VDOT

ENVIRONMENTAL ASSESSMENT

Traffic and Transportation Technical Report

February 2020

495 ExpressLanes NORTHERN EXTENSION

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EXECUTIVE SUMMARY

ES.1 INTRODUCTION

The Virginia Department of Transportation (VDOT), in coordination with the Federal Highway Administration (FHWA) as the lead federal agency, is evaluating an extension of the Interstate 495 (I-495) Express Lanes along approximately three miles of I-495, also referred to as the Capital Beltway, from their current northern terminus in the vicinity of the Old Dominion Drive overpass to the George Washington Memorial Parkway (GWMP) in the McLean area of Fairfax County, Virginia. The project location is shown in the vicinity map in **Figure ES-1**. Pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended, and in accordance with FHWA regulations[1], an Environmental Assessment (EA) is being prepared to analyze the potential social, economic, and environmental effects associated with the improvements being evaluated. As part of the EA being prepared, VDOT is evaluating in detail the environmental consequences of the No Build Alternative and one Build Alternative.

To support the EA, the purpose of this Traffic and Transportation Technical Report is to document:

- Existing traffic operations and safety conditions within the study area.
- Forecasted traffic volumes for future scenarios under No Build and Build conditions.
- Technical analysis and information in support of the development of alternatives.
- Traffic data needed for noise and air quality analysis to support the NEPA efforts.
- Future traffic operations and safety conditions under No Build and Build scenarios.

ES.1.1 Project Description and Location

The project extends from approximately south of the Dulles Toll Road / Route 267 interchange to the GWMP in the vicinity of the American Legion Memorial Bridge (ALMB). Although the proposed lanes would terminate at the GWMP, and the interchange provides a logical northern terminus for this study, additional improvements are anticipated to extend approximately 0.3 miles north of the GWMP to provide a tie-in to the existing road. The project also includes access ramp improvements and lane reconfigurations along portions of the Dulles Toll Road and the Dulles International Airport Access Highway, on either side of the Capital Beltway, from the Spring Hill Road Interchange to the Route 123 interchange. The proposed improvements entail new and reconfigured express lane ramps and general purpose lane ramps at the Dulles Interchange and tie-in connections to the Route 123/I-495 interchange. The project has independent utility since it would provide a usable facility and be a reasonable expenditure of funds even if no additional transportation improvements in the area are made.

In order to assess and document relevant resources that may be affected by the proposed project, the study area for the EA extends beyond the immediate area of the proposed improvements described above. The study area for the EA includes approximately four miles along I-495 between the Route 123 interchange and the ALMB at the Maryland state line. The study area also extends approximately 2,500 feet east along the GWMP. Intersecting roadways and interchanges are also included in the study area, as well as adjacent areas within 600 feet of the existing edge of pavement**.** The study area is a buffer around the road corridor

[1] NEPA and FHWA's regulations for Environmental Impact and Related Procedures can be found at 42 USC § 4332(c), as amended, and 23 CFR § 771, respectively.

that includes all natural, cultural, and physical resources that are analyzed in the EA. It does not represent the limits of disturbance (LOD) of the project nor imply right-of-way acquisition or construction impact, but rather extends beyond the project footprint to tie into the surrounding network, including tying into future network improvements. **Figure ES-2** depicts the project termini, study area, and LOD.

The existing I-495 facility within the study area currently has four northbound and four southbound general purpose (GP) lanes, supplemented in several locations by auxiliary lanes[2], acceleration/deceleration lanes at on- and off-ramps, and collector-distributor roadways[3]. Grade-separated interchanges provide access to and from I-495 and the Jones Branch Connector; Chain Bridge Road (Route 123); the Dulles Toll Road (DTR) and Dulles Airport Access Road (DAAR), collectively referred to as Route 267; Georgetown Pike (Route 193); and the GWMP. North of the study area, I-495 at the ALMB is a total of 10 lanes, including eight GP through lanes and two auxiliary lanes that connect to Clara Barton Parkway in Maryland and the GWMP in Virginia.

The southbound entrance onto the existing I-495 Express Lanes and northbound exit from the I-495 Express Lanes occur within the study area, approximately 2,000 feet south of Old Dominion Drive, as shown in **Figure ES-2**. However, drivers are permitted to use the northbound inside shoulder of the GP lanes during peak travel periods (6 AM - 11 AM and 2 PM - 8 PM Mon - Fri). The shoulder lane terminates by merging into the GP lanes just before reaching the GWMP interchange. All buses and vehicles with two axles can access the I-495 Express Lanes 24 hours a day, seven days a week. The I-495 Express Lanes operate as high-occupancy toll (HOT) lanes where vehicles with three or more occupants are not charged a toll. Trucks are currently prohibited from using the I-495 Express Lanes.

The southern portion of the study area surrounding the Route 267 interchange is surrounded by high-density commercial and residential development associated with the Tysons area. The study area between the Route 267 interchange and GWMP is comprised of suburban neighborhoods and supporting recreational areas that border the interstate, with direct access to I-495 limited to Route 193. North of the GWMP approaching the Maryland state line at the ALMB over the Potomac River is primarily open federal parkland associated with the GWMP to the east and Scotts Run Nature Preserve to the west.

Traffic Operations Study Area

Figure ES-3 shows the various components of the project Study Area for the I-495 NEXT Project:

[2] An auxiliary lane is defined by the American Association of State Highway and Transportation Officials (AASHTO) as the portion of the roadway adjoining the traveled way for speed change, turning, weaving, truck climbing, maneuvering of entering and leaving traffic, and other purposes supplementary to through-traffic movement. Auxiliary lanes are used to balance the traffic load and maintain a more uniform level of service on the highway. They facilitate the positioning of drivers at exits and the merging of drivers at entrances (AASHTO, 2018).

[3] Collector-distributor (C-D) roadways are supplemental facilities parallel to freeway mainlines that serve primarily to move weaving and lane-changing associated with closely-spaced on- and off-ramps away from the freeway mainline. C-D roadways are typically located at freeway interchanges where ramp-to-ramp weaving occurs or where closely-spaced major arterials are present and there is minimal room for multiple freeway mainline entrance and exit ramps.

- **Yellow – Project Footprint Study Area.** The I-495 NEXT Project Footprint Study Area includes I-495 from the Route 267 interchange to the ALMB, including all ramp termini of interchanges over that section.
- **Blue – Traffic Operations Analysis Study Area.** The Traffic Operations Analysis Study Area includes the full extent of the Project Footprint Study Area as well as one interchange north and south on I-495, and a number of additional intersections and interchanges which directly affect and/or are affected by operations on I-495 within the Project Footprint Study Area.

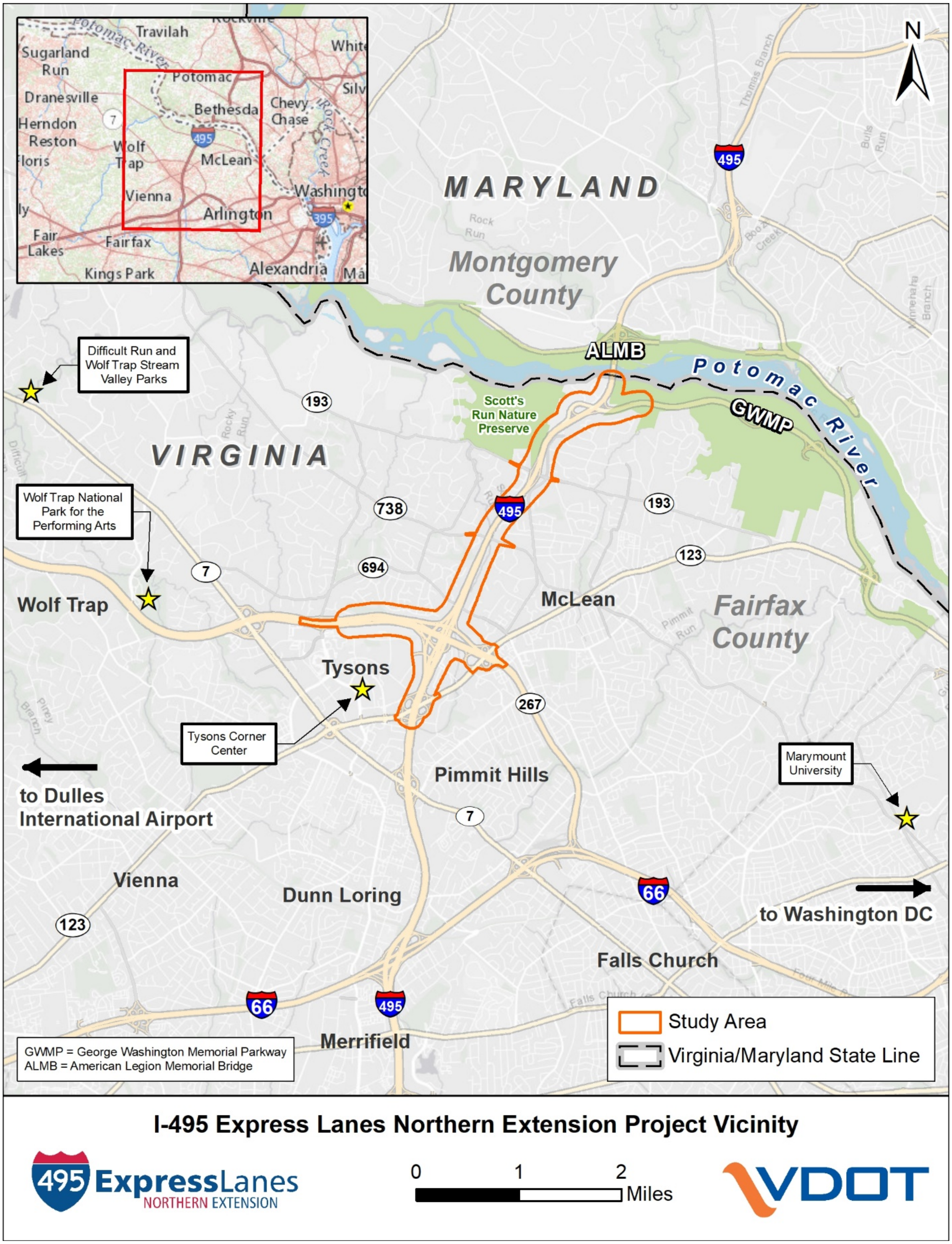


Figure ES-1. I-495 Express Lanes Northern Extension Vicinity

Figure ES-2. I-495 Express Lanes Northern Extension Project Limits

Figure ES-3. Traffic Operations Analysis Study Area

ES.1.2 Purpose and Need for Action

The purpose and need for the extension of Express Lanes on I-495 between Route 267 and the GWMP is to:

- **Reduce congestion** – Regional travel demand forecasting shows increased traffic volumes and travel demands as population and employment continue to grow within the region;
- **Provide additional travel choices** – Access to high-occupancy travel modes encourages drivers to choose alternatives to single-occupancy travel as well as provides an option to single-occupancy drivers to use the Express Lanes, freeing up capacity on the GP lanes; and
- **Improve travel reliability** – Duration and extent of congestion is expected to increase along with population and employment growth resulting in the need for commuters to spend additional time traveling to work. Travel times in the GP lanes are expected to continue to be increasingly unreliable, with median peak period travel times being several multiples of free-flow travel times and 95th percentile peak period travel times extending much longer. Express Lanes are designed to keep traffic flowing at 45 miles per hour or faster by dynamically adjusting tolls, allowing transit, high-occupancy, and toll-paying vehicles to have a much more reliable trip.

A detailed description of the purpose and need for the proposed project is provided in Chapter 1 of the EA.

ES.2 ANALYSIS METHODOLOGY

This section details the methodology for assessing traffic operations and safety impacts associated with the I-495 NEXT project. Detailed information on the analysis methodology is included in **Chapter 2.**

ES.2.1 Analysis Years and Scenarios

Traffic operations analysis consisted of an evaluation of existing conditions (2018), No Build conditions (2025 and 2045), and Build conditions (2025 and 2045):

- No Build conditions assume the completion of programmed transportation improvements consistent with the regional Constrained Long-Range Plan (CLRP) but without the I-495 Express Lanes Northern Extension project in place.
- Build conditions assume the incorporation of the project Preferred Alternative, which includes two Express Lanes in each direction along I-495 between Route 267 (Dulles Toll Road) and the GWMP, along with four general purpose (GP) lanes in each direction along the I-495 mainline and an auxiliary lane in each direction between Route 267 and Route 193 (Georgetown Pike). The construction of the Preferred Alternative is assumed to take place in phases, with the most critical components constructed first.

ES.2.2 Traffic Operations Analysis Methodology

Traffic Operations Data Collection

In support of the project, an extensive data collection effort and subsequent data review was completed during May and June 2018, including traffic counts, travel times, average freeway speeds from INRIX, queue length measurements, origin-destination (O-D) data from StreetLight Data, and signal timings.

Travel Demand Forecasting and Development of Future Traffic Volumes

Forecasts for future traffic demand were developed using the MWCOG travel demand model (version 2.3.75 using Round 9.1 Cooperative Forecasts for socioeconomic data). The MWCOG model was modified and validated to reflect existing conditions (year 2018) in the Study Area following guidance from FHWA and VDOT. Outputs from travel demand model runs were used to estimate growth on area roadway facilities and at intersections. Origin-destination (O-D) routes were developed from the model and used in the VISSIM traffic simulation models (described in the next section) to capture freeway weaving, merging, and diverging interactions.

Traffic Analysis Tools

VISSIM Version 9.0 was used for a comprehensive network traffic analysis for the freeways, interchanges, and adjacent intersections within the Traffic Operations Study Area limits. Surface street intersection operations were evaluated through a combination of Synchro 10 (to develop preliminary optimization for phasing and signal timing) and VISSIM (for microsimulation and analysis). The expanded arterial network beyond intersections immediately adjacent to freeway interchanges in the corridor was evaluated solely through Synchro. The VISSIM model was calibrated to reflect existing real-world conditions according to VDOT requirements in the *Traffic Operations and Safety Analysis Manual* (TOSAM) (VDOT, 2015).

Traffic Operations Analysis Measure of Effectiveness

The following measures of effectiveness (MOEs) were used for the operational analysis of the roadway network under existing and future Build and No Build conditions.

Freeway Performance Measures

- Simulated Average Speed (mph)
- Simulated Average Density (simulated vehicles per lane per mile)
- Simulated Volume (vehicles per hour)
- Percent of Demand Served: simulated volume (*processed volumes*) divided by actual volume (*input volumes*).
- Simulated Ramp Queue Length: reported average and maximum queue lengths (feet).
- Simulated Travel Time: reported for select network origin-destination travel paths (seconds).
- Congestion *Heat Maps*: incremental speeds reported for aggregated lanes, by time interval (mph).

Arterial/Intersection Performance Measures

- Control delay (Synchro) or microsimulation delay (VISSIM)
- Queue length (feet)

ES.2.3 Safety and Crash Analysis Methodology

A safety analysis was conducted consistent with VDOT requirements. It included an analysis of existing highway safety conditions and reported motor vehicle crashes on roads in the Study Area for a period of five years, as well as the development of qualitative and quantitative measures to evaluate future proposed alternatives and assess the safety effects of interstate access modifications on I-495 and the adjacent arterial network within the Study Area.

Safety Data Collection

Data for the safety analysis consisted of the following:

- Crash data from VDOT, Maryland SHA (MDSHA), and NPS for the previous five years (2013-2017)
- Traffic data in the form of Average Annual Daily Traffic (AADT) from VDOT for the previous five years as well as future daily traffic projections developed as part of the traffic operations analysis
- Roadway inventory data including geometric data from existing conditions as well as proposed future design concept plans

Existing Conditions Safety Analysis Methodology

The existing conditions quantitative safety analysis utilized historical crash data from the most recently-available five years' worth of data (2013-2017). It included the development of the following measures:

- Crash density and severity histograms (developed for the mainline);
- Crash heat maps for various crash types (developed for the mainline);
- Crash density maps (developed for the mainlines); and
- Crash rates (fatal, injury, property damage only (PDO) and total) (developed for the mainline and intersections).

Future Conditions Safety Analysis Methodology

For the purposes of future alternatives analysis on the I-495 corridor, a combination of three quantitative tools were employed:

- **Enhanced Interchange Safety Analysis Tool (ISATe)** for assessing general purpose freeway segments and interchanges
- **Project-Developed Express Lane Safety Performance Function (SPF)** for estimating future-year crashes in Express Lanes segments
- **Extended Highway Safety Manual (HSM) Spreadsheets** for estimating future-year crashes at arterial intersections

These tools were used to estimate the number of future-year crashes for the No Build and Build Alternatives to allow for comparison and estimate potential safety benefits.

ES.3 SUMMARY OF FINDINGS

This section provides highlights of the detailed traffic analysis and operations study that was performed for the assessment of existing and future conditions, including a project No Build and Build Alternative. Detailed information on the analysis is included in **Chapters 4** (Existing Traffic Operational Conditions), **7** (Future Scenarios Operational Conditions), and **8** (Existing and Future Safety Analysis).

ES.3.1 Existing Travel Patterns

Although traffic has distinctive peak periods along the I-495 corridor, increasing congestion has prolonged these peak periods and spilled queued traffic to parallel routes such as the GWMP, Route 193, and Route 123. A typical commuting pattern might show a morning peak in one direction and an afternoon peak in the opposite direction; however, the I-495 NEXT Study Area experiences congestion in both directions in both peak periods, with the most severe congestion along northbound I-495 due to a bottleneck at the ALMB.

From 2002 to 2017, the AADT for I-495 at the ALMB grew by 18 percent, with the transportation infrastructure expanding alongside this traffic growth to include the existing I-495 Express Lanes as well as a hard shoulder open to northbound traffic in the study area during periods of high demand. Projected population and employment growth, particularly in Tysons, is forecasted to significantly increase in future years and additionally strain highway capacity.

An analysis of travel patterns along I-495 using StreetLight Data, a provider of anonymized mobile device analytics to support transportation studies, shows that trips have a wide-ranging set of origins and destinations well outside the study area. Many trips within the study area originate in Tysons and in locations further to the south or west, such as Dulles International Airport (IAD) and Prince William County, and are destined for Maryland, especially areas along the I-270 corridor. A significant amount of travel across the ALMB is originating from or destined for jurisdictions beyond Fairfax County and Montgomery County (the two jurisdictions directly connected by the bridge). The bridge carries a significant amount of regional and inter-state travel. The ALMB and the I-95/I-495 Woodrow Wilson Bridge south of Washington, D.C. are the only two river crossings directly between Virginia and Maryland within the vicinity of Washington, D.C. As a result, they each carry very heavy traffic volumes exceeding 200,000 vehicles per day.

ES.3.2 Existing Conditions Traffic Operations

Peak Periods and Peak Hours

Due to the oversaturated conditions and historical trends within the study area, it was determined that the traffic analysis periods should be based upon the periods of heaviest congestion and slowest speeds along the northbound I-495 GP lanes as shown in the INRIX speed heat map in **Exhibit 4-1** in the main body of the report**.**

- For the AM peak period from 6:45 a.m. to 9:45 a.m., the network representative hour (peak hour) occurs between **7:45 a.m. and 8:45 a.m.** Queue spillback is tied to the on-ramp from GWMP and the weave across the ALMB, with the slowest speeds and longest queues occurring during the representative hour.
- For the PM peak period from 2:45 p.m. to 5:45 p.m., the network representative hour (peak hour) occurs between **3:45 p.m. and 4:45 p.m.** During the early afternoon hours between approximately 2:00 p.m. and 3:30 p.m., queue spillback and congestion along northbound I-495 is again tied to the on-ramp from GWMP and the weave across the ALMB. During the later afternoon hours after approximately 3:30 p.m., queues from downstream congestion in Maryland spill back across the ALMB, resulting in a single continuous queue. At this point, the back of the queue stabilizes for several hours, suggesting that demand is not increasing and is being processed at the same rate as it arrives.

Summary of Existing Operational Deficiencies

Based on the traffic simulation results, the travel demand is higher than the existing capacity for much of the study area under existing conditions. This is reflected in the high densities and low speeds found in many segments in the peak directions. General characteristics of congestion on the corridor include:

- **Substantial multi-hour queues in both directions.**
  - Bottlenecks created by major merge areas, as experienced in the northern terminus of the study area.
  - Congestion from downstream impacting study area network, including areas in Maryland north of the ALMB and congestion in Tysons south of the study area.
  - Bottlenecks created due to lane drops, such as the I-495 northbound GP merge where the shoulder lane terminates.
  - Bi-directional demand and weaving result in congestion in both directions during both peak periods, such as weaving along the I-495 northbound GP lanes between the on-ramp from Route 193 and the off-ramp to GWMP.
  - The on-ramp from the GWMP to I-495 northbound frequently queues back onto the GWMP outbound/westbound mainline for several miles to as far back as the GWMP/Route 123 interchange.
  - As shown in **Exhibit 4-1** in the main body of the report, in the northbound direction along I-495, the AM peak period lasts almost four hours, and the PM peak period lasts for more than six hours. In the southbound direction, the AM peak period lasts approximately two hours and the PM peak period lasts for approximately five hours.
- **Heavy volumes entering and exiting I-495 at the Route 267 interchange affect traffic in both directions for extended periods.**
  - Heavy demand from Route 267 entering an already congested segment of I-495 results in more congestion and queue spill-backs. The I-495 northbound GP on-ramp from DTR/DAAR eastbound frequently spills back to the DTR/DAAR mainlines due to heavy demand and congestion along I-495 northbound GP.
  - The I-495 southbound GP on-ramp from DTR/DAAR eastbound creates weaving issues along I-495 southbound, as the off-ramp to Route 123 and destinations in Tysons is just downstream of this location.
- **Cut-through traffic on local parallel arterials creates more disturbance along mainline.**
  - Vehicles detouring to avoid I-495 congestion create more disturbance to the flow of traffic by exiting to use parallel arterial facilities, such as Balls Hill Road and Swinks Mill Road, and then entering again at downstream locations along I-495, such as at Route 193.
- **High-Occupancy Toll (HOT) traffic to and from the I-495 Express Lanes and weaving in and out from GP lanes results in severe congestion.**
  - The speed differential as well as weaving in and out from the I-495 Express Lanes that have ingress and egress just north of the Route 267 interchange create congestion in the GP lanes.

ES.3.3 Overview of No Build and Build Alternative

No Build Alternative

The No Build Alternative includes recent improvements and planned projects. Notable regional projects outside of the study area that impact travel patterns within the study area were also included in developing traffic forecasts for future-year scenarios. **Table ES-1** provides a summary of projects included as background improvements for both No Build and Build conditions for I-495 Project NEXT traffic analysis.

All projects noted for completion by 2025 are included as part of 2025 No Build conditions; otherwise, the improvements are only included for 2045 No Build conditions.

Table ES-1. Summary of Background Transportation Projects

Project	Description	Completion / Opening Year
Jones Branch Connector / Scotts Crossing Road Extension	Construction of a four-lane roadway across I-495 connecting to Route 123; includes expansion of traffic signal with I-495 Express Lanes ramps and new traffic signals east of I-495 and west of Route 123	2019
Transform I-66 Inside the Beltway: Eastbound Widening	Construction of additional eastbound lane along I-66 eastbound between Dulles Connector Road (Route 267) and Exit 71/Glebe Road (Route 120)	2021
Route 123 Widening	Widening of Route 123 between Route 7 and I-495 to four through lanes in each direction	2021
Georgetown Pike/Balls Hill Road Intersection Improvements	Dedicated northbound left-turn lane and updates to signal phasing	2019
Transform I-66 Outside the Beltway	Construction of two Express Lanes in each direction (along with three remaining GP lanes) between I-495 and University Boulevard; improved bus service and transit routes, including park-and-ride lot expansions; interchange improvements and auxiliary lanes between interchanges	2022
I-495 Managed Lanes in Maryland	Construction of two tolled lanes in each direction across the ALMB, around I-495 in Maryland, and along I-270. Includes north-facing ramp connections to GWMP (GWMP westbound to I-495 northbound managed lanes and I-495 southbound managed lanes to GWMP eastbound).	2025[4]
Dulles Interchange Master Plan	Construction of new direct access ramps from I-495 northbound and southbound GP lanes to DAAR westbound; reconstruction of several existing ramp movements at interchange including C-D roads along eastbound DTR and southbound I-495; auxiliary lanes along I-495 GP between Route 267 and Route 193	2030[5]

[4] A sensitivity analysis has been conducted assessing the impacts of a No Build and Build condition for Project NEXT if the I-495 Maryland managed lanes system is not yet complete by 2025. This analysis is included as **Appendix I.**

[5] I-495 northbound GP auxiliary lane between Route 267 and Route 193 assumed to be in place by 2025.

Project	Description	Completion / Opening Year
Dulles Toll Road All-Electronic Tolling	Conversion to high-speed all-electronic tolling and removal of existing toll booths	2030
Dulles Toll Road Urban Frontage Road west of Spring Hill Road	Construction of two-lane frontage road outside of DTR mainline between Route 7 and Spring Hill Road; includes new direct connections from frontage road to Tyco Road	2037
Transform I-66 Inside the Beltway: Both Directions Express Lanes Operations	Both directions of I-66 east of I-495 operated as Express Lanes across all lanes (HOV-3 free with EZ-Pass switched to HOV-3 mode; tolled for all other vehicles) during both peak periods.	2040

Build Alternative

The Build Alternative will consist of the following elements:

- Extending the existing four I-495 Express Lanes from their current terminus between the I-495/Route 267 interchange and the Old Dominion Drive overpass north approximately 1.6 miles to the GWMP interchange, at which point the Express Lanes would seamlessly tie into the Maryland managed lane system. In order to reduce the LOD, the extended Express Lanes would be separated from the GP lanes by flexible delineators, consistent with the configuration of the existing I-495 Express Lanes, requiring approximately an additional 8 feet. This eliminates the need to provide full shoulders and concrete barrier separation in each direction, which would require an additional 56 feet in comparison. **Figure ES-4** shows a typical section for I-495, with two Express Lanes in either direction separated by flexible delineators.
- Additional GP auxiliary lanes between the Route 267 and Route 193 interchanges. North of the Route 193 interchange, an auxiliary lane is already provided in the northbound direction; in the southbound direction, a C-D road will take the place of an auxiliary lane. Through the entire project area, the Build Alternative would retain the existing number of GP lanes in each direction between the I-495/Route 267 interchange and the GWMP.
- Additional access to the Express Lanes network (described further in this section).
- Improvements to I-495 interchanges between Route 123 and GWMP (described further in this section)
- Reconstruction of I-495 overpasses in the study area: Old Dominion Drive and Live Oak Drive (described further in this section)

<u>Proposed Access to the Express Lanes</u>

The Build Alternative would provide the following access to and from the Express Lanes:

- Flyover exchange ramps to provide access from the northbound I-495 GP lanes to the northbound I-495 Express Lanes, and from the southbound I-495 Express Lanes to the southbound I-495 GP lanes. These exchange ramps would be located at the Route 267 interchange.

- New Express Lanes access to and from Route 267:
  - Eastbound Route 267 (DTR) to northbound I-495 Express
  - Westbound Route 267 (Dulles Connector Road) to northbound I-495 Express
  - Southbound I-495 Express to eastbound Route 267 (DCR). This movement would tie into an eastbound C-D road along Route 267 at the Route 267/Route 123 interchange, allowing access to both the eastbound Dulles Connector Road and Route 123.
  - Note that the southbound I-495 Express to westbound Route 267 (DTR) movement is already provided today; additionally, the northbound I-495 Express to westbound Route 267 (DTR) and eastbound Route 267 (DTR) to southbound I-495 Express movements are also provided today.
- New Express Lanes access to and from GWMP:
  - Northbound I-495 Express to GWMP
  - GWMP to southbound I-495 Express
  - Note that the Maryland managed lanes system (assumed to be in place under No Build conditions) would provide access to the movements from GWMP to northbound I-495 Maryland managed lanes and from southbound I-495 Maryland managed lanes to GWMP.

Route 267 Interchange

The Build Alternative includes significant modifications to the I-495/Route 267 interchange, including modifications to several of the GP ramp connections. Individual Ramp movements are discussed in detail below and can be seen in **Exhibit 6-2a** in the main body of the report. Modified Access refers to movements which are provided under the existing interchange configuration, while Additional Access refers to movements which are not provided under the existing interchange configuration. All access provided in the existing interchange configuration is maintained in some form through all phases of the Build Alternative.

- **GX:** Ramp GX is a one-lane ramp which provides Additional Access from northbound I-495 GP lanes, from and Route 123 at the I-495/Route 123 interchange, to northbound I-495 Express Lanes. Ramp GX would be provided via a connection from ramp G2 to ramp E1.
- **XG:** Ramp XG is a one- lane ramp which provides Additional Access from southbound I-495 Express Lanes to southbound I-495 GP lanes. Ramp XG would be provided via flyover ramp connecting ramp E2 to ramp D1.
- **E1:** Ramp E1 provides Modified Access from eastbound DTR and eastbound DAAR to northbound and southbound I-495 Express Lanes, with one lane of capacity to each Express Lane facility. Modified Access from eastbound DTR and eastbound DAAR would be provided via a C-D road which collects traffic from the DTR and DAAR upstream of the Route 267 interchange and then flies over eastbound DTR.
- **E2:** Ramp E2 is a one-lane ramp which provides Additional Access from southbound I-495 Express Lanes to eastbound DTR.
- **E3:** Ramp E3 is a one-lane ramp which provides Additional Access from westbound DCR to northbound I-495 Express Lanes. Ramp E3 merges with ramp E1 before tying into northbound I-495 Express Lanes.
- **G1:** Ramp G1 is a one-lane ramp which provides Modified Access from southbound I-495 GP lanes to eastbound DTR. Ramp G1 also provides access to Route 123 at the Route 267/Route 123 interchange via a connection to ramp D2 and subsequent connection to ramp G4.

- **G2:** Ramp G2 provides Modified Access from northbound I-495 to westbound DTR with one lane of capacity. Ramp G2 also provides access from Route 123 at the I-495/Route 123 interchange via the proposed C-D road system at that interchange.
- **G3:** Ramp G3 is a two-lane ramp which provides Modified Access from eastbound DTR to northbound I-495 GP lanes. Ramp G3 will be extended to combine with ramps G10 and G9 about before tying into northbound I-495 GP lanes about 0.6 miles downstream of the existing tie in point.
- **G4:** Ramp G4 provides Modified Access from eastbound DTR to the Route 123 C-D road at the Route 267/Route 123 interchange. Ramp G4 also provides access to the Route 123 C-D from eastbound DAAR via a connection from ramp D2.
- **G5:** Ramp G5 is a two-lane ramp which provides Modified Access from southbound I-495 GP lanes to westbound DTR.
- **G6:** Ramp G6 provides Modified Access from southbound I-495 GP lanes to the proposed Route 123 C-D road at the I-495/Route 123 interchange with one lane of capacity.
- **G7:** Ramp G7 is a one-lane ramp which provides Modified Access from eastbound DTR to the propose Route 123 C-D road at the I-495/Route 123 interchange.
- **G8:** Ramp G8 is a one-lane ramp which provides Modified Access from eastbound DTR to southbound I-495 GP lanes.
- **G9:** Ramp G9 is a one-lane ramp which provides Modified Access from the Route 123 C-D road at the I-495/Route 123 interchange to northbound I-495 GP lanes (provided access to the northbound GP lanes from Route 123). Ramp G9 is provided via a connection from ramp G2 to combined ramps G3 and G10.
- **G10:** Ramp G10 is a one-lane ramp which provides Modified Access from westbound DTR to northbound I-495. Ramp G10 is provided via a connection from the westbound DTR mainline to ramp G3.
- **D1:** Ramp D1 provides Modified Access from eastbound DAAR (indirectly via eastbound DTR) to southbound I-495 GP lanes with one lane of capacity.
- **D2:** Ramp D2 provides Modified Access from eastbound DAAR to northbound I-495 GP lanes with one lane of capacity.
- **D3:** Ramp D3 is a one-lane ramp which provides Additional Access from southbound I-495 GP lanes to westbound DAAR.
- **D4:** Ramp D4 is a one-lane ramp which provides Additional Access from northbound I-495 GP lanes to westbound DAAR.

GWMP Interchange

The Build Alternative also includes modifications to the GWMP interchange, the northernmost interchange on I-495 in Virginia. These modifications can be seen in **Exhibit 6-2e** in the main body of the report**.** All existing GP movements at the GWMP would be maintained under the Build Alternative but would be modified to accommodate additional access between I-495 Express Lanes and the GWMP provided under the Build Alternative.

Build Alternative Phasing

The Build Alternative would be implemented in multiple phases. Opening Year improvements (assumed to be in place by 2025 for traffic operations analysis) would include:

- The extension of the I-495 Express Lanes from the Route 267 interchange to the GWMP interchange, at which point the Express Lanes would seamlessly tie into the Maryland managed lanes system.
- Improvements to the Route 267 interchange, including connections from the Dulles Toll Road (both eastbound and westbound) to northbound I-495 Express and enhancements to the ramp from eastbound DTR to northbound I-495 GP.
- Improvements to the GWMP interchange, including connections from northbound I-495 Express to GWMP and from GWMP to southbound I-495 Express, and a new collector-distributor (C-D) road design along southbound I-495 GP between the GWMP and Route 193 interchanges.
- A new northbound I-495 GP auxiliary lane between the Route 267 and Route 193.
- Rebuilding of the Route 738 (Old Dominion Drive) overpass, the Live Oak Drive overpass, and the Route 193 interchange in order to accommodate the expanded cross-section of the I-495 mainline.
- A parallel bicycle/pedestrian trail between Route 694 (Lewinsville Road) and the GWMP.

Exhibits 6-1a through **6-1e** contain the concept plan sheets for the Build Alternative showing Opening Year improvements in place. Further improvements would be implemented between 2025 (Opening Year) and 2045 (Design Year) culminating into the Ultimate Build Configuration, which would include additional improvements at the Route 267 interchange and improvements to the Route 123 interchanges with both I-495 and Route 267. All improvements associated with the Build Alternative are assumed to be in place by 2045. **Exhibits 6-2a** through **6-2e** contain the concept plan sheets for the Build Alternative showing all improvements in place.

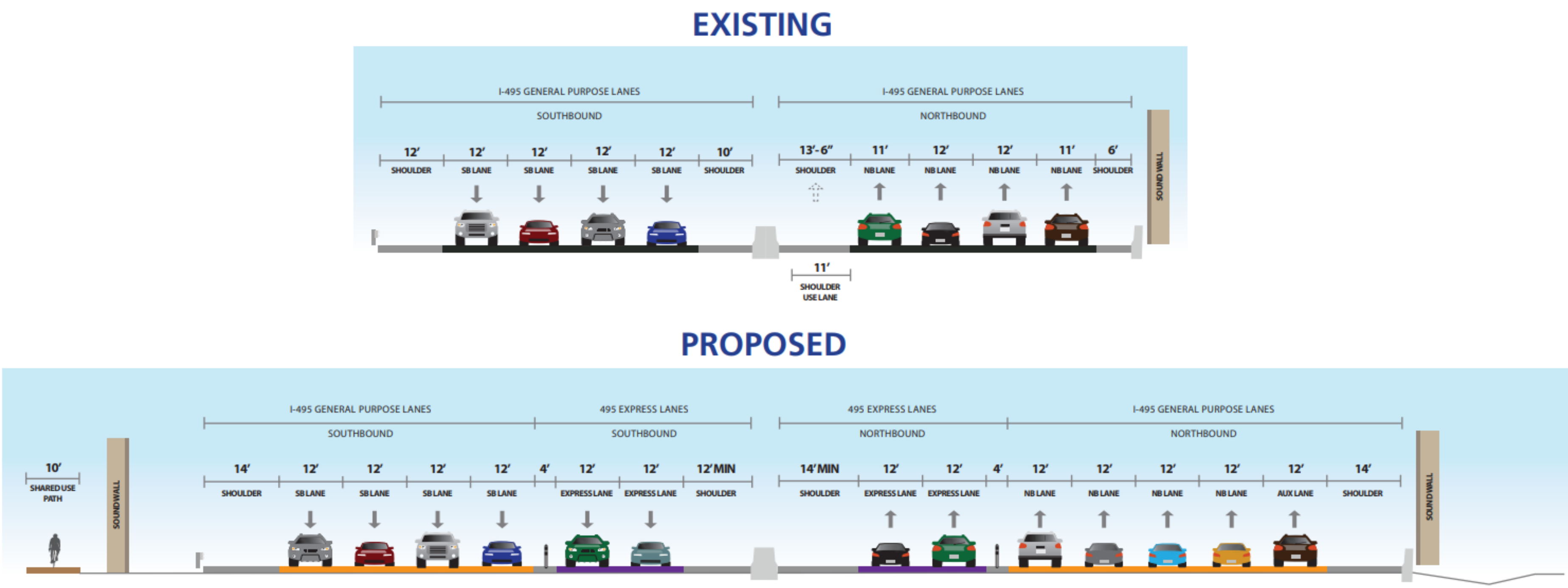


Figure ES-4. Existing and Build Alternative Typical Sections

ES.3.4 Future Conditions Traffic Operations

2025 AM Peak Period Summary

- Total demand along I-495 (GP plus Express) is forecasted to increase in the Build scenario along the length of the I-495 corridor. The greatest increases in demand are in the segments between Route 267 and GWMP, where Express Lanes are only present in the Build scenario and thus represent a substantial capacity increase from No Build conditions. Peak hour volumes are forecasted to increase in the Build scenario by between 2 to 9 percent in the northbound direction and between 2 to 6 percent in the southbound direction.
- **Figure ES-5** provides a "heat map" comparison of average speeds between 2025 No Build and Build conditions for the AM peak period along the I-495 GP lanes. Time of day during the peak period is provided on the horizontal axis while location along the corridor is provided along the vertical axis; the colors signify average speeds for each scenario. The figure indicates a more significant presence of congestion in the No Build scenario in both directions of the I-495 GP lanes as compared to the Build scenario.
- In the northbound direction along the I-495 GP lanes, congestion is observed under No Build conditions between Route 267 and Clara Barton Parkway (across the ALMB) due to heavy merging and weaving volumes on and near the bridge. Under Build conditions, a significant reduction in congestion is observed due to the additional capacity provided by the Express Lanes and the reduced weaving due to the continuity of the Express Lanes. The average travel time in the northbound GP lanes improves by approximately 3 minutes (a 24 percent improvement) in the Build condition.
- In the southbound direction along the I-495 GP lanes, congestion is observed under No Build conditions south of the ALMB and north of Route 267 due to weaving approaching the entrance to the Express Lanes system as well as merging from vehicles exiting the Maryland managed lanes system south of the ALMB. This congestion is largely mitigated under Build conditions. The average travel time in the southbound GP lanes improves by approximately 1.5 minutes (an 11 percent improvement).
- Both directions of the Express Lanes operate at or near the posted speed limit. To travel the length of the corridor via Express Lanes under No Build conditions, vehicles must utilize the congested GP lanes between Route 267 and GWMP as Express Lanes are not present.
- Along eastbound Route 267 (DTR) there is 47 percent improvement in travel time. With the improved operations along northbound I-495, the ramp from eastbound DTR to northbound I-495 does not spill back to eastbound DTR, improving operations along eastbound DTR. Travel times along the westbound DTR remain unchanged.
- Over the course of the AM peak period, total persons moved along I-495 are forecasted to increase from No Build to Build conditions by between 4 and 17 percent in the northbound direction (see **Figure ES-6**) and between 6 and 21 percent in the southbound direction (see **Figure ES-7**), depending upon location along the corridor.
- Arterial intersection operations are largely consistent between No Build and Build conditions, as both scenarios see the same percentage of intersections operating under failing conditions. These failing intersections are in the Tysons area and see continued growth in demand tied to commercial and residential growth in Tysons.

Table ES-2 presents an overall performance comparison table for the Build alternative versus the No Build alternative for 2025 AM conditions. The table shows that the Build alternative improves overall operations along the I-495 corridor given the improvement in travel times, reduction in congestion, and increase in persons moved.

Figure ES-5. 2025 No Build and Build – AM Peak Period Average Speeds, I-495 GP Lanes

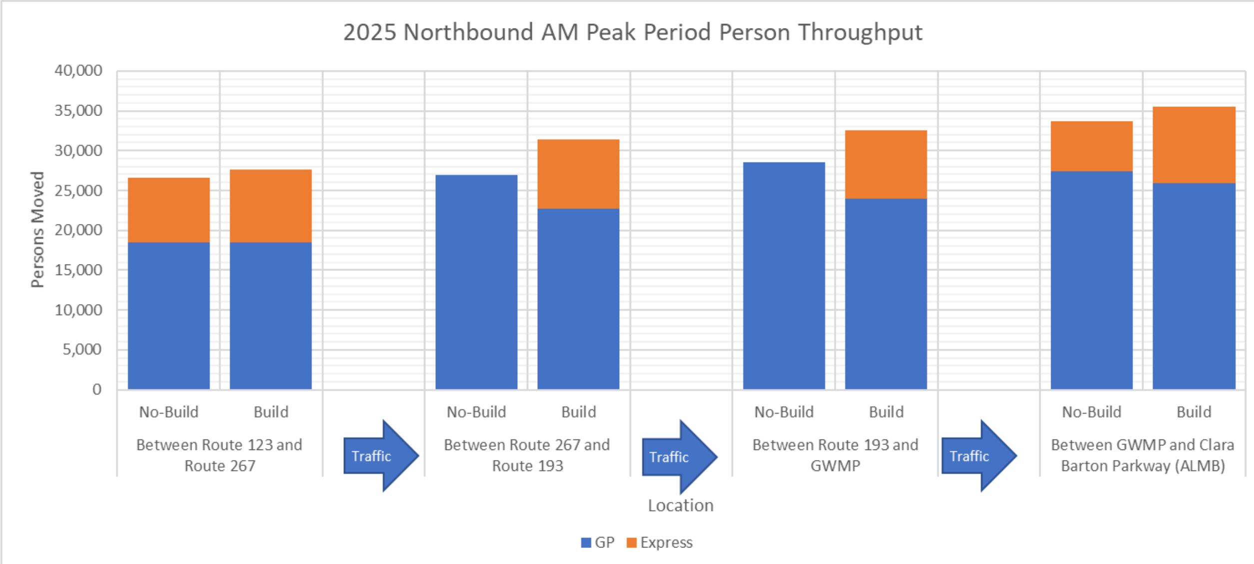


Figure ES-6. 2025 No Build and Build – AM Peak Period Person Throughput, I-495 Northbound

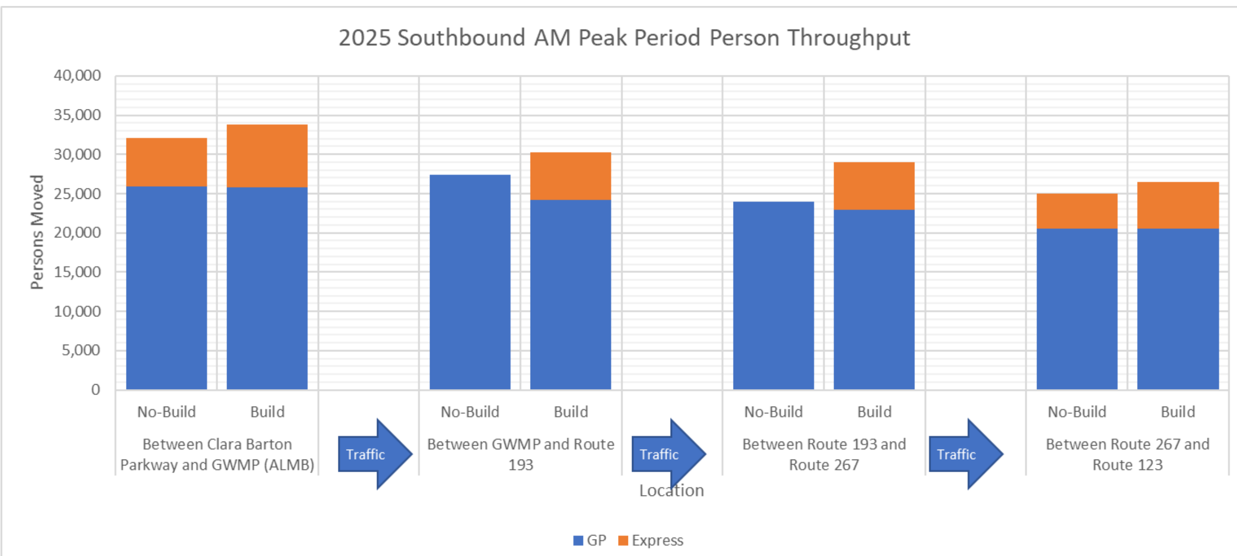
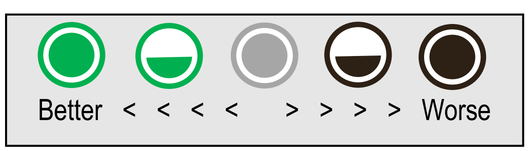


Figure ES-7. 2025 No Build and Build – AM Peak Period Person Throughput, I-495 Southbound

Table ES-2. Overall Performance Comparison for 2025 AM No Build and Build Alternative

Measure of Effectiveness	Description	Facility	2025 AM No Build Value	2025 AM Build Value	Build Performance Compared to No Build
Travel Times	End-to-end travel time along the facility through the Traffic Operations Study Area, measured in Minutes	I-495 NB GP	10	7	
		I-495 NB Express	8	6	
		I-495 SB GP	8	7	
		I-495 SB Express	7	6	
		Dulles Toll Road EB	3	2	
		Dulles Toll Road WB	2	2	
Extent and Duration of Congestion	Visual assessment of freeway mainline queue length and duration of congestion	I-495 NB GP			
		I-495 SB GP			
Person Throughput	Additional persons moved during peak period of Build condition and percentage increase	I-495 NB (All)	+4,500 (17%)		
		I-495 SB (All)	+5,000 (21%)		
Arterial Operations	Number of intersections operating at LOS F	Entire Study Area	7	7	
	Number of intersections operating at LOS D or better		19	17	



2025 PM Peak Period Summary

- Total demand along I-495 (GP plus Express) is forecasted to increase in the Build scenario along the length of the I-495 corridor. The greatest increases in demand are in the segments between Route 267 and GWMP, where Express Lanes are only present in the Build scenario and thus represent a substantial capacity increase from No Build conditions. Peak hour volumes are forecasted to increase in the Build scenario by between 10 to 29 percent in the northbound direction and between 7 to 12 percent in the southbound direction.
- **Figure ES-8** provides a "heat map" comparison of average speeds between 2025 No Build and Build conditions for the PM peak period along the I-495 GP lanes. Time of day during the peak period is provided on the horizontal axis while location along the corridor is provided along the vertical axis; the colors signify average speeds for each scenario. The figure indicates a more significant presence of congestion in the No Build scenario in both directions of the I-495 GP lanes as compared to the Build scenario.
- In the northbound direction along the I-495 GP lanes, congestion is observed under No Build conditions between Route 267 and Clara Barton Parkway (across the ALMB) due to heavy merging and weaving volumes on and near the bridge, especially early in the peak period. Under Build conditions, a significant reduction in congestion is observed due to the additional capacity provided by the Express Lanes and the reduced weaving due to the continuity of the Express Lanes. The average travel time in the northbound GP lanes improves by approximately 4 minutes (a 36 percent improvement) in the Build condition.
- In the southbound direction along the I-495 GP lanes, congestion is observed under No Build conditions south of the ALMB and north of Route 267 due to weaving approaching the left-side entrance to the southbound Express Lanes (between Route 193 and Route 267) and downstream right-side exit to westbound DTR, as both of these movements have heavy volumes. This congestion is also worsened in the No Build scenario due to the southbound Maryland managed lanes system terminating near the GWMP interchange, creating a merge that spills back upstream in the GP lanes across the ALMB. This congestion is largely mitigated under Build conditions. The average travel time in the southbound GP lanes improves by nearly 8 minutes (a 49 percent improvement).
- Both directions of the Express Lanes operate at or near the posted speed limit. To travel the length of the corridor via Express Lanes under No Build conditions, vehicles must utilize the congested GP lanes between Route 267 and GWMP as Express Lanes are not present.
- Along eastbound and westbound Route 267 (DTR), travel times are essentially identical between No Build and Build.
- Over the course of the PM peak period, total persons moved along I-495 are forecasted to increase from No Build to Build conditions by between 8 and 37 percent in the northbound direction (see **Figure ES-9**) and between 10 and 47 percent in the southbound direction (see **Figure ES-10**), depending upon location along the corridor.
- Arterial intersection operations see an improvement under Build conditions, as the percentage of intersections operating at failing conditions drops from 43 percent (No Build) to 33 percent (Build), and more than half of all intersections are LOS D or better in the Build condition, while only 33 percent are at LOS D or better in the No Build condition. Most of the failing intersections are in the Tysons area and see continued growth in demand tied to commercial and residential growth in Tysons.

Table ES-3 presents an overall performance comparison table for the Build alternative versus the No Build alternative for 2025 PM conditions. The table shows that the Build alternative improves overall operations along the I-495 corridor given the improvement in travel times, reduction in congestion, and increase in persons moved. Arterial operations are also shown to improve in the PM peak hour under the Build alternative.

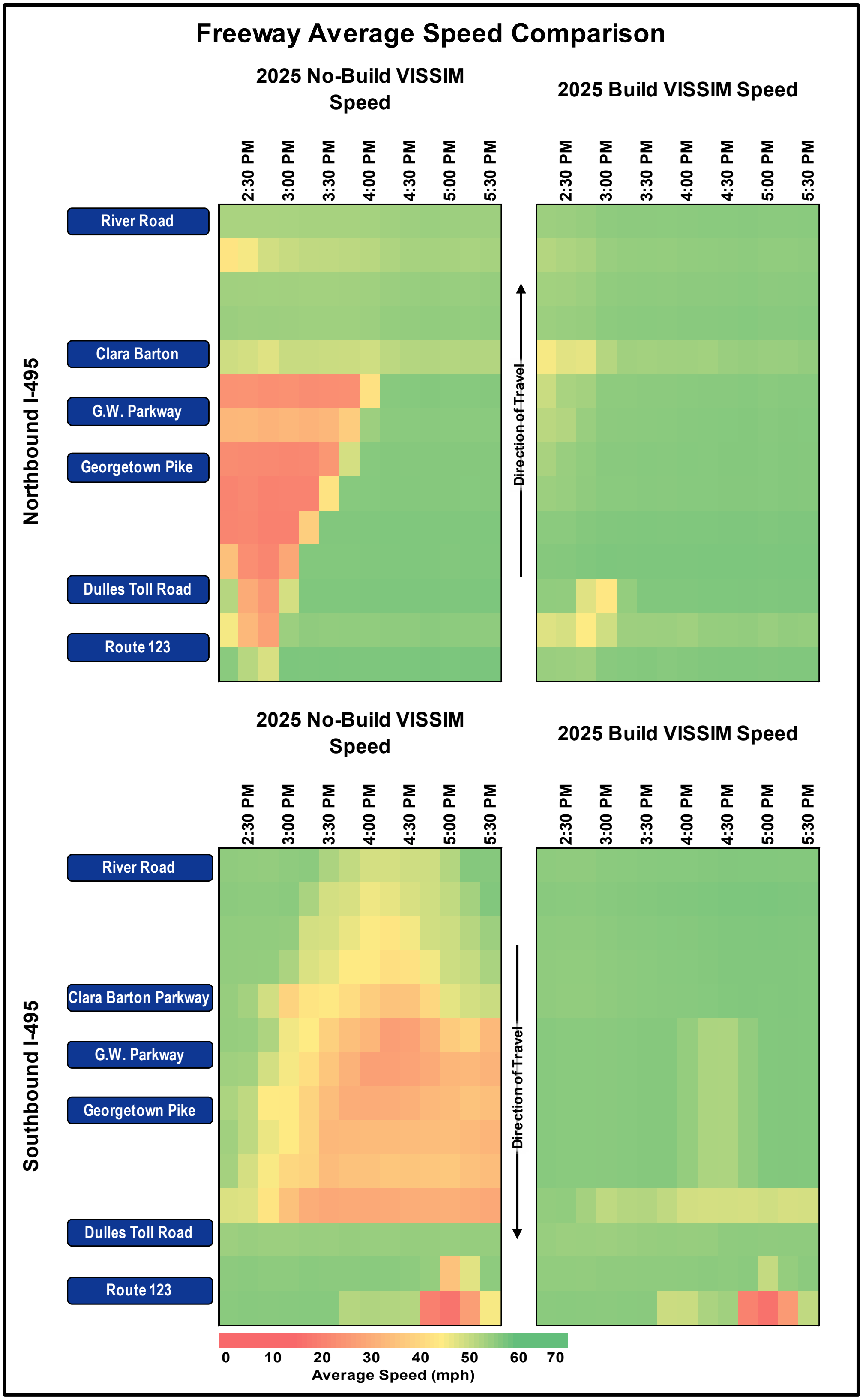


Figure ES-8. 2025 No Build and Build – PM Peak Period Average Speeds, I-495 GP Lanes

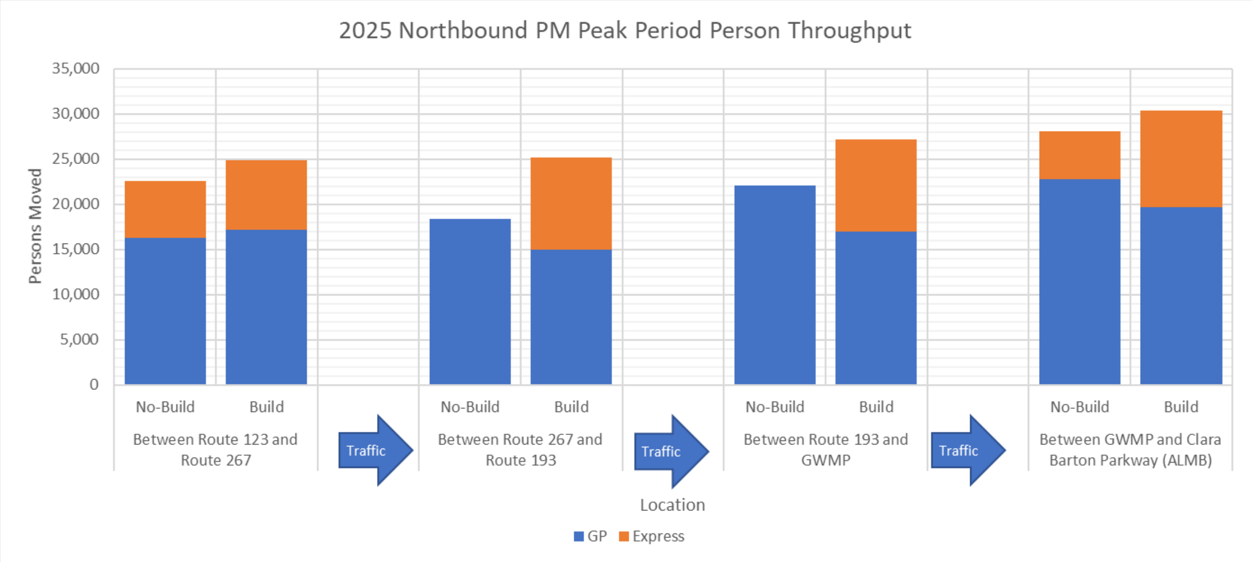


Figure ES-9. 2025 No Build and Build – PM Peak Period Person Throughput, I-495 Northbound

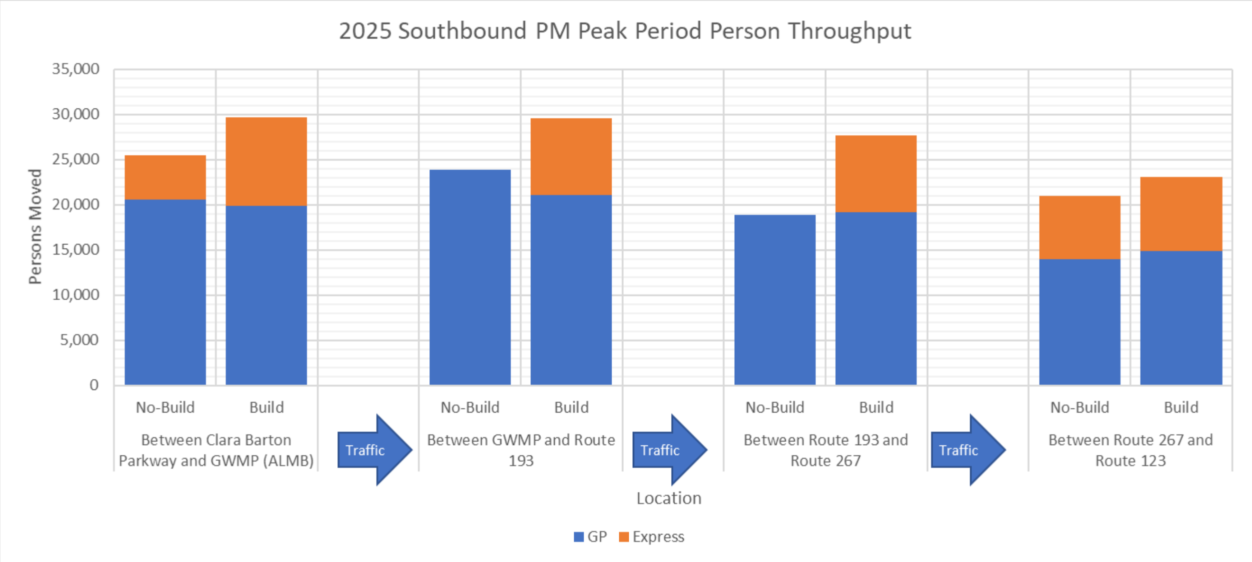
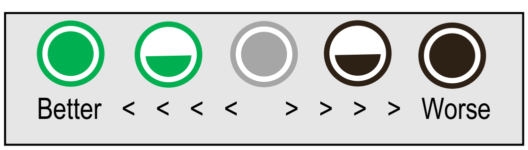


Figure ES-10. 2025 No Build and Build – PM Peak Period Person Throughput, I-495 Southbound

Table ES-3. Overall Performance Comparison for 2025 PM No Build and Build Alternative

Measure of Effectiveness	Description	Facility	2025 AM No Build Value	2025 AM Build Value	Build Performance Compared to No Build
Travel Times	End-to-end travel time along the facility through the Traffic Operations Study Area, measured in Minutes	I-495 NB GP	11	7	
		I-495 NB Express	8	6	
		I-495 SB GP	16	8	
		I-495 SB Express	8	6	
		Dulles Toll Road EB	2	2	
		Dulles Toll Road WB	2	2	
Extent and Duration of Congestion	Visual assessment of freeway mainline queue length and duration of congestion	I-495 NB GP			
		I-495 SB GP			
Person Throughput	Additional persons moved during peak period of Build condition and percentage increase	I-495 NB (All)	+6,800 (37%)		
		I-495 SB (All)	+8,800 (47%)		
Arterial Operations	Number of intersections operating at LOS F	Entire Study Area	12	10	
	Number of intersections operating at LOS D or better		13	17	



2045 AM Peak Period Summary

- Total demand along I-495 (GP plus Express) is forecasted to increase in the Build scenario along the length of the I-495 corridor. The greatest increases in demand are in the segments between Route 267 and GWMP, where Express Lanes are only present in the Build scenario and thus represent a substantial capacity increase from No Build conditions. Peak hour volumes are forecasted to increase in the Build scenario by between 3 to 11 percent in the northbound direction and between 4 to 6 percent in the southbound direction.
- **Figure ES-11** provides a "heat map" comparison of average speeds between 2045 No Build and Build conditions for the AM peak period along the I-495 GP lanes. Time of day during the peak period is provided on the horizontal axis while location along the corridor is provided along the vertical axis; the colors signify average speeds for each scenario. The figure indicates a more significant presence of congestion in the No Build scenario in both directions of the I-495 GP lanes as compared to the Build scenario.
- In the northbound direction along the I-495 GP lanes, congestion is observed under No Build conditions between Route 267 and Clara Barton Parkway (across the ALMB) due to heavy merging and weaving volumes on and near the bridge. Under Build conditions, a significant reduction in congestion is observed due to the additional capacity provided by the Express Lanes and the reduced weaving due to the continuity of the Express Lanes. The average travel time in the northbound GP lanes improves by approximately 4 minutes (a 33 percent improvement) in the Build condition.
- In the southbound direction along the I-495 GP lanes, severe congestion is observed under No Build conditions north of Route 193 through the northern extents of the Traffic Operations Study Area due to queue spillback from the merge at the southern Terminus of the Maryland managed lanes system. This congestion is significantly alleviated under Build conditions. The average travel time in the southbound GP lanes improves by nearly 9 minutes (a 54 percent improvement).
- Both directions of the Express Lanes operate at or near the posted speed limit, with the exceptions of the termini segments in the No Build conditions due to the merge of the Express Lanes into the GP lanes. To travel the length of the corridor via Express Lanes under No Build conditions, vehicles must utilize the congested GP lanes between Route 267 and GWMP, as Express Lanes are not present.
- Along eastbound Route 267 (DTR) there is 75 percent improvement in travel time. With the improved operations along northbound I-495, the ramp from eastbound DTR to northbound I-495 does not spill back to eastbound DTR, improving operations along eastbound DTR. Travel times along the westbound DTR remain unchanged.
- Over the course of the AM peak period, total persons moved along I-495 are forecasted to increase from No Build to Build conditions by between 6 and 33 percent in the northbound direction (see **Figure ES-12**) and between 29 and 35 percent in the southbound direction (see **Figure ES-13**), depending upon location along the corridor.
- Arterial intersection operations see an improvement under Build conditions, as the percentage of intersections operating at failing conditions drops from 33 percent (No Build) to 29 percent (Build), and more than half of all intersections are LOS D or better in the Build condition, while only 48 percent are at LOS D or better in the No Build condition. Most of the failing intersections are in the Tysons area and see continued growth in demand tied to commercial and residential growth in

Tysons. Improved arterial operations are observed along Route 193, most notably at the intersection with Balls Hill Road, where the northbound approach sees a significant improvement in operations.

Table ES-4 presents an overall performance comparison table for the Build alternative versus the No Build alternative for 2045 AM conditions. The table shows that the Build alternative improves overall operations along the I-495 corridor given the improvement in travel times, reduction in congestion, and increase in persons moved.

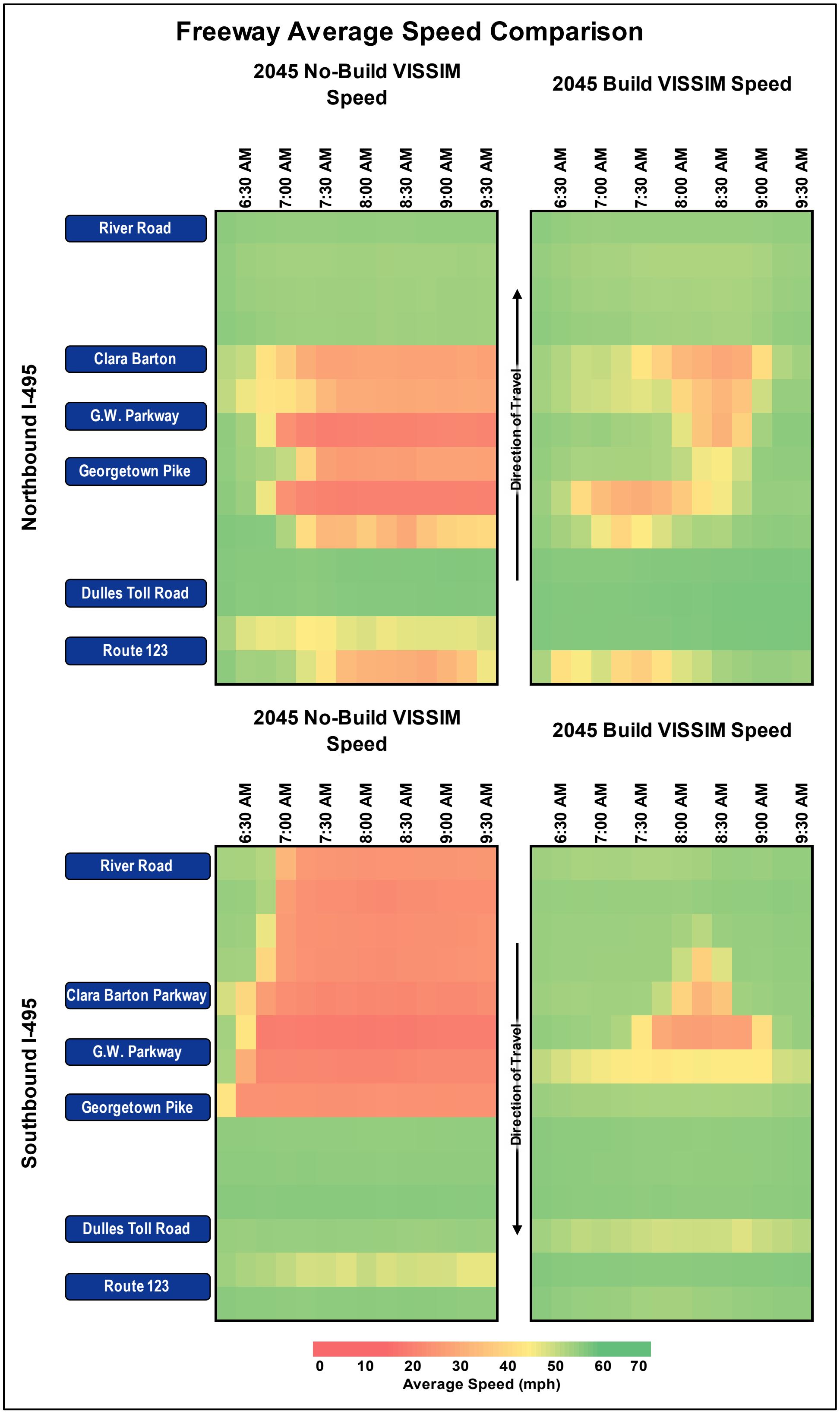


Figure ES-11. 2045 No Build and Build – AM Peak Period Average Speeds, I-495 GP Lanes

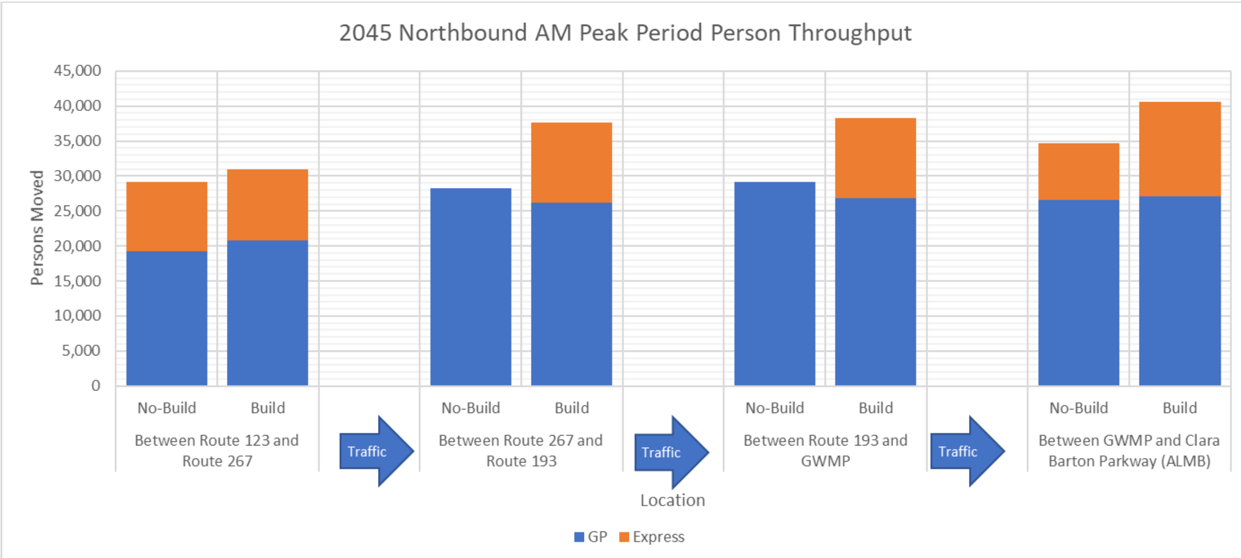


Figure ES-12. 2045 No Build and Build – AM Peak Period Person Throughput, I-495 Northbound

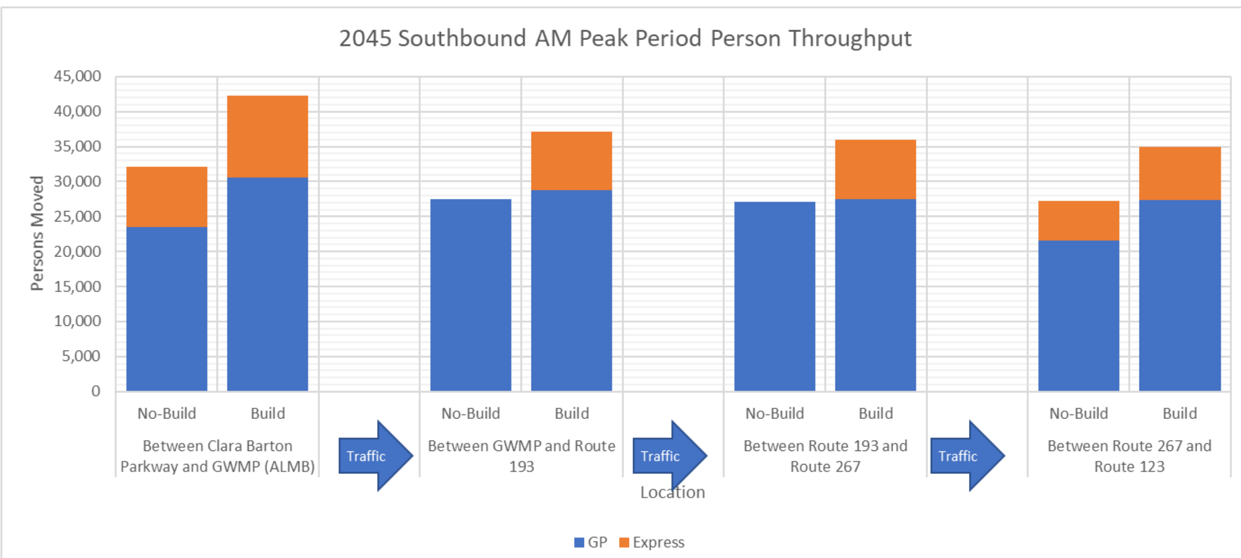
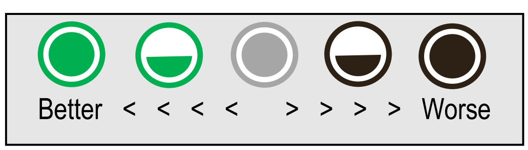


Figure ES-13. 2045 No Build and Build – AM Peak Period Person Throughput, I-495 Southbound

Table ES-4. Overall Performance Comparison for 2045 AM No Build and Build Alternative

Measure of Effectiveness	Description	Facility	2025 AM No Build Value	2025 AM Build Value	Build Performance Compared to No Build
Travel Times	End-to-end travel time along the facility through the Traffic Operations Study Area, measured in Minutes	I-495 NB GP	12	8	●
		I-495 NB Express	10	6	●
		I-495 SB GP	16	8	●
		I-495 SB Express	8	6	●
		Dulles Toll Road EB	7	2	●
		Dulles Toll Road WB	2	2	○
Extent and Duration of Congestion	Visual assessment of freeway mainline queue length and duration of congestion	I-495 NB GP			●
		I-495 SB GP			●
Person Throughput	Additional persons moved during peak period of Build condition and percentage increase	I-495 NB (All)	+9,300 (33%)		●
		I-495 SB (All)	+9,600 (35%)		●
Arterial Operations	Number of intersections operating at LOS F	Entire Study Area	10	10	○
	Number of intersections operating at LOS D or better		16	20	●



2045 PM Peak Period Summary

- Total demand along I-495 (GP plus Express) is forecasted to increase in the Build scenario along the length of the I-495 corridor. The greatest increases in demand are in the segments between Route 267 and GWMP, where Express Lanes are only present in the Build scenario and thus represent a substantial capacity increase from No Build conditions. Peak hour volumes are forecasted to increase in the Build scenario by between 3 to 20 percent in the northbound direction and between 7 to 12 percent in the southbound direction.
- **Figure ES-14** provides a "heat map" comparison of average speeds between 2045 No Build and Build conditions for the PM peak period along the I-495 GP lanes. Time of day during the peak period is provided on the horizontal axis while location along the corridor is provided along the vertical axis; the colors signify average speeds for each scenario. The figure indicates a more significant presence of congestion in the No Build scenario in both directions of the I-495 GP lanes as compared to the Build scenario. In the northbound direction, congestion remains in the Build scenario, but the extent and duration is lessened as compared to the No Build scenario.
- In the northbound direction along the I-495 GP lanes, severe congestion is observed under No Build conditions spilling back from the ALMB through the Route 267 interchange and essentially through the extents of the Traffic Operations Study Area; this congestion is worsened by spillback from the northbound GP lanes in Maryland later in the peak period, creating a single continuous area of congestion through the corridor. In the Build condition, the congestion in Maryland remains generally unchanged, but the extent of the queue spillback and duration on the Virginia side, especially south of Route 193, is not as significant as the No Build condition. This is attributable to the additional capacity provided by the Express Lanes and reduced weaving due to the continuity of the Express Lanes system. The average travel time in the northbound GP lanes improves by approximately 4.5 minutes (a 16 percent improvement) in the Build condition.
- In the southbound direction along the I-495 GP lanes, severe congestion is observed under No Build conditions north of Route 193 through the northern extents of the Traffic Operations Study Area due to queue spillback from the merge at the southern Terminus of the Maryland managed lanes system. This congestion is significantly alleviated under Build conditions. The average travel time in the southbound GP lanes improves by approximately 7.5 minutes (a 49 percent improvement).
- Both directions of the Express Lanes operate at or near the posted speed limit, with the exceptions of the termini segments in the No Build conditions due to the merge of the Express Lanes into the GP lanes. To travel the length of the corridor via Express Lanes under No Build conditions, vehicles must utilize the congested GP lanes between Route 267 and GWMP as Express Lanes are not present.
- Along eastbound and westbound Route 267 (DTR), travel times are essentially identical between No Build and Build.
- Over the course of the PM peak period, total persons moved along I-495 are forecasted to increase from No Build to Build conditions by between 10 and 35 percent in the northbound direction (see **Figure ES-15**) and between 16 and 32 percent in the southbound direction (see **Figure ES-16**), depending upon location along the corridor.
- Arterial intersection operations see an improvement under Build conditions, as the percentage of intersections operating at failing conditions drops from 43 percent (No Build) to 33 percent (Build), and 46 percent of intersections are LOS D or better in the Build condition, while only 33 percent are at LOS D or better in the No Build condition. Most of the failing intersections are in the Tysons

area and see continued growth in demand tied to commercial and residential growth in Tysons. Along Route 193, the signalized intersections all operate at LOS E or better under No Build and Build conditions; in the Build condition, a significant improvement in operations is realized along the northbound approach from Balls Hill Road at Route 193, which is failing under No Build conditions.

Table ES-5 presents an overall performance comparison table for the Build alternative versus the No Build alternative for 2045 PM conditions. The table shows that the Build alternative improves overall operations along the I-495 corridor given the improvement in travel times, reduction in congestion, and increase in persons moved. Arterial operations are also shown to improve in the PM peak hour under the Build alternative.

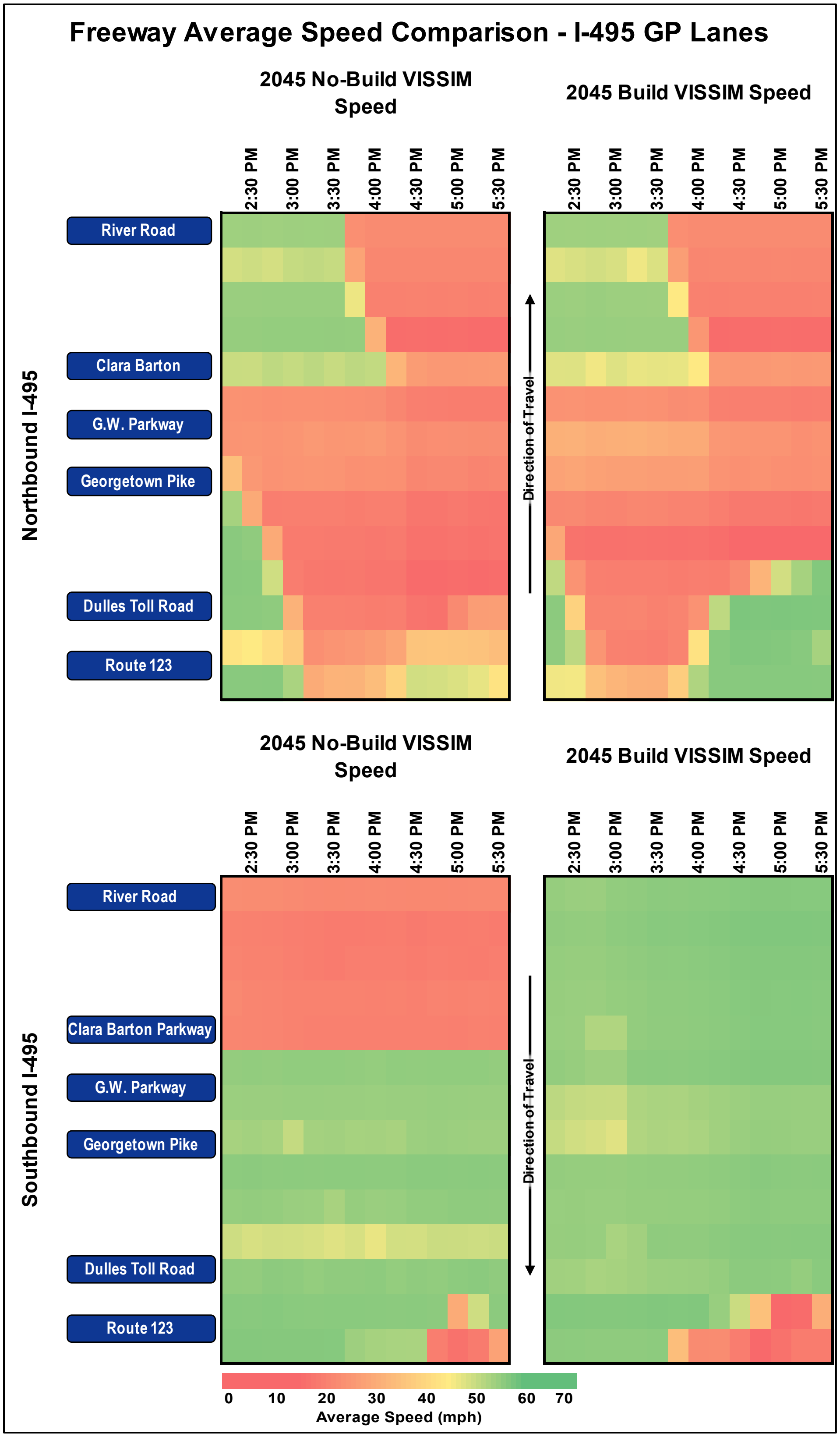


Figure ES-14. 2045 No Build and Build – PM Peak Period Average Speeds, I-495 GP Lanes

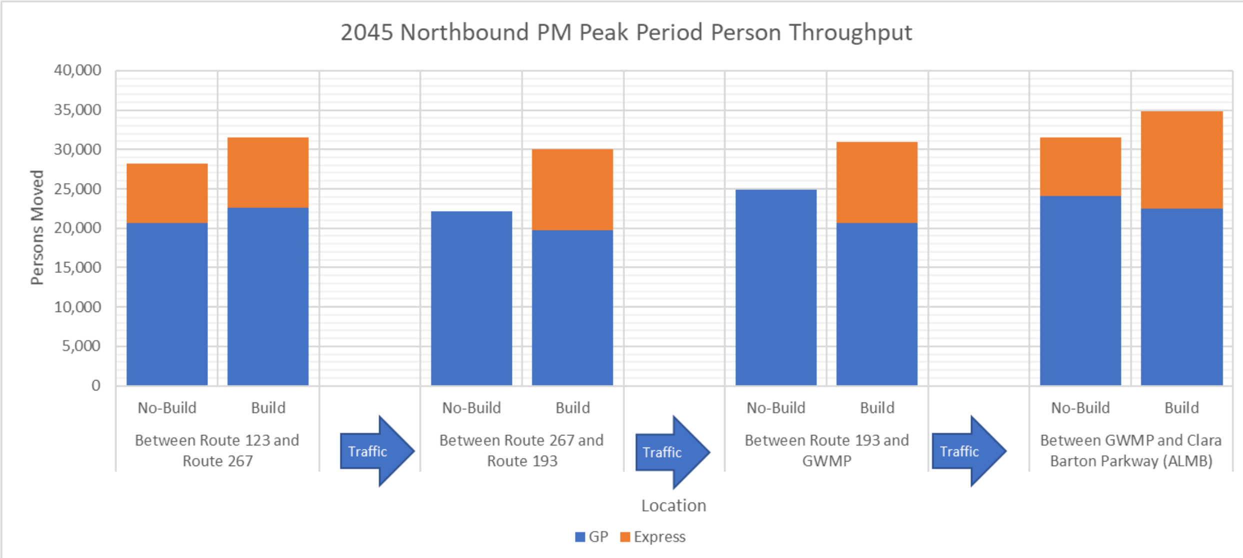


Figure ES-15. 2045 No Build and Build – PM Peak Period Person Throughput, I-495 Northbound

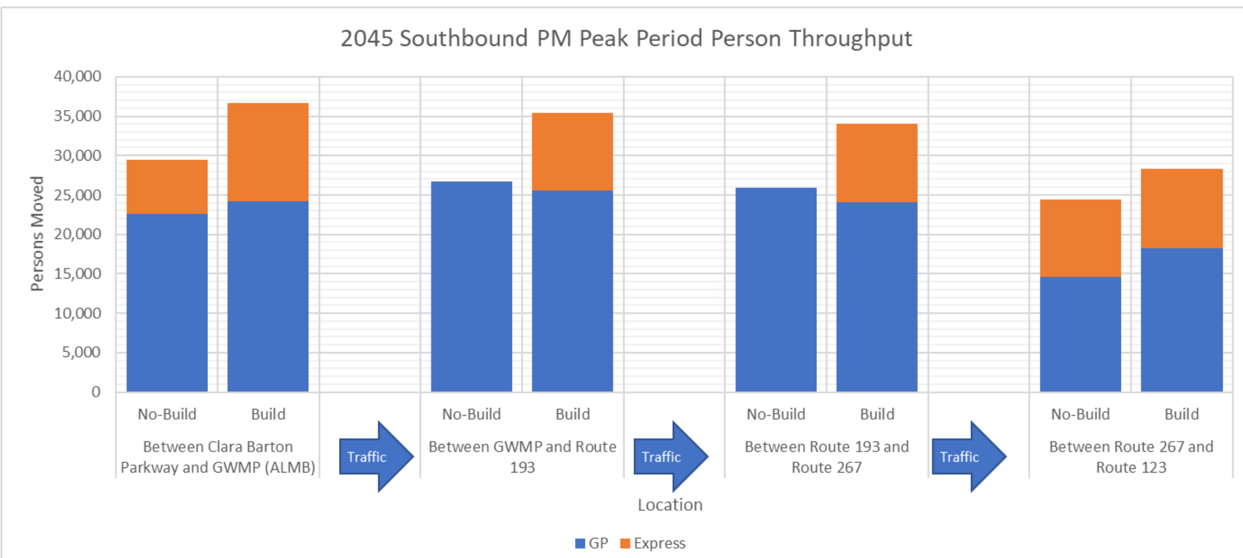
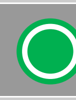
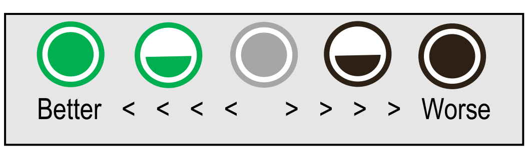


Figure ES-16. 2045 No Build and Build – PM Peak Period Person Throughput, I-495 Southbound

Table ES-5. Overall Performance Comparison for 2045 PM No Build and Build Alternative

Measure of Effectiveness	Description	Facility	2025 AM No Build Value	2025 AM Build Value	Build Performance Compared to No Build
Travel Times	End-to-end travel time along the facility through the Traffic Operations Study Area, measured in Minutes	I-495 NB GP	28	24	
		I-495 NB Express	16	6	
		I-495 SB GP	15	8	
		I-495 SB Express	7	6	
		Dulles Toll Road EB	2	2	
		Dulles Toll Road WB	2	2	
Extent and Duration of Congestion	Visual assessment of freeway mainline queue length and duration of congestion	I-495 NB GP			
		I-495 SB GP			
Person Throughput	Additional persons moved during peak period of Build condition and percentage increase	I-495 NB (All)	+7,800 (35%)		
		I-495 SB (All)	+8,700 (32%)		
Arterial Operations	Number of intersections operating at LOS F	Entire Study Area	11	10	
	Number of intersections operating at LOS D or better		14	18	



ES.3.5 Existing and Future Conditions Safety Analysis

Existing Conditions Crash History

Over the five-year period analysis period (2013-2017), there were a total of 1,736 crashes reported on the 4.6-mile section of I-495 (northbound and southbound) between the Route 7 interchange and the ALMB over the Potomac River. This section of I-495 includes the I-495 GP lanes, approximately 2.85 miles of the I-495 Express Lanes between Route 7 and the current northern terminus north of the Dulles Toll Road interchange, and approximately 22 ramps to and from I-495. During this five-year period, there were no fatal crashes, 455 injury crashes, and 1,281 property damage only (PDO) crashes reported in the freeway corridor.

Of the 1,736 of crashes reported within the study area between 2013 and 2017, the predominant crash type along the I-495 corridor is Rear-End-type crashes. Approximately 59 percent of all crashes were Rear-End collisions, compared to 22 percent Side-Swipe (same direction) crashes, 8 percent Angle crashes, 8 percent Run-Off-Road crashes, and 3 percent Other crashes.

<u>Northbound I-495 GP Lanes</u>

The crash rate for northbound I-495 from Route 7 to the ALMB is worse than the southbound crash rate between the same termini. Moreover, the crash rate for this northbound section is approximately 100 percent higher than the statewide crash rate. The injury crash rate is 25 percent higher than the statewide injury crash rate. The predominant type of crashes in the northbound GP lanes are Rear-End and Same-Direction Side-Swipe crashes. Traffic congestion in the study area significantly influences the safety conditions. Rear-End and Side-Swipe crashes tend to typically be prominent in congested corridors.

The following three segments of I-495 experience the highest number of Rear-End crashes:

- Northbound I-495 from Route 267 to Route 193, with 145 crashes;
- Northbound I-495 from the off-ramp to Route 193 to the on-ramp from Route 193, with 67 crashes
- Northbound I-495 from the off-ramp to GWMP to the on-ramp from GWMP, with 60 crashes.

<u>Northbound I-495 Express Lanes</u>

Compared to the statewide average crash rates from 2013 through 2017 for interstate facilities within Virginia, the crash rate for the northbound Express Lanes section of I-495, exclusive of the existing northern terminus and the transition section to the GP lanes, was approximately 17 percent lower. The injury crash rate is 71 percent lower than the statewide injury crash rate. This can be attributed to the reduced congestion and improved level of service offered to commuters using the Express Lanes.

<u>Southbound I-495 GP Lanes</u>

Compared with the statewide average crash rates from 2013 through 2017 for interstate facilities within Virginia, the southbound section of I-495 between the ALMB and Route 7 exhibited an approximately 11 percent lower crash rate. The injury crash rate is 42 percent lower than the statewide injury crash rate. The predominant types of crashes in the southbound GP lanes are Rear-End and Same-Direction Side-Swipe crashes. This implies that, in addition to the congestion, merging and lane-changing maneuvers executed influence traffic safety in the study area.

Southbound I-495 Express Lanes

Compared with the statewide average crash rates from 2013 through 2017 for interstate facilities within Virginia, the southbound Express Lanes section of I-495 exhibited an approximately 27 percent lower crash rate. The injury crash rate is 55 percent lower than the statewide injury crash rate. This can again be attributed to the reduced congestion and improved level offered to commuters using the Express Lanes.

Route 267

During the data collection period, there were 181 reported crashes on the Dulles Toll Road/Dulles Connector Road (DTR/DCR) mainline, 61 crashes reported on the eastbound ramps to I-495, and 10 crashes reported on the westbound off-ramp to I-495 northbound.

From the analysis, five "Hot Spots" were identified which in total account for 44 percent of crashes along the DTR/DCR study area:

- Hot Spot 1: westbound approach to the DTR mainline toll plaza
- Hot Spot 2: westbound weave area between the I-495 and Spring Hill interchanges
- Hot Spot 3: diverge area of the eastbound DTR exit ramps to I-495
- Hot Spot 4: eastbound weave area between the on-ramp from southbound I-495 and off-ramps to Route 123
- Hot Spot 5: diverge area along the eastbound DTR ramps to I-495 where drivers must properly lane position for the exit onto either northbound or southbound I-495

GWMP

Crash data obtained from NPS indicates two primary areas of significant crash activity: the ramps to and from the Turkey Run turnaround and the gore area for westbound GWMP to the I-495 ramps. The crash frequency of the Turkey Run Ramps is likely due to limited geometrics and very short acceleration and deceleration lanes. The crash activity at the gore area may be due to late lane changes or unsafe diverging maneuvers by motorists.

Future Conditions Crash Predictions

In **Table ES-6**, the crash frequency results from the 2025 No Build and Build conditions are compared with the crash frequency results from the 2045 No Build and Build conditions. These numbers represent the total predicted crashes in the Traffic Operations Study Area, including GP lanes, Express Lanes, and arterials. The total number of predicted crashes per year is anticipated to decrease in the 2045 No Build case compared to the 2025 No Build case due to CLRP improvements included within the study area (including the Maryland Traffic Relief Plan). Similarly, the total number of predicted crashes per year is anticipated to decrease in the 2045 Build case compared to the 2025 Build case.

For the 2025 No Build and Build scenarios, no improvements to I-495 on the Maryland side of the Potomac River (the Maryland Traffic Relief Plan) were assumed to be included. This represents a conservative (worst-case) assessment of safety conditions for 2025. The improvements to I-495 on the Maryland side of the river were assumed to be in place for both No Build and Build conditions for 2045.

Table ES-6. Total I-495 Traffic Operations Study Area Predicted Crash Frequency Summary

Year	Scenario	Total General Purpose, Express, and Arterial Intersection Predicted Crash Frequency (crashes/year)		
		KABC	PDO	Total
2025	No Build	278.1	583.3	861.4
	Build	280.2	588.2	868.4
2045	No Build	254.9	563.2	818.1
	Build	226.8	426.1	652.9

Under analyzed 2025 conditions, the Build condition has positive safety impacts on the I-495 corridor as well as the surrounding arterial network as compared to No Build conditions by improving throughput and reducing congestion in both directions of the I-495 corridor. However, if no improvements are constructed or undertaken in Maryland at the Express Lanes northern terminus of the I-495 NEXT project, it is anticipated there will be some potential safety concerns by introducing additional merge and diverge conflicts into the currently congested area of the GWMP and ALMB.

For 2045 conditions, the Build condition produces significant overall safety benefits as compared to No Build conditions by efficiently moving a greater volume of traffic with significantly reduced congestion in both directions of the I-495 corridor. With the full Express Lanes network extended into Maryland, it is anticipated that the corridor will operate at a much-improved level of safety as compared to No Build conditions. Comprehensively, the project is a significant improvement in overall safety.

Table 8-3. 2025 Arterial Intersection Predicted Crash Frequencies 8-46
Table 8-4. 2045 Arterial Intersection Predicted Crash Frequencies 8-47

CHAPTER 1.0 INTRODUCTION AND ORGANIZATION

The Virginia Department of Transportation (VDOT), in coordination with the Federal Highway Administration (FHWA) as the lead federal agency, is evaluating an extension of the Interstate 495 (I-495) Express Lanes along approximately three miles of I-495, also referred to as the Capital Beltway, from their current northern terminus in the vicinity of the Old Dominion Drive overpass to the George Washington Memorial Parkway (GWMP) in the McLean area of Fairfax County, Virginia. The project location is shown in the vicinity map in **Figure 1-1**. Pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended, and in accordance with FHWA regulations[1], an Environmental Assessment (EA) is being prepared to analyze the potential social, economic, and environmental effects associated with the improvements being evaluated. As part of the EA being prepared, VDOT is evaluating in detail the environmental consequences of the No Build Alternative and one Build Alternative.

To support the EA, the purpose of this Traffic and Transportation Technical Report is to document:

- Existing traffic operations and safety conditions within the study area.
- Forecasted traffic volumes for future scenarios under No Build and Build conditions.
- Technical analysis and information in support of the development of alternatives.
- Traffic data needed for noise and air quality analysis to support the NEPA efforts.
- Future traffic operations and safety conditions under No Build and Build scenarios.

1.1 PROJECT LIMITS

The project extends from approximately south of the Dulles Toll Road / Route 267 interchange to the GWMP in the vicinity of the American Legion Memorial Bridge (ALMB). Although the proposed lanes would terminate at the GWMP, and the interchange provides a logical northern terminus for this study, additional improvements are anticipated to extend approximately 0.3 miles north of the GWMP to provide a tie-in to the existing road. The project also includes access ramp improvements and lane reconfigurations along portions of the Dulles Toll Road and the Dulles International Airport Access Highway, on either side of the Capital Beltway, from the Spring Hill Road Interchange to the Route 123 interchange. The proposed improvements entail new and reconfigured express lane ramps and general purpose lane ramps at the Dulles Interchange and tie-in connections to the Route 123/I-495 interchange. The project has independent utility since it would provide a usable facility and be a reasonable expenditure of funds even if no additional transportation improvements in the area are made.

1.2 STUDY AREA

In order to assess and document relevant resources that may be affected by the proposed project, the study area for the EA extends beyond the immediate area of the proposed improvements described above. The study area for the EA includes approximately four miles along I-495 between the Route 123 interchange and the ALMB at the Maryland state line. The study area also extends approximately 2,500 feet east along the GWMP. Intersecting roadways and interchanges are also included in the study area, as well as adjacent areas within 600 feet of the existing edge of pavement**.** The study area is a buffer around the road corridor

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[1] NEPA and FHWA's regulations for Environmental Impact and Related Procedures can be found at 42 USC § 4332(c), as amended, and 23 CFR § 771, respectively.

that includes all natural, cultural, and physical resources that are analyzed in the EA. It does not represent the limits of disturbance (LOD) of the project nor imply right-of-way acquisition or construction impact, but rather extends beyond the project footprint to tie into the surrounding network, including tying into future network improvements. **Figure 1-2** depicts the project termini, study area, and LOD.

The existing I-495 facility within the study area currently has four northbound and four southbound general purpose (GP) lanes, supplemented in several locations by auxiliary lanes[2], acceleration/deceleration lanes at on- and off-ramps, and collector-distributor (C-D) roadways[3]. Grade-separated interchanges provide access to and from I-495 and the Jones Branch Connector; Chain Bridge Road (Route 123); the Dulles Toll Road (DTR), Dulles Airport Access Road (DAAR), and Dulles Connector Road (DCR), collectively referred to as Route 267; Georgetown Pike (Route 193); and the GWMP. North of the study area, I-495 at the ALMB is a total of 10 lanes, including eight GP through lanes and two auxiliary lanes that connect to Clara Barton Parkway in Maryland and the GWMP in Virginia.

The southbound entrance onto the existing I-495 Express Lanes and northbound exit from the I-495 Express Lanes occur within the study area, approximately 2,000 feet south of Old Dominion Drive, as shown in **Figure 1-2**. Drivers are permitted to use the northbound inside shoulder of the GP lanes during peak travel periods (6 AM - 11 AM and 2 PM - 8 PM Mon - Fri). The shoulder lane terminates by merging into the GP lanes just before reaching the GWMP interchange. All buses and vehicles with two axles can access the I-495 Express Lanes 24 hours a day, seven days a week. The I-495 Express Lanes operate as high-occupancy toll (HOT) lanes where vehicles with three or more occupants are not charged a toll. Trucks are currently prohibited from using the I-495 Express Lanes.

The southern portion of the study area surrounding the Route 267 interchange is surrounded by high-density commercial and residential development associated with the Tysons area. The study area between the Route 267 interchange and GWMP is comprised of suburban neighborhoods and supporting recreational areas that border the interstate, with direct access to I-495 limited to Route 193. North of the GWMP approaching the Maryland state line at the ALMB over the Potomac River is primarily open federal parkland associated with the GWMP to the east and Scotts Run Nature Preserve to the west.

The extended study areas for traffic operations and safety analysis are discussed in detail in **Chapter 2**.

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[2] An auxiliary lane is defined by the American Association of State Highway and Transportation Officials (AASHTO) as the portion of the roadway adjoining the traveled way for speed change, turning, weaving, truck climbing, maneuvering of entering and leaving traffic, and other purposes supplementary to through-traffic movement. Auxiliary lanes are used to balance the traffic load and maintain a more uniform level of service on the highway. They facilitate the positioning of drivers at exits and the merging of drivers at entrances (AASHTO, 2018).

[3] Collector-distributor (C-D) roadways are supplemental facilities parallel to freeway mainlines that serve primarily to move weaving and lane-changing associated with closely-spaced on- and off-ramps away from the freeway mainline. C-D roadways are typically located at freeway interchanges where ramp-to-ramp weaving occurs or where closely-spaced major arterials are present and there is minimal room for multiple freeway mainline entrance and exit ramps.

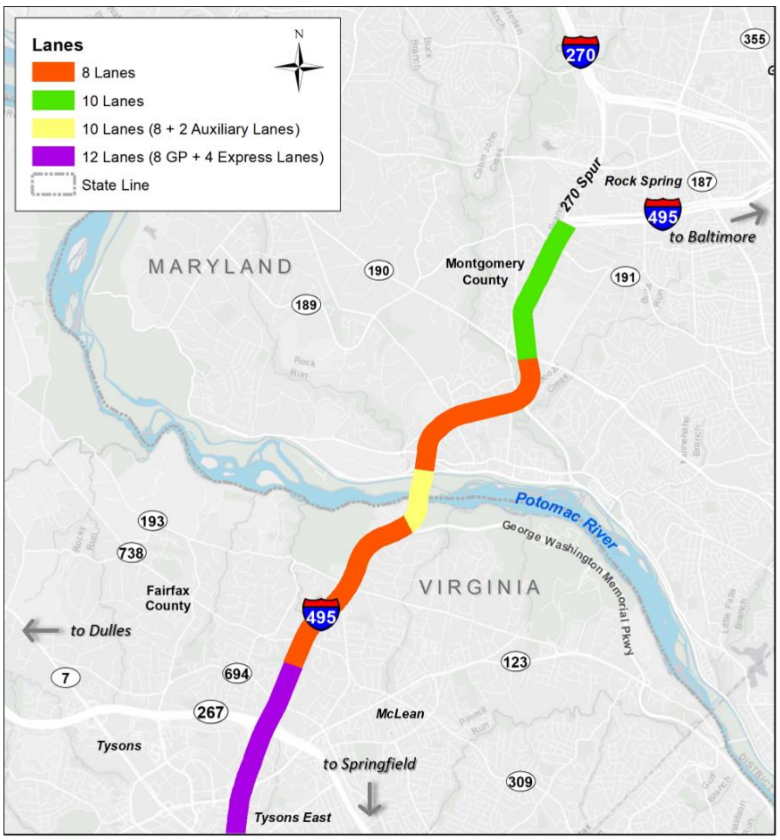
Figure 1-1. I-495 Express Lanes Northern Extension Project Vicinity

Figure 1-2. I-495 Express Lanes Northern Extension Project Limits

1.3 HISTORY OF I-495 AND PROJECT HISTORY

I-495 (also known as the Capital Beltway) is a 64-mile, multi-lane, circumferential freeway centered around Washington, D.C. and passing through Maryland and Virginia. The Virginia portion of I-495 is 22 miles, extending from the Woodrow Wilson Bridge in the City of Alexandria to the ALMB in Fairfax County.

Initial planning for I-495 began in 1950 with the publication of the 1950 Comprehensive Plan for the Washington area (NCPPC, 1952). Construction of I-495 began in 1957 and was completed in 1964. Originally, I-495 consisted of six lanes for most of its length except for 14.5 miles between the northern Potomac crossing (now the ALMB) and Interstate 95 (I-95) in Springfield, which was four lanes. Since its completion in 1964, many modifications and improvements have been implemented, such as the addition of lanes, construction or modification of interchanges, and safety improvements. In 1977, the Virginia side of I-495 was widened from four to eight lanes up to Route 193 (Georgetown Pike). In 1992, a portion of I-495 between Route 193 and the Interstate 270 (I-270) spur in Maryland was widened to eight lanes, and the ALMB was widened to 10 lanes (eight through lanes and two auxiliary lanes), as shown in **Figure 1-3**.



Service Layer Credits: Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community

Figure 1-3. Current I-495 Lane Segments

In January 1997, a Major Investment Study (MIS) was completed to evaluate a range of strategies for dealing with transportation deficiencies along the Capital Beltway corridor. The conclusion of the MIS was that highway improvements promoting high-occupancy vehicle (HOV) use, such as designated, non-tolled HOV lanes for vehicles with at least three occupants, would be the most effective transportation investment to serve current and future travel demand on the Capital Beltway (VDOT/FHWA, 2006).

In 1998, following the completion of the MIS, FHWA and VDOT launched preliminary location and environmental studies to evaluate the recommended improvements to the Capital Beltway, including widening for the addition of HOV lanes. Initially, an EA was prepared to determine if preparation of an Environmental Impact Statement (EIS) would be warranted. FHWA and VDOT subsequently determined that due to the large footprint of the project and the potential for environmental consequences, an EIS would be necessary. A Notice of Intent to prepare an EIS was published in the *Federal Register* in June 2000 (VDOT/FHWA, 2006).

FHWA and VDOT prepared the Capital Beltway Study Draft EIS in 2002 to evaluate the expansion and reconfiguration of I-495 from the ALMB to the I-95/I-495/I-395 interchange in Springfield. Initially, only HOV alternatives were proposed: the Concurrent HOV Alternative, in which one HOV lane would be added in each direction with no additional GP lanes; the Express/Local with HOV Alternative, which would separate short- and long-distance trips and provide one HOV lane in each direction; and the Barrier-Separated HOV Alternative, which would provide 12 through lanes in a 4-2-2-4 configuration, with four outer GP lanes and two barrier-separated inner HOV lanes in each direction. In addition, options for interchange configurations and direct access points for HOV traffic to the HOV lanes were evaluated for each alternative. During the public comment period for the Draft EIS, the alternatives were met with opposition from local governments and the general public due to excessive right-of-way acquisition and the displacement of as many as 294 residential properties (VDOT/FHWA, 2006).

Following publication of the Capital Beltway Study Draft EIS in March 2002, VDOT received a proposal pursuant to the Virginia Public-Private Transportation Act (PPTA), which allows for private entities to solicit VDOT to develop and/or operate and maintain transportation facilities that VDOT determines demonstrate a public need and benefit. The PPTA proposal included a plan to add four HOT lanes to 14.5 miles of I-495 between the existing GP lanes from the ALMB to the I-95/I-495/I-395 interchange in Springfield. This option required less right-of-way than the alternatives in the Draft EIS and would substantially reduce relocation impacts. Based on comments received on the Draft EIS and following the submittal of the PPTA proposal for HOT lanes, the three original Build Alternatives and interchange options were substantially revised and re-evaluated with both HOV and HOT lane options, resulting in six "refined" alternatives. Two of these refined alternatives were chosen for further development and more detailed study: the 12-Lane HOT / Managed Lanes Alternative, developed from the Barrier-Separated HOV Alternative presented in the Draft EIS; and a Revised 10-Lane Concurrent HOV Alternative. In January 2005, the Commonwealth Transportation Board (CTB) selected the 12-Lane HOT / Managed Lanes Alternative as the Preferred Alternative to be carried forward in the Final EIS (VDOT/FHWA, 2006). The Final EIS was completed and published in April 2006. FHWA issued a Record of Decision (ROD) in June 2006, approving the selection of the 12-Lane HOT / Managed Lanes Alternative as the Selected Action (FHWA, 2006).

In May 2007, it was determined that a change in the northern project limits was necessary to allow for a transition area between the entrance/exit to the HOT lanes and the ALMB (VDOT, 2007). A NEPA re-evaluation and an Interchange Justification Report (IJR) were completed in 2007 to include design updates and related impacts, and to modify the northern terminus of the HOT lanes from the ALMB to the current terminus south of Old Dominion Drive. Other NEPA re-evaluations were completed in June 2008, December 2008, May 2009, and July 2009 to account for minor design refinements.

Construction of the I-495 Express Lanes commenced in 2008, and the I-495 Express Lanes opened to traffic in November 2012.

In 2009, while construction was underway for the I-495 Express Lanes, the Metropolitan Washington Airports Authority (MWAA) developed the Dulles Interchange Long-Range Plan for the I-495/Route 267 interchange to determine what, if any, changes to the then-current plan for the interchange under the I-495 Express Lanes project may be necessary to accommodate other future interchange improvements. The Long-Range Plan determined that up to 11 additional ramp movements would be necessary to improve I-495 connections to and from the DAAR and DTR. VDOT in partnership with MWAA signed a Memorandum of Understanding (MOA) in May 2009 to incorporate three of these additional ramps into the I-495 Express Lanes project. Specifically, these ramps provided movements for southbound I-495 GP lanes to westbound DAAR; eastbound DAAR to southbound I-495 GP; and eastbound DAAR to northbound I-495 GP (VDOT/MWAA, 2009). A NEPA Re-evaluation of the Capital Beltway Study EIS was conducted, and the additional ramps were found to be consistent with the findings of the Final EIS (FHWA, 2009). An IJR for the Dulles Interchange was prepared and approved in December 2009 (VDOT, 2009). The ramps were constructed as part of the I-495 Express Lanes project and opened to traffic in September 2012.

1.4 PURPOSE AND NEED

The purpose and need for the extension of Express Lanes on I-495 between Route 267 and the GWMP is to:

- **Reduce congestion** – Regional travel demand forecasting shows increased traffic volumes and travel demands as population and employment continue to grow within the region;
- **Provide additional travel choices** – Access to high-occupancy travel modes encourages drivers to choose alternatives to single-occupancy travel as well as provides an option to single-occupancy drivers to use the Express Lanes, freeing up capacity on the GP lanes, and the addition of north-south pedestrian and bike facilities, which are currently lacking, improves travel choice; and
- **Improve travel reliability** – Duration and extent of congestion is expected to increase along with population and employment growth resulting in the need for commuters to spend additional time traveling to work. Travel times in the GP lanes are expected to continue to be increasingly unreliable, with median peak period travel times being several multiples of free-flow travel times and 95th percentile peak period travel times extending much longer. Express Lanes are designed to keep traffic flowing at 45 miles per hour or faster by dynamically adjusting tolls, allowing transit, high-occupancy, and toll-paying vehicles to have a much more reliable trip.

A detailed description of the purpose and need for the proposed project is provided in Chapter 1.0 of the EA.

1.5 REPORT ORGANIZATION

The organization of this report proceeds through the following chapters:

1. **Introduction and Organization**: describes project history, problem statement and study area.
2. **Methodology:** identifies data collection, assumptions, alternative development and scenarios that drive the travel demand forecasting steps, traffic operational analysis, and safety and crash analysis.
3. **Existing Transportation Networks**: presents the transportation infrastructure and options currently available along the corridor.

4. **Existing Traffic Operational Conditions**: provides an understanding of existing traffic and travel patterns as well as the performance of traffic operations. Note that this chapter is a condensed summary of material provided in the supplemental Existing Conditions Technical Report (VDOT, 2020x) associated with the EA.
5. **Background (No Build) Transportation Network:** documents assumptions for background improvements to the transportation network included as elements of future No Build conditions, including future planned projects.
6. **Build Transportation Network:** presents the elements included in the Build Alternative, including phasing of improvements.
7. **Future Scenarios Operational Conditions:** presents the details on the development of future traffic demand for 2025 and 2045 analysis years along with the operational results and findings of No Build and Build scenarios.
8. **Existing and Future Safety and Crash Analysis**: presents the existing conditions safety analysis and crash history as well as an assessment of projected future conditions using quantitative modeling techniques.
9. **References**: provides a list of references for this report.

CHAPTER 2.0 METHODOLOGY

This chapter details the methodology for assessing traffic operations and safety impacts associated with the I-495 NEXT project. It provides an overview of the scenarios, data collection, travel demand forecasting, traffic analysis tools and measures of effectiveness, and safety analysis methodology. It also provides an overview of traffic data prepared for the noise and air quality analysis associated with this project.

This methodology is consistent with and references the *I-495 NEXT Project Scoping Framework Document*, which was published on November 15, 2018 and is provided as **Appendix A**. The project framework document and its supplementary memoranda provide a much more detailed documentation of the methodology summarized in this chapter.

2.1 SCENARIOS AND ASSUMPTIONS

2.1.1 Analysis Years and Scenarios

Traffic operations analysis consisted of an evaluation of existing conditions (2018), No Build conditions (2025 and 2045), and Build conditions (2025 and 2045):

- The existing conditions transportation network is described in detail in **Chapter 3**. Operational analysis results for existing conditions are summarized in **Chapter 4.** An assessment of safety for existing conditions is provided in **Chapter 8.**
- No Build conditions assume the completion of programmed transportation improvements consistent with the regional Constrained Long-Range Plan (CLRP) but without the I-495 Express Lanes Northern Extension project in place. The roadway network associated with these background improvements is described in **Chapter 5**.
- Build conditions assume the incorporation of the project Preferred Alternative, which includes two Express Lanes in each direction along I-495 between Route 267 (Dulles Toll Road) and the GWMP, along with four general purpose (GP) lanes in each direction along the I-495 mainline and an auxiliary lane in each direction between Route 267 and Route 193 (Georgetown Pike). The construction of the Preferred Alternative is assumed to take place in phases, with the most critical components constructed first. The roadway network associated with the Build improvements, including the phasing of these improvements, is described in **Chapter 6**.

Operational analysis results comparing No Build and Build conditions are provided in **Chapter 7**. An assessment of safety for No Build and Build conditions is provided in **Chapter 8**.

Sensitivity Analysis for Future Traffic Operations prior to Maryland Managed Lanes Project
To understand the impacts and operational benefits or constraints of the I-495 NEXT project operations prior to the adjacent Maryland managed lanes system being in place (described in **Chapter 5**), a sensitivity analysis was performed for the 2025 analysis year. This sensitivity analysis included travel demand model runs, traffic volume forecasting, and traffic operations in VISSIM and Synchro. The results of this sensitivity analysis are provided in **Appendix I**.

2.1.2 Roadway Network Scope for Traffic Analysis

Figure 2-1 shows the various components of the project Study Area for the I-495 NEXT project:

- **Yellow – Project Footprint Study Area.** The I-495 NEXT Project Footprint Study Area includes I-495 from the Route 267 interchange to the ALMB, including all ramp termini of interchanges over that section.
- **Blue – Traffic Operations Analysis Study Area.** The Traffic Operations Analysis Study Area includes the full extent of the Project Footprint Study Area as well as one interchange north and south on I-495, and a number of additional intersections and interchanges which directly affect and/or are affected by operations on I-495 within the Project Footprint Study Area.

Figure 2-1: Project Study Area and Traffic Operations Analysis Study Area

2.2 DATA COLLECTION

In support of the project, an extensive data collection effort and subsequent data review was completed during May and June 2018.

- **Traffic counts:** intersection turning movement counts (TMC) and average daily traffic (ADT) counts were collected at 122 locations as shown in **Figure 2-2**.
- **Travel times:** travel time data was collected on the two major freeway corridors within the Study Area: I-495 (northbound and southbound directions; General Purpose lanes only) and Route 267 (eastbound and westbound directions; both Dulles Toll Road (DTR) and Dulles Airport Access Road (DAAR)) as well as select “system-to-system” routes that capture congestion experienced along ramps connecting one facility to another**.**
- **Freeway speeds:** INRIX speeds and travel times for both corridors, including both the existing I-495 Express Lanes south of the Study Area and the DAAR were obtained through RITIS.
- **Queues:** queueing data was collected at targeted critical locations; freeway mainline congestion and queues were reviewed against speed heat maps provided by INRIX and Google Maps’ typical traffic.
- **Origin-destination (O-D) data:** O-D, used for routing vehicles through the traffic network within the traffic simulation data, was reviewed from StreetLight Data and Metropolitan Washington Council of Governments (MWCOG), where StreetLight Data was used as the basis for O-D routing for the existing conditions traffic analysis and the MWCOG matrices were used as the basis for vehicle routing in future analysis year scenarios.
- **Signal timings:** Synchro models, provided by VDOT, were the source for signal timing data and the initial determination of unsignalized intersections. Some of the individual timing plans in the original Synchro files were revised and updated based on field observations.

A detailed review of data collected for the project is provided in the *I-495 Express Lanes Northern Extension Existing Conditions Technical Report* (VDOT, 2019a) as an associated technical report with the EA.

Figure 2-2. Traffic Count Locations

2.3 TRAVEL DEMAND FORECASTING AND DEVELOPMENT OF FUTURE TRAFFIC VOLUMES

Forecasts for future traffic demand were developed using the MWCOG travel demand model (version 2.3.75 using Round 9.1 Cooperative Forecasts for socioeconomic data). The MWCOG model was modified and developed to reflect existing conditions (year 2018) in the Study Area. This included existing conditions network modifications to reflect current traffic volumes, and these modifications were carried into subsequent 2025- and 2045-year I-495 NEXT model scenarios. Strategic modifications included highway network edits to better represent Study Area facilities as they exist (including micro-coding of ramps), modification to centroid connectors to improve loading of traffic, modifications to the default speed and capacity of certain facilities, and enhancements to penalties for crossing the Potomac River. Calibration of the model was based on guidance from the FHWA Transportation Model Improvement Program (TMIP) *Travel Model Validation and Reasonableness Checking Manual* (FHWA, 2010) and the Virginia *Travel Demand Modeling Policies and Procedures Manual* (VDOT, 2014). Updates to the model were validated by comparing daily counts versus model forecasts, peak period traffic counts to modeled data during the same periods, and AM and PM observed speeds and travel times to model speeds and travel times within the I-495 traffic operations analysis Study Area.

A detailed overview of travel demand modeling methodology is provided as **Appendix B**. A memorandum detailing the modifications made to the MWCOG model to better reflect existing conditions, including validation metrics, is provided as **Appendix C**.

Post-Processing of Model Results

Relevant edits to the calibrated existing conditions model network and scripts were carried forward to all future scenarios, including separate model scenarios for No Build and Build conditions as well as model scenarios developed for the various sensitivity tests. Outputs from these models were used to estimate growth on Study Area roadway links using National Cooperative Highway Research Program (*NCHRP 765)* industry-standard practices (Transportation Research Board, 2014). The *NCHRP 765* iterative-directional method was used to convert forecasted link volumes into forecasted turning movement volumes for arterial intersections. All traffic volumes on freeways and arterials were balanced.

Origin-Destination Routing for Traffic Analysis

Origin-destination (O-D) routing was used in the VISSIM traffic simulation models (described in the next section). In order to produce these O-D routes, a seeding O-D matrix was developed using a combination of StreetLight Data and MWCOG model subarea matrix outputs. This seeding matrix and balanced, post-processed volume targets were then imported into PTV VISUM travel demand modeling software for each scenario. An adjusted final matrix was developed using VISUM's TFlowFuzzy methodology with the seeding O-D matrix and volume targets. The final O-D matrices were disaggregated into two vehicles classes (auto and truck) for routing in the traffic analysis microsimulation models.

2.4 TRAFFIC ANALYSIS TOOLS AND METHODOLOGY

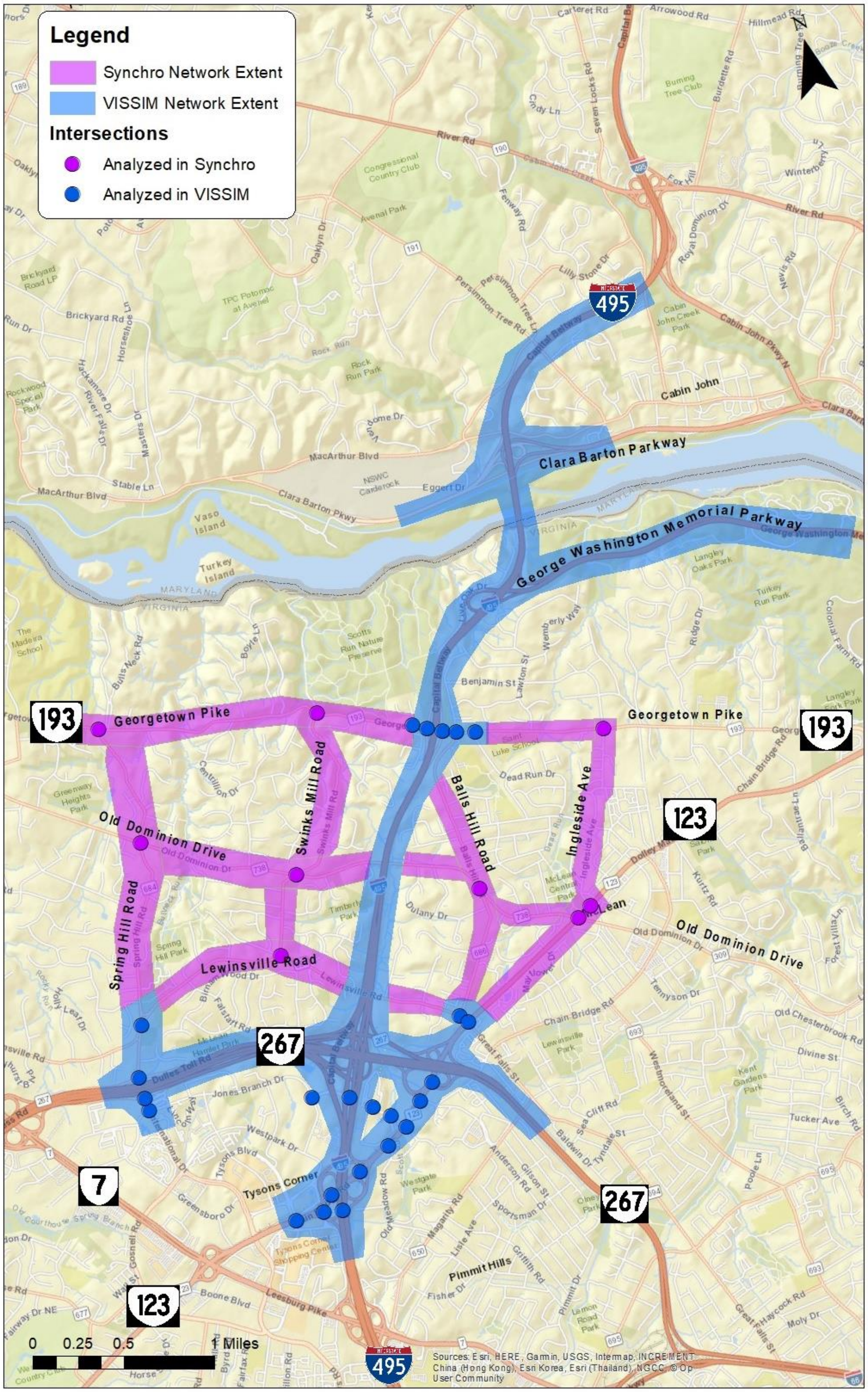
2.4.1 Traffic Analysis Tools

VISSIM Version 9.0 was used for a comprehensive network traffic analysis for the freeways, interchanges, and adjacent intersections within the traffic operations analysis area limits[1]. Surface street intersection operations were evaluated through a combination of Synchro 10 (in order to develop preliminary optimization for phasing and signal timing) and VISSIM (for microsimulation and analysis). The expanded arterial network beyond intersections immediately adjacent to freeway interchanges in the corridor was evaluated solely through Synchro. **Figure 2-3** provides a map of the network links and intersections that were analyzed using VISSIM versus Synchro, respectively.

Transit routes and stops were coded into the Study Area VISSIM network where they affect, or could affect, I-495 and related facility operations.

[1] The analysis tool selection matrix can be found within the VDOT *Traffic Operations and Safety Analysis Manual (TOSAM), Version 1.0* (VDOT, 2014).

Figure 2-3: Traffic Operations VISSIM and Synchro Analysis Areas



2.4.2 Measure of Effectiveness

The following measures of effectiveness (MOEs) were used for the operational analysis of the roadway network under existing and future Build and No Build conditions.

Freeway Performance Measures

- Simulated Average Speed (mph)
- Simulated Average Density (simulated vehicles per lane per mile but not reported as LOS)
- Simulated Volume (vehicles per hour)
- Percent of Demand Served: simulated volume (*processed volumes*) divided by actual volume (*input volumes*).
- Simulated Ramp Queue Length: reported average and maximum queue lengths (feet).
- Simulated Travel Time: reported for select network origin-destination travel paths (seconds).
- Congestion *Heat Maps*: incremental speeds reported for aggregated lanes, by time interval (mph).

Arterial/Intersection Performance Measures

Since VISSIM was used to evaluate intersections immediately adjacent to the Study Area freeway network while Synchro was used to evaluate the expanded arterial network, outputs have been reported differently for intersections, depending on which software analysis tool was used.

Synchro reports arterial intersection approach and movement delay outputs using control delay, while VISSIM reports these outputs using microsimulation delay. VDOT's TOSAM provides separate definitions for intersection control delay and microsimulation delay, both of which are measured in seconds per vehicle:

- **Control delay**: *delay associated with vehicles slowing in advance of an intersection, the time spent stopped on an intersection approach, the time spent as vehicles move up in the queue, and the time needed for vehicles to accelerate to their desired speed.* Highway Capacity Manual (HCM), 2010.
- **Microsimulation delay**[2]: *the difference between the simulated travel time and theoretical travel time if a vehicle was operating at the desired speed calculated by the microsimulation tool.*

Because VDOT's TOSAM recommends that LOS not be used to support microsimulation model results, microsimulation delay is reported and color-coded in the same way as HCM delay-based LOS and noted as "HCM-Analogous LOS." **Table 2-1** shows level of service (LOS) criteria for signalized and unsignalized intersections (both all-way and two-way, stop-controlled) as described in the HCM 2010.

Table 2-1. Level of Service Criteria for Intersections (HCM 2010)

LOS	Signalized Intersection (seconds)	Unsignalized Intersection (seconds)
A	≤10	≤10
B	10–20	10–15
C	20–35	15–25
D	35–55	25–35
E	55–80	35–50
F	≥80	≥50

[2] The HCM 2010 does not provide a definition, but microsimulation delay is calculated as described above.

2.4.3 Simulation Model Parameters

The simulation analysis periods, approved by the VDOT Northern Virginia District Traffic Engineer, are listed below. These periods were analyzed using a 30-minute seeding period for the AM VISSIM models and a 60-minute period for the PM models.

- AM peak: 6:45 a.m. to 9:45 a.m. (peak hour 7:45 a.m. to 8:45 a.m.).
- PM peak: 2:45 p.m. to 5:45 p.m. (peak hour 3:45 p.m. to 4:45 p.m.).

The simulation periods were determined based on a review of INRIX speed data, which showed the slowest speeds and heaviest queues during both the AM and PM peak periods as being along I-495 northbound. For each model scenario, 10 simulation runs were conducted, with the number of runs determined using the VDOT Sample Size Determination Tool. Further details on the development of the simulation analysis period can be found in the Framework Document in **Appendix A**. Further details on the number of simulation runs can be found in **Appendix D.**

2.4.4 Calibration of Existing VISSIM Models

The purpose of a simulation model is to investigate the effects of improvement alternatives. Simulation models are an efficient tool for evaluating improvements but are most effective when the base model matches real-world conditions. VISSIM, like other simulation software tools, was designed to be flexible enough that an analyst can calibrate the network to match the local conditions at a reasonably accurate level. It is well established that calibration is essential. The VDOT TOSAM provides detailed calibration criteria and acceptance targets for VISSIM models. The TOSAM was used in developing calibration criteria, which are described in greater detail in the *I-495 NEXT VISSIM Calibration Memorandum* which was approved and signed by the VDOT Northern Virginia District Traffic Engineer on July 27, 2018 and is provided in **Appendix D**. This memorandum includes detailed descriptions of the calibration process, edits made to the VISSIM models to achieve calibration, and comparisons of results with field observations.

2.5 SAFETY AND CRASH ANALYSIS METHODOLOGY

A safety analysis was conducted consistent with VDOT IIM-LD-200.9 (VDOT, 2017). It included an analysis of existing highway safety conditions and reported motor vehicle crashes on roads in the Study Area for a period of five years. It also included the development of qualitative and quantitative measures to evaluate future proposed alternatives and assess the safety effects of interstate access modifications on I-495 and the adjacent arterial network within the Study Area.

- Quantitative measures include the number of police-reported crashes (for existing conditions); annual crash frequencies expressed in terms of crashes per year; and reported crash rates expressed in terms of reported crashes per million vehicle miles traveled for roadway segments or million vehicles entering for intersections. Quantitative tools, which use multiple years of crash and traffic volume data, assist in the determination of crash patterns at specific locations and crash trends over time. They can also be used to assist in the identification of locations with relatively lower safety performance.
- Qualitative assessments assist in the identification of locations where roadway geometric conditions may pose significant demands on drivers and may contribute to potential driver errors that can result in crashes. Qualitative assessments are useful in identifying safety risks that can be addressed during the development of alternatives.

The following sections describe in more detail the methodology used to evaluate safety for existing conditions and future No Build and Build conditions. This chapter also describes data collected for use in the safety analysis. This methodology follows the safety analysis methodology described in the project Framework Document provided as **Appendix A**.

Safety analysis results for both existing and future conditions are described in **Chapter 8** of this document. Further detailed information regarding existing conditions safety is also provided in the associated *Existing Conditions Technical Report* (VDOT, 2019a) provided as a supplemental technical report with this EA.

2.5.1 Existing Conditions Safety Analysis Methodology

The existing conditions quantitative safety analysis utilized historical crash data from the most recently-available five years' worth of data (2013-2017). It included the development of the following measures:

- Crash density and severity histograms (developed for the mainline);
- Crash heat maps for various crash types (developed for the mainline);
- Crash density maps (developed for the mainlines); and
- Crash rates (fatal, injury, property damage only (PDO) and total) (developed for the mainline and intersections).

2.5.2 Future Conditions Safety Analysis Methodology

Qualitative Analysis

The qualitative analysis relied on a review of existing geometry, traffic conditions, a human factor approach to assess the driving task, consideration of driver expectancies, and where the potential was high for driver expectancy violations to occur. The qualitative assessment focused on locations there were identified high crash frequencies, high crash rates, or specific crash patterns based on an analysis of crash and traffic data from the latest available five full calendar years (i.e., 2013-2017). This included a review of the following:

- Proposed roadway signing and pavement marking plans
- Proposed new roadway and ramp alignments
- Long-range planned projects and roadway improvements

Concept plans have been reviewed and potential safety issues that warrant mitigation were identified. Extensive use has been made of relevant documents, positive guidance principles, human factors manuals, guidelines and processes for highway engineers and geometric design, and NCHRP and FHWA reports on safety effects related to interchanges, intersections, freeways, arterials, and ramp junctions. Notable documents include NCHRP Report 600, *Application of Human Factor Guidelines for Road Systems* (Transportation Research Board, 2012), AASHTO's *Highway Safety Design and Operations Guide* (i.e., the old AASHTO Yellow Book) (AASHTO, 1997), ITE's "Human Factors Issues in Intersection Safety" (ITE, 2004), FHWA reports such as *Driver Expectations When Navigating Complex Interchanges* (FHWA, 2013), materials cited in the National Highway Institute's "Human Factors for Transportation Engineers" and other relevant literature, such as *Human Factors Associated with Interchange Design Features* (TRB, 1993). Drivers often have difficulties following through the sequence of driving tasks, which leads to driving errors.

The objective of the qualitative safety analysis is to assess the relative level of safety that is likely to result from proposed improvements by considering the potential effect of the following on driver expectancies, the demands on and capabilities of the driver to perform all subtasks of the driving tasks, driver information processing capabilities, and driver decision-making capabilities, especially at route choice decision points:

- Geometric characteristics, including grades, vertical alignment, horizontal alignment, cross-sections,
- Roadside features.
- Conflict points
- Traffic operations, including weaving, lane changing, merging, diverging and stopping
- Relative safety hazards

Quantitative Analysis

Highway safety and design professionals use the AASHTO *Highway Safety Manual* (HSM) (AASHTO, 2010) as a resource to inform project development, design, and decision making so that resources can be allocated towards design features with the greatest potential to benefit safety and not purely for the sake of meeting design standards. The crash prediction methods identified in the HSM use, as basic input, geometric data that is key to roadway design and traffic data that is fundamental to project development. These safety analysis tools allow for the evaluation of existing conditions and the comparison of potential alternatives. They permit safety professionals to predict the number of crashes on the facility based on the roadway geometric features similar to how Highway Capacity Software is used to predict how a facility will function from an operational standpoint. Safety measures can now be used, along with other design considerations such as level of service, right-of-way, environmental impacts, and cost, as a quantified evaluation factor for design-related decisions and for balancing trade-offs between evaluation criteria.

Several quantitative analysis tools exist for use in applying the HSM Part C: Predictive Methods. These quantitative analysis tools use a combination of historical crash data and detailed geometric features of the roadway. For the purposes of future alternatives analysis on the I-495 corridor, a combination of three quantitative tools were employed:

- **Enhanced Interchange Safety Analysis Tool (ISATe).** ISATe is a safety analysis tool used to evaluate freeway and interchange systems. ISATe predicts crashes by crash location, i.e., mainline freeway segments, ramp segments, and ramp terminals. Inputs to the tool include both geometric and operational characteristics of roadway and ramp facilities. ISATe also analyzes ramp terminal crossroad intersections based on the number of lanes and arrangement of lanes and type of traffic control. For the purposes of mainline and interchange safety analysis and conditions on the I-495 corridor, ISATe was used to evaluate the 2025 No Build, 2025 Build, 2045 No Build, and 2045 Build Alternatives with the exception of the Existing and Proposed Express Lanes. The Express Lanes were analyzed using the safety performance function (SPF) tool developed for this project and described later in this section.
- **Developed Express Lane Safety Performance Function (SPF).** As the HSM (First Edition) does not have a crash prediction methodology for estimating the safety performance of separated/managed lanes, additional SPF development was necessary to fully assess the project Build Alternative. Using historical and available crash data, as well as traffic volume data and roadway geometric data for the existing segments of I-495 Express Lanes, an I-495 Express Lanes-specific SPF was developed. The SPF allows for estimation of future-year crashes for both existing Express Lane sections on I-495 (included in the No Build Alternative) and for new Express Lane sections that will be included in the Build Alternative.

- **Extended HSM Spreadsheets.** Extended HSM Spreadsheets were used to conduct safety analysis for arterial intersections within the Traffic Operations Study Area. The HSM spreadsheets are applicable for Rural Two-Lane, Two-Way Roads (HSM Chapter 10); Rural Multilane Highways (HSM Chapter 11); and Urban and Suburban Arterials (HSM Chapter 12). The tool predicts crashes by roadway segment and intersection.

The HSM methodologies also predict crash severity for each crash type using the KABCO scale (K – fatal crashes; A, B, C – injury crashes of decreasing severity; O – Property Damage Only (PDO) crashes); in some cases, crashes are also predicted by single vehicle and multiple vehicle crash types.

The safety analysis tools use crash prediction methods outlined in Part C: Predictive Methods (Volume 2) of the HSM. HSM safety prediction relies on SPFs, which express the predicted crash frequency for a basic roadway element (i.e., freeway or ramp segment, roadway segment, or intersection) defined by a specific volume, set of base geometric conditions, and in the case of intersections, traffic control conditions. Crash modification factors (CMF) express the relative change in crash frequency that could be expected with a change in one of the base geometric or traffic control conditions for the alternative being analyzed.

HSM Part C: Predictive Methods estimates the long-term crash frequency of a No Build or proposed Build Alternative. The first step in the predictive safety analysis process is predicting the number of crashes that will occur at a location based on the SPFs and CMFs. The incorporation of historical crash data, when available, is the second step in the predictive safety analysis process, resulting in the expected crash frequency. This process is known as the Empirical Bayes (EB) method. The expected crash frequency is the estimate of long-term average crash frequency of a segment, intersection, or network under a given set of geometric conditions and traffic volumes (e.g., Average Annual Daily Traffic (AADT)). If the expected crash frequency is greater than the predicted crash frequency, the crash location has potential for safety improvement (PSI) or an expected excess average crash frequency.

If reported crash data are either not available or not applicable, then the EB method is not used. This will be the case in situations where traffic volume, traffic control type, or geometric configuration at a site changes significantly over time so the historical crash data would no longer adequately represent the proposed condition. In this situation, an estimate of expected average crash frequency would not be calculated, so the evaluation of the safety condition would be limited to the evaluation of the estimate of predicted average crash frequency using the predictive crash models.

To be used most effectively, quantitative safety analysis tools require calibration on a state-by-state basis to accurately represent the number of crashes that can be reasonably expected on a roadway corridor. However, even lacking such calibration, the HSM tools can be used for relative evaluation of the predicted-to-expected crash frequency for existing conditions and also for comparisons between the predicted crash frequencies of design alternatives. Uncalibrated safety models were used to analyze safety in the I-495 corridor; calibration factors are not yet available for Virginia roadways. Therefore, a comparative approach using uncalibrated results was used to assess design alternatives from a safety perspective. HSM tools are limited to general purpose facilities, and tools to predict crash frequencies on Express Lanes have not yet been developed. Therefore, as noted, the project team developed crash prediction SPFs for Express Lanes using volume and geometry data from existing Express Lanes facilities in the region.

A summary of the different analysis tools and scenarios described above is shown in **Table 2-2**.

Table 2-2. Quantitative Safety Analysis Tool Summary

	2025 & 2045 No Build			*2025 & 2045 Build*		
Network Component	*Freeway*	*Express Lanes*	*Arterial*	*Freeway*	*Express Lanes*	*Arterial*
Tool	*ISATe*	*Developed SPFs*	*HSM*	*ISATe*	*Developed SPFs*	*HSM*
Measure(s) of Effectiveness (MOEs)	*Predicted Crash Frequency and Crash Rates*					

2.5.3 Safety Data Collection

Data for the safety analysis consisted of crash data, traffic data, and roadway inventory data. The sources of these data are described in the following sections.

Crash Data Collection

One of the primary measures to assess safety conditions of existing roads is related to the frequency and rate of reported crashes. VDOT maintains a clearinghouse of data for police-reported traffic crashes on roads maintained by VDOT. The tool used to extract crash data is known as the VDOT Crash Analysis Tool (Tableau) (VDOT, 2019b). The Tableau tool was developed by the Highway Safety Section of VDOT for the purpose of crash analysis. VDOT receives crash information from the Department of Motor Vehicles (DMV) through the DMV Traffic Records Electronic Data System. After VDOT has reviewed and processed the information from the DMV, which includes the addition of supplemental location data, the crash data is uploaded and made available via the VDOT Tableau tool on VDOT's website.

To compliment the crash data from VDOT, crash data were solicited and obtained from MDSHA and the National Parks Service (NPS) for roads under their jurisdiction, including sections of Clara Barton Parkway in Maryland and the GWMP. Crash data for the section of I-495 in Maryland from and including the ALMB to the Seven Locks Road overpass were obtained from MDSHA crash data inventory. The crash data from MDSHA and NPS did not have the same level of detail as the VDOT data; therefore, they were analyzed qualitatively.

The safety analysis was largely based on historic crash data from the VDOT Crash Analysis Tool for freeway segments, arterial segments, and intersections in the study area. Crash data was gathered for the five-year period from January 1, 2013 to December 31, 2017. Historic crash data was collected for the Express Lanes mainline, merge, and diverge segments in both directions between Route 7 and the terminus north of DTR interchange. Similar data was collected for GP lanes between Route 7 in Virginia to Clara Barton Parkway in Maryland. A total of 28 intersections or ramp terminals in or around the study area were investigated.

Traffic Data Collection

Traffic and roadway data were obtained to assist in documentation of existing safety conditions. VDOT maintains a clearinghouse of Average Annual Daily Traffic (AADT) count data for interstate, primary, and secondary roads in Virginia (VDOT, 2019c). Data is accessible for approximately the last 15 years. Consistent with conventional traffic and safety analysis, AADT data for the previous five years (2013-2017) were compiled for freeway segments and intersections in the study area. Traffic data was solicited from and obtained from the VDOT, Transurban (which operates and maintains the I-495 Express Lanes), MDSHA, and NPS.

The AADT was used to determine crash rates for freeway segments, ramps, and intersections within the study area. These rates were then compared to average local, state, and nationwide crash rates for similar highway facilities. This comparison provides a picture of the relative safety conditions within the study area.

Average Daily Traffic (ADT) was provided for the future scenarios using volume forecasts developed by the study team.

Roadway Inventory Data

Existing geometric information, which includes the number of travel lanes, among other elements, for the freeways, ramps, roadways and intersections in the study was collected for the quantitative assessment and evaluation of future geometric modification and predictive crash analysis. The numerical values of those geometric features were gathered using Google Earth Pro™.

Quantitative safety analyses require additional data that is not typically collected during the qualitative crash data collection process. The quantitative crash analysis tool for freeways and interchanges requires the collection and use of detailed design-level factors for freeway facilities, such as:

- Lane widths, in feet
- Shoulder widths (inside and outside), in feet
- Distance to barrier (freeway/ramps), in feet
- Median width, in feet
- Clear zone width, in feet
- Horizontal curve radius (especially on ramps), in feet
- Presence of shoulder rumble strips, yes or no
- Weaving length, in feet
- Location of ramp, left-hand or right-hand
- Ramp entrance and exit

For arterial intersections, in addition to projected volumes, both geometry and societal factors are taken into account, such as:

- Nearby schools, bus stops, and alcohol sales establishments
- Presence of red light cameras
- Presence of intersection lighting
- Intersection control type and signal phasing where applicable
- Approach lanes and lane types

Roadway inventory data for the I-495 mainline facility was collected from multiple sources. Existing and No-Build conditions roadway data elements were collected using Google Earth Pro™. For proposed future conditions, roadway data was obtained from the roadway design files prepared by the study team. Where specific design details for the future conditions were unknown, the study team made assumptions based on an assessment of existing conditions and preferred design standards for the design element in question.

2.6 TRAFFIC DATA FOR NOISE AND AIR QUALITY ANALYSIS

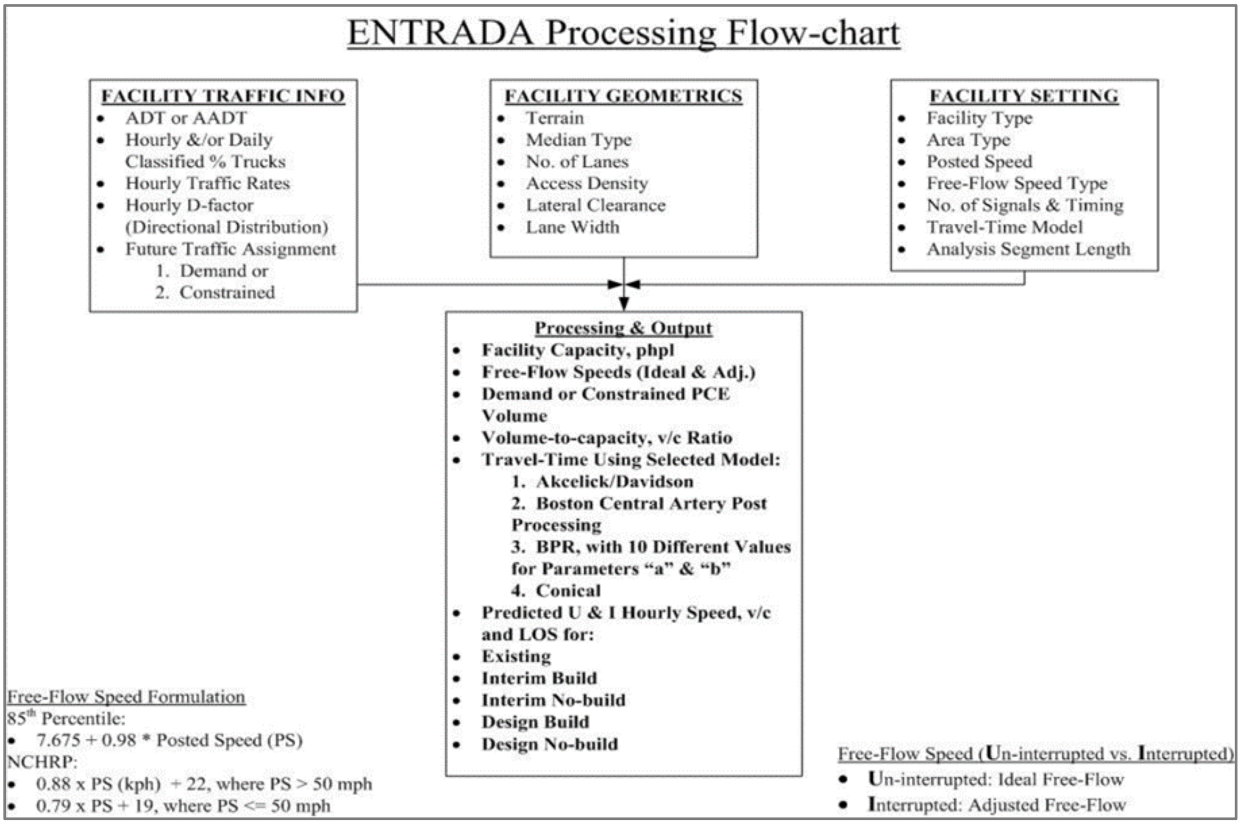
Travel demand forecasts developed as outlined in this chapter were post-processed using *NCHRP 765* guidelines. These outputs were combined with existing traffic count data and traffic operational modeling (from both Synchro and VISSIM) to determine the traffic data for the noise and air analysis. The following is a general list of overall post-processed traffic data provided for project-level noise and air analysis:

- AADT, average annual truck traffic (AATT), and capacity-constrained peak-period volumes as well as operating, posted, and congested speeds for each link in the project area.
- Hourly traffic distribution (K-factor), hourly directional distributions, hourly distribution of percent trucks with two axles and six tires, and percent trucks with three or more axles.
- Directional volumes, including turning or ramp movements (vehicles/hr/link) for the mainline roadway, study interchanges, affected intersections, and parallel facilities.
- Signal timings (cycle lengths and phasing, approach splits), as well as level of service based on control delay (includes intersection and approach delays and average queue lengths).
- Travel demand model outputs for all scenarios and years.
- GIS shapefiles with all roadway link identifiers and associated traffic data.
- Lane configuration diagrams for each mainline roadway and intersection/interchange within the project corridor showing through and turn lanes.

2.6.1 Traffic Data for Project-Level Noise Analysis

Traffic data needed for project-level noise analysis was developed using VDOT's Environmental Traffic Data Abstract (ENTRADA) tool, Version 2018-09, which is a program that standardizes the production of environmental traffic data. As per FHWA and VDOT policy, the traffic data used in the noise analysis must produce sound levels that are representative of the worst (loudest) hour of the day. In addition to the traffic data listed above, information about the corridor including facility geometry, access locations, and facility setting were also used as input for the ENTRADA tool. An overall process flowchart for the ENTRADA tool, along with input and output data, is illustrated in **Figure 2-4**.

Figure 2-4: ENTRADA Processing Flow Chart



For every roadway or ramp segment, a corresponding ENTRADA spreadsheet is developed with data compiled for both the existing and design year (No Build and Build scenarios). Lane configuration diagrams for each mainline roadway and intersection/interchange within the project corridor showing all through and turn lanes are included to show the roadway segmentation.

The following characteristics and inputs for each specific segment are developed for the creation of the ENTRADA files:

- **Segment length (miles):** The segment length corresponding to the length of the segment in the 2045 design year.
- **Area type:** Verified by field observations and confirmed with VDOT.
- **Directional percent hourly truck traffic:** From existing traffic count data, MWCOG model, and consistent with the peak-hour characteristics being modeled in VISSIM.
- **Existing hourly speeds by direction:** Consistent with the peak-hour characteristics modeled in VISSIM
- **Capacity** (per hour per lane).
- **Facility type.**
- **ADT:** Verified with existing traffic data.
- **Hour-by-hour percent trucks of the ADT:** Derived from existing traffic classification count data.
- **Hour-by-hour K-factors:** Derived from existing traffic data as a basis and adjusted for future conditions based on factors used for the MWCOG model.

- **Hour-by-hour directional split (D-factor):** Verified with existing traffic data and derived from MWCOG model outputs for future conditions.

The following physical characteristics were collected and entered as input (by individual segment) for each Build/No Build scenario for the creation of the ENTRADA files. For locations where limited data was available, existing physical conditions were assumed unless changes are being made in future scenarios:

- Cross section
- Number of lanes
- Outside shoulder width (feet)
- Inside shoulder width (feet)
- Lane width (feet)
- Terrain - consistent with GIS topo and verified with field observations
- Interchange/access density (per mile)
- Posted speed (miles per hour)
- Number of signals (in length of facility)

The following characteristics of a signalized facility were collected and entered as input (by individual segment) for the existing scenario for the creation of ENTRADA files:

- Signal cycle length.
- Signal green time.
- Segment delay adjustment factor.

A master database was developed to store input data for every roadway segment. A spreadsheet-based macro was also developed to automatically read the information from the database and create ENTRADA spreadsheets for every single identified segment. To ensure that ENTRADA produced reasonable results, hourly speed distribution outputs for the existing year were compared to available speed data (INRIX or field-collected) to determine the appropriate calibration parameter values.

2.6.2 Traffic Data for Project-Level Air Quality Analysis

Traffic data required to support air quality analysis for CO (Carbon Dioxide) screening analyses and Mobile Source Air Toxins (MSAT) were provided in consultation with VDOT. Below is a list of traffic data that was used for air quality analysis:

- **Existing raw traffic count information** (including intersection turning movement counts and detailed bus/truck data) by time period. This is primarily to evaluate existing heavy-duty diesel activity – an observation included in the MSAT documentation.
- **Travel Demand Model outputs for all scenarios** – loaded networks including ADT, percent trucks, vehicle miles travelled (VMT), peak/off-peak period factors for AM, midday, PM, and nighttime periods:
  - Existing (2018)
  - 2025 No Build
  - 2025 Build
  - 2045 No Build

  - 2045 Build

- **Refined traffic volume plots for existing and forecasted, build and No Build conditions,** primarily to inform the level of MSAT analysis required – determined to be Quantitative – and potentially CO analyses (should the mainline or interchange volumes prove to be of concern.) These plots will also be included in the Air Quality documentation for reference.
- **Highway Capacity Manual (HCM) Measures of Effectiveness (MOE)** on all approaches for all intersection evaluated – both those evaluated in VISSIM and those only evaluated in Synchro, in a single table, for supporting the CO screening analyses. Where actual HCM MOEs where unavailable, surrogate values available were provided.

Carbon Monoxide (CO)

While the CO air quality conformity requirements under the Clean Air Act (CAA) and its amendments expired in the NOVA region, a screening analysis is still required under the NEPA environmental rules in Virginia. A worst-case screening analysis at the most problematic intersections forecasted was performed by using operational summary data described above combined with MOVES-developed emission rates. Only the lowest performing locations (3 or more) are analyzed so a table listing appropriate HCM MOE was provided to identify the locations of interest and to be used as basic inputs into the CO screening analyses. Note that geometric data (intersection layouts and approach grades) were also provided for the locations of interest identified.

Mobile Source Air Toxics (MSAT)

To support the project-level air quality analysis, regional travel demand modeling output files encompassing the project corridor and "affected transportation network" were used for the base year and for the Build and No Build scenarios for the interim and design years for each alternative to support the quantitative MSAT analysis.

Travel Demand Model output files (loaded networks) were used to prepare a quantitative MSAT analysis for each alternative within the I-495 study corridor for the existing (2018), interim year (2025, No Build and Build), and design year (2045, No Build and Build). For purposes of the MSAT analysis, the development of the affected transportation network was based on FHWA training materials on the topic, as detailed in the air quality report.

CHAPTER 3.0 EXISTING TRANSPORTATION NETWORKS

This chapter provides an overview of the transportation facilities that currently exist within the project Traffic Operations Study Area, including roadway, transit, bicycle, and pedestrian facilities.

3.1 ROADWAY NETWORK

To assess the traffic impacts of the proposed project from the current northern termini of the existing I-495 Express Lanes to the ALMB, a Traffic Operations Study Area was defined to include the I-495 corridor between Route 123 in Tysons to and the I-495 overpass over Seven Locks Road in Montgomery County, Maryland.

In addition to the sections of the I-495 GP lanes and the sections of the I-495 Express Lanes, the traffic operations Study Area includes:

- Segments of the GWMP and the Clara Barton Parkway, which are under the responsibility of the National Park Service;
- Segments of the DTR and DAAR, which are under control of the Metropolitan Washington Airports Authority;
- Segments of the DCR, under the responsibility of VDOT; and
- Nine (9) interchanges.

The Traffic Operations Study Area also includes segments of primary and selected secondary roads that lie within the corridor.

A map of the project footprint area and the project Traffic Operations Study Area was previously provided in Chapter 2 as **Figure 2-1.** These facilities are described in more detail in the following sections.

3.1.1 I-495

The section of I-495 within the Study Area comprises a portion of the Capital Beltway. The entire Capital Beltway is a circumferential interstate highway of approximately 66 miles around Washington, D.C. and the core of the metropolitan region. I-495 is classified as an urban interstate by FHWA.

The segment of I-495 within the project footprint runs from just south of the Route 123 interchange to just north of the GWMP interchange at the ALMB (the Maryland state line). The I-495 GP lanes generally carry four through lanes in each direction, with a 12-foot paved right shoulder. South of Old Dominion Drive, to the left of the GP lanes in each direction are the I-495 Express Lanes, which are separated from the GP lanes by flexible bollards in most locations in the Study Area. The northern terminus of the Express Lanes is located just to the south of Old Dominion Drive. North of this location, the I-495 GP lanes remain four lanes in each direction south of Route 193, although a hard shoulder lane is open to traffic in the northbound direction during weekday peak periods. This single left-side shoulder lane, which began operations in 2015, is open to all traffic Monday through Friday from 6:00 AM to 11:00 AM and 2:00 PM to 8:00 PM.

Additional capacity is provided along I-495 between Route 193 and GWMP. In the northbound direction, a fifth auxiliary lane is provided along the right side between the on-ramp from Route 193 and the off-ramp to GWMP, in addition to the left-side hard shoulder lane, which terminates at the GWMP interchange. In the southbound direction, a C-D road is provided between the GWMP and Route 193 interchanges; all southbound traffic wishing to access either of these interchanges must exit north of the GWMP interchange. The C-D road carries two lanes plus an auxiliary lane between the on-ramp from GWMP and the off-ramp to Route 193; it then splits into a two-lane off-ramp to Route 193 and a single-lane on-ramp to the I-495 southbound mainline. During congested periods along the I-495 southbound mainline, counts indicate that the C-D road is often used to bypass traffic along the mainline.

3.1.2 I-495 Express Lanes

The existing I-495 Express Lanes opened in 2012 and feature two through lanes running in the median of I-495 in each direction at the south end of the Study Area. These lanes are separated from the GP lanes via flexible bollards. The Express Lanes are dynamically-priced, high-occupancy toll (HOT) lanes designed to increase capacity and travel time reliability by allowing transit and high occupancy vehicles (HOVs) to use the facility for free while tolling the excess capacity for single-occupancy vehicles (SOVs). Within the Study Area, ingress and egress to the northbound and southbound existing I-495 Express Lanes are provided at Westpark Drive and Jones Branch Drive in Tysons, with exclusive ramps that intersect the cross streets at signal-controlled intersections. Access is also provided from the northbound existing I-495 Express Lanes to DTR westbound, from the southbound existing I-495 Express Lanes to DTR westbound, and from DTR eastbound to the southbound existing I-495 Express Lanes.

The northern entrance to the southbound existing I-495 Express Lanes is from the left side of the southbound I-495 GP lanes, south of the Route 193 interchange and beginning just south of the bridge carrying Old Dominion Drive over I-495. The northern exit from the northbound existing I-495 Express Lanes merges onto the left side of the northbound I-495 GP lanes near this same location. At this point, the previously-mentioned left-side shoulder use lane begins.

3.1.3 Interchanges and Intersecting Roadways

The interchanges, excluding those that provide access to and from the existing I-495 Express Lanes, within the traffic operations analysis Study Area include the following:

- I-495/Route 123 interchange – a full cloverleaf interchange with access provided in all directions
- I-495/Route 267 interchange – a complex interchange with a variety of ramps providing access in certain directions, including the following:
    - From northbound I-495 GP lanes to westbound DTR
    - From northbound existing I-495 Express Lanes to westbound DTR
    - From southbound I-495 GP lanes to eastbound and westbound DTR
    - From southbound existing I-495 Express Lanes to westbound DTR
    - From the eastbound DTR to northbound and southbound I-495 GP lanes
    - From the eastbound DTR to southbound existing I-495 Express Lanes
    - From the eastbound DAAR to the I-495 GP lanes
    - From westbound DCR to northbound I-495 GP lanes
- I-495/Route 193 interchange – a conventional diamond interchange, with a C-D road along southbound I-495 that connects both the GWMP interchange and the Route 193 interchange.
- I-495/GWMP interchange – a trumpet-type, three-legged interchange providing access to and from both directions of I-495 and GWMP to the east of I-495.
- I-495/Clara Barton Parkway interchange – a hybrid interchange that features directional ramps provided for certain movements in each direction.
- Route 267/Spring Hill Road interchange – a conventional diamond with access provided in all directions.

- Route 267/Route 123 interchange – a hybrid partial cloverleaf interchange providing access in all directions, except for Route 123 northbound to Route 267 westbound.

Additionally, the following interchanges that provide access to and from the existing I-495 Express Lanes within the traffic operations analysis Study Area are included:

- I-495 Express Lanes and Westpark Drive
- I-495 Express Lanes and Jones Branch Connector
- I-495 Express Lanes and Route 267, which currently includes the following connections:
    - I-495 northbound Express to westbound DTR
    - I-495 southbound Express to westbound DTR
    - Eastbound DTR to I-495 southbound Express

3.1.4 Major Traffic Operations Study Area Arterials

The major non-freeway roads in the Study Area include the several arterials and collector streets, described below:

- Route 193 (Georgetown Pike) – Route 193 is a primary highway in Virginia that provides access from origins in western Fairfax County and eastern Loudoun County to I-495, destinations in McLean, including the Central Intelligence Agency, and destinations in Washington, D.C. via the GWMP and Chain Bridge over the Potomac River. It is a two-lane road for most of its length, with narrow or no shoulder along much of the route. Auxiliary turn lanes exist at the I-495 interchange areas.
- Dolley Madison Boulevard/Chain Bridge Road (Route 123) – Route 123 is a six-to-eight-lane major arterial and primary highway within the Study Area. It has multiple turn lanes at several major signal-controlled intersections.
- Spring Hill Road (Route 684) – the section of Spring Hill Road varies in cross section. At the south end of the Study Area, Spring Hill Road is a multilane highway, serving traffic in the Tysons area and providing a primary access to the DTR at an interchange. The section north of the DTR is largely a two-lane road, with some turn lanes at major intersections.
- Old Dominion Drive (Route 738) – the section of Old Dominion Drive in the Study Area is predominantly a two-lane road that provides a roadway connection between Route 123 and Spring Hill Road, with additional turn lanes provided at its intersection with Route 123. It passes through residential areas, crossing I-495 and connecting to Swinks Mill Road as well.
- Swinks Mill Road (Route 685) – the section of Swinks Mill Road in the Study Area is a two-lane street through a residential area with numerous driveways. It provides a roadway connection between Lewinsville Road and Route 193 and parallels I-495 just to the west. It primarily serves local traffic, although commuters do use this route during peak periods.
- Balls Hill Road (Route 686) – the section of Balls Hill Road in the Study Area provides a roadway connection from Route 123 and Route 193. Similar to Swinks Mill Road, it runs parallel to I-495 just to the east, and it is a two-lane street that serves the local community. During peak periods, commuters use Balls Hill Road to bypass the congested I-495 northbound GP lanes.
- Lewinsville Road (Route 694) – the section of Lewinsville Road in the Study Area is largely a two-lane street that functions as a major collector for residential and commuter traffic west of I-495. East of I-495, it is a multi-lane road with turn lanes at major intersections serving a large campus

with several office buildings. It parallels the DTR to the north and is also used by commuters during peak periods.

- Ingleside Avenue/Douglas Street – the sections of Ingleside Avenue and Douglas Street within the study are two-lane streets that provide access to the McLean Library and the McLean Community Center and primarily serves local residents. Together, they form a road connection between Route 123 and Route 193 in the McLean area, running parallel and to the east of Balls Hill Road.

3.2 HOV AND TRANSIT FACILITIES

The Study Area currently has in place the following HOV and transit facilities in place to serve commuters.

3.2.1 HOV Facilities

HOV-3 vehicles may ride in the I-495 Express Lanes for free using an EZ-Pass transponder that is switched to "HOV-3" mode. There are no HOV lanes along the I-495 GP mainline.

Within the traffic operations analysis Study Area, an HOV-2 lane heading westbound along the DTR is provided. This HOV-2 lane starts directly west of the DTR main toll plaza and is exclusive to HOV-2 traffic during the evening peak period (4:00 p.m. - 6:30 p.m., Monday – Friday). There is a corresponding eastbound HOV-2 lane along the DTR but terminates prior to Leesburg Pike which is outside of the I-495 NEXT traffic operations analysis Study Area.

Existing Conditions HOV Usage

As noted in Chapter 1 of the EA, according to a commuting survey conducted by MWCOG in 2016, nearly half (48 percent) of those surveyed who use HOV/Express Lanes for commuting said availability of the lanes influenced their mode choice decision. The survey also indicated that the presence of Express Lanes encourages the use of carpooling and vanpooling; nine percent of commuters who had access to an HOV/Express Lane reported carpooling or vanpooling as their primary mode choice, compared with five percent of commuters who did not have access. The existing I-495 and I-95 Express Lanes create a 40-mile HOV and bus network in northern Virginia and provide additional travel choices for a variety of users. However, because the existing Express Lanes end at Old Dominion Drive, travel choices for all northbound travelers are limited. No commuter bus service is offered within the Study Area or over the ALMB due to the absence of dedicated or managed lanes that would allow buses to travel more efficiently. Both HOV and single-occupant vehicles choosing to use the existing Express Lanes are forced to rejoin the GP lanes north of Old Dominion Drive with no options to bypass congestion or bottlenecks. Therefore, there is little or reduced advantage or incentive for travelers to choose carpooling, vanpooling, or transit options because these options are no more efficient than driving alone from this point to the north. Without dedicated transit or HOV/HOT lanes, single-occupant vehicle travel is the dominant mode choice within the corridor. Additionally, there is no opportunity to attract users away from the congested GP lanes, which would reduce the overall trip demand and congestion in the GP lanes. There is a need to provide options for and incentivize high-occupancy travel modes to reduce overall vehicle trips, particularly single-occupancy vehicles, in accordance with TPB recommendations.

Commuter choices are also affected by access. The northbound and southbound I-495 Express Lanes are accessible in both directions from Westpark Boulevard and Jones Branch Drive. From Route 7 and eastbound DTR/DAAR, only the southbound Express Lanes are accessible. There is currently no direct access to the northbound Express Lanes from the DTR, the DAAR, or Route 7. Given that the Express Lanes terminate to the south of GWMP, there is also no direct access to and from the Express Lanes in either direction from GWMP. Users are less likely to use the Express Lanes if the access points are inconvenient and insufficient for their needs.

3.2.2 Bus Transit

No commuter bus service is offered within the Study Area or over the ALMB, in part due to the absence of dedicated or managed lanes that would allow buses to travel more efficiently.

Currently three transit service providers operate bus service in areas adjacent to the corridor, along the routes listed below and identified in **Figure 3-1**:

Fairfax Connector Service

- Route 401/402: Backlick – Gallows
- Route 422: Boone Boulevard – Howard Avenue
- Route 423: Park Run – Westpark
- Route 424: Jones Branch Drive
- Route 432: Old Courthouse Beulah
- Route 442: Boone Boulevard – Howard Avenue
- Route 462: Dunn Loring – Navy Federal – Tysons
- Route 463: Maple Avenue – Vienna
- Route 494: Lorton – Springfield – Tysons
- Route 495: Burke Centre – Tysons
- Route 574: Reston – Tysons
- Route 599: Pentagon – Crystal City Express
- Route 721: Chain Bridge Road – McLean
- Route 724: Lewinsville Road

Potomac and Rappahannock Transportation Commission (PRTC) Service

- Linton Hall Metro Express: Gainesville – Tysons Corner
- Manassas Metro Express: Old Town Manassas – Tysons Corner
- Tysons Corner: Woodbridge - Tysons Corner

Washington Metropolitan Area Transit Authority (WMATA) Metrobus Service

- 23T: McLean – Crystal City
- 3T: Pimmit Hills
- 5A: Dulles – Washington, D.C.

3.2.3 Metrorail

The Study Area is served by the Silver Line Metrorail which opened in 2014 with five stations. Four of the five Silver Line Metrorail stations are in the vicinity of the I-495 Express Lanes Northern Extension Project; these include:

- McLean
- Tysons Corner
- Greensboro
- Spring Hill

The Metrorail service and stations in the Study Area are also shown in **Figure 3-1.**

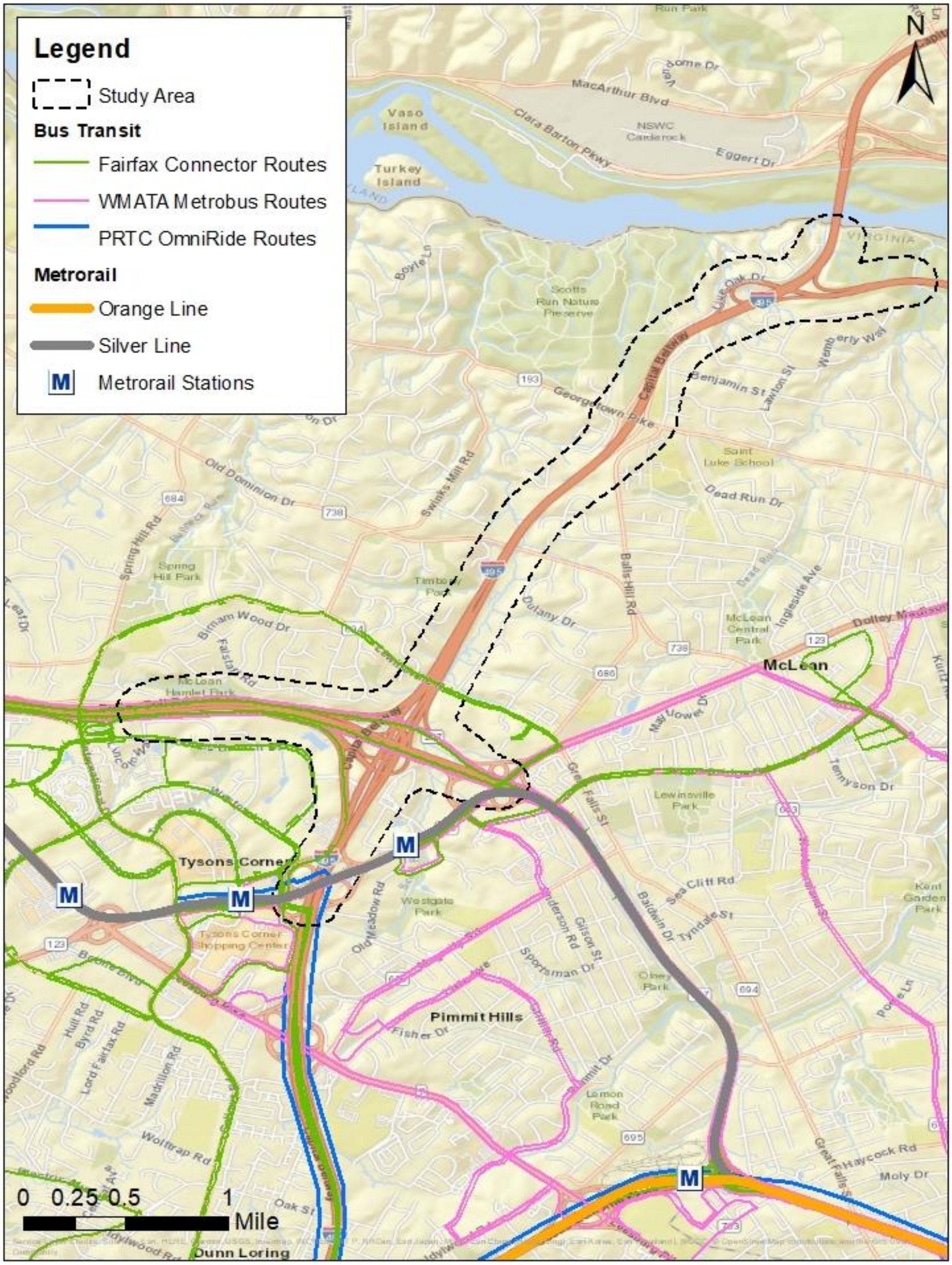
3.3 BICYCLE AND PEDESTRIAN FACILITIES

Bicycle and pedestrian facilities in the traffic operations analysis Study Area mainly consist of facilities along streets that cross I-495 on bridges.

Along Live Oak Drive and Route 738 (Old Dominion Drive), bicyclists must use the sidewalk or share the road with cars along the overpasses of I-495. Along Route 694 (Lewinsville Road), exclusive bike lanes are provided in each direction along the overpass across I-495.

Along Route 123, no bicycle or pedestrian facilities are currently provided crossing I-495.

Figure 3-1: Bus and Rail Transit Service in I-495 NEXT Project Area



CHAPTER 4.0 EXISTING TRAFFIC OPERATIONAL CONDITIONS

4.1 HISTORICAL TRAFFIC TRENDS ON I-495 CORRIDOR

Although traffic has distinctive peak periods along the I-495 corridor, increasing congestion has prolonged these peak periods and spilled queued traffic to parallel routes such as the GWMP, Route 193, and Route 123. A typical commuting pattern might show a morning peak in one direction and an afternoon peak in the opposite direction; however, the I-495 NEXT study area experiences congestion in both directions in both peak periods, with the most severe congestion along northbound I-495 due to a bottleneck at the ALMB.

From 2002 to 2017, the AADT for I-495 at the ALMB grew by 18 percent, with the transportation infrastructure expanding alongside this traffic growth to include Express Lanes as well as a hard shoulder open to northbound traffic in the study area during peak periods. Projected population and employment growth, particularly in Tysons, is forecasted to significantly increase in future years and additionally strain highway capacity.

Traffic counts from recent years reflect existing network capacity constraints. **Figure 4-1** and **Figure 4-2** compare the AADTs along northbound and southbound I-495, respectively, between 2013 and 2017 for five locations within the study area. These volumes are estimates from VDOT's historic traffic count books (VDOT, 2017). As shown, traffic volumes have been essentially stagnant the past few years, likely due to persisting capacity constraints along the corridor throughout the day.

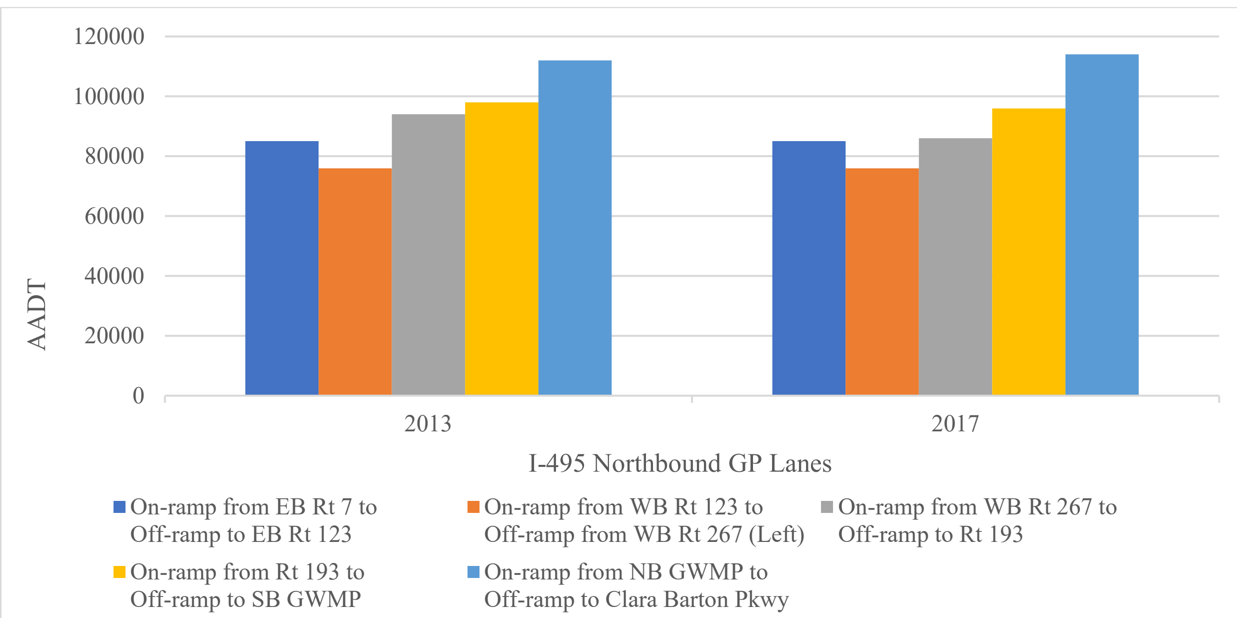


Figure 4-1. Recent Traffic Growth Along Northbound I-495

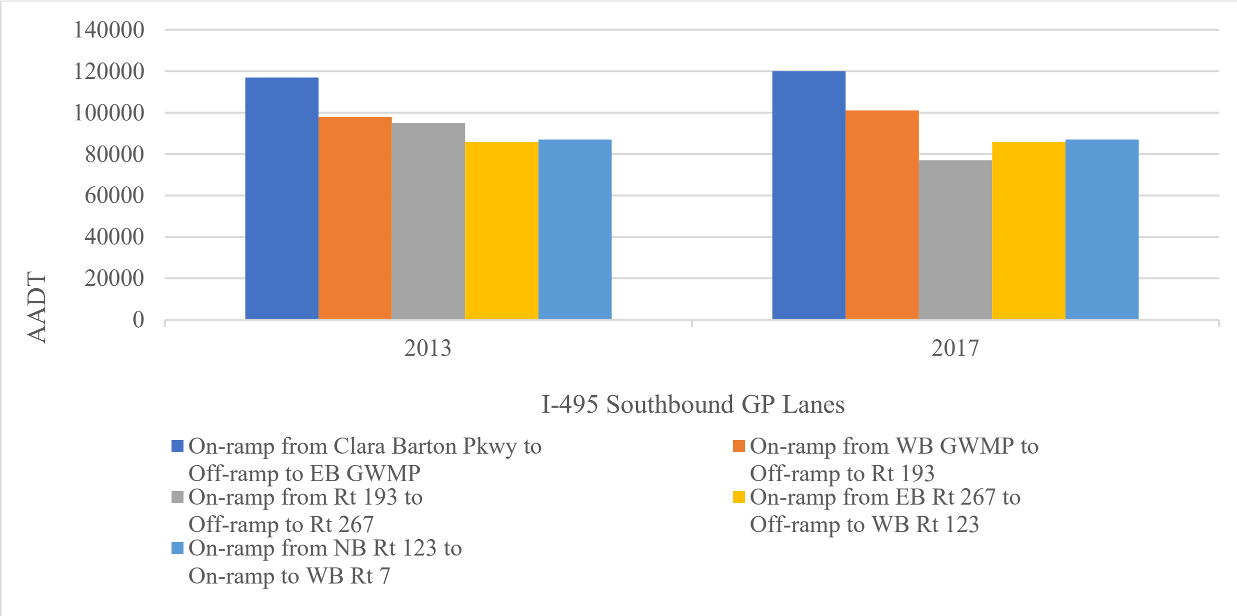


Figure 4-2. Recent Traffic Growth Along Southbound I-495

4.2 EXISTING TRAFFIC VOLUMES

4.2.1 Peaking Patterns and Existing Peak-Hour Volumes

Traffic conditions in the study area are severely oversaturated during the weekday AM and PM peak periods, with several hours of congestion in both directions, especially along northbound I-495 approaching the ALMB. Data collection verified that a single peak hour for the entire system does not exist due to low speeds. This constrains traffic throughput across several hours, often leading to lower flow rates during peak periods. **Figure 4-3** shows this pattern for the northbound I-495 GP lanes: traffic counts decrease starting around 2:00 p.m. and are lower than those observed during the early afternoon (when, during the early evening hours, the facility should theoretically be carrying higher volumes). Due to the oversaturated conditions and historical trends within the study area, it was determined that the traffic analysis periods should be based upon the periods of heaviest congestion and slowest speeds along the northbound I-495 GP lanes as shown in the INRIX speed heat map in **Exhibit 4-1.**

- For the AM peak period from 6:45 a.m. to 9:45 a.m., the network representative hour (peak hour) occurs between **7:45 a.m. and 8:45 a.m.** Queue spillback is tied to the on-ramp from GWMP and the weave across the ALMB, with the slowest speeds and longest queues occurring during the representative hour.
- For the PM peak period from 2:45 p.m. to 5:45 p.m., the network representative hour (peak hour) occurs between **3:45 p.m. and 4:45 p.m.** During the early afternoon hours between approximately 2:00 p.m. and 3:30 p.m., queue spillback and congestion along northbound I-495 is again tied to the on-ramp from GWMP and the weave across the ALMB. During the later afternoon hours after approximately 3:30 p.m., queues from downstream congestion in Maryland spill back across the ALMB, resulting in a single continuous queue. At this point, the back of the queue stabilizes for several hours, suggesting that demand is not increasing and is being processed at the same rate as it arrives.

After the AM and PM network peak hours were determined, existing traffic volumes were developed and balanced along freeway ramps and mainline segments, beginning with the I-495 GP segments and moving out to the connecting freeway system. Freeway ramp volumes were then held fixed and turning movement counts (TMCs) were balanced along arterial roadways. These balanced counts were compared to raw traffic counts and adjusted as necessary. As multi-hour simulation analysis requires the VISSIM network to be populated with traffic volumes beyond the network peak hour, input volumes were developed for each entry link into the network according to 15-minute flow rates observed in the traffic count data.

Peak hour volumes for the AM are provided for the I-495 (GP and Express) mainline and Route 267 mainline in **Exhibit 4-2a** and **Exhibit 4-2b** respectively. Peak hour volumes for the PM are provided for the I-495 mainline and Route 267 mainline in **Exhibit 4-3a** and **Exhibit 4-3b** respectively. Peak hour volumes for the arterial network are provided in **Exhibit 4-4a** through **Exhibit 4-4e.**

4.2.2 Existing Daily Traffic Volumes

Existing average weekday daily traffic (AWDT) volumes were estimated from traffic counts conducted in May and June 2018. AWDT in this report represents the average of data collected on a Tuesday, Wednesday, and Thursday. These data were additionally adjusted to balance traffic volumes in the study area. Average daily traffic (AWDT) volumes within the study area are provided in **Exhibit 4-5a** and **Exhibit 4-5b**.

Sample count data along four successive I-495 GP segments are shown in **Figure 4-3** and **Figure 4-4**, representing the average weekday hourly volumes at each location in the northbound and southbound directions, respectively. The daily curves indicate the expected volume distribution during an average weekday, with the highest throughput volumes observed during the AM peak period in both directions. Note that especially in the northbound direction, traffic volumes decrease through the AM and PM peak periods, as congestion constrains throughput along the corridor. This is particularly notable during the PM peak period, where actual throughput along I-495 is much lower than its hypothetical capacity (approximately 1,800 to 2,000 vehicles per hour per lane). This phenomenon is primarily in the northbound direction due to the bottleneck at the ALMB as opposed to the southbound direction, which, while there is still congestion present, contains multiple departure points for traffic to exit the facility (e.g. Route 267, Route 123).

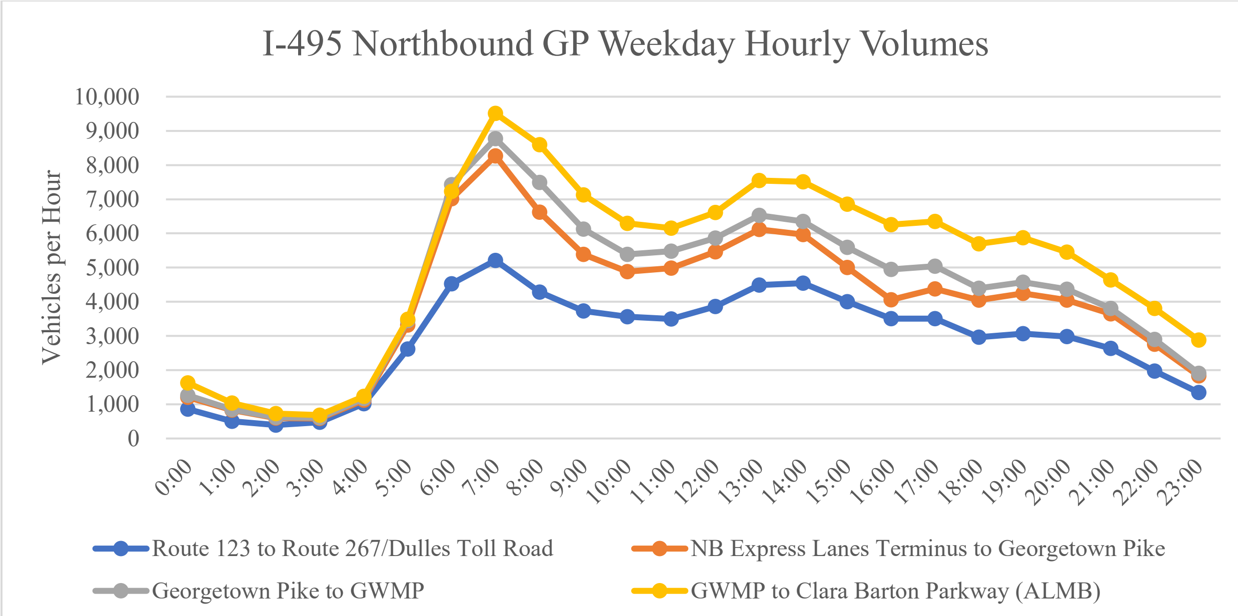


Figure 4-3. Average Weekday Hourly Volumes along Northbound I-495 GP Lanes

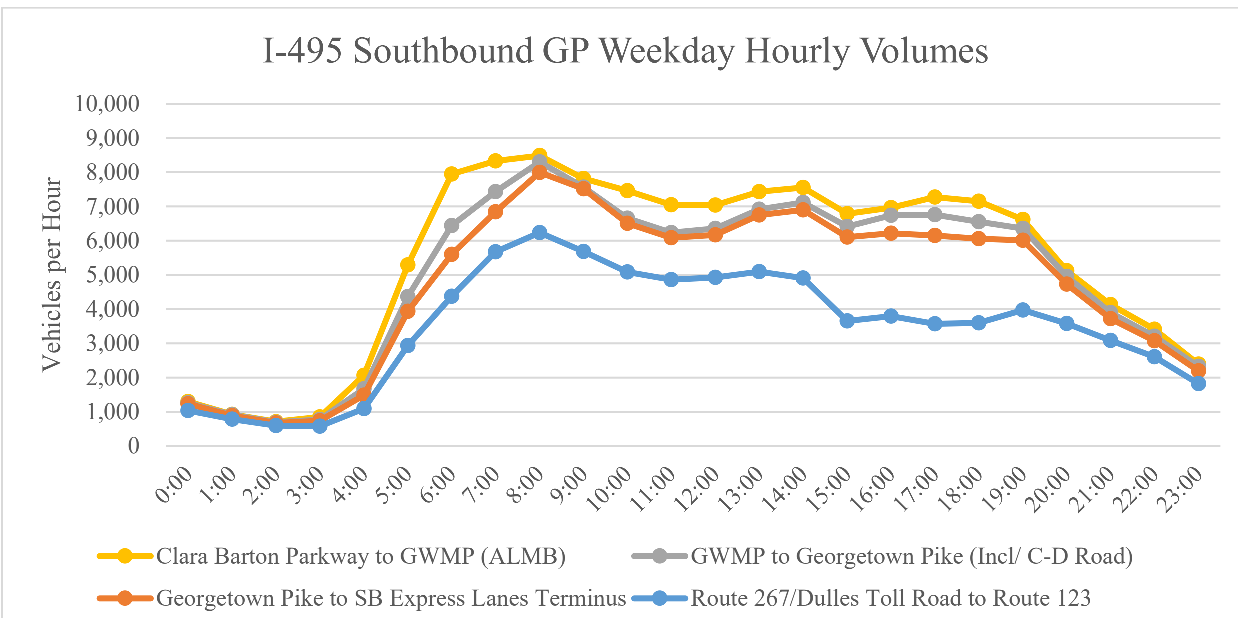


Figure 4-4. Average Weekday Hourly Volumes along Southbound I-495 GP Lanes

4.2.3 Vehicle Occupancy Data

The following assumptions were made regarding vehicle occupancy, which was used to estimate person throughput as a measure of effectiveness for existing conditions and future No Build No Build No Build and Build conditions:

- GP lanes: 1.1 persons/vehicle assumed. This is based on average non-HOV lane occupancy data for the region from a 2014 MWCOG study (MWCOG, 2014) as observed on various facilities in northern Virginia (I-395, I-95, I-66, and Dulles Toll Road).
- Express Lanes: 1.44 persons/vehicle assumed. This is derived from an assumption 18 percent of vehicles during the peak period operating as HOV-3 (3 persons/vehicle) based on available data for the existing I-495 Express Lanes through Tysons; the remaining 82 percent of vehicles (toll-paying) are assumed to have the same non-HOV auto occupancy as the GP lanes.

4.3 ORIGIN-DESTINATION (O-D) PATTERNS

The study area is located at a crossroads important to both the greater Washington, D.C. region and the East Coast as a whole. The Interstate 95 (I-95) corridor, the main freeway route for the eastern United States, splits into two parallel freeways around Washington, D.C. I-95 is signed for the north/south freeway running around the east side of Washington, D.C., while I-495 serves as a parallel route around the west side. Additionally, I-495 carries travel from Interstate 66 (I-66), the Dulles Toll Road (DTR), and Interstate 270 (I-270) to and from points adjacent to the study area in Maryland and Virginia. Within the study area is Tysons, the rapidly-growing central business and shopping district for Fairfax County. It contains the largest concentration of commercial office space in the Washington, D.C. region, and I-495 provides the main north-south link in and out of Tysons to other parts of the region. **Figure 4-5** shows the study area in the context of regional travel patterns.

An analysis of travel patterns along I-495 using StreetLight Data, a provider of anonymized mobile device analytics to support transportation studies, shows that trips have a wide-ranging set of origins and destinations well outside the study area. **Figure 4-6** and **Figure 4-7** provide maps of the most common trip origins and destinations, respectively, for trips carried along northbound I-495 between the DTR and Route 193. These maps show that many trips within the study area originate in Tysons and in locations further to the south or west, such as Dulles International Airport (IAD) and Prince William County, and are destined for Maryland, especially areas along the I-270 corridor.

Figure 4-8 shows the estimated average daily traffic volumes at all Potomac River crossings in the region. The I-495 ALMB at the north end of the study area and the I-95/I-495 Woodrow Wilson Bridge south of Washington, D.C. are the only two river crossings directly between Virginia and Maryland within the vicinity of Washington, D.C. As a result, they carry very heavy traffic volumes exceeding 200,000 vehicles per day. Error! Reference source not found. and Error! Reference source not found. break down the origin and destination jurisdictions (also provided by StreetLight Data), respectively, for AWDT crossing the ALMB along northbound I-495.

Figure 4-5. Study Area in the Context of Regional Travel Patterns

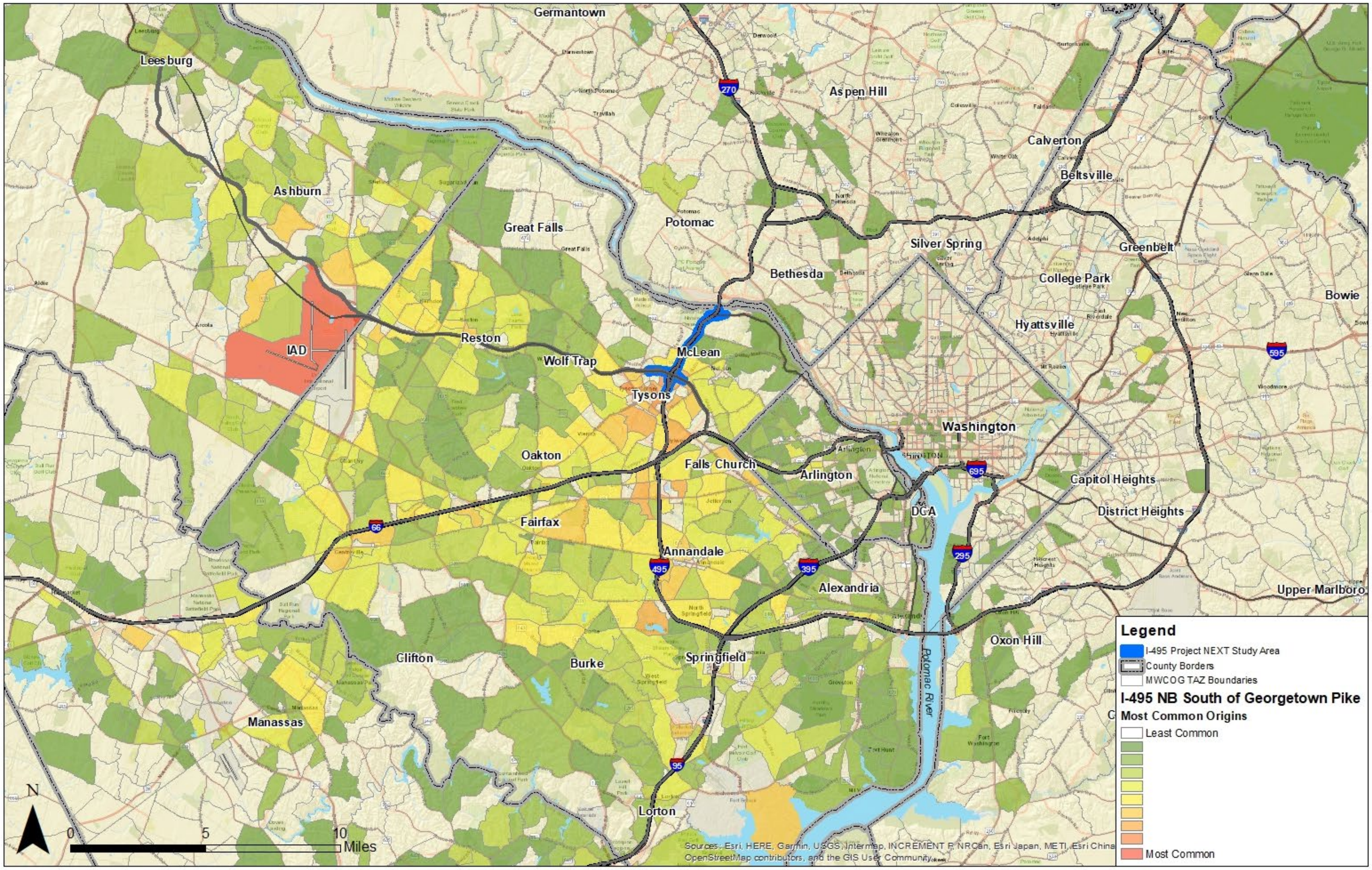


Figure 4-6. Trip Origins along Northbound I-495 between the DTR and Route 193

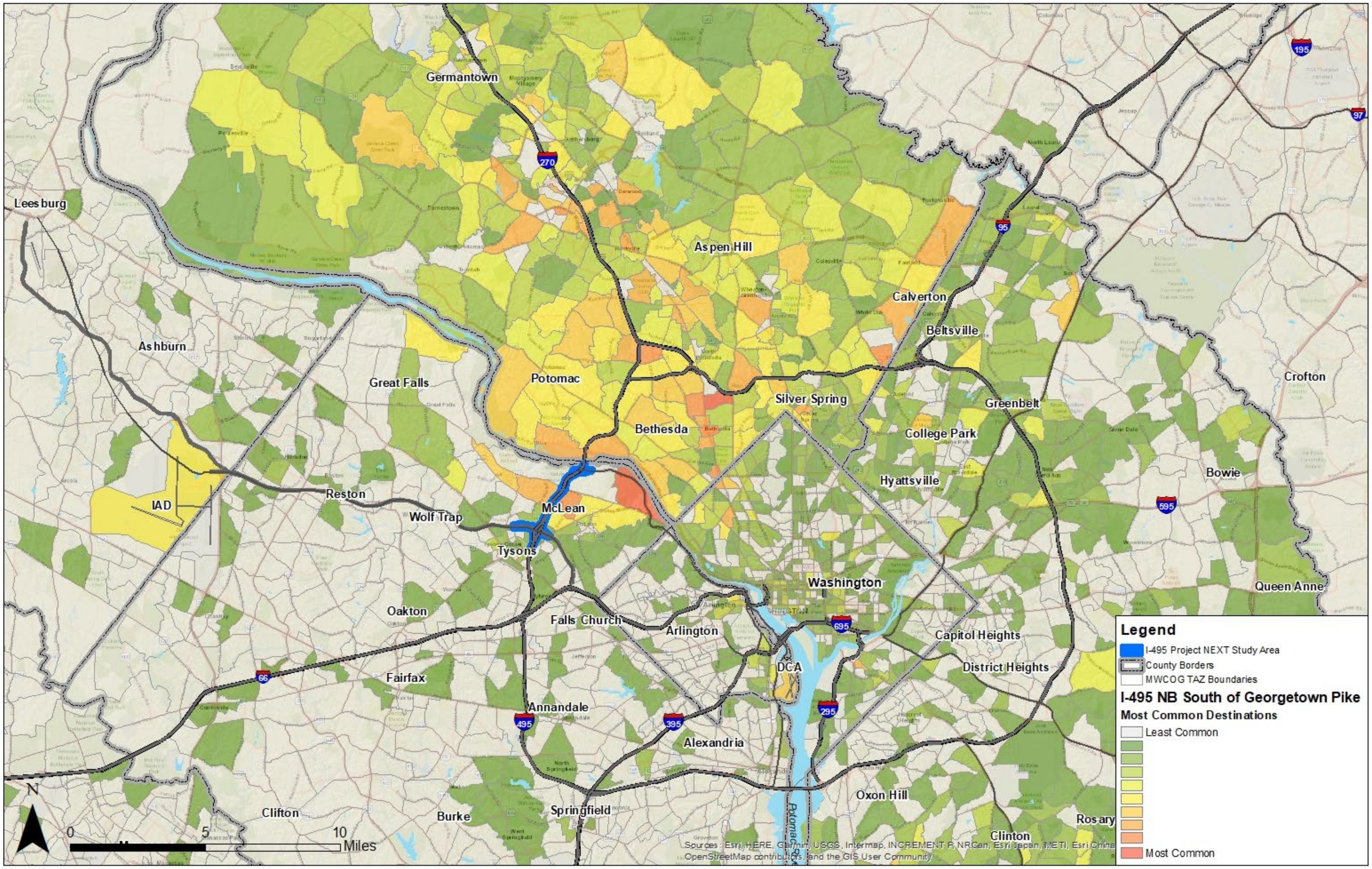


Figure 4-7. Trip Destinations along Northbound I-495 between the DTR and Route 193

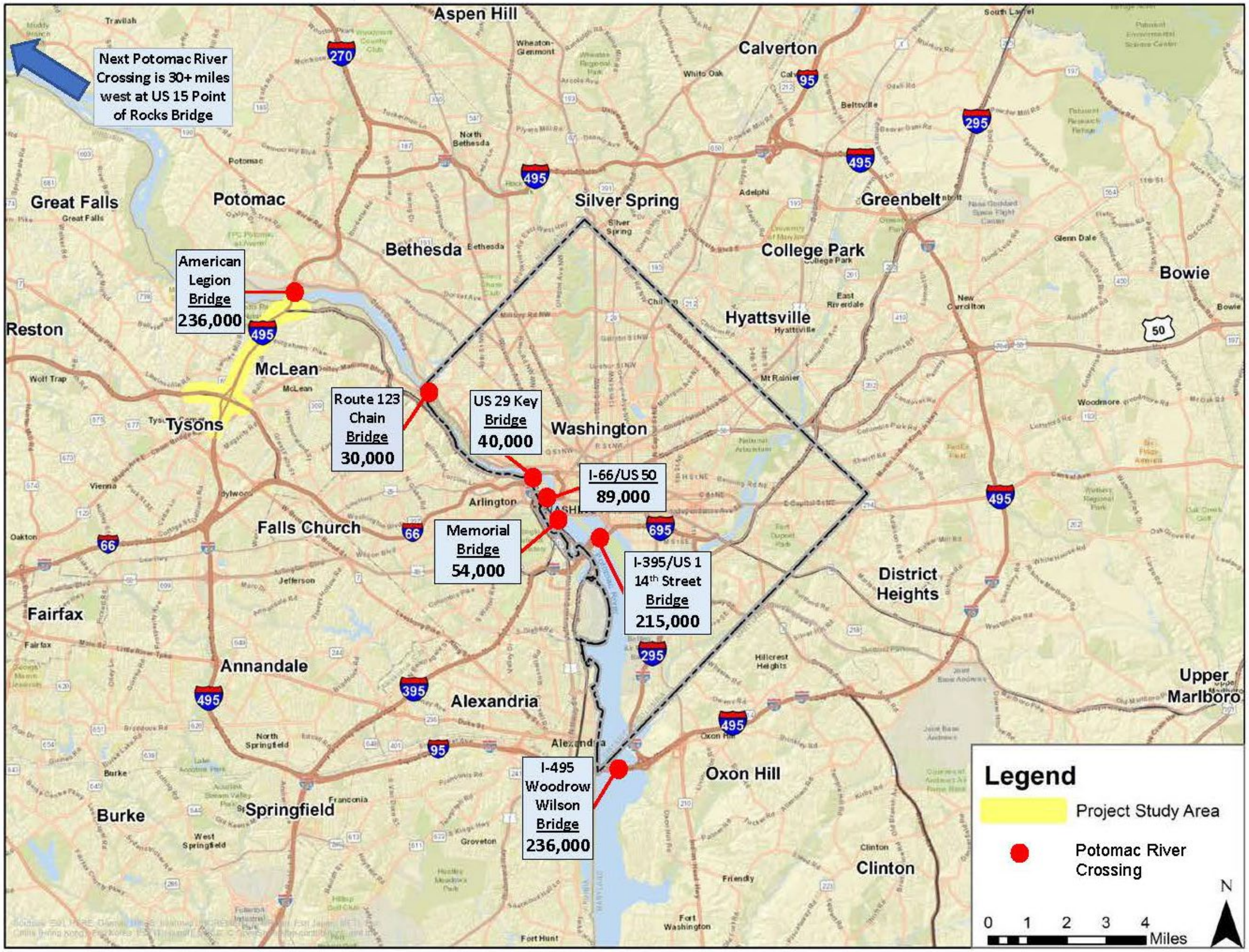


Figure 4-8. Average Daily Traffic Volumes at Potomac River Crossings in the Washington, D.C. Area

Table 4-1. Origin Jurisdiction for AWDT Along Northbound I-495 at the ALMB

Origin Jurisdiction	Percent Contribution to Traffic on ALMB (Northbound)
Fairfax County/Fairfax City/Falls Church	56.1%
Loudoun County	10.6%
Arlington County	8.7%
District of Columbia	8.7%
Prince William County/Manassas/Manassas Park	6.1%
City of Alexandria	3.1%
Other	6.6%

Table 4-2. Destination Jurisdiction for AWDT Along Northbound I-495 at the ALMB

Destination Jurisdiction	Percent Contribution to Traffic on ALMB (Northbound)
Montgomery County	68.5%
Prince George's County	12.6%
District of Columbia	7.2%
Frederick County	4.2%
Other	7.5%

4.4 EXISTING TRAFFIC OPERATIONS AND LEVELS OF SERVICE

4.4.1 Baseline VISSIM Model Development and Calibration

Calibration of the project existing conditions VISSIM models relied on guidance from the VDOT TOSAM (VDOT, 2015) and was previously described in **Chapter 2**; a detailed overview of the calibration process and measures is further provided as **Appendix D**. The complexity of the proposed project's VISSIM analysis network due to its existing operational deficiencies impacted the calibration target criteria selected for this study. These selected criteria include traffic volumes, speeds, travel times, and queue lengths. Since freeway congestion significantly impacts corridor operations, the calibration measures focused primarily on freeway operations. However, arterial throughputs and queue lengths at key intersections' critical movements were also compared to field observations during the calibration.

As also noted in **Chapter 2**, VISUM planning software was used to create origin-destination (O-D) matrices that reflect regional trip patterns based on data from StreetLight and MWCOG. These O-D matrices were merged with balanced freeway and ramp demand as well as balanced intersection turning movements to develop an O-D matrix reflecting travel patterns within the study area.

Simulation analysis periods were chosen and approved by the VDOT Northern Virginia District Traffic Engineer to cover the AM and PM peak periods (6:45 a.m. to 9:45 a.m. and 2:45 p.m. to 5:45 p.m., respectively). A 30-minute seeding period was used for the AM VISSIM models, while a 60-minute seeding period was used for the PM models. As VISSIM microsimulation models have random elements in the vehicle mix and other components, multiple runs of the model for each scenario are required to develop a statistically valid result. VDOT's Sample Size Determination tool was used to determine that 10 model runs were sufficient to obtain a statistically valid result. This calculation is provided in **Appendix D**.

4.4.2 Existing AM Freeway Operations

Exhibits 4-6a through **4-6c** and **Exhibits 4-7a** through **4-7c** illustrate the density and speed results, respectively, from the VISSIM models for the I-495 and Route 267 mainline segments in the study area for the AM peak period. In each figure, the centerline diagram laid over the aerial depicts the average densities or speeds during the peak hour from 7:45 a.m. to 8:45 a.m. in both directions along the mainline segments. The average densities and speeds are color-coded based on the congestion levels and ranges of speeds as depicted in the legend. The boxes on the top and bottom depict the densities and speeds in each direction for the entire peak period from 6:45 a.m. to 9:45 a.m., including the shoulder periods before and after the peak hour. Detailed tabular results can be found in **Appendix E.**

Density

In the AM peak period, northbound I-495 approaching the ALMB experiences congested-to-severely congested conditions for the entire peak period, beginning at the weave on the ALMB and continuing to the DTR interchange. At the interchange of Route 123 and I-495, the Route 123 eastbound off-ramp spills back to the northbound I-495 mainline.

Southbound I-495 between River Road and Route 193 experiences heavy congestion in the peak hour and in the shoulder hour with some segments operating under congested to severely congested levels. Congestion during the shoulder hour worsens compared to the peak hour as congestion clears upstream and more demand reaches the study area.

Speeds

Average VISSIM speeds show similar patterns as seen in the density diagrams, with speeds along northbound I-495 starting to break down approaching the ALMB and spill back to the Route 267 interchange. Average speeds in this segment are below 35 mph with some segments operating below 20 mph (queue condition). Average speeds along southbound I-495 range from 50 to 55 mph during the peak hour. In the shoulder hour, speeds drop below 35 mph in some segments between River Road and Clara Barton Parkway.

Simulated Volumes

Figure 4-9 shows the comparison between simulated vehicle throughput and the balanced traffic counts along northbound I-495 during the AM peak hour. As shown in the figure, most segments along northbound I-495 were able to process the balanced counts for the peak hour. It should be noted that balanced counts are those that have been post-processed from field counts and may not reflect collected, in-field traffic volumes due to capacity constraints.

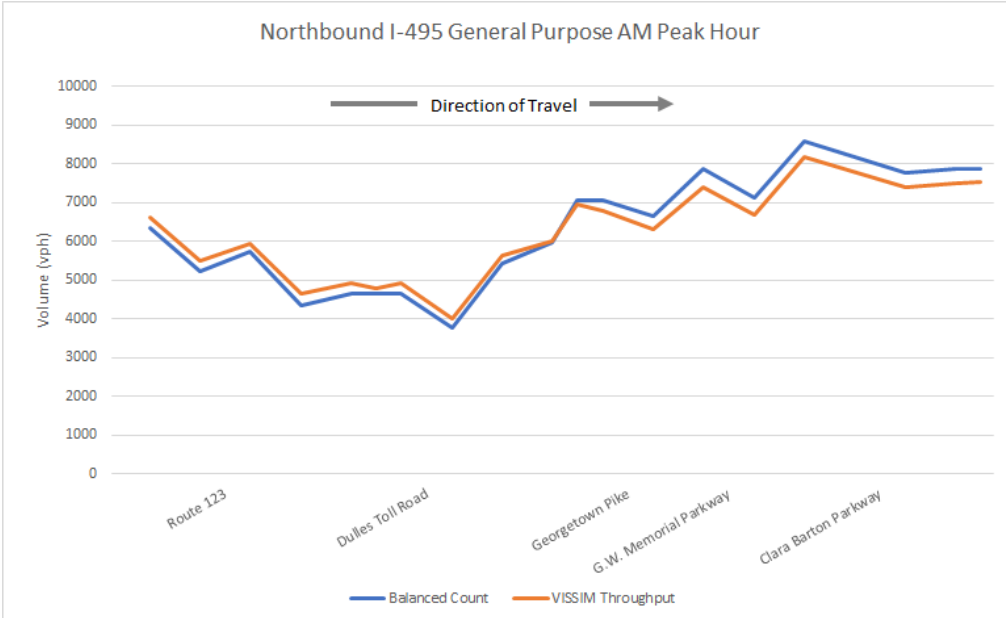


Figure 4-9. AM Peak Hour Balanced Count vs. Simulated Throughput – Northbound I-495

4.4.3 Existing PM Freeway Operations

Exhibits 4-8a through **4-8c** and **Exhibits 4-9a** through **4-9c** illustrate the density and speed results, respectively, from the VISSIM models for the I-495 and Route 267 mainline segments in the study area for the PM peak period. Similar to the AM peak figures, the centerline diagram depicts the average densities or speeds during the peak hour from 3:45 p.m. to 4:45 p.m. in both directions along the mainline segments. The average densities and speeds are color-coded based on the congestion levels and ranges of speeds as depicted in the legend. The boxes on the top and bottom depict the densities and speeds in each direction for the entire peak period from 2:45 p.m. to 5:45 p.m. Detailed tabular results can be found in **Appendix E**.

Density

In the PM peak period, northbound I-495 is severely congested due to two points of congestion. The first congestion point is located outside of the study area at I-270 in Maryland, and the second point is located between the Route 193 and the GWMP interchanges where the part-time shoulder lane drops on the left side while vehicles from the Route 193 interchange are also merging onto northbound I-495 on the right side. This pinch from both sides creates friction in the through lanes and worsens as the slowdown from I-270 in Maryland merges to this location. The resulting queue extends beyond the Route 123 interchange. The corridor operates under severe congestion, not only during the peak hour, but for the entire peak period.

Similarly, along southbound I-495, segments between River Road and the Route 267 interchange operate under severe congestion. The remaining segments between the Route 123 and Route 267 interchanges operate under light-to-moderate density levels.

Speeds

Average VISSIM speeds show similar patterns as seen in the density diagrams with speeds below 25 mph along northbound I-495 throughout the study area. Some segments operate below 20 mph (queue condition). The speeds are lower for the entire peak period for all northbound I-495 segments. Average speeds along southbound I-495 range from 10 to 35 mph between the Route 267 interchange and River Road.

Simulated Volumes

Figure 4-10 shows the comparison between simulated vehicle throughput and the balanced traffic counts along northbound I-495 during the PM peak hour. Similar to the AM peak hour, most northbound I-495 segments were able to process the balanced counts for the PM peak hour. All segments along northbound I-495 have unserved volumes of less than five percent except for a few between the Route 267 interchange and Route 193 interchange which have unserved demands of eight to nine percent. It should be noted that balanced counts are those that have been post-processed from field counts and may not reflect collected, in-field traffic volumes due to capacity constraints.

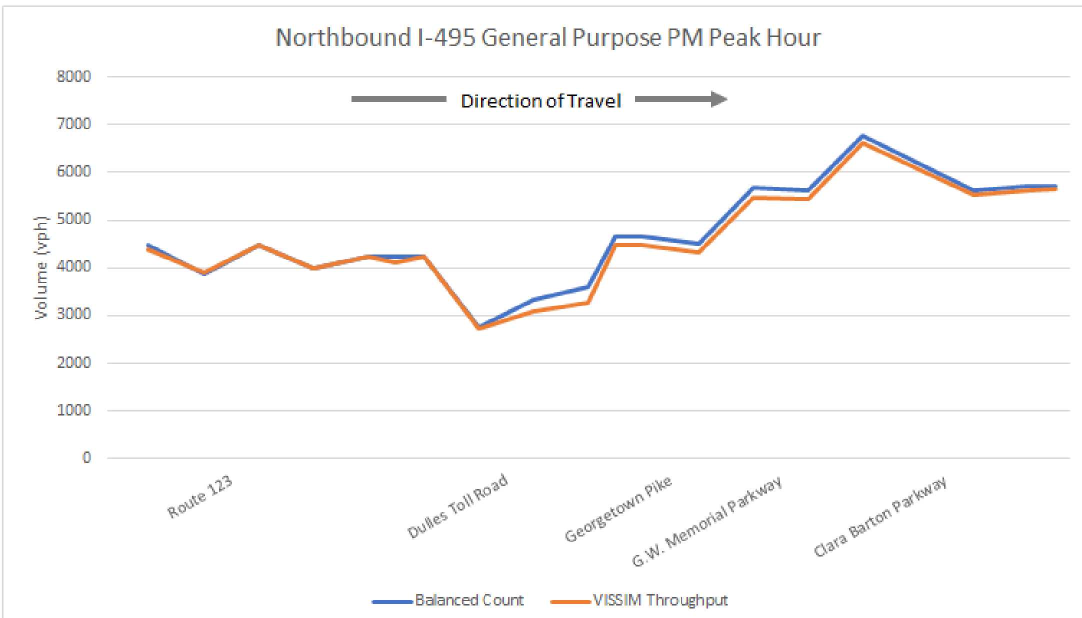


Figure 4-10. PM Peak Hour Balanced Count vs. Simulated Throughput – Northbound I-495

4.4.4 Existing Arterial Operations

AM Arterial Operations

<u>Intersections Evaluated in VISSIM</u>

With the exception of three intersections that operate at LOS F and one that operates at LOS E, almost 80 percent of the intersections within the study area operate at an adequate LOS during the AM peak hour from 7:45 a.m. – 8:45 a.m. as indicated in **Figure 4-11** and in **Table 4-3**. It is important to note that while many of these intersections operate at adequate overall microsimulation LOS, many of the individual approaches operate at failing conditions (see **Appendix F** for arterial intersection delay and LOS details).

<u>Intersections Evaluated in Synchro</u>

The expanded arterial network beyond intersections immediately adjacent to freeway interchanges in the corridor was evaluated solely through Synchro. With the exception of the Old Dominion Drive and Balls

Hill Road intersection which operates at LOS F, all intersections operate at an adequate LOS (LOS D or better) during the AM peak as indicated in **Table 4-4**.

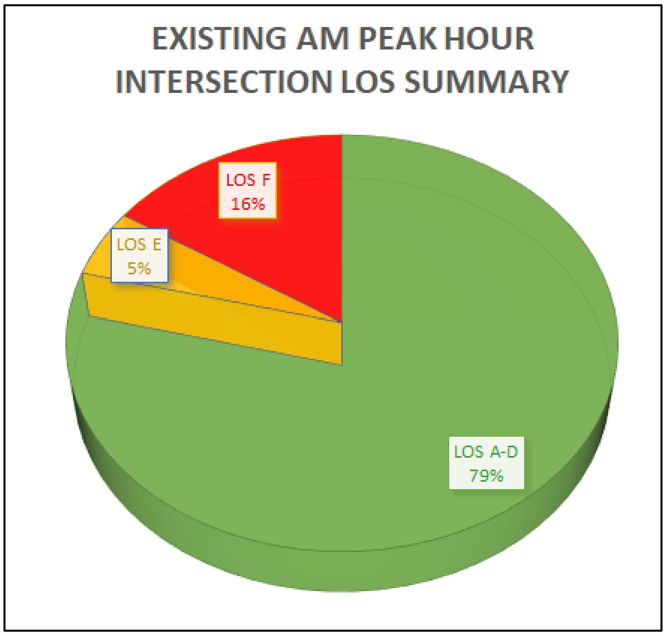


Figure 4-11. Summary of Arterial HCM-Analogous LOS for AM Existing Conditions

Table 4-3. VISSIM Intersection Microsimulation Delay and HCM-Analogous LOS – Existing AM Peak Hour

Intersection	Approach	Average Approach Microsimulation Delay (seconds/vehicle)	Approach HCM-Analogous LOS	Intersection Microsimulation Delay (seconds/vehicle)	Intersection HCM-Analogous LOS
Route 123 and Tysons Boulevard	NB	24.0	C	30.6	C
	SB	26.8	C		
	EB	64.1	E		
	WB	47.6	D		
Westpark Drive and Tysons Connector	NB	16.9	B	17.2	B
	SB	12.3	B		
	WB	19.1	B		
Tysons Connector and Express Lanes Ramps	NB	16.1	B	13.5	B
	SB	11.4	B		
	EB	9.8	A		
Route 123 and Capital One Tower Drive/Old Meadow Road	NB	119.0	F	74.3	E
	SB	19.7	B		
	EB	149.9	F		
	WB	59.6	E		
Route 123 and Scotts Crossing Boulevard/Colshire Drive	NB	16.1	B	19.7	B
	SB	19.1	B		
	EB	39.5	D		
	WB	61.3	E		
Route 123 and Route 267 Eastbound Off-Ramp/Anderson Road	NB	42.5	D	46.8	D
	SB	44.9	D		
	EB	43.7	D		
	WB	77.2	E		
Route 123 and Lewinsville Road/Great Falls Street	NB	124.0	F	100.9	F
	SB	78.4	E		
	EB	54.0	D		
	WB	122.2	F		
Lewinsville Road and Balls Hill Road	SB	167.4	F	26.5	C
	EB	23.7	C		
	WB	4.3	A		
Jones Branch Drive and Jones Branch Connector	NB	19.9	B	14.5	B
	SB	8.3	A		
	WB	15.4	B		
Jones Branch Connector and Express Lanes Ramps	NB	13.2	B	11.4	B
	SB	11.0	B		
	EB	10.1	B		
International Drive and Spring Hill Road/Jones Branch Drive	NB	53.7	D	48.0	D
	SB	42.2	D		
	EB	54.5	D		
	WB	64.5	E		

Intersection	Approach	Average Approach Microsimulation Delay (seconds/vehicle)	Approach HCM-Analogous LOS	Intersection Microsimulation Delay (seconds/vehicle)	Intersection HCM-Analogous LOS
Spring Hill Road and DTR Eastbound Ramps	NB	27.4	C	168.0	F
	SB	51.8	D		
	EB	311.4	F		
Spring Hill Road and DTR Westbound Ramps	NB	13.3	B	32.5	C
	SB	19.5	B		
	WB	74.6	E		
Spring Hill Road and Lewinsville Road	NB	60.4	E	52.4	D
	SB	80.7	F		
	EB	52.7	D		
	WB	33.3	C		
Route 193 and Helga Place/Linganore Drive	NB	6.7	A	56.1	F
	SB	56.1	F		
	EB	44.0	E		
	WB	0.5	A		
Route 193 and I-495 Southbound Ramps	SB	25.1	C	24.3	C
	EB	24.7	C		
	WB	22.5	C		
Route 193 and I-495 Northbound Ramps	NB	83.2	F	27.8	C
	EB	15.3	B		
	WB	19.7	B		
Route 193 and Balls Hill Road	NB	58.8	E	27.8	C
	SB	26.3	C		
	EB	19.3	B		
	WB	17.9	B		
Route 193 and Dead Run Drive	NB	8.7	A	9.3	A
	EB	1.0	A		
	WB	0.8	A		

Table 4-4. Synchro Intersection Delay and LOS – Existing AM Peak Hour

Intersection	Approach	Approach Delay (s/veh)	Approach LOS	Intersection Delay (s/veh)	Intersection LOS
Old Dominion Drive at Spring Hill Road	NB	21.5	C	13.9	B
	SB	26	C		
	EB	11.9	B		
	WB	7.9	A		
Old Dominion Drive at Swinks Mill Road	NB	48.9	D	29.3	C
	SB	38	D		
	EB	25	C		
	WB	8.5	A		

Intersection	Approach	Approach Delay (s/veh)	Approach LOS	Intersection Delay (s/veh)	Intersection LOS
Old Dominion Drive at Balls Hill Road	NB	121	F	101.9	F
	SB	112	F		
	EB	82.1	F		
	WB	113.3	F		
Route 123 at Old Dominion Drive	NB	17.6	B	39.5	D
	SB	29.4	C		
	EB	81.7	F		
	WB	77.7	E		
Georgetown Pike at Swinks Mill Road	NB	106.9	F	33.1	D
	SB	0.0	A		
	EB	0	A		
	WB	3.4	A		
Georgetown Pike at Spring Hill Road	NB	18.2	A	1.1	A
	EB	0	A		
	WB	1.2	A		
Lewinsville Road at Swinks Mill Road	SB	40.6	E	6.1	A
	EB	2.6	A		
	WB	0	A		
Route 123 at Ingleside Avenue	NB	0.3	A	0.9	A
	SB	0.6	A		
	EB	13.5	B		
	WB	10.4	B		
Douglass Drive at Route 193 (Georgetown Pike)	NB	36.8	E	7.4	A
	SB	24.8	C		
	EB	0.6	A		
	WB	1.9	A		

PM Arterial Operations

<u>Intersections Evaluated in VISSIM</u>

As shown in **Figure 4-12** and in **Table 4-5**, there are more intersections that operate at failing conditions during the PM peak hour from 3:45 p.m. to 4:45 p.m. than during the AM peak hour. Out of the total 19 intersections evaluated, five operate at failing conditions of LOS F, while three intersections operate at near-failing conditions of LOS E. The remaining intersections operate at an acceptable LOS D or better during the PM peak hour. It is important to note that while many of these intersections operate at adequate overall control LOS, many of the individual approaches operate at failing conditions. Additional detail on arterial traffic operations, including intersection approach delay and LOS is summarized in **Appendix F**.

<u>Intersections Evaluated in Synchro</u>

The expanded arterial network beyond intersections immediately adjacent to freeway interchanges in the corridor was evaluated solely through Synchro. As during the AM peak hour, only the Old Dominion Drive and Balls Hill Road intersection operates at LOS F, as indicated in **Table 4-6**. The remaining intersections operate at an adequate LOS (LOS D or better) during the PM peak hour. Although the intersections operate at an adequate overall control LOS, many of the individual approaches operate at failing conditions.

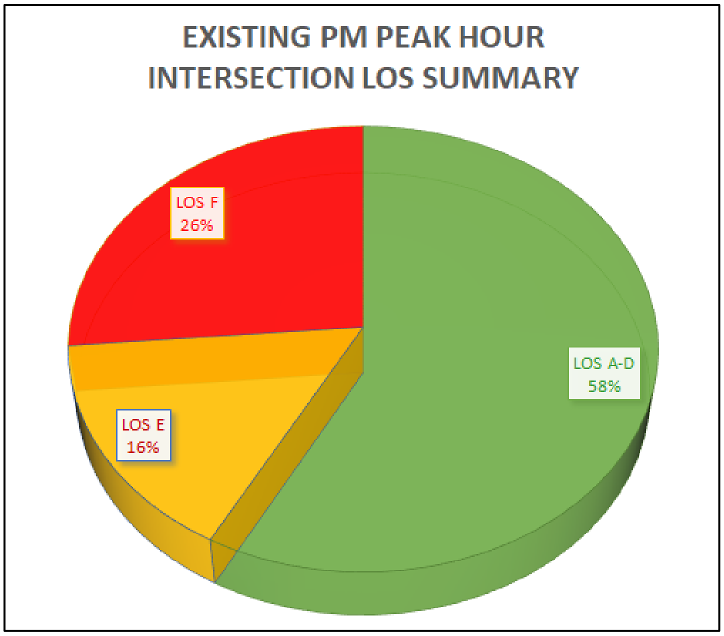


Figure 4-12. Summary of Arterial HCM-Analogous LOS for PM Existing Conditions

Table 4-5. VISSIM Intersection Microsimulation Delay and HCM-Analogous LOS – Existing PM Peak Hour

Intersection	Approach	Average Approach Microsimulation Delay (seconds/vehicle)	Approach HCM-Analogous LOS	Intersection Microsimulation Delay (seconds/vehicle)	Intersection HCM-Analogous LOS
Route 123 and Tysons Boulevard	NB	73.5	E	73.9	E
	SB	45.4	D		
	EB	96.9	F		
	WB	151.8	F		
Westpark Drive and Tysons Connector	NB	5.3	A	5.7	A
	SB	5.3	A		
	WB	12.0	B		
Tysons Connector and Express Lanes Ramps	NB	14.8	B	5.8	A
	SB	5.7	A		
	EB	5.1	A		
Route 123 and Capital One Tower Drive/Old Meadow Road	NB	39.7	D	39.8	D
	SB	22.0	C		
	EB	64.6	E		
	WB	84.8	F		
Route 123 and Scotts Crossing Boulevard/Colshire Drive	NB	8.9	A	18.9	B
	SB	17.2	B		
	EB	27.3	C		
	WB	88.3	F		
Route 123 and Route 267 Eastbound Off-Ramp/Anderson Road	NB	26.5	C	37.2	D
	SB	27.3	C		
	EB	50.6	D		
	WB	125.9	F		
Route 123 and Lewinsville Road/Great Falls Street	NB	80.6	F	91.9	F
	SB	117.5	F		
	EB	53.3	D		
	WB	111.8	F		
Lewinsville Road and Balls Hill Road	SB	45.7	D	113.9	F
	EB	225.9	F		
	WB	7.3	A		
Jones Branch Drive and Jones Branch Connector	NB	11.3	B	7.0	A
	SB	3.2	A		
	WB	15.7	B		
Jones Branch Connector and Express Lanes Ramps	NB	11.9	B	12.2	B
	SB	9.6	A		
	EB	12.5	B		
International Drive and Spring Hill Road/Jones Branch Drive	NB	67.2	E	60.9	E
	SB	62.7	E		
	EB	55.5	E		
	WB	59.1	E		
Spring Hill Road and DTR Eastbound Ramps	NB	7.6	A	14.8	B
	SB	4.6	A		
	EB	75.6	E		

Intersection	Approach	Average Approach Microsimulation Delay (seconds/vehicle)	Approach HCM-Analogous LOS	Intersection Microsimulation Delay (seconds/vehicle)	Intersection HCM-Analogous LOS
Spring Hill Road and DTR Westbound Ramps	NB	27.5	C	28.9	C
	SB	21.7	C		
	WB	56.1	E		
Spring Hill Road and Lewinsville Road	NB	82.4	F	62.4	E
	SB	74.2	E		
	EB	63.4	E		
	WB	40.3	D		
Route 193 and Helga Place/Linganore Drive	NB	0.0	A	245.1	F
	SB	245.1	F		
	EB	54.9	F		
	WB	0.7	A		
Route 193 and I-495 Southbound Ramps	SB	29.6	C	33.7	C
	EB	46.3	D		
	WB	28.1	C		
Route 193 and I-495 Northbound Ramps	NB	290.7	F	52.4	D
	EB	16.3	B		
	WB	45.3	D		
Route 193 and Balls Hill Road	NB	1,028.7	F	210.7	F
	SB	20.0	B		
	EB	7.7	A		
	WB	130.4	F		
Route 193 and Dead Run Drive	NB	140.4	F	141.4	F
	EB	0.2	A		
	WB	463.6	F		

Table 4-6. Synchro Intersection Delay and LOS – Existing PM Peak Hour

Intersection	Approach	Approach Delay (s/veh)	Approach Delay (s/veh)	Intersection Delay (s/veh)	Intersection LOS
Old Dominion Drive at Spring Hill Road	NB	28.5	C	16.5	B
	SB	19.1	B		
	EB	9.9	A		
	WB	15.7	B		
Old Dominion Drive at Swinks Mill Road	NB	31.2	C	19.2	B
	SB	21.9	C		
	EB	13.4	B		
	WB	17.1	B		
Old Dominion Drive at Balls Hill Road	NB	135	F	167.5	F
	SB	247.8	F		
	EB	179.1	F		
	WB	115.8	F		

Intersection	Approach	Approach Delay (s/veh)	Approach Delay (s/veh)	Intersection Delay (s/veh)	Intersection LOS
Route 123 at Old Dominion Drive	NB	27	C	47.3	D
	SB	40.2	D		
	EB	77.2	E		
	WB	86.1	F		
Georgetown Pike at Swinks Mill Road	NB	14.1	B	3.8	A
	SB	0	A		
	EB	0	A		
	WB	2.4	A		
Georgetown Pike at Spring Hill Road	NB	13.2	B	1.3	A
	EB	0	A		
	WB	1.2	A		
Lewinsville Road at Swinks Mill Road	SB	68.2	F	9.3	A
	EB	2.8	A		
	WB	0	A		
Route 123 at Ingleside Avenue	NB	3.3	A	2.6	A
	SB	0.2	A		
	EB	23.2	C		
	WB	10.7	A		
Douglass Drive at Route 193 (Georgetown Pike)	NB	104.5	F	20.3	C
	SB	42.6	E		
	EB	0.5	A		
	WB	3.7	A		

4.5 SUMMARY OF EXISTING OPERATIONAL DEFICIENCIES

Based on the traffic simulation results, the travel demand is higher than the existing capacity for much of the study area under existing conditions. This is reflected in the high densities and low speeds found in many segments in the peak directions. General characteristics of congestion on the corridor include:

- **Substantial multi-hour queues in both directions**.
  - Bottlenecks created by major merge areas, as experienced in the northern terminus of the study area.
  - Congestion from downstream impacting study area network, including areas in Maryland north of the ALMB and congestion in Tysons south of the study area.
  - Bottlenecks created due to lane drops, such as the I-495 northbound GP merge where the shoulder lane terminates.
  - Bi-directional demand and weaving result in congestion in both directions during both peak periods, such as weaving along I-495 northbound GP between the on-ramp from Route 193 and the off-ramp to GWMP.
  - The on-ramp from the GWMP to I-495 northbound frequently queues back onto the GWMP outbound/westbound mainline for several miles to as far back as the GWMP/Route 123 interchange.
  - As shown in **Exhibit 4-1**, in the northbound direction along I-495, the AM peak period lasts almost four hours, and the PM peak period lasts for more than six hours. In the

southbound direction, the AM peak period lasts approximately two hours and the PM peak period lasts for approximately five hours.

- **Heavy volumes entering and exiting I-495 at the Route 267 interchange affect traffic in both directions for extended periods**.
    - Heavy demand from Route 267 entering an already congested segment of I-495 results in more congestion and queue spill-backs. The I-495 northbound GP on-ramp from DTR/DAAR eastbound frequently spills back to the DTR/DAAR mainlines due to heavy demand and congestion along I-495 northbound GP. The I-495 southbound GP on-ramp from DTR/DAAR eastbound creates weaving issues along I-495 southbound, as the off-ramp to Route 123 and destinations in Tysons is just downstream of this location.
- **Cut-through traffic on local parallel arterials creates more disturbance along mainline.**
    - Vehicles detouring to avoid I-495 congestion create more disturbance to the flow of traffic by exiting to use parallel arterial facilities, such as Balls Hill Road and Swinks Mill Road, and then entering again at downstream locations along I-495, such as at Route 193.
- **High-Occupancy Toll (HOT) traffic to and from the I-495 Express Lanes and weaving in and out from GP lanes results in congestion.**
    - The speed differential as well as weaving in and out from the I-495 Express Lanes that have ingress and egress just north of the Route 267 interchange create congestion in the GP lanes.

4.5.1 Major Points of Congestion

- Northbound I-495
    - Hours of congestion: 7:00 a.m. to 11:00 a.m. and 1:30 p.m. to 8:00 p.m.
    - Congestion within the study area is largely due to downstream congestion from beyond the ALMB and starts between Route 193 and GWMP where the part-time shoulder lane drops on the left side and vehicles from Route 193 are merging on the right side. The slowdown from the Clara Barton Parkway interchange also impacts this segment.
    - Queues spill back beyond the DTR interchange in the AM and PM peak periods. Cut-through traffic trying to avoid I-495 congestion by entering from the Route 193 ramp creates congestion that starts as early as 1:30 p.m.
    - After 3 p.m., congestion from I-270 in Maryland starts to spill back and worsen existing queues, extending back to beyond the Route 123 interchange, where queues then generally stabilize and are sustained through the peak period.
    - Route 267, Route 193, and GWMP experience queuing on ramps, mainline segments, and arterial intersections due to northbound I-495 congestion, sometimes extending for miles in the case of GWMP.
- Southbound I-495
    - Hours of congestion: 8:00 a.m. to 10:00 a.m. and 2:00 p.m. to 7:00 p.m.
    - In the AM peak period, congestion begins at the Route 193 ramp where the C-D road from the GWMP merges on to southbound I-495 and is also used as a bypass lane for through traffic.
    - In the PM peak period, multiple localized bottlenecks combined with downstream congestion cause queue spillbacks in Tysons back to the DTR interchange. The traffic weaving between the on-ramp from eastbound Route 267 and the off-ramps to Route 123

adds to this congestion, resulting in congestion spilling back onto the Route 267 ramps and mainline.

- Route 193 ramp congestion due to the C-D road merge happens independently and starts earlier in the PM peak period, creating a separate bottleneck along southbound I-495. Vehicles merging on the right from the GWMP and Route 193 that weave across to access the I-495 Express Lanes add to this congestion. Downstream congestion causes more vehicles to try to enter the Express Lanes, resulting in more congestion upstream of the Express Lanes.

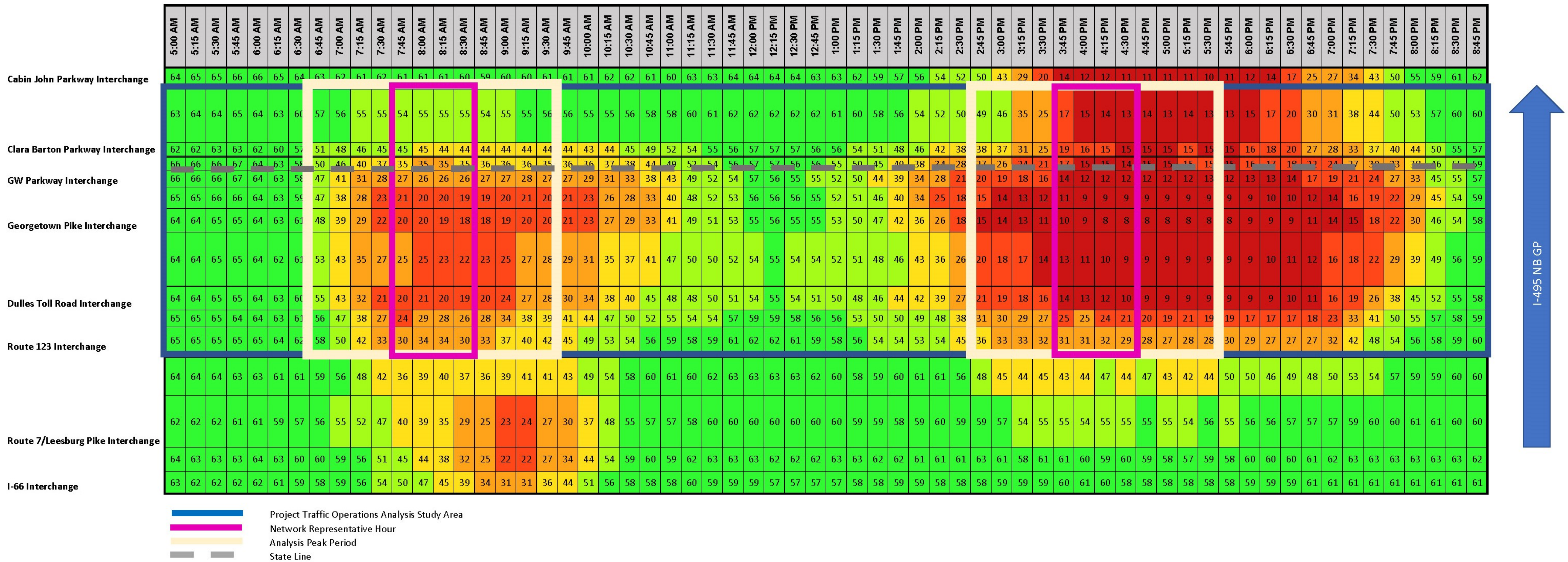


Exhibit 4-1. Definition of Peak Periods and Representative Hours – Northbound I-495

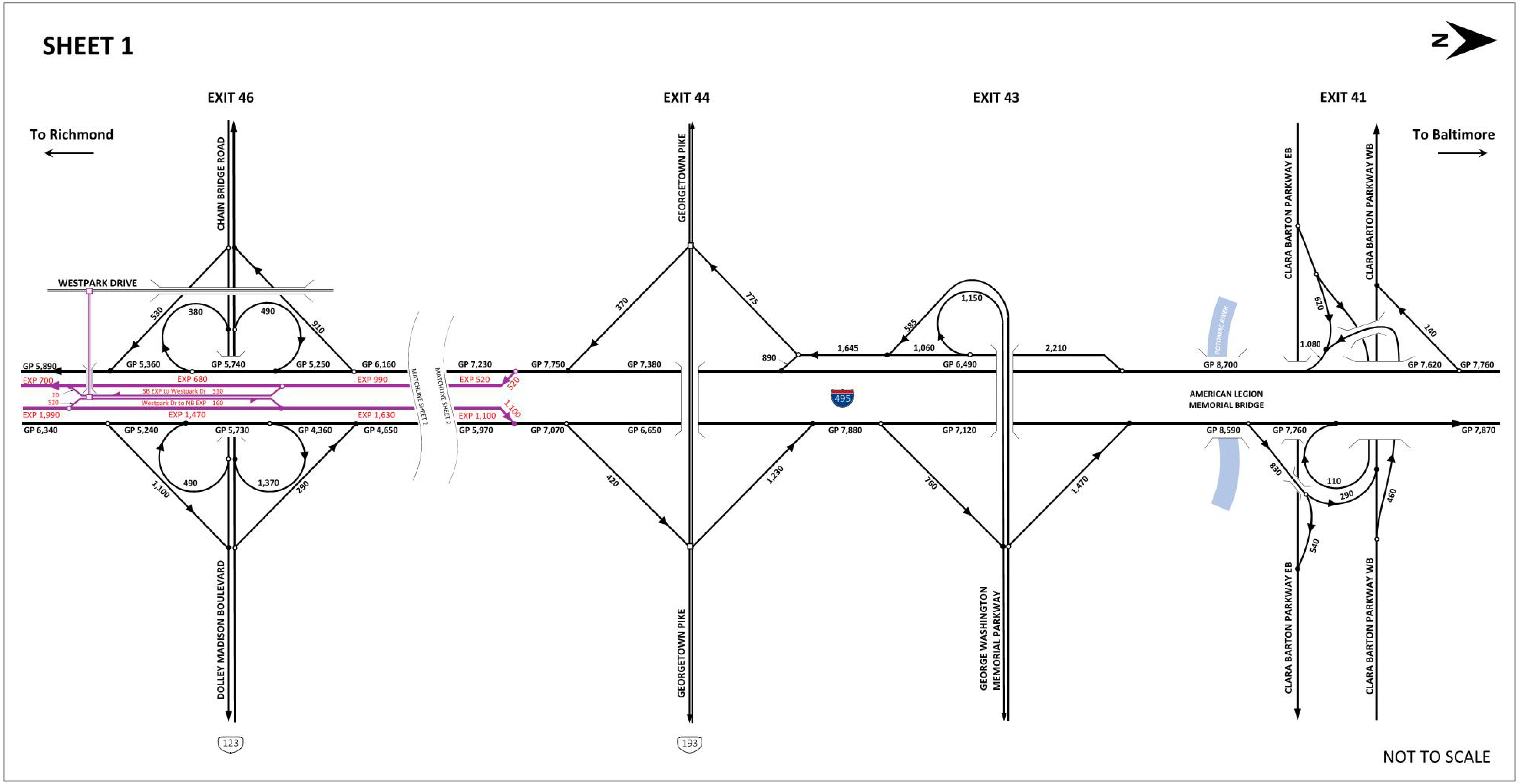


Exhibit 4.2a. Freeway Existing (2018) AM Peak Hour Volume – I-495

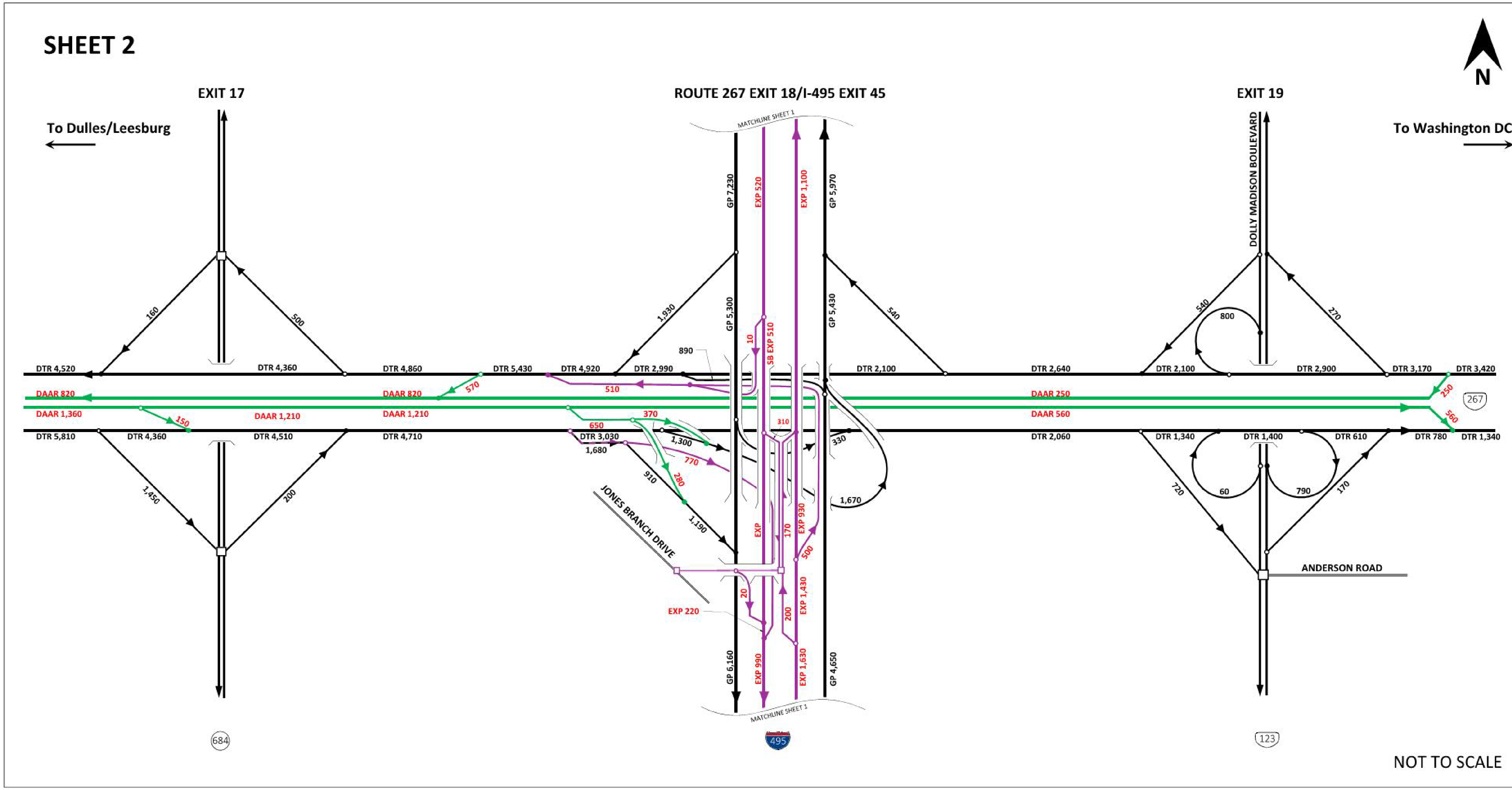


Exhibit 4.2b Freeway Existing (2018) AM Peak Hour Volume – Route 267

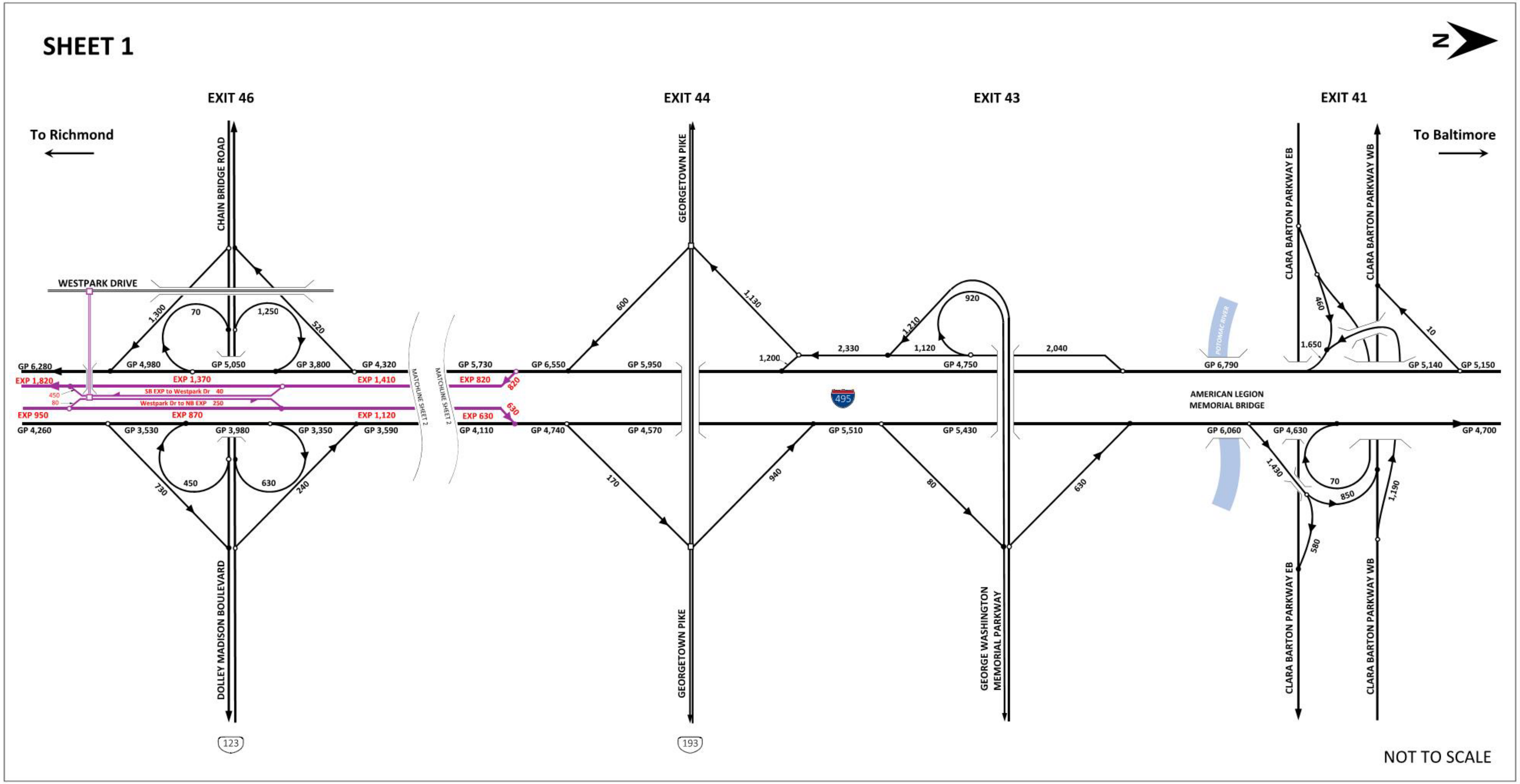


Exhibit 4.3a Freeway Existing (2018) PM Peak Hour Volume – I-495

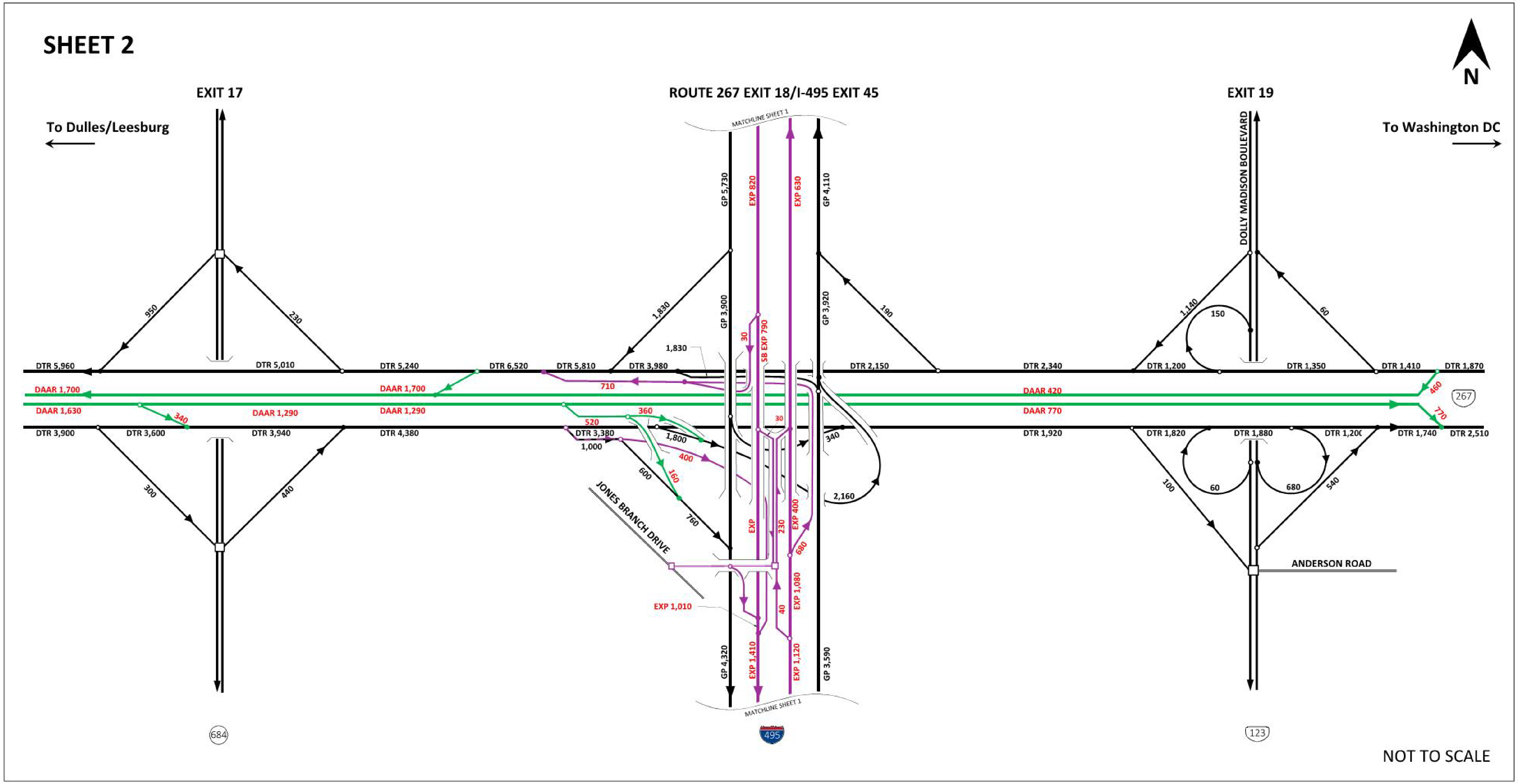


Exhibit 4.3b Freeway Existing (2018) PM Peak Hour Volume – Route 267

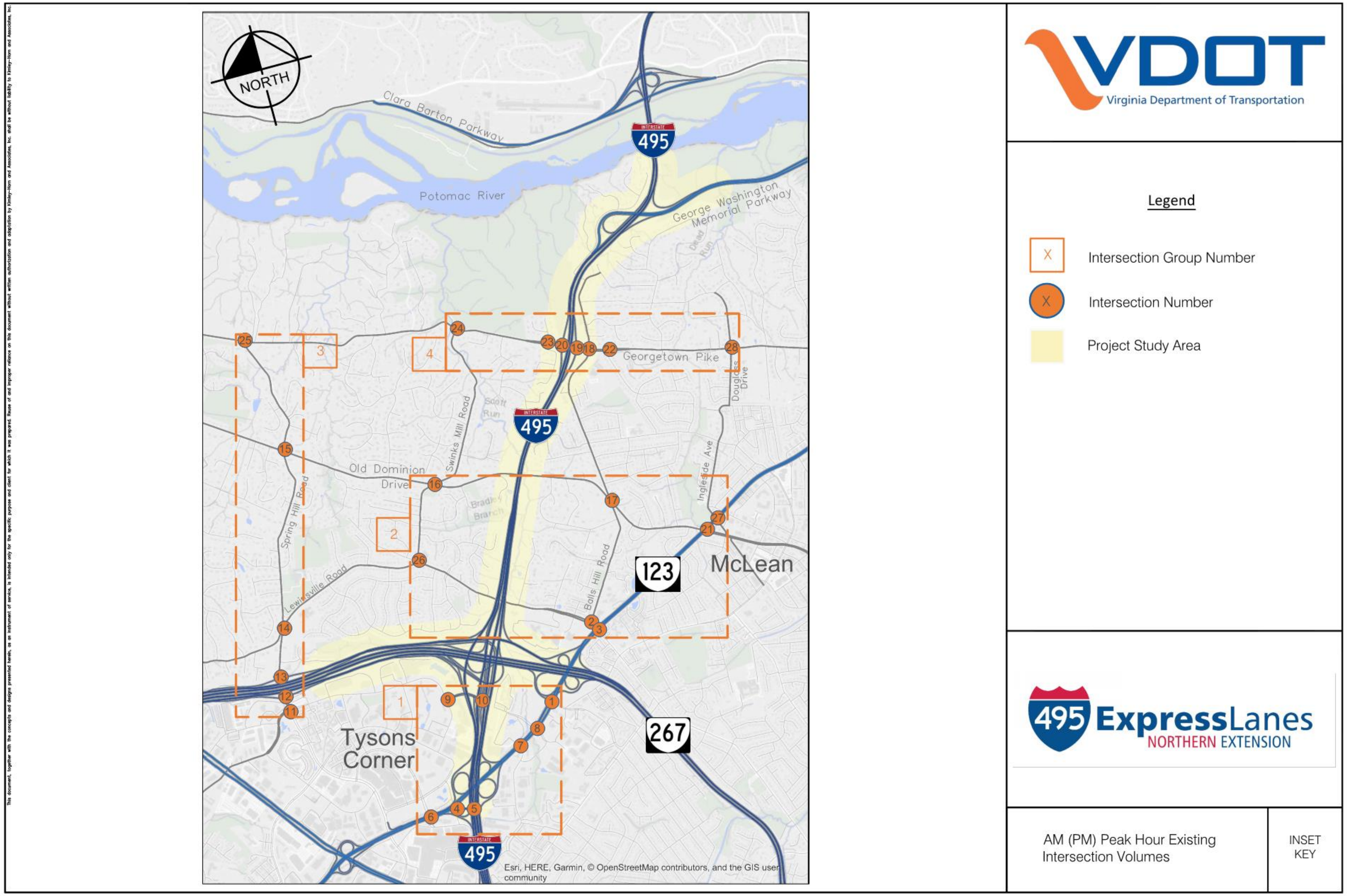
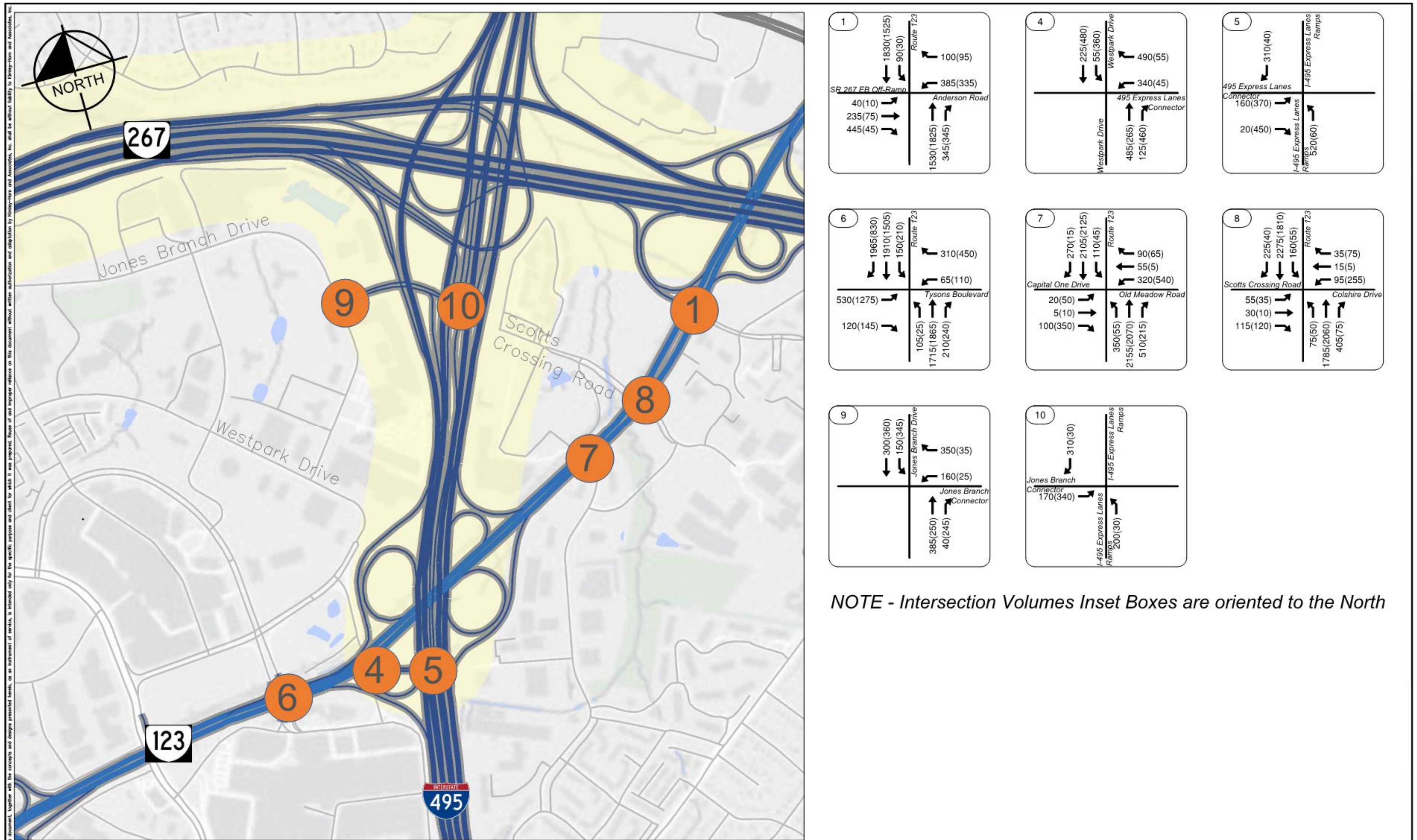


Exhibit 4-4a. Arterial Existing (2018) Peak Hour Turning Movement Volumes – Figure Key



VDOT Virginia Department of Transportation

Legend

X Intersection Number

495 Express Lanes NORTHERN EXTENSION

AM (PM) Peak Hour Existing Intersection Volumes

INSET 1

Exhibit 4-4b. Arterial Existing (2018) Peak Hour Turning Movement Volumes – Location 1

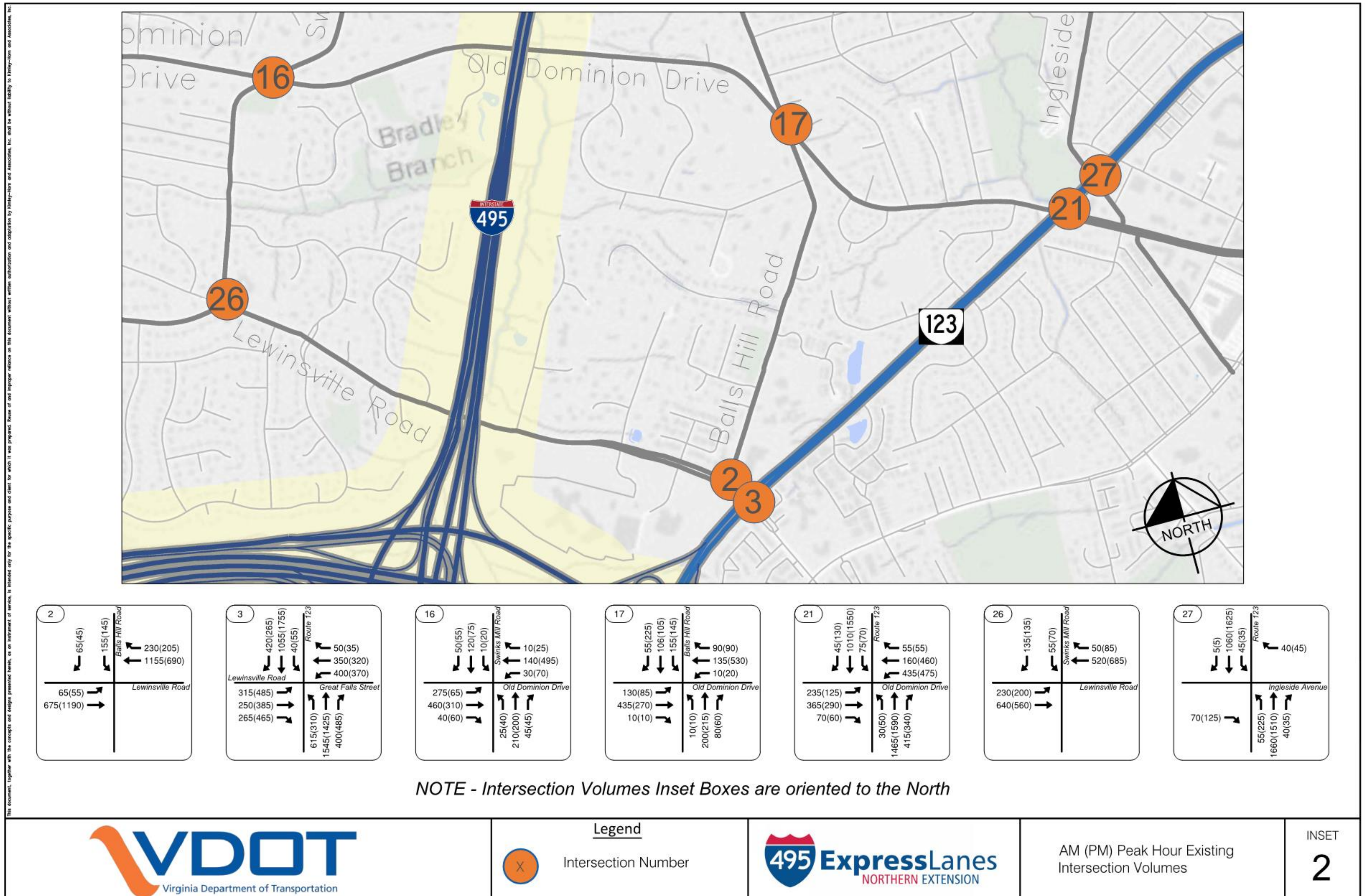


Exhibit 4-4c. Arterial Existing (2018) Peak Hour Turning Movement Volumes – Location 2

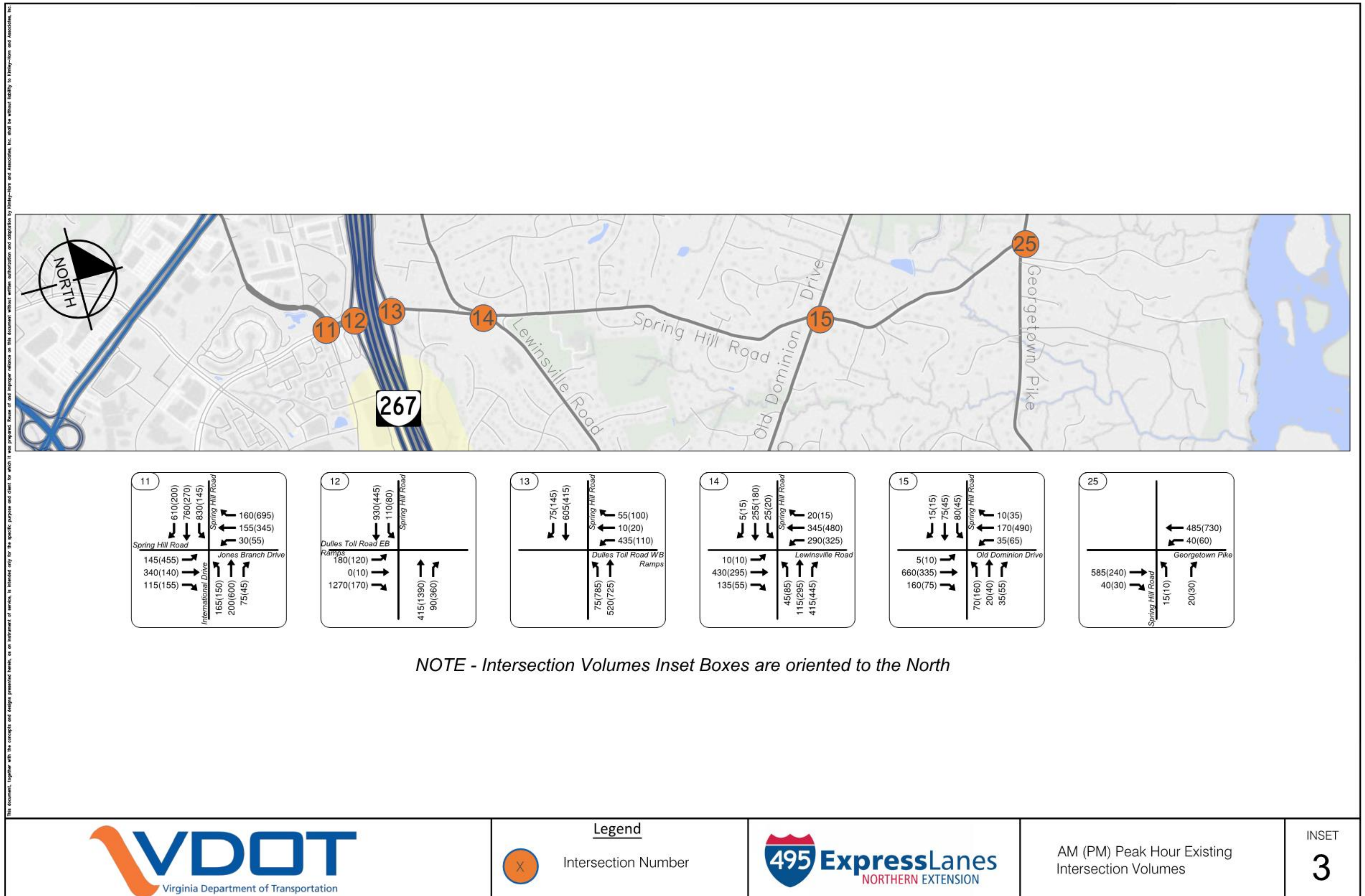


Exhibit 4-4d. Arterial Existing (2018) Peak Hour Turning Movement Volumes – Location 3

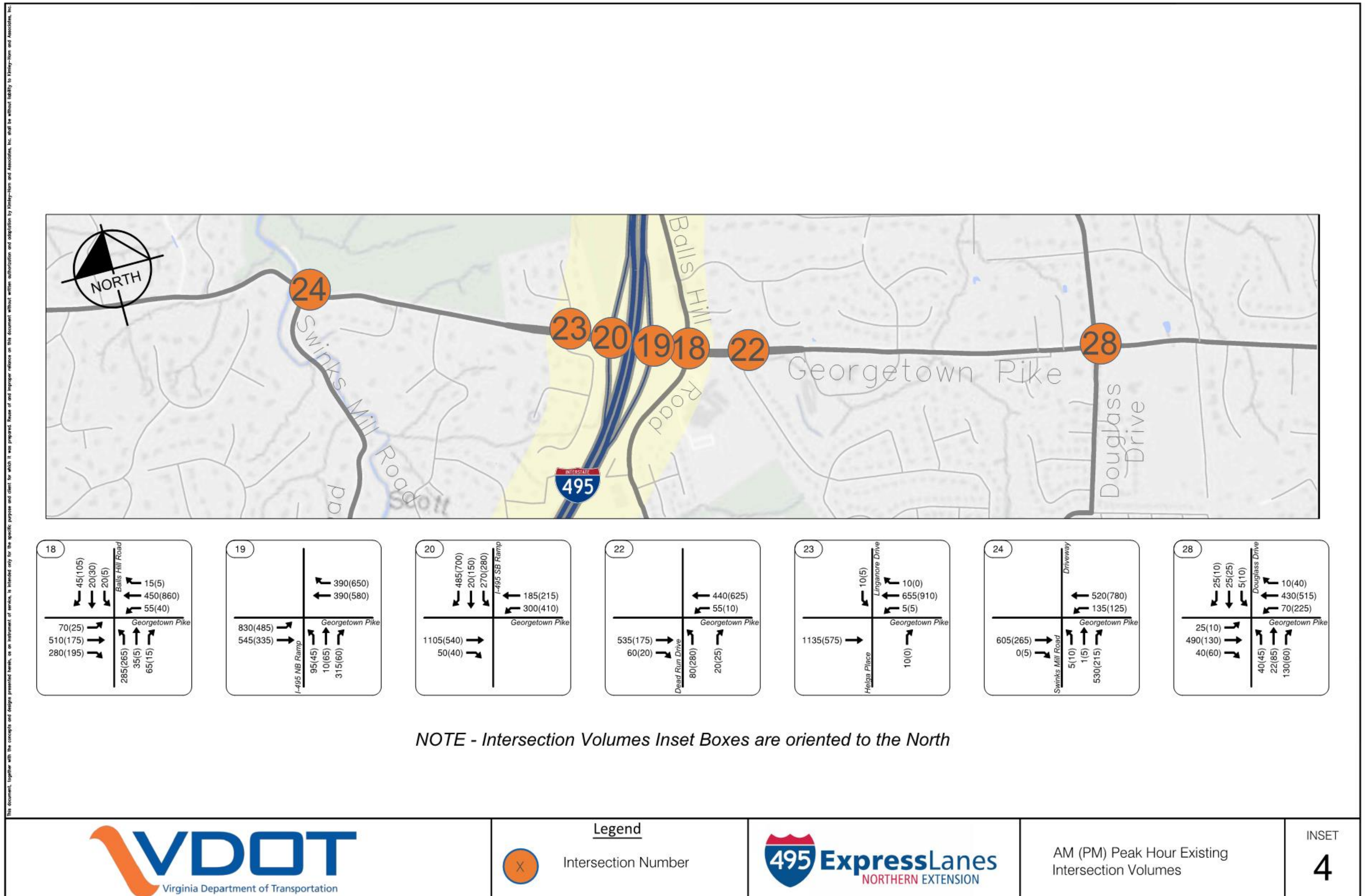


Exhibit 4-4e. Arterial Existing (2018) Peak Hour Turning Movement Volumes – Location 4

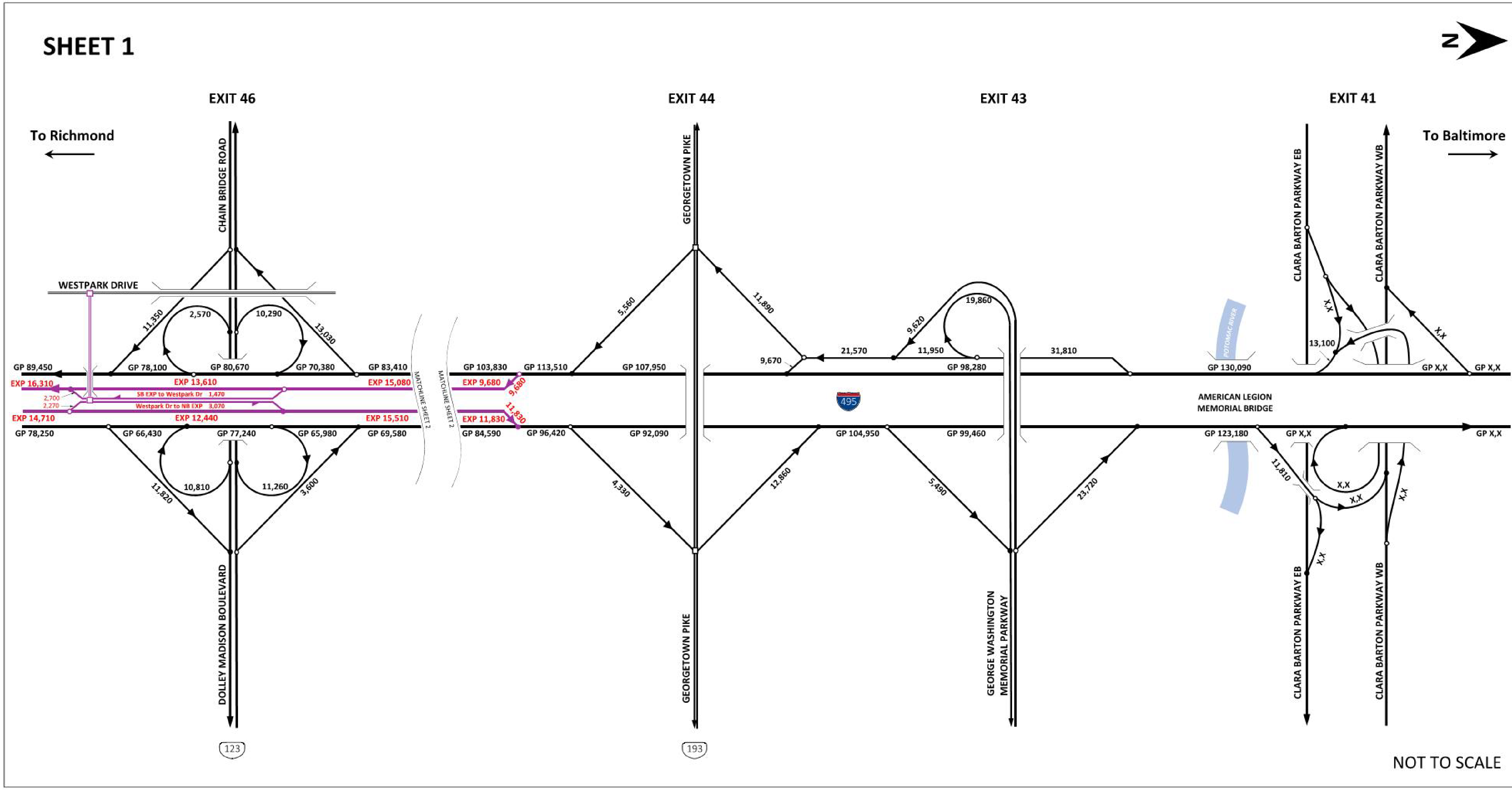


Exhibit 4.5a Freeway Existing (2018) ADT – I-495

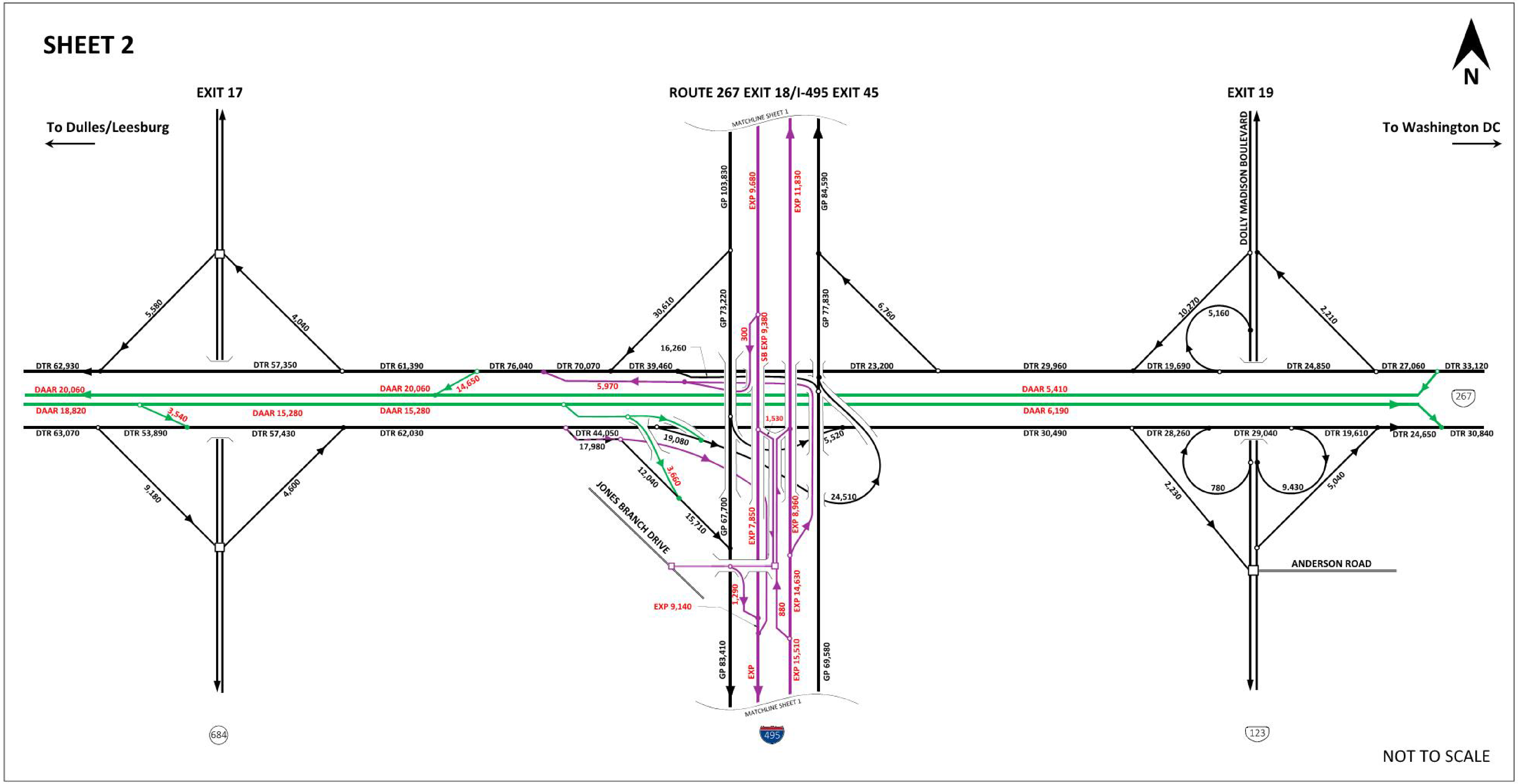


Exhibit 4.5b. Freeway Existing (2018) ADT – Route 267

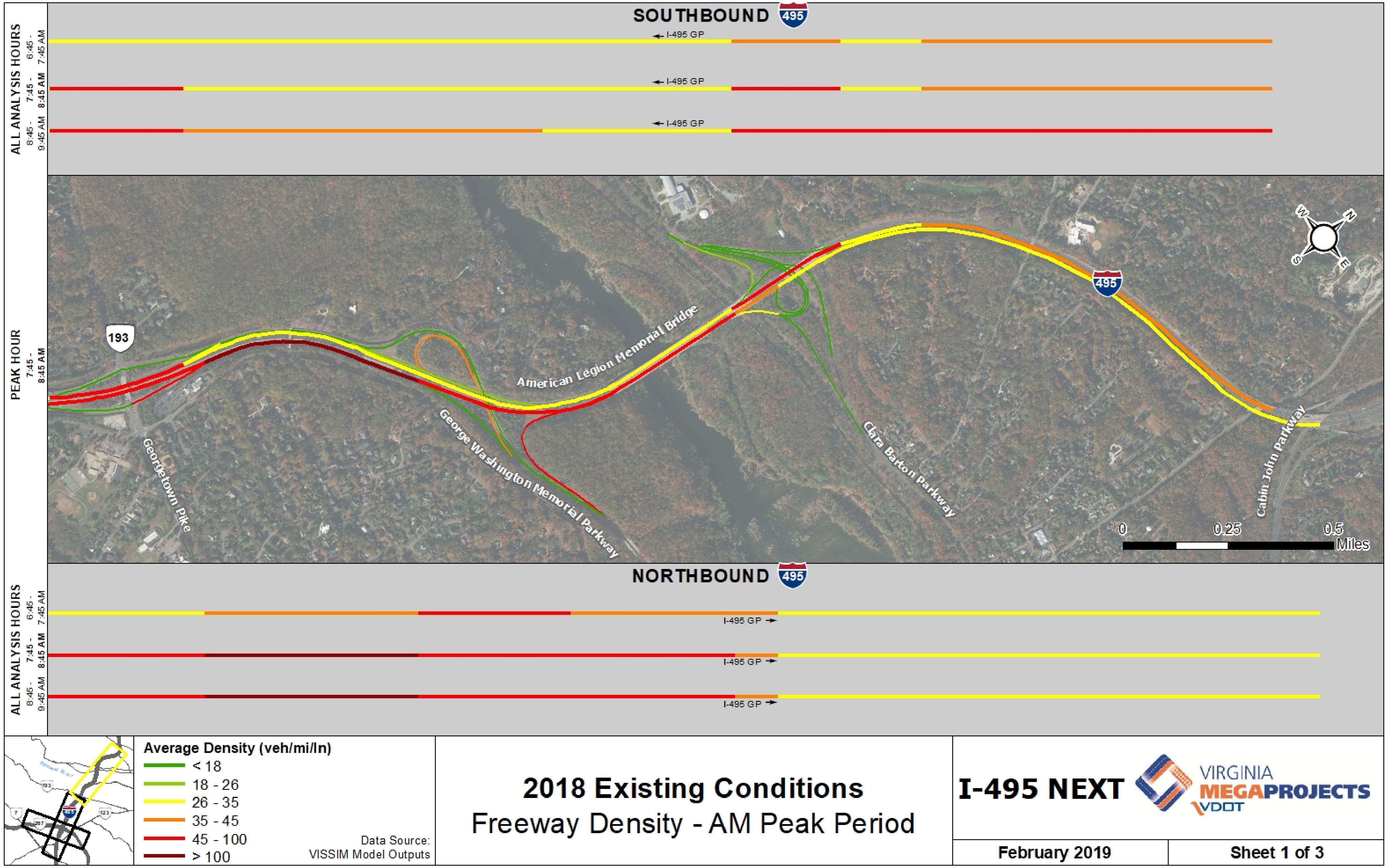


Exhibit 4-6a. I-495 AM Peak Period Average Densities – Georgetown Pike to Northern Terminus

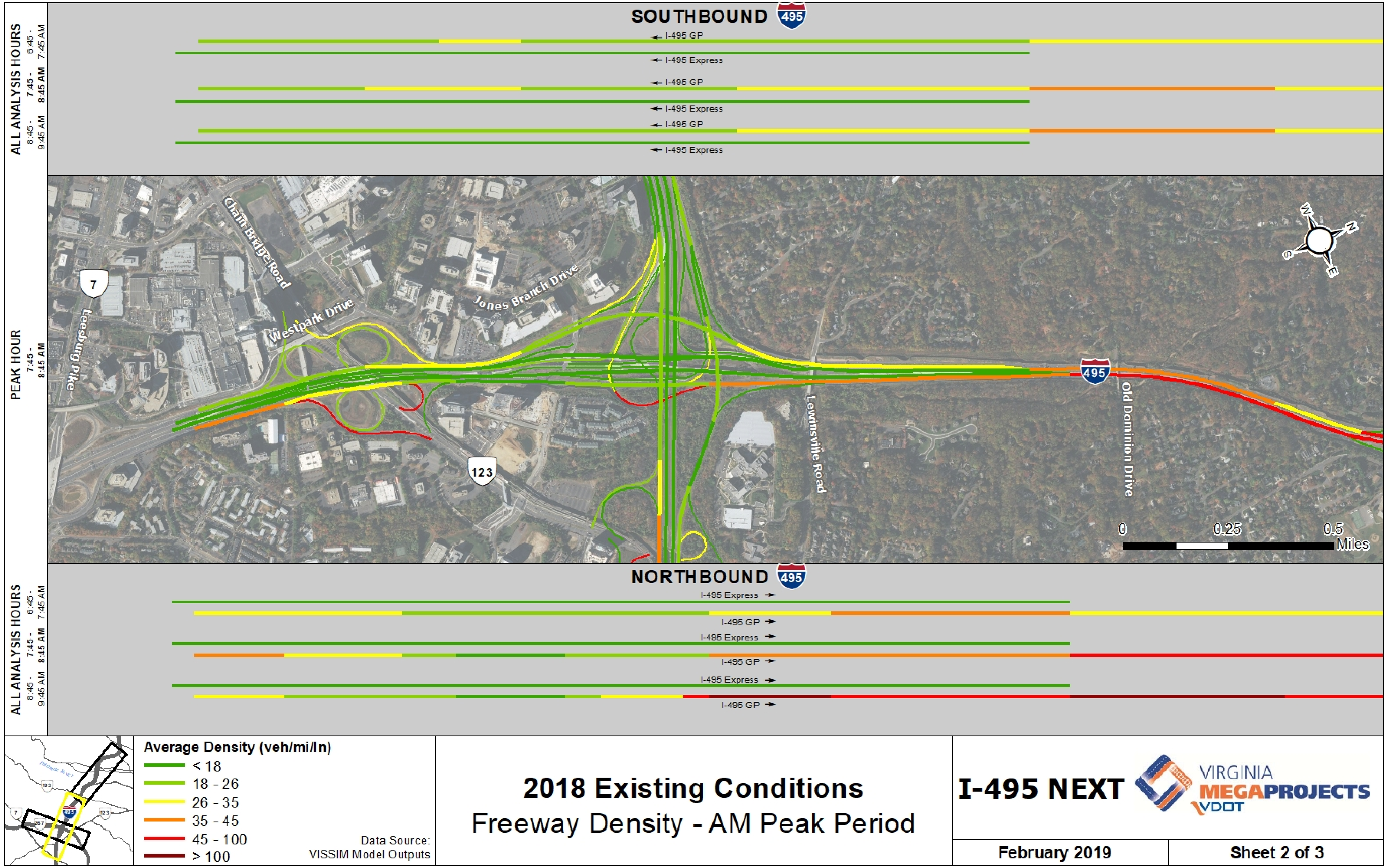


Exhibit 4-6b. I-495 AM Peak Period Average Densities – Southern Terminus through Old Dominion Drive

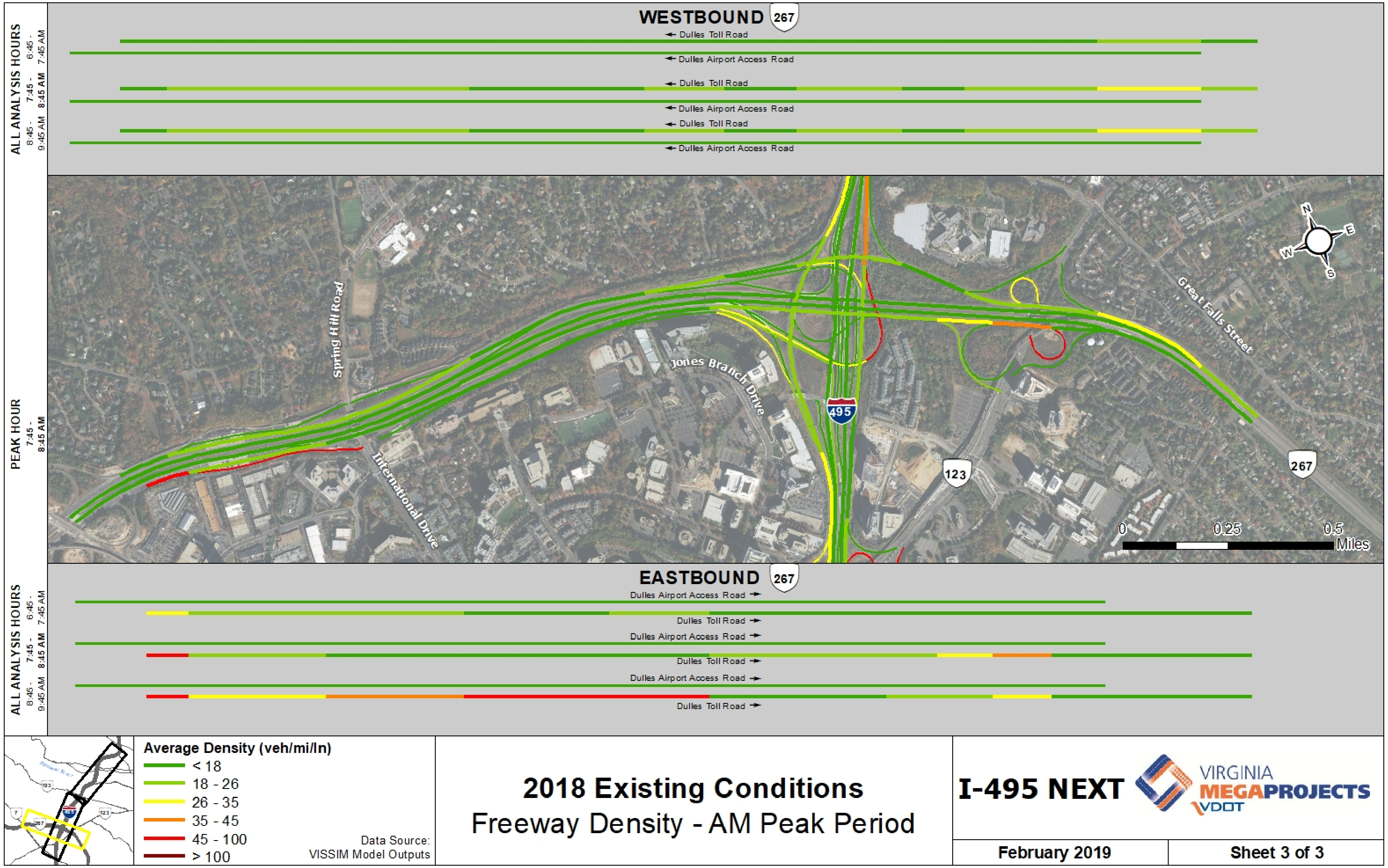


Exhibit 4-6c. Route 267 AM Peak Period Average Densities

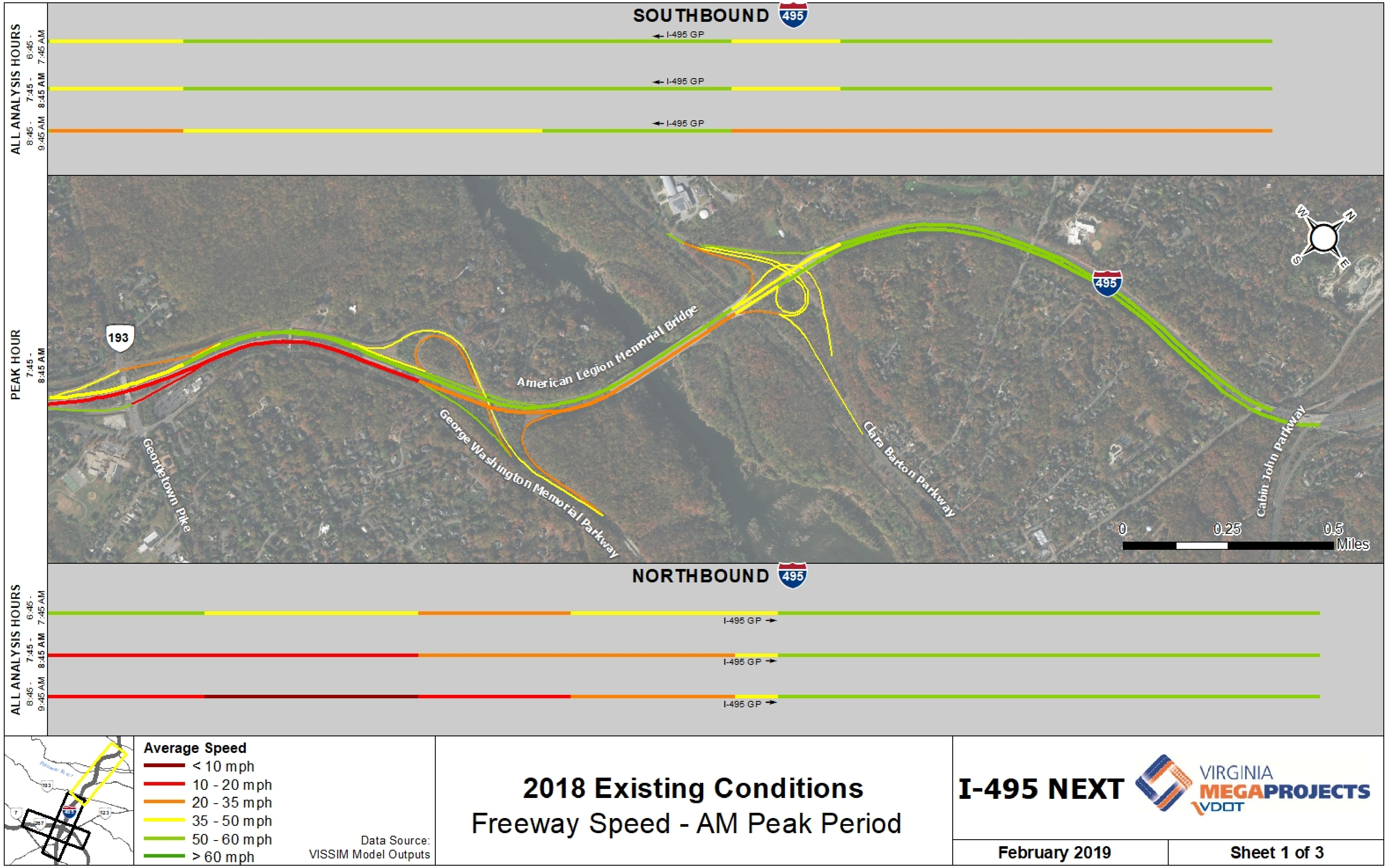


Exhibit 4-7a. I-495 AM Peak Period Average Speeds – Georgetown Pike to Northern Terminus

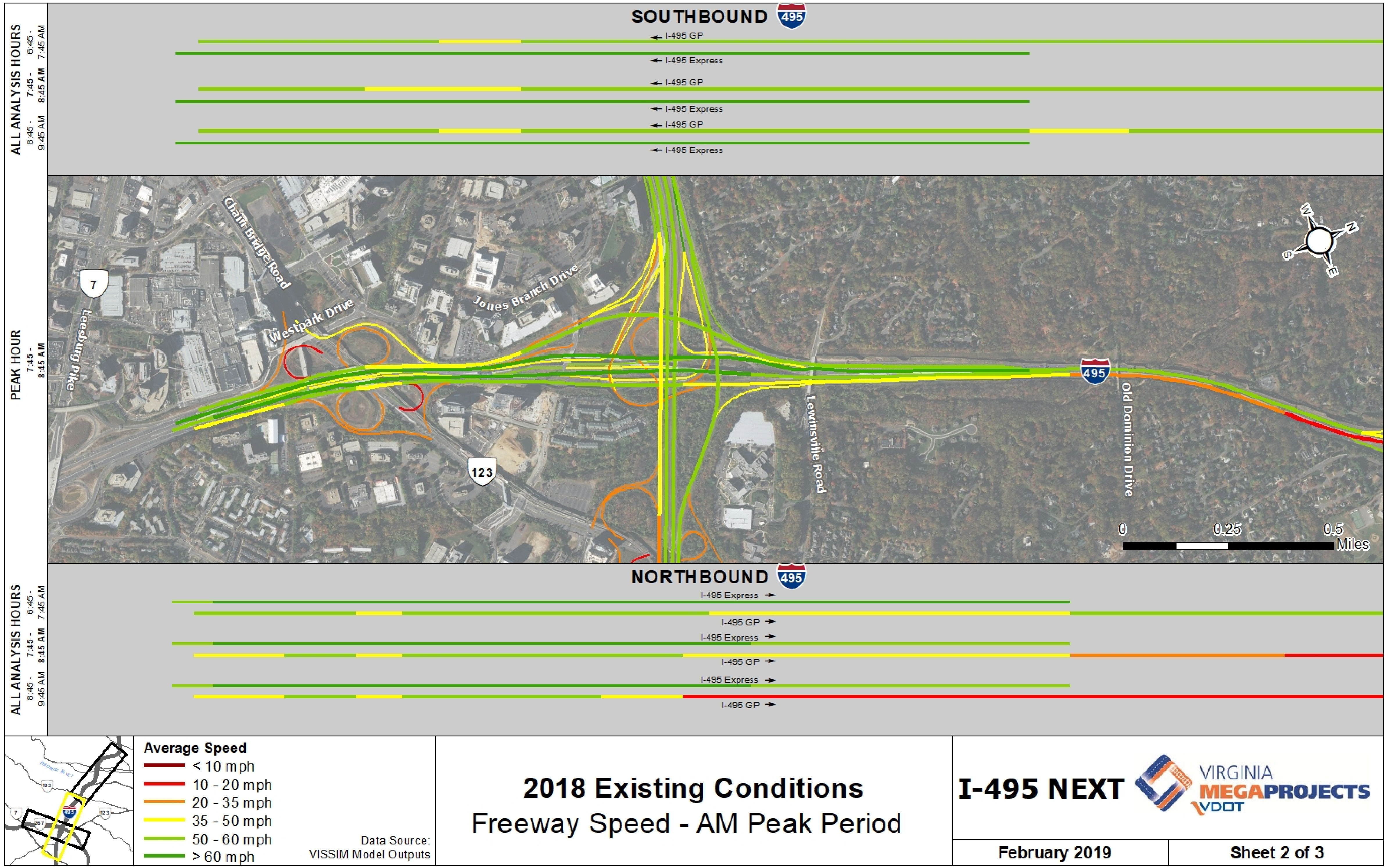


Exhibit 4-7b. I-495 AM Peak Period Average Speeds – Southern Terminus through Old Dominion Drive

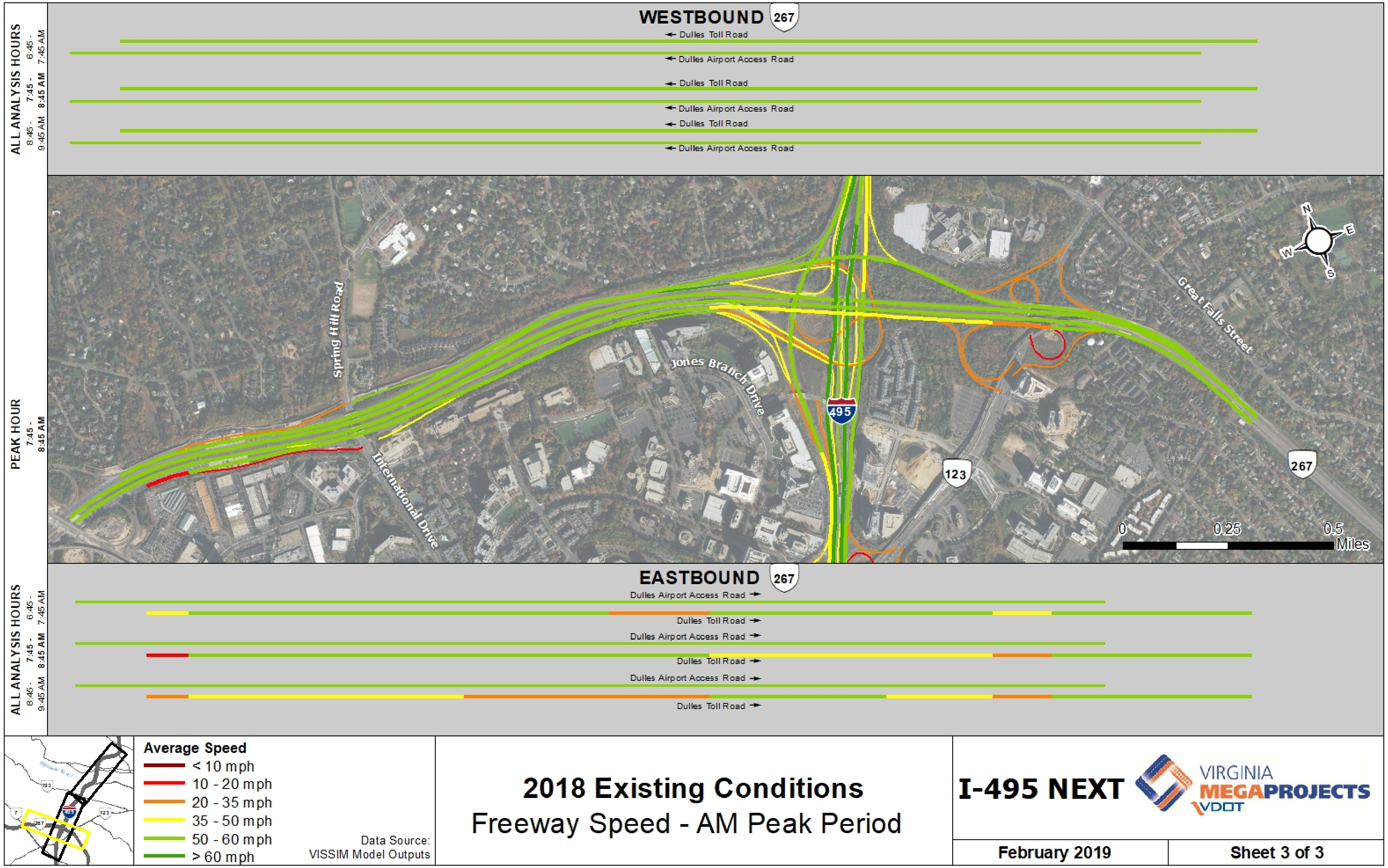


Exhibit 4-7c. Route 267 AM Peak Period Average Speeds

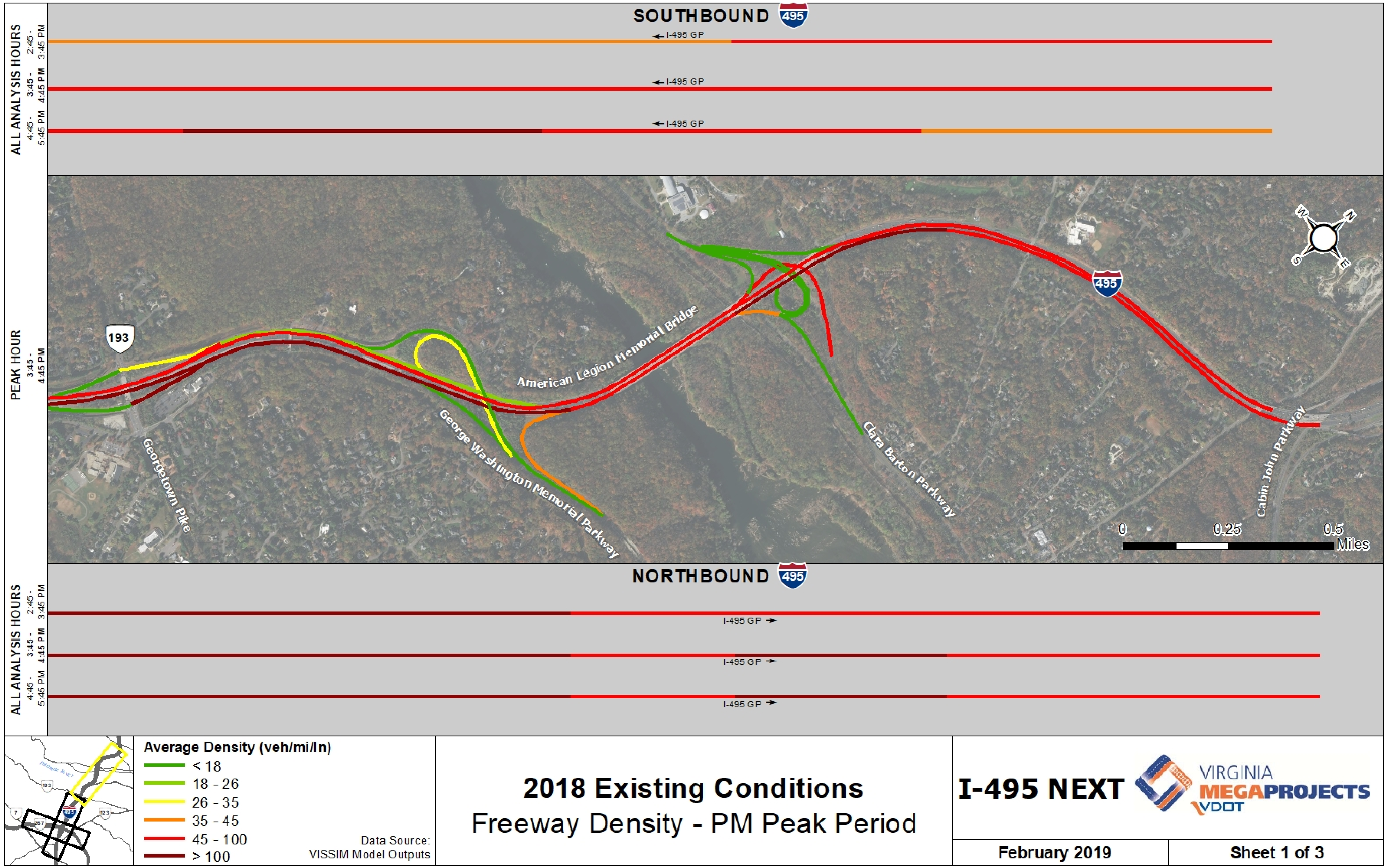


Exhibit 4-8a. I-495 PM Peak Period Average Densities – Georgetown Pike to Northern Terminus

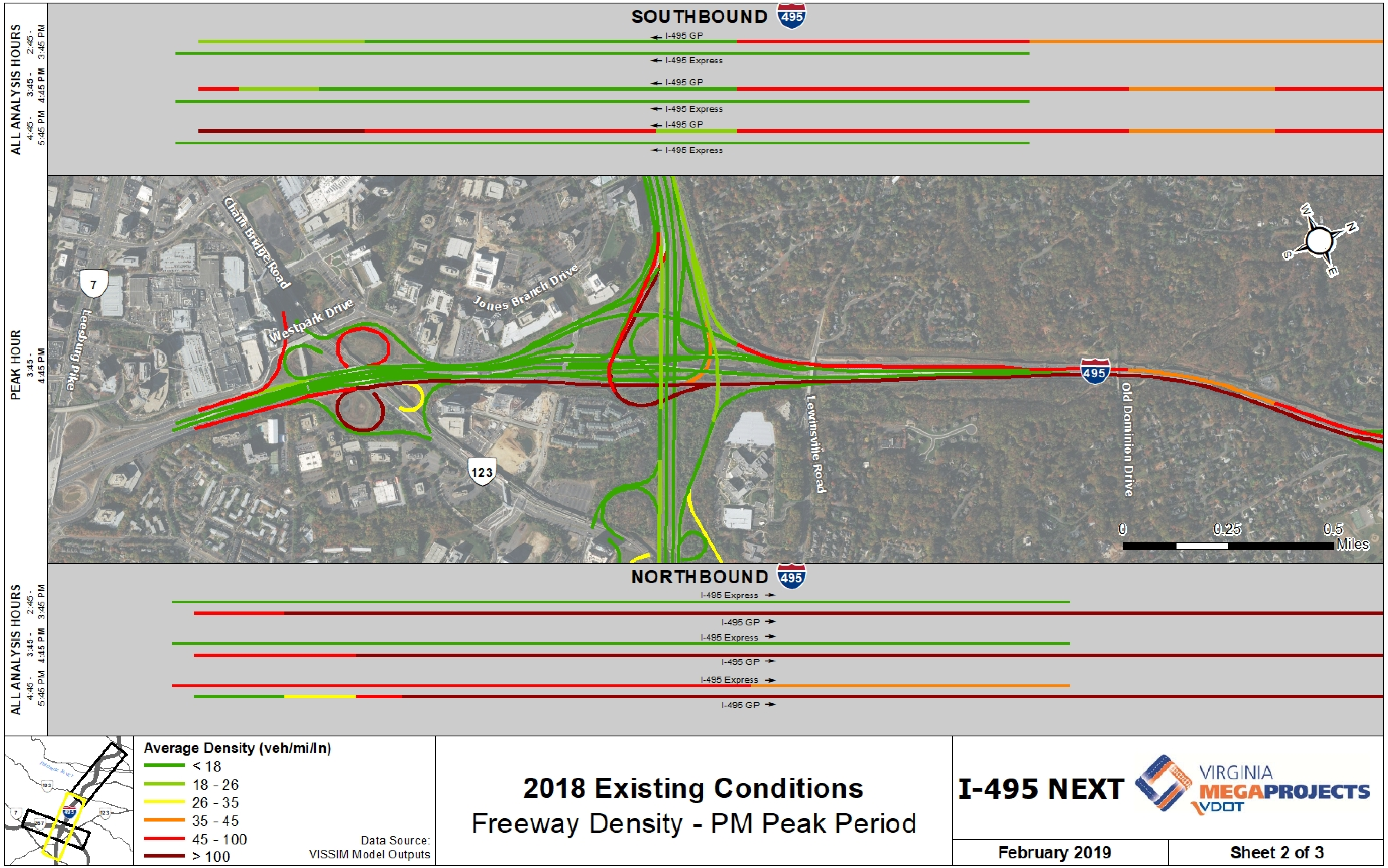


Exhibit 4-8b. I-495 PM Peak Period Average Densities – Southern Terminus through Old Dominion Drive

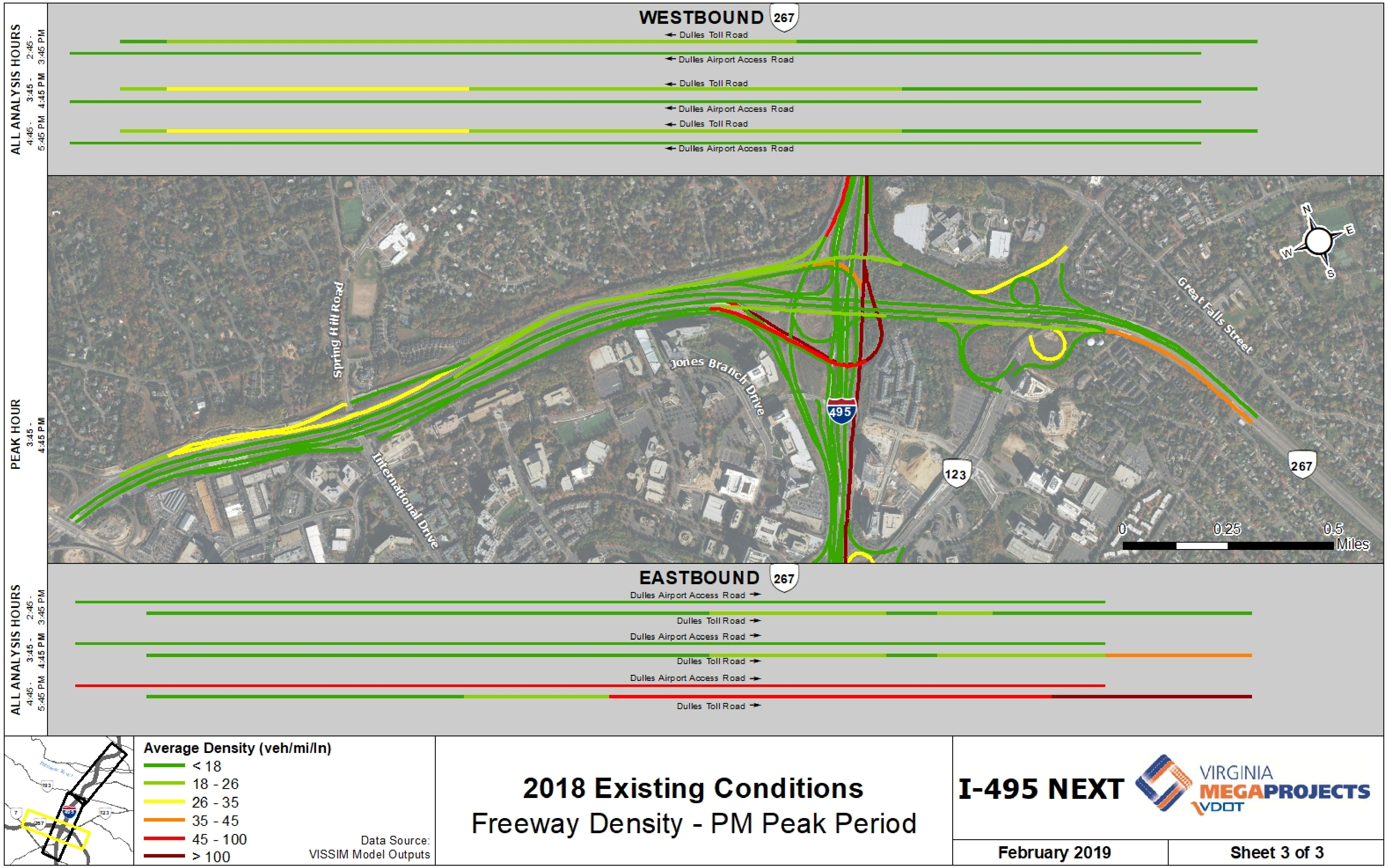


Exhibit 4-8c. Route 267 PM Peak Period Average Densities

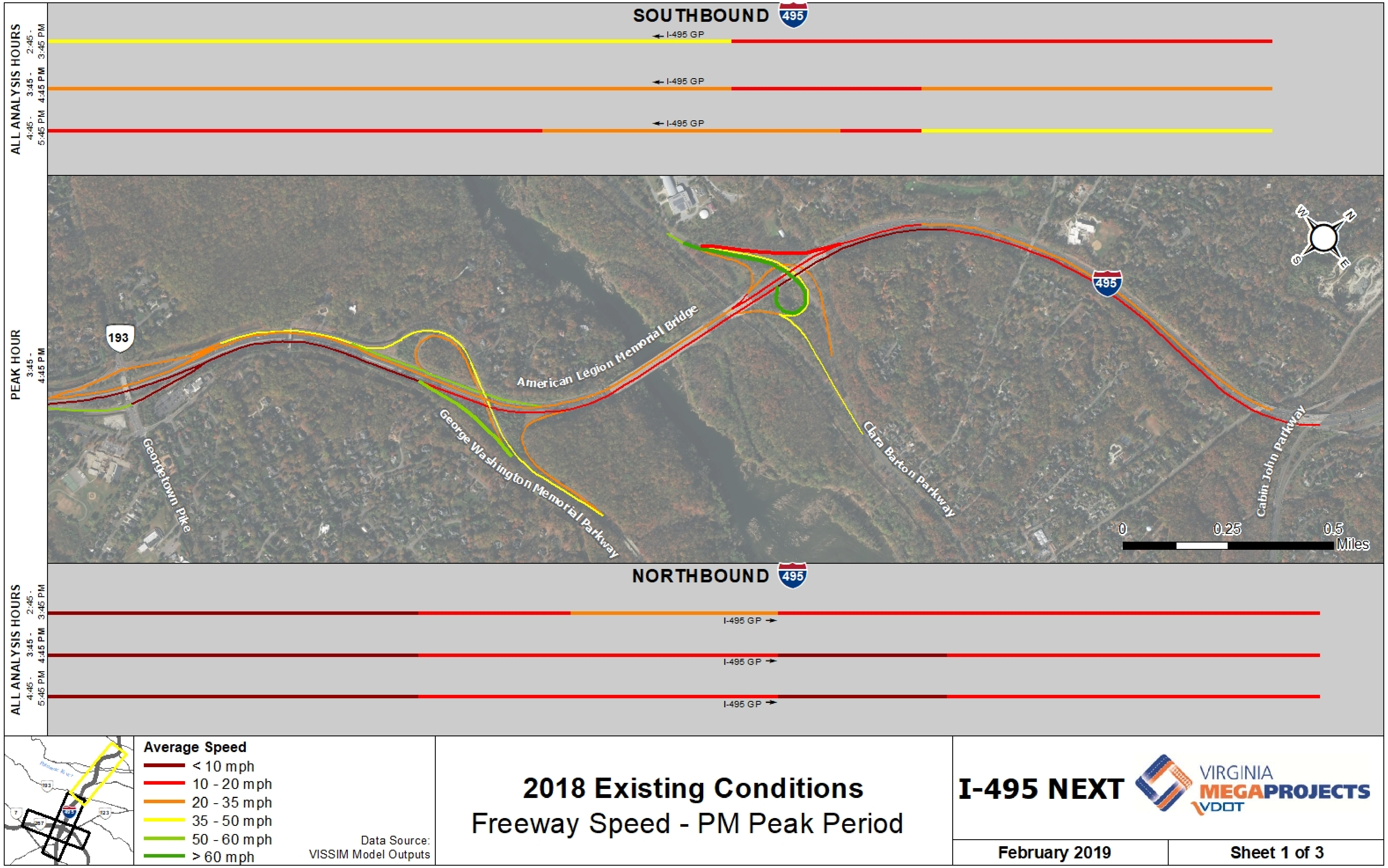


Exhibit 4-9a. I-495 PM Peak Period Average Speeds – Georgetown Pike to Northern Terminus

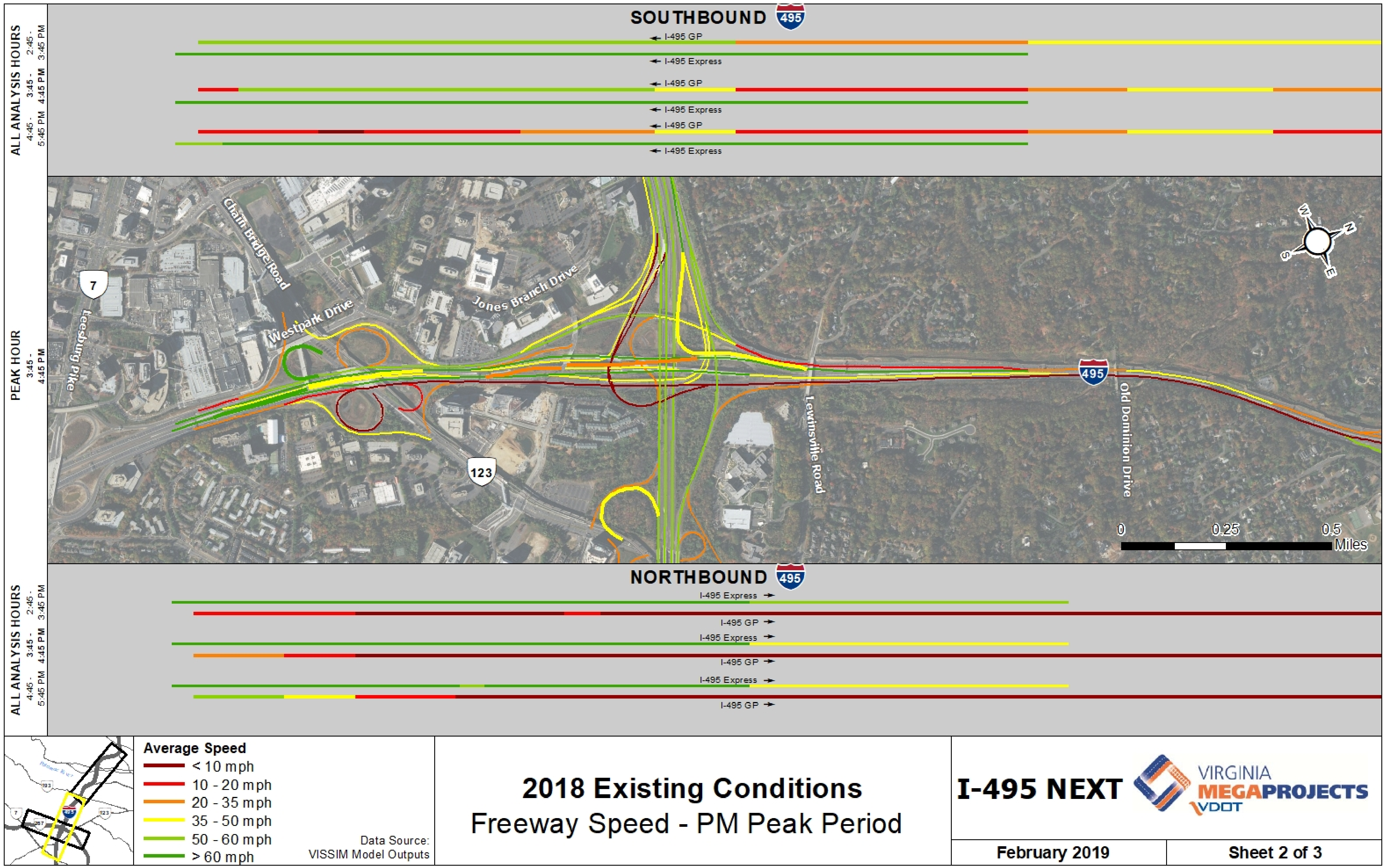


Exhibit 4-9b. I-495 PM Peak Period Average Speeds – Southern Terminus through Old Dominion Drive

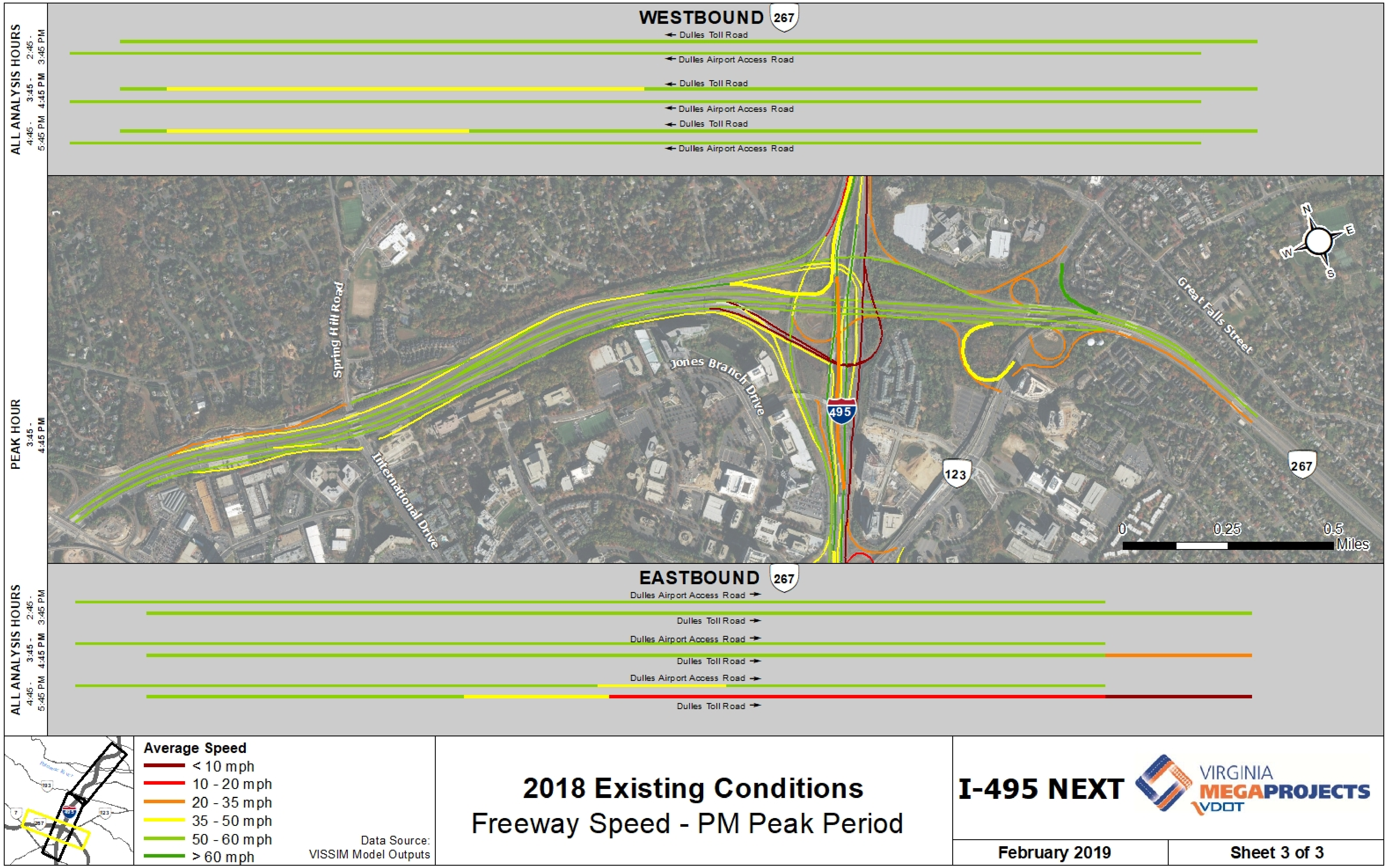


Exhibit 4-9c. Route 267 PM Peak Period Average Speeds

CHAPTER 5.0 BACKGROUND (NO BUILD) TRANSPORTATION NETWORK

This chapter details assumptions for background improvements to the transportation network included as elements of future No Build conditions, including recent improvements and future planned projects. Notable regional projects outside of the project study area that impact travel patterns within the study area are also included.

5.1 RECENT AND PLANNED IMPROVEMENTS IN FAIRFAX COUNTY

5.1.1 Jones Branch Connector/Scotts Crossing Road

At the time of the project existing conditions analysis (2018), the Jones Branch Connector carried traffic between Jones Branch Drive and the I-495 Express Lanes ramps, with an extension under construction to connect across I-495 to the east and meet Route 123 via a signalized intersection. This connection is now open and it provides an alternative east-west route between Route 123 and points in Tysons west of I-495, bypassing the I-495/Route 123 interchange. This extension is four lanes (two through lanes in each direction) and is referred to as Scotts Crossing Road. The signalized intersection with the I-495 Express Lanes ramps has been reconfigured to accommodate this new access to and from the east. **Figure 5-1** provides a map and concept for the Jones Branch Connector / Scotts Crossing Road project (Fairfax County, 2018).

Note that between the signal for the I-495 Express Lanes ramps and the signal where Scotts Crossing Road meets Route 123, two new signalized intersections are being constructed. These new signalized intersections provide access to existing and planned future developments, including the Capital One headquarters complex to the south of Scotts Crossing Road and west of Route 123. These two intersections have been included in all future traffic analysis scenarios; traffic volumes assumed for trips in and out of the Capital One complex have been developed in coordination with Fairfax County. These improvements are all assumed to be in place by 2025.

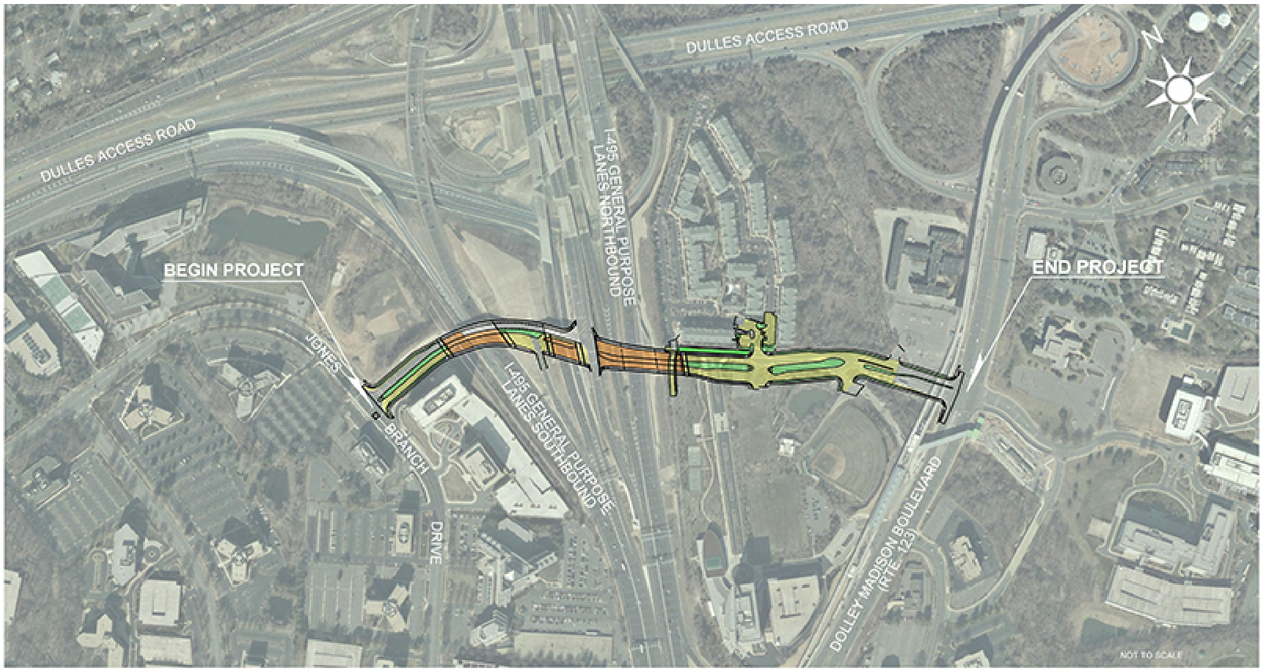


Figure 5-1. Jones Branch Connector Project (source: Fairfax County)

5.1.2 Planned Spot Improvements in Study Area

- **Balls Hill Road and Route 193 (Georgetown Pike)** – at the current signalized intersection of Balls Hill Road and Georgetown Pike, VDOT, in coordination with Fairfax County, recently completed the implementation of geometric and signal improvements to address capacity constraints (WSP USA, 2019). A dedicated northbound left-turn lane has been provided, and new signal heads have been installed to allow for eight-phase operations at the traffic signal. **Figure 5-2** provides a concept for these intersection improvements. These improvements are assumed to be in place by 2025.
- **All-electronic tolling at Dulles Toll Road main toll plaza** – removal of the main toll plaza; to be replaced by gantries allowing all traffic to pass through without slowing down (speed limit posted at 55 mph). This improvement is assumed to be in place by 2045 but not in place for 2025.

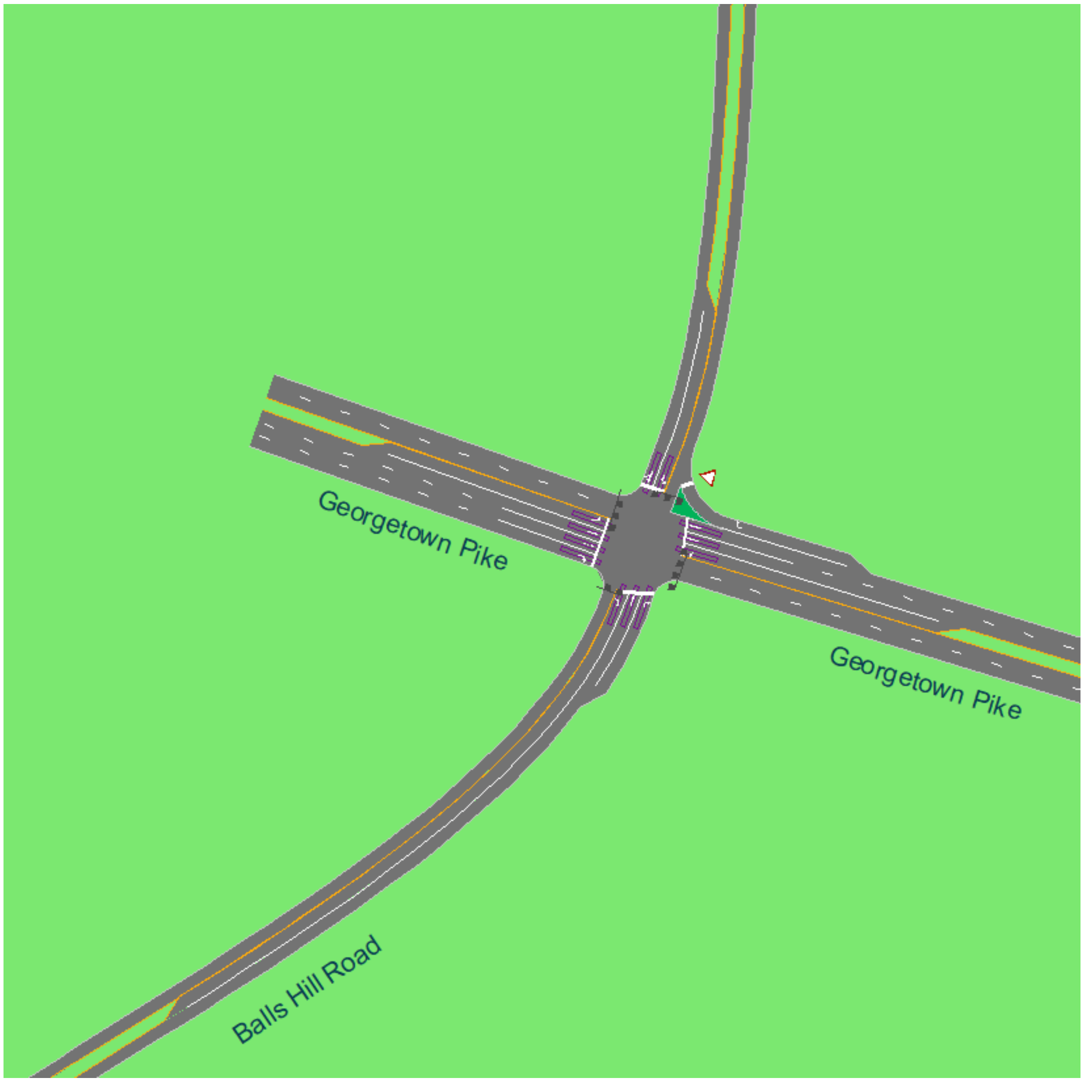


Figure 5-2. Georgetown Pike and Balls Hill Road Lane Configuration (source: WSP)

5.2 MARYLAND TRAFFIC RELIEF PLAN (TRP) AND I-495/I-270 P3 PROGRAM

The Maryland Department of Transportation State Highway Administration's (MDOT SHA) TRP was announced in 2017 by Maryland's Governor Larry Hogan. The TRP is a planned private-public partnership aimed at mitigating congestion along Maryland's most congested roads. The largest initiative in the TRP evaluates improvements for the I-495 and I-270 corridors in the Washington, DC, region.

The TRP is comprised of three parts which are outlined in MDOT SHA's Fact Sheet (MD SHA, 2017) found on their website. Part I, the most pertinent to the I-495 NEXT project, plans to add capacity to the Capital Beltway between the ALMB and Woodrow Wilson Bridge (the length of I-495 in Maryland). As part of that plan, I-495 will have managed lanes added for its entire length Maryland. This will include the area directly north of the proposed study area. **Figure 5-3** provides a map of the Maryland TRP and shows its adjacency to the VDOT I-495 NEXT project.

The Maryland TRP is included within the overall Regional Constrained Long-Range Plan (CLRP), which is discussed in further detail in the next section. Significant coordination between VDOT and MDOT has occurred throughout the planning process for the I-495 NEXT project to maintain consistency with elements of the TRP in the I-495 NEXT transportation operations analysis study area. These elements include the following:

- Two managed lanes in each direction over the ALMB and along I-495 into Maryland through the northern extents of the transportation operations analysis study area (just south of Cabin John Parkway / River Road).
- Connections between the Maryland managed lanes system and the GWMP, including a ramp from the southbound Maryland managed lanes to GWMP eastbound (inbound) and from GWMP westbound (outbound) to the northbound Maryland managed lanes.
- In the I-495 NEXT project No Build scenario, the Maryland managed lanes are assumed to terminate just south of the ALMB in Virginia in the vicinity of the GWMP interchange. **Exhibit 5-1** provides a concept for how this terminus would potentially be configured:
    - In the northbound direction, a left-side slip ramp from the GP lanes would be provided to develop one of the two northbound managed lanes into Maryland; the second northbound managed lane would be provided by the on-ramp from the GWMP westbound.
    - In the southbound direction, the two managed lanes leaving Maryland would split, with one lane becoming the off-ramp to the GWMP eastbound and the other lane merging into the I-495 southbound GP lanes.

Note that in the I-495 Project NEXT Build scenario, described in the next chapter, the Maryland managed lanes and Virginia Express Lanes form a continuous, seamless system through the study area with two barrier-separated lanes in each direction. In the Project NEXT No Build condition, the Maryland managed lanes system is assumed to be in place, leaving a gap section without Express Lanes between the Dulles Toll Road and the ALMB.

Within the Maryland managed lanes system in the traffic operations analysis study area, no further connections with the GP lanes or arterial network are assumed (e.g. no Express connections to or from Clara Barton Parkway). All connections to or from the managed lanes in Maryland are assumed to be located north of and outside the I-495 NEXT traffic operations analysis study area.

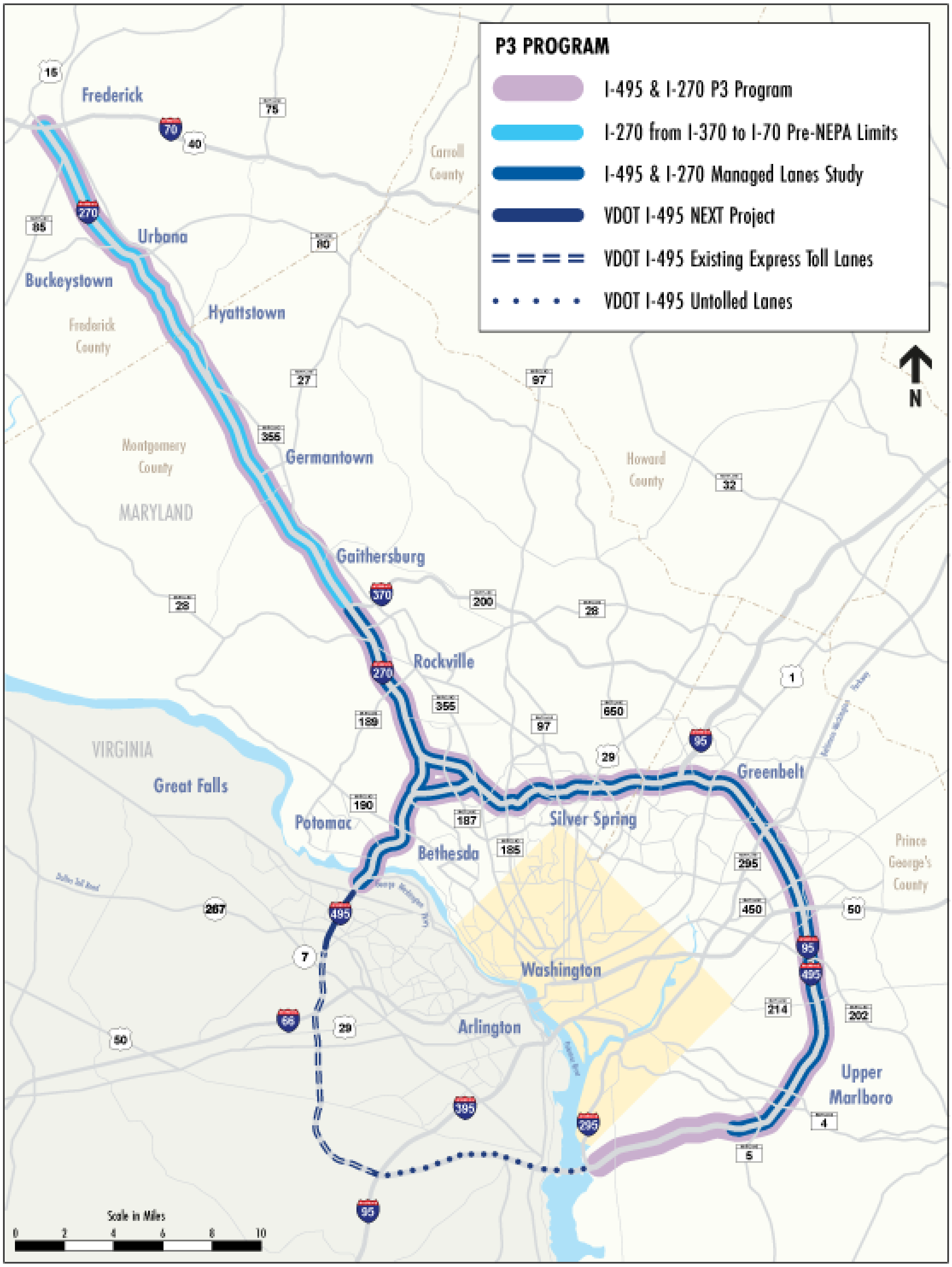


Figure 5-3. Maryland Traffic Relief Program

5.3 REGIONAL CONSTRAINED LONG-RANGE PLAN (CLRP): VISUALIZE 2045

Visualize 2045 is the federally-mandated constrained long-range transportation plan (CLRP) for the National Capital Region (NCR) (MWCOG, 2018). It identifies all regionally significant transportation investments planned through 2045. It was developed by the Transportation Planning Board (TPB) at MWCOG and was approved on October 17, 2018. Per federal NEPA regulations, all regional transportation projects included in the CLRP are included as background projects for I-495 Project NEXT, including incorporation in project travel demand models and traffic analysis simulation models where appropriate.

5.3.1 Route 123 Widening

Route 123 is programmed in the CLRP to be widened to four through lanes in each direction between Route 7 and I-495. This project is assumed to be in place for both 2025 and 2045 conditions. No widening is currently programmed along Route 123 east of I-495.

5.3.2 Dulles Interchange Master Plan

In 2009, while construction was underway for the I-495 Express Lanes, the Metropolitan Washington Airports Authority (MWAA) developed the Dulles Interchange Long-Range Plan for the I-495/Route 267 interchange to determine what, if any, changes to the then-current plan for the interchange under the I-495 Express Lanes project may be necessary to accommodate other future interchange improvements. The Long-Range Plan determined that up to 11 additional ramp movements would be necessary to improve I-495 connections to and from the DAAR and DTR. VDOT in partnership with MWAA signed a Memorandum of Understanding (MOA) in May 2009 to incorporate three of these additional ramps into the I-495 Express Lanes project. Specifically, these ramps provided movements for southbound I-495 GP Lanes to westbound DAAR; eastbound DAAR to southbound I-495 GP; and eastbound DAAR to northbound I-495 GP (VDOT/MWAA, 2009). A NEPA Re-evaluation of the Capital Beltway Study EIS was conducted, and the additional ramps were found to be consistent with the findings of the Final EIS (FHWA, 2009). An IJR for the Dulles Interchange was prepared and approved in December 2009 (VDOT, 2009). The ramps were constructed as part of the I-495 Express Lanes project and opened to traffic in September 2012.

The Dulles Interchange Master Plan, which is included in the regional CLRP, contains a series of proposed improvements to the I-495/Route 267 interchange. This plan includes the following elements to be constructed independent of I-495 Project NEXT:

- **New direct ramp connections**, including the following:
  - I-495 northbound GP lanes to westbound Dulles Airport Access Road (DAAR)
  - I-495 southbound GP lanes to westbound DAAR
- **New right-side flyover ramp from I-495 northbound GP lanes to westbound Dulles Toll Road**, eliminating the existing left-side ramp from I-495 northbound GP.
- **Capacity enhancements to ramp from eastbound Dulles Toll Road to I-495 northbound GP lanes** – widening this ramp to two lanes until it joins the I-495 mainline, at which point the two lanes merge into a single auxiliary lane.
- **Auxiliary lanes along I-495 north of Dulles Interchange** – an auxiliary lane will be provided in each direction between the Dulles Interchange and Georgetown Pike to improve the capacity of the GP lanes. The northbound auxiliary lane is assumed to be in place by 2025 while the southbound auxiliary lane is assumed to be in place by 2045.

- **C-D road system along I-495 between Route 123 and Dulles Interchange** – due to the short weaving areas between these two interchanges, a C-D road system is included within the Dulles Interchange Master Plan to improve capacity and reduce conflicting movements. Note that under Project NEXT No Build conditions, a C-D road is only shown for southbound I-495. These improvements are assumed to be in place by 2045.
- **C-D road system along Dulles Toll Road between Route 123 and Dulles Interchange** – due to the short weaving areas between these two interchanges, an eastbound C-D road system along the Dulles Toll Road is included within the Dulles Interchange Master Plan to improve capacity and reduce conflicting movements. These improvements are assumed to be in place by 2045.

Exhibits 5-2a through **5-2c** provide a concept for the Dulles Interchange assumed for I-495 NEXT No Build conditions for 2045. Note that the I-495 NEXT Build concept relocates and reconfigures several of these ramp connections.

5.3.3 Maryland Managed Lanes System

As noted in **Section 5.2**, as part of the Maryland TRP, managed lanes across the ALMB and in Maryland are assumed to be in place as a background project, as the TRP is contained within the regional CLRP. This includes north-facing managed lanes ramp connections at the GWMP interchange (westbound GWMP to northbound I-495 Maryland managed lanes and southbound I-495 Maryland managed lanes to eastbound GWMP).

To understand the impacts and operational benefits or constraints of Project NEXT operations prior to the Maryland managed lanes system being in place, a sensitivity analysis was performed for the 2025 analysis year. This sensitivity analysis included travel demand model runs, traffic volume forecasting, and traffic operations analysis in VISSIM and Synchro. The results of this sensitivity analysis are provided in **Appendix I.**

5.3.4 Dulles Toll Road and Tysons Improvements

Separate from the Dulles Interchange Master Plan improvements, the CLRP includes improvements to the west of the I-495/Route 267 interchange along the Dulles Toll Road to improve connectivity to Tysons. While Fairfax County is still determining which specific improvements will be implemented, upon coordination with the County, the following improvements were assumed and incorporated into the Project NEXT travel demand forecast models and traffic microsimulation models (where appropriate):

- New urban frontage road system along the Dulles Toll Road between Route 7 and Spring Hill Road. The east-facing ramps for this C-D road (eastbound on-ramp and westbound off-ramp) have been included in the microsimulation models.
- Two new connections from this C-D road to Tysons connecting to Tyco Road between Route 7 and Spring Hill Road. These connections are expected to relieve congestion at the Spring Hill Road interchange, especially the west-facing ramps (eastbound Dulles Toll Road to Spring Hill Road and Spring Hill Road to westbound Dulles Toll Road).

Exhibit 5-3 provides a VISSIM screen capture of the urban frontage road concept that was incorporated into the traffic analysis for I-495 NEXT. Note that in the CLRP, a connection to the east of Spring Hill Road providing direct access from the Dulles Toll Road to Jones Branch Drive is also noted. However, upon coordination with Fairfax County and noting the proximity to the I-495/Route 267 interchange, this improvement was not included as a background project.

These improvements along the Dulles Toll Road are not included for I-495 Project NEXT No Build conditions for 2025 but are included for 2045.

5.3.5 Transform I-66

The Transform I-66 project is located entirely outside of the project traffic operations analysis study area but is anticipated to impact travel within the study area. The following elements of the Transform I-66 project are noted:

- **Inside the Beltway** – east of I-495, I-66 was changed in 2017 to operate as an Express facility (only toll-paying and HOV-3 vehicles, which may ride free) across all lanes in the eastbound direction during the AM peak (5:30-9:30 AM) and westbound direction during the PM peak (3:00-7:00 PM) (VDOT, 2019d).
    - By 2025, I-66 eastbound will be widened to have a third through lane between the Dulles Connector Road and Glebe Road (VDOT, 2019e), improving eastbound capacity and ideally reducing queue spillback onto the Dulles Connector Road, which currently spills back into the project traffic operations analysis study area during the AM and PM peak periods.
    - By 2045, both I-66 eastbound and westbound are assumed to be operated as an Express facility in both directions during both peak periods according to the CLRP.
- **Outside the Beltway** – west of I-66 and including the I-66/I-495 interchange, I-66 is currently being reconstructed and widened to consist of three GP lanes and two Express Lanes in each direction (VDOT, 2019f). Several interchanges are being reconstructed to improve capacity, and an additional auxiliary GP lane is provided between most interchanges. The project will also feature new and improved bus service and transit routes, coupled with new and expanded park-and-ride lots to access the Express Lanes including more than 4,000 new park-and-ride spaces. Consistent with the regional Express network along I-495, I-95/I-395, and I-66 Inside the Beltway, the I-66 Express Lanes system will be free to HOV-3 vehicles (using an EZ-Pass transponder switched to "HOV-3" mode) and also allow toll-paying vehicles. This project, which is anticipated to be in place and operating prior to 2025, is anticipated to increase the capacity of I-66, impacting travel demand along I-495 as well.

5.4 STATEWIDE LONG-RANGE PLAN (VTRANS)

VTrans is Virginia's multimodal transportation plan developed by the Commonwealth Transportation Board (CTB) every four years. VTrans lays out the overarching vision and goals for transportation in the Commonwealth, identifies transportation investment priorities, and provides direction on implementation strategies and programs to the CTB and agencies such as VDOT. This plan is mandated both federally and at the state level and is used to guide investment decisions such as the Six Year Improvement Program (SYIP), including the SMART SCALE funding program.

The most recent edition of VTrans, VTrans 2040, was completed in January 2018 (Virginia OIPI, 2018). VTrans 2040 is comprised of a Vision Plan and Needs Assessment. The Needs Assessment is further comprised of the following:

- Corridor of Statewide Significance (CoSS) Needs Assessment
- Regional Network Needs Assessment
- Urban Development Area Needs Assessment

- Statewide Safety Needs Assessment

VTrans2040 also includes a set of recommendations highlighting critical projects for the next 10 years that address the VTrans vision, goals, and objectives within Virginia's most significant transportation needs. These recommendations are broken down to the project level. The recommendations included for Northern Virginia include several relevant background projects described in the previous sections including the funded Transform I-66 Inside and Outside the Beltway projects.

5.5 SUMMARY OF BACKGROUND TRANSPORTATION PROJECTS

Table 5-1 provides a summary of the projects previously described in this chapter, including anticipated project opening year. These projects have been included as background improvements for both No Build and Build conditions for I-495 Project NEXT traffic analysis. All projects noted for completion by 2025 are included as part of 2025 No Build conditions; otherwise, the improvements are only included for 2045 No Build conditions.

Table 5-1. Summary of Background Transportation Projects

Project	Description	Completion / Opening Year
Jones Branch Connector / Scotts Crossing Road Extension	Construction of a four-lane roadway across I-495 connecting to Route 123; includes expansion of traffic signal with I-495 Express Lanes ramps and new traffic signals east of I-495 and west of Route 123	2019
Transform I-66 Inside the Beltway: Eastbound Widening	Construction of additional eastbound lane along I-66 eastbound between Dulles Connector Road (Route 267) and Exit 71/Glebe Road (Route 120)	2021
Route 123 Widening	Widening of Route 123 between Route 7 and I-495 to four through lanes in each direction	2021
Georgetown Pike/Balls Hill Road Intersection Improvements	Dedicated northbound left-turn lane and updates to signal phasing	2019
Transform I-66 Outside the Beltway	Construction of two Express Lanes in each direction (along with three remaining GP lanes) between I-495 and University Boulevard; improved bus service and transit routes, including park-and-ride lot expansions; interchange improvements and auxiliary lanes between interchanges	2022
I-495 Managed Lanes in Maryland	Construction of two tolled lanes in each direction across the ALMB, around I-495 in Maryland, and along I-270. Includes north-facing ramp connections to GWMP (GWMP westbound to I-495 northbound managed lanes and I-495 southbound managed lanes to GWMP eastbound).	2025[i]

Project	Description	Completion / Opening Year
Dulles Interchange Master Plan	Construction of new direct access ramps from I-495 northbound and southbound GP lanes to DAAR westbound; reconstruction of several existing ramp movements at interchange including C-D roads along eastbound DTR and southbound I-495; auxiliary lanes along I-495 GP between Route 267 and Route 193	2030[ii]
Dulles Toll Road All-Electronic Tolling	Conversion to high-speed all-electronic tolling and removal of existing toll booths	2030
Dulles Toll Road Urban Frontage Road west of Spring Hill Road	Construction of two-lane frontage road outside of DTR mainline between Route 7 and Spring Hill Road; includes new direct connections from frontage road to Tyco Road	2037
Transform I-66 Inside the Beltway: Both Directions Express Lanes Operations	Both directions of I-66 east of I-495 operated as Express Lanes across all lanes (HOV-3 free with EZ-Pass switched to HOV-3 mode; tolled for all other vehicles) during both peak periods.	2040

[i] A sensitivity analysis has been conducted assessing the impacts of a No Build and Build condition for Project NEXT if the I-495 Maryland managed lanes system is not complete by 2025. This analysis is included as **Appendix I.**

[ii] I-495 northbound GP auxiliary lane between Route 267 and Route 193 assumed to be in place by 2025.

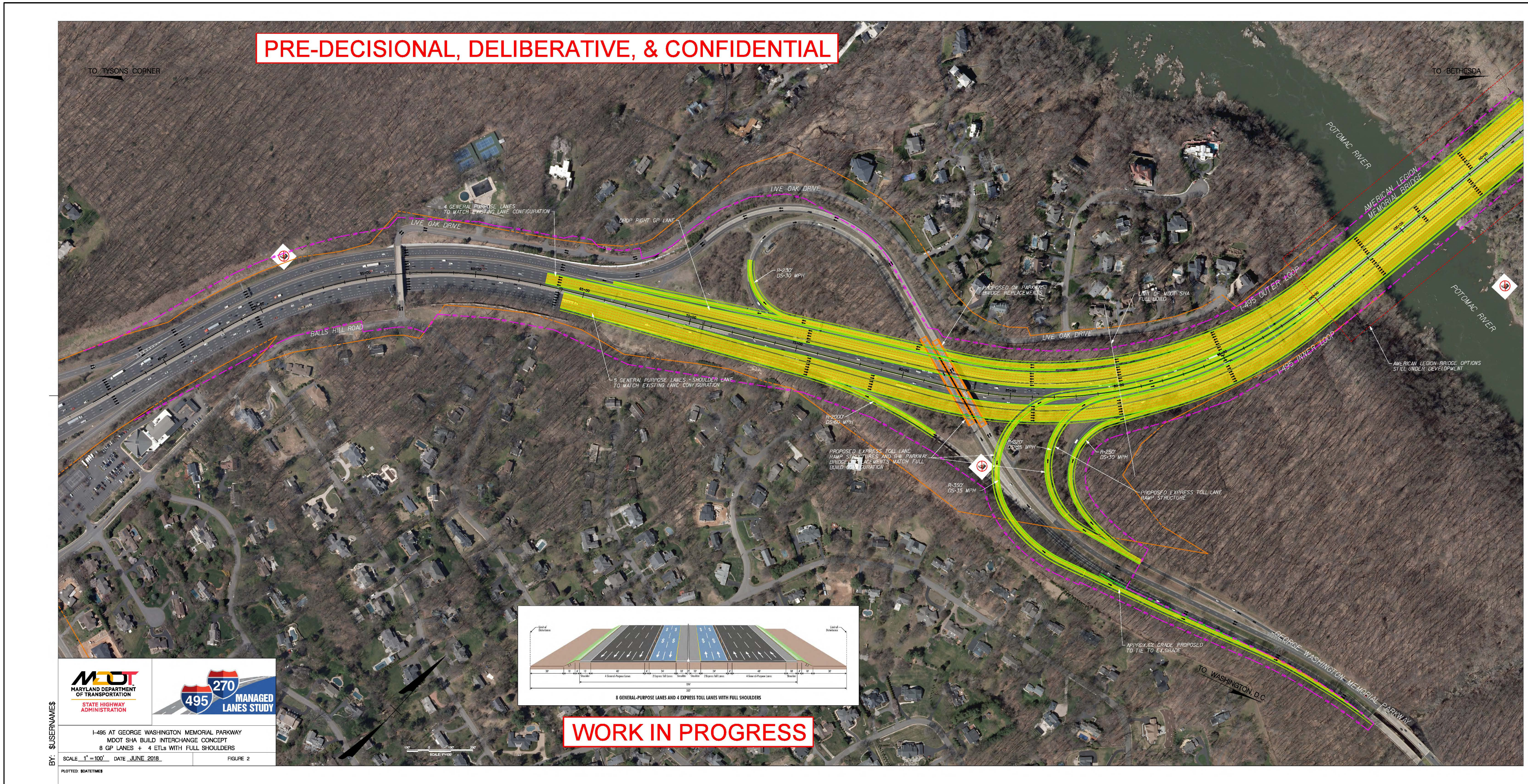


Exhibit 5-1. Project NEXT No-Build Geometry at GWMP Interchange and Maryland Express Lanes in Place

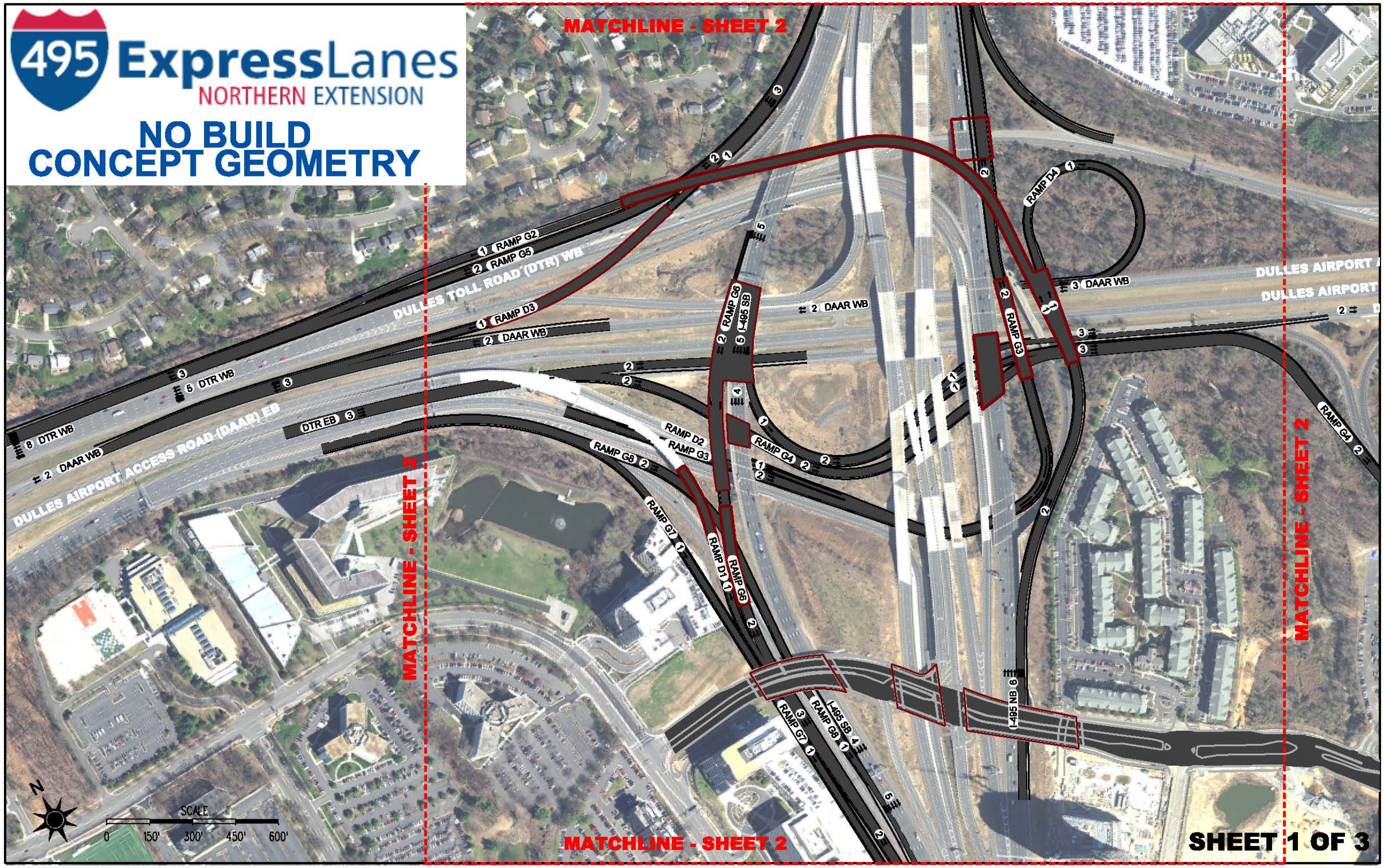


Exhibit 5-2a. Project NEXT No-Build Geometry at Route 267 Interchange (Sheet 1 of 3)

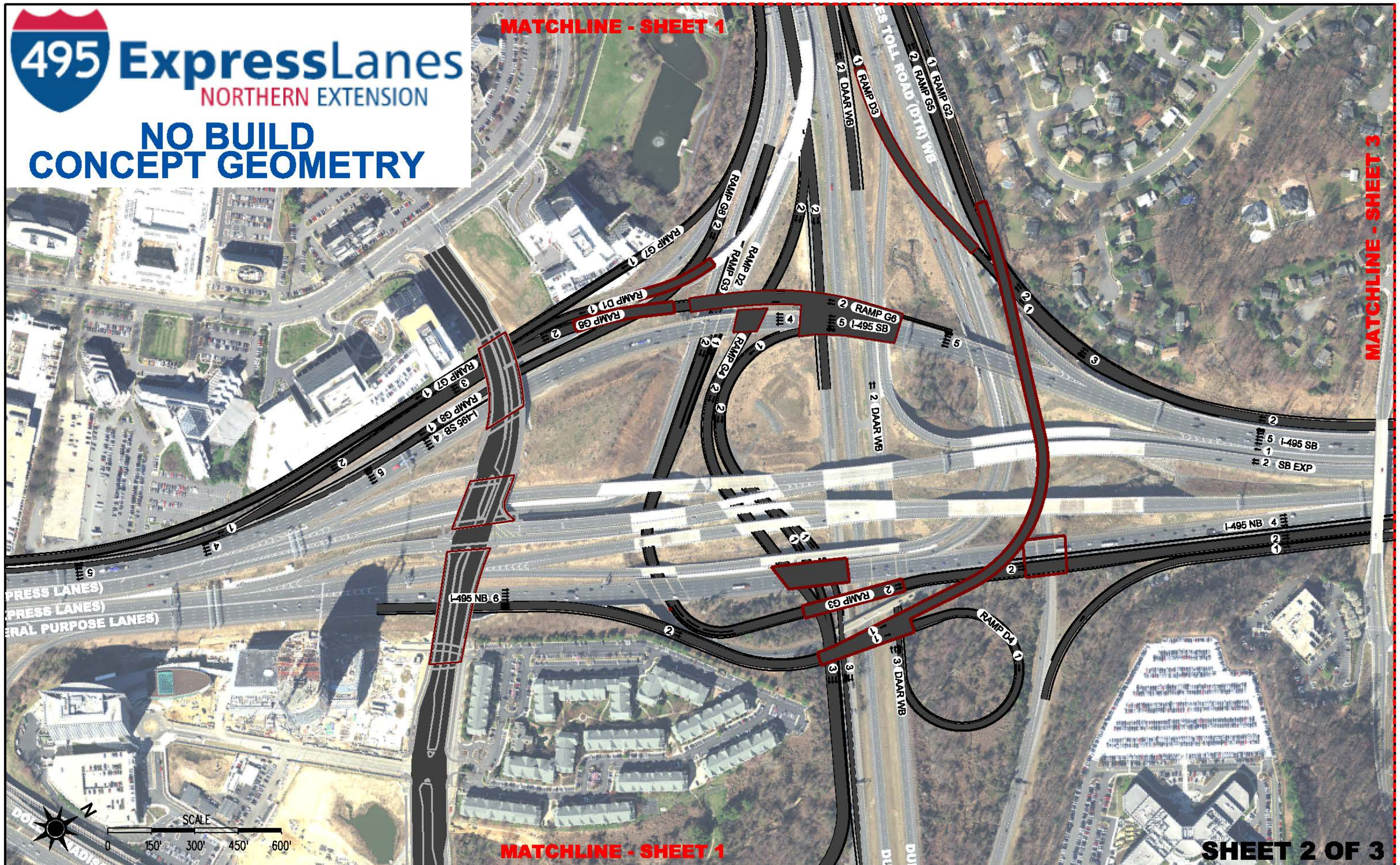


Exhibit 5-2b. Project NEXT No-Build Geometry at Route 267 Interchange (Sheet 2 of 3)

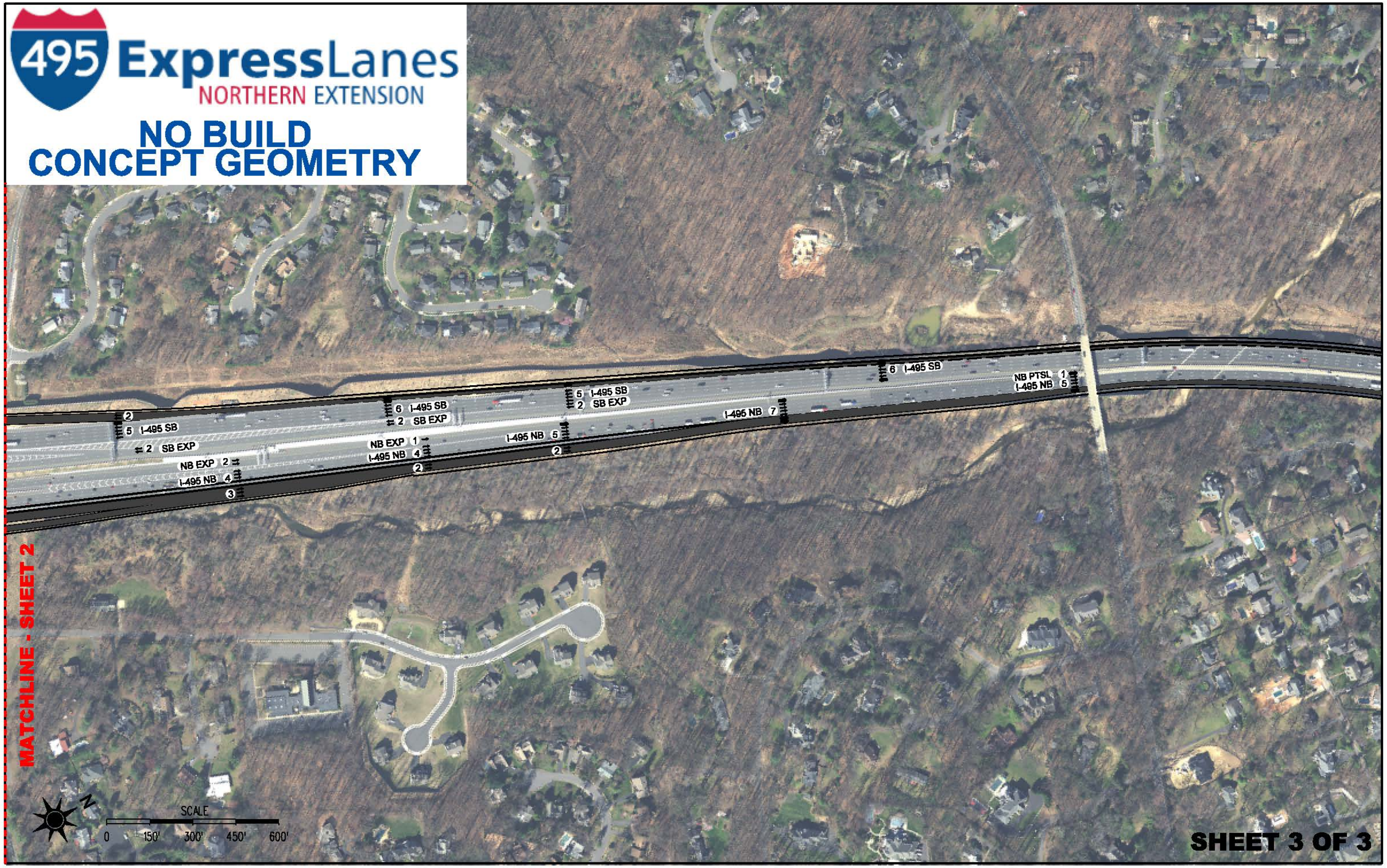


Exhibit 5-2c. Project NEXT No-Build Geometry at Route 267 Interchange (Sheet 3 of 3)

Exhibit 5-3. Route 267 Urban Frontage Road Concept (Assumed for Year 2045 Traffic Modeling and Analysis)

CHAPTER 6.0 BUILD TRANSPORTATION NETWORK

VDOT, in coordination with FHWA, local governments, regulatory agencies, and stakeholders considered a range of options that would reduce congestion, provide new travel choices, and improve travel reliability along I-495. These efforts resulted in the development of a single conceptual alternative (the Build Alternative) that includes extending the Express Lane system on I-495 north to the GWMP. The following factors were considered in the development of the alternative:

- The logical termini of the proposed project would connect with an existing Express Lane system to the south and a proposed Express Lane system to the north as programmed in the federally-approved 2045 CLRP for the region (the managed lanes system in Maryland as part of the Maryland Traffic Relief Plan; see **Chapter 5** for more details). As such, the only appropriate alternative to consider would be one that provides a seamless network of barrier-separate managed lanes between these termini;
- The proposed project is identified as a public-private partnership (P3) project, and the funding and implementation of the project would make other alternatives inappropriate for addressing project Purpose and Need, due to system continuity and operational consistency issues; and,
- The National Capital Region Transportation Planning Board (NCRTPB), which is the designated Metropolitan Planning Organization for the Washington, D.C. region under the Metropolitan Washington Council of Governments (MWCOG), established Express Lanes as an integral part of the system network of the National Capital Region.

The Build Alternative would be implemented in multiple phases. Opening Year improvements (assumed to be in place by 2025 for traffic operations analysis) would include:

- The extension of the I-495 Express Lanes from the Route 267 interchange to the GWMP interchange, at which point the Express Lanes would seamlessly tie into the Maryland managed lanes system.
- Improvements to the Route 267 interchange, including connections from the Dulles Toll Road (both eastbound and westbound) to northbound I-495 Express and enhancements to the ramp from eastbound DTR to northbound I-495 GP.
- Improvements to the GWMP interchange, including connections from northbound I-495 Express to GWMP and from GWMP to southbound I-495 Express, and a new collector-distributor (C-D) road design along southbound I-495 GP between the GWMP and Route 193 interchanges.
- A new northbound I-495 GP auxiliary lane between the Route 267 and Route 193.
- Rebuilding of the Route 738 (Old Dominion Drive) overpass, the Live Oak Drive overpass, and the Route 193 interchange in order to accommodate the expanded cross-section of the I-495 mainline.
- A parallel bicycle/pedestrian trail between Route 694 (Lewinsville Road) and the GWMP.

Exhibits 6-1a through **6-1e** contain the concept plan sheets for the Build Alternative showing Opening Year improvements in place. Further improvements would be implemented between 2025 (Opening Year) and 2045 (Design Year) culminating into the Ultimate Build Configuration, which would include additional improvements at the Route 267 interchange and improvements to the Route 123 interchanges with both I-495 and Route 267. All improvements associated with the Build Alternative are assumed to be in place by

2045. **Exhibits 6-2a** through **6-2e** contain the concept plan sheets for the Build Alternative showing all improvements in place.

Parallel to these efforts, the Maryland Project would be designed and implemented, under the direction of the Maryland State Highway Association (MDSHA) and through coordination with VDOT, to be completed by 2025 as stated in the CLRP. The Maryland project would include, among other improvements;

- The development of two new managed lanes in each direction on I-495 for approximately 0.4 miles from the GWMP to the ALMB.
- The redevelopment of the American Legion Memorial Bridge, which shall include managed lanes in each direction.
- Managed lanes continuing north into Maryland to I-270.

Due to its ability to address the needs of the project, establish connections and overpasses along the corridor, and accommodate future connections in the CLRP, including those connections to the planned managed lane network in Maryland, extending the Express Lane system on I-495 north to the GWMP along the existing alignment was deemed the single alternative retained for detailed study.

6.1 BUILD ALTERNATIVE: MAINLINE I-495

The Build Alternative would be implemented in multiple phases, although most improvements to the mainline I-495 cross-section will be complete in the Opening Year of 2025:

- In the Opening Year, the Build Alternative would extend the existing four I-495 Express Lanes from their current terminus between the I-495/Route 267 interchange and the Old Dominion Drive Overpass north approximately 1.6 miles to the GWMP interchange, at which point the Express Lanes would seamlessly tie into the Maryland managed lane system. In order to reduce the LOD, the extended Express Lanes would be separated from the GP lanes by flexible delineators, consistent with the configuration of the existing I-495 Express Lanes, requiring approximately an additional 8 feet. This eliminates the need to provide full shoulders and concrete barrier separation in each direction, which would require an additional 56 feet in comparison. **Figure 6-1** shows a typical section for I-495 with two Express Lanes in either direction separated by flexible delineators.
- In the Opening Year, the Build Alternative would also add a northbound GP auxiliary lane between the on-ramp from the various Route 267 interchange ramps (which tie in together before joining the I-495 mainline) and the off-ramp to Route 193. An auxiliary lane is already provided between the Route 193 and GWMP interchange today in the northbound direction; in the southbound direction, a C-D road will take the place of an auxiliary lane.

A southbound GP auxiliary lane between the on-ramp from Route 193 and the off-ramp to Route 267 would be provided as a part of the Ultimate Configuration by the Design Year of 2045.

Through the entire project area, the Build Alternative would retain the existing number of GP lanes in each direction between the I-495/Route 267 interchange and the GWMP, provide additional access to the Express Lane network, and improve the Route 267, Route 123, and GWMP interchanges. Details of specific design features included in the Build Alternative at these interchanges are discussed in the following sections.

The Build Alternative was developed using current design guidelines including the American Association of State Highway and Transportation Officials' (AASHTO) *A Policy on the Geometric Design of Highways and Streets,* also known as the Green Book, (AASHTO, 2018); AASHTO's *A Policy on Design Standards, Interstate System* (AASHTO, 2016); and the VDOT Road Design Manual (VDOT, 2019g). The design criteria used for this study are based on the functional classification of the roadways within the project study area. A descriptive list of the design waivers and design exceptions for the geometric elements of the Build Alternative that do not meet state and federal requirements can be found in the Interchange Justification Report (IJR) (VDOT, 2020).

A discussion of specific design features of the Build Alternative and how these features are addressed are included in the associated IJR (VDOT, 2020). The LOD is based on preliminary engineering and design, which has been developed to include both temporary and permanent impacts, including stormwater management facilities and construction access. As the project advances into the detailed stages of engineering and design, the anticipated impacts may be subject to change as opportunities to avoid or minimize impacts to resources or reduce cost are recognized.

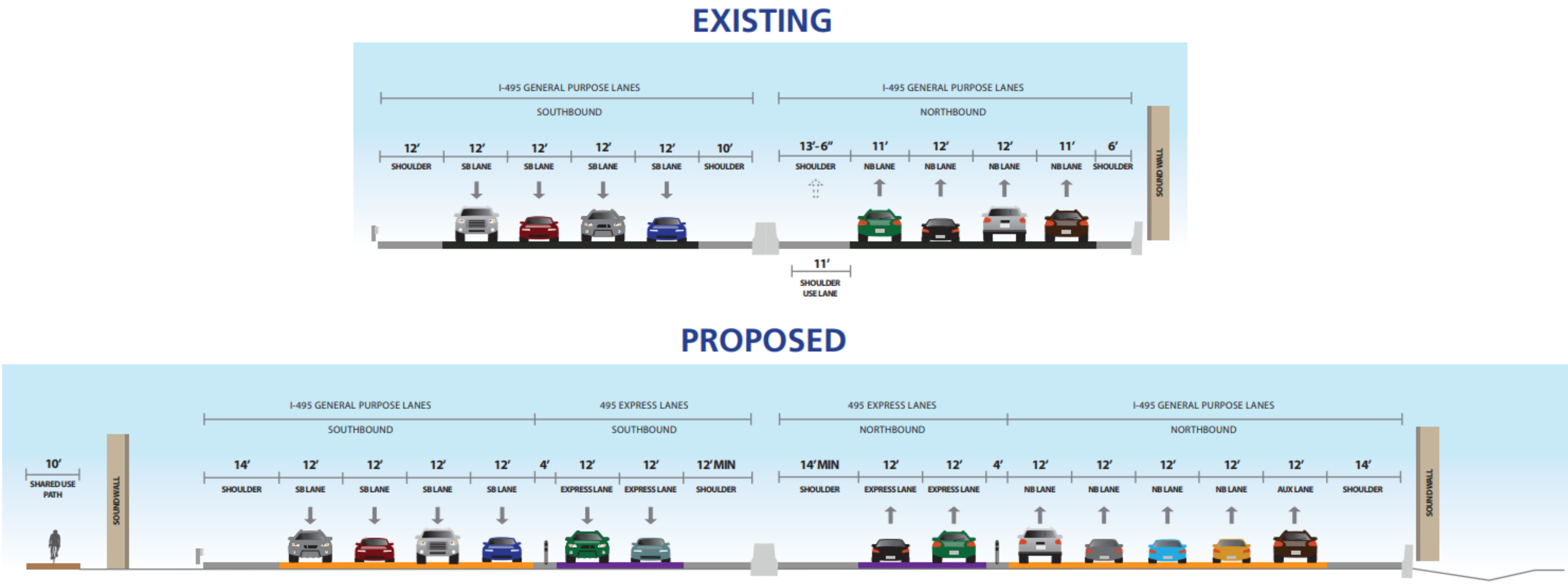


Figure 6-1. Existing and Build Alternative Typical Sections

6.2 PROPOSED ACCESS TO THE EXPRESS LANES

Table 6-1 summarizes the proposed Express Lanes access modifications within the I-495 study area. All existing access points at the I-495/Route 267 interchange would be maintained; however, the geometric configurations of these access points would change to accommodate additional movements. Access to and from the Express Lanes at the current Express Lane terminus (north of the Route 267 interchange) would be eliminated as the Express Lanes would be extended up to connect directly with the Maryland managed lanes facility at the GWMP. The managed lanes facility on I-495 in Maryland, which would extend south over the ALMB to GWMP is currently being planned by MDSHA.

6.2.1 Express Lanes Access in 2025 (Opening Year)

In the Opening Year of the Build Alternative, direct access from the northbound I-495 Express Lanes to the northbound I-495 GP lanes and from the southbound I-495 GP lanes to the southbound I-495 Express Lanes as provided at the current Express Lanes terminus (north of the Route 267 interchange) would be eliminated. This provides for the continuation of the Express Lanes system north through the current terminus of the Maryland system at the GWMP.

New access to and from the I-495 Express Lanes system would be provided via the following movements in the Opening Year:

- Eastbound Route 267 (DTR) to northbound I-495 Express
- Westbound Route 267 (Dulles Connector Road) to northbound I-495 Express
- Northbound I-495 Express to GWMP
- GWMP to southbound I-495 Express

Note that the current Express Lanes system already provides the southbound I-495 Express to westbound Route 267 (DTR) movement, which would be retained. The southbound I-495 Express to eastbound Route 267 (Dulles Connector Road) movement would not be provided in the Opening Year.

Also note that, as described in **Chapter 5**, the Maryland managed lanes system (assumed to be in place under No-Build conditions) would provide access to the following movements:

- GWMP to northbound I-495 Express
- Southbound I-495 Express to GWMP

Existing access at GWMP would be modified to accommodate the new Express Lanes access while minimizing the additional right-of-way required.

6.2.2 Express Lanes Access in 2045 (Design Year)

The Ultimate Configuration of the Build Alternative, to be completed by the Design Year of 2045, would include flyover exchange ramps to provide access from the northbound I-495 GP lanes to the northbound I-495 Express Lanes, and from the southbound I-495 Express Lanes to the southbound I-495 GP lanes. These exchange ramps would be located at the Route 267 interchange.

Additional access to the Express Lane facility would be provided at the Route 267 interchange via direct access from the southbound I-495 Express Lanes to eastbound Route 267 (Dulles Connector Road). This movement would tie into an eastbound C-D road along Route 267 at the Route 267/Route 123 interchange, allowing access to both the eastbound Dulles Connector Road and Route 123.

Finally, direct access from the eastbound DAAR to the northbound I-495 Express Lanes would be provided via an eastbound C-D road between eastbound DTR and eastbound DAAR east of Spring Hill Road.

Table 6-1. Express Lane Access Point Modifications

Access Point	Access		
	Existing	*Build Alternative 2025 (Opening Year)*	*Build Alternative 2045 (Design Year)*
Exchange Ramps	Current Express Lanes Terminus	(None provided)	• NB I-495 GP to NB I-495 Express Lanes (EXP) at the Route 267 interchange • SB I-495 EXP to SB I-495 GP at the Route 267 interchange
I-495/Route 267 Interchange	• NB I-495 EXP to WB Route 267 • SB I-495 EXP to WB Route 267 • NB I-495 EXP to Jones Branch Connector (JBC) • SB I-495 EXP to JBC • EB Route 267 to SB I-495 EXP • JBC to NB I-495 EXP • JBC to SB I-495 EXP	• All Access points provided under Existing Conditions • EB DTR to NB I-495 EXP • WB DTR to NB I-495 EXP	• All Access Points provided under Build Alternative Opening Year • SB I-495 EXP to EB Dulles Connector Road (including Route 123) • EB DAAR to NB I-495 EXP
George Washington Parkway	GP only; no EXP	• NB I-495 EXP to EB GWMP • WB GWMP to SB I-495 EXP • SB I-495 EXP to EB GWMP (Maryland system) • WB GWMP to NB I-495 EXP (Maryland system)	• All Access Points provided under Build Alternative Opening Year

6.3 ROUTE 267 INTERCHANGE

The Build Alternative includes significant modifications to the I-495/Route 267 interchange, including modifications to several of the GP ramp connections. This interchange is a critical component of the I-495 Express Lane network as it is adjacent to the rapidly growing Tysons area and provides direct access to and from Washington Dulles International Airport (IAD) via the DAAR. The I-495/Route 267 interchange is also close to several stops on the Metro's Silver Line, a major commuter line currently being extended to provide service to and from IAD.

Exhibit 6-2a illustrates the proposed Build Alternative Design at the Route 267 interchange. Individual Ramp movements are discussed in detail below. Modified Access refers to movements which are provided under the existing interchange configuration, while Additional Access refers to movements which are not provided under the existing interchange configuration. All access provided in the existing interchange configuration is maintained in some form through all phases of the Build Alternative.

6.3.1 Route 267 Interchange in 2025 (Opening Year)

The following improvements are assumed to be completed at the Route 267 by 2025:

- **G3:** Ramp G3 is a two-lane ramp which provides Modified Access from eastbound DTR to northbound I-495 GP lanes. In the Opening Year, ramp G3 will tie into northbound I-495 GP lanes at the same location as the existing ramp movement from eastbound DTR to northbound I-495. Note that by the Design Year, ramp G3 will be extended to combine with ramps G10 and G9 about before tying into northbound I-495 GP lanes about 0.6 miles downstream of the existing tie in point.
- **E1:** Ramp E1 provides Modified Access from eastbound DTR and eastbound DAAR to northbound and southbound I-495 Express Lanes, with one lane of capacity to each direction of the Express Lanes facility. In the Opening Year, ramp E1 would utilize the existing off-ramp from eastbound DTR, which is indirectly accessible from eastbound DAAR via an upstream slip ramp, leading to the newly constructed two-lane ramp which splits to provide one lane to southbound I-495 Express Lanes (an existing ramp) while the second lane continues under mainline I-495 and then flies over Route 267 where it merges with ramp E3 before tying into the northbound I-495 Express Lanes. By the Design Year, access from eastbound DTR and eastbound DAAR would be provided via a C-D road which collects traffic from the DTR and DAAR upstream of the Route 267 interchange, flies over eastbound DTR, and then ties into the portion of ramp E1 which would be constructed by the Opening Year of the Build Alternative.
- **E3:** Ramp E3 is a one-lane ramp which provides Additional Access from westbound DCR to northbound I-495 Express Lanes. Ramp E3 merges with ramp E1 before tying into northbound I-495 Express Lanes.

6.3.2 Route 267 Interchange in 2045 (Design Year)

The following improvements are assumed to be completed at the Route 267 interchange by 2045:

- **GX:** Ramp GX is a one-lane ramp which provides Additional Access from northbound I-495 GP lanes, from and Route 123 at the I-495/Route 123 interchange, to northbound I-495 Express Lanes. Ramp GX would be provided via a connection from ramp G2 to ramp E1.
- **XG:** Ramp XG is a one- lane ramp which provides Additional Access from southbound I-495 Express Lanes to southbound I-495 GP lanes. Ramp XG would be provided via flyover ramp connecting ramp E2 to ramp D1.
- **E2:** Ramp E2 is a one-lane ramp which provides Additional Access from southbound I-495 Express Lanes to eastbound DTR.
- **G1:** Ramp G1 is a one-lane ramp which provides Modified Access from southbound I-495 GP lanes to eastbound DTR. Ramp G1 also provides access to Route 123 at the Route 267/Route 123 interchange via a connection to ramp D2 and subsequent connection to ramp G4.

- **G2:** Ramp G2 provides Modified Access from northbound I-495 to westbound DTR with one lane of capacity. Ramp G2 also provides access from Route 123 at the I-495/Route 123 interchange via the proposed C-D road system at that interchange.
- **G3:** Ramp G3 is a two-lane ramp which provides Modified Access from eastbound DTR to northbound I-495 GP lanes. In the Opening Year, ramp G3 will tie into northbound I-495 GP lanes at the same location as the existing ramp movement from eastbound DTR to northbound I-495. By the Design Year, ramp G3 will be extended to combine with ramps G10 and G9 about before tying into northbound I-495 GP lanes about 0.6 miles downstream of the existing tie in point.
- **G4:** Ramp G4 provides Modified Access from eastbound DTR to the Route 123 C-D road at the Route 267/Route 123 interchange. Ramp G4 also provides access to the Route 123 C-D from eastbound DAAR via a connection from ramp D2.
- **G5:** Ramp G5 is a two-lane ramp which provides Modified Access from southbound I-495 GP lanes to westbound DTR.
- **G6:** Ramp G6 provides Modified Access from southbound I-495 GP lanes to the proposed Route 123 C-D road at the I-495/Route 123 interchange with one lane of capacity.
- **G7:** Ramp G7 is a one-lane ramp which provides Modified Access from eastbound DTR to the propose Route 123 C-D road at the I-495/Route 123 interchange.
- **G8:** Ramp G8 is a one-lane ramp which provides Modified Access from eastbound DTR to southbound I-495 GP lanes.
- **G9:** Ramp G9 is a one-lane ramp which provides Modified Access from the Route 123 C-D road at the I-495/Route 123 interchange to northbound I-495 GP lanes (provided access to the northbound GP lanes from Route 123). Ramp G9 is provided via a connection from ramp G2 to combined ramps G3 and G10.
- **G10:** Ramp G10 is a one-lane ramp which provides Modified Access from westbound DTR to northbound I-495. Ramp G10 to provided via a connection from the westbound DTR mainline to ramp G3.
- **D1:** Ramp D1 provides Modified Access from eastbound DAAR (indirectly via eastbound DTR) to southbound I-495 GP lanes with one lane of capacity.
- **D2:** Ramp D2 provides Modified Access from eastbound DAAR to northbound I-495 GP lanes with one lane of capacity.
- **D3:** Ramp D3 is a one-lane ramp which provides Additional Access from southbound I-495 GP lanes to westbound DAAR.
- **D4:** Ramp D4 is a one-lane ramp which provides Additional Access from northbound I-495 GP lanes to westbound DAAR.

6.4 GEORGE WASHINGTON MEMORIAL PARKWAY INTERCHANGE

The Build Alternative also includes modifications to the GWMP interchange, the northernmost interchange on I-495 in Virginia. Extending from I-495 just south of the ALMB east to Alexandria, the GWMP acts as a major commuter route for vehicles going to and from Northern Virginia, Maryland, and Washington, D.C.

Exhibit 6-2e illustrates the GWMP interchange under the Build Alternative. All existing GP movements at the GWMP would be maintained under the Build Alternative, but would be modified to accommodate additional access between I-495 Express Lanes and the GWMP provided under the Build Alternative. The

Opening Year (2025) of the Build Alternative would include two south facing ramps which would provide access from northbound I-495 Express Lanes to eastbound GWMP, and from westbound GWMP to southbound I-495 Express Lanes, while the Maryland Traffic Relief Plan project (also planned to be completed by 2025) would include two north facing ramps which would provide access from southbound I-495 managed lanes to eastbound GWMP, and from westbound GWMP to northbound I-495 managed lanes.

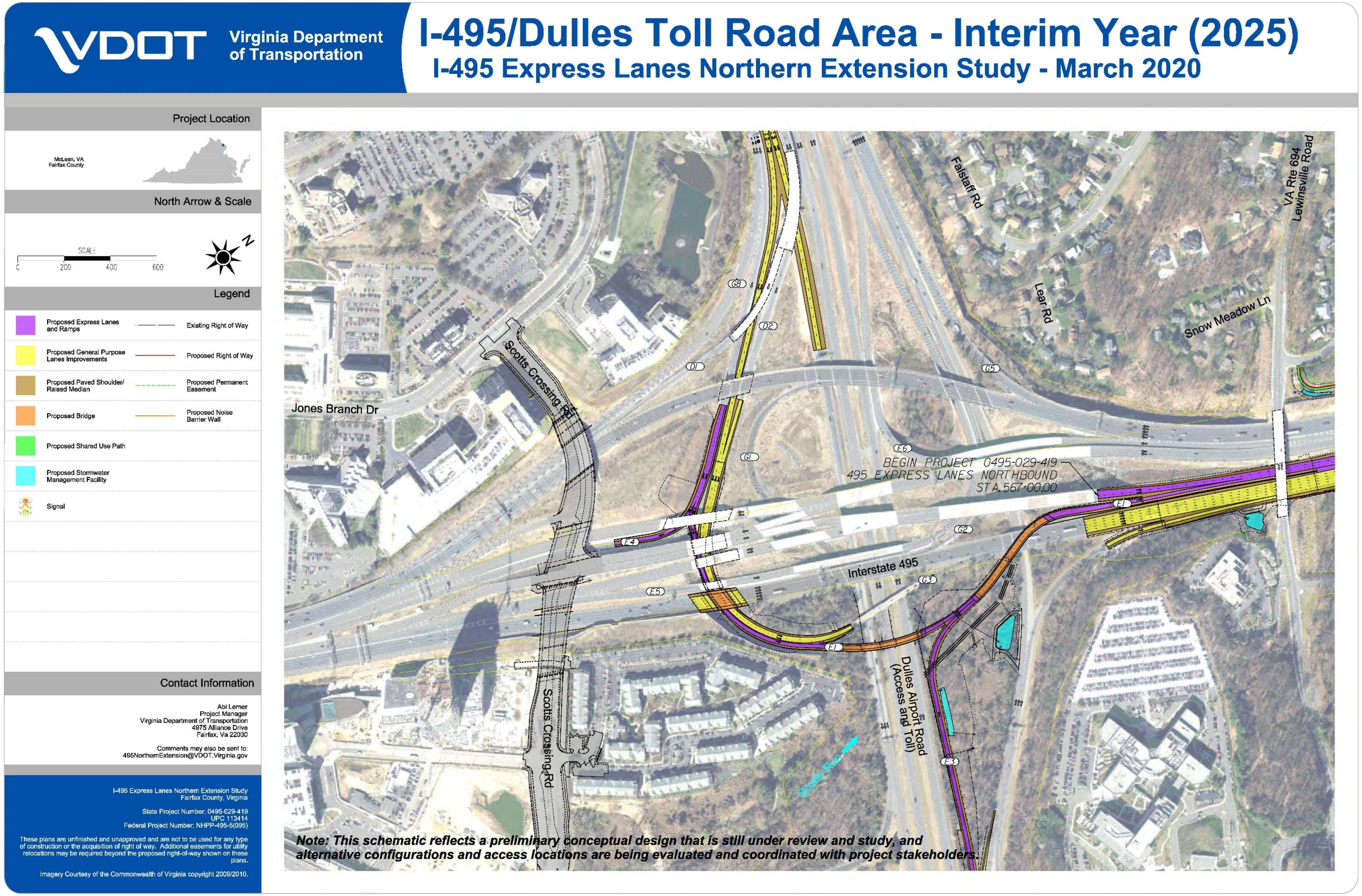


Exhibit 6-1a. Build Alternative Opening Year Improvements Concept Design (Sheet 1 of 5)

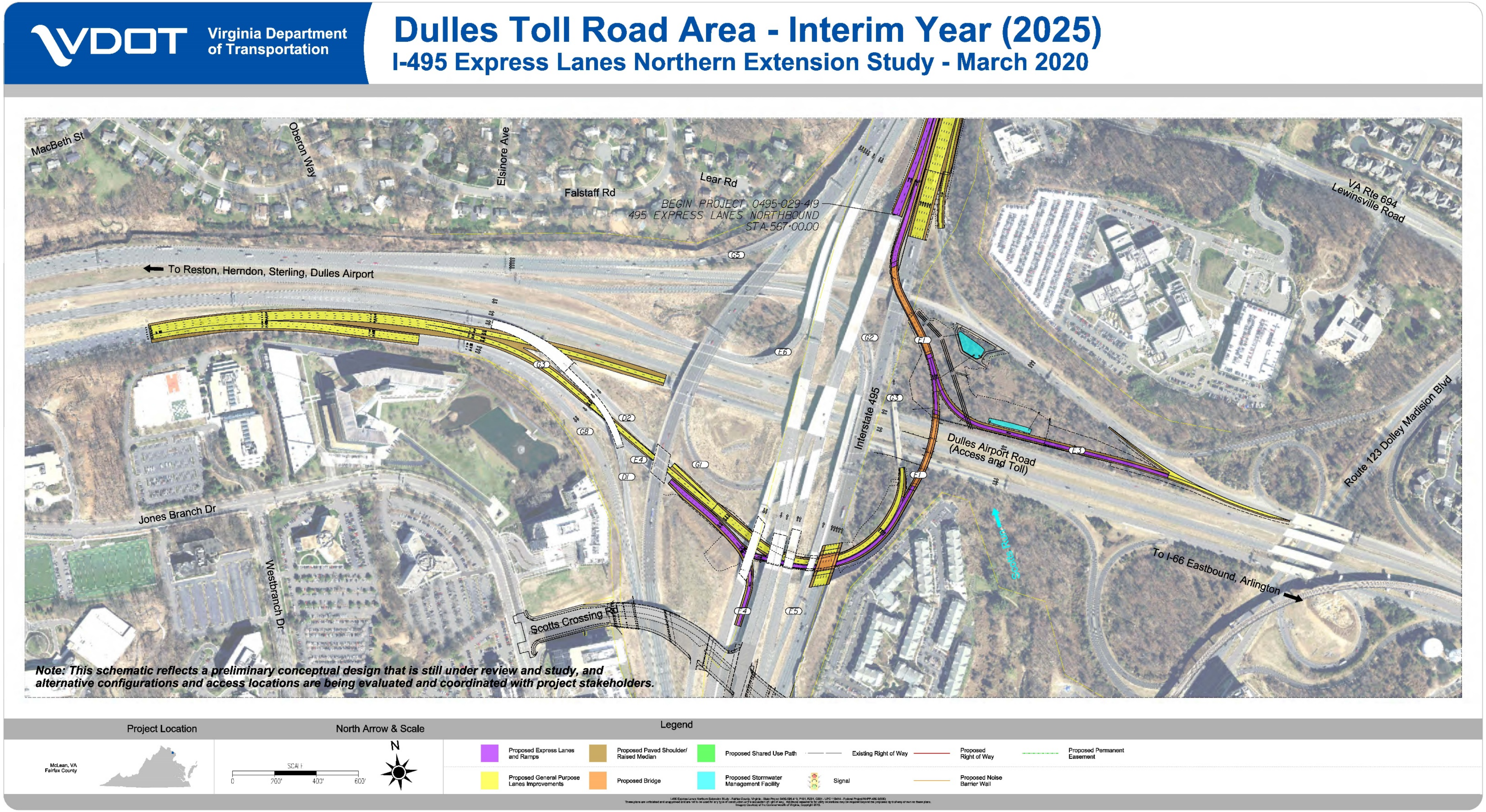


Exhibit 6-1b. Build Alternative Opening Year Improvements Concept Design (Sheet 2 of 5)

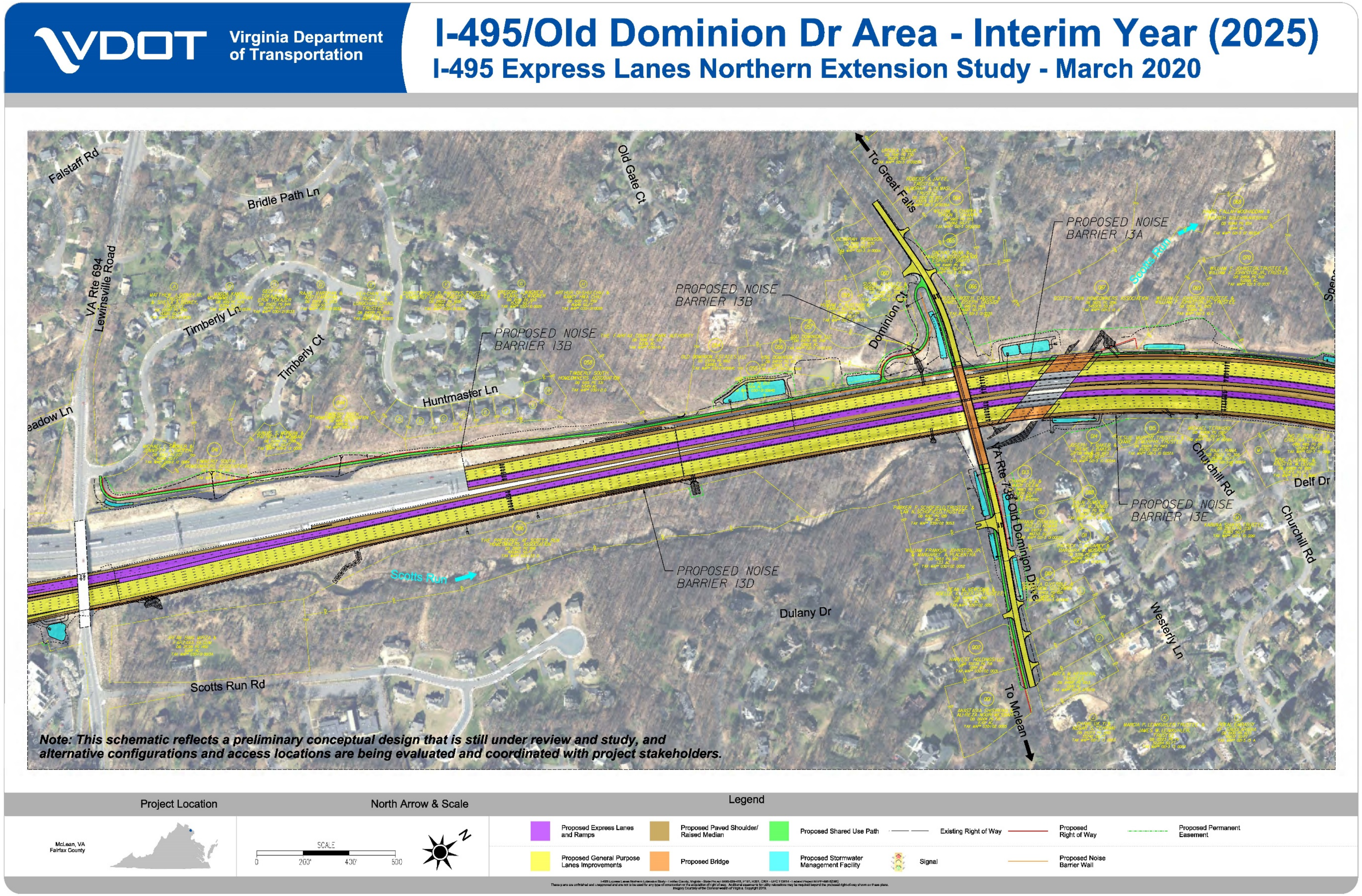


Exhibit 6-1c. Build Alternative Opening Year Improvements Concept Design (Sheet 3 of 5)

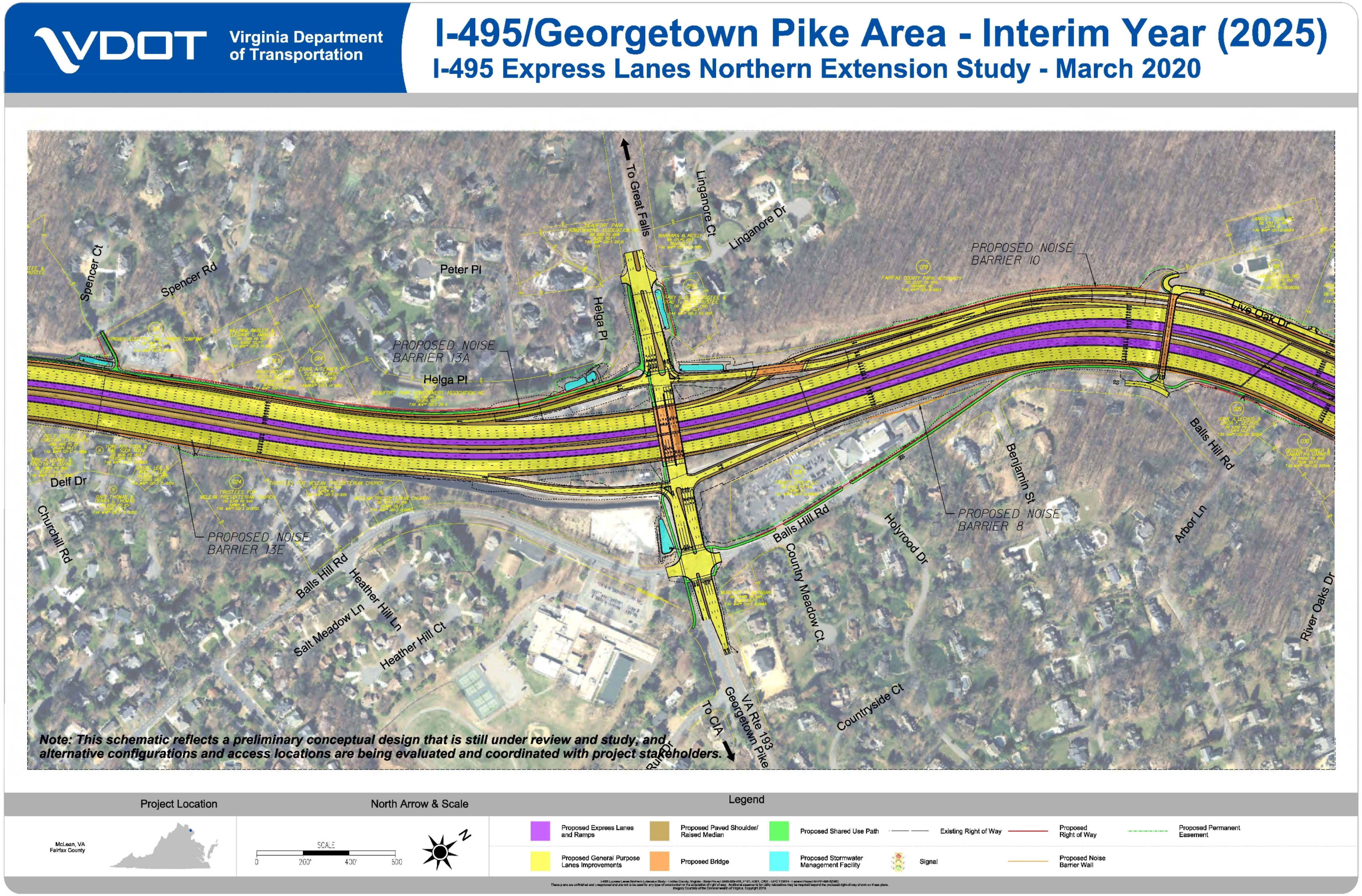


Exhibit 6-1d. Build Alternative Opening Year Improvements Concept Design (Sheet 4 of 5)

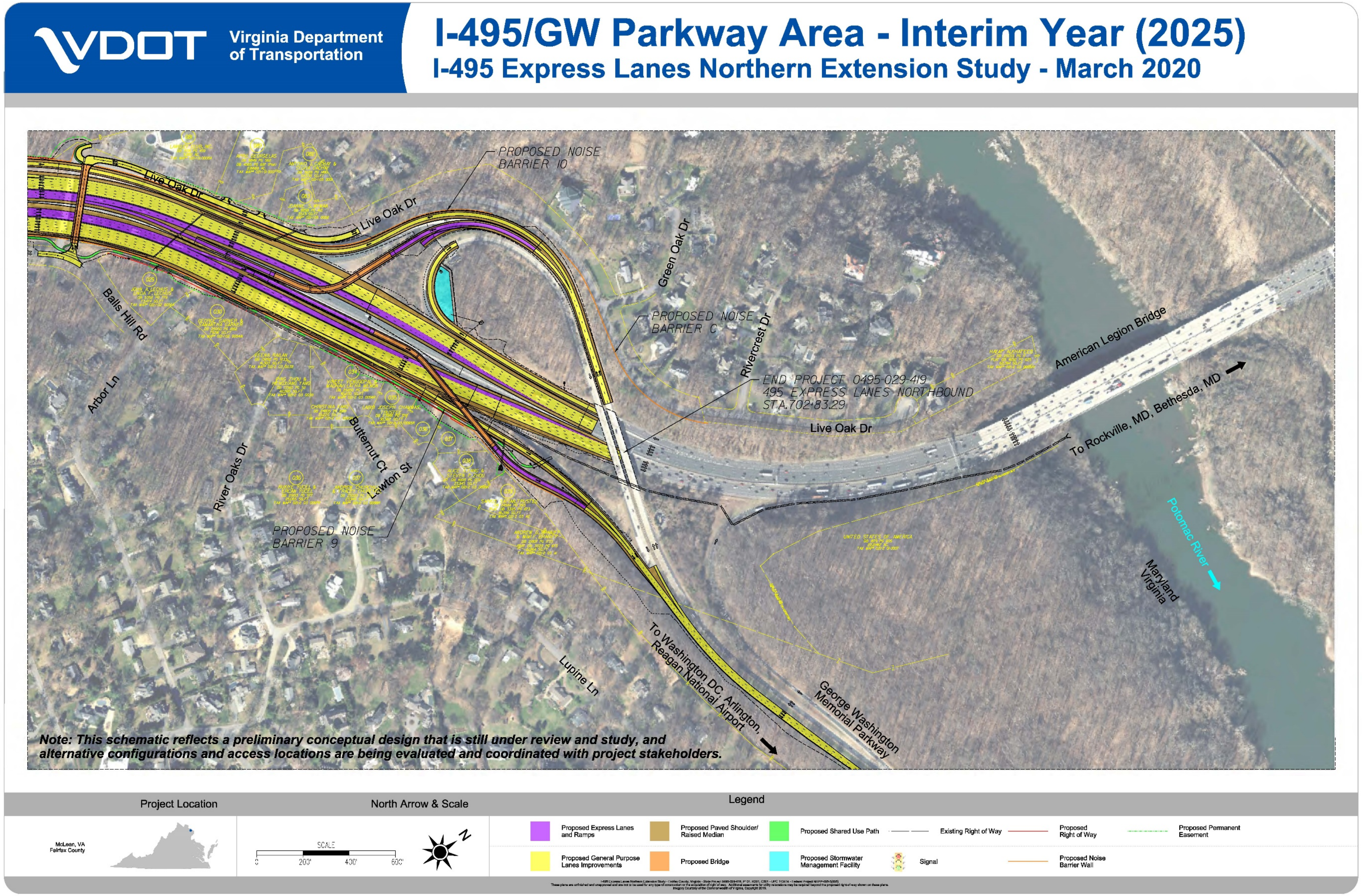


Exhibit 6-1e. Build Alternative Opening Year Improvements Concept Design (Sheet 5 of 5)

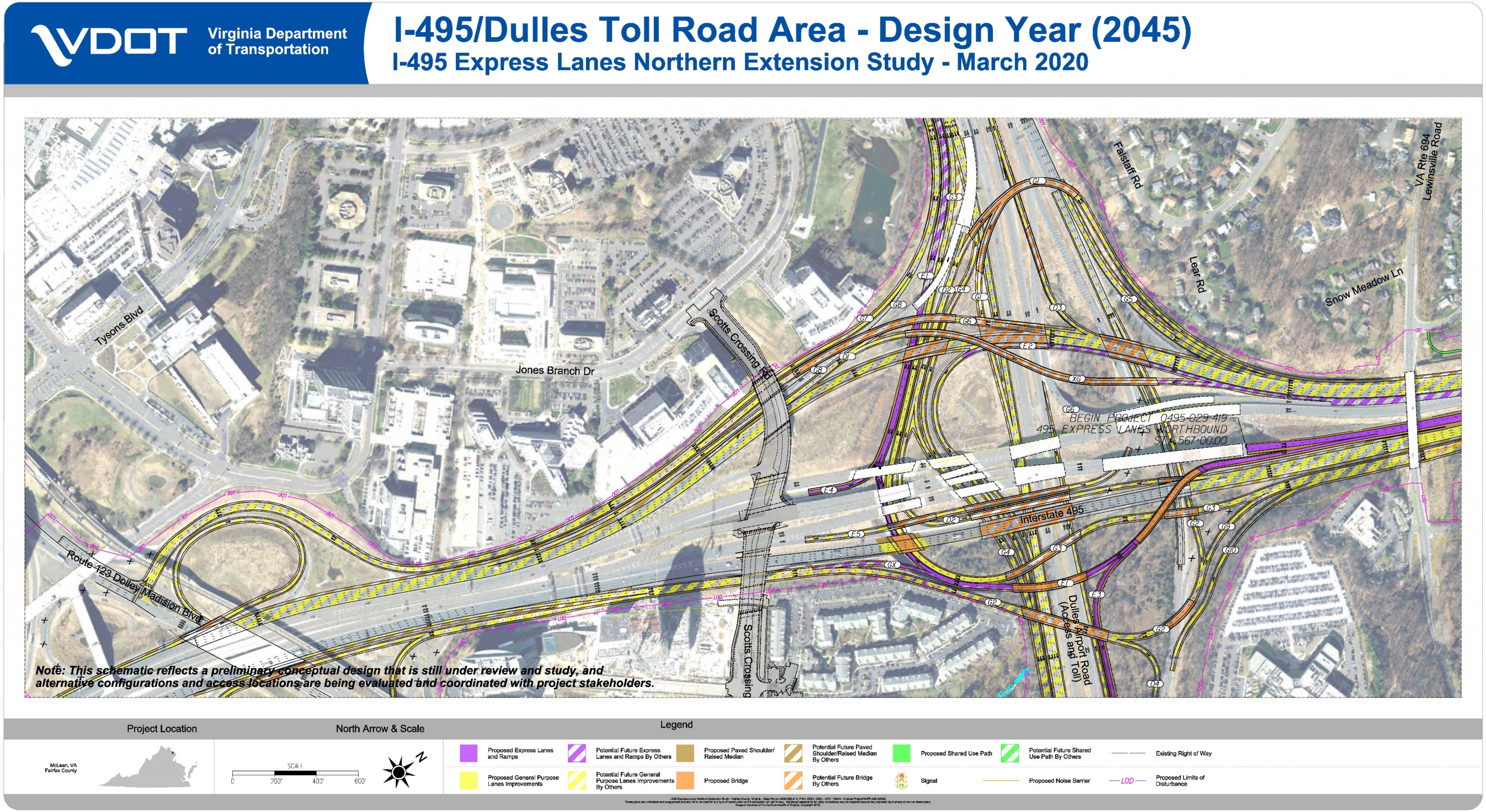


Exhibit 6-2a. Build Alternative Ultimate Configuration (Not to Preclude) Improvements Concept Design (Sheet 1 of 5)

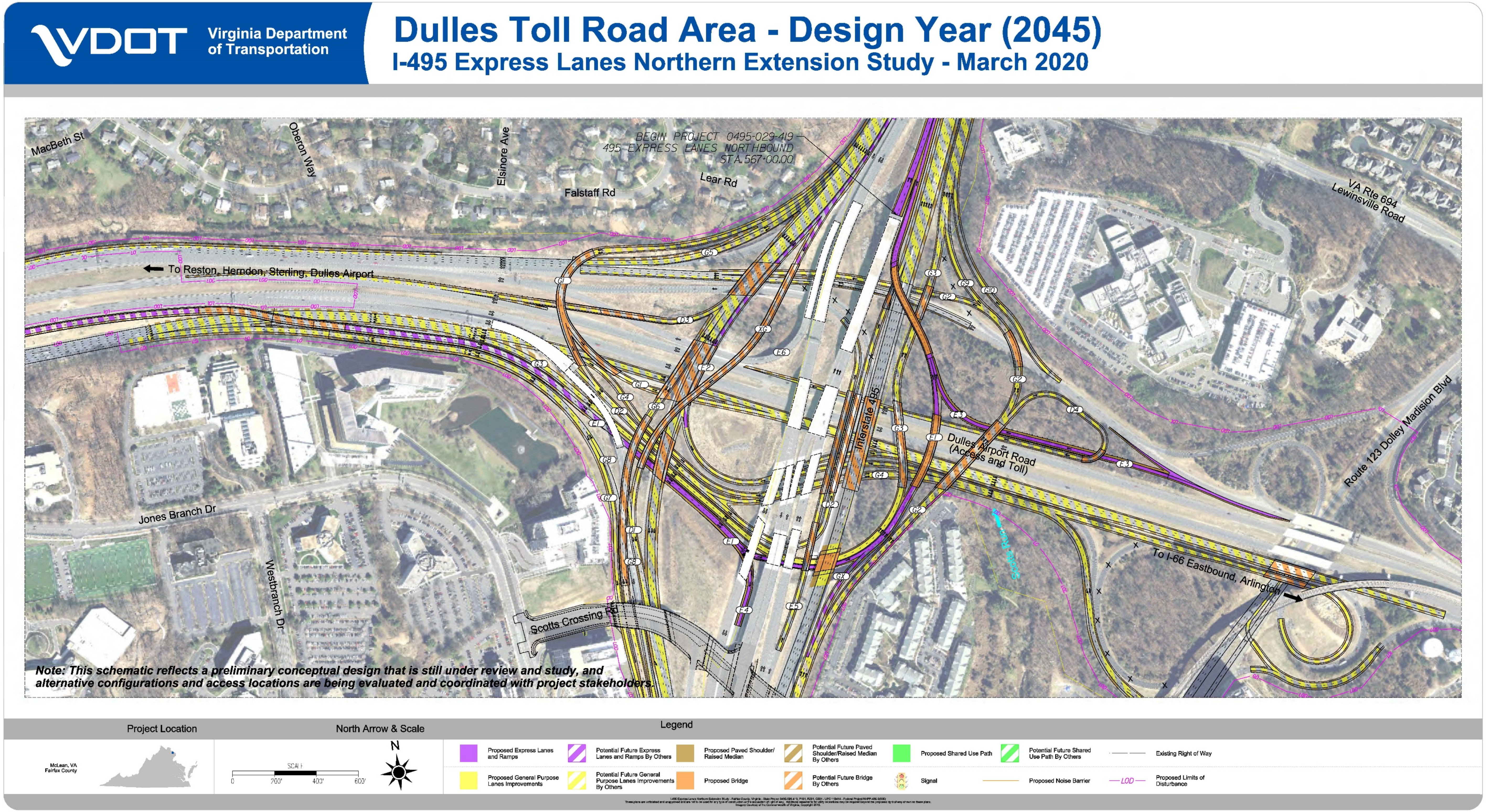


Exhibit 6-2b. Build Alternative Ultimate Configuration (Not to Preclude) Concept Design (Sheet 2 of 5)

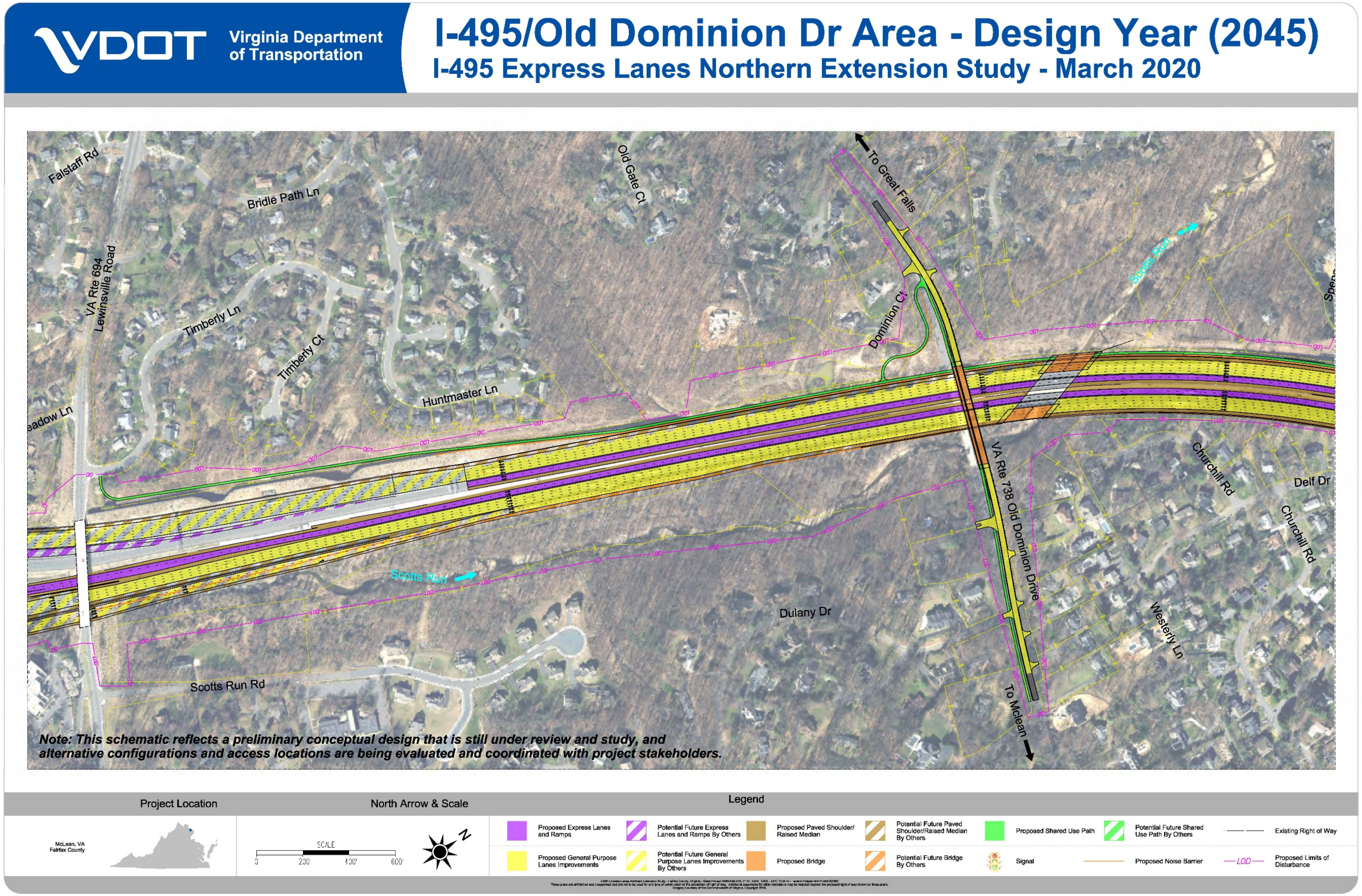


Exhibit 6-2c. Build Alternative Ultimate Configuration (Not to Preclude) Concept Design (Sheet 3 of 5)

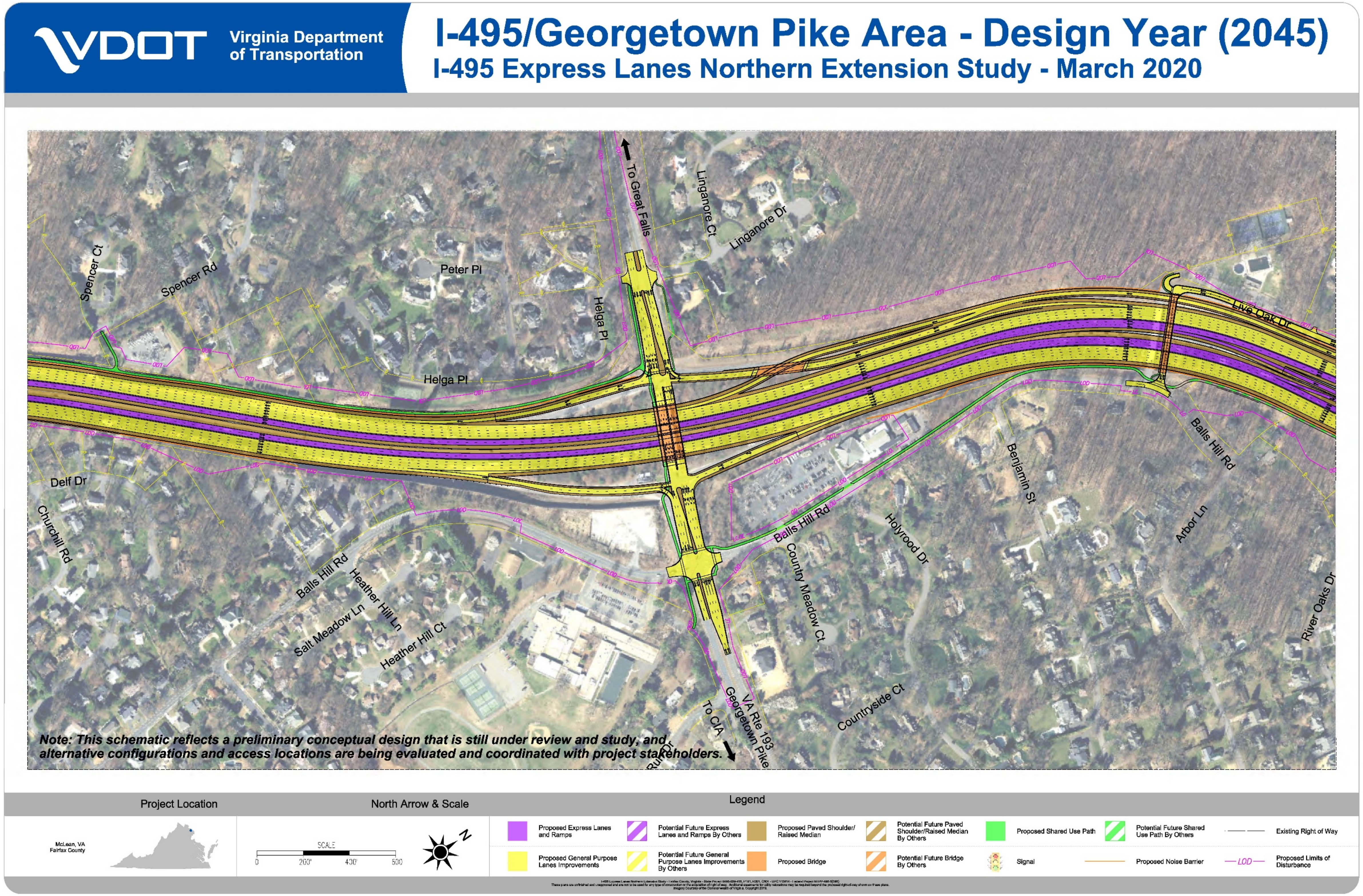


Exhibit 6-2d. Build Alternative Ultimate Configuration (Not to Preclude) Concept Design (Sheet 4 of 5)

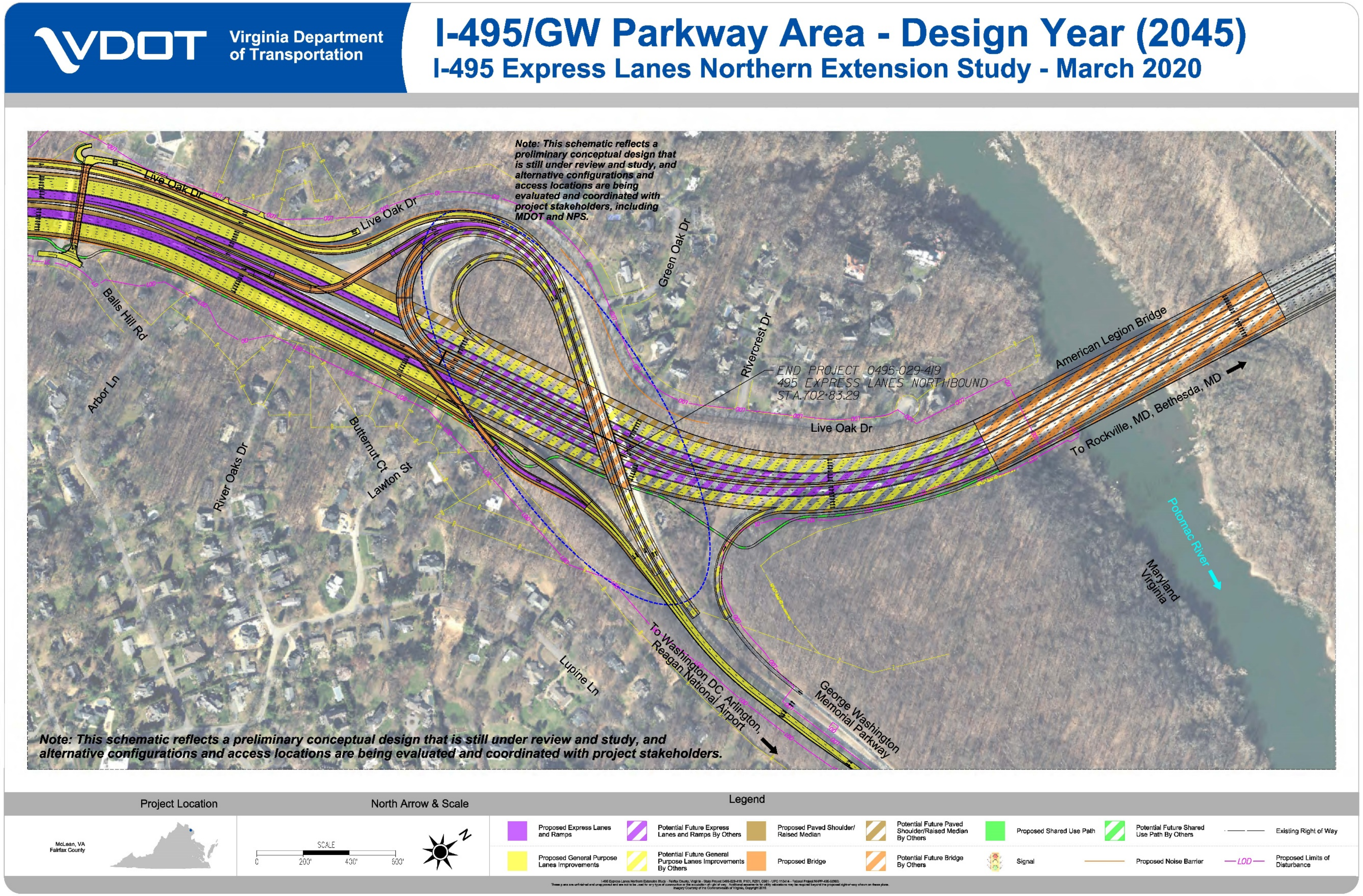


Exhibit 6-2e. Build Alternative Ultimate Configuration (Not to Preclude) Concept Design (Sheet 5 of 5)

CHAPTER 7.0 FUTURE SCENARIOS OPERATIONAL CONDITIONS

7.1 OVERVIEW OF NO BUILD AND BUILD OPERATIONS ANALYSIS

This chapter compares traffic operations for No Build and Build conditions for a 2025 interim year and 2045 design year. No Build traffic operations were analyzed according to the network described in **Chapter 5** while Build traffic operations were analyzed according to the network described in **Chapter 6**. Note that for both No Build and Build conditions, differences exist between the 2025 and 2045 networks. Traffic volumes also differ between the No Build and Build conditions for the same analysis years. Traffic volumes for each scenario were developed according to the methodology described in **Chapter 2**. These volumes and associated traffic operational impacts are described in the following sections.

Sensitivity Analysis for Future Traffic Operations prior to Maryland Managed Lanes Project

To understand the impacts and operational benefits or constraints of the I-495 NEXT project operations prior to the adjacent Maryland managed lanes system being in place (described in **Chapter 5**), a sensitivity analysis was performed for the 2025 analysis year. This sensitivity analysis included travel demand model runs, traffic volume forecasting, and traffic operations in VISSIM and Synchro. The results of this sensitivity analysis are provided in **Appendix I**.

7.2 2025 OPENING YEAR ANALYSIS

7.2.1 2025 Traffic Volumes

This section describes forecasted traffic volumes for the study area for 2025 No Build and Build conditions; the following sections detail the differences in traffic operations analysis results between the two conditions.

Peak hour freeway forecast volumes for 2025 conditions are provided in the following exhibits:

- **Exhibits 7-1a** and **7-1b** show 2025 No Build AM peak hour freeway volumes for the I-495 and Route 267 corridors, respectively.
- **Exhibits 7-2a** and **7-2b** show 2025 Build AM peak hour freeway volumes for the I-495 and Route 267 corridors, respectively.
- **Exhibits 7-3a** and **7-3b** show 2025 No Build PM peak hour freeway volumes for the I-495 and Route 267 corridors, respectively.
- **Exhibits 7-4a** and **7-4b** show 2025 Build PM peak hour freeway volumes for the I-495 and Route 267 corridors, respectively.

Arterial turning movement volumes for 2025 conditions are provided in the following exhibits:

- **Exhibits 7-5a** through **7-5e** show 2025 No Build AM and PM peak hour arterial turning movement volumes.
- **Exhibits 7-6a** through **7-6e** show 2025 Build AM and PM peak hour arterial turning movement volumes.

Average daily traffic forecast volumes for 2025 conditions are provided in the following exhibits:

- **Exhibits 7-7a** and **7-7b** show 2025 No Build ADT freeway volumes for the I-495 and Route 267 corridors, respectively.
- **Exhibits 7-8a** and **7-8b** show 2025 Build ADT freeway volumes for the I-495 and Route 267 corridors, respectively.

Peak Hour Traffic Volumes and Peaking Patterns

Figure 7-1 and **Figure 7-2** compare 2025 No Build and Build AM forecast peak hour mainline volumes with existing conditions along northbound and southbound I-495 (GP and Express combined), respectively.

- In the northbound direction, the highest traffic volumes in all scenarios are between the GWMP and Clara Barton Parkway (across the ALMB). The increases in volume from No Build to Build range from 200 vph to 700 vph (2 percent to 9 percent) across the four segments, with the largest increases in the segments between Route 267 and GWMP where the Build Alternative adds capacity from the Express Lanes.
- In the southbound direction, the highest traffic volumes in all scenarios are again between the Clara Barton Parkway and GWMP (across the ALMB). The increases in volume from No Build to Build range from 170 vph to 550 vph (2 percent to 6 percent) across the four segments, with the largest increase in the segments between GWMP and Route 267 where the Build Alternative adds capacity from the Express Lanes.

Figure 7-3 and **Figure 7-4** compare 2025 No Build and Build PM forecast peak hour mainline volumes with existing conditions along northbound and southbound I-495 (GP and Express combined), respectively.

- In the northbound direction, the highest traffic volumes in all scenarios are between the GWMP and Clara Barton Parkway (across the ALMB). The increases in volume from No Build to Build range from 730 vph to 1,540 vph (10 percent to 29 percent) across the four segments, with the largest increases in the segments between Route 267 and GWMP where the Build Alternative adds capacity from the Express Lanes.
- In the southbound direction, the highest traffic volumes in all scenarios are again between the Clara Barton Parkway and GWMP (across the ALMB). The increases in volume from No Build to Build range from 380 vph to 850 vph (7 percent to 12 percent) across the four segments, with the largest increase in the segments between GWMP and Route 267 where the Build Alternative adds capacity from the Express Lanes.

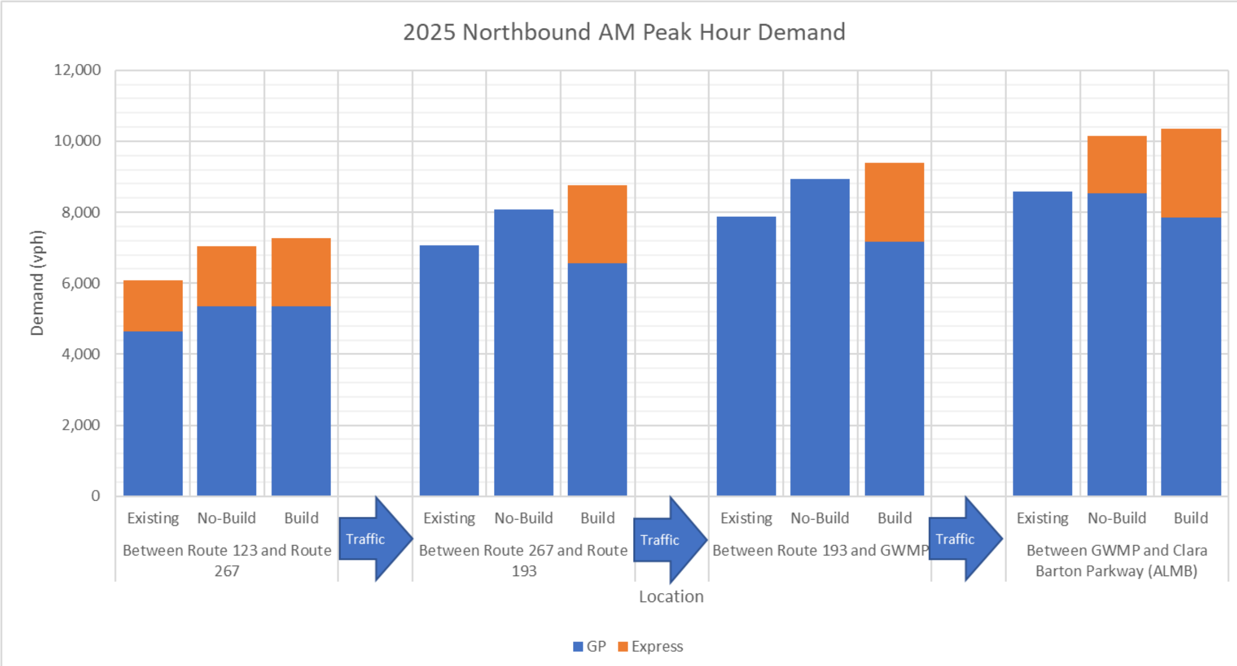


Figure 7-1: Existing and 2025 No Build AM Peak Hour Volumes - Northbound I-495

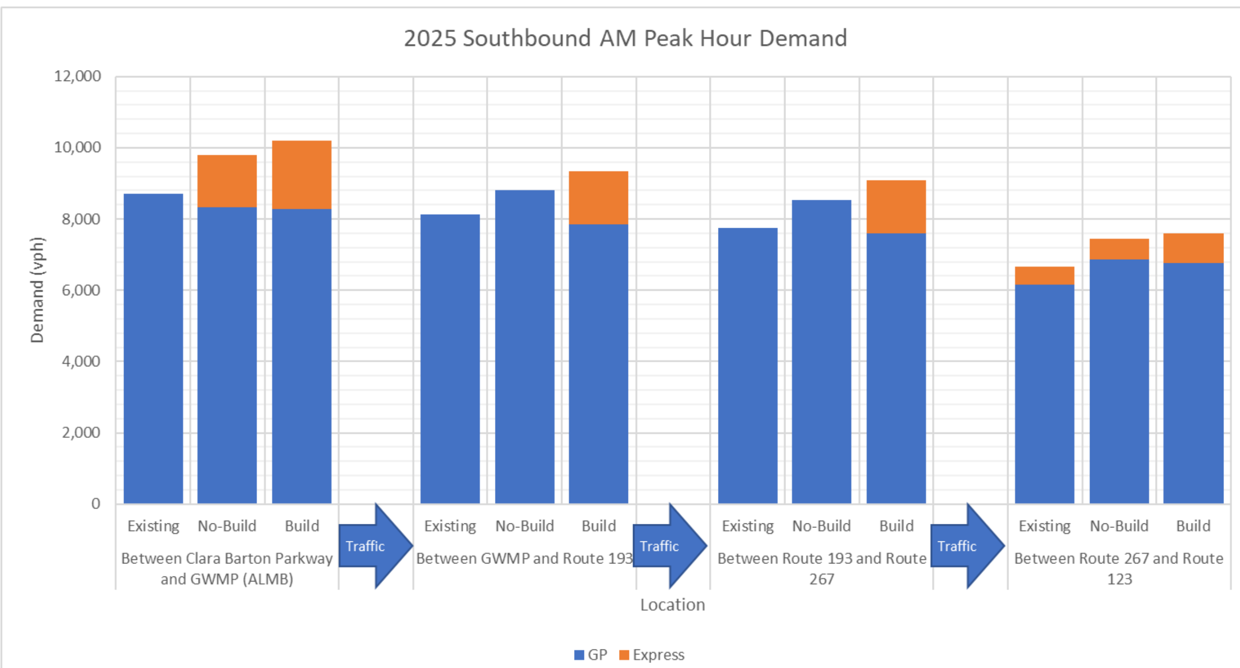


Figure 7-2: Existing and 2025 No Build AM Peak Hour Volumes - Southbound I-495

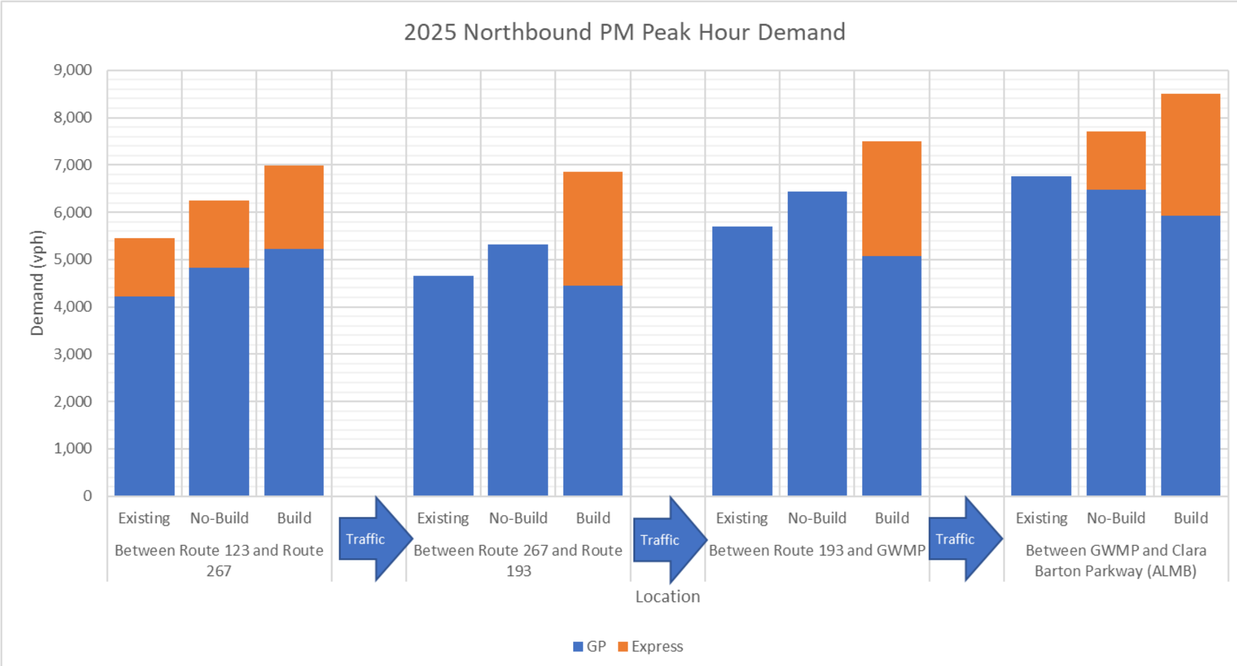


Figure 7-3: Existing and 2025 No Build PM Peak Hour Volumes - Northbound I-495

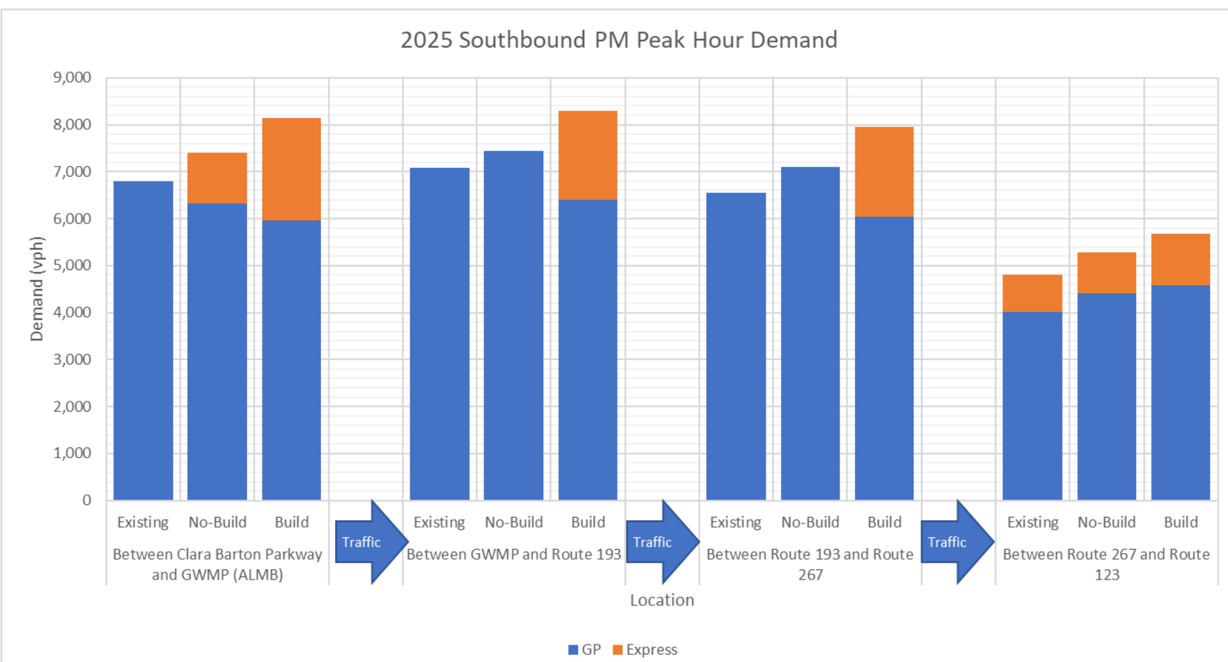


Figure 7-4: Existing and 2025 No Build PM Peak Hour Volumes - Southbound I-495

7.2.2 2025 No Build vs Build AM Freeway Operations

Exhibits 7-9 through **7-12** illustrate the density and speed results from the VISSIM models for the I-495 and Route 267 mainline segments in the study area for the AM peak period:

- **Exhibits 7-9a** through **7-9c** show 2025 No Build AM peak period freeway densities.
- **Exhibits 7-10a** through **7-10c** show 2025 Build AM peak period freeway densities.
- **Exhibits 7-11a** through **7-11c** show 2025 No Build AM peak period freeway speeds.
- **Exhibits 7-12a** through **7-12c** show 2025 Build AM peak period freeway speeds.

In each figure, the centerline diagram laid over the aerial depicts the average densities or speeds during the peak hour from 7:45 a.m. to 8:45 a.m. in both directions along the mainline segments. The average densities and speeds are color-coded based on the congestion levels and ranges of speeds as depicted in the legend. The boxes on the top and bottom depict the densities and speeds in each direction for the entire peak period from 6:45 a.m. to 9:45 a.m., including the shoulder periods before and after the peak hour. Detailed tabular results can be found in **Appendix G.**

Density

In the AM peak period, it can be seen from the exhibits that in the northbound GP lanes most segments in the Build condition operate under light-to-heavy density traffic for the entire study corridor, which represents a significant improvement over the No Build condition, in which segments between Route 267 and Clara Barton Parkway operate under significant congestion. With the proposed project (Build Alternative), the Express Lanes are continuous which helps with the operations along the corridor as it reduces traffic on the GP lanes and eliminates the friction between left side merges and diverges. **Figure 7-5** summarizes various densities along the northbound I-495 GP lanes. As can be seen in the figure, 43 percent of the freeway segments operate under congested to severe congestion in the No Build condition compared to 10 percent in the Build condition. All the segments along the northbound Express Lanes operate under light to moderate traffic congestion in both the scenarios.

In the southbound GP lanes, most segments operate under light to heavy traffic conditions for the entire corridor in the Build condition, as compared to several segments operating under severe congestion between Clara Barton Parkway and GWMP in the No-Build condition. The proposed project connects the Maryland managed lanes with the existing southbound Express Lanes in Virginia. This helps with the traffic operations in the Build as it eases congestion along the GP lanes; whereas in the No-Build condition, all Maryland managed lanes traffic must merge with the GP lanes near the GWMP interchange, creating a bottleneck. As seen in **Figure 7-6**, 35 percent of the segments operate under congested to severe congestion along the southbound I-495 GP lanes in the No Build condition compared to 12 percent operating under congested condition in the Build condition. All the segments along the southbound Express Lanes operate under light to moderate traffic congestion in both the scenarios.

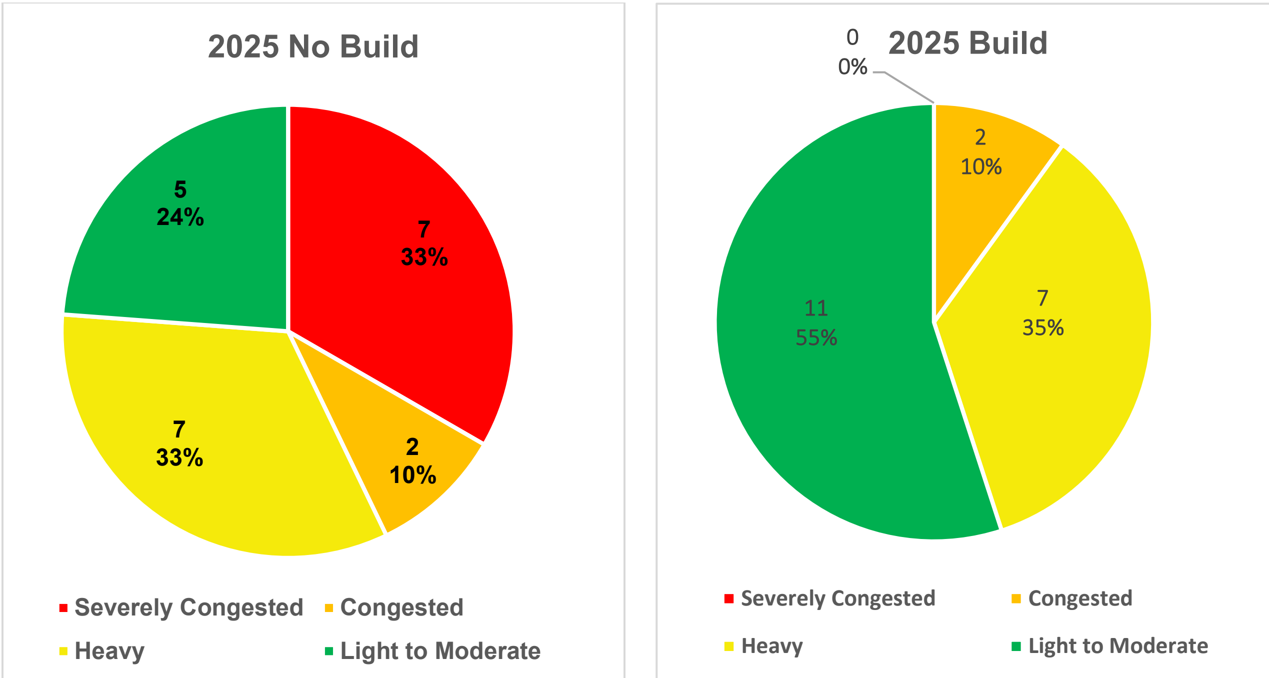


Figure 7-5: 2025 AM Freeway Segment Densities for I-495 Northbound GP Lanes

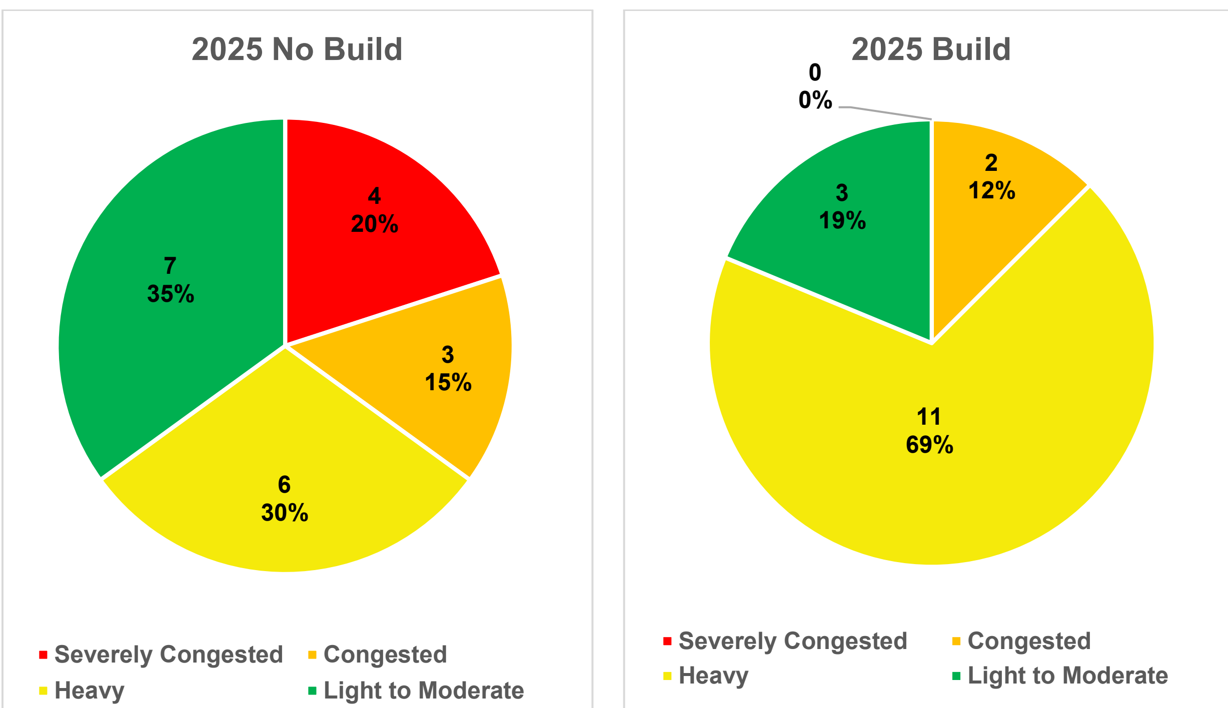


Figure 7-6: 2025 AM Freeway Segment Densities for I-495 Southbound GP Lanes

Speeds

As illustrated in **Exhibits 7-11** and **7-12**, the diagrams for average speeds in the AM peak period show similar patterns as seen in the density diagrams. Average speeds for the Build scenario in the GP lanes during the AM peak period in the northbound direction are at or near the posted speed limit, with a slight slowdown across the ALMB. In the No Build condition, however there is significant congestion between northbound Express Lanes terminus and ALMB. Consistent with the high-density levels, speeds range between 25 and 35 mph in those segments. In both the No Build and Build conditions, speeds are much higher north of the ALMB due to congestion relief provided by the Maryland managed lanes system.

In the southbound direction, all GP segments operate at free-flow conditions for most of the study corridor in the Build condition, with the exception of a slight slowdown near the Route 123 interchange. In the No Build condition, there is a slowdown north of the entrance to the southbound Express Lanes (between Route 193 and Route 267) due to weaving approaching the Express Lanes. Furthermore, in the No Build condition, due to the southbound Maryland managed lanes system terminating near the GWMP interchange, a merge bottleneck is created that spills back upstream in the southbound GP lanes across the ALMB.

Both directions of the Express Lanes operate at or near the posted speed limit.

Figure 7-7 provides a "heat map" comparison of average speeds between 2025 No Build and Build conditions for the AM peak period along the I-495 GP lanes. Time of day during the peak period is provided on the horizontal axis while location along the corridor is provided along the vertical axis; the colors signify average speeds for each scenario. The figure is consistent with the speed Exhibits and indicates a more significant presence of congestion in the No Build scenario in both directions of the I-495 GP lanes as compared to the Build scenario.

Figure 7-7: 2025 No Build and Build – AM Peak Period Average Speeds, I-495 GP Lanes

Travel Time

A comparison of AM peak period travel times for 2025 No Build and 2025 Build scenarios is shown in **Table 7-1**. Travel time measurements have been aggregated by direction of travel and facility type.

Table 7-1. 2025 AM Peak Period Travel Time Comparison

Route	GP Travel Times (Minutes: Seconds)		Express Lanes Travel Times (Minutes: Seconds)	
	2025 No Build	2025 Build	2025 No Build	2025 Build
Northbound I-495 (Route 123 to River Road)	9:37	6:53	7:43	6:12
Southbound I-495 (River Road to Route 123)	7:49	6:56	7:00	6:07
Eastbound Route 267 (Spring Hill Road to Route 123)	3:23	1:49	-	-
Westbound Route 267 (Route 123 to Spring Hill Road)	1:55	1:55	-	-

2025 Build AM peak period travel times improve or remain consistent as compared to No Build across all freeway facilities in the Traffic Operations Study Area.

- The average travel time in the northbound GP lanes improves by approximately 3 minutes (a 24 percent improvement) in the Build condition. The majority of the travel time savings are between Old Dominion Drive and Clara Barton Parkway, which is consistent with the speed results shown in the previous section.
- Vehicles traveling in the northbound Express Lanes see a 20 percent travel time improvement in the Build condition. The travel time improvement in the Build condition is between Lewinsville Road and GWMP, where in the No Build condition, vehicles need to travel on the congested GP lanes.
- In the southbound direction, GP travel times in the Build improve by 11 percent and Express Lanes travel time improve by 13 percent. Similar to northbound, providing a continuous Express Lanes system helps with the traffic operations.
- Along eastbound Route 267 (DTR) there is 47 percent improvement in travel time. With the improved operations along northbound I-495, the ramp from eastbound DTR to northbound I-495 does not spill back to eastbound DTR, improving operations along eastbound DTR.
- In the westbound direction, travel times along Route 267 (DTR) are essentially identical between No Build and Build.

Simulated Volumes and Demand Served

Figure 7-8 shows the comparison of unserved demand (vehicular throughput as compared to vehicular demand) between No Build and Build conditions for the AM peak hour in the northbound direction. As can be seen in the figure, all demand is served in the Build condition during the AM peak hour. In the No Build condition, the unserved demand is generally within 3 percent, and all segments with the unserved demand are located between Route 193 and River Road. The improved throughput in the Build condition can be attributed to the continuous Express Lanes system.

Figure 7-9 shows the comparison of unserved demand between No Build and Build conditions for the AM peak hour in the southbound direction. As can be seen in the figure, the unserved demand is within 3 percent in the Build compared to 6 percent in the No Build. The increased in the throughput in the Build condition can be attributed to the reduced congestion between Route 193 and Route 267 due to the new Express Lanes system being in place. The proposed project alleviates congestion in this segment, thus reducing the unserved demand.

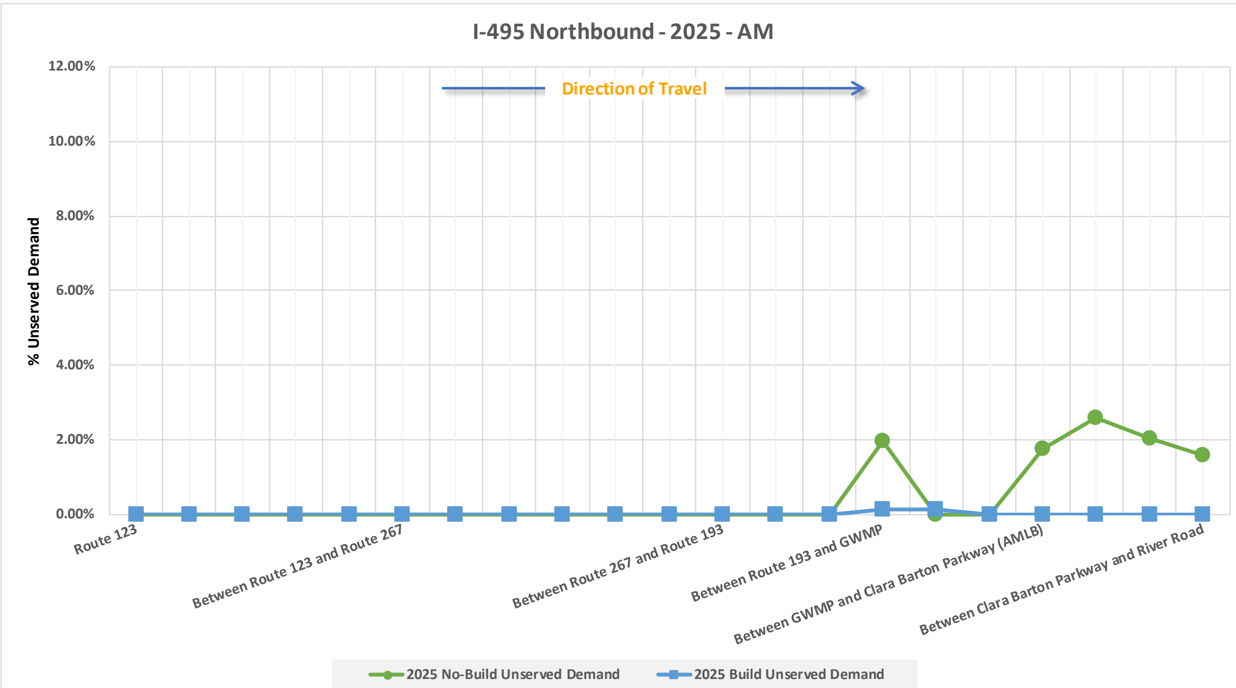


Figure 7-8. 2025 No Build and Build – AM Peak Hour Unserved Demand, I-495 Northbound

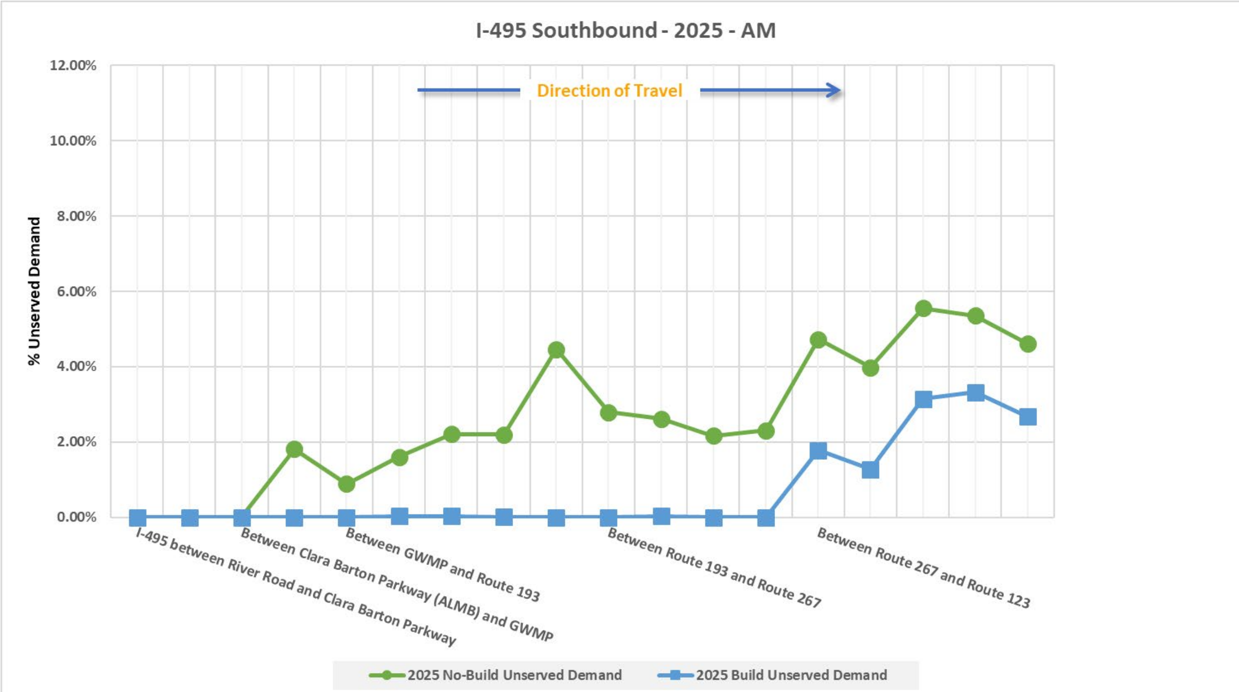


Figure 7-9. 2025 No Build and Build – AM Peak Hour Unserved Demand, I-495 Southbound

Person Throughput

Figure 7-10 and **Figure 7-11** display AM peak period person throughput along I-495 northbound and southbound, respectively (GP and Express combined). These figures show the estimated number of persons moved across a three-hour period based on simulated vehicle throughput and assumed vehicle occupancies for GP and Express Lanes. GP lanes are assumed to carry 1.1 persons per vehicle, based on the estimated non-HOV lane auto occupancy MWCOG has estimated across various interstate facilities in Northern Virginia (MWCOG, 2014). Express Lanes are assumed to carry 1.44 person per vehicle, based on a historic 18 percent HOV-3 utilization in the existing I-495 Express Lanes and assuming the remaining 82 percent of vehicles take on the non-HOV lane auto occupancy. These figures show that person throughput increases in the Build scenario across the length of the I-495 corridor in both directions due to the added capacity from the Express Lanes and increased occupancy of vehicles in those lanes.

- In the northbound direction, the highest person throughputs are across the ALMB. Increases in throughput from No Build to Build range from 4 to 17 percent, with the greatest increase in the segments between Route 267 and GWMP where the new Express Lanes significantly add capacity.
- In the southbound direction, the highest person throughputs are again across the ALMB. Increases in throughput from No Build to Build range from 6 to 21 percent, with the greatest increases again in the segments between GWMP and Route 267 where the new Express Lanes significantly add capacity.

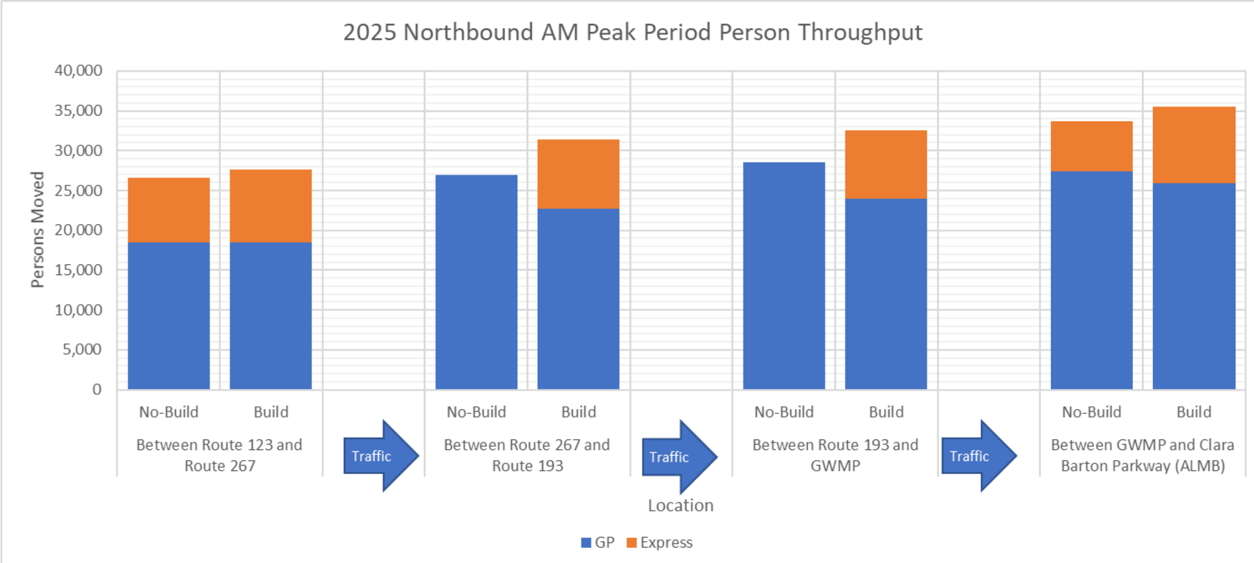


Figure 7-10. 2025 No Build and Build – AM Peak Period Person Throughput, I-495 Northbound

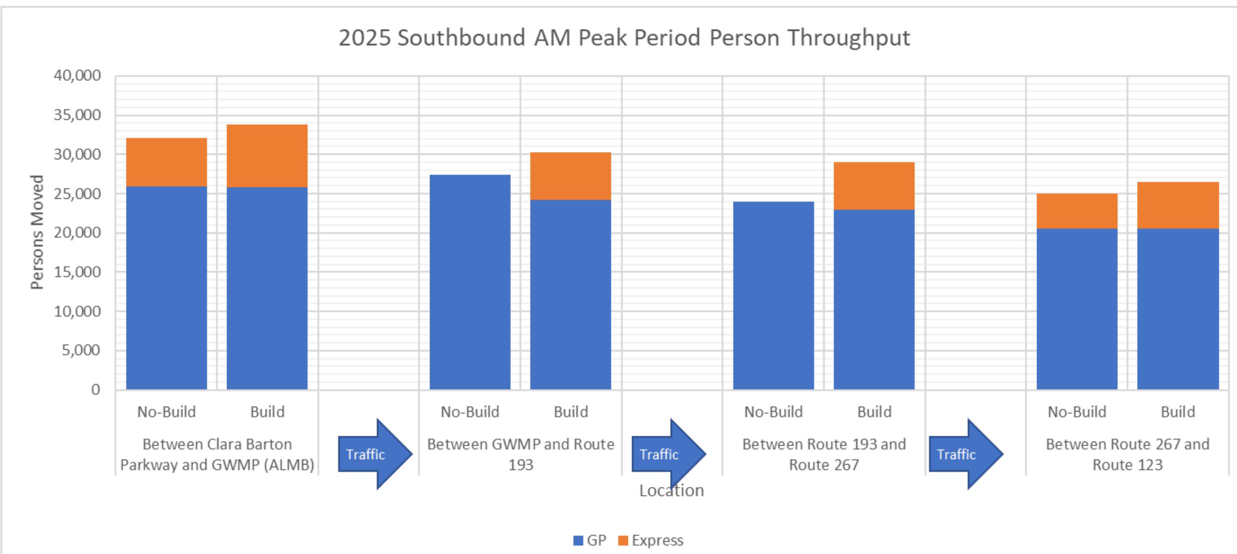


Figure 7-11. 2025 No Build and Build – AM Peak Period Person Throughput, I-495 Southbound

7.2.3 2025 No Build vs Build PM Freeway Operations

Exhibits 7-13 through **7-16** illustrate the density and speed results from the VISSIM models for the I-495 and Route 267 mainline segments in the study area for the PM peak period:

- **Exhibits 7-13a** through **7-13c** show 2025 No Build PM peak period freeway densities.
- **Exhibits 7-14a** through **7-14c** show 2025 Build PM peak period freeway densities.
- **Exhibits 7-15a** through **7-15c** show 2025 No Build PM peak period freeway speeds.
- **Exhibits 7-16a** through **7-16c** show 2025 Build PM peak period freeway speeds.

In each figure, the centerline diagram laid over the aerial depicts the average densities or speeds during the peak hour from 3:45 p.m. to 4:45 p.m. in both directions along the mainline segments. The average densities and speeds are color-coded based on the congestion levels and ranges of speeds as depicted in the legend. The boxes on the top and bottom depict the densities and speeds in each direction for the entire peak period from 2:45 p.m. to 5:45 p.m., including the shoulder periods before and after the peak hour. Detailed tabular results can be found in **Appendix G.**

Density

In the PM peak period, it can be seen from the exhibits that in the northbound GP lanes, all of the segments in the Build condition operate under light-to-moderate density traffic for the entire study corridor, which represents an improvement over the No Build condition. In the No Build condition, with the background projects in place including the Maryland managed lanes, there is still a significant improvement in operations along northbound I-495 compared to existing conditions; with the proposed project in the Build condition, there is further improvement. As seen in **Figure 7-12**, 100 percent of the segments operate at a light to moderate traffic conditions in the Build condition compared to 81 percent in the No Build condition.

In the southbound GP lanes, with the exception of one segment near Route 123 in Tysons, all of the freeway segments in the Build condition operate under light-to-congested traffic conditions, which represents a significant improvement over the No Build condition. The Build condition provide a continuous Express Lane system, which increases capacity and improves traffic operations. Also, in the Build condition, there is some shift in demand from GP to Express Lanes for the southbound I-495 to westbound DTR movement. This shift in the volume also helps in relieving the congestion experienced along southbound I-495 in the No Build. As seen in **Figure 7-13**, 87 percent segments operate at light to heavy traffic conditions in the Build compared to only 35 percent in the No Build.

Northbound and southbound Express Lanes segments operate under light to moderate traffic conditions in both the No Build and Build conditions.

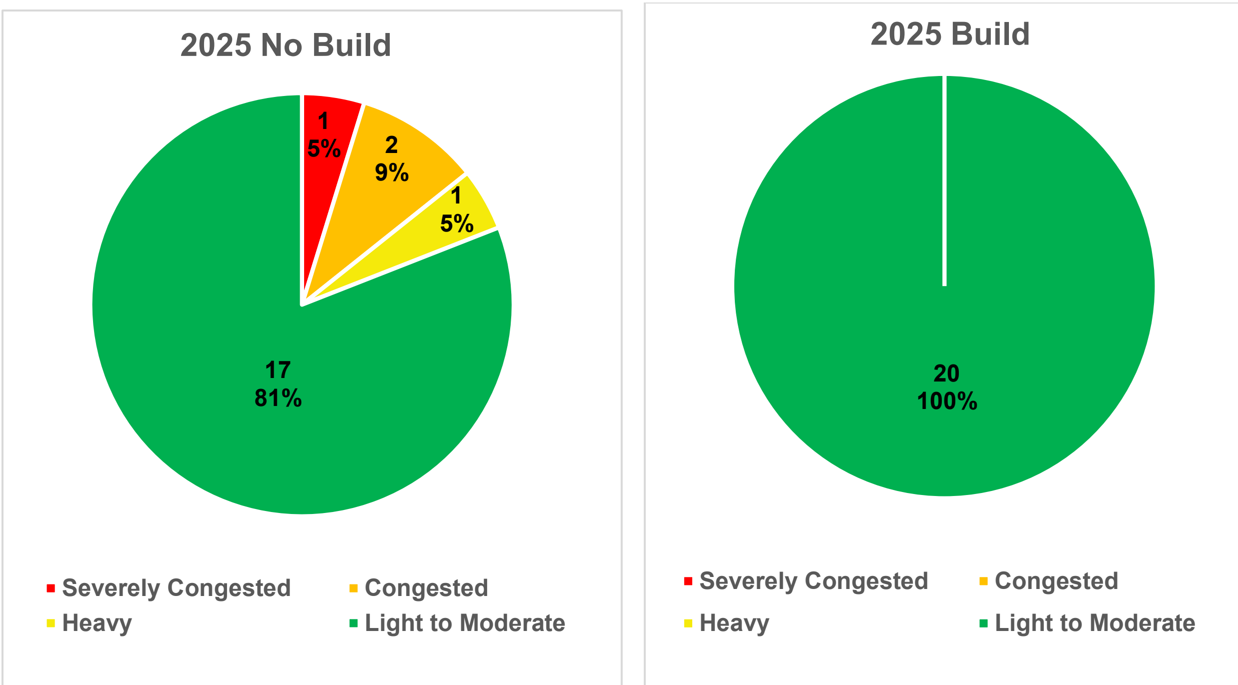


Figure 7-12: 2025 PM Freeway Segment Densities for I-495 Northbound GP Lanes

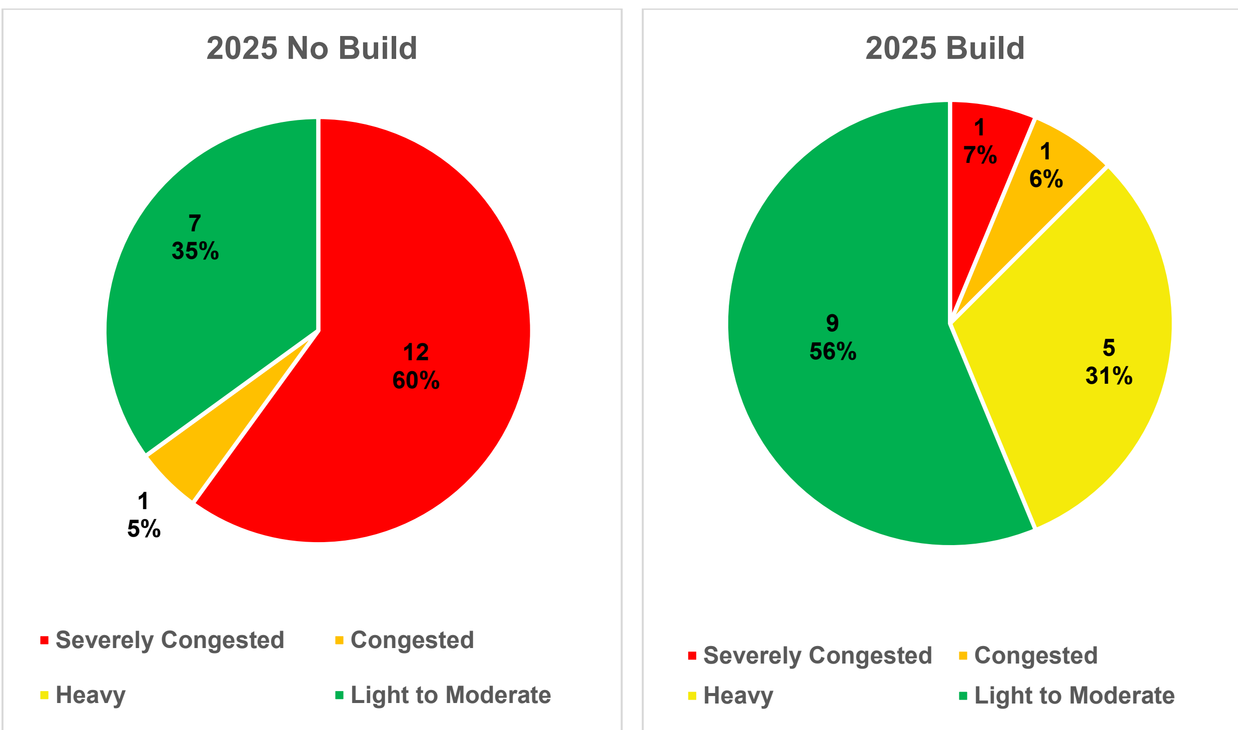


Figure 7-13: 2025 PM Freeway Segment Densities for I-495 Southbound GP Lanes

Speeds

As illustrated in **Exhibits 7-15** and **7-16**, the diagrams for average speeds in the PM peak period show similar patterns as seen in the density diagrams. Average speeds for the Build scenario in the GP lanes during the PM peak period in the northbound direction are at or near the posted speed limit. In the No Build condition, however there is significant congestion between northbound Express Lanes terminus and ALMB, at which point the Maryland managed lanes system begins. Consistent with the high density levels for these segments in the No Build condition, speeds range between 25 and 35 mph in these segments in the No Build condition. In both the No Build and Build conditions, speeds are much higher north of the ALMB due to congestion relief provided by the Maryland managed lanes system.

In the southbound direction, most GP segments operate at near free-flow conditions for most of the study corridor in the Build condition, with the exception of a slight slowdown near the Route 123 interchange due to congestion in Tysons. In the No Build condition, there is a slowdown north of the left-side entrance to the southbound Express Lanes (between Route 193 and Route 267) and downstream right-side exit to westbound DTR due to weaving approaching both the Express Lanes and DTR, as both of these movements have heavy volumes. This congestion is also worsened in the No Build scenario due to the southbound Maryland managed lanes system terminating near the GWMP interchange, creating a merge that spills back upstream in the GP lanes across the ALMB.

Both directions of the Express Lanes operate at or near the posted speed limit.

Figure 7-14 provides a "heat map" comparison of average speeds between 2025 No Build and Build conditions for the PM peak period along the I-495 GP lanes. Time of day during the peak period is provided on the horizontal axis while location along the corridor is provided along the vertical axis; the colors signify average speeds for each scenario. The figure is consistent with the speed Exhibits and indicates a more significant presence of congestion in the No Build scenario in both directions of the I-495 GP lanes.

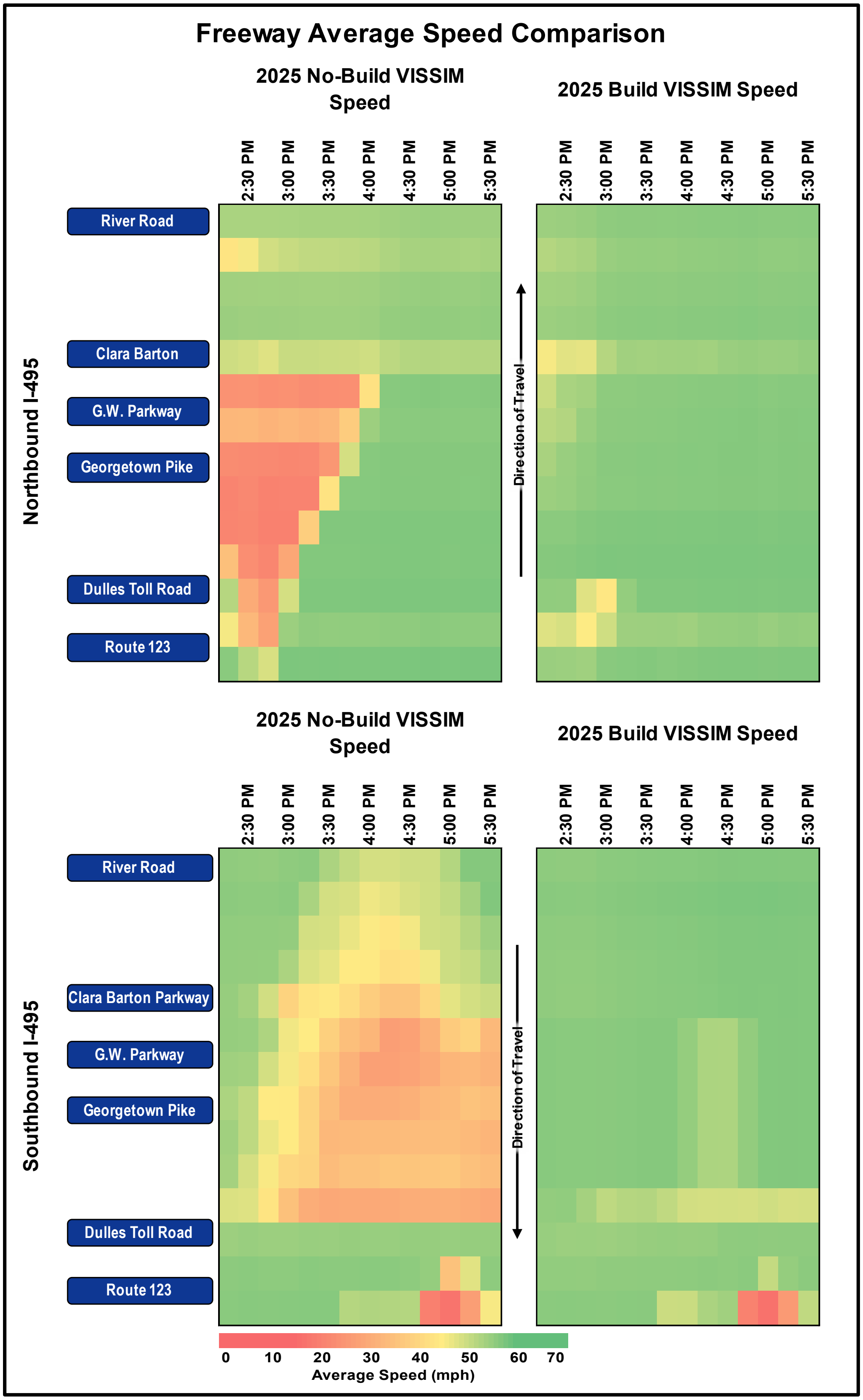


Figure 7-14: 2025 No Build and Build – PM Peak Period Average Speeds, I-495 GP Lanes

Travel Time

A comparison of PM peak period travel times for 2025 No Build and 2025 Build scenarios is shown in **Table 7-2**. Travel time measurements have been aggregated by direction of travel and facility type.

Table 7-2. 2025 PM Peak Period Travel Time Comparison

Route	GP Travel Times (Minutes: Seconds)		Express Lanes Travel Times (Minutes: Seconds)	
	2025 No Build	2025 Build	2025 No Build	2025 Build
Northbound I-495 (Route 123 to River Road)	10:36	6:45	8:02	6:05
Southbound I-495 (River Road to Route 123)	15:59	8:05	8:11	6:09
Eastbound Route 267 (Spring Hill Road to Route 123)	1:49	1:49	-	-
Westbound Route 267 (Route 123 to Spring Hill Road)	1:50	1:50	-	-

2025 Build PM peak period travel times improve or remain consistent as compared to No Build across all freeway facilities in the Traffic Operations Study Area.

- The average travel time in the northbound GP lanes improves by nearly 4 minutes (a 36 percent improvement). The majority of the travel time savings are between Old Dominion Drive and Clara Barton Parkway, which is consistent with the speed results shown in the previous section.
- Vehicles traveling on the northbound Express Lanes see a 24 percent travel time improvement. The travel time improvement in the Build condition is between Lewisville Road and GWMP, where in the No Build condition, vehicles need to travel on the congested GP lanes.
- In the southbound direction, GP travel times in the Build improve by nearly 8 minutes (49 percent) and Express Lanes travel time improve by 11 percent. Providing a continuous Express Lanes system, as well as some shift in the volume for the southbound I-495 to westbound DTR movement from GP lanes to Express Lanes, helps relieve the congestion.
- Along eastbound and westbound Route 267 (DTR), travel times are essentially identical between No Build and Build.

Simulated Volumes and Demand Served

Figure 7-15 shows the comparison of unserved demand (vehicular throughput as compared to vehicular demand) between No Build and Build conditions for the PM peak hour in the northbound direction. The figure suggests that the No Build condition does not have unserved demand north of GWMP during the PM peak hour; what this actually represents is unserved throughput from the previous hour(s), which are congested as shown in the speed heat map. As that throughput is now being served during the peak hour as opposed to the prior hour, the total peak hour throughput is equivalent to or exceeding the forecasted peak hour demand. In the Build condition, upstream of GWMP, the percent of unserved demand is generally consistent with the No Build condition. This unserved demand in both scenarios is attributable to heavy congestion along arterials in Tysons (such as Route 123) metering demand onto I-495.

Figure 7-16 shows the comparison of unserved demand between No Build and Build conditions for the PM peak hour in the southbound direction. As can be seen in the figure, the percentage of unserved demand is lower in the Build scenario along the length of the corridor. The increased in the throughput in the Build condition can be attributed to the reduced congestion between Route 193 and Route 267 due to the new Express Lanes system being in place. The proposed project alleviates congestion in this segment, thus reducing the unserved demand. South of Route 267, congestion along I-495 and along arterials in Tysons constrains demand in both the No Build and Build condition, thus increasing the percentage of unserved demand.

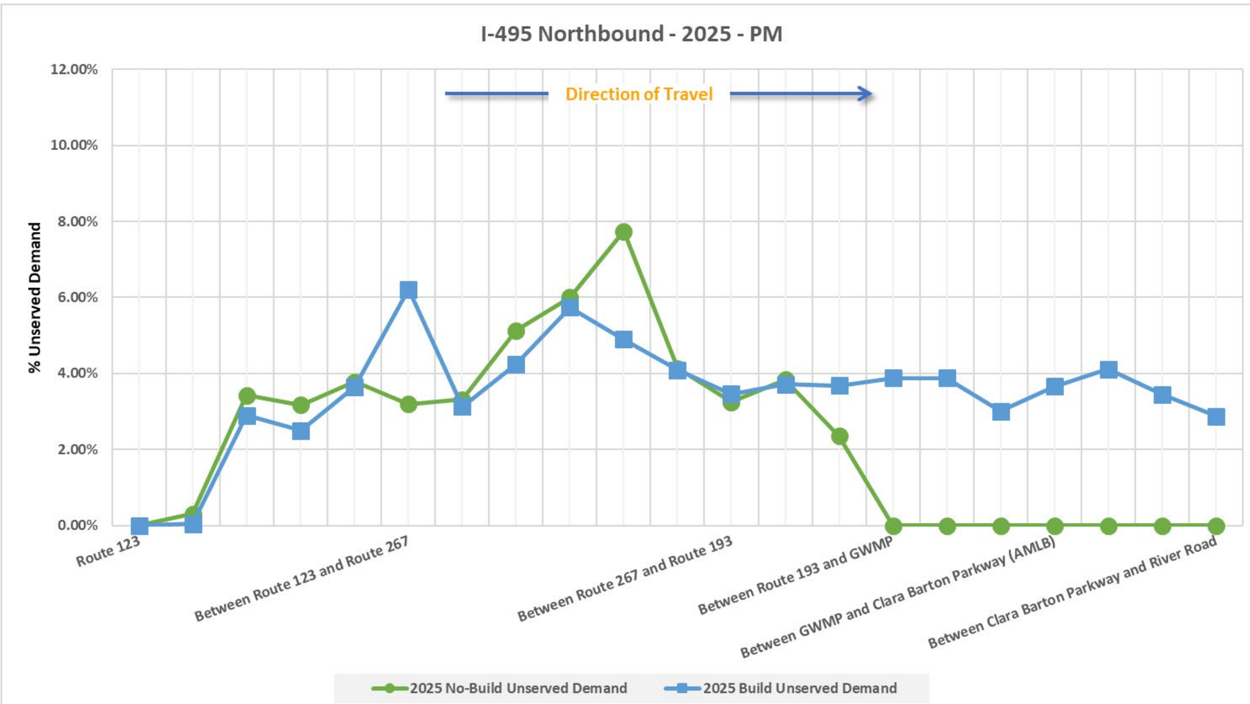


Figure 7-15. 2025 No Build and Build – PM Peak Hour Unserved Demand, I-495 Northbound

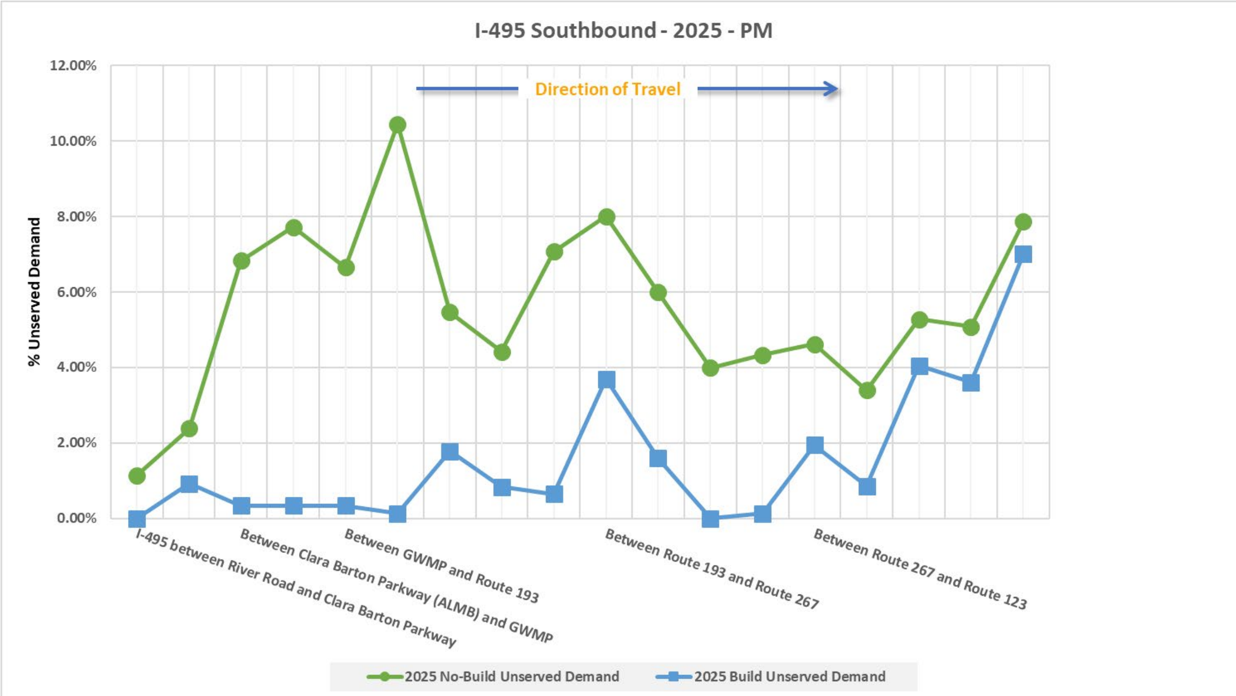


Figure 7-16. 2025 No Build and Build – PM Peak Hour Unserved Demand, I-495 Southbound

Person Throughput

Figure 7-17 and **Figure 7-18** display PM peak period person throughput along I-495 northbound and southbound, respectively (GP and Express combined). These figures show the estimated number of persons moved across a three-hour period based on simulated vehicle throughput and assumed vehicle occupancies for GP and Express Lanes. GP lanes are assumed to carry 1.1 persons per vehicle, based on the estimated non-HOV lane auto occupancy MWCOG has estimated across various interstate facilities in Northern Virginia (MWCOG, 2014). Express Lanes are assumed to carry 1.44 person per vehicle, based on a historic 18 percent HOV-3 utilization in the existing I-495 Express Lanes and assuming the remaining 82 percent of vehicles take on the non-HOV lane auto occupancy. These figures show that person throughput increases in the Build scenario across the length of the I-495 corridor in both directions due to the added capacity from the Express Lanes and increased occupancy of vehicles in those lanes.

- In the northbound direction, the highest person throughputs are across the ALMB. Increases in throughput from No Build to Build range from 8 to 37 percent, with the greatest increase in the segments between Route 267 and GWMP where the new Express Lanes significantly add capacity.
- In the southbound direction, the highest person throughputs are again across the ALMB. Increases in throughput from No Build to Build range from 10 to 47 percent, with the greatest increases again in the segments between GWMP and Route 267 where the new Express Lanes significantly add capacity.

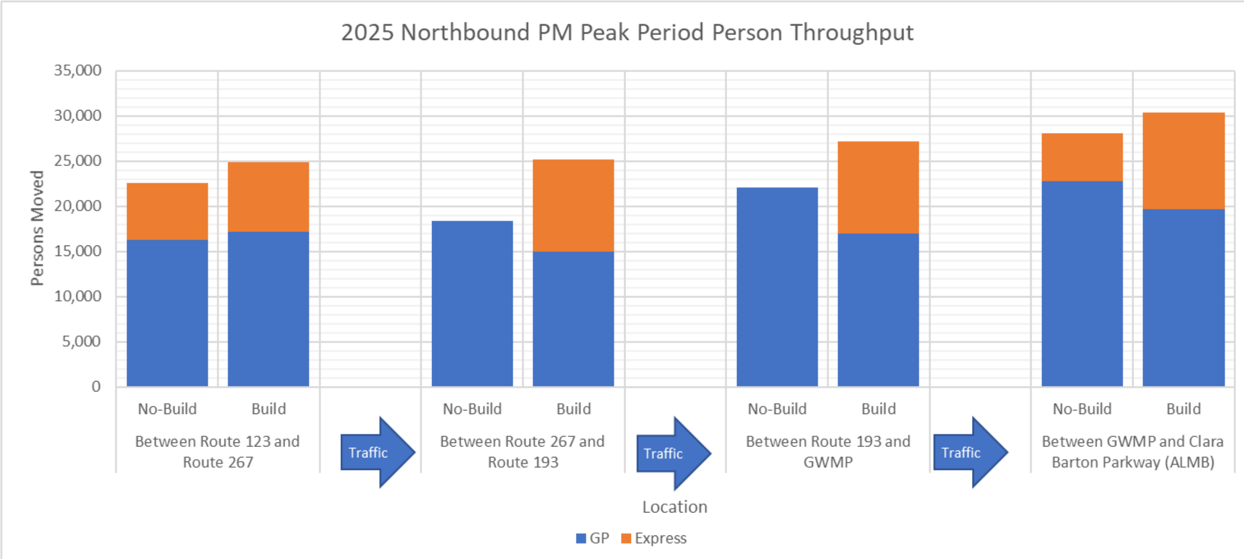


Figure 7-17. 2025 No Build and Build – PM Peak Period Person Throughput, I-495 Northbound

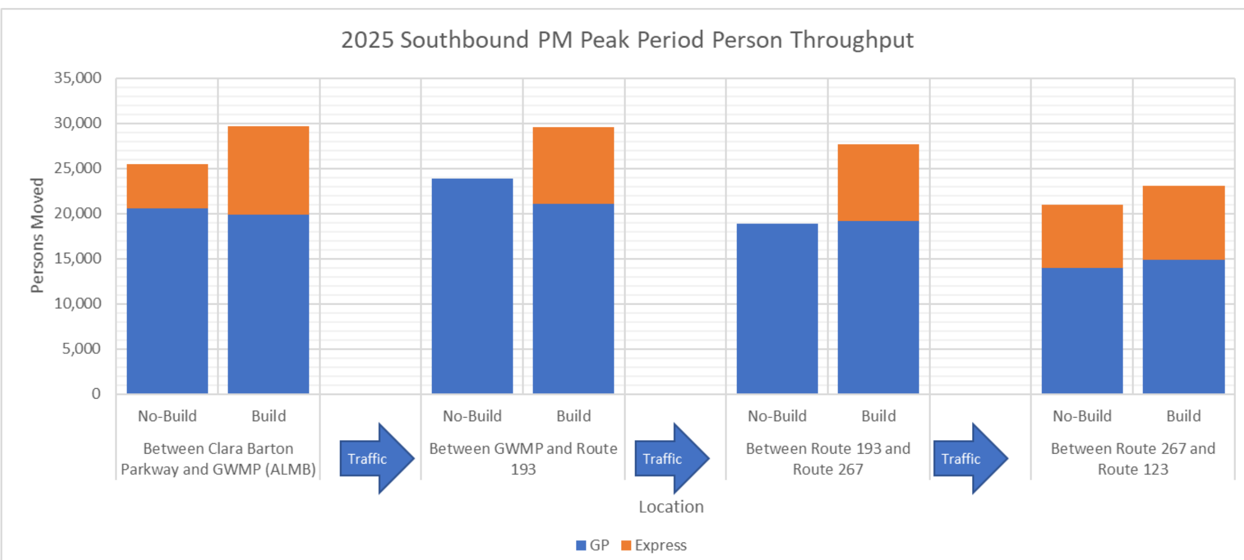


Figure 7-18. 2025 No Build and Build – PM Peak Period Person Throughput, I-495 Southbound

7.2.4 2025 No Build vs. Build Arterial Operations

AM Arterial Operations

Intersections Evaluated in VISSIM

Intersections in the Traffic Operations Study Area evaluated in VISSIM generally see similar operations in the 2025 AM peak hour under both No Build and Build conditions. **Figure 7-19** provides pie charts of overall intersection HCM-analogous LOS for No Build and Build conditions. The figure shows that both scenarios see the same percentage of intersections operating under failing conditions (19 percent).

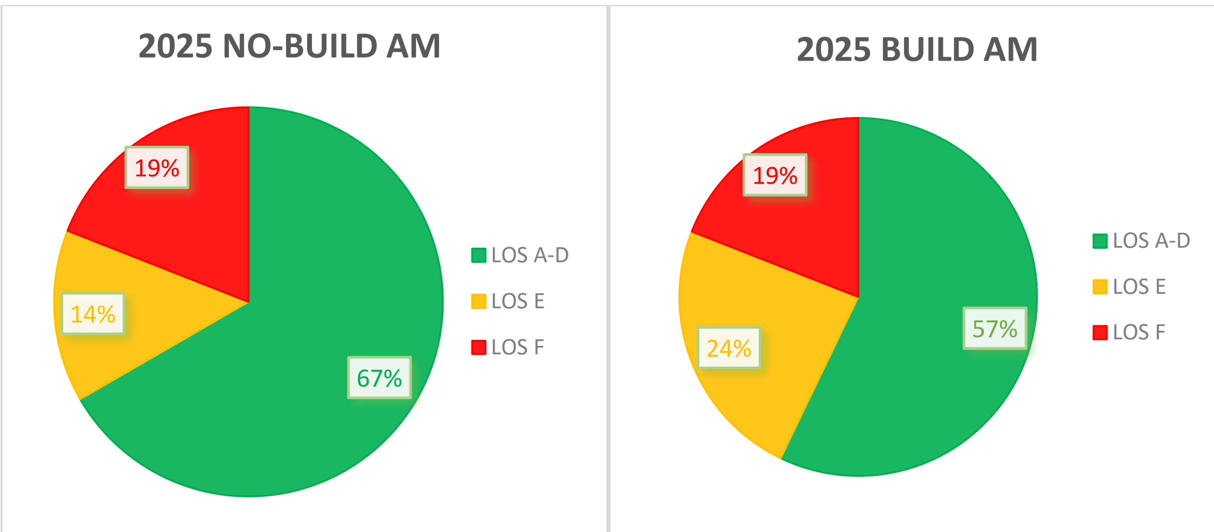


Figure 7-19. Summary of Arterial HCM-Analogous LOS, 2025 AM No Build vs. Build Conditions

Table 7-3 compares the overall intersection HCM-analogous LOS between the two scenarios for each intersection. A detailed breakdown of intersection delay and LOS, including delay and LOS by approach, is provided in **Appendix H.**

The following intersections operate under failing conditions under both 2025 No Build and Build conditions:

- Route 123 and Route 267 eastbound off-ramp/Anderson Road
- Route 123 and Lewinsville Road/Great Falls Street
- Spring Hill Road and Dulles Toll Road eastbound ramps

All three of these intersections are in the Tysons area and see continued growth in demand tied to commercial and residential growth in Tysons.

The unsignalized intersection of Route 193 and Helga Place/Linganore Drive is failing under 2025 No Build conditions due to heavy delays on the southbound approach; this stop-controlled approach sees few gaps for traffic to enter the mainline Route 193 traffic stream due to heavy congestion in along eastbound Route 193 (spilling back from the northbound on-ramp to I-495). In the Build scenario, this eastbound congestion along Route 193 is relieved due to improved operations along northbound I-495, which reduces queue spillback on the on-ramp from Route 193.

The signalized intersection of Route 123 and Capital One Tower Drive / Old Meadow Road is failing under 2025 Build conditions with an overall intersection delay of approximately 83 seconds; under No Build conditions, this intersection operates with a delay of approximately 78 seconds. This minor increase in delay is attributable to increased throughput along I-495, allowing more vehicles to access Route 123 in Tysons.

Table 7-3. VISSIM Intersection Microsimulation Delay and HCM-Analogous LOS – 2025 No Build vs. Build AM Peak Hour

Intersection Control	Intersection	2025 No-Build		2025 Build	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS
Signalized	Route 123 and Tysons Boulevard	32.6	C	33.3	C
Signalized	Westpark Drive and Tysons Connector	21.4	C	22.7	C
Signalized	Tysons Connector and Express Lanes Ramps	13.9	B	14.1	B
Signalized	Route 123 and Capital One Tower Drive/ Old Meadow Road	77.9	E	83.0	F
Signalized	Route 123 and Scotts Crossing Boulevard/ Colshire Drive	74.6	E	78.4	E
Signalized	Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road	106.8	F	86.8	F
Signalized	Route 123 and Lewinsville Road/ Great Falls Street	136.3	F	155.0	F
Signalized	Lewinsville Road and Balls Hill Road	22.5	C	22.0	C
Signalized	Jones Branch Drive and Jones Branch Connector	17.6	B	18.0	B
Signalized	Jones Branch Connector and Express Lanes Ramps	64.7	E	65.0	E
Signalized	Jones Branch Drive and Capital One (West)	17.0	B	17.6	B
Signalized	Jones Branch Drive and Capital One (East)	5.4	A	5.3	A
Signalized	International Drive and Spring Hill Road/ Jones Branch Drive	48.3	D	49.1	D
Signalized	Spring Hill Road and Dulles Toll Road Eastbound Ramps	159.8	F	150.7	F
Signalized	Spring Hill Road and Dulles Toll Road Westbound Ramps	31.9	C	77.1	E

Intersection Control	Intersection	2025 No-Build		2025 Build	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS
Signalized	Spring Hill Road and Lewinsville Road	54.1	D	57.6	E
Unsignalized	Route 193 and Helga Place/ Linganore Drive	139.6	F	39.5	E
Signalized	Route 193 and I-495 Southbound Ramps	25.4	C	23.9	C
Signalized	Route 193 and I-495 Northbound Ramps	20.5	C	20.7	C
Signalized	Route 193 and Balls Hill Road	21.1	C	23.0	C
Unsignalized	Route 193 and Dead Run Drive	9.6	A	9.5	A

Intersections Evaluated in Synchro

The expanded arterial network beyond intersections immediately adjacent to freeway interchanges in the corridor was evaluated solely through Synchro. **Table 7-4** compares the overall intersection delay and LOS between the two scenarios for each intersection.

Under both No Build and Build conditions, the following intersections are failing:

- Old Dominion Drive and Balls Hill Road (signalized)
- Route 193 and Swinks Mill Road (unsignalized)
- Route 193 and Douglass Drive (unsignalized)

Note that under Build conditions, while the two unsignalized intersections along Route 193 are experiencing failing conditions due to significant delays on stop-controlled approaches, a significant reduction in delay is achieved as compared to No Build conditions.

Table 7-4. 2025 Synchro Intersection Delay and LOS – 2025 No Build vs. Build AM Peak Hour

Intersection Control	Intersection Name	2025 No-Build AM		2025 Build AM	
		Intersection Delay (Sec/veh)	LOS	Intersection Delay (Sec/veh)	LOS
Signalized	Old Dominion Drive at Spring Hill Road	10.9	B	10.9	B
Signalized	Old Dominion Drive at Swinks Mill Road	16.2	B	16.2	B
Signalized	Old Dominion Drive at Balls Hill Road	101.5	F	101.5	F
Signalized	Route 123 at Old Dominion Drive	43.7	D	43.7	D
Unsignalized	Route 193 at Swinks Mill Road	221.4	F	101.9	F
Unsignalized	Route 193 at Spring Hill Road	18.0	C	16.7	C
Unsignalized	Lewinsville Road at Swinks Mill Road	46.7	E	47.6	E

Intersection Control	Intersection Name	2025 No-Build AM		2025 Build AM	
		Intersection Delay (Sec/veh)	LOS	Intersection Delay (Sec/veh)	LOS
Unsignalized	Route 123 at Ingleside Avenue	20.2	C	19.9	C
Unsignalized	Douglass Drive at Route 193	153.7	F	115.3	F

Figure 7-20 provides a summary comparison of overall intersection delay for Build conditions as compared to No Build conditions at each intersection in the Traffic Operations Study Area for the 2025 AM scenario. The figure shows whether an intersection shows an improvement in operations (increase in LOS in Build conditions if below LOS D for No Build conditions, or a significant reduction in delay if still operating at LOS F in Build conditions), a degradation in operations (decrease in LOS in Build conditions or significant increase in delay if operating at LOS F already in No Build conditions), or if operations remain generally consistent between the two scenarios.

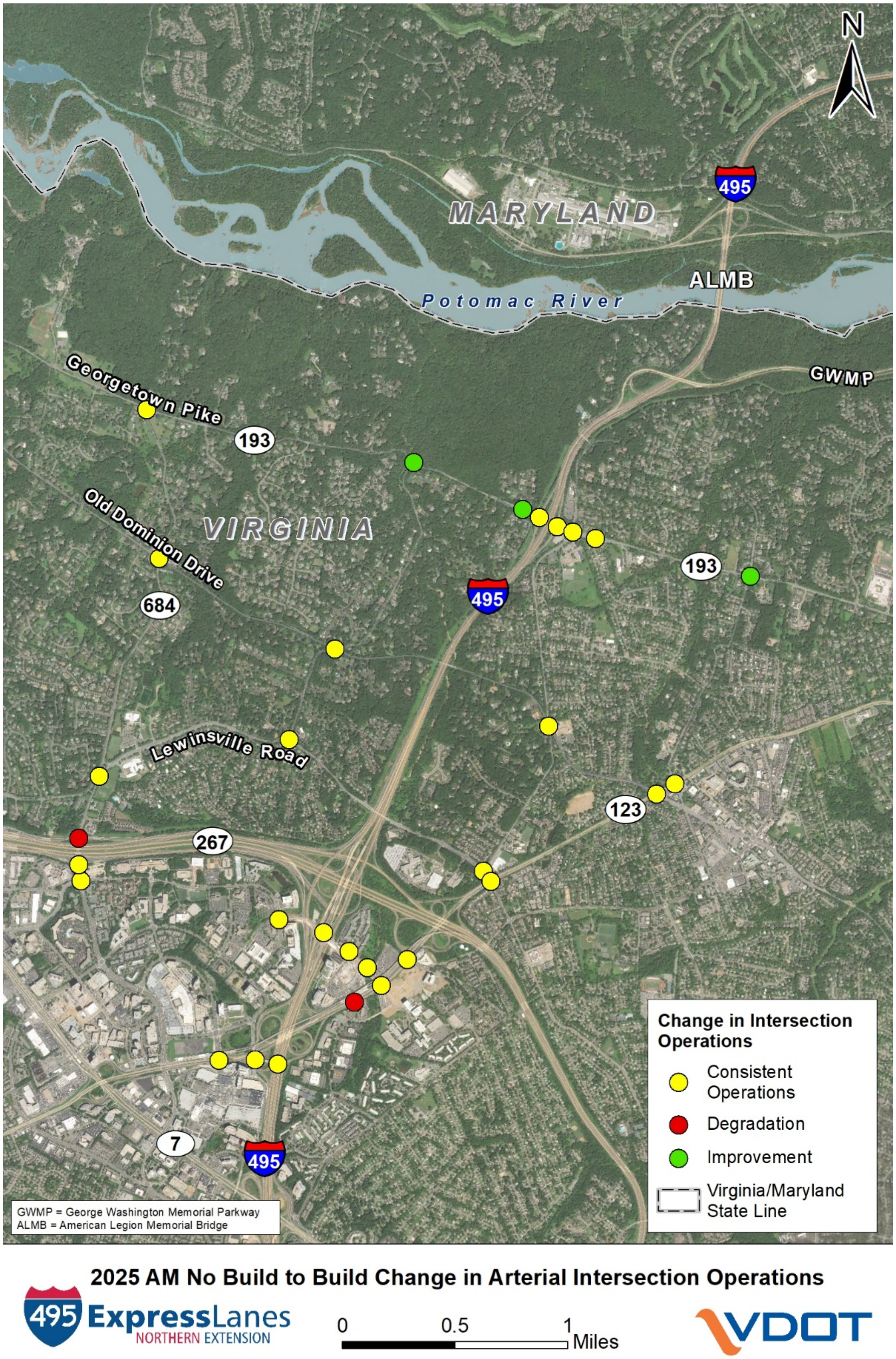


Figure 7-20. 2025 AM No Build to Build Change in Arterial Intersection Operations

PM Arterial Operations

Intersections Evaluated in VISSIM

Intersections in the Traffic Operations Study Area evaluated in VISSIM generally see improved operations in the 2025 PM peak hour in the Build condition as compared to No Build conditions. **Figure 7-21** provides pie charts of overall intersection HCM-analogous LOS for No Build and Build conditions. The figure shows under Build conditions, 33 percent of intersections are at LOS F while 43 percent are at LOS F under No Build conditions. Additionally, more than half of all intersections are LOS D or better in the Build condition, while only 33 percent are at LOS D or better in the No Build condition.

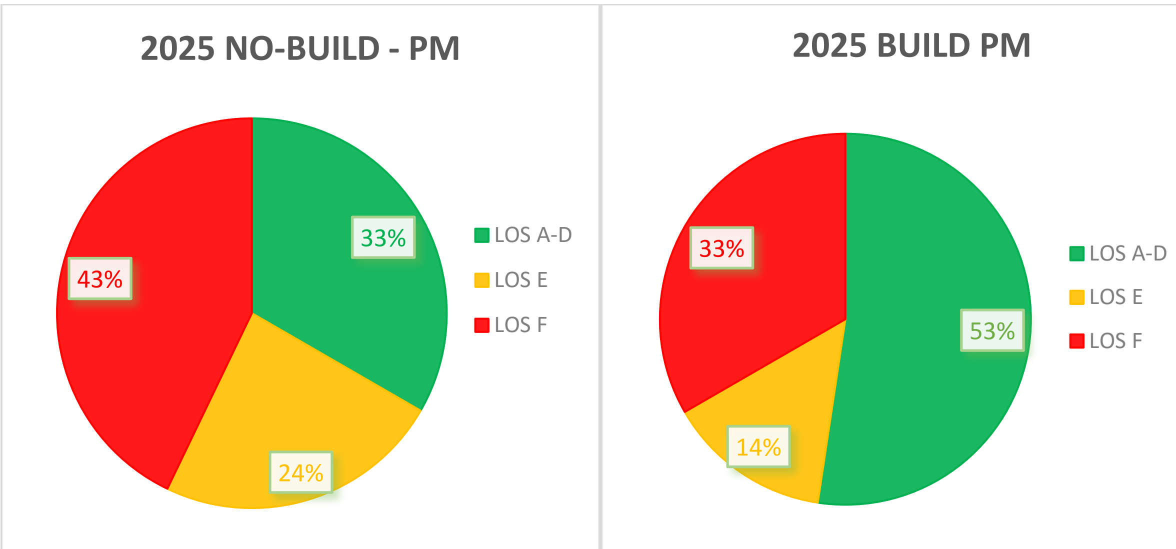


Figure 7-21. Summary of Arterial HCM-Analogous LOS, 2025 PM No Build vs. Build Conditions

Table 7-5 compares the overall intersection HCM-analogous LOS between the two scenarios for each intersection. A detailed breakdown of intersection delay and LOS, including delay and LOS by approach, is provided in **Appendix H.**

The following intersections operate under failing conditions under both 2025 No Build and Build conditions:

- Route 123 and Tysons Boulevard
- Route 123 and Capital One Tower Drive / Old Meadow Road
- Route 123 and Lewinsville Road/Great Falls Street
- Lewinsville Road and Balls Hill Road
- Jones Branch Connector and I-495 Express Lanes ramps
- International Drive and Spring Hill Road / Jones Branch Drive
- Route 193 and Dead Run Drive (unsignalized)

Most of these intersections are in the Tysons area and see continued growth in demand tied to commercial and residential growth in Tysons.

The signalized intersection of Route 123 and the Route 267 eastbound off-ramp / Anderson Road is failing under 2025 No Build conditions but improves to LOS E under 2025 Build conditions. However, the overall delay improves from approximately 86 seconds to approximately 79 seconds, representing a fairly minor improvement in operations.

The unsignalized intersection of Route 193 and Helga Place/Linganore Drive is failing under 2025 No Build conditions due to heavy delays on the southbound approach; this stop-controlled approach sees few gaps for traffic to enter the mainline Route 193 traffic stream due to heavy congestion in along eastbound Route 193 (spilling back from the northbound on-ramp to I-495). In the Build scenario, this eastbound congestion along Route 193 is relieved due to improved operations along northbound I-495, which reduces queue spillback on the on-ramp from Route 193.

Table 7-5. VISSIM Intersection Microsimulation Delay and HCM-Analogous LOS – 2025 No Build vs. Build PM Peak Hour

Intersection Control	Intersection	2025 No-Build		2025 Build	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS
Signalized	Route 123 and Tysons Boulevard	174.5	F	177.1	F
Signalized	Westpark Drive and Tysons Connector	11.4	B	10.4	B
Signalized	Tysons Connector and Express Lanes Ramps	7.6	A	7.4	A
Signalized	Route 123 and Capital One Tower Drive/ Old Meadow Road	177.1	F	178.7	F
Signalized	Route 123 and Scotts Crossing Boulevard/ Colshire Drive	76.9	E	71.9	E
Signalized	Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road	85.9	F	78.7	E
Signalized	Route 123 and Lewinsville Road/ Great Falls Street	116.3	F	113.9	F
Signalized	Lewinsville Road and Balls Hill Road	116.6	F	117.1	F
Signalized	Jones Branch Drive and Jones Branch Connector	16.2	B	16.6	B
Signalized	Jones Branch Connector and Express Lanes Ramps	149.3	F	144.7	F
Signalized	Jones Branch Drive and Capital One (West)	21.0	C	20.5	C
Signalized	Jones Branch Drive and Capital One (East)	8.3	A	7.2	A
Signalized	International Drive and Spring Hill Road/ Jones Branch Drive	89.0	F	99.8	F
Signalized	Spring Hill Road and Dulles Toll Road Eastbound Ramps	20.2	C	20.1	C

Intersection Control	Intersection	2025 No-Build		2025 Build	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS
Signalized	Spring Hill Road and Dulles Toll Road Westbound Ramps	61.8	E	39.8	D
Signalized	Spring Hill Road and Lewinsville Road	75.0	E	76.5	E
Unsignalized	Route 193 and Helga Place/ Linganore Drive	157.9	F	28.0	D
Signalized	Route 193 and I-495 Southbound Ramps	61.7	E	42.5	D
Signalized	Route 193 and I-495 Northbound Ramps	19.9	B	21.5	C
Signalized	Route 193 and Balls Hill Road	65.0	E	35.5	D
Unsignalized	Route 193 and Dead Run Drive	58.6	F	71.5	F

Intersections Evaluated in Synchro

The expanded arterial network beyond intersections immediately adjacent to freeway interchanges in the corridor was evaluated solely through Synchro. **Table 7-6** compares the overall intersection delay and LOS between the two scenarios for each intersection.

Under both No Build and Build conditions, the following intersections are failing:

- Old Dominion Drive and Balls Hill Road (signalized)
- Lewinsville Road and Swinks Mill Road (unsignalized)
- Route 193 and Douglass Drive (unsignalized)

Two of these three intersections are also failing in the 2025 AM peak hour under both No Build and Build conditions. Note that under Build conditions, while the intersection of Route 193 and Douglass Drive is still failing, a significant reduction in delay is achieved as compared to No Build conditions.

Table 7-6. 2025 Synchro Intersection Delay and LOS – 2025 No Build vs. Build PM Peak Hour

Intersection Control	Intersection Name	2025 No Build PM		2025 Build PM	
		Intersection Delay (Sec/veh)	LOS	Intersection Delay (Sec/veh)	LOS
Signalized	Old Dominion Drive at Spring Hill Road	10.8	B	10.8	B
Signalized	Old Dominion Drive at Swinks Mill Road	12.1	B	12.1	B
Signalized	Old Dominion Drive at Balls Hill Road	189.4	F	181.5	F

Intersection Control	Intersection Name	2025 No Build PM		2025 Build PM	
		Intersection Delay (Sec/veh)	LOS	Intersection Delay (Sec/veh)	LOS
Signalized	Route 123 at Old Dominion Drive	41.9	D	41.7	D
Unsignalized	Route 193 at Swinks Mill Road	23.4	C	15.8	C
Unsignalized	Georgetown Pike at Spring Hill Road	13.3	B	12.7	B
Unsignalized	Lewinsville Road at Swinks Mill Road	85.8	F	87.9	F
Unsignalized	Route 123 at Ingleside Avenue	24.9	C	24.9	C
Unsignalized	Douglass Drive at Route 193	280.2	F	144.2	F

Figure 7-22 provides a summary comparison of overall intersection delay for Build conditions as compared to No Build conditions at each intersection in the Traffic Operations Study Area for the 2025 PM scenario. The figure shows whether an intersection shows an improvement in operations (increase in LOS in Build conditions if below LOS D for No Build conditions, or a significant reduction in delay if still operating at LOS F in Build conditions), a degradation in operations (decrease in LOS in Build conditions or significant increase in delay if operating at LOS F already in No Build conditions), or if operations remain generally consistent between the two scenarios.

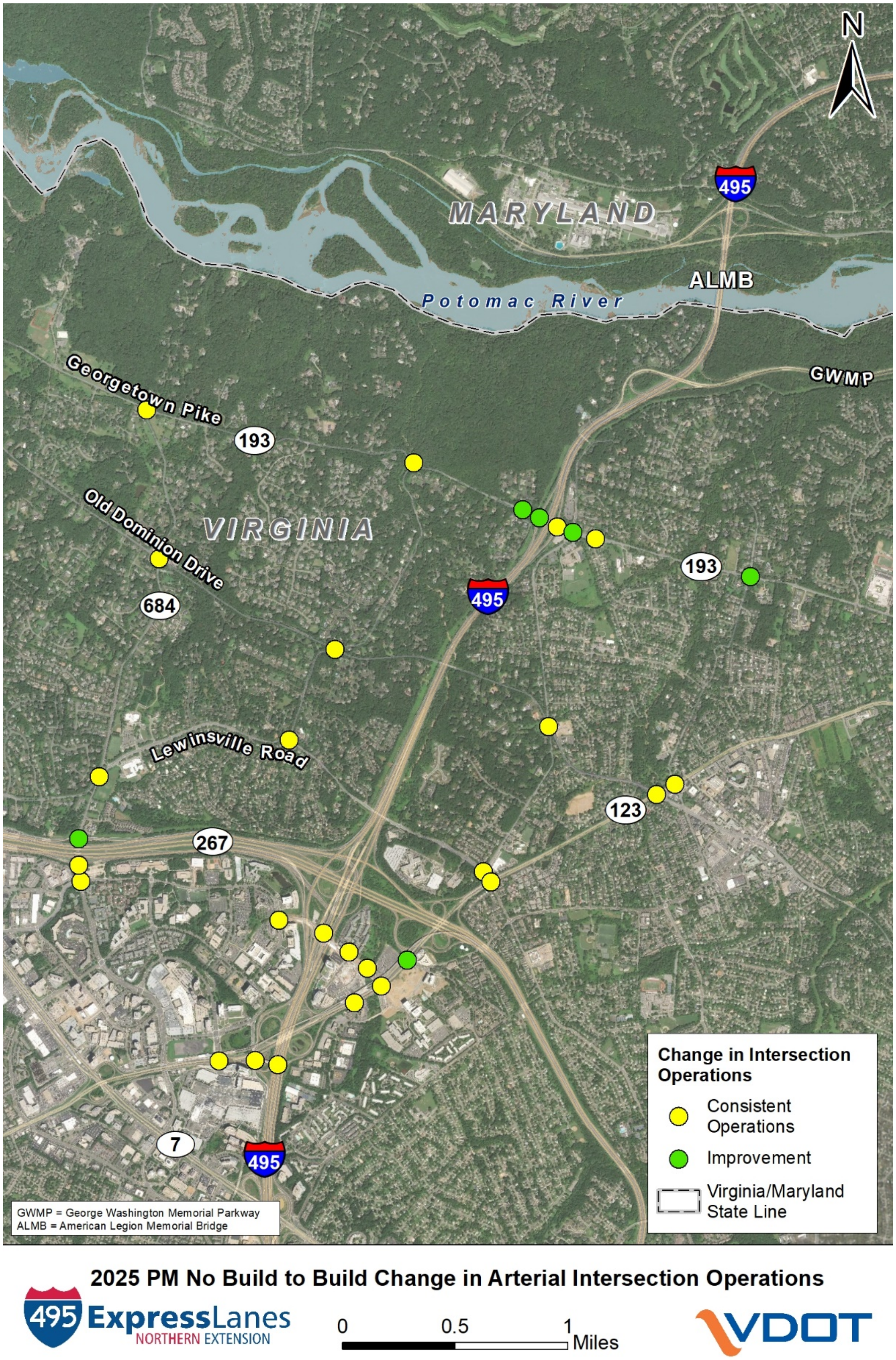


Figure 7-22. 2025 PM No Build to Build Change in Arterial Intersection Operations

7.2.5 Summary of 2025 Operations

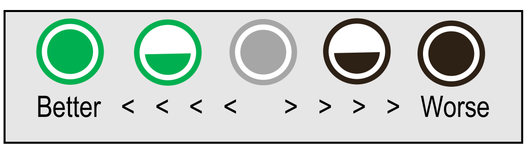
2025 AM Peak Period Summary

- Total demand along I-495 (GP plus Express) is forecasted to increase in the Build scenario along the length of the I-495 corridor. The greatest increases in demand are in the segments between Route 267 and GWMP, where Express Lanes are only present in the Build scenario and thus represent a substantial capacity increase from No Build conditions. Peak hour volumes are forecasted to increase in the Build scenario by between 2 to 9 percent in the northbound direction and between 2 to 6 percent in the southbound direction.
- In the northbound direction along the I-495 GP lanes, congestion is observed under No Build conditions between Route 267 and Clara Barton Parkway (across the ALMB) due to heavy merging and weaving volumes on and near the bridge. Under Build conditions, a significant reduction in congestion is observed due to the additional capacity provided by the Express Lanes and the reduced weaving due to the continuity of the Express Lanes. The average travel time in the northbound GP lanes improves by approximately 3 minutes (a 24 percent improvement) in the Build condition.
- In the southbound direction along the I-495 GP lanes, congestion is observed under No Build conditions south of the ALMB and north of Route 267 due to weaving approaching the entrance to the Express Lanes system as well as merging from vehicles exiting the Maryland managed lanes system south of the ALMB. This congestion is largely mitigated under Build conditions. The average travel time in the southbound GP lanes improves by approximately 1.5 minutes (an 11 percent improvement).
- Both directions of the Express Lanes operate at or near the posted speed limit. To travel the length of the corridor via Express Lanes under No Build conditions, vehicles must utilize the congested GP lanes between Route 267 and GWMP as Express Lanes are not present.
- Along eastbound Route 267 (DTR) there is 47 percent improvement in travel time. With the improved operations along northbound I-495, the ramp from eastbound DTR to northbound I-495 does not spill back to eastbound DTR, improving operations along eastbound DTR. Travel times along the westbound DTR remain unchanged.
- Over the course of the AM peak period, total persons moved along I-495 are forecasted to increase from No Build to Build conditions by between 4 and 17 percent in the northbound direction and between 6 and 21 percent in the southbound direction, depending upon location along the corridor.
- Arterial intersection operations are largely consistent between No Build and Build conditions, as both scenarios see the same percentage of intersections operating under failing conditions. These failing intersections are in the Tysons area and see continue growth in demand tied to commercial and residential growth in Tysons.

Table 7-7 presents an overall performance comparison table for the Build alternative versus the No Build alternative for 2025 AM conditions. The table shows that the Build alternative improves overall operations along the I-495 corridor given the improvement in travel times, reduction in congestion, and increase in persons moved.

Table 7-7. Overall Performance Comparison for 2025 AM No Build and Build Alternative

Measure of Effectiveness	Description	Facility	2025 AM No Build Value	2025 AM Build Value	Build Performance Compared to No Build
Travel Times	End-to-end travel time along the facility through the Traffic Operations Study Area, measured in Minutes	I-495 NB GP	10	7	
		I-495 NB Express	8	6	
		I-495 SB GP	8	7	
		I-495 SB Express	7	6	
		Dulles Toll Road EB	3	2	
		Dulles Toll Road WB	2	2	
Extent and Duration of Congestion	Visual assessment of freeway mainline queue length and duration of congestion	I-495 NB GP			
		I-495 SB GP			
Person Throughput	Additional persons moved during peak period of Build condition and percentage increase	I-495 NB (All)	+4,500 (17%)		
		I-495 SB (All)	+5,000 (21%)		
Arterial Operations	Number of intersections operating at LOS F	Entire Study Area	7	7	
	Number of intersections operating at LOS D or better		19	17	



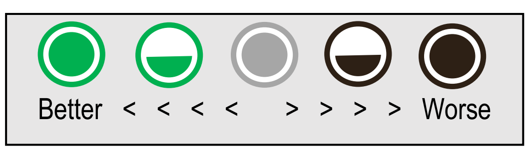
2025 PM Peak Period Summary

- Total demand along I-495 (GP plus Express) is forecasted to increase in the Build scenario along the length of the I-495 corridor. The greatest increases in demand are in the segments between Route 267 and GWMP, where Express Lanes are only present in the Build scenario and thus represent a substantial capacity increase from No Build conditions. Peak hour volumes are forecasted to increase in the Build scenario by between 10 to 29 percent in the northbound direction and between 7 to 12 percent in the southbound direction.
- In the northbound direction along the I-495 GP lanes, congestion is observed under No Build conditions between Route 267 and Clara Barton Parkway (across the ALMB) due to heavy merging and weaving volumes on and near the bridge, especially early in the peak period. Under Build conditions, a significant reduction in congestion is observed due to the additional capacity provided by the Express Lanes and the reduced weaving due to the continuity of the Express Lanes. The average travel time in the northbound GP lanes improves by approximately 4 minutes (a 36 percent improvement) in the Build condition.
- In the southbound direction along the I-495 GP lanes, congestion is observed under No Build conditions south of the ALMB and north of Route 267 due to weaving approaching the left-side entrance to the southbound Express Lanes (between Route 193 and Route 267) and downstream right-side exit to westbound DTR, as both of these movements have heavy volumes. This congestion is also worsened in the No Build scenario due to the southbound Maryland managed lanes system terminating near the GWMP interchange, creating a merge that spills back upstream in the GP lanes across the ALMB. This congestion is largely mitigated under Build conditions. The average travel time in the southbound GP lanes improves by nearly 8 minutes (a 49 percent improvement).
- Both directions of the Express Lanes operate at or near the posted speed limit. To travel the length of the corridor via Express Lanes under No Build conditions, vehicles must utilize the congested GP lanes between Route 267 and GWMP as Express Lanes are not present.
- Along eastbound and westbound Route 267 (DTR), travel times are essentially identical between No Build and Build.
- Over the course of the PM peak period, total persons moved along I-495 are forecasted to increase from No Build to Build conditions by between 8 and 37 percent in the northbound direction and between 10 and 47 percent in the southbound direction, depending upon location along the corridor.
- Arterial intersection operations see an improvement under Build conditions, as the percentage of intersections operating at failing conditions drops from 43 percent (No Build) to 33 percent (Build), and more than half of all intersections are LOS D or better in the Build condition, while only 33 percent are at LOS D or better in the No Build condition. Most of the failing intersections are in the Tysons area and see continue growth in demand tied to commercial and residential growth in Tysons.

Table 7-8 presents an overall performance comparison table for the Build alternative versus the No Build alternative for 2025 PM conditions. The table shows that the Build alternative improves overall operations along the I-495 corridor given the improvement in travel times, reduction in congestion, and increase in persons moved. Arterial operations are also shown to improve in the PM peak hour under the Build alternative.

Table 7-8. Overall Performance Comparison for 2025 PM No Build and Build Alternative

Measure of Effectiveness	Description	Facility	2025 AM No Build Value	2025 AM Build Value	Build Performance Compared to No Build
Travel Times	End-to-end travel time along the facility through the Traffic Operations Study Area, measured in Minutes	I-495 NB GP	11	7	●
		I-495 NB Express	8	6	●
		I-495 SB GP	16	8	●
		I-495 SB Express	8	6	●
		Dulles Toll Road EB	2	2	○
		Dulles Toll Road WB	2	2	○
Extent and Duration of Congestion	Visual assessment of freeway mainline queue length and duration of congestion	I-495 NB GP			●
		I-495 SB GP			●
Person Throughput	Additional persons moved during peak period of Build condition and percentage increase	I-495 NB (All)	+6,800 (37%)		●
		I-495 SB (All)	+8,800 (47%)		●
Arterial Operations	Number of intersections operating at LOS F	Entire Study Area	12	10	◒
	Number of intersections operating at LOS D or better		13	17	●



7.3 2045 DESIGN YEAR ANALYSIS

7.3.1 2045 Traffic Volumes

This section describes forecasted traffic volumes for the study area for 2045 No Build and Build conditions; the following sections detail the differences in traffic operations analysis results between the two conditions.

Peak hour freeway forecast volumes for 2045 conditions are provided in the following exhibits:

- **Exhibits 7-17a** and **7-17b** show 2045 No Build AM peak hour freeway volumes for the I-495 and Route 267 corridors, respectively.
- **Exhibits 7-18a** and **7-18b** show 2045 Build AM peak hour freeway volumes for the I-495 and Route 267 corridors, respectively.
- **Exhibits 7-19a** and **7-19b** show 2045 No Build PM peak hour freeway volumes for the I-495 and Route 267 corridors, respectively.
- **Exhibits 7-20a** and **7-20b** show 2045 Build PM peak hour freeway volumes for the I-495 and Route 267 corridors, respectively.

Arterial turning movement volumes for 2045 conditions are provided in the following exhibits:

- **Exhibits 7-21a** through **7-21e** show 2045 No Build AM and PM peak hour arterial turning movement volumes.
- **Exhibits 7-22a** through **7-22e** show 2045 Build AM and PM peak hour arterial turning movement volumes.

Average daily traffic forecast volumes for 2045 conditions are provided in the following exhibits:

- **Exhibits 7-23a** and **7-23b** show 2045 No Build ADT freeway volumes for the I-495 and Route 267 corridors, respectively.
- **Exhibits 7-24a** and **7-24b** show 2045 Build ADT freeway volumes for the I-495 and Route 267 corridors, respectively.

Peak Hour Traffic Volumes and Peaking Patterns

Figure 7-23 and **Figure 7-24** compare 2045 No Build and Build AM forecast peak hour mainline volumes with existing conditions along northbound and southbound I-495 (GP and Express combined), respectively.

- In the northbound direction, the highest traffic volumes in all scenarios are between the GWMP and Clara Barton Parkway (across the ALMB). The increases in volume from No Build to Build range from 280 vph to 1,080 vph (3 percent to 11 percent) across the four segments, with the largest increases in the segments between Route 267 and GWMP where the Build Alternative adds capacity from the Express Lanes.
- In the southbound direction, the highest traffic volumes in all scenarios are again between the Clara Barton Parkway and GWMP (across the ALMB). The increases in volume from No Build to Build range from 410 vph to 690 vph (4 percent to 6 percent) across the four segments, with the largest increase in the segments between GWMP and Route 267 where the Build Alternative adds capacity from the Express Lanes.

Figure 7-25 and **Figure 7-26** compare 2045 No Build and Build PM forecast peak hour mainline volumes with existing conditions along northbound and southbound I-495 (GP and Express combined), respectively.

- In the northbound direction, the highest traffic volumes in all scenarios are between the GWMP and Clara Barton Parkway (across the ALMB). The increases in volume from No Build to Build range from 260 vph to 1,400 vph (3 percent to 20 percent) across the four segments, with the largest increases in the segments between Route 267 and GWMP where the Build Alternative adds capacity from the Express Lanes.
- In the southbound direction, the highest traffic volumes in all scenarios are again between the Clara Barton Parkway and GWMP (across the ALMB). The increases in volume from No Build to Build range from 660 vph to 1,020 vph (7 percent to 12 percent) across the four segments, with the largest increase in the segments between GWMP and Route 267 where the Build Alternative adds capacity from the Express Lanes.

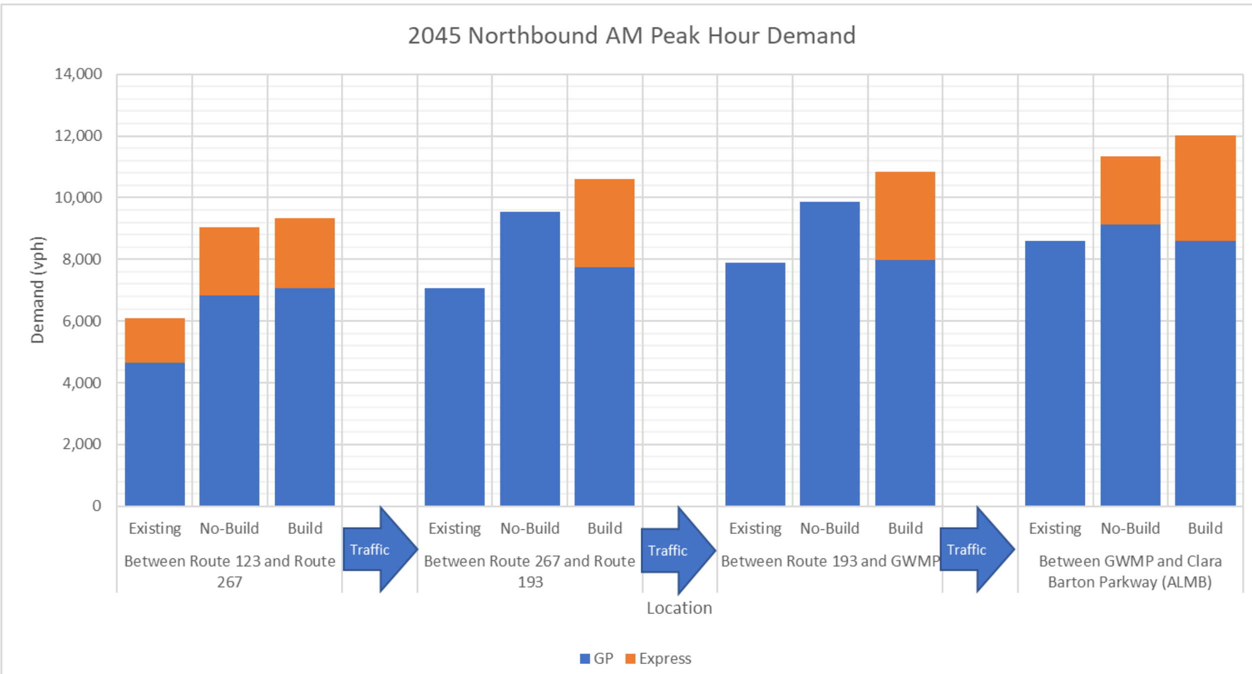


Figure 7-23: Existing and 2045 No Build AM Peak Hour Volumes - Northbound I-495

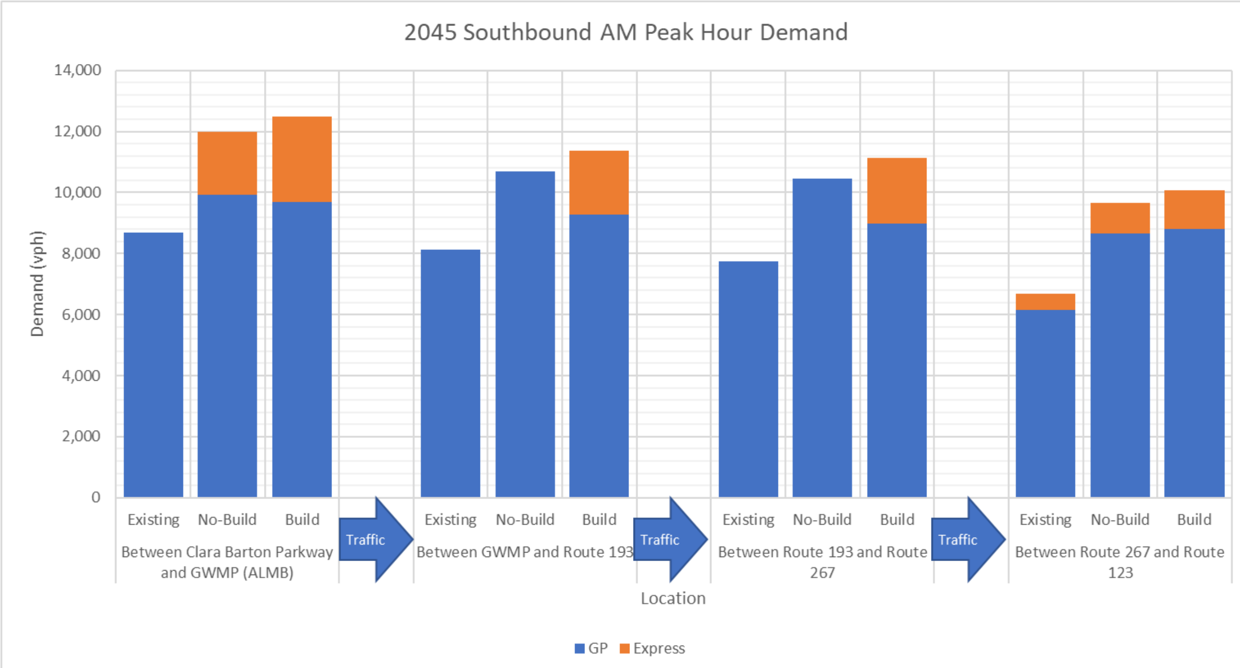


Figure 7-24: Existing and 2045 No Build AM Peak Hour Volumes - Southbound I-495

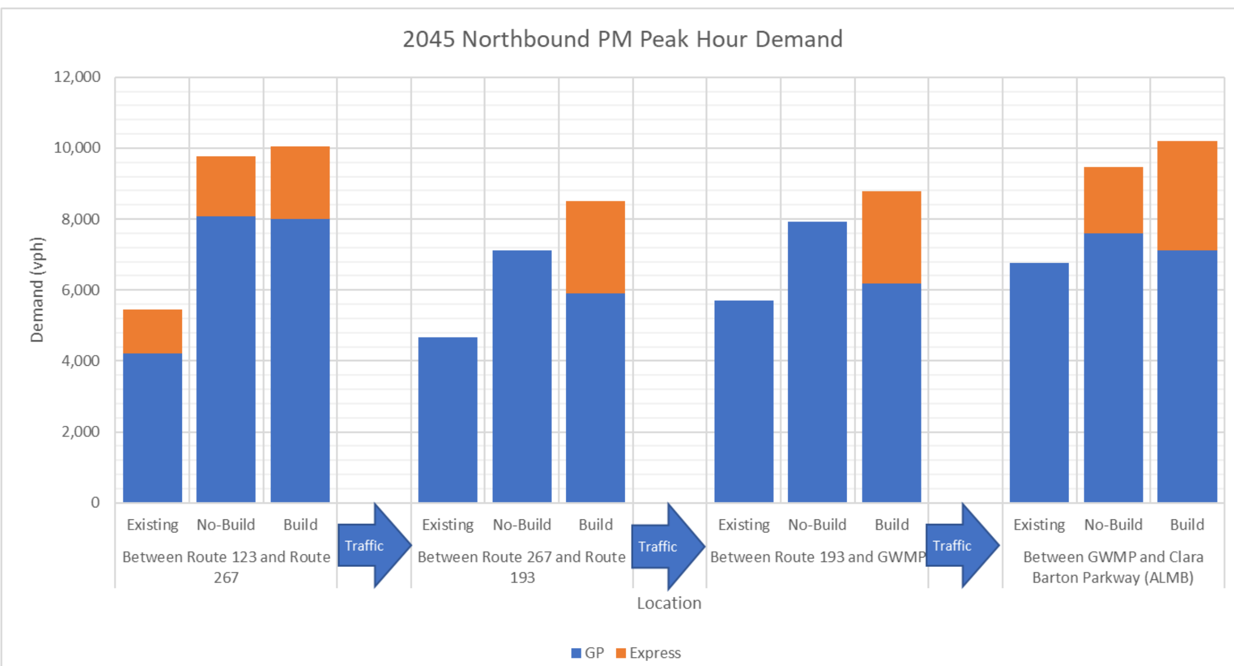


Figure 7-25: Existing and 2045 No Build PM Peak Hour Volumes - Northbound I-495

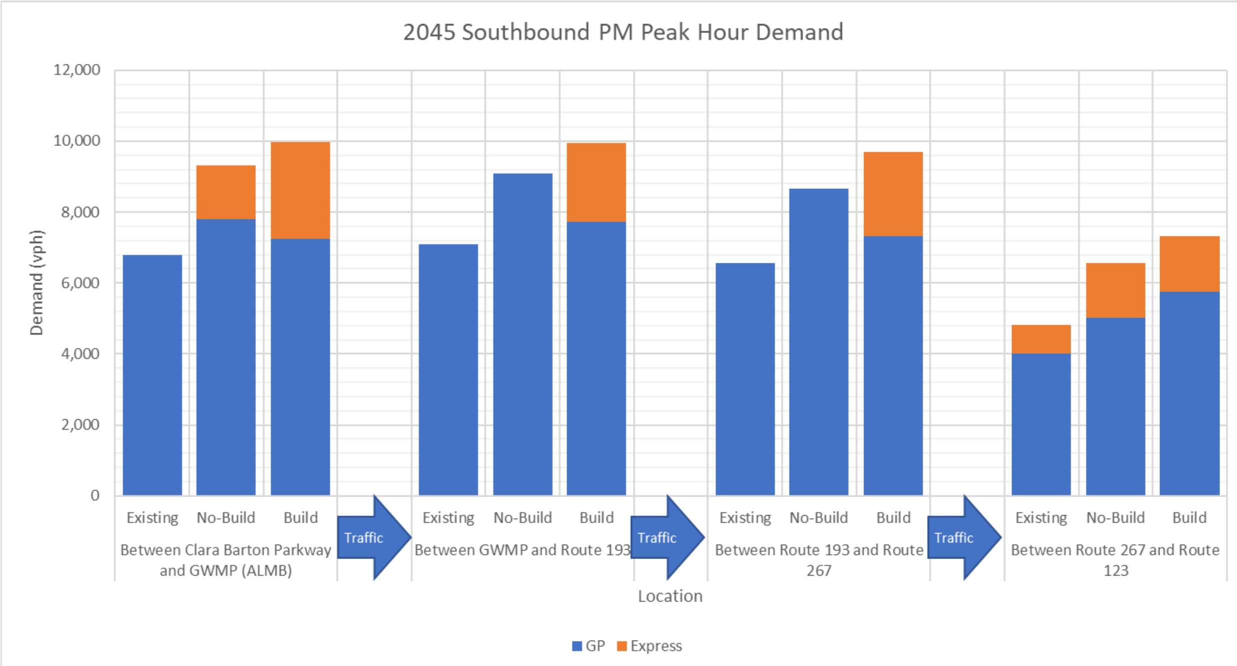


Figure 7-26: Existing and 2045 No Build PM Peak Hour Volumes - Southbound I-495

7.3.2 2045 No Build vs. Build AM Freeway Operations

Exhibits 7-25 through **7-28** illustrate the density and speed results from the VISSIM models for the I-495 and Route 267 mainline segments in the study area for the AM peak period:

- **Exhibits 7-25a** through **7-25c** show 2045 No Build AM peak period freeway densities.
- **Exhibits 7-26a** through **7-26c** show 2045 Build AM peak period freeway densities.
- **Exhibits 7-27a** through **7-27c** show 2045 No Build AM peak period freeway speeds.
- **Exhibits 7-28a** through **7-28c** show 2045 Build AM peak period freeway speeds.

In each figure, the centerline diagram laid over the aerial depicts the average densities or speeds during the peak hour from 7:45 a.m. to 8:45 a.m. in both directions along the mainline segments. The average densities and speeds are color-coded based on the congestion levels and ranges of speeds as depicted in the legend. The boxes on the top and bottom depict the densities and speeds in each direction for the entire peak period from 6:45 a.m. to 9:45 a.m., including the shoulder periods before and after the peak hour. Detailed tabular results can be found in **Appendix G.**

Density

In the AM peak period, it can be seen from the exhibits that in the northbound direction, more than half of the segments operate under congested to severe densities in both the No Build and Build conditions. **Figure 7-27** summarizes various densities along northbound I-495 GP lanes. As can be seen in the figure, 65 percent of the freeway segments operate under congested to severe congestion in the No Build condition compared to 72 percent in the Build condition. Although the Build condition has a slight increase in the number of congested segments compared to No Build, the volume processed increases significantly in the Build condition (thus increasing density); additionally, as shown in the following sections, speeds and travel times improve in the Build condition. The Build condition also sees a higher percentage of segments operating under light to moderate densities in the northbound direction (22 percent versus 12 percent).

As seen in **Figure 7-28**, 52 percent of the segments operate under congested to severe congestion along the southbound I-495 GP lanes in the No Build condition as compared to 47 percent operating under congested to severe congested densities in the Build condition. In the No Build condition, the segment between Georgetown Pike and River Road operates under severe congestion due to the merge from the terminus of the southbound Maryland managed lanes system; this severe congestion meters traffic from getting downstream, artificially improving operations in the downstream southbound segments. The proposed project (Build condition) significantly alleviates this congestion, and as a result, more demand is processed which results in slightly higher density levels compared to No Build conditions.

All the segments along the northbound and southbound Express Lanes operate under light to moderate traffic congestion in both the scenarios with the exceptions of the segments approaching the Express Lanes termini in the No Build condition.

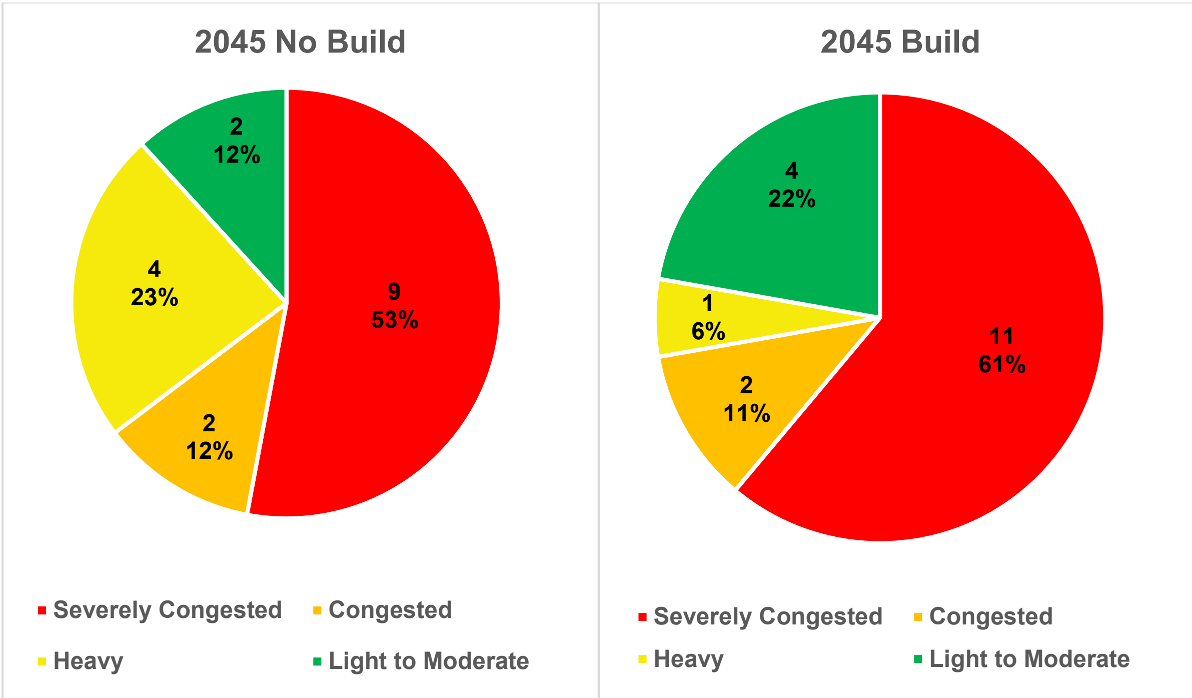


Figure 7-27: 2045 AM Freeway Segment Densities for I-495 Northbound

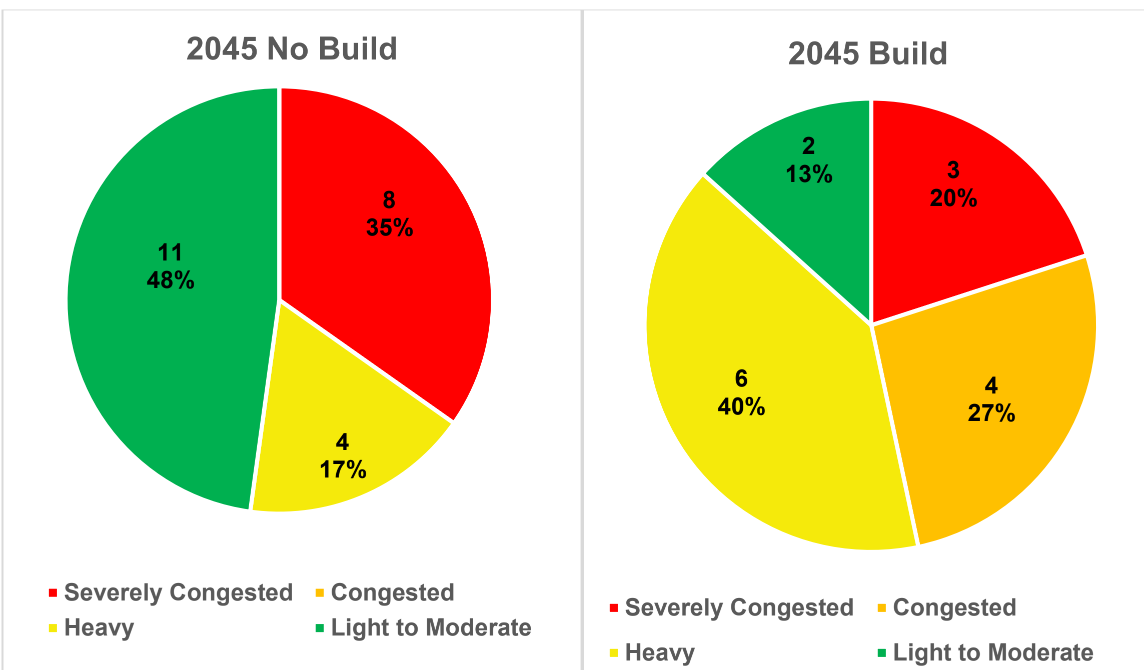


Figure 7-28: 2045 AM Freeway Segment Densities for I-495 Southbound

Speeds

As illustrated in **Exhibits 7-27** and **7-28**, the diagrams for average speeds in the AM peak period generally show similar patterns as seen in the density diagrams. In the northbound GP lanes, in the No Build condition, the corridor is severely congested from south of Route 193 (Georgetown Pike) to the Clara Barton Parkway across the ALMB. In the Build condition, some of this congestion remains, but it is significantly alleviated as compared to No Build, and higher speeds are observed. In both the No Build and Build conditions, speeds are much higher north of the ALMB due to congestion relief provided by the Maryland managed lanes system.

In the southbound GP lanes, in the No Build condition, severe congestion is observed between the entrance to the network and Route 193. As noted in the previous section, this congestion is due to the merge from the terminus of the southbound Maryland managed lanes system, as all traffic must rejoin the GP lanes at this point. This creates significant queue spillback in the southbound GP lanes and meters traffic at this point, resulting in artificially high speeds and limited congestion south of Route 193. In the Build condition, the continuous Express Lanes system significantly relieves congestion along the southbound GP lanes as that merge point is eliminated; some congestion across the ALMB remains, with low speeds observed spilling back into Maryland during the peak hour.

Both directions of the Express Lanes operate at or near the posted speed limit.

Figure 7-29 provides a “heat map” comparison of average speeds between 2045 No Build and Build conditions for the AM peak period along the I-495 GP lanes. Time of day during the peak period is provided on the horizontal axis while location along the corridor is provided along the vertical axis; the colors signify average speeds for each scenario. The figure is consistent with the speed Exhibits and indicates a more significant presence of congestion in the No Build scenario in both directions of the I-495 GP lanes.

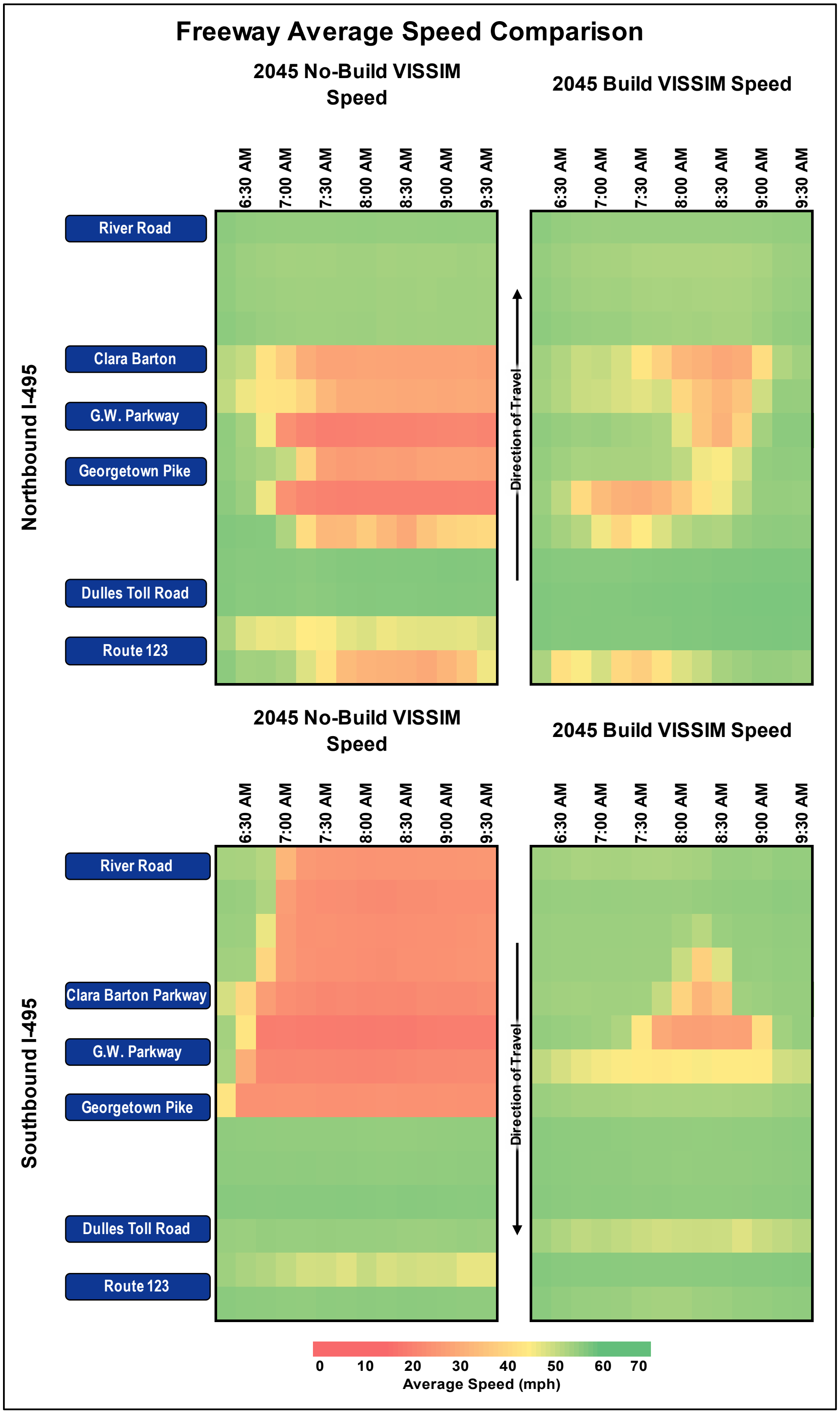


Figure 7-29: 2045 No Build and Build – AM Peak Period Average Speeds, I-495 GP Lanes

Travel Time

A comparison of AM peak period travel times for 2045 No Build and 2045 Build scenarios is shown in **Table 7-9**. Travel time measurements have been aggregated by direction of travel and facility type.

Table 7-9. 2045 AM Peak Period Travel Time Comparison

Route	GP Travel Times (Minutes: Seconds)		Express Lanes Travel Times (Minutes: Seconds)	
	2045 No Build	2045 Build	2045 No Build	2045 Build
Northbound I-495 (Route 123 to River Road)	11:59	8:03	9:37	5:43
Southbound I-495 (River Road to Route 123)	16:15	7:32	8:04	5:41
Eastbound Route 267 (Spring Hill Road to Route 123)	7:21	1:51	-	-
Westbound Route 267 (Route 123 to Spring Hill Road)	1:56	2:01	-	-

2045 Build AM peak period travel times improve or remain consistent as compared to No Build across all freeway facilities in the Traffic Operations Study Area

- The average travel time in the northbound GP lanes improves by approximately 4 minutes (a 33 percent improvement) in the Build condition. The majority of the travel time savings are between Old Dominion Drive and Clara Barton Parkway, which is consistent with the speed results shown in the previous section.
- Vehicles traveling in the northbound Express Lanes see a nearly 4-minute improvement (41 percent) in the Build condition. The travel time improvement in the Build condition is between Lewinsville Road and GWMP, where in the No Build condition, vehicles need to travel on the congested GP lanes.
- In the southbound direction, GP travel times in the Build improve by nearly 9 minutes (54 percent) and Express Lanes travel time improve by approximately 2.5 minutes (30 percent). Similar to northbound, providing a continuous Express Lanes system helps with the traffic operations.
- Along eastbound Route 267 (DTR) there is a 5.5-minute (75 percent) improvement in travel time. With the improved operations along northbound I-495, the ramp from eastbound DTR to northbound I-495 does not spill back to eastbound DTR, significantly improving operations along eastbound DTR.
- In the westbound direction, travel times along Route 267 (DTR) are generally consistent between No Build and Build.

Simulated Volumes and Demand Served

Figure 7-30 shows the comparison of unserved demand (vehicular throughput as compared to vehicular demand) between No Build and Build conditions for the AM peak hour in the northbound direction. As can be seen in the figure, nearly all demand is served in the Build condition during the AM peak hour except for a small percentage over the ALMB. In the No Build condition, the unserved demand exceeds 10 percent north of the Route 267 interchange due to the heavy congestion. The improved throughput in the Build condition can be attributed to the continuous Express Lanes system, which alleviates congestion and allows demand to be processed more quickly.

Figure 7-31 shows the comparison of unserved demand between No Build and Build conditions for the AM peak hour in the southbound direction. As can be seen in the figure, the unserved demand is generally within 5 percent in the Build compared to more than 20 percent in the No Build for the length of the corridor. The increased in the throughput in the Build condition can be attributed to the reduced congestion between Route 193 and Route 267 due to the new Express Lanes system being in place; in the No Build condition, the severe congestion at the terminus of the Maryland managed lanes system constrains demand from reaching points south of this point. The proposed project alleviates congestion in this segment, thus reducing the unserved demand.

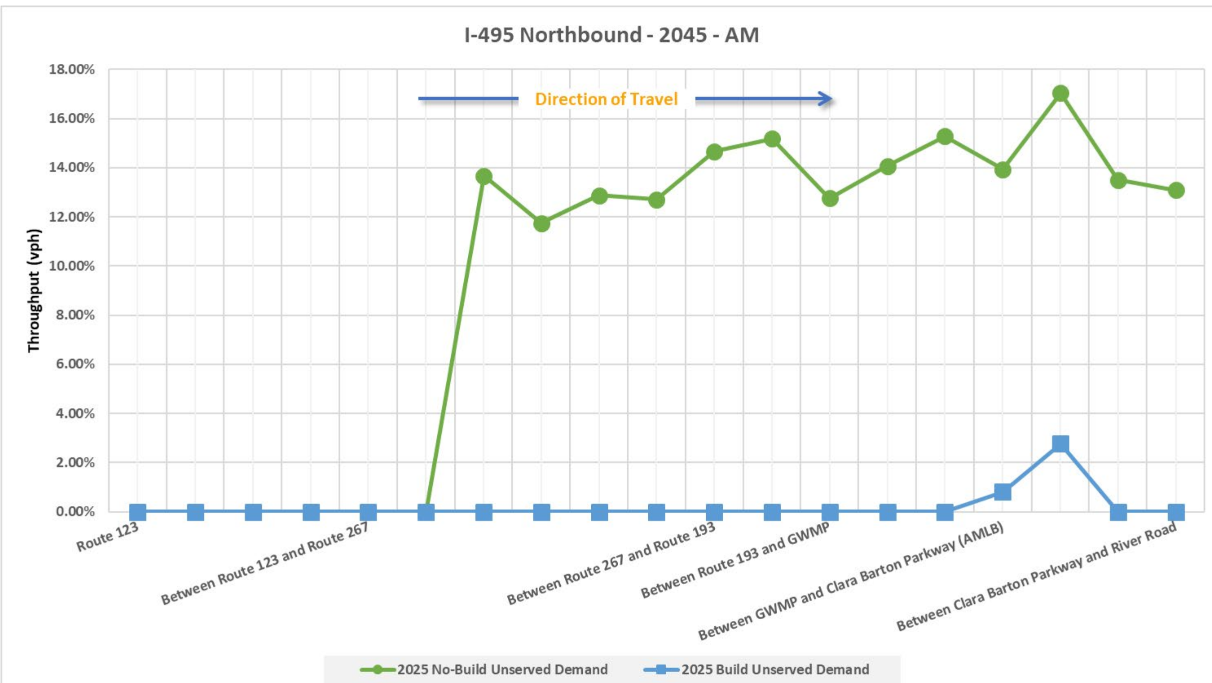


Figure 7-30. 2045 No Build and Build – AM Peak Hour Unserved Demand, I-495 Northbound

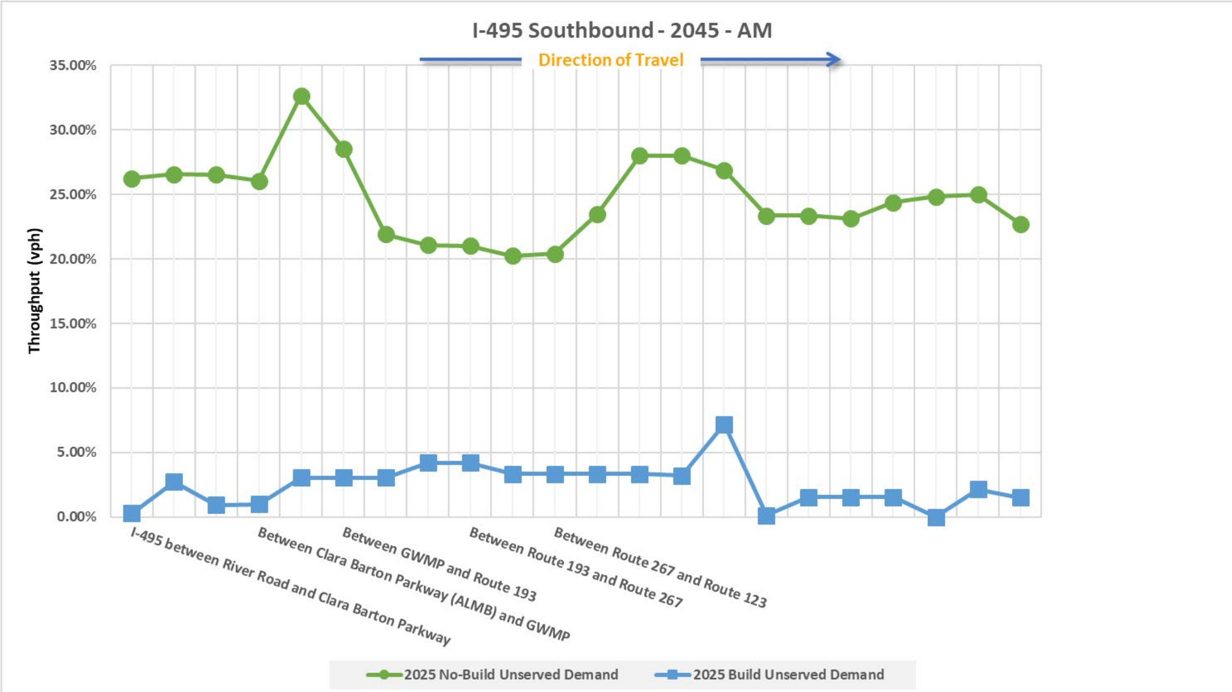


Figure 7-31. 2045 No Build and Build – AM Peak Hour Unserved Demand, I-495 Southbound

Person Throughput

Figure 7-32 and **Figure 7-33** display AM peak period person throughput along I-495 northbound and southbound, respectively (GP and Express combined). These figures show the estimated number of persons moved across a three-hour period based on simulated vehicle throughput and assumed vehicle occupancies for GP and Express Lanes. GP lanes are assumed to carry 1.1 persons per vehicle, based on the estimated non-HOV lane auto occupancy MWCOG has estimated across various interstate facilities in Northern Virginia (MWCOG, 2014). Express Lanes are assumed to carry 1.44 person per vehicle, based on a historic 18 percent HOV-3 utilization in the existing I-495 Express Lanes and assuming the remaining 82 percent of vehicles take on the non-HOV lane auto occupancy. These figures show that person throughput increases in the Build scenario across the length of the I-495 corridor in both directions due to the added capacity from the Express Lanes and increased occupancy of vehicles in those lanes.

- In the northbound direction, the highest person throughputs are across the ALMB. Increases in throughput from No Build to Build range from 6 to 33 percent, with the greatest increase in the segments between Route 267 and GWMP where the new Express Lanes significantly add capacity.
- In the southbound direction, the highest person throughputs are again across the ALMB. Increases in throughput from No Build to Build range from 29 to 35 percent, with the greatest increases again in the segments between GWMP and Route 267 where the new Express Lanes significantly add capacity. Note that the southbound throughput in the No Build scenario is heavily constrained due to the merge with the southbound Maryland managed lanes terminus; this reduces throughput along the length of the corridor.

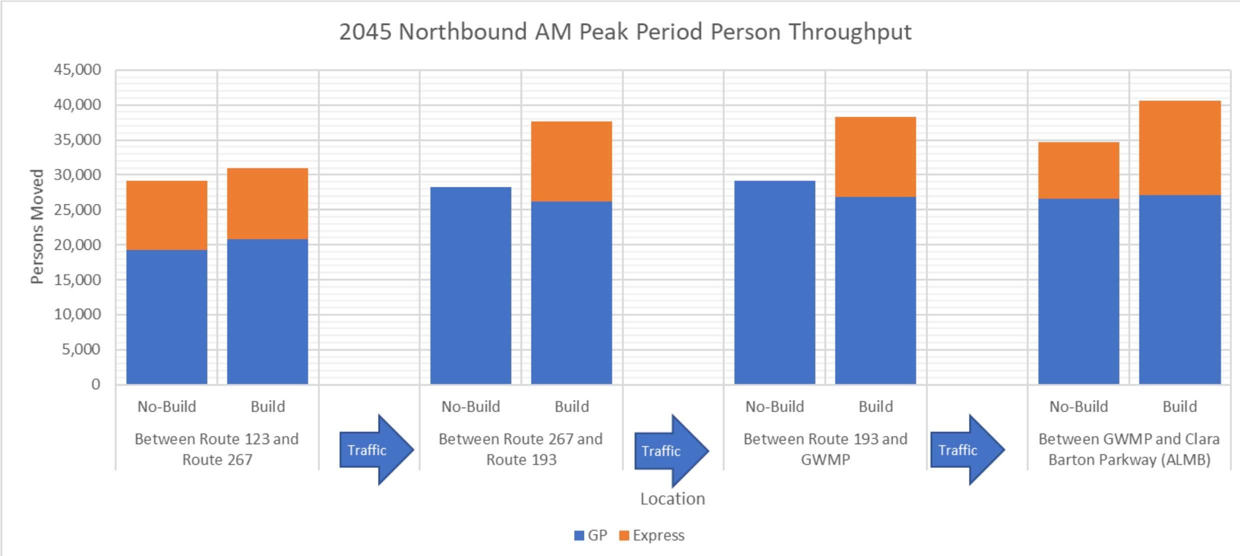


Figure 7-32. 2045 No Build and Build – AM Peak Period Person Throughput, I-495 Northbound

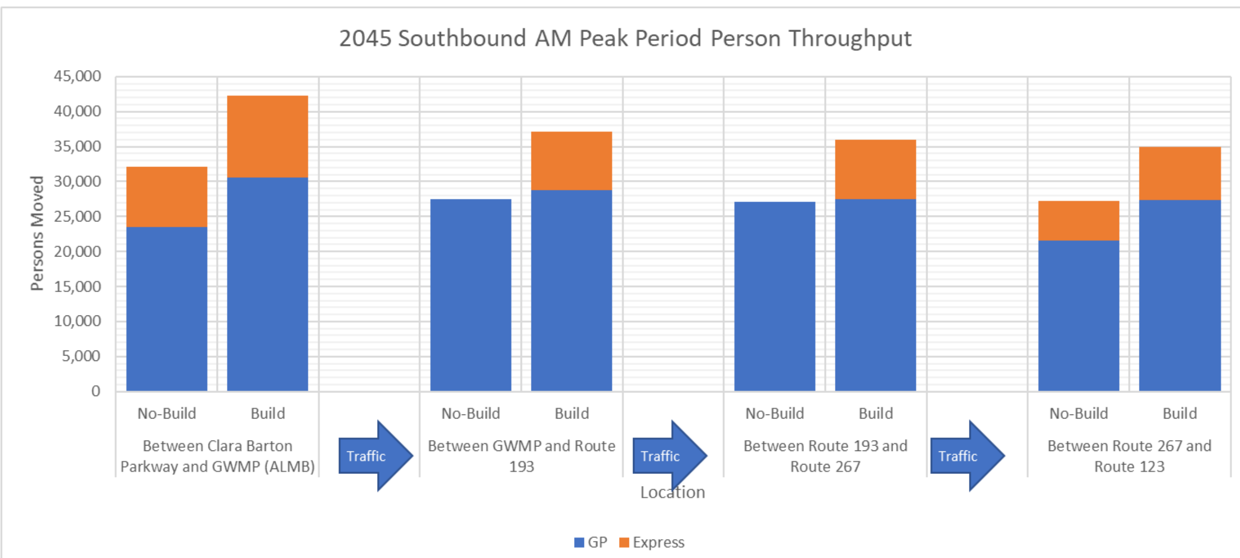


Figure 7-33. 2045 No Build and Build – AM Peak Period Person Throughput, I-495 Southbound

7.3.3 2045 No Build vs. Build PM Freeway Operations

Exhibits 7-29 through **7-32** illustrate the density and speed results from the VISSIM models for the I-495 and Route 267 mainline segments in the study area for the PM peak period:

- **Exhibits 7-29a** through **7-29c** show 2045 No Build PM peak period freeway densities.
- **Exhibits 7-30a** through **7-30c** show 2045 Build PM peak period freeway densities.
- **Exhibits 7-31a** through **7-31c** show 2045 No Build PM peak period freeway speeds.
- **Exhibits 7-32a** through **7-32c** show 2045 Build PM peak period freeway speeds.

In each figure, the centerline diagram laid over the aerial depicts the average densities or speeds during the peak hour from 3:45 p.m. to 4:45 p.m. in both directions along the mainline segments. The average densities and speeds are color-coded based on the congestion levels and ranges of speeds as depicted in the legend. The boxes on the top and bottom depict the densities and speeds in each direction for the entire peak period from 2:45 p.m. to 5:45 p.m., including the shoulder periods before and after the peak hour. Detailed tabular results can be found in **Appendix G.**

Density

In the PM peak period, it can be seen from the exhibits that in the northbound GP lanes, all of the segments in the No Build condition are severely congested. As seen in **Figure 7-34**, 100 percent of the segments in the No Build condition are severely congested, whereas 67 percent are severely congested in the Build condition. In the Build condition, 22 percent of northbound GP segments operate under light to moderate freeway densities, a significant improvement from No Build conditions.

In the southbound GP lanes, as shown in **Figure 7-35**, the Build condition shows a slight improvement as compared to the No Build condition in terms of an increase in segments operating under light to moderate densities and a decrease in segments operating under severely congested freeway segment densities. The locations of the south congested segments vary somewhat between the two scenarios, however. In the No Build condition, due to the merge from the southbound Maryland managed lanes, severe congestion is observed north of the ALMB while downstream segments are artificially metered. In the Build condition, downstream segments such as those near Route 123 in Tysons see higher freeway densities due to increased throughput from the improved upstream capacity.

Northbound and southbound Express Lanes segments operate under light to moderate traffic conditions in both the No Build and Build conditions, with the exceptions of the segments approaching the Express Lanes termini in the No Build condition.

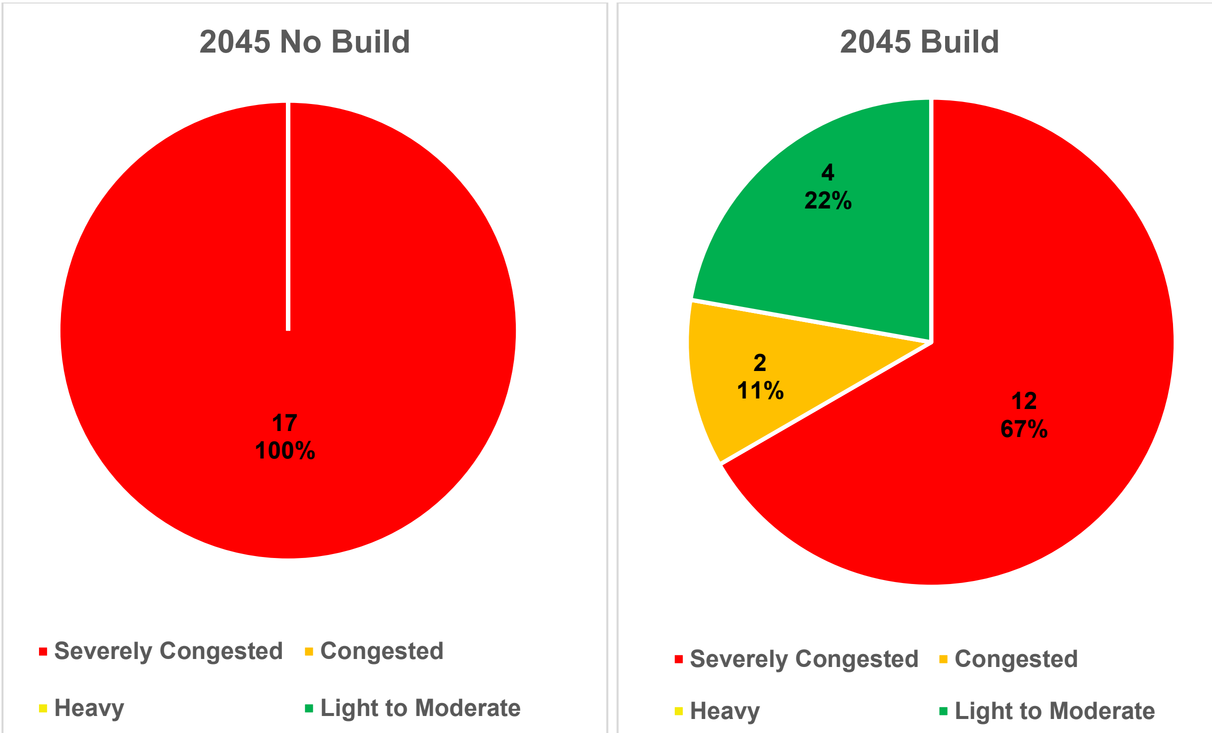


Figure 7-34: 2045 PM Freeway Segment Densities for I-495 Northbound

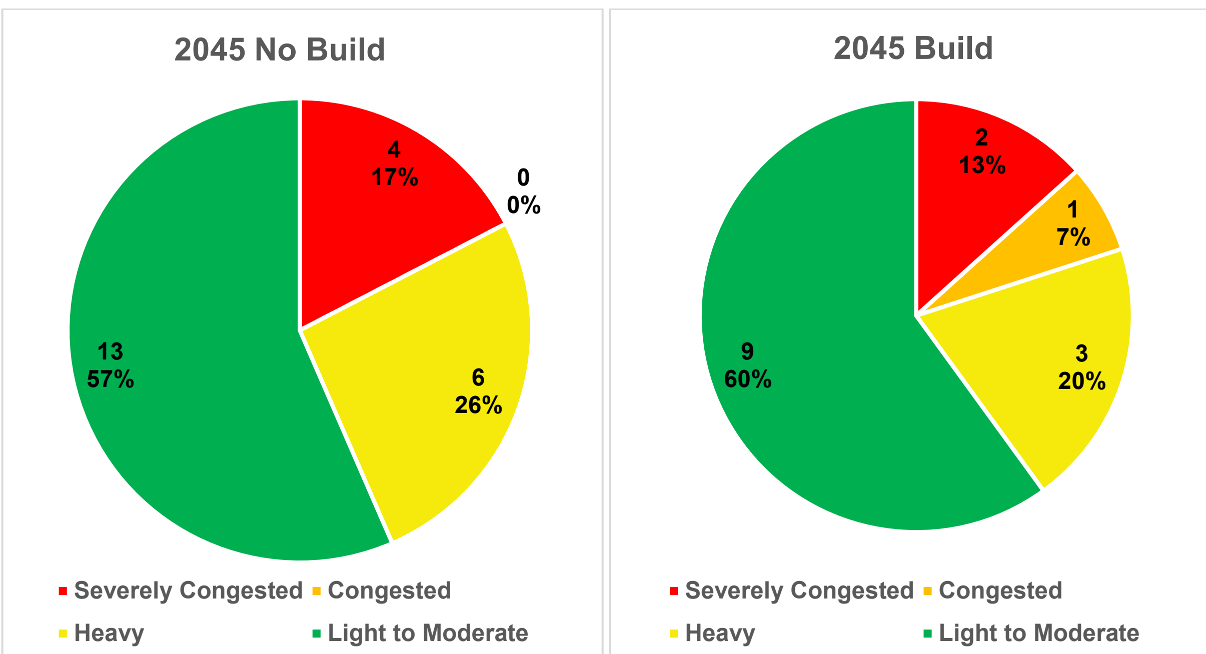


Figure 7-35: 2045 PM Freeway Segment Densities for I-495 Southbound

Speeds

As illustrated in **Exhibits 7-31** and **7-32**, the diagrams for average speeds in the PM peak period show similar patterns as seen in the density diagrams. In the northbound GP lanes, in the No Build condition, severe congestion is observed spilling back from the ALMB through the Route 267 interchange and essentially through the extents of the Traffic Operations Study Area; this congestion is worsened by spillback from the northbound GP lanes in Maryland later in the peak period, creating a single continuous area of congestion through the corridor. In the Build condition, the congestion in Maryland remains generally unchanged, but the extent of the queue spillback and duration on the Virginia side, especially south of Route 193, is not as significant as the No Build condition.

In the southbound GP lanes, in the No Build condition, severe congestion is observed north of the ALMB due to spillback from the merge with the terminus of the southbound Maryland managed lanes system and weaving on the bridge itself; higher speeds are observed south of this point. In the Build condition, the queue spillback into Maryland is essentially eliminated due to the continuity of the Express Lanes system and elimination of the merge from the No Build condition. In the Build condition, given that more throughput is able to reach downstream locations, lower speeds are observed at the southern extents of the Traffic Operations Study Area in Tysons.

Both directions of the Express Lanes operate at or near the posted speed limit.

Figure 7-36 provides a "heat map" comparison of average speeds between 2045 No Build and Build conditions for the PM peak period along the I-495 GP lanes. Time of day during the peak period is provided on the horizontal axis while location along the corridor is provided along the vertical axis; the colors signify average speeds for each scenario. The figure is consistent with the speed Exhibits and indicates a more significant presence of congestion in the No Build scenario in both directions of the I-495 GP lanes.

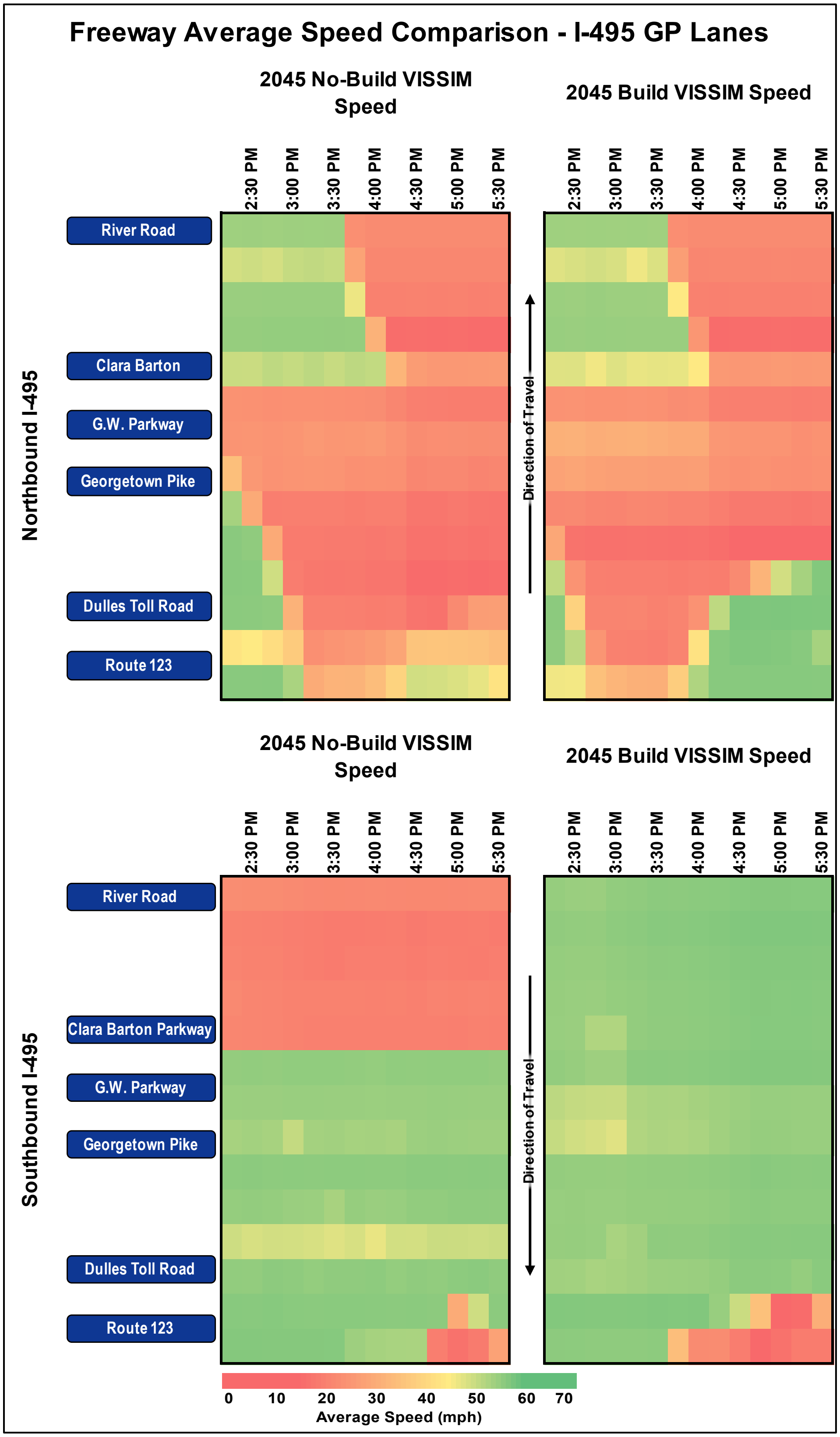


Figure 7-36: 2045 No Build and Build – PM Peak Period Average Speeds, I-495 GP Lanes

Travel Time

A comparison of PM peak period travel times for 2045 No Build and 2045 Build scenarios is shown in **Table 7-10**. Travel time measurements have been aggregated by direction of travel and facility type.

Table 7-10. 2045 PM Peak Period Travel Time Comparison

Route	GP Travel Times (Minutes: Seconds)		Express Lanes Travel Times (Minutes: Seconds)	
	2045 No Build	2045 Build	2045 No Build	2045 Build
Northbound I-495 (Route 123 to River Road)	28:18	23:42	15:59	5:39
Southbound I-495 (River Road to Route 123)	15:16	7:46	6:42	5:49
Eastbound Route 267 (Spring Hill Road to Route 123)	1:48	1:52	-	-
Westbound Route 267 (Route 123 to Spring Hill Road)	1:50	1:52	-	-

2045 Build PM peak period travel times improve or remain consistent as compared to No Build across all freeway facilities in the Traffic Operations Study Area.

- The average travel time in the northbound GP lanes improves by approximately 4.5 minutes (a 16 percent improvement). The majority of the travel time savings are south of GWMP, which is consistent with the speed results shown in the previous section.
- Vehicles traveling on the northbound Express Lanes see a 10-minute (65 percent) travel time improvement. The travel time improvement in the Build condition is between Lewisville Road and GWMP, where in the No Build condition, vehicles need to travel on the congested GP lanes.
- In the southbound direction, GP travel times in the Build improve by 7.5 minutes (49 percent improvement) and Express Lanes travel times improve by 1 minute (13 percent). Providing a continuous Express Lanes system, eliminating the merge from the terminus of the southbound Maryland managed lanes system, helps relieve the congestion.
- Along eastbound and westbound Route 267 (DTR), travel times are essentially identical between No Build and Build.

Simulated Volumes and Demand Served

Figure 7-37 shows the comparison of unserved demand (vehicular throughput as compared to vehicular demand) between No Build and Build conditions for the PM peak hour in the northbound direction. As can be seen in the figure, nearly all demand is served in the Build condition during the PM peak hour except for a small percentage near the Route 123, which likely represents demand from arterials being metered within the arterial network. In the No Build condition, the unserved demand is between 4 and 8 percent north of the Route 267 interchange due to the heavy congestion. The improved throughput in the Build condition can be attributed to the continuous Express Lanes system, which alleviates congestion and allows demand to be processed more quickly.

Figure 7-38 shows the comparison of unserved demand between No Build and Build conditions for the PM peak hour in the southbound direction. As can be seen in the figure, the percentage of unserved demand is lower in the Build scenario along the length of the corridor. The increased throughput in the Build condition can be attributed to the reduced congestion between Route 193 and Route 267 due to the new Express Lanes system being in place. The proposed project alleviates congestion in this segment, thus reducing the unserved demand. South of Route 267, congestion along I-495 and along arterials in Tysons constrains demand in both the No Build and Build condition, thus increasing the percentage of unserved demand.

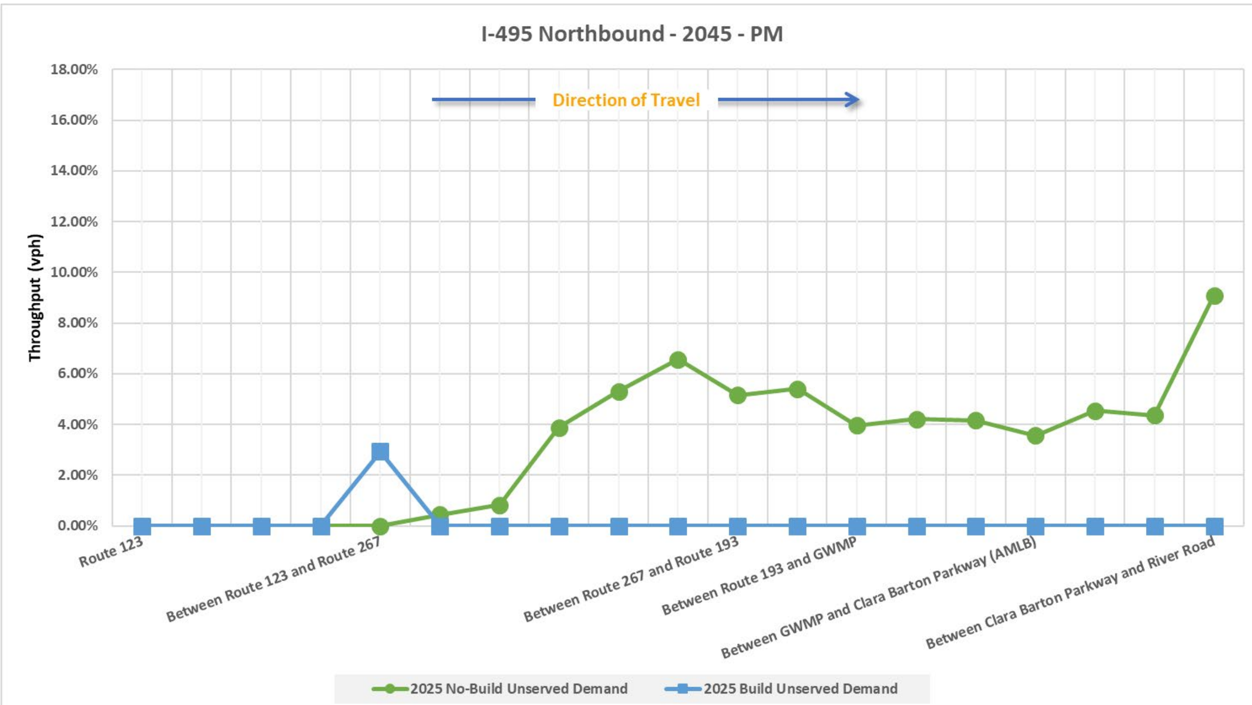


Figure 7-37. 2045 No Build and Build – PM Peak Hour Unserved Demand, I-495 Northbound

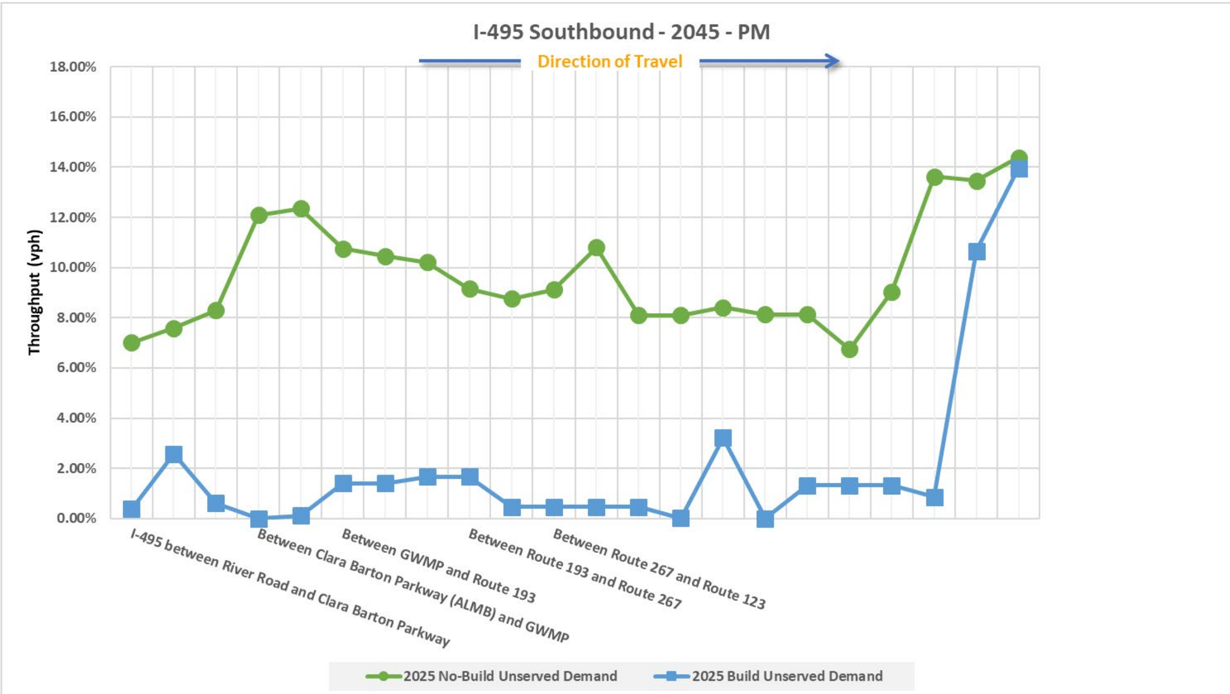


Figure 7-38. 2045 No Build and Build – PM Peak Hour Unserved Demand, I-495 Southbound

Person Throughput

Figure 7-39 and **Figure 7-40** display PM peak period person throughput along I-495 northbound and southbound, respectively (GP and Express combined). These figures show the estimated number of persons moved across a three-hour period based on simulated vehicle throughput and assumed vehicle occupancies for GP and Express Lanes. GP lanes are assumed to carry 1.1 persons per vehicle, based on the estimated non-HOV lane auto occupancy MWCOG has estimated across various interstate facilities in Northern Virginia (MWCOG, 2014). Express Lanes are assumed to carry 1.44 person per vehicle, based on a historic 18 percent HOV-3 utilization in the existing I-495 Express Lanes and assuming the remaining 82 percent of vehicles take on the non-HOV lane auto occupancy. These figures show that person throughput increases in the Build scenario across the length of the I-495 corridor in both directions due to the added capacity from the Express Lanes and increased occupancy of vehicles in those lanes.

- In the northbound direction, the highest person throughputs are across the ALMB. Increases in throughput from No Build to Build range from 10 to 35 percent, with the greatest increase in the segments between Route 267 and GWMP where the new Express Lanes significantly add capacity.
- In the southbound direction, the highest person throughputs are again across the ALMB. Increases in throughput from No Build to Build range from 16 to 32 percent, with the greatest increases again in the segments between GWMP and Route 267 where the new Express Lanes significantly add capacity.

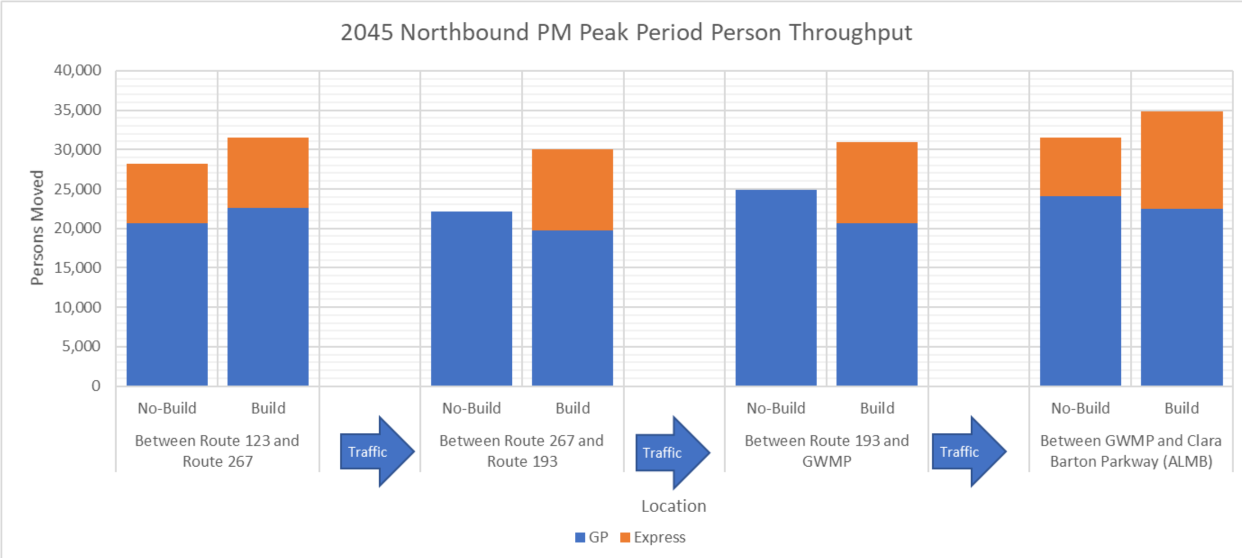


Figure 7-39. 2045 No Build and Build – PM Peak Period Person Throughput, I-495 Northbound

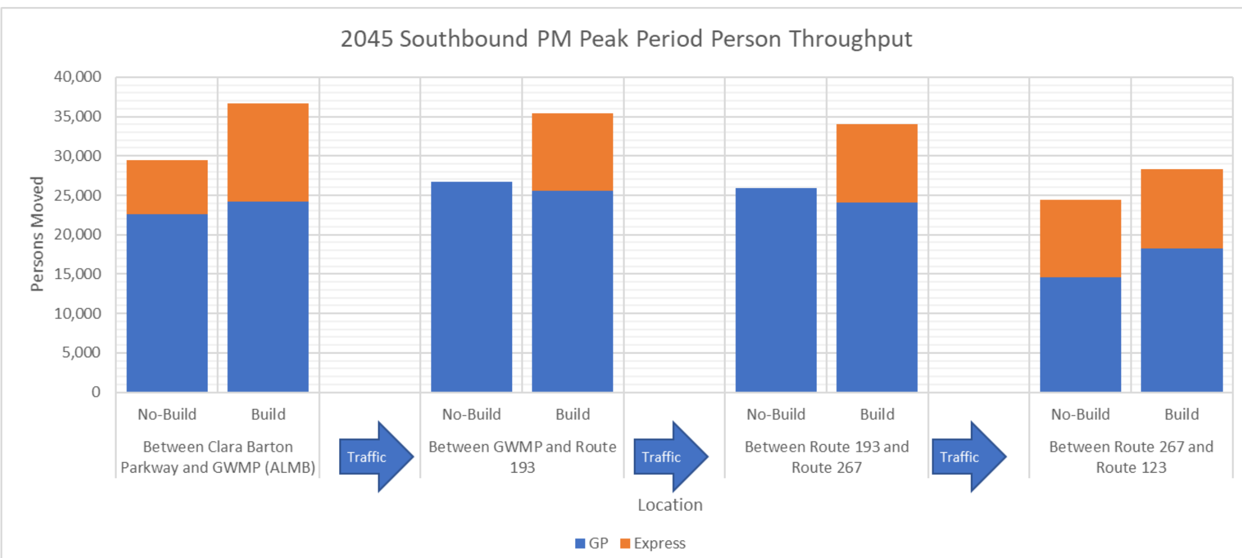


Figure 7-40. 2045 No Build and Build – PM Peak Period Person Throughput, I-495 Southbound

7.3.4 2045 No Build vs. Build Arterial Operations

AM Arterial Operations

<u>Intersections Evaluated in VISSIM</u>

Intersections in the Traffic Operations Study Area evaluated in VISSIM generally see improved operations in the 2045 AM peak hour under Build conditions as compared to No Build conditions. **Figure 7-41** provides pie charts of overall intersection HCM-analogous LOS for No Build and Build conditions. The figure shows that, in the Build condition, a lower percentage of intersections are failing (29 percent versus 33 percent) and a higher percentage of intersections are operating at an acceptable LOS (A to D; 58 percent versus 48 percent).

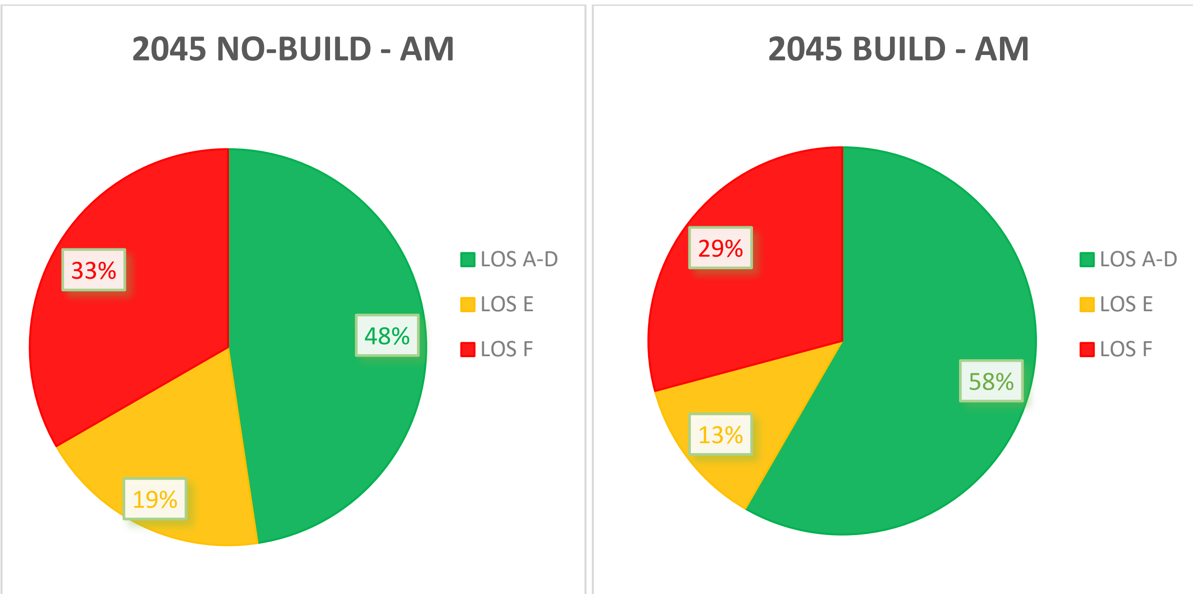


Figure 7-41. Summary of Arterial HCM-Analogous LOS, 2045 AM No Build vs. Build Conditions

Table 7-11 compares the overall intersection HCM-analogous LOS between the two scenarios for each intersection. A detailed breakdown of intersection delay and LOS, including delay and LOS by approach, is provided in **Appendix H.**

The following signalized intersections operate under failing conditions under both 2045 No Build and Build conditions:

- Route 123 and Lewinsville Road/Great Falls Street
- Lewinsville Road and Balls Hil. Road
- Spring Hill Road and Dulles Toll Road eastbound ramps

All three of these intersections are in the Tysons area and see continued growth in demand tied to commercial and residential growth in Tysons.

The following intersections are failing under No Build conditions but see improved operations (LOS E or better) under Build conditions:

- Route 123 and Capital One Tower Drive / Old Meadow Road
- Route 123 and Route 267 eastbound off-ramp / Anderson Road
- Jones Branch Connector and Express Lanes ramps

These improvements are likely attributable to improved operations along Route 123. New traffic signals are proposed in the Build condition with the off-ramps from I-495; coordination among these signals improves operations in the Build condition. Note that heavy arterial congestion is still observed along arterials in Tysons in the Build condition, including along several side street approaches.

In the Build condition, some arterial locations experience a deterioration in operations due to improved throughput from freeways that were previously metered in the No Build condition. This is most prevalent along Spring Hill Road near its interchange with Route 267, where the intersections of Spring Hill Road with the Dulles Toll Road westbound ramps and with Lewinsville Road are both failing in the Build condition. While demand for these intersections is not forecasted to change significantly between the No Build and Build conditions, throughput from upstream locations (such as I-495 southbound) is not constrained upstream in the Build condition.

The unsignalized intersection of Route 193 and Helga Place/Linganore Drive is failing under both 2045 No Build and Build conditions due to heavy delays on the southbound approach; this stop-controlled approach sees few gaps for traffic to enter the mainline Route 193 traffic stream due to heavy congestion in along eastbound Route 193 (spilling back from the northbound on-ramp to I-495). In the Build scenario, this eastbound congestion along Route 193 is relieved due to improved operations along northbound I-495, which reduces queue spillback on the on-ramp from Route 193. This is also reflected in the improved operations in the Build condition at all three signalized intersections along Route 193, most notably at the intersection with Balls Hill Road, where the northbound approach sees a significant improvement in operations.

Table 7-11. VISSIM Intersection Microsimulation Delay and HCM-Analogous LOS – 2045 No Build vs. Build AM Peak Hour

Intersection Control	Intersection	2045 No-Build		2045 Build	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS
Signalized	Route 123 and Tysons Boulevard	45.4	D	29.5	C
Signalized	Westpark Drive and Tysons Connector	31.8	C	35.2	D
Signalized	Tysons Connector and Express Lanes Ramps	24.0	C	26.5	C
Signalized	Route 123 and EB DTR/SB I-495 C-D Road	*	*	14.6	B
Signalized	Route 123 and NB I-495 Ramp	*	*	43.2	D
Signalized	Route 123 and Capital One Tower Drive/ Old Meadow Road	105.9	F	69.8	E
Signalized	Route 123 and Scotts Crossing Boulevard/ Colshire Drive	55.4	E	71.3	E
Signalized	Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road	145.6	F	79.3	E

Intersection Control	Intersection	2045 No-Build		2045 Build	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS
Signalized	Route 123 & Route 267 Eastbound On-Ramp	*	*	155.7	F
Signalized	Route 123 and Lewinsville Road/ Great Falls Street	211.0	F	234.3	F
Signalized	Lewinsville Road and Balls Hill Road	102.8	F	90.6	F
Signalized	Jones Branch Drive and Jones Branch Connector	19.3	B	18.9	B
Signalized	Jones Branch Connector and Express Lanes Ramps	100.2	F	33.5	C
Signalized	Jones Branch Drive and Capital One (West)	36.1	D	35.6	D
Signalized	Jones Branch Drive and Capital One (East)	26.0	C	26.5	C
Signalized	International Drive and Spring Hill Road/ Jones Branch Drive	45.7	D	45.8	D
Signalized	Spring Hill Road and Dulles Toll Road Eastbound Ramps	123.0	F	217.9	F
Signalized	Spring Hill Road and Dulles Toll Road Westbound Ramps	26.2	C	85.7	F
Signalized	Spring Hill Road and Lewinsville Road	57.2	E	138.7	F
Unsignalized	Route 193 and Helga Place/ Linganore Drive	231.7	F	72.7	F
Signalized	Route 193 and I-495 Southbound Ramps	40.2	D	39.1	D
Signalized	Route 193 and I-495 Northbound Ramps	69.1	E	54.8	D
Signalized	Route 193 and Balls Hill Road	59.7	E	25.1	C
Unsignalized	Route 193 and Dead Run Drive	14.3	B	14.3	B

*This intersection is not provided under the No Build conditions.

Intersections Evaluated in Synchro

The expanded arterial network beyond intersections immediately adjacent to freeway interchanges in the corridor was evaluated solely through Synchro. **Table 7-12** compares the overall intersection delay and LOS between the two scenarios for each intersection.

Under both No Build and Build conditions, the following intersections are failing:

- Old Dominion Drive and Balls Hill Road (signalized)
- Route 193 and Swinks Mill Road (unsignalized)
- Route 193 and Douglass Drive (unsignalized)

Note that under Build conditions, while the two unsignalized intersections along Route 193 are experiencing failing conditions due to significant delays on stop-controlled approaches, a significant reduction in delay is achieved as compared to No Build conditions. This is consistent with the VISSIM findings at adjacent intersections along the Route 193 corridor, where operations improve significantly in the Build condition.

Table 7-12. 2045 Synchro Intersection Delay and LOS – 2045 No Build vs. Build AM Peak Hour

Intersection Control	Intersection Name	2045 No-Build AM		2045 Build AM	
		Intersection Delay (Sec/veh)	LOS	Intersection Delay (Sec/veh)	LOS
Signalized	Old Dominion Drive at Spring Hill Road	11.3	B	11.2	B
Signalized	Old Dominion Drive at Swinks Mill Road	15.6	B	14.6	B
Signalized	Old Dominion Drive at Balls Hill Road	97.1	F	87.0	F
Signalized	Route 123 at Old Dominion Drive	48.8	D	45.0	D
Unsignalized	Route 193 at Swinks Mill Road	187.8	F	59.3	F
Unsignalized	Route 193 at Spring Hill Road	23.9	C	23.5	C
Unsignalized	Lewinsville Road at Swinks Mill Road	2.6	A	2.6	A
Unsignalized	Route 123 at Ingleside Avenue	22.8	C	23.2	C
Unsignalized	Douglass Drive at Route 193	478.6	F	236.7	F

Figure 7-42 provides a summary comparison of overall intersection delay for Build conditions as compared to No Build conditions at each intersection in the Traffic Operations Study Area for the 2045 AM scenario. The figure shows whether an intersection shows an improvement in operations (increase in LOS in Build conditions if below LOS D for No Build conditions, or a significant reduction in delay if still operating at LOS F in Build conditions), a degradation in operations (decrease in LOS in Build conditions or significant increase in delay if operating at LOS F already in No Build conditions), or if operations remain generally consistent between the two scenarios.

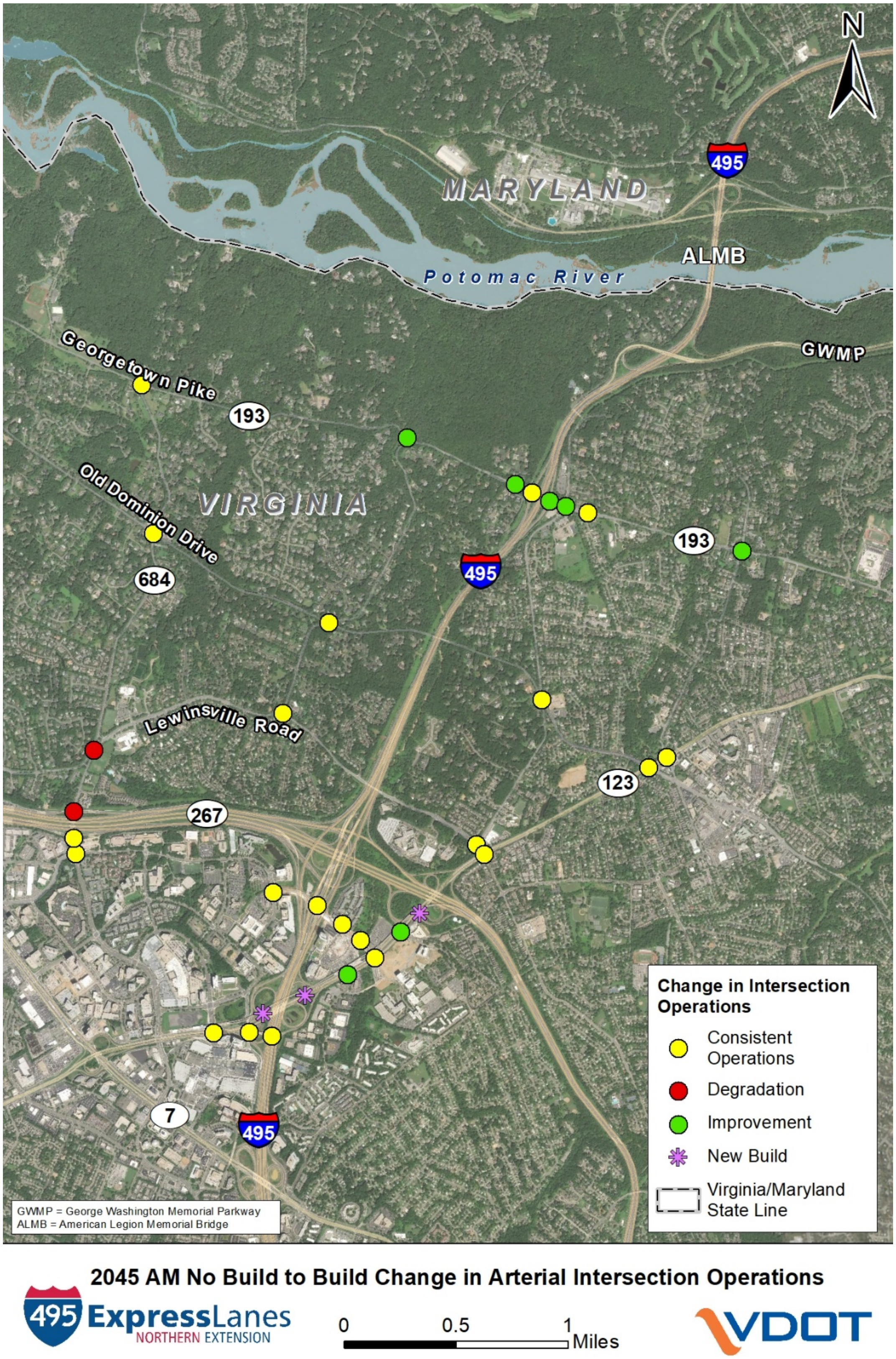


Figure 7-42. 2045 AM No Build to Build Change in Arterial Intersection Operations

PM Arterial Operations

Intersections Evaluated in VISSIM

Intersections in the Traffic Operations Study Area evaluated in VISSIM generally see improved operations in the 2045 PM peak hour under Build conditions as compared to No Build conditions. **Figure 7-43** provides pie charts of overall intersection HCM-analogous LOS for No Build and Build conditions. The figure shows that, in the Build condition, a lower percentage of intersections are failing (33 percent versus 43 percent) and a higher percentage of intersections are operating at an acceptable LOS (A to D; 46 percent versus 33 percent).

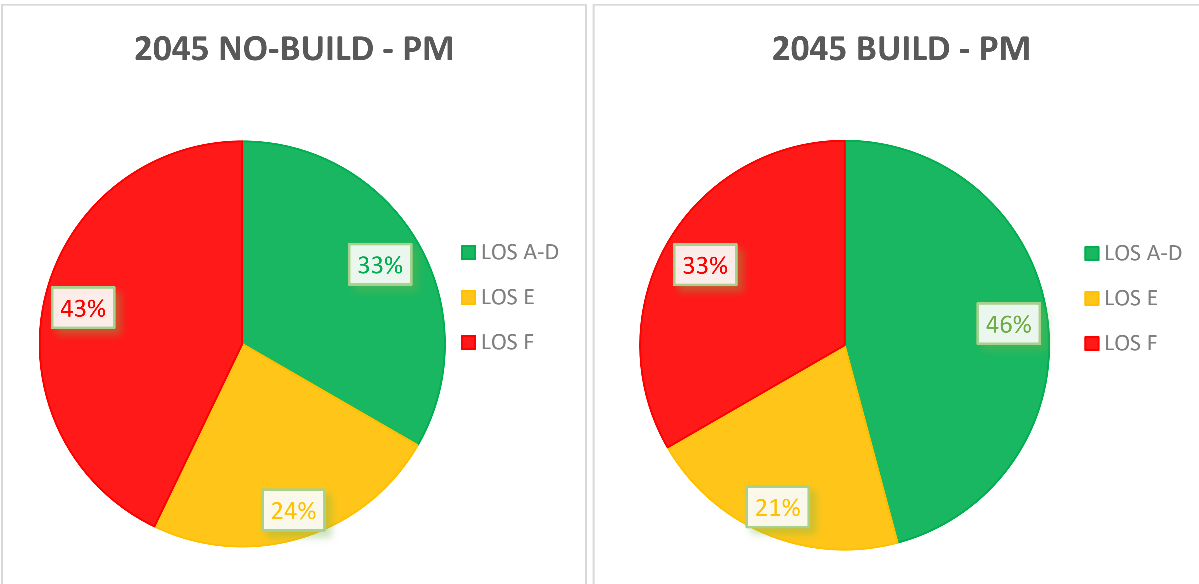


Figure 7-43. Summary of Arterial HCM-Analogous LOS, 2045 PM No Build vs. Build Conditions

Table 7-13 compares the overall intersection HCM-analogous LOS between the two scenarios for each intersection. A detailed breakdown of intersection delay and LOS, including delay and LOS by approach, is provided in **Appendix H.**

The following signalized intersections operate under failing conditions under both 2045 No Build and Build conditions:

- Route 123 and Tysons Boulevard
- Route 123 and Route 267 eastbound off-ramp / Anderson Road
- Route 123 and Lewinsville Road/Great Falls Street
- Lewinsville Road and Balls Hill Road
- Jones Branch Connector and I-495 Express Lanes ramps
- Jones Branch Connector and Capital One driveway (West)

All of these intersections are in the Tysons area and see continued growth in demand tied to commercial and residential growth in Tysons.

The following signalized intersections are failing under No Build conditions but see improved operations (LOS E or better) under Build conditions:

- Route 123 and Capital One Tower Drive / Old Meadow Road

- Route 123 and Scotts Crossing Boulevard / Colshire Drive
- Jones Branch Connector and Express Lanes ramps

These improvements are likely attributable to improved operations along Route 123. New traffic signals are proposed in the Build condition with the off-ramps from I-495; coordination among these signals improves operations in the Build condition. Note that heavy arterial congestion is still observed along arterials in Tysons in the Build condition, including along several side street approaches.

In the Build condition, some arterial locations experience a deterioration in operations due to improved throughput from freeways that were previously metered in the No Build condition. This is most prevalent along the Jones Branch Connector / Scotts Crossing Boulevard, where three intersections are failing in the Build condition. While demand for these intersections is not forecasted to change significantly between the No Build and Build conditions, throughput from upstream locations (such as I-495 southbound) is not constrained upstream in the Build condition.

The unsignalized intersection of Route 193 and Helga Place/Linganore Drive is failing under 2045 No Build conditions due to heavy delays on the southbound approach; this stop-controlled approach sees few gaps for traffic to enter the mainline Route 193 traffic stream due to heavy congestion in along eastbound Route 193 (spilling back from the northbound on-ramp to I-495). In the Build scenario, this eastbound congestion along Route 193 is relieved due to improved operations along northbound I-495, which reduces queue spillback on the on-ramp from Route 193. Along Route 193, the signalized intersections all operate at LOS E or better under No Build and Build conditions; in the Build condition, a significant improvement in operations is realized along the northbound approach from Balls Hill Road at Route 193, which is failing under No Build conditions.

Table 7-13. VISSIM Intersection Microsimulation Delay and HCM-Analogous LOS – 2045 No Build vs. Build PM Peak Hour

Intersection Control	Intersection	2045 No-Build		2045 Build	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS
Signalized	Route 123 and Tysons Boulevard	206.0	F	209.9	F
Signalized	Westpark Drive and Tysons Connector	15.8	B	18.8	B
Signalized	Tysons Connector and Express Lanes Ramps	13.8	B	13.7	B
Signalized	Route 123 and EB DTR/SB I-495 C-D Road	*	*	6.9	A
Signalized	Route 123 and NB I-495 Ramp	*	*	23.7	C
Signalized	Route 123 and Capital One Tower Drive/ Old Meadow Road	80.2	F	77.5	E
Signalized	Route 123 and Scotts Crossing Boulevard/ Colshire Drive	80.3	F	71.4	E

Intersection Control	Intersection	2045 No-Build		2045 Build	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS
Signalized	Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road	192.9	F	89.3	F
Signalized	Route 123 & EB DTR Ramps	*	*	198.6	F
Signalized	Route 123 and Lewinsville Road/ Great Falls Street	230.1	F	260.2	F
Signalized	Lewinsville Road and Balls Hill Road	168.7	F	212.1	F
Signalized	Jones Branch Drive and Jones Branch Connector	76.6	E	143.9	F
Signalized	Jones Branch Connector and Express Lanes Ramps	132.6	F	138.0	F
Signalized	Jones Branch Drive and Capital One (West)	93.5	F	99.5	F
Signalized	Jones Branch Drive and Capital One (East)	72.3	E	70.7	E
Signalized	International Drive and Spring Hill Road/ Jones Branch Drive	47.6	D	51.4	D
Signalized	Spring Hill Road and Dulles Toll Road Eastbound Ramps	21.6	C	23.6	C
Signalized	Spring Hill Road and Dulles Toll Road Westbound Ramps	31.6	C	38.1	D
Signalized	Spring Hill Road and Lewinsville Road	67.2	E	69.1	E
Unsignalized	Route 193 and Helga Place/ Linganore Drive	125.6	F	15.9	C
Signalized	Route 193 and I-495 Southbound Ramps	24.5	C	21.6	C
Signalized	Route 193 and I-495 Northbound Ramps	60.3	E	63.6	E
Signalized	Route 193 and Balls Hill Road	40.7	D	18.4	B
Unsignalized	Route 193 and Dead Run Drive	40.6	E	13.8	B

*This intersection is not provided under the No Build conditions.

<u>Intersections Evaluated in Synchro</u>

The expanded arterial network beyond intersections immediately adjacent to freeway interchanges in the corridor was evaluated solely through Synchro. **Table 7-14** compares the overall intersection delay and LOS between the two scenarios for each intersection.

Under both No Build and Build conditions, the following intersections are failing:

- Old Dominion Drive and Balls Hill Road (signalized)
- Route 193 and Douglass Drive (unsignalized)

These same two intersections are failing in the 2045 AM peak hour under both No Build and Build conditions. Note that under Build conditions, while the intersection of Route 193 and Douglass Drive is still failing, a significant reduction in delay is achieved as compared to No Build conditions.

Table 7-14. 2045 Synchro Intersection Delay and LOS – 2045 No Build vs. Build PM Peak Hour

Intersection Control	Intersection Name	2045 No-Build PM		2045 Build PM	
		Intersection Delay (Sec/veh)	LOS	Intersection Delay (Sec/veh)	LOS
Signalized	Old Dominion Drive at Spring Hill Road	11.0	B	9.9	A
Signalized	Old Dominion Drive at Swinks Mill Road	11.7	B	10.1	B
Signalized	Old Dominion Drive at Balls Hill Road	209.9	F	174.6	F
Signalized	Route 123 at Old Dominion Drive	35.2	D	36.4	D
Unsignalized	Route 193 at Swinks Mill Road	25.8	D	18.1	C
Unsignalized	Route 193 at Spring Hill Road	20.1	C	19.6	C
Unsignalized	Lewinsville Road at Swinks Mill Road	2.6	A	2.6	A
Unsignalized	Route 123 at Ingleside Avenue	28.5	D	26.1	D
Unsignalized	Douglass Drive at Route 193	898.5	F	513.1	F

Figure 7-44 provides a summary comparison of overall intersection delay for Build conditions as compared to No Build conditions at each intersection in the Traffic Operations Study Area for the 2045 AM scenario. The figure shows whether an intersection shows an improvement in operations (increase in LOS in Build conditions if below LOS D for No Build conditions, or a significant reduction in delay if still operating at LOS F in Build conditions), a degradation in operations (decrease in LOS in Build conditions or significant increase in delay if operating at LOS F already in No Build conditions), or if operations remain generally consistent between the two scenarios.

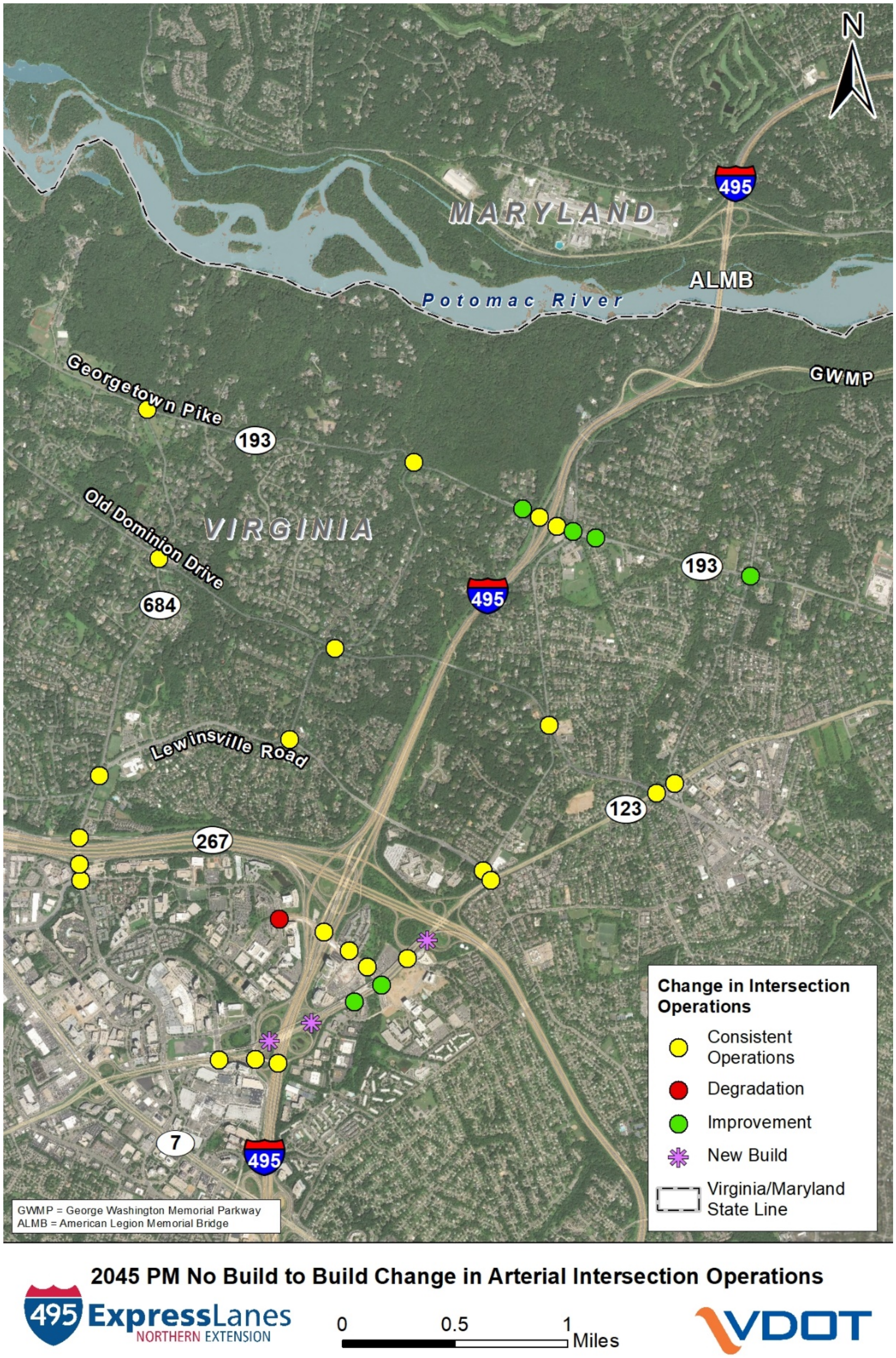


Figure 7-44. 2045 PM No Build to Build Change in Arterial Intersection Operations

7.3.5 Summary of 2045 Operations

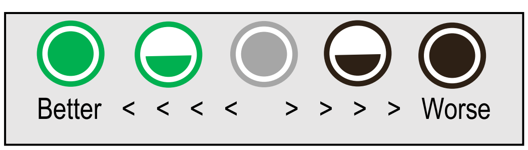
2045 AM Peak Period Summary

- Total demand along I-495 (GP plus Express) is forecasted to increase in the Build scenario along the length of the I-495 corridor. The greatest increases in demand are in the segments between Route 267 and GWMP, where Express Lanes are only present in the Build scenario and thus represent a substantial capacity increase from No Build conditions. Peak hour volumes are forecasted to increase in the Build scenario by between 3 to 11 percent in the northbound direction and between 4 to 6 percent in the southbound direction.
- In the northbound direction along the I-495 GP lanes, congestion is observed under No Build conditions between Route 267 and Clara Barton Parkway (across the ALMB) due to heavy merging and weaving volumes on and near the bridge. Under Build conditions, a significant reduction in congestion is observed due to the additional capacity provided by the Express Lanes and the reduced weaving due to the continuity of the Express Lanes. The average travel time in the northbound GP lanes improves by approximately 4 minutes (a 33 percent improvement) in the Build condition.
- In the southbound direction along the I-495 GP lanes, severe congestion is observed under No Build conditions north of Route 193 through the northern extents of the Traffic Operations Study Area due to queue spillback from the merge at the southern Terminus of the Maryland managed lanes system. This congestion is significantly alleviated under Build conditions. The average travel time in the southbound GP lanes improves by nearly 9 minutes (a 54 percent improvement).
- Both directions of the Express Lanes operate at or near the posted speed limit, with the exceptions of the termini segments in the No Build conditions which much merge into the GP lanes. To travel the length of the corridor via Express Lanes under No Build conditions, vehicles must utilize the congested GP lanes between Route 267 and GWMP, as Express Lanes are not present.
- Along eastbound Route 267 (DTR) there is 75 percent improvement in travel time. With the improved operations along northbound I-495, the ramp from eastbound DTR to northbound I-495 does not spill back to eastbound DTR, improving operations along eastbound DTR. Travel times along the westbound DTR remain unchanged.
- Over the course of the AM peak period, total persons moved along I-495 are forecasted to increase from No Build to Build conditions by between 6 and 33 percent in the northbound direction and between 29 and 35 percent in the southbound direction, depending upon location along the corridor.
- Arterial intersection operations see an improvement under Build conditions, as the percentage of intersections operating at failing conditions drops from 33 percent (No Build) to 29 percent (Build), and more than half of all intersections are LOS D or better in the Build condition, while only 48 percent are at LOS D or better in the No Build condition. Most of the failing intersections are in the Tysons area and see continue growth in demand tied to commercial and residential growth in Tysons. Improved arterial operations are observed along Route 193, most notably at the intersection with Balls Hill Road, where the northbound approach sees a significant improvement in operations.

Table 7-15 presents an overall performance comparison table for the Build alternative versus the No Build alternative for 2045 AM conditions. The table shows that the Build alternative improves overall operations along the I-495 corridor given the improvement in travel times, reduction in congestion, and increase in persons moved.

Table 7-15. Overall Performance Comparison for 2045 AM No Build and Build Alternative

Measure of Effectiveness	Description	Facility	2025 AM No Build Value	2025 AM Build Value	Build Performance Compared to No Build
Travel Times	End-to-end travel time along the facility through the Traffic Operations Study Area, measured in Minutes	I-495 NB GP	12	8	●
		I-495 NB Express	10	6	●
		I-495 SB GP	16	8	●
		I-495 SB Express	8	6	●
		Dulles Toll Road EB	7	2	●
		Dulles Toll Road WB	2	2	○
Extent and Duration of Congestion	Visual assessment of freeway mainline queue length and duration of congestion	I-495 NB GP			●
		I-495 SB GP			●
Person Throughput	Additional persons moved during peak period of Build condition and percentage increase	I-495 NB (All)	+9,300 (33%)		●
		I-495 SB (All)	+9,600 (35%)		●
Arterial Operations	Number of intersections operating at LOS F	Entire Study Area	10	10	○
	Number of intersections operating at LOS D or better		16	20	●

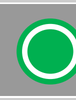


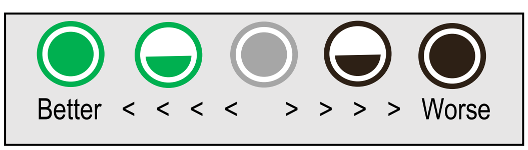
2045 PM Peak Period Summary

- Total demand along I-495 (GP plus Express) is forecasted to increase in the Build scenario along the length of the I-495 corridor. The greatest increases in demand are in the segments between Route 267 and GWMP, where Express Lanes are only present in the Build scenario and thus represent a substantial capacity increase from No Build conditions. Peak hour volumes are forecasted to increase in the Build scenario by between 3 to 20 percent in the northbound direction and between 7 to 12 percent in the southbound direction.
- In the northbound direction along the I-495 GP lanes, severe congestion is observed under No Build conditions spilling back from the ALMB through the Route 267 interchange and essentially through the extents of the Traffic Operations Study Area; this congestion is worsened by spillback from the northbound GP lanes in Maryland later in the peak period, creating a single continuous area of congestion through the corridor. In the Build condition, the congestion in Maryland remains generally unchanged, but the extent of the queue spillback and duration on the Virginia side, especially south of Route 193, is not as significant as the No Build condition. This is attributable to the additional capacity provided by the Express Lanes and reduced weaving due to the continuity of the Express Lanes system. The average travel time in the northbound GP lanes improves by approximately 4.5 minutes (a 16 percent improvement) in the Build condition.
- In the southbound direction along the I-495 GP lanes, severe congestion is observed under No Build conditions north of Route 193 through the northern extents of the Traffic Operations Study Area due to queue spillback from the merge at the southern Terminus of the Maryland managed lanes system. This congestion is significantly alleviated under Build conditions. The average travel time in the southbound GP lanes improves by approximately 7.5 minutes (a 49 percent improvement).
- Both directions of the Express Lanes operate at or near the posted speed limit, with the exceptions of the termini segments in the No Build conditions which much merge into the GP lanes. To travel the length of the corridor via Express Lanes under No Build conditions, vehicles must utilize the congested GP lanes between Route 267 and GWMP as Express Lanes are not present.
- Along eastbound and westbound Route 267 (DTR), travel times are essentially identical between No Build and Build.
- Over the course of the PM peak period, total persons moved along I-495 are forecasted to increase from No Build to Build conditions by between 10 and 35 percent in the northbound direction and between 16 and 32 percent in the southbound direction, depending upon location along the corridor.
- Arterial intersection operations see an improvement under Build conditions, as the percentage of intersections operating at failing conditions drops from 43 percent (No Build) to 33 percent (Build), and 46 percent of intersections are LOS D or better in the Build condition, while only 33 percent are at LOS D or better in the No Build condition. Most of the failing intersections are in the Tysons area and see continue growth in demand tied to commercial and residential growth in Tysons. Along Route 193, the signalized intersections all operate at LOS E or better under No Build and Build conditions; in the Build condition, a significant improvement in operations is realized along the northbound approach from Balls Hill Road at Route 193, which is failing under No Build conditions.

Table 7-16 presents an overall performance comparison table for the Build alternative versus the No Build alternative for 2045 PM conditions. The table shows that the Build alternative improves overall operations along the I-495 corridor given the improvement in travel times, reduction in congestion, and increase in persons moved. Arterial operations are also shown to improve in the PM peak hour under the Build alternative.

Table 7-16. Overall Performance Comparison for 2045 PM No Build and Build Alternative

Measure of Effectiveness	Description	Facility	2025 AM No Build Value	2025 AM Build Value	Build Performance Compared to No Build
Travel Times	End-to-end travel time along the facility through the Traffic Operations Study Area, measured in Minutes	I-495 NB GP	28	24	
		I-495 NB Express	16	6	
		I-495 SB GP	15	8	
		I-495 SB Express	7	6	
		Dulles Toll Road EB	2	2	
		Dulles Toll Road WB	2	2	
Extent and Duration of Congestion	Visual assessment of freeway mainline queue length and duration of congestion	I-495 NB GP			
		I-495 SB GP			
Person Throughput	Additional persons moved during peak period of Build condition and percentage increase	I-495 NB (All)	+7,800 (35%)		
		I-495 SB (All)	+8,700 (32%)		
Arterial Operations	Number of intersections operating at LOS F	Entire Study Area	11	10	
	Number of intersections operating at LOS D or better		14	18	



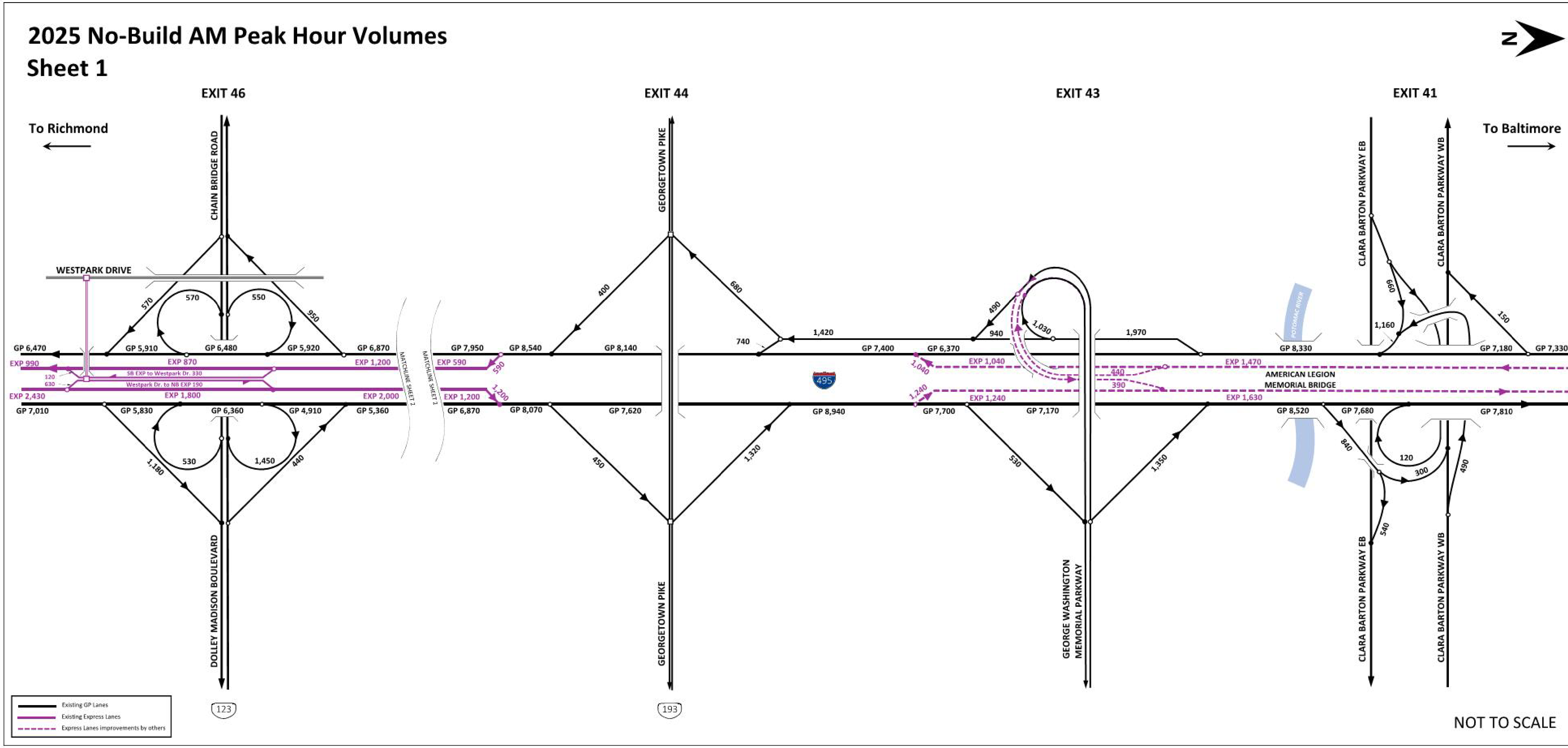


Exhibit 7-1a. Freeway 2025 No Build AM Peak Hour Volume – I-495

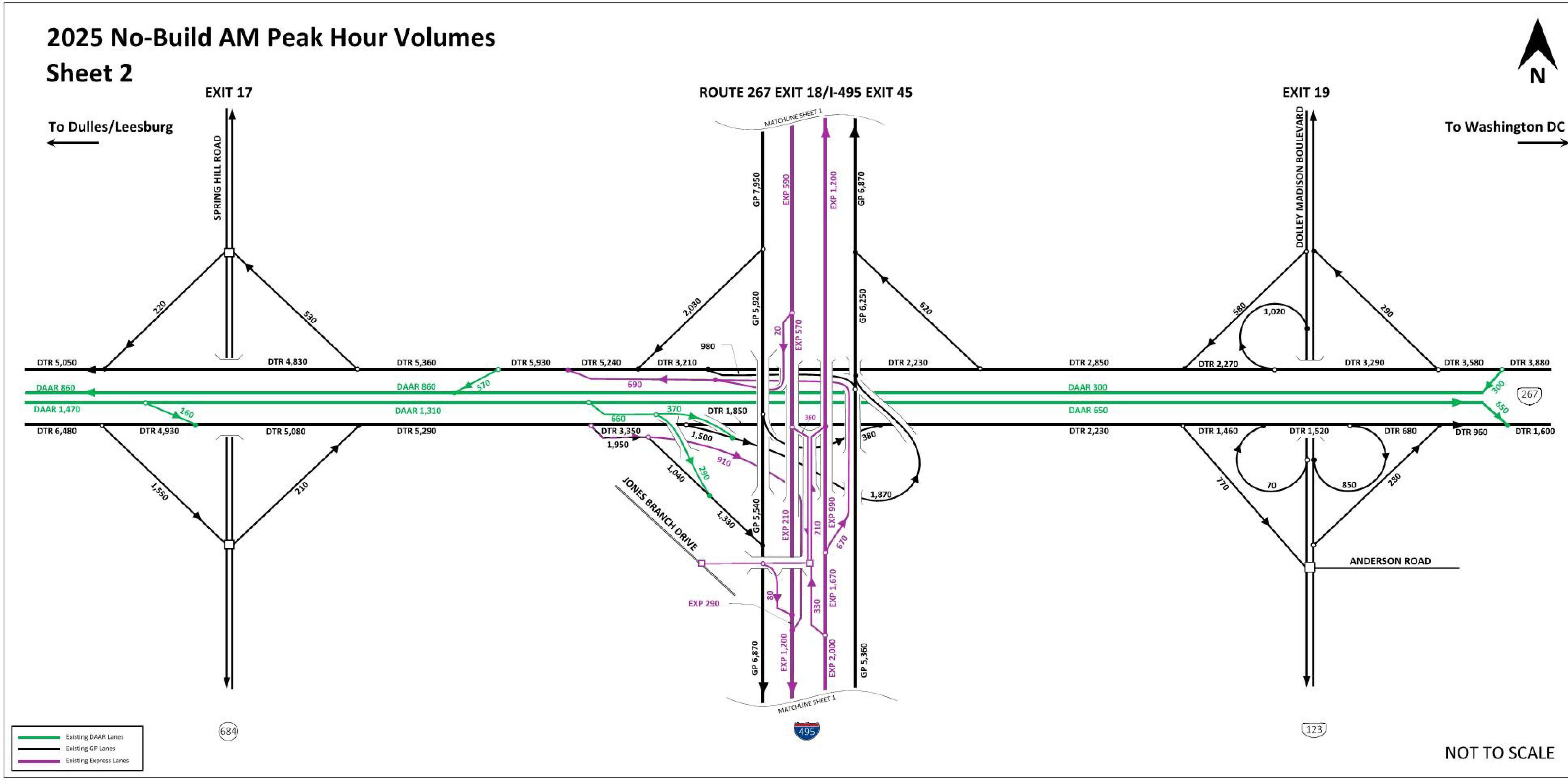


Exhibit 7-1b. Freeway 2025 No Build AM Peak Hour Volume – Route 267

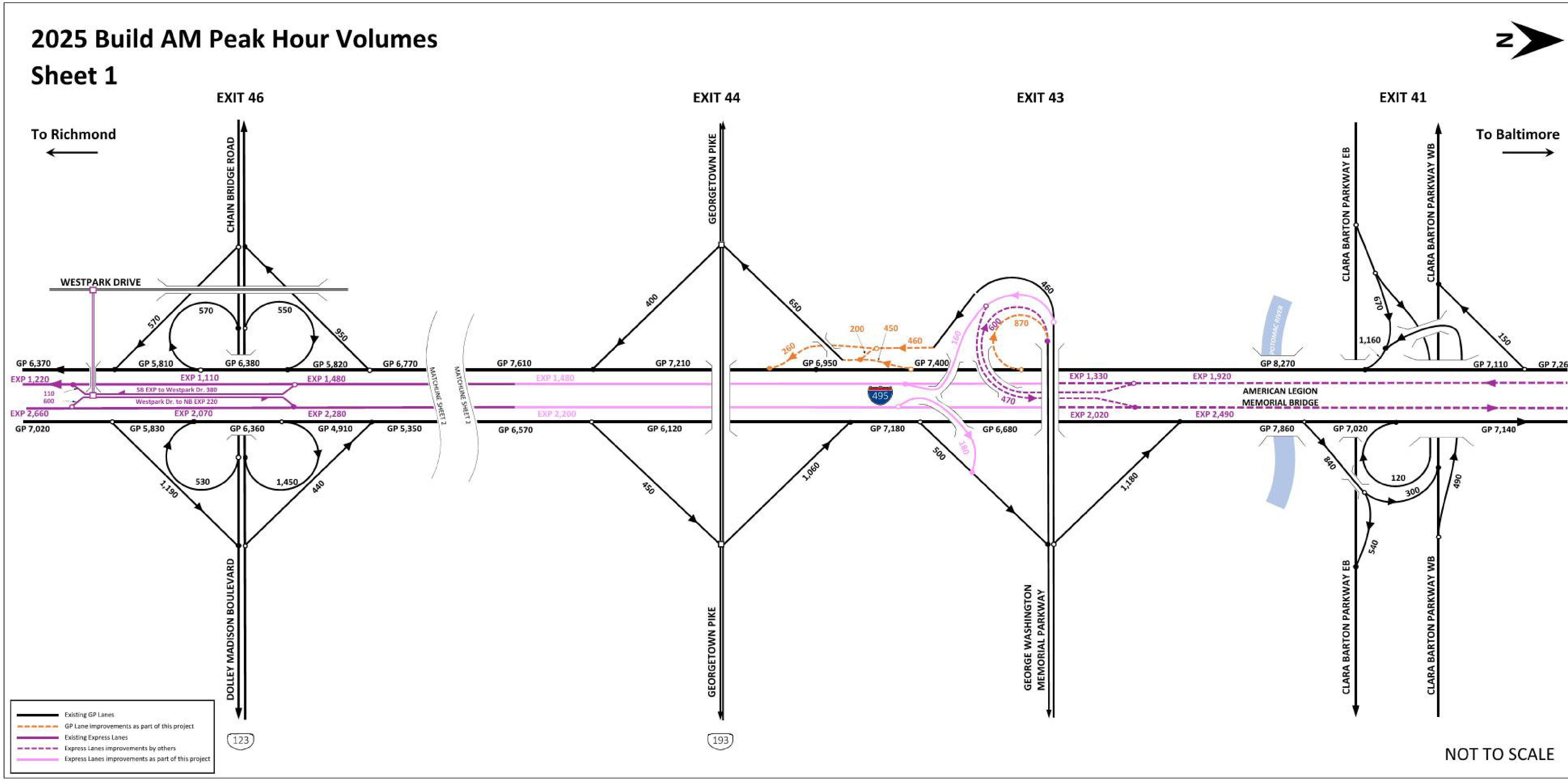


Exhibit 7-2a. Freeway 2025 Build AM Peak Hour Volume – I-495

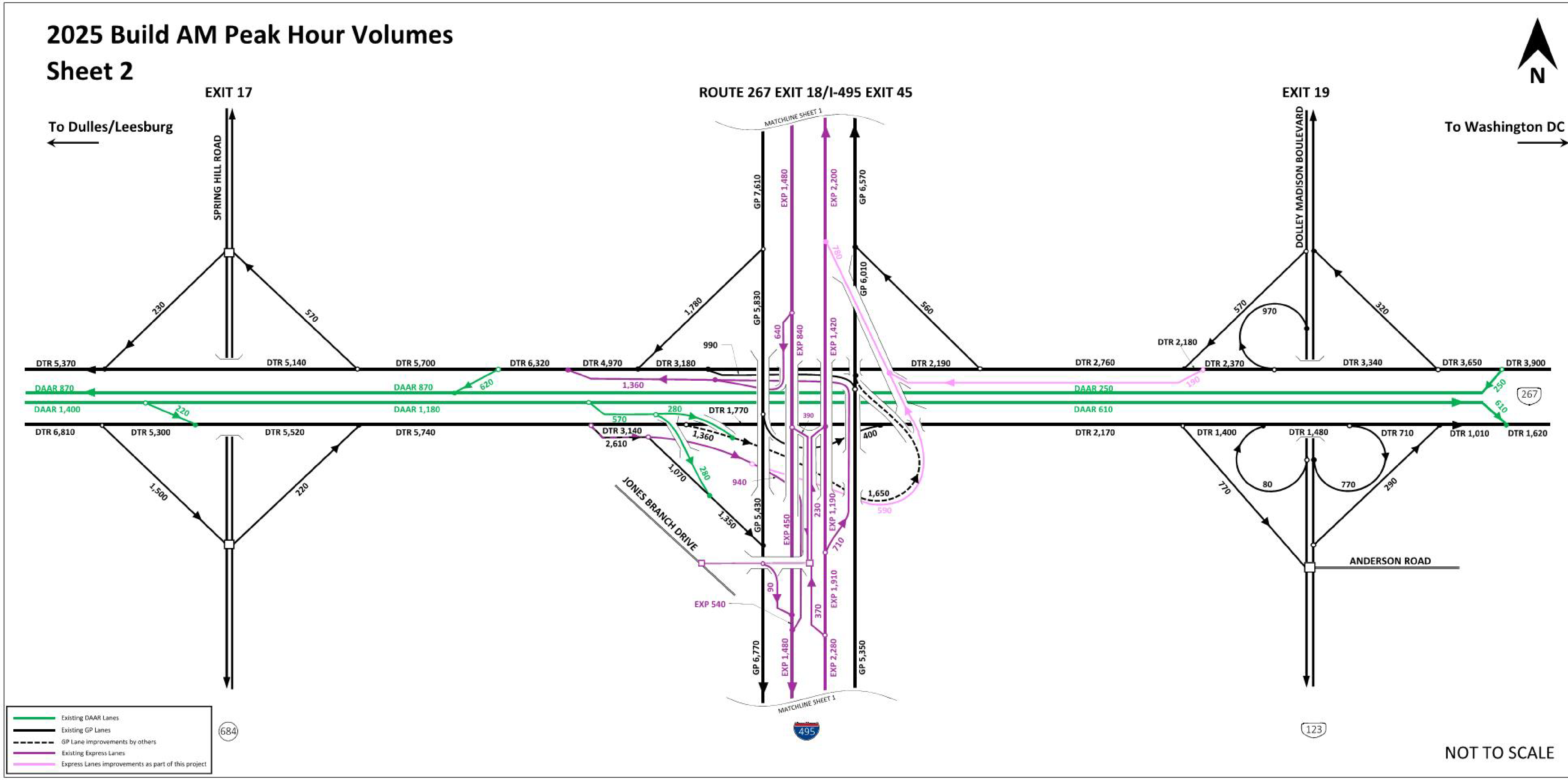


Exhibit 7-2b. Freeway 2025 Build AM Peak Hour Volume – Route 267

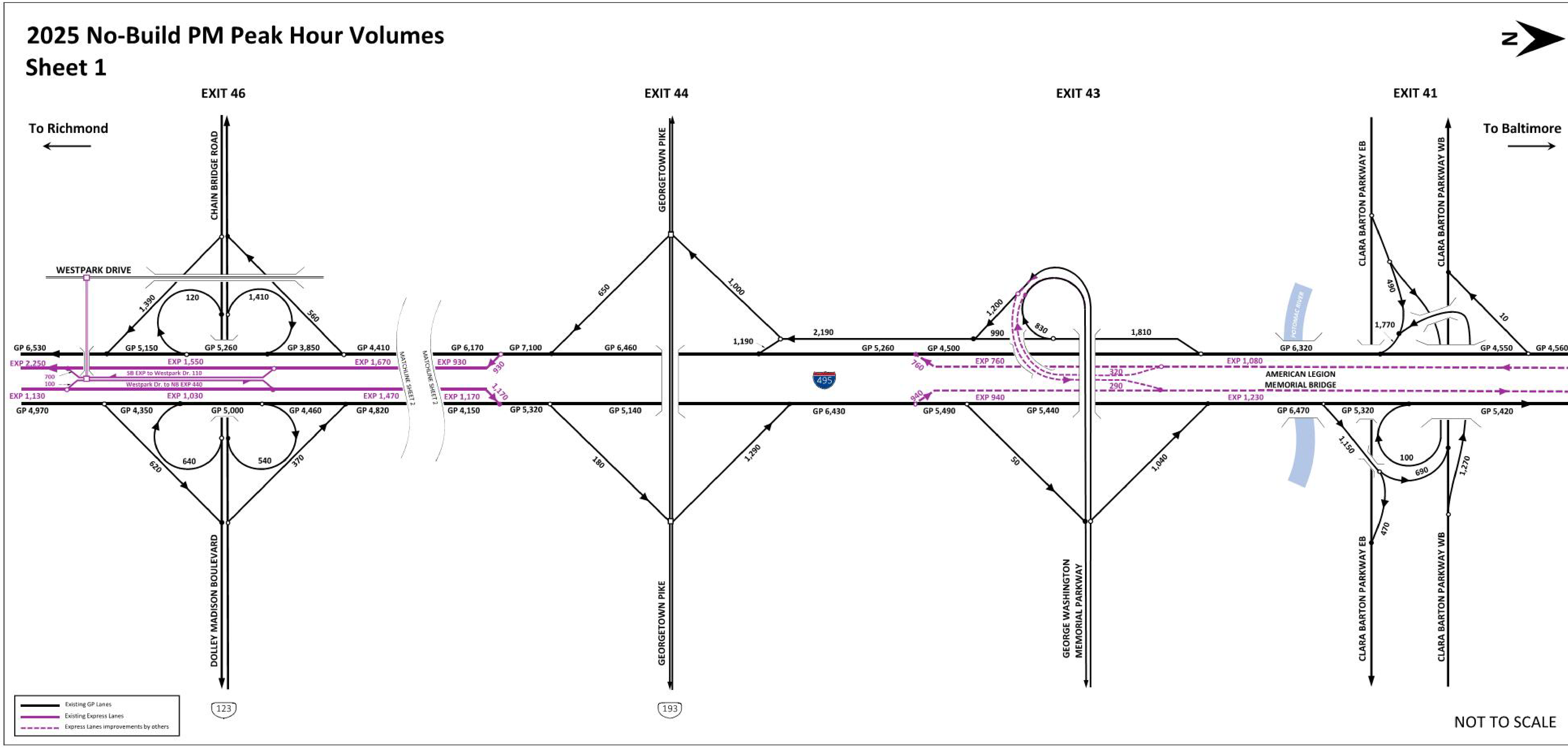


Exhibit 7-3a. Freeway No Build PM Peak Hour Volume – I-495

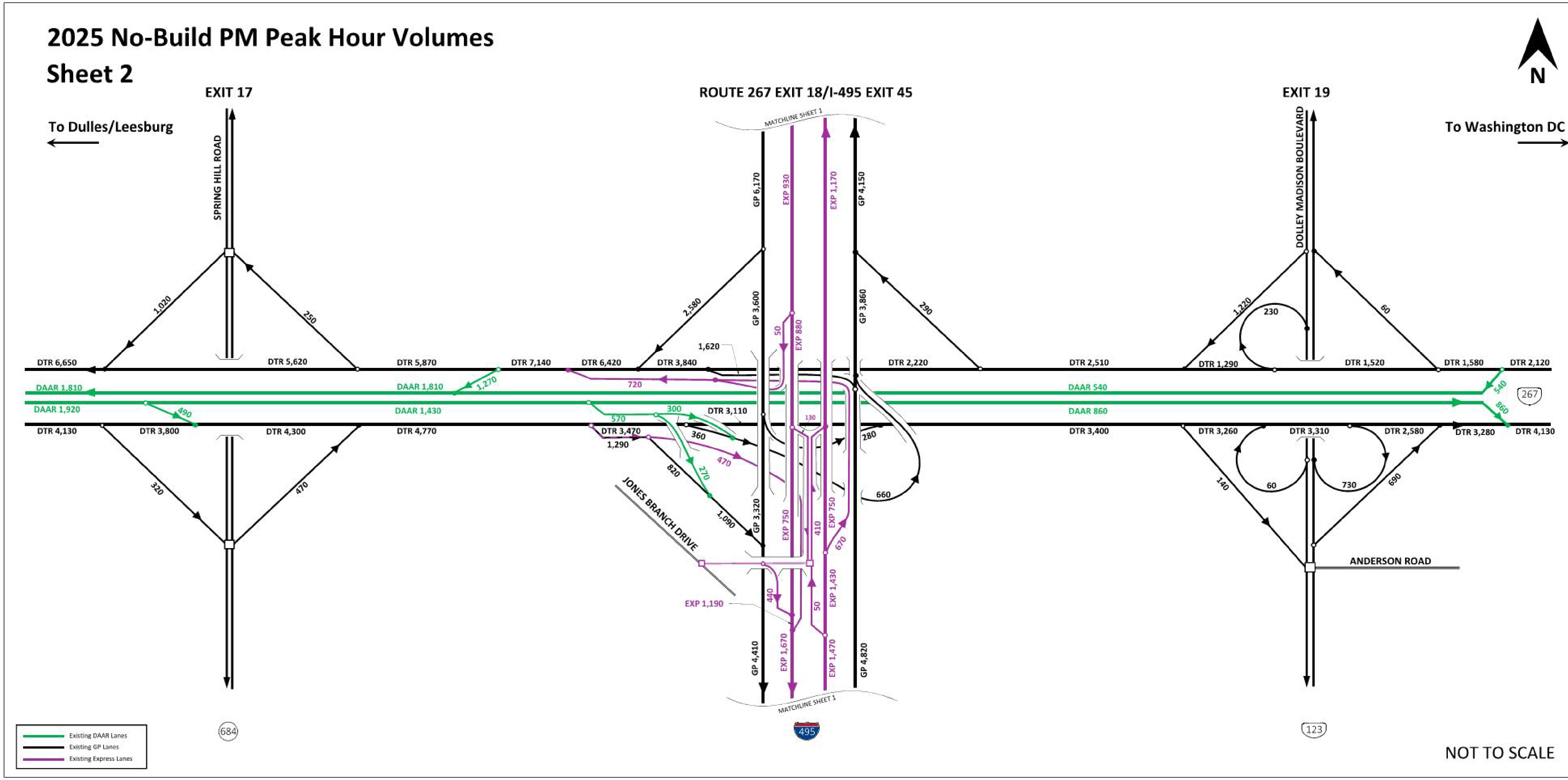


Exhibit 7-3b. Freeway No Build PM Peak Hour Volume – Route 267

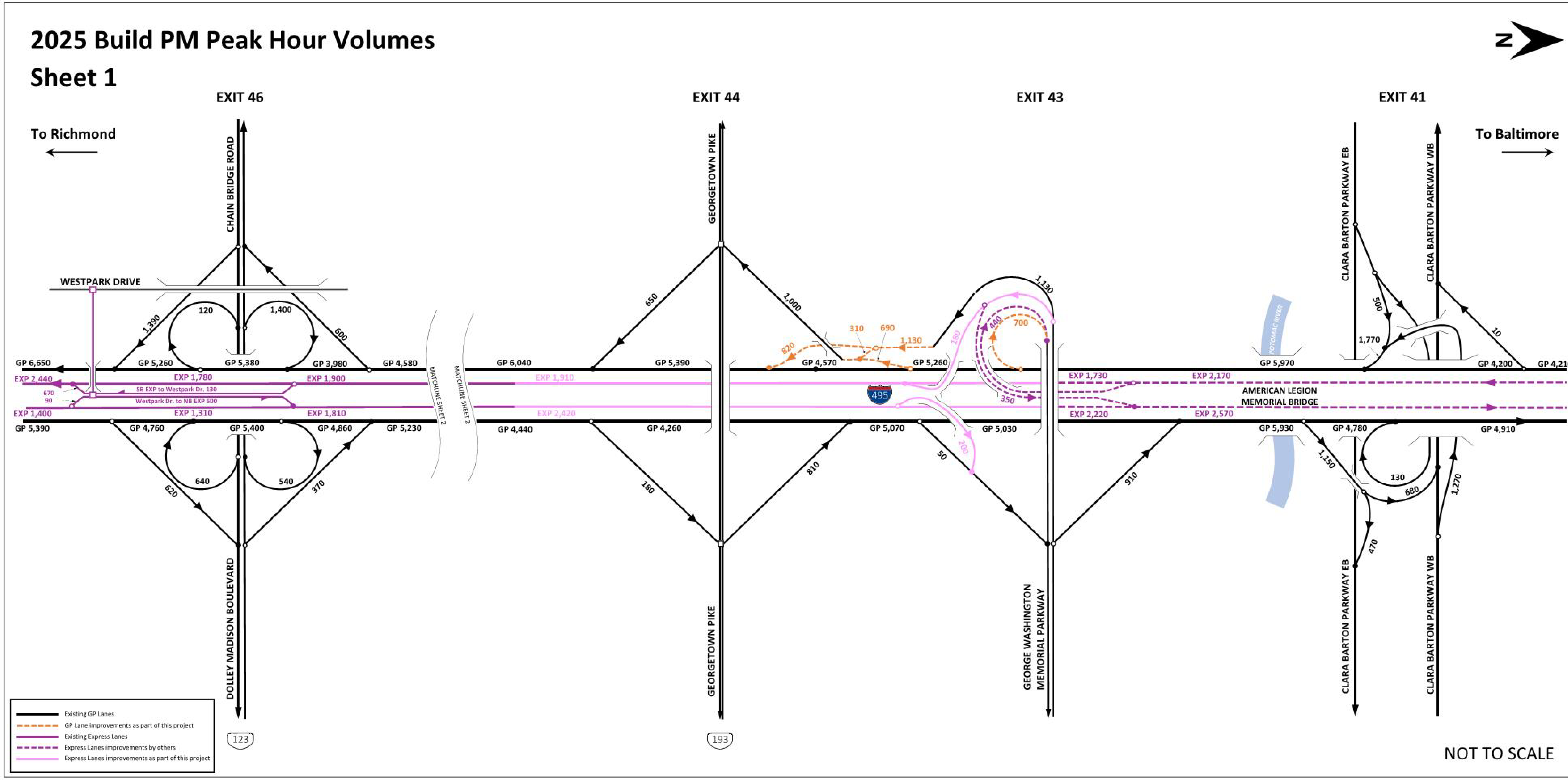


Exhibit 7-4a. Freeway Build PM Peak Hour Volume – I-495

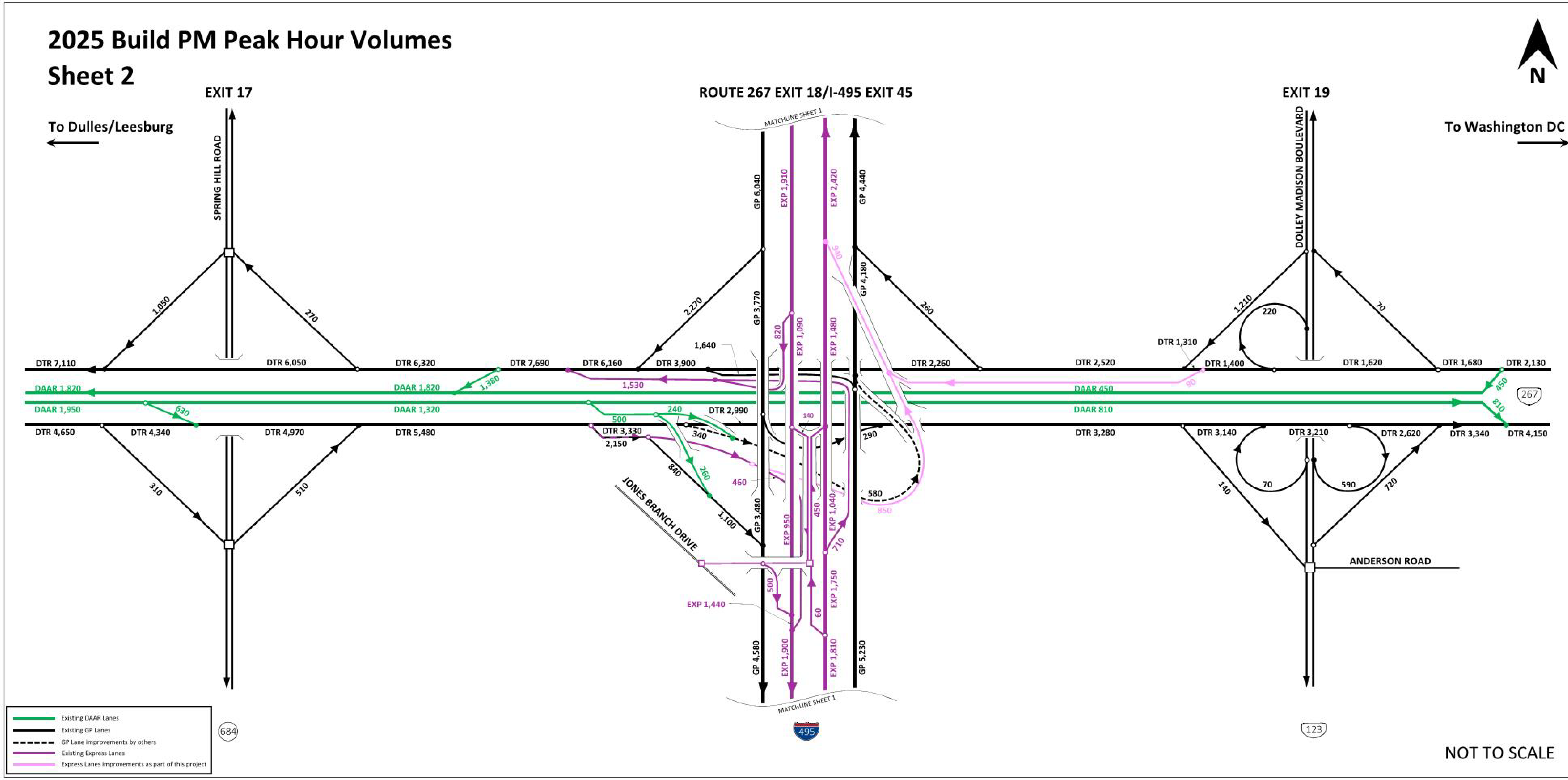


Exhibit 7-4b. Freeway Build PM Peak Hour Volume – Route 267

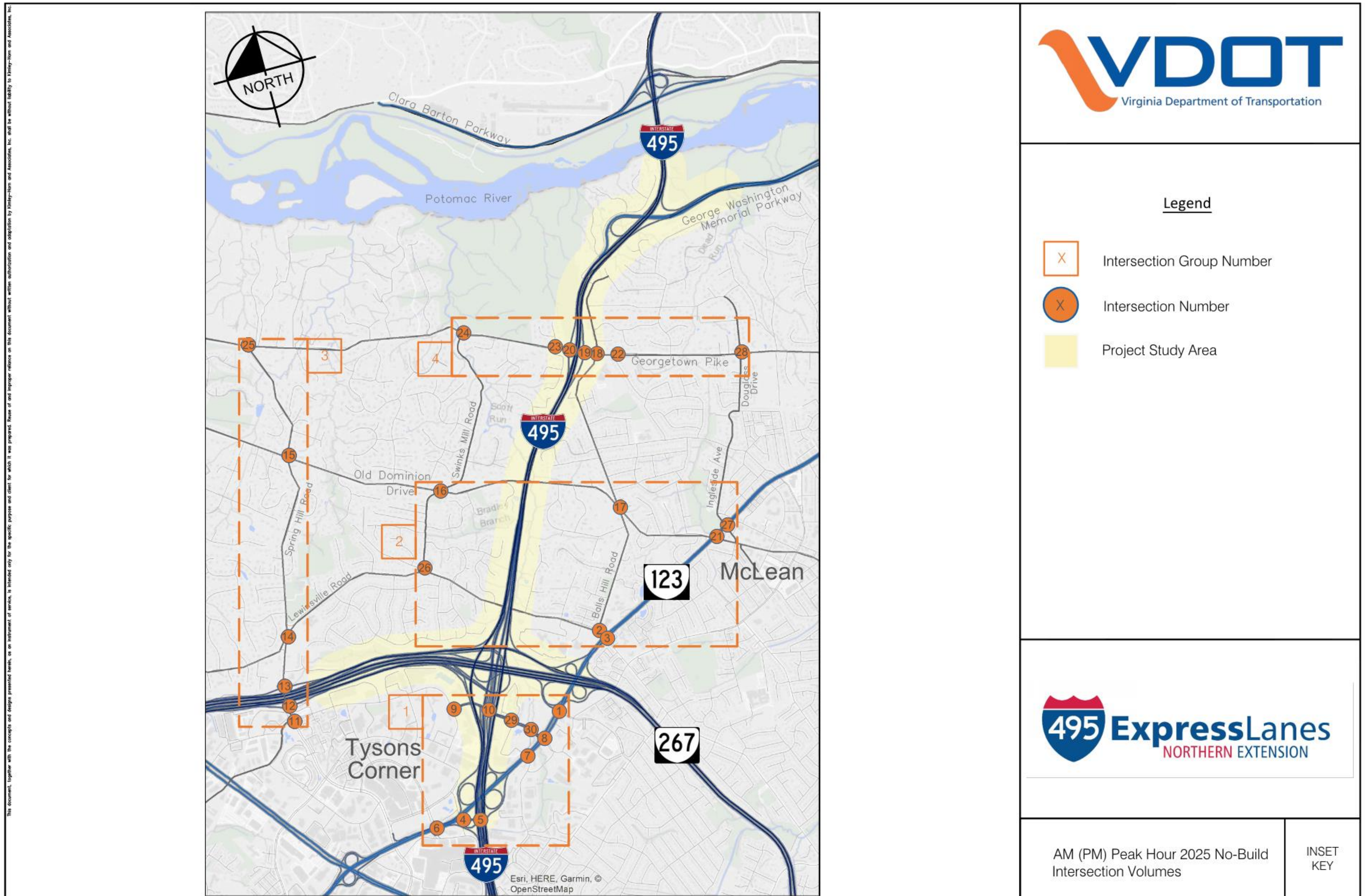


Exhibit 7-5a. Arterial 2025 No Build Peak Hour Turning Movement Volumes – Figure Key

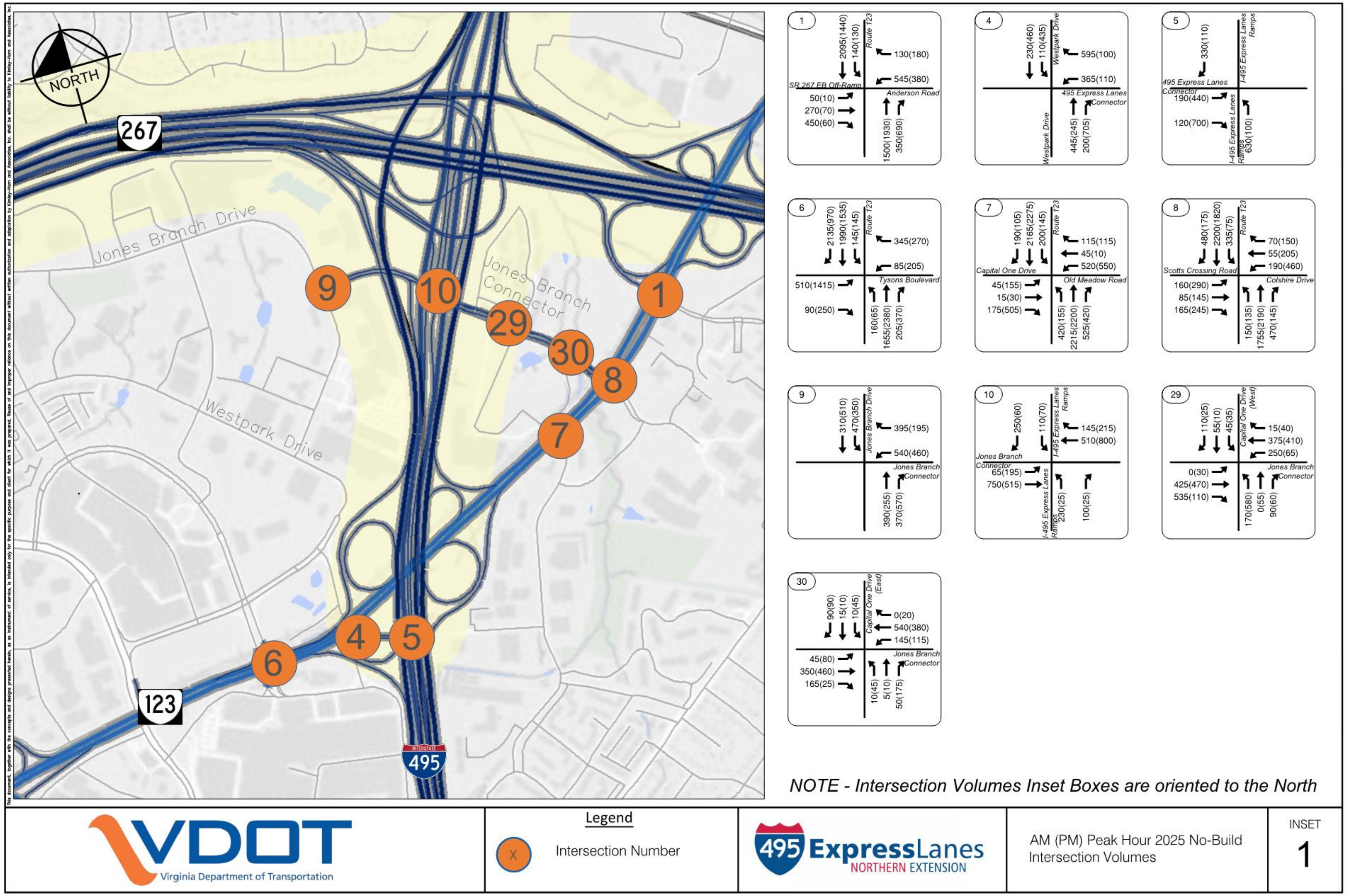


Exhibit 7-5b. Arterial 2025 No Build Peak Hour Turning Movement Volumes – Location 1

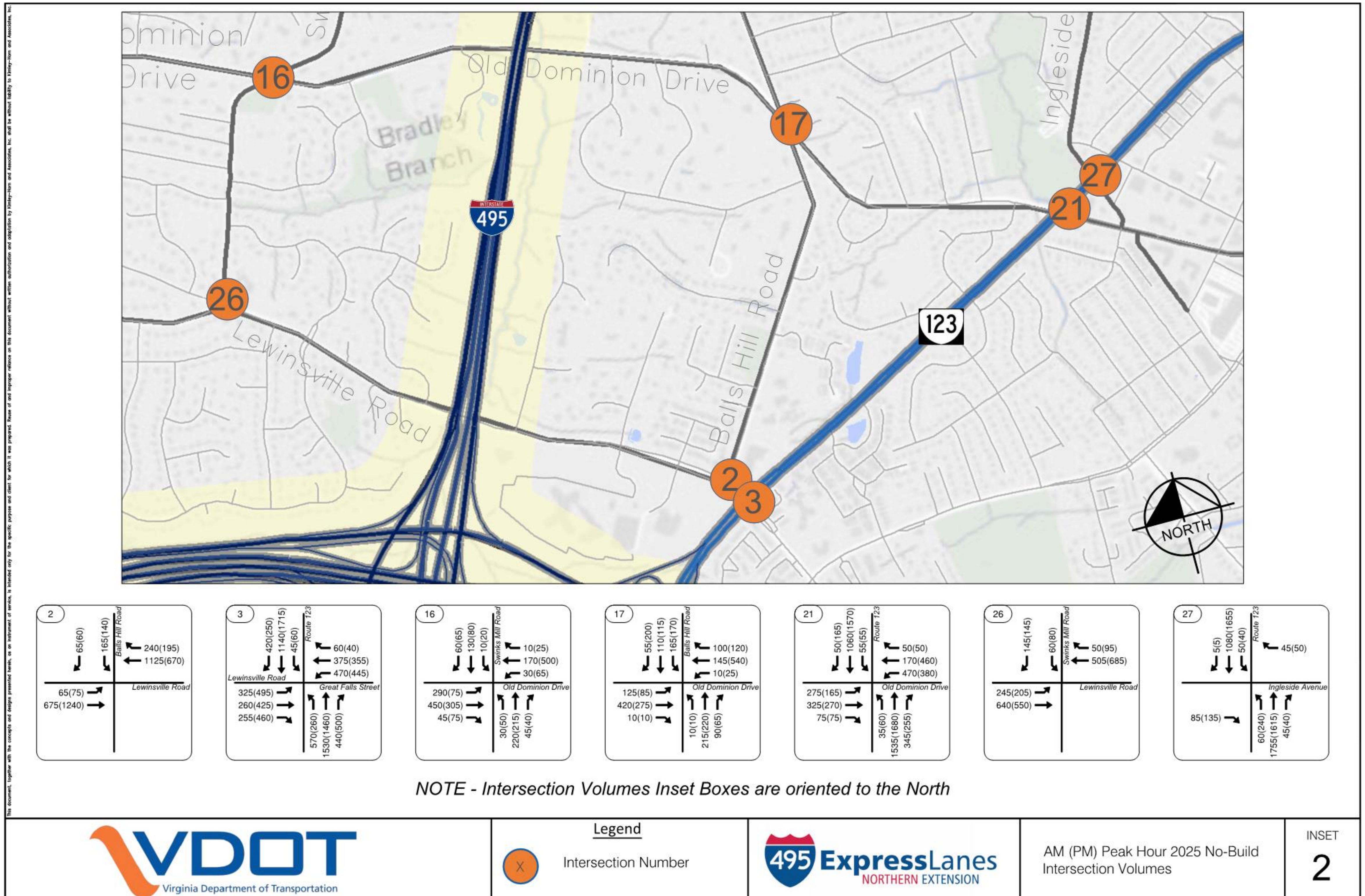


Exhibit 7-5c. Arterial 2025 No Build Peak Hour Turning Movement Volumes – Location 2

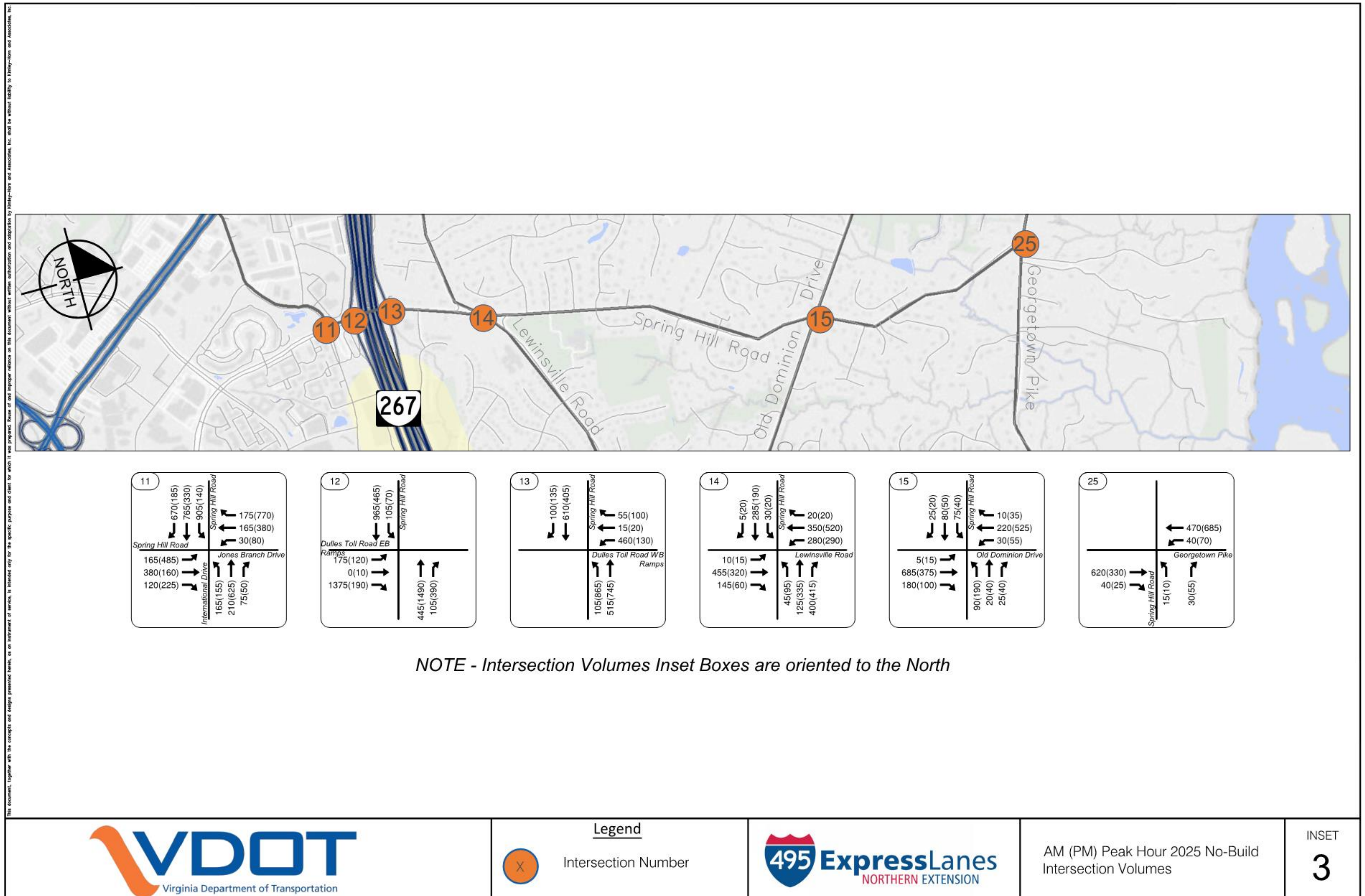


Exhibit 7-5d. Arterial 2025 No Build Peak Hour Turning Movement Volumes – Location 3

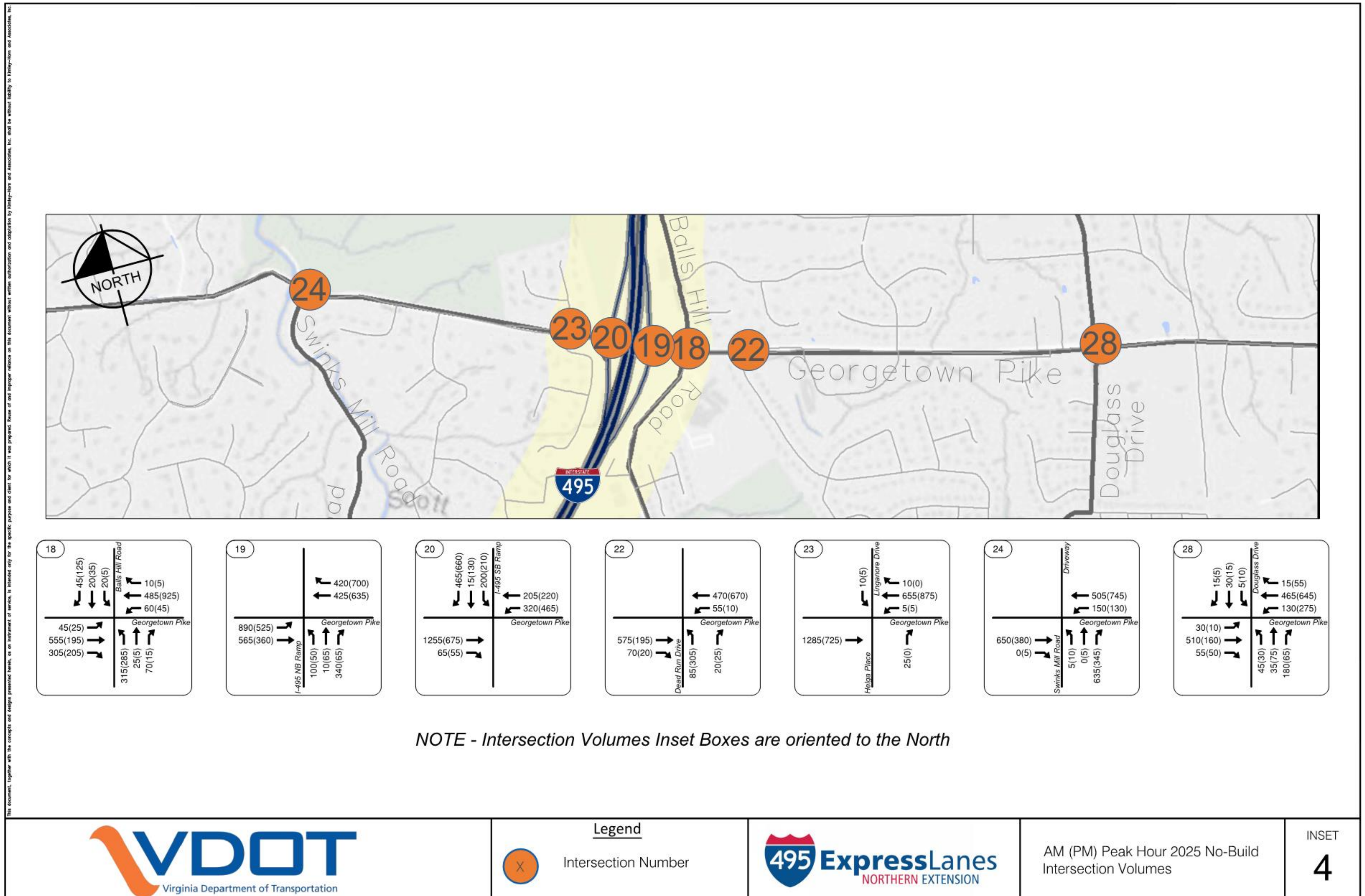


Exhibit 7-5e. Arterial 2025 No Build Peak Hour Turning Movement Volumes – Location 4

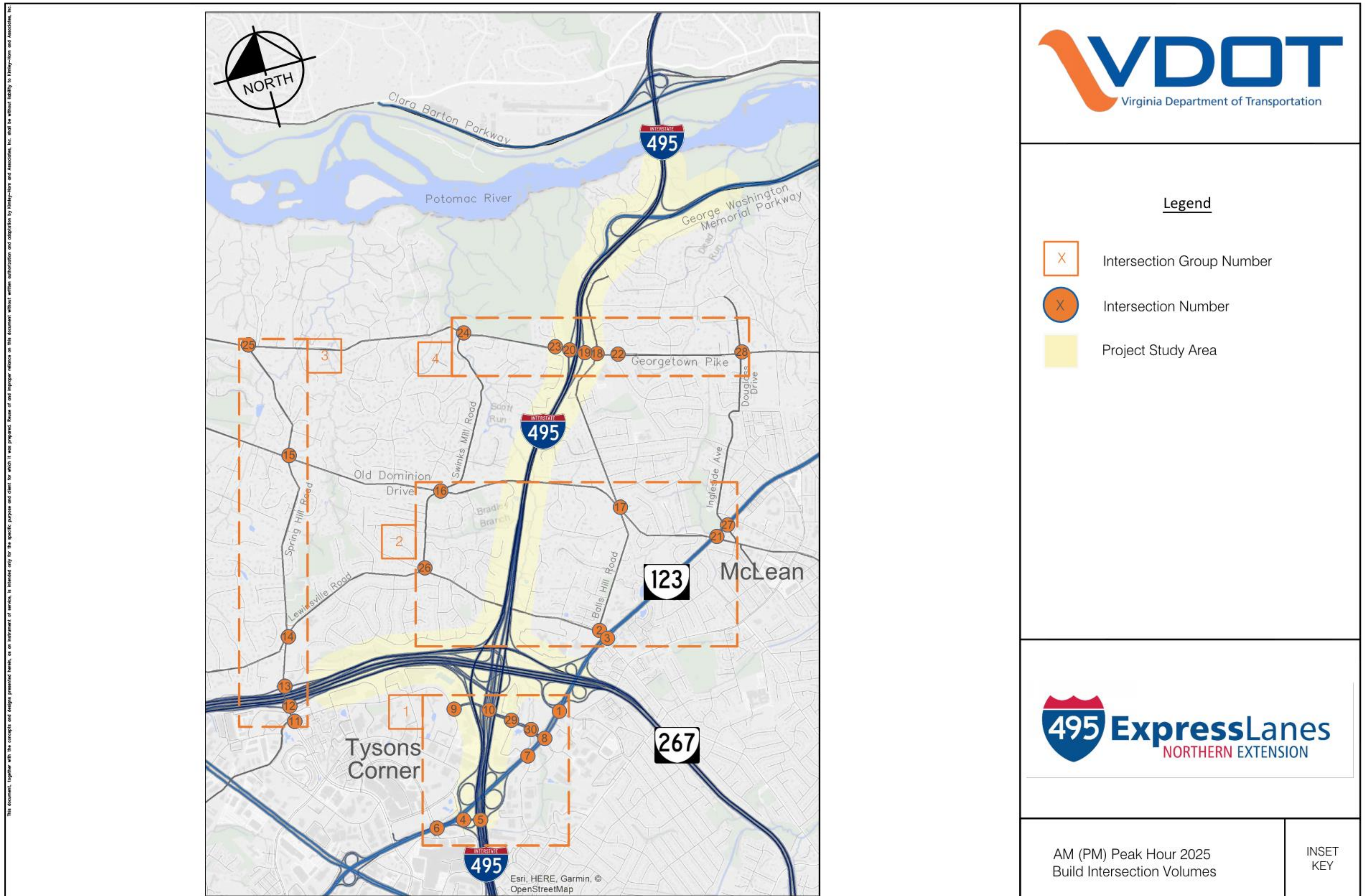


Exhibit 7-6a. Arterial 2025 Build Peak Hour Turning Movement Volumes – Figure Key

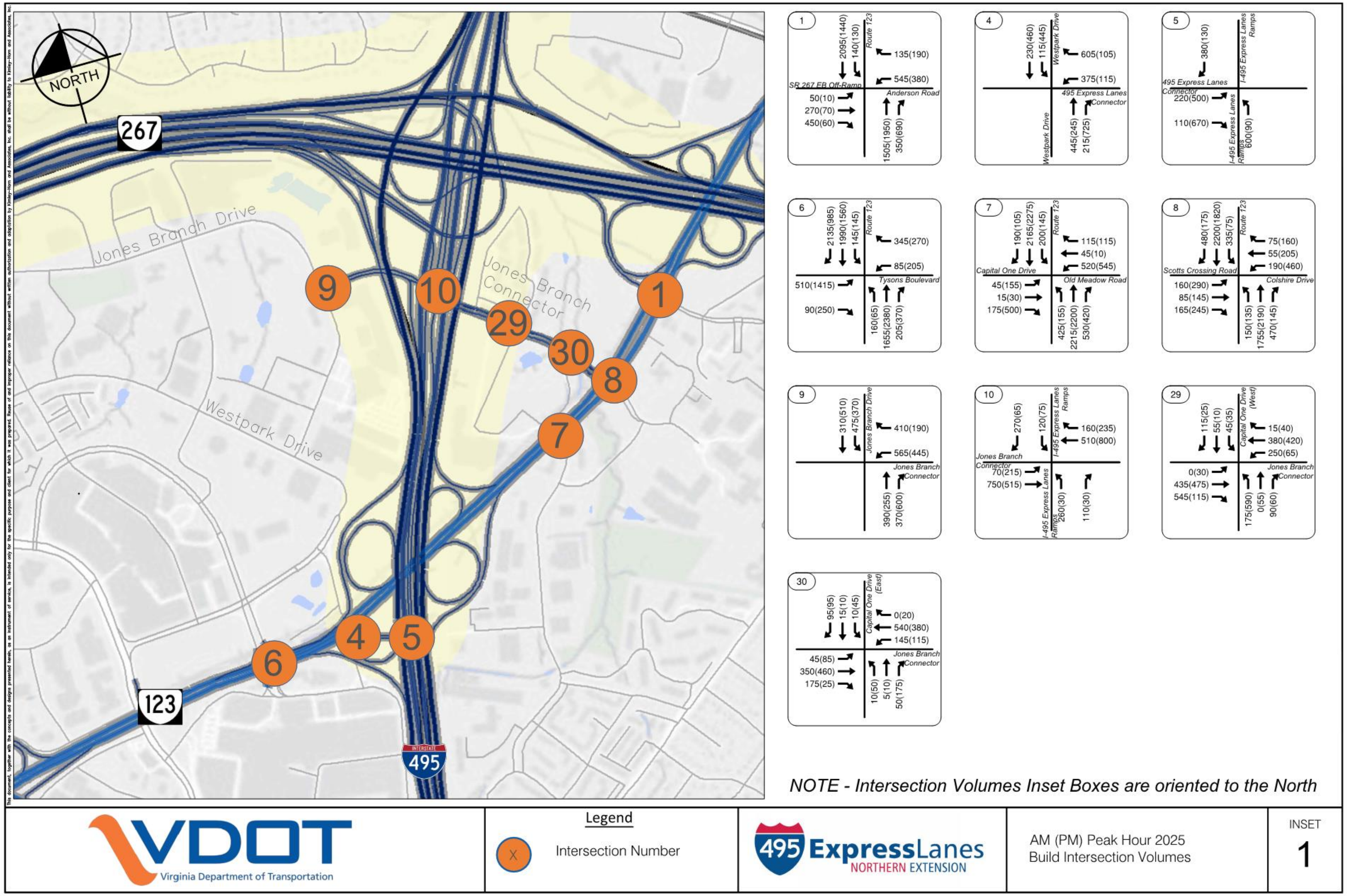


Exhibit 7-6b. Arterial 2025 Build Peak Hour Turning Movement Volumes – Location 1

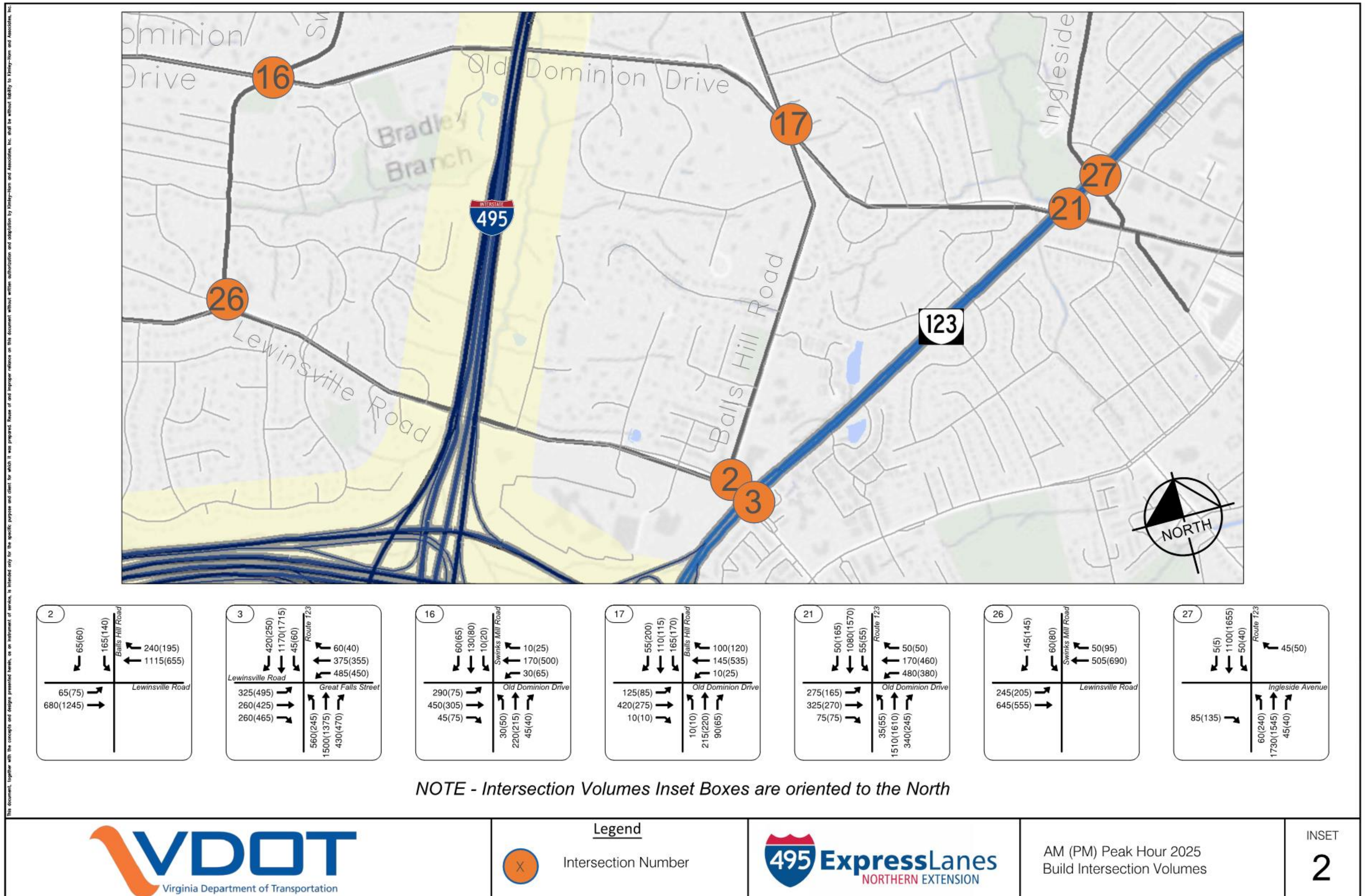


Exhibit 7-6c. Arterial 2025 Build Peak Hour Turning Movement Volumes – Location 2

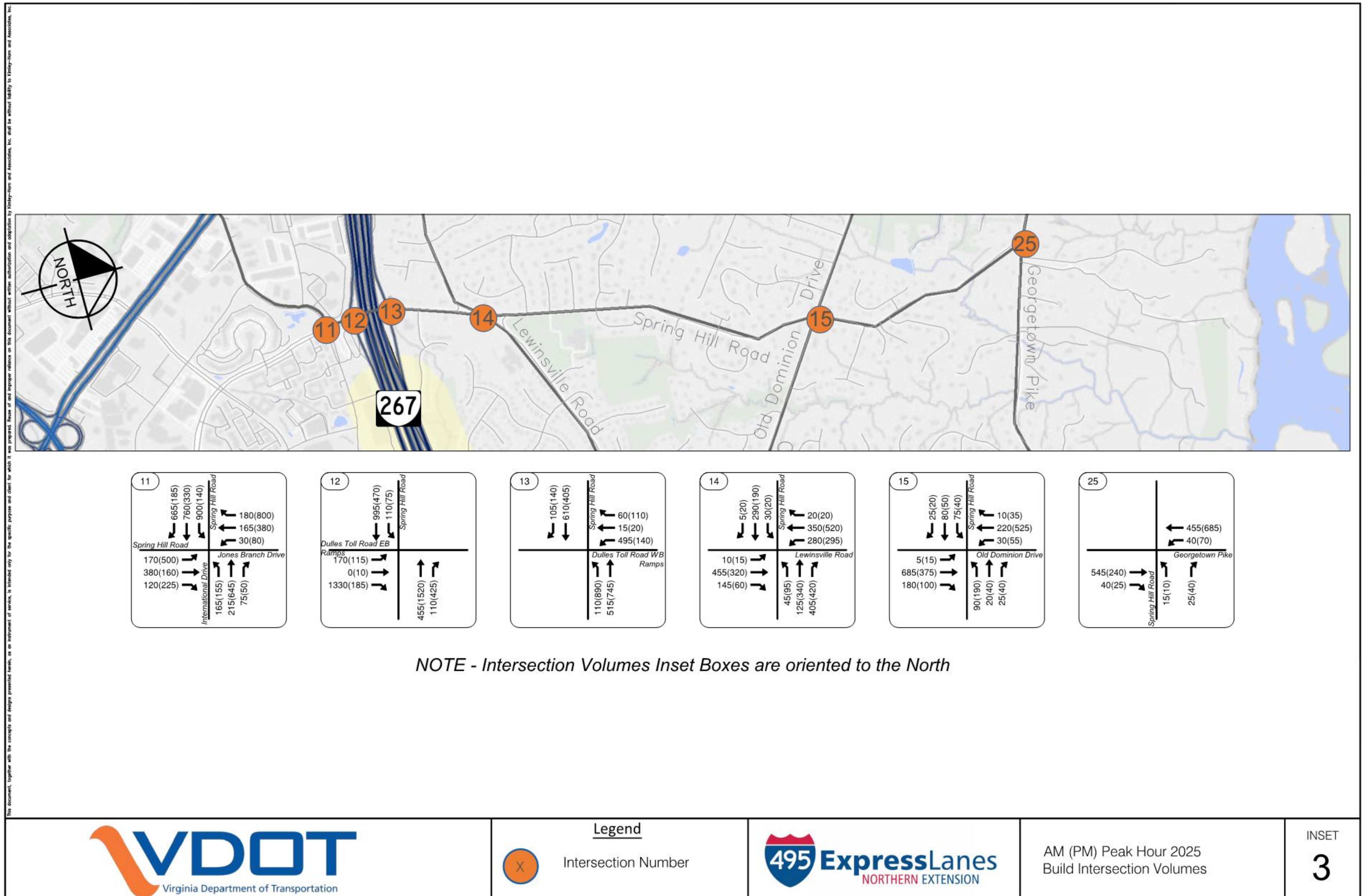


Exhibit 7-6d. Arterial 2025 Build Peak Hour Turning Movement Volumes – Location 3

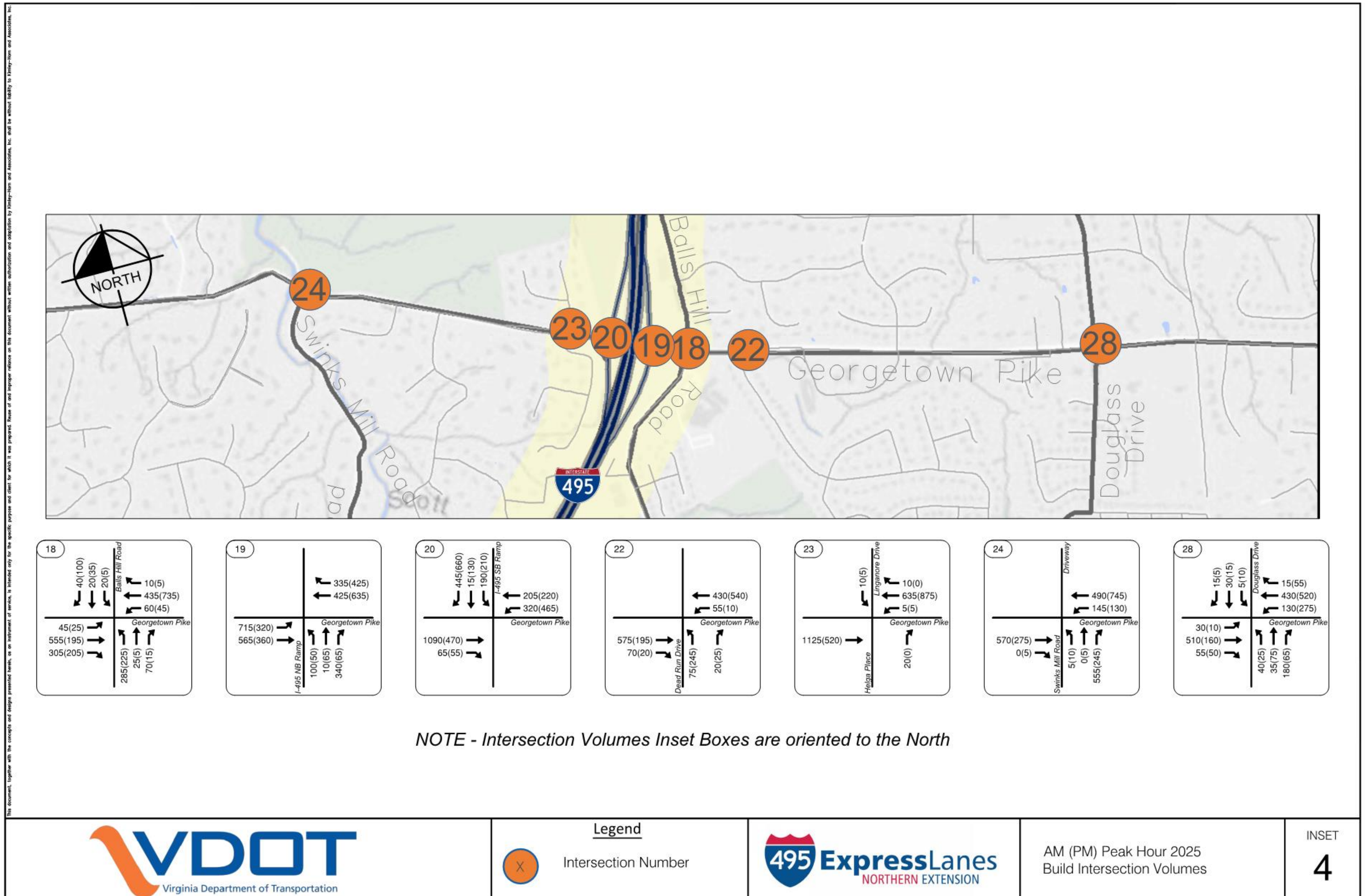


Exhibit 7-6e. Arterial 2025 Build Peak Hour Turning Movement Volumes – Location 4

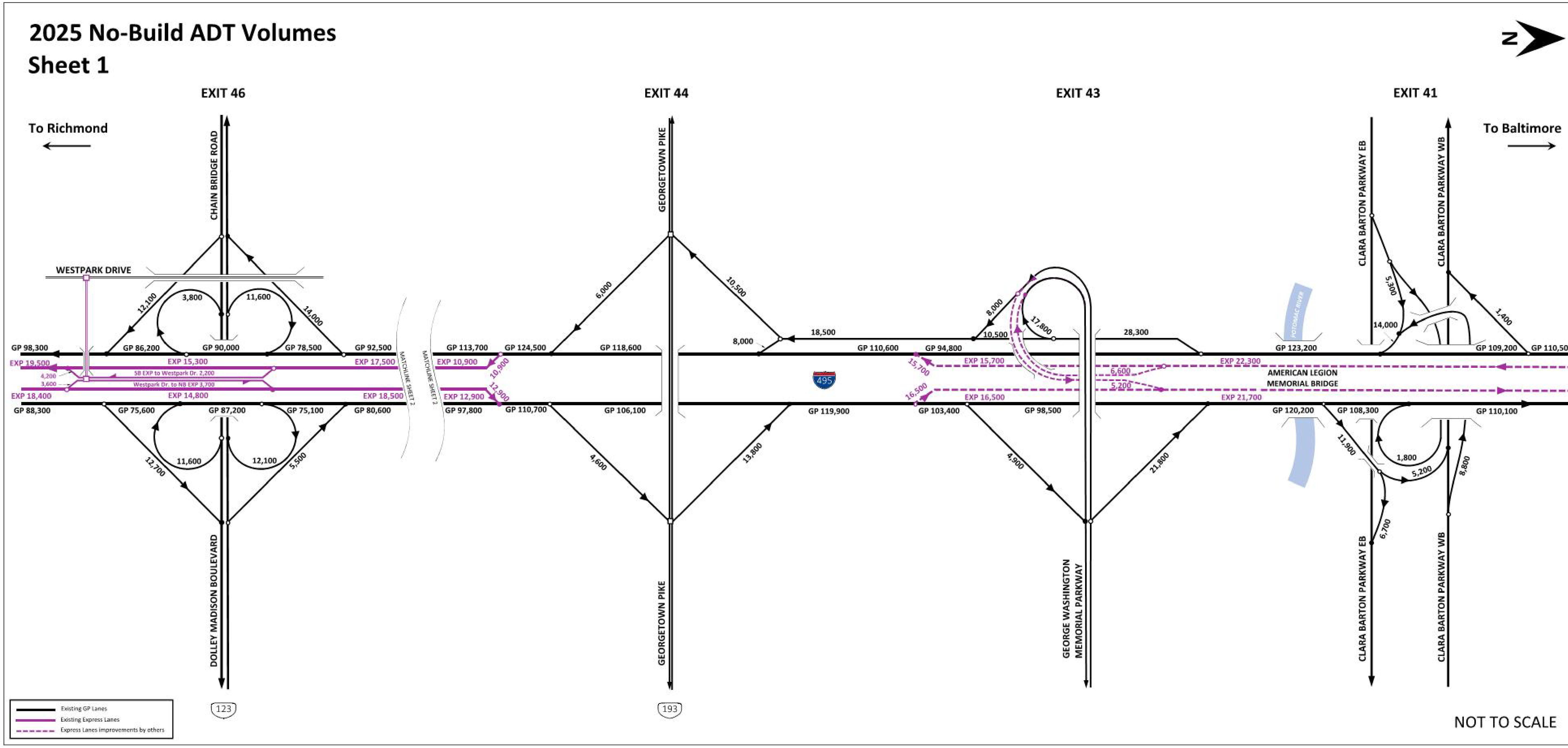


Exhibit 7-7a. Freeway No Build ADT – I-495

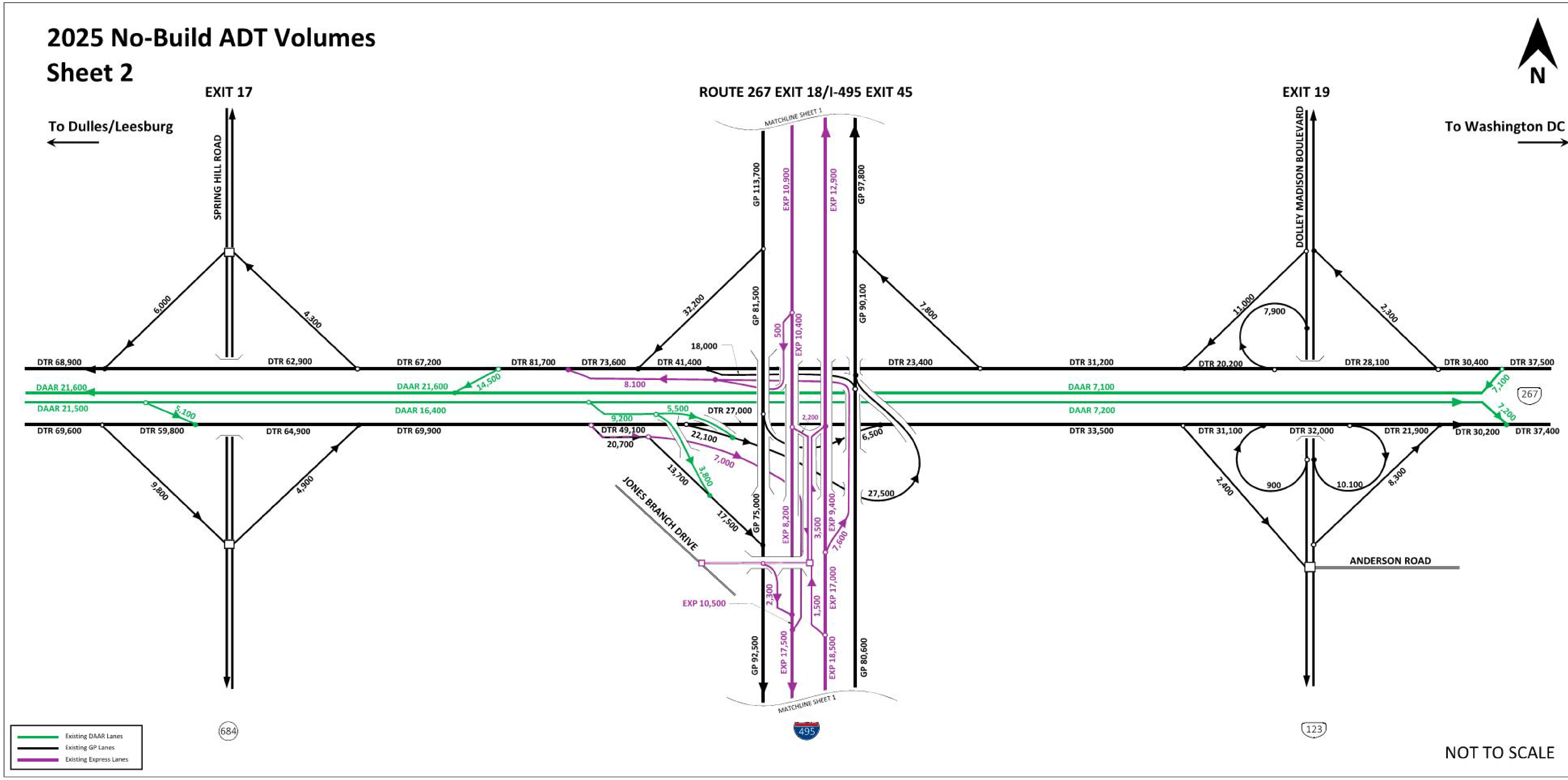


Exhibit 7-7b. Freeway No Build ADT – Route 267

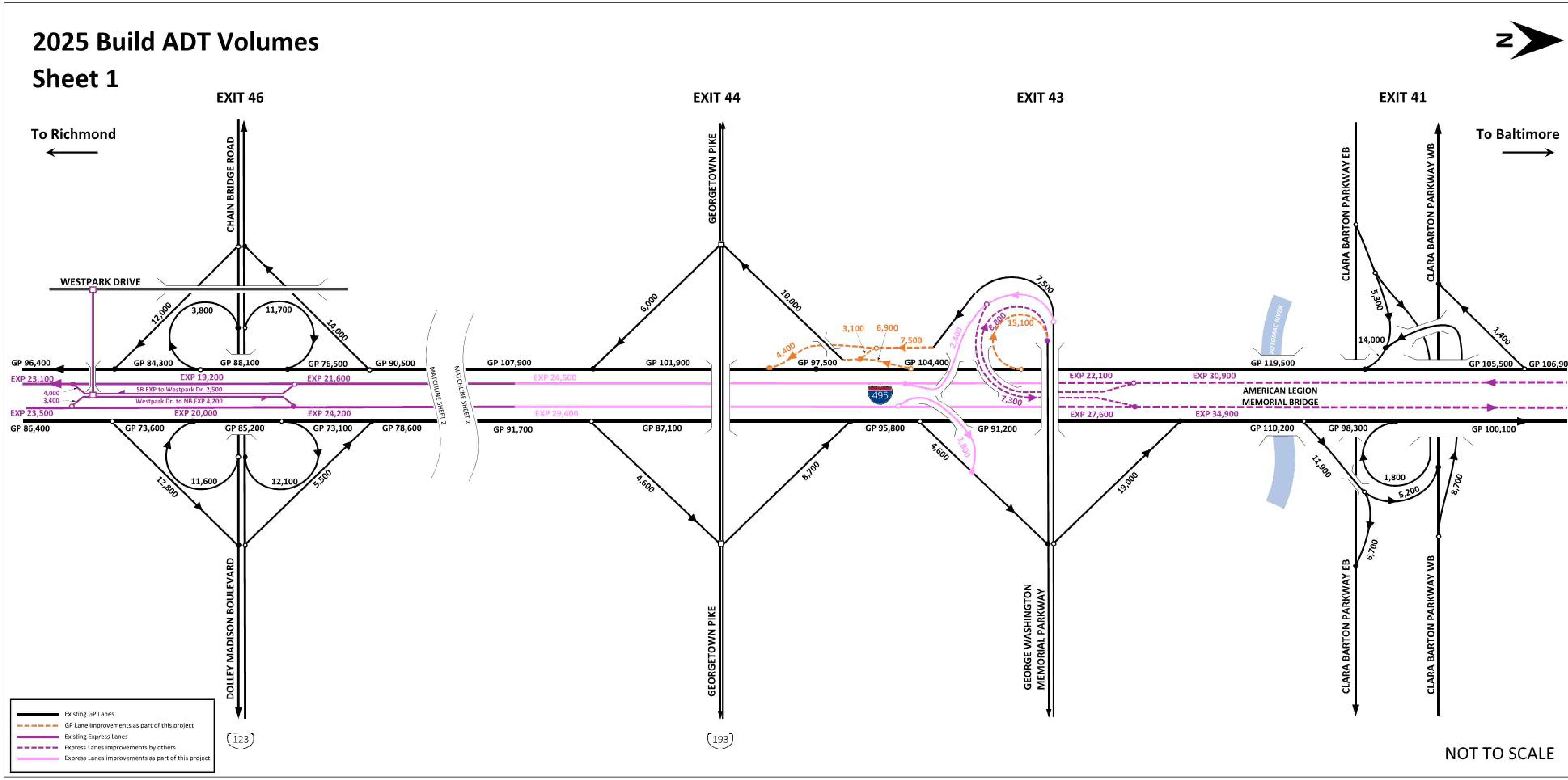


Exhibit 7-8a. Freeway Build ADT – I-495

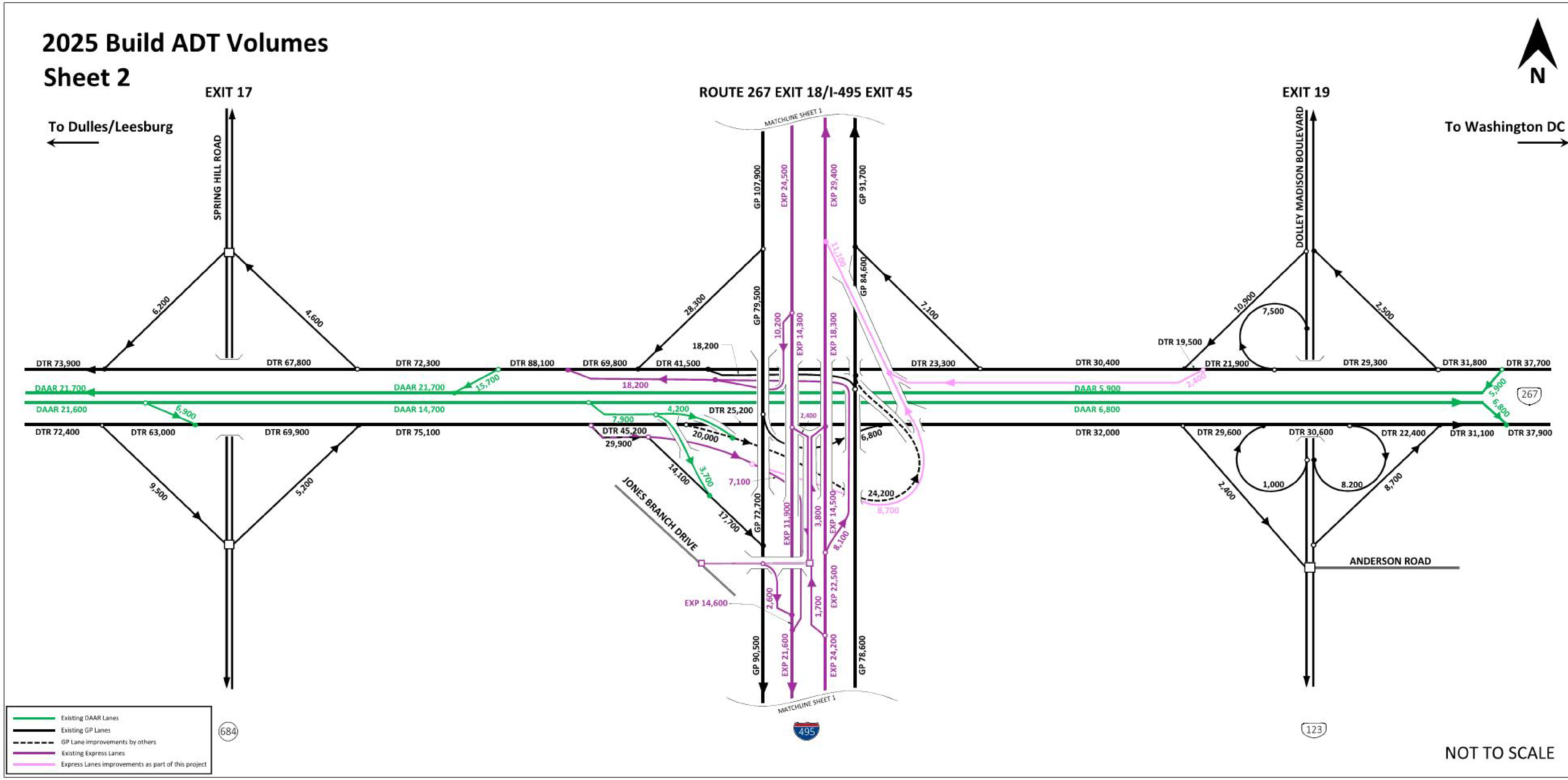


Exhibit 7-8b. Freeway Build ADT – Route 267

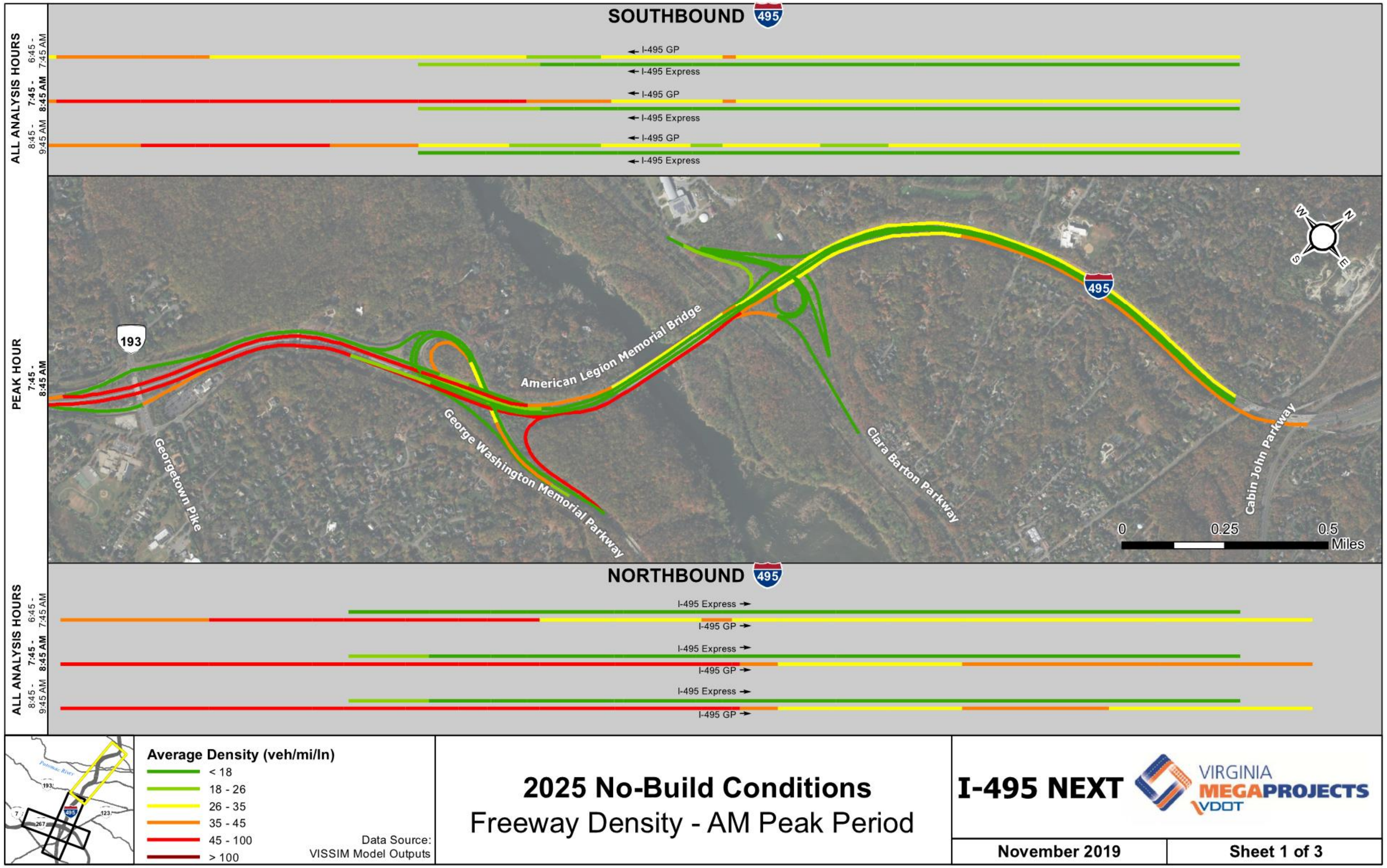


Exhibit 7-9a. 2025 No Build I-495 AM Peak Period Average Densities – Georgetown Pike to Cabin John Parkway

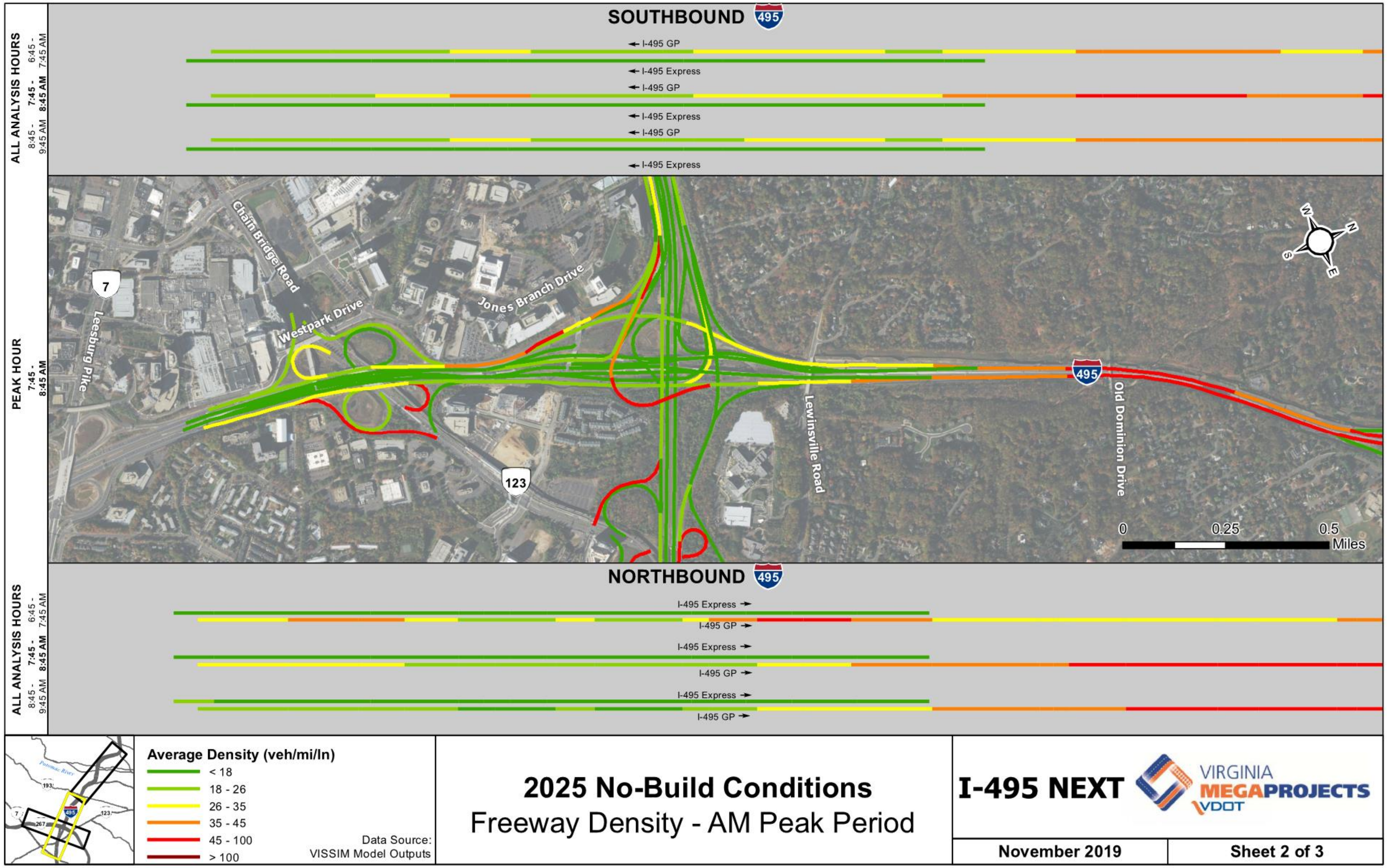


Exhibit 7-9b. 2025 No Build I-495 AM Peak Period Average Densities – Route 123 through Old Dominion Drive

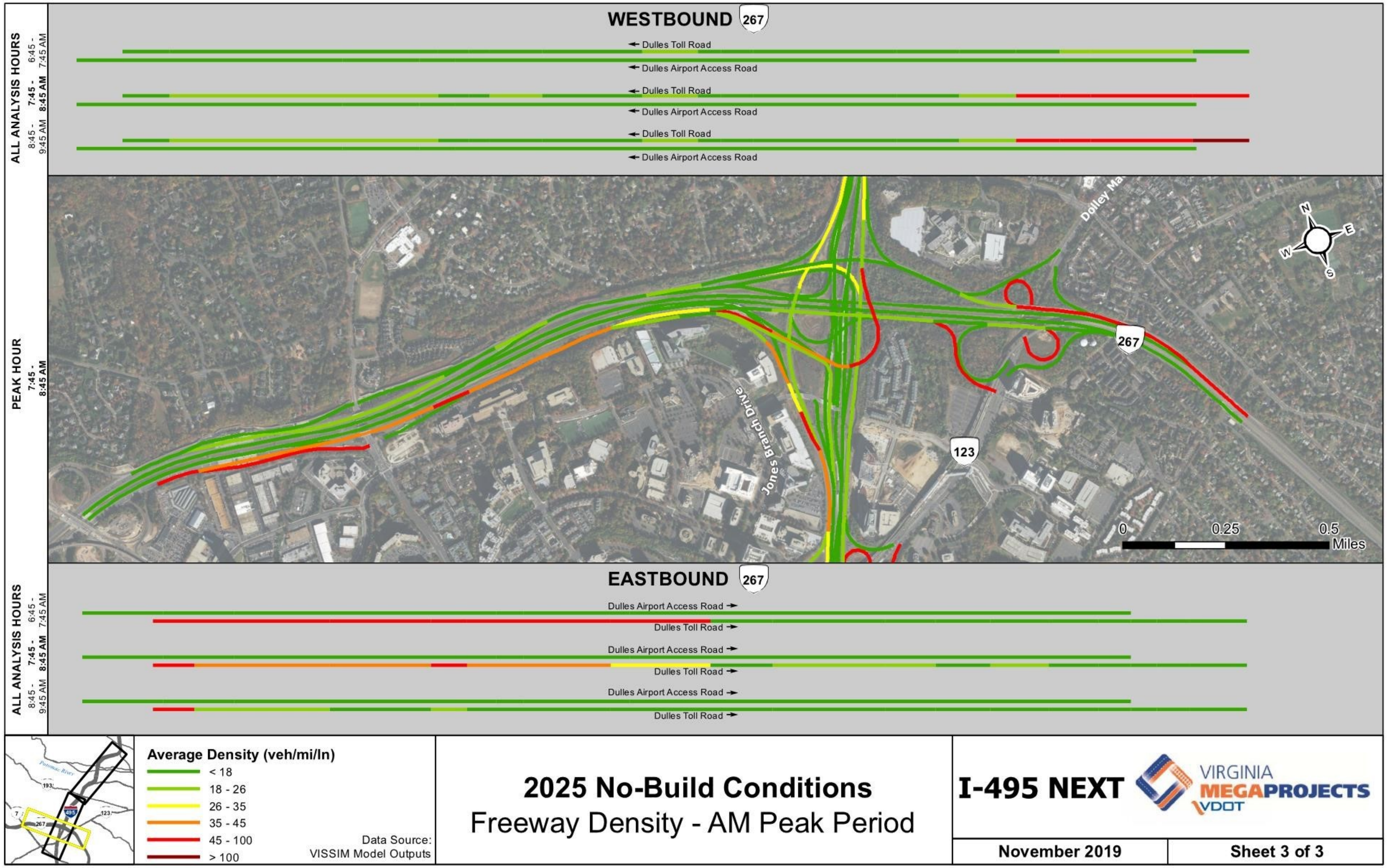


Exhibit 7-9c. 2025 No Build Route 267 AM Peak Period Average Densities

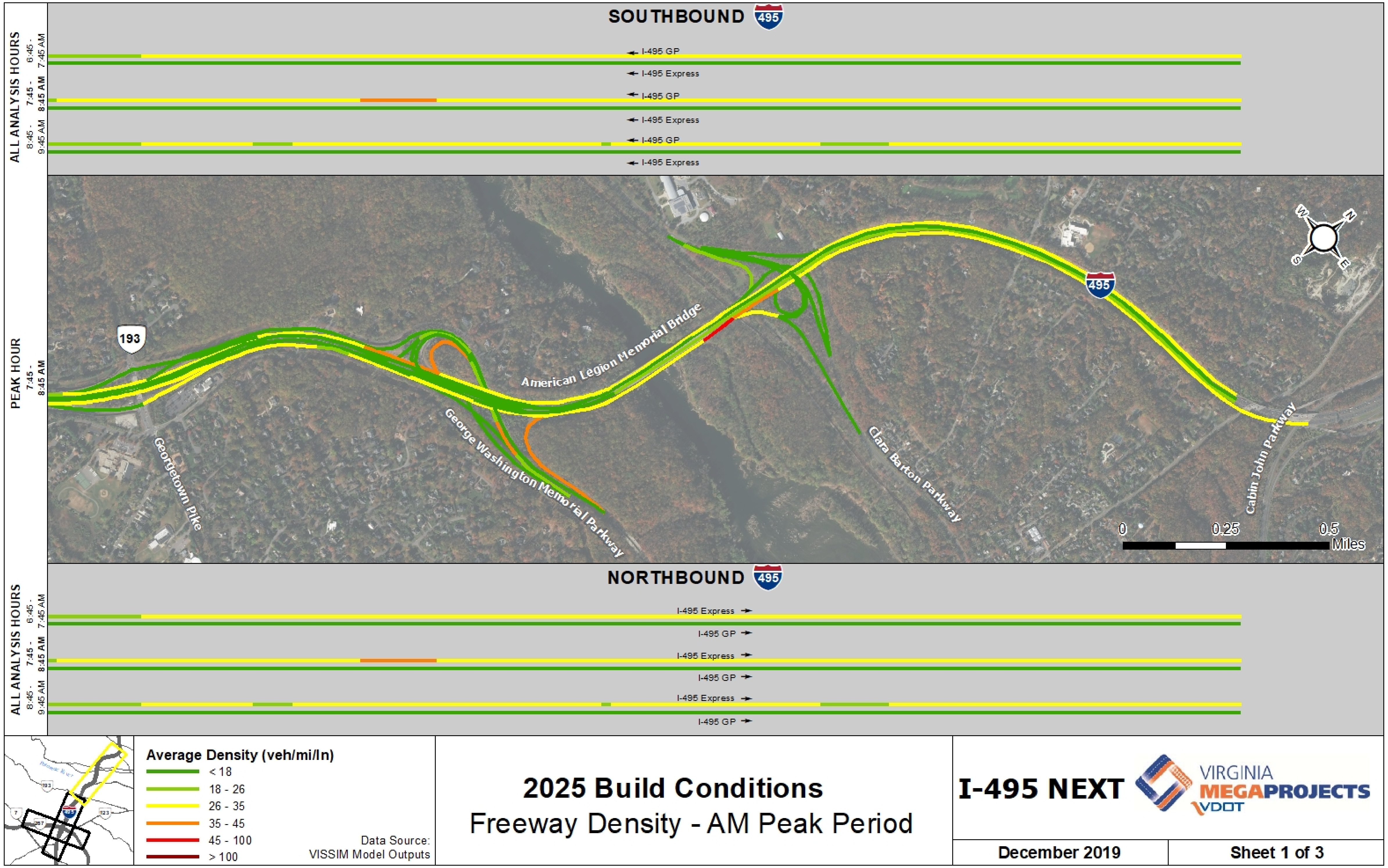


Exhibit 7-10a. 2025 Build I-495 AM Peak Period Average Densities – Georgetown Pike to Cabin John Parkway

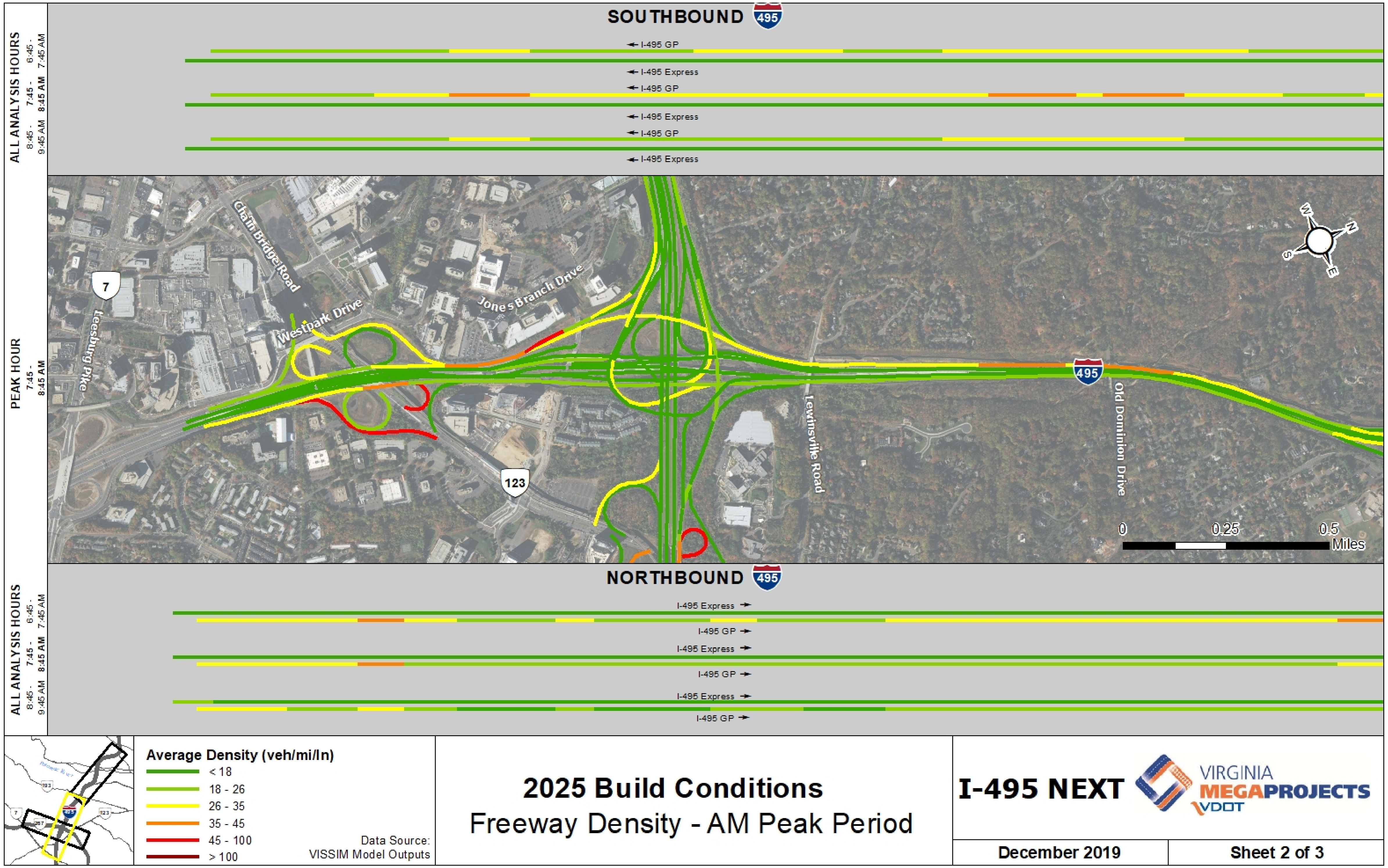


Exhibit 7-10b. 2025 Build I-495 AM Peak Period Average Densities – Route 123 through Old Dominion Drive

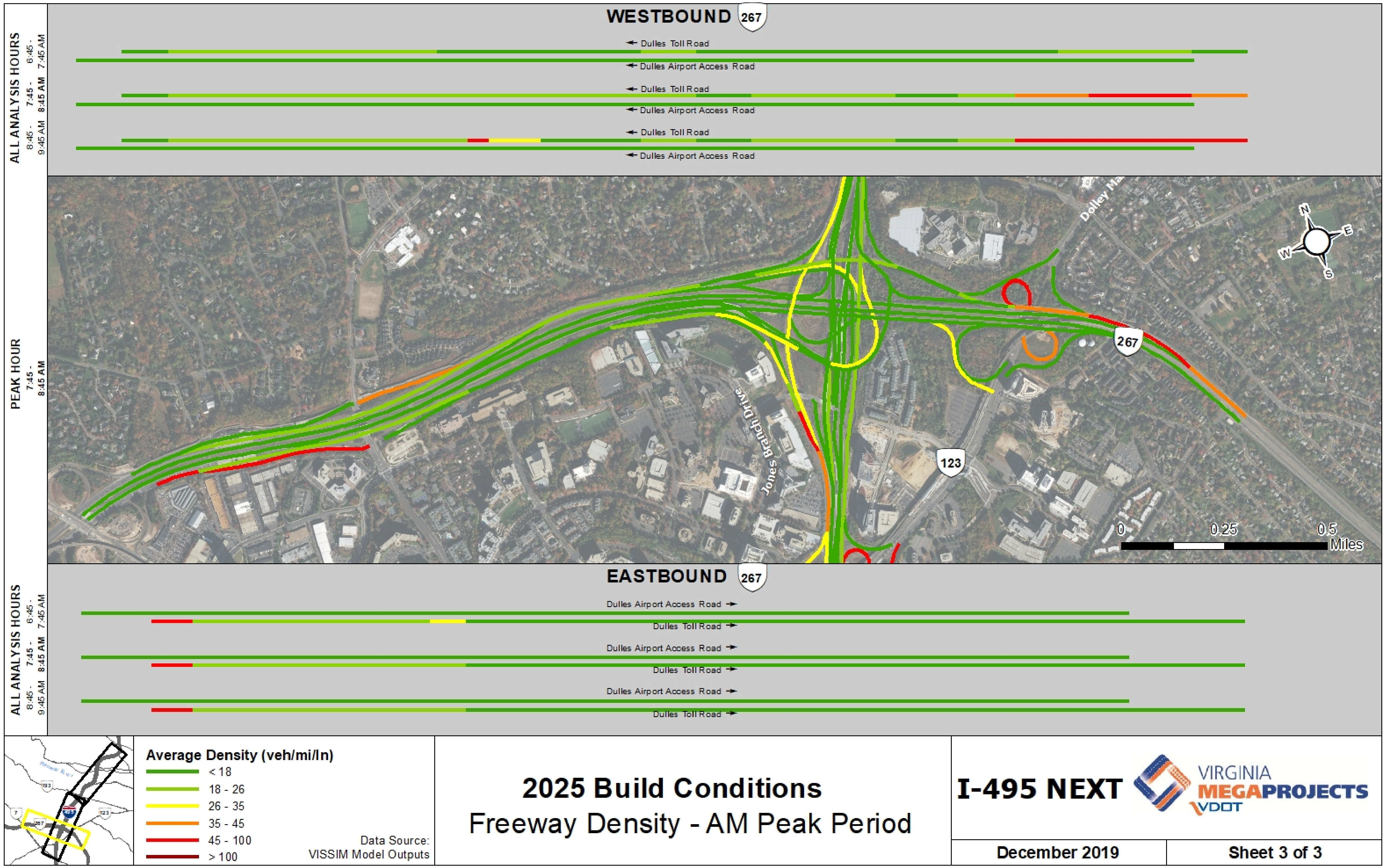


Exhibit 7-10c. 2025 Build Route 267 AM Peak Period Average Densities

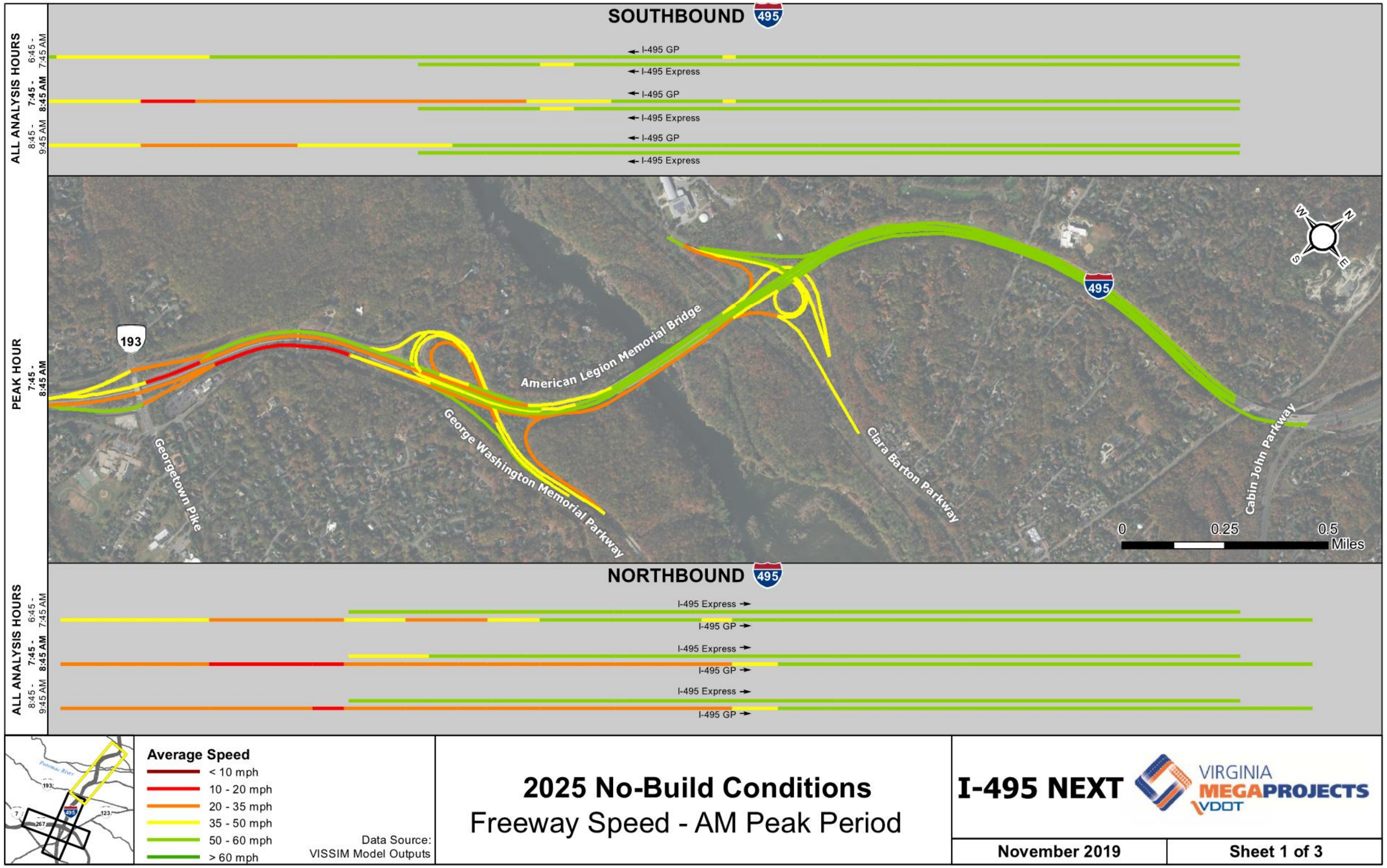


Exhibit 7-11a. 2025 No Build I-495 AM Peak Period Average Speeds – Georgetown Pike to Cabin John Parkway

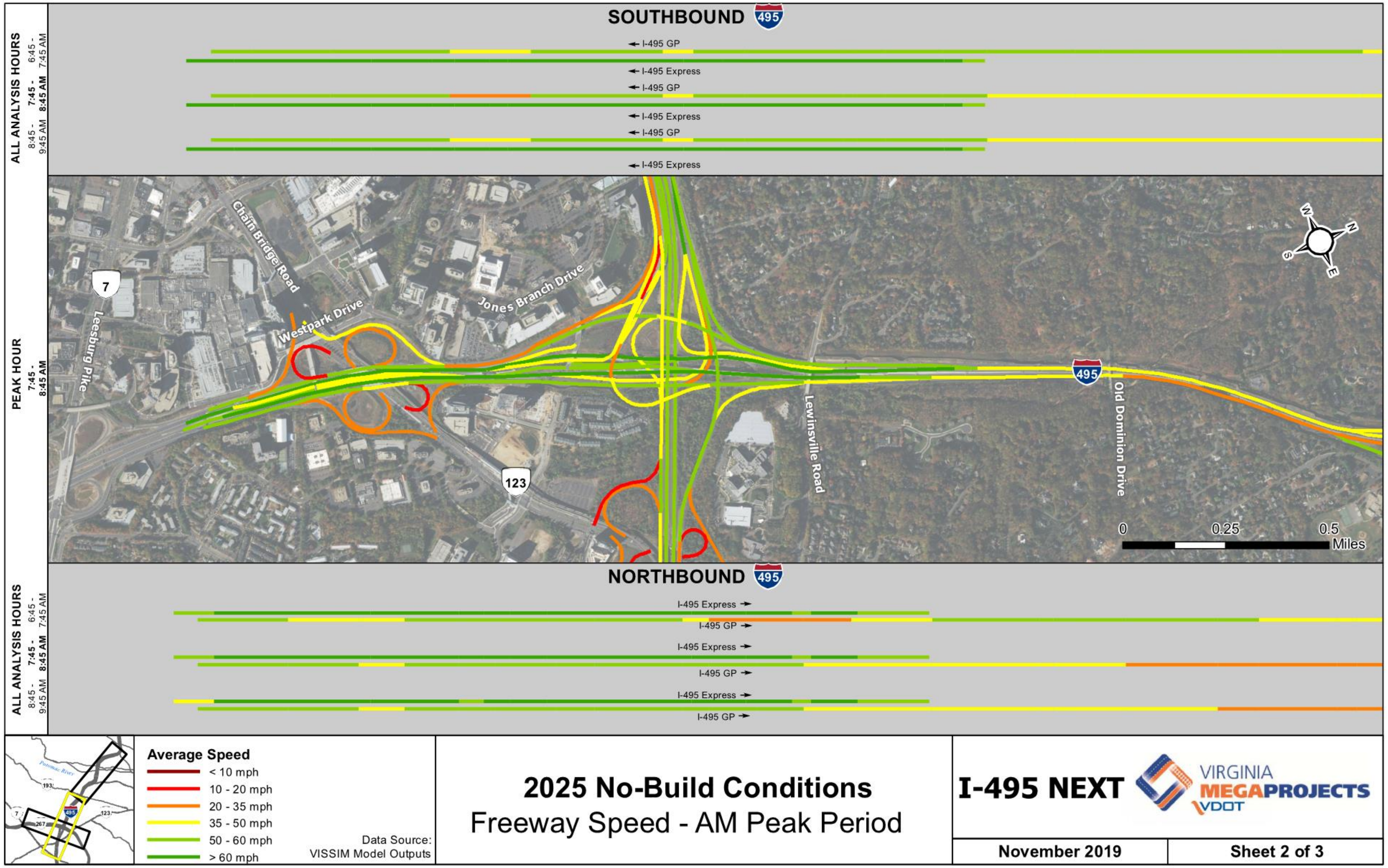


Exhibit 7-11b. 2025 No Build I-495 AM Peak Period Average Speeds – Route 123 through Old Dominion Drive

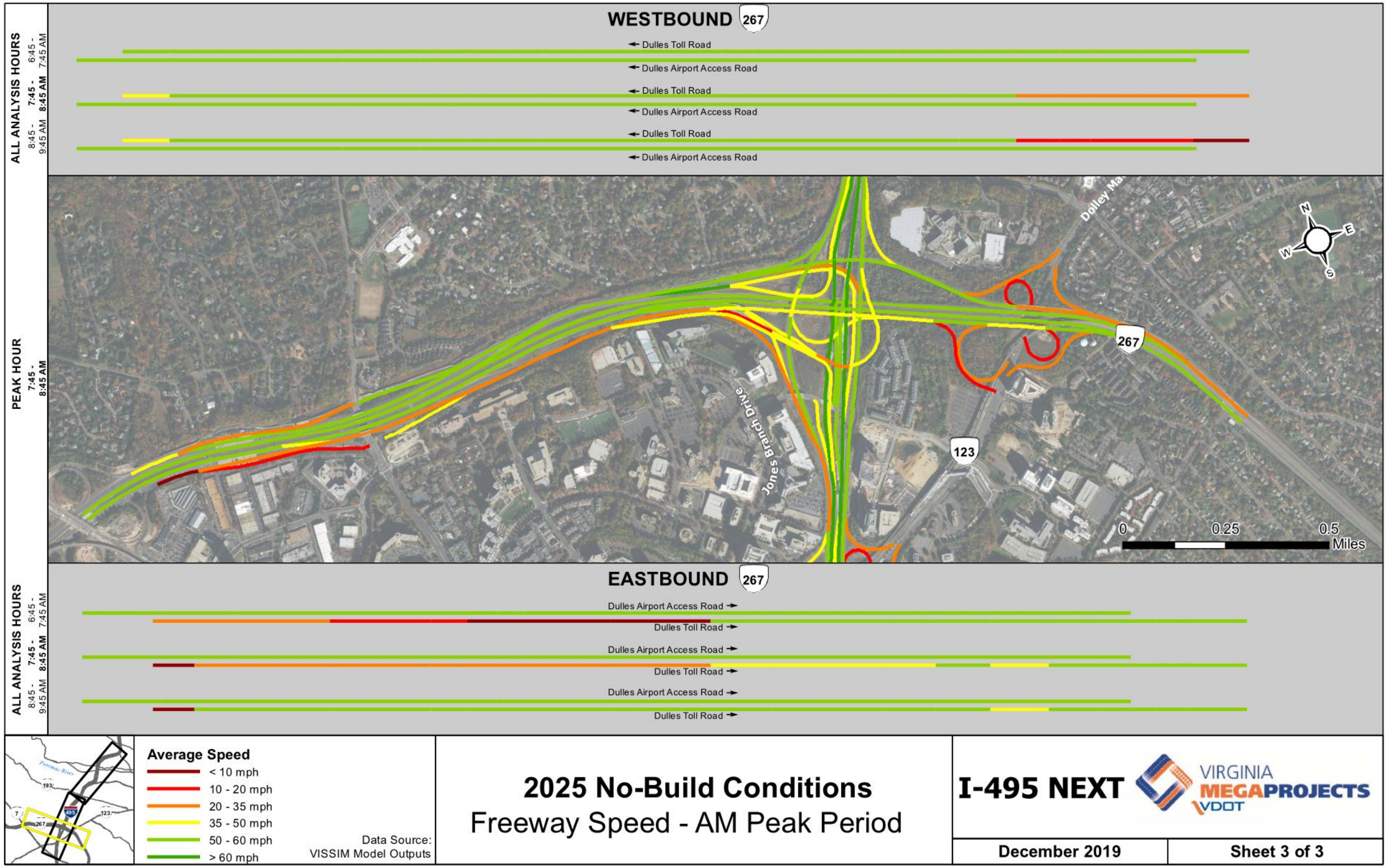


Exhibit 7-11c. 2025 No Build Route 267 AM Peak Period Average Speeds

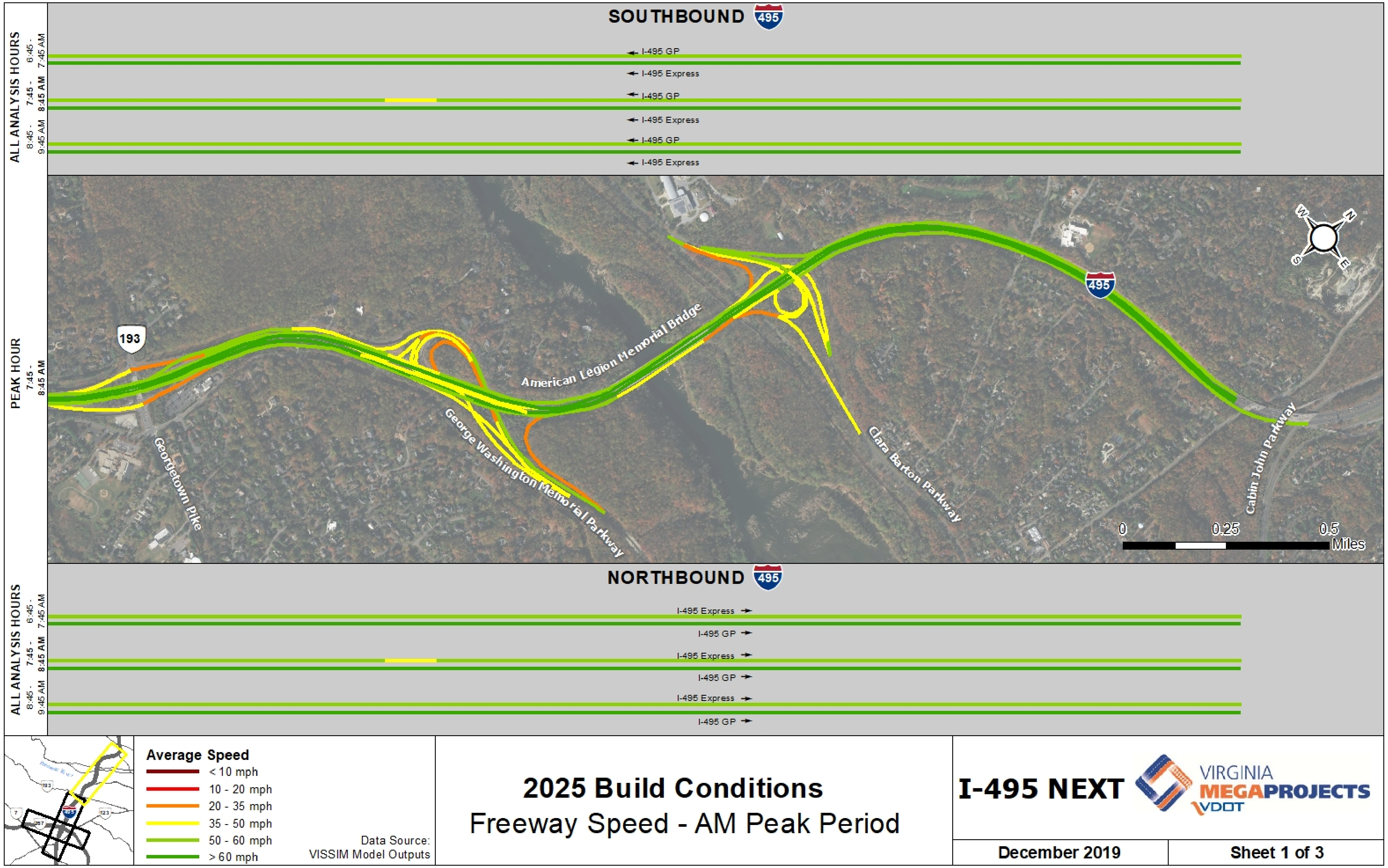


Exhibit 7-12a. 2025 Build I-495 AM Peak Period Average Speeds – Georgetown Pike to Cabin John Parkway

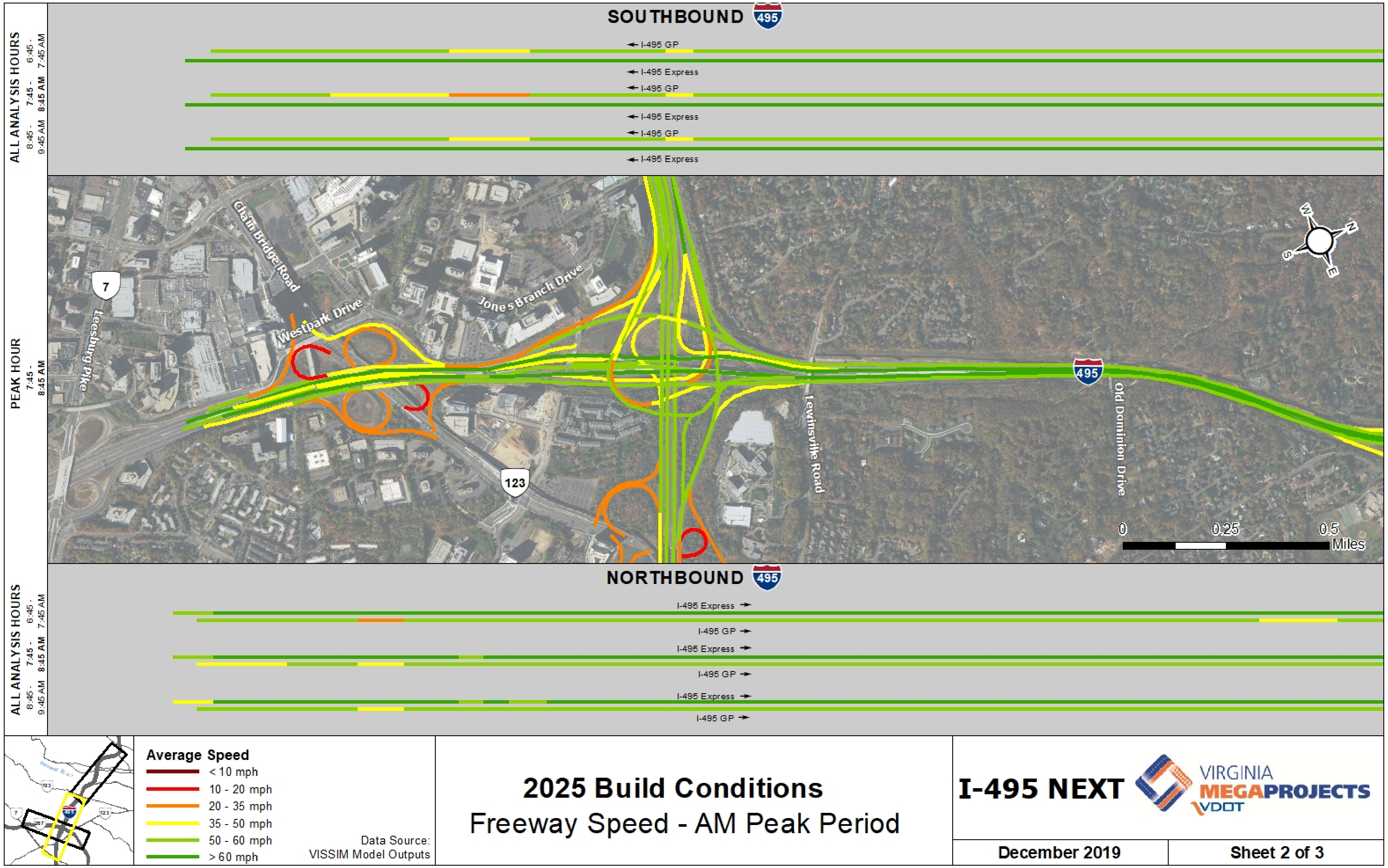


Exhibit 7-12b. 2025 Build I-495 AM Peak Period Average Speeds – Route 123 through Old Dominion Drive

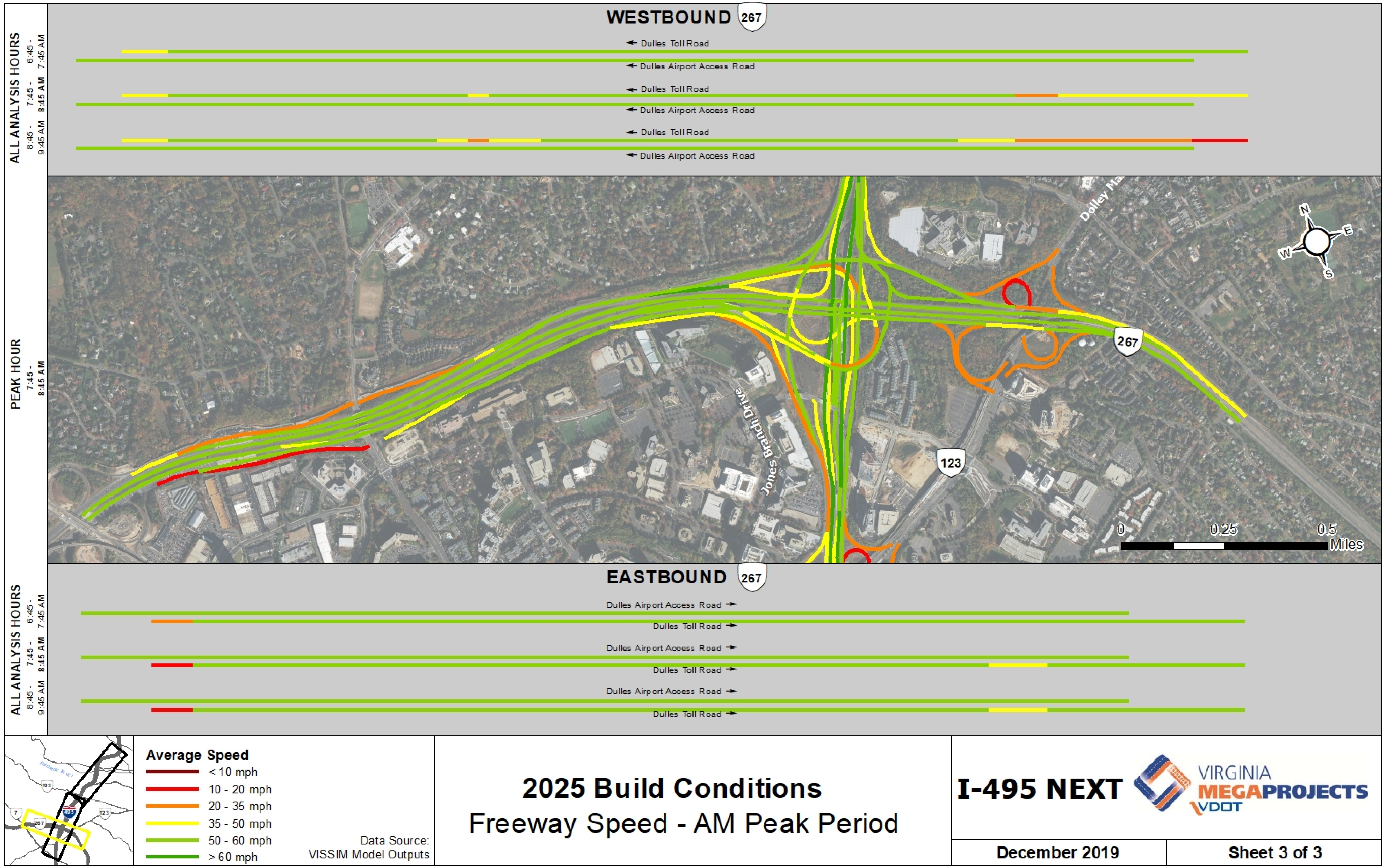


Exhibit 7-12c. 2025 Build Route 267 AM Peak Period Average Speeds

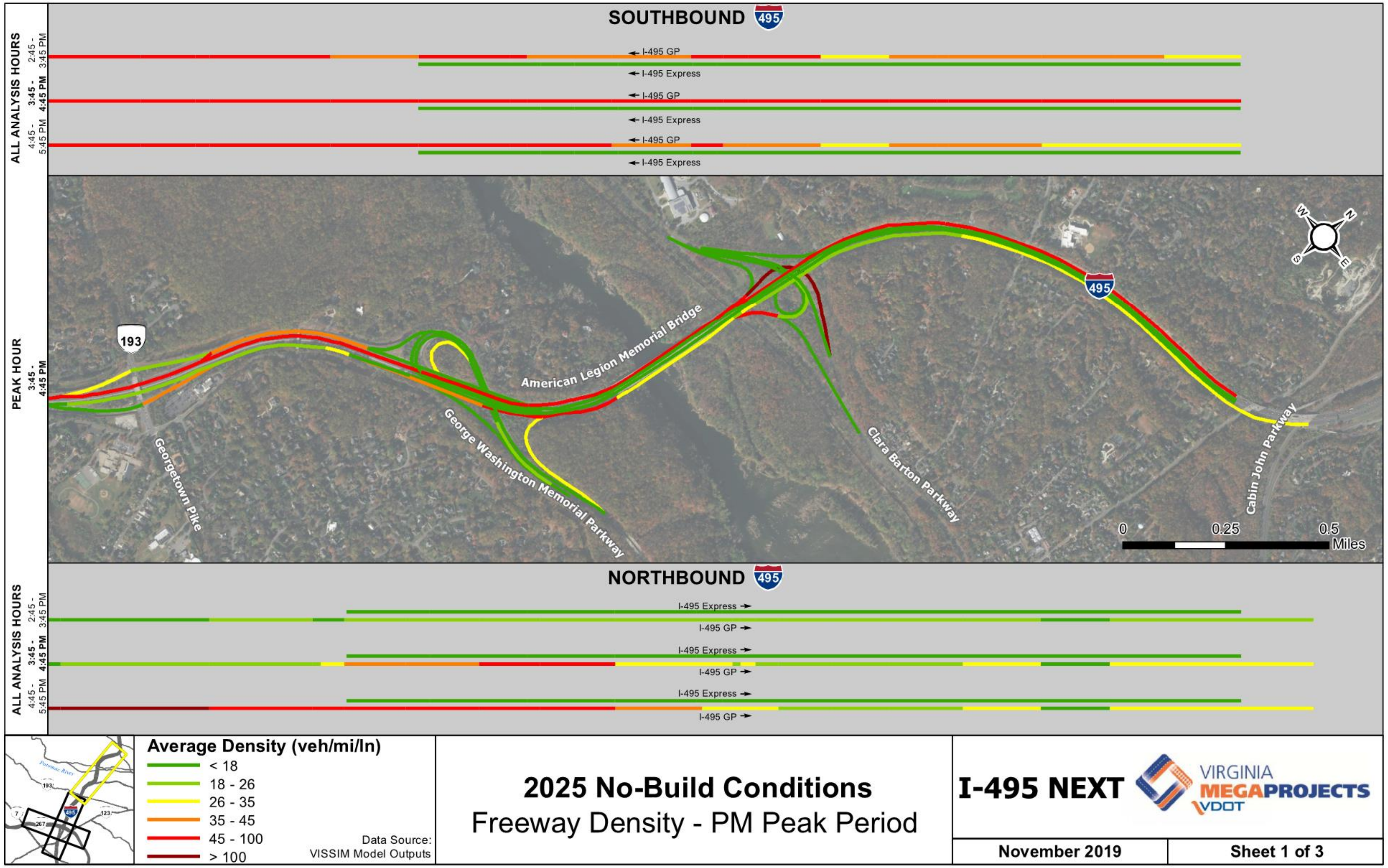


Exhibit 7-13a. 2025 No Build I-495 PM Peak Period Average Densities – Georgetown Pike to Cabin John Parkway

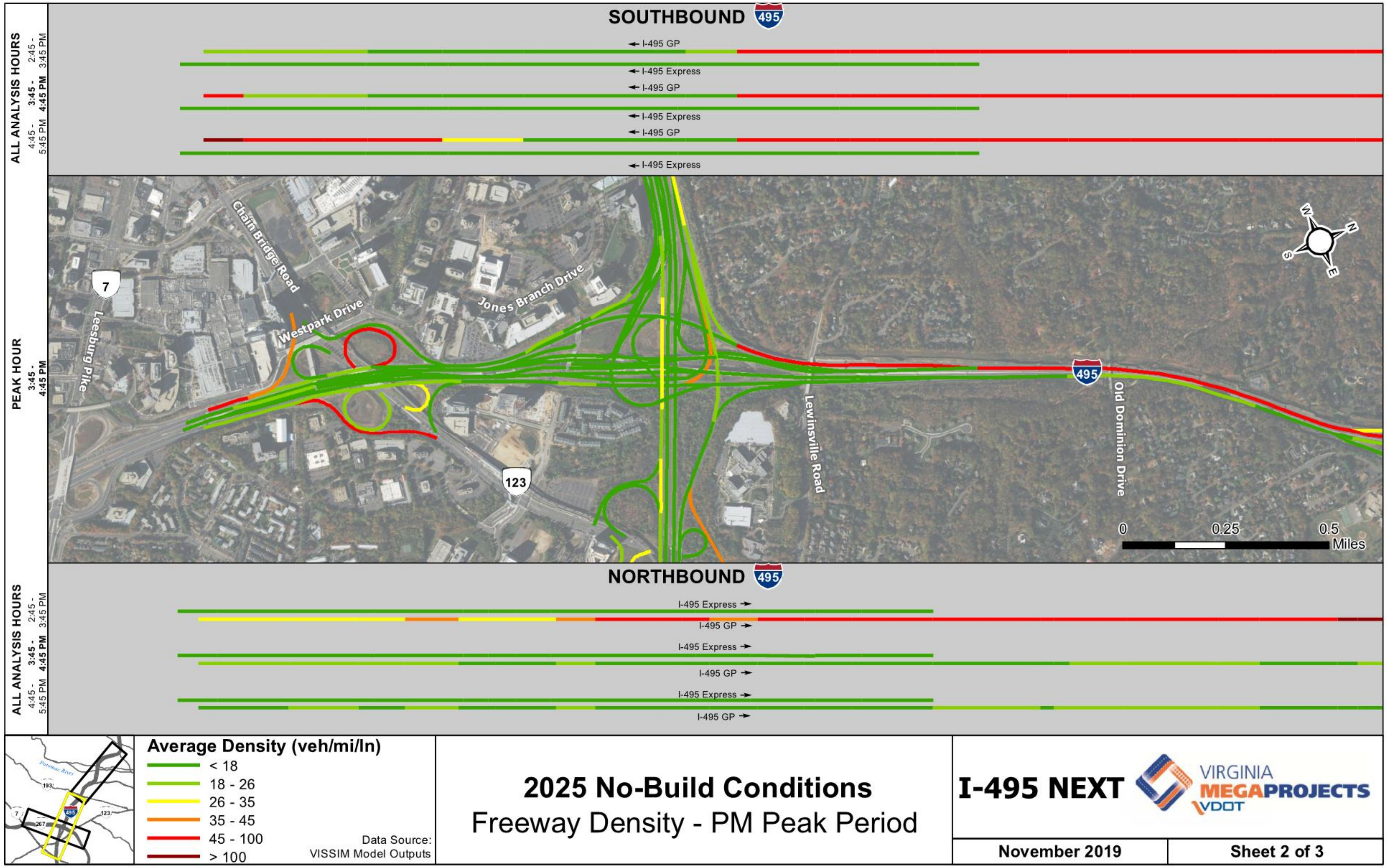


Exhibit 7-13b. 2025 No Build I-495 PM Peak Period Average Densities – Route 123 through Old Dominion Drive

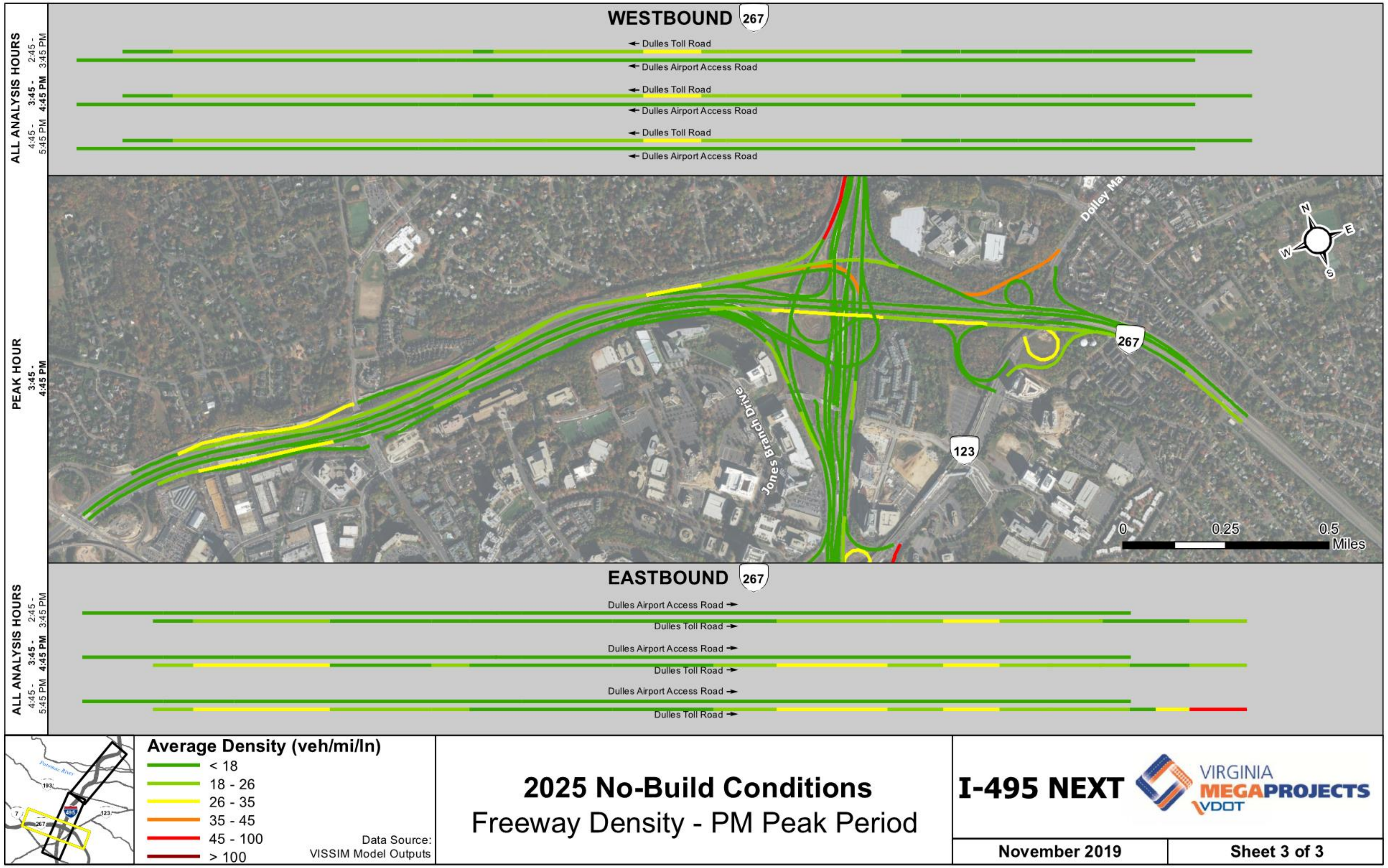


Exhibit 7-13c. 2025 No Build Route 267 PM Peak Period Average Densities

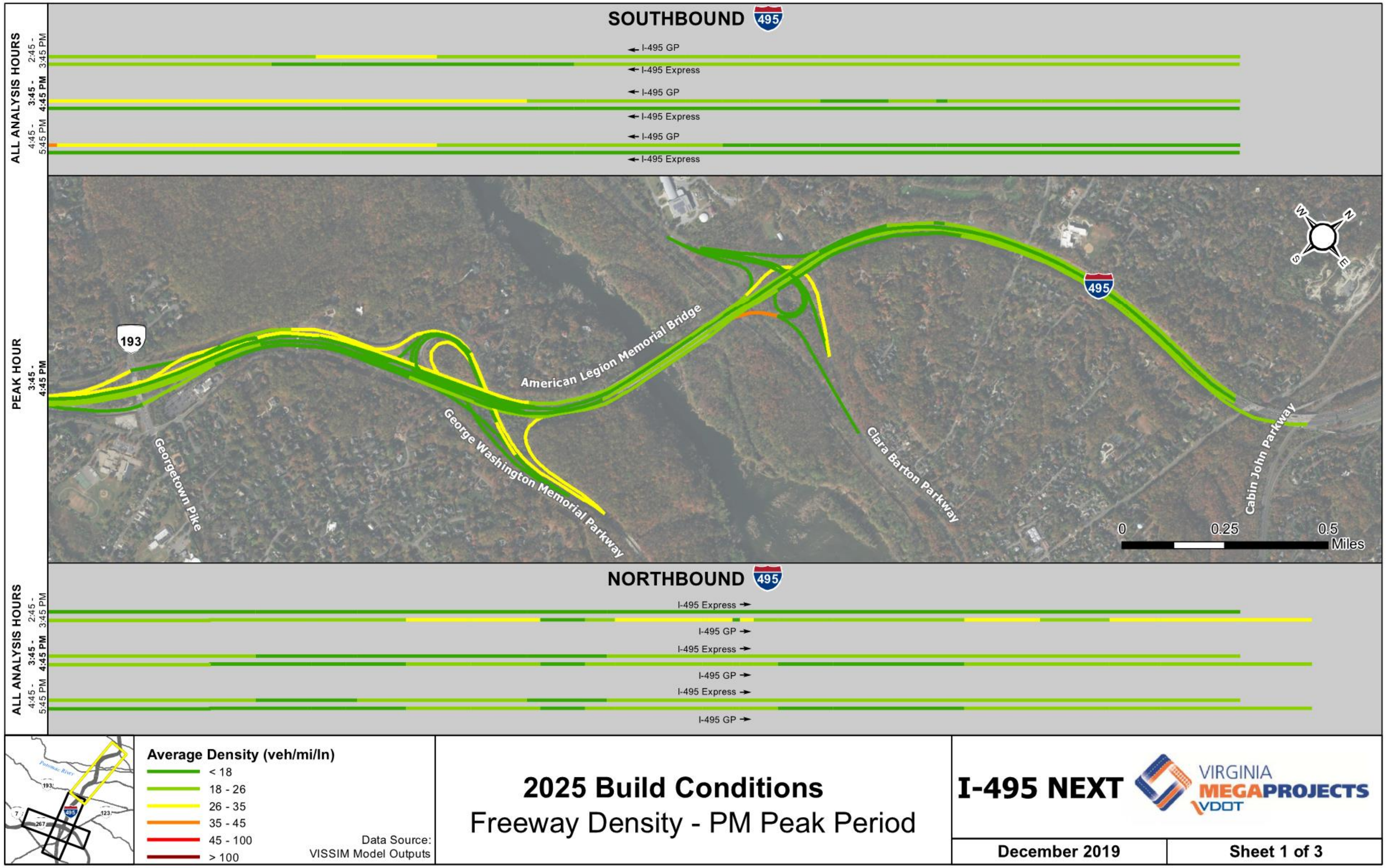


Exhibit 7-14a. 2025 Build I-495 PM Peak Period Average Densities – Georgetown Pike to Cabin John Parkway

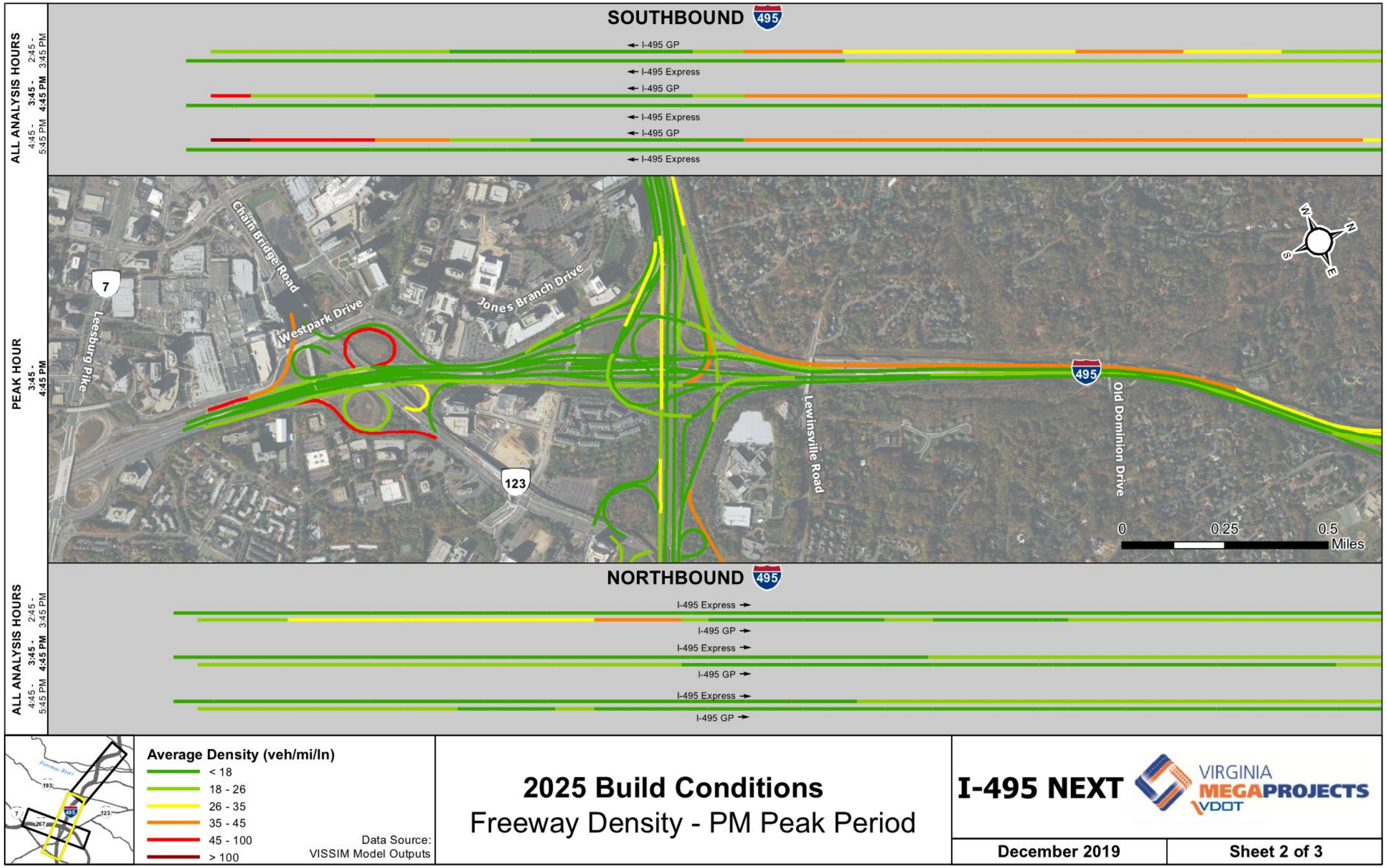


Exhibit 7-14b. 2025 Build I-495 PM Peak Period Average Densities – Route 123 through Old Dominion Drive

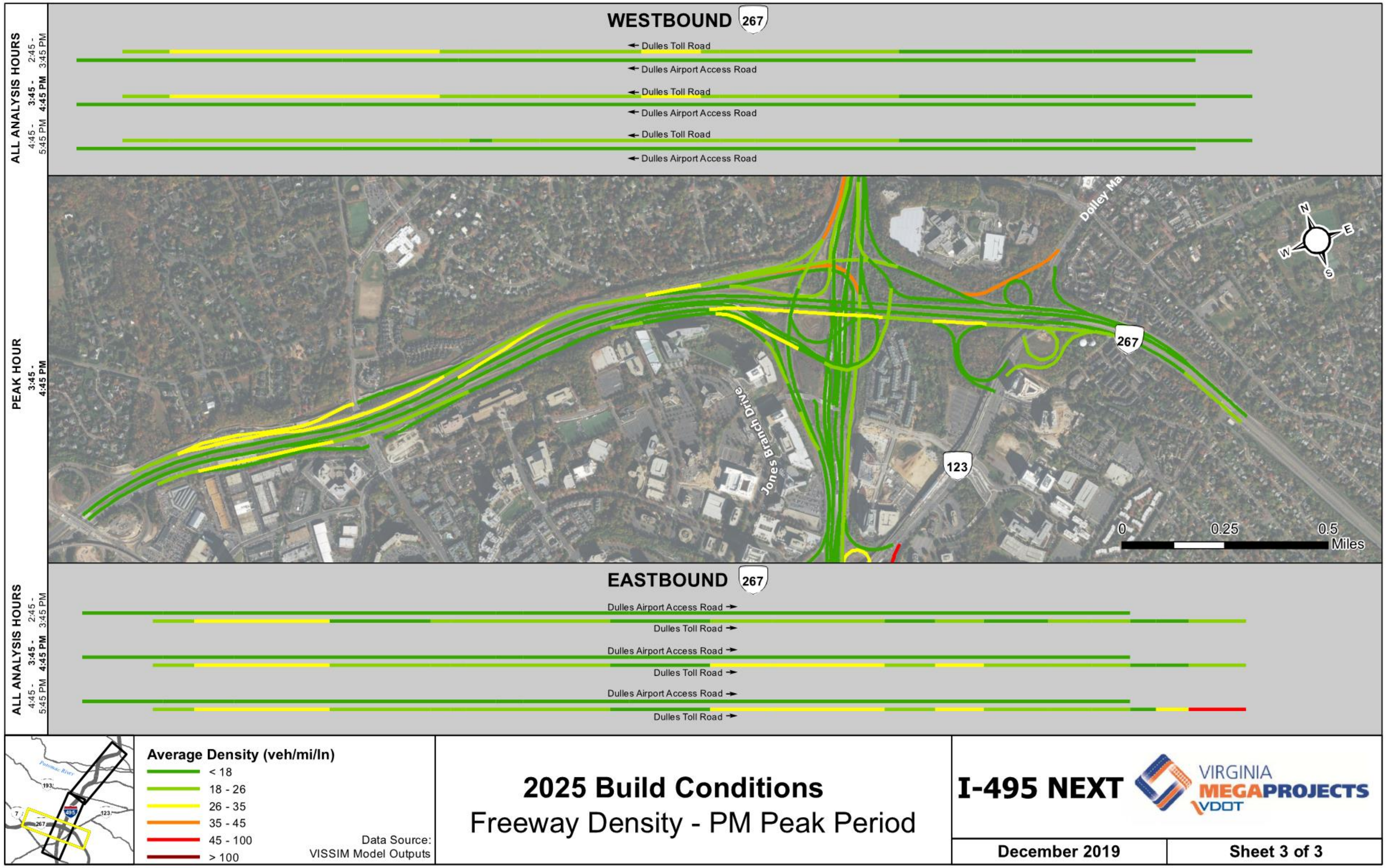


Exhibit 7-14c. 2025 Build Route 267 PM Peak Period Average Densities

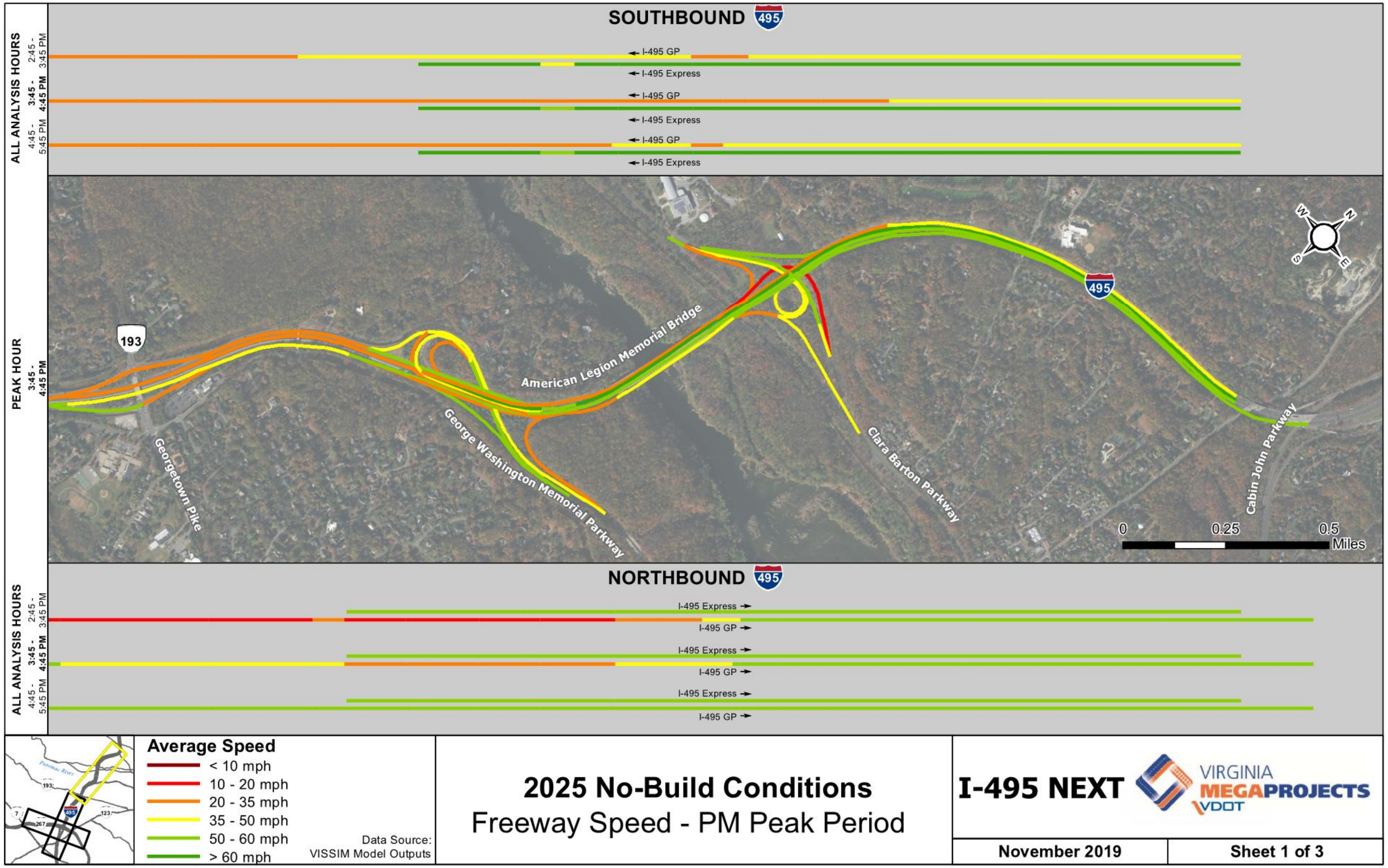


Exhibit 7-15a. 2025 No Build I-495 PM Peak Period Average Speeds – Georgetown Pike to Cabin John Parkway

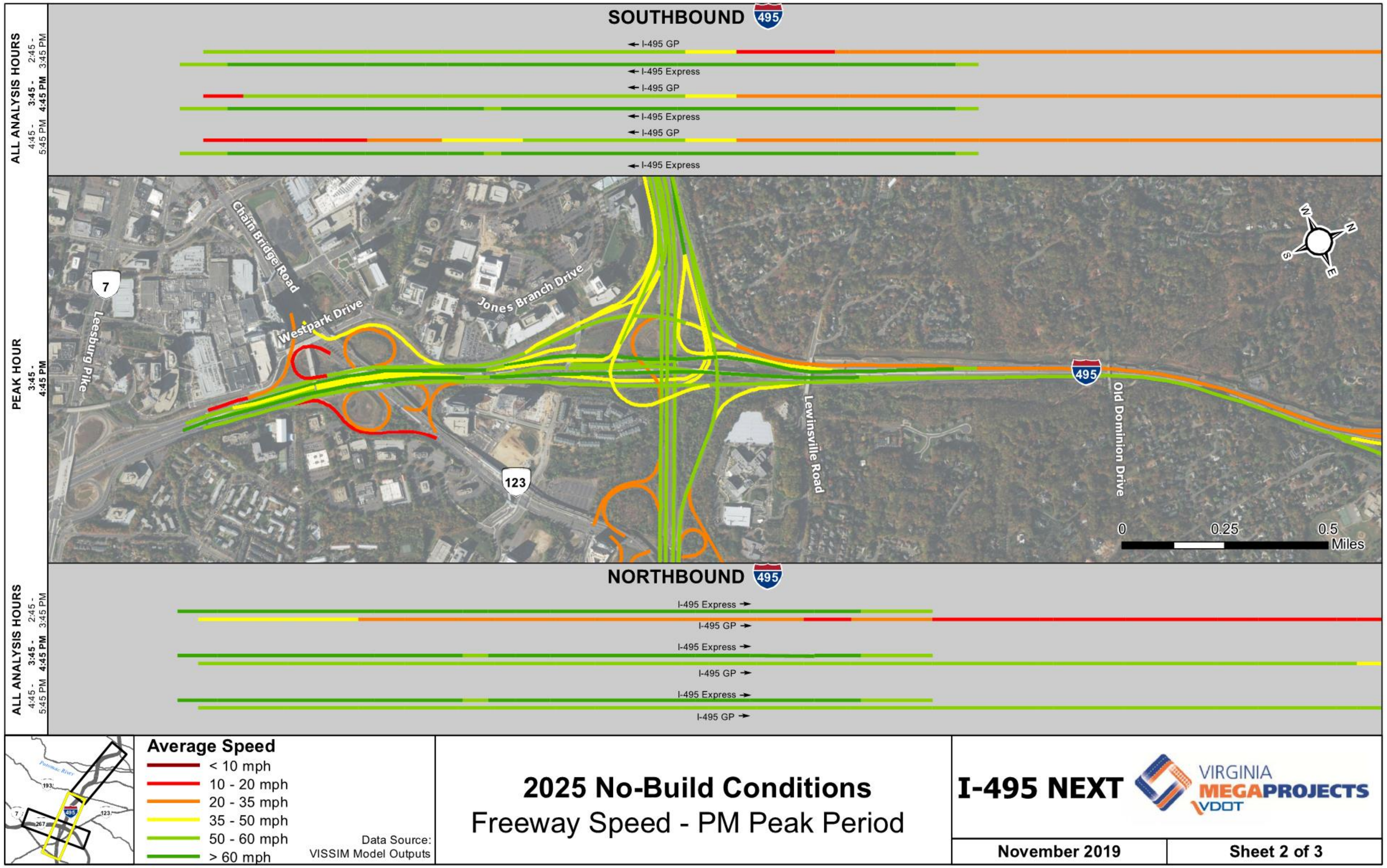


Exhibit 7-15b. 2025 No Build I-495 PM Peak Period Average Speeds – Route 123 through Old Dominion Drive

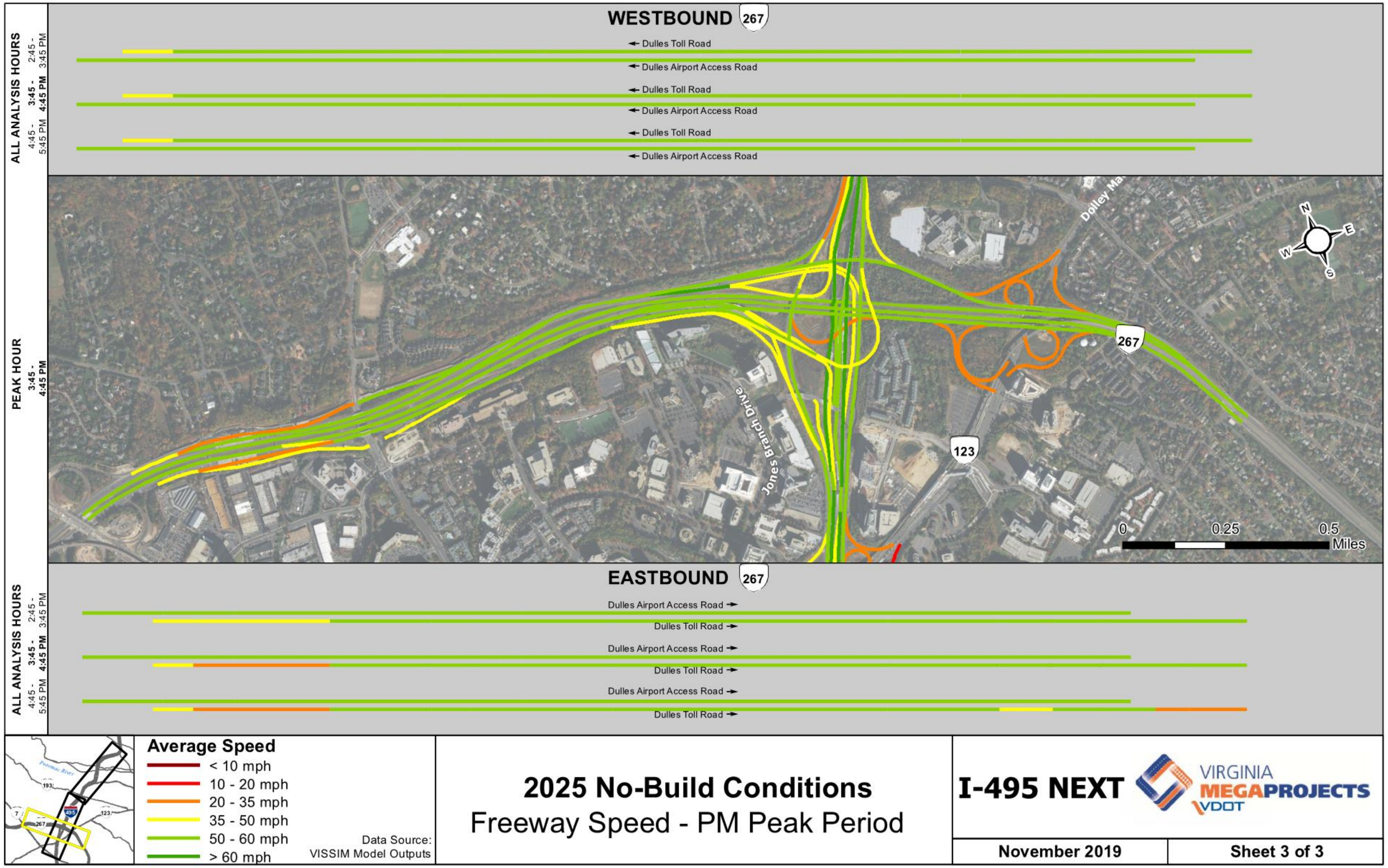


Exhibit 7-15c. 2025 No Build Route 267 PM Peak Period Average Speeds

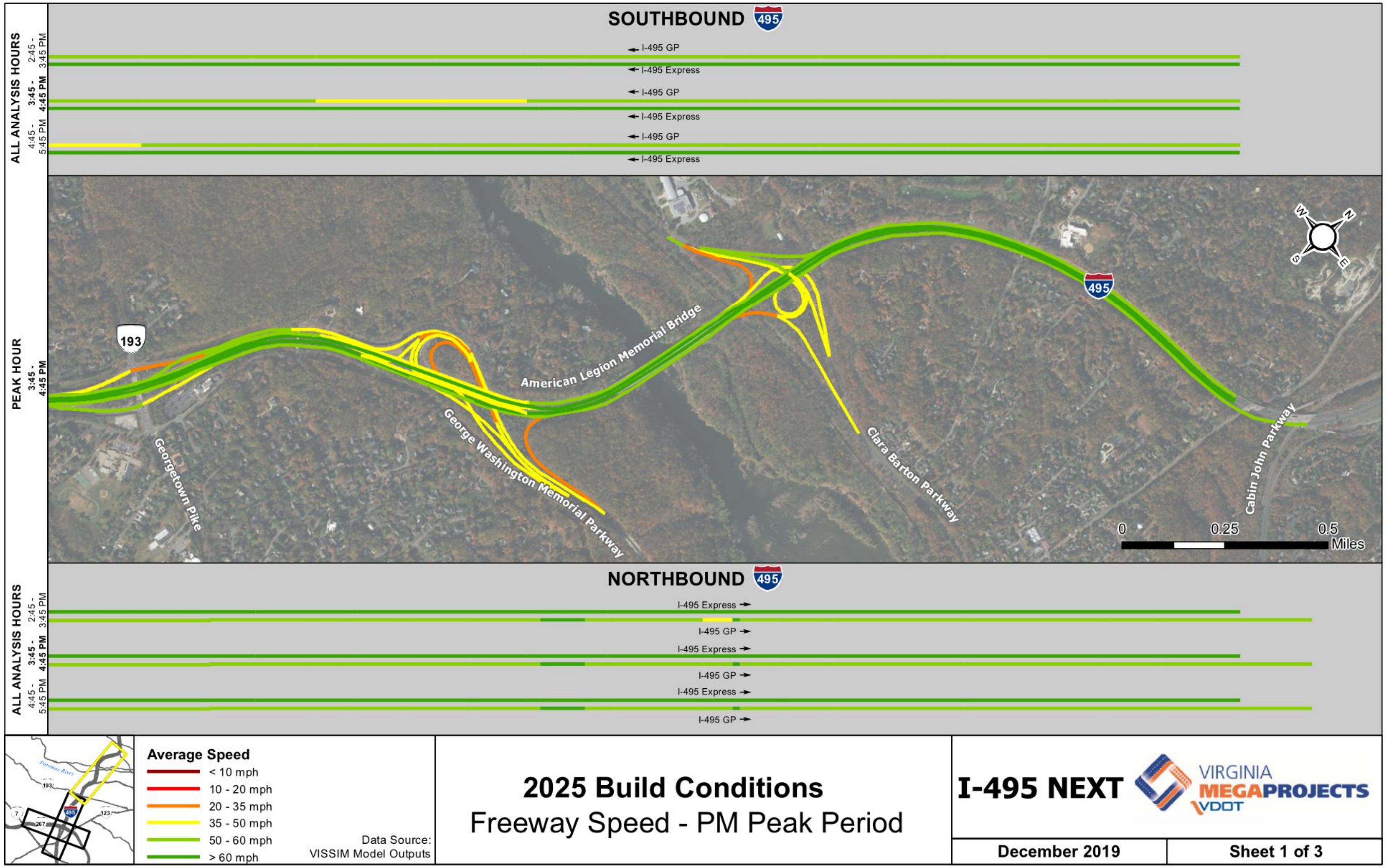


Exhibit 7-16a. 2025 Build I-495 PM Peak Period Average Speeds – Georgetown Pike to Cabin John Parkway

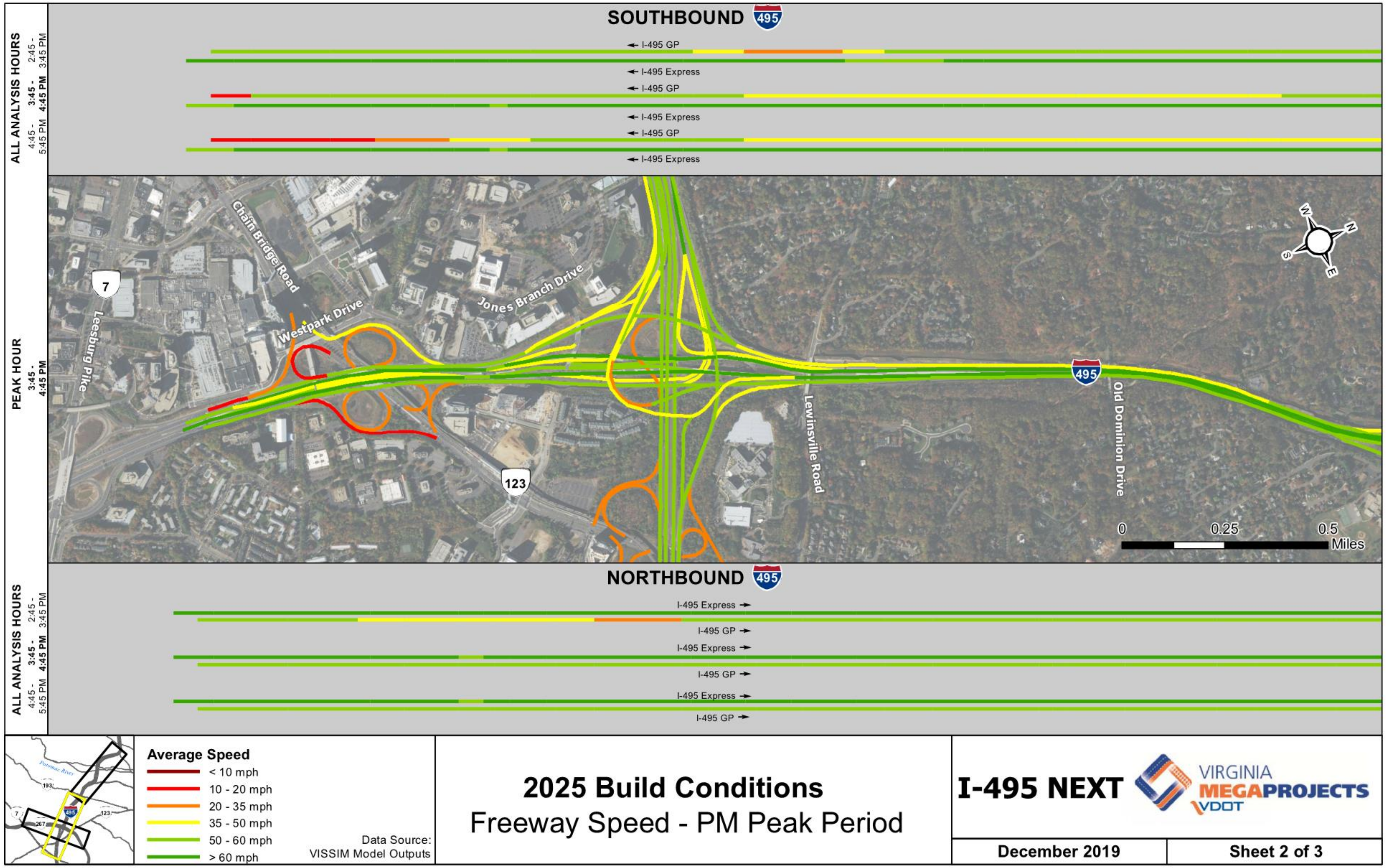


Exhibit 7-16b. 2025 Build I-495 PM Peak Period Average Speeds – Route 123 through Old Dominion Drive

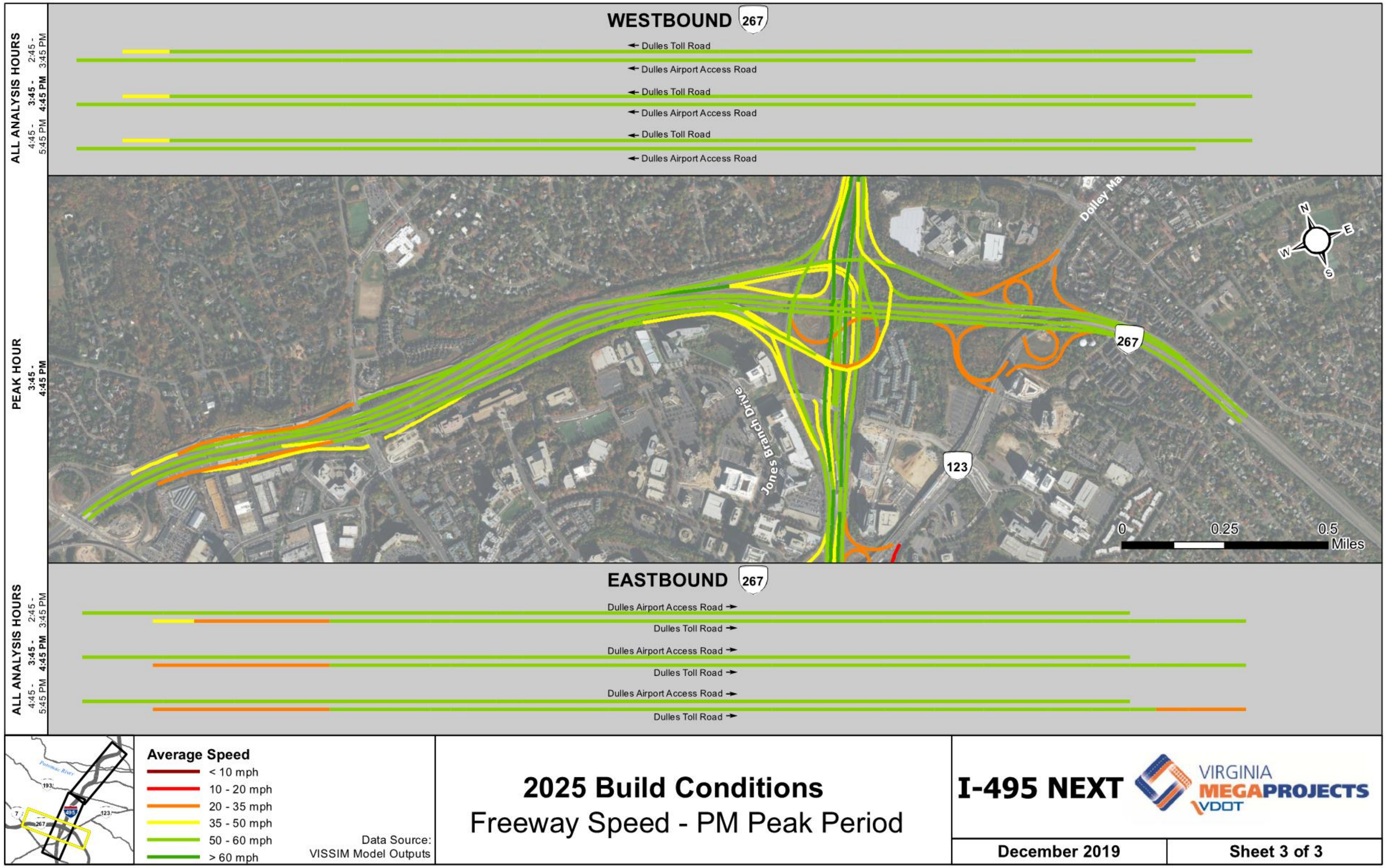


Exhibit 7-16c. 2025 Build Route 267 PM Peak Period Average Speeds

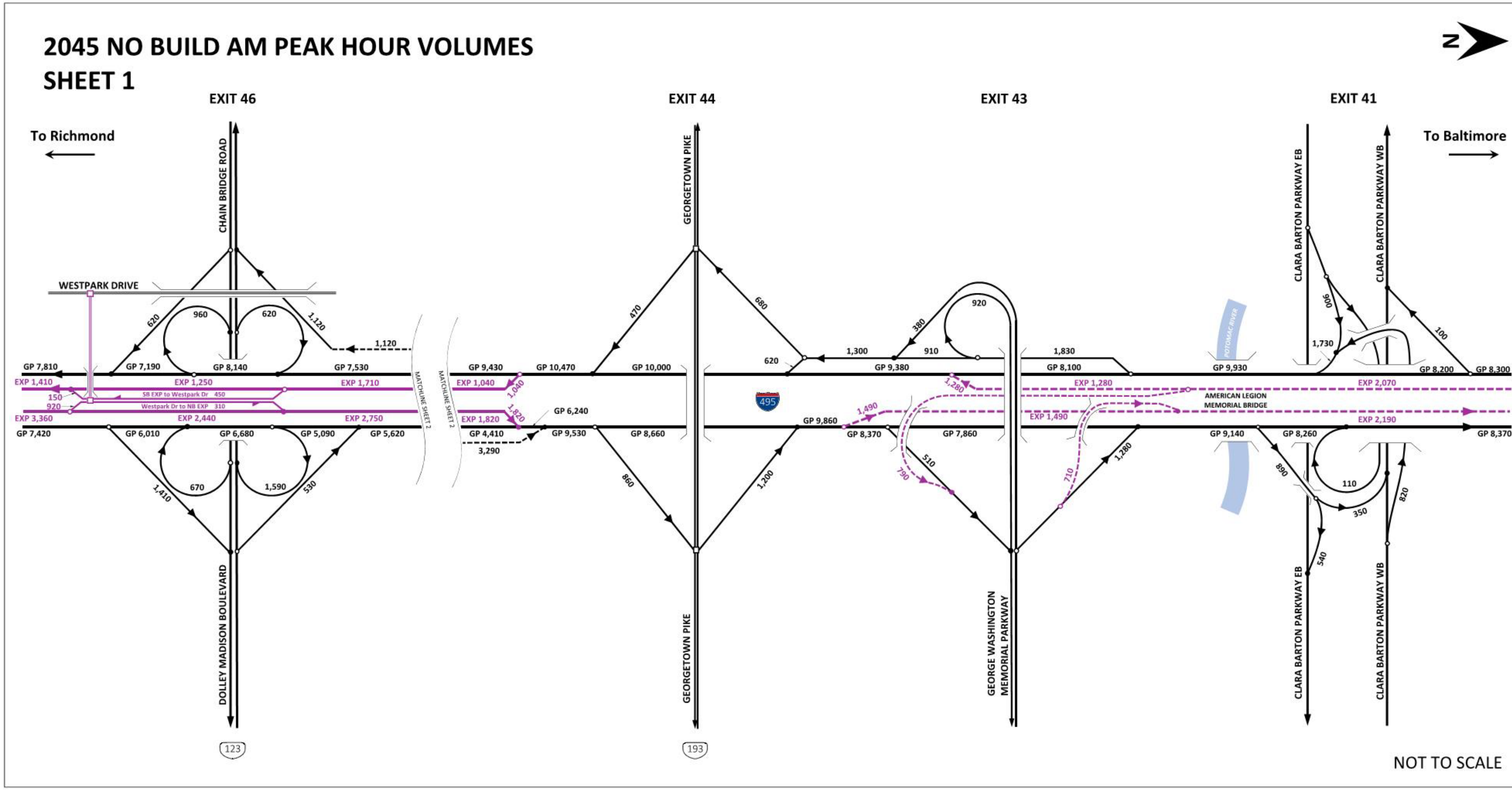


Exhibit 7-17a. Freeway 2045 No Build AM Peak Hour Volume – I-495

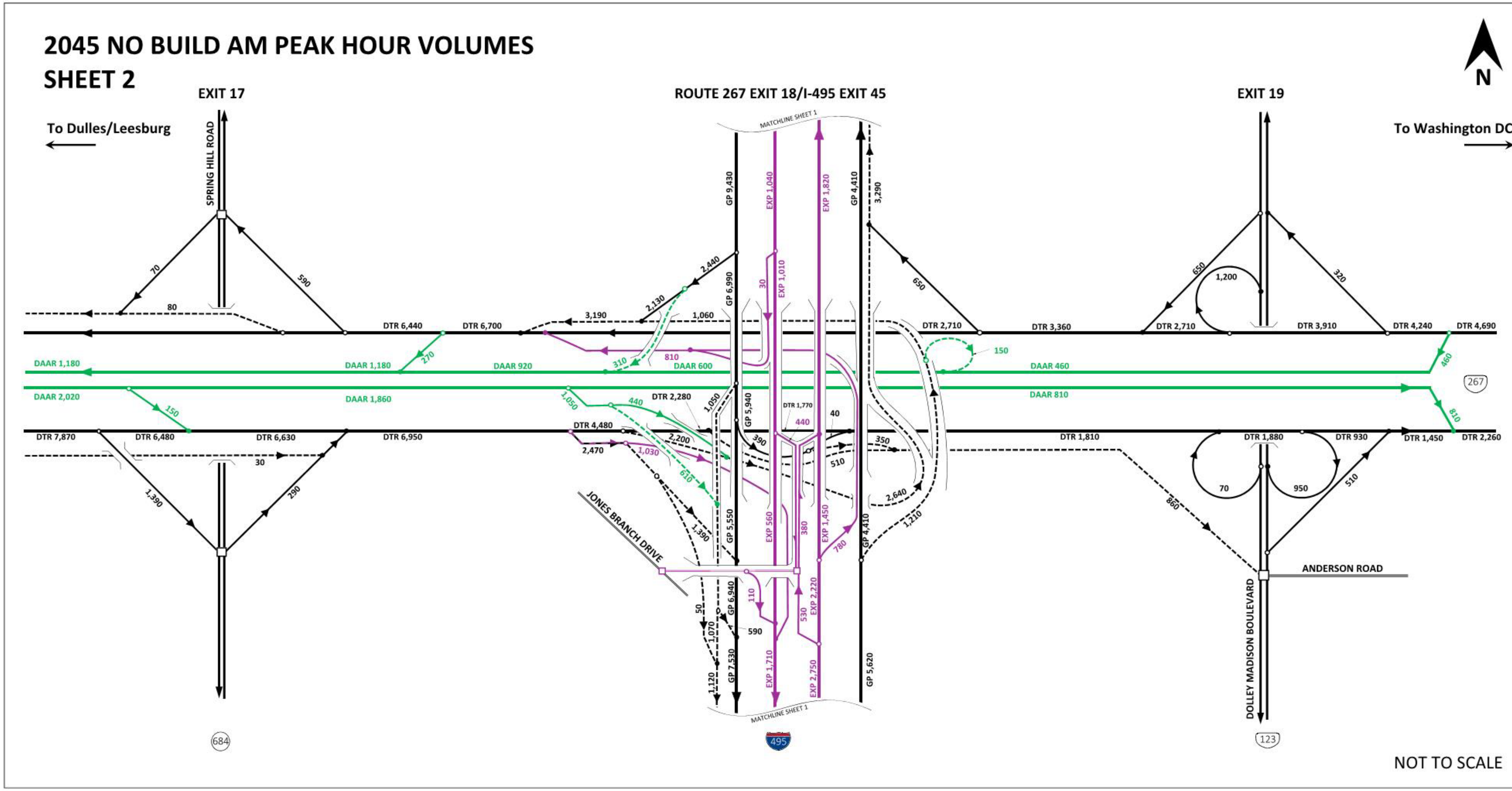


Exhibit 7-17b. Freeway 2045 No Build AM Peak Hour Volume – Route 267

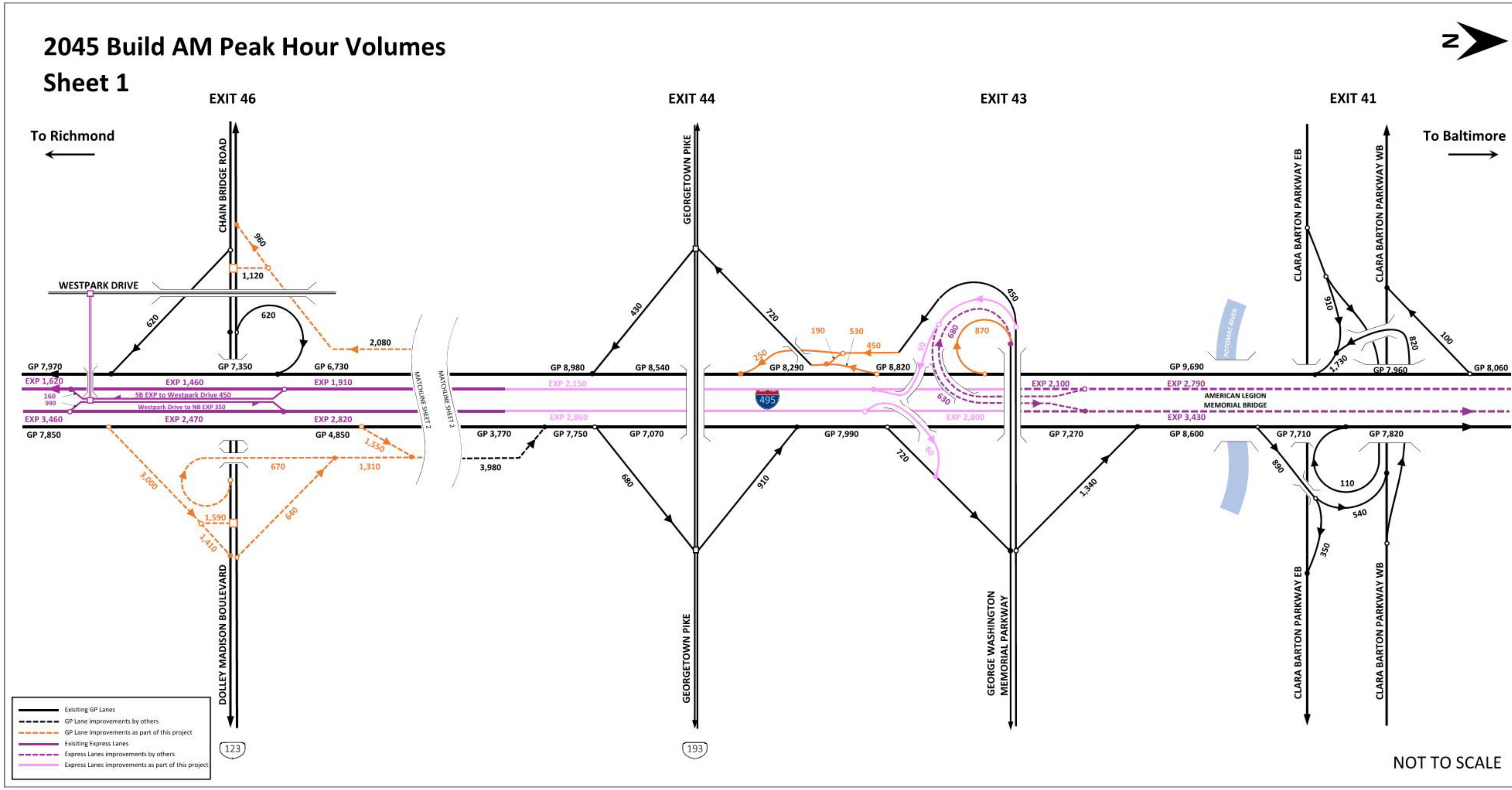


Exhibit 7-18a. Freeway 2045 Build AM Peak Hour Volume – I-495

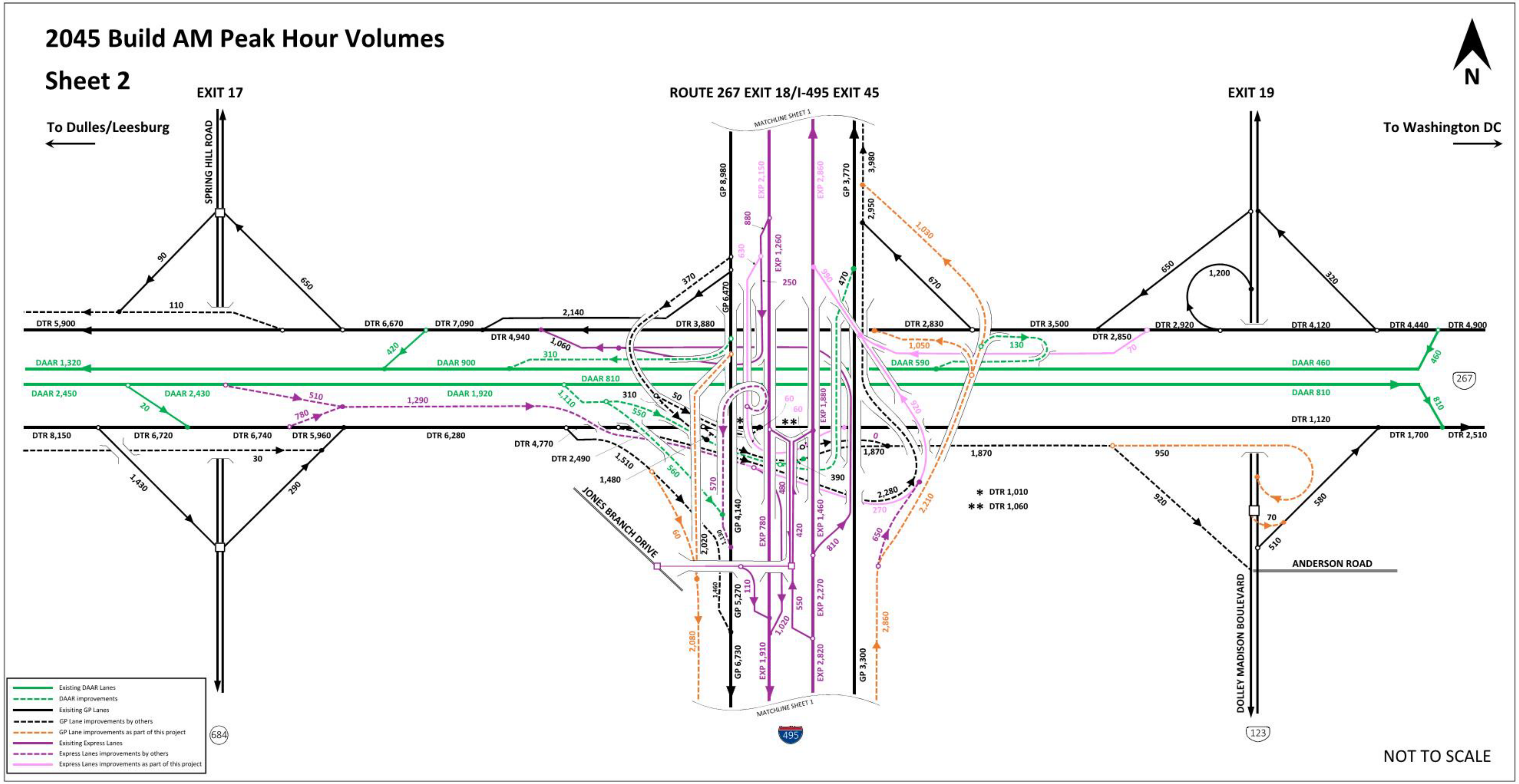


Exhibit 7-18b. Freeway 2045 Build AM Peak Hour Volume – Route 267

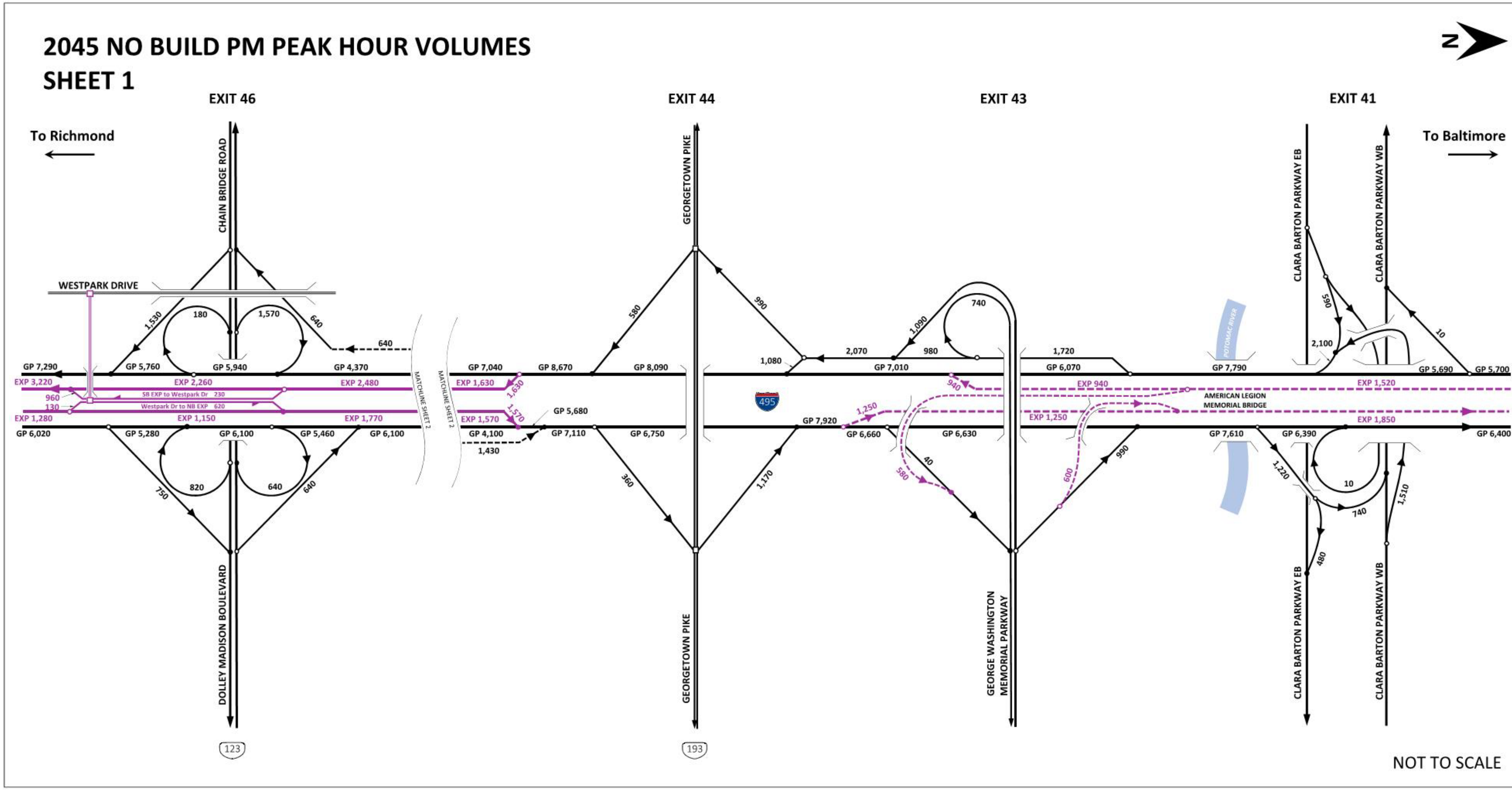


Exhibit 7-19a. Freeway 2045 No Build PM Peak Hour Volume – I-495

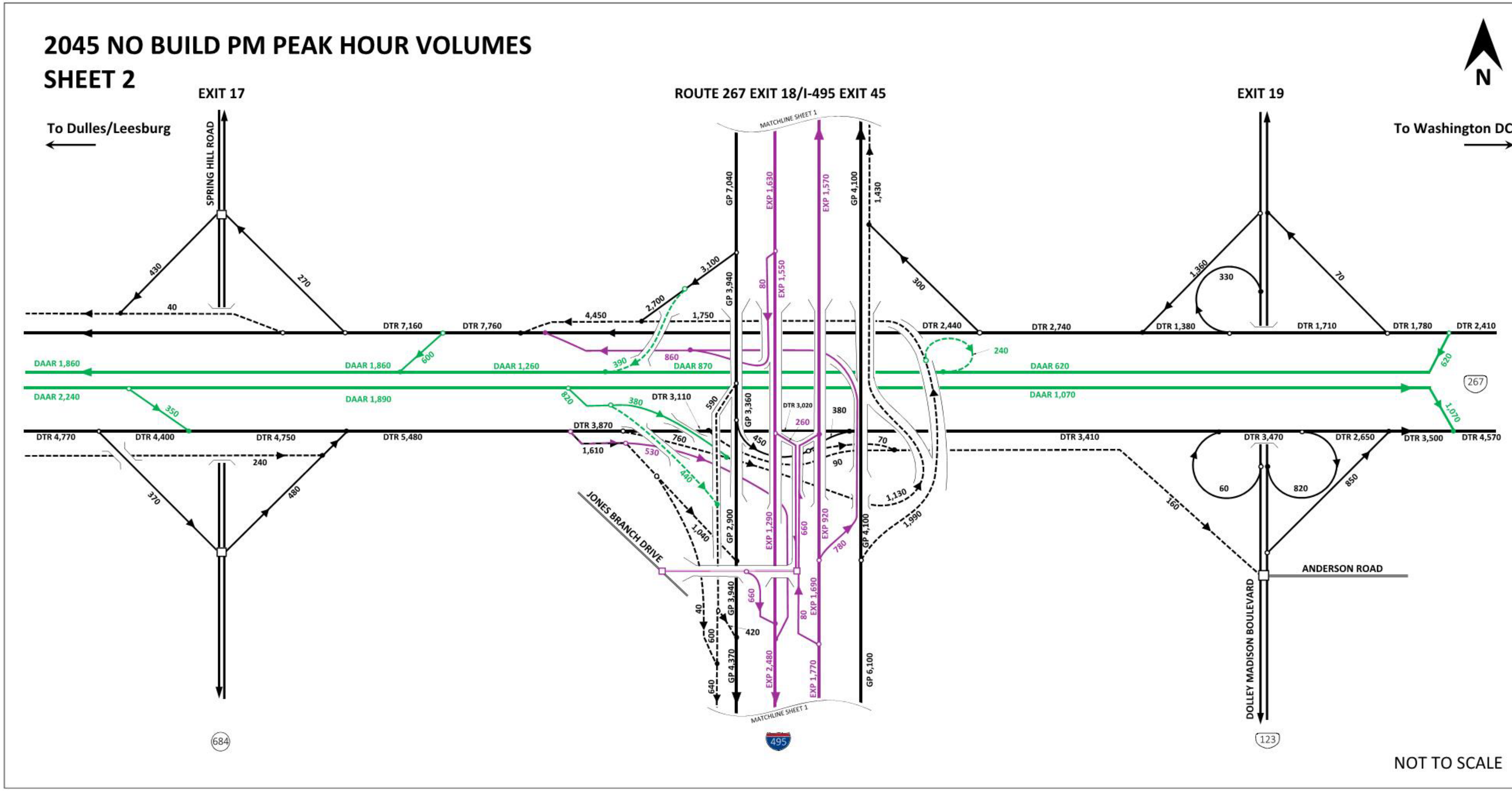


Exhibit 7-19b. Freeway 2045 No Build PM Peak Hour Volume – Route 267

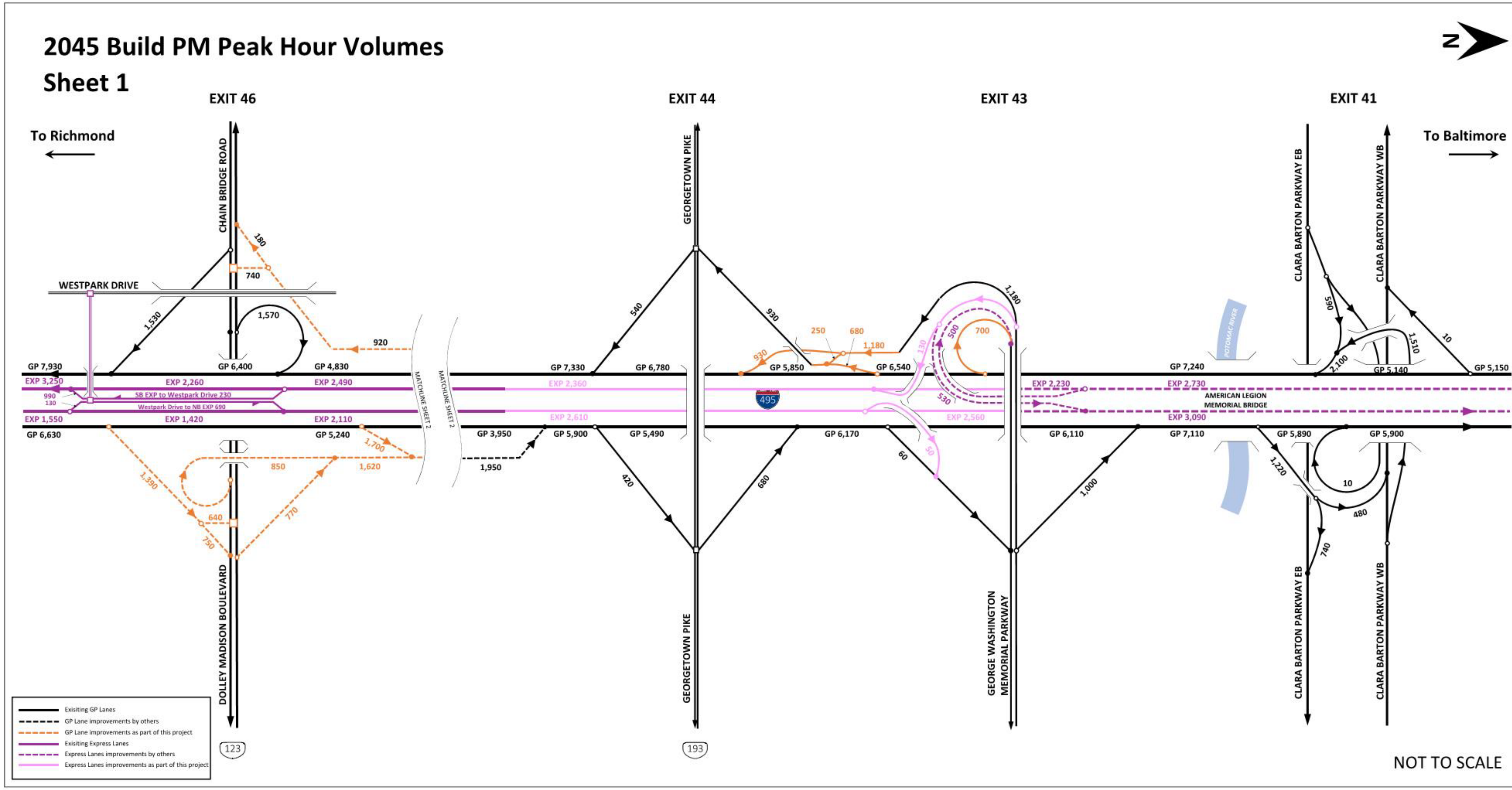


Exhibit 7-20a. Freeway 2045 Build PM Peak Hour Volume – I-495

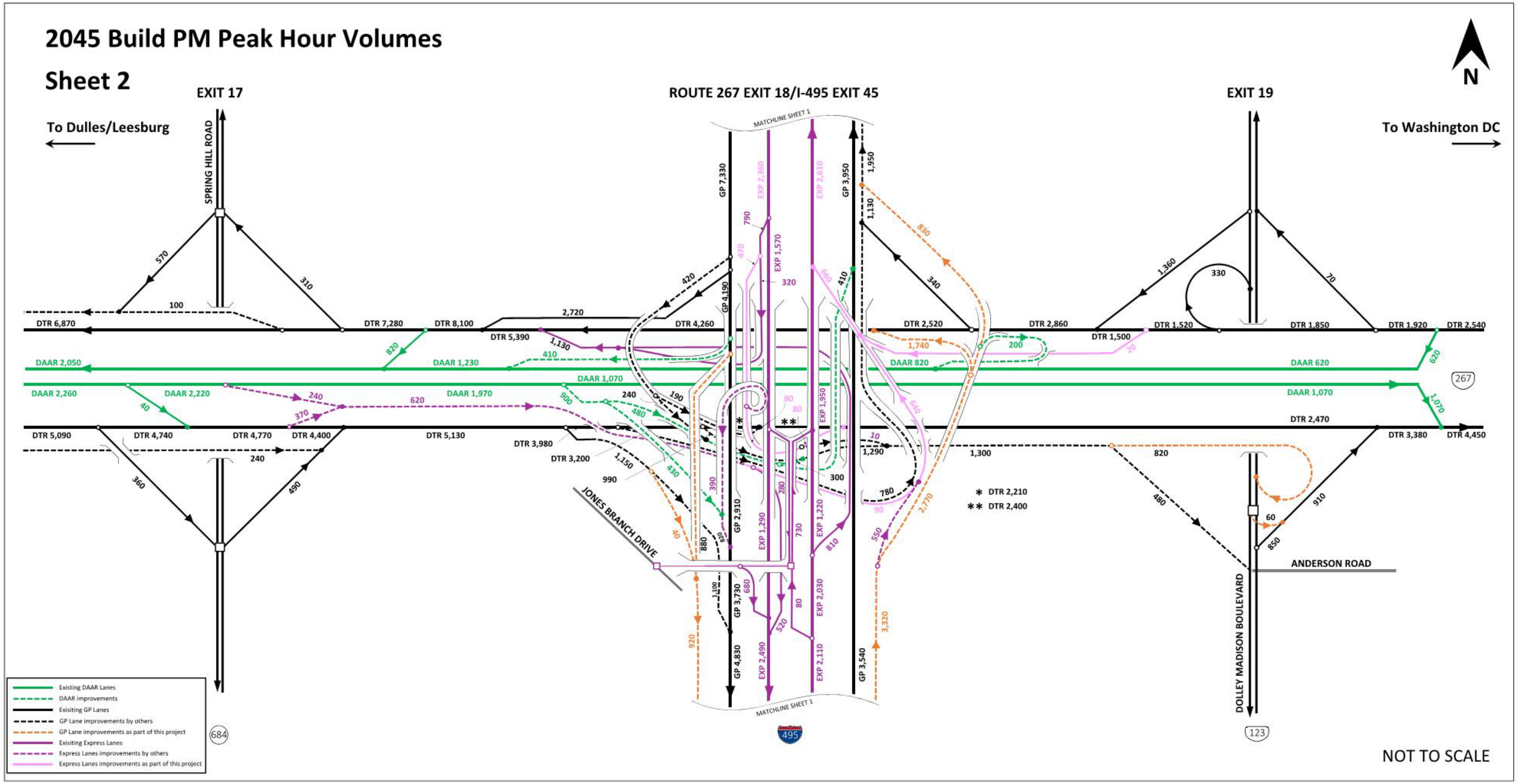


Exhibit 7-20b. Freeway 2045 Build PM Peak Hour Volume – Route 267

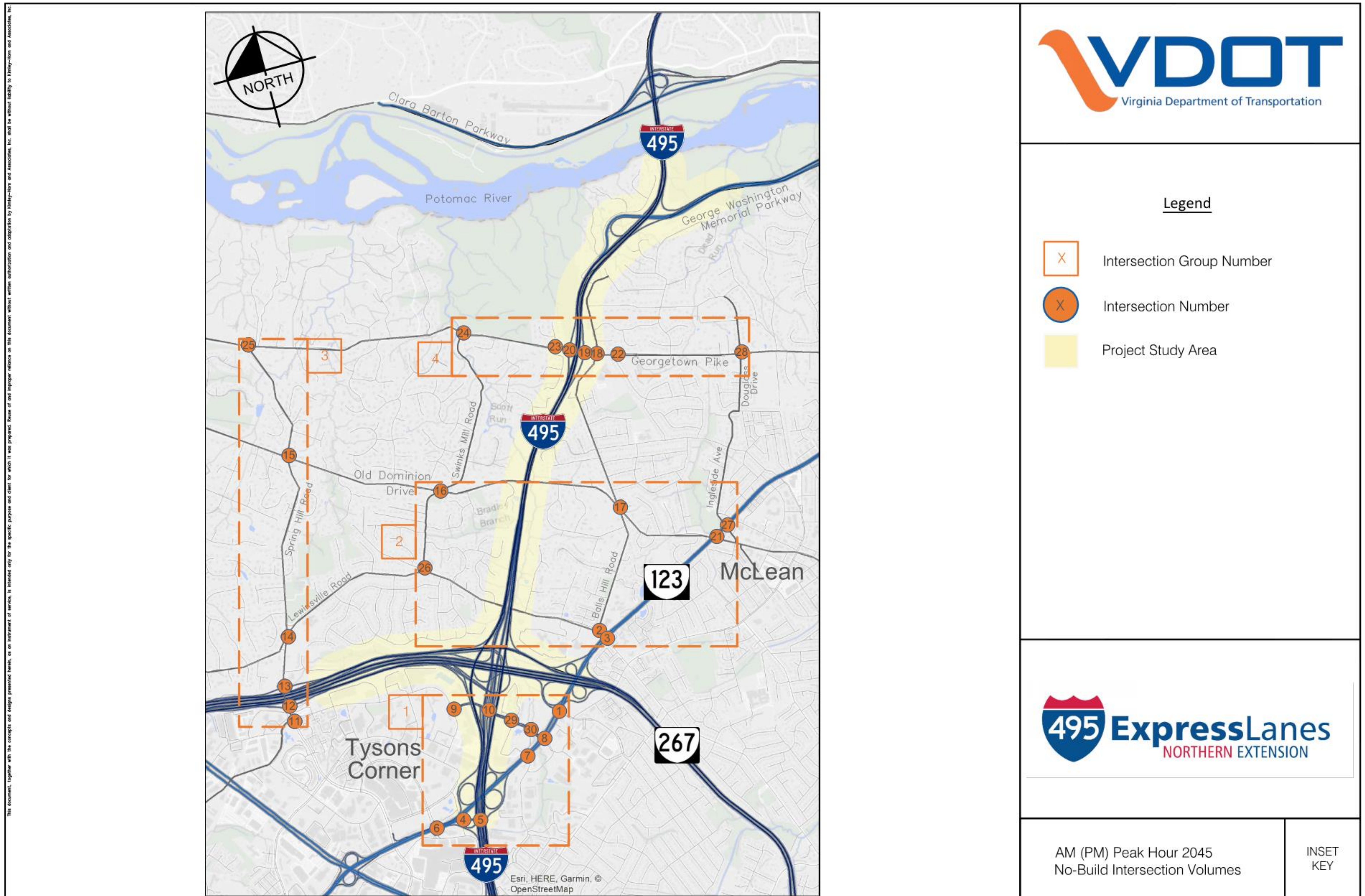


Exhibit 7-21a. Arterial 2045 No Build Peak Hour Turning Movement Volumes – Figure Key

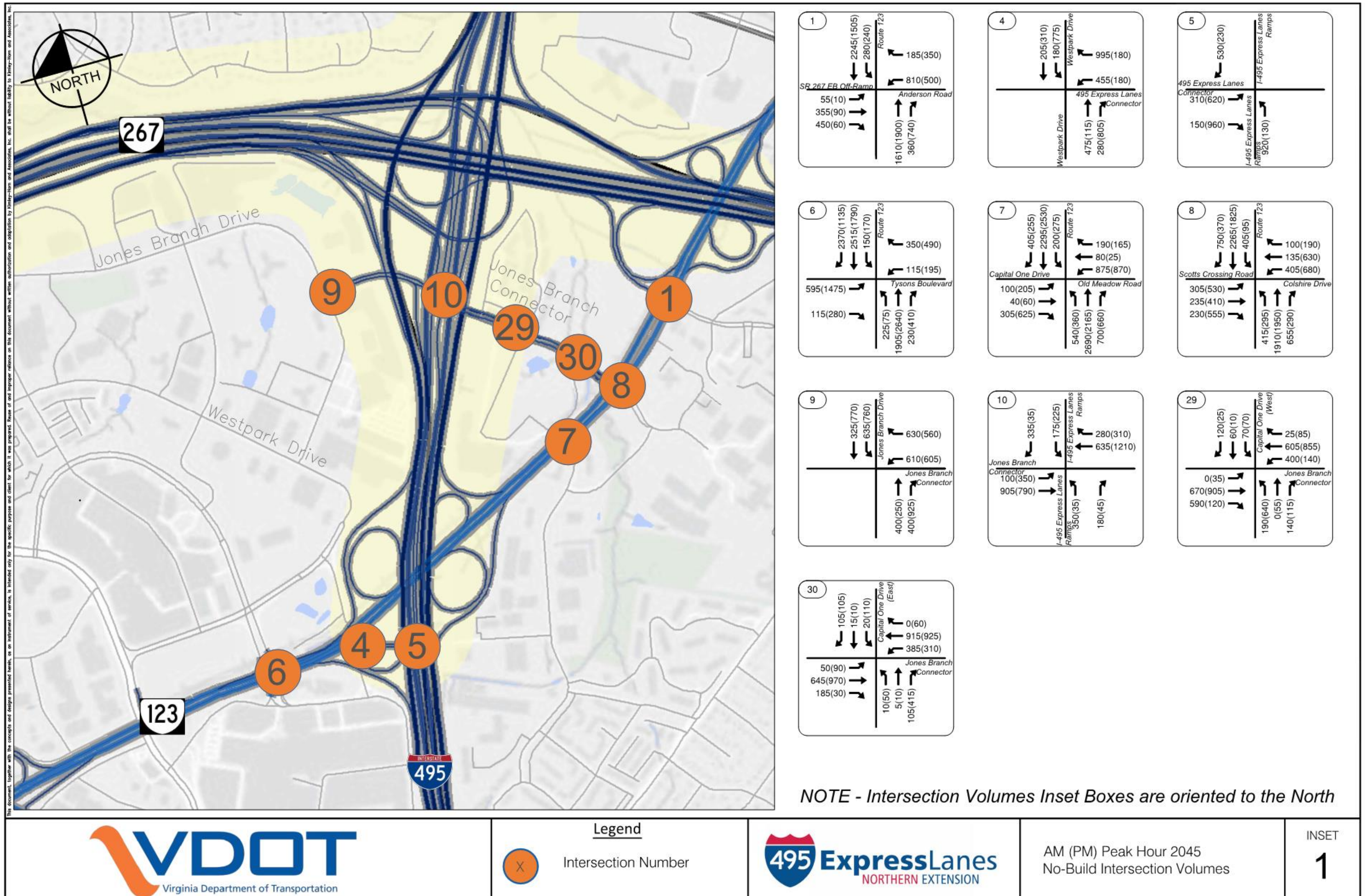


Exhibit 7-21b. Arterial 2045 No Build Peak Hour Turning Movement Volumes – Location 1

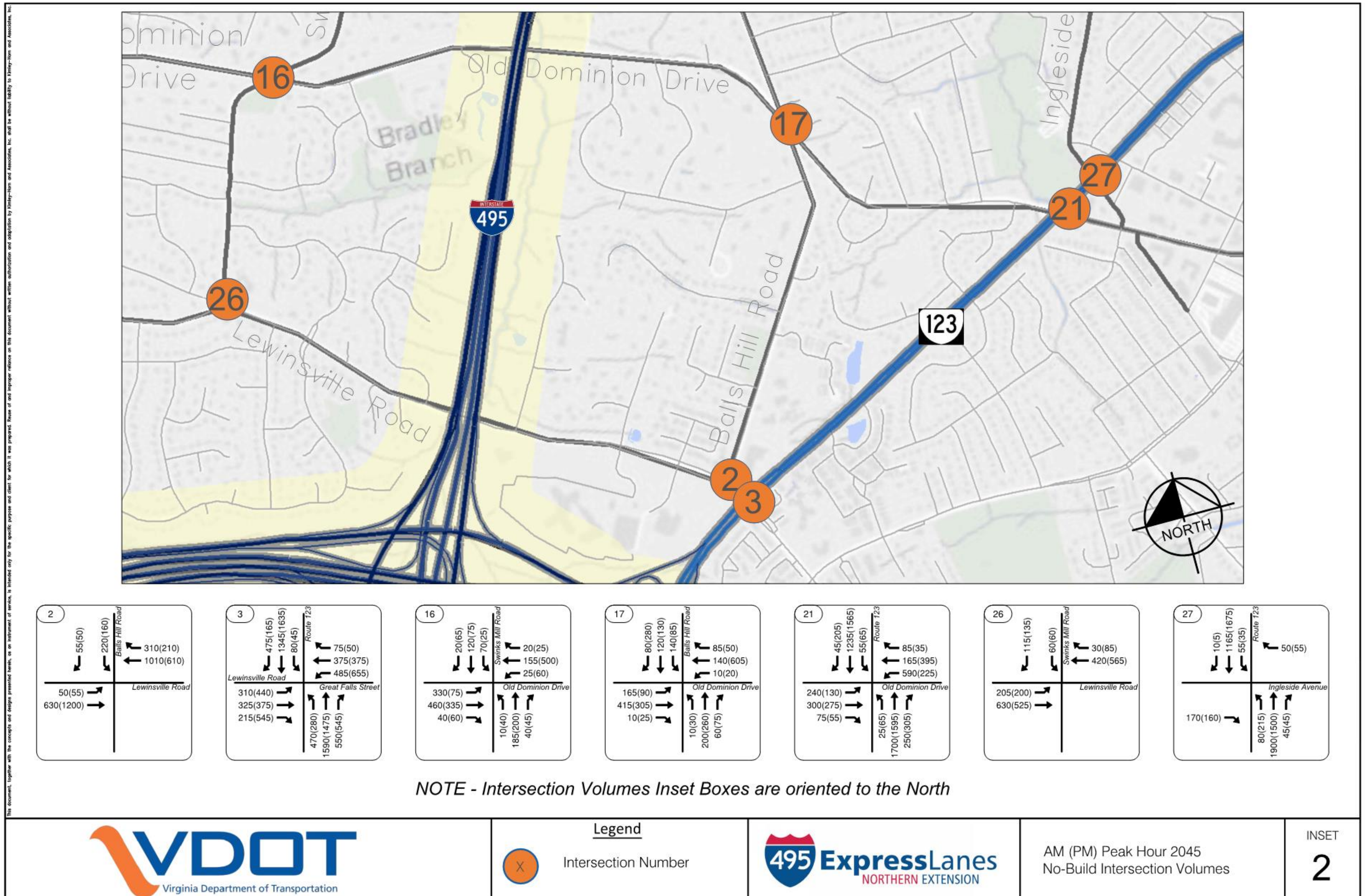


Exhibit 7-21c. Arterial 2045 No Build Peak Hour Turning Movement Volumes – Location 2

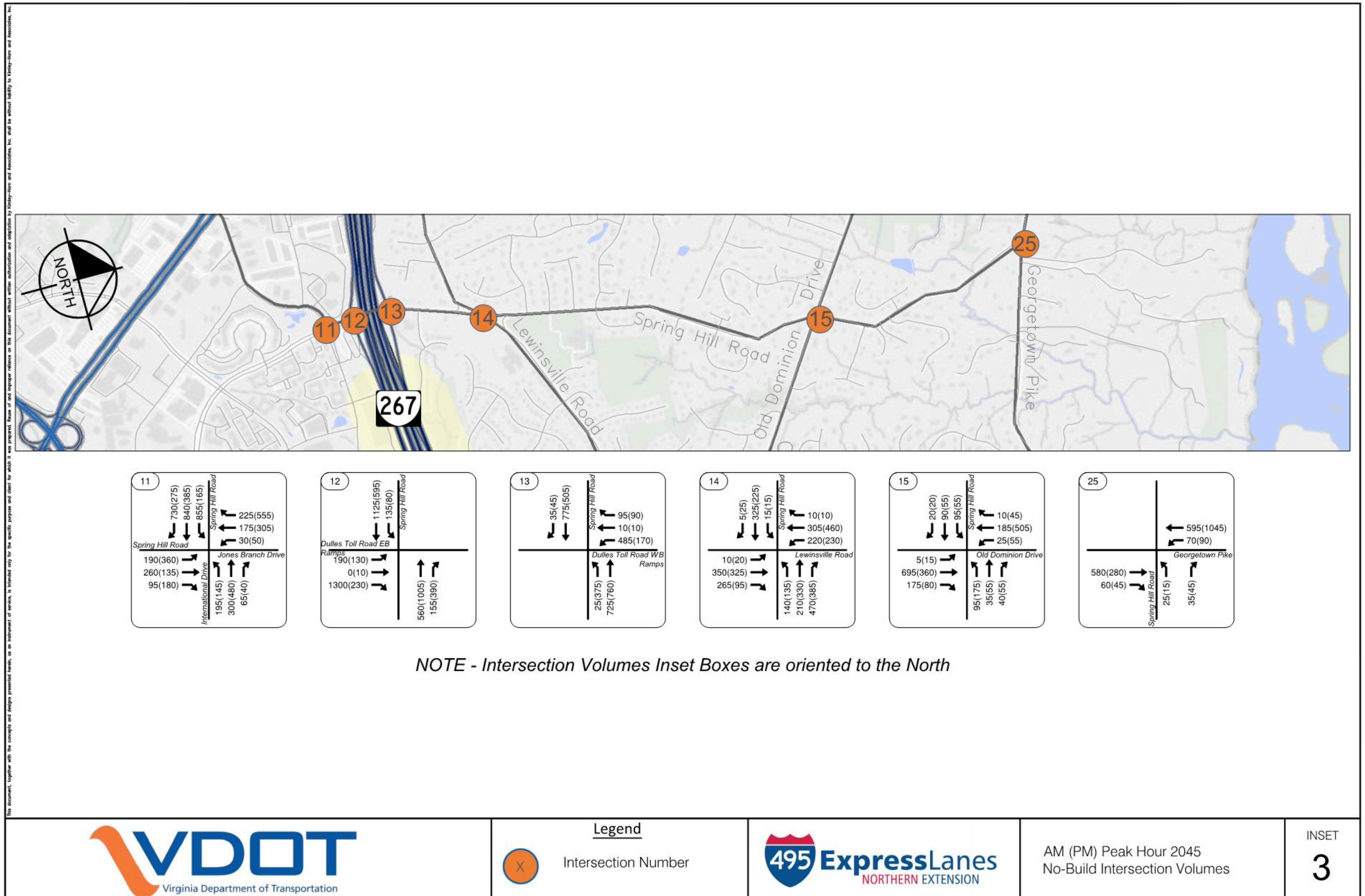


Exhibit 7-21d. Arterial 2045 No Build Peak Hour Turning Movement Volumes – Location 3

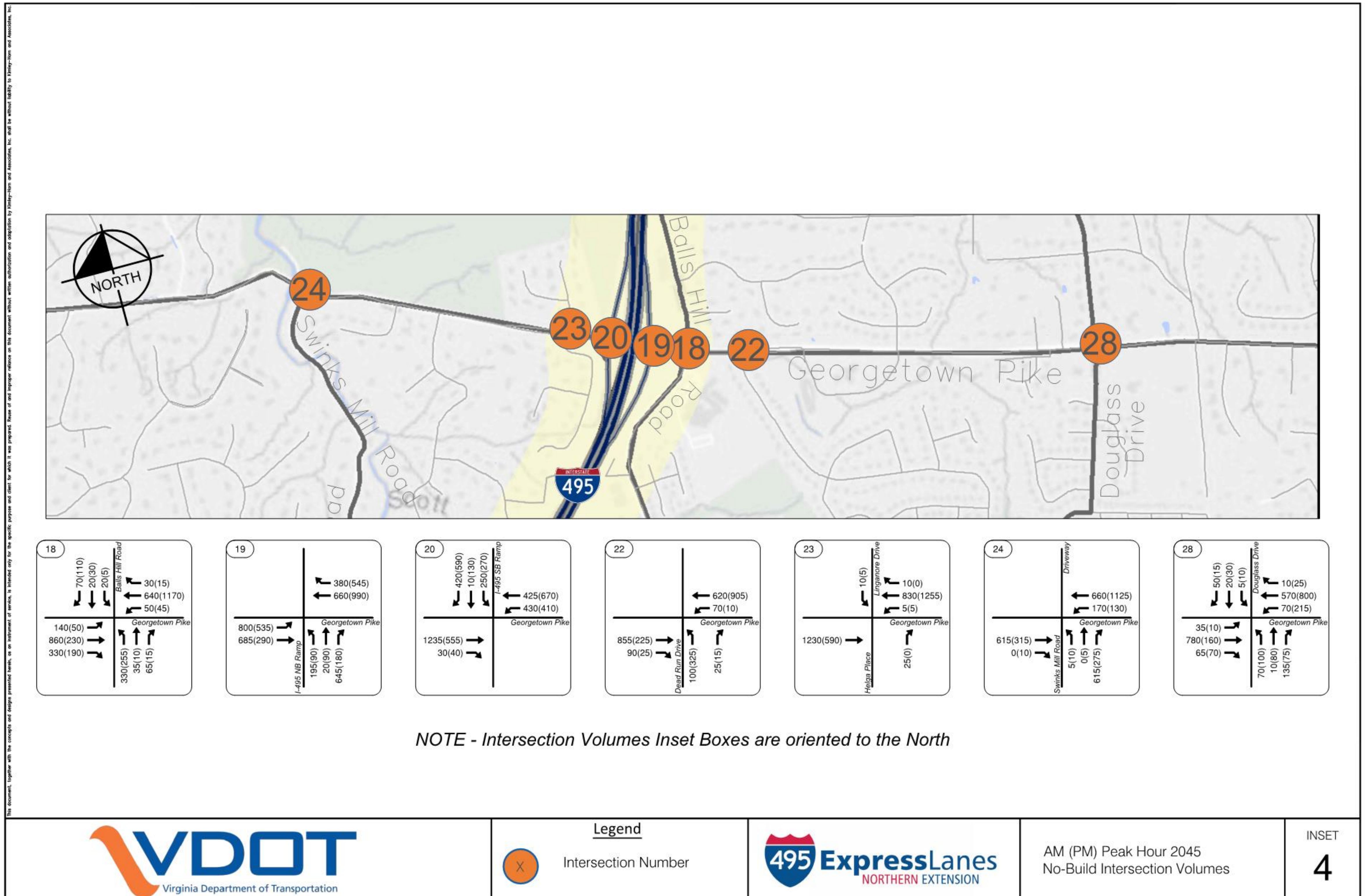


Exhibit 7-21e. Arterial 2045 No Build Peak Hour Turning Movement Volumes – Location 4

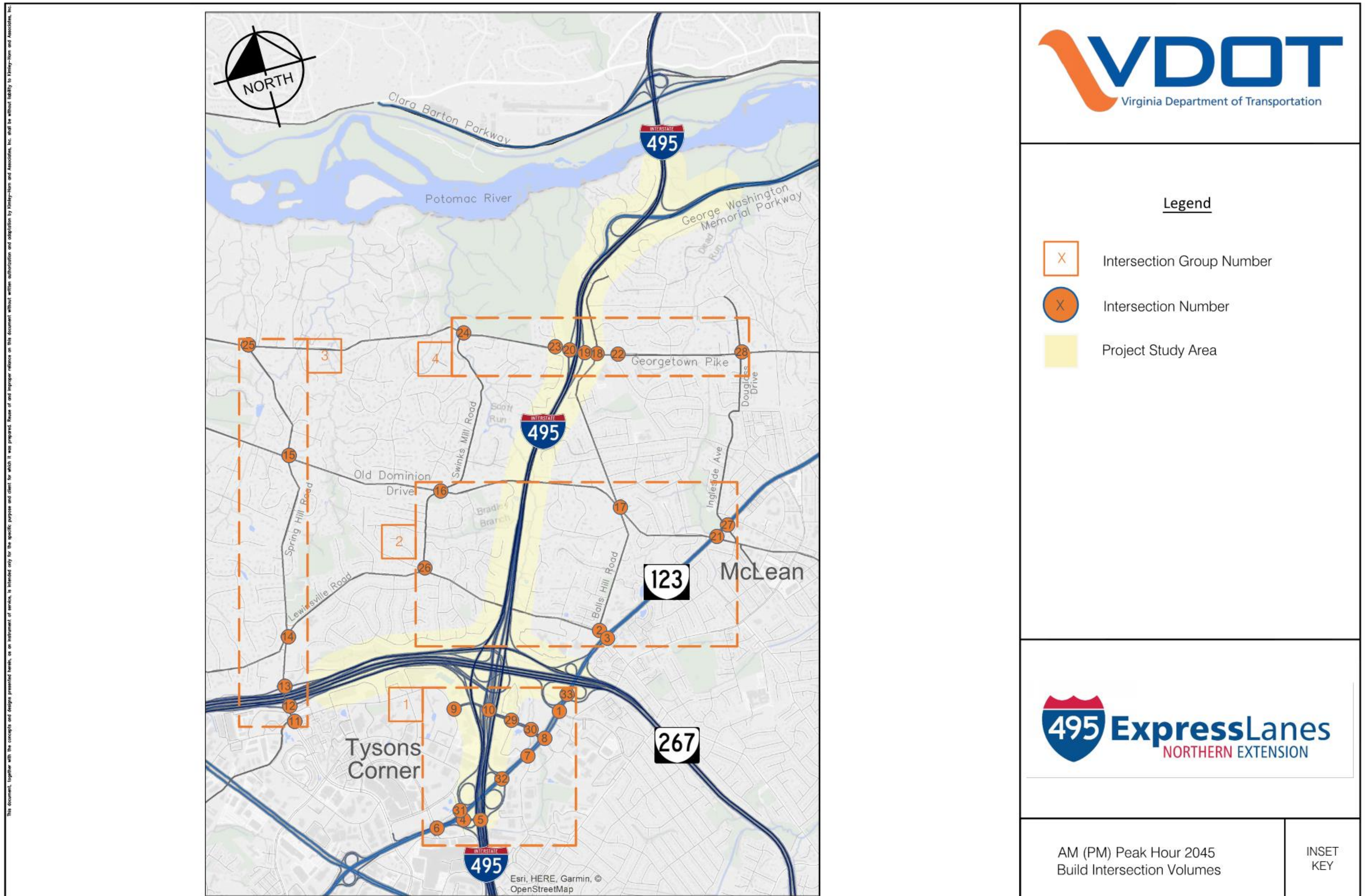


Exhibit 7-22a. Arterial 2045 Build Peak Hour Turning Movement Volumes – Figure Key

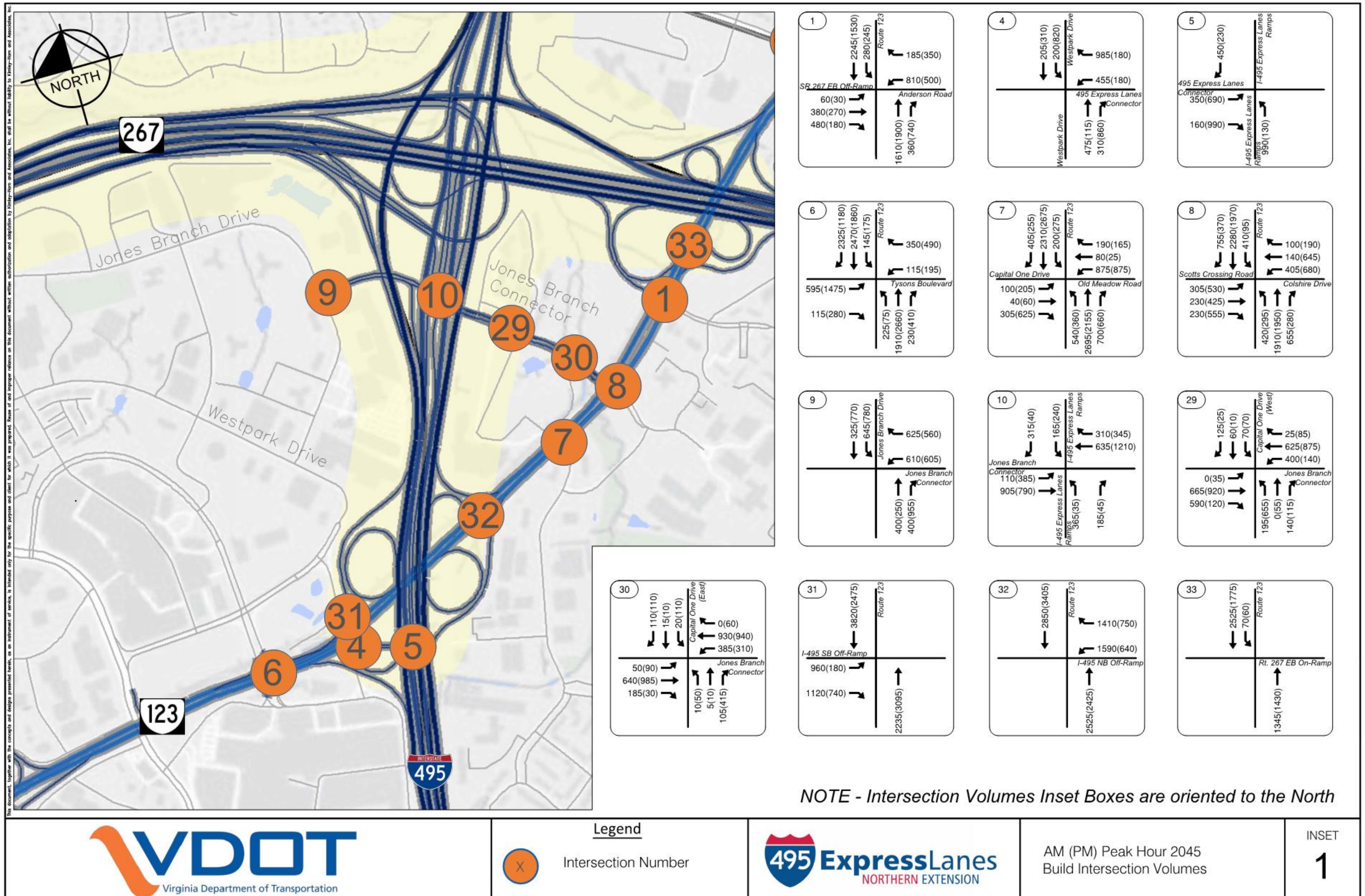


Exhibit 7-22b. Arterial 2045 Build Peak Hour Turning Movement Volumes – Location 1

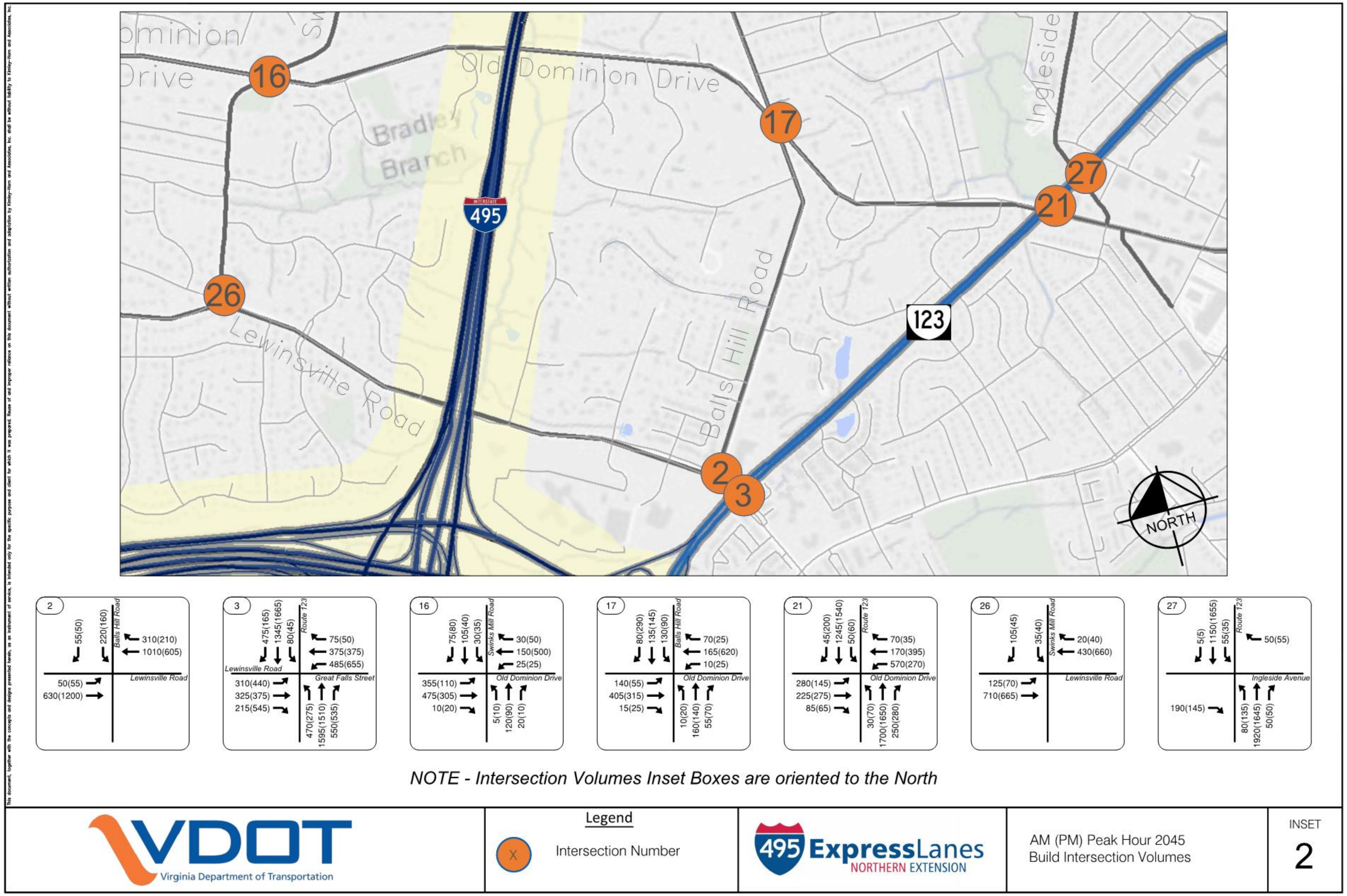


Exhibit 7-22c. Arterial 2045 Build Peak Hour Turning Movement Volumes – Location 2

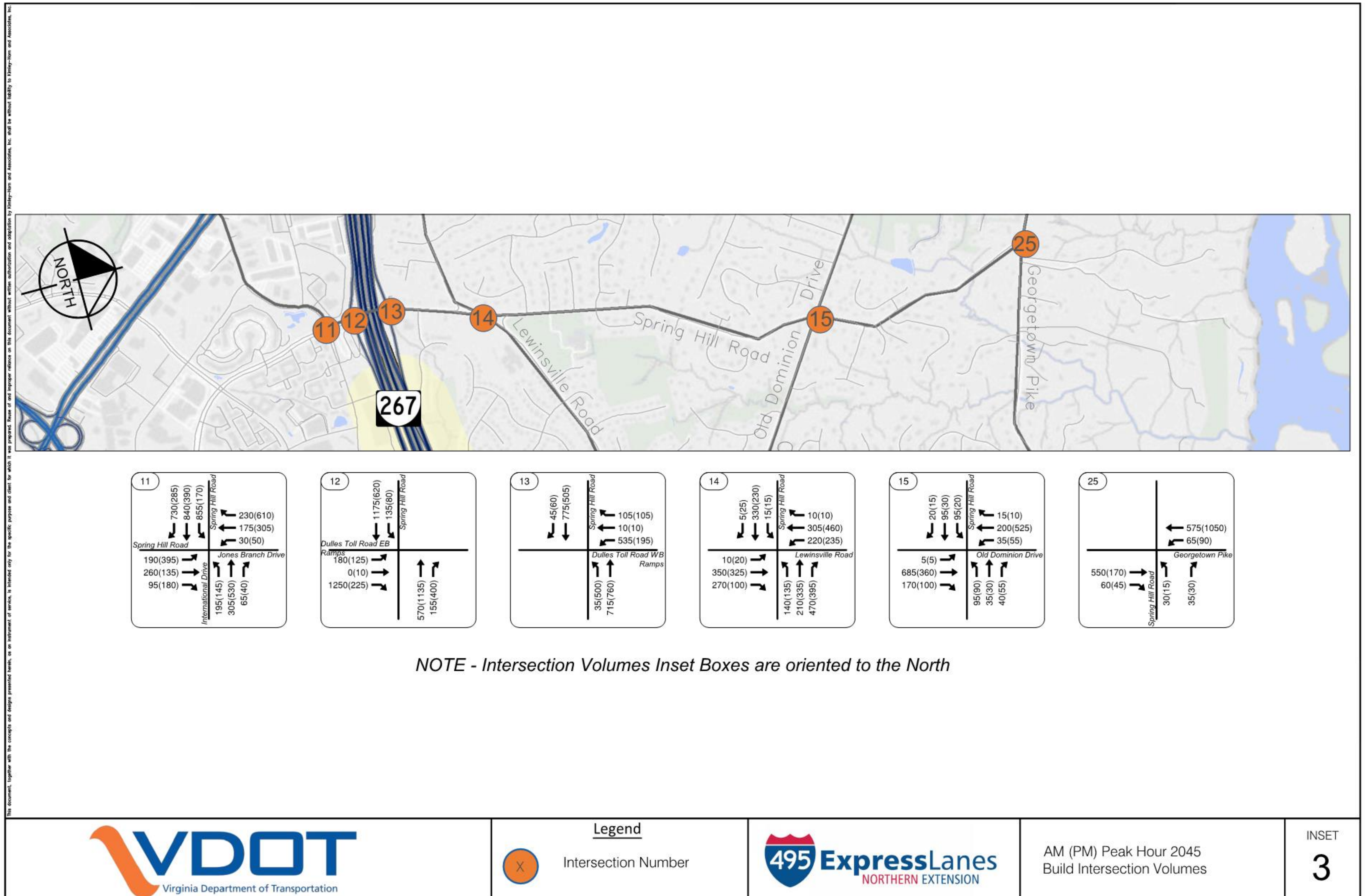


Exhibit 7-22d. Arterial 2045 Build Peak Hour Turning Movement Volumes – Location 3

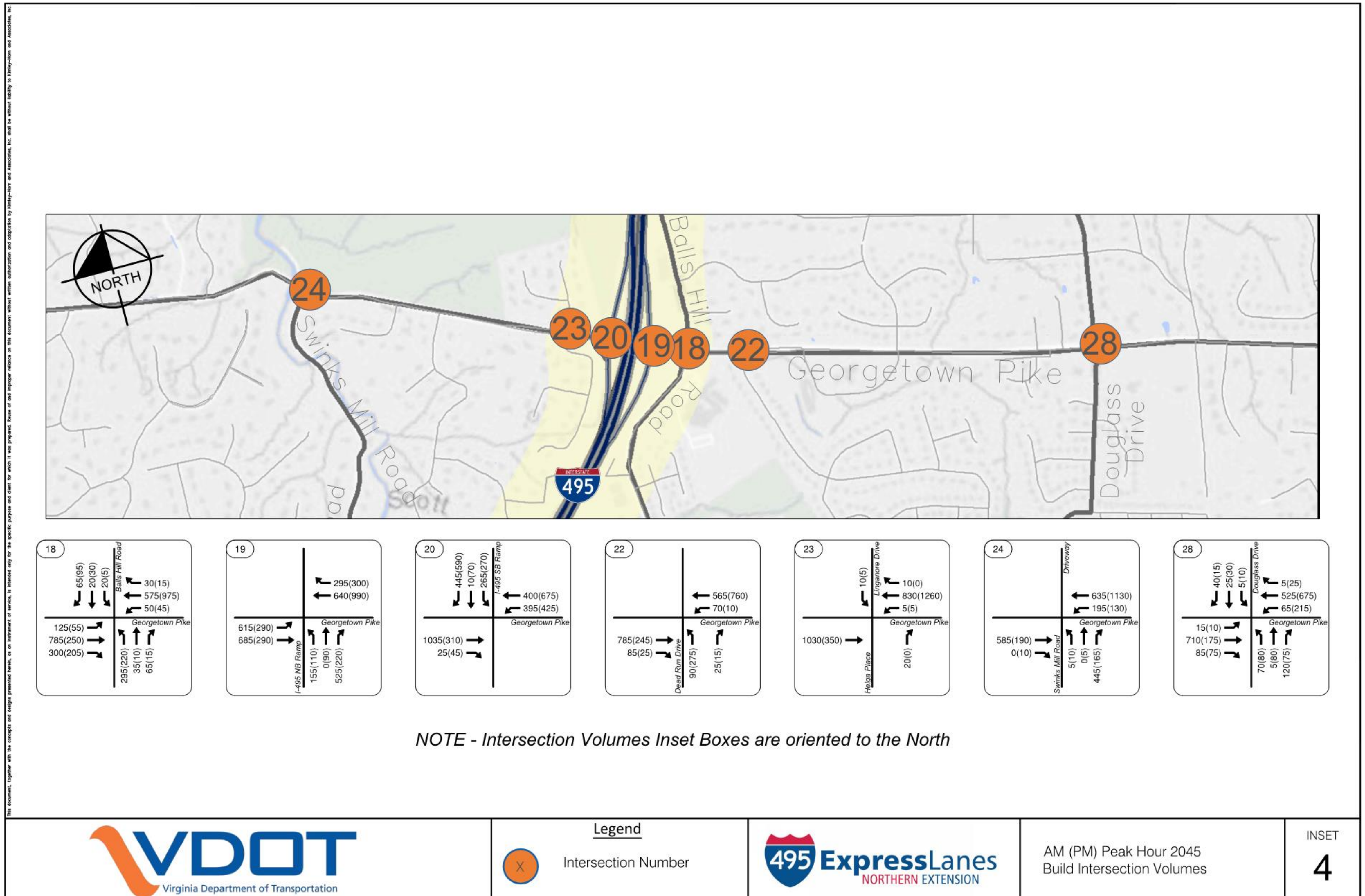


Exhibit 7-22e. Arterial 2045 Build Peak Hour Turning Movement Volumes – Location 4

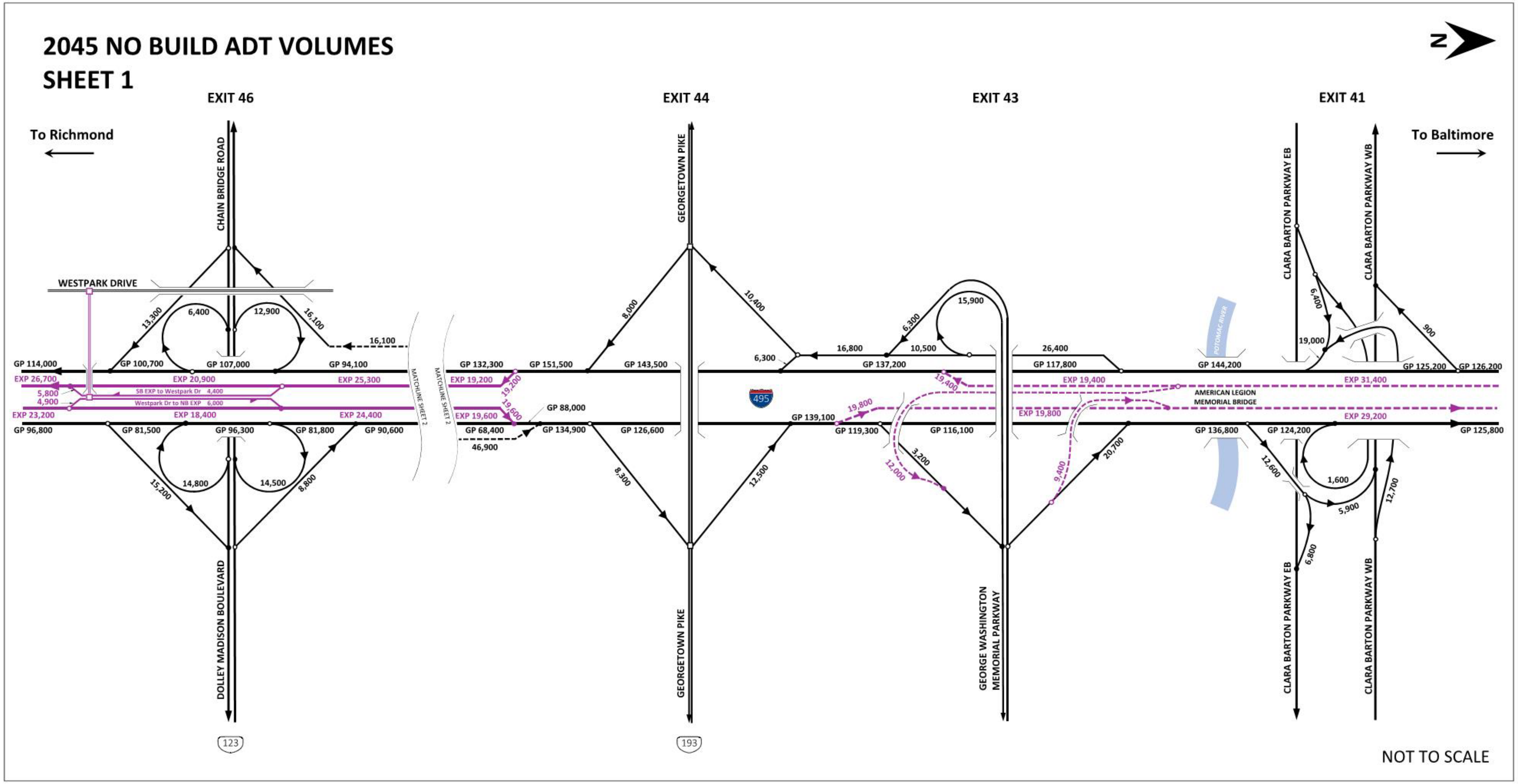


Exhibit 7-23a. Freeway 2045 No Build ADT – I-495

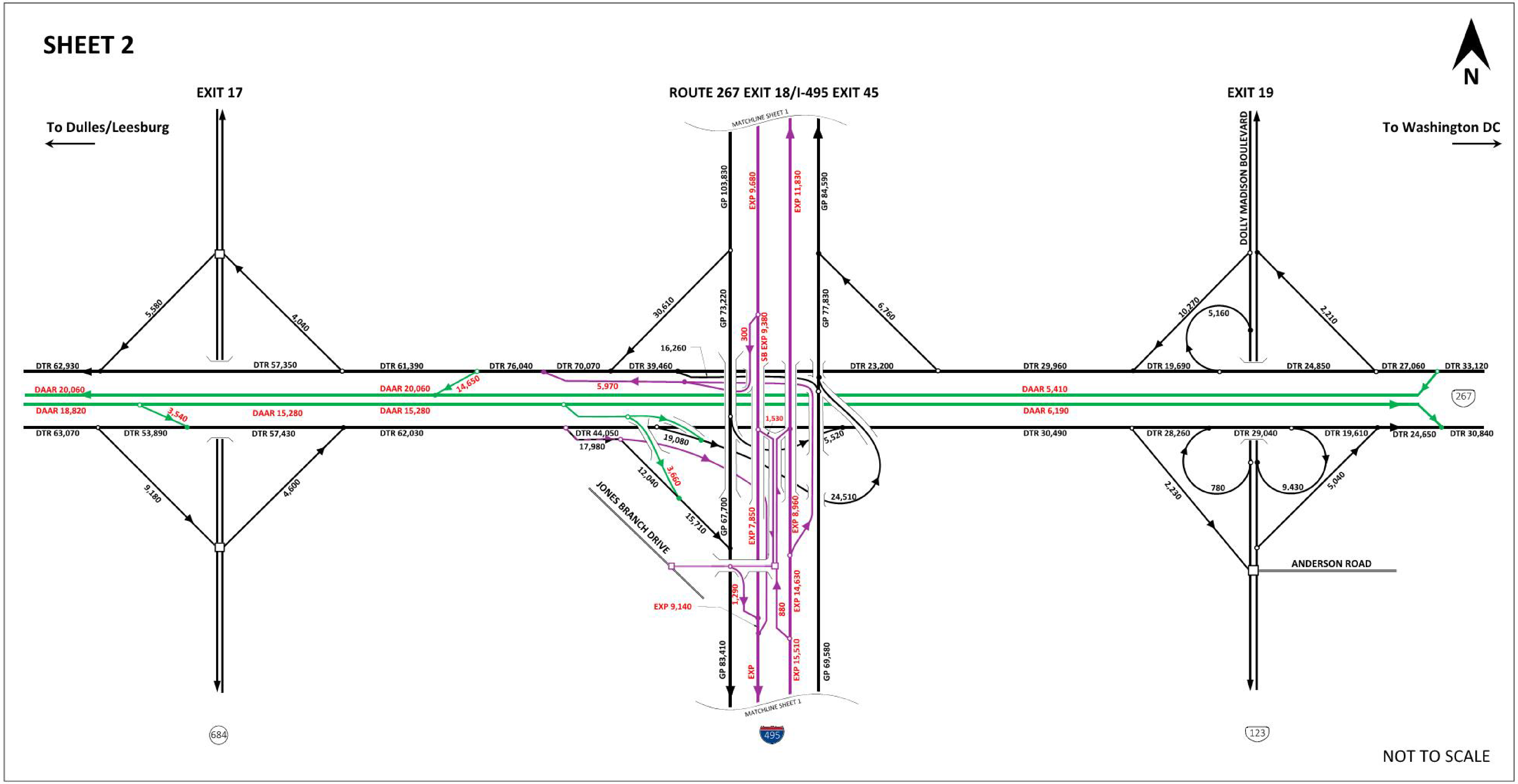


Exhibit 7-23b. Freeway 2045 No Build ADT – Route 267

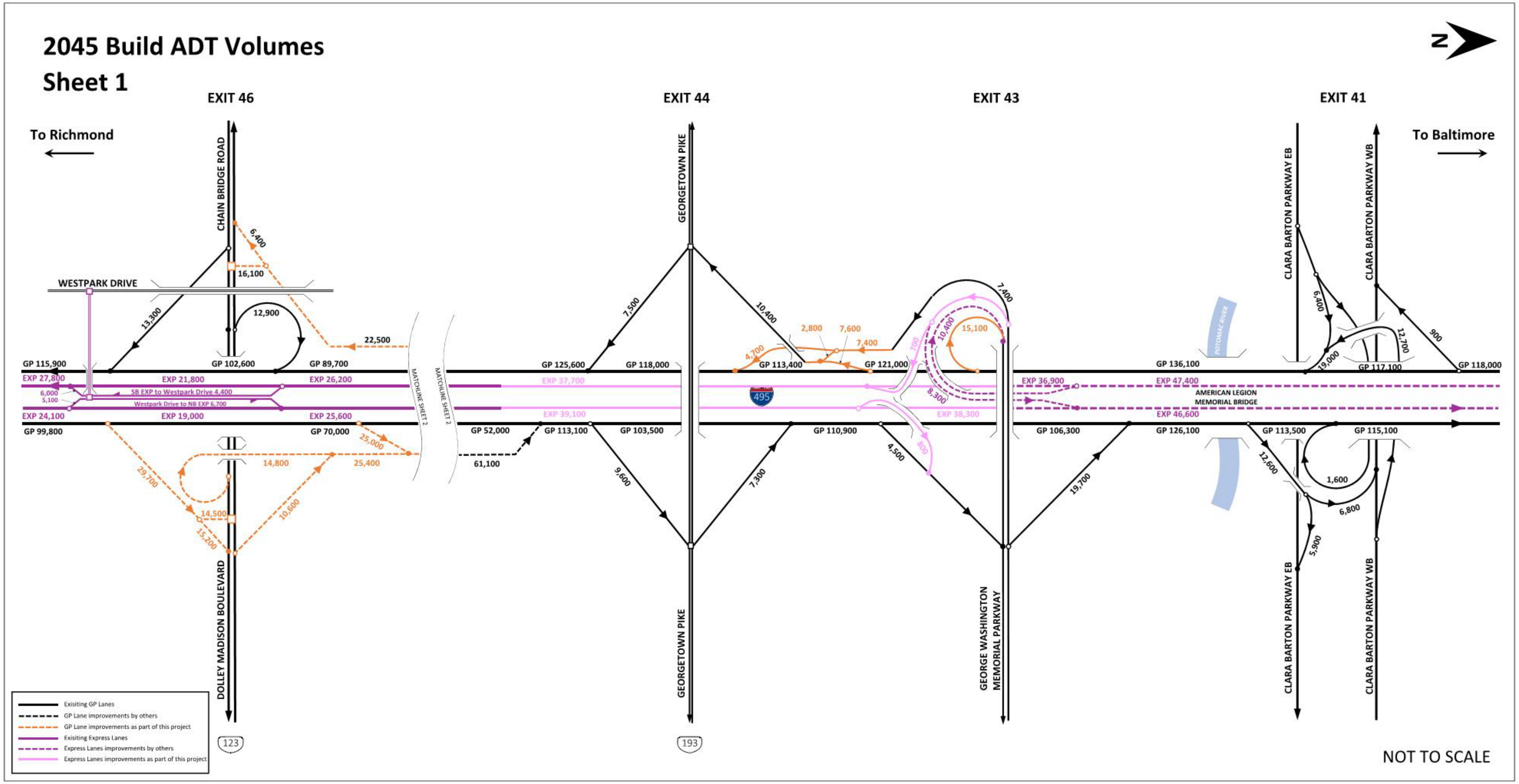


Exhibit 7-24a. Freeway 2045 Build ADT – I-495

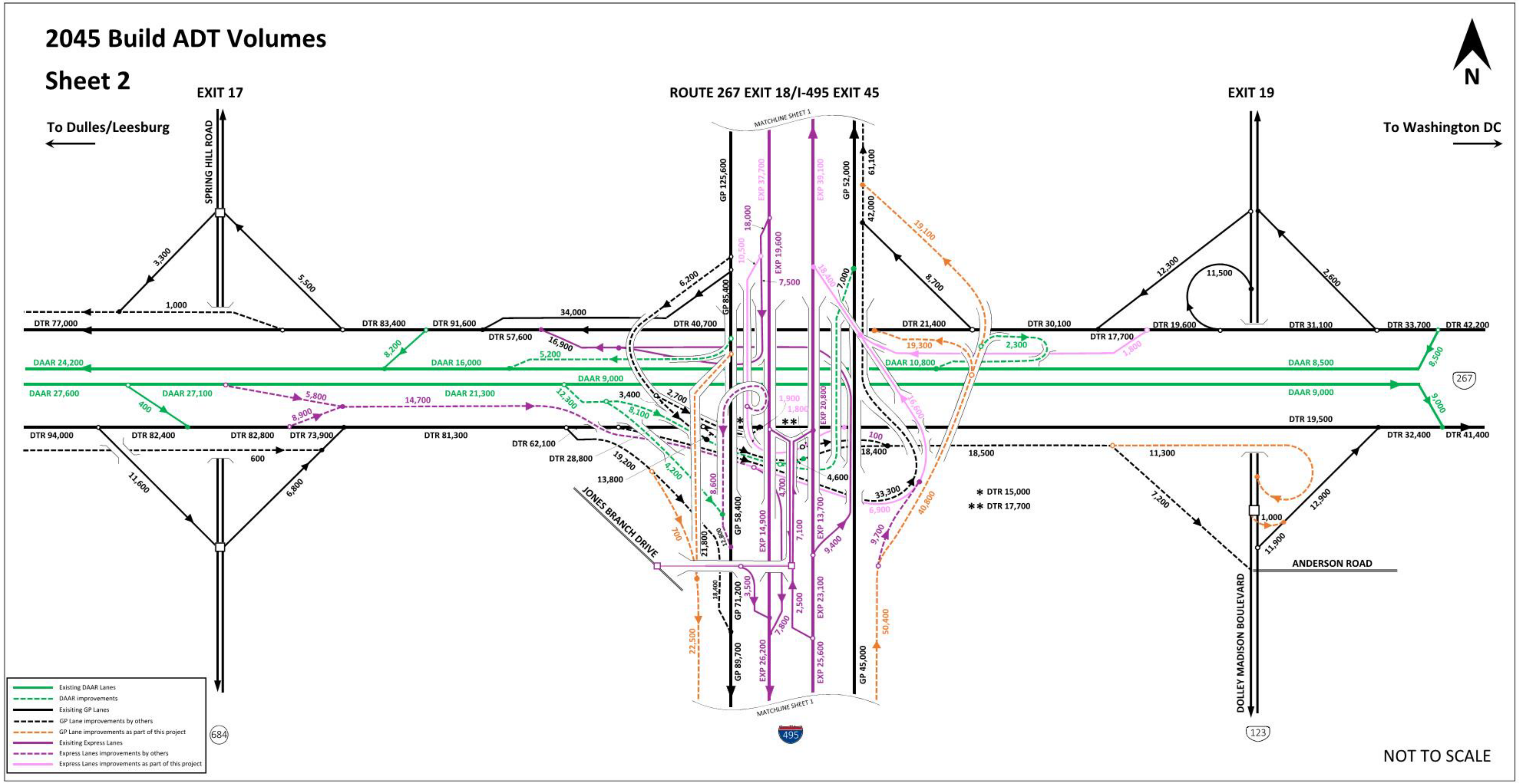


Exhibit 7-24b. Freeway 2045 Build ADT – Route 267

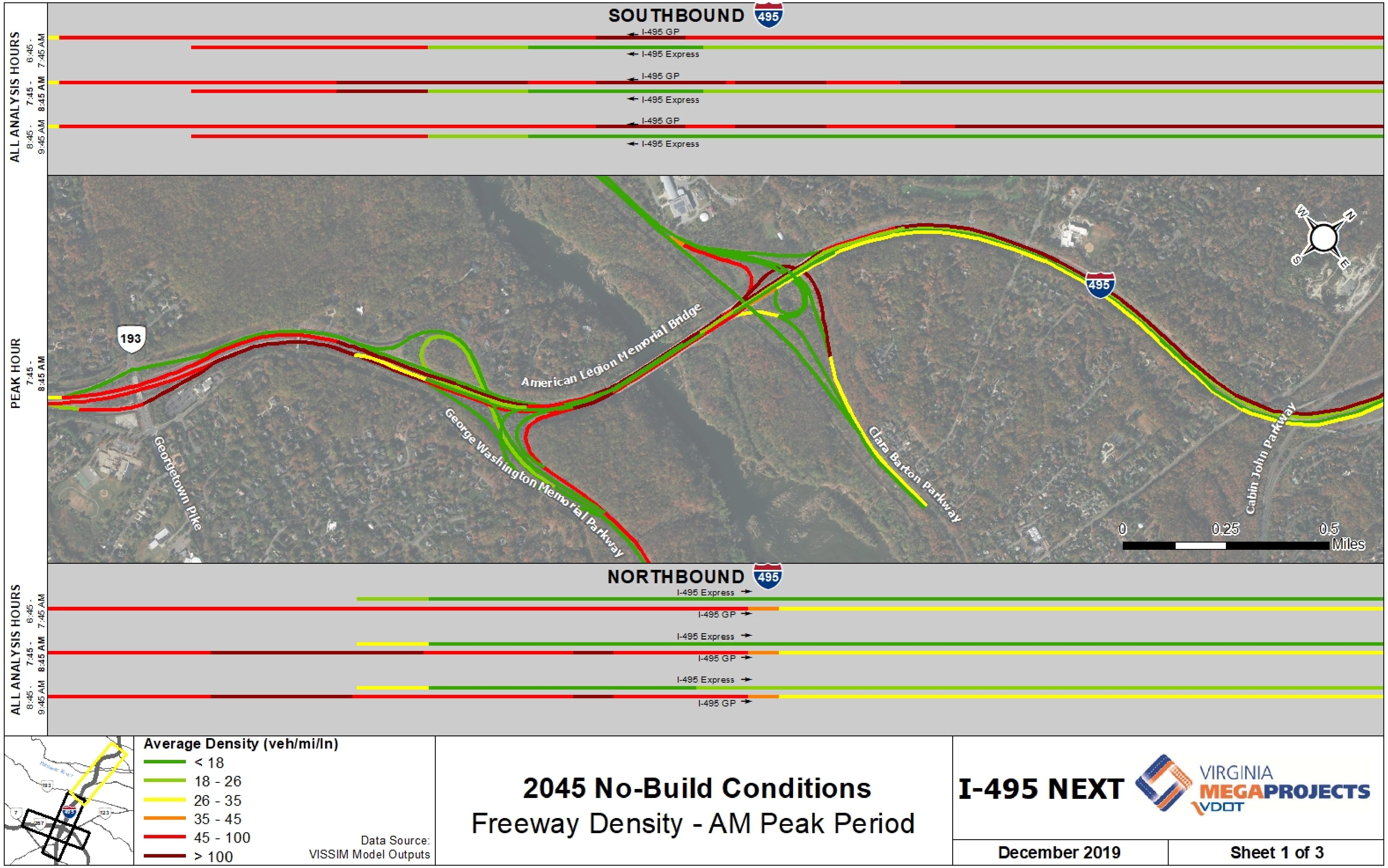


Exhibit 7-25a. 2045 No Build I-495 AM Peak Period Average Densities – Georgetown Pike to Cabin John Parkway

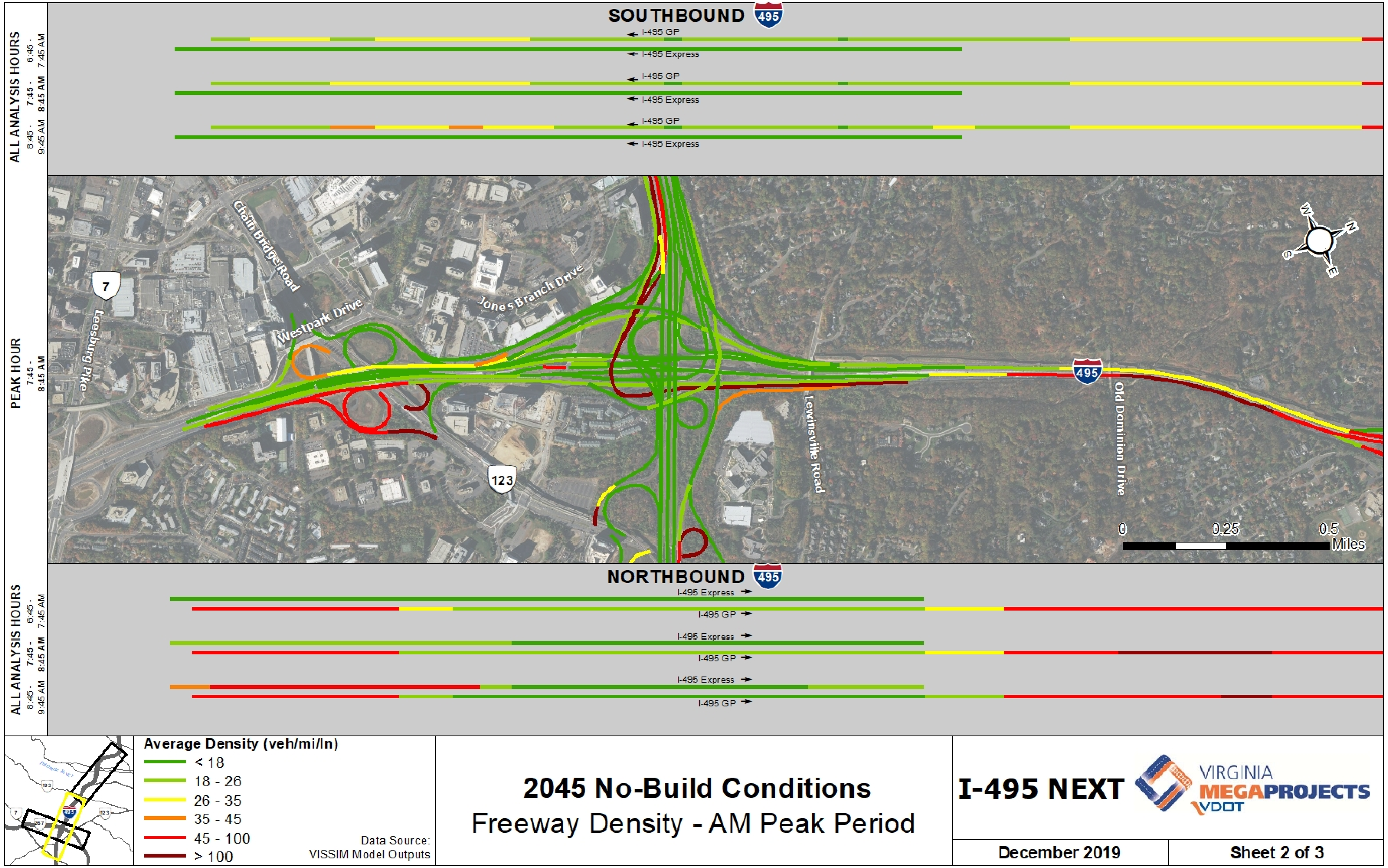


Exhibit 7-25b. 2045 No Build I-495 AM Peak Period Average Densities – Route 123 through Old Dominion Drive

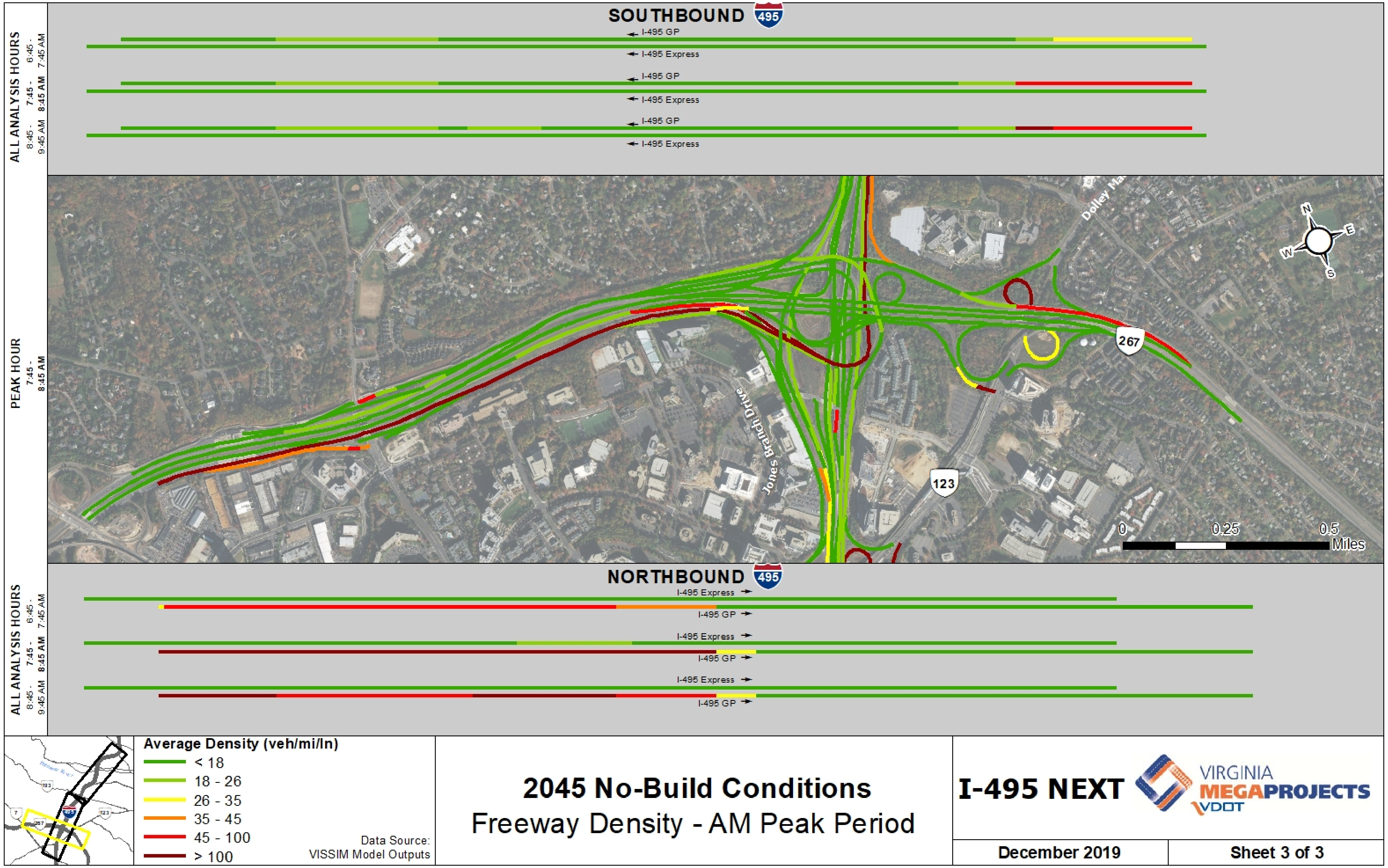


Exhibit 7-25c. 2045 No Build Route 267 AM Peak Period Average Densities

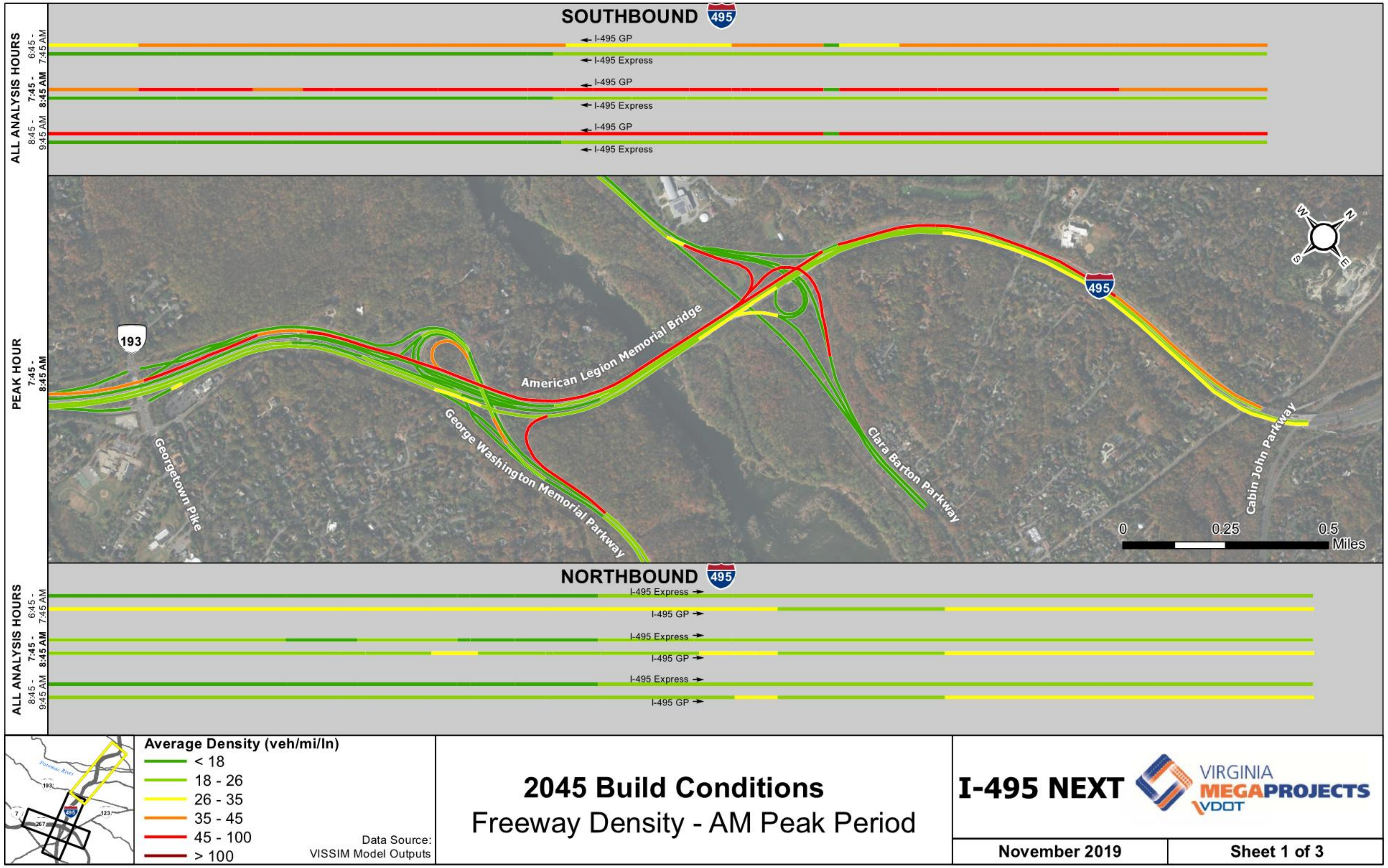


Exhibit 7-26a. 2045 Build I-495 AM Peak Period Average Densities – Georgetown Pike to Cabin John Parkway

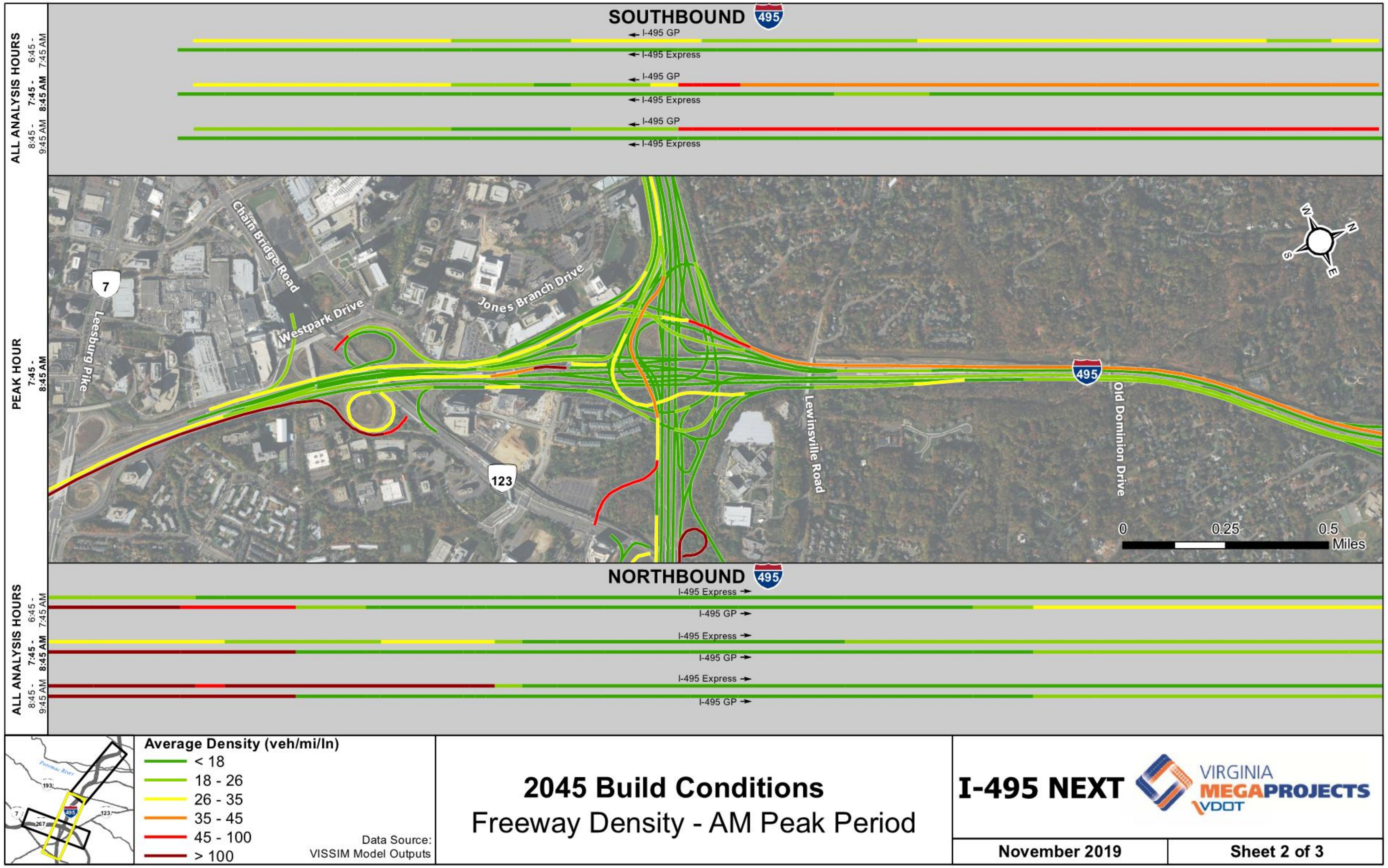


Exhibit 7-26b. 2045 Build I-495 AM Peak Period Average Densities – Route 123 through Old Dominion Drive

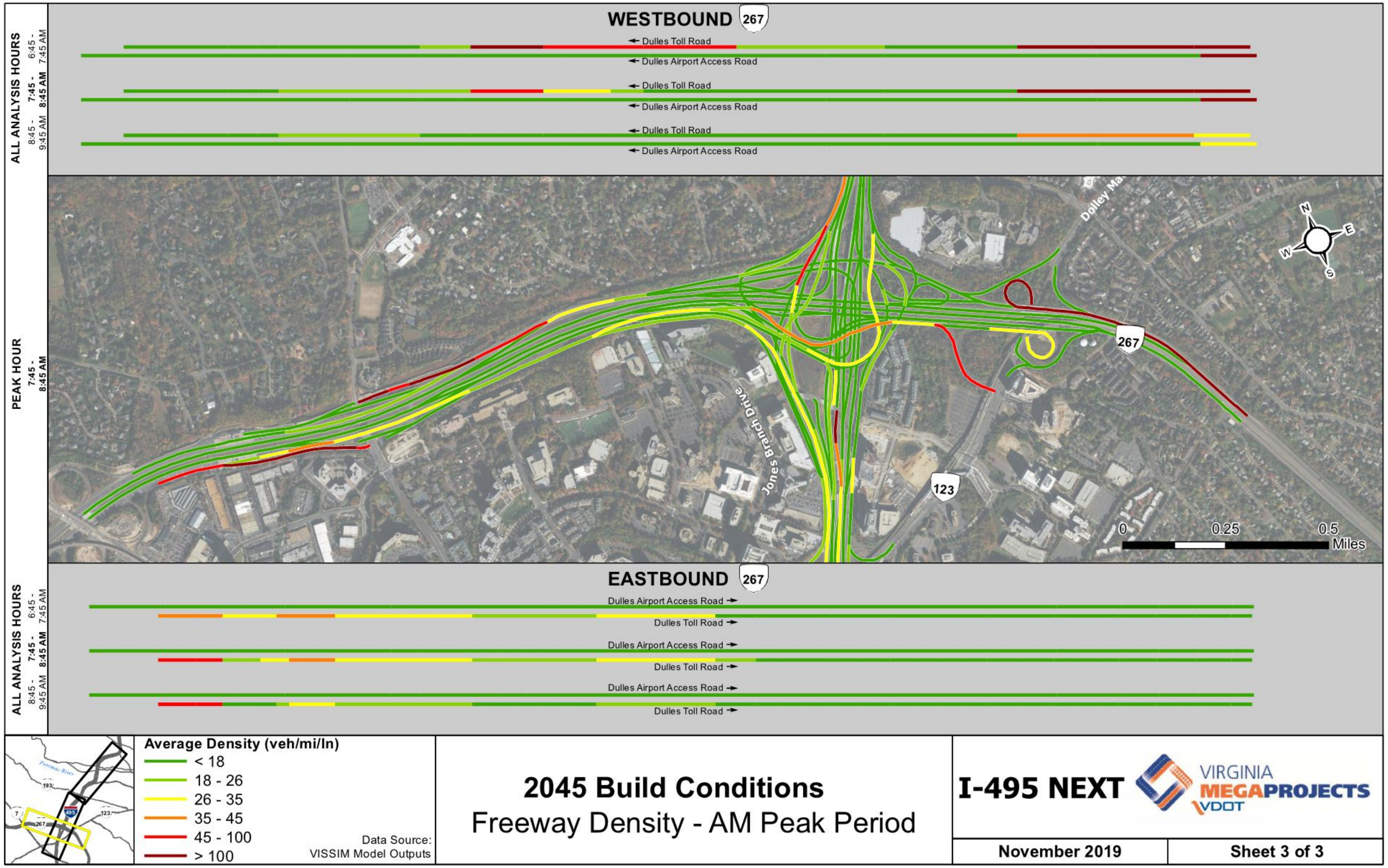


Exhibit 7-26c. 2045 Build Route 267 AM Peak Period Average Densities

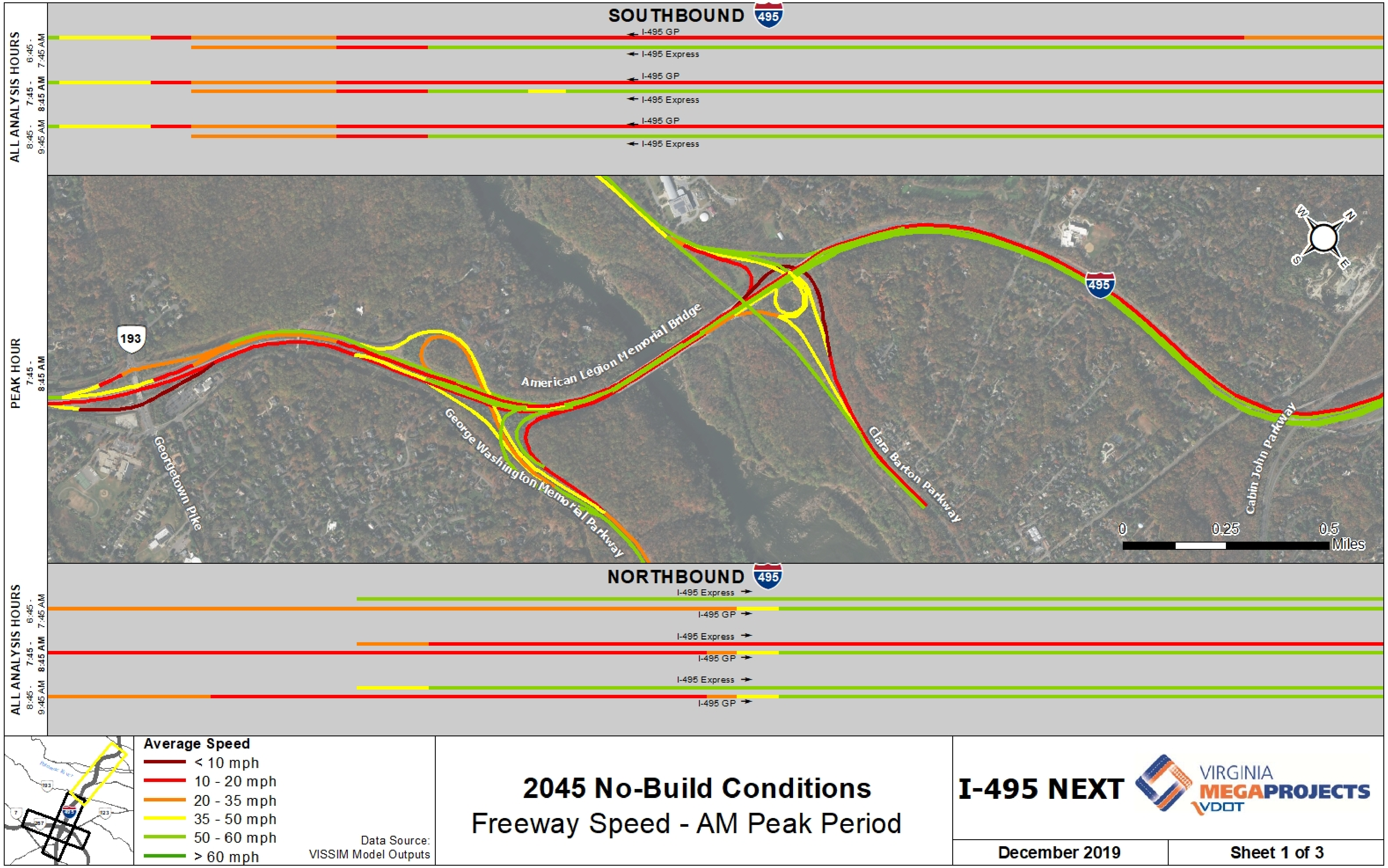


Exhibit 7-27a. 2045 No Build I-495 AM Peak Period Average Speeds – Georgetown Pike to Cabin John Parkway

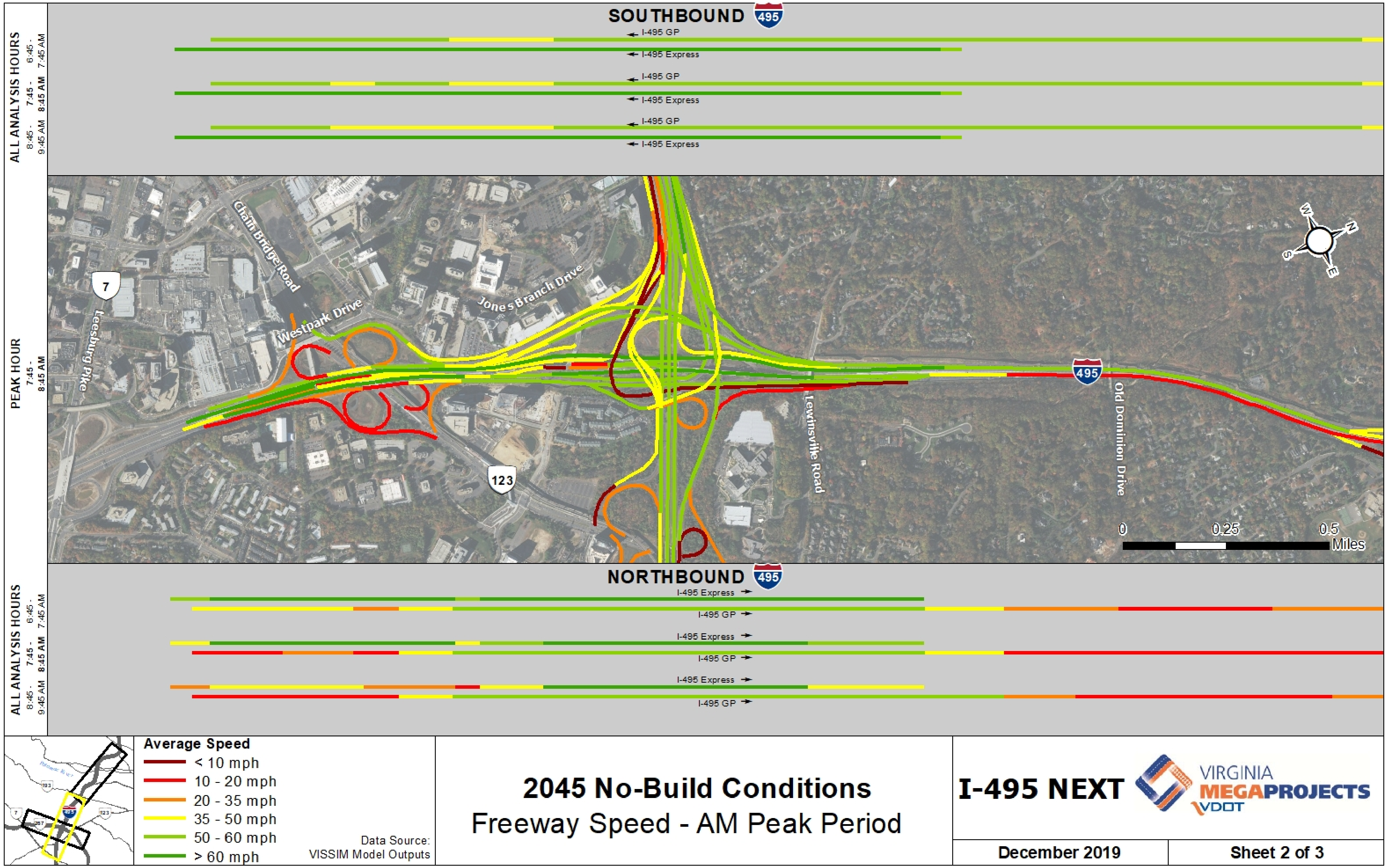


Exhibit 7-27b. 2045 No Build I-495 AM Peak Period Average Speeds – Route 123 through Old Dominion Drive

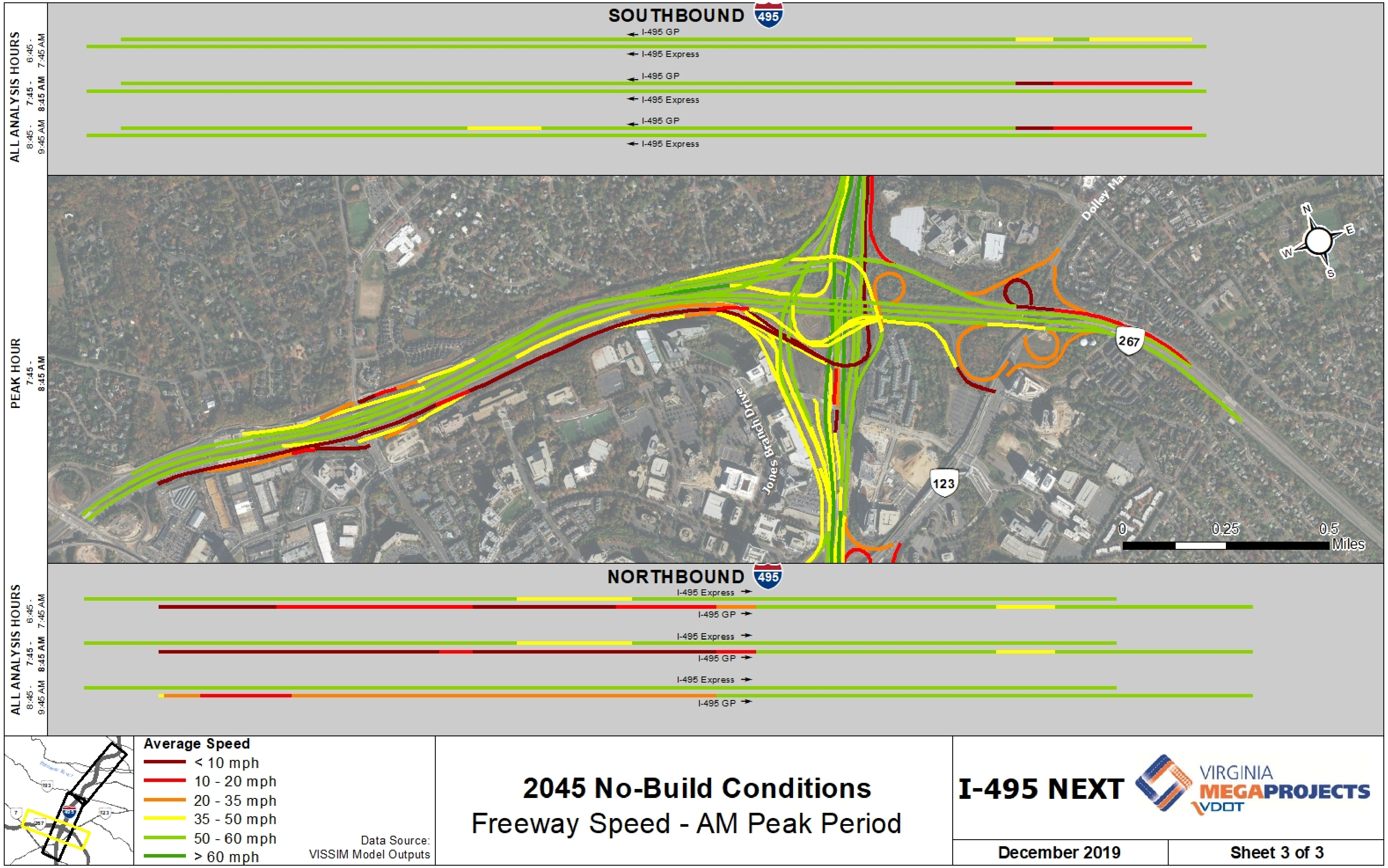


Exhibit 7-27c. 2045 No Build Route 267 AM Peak Period Average Speeds

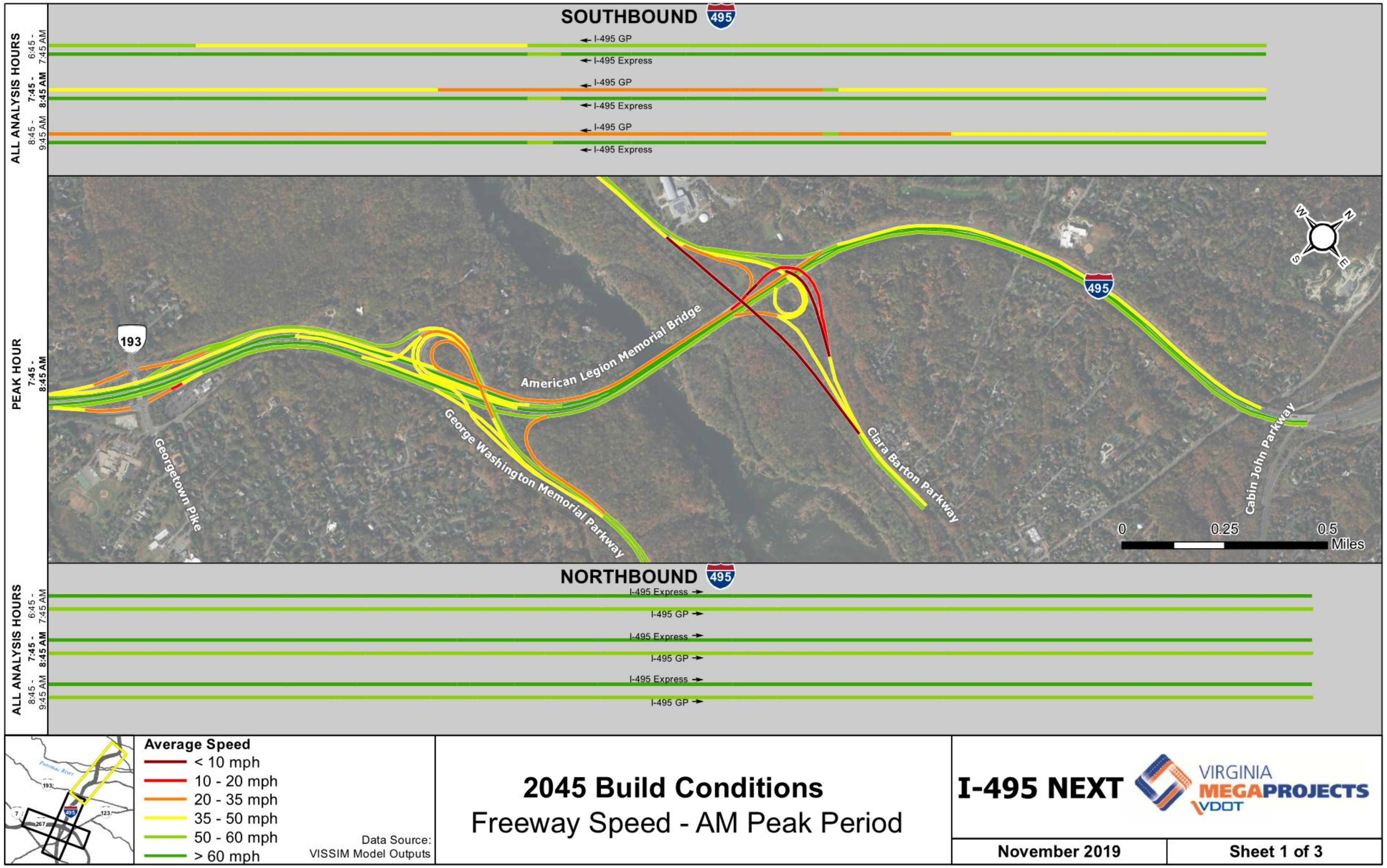


Exhibit 7-28a. 2045 Build I-495 AM Peak Period Average Speeds – Georgetown Pike to Cabin John Parkway

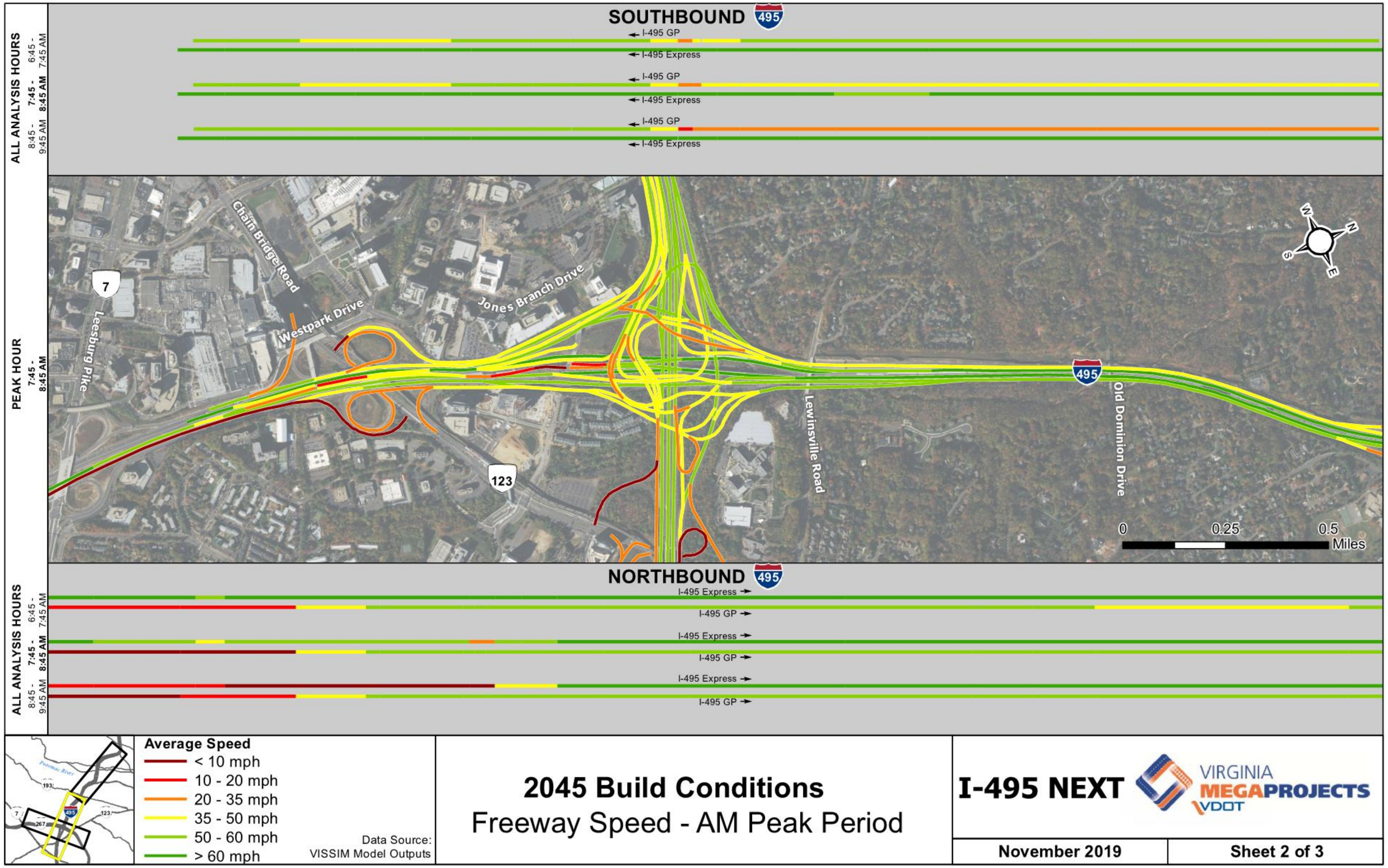


Exhibit 7-28b. 2045 Build I-495 AM Peak Period Average Speeds – Route 123 through Old Dominion Drive

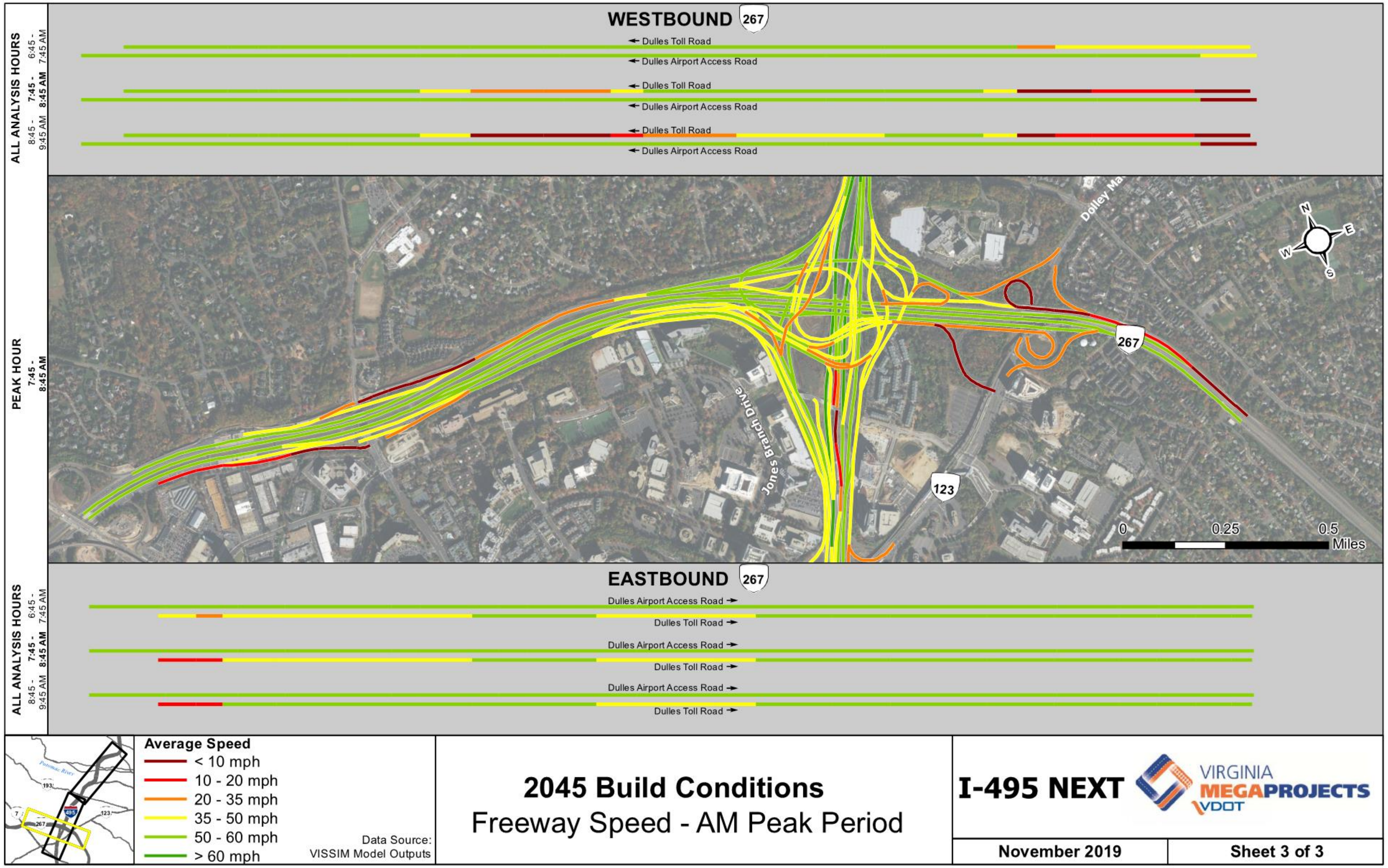


Exhibit 7-28c. 2045 Build Route 267 AM Peak Period Average Speeds

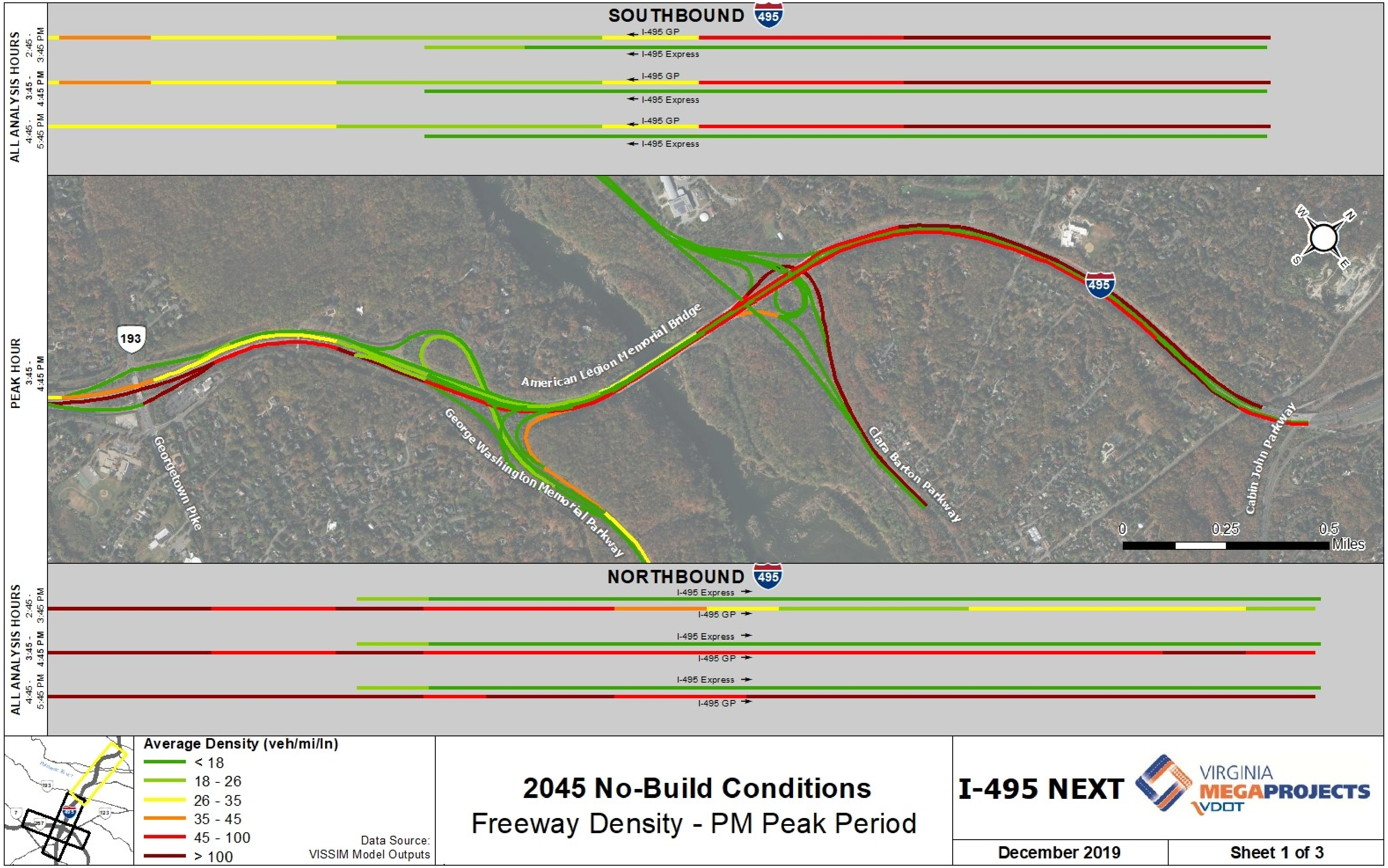


Exhibit 7-29a. 2045 No Build I-495 PM Peak Period Average Densities – Georgetown Pike to Cabin John Parkway

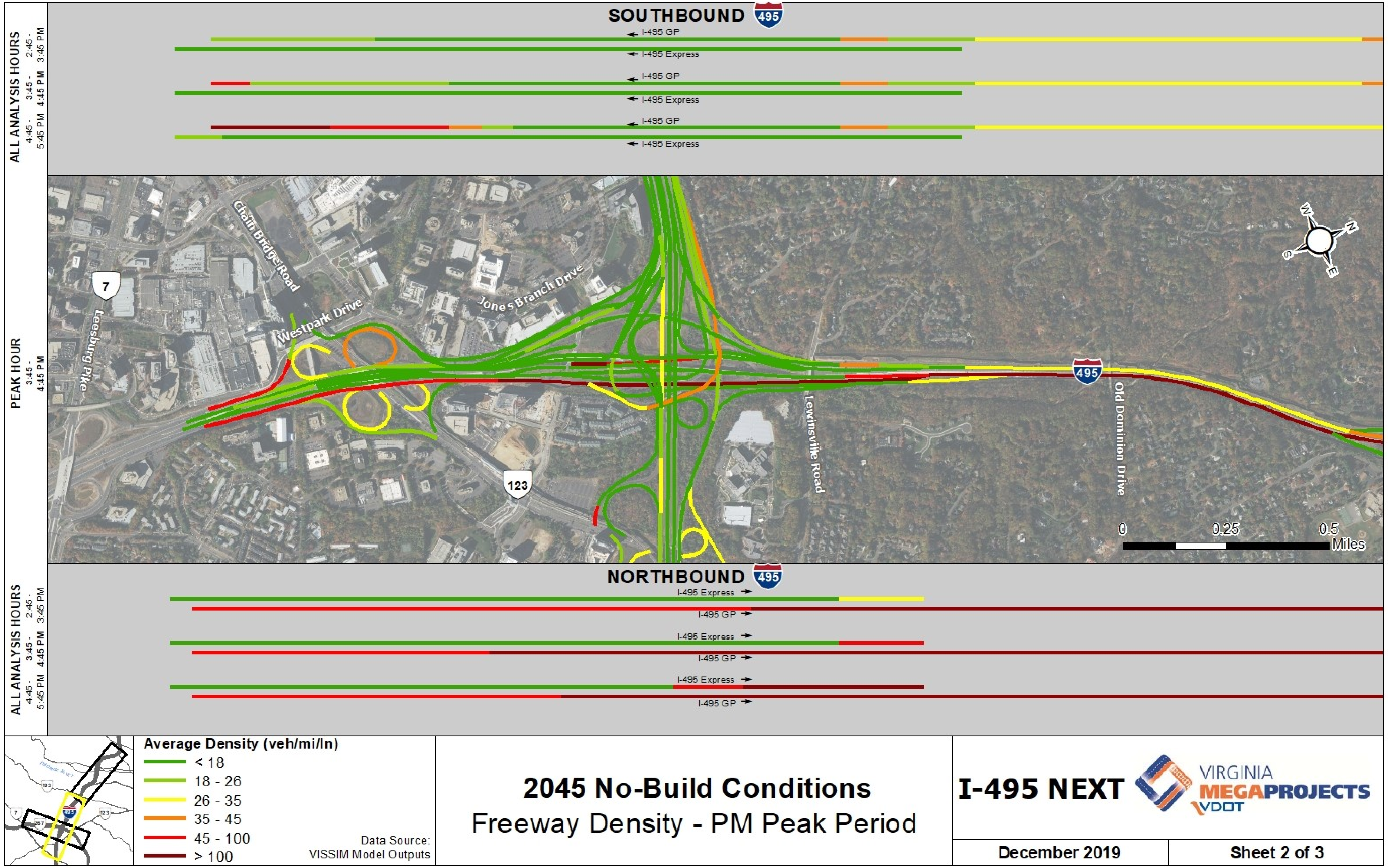


Exhibit 7-29b. 2045 No Build I-495 PM Peak Period Average Densities – Route 123 through Old Dominion Drive

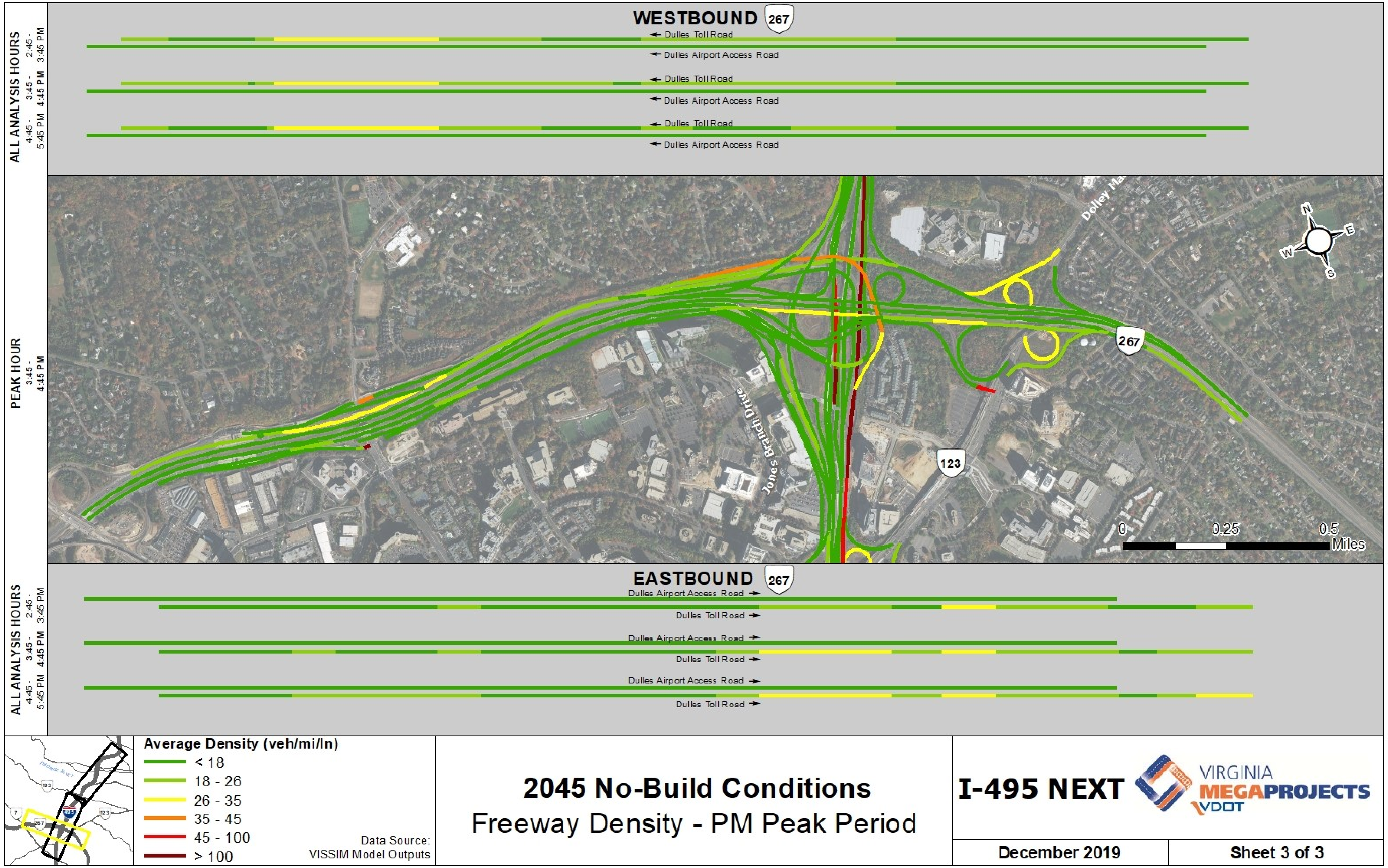


Exhibit 7-29c. 2045 No Build Route 267 PM Peak Period Average Densities

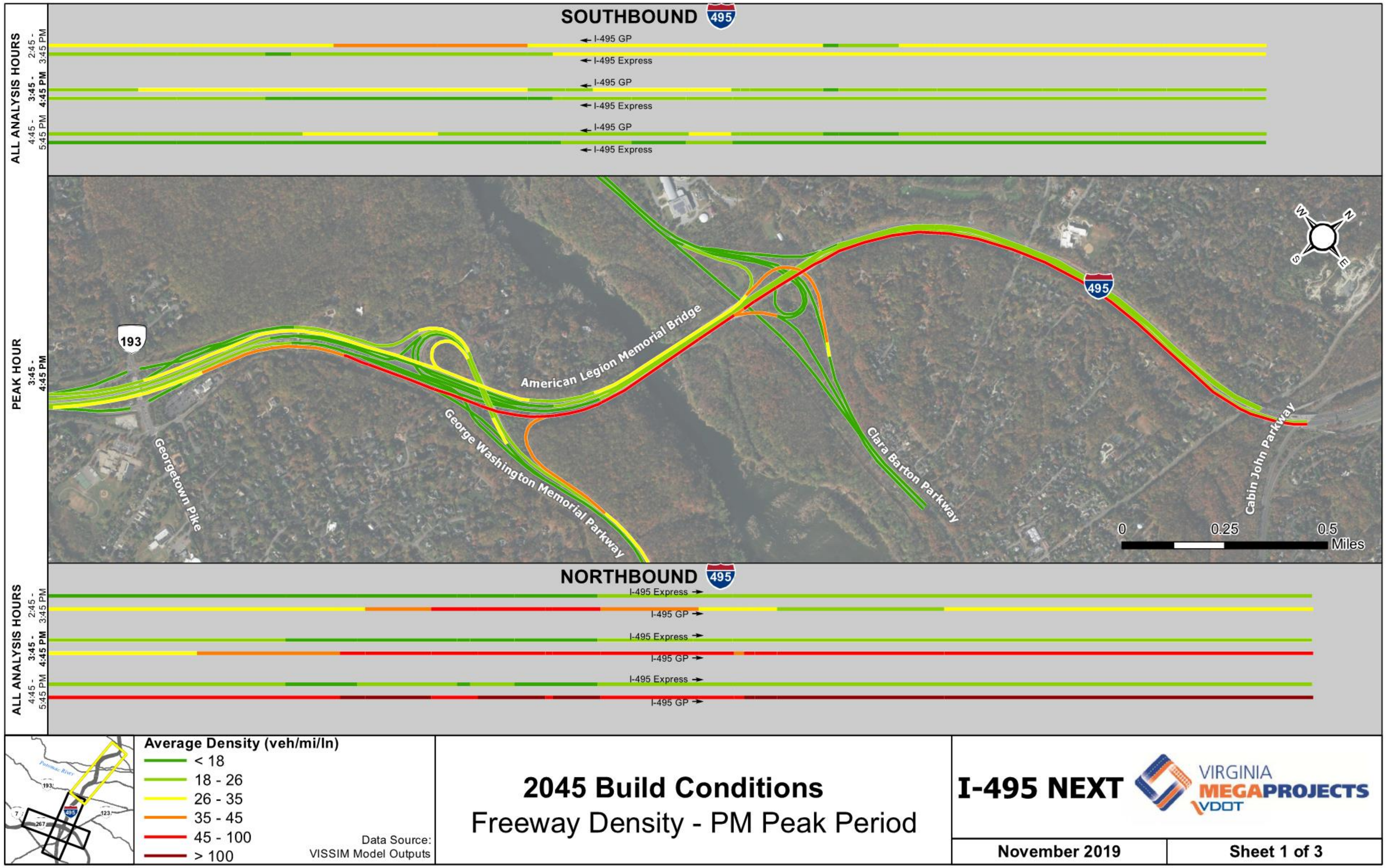


Exhibit 7-30a. 2045 Build I-495 PM Peak Period Average Densities – Georgetown Pike to Cabin John Parkway

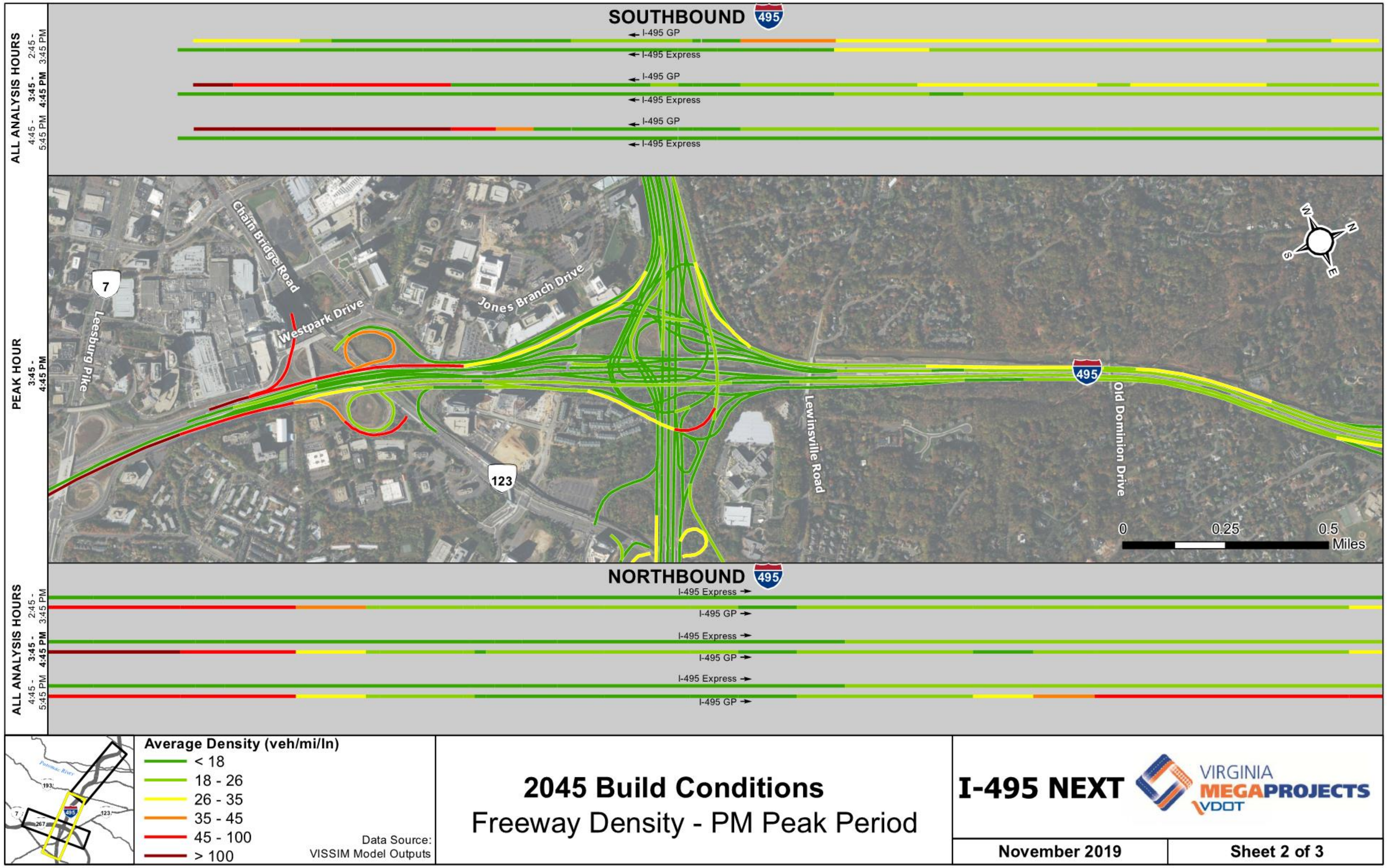


Exhibit 7-30b. 2045 Build I-495 PM Peak Period Average Densities – Route 123 through Old Dominion Drive

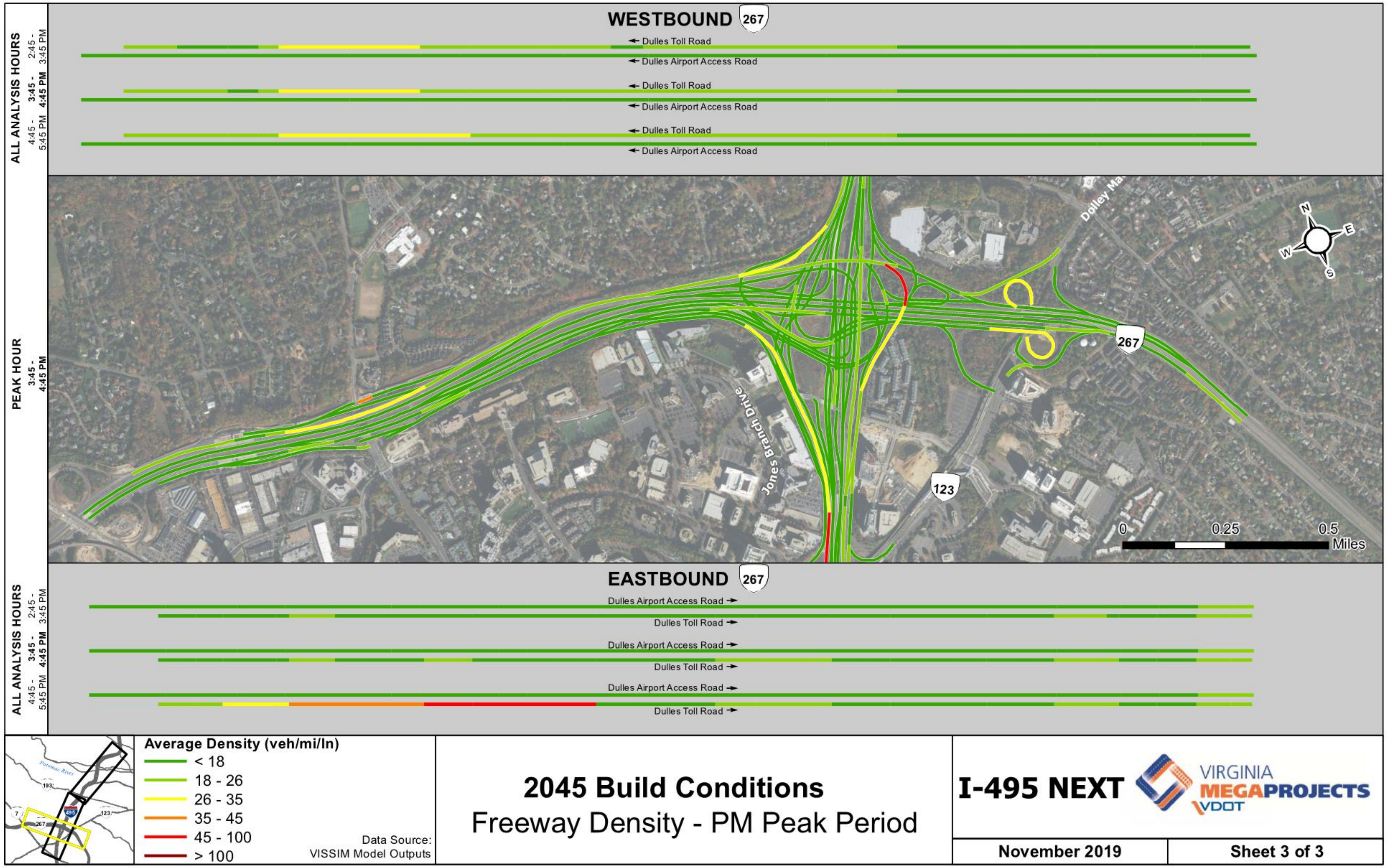


Exhibit 7-30c. 2045 Build Route 267 PM Peak Period Average Densities

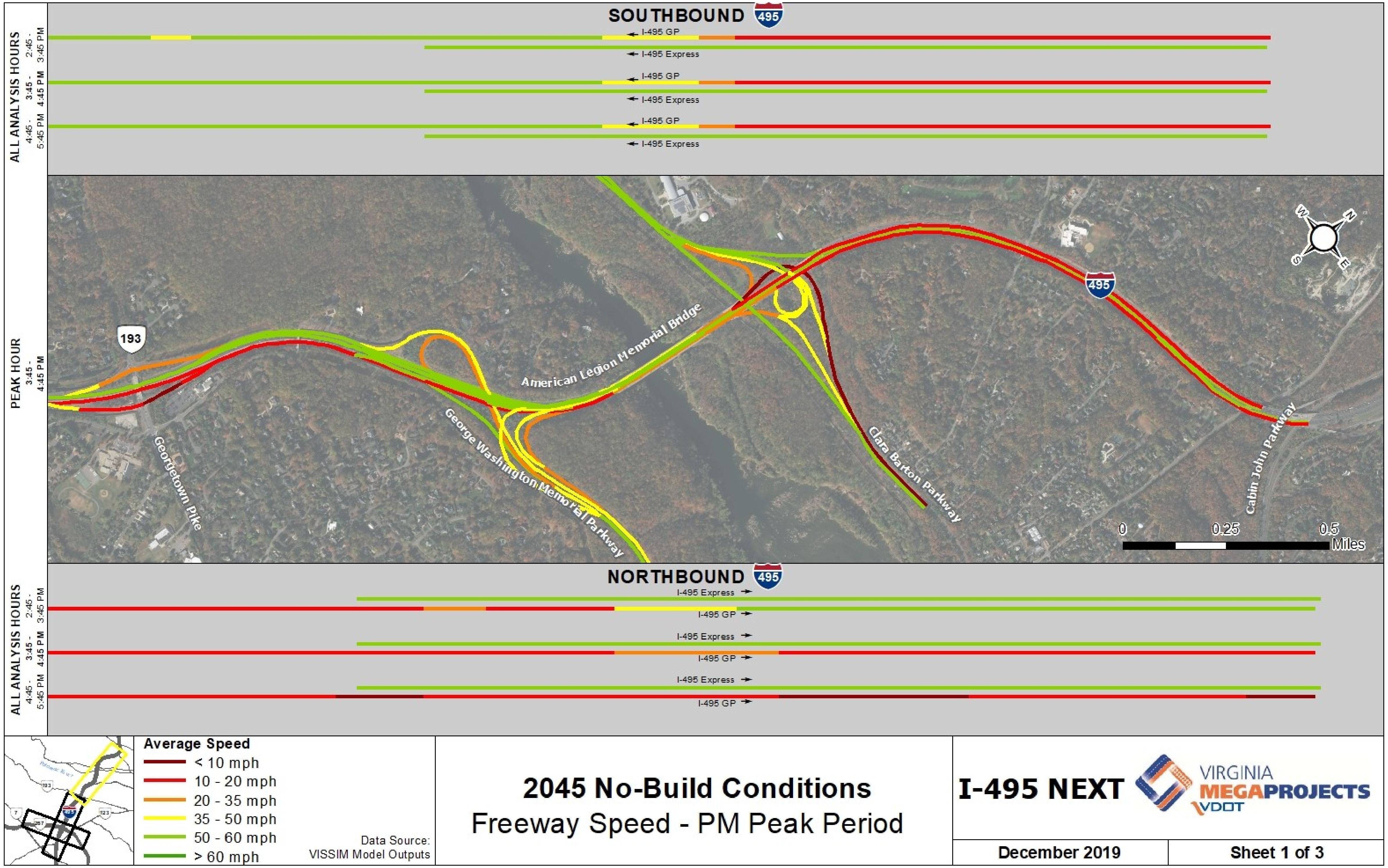


Exhibit 7-31a. 2045 No Build I-495 PM Peak Period Average Speeds – Georgetown Pike to Cabin John Parkway

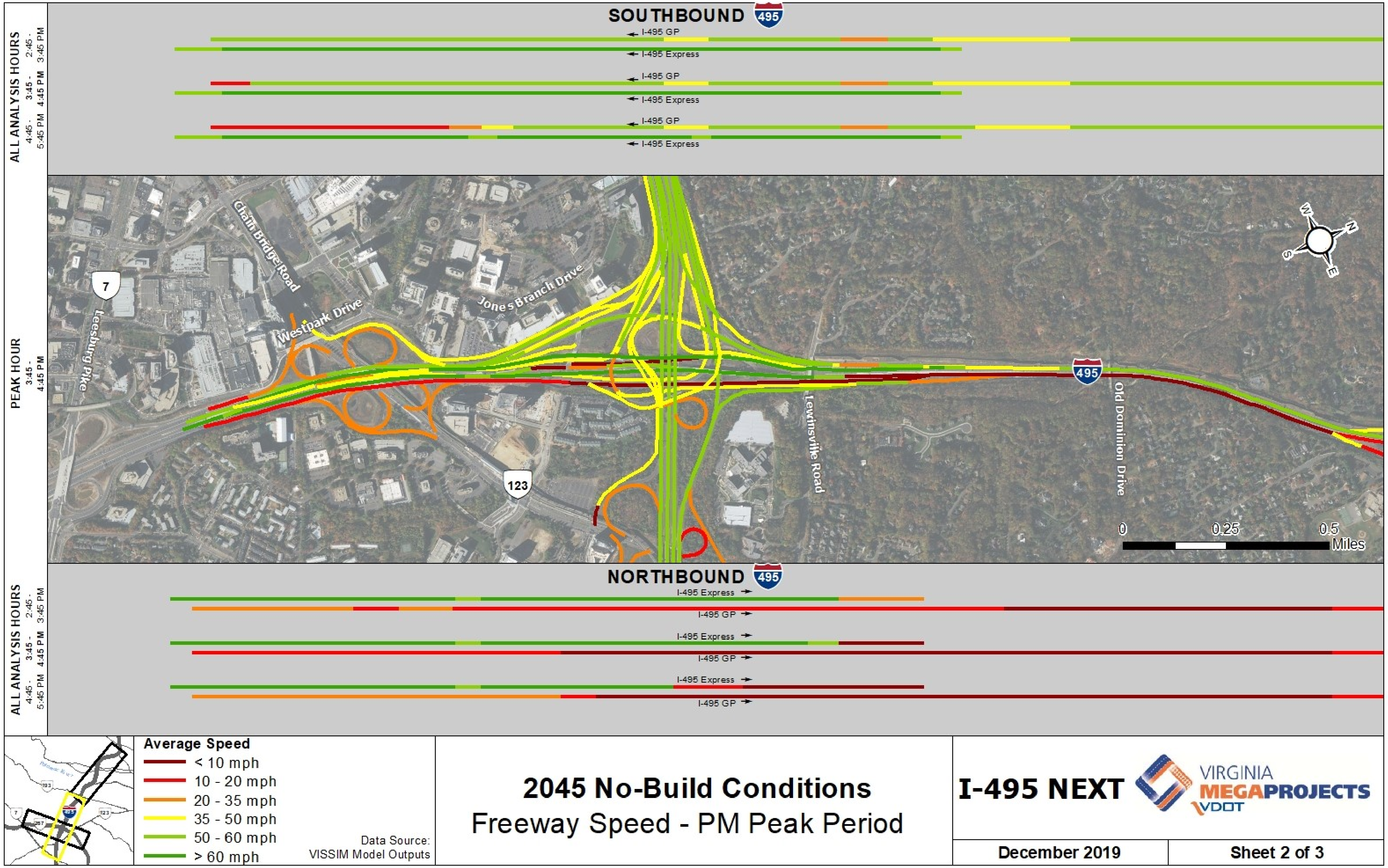


Exhibit 7-31b. 2045 No Build I-495 PM Peak Period Average Speeds – Route 123 through Old Dominion Drive

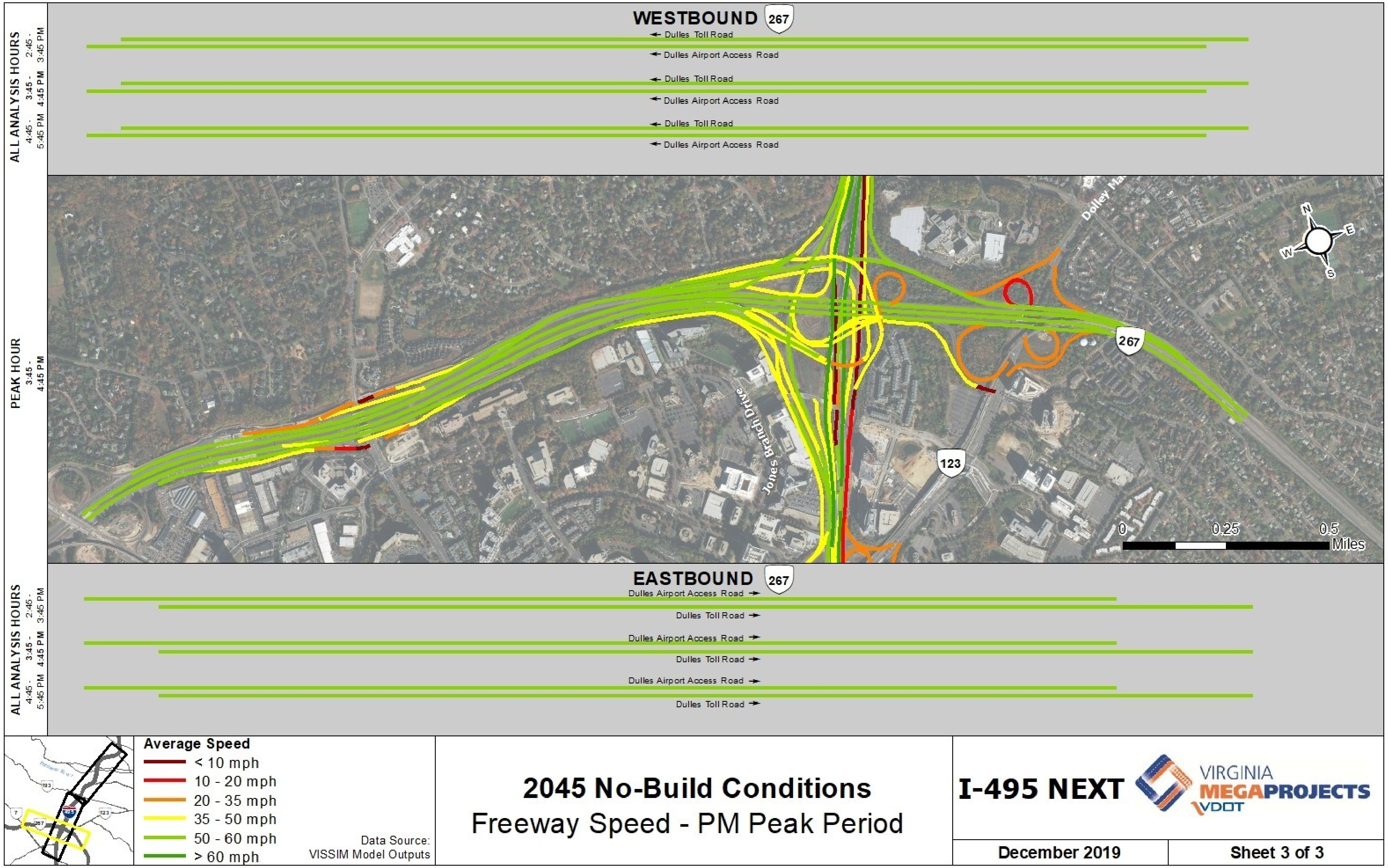


Exhibit 7-31c. 2045 No Build Route 267 PM Peak Period Average Speeds

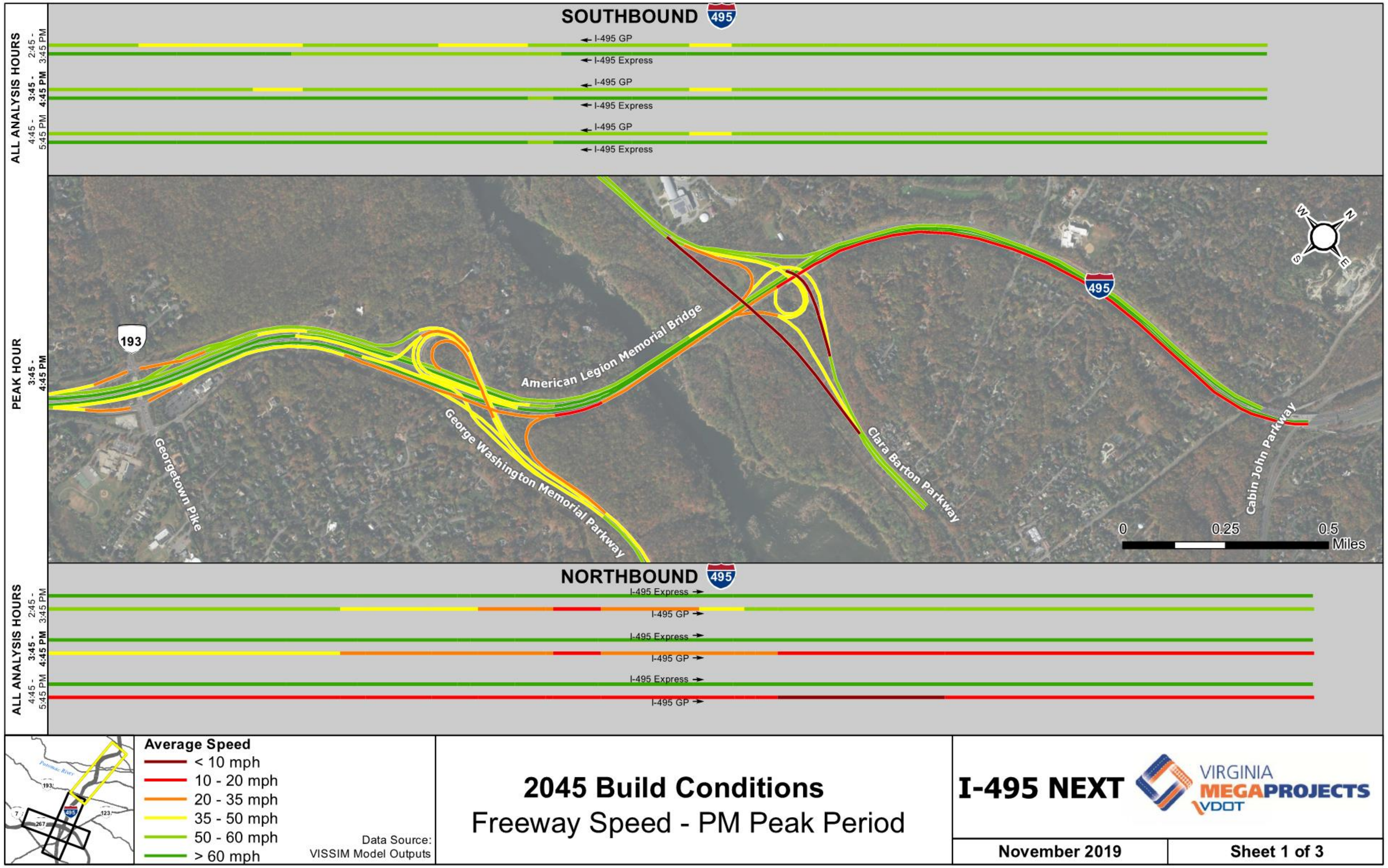


Exhibit 7-32a. 2045 Build I-495 PM Peak Period Average Speeds – Georgetown Pike to Cabin John Parkway

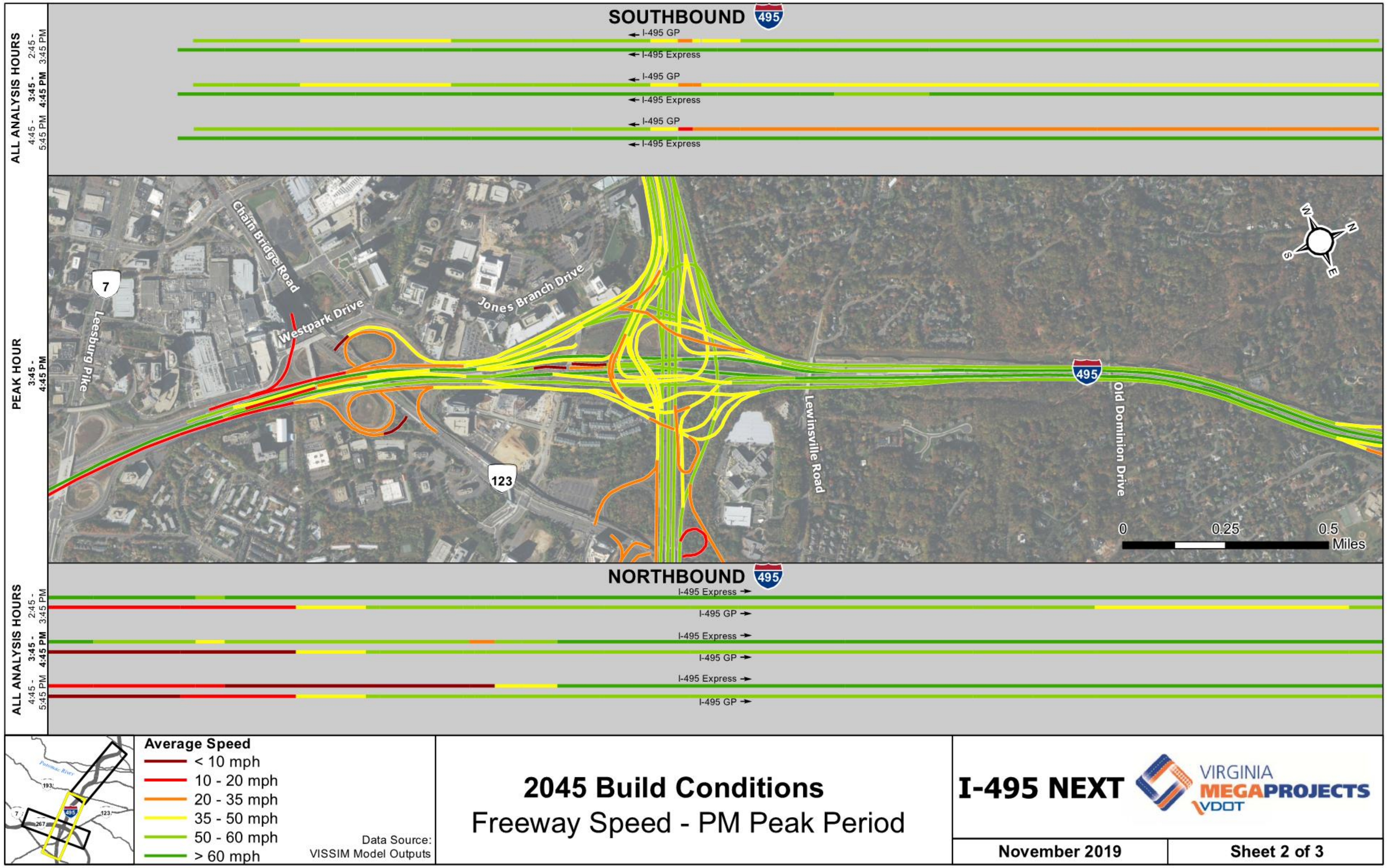


Exhibit 7-32b. 2045 Build I-495 PM Peak Period Average Speeds – Route 123 through Old Dominion Drive

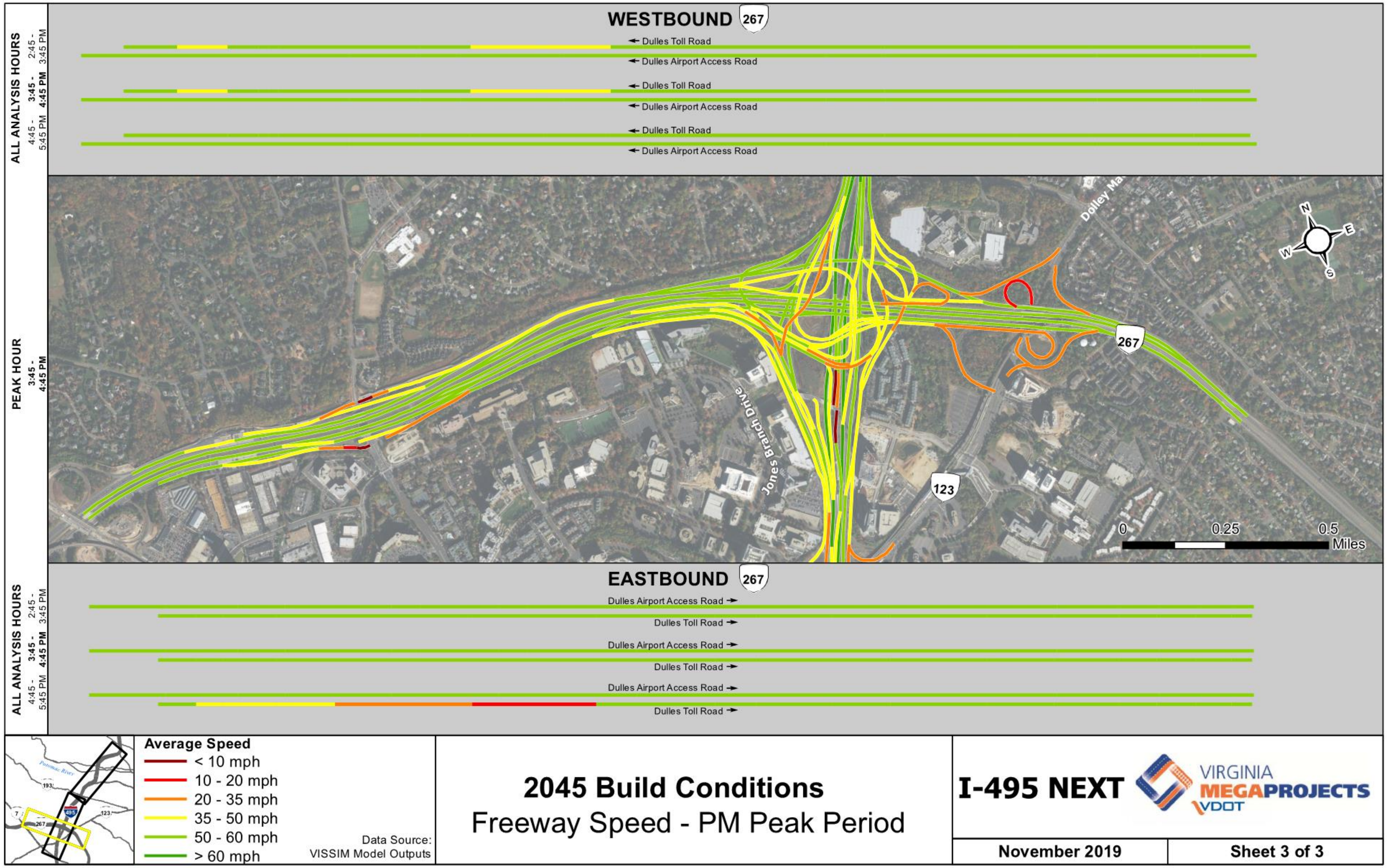


Exhibit 7-32c. 2045 Build Route 267 PM Peak Period Average Speeds

CHAPTER 8.0 EXISTING AND FUTURE SAFETY ANALYSIS

8.1 INTRODUCTION AND OVERVIEW

The project Traffic Operations Study Area is regularly characterized by heavy congestion, most especially in the area of the GWMP interchange and the ALMB on the northern portion of the corridor and the Route 267 interchange on the southern end. This congestion, most prevalent during the morning and evening peak periods, creates strong potential for crashes, especially multi-vehicle crashes such as rear end and sideswipe collisions. This congestion also regularly causes drivers to seek alternate routes on surrounding arterials, collectors, and residential streets in an attempt to reduce or avoid delay. This re-routing creates increased safety risks on those diversion routes that can also have negative safety impacts.

This chapter summarizes the following assessments of Traffic Operations Study Area safety:

- Existing conditions – crash frequencies (expressed in number of crashes per year) and crash rates (expressed in number of crashes per 100 million VMT for freeway segments or per million entering vehicles for intersections) based on historic crash data for the corridor
- Future No Build and Build conditions – predicted future crash probabilities, expressed in crash frequencies and crash rates, using HSM-based tools including:
    - ISATe for GP freeway segments and interchanges
    - Project-specific SPFs for Express Lanes segments
    - HSM spreadsheets for arterial intersections

The methodology applied for the existing and future safety analyses is documented in **Chapter 2**.

8.2 EXISTING CONDITIONS CRASH HISTORY AND SAFETY ANALYSIS

This section provides a summary of existing conditions total crashes along I-495, crash frequencies and rates for individual freeway sections of I-495, and trends for crash severity and type for individual freeway sections of I-495. It also contains a summary of crash history data for the Route 267 and GWMP corridors as well as arterial intersections. A detailed review of crash history throughout the entire Traffic Operations Study Area, including point maps of individual crash locations, is provided in the *Existing Conditions Technical Report* (VDOT, 2019a).

8.2.1 I-495 Corridor Crash History Summary

Existing Conditions Crash History Totals

Over the five-year period analysis period, there were a total of 1,736 crashes reported on the 4.6-mile section of I-495 (northbound and southbound) between the Route 7 interchange and the ALMB over the Potomac River. This section of I-495 includes the I-495 GP lanes, approximately 2.85 miles of the I-495 Express Lanes between Route 7 and the current northern terminus north of the Dulles Toll Road interchange, and approximately 22 ramps to and from I-495. During this five-year period, there were no fatal crashes, 455 injury crashes, and 1,281 property damage only (PDO) crashes reported in the freeway corridor.

Of the 1,736 of crashes reported within the study area between 2013 and 2017, the predominant crash type along the I-495 corridor is Rear-End-type crashes. Approximately 59 percent of all crashes were Rear-End collisions, compared to 22 percent Side-Swipe (same direction) crashes, 8 percent Angle crashes, 8 percent Run-Off-Road crashes, and 3 percent Other crashes.

Existing Conditions Crash Frequencies by Freeway Facility

The following summarizes crash frequencies along the I-495 corridor in terms of total crashes per mile per year.

- Crash frequencies are much lower in the Express Lanes than the GP lanes, with reported crash frequencies in the northbound direction ranging between 0 and 1.8 crashes per year per quarter-mile section and in the southbound direction ranging from 0 to 1.6 crashes per year per quarter-mile section.
- In the northbound GP lanes, nearly all segments analyzed average at least 10 crashes per year per quarter-mile section. The highest crash frequencies were near the Route 193 interchange, where one quarter-mile segment experiences more than 17 crashes per year, and near the merge from the GWMP on-ramp, which experiences nearly 20 crashes per year in a single quarter-mile segment.
- In the southbound GP lanes, crash frequencies are lower than in the northbound direction, likely due to less severe congestion experienced. Crash frequencies range from approximately 3 to 12 crashes per year per quarter-mile segment, with the highest crash rates near the southbound off-ramps to Route 267 (9.8 crashes per year) and near the southbound off-ramps to Route 123 (12.0 crashes per year).
- The southbound I-495 GP lanes within the study area included only two quarter-mile sections that had 9 or more crashes per year. By comparison, the northbound I-495 GP lanes within the study area had 15 quarter-mile sections that had 9 or more crashes per year. There were 594 reported crashes on the southbound GP lanes within the study area and 1,106 reported crashes on the northbound GP lanes.

Existing Conditions Crash Rates by Freeway Facility

The following summarizes crash rates along the I-495 corridor in terms of total crashes per 100 million vehicle miles traveled (VMT). Crash rates consider the influence of vehicular flows on crash occurrence and can be considered a normalization accounting for traffic volumes. **Figure 8-1** shows the crash rates for the northbound and southbound Express Lanes, while **Figure 8-2** provides the crash rates for the northbound and southbound GP lanes.

- In the northbound Express Lanes, one section exceeds a crash rate of 150 crashes per 100 million VMT; in the southbound Express Lanes, six sections exceed this rate. Within the Traffic Operations Study Area, there are more merges, diverges and weaving areas associated with the southbound Express Lanes compared to the northbound Express Lanes. Notably, there is one section of the southbound Express Lanes where two ramps merge in close proximity followed by a downstream off-ramp. This section had the highest crash rate of all the Express Lanes sections. The southbound Express Lanes also have more frequent changes in horizontal and vertical alignment, in addition to more access points.
- In the northbound GP lanes, there were eight sections that had reported crash rates exceeding 150 crashes per 100 million VMT. One northbound GP section had a crash rate of over 500 crashes per 100 million VMT: the section including the left-hand exit ramp to westbound Route 267 and the merge of the on-ramp from eastbound Route 267. Frequently queueing from downstream in the northbound GP lanes extends into this area. Consequently, the geometric conditions, coupled with the heavy traffic flows (for both of these ramp movements) and congestion all contribute to this location's very high crash rate.

- In the southbound GP lanes, there were no sections that have reported crash rates exceeding 150 crashes per million VMT.

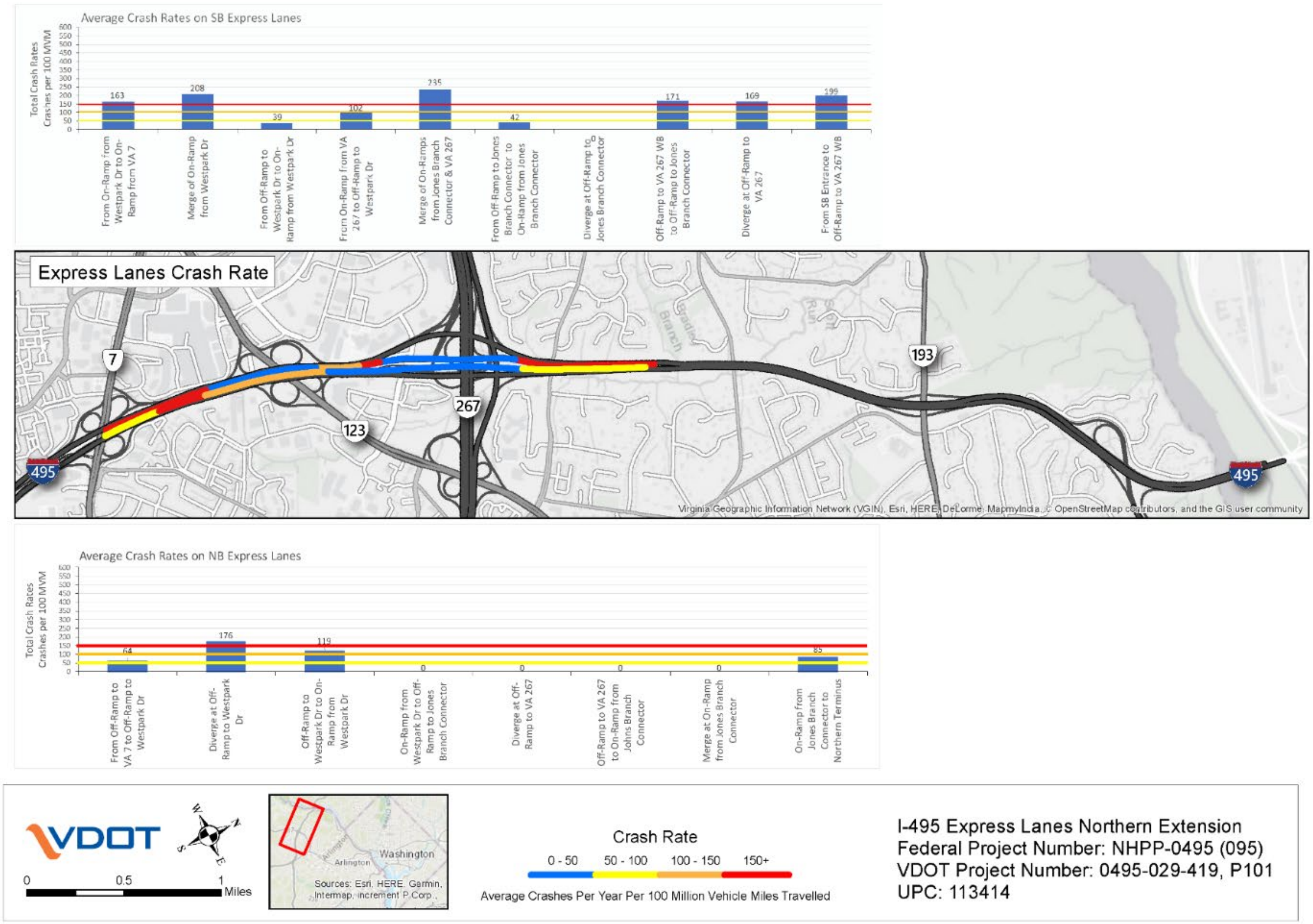


Figure 8-1. Crash Rates per Million VMT for I-495 Northbound and Southbound Express Lanes (2013-2017)

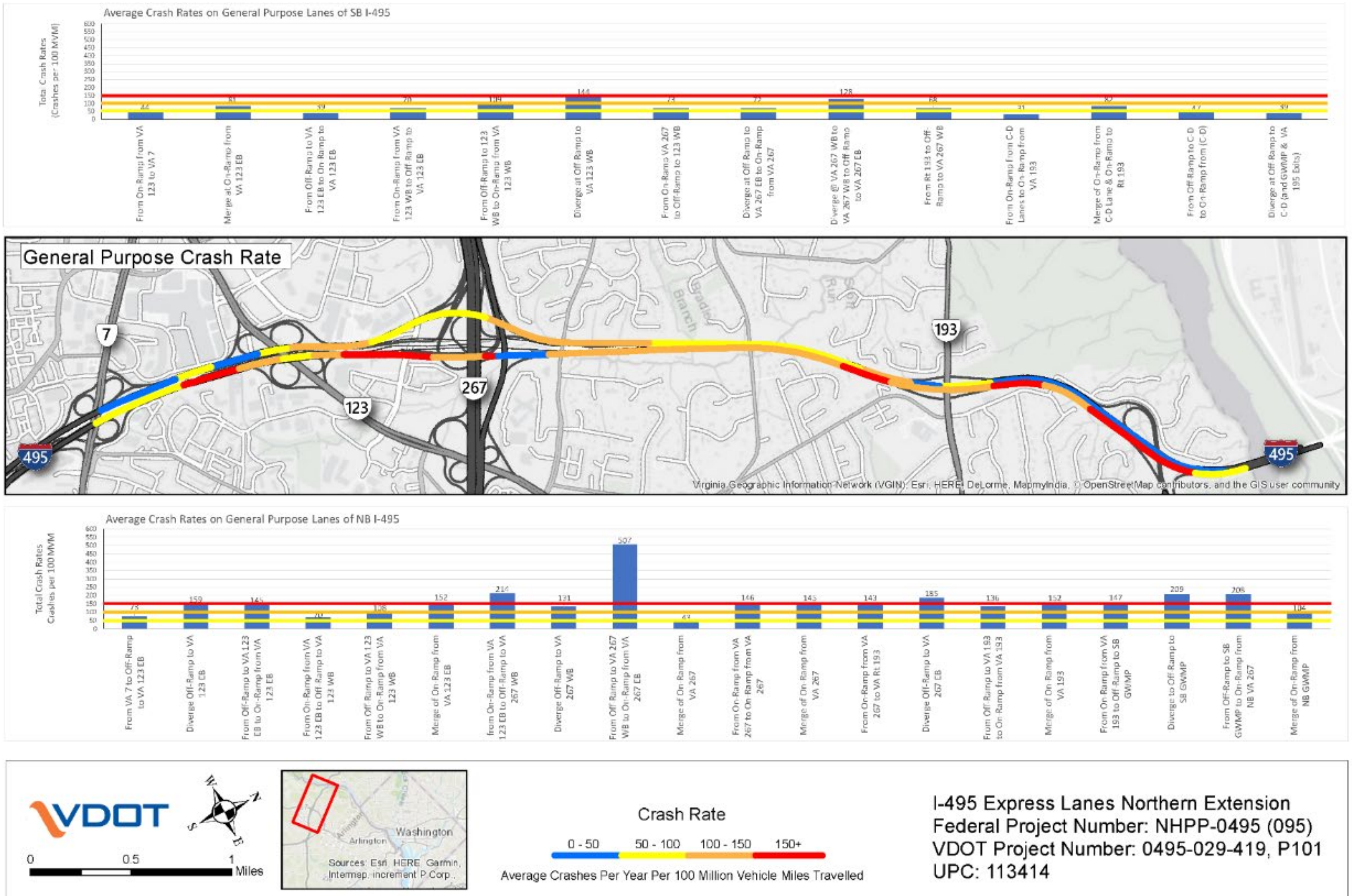


Figure 8-2. Crash Rates per Million VMT for I-495 Northbound and Southbound GP Lanes (2013-2017)

Summary of I-495 Crash History and Safety Issues

Northbound I-495 GP Lanes

The crash rate for northbound I-495 from Route 7 to the ALMB is worse than the southbound crash rate between the same termini. Moreover, the crash rate for this northbound section is approximately 100 percent higher than the statewide crash rate. The injury crash rate is 25 percent higher than the statewide injury crash rate. There were no fatalities reported. The northbound section includes the current northern terminus of the I-495 Express Lanes, 5 merges, 4 diverges, and a dynamic shoulder use lane. Over 70 percent of the crashes in all basic, diverge, and merge segments are PDO crashes in the northbound direction. The predominant type of crashes in all basic, diverge, and merge segments are Rear-End and Same-Direction Side-Swipe crashes. Traffic congestion in the study area influences the safety conditions. Rear-End and Side-Swipe crashes tend to typically be prominent in congested corridors.

The following three segments of I-495 experience the highest number of Rear-End crashes:

- Northbound I-495 from Route 267 to Route 193, with 145 crashes;
- Northbound I-495 from the off-ramp to Route 193 to the on-ramp from Route 193, with 67 crashes
- Northbound I-495 from the off-ramp to GWMP to the on-ramp from GWMP, with 60 crashes.

Each of these segments is located on northbound I-495 from the Route 267 interchange to near the GWMP where the northbound part-time shoulder lane currently terminates. A dynamic shoulder running lane was added in 2015, with a majority of the construction occurring from 2014 to 2015. This shoulder use lane drop contributes to increased turbulence in the traffic stream, creating the higher potential for Rear-End crashes to occur due to the stop-and-go nature of traffic operations in this area. This is further exacerbated by the long upgrade section north of the ALMB, which continues to the River Road interchange.

Northbound I-495 Express Lanes

Compared to the statewide average crash rates from 2013 through 2017 for interstate facilities within Virginia, the crash rate for the northbound Express Lanes section of I-495, exclusive of the existing northern terminus and the transition section to the GP lanes, was approximately 17 percent lower. The injury crash rate is 71 percent lower than the statewide injury crash rate. There were no fatalities reported. This can be attributed to the reduced congestion and improved LOS offered to commuters using the Express Lanes.

Southbound I-495 GP Lanes

Compared with the statewide average crash rates from 2013 through 2017 for interstate facilities within Virginia, the southbound section of I-495 between the ALMB and Route 7 exhibited an approximately 11 percent lower crash rate. The injury crash rate is 42 percent lower than the statewide injury crash rate. Over the five-year period, there were no fatal crashes reported. The southbound section includes the separated C-D roadway that provides access to the GWMP, which is operated and maintained by the NPS, and Route 193. The predominant type of crashes in all basic, diverge, and merge segments are Rear-End and Same-Direction Side-Swipe crashes. It is observed that diverge segments have an almost equal number of Rear-End and Side-Swipe crashes. This implies that in addition to the congestion, the merging and lane-changing maneuvers executed influence traffic safety in the study area.

Southbound I-495 Express Lanes

Compared with the statewide average crash rates from 2013 through 2017 for interstate facilities within Virginia, the southbound Express Lanes section of I-495 exhibited an approximately 27 percent lower crash rate. The injury crash rate is 55 percent lower than the statewide injury crash rate. There were no fatalities reported. This can be attributed to the reduced congestion and improved LOS offered to commuters using the Express Lanes.

8.2.2 Route 267 Crash History Summary

Further analysis was conducted on the section of the Dulles Toll Road/Dulles Connector Road (DTR/DCR) for the 2.5-mile mainline segment in the area of the I-495 Interchange (Exit 18). The analysis was broken up into the DTR/DCR mainline and Exit 18 off-ramps to I-495. The analysis included a six-year period from 2013-2018 which are the most complete years available at the time of analysis. During this period, there were 181 reported crashes on the DTR/DCR mainline, 61 crashes reported on the eastbound ramps to I-495, and 10 crashes reported on the westbound off-ramp to I-495 northbound.

From the analysis, five "Hot Spots", shown in **Figure 8-3**, were identified which in total account for 44 percent of all crashes along the DTR/DCR study area:

- Hot Spot 1 coincides with the westbound approach to the mainline toll plaza. Rear-End and Side-Swipe crashes combined comprise 85 percent of overall crashes at this location.
- Hot Spot 2 coincides with the westbound weave area between the I-495 and Spring Hill Road interchanges. Traffic is entering from the right from the heavy movement from I-495 southbound and is exiting to the right to access Spring Hill Road. Additionally, traffic is exiting to the left to access the Dulles Airport Access Road, and additional traffic is merging to the left to access the higher-speed EZ-Pass lanes at the downstream toll plaza. Notably, Rear-End and Side-Swipe crashes comprise 87 percent of overall crashes at this location.
- Hot Spot 3 coincides with the diverge area of the eastbound DTR and Exit 18 ramps to I-495, which represents a major decision point for drivers. Rear-End and Side-Swipe collisions are common, especially during congested periods. Approximately 91 percent of the collisions in this location are Rear-End and Side-Swipe type collisions.
- Hot Spot 4 coincides the eastbound weave area between the merge from southbound I-495 to eastbound DTR and the diverge to Exit 19 (Route 123). Exit 19 frequently sees significant congestion during peak periods due to spillback from the heavy loop ramp to Route 123 northbound. Rear-End and Side-Swipe type collisions comprise 79 percent of total crashes.
- Hot Spot 5 is just downstream from Hot Spot 3 and coincides with the diverge area of the Exit 18 ramps where drivers must properly lane position for the exit onto either northbound or southbound I-495. It has a similar pattern of Rear-End and Side-Swipe collisions; however, it does have additional presence of Fixed Object – Off Road collisions associated with the horizontal curvature of the segment. Overall, 68 percent of the total crash activity is Read-End and Side-Swipe type collisions, while 28 percent of the crashes are Fixed Object - Off Road.

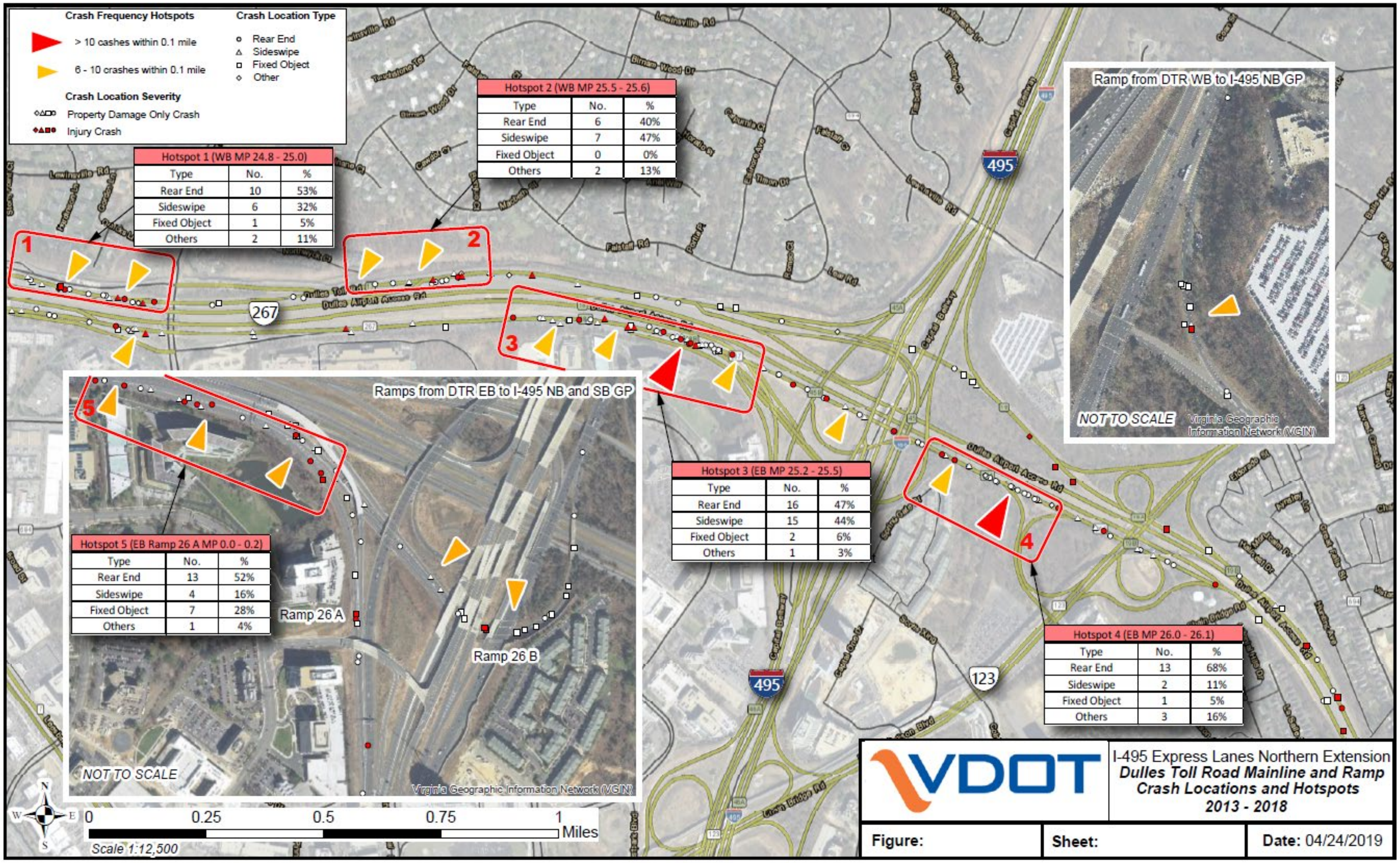


Figure 8-3. Detailed DTR/DCR Hot Spot Locations (2013-2018)

8.2.3 George Washington Memorial Parkway Crash History Summary

For thorough analysis of the entire project area, crash data was requested from the National Park Service (NPS) for the George Washington Memorial Parkway (GWMP) from the I-495 interchange to the Turkey Run Turnaround Ramps. Complete NPS data was provided for calendar years 2014-2017 which were the most recent full years available. NPS crash data include date/time, severity, and GPS locations of investigated incidents. Details, such as type of collision or diagrams of the crash, were not available from the data received. A summary of crashes by year and severity is shown in **Table 8-1**.

Table 8-1. Summary of NPS Crash Data for GWMP between I-495 and Turkey Run Interchange (2014-2017)

George Washington Mem Pkwy Crashes			
	PDO	Injury	Total
2014	76	5	81
2015	78	13	91
2016	70	5	75
2017	86	5	91

The data indicate the two primary areas of significant activity are the ramps to and from the Turkey Run turnaround and the gore area for westbound GWMP to the I-495 ramps. The crash frequency of the Turkey Run Ramps is likely due to limited geometrics and very short acceleration and deceleration lanes. The crash activity at the gore area may be due to late lane changes or unsafe diverging maneuvers by motorists.

Based on the number of crashes, calculations were performed to determine the segment crash rate. The rate was calculated on the segment from I-495 to the eastern most ramps for the Turkey Run Turnaround and utilized existing traffic volumes. The segment crash rate is 2.13 crashes per million VMT and 0.18 injuries per million VMT.

8.2.4 Arterial Intersections Crash History Summary

As traffic continues to encounter increasing levels of congestion, some drivers seek alternative routes to avoid the congestion. As a result, there are several intersections on the arterial streets within the vicinity of the interstate freeway that have experienced high annual crash frequencies and intersection crash rates. At several of these intersections, the intersection crash rate is significantly higher than the statewide intersection average crash rates for similar intersections. A total of 28 intersections were identified and assessed in terms of safety. A total of 1 fatal crash, 205 injury crashes, and 306 property damage only (PDO) crashes were reported over the five-year period at these 28 intersections. The average annual number of crashes per year per intersection varied from 1 to 16 intersection crashes per year. The associated intersection crash rates varied from 0.07 to 1.18 intersection crashes per million entering vehicles.

Additionally, the following existing conditions trends were observed along arterials:

- **Figure 8-4** and **Figure 8-5** show that the intersections of Route 123 (Chain Bridge Road) with Tysons Boulevard and Old Meadow Road have high crash rates and crash frequencies. Both intersections are adjacent to I-495 with several high traffic volume generators nearby. Both intersections experience heavy traffic congestion, leading to increased crashes.

- Across all intersections in the Traffic Operations Study area, approximately 40 percent of intersection crashes are injury crashes, which is notably high.
- Most of the crashes are either Rear-End crashes or angle crashes. Therefore, it can be inferred that heavy congestion primarily contributes to the intersection crashes in the study area.
- Based on the analysis of the reported crash data for this five-year period, environmental factors as lighting, weather, and pavement condition did not significantly affect the safety performance of the intersections.

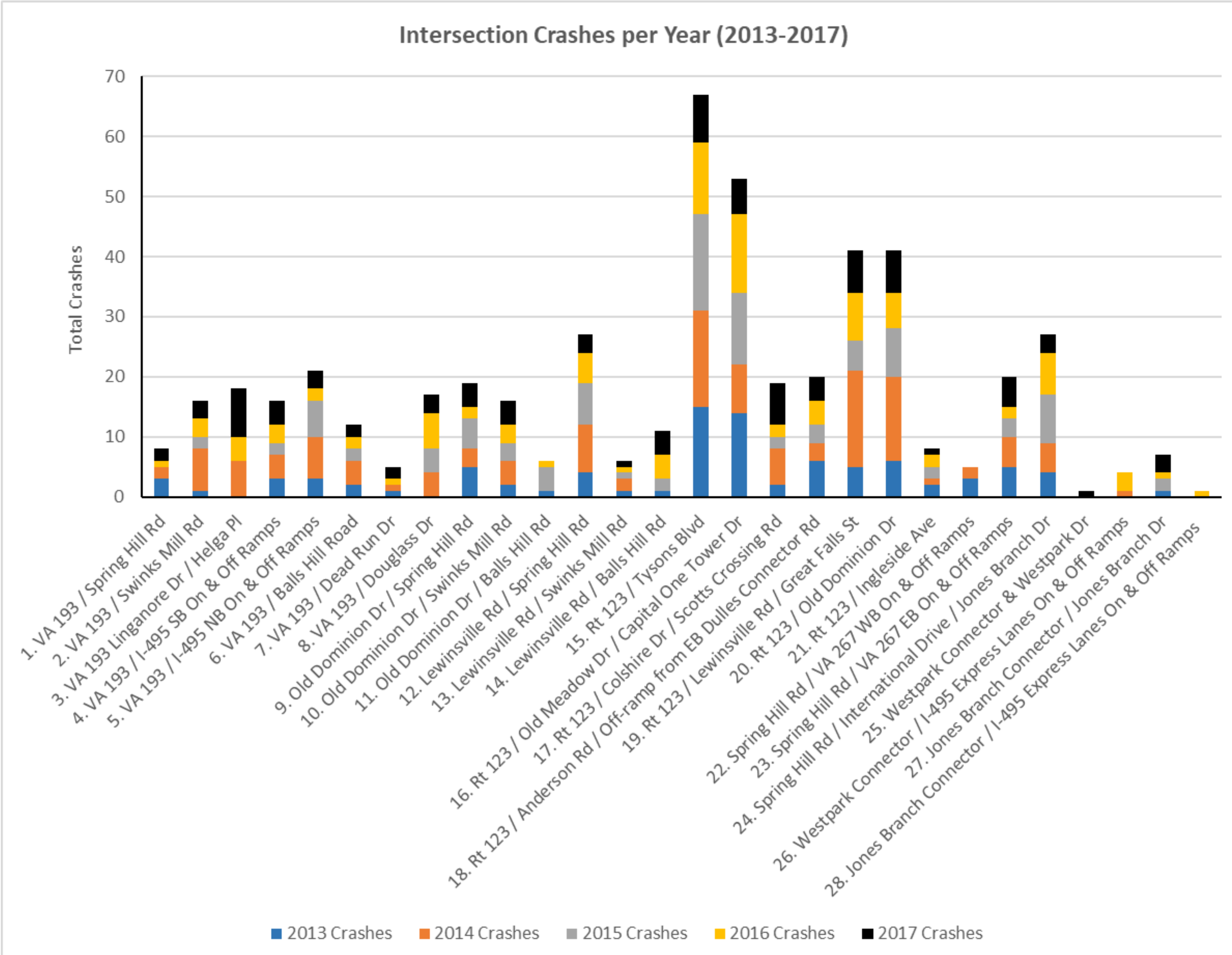


Figure 8-4. Arterial Intersection Crashes Reported by Year (2013-2017)

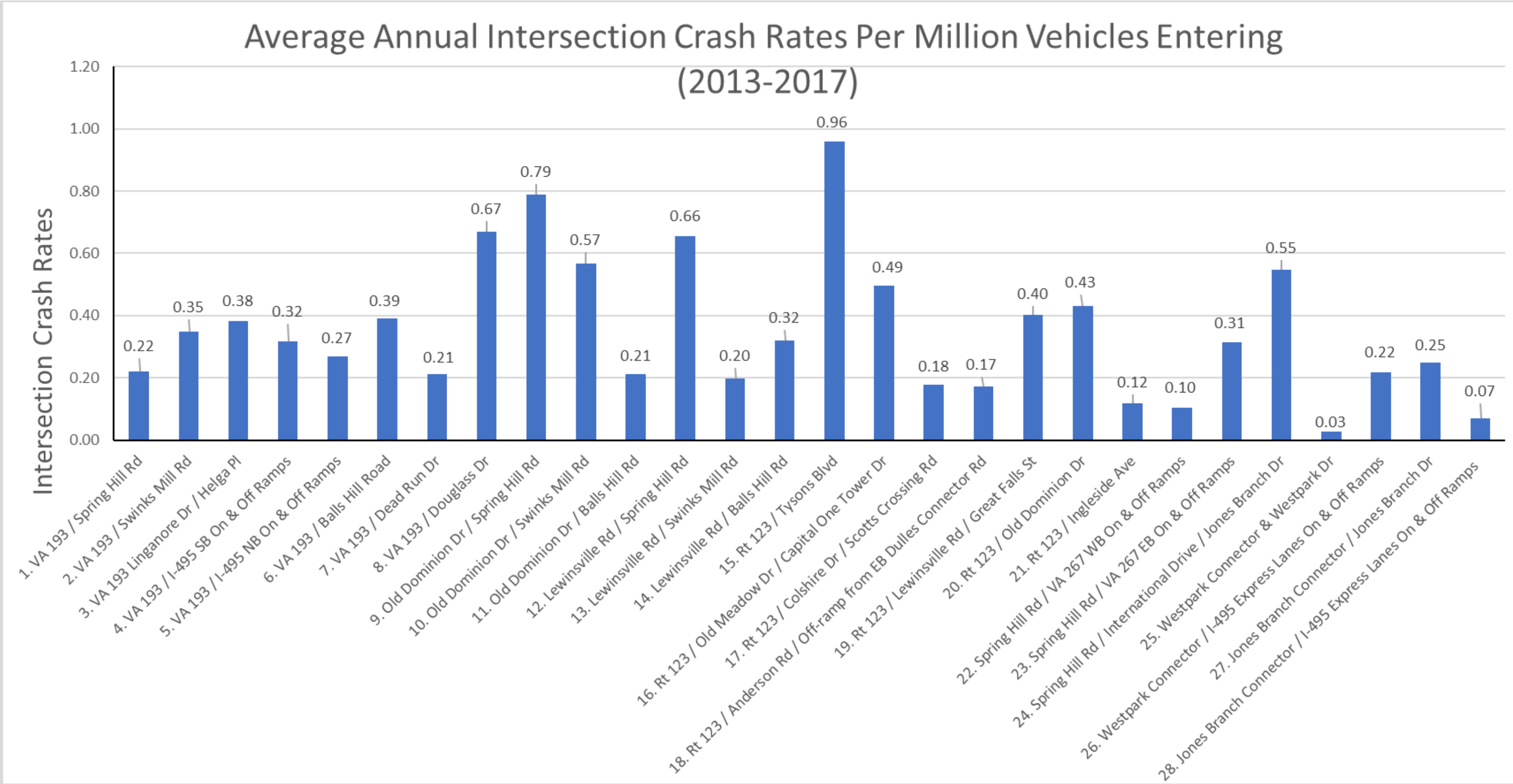


Figure 8-5. Arterial Intersection Crash Rates per Million Vehicles Entering (2013-2017)

8.3 FUTURE CONDITIONS SAFETY ANALYSIS

The operations and design elements of a proposed freeway system or interchange design project affect safety performance. Through the use of the principles and concepts in the HSM and safety analysis tools including ISATe, a project-specific SPF, and Extended HSM Spreadsheets, the project study team evaluated the safety impact of changes to the design. HSM methods and tools were used to predict the safety performance of design alternatives.

Section 8.2 summarized the results of the existing conditions safety evaluation and determination of potential for safety improvement at locations within the Traffic Operations Analysis Study Area. Additionally, the intent of the safety analysis is to provide insight into detailed design elements and aid in refining the Preferred Alternative during the design phase of project development. To address this second item, future conditions safety analysis was performed for the No Build and proposed Build conditions for both 2025 and 2045 analysis years for four configurations: 2025 No Build, 2025 Build, 2045 No Build, and 2045 Build. Note that, as discussed in **Chapter 5** (for No Build conditions) and **Chapter 6** (for Build conditions), various elements proposed to be in place by 2045 are not assumed to be in place by 2025. Additionally, for the 2025 No Build and Build scenarios only, it was determined upon consultation with VDOT that crash predictions would be based on a scenario in which the Maryland managed lanes system is not yet constructed. This assumes a conservative "worst case" condition for safety analysis for 2025.

8.3.1 Evaluation Approach and Process

Crash Prediction on Freeway and Ramp Segments Using ISATe

The Interchange Safety Analysis Tool–Enhanced (ISATe) was used to evaluate and compare the expected safety performance of freeway and ramp segments. ISATe enables prediction of interchange safety performance (including mainline segments, ramp segments, and ramp terminal intersections). It was adopted for use in the HSM as a crash prediction method for predictive safety performance of freeways and interchanges. (It should be noted that this specific tool is cited by FHWA as an example, and not as an endorsement over others).

To align with the national emphasis on addressing fatal and severe injury crashes, the I-495 NEXT safety performance evaluation focused on predicting the number of KAB crashes (K is a fatal crash, A is an incapacitating injury crash, and B is a non-incapacitating injury crash) expected for each alternative (No Build and Build) for 2025 and 2045. The project study team did not calculate the societal costs associated with the number of predicted crashes over the study periods; however, it may be performed at a later date.

Crash Prediction on the Express Lanes Using Safety Performance Functions (SPFs)

For evaluating Express Lanes freeway segments, a project-specific SPF was developed. In developing the SPF, it is important to recognize the underlying assumptions on which the new relationships were based. These included the following:

- Because I-495 Express Lanes operate within an uncongested regime, SPFs would be directly related to AADT as a dependent variable within certain thresholds.
- Traffic volumes and crash history for the existing I-495 Express Lane sections for the most recently available 5 years (January 1, 2013 through December 31, 2017) were deemed adequate from a historical perspective and used to develop new SPFs for the Express Lanes directional segments consisting of two lanes.

The salient features of the crash data, from which the SPF were developed, are described as follows:

- A total of 396 crashes were reported over a period of 5 years on the I-495 Express Lanes.
- Of those 396 reported crashes, 49 reported crashes occurred within the Diverge Segments and 45 reported crashes occurred within the Merge Segments. The remaining 302 reported crashes occurred on the Basic and Weave Segments.

A series of statistical models were developed to predict crashes. The primary independent variables used in the regression analyses were AADT, segment length and segment type (Merge, Diverge or Basic/Weave). The number of predicted crashes per year was the dependent variable in each model. The following functional forms for SPFs were tested:

Group 1 (Each model included segment length as one of the independent variables):

1. All reported crashes as a function of AADT, segment length and segment type
2. All reported crashes as a function of AADT and segment length
3. Basic and weave segment crashes as a function of AADT and segment length
4. Merge segment crashes as a function of AADT and segment length
5. Diverge segment crashes as a function of AADT and segment length

Group 2 (None of the models included section length as an independent variable)

1. All reported crashes as a function of AADT and segment type
2. All reported crashes as a function of AADT
3. Basic and weave Segment Crashes as a function of AADT
4. Merge segment crashes as a function of AADT
5. Diverge segment crashes as a function of AADT

The results of the statistical regression modelling were as follows:

Group 1:

1. All Crashes as a function of AADT, segment length and segment type: Segment type was insignificant.
2. All Crashes as a function of AADT and segment length: All variables were significant.
3. Basic and Weave Segment Crashes as a function of AADT and segment length: All variables were significant.
4. Merge Segment Crashes as a function of AADT and segment length: All variables were insignificant.
5. Diverge Segment Crashes as a function of AADT and segment length: AADT was insignificant.

Group 2:

1. All Crashes as a function of AADT and segment type: AADT and segment type variables were insignificant.
2. All Crashes as a function of AADT: All variables were significant.
3. Basic and Weave Segment Crashes as a function of AADT: All variables were insignificant.
4. Merge Segment Crashes as a function of AADT: All variables were insignificant.
5. Diverge Segment Crashes as a function of AADT: All variables were insignificant.

The results of the statistical modeling results and the statistical model forms were included a previous technical memorandum titled *Development of Safety Performance Functions (SPFs) for I-495 Express Lanes*. This memorandum is provided as **Appendix J.** The results show that SFP2 in Group 1 and SPF7 in Group 2 were the only models in which all of their independent variables were found to be statistically significant. Of the two, SFP2 in Group 1 had a much higher R-squared value, which reflects a better "goodness of fit," compared to SPF7 in Group 2. Intuitively, predicted crashes should have a direct correlation to AADT and roadway segment length. The models in the Highway Safety Manual for crash prediction are also very similar in form but with different coefficients.

On the basis of the analysis conducted, the proposed SPF for Express Lanes on I-495 is given below for the non-linear and linear regression models.

Regression: Expectation ($Crashes_{i,t}$) = exponential (0.011022579 + 0.987113593 * ln($Segment\ Length_{i,t}$) + 0.141283034 * ln($AADT_{i,t}$)

Linear Regression: Expectation ($Crashes_{i,t}$) = 0.550840245 + 4.130999289 * $Segment\ Length_{i,t}$) - 0.000121228 * $AADT_{i,t}$)

Where:

$Crashes_{i,t}$ = Crashes/year on Segment i for Time period t,

$Segment\ Length_{i,t}$ = Segment Length on Segment i for Time period t and

$AADT_{i,t}$ = Average Annual Daily Traffic on Segment i for Time period t.

The non-linear regression form had an R-squared value of 0.51 and the linear regression form had an R-squared value of 0.564; therefore, the linear regression model form was chosen due to the better R-squared value. There was a challenge with linear regression model for a limited number of cases where the model had a negative prediction of crashes. To fix that challenge, the form of the linear regression model was modified to be the max value of 0 and linear regression predicted crashes; this change in the model form solved the challenge by replacing negative prediction of crashes with zero. The R-squared for the modified form continued to be 0.564.

On the basis of the analysis conducted, the proposed SPF for Express Lanes on I-495 is given below:

Expectation ($Crashes_{i,t}$) = Max[0.550840245 + 4.130999289 * $Segment\ Length_{i,t}$) -0.000121228 * $AADT_{i,t}$), 0]

Where:

$Crashes_{i,t}$ = Crashes/year on Segment i for Time period t,

$Segment\ Length_{i,t}$ = Segment Length on Segment i for Time period t and

$AADT_{i,t}$ = Average Annual Daily Traffic on Segment i for Time period t.

This equation applies to all Freeway sections: Merge, Diverge, Basic, and Weave.

Appendix J includes a comparison of the actual crashes and predicted crashes for all segments of the Express Lanes in the existing conditions. The comparison shows the difference in the total crashes predicted using linear regression model versus actual crash performance is less than 1 crash in five years for existing conditions. The proposed SPF for I-495 Express Lanes can be used for the prediction of crashes for future No Build and Build alternatives for the I-495 NEXT project.

Crash Prediction on Arterials using Extended HSM Spreadsheets

Extended HSM Spreadsheets were used to conduct safety analysis for arterial intersections within the Traffic Operations Study Area. The HSM spreadsheets are applicable for Rural Two-Lane, Two-Way Roads (HSM Chapter 10); Rural Multilane Highways (HSM Chapter 11); and Urban and Suburban Arterials (HSM Chapter 12). The tool predicts crashes by roadway segment and intersection.

8.3.2 Total Crash Prediction

In **Table 8-2**, the crash frequency results from the 2025 No Build and Build conditions are compared with the crash frequency results from the 2045 No Build and Build conditions. These numbers represent the total predicted crashes in the Traffic Operations Study Area, including GP lanes, Express Lanes, and arterials. The total number of predicted crashes per year is anticipated to decrease in the 2045 No Build case compared to the 2025 No Build case due to CLRP improvements included within the study area (including the Maryland Traffic Relief Plan). Similarly, the total number of predicted crashes per year is anticipated to decrease in the 2045 Build case compared to the 2025 Build case. The improvements to I-495 on the Maryland side of the river were assumed to be in place for both No Build and Build conditions for 2045 only.

Table 8-2. Total I-495 Traffic Operations Study Area Predicted Crash Frequency Summary

Year	Scenario	Total General Purpose, Express, and Arterial Intersection Predicted Crash Frequency (crashes/year)		
		KABC	PDO	Total
2025	No Build	278.1	583.3	861.4
	Build	280.2	588.2	868.4
2045	No Build	254.9	563.2	818.1
	Build	226.8	426.1	652.9

8.3.3 Freeway Crash Prediction by Segment

Crash Analysis Zones Overview

Predicted crash frequencies and crash rates were calculated for individual freeway segments. For reporting purposes, these metrics were aggregated into interchange zones and/or segment zones within the Traffic Operations Study Area. Below is a description of limits for the various crash analysis zones.

- I-495 Interchanges
    - I-495/Route 123 and I-495/Route 267 interchanges were combined as one zone. These two interchanges were grouped together because of their close proximity and interconnectedness, especially in the 2045 scenarios in which C-D roads provide connectivity between the interchanges. See **Figure 8-6** for limits of I-495 Interchange Zone: Route 123 and Route 267 Combined.

  - I-495/Route 193 and I-495/GWMP interchanges were also combined as one zone for similar reasons. The interchanges currently share a C-D road in the southbound direction. See **Figure 8-7** for limits of Interchange Zone: Route 193 and GWMP Combined.
- Northbound I-495 GP Lane segments
  - From Route 7 to Route 123
  - From Route 267 to Route 193
- Southbound I-495 GP Lane segments
  - From Route 193 to Route 267
  - From Route 123 to Route 7
- Northbound I-495 Express Lanes segments
  - From Route 7 to I-495/Route 123/Route 267 interchanges
  - Within the I-495/Route 123/Route 267 interchanges[1]
  - From I-495/Route 123/Route 267 interchange to GWMP interchange
  - From GWMP interchange to the state line
- Southbound I-495 Express Lanes segments
  - From the state line to GWMP interchange
  - From to GWMP interchange to I-495/Route 123/Route 267 interchanges[1]
  - Within the I-495/Route 123/Route 267 interchanges
  - From I-495/Route 123/Route 267 interchanges to Route 7
- Route 267 (Dulles Toll Road) interchanges and segments
  - Spring Hill Road and Route 267 (Dulles Toll Road) interchange. See **Figure 8-8** for limits of the Route 267 Interchange Zone at Spring Hill Road and Dulles Toll Road.
  - I-495 and Route 267 (Dulles Toll Road) interchange (mainline only; all ramps for the I-495/Route 267 interchange are included in the I-495/Route 267 interchange zone). See **Figure 8-9** for limits of the Route 267 Interchange Zone at I-495.
  - Route 123 and Route 267 (Dulles Toll Road) interchange. See **Figure 8-10** for limits of the Route 267 Interchange Zone at Route 123.
  - Route 267 eastbound from Route 123 interchange to 0.03 miles east of the bridge over Route 650
  - Route 267 westbound from 0.03 miles east of the bridge over Route 650 to the Route 123 interchange
- Route 267 (Dulles Airport Access Road) segments
  - Eastbound Route 267 (DAAR) from Spring Hill Road to the eastern terminus
  - Westbound Route 267 (DAAR) from the eastern terminus to Spring Hill Road

[1] For the 2045 Build Alternative, it should be noted that because Ramp E1 from Route 267 (DTR & DAAR) eastbound is nearly 1 mile in length and serves both the northbound and southbound Express Lanes, and therefore accounts for a significant portion of the 2045 Build Express Lanes ramp crashes, the crash predictions for Ramp E1 were distributed to the northbound Express Lanes within the I-495/Route 123/Route 267 interchanges and to the southbound Express Lanes within the I-495/Route 123/Route 267 interchanges by percentage of ADT volume destined to each. See **Figure 8-11**.

Figure 8-6. I-495 Interchange Zone: Route 123 and Route 267 Combined

Figure 8-7. I-495 Interchange Zone: Route 193 and GWMP Combined

Figure 8-8. Route 267 Interchange Zone: Spring Hill Road and Dulles Toll Road

Figure 8-9. Route 267 Interchange Zone: I-495 (Dulles Toll Road Mainline Only)

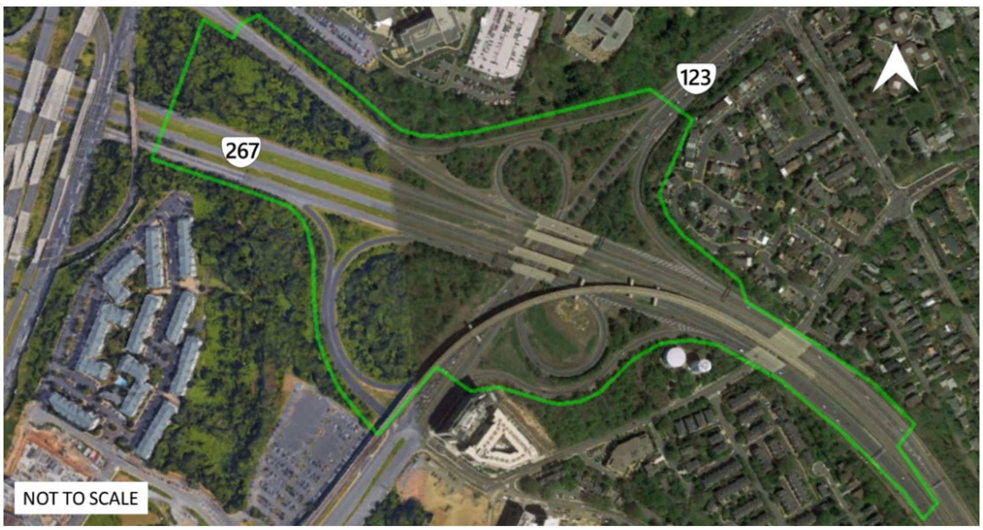


Figure 8-10. Route 267 Interchange Zone: Route 123

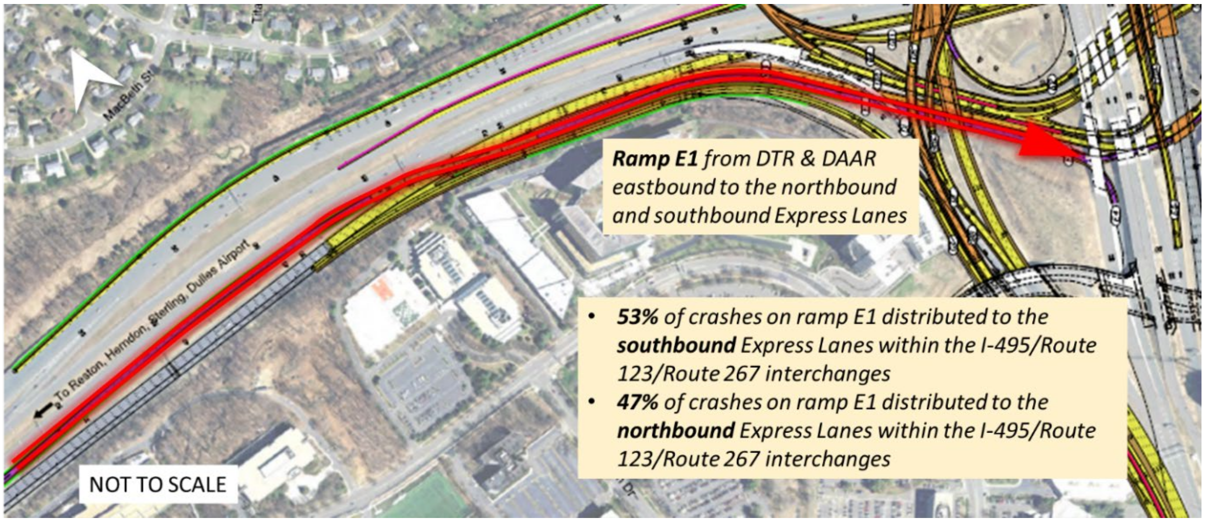


Figure 8-11. Ramp E1 from eastbound DTR and DAAR to northbound and southbound I-495 Express Lanes

2025 No Build and Build Crash Rate Predictions

I-495 Interchanges

The predicted crash rate per 100 million entering vehicles (MEV) for the two I-495 interchange areas for 2025 No Build and Build conditions are summarized **Figure 8-12**. The following summarize the comparative crash rates for the I-495 interchanges under 2025 conditions**:**

- The predicted crash rate for the I-495 GP interchanges with Route 123 and Route 267 slightly decreases between the No Build and Build conditions. Under 2025 Build conditions, the Express Lanes northern terminus is removed from the I-495 and Route 267 interchange area; therefore, the merge and diverge conflicts associated with the northern terminus are no longer present which yield a lower predicted crash rate.
- The predicted crash rate for the I-495 GP interchanges with Route 193 and the GWMP increases by nearly 23 more crashes per 100 MEV from No Build to Build conditions. This change in predicted crashes is the result of (1) the additional ramp terminals associated with the GWMP which increases the potential for conflict and crashes and (2) the terminus for the I-495 Express Lanes assumed for 2025 Build conditions for this safety analysis, which is assumed to be located at the GWMP interchange. This terminus creates a heavy merge in the northbound direction and diverge in the southbound direction.

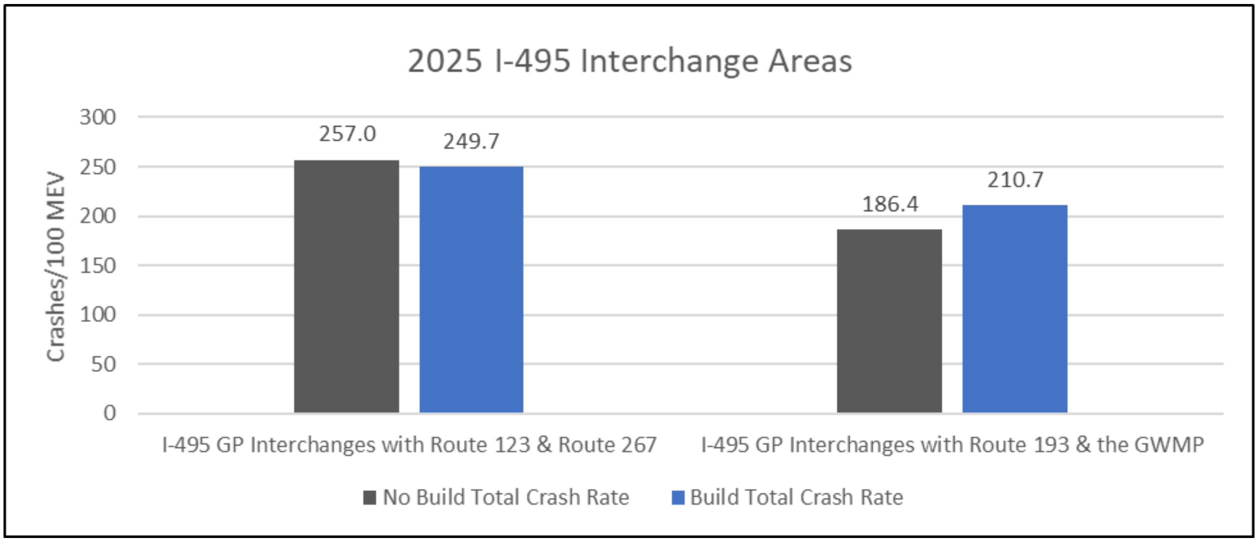


Figure 8-12. 2025 No Build and Build Predicted Crash Rates: I-495 Interchange Areas

I-495 GP Lanes

Figure 8-13 shows the predicted crash rate per 100 million vehicle miles traveled (MVMT) for two segments of the northbound I-495 GP lanes between 2025 No Build and Build conditions. The following summarize the comparative crash rates for the northbound I-495 GP lanes under 2025 conditions**:**

- The predicted crash rate for the northbound GP lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 shows a nominal increase between 2025 No Build and Build conditions.
- The predicted crash rate for the northbound GP lanes from Route 267 to the interchanges with Route 193 and the GWMP decreases significantly by nearly 20 crashes per 100 MVMT from No Build to Build conditions. The extension of the Express Lanes to the Maryland border diverts traffic volume from the GP lanes to the Express Lanes through this segment, reducing congestion and therefore lowering the potential for crashes to occur.

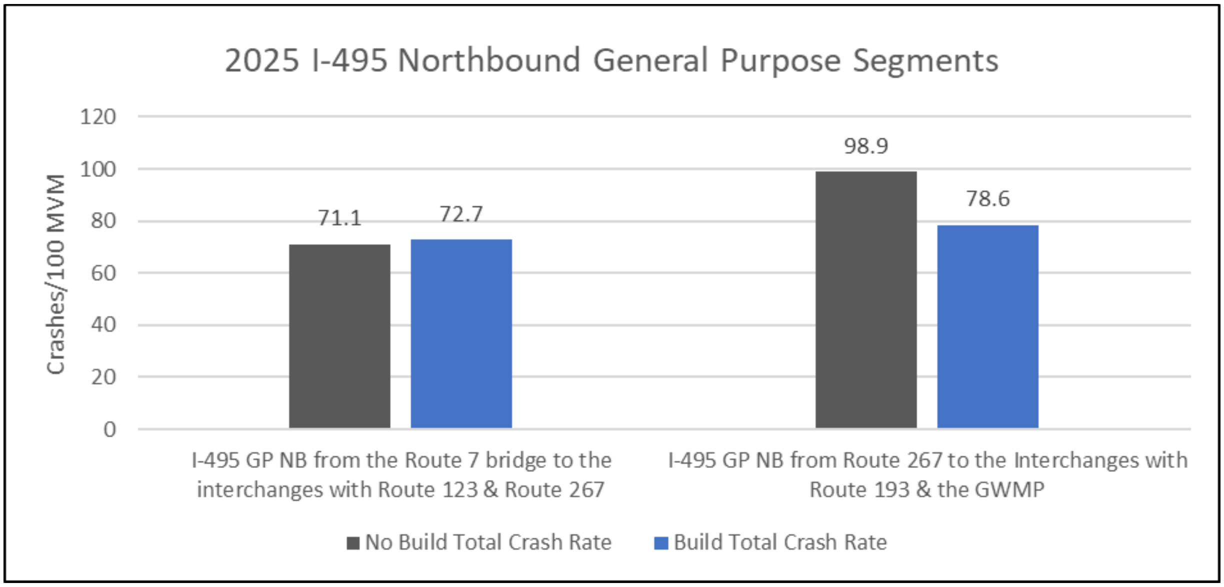


Figure 8-13. 2025 No Build and Build Predicted Crash Rates: Northbound I-495 GP Lanes

Figure 8-14 provides a summary of predicted crash rates for two segments of the southbound I-495 GP lanes under 2025 No Build and Build conditions. The following summarize the comparative crash rates for the southbound I-495 GP lanes under 2025 conditions**:**

- The predicted crash rate for the southbound I-495 GP lanes from Route 267 to the interchanges with Route 193 and the GWMP decreases by nearly 20 crashes per MVMT between No Build and Build conditions. The extension of the Express Lanes to the GWMP diverts volume from the GP lanes to the Express Lanes through this segment, reducing congestion and therefore lowering the potential for crashes to occur.
- The predicted crash rate for the southbound I-495 GP lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 shows a nominal increase between No Build and Build.

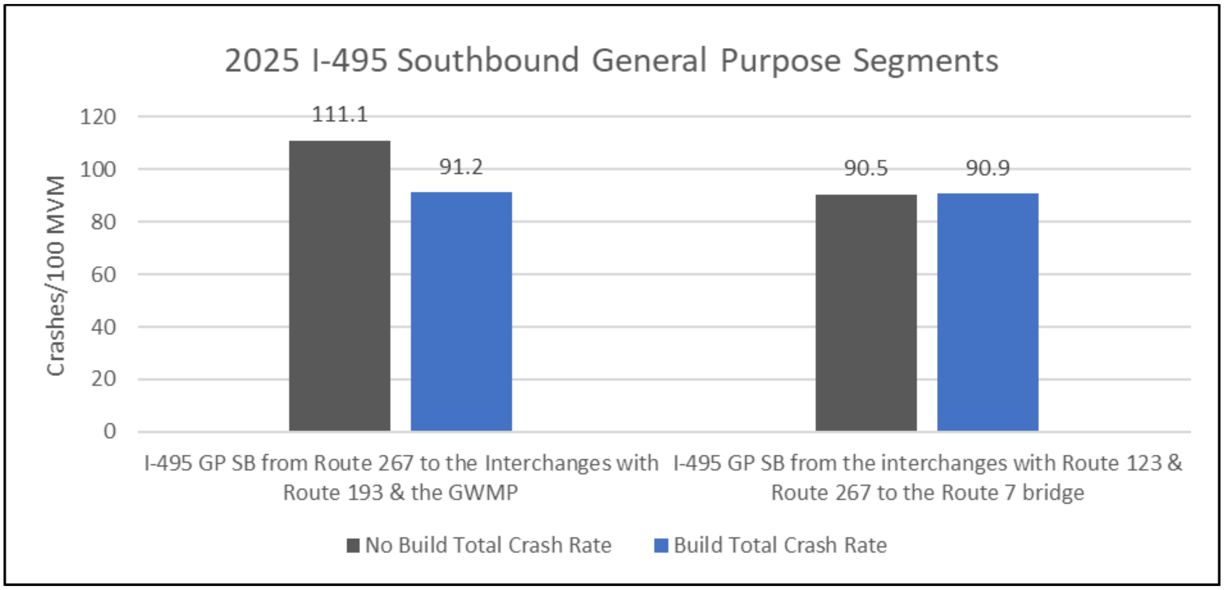


Figure 8-14. 2025 No Build and Build Predicted Crash Rates: Southbound I-495 GP Lanes

I-495 Express Lanes

Figure 8-15 shows the predicted crash rate at four locations on the northbound Express Lanes under 2025 No Build and Build conditions. The following summarize the comparative crash rates for the northbound I-495 Express Lanes under 2025 conditions**:**

- The Express Lanes predicted crash rate from the existing northern terminus to the state line is shown only for the Build condition. Express Lanes are not present in the No Build condition for this section.
- The predicted crash rate the northbound Express Lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 decreases by approximately 17 crashes per 100 MVMT from No Build to Build conditions.
- The predicted crash rate for the northbound Express Lanes within the Route 123 and Route 267 interchanges decreases by 22 crashes per 100 MVMT from No Build to Build conditions.

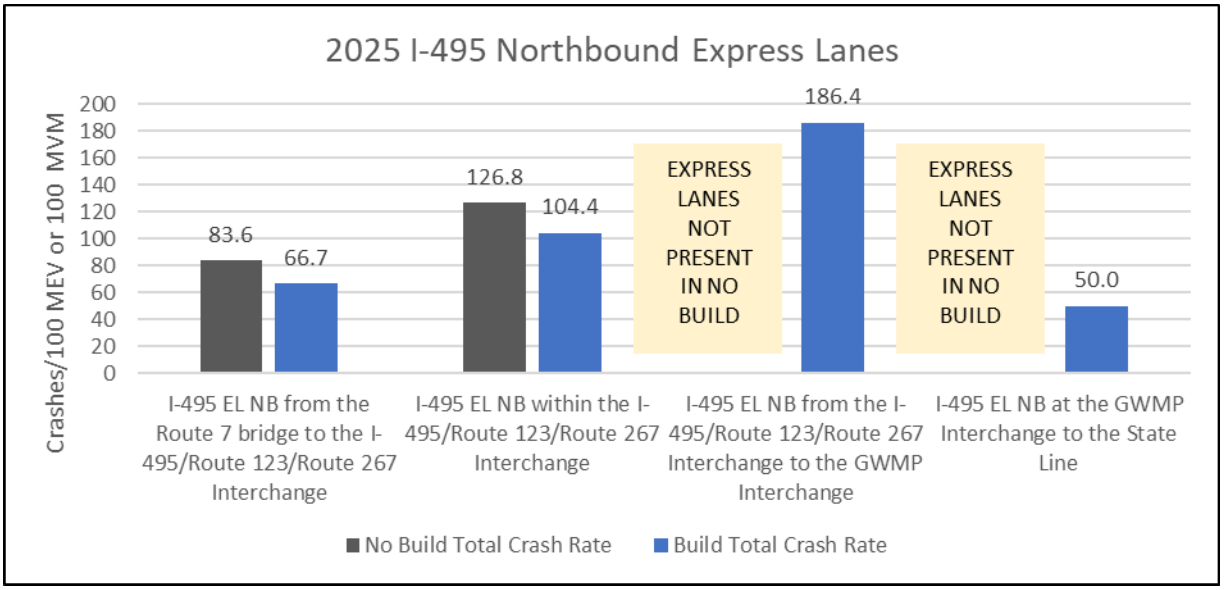


Figure 8-15. 2025 No Build and Build Predicted Crash Rates: Northbound I-495 Express Lanes

Figure 8-16 shows the predicted crash rate for four segments on the southbound Express Lanes between 2025 No Build and Build conditions. The following summarize the comparative crash rates for the southbound I-495 Express Lanes under 2025 conditions**:**

- The Express Lanes predicted crash rate from the existing northern terminus to the state line is shown only for the Build condition. Express Lanes are not present in the No Build condition for this section.
- The predicted crash rate for the southbound Express Lanes within the Route 123 and Route 267 interchanges decrease by 24 crashes per 100 MVMT from No Build to Build.
- The predicted crash rate for the southbound Express Lanes from the interchanges with Route 123 and Route 267 to the Route 7 bridge decrease by approximately 18 crashes per 100 MVMT from No Build to Build.

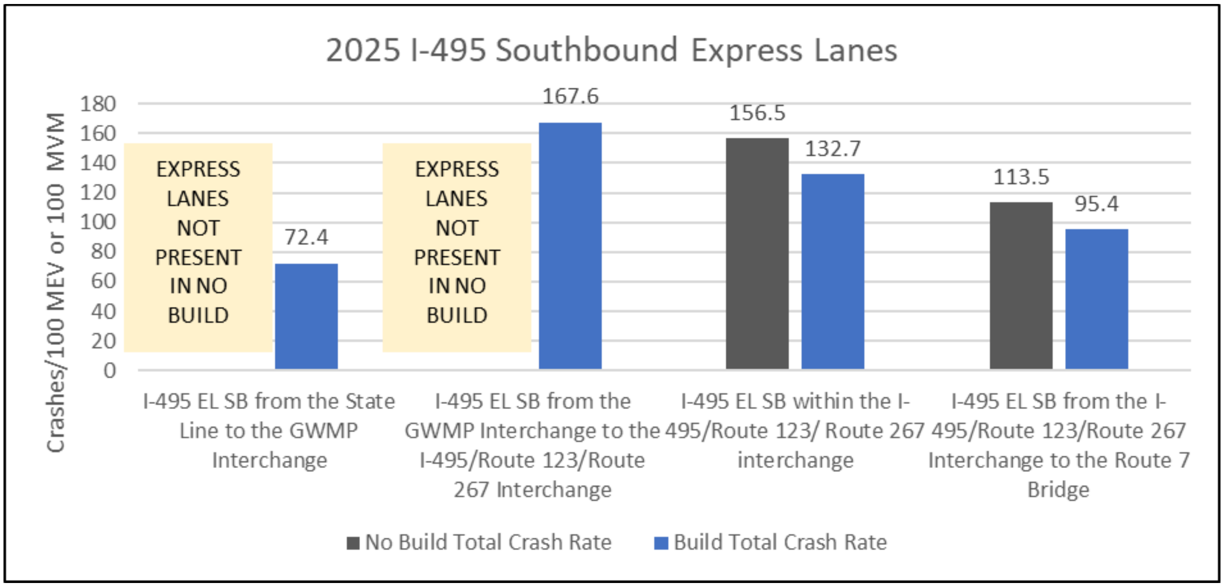


Figure 8-16. 2025 No Build and Build SPFs Developed for Express Lanes Predicted Crash Rate Summary (Southbound Express Lanes)

Route 267

Figure 8-17 shows the predicted crash rate for five segments of Route 267 (DTR) between 2025 No Build and Build conditions. The following summarize the comparative crash rates for the DTR under 2025 conditions**:**

- The predicted crash rate for the DTR interchange with Spring Hill Road increases by 16 crashes per 100 MVMT from No Build to Build conditions. This zone includes the mainline weave on eastbound DTR and the mainline weave on westbound DTR between Spring Hill Road and I-495. Due to the Express Lanes extension and the new access from eastbound DTR to the northbound Express Lanes, volume increases through the mainline weave sections. This causes an increase in friction and conflicts between vehicles, which increases predicted crash rate for the Build conditions compared to the No Build.
- The predicted crash rate for the DTR interchange with I-495 (crash rate along the DTR segments only) slightly decrease from No Build to Build.
- The predicted crash rate for the DTR interchange with the Route 123 decrease by 18 crashes per MVMT from No Build to Build conditions. It should be noted that the higher crash frequency at the DTR/Route 123 interchange as compared to other segments of the DTR is due to (1) the two mainline weaving sections between the interchange with I-495 and Route 123 are included in the DTR/Route 123 interchange zone and (2) while the length of the DTR/Route 123 interchange zone is similar to the length of the DTR/I-495 interchange zone, all ramps to and from Route 123 are accounted for in the DTR/Route 123 interchange zone. The ramps for the DTR/I-495 interchange are accounted for in the "I-495 GP Interchange with Route 267 & Route 123" zone and are not shown with the DTR results to avoid double-counting evaluation results.
- The predicted crash rate for eastbound DTR from the Route 123 interchange to the eastern terminus of the study area (0.03 miles past the Route 650 bridge) slightly increase from No Build to Build.

- The predicted crash rate for westbound DTR from the eastern terminus to the Route 123 interchange slightly decrease from No Build to Build.

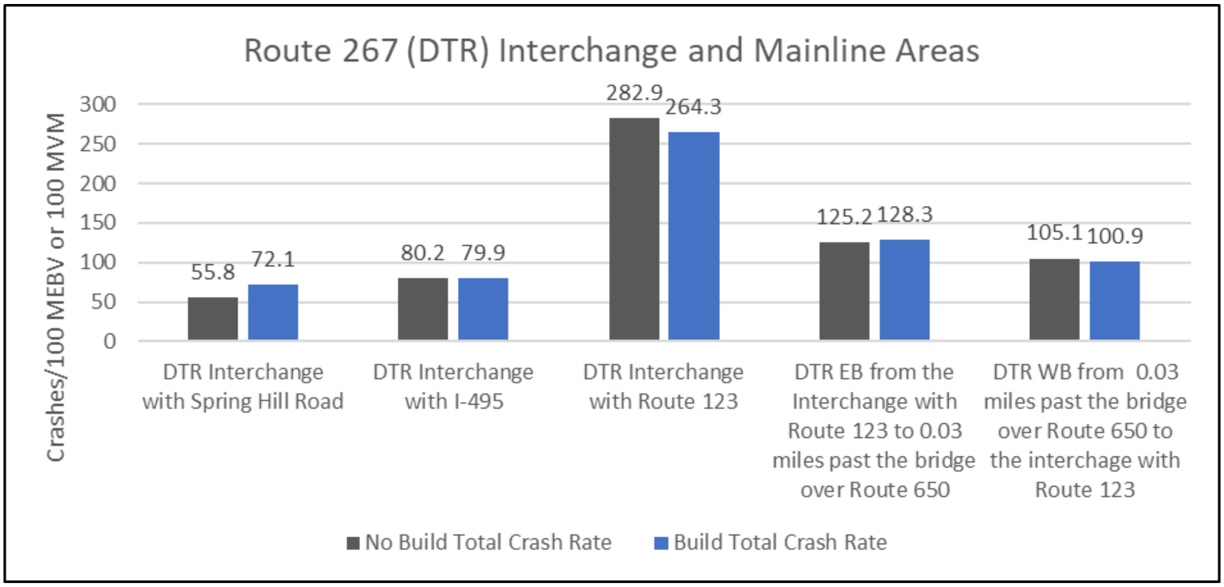


Figure 8-17. 2025 No Build and Build ISATe Predicted Crash Rate Summary for Route 267 (DTR)

Figure 8-18 shows the predicted crash rate for eastbound and westbound Route 267 (DAAR) under 2025 No Build and Build conditions. The following summarize the comparative crash rates for the DAAR under 2025 conditions**:**

- The predicted crash rate for eastbound DAAR slightly decreases by 3 crashes per 100 MVMT from No Build to Build conditions due to traffic volume fluctuations. There are no changes to eastbound DAAR geometry under the 2025 Build condition.
- The predicted crash rate for westbound DAAR slightly increases by 4 crashes per 100 MVMT from No Build to Build conditions. There are no changes to the DAAR westbound geometry in the 2025 Build condition.

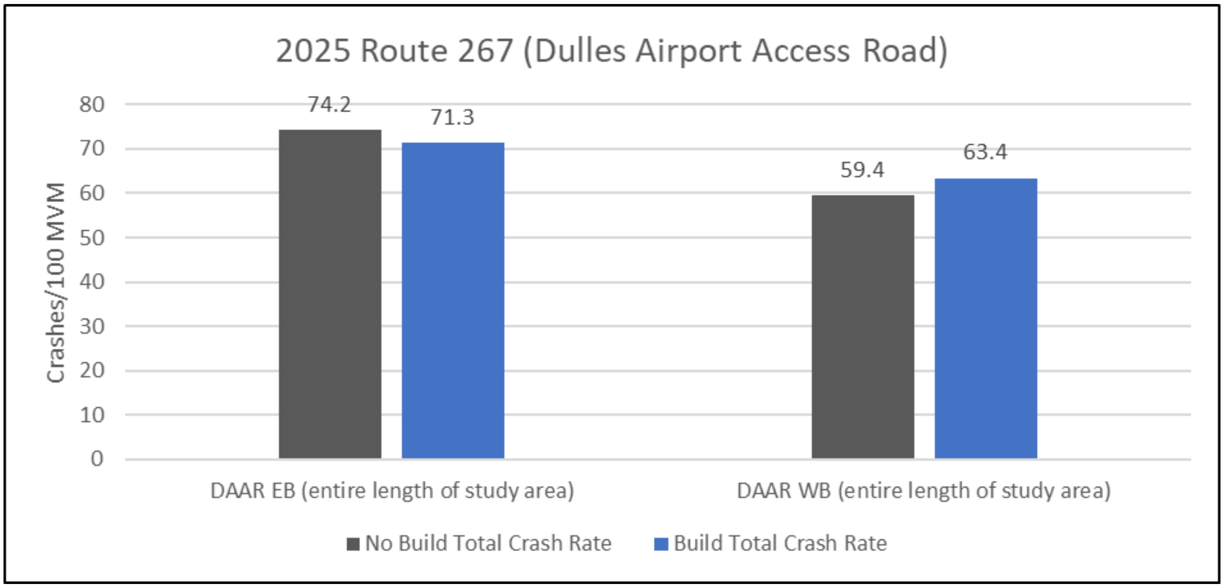


Figure 8-18. 2025 No Build and Build ISATe Predicted Crash Rate Summary for Route 267 (DAAR)

2025 No Build and Build Crash Frequency Predictions

I-495 Interchanges

Figure 8-19 shows the predicted crash frequency (crashes/year) for two segments of the I-495 interchanges between 2025 No Build and Build conditions. The following summarize the comparative crash frequencies for the I-495 interchanges under 2025 conditions**:**

- The predicted annual crash frequency for the I-495 GP interchanges with Route 123 and Route 267 slightly decrease by 13 crashes per year from No Build to Build conditions. In the 2025 Build alternative, the Express Lanes northern terminus is removed from the I-495 and Route 267 interchange area; therefore, the merge and diverge conflicts associated with the northern terminus are no longer present.
- The predicted annual crash frequency for the I-495 GP interchanges with Route 193 and the George Washington Memorial Parkway significantly increases by 7 crashes per year from No Build to Build, due to (1) the additional ramp terminals associated with the GWMP which increases the potential for conflict and crashes and (2) the terminus for the I-495 Express Lanes assumed for 2025 Build conditions for this safety analysis, which is assumed to be located at the GWMP interchange. This terminus creates a heavy merge in the northbound direction and diverge in the southbound direction.

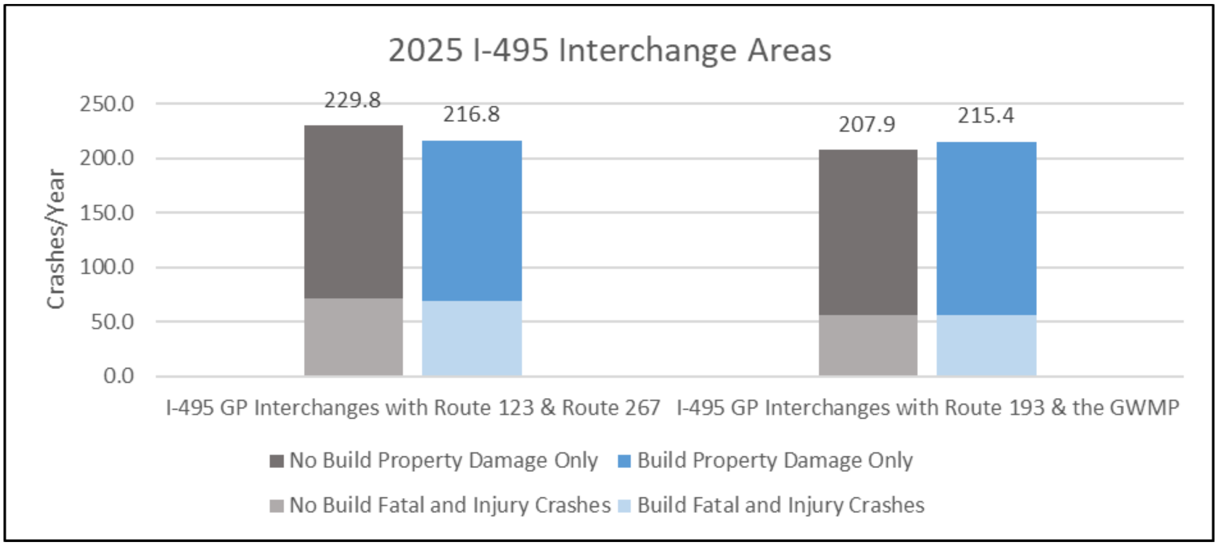


Figure 8-19. 2025 No Build and Build ISATe Predicted Crash Frequency Summary for I-495 Interchange

I-495 GP Lanes

Figure 8-20 shows the predicted annual crash frequency for two segments of the northbound GP lanes between 2025 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the northbound I-495 GP lanes under 2025 conditions**:**

- The predicted annual crash frequency for the northbound GP lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 increases nominally from No Build to Build due to a slight increase in predicted volume and therefore in predicted crash frequency.
- The predicted annual crash frequency for the northbound GP lanes from Route 267 to the interchanges with Route 193 and the GWMP significantly decreases by approximately 6 crashes per year from No Build to Build conditions. The extension of the Express Lanes to the Maryland state line diverts volume from the GP Lanes to the Express Lanes through this segment; therefore, lowering the potential for crashes to occur.

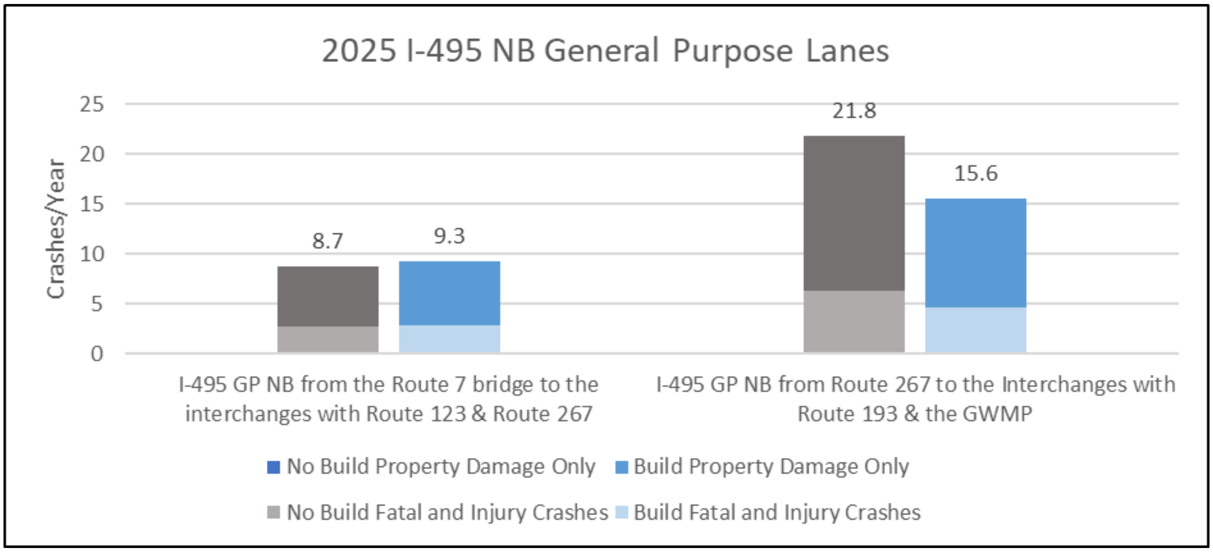


Figure 8-20. 2025 No Build and Build ISATe Predicted Crash Frequency Summary for Northbound I-495 GP Lanes

Figure 8-21 shows the predicted crash frequency (crashes/year) for two segments of the southbound GP lanes between 2025 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the southbound I-495 GP lanes under 2025 conditions**:**

- The predicted annual crash frequency for the southbound I-495 GP lanes from Route 267 to the interchanges with Route 193 and the GWMP significantly decreases by approximately 5 crashes per year from No Build to Build conditions. The extension of the Express Lanes from the Maryland state line diverts traffic volume from the GP Lanes to the Express Lanes through this segment; therefore, lowering the potential for crashes to occur.
- The predicted annual crash frequency for the southbound GP lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 show a nominal increase and is effectively stable.

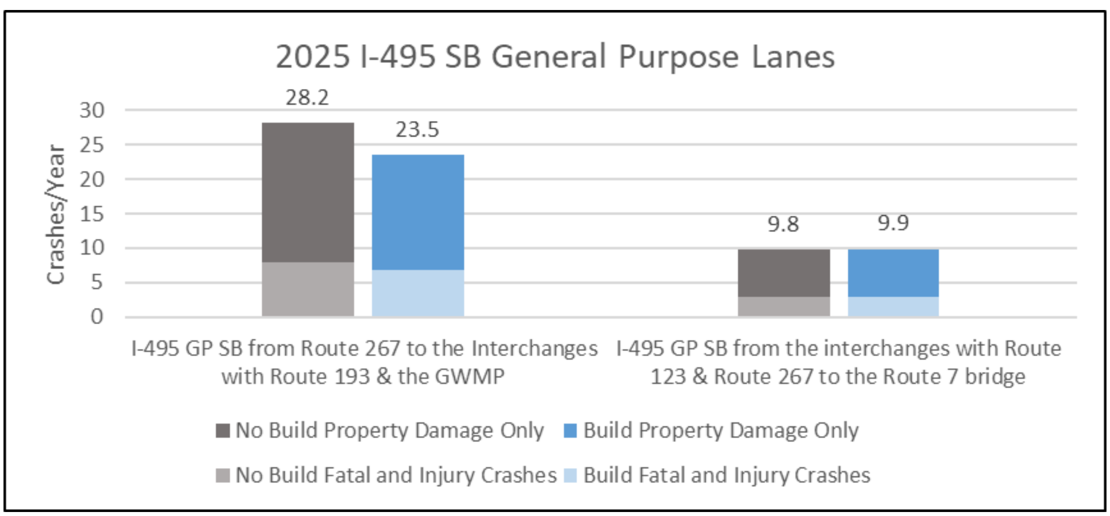


Figure 8-21. 2025 No Build and Build ISATe Predicted Crash Frequency Summary for Southbound I-495 GP Lanes

I-495 Express Lanes

Figure 8-22 shows the predicted crash frequency (crashes/year) for four segments of the northbound Express Lanes between 2025 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the northbound I-495 Express Lanes under 2025 conditions**:**

- The Express Lanes predicted annual crash frequency from the existing northern terminus to the state line is shown only for the Build condition. Express Lanes are not present in the No Build condition for this section.
- The predicted annual crash frequency for the northbound Express Lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 is expected have nominal change between the No Build to Build conditions.
- While the predicted crash rate for the northbound Express Lanes within the Route 123 and Route 267 interchanges decreases from No Build to Build, the crash frequency increases slightly. The Express Lanes extension and additional access from Route 267 eastbound increases demand on the existing and future mainline and ramps through these two interchanges, therefore increasing the predicted overall number of crashes.

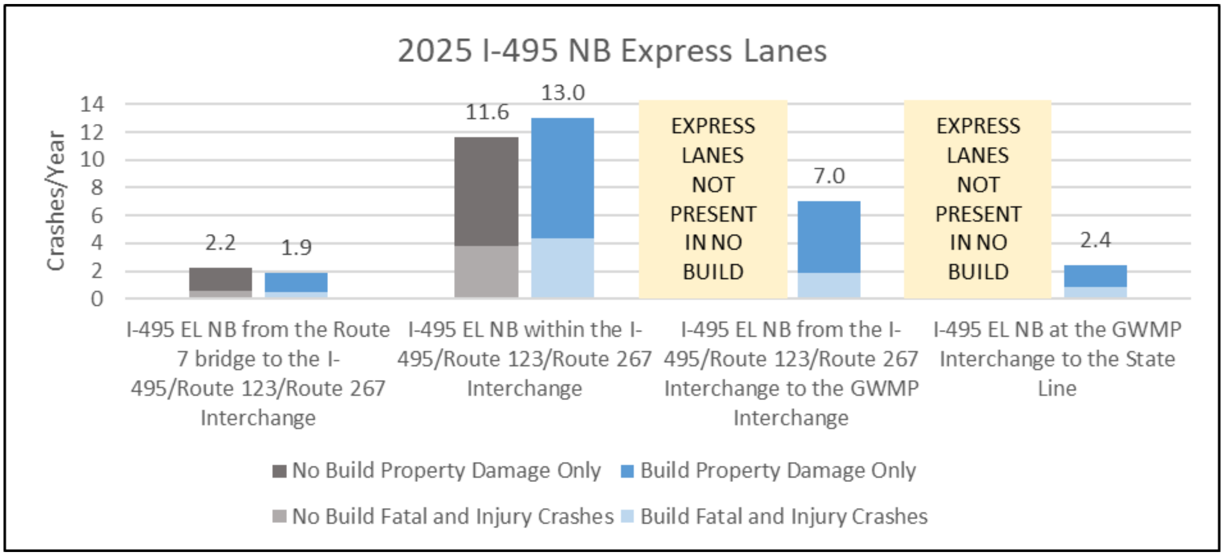


Figure 8-22. 2025 No Build and Build SPFs Developed for Express Lanes Predicted Crash Frequency Summary for Northbound I-495 Express Lanes

Figure 8-23 shows the predicted crash frequency (crashes/year) for four segments of the southbound Express lanes between 2025 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the southbound I-495 Express Lanes under 2025 conditions**:**

- The Express Lanes predicted annual crash frequency from the existing northern terminus to the state line is shown only for the Build condition. Express Lanes are not present in the No Build condition for this section.
- The predicted annual crash frequency for the southbound Express Lanes within the Route 123 and Route 267 interchanges increases slightly from No Build to Build conditions.

- The predicted annual crash frequency for the southbound Express Lanes from the interchanges with Route 123 and Route 267 to the Route 7 bridge experience a nominal decrease from No Build to Build conditions.

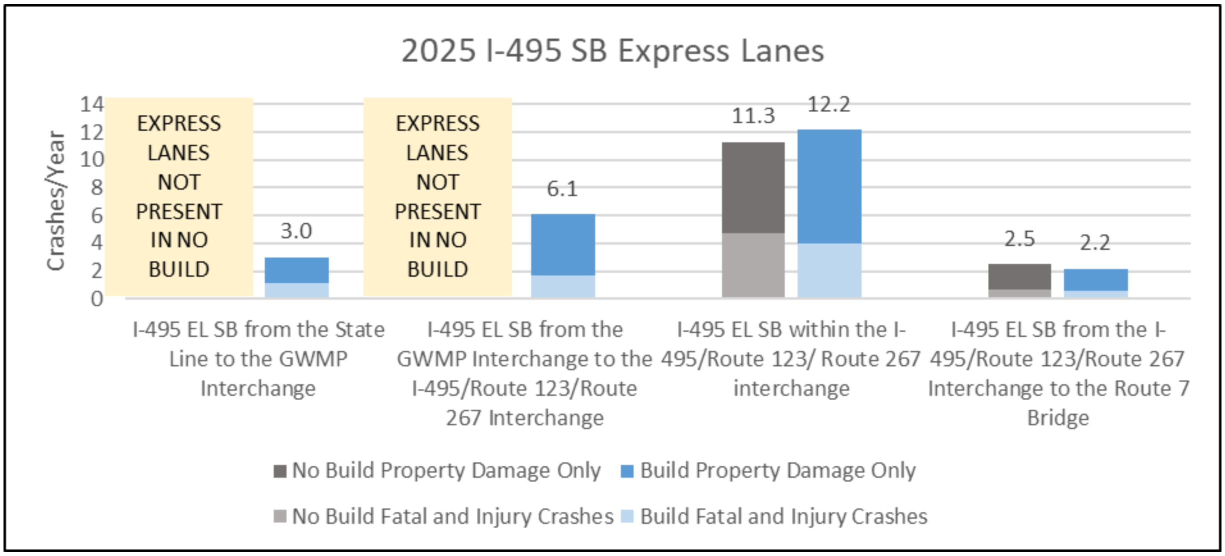


Figure 8-23. 2025 No Build and Build SPFs Developed for Express Lanes Predicted Crash Frequency Summary for Southbound I-495 Express Lanes

Route 267

Figure 8-24 shows the predicted crash frequency (crashes/year) for five segments of Route 267 (DTR) between 2025 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the DTR under 2025 conditions**:**

- The predicted annual crash frequency for the DTR interchange with Spring Hill Road significantly increases by 10 crashes per year from No Build to Build conditions. The Express Lanes extension and additional access from DTR eastbound to the northbound Express Lanes increases demand on the DTR mainline and on the ramps through the Spring Hill Road interchange. This zone includes the mainline weave on eastbound DTR and the mainline weave on westbound DTR between Spring Hill Road and I-495. Due to the Express Lanes extension and the new access from eastbound DTR to the northbound Express Lanes, volume increases through the mainline weave sections. This causes an increase in friction and conflicts, which increases the total number of predicted crashes for the Build conditions compared to the No Build.
- While the predicted crash rate for the DTR interchange with I-495 (crash rate along the DTR segments only) slightly decreases from No Build to Build, the crash frequency slightly increases. The Express Lanes extension and additional access from DTR eastbound to the northbound Express Lanes will increase volume on the DTR mainline. While the overall number of crashes could potentially increase due to the increase in volume, the reduced crash rate does not indicate a potential safety issue.
- The predicted annual crash frequency for the DTR interchange with the Route 123 decreases from No Build to Build conditions. It should be noted that the higher crash frequency at the DTR/Route 123 interchange compared to the rest of the DTR is due to (1) the two mainline weaving sections between the interchange with I-495 and Route 123 that are included in the DTR/Route 123

interchange zone and (2) while the length of the DTR/Route 123 zone is similar to the length of the DTR/I-495 zone, all ramps to and from Route 123 are accounted for in the DTR/Route 123 interchange zone. The ramps for the DTR/I-495 interchange are only included in the "I-495 GP Interchange with Route 267 & Route 123" zone and are not shown with the DTR results to avoid double counting evaluation results.

- The predicted crash frequency on eastbound DTR from the Route 123 interchange to the eastern terminus of the study area (0.03 miles past the Route 650 bridge) shows a nominal change from 2025 No Build to 2025 Build.
- The predicted crashes frequency for westbound DTR from the eastern terminus to the Route 123 interchange is effectively stable across both alternatives.

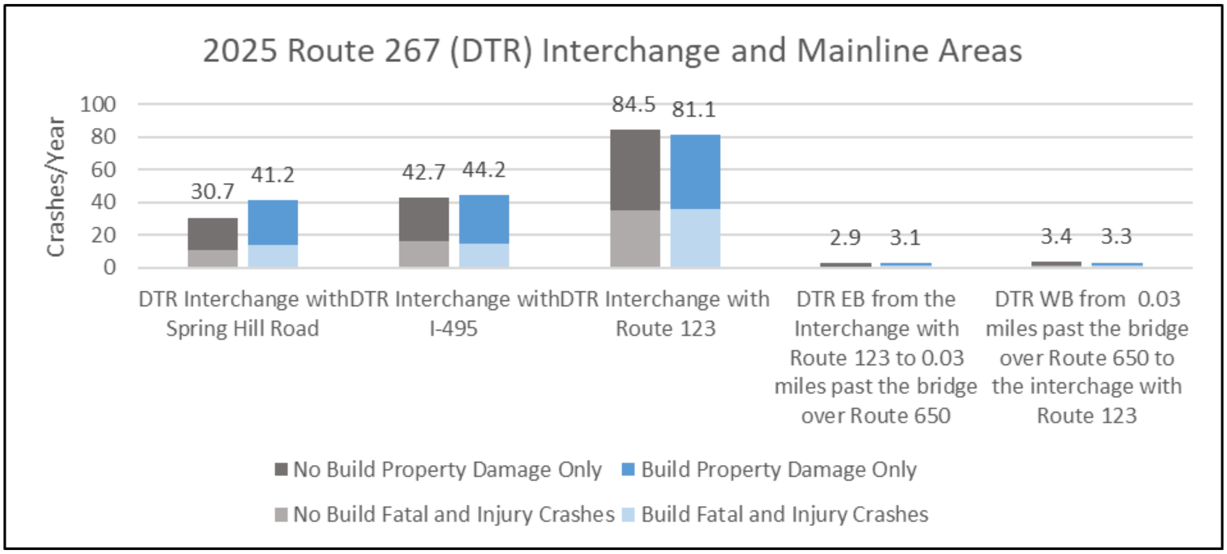


Figure 8-24. 2025 No Build and Build ISATe Predicted Crash Frequency Summary for Route 267 (DTR)

Figure 8-25 shows the predicted crash frequency (crashes/year) for each direction of Route 267 (DAAR) between 2025 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the DAAR under 2025 conditions**:**

- The predicted annual crash frequency change for eastbound DAAR from No Build to Build conditions is nominal.
- The predicted annual crash frequency change for westbound DAAR from No Build to Build conditions is nominal.

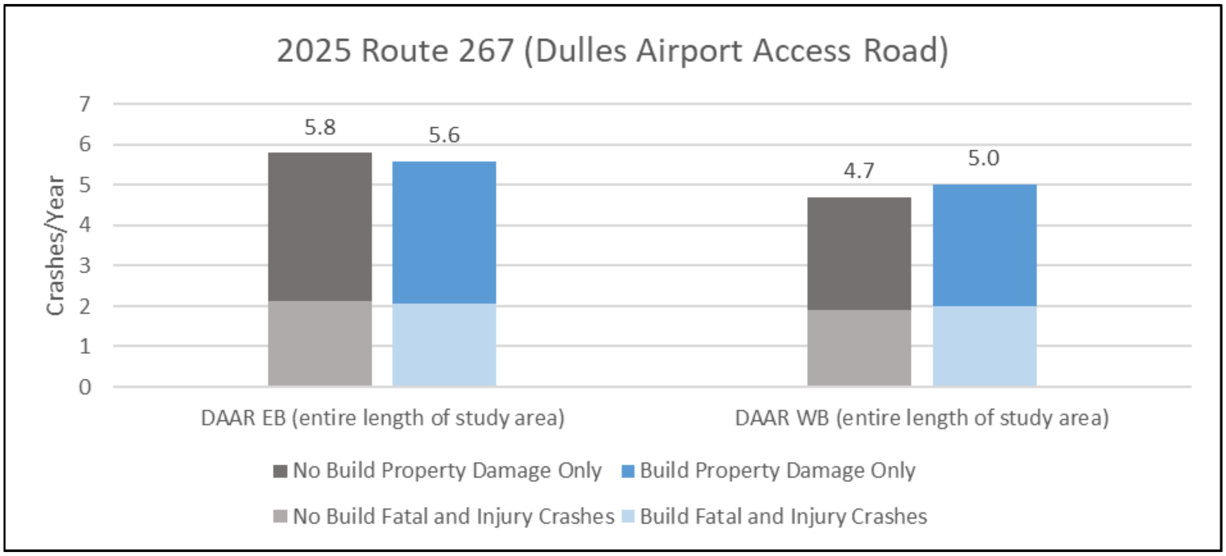


Figure 8-25. 2025 No Build and Build ISATe Predicted Crash Frequency Summary for Route 267 (DAAR)

2045 No Build and Build Crash Rate Predictions

I-495 Interchanges

Figure 8-26 shows the predicted crash rate per 100 MEV for the two major interchange areas of the I-495 GP Lanes between 2045 No Build and Build conditions. The following summarize the comparative crash rates for the I-495 interchanges under 2045 conditions**:**

- The predicted crash rate for the I-495 GP interchanges with Route 123 and Route 267 shows a negligible change from No Build to Build conditions.
- The predicted crash rate decreases significantly by 132 crashes per 100 MEV for the Route 193 and GWMP interchange analysis zone when comparing the No Build and Build conditions. There are multiple contributing factors:
  - (1) In the 2045 No Build condition, it is assumed that the Maryland managed lanes terminate within this zone. A merge from the southbound Maryland managed lanes and a diverge to the northbound Maryland managed lanes at this location will result in conflicts between vehicles continuing on the GP lanes and traffic merging from and diverging to the Maryland managed lanes.
  - (2) There is a decrease in approximately 35,000 ADT for vehicles entering this zone on the GP lanes in the 2045 Build conditions compared to the 2045 No Build conditions. This is due to vehicles choosing to either enter and exit the Express Lanes directly from the new GWMP access to and from the south and through trips traveling north and south on the Express Lanes bypassing the GP lanes all together.
  - (3) In the Build condition, the southbound ramp and C-D lane geometric re-configuration between GWMP and Route 193 removes weaving conflicts between vehicles destined for southbound I-495 and vehicles destined to Route 193. Additionally, the ability for "queue jumpers" to use the southbound C-D lanes and cause additional unnecessary weaving and merging conflicts is eliminated in the Build condition.

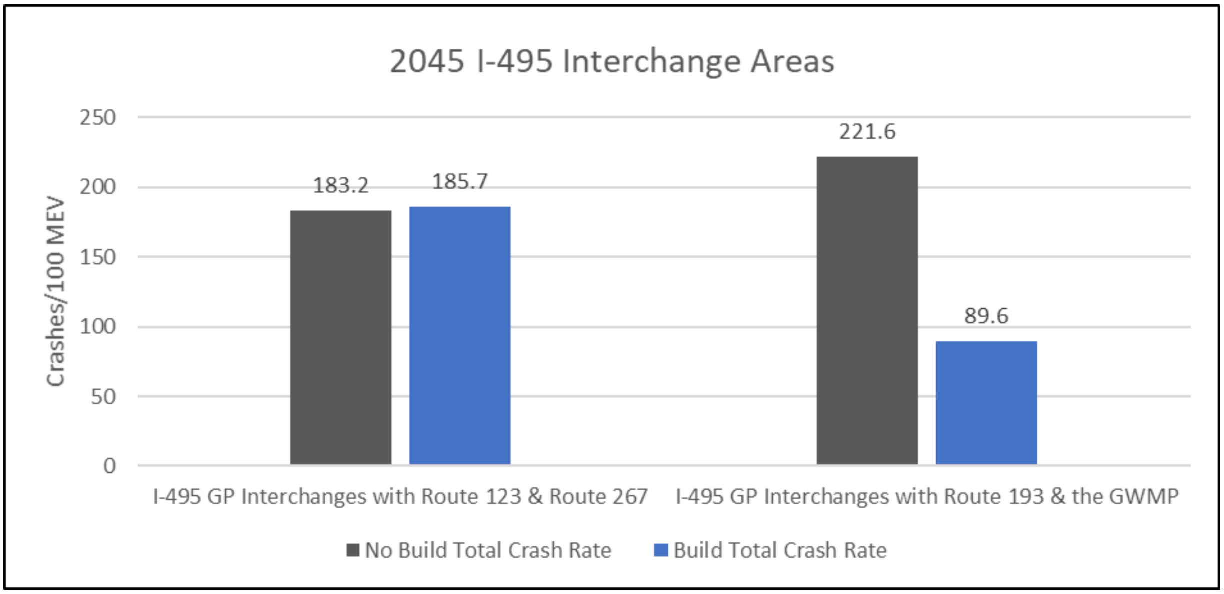


Figure 8-26. 2045 No Build and Build ISATe Predicted Crash Rate Summary for I-495 GP Interchange Areas

I-495 GP Lanes

Figure 8-27 shows the predicted crash rate per 100 MVMT for two segments of the northbound GP lanes between 2045 No Build and Build conditions. The following summarize the comparative crash rates for the northbound I-495 GP lanes under 2045 conditions**:**

- The predicted crash rate for the northbound GP lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 decreases by 21 crashes per 100 MVMT from No Build to Build conditions due to the C-D road system in both directions separating interchange traffic from through traffic and reducing weaving conflicts.
- The predicted crash rate for the northbound GP lanes from Route 267 to the interchanges with Route 193 and the GWMP decreases by nearly 10 crashes per 100 MVMT from No Build to Build conditions. The extension of the Express Lanes to the Maryland state line diverts volume from the GP Lanes to the Express Lanes through this segment, reducing congestion and there therefore lowering the potential for crashes to occur.

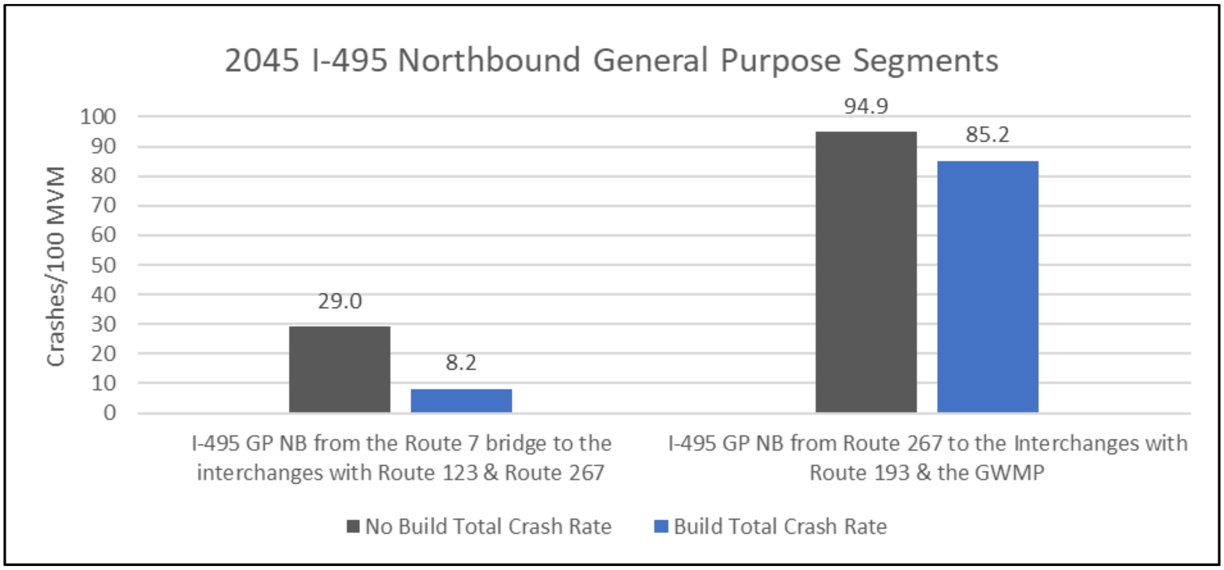


Figure 8-27. 2045 No Build and Build ISATe Predicted Crash Rate Summary for Northbound I-495 GP Lanes

Figure 8-28 shows the predicted crash rate for two segments of the southbound GP lanes between 2045 No Build and Build conditions. The following summarize the comparative crash rates for the southbound I-495 GP lanes under 2045 conditions**:**

- The predicted crash rate for the southbound I-495 GP lanes from Route 267 to the interchanges with Route 193 and the GWMP decrease from No Build to Build conditions. The extension of the Express Lanes from the northern terminus to the state line diverts volume from the GP Lanes to the Express Lanes through this segment; therefore, lowering projected crashes.
- The predicted crash rate for the southbound GP lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 show a nominal increase from No Build to Build conditions.

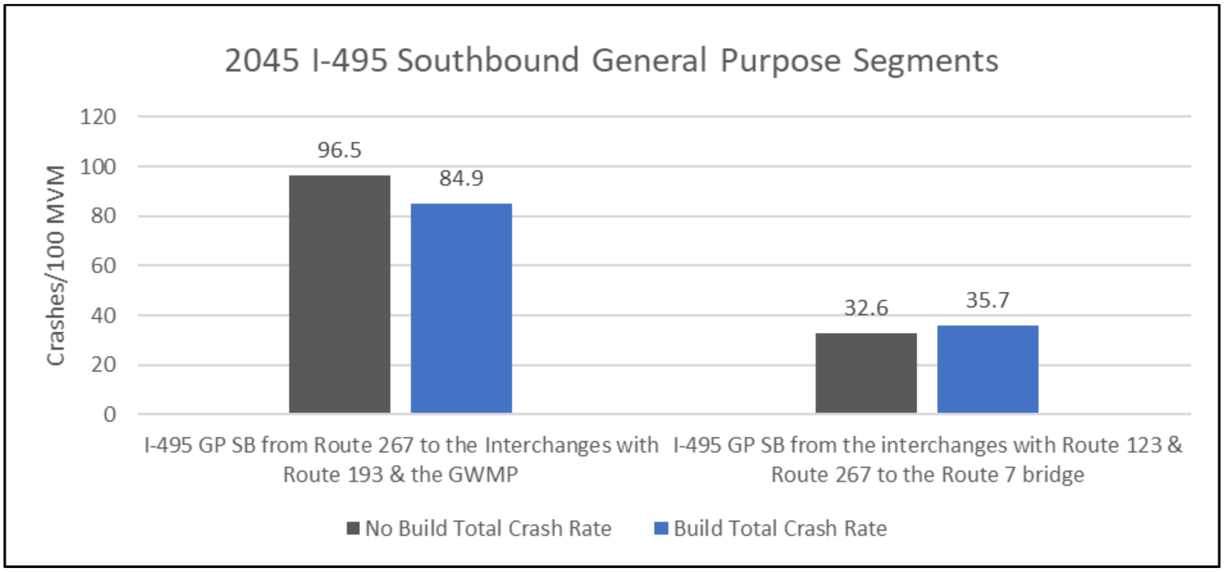


Figure 8-28. 2045 No Build and Build ISATe Predicted Crash Rate Summary for Southbound I-495 GP Lanes

I-495 Express Lanes

Figure 8-29 shows the predicted crash rate for four segments of the northbound Express Lanes between 2045 No Build and Build conditions. The following summarize the comparative crash rates for the northbound I-495 Express Lanes under 2045 conditions**:**

- The Express Lanes predicted crash rate from the existing northern terminus to the GWMP interchange is shown only for the Build condition. Express Lanes are not present in the No Build condition for this section.
- The predicted crash rate for the northbound Express Lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 decreases by nearly 14 crashes per 100 MVMT from No Build to Build conditions largely due to the increase in volume without introducing any new access for this segment.
- The predicted crash rate for the northbound Express Lanes within the Route 123 and Route 267 interchanges increases in the Build condition by 18 crashes per 100 MVMT due to the introduction of connecting ramps from Route 267 and an increase in volume on existing Express Lanes ramps. Note that in 2045 Build conditions, ramp-related crashes account for approximately 75 percent of all Express Lanes crashes in the I-495/Route 267/Route 123 interchange zone.
- The predicted crash rate for the northbound Express Lanes from the GWMP to the state line decreases by 7 crashes per MVMT from 2045 No Build conditions to 2045 Build conditions, as the Build condition provides a continuous Express Lanes system whereas the No Build condition assumes the southern terminus of the Maryland managed lanes system, featuring a southbound merge and northbound diverge.

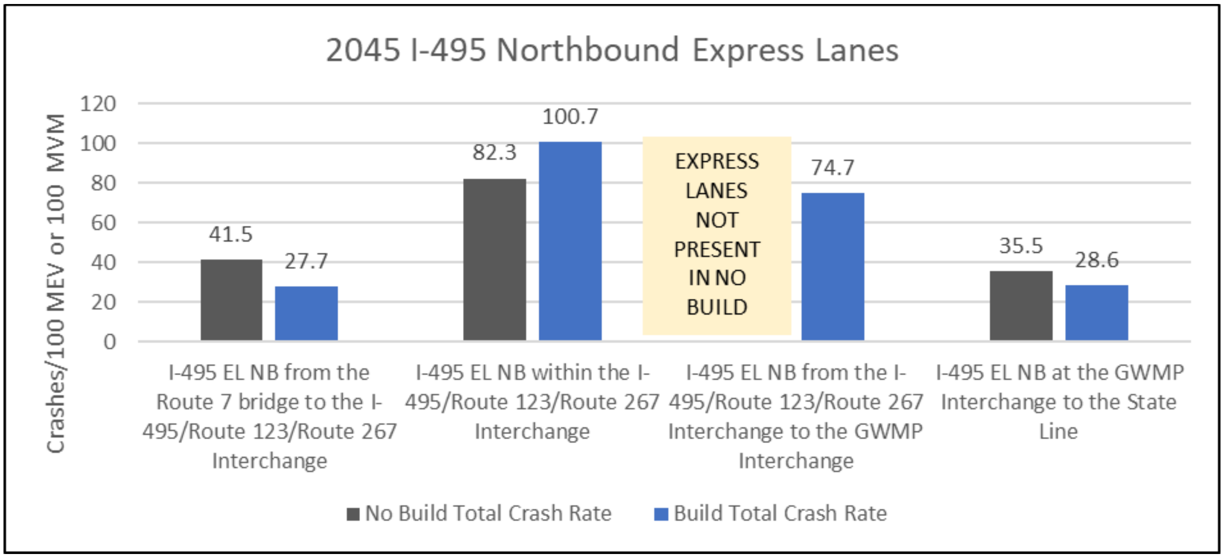


Figure 8-29. 2045 No Build and Build SPFs Developed for Express Lanes Predicted Crash Rate Summary for I-495 Northbound Express Lanes

Figure 8-30 shows the predicted crash rate for four segments of the southbound Express lanes between 2045 No Build and Build conditions. The following summarize the comparative crash rates for the southbound I-495 Express Lanes under 2045 conditions**:**

- The Express Lanes predicted crash rate from the GWMP interchange to the existing northern terminus is shown only for the Build condition. Express Lanes are not present in the No Build condition for this section.
- The predicted crash rate for the southbound Express Lanes from the GWMP to the state lines decrease by nearly 14 crashes per 100 MVMT from 2045 No Build conditions to 2045 Build conditions, as the Build condition provides a continuous Express Lanes system whereas the No Build condition assumes the southern terminus of the Maryland managed lanes system, featuring a southbound merge and northbound diverge.
- The predicted crash rate for the southbound Express Lanes within the Route 123 and Route 267 interchanges increases by nearly 22 crashes per 100 MVMT. Similar to the northbound Express Lanes, this is due to the introduction of connecting ramps from and to Route 267 and increases in volume on existing Express Lanes ramps. In 2045 Build conditions, ramp related crashes account for approximately 70 percent of all Express Lanes crashes in the I-495/Route 267/Route 123 interchange zone.
- The predicted crash rate for the southbound Express Lanes from the interchanges with Route 123 and Route 267 to the Route 7 bridge decreases from No Build to Build largely due to the increase in volume without introducing any new access for this segment.

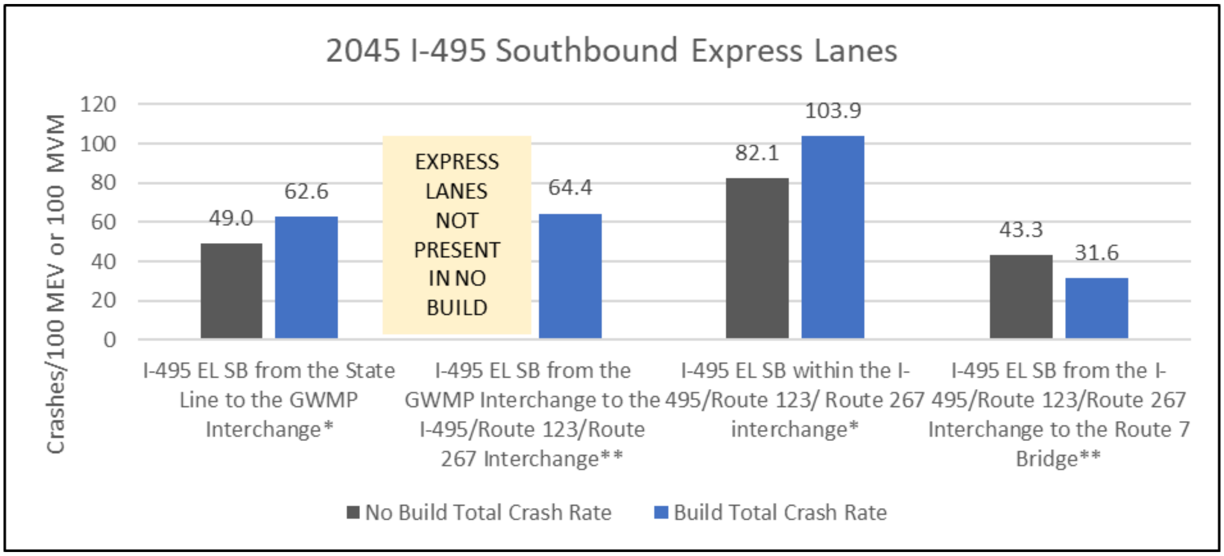


Figure 8-30. 2045 No Build and Build SPFs Developed for Express Lanes Predicted Crash Rate Summary for I-495 Southbound Express Lanes

Route 267

Figure 8-31 shows the predicted crash rate for five segments of Route 267 (DTR) between 2045 No Build and Build conditions. The following summarize the comparative crash rates for the DTR under 2045 conditions:

- The DTR crash rates decrease slightly in the Build condition as compared to the No Build condition at the interchange of Spring Hill Road and at the interchange with Route 123.
- The DTR crash rates increase slightly in the Build condition as compared to the No Build condition at the interchange with I-495; this is attributable to the increased demand from the Express Lanes extension and additional ramp connections to and from the Express Lanes.
- The DTR crash rates for the eastbound and westbound between the Route 123 interchange and the eastern terminus (0.03 miles past the Route 650 bridge) are significantly higher that segments to the west; however, these segments are quite short in length and overall annual crash frequencies are quite low. In both directions of the DTR along these segments, a decrease is predicted in Build conditions as compared to No Build conditions.

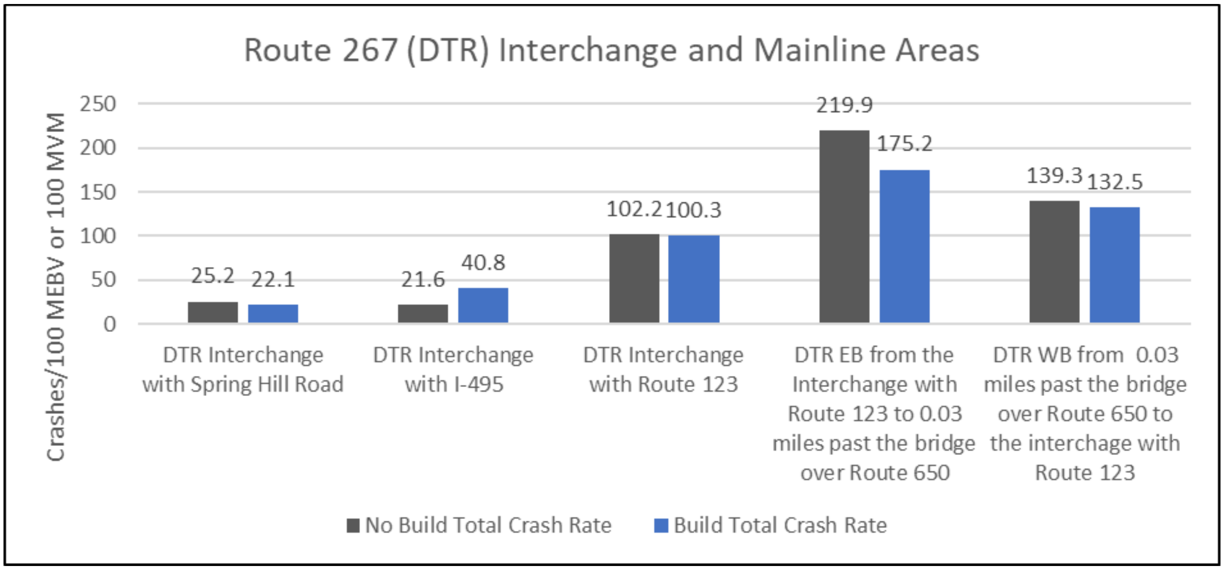


Figure 8-31. 2045 No Build and Build ISATe Predicted Crash Rate Summary for Route 267 (DTR)

Figure 8-32 shows the predicted crash crate for each direction of Route 267 (DAAR) between 2045 No Build and Build conditions. The following summarize the comparative crash rates for the DAAR under 2045 conditions:

- The predicted crash rate for eastbound DAAR decreases from No Build to Build conditions due to new direct access to the I-495 Express Lanes.
- The predicted crash rate for westbound DAAR shows a nominal decrease from No Build to Build conditions.

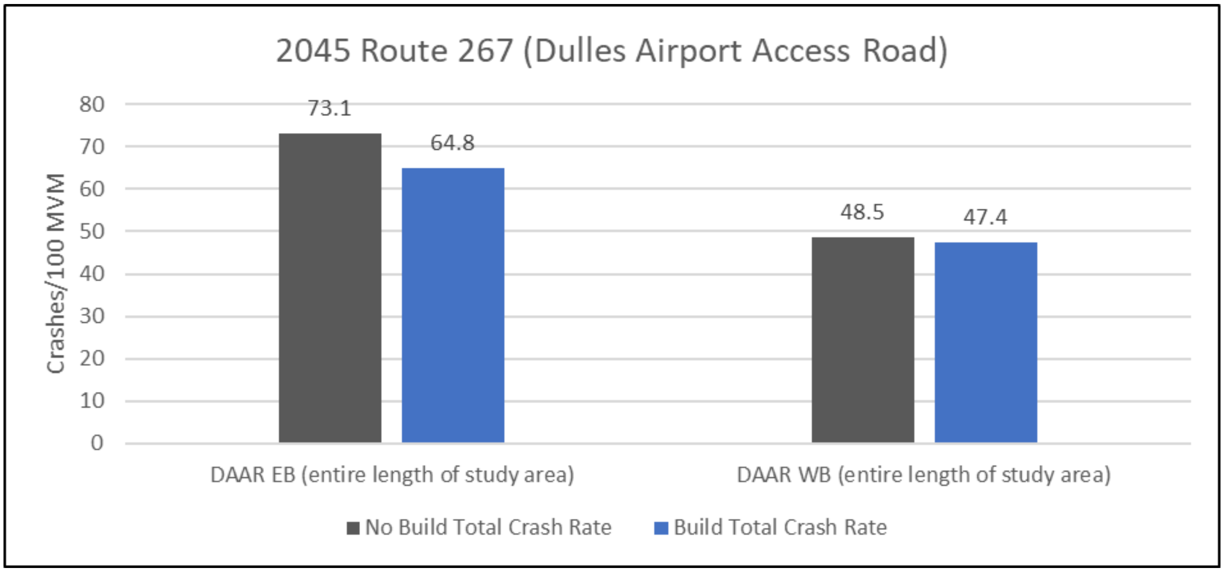


Figure 8-32. 2045 No Build and Build ISATe Predicted Crash Rate Summary for Route 267 (DAAR)

2045 No Build and Build Crash Frequency Predictions

I-495 Interchanges

Figure 8-33 shows the predicted crash frequency (crashes/year) for two segments of the I-495 interchanges between 2045 No Build and Build conditions. The following summarize the comparative crash frequencies for the I-495 interchanges under 2045 conditions:

- The predicted annual crash frequency decreases for the I-495 GP interchanges with Route 123 and Route 267 due to geometric improvements and a C-D system that separates interchange movements from mainline through movements.
- The predicted annual crash frequency decreases significantly by nearly 168 crashes per year for the Route 193 and GWMP interchange analysis zone when comparing the No Build and Build conditions. There are multiple contributing factors:
    - (1) In the 2045 No Build condition, it is assumed that the Maryland managed lanes terminate within this zone. A merge from the southbound Maryland managed lanes and a diverge to the northbound Maryland managed lanes at this location will result in conflicts between vehicles continuing on the GP lanes and traffic merging from and diverging to the Maryland managed lanes.
    - (2) There is a decrease in approximately 35,000 ADT for vehicles entering this zone on the GP lanes in the 2045 Build conditions compared to the 2045 No Build conditions. This is due to vehicles choosing to either enter and exit the Express Lanes directly from the new GWMP access to and from the south and through trips traveling north and south on the Express Lanes bypassing the GP lanes all together.
    - (3) In the Build condition, the southbound ramp and C-D lane geometric re-configuration between GWMP and Route 193 removes weaving conflicts between vehicles destined for southbound I-495 and vehicles destined to Route 193. Additionally, the ability for "queue jumpers" to use the southbound C-D lanes and cause additional unnecessary weaving and merging conflicts is eliminated in the Build condition.

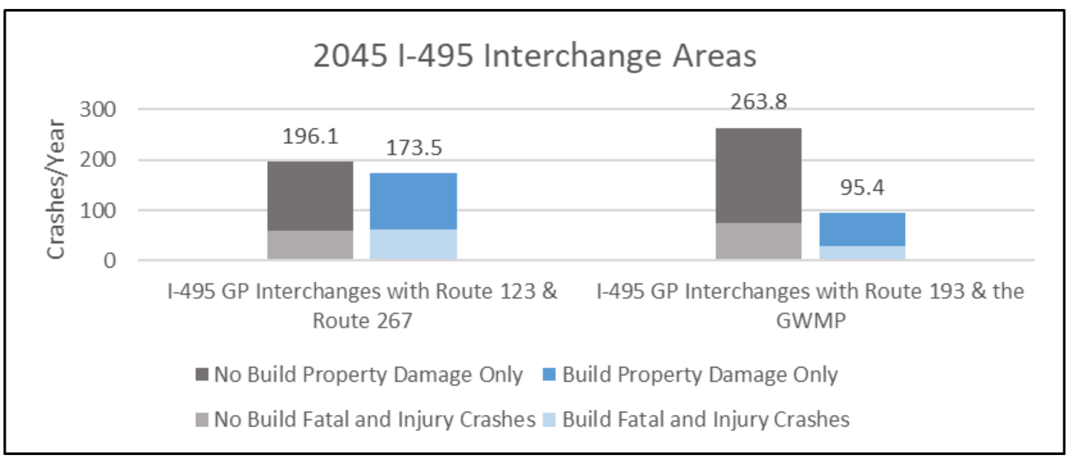


Figure 8-33. 2045 No Build and Build ISATe Predicted Crash Frequency Summary for I-495 GP Interchange Areas

I-495 GP Lanes

Figure 8-34 shows the predicted annual crash frequency for two segments of the northbound GP lanes between 2045 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the northbound I-495 GP lanes under 2045 conditions**:**

- The predicted annual crash frequency for the northbound GP lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 decreases from No Build to Build conditions due to the C-D road system in both directions separating interchange traffic from through traffic and reducing weaving conflicts.
- The predicted annual crash frequency for the northbound GP lanes from Route 267 to the interchanges with Route 193 and the GWMP decreases from No Build to Build conditions. The extension of the Express Lanes to the Maryland state line diverts volume from the GP Lanes to the Express Lanes through this segment, reducing congestion and there therefore lowering the potential for crashes to occur.

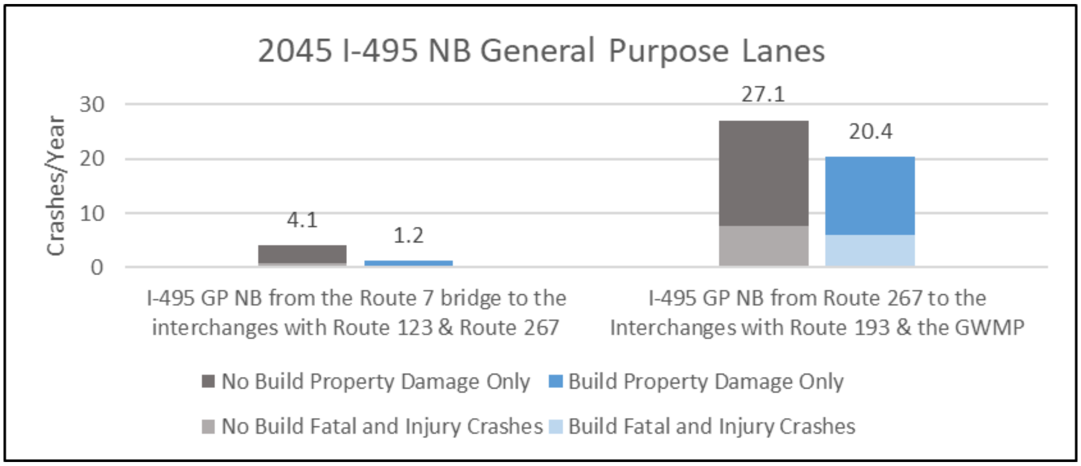


Figure 8-34. 2045 No Build and Build ISATe Predicted Crash Frequency Summary for I-495 Northbound GP Lanes

Figure 8-35 shows the predicted annual crash frequency for two segments of the southbound GP lanes between 2045 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the southbound I-495 GP lanes under 2045 conditions**:**

- The predicted annual crash frequency for the I-495 southbound GP lanes from Route 267 to the interchanges with Route 193 and the GWMP decreases by 9 crashes per year from No Build to Build. The extension of the Express Lanes from the northern terminus to the state line diverts volume from the GP Lanes to the Express Lanes through this segment; therefore, lowering the projected number of crashes.
- The predicted annual crash frequency for the southbound GP lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 shows a nominal increase from No Build to Build conditions.

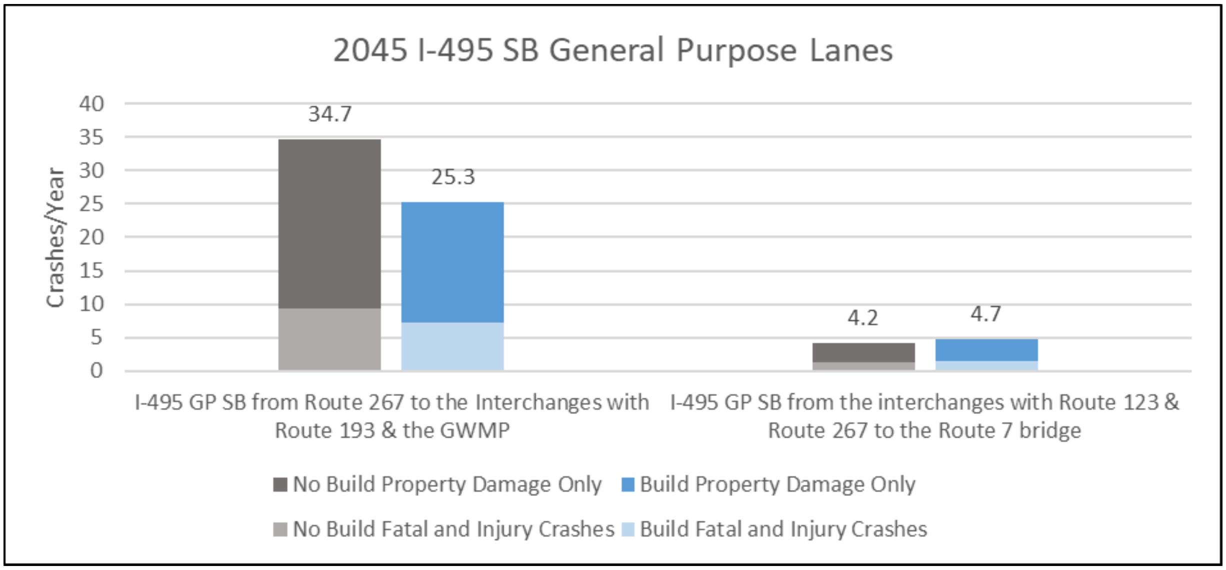


Figure 8-35. 2045 No Build and Build ISATe Predicted Crash Frequency Summary for I-495 Southbound GP Lanes

<u>I-495 Express Lanes</u>

Figure 8-36 shows the predicted annual crash frequency for four segments of the northbound Express Lanes between 2045 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the northbound I-495 Express Lanes under 2045 conditions**:**

- The Express Lanes predicted crash frequency from the existing northern terminus to the GWMP interchange is shown only for the Build condition. Express Lanes are not present in the No Build condition for this section.
- The predicted crash frequency for the northbound Express Lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 decreases nominally from No Build to Build conditions.
- The predicted crash rate for the northbound Express Lanes within the Route 123 and Route 267 interchanges increases in the Build condition due to the introduction of connecting ramps from Route 267 and an increase in volume on existing Express Lanes ramps. Note that in 2045 Build conditions, ramp-related crashes account for approximately 75 percent of all Express Lanes crashes in the I-495/Route 267/Route 123 interchange zone.
- Given the increase in volume and connections to the south on I-495 and to the GWMP, the predicted annual crash frequency for the northbound Express Lanes from the GWMP interchange to the state line increase nominally from 2045 No Build to 2045 Build conditions.

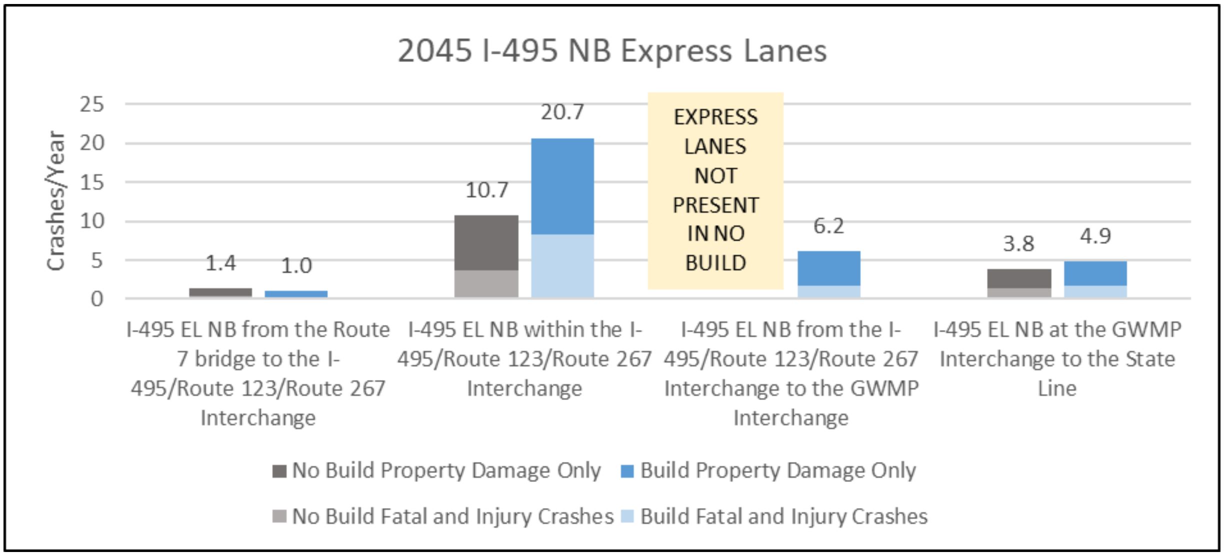


Figure 8-36. 2045 No Build and Build SPFs Developed for Express Lanes Predicted Crash Frequency Summary for I-495 Northbound Express Lanes

Figure 8-37 shows the predicted crash frequency (crashes/year) for four segments of the southbound Express lanes between 2045 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the southbound I-495 Express Lanes under 2045 conditions**:**

- The Express Lanes predicted annual crash frequency from the existing northern terminus to the GWMP interchange is shown only for the Build condition. Express Lanes are not present in the No Build condition for this section.
- The predicted annual crash frequency for the southbound Express Lanes from the GWMP to the state line decreases from 2045 No Build to 2045 Build conditions, as the Build condition provides a continuous Express Lanes system whereas the No Build condition assumes the southern terminus of the Maryland managed lanes system, featuring a southbound merge and northbound diverge.
- The predicted annual crash frequency for the southbound Express Lanes within the Route 123 and Route 267 interchanges increases. Similar to the northbound Express Lanes, this is due to the introduction of connecting ramps from and to Route 267 and increases in volume on existing Express Lanes ramps. In 2045 Build conditions, ramp related crashes account for approximately 70 percent of all Express Lanes crashes in the I-495/Route 267/Route 123 interchange zone.
- The predicted annual crash frequency for the southbound Express Lanes from the interchanges with Route 123 and Route 267 to the Route 7 bridge decreases nominally.

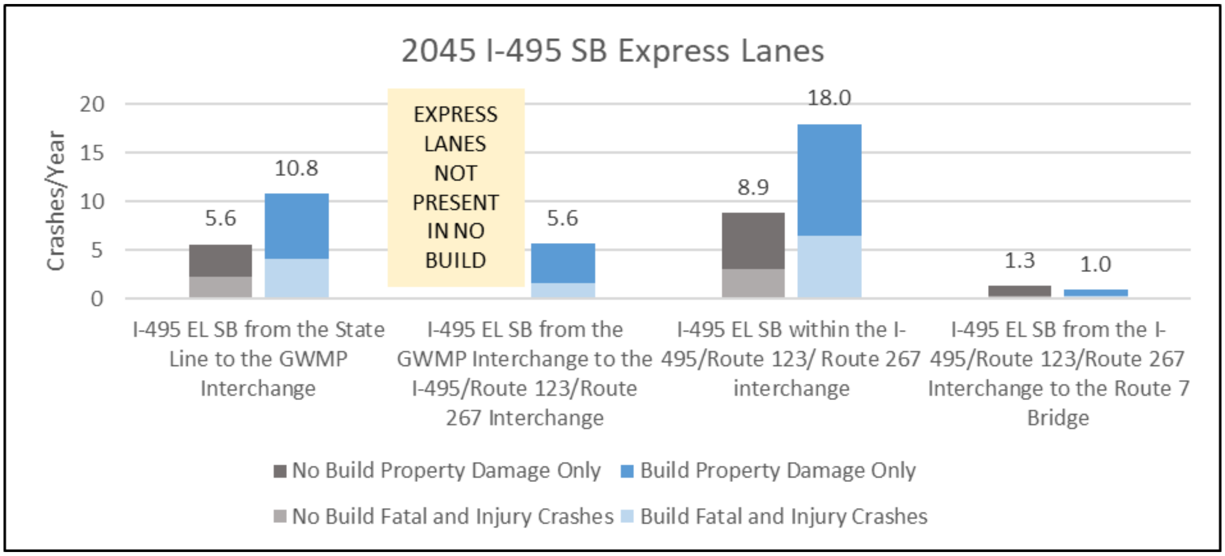


Figure 8-37. 2045 No Build and Build SPFs Developed for Express Lanes Predicted Crash Frequency Summary for I-495 Southbound Express Lanes

Route 267

Figure 8-38 shows the predicted crash frequency for five segments of Route 267 (DTR) between 2045 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the DTR under 2045 conditions:

- The annual crash frequency along the DTR increases in the Build condition through the interchange with I-495 due to the increased demand from the Express Lanes extension and additional ramp connections to the Express Lanes.
- Annual crash frequencies at other locations along the DTR are predicted to decrease slightly or remain stable.

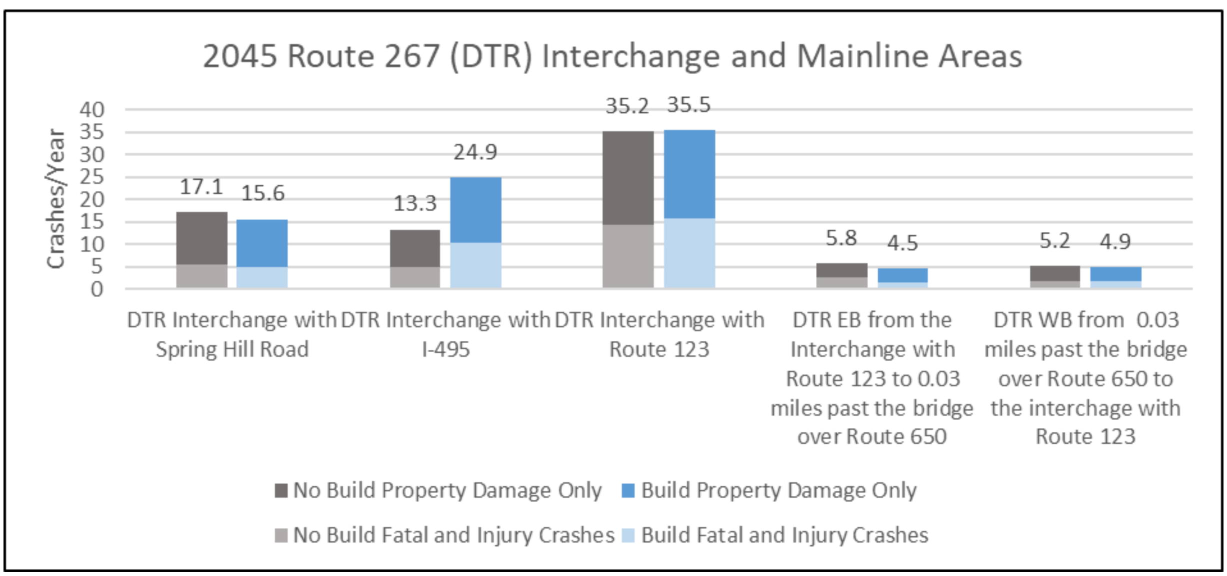


Figure 8-38. 2045 No Build and Build ISATe Predicted Crash Frequency Summary for Route 267 (DTR)

Figure 8-39 shows the predicted crash frequency for each direction of Route 267 (DAAR) between 2045 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the DAAR under 2045 conditions:

- The predicted annual crash frequency for eastbound DAAR shows a nominal change from 2045 No Build to Build conditions.
- The predicted annual crash frequency for westbound DAAR shows a nominal change from 2045 No Build to 2045 Build conditions.

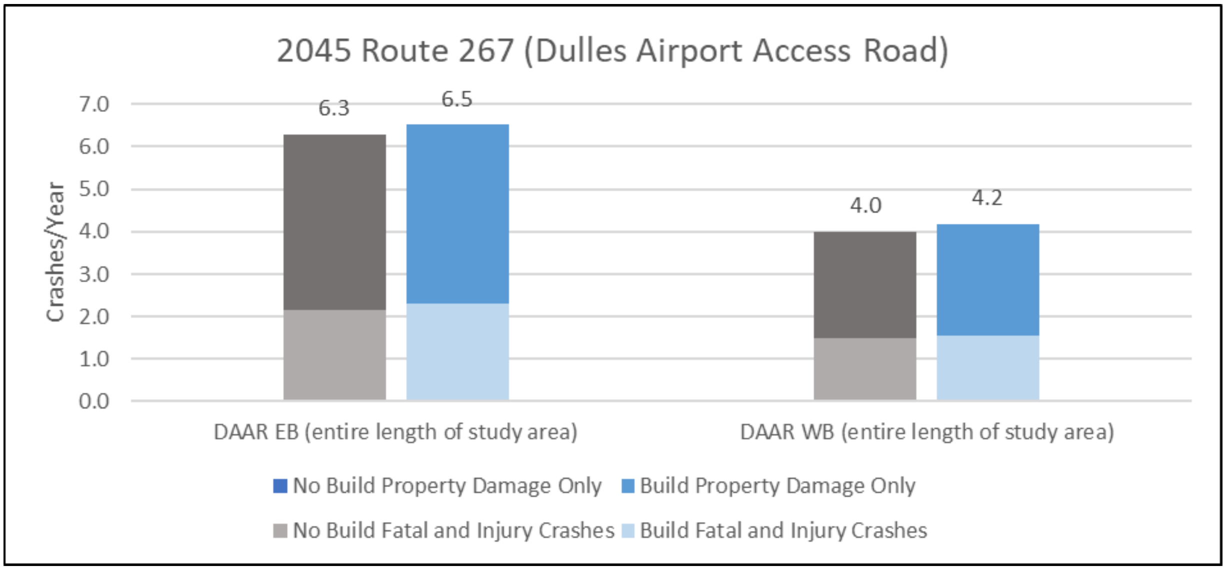


Figure 8-39. 2045 No Build and Build ISATe Predicted Crash Frequency Summary for Route 267 (DAAR)

8.3.4 Arterial Crash Prediction

Predicted crash frequencies were calculated for each of the 33 arterial intersections in the Traffic Operations Study Area. Predicted annual number of fatal, injury, and property damage only crashes were identified by location for future No Build and Build conditions.

Table 8-3 provides a summary of predicted crash frequencies for 2025 No Build and Build conditions. In 2025, all intersections have a nominal decrease or no change in crash frequencies from No Build to Build conditions. The predicted annual number crashes is forecasted to reduce by approximately 4 percent (2 fatal or injury crashes and 4 PDO crashes per year) when comparing 2025 No Build and Build conditions for the entire Traffic Operations Study Area.

Table 8-4 provides a summary of predicted crash frequencies for 2045 No Build and Build conditions. In 2045, all intersections have a nominal decrease or no change in crash frequencies from No Build to Build conditions. The predicted annual number of crashes is estimated to reduce by approximately 1 percent (1 PDO crash per year) when comparing arterial intersections under 2045 No Build and Build conditions for the entire Traffic Operations Study Area.

Table 8-3. 2025 Arterial Intersection Predicted Crash Frequencies

Intersection	Predicted Annual Number of Fatal & Injury Crashes			Predicted Annual Number of Property Damage Only (PDO) Crashes			Predicted Annual Number of Total Crashes		
	2025 No Build	2025 Build	Difference	2025 No Build	2025 Build	Difference	2025 No Build	2025 Build	Difference
Intersection #1 - Anderson Rd/267 EB Off-ramp & Dolley Madison Blvd	2.9	2.8	-0.1	5.2	4.9	-0.3	8.1	7.7	-0.4
Intersection #2 - Lewsinsville Rd & Balls Hill Rd	0.6	0.6	0.0	1.1	1.1	0.0	1.7	1.7	0.0
Intersection #3 - Dolley Madison Blvd & Lewinsville Rd/Great Falls St	2.7	2.6	-0.1	4.9	4.7	-0.2	7.6	7.3	-0.3
Intersection #4 - Westpark Dr & 495 Exp. Lanes Connector	1.0	1.0	0.0	1.9	1.9	0.0	2.9	2.9	0.0
Intersection #5 - 495 Exp. Lanes Ramps & 495 Exp. Lanes Connector	0.5	0.5	0.0	0.9	0.8	-0.1	1.4	1.3	-0.1
Intersection #6 - Tysons Blvd & Chain Bridge Rd	3.8	3.7	-0.1	6.3	6.3	0.0	10.1	10.0	-0.1
Intersection #7 - Capital One Dr/Old Meadow Rd & Dolley Madison Blvd	3.7	3.6	-0.1	6.2	6.1	-0.1	9.9	9.7	-0.2
Intersection #8 - Dolley Madison Blvd & Scotts Crossing Rd/Colshire Dr	3.1	3.0	-0.1	5.3	5.2	-0.1	8.4	8.2	-0.2
Intersection #9 - Jones Branch Dr/Jones Branch Connector	1.2	1.2	0.0	2.4	2.4	0.0	3.6	3.6	0.0
Intersection #10 - 495 Exp. Lanes Ramps & Jones Branch Connector	0.4	0.4	0.0	0.7	0.7	0.0	1.1	1.1	0.0
Intersection #11 - Spring Hill Rd/International Dr & Jones Branch Dr	0.9	1.0	0.1	1.8	1.9	0.1	2.7	2.9	0.2
Intersection #12 - Spring Hill Rd & DTR EB Ramps	1.3	1.3	0.0	2.6	2.6	0.0	3.9	3.9	0.0
Intersection #13 - Spring Hill Rd & DTR WB Ramps	1.3	1.3	0.0	2.6	2.6	0.0	3.9	3.9	0.0
Intersection #14 - Spring Hill Rd & Lewinsville Rd	1.8	1.8	0.0	3.6	3.6	0.0	5.4	5.4	0.0
Intersection #15 - Spring Hill Rd & Old Dominion Dr	0.7	0.7	0.0	1.4	1.4	0.0	2.1	2.1	0.0
Intersection #16 - Old Dominion Dr & Swinks Mill Rd	0.7	0.7	0.0	1.6	1.6	0.0	2.3	2.3	0.0
Intersection #17 - Old Dominion Dr & Balls Hill Rd	0.7	0.7	0.0	1.5	1.5	0.0	2.2	2.2	0.0
Intersection #18 - Georgetown Pike & Balls Hill Rd	1.1	0.9	-0.2	2.1	1.7	-0.4	3.2	2.6	-0.6
Intersection #19 - Georgetown Pike & 495 NB Ramp	1.5	1.2	-0.3	3.2	2.6	-0.6	4.7	3.8	-0.9
Intersection #20 - Georgetown Pike & 495 SB Ramp	3.2	3.0	-0.2	7.6	7.0	-0.6	10.8	10.0	-0.8
Intersection #21 - Dolley Madison Blvd & Old Dominion Dr	2.0	1.8	-0.2	3.6	3.4	-0.2	5.6	5.2	-0.4
Intersection #22 - Georgetown Pike and Dead Run Dr	1.2	1.0	-0.2	1.8	1.5	-0.3	3.0	2.5	-0.5
Intersection #23 - Georgetown Pike & Helga Place/Linganore Dr	0.8	0.7	-0.1	1.3	1.1	-0.2	2.1	1.8	-0.3
Intersection #24 - Georgetown Pike & Swinks Mill Rd	0.9	0.7	-0.2	1.6	1.3	-0.3	2.5	2.0	-0.5
Intersection #25 - Georgetown Pike & Spring Hill Rd	0.5	0.4	-0.1	0.6	0.5	-0.1	1.1	0.9	-0.2
Intersection #26 - Lewinsville Rd & Swinks Mill Rd	0.5	0.5	0.0	0.7	0.7	0.0	1.2	1.2	0.0
Intersection #27 - Dolley Madison Blvd & Ingleside Ave	1.8	1.7	-0.1	2.4	2.3	-0.1	4.2	4.0	-0.2
Intersection #28 - Georgetown Pike & Douglass Dr	1.2	1.0	-0.2	1.8	1.5	-0.3	3.0	2.5	-0.5
Intersection #29 - Jones Branch Connector & Capital One Dr (West)	1.5	1.5	0.0	2.9	2.9	0.0	4.4	4.4	0.0
Intersection #30 - Jones Branch Connector & Capital One Dr (East)	0.6	0.6	0.0	1.1	1.1	0.0	1.7	1.7	0.0
Intersection #31 - Chain Bridge Rd & 495 SB Off-Ramp	3.3	3.3	0.0	8.1	8.1	0.0	11.4	11.4	0.0
Intersection #32 - Dolley Madison Blvd & 495 NB Off-ramp	3.2	3.2	0.0	7.6	7.7	0.1	10.8	10.9	0.1
Intersection #33 - Dolley Madison Blvd & 267 EB On-Ramp	1.8	1.8	0.0	4.0	3.8	-0.2	5.8	5.6	-0.2
Total	***52.4***	***50.2***	***-2.2***	***100.4***	***96.5***	***-3.9***	***152.8***	***146.7***	***-6.1***

Table 8-4. 2045 Arterial Intersection Predicted Crash Frequencies

Intersection	Predicted Annual Number of Fatal & Injury Crashes			Predicted Annual Number of Property Damage Only (PDO) Crashes			Predicted Annual Number of Total Crashes		
	2045 No Build	2045 Build	Difference	2045 No Build	2045 Build	Difference	2045 No Build	2045 Build	Difference
Intersection #1 - Anderson Rd/267 EB Off-ramp & Dolley Madison Blvd	5.8	5.9	0.1	9.9	10.0	0.1	15.7	15.9	0.2
Intersection #2 - Lewsinsville Rd & Balls Hill Rd	0.8	0.8	0.0	1.4	1.4	0.0	2.2	2.2	0.0
Intersection #3 - Dolley Madison Blvd & Lewinsville Rd/Great Falls St	4.0	4.0	0.0	6.7	6.8	0.1	10.7	10.8	0.1
Intersection #4 - Westpark Dr & 495 Exp. Lanes Connector	1.5	1.5	0.0	3.3	3.3	0.0	4.8	4.8	0.0
Intersection #5 - 495 Exp. Lanes Ramps & 495 Exp. Lanes Connector	0.9	1.0	0.1	1.8	1.9	0.1	2.7	2.9	0.2
Intersection #6 - Tysons Blvd & Chain Bridge Rd	3.4	3.5	0.1	6.0	6.1	0.1	9.4	9.6	0.2
Intersection #7 - Capital One Dr/Old Meadow Rd & Dolley Madison Blvd	3.1	3.1	0.0	5.5	5.4	-0.1	8.6	8.5	-0.1
Intersection #8 - Dolley Madison Blvd & Scotts Crossing Rd/Colshire Dr	3.4	3.4	0.0	6.0	6.0	0.0	9.4	9.4	0.0
Intersection #9 - Jones Branch Dr/Jones Branch Connector	1.1	1.1	0.0	2.1	2.1	0.0	3.2	3.2	0.0
Intersection #10 - 495 Exp. Lanes Ramps & Jones Branch Connector	0.4	0.4	0.0	0.8	0.8	0.0	1.2	1.2	0.0
Intersection #11 - Spring Hill Rd/International Dr & Jones Branch Dr	0.4	0.4	0.0	0.9	0.9	0.0	1.3	1.3	0.0
Intersection #12 - Spring Hill Rd & DTR EB Ramps	1.3	1.3	0.0	2.8	2.8	0.0	4.1	4.1	0.0
Intersection #13 - Spring Hill Rd & DTR WB Ramps	1.1	1.1	0.0	2.2	2.3	0.1	3.3	3.4	0.1
Intersection #14 - Spring Hill Rd & Lewinsville Rd	1.8	1.8	0.0	3.6	3.6	0.0	5.4	5.4	0.0
Intersection #15 - Spring Hill Rd & Old Dominion Dr	0.9	0.9	0.0	2.0	2.0	0.0	2.9	2.9	0.0
Intersection #16 - Old Dominion Dr & Swinks Mill Rd	0.9	0.9	0.0	1.9	1.8	-0.1	2.8	2.7	-0.1
Intersection #17 - Old Dominion Dr & Balls Hill Rd	0.8	0.9	0.1	1.8	1.9	0.1	2.6	2.8	0.2
Intersection #18 - Georgetown Pike & Balls Hill Rd	1.0	1.0	0.0	2.1	2.0	-0.1	3.1	3.0	-0.1
Intersection #19 - Georgetown Pike & 495 NB Ramp	1.2	1.0	-0.2	2.6	2.1	-0.5	3.8	3.1	-0.7
Intersection #20 - Georgetown Pike & 495 SB Ramp	3.1	2.8	-0.3	7.4	6.6	-0.8	10.5	9.4	-1.1
Intersection #21 - Dolley Madison Blvd & Old Dominion Dr	1.7	1.7	0.0	3.2	3.1	-0.1	4.9	4.8	-0.1
Intersection #22 - Georgetown Pike and Dead Run Dr	1.5	1.6	0.1	2.2	2.2	0.0	3.7	3.8	0.1
Intersection #23 - Georgetown Pike & Helga Place/Linganore Dr	0.8	0.8	0.0	1.3	1.2	-0.1	2.1	2.0	-0.1
Intersection #24 - Georgetown Pike & Swinks Mill Rd	1.0	0.9	-0.1	1.9	1.8	-0.1	2.9	2.7	-0.2
Intersection #25 - Georgetown Pike & Spring Hill Rd	0.6	0.6	0.0	0.8	0.7	-0.1	1.4	1.3	-0.1
Intersection #26 - Lewinsville Rd & Swinks Mill Rd	0.7	0.7	0.0	1.1	1.1	0.0	1.8	1.8	0.0
Intersection #27 - Dolley Madison Blvd & Ingleside Ave	2.8	2.8	0.0	3.6	3.6	0.0	6.4	6.4	0.0
Intersection #28 - Georgetown Pike & Douglass Dr	1.5	1.6	0.1	2.1	2.2	0.1	3.6	3.8	0.2
Intersection #29 - Jones Branch Connector & Capital One Dr (West)	1.5	1.5	0.0	2.9	2.9	0.0	4.4	4.4	0.0
Intersection #30 - Jones Branch Connector & Capital One Dr (East)	0.6	0.6	0.0	1.2	1.2	0.0	1.8	1.8	0.0
Intersection #31 - Chain Bridge Rd & 495 SB Off-Ramp	3.7	3.7	0.0	9.0	8.8	-0.2	12.7	12.5	-0.2
Intersection #32 - Dolley Madison Blvd & 495 NB Off-ramp	1.5	1.5	0.0	3.3	3.2	-0.1	4.8	4.7	-0.1
Intersection #33 - Dolley Madison Blvd & 267 EB On-Ramp	3.5	3.4	-0.1	8.2	8.2	0.0	11.7	11.6	-0.1
Total	***58.3***	***58.2***	***-0.1***	***111.6***	***110.0***	***-1.6***	***169.9***	***168.2***	***-1.7***

8.3.5 Future Safety Analysis Conclusions

Planning-level crash prediction analysis was performed using industry-standard practices and highway safety analysis tools. This analysis evaluated the safety performance of the differences between the 2025 No Build and Build conditions and the 2045 No Build and Build conditions. This evaluation considered all locations within the I-495 NEXT Traffic Operations Study Area affected by changes in geometry or forecasted volumes: interchanges, freeway segments, ramp segments, and key arterial intersections. Both qualitative and quantitative analyses were conducted to evaluate No Build and Build conditions in the I-495 NEXT corridor between Route 7 and the ALMB.

Under analyzed 2025 conditions, the Build condition has positive safety impacts on the I-495 corridor as well as the surrounding arterial network as compared to No Build conditions by improving throughput and reducing congestion in both directions of the I-495 corridor. However, if no improvements are constructed or undertaken in Maryland at the Express Lanes northern terminus of the I-495 NEXT project, it is anticipated there will be some potential safety concerns by introducing additional merge and diverge conflicts into the currently congested area of the GWMP and ALMB.

For 2045 conditions, the Build condition produces significant overall safety benefits as compared to No Build conditions by efficiently moving a greater volume of traffic with significantly reduced congestion in both directions of the I-495 corridor. With the full Express Lanes network extended into Maryland, it is anticipated that the corridor will operate at a much-improved level of safety as compared to No Build conditions. Comprehensively, the project is a significant improvement in overall safety.

In both 2025 and 2045 analysis scenarios, the I-495 NEXT Project is anticipated to have a positive impact on the safety of the corridor within the EA project study area. Based on analysis of both scenarios, it is projected that the safety benefits of the project will improve into future years and have an increasing reduction in overall crash activity and crash rates along the corridor.

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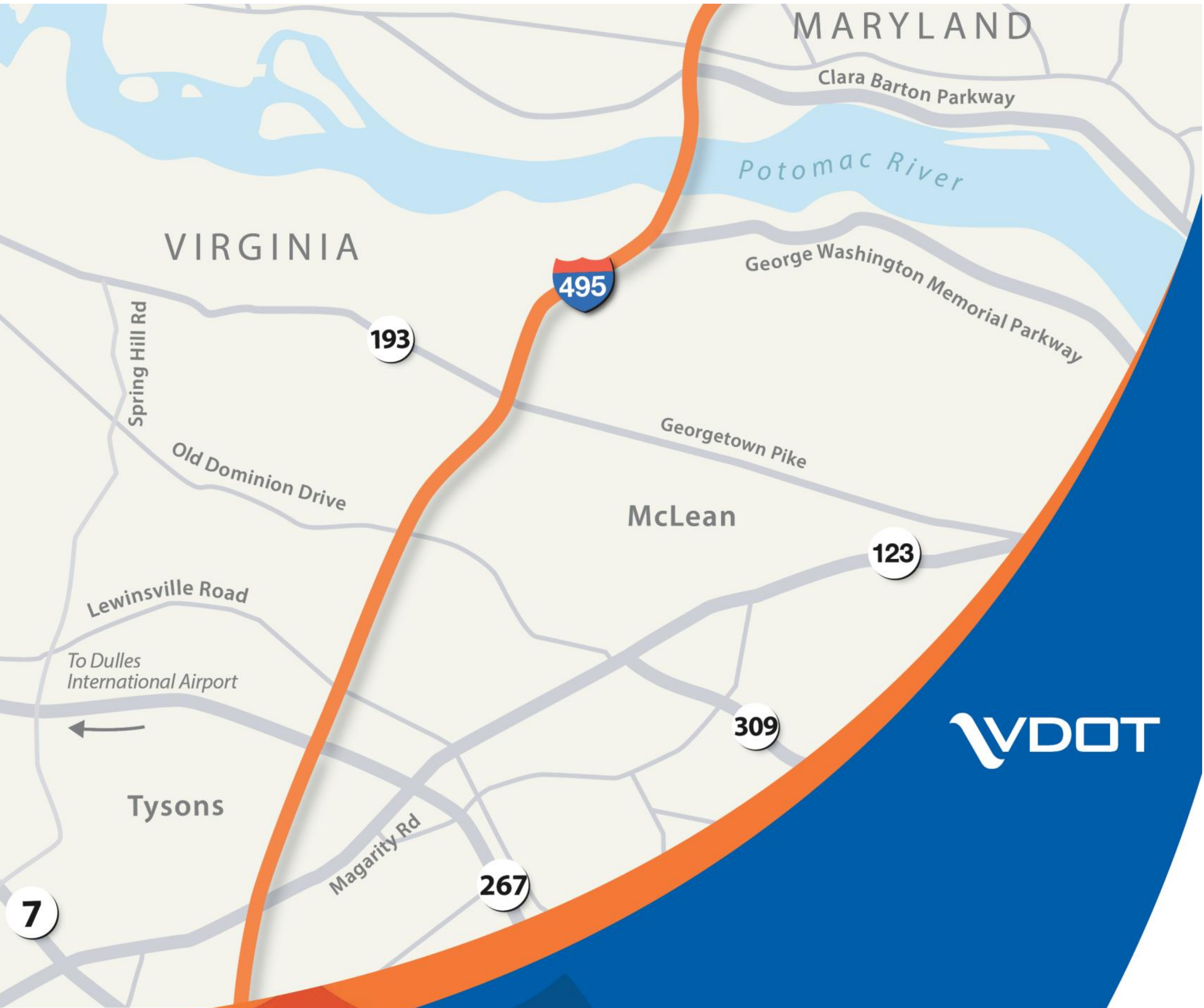

VDOT

ENVIRONMENTAL ASSESSMENT

Traffic and Transportation Technical Report Appendices

February 2020

495 ExpressLanes NORTHERN EXTENSION

Appendix A: Project Scoping Framework Document

I-495 Express Lanes Northern Extension Project (I-495 NEXT Project)

FINAL EXECUTED VERSION

Scoping Framework Document for *I-495 NEXT Project*

FHWA Concurrence for Approach and Methodology

VDOT Contract ID No. 45978 /Project No. 113414

NOVEMBER 15, 2018

Prepared for:

NOVA District, Fairfax
Central Office, Richmond

Virginia Division, Richmond

Prepared by:

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ATTACHMENTS/APPENDICES

1. I-495 NEXT Traffic Operation Analysis Framework Memorandum
2. I-495 NEXT Travel Demand Forecasting Memorandum
3. I-495 NEXT VISSIM Calibration Memorandum
4. I-495 NEXT Crash Analysis Framework Memorandum
5. I-495 NEXT Air/Noise Analysis Framework Memorandum

INTRODUCTION

This document outlines the scope of work for the traffic forecasting and analysis associated with the I-495 NEXT Project. The consultant team will provide technical support of the National Environmental Policy Act (NEPA) studies (documented in an Environmental Assessment), Preliminary Engineering and Options Development, and other analyses performed in support of the associated technical reports prepared to inform the NEPA decision making process. This task will primarily focus on efforts to prepare a Traffic and Transportation Technical Report (TATTR) and a system Interchange Justification Report (IJR) based on the guidance from VDOT Central Office that is updated from the previous IIM 200.9, in order to be consistent with the May 2017 update to FHWA policy on NEPA and IJRs for federal actions involving interchanges and interstate access. The TATTR and IJR will serve to support the technical studies as a part of VDOT's I-495 NEXT Project, and to document the project traffic analysis.

Background

The Virginia Department of Transportation (VDOT), in partnership with the Federal Highway Administration (FHWA), is developing transportation improvements in the I-495 corridor from the Dulles Toll Road (State Route 267) to the vicinity of the American Legion Bridge and the Maryland state line, called the I-495 Express Lanes Northern Extension (NEXT) project. The project proposes to add two (2) managed lanes in each direction, and the study corridor extends approximately three miles from the I-495 interchange with the Dulles Toll Road to the George Washington Memorial Parkway (GWMP) in the McLean area of Fairfax County.

The Capital Beltway, or I-495, is a 64-mile multi-lane circumferential freeway centered around Washington, D.C. and passing through Maryland and Virginia. The Virginia portion of I-495 is 22 miles, extending from the Woodrow Wilson Bridge in Alexandria to the American Legion Bridge in Fairfax County. The existing I-495 facility within the study area currently has four northbound and four southbound general purpose lanes, with auxiliary lanes or collector-distributor roadways provided at several interchanges. North of the study area, I-495 at the American Legion Bridge has a total of 10 lanes, eight general purpose through lanes and two auxiliary lanes that connect Clara Barton Parkway in Maryland and the GWMP in Virginia.

The existing I-495 Express Lanes extend for 14 miles along I-495, from the I-95/I-495/I-395 interchange in Springfield to south of Old Dominion Drive in McLean (just north of the Dulles Toll Road interchange). The two existing northbound Express Lanes end just south of Old Dominion Drive by merging into a single lane-controlled shoulder/travel lane, which is open to traffic during the AM and PM peak periods. This fifth lane continues for a total length of approximately 1.8 miles before merging with the general purpose lanes at the GWMP interchange. The Express Lanes are separated from the general purpose lanes by flexible bollards. All buses and vehicles with two axles can access the Express Lanes 24 hours a day, seven days a week. High-Occupancy Vehicles (HOV) with three or more occupants are not charged a toll. No trucks are currently permitted to use the Express Lanes.

Current Studies

The proposed effort will be comprehensive in its scope and multi-purpose. The analysis will serve to develop the environmental documentation needed per NEPA, the operational analysis report needed for interchange justification/modification, preliminary engineering, and an assessment of potential costs and revenues from variably-priced express lanes.

The following studies have been conducted to support the further development and documentation of specific infrastructure and operations recommendations for the I-495 NEXT Project:

- Final EIS Completed April 2006 (Project northern terminus near George Washington Parkway)
- ROD Issued June 2006
- IJR Approved December 2007 (northern terminus revised to north of Lewinsville Road, 5th GP lane south of Rte. 193)
- NEPA Reevaluations Completed (May 2007, June 2008, December 2008, May 2009, July 2009)
- Dulles Interchange NEPA Reevaluation November 2009
- Dulles Interchange IJR Approved December 2009
- Express Lanes and Dulles Interchange Open to traffic November 2012
- I-495 North Shoulder Lane Use Project (1½ Mile Express Lanes Merge to GW Parkway)

Document Purpose

This IJR scoping document describes the format and content of an IJR for one combination of access options and a single Build Alternative concept, as identified in the EA. This combination will be referred to as the *Preferred Alternative*. In terms of the IJR, the Preferred Alternative consists of the following:

- General purpose lanes
- Express Lanes carrying HOV-3 traffic, toll-paying traffic, and trucks (assumed conservative case)
- Transportation system management
- ITS

The I-495 NEXT Project EA and IJR will document the need for new and modified access to support and accommodate the Express Lanes, and general purpose lane modifications. The IJR will be submitted in coordination with preliminary design plans and the EA prepared by VDOT. The EA and preliminary engineering plans are being prepared concurrently with the IJR.

It should also be noted that the Express Lanes carrying HOV, toll-paying vehicles, trucks, and any potential new transit service will have connectivity to the existing high-occupancy, variably priced Express Lanes along I-495 and recently-constructed Express Lanes along I-66 Inside the Beltway between I-495 and the Washington, DC, boundary (via the Dulles Toll Road Connector).

PURPOSE & NEED

The Purpose and Need for the EA has not yet been fully established but will be developed as part of NEPA scoping process and included in the IJR. A number of corridor transportation needs have been identified in the Draft In-progress Purpose and Need. Needs for the I-495 corridor are related to issues such as:

- Reduce congestion and improve roadway safety
- Provide additional travel choices
- Improve travel reliability

Reduce Congestion and Improve Roadway Safety. In the fourth quarter of 2017, I-495 between I-66 and the I-270 Spur, including the study area and the American Legion Bridge, was ranked second on the list of top ten bottlenecks in the Washington, D.C. region by the National Capital Region Transportation Planning Board, up from being ranked fifth in 2016 (TPB, 2017). The GWMP is used as a primary commuting route and also experiences moderate congestion throughout its length, but particularly on the on ramp to I-495 northbound in the PM peak period (NPS NCR Long Range Transportation Plan, 2018).

Congestion and unsafe weaving movements of vehicles at the northern terminus of the I-495 Express Lanes also results in crashes and safety concerns in the study area. According to crash data collected along northbound I-495 from the Dulles Toll Road interchange to the American Legion Bridge over an approximate nine-month period starting November 17, 2012 (the opening of the existing I-495 Express Lanes), a total of 81 crashes were recorded in the study area. Of the 81 crashes recorded, 57 (approximately 70 percent) of the crashes occurred between south of the Dulles Toll Road interchange to the off-ramp at Georgetown Pike. The most common contributing circumstances recorded by police officers were congestion and vehicles changing lanes. Furthermore, the segment within the study area between Old Dominion Drive and the off-ramp to Georgetown Pike had the highest crash density with a crash rate of 152 (per 100 million VMT), which is far above the Northern Virginia Average Interstate Crash Rate of 99 (per 100 million VMT) (VAP3, Detail-Level Project Screening Report, 2014).

Provide Additional Travel Choices. The existing I-495 and I-95 Express Lanes create a 40-mile HOV and bus network in northern Virginia and provide additional travel choices for a variety of users. However, because the existing Express Lanes end at Old Dominion Drive, travel choices for all northbound travelers are limited. No commuter bus service is offered within the study area or over the American Legion Bridge due to the absence of dedicated or managed lanes that would allow buses to travel more efficiently. Both HOV and single-occupant vehicles choosing to use the existing Express Lanes are forced to rejoin the GP lanes north of Old Dominion Drive with no options to bypass congestion or bottlenecks. Travelers are therefore less likely to choose carpooling, vanpooling, or transit options because these options are no more efficient than driving alone.

Commuter choices are also affected by access. The northbound and southbound I-495 Express Lanes are accessible in both directions from Westpark Boulevard and Jones Branch Drive. From Route 7 and eastbound Route 267, only the southbound Express Lanes are accessible. There is currently no direct access to the northbound Express Lanes from Route 267 or Route 7. There is also no direct access to and from the Express Lanes in either direction from GWMP. Also, the planned I-495/I-270 Managed Lanes Study is evaluating the feasibility of Express Lanes along the entire I-495 corridor in Maryland, including the American Legion Bridge. Because the I-495 Express Lanes in Virginia currently end two miles south of the American Legion Bridge, there would be a two-mile gap in the I-495 Express Lanes network, representing the only interruption in Express Lanes service for the entire 64-mile I-495 loop. Travel choices for both northbound and southbound travelers would continue to be limited within this two-mile stretch because all Express Lanes users would be forced to merge into GP lanes, with no options to bypass congestion or bottlenecks.

Improve Travel Reliability. A 2016 commuter survey conducted by MWCOG revealed that over 80 percent of commuters in the region add extra time to their commutes to account for travel time variability due to congestion, bottlenecks, crashes, weather events, and other factors. These issues contribute to highly variable travel speeds and travel times for all users within the study area, including single occupancy, HOV, transit, and freight vehicles alike. Motorists who report using HOV or Express Lanes save an average of 20 minutes on their commute; however, due to congestion and reduced travel speeds at the northern terminus of the northbound I-495 Express Lanes, users traveling to Maryland or the GWMP are not able to reap the full benefits of the existing Express Lanes. The duration and extent of congestion within the study area is expected to increase with population, employment, and subsequent traffic volumes. Variability in travel speeds and travel times is therefore expected to worsen in the future. The proposed project will extend the I-495 Express Lanes from their existing northern terminus to Maryland, providing a seamless reliable travel option for HOV or toll-paying motorists traveling to or from Maryland and the GWMP.

PROJECT SCOPE & ASSUMPTIONS SUMMARY

The proposed project scope for the EA includes four general purpose lanes (keeping the same number of general purpose lanes that are utilized now) and two Express Lanes in each direction of I-495, consistent with the existing I-495 Express Lanes configuration south of the project limits. The approach to the preparation of the EA, IJR, preliminary engineering effort, and supporting technical studies will be closely coordinated among VDOT, VAP3, FHWA, and MDOT/SHA.

Scoping Definitions:

Two Express Lanes

Two lanes in each direction of I-495 that would operate as a high-occupancy variably priced toll facility with non-toll vehicles required to carry three or more persons or as required by the Code of Virginia.

Four General Purpose Lanes

Four non-tolled general purpose lanes in each direction at all times open to all traffic with shoulders [no traffic use of shoulders].

Auxiliary Lanes

The CLRP and previously approved IJRs and NEPA documents commit to implementing one northbound and one southbound auxiliary lane between the Dulles Toll Road and Georgetown Pike by 2030, consistent with the CLRP.

Dulles Interchange Long Range Plan

The CLRP and previously approved IJRs and NEPA documents reference a master plan for the Dulles Interchange that was developed in coordination with MWAA and FHWA in 2009 and 2010. The plan provides for full connectivity between the Dulles Toll Road, Dulles Airport Access Road, and I-495 General Purpose Lanes and Express Lanes. The plan was approved in concept by FHWA and the original I-495 Express Lanes were constructed to facilitate the future construction of the additional ramp movements. Several ramps included in the Long Range Plan are proposed to be constructed as part of the scope of this project.

Milestone Schedule Approach & IJR Review Process

- IJR Scoping Framework Document Concurrence – FHWA meetings required.
- Development of IJR simulation models for the Preferred Alternative:
  - 2018 Existing Conditions
  - 2025 and 2045 No-Build Conditions
  - 2025 and 2045 Build Conditions
- VISSIM model simulation – walk-through meeting with FHWA and VDOT.
  - Will include base model summary and calibration of existing model
- Interim results review – submittal of revised/post-processed Measures of Effectiveness (MOEs).
- Submittal of Draft IJR document.
- Concurrent VDOT/FHWA review of Draft IJR document.

- Comment resolution meeting with FHWA and VDOT.
- Comments responses and IJR revisions – Prepare Final IJR document.
- Submit Final IJR document – Northern Virginia (NOVA) District Office => VDOT Central Office => FHWA Virginia Division Field Office => FHWA Headquarters.
- 30 days required for VDOT and FHWA final review processing to issue a *Finding of Engineering and Operational Acceptability* => Confirmation of NEPA compliance => **Final IJR Approval.**

Interstate Access Request Review occurs on 3 levels:

- **Traffic forecasts** – VDOT Northern Regional Operations (NRO) - Traffic Engineering and Transportation Planning.
- **Draft IJR Report** – VDOT NOVA District Office, VDOT Central Office, FHWA Virginia Division, and FHWA Headquarters (HQ).
- **Final IJR Report** – VDOT Central Office, FHWA Virginia Division, and FHWA HQ.

ASSUMPTIONS

Study Area Limits

The Project Footprint Study Area for the I-495 NEXT Project spans I-495 from the Dulles Toll Road interchange (Route 267) to the American Legion Bridge (north of the George Washington Memorial Parkway [GWMP]). The Traffic Operational Analysis Study Area includes the full extent of the Project Footprint Study Area as well as one additional intersection north and south, extending from just south of the Chain Bridge Road (Route 123) interchange to the bridge over Seven Locks Road in Maryland, which is just south of the Cabin John Parkway interchange. The Traffic Operational Analysis Study Area also includes the following interchanges and intersections:

- The GWMP from I-495 to the bridge over Turkey Run loop road, which is just west of the Turkey Run Farm interchange
- Clara Barton Parkway and its interchange with I-495, including all ramps at that interchange, from a location just east of the Clara Barton Parkway/Carderock interchange to a location just east of the Clara Barton Parkway/Clara Barton Access Road interchange
- Georgetown Pike (VA Route 193), including its interchange with I-495 and all ramps, ramp terminals and road segments contained therein, as well as the section of Georgetown Pike from the Spring Hill Road intersection to the Dead Run Drive intersection, including intersections with: Swinks Mill Rd, Linganore Drive/Helga Place and Balls Hill Road
- Old Dominion Drive (VA Route 738), from the Spring Hill Road intersection to the Balls Hill Road intersection, including the intersections at the termini and the intersection with Swinks Mill Road
- Swinks Mill Road (VA Route 684) from its intersection with Georgetown Pike to its intersection with Lewinsville Road, including the intersections at the termini and its intersection with Old Dominion Drive
- Lewinsville Road (VA Route 694), from its intersection with Spring Hill Road to its intersection with Dolley Madison Road, including the intersections at the termini and its intersections with Swinks Mill Road and Balls Hill Road
- Chain Bridge Road (VA Route 123), including its interchange with I-495 with all ramps, ramp terminals and road segments contained therein, as well as the section from its intersection with Tysons Blvd/Tysons Mall Ring Road entrance to its intersection with Great Falls Street / Lewinsville Road, inclusive, and its intersections with Old Meadow Road / Capital One Tower Drive, Scotts Crossing Road / Colshire Drive, and Anderson Road / Dulles Toll Road Connector ramp terminal within that section

- Dulles Toll Road (VA Route 267) / Dulles Airport Access Road from just west of the Spring Hill Road to the bridge over Magarity Road, which is east of the Dulles Toll Road / Dolley Madison Boulevard (VA Route 123) interchange
- Spring Hill Road (VA Route 684), including its interchange with Dulles Toll Road with all ramps, ramp terminals and road segments contained therein, and the section of Spring Hill Road from its intersection with Georgetown Pike to its intersection with Tyco Road/Jones Branch Road intersection, inclusive, and its intersections with Old Dominion Drive and Lewinsville Road within that section

Figure 1 shows the various components of the project study area for the I-495 NEXT Project:

- **Yellow – Project Footprint Study Area.** The I-495 NEXT Project Study area includes I-495 from the Dulles Toll Road interchange to the American Legion Bridge, including all ramp termini of interchanges over that section
- **Blue – Traffic Operations Analysis Study Area.** The Traffic Operations Analysis Study Area, described in detail above, includes the full extent of the Project Footprint Study Area as well as one interchange north and south on I-495, and a number of additional intersections and interchanges which directly affect, and are affected by operations on I-495 within the Project Footprint Study Area

Figure 1: Project Study Area

Data Collection

Traffic Volumes

Intersection turning movement counts were conducted for a 15-hour time period from 5 AM to 8 PM which would include AM and PM peak period. For mainline segments, traffic counts were conducted before and after each major interchange along with all the ramps in the Study area. Data was collected in May and June 2018, prior to the end of the school year, and was summarized in 15-minute intervals.

Traffic count locations are shown in Figure 2 and listed in **the I-495 NEXT Traffic Operation Analysis Framework Memorandum**.

Traffic volumes used in the traffic and operations analysis will consist of the following:

- **Existing (2018)** – Developed from field counts (ramps, freeway mainline, and intersection turning movements) conducted during typical weekdays in May and June 2018 while Fairfax County schools were still in session. Traffic counts were taken on the same days as other locations wherever possible to minimize variability in the calibration process. Count data will be post-processed and balanced between all adjacent locations in the traffic operations analysis study area.
- **Opening Year (2025)** – No Build and one Build alternative developed through modifications to the MWCOG 2025 travel demand model for the I-495 corridor and post-processed based on 2018 data collection.
- **Design Year (2045)** – No Build and one Build alternative developed through modifications to the MWCOG 2045 travel demand model for the I-495 corridor and post-processed based on 2018 data collection.

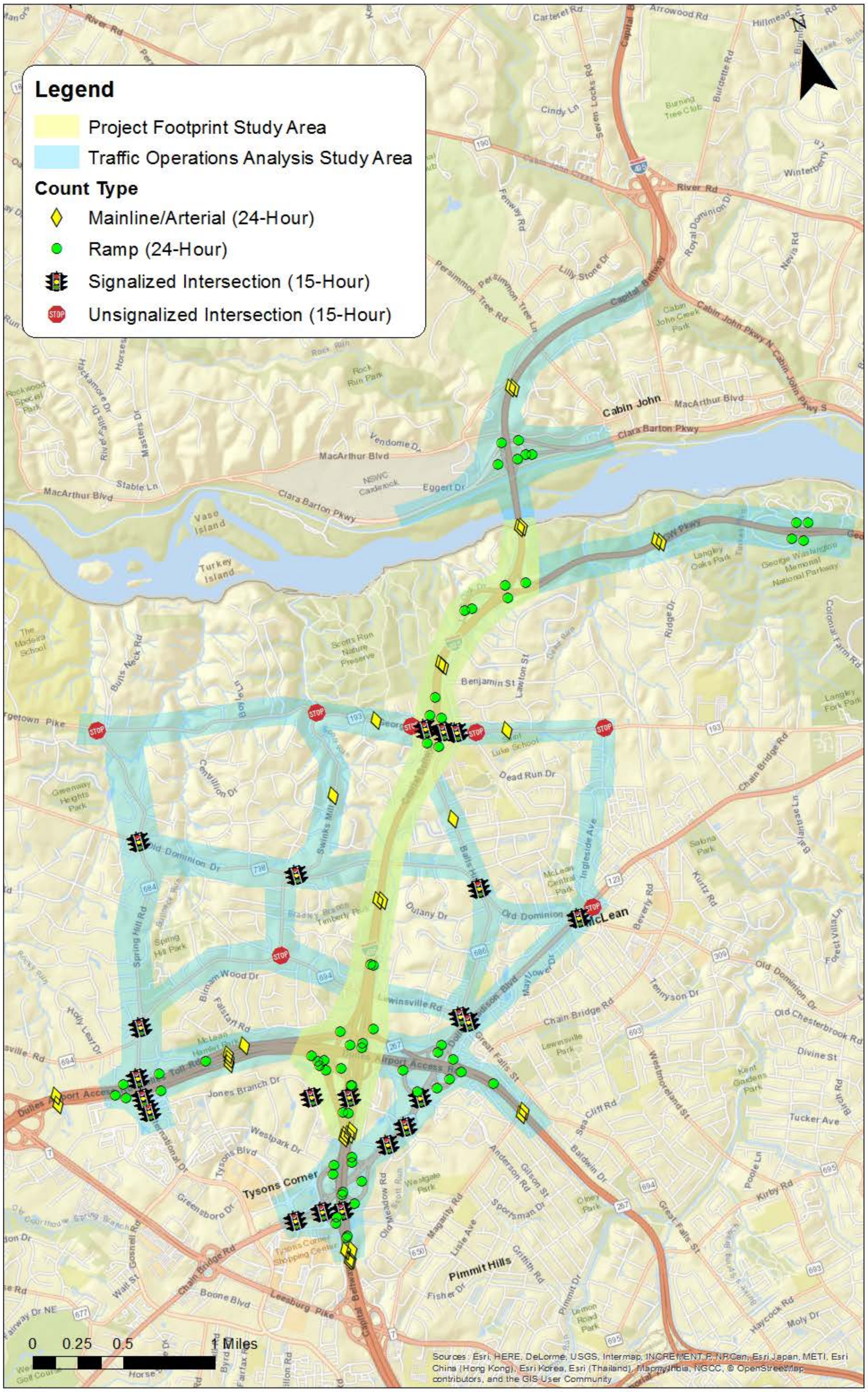


Figure 2: Traffic Count Locations

Origin-Destination Data

The traffic simulation modeling effort will route vehicles through the traffic network according to origin-destination routing. Origin-destination data will be reviewed from the following sources:

- StreetLight Data, which via a VDOT subscription provides customized origin-destination data with a very high level of spatial accuracy based on aggregated cellular device GPS/location-based services data. StreetLight Data allows for a user to provide custom origins and destinations, such as on- and off-ramps for all freeways in a study area or entry/exit links to a study area. It is anticipated that StreetLight Data will be used as the basis for origin-destination routing for the existing conditions traffic analysis, at the very least for the freeway and ramp segments of the study area.
- MWCOG regional travel demand model, which outputs O-D matrices for various vehicle types between each traffic analysis zone (TAZ) in the Washington, DC, metropolitan area. The travel patterns within the model base year (2017) have been calibrated against 2007/2008 regional household travel survey data, so the travel patterns are somewhat dated. Additionally, this dataset is not as granular as needed to account for freeway weaving proportions. However, given that the travel demand model provides O-D matrices for future years, it is anticipated that these may be used as the basis for vehicle routing in future analysis year scenarios.

Speeds and Travel Times

Floating car travel were conducted in June 2018 during the AM and PM peak periods. Wherever possible, travel times were collected on the same days as traffic counts to minimize variability in the calibration process. Travel time segments are listed in the **I-495 NEXT Traffic Operation Analysis Framework Memorandum**.

Time Periods:

- Weekday (Tuesday, Wednesday or Thursday) AM Peak Period: runs beginning no earlier than 5:30 AM and concluding not later than 9:30 AM
- Weekday (Tuesday, Wednesday or Thursday) PM Peak Period: runs beginning no earlier than 3:00 PM and concluding not later than 7:00 PM

In addition, INRIX vehicle probe speed data has been queried for the corridor using the RITIS Congestion Scan tool, which provides a “heat map” of vehicle speeds temporally and spatially along a corridor. This data has been pulled for “average weekdays” (Tuesday, Wednesday, and Thursday) for the 12 most recently available months of data (July 2017 through June 2018).

Queueing Data

Queuing within the study area is notably inconsistent and can oscillate numerous times within the peak periods, or be absent altogether on some days. A qualitative subjective assessment will be conducted for queue lengths at targeted locations in addition to the review of freeway mainline congestion/queues against the speed heat maps. Queueing along the freeway segments of the corridor will be provided via the INRIX heat map and verified against Google Maps’ typical traffic. Queueing along arterials and ramps will be obtained via screen captures from Google Maps’ typical traffic. Targeted spot locations and the methodology have been identified in the I-495 NEXT Traffic Analysis Microsimulation Calibration Methodology Memorandum. This memorandum was approved and signed by the VDOT NoVA District Traffic Engineer on July 27, 2018.

Analysis Scenarios

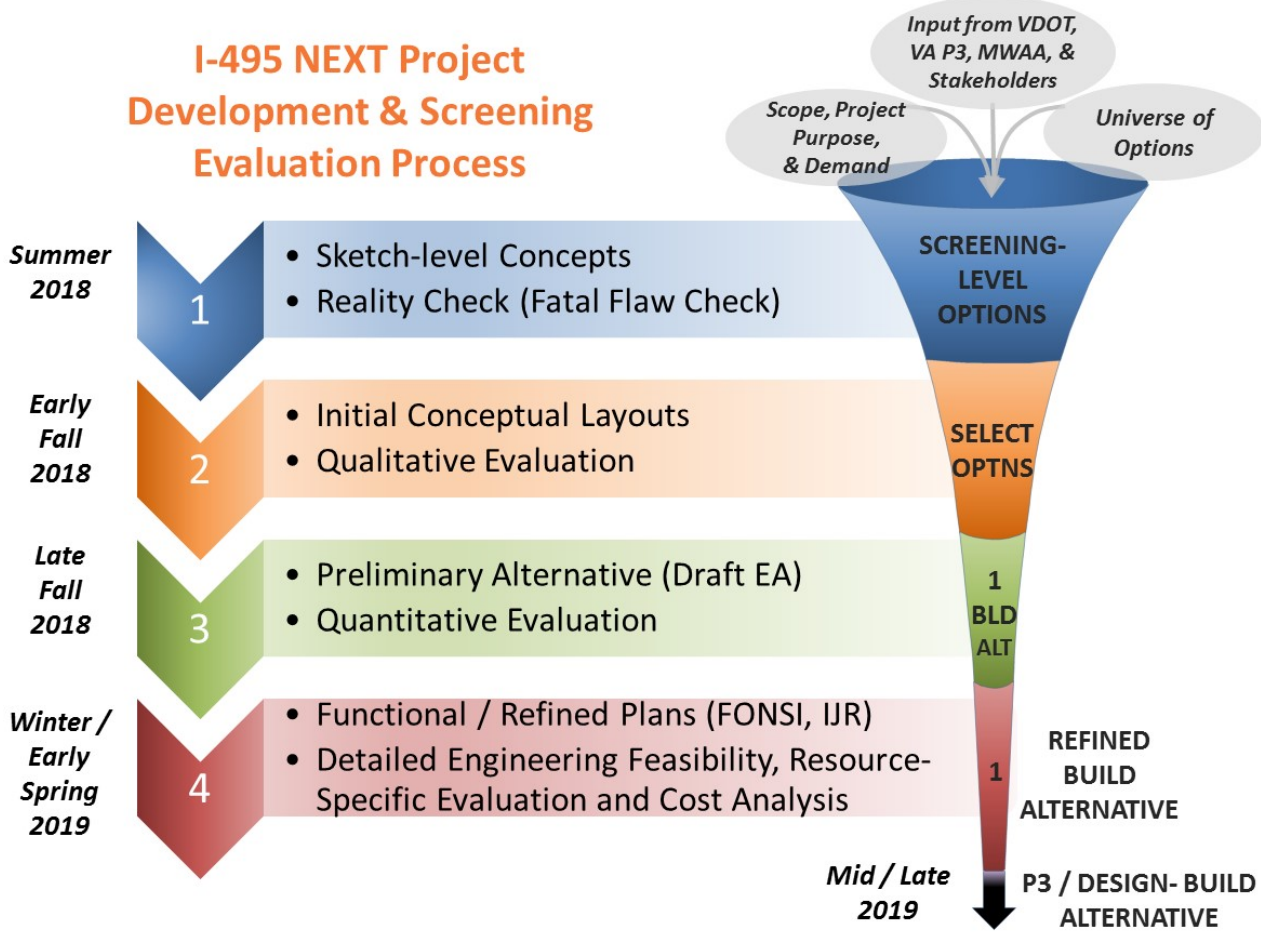
All analysis scenarios will be evaluated against the typical weekday AM peak period and PM peak period. The exact hours of analysis hours will be determined after assessing the traffic data and diurnal patterns.

- **Existing Conditions** – Calibrated against 2018 traffic conditions and the 2017 MWCOG model.
- **No-Build (w/ CLRP) Conditions** (2025 and 2045) – The 2025 and 2045 No-Build scenario assumes the existing transportation system in addition to all projects funded for construction in the *National Capital Region's Draft 2017 CLRP* through 2025 and 2045. The TPB adopted the 2016 CLRP in November 2016. Some of the regionally significant and corridor-specific projects include the following (taken from http://www.mwcog.org/clrp/projects/highway.asp):
  - I-495 Managed Lanes / I-270 Managed Lanes in Maryland
  - Transform I-66 Outside the Beltway – widening and express lanes, plus HOV-3
  - Transform I-66 Inside the Beltway – widening and dual-direction express lanes by 2045, plus HOV-3; note that the regional CLRP assumes that by 2045, I-66 is tolled in both directions during the peak period east of I-495, but it currently is only tolled in one direction in the peak period (eastbound in the AM and westbound in the PM).
  - Dulles Toll Road interchange ramps and Dulles Airport Access Road ramps by 2030
  - Metro Silver Line Extension to Dulles Airport and Loudoun County
  - Completion of the Jones Branch Connector
- **Build Conditions** – Assumes the No-Build configuration as a base condition and will reflect geometry, access points, and lane configuration proposed in the preliminary I-495 express lanes design concepts developed by the NEPA team and preliminary design team. The Consultant team will code express lanes, new access points, and other network changes, along with updated traffic demand and routing decisions for the 2025 and 2045 Build scenarios.

Proposed Modifications in Access (Express Lanes Access Alternatives)

Proposed modifications in access will be determined as part of the Preliminary Engineering and Options Development. The Consultant Team will use an iterative process to refine and improve roadway design based on traffic operations results. For this process, the team will develop “mini” VISSIM models for access options which will be utilized to test and evaluate traffic impacts of concept refinements. The Consultant Team will incorporate these improvements and additions that are ultimately adopted for the build concept into the overall VISSIM models used to perform the traffic analysis for the IJR. Any modifications in access adopted for the build concept will be documented in the IJR.

Figure 3: Alternatives / Options Development and Screening Process



Drafts of the Express Lane access locations for an interim year (2025) and a Preferred Alternative (2045) are shown in **Figure 4** and **Figure 5**. . VDOT will coordinate with MDOT/State Highway Administration to reach an agreement that will allow HOV-3+ users to get in and out of the Virginia Express Lanes without paying a toll. The existing entrance to the southbound I-495 Express Lanes will be modified to account for the proposed system connection with Maryland’s future Express Toll Lanes, and a new entrance ramp from the general purpose lanes is anticipated to be constructed north of the American Legion Bridge as part of Maryland’s project.

VDOT is considering potential phasing of the project improvements at the Dulles Interchange. This includes constructing the proposed southbound Express Lanes ramp to eastbound Dulles toll Road (Route 267). The ramp will be included in the NEPA action / footprint and will be included in the design horizon year (2045) in the IJR, but will be assumed as not part of the opening year (2025) in the IJR.

Figure 4: Express Lane Access Movements Interim Year 2025

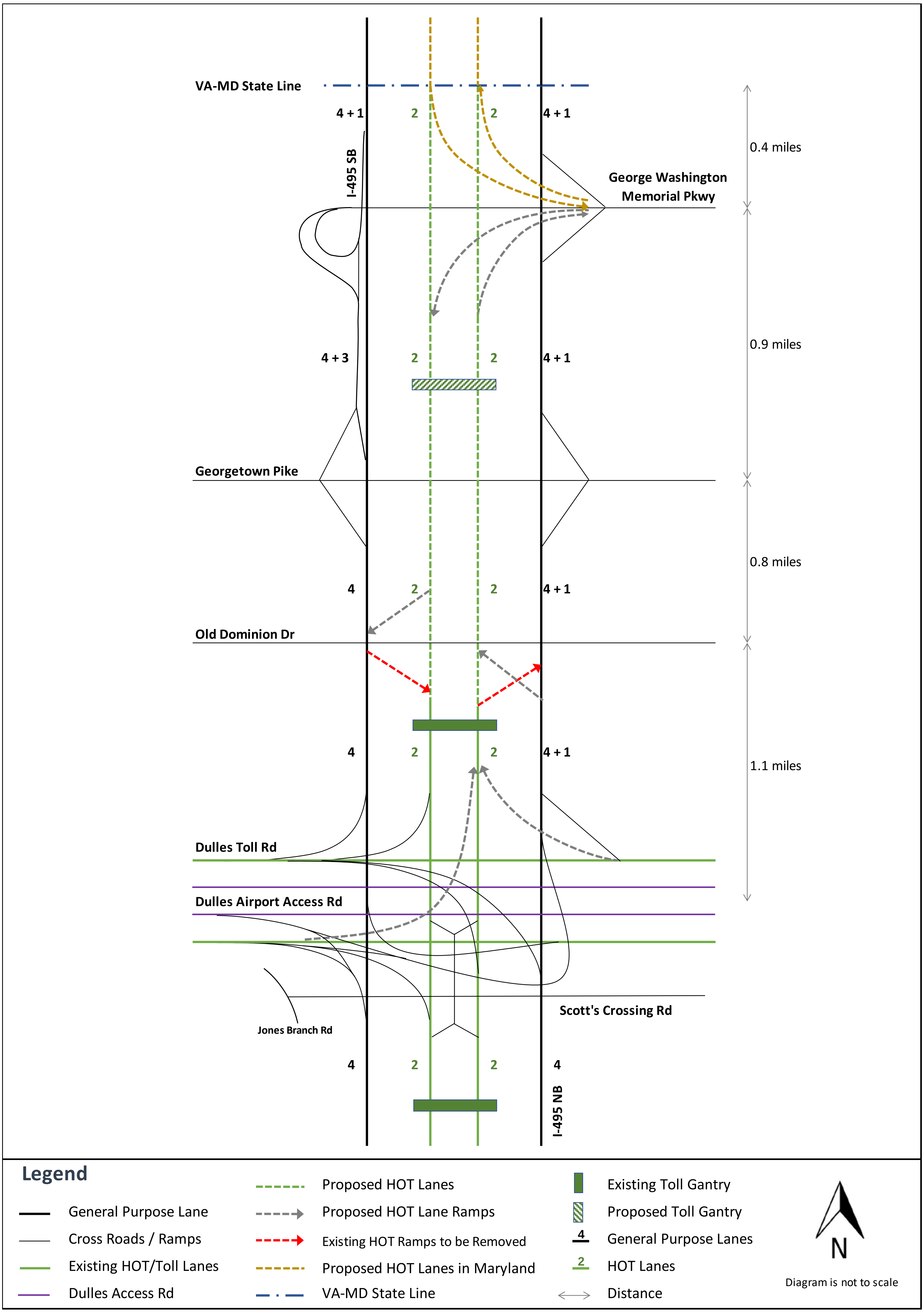
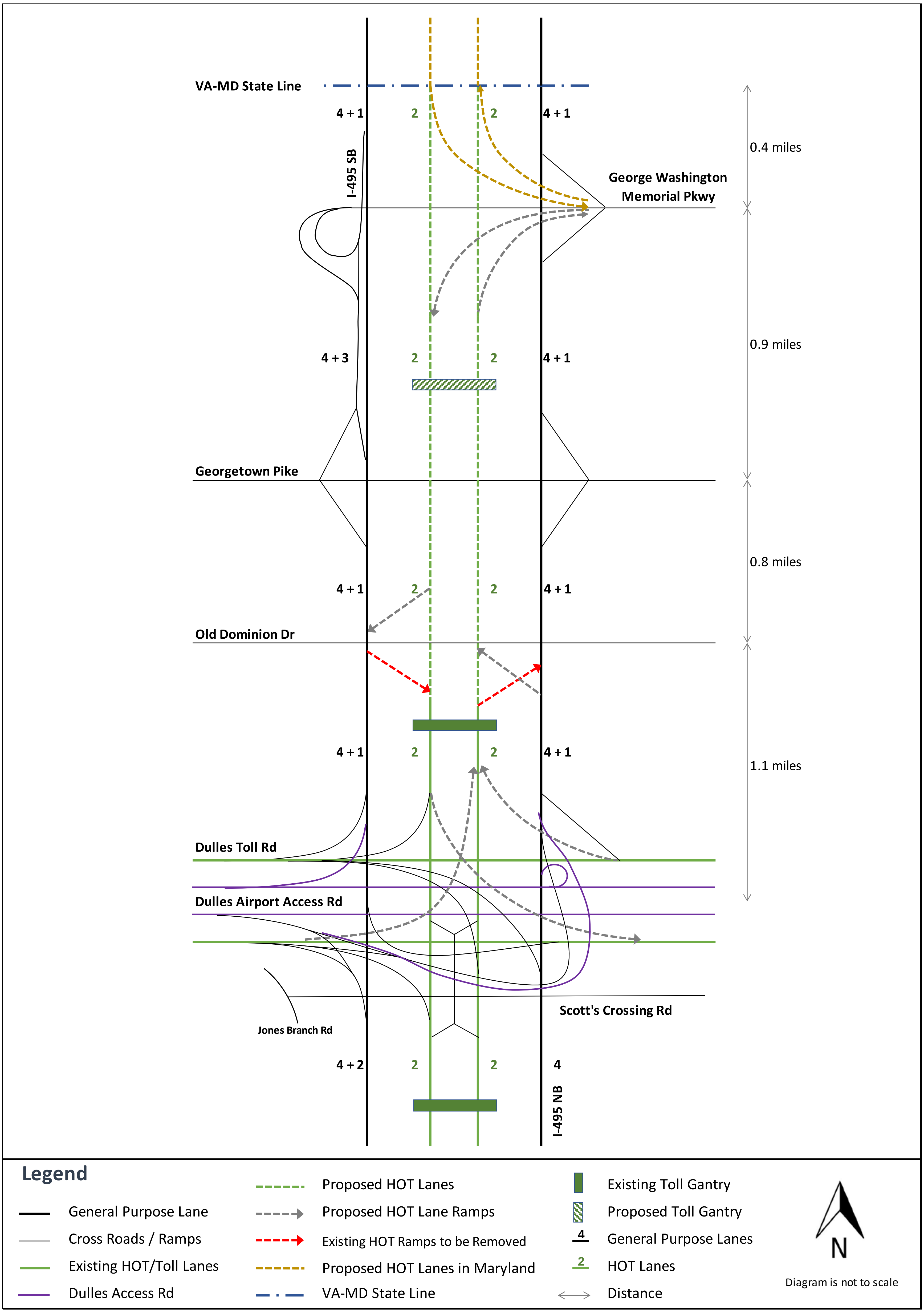


Figure 5: Express Lane Access Preferred Alternative 2045



Travel Demand Modeling Methodology and Key Assumptions

The latest MWCOG travel demand model version based on the 3,722 traffic analysis zone (TAZ) system will be used in conjunction with Round 9.1 Cooperative Forecasts (socioeconomic data) for the Existing, Opening, and Design model years. The MWCOG model base year is 2017; a project Existing Conditions (year 2018) model will be prepared, modified and calibrated to reflect field counts. Modifications will be carried forward into future analysis year model scenarios.

The MWCOG model will be strategically modified with specific alterations to improve the accuracy and reliability of forecasts for the I-495 study corridor, roadways connected to the corridor, and transit services in the vicinity of the corridor. The calibration targets will be based on guidance from the FHWA Transportation Model Improvement Program (TMIP) *Travel Model Validation and Reasonableness Checking Manual* and the Virginia *Travel Demand Modeling Policies and Procedures Manual*. Because the MWCOG/TPB Model is already subject to scrutiny as a regional model which has been a subject of FHWA's TMIP Peer Review process, the validation process for the I-495 Project NEXT model will focus on the I-495 Traffic Operations Analysis Study Area and will compare: daily counts versus model forecasts, peak period traffic counts to modeled data during the same periods, and AM and PM observed speeds and travel times to model speeds and travel times.

Toll Diversion Curves from OP3's consultant, based on existing express lane usage on the Capital Beltway Express Lanes, will also be validated in order to increase confidence in the model and maintain relative consistency between traffic and revenue studies for I-495 in Virginia, and regional planning studies of MDOT's proposed managed lanes system in Maryland. The MWCOG model will be used as the starting point for estimating usage of the Express Lanes and the breakdown of toll-paying versus HOV trips. The MWCOG model is a "four-step," trip-based regional travel demand model with a macroscopic, static equilibrium traffic assignment. Toll values provided as inputs in dollars are converted to value-of-time for the assignment process. These toll values can vary according to different vehicle classes and time of day; additionally, tolls can be represented by a fixed point or be distance-based tolls (as is the case with the Express Lane system in Northern Virginia). The model uses a speed feedback (SFB) loop which iterates through all four steps to ensure that travel speeds output from the traffic assignment are the same as those used as inputs to the trip distribution and mode choice. Output volumes from the model will be post-processed using NCHRP 255/765 guidance.

Travel demand forecasting activity will be coordinated between the traffic and revenue study, IJR, and NEPA effort in order to maintain consistency in forecasting among these efforts to the maximum extent practical. Alterations to the MWCOG travel demand model to improve corridor calibration may include:

- Highway network modifications to better represent study area facilities as they exist and are planned, such as modifications to link facility types. Ramps will be micro-coded to improve forecasts and correlation to the microsimulation process.
- Traffic Analysis Zone (TAZ) splits and centroid connector location changes to improve model loading for all modeled modes of transportation.
- Changes to external trip assumptions to improve consistency with origin-destination data and traffic and revenue evaluations.
- Use of toll diversion methodology to forecast Express Lane trips.
- Changes in the time-of-day distribution to improve forecasting of peak period trips, changes in the Volume Delay Function (VDF) curves, and changes in the default speed and capacity of some facility types.

Key assumptions associated with the travel forecasting process are included in the **I-495 NEXT Travel Demand Forecasting Framework Memorandum.**

Methodology and Key Assumptions for Post-Processing of Modeling Results

Post-processing of travel demand model output is necessary to develop traffic volume forecasts for analysis of operations during peak periods/peak hours. Post-processing of travel demand forecasts for vehicular volumes will follow NCHRP 255/765 guidelines and the TFlowFuzzy methodology included in the VISUM planning tool for estimating balanced No-Build and Build peak period volumes. The post-processing methodology will account for peak spreading of demand, as the hourly capacity of a given link will be used as a threshold for forecast volumes. Forecasted volumes above this threshold will be post-processed onto adjacent shoulder hours.

Existing balanced volumes will be developed outside of the MWCOG travel demand model using field count data; origin-destination (O-D) routing will be obtained utilizing StreetLight Data and the O-D matrix will be adjusted using VISUM's TFlowFuzzy methodology to match target balanced volumes along the corridor.

Traffic Operational Analysis Methods/Parameters

Traffic Analysis Tools

VISSIM Version 9.0, Build 13 will be used for a comprehensive network traffic analysis performed within the study area limits. (Reference analysis tool selection matrix, *VDOT Traffic Operations and Safety Analysis Manual [TOSAM]* V1.0[1], Appendix D.) Additional calibration, based on simulated volume processed, travel times, queues, and speed profiles, will be performed against 2018 measured field conditions and traffic data.

Surface street intersection operations will be evaluated through a combination of Synchro 10 (in order to develop preliminary optimization for phasing and signal timing) and VISSIM (for microsimulation and analysis). Transit routes and stops will be coded into the study area VISSIM network where they affect or could affect I-495 and related facility operations.

Vehicle Classes

The following vehicle classes will be assumed for the traffic operations analysis VISSIM modeling:

- General purpose (non-toll-paying) cars
- HOV3+ cars
- HOT (toll paying) cars
- GP (non-toll-paying) trucks
- HOT (toll paying) trucks

Measures of Effectiveness

The following measures of effectiveness (MOEs) will be used for the operational analysis of the roadway network under existing and future Build and No-Build conditions. Wherever possible, MOEs will be provided in graphical format or GIS maps. These MOEs will be developed according to guidance from the VDOT TOSAM.

[1] http://www.virginiadot.org/business/resources/TOSAM.pdf

Freeway Performance Measures

- Simulated Average Speed (mph)
- Simulated Average Density (simulated vehicles per lane per mile, color-coded similar to the analogous HCS Density-Based LOS Thresholds but not reported as LOS)
- Simulated Volume (vehicles per hour)

The VISSIM freeway MOEs will be reported for each freeway segment. Methodology for the merge/diverge/weave segment analyses will be consistent with procedures outlined in the *Highway Capacity Manual* for the area of influence within the designated segments. This methodology will be consistent with the TOSAM. In addition, the following freeway MOEs also are proposed for reporting in the IJR:

- **Percent of Demand Served.** Simulated Volume (*processed volumes*) divided by Actual Volume (*input volumes*).
- **Simulated Ramp Queue Length.** Reported average and maximum queue lengths (feet).
- **Simulated Travel Time.** Reported for select network origin-destination travel paths (seconds).
- **Congestion *Heat Maps*.** Incremental speeds reported for aggregated lanes, by time interval (mph).

Additionally, for freeway segments, lane-by-lane MOE graphics will be produced showing individual lane speeds and densities.

Arterial/Intersection Performance Measures

- **Simulated Intersection Level of Service (LOS) and Average Control Delay.** Reported by approach and by intersection (seconds per simulated vehicle, color-coded in similar fashion as the analogous Highway Capacity Manual (HCM) Delay-Based LOS Thresholds but again not reported as LOS). Delay will be reported as “microsimulation delay” per guidance from the VDOT TOSAM.
- **Simulated Intersection Approach Queue.** Reported by movement (feet).
- **Percent of Demand Served.** Simulated Volume (*processed volumes*) divided by Actual Volume (*input volumes*).

Traffic Modeling Methodology and Main Assumptions

Calibration Methodology for Base Models

The VISSIM base models will be calibrated based on guidance from the *VDOT Traffic Operations and Safety Analysis Manual (TOSAM)*, Version 1.0 which takes into account the FHWA guidance. Figure 6 shows the criteria and acceptance targets from the TOSAM.

Figure 6: VDOT TOSAM Calibration Criteria and Acceptance Targets

Simulated Measure	Calibration Threshold	
Simulated Traffic Volume (vehicles per hour) **The top 85% of the network links, based on link traffic volume, or a select number of critical links and/or movements, as determined by the RTE or his/her designee, shall meet the calibration thresholds. The traffic volumes identified in the calibration thresholds are actual traffic volumes as opposed to simulated traffic volumes.**	Within ± 20% for <100 vph Within ± 15% for ≥100 vph to <300 vph Within ± 10% for ≥300 vph to <1,000 vph Within ± 5% for ≥1,000 vph	
Simulated Average Speed (miles per hour) **The top 85% of the network links, based on link traffic volume, or a select number of critical links and/or movements, as determined by the RTE or his/her designee, shall meet the calibration thresholds.**	Within ± 5 mph of average observed speeds on arterials Within ± 7 mph of average observed speeds on freeways	
Simulated Travel Time (seconds) **Eight-five percent (85%) of the travel time routes, or a select number of critical routes, as determined by the RTE or his/her designee, shall meet the calibration thresholds. Travel time routes should be determined in cooperation with the VDOT project manager based on project needs and goals.**	Within ± 30% for average observed travel times on arterials Within ± 20% for average observed travel times on freeways The travel time should be calibrated for segments and routes separately or as deemed appropriate by the VDOT project manager.	
Simulated Queue Length (feet) **The top 85% of the network links, based on link traffic volume, or a select number of critical links and/or movements, as determined by the RTE or his/her designee, shall meet the calibration thresholds.**	Undersaturated conditions (refer to Section 2.6 for guidance)	*Average queue length on arterials:* Within ± 30% for movements ≤10 vph Within ± 20% for movements >10 vph
		Maximum queue length on arterials: Within ± 25%
	Oversaturated conditions (refer to Section 2.6 for guidance)	*Average queue length:* Within ± 20% on arterials Within ± 30% on freeways
		Maximum queue length: Within ± 20% on arterials Within ± 35% on freeways

Table 1 shows the criteria and thresholds proposed for VISSIM model calibration. The criteria listed below deviates from TOSAM requirements for simulated average speeds and simulated queue length. Speeds are highly variable on the interstate mainline as well as on the local arterial network and residential roadways, and can vary substantially by hour and by day. Instead, the simulated average speed will be captured as part of the travel time calibration process and the visual review of bottleneck locations against speed heat maps will be conducted. Average speeds will still be extracted from the VISSIM models along the freeway corridors (I-495 general purpose, I-495 HOT, and SR 267) at one-half mile intervals and compared visually against speed heat maps generated from INRIX vehicle probe data.

Similarly, queuing within the study area is notably inconsistent and can oscillate numerous times within the peak periods, or be absent altogether on some days. A qualitative subjective assessment will be conducted for queue lengths at targeted locations in addition to the review of freeway mainline congestion/queues against the speed heat maps. The targeted locations have been identified in **I-495 NEXT VISSIM Calibration Memorandum** which was approved and signed by the VDOT NoVA District Traffic Engineer on July 27, 2018

Table 1: VISSIM Calibration Criteria and Acceptance Targets

Calibration Item	Basis	Criteria	Target
Simulated Traffic Volume (Intersections)	**By Intersection Approach**	Within ± 20% for <100 vph	At least 85% of all Intersection Approaches
		Within ± 15% for ≥ 100 vph to < 300 vph	
		Within ± 10% for ≥ 300 vph to < 1,000 vph	
		Within ± 5% for ≥ 1,000 vph	
Simulated Traffic Volume (Freeways)	**By Freeway Segment**	Within ± 20% for <100 vph	At least 85% of all Freeway Segments
		Within ± 15% for ≥ 100 vph to < 300 vph	
		Within ± 10% for ≥ 300 vph to < 1,000 vph	
		Within ± 5% for ≥ 1,000 vph	
Simulated Travel Time	**By Route**	Within ± 30% for average travel times on arterials	At least 85% of all Travel Time Routes (Including Segments)
		Within ± 20% for average travel times on freeways	
Maximum Simulated Queue Length	**By Approach for Targeted Critical Locations**	Modeled queues qualitatively reflect the impacts of observed queues	Qualitative Visual Match
Visual Review of Bottleneck Locations	**Targeted Critical Locations**	Speed heat maps qualitatively reflect patterns and duration of congestions	Qualitative Subjective Assessment

Potential Adjustments for Calibration

Adjustments to the VISSIM model during the calibration process will follow guidance from the VDOT TOSAM. These adjustments could include modifications to lane change distance for connectors, driver behavior along freeways and arterials, adjustments to desired speeds for vehicles at the network termini (such as along I-495 northbound leaving the study area), etc. The technical memorandum detailing calibration results will identify any potential deviations from TOSAM guidance.

Quality Control and Assurance

The development of VISSIM models includes an extensive quality assurance/quality control process. All network inputs entered by a modeler will be checked by another modeler not associated with the development of the section. All routes and signal settings will be checked by a second modeler different from the one who entered the inputs into the VISSIM models. Close coordination will be maintained throughout the modeling effort to incorporate adequate geometric improvements into the VISSIM models.

Seeding Time, Simulation Time, and Number of Runs

After assessing the existing traffic counts and the diurnal patterns, the initialization/seeding time and the model simulation run time will be determined. Figure 7 shows the INRIX speed heat map for the I-495 northbound general purpose lanes (pulled from RITIS for average Tuesdays, Wednesdays, and Thursdays from July 2017 to June 2018) and proposed analysis time periods and "network representative" or peak hours (for volume balancing purposes and MOE summaries). Upon review of the INRIX speed data, the slowest speeds and heaviest queues during both the AM and PM are along I-495 northbound.

- AM: proposed analysis period from 6:45 AM to 9:45 AM; network representative hour from 7:45 AM to 8:45 AM. Queue spillback is tied to the on-ramp from GWMP and the weave across the American Legion Bridge, with the slowest speeds and longest queues occurring during the peak hour.
- PM: proposed analysis period from 2:45 PM to 5:45 PM; network representative hour from 3:45 PM to 4:45 PM. During the early afternoon hours (after approximately 2 PM), queue spillback and congestion along I-495 northbound is again tied to the on-ramp from GWMP and the weave across the American Legion Bridge. During the later afternoon hours (after approximately 3:30 PM, queues from downstream congestion in Maryland have spilled back across the American Legion Bridge, resulting in a single continuous queue. At this point, the back of the queue is observed to stabilize for several hours, essentially suggesting that demand is not increasing and being processed at the same rate as it arrives.

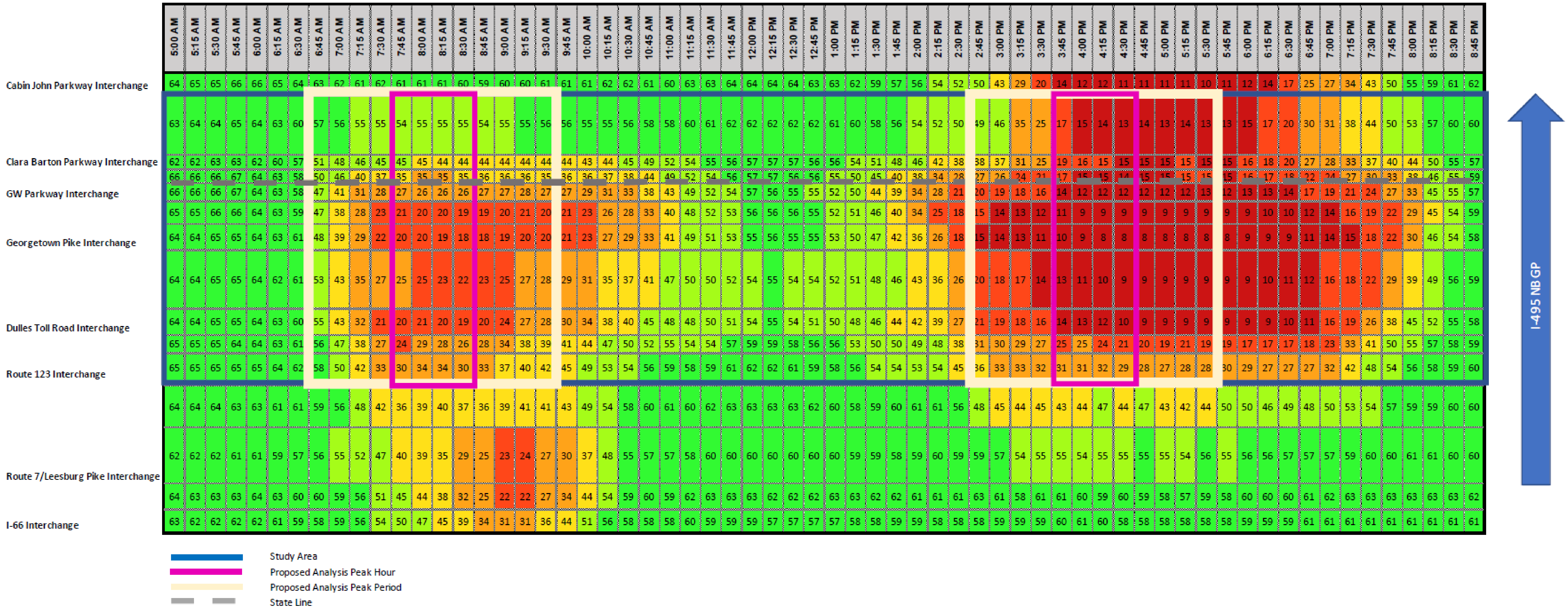
The model simulation period will be longer than the three-hour analysis period, as a seeding period will be provided prior to this analysis period to allow traffic volume to load into the network. The actual seeding period time will be established during the calibration process. MOEs will be reported for all three hours of the analysis period.

Given the stochastic nature of the VISSIM models, they need to be run with several different random seeds (to be determined based on statistical analysis) and the results need to be post-processed and averaged to determine the current state of traffic operations in the corridor. The total number of runs necessary for the analysis will be determined based on guidance from the TOSAM. The VDOT Sample Size Determination Tool, which was developed based on FHWA's statistical process to ensure that an appropriate number of microsimulation runs are performed at a 95^{th} percentile confidence level, will be used per guidance from the TOSAM.

Demand Review

As shown in Figure 7, the study area experiences severe congestion for several hours each day. The I-495 corridor is oversaturated and processes less traffic than its capacity, as observed in existing field counts. The existing demand is likely much higher than these processed throughput counts. The project team has received estimated demand volumes from Maryland SHA for overlapping segments of the project study area (from just south of Georgetown Pike to all points north). VISSIM inputs may be revised using an iterative manual process taking into account MDSHA demand estimates and unconstrained 15-minute flow data from various input locations. The INRIX data allows for estimation of the duration and distance of queues along the I-495 mainline, which can in turn be used to estimate the unserved demand during the peak period. The end result will still be a VISSIM model in which demand has been increased, but throughput aligns with balanced counts and speeds match field data.

Figure 7: INRIX Speed Heat Map for I-495 Northbound GP and Proposed Analysis Periods



SAFETY ANALYSIS

A safety analysis will be conducted, consistent with VDOT IIM-LD-200.9. The analysis will involve the analysis of existing highway safety conditions and reported motor vehicle crashes on roads in the study area for a period of five (5) years, and the development of qualitative and quantitative measures to evaluate proposed alternatives and assess the safety effects of interstate access modifications on I-495 and the adjacent arterial network within the study area. The Enhanced Interchange Safety Analysis Tool (ISATe) will be used to evaluate the quantitative safety impacts of interstate access modifications on I-495. Since the ISATe model was not developed for and is therefore not appropriate for the analysis of facilities with express lanes, this proposed safety analysis will feature the development of Safety Performance Functions for express lanes and inclusion of crash predictions from the application of those functions. In addition, Highway Safety Manual (HSM) methodologies will be used to evaluate the quantitative safety effects of the proposed interstate access modifications, notably geometric changes at the interchanges and ramp terminals on the intersecting arterial system adjacent to the interchanges and the resulting changes in traffic volumes projected to occur. In addition, a qualitative safety analysis will be performed.

Reported Crash Data, Crash Summaries & Collision Diagrams

Data on motor vehicle crashes reported on I-495 mainline, ramps, Collector-Distributor Road sections, selected arterial segments and at-grade intersections within the IJR study area will be analyzed and summarized. Data on reported crashes from January 1, 2013, to December 31, 2017, will be solicited and obtained from the Virginia Department of Transportation, the Maryland Department of Transportation, and the National Park Service for roads in the study area that were previously identified for the traffic operations analysis. The study area includes sections of the George Washington Memorial Parkway and sections of the Clara Barton Parkway, which are maintained by NPS, and sections of I-495 in Maryland which are maintained by the MDSHA of the MDOT.

The crash data will be summarized in a tabular format for up to 10 crash factors, such as weather conditions, lighting conditions, type of collision, day-of-week/time-of-day, and severity of crash, among others. The data will be summarized to identify trends in reported crashes, crash patterns and high-crash locations.

Crash location maps and crash density “heat” maps will be developed to display the following crash types along the I-495 study corridor:

- Total number of crashes
- Fatal + Injury crashes
- Crashes reported during the Weekday AM peak period (e.g., 5 AM to 10 AM)
- Crashes reported during the Weekday PM peak period (e.g., 3 PM to 8 PM)
- Rear-end crashes
- Sideswipe, same direction crashes
- Fixed-object, ran-off-road crashes

Mainline crash density histograms will be developed for I-495 from the Dulles Toll Road (VA 267) to the American Legion Memorial Bridge over the Potomac River, summarized in logical segments. The type and severity of crashes for each segment within the safety analysis study area also will be summarized.

Crash rates will be estimated and summarized, in tabular format, for the I-495 general purpose lane segments for the latest 5-year period and compared using the following crash rates provided by VDOT Central Office:

- Total Crash rates and Fatal+Injury crash rates for all Interstates in Virginia
- Total crash rates and Fatal+Injury crash rates for the Capital Beltway, which includes sections of I-495 and I-95 in Virginia.

Exposure estimates for the calculation of crash rates will be based on best available estimates of Average Annual Daily Traffic (AADTs). The results of this safety analysis will be used during the preliminary design phase of the project and during the development and screening of proposed interchange concepts phase of the project.

A field review will be conducted to complement the analysis of crashes reported over the five-year period. The results of this field review will be summarized in a brief technical memorandum to be used during the development of the design concepts. Crash trends and crash patterns will be described within hot spot locations.

Qualitative Analysis

A qualitative analysis of proposed improvements for one Preferred Build alternative will be completed. Engineering judgment, human factors analysis techniques to assess the ability of drivers to safely perform driving task and make speed, steering, and navigational decisions, and published literature will be used in this qualitative safety assessment. Concept plans will be reviewed and potential safety issues that warrant mitigation will be identified. These potential safety deficiencies will be identified in description detail, and the rationale for the safety concern will be documented in a concise memo. Extensive use will be made of relevant documents, positive guidance principles, human factors manuals, guidelines and processes for highway engineers and geometric design, and NCHRP and FHWA reports on safety effects related to interchanges, intersections, freeways, arterials, and ramp junctions. Notable documents include NCHRP report 600, “Application of Human Factor Guidelines for Road Systems”, AASTHO’s “Highway Safety Design and Operations Guide” (i.e., the old AASHTO Yellow Book), ITE’s “Human Factors Issues in Intersection Safety,” FHWA reports such as “Driver Expectations When Navigating Complex Interchanges, materials cited in the National Highway Institute’s “Human Factors for Transportation Engineers,” and other relevant literature, such as “Human Factors Associated with Interchange Design Features.” Drivers, often have difficulties following through the sequence of driving tasks, which leads to driving errors. The most common driving errors include improper lookout (faulty visual surveillance), inattention, false assumption, excessive speed, improper maneuvers, improper evasive action, and internal distraction.

The objective of the qualitative safety analysis is to identify assess the relative level of safety that is likely to result from proposed improvements by considering the potential effect of the following on driver expectancies, the demands on and capabilities of the driver to perform all subtasks of the driving tasks, driver information processing capabilities, and driver decision making capabilities especially at route choice decision points:

- Geometric characteristics, including grades, vertical alignment, horizontal alignment, cross-sections,
- Roadside features.
- Conflict points

- Traffic operations, including weaving, lane changing, merging, diverging and stopping
- Relative safety hazards

A brief summary of the qualitative safety assessment for the Preferred Build alternative will be prepared.

Quantitative Analysis

A quantitative analysis to evaluate the No-Build scenario and the benefits of the proposed improvements for the I-495 general purposes mainline and ramps associated with the Preferred Build improvement conditions. To minimize cost and schedule impacts, the quantitative analysis will be performed using an approach tailored to fit the intended purpose of the IJR document.

For the IJR, a planning-level crash analysis will be performed using the aforementioned tools to compare only the differences between the No-Build and Preferred Build alternatives corresponding to I-495 interchanges, freeway segments, ramp segments, intersections, and arterials affected by new ramps or access to/from the Express Lanes facility.

Assumptions regarding safety and crash analysis:

- Safety analyses will only be conducted on the roadway sections identified in the study area, consisting of interstate mainline segments, ramp segments, C-D Road segments, ramp termini, and at selected at-grade intersections.

- ISATe will be used to evaluate freeway and interchange safety for the general purpose lane sections, based on FHWA/AASHTO regulations and guidance. Using reported crash history and best available exposure estimates for the sections of the I-495 Express Lanes, safety performance functions will be developed for Express Lane sections. Then, those safety performance functions will be applied to develop estimated crash predictions for the future years (2025 and 2045) for both the No-Build and the Preferred Build alternatives.

- HSM NCHRP 17-38 spreadsheets (Virginia edition) will be used to analyze 5 years of continuous crash data for the crossroad segments. ISATe will be used to analyze the crossroad ramp terminal intersections within these segments.

- Freeway analysis will be limited to the I-495 mainline facility, and no analysis will be performed for the Express Lane facility, since current analysis tools do not provide for crash prediction and safety performance evaluation on Express Lane facilities.

- Quantitative analysis will be performed within the analysis limits of the available safety analysis tools; however, it should be noted that some geometric configurations are not able to be modeled using these tools. In these situations, qualitative analysis will be incorporated into the evaluation to supplement any gaps in the quantitative analysis.

- All crash data will be provided by VDOT in GIS shapefile or geodatabase format. The consultant team will rely on the crash data directly from the VDOT Roadway Network System (RNS) and will not review individual crash reports to verify the accuracy of the information.

Deliverables

- Crash field review technical memorandum

- Existing safety conditions memorandum
- Qualitative Safety Assessment of the Preferred Build Alternative memorandum
- Crash/safety analysis sections for the IJR and TTR.

REPORT DELIVERABLES

The following documents will be produced as deliverables during the course of the project and for the culmination of analysis and data collection.

- **Existing Conditions Technical Memorandum**. The following will be included within the Existing Conditions Technical Memorandum:
    - Data collection overview
    - Review of volumes development process (describing count data post-processing and volume balancing)
    - Travel demand forecast model calibration and outputs
    - Traffic simulation model calibration
    - Documentation of existing conditions (outputs from traffic simulation model supplemented by discussion of field conditions)
    - Safety analysis for the study area
- **Draft Traffic and Transportation Report (TATTR).** Prepared in support of the EA (to be included as an appendix to the NEPA documentation). For the entire study area, a technical report will be prepared to document and support all analysis that is performed for the determination of traffic volume forecasts, traffic impacts as they relate to NEPA and the proposed action, the inputs and analysis that feed the Air Quality Analysis, and the data to support the Noise Analysis. This document also will be used as a supporting technical report for the system-wide IJR described below.
- **Final TATTR.** Incorporate VDOT/FHWA comments and submit modified document that will secure interstate access approval from FHWA. It is assumed that concurrent reviews will occur on the preliminary Final TATTR, with a consolidated set of review comments at the conclusion of the draft review.
- **Draft IJR.** Incorporate traffic engineering and operational analysis as well as results from the VAP3's Proposed Design Plans and EA into the IJR. IJR will be prepared based on the guidance set forth in IIM-LD200.9 with exceptions to be consistent with the May 2017 update to FHWA policy on NEPA and IJRs per VDOT's direction. This document will note any potential Limited Access changes required, as well as any potential Design Exceptions or Design Waivers being requested. The IJR will also include a discussion on the use of available typical section width and how that width will be distributed for the proposed typical, showing a hierarchy for distributing the available width between shoulders, travel lanes, and median width. A draft version of the document will be provided to VDOT Central Office and FHWA (Virginia Division Office and Headquarters Office) for review and comments. For budgeting purposes, it is assumed that concurrent reviews will occur, with a consolidated set of review comments at the conclusion of the draft review.
- **Final IJR.** Incorporate VDOT and FHWA comments and submit modified document that will secure IJR approval from FHWA. It is assumed that concurrent reviews will occur on the preliminary Final IJR, with a consolidated set of review comments at the conclusion of the preliminary final review.

Review Process

It is anticipated that a two-week comment period will be provided for review of the Draft IJR. These comments will be addressed within 3 weeks of being received upon which a final report will be submitted.

Accepted and agreed upon by FHWA & VDOT:

______________________________ _______________

Virginia Department of Transportation — Date
Northern Virginia District/Virginia MegaProjects Project Manager

______________________________ _______________

Virginia Department of Transportation — Date
Northern Virginia District/Virginia MegaProjects Project Director

______________________________ _______________

Virginia Department of Transportation — Date
Northern Virginia District/Traffic Engineering

______________________________ _______________

Virginia Department of Transportation — Date
Northern Virginia District/Location and Design

______________________________ _______________

Virginia Department of Transportation — Date
Central Office

______________________________ _______________

FHWA Virginia Division Office — Date

MEMORANDUM

To: Rahul Trivedi, P.E., VDOT NoVA District Transportation Planning Manager
Amir Shahpar, P.E., VDOT NoVA District Modeling Manager
Abi Lerner, P.E., VDOT Project Manager

From: Rob Prunty, P.E.
Raj Paradkar, P.E.
Anthony Gallo, P.E.
Sarah Knox, P.E.
Kimley-Horn and Associates, Inc.

Date: August 26, 2018

Subject: I-495 NEXT Travel Demand Forecasting Framework

Introduction

This memorandum documents the travel demand forecasting framework associated with the I-495 NEXT Project. This memorandum is intended to supplement the overarching I-495 NEXT Project Scoping Framework Document.

The following elements of the traffic operations analysis are laid out in detail in this document:

- Travel demand modeling assumptions and calibration/validation
- Traffic volume post-processing for use in traffic operations and air/noise analysis

Travel Demand Modeling Methodology

Existing Conditions Model Calibration and Validation

The latest MWCOG travel demand model version on the 3,722 traffic analysis zone (TAZ) system will be used in conjunction with Round 9.1 Cooperative Forecasts (socioeconomic data) for the Existing, Opening, and Design model years. The MWCOG model base year is 2017; a project Existing Conditions (year 2018) model will be prepared, modified and calibrated to reflect field counts. Modifications will be carried forward into future analysis year model scenarios.

The MWCOG model will be strategically modified with specific alterations to improve the accuracy and reliability of forecasts for the I-495 study corridor, roadways connected to the corridor, and transit services in the vicinity of the corridor. The calibration targets will be based on guidance from the FHWA Transportation Model Improvement Program (TMIP) *Travel Model Validation and Reasonableness Checking Manual* and the Virginia *Travel Demand Modeling Policies and Procedures Manual*. Because the MWCOG/TPB Model is already subject to scrutiny as a regional model which has been a subject of FHWA's TMIP Peer Review process, the validation process for the I-495 Project NEXT model will focus on the I-495 Traffic Operations Analysis Study Area and will include the following comparisons:

- Regional comparisons to VDOT AADTs at the daily level (daily level only)
  - Percent difference in total volume for cutlines
- I-495 NEXT study area comparisons to field traffic counts (AM/PM periods and daily)
  - R-squared between modeled volumes and counts on links
  - Percent difference in total volumes for freeways/arterials
  - Percent root mean squared error (%RMSE) by volume group or facility type
- Travel time comparisons of model outputs to floating car runs data collected (AM/PM periods only; reasonableness checks only)

Table 1 provides a listing of travel demand model calibration criteria, which were discussed and verbally approved by VDOT during a call on July 24, 2018.

Table 1. Travel Demand Forecast Model Calibration Criteria

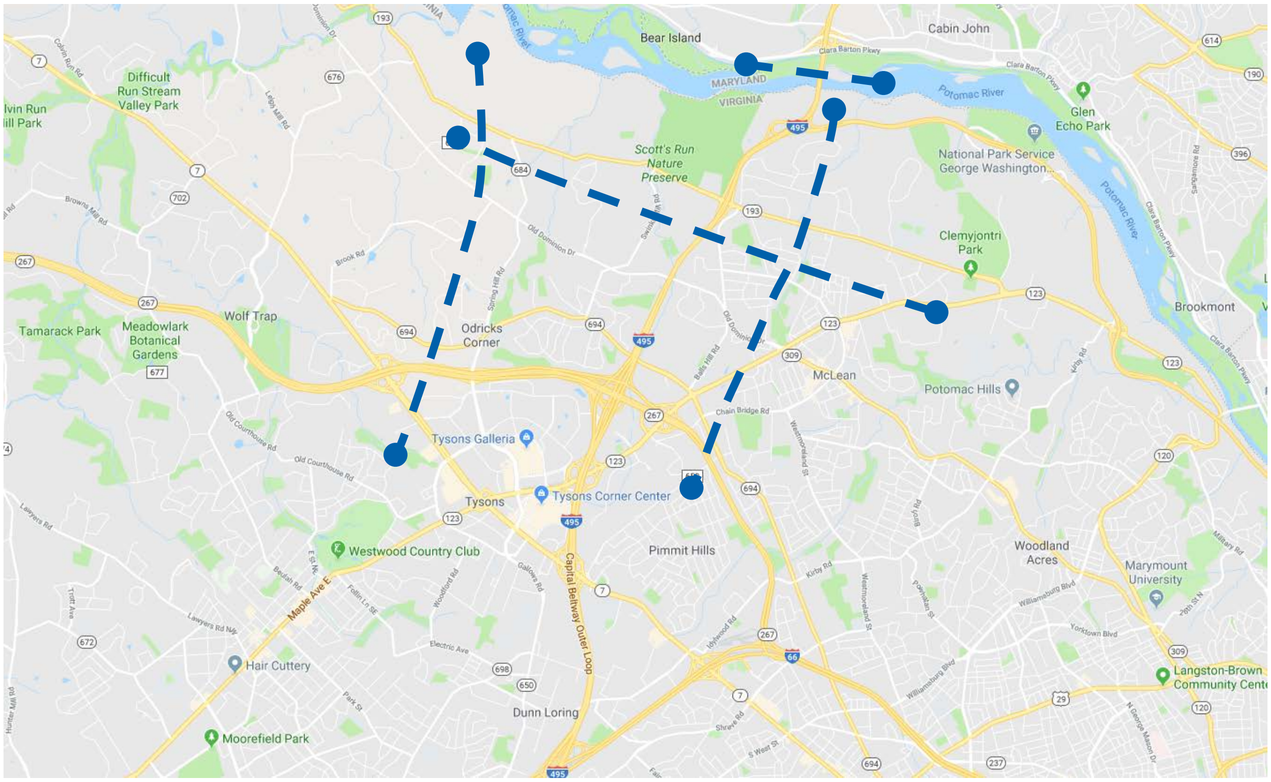
Calibration Scale	Calibration Check	Calibration Threshold			
Regional	% Difference in Total Volume for Cutlines (24-Hour Volumes)	Cutline Volume	VTM	FHWA	***Proposed***
		50,000	10%	35%	***10%***
		100,000	8.75%	25%	***10%***
		150,000	7.50%	20%	***10%***
		200,000	6.25%	18%	***8%***
		250,000	5%	15%	***7%***
Study Area	R-Squared between modeled volume and counts on links (AM Period, PM Period, and 24-Hour Volumes)		VTM	FHWA	***Proposed***
			0.9	0.88	***0.9***
	% Difference in Total Volume by Facility Type (AM Period, PM Period, and 24-Hour Volumes)	Facility Type	VTM	FHWA	***Proposed***
		Freeways	6%	7%	***6%***
		Major Arterials	7%	10%	***10%***
		Minor Arterials	10%	15%	***15%***
	%RMSE by Facility Type (AM and PM Period)	Facility Type	VTM	FHWA	***Proposed***
		Freeways	30%	-	***30%***
		Major Arterials	45%	-	***45%***
		Minor Arterials	60%	-	***60%***
		Overall	40%	-	***40%***
	%RMSE by Facility Type (24-Hour Volumes)	Facility Type	VTM	FHWA	***Proposed***
		Freeways	20%	-	***20%***
		Major Arterials	35%	-	***35%***
		Minor Arterials	50%	-	***50%***
		Overall	30%	-	***30%***
	Travel Times (AM and PM Period)	No specific measures in VTM or FHWA; compare model outputs to floating car travel runs and check to see if travel times are within min and max of observed travel times. Note that these are reasonableness checks only.			

The following regional cut-lines will be used in the calibration process:

- East/west travel west of study area
  - Georgetown Pike west of Spring Hill Road
  - Old Dominion Drive west of Spring Hill Road
  - Lewinsville Road west of Spring Hill Road
  - Route 267 between Route 7 and Spring Hill Road
  - Route 7 just east of Route 267
- East/west travel east of study area
  - George Washington Memorial Parkway east of I-495
  - Georgetown Pike east of I-495
  - Old Dominion Drive between Balls Hill Road and Route 123
  - Route 123 east of Lewinsville Road/Great Falls Street
  - Chain Bridge Road east of Great Falls Street
  - Great Falls Street east/south of Chain Bridge Road
  - Route 267 east of Route 123
- North/south travel north of study area
  - I-495 American Legion Bridge
- North/south travel within study area
  - Spring Hill Road south of Georgetown Pike
  - Swinks Mill Road south of Georgetown Pike
  - I-495 south of Georgetown Pike
  - Balls Hill Road south of Georgetown Pike
  - Douglas Drive south of Georgetown Pike
  - Route 123 west/south of Georgetown Pike

Figure 1 shows a map of the proposed cut-lines for the calibration process.

Figure 1. Proposed Cut-Lines for Travel Demand Model Calibration Process.



Toll Diversion Curves from OP3's consultant, based on existing express lane usage on the Capital Beltway Express Lanes, will also be validated in order to increase confidence in the model and maintain relative consistency between traffic and revenue studies for I-495 in Virginia, and regional planning studies of MDOT's proposed managed lanes system in Maryland.

Travel demand forecasting activity will be coordinated between the traffic and revenue study, and IJR/NEPA effort in order to maintain consistency in forecasting among these efforts to the maximum extent practical. Alterations to the MWCOG travel demand model to improve corridor calibration may include:

- Highway network modifications to better represent study area facilities as they exist and are planned, such as modifications to link facility types. Ramps will be micro-coded to improve forecasts and correlation to the microsimulation process.
- Traffic Analysis Zone (TAZ) splits and centroid connector location changes to improve model loading for all modeled modes of transportation.
- Changes to external trip assumptions to improve consistency with origin-destination data and traffic and revenue evaluations.
- Use of toll diversion methodology to forecast Express Lane trips.

- Changes in the time-of-day distribution to improve forecasting of peak period trips, changes in the Volume Delay Function (VDF) curves, and changes in the default speed and capacity of some facility types.

Future Analysis Scenario Assumptions

The I-495 NEXT traffic analysis will assess operations for a project Design Year of 2045 and Interim Year of 2025. The traffic analysis will account for a No-Build scenario and one Build alternative. Separate travel demand model networks will be developed for each of the future-year scenarios to be used for forecasting traffic volumes.

The travel demand model No-Build networks will include all roadway projects in the most up-to-date regional CLRP. In addition, the No-Build networks will account for the following elements:

- **I-495/Dulles Toll Road Interchange Ramps** – currently unbuilt ramps at the I-495/Dulles Toll Road, including ramps to and from the I-495 Express Lanes and Dulles Airport Access Road, for which preliminary engineering has completed and construction is anticipated prior to the I-495 NEXT project being in place.
- **Auxiliary lanes along I-495** – general-purpose auxiliary lanes to be added along I-495 between the Dulles Toll Road interchange and the Georgetown Pike interchange
- **Express Lanes in Maryland** – the I-495 NEXT team will be coordinating closely with the Maryland Department of Transportation (MDOT) on plans for a network of express lanes in Maryland, including lanes along I-495 and I-270. These plans are currently ongoing, but the I-495 NEXT No-Build and Build networks will contain the same assumptions for the Express Lanes in Maryland:
  - Locations of access and network structure
  - Vehicle types allowed in express lanes, including those which must pay a toll and those which are exempt (if any) – could include HOV2/HOV3+ or trucks

Summary of Travel Demand Modeling Assumptions

Table 1 lists key assumptions associated with the travel forecasting process.

Table 2: Travel Demand Forecasting Model Assumptions

<table>
<tr><th>Model Parameter</th><th>Assumption</th><th>Comments</th></tr>
<tr><td colspan="3">Model</td></tr>
<tr><td>Analysis Years
2018 (Existing)
2025 (Interim Year)
2045 (Design Year)</td><td><u>MWCOG Model</u>
2018 (Validation Year)
2025
2045</td><td>MWCOG travel demand model has model inputs at 5-year increments plus a year 2017 input dataset. Intermediate years can be developed by interpolating input data and modifying networks to represent planned conditions.</td></tr>
<tr><td>Time Periods</td><td>Four time periods are modeled in the forecasts. The sum of the four time periods represents average weekday daily traffic:<table><tr><th>Period</th><th>Hours</th></tr><tr><td>AM</td><td>6 a.m. – 9 a.m.</td></tr><tr><td>Midday</td><td>9 a.m. – 3 p.m.</td></tr><tr><td>PM</td><td>3 p.m. – 7 p.m.</td></tr><tr><td>Night</td><td>7 p.m. – 6 a.m.</td></tr></table></td><td>Hours split based on MWCOG household survey data (2007/2008).</td></tr>
<tr><td>Speed</td><td>Consistent with current conditions in the HOV and general purpose (GP) lanes.</td><td>Consistent with existing conditions. Same as speed/travel time curves based on MWCOG unless validation suggests modification.</td></tr>
<tr><td>Link Capacity</td><td>Lane capacities are defined consistent with the MWCOG model approach.</td><td>The MWCOG facility and area type capacity tables are used to determine link capacities. Use same speed-flow curves consistent with TPB model unless validation suggests modification.</td></tr>
<tr><td>Peak Factors</td><td>Peak period to peak hour factors:<table><tr><th>Period</th><th>2010</th><th>2025</th><th>2040</th></tr><tr><td>AM</td><td>0.417</td><td>0.38</td><td>0.34</td></tr><tr><td>PM</td><td>0.294</td><td>0.272</td><td>0.25</td></tr></table></td><td>Existing peak period values were derived from the 2007/2008 MWCOG Household Travel Survey. The peak hour factors decline in future years in recognition of the increased congestion expected in the region causing less peaked periods. This assumption spreads the traffic evenly over the entire peak period.</td></tr>
<tr><td>Socioeconomic Data</td><td>MWCOG Round 9.1 socioeconomic data will be used.</td><td></td></tr>
</table>

Table 2: Travel Demand Forecasting Model Assumptions

Model Parameter	Assumption	Comments
Network		
Project Description (I-495 Northern Extension)	Two Express Lanes in each direction along I-495 between the Dulles Toll Road (Route 267) and George Washington Memorial Parkway. Specifics to be addressed in the preliminary design effort.	
Project Extent	Dulles Toll Road in Tysons to GWMP near Maryland State Line	
I-495 (Capital Beltway) Express Lanes	Existing: Express Lanes on I-495 between I-95/I-395 and Dulles Toll Road Future: Existing Express Lanes on I-495 plus new Express Lanes in Maryland along I-495 and I-270.	Access, tolling parameters, and vehicle restrictions for I-495 Express Lanes in Maryland to be determined in coordination with MDOT.
HOV	Beginning in 2020, all HOV facilities in the Northern Virginia area are assumed to become HOV-3+.	I-495 and I-95 Express Lanes are free to HOV-3 vehicles currently; HOV lanes along I-66 and Dulles Toll Road are HOV-2 currently. HOV restrictions in Maryland to be determined in coordination with MDOT. See Table 3 for further explanation.
Toll Assumptions		
Tolling Methodology	Tolling assumptions will be kept consistent with MWCOG's default factors for I-495, I-95/395, and I-66 HOT Lanes in the final assignment iteration.	
Toll Approach	Variable toll rates by roadway segment, based on maintaining Express Lane speed goal of 55 mph.	Adopted to account for varying demand levels along the length of the project.
Mode Assumptions in I-495 NEXT Express Lanes		

Table 2: Travel Demand Forecasting Model Assumptions

Model Parameter	*Assumption*	*Comments*
Vehicle Class	HOV-3+: Free Other cars and medium trucks: Toll Heavy trucks: Are permitted in the I-495 Express Lanes from the Dulles Toll Road to the project terminus north of the GWMP.	Vehicle class restrictions for I-495 Express Lanes in Maryland to be determined in coordination with MDOT
HOV Vehicles	Use the MWCOG model HOV module. Beginning in 2020, all HOV facilities in Northern Virginia area will be HOV-3+.	The HOV estimates provided are an output of the *mode choice* and *carpool occupancy* models developed by MWCOG.

Table 3. HOV and Tolling Assumptions for Facilities in Study Area

Facility	2018	2025	2045
I-495 (Existing Express Lanes Network)	All vehicles except trucks permitted in barrier-separated express lanes. All vehicles except HOV3+ must pay a toll.		
Dulles Toll Road (SR 267)	HOV2+ vehicles only allowed in left-most lane eastbound (AM peak) and westbound (PM peak)	HOV3+ vehicles only allowed in left-most lane eastbound (AM peak) and westbound (PM peak)	
I-66 (Outside the Beltway)	HOV2+ vehicles only allowed in left-most lane eastbound (AM peak) and westbound (PM peak)	All vehicles (including trucks) permitted in barrier-separated express lanes. All vehicles except HOV3+ must pay a toll.	
I-66 (Inside the Beltway)	All vehicles except trucks permitted. During AM peak eastbound and PM peak westbound, lanes are tolled except for HOV2+ vehicles.	All vehicles except trucks permitted. During AM peak eastbound and PM peak westbound, lanes are tolled except for HOV3+ vehicles.	All vehicles except trucks permitted. During AM peak and PM peak in both directions, lanes are tolled except for HOV3+ vehicles.

Traffic Volume Post-Processing

Post-processing of travel demand model output is necessary to develop traffic volume forecasts for analysis of operations during peak periods/peak hours. Post-processing of travel demand forecasts for vehicular volumes will follow NCHRP 255/765 guidelines for estimating balanced No-Build and Build peak period volumes. Existing balanced volumes will be developed outside of the MWCOG travel demand model using field count data; origin-destination (O-D) routing will be obtained utilizing StreetLight Data or the MWCOG model, and the O-D matrix will be adjusted using VISUM's TFlowFuzzy methodology to match target balanced volumes along the corridor. The O-D matrix will be imported into VISSIM for traffic microsimulation analysis.

Traffic volumes for the traffic operations analysis and air quality and noise analyses for future scenarios will be developed using travel demand model outputs and NCHRP 255/765 guidelines. For future scenario VISSIM microsimulation analysis, O-D routing will again be developed using MWCOG model outputs as a seeding matrix and VISUM's TFlowFuzzy process to create an adjusted O-D matrix that matches target forecast volumes in the study area.

Conclusion

The travel demand model methodology and calibration/validation criteria were reviewed with VDOT staff on a call on July 24, 2018. This methodology will be carried forward for travel demand forecasting for the I-495 NEXT project.

Kimley»Horn ATCS

MEMORANDUM

To: Ivan Horodyskyj, P.E., VDOT NoVA District Traffic Engineer
Abi Lerner, P.E., VDOT Project Manager

From: Rob Prunty, P.E.
Raj Paradkar, P.E.
Anthony Gallo, P.E.
Kimley-Horn and Associates, Inc.

Date: August 29, 2018

Subject: I-495 NEXT Traffic Operations Analysis Framework

Introduction

This memorandum documents the traffic operations analysis framework associated with the I-495 NEXT Project. This memorandum is intended to supplement the overarching I-495 NEXT Project Scoping Framework Document.

The following elements of the traffic operations analysis are laid out in detail in this document:

- Traffic data collection
- Traffic analysis tools and measures of effectiveness (MOEs)
- Traffic simulation model calibration methodology and assumptions

Traffic Data Collection

Traffic Volumes

The following intersection locations will have traffic counts conducted in the year 2018 and be analyzed as part of the traffic operations analysis:

1. Westpark Drive Connector at I-495 Express Lane ramp terminals
2. Westpark Drive Connector at West Park Drive
3. Route 123 at Tysons Boulevard / Entrance to Tysons Mall Ring Road
4. Route 123 at Old Meadow Road / Capital One Tower Drive
5. Route 123 at Scotts Crossing Road / Colshire Drive
6. Route 123 at Anderson Road / Dulles Toll Road Connector ramp terminal
7. Route 123 at Great Falls Street / Lewinsville Road
8. Lewinsville Road at Balls Hill Road
9. Lewinsville Road at Swinks Mill Road
10. Lewinsville Road at Spring Hill Road
11. Spring Hill Road at Dulles Toll Road WB ramp terminals
12. Spring Hill Road at Dulles Toll Road EB ramp terminals
13. Spring Hill Road at International Drive / Jones Branch Drive

14. Jones Branch Drive at Jones Branch Connector
15. Jones Branch Connector at I-495 Express Lane ramp terminals
16. Old Dominion at Spring Hill Road
17. Old Dominion at Swinks Mill Road
18. Old Dominion at Balls Hill Road
19. Georgetown Pike at Dead Run Drive
20. Georgetown Pike at Balls Hill Road
21. Georgetown Pike at NB I-495 GP NB ramp terminals
22. Georgetown Pike at SB I-495 GP NB ramp terminals
23. Georgetown Pike at Linganore Drive / Helga Place
24. Georgetown Pike at Swinks Mill Road
25. Georgetown Pike at Spring Hill Road
26. Georgetown Pike at Douglass Drive
27. Route 123 at Ingleside Avenue
28. Route 123 at Old Dominion Drive

The following interchanges will have traffic counts conducted in the year 2018 and will be analyzed as part of the traffic operations analysis:

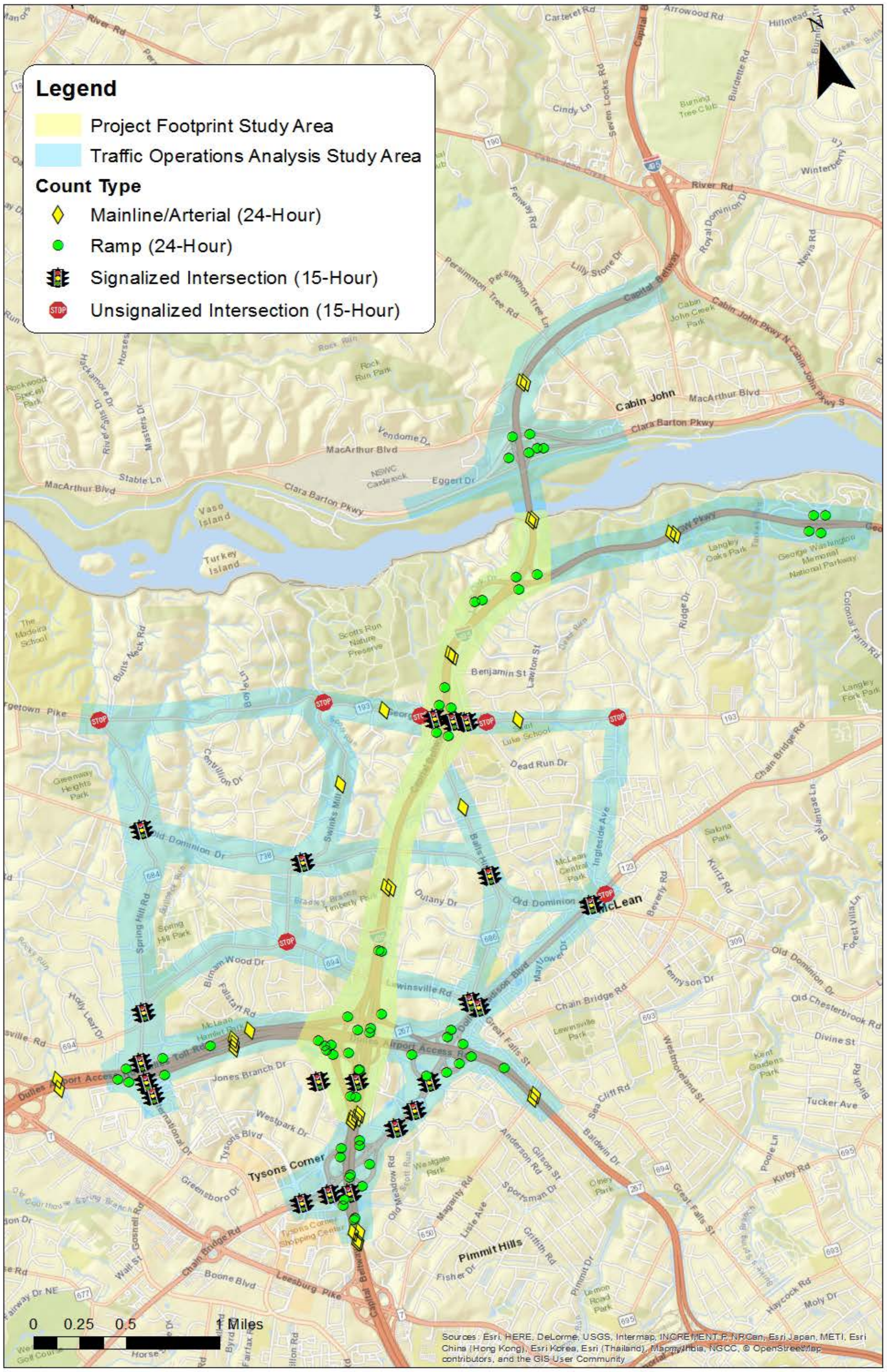
1. I-495 GP at Route 123
2. I-495 Express Lanes at Westpark Drive Connector
3. I-495 Express Lanes at Jones Branch Connector
4. I-495 GP at Dulles Toll Road and Dulles Airport Access Road
5. I-495 Express Lanes at Dulles Toll Road
6. I-495 at Georgetown Pike
7. I-495 at George Washington Memorial Parkway
8. I-495 at Clara Barton Parkway
9. Dulles International Airport Access Highway ramps to / from Dulles Toll Road (VA Route 267), east and west of I-495
10. Dulles Toll Road (VA Route 267) at Spring Hill Road (VA Route 684)
11. Dulles Toll Road (VA Route 267) at Dolley Madison Road (VA Route 123)
12. George Washington Memorial Parkway and Turkey Run Park

Traffic count locations are shown in Figure 1.

Traffic volumes used in the traffic and operations analysis will consist of the following:

- **Existing (2018)** – Developed from field counts (ramps, freeway mainline, and intersection turning movements) conducted in June 2018. Count data will be post-processed and balanced between all adjacent locations in the traffic operations analysis study area.
- **Opening Year (2025)** – No Build and one Build alternative developed through modifications to the MWCOG 2025 travel demand model for the I-495 corridor and post-processed based on 2018 data collection.
- **Design Year (2045)** – No Build and one Build alternative developed through modifications to the MWCOG 2045 travel demand model for the I-495 corridor and post-processed based on 2018 data collection.

Figure 1: Traffic Count Locations



Origin-Destination Data

The traffic simulation modeling effort will route vehicles through the traffic network according to origin-destination routing. Origin-destination data will be reviewed from the following sources:

- StreetLight Data, which via a VDOT subscription provides customized origin-destination data with a very high level of spatial accuracy based on aggregated cellular device GPS/location-based services data. StreetLight Data allows for a user to provide custom origins and destinations, such as on- and off-ramps for all freeways in a study area or entry/exit links to a study area. It is anticipated that StreetLight Data will be used as the basis for origin-destination routing for the existing conditions traffic analysis, at the very least for the freeway and ramp segments of the study area.
- MWCOG regional travel demand model, which outputs O-D matrices for various vehicle types between each traffic analysis zone (TAZ) in the Washington, DC, metropolitan area. The travel patterns within the model base year (2017) have been calibrated against 2007/2008 regional household travel survey data, so the travel patterns are somewhat dated. Additionally, this dataset is not as granular as needed to account for freeway weaving proportions. However, given that the travel demand model provides O-D matrices for future years, it is anticipated that these may be used as the basis for vehicle routing in future analysis year scenarios.

Speeds and Travel Times

Floating car travel time runs were conducted in June 2018 during the AM and PM peak periods for the following segments:

Corridor #	Corridor Name
1	I-495 Northbound – From south of Route 123 to River Road CD road;
3	I-495 Southbound – From River Road CD road to south of Route 123;
2	I-495 Northbound to DTR Westbound – From Route 123 to Spring Hill Road;
8	DTR Eastbound to I-495 Southbound – From west of Spring Hill Road to south of Route 123
4	I-495 Southbound to DTR Connector Eastbound from River Road CD road to east of Route 123
10	DTR Westbound Connector to I-495 Northbound – from east of Route 123 to River Road CD road.
5	I-495 Southbound to DTR Westbound – From River Road CD road to Spring Hill Road;
7	DTR Eastbound to I-495 Northbound – From west of Spring Hill Road to River Road CD road;
6	DTR Eastbound – From west of Spring Hill Road to east of Route 123;
9	DTR Westbound – From east of Route 123 to west of Spring Hill Road

In addition, INRIX vehicle probe speed data has been queried for the corridor using the RITIS Congestion Scan tool, which provides a “heat map” of vehicle speeds temporally and spatially along a corridor. This data has been pulled for “average weekdays” (Tuesday, Wednesday, and Thursday) for the 12 most recently available months of data (July 2017 through June 2018).

Queueing Data

Queueing along the freeway segments of the corridor will be provided via the INRIX heat map and verified against Google Maps’ typical traffic. Queueing along arterials and ramps will be obtained via screen captures from Google Maps’ typical traffic. Targeted spot locations will be verified in the field.

Traffic Operational Analysis Tools and Measures

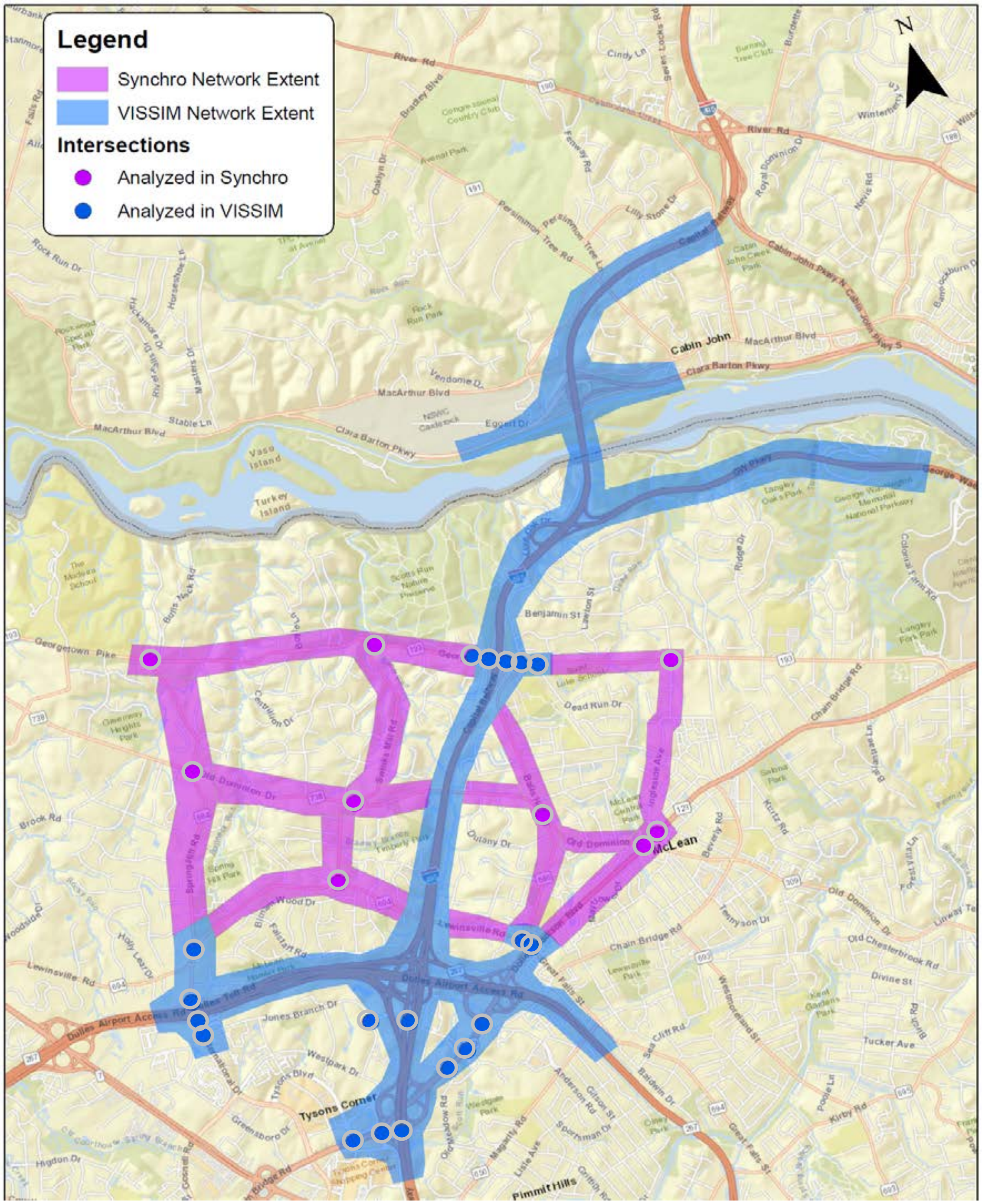
Traffic Analysis Tools

VISSIM Version 9.0 will be used for a comprehensive network traffic analysis for the freeways, interchanges, and adjacent intersections within the traffic operations analysis area limits. (Reference analysis tool selection matrix, *VDOT Traffic Operations and Safety Analysis Manual [TOSAM]* V1.0[1], Appendix D.) Additional calibration, based on simulated volume processed, travel times, queues, and speed profiles, will be performed against 2018 measured field conditions and traffic data.

Surface street intersection operations will be evaluated through a combination of Synchro 10 (in order to develop preliminary optimization for phasing and signal timing) and VISSIM (for microsimulation and analysis). The expanded arterial network beyond intersections immediately adjacent to freeway interchanges in the corridor will be evaluated solely through Synchro. Transit routes and stops will be coded into the study area VISSIM network where they affect or could affect I-495 and related facility operations. The VISSIM and Synchro study areas are shown in Figure 2.

[1] http://www.virginiadot.org/business/resources/TOSAM.pdf

Figure 2. I-495 NEXT Traffic Operations VISSIM and Synchro Analysis Areas



Vehicle Classes

The following vehicle classes will be assumed for the traffic operations analysis VISSIM modeling:

- General purpose (non-toll-paying) cars
- HOV3+ cars
- HOT (toll paying) cars
- GP (non-toll-paying) trucks
- HOT (toll paying) trucks

Measures of Effectiveness

The following measures of effectiveness (MOEs) will be used for the operational analysis of the roadway network under existing and future Build and No-Build conditions.

Freeway Performance Measures

- Simulated Average Speed (mph)
- Simulated Average Density (pc/ln/mile, color-coded similar to the equivalent Density-Based LOS Thresholds)
- Simulated Volume (vehicles per hour)

The VISSIM freeway MOEs will be reported for each freeway segment. In addition, the following freeway MOEs also are proposed for reporting in the IJR:

- **Percent of Demand Served.** Simulated Volume (*processed volumes*) divided by Actual Volume (*input volumes*).
- **Simulated Ramp Queue Length.** Reported for 50^{th} and 95^{th} percentiles (feet).
- **Simulated Travel Time.** Reported for select network origin-destination travel paths (seconds).
- **Congestion *Heat Maps*.** Incremental speeds reported for aggregated lanes, by time interval (mph).

Arterial/Intersection Performance Measures

- **Simulated Intersection Level of Service (LOS) and Average Control Delay.** Reported by approach and by intersection (sec/veh, color-coded in similar fashion as the equivalent Highway Capacity Manual (HCM) Delay-Based LOS Thresholds).
- **Simulated Intersection Approach Queue.** Reported by movement (feet).
- **Percent of Demand Served.** Simulated Volume (*processed volumes*) divided by Actual Volume (*input volumes*).

Traffic Modeling Methodology and Assumptions

Calibration Methodology for Base Models

The VISSIM base models will be calibrated based on guidance from *VDOT Traffic Operations and Safety Analysis Manual (TOSAM)*, Version 1. A full review of the criteria and acceptance targets is provided in the attached **I-495 NEXT Traffic Analysis Microsimulation Calibration Methodology Memorandum**. This memorandum was approved and signed by the VDOT NoVA District Traffic

Engineer on July 27, 2018. The following criteria and thresholds are proposed for VISSIM model calibration:

<table>
<tr><th>Calibration Item</th><th>Basis</th><th>Criteria</th><th>Target</th></tr>
<tr><td rowspan="4">Simulated Traffic Volume (Intersections)</td><td rowspan="4">By Intersection Approach</td><td>Within ± 20% for <100 vph</td><td rowspan="4">At least 85% of all Intersection Approaches</td></tr>
<tr><td>Within ± 15% for ≥ 100 vph to < 300 vph</td></tr>
<tr><td>Within ± 10% for ≥ 300 vph to < 1,000 vph</td></tr>
<tr><td>Within ± 5% for ≥ 1,000 vph</td></tr>
<tr><td rowspan="4">Simulated Traffic Volume (Freeways)</td><td rowspan="4">By Freeway Segment</td><td>Within ± 20% for <100 vph</td><td rowspan="4">At least 85% of all Freeway Segments</td></tr>
<tr><td>Within ± 15% for ≥ 100 vph to < 300 vph</td></tr>
<tr><td>Within ± 10% for ≥ 300 vph to < 1,000 vph</td></tr>
<tr><td>Within ± 5% for ≥ 1,000 vph</td></tr>
<tr><td rowspan="2">Simulated Travel Time</td><td rowspan="2">By Route</td><td>Within ± 30% for average travel times on arterials</td><td rowspan="2">At least 85% of all Travel Time Routes (Including Segments)</td></tr>
<tr><td>Within ± 20% for average travel times on freeways</td></tr>
<tr><td>Maximum Simulated Queue Length</td><td>By Approach for Targeted Critical Locations</td><td>Modeled queues qualitatively reflect the impacts of observed queues</td><td>Qualitative Visual Match</td></tr>
<tr><td>Visual Review of Bottleneck Locations</td><td>Targeted Critical Locations</td><td>Speed heat maps qualitatively reflect patterns and duration of congestion</td><td>Qualitative Subjective Assessment</td></tr>
</table>

The following locations have been proposed for queue length calibration and reporting:

Queue Type	**Location**
Ramp	Ramp from SR 267 EB to I-495 NB GP
Ramp	Ramp from DAAR EB to I-495 NB GP
Ramp	Ramp from SR 267 EB to I-495 SB GP
Ramp	Ramp from SR 267 EB to Route 123 NB
Ramp	Ramp from Georgetown Pike (SR 193) to I-495 NB GP
Ramp	Ramp from George Washington Memorial Parkway NB to I-495 NB GP
Approach	Georgetown Pike (SR 193) EB approaching I-495 NB GP ramps
Approach	Georgetown Pike (SR 193) WB approaching I-495 NB GP ramps

Approach	Balls Hill Rd NB approaching Georgetown Pike
Approach	Spring Hill Rd NB approaching Lewinsville Road
Approach	Route 123 NB approaching Great Falls St
Approach	Lewinsville Road EB approaching Balls Hill Road

Potential Adjustments for Calibration

Adjustments to the VISSIM model during the calibration process will follow guidance from the VDOT TOSAM. These adjustments could include modifications to lane change distance for connectors, driver behavior along freeways and arterials, adjustments to desired speeds for vehicles at the network termini (such as along I-495 northbound leaving the study area), etc. The technical memorandum detailing calibration results will identify any potential deviations from TOSAM guidance.

Simulation Time, Seeding Time, and Number of Runs

The I-495 NEXT traffic operations study area is a severely oversaturated network during the weekday AM and PM peak periods, with several hours of congestion in both directions along I-495, especially along I-495 northbound approaching the American Legion Bridge. During these congested periods, traffic volume throughput is constrained due to low speeds and can be much lower than the actual maximum counted volumes along the freeway. Due to the oversaturated conditions, the analysis period was selected based on the heaviest periods of congestion and slowest speeds experienced along the corridor.

Figure 3 shows 15-minute average speeds along the I-495 northbound general purpose lanes through the study area for average weekdays (Tuesday, Wednesday, and Thursday) from July 2017 through June 2018. Note that during both the AM and PM peak periods, speeds along I-495 northbound are slower than speeds along I-495 southbound due to the downstream bottleneck at the American Legion Bridge. Thus, the analysis period and peak hours have been selected specifically based on congestion in the I-495 northbound general purpose lanes.

Figure 3 also show the proposed simulation analysis periods, which were also approved by the VDOT NoVA District Traffic Engineer as documented in the attached memorandum. These analysis periods would each be preceded by a 30-minute seeding period in the VISSIM models:

Kimley»Horn ATCS

Figure 3: INRIX 15-Minute Average Speeds Along I-495 Northbound GP and Proposed Simulation Analysis Periods

Location	5:00 AM	5:15 AM	5:30 AM	5:45 AM	6:00 AM	6:15 AM	6:30 AM	6:45 AM	7:00 AM	7:15 AM	7:30 AM	7:45 AM	8:00 AM	8:15 AM	8:30 AM	8:45 AM	9:00 AM	9:15 AM	9:30 AM	9:45 AM	10:00 AM	10:15 AM	10:30 AM	10:45 AM	11:00 AM	11:15 AM	11:30 AM	11:45 AM	12:00 PM	12:15 PM	12:30 PM	12:45 PM
Cabin John Parkway Interchange	64	65	65	66	66	65	64	63	62	61	62	61	61	61	60	59	60	60	61	61	61	62	62	61	60	63	63	64	64	64	64	63
	63	64	64	65	64	63	60	57	56	55	55	54	55	55	55	54	55	55	56	56	55	55	56	58	58	60	61	62	62	62	62	62
Clara Barton Parkway Interchange	62	62	63	63	62	60	57	51	48	46	45	45	45	44	44	44	44	44	44	44	43	44	45	49	52	54	55	56	57	57	57	56
	66	66	66	67	64	63	58	50	46	40	37	35	35	35	35	36	36	36	35	36	36	37	38	44	49	52	54	56	57	57	56	56
GW Parkway Interchange	66	66	66	67	64	63	58	47	41	31	28	27	26	26	26	27	27	28	27	27	29	31	33	38	43	49	52	54	57	56	55	55
	65	65	66	66	64	63	59	47	38	28	23	21	20	20	19	19	20	21	20	21	23	26	28	33	40	48	52	53	56	56	56	55
Georgetown Pike Interchange	64	64	65	65	64	63	61	48	39	29	22	20	20	19	18	18	19	20	20	21	23	27	29	33	41	49	51	53	55	56	55	55
	64	64	65	65	64	62	61	53	43	35	27	25	25	23	22	23	25	27	28	29	31	35	37	41	47	50	50	52	54	55	54	54
Dulles Toll Road Interchange	64	64	65	65	64	63	60	55	43	32	21	20	21	20	19	20	24	27	28	30	34	38	40	45	48	48	50	51	54	55	54	51
	65	65	65	64	64	63	61	56	47	38	27	24	29	28	26	28	34	38	39	41	44	47	50	52	55	54	54	57	59	59	58	56
Route 123 Interchange	65	65	65	65	65	64	62	58	50	42	33	30	34	34	30	33	37	40	42	45	49	53	54	56	59	58	59	61	62	62	61	59
	64	64	64	63	63	61	61	59	56	48	42	36	39	40	37	36	39	41	41	43	49	54	58	60	61	60	62	63	63	63	63	62
Route 7/Leesburg Pike Interchange	62	62	62	61	61	59	57	56	55	52	47	40	39	35	29	25	23	24	27	30	37	48	55	57	57	58	60	60	60	60	60	60
	64	63	63	63	64	63	60	60	59	56	51	45	44	38	32	25	22	22	27	34	44	54	59	60	59	62	63	63	63	62	62	62
I-66 Interchange	63	62	62	62	62	61	59	58	59	56	54	50	47	45	39	34	31	31	36	44	51	56	58	58	58	60	59	59	59	57	57	57

Location	1:00 PM	1:15 PM	1:30 PM	1:45 PM	2:00 PM	2:15 PM	2:30 PM	2:45 PM	3:00 PM	3:15 PM	3:30 PM	3:45 PM	4:00 PM	4:15 PM	4:30 PM	4:45 PM	5:00 PM	5:15 PM	5:30 PM	5:45 PM	6:00 PM	6:15 PM	6:30 PM	6:45 PM	7:00 PM	7:15 PM	7:30 PM	7:45 PM	8:00 PM	8:15 PM	8:30 PM	8:45 PM
Cabin John Parkway Interchange	63	62	59	57	56	54	52	50	43	29	20	14	12	12	11	11	11	11	10	11	12	14	17	25	27	34	43	50	55	59	61	62
	61	60	58	56	54	52	50	49	46	35	25	17	15	14	13	14	13	14	13	13	15	17	20	30	31	38	44	50	53	57	60	60
Clara Barton Parkway Interchange	56	54	51	48	46	42	38	38	37	31	25	19	16	15	15	15	15	15	15	15	16	18	20	27	28	33	37	40	44	50	55	57
	55	50	45	40	38	34	28	27	26	24	21	17	15	15	14	15	15	15	15	15	16	17	18	22	24	27	30	33	38	46	55	59
GW Parkway Interchange	52	50	44	39	34	28	21	20	19	18	16	14	12	12	12	12	12	12	13	12	13	13	14	17	19	21	24	27	33	45	55	57
	52	51	46	40	34	25	18	15	14	13	12	11	9	9	9	9	9	9	9	9	9	10	10	12	14	16	19	22	29	45	54	59
Georgetown Pike Interchange	53	50	47	42	36	26	18	15	14	13	11	10	9	8	8	8	8	8	8	8	9	9	9	11	14	15	18	22	30	46	54	58
	52	51	48	46	43	36	26	20	18	17	14	13	11	10	9	9	9	9	9	9	9	10	11	12	16	18	22	29	39	49	56	59
Dulles Toll Road Interchange	50	48	46	44	42	39	27	21	19	18	16	14	13	12	10	9	9	9	9	9	9	9	10	11	16	19	26	38	45	52	55	58
	56	53	50	50	49	48	38	31	30	29	27	25	25	24	21	20	19	21	19	19	17	17	17	18	23	33	41	50	55	57	58	59
Route 123 Interchange	58	56	54	54	53	54	45	36	33	33	32	31	31	32	29	28	27	28	28	30	29	27	27	27	32	42	48	54	56	58	59	60
	60	58	59	60	61	61	56	48	45	44	45	43	44	47	44	47	43	42	44	50	50	46	49	48	50	53	54	57	59	59	60	60
Route 7/Leesburg Pike Interchange	60	59	59	58	59	60	59	59	57	54	55	55	54	55	55	55	55	54	56	55	56	56	57	57	57	59	60	60	61	61	60	60
	63	63	62	62	61	61	61	63	61	58	61	61	60	59	60	59	58	57	59	58	60	60	60	61	62	63	63	63	63	63	63	62
I-66 Interchange	57	58	58	59	59	58	58	58	59	59	59	60	61	60	58	58	58	58	58	58	59	59	59	61	61	61	61	61	61	61	61	61

I-495 NB GP

Study Area
Proposed Analysis Peak Hour
Proposed Analysis Peak Period
State Line

- AM peak: 6:45 AM to 9:45 AM (peak hour 7:45 AM to 8:45 AM). This will capture the onset of queueing back from the American Legion Bridge and the start of the dissipation of the queue. The peak hour captures the current worst extent of queueing.
- PM peak: 2:45 PM to 5:45 PM (peak hour 3:45 PM to 4:45 PM). This peak period is intended to capture queue formation from the American Legion Bridge *before the queue from points further north in Maryland spill back and create a single continuous queue*. This can be observed in the figure, as prior to approximately 3:30 PM, congestion in Virginia does not continue into Maryland. By approximately 4:00 PM, a single continuous area of congestion is present from north of the study area through the Route 123 interchange. Between approximately 4:00 PM and 7:00 PM, however, the extent of queueing stays relatively consistent – to the Route 123 interchange. The congestion does not fully dissipate until after 8:00 PM on average – note that the proposed traffic analysis period is not recommended to last until this point. Rather, the proposed traffic analysis period captures the onset of queueing (from when the queue is not due to spillback from Maryland) until it reaches its maximum.

Although the peak period in the afternoon and evening typically extends beyond six hours of congestion, the proposed analysis periods will still capture the onset of congestion and maximum extents of congestion, while allowing for the analysis to proceed in a streamlined manner within the scope and schedule of the project.

Conclusion

The VISSIM calibration criteria and simulation analysis peak hours and peak periods have been reviewed and approved by the VDOT NoVA District Traffic Engineer. The elements of the traffic analysis framework were presented to VDOT staff on July 20, 2018. The analysis tools and framework described in this document will be carried forward for the I-495 NEXT project.

MEMORANDUM

To: Ivan Horodyskyj, P.E., VDOT NoVA District Traffic Engineer
Abi Lerner, P.E., VDOT Project Manager

From: Rob Prunty, P.E.
Raj Paradkar, P.E.
Anthony Gallo, P.E.
Kimley-Horn and Associates, Inc.

Date: July 24, 2018

Subject: I-495 NEXT Traffic Analysis Microsimulation Calibration Methodology

Introduction

This memorandum documents the proposed calibration methodology for the I-495 Northern Extension (NEXT) project traffic operations analysis in support of the project National Environmental Policy Act (NEPA) studies and Preliminary Engineering and Operations Development. The ATCS/Kimley-Horn consultant team (henceforth referred to as "consultant team") has proposed a traffic microsimulation calibration methodology based on guidance set forth in the VDOT *Traffic Operations and Safety Analysis Manual* (TOSAM)[1], Version 1.0 (released November 2015). This manual, which is currently being updated to Version 2.0, contains direction related to calibration of VISSIM models that are considered mandatory conditions in which any deviations require approval from the Regional (now District) Traffic Engineer or his/her designee. The consultant team is requesting approval for deviations in calibration methodology for specific criteria (simulated average speeds and simulated queue lengths), given the volatile traffic flows and inconsistent queuing in the study area, as well as the direction from VDOT to streamline the project scale and schedule. The proposed alternative methodologies for calibration of these measures are documented below.

In conjunction with the VISSIM calibration, this memorandum also includes a discussion of the proposed simulation analysis period. The consultant team also requests approval for using these proposed periods in the VISSIM microsimulation analysis.

VISSIM Calibration Methodology

Existing conditions (2018) microsimulation networks will be developed using VISSIM 9.0 software. The VISSIM study area is shown in Figure 1.

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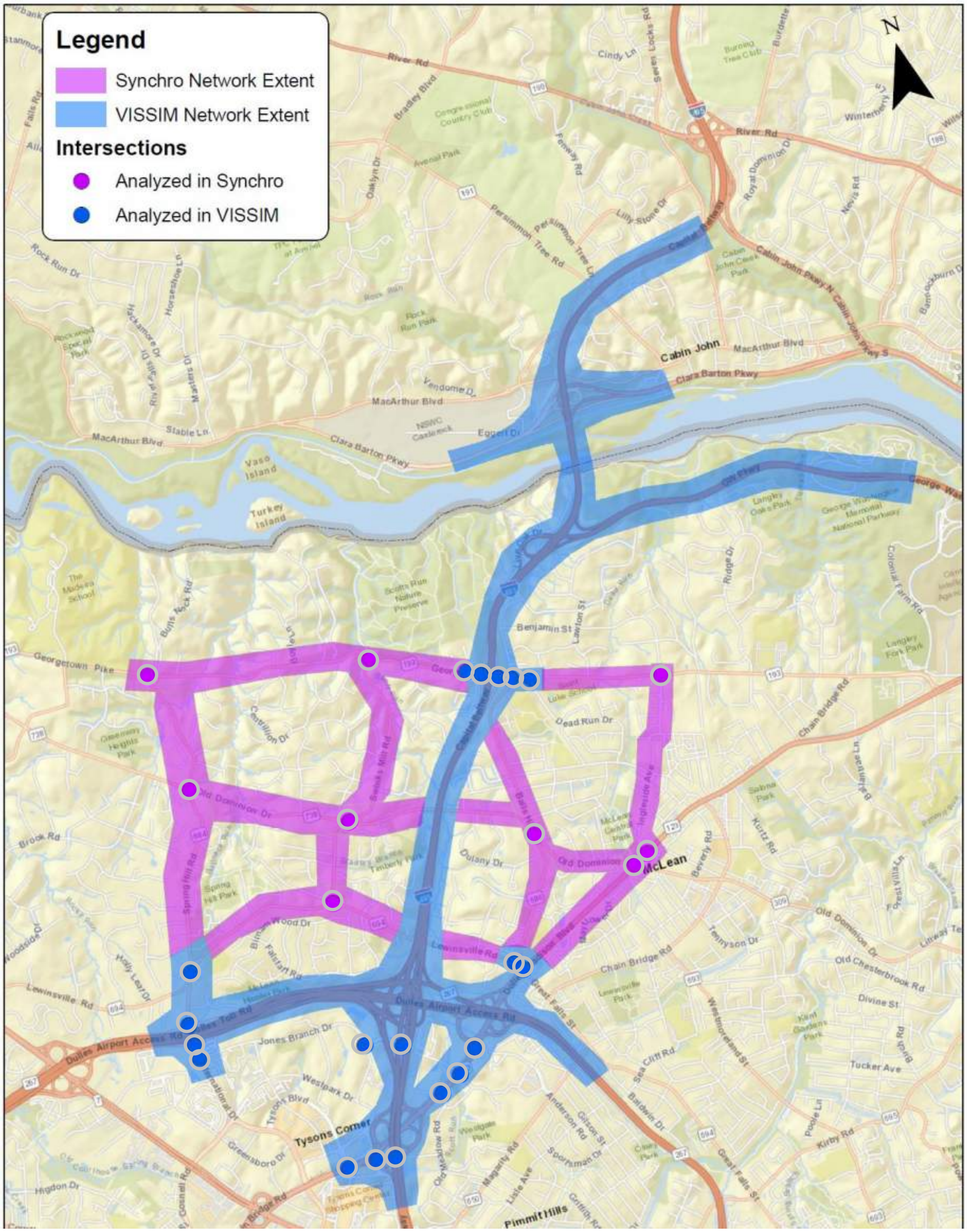
[1] http://www.virginiadot.org/business/resources/TOSAM.pdf

Figure 1. I-495 NEXT Traffic Operations Analysis Study Area



The VISSIM base models will be calibrated based on guidance from the *FHWA Traffic Analysis Toolbox Volume III* and the TOSAM. **Error! Not a valid bookmark self-reference.** shows the criteria and acceptance targets from the FHWA Toolbox that are recommended to be used in determining when calibration is achieved; Figure 3 shows the criteria and acceptance targets from the TOSAM.

Figure 2: FHWA Toolbox Calibration Criteria and Acceptance Targets

Criteria and Measures	Calibration Acceptance Targets
Hourly Flows, Model Versus Observed	
Individual Link Flows	
Within 15%, for 700 veh/h < Flow < 2700 veh/h	> 85% of cases
Within 100 veh/h, for Flow < 700 veh/h	> 85% of cases
Within 400 veh/h, for Flow > 2700 veh/h	> 85% of cases
Sum of All Link Flows	Within 5% of sum of all link counts
GEH Statistic < 5 for Individual Link Flows*	> 85% of cases
GEH Statistic for Sum of All Link Flows	GEH < 4 for sum of all link counts
Travel Times, Model Versus Observed	
Journey Times, Network	
Within 15% (or 1 min, if higher)	> 85% of cases
Visual Audits	
Individual Link Speeds	
Visually Acceptable Speed-Flow Relationship	To analyst's satisfaction
Bottlenecks	
Visually Acceptable Queuing	To analyst's satisfaction

*The GEH statistic is computed as follows:

$$GEH = \sqrt{\frac{(E-V)^2}{(E+V)/2}} \quad (4)$$

where:

E = model estimated volume
V = field count

Figure 3: VDOT TOSAM Calibration Criteria and Acceptance Targets

Simulated Measure	Calibration Threshold	
Simulated Traffic Volume (vehicles per hour) **The top 85% of the network links, based on link traffic volume, or a select number of critical links and/or movements, as determined by the RTE or his/her designee, shall meet the calibration thresholds. The traffic volumes identified in the calibration thresholds are actual traffic volumes as opposed to simulated traffic volumes.**	Within ± 20% for <100 vph Within ± 15% for ≥100 vph to <300 vph Within ± 10% for ≥300 vph to <1,000 vph Within ± 5% for ≥1,000 vph	
Simulated Average Speed (miles per hour) **The top 85% of the network links, based on link traffic volume, or a select number of critical links and/or movements, as determined by the RTE or his/her designee, shall meet the calibration thresholds.**	Within ± 5 mph of average observed speeds on arterials Within ± 7 mph of average observed speeds on freeways	
Simulated Travel Time (seconds) **Eight-five percent (85%) of the travel time routes, or a select number of critical routes, as determined by the RTE or his/her designee, shall meet the calibration thresholds. Travel time routes should be determined in cooperation with the VDOT project manager based on project needs and goals.**	Within ± 30% for average observed travel times on arterials Within ± 20% for average observed travel times on freeways The travel time should be calibrated for segments and routes separately or as deemed appropriate by the VDOT project manager.	
Simulated Queue Length (feet) **The top 85% of the network links, based on link traffic volume, or a select number of critical links and/or movements, as determined by the RTE or his/her designee, shall meet the calibration thresholds.**	Undersaturated conditions (refer to Section 2.6 for guidance)	*Average queue length on arterials:* Within ± 30% for movements ≤10 vph Within ± 20% for movements >10 vph
		Maximum queue length on arterials: Within ± 25%
	Oversaturated conditions (refer to Section 2.6 for guidance)	*Average queue length:* Within ± 20% on arterials Within ± 30% on freeways
		Maximum queue length: Within ± 20% on arterials Within ± 35% on freeways

The following criteria and thresholds are proposed for VISSIM model calibration:

Calibration Item	Basis	Criteria	Target
Simulated Traffic Volume (Intersections)	**By Intersection Approach**	Within ± 20% for <100 vph	At least 85% of all Intersection Approaches
		Within ± 15% for ≥ 100 vph to < 300 vph	
		Within ± 10% for ≥ 300 vph to < 1,000 vph	
		Within ± 5% for ≥ 1,000 vph	
Simulated Traffic Volume (Freeways)	**By Freeway Segment**	Within ± 20% for <100 vph	At least 85% of all Freeway Segments
		Within ± 15% for ≥ 100 vph to < 300 vph	
		Within ± 10% for ≥ 300 vph to < 1,000 vph	
		Within ± 5% for ≥ 1,000 vph	
Simulated Travel Time	**By Route**	Within ± 30% for average travel times on arterials	At least 85% of all Travel Time Routes (Including Segments)
		Within ± 20% for average travel times on freeways	
Maximum Simulated Queue Length	**By Approach for Targeted Critical Locations**	Modeled queues qualitatively reflect the impacts of observed queues	Qualitative Visual Match
Visual Review of Bottleneck Locations	**Targeted Critical Locations**	Speed heat maps qualitatively reflect patterns and duration of congestion	Qualitative Subjective Assessment

DEVIATIONS FROM TOSAM REQUIREMENTS

The following requirements from the TOSAM have been modified for the proposed VISSIM calibration process for this project:

- Simulated Average Speed – the TOSAM requires that the top 85 percent of network links (based on link traffic volumes) or a select number of critical links and/or movements, as determined by the DTE or his/her designee, meet a calibration threshold of average speeds within 5 mph for arterials and 7 mph for highways.
  - *Speeds are highly variable on the interstate mainline as well as on the local arterial network and residential roadways, and can vary substantially by hour and by day. The consultant team proposes that simulated average speed be captured as part of the travel time calibration process and the visual review of bottleneck locations against speed heat*

maps. Average speeds will still be extracted from the VISSIM models along the freeway corridors (I-495 general purpose, I-495 HOT, and SR 267) at one-half mile intervals and compared visually against speed heat maps generated from INRIX vehicle probe data.

- Simulated Queue Length – the TOSAM requires that the top 85 percent of network links (based on link traffic volumes), or a select number of critical links and/or movements, as determined by the DTE or his/her designee, meet calibration thresholds of measured queue lengths depending on whether conditions are oversaturated or undersaturated. These thresholds are detailed in Figure 3.
    - *Queuing within the study area is notably inconsistent and can oscillate numerous times within the peak periods, or be absent altogether on some days. The consultant team proposes that a qualitative subjective assessment be conducted for queue lengths at targeted locations in addition to the review of freeway mainline congestion/queues against the speed heat maps. Targeted locations will be determined in conjunction with the DTE for freeway ramps and arterials. Several proposed targeted locations are suggested in the following table:*

Queue Type	Location
Ramp	Ramp from SR 267 EB to I-495 NB GP
Ramp	Ramp from DAAR EB to I-495 NB GP
Ramp	Ramp from SR 267 EB to I-495 SB GP
Ramp	Ramp from SR 267 EB to Route 123 NB
Ramp	Ramp from Georgetown Pike (SR 193) to I-495 NB GP
Ramp	Ramp from George Washington Memorial Parkway NB to I-495 NB GP
Approach	Georgetown Pike (SR 193) EB approaching I-495 NB GP ramps
Approach	Georgetown Pike (SR 193) WB approaching I-495 NB GP ramps
Approach	Balls Hill Rd NB approaching Georgetown Pike
Approach	Spring Hill Rd NB approaching Lewinsville Road
Approach	Route 123 NB approaching Great Falls St
Approach	Lewinsville Road EB approaching Balls Hill Road

POTENTIAL ADJUSTMENTS FOR CALIBRATION

Adjustments to the VISSIM model during the calibration process will follow guidance from the VDOT TOSAM. These adjustments could include modifications to lane change distance for connectors, driver behavior along freeways and arterials, adjustments to desired speeds for vehicles at the network termini (such as along I-495 northbound leaving the study area), etc. The technical memorandum detailing calibration results will identify any potential deviations from TOSAM guidance.

Simulation Analysis Period

The I-495 NEXT traffic operations study area is a severely oversaturated network during the weekday AM and PM peak periods, with several hours of congestion in both directions along I-495, especially along I-495 northbound approaching the American Legion Bridge. During these congested periods, traffic volume throughput is constrained due to low speeds and can be much lower than the actual maximum counted volumes along the freeway. Figure 4 shows an example of this phenomenon along the I-495 northbound general purpose lanes over three days in June 2018. During the PM peak period, starting around 2 PM, traffic counts decrease and do not get above 5,000 vph across a four-lane section, which theoretically should be able to carry much higher volumes. Due to the oversaturated conditions, the consultant team does not recommend using the maximum recorded values from traffic counts to represent peak conditions in the study area; rather, the consultant team recommends selecting an analysis period based on the heaviest periods of congestion and slowest speeds experienced along the corridor.

Figure 4. Hourly Traffic Counts along I-495 Northbound GP south of Route 267

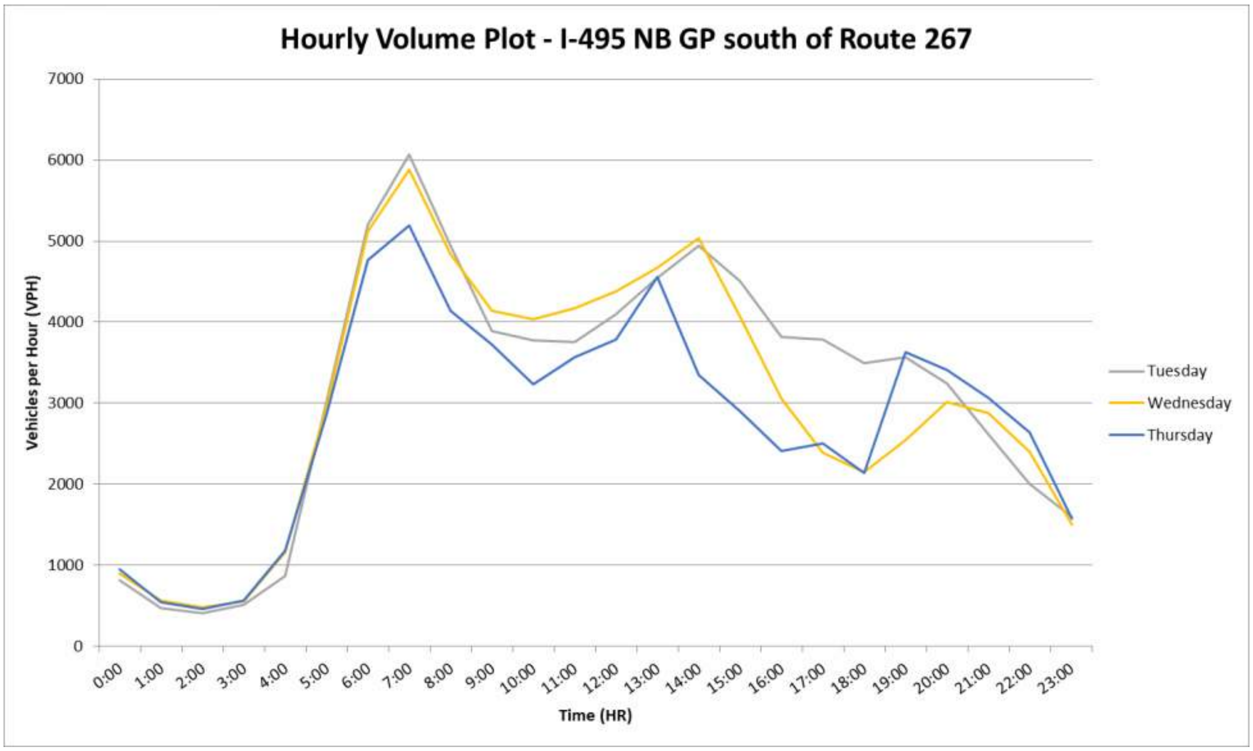


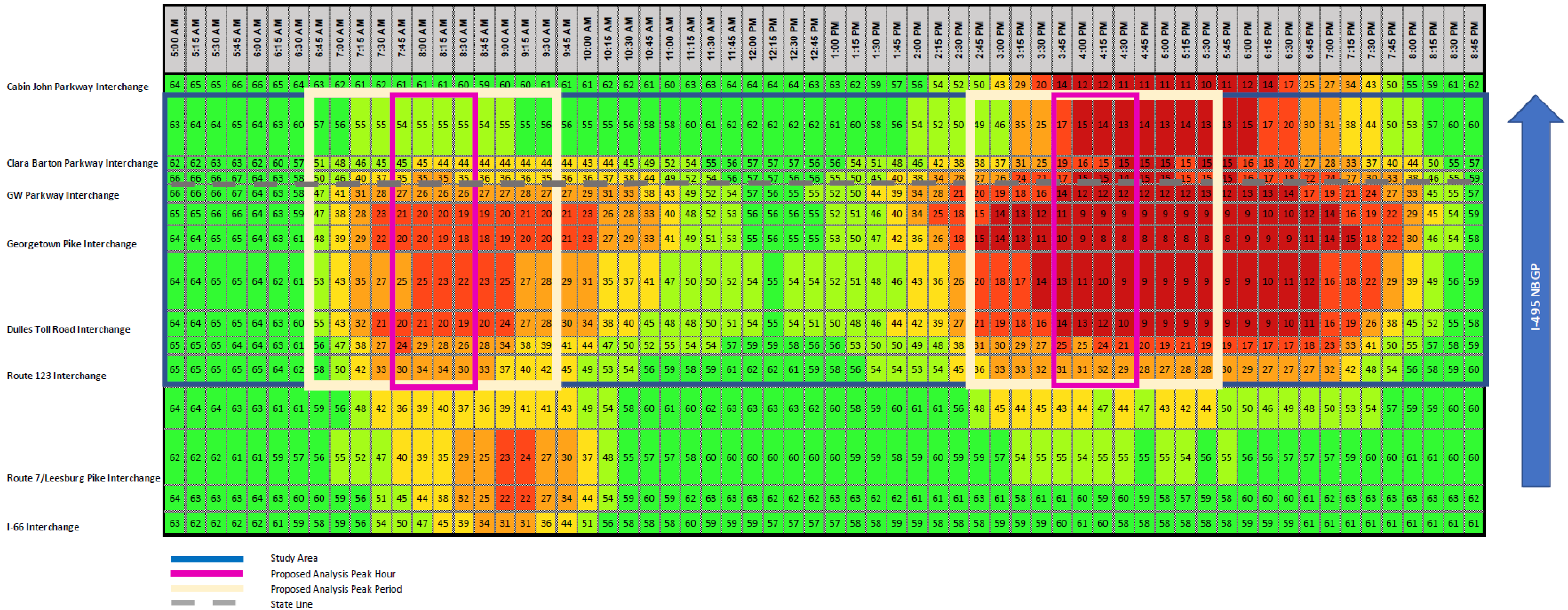
Figure 5 shows 15-minute average speeds along the I-495 northbound general purpose lanes through the study area for average weekdays (Tuesday, Wednesday, and Thursday) from July 2017 through June 2018. Note that during both the AM and PM peak periods, speeds along I-495 northbound are slower than speeds along I-495 southbound due to the downstream bottleneck at the American Legion Bridge. The consultant team recommends selecting an analysis period based specifically on congestion in the I-495 northbound general purpose lanes.

Figure 5 also shows the consultant team’s proposed simulation analysis periods. These analysis periods would each be preceded by a 30-minute seeding period in the VISSIM models.

- AM peak: 6:45 AM to 9:45 AM (peak hour 7:45 AM to 8:45 AM). This will capture the onset of queueing back from the American Legion Bridge and the start of the dissipation of the queue. The peak hour captures the current worst extent of queueing.
- PM peak: 2:45 PM to 5:45 PM (peak hour 3:45 PM to 4:45 PM). This peak period is intended to capture queue formation from the American Legion Bridge *before the queue from points further north in Maryland spill back and create a single continuous queue*. This can be observed in the figure, as prior to approximately 3:30 PM, congestion in Virginia does not continue into Maryland. By approximately 4:00 PM, a single continuous area of congestion is present from north of the study area through the Route 123 interchange. Between approximately 4:00 PM and 7:00 PM, however, the extent of queueing stays relatively consistent – to the Route 123 interchange. The congestion does not fully dissipate until after 8:00 PM on average – note that the proposed traffic analysis period is not recommended to last until this point. Rather, the proposed traffic analysis period captures the onset of queueing (from when the queue is not due to spillback from Maryland) until it reaches its maximum.

While neither of the proposed analysis periods capture the entire period of congestion along the northbound direction of I-495, the consultant team does not recommend creating a microsimulation analysis for those full periods, based on VDOT's request to streamline the analysis and focus on the areas and times of greatest importance. For example, although the peak period in the afternoon / evening typically extends beyond six hours of congestion, the proposed analysis periods for study will still capture the onset of congestion and maximum extents of congestion, while allowing for the analysis to proceed in a streamlined manner within the scope and schedule of the project.

Figure 5: INRIX 15-Minute Average Speeds Along I-495 Northbound GP and Proposed Simulation Analysis Periods



Conclusion

Recognizing the large scale of the I-495 NEXT traffic analysis efforts and constrained schedule, the consultant team requests that the District Traffic Engineer approve these proposed deviations in simulated speeds and simulated queue lengths from the VDOT TOSAM for the traffic microsimulation calibration. These deviations will not impact the ability of the microsimulation model to accurately represent typical real-world traffic conditions, and will instead focus the traffic analysis efforts on the most critical locations to the project.

Similarly, the consultant team requests that the District Traffic Engineer approve the proposed simulation analysis periods for the microsimulation model. These periods will capture the onset of congestion and maximum extents of congestion.

____ _____________________

VDOT NoVA District Traffic Engineer Concurrence Date

MEMORANDUM

To: Ivan Horodyskyj, P.E., VDOT NoVA District Traffic Engineer
Abi Lerner, P.E., VDOT Project Manager

From: Rob Prunty, P.E., Kimley-Horn
Warren E. Hughes, P.E., ATCS, P.L.C.
Ram Jagannathan, ATCS, P.L.C.
ATCS, PLC

Date: August 27, 2018

Subject: I-495 NEXT Crash Analysis Framework

Introduction

This memorandum documents the details associated with the crash analysis framework for the I-495 Express Lanes Northern Extension Project. This memorandum is intended to supplement the information presented in the I-495 NEXT Project Scoping Framework Document.

The following elements of the crash and safety analysis are laid out in detail in this document:

- Data collection
- Existing crash analysis methodology, measures of effectiveness, and assumptions
- Development of Safety Performance Function (SPF) for Express Lanes
- Crash prediction methodology for freeway and ramp segments
- Crash prediction methodology for ramp junctions, at-grade intersections and arterial segments
- Qualitative safety analysis methodology

Data Collection

Five years of crash data (January 1, 2013 to December 31, 2017) will be used in this study. Available VDOT crash data will be collected for crashes reported on arterial segments, at-grade intersections, ramps and freeway segments within the study area that are in Virginia. Crash data will also be collected from the Maryland State Highway Administration (MDSHA) for those segments of roads in Maryland that are within the traffic operations study area. Due to the fact that National Park Service (NPS) Police report crashes on the George Washington Memorial Parkway (GWMP) and the Clara Barton Parkway using a different crash report form, crash data will also be collected from the National Park Service for segments of those parkways that are within the traffic operations study area.

In addition, the Consultant Team will make use of the VDOT's Tableau tool to extract data on reported crashes from VDOT's crash database. The Consultant Team will request copies of FR300 reports only for specific crashes to develop more detailed crash summaries and collision diagrams where appropriate. Since the study area includes roads that are under the responsibility of the National Park Service (i.e., George Washington Memorial Parkway and Clara Barton Parkway) and the Maryland State Highway

Administration, the Consultant Team will solicit data on reported crashes on their roads within the traffic operations study area. This will ensure that all reported crashes that occur in and near the GWMP / I-495 interchange and on the American Legion Bridge can properly be included in the analysis. We recognize that VDOT, MWAA, MDSHA/MDOT and NPS may have different thresholds for crash reporting, specifically with respect to crash severity. We plan to use the crash severity determined by the agencies as-is while including the reporting criteria in the appendix of the document. All crash data will be provided by VDOT in GIS shapefile or geodatabase format. The Consultant Team will rely on the crash data directly from the VDOT RNS and will not review individual crash reports to verify the accuracy of that information.

To develop crash rates, data on vehicle exposure will be gathered from all available sources, including Average Daily Traffic (ADT) flows contained in the Virginia DOT annual traffic count books and data on historical ADT flows from the Maryland State Highway Administration. In addition, exposure data will be solicited from the operators of the I-495 Express Lanes for the last five years, since data is not reported by VDOT for these express lanes. Lastly, exposure data will be requested from the NPS for the parkway segments, including ramps and other roadway facilities maintained by the NPS that are within the traffic operations study area.

Existing Crash Analysis Methodology, Measures of Effectiveness, and Assumptions

The Consultant Team will analyze and summarize VDOT-provided crash data for I-495 and Dulles Toll Road mainline and ramps and intersecting (at an interchange) surface streets within the IJR study area. To the extent possible, the Consultant Team will develop a simplified crash "pin" map for the segments of the GWMP within the traffic operations study area. In addition, the Consultant Team will develop summaries and graphics of reported crashes on the segments of I-495 in Maryland to better understand crash patterns that may be affected by traffic conditions in Virginia.

The Consultant Team will summarize crash data in a tabular format for up to 10 elements such as weather conditions, lighting conditions, type of collision, and severity of crash. The Consultant Team will summarize data to identify crash patterns and high crash locations.

The Consultant Team will develop directional crash density "heat" maps to display the following crash patterns along the I-495 and Dulles Toll Road study corridors:

- Total number of crashes;
- Injury crashes;
- Lighting conditions;
- AM peak period conditions;
- PM peak period conditions;
- Rear-end crashes;
- Sideswipe same direction crashes; and
- Fixed-object off-road crashes.

The Consultant Team will develop mainline crash density histograms for I-495 from Route 123 to the American Legion Bridge, and along the Dulles Toll Road / Dulles Airport Access Road from Spring Hill Road to Route 123 (Dolley Madison Blvd), summarized in half-mile segments. The Consultant Team also will summarize the type of crashes for each half-mile segment within the study area.

The Consultant Team will identify high-crash locations along the corridor. The Consultant Team will use a 95th percentile confidence interval (average plus two standard deviations) for the corridor as a threshold for determining high crash locations. Sections with total crashes above the 95th percentile confidence interval will be considered a high-crash location. The Consultant Team will provide a summary of crashes at these locations in tabular format.

The Consultant Team will summarize crashes, in tabular format, for the latest five-year period and compare the following crash rates provided by VDOT Central Office:

- Crash, injury, and fatality crash rates for I-495 and Dulles Toll Road within the study area;
- Crash, injury, and fatality crash rates for I-495 and Dulles Toll Road statewide; and
- Statewide crash, injury, and fatality average crash rates for interstates.

Safety performance will be investigated to understand the nuances and impacts of weather, roadway lighting, traffic volumes, pavement condition, driver impairment and distraction, presence of work zone, work zone activity levels, etc. In this analysis, crash frequency, crash rate, crash severity and magnitude of crashes will be investigated to better understand past safety performance of I-495 Express Lanes in order to develop relationships (i.e., safety performance functions) for the analysis of future year traffic conditions under the Build and the No Build alternatives.

The implications with respect to existing and current safety issues and crash patterns from this safety analysis will be used to inform the roadway designers during the preliminary design phase of the project and during the development and screening of proposed interchange concepts phase of the project.

Development of Safety Performance Functions for Express Lanes

The Highway Safety Manual (HSM), first edition, does not have a prediction methodology for estimating the safety performance of urban interstates that also contain Express Lanes. For the I-495 Express Lanes Northern Extension study, the availability of safety performance functions would help predict the expected crash performance on Express Lanes after project completion. Hence, this study will use Interchange Safety Analysis Tool-Enhanced (ISATe) for analyzing the safety performance of the general purpose sections and interchanges. In addition, the study will build safety performance functions for this project using available crash data on I-495 Express Lanes (EL). the objective is to develop the relationships such that future year crash experience can be estimated for both existing express lane sections on I-495 and for new express lane sections that will be included in the Build alternative. Some inherent assumptions used in this study are listed below:

- The driver behavior and familiarity with the roadway are similar for current I-495 Express lanes and I-495 General Purpose lanes.

- The weather conditions on current I-495 EL and I-495 general purpose lanes are similar as they are geographically proximate.

- The traffic composition on current I-495 EL and I-495 NEXT are similar.

For the purpose of building the crash prediction model for the express lanes, the following interchange pairs / segments on I-495 used in the study are listed below:

- South End – Braddock Road
- Braddock Rd - Route 236

- Route 236 – Gallows Road
- Gallows Road - Route 50
- Route 50 - Lee Hwy
- Lee Hwy - I-66
- I-66 - Route 7
- Route 7 - Route 123
- Route 123 – VA 267
- VA 267 – North End

Crash Prediction Methodology for Freeway and Ramp Segments and Assumptions

The Consultant Team will conduct a safety and crash analysis consistent with VDOT's IIM-LD-200.9. The Consultant Team's analysis will involve qualitative and quantitative measures to evaluate proposed alternatives and demonstrate the effects of interstate access modifications on safety of I-495 and the local surface street system. The Consultant Team will use ISATe to evaluate the quantitative effect of interstate access modifications on safety on I-495 general purpose lanes and HSM methodologies to evaluate the safety impacts of the proposed interchange concepts on the arterial system adjacent to the interchanges. Assumptions for the safety analysis are given below:

- Safety analyses will be performed for interstate mainline segments, ramp termini, and adjacent crossroads segments and crossroad intersections within the IJR study area, limited to the area for traffic data collection;
- FHWA's Enhanced Interchange Safety Analysis Tool (ISATe) will be used to evaluate freeway and interchange safety, based on FHWA/AASHTO regulations and guidance;
- The Highway Safety Manual (HSM) and NCHRP 17-38 spreadsheets (VA editions) will be used to analyze five-year continuous crash history for the crossroad segments. ISATe will be used to analyze the crossroad ramp terminal intersections within these segments;
- Freeway analysis will focus on the I-495 Mainline Facility. To the extent possible within the available reported crash data for express lanes in Virginia, the Consultant team will develop a safety performance function for express lane sections. Currently available analysis tools do not provide for crash prediction and safety performance evaluation of managed lane facilities (express lanes). If the review agencies deem that the methodology and results are applicable, then the safety results for the express lanes will be included in the analysis.;
- Qualitative assessments will be performed for conditions where the quantitative analysis is not appropriate.;
- Quantitative analysis will be performed within the limits of the available safety analysis tools. However, it should be noted that some geometric conditions are not able to be modeled using these tools. In these situations, qualitative analysis will be incorporated into the evaluation to supplement any gaps in the quantitative analysis; and
- Using ISATe, the safety performance of the I-495 NEXT interchanges will be predicted for future traffic volumes.

The EL SPF-based crash predictions will be added as a layer on top of the ISATe crash predictions for the GP Lanes and Ramps to compare the safety performance of the Build and No-Build conditions for future years.

Crash Prediction Methodology for Ramp Junctions, At-Grade Intersections and Arterial Segments and Assumptions

For VA Route 193, we will use the HSM to predict crashes on the arterial segments and intersections. Intersection boundaries will encompass 500 feet of roadway on all intersecting approaches. We plan to analyze the interchange ramp terminals and all signalized intersections within a radius of 0.5 mile from the interchange ramp terminals on VA Route 193. We will use the calibration factors for VA and check to see if the crash predictions are reasonable. If needed, we will refine the calibration factors for the SPFs in the HSM using additional VA data. The limit of the crash prediction will be for multiple-vehicle crashes only. Given the limited amount of data, we will not be able to predict additional single-vehicle, vehicle-bicycle, and vehicle-pedestrian crashes.

Qualitative Safety Analysis Methodology and Assumptions

Finally, a driver Info Overload analysis will be conducted. For every 1/10th of a mile, the number of signs needed to be processed by the driver will be documented and the burdensome nature of the same will be qualitatively ranked on a five-point scale (low-effort to extreme-effort). Based on the results of the qualitative analysis, the development of the IJR Guide Sign Plan will be guided to identify concerns with respect to signing deficiencies.

Kimley»Horn

VDOT Virginia Department of Transportation

MEMORANDUM

To: Susan Shaw – VDOT MegaProjects Director

From: Kimley-Horn and Associates
Rob Prunty, P.E.
Adrienne Ameel, P.E.

Cc: Abraham Lerner – Associate Manager of Special Project Development

Date: October 31, 2018

Subject: I-495 Project Next – Environmental Traffic Data (ENTRADA) and Air Quality Impact Analysis Traffic Data

ENVIRONMENTAL TRAFFIC DATA (ENTRADA)

Traffic data sets will be prepared for the NEPA-level Noise Impacts analysis. Project level Noise locations will be identified using FHWA and EPA protocol and/or guidance documentation consistent with VDOT's practice. The traffic analysis data required for ENTRADA will include existing (2018) year, and build and no-build scenarios for the design (2045) year. The ENTRADA study area limits were determined based on a meeting with VDOT on August 29, 2018. The ENTRADA study area map is shown in **Figure 1**.

The ENTRADA study area includes the following:

- Mainline roadways;
- Cross streets associated with existing interchanges;
- Intersections/Interchanges; and
- Parallel facilities with an AADT greater than 3,000 within the project corridor (as defined by the second signalized public road intersection on either side of I-495, excluding I-495 ramp termini).

ENTRADA Version 2018-09 from VDOT will be utilized, in combination a macro-driven master database that links the various files for all the segments. Synchro 9 will be utilized for intersection analysis reporting for the NEPA team.

The traffic data for the Noise analysis will be developed using the regional travel demand modeling (TDM) output files encompassing the I-495 study corridor and affected transportation network for the base year and the build and no-build scenario for the design year 2045. The travel demand forecasts will be post processed and developed using NCHRP Report 765 and NCHRP Report 255 guidelines. Each link within the TDM output files will contain a link identifier, link length (miles), AADT, number of lanes, HPMS area type, HPMS functional classification, free-flow speed, and hourly lane capacity (vehicles/hour/lane). The following post-processed environmental traffic volume data will be provided:

- Average annual daily traffic (AADT), levels of service, average annual truck traffic (AATT), and capacity-constrained peak-period volumes as well as operating, posted and congested speeds for each link in the project area;
- Percent trucks with two axles and six tires, the percent trucks with three or more axles, and directional distributions;
- For the mainline, intersections/interchanges and parallel facilities, directional volumes, including turning or ramp movements (vehicles/hr/link);
- Lane configuration diagrams for each mainline roadway and intersection/interchange within the project corridor showing through and turn lanes; and
- Signal timings (cycle lengths and phasing, approach splits), as well as Level of Service based on control delay (includes intersection and approach delays).

The data will be compiled using VDOT's ENTRADA spreadsheets (2018-09) and Synchro files. Both Excel and pdf files of the spreadsheets will be produced.

The following inputs will be set up on a master project database and imported into each specific segment file for the creation of the ENTRADA files:

- Segment Length (miles) - The segment length will be the length of the segment in the 2045 design year;
- Area Type - Will be verified by field observations and confirmed with VDOT;
- Directional Percent Hourly Truck Traffic - Sourced from the MWCOG Model and be consistent with the peak period characteristics being modeled in VISSIM. They will be verified with the available existing traffic data; and
- Existing Hourly Speeds by Direction - Will be verified by existing traffic data and consistent with the peak period characteristics being modeled in VISSIM.

The following physical characteristics will be collected and entered as input (by individual segment) for 2045 build/no-build scenario for the creation of the ENTRADA files. Based on discussions with VDOT, it was determined that 2025 build/no-build scenarios were not necessary for the ENTRADA files. The existing physical conditions would be assumed unless changes are being made in future scenarios.

- Cross Section;
- Number of Lanes;
- Outside Shoulder Width (ft);
- Inside Shoulder Width (ft);
- Lane Width;
- Terrain - The terrain will be consistent with GIS topo and verified with field observations;
- Interchange/Access Density (per mile);
- Posted Speed; and
- Number of Signals (in length of facility).

The following characteristics for signalized facilities will be collected and entered as input (by individual segment) for the existing scenario for the creation of ENTRADA files, and developed for the build/no-build scenarios. Any adjustments and post-processing of volumes made for the peak period characteristics, as used for the detailed traffic operational analysis (for the TATTR and IJR), will be consistently applied for those values in ENTRADA:

- Signal Cycle length;
- Signal Green Time; and
- Segment Delay Adjustment Factor.

The following characteristics for each scenario will be developed for the creation of the ENTRADA files and will be sourced from the MWCOG Model. Any adjustments and post-processing of volumes made for the peak period characteristics, as used for the detailed traffic operational analysis (for the TATTR and IJR), will be consistently applied for those values in ENTRADA:

- Capacity (pcphpl);
- Facility Type;
- ADT - Will be verified with existing traffic data;
- % trucks of the ADT - Will be derived from existing traffic classification count data;
- K-factors for each hour - Will be derived from existing traffic data as a basis and adjusted for future conditions based on factors used for the MWCOG Model; and
- Directional Split (D-factor) for each hour - Will be verified with existing traffic data and derived MWCOG Model outputs for future conditions.

The ENTRADA study area map is shown in **Figure 1**. The study area network extends beyond the 500-foot offset from the project footprint in order to include complete segmentation elements that are located partially within the 500-foot offset area.

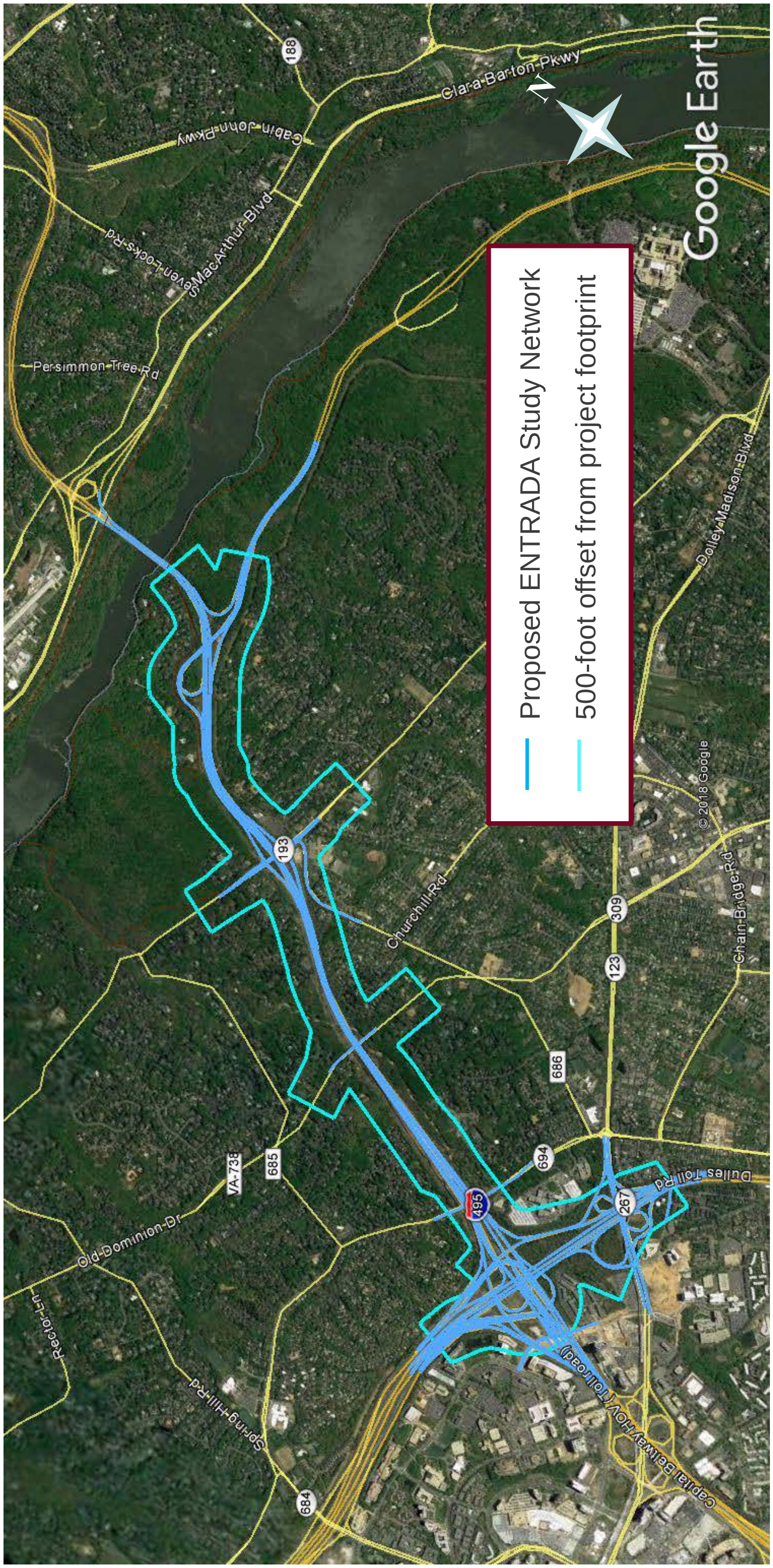


Figure 1 –ENTRADA Study Area

AIR QUALITY

MSAT Analysis

Using the regional TDM output files to prepare a quantitative mobile source air toxics (MSAT) analysis for the I-495 study corridor for the existing (2018), opening year (2025, no-build and build), and design year (2045, no-build and build). For purposes of the MSAT analysis, the affected transportation network could include roadways located several miles away from the project corridor, based on the results of the quantitative comparison between the no-build and the build scenarios for increases in traffic forecast volumes (VDOT typically uses +/- 5% per FHWA guidance) on major roadway links within the Northern Virginia region (as determined by model runs using the MWCOG Model).

The following deliverables will be produced:

- ENTRADA information sets for VDOT NEPA team for existing conditions (2018) (five electronic copies in Excel format linked to a macro-driven master database file);
- Synchro files for all intersections identified within the NEPA traffic analysis study area (five electronic copies);
- Lane diagrams for the Existing scenario (five electronic copies);
- Traffic information listed above, compiled into tabular form in a consolidated NEPA Traffic Input Data Report (five electronic copies); and
- MSAT analysis inputs for VDOT NEPA team (five electronic copies).

Appendix B: Travel Demand Modeling Methodology

MEMORANDUM

To: Rahul Trivedi, P.E., VDOT NoVA District Transportation Planning Manager
Amir Shahpar, P.E., VDOT NoVA District Modeling Manager
Abi Lerner, P.E., VDOT Project Manager

From: Rob Prunty, P.E.
Raj Paradkar, P.E.
Anthony Gallo, P.E.
Sarah Knox, P.E.
Kimley-Horn and Associates, Inc.

Date: August 26, 2018

Subject: I-495 NEXT Travel Demand Forecasting Framework

Introduction

This memorandum documents the travel demand forecasting framework associated with the I-495 NEXT Project. This memorandum is intended to supplement the overarching I-495 NEXT Project Scoping Framework Document.

The following elements of the traffic operations analysis are laid out in detail in this document:

- Travel demand modeling assumptions and calibration/validation
- Traffic volume post-processing for use in traffic operations and air/noise analysis

Travel Demand Modeling Methodology

Existing Conditions Model Calibration and Validation

The latest MWCOG travel demand model version on the 3,722 traffic analysis zone (TAZ) system will be used in conjunction with Round 9.1 Cooperative Forecasts (socioeconomic data) for the Existing, Opening, and Design model years. The MWCOG model base year is 2017; a project Existing Conditions (year 2018) model will be prepared, modified and calibrated to reflect field counts. Modifications will be carried forward into future analysis year model scenarios.

The MWCOG model will be strategically modified with specific alterations to improve the accuracy and reliability of forecasts for the I-495 study corridor, roadways connected to the corridor, and transit services in the vicinity of the corridor. The calibration targets will be based on guidance from the FHWA Transportation Model Improvement Program (TMIP) *Travel Model Validation and Reasonableness Checking Manual* and the Virginia *Travel Demand Modeling Policies and Procedures Manual*. Because the MWCOG/TPB Model is already subject to scrutiny as a regional model which has been a subject of FHWA's TMIP Peer Review process, the validation process for the I-495 Project NEXT model will focus on the I-495 Traffic Operations Analysis Study Area and will include the following comparisons:

- Regional comparisons to VDOT AADTs at the daily level (daily level only)
  - Percent difference in total volume for cutlines
- I-495 NEXT study area comparisons to field traffic counts (AM/PM periods and daily)
  - R-squared between modeled volumes and counts on links
  - Percent difference in total volumes for freeways/arterials
  - Percent root mean squared error (%RMSE) by volume group or facility type
- Travel time comparisons of model outputs to floating car runs data collected (AM/PM periods only; reasonableness checks only)

Table 1 provides a listing of travel demand model calibration criteria, which were discussed and verbally approved by VDOT during a call on July 24, 2018.

Table 1. Travel Demand Forecast Model Calibration Criteria

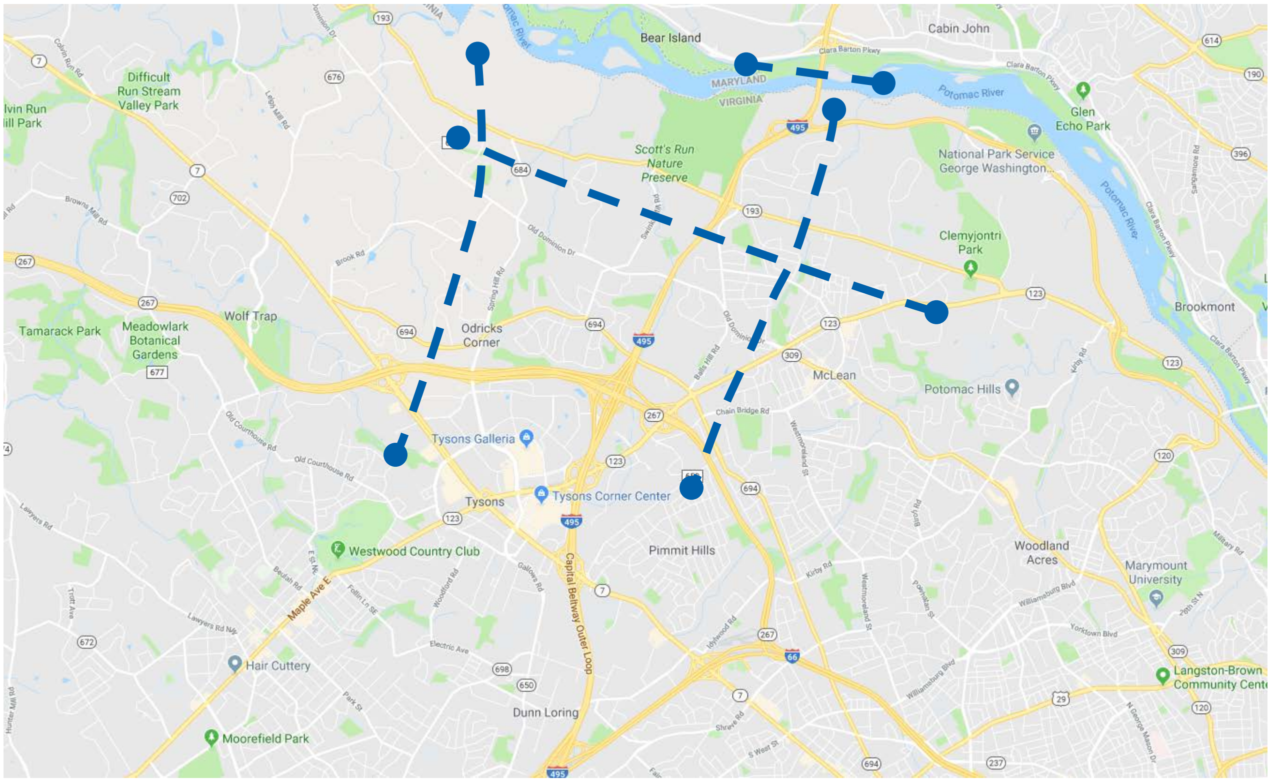
Calibration Scale	Calibration Check	Calibration Threshold			
Regional	% Difference in Total Volume for Cutlines (24-Hour Volumes)	Cutline Volume	VTM	FHWA	***Proposed***
		50,000	10%	35%	***10%***
		100,000	8.75%	25%	***10%***
		150,000	7.50%	20%	***10%***
		200,000	6.25%	18%	***8%***
		250,000	5%	15%	***7%***
Study Area	R-Squared between modeled volume and counts on links (AM Period, PM Period, and 24-Hour Volumes)		VTM	FHWA	***Proposed***
			0.9	0.88	***0.9***
	% Difference in Total Volume by Facility Type (AM Period, PM Period, and 24-Hour Volumes)	Facility Type	VTM	FHWA	***Proposed***
		Freeways	6%	7%	***6%***
		Major Arterials	7%	10%	***10%***
		Minor Arterials	10%	15%	***15%***
	%RMSE by Facility Type (AM and PM Period)	Facility Type	VTM	FHWA	***Proposed***
		Freeways	30%	-	***30%***
		Major Arterials	45%	-	***45%***
		Minor Arterials	60%	-	***60%***
		Overall	40%	-	***40%***
	%RMSE by Facility Type (24-Hour Volumes)	Facility Type	VTM	FHWA	***Proposed***
		Freeways	20%	-	***20%***
		Major Arterials	35%	-	***35%***
		Minor Arterials	50%	-	***50%***
		Overall	30%	-	***30%***
	Travel Times (AM and PM Period)	No specific measures in VTM or FHWA; compare model outputs to floating car travel runs and check to see if travel times are within min and max of observed travel times. Note that these are reasonableness checks only.			

The following regional cut-lines will be used in the calibration process:

- East/west travel west of study area
  - Georgetown Pike west of Spring Hill Road
  - Old Dominion Drive west of Spring Hill Road
  - Lewinsville Road west of Spring Hill Road
  - Route 267 between Route 7 and Spring Hill Road
  - Route 7 just east of Route 267
- East/west travel east of study area
  - George Washington Memorial Parkway east of I-495
  - Georgetown Pike east of I-495
  - Old Dominion Drive between Balls Hill Road and Route 123
  - Route 123 east of Lewinsville Road/Great Falls Street
  - Chain Bridge Road east of Great Falls Street
  - Great Falls Street east/south of Chain Bridge Road
  - Route 267 east of Route 123
- North/south travel north of study area
  - I-495 American Legion Bridge
- North/south travel within study area
  - Spring Hill Road south of Georgetown Pike
  - Swinks Mill Road south of Georgetown Pike
  - I-495 south of Georgetown Pike
  - Balls Hill Road south of Georgetown Pike
  - Douglas Drive south of Georgetown Pike
  - Route 123 west/south of Georgetown Pike

Figure 1 shows a map of the proposed cut-lines for the calibration process.

Figure 1. Proposed Cut-Lines for Travel Demand Model Calibration Process.



Toll Diversion Curves from OP3's consultant, based on existing express lane usage on the Capital Beltway Express Lanes, will also be validated in order to increase confidence in the model and maintain relative consistency between traffic and revenue studies for I-495 in Virginia, and regional planning studies of MDOT's proposed managed lanes system in Maryland.

Travel demand forecasting activity will be coordinated between the traffic and revenue study, and IJR/NEPA effort in order to maintain consistency in forecasting among these efforts to the maximum extent practical. Alterations to the MWCOG travel demand model to improve corridor calibration may include:

- Highway network modifications to better represent study area facilities as they exist and are planned, such as modifications to link facility types. Ramps will be micro-coded to improve forecasts and correlation to the microsimulation process.
- Traffic Analysis Zone (TAZ) splits and centroid connector location changes to improve model loading for all modeled modes of transportation.
- Changes to external trip assumptions to improve consistency with origin-destination data and traffic and revenue evaluations.
- Use of toll diversion methodology to forecast Express Lane trips.

- Changes in the time-of-day distribution to improve forecasting of peak period trips, changes in the Volume Delay Function (VDF) curves, and changes in the default speed and capacity of some facility types.

Future Analysis Scenario Assumptions

The I-495 NEXT traffic analysis will assess operations for a project Design Year of 2045 and Interim Year of 2025. The traffic analysis will account for a No-Build scenario and one Build alternative. Separate travel demand model networks will be developed for each of the future-year scenarios to be used for forecasting traffic volumes.

The travel demand model No-Build networks will include all roadway projects in the most up-to-date regional CLRP. In addition, the No-Build networks will account for the following elements:

- **I-495/Dulles Toll Road Interchange Ramps** – currently unbuilt ramps at the I-495/Dulles Toll Road, including ramps to and from the I-495 Express Lanes and Dulles Airport Access Road, for which preliminary engineering has completed and construction is anticipated prior to the I-495 NEXT project being in place.
- **Auxiliary lanes along I-495** – general-purpose auxiliary lanes to be added along I-495 between the Dulles Toll Road interchange and the Georgetown Pike interchange
- **Express Lanes in Maryland** – the I-495 NEXT team will be coordinating closely with the Maryland Department of Transportation (MDOT) on plans for a network of express lanes in Maryland, including lanes along I-495 and I-270. These plans are currently ongoing, but the I-495 NEXT No-Build and Build networks will contain the same assumptions for the Express Lanes in Maryland:

    - Locations of access and network structure
    - Vehicle types allowed in express lanes, including those which must pay a toll and those which are exempt (if any) – could include HOV2/HOV3+ or trucks

Summary of Travel Demand Modeling Assumptions

Table 1 lists key assumptions associated with the travel forecasting process.

Table 2: Travel Demand Forecasting Model Assumptions

<table>
<tr><th>Model Parameter</th><th>Assumption</th><th>Comments</th></tr>
<tr><td colspan="3">Model</td></tr>
<tr><td>Analysis Years
2018 (Existing)
2025 (Interim Year)
2045 (Design Year)</td><td><u>MWCOG Model</u>
2018 (Validation Year)
2025
2045</td><td>MWCOG travel demand model has model inputs at 5-year increments plus a year 2017 input dataset. Intermediate years can be developed by interpolating input data and modifying networks to represent planned conditions.</td></tr>
<tr><td>Time Periods</td><td>Four time periods are modeled in the forecasts. The sum of the four time periods represents average weekday daily traffic:<table><tr><th>Period</th><th>Hours</th></tr><tr><td>AM</td><td>6 a.m. – 9 a.m.</td></tr><tr><td>Midday</td><td>9 a.m. – 3 p.m.</td></tr><tr><td>PM</td><td>3 p.m. – 7 p.m.</td></tr><tr><td>Night</td><td>7 p.m. – 6 a.m.</td></tr></table></td><td>Hours split based on MWCOG household survey data (2007/2008).</td></tr>
<tr><td>Speed</td><td>Consistent with current conditions in the HOV and general purpose (GP) lanes.</td><td>Consistent with existing conditions. Same as speed/travel time curves based on MWCOG unless validation suggests modification.</td></tr>
<tr><td>Link Capacity</td><td>Lane capacities are defined consistent with the MWCOG model approach.</td><td>The MWCOG facility and area type capacity tables are used to determine link capacities. Use same speed-flow curves consistent with TPB model unless validation suggests modification.</td></tr>
<tr><td>Peak Factors</td><td>Peak period to peak hour factors:<table><tr><th>Period</th><th>2010</th><th>2025</th><th>2040</th></tr><tr><td>AM</td><td>0.417</td><td>0.38</td><td>0.34</td></tr><tr><td>PM</td><td>0.294</td><td>0.272</td><td>0.25</td></tr></table></td><td>Existing peak period values were derived from the 2007/2008 MWCOG Household Travel Survey. The peak hour factors decline in future years in recognition of the increased congestion expected in the region causing less peaked periods. This assumption spreads the traffic evenly over the entire peak period.</td></tr>
<tr><td>Socioeconomic Data</td><td>MWCOG Round 9.1 socioeconomic data will be used.</td><td></td></tr>
</table>

Table 2: Travel Demand Forecasting Model Assumptions

Model Parameter	Assumption	Comments
Network		
Project Description (I-495 Northern Extension)	Two Express Lanes in each direction along I-495 between the Dulles Toll Road (Route 267) and George Washington Memorial Parkway. Specifics to be addressed in the preliminary design effort.	
Project Extent	Dulles Toll Road in Tysons to GWMP near Maryland State Line	
I-495 (Capital Beltway) Express Lanes	Existing: Express Lanes on I-495 between I-95/I-395 and Dulles Toll Road Future: Existing Express Lanes on I-495 plus new Express Lanes in Maryland along I-495 and I-270.	Access, tolling parameters, and vehicle restrictions for I-495 Express Lanes in Maryland to be determined in coordination with MDOT.
HOV	Beginning in 2020, all HOV facilities in the Northern Virginia area are assumed to become HOV-3+.	I-495 and I-95 Express Lanes are free to HOV-3 vehicles currently; HOV lanes along I-66 and Dulles Toll Road are HOV-2 currently. HOV restrictions in Maryland to be determined in coordination with MDOT. See Table 3 for further explanation.
Toll Assumptions		
Tolling Methodology	Tolling assumptions will be kept consistent with MWCOG's default factors for I-495, I-95/395, and I-66 HOT Lanes in the final assignment iteration.	
Toll Approach	Variable toll rates by roadway segment, based on maintaining Express Lane speed goal of 55 mph.	Adopted to account for varying demand levels along the length of the project.
Mode Assumptions in I-495 NEXT Express Lanes		

Table 2: Travel Demand Forecasting Model Assumptions

Model Parameter	*Assumption*	*Comments*
Vehicle Class	HOV-3+: Free Other cars and medium trucks: Toll Heavy trucks: Are permitted in the I-495 Express Lanes from the Dulles Toll Road to the project terminus north of the GWMP.	Vehicle class restrictions for I-495 Express Lanes in Maryland to be determined in coordination with MDOT
HOV Vehicles	Use the MWCOG model HOV module. Beginning in 2020, all HOV facilities in Northern Virginia area will be HOV-3+.	The HOV estimates provided are an output of the *mode choice* and *carpool occupancy* models developed by MWCOG.

Table 3. HOV and Tolling Assumptions for Facilities in Study Area

Facility	2018	2025	2045
I-495 (Existing Express Lanes Network)	All vehicles except trucks permitted in barrier-separated express lanes. All vehicles except HOV3+ must pay a toll.		
Dulles Toll Road (SR 267)	HOV2+ vehicles only allowed in left-most lane eastbound (AM peak) and westbound (PM peak)	HOV3+ vehicles only allowed in left-most lane eastbound (AM peak) and westbound (PM peak)	
I-66 (Outside the Beltway)	HOV2+ vehicles only allowed in left-most lane eastbound (AM peak) and westbound (PM peak)	All vehicles (including trucks) permitted in barrier-separated express lanes. All vehicles except HOV3+ must pay a toll.	
I-66 (Inside the Beltway)	All vehicles except trucks permitted. During AM peak eastbound and PM peak westbound, lanes are tolled except for HOV2+ vehicles.	All vehicles except trucks permitted. During AM peak eastbound and PM peak westbound, lanes are tolled except for HOV3+ vehicles.	All vehicles except trucks permitted. During AM peak and PM peak in both directions, lanes are tolled except for HOV3+ vehicles.

Traffic Volume Post-Processing

Post-processing of travel demand model output is necessary to develop traffic volume forecasts for analysis of operations during peak periods/peak hours. Post-processing of travel demand forecasts for vehicular volumes will follow NCHRP 255/765 guidelines for estimating balanced No-Build and Build peak period volumes. Existing balanced volumes will be developed outside of the MWCOG travel demand model using field count data; origin-destination (O-D) routing will be obtained utilizing StreetLight Data or the MWCOG model, and the O-D matrix will be adjusted using VISUM's TFlowFuzzy methodology to match target balanced volumes along the corridor. The O-D matrix will be imported into VISSIM for traffic microsimulation analysis.

Traffic volumes for the traffic operations analysis and air quality and noise analyses for future scenarios will be developed using travel demand model outputs and NCHRP 255/765 guidelines. For future scenario VISSIM microsimulation analysis, O-D routing will again be developed using MWCOG model outputs as a seeding matrix and VISUM's TFlowFuzzy process to create an adjusted O-D matrix that matches target forecast volumes in the study area.

Conclusion

The travel demand model methodology and calibration/validation criteria were reviewed with VDOT staff on a call on July 24, 2018. This methodology will be carried forward for travel demand forecasting for the I-495 NEXT project.

Appendix C: Travel Demand Modeling Calibration Memorandum

MEMORANDUM

To: Abi Lerner, P.E., VDOT Project Manager
Rahul Trivedi, P.E., VDOT NoVA District Transportation Planning Manager
Amir Shahpar, P.E., VDOT NoVA District Modeling Manager

From: Rob Prunty, P.E.
Raj Paradkar, P.E.
Anthony Gallo, P.E.
Kimley-Horn and Associates, Inc.

Date: October 10, 2018

Subject: I-495 NEXT Travel Demand Forecasting Existing Conditions (2018) Model Calibration

Introduction

This memorandum summarizes the results of the 2018 Existing Conditions year travel demand model calibration process for the I-495 NEXT Project. This process followed the agreed-upon methodology for travel demand forecasting as documented in the *I-495 NEXT Travel Demand Model Forecasting Framework* memorandum dated August 26, 2018. The result from this process is a modified, calibrated version of the MWCOG regional travel demand model for a 2018-year scenario which more accurately reflects field traffic counts and VDOT traffic counts. The model network contains additional detail in the vicinity of the study area as compared to the default MWCOG model network. The modifications applied to the calibrated 2018 model will be applied (where appropriate) to the 2025 and 2045 MWCOG model files for future No-Build and Build scenario analyses.

Model Calibration Process Overview

Model Version

The latest MWCOG travel demand model version on the 3,722 traffic analysis zone (TAZ) system is being used in conjunction with Round 9.1 Cooperative Forecasts (socioeconomic data) for the Existing, Opening, and Design model years. The MWCOG model base year is 2017; a project Existing Conditions (year 2018) model has been prepared, modified and calibrated to reflect field counts.

Calibration Criteria and Thresholds

The MWCOG model has been strategically modified with specific alterations to improve the accuracy and reliability of forecasts for the I-495 study corridor and roadways connected to the corridor. The calibration targets were developed based on guidance from the FHWA Transportation Model Improvement Program (TMIP) *Travel Model Validation and Reasonableness Checking Manual* and the Virginia *Travel Demand Modeling Policies and Procedures Manual*. Because the MWCOG/TPB Model is already subject to scrutiny as a regional model which has been a subject of FHWA's TMIP

Peer Review process, the validation process for the I-495 Project NEXT model is focused on the I-495 Traffic Operations Analysis Study Area and includes the following comparisons:

- Regional comparisons to VDOT AADTs at the daily level (daily level only)
  - Percent difference in total volume for cutlines
- I-495 NEXT traffic operations study area comparisons to field traffic counts (AM/PM periods and daily)
  - R-squared between modeled volumes and counts on links
  - Percent difference in total volumes for freeways/arterials
  - Percent root mean squared error (%RMSE) by volume group or facility type
- Travel time comparisons of model outputs to floating car runs data collected (AM/PM periods only; reasonableness checks only)

Table 1 provides a listing of travel demand model calibration criteria, which were discussed and verbally approved by VDOT during a call on July 24, 2018.

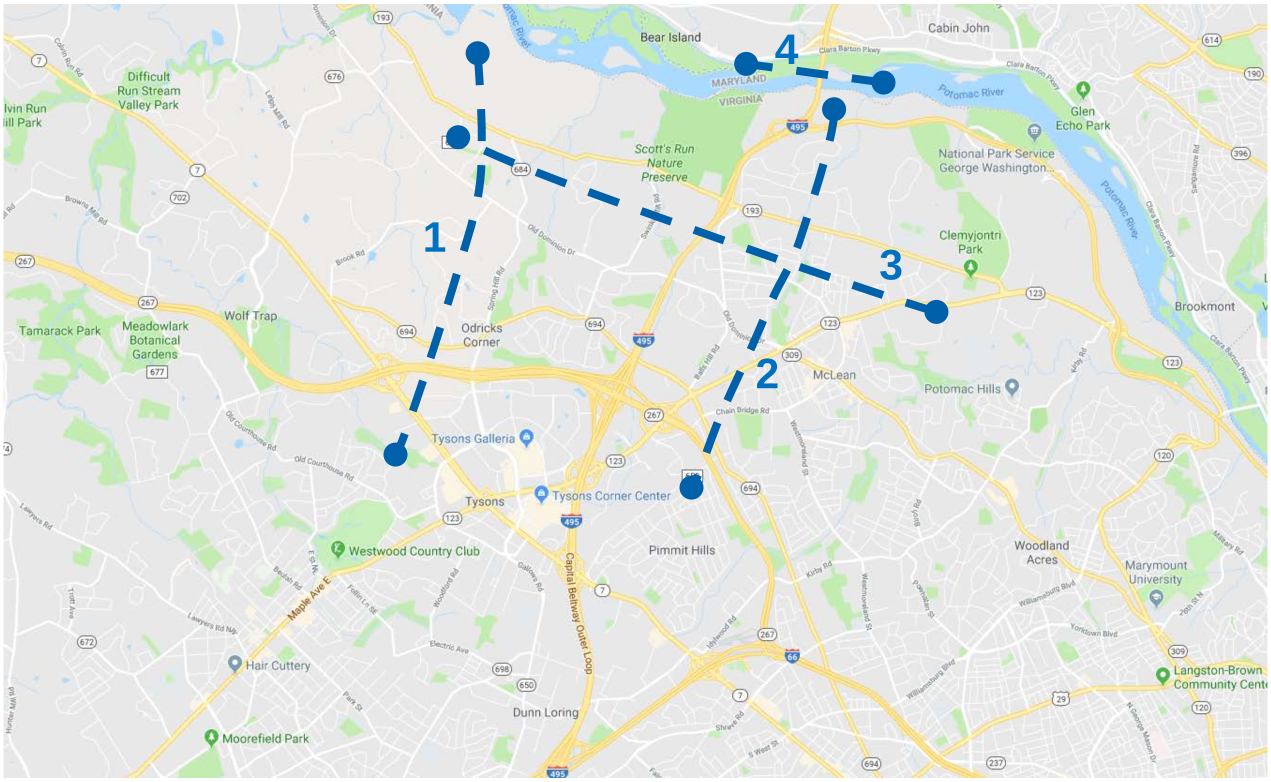
Table 1. Travel Demand Forecast Model Calibration Criteria

Calibration Scale	Calibration Check	Calibration Threshold			
Regional	% Difference in Total Volume for Cutlines (24-Hour Volumes)	Cutline Volume	VTM	FHWA	***Proposed***
		50,000	10%	35%	***10%***
		100,000	8.75%	25%	***10%***
		150,000	7.50%	20%	***10%***
		200,000	6.25%	18%	***8%***
		250,000	5%	15%	***7%***
Study Area	R-Squared between modeled volume and counts on links (AM Period, PM Period, and 24-Hour Volumes)		VTM	FHWA	***Proposed***
			0.9	0.88	***0.9***
	% Difference in Total Volume by Facility Type (AM Period, PM Period, and 24-Hour Volumes)	Facility Type	VTM	FHWA	***Proposed***
		Freeways	6%	7%	***6%***
		Major Arterials	7%	10%	***10%***
		Minor Arterials	10%	15%	***15%***
	%RMSE by Facility Type (AM and PM Period)	Facility Type	VTM	FHWA	***Proposed***
		Freeways	30%	-	***30%***
		Major Arterials	45%	-	***45%***
		Minor Arterials	60%	-	***60%***
		Overall	40%	-	***40%***
	%RMSE by Facility Type (24-Hour Volumes)	Facility Type	VTM	FHWA	***Proposed***
		Freeways	20%	-	***20%***
		Major Arterials	35%	-	***35%***
		Minor Arterials	50%	-	***50%***
		Overall	30%	-	***30%***
	Travel Times (AM and PM Period)	No specific measures in VTM or FHWA; compare model outputs to floating car travel runs and check to see if travel times are within min and max of observed travel times. Note that these are reasonableness checks only.			

The following regional cut-lines were used in the calibration process. Figure 1 shows a map of the proposed cut-lines for the calibration process.

- East/west travel west of study area (#1 on map)
  - Georgetown Pike west of Spring Hill Road
  - Old Dominion Drive west of Spring Hill Road
  - Lewinsville Road west of Spring Hill Road
  - Route 267 between Route 7 and Spring Hill Road
  - Route 7 just east of Route 267
- East/west travel east of study area (#2 on map)
  - George Washington Memorial Parkway east of I-495
  - Georgetown Pike east of I-495
  - Old Dominion Drive between Balls Hill Road and Route 123
  - Route 123 east of Lewinsville Road/Great Falls Street
  - Chain Bridge Road east of Great Falls Street
  - Great Falls Street east/south of Chain Bridge Road
  - Route 267 east of Route 123
- North/south travel within study area (#3 on map)
  - Spring Hill Road south of Georgetown Pike
  - Swinks Mill Road south of Georgetown Pike
  - I-495 south of Georgetown Pike
  - Balls Hill Road south of Georgetown Pike
  - Douglas Drive south of Georgetown Pike
  - Route 123 west/south of Georgetown Pike
- North/south travel north of study area (#4 on map)
  - I-495 American Legion Bridge

Figure 1. Proposed Cut-Lines for Travel Demand Model Calibration Process.



Calibration Data Used

Traffic counts used for the I-495 NEXT project traffic operations analysis were taken during May and June 2018. All 48-hour mainline counts (30 locations in the study area) were also used in the travel demand model calibration process. An additional three intersection turning movement counts were utilized along Route 123, where 48-hour counts were not taken. Count locations used in the link-level calibration in the project study area are shown in Table 2. Where applicable, these counts were also used in the cutline calibration. However, at most cutline link locations, VDOT 2017 traffic count estimates for Fairfax County[1] were used in the absence of 2018 field count data.

[1] http://www.virginiadot.org/info/resources/Traffic_2017/AADT_029_Fairfax_2017.pdf

Table 2. Traffic Count Locations Used in I-495 NEXT Study Area Model Calibration.

Roadway	Location
I-495	North of Clara Barton Pkwy American Legion Bridge GW Pkwy to Georgetown Pike Georgetown Pike to Dulles Toll Rd Dulles Toll Rd to Route 123 Route 123 to Route 7
I-495 (HOT)	Westpark Dr to Jones Branch Dr South of Westpark Dr
George Washington Mem Pkwy	East of I-495
Route 193 (Georgetown Pike)	Swinks Mill Rd to I-495 Dead Run Dr to Douglass Dr
Route 685 (Swinks Mill Road)	Old Dominion Dr to Georgetown Pike
Route 686 (Balls Hill Road)	Old Dominion Dr to Georgetown Pike
Dulles Airport Access Road	Spring Hill Rd to I-495
Route 267 (Dulles Toll Road)	Route 7 to Spring Hill Rd Spring Hill Rd to I-495 East of Route 123
Route 123	Tysons Blvd to I-495 Scotts Crossing Rd to Anderson Rd Great Falls St to Old Dominion Dr

Model Edits

The following edits have been applied to the MWCOG model during the I-495 NEXT 2018 Existing Conditions calibration. These edits are the results of an extensive process of testing and tweaking various parameters known to impact facility loading while still maintaining the integrity of the overall model processes and procedures. Approximately 40 test runs have been completed at this point. Edits include:

- Significant modifications to link/node geometry to more accurately represent facilities in the study area and show consistency with Fairfax County model; these include coding of individual ramp movements at interchanges along I-495 and SR 267 in the study area and coding of facilities that are not in the MWCOG model, such as Balls Hill Road, Churchill Road, and roadways in the vicinity of the McLean Metrorail station area. This also includes coding of auxiliary lanes along I-495 (including the I-495 northbound left shoulder lane which is open during AM and PM peak periods) and the collector-distributor road system at the George Washington Memorial Parkway interchange.
- Modifications to centroid connector locations and number of centroid connectors for each zone, generally maintaining consistency with the Fairfax County model
- Modifications to facility type (FTYPE) along certain corridors, including:
    - Modifying Clara Barton Parkway to be a major arterial instead of freeway between I-495 and MacArthur Blvd

- Modifying Route 123 to be an expressway instead of major arterial between Georgetown Pike and George Washington Parkway
- Modifying Georgetown Pike to be a major arterial instead of minor arterial between I-495 and Route 123

- Modifications to tolling parameters in the toll escalation input file (toll_esc.dbf), including:
  - In order to obtain loading along the I-495 HOT lanes more consistent with field counts, the distance factor ("DSTFAC") for segments along the I-495 HOT lanes that was set to 20 (cents/mile) by default was increased to 30 (segments that were already higher than 30 were held fixed). Additionally, due to observed high loading of the HOT lanes near the northern termini during the AM peak period, the AM factor ("AM_TFTR") was increased from 1.0 to 2.5 only in these segments near Route 267, making the HOT lanes less attractive in the AM at their northern termini.
  - In order to obtain loading along SR 267 near the toll plaza in off-peak periods and reduce trips diverting to use Route 7 or Georgetown Pike, the off-peak factor ("OP_TFTR") for toll group 1 (fixed tolls) was reduced from 1.0 to 0.4, making the toll plaza more attractive. This facility otherwise sees very low traffic volumes during off-peak periods in the model (as compared to field counts) due to the toll and likely perceived "parallel" paths along Route 7 and Georgetown Pike, which were loading higher-than-observed volumes without this change.

- As a last resort, modifying the time penalty for links near the American Legion Bridge crossing the Potomac River[2]. Various tests were conducted to examine these time penalties. After extensive calibration edits and review, time penalties were modified within the highway assignment script, which allowed for customizing time penalties for the bridge by time of day. Table 3 shows the time penalties which were incorporated into the highway assignment script for each time period and direction on the bridge and, in the case of the PM peak period, links near the bridge.

Table 3. Additional time penalties applied to I-495 links.

Location		AM Penalty (min)	PM Penalty (min)	Off-Peak Penalty (min)
NB	South of Georgetown Pike (HOT lanes termini merge)	-	5	-

[2] Prior to implementation of the changes to the time penalties, modeled daily volumes along the American Legion Bridge were approximately 40,000 vpd higher than field counts, including volumes that were nearly 25,000 higher in the PM peak period. These high volumes reflect other attempted modifications to reduce the capacity over the bridge, including area type overrides and changes to time-of-day parameters to shift more trips to the off-peak periods.

Location		AM Penalty (min)	PM Penalty (min)	Off-Peak Penalty (min)
	Between Georgetown Pike and GW Parkway	-	5	-
	Between GW Parkway and Clara Barton Parkway (American Legion Bridge)	10	15	2
	North of Clara Barton Parkway	-	5	-
SB	Between Clara Barton Parkway and GW Parkway (American Legion Bridge)	10	12	2

- A time penalty of 1 minute was also added to Leesburg Pike eastbound just east of SR 267, which is heavily congested during peak hours and was seeing loading of trips that would likely otherwise utilize SR 267.

A figure showing the modified I-495 NEXT model network, including highlighting of links with time penalties, is provided in the Appendix.

Calibration Results

Cutline Calibration

Table 3 shows the calibration results for total volumes across the four cutlines. All four cutlines are meeting the calibration thresholds. A table showing comparisons of individual links across each cutline is provided in the Appendix.

Table 4. Cutline Calibration Results (24-Hour Volumes)

Cutline	Cutline Volume (Counts)	Cutline Volume (Modeled)	% Difference	Criteria	Meets?
#1: East/West Travel West of Study Area	237,732	254,548	7.1%	8.0%	Yes
#2: East/West Travel East of Study Area	238,441	232,041	-2.7%	8.0%	Yes
#3: North/South Travel Near Study Area	272,054	286,029	5.1%	7.0%	Yes
#4: North/South Travel North of Study Area	236,081	245,090	3.8%	8.0%	Yes

Study Area Link Calibration

Table 4 provides an overview of AM peak period link calibration results. Table 5 shows this same comparison for the PM peak period. Table 6 shows these results at the daily (24-hour) level. A full comparison of individual links in each period is provided in the Appendix.

- R-squared between modeled volumes and counts on links is meeting for all three time periods.
- At the daily level and AM peak period level, all link calibration metrics are met for all facility types.
- For the AM peak period level, all link calibration metrics are met for freeways and major arterials.
- For the PM peak period level, all link calibration metrics are being met except for percent difference in total volume by facility type for freeways. This is the result of several consecutive freeway links along I-495 northbound all loading higher than field counts. Note that this high loading even is present after significant increases to time penalties along the American Legion Bridge, including modifications to model scripts to further increase the time penalty in the PM in the northbound direction. Minor arterials are also not meeting the percent difference in total volume metric or percent RMSE metric, though there are only two links being used in this calculation.

Table 5. AM Peak Period Link Calibration Results

Calibration Check		Model Outputs	Threshold		Meets?	n
R-squared between modeled volumes and counts on links		0.97	>=	0.9	Yes	20
% Difference in Total Volume by Facility Type	Freeways	0%	<=	6%	Yes	12
	Major Arterials	-10%	<=	10%	Yes	6
	Minor Arterials	9%	<=	15%	Yes	2
% RMSE by Facility Type	Freeways	12%	<=	30%	Yes	12
	Major Arterials	19%	<=	45%	Yes	6
	Minor Arterials	25%	<=	60%	Yes	2
	Overall	14%	<=	40%	Yes	20

Table 6. PM Peak Period Link Calibration Results

Calibration Check		Model Outputs	Threshold		Meets?	n
R-squared between modeled volumes and counts on links		0.97	>=	0.9	Yes	20
% Difference in Total Volume by Facility Type	Freeways	6%	<=	6%	No	12
	Major Arterials	1%	<=	10%	Yes	6
	Minor Arterials	52%	<=	15%	No	2
% RMSE by Facility Type	Freeways	14%	<=	30%	Yes	12
	Major Arterials	10%	<=	45%	Yes	6
	Minor Arterials	62%	<=	60%	No	2
	Overall	15%	<=	40%	Yes	20

Table 7. 24-Hour Link Calibration Results

Calibration Check		Model Outputs	Threshold		Meets?	n
R-squared between modeled volumes and counts on links		0.98	>=	0.9	Yes	17
	Freeways	0%	<=	6%	Yes	12

Calibration Check		Model Outputs	Threshold		Meets?	n
% Difference in Total Volume by Facility Type	Major Arterials	-2%	<=	10%	Yes	3
	Minor Arterials	3%	<=	15%	Yes	2
% RMSE by Facility Type	Freeways	11%	<=	30%	Yes	12
	Major Arterials	27%	<=	45%	Yes	3
	Minor Arterials	4%	<=	60%	Yes	2
	Overall	28%	<=	40%	Yes	17

Travel Times (Reasonableness Check Only)

Travel times along I-495 within the study are have been estimated from the model outputs by dividing each individual link distance (in miles) by the link's final congested speed (in miles per hour). Model travel times along I-495 northbound in the AM and I-495 southbound in the PM are within the INRIX 5th to 95th percentile range. Along I-495 northbound in the PM, the model travel time technically falls within the INRIX range but is only 7 minutes, which is very low when compared to field travel time runs. Along I-495 southbound in the AM, the model travel time is higher than the 95th percentile INRIX travel time. Note that none of these travel time directly account for the "perceived time penalty" along the American Legion Bridge that is used to influence traffic assignment; rather, these travel times represent congested speeds along each link based model volume-delay-function (VDF) curves. The travel demand model is not calibrated at a regional level to any measure of speed or travel time, and it is not designed to model link speeds at a detailed level.

Conclusion

This memorandum documents the calibration process and results for the MWCOG travel demand model used for the I-495 NEXT project. As such, the model calibration is considered adequate for representing base year traffic counts and for the application in future scenarios. The modifications applied to the calibrated 2018 model will be applied (where appropriate) to the 2025 and 2045 MWCOG model for future No-Build and Build analyses.

Appendix

- Map of modified I-495 NEXT model network in study area
- Table showing individual link calibration along cutlines
- Table showing individual link calibration within study area

Figure 2. Modified I-495 NEXT model network in study area.

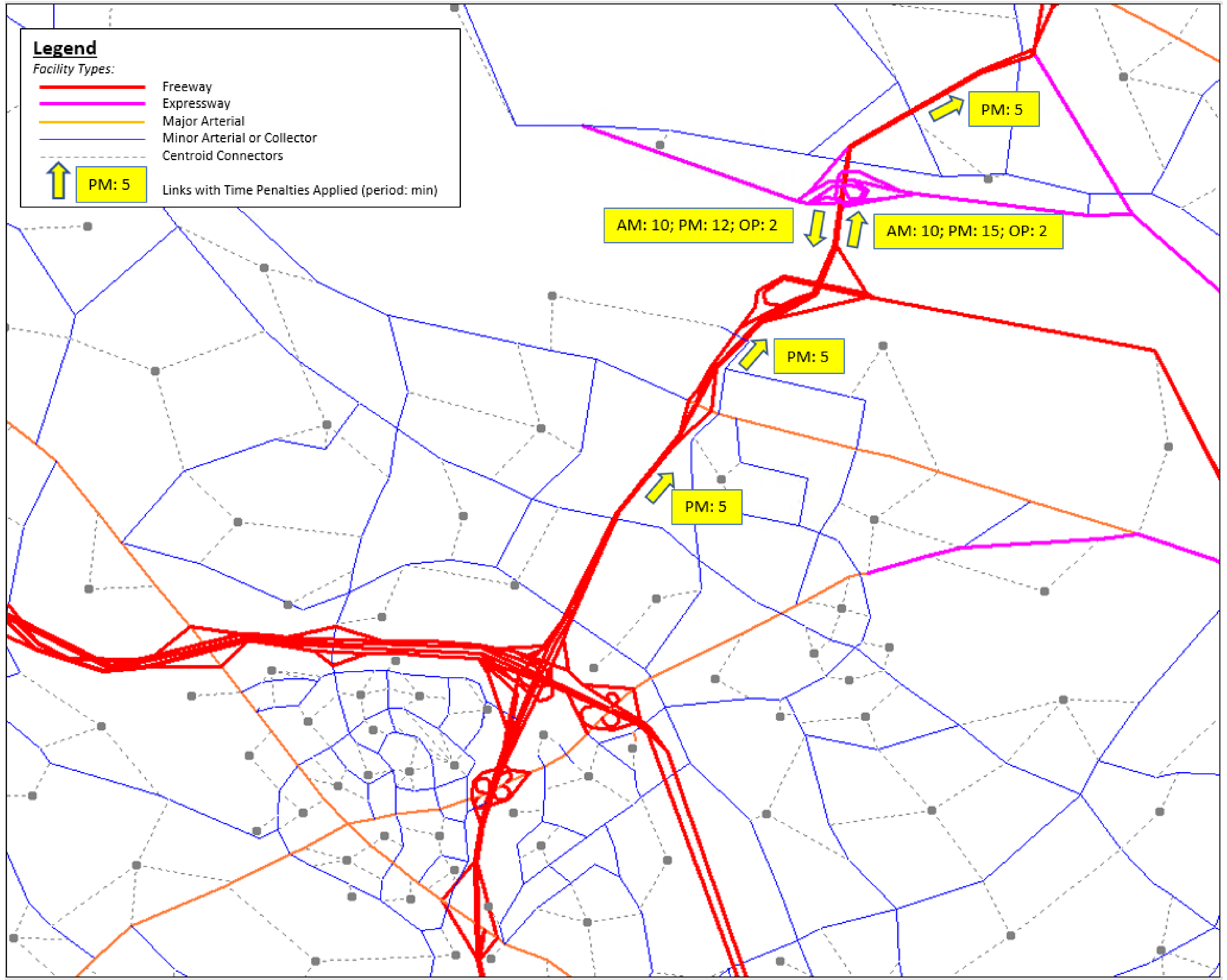


Table 8. Comparison of individual link volumes along model cutlines.

Cutline	Roadway	VDOT Count Location	VDOT 2017 AAWDT	Comparison Count Used	Modeled Volume	Difference	% Difference	Criteria	Meets?
#1: East/West Travel West of Study Area	Route 193 (Georgetown Pike)	"Urban Boundary" to Capital Beltway	25,000	25,000	26,088	1,088	4.4%	8.0%	Yes
	Route 738 (Old Dominion Dr)	Towlston Rd to Spring Hill Rd	10,000	10,000	11,247	1,247	12.5%		
	Route 694 (Lewinsville Rd)	Leesburg Pike to Spring Hill Rd	11,000	11,000	10,366	-634	-5.8%		
	Route 267 (Dulles Toll Road)	Leesburg Pike to International Dr	116,000	123,732	134,555	10,823	8.7%		
	Route 7 (Leesburg Pike)	Route 267 to Route 123	68,000	68,000	72,292	4,292	6.3%		
	Cutline Total		**230,000**	**237,732**	**254,548**	**16,816**	**7.1%**		
#2: East/West Travel East of Study Area	George Washington Mem Pkwy	Arlington County Line to Capital Beltway	53,000	65,950	55,976	-9,974	-15.1%	8.0%	Yes
	Route 193 (Georgetown Pike)	Capital Beltway to Chain Bridge Rd	13,000	12,956	12,449	-507	-3.9%		
	Route 738 (Old Dominion Dr)	Balls Hill Rd to Route 123	12,000	12,000	12,323	323	2.7%		
	Route 123 (Dolley Madison Blvd)	Route 267 to Old Dominion Drive	47,000	47,000	47,830	830	1.8%		
	SR 3547 (Chain Bridge Rd)	Great Falls St to Westmoreland St	20,000	20,000	16,159	-3,841	-19.2%		
	Route 694 (Great Falls St)	Chain Bridge Rd to Magarity Rd	15,000	15,000	16,365	1,365	9.1%		
	Route 267 (Dulles Toll Road)	Route 123 to I-66	59,000	65,535	70,939	5,404	8.2%		
	Cutline Total		**219,000**	**238,441**	**232,041**	**-6,400**	**-2.7%**		
#3: North/South Travel Near Study Area	Route 684 (Spring Hill Road)	Old Dominion Dr to Georgetown Pike	1,800	1,800	1,750	-50	-2.8%	7.0%	Yes
	Route 685 (Swinks Mill Road)	Old Dominion Dr to Georgetown Pike	6,400	5,621	5,762	141	2.5%		
	I-495	Route 267 to Georgetown Pike	169,000	211,277	223,992	12,715	6.0%		
	Route 686 (Balls Hill Road)	Old Dominion Dr to Georgetown Pike	8,500	8,456	8,782	326	3.9%		
	Route 837 (Douglass Dr)	Georgetown Pike to Baron Rd	2,900	2,900	3,358	458	15.8%		
	Route 123 (Chain Bridge Rd)	Old Dominion Dr to Georgetown Pike	42,000	42,000	42,385	385	0.9%		
	Cutline Total		**230,600**	**272,054**	**286,029**	**13,975**	**5.1%**		
#4: North/South Travel North of Study Area	**I-495 (American Legion Bridge)**	**Cutline Total**	**239,000**	**236,081**	**245,090**	**9,009**	**3.8%**	**8.0%**	**Yes**

*Note: traffic counts highlighted in blue represent locations in which field counts for this study were available and used.

1. VDOT AAWDT location along GW Parkway is unclear - multiple interchanges between Arlington County line and I-495
2. VDOT count estimate along I-495 south of Georgetown Pike may be south of HOT lanes termini; comparison count used is field count north of HOT lanes termini.

Table 9. Comparison of individual link volumes within study area.

Roadway	Location	Facility Type	2-Way Field Count Volumes			2-Way TDFM Volumes			Comparison (Model vs. Count)					
									AM		PM		24 Hours	
			AM Peak Total	PM Peak Total	24-Hour Total	AM Peak Total	PM Peak Total	24-Hour Total	Diff	Diff%	Diff	Diff%	Diff	Diff%
I-495	North of Clara Barton Pkwy	Freeways	44,910	41,029	229,916	39,702	44,160	224,203	-5,208	-11.6%	3,131	7.6%	-5,713	-2.5%
	American Legion Bridge	Freeways	45,238	45,846	236,081	47,926	54,521	245,090	2,687	5.9%	8,675	18.9%	9,009	3.8%
	GW Pkwy to Georgetown Pike	Freeways	38,879	36,236	194,816	44,668	44,818	223,156	5,789	14.9%	8,582	23.7%	28,339	14.5%
	Georgetown Pike to Dulles Toll Rd	Freeways	41,060	44,076	211,277	44,647	47,040	223,992	3,587	8.7%	2,964	6.7%	12,715	6.0%
	Dulles Toll Rd to Route 123	Freeways	32,597	29,069	161,487	28,460	29,411	139,549	-4,138	-12.7%	342	1.2%	-21,938	-13.6%
	Route 123 to Route 7	Freeways	34,526	38,152	180,269	30,555	35,144	152,132	-3,971	-11.5%	-3,008	-7.9%	-28,137	-15.6%
I-495 (HOT)	Westpark Dr to Jones Branch Dr	Freeways	5,949	10,737	30,610	7,136	10,419	30,659	1,187	20.0%	-318	-3.0%	49	0.2%
	South of Westpark Dr	Freeways	5,927	11,387	31,379	6,849	9,999	28,718	923	15.6%	-1,387	-12.2%	-2,661	-8.5%
George Washington Mem Pkwy	East of I-495	Major Arterials	13,642	16,512	65,950	9,716	15,988	55,976	-3,926	-28.8%	-524	-3.2%	-9,974	-15.1%
Route 193 (Georgetown Pike)	Swinks Mill Rd to I-495	Major Arterials	4,238	5,685	20,478	5,104	8,012	31,691	866	20.4%	2,327	40.9%	11,213	54.8%
	Dead Run Dr to Douglass Dr	Major Arterials	2,975	3,783	12,956	2,268	3,417	10,019	-707	-23.8%	-367	-9.7%	-2,937	-22.7%
Route 685 (Swinks Mill Road)	Old Dominion Dr to Georgetown Pike	Minor Arterials	1,343	1,840	5,621	1,146	2,256	5,762	-197	-14.7%	416	22.6%	141	2.5%
Route 686 (Balls Hill Road)	Old Dominion Dr to Georgetown Pike	Minor Arterials	1,579	2,344	8,456	2,051	4,117	8,782	472	29.9%	1,773	75.6%	326	3.9%
Dulles Airport Access Road	Spring Hill Rd to I-495	Freeways	3,448	5,354	20,001	2,754	3,103	11,642	-694	-20.1%	-2,251	-42.0%	-8,359	-41.8%
Route 267 (Dulles Toll Road)	Route 7 to Spring Hill Rd	Freeways	25,609	36,862	123,732	26,918	37,505	134,555	1,309	5.1%	643	1.7%	10,823	8.7%
	Spring Hill Rd to I-495	Freeways	26,620	39,263	134,140	26,502	40,553	135,185	-118	-0.4%	1,290	3.3%	1,044	0.8%
	East of Route 123	Freeways	12,137	15,453	65,535	12,168	19,107	70,939	31	0.3%	3,654	23.6%	5,404	8.2%
Route 123	Tysons Blvd to I-495	Major Arterials	15,841	23,502	Data not available	15,239	21,956	89,550	-602	-3.8%	-1,546	-6.6%	Data not available	
	Scotts Crossing Rd to Anderson Rd	Major Arterials	9,862	16,226		9,111	17,763	58,571	-751	-7.6%	1,537	9.5%		
	Great Falls St to Old Dominion Dr	Major Arterials	8,870	14,752		8,572	14,211	47,830	-298	-3.4%	-541	-3.7%		

Appendix D: VISSIM Calibration Memorandum

ATCS Kimley»Horn

MEMORANDUM

To: Ivan Horodyskyj, P.E., VDOT NoVA District Traffic Engineer
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Date: November 16, 2018

Subject: I-495 NEXT Traffic Analysis Microsimulation Calibration Results Memorandum

Introduction

This memorandum documents the calibration results for the I-495 Northern Extension (NEXT) project traffic operations analysis in support of the project National Environmental Policy Act (NEPA) studies and Preliminary Engineering and Operations Development. The ATCS/Kimley-Horn consultant team (henceforth referred to as "consultant team") conducted calibration of VISSIM traffic simulation models for the 2018 Existing Conditions. The traffic microsimulation calibration methodology was based on guidance set forth in the VDOT *Traffic Operations and Safety Analysis Manual* (TOSAM)[1], Version 1.0 (released November 2015) and as outlined in the I-495 NEXT Traffic Analysis Microsimulation Calibration Methodology memorandum.

Simulation Analysis Period

The I-495 NEXT traffic operations study area is a severely oversaturated network during the weekday AM and PM peak periods, with several hours of congestion in both directions along I-495, especially along I-495 northbound approaching the American Legion Bridge. During these congested periods, traffic volume throughput is constrained due to low speeds and can be much lower than the actual maximum counted volumes along the freeway. Figure 1 shows an example of this phenomenon along the I-495 northbound general purpose lanes over three days in June 2018. During the PM peak period, starting around 2 PM, traffic counts decrease and do not get above 5,000 vph across a four-lane section, which theoretically should be able to carry much higher volumes. Due to the oversaturated conditions, the consultant team selected an analysis period based on the heaviest periods of congestion and slowest speeds experienced along the corridor.

[1] http://www.virginiadot.org/business/resources/TOSAM.pdf

Figure 1. Hourly Traffic Counts along I-495 Northbound GP south of Route 267

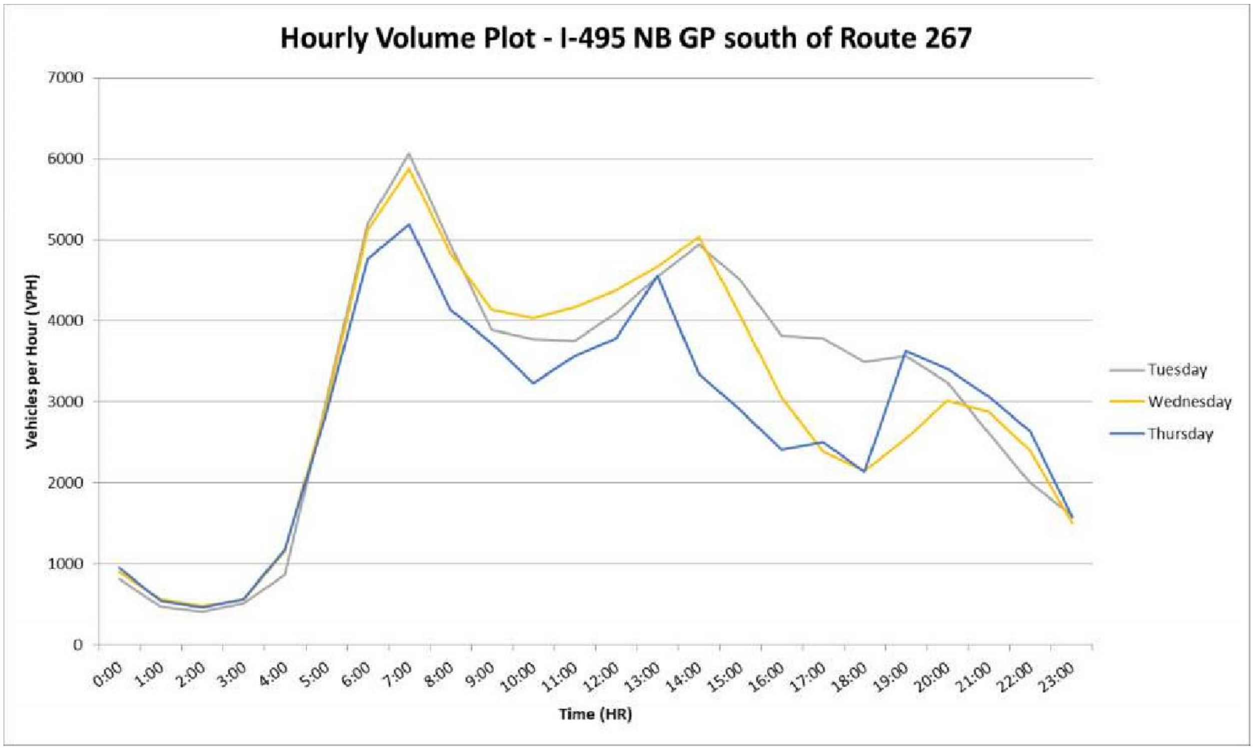


Figure 2 shows 15-minute average speeds along the I-495 northbound general purpose lanes through the study area for average weekdays (Tuesday, Wednesday, and Thursday) from July 2017 through June 2018. Note that during both the AM and PM peak periods, speeds along I-495 northbound are slower than speeds along I-495 southbound due to the downstream bottleneck at the American Legion Bridge. The consultant team selected an analysis period based on congestion in the I-495 northbound general purpose lanes.

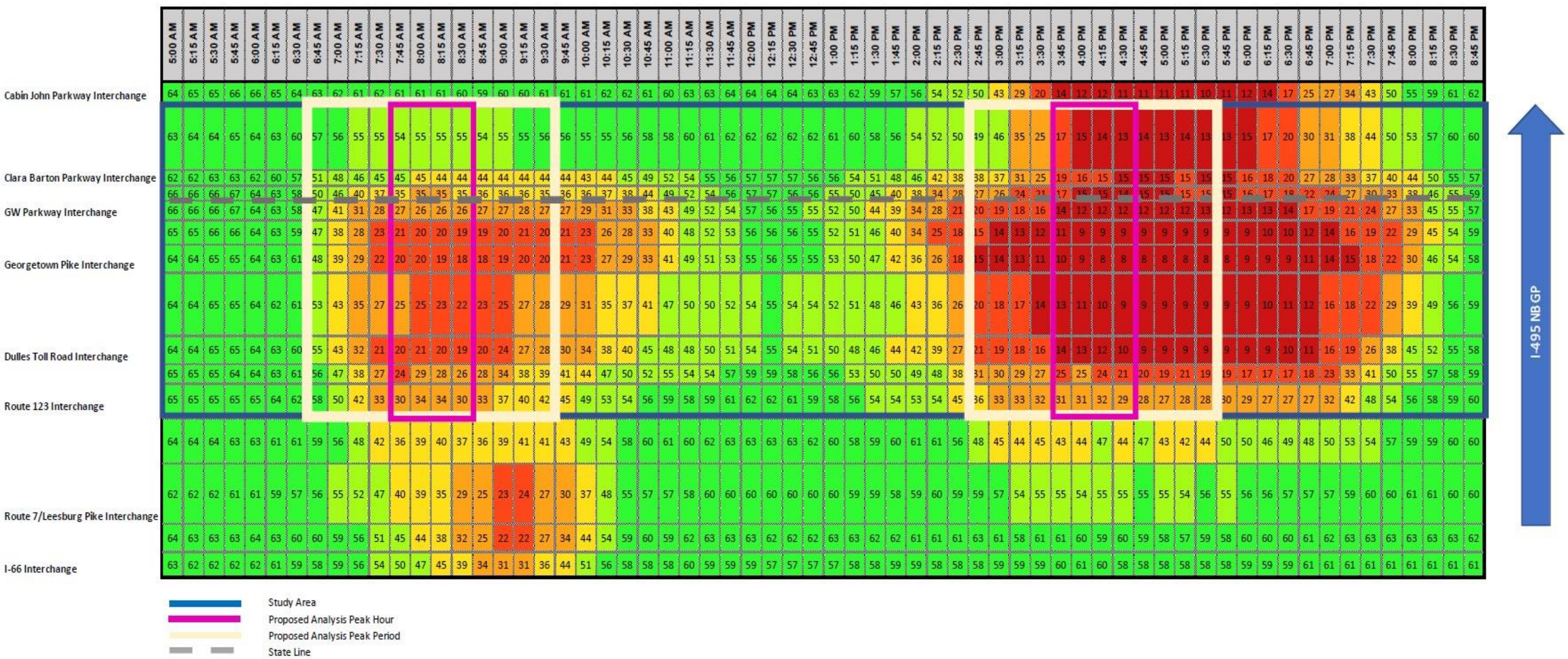
Figure 2 also shows the simulation analysis periods. These analysis periods would each be preceded by a seeding period in the VISSIM models.

- AM peak: 6:45 AM to 9:45 AM (peak hour 7:45 AM to 8:45 AM). This captures the onset of queueing back from the American Legion Bridge and the start of the dissipation of the queue. The peak hour captures the current worst extent of queueing.
- PM peak: 2:45 PM to 5:45 PM (peak hour 3:45 PM to 4:45 PM). This peak period is intended to capture queue formation from the American Legion Bridge *before the queue from points further north in Maryland spill back and create a single continuous queue*. This can be observed in the figure, as prior to approximately 3:30 PM, congestion in Virginia does not continue into Maryland. By approximately 4:00 PM, a single continuous area of congestion is present from north of the study area through the Route 123 interchange. Between approximately 4:00 PM and 7:00 PM, however, the extent of queueing stays relatively consistent – to the Route 123 interchange. The congestion does not fully dissipate until after

8:00 PM on average – note that the proposed traffic analysis period is not recommended to last until this point. Rather, the proposed traffic analysis period captures the onset of queueing (from when the queue is not due to spillback from Maryland) until it reaches its maximum.

While neither of the proposed analysis periods capture the entire period of congestion along the northbound direction of I-495, the primary focus was the areas and times of greatest importance. For example, although the peak period in the afternoon / evening typically extends beyond six hours of congestion, the proposed analysis periods for study stills capture the onset of congestion and maximum extents of congestion.

Figure 2: INRIX 15-Minute Average Speeds Along I-495 Northbound GP and Proposed Simulation Analysis Periods



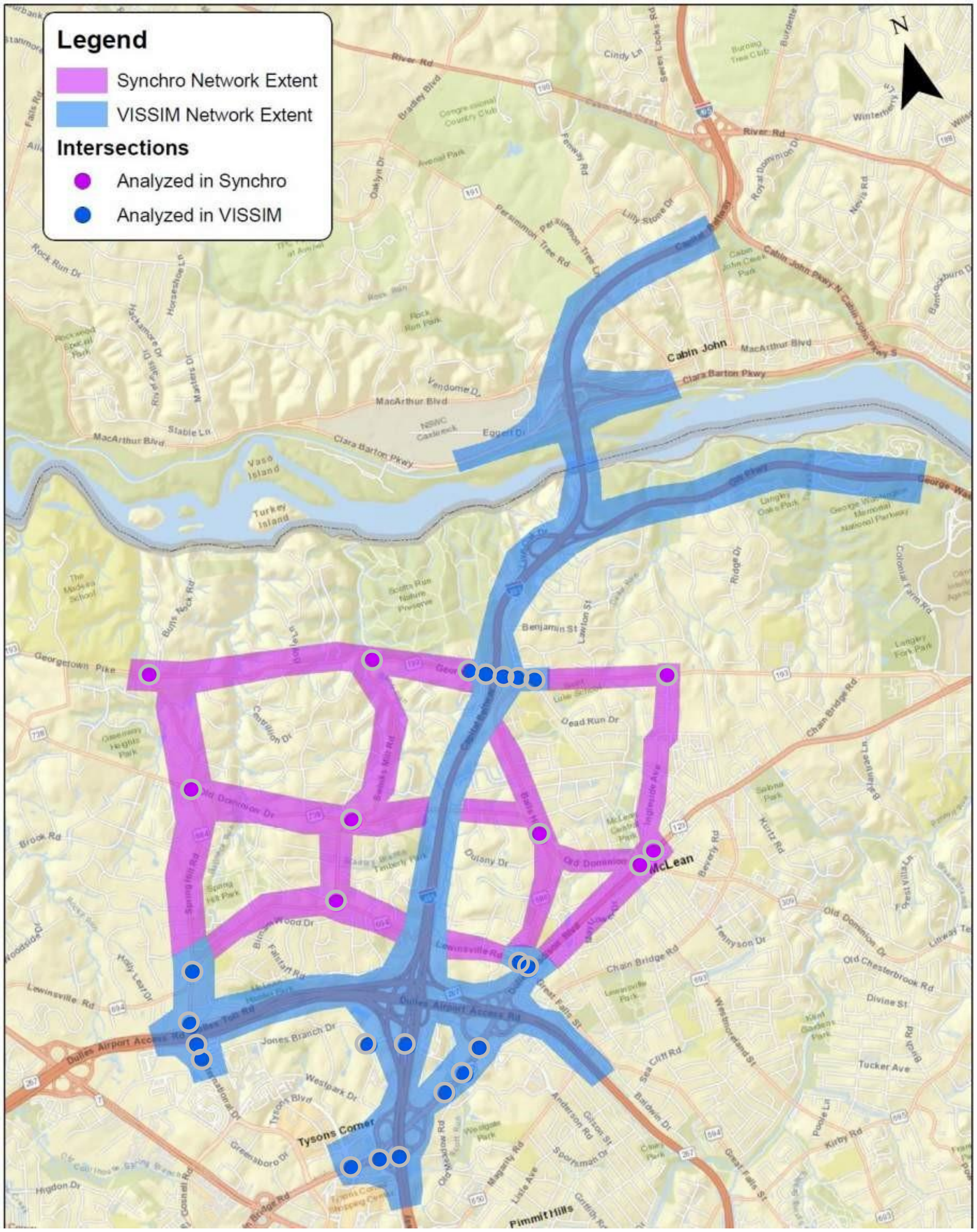
Purpose of a Calibration

The purpose of a simulation model is to investigate the impacts of the proposed improvement alternatives. The existing AM and PM peak period VISSIM models were developed for the Study Area to calibrate and validate the VISSIM simulation models. Calibration is the adjustment of the model parameters to improve the model's ability to reproduce observed traffic conditions. It is the required step during any traffic analysis to ensure the model can reproduce local driver behavior and traffic performance characteristics, and should be done prior to evaluating different alternatives. VISSIM, like most simulation models, was designed to be flexible enough that an analyst can correctly calibrate the network to match the location conditions at a reasonably accurate level. However, the default values will (almost) never give accurate results for a specific area. Therefore, calibration is required to adjust the VISSIM model parameters to replicate the traffic characteristics of the Study Area.

VISSIM Calibration Methodology

Existing conditions (2018) microsimulation networks were developed using VISSIM 9.14 software. The VISSIM study area is shown in Figure 3.

Figure 3. I-495 NEXT Traffic Operations Analysis Study Area



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The VISSIM base models were calibrated based on criteria and thresholds outlined in the approved I-495 NEXT Traffic Analysis Microsimulation Calibration Methodology memorandum and as shown below.

Table 1. I-495 NEXT VISSIM Calibration Targets

Calibration Item	Basis	Criteria	Target
Simulated Traffic Volume (Intersections)	**By Intersection Approach**	Within ± 20% for <100 vph	At least 85% of all Intersection Approaches
		Within ± 15% for ≥ 100 vph to < 300 vph	
		Within ± 10% for ≥ 300 vph to < 1,000 vph	
		Within ± 5% for ≥ 1,000 vph	
Simulated Traffic Volume (Freeways)	**By Freeway Segment**	Within ± 20% for <100 vph	At least 85% of all Freeway Segments
		Within ± 15% for ≥ 100 vph to < 300 vph	
		Within ± 10% for ≥ 300 vph to < 1,000 vph	
		Within ± 5% for ≥ 1,000 vph	
Simulated Travel Time	**By Route**	Within ± 30% for average travel times on arterials	At least 85% of all Travel Time Routes (Including Segments)
		Within ± 20% for average travel times on freeways	
Maximum Simulated Queue Length	**By Approach for Targeted Critical Locations**	Modeled queues qualitatively reflect the impacts of observed queues	Qualitative Visual Match
Visual Review of Bottleneck Locations	**Targeted Critical Locations**	Speed heat maps qualitatively reflect patterns and duration of congestion	Qualitative Subjective Assessment

DEVIATIONS FROM TOSAM REQUIREMENTS

The following requirements from the TOSAM have been modified for the VISSIM calibration process for this project:

- Simulated Average Speed
- Simulated Queue Length

Details of the deviations are outlined in the approved I-495 NEXT Traffic Analysis Microsimulation Calibration Methodology memorandum.

Calibration Data Sources

Extensive traffic data collection occurred as part of this study. Data collection included intersection turning movement counts (TMC) and average daily traffic (ADT) counts. TMC data was collected during a 15-hour period on a weekday and ADT count data was collected over 3 consecutive days at each of the identified ramps, mainline interstate, and arterial count locations.

In addition, floating car travel times were collected for the northbound and southbound I-495 general purpose (GP) lanes and eastbound and westbound SR-267. The team collected 10 runs for each peak period. The travel time and volumes data were screened for poor and erroneous data points prior to use in the VISSIM model calibration process.

In addition to the data collected above, other data sources were used in the VISSIM model calibration effort:

- Existing signal timings were provided by VDOT.
- Channelization was based on high-resolution aerial images, Google Earth Street view, and field verification.
- Corridor congestion diagrams and speeds were compiled for the Study Corridor. Average vehicle speeds were obtained from the University of Maryland Center for Advanced Transportation Technology (CATT). Their website serves as a warehouse for data collected from INRIX which uses GPS probe vehicle data to determine average corridor speeds and travel times.

Seeding Period

The seeding period is the period the model requires for the network-wide volumes to become stable. The length of the seeding period depends on numerous network factors like the size of the network and level of congestion. A seeding step is needed to ensure that output data is not collected until the end of the seeding period is reached. If it is collected earlier, simulation measures (e.g., travel time and congestion) may be under-reported. The guidance from VDOT suggests that seeding time should be determined based on either the existing peak hour travel time to traverse between the farthest points of the study network in the peak direction of travel or twice the off-peak travel time between the network study limits.

The peak travel time for the AM is approximately 13 mins and the PM is 44 minutes. As a result, a seeding period of 30 mins was found to be adequate for the AM and 60 mins for the PM models.

Number of Model Runs

Given the stochastic nature of the microsimulation, VISSIM models need to be run with several different random seeds. The results need to be post-processed and averaged to determine the representative state of traffic operations in the study network. To obtain a statistically valid result, the number of runs necessary for the analysis were determined based on VDOT Sample Size Determination Tool as shown in the **Figure 4.**

Figure 4. VDOT Sample Size Determination Tool

VDOT Virginia Department of Transportation

Sample Size Determination Tool, Version 2.0

(pink)	User Inputs
(green)	Constants
(blue)	Outputs

Sample Size (N) = Number of Model Runs

Sample Mean $(X_s) = (1/N)\ (X_1 + X_2 + X_3 \ldots + X_N)$

Sample Standard Deviation $(S_s) = \sqrt{[(\Sigma(X-X_s)^2)/(N-1)]}$

Sampling Error = $Z\ (S_s/\sqrt{N})$

Confidence Level = $X_s \pm Z\ (S_s/\sqrt{N})$

% of Sample Mean (E) = % Tolerance * X_s

Sample Size Needed = $[(Z)^2 * (S_s)^2] / (E)^2$

Model Iterations

Measure of Effectiveness (MOE):	Speed
Confidence Interval:	95%
Tolerance Error:	10%
Number of Model Runs:	10

Run Number	*Speed*
1	11.11
2	11.53
3	10.78
4	11.37
5	10.86
6	11.15
7	11.12
8	11.28
9	10.57
10	11.12
11	
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Sample Size Outputs

N	=	10.0
X_s	=	11.1
S_s	=	0.3
E	=	1.1
Z	=	1.96

Sampling Error	=	0.18		
95% Confidence Interval	=	10.9	to	11.3
Percentage of Mean	=	1.60%		Good
Sample Size Needed	=	**10**		

Z is the number of standard deviations away from the mean corresponding to the required confidence level in a normal distribution.

Average link speed was identified as the MOE and up to two (2) different locations along I-495 northbound were chosen based on the locations where count data was collected. Following the steps of the VDOT Sample Size Determination Tool, as shown in **Figure 4**, it was determined that 10 runs were sufficient for all the scenarios. Therefore, the final results from the calibration models and the existing conditions models will be reported using the average of 10 simulation runs.

Calibration Parameters

Calibrating the AM and PM peak period I-495 corridor existing VISSIM models involved adjusting specific parameters to achieve the target volume, speeds, and travel time thresholds. The primary parameters that were adjusted included the following.

Speed Distributions: Typically, the VISSIM model was coded with a desired speed distribution set to match posted speed limits. Speed distributions were established that 85 percent of vehicles would travel at or above the posted speed limit, and the maximum speed for each distribution was capped to 10 mph above the posted speed limit.

In addition, the network termini operate at a very constrained condition during the PM peak periods, free-flow speeds at the roadway network termini were reduced to replicate the conditions observed. Free-flow speed reductions aid in replicating the stop-and-go traffic conditions that occur regularly beyond the edges of the roadway network used in the VISSIM microsimulation models. Modification of free-flow speeds at the edge of the network to help replicate downstream and upstream congestion is an industry-acceptable technique used in calibration of microsimulation models.

Lane Change Distances: Lane-change look-back distances is the distance in the VISSIM model where a vehicle will start attempting to make a lane change to a target lane prior to an off-ramp, a lane-drop, or change in direction in travel. This lane-change distance is a parameter on every connector in the VISSIM network, and its default change distance value is 656 feet. This distance is typically acceptable for low speed, intersection turning movements; however, it would provide extremely challenging lane changing behavior for freeway diverges and lane drops. As a starting point in the VISSIM model, the lane-change distance for diverges and lane drops was modified to match the first field observed way-finding sign. This distance is typically one mile upstream of an off-ramp. The parameter was then adjusted on a case by case basis at different locations with the goal of calibrating existing queues, speeds, and travel times within the study area.

Driver Behavior – Car-Following Adjustments: VISSIM incorporates two different car-following models – one for freeways and one for arterials. In combination with other operational parameters, analysts have the ability to adjust these parameters as needed to achieve desired flow conditions. In addition to other parameters, such as vehicle speed, heavy vehicle percentage, and number of lanes, the car-following parameters effectively change roadway capacity, vehicle spacing and headways.

The car-following parameters adjusted during the calibration process for freeways were modified based on previous experiences with similar type of networks and operations, engineering judgment, and field observations. They were typically adjusted if a field condition (i.e. poor vertical sight distance, narrow lateral clearances, etc.) warranted a change from VISSIM default parameters. From the list of car-following parameters that can be modified, three are the most sensitive for calibration:

- CC0 – Standstill Distance is defined as the desired distance between stopped cars. This parameter is typically used to increase or decrease vehicle spacing while vehicles are in queue and is used during calibration to affect queue duration and length. CC0 value was changed to range from 4.96 to 5.71.

- CC1 – Headway Time is not a direct measure of headway time but rather a factor that affects the following (minimum desired safety) distance. The higher this value, the more cautious the driver is; thus reducing capacity. In the case of high volumes, it is the following distance that has the strongest influence on capacity. Based on default VISSIM parameters (including CC1), the capacity of an urban freeway link is approximately 1900 vehicles/hour/lane (vphpl). CC1 was changed from 0.90 to values ranging from 0.8 to 1.25 seconds.

- CC2 – Following Variation is the longitudinal oscillation and how much more distance than the desired safety distance a driver allows before moving closer to the vehicle in front. CC2 value was changed to range from 13.12 to 17.00.

All the above changes are within the acceptable thresholds set forth in TOSAM.

***Driver Behavior – Lane-Change Adjustments*:** Another important parametric change focused on the lane-changing parameters. VISSIM includes parameters for necessary (in order to make a turning movement) and discretionary lane changes (for more room/higher speed). The lane-change parameters were modified from default values in order to achieve more realistic lane-change behavior in the model. Most of the model modifications occurred at high-volume merges. Three main parameters were changed, the maximum and accepted deceleration between the vehicle making a necessary lane change and the vehicle that vehicle is moving ahead of, the safety reduction factor, and the maximum deceleration rate for cooperative breaking.

Adjustments in the lane-change parameters were used to better replicate actual driver behavior under congested and severe weaving conditions in the simulation model. It is important to note that many of these changes are link specific to account for the variations in geometric and accompanying driver behaviors along the corridor. Furthermore, values may differ between the AM and PM peak hours since motorists will change their lane-change aggressiveness based on prevailing traffic conditions.

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Calibration Results

AM EXISTING MODEL

Travel Time Calibration Results

Travel times produced from the VISSIM model were compared to field measures based on the criteria described in previous sections. **Figure 5** and **Table 2** summarize the results for the following corridor segments:

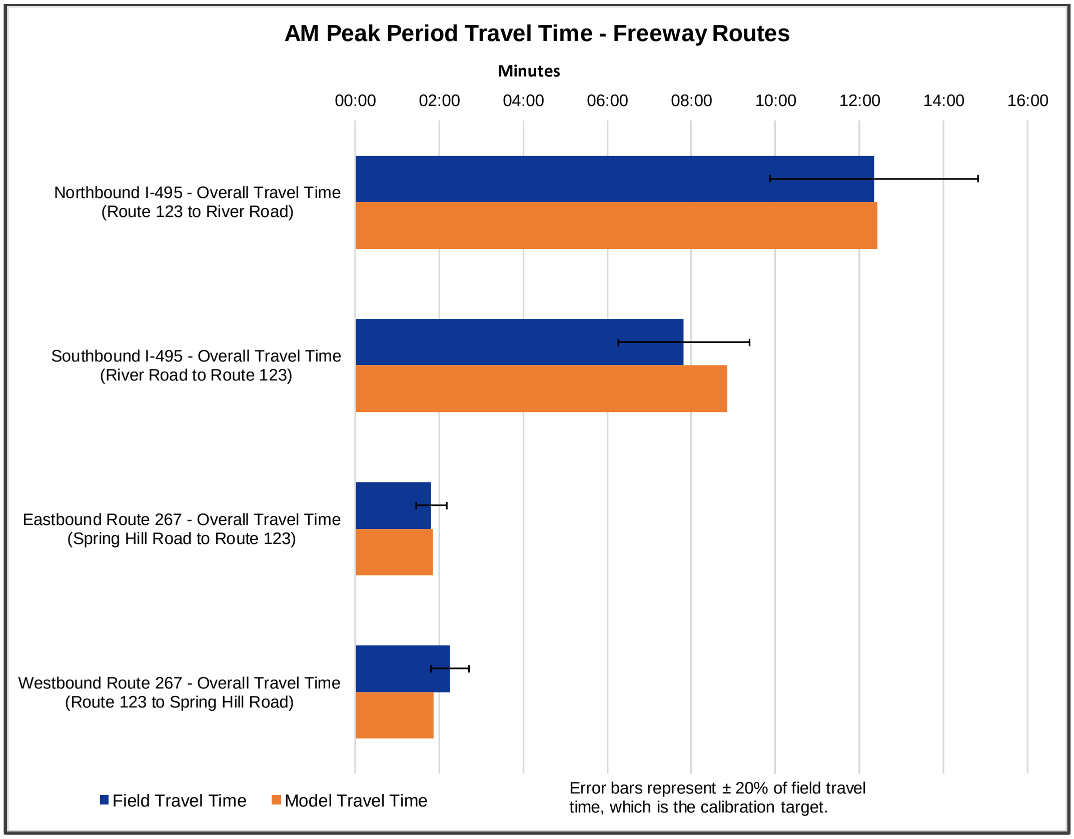
- I-495 NB: Rt. 123 to River Road
- I-495 SB: River Road to Rt. 123
- SR-267 EB: Spring Hill Road to Rt. 123
- SR-267: Rt. 123 to Spring Hill Road

In **Figure 5**, calibration targets are depicted with high-low bars on field travel-time measures. As shown in this figure and on **Table 2**, calibration targets are met for 92 percent of the segments. The travel time for the entire northbound I-495 corridor is within 5 percent of the field travel times and similarly for southbound I-495 is within 1 percent. Detailed travel time results for each of the sub-segment is provided in Attachment A.

Table 2. Existing AM - Summary of Travel Time Calibration

	Travel Time Criteria	Subtotal	Total	Percent	Target	Target Met
Routes (n = 25)	Within ± 30% for average travel time on arterials	0	23	92%	85%	Yes
	Within ± 20% for average travel times on freeways	23				

Figure 5. Existing AM - Travel Time Results



VOLUME CALIBRATION RESULTS

Throughput volumes produced by the VISSIM model were compared to balanced traffic counts based on the criteria described in previous section. **Table 3** summarizes the comparison based on volume criteria for northbound and southbound I-495 and for eastbound and westbound Route 267. The results are grouped by freeway mainline segments and ramps. **Table 4** includes comparison results for all arterial approaches within the study area. In the northbound direction, there are segments which do not meet the targets; however, for the overall, 90 percent of the segments meet the criteria. The target was to meet the criteria for 85 percent of the mainline segments and ramps. The model matches to the target. Also, as seen in **Table 4** below, 92 percent of the intersection approaches meet the target of 85 percent criteria. Attachment A provides the freeway segments, ramps and intersection demand and throughput comparison.

Table 3. Existing AM - Summary of Freeway/Ramp Volume Calibration

	Volume Criteria	Subtotal	Total	Percent	Target	Target Met
Segments (n = 142)	Within ± 20% for < 100 vph	3	129	90%	85%	Yes
	Within ± 15% for ≥ 100 vph to < 300 vph	16				
	Within ± 10% for ≥ 300 vph to < 1,000 vph	40				
	Within ± 5% for ≥ 1,000 vph	69				

Table 4. Existing AM - Summary of Arterial Volume Calibration

	Volume Criteria	Subtotal	Total	Percent	Target	Target Met
Approaches (n = 66)	Within ± 20% for < 100 vph	3	61	92%	85%	Yes
	Within ± 15% for ≥ 100 vph to < 300 vph	10				
	Within ± 10% for ≥ 300 vph to < 1,000 vph	34				
	Within ± 5% for ≥ 1,000 vph	14				

BOTTLENECK LOCATIONS, LENGTH AND DURATION OF BACKUPS

Comparison of INRIX data with travel speeds measured in the model every half mile provided a very useful way for checking bottleneck locations as well as the extent and temporal distribution of mainline queues and overall congestion. **Figure 6** depicts the "heat" diagrams for the entire corridor for the northbound and southbound I-495 in the AM period. As shown, there is a very reasonable match between INRIX and VISSIM results. It is important to note, that while this comparison provides a powerful way of checking the general validity of the model, other measures such as travel time and volumes are significantly more reliable and were given higher priority in the calibration process. Nevertheless, the results for the AM model are reasonably close to what is observed from INRIX data in terms of specific bottleneck locations, length, and duration of backups.

Simulated Queue Length

As noted earlier, queuing within the study area is notably inconsistent and can oscillate numerous times within the peak periods, or be absent altogether on some days. As outlined in the I-495 NEXT Calibration Memorandum a qualitative subjective assessment was conducted for queue lengths at targeted locations in addition to the review of freeway mainline congestion/queues against the speed heat maps as shown above. Based on the VISSIM results the modeled queues qualitatively reflect the impacts of observed queues at most of the locations that were identified.

Figure 6: Speed Diagrams – Comparison of INRIX Data and VISSIM Results – AM Period

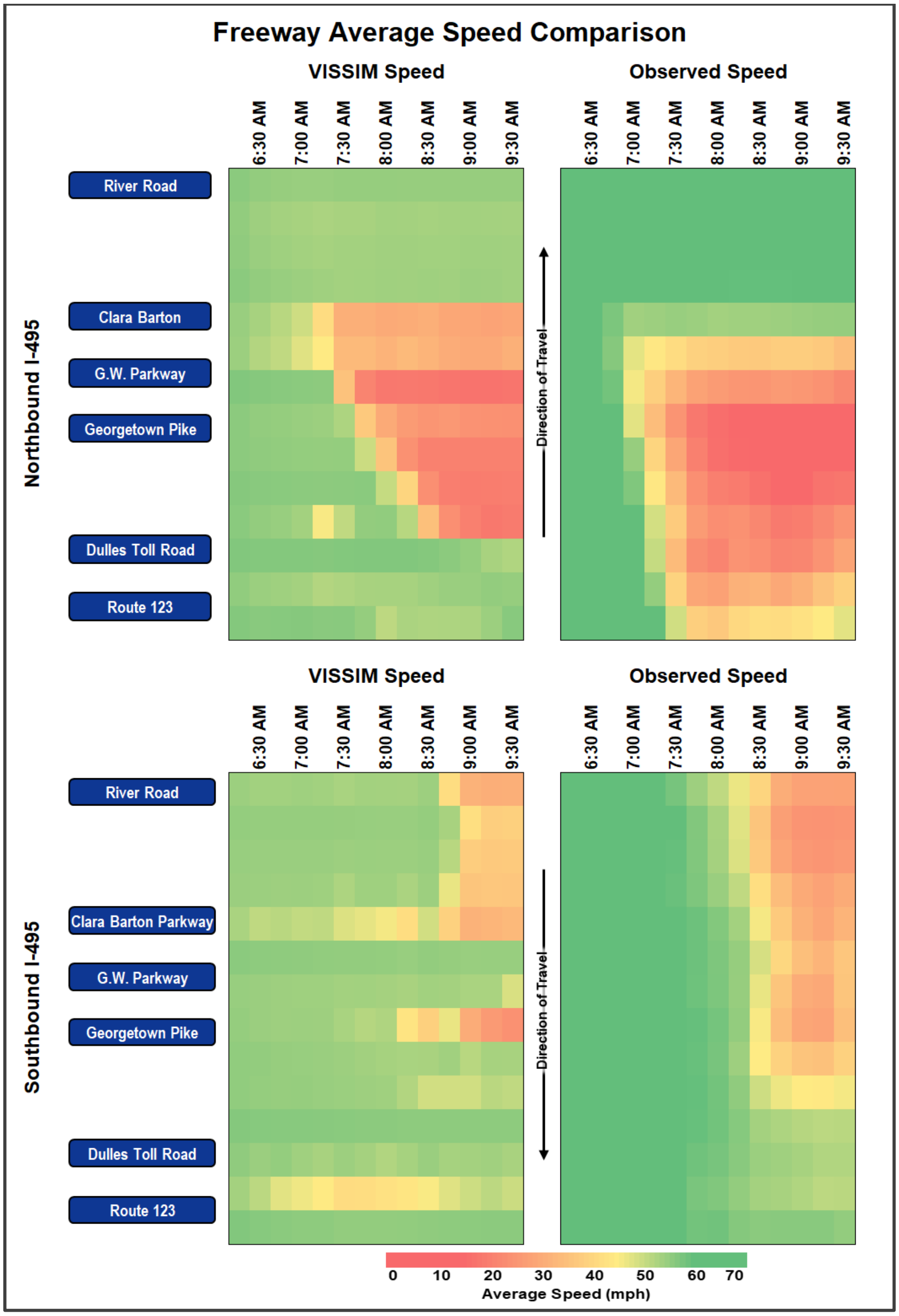


Table 5. Existing AM - Summary of Queue Length Calibration

	Queue Criteria	Total	Percent	Target	Target Met
Approaches (n = 12)	Modeled queues qualitatively reflect the impacts of observed queues (e.g., spillback from ramp intersections, turn bay, or downstream intersection)	10	83%	85%	No

PM EXISTING MODEL

Travel Time Calibration Results

Travel times produced from the VISSIM model were compared to field measures based on the criteria described in previous sections. **Figure 7** and **Table 5** summarize the results for the following corridor segments:

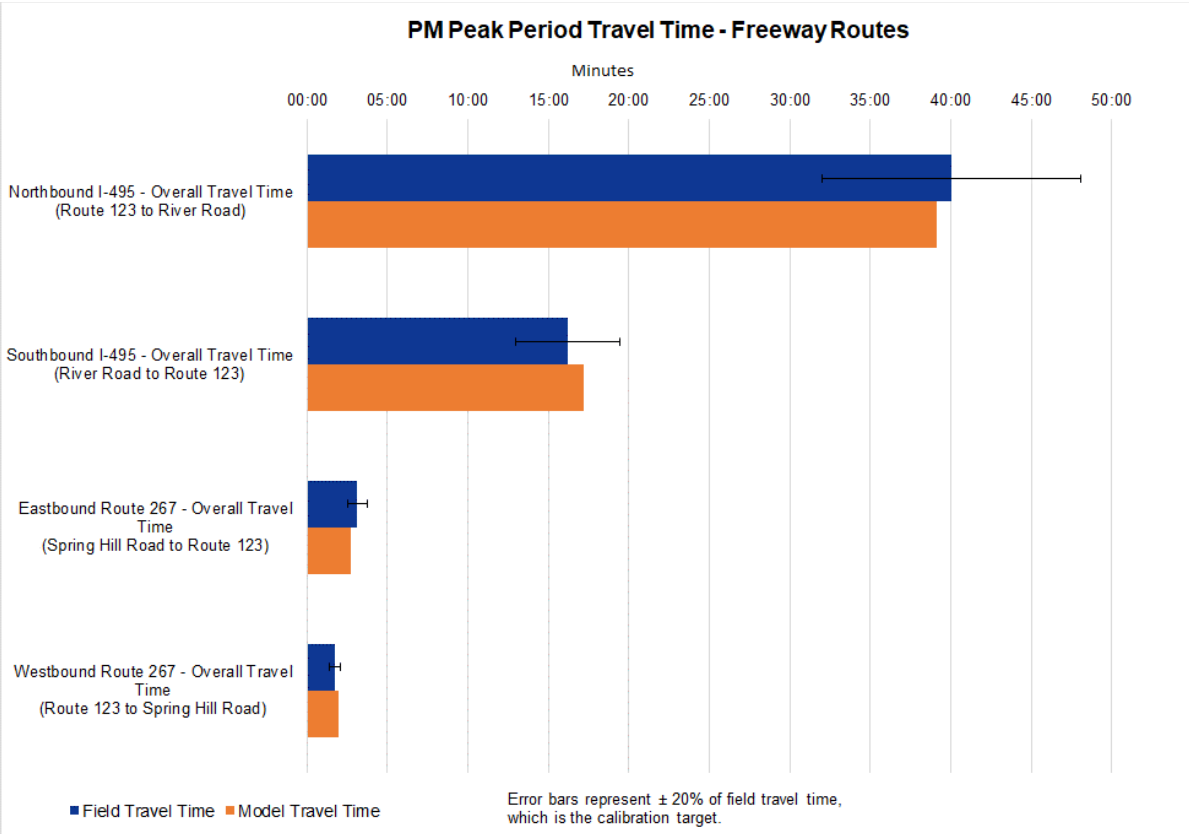
- I-495 NB: Rt. 123 to River Road
- I-495 SB: River Road to Rt. 123
- SR-267 EB: Spring Hill Road to Rt. 123
- SR-267: Rt. 123 to Spring Hill Road

As shown in **Figure 7** and on **Table 6**, calibration targets are met for 92 percent of the segments. The travel time for the entire northbound I-495 corridor is within 2 percent of the field travel times and similarly for southbound I-495 is within 6 percent. Detailed travel time results for each of the sub-segment is provided in Attachment B.

Table 6. Existing PM - Summary of Travel Time Calibration

	Travel Time Criteria	Subtotal	Total	Percent	Target	Target Met
Routes (n = 25)	Within ± 30% for average travel time on arterials	0	23	92%	85%	Yes
	Within ± 20% for average travel times on freeways	23				

Figure 7. Existing PM - Travel Time Results



VOLUME CALIBRATION RESULTS

Throughput volumes produced by the VISSIM model were compared to balanced traffic counts based on the criteria described in previous section. **Table 7** summarizes the comparison based on volume criteria for northbound and southbound I-495 and for eastbound and westbound Route 267. The results are grouped by freeway mainline segments and ramps. **Table 8** includes comparison results for all arterial approaches within the study area.

In the northbound and southbound direction, there are few segments which do not meet the targets; however, for the overall, 88 percent of the segments meet the criteria. The target was to meet the criteria for 85 percent of the mainline segments and ramps. The model matches to the target. Also, as seen in **Table 7** below, 83 percent of the intersection approaches meet the target of 85 percent criteria. Although the intersection approaches do not meet the criteria, some of the approaches are very close to meeting the target.

Attachment B provides the freeway segments, ramps and intersection demand and throughput comparison.

Table 7. Existing PM - Summary of Freeway/Ramp Volume Calibration

	Volume Criteria	Subtotal	Total	Percent	Target	Target Met
Segments (n = 142)	Within ± 20% for < 100 vph	9	125	88%	85%	Yes
	Within ± 15% for ≥ 100 vph to < 300 vph	9				
	Within ± 10% for ≥ 300 vph to < 1,000 vph	30				
	Within ± 5% for ≥ 1,000 vph	77				

Table 8. Existing PM - Summary of Arterial Volume Calibration

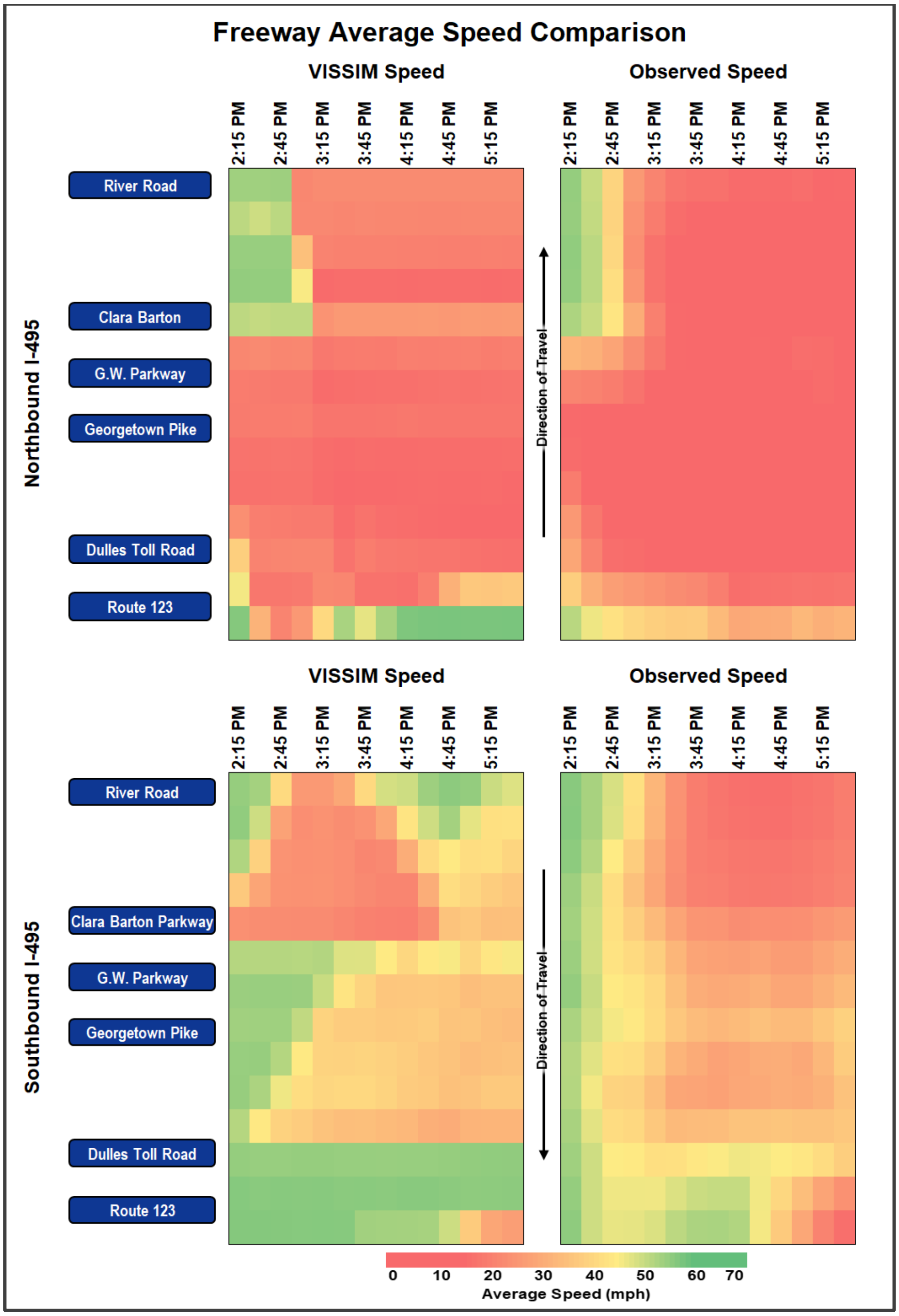
	Volume Criteria	Subtotal	Total	Percent	Target	Target Met
Approaches (n = 66)	Within ± 20% for < 100 vph	6	55	83%	85%	No
	Within ± 15% for ≥ 100 vph to < 300 vph	9				
	Within ± 10% for ≥ 300 vph to < 1,000 vph	28				
	Within ± 5% for ≥ 1,000 vph	12				

BOTTLENECK LOCATIONS, LENGTH AND DURATION OF BACKUPS

Comparison of INRIX data with travel speeds measured in the model every half mile provided a very useful way for checking bottleneck locations as well as the extent and temporal distribution of mainline queues and overall congestion. **Figure 8** depicts the "heat" diagrams for the entire corridor for the northbound and southbound I-495 in the PM period. As shown, there is a very reasonable match between INRIX and VISSIM results. It is important to note, that while this comparison provides a powerful way of checking the general validity of the model, other measures such as travel time and volumes are significantly more reliable and were given higher priority in the calibration process. Nevertheless, the results for the PM model are reasonably close to what is observed from INRIX data in terms of specific bottleneck locations, length, and duration of backups.

Vehicles traveling in the Northbound direction on I-495 during the PM peak period experience significant congestion. There are two bottlenecks or points of congestion in the Northbound direction. The first congestion spot stemming outside of the project area and the second location is near the George Washington Parkway. Heavy volumes from George Washington Parkway, Georgetown Pike and the lane drop on the left all happening in the proximity creates a friction. This congestion causes speeds as low as 15MPH with congestion spilling back to Route 123 interchange. As seen in **Figure 8** both the congestion spots have been captured in the model.

Figure 8: Speed Diagrams – Comparison of INRIX Data and VISSIM Results – PM Period



Simulated Queue Length

As noted earlier, queuing within the study area is notably inconsistent and can oscillate numerous times within the peak periods or be absent altogether on some days. As outlined in the I-495 NEXT Calibration Memorandum a qualitative subjective assessment was conducted for queue lengths at targeted locations in addition to the review of freeway mainline congestion/queues against the speed heat maps as shown above. Based on the VISSIM results, as shown in **Table 9** the modeled queues qualitatively reflect the impacts of observed queues at the 11 segments, out of 12 segments that were identified. **Attachment B** provides the comparison for all the targeted locations.

Table 9. Existing PM - Summary of Queue Length Calibration

	Queue Criteria	Total	Percent	Target	Target Met
Approaches (n = 12)	Modeled queues qualitatively reflect the impacts of observed queues (e.g., spillback from ramp intersections, turn bay, or downstream intersection)	11	92%	85%	Yes

CONCLUSION

Based on the results obtained from the VISSIM AM and PM model and their comparison with field data for all the calibration measures listed in previous sections, the Consultant Team concludes that the models are reasonably calibrated to the standards and guidelines established by VDOT and, therefore, this model can be used as base model to develop future scenarios.

Table 10: I-495 NEXT - AM Peak Period Calibration Summary

Calibration Item	Basis	Criteria	Total	Percent	Target	Target Met
Simulated Traffic Volume (Intersections)	**Approaches (n = 66)**	Within ± 20% for <100 vph Within ± 15% for ≥ 100 vph to < 300 vph Within ± 10% for ≥ 300 vph to < 1,000 vph Within ± 5% for ≥ 1,000 vph	61	92%	85%	Yes
Simulated Traffic Volume (Freeways)	**Segments (n = 142)**	Within ± 20% for <100 vph Within ± 15% for ≥ 100 vph to < 300 vph Within ± 10% for ≥ 300 vph to < 1,000 vph Within ± 5% for ≥ 1,000 vph	1298	90%	85%	Yes
Simulated Travel Time	**Routes (n = 25)**	Within ± 30% for average travel time on arterials Within ± 20% for average travel times on freeways	23	92%	85%	Yes
Maximum Simulated Queue Length	**Approaches**	Modeled queues qualitatively reflect the impacts of observed queues				Reasonably Calibrated
Visual Review of Bottleneck Locations	**Targeted Critical Locations**	Speed heat maps qualitatively reflect patterns and duration of congestions				Reasonably Calibrated

Table 11: I-495 NEXT - PM Peak Period Calibration Summary

Calibration Item	Basis	Criteria	Total	Percent	Target	Target Met
Simulated Traffic Volume (Intersections)	Approaches (n = 66)	Within ± 20% for <100 vph Within ± 15% for ≥ 100 vph to < 300 vph Within ± 10% for ≥ 300 vph to < 1,000 vph Within ± 5% for ≥ 1,000 vph	55	83%	85%	No
Simulated Traffic Volume (Freeways)	Segments (n = 142)	Within ± 20% for <100 vph Within ± 15% for ≥ 100 vph to < 300 vph Within ± 10% for ≥ 300 vph to < 1,000 vph Within ± 5% for ≥ 1,000 vph	125	88%	85%	Yes
Simulated Travel Time	Routes (n = 25)	Within ± 30% for average travel time on arterials Within ± 20% for average travel times on freeways	23	92%	85%	Yes
Maximum Simulated Queue Length	Approaches	Modeled queues qualitatively reflect the impacts of observed queues				Reasonably Calibrated
Visual Review of Bottleneck Locations	Targeted Critical Locations	Speed heat maps qualitatively reflect patterns and duration of congestions				Reasonably Calibrated

AM Peak Period Calibration Summary

Calibration Item	Basis	Criteria	Total	Percent	Target	Target Met
Simulated Traffic Volume (Intersections)	**Approaches (n = 66)**	Within ± 20% for <100 vph Within ± 15% for ≥ 100 vph to < 300 vph Within ± 10% for ≥ 300 vph to < 1,000 vph Within ± 5% for ≥ 1,000 vph	61	92%	85%	Yes
Simulated Traffic Volume (Freeways)	**Segments (n = 142)**	Within ± 20% for <100 vph Within ± 15% for ≥ 100 vph to < 300 vph Within ± 10% for ≥ 300 vph to < 1,000 vph Within ± 5% for ≥ 1,000 vph	128	90%	85%	Yes
Simulated Travel Time	**Routes (n = 25)**	Within ± 30% for average travel time on arterials Within ± 20% for average travel times on freeways	23	92%	85%	Yes
Maximum Simulated Queue Length	**Approaches (n = 18)**	Modeled queues qualitatively reflect the impacts of observed queues				Reasonably Calibrated
Visual Review of Bottleneck Locations	**Targeted Critical Locations**	Speed heat maps qualitatively reflect patterns and duration of congestions				Reasonably Calibrated

* Deviation from TOSAM Requirements

1. Simulated Average Speed – Speeds are highly variable on the interstate mainline as well as on the local arterial network and residential roadways, and can vary substantially by hour and by day. Simulated average speed was captured as part of the travel time calibration process and the visual review of bottleneck locations against speed heat maps.

2. Simulated Queue Length – Queuing within the study area is notably inconsistent and can oscillate numerous times within the peak periods, or be absent altogether on some days. A qualitative subjective assessment was conducted for queue lengths at targeted locations in addition to the review of freeway mainline congestion/queues against the speed heat maps.

Travel Time Calibration

AM Peak Period (6:45-9:45 AM)

	Travel Time Criteria	Subtotal	Total	Percent	Target	Target Met
Routes (n = 25)	Within ± 30% for average travel time on arterials	0	23	92%	85%	Yes
	Within ± 20% for average travel times on freeways	23				

Segment ID	Route	Peak Period Travel Time			
		Field (MM:SS)	VISSIM (MM:SS)	Difference (MM:SS)	Difference (%)
Freeway Routes					
1000	**Northbound I-495 - Overall Travel Time (Route 123 to River Road)**	**12:21**	**12:57**	**00:36**	**5%**
1001	Route 123 to Dulles Toll Road	00:51	00:51	-00:00	0%
1002	Dulles Toll Road to Lewinsville Road	00:34	00:45	00:12	35%
1003	Lewinsville Road to Old Dominion Drive	01:34	01:52	00:19	20%
1004	Old Dominion Drive to Georgetown Pike	02:27	02:27	00:00	0%
1005	Georgetown Pike to George Washington Memorial Parkway	03:00	03:18	00:17	10%
1006	George Washington Memorial Parkway to Clara Barton Parkway	01:37	01:37	-00:00	0%
1007	Clara Barton Parkway to River Road	02:19	02:08	-00:11	-8%
3000	**Southbound I-495 - Overall Travel Time (River Road to Route 123)**	**07:50**	**07:47**	**-00:03**	**-1%**
3003	River Road to Clara Barton Parkway	02:20	02:32	00:12	8%
3004	Clara Barton Parkway to George Washington Memorial Parkway	01:02	01:00	-00:02	-3%
3005	George Washington Memorial Parkway to Georgetown Pike	01:28	01:15	-00:12	-14%
3006	Georgetown Pike to Old Dominion Drive	01:01	00:55	-00:06	-9%
3007	Old Dominion Drive to Lewinsville Road	00:51	00:50	-00:01	-2%
3008	Lewinsville Road to Dulles Toll Road	00:25	00:23	-00:02	-7%
3009	Dulles Toll Road to Route 123	00:44	00:51	00:08	18%

AM Travel Time Calibration

Segment ID	Route	Peak Period Travel Time			
		Field (MM:SS)	VISSIM (MM:SS)	Difference (MM:SS)	Difference (%)
Freeway Routes					
6000	**Eastbound Route 267 - Overall Travel Time (Spring Hill Road to Route 123)**	**01:56**	**02:11**	**00:15**	**13%**
6001	Spring Hill Road to I-495	01:16	01:28	00:12	16%
6002	I-495 to Route 123	00:40	00:43	00:03	7%
9000	**Westbound Route 267 - Overall Travel Time**	**02:15**	**01:52**	**-00:23**	**-17%**
9001	Route 123 to I-495	00:38	00:30	-00:08	-20%
9002	I-495 to Spring Hill Road	01:37	01:22	-00:15	-16%
2000	**Northbound I-495 to Westbound Route 267 (Route 123 to Spring Hill Road)**	**02:02**	**02:10**	**00:08**	**6%**
2001	Route 123 to Dulles Toll Road Ramp	00:47	00:51	00:04	8%
2002	Dulles Toll Road Ramp to Spring Hill Road	01:15	01:19	00:04	5%

Volume Calibration (Freeways)

AM Peak Hour (7:45-8:45 AM)

	Volume Criteria	Subtotal	Total	Percent	Target	Target Met
Segments (n = 142)	Within ± 20% for < 100 vph	3	128	90%	85%	Yes
	Within ± 15% for ≥ 100 vph to < 300 vph	16				
	Within ± 10% for ≥ 300 vph to < 1,000 vph	40				
	Within ± 5% for ≥ 1,000 vph	69				

Interchange	Segment	Type	Balanced Count (vph)	VISSIM Through-put (vph)	Difference (vph)	Difference (%)
NORTHBOUND I-495						
Route 123	Upstream	Weave	6,340	6,640	300	5%
	Off-ramp to NB Route 123	Ramp	1,100	1,093	-7	-1%
	Between Ramps	Basic	5,240	5,505	265	5%
	On-ramp from NB Route 123	Ramp	490	473	-17	-3%
	Between Ramps	Weave	5,730	5,958	228	4%
	Off-ramp to SB Route 123	Ramp	1,370	1,352	-18	-1%
	Between Ramps	Basic	4,360	4,655	295	7%
	On-ramp from SB Route 123	Ramp	290	285	-5	-2%
	Downstream	Merge	4,650	4,921	271	6%
I-495 between Route 123 and Dulles Toll Road		Basic	4,650	4,806	156	3%
Dulles Toll Road	Upstream	Diverge	4,650	4,942	292	6%
	Off-ramp to WB Dulles Toll Road	Ramp	890	894	4	0%
	Between Ramps	Basic	3,760	4,006	246	7%
	On-ramp from EB Dulles Toll Road	Ramp	1,670	1,699	29	2%
	Between Ramps	Merge	5,430	5,640	210	4%
	On-ramp from WB Dulles Toll Road	Ramp	540	529	-11	-2%
	Downstream	Merge	5,970	6,026	56	1%
I-495 between Dulles Toll Road and Georgetown Pike		Basic	7,070	6,975	-95	-1%
Georgetown Pike	Upstream	Diverge	7,070	6,790	-280	-4%
	Off-ramp to Georgetown Pike	Ramp	420	403	-17	-4%
	Between Ramps	Basic	6,650	6,314	-336	-5%
	On-ramp from Georgetown Pike	Ramp	1,230	1,191	-39	-3%
I-495 between Georgetown Pike and George Washington Memorial Parkway		Weave	7,880	7,420	-460	-6%
George Washington Memorial	Off-ramp to G.W. Memorial Parkway	Ramp	760	715	-45	-6%
	Between Ramps	Basic	7,120	6,697	-423	-6%
	On-ramp from G.W. Memorial Parkway	Ramp	1,470	1,487	17	1%
I-495 between George Washington Memorial Parkway and Clara Barton Parkway		Weave	8,590	8,183	-407	-5%
Clara Barton Parkway	Off-ramp to Clara Barton Parkway	Ramp	830	751	-79	-9%
	Off-ramp to EB Clara Barton Parkway	Ramp	540	493	-47	-9%
	Off-ramp to WB Clara Barton Parkway	Ramp	290	269	-21	-7%
	Between Ramps	Basic	7,760	7,414	-346	-4%
	On-ramp from WB Clara Barton Parkway	Ramp	110	110	0	0%
	Downstream	Merge	7,870	7,498	-372	-5%
I-495 between Clara Barton Parkway and River Road		Basic	7,870	7,531	-339	-4%

AM Volume Calibration (Freeways)

Interchange	Segment	Type	Balanced Count (vph)	VISSIM Through-put (vph)	Difference (vph)	Difference (%)
NORTHBOUND I-495 EXPRESS LANES						
Westpark Drive	Upstream	Diverge	1,990	1,964	-26	-1%
	Off-ramp to Westpark Drive	Ramp	520	506	-14	-3%
	Between Ramps	Basic	1,470	1,469	-1	0%
	On-ramp from Westpark Drive	Ramp	160	158	-2	-1%
I-495 Express Lanes between Westpark Drive and Jones Branch Connector		Weave	1,630	1,620	-10	-1%
Jones Branch Drive/Dulles Toll Road	Off-ramp to Jones Branch Connector	Ramp	200	195	-5	-3%
	Between Ramps	Diverge	1,430	1,416	-14	-1%
	Off-Ramp to WB Dulles Toll Road	Ramp	500	499	-1	0%
	Between Ramps	Basic	930	923	-7	-1%
	On-ramp from Jones Branch Connector	Ramp	170	166	-4	-2%
	Downstream	Merge	1,100	1,082	-18	-2%
I-495 Express Lanes End		Basic	1,100	1,085	-15	-1%
SOUTHBOUND I-495						
I-495 between River Road and Clara Barton Parkway		Basic	7,760	8,050	290	4%
Clara Barton Parkway	Off-ramp to WB Clara Barton Parkway	Ramp	140	142	2	1%
	Between Ramps	Basic	7,620	7,910	290	4%
	On-ramp to WB Clara Barton Parkway	Ramp	460	457	-3	-1%
	On-ramp from EB Clara Barton Parkway	Ramp	620	617	-3	0%
	On-ramp from Clara Barton Parkway	Ramp	1,080	1,077	-3	0%
I-495 between Clara Barton Parkway and George Washington Memorial Parkway		Weave	8,700	8,998	298	3%
George Washington Memorial Parkway/ Georgetown Pike	Off-ramp to C-D Road	Ramp	2,210	2,285	75	3%
	Off-ramp to G.W. Memorial Parkway	Ramp	1,150	1,183	33	3%
	Between Ramps (C-D)	Basic	1,060	1,112	52	5%
	On-ramp from G.W. Memorial Parkway	Ramp	585	444	-141	-24%
	Between Ramps (C-D)	Weave	1,645	1,549	-96	-6%
	Off-ramp to Georgetown Pike	Ramp	775	623	-152	-20%
	Between Ramp (Mainline)	Basic	6,490	6,718	228	4%
	On-Ramp from C-D Road	Ramp	890	930	40	4%
	Between Ramps	Merge	7,380	7,612	232	3%
	On-ramp from Georgetown Pike	Ramp	370	348	-22	-6%
	Downstream	Merge	7,750	7,938	188	2%
I-495 between Georgetown Pike and Dulles Toll Road		Diverge	7,750	7,966	216	3%
Dulles Toll Road	Upstream	Diverge	7,230	7,397	167	2%
	Off-ramp to WB Dulles Toll Road	Ramp	1,930	1,955	25	1%
	Between Ramps	Diverge	5,300	5,458	158	3%
	Off-ramp to EB Dulles Toll Road	Ramp	330	334	4	1%
	Between Ramps	Basic	4,970	5,105	135	3%
	On-ramp from EB Dulles Toll Road	Ramp	1,190	1,119	-71	-6%
I-495 between Dulles Toll Road and Route 123		Weave	6,160	6,232	72	1%
Route 123	Off-ramp to SB Route 123	Ramp	910	959	49	5%
	Between Ramps	Basic	5,250	5,339	89	2%
	On-ramp from SB Route 123	Ramp	490	484	-6	-1%
	Between Ramps	Weave	5,740	5,805	65	1%
	Off-ramp to NB Route 123	Ramp	380	397	17	5%
	Between Ramps	Basic	5,360	5,436	76	1%
	On-ramp from NB Route 123	Ramp	530	514	-16	-3%
	Downstream	Weave	5,890	5,968	78	1%

AM Volume Calibration (Freeways)

Interchange	Segment	Type	Balanced Count (vph)	VISSIM Through-put (vph)	Difference (vph)	Difference (%)
SOUTHBOUND I-495 EXPRESS LANES						
Dulles Toll Road/Jones Branch Drive	Upstream	Diverge	520	548	28	5%
	Off-ramp to EB Dulles Toll Road	Ramp	10	9	-1	-9%
	Between Ramps	Diverge	510	540	30	6%
	Off-ramp to Jones Branch Connector	Ramp	310	327	17	6%
	Between Ramps	Basic	200	211	11	6%
	On-ramp from Jones Branch Connector	Ramp	20	20	0	0%
	Between Ramps	Merge	220	226	6	3%
	On-ramp from EB Dulles Toll Road	Ramp	770	772	2	0%
I-495 between Dulles Toll Road and Westpark Drive		Weave	990	996	6	1%
Westpark Drive	Off-ramp to Westpark Drive	Ramp	310	319	9	3%
	Between Ramps	Basic	680	689	9	1%
	On-ramp from Westpark Drive	Ramp	20	25	5	26%
	Downstream	Merge	700	706	6	1%
EASTBOUND DULLES TOLL ROAD						
Spring Hill Road	Upstream	Diverge	5,810	5,779	-31	-1%
	Off-ramp to Spring Hill Road	Ramp	1,450	1,365	-85	-6%
	Between Ramps	Basic	4,360	4,376	16	0%
	On-ramp from Dulles Access Road	Ramp	150	153	3	2%
	Between Ramps	Merge	4,510	4,535	25	1%
	On-ramp from Spring Hill Road	Ramp	200	202	2	1%
Dulles Toll Road between Spring Hill Road and I-495		Weave	4,710	4,747	37	1%
I-495	Off-ramp to SB I-495	Ramp	1,680	1,689	9	1%
	Between Ramps	Diverge	3,030	3,043	13	0%
	Off-ramp to NB I-495	Ramp	1,300	1,306	6	0%
	Between Ramps	Basic	1,730	1,753	23	1%
	On-ramp from SB I-495	Ramp	See above - Southbound I-495			
Dulles Toll Road Between I-495 and Route 123		Weave	2,060	2,054	-6	0%
Route 123	Off-ramp to SB Route 123	Ramp	720	728	8	1%
	Between Ramps	Basic	1,340	1,349	9	1%
	On-ramp from SB Route 123	Ramp	60	57	-3	-4%
	Between Ramps	Weave	1,400	1,408	8	1%
	Off-ramp to NB Route 123	Ramp	790	765	-25	-3%
	Between Ramps	Basic	610	629	19	3%
	On-ramp to NB Route 123	Ramp	170	167	-3	-2%
	Between Ramps	Merge	780	785	5	1%
	On-ramp from Dulles Access Road	Ramp	560	557	-3	-1%
	Downstream	Merge	1,340	1,332	-8	-1%
EASTBOUND DULLES ACCESS ROAD						
Spring Hill Road	Upstream	Diverge	1,360	1,344	-16	-1%
	Off-ramp to Dulles Toll Road	Ramp	See above - Eastbound Dulles Toll Road			
	Downstream	Basic	1,210	1,205	-5	0%
I-495	Upstream	Diverge	1,210	1,208	-2	0%
	Off-ramp to I-495	Ramp	650	645	-5	-1%
	Off-ramp to SB I-495	Ramp	280	278	-2	-1%
	Off-ramp to NB I-495	Ramp	370	373	3	1%
	Downstream	Basic	See above - Eastbound Dulles Toll Road			

AM Volume Calibration (Freeways)

Interchange	Segment	Type	Balanced Count (vph)	VISSIM Through-put (vph)	Difference (vph)	Difference (%)
WESTBOUND DULLES TOLL ROAD						
Route 123	Upstream	Diverge	3,420	3,413	-7	0%
	Off-ramp to Dulles Access Road	Ramp	250	249	-1	0%
	Between Ramps	Diverge	3,170	3,140	-30	-1%
	Off-ramp to NB Route 123	Ramp	270	273	3	1%
	Between Ramps	Diverge	2,900	2,847	-53	-2%
	Off-ramp to SB Route 123	Ramp	800	795	-5	-1%
	Between Ramps	Basic	2,100	2,072	-28	-1%
	On-ramp from SB Route 123	Ramp	540	529	-11	-2%
Dulles Toll Road between Route 123 and I-495		Weave	2,640	2,597	-43	-2%
I-495	Off-ramp to NB I-495	Ramp	See above - Northbound I-495			
	Between Ramps	Basic	2,100	2,080	-20	-1%
	On-ramp from NB I-495	Ramp	See above - Northbound I-495			
	Between Ramps	Basic	2,990	2,936	-54	-2%
	On-ramp form SB I-495	Ramp	See above - Southbound I-495			
	Between Ramps	Merge	4,920	4,882	-38	-1%
	On-ramp from I-495 Express Lanes	Ramp	510	504	-6	-1%
Dulles Toll Road between I-495 and Spring Hill Road		Weave	5,430	5,406	-24	0%
Spring Hill Road	Off-ramp to Dulles Access Road	Ramp	570	574	4	1%
	Between Ramps	Diverge	4,860	4,619	-241	-5%
	Off-ramp to Spring Hill Road	Ramp	500	498	-2	0%
	Between Ramps	Basic	4,360	4,354	-6	0%
	On-ramp from Spring Hill Road	Ramp	160	160	0	0%
	Downstream	Merge	4,520	4,414	-106	-2%
WESTBOUND DULLES ACCESS ROAD						
Spring Hill Road	Upstream	Basic	See above - Westbound Dulles Toll Road			
	On-ramp from Dulles Toll Road	Ramp	See above - Westbound Dulles Toll Road			
	Downstream	Merge	820	815	-5	-1%

Volume Calibration (Intersections)

AM Peak Hour (7:45-8:45 AM)

	Volume Criteria	Subtotal	Total	Percent	Target	Target Met
Approaches (n = 66)	Within ± 20% for < 100 vph	3	61	92%	85%	Yes
	Within ± 15% for ≥ 100 vph to < 300 vph	10				
	Within ± 10% for ≥ 300 vph to < 1,000 vph	34				
	Within ± 5% for ≥ 1,000 vph	14				

#	Intersection	Approach	Movement	Balanced Count (vph)		VISSIM Throughput (vph)		Difference (vph)		Difference (%)	
6	Route 123 and Tysons Boulevard	NB	LT	105	2,030	100	2,002	-5	-28	-5%	-1%
			TH	1,715		1,699		-16		-1%	
			RT	210		203		-7		-3%	
		SB	LT	150	4,025	149	4,022	-1	-3	-1%	0%
			TH	1,910		1,917		7		0%	
			RT	1,965		1,956		-9		0%	
		EB	LT	530	650	526	662	-4	12	-1%	2%
			RT	120		136		16		13%	
		WB	LT	65	375	64	374	-1	-1	-2%	0%
			RT	310		310		0		0%	
		Intersection		7,080		7,060		-20		0%	
4	Westpark Drive and Tysons Connector	NB	TH	485	610	477	602	-8	-8	-2%	-1%
			RT	125		125		0		0%	
		SB	LT	55	280	59	283	4	3	7%	1%
			TH	225		224		-1		0%	
		WB	LT	340	830	343	830	3	0	1%	0%
			RT	490		487		-3		-1%	
		Intersection		1,720		1,715		-5		0%	
5	Tysons Connector and Express Lanes Ramps	NB	LT	520	520	517	517	-3	-3	-1%	-1%
		SB	RT	310	310	319	319	9	9	3%	3%
		EB	LT	160	180	158	183	-2	3	-1%	2%
			RT	20		25		5		25%	
		Intersection		1,010		1,019		9		1%	
7	Route 123 and Capital One Tower Drive/ Old Meadow Road	NB	LT	350	3,015	300	2,990	-50	-25	-14%	-1%
			TH	2,155		2,182		27		1%	
			RT	510		508		-2		0%	
		SB	LT	110	2,485	95	2,463	-15	-22	-14%	-1%
			TH	2,105		2,091		-14		-1%	
			RT	270		277		7		3%	
		EB	LT	20	120	19	106	-1	-14	-5%	-12%
			RT	100		87		-13		-13%	
		WB	LT	320	465	316	468	-4	3	-1%	1%
			TH	55		57		2		4%	
			RT	90		95		5		6%	
		Intersection		6,085		6,027		-58		-1%	

AM Volume Calibration (Intersections)

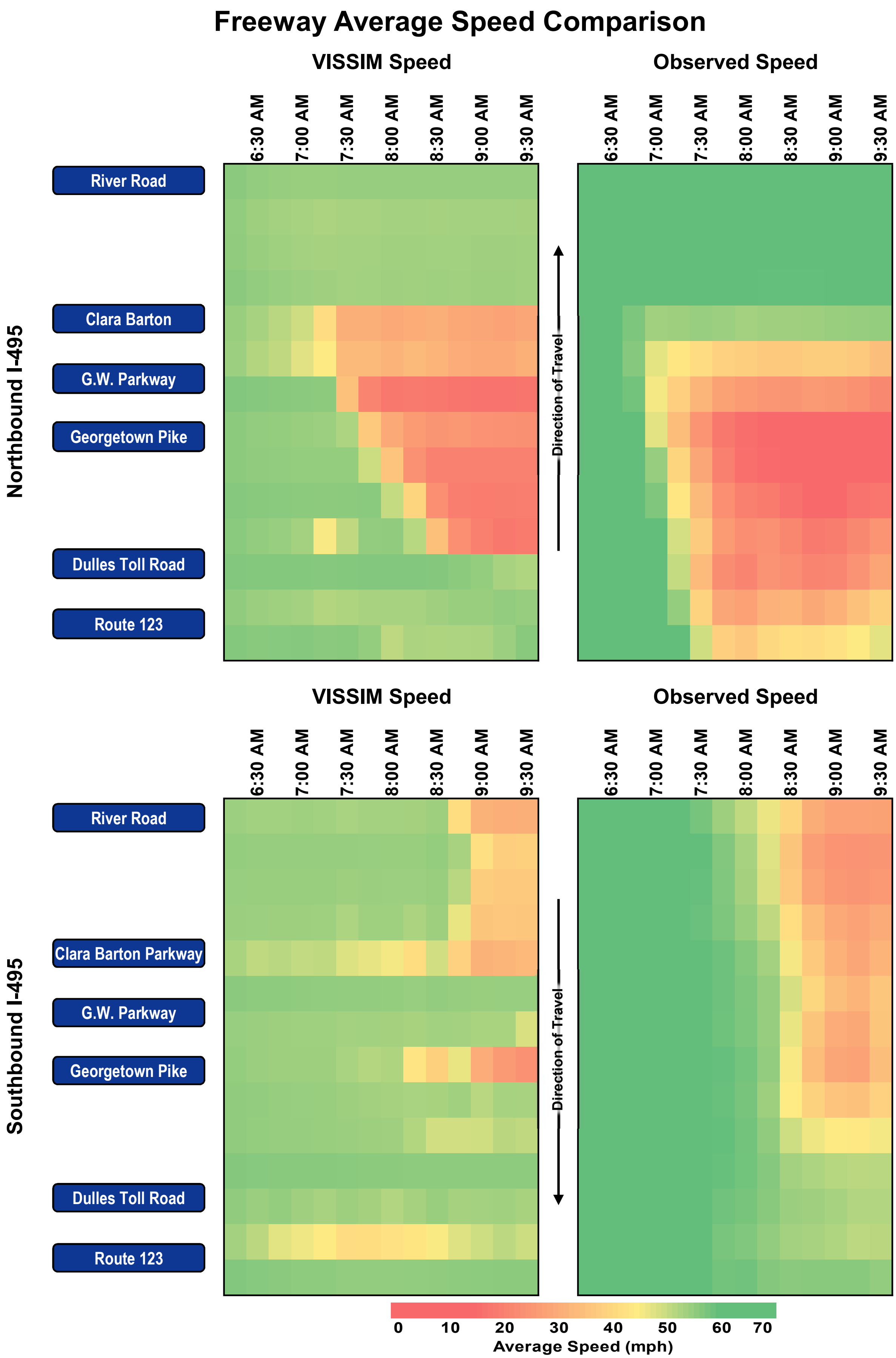
#	Intersection	Approach	Movement	Balanced Count (vph)		VISSIM Throughput (vph)		Difference (vph)		Difference (%)	
8	Route 123 and Scotts Crossing Boulevard/ Colshire Drive	NB	LT	75	2,265	73	2,288	-2	23	-3%	1%
			TH	1,785		1,791		6		0%	
			RT	405		424		19		5%	
		SB	LT	160	2,660	160	2,643	0	-17	0%	-1%
			TH	2,275		2,257		-18		-1%	
			RT	225		226		1		0%	
		EB	LT	55	200	55	197	0	-3	0%	-2%
			TH	30		28		-2		-7%	
			RT	115		114		-1		-1%	
		WB	LT	95	145	94	143	-1	-2	-1%	-1%
			TH	15		15		0		0%	
			RT	35		34		-1		-3%	
		Intersection		5,270		5,271		1		0%	
1	Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road	NB	TH	1,530	1,875	1,530	1,878	0	3	0%	0%
			RT	345		348		3		1%	
		SB	LT	90	1,920	83	1,919	-7	-1	-8%	0%
			TH	1,830		1,836		6		0%	
		EB	LT	40	720	40	734	0	14	0%	2%
			TH	235		235		0		0%	
			RT	445		459		14		3%	
		WB	LT	385	485	357	459	-28	-26	-7%	-5%
			RT	100		102		2		2%	
		Intersection		5,000		4,990		-10		0%	
3	Route 123 and Lewinsville Road/ Great Falls Street	NB	LT	615	2,560	584	2,495	-31	-65	-5%	-3%
			TH	1,545		1,524		-21		-1%	
			RT	400		387		-13		-3%	
		SB	LT	40	1,515	38	1,505	-2	-10	-5%	-1%
			TH	1,055		1,062		7		1%	
			RT	420		405		-15		-4%	
		EB	LT	315	830	324	855	9	25	3%	3%
			TH	250		256		6		2%	
			RT	265		275		10		4%	
		WB	LT	400	800	387	770	-13	-30	-3%	-4%
			TH	350		335		-15		-4%	
			RT	50		48		-2		-4%	
		Intersection		5,705		5,625		-80		-1%	
2	Lewinsville Road and Balls Hill Road	SB	LT	155	220	161	223	6	3	4%	1%
			RT	65		62		-3		-5%	
		EB	LT	65	740	60	746	-5	6	-8%	1%
			TH	675		686		11		2%	
		WB	TH	1,155	1,385	1,107	1,327	-48	-58	-4%	-4%
			RT	230		220		-10		-4%	
		Intersection		2,345		2,296		-49		-2%	
9	Jones Branch Drive and Jones Branch Connector	NB	TH	385	425	384	424	-1	-1	0%	0%
			RT	40		40		0		0%	
		SB	LT	150	450	149	450	-1	0	-1%	0%
			TH	300		301		1		0%	
		WB	LT	160	510	168	525	8	15	5%	3%
			RT	350		357		7		2%	
		Intersection		1,385		1,399		14		1%	

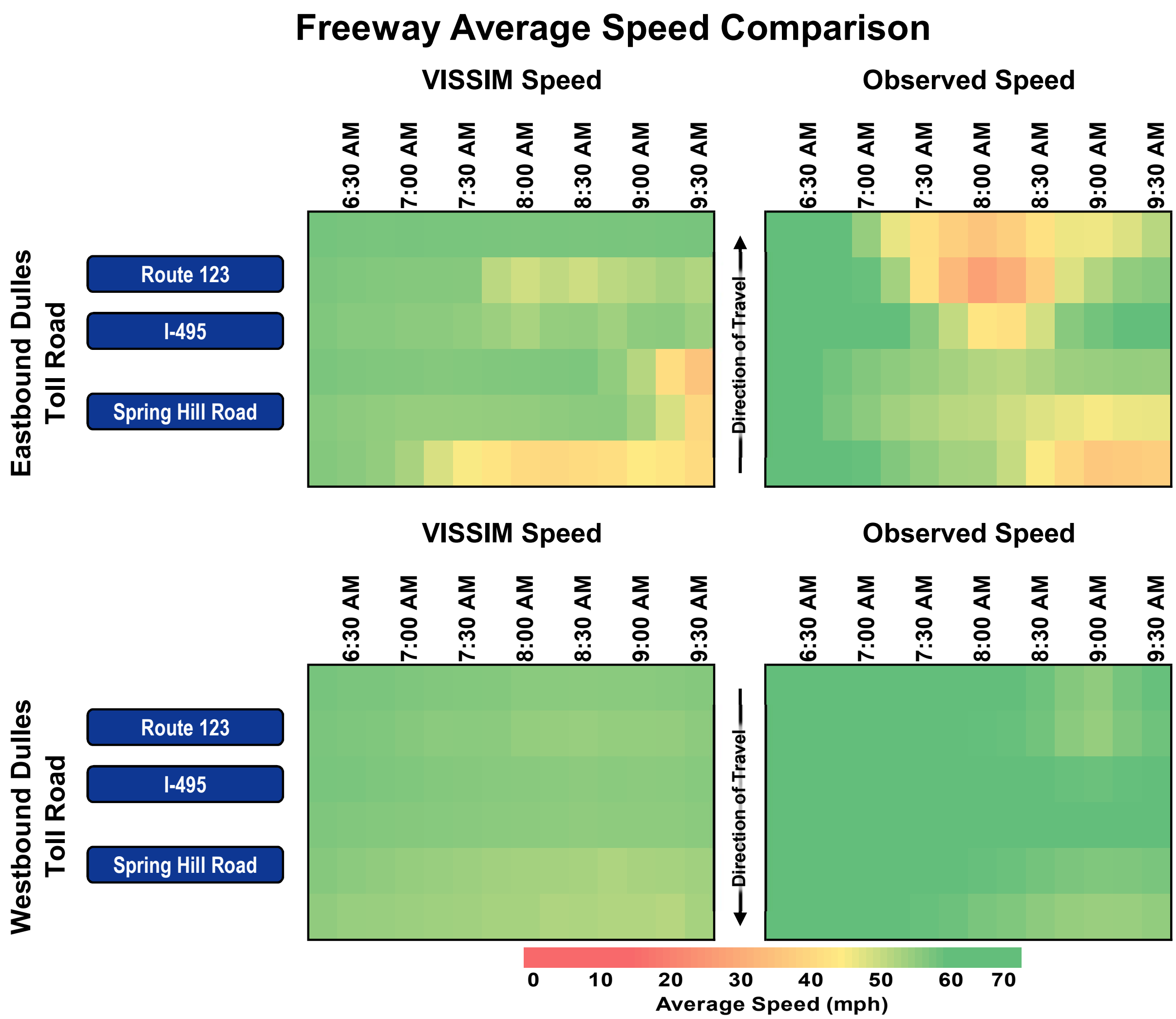
AM Volume Calibration (Intersections)

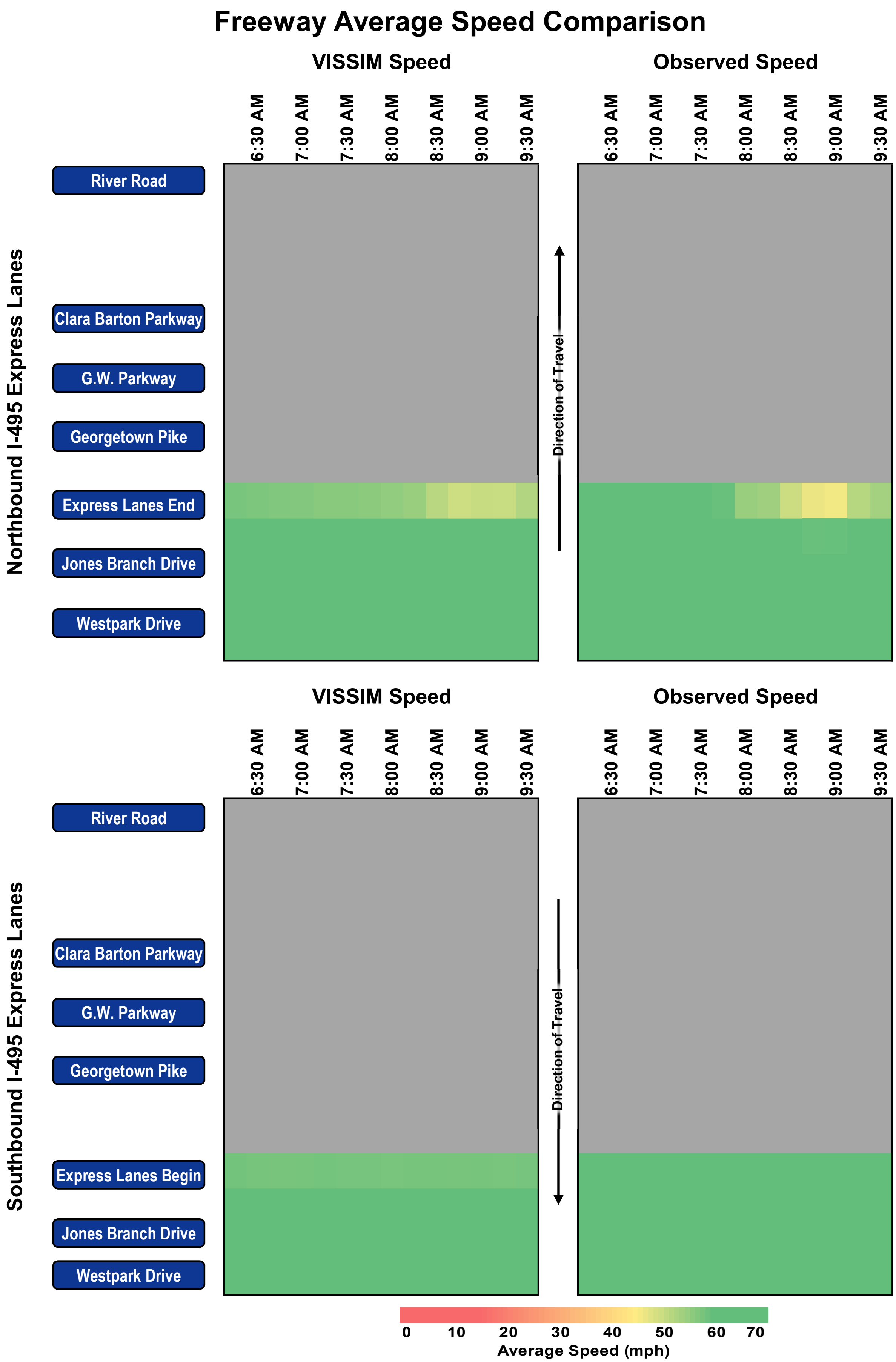
#	Intersection	Approach	Movement	Balanced Count (vph)		VISSIM Throughput (vph)		Difference (vph)		Difference (%)	
10	Jones Branch Connector and Express Lanes Ramps	NB	LT	200	200	196	196	-4	-4	-2%	-2%
		SB	RT	310	310	331	331	21	21	7%	7%
		EB	LT	170	170	167	167	-3	-3	-2%	-2%
		Intersection		680		694		14		2%	
11	International Drive and Spring Hill Road/Jones Branch Drive	NB	LT	165	440	156	430	-9	-10	-5%	-2%
			TH	200		197		-3		-2%	
			RT	75		77		2		3%	
		SB	LT	830	2,200	778	2,079	-52	-121	-6%	-6%
			TH	760		733		-27		-4%	
			RT	610		568		-42		-7%	
		EB	LT	145	600	150	595	5	-5	3%	-1%
			TH	340		333		-7		-2%	
			RT	115		112		-3		-3%	
		WB	LT	30	345	30	348	0	3	0%	1%
			TH	155		160		5		3%	
			RT	160		158		-2		-1%	
		Intersection		3,585		3,452		-133		-4%	
12	Spring Hill Road and Dulles Toll Road Eastbound Ramps	NB	TH	415	505	418	513	3	8	1%	2%
			RT	90		95		5		6%	
		SB	LT	110	1,040	117	1,037	7	-3	6%	0%
			TH	930		920		-10		-1%	
		EB	LT	180	1,450	169	1,342	-11	-108	-6%	-7%
			TH	0		0		0		0%	
			RT	1,270		1,173		-97		-8%	
		Intersection		2,995		2,892		-103		-3%	
13	Spring Hill Road and Dulles Toll Road Westbound Ramps	NB	LT	75	595	78	589	3	-6	4%	-1%
			TH	520		511		-9		-2%	
		SB	TH	605	680	615	691	10	11	2%	2%
			RT	75		76		1		1%	
		WB	LT	435	500	420	480	-15	-20	-3%	-4%
			TH	10		9		-1		-10%	
			RT	55		51		-4		-7%	
		Intersection		1,775		1,760		-15		-1%	
14	Spring Hill Road and Lewinsville Road	NB	LT	45	575	40	557	-5	-18	-11%	-3%
			TH	115		115		0		0%	
			RT	415		402		-13		-3%	
		SB	LT	25	285	22	281	-3	-4	-12%	-1%
			TH	255		254		-1		0%	
			RT	5		5		0		0%	
		EB	LT	10	575	8	573	-2	-2	-20%	0%
			TH	430		422		-8		-2%	
			RT	135		143		8		6%	
		WB	LT	290	655	298	655	8	0	3%	0%
			TH	345		338		-7		-2%	
			RT	20		19		-1		-5%	
		Intersection		2,090		2,066		-24		-1%	

AM Volume Calibration (Intersections)

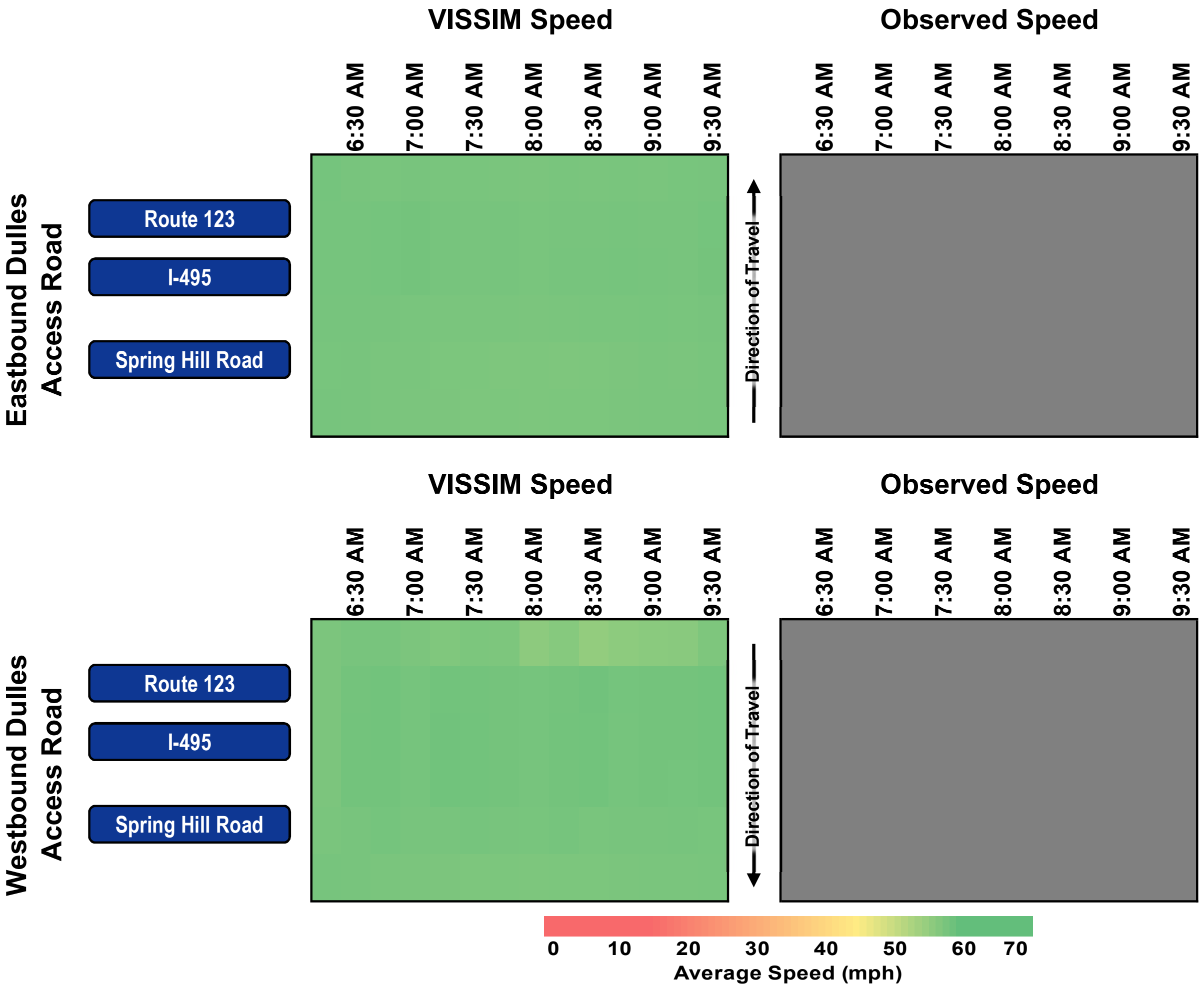
#	Intersection	Approach	Movement	Balanced Count (vph)		VISSIM Throughput (vph)		Difference (vph)		Difference (%)	
23	Georgetown Pike and Helga Place/ Linganore Drive	NB	LT	0	10	1	8	1	-2	-	-20%
			TH	0		0		0		0%	
			RT	10		7		-3		-30%	
		SB	LT	10	10	7	8	-3	-2	-30%	-20%
			TH	0		0		0		0%	
			RT	0		1		1		-	
		EB	TH	1,135	1,135	1,118	1,118	-17	-17	-1%	-1%
			RT	0		0		0		0%	
		WB	LT	5	670	4	594	-1	-76	-20%	-11%
			TH	655		579		-76		-12%	
			RT	10		11		1		10%	
		Intersection		1,825		1,728		-97		-5%	
20	Georgetown Pike and I-495 Southbound Ramps	SB	LT	270	775	217	628	-53	-147	-20%	-19%
			TH	20		3		-17		-85%	
			RT	485		408		-77		-16%	
		EB	TH	1,105	1,155	1,088	1,138	-17	-17	-2%	-1%
			RT	50		50		0		0%	
		WB	LT	300	485	300	487	0	2	0%	0%
			TH	185		187		2		1%	
		Intersection		2,415		2,253		-162		-7%	
19	Georgetown Pike and I-495 Northbound Ramps	NB	LT	95	420	95	409	0	-11	0%	-3%
			TH	10		9		-1		-10%	
			RT	315		305		-10		-3%	
		EB	LT	830	1,375	820	1,302	-10	-73	-1%	-5%
			TH	545		482		-63		-12%	
		WB	TH	390	780	386	767	-4	-13	-1%	-2%
			RT	390		381		-9		-2%	
		Intersection		2,575		2,478		-97		-4%	
18	Georgetown Pike and Balls Hill Road	NB	LT	285	385	281	382	-4	-3	-1%	-1%
			TH	35		36		1		3%	
			RT	65		65		0		0%	
		SB	LT	20	85	19	85	-1	0	-5%	0%
			TH	20		21		1		5%	
			RT	45		45		0		0%	
		EB	LT	70	860	64	778	-6	-82	-9%	-10%
			TH	510		478		-32		-6%	
			RT	280		236		-44		-16%	
		WB	LT	55	520	54	510	-1	-10	-2%	-2%
			TH	450		440		-10		-2%	
			RT	15		16		1		7%	
		Intersection		1,850		1,755		-95		-5%	
22	Georgetown Pike and Dead Run Drive	NB	LT	80	100	77	97	-3	-3	-4%	-3%
			RT	20		20		0		0%	
		EB	TH	535	595	508	564	-27	-31	-5%	-5%
			RT	60		56		-4		-7%	
		WB	LT	55	495	53	488	-2	-7	-4%	-1%
			TH	440		435		-5		-1%	
		Intersection		1,190		1,149		-41		-3%	


Freeway Average Speed Comparison
VISSIM Speed
Observed Speed
6:30 AM
7:00 AM
7:30 AM
8:00 AM
8:30 AM
9:00 AM
9:30 AM
Northbound I-495
River Road
Clara Barton
G.W. Parkway
Georgetown Pike
Dulles Toll Road
Route 123
Direction of Travel
Southbound I-495
River Road
Clara Barton Parkway
G.W. Parkway
Georgetown Pike
Dulles Toll Road
Route 123
0
10
20
30
40
50
60
70
Average Speed (mph)


Freeway Average Speed Comparison
VISSIM Speed
Observed Speed
6:30 AM
7:00 AM
7:30 AM
8:00 AM
8:30 AM
9:00 AM
9:30 AM
Eastbound Dulles Toll Road
Route 123
I-495
Spring Hill Road
Direction of Travel
Westbound Dulles Toll Road
0
10
20
30
40
50
60
70
Average Speed (mph)


Freeway Average Speed Comparison
Northbound I-495 Express Lanes
VISSIM Speed
Observed Speed
6:30 AM
7:00 AM
7:30 AM
8:00 AM
8:30 AM
9:00 AM
9:30 AM
River Road
Clara Barton Parkway
G.W. Parkway
Georgetown Pike
Express Lanes End
Jones Branch Drive
Westpark Drive
Direction of Travel
Southbound I-495 Express Lanes
VISSIM Speed
Observed Speed
6:30 AM
7:00 AM
7:30 AM
8:00 AM
8:30 AM
9:00 AM
9:30 AM
River Road
Clara Barton Parkway
G.W. Parkway
Georgetown Pike
Express Lanes Begin
Jones Branch Drive
Westpark Drive
Direction of Travel
0 10 20 30 40 50 60 70
Average Speed (mph)

Freeway Average Speed Comparison



Queue Length Calibration

AM Peak Period (6:45-9:45 AM)

	Queue Criteria	Total	Percent	Target	Target Met
Approaches (n = 12)	Modeled queues qualitatively reflect the impacts of observed queues (e.g., spillback from ramp intersections, turn bay, or downstream intersection)	10	83%	85%	No

Interchange	Location	Observed Max Queue (feet)	VISSIM Max Queue (feet)	Max Queue Difference (feet)	Max Queue Difference (%)	Field Conditions Represented (Yes/No)
I-495 / Route 267 Interchange	Ramp from SR 267 EB to I-495 NB GP	5540	6,743	1,203	22%	Y
	Ramp from DAAR EB to I-495 NB GP	2450	1,765	-685	-28%	Y
	Ramp from SR 267 EB to I-495 SB GP	2550	522	-2,028	-80%	N
I-495 / Georgetown Pike Road Interchange	Ramp from Georgetown Pike to I-495 NB GP	790	671	-119	-15%	Y
	Georgetown Pike EB approaching I-495 NB GP ramps	2200	2,169	-31	-1%	Y
	Georgetown Pike WB approaching I-495 NB GP ramps	470	336	-134	-28%	y
	Balls Hill Rd NB approaching Georgetown Pike	655	461	-194	-30%	Y
I-495 / George Washington Parkway Interchange	Ramp from GW Parkway NB/WB to I-495 NB GP	3,030	3,066	36	1%	Y
Route 267 / Spring Hill Road Interchange	Spring Hill Rd NB approaching Lewinsville Rd	1200	468	-732	-61%	Y
Route 267 / Route 123 Interchange	Ramp from SR 267 EB to Route 123 NB	1200	1,492	292	24%	y
	Route 123 NB approaching Great Falls St	3450	2,494	-956	-28%	Y
	Lewinsville Rd EB approaching Balls Hill Rd	2400	366	-2,034	-85%	N

* - Queues extend beyond the VISSIM network limits

I-495 NEXT : PM Peak Period Calibration Summary

Calibration Item	Basis	Criteria	Total	Percent	Target	Target Met
Simulated Traffic Volume (Intersections)	**Approaches (n = 66)**	Within ± 20% for <100 vph Within ± 15% for ≥ 100 vph to < 300 vph Within ± 10% for ≥ 300 vph to < 1,000 vph Within ± 5% for ≥ 1,000 vph	55	83%	85%	No
Simulated Traffic Volume (Freeways)	**Segments (n = 142)**	Within ± 20% for <100 vph Within ± 15% for ≥ 100 vph to < 300 vph Within ± 10% for ≥ 300 vph to < 1,000 vph Within ± 5% for ≥ 1,000 vph	125	88%	85%	Yes
Simulated Travel Time	**Routes (n = 25)**	Within ± 30% for average travel time on arterials Within ± 20% for average travel times on freeways	23	92%	85%	Yes
Maximum Simulated Queue Length	**Approaches (n = 12)**	Modeled queues qualitatively reflect the impacts of observed queues				Resonably Calibrated
Visual Review of Bottleneck Locations	**Targeted Critical Locations**	Speed heat maps qualitatively reflect patterns and duration of congestions				Resonably Calibrated

* Deviation from TOSAM Requirements

1. Simulated Average Speed – Speeds are highly variable on the interstate mainline as well as on the local arterial network and residential roadways, and can vary substantially by hour and by day. Simulated average speed was captured as part of the travel time calibration process and the visual review of bottleneck locations against speed heat maps.

2. Simulated Queue Length – Queuing within the study area is notably inconsistent and can oscillate numerous times within the peak periods, or be absent altogether on some days. A qualitative subjective assessment was conducted for queue lengths at targeted locations in addition to the review of freeway mainline congestion/queues against the speed heat maps.

Travel Time Calibration

PM Peak Period (2:45-5:45 PM)

	Travel Time Criteria	Subtotal	Total	Percent	Target	Target Met
Routes (n = 25)	Within ± 30% for average travel time on arterials	0	23	92%	85%	Yes
	Within ± 20% for average travel times on freeways	23				

Segment ID	Route	Peak Period Travel Time			
		Field (MM:SS)	VISSIM (MM:SS)	Difference (MM:SS)	Difference (%)
Freeway Routes					
1000	**Northbound I-495 - Overall Travel Time (Route 123 to River Road)**	**40:02**	**39:07**	**-00:56**	**-2%**
1001	Route 123 to Dulles Toll Road	05:56	05:22	-00:33	-9%
1002	Dulles Toll Road to Lewinsville Road	03:21	03:04	-00:16	-8%
1003	Lewinsville Road to Old Dominion Drive	06:18	06:37	00:19	5%
1004	Old Dominion Drive to Georgetown Pike	06:44	06:51	00:07	2%
1005	Georgetown Pike to George Washington Memorial Parkway	07:24	06:09	-01:16	-17%
1006	George Washington Memorial Parkway to Clara Barton Parkway	03:03	03:01	-00:02	-1%
1007	Clara Barton Parkway to River Road	07:16	08:02	00:45	10%
3000	**Southbound I-495 - Overall Travel Time (River Road to Route 123)**	**16:13**	**17:12**	**01:00**	**6%**
3003	River Road to Clara Barton Parkway	05:22	05:29	00:07	2%
3004	Clara Barton Parkway to George Washington Memorial Parkway	01:49	02:01	00:11	11%
3005	George Washington Memorial Parkway to Georgetown Pike	02:31	02:43	00:12	8%
3006	Georgetown Pike to Old Dominion Drive	01:56	02:04	00:08	7%
3007	Old Dominion Drive to Lewinsville Road	01:46	02:27	00:40	38%
3008	Lewinsville Road to Dulles Toll Road	00:50	00:49	-00:01	-3%
3009	Dulles Toll Road to Route 123	01:57	01:39	-00:18	-16%
6000	**Eastbound Route 267 - Overall Travel Time (Spring Hill Road to Route 123)**	**03:08**	**02:42**	**-00:26**	**-14%**
6001	Spring Hill Road to I-495	02:00	01:46	-00:14	-11%
6002	I-495 to Route 123	01:08	00:56	-00:12	-18%

PM Travel Time Calibration

Segment ID	Route	Peak Period Travel Time			
		Field (MM:SS)	VISSIM (MM:SS)	Difference (MM:SS)	Difference (%)
Freeway Routes					
9000	**Westbound Route 267 - Overall Travel Time**	**01:46**	**01:57**	**00:11**	**10%**
9001	Route 123 to I-495	00:34	00:30	-00:03	-10%
9002	I-495 to Spring Hill Road	01:12	01:27	00:15	20%
2000	**Northbound I-495 to Westbound Route 267 (Route 123 to Spring Hill Road)**	**06:14**	**06:48**	**00:34**	**9%**
2001	Route 123 to Dulles Toll Road Ramp	04:38	05:23	00:46	16%
2002	Dulles Toll Road Ramp to Spring Hill Road	01:37	01:25	-00:12	-12%

Volume Calibration (Freeways)

PM Peak Hour (3:45-4:45 PM)

	Volume Criteria	Subtotal	Total	Percent	Target	Target Met
Segments (n = 142)	Within ± 20% for < 100 vph	9	125	88%	85%	Yes
	Within ± 15% for ≥ 100 vph to < 300 vph	9				
	Within ± 10% for ≥ 300 vph to < 1,000 vph	30				
	Within ± 5% for ≥ 1,000 vph	77				

Interchange	Segment	Type	Balanced Count (vph)	VISSIM Through-put (vph)	Difference (vph)	Difference (%)
NORTHBOUND I-495						
Route 123	Upstream	Weave	4,460	4,368	-92	-2%
	Off-ramp to NB Route 123	Ramp	580	568	-12	-2%
	Between Ramps	Basic	3,880	3,890	10	0%
	On-ramp from NB Route 123	Ramp	600	574	-26	-4%
	Between Ramps	Weave	4,480	4,487	7	0%
	Off-ramp to SB Route 123	Ramp	500	512	12	2%
	Between Ramps	Basic	3,980	3,997	17	0%
	On-ramp from SB Route 123	Ramp	240	242	2	1%
	Downstream	Merge	4,220	4,223	3	0%
I-495 between Route 123 and Dulles Toll Road		Basic	4,220	4,097	-123	-3%
Dulles Toll Road	Upstream	Diverge	4,220	4,224	4	0%
	Off-ramp to WB Dulles Toll Road	Ramp	1,470	1,478	8	1%
	Between Ramps	Basic	2,750	2,725	-25	-1%
	On-ramp from EB Dulles Toll Road	Ramp	590	387	-203	-34%
	Between Ramps	Merge	3,340	3,072	-268	-8%
	On-ramp from WB Dulles Toll Road	Ramp	250	240	-10	-4%
	Downstream	Merge	3,590	3,258	-332	-9%
I-495 between Dulles Toll Road and Georgetown Pike		Basic	4,660	4,467	-193	-4%
Georgetown Pike	Upstream	Diverge	4,660	4,463	-197	-4%
	Off-ramp to Georgetown Pike	Ramp	170	162	-8	-5%
	Between Ramps	Basic	4,490	4,330	-160	-4%
	On-ramp from Georgetown Pike	Ramp	1,200	1,110	-90	-7%
I-495 between Georgetown Pike and George Washington Memorial Parkway		Weave	5,690	5,466	-224	-4%
George Washington Memorial	Off-ramp to G.W. Memorial Parkway	Ramp	60	53	-7	-12%
	Between Ramps	Basic	5,630	5,433	-197	-4%
	On-ramp from G.W. Memorial Parkway	Ramp	1,130	1,163	33	3%
I-495 between George Washington Memorial Parkway and Clara Barton Parkway		Weave	6,760	6,615	-145	-2%
Clara Barton Parkway	Off-ramp to Clara Barton Parkway	Ramp	1,140	1,059	-81	-7%
	Off-ramp to EB Clara Barton Parkway	Ramp	460	434	-26	-6%
	Off-ramp to WB Clara Barton Parkway	Ramp	680	642	-38	-6%
	Between Ramps	Basic	5,620	5,535	-85	-2%
	On-ramp from WB Clara Barton Parkway	Ramp	90	90	0	0%
	Downstream	Merge	5,710	5,608	-102	-2%
I-495 between Clara Barton Parkway and River Road		Basic	5,710	5,643	-67	-1%

PM Volume Calibration (Freeways)

Interchange	Segment	Type	Balanced Count (vph)	VISSIM Through-put (vph)	Difference (vph)	Difference (%)
NORTHBOUND I-495 EXPRESS LANES						
Westpark Drive	Upstream	Diverge	950	943	-7	-1%
	Off-ramp to Westpark Drive	Ramp	60	66	6	10%
	Between Ramps	Basic	890	886	-4	0%
	On-ramp from Westpark Drive	Ramp	370	369	-1	0%
I-495 Express Lanes between Westpark Drive and Jones Branch Connector		Weave	1,260	1,255	-5	0%
Jones Branch Drive/Dulles Toll Road	Off-ramp to Jones Branch Connector	Ramp	30	32	2	5%
	Between Ramps	Diverge	1,230	1,215	-15	-1%
	Off-Ramp to WB Dulles Toll Road	Ramp	500	488	-12	-2%
	Between Ramps	Basic	730	734	4	1%
	On-ramp from Jones Branch Connector	Ramp	340	328	-12	-3%
	Downstream	Merge	1,070	1,057	-13	-1%
I-495 Express Lanes End		Basic	1,070	1,057	-13	-1%
SOUTHBOUND I-495						
I-495 between River Road and Clara Barton Parkway		Basic	5,150	5,459	309	6%
Clara Barton Parkway	Off-ramp to WB Clara Barton Parkway	Ramp	10	11	1	14%
	Between Ramps	Basic	5,140	5,698	558	11%
	On-ramp to WB Clara Barton Parkway	Ramp	1,190	1,133	-57	-5%
	On-ramp from EB Clara Barton Parkway	Ramp	460	454	-6	-1%
	On-ramp from Clara Barton Parkway	Ramp	1,650	1,580	-70	-4%
I-495 between Clara Barton Parkway and George Washington Memorial Parkway		Weave	6,790	7,323	533	8%
George Washington Memorial Parkway/ Georgetown Pike	Off-ramp to C-D Road	Ramp	2,040	2,202	162	8%
	Off-ramp to G.W. Memorial Parkway	Ramp	920	996	76	8%
	Between Ramps (C-D)	Basic	1,120	1,217	97	9%
	On-ramp from G.W. Memorial Parkway	Ramp	1,210	1,232	22	2%
	Between Ramps (C-D)	Weave	2,330	2,446	116	5%
	Off-ramp to Georgetown Pike	Ramp	1,130	1,220	90	8%
	Between Ramp (Mainline)	Basic	4,750	5,035	285	6%
	On-Ramp from C-D Road	Ramp	1,200	1,239	39	3%
	Between Ramps	Merge	5,950	6,176	226	4%
	On-ramp from Georgetown Pike	Ramp	600	547	-53	-9%
	Downstream	Merge	6,550	6,659	109	2%
I-495 between Georgetown Pike and Dulles Toll Road		Diverge	6,550	6,535	-15	0%
Dulles Toll Road	Upstream	Diverge	5,730	5,579	-151	-3%
	Off-ramp to WB Dulles Toll Road	Ramp	2,450	2,338	-112	-5%
	Between Ramps	Diverge	3,280	3,237	-43	-1%
	Off-ramp to EB Dulles Toll Road	Ramp	240	239	-1	0%
	Between Ramps	Basic	3,040	2,992	-48	-2%
	On-ramp from EB Dulles Toll Road	Ramp	980	878	-102	-10%
I-495 between Dulles Toll Road and Route 123		Weave	4,020	3,877	-143	-4%
Route 123	Off-ramp to SB Route 123	Ramp	520	508	-12	-2%
	Between Ramps	Basic	3,500	3,413	-87	-2%
	On-ramp from SB Route 123	Ramp	1,250	1,194	-56	-4%
	Between Ramps	Weave	4,750	4,595	-155	-3%
	Off-ramp to NB Route 123	Ramp	70	65	-5	-8%
	Between Ramps	Basic	4,680	4,556	-124	-3%
	On-ramp from NB Route 123	Ramp	1,300	1,245	-55	-4%
	Downstream	Weave	5,980	5,813	-167	-3%

PM Volume Calibration (Freeways)

Interchange	Segment	Type	Balanced Count (vph)	VISSIM Through-put (vph)	Difference (vph)	Difference (%)
SOUTHBOUND I-495 EXPRESS LANES						
Dulles Toll Road/Jones Branch Drive	Upstream	Diverge	820	849	29	3%
	Off-ramp to EB Dulles Toll Road	Ramp	30	38	8	28%
	Between Ramps	Diverge	790	813	23	3%
	Off-ramp to Jones Branch Connector	Ramp	30	31	1	3%
	Between Ramps	Basic	760	782	22	3%
	On-ramp from Jones Branch Connector	Ramp	250	253	3	1%
	Between Ramps	Merge	1,010	1,012	2	0%
	On-ramp from EB Dulles Toll Road	Ramp	400	394	-6	-2%
I-495 between Dulles Toll Road and Westpark Drive		Weave	1,410	1,416	6	0%
Westpark Drive	Off-ramp to Westpark Drive	Ramp	40	43	3	8%
	Between Ramps	Basic	1,370	1,389	19	1%
	On-ramp from Westpark Drive	Ramp	450	450	0	0%
	Downstream	Merge	1,820	1,820	0	0%
EASTBOUND DULLES TOLL ROAD						
Spring Hill Road	Upstream	Diverge	3,700	3,693	-7	0%
	Off-ramp to Spring Hill Road	Ramp	300	290	-10	-3%
	Between Ramps	Basic	3,400	3,373	-27	-1%
	On-ramp from Dulles Access Road	Ramp	340	347	7	2%
	Between Ramps	Merge	3,740	3,718	-22	-1%
	On-ramp from Spring Hill Road	Ramp	440	419	-21	-5%
Dulles Toll Road between Spring Hill Road and I-495		Weave	4,180	4,138	-43	-1%
I-495	Off-ramp to SB I-495	Ramp	1,120	1,104	-16	-1%
	Between Ramps	Diverge	3,060	3,018	-42	-1%
	Off-ramp to NB I-495	Ramp	300	267	-33	-11%
	Between Ramps	Basic	2,760	2,726	-34	-1%
	On-ramp from SB I-495	Ramp	See above - Southbound I-495			
Dulles Toll Road Between I-495 and Route 123		Weave	3,000	2,916	-84	-3%
Route 123	Off-ramp to SB Route 123	Ramp	130	129	-1	0%
	Between Ramps	Basic	2,870	2,821	-49	-2%
	On-ramp from SB Route 123	Ramp	50	38	-12	-24%
	Between Ramps	Weave	2,920	2,869	-51	-2%
	Off-ramp to NB Route 123	Ramp	680	681	1	0%
	Between Ramps	Basic	2,240	2,192	-48	-2%
	On-ramp to NB Route 123	Ramp	450	432	-18	-4%
	Between Ramps	Merge	2,690	2,577	-113	-4%
	On-ramp from Dulles Access Road	Ramp	740	738	-2	0%
	Downstream	Merge	3,430	3,270	-160	-5%
EASTBOUND DULLES ACCESS ROAD						
Spring Hill Road	Upstream	Diverge	1,630	1,613	-17	-1%
	Off-ramp to Dulles Toll Road	Ramp	See above - Eastbound Dulles Toll Road			
	Downstream	Basic	1,290	1,286	-4	0%
I-495	Upstream	Diverge	1,290	1,288	-2	0%
	Off-ramp to I-495	Ramp	550	525	-25	-4%
	Off-ramp to SB I-495	Ramp	260	239	-21	-8%
	Off-ramp to NB I-495	Ramp	290	219	-71	-24%
	Downstream	Basic	See above - Eastbound Dulles Toll Road			

PM Volume Calibration (Freeways)

Interchange	Segment	Type	Balanced Count (vph)	VISSIM Through-put (vph)	Difference (vph)	Difference (%)
WESTBOUND DULLES TOLL ROAD						
Route 123	Upstream	Diverge	1,870	1,870	0	0%
	Off-ramp to Dulles Access Road	Ramp	460	457	-3	-1%
	Between Ramps	Diverge	1,410	1,408	-2	0%
	Off-ramp to NB Route 123	Ramp	60	64	4	6%
	Between Ramps	Diverge	1,350	1,337	-13	-1%
	Off-ramp to SB Route 123	Ramp	150	150	0	0%
	Between Ramps	Basic	1,200	1,195	-5	0%
	On-ramp from SB Route 123	Ramp	1,140	1,100	-40	-4%
Dulles Toll Road between Route 123 and I-495		Weave	2,340	2,289	-51	-2%
I-495	Off-ramp to NB I-495	Ramp	See above - Northbound I-495			
	Between Ramps	Basic	2,090	2,063	-27	-1%
	On-ramp from NB I-495	Ramp	See above - Northbound I-495			
	Between Ramps	Basic	3,560	3,497	-63	-2%
	On-ramp from SB I-495	Ramp	See above - Southbound I-495			
	Between Ramps	Merge	6,010	5,832	-178	-3%
	On-ramp from I-495 Express Lanes	Ramp	530	523	-7	-1%
Dulles Toll Road between I-495 and Spring Hill Road		Weave	6,540	6,384	-156	-2%
Spring Hill Road	Off-ramp to Dulles Access Road	Ramp	1,280	1,229	-51	-4%
	Between Ramps	Diverge	5,260	5,103	-157	-3%
	Off-ramp to Spring Hill Road	Ramp	230	219	-11	-5%
	Between Ramps	Basic	5,030	4,946	-84	-2%
	On-ramp from Spring Hill Road	Ramp	950	891	-59	-6%
	Downstream	Merge	5,980	5,809	-171	-3%
WESTBOUND DULLES ACCESS ROAD						
Spring Hill Road	Upstream	Basic	See above - Westbound Dulles Toll Road			
	On-ramp from Dulles Toll Road	Ramp	See above - Westbound Dulles Toll Road			
	Downstream	Merge	1,740	1,676	-64	-4%

Volume Calibration (Intersections)

PM Peak Hour (3:45-4:45 PM)

	Volume Criteria	Subtotal	Total	Percent	Target	Target Met
Approaches (n = 66)	Within ± 20% for < 100 vph	6	55	83%	85%	No
	Within ± 15% for ≥ 100 vph to < 300 vph	9				
	Within ± 10% for ≥ 300 vph to < 1,000 vph	28				
	Within ± 5% for ≥ 1,000 vph	12				

#	Intersection	Approach	Movement	Balanced Count (vph)		VISSIM Throughput (vph)		Difference (vph)		Difference (%)	
6	Route 123 and Tysons Boulevard	NB	LT	25	2,130	24	2,098	-1	-32	-4%	-2%
			TH	1,865		1,835		-30		-2%	
			RT	240		239		-1		0%	
		SB	LT	210	2,545	199	2,490	-11	-55	-5%	-2%
			TH	1,505		1,466		-39		-3%	
			RT	830		825		-5		-1%	
		EB	LT	1,275	1,420	1,211	1,359	-64	-61	-5%	-4%
			RT	145		148		3		2%	
		WB	LT	110	560	110	521	0	-39	0%	-7%
			RT	450		411		-39		-9%	
		Intersection		6,655		6,468		-187		-3%	
4	Westpark Drive and Tysons Connector	NB	TH	265	725	260	716	-5	-9	-2%	-1%
			RT	460		456		-4		-1%	
		SB	LT	360	840	366	840	6	0	2%	0%
			TH	480		474		-6		-1%	
		WB	LT	45	100	50	111	5	11	11%	11%
			RT	55		61		6		11%	
		Intersection		1,665		1,667		2		0%	
5	Tysons Connector and Express Lanes Ramps	NB	LT	60	60	67	67	7	7	12%	12%
		SB	RT	40	40	43	43	3	3	8%	8%
		EB	LT	370	820	369	822	-1	2	0%	0%
			RT	450		453		3		1%	
		Intersection		920		932		12		1%	
7	Route 123 and Capital One Tower Drive/ Old Meadow Road	NB	LT	55	2,340	49	2,251	-6	-89	-11%	-4%
			TH	2,070		1,994		-76		-4%	
			RT	215		208		-7		-3%	
		SB	LT	45	2,185	38	2,078	-7	-107	-16%	-5%
			TH	2,125		2,026		-99		-5%	
			RT	15		14		-1		-7%	
		EB	LT	50	400	50	400	0	0	0%	0%
			RT	350		350		0		0%	
		WB	LT	540	610	531	609	-9	-1	-2%	0%
			TH	5		5		0		0%	
			RT	65		73		8		12%	
		Intersection		5,535		5,338		-197		-4%	

PM Volume Calibration (Intersections)

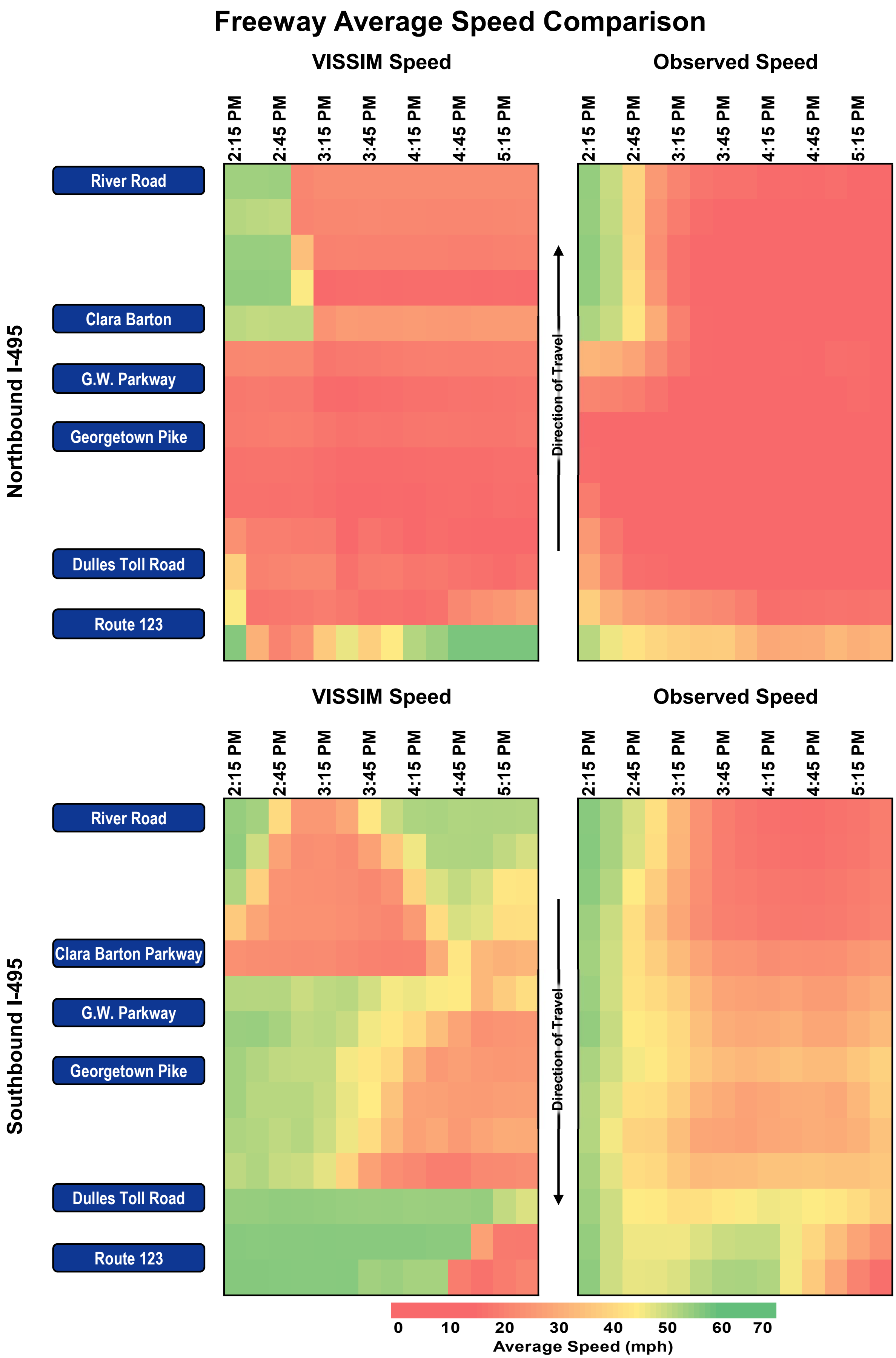
#	Intersection	Approach	Movement	Balanced Count (vph)		VISSIM Throughput (vph)		Difference (vph)		Difference (%)	
8	Route 123 and Scotts Crossing Boulevard/ Colshire Drive	NB	LT	50	2,185	50	2,122	0	-63	0%	-3%
			TH	2,060		2,003		-57		-3%	
			RT	75		69		-6		-8%	
		SB	LT	55	1,880	58	1,804	3	-76	5%	-4%
			TH	1,785		1,708		-77		-4%	
			RT	40		38		-2		-5%	
		EB	LT	35	165	36	164	1	-1	3%	-1%
			TH	10		10		0		0%	
			RT	120		118		-2		-2%	
		WB	LT	255	335	253	332	-2	-3	-1%	-1%
			TH	5		5		0		0%	
			RT	75		74		-1		-1%	
		Intersection		4,565		4,422		-143		-3%	
1	Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road	NB	TH	1,825	2,170	1,777	2,123	-48	-47	-3%	-2%
			RT	345		346		1		0%	
		SB	LT	30	1,555	28	1,467	-2	-88	-7%	-6%
			TH	1,525		1,439		-86		-6%	
		EB	LT	10	130	9	130	-1	0	-10%	0%
			TH	75		75		0		0%	
			RT	45		46		1		2%	
		WB	LT	335	430	312	403	-23	-27	-7%	-6%
			RT	95		91		-4		-4%	
		Intersection		4,285		4,123		-162		-4%	
3	Route 123 and Lewinsville Road/ Great Falls Street	NB	LT	310	2,220	298	2,169	-12	-51	-4%	-2%
			TH	1,425		1,394		-31		-2%	
			RT	485		477		-8		-2%	
		SB	LT	55	2,075	54	2,002	-1	-73	-2%	-4%
			TH	1,755		1,699		-56		-3%	
			RT	265		249		-16		-6%	
		EB	LT	485	1,335	371	1,050	-114	-285	-24%	-21%
			TH	385		304		-81		-21%	
			RT	465		375		-90		-19%	
		WB	LT	370	725	367	712	-3	-13	-1%	-2%
			TH	320		313		-7		-2%	
			RT	35		32		-3		-9%	
		Intersection		6,355		5,933		-422		-7%	
2	Lewinsville Road and Balls Hill Road	SB	LT	145	190	145	188	0	-2	0%	-1%
			RT	45		43		-2		-4%	
		EB	LT	55	1,245	45	937	-10	-308	-18%	-25%
			TH	1,190		892		-298		-25%	
		WB	TH	690	895	668	864	-22	-31	-3%	-3%
			RT	205		196		-9		-4%	
		Intersection		2,330		1,989		-341		-15%	
9	Jones Branch Drive and Jones Branch Connector	NB	TH	250	495	255	494	5	-1	2%	0%
			RT	245		239		-6		-2%	
		SB	LT	345	705	348	703	3	-2	1%	0%
			TH	360		355		-5		-1%	
		WB	LT	25	60	26	63	1	3	4%	5%
			RT	35		37		2		6%	
		Intersection		1,260		1,260		0		0%	

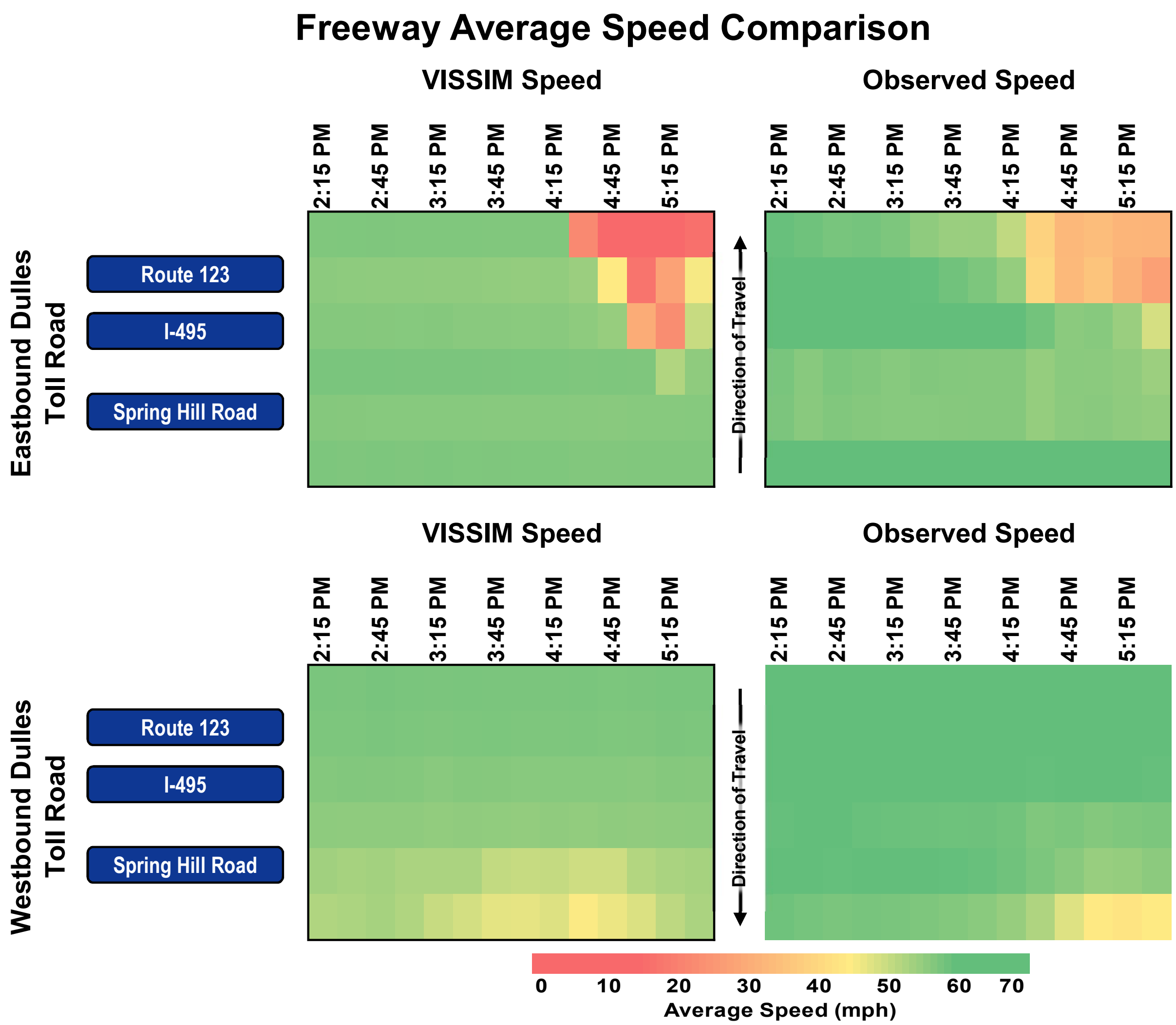
PM Volume Calibration (Intersections)

#	Intersection	Approach	Movement	Balanced Count (vph)		VISSIM Throughput (vph)		Difference (vph)		Difference (%)	
10	Jones Branch Connector and Express Lanes Ramps	NB	LT	30	30	32	32	2	2	7%	7%
		SB	RT	30	30	31	31	1	1	3%	3%
		EB	LT	340	340	329	329	-11	-11	-3%	-3%
		Intersection		400		392		-8		-2%	
11	International Drive and Spring Hill Road/Jones Branch Drive	NB	LT	150	795	146	774	-4	-21	-3%	-3%
			TH	600		585		-15		-3%	
			RT	45		43		-2		-4%	
		SB	LT	145	615	137	589	-8	-26	-6%	-4%
			TH	270		261		-9		-3%	
			RT	200		191		-9		-5%	
		EB	LT	455	750	435	736	-20	-14	-4%	-2%
			TH	140		143		3		2%	
			RT	155		158		3		2%	
		WB	LT	55	1,095	52	1,082	-3	-13	-5%	-1%
			TH	345		350		5		1%	
			RT	695		680		-15		-2%	
		Intersection		3,255		3,181		-74		-2%	
12	Spring Hill Road and Dulles Toll Road Eastbound Ramps	NB	TH	1,390	1,750	1,348	1,694	-42	-56	-3%	-3%
			RT	360		346		-14		-4%	
		SB	LT	80	525	80	505	0	-20	0%	-4%
			TH	445		425		-20		-4%	
		EB	LT	120	300	105	284	-15	-16	-13%	-5%
			TH	10		9		-1		-10%	
			RT	170		170		0		0%	
		Intersection		2,575		2,483		-92		-4%	
13	Spring Hill Road and Dulles Toll Road Westbound Ramps	NB	LT	785	1,510	747	1,428	-38	-82	-5%	-5%
			TH	725		681		-44		-6%	
		SB	TH	415	560	402	543	-13	-17	-3%	-3%
			RT	145		141		-4		-3%	
		WB	LT	110	230	105	218	-5	-12	-5%	-5%
			TH	20		19		-1		-5%	
			RT	100		94		-6		-6%	
		Intersection		2,300		2,189		-111		-5%	
14	Spring Hill Road and Lewinsville Road	NB	LT	85	825	74	752	-11	-73	-13%	-9%
			TH	295		266		-29		-10%	
			RT	445		412		-33		-7%	
		SB	LT	20	215	18	206	-2	-9	-10%	-4%
			TH	180		173		-7		-4%	
			RT	15		15		0		0%	
		EB	LT	10	360	9	353	-1	-7	-10%	-2%
			TH	295		292		-3		-1%	
			RT	55		52		-3		-5%	
		WB	LT	325	820	319	809	-6	-11	-2%	-1%
			TH	480		473		-7		-1%	
			RT	15		17		2		13%	
		Intersection		2,220		2,120		-100		-5%	

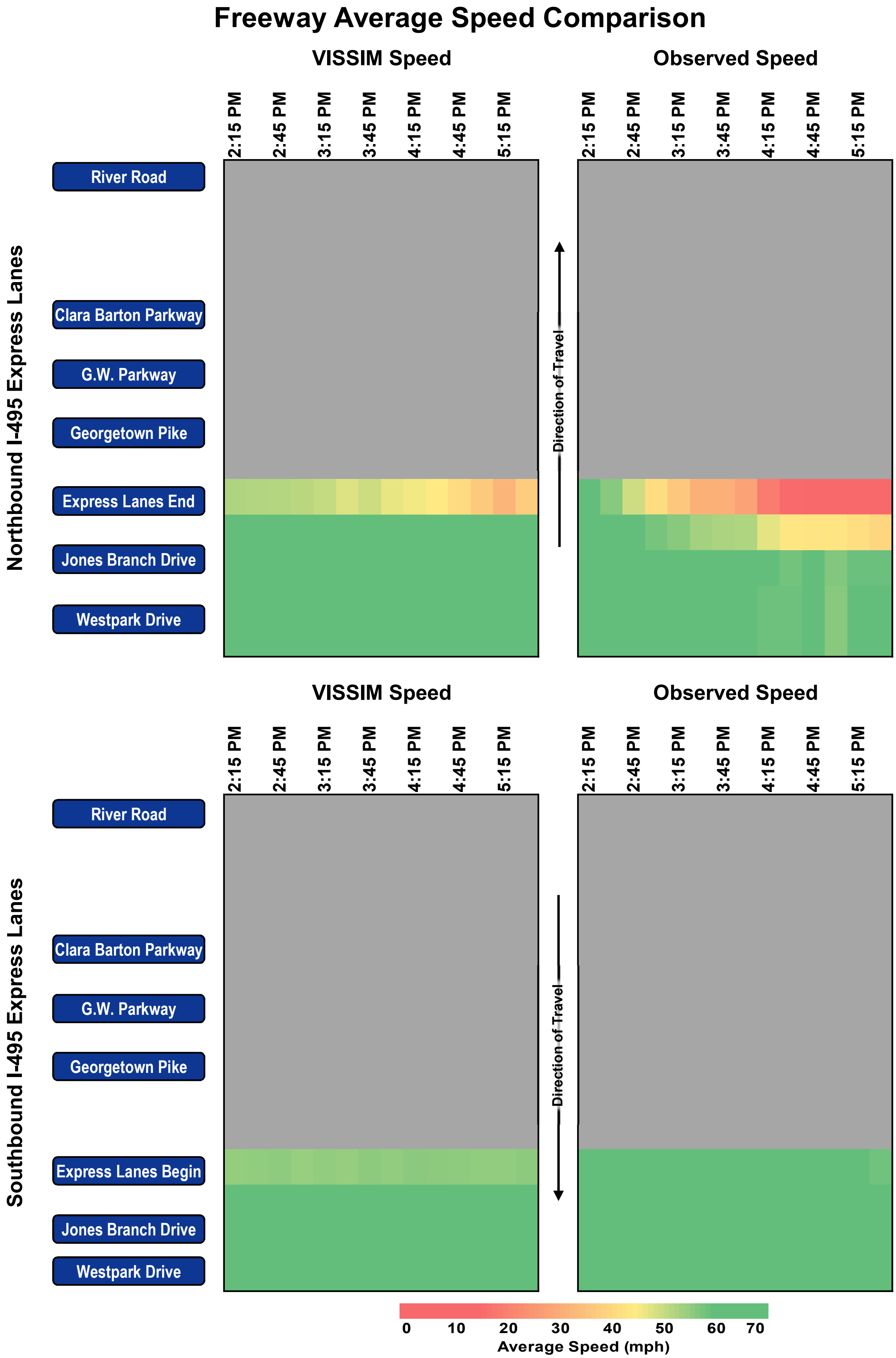
PM Volume Calibration (Intersections)

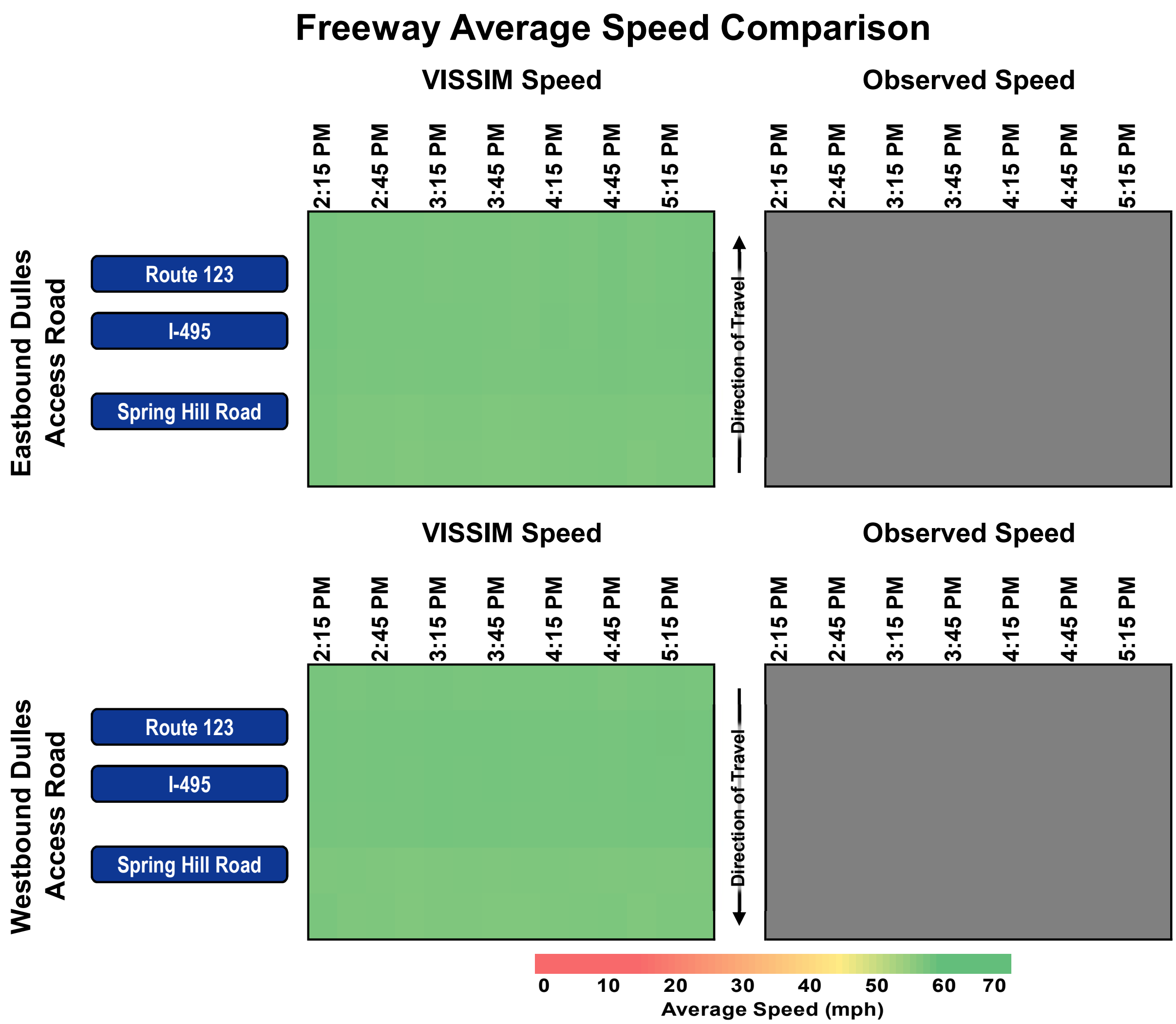
#	Intersection	Approach	Movement	Balanced Count (vph)		VISSIM Throughput (vph)		Difference (vph)		Difference (%)	
23	Georgetown Pike and Helga Place/ Linganore Drive	NB	LT	0	0	0	0	0	0	0%	0%
			TH	0		0		0		0%	
			RT	0		0		0		0%	
		SB	LT	5	5	3	3	-2	-2	-40%	-40%
			TH	0		0		0		0%	
			RT	0		0		0		0%	
		EB	TH	575	575	607	607	32	32	6%	6%
			RT	0		0		0		0%	
		WB	LT	5	915	6	917	1	2	20%	0%
			TH	910		911		1		0%	
			RT	0		0		0		0%	
		Intersection		1,495		1,527		32		2%	
20	Georgetown Pike and I-495 Southbound Ramps	SB	LT	280	1,130	299	1,223	19	93	7%	8%
			TH	150		162		12		8%	
			RT	700		762		62		9%	
		EB	TH	540	580	579	625	39	45	7%	8%
			RT	40		46		6		15%	
		WB	LT	410	625	347	505	-63	-120	-15%	-19%
			TH	215		158		-57		-27%	
		Intersection		2,335		2,353		18		1%	
19	Georgetown Pike and I-495 Northbound Ramps	NB	LT	45	170	43	163	-2	-7	-4%	-4%
			TH	65		62		-3		-5%	
			RT	60		58		-2		-3%	
		EB	LT	485	820	525	879	40	59	8%	7%
			TH	335		354		19		6%	
		WB	TH	580	1,230	465	989	-115	-241	-20%	-20%
			RT	650		524		-126		-19%	
		Intersection		2,220		2,031		-189		-9%	
18	Georgetown Pike and Balls Hill Road	NB	LT	265	285	191	206	-74	-79	-28%	-28%
			TH	5		4		-1		-20%	
			RT	15		11		-4		-27%	
		SB	LT	5	140	5	138	0	-2	0%	-1%
			TH	30		31		1		3%	
			RT	105		102		-3		-3%	
		EB	LT	25	395	24	413	-1	18	-4%	5%
			TH	175		182		7		4%	
			RT	195		207		12		6%	
		WB	LT	40	905	29	727	-11	-178	-28%	-20%
			TH	860		695		-165		-19%	
			RT	5		3		-2		-40%	
		Intersection		1,725		1,484		-241		-14%	
22	Georgetown Pike and Dead Run Drive	NB	LT	280	305	290	316	10	11	4%	4%
			RT	25		26		1		4%	
		EB	TH	175	195	175	198	0	3	0%	2%
			RT	20		23		3		15%	
		WB	LT	10	635	7	410	-3	-225	-30%	-35%
			TH	625		403		-222		-36%	
		Intersection		1,135		924		-211		-19%	


Freeway Average Speed Comparison
VISSIM Speed
Observed Speed
2:15 PM
2:45 PM
3:15 PM
3:45 PM
4:15 PM
4:45 PM
5:15 PM
Northbound I-495
River Road
Clara Barton
G.W. Parkway
Georgetown Pike
Dulles Toll Road
Route 123
Direction of Travel
Southbound I-495
River Road
Clara Barton Parkway
G.W. Parkway
Georgetown Pike
Dulles Toll Road
Route 123
Direction of Travel
0
10
20
30
40
50
60
70
Average Speed (mph)



Freeway Average Speed Comparison
VISSIM Speed
Observed Speed
2:15 PM
2:45 PM
3:15 PM
3:45 PM
4:15 PM
4:45 PM
5:15 PM
Eastbound Dulles Toll Road
Westbound Dulles Toll Road
Route 123
I-495
Spring Hill Road
Direction of Travel
0
10
20
30
40
50
60
70
Average Speed (mph)


Freeway Average Speed Comparison
VISSIM Speed
Observed Speed
2:15 PM
2:45 PM
3:15 PM
3:45 PM
4:15 PM
4:45 PM
5:15 PM
Northbound I-495 Express Lanes
River Road
Clara Barton Parkway
G.W. Parkway
Georgetown Pike
Express Lanes End
Jones Branch Drive
Westpark Drive
Direction of Travel
Southbound I-495 Express Lanes
Express Lanes Begin
0
10
20
30
40
50
60
70
Average Speed (mph)


Freeway Average Speed Comparison
VISSIM Speed
Observed Speed
2:15 PM
2:45 PM
3:15 PM
3:45 PM
4:15 PM
4:45 PM
5:15 PM
Eastbound Dulles Access Road
Route 123
I-495
Spring Hill Road
Direction of Travel
Westbound Dulles Access Road
0
10
20
30
40
50
60
70
Average Speed (mph)

Queue Length Calibration

PM Peak Period (2:45-5:45 PM)

	Queue Criteria	Total	Percent	Target	Target Met
Approaches (n = 12)	Modeled queues qualitatively reflect the impacts of observed queues (e.g., spillback from ramp intersections, turn bay, or downstream intersection)	11	92%	85%	Yes

Interchange	Location	Observed Max Queue (feet)	VISSIM Max Queue (feet)	Max Queue Difference (feet)	Max Queue Difference (%)	Field Conditions Represented (Yes/No)
I-495 / Route 267 Interchange	Ramp from SR 267 EB to I-495 NB GP	4490	4,941	451	10%	Y
	Ramp from DAAR EB to I-495 NB GP	4430	4,098	-332	-7%	Y
	Ramp from SR 267 EB to I-495 SB GP	2620	2,602	-18	-1%	Y
I-495 / Georgetown Pike Road Interchange	Ramp from Georgetown Pike to I-495 NB GP	1110	1,137	27	2%	Y
	Georgetown Pike EB approaching I-495 NB GP ramps	1600*	1,600	0	0%	Y
	Georgetown Pike WB approaching I-495 NB GP ramps	2400*	2,407	-923	-28%	Y
	Balls Hill Rd NB approaching Georgetown Pike	1470	1,505	35	2%	Y
I-495 / George Washington Parkway Interchange	Ramp from GW Parkway NB/WB to I-495 NB GP	8000*	7,997	-3	0%	Y
Route 267 / Spring Hill Road Interchange	Spring Hill Rd NB approaching Lewinsville Rd	4000*	3,938	-62	-2%	Y
Route 267 / Route 123 Interchange	Ramp from SR 267 EB to Route 123 NB	1100	848	-252	-23%	Y
	Route 123 NB approaching Great Falls St	2380	1,450	-930	-39%	N
	Lewinsville Rd EB approaching Balls Hill Rd	2200*	2,201	1	0%	Y

* - Queues extend beyond the VISSIM network limits

Appendix E: Detailed Existing Conditions Freeway Operations Analysis Results

AM Peak Hour Freeway Volume, Density, and Speed

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
NORTHBOUND I-495 EXPRESS LANES					
Route 123	Upstream	Weave	6,633	45	37.3
	Off-ramp to NB Route 123	Ramp	1,093	21	69.7
	Between Ramps	Basic	5,505	52	26.4
	On-ramp from NB Route 123	Ramp	473	25	19.0
	Between Ramps	Weave	5,958	42	28.8
	Off-ramp to SB Route 123	Ramp	1,352	19	70.1
	Between Ramps	Basic	4,655	54	21.7
	On-ramp from SB Route 123	Ramp	285	30	9.5
	Downstream	Merge	4,921	55	17.9
I-495 between Route 123 and Dulles Toll Road		Basic	4,806	56	21.4
Dulles Toll Road	Upstream	Diverge	4,942	52	19.4
	Off-ramp to WB Dulles Toll Road	Ramp	894	34	26.4
	Between Ramps	Basic	4,006	47	24.3
	On-ramp from EB Dulles Toll Road	Ramp	1,699	33	54.5
	Between Ramps	Merge	5,640	40	35.7
	On-ramp from WB Dulles Toll Road	Ramp	529	40	13.2
	Downstream	Merge	6,026	36	43.9
I-495 between Dulles Toll Road and Georgetown Pike		Basic	6,975	24	65.9
Georgetown Pike	Upstream	Diverge	6,790	17	75.4
	Off-ramp to Georgetown Pike	Ramp	403	52	7.7
	Between Ramps	Basic	6,314	15	84.1
	On-ramp from Georgetown Pike	Ramp	1,191	16	75.6
I-495 between Georgetown Pike and George Washington Memorial Parkway		Weave	7,420	11	109.9
George Washington Memorial Parkway	Off-ramp to G.W. Memorial Parkway	Ramp	715	51	14.0
	Between Ramps	Basic	6,697	22	72.1
	On-ramp from G.W. Memorial Parkway	Ramp	1,487	21	69.9
I-495 between George Washington Memorial Parkway and Clara Barton Parkway		Weave	8,183	23	72.1
Clara Barton Parkway	Off-ramp to Clara Barton Parkway	Ramp	751	26	28.7
	Off-ramp to EB Clara Barton Parkway	Ramp	493	40	12.4
	Off-ramp to WB Clara Barton Parkway	Ramp	269	38	7.1
	Between Ramps	Basic	7,414	45	41.8
	On-ramp from WB Clara Barton Parkway	Ramp	110	37	3.0
	Downstream	Merge	7,498	54	27.6
I-495 between Clara Barton Parkway and River Road		Basic	7,531	54	34.3
NORTHBOUND I-495 EXPRESS LANES					
	Upstream	Diverge	1,964	57	11.5

AM Freeway Traffic Operations Results

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
Westpark Drive	Off-ramp to Westpark Drive	Ramp	506	58	8.8
	Between Ramps	Basic	1,469	67	10.9
	On-ramp from Westpark Drive	Ramp	158	40	3.9
I-495 Express Lanes between Westpark Drive and Jones Branch Connector		Weave	1,620	62	8.7
Jones Branch Connector/ Dulles Toll Road	Off-ramp to Jones Branch Connector	Ramp	195	58	3.4
	Between Ramps	Diverge	1,416	64	8.4
	Off-Ramp to WB Dulles Toll Road	Ramp	499	45	11.1
	Between Ramps	Basic	923	68	6.8
	On-ramp from Jones Branch Connector	Ramp	166	48	3.4
	Downstream	Merge	1,082	68	6.8
I-495 Express Lanes End		Basic	1,085	59	9.2
SOUTHBOUND I-495					
I-495 between River Road and Clara Barton Parkway		Basic	8,045	52	33.9
Clara Barton Parkway	Off-ramp to WB Clara Barton Parkway	Ramp	142	56	2.6
	Between Ramps	Basic	7,910	44	45.8
	On-ramp to WB Clara Barton Parkway	Ramp	457	40	11.3
	On-ramp from EB Clara Barton Parkway	Ramp	617	32	19.2
	On-ramp from Clara Barton Parkway	Ramp	1,077	42	12.8
I-495 between Clara Barton Parkway and George Washington Memorial Parkway		Weave	8,998	53	32.4
George Washington Memorial Parkway/ Georgetown Pike	Off-ramp to C-D Road	Ramp	2,285	51	22.5
	Off-ramp to G.W. Memorial Parkway	Ramp	1,183	30	39.6
	Between Ramps (C-D)	Basic	1,112	50	22.3
	On-ramp from G.W. Memorial Parkway	Ramp	444	48	4.6
	Between Ramps (C-D)	Weave	1,549	54	9.6
	Off-ramp to Georgetown Pike	Ramp	623	27	11.7
	Between Ramp (Mainline)	Basic	6,718	51	32.8
	On-Ramp from C-D Road	Ramp	930	38	27.4
	Between Ramps	Merge	7,612	38	46.9
	On-ramp from Georgetown Pike	Ramp	348	38	9.2
	Downstream	Merge	7,938	53	32.1
I-495 between Georgetown Pike and Dulles Toll Road		Diverge	7,966	52	35.4
Dulles Toll Road	Upstream	Diverge	7,397	52	28.3
	Off-ramp to WB Dulles Toll Road	Ramp	1,955	55	17.7
	Between Ramps	Diverge	5,458	51	24.9
	Off-ramp to EB Dulles Toll Road	Ramp	334	35	9.5
	Between Ramps	Basic	5,105	53	23.9
	On-ramp from EB Dulles Toll Road	Ramp	1,119	27	21.8
I-495 between Dulles Toll Road and Route 123		Weave	6,232	37	34.1
Route 123	Off-ramp to SB Route 123	Ramp	959	36	26.5

AM Freeway Traffic Operations Results

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
	Between Ramps	Basic	5,339	50	26.4
	On-ramp from SB Route 123	Ramp	484	26	18.7
	Between Ramps	Weave	5,805	51	22.9
	Off-ramp to NB Route 123	Ramp	397	20	19.9
	Between Ramps	Basic	5,436	54	25.0
	On-ramp from NB Route 123	Ramp	514	27	19.0
	Downstream	Weave	5,968	55	21.6
SOUTHBOUND I-495 EXPRESS LANES					
Dulles Toll Road/ Jones Branch Connector	Upstream	Diverge	548	67	4.1
	Off-ramp to EB Dulles Toll Road	Ramp	9	47	0.2
	Between Ramps	Diverge	540	67	3.6
	Off-ramp to Jones Branch Connector	Ramp	327	55	6.0
	Between Ramps	Basic	211	68	1.6
	On-ramp from Jones Branch Connector	Ramp	20	24	0.8
	Between Ramps	Merge	226	62	1.2
	On-ramp from EB Dulles Toll Road	Ramp	772	42	18.4
I-495 between Dulles Toll Road and Westpark Drive		Weave	996	67	4.2
Westpark Drive	Off-ramp to Westpark Drive	Ramp	319	50	3.2
	Between Ramps	Basic	689	68	5.1
	On-ramp from Westpark Drive	Ramp	25	37	0.7
	Downstream	Merge	706	67	3.5
EASTBOUND DULLES TOLL ROAD					
Spring Hill Road	Upstream	Diverge	5,779	18	57.7
	Off-ramp to Spring Hill Road	Ramp	1,365	14	97.5
	Between Ramps	Basic	4,376	53	18.8
	On-ramp from Dulles Access Road	Ramp	153	48	3.2
	Between Ramps	Merge	4,535	55	17.6
	On-ramp from Spring Hill Road	Ramp	202	38	2.7
Dulles Toll Road between Spring Hill Road and I-495		Weave	4,747	57	14.0
I-495	Off-ramp to SB I-495	Ramp	1,689	54	15.7
	Between Ramps	Diverge	3,043	51	12.8
	Off-ramp to NB I-495	Ramp	1,306	28	28.9
	Between Ramps	Basic	1,753	49	20.4
	On-ramp from SB I-495	Ramp	See above - Southbound I-495		
Dulles Toll Road Between I-495 and Route 123		Weave	2,054	46	25.1
Route 123	Off-ramp to SB Route 123	Ramp	728	29	25.6
	Between Ramps	Basic	1,349	46	31.1
	On-ramp from SB Route 123	Ramp	57	27	2.2
	Between Ramps	Weave	1,408	33	42.5
	Off-ramp to NB Route 123	Ramp	765	14	79.7
	Between Ramps	Basic	629	57	5.6
	On-ramp to NB Route 123	Ramp	167	26	6.5

AM Freeway Traffic Operations Results

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
	Between Ramps	Merge	785	54	4.9
	On-ramp from Dulles Access Road	Ramp	557	58	4.8
	Downstream	Merge	1,332	58	6.4
EASTBOUND DULLES ACCESS ROAD					
Spring Hill Road	Upstream	Diverge	1,344	57	10.2
	Off-ramp to Dulles Toll Road	Ramp	See above - Eastbound Dulles Toll Road		
	Downstream	Basic	1,205	57	10.5
I-495	Upstream	Diverge	1,208	57	7.0
	Off-ramp to I-495	Ramp	645	54	6.0
	Off-ramp to SB I-495	Ramp	278	37	7.5
	Off-ramp to NB I-495	Ramp	373	44	8.4
	Downstream	Basic	See above - Eastbound Dulles Toll Road		
WESTBOUND DULLES TOLL ROAD					
Route 123	Upstream	Diverge	3,413	56	20.4
	Off-ramp to Dulles Access Road	Ramp	249	58	2.1
	Between Ramps	Diverge	3,140	52	30.3
	Off-ramp to NB Route 123	Ramp	273	29	9.5
	Between Ramps	Diverge	2,847	53	22.8
	Off-ramp to SB Route 123	Ramp	795	26	30.7
	Between Ramps	Basic	2,072	56	18.5
	On-ramp from SB Route 123	Ramp	529	32	16.4
Dulles Toll Road between Route 123 and I-495		Weave	2,597	55	15.8
I-495	Off-ramp to NB I-495	Ramp	See above - Northbound I-495		
	Between Ramps	Basic	2,080	56	18.5
	On-ramp from NB I-495	Ramp	See above - Northbound I-495		
	Between Ramps	Basic	2,936	56	17.3
	On-ramp form SB I-495	Ramp	See above - Southbound I-495		
	Between Ramps	Merge	4,882	56	20.3
	On-ramp from I-495 Express Lanes	Ramp	504	68	3.7
Dulles Toll Road between I-495 and Spring Hill Road		Weave	5,406	54	16.8
Spring Hill Road	Off-ramp to Dulles Access Road	Ramp	574	54	10.6
	Between Ramps	Diverge	4,619	54	16.9
	Off-ramp to Spring Hill Road	Ramp	498	51	10.4
	Between Ramps	Basic	4,354	55	19.2
	On-ramp from Spring Hill Road	Ramp	160	35	4.6
	Downstream	Merge	4,414	54	14.7
WESTBOUND DULLES ACCESS ROAD					
Spring Hill Road	Upstream	Basic	See above - Westbound Dulles Toll Road		
	On-ramp from Dulles Toll Road	Ramp	See above - Westbound Dulles Toll Road		
	Downstream	Merge	815	58	6.2

PM Peak Hour Freeway Volume, Density, and Speed

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (Updated) (vpmpl)
NORTHBOUND I-495 EXPRESS LANES					
Route 123	Upstream	Weave	4,425	27	47.3
	Off-ramp to NB Route 123	Ramp	568	41	14.0
	Between Ramps	Basic	3,890	12	91.4
	On-ramp from NB Route 123	Ramp	574	3	173.1
	Between Ramps	Weave	4,487	7	126.5
	Off-ramp to SB Route 123	Ramp	512	18	27.7
	Between Ramps	Basic	3,997	8	132.0
	On-ramp from SB Route 123	Ramp	242	26	10.4
	Downstream	Merge	4,223	7	129.8
I-495 between Route 123 and Dulles Toll Road		Basic	4,097	9	120.4
Dulles Toll Road	Upstream	Diverge	4,224	6	133.6
	Off-ramp to WB Dulles Toll Road	Ramp	1,478	38	38.7
	Between Ramps	Basic	2,725	6	124.0
	On-ramp from EB Dulles Toll Road	Ramp	387	2	190.5
	Between Ramps	Merge	3,072	5	126.4
	On-ramp from WB Dulles Toll Road	Ramp	240	33	8.2
	Downstream	Merge	3,258	5	133.1
I-495 between Dulles Toll Road and Georgetown Pike		Basic	4,467	7	134.6
Georgetown Pike	Upstream	Diverge	4,463	7	122.5
	Off-ramp to Georgetown Pike	Ramp	162	53	3.0
	Between Ramps	Basic	4,330	7	125.6
	On-ramp from Georgetown Pike	Ramp	1,110	9	124.2
I-495 between Georgetown Pike and George Washington Memorial Parkway		Weave	5,466	8	110.6
George Washington Memorial Parkway	Off-ramp to G.W. Memorial Parkway	Ramp	53	55	1.0
	Between Ramps	Basic	5,433	12	103.5
	On-ramp from G.W. Memorial Parkway	Ramp	1,163	28	41.7
I-495 between George Washington Memorial Parkway and Clara Barton Parkway		Weave	6,615	19	77.3
Clara Barton Parkway	Off-ramp to Clara Barton Parkway	Ramp	1,059	27	39.8
	Off-ramp to EB Clara Barton Parkway	Ramp	434	40	10.8
	Off-ramp to WB Clara Barton Parkway	Ramp	642	38	17.0
	Between Ramps	Basic	5,535	13	102.4
	On-ramp from WB Clara Barton Parkway	Ramp	90	37	2.5
	Downstream	Merge	5,608	9	121.6
I-495 between Clara Barton Parkway and River Road		Basic	5,643	13	93.8
NORTHBOUND I-495 EXPRESS LANES					
	Upstream	Diverge	943	66	6.9

PM Freeway Traffic Operations Results

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (Updated) (vpmpl)
Westpark Drive	Off-ramp to Westpark Drive	Ramp	66	58	1.1
	Between Ramps	Basic	886	68	6.5
	On-ramp from Westpark Drive	Ramp	369	40	9.2
I-495 Express Lanes between Westpark Drive and Jones Branch Connector		Weave	1,255	61	6.9
Jones Branch Connector/ Dulles Toll Road	Off-ramp to Jones Branch Connector	Ramp	32	59	0.5
	Between Ramps	Diverge	1,215	65	7.1
	Off-Ramp to WB Dulles Toll Road	Ramp	488	45	10.8
	Between Ramps	Basic	734	68	5.4
	On-ramp from Jones Branch Connector	Ramp	328	48	6.8
	Downstream	Merge	1,057	68	6.7
I-495 Express Lanes End		Basic	1,057	42	11.3
SOUTHBOUND I-495					
I-495 between River Road and Clara Barton Parkway		Basic	5,459	20	65.4
Clara Barton Parkway	Off-ramp to WB Clara Barton Parkway	Ramp	11	56	0.2
	Between Ramps	Basic	5,698	15	98.7
	On-ramp to WB Clara Barton Parkway	Ramp	1,133	22	63.4
	On-ramp from EB Clara Barton Parkway	Ramp	454	32	14.1
	On-ramp from Clara Barton Parkway	Ramp	1,580	11	71.9
I-495 between Clara Barton Parkway and George Washington Memorial Parkway		Weave	7,323	31	48.6
George Washington Memorial Parkway/ Georgetown Pike	Off-ramp to C-D Road	Ramp	2,202	56	20.8
	Off-ramp to G.W. Memorial Parkway	Ramp	996	32	31.3
	Between Ramps (C-D)	Basic	1,217	52	23.6
	On-ramp from G.W. Memorial Parkway	Ramp	1,232	48	12.7
	Between Ramps (C-D)	Weave	2,446	43	24.2
	Off-ramp to Georgetown Pike	Ramp	1,220	22	28.6
	Between Ramp (Mainline)	Basic	5,035	28	66.4
	On-Ramp from C-D Road	Ramp	1,239	26	63.4
	Between Ramps	Merge	6,176	24	65.5
	On-ramp from Georgetown Pike	Ramp	547	32	17.2
	Downstream	Merge	6,659	20	79.3
I-495 between Georgetown Pike and Dulles Toll Road		Diverge	6,535	21	70.9
Dulles Toll Road	Upstream	Diverge	5,579	13	90.9
	Off-ramp to WB Dulles Toll Road	Ramp	2,338	51	23.1
	Between Ramps	Diverge	3,237	54	15.7
	Off-ramp to EB Dulles Toll Road	Ramp	239	29	8.3
	Between Ramps	Basic	2,992	56	13.3
	On-ramp from EB Dulles Toll Road	Ramp	878	37	11.9
I-495 between Dulles Toll Road and Route 123		Weave	3,877	55	14.2
Route 123	Off-ramp to SB Route 123	Ramp	508	37	13.8

PM Freeway Traffic Operations Results

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (Updated) (vpmpl)
	Between Ramps	Basic	3,413	57	15.1
	On-ramp from SB Route 123	Ramp	1,194	25	48.6
	Between Ramps	Weave	4,595	53	17.2
	Off-ramp to NB Route 123	Ramp	65	20	3.3
	Between Ramps	Basic	4,556	55	20.7
	On-ramp from NB Route 123	Ramp	1,245	26	48.6
	Downstream	Weave	5,813	17	69.2
SOUTHBOUND I-495 EXPRESS LANES					
Dulles Toll Road/ Jones Branch Connector	Upstream	Diverge	849	68	6.3
	Off-ramp to EB Dulles Toll Road	Ramp	38	47	0.8
	Between Ramps	Diverge	813	67	5.4
	Off-ramp to Jones Branch Connector	Ramp	31	55	0.6
	Between Ramps	Basic	782	68	5.8
	On-ramp from Jones Branch Connector	Ramp	253	24	10.6
	Between Ramps	Merge	1,012	53	6.4
	On-ramp from EB Dulles Toll Road	Ramp	394	40	10.0
I-495 between Dulles Toll Road and Westpark Drive		Weave	1,416	63	6.2
Westpark Drive	Off-ramp to Westpark Drive	Ramp	43	49	0.4
	Between Ramps	Basic	1,389	68	10.3
	On-ramp from Westpark Drive	Ramp	450	38	12.0
	Downstream	Merge	1,820	60	10.1
EASTBOUND DULLES TOLL ROAD					
Spring Hill Road	Upstream	Diverge	3,693	58	10.7
	Off-ramp to Spring Hill Road	Ramp	290	46	6.2
	Between Ramps	Basic	3,373	57	14.0
	On-ramp from Dulles Access Road	Ramp	347	47	7.4
	Between Ramps	Merge	3,718	57	13.9
	On-ramp from Spring Hill Road	Ramp	419	36	5.9
Dulles Toll Road between Spring Hill Road and I-495		Weave	4,138	57	12.1
I-495	Off-ramp to SB I-495	Ramp	1,104	47	11.7
	Between Ramps	Diverge	3,018	56	10.7
	Off-ramp to NB I-495	Ramp	267	5	50.1
	Between Ramps	Basic	2,726	55	21.5
	On-ramp from SB I-495	Ramp	See above - Southbound I-495		
Dulles Toll Road Between I-495 and Route 123		Weave	2,916	55	17.7
Route 123	Off-ramp to SB Route 123	Ramp	129	32	4.0
	Between Ramps	Basic	2,821	55	25.7
	On-ramp from SB Route 123	Ramp	38	27	1.4
	Between Ramps	Weave	2,869	51	18.9
	Off-ramp to NB Route 123	Ramp	681	23	31.8
	Between Ramps	Basic	2,192	54	20.2
	On-ramp to NB Route 123	Ramp	432	25	17.2

PM Freeway Traffic Operations Results

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (Updated) (vpmpl)
	Between Ramps	Merge	2,577	45	19.9
	On-ramp from Dulles Access Road	Ramp	738	58	6.4
	Downstream	Merge	3,270	33	37.8
EASTBOUND DULLES ACCESS ROAD					
Spring Hill Road	Upstream	Diverge	1,613	56	12.4
	Off-ramp to Dulles Toll Road	Ramp	See above - Eastbound Dulles Toll Road		
	Downstream	Basic	1,286	57	11.3
I-495	Upstream	Diverge	1,288	56	7.8
	Off-ramp to I-495	Ramp	525	8	47.7
	Off-ramp to SB I-495	Ramp	239	35	6.8
	Off-ramp to NB I-495	Ramp	219	1	161.7
	Downstream	Basic	See above - Eastbound Dulles Toll Road		
WESTBOUND DULLES TOLL ROAD					
Route 123	Upstream	Diverge	1,870	58	10.8
	Off-ramp to Dulles Access Road	Ramp	457	58	3.9
	Between Ramps	Diverge	1,408	57	12.3
	Off-ramp to NB Route 123	Ramp	64	29	2.2
	Between Ramps	Diverge	1,337	56	10.0
	Off-ramp to SB Route 123	Ramp	150	27	5.6
	Between Ramps	Basic	1,195	57	10.4
	On-ramp from SB Route 123	Ramp	1,100	32	34.9
Dulles Toll Road between Route 123 and I-495		Weave	2,289	51	15.1
I-495	Off-ramp to NB I-495	Ramp	See above - Northbound I-495		
	Between Ramps	Basic	2,063	56	18.3
	On-ramp from NB I-495	Ramp	See above - Northbound I-495		
	Between Ramps	Basic	3,497	56	20.9
	On-ramp form SB I-495	Ramp	See above - Southbound I-495		
	Between Ramps	Merge	5,832	52	25.0
	On-ramp from I-495 Express Lanes	Ramp	523	68	3.9
Dulles Toll Road between I-495 and Spring Hill Road		Weave	6,384	50	21.7
Spring Hill Road	Off-ramp to Dulles Access Road	Ramp	1,229	52	23.6
	Between Ramps	Diverge	4,917	46	22.6
	Off-ramp to Spring Hill Road	Ramp	219	55	4.0
	Between Ramps	Basic	4,946	44	33.8
	On-ramp from Spring Hill Road	Ramp	891	30	30.0
	Downstream	Merge	5,586	48	19.1
WESTBOUND DULLES ACCESS ROAD					
Spring Hill Road	Upstream	Basic	See above - Westbound Dulles Toll Road		
	On-ramp from Dulles Toll Road	Ramp	See above - Westbound Dulles Toll Road		
	Downstream	Merge	1,676	57	12.9

Appendix F: Detailed Existing Conditions Arterial Operations Analysis Results

AM Arterial Traffic Operations Results

VISSIM AM Peak Hour Intersection Volume, Delay, and Queue Length

Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
Route 123 and Tysons Boulevard	NB	LT	100	2,002	93.0	24.0	111	111	399	399
		TH	1,699		20.5		111		399	
		RT	203		19.3		111		399	
	SB	LT	149	4,022	121.4	26.8	98	98	349	1,037
		TH	1,917		26.1		85		1,037	
		RT	1,956		20.3		0		9	
	EB	LT	526	662	79.4	64.1	106	106	312	312
		RT	136		4.9		40		221	
	WB	LT	64	374	71.1	47.6	22	77	99	151
		RT	310		42.7		77		151	
	Intersection		7,060		30.6					
Westpark Drive and Tysons Connector	NB	TH	477	602	17.6	16.9	34	34	241	241
		RT	125		14.5		29		235	
	SB	LT	59	283	11.9	12.3	16	16	173	173
		TH	224		12.4		16		173	
	WB	LT	343	830	22.9	19.1	69	77	358	374
		RT	487		16.5		77		374	
	Intersection		1,715		17.2					
Tysons Connector and Express Lanes Ramps	NB	LT	517	517	16.1	16.1	22	22	151	151
	SB	RT	319	319	11.4	11.4	12	12	100	100
	EB	LT	158	183	11.2	9.8	9	9	153	153
		RT	25		0.8		5		141	
	Intersection		1,019		13.5					
Route 123 and Capital One Tower Drive/ Old Meadow Road	NB	LT	300	2,990	293.5	119.0	713	770	1,942	2,000
		TH	2,182		99.3		713		1,942	
		RT	508		100.4		770		2,000	
	SB	LT	95	2,463	126.9	19.7	112	112	707	707
		TH	2,091		16.5		112		707	
		RT	277		7.0		112		707	
	EB	LT	19	106	105.6	149.9	100	100	227	227
		RT	87		159.6		100		227	
	WB	LT	316	468	69.5	59.6	113	115	443	447
		TH	57		74.2		113		443	
		RT	95		18.0		115		447	
	Intersection		6,027		74.3					
	NB	LT	73	2,288	101.9	16.1	71	71	503	503
		TH	1,791		13.4		71		503	
		RT	424		13.1		71		503	
	SB	LT	160	2,643	112.5	19.1	162	162	835	835
		TH	2,257		13.4		162		835	

AM Arterial Traffic Operations Results

Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
Route 123 and Scotts Crossing Boulevard/ Colshire Drive		**RT**	226		9.8		162		835	
	EB	**LT**	55	197	83.6	39.5	40	44	183	189
		TH	28		89.3		40		183	
		RT	114		6.1		44		189	
	WB	**LT**	94	143	75.3	61.3	33	33	134	134
		TH	15		73.5		33		134	
		RT	34		17.2		33		134	
	Intersection		5,271		19.7					
Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road	**NB**	**TH**	1,530	1,878	49.9	42.5	201	201	759	759
		RT	348		10.2		169		716	
	SB	**LT**	83	1,919	118.0	44.9	242	242	925	925
		TH	1,836		41.6		242		925	
	EB	**LT**	40	734	80.6	43.7	121	121	764	764
		TH	235		83.2		121		764	
		RT	459		20.2		1		115	
	WB	**LT**	357	459	88.1	77.2	145	176	350	386
		RT	102		39.3		176		386	
	Intersection		4,990		46.8					
Route 123 and Lewinsville Road/ Great Falls Street	**NB**	**LT**	584	2,495	119.8	124.0	2,103	2,103	3,782	3,797
		TH	1,524		136.4		2,103		3,782	
		RT	387		82.0		2,005		3,797	
	SB	**LT**	38	1,505	100.4	78.4	376	376	1,218	1,218
		TH	1,062		91.2		376		1,218	
		RT	405		42.7		340		1,218	
	EB	**LT**	324	855	77.2	54.0	127	127	303	303
		TH	256		65.0		127		303	
		RT	275		16.5		17		190	
	WB	**LT**	387	770	129.5	122.2	379	379	968	968
		TH	335		117.0		379		968	
		RT	48		100.5		321		907	
	Intersection		5,625		100.9					
Lewinsville Road and Balls Hill Road	**SB**	**LT**	161	223	176.5	167.4	230	230	744	744
		RT	62		143.8		230		744	
	EB	**LT**	60	746	26.9	23.7	52	52	497	497
		TH	686		23.5		52		497	
	WB	**TH**	1,107	1,327	4.5	4.3	20	33	217	262
		RT	220		3.7		33		262	
	Intersection		2,296		26.5					
Jones Branch Drive and Jones	**NB**	**TH**	384	424	20.6	19.9	28	28	200	200
		RT	40		13.4		8		151	
	SB	**LT**	149	450	9.3	8.3	10	10	104	104
		TH	301		7.9		10		104	

AM Arterial Traffic Operations Results

Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
Branch Connector	WB	LT	168	525	27.9	15.4	31	53	218	269
		RT	357		9.5		53		269	
	Intersection		1,399		14.5					
Jones Branch Connector and Express Lanes Ramps	NB	LT	196	196	13.2	13.2	10	10	79	79
	SB	RT	331	331	11.0	11.0	14	14	94	94
	EB	LT	167	167	10.1	10.1	9	9	133	133
	Intersection		694		11.4					
International Drive and Spring Hill Road/ Jones Branch Drive	NB	LT	156	430	62.4	53.7	68	79	218	248
		TH	197		65.3		68		218	
		RT	77		6.6		79		248	
	SB	LT	778	2,079	46.4	42.2	245	245	468	468
		TH	733		51.5		245		468	
		RT	568		24.5		183		399	
	EB	LT	150	595	64.3	54.5	103	103	306	306
		TH	333		66.5		103		306	
		RT	112		6.0		57		250	
	WB	LT	30	348	66.7	64.5	68	68	206	206
		TH	160		71.8		68		206	
		RT	158		56.7		39		206	
	Intersection		3,452		48.0					
Spring Hill Road and Dulles Toll Road Eastbound Ramps	NB	TH	418	513	33.5	27.4	49	49	233	233
		RT	95		0.5		1		80	
	SB	LT	117	1,037	31.8	51.8	114	114	461	461
		TH	920		54.4		114		461	
	EB	LT	169	1,342	304.4	311.4	5,506	5,514	6,674	6,682
		TH	0		0.0		5,506		6,674	
		RT	1,173		312.5		5,514		6,682	
	Intersection		2,892		168.0					
Spring Hill Road and Dulles Toll Road Westbound Ramps	NB	LT	78	589	38.1	13.3	33	33	334	334
		TH	511		9.5		33		334	
	SB	TH	615	691	20.3	19.5	49	54	518	535
		RT	76		13.4		54		535	
	WB	LT	420	480	75.5	74.6	102	120	399	430
		TH	9		68.4		102		399	
		RT	51		67.7		120		430	
	Intersection		1,760		32.5					
Spring Hill Road and Lewinsville Road	NB	LT	40	557	84.1	60.4	124	124	722	722
		TH	115		83.1		124		722	
		RT	402		51.5		124		722	
	SB	LT	22	281	80.9	80.7	160	160	590	590
		TH	254		80.9		160		590	
		RT	5		70.4		160		590	
	EB	LT	8	573	73.3	52.7	223	223	898	898

AM Arterial Traffic Operations Results

Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
		TH	422		66.0		223		898	
		RT	143		12.2		9		366	
	WB	LT	298		38.6		82		431	
		TH	338	655	30.5	33.3	82	82	431	431
		RT	19		1.7		2		134	
	Intersection		2,066		52.4					
Georgetown Pike and Helga Place/ Linganore Drive	NB	LT	1		10.9		0		49	
		TH	0	8	0.0	6.7	0	0	49	49
		RT	7		6.1		0		48	
	SB	LT	7				2		63	
		TH	0	8	56.1	50.1	1	2	81	89
		RT	1				1		89	
	EB	TH	1,118	1,118	44.0	44.0	586	586	1,943	1,943
		RT	0		0.0		586		1,943	
	WB	LT	4		21.3		1		38	
		TH	579	594	0.4	0.5	0	1	36	38
		RT	11		0.7		0		36	
	Intersection		1,728		56.1					
Georgetown Pike and I-495 Southbound Ramps	SB	LT	217		65.4		85		365	
		TH	3	628	73.9	25.1	85	85	365	365
		RT	408		3.4		29		322	
	EB	TH	1,088	1,138	25.8	24.7	202	202	544	544
		RT	50		0.5		142		439	
	WB	LT	300	487	31.7	22.5	36	36	322	322
		TH	187		7.9		36		322	
	Intersection		2,253		24.3					
Georgetown Pike and I-495 Northbound Ramps	NB	LT	95		141.1		51		223	
		TH	9	409	143.4	83.2	51	51	223	223
		RT	305		63.3		14		195	
	EB	LT	820	1,302	22.2	15.3	85	85	421	421
		TH	482		3.5		85		421	
	WB	TH	386	767	34.8	19.7	69	69	403	403
		RT	381		4.3		2		48	
	Intersection		2,478		27.8					
Georgetown Pike and Balls Hill Road	NB	LT	281		64.5		153		630	
		TH	36	382	63.4	58.8	153	153	630	630
		RT	65		32.0		93		572	
	SB	LT	19		55.1		10		87	
		TH	21	85	48.8	26.3	10	10	87	87
		RT	45		3.6		5		75	
	EB	LT	64		86.2		55		325	
		TH	478	778	17.2	19.3	55	55	325	343
		RT	236		5.3		40		343	

AM Arterial Traffic Operations Results

Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	WB	LT	54	510	12.3	17.9	32	32	284	284
		TH	440		19.1		32		284	
		RT	16		4.6		32		284	
	Intersection		1,755		27.8					
Georgetown Pike and Dead Run Drive	NB	LT	77	97	9.3	8.7	5	5	103	103
		RT	20		6.5		4		100	
	EB	TH	508	564	1.0	1.0	1	1	123	123
		RT	56		1.2		1		123	
	WB	LT	53	488	3.8	0.8	1	1	56	56
		TH	435		0.4		0		0	
	Intersection		1,149		9.3					

AM Arterial Traffic Operations Results

Synchro AM Peak Hour Intersection Approach Delay and Level of Service

Signalization	Intersection Name	Approach	Delay	LOS
Signalized	Old Dominion Drive at Spring Hill Road	Northbound (Springhill Road)	21.5	C
		Southbound (Springhill Road)	26.0	C
		Eastbound (Old Dominion Drive)	11.9	B
		Westbound (Old Dominion Drive)	7.9	A
Signalized	Old Dominion Drive at Swinks Mill Road	Northbound (Swinks Mill Road)	48.9	D
		Southbound (Swinks Mill Road)	38.0	D
		Eastbound (Old Dominion Drive)	25.0	C
		Westbound (Old Dominion Drive)	8.5	A
Signalized	Old Dominion Drive at Balls Hill Road	Northbound (Balls Hill Road)	121.0	F
		Southbound (Balls Hill Road)	112.0	F
		Eastbound (Old Dominion Drive)	82.1	F
		Westbound (Old Dominion Drive)	113.3	F
Signalized	Route 123 at Old Dominion Drive	Northbound (Route 123)	17.6	B
		Southbound (Route 123)	29.4	C
		Eastbound (Old Dominion Drive)	81.7	F
		Westbound (Old Dominion Drive)	77.7	E
Unsignalized	Georgetown Pike at Swinks Mill Road	Northbound (Swinks Mill Road)	106.9	F
		Southbound (Driveway)	0.0	A
		Eastbound (Georgetown Pike)	0.0	A
		Westbound (Georgetown Pike)	3.4	A
Unsignalized	Georgetown Pike at Spring Hill Road	Northbound (Spring Hill Road)	18.2	A
		Eastbound (Georgetown Pike)	0.0	A

AM Arterial Traffic Operations Results

Signalization	Intersection Name	Approach	Delay	LOS
		Westbound (Georgetown Pike)	1.2	A
Unsignalized	Lewinsville Road at Swinks Mill Road	Southbound (Swinks Mill Road)	40.6	E
		Eastbound (Lewinsville Road)	2.6	A
		Westbound (Lewinsville Road)	0	A
Unsignalized	Route 123 at Ingleside Avenue	Northbound (Route 123)	0.3	A
		Southbound (Route 123)	0.6	A
		Eastbound (Ingleside Avenue)	13.5	B
		Westbound (Ingleside Avenue)	10.4	B
Unsignalized	Douglass Drive at Route 193 (Georgetown Pike)	Northbound (Douglass Drive)	36.8	E
		Southbound (Douglass Drive)	24.8	C
		Eastbound (Georgetown Pike)	0.6	A
		Westbound (Georgetown Pike)	1.9	A

AM Arterial Traffic Operations Results

Synchro AM Peak Hour Arterial Queue Lengths

Signalization	Intersection Name	Approach	Queue Length	
			50th (feet)	95th (feet)
Signalized	Old Dominion Drive at Spring Hill Road	EBL*	137	239
		EBT*	137	239
		EBR	31	99
		WBL*	60	136
		WBT*	60	136
		WBR	1	6
		NBL*	61	113
		NBT*	61	113
		NBR*	61	113
		SBL*	77	138
		SBT*	77	138
		SBR*	77	138
Signalized	Old Dominion Drive at Swinks Mill Road	EBL*	380	651
		EBT*	380	651
		EBR*	380	651
		WBL*	61	130
		WBT*	61	130
		WBR*	61	130
		NBL*	218	486
		NBT*	218	486
		NBR*	218	486
		SBL*	120	268
		SBT*	120	268
		SBR*	120	268
Signalized	Old Dominion Drive at Balls Hill Road	EBL*	441	670
		EBT*	441	670
		EBR*	441	670
		WBL*	243	439
		WBT*	243	439
		WBR*	243	439
		NBL*	271	454
		NBT*	271	454
		NBR*	271	454
		SBL*	454	891
		SBT*	454	891
		SBR*	454	891

AM Arterial Traffic Operations Results

Signalization	Intersection Name	Approach	Queue Length	
			50th (feet)	95th (feet)
Signalized	Route 123 at Old Dominion Drive	EBL	106	195
		EBL	136	245
		EBT	218	446
		EBT	233	457
		EBR	38	212
		WBL	245	347
		WBL	279	363
		WBT	347	832
		WBTR	167	560
		NBL	10	54
		NBT	167	365
		NBT	185	386
		NBR	27	165
		SBL	38	125
		SBT	207	380
		SBTR	239	412
Unsignalized	Georgetown Pike at Swinks Mill Road	WBL*	86	200
		WBT*	86	200
		NBL*	289	336
		NBT*	289	336
		NBR*	289	336
Unsignalized	Georgetown Pike at Spring Hill Road	EBT*	0	2
		EBR*	0	2
		WBL*	38	132
		WBT*	38	132
		NBL*	20	43
		NBR*	20	43
Unsignalized	Lewinsville Road at Swinks Mill Road	EBL	51	92
		WBT*	2	14
		WBR*	2	14
		SBL	36	78
		SBR	55	104
Unsignalized	Route 123 at Ingleside Avenue	EBR	46	111
		WBR	27	60
		NBL	21	54
		NBT	1	37
		NBTR	1	7
		SBL	22	55
		SBT	9	68

AM Arterial Traffic Operations Results

Signalization	Intersection Name	Approach	Queue Length	
			50th (feet)	95th (feet)
		SBTR	58	402
Unsignalized	Douglass Drive at Route 193 (Georgetown Pike)	EBL*	21	80
		EBT*	21	80
		EBR*	21	80
		WBL*	42	121
		WBT*	42	121
		WBR*	42	121
		NBL*	77	146
		NBT*	77	146
		NBR*	77	146
		SBL*	33	64
		SBT*	33	64
		SBR*	33	64
* indicates a single lane that includes more than one movement for which total queueing feet are shown (ie. queueing associated with a single EBLT lane is shown above both for the EB L and T movements)				

PM Arterial Traffic Operations Results

VISSIM PM Peak Hour Intersection Volume, Delay, and Queue Length

Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
Route 123 and Tysons Boulevard	NB	LT	24	2,098	117.7	73.5	385	385	1,320	1,320
		TH	1,835		74.3		385		1,320	
		RT	239		63.2		385		1,320	
	SB	LT	199	2,490	163.8	45.4	186	186	504	504
		TH	1,466		43.8		122		504	
		RT	825		19.7		0		0	
	EB	LT	1,211	1,359	102.8	96.9	476	476	1,406	1,406
		RT	148		48.4		401		1,316	
	WB	LT	110	521	40.9	151.8	18	430	98	1,027
		RT	411		181.5		430		1,027	
	Intersection		6,468		73.9					
Westpark Drive and Tysons Connector	NB	TH	260	716	4.9	5.3	8	8	162	162
		RT	456		5.5		6		156	
	SB	LT	366	840	5.4	5.3	16	16	266	266
		TH	474		5.2		16		266	
	WB	LT	50	111	19.9	12.0	6	6	83	98
		RT	61		5.6		4		98	
	Intersection		1,667		5.7					
Tysons Connector and Express Lanes Ramps	NB	LT	67	67	14.8	14.8	3	3	61	61
	SB	RT	43	43	5.7	5.7	1	1	36	36
	EB	LT	369	822	7.7	5.1	14	14	239	239
		RT	453		3.1		11		227	
	Intersection		932		5.8					
Route 123 and Capital One Tower Drive/ Old Meadow Road	NB	LT	49	2,251	116.6	39.7	168	187	765	823
		TH	1,994		36.7		168		765	
		RT	208		50.6		187		823	
	SB	LT	38	2,078	123.1	22.0	112	112	684	684
		TH	2,026		20.2		112		684	
		RT	14		4.2		112		684	
	EB	LT	50	400	115.3	64.6	134	134	490	490
		RT	350		57.3		134		490	
	WB	LT	531	609	90.2	84.8	214	218	581	585
		TH	5		94.4		214		581	
		RT	73		44.8		218		585	
	Intersection		5,338		39.8					

PM Arterial Traffic Operations Results

Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
Route 123 and Scotts Crossing Boulevard/ Colshire Drive	NB	LT	50	2,122	123.4	8.9	45	45	580	580
		TH	2,003		6.2		45		580	
		RT	69		3.0		45		580	
	SB	LT	58	1,804	108.1	17.2	74	74	465	465
		TH	1,708		14.5		74		465	
		RT	38		2.4		74		465	
	EB	LT	36	164	80.9	27.3	20	23	108	114
		TH	10		79.4		20		108	
		RT	118		6.5		23		114	
	WB	LT	253	332	110.1	88.3	109	109	399	399
		TH	5		91.2		109		399	
		RT	74		13.4		109		399	
	Intersection		4,422		18.9					
Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road	NB	TH	1,777	2,123	28.5	26.5	151	151	848	848
		RT	346		15.9		124		805	
	SB	LT	28	1,467	113.5	27.3	106	106	600	600
		TH	1,439		25.6		106		600	
	EB	LT	9	130	73.8	50.6	35	35	177	177
		TH	75		77.2		35		177	
		RT	46		2.9		0		19	
	WB	LT	312	403	137.1	125.9	193	203	366	377
		RT	91		87.6		203		377	
	Intersection		4,123		37.2					
Route 123 and Lewinsville Road/ Great Falls Street	NB	LT	298	2,169	208.6	80.6	564	564	1,921	1,938
		TH	1,394		69.8		564		1,921	
		RT	477		32.1		525		1,938	
	SB	LT	54	2,002	146.7	117.5	1,292	1,292	2,719	2,719
		TH	1,699		119.7		1,292		2,719	
		RT	249		95.8		1,125		2,698	
	EB	LT	371	1,050	74.8	53.3	187	187	318	318
		TH	304		67.8		187		318	
		RT	375		20.3		24		246	
	WB	LT	367	712	116.6	111.8	299	299	713	713
		TH	313		110.1		299		713	
		RT	32		73.9		242		653	

PM Arterial Traffic Operations Results

Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	Intersection		5,933		91.9					
Lewinsville Road and Balls Hill Road	SB	LT	145	188	50.0	45.7	30	30	217	217
		RT	43		31.0		30		217	
	EB	LT	45	937	240.0	225.9	1,824	1,824	2,223	2,223
		TH	892		225.2		1,824		2,223	
	WB	TH	668	864	7.7	7.3	39	39	313	313
		RT	196		6.0		35		301	
	Intersection		1,989		113.9					
Jones Branch Drive and Jones Branch Connector	NB	TH	255	494	13.1	11.3	19	19	236	236
		RT	239		9.4		7		188	
	SB	LT	348	703	4.0	3.2	4	4	114	114
		TH	355		2.4		4		114	
	WB	LT	26	63	31.5	15.7	4	4	73	104
		RT	37		4.7		3		104	
	Intersection		1,260		7.0					
Jones Branch Connector and Express Lanes Ramps	NB	LT	32	32	11.9	11.9	2	2	47	47
	SB	RT	31	31	9.6	9.6	1	1	46	46
	EB	LT	329	329	12.5	12.5	23	23	236	236
	Intersection		392		12.2					
International Drive and Spring Hill Road/ Jones Branch Drive	NB	LT	146	774	62.3	67.2	167	186	509	538
		TH	585		72.1		167		509	
		RT	43		17.6		186		538	
	SB	LT	137	589	93.0	62.7	86	86	228	228
		TH	261		89.0		86		228	
		RT	191		5.3		29		159	
	EB	LT	435	736	71.2	55.5	131	131	435	459
		TH	143		63.7		131		435	
		RT	158		4.7		122		459	
	WB	LT	52	1,082	61.0	59.1	185	185	799	799
		TH	350		63.2		185		799	
		RT	680		56.8		152		799	
	Intersection		3,181		60.9					
Spring Hill Road and Dulles Toll Road Eastbound Ramps	NB	TH	1,348	1,694	9.3	7.6	49	49	455	455
		RT	346		0.9		18		303	
	SB	LT	80	505	22.0	4.6	4	4	118	118
		TH	425		1.4		4		118	
	EB	LT	105	284	80.2	75.6	57	59	190	199
		TH	9		76.6		57		190	
		RT	170		72.8		59		199	
	Intersection		2,483		14.8					

PM Arterial Traffic Operations Results

Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
Spring Hill Road and Dulles Toll Road Westbound Ramps	NB	LT	747	1,428	35.1	27.5	155	155	534	534
		TH	681		19.2		155		534	
	SB	TH	402	543	24.0	21.7	40	45	390	407
		RT	141		15.2		45		407	
	WB	LT	105	218	59.8	56.1	26	37	149	180
		TH	19		67.0		26		149	
		RT	94		49.9		37		180	
	Intersection		2,189		28.9					
Spring Hill Road and Lewinsville Road	NB	LT	74	752	97.9	82.4	519	519	1,519	1,519
		TH	266		101.4		519		1,519	
		RT	412		67.4		519		1,519	
	SB	LT	18	206	75.0	74.2	104	104	411	411
		TH	173		74.0		104		411	
		RT	15		76.3		104		411	
	EB	LT	9	353	68.9	63.4	157	157	647	647
		TH	292		73.3		157		647	
		RT	52		6.8		1		47	
	WB	LT	319	809	43.5	40.3	139	139	585	585
		TH	473		39.3		139		585	
		RT	17		7.8		17		288	
	Intersection		2,120		62.4					
Georgetown Pike and Helga Place/ Linganore Drive	NB	LT	0	0	0.0	0.0	0	0	0	0
		TH	0		0.0		0		0	
		RT	0		0.0		0		0	
	SB	LT	3	3	245.1	245.1	4	4	48	74
		TH	0		0.0		2		66	
		RT	0		0.0		3		74	
	EB	TH	607	607	54.9	54.9	237	237	694	694
		RT	0		0.0		237		694	
	WB	LT	6	917	13.0	0.7	1	1	51	61
		TH	911		0.6		0		61	
		RT	0		0.0		0		61	
	Intersection		1,527		245.1					
Georgetown Pike and I-495 Southbound Ramps	SB	LT	299	1,223	50.7	29.6	150	150	627	627
		TH	162		52.1		150		627	
		RT	762		16.5		70		572	
	EB	TH	579	625	50.0	46.3	237	237	540	540
		RT	46		0.5		164		434	
	WB	LT	347	505	37.9	28.1	53	53	401	401
		TH	158		6.5		53		401	
	Intersection		2,353		33.7					

PM Arterial Traffic Operations Results

Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
Georgetown Pike and I-495 Northbound Ramps	**NB**	**LT**	43	163	309.4	290.7	32	32	173	173
		TH	62		314.5		32		173	
		RT	58		251.5		6		145	
	EB	**LT**	525	879	26.0	16.3	52	52	435	435
		TH	354		2.0		52		435	
	WB	**TH**	465	989	21.9	45.3	171	171	438	438
		RT	524		66.1		169		359	
	Intersection		2,031		52.4					
Georgetown Pike and Balls Hill Road	**NB**	**LT**	191	206	1,030.7	1,028.7	1,462	1,510	1,519	1,567
		TH	4		1,145.2		1,462		1,519	
		RT	11		951.8		1,510		1,567	
	SB	**LT**	5	138	43.1	20.0	8	8	84	84
		TH	31		40.5		8		84	
		RT	102		12.6		3		73	
	EB	**LT**	24	413	69.7	7.7	12	12	93	93
		TH	182		5.5		12		93	
		RT	207		2.5		3		91	
	WB	**LT**	29	727	29.6	130.4	526	526	617	617
		TH	695		134.6		526		617	
		RT	3		125.9		526		617	
	Intersection		1,484		210.7					
Georgetown Pike and Dead Run Drive	**NB**	**LT**	290	316	141.4	140.4	352	352	997	997
		RT	26		129.0		350		995	
	EB	**TH**	175	198	0.2	0.2	0	0	3	3
		RT	23		0.6		0		3	
	WB	**LT**	7	410	304.2	463.6	1,529	1,529	1,648	1,648
		TH	403		466.4		1,463		1,582	
	Intersection		924		141.4					

PM Arterial Traffic Operations Results

Synchro PM Peak Hour Intersection Approach Delay and Level of Service

Signalization	Intersection Name	Approach	Delay	LOS
Signalized	Old Dominion Drive at Spring Hill Road	Northbound (Springhill Road)	28.5	C
		Southbound (Springhill Road)	19.1	B
		Eastbound (Old Dominion Drive)	9.9	A
		Westbound (Old Dominion Drive)	15.7	B
Signalized	Old Dominion Drive at Swinks Mill Road	Northbound (Swinks Mill Road)	31.2	C
		Southbound (Swinks Mill Road)	21.9	C
		Eastbound (Old Dominion Drive)	13.4	B
		Westbound (Old Dominion Drive)	17.1	B
Signalized	Old Dominion Drive at Balls Hill Road	Northbound (Balls Hill Road)	135.0	F
		Southbound (Balls Hill Road)	247.8	F
		Eastbound (Old Dominion Drive)	179.1	F
		Westbound (Old Dominion Drive)	115.8	F
Signalized	Route 123 at Old Dominion Drive	Northbound (Route 123)	27.0	C
		Southbound (Route 123)	40.2	D
		Eastbound (Old Dominion Drive)	77.2	E
		Westbound (Old Dominion Drive)	86.1	F
Unsignalized	Georgetown Pike at Swinks Mill Road	Northbound (Swinks Mill Road)	14.1	B
		Southbound (Driveway)	0.0	A
		Eastbound (Georgetown Pike)	0.0	A
		Westbound (Georgetown Pike)	2.4	A
Unsignalized	Georgetown Pike at Spring Hill Road	Northbound (Spring Hill Road)	13.2	B
		Eastbound (Georgetown Pike)	0.0	A

PM Arterial Traffic Operations Results

Signalization	Intersection Name	Approach	Delay	LOS
		Westbound (Georgetown Pike)	1.2	A
Unsignalized	Lewinsville Road at Swinks Mill Road	Southbound (Swinks Mill Road)	68.2	F
		Eastbound (Lewinsville Road)	2.8	A
		Westbound (Lewinsville Road)	0.0	A
Unsignalized	Route 123 at Ingleside Avenue	Northbound (Route 123)	3.3	A
		Southbound (Route 123)	0.2	A
		Eastbound (Ingleside Avenue)	23.2	C
		Westbound (Ingleside Avenue)	10.7	A
Unsignalized	Douglass Drive at Route 193 (Georgetown Pike)	Northbound (Douglass Drive)	104.5	F
		Southbound (Douglass Drive)	42.6	E
		Eastbound (Georgetown Pike)	0.5	A
		Westbound (Georgetown Pike)	3.7	A

PM Arterial Traffic Operations Results

Synchro PM Peak Hour Arterial Queue Lengths

Signalization	Intersection Name	Approach	Queue Length	
			50th (feet)	95th (feet)
Signalized	Old Dominion Drive at Spring Hill Road	EBL*	78	147
		EBT*	78	147
		EBR	14	35
		WBL*	156	294
		WBT*	156	294
		WBR	4	15
		NBL*	106	186
		NBT*	106	186
		NBR*	106	186
		SBL*	48	89
		SBT*	48	89
		SBR*	48	89
Signalized	Old Dominion Drive at Swinks Mill Road	EBL*	209	410
		EBT*	209	410
		EBR*	209	410
		WBL*	215	391
		WBT*	215	391
		WBR*	215	391
		NBL*	130	269
		NBT*	130	269
		NBR*	130	269
		SBL*	81	190
		SBT*	81	190
		SBR*	81	190
Signalized	Old Dominion Drive at Balls Hill Road	EBL*	283	430
		EBT*	283	430
		EBR*	283	430
		WBL*	994	1093
		WBT*	994	1093
		WBR*	994	1093
		NBL*	228	414
		NBT*	228	414
		NBR*	228	414
		SBL*	628	1149
		SBT*	628	1149
		SBR*	628	1149
Signalized		EBL	74	160

PM Arterial Traffic Operations Results

Signalization	Intersection Name	Approach	Queue Length	
			50th (feet)	95th (feet)
	Route 123 at Old Dominion Drive	EBL	81	184
		EBT	148	299
		EBT	171	371
		EBR	28	173
		WBL	189	361
		WBL	286	423
		WBT	722	978
		WBTR	575	909
		NBL	165	461
		NBT	1515	3046
		NBT	1539	3079
		NBR	317	604
		SBL	60	211
		SBT	321	479
		SBTR	339	484
Unsignalized	Georgetown Pike at Swinks Mill Road	EBT*	0	2
		EBR*	0	2
		WBL*	49	127
		WBT*	49	127
		NBL*	54	116
		NBT*	54	116
		NBR*	54	116
Unsignalized	Georgetown Pike at Spring Hill Road	WBL*	25	87
		WBT*	25	87
		NBL*	19	43
		NBR*	19	43
Unsignalized	Lewinsville Road at Swinks Mill Road	EBL	56	108
		WBT*	4	18
		WBR*	4	18
		SBL	51	99
		SBR	50	92
Unsignalized	Route 123 at Ingleside Avenue	EBR	233	246
		WBR	36	75
		NBL	122	177
		NBT	335	509
		NBTR	287	552
		SBL	25	77
		SBT	149	298
		SBTR	430	1001

PM Arterial Traffic Operations Results

Signalization	Intersection Name	Approach	Queue Length	
			50th (feet)	95th (feet)
Unsignalized	Douglass Drive at Route 193 (Georgetown Pike)	EBL*	7	35
		EBT*	7	35
		EBR*	7	35
		WBL*	45	108
		WBT*	45	108
		WBR*	45	108
		NBL*	94	197
		NBT*	94	197
		NBR*	94	197
		SBL*	28	59
		SBT*	28	59
		SBR*	28	59
* indicates a single lane that includes more than one movement for which total queueing feet are shown (ie. queueing associated with a single EBLT lane is shown above both for the EB L and T movements)				

Appendix G: Detailed Future Conditions Freeway Operations Analysis Results

2025 NO BUILD AM PEAK HOUR FREEWAY RESULTS

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
NORTHBOUND I-495					
Route 123	Upstream	Weave	7,327	55	27.0
	Off-ramp to NB Route 123	Ramp	1,169	28	49.9
	Between Ramps	Basic	6,130	53	29.1
	On-ramp from NB Route 123	Ramp	538	25	21.6
	Between Ramps	Weave	6,649	40	33.7
	Off-ramp to SB Route 123	Ramp	1,448	19	75.4
	Between Ramps	Basic	5,252	53	24.9
	On-ramp from SB Route 123	Ramp	363	30	12.0
	Downstream	Merge	5,597	54	20.9
I-495 between Route 123 and Dulles Toll Road		Weave	5,624	56	21.7
Dulles Toll Road	Upstream	Diverge	5,631	55	20.3
	Off-ramp to WB Dulles Toll Road	Ramp	985	34	29.1
	Between Ramps	Basic	4,614	56	20.6
	On-ramp from EB Dulles Toll Road	Ramp	1,629	22	67.5
	On-ramp from EB DAAAR	Ramp	300	49	6.1
	On-ramp from EB DTR/DAAR	Ramp	1,944	33	50.4
	Between Ramps	Merge	6,518	51	30.0
	On-ramp from WB Dulles Toll Road	Ramp	540	41	13.1
	Between Ramps	Merge	6,993	49	34.9
	On-ramp from NB I-495 Express Lanes	Ramp	1,156	58	10.0
	Downstream	Basic	8,248	46	40.2
I-495 between Dulles Toll Road and Georgetown Pike		Basic	8,293	31	62.5
Georgetown Pike	Upstream	Diverge	8,210	28	51.9
	Off-ramp to Georgetown Pike	Ramp	439	52	8.4
	Between Ramps	Basic	7,798	25	65.9
	On-ramp from Georgetown Pike	Ramp	1,259	31	40.9
I-495 between Georgetown Pike and George Washington Memorial Parkway		Weave	8,764	16	91.1
George Washington Memorial Parkway	Off-ramp to I-495 Express Lanes (MD)	Ramp	1,192	50	23.9
	Between Ramps	Diverge	7,757	24	66.8
	Off-ramp to G.W. Memorial Parkway	Ramp	488	53	9.2
	Between Ramps	Basic	7,226	28	65.9
	On-ramp from G.W. Memorial Parkway	Ramp	1,346	27	49.9
I-495 between George Washington Memorial Parkway and Clara Barton Parkway		Weave	8,369	29	59.3

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
Clara Barton Parkway	Off-ramp to Clara Barton Parkway	Ramp	947	26	36.5
	Off-ramp to EB Clara Barton Parkway	Ramp	677	40	17.1
	Off-ramp to WB Clara Barton Parkway	Ramp	289	38	7.6
	Between Ramps	Basic	7,480	50	37.7
	On-ramp from EB Clara Barton Parkway	Ramp	118	37	3.2
	Downstream	Merge	7,651	55	27.9
I-495 between Clara Barton Parkway and River Road		Basic	7,686	54	33.1
NORTHBOUND I-495 EXPRESS LANES					
Westpark Drive	Upstream	Diverge	2,398	54	14.9
	Off-ramp to Westpark Drive	Ramp	623	57	11.0
	Between Ramps	Basic	1,787	66	13.5
	On-ramp from Westpark Drive	Ramp	185	40	4.6
I-495 Express Lanes between Westpark Drive and Jones Branch Connector		Weave	1,960	62	10.6
Jones Branch Connector/ Dulles Toll Road	Off-ramp to Jones Branch Connector	Ramp	311	58	5.4
	Between Ramps	Diverge	1,629	62	8.7
	Off-Ramp to WB Dulles Toll Road	Ramp	671	45	15.0
	Between Ramps	Basic	966	67	7.2
	On-ramp from Jones Branch Connector	Ramp	195	58	3.4
	Downstream	Merge	1,157	68	7.6
I-495 Express Lanes End		Basic	1,156	58	10.0
I-495 Express Lanes Begin (MD Southern Terminus)		Basic	1,139	54	16.4
George Washington Memorial Parkway	On-ramp from G.W. Memorial Parkway	Ramp	380	40	9.5
	Downstream	Merge	1,568	57	13.8
	Downstream	Basic	1,583	57	13.8
SOUTHBOUND I-495					
I-495 between River Road and Clara Barton Parkway		Basic	7,347	55	33.5
	Off-ramp to WB Clara Barton Parkway	Ramp	153	56	2.8
	Between Ramps	Basic	7,195	53	34.0
	On-ramp from WB Clara Barton Parkway	Ramp	486	41	11.9
	On-ramp from EB Clara Barton Parkway	Ramp	667	32	20.7
	On-ramp from Clara Barton Parkway	Ramp	1,109	41	13.6

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
I-495 between Clara Barton Parkway and George Washington Memorial Parkway		Weave	8,230	47	34.0
	Off-ramp to C-D Road	Ramp	1,973	53	18.7
	Off-ramp to G.W. Memorial Parkway	Ramp	1,031	25	41.3
	Between Ramps (C-D)	Basic	933	54	17.3
	On-ramp from G.W. Memorial Parkway	Ramp	792	49	8.1
	Between Ramps (C-D)	Weave	1,408	56	8.4
	Off-ramp to Georgetown Pike	Ramp	676	28	12.3
	Between Ramp (Mainline)	Basic	6,245	29	57.0
	On-ramp from I-495 Express Lanes (MD)	Ramp	1,032	55	18.8
	Between Ramp (Mainline)	Merge	7,262	22	71.7
	Between Ramp (Mainline)	Basic	7,184	22	82.3
	On-Ramp from C-D Road	Ramp	724	52	14.0
	Between Ramps	Merge	7,960	37	53.2
	On-ramp from Georgetown Pike	Ramp	401	37	10.7
	Between Ramps	Merge	8,353	48	43.9
	Off-ramp to SB I-495 Express Lanes	Ramp	606	59	5.1
	Downstream	Basic	7,595	53	35.6
I-495 between Georgetown Pike and Dulles Toll Road		Diverge	7,510	55	27.4
Dulles Toll Road	Upstream	Diverge	7,742	53	29.3
	Off-ramp to WB Dulles Toll Road	Ramp	1,965	55	17.7
	Between Ramps	Diverge	5,792	45	25.8
	Off-ramp to EB Dulles Toll Road	Ramp	356	35	10.2
	Between Ramps	Basic	5,412	52	25.9
	On-ramp from EB Dulles Toll Road	Ramp	937	28	33.9
	On-ramp from EB DAAR	Ramp	297	37	8.1
	On-ramp from EB Dulles Toll Road	Ramp	1,146	26	46.1
I-495 between Dulles Toll Road and Route 123		Weave	6,545	35	37.8
Route 123	Off-ramp to SB Route 123	Ramp	935	36	25.8
	Between Ramps	Basic	5,684	51	27.9
	On-ramp from SB Route 123	Ramp	457	26	17.7
	Between Ramps	Weave	6,120	50	24.5
	Off-ramp to NB Route 123	Ramp	553	20	27.8
	Between Ramps	Basic	5,593	55	25.6
	On-ramp from NB Route 123	Ramp	559	27	20.8
	Downstream	Weave	6,172	55	22.3
SOUTHBOUND I-495 EXPRESS LANES					
	Upstream	Basic	1,464	57	13.0

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
George Washington Memorial Parkway	Upstream	Diverge	1,460	56	12.9
	Off-Ramp to G.W. Memorial Parkway	Ramp	427	39	11.1
	Downstream	Merge	1,441	56	12.8
I-495 Express Lanes End (MD Southern Terminus)		Basic	1,032	54	19.2
I-495 Express Lanes Begin (VA Northern Terminus)		Basic	606	59	5.1
Dulles Toll Road/ Jones Branch Connector	Upstream	Diverge	604	67	4.5
	Off-ramp to WB Dulles Toll Road	Ramp	26	47	0.6
	Between Ramps	Diverge	580	67	4.0
	Off-ramp to Jones Branch Connector	Ramp	360	54	6.7
	Between Ramps	Basic	216	68	1.6
	On-ramp from Jones Branch Connector	Ramp	73	40	1.9
	Between Ramps	Merge	284	62	1.5
	On-ramp from EB Dulles Toll Road	Ramp	861	42	20.6
I-495 between Dulles Toll Road and Westpark Drive		Weave	1,142	67	4.7
Westpark Drive	Off-ramp to Westpark Drive	Ramp	282	50	2.8
	Between Ramps	Basic	815	68	6.0
	On-ramp from Westpark Drive	Ramp	128	38	3.4
	Downstream	Merge	933	64	4.9
EASTBOUND DULLES TOLL ROAD					
Spring Hill Road	Upstream	Diverge	4,962	9	95.6
	Off-ramp to Spring Hill Road	Ramp	1,157	17	68.2
	Between Ramps	Basic	4,109	23	44.8
	On-ramp from Dulles Access Road	Ramp	220	45	5.0
	Between Ramps	Merge	4,465	22	45.0
	On-ramp from Spring Hill Road	Ramp	206	36	2.6
Dulles Toll Road between Spring Hill Road and I-495		Weave	4,982	22	38.6
I-495	Off-ramp to SB I-495	Ramp	1,815	42	21.6
	Off-ramp to SB I-495 Express Lanes	Ramp	861	42	20.6
	Off-ramp to SB I-495 GP	Ramp	940	28	33.9
	Between Ramps	Diverge	3,360	20	34.3
	Off-ramp to NB I-495	Ramp	1,607	22	67.5
	Between Ramps	Basic	1,815	48	16.9
	On-ramp from SB I-495	Ramp	See above - Southbound I-495		
Dulles Toll Road Between I-495 and Route 123		Weave	2,138	38	22.8
Route 123	Off-ramp to SB Route 123	Ramp	749	15	60.9
	Between Ramps	Basic	1,411	52	14.1

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
	On-ramp from SB Route 123	Ramp	66	27	2.5
	Between Ramps	Weave	1,480	36	18.4
	Off-ramp to NB Route 123	Ramp	822	17	56.8
	Between Ramps	Basic	656	57	5.7
	On-ramp to NB Route 123	Ramp	243	26	9.5
	Between Ramps	Merge	886	53	5.6
	On-ramp from Dulles Access Road	Ramp	649	58	5.6
	Downstream	Merge	1,524	58	7.7
EASTBOUND DULLES ACCESS ROAD					
Spring Hill Road	Upstream	Diverge	1,452	57	12.1
	Off-ramp to Dulles Toll Road	Ramp	See above - Eastbound Dulles Toll Road		
	Downstream	Basic	1,248	57	10.5
I-495	Upstream	Diverge	1,250	57	7.3
	Off-ramp to I-495	Ramp	592	54	5.5
	Off-ramp to SB I-495	Ramp	297	37	8.1
	Off-ramp to NB I-495	Ramp	300	45	6.7
	Downstream	Basic	See above - Eastbound Dulles Toll Road		
WESTBOUND DULLES TOLL ROAD					
Route 123	Upstream	Diverge	3,655	29	50.1
	Off-ramp to Dulles Access Road	Ramp	278	58	2.4
	Between Ramps	Diverge	3,261	30	59.0
	Off-ramp to NB Route 123	Ramp	260	29	9.0
	Between Ramps	Diverge	2,926	26	55.6
	Off-ramp to SB Route 123	Ramp	900	11	91.9
	Between Ramps	Basic	2,022	54	18.9
	On-ramp from SB Route 123	Ramp	505	32	15.6
Dulles Toll Road between Route 123 and I-495		Weave	2,523	55	15.4
I-495	Off-ramp to NB I-495	Ramp	See above - Northbound I-495		
	Between Ramps	Basic	2,002	56	17.9
	On-ramp from NB I-495	Ramp	See above - Northbound I-495		
	Between Ramps	Basic	2,950	56	17.5
	On-ramp from SB I-495	Ramp	See above - Northbound I-495		
	Between Ramps	Merge	4,908	56	20.4
	On-ramp from NB I-495 Express Lanes	Ramp	671	45	15.0
	On-ramp from SB I-495 Express Lanes	Ramp	26	47	0.6
	On-ramp from I-495 Express Lanes	Ramp	691	68	5.1
Dulles Toll Road between I-495 and Spring Hill Road		Weave	5,622	55	17.0
Spring Hill Road	Off-ramp to Dulles Access Road	Ramp	562	54	10.4
	Between Ramps	Diverge	4,836	56	17.1

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
	Off-ramp to Spring Hill Road	Ramp	493	53	9.5
	Between Ramps	Basic	4,591	55	20.2
	On-ramp from Spring Hill Road	Ramp	208	35	6.0
	Downstream	Merge	4,675	54	15.5
WESTBOUND DULLES ACCESS ROAD					
Spring Hill Road	Upstream	Basic	See above - Westbound Dulles Toll Road		
	On-ramp from Dulles Toll Road	Ramp	See above - Westbound Dulles Toll Road		
	Downstream	Merge	834	58	4.8

2025 BUILD AM PEAK HOUR FREEWAY RESULTS

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
NORTHBOUND I-495					
Route 123	Upstream	Weave	7,339	54	27.6
	Off-ramp to NB Route 123	Ramp	1,196	22	64.9
	Between Ramps	Basic	6,117	53	28.8
	On-ramp from NB Route 123	Ramp	522	25	21.1
	Between Ramps	Weave	6,621	37	36.3
	Off-ramp to SB Route 123	Ramp	1,462	19	76.6
	Between Ramps	Basic	5,213	53	24.6
	On-ramp from SB Route 123	Ramp	355	30	11.7
	Downstream	Merge	5,547	54	20.6
I-495 between Route 123 and Dulles Toll Road		Weave	5,572	56	21.5
Dulles Toll Road	Upstream	Diverge	5,580	55	20.2
	Off-ramp to WB Dulles Toll Road	Ramp	1,002	34	29.6
	Between Ramps	Basic	4,543	56	20.2
	On-ramp from EB Dulles Toll Road	Ramp	1,293	57	11.3
	On-ramp from EB DAAR	Ramp	294	45	7.6
	On-ramp from EB DTR/DAAR	Ramp	1,611	30	29.8
	Between Ramps	Merge	6,144	56	21.6
	On-ramp from WB Dulles Toll Road	Ramp	493	40	12.4
	Between Ramps	Merge	6,594	56	19.3
	Downstream	Basic	6,666	56	23.7
I-495 between Dulles Toll Road and Georgetown Pike		Basic	6,724	56	24.1
Georgetown Pike	Upstream	Diverge	6,683	52	25.6
	Off-ramp to Georgetown Pike	Ramp	433	47	9.2
	Between Ramps	Basic	6,268	55	28.6
	On-ramp from Georgetown Pike	Ramp	1,035	34	30.1
I-495 between Georgetown Pike and George Washington Memorial Parkway		Weave	7,170	56	25.7
GWMP	Off-ramp to G.W. Memorial Parkway	Ramp	472	45	10.4
	Between Ramps	Merge	6,857	53	32.3
	On-ramp from G.W. Memorial Parkway	Ramp	1,166	31	37.2
I-495 between George Washington Memorial Parkway and Clara Barton Parkway		Weave	7,952	47	34.4
Clara Barton Parkway	Off-ramp to Clara Barton Parkway	Ramp	844	26	32.6
	Off-ramp to EB Clara Barton Parkway	Ramp	549	40	13.8
	Off-ramp to WB Clara Barton Parkway	Ramp	316	38	8.3
	Between Ramps	Basic	7,202	50	36.1
	On-ramp from EB Clara Barton Parkway	Ramp	121	37	3.3
	Downstream	Merge	7,349	55	26.7
I-495 between Clara Barton Parkway and River Road		Basic	7,384	54	31.6

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
NORTHBOUND I-495 EXPRESS LANES					
Westpark Drive	Upstream	Diverge	2,625	53	16.5
	Off-ramp to Westpark Drive	Ramp	592	57	10.4
	Between Ramps	Basic	2,047	66	15.5
	On-ramp from Westpark Drive	Ramp	216	40	5.4
I-495 Express Lanes between Westpark Drive and Jones Branch Connector		Weave	2,252	59	12.8
Jones Branch Drive/Dulles Toll Road	Off-ramp to Jones Branch Connector	Ramp	355	56	6.4
	Between Ramps	Diverge	1,873	60	10.4
	Off-Ramp to WB Dulles Toll Road	Ramp	711	45	15.9
	Between Ramps	Basic	1,169	67	8.7
	On-ramp from Jones Branch Connector	Ramp	215	58	3.7
	Between Ramps	Merge	1,378	67	9.1
	On-ramp from EB Dulles Toll Road	Ramp	565	57	10.0
	On-ramp from WB Dulles Toll Road	Ramp	187	57	3.3
	Combined on-ramp from Dulles Toll Road	Ramp	752	56	11.4
	Downstream	Merge	2,137	66	13.5
I-495 Express Lanes between Dulles Toll Road and GWMP		Basic	2,135	66	16.1
GWMP	Upstream	Diverge	2,125	66	10.7
	Off-ramp to GWMP	Ramp	183	42	4.4
	Between Ramps	Basic	1,949	66	14.8
	On-ramp from GWMP	Ramp	457	37	12.3
	Downstream	Merge	2,388	66	12.1
I-495 Express Lanes between GWMP and River Road		Basic	2,396	66	18.3
SOUTHBOUND I-495					
I-495 between River Road and Clara Barton Parkway		Basic	7,280	55	33.1
	Off-ramp to WB Clara Barton Parkway	Ramp	151	56	2.7
	Between Ramps	Basic	7,138	55	32.7
	On-ramp from WB Clara Barton Parkway	Ramp	482	41	11.8
	On-ramp from EB Clara Barton Parkway	Ramp	654	32	20.4
	On-ramp from Clara Barton Parkway	Ramp	1,104	43	13.0
I-495 between Clara Barton Parkway and George Washington Memorial Parkway		Weave	8,168	54	30.3
George Washington Memorial Parkway/ Georgetown Pike	Off-ramp to G.W. Memorial Parkway	Ramp	883	23	39.2
	Between Ramp (Mainline)	Basic	7,241	50	36.2
	Between Ramps	Diverge	7,320	53	31.4
	Off-ramp from SB I-495 to Georgetown Pike	Ramp	446	57	7.9
	Off-ramp from GWMP to Georgetown Pike	Ramp	195	57	3.4
	Combined off-ramp to Georgetown Pike	Ramp	643	27	12.2

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
	Between Ramps	Merge	6,919	53	32.6
	On-ramp from GWMP	Ramp	260	57	4.5
	Between Ramps	Basic	7,191	55	26.2
	On-ramp from Georgetown Pike	Ramp	409	40	10.3
I-495 between Georgetown Pike and Dulles Toll Road		Diverge	7,375	55	27.1
Dulles Toll Road	Upstream	Diverge	7,608	52	29.5
	Off-ramp to WB Dulles Toll Road	Ramp	1,755	56	15.8
	Between Ramps	Diverge	5,882	42	28.5
	Off-ramp to EB Dulles Toll Road	Ramp	398	35	11.4
	Between Ramps	Basic	5,464	51	26.6
	On-ramp from EB Dulles Toll Road	Ramp	985	34	22.6
	On-ramp from EB DAAR	Ramp	282	37	7.7
	On-ramp from EB DTR/DAAR	Ramp	1,181	28	41.8
I-495 between Dulles Toll Road and Route 123		Weave	6,649	32	41.1
Route 123	Off-ramp to SB Route 123	Ramp	979	36	27.0
	Between Ramps	Basic	5,746	50	29.0
	On-ramp from SB Route 123	Ramp	454	26	17.5
	Between Ramps	Weave	6,179	49	25.2
	Off-ramp to NB Route 123	Ramp	591	20	29.9
	Between Ramps	Basic	5,617	54	25.9
	On-ramp from NB Route 123	Ramp	564	27	20.9
	Downstream	Weave	6,200	55	22.4
SOUTHBOUND I-495 EXPRESS LANES					
I-495 Express Lanes between River Road and GWMP		Basic	1,920	66	14.5
GWMP	Upstream	Diverge	1,885	61	10.3
	Off-ramp to GWMP	Ramp	598	39	15.3
	Between Ramps	Basic	1,323	66	10.0
	On-ramp from GWMP	Ramp	153	42	3.7
	Downstream	Merge	1,466	66	7.4
Dulles Toll Road/ Jones Branch Connector	Upstream	Basic	1,473	66	11.2
	Off-ramp to WB Dulles Toll Road	Ramp	644	45	14.2
	Between Ramps	Diverge	834	66	5.6
	Off-ramp to Jones Branch Connector	Ramp	390	53	7.4
	Between Ramps	Basic	441	68	3.3
	On-ramp from Jones Branch Connector	Ramp	83	40	2.1
	Between Ramps	Merge	515	64	2.7
	On-ramp from EB Dulles Toll Road	Ramp	1,476	43	34.1
I-495 between Dulles Toll Road and Westpark Drive		Weave	1,423	66	5.9
Westpark Drive	Off-ramp to Westpark Drive	Ramp	316	49	3.2
	Between Ramps	Basic	1,062	68	7.8
	On-ramp from Westpark Drive	Ramp	113	38	3.0
	Downstream	Merge	1,161	65	6.0

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
EASTBOUND DULLES TOLL ROAD					
Spring Hill Road	Upstream	Diverge	6,394	13	81.9
	Off-ramp to Spring Hill Road	Ramp	1,383	18	80.1
	Between Ramps	Basic	4,979	54	22.9
	On-ramp from Dulles Access Road	Ramp	220	48	4.6
	Between Ramps	Merge	5,203	53	21.1
	On-ramp from Spring Hill Road	Ramp	212	37	2.7
Dulles Toll Road between Spring Hill Road and I-495		Weave	5,416	56	16.2
I-495	Off-ramp to SB I-495 GP/I-495 Express Lanes	Ramp	2,424	42	20.4
	Off-ramp to SB I-495 Express Lanes	Ramp	909	43	21.2
	Off-ramp to NB I-495 Express Lanes	Ramp	565	57	10.0
	Off-ramp to SB I-495 GP	Ramp	977	34	22.6
	Between Ramps	Diverge	2,912	56	13.0
	Off-ramp to NB I-495	Ramp	1,293	57	11.3
	Between Ramps	Basic	1,655	56	14.7
	On-ramp from SB I-495	Ramp	See above - Southbound I-495		
Dulles Toll Road Between I-495 and Route 123		Weave	2,021	55	12.2
Route 123	Off-ramp to SB Route 123	Ramp	737	25	30.2
	Between Ramps	Basic	1,309	57	11.6
	On-ramp from SB Route 123	Ramp	68	27	2.6
	Between Ramps	Weave	1,384	47	10.5
	Off-ramp to NB Route 123	Ramp	718	22	38.4
	Between Ramps	Basic	666	58	5.8
	On-ramp to NB Route 123	Ramp	248	25	9.8
	Between Ramps	Merge	902	53	5.7
	On-ramp from Dulles Access Road	Ramp	610	58	5.3
	Downstream	Merge	1,502	58	7.5
EASTBOUND DULLES ACCESS ROAD					
Spring Hill Road	Upstream	Diverge	1,382	57	11.5
	Off-ramp to Dulles Toll Road	Ramp	See above - Eastbound Dulles Toll Road		
	Downstream	Basic	1,178	57	9.9
I-495	Upstream	Diverge	1,180	57	6.9
	Off-ramp to I-495	Ramp	565	53	5.4
	Off-ramp to SB I-495	Ramp	282	37	7.7
	Off-ramp to NB I-495	Ramp	294	36	9.9
	Downstream	Basic	See above - Eastbound Dulles Toll Road		
WESTBOUND DULLES TOLL ROAD					
Route 123	Upstream	Diverge	3,824	40	36.6
	Off-ramp to Dulles Access Road	Ramp	243	58	2.1
	Between Ramps	Diverge	3,490	36	50.1
	Off-ramp to NB Route 123	Ramp	304	29	10.6
	Between Ramps	Diverge	3,136	37	41.0

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
	Off-ramp to SB Route 123	Ramp	901	15	68.1
	Between Ramps	Basic	2,240	51	22.1
	Off-ramp to NB I-495 Express Lanes	Ramp	187	57	3.3
	Between Ramps	Basic	2,045	56	18.2
	On-ramp from SB Route 123	Ramp	492	32	15.2
Dulles Toll Road between Route 123 and I-495		Weave	2,544	54	15.7
I-495	Off-ramp to NB I-495	Ramp	See above - Northbound I-495		
	Between Ramps	Basic	2,065	56	18.3
	On-ramp from NB I-495	Ramp	See above - Northbound I-495		
	Between Ramps	Basic	3,029	56	17.9
	On-ramp from SB I-495	Ramp	See above - Northbound I-495		
	Between Ramps	Merge	4,781	56	19.7
	On-ramp from NB I-495 Express Lanes	Ramp	711	45	15.9
	On-ramp from SB I-495 Express Lanes	Ramp	644	45	14.2
	On-ramp from I-495 Express Lanes	Ramp	1,348	66	10.2
Dulles Toll Road between I-495 and Spring Hill Road		Weave	6,145	57	18.1
Spring Hill Road	Off-ramp to Dulles Access Road	Ramp	614	56	10.9
	Between Ramps	Diverge	5,280	52	20.4
	Off-ramp to Spring Hill Road	Ramp	547	27	37.0
	Between Ramps	Basic	4,993	56	21.9
	On-ramp from Spring Hill Road	Ramp	218	35	6.3
	Downstream	Merge	5,078	53	17.1
WESTBOUND DULLES ACCESS ROAD					
Spring Hill Road	Upstream	Basic	See above - Westbound Dulles Toll Road		
	On-ramp from Dulles Toll Road	Ramp	See above - Westbound Dulles Toll Road		
	Downstream	Merge	851	58	4.9

2025 NO BUILD PM PEAK HOUR FREEWAY RESULTS

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
NORTHBOUND I-495					
Route 123	Upstream	Weave	4,983	55	21.6
	Off-ramp to NB Route 123	Ramp	611	14	72.1
	Between Ramps	Basic	4,337	56	19.5
	On-ramp from NB Route 123	Ramp	507	25	20.5
	Between Ramps	Weave	4,829	53	18.4
	Off-ramp to SB Route 123	Ramp	544	21	26.4
	Between Ramps	Basic	4,319	55	19.8
	On-ramp from SB Route 123	Ramp	336	30	11.1
	Downstream	Merge	4,638	54	17.3
I-495 between Route 123 and Dulles Toll Road		Weave	4,666	56	18.3
Dulles Toll Road	Upstream	Diverge	4,660	55	17.1
	Off-ramp to WB Dulles Toll Road	Ramp	1,601	38	42.0
	Between Ramps	Basic	3,036	57	13.3
	On-ramp from EB Dulles Toll Road	Ramp	355	57	4.4
	On-ramp from EB DAAAR	Ramp	291	50	5.9
	On-ramp from EB DTR/DAAR	Ramp	648	38	15.3
	Between Ramps	Merge	3,628	57	14.8
	On-ramp from WB Dulles Toll Road	Ramp	279	38	7.3
	Between Ramps	Merge	3,829	57	16.7
	On-ramp from NB I-495 Express Lanes	Ramp	1,147	58	9.9
	Downstream	Basic	5,100	57	17.9
I-495 between Dulles Toll Road and Georgetown Pike		Basic	5,147	57	18.2
Georgetown Pike	Upstream	Diverge	5,116	56	15.2
	Off-ramp to Georgetown Pike	Ramp	175	54	3.2
	Between Ramps	Basic	5,019	50	20.6
	On-ramp from Georgetown Pike	Ramp	1,405	32	44.4
I-495 between Georgetown Pike and George Washington Memorial Parkway		Weave	6,453	43	26.1
George Washington Memorial Parkway	Off-ramp to I-495 Express Lanes (MD)	Ramp	955	55	17.3
	Between Ramps	Diverge	5,644	33	35.2
	Off-ramp to G.W. Memorial Parkway	Ramp	49	58	0.8
	Between Ramps	Basic	5,694	31	46.2
	On-ramp from G.W. Memorial Parkway	Ramp	1,040	31	33.5
I-495 between George Washington Memorial Parkway and Clara Barton Parkway		Weave	6,842	39	36.6
Clara Barton Parkway	Off-ramp to Clara Barton Parkway	Ramp	1,239	26	47.0
	Off-ramp to EB Clara Barton Parkway	Ramp	511	44	11.7
	Off-ramp to WB Clara Barton Parkway	Ramp	741	38	19.7
	Between Ramps	Basic	5,519	53	24.8
	On-ramp from EB Clara Barton Parkway	Ramp	103	37	2.8
	Downstream	Merge	5,693	55	20.7
I-495 between Clara Barton Parkway and River Road		Basic	5,734	54	24.5

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
NORTHBOUND I-495 EXPRESS LANES					
Westpark Drive	Upstream	Diverge	1,123	67	8.2
	Off-ramp to Westpark Drive	Ramp	105	58	1.8
	Between Ramps	Basic	1,029	68	7.6
	On-ramp from Westpark Drive	Ramp	445	40	11.2
I-495 Express Lanes between Westpark Drive and Jones Branch Connector		Weave	1,474	60	8.2
Jones Branch Connector/ Dulles Toll Road	Off-ramp to Jones Branch Connector	Ramp	50	58	0.9
	Between Ramps	Diverge	1,415	64	8.4
	Off-Ramp to WB Dulles Toll Road	Ramp	667	45	14.9
	Between Ramps	Basic	757	68	5.6
	On-ramp from Jones Branch Connector	Ramp	386	56	6.9
	Downstream	Merge	1,142	68	7.5
I-495 Express Lanes End		Basic	1,147	58	9.9
I-495 Express Lanes Begin (MD Southern Terminus)		Basic	958	56	12.4
George Washington Memorial Parkway	On-ramp from G.W. Memorial Parkway	Ramp	290	41	7.1
	Downstream	Merge	1,245	56	11.1
	Downstream	Basic	1,247	56	11.3
SOUTHBOUND I-495					
I-495 between River Road and Clara Barton Parkway		Basic	4,508	39	55.0
	Off-ramp to WB Clara Barton Parkway	Ramp	9	55	0.2
	Between Ramps	Basic	4,442	30	68.9
	On-ramp from WB Clara Barton Parkway	Ramp	934	17	108.1
	On-ramp from EB Clara Barton Parkway	Ramp	481	31	15.9
	On-ramp from Clara Barton Parkway	Ramp	1,395	17	79.6
I-495 between Clara Barton Parkway and George Washington Memorial Parkway		Weave	5,888	27	58.3
	Off-ramp to C-D Road	Ramp	1,699	54	15.8
	Off-ramp to G.W. Memorial Parkway	Ramp	799	29	27.6
	Between Ramps (C-D)	Basic	893	52	17.4
	On-ramp from G.W. Memorial Parkway	Ramp	1,445	48	15.0
	Between Ramps (C-D)	Weave	2,111	26	41.7
	Off-ramp to Georgetown Pike	Ramp	903	23	19.7
	Between Ramp (Mainline)	Basic	4,173	22	93.1
	On-ramp from I-495 Express Lanes (MD)	Ramp	762	65	11.8
	Between Ramp (Mainline)	Merge	4,842	24	68.7
	Between Ramp (Mainline)	Basic	4,711	23	91.6
	On-Ramp from C-D Road	Ramp	1,204	20	89.9
	Between Ramps	Merge	6,107	27	71.7
	On-ramp from Georgetown Pike	Ramp	664	27	26.3
	Between Ramps	Merge	6,786	27	80.5
	Off-ramp to SB I-495 Express Lanes	Ramp	962	58	8.3
	Downstream	Basic	5,734	26	78.0
I-495 between Georgetown Pike and Dulles Toll Road		Diverge	5,676	23	87.7
	Upstream	Diverge	5,800	22	71.0

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
Dulles Toll Road	Off-ramp to WB Dulles Toll Road	Ramp	2,413	52	23.3
	Between Ramps	Diverge	3,456	50	16.3
	Off-ramp to EB Dulles Toll Road	Ramp	272	29	9.5
	Between Ramps	Basic	3,176	56	14.1
	On-ramp from EB Dulles Toll Road	Ramp	810	41	14.4
	On-ramp from EB DAAR	Ramp	280	37	7.6
	On-ramp from EB Dulles Toll Road	Ramp	1,014	44	21.9
I-495 between Dulles Toll Road and Route 123		Weave	4,206	54	15.6
Route 123	Off-ramp to SB Route 123	Ramp	534	37	14.4
	Between Ramps	Basic	3,719	56	16.5
	On-ramp from SB Route 123	Ramp	1,278	25	52.1
	Between Ramps	Weave	4,983	53	18.8
	Off-ramp to NB Route 123	Ramp	117	19	6.3
	Between Ramps	Basic	4,888	53	22.9
	On-ramp from NB Route 123	Ramp	1,120	25	44.2
	Downstream	Weave	6,016	16	74.0
SOUTHBOUND I-495 EXPRESS LANES					
George Washington Memorial Parkway	Upstream	Basic	1,079	68	8.0
	Upstream	Diverge	1,086	67	8.1
	Off-Ramp to G.W. Memorial Parkway	Ramp	330	42	8.0
	Downstream	Merge	1,085	67	8.1
I-495 Express Lanes End (MD Southern Terminus)		Basic	762	65	11.8
I-495 Express Lanes Begin (VA Northern Terminus)		Basic	962	58	8.3
Dulles Toll Road/ Jones Branch Connector	Upstream	Diverge	959	67	7.2
	Off-ramp to WB Dulles Toll Road	Ramp	90	47	1.9
	Between Ramps	Diverge	870	67	5.9
	Off-ramp to Jones Branch Connector	Ramp	130	54	2.4
	Between Ramps	Basic	741	68	5.5
	On-ramp from Jones Branch Connector	Ramp	430	40	10.8
	Between Ramps	Merge	1,146	59	6.5
	On-ramp from EB Dulles Toll Road	Ramp	466	39	11.8
I-495 between Dulles Toll Road and Westpark Drive		Weave	1,628	65	6.5
Westpark Drive	Off-ramp to Westpark Drive	Ramp	160	50	1.6
	Between Ramps	Basic	1,236	68	9.1
	On-ramp from Westpark Drive	Ramp	690	38	18.4
	Downstream	Merge	1,909	57	11.1
EASTBOUND DULLES TOLL ROAD					
Spring Hill Road	Upstream	Diverge	4,118	35	19.4
	Off-ramp to Spring Hill Road	Ramp	324	43	7.6
	Between Ramps	Basic	3,759	35	26.9
	On-ramp from Dulles Access Road	Ramp	488	47	10.4
	Between Ramps	Merge	4,246	52	17.3
	On-ramp from Spring Hill Road	Ramp	422	34	5.6
Dulles Toll Road between Spring Hill Road and I-495		Weave	4,670	57	13.7
I-495	Off-ramp to SB I-495	Ramp	1,277	46	12.0
	Off-ramp to SB I-495 Express Lanes	Ramp	466	39	11.8

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
	Off-ramp to SB I-495 GP	Ramp	805	41	14.4
	Between Ramps	Diverge	3,380	57	11.9
	Off-ramp to NB I-495	Ramp	356	57	4.4
	Between Ramps	Basic	3,019	55	24.1
	On-ramp from SB I-495	Ramp	See above - Southbound I-495		
Dulles Toll Road Between I-495 and Route 123		Weave	3,234	54	19.9
Route 123	Off-ramp to SB Route 123	Ramp	137	33	4.2
	Between Ramps	Basic	3,134	54	28.8
	On-ramp from SB Route 123	Ramp	47	27	1.7
	Between Ramps	Weave	3,193	52	20.4
	Off-ramp to NB Route 123	Ramp	723	25	29.3
	Between Ramps	Basic	2,483	56	22.3
	On-ramp to NB Route 123	Ramp	572	25	22.8
	Between Ramps	Merge	3,008	53	19.0
	On-ramp from Dulles Access Road	Ramp	868	57	7.6
	Downstream	Merge	3,854	56	20.0
EASTBOUND DULLES ACCESS ROAD					
Spring Hill Road	Upstream	Diverge	1,901	57	16.0
	Off-ramp to Dulles Toll Road	Ramp	See above - Eastbound Dulles Toll Road		
	Downstream	Basic	1,435	57	12.1
I-495	Upstream	Diverge	1,438	57	8.3
	Off-ramp to I-495	Ramp	566	54	5.2
	Off-ramp to SB I-495	Ramp	280	37	7.6
	Off-ramp to NB I-495	Ramp	291	45	6.5
	Downstream	Basic	See above - Eastbound Dulles Toll Road		
WESTBOUND DULLES TOLL ROAD					
Route 123	Upstream	Diverge	2,117	57	12.3
	Off-ramp to Dulles Access Road	Ramp	547	58	4.7
	Between Ramps	Diverge	1,563	57	13.7
	Off-ramp to NB Route 123	Ramp	61	29	2.1
	Between Ramps	Diverge	1,494	56	11.2
	Off-ramp to SB Route 123	Ramp	228	27	8.5
	Between Ramps	Basic	1,277	57	11.2
	On-ramp from SB Route 123	Ramp	1,106	32	35.1
Dulles Toll Road between Route 123 and I-495		Weave	2,377	50	15.7
I-495	Off-ramp to NB I-495	Ramp	See above - Northbound I-495		
	Between Ramps	Basic	2,113	56	18.8
	On-ramp from NB I-495	Ramp	See above - Northbound I-495		
	Between Ramps	Basic	3,666	56	21.9
	On-ramp from SB I-495	Ramp	See above - Northbound I-495		
	Between Ramps	Merge	6,074	53	26.3
	On-ramp from NB I-495 Express Lanes	Ramp	667	45	14.9
	On-ramp from SB I-495 Express Lanes	Ramp	90	47	1.9
	On-ramp from I-495 Express Lanes	Ramp	752	68	5.6
Dulles Toll Road between I-495 and Spring Hill Road		Weave	6,854	53	21.4

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
Spring Hill Road	Off-ramp to Dulles Access Road	Ramp	1,220	52	23.6
	Between Ramps	Diverge	5,386	55	19.3
	Off-ramp to Spring Hill Road	Ramp	421	53	7.9
	Between Ramps	Basic	5,244	56	22.8
	On-ramp from Spring Hill Road	Ramp	1,016	32	32.2
	Downstream	Merge	5,985	52	20.6
WESTBOUND DULLES ACCESS ROAD					
Spring Hill Road	Upstream	Basic	See above - Westbound Dulles Toll Road		
	On-ramp from Dulles Toll Road	Ramp	See above - Westbound Dulles Toll Road		
	Downstream	Merge	1,757	57	10.3

2025 BUILD PM PEAK HOUR FREEWAY RESULTS

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
NORTHBOUND I-495					
Route 123	Upstream	Weave	5,390	55	22.9
	Off-ramp to NB Route 123	Ramp	614	13	62.4
	Between Ramps	Basic	4,758	56	21.3
	On-ramp from NB Route 123	Ramp	501	25	20.3
	Between Ramps	Weave	5,244	52	20.1
	Off-ramp to SB Route 123	Ramp	542	21	26.0
	Between Ramps	Basic	4,738	55	21.7
	On-ramp from SB Route 123	Ramp	318	30	10.5
	Downstream	Merge	5,039	54	18.7
I-495 between Route 123 and Dulles Toll Road		Weave	4,905	55	20.0
Dulles Toll Road	Upstream	Diverge	5,066	54	18.6
	Off-ramp to WB Dulles Toll Road	Ramp	1,605	38	42.3
	Between Ramps	Basic	3,437	57	15.1
	On-ramp from EB Dulles Toll Road	Ramp	324	58	2.8
	On-ramp from EB DAAR	Ramp	234	44	5.3
	On-ramp from EB DTR/DAAR	Ramp	557	42	9.3
	Between Ramps	Merge	3,940	57	14.0
	On-ramp from WB Dulles Toll Road	Ramp	246	36	6.8
	Between Ramps	Merge	4,222	57	12.3
	Downstream	Basic	4,258	57	14.9
I-495 between Dulles Toll Road and Georgetown Pike		Basic	4,287	57	15.1
Georgetown Pike	Upstream	Diverge	4,275	56	15.3
	Off-ramp to Georgetown Pike	Ramp	176	53	3.3
	Between Ramps	Basic	4,103	56	18.3
	On-ramp from Georgetown Pike	Ramp	785	36	21.9
I-495 between Georgetown Pike and George Washington Memorial Parkway		Weave	4,873	56	17.3
GWMP	Off-ramp to G.W. Memorial Parkway	Ramp	48	47	1.0
	Between Ramps	Merge	4,879	56	21.6
	On-ramp from G.W. Memorial Parkway	Ramp	903	31	29.0
I-495 between George Washington Memorial Parkway and Clara Barton Parkway		Weave	5,713	56	20.6
Clara Barton Parkway	Off-ramp to Clara Barton Parkway	Ramp	1,108	26	42.3
	Off-ramp to EB Clara Barton Parkway	Ramp	458	40	11.5
	Off-ramp to WB Clara Barton Parkway	Ramp	661	38	17.5
	Between Ramps	Basic	4,584	55	20.9
	On-ramp from EB Clara Barton Parkway	Ramp	130	37	3.5
	Downstream	Merge	4,741	56	16.8
I-495 between Clara Barton Parkway and River Road		Basic	4,769	56	19.9
NORTHBOUND I-495 EXPRESS LANES					
Westpark Drive	Upstream	Diverge	1,389	65	7.1
	Off-ramp to Westpark Drive	Ramp	91	58	1.6

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
	Between Ramps	Basic	1,312	67	9.7
	On-ramp from Westpark Drive	Ramp	481	40	12.1
I-495 Express Lanes between Westpark Drive and Jones Branch Connector		Weave	1,792	60	10.0
Jones Branch Drive/Dulles Toll Road	Off-ramp to Jones Branch Connector	Ramp	60	57	1.1
	Between Ramps	Diverge	1,719	63	9.2
	Off-Ramp to WB Dulles Toll Road	Ramp	715	45	16.0
	Between Ramps	Basic	1,014	67	7.5
	On-ramp from Jones Branch Connector	Ramp	433	56	7.7
	Between Ramps	Merge	1,445	61	18.2
	On-ramp from EB Dulles Toll Road	Ramp	833	44	18.7
	On-ramp from WB Dulles Toll Road	Ramp	87	58	1.5
	Combined on-ramp from Dulles Toll Road	Ramp	920	44	17.6
	Downstream	Merge	2,367	64	15.2
I-495 Express Lanes between Dulles Toll Road and GWMP		Basic	2,375	66	18.0
GWMP	Upstream	Diverge	2,363	66	11.9
	Off-ramp to GWMP	Ramp	196	41	4.8
	Between Ramps	Basic	2,163	66	16.5
	On-ramp from GWMP	Ramp	352	37	9.7
	Downstream	Merge	2,513	66	12.7
I-495 Express Lanes between GWMP and River Road		Basic	2,533	65	19.4
SOUTHBOUND I-495					
I-495 between River Road and Clara Barton Parkway		Basic	4,219	57	18.5
	Off-ramp to WB Clara Barton Parkway	Ramp	10	56	0.2
	Between Ramps	Basic	4,161	56	18.4
	On-ramp from WB Clara Barton Parkway	Ramp	1,262	40	31.9
	On-ramp from EB Clara Barton Parkway	Ramp	490	33	15.1
	On-ramp from Clara Barton Parkway	Ramp	1,714	42	20.2
I-495 between Clara Barton Parkway and George Washington Memorial Parkway		Weave	5,950	53	23.2
George Washington Memorial Parkway/ Georgetown Pike	Off-ramp to G.W. Memorial Parkway	Ramp	700	22	32.6
	Between Ramp (Mainline)	Basic	5,253	50	31.6
	Between Ramps	Diverge	5,166	51	26.7
	Off-ramp from SB I-495 to Georgetown Pike	Ramp	676	56	12.2
	Off-ramp from GWMP to Georgetown Pike	Ramp	293	55	5.4
	Combined off-ramp to Georgetown Pike	Ramp	988	29	17.7
	Between Ramps	Merge	4,532	51	30.4
	On-ramp from GWMP	Ramp	796	50	31.2
	Between Ramps	Basic	5,355	52	30.3
	On-ramp from Georgetown Pike	Ramp	641	37	33.9

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
I-495 between Georgetown Pike and Dulles Toll Road		Diverge	5,817	48	34.8
Dulles Toll Road	Upstream	Diverge	5,944	37	40.9
	Off-ramp to WB Dulles Toll Road	Ramp	2,227	53	21.1
	Between Ramps	Diverge	3,776	52	17.2
	Off-ramp to EB Dulles Toll Road	Ramp	292	28	10.3
	Between Ramps	Basic	3,476	57	15.4
	On-ramp from EB Dulles Toll Road	Ramp	817	41	14.5
	On-ramp from EB DAAR	Ramp	261	37	7.1
	On-ramp from EB DTR/DAAR	Ramp	1,003	43	21.7
I-495 between Dulles Toll Road and Route 123		Weave	4,491	53	16.8
Route 123	Off-ramp to SB Route 123	Ramp	596	37	16.1
	Between Ramps	Basic	3,946	56	17.5
	On-ramp from SB Route 123	Ramp	1,227	25	49.8
	Between Ramps	Weave	5,162	53	19.3
	Off-ramp to NB Route 123	Ramp	118	19	6.2
	Between Ramps	Basic	5,070	53	24.3
	On-ramp from NB Route 123	Ramp	1,105	25	44.7
	Downstream	Weave	6,184	16	76.9
SOUTHBOUND I-495 EXPRESS LANES					
I-495 Express Lanes between River Road and GWMP		Basic	2,181	66	16.4
GWMP	Upstream	Diverge	2,161	64	11.3
	Off-ramp to GWMP	Ramp	452	39	11.5
	Between Ramps	Basic	1,743	66	13.2
	On-ramp from GWMP	Ramp	181	43	4.2
	Downstream	Merge	1,899	66	9.6
Dulles Toll Road/ Jones Branch Connector	Upstream	Basic	1,936	63	15.4
	Off-ramp to WB Dulles Toll Road	Ramp	846	45	18.9
	Between Ramps	Diverge	1,098	66	7.4
	Off-ramp to Jones Branch Connector	Ramp	143	53	2.7
	Between Ramps	Basic	956	67	7.1
	On-ramp from Jones Branch Connector	Ramp	488	40	12.2
	Between Ramps	Merge	1,411	59	7.9
	On-ramp from EB Dulles Toll Road	Ramp	1,288	40	32.4
I-495 between Dulles Toll Road and Westpark Drive		Weave	1,878	65	8.1
Westpark Drive	Off-ramp to Westpark Drive	Ramp	133	49	1.4
	Between Ramps	Basic	1,766	67	13.1
	On-ramp from Westpark Drive	Ramp	671	38	17.9
	Downstream	Merge	2,411	59	13.6
EASTBOUND DULLES TOLL ROAD					
Spring Hill Road	Upstream	Diverge	4,634	35	22.0
	Off-ramp to Spring Hill Road	Ramp	307	43	7.1
	Between Ramps	Basic	4,287	35	30.9
	On-ramp from Dulles Access Road	Ramp	625	47	13.4
	Between Ramps	Merge	4,909	52	20.3
	On-ramp from Spring Hill Road	Ramp	456	35	6.1

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
Dulles Toll Road between Spring Hill Road and I-495		Weave	5,358	56	15.8
I-495	Off-ramp to SB I-495 GP/I-495 Express Lanes	Ramp	2,063	44	16.7
	Off-ramp to SB I-495 Express Lanes	Ramp	796	50	31.2
	Off-ramp to NB I-495 Express Lanes	Ramp	951	34	7.0
	Off-ramp to SB I-495 GP	Ramp	813	41	14.5
	Between Ramps	Diverge	3,238	56	14.5
	Off-ramp to NB I-495	Ramp	323	58	2.8
	Between Ramps	Basic	2,911	55	26.3
	On-ramp from SB I-495	Ramp	See above - Southbound I-495		
Dulles Toll Road Between I-495 and Route 123		Weave	3,150	54	19.4
Route 123	Off-ramp to SB Route 123	Ramp	136	33	4.2
	Between Ramps	Basic	3,051	55	27.9
	On-ramp from SB Route 123	Ramp	55	27	2.0
	Between Ramps	Weave	3,119	52	20.0
	Off-ramp to NB Route 123	Ramp	579	25	23.1
	Between Ramps	Basic	2,554	56	23.0
	On-ramp to NB Route 123	Ramp	610	25	24.4
	Between Ramps	Merge	3,118	53	19.7
	On-ramp from Dulles Access Road	Ramp	828	57	7.2
	Downstream	Merge	3,925	56	20.4
EASTBOUND DULLES ACCESS ROAD					
Spring Hill Road	Upstream	Diverge	1,925	57	16.2
	Off-ramp to Dulles Toll Road	Ramp	See above - Eastbound Dulles Toll Road		
	Downstream	Basic	1,321	57	11.1
I-495	Upstream	Diverge	1,325	57	7.7
	Off-ramp to I-495	Ramp	492	54	4.5
	Off-ramp to SB I-495	Ramp	261	37	7.1
	Off-ramp to NB I-495	Ramp	234	44	5.3
	Downstream	Basic	See above - Eastbound Dulles Toll Road		
WESTBOUND DULLES TOLL ROAD					
Route 123	Upstream	Diverge	2,134	57	12.4
	Off-ramp to Dulles Access Road	Ramp	442	58	3.8
	Between Ramps	Diverge	1,685	57	14.8
	Off-ramp to NB Route 123	Ramp	70	29	2.4
	Between Ramps	Diverge	1,605	56	12.1
	Off-ramp to SB Route 123	Ramp	227	27	8.5
	Between Ramps	Basic	1,387	57	12.2
	Off-ramp to NB I-495 Express Lanes	Ramp	954	31	15.2
	Between Ramps	Basic	87	58	1.5
	On-ramp from SB Route 123	Ramp	1,121	31	35.6
Dulles Toll Road between Route 123 and I-495		Weave	2,412	51	15.9
I-495	Off-ramp to NB I-495	Ramp	See above - Northbound I-495		
	Between Ramps	Basic	2,179	56	19.4
	On-ramp from NB I-495	Ramp	See above - Northbound I-495		
	Between Ramps	Basic	3,734	56	22.3
	On-ramp from SB I-495	Ramp	See above - Northbound I-495		

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
	Between Ramps	Merge	5,955	54	25.2
	On-ramp from NB I-495 Express Lanes	Ramp	715	45	16.0
	On-ramp from SB I-495 Express Lanes	Ramp	846	45	18.9
	On-ramp from I-495 Express Lanes	Ramp	1,555	65	11.9
Dulles Toll Road between I-495 and Spring Hill Road		Weave	7,542	55	23.0
Spring Hill Road	Off-ramp to Dulles Access Road	Ramp	1,372	53	26.0
	Between Ramps	Diverge	5,900	54	21.3
	Off-ramp to Spring Hill Road	Ramp	272	54	5.0
	Between Ramps	Basic	5,934	55	26.4
	On-ramp from Spring Hill Road	Ramp	900	31	29.0
	Downstream	Merge	6,573	52	23.0
WESTBOUND DULLES ACCESS ROAD					
Spring Hill Road	Upstream	Basic	See above - Westbound Dulles Toll Road		
	On-ramp from Dulles Toll Road	Ramp	See above - Westbound Dulles Toll Road		
	Downstream	Merge	1,803	57	10.6

2045 NO BUILD AM PEAK HOUR FREEWAY RESULTS

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
NORTHBOUND I-495					
Route 123	Upstream	Weave	7,491	17	86.7
	Off-ramp to NB Route 123	Ramp	1,318	10	131.5
	Between Ramps	Basic	6,106	36	44.2
	On-ramp from NB Route 123	Ramp	665	22	30.3
	Between Ramps	Weave	6,753	24	58.5
	Off-ramp to SB Route 123	Ramp	1,545	18	88.7
	Between Ramps	Basic	5,254	50	26.3
	On-ramp from SB Route 123	Ramp	412	30	13.7
I-495 between Route 123 and Dulles Toll Road		Weave	5,668	53	21.2
Dulles Toll Road	Off-ramp to WB DTR/DAAR	Ramp	1,174	54	11.0
	Off-ramp to WB DAAR	Ramp	149	30	5.0
	Off-ramp to WB DTR	Ramp	1,025	48	21.5
	Between Ramps	Basic	4,428	56	19.9
	On-ramp from NB I-495 Express Lanes	Ramp	1,728	53	16.4
	Between Ramps	Merge	6,179	40	31.5
	On-Ramp from EB DTR	Ramp	1,356	4	156.9
	On-Ramp from EB DAAR	Ramp	331	2	180.6
	On-ramp from EB DTR/DAAR	Ramp	1,658	5	153.9
	On-Ramp from WB DTR	Ramp	466	13	55.0
	Combined C-D Road On-Ramp from DAAR/DTR	Ramp	2,107	8	138.4
	Downstream	Merge	8,318	15	84.0
I-495 between Dulles Toll Road and Georgetown Pike		Weave	8,133	14	101.6
Georgetown Pike	Off-ramp to Georgetown Pike	Ramp	783	39	21.7
	Between Ramps	Basic	7,345	19	78.1
	On-ramp from Georgetown Pike	Ramp	1,047	8	124.2
I-495 between Georgetown Pike and George Washington Memorial Parkway		Weave	8,523	13	109.0
George Washington Memorial Parkway	Off-ramp to I-495 Express Lanes (MD)	Ramp	1,331	49	27.0
	Between Ramps	Diverge	7,193	14	106.3
	Off-ramp to G.W. Memorial Parkway	Ramp	348	50	7.0
	Between Ramps	Basic	6,659	21	83.0
	On-ramp from G.W. Memorial Parkway	Ramp	1,173	13	92.5
I-495 between George Washington Memorial Parkway and Clara Barton Parkway		Weave	7,908	19	85.7
Clara Barton Parkway	Off-ramp to Clara Barton Parkway	Ramp	865	27	32.6
	Off-ramp to EB Clara Barton Parkway	Ramp	576	41	14.1
	Off-ramp to WB Clara Barton Parkway	Ramp	304	38	8.0
	Between Ramps	Basic	6,853	45	39.6
	On-ramp from EB Clara Barton Parkway	Ramp	106	37	2.9
	Downstream	Merge	7,239	55	26.6

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
I-495 between Clara Barton Parkway and River Road		Basic	7,208	54	32.9
NORTHBOUND I-495 EXPRESS LANES					
Westpark Drive	Upstream	Diverge	3,350	61	25.8
	Off-ramp to Westpark Drive	Ramp	1,196	56	21.2
	Between Ramps	Basic	2,127	67	15.9
	On-ramp from Westpark Drive	Ramp	279	40	7.0
I-495 Express Lanes between Westpark Drive and Jones Branch Connector		Weave	2,399	59	13.6
Jones Branch Connector/ Dulles Toll Road	Off-ramp to Jones Branch Connector	Ramp	216	57	3.8
	Between Ramps	Diverge	2,117	60	13.8
	Off-Ramp to WB Dulles Toll Road	Ramp	769	51	15.2
	Between Ramps	Basic	1,403	67	10.5
	On-ramp from Jones Branch Connector	Ramp	321	58	5.6
	Downstream	Merge	1,714	67	10.8
I-495 Express Lanes End (VA Northern Terminus)		Basic	1,728	53	16.4
I-495 Express Lanes Begin (MD Southern Terminus)		Basic	1,331	54	18.3
George Washington Memorial Parkway	On-ramp from G.W. Memorial Parkway	Ramp	799	37	21.4
	Downstream	Merge	1,968	57	17.5
	Downstream	Basic	1,974	56	17.6
SOUTHBOUND I-495					
I-495 between River Road and Clara Barton Parkway		Basic	6,110	15	103.0
Clara Barton Parkway	Upstream	Diverge	6,096	15	89.1
	Off-ramp to WB Clara Barton Parkway	Ramp	77	56	1.4
	Between Ramps	Basic	6,025	15	103.1
	On-ramp from WB Clara Barton Parkway	Ramp	572	3	166.1
	On-ramp from EB Clara Barton Parkway	Ramp	852	10	90.1
	On-ramp from Clara Barton Parkway	Ramp	1,377	6	114.9
I-495 between Clara Barton Parkway and George Washington Memorial Parkway		Weave	6,985	14	98.0
	Off-ramp to C-D Road	Ramp	1,368	53	13.1
	Off-ramp to G.W. Memorial Parkway	Ramp	685	26	26.7
	Between Ramps (C-D)	Basic	691	54	12.8
	On-ramp from G.W. Memorial Parkway	Ramp	889	48	9.3
	Between Ramps (C-D)	Weave	1,042	56	6.2
	Off-ramp to Georgetown Pike	Ramp	518	27	9.8
	Between Ramp (Mainline)	Basic	5,376	15	99.7
	On-ramp from I-495 Express Lanes (MD)	Ramp	1,286	54	23.6
	Between Ramp (Mainline)	Merge	7,299	17	94.3
	Between Ramp (Mainline)	Basic	7,323	21	86.0
	On-Ramp from C-D Road	Ramp	525	35	15.0
	Between Ramps	Merge	7,897	29	70.5
	On-ramp from Georgetown Pike	Ramp	418	38	11.1
I-495 between Georgetown Pike and Dulles Toll Road		Weave	8,303	55	30.2

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
Dulles Toll Road / Route 123	Upstream	Diverge	8,333	55	26.4
	Off-ramp to SB I-495 Express Lanes	Ramp	984	59	8.3
	Between Ramps	Diverge	7,214	56	22.9
	Off-ramp to WB DTR/DAAR	Ramp	1,872	56	15.2
	Off-ramp to WB DTR	Ramp	1,625	57	14.3
	Off-ramp to WB DAAR	Ramp	249	57	4.4
	Between Ramps	Diverge	5,033	55	19.4
	Off-ramp to Route 123 SB (C-D Road)	Ramp	902	57	8.0
	Between Ramps	Diverge	4,342	53	16.5
	Off-ramp to EB DTR (and Route 123 McLean)	Ramp	306	43	5.3
	Between Ramps	Basic	4,253	57	18.8
	On-ramp from EB Dulles Toll Road	Ramp	961	42	22.7
	Between Ramps (Mainline)	Merge	5,186	50	22.8
	On-ramp from EB DAAR (to C-D Road)	Ramp	523	45	11.5
	C-D Road between On-Ramp from DAAR EB and Merge with I-495 SB GP	Merge	1,426	55	8.6
	Mainline Between On-Ramp from C-D Road and Off-Ramp to Route 123 SB	Merge	6,503	44	29.9
	Off-ramp to SB Route 123 (only for DAAR EB to Route 123 traffic, plus all upstream traffic already on C-D road)	Ramp	915	52	17.6
	Ramp from EB Dulles Toll Road to Route 123 SB/WB	Ramp	48	46	1.1
	Total Off-Ramp to Route 123 SB/WB	Ramp	962	33	14.6
	Between Ramps (Mainline)	Basic	5,703	53	26.8
	On-ramp from SB Route 123	Ramp	432	26	16.7
	Between Ramps	Weave	6,118	48	25.6
	Off-ramp to NB Route 123	Ramp	756	19	39.0
	Between Ramps	Basic	5,394	55	24.7
	On-ramp from NB Route 123	Ramp	618	27	23.0
	Downstream	Weave	6,036	55	21.8
SOUTHBOUND I-495 EXPRESS LANES					
George Washington Memorial Parkway	Upstream	Basic	2,064	56	18.5
	Upstream	Diverge	2,015	52	22.6
	Off-Ramp to G.W. Memorial Parkway	Ramp	641	43	15.9
	Downstream	Merge	2,044	32	47.4
I-495 Express Lanes End (MD Southern Terminus)		Basic	1,286	54	23.6
I-495 Express Lanes Begin (VA Northern Terminus)		Basic	984	59	8.3
Dulles Toll Road/ Jones Branch Connector	Upstream	Diverge	957	67	7.2
	Off-ramp to WB Dulles Toll Road	Ramp	20	48	0.4
	Between Ramps	Basic	960	68	7.1
	Between Ramps	Diverge	960	65	6.5
	Off-ramp to Jones Branch Connector	Ramp	468	52	8.9

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
	Between Ramps	Basic	496	68	3.7
	On-ramp from Jones Branch Connector	Ramp	85	40	2.1
	Between Ramps	Merge	570	64	3.0
	On-ramp from EB Dulles Toll Road	Ramp	655	39	16.8
I-495 between Dulles Toll Road and Westpark Drive		Weave	1,228	65	5.3
Westpark Drive	Off-ramp to Westpark Drive	Ramp	507	49	5.1
	Between Ramps	Basic	732	68	5.4
	On-ramp from Westpark Drive	Ramp	118	38	3.1
	Downstream	Merge	847	63	4.4
EASTBOUND DULLES TOLL ROAD					
Spring Hill Road	Upstream	Diverge	4,944	6	144.0
	Off-ramp to Spring Hill Road	Ramp	737	31	26.1
	Between Ramps	Basic	4,058	7	133.4
	On-ramp from Dulles Access Road	Ramp	146	34	4.7
	Between Ramps	Merge	4,199	7	132.8
	On-Ramp from EB C-D Road (New)	Ramp	28	35	0.8
	On-ramp from Spring Hill Road	Ramp	284	36	4.3
Dulles Toll Road between Spring Hill Road and I-495		Weave	4,496	6	132.4
I-495 / Route 123	Off-ramp to SB I-495	Ramp	1,662	42	19.7
	Between Ramps	Diverge	2,786	4	155.4
	Off-ramp to NB I-495	Ramp	1,356	4	156.9
	Between Ramps	Diverge	1,385	19	28.9
	Off-ramp to Route 123 SB (C-D Road)	Ramp	326	43	3.8
	Between Ramps (Mainline)	Basic	1,052	54	9.8
	On-ramp from SB I-495 (Total Volume)	Ramp	See above - Southbound I-495		
	Ramp from SB I-495 to Route 123 SB (C-D Road)	Ramp	264	40	6.7
	Ramp from SB I-495 to EB DTR	Ramp	40	40	1.0
	Off-ramp to SB Route 123 (C-D Road)	Ramp	593	35	6.5
	Mainline Between On-Ramp from SB I-495 and On-Ramp from SB Route 123	Merge	1,091	56	8.0
	On-ramp from SB Route 123	Ramp	54	27	2.0
	Between Ramps	Weave	1,150	45	8.9
	Off-ramp to NB Route 123	Ramp	612	22	28.2
	Between Ramps	Basic	538	58	4.7
	On-ramp from NB Route 123	Ramp	390	25	15.6
	Between Ramps	Merge	916	51	6.0
	On-ramp from Dulles Access Road	Ramp	743	58	6.4
	Downstream	Merge	1,647	57	8.0
EASTBOUND DULLES ACCESS ROAD					
Spring Hill Road	Upstream	Diverge	1,987	58	11.1
	Off-ramp to Dulles Toll Road	Ramp	See above - Eastbound Dulles Toll Road		
	Downstream	Basic	1,858	53	12.3
I-495	Upstream	Diverge	1,778	30	37.3

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
	Off-ramp to I-495	Ramp	916	9	99.1
	Off-ramp to SB I-495	Ramp	523	45	11.5
	Off-ramp to NB I-495	Ramp	331	2	180.6
	Downstream	Basic	See above - Eastbound Dulles Toll Road		
WESTBOUND DULLES TOLL ROAD					
Route 123	Upstream	Diverge	3,595	11	112.1
	Off-ramp to Dulles Access Road	Ramp	335	53	3.2
	Between Ramps	Diverge	3,143	18	92.5
	Off-ramp to NB Route 123	Ramp	236	29	8.2
	Between Ramps	Diverge	2,855	15	89.2
	Off-ramp to SB Route 123	Ramp	867	7	139.3
	Between Ramps	Basic	1,999	51	19.7
	On-ramp from SB Route 123	Ramp	471	32	14.6
Dulles Toll Road between Route 123 and I-495		Weave	2,477	51	16.7
I-495	Off-ramp to NB I-495	Ramp	See above - Northbound I-495		
	Between Ramps	Basic	2,002	56	18.0
	On-ramp from I-495 Express Lanes	Ramp	782	60	6.5
	Between Ramps	Weave	2,769	57	12.2
	On-ramp from NB I-495 GP	Ramp	See above - Northbound I-495		
	On-ramp form SB I-495 GP	Ramp	See above - Southbound I-495		
	On-ramp from I-495 GP (Combined)	Ramp	2,648	57	15.5
Dulles Toll Road between I-495 and Spring Hill Road		Weave	5,437	57	13.6
Spring Hill Road	Off-ramp to Dulles Access Road	Ramp	207	57	3.6
	Between Ramps	Diverge	5,205	41	40.6
	Off-ramp to Spring Hill Road	Ramp	478	52	9.5
	Off-ramp to WB C-D Road (New)	Ramp	64	56	1.1
	Between Ramps	Basic	4,703	56	20.5
	On-ramp from Spring Hill Road (C-D Road)	Ramp	64	56	1.1
	Downstream	Basic	4,661	55	14.9
WESTBOUND DULLES ACCESS ROAD					
I-495	Upstream	Basic	See above - Westbound Dulles Toll Road		
	On-ramp from I-495 NB GP	Ramp	See above - Northbound I-495		
	Between Ramps	Merge	477	57	2.4
	Between Ramps	Basic	483	58	2.8
	On-ramp from I-495 SB GP	Ramp	See above - Southbound I-495		
	Between Ramps	Merge	731	58	3.7
	Between Ramps	Basic	734	58	4.2
Spring Hill Road	On-ramp from Dulles Toll Road	Ramp	See above - Westbound Dulles Toll Road		
	Downstream	Merge	931	58	4.9

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Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
NORTHBOUND I-495 GENERAL PURPOSE LANES					
Route 123	Upstream	Weave	8,178	47	36.5
	Off-ramp to Route 123	Ramp	3,043	30	53.6
I-495 between Route 123 and Dulles Toll Road		Basic	5,191	53	24.5
		Diverge	4,749	56	17.5
Dulles Toll Road	On-ramp from EB Route 123	Ramp	663	26	26.8
	On-ramp from WB Route 123	Ramp	465	24	41.9
	C-D Between Ramps (Combined Route 123)	Merge	1,103	33	46.9
	Off-ramp to I-495/Route 123 C-D Road	Ramp	1,537	40	26.6
	C-D Between Ramps (Combined I-495/Route 123)	Weave	2,626	31	51.0
	Off-ramp to NB I-495 HOT	Ramp	651	44	14.9
	C-D Between Ramps (to DTR/DAAR/I-495)	Diverge	2,023	26	58.4
	Off-ramp to WB DAAR	Ramp	105	35	3.0
	C-D Between Ramps (to DTR/I-495)	Diverge	1,913	15	79.9
	Off-ramp to WB DTR	Ramp	919	48	19.0
	C-D Between Ramps (to NB I-495)	Ramp	1,022	23	46.7
	Mainline Between Ramps	Basic	3,537	57	15.8
	On-ramp from EB DAAR	Ramp	468	42	11.2
	Mainline Between Ramps	Merge	4,039	57	17.3
	On-ramp from EB DTR	Ramp	2,443	22	61.2
	On-ramp from WB DTR	Ramp	501	8	122.7
	Between Ramps (Combined DTR/I-495)	-	3,033	21	57.1
	On-ramp from I-495 NB C-D Road (Combined Ramps from DTR and Route 123)	Ramp	4,030	23	76.9
I-495 between Dulles Toll Road and Georgetown Pike		Weave	8,188	35	50.4
Georgetown Pike	Off-ramp to Georgetown Pike	Ramp	736	36	20.6
	Between Ramps	Basic	7,639	41	48.1
	On-ramp from Georgetown Pike	Ramp	889	36	24.5
I-495 between Georgetown Pike and George Washington Memorial Parkway		Weave	8,486	32	54.4
GWMP	Off-ramp to G.W. Memorial Parkway	Ramp	761	45	17.0
	Between Ramps	Basic	7,667	30	65.0
	On-ramp from G.W. Memorial Parkway	Ramp	1,336	26	52.1
I-495 between George Washington Memorial Parkway and Clara Barton Parkway		Weave	8,531	27	66.9
Clara Barton Parkway	Off-ramp to Clara Barton Parkway	Ramp	913	26	35.4
	Off-ramp to EB Clara Barton Parkway	Ramp	569	40	14.3
	Off-ramp to WB Clara Barton Parkway	Ramp	360	38	9.5
	Between Ramps	Basic	7,496	44	45.2
	On-ramp from EB Clara Barton Parkway	Ramp	112	37	3.0

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
I-495 between Clara Barton Parkway and River Road		Merge	8,048	54	29.8
		Basic	8,082	53	37.3
NORTHBOUND I-495 EXPRESS LANES					
Westpark Drive	Upstream	Diverge	3,462	63	26.3
	Off-ramp to Westpark Drive	Ramp	1,270	56	22.5
	Between Ramps	Basic	2,158	67	16.2
	On-ramp from Westpark Drive	Ramp	312	40	7.9
I-495 Express Lanes between Westpark Drive and Jones Branch Connector		Weave	2,461	59	13.9
Jones Branch Drive/Dulles Toll Road	Off-ramp to Jones Branch Connector	Ramp	249	56	4.5
	Between Ramps	Diverge	2,125	58	14.4
	Off-Ramp to WB Dulles Toll Road	Ramp	785	44	17.7
	Between Ramps	Basic	1,423	66	10.8
	On-ramp from Jones Branch Connector	Ramp	359	57	6.3
	Between Ramps	Merge	1,774	67	10.9
	On-ramp from EB DTR	Ramp	287	28	10.3
	On-ramp from NB I-495 GP	See above - results from Northbound I-495 GP Lanes			
	Combined EB DTR/ NB I-495	Merge	935	40	14.3
	On-ramp from WB DTR	Ramp	47	49	1.0
	On-ramp from Combined DTR/NB I-495	Ramp	959	49	17.2
I-495 Express Lanes between Dulles Toll Road and GWMP		Basic	2,758	65	20.5
	Off-ramp to G.W. Memorial Parkway	Ramp	60	42	1.4
	Between Ramps	Basic	2,684	65	20.3
	On-ramp from G.W. Memorial Parkway	Ramp	602	36	16.7
	Downstream	Merge	3,307	64	21.5
	Downstream	Basic	3,321	65	25.7
SOUTHBOUND I-495 GENERAL PURPOSE LANES					
I-495 between River Road and Clara Barton Parkway		Basic	8,036	52	39.2
		Diverge	7,839	37	47.0
Clara Barton Parkway	Off-ramp to WB Clara Barton Parkway	Ramp	100	56	1.8
	Between Ramps	Basic	7,886	32	62.6
	On-ramp from EB Clara Barton Parkway	Ramp	897	24	38.8
	On-ramp from WB Clara Barton Parkway	Ramp	750	13	66.0
	On-ramp from Clara Barton Parkway	Ramp	1,595	11	74.5
I-495 between Clara Barton Parkway and GWMP		Weave	9,595	26	72.5
George Washington Memorial Parkway & Georgetown Pike	Off-ramp to G.W. Memorial Parkway	Ramp	850	23	37.7
	Between Ramps	Diverge	8,551	50	41.2
	Off-ramp to Georgetown Pike	Ramp	520	57	9.2
	On-ramp from G.W to SB I-495 C-D Road	Ramp	437	53	6.7
	Off-ramp from C-D Road to Georgetown Pike	Ramp	186	58	3.2
	Combined G.W./I-495 to Georgetown Pike	Ramp	707	22	15.8
	Between Ramp (Mainline)	Basic	8,039	53	37.8

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
	On-ramp from SB I-495 CD Road	Ramp	251	57	4.4
	Between Ramp (Mainline)	Basic	8,183	54	30.0
	On-ramp from Georgetown Pike	Ramp	401	39	10.4
I-495 between Georgetown Pike and Dulles Toll Road		Weave	8,681	55	29.6
Dulles Toll Road & Route 123	Off-ramp to EB DTR	Ramp	366	57	6.4
	Off-ramp to WB DTR	Ramp	2,119	55	19.4
	Between Ramps	Diverge	6,262	49	25.4
	Off-ramp to WB DAAR	Ramp	303	57	5.3
	Between Ramps	Diverge	5,718	31	37.2
	Off-ramp to I-495/Route 123 C-D Road	Ramp	1,868	55	16.9
	Between Ramps	Basic	4,135	52	26.5
	On-ramp from SB I-495 HOT	Ramp	583	39	15.1
	On-ramp from EB DAAR	Ramp	557	32	17.7
	Between Ramps (Combined I-495 HOT/DAAR)	Ramp	1,116	54	10.3
	Between Ramps	Basic	5,189	56	21.9
	Ramp from EB DTR to I-495/Route 123 C-D Road	Ramp	1,554	38	20.8
	On-ramp from EB DTR to Route 123	Ramp	55	45	1.2
	Combined off-ramp to Route 123 from C-D/SB I-495	Ramp	1,939	47	19.1
	On-ramp from EB DTR to SB I-495	Ramp	1,492	43	34.4
	Between Ramps	Merge	6,769	41	33.2
	On-ramp from WB Route 123	Ramp	404	27	15.2
	Between Ramps	Merge	7,192	50	33.3
	On-ramp from EB Route 123	Ramp	620	27	23.4
	Downstream	Weave	7,849	54	28.8
SOUTHBOUND I-495 EXPRESS LANES					
George Washington Memorial Parkway	Upstream	Basic	2,783	66	21.1
	Upstream	Diverge	2,791	61	20.1
	Off-Ramp to G.W. Memorial Parkway	Ramp	676	39	17.4
	Between Ramps	Basic	1,896	66	15.9
	On-ramp from G.W. Memorial Parkway	Ramp	53	46	1.2
I-495 Express Lanes between G.W. Parkway and Dulles Toll Road		Basic	2,029	65	16.5
Dulles Toll Road & Route 123	Off-ramp to SB I-495/DTR	Ramp	877	57	10.1
	Off-ramp to WB DTR	Ramp	251	41	6.1
	Off-ramp to SB I-495/EB DTR	Ramp	607	43	14.6
	Off-ramp to SB I-495	See above - results from Southbound I-495 GP Lanes			
	Off-ramp to EB DTR/Route 123	Ramp	59	45	1.3
	Off-ramp to EB DTR	Ramp	57	39	1.5
	Off-ramp to Route 123	Ramp	1	38	0.0
	Between Ramps	Basic	1,289	65	9.1

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
	Off-ramp to Jones Branch Connector	Ramp	485	53	9.1
	Between Ramps	Basic	801	68	5.9
	On-ramp from Jones Branch Connector	Ramp	94	40	2.3
	Between Ramps	Basic	874	65	4.5
	On-ramp from EB DTR	Ramp	1,002	44	22.8
I-495 between Dulles Toll Road and Westpark Drive		Weave	1,883	65	8.1
Westpark Drive	Off-ramp to Westpark Drive	Ramp	439	49	4.5
	Between Ramps	Basic	1,461	67	10.9
	On-ramp from Westpark Drive	Ramp	122	38	3.3
	Downstream	Weave	1,569	65	8.0
EASTBOUND DULLES TOLL ROAD					
Spring Hill Road	Upstream	Diverge	8,036	24	60.2
	Off-ramp to Spring Hill Road	Ramp	1,223	11	116.9
	Between Ramps	Merge	6,773	39	37.5
	On-ramp from DAAR	Ramp	19	48	0.4
	Between Ramps	Weave	6,855	46	30.5
	Off-ramp from EB DTR to I-495 HOT	Ramp	764	56	13.7
	Off-ramp from EB DAAR to I-495 HOT	Ramp	504	55	9.2
	Between Ramps (Combined DTR/DAAR)	Basic	1,291	51	12.7
	Off-ramp to NB I-495 HOT	See above - results from Northbound I-495 GP Lanes			
	Off-ramp to SB I-495 HOT	See above - results from Southbound I-495 GP Lanes			
	Between Ramps	Basic	6,111	47	32.9
	On-Ramp from EB C-D Road (New)	Ramp	28	36	0.8
	On-ramp from Spring Hill Road	Ramp	281	36	3.9
Dulles Toll Road between Spring Hill Road and I-495		Weave	6,379	46	24.6
I-495 / Route 123	Off-ramp to SB I-495 C-D Road	See above - results from Southbound I-495 GP Lanes			
	Off-ramp to SB I-495	See above - results from Southbound I-495 GP Lanes			
	Off-ramp to Route 123	See above - results from Southbound I-495 GP Lanes			
	Between Ramps	Basic	4,829	36	35.3
	Off-ramp to NB I-495	See above - results from Northbound I-495 GP Lanes			
	Between Ramps	Basic	2,380	44	18.0
	Off-ramp to Route 123 SB (C-D Road)	Ramp	1,481	43	34.7
	Between Ramps	Basic	1,022	57	8.9
	On-ramp from SB I-495 (Total Volume)	See above - results from Southbound I-495 GP Lanes			
	Ramp from SB I-495 to Route 123 SB (C-D Road)	Ramp	302	57	5.3
	Ramp from SB I-495 to EB DTR	Ramp	52	58	0.9
	On-ramp from EB DAAR to C-D Road	Ramp	524	43	12.1

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
	Between Ramps (Combined DAAR/I-495)	Ramp	853	55	7.7
	Off-ramp to NB I-495 from DAAR	See above - results from Northbound I-495 GP Lanes			
	Off-ramp to Route 123 C-D Road	Ramp	359	36	10.0
	Off-ramp from EB DTR, SB I-495, EB DAAR	Ramp	1,875	40	23.7
	On-ramp from SB I-495 HOT	See above - results from Southbound I-495 Express Lanes			
	CD-Road to Route 123 (Combined)	Weave	1,827	32	21.2
	Off-ramp to WB Route 123	Ramp	939	7	90.4
	Off-ramp to EB Route 123	Ramp	944	29	29.0
	Mainline Between On-Ramp from SB I-495 and On-Ramp from SB I-495 HOT	Basic	1,073	58	6.2
	On-ramp from SB I-495 HOT	See above - results from Southbound I-495 Express Lanes			
	Mainline Between On-Ramp from I-495 SB HOT and On-Ramps from Route 123	Merge	1,135	58	7.0
	On-ramp from WB Route 123	Ramp	52	28	1.8
	On-ramp from EB Route 123	Ramp	386	24	15.9
	On-ramp from Route 123 (Combined)	Ramp	442	26	13.9
	Between Ramps	Basic	1,567	53	9.9
	On-ramp from EB DAAR	Ramp	815	58	7.1
	Downstream	Merge	2,371	57	12.0
EASTBOUND DULLES ACCESS ROAD					
	Upstream	Diverge	2,450	58	13.6
	Off-ramp to Dulles Toll Road	See above - results from Eastbound Dulles Toll Road			
Dulles Airport Access Road between Spring Hill Road and I-495		Diverge	2,293	57	12.9
I-495	Off-ramp to I-495 HOT	See above - results from Eastbound Dulles Toll Road			
I-495	Between Ramps	Diverge	1,924	57	9.3
I-495	Off-ramp to NB I-495	Ramp	524	43	12.1
I-495	Off-ramp to SB I-495	See above - results from Southbound I-495 GP Lanes			
I-495	Off-ramp to I-495 (Combined Ramps)	Ramp	1,095	45	12.1
I-495	Downstream	Basic	818	58	5.1
WESTBOUND DULLES TOLL ROAD					
Route 123	Upstream	Diverge	3,289	8	135.1
Route 123	Off-ramp to Dulles Airport Access Road	Ramp	303	52	2.9
Route 123	Between Ramps	Diverge	2,929	15	104.8
Route 123	Off-ramp to NB Route 123	Ramp	215	29	7.5
Route 123	Between Ramps	Diverge	2,710	12	105.8
Route 123	Off-ramp to SB Route 123	Ramp	765	6	148.7
Route 123	Between Ramps	Diverge	1,923	49	13.1

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
	Off-ramp to NB I-495 HOT	See above - results from Northbound I-495 Express Lanes			
	Between Ramps	Basic	1,859	56	16.8
	On-ramp from SB Route 123	Ramp	455	7	107.8
Dulles Toll Road between Route 123 and I-495		Weave	2,354	19	51.3
I-495	Off-ramp to NB I-495	See above - results from Northbound I-495 GP Lanes			
	Between Ramps	Basic	1,862	56	16.6
	On-ramp from NB I-495/Route 123	See above - results from Northbound I-495 GP Lanes			
	Between Ramps	Basic	2,712	57	16.0
	On-ramp from SB I-495 GP	See above - results from Southbound I-495 GP Lanes			
	Between Ramps	Basic	4,758	57	16.8
	On-ramp from NB I-495 HOT	See above - results from Northbound I-495 Express Lanes			
	On-ramp from SB I-495 HOT	See above - results from Southbound I-495 Express Lanes			
	On-ramp from I-495 HOT	Ramp	1,031	59	8.8
Dulles Toll Road between I-495 and Spring Hill Road		Weave	5,831	56	15.1
Spring Hill Road	Off-ramp to WB DAAR	Ramp	396	54	7.3
	Between Ramps	Diverge	5,531	53	17.4
	Off-ramp to Spring Hill Road	Ramp	599	42	14.9
	Between Ramps	Diverge	4,877	55	17.8
	Off-ramp to Spring Hill C-D Road	Ramp	43	47	0.9
	Between Ramps	Basic	4,890	56	21.7
	On-ramp from Spring Hill Road	Ramp	143	33	2.2
	Downstream	Basic	4,740	53	15.3
WESTBOUND DULLES ACCESS ROAD					
I-495	Upstream	Basic	303	56	2.1
	On-ramp from I-495 NB GP	Ramp	105	35	3.0
	Between Ramps	Merge	410	58	2.2
	On-ramp from I-495 SB GP	Ramp	303	57	5.3
	Between Ramps	Merge	715	58	3.9
Spring Hill Road	On-ramp from Dulles Toll Road	See above - results from Westbound Dulles Toll Road			
	Downstream	Merge	1,099	58	6.2

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Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
NORTHBOUND I-495 EXPRESS LANES					
Route 123	Upstream	Weave	6,723	19	71.5
	Off-ramp to NB Route 123	Ramp	826	35	23.8
	Between Ramps	Basic	5,901	18	84.7
	On-ramp from NB Route 123	Ramp	636	22	28.9
	Between Ramps	Weave	6,533	15	86.3
	Off-ramp to SB Route 123	Ramp	693	21	33.3
	Between Ramps	Basic	5,895	18	82.6
	On-ramp from SB Route 123	Ramp	440	30	14.9
I-495 between Route 123 and Dulles Toll Road		Weave	6,323	13	99.0
Dulles Toll Road	Off-ramp to WB DTR/DAAR	Ramp	2,140	36	30.5
	Off-ramp to WB DAAR	Ramp	270	30	9.1
	Off-ramp to WB DTR	Ramp	1,880	44	42.7
	Between Ramps	Basic	4,082	8	125.2
	On-ramp from NB I-495 Express Lanes	Ramp	1,353	9	75.3
	Between Ramps	Merge	5,441	9	126.2
	On-Ramp from EB DTR	Ramp	724	58	6.3
	On-Ramp from EB DAAR	Ramp	383	42	9.0
	On-ramp from EB DTR/DAAR	Ramp	1,105	15	88.5
	On-Ramp from WB DTR	Ramp	187	51	3.6
	Combined C-D Road On-Ramp from DAAR/DTR	Ramp	1,260	37	18.8
	Downstream	Merge	6,643	8	134.8
I-495 between Dulles Toll Road and Georgetown Pike		Weave	6,743	9	128.1
Georgetown Pike	Off-ramp to Georgetown Pike	Ramp	315	37	8.4
	Between Ramps	Basic	6,385	12	105.1
	On-ramp from Georgetown Pike	Ramp	1,233	11	112.4
I-495 between Georgetown Pike and George Washington Memorial Parkway		Weave	7,606	13	98.1
George Washington Memorial Parkway	Off-ramp to I-495 Express Lanes (MD)	Ramp	1,179	54	21.8
	Between Ramps	Diverge	6,380	10	123.5
	Off-ramp to G.W. Memorial Parkway	Ramp	43	52	0.8
	Between Ramps	Basic	6,355	16	96.5
	On-ramp from G.W. Memorial Parkway	Ramp	990	31	31.5
I-495 between George Washington Memorial Parkway and Clara Barton Parkway		Weave	7,339	24	65.3
Clara Barton Parkway	Off-ramp to Clara Barton Parkway	Ramp	1,057	27	39.6
	Off-ramp to EB Clara Barton Parkway	Ramp	432	40	10.8
	Off-ramp to WB Clara Barton Parkway	Ramp	633	38	16.8
	Between Ramps	Basic	6,100	24	60.8
	On-ramp from WB Clara Barton Parkway	Ramp	10	38	0.3
	Downstream	Merge	6,121	15	79.9
I-495 between Clara Barton Parkway and River Road		Basic	5,819	17	84.0
NORTHBOUND I-495 EXPRESS LANES					
Westpark Drive	Upstream	Diverge	1,242	66	8.8
	Off-ramp to Westpark Drive	Ramp	132	58	2.3
	Between Ramps	Basic	1,148	68	8.5

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
	On-ramp from Westpark Drive	Ramp	605	40	15.2
I-495 Express Lanes between Westpark Drive and Jones Branch Connector		Weave	1,752	58	10.1
Jones Branch Connector/ Dulles Toll Road	Off-ramp to Jones Branch Connector	Ramp	83	56	1.5
	Between Ramps	Diverge	1,659	62	10.1
	Off-Ramp to WB Dulles Toll Road	Ramp	769	45	17.2
	Between Ramps	Basic	897	68	6.6
	On-ramp from Jones Branch Connector	Ramp	491	34	7.2
	Downstream	Merge	1,388	66	9.2
I-495 Express Lanes End (VA Northern Terminus)		Basic	1,353	21	58.2
I-495 Express Lanes Begin (MD Southern Terminus)		Basic	1,179	56	15.5
George Washington Memorial Parkway	On-ramp from G.W. Memorial Parkway	Ramp	583	43	15.1
	Downstream	Merge	1,790	57	15.8
	Downstream	Basic	1,801	56	16.0
SOUTHBOUND I-495					
I-495 between River Road and Clara Barton Parkway		Basic	5,301	12	111.9
Clara Barton Parkway	Upstream	Diverge	5,267	12	87.8
	Off-ramp to WB Clara Barton Parkway	Ramp	10	57	0.2
	Between Ramps	Basic	5,218	13	99.3
	On-ramp to WB Clara Barton Parkway	Ramp	978	7	146.8
	On-ramp from EB Clara Barton Parkway	Ramp	579	32	18.0
	On-ramp from Clara Barton Parkway	Ramp	1,544	8	96.3
I-495 between Clara Barton Parkway and George Washington Memorial Parkway		Weave	6,848	44	33.2
George Washington Memorial Parkway/ Georgetown Pike	Off-ramp to C-D Road	Ramp	1,509	55	13.8
	Off-ramp to G.W. Memorial Parkway	Ramp	662	26	25.9
	Between Ramps (C-D)	Basic	839	54	15.5
	On-ramp from G.W. Memorial Parkway	Ramp	1,592	48	16.7
	Between Ramps (C-D)	Weave	1,942	56	11.5
	Off-ramp to Georgetown Pike	Ramp	862	26	16.9
	Between Ramp (Mainline)	Basic	5,339	54	24.4
	On-ramp from I-495 Express Lanes (MD)	Ramp	952	53	17.8
	Between Ramp (Mainline)	Merge	6,188	55	23.8
	Between Ramp (Mainline)	Basic	6,294	55	28.7
	On-Ramp from C-D Road	Ramp	1,085	53	20.3
	Between Ramps	Merge	7,349	52	32.9
	On-ramp from Georgetown Pike	Ramp	572	39	14.5
I-495 between Georgetown Pike and Dulles Toll Road		Weave	7,910	56	28.4
Dulles Toll Road / Route 123	Upstream	Diverge	7,880	46	30.5
	Off-ramp to SB I-495 Express Lanes	Ramp	1,553	60	12.9
	Between Ramps	Diverge	6,280	43	28.2
	Off-ramp to WB DTR/DAAR	Ramp	2,789	53	26.2
	Off-ramp to WB DTR	Ramp	2,410	55	21.9
	Off-ramp to WB DAAR	Ramp	383	56	6.8
	Between Ramps	Diverge	3,621	55	13.1
	Off-ramp to Route 123 SB (C-D Road)	Ramp	535	57	4.7
	Between Ramps	Diverge	3,078	50	12.4
	Off-ramp to EB Dulles Toll Road	Ramp	397	46	8.6

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
	Between Ramps	Basic	2,664	57	11.6
	On-ramp from EB Dulles Toll Road	Ramp	1,006	44	22.8
	Between Ramps (Mainline)	Merge	3,676	53	15.0
	On-ramp from EB DAAR (to C-D Road)	Ramp	431	38	11.5
	C-D Road between On-Ramp from DAAR EB and Merge with I-495 SB GP	Merge	959	57	5.6
	Mainline Between On-Ramp from C-D Road and Off-Ramp to Route 123 SB	Merge	4,520	55	16.6
	Off-ramp to SB Route 123 (only for DAAR EB to Route 123 traffic, plus all upstream traffic already on C-D road)	Ramp	546	41	13.4
	Ramp from EB Dulles Toll Road to Route 123 SB/WB	Ramp	40	45	0.9
	Total Off-Ramp to Route 123 SB/WB	Ramp	585	40	7.3
	Between Ramps	Basic	4,086	57	18.1
	On-ramp from SB Route 123	Ramp	1,063	25	42.8
	Between Ramps	Weave	5,130	54	19.1
	Off-ramp to NB Route 123	Ramp	169	21	8.1
	Between Ramps	Basic	4,984	55	22.8
	On-ramp from NB Route 123	Ramp	1,255	25	50.7
	Downstream	Weave	6,241	16	75.8
SOUTHBOUND I-495 EXPRESS LANES					
George Washington Memorial Parkway	Upstream	Basic	1,526	57	13.4
	Upstream	Diverge	1,517	56	13.5
	Off-Ramp to G.W. Memorial Parkway	Ramp	1,251	33	18.9
	Downstream	Merge	1,530	48	18.2
I-495 Express Lanes End (MD Southern Terminus)		Basic	952	53	17.8
I-495 Express Lanes Begin (VA Northern Terminus)		Basic	1,552	53	14.6
Dulles Toll Road/ Jones Branch Connector	Upstream	Diverge	1,553	66	11.8
	Off-ramp to WB Dulles Toll Road	Ramp	65	47	1.4
	Between Ramps	Basic	1,489	67	11.0
	Between Ramps	Diverge	1,487	65	10.2
	Off-ramp to Jones Branch Connector	Ramp	234	6	86.0
	Between Ramps	Basic	1,244	67	9.3
	On-ramp from Jones Branch Connector	Ramp	516	40	13.0
	Between Ramps	Merge	1,718	60	9.5
	On-ramp from EB Dulles Toll Road	Ramp	527	39	13.4
I-495 between Dulles Toll Road and Westpark Drive		Weave	2,264	64	9.9
Westpark Drive	Off-ramp to Westpark Drive	Ramp	193	49	2.0
	Between Ramps	Basic	2,095	67	15.7
	On-ramp from Westpark Drive	Ramp	937	38	25.0
	Downstream	Merge	3,001	58	17.2
EASTBOUND DULLES TOLL ROAD					
Spring Hill Road	Upstream	Diverge	4,763	56	14.1
	Off-ramp to Spring Hill Road	Ramp	363	47	7.8
	Between Ramps	Basic	4,370	56	18.0
	On-ramp from Dulles Access Road	Ramp	352	46	7.7
	Between Ramps	Merge	4,722	56	17.8
	On-Ramp from EB C-D Road (New)	Ramp	238	36	
	On-ramp from Spring Hill Road	Ramp	688	35	9.7

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
Dulles Toll Road between Spring Hill Road and I-495		Weave	5,405	57	15.9
I-495 / Route 123	Off-ramp to SB I-495	Ramp	1,585	48	16.7
	Between Ramps	Diverge	3,801	57	13.4
	Off-ramp to NB I-495	Ramp	724	58	6.3
	Between Ramps	Diverge	3,080	54	18.9
	Off-ramp to Route 123 SB (C-D Road)	Ramp	86	44	1.0
	Between Ramps (Mainline)	Basic	2,978	55	26.9
	On-ramp from SB I-495 (Total Volume)	Ramp	See above - Southbound I-495		
	Ramp from SB I-495 to Route 123 SB (C-D Road)	Ramp	71	37	1.9
	Ramp from SB I-495 to EB DTR	Ramp	326	38	8.5
	Off-ramp to SB Route 123 (C-D Road)	Ramp	158	43	1.2
	Mainline Between On-Ramp from SB I-495 and On-Ramp from SB Route 123	Merge	3,297	54	25.3
	On-ramp from SB Route 123	Ramp	52	27	1.9
	Between Ramps	Weave	3,361	51	21.9
	Off-ramp to NB Route 123	Ramp	802	25	32.7
	Between Ramps	Basic	2,573	56	23.1
	On-ramp to NB Route 123	Ramp	603	25	24.1
	Between Ramps	Merge	3,127	53	19.7
	On-ramp from Dulles Access Road	Ramp	1,072	58	9.3
	Downstream	Merge	4,180	56	20.9
EASTBOUND DULLES ACCESS ROAD					
Spring Hill Road	Upstream	Diverge	2,217	56	11.8
	Off-ramp to Dulles Toll Road	Ramp	See above - Eastbound Dulles Toll Road		
	Downstream	Basic	1,892	57	10.7
I-495	Upstream	Diverge	1,893	58	8.2
	Off-ramp to I-495	Ramp	811	54	7.5
	Off-ramp to SB I-495	Ramp	431	38	11.5
	Off-ramp to NB I-495	Ramp	383	42	9.0
	Downstream	Basic	See above - Eastbound Dulles Toll Road		
WESTBOUND DULLES TOLL ROAD					
Route 123	Upstream	Diverge	2,405	57	14.0
	Off-ramp to Dulles Access Road	Ramp	613	58	5.3
	Between Ramps	Diverge	1,782	57	15.7
	Off-ramp to NB Route 123	Ramp	69	29	2.4
	Between Ramps	Diverge	1,703	56	12.9
	Off-ramp to SB Route 123	Ramp	330	14	24.1
	Between Ramps	Basic	1,383	57	12.1
	On-ramp from SB Route 123	Ramp	866	32	27.4
Dulles Toll Road between Route 123 and I-495		Weave	2,242	53	14.2
I-495	Off-ramp to NB I-495	Ramp	See above - Northbound I-495		
	Between Ramps	Basic	2,069	56	18.3
	On-ramp from I-495 Express Lanes	Ramp	829	59	7.0
	Between Ramps	Weave	2,871	57	12.5
	On-ramp from NB I-495 GP	Ramp	See above - Northbound I-495		
	On-ramp from SB I-495 GP	Ramp	See above - Southbound I-495		
	On-ramp from I-495 GP (Combined)	Ramp	4,287	56	25.5
Dulles Toll Road between I-495 and Spring Hill Road		Weave	7,192	56	18.2

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
Spring Hill Road	Off-ramp to Dulles Access Road	Ramp	464	55	8.5
	Between Ramps	Diverge	6,718	53	21.0
	Off-ramp to Spring Hill Road	Ramp	209	45	4.6
	Off-ramp to WB C-D Road (New)	Ramp	34	47	0.7
	Between Ramps	Basic	6,481	56	29.1
	On-ramp from Spring Hill Road (C-D Road)	Ramp	389	34	5.7
	Downstream	Basic	413	50	18.2
WESTBOUND DULLES ACCESS ROAD					
I-495	Upstream	Basic	See above - Westbound Dulles Toll Road		
	On-ramp from I-495 NB GP	Ramp	See above - Northbound I-495		
	Between Ramps	Merge	888	57	4.4
	Between Ramps	Basic	889	58	5.1
	On-ramp from I-495 SB GP	Ramp	See above - Southbound I-495		
	Between Ramps	Merge	1,270	58	6.8
	Between Ramps	Basic	1,272	58	7.3
Spring Hill Road	On-ramp from Dulles Toll Road	Ramp	See above - Westbound Dulles Toll Road		
	Downstream	Merge	1,715	58	9.1

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Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
NORTHBOUND I-495 GENERAL PURPOSE LANES					
Route 123	Upstream	Weave	6,814	40	35.7
	Off-ramp to Route 123	Ramp	1,457	40	18.2
I-495 between Route 123 and Dulles Toll Road		Basic	5,547	34	41.6
		Diverge	5,102	24	46.0
Dulles Toll Road	On-ramp from EB Route 123	Ramp	632	28	23.1
	On-ramp from WB Route 123	Ramp	498	30	16.7
	C-D Between Ramps (Combined Route 123)	Merge	1,111	40	19.8
	Off-ramp to I-495/Route 123 C-D Road	Ramp	1,801	47	19.2
	C-D Between Ramps (Combined I-495/Route 123)	Weave	2,895	45	21.4
	Off-ramp to NB I-495 HOT	Ramp	576	45	12.8
	C-D Between Ramps (to DTR/DAAR/I-495)	Diverge	2,366	42	24.8
	Off-ramp to WB DAAR	Ramp	153	31	5.0
	C-D Between Ramps (to DTR/I-495)	Diverge	2,223	24	47.5
	Off-ramp to WB DTR	Ramp	1,645	44	37.6
	C-D Between Ramps (to NB I-495)	Ramp	580	34	17.5
	Mainline Between Ramps	Basic	3,849	16	65.2
	On-ramp from EB DAAR	Ramp	443	3	166.7
	Mainline Between Ramps	Merge	4,561	9	113.7
	On-ramp from EB DTR	Ramp	774	41	9.5
	On-ramp from WB DTR	Ramp	199	48	4.1
	Between Ramps (Combined DTR/I-495)	-	1,308	47	10.8
	On-ramp from I-495 NB C-D Road (Combined Ramps from DTR and Route 123)	Ramp	1,521	17	62.0
I-495 between Dulles Toll Road and Georgetown Pike		Weave	5,985	10	122.3
Georgetown Pike	Off-ramp to Georgetown Pike	Ramp	339	35	9.7
	Between Ramps	Basic	5,606	15	95.0
	On-ramp from Georgetown Pike	Ramp	646	29	22.3
I-495 between Georgetown Pike and George Washington Memorial Parkway		Weave	6,221	15	84.2
George Washington Memorial Parkway	Off-ramp to G.W. Memorial Parkway	Ramp	51	47	1.1
	Between Ramps	Basic	6,148	16	97.4
	On-ramp from G.W. Memorial Parkway	Ramp	1,006	28	36.0
I-495 between George Washington Memorial Parkway and Clara Barton Parkway		Weave	6,793	21	73.3
Clara Barton Parkway	Off-ramp to Clara Barton Parkway	Ramp	946	27	35.4
	Off-ramp to EB Clara Barton Parkway	Ramp	391	40	9.8
	Off-ramp to WB Clara Barton Parkway	Ramp	563	38	14.9
	Between Ramps	Basic	5,042	22	65.9
	On-ramp from EB Clara Barton Parkway	Ramp	9	37	0.2
I-495 between Clara Barton Parkway and River Road		Merge	6,074	15	83.8
		Basic	5,954	17	83.8
NORTHBOUND I-495 EXPRESS LANES					

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
Westpark Drive	Upstream	Diverge	1,553	67	11.1
	Off-ramp to Westpark Drive	Ramp	134	59	2.3
	Between Ramps	Basic	1,417	67	10.5
	On-ramp from Westpark Drive	Ramp	664	40	16.7
I-495 Express Lanes between Westpark Drive and Jones Branch Connector		Weave	2,080	59	11.8
Jones Branch Drive/Dulles Toll Road	Off-ramp to Jones Branch Connector	Ramp	83	57	1.5
	Between Ramps	Diverge	1,918	61	12.3
	Off-Ramp to WB Dulles Toll Road	Ramp	795	45	17.8
	Between Ramps	Basic	1,200	67	9.0
	On-ramp from Jones Branch Connector	Ramp	527	56	9.4
	Between Ramps	Merge	1,719	67	10.5
	On-ramp from EB DTR	Ramp	103	28	3.7
	On-ramp from NB I-495 GP	See above - results from Northbound I-495 GP Lanes			
	Combined EB DTR/ NB I-495	Merge	676	42	9.9
	On-ramp from WB DTR	Ramp	18	48	0.4
	On-ramp from Combined DTR/NB I-495	Ramp	675	49	12.0
I-495 Express Lanes between Dulles Toll Road and G.W. Memorial Parkway		Basic	2,412	66	17.8
George Washington Memorial Parkway	Off-ramp to G.W. Memorial Parkway	Ramp	56	42	1.3
	Between Ramps	Basic	2,348	66	17.7
	On-ramp from G.W. Memorial Parkway	Ramp	528	36	14.6
	Downstream	Merge	2,897	65	18.6
	Downstream	Basic	2,914	65	22.5
SOUTHBOUND I-495 GENERAL PURPOSE LANES					
I-495 between River Road and Clara Barton Parkway		Basic	5,130	56	22.8
		Diverge	5,018	56	19.8
Clara Barton Parkway	Off-ramp to WB Clara Barton Parkway	Ramp	10	56	0.2
	Between Ramps	Basic	5,108	56	22.9
	On-ramp from EB Clara Barton Parkway	Ramp	584	32	18.1
	On-ramp from WB Clara Barton Parkway	Ramp	1,493	37	39.9
	On-ramp from Clara Barton Parkway	Ramp	2,060	32	32.6
I-495 between Clara Barton Parkway and George Washington Memorial Parkway		Weave	7,263	52	27.5
George Washington Memorial Parkway & Georgetown Pike	Off-ramp to G.W. Memorial Parkway	Ramp	700	22	31.3
	Between Ramps	Diverge	6,532	52	29.2
	Off-ramp to Georgetown Pike	Ramp	651	55	11.8
	On-ramp from G.W to SB I-495 C-D Road	Ramp	1,182	52	18.7
	Off-ramp from C-D Road to Georgetown Pike	Ramp	252	58	4.4
	Combined G.W./I-495 to Georgetown Pike	Ramp	934	26	17.9
	Between Ramp (Mainline)	Basic	5,750	53	27.2
	On-ramp from SB I-495 CD Road	Ramp	917	55	16.6
	Between Ramp (Mainline)	Basic	6,667	55	24.3
	On-ramp from Georgetown Pike	Ramp	539	39	13.8
I-495 between Georgetown Pike and Dulles Toll Road		Weave	7,297	54	25.2
Dulles Toll Road & Route 123	Off-ramp to EB DTR	Ramp	426	56	7.7
	Off-ramp to WB DTR	Ramp	2,775	53	26.3

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
	Between Ramps	Diverge	4,190	55	15.0
	Off-ramp to WB DAAR	Ramp	397	57	7.0
	Between Ramps	Diverge	3,659	47	15.7
	Off-ramp to I-495/Route 123 C-D Road	Ramp	885	57	7.8
	Between Ramps	Basic	2,959	56	17.6
	On-ramp from SB I-495 HOT	Ramp	392	39	10.1
	On-ramp from EB DAAR	Ramp	418	30	13.7
	Between Ramps (Combined I-495 HOT/DAAR)	Ramp	794	54	7.3
	Between Ramps	Basic	3,681	55	16.2
	Ramp from EB DTR to I-495/Route 123 C-D Road	Ramp	1,115	43	13.3
	On-ramp from EB DTR to Route 123	Ramp	43	45	1.0
	Combined off-ramp to Route 123 from C-D/SB I-495	Ramp	911	45	9.1
	On-ramp from EB DTR to SB I-495	Ramp	1,052	38	30.2
	Between Ramps	Merge	4,788	32	40.4
	On-ramp from WB Route 123	Ramp	983	24	41.4
	Between Ramps	Merge	5,718	18	81.6
	On-ramp from EB Route 123	Ramp	1,169	19	63.5
	Downstream	Weave	6,823	13	105.7
SOUTHBOUND I-495 EXPRESS LANES					
George Washington Memorial Parkway	Upstream	Basic	2,741	66	20.8
	Upstream	Diverge	2,753	62	19.4
	Off-Ramp to G.W. Memorial Parkway	Ramp	512	39	13.1
	Between Ramps	Basic	2,008	66	16.8
	On-ramp from G.W. Memorial Parkway	Ramp	127	46	2.8
		Basic	2,199	65	18.2
Dulles Toll Road & Route 123	Off-ramp to SB I-495/DTR	Ramp	783	57	9.0
	Off-ramp to WB DTR	Ramp	326	41	7.9
	Off-ramp to SB I-495/EB DTR	Ramp	443	42	10.9
	Off-ramp to SB I-495	See above - results from Southbound I-495 GP Lanes			
	Off-ramp to EB DTR/Route 123	Ramp	79	46	1.7
	Off-ramp to EB DTR	Ramp	68	39	1.8
	Off-ramp to Route 123	Ramp	10	39	0.3
	Between Ramps	Basic	1,590	66	11.2
	Off-ramp to Jones Branch Connector	Ramp	290	56	5.2
	Between Ramps	Basic	1,299	67	9.7
	On-ramp from Jones Branch Connector	Ramp	495	40	12.5
	Between Ramps	Basic	1,753	60	9.7
	On-ramp from EB DTR	Ramp	492	45	11.0
I-495 between Dulles Toll Road and Westpark Drive		Weave	2,266	64	9.9
Westpark Drive	Off-ramp to Westpark Drive	Ramp	212	49	2.2
	Between Ramps	Basic	2,075	66	15.7
	On-ramp from Westpark Drive	Ramp	965	38	25.7
	Downstream	Weave	3,014	58	17.4
EASTBOUND DULLES TOLL ROAD					

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
Spring Hill Road	Upstream	Diverge	5,077	56	15.0
	Off-ramp to Spring Hill Road	Ramp	361	47	7.8
	Between Ramps	Merge	4,706	53	17.6
	On-ramp from DAAR	Ramp	106	47	2.3
	Between Ramps	Weave	4,788	57	16.9
	Off-ramp from EB DTR to I-495 HOT	Ramp	349	57	6.1
	Off-ramp from EB DAAR to I-495 HOT	Ramp	241	56	4.3
	Between Ramps (Combined DTR/DAAR)	Basic	600	52	5.8
	Off-ramp to NB I-495 HOT	See above - results from Northbound I-495 GP Lanes			
	Off-ramp to SB I-495 HOT	See above - results from Southbound I-495 GP Lanes			
	Between Ramps	Basic	4,441	56	19.6
	On-Ramp from EB C-D Road (New)	Ramp	238	36	6.7
	On-ramp from Spring Hill Road	Ramp	687	36	9.7
Dulles Toll Road between Spring Hill Road and I-495		Weave	5,092	56	15.1
I-495 / Route 123	Off-ramp to SB I-495 C-D Road	See above - results from Southbound I-495 GP Lanes			
	Off-ramp to SB I-495	See above - results from Southbound I-495 GP Lanes			
	Off-ramp to Route 123	See above - results from Southbound I-495 GP Lanes			
	Between Ramps	Basic	3,930	56	17.7
	Off-ramp to NB I-495	See above - results from Northbound I-495 GP Lanes			
	Between Ramps	Basic	3,027	54	18.8
	Off-ramp to Route 123 SB (C-D Road)	Ramp	1,031	44	23.4
	Between Ramps	Basic	2,135	57	18.9
	On-ramp from SB I-495 (Total Volume)	See above - results from Southbound I-495 GP Lanes			
	Ramp from SB I-495 to Route 123 SB (C-D Road)	Ramp	232	4	57.1
	Ramp from SB I-495 to EB DTR	Ramp	189	58	3.3
	On-ramp from EB DAAR to C-D Road	Ramp	377	3	139.7
	Between Ramps (Combined DAAR/I-495)	Ramp	661	2	151.4
	Off-ramp to NB I-495 from DAAR	See above - results from Northbound I-495 GP Lanes			
	Off-ramp to Route 123 C-D Road	Ramp	239	35	6.9
	Off-ramp from EB DTR, SB I-495, EB DAAR	Ramp	1,290	41	15.8
	On-ramp from SB I-495 HOT	See above - results from Southbound I-495 Express Lanes			
	CD-Road to Route 123 (Combined)	Weave	1,265	35	12.0
	Off-ramp to WB Route 123	Ramp	502	16	16.0
	Off-ramp to EB Route 123	Ramp	794	29	24.3
	Mainline Between On-Ramp from SB I-495 and On-Ramp from SB I-495 HOT	Basic	2,317	57	13.5
	On-ramp from SB I-495 HOT	See above - results from Southbound I-495 Express Lanes			

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
	Mainline Between On-Ramp from I-495 SB HOT and On-Ramps from Route 123	Merge	2,389	56	15.0
	On-ramp from WB Route 123	Ramp	44	28	1.5
	On-ramp from EB Route 123	Ramp	573	25	23.4
	On-ramp from Route 123 (Combined)	Ramp	621	25	19.6
	Between Ramps	Basic	2,987	53	18.9
	On-ramp from EB DAAR	Ramp	1,081	57	9.4
	Downstream	Merge	4,050	56	21.0
EASTBOUND DULLES ACCESS ROAD					
	Upstream	Diverge	2,257	57	12.5
	Off-ramp to Dulles Toll Road	See above - results from Eastbound Dulles Toll Road			
		Diverge	2,031	57	11.4
I-495	Off-ramp to I-495 HOT	See above - results from Eastbound Dulles Toll Road			
	Between Ramps	Diverge	1,913	35	27.9
	Off-ramp to NB I-495	Ramp	377	3	139.7
	Off-ramp to SB I-495	See above - results from Southbound I-495 GP Lanes			
	Off-ramp to I-495	Ramp	807	4	126.9
	Downstream	Basic	1,083	58	6.7
WESTBOUND DULLES TOLL ROAD					
Route 123	Upstream	Diverge	2,539	57	14.8
	Off-ramp to Dulles Airport Access Road	Ramp	620	58	5.4
	Between Ramps	Diverge	1,908	57	16.8
	Off-ramp to NB Route 123	Ramp	66	29	2.3
	Between Ramps	Diverge	1,844	56	13.8
	Off-ramp to SB Route 123	Ramp	330	12	27.8
	Between Ramps	Diverge	1,518	57	8.9
	Off-ramp to NB I-495 HOT	See above - results from Northbound I-495 Express Lanes			
	Between Ramps	Basic	1,486	57	13.0
	On-ramp from SB Route 123	Ramp	798	32	25.2
Dulles Toll Road between Route 123 and I-495		Weave	2,294	50	15.2
I-495	Off-ramp to NB I-495	See above - results from Northbound I-495 GP Lanes			
	Between Ramps	Basic	2,028	56	18.0
	On-ramp from NB I-495/Route 123	See above - results from Northbound I-495 GP Lanes			
	Between Ramps	Basic	3,667	56	21.8
	On-ramp from SB I-495 GP	See above - results from Southbound I-495 GP Lanes			
	Between Ramps	Basic	6,311	56	22.5
	On-ramp from NB I-495 HOT	See above - results from Northbound I-495 Express Lanes			
	On-ramp from SB I-495 HOT	See above - results from Southbound I-495 Express Lanes			
	On-ramp from I-495 HOT	Ramp	1,116	59	9.5
Dulles Toll Road between I-495 and Spring Hill Road		Weave	7,489	52	20.5

Interchange	Segment	Type	Average Throughput (vph)	Average Speed (mph)	Average Density (vpmpl)
Spring Hill Road	Off-ramp to WB DAAR	Ramp	745	52	14.2
	Between Ramps	Diverge	6,875	51	22.5
	Off-ramp to Spring Hill Road	Ramp	286	45	6.4
	Between Ramps	Diverge	6,516	54	24.3
	Off-ramp to Spring Hill C-D Road	Ramp	0	0	0.0
	Between Ramps	Basic	6,594	56	29.7
	On-ramp from Spring Hill Road	Ramp	583	34	8.6
	Downstream	Basic	6,402	51	21.1
WESTBOUND DULLES ACCESS ROAD					
I-495	Upstream	Basic	620	58	4.2
	On-ramp from I-495 NB GP	Ramp	153	31	5.0
	Between Ramps	Merge	779	58	4.1
	On-ramp from I-495 SB GP	Ramp	397	57	7.0
	Between Ramps	Merge	1,177	58	6.5
Spring Hill Road	On-ramp from Dulles Toll Road	See above - results from Westbound Dulles Toll Road			
	Downstream	Merge	1,904	58	10.8

Appendix H: Detailed Future Conditions Arterial Operations Analysis Results

2025 NO BUILD AM PEAK HOUR ARTERIAL INTERSECTION RESULTS

2025 No Build AM VISSIM Peak Hour Intersection Volume, Delay, and Queue Length

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
6	Route 123 and Tysons Boulevard	NB	LT	145	1,996	92.6	25.5	126	126	407	407
			TH	1,648		20.5		126		407	
			RT	203		17.5		126		407	
		SB	LT	139	3,975	123.5	29.3	92	120	315	1,441
			TH	1,849		29.7		120		1,441	
			RT	1,987		22.4		0		5	
		EB	LT	510	611	78.7	66.8	103	103	298	298
			RT	101		7.0		37		208	
		WB	LT	85	427	70.5	47.4	29	82	117	161
			RT	342		41.7		82		161	
		Intersection		7,009		32.6					
4	Westpark Drive and Tysons Connector	NB	TH	437	634	21.3	20.5	45	45	262	262
			RT	197		18.6		40		255	
		SB	LT	117	343	12.5	12.2	18	18	183	183
			TH	226		12.1		18		183	
		WB	LT	327	908	30.4	25.5	101	111	419	435
			RT	581		22.8		111		435	
		Intersection		1,885		21.4					
5	Tysons Connector and Express Lanes Ramps	NB	LT	638	638	17.4	17.4	27	27	173	173
		SB	RT	281	281	12.6	12.6	12	12	96	96
		EB	LT	186	315	12.5	8.0	13	13	173	173
			RT	129		1.4		8		161	
		Intersection		1,234		13.9					
7	Route 123 and Capital One Tower Drive/Old Meadow Road	NB	LT	291	3,110	321.1	86.5	547	605	1,255	1,313
			TH	2,303		63.4		547		1,255	
			RT	516		57.5		605		1,313	
		SB	LT	150	2,116	135.8	43.4	289	289	766	766
			TH	1,809		38.0		289		766	
			RT	157		17.4		289		766	
		EB	LT	27	100	563.4	556.7	444	444	494	494
			RT	73		554.3		444		494	
		WB	LT	509	677	83.4	75.4	211	214	652	656
			TH	45		85.3		211		652	
			RT	123		38.6		214		656	
		Intersection		6,003		77.9					
8	Route 123 and Scotts Crossing	NB	LT	233	2,427	90.1	55.1	278	278	761	761
			TH	1,723		54.4		278		761	
			RT	471		40.7		278		761	

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	Boulevard/ Colshire Drive	SB	LT	269	2,421	102.4	98.7	646	646	968	968
			TH	1,736		100.1		646		968	
			RT	416		90.2		646		968	
		EB	LT	148	391	88.9	51.8	66	67	191	215
			TH	84		72.3		66		191	
			RT	159		6.3		67		215	
		WB	LT	188	311	89.9	67.7	68	68	184	184
			TH	55		69.8		68		184	
			RT	68		4.6		68		184	
		Intersection		5,550		74.6					
1	Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road	NB	TH	1,482	1,822	54.5	46.8	200	200	734	734
			RT	340		12.9		174		692	
		SB	LT	109	1,964	219.3	150.6	2,482	2,482	6,438	6,438
			TH	1,855		146.5		2,482		6,438	
		EB	LT	48	728	128.6	99.0	553	553	2,650	2,650
			TH	257		133.2		553		2,650	
			RT	423		74.8		330		1,780	
		WB	LT	300	375	188.2	185.1	307	343	380	416
			RT	75		172.7		343		416	
		Intersection		4,889		106.8					
3	Route 123 and Lewinsville Road/ Great Falls Street	NB	LT	529	2,410	95.4	88.2	963	963	2,980	2,980
			TH	1,459		96.5		963		2,980	
			RT	422		50.3		882		2,968	
		SB	LT	44	1,529	145.6	115.9	763	763	2,007	2,007
			TH	1,093		128.1		763		2,007	
			RT	392		78.5		730		2,003	
		EB	LT	315	828	75.0	53.3	122	122	296	296
			TH	263		61.6		122		296	
			RT	250		17.3		16		154	
		WB	LT	369	718	434.6	437.1	1,990	1,990	2,851	2,851
			TH	300		441.4		1,990		2,851	
			RT	49		429.7		1,929		2,790	
		Intersection		5,485		136.3					
2	Lewinsville Road and Balls Hill Road	SB	LT	161	221	149.3	138.9	208	208	693	693
			RT	60		111.1		208		693	
		EB	LT	68	732	20.5	18.4	35	35	301	301
			TH	664		18.2		35		301	
		WB	TH	1,016	1,228	4.1	4.0	17	29	213	259
			RT	212		3.6		29		259	
		Intersection		2,181		22.5					
9	Jones Branch Drive and	NB	TH	386	751	29.2	19.2	73	89	408	445
			RT	365		8.7		89		445	
		SB	LT	469	771	14.9	12.9	32	32	239	239

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	Jones Branch Connector		TH	302		9.9		32		239	
		WB	LT	535	908	31.9	20.2	63	63	352	352
			RT	373		3.5		63		352	
		Intersection		2,430		17.6					
10	Jones Branch Connector and Express Lanes Ramps	NB	LT	227	326	39.3	35.8	38	51	168	201
			RT	99		27.9		51		201	
		SB	LT	109	366	42.3	28.1	38	38	186	186
			RT	257		22.1		28		175	
		EB	LT	64	829	79.1	20.1	32	32	274	274
			TH	740		15.6		32		274	
			RT	25		3.2		0		58	
		WB	LT	51	601	43.0	17.1	31	31	234	243
			TH	418		18.0		31		234	
			RT	132		4.1		30		243	
		Intersection		756		64.7					
29	Jones Branch Drive and Capital One (West)	NB	LT	169	258	40.3	35.7	35	43	151	167
			TH	1		30.7		35		151	
			RT	88		26.9		43		167	
		SB	LT	44	207	42.4	34.5	33	39	206	244
			TH	55		48.8		33		206	
			RT	108		24.0		39		244	
		EB	LT	0	931	0.0	12.9	36	55	315	357
			TH	408		14.8		36		315	
			RT	523		11.4		55		357	
		WB	LT	209	544	10.7	8.6	13	13	128	150
			TH	324		7.4		13		128	
			RT	11		1.8		11		150	
		Intersection		1,940		17.0					
30	Jones Branch Drive and Capital One (East)	NB	LT	10	63	42.7	15.0	3	3	44	68
			TH	5		38.8		3		44	
			RT	48		6.7		3		68	
		SB	LT	9	114	39.7	14.6	5	5	60	87
			TH	17		42.3		5		60	
			RT	88		6.7		4		87	
		EB	LT	45	539	5.4	3.3	6	6	124	141
			TH	338		3.3		6		124	
			RT	156		2.6		6		141	
		WB	LT	205	701	7.7	4.7	10	12	202	232
			TH	447		3.5		10		202	
			RT	49		3.5		12		232	
		Intersection		1,417		5.4					
11	International Drive and Spring Hill	NB	LT	155	444	63.1	55.3	72	85	228	258
			TH	211		67.1		72		228	
			RT	78		7.9		85		258	

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	Road/ Jones Branch Drive	SB	LT	690	1,842	46.0	39.9	211	211	481	481
			TH	600		50.3		211		481	
			RT	552		21.0		155		412	
		EB	LT	160	656	65.5	57.9	122	122	382	382
			TH	377		70.9		122		382	
			RT	119		6.6		75		326	
		WB	LT	30	375	70.4	64.4	72	72	221	221
			TH	171		73.3		72		221	
			RT	174		54.5		43		221	
		Intersection		3,317		48.3					
12	Spring Hill Road and Dulles Toll Road Eastbound Ramps	NB	TH	440	552	28.9	23.1	44	44	226	226
			RT	112		0.5		1		74	
		SB	LT	104	1,013	25.9	48.0	111	111	478	478
			TH	909		50.5		111		478	
		EB	LT	118	1,081	322.4	334.5	3,580	3,602	7,127	7,135
			TH	0		0.0		3,580		7,127	
			RT	963		336.0		3,602		7,135	
		Intersection		2,646		159.8					
13	Spring Hill Road and Dulles Toll Road Westbound Ramps	NB	LT	103	558	36.4	16.2	37	37	371	371
			TH	455		11.6		37		371	
		SB	TH	603	704	22.6	21.3	56	61	509	525
			RT	101		13.9		61		525	
		WB	LT	417	477	66.6	65.7	87	104	457	487
			TH	9		66.8		87		457	
			RT	51		58.4		104		487	
		Intersection		1,739		31.9					
14	Spring Hill Road and Lewinsville Road	NB	LT	41	501	85.1	65.2	126	126	743	743
			TH	114		89.3		126		743	
			RT	346		54.9		126		743	
		SB	LT	29	310	81.4	82.1	187	187	625	625
			TH	275		82.3		187		625	
			RT	6		75.5		187		625	
		EB	LT	11	605	69.3	55.2	255	255	1,004	1,004
			TH	450		67.3		255		1,004	
			RT	144		16.3		11		368	
		WB	LT	286	651	38.1	31.2	75	75	416	416
			TH	344		27.4		75		416	
			RT	21		1.0		1		119	
		Intersection		2,067		54.1					
23	Georgetown Pike and Helga Place/ Linganore Drive	NB	LT	0	23	0.0	6.2	1	1	61	62
			TH	0		0.0		1		62	
			RT	23		6.2		1		60	
		SB	LT	8	8	139.6	139.6	6	6	55	82
			TH	0		0.0		2		73	

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
			RT	0		0.0		2		82	
		EB	TH	1,231	1,231	84.7	84.7	1,454	1,454	2,713	2,713
			RT	0		0.0		1,454		2,713	
		WB	LT	4	670	22.0	0.6	1	1	41	53
			TH	654		0.5		0		53	
			RT	12		1.0		0		53	
		Intersection		1,932		139.6					
20	Georgetown Pike and I-495 Southbound Ramps	SB	LT	203	683	66.8	23.7	86	86	333	333
			TH	15		69.6		86		333	
			RT	465		3.4		24		286	
		EB	TH	1,211	1,273	29.3	27.9	242	242	546	546
			RT	62		0.6		177		440	
		WB	LT	330	535	30.3	21.7	40	40	339	339
			TH	205		8.0		40		339	
		Intersection		2,491		25.4					
19	Georgetown Pike and I-495 Northbound Ramps	NB	LT	101	445	104.7	43.0	58	58	248	248
			TH	11		105.9		58		248	
			RT	333		22.2		17		219	
		EB	LT	846	1,408	19.0	12.9	86	86	430	430
			TH	562		3.7		86		430	
		WB	TH	431	841	39.1	21.4	78	78	394	394
			RT	410		2.7		0		0	
		Intersection		2,694		20.5					
18	Georgetown Pike and Balls Hill Road	NB	LT	310	408	57.8	47.4	119	119	465	465
			TH	25		43.1		119		465	
			RT	73		4.8		110		455	
		SB	LT	20	84	54.3	35.4	16	16	116	116
			TH	21		60.3		16		116	
			RT	43		14.4		8		105	
		EB	LT	44	892	17.3	12.5	34	35	330	341
			TH	542		16.3		34		330	
			RT	306		5.0		35		341	
		WB	LT	56	549	11.5	13.4	24	24	231	231
			TH	483		13.8		24		231	
			RT	10		4.4		24		231	
		Intersection		1,933		21.1					
22	Georgetown Pike and Dead Run Drive	NB	LT	85	104	9.6	9.2	6	6	97	97
			RT	19		7.1		5		94	
		EB	TH	566	636	1.0	1.0	1	1	130	130
			RT	70		1.3		1		130	
		WB	LT	58	521	3.9	0.8	1	1	59	59
			TH	463		0.4		0		4	
		Intersection		1,261		9.6					

2025 No Build AM Synchro Peak Hour Intersection Approach Delay and Level of Service

	Intersection Level of Service by Approach - 2025 No Build AM Conditions				
#	Signalization	Intersection Name	Approach	Delay	LOS
15	Signalized	Old Dominion Drive at Spring Hill Road	Northbound (Springhill Road)	14.7	B
			Southbound (Springhill Road)	15.2	B
			Eastbound (Old Dominion Drive)	10.4	B
			Westbound (Old Dominion Drive)	7.3	A
16	Signalized	Old Dominion Drive at Swinks Mill Road	Northbound (Swinks Mill Road)	25.3	C
			Southbound (Swinks Mill Road)	22.8	C
			Eastbound (Old Dominion Drive)	13.6	B
			Westbound (Old Dominion Drive)	6.6	A
17	Signalized	Old Dominion Drive at Balls Hill Road	Northbound (Balls Hill Road)	120.6	F
			Southbound (Balls Hill Road)	115.7	F
			Eastbound (Old Dominion Drive)	84.6	F
			Westbound (Old Dominion Drive)	96.3	F
21	Signalized	Route 123 at Old Dominion Drive	Northbound (Route 123)	27.7	C
			Southbound (Route 123)	24.4	C
			Eastbound (Old Dominion Drive)	84.2	F
			Westbound (Old Dominion Drive)	87.4	F
24	Unsignalized	Georgetown Pike at Swinks Mill Road	Northbound (Swinks Mill Road)	221.4	F
			Southbound (Driveway)	0.0	A
			Eastbound (Georgetown Pike)	0.0	A
			Westbound (Georgetown Pike)	2.2	A
25	Unsignalized	Georgetown Pike at Spring Hill Road	Northbound (Spring Hill Road)	18.0	C
			Eastbound (Georgetown Pike)	0.0	A
			Westbound (Georgetown Pike)	0.7	A
26	Unsignalized	Lewinsville Road at Swinks Mill Road	Southbound (Swinks Mill Road)	46.7	E
			Eastbound (Lewinsville Road)	2.7	A
			Westbound (Lewinsville Road)	0.0	A
27	Unsignalized	Route 123 at Ingleside Avenue	Northbound (Route 123)	0.4	A
			Southbound (Route 123)	0.8	A
			Eastbound (Ingleside Avenue)	14.0	B
			Westbound (Ingleside Avenue)	20.2	C
28	Unsignalized	Douglass Drive at Route 193 (Georgetown Pike)	Northbound (Douglass Drive)	153.7	F
			Southbound (Douglass Drive)	48.5	E
			Eastbound (Georgetown Pike)	0.4	A
			Westbound (Georgetown Pike)	1.9	A

2025 No Build AM Synchro Peak Hour Arterial Queue Lengths

Queue Length by Movement - 2025 No Build AM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
Signalized	Old Dominion Drive at Spring Hill Road	EBL*	145	261	-
		EBT*	145	261	-
		EBR	42	134	195
		WBL*	77	164	-
		WBT*	77	164	-
		WBR	1	5	480
		NBL*	67	123	-
		NBT*	67	123	-
		NBR*	67	123	-
		SBL*	86	147	-
		SBT*	86	147	-
		SBR*	86	147	-
Signalized	Old Dominion Drive at Swinks Mill Road	EBL*	459	806	-
		EBT*	459	806	-
		EBR*	459	806	-
		WBL*	69	148	-
		WBT*	69	148	-
		WBR*	69	148	-
		NBL*	331	809	-
		NBT*	331	809	-
		NBR*	331	809	-
		SBL*	135	295	-
		SBT*	135	295	-
		SBR*	135	295	-
Signalized	Old Dominion Drive at Balls Hill Road	EBL*	632	994	-
		EBT*	632	994	-
		EBR*	632	994	-
		WBL*	219	421	-
		WBT*	219	421	-
		WBR*	219	421	-
		NBL*	224	411	-
		NBT*	224	411	-
		NBR*	224	411	-
		SBL*	731	1304	-
		SBT*	731	1304	-

Queue Length by Movement - 2025 No Build AM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
		SBR*	731	1304	-
Signalized	Route 123 at Old Dominion Drive	EBL	101	173	235
		EBL	120	197	235
		EBT	166	339	-
		EBT	200	426	-
		EBR	42	220	330
		WBL	282	350	300
		WBL	310	353	300
		WBT	514	941	-
		WBTR*	247	682	-
		NBL	10	31	390
		NBT	134	290	-
		NBT	150	311	-
		NBR	14	90	390
		SBL	24	101	260
		SBT	239	396	-
		SBTR*	247	403	-
Unsignalized	Georgetown Pike at Swinks Mill Road	EBT*	0	5	-
		EBR*	0	5	-
		WBL*	101	212	-
		WBT*	101	212	-
		NBL*	294	314	-
		NBT*	294	314	-
		NBR*	294	314	-
Unsignalized	Georgetown Pike at Spring Hill Road	EBT*	0	3	-
		EBR*	0	3	-
		WBL*	38	115	-
		WBT*	38	115	-
		NBL*	22	47	-
		NBR*	22	47	-
Unsignalized	Lewinsville Road at Swinks Mill Road	EBL	56	106	250
		WBT*	2	11	-
		WBR*	2	11	-
		SBL	59	130	-
		SBR	58	87	50
Unsignalized		EBR	62	167	-
		WBR	27	58	-

Queue Length by Movement - 2025 No Build AM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
	Route 123 at Ingleside Avenue	NBL	19	51	110
		NBT	0	7	
		NBTR*	0	7	-
		SBL	21	57	200
		SBT	138	667	-
		SBTR*	137	659	-
Unsignalized	Douglass Drive at Route 193 (Georgetown Pike)	EBL*	27	104	-
		EBT*	27	104	-
		EBR*	27	104	-
		WBL*	73	182	-
		WBT*	73	182	-
		WBR*	73	182	-
		NBL*	176	397	-
		NBT*	176	397	-
		NBR*	176	397	-
		SBL*	35	79	-
		SBT*	35	79	-
		SBR*	35	79	-

* indicates a single lane that includes more than one movement for which total queueing feet are shown (ie. queueing associated with a single EBLT lane is shown above both for the EBL and T movements)

2025 BUILD AM PEAK HOUR ARTERIAL INTERSECTION RESULTS

2025 Build AM VISSIM Peak Hour Intersection Volume, Delay, and Queue Length

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
6	Route 123 and Tysons Boulevard	NB	LT	148	1,992	92.8	25.6	129	129	391	391
			TH	1,642		20.4		129		391	
			RT	202		18.3		129		391	
		SB	LT	129	4,064	121.0	30.7	86	137	289	1,302
			TH	1,875		31.0		137		1,302	
			RT	2,060		24.8		0		0	
		EB	LT	509	612	78.7	66.5	103	103	305	305
			RT	103		6.1		37		215	
		WB	LT	81	428	72.1	46.8	28	83	114	163
			RT	347		40.9		83		163	
		Intersection		7,096		33.3					
4	Westpark Drive and Tysons Connector	NB	TH	439	649	21.1	19.9	45	45	267	267
			RT	210		17.4		39		261	
		SB	LT	119	347	10.9	11.7	18	18	177	177
			TH	228		12.2		18		177	
		WB	LT	329	911	34.9	28.9	118	129	514	529
			RT	582		25.5		129		529	
		Intersection		1,907		22.7					
5	Tysons Connector and Express Lanes Ramps	NB	LT	605	605	17.8	17.8	26	26	178	178
		SB	RT	315	315	12.4	12.4	13	13	107	107
		EB	LT	216	329	12.7	8.8	15	15	202	202
			RT	113		1.5		10		190	
		Intersection		1,249		14.1					
7	Route 123 and Capital One Tower Drive/ Old Meadow Road	NB	LT	292	3,188	335.0	100.4	617	675	1,401	1,460
			TH	2,351		77.0		617		1,401	
			RT	545		75.9		675		1,460	
		SB	LT	152	2,132	135.4	38.6	479	479	814	814
			TH	1,818		32.6		479		814	
			RT	162		14.1		479		814	
		EB	LT	25	98	580.7	548.2	444	444	496	496
			RT	73		537.1		444		496	
		WB	LT	510	679	81.8	74.0	205	208	608	612
			TH	44		87.2		205		608	
			RT	125		37.8		208		612	
		Intersection		6,097		83.0					
8	Route 123 and Scotts Crossing	NB	LT	260	2,471	96.7	59.2	303	303	763	763
			TH	1,737		58.5		303		763	
			RT	474		41.4		303		763	

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	Boulevard/ Colshire Drive	SB	LT	276	2,428	102.5	100.4	619	619	934	934
			TH	1,739		101.3		619		934	
			RT	413		95.2		619		934	
		EB	LT	159	406	91.9	70.9	86	93	225	242
			TH	83		72.7		86		225	
			RT	164		49.7		93		242	
		WB	LT	191	317	91.3	68.5	71	71	191	191
			TH	56		71.0		71		191	
			RT	70		4.5		71		191	
		Intersection		5,622		78.4					
1	Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road	NB	TH	1,497	1,842	54.1	46.5	208	208	762	762
			RT	345		13.8		180		719	
		SB	LT	99	1,974	194.3	119.3	1,686	1,686	4,928	4,928
			TH	1,875		115.3		1,686		4,928	
		EB	LT	47	725	83.0	51.3	195	195	905	905
			TH	253		86.3		195		905	
			RT	425		27.1		30		626	
		WB	LT	293	369	187.5	183.3	307	343	378	414
			RT	76		166.8		343		414	
		Intersection		4,910		86.8					
3	Route 123 and Lewinsville Road/ Great Falls Street	NB	LT	527	2,361	88.0	77.0	649	649	1,876	1,876
			TH	1,431		82.6		649		1,876	
			RT	403		42.4		537		1,856	
		SB	LT	38	1,492	209.3	180.8	1,269	1,269	2,665	2,665
			TH	1,073		194.1		1,269		2,665	
			RT	381		140.3		1,239		2,665	
		EB	LT	318	837	71.3	51.9	117	117	297	297
			TH	259		63.1		117		297	
			RT	260		17.0		18		174	
		WB	LT	368	720	472.4	477.0	2,194	2,194	2,842	2,842
			TH	302		482.7		2,194		2,842	
			RT	50		476.9		2,133		2,781	
		Intersection		5,410		155.0					
2	Lewinsville Road and Balls Hill Road	SB	LT	158	221	152.3	145.2	206	206	762	762
			RT	63		127.6		206		762	
		EB	LT	64	737	18.4	16.3	30	30	270	270
			TH	673		16.1		30		270	
		WB	TH	1,003	1,220	3.1	3.1	12	22	211	256
			RT	217		3.1		22		256	
		Intersection		2,178		22.0					
9	Jones Branch Drive and	NB	TH	387	750	29.2	19.2	74	89	406	443
			RT	363		8.6		89		443	
		SB	LT	459	778	15.3	13.3	34	34	241	241

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	Jones Branch Connector		TH	319		10.4		34		241	
		WB	LT	562	967	33.2	20.8	69	69	362	362
			RT	405		3.7		69		362	
		Intersection		2,495		18.0					
10	Jones Branch Connector and Express Lanes Ramps	NB	LT	263	371	40.7	37.7	44	59	181	214
			RT	108		30.5		59		214	
		SB	LT	124	395	44.4	29.6	44	44	212	212
			RT	271		22.9		33		207	
		EB	LT	67	815	78.8	20.8	32	32	230	230
			TH	723		16.0		32		230	
			RT	25		3.3		0		54	
		WB	LT	62	641	44.0	18.0	35	35	262	271
			TH	430		18.9		35		262	
			RT	149		4.4		34		271	
		Intersection		833		65.0					
29	Jones Branch Drive and Capital One (West)	NB	LT	174	262	42.7	37.3	37	47	172	188
			TH	1		43.9		37		172	
			RT	87		26.2		47		188	
		SB	LT	45	213	41.0	37.3	39	47	210	247
			TH	55		54.2		39		210	
			RT	113		27.6		47		247	
		EB	LT	0	943	0.0	13.4	38	59	251	297
			TH	429		15.4		38		251	
			RT	514		11.7		59		297	
		WB	LT	233	600	11.6	8.8	15	15	130	148
			TH	353		7.2		15		130	
			RT	14		1.7		13		148	
		Intersection		2,018		17.6					
30	Jones Branch Drive and Capital One (East)	NB	LT	12	63	46.7	16.2	3	3	52	65
			TH	4		37.6		3		52	
			RT	47		6.6		3		65	
		SB	LT	10	118	40.9	13.5	5	5	61	80
			TH	13		40.1		5		61	
			RT	95		6.9		4		80	
		EB	LT	46	561	5.2	2.9	5	6	106	122
			TH	349		2.7		5		106	
			RT	166		2.6		6		122	
		WB	LT	231	725	7.6	4.9	10	13	200	230
			TH	494		3.6		10		200	
			RT	0		0.0		13		230	
		Intersection		1,467		5.3					
11	International Drive and Spring Hill	NB	LT	155	447	63.3	55.6	73	86	226	255
			TH	215		67.0		73		226	
			RT	77		8.4		86		255	

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	Road/ Jones Branch Drive	SB	LT	809	2,084	47.6	41.9	291	291	476	476
			TH	693		51.9		291		476	
			RT	582		22.2		228		407	
		EB	LT	166	659	65.4	58.4	122	122	373	373
			TH	375		71.5		122		373	
			RT	118		6.9		75		316	
		WB	LT	28	380	77.5	64.4	73	73	220	220
			TH	171		72.9		73		220	
			RT	181		54.4		43		220	
		Intersection		3,570		49.1					
12	Spring Hill Road and Dulles Toll Road Eastbound Ramps	NB	TH	461	571	30.5	24.7	48	48	237	237
			RT	110		0.5		1		92	
		SB	LT	112	1,017	40.4	82.9	236	236	542	542
			TH	905		88.2		236		542	
		EB	LT	145	1,342	246.4	255.6	4,775	4,796	7,130	7,138
			TH	0		0.0		4,775		7,130	
			RT	1,197		256.7		4,796		7,138	
		Intersection		2,930		150.7					
13	Spring Hill Road and Dulles Toll Road Westbound Ramps	NB	LT	111	608	30.2	16.3	42	42	341	341
			TH	497		13.3		42		341	
		SB	TH	608	712	30.5	28.8	87	95	684	700
			RT	104		19.0		95		700	
		WB	LT	421	475	230.3	227.3	476	503	1,607	1,638
			TH	6		186.5		476		1,607	
			RT	48		206.7		503		1,638	
		Intersection		1,795		77.1					
14	Spring Hill Road and Lewinsville Road	NB	LT	46	547	82.1	63.3	136	136	751	751
			TH	121		89.2		136		751	
			RT	380		52.7		136		751	
		SB	LT	27	316	82.5	83.5	193	193	637	637
			TH	284		83.5		193		637	
			RT	5		86.3		193		637	
		EB	LT	10	603	79.0	65.0	310	310	1,115	1,115
			TH	448		78.5		310		1,115	
			RT	145		22.3		27		574	
		WB	LT	285	650	40.3	33.5	81	81	425	425
			TH	344		29.7		81		425	
			RT	21		2.0		2		128	
		Intersection		2,116		57.6					
23	Georgetown Pike and Helga Place/ Linganore Drive	NB	LT	0	19	0.0	6.1	1	1	54	54
			TH	0		0.0		1		54	
			RT	19		6.1		1		53	
		SB	LT	8	8	39.5	39.5	2	2	54	80
			TH	0		0.0		1		71	

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
			RT	0		0.0		1		80	
		EB	TH	1,114	1,114	9.8	9.8	72	72	1,385	1,385
			RT	0		0.0		72		1,385	
		WB	LT	5	643	14.3	0.5	0	0	52	52
			TH	630		0.4		0		50	
			RT	8		0.8		0		50	
		Intersection		1,784		39.5					
20	Georgetown Pike and I-495 Southbound Ramps	SB	LT	193	650	67.4	25.3	82	82	362	362
			TH	17		72.5		82		362	
			RT	440		5.0		23		298	
		EB	TH	1,077	1,147	23.8	22.4	159	159	532	532
			RT	70		0.6		102		427	
		WB	LT	326	531	37.5	25.4	47	47	355	355
			TH	205		6.3		47		355	
		Intersection		2,328		23.9					
19	Georgetown Pike and I-495 Northbound Ramps	NB	LT	104	442	92.2	32.1	59	59	245	245
			TH	11		92.8		59		245	
			RT	327		11.0		21		217	
		EB	LT	705	1,264	27.5	17.0	94	94	427	427
			TH	559		3.8		94		427	
		WB	TH	421	753	34.4	20.3	73	73	379	379
			RT	332		2.4		0		0	
		Intersection		2,459		20.7					
18	Georgetown Pike and Balls Hill Road	NB	LT	290	386	56.3	46.0	107	107	463	463
			TH	27		41.0		107		463	
			RT	69		4.5		99		453	
		SB	LT	18	76	181.7	73.8	28	28	133	133
			TH	19		76.6		28		133	
			RT	39		22.7		19		122	
		EB	LT	42	879	15.4	13.7	40	43	345	361
			TH	536		17.4		40		345	
			RT	301		6.7		43		361	
		WB	LT	60	495	13.1	13.9	22	22	230	230
			TH	425		14.2		22		230	
			RT	10		3.7		22		230	
		Intersection		1,836		23.0					
22	Georgetown Pike and Dead Run Drive	NB	LT	74	93	9.5	8.8	5	5	86	86
			RT	19		6.4		4		83	
		EB	TH	559	625	1.5	1.5	1	1	181	181
			RT	66		1.6		1		181	
		WB	LT	56	480	4.1	0.8	1	1	59	59
			TH	424		0.4		0		5	
		Intersection		1,198		9.5					

2025 Build AM Synchro Peak Hour Intersection Approach Delay and Level of Service

	Intersection Level of Service by Approach - 2025 Build AM Conditions				
#	Signalization	Intersection Name	Approach	Delay	LOS
15	Signalized	Old Dominion Drive at Spring Hill Road	Northbound (Springhill Road)	14.7	B
			Southbound (Springhill Road)	15.2	B
			Eastbound (Old Dominion Drive)	10.4	B
			Westbound (Old Dominion Drive)	7.3	A
16	Signalized	Old Dominion Drive at Swinks Mill Road	Northbound (Swinks Mill Road)	25.3	C
			Southbound (Swinks Mill Road)	22.8	C
			Eastbound (Old Dominion Drive)	13.6	B
			Westbound (Old Dominion Drive)	6.7	A
17	Signalized	Old Dominion Drive at Balls Hill Road	Northbound (Balls Hill Road)	120.6	F
			Southbound (Balls Hill Road)	115.7	F
			Eastbound (Old Dominion Drive)	84.6	F
			Westbound (Old Dominion Drive)	96.3	F
21	Signalized	Route 123 at Old Dominion Drive	Northbound (Route 123)	27.8	C
			Southbound (Route 123)	25.1	C
			Eastbound (Old Dominion Drive)	83.9	F
			Westbound (Old Dominion Drive)	85.3	F
24	Unsignalized	Georgetown Pike at Swinks Mill Road	Northbound (Swinks Mill Road)	101.9	F
			Southbound (Driveway)	0.0	A
			Eastbound (Georgetown Pike)	0.0	A
			Westbound (Georgetown Pike)	2.1	A
25	Unsignalized	Georgetown Pike at Spring Hill Road	Northbound (Spring Hill Road)	16.7	C
			Eastbound (Georgetown Pike)	0.0	A
			Westbound (Georgetown Pike)	0.7	A
26	Unsignalized	Lewinsville Road at Swinks Mill Road	Southbound (Swinks Mill Road)	47.6	E
			Eastbound (Lewinsville Road)	2.7	A
			Westbound (Lewinsville Road)	0.0	A
27	Unsignalized	Route 123 at Ingleside Avenue	Northbound (Route 123)	0.4	A
			Southbound (Route 123)	0.7	A
			Eastbound (Ingleside Avenue)	14.2	B
			Westbound (Ingleside Avenue)	19.9	C
28	Unsignalized	Douglass Drive at Route 193 (Georgetown Pike)	Northbound (Douglass Drive)	115.3	F
			Southbound (Douglass Drive)	45.2	E
			Eastbound (Georgetown Pike)	0.4	A
			Westbound (Georgetown Pike)	2.1	A

2025 Build AM Synchro Peak Hour Arterial Queue Lengths

Queue Length by Movement - 2025 Build AM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
Signalized	Old Dominion Drive at Spring Hill Road	EBL*	143	248	-
		EBT*	143	248	-
		EBR	35	117	195
		WBL*	69	153	-
		WBT*	69	153	-
		WBR	1	5	480
		NBL*	66	121	-
		NBT*	66	121	-
		NBR*	66	121	-
		SBL*	80	141	-
		SBT*	80	141	-
		SBR*	80	141	-
Signalized	Old Dominion Drive at Swinks Mill Road	EBL*	556	1014	-
		EBT*	556	1014	-
		EBR*	556	1014	-
		WBL*	66	136	-
		WBT*	66	136	-
		WBR*	66	136	-
		NBL*	423	1008	-
		NBT*	423	1008	-
		NBR*	423	1008	-
		SBL*	226	522	-
		SBT*	226	522	-
		SBR*	226	522	-
Signalized	Old Dominion Drive at Balls Hill Road	EBL*	638	1058	-
		EBT*	638	1058	-
		EBR*	638	1058	-
		WBL*	317	596	-
		WBT*	317	596	-
		WBR*	317	596	-
		NBL*	228	416	-
		NBT*	228	416	-
		NBR*	228	416	-
		SBL*	728	1316	-
		SBT*	728	1316	-

Queue Length by Movement - 2025 Build AM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
		SBR*	728	1316	-
Signalized	Route 123 at Old Dominion Drive	EBL	101	172	235
		EBL	118	190	235
		EBT	155	270	-
		EBT	179	352	-
		EBR	17	138	330
		WBL	270	353	300
		WBL	297	362	300
		WBT	394	847	-
		WBTR*	199	594	-
		NBL	16	67	390
		NBT	118	272	-
		NBT	129	286	-
		NBR	15	114	390
		SBL	40	159	260
		SBT	236	386	-
		SBTR*	244	395	-
Unsignalized	Georgetown Pike at Swinks Mill Road	EBT*	0	0	-
		EBR*	0	0	-
		WBL*	80	178	-
		WBT*	80	178	-
		NBL*	288	331	-
		NBT*	288	331	-
		NBR*	288	331	-
Unsignalized	Georgetown Pike at Spring Hill Road	EBT*	0	0	-
		EBR*	0	0	-
		WBL*	30	98	-
		WBT*	30	98	-
		NBL*	24	48	-
		NBR*	24	48	-
Unsignalized	Lewinsville Road at Swinks Mill Road	EBL	52	100	250
		WBT*	2	12	-
		WBR*	2	12	-
		SBL	66	163	-
		SBR	57	88	50
Unsignalized	Route 123 at Ingleside Avenue	EBR	46	117	-
		WBR	28	58	-

Queue Length by Movement - 2025 Build AM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
		NBL	20	48	110
		NBT	0	6	
		NBTR*	1	6	-
		SBL	23	59	200
		SBT	53	393	-
		SBTR*	55	398	-
Unsignalized	Douglass Drive at Route 193 (Georgetown Pike)	EBL*	20	75	-
		EBT*	20	75	-
		EBR*	20	75	-
		WBL*	71	169	-
		WBT*	71	169	-
		WBR*	71	169	-
		NBL*	135	277	-
		NBT*	135	277	-
		NBR*	135	277	-
		SBL*	34	68	-
		SBT*	34	68	-
		SBR*	34	68	-

* indicates a single lane that includes more than one movement for which total queueing feet are shown (ie. queueing associated with a single EBLT lane is shown above both for the EB L and T movements)

2025 NO BUILD PM PEAK HOUR ARTERIAL INTERSECTION RESULTS

2025 No Build PM VISSIM Peak Hour Intersection Volume, Delay, and Queue Length

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
6	Route 123 and Tysons Boulevard	NB	LT	43	2,160	380.4	324.7	3,079	3,079	3,662	3,662
			TH	1,851		326.9		3,079		3,662	
			RT	266		300.4		3,079		3,662	
		SB	LT	135	2,532	115.6	33.6	87	132	307	527
			TH	1,461		41.0		132		527	
			RT	936		10.1		0		0	
		EB	LT	1,043	1,228	257.1	245.6	1,295	1,295	1,570	1,570
			RT	185		180.7		1,204		1,480	
		WB	LT	203	471	41.7	58.2	32	105	173	305
			RT	268		70.7		105		305	
		Intersection		6,391		174.5					
4	Westpark Drive and Tysons Connector	NB	TH	239	926	12.2	13.8	45	45	262	262
			RT	687		14.4		42		255	
		SB	LT	443	891	7.8	7.2	24	24	250	250
			TH	448		6.6		24		250	
		WB	LT	147	267	26.8	17.3	23	25	160	175
			RT	120		5.7		25		175	
		Intersection		2,084		11.4					
5	Tysons Connector and Express Lanes Ramps	NB	LT	107	107	17.0	17.0	7	7	68	68
		SB	RT	161	161	6.7	6.7	4	4	63	63
		EB	LT	447	1,140	10.3	6.8	26	26	325	325
			RT	693		4.6		22		312	
		Intersection		1,408		7.6					
7	Route 123 and Capital One Tower Drive/Old Meadow Road	NB	LT	129	2,255	336.0	329.8	1,981	2,037	3,147	3,205
			TH	1,785		335.3		1,981		3,147	
			RT	341		298.6		2,037		3,205	
		SB	LT	128	2,387	134.2	44.4	272	272	764	764
			TH	2,156		40.9		272		764	
			RT	103		6.3		272		764	
		EB	LT	119	500	248.3	139.7	331	331	483	483
			RT	381		105.8		331		483	
		WB	LT	520	641	171.2	163.4	467	471	851	855
			TH	10		177.4		467		851	
			RT	111		125.1		471		855	
		Intersection		5,783		177.1					
8	Route 123 and Scotts Crossing	NB	LT	115	2,011	160.0	111.1	578	578	795	795
			TH	1,778		114.6		578		795	
			RT	118		10.9		578		795	

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	Boulevard/ Colshire Drive	**SB**	**LT**	73	1,940	93.4	40.0	200	200	700	700
			TH	1,706		38.6		200		700	
			RT	161		30.6		200		700	
		EB	**LT**	280	667	110.3	69.1	129	133	469	476
			TH	143		80.8		129		469	
			RT	244		14.9		133		476	
		WB	**LT**	452	799	116.2	86.9	180	180	410	410
			TH	199		76.5		180		410	
			RT	148		11.6		180		410	
		Intersection		5,417		76.9					
1	**Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road**	**NB**	**TH**	1,603	2,164	116.9	108.7	881	881	1,033	1,033
			RT	561		85.6		839		991	
		SB	**LT**	116	1,486	118.0	36.7	149	149	604	604
			TH	1,370		29.9		149		604	
		EB	**LT**	11	136	68.4	44.7	33	33	193	193
			TH	66		78.3		33		193	
			RT	59		2.6		0		14	
		WB	**LT**	302	448	162.6	150.9	283	293	376	387
			RT	146		126.9		293		387	
		Intersection		4,234		85.9					
3	**Route 123 and Lewinsville Road/ Great Falls Street**	**NB**	**LT**	236	2,007	106.0	43.6	235	235	1,136	1,136
			TH	1,316		42.0		235		1,136	
			RT	455		16.1		167		1,106	
		SB	**LT**	58	2,005	99.9	55.0	416	416	1,528	1,528
			TH	1,707		56.3		416		1,528	
			RT	240		34.5		185		1,396	
		EB	**LT**	358	1,033	72.5	52.8	181	181	302	302
			TH	320		66.8		181		302	
			RT	355		20.4		22		213	
		WB	**LT**	349	669	625.1	615.8	2,595	2,595	2,850	2,850
			TH	287		609.6		2,595		2,850	
			RT	33		570.9		2,535		2,790	
		Intersection		5,714		116.3					
2	**Lewinsville Road and Balls Hill Road**	**SB**	**LT**	141	196	41.8	38.7	28	28	197	197
			RT	55		30.8		28		197	
		EB	**LT**	54	934	226.7	222.5	1,825	1,825	2,215	2,215
			TH	880		222.3		1,825		2,215	
		WB	**TH**	604	767	7.6	7.4	35	35	322	322
			RT	163		6.8		32		312	
		Intersection		1,897		116.6					
9	**Jones Branch Drive and**	**NB**	**TH**	255	811	25.1	14.7	50	66	413	444
			RT	556		10.0		66		444	
		SB	**LT**	345	850	15.6	11.7	36	36	353	353

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	Jones Branch Connector		TH	505		9.1		36		353	
		WB	LT	447	643	32.7	24.0	54	54	395	395
			RT	196		4.3		54		395	
		Intersection		2,304		16.2					
10	Jones Branch Connector and Express Lanes Ramps	NB	LT	25	51	44.0	27.9	6	6	65	75
			RT	26		12.5		4		75	
		SB	LT	71	130	47.3	41.9	25	25	155	155
			RT	59		35.4		13		134	
		EB	LT	185	896	50.6	16.2	12	12	130	157
			TH	504		8.4		12		130	
			RT	207		4.4		11		157	
		WB	LT	225	990	69.7	33.6	71	76	381	395
			TH	559		30.4		71		381	
			RT	206		3.0		76		395	
		Intersection		366		149.3					
29	Jones Branch Drive and Capital One (West)	NB	LT	570	687	33.5	33.0	82	91	300	314
			TH	53		34.1		82		300	
			RT	64		28.4		91		314	
		SB	LT	34	68	46.4	34.4	11	23	70	108
			TH	9		52.6		11		70	
			RT	25		11.5		23		108	
		EB	LT	29	598	10.5	12.6	27	36	162	204
			TH	460		15.0		27		162	
			RT	109		3.1		36		204	
		WB	LT	65	489	12.5	12.5	20	26	216	249
			TH	387		13.4		20		216	
			RT	37		3.0		26		249	
		Intersection		1,842		21.0					
30	Jones Branch Drive and Capital One (East)	NB	LT	44	230	41.0	16.3	12	12	93	107
			TH	10		35.7		12		93	
			RT	176		9.0		9		107	
		SB	LT	44	144	41.2	19.6	11	11	89	92
			TH	10		39.4		11		89	
			RT	90		6.8		5		92	
		EB	LT	79	557	3.8	3.3	5	5	111	147
			TH	452		3.3		5		111	
			RT	26		2.3		5		147	
		WB	LT	106	478	7.0	6.7	9	11	180	193
			TH	355		6.7		9		180	
			RT	17		6.1		11		193	
		Intersection		1,409		8.3					
11	International Drive and Spring Hill	NB	LT	150	773	85.1	96.9	236	258	708	738
			TH	575		104.2		236		708	
			RT	48		46.2		258		738	

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	Road/ Jones Branch Drive	SB	LT	135	635	81.1	61.8	90	90	286	286
			TH	325		84.2		90		286	
			RT	175		5.5		35		217	
		EB	LT	445	828	98.5	71.7	193	198	787	811
			TH	162		78.7		193		787	
			RT	221		12.8		198		811	
		WB	LT	74	1,092	105.7	112.2	490	490	1,496	1,496
			TH	344		118.0		490		1,496	
			RT	674		110.0		453		1,496	
		Intersection		3,328		89.0					
12	Spring Hill Road and Dulles Toll Road Eastbound Ramps	NB	TH	1,321	1,682	19.0	15.1	123	123	515	515
			RT	361		1.0		63		362	
		SB	LT	65	518	25.4	4.6	3	3	108	108
			TH	453		1.6		3		108	
		EB	LT	117	316	82.2	73.1	63	66	198	206
			TH	9		0.0		63		198	
			RT	190		70.9		66		206	
		Intersection		2,516		20.2					
13	Spring Hill Road and Dulles Toll Road Westbound Ramps	NB	LT	756	1,413	36.8	37.9	217	217	542	542
			TH	657		39.3		217		542	
		SB	TH	405	538	31.0	29.0	62	69	532	548
			RT	133		23.1		69		548	
		WB	LT	116	343	215.5	211.3	303	333	610	640
			TH	147		208.9		303		610	
			RT	80		209.8		333		640	
		Intersection		2,294		61.8					
14	Spring Hill Road and Lewinsville Road	NB	LT	73	716	139.5	121.8	802	802	1,547	1,547
			TH	282		142.4		802		1,547	
			RT	361		102.3		802		1,547	
		SB	LT	20	220	71.9	75.8	116	116	477	477
			TH	182		76.4		116		477	
			RT	18		73.4		116		477	
		EB	LT	15	383	83.3	61.7	170	170	687	687
			TH	303		72.2		170		687	
			RT	65		7.6		1		56	
		WB	LT	292	818	43.5	40.1	142	142	608	608
			TH	507		39.4		142		608	
			RT	19		8.7		19		311	
		Intersection		2,137		75.0					
23	Georgetown Pike and Helga Place/ Linganore Drive	NB	LT	0	1	0.0	6.2	0	0	41	41
			TH	0		0.0		0		41	
			RT	1		6.2		0		40	
		SB	LT	4	4	157.9	157.9	3	3	50	77
			TH	0		0.0		0		68	

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
			RT	0		0.0		0		77	
		EB	TH	787	787	59.4	59.4	344	344	693	693
			RT	0		0.0		344		693	
		WB	LT	5	834	6.7	1.1	0	1	44	169
			TH	826		1.0		1		169	
			RT	3		0.6		1		169	
		Intersection		1,626		157.9					
20	Georgetown Pike and I-495 Southbound Ramps	SB	LT	191	910	102.4	75.8	99	99	652	652
			TH	119		102.1		99		652	
			RT	600		62.2		41		606	
		EB	TH	755	816	48.6	45.0	288	288	542	542
			RT	61		0.5		211		436	
		WB	LT	491	727	85.5	62.9	196	196	443	443
			TH	236		15.8		196		443	
		Intersection		2,453		61.7					
19	Georgetown Pike and I-495 Northbound Ramps	NB	LT	51	176	63.3	38.7	36	36	176	176
			TH	63		55.0		36		176	
			RT	62		1.8		6		146	
		EB	LT	592	944	21.2	14.9	79	79	432	432
			TH	352		4.4		79		432	
		WB	TH	672	1,404	39.1	20.9	149	149	453	453
			RT	732		4.3		6		238	
		Intersection		2,524		19.9					
18	Georgetown Pike and Balls Hill Road	NB	LT	305	323	191.2	184.2	443	443	1,142	1,142
			TH	5		103.1		443		1,142	
			RT	13		51.1		434		1,133	
		SB	LT	5	166	67.5	41.7	41	41	317	317
			TH	38		72.7		41		317	
			RT	123		31.1		34		305	
		EB	LT	27	414	62.4	11.9	17	17	106	121
			TH	189		14.4		17		106	
			RT	198		2.6		11		121	
		WB	LT	46	1,009	28.7	52.5	220	220	608	608
			TH	958		53.8		220		608	
			RT	5		40.2		220		608	
		Intersection		1,912		65.0					
22	Georgetown Pike and Dead Run Drive	NB	LT	307	335	55.3	55.5	149	149	509	509
			RT	28		58.6		147		507	
		EB	TH	188	207	0.3	0.4	0	0	0	0
			RT	19		0.9		0		0	
		WB	LT	11	686	19.5	41.1	271	271	1,360	1,360
			TH	675		41.5		254		1,295	
		Intersection		1,228		58.6					

2025 No Build PM Synchro Peak Hour Intersection Approach Delay and Level of Service

	Intersection Level of Service by Approach - 2025 No Build PM Conditions				
#	Signalization	Intersection Name	Approach	Delay	LOS
15	Signalized	Old Dominion Drive at Spring Hill Road	Northbound (Springhill Road)	16.2	B
			Southbound (Springhill Road)	13.7	B
			Eastbound (Old Dominion Drive)	8.0	A
			Westbound (Old Dominion Drive)	10.2	B
16	Signalized	Old Dominion Drive at Swinks Mill Road	Northbound (Swinks Mill Road)	15.7	B
			Southbound (Swinks Mill Road)	13.8	B
			Eastbound (Old Dominion Drive)	9.9	A
			Westbound (Old Dominion Drive)	11.5	B
17	Signalized	Old Dominion Drive at Balls Hill Road	Northbound (Balls Hill Road)	214.1	F
			Southbound (Balls Hill Road)	218.6	F
			Eastbound (Old Dominion Drive)	205.7	F
			Westbound (Old Dominion Drive)	149.3	F
21	Signalized	Route 123 at Old Dominion Drive	Northbound (Route 123)	25.9	C
			Southbound (Route 123)	26.7	C
			Eastbound (Old Dominion Drive)	85.8	F
			Westbound (Old Dominion Drive)	86.8	F
24	Unsignalized	Georgetown Pike at Swinks Mill Road	Northbound (Swinks Mill Road)	23.4	C
			Southbound (Driveway)	0.0	A
			Eastbound (Georgetown Pike)	0.0	A
			Westbound (Georgetown Pike)	1.3	A
25	Unsignalized	Georgetown Pike at Spring Hill Road	Northbound (Spring Hill Road)	13.3	B
			Eastbound (Georgetown Pike)	0.0	A
			Westbound (Georgetown Pike)	0.8	A
26	Unsignalized	Lewinsville Road at Swinks Mill Road	Southbound (Swinks Mill Road)	85.8	F
			Eastbound (Lewinsville Road)	2.9	A
			Westbound (Lewinsville Road)	0.0	A
27	Unsignalized	Route 123 at Ingleside Avenue	Northbound (Route 123)	3.6	A
			Southbound (Route 123)	0.4	A
			Eastbound (Ingleside Avenue)	24.9	C
			Westbound (Ingleside Avenue)	18.6	C
28	Unsignalized	Douglass Drive at Route 193 (Georgetown Pike)	Northbound (Douglass Drive)	280.2	F
			Southbound (Douglass Drive)	221.9	F
			Eastbound (Georgetown Pike)	0.4	A
			Westbound (Georgetown Pike)	2.3	A

2025 No Build PM Synchro Peak Hour Arterial Queue Lengths

Queue Length by Movement - 2025 No Build PM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
Signalized	Old Dominion Drive at Spring Hill Road	EBL*	98	189	-
		EBT*	98	189	-
		EBR	19	64	195
		WBL*	200	420	-
		WBT*	200	420	-
		WBR	12	121	480
		NBL*	122	208	-
		NBT*	122	208	-
		NBR*	122	208	-
		SBL*	55	109	-
		SBT*	55	109	-
		SBR*	55	109	-
Signalized	Old Dominion Drive at Swinks Mill Road	EBL*	400	815	-
		EBT*	400	815	-
		EBR*	400	815	-
		WBL*	380	715	-
		WBT*	380	715	-
		WBR*	380	715	-
		NBL*	188	339	-
		NBT*	188	339	-
		NBR*	188	339	-
		SBL*	84	184	-
		SBT*	84	184	-
		SBR*	84	184	-
Signalized	Old Dominion Drive at Balls Hill Road	EBL*	820	1220	-
		EBT*	820	1220	-
		EBR*	820	1220	-
		WBL*	917	1335	-
		WBT*	917	1335	-
		WBR*	917	1335	-
		NBL*	286	552	-
		NBT*	286	552	-
		NBR*	286	552	-
		SBL*	1250	1517	-
		SBT*	1250	1517	-

Queue Length by Movement - 2025 No Build PM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
		SBR*	1250	1517	-
Signalized	Route 123 at Old Dominion Drive	EBL	49	109	235
		EBL	64	128	235
		EBT	111	268	-
		EBT	151	405	-
		EBR	40	208	330
		WBL	251	351	300
		WBL	313	363	300
		WBT	690	978	-
		WBTR*	486	930	-
		NBL	29	77	390
		NBT	167	305	-
		NBT	178	319	-
		NBR	7	31	390
		SBL	71	250	260
		SBT	357	459	-
		SBTR*	362	459	-
Unsignalized	Georgetown Pike at Swinks Mill Road	EBT*	0	2	-
		EBR*	0	2	-
		WBL*	62	148	-
		WBT*	62	148	-
		NBL*	100	201	-
		NBT*	100	201	-
		NBR*	100	201	-
Unsignalized	Georgetown Pike at Spring Hill Road	EBT*	0	5	-
		EBR*	0	5	-
		WBL*	39	124	-
		WBT*	39	124	-
		NBL*	26	51	-
		NBR*	26	51	-
Unsignalized	Lewinsville Road at Swinks Mill Road	EBL	67	128	250
		WBT*	4	21	-
		WBR*	4	21	-
		SBL	168	413	-
		SBR	61	96	50
Unsignalized		EBR	229	280	-
		WBR	29	62	-

Queue Length by Movement - 2025 No Build PM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
	Route 123 at Ingleside Avenue	NBL	100	172	110
		NBT	101	310	
		NBTR*	79	289	-
		SBL	37	141	200
		SBT	499	1099	-
		SBTR*	495	1084	-
Unsignalized	Douglass Drive at Route 193 (Georgetown Pike)	EBL*	11	58	-
		EBT*	11	58	-
		EBR*	11	58	-
		WBL*	83	227	-
		WBT*	83	227	-
		WBR*	83	227	-
		NBL*	230	512	-
		NBT*	230	512	-
		NBR*	230	512	-
		SBL*	30	73	-
		SBT*	30	73	-
		SBR*	30	73	-

* indicates a single lane that includes more than one movement for which total queueing feet are shown (ie. queueing associated with a single EBLT lane is shown above both for the EBL and T movements)

2025 BUILD PM PEAK HOUR ARTERIAL INTERSECTION RESULTS

2025 Build PM VISSIM Peak Hour Intersection Volume, Delay, and Queue Length

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
6	Route 123 and Tysons Boulevard	NB	LT	42	2,111	382.9	333.8	3,082	3,082	3,667	3,667
			TH	1,803		336.7		3,082		3,667	
			RT	266		306.6		3,082		3,667	
		SB	LT	135	2,559	111.9	34.4	81	139	302	550
			TH	1,489		42.2		139		550	
			RT	935		10.8		0		0	
		EB	LT	1,073	1,274	257.4	245.8	1,286	1,286	1,570	1,570
			RT	201		183.7		1,196		1,480	
		WB	LT	207	473	42.6	64.6	33	123	166	367
			RT	266		81.7		123		367	
		Intersection		6,417		177.1					
4	Westpark Drive and Tysons Connector	NB	TH	238	946	11.0	12.8	40	40	258	258
			RT	708		13.4		37		252	
		SB	LT	440	904	6.9	6.4	21	21	253	253
			TH	464		6.0		21		253	
		WB	LT	118	225	26.2	16.4	18	18	151	166
			RT	107		5.6		18		166	
		Intersection		2,075		10.4					
5	Tysons Connector and Express Lanes Ramps	NB	LT	92	92	18.4	18.4	6	6	63	63
		SB	RT	133	133	6.4	6.4	3	3	59	59
		EB	LT	482	1,157	10.0	6.7	26	26	285	285
			RT	675		4.3		21		272	
		Intersection		1,382		7.4					
7	Route 123 and Capital One Tower Drive/Old Meadow Road	NB	LT	123	2,296	338.7	329.5	2,080	2,138	3,253	3,311
			TH	1,831		334.6		2,080		3,253	
			RT	342		299.0		2,138		3,311	
		SB	LT	121	2,366	130.0	42.7	255	255	758	758
			TH	2,143		39.6		255		758	
			RT	102		6.0		255		758	
		EB	LT	95	378	279.5	175.6	365	365	483	483
			RT	283		140.7		365		483	
		WB	LT	530	656	150.9	142.9	416	419	825	829
			TH	10		158.2		416		825	
			RT	116		104.9		419		829	
		Intersection		5,696		178.7					
8	Route 123 and Scotts Crossing	NB	LT	122	2,046	159.8	109.6	574	574	789	789
			TH	1,801		112.8		574		789	
			RT	123		11.8		574		789	

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	Boulevard/ Colshire Drive	SB	LT	72	1,932	97.1	37.0	178	178	589	589
			TH	1,696		35.2		178		589	
			RT	164		30.1		178		589	
		EB	LT	283	651	10.5	32.4	3	97	98	400
			TH	142		27.0		97		400	
			RT	226		63.4		88		387	
		WB	LT	456	815	136.8	91.4	187	187	598	598
			TH	203		52.1		187		598	
			RT	156		9.8		187		598	
		Intersection		5,444		71.9					
1	Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road	NB	TH	1,651	2,226	102.2	94.7	872	872	1,025	1,025
			RT	575		73.1		829		982	
		SB	LT	108	1,471	109.1	35.0	139	139	659	659
			TH	1,363		29.1		139		659	
		EB	LT	9	135	67.0	46.1	34	34	176	176
			TH	69		79.8		34		176	
			RT	57		2.0		0		20	
		WB	LT	297	451	165.1	152.5	284	294	375	386
			RT	154		128.1		294		386	
		Intersection		4,283		78.7					
3	Route 123 and Lewinsville Road/ Great Falls Street	NB	LT	216	1,881	107.6	42.4	209	209	1,038	1,038
			TH	1,243		40.4		209		1,038	
			RT	422		14.7		134		991	
		SB	LT	61	2,013	99.0	50.8	370	370	1,508	1,508
			TH	1,707		52.0		370		1,508	
			RT	245		30.3		165		1,244	
		EB	LT	352	1,036	74.1	52.2	181	181	307	307
			TH	324		63.8		181		307	
			RT	360		20.3		23		229	
		WB	LT	355	675	605.5	596.2	2,575	2,575	2,850	2,850
			TH	285		589.2		2,575		2,850	
			RT	35		559.5		2,515		2,790	
		Intersection		5,605		113.9					
2	Lewinsville Road and Balls Hill Road	SB	LT	138	197	40.9	37.6	27	27	196	196
			RT	59		29.9		27		196	
		EB	LT	53	939	220.0	221.7	1,821	1,821	2,217	2,217
			TH	886		221.8		1,821		2,217	
		WB	TH	588	752	7.5	7.4	33	33	310	310
			RT	164		6.7		29		299	
		Intersection		1,888		117.1					
9	Jones Branch Drive and	NB	TH	251	842	25.4	14.6	51	67	379	410
			RT	591		10.0		67		410	
		SB	LT	372	868	14.9	12.1	38	38	395	395

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	Jones Branch Connector		TH	496		10.0		38		395	
		WB	LT	455	641	34.2	25.4	58	58	367	367
			RT	186		3.8		58		367	
		Intersection		2,351		16.6					
10	Jones Branch Connector and Express Lanes Ramps	NB	LT	29	60	47.6	30.7	8	8	79	90
			RT	31		14.8		5		90	
		SB	LT	78	145	47.1	42.8	26	26	148	148
			RT	67		38.0		15		131	
		EB	LT	205	959	49.0	16.3	13	13	137	167
			TH	511		8.8		13		137	
			RT	243		4.7		13		167	
		WB	LT	248	1,027	69.7	34.7	76	80	381	395
			TH	544		32.2		76		381	
			RT	235		3.5		80		395	
		Intersection		410		144.7					
29	Jones Branch Drive and Capital One (West)	NB	LT	586	698	34.1	34.1	86	95	304	318
			TH	52		37.3		86		304	
			RT	60		31.2		95		318	
		SB	LT	35	68	48.7	35.0	11	23	66	103
			TH	9		46.3		11		66	
			RT	24		10.9		23		103	
		EB	LT	32	615	9.9	11.7	26	35	159	200
			TH	467		13.9		26		159	
			RT	116		3.3		35		200	
		WB	LT	63	511	10.7	10.5	18	24	174	207
			TH	409		11.2		18		174	
			RT	39		2.3		24		207	
		Intersection		1,892		20.5					
30	Jones Branch Drive and Capital One (East)	NB	LT	53	233	41.5	17.1	14	14	90	105
			TH	8		37.8		14		90	
			RT	172		8.7		10		105	
		SB	LT	45	147	39.4	18.7	11	11	102	102
			TH	10		36.0		11		102	
			RT	92		6.8		5		99	
		EB	LT	87	562	4.8	3.0	5	5	104	142
			TH	450		2.7		5		104	
			RT	25		2.0		4		142	
		WB	LT	106	491	5.7	4.0	5	6	122	135
			TH	366		3.5		5		122	
			RT	19		3.3		6		135	
		Intersection		1,433		7.2					
11	International Drive and Spring Hill	NB	LT	135	753	112.4	133.9	336	359	1,037	1,067
			TH	573		142.1		336		1,037	
			RT	45		92.9		359		1,067	

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	Road/ Jones Branch Drive	SB	LT	135	647	81.3	60.0	91	91	287	287
			TH	321		83.8		91		287	
			RT	191		5.0		35		218	
		EB	LT	459	833	110.0	79.3	227	232	1,009	1,033
			TH	156		81.5		227		1,009	
			RT	218		13.3		232		1,033	
		WB	LT	70	1,121	108.6	114.9	499	499	1,499	1,499
			TH	352		116.6		499		1,499	
			RT	699		114.7		462		1,499	
		Intersection		3,354		99.8					
12	Spring Hill Road and Dulles Toll Road Eastbound Ramps	NB	TH	1,330	1,716	20.2	15.9	132	132	513	513
			RT	386		1.1		67		361	
		SB	LT	73	543	27.4	5.1	4	4	113	113
			TH	470		1.6		4		113	
		EB	LT	105	299	84.6	71.7	60	62	192	200
			TH	10		0.0		60		192	
			RT	184		68.2		62		200	
		Intersection		2,558		20.1					
13	Spring Hill Road and Dulles Toll Road Westbound Ramps	NB	LT	768	1,406	33.4	37.8	222	222	546	546
			TH	638		43.1		222		546	
		SB	TH	396	535	28.2	25.3	48	54	420	436
			RT	139		16.9		54		436	
		WB	LT	150	259	73.7	80.4	59	79	222	253
			TH	8		85.9		59		222	
			RT	101		90.0		79		253	
		Intersection		2,200		39.8					
14	Spring Hill Road and Lewinsville Road	NB	LT	84	718	136.0	120.0	782	782	1,553	1,553
			TH	284		139.6		782		1,553	
			RT	350		100.3		782		1,553	
		SB	LT	19	221	77.7	77.1	118	118	499	499
			TH	182		77.9		118		499	
			RT	20		69.7		118		499	
		EB	LT	16	382	78.8	68.0	192	192	775	775
			TH	309		78.3		192		775	
			RT	57		9.1		1		57	
		WB	LT	295	822	46.1	42.3	153	153	645	645
			TH	508		41.3		153		645	
			RT	19		9.9		22		348	
		Intersection		2,143		76.5					
23	Georgetown Pike and Helga Place/ Linganore Drive	NB	LT	0	0	0.0	0.0	0	0	0	0
			TH	0		0.0		0		0	
			RT	0		0.0		0		0	
		SB	LT	3	4	12.8	12.8	0	0	53	80
			TH	0		0.0		0		71	

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
			RT	1		28.0		0		80	
		EB	TH	514	514	0.2	0.2	0	0	15	15
			RT	0		0.0		0		15	
		WB	LT	5	865	1.9	0.9	0	1	52	134
			TH	857		0.9		1		134	
			RT	3		0.9		1		134	
		Intersection		1,383		28.0					
20	Georgetown Pike and I-495 Southbound Ramps	SB	LT	209	986	64.4	36.2	114	114	519	519
			TH	133		74.4		114		519	
			RT	644		19.1		51		452	
		EB	TH	469	524	25.3	22.7	56	56	379	379
			RT	55		0.4		15		273	
		WB	LT	472	691	87.0	66.5	175	175	442	442
			TH	219		22.2		175		442	
		Intersection		2,201		42.5					
19	Georgetown Pike and I-495 Northbound Ramps	NB	LT	50	179	56.9	35.6	35	35	177	177
			TH	62		55.6		35		177	
			RT	67		1.2		6		149	
		EB	LT	318	676	22.6	12.8	31	31	319	319
			TH	358		4.0		31		319	
		WB	TH	639	1,052	39.5	24.7	121	121	449	449
			RT	413		1.8		0		0	
		Intersection		1,907		21.5					
18	Georgetown Pike and Balls Hill Road	NB	LT	225	247	59.7	55.5	86	86	379	379
			TH	5		42.3		86		379	
			RT	17		4.5		12		310	
		SB	LT	5	138	58.9	34.5	27	27	211	211
			TH	35		62.3		27		211	
			RT	98		23.4		21		199	
		EB	LT	27	426	68.7	9.9	15	15	106	118
			TH	199		9.4		15		106	
			RT	200		2.6		7		118	
		WB	LT	45	769	22.7	43.4	105	105	457	457
			TH	719		44.8		105		457	
			RT	5		35.9		105		457	
		Intersection		1,580		35.5					
22	Georgetown Pike and Dead Run Drive	NB	LT	240	264	71.5	70.3	140	140	351	351
			RT	24		58.3		138		349	
		EB	TH	201	221	0.3	0.3	0	0	6	6
			RT	20		0.8		0		6	
		WB	LT	10	528	14.5	49.3	144	144	282	282
			TH	518		50.0		139		246	
		Intersection		1,013		71.5					

2025 Build PM Synchro Peak Hour Intersection Approach Delay and Level of Service

	Intersection Level of Service by Approach - 2025 Build PM Conditions				
#	Signalization	Intersection Name	Approach	Delay	LOS
15	Signalized	Old Dominion Drive at Spring Hill Road	Northbound (Springhill Road)	16.2	B
			Southbound (Springhill Road)	13.7	B
			Eastbound (Old Dominion Drive)	8.0	A
			Westbound (Old Dominion Drive)	10.2	B
16	Signalized	Old Dominion Drive at Swinks Mill Road	Northbound (Swinks Mill Road)	15.7	B
			Southbound (Swinks Mill Road)	13.8	B
			Eastbound (Old Dominion Drive)	9.9	A
			Westbound (Old Dominion Drive)	11.4	B
17	Signalized	Old Dominion Drive at Balls Hill Road	Northbound (Balls Hill Road)	225.6	F
			Southbound (Balls Hill Road)	207.1	F
			Eastbound (Old Dominion Drive)	197.3	F
			Westbound (Old Dominion Drive)	135.7	F
21	Signalized	Route 123 at Old Dominion Drive	Northbound (Route 123)	24.7	C
			Southbound (Route 123)	26.5	C
			Eastbound (Old Dominion Drive)	85.8	F
			Westbound (Old Dominion Drive)	86.8	F
24	Unsignalized	Georgetown Pike at Swinks Mill Road	Northbound (Swinks Mill Road)	15.8	C
			Southbound (Driveway)	0.0	A
			Eastbound (Georgetown Pike)	0.0	A
			Westbound (Georgetown Pike)	1.2	A
25	Unsignalized	Georgetown Pike at Spring Hill Road	Northbound (Spring Hill Road)	12.7	B
			Eastbound (Georgetown Pike)	0.0	A
			Westbound (Georgetown Pike)	0.7	A
26	Unsignalized	Lewinsville Road at Swinks Mill Road	Southbound (Swinks Mill Road)	87.9	F
			Eastbound (Lewinsville Road)	2.9	A
			Westbound (Lewinsville Road)	0.0	A
27	Unsignalized	Route 123 at Ingleside Avenue	Northbound (Route 123)	3.8	A
			Southbound (Route 123)	0.3	A
			Eastbound (Ingleside Avenue)	24.9	C
			Westbound (Ingleside Avenue)	17.8	C
28	Unsignalized	Douglass Drive at Route 193 (Georgetown Pike)	Northbound (Douglass Drive)	144.2	F
			Southbound (Douglass Drive)	83.5	F
			Eastbound (Georgetown Pike)	0.4	A
			Westbound (Georgetown Pike)	2.7	A

2025 Build PM Synchro Peak Hour Arterial Queue Lengths

Queue Length by Movement - 2025 Build PM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
Signalized	Old Dominion Drive at Spring Hill Road	EBL*	105	198	-
		EBT*	105	198	-
		EBR	24	89	195
		WBL*	196	397	-
		WBT*	196	397	-
		WBR	9	95	480
		NBL*	125	211	-
		NBT*	125	211	-
		NBR*	125	211	-
		SBL*	53	100	-
		SBT*	53	100	-
		SBR*	53	100	-
Signalized	Old Dominion Drive at Swinks Mill Road	EBL*	397	848	-
		EBT*	397	848	-
		EBR*	397	848	-
		WBL*	328	623	-
		WBT*	328	623	-
		WBR*	328	623	-
		NBL*	210	408	-
		NBT*	210	408	-
		NBR*	210	408	-
		SBL*	94	207	-
		SBT*	94	207	-
		SBR*	94	207	-
Signalized	Old Dominion Drive at Balls Hill Road	EBL*	755	1130	-
		EBT*	755	1130	-
		EBR*	755	1130	-
		WBL*	883	1301	-
		WBT*	883	1301	-
		WBR*	883	1301	-
		NBL*	280	514	-
		NBT*	280	514	-
		NBR*	280	514	-
		SBL*	1280	1466	-
		SBT*	1280	1466	-

Queue Length by Movement - 2025 Build PM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
		SBR*	1280	1466	-
Signalized	Route 123 at Old Dominion Drive	EBL	46	105	235
		EBL	63	129	235
		EBT	117	285	-
		EBT	140	359	-
		EBR	37	200	330
		WBL	267	354	300
		WBL	310	362	300
		WBT	647	974	-
		WBTR*	463	872	-
		NBL	35	160	390
		NBT	240	555	-
		NBT	250	572	-
		NBR	67	302	390
		SBL	67	245	260
		SBT	362	444	-
		SBTR*	366	452	-
Unsignalized	Georgetown Pike at Swinks Mill Road	EBT*	0	0	-
		EBR*	0	0	-
		WBL*	48	132	-
		WBT*	48	132	-
		NBL*	56	112	-
		NBT*	56	112	-
		NBR*	56	112	-
Unsignalized	Georgetown Pike at Spring Hill Road	EBT*	0	0	-
		EBR*	0	0	-
		WBL*	28	91	-
		WBT*	28	91	-
		NBL*	21	42	-
		NBR*	21	42	-
Unsignalized	Lewinsville Road at Swinks Mill Road	EBL	69	131	250
		WBT*	5	23	-
		WBR*	5	23	-
		SBL	136	351	-
		SBR	62	95	50
Unsignalized	Route 123 at Ingleside Avenue	EBR	218	291	-
		WBR	29	61	-

Queue Length by Movement - 2025 Build PM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
		NBL	99	173	110
		NBT	117	346	
		NBTR*	87	320	-
		SBL	48	177	200
		SBT	522	1166	-
		SBTR*	522	1159	-
Unsignalized	Douglass Drive at Route 193 (Georgetown Pike)	EBL*	6	39	-
		EBT*	6	39	-
		EBR*	6	39	-
		WBL*	70	168	-
		WBT*	70	168	-
		WBR*	70	168	-
		NBL*	105	258	-
		NBT*	105	258	-
		NBR*	105	258	-
		SBL*	23	52	-
		SBT*	23	52	-
		SBR*	23	52	-

* indicates a single lane that includes more than one movement for which total queueing feet are shown (ie. queueing associated with a single EBLT lane is shown above both for the EB L and T movements)

2045 NO BUILD AM PEAK HOUR ARTERIAL INTERSECTION RESULTS

2045 No Build AM VISSIM Peak Hour Intersection Volume, Delay, and Queue Length

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
6	Route 123 and Tysons Boulevard	NB	LT	203	2,320	89.8	29.6	164	164	513	513
			TH	1,889		24.4		164		513	
			RT	228		19.5		164		513	
		SB	LT	124	4,130	110.6	49.9	66	2,220	288	5,372
			TH	2,031		44.6		2,220		5,372	
			RT	1,975		51.5		2,164		5,293	
		EB	LT	596	721	79.8	67.0	120	120	349	349
			RT	125		6.3		51		259	
		WB	LT	114	461	72.1	50.1	37	84	137	170
			RT	347		42.9		84		170	
		Intersection		7,632		45.4					
4	Westpark Drive and Tysons Connector	NB	TH	342	537	77.6	74.6	177	177	275	275
			RT	195		69.4		171		268	
		SB	LT	187	384	29.7	27.6	44	44	248	248
			TH	197		25.7		44		248	
		WB	LT	487	1,728	26.8	19.4	167	171	635	643
			RT	1,241		16.5		171		643	
		Intersection		2,649		31.8					
5	Tysons Connector and Express Lanes Ramps	NB	LT	1,222	1,222	23.0	23.0	68	68	413	413
		SB	RT	505	505	29.3	29.3	57	57	351	351
		EB	LT	281	399	28.0	20.3	49	49	337	337
			RT	118		1.9		43		325	
		Intersection		2,126		24.0					
7	Route 123 and Capital One Tower Drive/ Old Meadow Road	NB	LT	388	3,667	97.5	113.9	6,750	6,808	7,714	7,772
			TH	2,636		114.8		6,750		7,714	
			RT	643		120.0		6,808		7,772	
		SB	LT	114	2,084	127.1	35.8	171	171	765	765
			TH	1,667		33.6		171		765	
			RT	303		14.0		171		765	
		EB	LT	76	294	276.5	160.0	384	384	489	489
			RT	218		119.3		384		489	
		WB	LT	531	691	259.7	251.8	762	765	872	876
			TH	42		267.3		762		872	
			RT	118		210.9		765		876	
		Intersection		6,736		105.9					
8	Route 123 and Scotts Crossing Boulevard/	NB	LT	455	2,806	128.3	37.4	209	209	552	552
			TH	1,742		18.0		209		552	
			RT	609		25.3		209		552	
		SB	LT	274	2,281	94.5	38.3	217	217	612	612
			TH	1,508		32.9		217		612	

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	Colshire Drive		**RT**	499		23.9		217		612	
		EB	**LT**	242	621	167.1	132.4	305	309	569	574
			TH	196		169.0		305		569	
			RT	183		47.4		309		574	
		WB	**LT**	389	622	167.8	122.5	215	215	588	588
			TH	128		81.0		215		588	
			RT	105		5.2		215		588	
		Intersection		6,330		55.4					
1	**Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road**	**NB**	**TH**	1,472	1,782	24.3	21.9	92	92	494	494
			RT	310		10.4		65		451	
		SB	**LT**	152	1,838	566.2	275.1	5,733	5,733	7,371	7,371
			TH	1,686		248.9		5,733		7,371	
		EB	**LT**	35	585	102.4	74.7	213	213	861	861
			TH	244		106.6		213		861	
			RT	306		46.2		93		654	
		WB	**LT**	223	280	232.6	230.1	314	350	374	410
			RT	57		220.6		350		410	
		Intersection		4,485		145.6					
3	**Route 123 and Lewinsville Road/ Great Falls Street**	**NB**	**LT**	369	2,029	67.7	44.7	289	289	1,927	1,934
			TH	1,237		45.8		289		1,927	
			RT	423		21.6		217		1,934	
		SB	**LT**	57	1,426	371.2	348.2	2,628	2,629	3,061	3,061
			TH	1,015		363.4		2,628		3,061	
			RT	354		300.9		2,629		3,061	
		EB	**LT**	298	760	99.3	71.4	161	161	299	299
			TH	287		71.3		161		299	
			RT	175		24.1		13		126	
		WB	**LT**	335	666	581.7	583.5	2,501	2,501	2,850	2,850
			TH	275		588.2		2,501		2,850	
			RT	56		570.6		2,440		2,789	
		Intersection		4,881		211.0					
2	**Lewinsville Road and Balls Hill Road**	**SB**	**LT**	129	160	1,053.7	1,033.3	1,527	1,527	1,788	1,788
			RT	31		948.2		1,527		1,788	
		EB	**LT**	46	674	24.0	32.7	68	68	406	406
			TH	628		33.3		68		406	
		WB	**TH**	780	1,015	2.7	2.7	9	16	199	245
			RT	235		2.8		16		245	
		Intersection		1,849		102.8					
9	**Jones Branch Drive and Jones**	**NB**	**TH**	379	770	37.8	26.0	116	133	588	625
			RT	391		14.7		133		625	
		SB	**LT**	609	941	16.6	14.8	45	45	341	341
			TH	332		11.4		45		341	
		WB	**LT**	475	929	32.2	18.4	59	59	307	307

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	Branch Connector		RT	454		4.0		59		307	
		Intersection		2,640		19.3					
10	Jones Branch Connector and Express Lanes Ramps	NB	LT	148	219	44.0	41.1	30	39	147	180
			RT	71		35.1		39		180	
		SB	LT	160	473	46.8	31.4	57	57	248	248
			RT	313		23.5		47		247	
		EB	LT	92	941	83.9	43.2	83	83	470	470
			TH	823		39.6		83		470	
			RT	26		12.9		0		54	
		WB	LT	62	763	45.7	18.3	44	46	266	275
			TH	471		21.1		44		266	
			RT	230		5.3		46		275	
		Intersection		784		100.2					
29	Jones Branch Drive and Capital One (West)	NB	LT	184	320	50.2	50.7	66	78	236	252
			TH	1		100.4		66		236	
			RT	135		51.0		78		252	
		SB	LT	68	247	54.4	41.3	43	54	213	250
			TH	59		52.5		43		213	
			RT	120		28.4		54		250	
		EB	LT	0	1,004	0.0	46.4	218	247	952	999
			TH	528		59.8		218		952	
			RT	476		31.5		247		999	
		WB	LT	308	787	27.0	15.3	37	37	256	277
			TH	462		7.9		37		256	
			RT	17		2.0		28		277	
		Intersection		2,358		36.1					
30	Jones Branch Drive and Capital One (East)	NB	LT	10	112	48.9	56.3	19	29	119	146
			TH	5		55.5		19		119	
			RT	97		57.2		29		146	
		SB	LT	19	137	64.7	19.3	7	7	70	91
			TH	14		44.0		7		70	
			RT	104		7.7		5		91	
		EB	LT	43	717	12.5	39.9	113	119	398	410
			TH	525		46.1		113		398	
			RT	149		26.0		119		410	
		WB	LT	365	1,091	19.4	14.7	55	60	433	458
			TH	676		12.4		55		433	
			RT	50		10.9		60		458	
		Intersection		2,057		26.0					
11	International Drive and Spring Hill Road/ Jones	NB	LT	192	546	60.8	56.8	89	104	272	302
			TH	294		64.3		89		272	
			RT	60		7.7		104		302	
		SB	LT	526	1,656	41.9	33.7	140	140	462	462
			TH	598		44.4		140		462	

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	Branch Drive		RT	532		13.5		93		393	
		EB	LT	184	641	65.5	58.3	116	116	355	355
			TH	362		68.4		116		355	
			RT	95		5.9		69		299	
		WB	LT	28	432	68.0	59.0	75	75	243	243
			TH	178		72.7		75		243	
			RT	226		47.1		45		243	
		Intersection		3,275		45.7					
12	Spring Hill Road and Dulles Toll Road Eastbound Ramps	NB	TH	550	714	23.2	18.0	44	44	257	257
			RT	164		0.6		3		114	
		SB	LT	131	1,163	18.5	27.0	74	74	477	477
			TH	1,032		28.1		74		477	
		EB	LT	100	717	352.1	383.1	3,080	3,094	5,301	5,309
			TH	0		0.0		3,080		5,301	
			RT	617		388.1		3,094		5,309	
		Intersection		2,594		123.0					
13	Spring Hill Road and Dulles Toll Road Westbound Ramps	NB	LT	28	652	43.8	17.7	53	53	437	437
			TH	624		16.5		53		437	
		SB	TH	772	810	17.4	17.2	48	54	507	523
			RT	38		13.0		54		523	
		WB	LT	385	467	55.2	53.8	92	109	561	591
			TH	9		57.7		92		561	
			RT	73		46.0		109		591	
		Intersection		1,929		26.2					
14	Spring Hill Road and Lewinsville Road	NB	LT	111	682	101.2	86.7	425	425	1,416	1,416
			TH	180		98.4		425		1,416	
			RT	391		77.3		425		1,416	
		SB	LT	17	332	70.9	71.9	170	170	603	603
			TH	310		71.9		170		603	
			RT	5		76.0		170		603	
		EB	LT	12	620	59.3	37.4	147	147	717	717
			TH	344		58.3		147		717	
			RT	264		9.1		14		349	
		WB	LT	232	543	37.3	33.7	70	70	338	338
			TH	301		32.0		70		338	
			RT	10		1.0		0		42	
		Intersection		2,177		57.2					
23	Georgetown Pike and Helga Place/ Linganore Drive	NB	LT	0	23	0.0	6.1	1	1	54	55
			TH	0		0.0		1		55	
			RT	23		6.1		1		53	
		SB	LT	8	8	231.7	231.7	10	10	68	94
			TH	0		0.0		9		86	
			RT	0		0.0		7		94	
		EB	TH	1,124	1,124	122.4	122.4	1,800	1,800	2,721	2,721

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
			RT	0		0.0		1,800		2,721	
		WB	LT	4	724	16.6	1.1	1	1	42	90
			TH	711		1.0		1		90	
			RT	9		1.1		1		90	
		Intersection		1,879		231.7					
20	Georgetown Pike and I-495 Southbound Ramps	SB	LT	196	523	68.3	28.4	83	83	338	338
			TH	8		69.6		83		338	
			RT	319		2.9		24		283	
		EB	TH	1,134	1,160	41.3	40.4	297	297	538	538
			RT	26		1.1		219		432	
		WB	LT	390	798	73.3	47.6	140	140	432	432
			TH	408		23.1		140		432	
		Intersection		2,481		40.2					
19	Georgetown Pike and I-495 Northbound Ramps	NB	LT	183	797	184.2	140.4	1,583	1,583	2,620	2,620
			TH	20		188.9		1,583		2,620	
			RT	594		125.3		1,555		2,597	
		EB	LT	723	1,317	51.0	38.1	192	192	444	444
			TH	594		22.4		192		444	
		WB	TH	619	964	54.3	52.5	217	217	448	448
			RT	345		49.3		102		352	
		Intersection		3,078		69.1					
18	Georgetown Pike and Balls Hill Road	NB	LT	289	379	177.5	151.7	471	471	1,265	1,265
			TH	34		104.0		471		1,265	
			RT	56		47.4		462		1,255	
		SB	LT	0	86	0.0	66.1	142	142	234	234
			TH	20		105.7		142		234	
			RT	66		54.1		131		222	
		EB	LT	109	1,168	92.7	24.8	156	156	419	431
			TH	780		19.3		156		419	
			RT	279		13.5		132		431	
		WB	LT	51	694	36.0	67.6	176	176	548	548
			TH	616		71.6		176		548	
			RT	27		35.0		176		548	
		Intersection		2,327		59.7					
22	Georgetown Pike and Dead Run Drive	NB	LT	99	123	14.3	13.4	10	10	109	109
			RT	24		9.8		8		107	
		EB	TH	756	841	1.6	1.5	2	2	245	245
			RT	85		1.4		2		245	
		WB	LT	72	680	18.3	18.4	107	107	722	722
			TH	608		18.4		96		656	
		Intersection		1,644		14.3					

2045 No Build AM Synchro Peak Hour Intersection Approach Delay and Level of Service

	Intersection Level of Service by Approach - 2045 No Build AM Conditions				
#	Signalization	Intersection Name	Approach	Delay	LOS
15	Signalized	Old Dominion Drive at Spring Hill Road	Northbound (Springhill Road)	15.4	B
			Southbound (Springhill Road)	15.8	B
			Eastbound (Old Dominion Drive)	10.5	B
			Westbound (Old Dominion Drive)	7.0	A
16	Signalized	Old Dominion Drive at Swinks Mill Road	Northbound (Swinks Mill Road)	26.3	C
			Southbound (Swinks Mill Road)	25.9	C
			Eastbound (Old Dominion Drive)	12.4	B
			Westbound (Old Dominion Drive)	5.5	A
17	Signalized	Old Dominion Drive at Balls Hill Road	Northbound (Balls Hill Road)	121.5	F
			Southbound (Balls Hill Road)	109.7	F
			Eastbound (Old Dominion Drive)	78.1	E
			Westbound (Old Dominion Drive)	98.3	F
21	Signalized	Route 123 at Old Dominion Drive	Northbound (Route 123)	37.3	D
			Southbound (Route 123)	29.7	C
			Eastbound (Old Dominion Drive)	84.6	F
			Westbound (Old Dominion Drive)	86.2	F
24	Unsignalized	Georgetown Pike at Swinks Mill Road	Northbound (Swinks Mill Road)	187.8	F
			Southbound (Driveway)	0.0	A
			Eastbound (Georgetown Pike)	0.0	A
			Westbound (Georgetown Pike)	2.0	A
25	Unsignalized	Georgetown Pike at Spring Hill Road	Northbound (Spring Hill Road)	23.9	C
			Eastbound (Georgetown Pike)	0.0	A
			Westbound (Georgetown Pike)	1.0	A
26	Unsignalized	Lewinsville Road at Swinks Mill Road	Southbound (Swinks Mill Road)	31.4	D
			Eastbound (Lewinsville Road)	2.2	A
			Westbound (Lewinsville Road)	0.0	A
27	Unsignalized	Route 123 at Ingleside Avenue	Northbound (Route 123)	0.5	A
			Southbound (Route 123)	0.9	A
			Eastbound (Ingleside Avenue)	17.7	C
			Westbound (Ingleside Avenue)	22.8	C
28	Unsignalized	Douglass Drive at Route 193 (Georgetown Pike)	Northbound (Douglass Drive)	478.6	F
			Southbound (Douglass Drive)	45.9	E
			Eastbound (Georgetown Pike)	0.3	A
			Westbound (Georgetown Pike)	1.1	A

2045 No Build AM Synchro Peak Hour Arterial Queue Lengths

Queue Length by Movement - 2045 No Build AM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
Signalized	Old Dominion Drive at Spring Hill Road	EBL*	171	288	-
		EBT*	171	288	-
		EBR	49	156	195
		WBL*	70	159	-
		WBT*	70	159	-
		WBR	1	4	480
		NBL*	86	153	-
		NBT*	86	153	-
		NBR*	86	153	-
		SBL*	102	172	-
		SBT*	102	172	-
		SBR*	102	172	-
Signalized	Old Dominion Drive at Swinks Mill Road	EBL*	848	1453	-
		EBT*	848	1453	-
		EBR*	848	1453	-
		WBL*	73	659	-
		WBT*	73	659	-
		WBR*	73	659	-
		NBL*	134	256	-
		NBT*	134	256	-
		NBR*	134	256	-
		SBL*	367	676	-
		SBT*	367	676	-
		SBR*	367	676	-
Signalized	Old Dominion Drive at Balls Hill Road	EBL*	505	856	-
		EBT*	505	856	-
		EBR*	505	856	-
		WBL*	227	429	-
		WBT*	227	429	-
		WBR*	227	429	-
		NBL*	174	313	-
		NBT*	174	313	-
		NBR*	174	313	-
		SBL*	468	831	-
		SBT*	468	831	-
		SBR*	468	831	-

Queue Length by Movement - 2045 No Build AM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
Signalized	Route 123 at Old Dominion Drive	EBL	98	178	235
		EBL	117	207	235
		EBT	158	305	-
		EBT	179	364	-
		EBR	26	167	330
		WBL	302	330	300
		WBL	321	330	300
		WBT	759	892	-
		WBTR*	297	737	-
		NBL	12	71	390
		NBT	174	352	-
		NBT	190	378	-
		NBR	15	128	390
		SBL	37	158	260
		SBT	258	428	-
		SBTR*	263	433	-
Unsignalized	Georgetown Pike at Swinks Mill Road	EBT*	0	0	-
		EBR*	0	0	-
		WBL*	128	284	-
		WBT*	128	284	-
		NBL*	294	314	-
		NBT*	294	314	-
		NBR*	294	314	-
Unsignalized	Georgetown Pike at Spring Hill Road	EBT*	0	4	-
		EBR*	0	4	-
		WBL*	56	160	-
		WBT*	56	160	-
		NBL*	32	64	-
		NBR*	32	64	-
Unsignalized	Lewinsville Road at Swinks Mill Road	EBL	41	78	250
		WBT*	1	8	-
		WBR*	1	8	-
		SBL	49	116	-
		SBR	52	83	50
Unsignalized	Route 123 at Ingleside Avenue	EBR	75	160	-
		WBR	33	70	-
		NBL	30	65	110
		NBT	1	9	

Queue Length by Movement - 2045 No Build AM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
		NBTR*	1	9	-
		SBL	25	63	200
		SBT	71	446	-
		SBTR*	71	449	-
Unsignalized	Douglass Drive at Route 193 (Georgetown Pike)	EBL*	55	208	-
		EBT*	55	208	-
		EBR*	55	208	-
		WBL*	90	245	-
		WBT*	90	245	-
		WBR*	90	245	-
		NBL*	275	550	-
		NBT*	275	550	-
		NBR*	275	550	-
		SBL*	61	141	-
		SBT*	61	141	-
		SBR*	61	141	-
* indicates a single lane that includes more than one movement for which total queueing feet are shown (ie. queueing associated with a single EBLT lane is shown above both for the EB L and T movements)					

2045 BUILD AM PEAK HOUR ARTERIAL INTERSECTION RESULTS

2045 Build AM VISSIM Peak Hour Intersection Volume, Delay, and Queue Length

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
6	Route 123 and Tysons Boulevard	NB	LT	206	2,332	89.7	27.4	160	160	518	518
			TH	1,898		21.8		160		518	
			RT	228		18.2		160		518	
		SB	LT	117	4,115	101.7	18.6	75	126	275	963
			TH	2,011		23.8		126		963	
			RT	1,987		8.4		85		884	
		EB	LT	596	721	88.1	74.0	138	138	378	378
			RT	125		6.8		65		288	
		WB	LT	113	459	76.0	67.4	36	117	134	409
			RT	346		64.6		117		409	
		Intersection		7,627		29.5					
4	Westpark Drive and Tysons Connector	NB	TH	321	530	82.3	79.2	179	179	264	264
			RT	209		74.4		174		258	
		SB	LT	206	401	29.4	28.9	50	50	277	277
			TH	195		28.4		50		277	
		WB	LT	474	1,725	28.2	23.1	196	196	638	638
			RT	1,251		21.2		196		637	
		Intersection		2,656		35.2					
5	Tysons Connector and Express Lanes Ramps	NB	LT	1,283	1,283	25.3	25.3	78	78	455	455
		SB	RT	440	440	32.2	32.2	43	43	224	224
		EB	LT	314	437	33.1	24.5	66	66	387	387
			RT	123		2.5		60		375	
		Intersection		2,160		26.5					
31	Route 123 and EB DTR/SB I-495 C-D Road	NB	TH	2,233	2,233	10.1	10.1	65	65	581	581
		SB	TH	3,055	3,055	8.9	8.9	43	43	642	642
		EB	LT	870	1,931	49.8	28.8	134	134	699	699
			RT	1,061		11.6		134		699	
		Intersection		7,219		14.6					
32	Route 123 and NB I-495 Ramp	NB	TH	2,426	2,426	16.8	16.8	140	140	755	755
		SB	TH	1,853	1,853	12.4	12.4	82	82	455	455
		WB	LT	1,622	3,075	63.8	82.5	777	777	3,086	3,086
			RT	1,453		103.4		774		3,082	
		Intersection		7,354		43.2					
7	Route 123 and Capital One Tower Drive/Old Meadow Road	NB	LT	515	3,895	98.5	41.5	344	392	1,017	1,075
			TH	2,687		33.5		344		1,017	
			RT	693		30.4		392		1,075	
		SB	LT	113	1,990	135.8	44.3	182	182	615	615
			TH	1,584		38.4		182		615	
			RT	293		41.1		182		615	
		EB	LT	59	229	290.7	241.2	407	407	493	493
			RT	170		224.0		407		493	
		WB	LT	523	684	254.9	247.2	758	762	876	881

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
			TH	44		258.3		758		876	
			RT	117		208.7		762		881	
		Intersection		6,798		69.8					
8	Route 123 and Scotts Crossing Boulevard/ Colshire Drive	NB	LT	387	2,853	124.2	40.0	220	220	629	629
			TH	1,817		23.0		220		629	
			RT	649		37.3		220		629	
		SB	LT	288	2,235	103.8	44.3	340	360	774	797
			TH	1,428		36.7		340		774	
			RT	519		32.1		360		797	
		EB	LT	256	650	162.8	129.9	323	329	572	578
			TH	201		151.8		323		572	
			RT	193		63.4		329		578	
		WB	LT	362	583	368.4	263.3	580	580	890	890
			TH	124		135.9		580		890	
			RT	97		33.8		580		890	
		Intersection		6,321		71.3					
1	Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road	NB	TH	1,521	1,837	22.1	20.0	88	88	532	532
			RT	316		10.2		60		490	
		SB	LT	138	1,647	219.3	80.5	573	573	699	699
			TH	1,509		67.8		573		699	
		EB	LT	62	909	190.7	143.9	662	662	1,259	1,259
			TH	375		187.2		662		1,259	
			RT	472		103.3		442		1,228	
		WB	LT	235	290	253.2	246.1	304	315	376	387
			RT	55		215.4		315		387	
		Intersection		4,683		79.3					
33	Route 123 & EB DTR Ramps	NB	TH	1,257	1,257	2.6	2.6	4	4	201	201
		SB	LT	54	1,740	252.8	266.3	886	6,203	1,475	6,730
			TH	1,686		266.7		6,203		6,730	
		Intersection		2,997		155.7					
3	Route 123 and Lewinsville Road/ Great Falls Street	NB	LT	411	2,447	69.5	46.8	347	347	1,516	1,538
			TH	1,529		49.2		347		1,516	
			RT	507		21.1		265		1,538	
		SB	LT	50	1,195	476.5	501.8	2,765	2,766	3,062	3,063
			TH	845		528.1		2,765		3,062	
			RT	300		431.8		2,766		3,063	
		EB	LT	293	790	105.2	82.9	214	214	311	311
			TH	300		81.4		214		311	
			RT	197		52.1		20		187	
		WB	LT	331	646	658.8	635.1	2,556	2,556	2,851	2,851
			TH	263		616.9		2,556		2,851	
			RT	52		576.2		2,496		2,791	
		Intersection		5,078		234.3					
2	Lewinsville Road and	SB	LT	170	213	595.4	582.6	1,119	1,119	1,757	1,757
			RT	43		531.8		1,119		1,757	
		EB	LT	44	659	36.8	64.5	132	132	559	559

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	Balls Hill Road		**TH**	615		66.5		132		559	
		WB	**TH**	754	994	2.5	2.5	7	7	196	196
			RT	240		2.5		5		184	
		Intersection		1,866		90.6					
9	**Jones Branch Drive and Jones Branch Connector**	**NB**	**TH**	374	764	35.4	24.3	115	136	629	660
			RT	390		13.7		136		660	
		SB	**LT**	624	958	16.3	14.4	39	39	279	279
			TH	334		10.9		39		279	
		WB	**LT**	489	947	33.0	19.1	57	57	271	271
			RT	458		4.3		57		271	
		Intersection		2,669		18.9					
10	**Jones Branch Connector and Express Lanes Ramps**	**NB**	**LT**	147	246	38.0	34.7	38	41	182	193
			RT	99		29.8		41		193	
		SB	**LT**	164	489	52.2	32.2	61	61	274	274
			RT	325		22.0		48		264	
		EB	**LT**	104	972	79.9	46.2	84	92	466	496
			TH	842		42.9		84		466	
			RT	26		18.8		92		496	
		WB	**LT**	68	795	42.8	18.4	52	55	329	342
			TH	470		23.7		52		329	
			RT	257		2.3		55		342	
		Intersection		2,502		33.5					
29	**Jones Branch Drive and Capital One (West)**	**NB**	**LT**	185	322	54.0	52.4	67	76	238	251
			TH	1		61.9		67		238	
			RT	136		50.1		76		251	
		SB	**LT**	70	249	51.0	48.8	56	85	252	290
			TH	57		65.8		56		252	
			RT	122		39.6		85		290	
		EB	**LT**	0	1,065	0.0	42.3	198	224	854	895
			TH	561		54.8		198		854	
			RT	504		28.5		224		895	
		WB	**LT**	307	815	32.3	16.2	43	43	272	301
			TH	490		6.6		43		272	
			RT	18		1.4		29		301	
		Intersection		2,451		35.6					
30	**Jones Branch Drive and Capital One (East)**	**NB**	**LT**	10	106	62.4	87.9	39	46	157	175
			TH	4		65.6		39		157	
			RT	92		91.7		46		175	
		SB	**LT**	20	144	67.2	19.9	7	7	65	90
			TH	15		36.7		7		65	
			RT	109		9.0		7		90	
		EB	**LT**	45	757	10.7	39.5	96	111	361	399
			TH	553		46.9		96		361	
			RT	159		22.1		111		399	
		WB	**LT**	286	1,035	15.3	11.6	39	41	411	424
			TH	700		10.2		39		411	

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
			RT	49		9.2		41		424	
		Intersection		2,042		26.5					
11	International Drive and Spring Hill Road/ Jones Branch Drive	NB	LT	193	552	59.8	58.2	92	107	286	316
			TH	300		67.2		92		286	
			RT	59		7.4		107		316	
		SB	LT	649	1,997	46.8	42.7	288	288	472	472
			TH	747		52.9		288		472	
			RT	601		25.6		224		403	
		EB	LT	185	541	65.9	54.8	91	96	274	298
			TH	262		64.5		91		274	
			RT	94		5.7		96		298	
		WB	LT	28	439	65.0	33.6	52	52	204	204
			TH	178		68.4		52		204	
			RT	233		3.3		29		204	
		Intersection		3,529		45.8					
12	Spring Hill Road and Dulles Toll Road Eastbound Ramps	NB	TH	560	722	46.7	37.0	98	98	345	345
			RT	162		3.2		19		192	
		SB	LT	101	1,059	49.6	99.8	324	324	554	554
			TH	958		105.1		324		554	
		EB	LT	166	1,219	336.5	427.6	5,026	5,038	6,533	6,541
			TH	0				5,026		6,533	
			RT	1,053		442.0		5,038		6,541	
		Intersection		3,000		217.9					
13	Spring Hill Road and Dulles Toll Road Westbound Ramps	NB	LT	37	717	47.0	30.8	101	101	440	440
			TH	680		30.0		101		440	
		SB	TH	620	666	143.1	142.7	905	910	1,613	1,618
			RT	46		138.3		910		1,618	
		WB	LT	442	589	86.9	88.0	164	186	587	617
			TH	62		97.3		164		587	
			RT	85		86.7		186		617	
		Intersection		1,972		85.7					
14	Spring Hill Road and Lewinsville Road	NB	LT	112	731	133.1	117.3	732	732	1,531	1,531
			TH	182		134.3		732		1,531	
			RT	437		106.2		732		1,531	
		SB	LT	17	336	97.7	128.5	251	251	741	741
			TH	314		130.4		251		741	
			RT	5		118.1		251		741	
		EB	LT	7	354	338.6	303.7	653	671	1,378	1,378
			TH	202		291.1		653		1,378	
			RT	145		319.6		671		1,212	
		WB	LT	226	537	106.5	65.5	109	109	434	434
			TH	302		36.7		109		434	
			RT	9		1.9		4		139	
		Intersection		1,958		138.7					
23	Georgetown Pike and	NB	LT	0	19	0.0	0.0	1	1	52	53
			TH	0		0.0		1		53	

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	Helga Place/ Linganore Drive		RT	19		0.0		1		51	
		SB	LT	8	8	72.7	72.7	4	4	63	89
			TH	0		0.0		1		81	
			RT	0		0.0		1		89	
		EB	TH	1,020	1,020	16.4	16.4	98	98	683	683
			RT	0		0.0		98		683	
		WB	LT	6	850	9.9	1.2	0	1	42	121
			TH	834		1.1		1		121	
			RT	10		0.0		1		121	
		Intersection		1,897		72.7					
20	Georgetown Pike and I-495 Southbound Ramps	SB	LT	269	720	66.6	29.1	107	107	404	404
			TH	11		65.4		107		404	
			RT	440		5.3		38		359	
		EB	TH	1,018	1,042	43.0	42.1	243	243	539	539
			RT	24		0.4		170		434	
		WB	LT	384	797	71.9	44.3	144	144	440	440
			TH	413		18.8		144		440	
		Intersection		2,559		39.1					
19	Georgetown Pike and I-495 Northbound Ramps	NB	LT	166	740	173.8	129.1	113	113	629	629
			TH	22		172.3		113		629	
			RT	552		114.0		83		601	
		EB	LT	598	1,279	46.6	31.7	211	211	455	455
			TH	681		18.5		211		455	
		WB	TH	630	920	39.2	27.3	114	114	451	451
			RT	290		1.4		0		0	
		Intersection		2,939		54.8					
18	Georgetown Pike and Balls Hill Road	NB	LT	293	395	55.2	46.7	105	105	404	445
			TH	37		51.4		105		404	
			RT	65		5.6		72		445	
		SB	LT	21	103	54.3	42.0	24	24	153	153
			TH	20		77.8		24		153	
			RT	62		26.3		16		142	
		EB	LT	126	1,230	22.2	16.0	88	91	411	426
			TH	807		16.1		88		411	
			RT	297		13.1		91		426	
		WB	LT	49	640	20.7	26.4	55	55	363	363
			TH	562		27.8		55		363	
			RT	29		9.3		55		363	
		Intersection		2,368		25.1					
22	Georgetown Pike and Dead Run Drive	NB	LT	90	114	14.3	13.4	9	9	121	121
			RT	24		10.2		8		118	
		EB	TH	810	898	2.3	2.2	3	3	287	287
			RT	88		1.2		3		287	
		WB	LT	72	628	9.8	1.6	5	5	93	93
			TH	556		0.6		0		22	
		Intersection		1,640		14.3					

2045 Build AM Synchro Peak Hour Intersection Approach Delay and Level of Service

	Intersection Level of Service by Approach - 2045 Build AM Conditions				
#	Signalization	Intersection Name	Approach	Delay	LOS
15	Signalized	Old Dominion Drive at Spring Hill Road	Northbound (Springhill Road)	15.1	B
			Southbound (Springhill Road)	15.7	B
			Eastbound (Old Dominion Drive)	10.5	B
			Westbound (Old Dominion Drive)	7.4	A
16	Signalized	Old Dominion Drive at Swinks Mill Road	Northbound (Swinks Mill Road)	24.5	C
			Southbound (Swinks Mill Road)	26.6	C
			Eastbound (Old Dominion Drive)	12.2	B
			Westbound (Old Dominion Drive)	5.3	A
17	Signalized	Old Dominion Drive at Balls Hill Road	Northbound (Balls Hill Road)	108.0	F
			Southbound (Balls Hill Road)	91.8	F
			Eastbound (Old Dominion Drive)	78.7	E
			Westbound (Old Dominion Drive)	79.7	E
21	Signalized	Route 123 at Old Dominion Drive	Northbound (Route 123)	32.6	C
			Southbound (Route 123)	27.0	C
			Eastbound (Old Dominion Drive)	85.2	F
			Westbound (Old Dominion Drive)	82.0	F
24	Unsignalized	Georgetown Pike at Swinks Mill Road	Northbound (Swinks Mill Road)	59.3	F
			Southbound (Driveway)	0.0	A
			Eastbound (Georgetown Pike)	0.0	A
			Westbound (Georgetown Pike)	2.2	A
25	Unsignalized	Georgetown Pike at Spring Hill Road	Northbound (Spring Hill Road)	23.5	C
			Eastbound (Georgetown Pike)	0.0	A
			Westbound (Georgetown Pike)	0.9	A
26	Unsignalized	Lewinsville Road at Swinks Mill Road	Southbound (Swinks Mill Road)	19.0	C
			Eastbound (Lewinsville Road)	1.3	A
			Westbound (Lewinsville Road)	0.0	A
27	Unsignalized	Route 123 at Ingleside Avenue	Northbound (Route 123)	0.5	A
			Southbound (Route 123)	0.9	A
			Eastbound (Ingleside Avenue)	18.3	C
			Westbound (Ingleside Avenue)	23.2	C
28	Unsignalized	Douglass Drive at Route 193 (Georgetown Pike)	Northbound (Douglass Drive)	236.7	F
			Southbound (Douglass Drive)	36.9	E
			Eastbound (Georgetown Pike)	0.2	A
			Westbound (Georgetown Pike)	1.1	A

2045 Build AM Synchro Peak Hour Arterial Queue Lengths

Queue Length by Movement - 2045 Build AM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
Signalized	Old Dominion Drive at Spring Hill Road	EBL*	164	283	-
		EBT*	164	283	-
		EBR	46	145	195
		WBL*	74	158	-
		WBT*	74	158	-
		WBR	2	7	480
		NBL*	83	147	-
		NBT*	83	147	-
		NBR*	83	147	-
		SBL*	103	185	-
		SBT*	103	185	-
		SBR*	103	185	-
Signalized	Old Dominion Drive at Swinks Mill Road	EBL*	616	1169	-
		EBT*	616	1169	-
		EBR*	616	1169	-
		WBL*	63	139	-
		WBT*	63	139	-
		WBR*	63	139	-
		NBL*	69	150	-
		NBT*	69	150	-
		NBR*	69	150	-
		SBL*	126	239	-
		SBT*	126	239	-
		SBR*	126	239	-
Signalized	Old Dominion Drive at Balls Hill Road	EBL*	567	986	-
		EBT*	567	986	-
		EBR*	567	986	-
		WBL*	225	403	-
		WBT*	225	403	-
		WBR*	225	403	-
		NBL*	146	270	-
		NBT*	146	270	-
		NBR*	146	270	-
		SBL*	732	1266	-
		SBT*	732	1266	-

Queue Length by Movement - 2045 Build AM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
		SBR*	732	1266	-
Signalized	Route 123 at Old Dominion Drive	EBL	118	200	235
		EBL	135	217	235
		EBT	119	255	-
		EBT	124	202	-
		EBR	4	47	330
		WBL	287	356	300
		WBL	308	362	300
		WBT	465	898	-
		WBTR*	212	601	-
		NBL	10	35	390
		NBT	181	362	-
		NBT	198	392	-
		NBR	16	143	390
		SBL	42	170	260
		SBT	265	433	-
		SBTR*	275	444	-
Unsignalized	Georgetown Pike at Swinks Mill Road	EBT*	0	2	-
		EBR*	0	2	-
		WBL*	113	245	-
		WBT*	113	245	-
		NBL*	165	298	-
		NBT*	165	298	-
		NBR*	165	298	-
Unsignalized	Georgetown Pike at Spring Hill Road	EBT*	0	4	-
		EBR*	0	4	-
		WBL*	61	162	-
		WBT*	61	162	-
		NBL*	33	71	-
		NBR*	33	71	-
Unsignalized	Lewinsville Road at Swinks Mill Road	EBL	28	56	250
		WBT*	0	4	-
		WBR*	0	4	-
		SBL	33	82	-
		SBR	48	79	50
Unsignalized		EBR	87	168	-
		WBR	31	61	-

Queue Length by Movement - 2045 Build AM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
	Route 123 at Ingleside Avenue	NBL	30	64	110
		NBT	0	6	
		NBTR*	0	6	-
		SBL	29	71	200
		SBT	16	75	-
		SBTR*	17	79	-
Unsignalized	Douglass Drive at Route 193 (Georgetown Pike)	EBL*	22	100	-
		EBT*	22	100	-
		EBR*	22	100	-
		WBL*	69	208	-
		WBT*	69	208	-
		WBR*	69	208	-
		NBL*	185	425	-
		NBT*	185	425	-
		NBR*	185	425	-
		SBL*	46	95	-
		SBT*	46	95	-
		SBR*	46	95	-

* indicates a single lane that includes more than one movement for which total queueing feet are shown (ie. queueing associated with a single EBLT lane is shown above both for the EB L and T movements)

2045 NO BUILD PM PEAK HOUR ARTERIAL INTERSECTION RESULTS

2045 No Build PM VISSIM Peak Hour Intersection Volume, Delay, and Queue Length

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
6	Route 123 and Tysons Boulevard	NB	LT	44	2,013	513.5	490.2	3,203	3,203	3,668	3,668
			TH	1,718		490.4		3,203		3,668	
			RT	251		484.4		3,203		3,668	
		SB	LT	135	2,605	91.2	42.1	61	167	276	830
			TH	1,477		51.3		167		830	
			RT	993		21.8		105		723	
		EB	LT	1,301	1,561	180.3	169.5	1,159	1,159	1,572	1,572
			RT	260		115.4		1,072		1,485	
		WB	LT	202	690	45.1	78.1	34	247	172	764
			RT	488		91.9		247		764	
		Intersection		6,869		206.0					
4	Westpark Drive and Tysons Connector	NB	TH	109	867	16.9	20.9	75	75	262	262
			RT	758		21.5		71		256	
		SB	LT	769	1,079	11.1	9.7	43	43	405	405
			TH	310		6.4		43		405	
		WB	LT	157	328	35.6	22.3	37	37	199	199
			RT	171		10.1		34		199	
		Intersection		2,274		15.8					
5	Tysons Connector and Express Lanes Ramps	NB	LT	135	135	21.3	21.3	10	10	81	81
		SB	RT	194	194	7.1	7.1	4	4	75	75
		EB	LT	607	1,549	17.0	14.0	88	88	596	596
			RT	942		12.1		82		584	
		Intersection		1,878		13.8					
7	Route 123 and Capital One Tower Drive/ Old Meadow Road	NB	LT	256	2,803	125.9	58.2	305	341	1,037	1,095
			TH	1,976		53.8		305		1,037	
			RT	571		43.1		341		1,095	
		SB	LT	199	2,259	72.5	45.8	272	272	765	765
			TH	1,863		47.0		272		765	
			RT	197		6.9		272		765	
		EB	LT	111	458	187.7	128.3	340	340	488	488
			RT	347		109.3		340		488	
		WB	LT	564	694	256.4	249.8	755	759	868	872
			TH	17		262.8		755		868	
			RT	113		215.2		759		872	
		Intersection		6,214		80.2					
8	Route 123 and Scotts Crossing Boulevard/	NB	LT	299	2,199	146.8	41.4	177	177	627	627
			TH	1,643		27.5		177		627	
			RT	257		8.0		177		627	
		SB	LT	76	1,694	124.8	77.2	478	501	865	888
			TH	1,337		81.1		478		865	

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	Colshire Drive		RT	281		45.7		501		888	
		EB	LT	333	942	169.1	113.4	435	441	581	588
			TH	261		116.5		435		581	
			RT	348		57.7		441		588	
		WB	LT	513	1,115	124.7	133.7	642	642	1,000	1,000
			TH	462		160.4		642		1,000	
			RT	140		78.5		642		1,000	
		Intersection		5,950		80.3					
1	Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road	NB	TH	1,538	2,100	66.7	59.4	347	347	1,000	1,000
			RT	562		39.4		307		957	
		SB	LT	145	1,329	581.6	433.5	2,334	2,334	2,663	2,663
			TH	1,184		415.3		2,334		2,663	
		EB	LT	10	159	87.1	47.0	40	40	201	201
			TH	89		72.4		40		201	
			RT	60		2.8		0		29	
		WB	LT	256	436	174.0	155.6	294	304	378	389
			RT	180		129.4		304		389	
		Intersection		4,024		192.9					
3	Route 123 and Lewinsville Road/ Great Falls Street	NB	LT	236	2,005	100.4	44.6	248	248	1,236	1,236
			TH	1,282		45.0		248		1,236	
			RT	487		16.8		165		1,171	
		SB	LT	31	1,308	370.8	401.7	2,401	2,401	3,058	3,058
			TH	1,155		406.1		2,401		3,058	
			RT	122		367.9		1,680		2,882	
		EB	LT	382	1,179	67.0	69.3	199	199	307	312
			TH	319		61.7		199		307	
			RT	478		76.2		185		312	
		WB	LT	286	487	968.7	922.0	2,678	2,678	2,847	2,847
			TH	178		860.6		2,678		2,847	
			RT	23		816.2		2,618		2,787	
		Intersection		4,979		230.1					
2	Lewinsville Road and Balls Hill Road	SB	LT	151	197	314.6	290.7	365	365	907	907
			RT	46		212.0		365		907	
		EB	LT	48	1,066	189.6	228.8	1,741	1,741	2,216	2,216
			TH	1,018		230.6		1,741		2,216	
		WB	TH	413	545	7.6	7.2	18	18	301	301
			RT	132		6.3		15		290	
		Intersection		1,808		168.7					
9	Jones Branch Drive and Jones	NB	TH	148	647	221.8	229.4	831	857	1,619	1,650
			RT	499		231.6		857		1,650	
		SB	LT	726	1,477	46.6	35.9	186	186	1,246	1,246
			TH	751		25.5		0		0	
		WB	LT	526	1,016	63.8	38.7	135	135	573	573

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	Branch Connector		RT	490		11.7		0		0	
		Intersection		3,140		76.6					
10	Jones Branch Connector and Express Lanes Ramps	NB	LT	37	80	63.5	73.9	23	27	107	118
			RT	43		82.9		27		118	
		SB	LT	192	224	539.6	497.4	787	787	1,224	1,224
			RT	32		244.1		745		1,221	
		EB	LT	230	1,140	170.9	188.2	422	444	936	966
			TH	497		277.4		422		936	
			RT	413		90.5		444		966	
		WB	LT	106	1,324	56.5	26.5	119	124	632	646
			TH	949		29.2		119		632	
			RT	269		4.9		124		646	
		Intersection		2,768		132.6					
29	Jones Branch Drive and Capital One (West)	NB	LT	585	730	65.3	70.9	206	218	313	327
			TH	49		78.3		206		313	
			RT	96		101.4		218		327	
		SB	LT	68	104	71.4	54.3	18	36	92	130
			TH	10		46.9		18		92	
			RT	26		12.7		36		130	
		EB	LT	24	718	141.6	211.8	879	919	1,106	1,147
			TH	611		226.9		879		1,106	
			RT	83		120.5		919		1,147	
		WB	LT	107	849	25.4	17.6	46	57	290	319
			TH	674		17.8		46		290	
			RT	68		3.3		57		319	
		Intersection		2,401		93.5					
30	Jones Branch Drive and Capital One (East)	NB	LT	17	140	394.5	431.3	237	254	274	292
			TH	3		410.6		237		274	
			RT	120		437.0		254		292	
		SB	LT	109	221	117.8	64.6	51	51	198	222
			TH	10		41.0		51		198	
			RT	102		10.1		38		222	
		EB	LT	63	781	15.4	81.9	248	281	432	470
			TH	695		88.7		248		432	
			RT	23		57.5		281		470	
		WB	LT	277	1,047	30.5	18.9	61	61	433	446
			TH	724		14.9		61		433	
			RT	46		11.7		61		446	
		Intersection		2,189		72.3					
11	International Drive and Spring Hill Road/ Jones	NB	LT	141	629	45.6	53.8	111	128	478	508
			TH	448		60.0		111		478	
			RT	40		12.0		128		508	
		SB	LT	154	764	64.5	43.8	78	78	340	340
			TH	370		58.9		78		340	

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
	Branch Drive		RT	240		7.3		32		271	
		EB	LT	352	672	70.3	50.9	101	101	298	323
			TH	139		62.5		101		298	
			RT	181		4.2		90		323	
		WB	LT	47	877	71.8	44.1	149	149	750	750
			TH	310		75.5		149		750	
			RT	520		22.9		119		750	
		Intersection		2,942		47.6					
12	Spring Hill Road and Dulles Toll Road Eastbound Ramps	NB	TH	935	1,309	18.5	14.5	99	99	486	486
			RT	374		4.5		57		339	
		SB	LT	77	628	15.8	8.3	12	12	197	197
			TH	551		7.3		12		197	
		EB	LT	126	364	75.8	70.2	67	70	301	309
			TH	11		85.5		67		301	
			RT	227		66.4		70		309	
		Intersection		2,301		21.6					
13	Spring Hill Road and Dulles Toll Road Westbound Ramps	NB	LT	338	1,043	43.1	34.2	142	142	519	519
			TH	705		29.9		142		519	
		SB	TH	495	541	17.7	17.2	34	34	445	450
			RT	46		12.7		34		450	
		WB	LT	130	207	50.0	56.3	33	47	185	215
			TH	8		66.3		33		185	
			RT	69		67.0		47		215	
		Intersection		1,791		31.6					
14	Spring Hill Road and Lewinsville Road	NB	LT	111	741	117.4	106.3	725	725	1,546	1,546
			TH	287		119.6		725		1,546	
			RT	343		91.5		725		1,546	
		SB	LT	16	257	67.8	64.9	115	115	467	467
			TH	217		64.6		115		467	
			RT	24		64.8		115		467	
		EB	LT	19	433	71.5	47.3	140	140	579	579
			TH	321		58.1		140		579	
			RT	93		5.1		2		107	
		WB	LT	236	695	40.6	38.6	119	119	499	499
			TH	449		38.4		119		499	
			RT	10		3.4		7		202	
		Intersection		2,126		67.2					
23	Georgetown Pike and Helga Place/ Linganore Drive	NB	LT	0	1	0.0	0.0	0	0	40	41
			TH	0		0.0		0		41	
			RT	1		0.0		0		39	
		SB	LT	4	4	125.6	125.6	2	2	50	76
			TH	0		0.0		1		67	
			RT	0		0.0		1		76	
		EB	TH	599	599	27.0	27.0	110	110	624	624

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
			RT	0		0.0		110		624	
		WB	LT	6	1,198	6.8	3.1	1	7	153	349
			TH	1,185		3.2		7		349	
			RT	7		0.0		7		349	
		Intersection		1,802		125.6					
20	Georgetown Pike and I-495 Southbound Ramps	SB	LT	241	866	45.4	22.5	105	105	476	476
			TH	119		48.4		105		476	
			RT	506		5.6		44		425	
		EB	TH	575	615	41.5	38.8	187	187	535	535
			RT	40		0.4		121		430	
		WB	LT	420	1,110	33.9	18.0	75	75	423	423
			TH	690		8.4		75		423	
		Intersection		2,591		24.5					
19	Georgetown Pike and I-495 Northbound Ramps	NB	LT	78	315	345.4	305.1	85	85	418	418
			TH	81		344.5		85		418	
			RT	156		264.5		48		390	
		EB	LT	561	822	62.1	45.9	170	170	441	441
			TH	261		11.0		170		441	
		WB	TH	1,025	1,601	19.2	19.5	114	114	458	458
			RT	576		20.1		44		353	
		Intersection		2,738		60.3					
18	Georgetown Pike and Balls Hill Road	NB	LT	257	284	86.0	80.1	151	151	596	596
			TH	10		44.8		151		596	
			RT	17		10.8		141		586	
		SB	LT	4	145	47.5	35.9	30	30	243	243
			TH	29		65.2		30		243	
			RT	112		27.9		24		232	
		EB	LT	42	419	23.0	9.3	9	9	240	240
			TH	208		10.6		9		240	
			RT	169		4.2		8		240	
		WB	LT	41	1,285	22.1	42.9	238	238	603	603
			TH	1,228		43.7		238		603	
			RT	16		33.4		238		603	
		Intersection		2,133		40.7					
22	Georgetown Pike and Dead Run Drive	NB	LT	333	345	0.0	1.4	108	108	516	516
			RT	12		40.6		106		513	
		EB	TH	207	229	0.5	0.6	0	0	18	18
			RT	22		0.9		0		18	
		WB	LT	10	934	40.0	56.9	601	601	1,586	1,586
			TH	924		57.1		570		1,520	
		Intersection		1,508		40.6					

2045 No Build PM Synchro Peak Hour Intersection Approach Delay and Level of Service

	Intersection Level of Service by Approach - 2045 No Build PM Conditions				
#	Signalization	Intersection Name	Approach	Delay	LOS
15	Signalized	Old Dominion Drive at Spring Hill Road	Northbound (Springhill Road)	16.2	B
			Southbound (Springhill Road)	13.8	B
			Eastbound (Old Dominion Drive)	8.1	A
			Westbound (Old Dominion Drive)	10.1	B
16	Signalized	Old Dominion Drive at Swinks Mill Road	Northbound (Swinks Mill Road)	15.4	B
			Southbound (Swinks Mill Road)	13.7	B
			Eastbound (Old Dominion Drive)	9.7	A
			Westbound (Old Dominion Drive)	11.0	B
17	Signalized	Old Dominion Drive at Balls Hill Road	Northbound (Balls Hill Road)	225.2	F
			Southbound (Balls Hill Road)	233.5	F
			Eastbound (Old Dominion Drive)	227.3	F
			Westbound (Old Dominion Drive)	173.6	F
21	Signalized	Route 123 at Old Dominion Drive	Northbound (Route 123)	19.9	B
			Southbound (Route 123)	21.6	C
			Eastbound (Old Dominion Drive)	84.9	F
			Westbound (Old Dominion Drive)	86.7	F
24	Unsignalized	Georgetown Pike at Swinks Mill Road	Northbound (Swinks Mill Road)	25.8	D
			Southbound (Driveway)	0.0	A
			Eastbound (Georgetown Pike)	0.0	A
			Westbound (Georgetown Pike)	0.9	A
25	Unsignalized	Georgetown Pike at Spring Hill Road	Northbound (Spring Hill Road)	20.1	C
			Eastbound (Georgetown Pike)	0.0	A
			Westbound (Georgetown Pike)	0.6	A
26	Unsignalized	Lewinsville Road at Swinks Mill Road	Southbound (Swinks Mill Road)	35.9	E
			Eastbound (Lewinsville Road)	2.7	A
			Westbound (Lewinsville Road)	0.0	A
27	Unsignalized	Route 123 at Ingleside Avenue	Northbound (Route 123)	3.2	A
			Southbound (Route 123)	0.3	A
			Eastbound (Ingleside Avenue)	28.5	D
			Westbound (Ingleside Avenue)	17.5	C
28	Unsignalized	Douglass Drive at Route 193 (Georgetown Pike)	Northbound (Douglass Drive)	898.5	F
			Southbound (Douglass Drive)	269.2	F
			Eastbound (Georgetown Pike)	0.4	A
			Westbound (Georgetown Pike)	1.7	A

2045 No Build PM Synchro Peak Hour Arterial Queue Lengths

Queue Length by Movement - 2045 No Build PM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
Signalized	Old Dominion Drive at Spring Hill Road	EBL*	98	187	-
		EBT*	98	187	-
		EBR	19	65	195
		WBL*	189	368	-
		WBT*	189	368	-
		WBR	8	79	480
		NBL*	130	213	-
		NBT*	130	213	-
		NBR*	130	213	-
		SBL*	62	118	-
		SBT*	62	118	-
		SBR*	62	118	-
Signalized	Old Dominion Drive at Swinks Mill Road	EBL*	340	759	-
		EBT*	340	759	-
		EBR*	340	759	-
		WBL*	288	571	-
		WBT*	288	571	-
		WBR*	288	571	-
		NBL*	148	273	-
		NBT*	148	273	-
		NBR*	148	273	-
		SBL*	80	168	-
		SBT*	80	168	-
		SBR*	80	168	-
Signalized	Old Dominion Drive at Balls Hill Road	EBL*	892	1132	-
		EBT*	892	1132	-
		EBR*	892	1132	-
		WBL*	938	1219	-
		WBT*	938	1219	-
		WBR*	938	1219	-
		NBL*	415	711	-
		NBT*	415	711	-
		NBR*	415	711	-
		SBL*	1261	1484	-
		SBT*	1261	1484	-
		SBR*	1261	1484	-

Queue Length by Movement - 2045 No Build PM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
Signalized	Route 123 at Old Dominion Drive	EBL	27	74	235
		EBL	43	102	235
		EBT	112	218	-
		EBT	129	245	-
		EBR	19	133	330
		WBL	132	270	300
		WBL	190	325	300
		WBT	286	507	-
		WBTR*	229	420	-
		NBL	31	79	390
		NBT	127	288	-
		NBT	141	308	-
		NBR	9	91	390
		SBL	113	328	260
		SBT	363	452	-
		SBTR*	370	447	-
Unsignalized	Georgetown Pike at Swinks Mill Road	EBT*	0	0	-
		EBR*	0	0	-
		WBL*	68	205	-
		WBT*	68	205	-
		NBL*	94	221	-
		NBT*	94	221	-
		NBR*	94	221	-
Unsignalized	Georgetown Pike at Spring Hill Road	EBT*	0	6	-
		EBR*	0	6	-
		WBL*	51	146	-
		WBT*	51	146	-
		NBL*	30	66	-
		NBR*	30	66	-
Unsignalized	Lewinsville Road at Swinks Mill Road	EBL	60	125	250
		WBT*	3	18	-
		WBR*	3	18	-
		SBL	59	139	-
		SBR	56	86	50
Unsignalized	Route 123 at Ingleside Avenue	EBR	232	266	-
		WBR	33	64	-
		NBL	92	162	110
		NBT	80	273	

Queue Length by Movement - 2045 No Build PM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
		NBTR*	59	245	-
		SBL	58	206	200
		SBT	616	1231	-
		SBTR*	617	1227	-
Unsignalized	Douglass Drive at Route 193 (Georgetown Pike)	EBL*	12	59	-
		EBT*	12	59	-
		EBR*	12	59	-
		WBL*	72	172	-
		WBT*	72	172	-
		WBR*	72	172	-
		NBL*	568	624	-
		NBT*	568	624	-
		NBR*	568	624	-
		SBL*	47	103	-
		SBT*	47	103	-
		SBR*	47	103	-

* indicates a single lane that includes more than one movement for which total queueing feet are shown (ie. queueing associated with a single EBLT lane is shown above both for the EB L and T movements)

2045 BUILD PM PEAK HOUR ARTERIAL INTERSECTION RESULTS

2045 Build PM VISSIM Peak Hour Intersection Volume, Delay, and Queue Length

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
6	Route 123 and Tysons Boulevard	NB	LT	44	2,024	521.7	493.0	3,200	3,200	3,666	3,666
			TH	1,723		492.9		3,200		3,666	
			RT	257		488.7		3,200		3,666	
		SB	LT	128	2,690	65.9	34.3	53	196	270	812
			TH	1,522		44.4		196		812	
			RT	1,040		15.5		148		733	
		EB	LT	1,131	1,356	217.5	207.4	1,238	1,238	1,572	1,572
			RT	225		156.6		1,148		1,482	
		WB	LT	199	684	45.9	67.4	34	201	166	790
			RT	485		76.3		201		790	
		Intersection		6,754		209.9					
4	Westpark Drive and Tysons Connector	NB	TH	105	879	24.2	27.2	111	111	265	265
			RT	774		27.6		107		259	
		SB	LT	819	1,120	12.2	10.8	52	52	504	504
			TH	301		6.8		52		504	
		WB	LT	170	348	36.9	23.7	42	42	211	211
			RT	178		11.1		40		211	
		Intersection		2,347		18.8					
5	Tysons Connector and Express Lanes Ramps	NB	LT	136	136	23.7	23.7	12	12	84	84
		SB	RT	213	213	6.9	6.9	5	5	65	65
		EB	LT	669	1,640	16.9	13.8	93	93	602	602
			RT	971		11.7		86		589	
		Intersection		1,989		13.7					
31	Route 123 and EB DTR/SB I-495 C-D Road	NB	TH	2,371	2,371	5.0	5.0	24	24	375	375
		SB	TH	1,935	1,935	5.3	5.3	15	15	212	212
		EB	LT	185	931	47.2	15.2	49	49	363	363
			RT	746		7.2		49		363	
		Intersection		5,237		6.9					
32	Route 123 and NB I-495 Ramp	NB	TH	1,918	1,918	10.2	10.2	52	52	439	439
		SB	TH	2,254	2,254	21.0	21.0	176	176	829	829
		WB	LT	683	1,465	49.1	45.5	93	93	405	405
			RT	782		42.4		93		402	
		Intersection		5,637		23.7					
7	Route 123 and Capital One Tower Drive/ Old Meadow Road	NB	LT	300	2,712	172.8	55.6	316	361	998	1,056
			TH	1,852		46.5		316		998	
			RT	560		23.0		361		1,056	
		SB	LT	193	2,317	72.7	37.8	181	181	707	707
			TH	1,918		36.3		181		707	
			RT	206		19.1		181		707	
		EB	LT	83	337	207.4	165.4	373	373	486	486
			RT	254		151.7		373		486	
		WB	LT	530	651	270.8	264.8	765	769	869	873

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
			TH	15		280.7		765		869	
			RT	106		232.6		769		873	
		Intersection		6,017		77.5					
8	Route 123 and Scotts Crossing Boulevard/ Colshire Drive	NB	LT	252	2,048	147.3	31.5	140	140	320	320
			TH	1,556		16.5		140		320	
			RT	240		7.5		140		320	
		SB	LT	78	1,771	117.3	56.7	379	401	822	845
			TH	1,412		59.0		379		822	
			RT	281		28.4		401		845	
		EB	LT	333	964	167.5	110.5	430	437	582	589
			TH	277		111.5		430		582	
			RT	354		56.2		437		589	
		WB	LT	500	1,106	129.1	135.0	645	645	1,003	1,003
			TH	466		159.1		645		1,003	
			RT	140		76.2		645		1,003	
		Intersection		5,889		71.4					
1	Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road	NB	TH	1,484	2,026	55.5	48.5	257	257	912	912
			RT	542		29.4		219		870	
		SB	LT	137	1,262	229.6	110.6	622	622	698	698
			TH	1,125		96.1		622		698	
		EB	LT	35	488	169.7	139.2	184	184	761	761
			TH	270		162.6		184		761	
			RT	183		98.9		1		220	
		WB	LT	240	417	188.4	164.3	296	306	372	382
			RT	177		131.7		306		382	
		Intersection		4,193		89.3					
33	Route 123 & EB DTR Ramps	NB	TH	1,142	1,142	5.3	5.3	7	7	282	282
		SB	LT	45	1,357	380.8	361.3	12	1,761	146	2,018
			TH	1,312		360.7		1,761		2,018	
		Intersection		2,499		198.6					
3	Route 123 and Lewinsville Road/ Great Falls Street	NB	LT	228	2,019	95.3	42.9	268	268	1,408	1,408
			TH	1,321		43.7		268		1,408	
			RT	470		15.2		181		1,320	
		SB	LT	30	1,176	463.0	515.9	2,803	2,803	3,065	3,065
			TH	1,042		521.9		2,803		3,065	
			RT	104		470.9		2,141		2,761	
		EB	LT	365	1,122	65.0	77.2	210	232	308	316
			TH	315		61.8		210		308	
			RT	442		98.1		232		316	
		WB	LT	276	463	1,055.3	1,002.3	2,688	2,688	2,847	2,847
			TH	165		928.9		2,688		2,847	
			RT	22		887.2		2,628		2,787	
		Intersection		4,780		260.2					
2	Lewinsville Road and Balls Hill Road	SB	LT	130	172	564.2	533.9	671	671	1,402	1,402
			RT	42		440.2		671		1,402	
		EB	LT	45	1,022	197.0	259.5	1,741	1,741	2,217	2,217
			TH	977		262.3		1,741		2,217	

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
		WB	TH	385	506	7.2	7.1	15	15	281	281
			RT	121		6.5		13		269	
		Intersection		1,700		212.1					
9	Jones Branch Drive and Jones Branch Connector	NB	TH	97	448	563.8	614.7	1,282	1,312	1,621	1,653
			RT	351		628.8		1,312		1,653	
		SB	LT	732	1,460	94.7	73.7	440	440	1,413	1,413
			TH	728		52.6		440		1,413	
		WB	LT	532	1,027	62.9	38.3	132	132	523	523
			RT	495		11.8		132		523	
		Intersection		2,935		143.9					
10	Jones Branch Connector and Express Lanes Ramps	NB	LT	37	82	54.6	50.1	15	16	95	106
			RT	45		46.4		16		106	
		SB	LT	251	293	69.9	63.4	90	90	334	334
			RT	42		24.7		14		276	
		EB	LT	227	1,066	260.3	297.5	666	696	937	967
			TH	445		441.8		666		937	
			RT	394		155.9		696		967	
		WB	LT	103	1,357	61.8	34.2	177	185	737	751
			TH	953		39.4		177		737	
			RT	301		8.4		185		751	
		Intersection		2,798		138.0					
29	Jones Branch Drive and Capital One (West)	NB	LT	595	734	71.9	77.2	228	240	311	324
			TH	45		88.6		228		311	
			RT	94		105.1		240		324	
		SB	LT	66	103	72.1	54.6	17	36	81	119
			TH	10		49.7		17		81	
			RT	27		13.6		36		119	
		EB	LT	27	741	157.7	221.2	1,046	1,087	1,111	1,152
			TH	630		236.0		1,046		1,111	
			RT	84		130.2		1,087		1,152	
		WB	LT	110	858	25.7	18.8	50	61	343	371
			TH	682		19.3		50		343	
			RT	66		3.2		61		371	
		Intersection		2,436		99.5					
30	Jones Branch Drive and Capital One (East)	NB	LT	16	139	411.7	447.4	236	254	265	282
			TH	2		524.4		236		265	
			RT	121		450.9		254		282	
		SB	LT	109	227	99.7	54.2	42	42	186	211
			TH	10		26.1		42		186	
			RT	108		10.9		24		211	
		EB	LT	64	803	14.8	78.3	247	280	441	479
			TH	716		84.6		247		441	
			RT	23		58.1		280		479	
		WB	LT	233	1,007	27.9	16.4	49	50	376	389
			TH	731		13.0		49		376	
			RT	43		11.5		50		389	
		Intersection		2,176		70.7					

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
11	International Drive and Spring Hill Road/ Jones Branch Drive	NB	LT	136	668	56.2	69.2	150	168	575	605
			TH	494		76.5		150		575	
			RT	38		20.7		168		605	
		SB	LT	155	764	59.6	42.3	74	74	340	340
			TH	369		57.6		74		340	
			RT	240		7.6		31		273	
		EB	LT	385	702	70.2	51.9	107	107	336	360
			TH	140		61.7		107		336	
			RT	177		4.5		97		360	
		WB	LT	45	911	74.9	45.5	169	169	926	926
			TH	303		75.9		169		926	
			RT	563		26.8		138		926	
		Intersection		3,045		51.4					
12	Spring Hill Road and Dulles Toll Road Eastbound Ramps	NB	TH	1,051	1,425	21.3	17.2	135	135	513	513
			RT	374		5.9		82		361	
		SB	LT	77	628	22.8	11.4	18	18	225	225
			TH	551		9.8		18		225	
		EB	LT	125	362	75.3	69.7	64	69	287	295
			TH	11		75.1		64		287	
			RT	226		66.4		69		295	
		Intersection		2,415		23.6					
13	Spring Hill Road and Dulles Toll Road Westbound Ramps	NB	LT	453	1,153	41.7	38.7	175	175	532	532
			TH	700		36.8		175		532	
		SB	TH	489	548	23.7	23.0	49	50	496	501
			RT	59		17.3		50		501	
		WB	LT	135	282	48.3	65.1	62	78	292	322
			TH	77		79.0		62		292	
			RT	70		82.1		78		322	
		Intersection		1,983		38.1					
14	Spring Hill Road and Lewinsville Road	NB	LT	105	742	124.5	112.7	768	768	1,550	1,550
			TH	293		123.7		768		1,550	
			RT	344		99.8		768		1,550	
		SB	LT	15	263	65.3	65.1	116	116	435	435
			TH	224		64.8		116		435	
			RT	24		67.2		116		435	
		EB	LT	18	438	62.1	46.4	138	138	605	605
			TH	324		57.7		138		605	
			RT	96		5.2		2		126	
		WB	LT	236	696	41.5	38.4	118	118	498	498
			TH	451		37.5		118		498	
			RT	9		2.3		7		201	
		Intersection		2,139		69.1					
23	Georgetown Pike and Helga Place/ Linganore Drive	NB	LT	0	1	0.0	0.0	0	0	40	41
			TH	0		0.0		0		41	
			RT	1		0.0		0		39	
		SB	LT	3	4	15.9	12.0	0	0	50	76
			TH	0		0.0		0		67	

#	Intersection	Approach	Movement	Average Throughput (vph)		Average Delay (sec/veh)		Average Queue Length (feet)		Max Queue Length (feet)	
			RT	1		0.0		0		76	
		EB	TH	347	347	0.4	0.4	0	0	24	24
			RT	0		0.0		0		24	
		WB	LT	6	1,273	2.0	4.1	0	13	85	417
			TH	1,259		4.2		13		417	
			RT	8		0.0		13		417	
		Intersection		1,625		15.9					
20	Georgetown Pike and I-495 Southbound Ramps	SB	LT	276	947	47.0	22.0	98	98	442	442
			TH	74		48.4		98		442	
			RT	597		7.2		38		395	
		EB	TH	309	354	26.2	22.9	48	48	380	380
			RT	45		0.4		12		274	
		WB	LT	441	1,113	39.0	20.8	92	92	424	424
			TH	672		8.8		92		424	
		Intersection		2,414		21.6					
19	Georgetown Pike and I-495 Northbound Ramps	NB	LT	86	342	343.4	310.4	58	58	428	428
			TH	74		344.3		58		428	
			RT	182		281.1		28		400	
		EB	LT	296	588	74.1	39.1	92	92	373	373
			TH	292		3.5		92		373	
		WB	TH	1,013	1,304	12.4	10.0	45	45	430	430
			RT	291		1.5		0		0	
		Intersection		2,234		63.6					
18	Georgetown Pike and Balls Hill Road	NB	LT	219	246	42.3	39.4	57	57	289	289
			TH	11		33.7		57		289	
			RT	16		4.1		49		279	
		SB	LT	5	131	43.4	29.3	21	21	193	193
			TH	31		57.3		21		193	
			RT	95		19.5		15		182	
		EB	LT	49	476	17.0	8.8	10	10	231	246
			TH	223		10.4		10		231	
			RT	204		5.0		10		246	
		WB	LT	49	1,049	10.8	16.6	57	57	473	473
			TH	985		17.0		57		473	
			RT	15		7.9		57		473	
		Intersection		1,902		18.4					
22	Georgetown Pike and Dead Run Drive	NB	LT	276	290	13.8	13.7	28	28	221	221
			RT	14		11.4		26		219	
		EB	TH	223	243	0.4	0.5	0	0	5	5
			RT	20		0.9		0		5	
		WB	LT	9	772	2.1	1.3	2	2	147	147
			TH	763		1.3		2		103	
		Intersection		1,305		13.8					

2045 Build PM Synchro Peak Hour Intersection Approach Delay and Level of Service

	Intersection Level of Service by Approach - 2045 Build PM Conditions				
#	Signalization	Intersection Name	Approach	Delay	LOS
15	Signalized	Old Dominion Drive at Spring Hill Road	Northbound (Springhill Road)	14.8	B
			Southbound (Springhill Road)	13.4	B
			Eastbound (Old Dominion Drive)	7.6	A
			Westbound (Old Dominion Drive)	10.0	A
16	Signalized	Old Dominion Drive at Swinks Mill Road	Northbound (Swinks Mill Road)	13.0	B
			Southbound (Swinks Mill Road)	13.7	B
			Eastbound (Old Dominion Drive)	8.5	A
			Westbound (Old Dominion Drive)	9.7	A
17	Signalized	Old Dominion Drive at Balls Hill Road	Northbound (Balls Hill Road)	231.0	F
			Southbound (Balls Hill Road)	203.8	F
			Eastbound (Old Dominion Drive)	179.3	F
			Westbound (Old Dominion Drive)	129.5	F
21	Signalized	Route 123 at Old Dominion Drive	Northbound (Route 123)	21.8	C
			Southbound (Route 123)	22.5	C
			Eastbound (Old Dominion Drive)	85.8	F
			Westbound (Old Dominion Drive)	82.2	F
24	Unsignalized	Georgetown Pike at Swinks Mill Road	Northbound (Swinks Mill Road)	18.1	C
			Southbound (Driveway)	0.0	A
			Eastbound (Georgetown Pike)	0.0	A
			Westbound (Georgetown Pike)	0.8	A
25	Unsignalized	Georgetown Pike at Spring Hill Road	Northbound (Spring Hill Road)	19.6	C
			Eastbound (Georgetown Pike)	0.0	A
			Westbound (Georgetown Pike)	0.6	A
26	Unsignalized	Lewinsville Road at Swinks Mill Road	Southbound (Swinks Mill Road)	29.1	D
			Eastbound (Lewinsville Road)	0.9	A
			Westbound (Lewinsville Road)	0.0	A
27	Unsignalized	Route 123 at Ingleside Avenue	Northbound (Route 123)	1.4	A
			Southbound (Route 123)	0.3	A
			Eastbound (Ingleside Avenue)	26.1	D
			Westbound (Ingleside Avenue)	19.4	C
28	Unsignalized	Douglass Drive at Route 193 (Georgetown Pike)	Northbound (Douglass Drive)	513.1	F
			Southbound (Douglass Drive)	98.0	F
			Eastbound (Georgetown Pike)	0.3	A
			Westbound (Georgetown Pike)	1.9	A

2045 Build PM Synchro Peak Hour Arterial Queue Lengths

Queue Length by Movement - 2045 Build PM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
Signalized	Old Dominion Drive at Spring Hill Road	EBL*	62	117	-
		EBT*	62	117	-
		EBR	15	38	195
		WBL*	126	240	-
		WBT*	126	240	-
		WBR	1	5	480
		NBL*	73	128	-
		NBT*	73	128	-
		NBR*	73	128	-
		SBL*	33	70	-
		SBT*	33	70	-
		SBR*	33	70	-
Signalized	Old Dominion Drive at Swinks Mill Road	EBL*	197	437	-
		EBT*	197	437	-
		EBR*	197	437	-
		WBL*	135	266	-
		WBT*	135	266	-
		WBR*	135	266	-
		NBL*	34	90	-
		NBT*	34	90	-
		NBR*	34	90	-
		SBL*	57	131	-
		SBT*	57	131	-
		SBR*	57	131	-
Signalized	Old Dominion Drive at Balls Hill Road	EBL*	568	1057	-
		EBT*	568	1057	-
		EBR*	568	1057	-
		WBL*	497	1148	-
		WBT*	497	1148	-
		WBR*	497	1148	-
		NBL*	144	289	-
		NBT*	144	289	-
		NBR*	144	289	-
		SBL*	1289	1437	-
		SBT*	1289	1437	-

Queue Length by Movement - 2045 Build PM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
		SBR*	1289	1437	-
Signalized	Route 123 at Old Dominion Drive	EBL	47	112	235
		EBL	71	167	235
		EBT	197	465	-
		EBT	318	751	-
		EBR	157	422	330
		WBL	206	330	300
		WBL	264	386	300
		WBT	532	955	-
		WBTR*	192	552	-
		NBL	24	77	390
		NBT	114	261	-
		NBT	121	277	-
		NBR	7	53	390
		SBL	39	182	260
		SBT	357	432	-
		SBTR*	362	436	-
Unsignalized	Georgetown Pike at Swinks Mill Road	EBT*	0	0	-
		EBR*	0	0	-
		WBL*	41	125	-
		WBT*	41	125	-
		NBL*	54	130	-
		NBT*	54	130	-
		NBR*	54	130	-
Unsignalized	Georgetown Pike at Spring Hill Road	EBT*	0	2	-
		EBR*	0	2	-
		WBL*	38	118	-
		WBT*	38	118	-
		NBL*	24	52	-
		NBR*	24	52	-
Unsignalized	Lewinsville Road at Swinks Mill Road	EBL	22	48	250
		WBT*	0	4	-
		WBR*	0	4	-
		SBL	32	75	-
		SBR	29	62	50
Unsignalized		EBR	222	277	-
		WBR	30	65	-

Queue Length by Movement - 2045 Build PM Conditions					
Signalization	Intersection Name	Approach	Queue Length		
			50th (feet)	95th (feet)	Storage Bay Dist.
	Route 123 at Ingleside Avenue	NBL	40	121	110
		NBT	15	101	
		NBTR*	7	72	-
		SBL	17	95	200
		SBT	678	1256	-
		SBTR*	680	1255	-
Unsignalized	Douglass Drive at Route 193 (Georgetown Pike)	EBL*	9	43	-
		EBT*	9	43	-
		EBR*	9	43	-
		WBL*	64	155	-
		WBT*	64	155	-
		WBR*	64	155	-
		NBL*	371	671	-
		NBT*	371	671	-
		NBR*	371	671	-
		SBL*	40	79	-
		SBT*	40	79	-
		SBR*	40	79	-

* indicates a single lane that includes more than one movement for which total queueing feet are shown (ie. queueing associated with a single EBLT lane is shown above both for the EB L and T movements)

Appendix I: Sensitivity Analysis

APPENDIX I FUTURE SCENARIOS SENSITIVITY ANALYSES

1 2025 OPENING YEAR PRIOR TO MARYLAND MANAGED LANES ANALYSIS

This document is provided as a supplement to the I-495 NEXT Project *Traffic and Transportation Technical Report.* It summarizes traffic forecast volumes and operations for sensitivity test scenarios assuming that the background CLRP project of I-495 managed lanes north of the ALMB (the Maryland managed lanes project) is not completed before the I-495 NEXT project. This analysis was conducted for 2025 No Build and 2025 Build conditions, both without the Maryland managed lanes in place. The scenarios assuming the Maryland managed lanes are not yet in place are referred to throughout this document as the "Pre-Maryland" scenarios for simplicity.

For the purposes of traffic operations analysis for these scenarios, the terminus of the I-495 NEXT Express Lanes, including northbound merge and southbound diverge sections from the GP lanes, is assumed to be located completely south of the existing GWMP overpass. The GWMP overpass is not reconstructed and the existing bridge piers remain in place. The southbound off-ramp to GWMP utilizes the existing off-ramp location currently serving traffic destined for both GWMP and Route 193; a new separate off-ramp for southbound traffic destined for Route 193 would be constructed to the south. See **Exhibit 1**.

The following sections summarize forecast volumes and traffic operations results for the 2025 "Pre-Maryland" scenarios.

1.1 2025 Prior to Maryland Managed Lanes Traffic Volumes

This section describes forecasted traffic volumes for the study area for 2025 No Build and Build conditions prior to the Maryland managed lanes being in place; subsequent sections detail the differences in traffic operations analysis results between the two conditions.

Peak hour freeway forecast volumes for 2025 "Pre-Maryland" conditions are provided in the following exhibits:

- **Exhibits 2a** and **2b** show 2025 No Build AM peak hour freeway volumes for the I-495 and Route 267 corridors, respectively.
- **Exhibits 3a** and **3b** show 2025 Build AM peak hour freeway volumes for the I-495 and Route 267 corridors, respectively.
- **Exhibits 4a** and **4b** show 2025 No Build PM peak hour freeway volumes for the I-495 and Route 267 corridors, respectively.
- **Exhibits 5a** and **5b** show 2025 Build PM peak hour freeway volumes for the I-495 and Route 267 corridors, respectively.

Arterial turning movement volumes for 2025 conditions are provided in the following exhibits:

- **Exhibits 6a** through **6e** show 2025 No Build AM and PM peak hour arterial turning movement volumes.
- **Exhibits 7a** through **7e** show 2025 Build AM and PM peak hour arterial turning movement volumes.

Average daily traffic forecast volumes for 2025 conditions are provided in the following exhibits:

- **Exhibits 8a** and **8b** show 2025 No Build ADT freeway volumes for the I-495 and Route 267 corridors, respectively.
- **Exhibits 9a** and **9b** show 2025 Build ADT freeway volumes for the I-495 and Route 267 corridors, respectively.

Peak Hour Traffic Volumes and Peaking Patterns

Figure 1 and **Figure 2** compare 2025 No Build and Build AM forecast peak hour mainline volumes with existing conditions along northbound and southbound I-495 (GP and Express combined), respectively. Volumes are shown for both the "Pre-Maryland" scenarios as well as the default scenarios assumed for the EA which include the Maryland managed lanes.

- In the northbound direction, the highest traffic volumes in all scenarios are between the GWMP and Clara Barton Parkway (across the ALMB). The increases in volume from No Build (Pre-Maryland) to Build (Pre-Maryland) range from 80 vph to 630 vph (1 percent to 8 percent) across the four segments, with the largest increases in the segments south of Route 193. In the "Pre-Maryland" scenarios, capacity is constrained across the ALMB given the assumption of the Express Lanes terminating south of the bridge.
- In the southbound direction, the highest traffic volumes in all scenarios are again between the Clara Barton Parkway and GWMP (across the ALMB). The increases in volume from No Build to Build range from 130 vph to 360 vph (1 percent to 4 percent) across the four segments, with the largest increase in the segments south of GWMP where the Build Alternative adds capacity from the Express Lanes. In the "Pre-Maryland" scenarios, capacity is constrained across the ALMB given the assumption of the Express Lanes beginning south of the bridge.

Figure 3 and **Figure 4** compare 2025 No Build and Build PM forecast peak hour mainline volumes with existing conditions along northbound and southbound I-495 (GP and Express combined), respectively. Volumes are again shown for both the "Pre-Maryland" scenarios as well as the default scenarios assumed for the EA which include the Maryland managed lanes.

- In the northbound direction, the highest traffic volumes in all scenarios are between the GWMP and Clara Barton Parkway (across the ALMB). The increases in volume from No Build to Build range from 60 vph to 880 vph (1 percent to 18 percent) across the four segments, with the largest increases in the segments between Route 267 and GWMP where the Build Alternative adds capacity from the Express Lanes. In the "Pre-Maryland" scenarios, capacity is again constrained across the ALMB given the assumption of the Express Lanes terminating south of the bridge.
- In the southbound direction, the highest traffic volumes in all scenarios are again between the Clara Barton Parkway and GWMP (across the ALMB). The increases in volume from No Build to Build range from 90 vph to 280 vph (1 percent to 4 percent) across the four segments, with the largest increase in the segments between GWMP and Route 267 where the Build Alternative adds capacity from the Express Lanes. In the "Pre-Maryland" scenarios, capacity is again constrained across the ALMB given the assumption of the Express Lanes beginning south of the bridge.

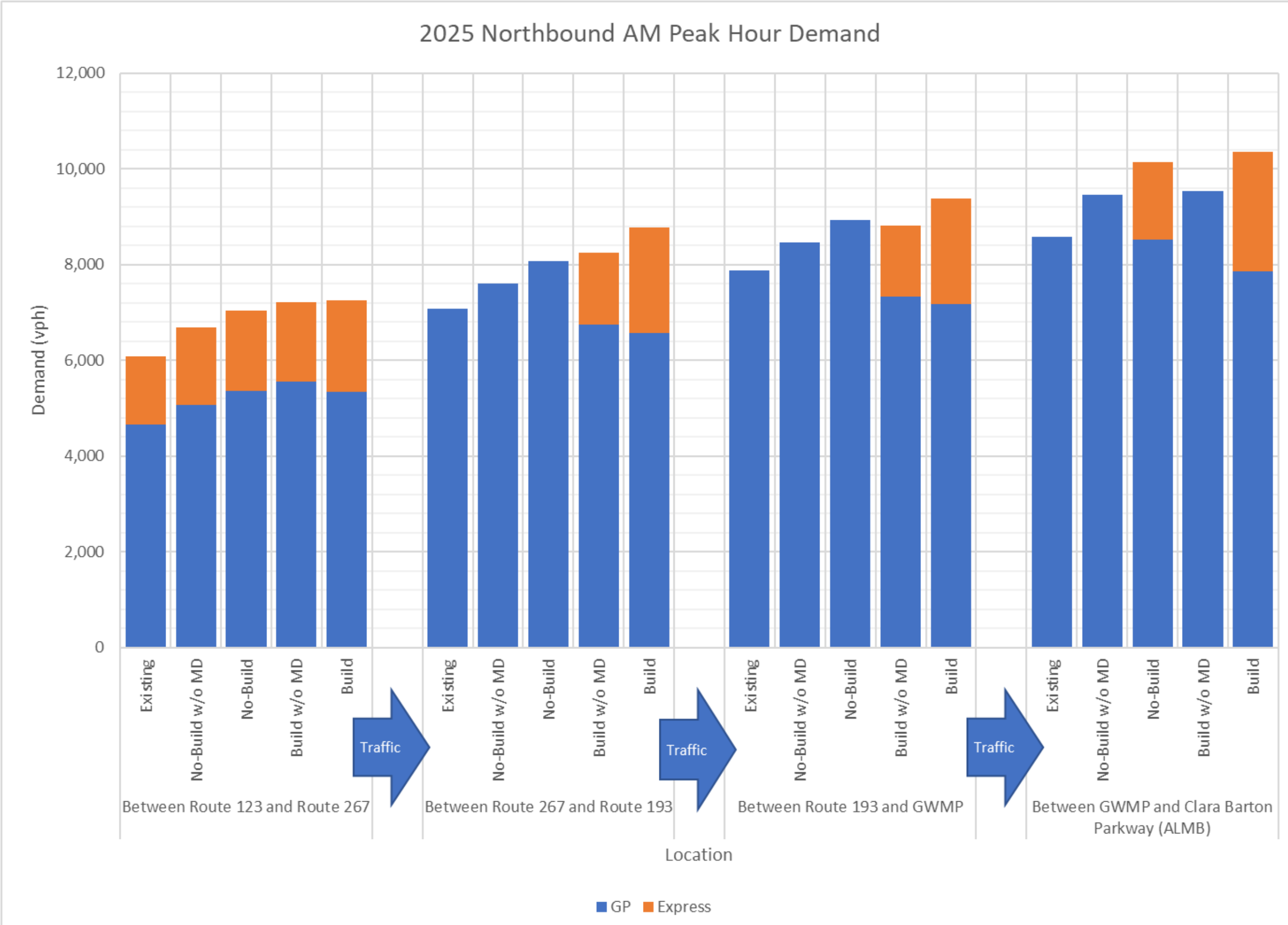


Figure 1: Existing and 2025 AM Peak Hour Volumes - Northbound I-495

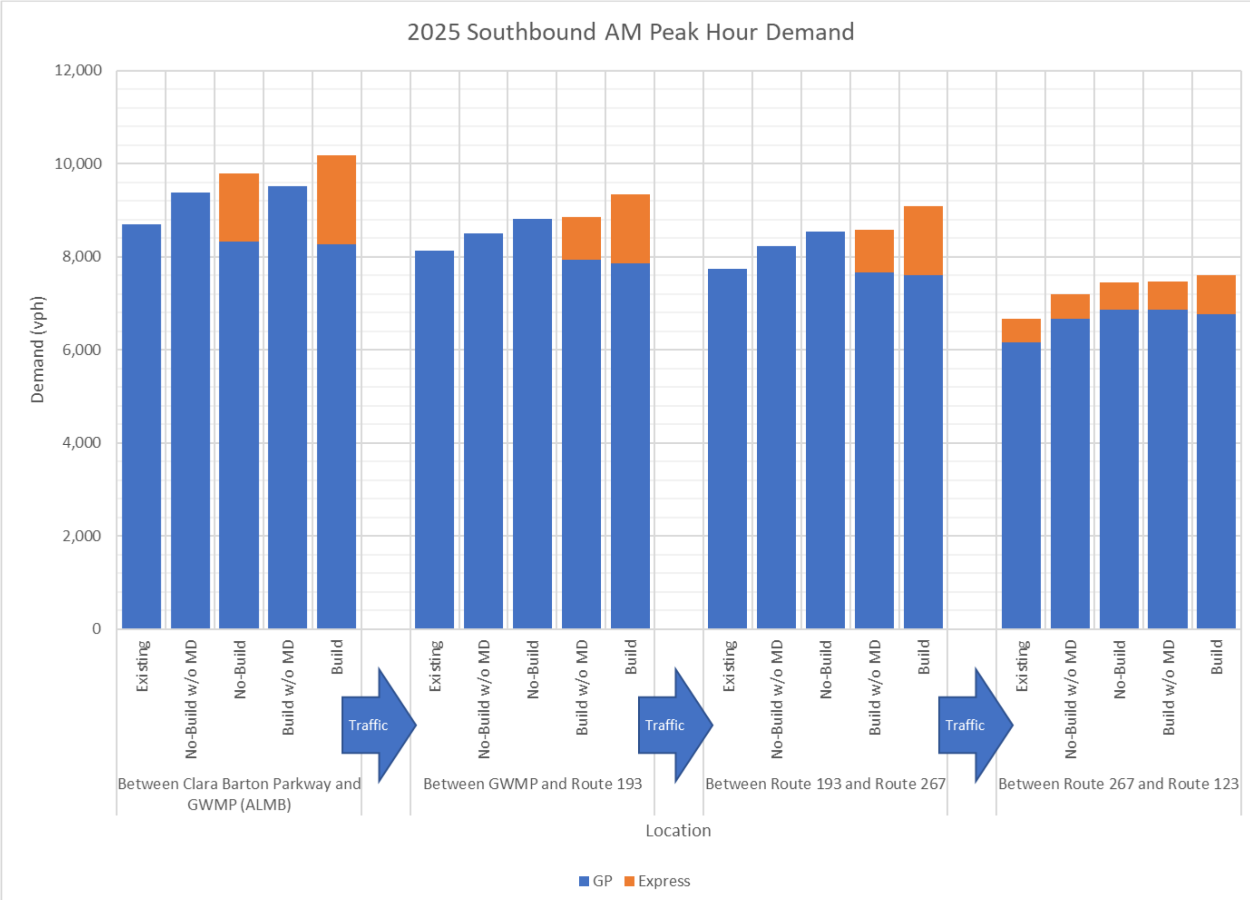


Figure 2: Existing and 2025 AM Peak Hour Volumes - Southbound I-495

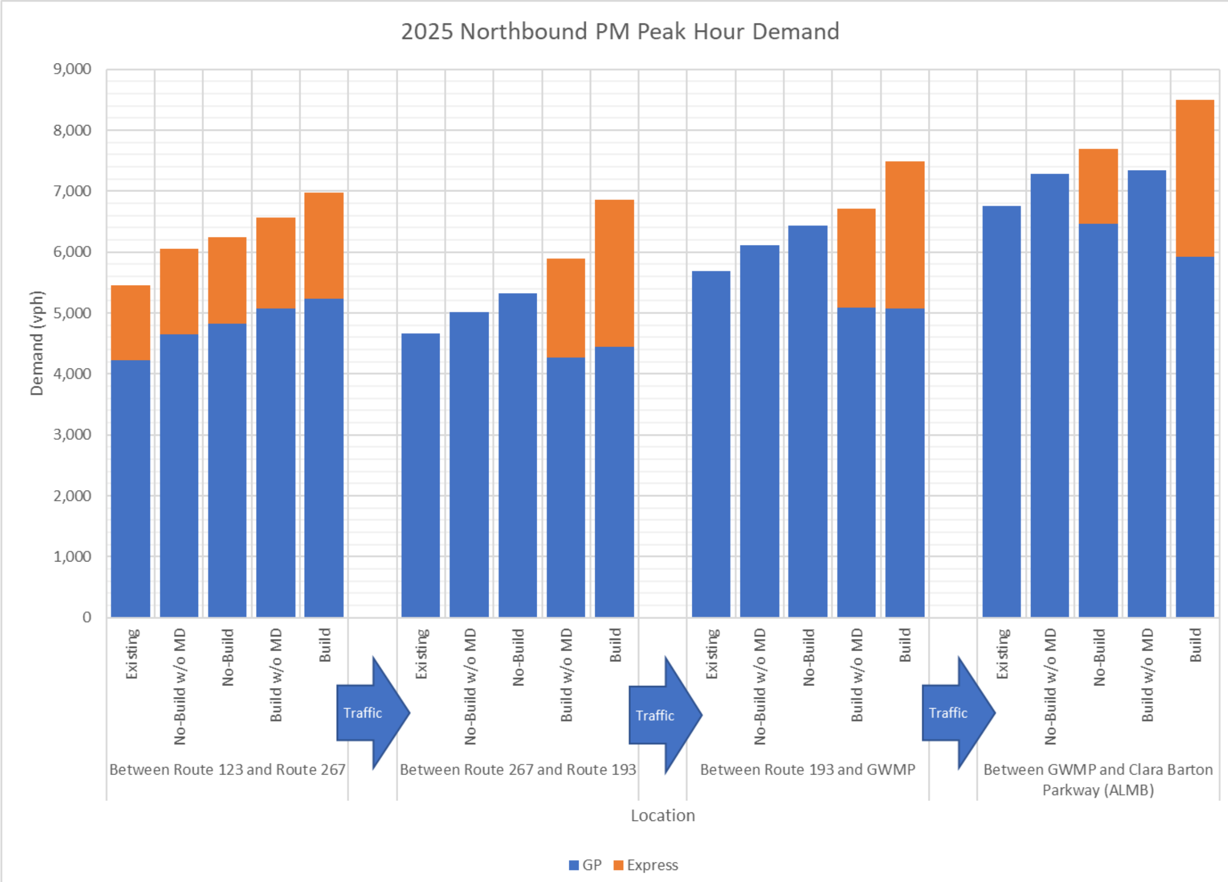


Figure 3: Existing and 2025 PM Peak Hour Volumes - Northbound I-495

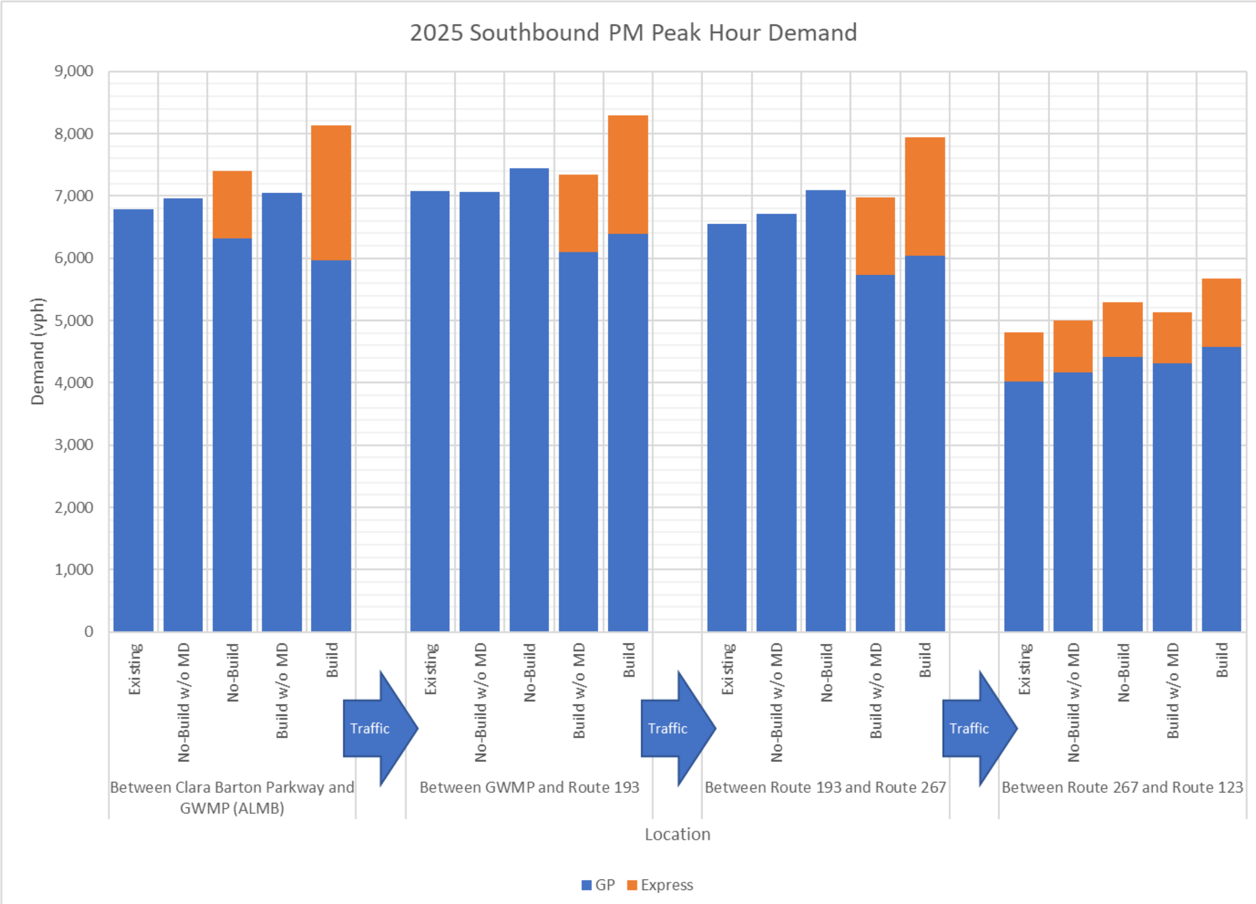


Figure 4: Existing and 2025 PM Peak Hour Volumes - Southbound I-495

1.2 2025 No Build vs Build "Pre-Maryland" AM Freeway Operations

Speeds

Figure 5 provides a "heat map" comparison of average speeds between 2025 No Build (Pre-Maryland) and Build (Pre-Maryland) conditions for the AM peak period along the I-495 GP lanes. Time of day during the peak period is provided on the horizontal axis while location along the corridor is provided along the vertical axis; the colors signify average speeds for each scenario.

As illustrated in the figure, in both scenarios, in the northbound GP lanes, congestion and queueing is observed from Clara Barton Parkway (across the ALMB) spilling back to the Route 267 interchange. The onset of congested speeds is observed to be slightly earlier during the Build scenario, resulting in a longer duration of congestion and longer queue spillback during the peak period. In both the scenarios, the observed northbound GP congestion is attributable to weaving and merging across the ALMB, including the heavy on-ramp movement from GWMP as well as the on-ramp from Route 193. In the Build condition, there is an additional left-side merge just south of the ALMB for the terminus of the northbound Express Lanes; this creates additional merging and weaving across the bridge (the section of the facility that is already experiencing the highest demand), worsening upstream congestion. Additionally, in the Build scenario, due to the new Express Lanes being in place between Route 267 and GWMP, the left-side shoulder lane which is typically open to traffic during this period (and is assumed to be open in the No Build scenario) is no longer open. This results in more rapid onset of queue spillback south of Route 193 in the Build scenario.

In the southbound GP lanes, in both scenarios, congestion and queueing is observed north of the ALMB and back into Maryland, while limited congestion is observed south of the bridge. The bridge acts as a bottleneck, metering southbound traffic into Virginia and generally resulting in higher speeds south of the bridge.

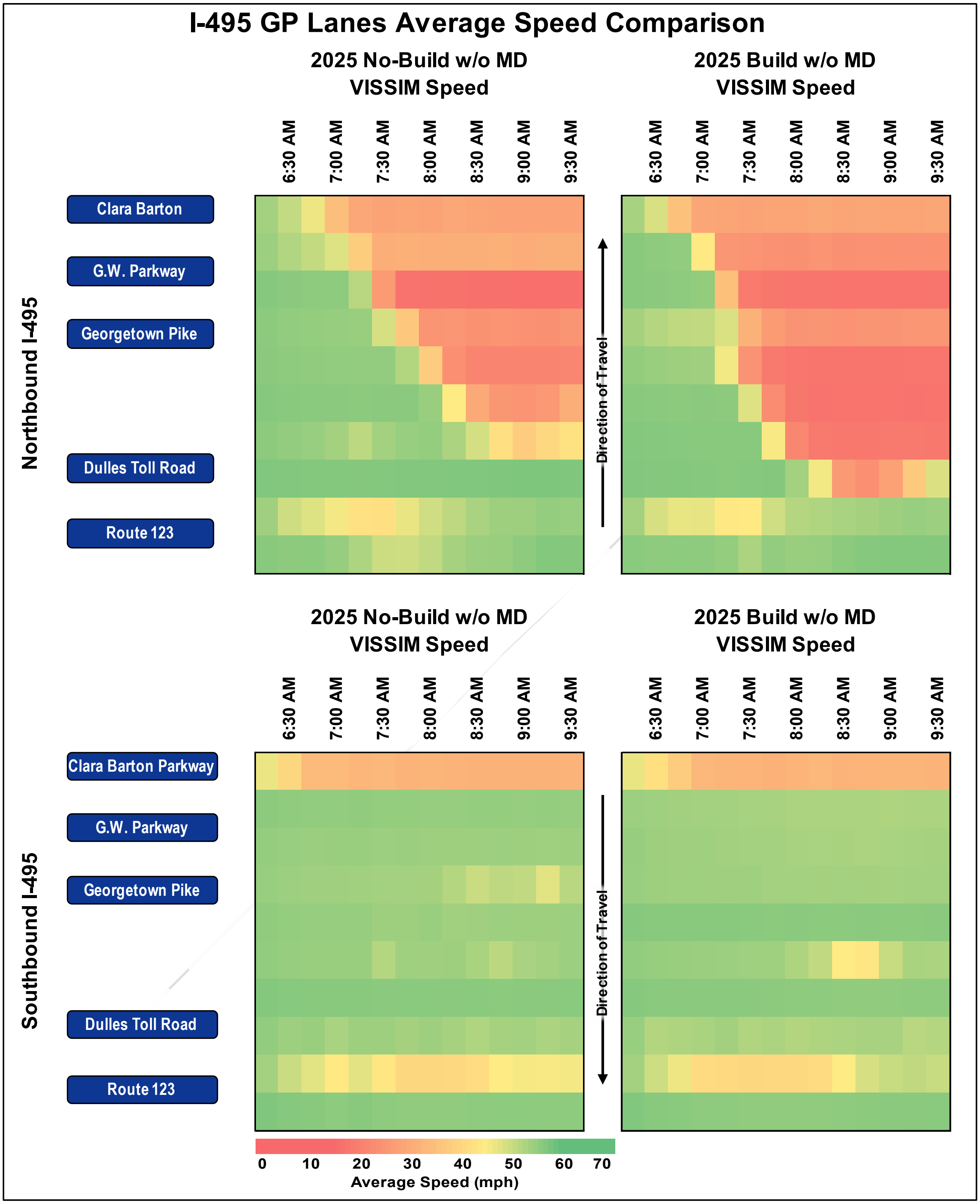


Figure 5. 2025 No Build and Build (Pre-Maryland) – AM Peak Period Average Speeds, I-495 GP Lanes

Travel Times

A comparison of AM peak period travel times for 2025 No Build (Pre-Maryland) and 2025 Build (Pre-Maryland) scenarios is shown in **Table 1**. Travel time measurements have been aggregated by direction of travel and facility type. Note that travel times are only shown south of Clara Barton Parkway.

Table 1. 2025 AM Peak Period Travel Time Comparison

Route	GP Travel Times (Minutes: Seconds)		Express Lanes Travel Times (Minutes: Seconds)	
	2025 No Build Pre-MD	2025 Build Pre-MD	2025 No Build Pre-MD	2025 Build Pre-MD
Northbound I-495 (Route 123 to Clara Barton Parkway)	10:21	14:22	9:46	5:25
Southbound I-495 (Clara Barton Parkway to Route 123)	5:06	5:11	4:45	4:21
Eastbound Route 267 (Spring Hill Road to Route 123)	2:57	3:37	-	-
Westbound Route 267 (Route 123 to Spring Hill Road)	1:57	2:03	-	-

The following observations are noted with regard to AM peak period travel times prior to the Maryland managed lanes being in place:

- The average end-to-end travel time between Route 123 and Clara Barton Parkway in the northbound GP lanes increases by approximately 4 minutes (a 39 percent deterioration) in the Build condition. This deterioration is attributable to the increased merging and weaving across the ALMB due to the left-side merge from the new northbound Express Lanes terminus, consistent with the speed results shown in the previous section. The most significant increases in travel time are for the segments between Lewinsville Road and GWMP.
- Vehicles traveling in the northbound Express Lanes see an improvement of more than 4 minutes (a 44 percent improvement). The travel time improvement in the Build condition is between Lewinsville Road and GWMP, where in the No Build condition, all vehicles are forced to travel on the congested GP lanes.
- In the southbound GP lanes, travel times are essentially consistent between the No Build and Build conditions; in the southbound Express Lanes, travel times improve by less than 30 seconds (an 8 percent improvement) in the Build condition. Overall end-to-end operations between Clara Barton Parkway and Route 123 are fairly similar between the two scenarios.
- Along eastbound Route 267 (DTR), there is 23 percent deterioration in travel time in the Build condition. The ramp from eastbound DTR to the northbound I-495 GP lanes spills back to eastbound DTR due to increased congestion in the GP lanes, worsening operations on the eastbound DTR.
- In the westbound direction, travel times along Route 267 (DTR) are essentially identical between No Build and Build.

Person Throughput

Figure 6 and **Figure 7** display 2025 "Pre-Maryland" scenarios AM peak period person throughput along I-495 northbound and southbound, respectively (GP and Express combined). These figures show the estimated number of persons moved across a three-hour period based on simulated vehicle throughput and assumed vehicle occupancies for GP and Express Lanes. These figures show that person throughput increases in the Build scenario between Route 267 and GWMP due to the added capacity from the Express Lanes and increased occupancy of vehicles in those lanes. Across the ALMB, person throughputs are generally consistent between the No Build and Build scenarios.

- In the northbound direction, increases in throughput from No Build to Build range from 0 to 10 percent, with the greatest increase in the segments between Route 267 and GWMP where the new Express Lanes significantly add capacity. South of Route 267 and across the ALMB, the number of persons moved during the peak period is essentially consistent between No Build and Build conditions.
- In the southbound direction, increases in throughput from No Build to Build range from 1 to 8 percent, with the greatest increases again in the segments between GWMP and Route 267 where the new Express Lanes significantly add capacity. Across the ALMB, the number of persons moved during the peak period is essentially consistent between No Build and Build conditions.

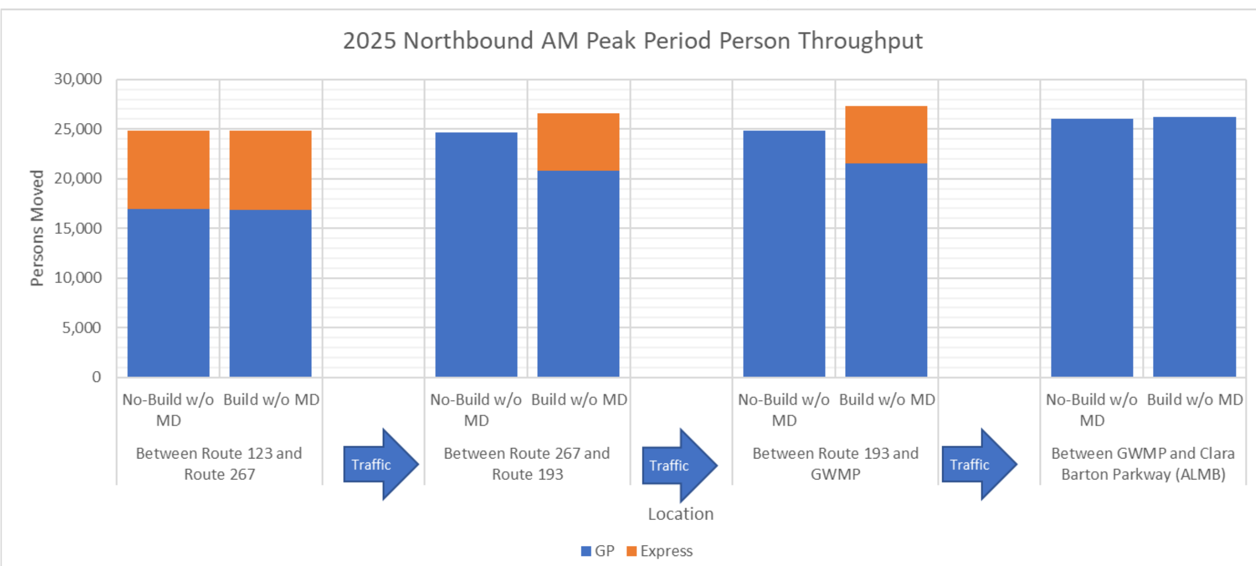


Figure 6. 2025 No Build and Build (Pre-Maryland) – AM Peak Period Person Throughput, I-495 Northbound

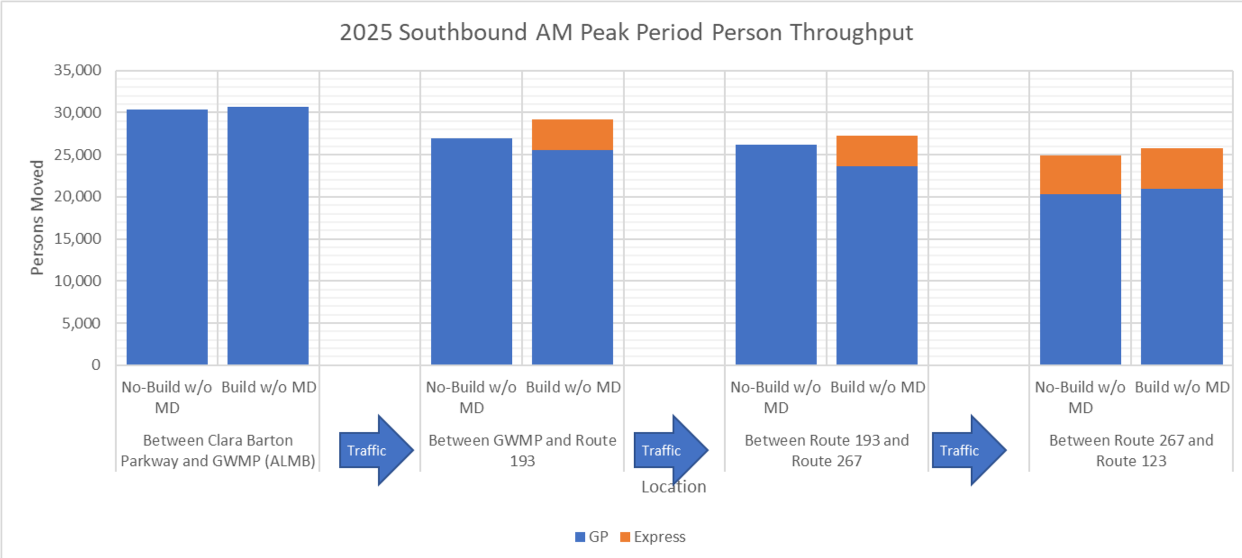


Figure 7. 2025 No Build and Build (Pre-Maryland) – AM Peak Period Person Throughput, I-495 Southbound

1.3 2025 No Build vs Build "Pre-Maryland" PM Freeway Operations

Speeds

Figure 8 provides a "heat map" comparison of average speeds between 2025 No Build (Pre-Maryland) and Build (Pre-Maryland) conditions for the PM peak period along the I-495 GP lanes. Time of day during the peak period is provided on the horizontal axis while location along the corridor is provided along the vertical axis; the colors signify average speeds for each scenario.

As illustrated in the figure, in both scenarios, in the northbound GP lanes, congestion and queueing is observed for essentially the entire peak period from Clara Barton Parkway (across the ALMB) spilling back through the extents of the Traffic Operations Study Area. Downstream external congestion from northbound I-495 in Maryland spills back early in the peak period, forming essentially a continuous end-to-end area of congestion.

In the southbound GP lanes, in both scenarios, congestion and queueing is observed north of the ALMB and back into Maryland, while limited congestion is observed south of the bridge. The bridge acts as a bottleneck, metering southbound traffic into Virginia and generally resulting in higher speeds south of the bridge. In the Build scenario, some relief to the congestion in Maryland is provided later in the peak period due to the additional capacity provided south of the ALMB; this results in additional demand being able to access downstream points and actually slightly worsens queue spillback from I-495 through Tysons at the south end of the Traffic Operations Study Area.

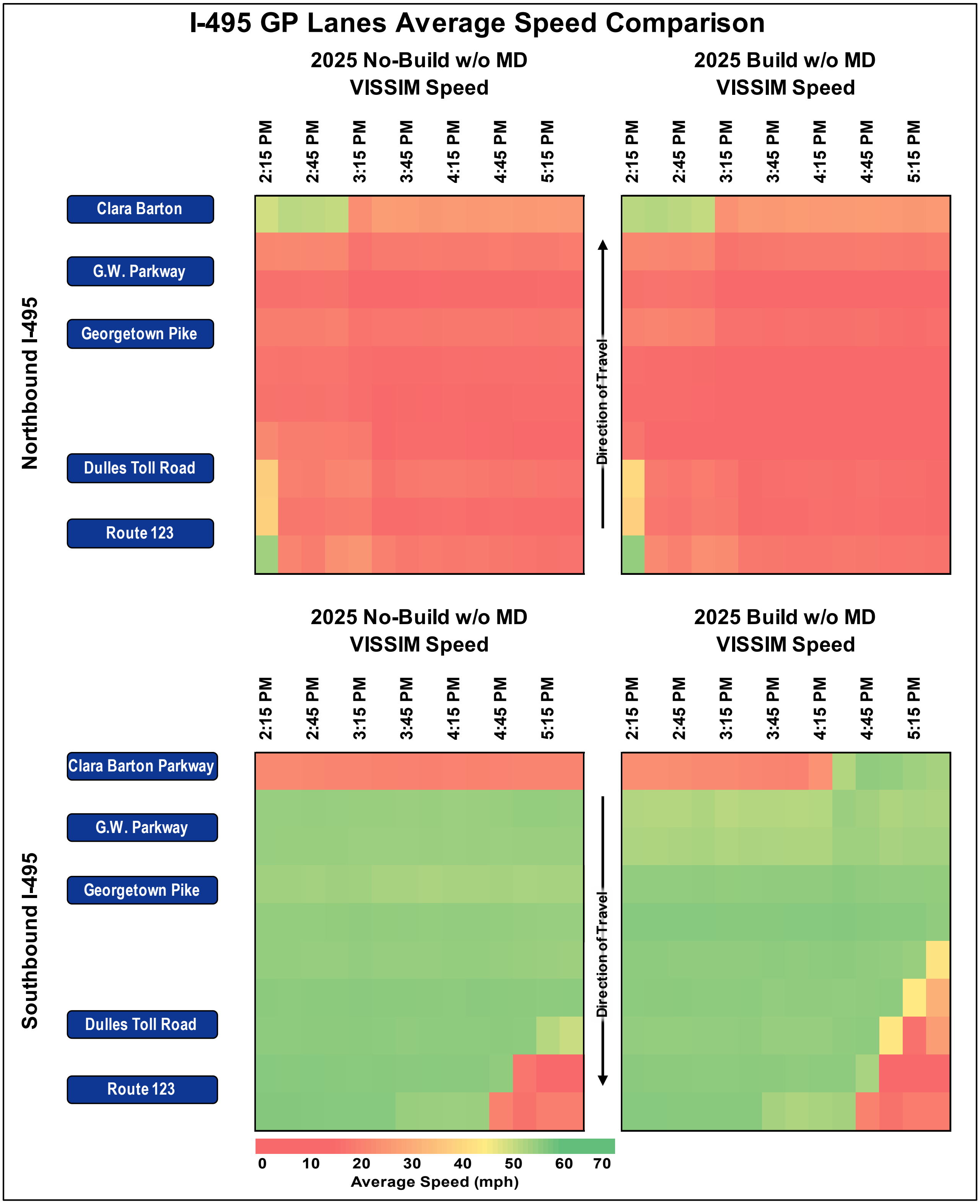


Figure 8. 2025 No Build and Build (Pre-Maryland) – PM Peak Period Average Speeds, I-495 GP Lanes

Travel Times

A comparison of PM peak period travel times for 2025 No Build (Pre-Maryland) and 2025 Build (Pre-Maryland) scenarios is shown in **Table 2**. Travel time measurements have been aggregated by direction of travel and facility type. Note that travel times are only shown south of Clara Barton Parkway.

Table 2. 2025 PM Peak Period Travel Time Comparison

Route	GP Travel Times (Minutes: Seconds)		Express Lanes Travel Times (Minutes: Seconds)	
	2025 No Build Pre-MD	2025 Build Pre-MD	2025 No Build Pre-MD	2025 Build Pre-MD
Northbound I-495 (Route 123 to Clara Barton Parkway)	31:35	37:19	20:14	7:09
Southbound I-495 (Clara Barton Parkway to Route 123)	6:22	6:49	5:13	4:39
Eastbound Route 267 (Spring Hill Road to Route 123)	1:49	1:50	-	-
Westbound Route 267 (Route 123 to Spring Hill Road)	1:52	1:50	-	-

The following observations are noted with regard to PM peak period travel times prior to the Maryland managed lanes being in place:

- The average end-to-end travel time between Route 123 and Clara Barton Parkway in the northbound GP lanes increases by approximately 6 minutes (an 18 percent deterioration) in the Build condition. This deterioration is attributable to the increased merging and weaving across the ALMB due to the left-side merge from the new northbound Express Lanes terminus. The most significant increases in travel time are for the segments between Lewinsville Road and GWMP.
- Vehicles traveling in the northbound Express Lanes see an improvement of more than 14 minutes (a 65 percent improvement). The travel time improvement in the Build condition is between Lewinsville Road and GWMP, where in the No Build condition, all vehicles are forced to travel on the congested GP lanes.
- In the southbound GP lanes, travel times from Clara Barton Parkway to Route 123 improve by approximately 30 seconds (a 7 percent improvement) in the Build condition, with nearly all of this improvement being north of GWMP; in the southbound Express Lanes, travel times also improve by approximately 30 seconds (a 11 percent improvement) in the Build condition.
- Along eastbound and westbound Route 267 (DTR), travel times are essentially identical between No Build and Build.

Person Throughput

Figure 9 and **Figure 10** display 2025 "Pre-Maryland" scenarios PM peak period person throughput along I-495 northbound and southbound, respectively (GP and Express combined). These figures show the estimated number of persons moved across a three-hour period based on simulated vehicle throughput and assumed vehicle occupancies for GP and Express Lanes. These figures show that person throughput increases in the Build scenario between Route 267 and GWMP due to the added capacity from the Express Lanes and increased occupancy of vehicles in those lanes. Across the ALMB, person throughputs are generally consistent between the No Build and Build scenarios.

- In the northbound direction, increases in throughput from No Build to Build range from 0 to 21 percent, with the greatest increase in the segments between Route 267 and GWMP where the new Express Lanes significantly add capacity. Across the ALMB, the number of persons moved during the peak period is essentially consistent between No Build and Build conditions.
- In the southbound direction, increases in throughput from No Build to Build range from 4 to 17 percent, with the greatest increases again in the segments between GWMP and Route 267 where the new Express Lanes significantly add capacity. Across the ALMB, the number of persons moved during the peak period improves slightly from No Build to Build conditions.

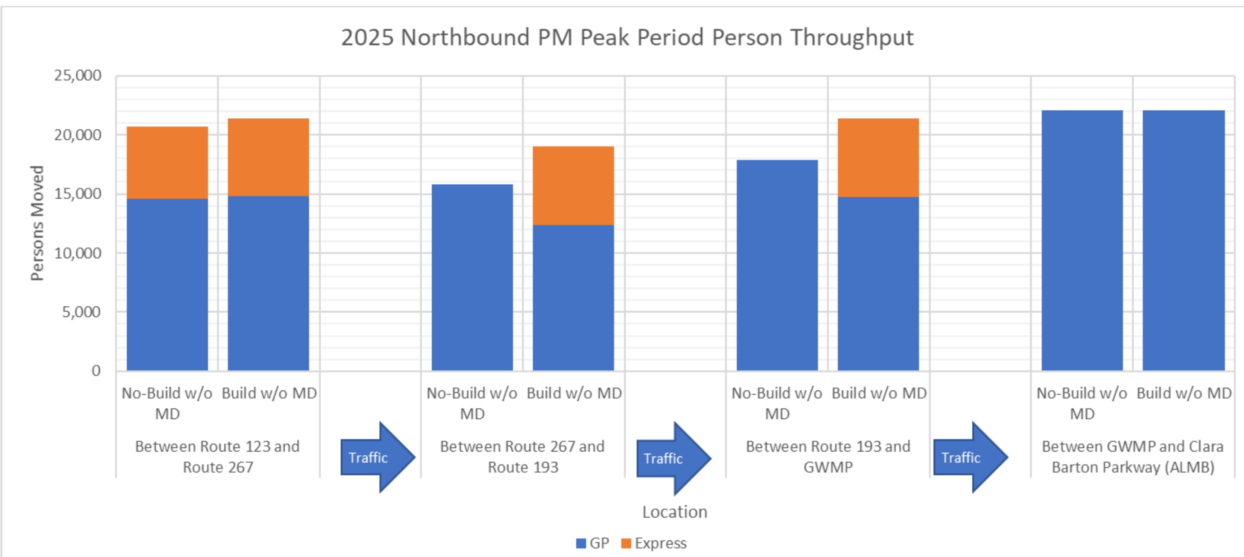


Figure 9. 2025 No Build and Build (Pre-Maryland) – PM Peak Period Person Throughput, I-495 Northbound

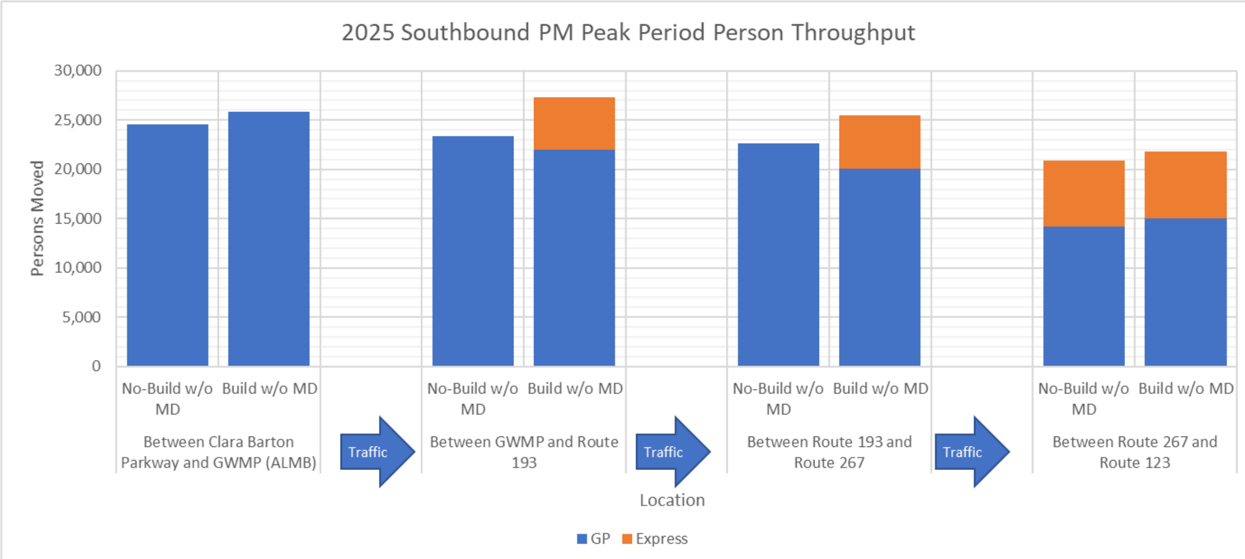


Figure 10. 2025 No Build and Build (Pre-Maryland) – PM Peak Period Person Throughput, I-495 Southbound

1.4 2025 No Build vs Build "Pre-Maryland" Arterial Operations

AM Arterial Operations

Intersections Evaluated in VISSIM

Intersections in the Traffic Operations Study Area evaluated in VISSIM generally see similar operations in the 2025 AM peak hour under both No Build and Build conditions. **Figure 11** provides pie charts of overall intersection HCM-analogous LOS for No Build and Build (Pre-Maryland) conditions. The figure shows that the Build scenario sees a lower percentage of intersections operating at failing conditions (24 percent versus 29 percent) but also sees a slightly lower percentage of intersections operating at LOS D or better (52 percent versus 59 percent).

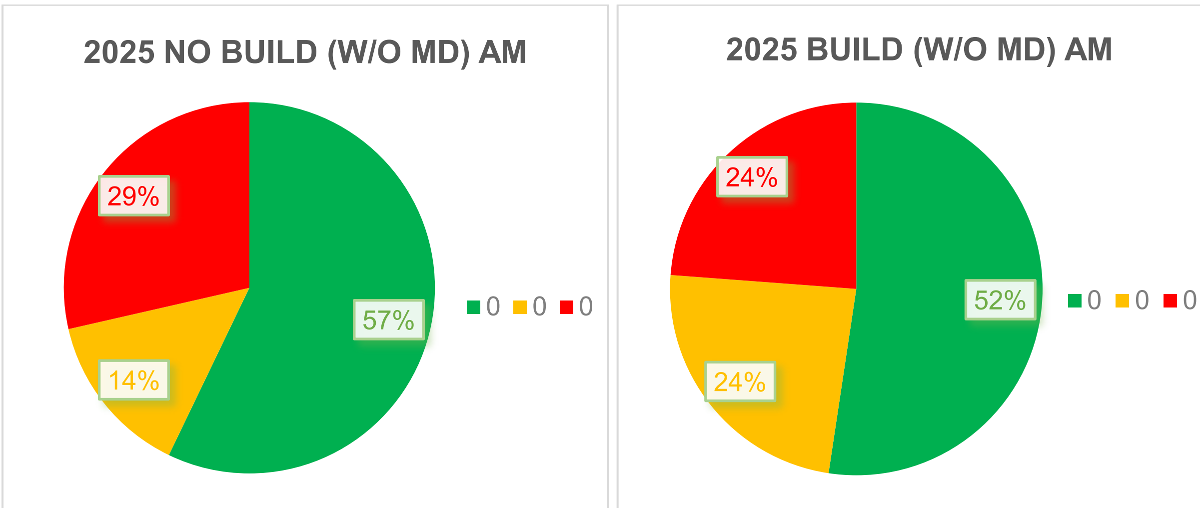


Figure 11. Summary of Arterial HCM-Analogous LOS, 2025 AM No Build vs. Build (Pre-Maryland) Conditions

The following intersections operate under failing conditions under both 2025 No Build and Build (Pre-Maryland) conditions:

- Route 123 and Capital One Tower Drive/Old Meadow Road
- Route 123 and Route 267 eastbound off-ramp/Anderson Road
- Route 123 and Lewinsville Road/Great Falls Street
- Spring Hill Road and Dulles Toll Road eastbound ramps

All of these intersections are in the Tysons area and see continued growth in demand tied to commercial and residential growth in Tysons.

The unsignalized intersection of Route 193 and Helga Place/Linganore Drive is failing under 2025 No Build conditions due to heavy delays on the southbound approach; this stop-controlled approach sees few gaps for traffic to enter the mainline Route 193 traffic stream due to heavy congestion along eastbound Route 193 (spilling back from the northbound on-ramp to I-495). In the Build scenario, this eastbound congestion along Route 193 is relieved, which reduces queue spillback on the on-ramp from Route 193.

Table 3. VISSIM Intersection Microsimulation Delay and HCM-Analogous LOS – 2025 No Build vs. Build (Pre-Maryland) AM Peak Hour

Intersection Control	Intersection	2025 No-Build		2025 Build	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS
Signalized	Route 123 and Tysons Boulevard	35.5	D	33.2	C
Signalized	Westpark Drive and Tysons Connector	21.2	C	20.8	C
Signalized	Tysons Connector and Express Lanes Ramps	13.9	B	13.7	B
Signalized	Route 123 and Capital One Tower Drive/ Old Meadow Road	95.4	F	89.0	F
Signalized	Route 123 and Scotts Crossing Boulevard/ Colshire Drive	79.4	E	79.7	E
Signalized	Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road	97.7	F	83.5	F
Signalized	Route 123 and Lewinsville Road/ Great Falls Street	148.1	F	134.5	F
Signalized	Lewinsville Road and Balls Hill Road	43.2	D	60.6	E
Signalized	Jones Branch Drive and Jones Branch Connector	17.2	B	17.9	B
Signalized	Jones Branch Connector and Express Lanes Ramps	23.0	C	22.9	C
Signalized	Jones Branch Drive and Capital One (West)	17.2	B	17.3	B
Signalized	Jones Branch Drive and Capital One (East)	5.4	A	5.3	A
Signalized	International Drive and Spring Hill Road/ Jones Branch Drive	49.7	D	51.5	D
Signalized	Spring Hill Road and Dulles Toll Road Eastbound Ramps	163.1	F	179.4	F
Signalized	Spring Hill Road and Dulles Toll Road Westbound Ramps	49.5	D	72.8	E
Signalized	Spring Hill Road and Lewinsville Road	56.4	E	59.8	E
Unsignalized	Route 193 and Helga Place/ Linganore Drive	146.0	F	44.8	E

Intersection Control	Intersection	2025 No-Build		2025 Build	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS
Signalized	Route 193 and I-495 Southbound Ramps	30.6	C	26.7	C
Signalized	Route 193 and I-495 Northbound Ramps	72.5	E	88.1	F
Signalized	Route 193 and Balls Hill Road	130.3	F	46.9	D
Unsignalized	Route 193 and Dead Run Drive	9.1	A	9.3	A

Intersections Evaluated in Synchro

The expanded arterial network beyond intersections immediately adjacent to freeway interchanges in the corridor were evaluated solely through Synchro. **Table 4** compares the overall intersection delay and LOS between the two “Pre-Maryland” scenarios for each intersection.

Under both No Build and Build (Pre-Maryland) conditions, the following intersections are failing:

- Old Dominion Drive and Balls Hill Road (signalized)
- Route 193 and Swinks Mill Road (unsignalized)
- Route 193 and Douglass Drive (unsignalized)

Note that under Build conditions, while the two unsignalized intersections along Route 193 are experiencing failing conditions due to significant delays on stop-controlled approaches, a significant reduction in delay is achieved compared to No Build conditions.

Table 4. 2025 Synchro Intersection Delay and LOS – 2025 No Build vs. Build (Pre-Maryland) AM Peak Hour

Intersection Control	Intersection Name	2025 No Build Pre-MD		2025 Build Pre-MD	
		Intersection Delay (Sec/veh)	LOS	Intersection Delay (Sec/veh)	LOS
Signalized	Old Dominion Drive at Spring Hill Road	10.9	B	10.9	B
Signalized	Old Dominion Drive at Swinks Mill Road	16.2	B	16.2	B
Signalized	Old Dominion Drive at Balls Hill Road	101.5	F	101.5	F
Signalized	Route 123 at Old Dominion Drive	43.2	D	43.2	D
Unsignalized	Route 193 at Swinks Mill Road	213.3	F	78.3	F
Unsignalized	Route 193 at Spring Hill Road	17.7	C	16.1	C
Unsignalized	Lewinsville Road at Swinks Mill Road	8.9	A	8.9	A
Unsignalized	Route 123 at Ingleside Avenue	20	C	19.2	C
Unsignalized	Douglass Drive at Route 19	153.7	F	105.3	F

PM Arterial Operations

Intersections Evaluated in VISSIM

Intersections in the Traffic Operations Study Area evaluated in VISSIM generally see slightly improved operations in the 2025 PM peak hour in the Build scenario as compared to the No Build scenario. **Figure 12** provides pie charts of overall intersection HCM-analogous LOS for No Build and Build (Pre-Maryland) conditions. The figure shows, under Build conditions 28 percent of intersections are at LOS F while 38 percent are at LOS F under No Build conditions. Additionally, 48 percent intersections are LOS D or better in the Build condition, while only 43 percent are at LOS D or better in the No Build condition.

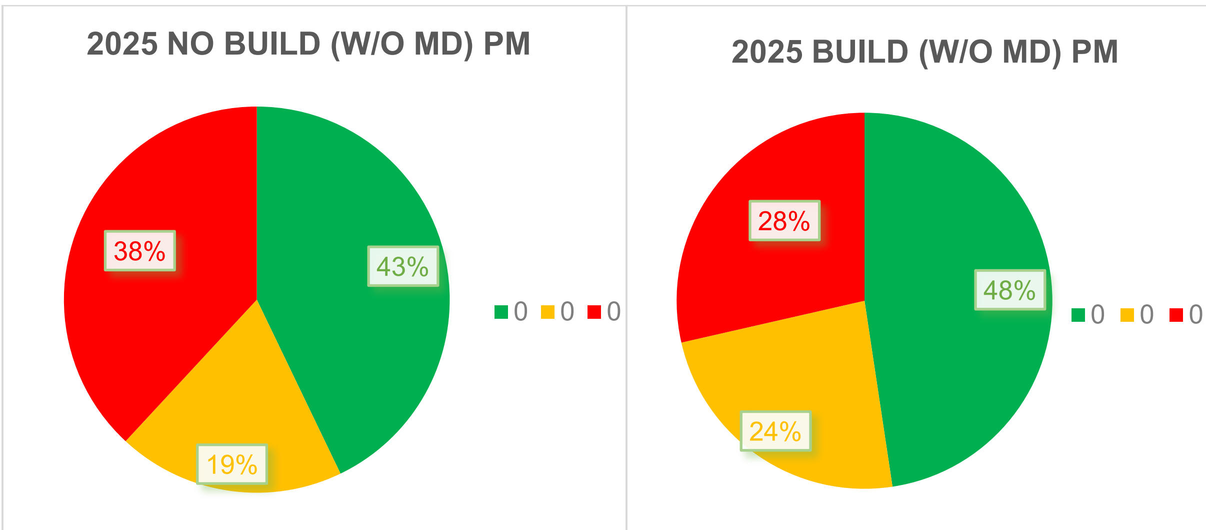


Figure 12. Summary of Arterial HCM-Analogous LOS, 2025 PM No Build vs. Build (Pre-Maryland) Conditions

Table 5 compares the overall intersection HCM-analogous LOS between the two scenarios for each intersection. The following intersections operate under failing conditions under both 2025 No Build and Build (Pre-Maryland) conditions:

- Route 123 and Tysons Boulevard
- Route 123 and Lewinsville Road/Great Falls Street
- Lewinsville Road and Balls Hill Road
- Route 193 and Balls Hill Road
- Route 193 and Dead Run Drive (unsignalized)

The first three listed failing intersections are in the Tysons area and see continued growth in demand tied to commercial and residential growth in Tysons. Additionally, the intersection of Route 123 and Capital One Tower Drive / Old Meadow Road is failing under No Build conditions but not under Build conditions.

The unsignalized intersection of Route 193 and Helga Place/Linganore Drive is failing under 2025 No Build conditions due to heavy delays on the southbound approach; this stop-controlled approach sees few gaps for traffic to enter the mainline Route 193 traffic stream due to heavy congestion in along eastbound Route 193 (spilling back from the northbound on-ramp to I-495). In the Build scenario, this eastbound congestion along Route 193 is relieved due to improved operations along northbound I-495, which reduces queue spillback on the on-ramp from Route 193. All intersections along Route 193 see a reduction in delay in the Build scenario as compared to the No Build scenario.

Table 5. VISSIM Intersection Microsimulation Delay and HCM-Analogous LOS – 2025 No Build vs. Build (Pre-Maryland) PM Peak Hour

Intersection Control	Intersection	2025 No-Build		2025 Build	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS
Signalized	Route 123 and Tysons Boulevard	174.9	F	169.9	F
Signalized	Westpark Drive and Tysons Connector	11.3	B	10.0	A
Signalized	Tysons Connector and Express Lanes Ramps	7.4	A	7.5	A
Signalized	Route 123 and Capital One Tower Drive/ Old Meadow Road	143.0	F	76.3	E
Signalized	Route 123 and Scotts Crossing Boulevard/ Colshire Drive	67.8	E	56.4	E
Signalized	Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road	75.8	E	72.4	E
Signalized	Route 123 and Lewinsville Road/ Great Falls Street	114.5	F	115.1	F
Signalized	Lewinsville Road and Balls Hill Road	116.7	F	117.8	F
Signalized	Jones Branch Drive and Jones Branch Connector	15.9	B	16.0	B
Signalized	Jones Branch Connector and Express Lanes Ramps	25.9	C	26.1	C
Signalized	Jones Branch Drive and Capital One (West)	20.4	C	20.2	C
Signalized	Jones Branch Drive and Capital One (East)	6.9	A	7.0	A
Signalized	International Drive and Spring Hill Road/ Jones Branch Drive	73.9	E	94.1	F
Signalized	Spring Hill Road and Dulles Toll Road Eastbound Ramps	17.7	B	19.5	B
Signalized	Spring Hill Road and Dulles Toll Road Westbound Ramps	35.1	D	41.5	D
Signalized	Spring Hill Road and Lewinsville Road	73.9	E	76.2	E

Intersection Control	Intersection	2025 No-Build		2025 Build	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS
Unsignalized	Route 193 and Helga Place/ Linganore Drive	311.0	F	20.0	E
Signalized	Route 193 and I-495 Southbound Ramps	37.4	D	26.4	C
Signalized	Route 193 and I-495 Northbound Ramps	89.3	F	68.9	E
Signalized	Route 193 and Balls Hill Road	454.1	F	258.4	F
Unsignalized	Route 193 and Dead Run Drive	1,256.9	F	812.6	F

Intersections Evaluated in Synchro

The expanded arterial network beyond intersections immediately adjacent to freeway interchanges in the corridor was evaluated solely through Synchro. **Table 6** compares the overall intersection delay and LOS between the two "Pre-Maryland" scenarios for each intersection.

Under both No Build and Build (Pre-Maryland) conditions, the following intersections are failing:

- Old Dominion Drive and Balls Hill Road (signalized)
- Route 193 and Douglass Drive (unsignalized)

These intersections are both also failing in the 2025 AM peak hour under both No Build and Build (Pre-Maryland) conditions. Note that under Build conditions, while the intersection of Route 193 and Douglass Drive is still failing, a significant reduction in delay is achieved as compared to No Build conditions.

Table 6. 2025 Synchro Intersection Delay and LOS – 2025 No Build vs. Build (Pre-Maryland) PM Peak Hour

Intersection Control	Intersection Name	2025 No Build Pre-MD		2025 Build Pre-MD	
		Intersection Delay (Sec/veh)	LOS	Intersection Delay (Sec/veh)	LOS
Signalized	Old Dominion Drive at Spring Hill Road	10.8	B	10.8	B
Signalized	Old Dominion Drive at Swinks Mill Road	12.1	B	12.1	B
Signalized	Old Dominion Drive at Balls Hill Road	189.4	F	189.4	F
Signalized	Route 123 at Old Dominion Drive	41.9	D	41.6	D
Unsignalized	Route 193 at Swinks Mill Road	23.4	C	17.9	C
Unsignalized	Route 193 at Spring Hill Road	13.3	B	12.9	B

Intersection Control	Intersection Name	2025 No Build Pre-MD		2025 Build Pre-MD	
		Intersection Delay (Sec/veh)	LOS	Intersection Delay (Sec/veh)	LOS
Unsignalized	Lewinsville Road at Swinks Mill Road	26.6	D	26.6	D
Unsignalized	Route 123 at Ingleside Avenue	24.9	C	24.8	C
Unsignalized	Douglass Drive at Route 193	280.2	F	181	F

1.5 Summary of 2025 No Build and Build "Pre-Maryland" Operations

2025 AM Peak Period Summary

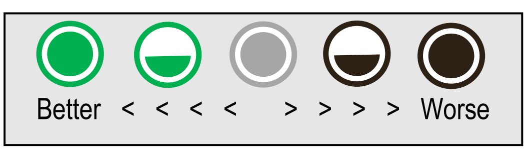
- Total demand along I-495 (GP plus Express) is forecasted to increase in the Build scenario along the length of the I-495 corridor. The greatest increases in demand are in the segments between Route 267 and GWMP, where Express Lanes are only present in the Build scenario and thus represent a substantial capacity increase from No Build conditions. Peak hour volumes are forecasted to increase in the Build scenario by between 1 to 8 percent in the northbound direction and between 1 to 4 percent in the southbound direction. In the "No Maryland" scenarios, capacity is constrained across the ALMB given the assumption of the Express Lanes terminating south of the bridge.
- In the northbound direction along the I-495 GP lanes, congestion and queueing is observed in both scenarios from Clara Barton Parkway (across the ALMB) spilling back to the Route 267 interchange. The onset of congested speeds is observed to be slightly earlier during the Build scenario, resulting in a longer duration of congestion and longer queue spillback during the peak period. In the both scenarios, the observed northbound GP congestion is attributable to weaving and merging across the ALMB, including the heavy on-ramp movement from GWMP as well as the on-ramp from Route 193. In the Build condition, there is an additional left-side merge just south of the ALMB for the terminus of the northbound Express Lanes; this creates additional merging and weaving across the bridge (the section of the facility that is already experiencing the highest demand), worsening upstream congestion. Additionally, in the Build scenario, due to the new Express Lanes being in place between Route 267 and GWMP, the left-side shoulder lane which is typically open to traffic during this period (and is assumed to be open in the No Build scenario) is no longer open. This results in more rapid onset of queue spillback south of Route 193 in the Build scenario. Overall end-to-end travel times between Route 123 and Clara Barton Parkway in the northbound GP lanes increase by approximately 4 minutes (a 39 percent deterioration) in the Build condition. The most significant increases in travel time are for the segments between Lewinsville Road and GWMP.
- In the southbound direction along the I-495 GP lanes, congestion and queueing is observed north of the ALMB and back into Maryland, while limited congestion is observed south of the bridge. The bridge acts as a bottleneck, metering southbound traffic into Virginia and generally resulting in higher speeds south of the bridge. Travel times are essentially consistent between the No Build and Build conditions.
- Both directions of the Express Lanes operate at or near the posted speed limit, with the exceptions of the termini segments which much merge into the GP lanes. To travel the length of the corridor via Express Lanes under No Build conditions, vehicles must utilize the congested GP lanes between Route 267 and GWMP as Express Lanes are not present; all vehicles must use the GP lanes north of GWMP in both scenarios. End-to-end trips between Route 123 and Clara Barton Parkway using the Express Lanes in the northbound direction are 4 minutes faster in the Build scenario (44 percent improvement) and in the southbound direction are approximately 30 seconds faster in the Build scenario (8 percent improvement).
- Along eastbound Route 267 (DTR), there is 23 percent deterioration in travel time in the Build condition. Along westbound DTR, travel times are essentially identical between No Build and Build.

- Over the course of the AM peak period, total persons moved along I-495 are forecasted to increase from No Build to Build conditions by between 0 and 10 percent in the northbound direction and between 1 and 8 percent in the southbound direction, depending upon location along the corridor. Person throughput increases in the Build scenario between Route 267 and GWMP due to the added capacity from the Express Lanes and increased occupancy of vehicles in those lanes. Across the ALMB, person throughputs are generally consistent between the No Build and Build scenarios.
- Arterial intersection operations remain generally consistent between No Build and Build conditions in the AM peak period. The Build scenario sees a lower percentage of intersections operating at failing conditions (24 percent versus 29 percent) but also sees a slightly lower percentage of intersections operating at LOS D or better (52 percent versus 59 percent). Most of the failing intersections are in the Tysons area and see continue growth in demand tied to commercial and residential growth in Tysons.

Table 7 presents an overall performance comparison table for the Build alternative versus the No Build alternative for 2025 AM conditions prior to the Maryland managed lanes system being in place.

Table 7. Overall Performance Comparison for 2025 AM No Build and Build Alternative Prior to Maryland Managed Lanes System Being in Place

Measure of Effectiveness	Description	Facility	2025 AM No Build Value	2025 AM Build Value	Build Performance Compared to No Build
Travel Times	End-to-end travel time along the facility through the Traffic Operations Study Area, measured in Minutes	I-495 NB GP	10	14	
		I-495 NB Express	10	5	
		I-495 SB GP	5	5	
		I-495 SB Express	5	4	
		Dulles Toll Road EB	3	4	
		Dulles Toll Road WB	2	2	
Extent and Duration of Congestion	Visual assessment of freeway mainline queue length and duration of congestion	I-495 NB GP			
		I-495 SB GP			
Person Throughput	Additional persons moved during peak period of Build condition and percentage increase	I-495 NB (All)	+2,400 (10%)		
		I-495 SB (All)	+2,300 (8%)		
Arterial Operations	Number of intersections operating at LOS F	Entire Study Area	9	8	
	Number of intersections operating at LOS D or better		18	17	



2025 PM Peak Period Summary

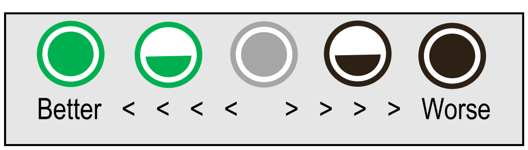
- Total demand along I-495 (GP plus Express) is forecasted to increase in the Build scenario along the length of the I-495 corridor. The greatest increases in demand are in the segments between Route 267 and GWMP, where Express Lanes are only present in the Build scenario and thus represent a substantial capacity increase from No Build conditions. Peak hour volumes are forecasted to increase in the Build scenario by between 1 to 18 percent in the northbound direction and between 1 to 4 percent in the southbound direction. In the "Pre-Maryland" scenarios, capacity is constrained across the ALMB given the assumption of the Express Lanes terminating south of the bridge.
- In the northbound direction along the I-495 GP lanes, congestion and queueing is observed in both scenarios for essentially the entire peak period from Clara Barton Parkway (across the ALMB) spilling back through the extents of the Traffic Operations Study Area. Downstream external congestion from northbound I-495 in Maryland spills back early in the peak period, forming essentially a continuous end-to-end area of congestion. The average end-to-end travel time between Route 123 and Clara Barton Parkway in the northbound GP lanes increases by approximately 6 minutes (an 18 percent deterioration) in the Build condition. This deterioration is attributable to the increased merging and weaving across the ALMB due to the left-side merge from the new northbound Express Lanes terminus. The most significant increases in travel time are for the segments between Lewinsville Road and GWMP.
- In the southbound direction along the I-495 GP lanes, congestion and queueing is observed in both scenarios north of the ALMB and back into Maryland, while limited congestion is observed south of the bridge. The bridge acts as a bottleneck, metering southbound traffic into Virginia and generally resulting in higher speeds south of the bridge. In the Build scenario, some relief to the congestion in Maryland is provided later in the peak period due to the additional capacity provided south of the ALMB. Travel times from Clara Barton Parkway to Route 123 improve by approximately 30 seconds (a 7 percent improvement) in the Build condition, with nearly all of this improvement being north of GWMP.
- Both directions of the Express Lanes operate at or near the posted speed limit, with the exceptions of the termini segments which much merge into the GP lanes. To travel the length of the corridor via Express Lanes under No Build conditions, vehicles must utilize the congested GP lanes between Route 267 and GWMP as Express Lanes are not present; all vehicles must use the GP lanes north of GWMP in both scenarios. End-to-end trips between Route 123 and Clara Barton Parkway using the Express Lanes in the northbound direction are 14 minutes faster in the Build scenario (65 percent improvement) and in the southbound direction are 30 seconds faster in the Build scenario (11 percent improvement).
- Along eastbound and westbound Route 267 (DTR), travel times are essentially identical between No Build and Build.
- Over the course of the PM peak period, total persons moved along I-495 are forecasted to increase from No Build to Build conditions by between 0 and 21 percent in the northbound direction and between 4 and 17 percent in the southbound direction, depending upon location along the corridor. Person throughput increases in the Build scenario between Route 267 and GWMP due to the added capacity from the Express Lanes and increased occupancy of vehicles in those lanes. Across the ALMB, person throughputs are generally consistent between the No Build and Build scenarios.

- Arterial intersection operations see an improvement under Build conditions, as the percentage of intersections operating at failing conditions drops from 38 percent (No Build) to 28 percent (Build), and 48 percent of intersections are LOS D or better in the Build condition, while only 43 percent are at LOS D or better in the No Build condition. Most of the failing intersections are in the Tysons area and see continue growth in demand tied to commercial and residential growth in Tysons. Along Route 193, all intersections see a reduction in delay in the Build scenario compared to the No Build scenario.

Table 8 presents an overall performance comparison table for the Build alternative versus the No Build alternative for 2025 PM conditions prior to the Maryland managed lanes system being in place.

Table 8. Overall Performance Comparison for 2025 PM No Build and Build Alternative Prior to Maryland Managed Lanes System Being in Place

Measure of Effectiveness	Description	Facility	2025 AM No Build Value	2025 AM Build Value	Build Performance Compared to No Build
Travel Times	End-to-end travel time along the facility through the Traffic Operations Study Area, measured in Minutes	I-495 NB GP	32	37	
		I-495 NB Express	20	7	
		I-495 SB GP	6.5	7	
		I-495 SB Express	5	4.5	
		Dulles Toll Road EB	2	2	
		Dulles Toll Road WB	2	2	
Extent and Duration of Congestion	Visual assessment of freeway mainline queue length and duration of congestion	I-495 NB GP			
		I-495 SB GP			
Person Throughput	Additional persons moved during peak period of Build condition and percentage increase	I-495 NB (All)	+3,300 (21%)		
		I-495 SB (All)	+3,900 (17%)		
Arterial Operations	Number of intersections operating at LOS F	Entire Study Area	10	8	
	Number of intersections operating at LOS D or better		16	16	



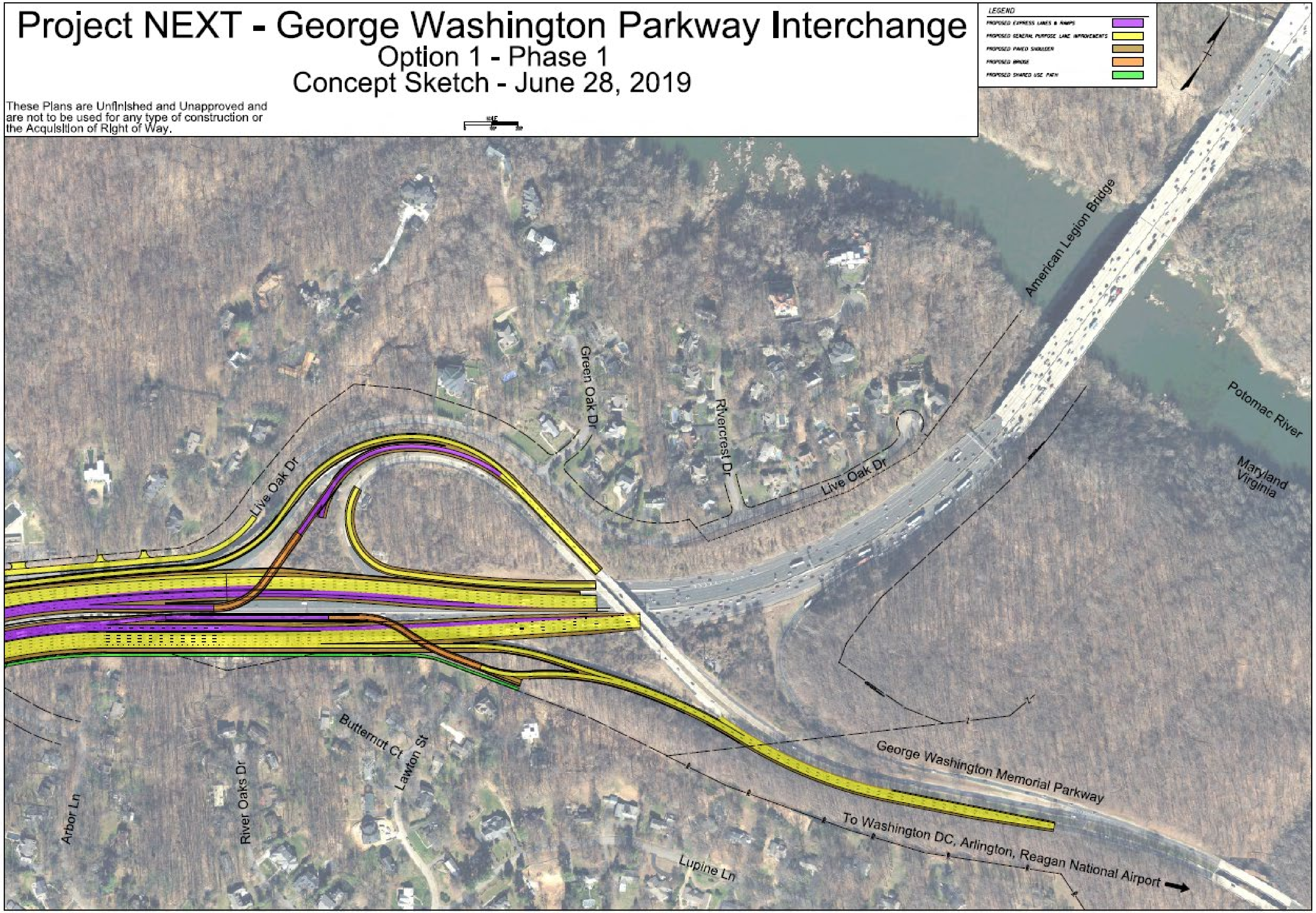


Exhibit 1. 2025 Build Pre-Maryland Managed Lanes Northern Terminus Concept

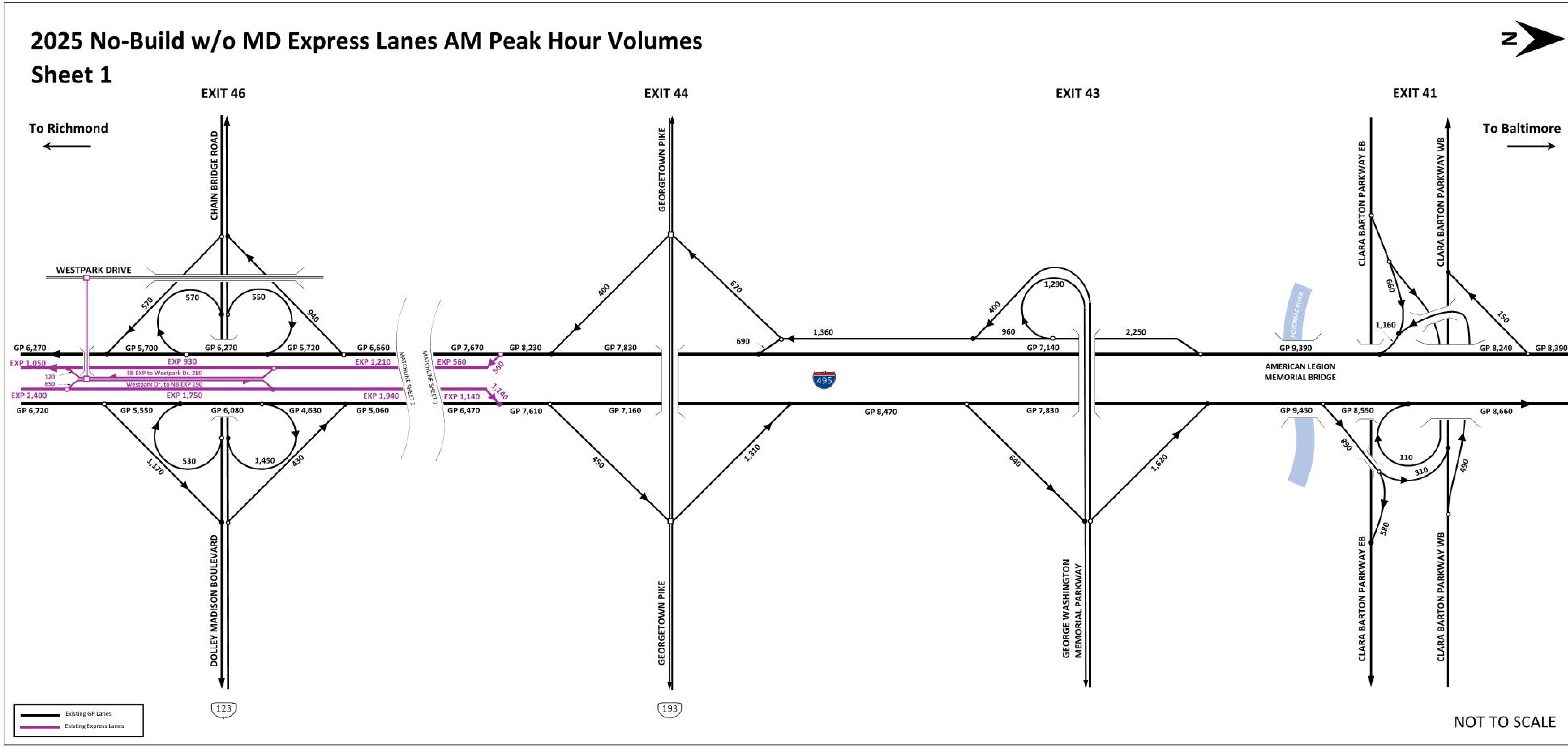


Exhibit 2a. Freeway 2025 No Build (Pre-Maryland Managed Lanes) AM Peak Hour Volume – I-495

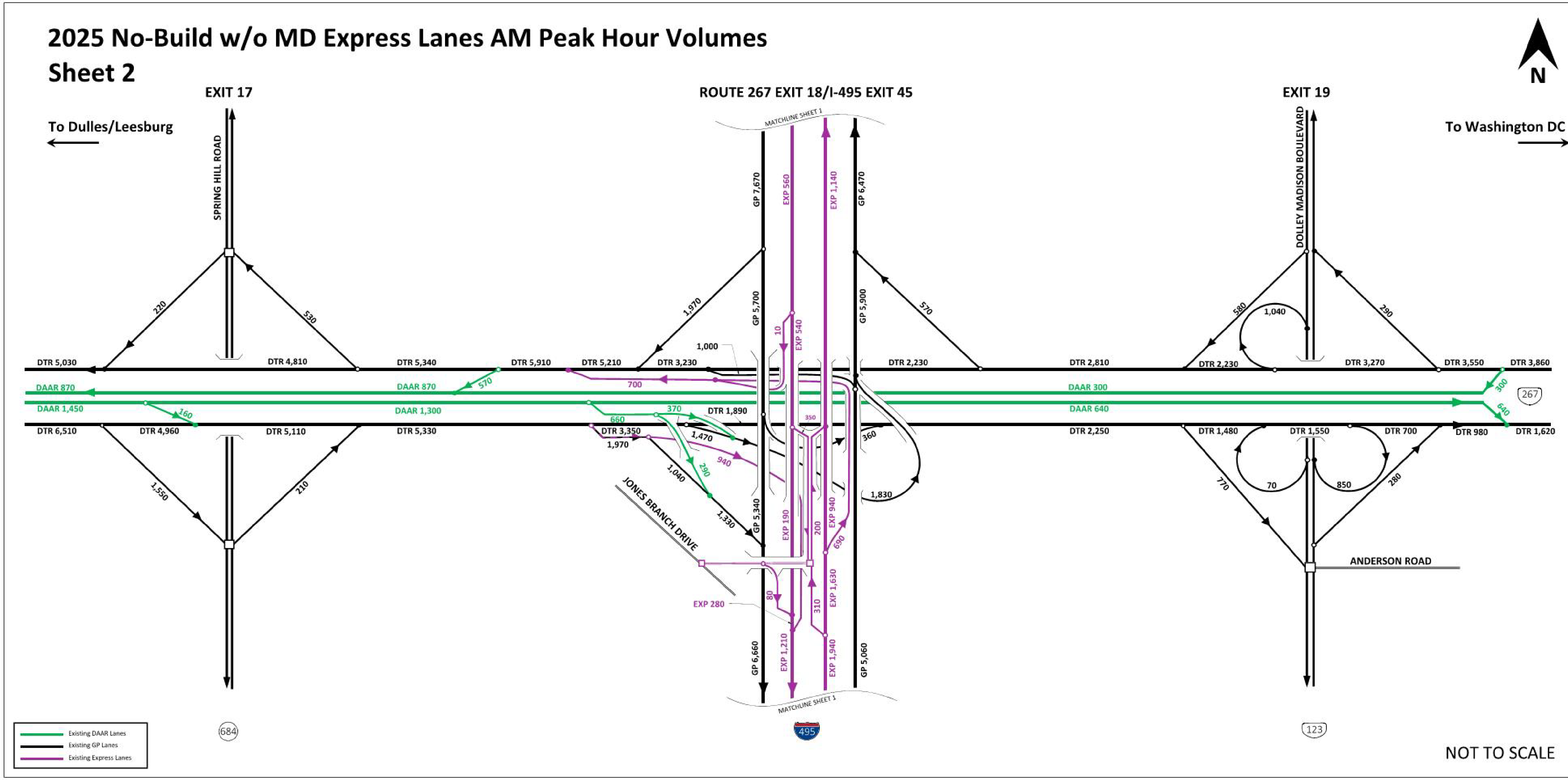


Exhibit 2b. Freeway 2025 No Build (Pre-Maryland Managed Lanes) AM Peak Hour Volume – Route 267

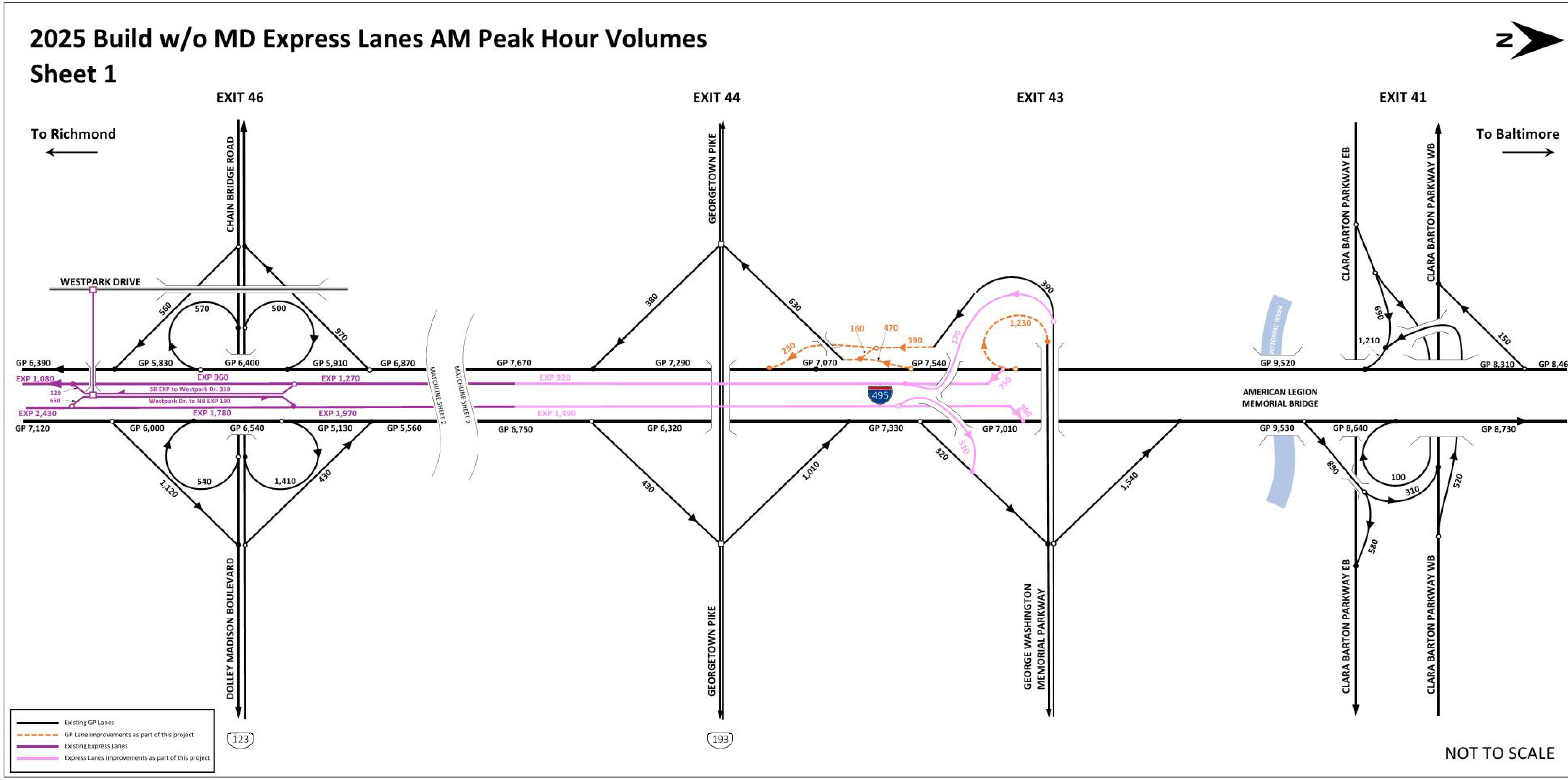


Exhibit 3a. Freeway 2025 Build (Pre-Maryland Managed Lanes) AM Peak Hour Volume – I-495

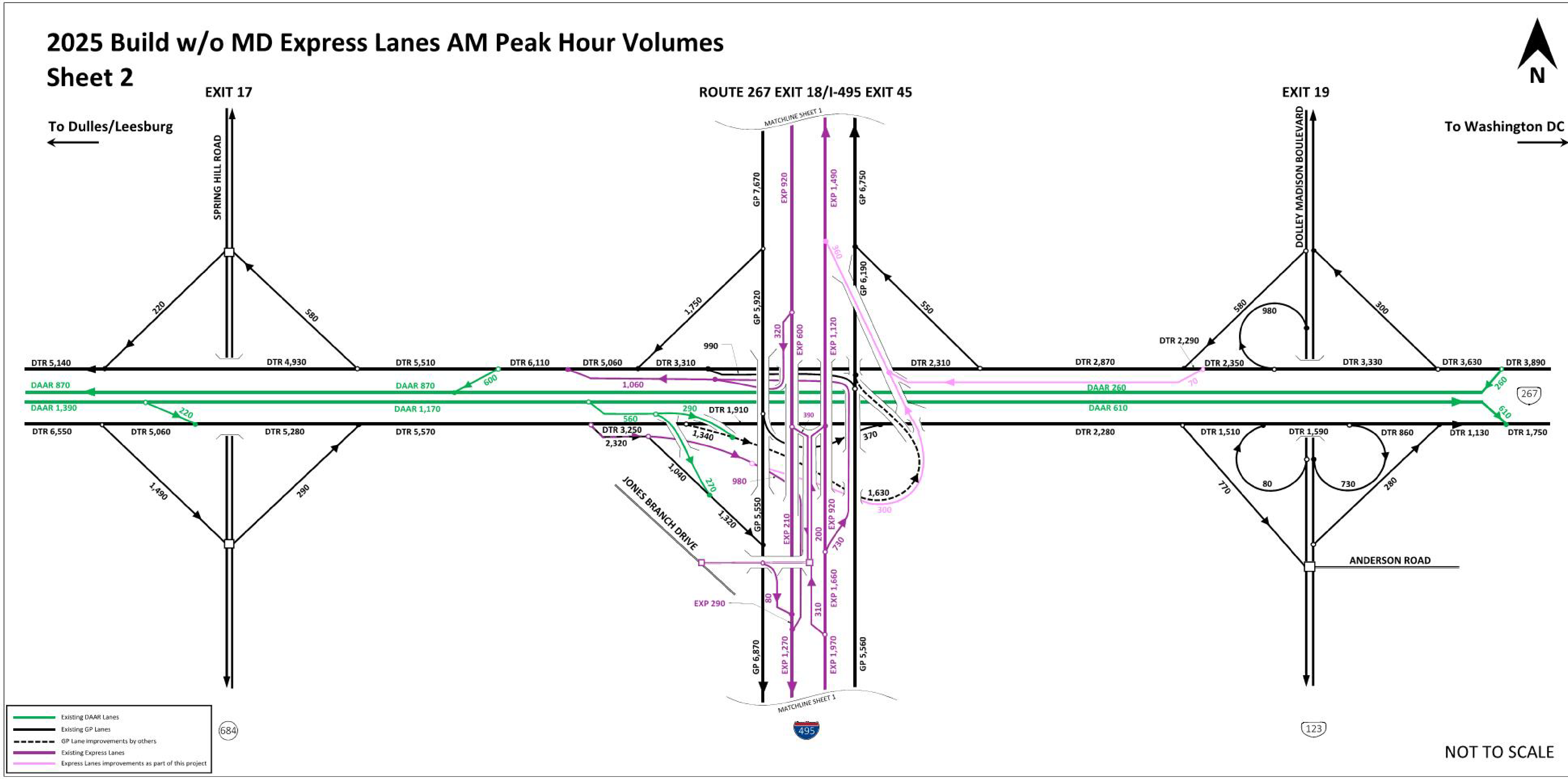


Exhibit 3b. Freeway 2025 Build (Pre-Maryland Managed Lanes) AM Peak Hour Volume – Route 267

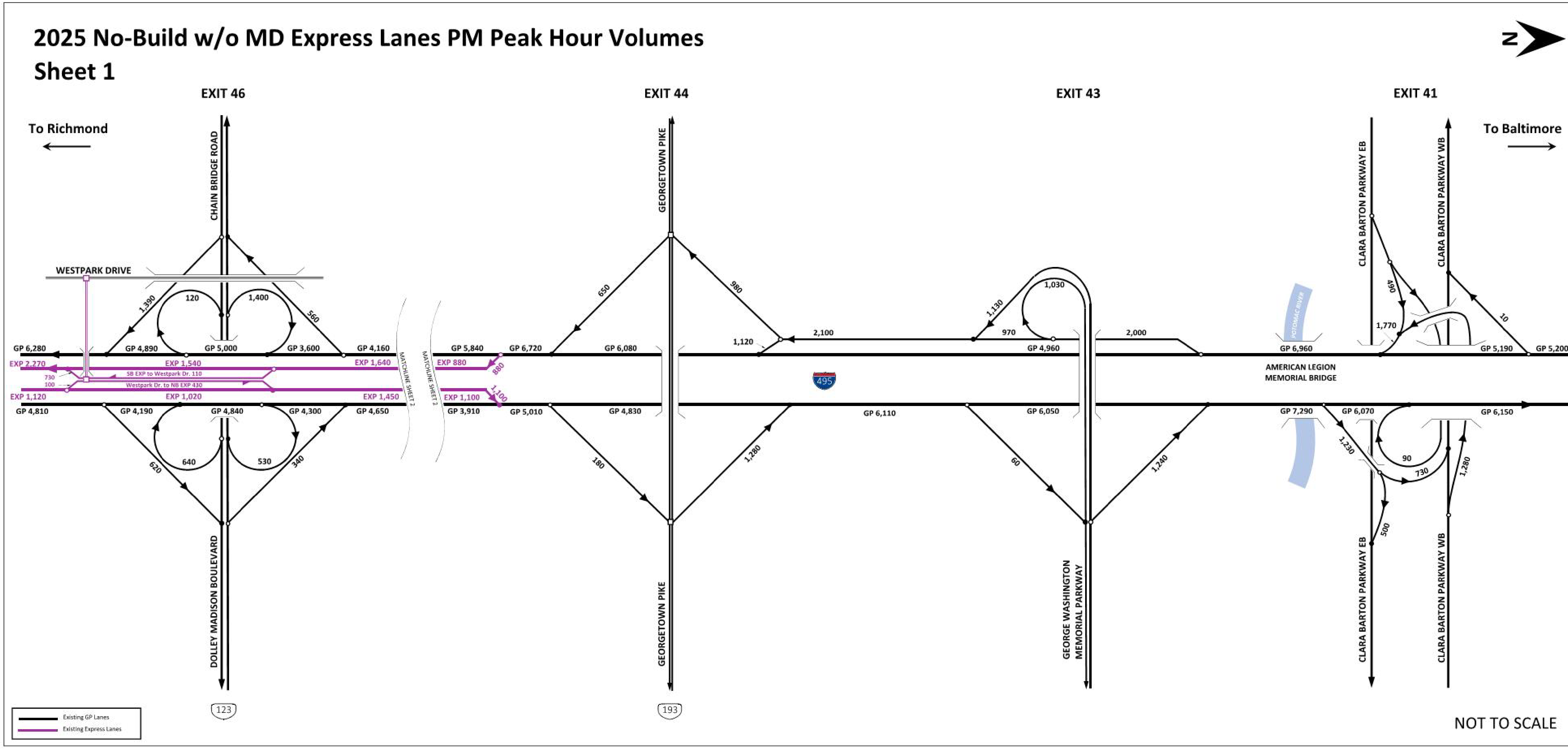


Exhibit 4a. Freeway 2025 No-Build (Pre-Maryland Managed Lanes) PM Peak Hour Volume – I-495

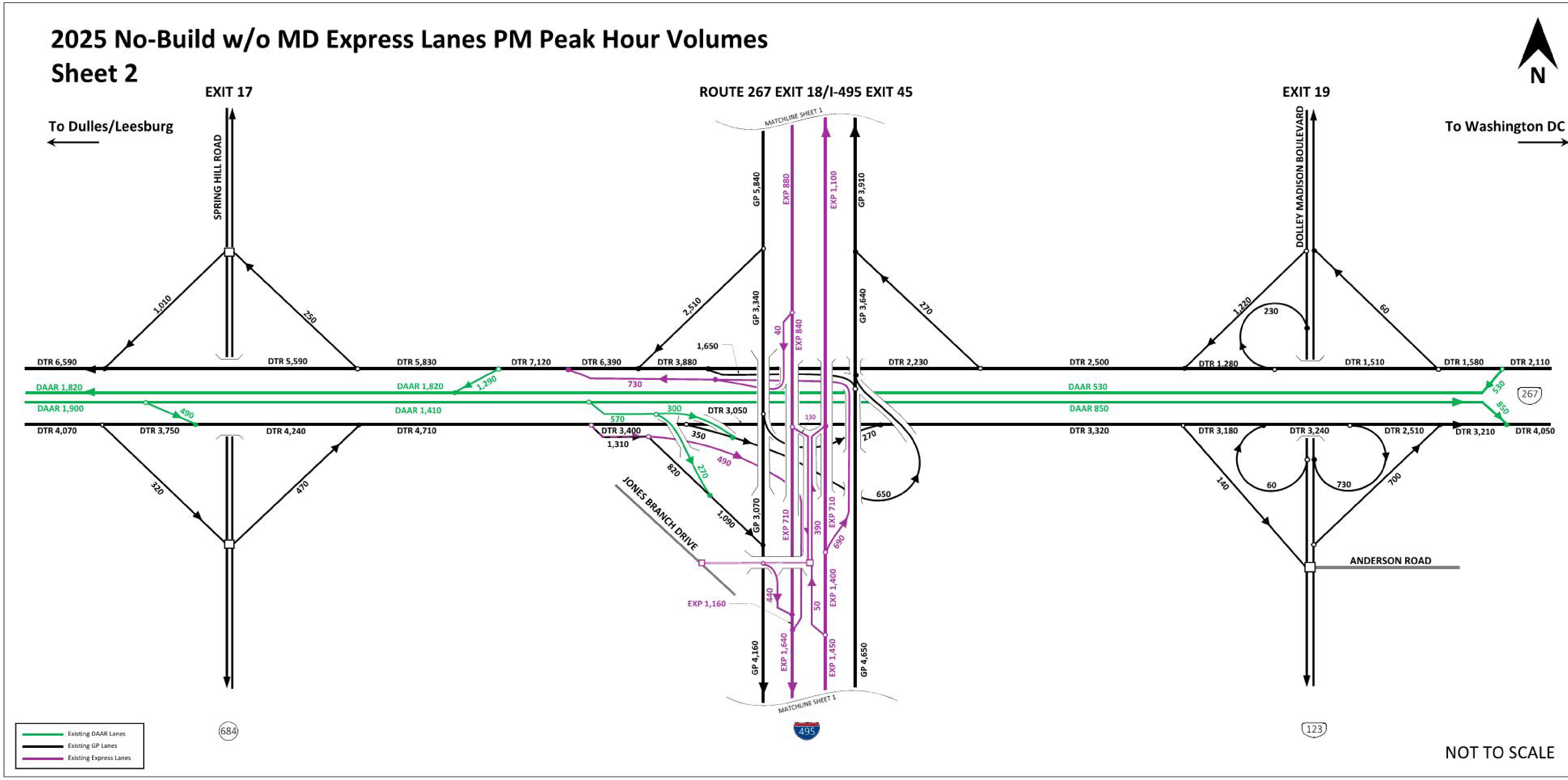


Exhibit 4b. Freeway 2025 No-Build (Pre-Maryland Managed Lanes) PM Peak Hour Volume – Route 267

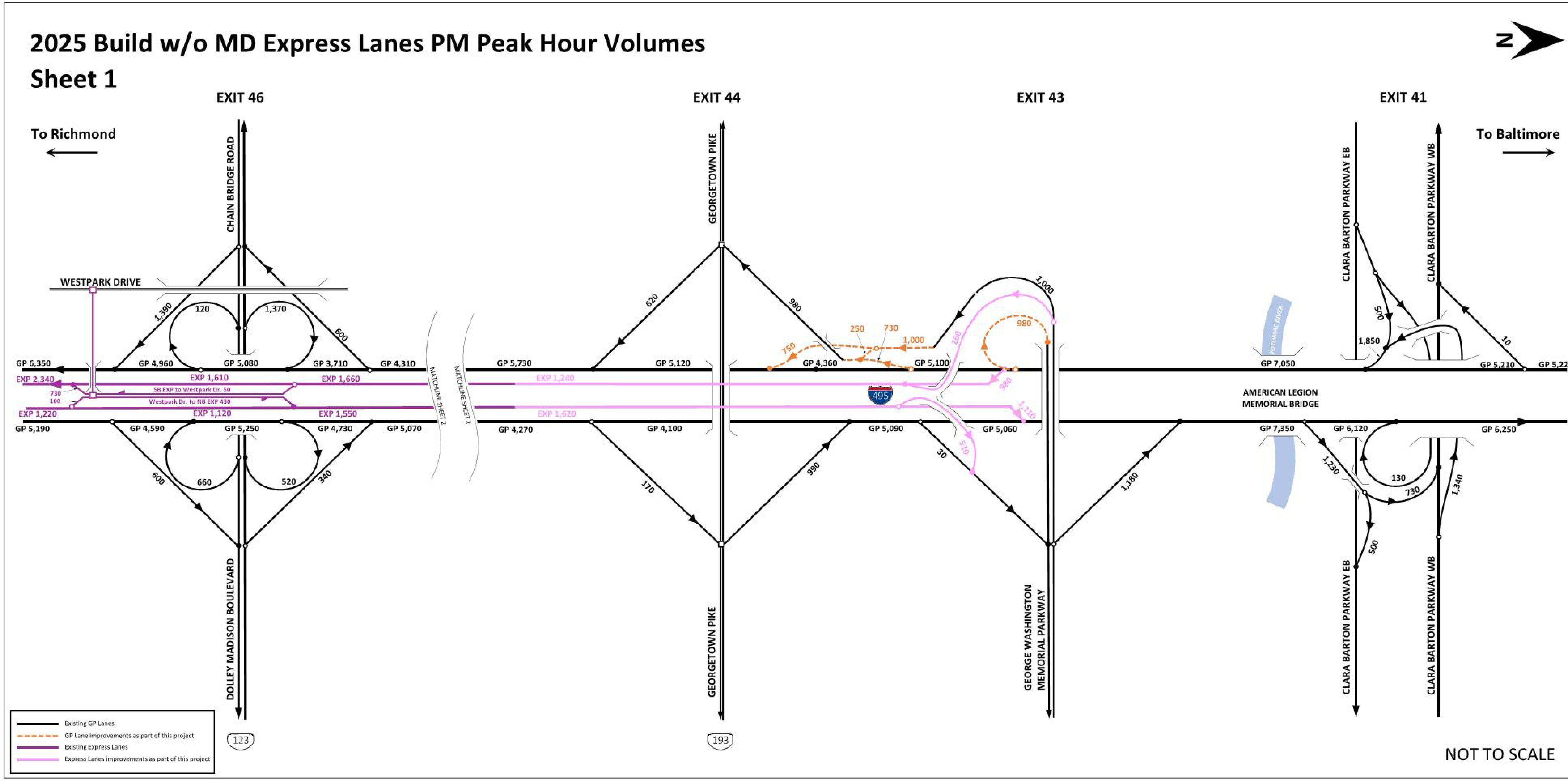


Exhibit 5a. Freeway 2025 Build (Pre-Maryland Managed Lanes) PM Peak Hour Volume – I-495

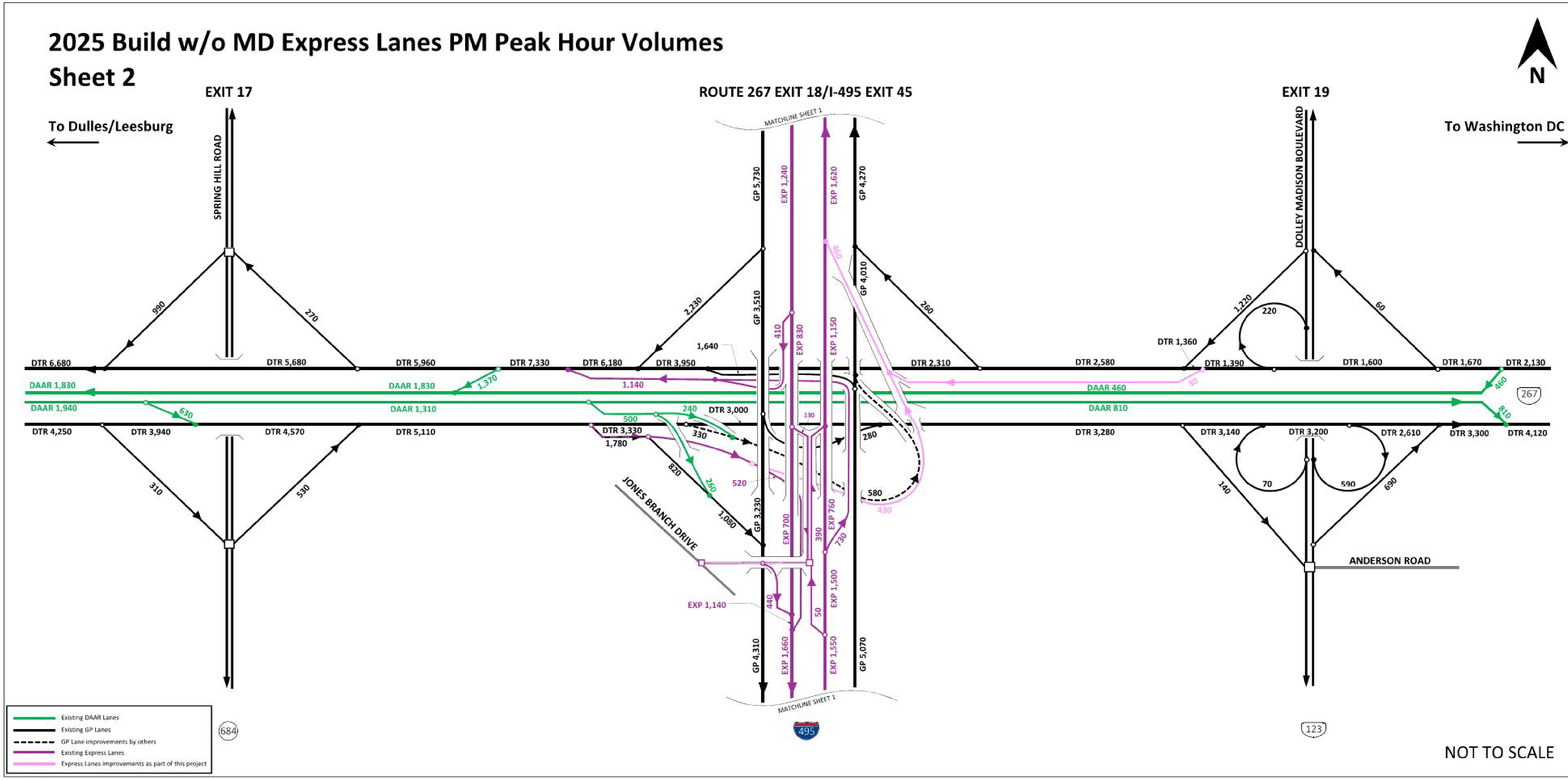
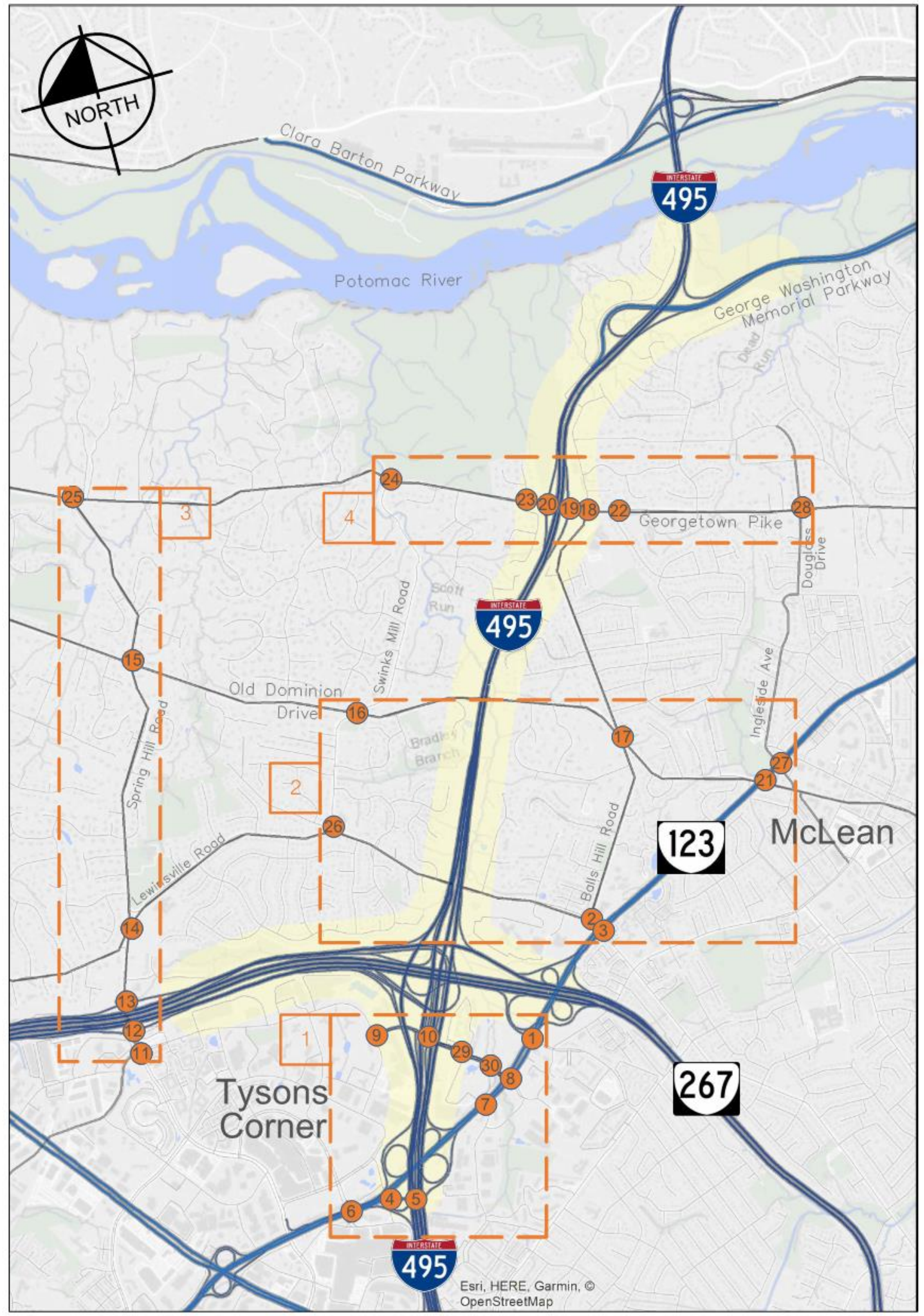


Exhibit 5b. Freeway 2025 Build (Pre-Maryland Managed Lanes) PM Peak Hour Volume – Route 267



VDOT Virginia Department of Transportation

Legend

- X Intersection Group Number
- X Intersection Number
- Project Study Area

495 ExpressLanes NORTHERN EXTENSION

AM (PM) Peak Hour 2025 No-Build without MD Intersection Volumes

FIGURE KEY

Exhibit 6a. Arterial 2025 No Build (Pre-Maryland Managed Lanes) Peak Hour Turning Movement Volumes – Figure Key

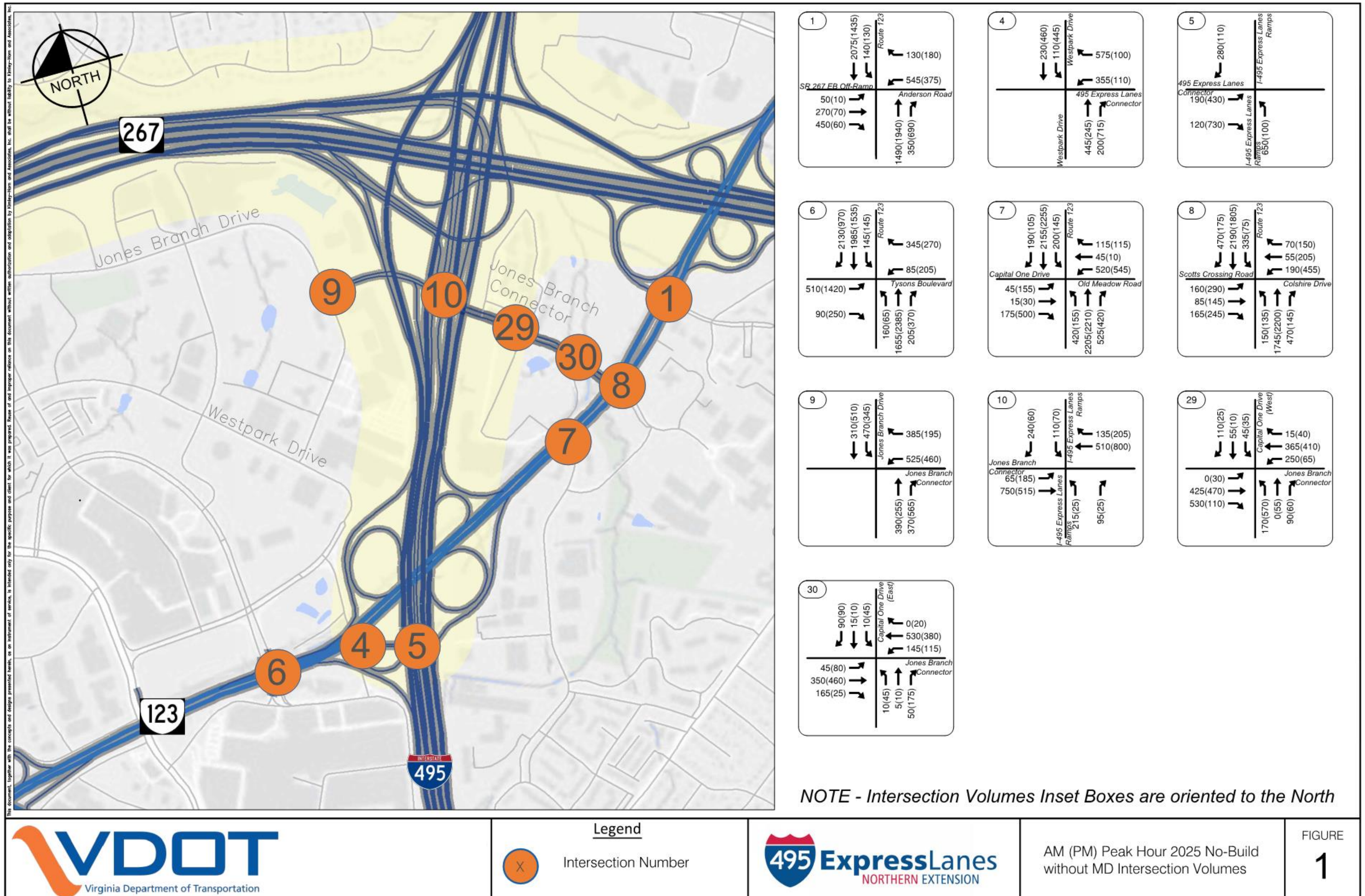


Exhibit 6b. Arterial 2025 No Build (Pre-Maryland Managed Lanes) Peak Hour Turning Movement Volumes – Location 1

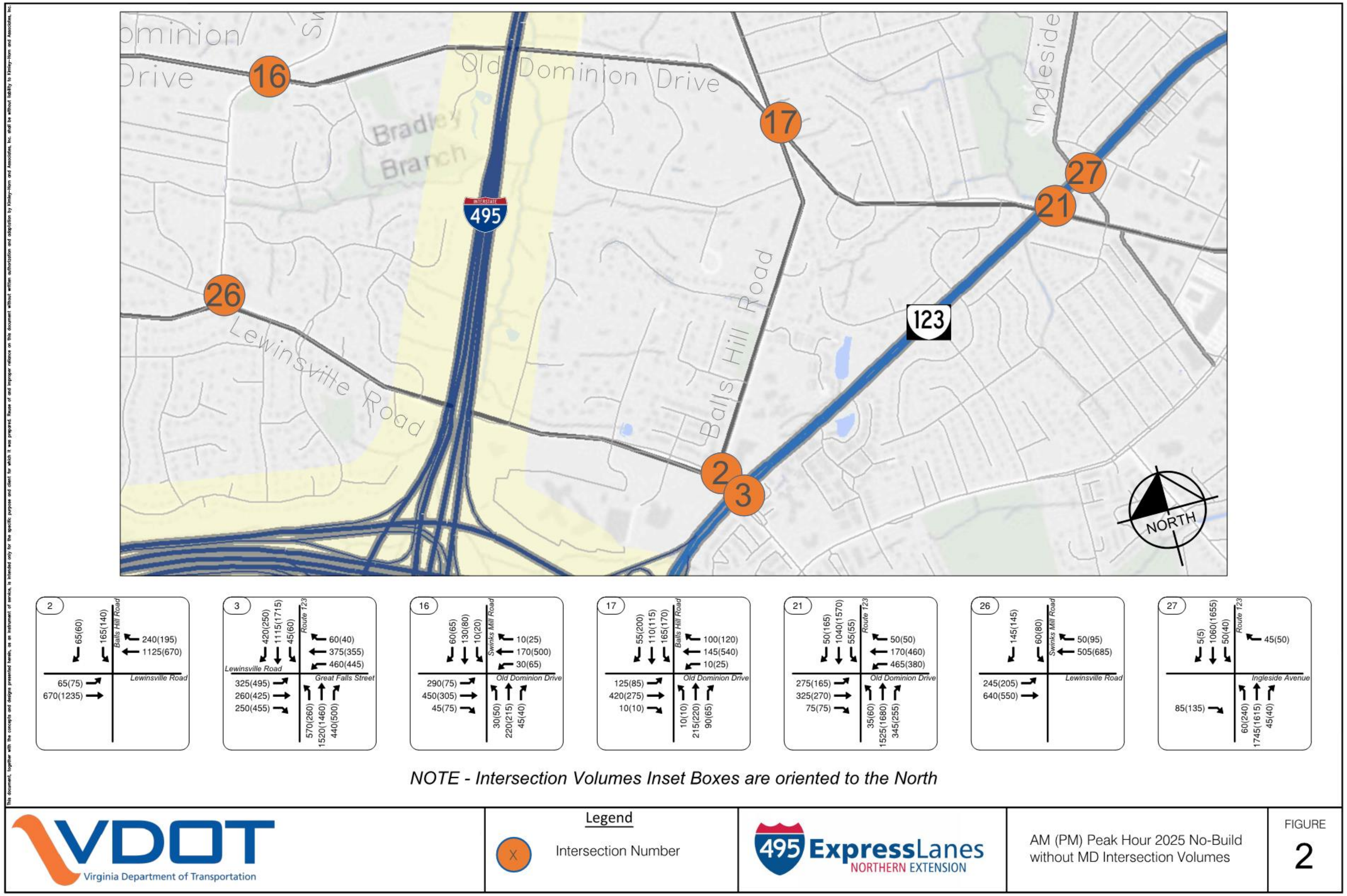


Exhibit 6c. Arterial 2025 No Build (Pre-Maryland Managed Lanes) Peak Hour Turning Movement Volumes – Location 2

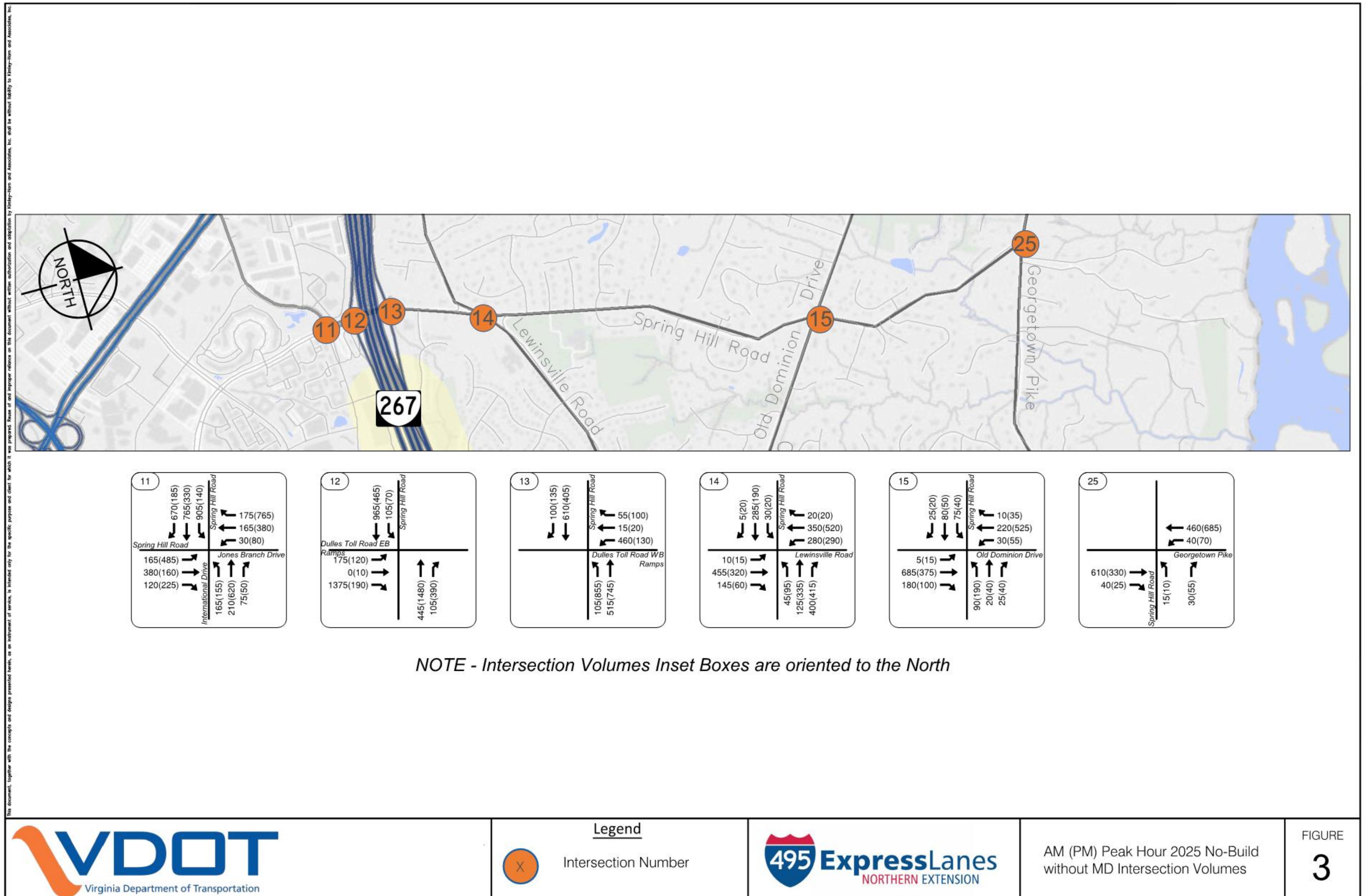


Exhibit 6d. Arterial 2025 No Build (Pre-Maryland Managed Lanes) Peak Hour Turning Movement Volumes – Location 3

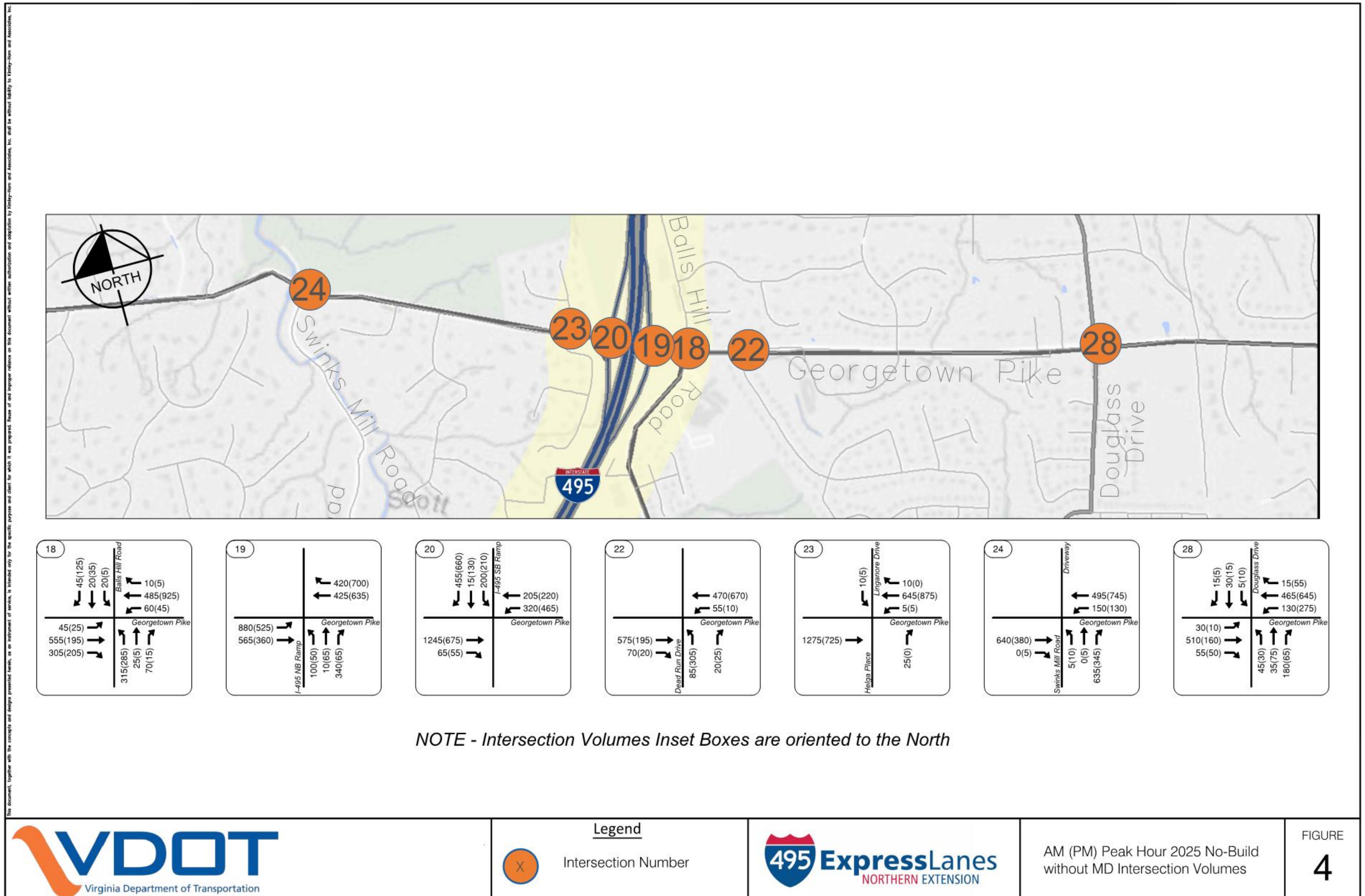


Exhibit 6e. Arterial 2025 No Build (Pre-Maryland Managed Lanes) Peak Hour Turning Movement Volumes – Location 4

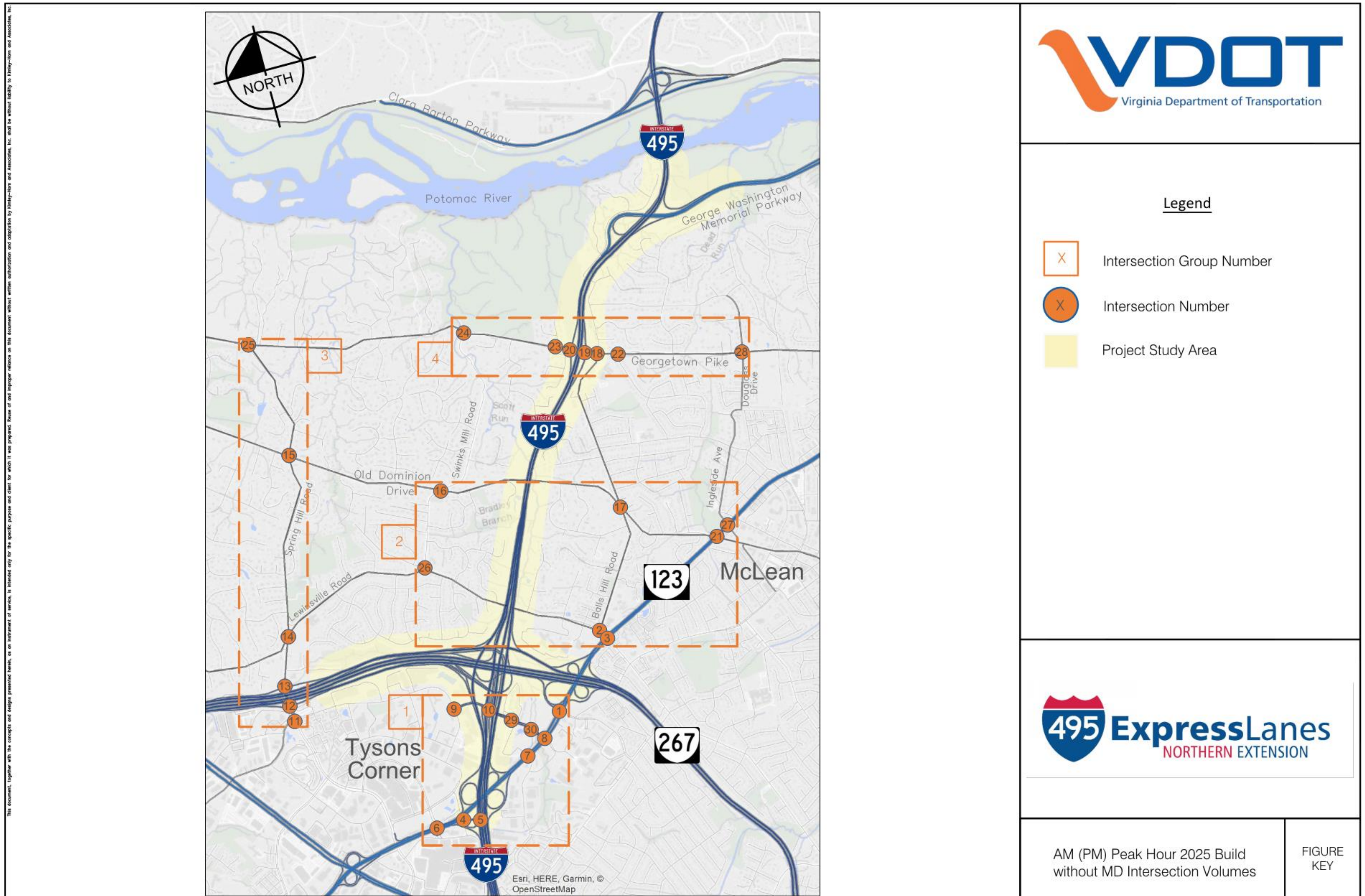


Exhibit 7a. Arterial 2025 Build (Pre-Maryland Managed Lanes) Peak Hour Turning Movement Volumes – Figure Key

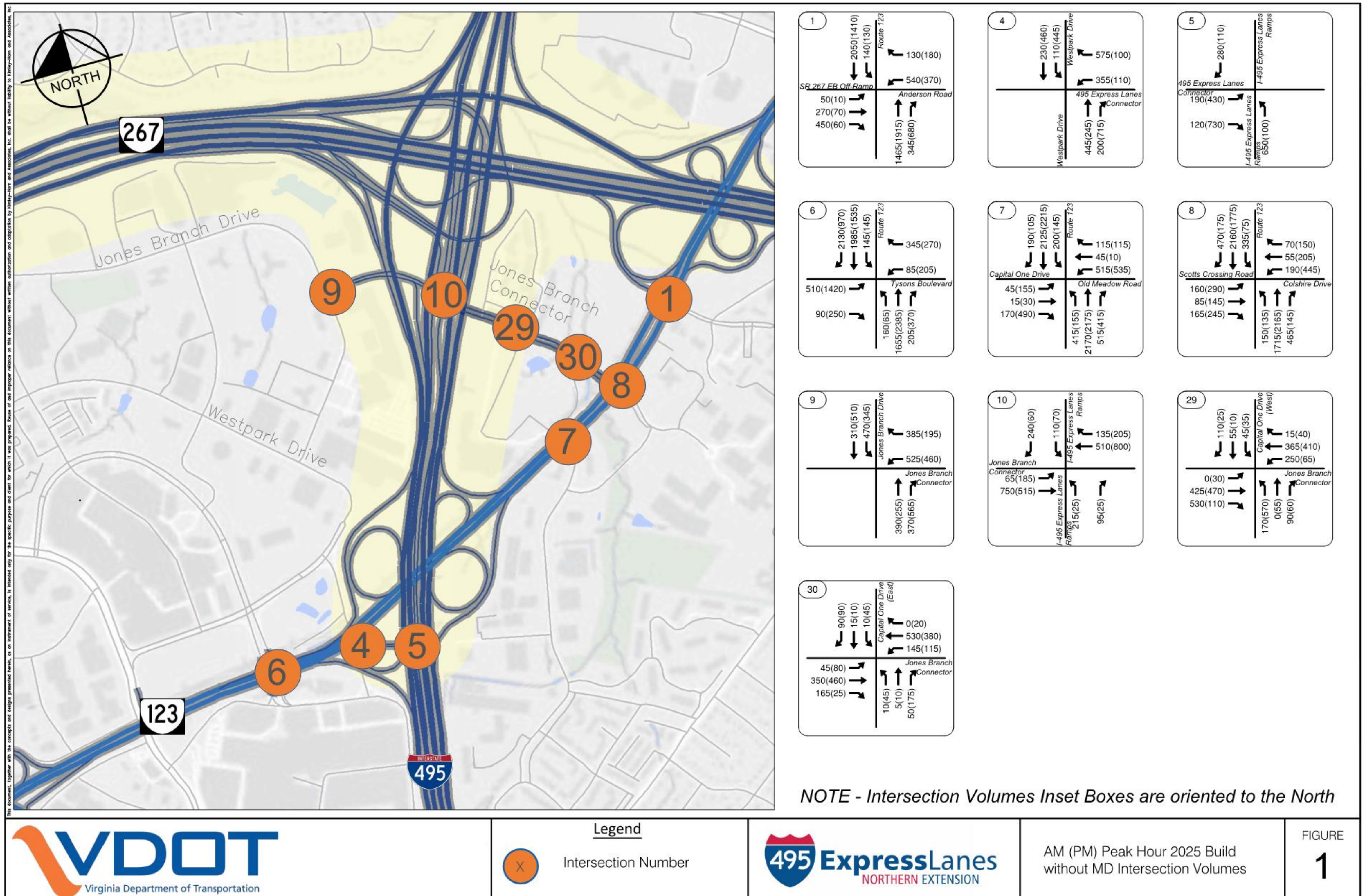


Exhibit 7b. Arterial 2025 Build (Pre-Maryland Managed Lanes) Peak Hour Turning Movement Volumes – Location 1

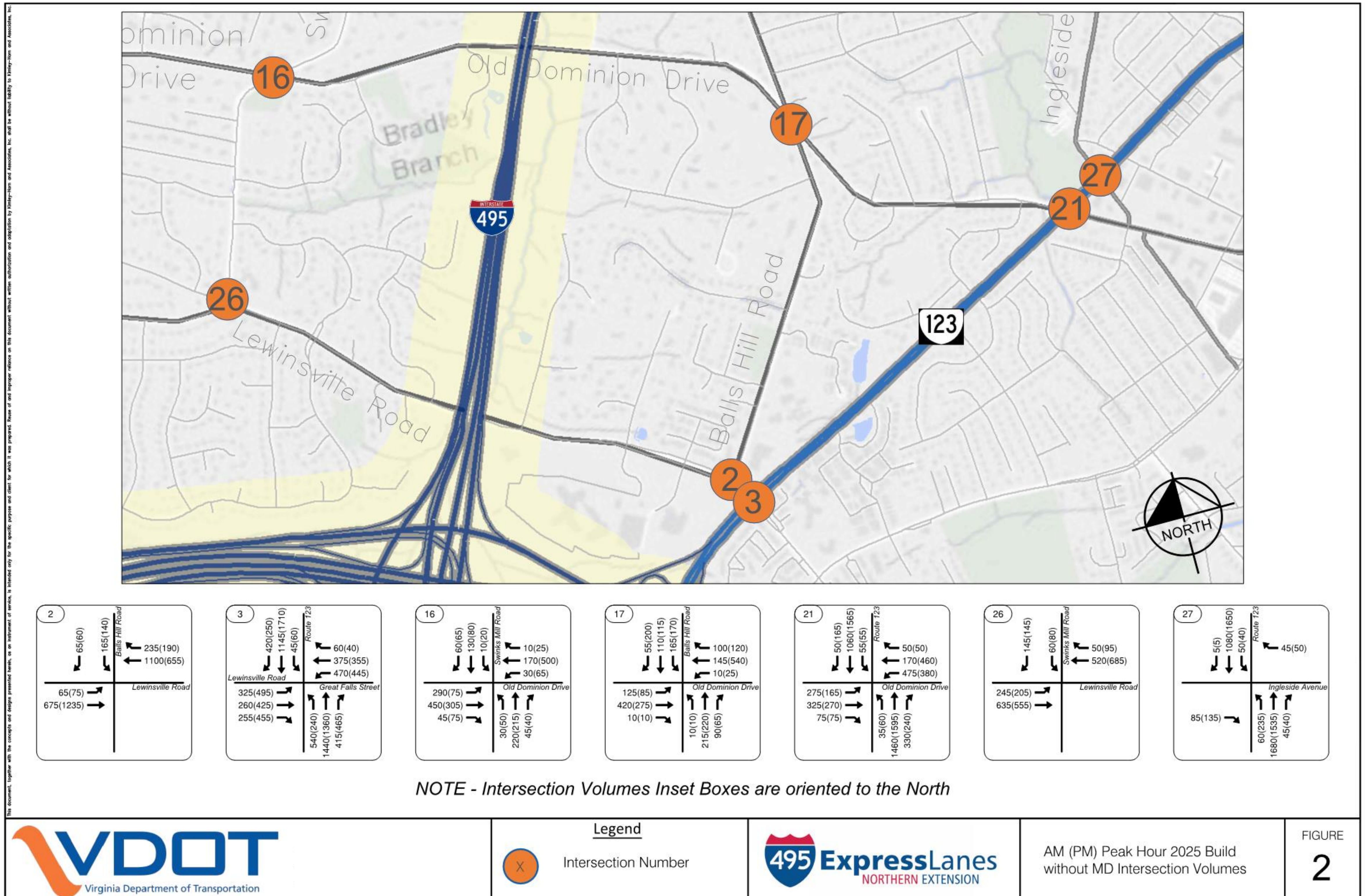


Exhibit 7c. Arterial 2025 Build (Pre-Maryland Managed Lanes) Peak Hour Turning Movement Volumes – Location 2

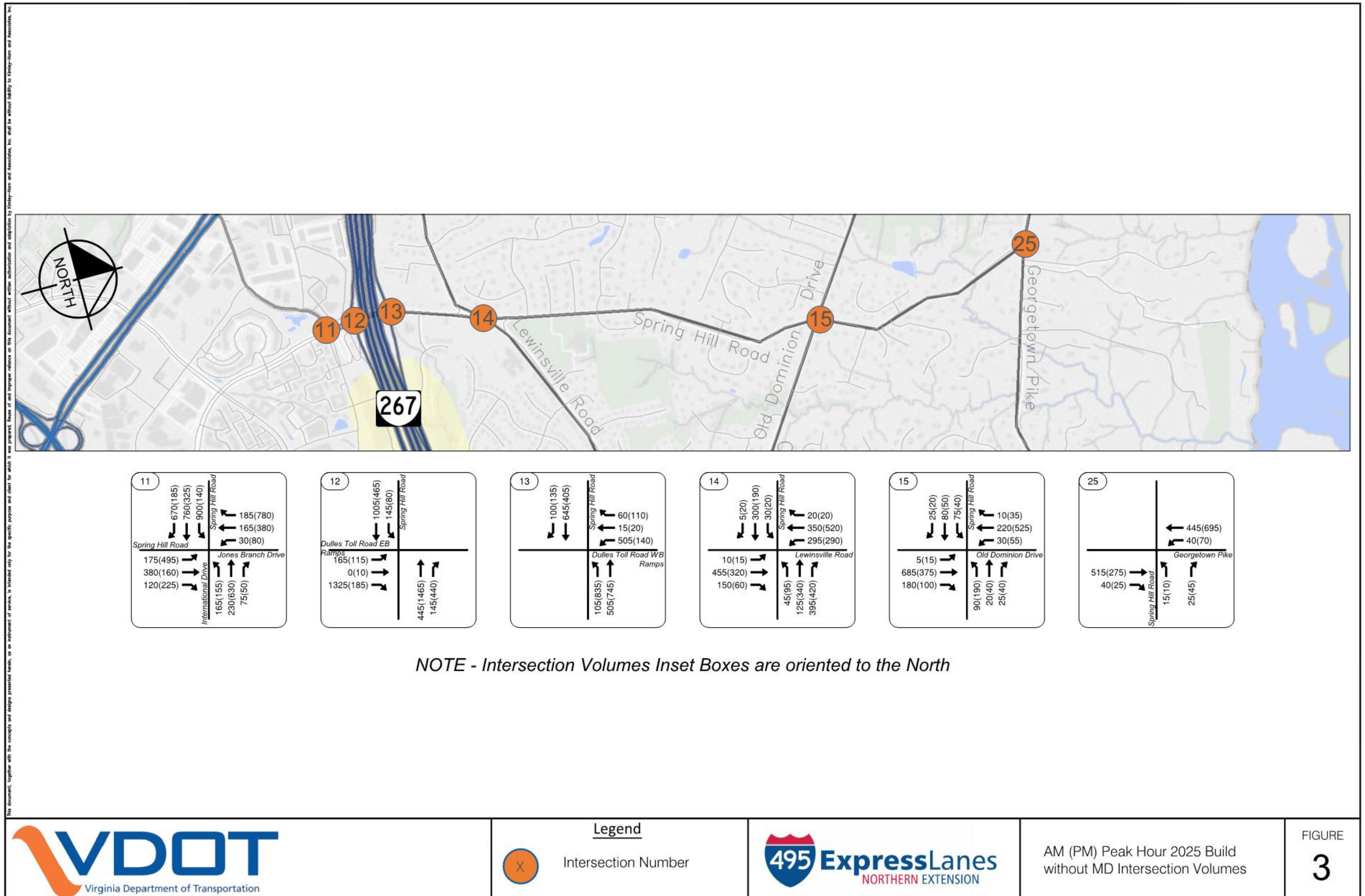


Exhibit 7d. Arterial 2025 Build (Pre-Maryland Managed Lanes) Peak Hour Turning Movement Volumes – Location 3

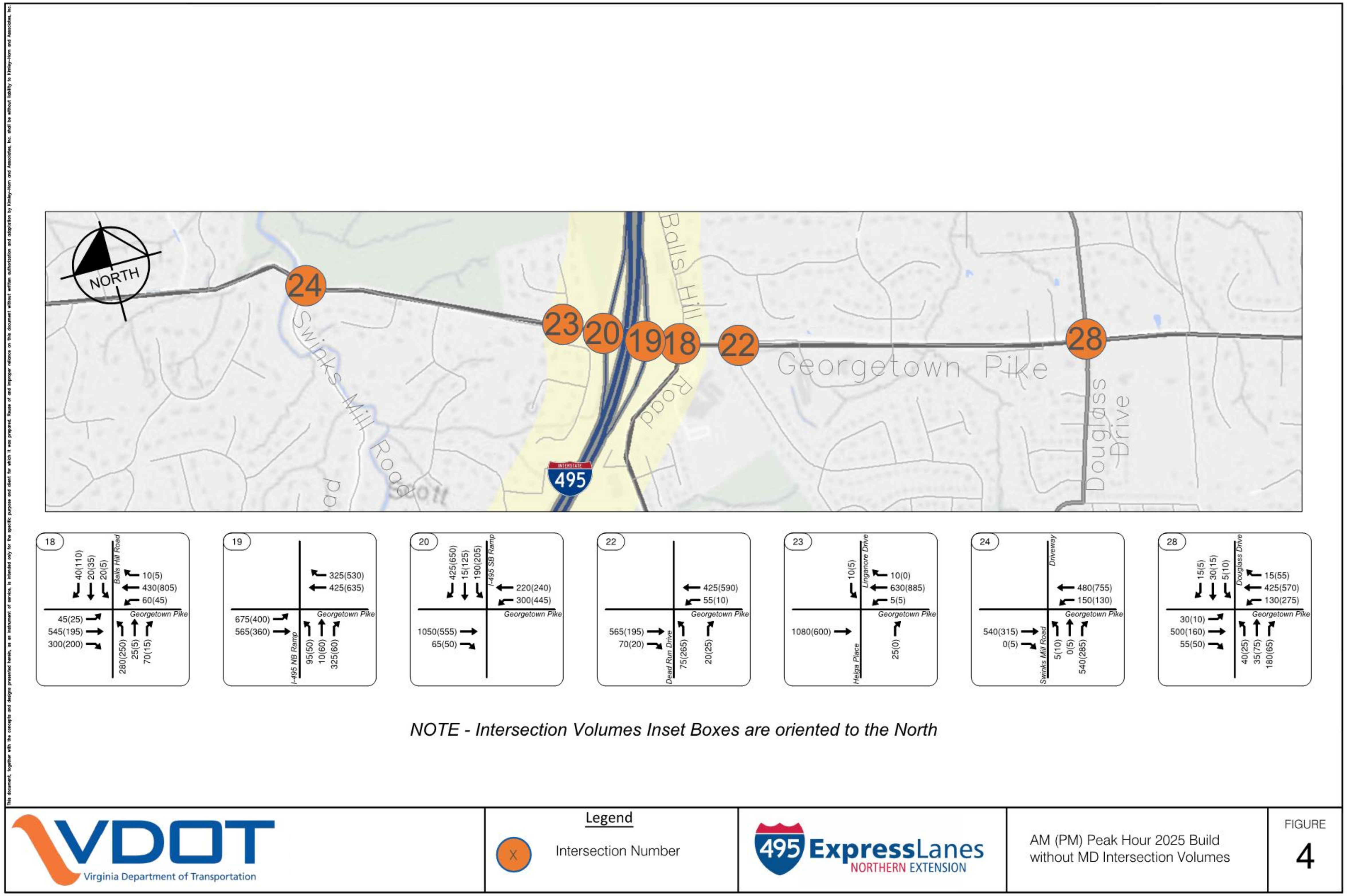


Exhibit 7e. Arterial 2025 Build (Pre-Maryland Managed Lanes) Peak Hour Turning Movement Volumes – Location 4

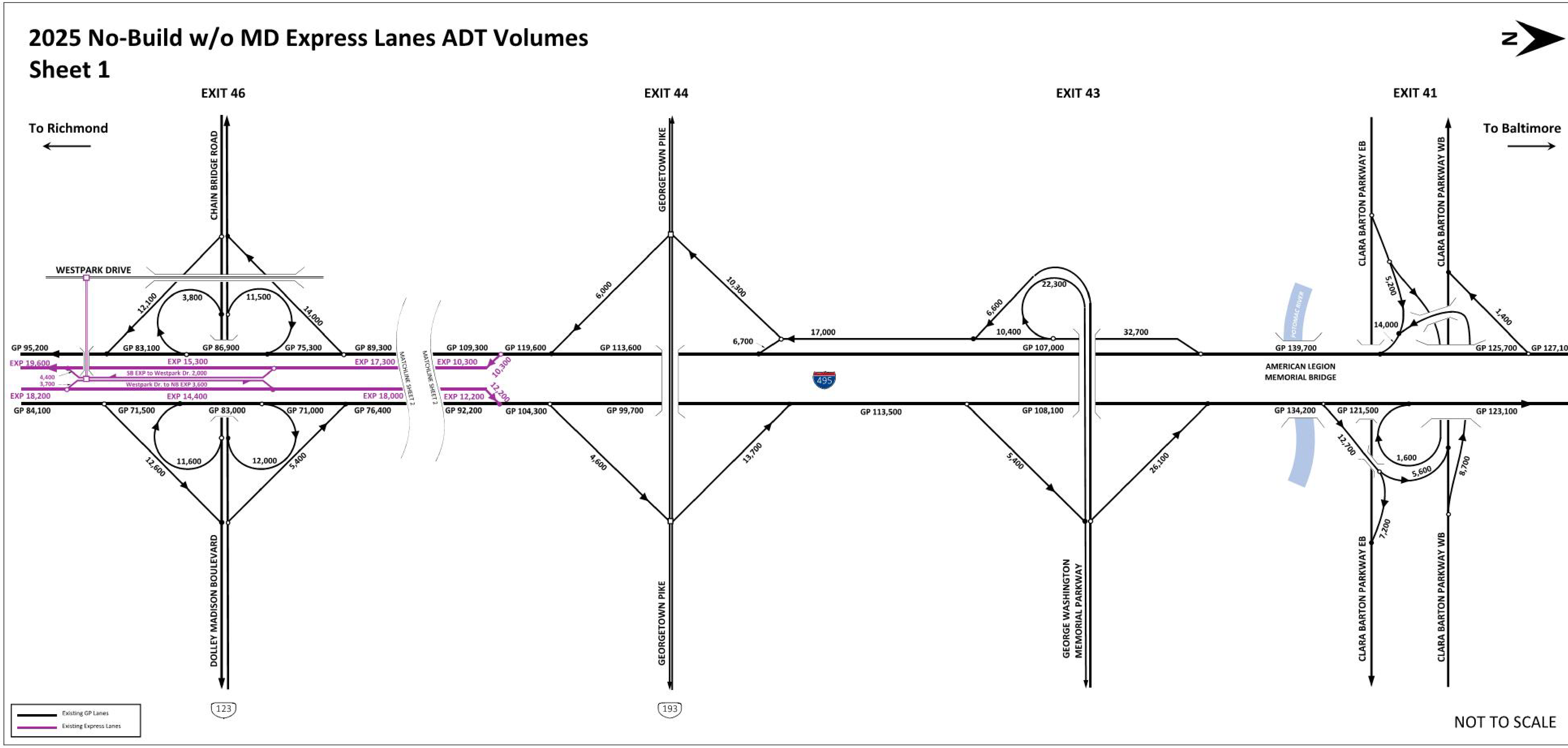


Exhibit 8a. Freeway 2025 No Build (Pre-Maryland Managed Lanes) Lanes ADT – I-495

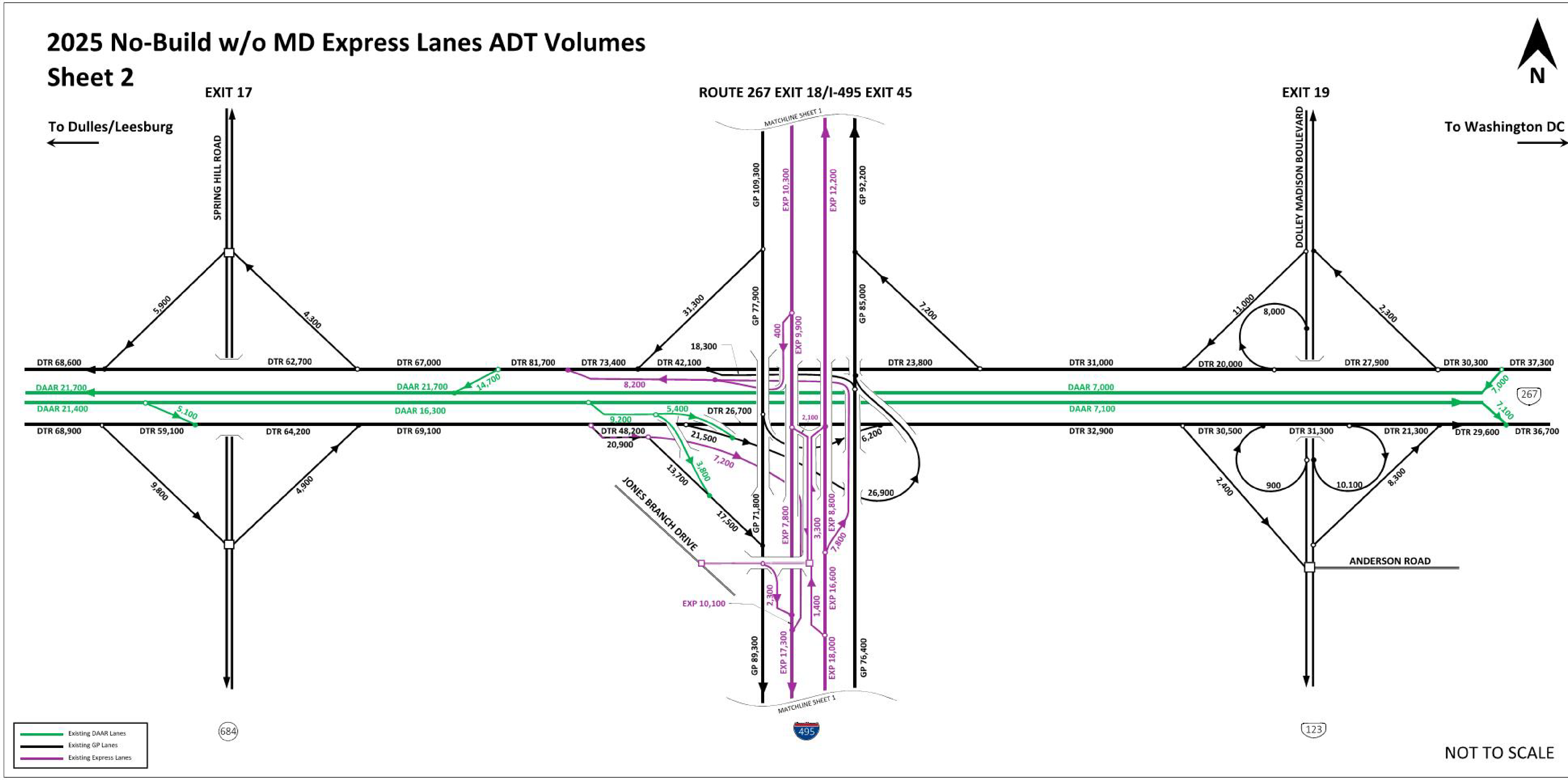


Exhibit 8b. Freeway 2025 No Build (Pre-Maryland Managed Lanes) ADT – Route 267

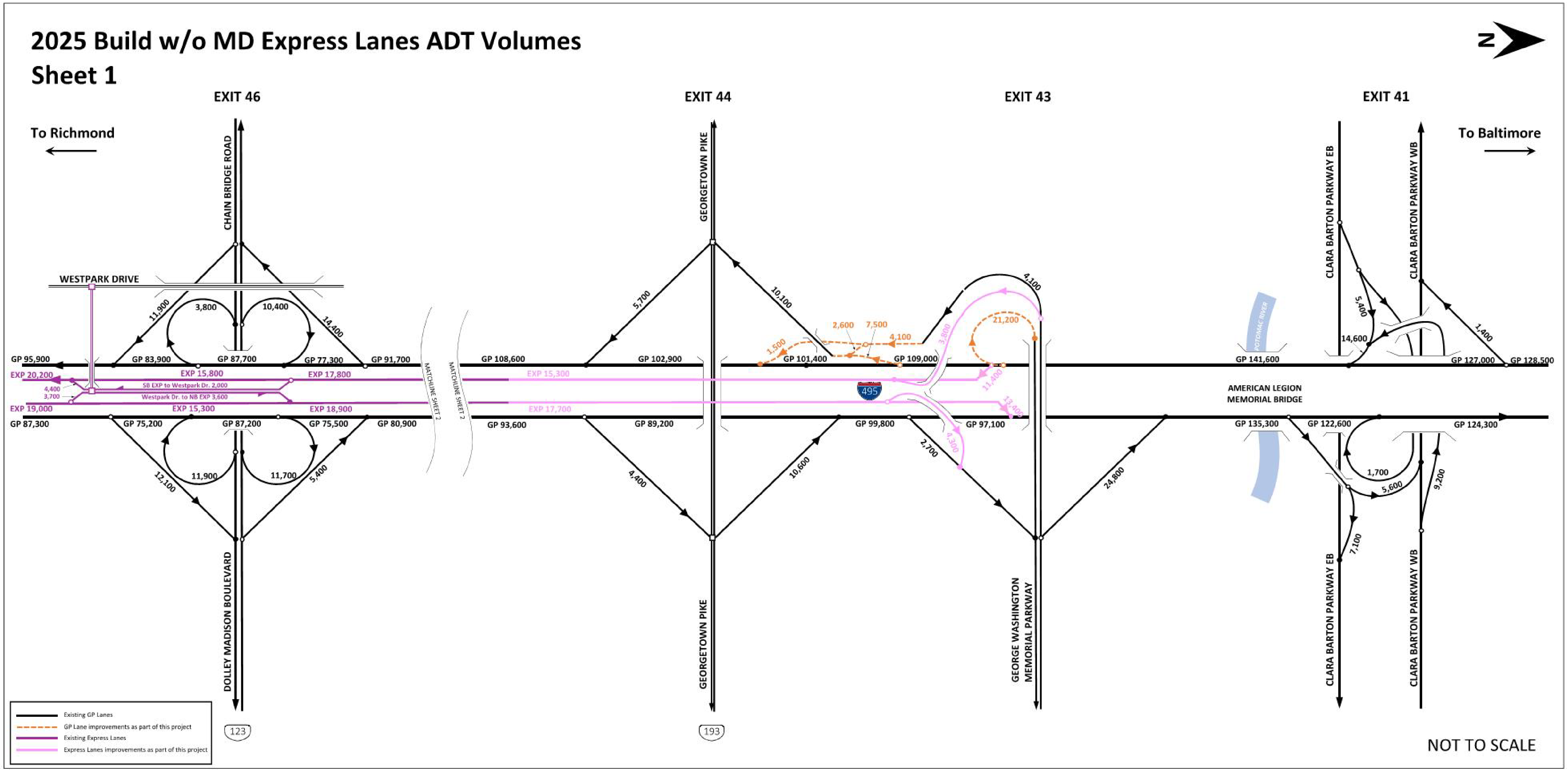


Exhibit 9a. Freeway 2025 Build (Pre-Maryland Managed Lanes) ADT – I-495

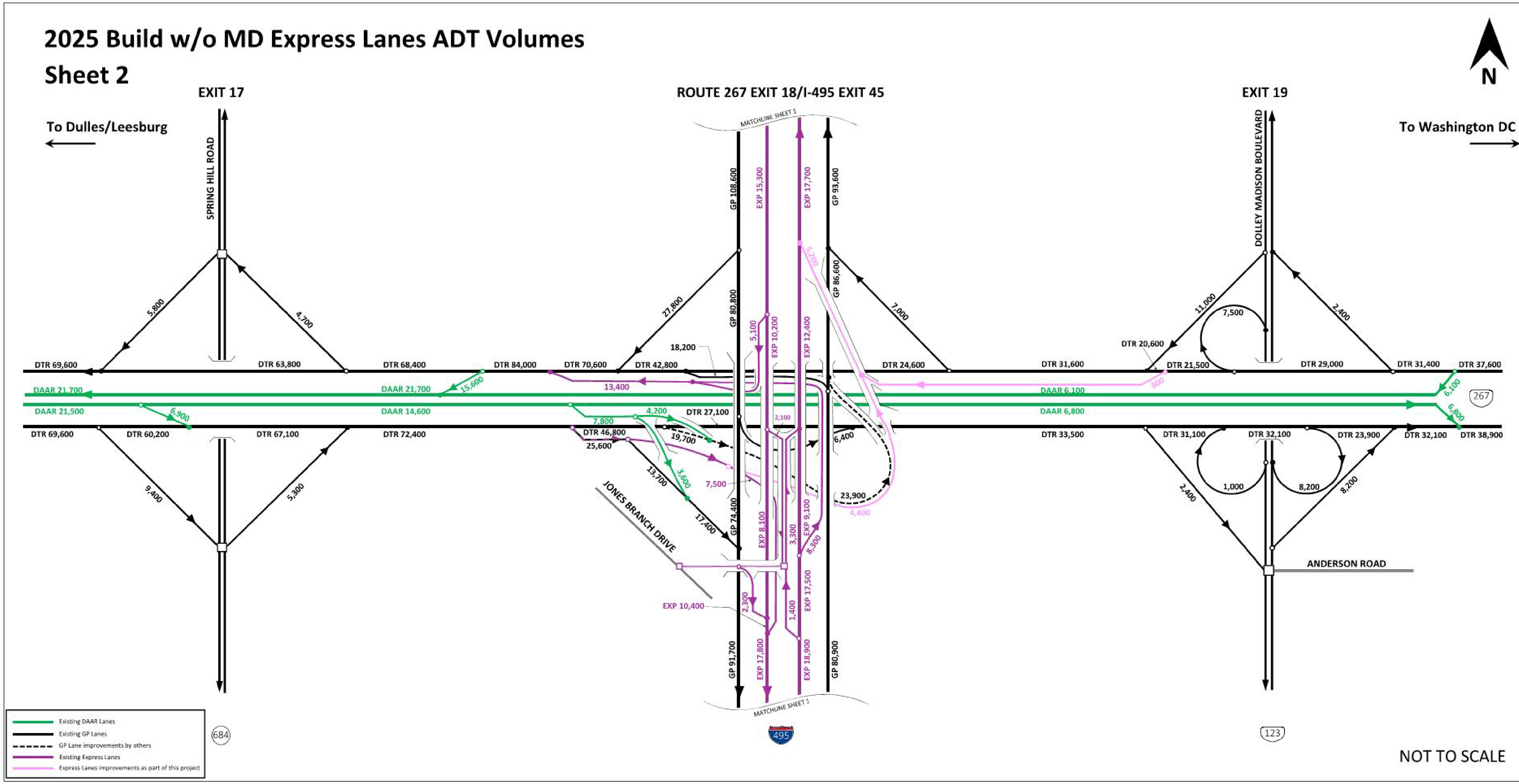


Exhibit 9b. Freeway 2025 Build (Pre-Maryland Managed Lanes) ADT – Route 267

Appendix J: Safety and Crash Analysis Technical Memorandum

MEMORANDUM

To: Abi Lerner, P.E., VDOT Project Manager

From: Warren E. Hughes, P.E., ATCS, P.L.C.
Ram Jagannathan, ATCS, P.L.C.
Rob Prunty, P.E., Kimley-Horn

Date: March 25, 2019

Subject: Development of Safety Performance Functions (SPFs) for I-495 Express Lanes

Introduction

This memorandum documents the development a new Safety Performance Functions (SPFs) for Express Lanes that was conducted as part of the I-495 Express Lanes Northern Extension Project. The methodology followed the framework that had been proposed in the memo dated November 15, 2018, which was submitted to and accepted by FHWA and VDOT.

Framework and Methodology for the Development of SPFs and Crash Prediction for Express Lanes

Treatment of Freeway Segments:

The Highway Safety Manual (HSM), first edition, does not have a crash prediction methodology for estimating the safety performance of separated express lanes or urban interstate corridors with express lanes/managed lane facilities. At the time that safety analyses were conducted for I-495 and for I-66, there was insufficient experience with express lanes in Virginia to properly predict crashes for express lanes. During the conduct of the I-495 Express Lanes Northern Extension study, it was proposed to VDOT and FHWA that sufficient crash history associated with express lanes on I-495 (the Capital Beltway) and that SPFs could be developed to help predict the expected crashes on both existing and new express lanes. With the development and application of SPF for express lanes, a more complete assessment could be performed for the safety performance of both the no-build and build alternatives related to extending the I-495 Express Lanes north to the American Legion Memorial Bridge. Using historical and available crash data, traffic volume data and roadway geometric data for the existing segments of I-495 Express Lanes, a SPF was developed. The SPFs will allow for estimation of future year crash experience for both existing express lane sections on I-495 and for new express lane sections that will be included in the Build alternative.

The study area includes approximately 3.5 miles along I-495 between the Route 123 interchange and the Maryland state line at the American Legion Memorial Bridge. The study area also extends approximately 2,500 feet east along the George Washington Memorial Parkway. Intersecting roadways and interchanges are also included in the study area, as well as adjacent areas within 600 feet of the existing edge of pavement, as shown in Figure 1. The Express Lanes extension is shown in Figure 2.

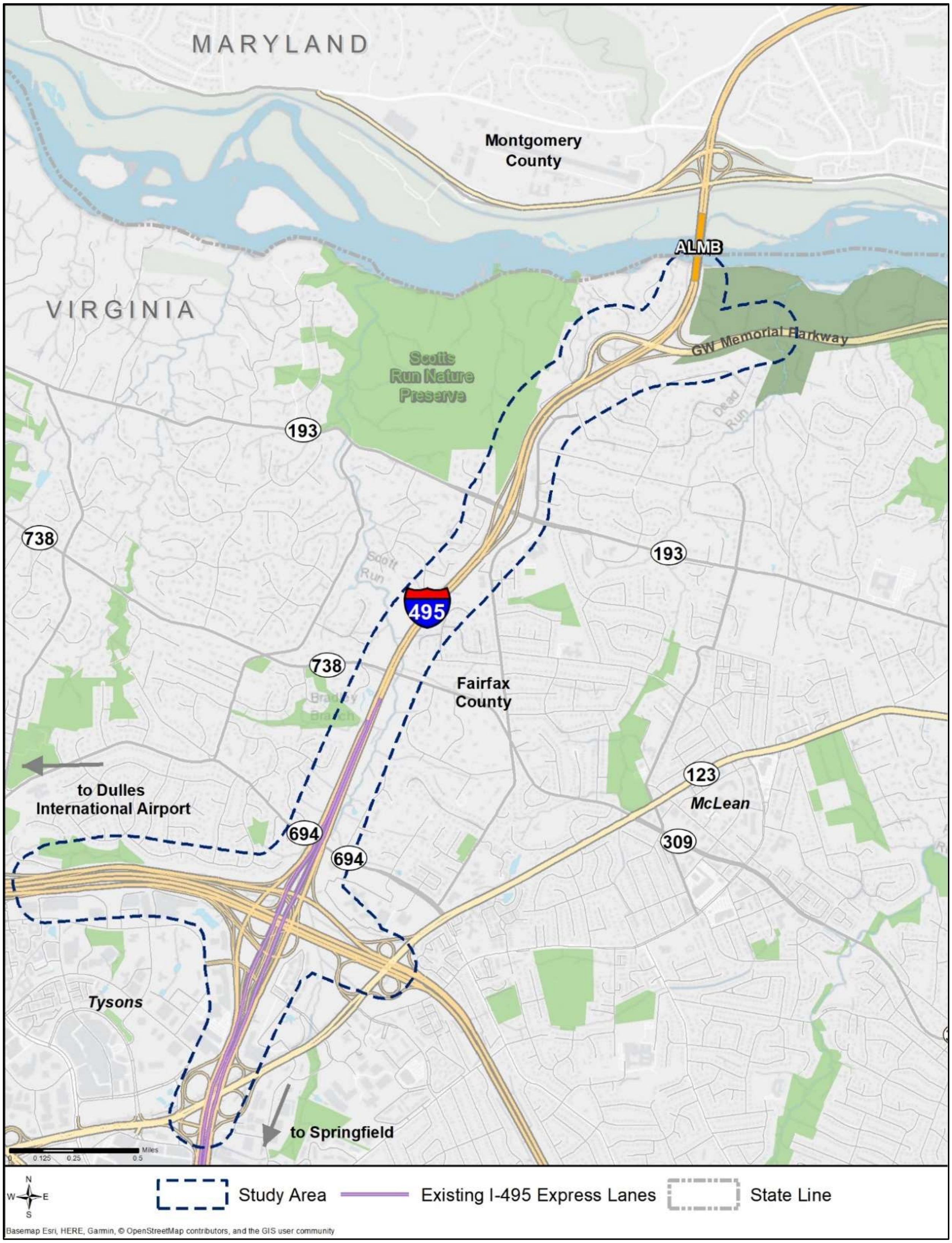
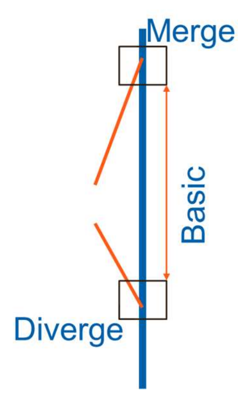


Figure 1: Express Lanes Northern Extension Study Area

Figure 2: I-495 Express Lanes Northern Extension (from Transurban Public Information Meeting, March 2018)

The construct of the safety performance prediction model was initially established to separate express lanes sections into one of three component parts, as shown below:



The Segmentation of express lanes includes: Basic Section (BS), which were between merge and diverge areas, Diverge Section (DS), which included 500 feet upstream and downstream of the diverge point, and Merge Section (MS), which included 500 feet upstream and downstream of the merge point. These are shown in the figure to the right side.

Based on this approach to segmentation, the sample size used in the development of the SPF for express lanes included the following:

<u>For Northbound Express Lanes segments</u>:

1. BS - From the Southern NB Entrance to the on-ramp from Braddock Road
2. BS - From the on-ramp from Braddock Rd to the on-ramp from Gallows Road
3. BS - From the on-ramp from Gallows Road to the off-ramp to Lee Highway
4. BS - From the off-ramp to Lee Hwy to the off-ramp to I-66
5. BS - From the off-ramp to I-66 to the on-ramp from I-66 EB
6. BS - From the on-ramp from I-66 EB to the off-ramp to Leesburg Pike (VA Rte. 7)
7. BS - From the off-ramp to Leesburg Pike (VA Rte. 7) to the off-ramp to Westpark Drive Connector

8. BS - From the off-ramp to Westpark Drive Connector to the on-ramp from Westpark Drive Connector
9. BS - From the on-ramp from Westpark Drive Connector to the off-ramp to Jones Branch Connector
10. BS - From the off-ramp to Jones Branch Connector to the off-ramp to VA Rte. 267
11. BS - From the off-ramp to VA Rte. 267 to the on-ramp from Jones Branch Connector
12. BS - From on-ramp from Jones Branch Connector to Northern NB Exit to GP Lane
13. DS - off-ramp to Lee Highway
14. DS - off-ramp to I-66
15. DS - off-ramp to Leesburg Pike (VA Rte. 7)
16. DS - off-ramp to Westpark Drive Connector
17. DS - off-ramp to Jones Branch Connector
18. DS - off-ramp to VA Rte. 267
19. MS - on-ramp from Braddock Road
20. MS - on-ramp from Gallows Road
21. MS - on-ramp from I-66 EB
22. MS - on-ramp from Westpark Drive Connector
23. MS - on-ramp from Jones Branch Connector

<u>For Southbound Express Lanes segments</u>:

1. BS - From Northern SB Entrance to the off-ramp to VA Rte. 267
2. BS - From the off-ramp to VA Rte. 267 to off-ramp to Jones Branch Connector
3. BS - From the off-ramp to Jones Branch Connector to the on-ramp from Jones Branch Connector
4. BS - From On-Ramp from Jones Branch Connector and On-Ramp from VA Rte. 267
5. BS - From the on-ramp from VA Rte. 267 to the off-ramp to Westpark Drive Connector
6. BS - From the off-ramp to Westpark Drive Connector to the on-ramp from Westpark Drive Connector
7. BS - From the on-ramp from Westpark Drive Connector to the on-ramp from Leesburg Pike (VA Rte. 7)
8. BS - From the on-ramp from Leesburg Pike (VA Rte. 7) to the off-ramp from I-66 WB
9. BS - From the off-ramp from I-66 WB to the on-ramp from I-66 WB & EB
10. BS - From the on-ramp from I-66 WB and EB to the on-ramp from Lee Highway
11. BS - From the on-ramp from Lee Highway to the off-ramp to Gallows Road
12. BS - From the off-ramp to Gallows Road to the off-ramp to Braddock Road
13. BS - From the off-ramp to Braddock Road to the Southern SB Exit
14. DS - off-ramp to VA Rte. 267
15. DS - off-ramp to Jones Branch Connector
16. DS - off-ramp to Westpark Drive Connector
17. DS - off-ramp from I-66 WB
18. DS - off-ramp to Gallows Road
19. DS - off-ramp to Braddock Road
20. MS - on-ramp from Jones Branch Connector
21. MS - on-ramp from VA Rte. 267
22. MS - on-ramp from Westpark Drive Connector
23. MS - On-ramp from Leesburg Pike (VA Rte. 7)
24. MS - on-ramp from I-66 WB & EB
25. MS - on-ramp from Lee Highway

It is important to note that in the development of the Safety Performance Function, the transition areas at the end of the express lanes and the ramps to/from the express lanes were excluded from the analysis. More detail on why this was done is provided in the succeeding paragraphs.

Treatment of Endings of Express Lanes:

Based on INRIX and other travel time/speed observations, free flow conditions do not always exist at the downstream ends of express lanes where drivers coming from the express lanes must merge with adjacent traffic traveling in the general purpose (GP) lanes. Frequently, congestion occurs in this transition area due to downstream capacity limitations. Consequently, the transition zones do not operate as well as the upstream sections of the express lanes. To properly account for this, it is necessary to segregate the transition from the express lanes for the purposes of development of a SPF for express lanes. A line is needed to demark the end of the free flow, higher speed travel on express lanes and the beginning of the point where flow on express lanes is affected by downstream congestion and capacity-limitations associated with the GP lanes. Beyond the demarcation lines, ISATe is appropriate to analyze the sections of the Express Lanes that are no longer operating under free flow conditions.

Treatment of Ramps to/from Express Lanes:

No SPFs were developed for individual ramps to or from the express lanes. There were relatively few crashes reported on the ramps to/from the express lanes. Most of the crashes that occurred within the vicinity of the express lane ramps are reported in/near merges and diverges. As noted in the methodology memo, ISATe will be used to analyze the safety of express lane (EL) ramps. This will be in a manner similar to how ISATe is used to analyze ramps to and from the general purpose (GP) lanes. Consequently, ISATe procedures will be used for all EL and GP ramps for the 2025 and 2045 No-Build and Build alternatives.

Development of Safety Performance Functions for Express Lanes

In developing the safety performance functions, it is important to recognize the underlying assumptions on which the new relationships were based. These included the following:

- Because I-495 ELs operate within an uncongested regime, SPFs would be directly related to AADT as a dependent variable within certain thresholds.
- Traffic Volumes and Crash History for Existing I-495 Express Lane sections for the past 5 years (Jan. 1, 2013 through Dec. 31, 2017) were deemed adequate from a historical perspective and used to develop new SPFs for the express lanes directional segments consisting of two lanes.

The salient features of the crash data, from which the SPF were developed, are described as follows:

- A total of 396 crashes were reported over a period of 5 years on the I-495 express lanes.
- Of those 396 reported crashes, 49 reported crashes occurred within the Diverge Segments and 45 reported crashes occurred within the Merge Segments. The remaining 302 reported crashes occurred on the Basic and Weave Segments.

A series of statistical models were developed to predict crashes. The primary independent variables used in the regression analyses were AADT, segment length and segment type (Merge, Diverge or Basic/Weave). The number of predicted crashes per year was the dependent variable in each model. The following functional forms for SPFs were tested:

Group 1 (Each model included segment length as one of the independent variables):

1. All reported crashes as a function of AADT, segment length and segment type
2. All reported crashes as a function of AADT and segment length
3. Basic and weave segment crashes as a function of AADT and segment length
4. Merge segment crashes as a function of AADT and segment length
5. Diverge segment crashes as a function of AADT and segment length

Group 2 (None of the models included section length as an independent variable)

6. All reported crashes as a function of AADT and segment type
7. All reported crashes as a function of AADT
8. Basic and weave Segment Crashes as a function of AADT
9. Merge segment crashes as a function of AADT
10. Diverge segment crashes as a function of AADT

The results of the statistical regression modelling were as follows:

Group 1:

1. All Crashes as a function of AADT, segment length and segment type: Segment type was insignificant.
2. All Crashes as a function of AADT and segment length: All variables were significant.
3. Basic and Weave Segment Crashes as a function of AADT and segment length: All variables were significant.
4. Merge Segment Crashes as a function of AADT and segment length: All variables were insignificant.
5. Diverge Segment Crashes as a function of AADT and segment length: AADT was insignificant.

Group 2:

6. All Crashes as a function of AADT and segment type: AADT and segment type variables were insignificant.
7. All Crashes as a function of AADT: All variables were significant.
8. Basic and Weave Segment Crashes as a function of AADT: All variables were insignificant.
9. Merge Segment Crashes as a function of AADT: All variables were insignificant.
10. Diverge Segment Crashes as a function of AADT: All variables were insignificant.

The results of the statistical modelling results and the statistical model forms are included in an appendix at the end of this memo. The results show that SFP2 in Group 1 and SPF7 in Group 2 were the only models in which all of their independent variables were found to be statistically significant. Of the two, SFP2 in Group 1 had a much higher R-squared value, which reflects a better "goodness of fit," compared to SPF7 in Group 2. Intuitively, predicted crashes should have a direct correlation to AADT and roadway segment length. The models in the Highway Safety Manual for crash prediction are also very similar in form but with different coefficients.

On the basis of the analysis conducted, the proposed SPF for express lanes on I-495 is given below for the non-linear and linear regression models.

Non-Linear Regression: Expectation ($Crashes_{i,t}$) = exponential (0.011022579 + 0.987113593 * ln(Segment $Length_{i,t}$) + 0.141283034 * ln($AADT_{i,t}$)

Linear Regression: Expectation ($Crashes_{i,t}$) = 0.550840245 + 4.130999289 * Segment $Length_{i,t}$) - 0.000121228 * $AADT_{i,t}$)

Where:

$Crashes_{i,t}$ = Crashes/year on Segment i for Time period t,

Segment $Length_{i,t}$ = Segment Length on Segment i for Time period t and

$AADT_{i,t}$ = Average Annual Daily Traffic on Segment i for Time period t.

The non-linear regression form had an R-squared value of 0.51 and the linear regression form had an R-squared value of 0.564; therefore, the linear regression model form was chosen due to the better R-squared value. There was a challenge with linear regression model for a limited number of cases where the model had a negative prediction of crashes. To fix that challenge, the form of the linear regression model was modified to be the max value of 0 and linear regression predicted crashes; this change in the model form solved the challenge by replacing negative prediction of crashes with zero. The R-squared for the modified form continued to be 0.564.

On the basis of the analysis conducted, the proposed SPF for express lanes on I-495 is given below:

Expectation ($Crashes_{i,t}$) = Max[0.550840245 + 4.130999289 * Segment $Length_{i,t}$) -0.000121228 * $AADT_{i,t}$), 0]

Where:

$Crashes_{i,t}$ = Crashes/year on Segment i for Time period t,

$Segment\ Length_{i,t}$ = Segment Length on Segment i for Time period t and

$AADT_{i,t}$ = Average Annual Daily Traffic on Segment i for Time period t.

This equation applies to Merge Sections, Diverge Sections and Basic+Weave Sections. The Appendix includes a comparison of the actual crashes and predicted crashes for all segments in the existing conditions. The comparison shows the difference in the total crashes predicted using linear regression model versus actual crash performance is less than 1 crash in five years for existing conditions. The proposed SPF for I-495 Express lanes can be used for the prediction of crashes for future No-Build and Build alternatives for the I-495 Express Lanes Northern Extension project.

Appendix - Statistical Modelling Results

Comparison of Predicted Crashes versus Actual Crashes for Existing Crashes

ID	Segment	Year	Length (miles)	AADT	Crashes	Non-Linear Predicted Crashes	Linear Predicted Crashes
NB Express Lanes – BS & WS Segments							
1	BS - From the Southern NB Entrance to the on-ramp from Braddock Road	2013	2.27	7966	24.0	8.1	9.0
2	BS - From the on-ramp from Braddock Rd to the on-ramp from Gallows Road	2013	2.61	9481	9.0	9.5	10.2
3	BS - From the on-ramp from Gallows Road to the off-ramp to Lee Highway	2013	0.62	10879	2.0	2.3	1.8
4	BS - From the off-ramp to Lee Hwy to the off-ramp to I-66	2013	0.33	9741	3.0	1.2	0.7
5	BS - From the off-ramp to I-66 to the on-ramp from I-66 EB	2013	0.88	7671	0.0	3.2	3.3
6	BS - From the on-ramp from I-66 EB to the off-ramp to Leesburg Pike (VA Rt 7)	2013	0.61	10782	2.0	2.3	1.8
7	BS - From the off-ramp to Leesburg Pike (VA Rt 7) to the off-ramp to Westpark Drive Connector	2013	0.63	9320	2.0	2.3	2.0
8	BS - From the off-ramp to Westpark Drive Connector to the on-ramp from Westpark Drive Connector	2013	0.5	8072	0.0	1.8	1.6
9	WS - From the on-ramp from Westpark Drive Connector to the off-ramp to Jones Branch Connector	2013	0.18	8964	0.0	0.7	0.2
11	BS - From the off-ramp to VA Rt 267 to the on-ramp from Jones Branch Connector	2013	0.28	926	0.0	0.8	1.6
12	BS - From on-ramp from Jones Branch Connector to Northern NB Exit to GP Lane	2013	0.49	2786	2.0	1.5	2.2
	SubTotal BS&WS crashes	2013			44.0	33.7	34.4
1	BS - From the Southern NB Entrance to the on-ramp from Braddock Road	2014	2.27	9349	14.0	8.3	8.8
2	BS - From the on-ramp from Braddock Rd to the on-ramp	2014	2.61	11168	9.0	9.7	10.0

	from Gallows Road						
3	BS - From the on-ramp from Gallows Road to the off-ramp to Lee Highway	2014	0.62	12936	3.0	2.4	1.5
4	BS - From the off-ramp to Lee Hwy to the off-ramp to I-66	2014	0.33	11446	1.0	1.3	0.5
5	BS - From the off-ramp to I-66 to the on-ramp from I-66 EB	2014	0.88	9015	2.0	3.2	3.1
6	BS - From the on-ramp from I-66 EB to the off-ramp to Leesburg Pike (VA Rt 7)	2014	0.61	12655	0.0	2.4	1.5
7	BS - From the off-ramp to Leesburg Pike (VA Rt 7) to the off-ramp to Westpark Drive Connector	2014	0.63	10853	2.0	2.4	1.8
8	BS - From the off-ramp to Westpark Drive Connector to the on-ramp from Westpark Drive Connector	2014	0.5	9373	5.0	1.9	1.5
9	WS - From the on-ramp from Westpark Drive Connector to the off-ramp to Jones Branch Connector	2014	0.18	10663	0.0	0.7	0.0
11	BS - From the off-ramp to VA Rt 267 to the on-ramp from Jones Branch Connector	2014	0.28	1255	0.0	0.8	1.6
12	BS - From on-ramp from Jones Branch Connector to Northern NB Exit to GP Lane	2014	0.49	3277	2.0	1.6	2.2
	SubTotal BS&WS crashes	2014			38.0	34.5	32.5
1	BS - From the Southern NB Entrance to the on-ramp from Braddock Road	2015	2.27	10783	9.0	8.4	8.6
2	BS - From the on-ramp from Braddock Rd to the on-ramp from Gallows Road	2015	2.61	12714	3.0	9.9	9.8
3	BS - From the on-ramp from Gallows Road to the off-ramp to Lee Highway	2015	0.62	14517	0.0	2.4	1.4
4	BS - From the off-ramp to Lee Hwy to the off-ramp to I-66	2015	0.33	12732	2.0	1.3	0.4
5	BS - From the off-ramp to I-66 to the on-ramp from I-66 EB	2015	0.88	10041	1.0	3.3	3.0
6	BS - From the on-ramp from I-66 EB to the off-ramp to Leesburg Pike (VA Rt 7)	2015	0.61	13982	0.0	2.4	1.4
7	BS - From the off-ramp to Leesburg Pike (VA Rt 7) to the off-ramp to Westpark Drive Connector	2015	0.63	11971	4.0	2.4	1.7
8	BS - From the off-ramp to Westpark Drive Connector to	2015	0.5	10422	3.0	1.9	1.4

	the on-ramp from Westpark Drive Connector						
9	WS - From the on-ramp from Westpark Drive Connector to the off-ramp to Jones Branch Connector	2015	0.18	11962	0.0	0.7	0.0
11	BS - From the off-ramp to VA Rt 267 to the on-ramp from Jones Branch Connector	2015	0.28	1529	0.0	0.8	1.5
12	BS - From on-ramp from Jones Branch Connector to Northern NB Exit to GP Lane	2015	0.49	3714	2.0	1.6	2.1
	SubTotal BS&WS crashes	2015			24.0	35.1	31.2
1	BS - From the Southern NB Entrance to the on-ramp from Braddock Road	2016	2.27	11547	10.0	8.5	8.5
2	BS - From the on-ramp from Braddock Rd to the on-ramp from Gallows Road	2016	2.61	13560	6.0	10.0	9.7
3	BS - From the on-ramp from Gallows Road to the off-ramp to Lee Highway	2016	0.62	15311	1.0	2.5	1.3
4	BS - From the off-ramp to Lee Hwy to the off-ramp to I-66	2016	0.33	13345	1.0	1.3	0.3
5	BS - From the off-ramp to I-66 to the on-ramp from I-66 EB	2016	0.88	10412	3.0	3.3	2.9
6	BS - From the on-ramp from I-66 EB to the off-ramp to Leesburg Pike (VA Rt 7)	2016	0.61	14623	0.0	2.4	1.3
7	BS - From the off-ramp to Leesburg Pike (VA Rt 7) to the off-ramp to Westpark Drive Connector	2016	0.63	12511	0.0	2.4	1.6
8	BS - From the off-ramp to Westpark Drive Connector to the on-ramp from Westpark Drive Connector	2016	0.5	10891	2.0	1.9	1.3
9	WS - From the on-ramp from Westpark Drive Connector to the off-ramp to Jones Branch Connector	2016	0.18	12507	0.0	0.7	0.0
11	BS - From the off-ramp to VA Rt 267 to the on-ramp from Jones Branch Connector	2016	0.28	1625	0.0	0.8	1.5
12	BS - From on-ramp from Jones Branch Connector to Northern NB Exit to GP Lane	2016	0.49	3804	1.0	1.6	2.1
	SubTotal BS&WS crashes	2016			24.0	35.4	30.5
1	BS - From the Southern NB Entrance to the on-ramp from Braddock Road	2017	2.27	12506	9.0	8.6	8.4
2	BS - From the on-ramp from Braddock Rd to the on-ramp	2017	2.61	14677	5.0	10.1	9.6

	from Gallows Road						
3	BS - From the on-ramp from Gallows Road to the off-ramp to Lee Highway	2017	0.62	16523	1.0	2.5	1.1
4	BS - From the off-ramp to Lee Hwy to the off-ramp to I-66	2017	0.33	14378	4.0	1.3	0.2
5	BS - From the off-ramp to I-66 to the on-ramp from I-66 EB	2017	0.88	11028	3.0	3.3	2.8
6	BS - From the on-ramp from I-66 EB to the off-ramp to Leesburg Pike (VA Rt 7)	2017	0.61	15686	0.0	2.4	1.2
7	BS - From the off-ramp to Leesburg Pike (VA Rt 7) to the off-ramp to Westpark Drive Connector	2017	0.63	13505	0.0	2.5	1.5
8	BS - From the off-ramp to Westpark Drive Connector to the on-ramp from Westpark Drive Connector	2017	0.5	11793	1.0	1.9	1.2
9	WS - From the on-ramp from Westpark Drive Connector to the off-ramp to Jones Branch Connector	2017	0.18	13720	0.0	0.7	0.0
11	BS - From the off-ramp to VA Rt 267 to the on-ramp from Jones Branch Connector	2017	0.28	1767	0.0	0.8	1.5
12	BS - From on-ramp from Jones Branch Connector to Northern NB Exit to GP Lane	2017	0.49	4180	2.0	1.6	2.1
	SubTotal BS&WS crashes	2017			25.0	35.8	29.5
SB Express Lanes – BS & WS Segments							
24	BS - From Northern SB Entrance to the off-ramp to VA Rt 267	2013	0.15	4565	1.0	0.5	0.6
26	BS - From the off-ramp to VA Rt 267 to off-ramp to Jones Branch Connector	2013	0.21	3730	0.0	0.7	1.0
28	BS - From the off-ramp to Jones Branch Connector to the on-ramp from Jones Branch Connector	2013	0.35	8345	1.0	1.3	1.0
32	WS - From the on-ramp from VA Rt 267 to the off-ramp to Westpark Drive Connector	2013	0.17	6216	1.0	0.6	0.5
34	BS - From the off-ramp to Westpark Drive Connector to the on-ramp from Westpark Drive Connector	2013	0.45	8072	2.0	1.6	1.4
36	BS - From the on-ramp from Westpark Drive Connector to the on-ramp from Leesburg Pike (VA Rt 7)	2013	0.7	7356	9.0	2.5	2.6
38	BS - From the on-ramp from Leesburg Pike (VA Rt 7) to	2013	0.53	8336	4.0	1.9	1.7

	the off-ramp from I-66 WB						
40	BS - From the off-ramp from I-66 WB to the on-ramp from I-66 WB & EB	2013	0.41	6577	2.0	1.5	1.4
42	BS - From the on-ramp from I-66 WB and EB to the on-ramp from Lee Highway	2013	0.75	7755	6.0	2.7	2.7
44	BS - From the on-ramp from Lee Highway to the off-ramp to Gallows Road	2013	0.56	8732	0.0	2.1	1.8
46	BS - From the off-ramp to Gallows Road to the off-ramp to Braddock Road	2013	2.6	7353	20.0	9.1	10.4
48	BS - From the off-ramp to Braddock Road to the Southern SB Exit	2013	1.39	5861	10.0	4.8	5.6
	SubTotal BS&WS crashes	2013			56.0	29.3	30.7
24	BS - From Northern SB Entrance to the off-ramp to VA Rt 267	2014	0.15	5300	1.0	0.5	0.5
26	BS - From the off-ramp to VA Rt 267 to off-ramp to Jones Branch Connector	2014	0.21	4368	1.0	0.7	0.9
28	BS - From the off-ramp to Jones Branch Connector to the on-ramp from Jones Branch Connector	2014	0.35	10064	0.0	1.3	0.8
32	WS - From the on-ramp from VA Rt 267 to the off-ramp to Westpark Drive Connector	2014	0.17	7268	0.0	0.6	0.4
34	BS - From the off-ramp to Westpark Drive Connector to the on-ramp from Westpark Drive Connector	2014	0.45	9373	0.0	1.7	1.3
36	BS - From the on-ramp from Westpark Drive Connector to the on-ramp from Leesburg Pike (VA Rt 7)	2014	0.7	8646	3.0	2.6	2.4
38	BS - From the on-ramp from Leesburg Pike (VA Rt 7) to the off-ramp from I-66 WB	2014	0.53	9862	4.0	2.0	1.5
40	BS - From the off-ramp from I-66 WB to the on-ramp from I-66 WB & EB	2014	0.41	7806	1.0	1.5	1.3
42	BS - From the on-ramp from I-66 WB and EB to the on-ramp from Lee Highway	2014	0.75	9253	4.0	2.8	2.5
44	BS - From the on-ramp from Lee Highway to the off-ramp to Gallows Road	2014	0.56	10594	1.0	2.1	1.6
46	BS - From the off-ramp to Gallows Road to the off-ramp to Braddock Road	2014	2.6	8972	7.0	9.4	10.2

48	BS - From the off-ramp to Braddock Road to the Southern SB Exit	2014	1.39	7212	4.0	4.9	5.4
	SubTotal BS&WS crashes	2014			26.0	30.1	28.8
24	BS - From Northern SB Entrance to the off-ramp to VA Rt 267	2015	0.15	6446	0.0	0.5	0.4
26	BS - From the off-ramp to VA Rt 267 to off-ramp to Jones Branch Connector	2015	0.21	5379	3.0	0.7	0.8
28	BS - From the off-ramp to Jones Branch Connector to the on-ramp from Jones Branch Connector	2015	0.35	11394	0.0	1.3	0.6
32	WS - From the on-ramp from VA Rt 267 to the off-ramp to Westpark Drive Connector	2015	0.17	8748	0.0	0.6	0.2
34	BS - From the off-ramp to Westpark Drive Connector to the on-ramp from Westpark Drive Connector	2015	0.45	10422	0.0	1.7	1.1
36	BS - From the on-ramp from Westpark Drive Connector to the on-ramp from Leesburg Pike (VA Rt 7)	2015	0.7	10352	2.0	2.6	2.2
38	BS - From the on-ramp from Leesburg Pike (VA Rt 7) to the off-ramp from I-66 WB	2015	0.53	11785	1.0	2.0	1.3
40	BS - From the off-ramp from I-66 WB to the on-ramp from I-66 WB & EB	2015	0.41	9326	0.0	1.5	1.1
42	BS - From the on-ramp from I-66 WB and EB to the on-ramp from Lee Highway	2015	0.75	11083	5.0	2.8	2.3
44	BS - From the on-ramp from Lee Highway to the off-ramp to Gallows Road	2015	0.56	12754	3.0	2.2	1.3
46	BS - From the off-ramp to Gallows Road to the off-ramp to Braddock Road	2015	2.6	10880	5.0	9.7	10.0
48	BS - From the off-ramp to Braddock Road to the Southern SB Exit	2015	1.39	8930	5.0	5.1	5.2
	SubTotal BS&WS crashes	2015			24.0	30.8	26.5
24	BS - From Northern SB Entrance to the off-ramp to VA Rt 267	2016	0.15	7372	1.0	0.5	0.3
26	BS - From the off-ramp to VA Rt 267 to off-ramp to Jones Branch Connector	2016	0.21	6244	0.0	0.7	0.7
28	BS - From the off-ramp to Jones Branch Connector to the on-ramp from Jones Branch Connector	2016	0.35	11903	0.0	1.4	0.6

32	WS - From the on-ramp from VA Rt 267 to the off-ramp to Westpark Drive Connector	2016	0.17	9974	0.0	0.6	0.0
34	BS - From the off-ramp to Westpark Drive Connector to the on-ramp from Westpark Drive Connector	2016	0.45	10891	0.0	1.7	1.1
36	BS - From the on-ramp from Westpark Drive Connector to the on-ramp from Leesburg Pike (VA Rt 7)	2016	0.7	11851	2.0	2.7	2.0
38	BS - From the on-ramp from Leesburg Pike (VA Rt 7) to the off-ramp from I-66 WB	2016	0.53	13566	1.0	2.1	1.1
40	BS - From the off-ramp from I-66 WB to the on-ramp from I-66 WB & EB	2016	0.41	10685	1.0	1.6	0.9
42	BS - From the on-ramp from I-66 WB and EB to the on-ramp from Lee Highway	2016	0.75	12820	6.0	2.9	2.1
44	BS - From the on-ramp from Lee Highway to the off-ramp to Gallows Road	2016	0.56	14704	0.0	2.2	1.1
46	BS - From the off-ramp to Gallows Road to the off-ramp to Braddock Road	2016	2.6	12473	4.0	9.8	9.8
48	BS - From the off-ramp to Braddock Road to the Southern SB Exit	2016	1.39	10387	6.0	5.2	5.0
	SubTotal BS&WS crashes	2016			21.0	31.4	24.7
24	BS - From Northern SB Entrance to the off-ramp to VA Rt 267	2017	0.15	8446	0.0	0.6	0.1
26	BS - From the off-ramp to VA Rt 267 to off-ramp to Jones Branch Connector	2017	0.21	7177	0.0	0.8	0.5
28	BS - From the off-ramp to Jones Branch Connector to the on-ramp from Jones Branch Connector	2017	0.35	13103	0.0	1.4	0.4
32	WS - From the on-ramp from VA Rt 267 to the off-ramp to Westpark Drive Connector	2017	0.17	11196	2.0	0.7	0.0
34	BS - From the off-ramp to Westpark Drive Connector to the on-ramp from Westpark Drive Connector	2017	0.45	11793	0.0	1.7	1.0
36	BS - From the on-ramp from Westpark Drive Connector to the on-ramp from Leesburg Pike (VA Rt 7)	2017	0.7	13374	2.0	2.7	1.8
38	BS - From the on-ramp from Leesburg Pike (VA Rt 7) to the off-ramp from I-66 WB	2017	0.53	15226	1.0	2.1	0.9
40	BS - From the off-ramp from I-66 WB to the on-ramp from	2017	0.41	11907	0.0	1.6	0.8

	I-66 WB & EB						
42	BS - From the on-ramp from I-66 WB and EB to the on-ramp from Lee Highway	2017	0.75	14311	1.0	2.9	1.9
44	BS - From the on-ramp from Lee Highway to the off-ramp to Gallows Road	2017	0.56	16408	0.0	2.2	0.9
46	BS - From the off-ramp to Gallows Road to the off-ramp to Braddock Road	2017	2.6	13992	8.0	10.0	9.6
48	BS - From the off-ramp to Braddock Road to the Southern SB Exit	2017	1.39	11816	6.0	5.3	4.9
	SubTotal BS&WS crashes	2017			20.0	31.9	22.8
NB Express Lanes – MS Segments							
19	MS - on-ramp from Braddock Road	2013	0.2	1515	1.0	0.6	1.2
20	MS - on-ramp from Gallows Road	2013	0.2	1398	2.0	0.6	1.2
21	MS - on-ramp from I-66 EB	2013	0.2	3110	3.0	0.6	1.0
23	MS - on-ramp from Jones Branch Connector	2013	0.2	926	0.0	0.5	1.3
	SubTotal MS crashes	2013			6.0	2.3	4.7
19	MS - on-ramp from Braddock Road	2014	0.2	1820	0.0	0.6	1.2
20	MS - on-ramp from Gallows Road	2014	0.2	1768	0.0	0.6	1.2
21	MS - on-ramp from I-66 EB	2014	0.2	3640	2.0	0.7	0.9
23	MS - on-ramp from Jones Branch Connector	2014	0.2	1255	0.0	0.6	1.2
	SubTotal MS crashes	2014			2.0	2.4	4.5
19	MS - on-ramp from Braddock Road	2015	0.2	1930	1.0	0.6	1.1
20	MS - on-ramp from Gallows Road	2015	0.2	1803	2.0	0.6	1.2
21	MS - on-ramp from I-66 EB	2015	0.2	3941	1.0	0.7	0.9
23	MS - on-ramp from Jones Branch Connector	2015	0.2	1529	0.0	0.6	1.2
	SubTotal MS crashes	2015			4.0	2.4	4.4
19	MS - on-ramp from Braddock Road	2016	0.2	2013	2.0	0.6	1.1
20	MS - on-ramp from Gallows Road	2016	0.2	1751	0.0	0.6	1.2
21	MS - on-ramp from I-66 EB	2016	0.2	4211	0.0	0.7	0.9
23	MS - on-ramp from Jones Branch Connector	2016	0.2	1625	0.0	0.6	1.2
	SubTotal MS crashes	2016			2.0	2.5	4.3
19	MS - on-ramp from Braddock Road	2017	0.2	2171	1.0	0.6	1.1

20	MS - on-ramp from Gallows Road	2017	0.2	1846	0.0	0.6	1.2
21	MS - on-ramp from I-66 EB	2017	0.2	4658	1.0	0.7	0.8
23	MS - on-ramp from Jones Branch Connector	2017	0.2	1767	0.0	0.6	1.2
	SubTotal MS crashes	2017			2.0	2.5	4.2
SB Express Lanes – MS Segments							
29	MS - on-ramp from Jones Branch Connector	2013	0.08	926	1.0	0.2	0.8
35	MS - on-ramp from Westpark Drive Connector	2013	0.2	893	3.0	0.5	1.3
37	MS - on-ramp from Leesburg Pike (VA Rt 7)	2013	0.2	980	4.0	0.5	1.3
41	MS - on-ramp from I-66 WB & EB	2013	0.2	1178	0.0	0.6	1.2
43	MS - on-ramp from Lee Highway	2013	0.2	977	1.0	0.5	1.3
	SubTotal MS crashes	2013			9.0	2.4	5.8
29	MS - on-ramp from Jones Branch Connector	2014	0.08	1255	0.0	0.2	0.7
35	MS - on-ramp from Westpark Drive Connector	2014	0.2	1289	0.0	0.6	1.2
37	MS - on-ramp from Leesburg Pike (VA Rt 7)	2014	0.2	1216	2.0	0.6	1.2
41	MS - on-ramp from I-66 WB & EB	2014	0.2	1447	0.0	0.6	1.2
43	MS - on-ramp from Lee Highway	2014	0.2	1341	1.0	0.6	1.2
	SubTotal MS crashes	2014			3.0	2.5	5.6
29	MS - on-ramp from Jones Branch Connector	2015	0.08	1529	1.0	0.2	0.7
35	MS - on-ramp from Westpark Drive Connector	2015	0.2	1540	2.0	0.6	1.2
37	MS - on-ramp from Leesburg Pike (VA Rt 7)	2015	0.2	1432	2.0	0.6	1.2
41	MS - on-ramp from I-66 WB & EB	2015	0.2	1756	1.0	0.6	1.2
43	MS - on-ramp from Lee Highway	2015	0.2	1671	2.0	0.6	1.2
	SubTotal MS crashes	2015			8.0	2.6	5.4
29	MS - on-ramp from Jones Branch Connector	2016	0.08	1625	0.0	0.2	0.7
35	MS - on-ramp from Westpark Drive Connector	2016	0.2	1616	1.0	0.6	1.2
37	MS - on-ramp from Leesburg Pike (VA Rt 7)	2016	0.2	1715	3.0	0.6	1.2
41	MS - on-ramp from I-66 WB & EB	2016	0.2	2135	1.0	0.6	1.1
43	MS - on-ramp from Lee Highway	2016	0.2	1885	2.0	0.6	1.1
	SubTotal MS crashes	2016			7.0	2.6	5.3
29	MS - on-ramp from Jones Branch Connector	2017	0.08	1767	1.0	0.2	0.7
35	MS - on-ramp from Westpark Drive Connector	2017	0.2	1927	1.0	0.6	1.1

37	MS - on-ramp from Leesburg Pike (VA Rt 7)	2017	0.2	1852	3.0	0.6	1.2
41	MS - on-ramp from I-66 WB & EB	2017	0.2	2404	1.0	0.6	1.1
43	MS - on-ramp from Lee Highway	2017	0.2	2096	0.0	0.6	1.1
	SubTotal MS crashes	2017			6.0	2.7	5.2
NB Express Lanes – DS Segments							
13	DS - off-ramp to Lee Highway	2013	0.2	1138	3.0	0.6	1.2
14	DS - off-ramp to I-66	2013	0.2	2070	2.0	0.6	1.1
15	DS - off-ramp to Leesburg Pike (VA Rt 7)	2013	0.2	1461	0.0	0.6	1.2
16	DS - off-ramp to Westpark Drive Connector	2013	0.2	1249	3.0	0.6	1.2
18	DS - off-ramp to VA Rt 267 NB	2013	0.13	2786	0.0	0.4	0.8
	SubTotal DS crashes	2013			8.0	2.7	5.5
13	DS - off-ramp to Lee Highway	2014	0.2	1490	1.0	0.6	1.2
14	DS - off-ramp to I-66	2014	0.2	2431	2.0	0.6	1.1
15	DS - off-ramp to Leesburg Pike (VA Rt 7)	2014	0.2	1803	0.0	0.6	1.2
16	DS - off-ramp to Westpark Drive Connector	2014	0.2	1479	0.0	0.6	1.2
18	DS - off-ramp to VA Rt 267 NB	2014	0.13	3277	0.0	0.4	0.7
	SubTotal DS crashes	2014			3.0	2.8	5.3
13	DS - off-ramp to Lee Highway	2015	0.2	1784	1.0	0.6	1.2
14	DS - off-ramp to I-66	2015	0.2	2692	0.0	0.6	1.1
15	DS - off-ramp to Leesburg Pike (VA Rt 7)	2015	0.2	2011	0.0	0.6	1.1
16	DS - off-ramp to Westpark Drive Connector	2015	0.2	1549	2.0	0.6	1.2
18	DS - off-ramp to VA Rt 267 NB	2015	0.13	3714	0.0	0.4	0.6
	SubTotal DS crashes	2015			3.0	2.8	5.2
13	DS - off-ramp to Lee Highway	2016	0.2	1966	1.0	0.6	1.1
14	DS - off-ramp to I-66	2016	0.2	2933	1.0	0.6	1.0
15	DS - off-ramp to Leesburg Pike (VA Rt 7)	2016	0.2	2112	0.0	0.6	1.1
16	DS - off-ramp to Westpark Drive Connector	2016	0.2	1619	1.0	0.6	1.2
18	DS - off-ramp to VA Rt 267 NB	2016	0.13	3804	0.0	0.4	0.6
	SubTotal DS crashes	2016			3.0	2.9	5.1
13	DS - off-ramp to Lee Highway	2017	0.2	2144	2.0	0.6	1.1
14	DS - off-ramp to I-66	2017	0.2	3351	1.0	0.6	1.0

15	DS - off-ramp to Leesburg Pike (VA Rt 7)	2017	0.2	2181	0.0	0.6	1.1
16	DS - off-ramp to Westpark Drive Connector	2017	0.2	1712	1.0	0.6	1.2
18	DS - off-ramp to VA Rt 267 NB	2017	0.13	4180	0.0	0.4	0.6
	SubTotal DS crashes	2017			4.0	2.9	5.0
SB Express Lanes – DS Segments							
25	DS - off-ramp to VA Rt 267 SB	2013	0.2	835	0.0	0.5	1.3
27	DS - off-ramp to Jones Branch Connector	2013	0.2	619	0.0	0.5	1.3
39	DS - off-ramp from I-66 WB	2013	0.2	1759	2.0	0.6	1.2
45	DS - off-ramp to Gallows Road	2013	0.2	1379	3.0	0.6	1.2
47	DS - off-ramp to Braddock Road	2013	0.2	1492	4.0	0.6	1.2
	SubTotal DS crashes	2013			9.0	2.8	6.1
25	DS - off-ramp to VA Rt 267 SB	2014	0.2	932	1.0	0.5	1.3
27	DS - off-ramp to Jones Branch Connector	2014	0.2	599	0.0	0.5	1.3
39	DS - off-ramp from I-66 WB	2014	0.2	2055	0.0	0.6	1.1
45	DS - off-ramp to Gallows Road	2014	0.2	1623	1.0	0.6	1.2
47	DS - off-ramp to Braddock Road	2014	0.2	1760	0.0	0.6	1.2
	SubTotal DS crashes	2014			2.0	2.8	6.0
25	DS - off-ramp to VA Rt 267 SB	2015	0.2	1067	1.0	0.6	1.2
27	DS - off-ramp to Jones Branch Connector	2015	0.2	568	0.0	0.5	1.3
39	DS - off-ramp from I-66 WB	2015	0.2	2458	3.0	0.6	1.1
45	DS - off-ramp to Gallows Road	2015	0.2	1874	0.0	0.6	1.1
47	DS - off-ramp to Braddock Road	2015	0.2	1959	1.0	0.6	1.1
	SubTotal DS crashes	2015			5.0	2.9	5.9
25	DS - off-ramp to VA Rt 267 SB	2016	0.2	1128	2.0	0.6	1.2
27	DS - off-ramp to Jones Branch Connector	2016	0.2	604	0.0	0.5	1.3
39	DS - off-ramp from I-66 WB	2016	0.2	2881	1.0	0.6	1.0
45	DS - off-ramp to Gallows Road	2016	0.2	2231	1.0	0.6	1.1
47	DS - off-ramp to Braddock Road	2016	0.2	2086	0.0	0.6	1.1
	SubTotal DS crashes	2016			4.0	2.9	5.8
25	DS - off-ramp to VA Rt 267 SB	2017	0.2	1269	0.0	0.6	1.2
27	DS - off-ramp to Jones Branch Connector	2017	0.2	617	0.0	0.5	1.3

39	DS - off-ramp from I-66 WB	2017	0.2	3319	2.0	0.6	1.0
45	DS - off-ramp to Gallows Road	2017	0.2	2416	1.0	0.6	1.1
47	DS - off-ramp to Braddock Road	2017	0.2	2176	1.0	0.6	1.1
	SubTotal DS crashes	2017			4.0	3.0	5.7
	TOTAL CRASHES				396.0	381.6	396.9

Statistical Model Forms

Group 1: 1 - All Crashes as a function of AADT, segment length and segment type – Linear Regression

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.753237136					
R Square	0.567366182					
Adjusted R Square	0.558924547					
Standard Error	2.016754958					
Observations	210					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	4	1093.460528	273.3651319	67.21045757	2.98084E-36	
Residual	205	833.7966153	4.067300563			
Total	209	1927.257143				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.455099982	0.304427175	1.494938759	0.136468169	-0.1451097	1.055309665
Var - Segment Length	4.081164737	0.266583921	15.30911812	8.80903E-36	3.555566945	4.606762528
Var - AADT	-0.00017734	5.41114E-05	-3.277318667	0.001230816	-0.000284026	-7.0654E-05
Var - Model Type 1	0.775941561	0.542836101	1.429421438	0.154405258	-0.294315996	1.846199118
Var - Model Type 2	0.199571911	0.41442907	0.481558668	0.630633148	-0.617517893	1.016661714

Group 1: 2 - All Crashes as a function of AADT and segment length – Linear Regression

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.750749642					
R Square	0.563625024					
Adjusted R Square	0.559408841					
Standard Error	2.015647471					
Observations	210					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	2	1086.250354	543.125177	133.6813366	5.31488E-38	
Residual	207	841.0067888	4.062834729			
Total	209	1927.257143				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.550840245	0.231211878	2.382404616	0.018105085	0.095008249	1.006672241
X Variable 1	4.130999289	0.264245259	15.63320115	6.77688E-37	3.610042299	4.651956278
X Variable 2	-0.000121228	3.35931E-05	-3.608727273	0.00038588	-0.000187457	-5.49999E-05

Group 1: 3 - Basic and Weave Segment Crashes as a function of AADT and segment length – Linear Regression

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.751786543					
R Square	0.565183006					
Adjusted R Square	0.557418417					
Standard Error	2.556090366					
Observations	115					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	2	951.1587676	475.5793838	72.78981454	5.56115E-21	
Residual	112	731.7629715	6.53359796			
Total	114	1682.921739				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1.299435488	0.723555074	1.795904052	0.075205939	-0.134196141	2.733067118
Var - Segment Length	4.085369457	0.338595845	12.06562196	5.52822E-22	3.414485194	4.75625372
Var - AADT	-0.000184639	7.03474E-05	-2.624668384	0.009883918	-0.000324023	-4.52542E-05

Group 1: 4 - Merge Segment Crashes as a function of AADT and segment length – Linear Regression

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.167869458					
R Square	0.028180155					
Adjusted R Square	-0.018096981					
Standard Error	1.071774855					
Observations	45					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	2	1.398988129	0.699494065	0.608943369	0.548657135	
Residual	42	48.24545632	1.148701341			
Total	44	49.64444444				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.280502347	0.835337028	0.335795419	0.738696895	-1.405276025	1.966280718
Var - Segment Length	4.754931687	4.309129521	1.103455272	0.276111891	-3.941243754	13.45110713
Var - AADT	-4.28738E-05	0.000196754	-0.217905741	0.828557812	-0.000439939	0.000354191

Group 1: 5 - Diverge Segment Crashes as a function of AADT and segment length – Linear Regression

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.313987521					
R Square	0.098588163					
Adjusted R Square	0.059396344					
Standard Error	1.021656556					
Observations	49					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	2	5.251328694	2.625664347	2.515529153	0.091882944	
Residual	46	48.01397743	1.043782118			
Total	48	53.26530612				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-3.230890795	1.989573254	-1.623911453	0.111228507	-7.235694043	0.773912452
Var - Segment Length	19.24080239	8.811905381	2.183500794	0.034137274	1.503356834	36.97824795
Var - AADT	0.000205393	0.000213802	0.960671251	0.341740192	-0.000224967	0.000635754

Group 2: 6 - All Crashes as a function of AADT and segment type – Linear Regression

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.269724972					
R Square	0.072751561					
Adjusted R Square	0.059247943					
Standard Error	2.945332145					
Observations	210					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	3	140.2109648	46.73698827	5.387560603	0.001371167	
Residual	206	1787.046178	8.674981447			
Total	209	1927.257143				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.907172063	0.442498423	2.050113662	0.041619897	0.03476577	1.779578355
Var - AADT	-3.71069E-06	7.72706E-05	-0.048022058	0.961745188	-0.000156053	0.000148632
Var - Model Type 1	1.755330322	0.787250161	2.229698271	0.026846963	0.20322989	3.307430755
Var - Model Type 2	0.188571588	0.605244291	0.311562769	0.755687918	-1.004695779	1.381838954

Group 2: 7 - All Crashes as a function of AADT – Linear Regression

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.221762994					
R Square	0.049178826					
Adjusted R Square	0.04460757					
Standard Error	2.968161905					
Observations	210					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	1	94.78024298	94.78024298	10.75827507	0.001217095	
Residual	208	1832.4769	8.809985096			
Total	209	1927.257143				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1.002623055	0.338290863	2.963789939	0.00339307	0.335704724	1.669541386
Var - AADT	0.000141744	4.32149E-05	3.279980955	0.001217095	5.65487E-05	0.000226939

Group 2: 8 - Basic and Weave Segment Crashes as a function of AADT – Linear Regression

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.001239642					
R Square	1.53671E-06					
Adjusted R Square	-0.008848007					
Standard Error	3.859156624					
Observations	115					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	1	0.002586165	0.002586165	0.000173649	0.989509353	
Residual	113	1682.919153	14.89308985			
Total	114	1682.921739				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	2.639498008	1.07946903	2.445181785	0.01602166	0.500875168	4.778120848
Var - AADT	-1.36657E-06	0.000103704	-0.013177582	0.989509353	-0.000206823	0.00020409

Group 2: 9 - Merge Segment Crashes as a function of AADT – Linear Regression

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.002514256					
R Square	6.32148E-06					
Adjusted R Square	-0.023249345					
Standard Error	1.074483441					
Observations	45					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	1	0.000313827	0.000313827	0.000271825	0.986922032	
Residual	43	49.64413062	1.154514666			
Total	44	49.64444444				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1.094795327	0.392422755	2.789836502	0.007829064	0.303399417	1.886191237
Var - AADT	-3.19734E-06	0.000193929	-0.016487131	0.986922032	-0.000394293	0.000387898

Group 2: 10 - Basic and Weave Segment Crashes as a function of AADT – Linear Regression

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.071841641							
R Square	0.005161221							
Adjusted R Square	-0.016005561							
Standard Error	1.06181691							
Observations	49							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	0.274914037	0.274914037	0.243835896	0.62374909			
Residual	47	52.99039209	1.127455151					
Total	48	53.26530612						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*Ipper 95.0%*
Intercept	1.043630191	0.368954663	2.828613638	0.006851573	0.301389148	1.785871234	0.301389	1.785871
Var - AADT	-8.57686E-05	0.000173692	-0.493797424	0.62374909	-0.000435192	0.000263654	-0.00044	0.000264