

# I-495 Express Lanes Northern Extension Interchange Justification Report Addendum

December 2021

The findings of this document have been agreed upon between the Virginia Department of Transportation and Federal Highway Administration. The recommendations in this document will be carried forward in support of the Addendum to the I-495 NEXT Interchange Justification Report, originally approved June 11, 2021.

---

Abraham Lerner, P.E.  
I-495 NEXT Project Manager  
Associate Manager Special Projects  
Virginia Department of Transportation

---

12/17/2021

---

Date

---

Stephen L. Bates, P.E.  
NOVA District Location and Design Engineer  
Virginia Department of Transportation

---

Date

---

Gilbert Chlewicki, P.E.  
Northern Virginia District Traffic Engineer  
Virginia Department of Transportation

---

Date

---

Emmett R. Heltzel, P.E.  
State Location and Design Engineer  
Location and Design Division  
Virginia Department of Transportation

---

Date

---

Thomas L. Nelson, Jr., P.E.  
Division Administrator  
Federal Highway Administration, Virginia Division

---

Date

## EXECUTIVE SUMMARY

This Interchange Justification Report Addendum provides an update to the I-495 Express Lanes Northern Extension (NEXT) Interchange Justification Report (IJR), which was approved by FHWA on June 11, 2021. This Addendum evaluates further modifications to the Proposed Action from the Approved IJR at the I-495 interchanges with the George Washington Memorial Parkway (GWMP) and Route 193 (Georgetown Pike). **Figure ES-1** shows the original project Study Area for the entire I-495 NEXT project and the IJR Addendum Study Area.

The improvements proposed through this Addendum include the following:

- Modified Conceptual Plan for GWMP interchange (see **Figure ES-2**)
  - Relocation of the ramp from northbound I-495 Express to GWMP from the location proposed in the Approved IJR Conceptual Plan: this ramp would now fly over the southbound I-495 GP and Express Lanes and tie into GWMP on the west side of I-495 in order to reduce impacts on the east side of the I-495/GWMP interchange.
- Modified Conceptual Plan for Route 193 (Georgetown Pike) interchange (see **Figure ES-2**)
  - Channelized free-flow right-turn from westbound Route 193 to northbound I-495.
  - Northbound I-495 on-ramp refinements, including a longer acceleration and an additional merge lane on the ramp beyond the merge gore point with I-495.
  - Revised Route 193 overpass typical section, including a wider bridge with a six-foot-wide sidewalk on the north side of the bridge and a trail connection to Scotts Run Nature Preserve.

Note these modifications for the I-495 NEXT project are not anticipated to require any additional Design Exceptions or Design Waivers.

**Figure ES-3** shows the additional improvements that will be constructed with the Maryland project, which were analyzed for the purposes of traffic and safety:

- Addition of a proposed exchange ramp from northbound I-495 GP to northbound I-495 Express: this new ramp would provide northbound ingress to the I-495 Express Lanes. The corresponding movement from northbound I-495 Express to northbound I-495 GP would be accommodated within Maryland in the vicinity of the River Road interchange, or at a location further to the north, consistent with the approved CLRP.
- Addition of a proposed exchange ramp from southbound I-495 Express to southbound I-495 GP: this new ramp would provide southbound egress from the I-495 Express Lanes. The corresponding movement from southbound I-495 GP to southbound I-495 Express would be accommodated at various points upstream in Maryland, consistent with approved CLRP.

Note that these modifications are assumed to be provided as part of the Maryland project and as such will be subject to VDOT's review process as that project moves forward on a parallel but independent track.

These improvements continue to satisfy FHWA's IJR Policy Points that must be addressed for all requests for new or modified access points to the existing Interstate Highway System

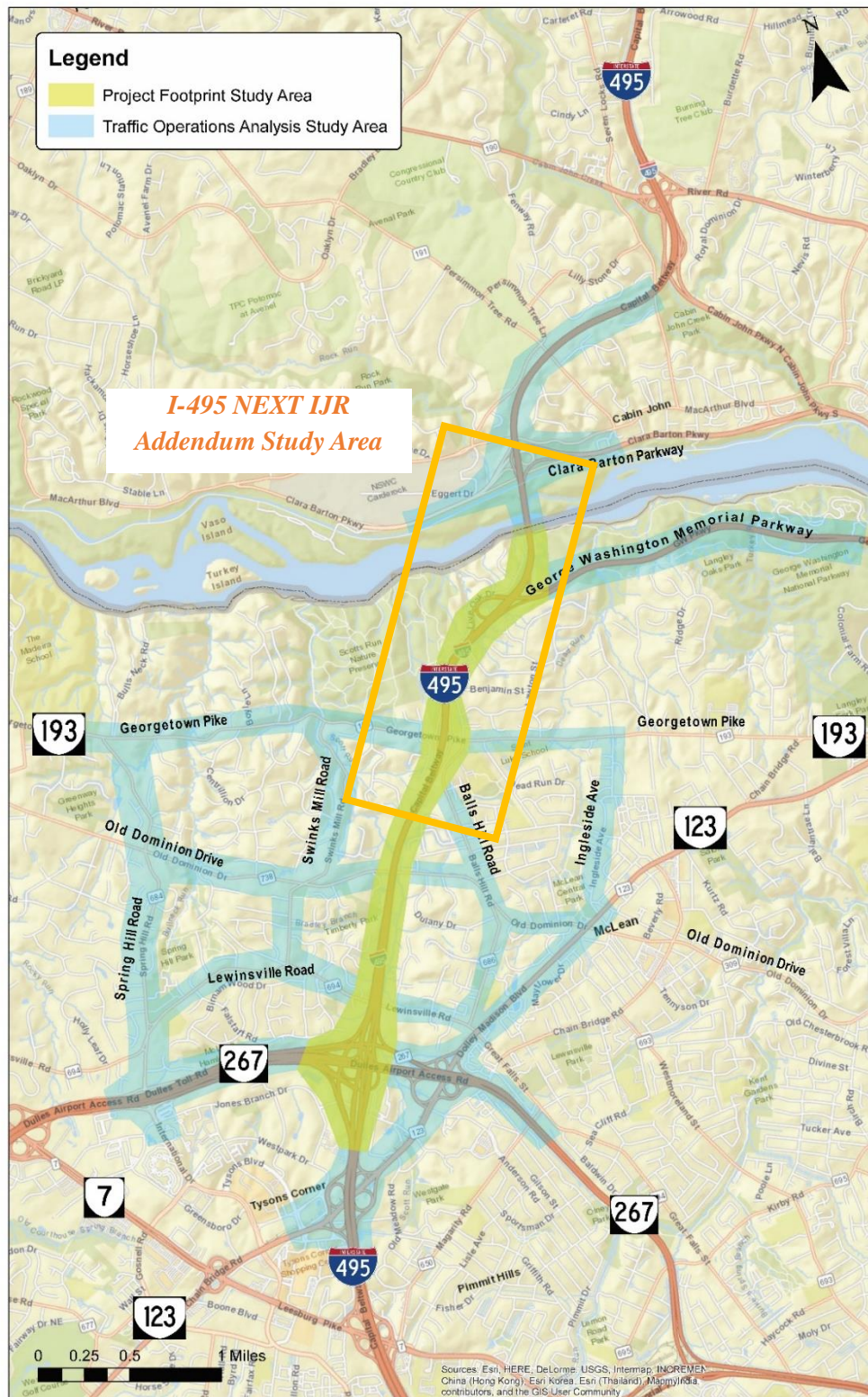


Figure ES-1. Project Traffic Operations Analysis Study Area and IJR Addendum Study Area

**Table ES-1** provides a comparison summary of traffic operations results across the AM and PM peak periods for both 2025 and 2045, with results being compared for the Build (Modified) condition against both the Build (Approved IJR) and No Build condition.

- 2025 AM:** Freeway operations are consistent between Build (Modified) and Build (Approved IJR) conditions. GP lane operations improve as compared to No Build conditions in both directions. Consistent traffic operations are observed along Route 193 between Build (Modified) and Build (Approved IJR) conditions.
- 2025 PM:** Freeway operations are generally consistent between Build (Modified) and Build (Approved IJR) conditions, with the Build (Modified) conditions showing a slight improvement in travel times in the southbound GP lanes. GP lane operations improve as compared to No Build conditions in both directions. Improved traffic operations are observed along Route 193 in the Build (Modified) condition as compared to the Build (Approved IJR) condition due to the increased capacity provided at the Route 193 interchange. Both Build scenarios show improved operations on Route 193 as compared to the No Build condition.
- 2045 AM:** Freeway operations are generally consistent between Build (Modified) and Build (Approved IJR) conditions, with the Build (Modified) conditions showing slight improvements in travel times in both directions in the GP lanes due to reduced congestion over the ALMB. GP lane operations improve as compared to No Build conditions in both directions. Improved traffic operations are observed along Route 193 in the Build (Modified) condition as compared to the Build (Approved IJR) condition due to the increased capacity provided at the Route 193 interchange. Both Build scenarios show improved operations on Route 193 as compared to the No Build condition.
- 2045 PM:** Freeway operations are generally consistent between Build (Modified) and Build (Approved IJR) conditions, with the Build (Modified) conditions showing a slight increase in travel times (approximately 1.5 minutes) in the southbound GP lanes due to increased traffic demand south of Route 193 (south of the exchange ramp from the southbound Express Lanes). GP lane operations improve as compared to No Build conditions in both directions. Consistent traffic operations are observed along Route 193 between Build (Modified) and Build (Approved IJR) conditions.

**Table ES-1. Comparison of Traffic Operational MOEs for Build (Modified) Condition**

Measure of Effectiveness	Build (Modified) - 2025 AM		Build (Modified) - 2025 PM		Build (Modified) - 2045 AM		Build (Modified) - 2045 PM	
	vs. Build (Approved IJR)	vs. No Build	vs. Build (Approved IJR)	vs. No Build	vs. Build (Approved IJR)	vs. No Build	vs. Build (Approved IJR)	vs. No Build
Northbound GP Lanes Operations	Consistent	Improved	Consistent	Improved	Slightly Improved	Improved	Consistent	Improved
Southbound GP Lanes Operations	Consistent	Improved	Slightly Improved	Improved	Slightly Improved	Improved	Slightly Worse	Improved
Express Lanes Operations (Both Directions)	Consistent	-	Consistent	-	Consistent	-	Consistent	-
Route 193 Operations	Consistent	Consistent	Improved	Improved	Improved	Improved	Consistent	Improved

Overall, the Build (Modified) condition is projected to result in an approximately 4 percent increase in crashes as compared to the Build (Approved IJR) condition. This is attributable to the increase in traffic demand in the GP lanes for both directions south of the GWMP in the Build (Modified) condition. However, the Build (Modified) condition still results in a nearly 19 percent decrease in total crashes in the IJR Addendum study area as compared to No Build conditions. Furthermore, it is important to note that the Build (Modified) condition provides additional access to and from the Express Lanes, resulting in increased travel choices for drivers, as well as a projected decrease in GP lanes traffic across the ALMB.

An updated Conceptual Signing Plan is provided in **Appendix A** of the attached IJR Addendum.

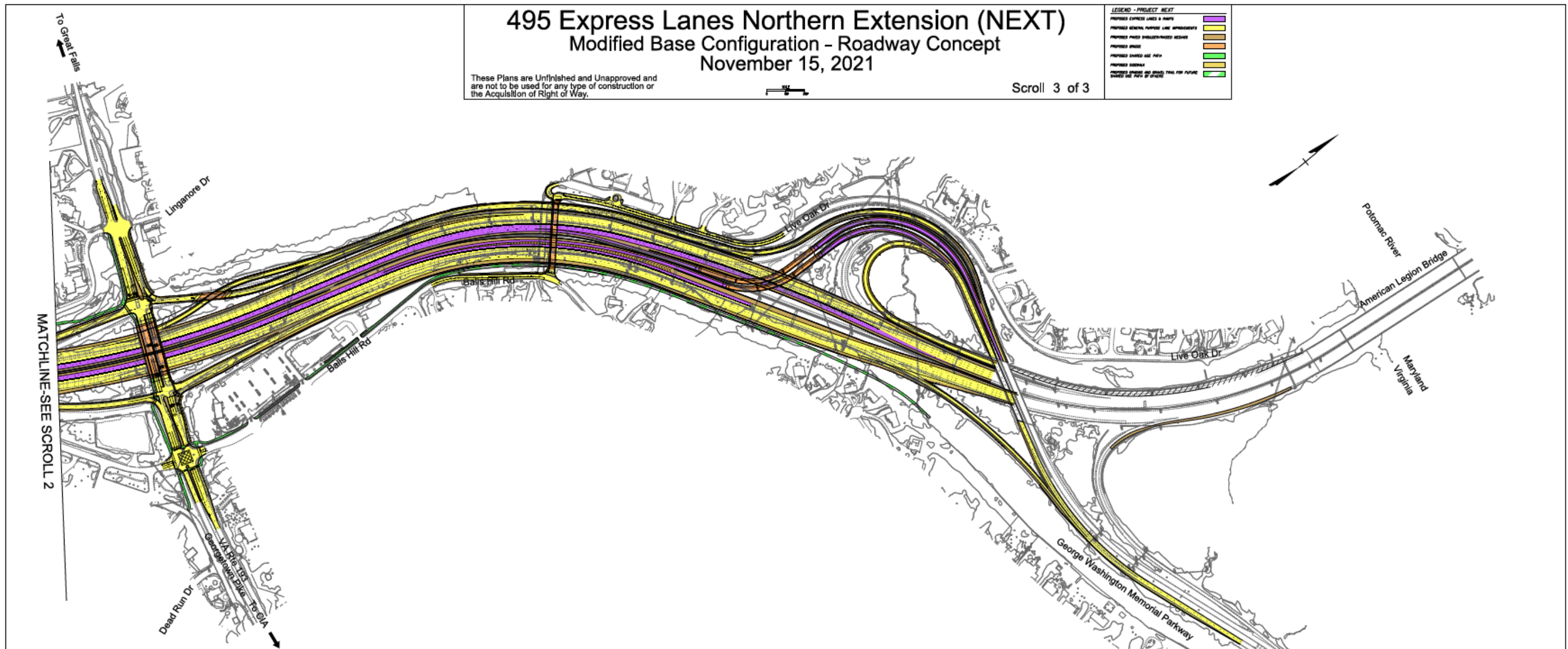


Figure ES-2: Modified Conceptual Plan for the Route 193 (Georgetown Pike) Interchange and George Washington Memorial Parkway Interchange: I-495 NEXT Project Only

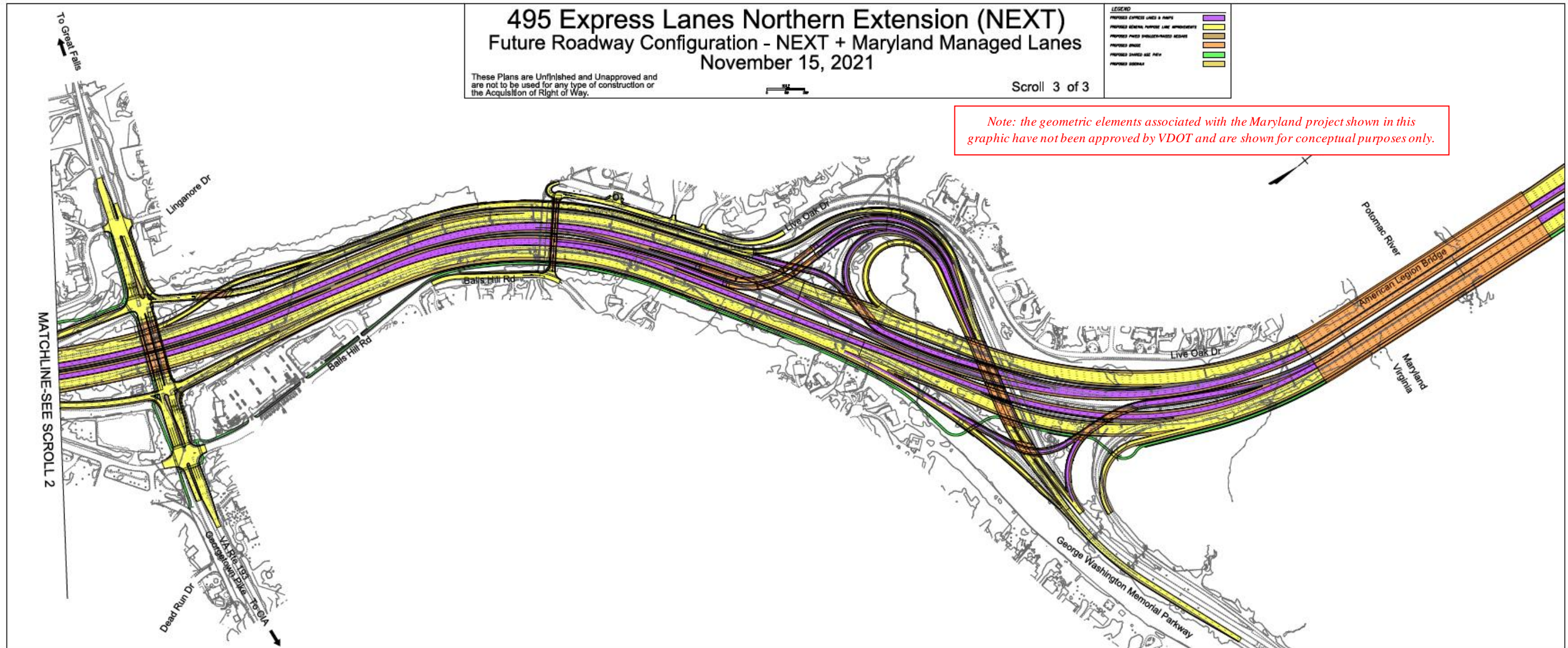


Figure ES-3. Modified Conceptual Plan for the Route 193 (Georgetown Pike) Interchange and George Washington Memorial Parkway Interchange I-495: NEXT + Maryland Managed Lanes Project



## 1. INTRODUCTION

This Interchange Justification Report Addendum provides an update to the I-495 Express Lanes Northern Extension (NEXT) Interchange Justification Report (IJR), which was approved by FHWA on June 11, 2021. This Addendum evaluates further modifications to the Proposed Action from the Approved IJR at the I-495 interchanges with the George Washington Memorial Parkway (GWMP) and Route 193 (Georgetown Pike).

This document has been prepared to satisfy the requirements set forth by Federal and State Policy for changes in interstate access. It is consistent with the Virginia Department of Transportation's (VDOT's) Location and Design Division Instructional and Informational Memorandum LD-200.9, and in accordance with FHWA's policy on *Access to the Interstate System* dated August 27, 2009, and updated May 22, 2017.

### 1.1 PROPOSED ACTION FROM APPROVED IJR

VDOT, in cooperation with the FHWA and Fairfax County, evaluated improvement alternatives for an extension of the 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 GWMP in the McLean area of Fairfax County. The development of improvements in this corridor followed the National Environmental Policy Act (NEPA) process, and in accordance with FHWA regulations, an Environmental Assessment (EA) was prepared. A Finding of No Significant Impact (FONSI) was issued on October 4, 2021, and a Finding of Engineering and Operational Acceptability was issued by FHWA on June 11, 2021.

Under this project, I-495 would be improved to provide the following:

- Extension of the existing I-495 Express Lanes, with two Express Lanes provided in each direction 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.
- Additional general purpose (GP) auxiliary lanes between the Route 267 and Route 193 interchanges to supplement the existing four GP through lanes in each direction.
- Additional access to and from the Express Lanes network
- Improvements to I-495 interchanges between Route 123 and GWMP
- Reconstruction of I-495 overpasses in the study area at Old Dominion Drive and Live Oak Drive

The improvements described in this Addendum are consistent with the Proposed Action from the Approved IJR and include further improvements to I-495 interchanges and additional access to and from the Express Lanes network. The further improvements are described in detail in **Section 3**.

These items satisfy the project Purpose and Need, described in Chapter 2 of the Approved IJR.

### 1.2 IJR ADDENDUM STUDY AREA

**Figure 1-1** shows the original project Study Area for the entire I-495 NEXT project and the IJR Addendum Study Area. The project Traffic Operational Analysis Study Area is consistent with the Study Area shown in the Approved IJR. Note that the improvements in this Addendum are focused at the I-495 interchanges with GWMP and Route 193; as such, the IJR Addendum Study Area focuses on operations along I-495 from south of Route 193 to Clara Barton Parkway, including operations along Route 193 and the GWMP.



Figure 1-1. Project Traffic Operations Analysis Study Area and IJR Addendum Study Area

## 2. NO BUILD ALTERNATIVE

This section provides a brief update on the project No Build Alternative, which is described in Chapter 6 of the Approved IJR. The No Build Alternative assumes the construction of the adjacent managed lanes system in Maryland across the ALMB, around the I-495 Beltway in Maryland, and along I-270 in Maryland north to I-370 (see Section 6.2.1 of the Approved IJR).

Upon coordination with Maryland DOT – State Highway Administration (MDOT-SHA) in Summer 2021, MDOT-SHA staff shared updated conceptual plans for the I-495 interchanges with Cabin John Parkway, River Road, I-270, and points north along I-270. These conceptual plans result in changes in access into and out of the managed lanes system within Maryland but do not impact the I-495 NEXT No Build Alternative within the Study Area, which assumes that the Maryland managed lanes system would terminate near the GWMP interchange in Virginia. Northbound ingress and southbound egress from the system would be provided via left-side slip ramps at this location, similar to how the existing I-495 Express Lanes network terminus exists north of the Dulles Toll Road.

Given the changes in the network in Maryland beyond the I-495 NEXT Study Area, VDOT re-ran the I-495 NEXT travel demand model (a modified version of the MWCOC model described in Chapter 8 of the Approved IJR) with those changes in place to determine the impact, if any, on forecasted traffic volumes in Virginia within the Study Area. The results of these model runs showed a slight decrease in traffic in the Maryland managed lanes (statistically insignificant due to being within the margin of error), and essentially no change in the GP lanes. Therefore, VDOT conservatively assumed the same traffic forecasts and traffic analysis results for the No Build scenarios from the approved I-495 NEXT IJR. The assumptions for the network in Maryland are consistent with the regional Constrained Long-Range Plan (CLRP) Documentation summarizing the results of these model runs is included in **Appendix B**.

## 3. UPDATE TO PROPOSED ACTION (VDOT / TRANSURBAN 495 NEXT CHANGES)

The improvements proposed through this Addendum include the following:

- Modified Conceptual Plan for GWMP interchange (see **Exhibit 3-1**)
  - Relocation of the ramp from northbound I-495 Express to GWMP from the location proposed in the Approved IJR Conceptual Plan: this ramp would now fly over the southbound I-495 GP and Express Lanes and tie into GWMP on the west side of I-495 in order to reduce impacts on the east side of the I-495/GWMP interchange.
- Modified Conceptual Plan for Route 193 (Georgetown Pike) interchange (see **Exhibit 3-1**)
  - Channelized free-flow right-turn from westbound Route 193 to northbound I-495
  - Northbound I-495 on-ramp refinements, including a longer acceleration and an additional merge lane on the ramp beyond the merge gore point with I-495.
  - Revised Route 193 overpass typical section, including a wider bridge with a six-foot-wide sidewalk on the north side of the bridge and a trail connection to Scotts Run Nature Preserve

Note these modifications for the I-495 NEXT project are not anticipated to require any additional Design Exceptions or Design Waivers.

**Exhibit 3-2** shows the additional improvements that will be constructed with the Maryland project, which were analyzed for the purposes of traffic and safety:

- Addition of a proposed exchange ramp from northbound I-495 GP to northbound I-495 Express: this new ramp would provide northbound ingress to the I-495 Express Lanes. The corresponding movement from northbound I-495 Express to northbound I-495 GP would be accommodated within Maryland in the vicinity of the River Road interchange, or at a location further to the north, consistent with the approved CLRP.
- Addition of a proposed exchange ramp from southbound I-495 Express to southbound I-495 GP: this new ramp would provide southbound egress from the I-495 Express Lanes. The corresponding movement from southbound I-495 GP to southbound I-495 Express would be accommodated at various points upstream in Maryland, consistent with approved CLRP.

Note that these modifications are assumed to be provided as part of the Maryland project and as such will be subject to VDOT's review process as that project moves forward on a parallel but independent track.

## 4. FHWA AND VDOT INTERSTATE ACCESS POLICY COMPLIANCE

FHWA requires the preparation of an IJR for every proposed highway system modification that affects Interstate Highway access to facilitate the agency's independent evaluation of the request and to ensure that alternatives and pertinent factors have been appropriately considered. As the United States Department of Transportation's final reviewing agency and authority for all Interstate Highway access requests, FHWA has specified two justification policy points that must be addressed for all requests for new or modified access points to the existing Interstate Highway System. This report addresses both policy points for the proposed new and modified access points on the I-495 corridor between Route 267 and the ALMB. Additional factors beyond the operation, safety, and engineering acceptability of the requested change will be addressed as part of a separate of related NEPA process.

### 4.1.1 Policy Point 1

#### ***Policy Point 1***

*An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis should, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (23 CFR 625.2(a), 655.603(d) and 771.111(f)).*

*The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, should be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access should include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute, and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each*

request should also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).

### ***Response to Policy Point 1***

#### Study Area

The study area for operational analyses and safety performed as a part of this IJR, described in Chapter 4 of the Approved IJR, satisfies the FHWA requirements for roadway network analysis.

#### Operational and Safety Analyses

The traffic operations and safety analyses were performed for three analysis years: existing conditions (2018), 2025, and 2045. This analysis includes No Build and Build conditions in both 2025 and 2045. The traffic operational analyses and quantitative safety studies consistent with FHWA policy were documented in Chapters 9 and 10 of the Approved IJR, respectively. This IJR Addendum document confirms that traffic operations and safety conditions for the Modified 2025 and 2045 Build scenarios, henceforth referred to as “Build (Modified)” scenarios, remain generally consistent with the operations and safety conditions from the Build (Approved IJR) scenarios and show an improvement over No Build conditions.

Chapter 8 of the Approved IJR details the forecast traffic volumes for 2025 and 2045 and the methodology used to develop them. The modified forecast traffic volumes for 2025 Build (Modified) and 2045 Build (Modified) conditions are described in **Section 5** of this document.

The proposed plan for I-495 will result in marked operational improvements to the overall system by increasing capacity and improving access on the GP lanes by transferring some of the traffic currently using the over-saturated GP lanes to the proposed Express Lanes. The Express Lanes, which are physically separated from the GP lanes, operate at desirable travel speeds. In addition, adjacent crossroad intersections to the interchanges and local network also benefit from the proposed plan as indicated by less queue spillback from the I-495 mainline and less cut-through traffic within the influence area as a result of oversaturated conditions under the No Build scenarios. A detailed assessment of traffic operations using microsimulation (VISSIM) is presented in Chapter 9 of the Approved IJR and in **Section 6** of this document for the Build (Modified) scenarios.

From a safety perspective, detailed qualitative and quantitative safety analyses were conducted for the corridor on the general purpose lanes, ramps, arterials, and intersections and are detailed in Chapter 10 of the Approved IJR. Highway safety and design professionals used the *Highway Safety Manual* (HSM) as a resource to inform project development, design, and decision making in determining design features with the greatest potential to benefit safety. The crash prediction methods identified in the HSM use key elements for roadway design and traffic data that are fundamental to project development. Three safety analysis 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.

Planning level crash analysis was performed using industry standard practice and highway safety analysis tools. This analysis evaluated the safety performance of existing conditions and assessed the differences between the 2045 No Build and Build alternatives. The safety analyses focused on the network as a system, including mainline segments, ramps, C-D roads, intersections, and arterials. The quantitative safety evaluation of I-495 operations revealed an overall improvement in safety in 2045 under the Build Alternative compared to the No Build 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. The detailed results of these analysis are described in Chapter 9 of the Approved IJR and in **Section 7** of this document for the Build (Modified) condition. This document shows that the Build (Modified) condition results in generally consistent crash predictions with the Build (Approved IJR) condition, with both showing a significant reduction in crashes as compared to the No Build condition.

#### Conceptual Signing Plan

A conceptual signing plan for the Build Alternative was developed to demonstrate that the improvements could be signed in accordance with the Manual on Uniform Traffic Control Devices (MUTCD). The original conceptual signing plan for the Build Alternative was provided as Appendix C to the Approved IJR. The conceptual signing plan for the Modified Build Alternative was developed in coordination with VDOT, Fairfax County, and NPS and is included in **Appendix A** for reference.

#### **4.1.2 Policy Point 2**

##### ***Policy Point 2***

*The proposed access connects to a public road only and will provide for all traffic movements. Less than “full interchanges” may be considered on a case-by-case basis for applications requiring special access, such as managed lanes (e.g., transit, HOVs, HOT lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)). In rare instances where all basic movements are not provided by the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial-interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding signage, impacts on local intersections, mitigation of driver expectation leading to wrong-way movements on ramps, etc. The report should describe whether future provision of a full interchange is precluded by the proposed design.*

##### ***Response to Policy Point 2***

The proposed plan provides access to public roads for all the interchange improvements. A few partial interchanges were proposed or retained and incorporated into the access configuration to connect to the I-495 GP lanes and/or Express Lanes in the Build Alternative and Phase 1 concept because of special access conditions associated with Express Lanes and existing configuration at the I-495/Route 267 interchange.

The improvements associated with this IJR Addendum create an additional partial interchange at the GWMP interchange, as access is provided from the northbound GP lanes to the northbound Express Lanes

and from the southbound Express Lanes to the southbound GP lanes. The reverse movements – northbound Express to northbound GP and southbound GP to southbound Express – were assumed to be provided north of the study area in Maryland given ongoing coordination with MDOT.

At the GWMP interchange, the I-495 NEXT Project provides access from the northbound Express Lanes to GWMP and from GWMP to the southbound Express Lanes (south-facing movements). The north-facing Express Lanes connection movements (southbound Express Lanes to GWMP and GWMP to northbound Express Lanes) are planned to be provided by the Maryland managed lanes project, as the I-495 Express Lanes in Virginia will transition into the Maryland system north of GWMP.

## 5. UPDATED TRAFFIC FORECASTS

Consistent with the Approved IJR, forecasts for future traffic demand were developed using the MWCOG travel demand model (version 2.3.75 using Route 9.1 Cooperative Forecasts for socioeconomic data). Outputs from the model were used to estimate growth on Study Area roadway links using National Cooperative Highway Research Program (NCHRP) 765 industry-standard practices. The development and validation of the travel demand model, as well as more detail on the traffic forecasting process, is described in Chapter 8 of the Approved IJR.

The I-495 NEXT travel demand models were modified for the 2025 Build (Modified) and 2045 Build (Modified) conditions to include the modifications described in **Section 3** as well as the network changes in Maryland just north of the Study Area described in **Section 2**, resulting in revised traffic forecasts for the Build (Modified) scenarios as compared to the Build (Approved IJR) scenarios.

**Exhibits 5-1a** through **5-1c** show the 2025 Build (Modified) forecast traffic volumes at the daily, AM peak hour, and PM peak hour level, respectively. **Exhibits 5-2a** through **5-2c** show these volumes for the 2045 Build (Modified) condition. All of these figures provide a comparison showing the change in volume against the Build (Approved IJR) condition. The forecast traffic volumes for the 2025 and 2045 Build (Approved IJR) and No Build conditions can be found within the Approved IJR; a discussion of traffic volumes is contained in Chapter 8 and the volume diagrams are provided in the *Traffic and Transportation Technical Report (TATTR)*, which is attached by reference to the Approved IJR.

As shown in these figures, in the Build (Modified) condition, traffic volumes show a slight increase in the GP lanes south of the GWMP and a decrease in the GP lanes north of the GWMP due to the proposed exchange ramps at the GWMP interchange. These exchange ramps result in additional demand for the Express Lanes across the ALMB, providing some relief to the GP lanes across the bridge.

Separately, **Exhibits 5-1d** and **5-1e** show the 2025 Build (Approved IJR) side-by-side against the 2025 Build (Modified) forecast traffic volumes along Route 193 for the AM and PM peak hours, respectively. **Exhibits 5-2d** and **5-2e** show these same comparisons for the 2045 Build (Approved IJR) and Build (Modified) conditions. Similar to the freeway forecast volumes, the forecasts for 2025 and 2045 Build (Approved IJR) and No Build conditions can be found within the Approved IJR, including volume figures in the TATTR (Attachment 1 to the IJR).

## 6. UPDATED TRAFFIC ANALYSIS

This section compares the traffic operational performance of the Build (Modified) condition for the I-495 NEXT project for the 2025 and 2045 analysis years. Comparisons are provided against the Build (Approved IJR) condition and against the No Build condition, results of which are consistent with those in Chapter 9 of the Approved IJR. Chapter 9 of the Approved IJR also provides details on the traffic operational analysis methodology, including analysis tools and software (Vissim Version 9.0 and Synchro 10).

Measures of effectiveness (MOEs) are consistent with the Approved IJR and the VDOT *Traffic Operations and Safety Analysis Manual* (TOSAM). The following MOEs were compared in this IJR Addendum:

- Freeway Performance
  - Simulated Average Density (simulated vehicles per lane per mile but not reported as LOS), focusing on segments in the IJR Addendum study area in which congestion was observed under Build (Approved IJR) or Build (Modified) conditions.
  - Simulated Average Speed (mph) and Congestion *Heat Maps*: incremental speeds reported for aggregated lanes, by time interval (mph)
  - Simulated Travel Time (seconds): reported for travel paths along northbound and southbound I-495 for both the GP lanes and Express Lanes
  - Simulated Ramp Queue Length: reported average and 95th percentile queue lengths (feet), focusing on locations in the IJR Addendum study area in which queue spillback was observed to exceed storage.
  - Person Throughput (persons per peak period): number of persons moved along the I-495 corridor between each interchange in the IJR Addendum study area
- Arterial Performance
  - Microsimulation Delay and HCM-Analogous Level of Service, focused on intersection locations in the IJR Addendum study area (Route 193)
  - Intersection Queue Length, again focused on intersection locations in the IJR Addendum study area

In 2025, the Build conditions are analyzed using the Phase 1 design concept; in 2045, the Build conditions are analyzed using the Ultimate configuration concept as described in Chapter 6 of the Approved IJR.

The traffic models for the IJR Addendum are provided as **Appendix C**.

### 6.1 2025 CONDITIONS: NO BUILD VS. BUILD (APPROVED IJR) VS. BUILD (MODIFIED)

#### 6.1.1 2025 AM Peak Freeway Operation

##### 2025 AM Densities

**Table 6-1** provides a list of all freeway mainline segments (in the IJR Addendum study area) classified as “congested” (density greater than 35 vehicles per mile per lane) or “severely congested” (density greater than 45 vpmpl) from the Build (Approved IJR) condition. Average speed and density results in the 2025 Build (Modified) condition remain consistent with 2025 Build (Approved IJR) conditions; for both freeway segments that show congested conditions, a slight reduction in density is observed. Tables showing the densities of all freeway segments in the IJR Addendum study area, including those under No Build conditions, can be found in **Appendix D**.



**Table 6-1. 2025 Build AM Peak Hour Congested Freeway Segments**

Facility	Segment	Type	2025 Build (Approved IJR)			2025 Build (Modified)		
			Average Speed (mph)	Average Density (vp/ml)	Congestion Level	Average Speed (mph)	Average Density (vp/ml)	Congestion Level
SB I-495 (GP)	Between ramp to GWMP and ramp to Route 193	Basic	50	36.2	Congested	50	35.5	Congested

### 2025 AM Speeds

**Figure 6-1** and **Figure 6-2** provide a “heat map” comparison of AM peak period average speeds among 2025 No Build, 2025 Build (Approved IJR), and 2025 Build (Modified) conditions along the I-495 GP lanes and the I-495 Express Lanes, respectively. 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 “heat maps” reflect reduced congestion between Clara Barton Parkway and Dulles Toll Road in both Build conditions. The I-495 GP lanes in the 2025 Build (Modified) condition show speeds that remain consistent with the 2025 Build (Approved IJR) condition. The Express Lanes in the 2025 Build (Modified) condition operate consistently with the 2025 Build (Approved IJR) condition, showing average speeds at or near the posted speed limit throughout the peak period.



**Figure 6-1. AM Peak Period Average Speeds along I-495 GP Lanes for 2025 No Build, 2025 Build (Approved IJR), and 2025 Build (Modified) Conditions**



Figure 6-2. AM Peak Period Average Speeds along I-495 Express Lanes for 2025 No Build, 2025 Build (Approved IJR), and 2025 Build (Modified) Conditions

2025 AM Travel Times

A comparison of AM peak period travel times for 2025 No Build, 2025 Build (Approved IJR), and 2025 Build (Modified) conditions is shown in **Table 6-2**. Travel time measurements have been aggregated by direction of travel and facility type.

**Table 6-2. 2025 AM Peak Period Travel Time Comparison**

Route	GP Travel Times (Minutes: Seconds)			Express Lanes Travel Times (Minutes: Seconds)		
	2025 No Build	2025 Build (Approved IJR)	2025 Build (Modified)	2025 No Build	2025 Build (Approved IJR)	2025 Build (Modified)
Northbound I-495 (Route 123 to River Road)	9:37	6:53	6:50	7:43	6:12	6:09
Southbound I-495 (River Road to Route 123)	7:49	6:56	6:56	7:00	6:07	6:06

Travel time improvements in the 2025 Build (Modified) condition remain consistent with improvements shown in the 2025 Build (Approved IJR) condition when comparing to the 2025 No Build condition.

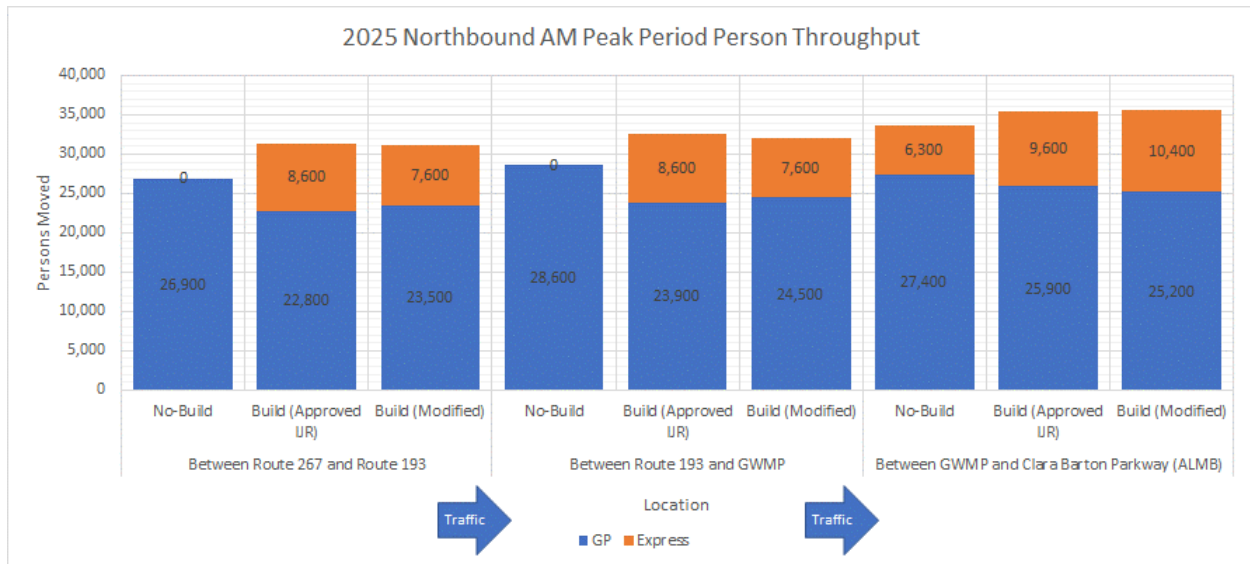
- The northbound GP lanes show a consistent improvement of approximately 3 minutes in 2025 Build (Modified) and 2025 Build (Approved IJR) conditions.
- The northbound Express Lanes show a consistent improvement of approximately 1.5 minutes in 2025 Build (Modified) and 2025 Build (Approved IJR) conditions.
- The southbound GP lanes show a consistent improvement of approximately 1 minute in 2025 Build (Modified) and 2025 Build (Approved IJR) conditions.
- The southbound Express Lanes show a consistent improvement of approximately 1 minute in 2025 Build (Modified) and 2025 Build (Approved IJR) conditions.

2025 AM Ramp Queues

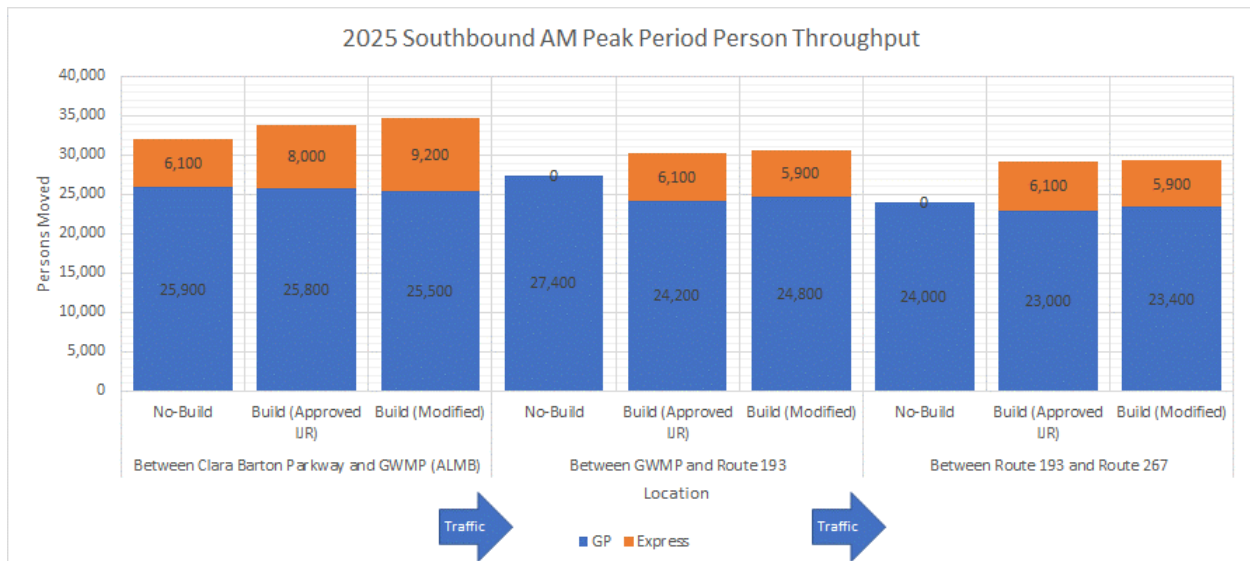
There are no locations in the IJR Addendum study area in which ramp queues are exceeding storage in any of the 2025 No Build, Build (Approved IJR), or Build (Modified) conditions. **Appendix E** summarizes queueing for all ramps in the IJR Addendum study area.

**2025 AM Person Throughput**

**Figure 6-3** and **Figure 6-4** display 2025 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. Person throughput generally remains consistent between Build (Modified) and Build (Approved IJR) conditions and represents an increase over person throughput from the No Build condition in the 2025 AM peak period.



**Figure 6-3. 2025 AM Peak Period Person Throughput, I-495 Northbound**



**Figure 6-4. 2025 AM Peak Period Person Throughput, I-495 Southbound**

## 6.1.2 2025 AM Peak Intersection Operations

### 2025 AM Intersection Delay and Level of Service

**Table 6-3** compares the overall intersection HCM-analogous LOS among No Build, Build (Approved IJR), and Build (Modified) conditions for each intersection along Route 193 for the 2025 AM peak hour. The unsignalized intersection of Route 193 and Helga Place/Linganore Drive shows an improvement of approximately 120 s/veh and 20 s/veh in comparison to No Build and Build (Approved IJR) conditions, respectively. This is due to the capacity improvements along eastbound and westbound Route 193 within the interchange with I-495. All other Route 193 intersections show delay results that are generally consistent through all three scenarios.

**Table 6-3. VISSIM Intersection Microsimulation Delay and HCM-Analogous LOS – 2025 No Build vs. 2025 Build (Approved IJR) vs. 2025 Build (Modified), AM Peak Hour**

Intersection Control	Intersection	2025 No Build		2025 Build (Approved IJR)		2025 Build (Modified)	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	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	139.6	F	39.5	E	19.9	C
Signalized	Route 193 and I-495 Southbound Ramps	25.4	C	23.9	C	23.5	C
Signalized	Route 193 and I-495 Northbound Ramps	20.5	C	20.7	C	20.4	C
Signalized	Route 193 and Balls Hill Road	21.1	C	23.0	C	23.0	C
Unsignalized	Route 193 and Dead Run Drive	9.6	A	9.5	A	10.1	B

### 2025 AM Intersection Queues

Within the IJR Addendum study area, while the 2025 AM Build (Modified) condition has intersection movement queues that exceed storage, there are no locations where this is not also the case under No Build conditions. Consistent with the Build (Approved IJR) condition, there are no locations in which intersection queues degrade as compared to No Build conditions. A full comparison of queuing at all intersection approach locations is provided in **Appendix E**.

### 6.1.3 2025 PM Peak Freeway Operations

#### 2025 PM Densities

**Table 6-4** provides a list of all freeway mainline segments (in the IJR Addendum study area) classified as “congested” (density greater than 35 vehicles per mile per lane) or “severely congested” (density greater than 45 vpmp) from the Build (Approved IJR) condition. Average speed and density results in the 2025 Build (Modified) condition remain consistent with 2025 Build (Approved IJR) conditions; for the single freeway segment that shows congested conditions, a slight reduction in density is observed. Tables showing the densities of all freeway segments in the IJR Addendum study area, including those under No Build conditions, can be found in **Appendix D**.

**Table 6-4. 2025 Build PM Peak Hour Congested Freeway Segments**

Facility	Segment	Type	2025 Build (Approved IJR)			2025 Build (Modified)		
			Average Speed	Average Density (vpmp)	Congestion Level	Average Speed	Average Density (vpmp)	Congestion Level
SB I-495 (GP)	North of ramp to WB DTR (between Route 193 and DTR)	Diverge	37	40.9	Congested	34	36.5	Congested

#### 2025 PM Speeds

**Figure 6-5** and **Figure 6-6** provide a “heat map” comparison of PM peak period average speeds among 2025 No Build, 2025 Build (Approved IJR), and 2025 Build (Modified) conditions along the I-495 GP lanes and the I-495 Express Lanes, respectively. 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 “heat maps” reflect reduced congestion between Clara Barton Parkway and Route 123 on the I-495 GP lanes in both Build conditions. The I-495 GP lanes in the 2025 Build (Modified) condition show speeds that remain consistent with the 2025 Build (Approved IJR) condition. The Express Lanes in 2025 Build (Modified) condition operate consistently with 2025 Build (Approved IJR) condition, showing average speeds at or near the posted speed limit throughout the peak period.



Figure 6-5. PM Peak Period Average Speeds along I-495 GP Lanes for 2025 No Build, 2025 Build (Approved IJR), and 2025 Build (Modified) Conditions





**Figure 6-6. PM Peak Period Average Speeds along I-495 Express Lanes for 2025 No Build, 2025 Build (Approved IJR), and 2025 Build (Modified) Conditions**

### 2025 PM Travel Times

A comparison of PM peak period travel times for 2025 No Build, 2025 Build (Approved IJR), and 2025 Build (Modified) conditions is shown in **Table 6-5**. Travel time measurements have been aggregated by direction of travel and facility type.

**Table 6-5. 2025 PM Peak Period Travel Time Comparison**

Route	GP Travel Times (Minutes: Seconds)			Express Lanes Travel Times (Minutes: Seconds)		
	2025 No Build	2025 Build (Approved IJR)	2025 Build (Modified)	2025 No Build	2025 Build (Approved IJR)	2025 Build (Modified)
Northbound I-495 (Route 123 to River Road)	10:36	6:45	6:39	8:02	6:05	6:04
Southbound I-495 (River Road to Route 123)	15:59	8:05	6:56	8:11	6:09	6:05

Travel times improvements in the 2025 Build (Modified) condition remain generally consistent with improvements shown in the 2025 Build (Approved IJR) condition when comparing to the 2025 No Build condition.

- The northbound GP lanes show a consistent improvement of approximately 4 minutes in 2025 Build (Modified) and 2025 Build (Approved IJR) conditions.
- The northbound Express Lanes show a consistent improvement of approximately 2 minutes in 2025 Build (Modified) and 2025 Build (Approved IJR) conditions.
- The southbound GP lanes show a travel time improvement of approximately 9 minutes in the 2025 Build (Modified) condition in comparison to 2025 No Build, which actually represents a travel time savings of an additional 1 minute from 2025 Build (Approved IJR) conditions.
- The southbound Express Lanes show a consistent improvement of approximately 2 minutes in 2025 Build (Modified) and 2025 Build (Approved IJR) conditions.

### 2025 PM Ramp Queues

**Table 6-6** provides a summary of freeway ramp queues exceeding available storage under 2025 No Build, 2025 Build (Approved IJR), or 2025 Build (Modified) conditions during the PM peak period in the IJR Addendum study area. The ramp from westbound Clara Barton Parkway to the southbound I-495 GP lanes, which sees significant queue spillback under both No Build and Build (Approved IJR) conditions, no longer sees queue spillback under Build (Modified) conditions due to congestion relief on the ALMB, as some GP lanes demand is projected to shift to utilize the Express Lanes due to the new exchange ramp provided just downstream of this location.

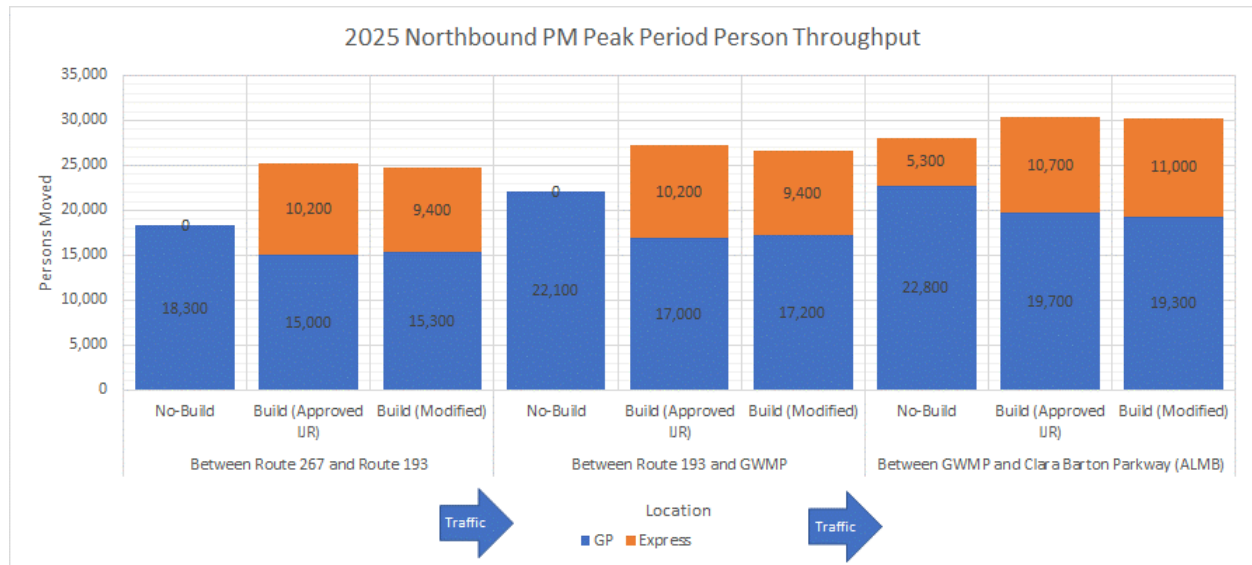
**Appendix E** summarizes queuing for all ramps in the IJR Addendum study area.

**Table 6-6. 2025 PM Ramp Queues Exceeding Storage**

Ramp Name	2025 No Build			2025 Build (Approved IJR)			2025 Build (Modified)		
	95th % Average Ramp Queue (feet)	Ramp Storage (feet)	Storage Exceeded?	95th % Average Ramp Queue (feet)	Ramp Storage (feet)	Storage Exceeded?	95th % Average Ramp Queue (feet)	Ramp Storage (feet)	Storage Exceeded?
Clara Barton WB to I-495 SB GP	7,122	2,095	Yes	6,887	2,095	Yes	0	2,095	No

2025 PM Person Throughput

**Figure 6-7** and **Figure 6-8** display 2025 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. Person throughput generally remains consistent between Build (Modified) and Build (Approved IJR) conditions and represents an increase over person throughput from the No Build condition in the 2025 PM peak period.



**Figure 6-7. 2025 PM Peak Period Person Throughput, I-495 Northbound**

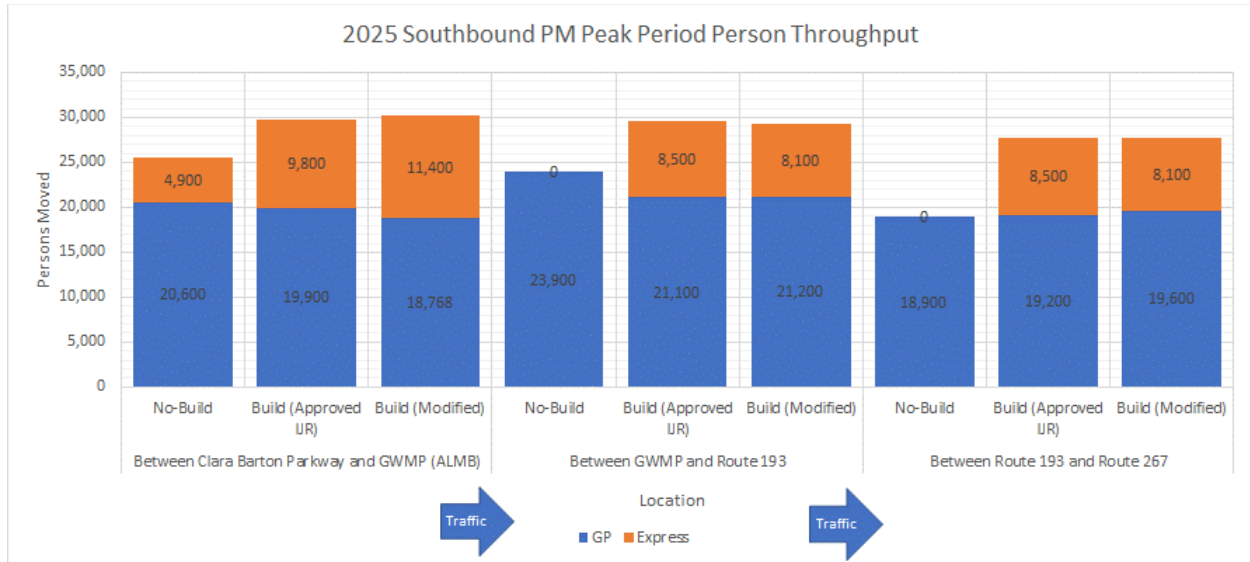


Figure 6-8. 2025 PM Peak Period Person Throughput, I-495 Southbound

### 6.1.4 2025 PM Peak Intersection Operations

#### 2025 PM Intersection Delay and Level of Service

Table 6-7 compares the overall intersection HCM-analogous LOS among No Build, Build (Approved IJR), and Build (Modified) conditions for each intersection along Route 193 for the 2025 PM peak hour. Due to capacity improvements along eastbound and westbound Route 193, operations are improved at all intersections when comparing 2025 Build (Modified) conditions to both scenarios.

**Table 6-7. VISSIM Intersection Microsimulation Delay and HCM-Analogous LOS – 2025 No Build vs. 2025 Build (Approved IJR) vs. 2025 Build (Modified) PM Peak Hour**

Intersection Control	Intersection	2025 No Build		2025 Build (Approved IJR)		2025 Build (Modified)	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	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	157.9	F	28.0	D	12.9	B
Signalized	Route 193 and I-495 Southbound Ramps	61.7	E	42.5	D	24.8	C
Signalized	Route 193 and I-495 Northbound Ramps	19.9	B	21.5	C	16.6	B
Signalized	Route 193 and Balls Hill Road	65.0	E	35.5	D	20.3	C
Unsignalized	Route 193 and Dead Run Drive	58.6	F	71.5	F	11.9	B

2025 PM Intersection Queues

Within the IJR Addendum study area, while the 2025 PM Build (Modified) condition has intersection movement queues that exceed storage, there are no locations where this is not also the case under No Build conditions. Consistent with the Build (Approved IJR) condition, there are no locations in which intersection queues degrade as compared to No Build conditions. A full comparison of queuing at all intersection approach locations is provided in **Appendix E**.

**6.2 2045 CONDITIONS: NO BUILD VS. BUILD (APPROVED IJR) VS. BUILD (MODIFIED)**

**6.2.1 2045 AM Peak Freeway Operations**

2045 AM Densities

**Table 6-8** provides a list of all freeway mainline segments (in the IJR Addendum study area) classified as “congested” (density greater than 35 vehicles per mile per lane) or “severely congested” (density greater than 45 vpmpl) from the Build (Approved IJR) condition. Average speed and density results in the 2045 Build (Modified) condition generally remain consistent with or improve upon the 2045 Build (Approved

IJR) condition, with 12 of the 13 freeway segments showing an improvement in density. Tables showing the densities of all freeway segments in the IJR Addendum study area, including those under No Build conditions, can be found in **Appendix D**.

**Table 6-8. 2045 Build AM Peak Hour Congested Freeway Segments**

Facility	Segment	Type	2045 Build (Approved IJR)			2045 Build (Modified)		
			Average Speed (mph)	Average Density (vpmpl)	Congestion Level	Average Speed (mph)	Average Density (vpmpl)	Congestion Level
NB I-495 (GP)	Between DTR and Route 193	Weave	35	50.4	Severely Congested	43	43.3	Congested
NB I-495 (GP)	Between ramps to/from Route 193	Basic	41	48.1	Severely Congested	42	51.6	Severely Congested
NB I-495 (GP)	Between Route 193 and GWMP	Weave	32	54.4	Severely Congested	37	52.3	Severely Congested
NB I-495 (GP)	Between ramps to/from GWMP	Basic	30	65.0	Severely Congested	49	37.7	Congested
NB I-495 (GP)	Between GWMP and Clara Barton Parkway	Weave	27	66.9	Severely Congested	48	36.1	Congested
SB I-495 (GP)	Between Clara Barton Parkway and GWMP	Weave	26	72.5	Severely Congested	38	51.8	Severely Congested
SB I-495 (GP)	Between ramp to GWMP and ramp to Route 193	Diverge	50	41.2	Congested	50	40.9	Congested
SB I-495 (GP)	Between ramps to Route 193 and from SB I-495 C-D Road	Basic	53	37.8	Congested	53	37.0	Congested

### 2045 AM Speeds

**Figure 6-9** and **Figure 6-10** provide a “heat map” comparison of AM peak period average speeds among 2045 No Build, 2045 Build (Approved IJR), and 2045 Build (Modified) along the I-495 GP lanes and the I-495 Express Lanes, respectively. 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 northbound GP lanes “heat maps” reflect reduced congestion between the Dulles Toll Road and Clara Barton Parkway in both Build conditions. The southbound GP lanes “heat maps” reflect reduced congestion between River Road and Route 193 in both Build conditions. In both directions of the GP lanes, speeds in the 2045 Build (Modified) condition show slight improvements as compared with the 2045 Build (Approved IJR) condition. This is due to congestion relief provided across the ALMB in both directions due to a projected shift in demand for some GP lanes trips to the Express Lanes via the new exchange ramps proposed just south of the bridge in the Build (Modified) condition.

The Express Lanes in the 2025 Build (Modified) condition operate consistently with the 2025 Build (Approved IJR) condition, showing average speeds at or near the posted speed limit throughout the peak period.

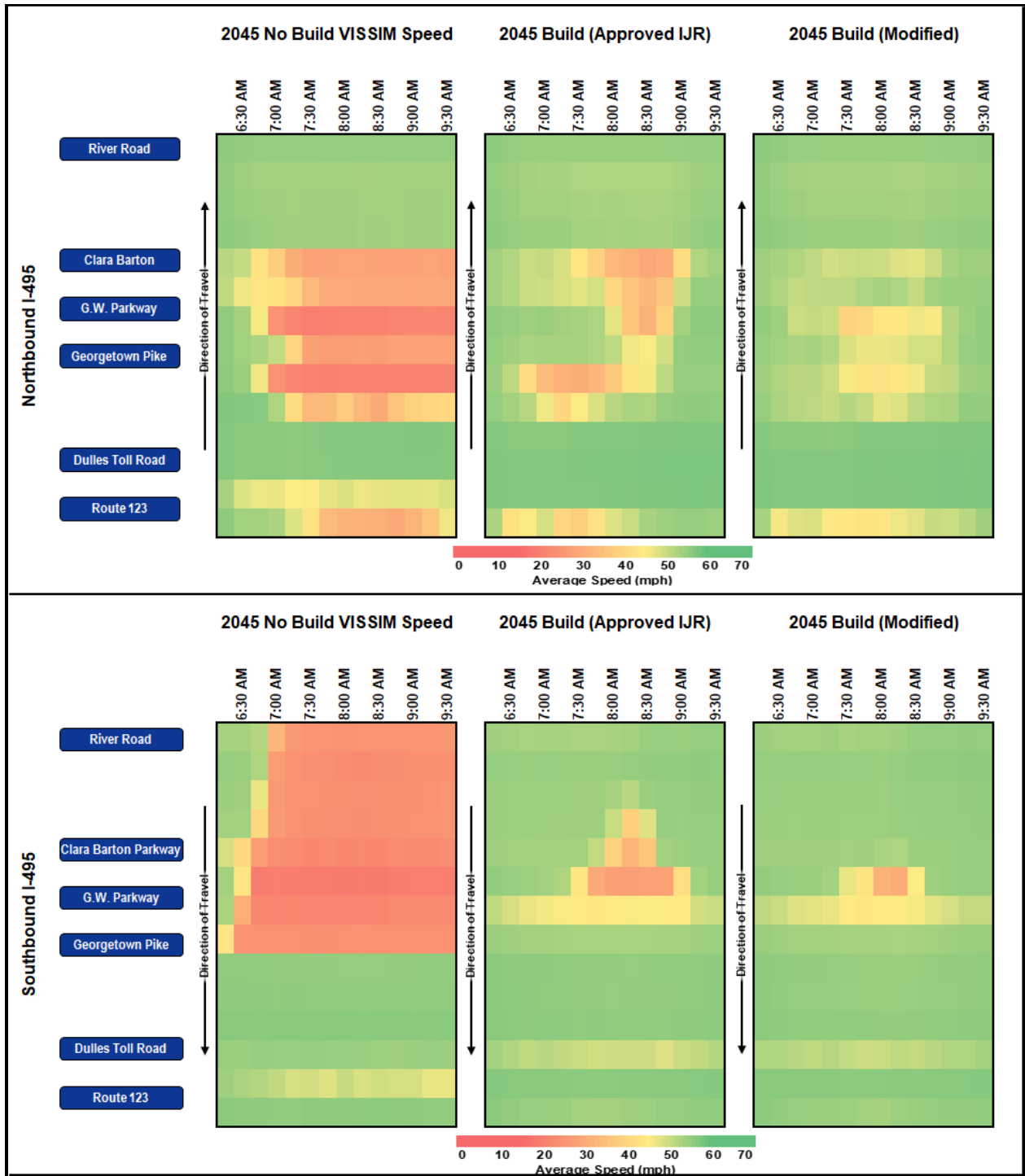


Figure 6-9. AM Peak Period Average Speeds along I-495 GP Lanes for 2045 No Build, 2045 Build (Approved IJR), and 2045 Build (Modified) Condition



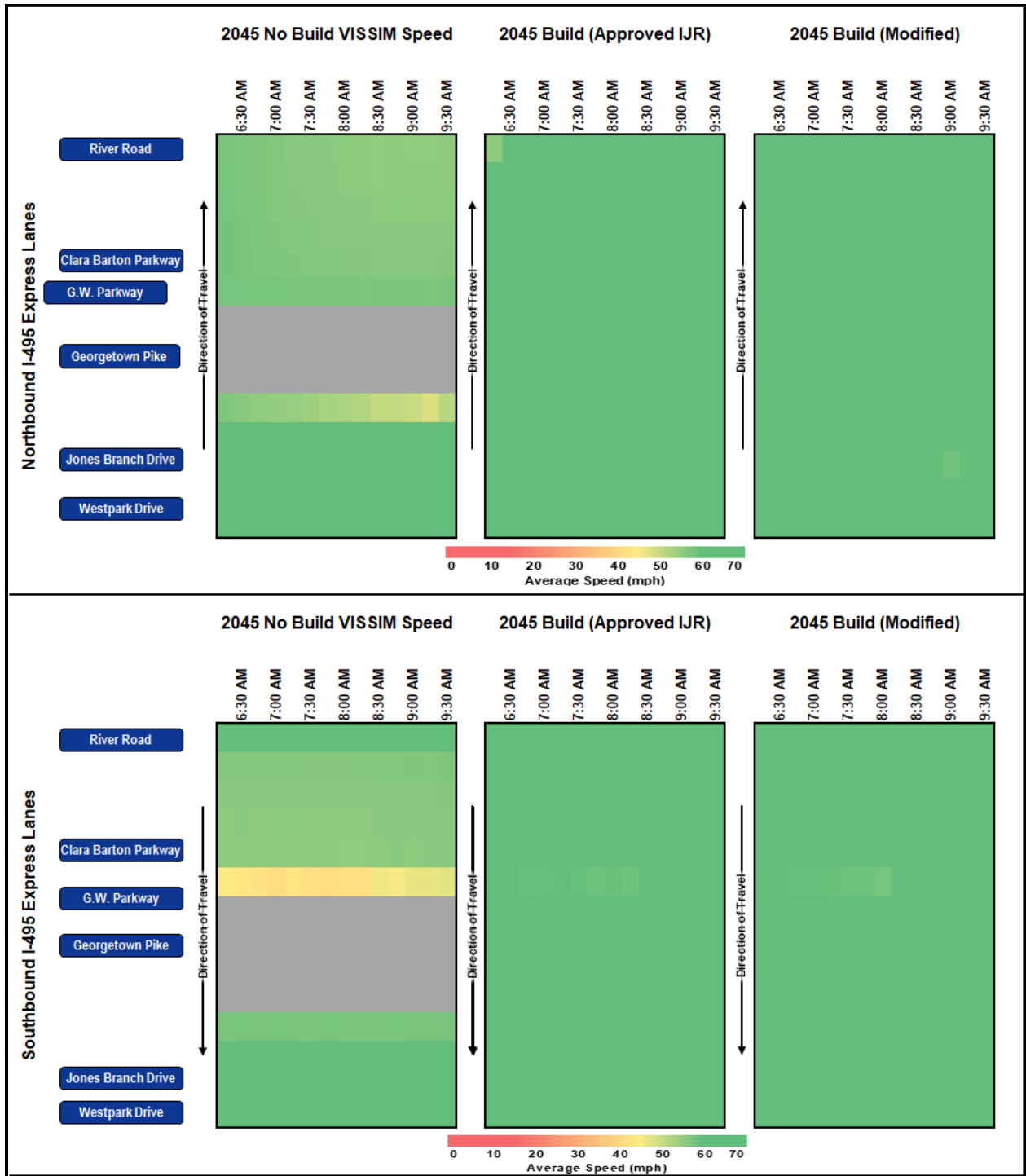


Figure 6-10. AM Peak Period Average Speeds along I-495 Express Lanes for 2045 No Build, 2045 Build (Approved IJR), and 2045 Build (Modified) Conditions

### 2045 AM Travel Times

A comparison of AM peak period travel times for 2045 No Build, 2045 Build (Approved IJR), and 2045 Build (Modified) conditions is shown in **Table 6-9**. Travel time measurements have been aggregated by direction of travel and facility type.

**Table 6-9. 2045 AM Peak Period Travel Time Comparison**

Route	GP Travel Times (Minutes: Seconds)			Express Lanes Travel Times (Minutes: Seconds)		
	2045 No Build	2045 Build (Approved IJR)	2045 Build (Modified)	2045 No Build	2045 Build (Approved IJR)	2045 Build (Modified)
Northbound I-495 (Route 123 to River Road)	11:59	8:03	7:27	9:37	5:43	5:40
Southbound I-495 (River Road to Route 123)	16:15	7:32	7:05	8:04	5:41	5:40

Travel times improvements in the 2045 Build (Modified) condition remain generally consistent with improvements shown in the 2045 Build (Approved IJR) condition when comparing to the 2045 No Build condition.

- The northbound GP lanes show a travel time improvement of approximately 4.5 minutes in the 2045 Build (Modified) condition in comparison to 2045 No Build, which actually represents a travel time savings of an additional 30 seconds from 2045 Build (Approved IJR) conditions.
- The northbound Express Lanes show a consistent improvement of approximately 4 minutes in 2045 Build (Modified) and 2045 Build (Approved IJR) conditions.
- The southbound GP lanes show a travel time improvement of approximately 9 minutes in the 2045 Build (Modified) condition in comparison to 2045 No Build, which actually represents a travel time savings of an additional 30 seconds from 2045 Build (Approved IJR) conditions.
- The southbound Express Lanes show a consistent improvement of approximately 2.5 minutes in 2045 Build (Modified) and 2045 Build (Approved IJR) conditions.

### 2045 AM Ramp Queues

**Table 6-10** provides a summary of freeway ramp queues exceeding available storage under 2045 No Build, 2045 Build (Approved IJR), or 2045 Build (Modified) conditions during the AM peak period in the IJR Addendum study area. In the 2045 (Approved IJR) condition, the only ramp that continued to exceed storage was the ramp from westbound Clara Barton Parkway to the southbound I-495 GP lanes. However, this queue is eliminated in the 2045 Build (Modified) condition due to congestion relief on the ALMB, as some GP lanes demand is projected to shift to utilize the Express Lanes due to the new exchange ramp provided just downstream of this location.

**Appendix E** summarizes queueing for all ramps in the IJR Addendum study area.

**Table 6-10. 2045 AM Ramp Queues Exceeding Storage**

Ramp Name	2045 No Build			2045 Build (Approved IJR)			2045 Build (Modified)		
	95th % Average Ramp Queues (feet)	Ramp Storage (feet)	Storage Exceeded?	95th % Average Ramp Queues (feet)	Ramp Storage (feet)	Storage Exceeded?	95th % Average Ramp Queues (feet)	Ramp Storage (feet)	Storage Exceeded?
I-495 NB GP to Route 193	4,995	1,225	Yes	152	1,225	No	80	1,225	No
Route 193 to I-495 NB GP	1,106	930	Yes	0	930	No	0	930	No
Clara Barton EB to I-495 SB GP	3,142	1,100	Yes	237	1,100	No	0	1,100	No
Clara Barton WB to I-495 SB GP	7,123	2,095	Yes	2,821	2,095	Yes	0	2,095	No

#### 2045 AM Person Throughput

**Figure 6-11** and **Figure 6-12** display 2045 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. Person throughput generally remains consistent between Build (Modified) and Build (Approved IJR) conditions and represents an increase over person throughput from the No Build condition in the 2045 AM peak period.

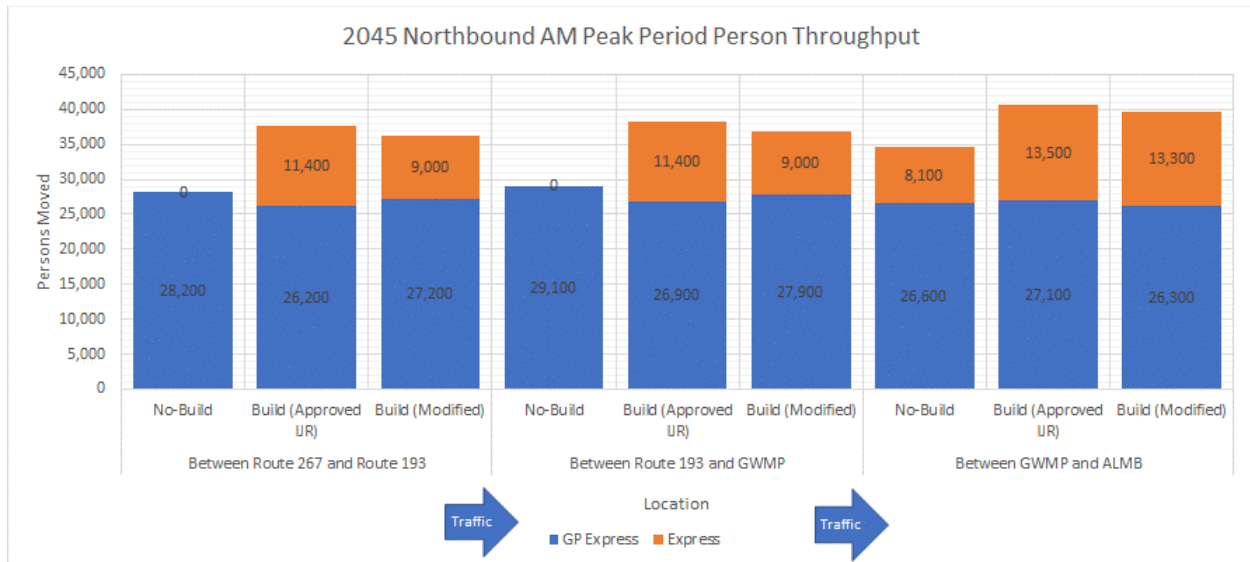


Figure 6-11. 2045 AM Peak Period Person Throughput, I-495 Northbound

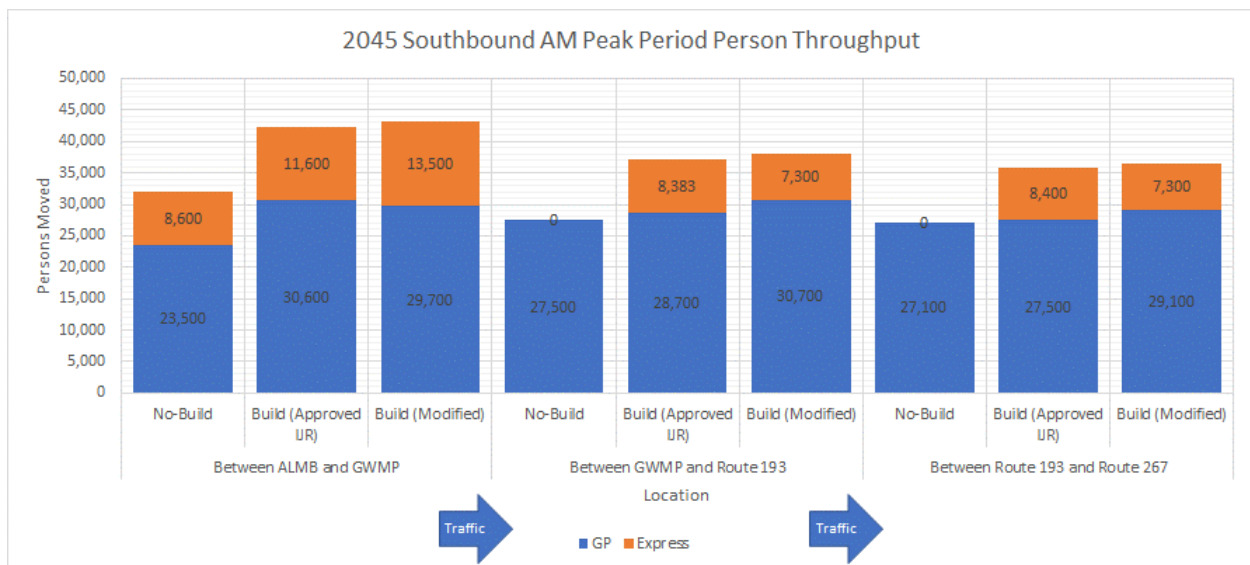


Figure 6-12. 2045 AM Peak Period Person Throughput, I-495 Southbound

## 6.2.2 2045 AM Peak Intersection Operations

### 2045 AM Intersection Delay and Level of Service

**Table 6-11** compares the overall intersection HCM-analogous LOS among No Build, Build (Approved IJR), and Build (Modified) conditions for each intersection along Route 193 for the 2045 AM peak hour. Due to capacity improvements along eastbound and westbound Route 193 within the interchange with I-495, all intersections perform at LOS E or better under Build (Modified) conditions, and the two signalized intersections with the I-495 ramps show an improvement as compared to Build (Approved IJR) conditions.

**Table 6-11. VISSIM Intersection Microsimulation Delay and HCM-Analogous LOS – 2045 No Build vs. 2045 Build (Approved IJR) vs. 2045 Build (Modified) AM Peak Hour**

Intersection Control	Intersection	2045 No Build		2045 Build (Approved IJR)		2045 Build (Modified)	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	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	231.7	F	72.7	F	41.6	E
Signalized	Route 193 and I-495 Southbound Ramps	40.2	D	39.1	D	33.6	C
Signalized	Route 193 and I-495 Northbound Ramps	69.1	E	54.8	D	33.7	C
Signalized	Route 193 and Balls Hill Road	59.7	E	25.1	C	21.1	C
Unsignalized	Route 193 and Dead Run Drive	14.3	B	14.3	B	14.7	B

### 2045 AM Intersection Queues

Within the IJR Addendum study area, while the 2045 AM Build (Modified) condition has intersection movement queues that exceed storage, there are no locations where this is not also the case under No Build conditions. Consistent with the Build (Approved IJR) condition, there are no locations in which intersection queues degrade as compared to No Build conditions. A full comparison of queuing at all intersection approach locations is provided in **Appendix E**.

### **6.2.3 2045 PM Peak Freeway Operations**

#### 2045 PM Densities

**Table 6-12** provides a list of all freeway mainline segments (in the IJR Addendum study area) classified as “congested” (density greater than 35 vehicles per mile per lane) or “severely congested” (density greater than 45 vpmpl). Average speed and density results in the 2045 Build (Modified) condition generally remain consistent with the 2045 Build (Approved IJR) condition. Tables showing the densities of all freeway segments in the IJR Addendum study area, including those under No Build conditions, can be found in **Appendix D**.

**Table 6-12. 2045 Build PM Peak Hour Congested Freeway Segments**

Facility	Segment	Type	2045 Build (Approved IJR)			2045 Build (Modified)		
			Average Speed (mph)	Average Density (vpmppl)	Congestion Level	Average Speed (mph)	Average Density (vpmppl)	Congestion Level
NB I-495 (GP)	Between DTR and Route 193	Weave	10	122.3	Severely Congested	10	121.2	Severely Congested
NB I-495 (GP)	Between ramps to/from Route 193	Basic	15	95.0	Severely Congested	15	94.5	Severely Congested
NB I-495 (GP)	Between Route 193 and GWMP	Weave	15	84.2	Severely Congested	14	84.5	Severely Congested
NB I-495 (GP)	Between ramps to/from GWMP	Basic	16	97.4	Severely Congested	16	96.8	Severely Congested
NB I-495 (GP)	Between GWMP and Clara Barton Parkway	Weave	21	73.3	Severely Congested	21	72.8	Severely Congested

### 2045 PM Speeds

**Figure 6-13** and **Figure 6-14** provide a “heat map” comparison of PM peak period average speeds among 2045 No Build, 2045 Build (Approved IJR), and 2045 Build (Modified) conditions along the I-495 GP lanes and the I-495 Express 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 northbound GP lanes “heat maps” are consistent between both Build conditions and reflect a reduction in congestion south of Route 193 as compared to No Build conditions. The southbound GP “heat maps” reflect reduced congestion between River Road and Clara Barton Parkway in the Build conditions as compared to No Build conditions. Note that the Build (Modified) condition is observed to have more occasional slowdowns south of Route 193 as compared to the Build (Approved IJR) condition due to increased traffic demand in the GP lanes in this area from the upstream Express-to-GP exchange ramp. Overall speeds and travel times, described in the following section, still represent a substantial improvement over No Build conditions.

The Express Lanes in the 2045 Build (Modified) condition operate consistently with the 2045 Build (Approved IJR) condition, showing average speeds at or near the posted speed limit throughout the peak period.

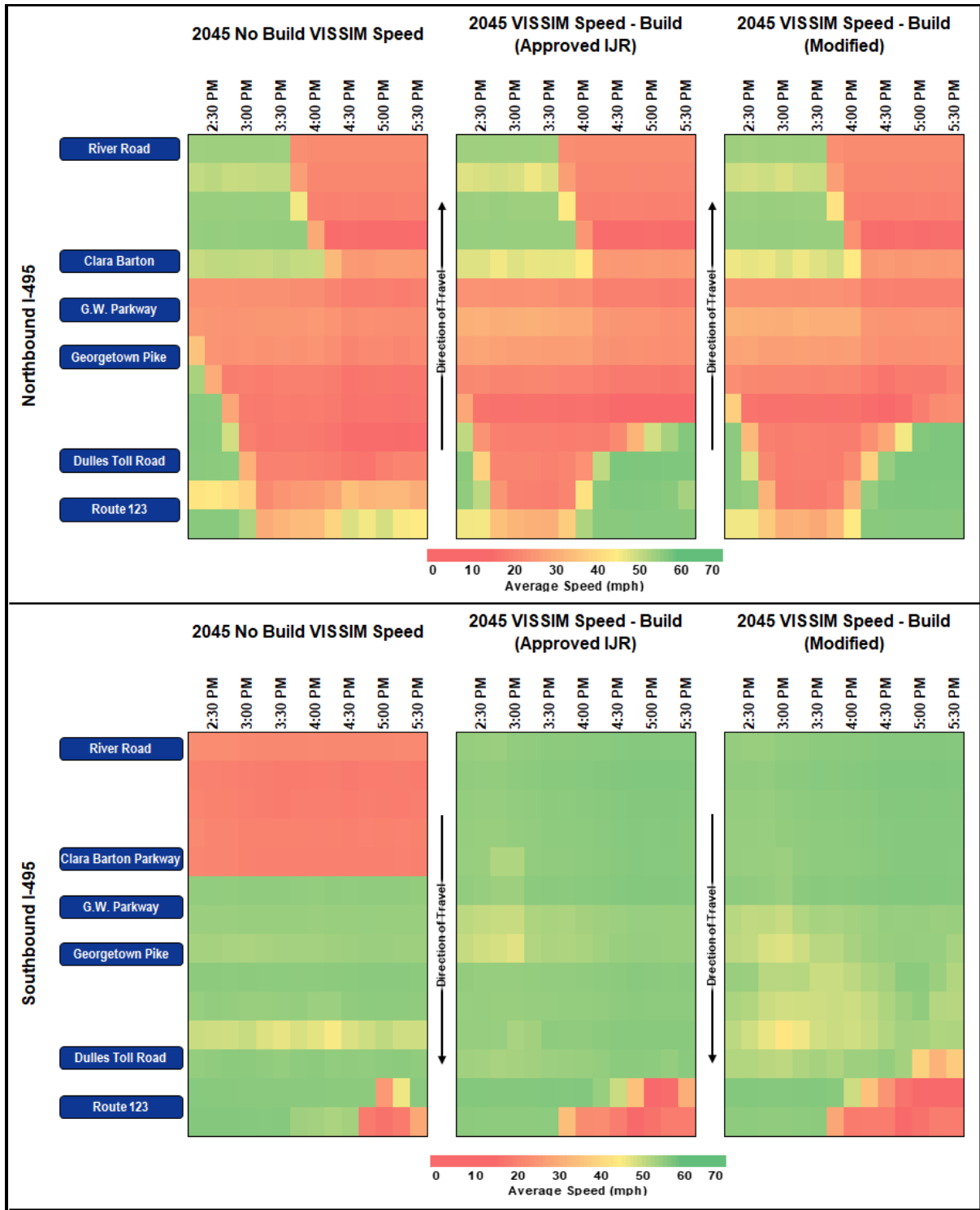
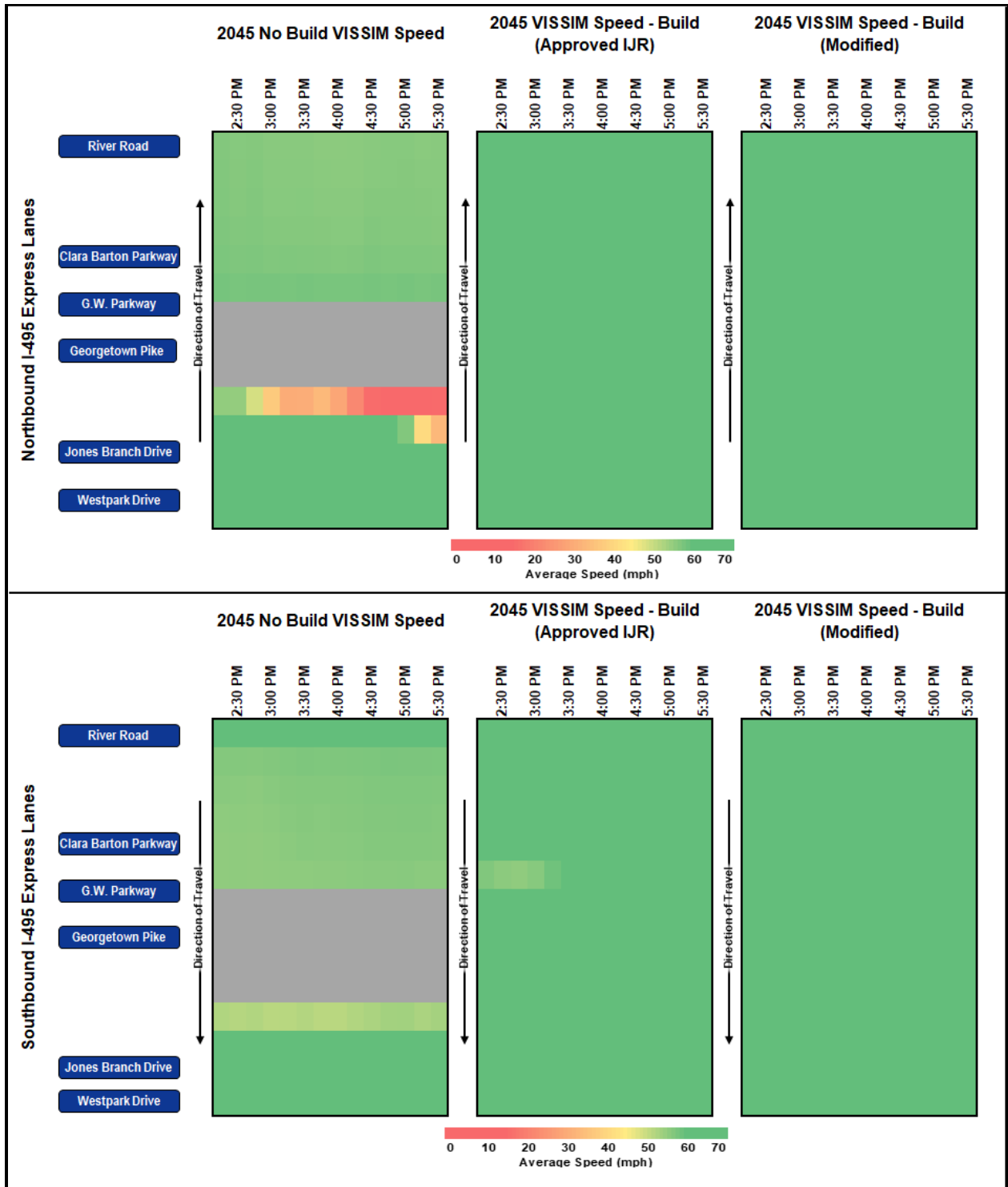


Figure 6-13. PM Peak Period Average Speeds along I-495 GP Lanes for 2045 No Build, 2045 Build (Approved IJR), and 2045 Build (Modified) Conditions



**Figure 6-14. PM Peak Period Average Speeds along I-495 Express Lanes for 2045 No Build, 2045 Build (Approved IJR), and 2045 Build (Modified) Conditions**



2045 PM Travel Times

A comparison of PM peak period travel times for 2045 No Build, 2045 Build (Approved IJR), and 2045 Build (Modified) conditions is shown in **Table 6-13**. Travel time measurements have been aggregated by direction of travel and facility type.

**Table 6-13. 2045 PM Peak Period Travel Time Comparison**

Route	GP Travel Times (Minutes: Seconds)			Express Lanes Travel Times (Minutes: Seconds)		
	2045 No Build	2045 Build (Approved IJR)	2045 Build (Modified)	2045 No Build	2045 Build (Approved IJR)	2045 Build (Modified)
Northbound I-495 (Route 123 to River Road)	28:18	23:42	23:25	15:59	5:39	5:40
Southbound I-495 (River Road to Route 123)	15:16	7:46	9:12	6:42	5:49	5:40

Travel times improvements in 2045 Build (Modified) remain consistent with improvements shown 2045 Build (Approved IJR) when comparing to 2045 No Build.

- The northbound GP lanes show a consistent improvement of approximately 5 minutes in 2045 Build (Modified) and 2045 Build (Approved IJR) conditions.
- The northbound Express Lanes show a consistent improvement of approximately 10 minutes in 2045 Build (Modified) and 2045 Build (Approved IJR) conditions.
- The southbound GP lanes show a travel time improvement of approximately 6 minutes in the 2045 Build (Modified) condition in comparison to 2045 No Build. Note that this represents a travel time increase of approximately 1.5 minutes from 2045 Build (Approved IJR) conditions, due to increased traffic demand in the GP lanes in this area from the upstream Express-to-GP exchange ramp.
- The southbound Express Lanes show a consistent improvement of approximately 1 minute in 2045 Build (Modified) and 2045 Build (Approved IJR) conditions.

2045 PM Ramp Queues

**Table 6-14** provides a summary of freeway ramp queues exceeding available storage under 2045 No Build, 2045 Build (Approved IJR), or 2045 Build (Modified) during the PM peak period in the IJR Addendum study area. The only ramp that exceeded storage in No Build conditions was the ramp from westbound Clara Barton Parkway to the southbound I-495 GP lanes. However, this queue is eliminated in the 2045 Build (Approved IJR) condition and remains consistent in the 2045 Build (Modified) condition.

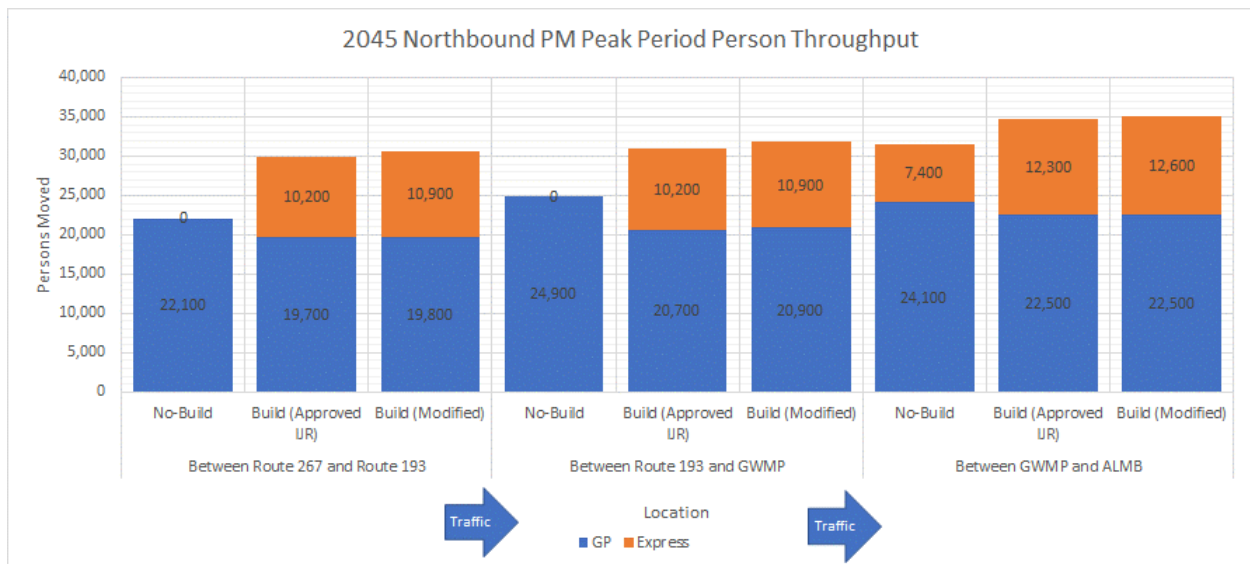
**Appendix E** summarizes queueing for all ramps in the IJR Addendum study area.

**Table 6-14. 2045 PM Ramp Queues Exceeding Storage**

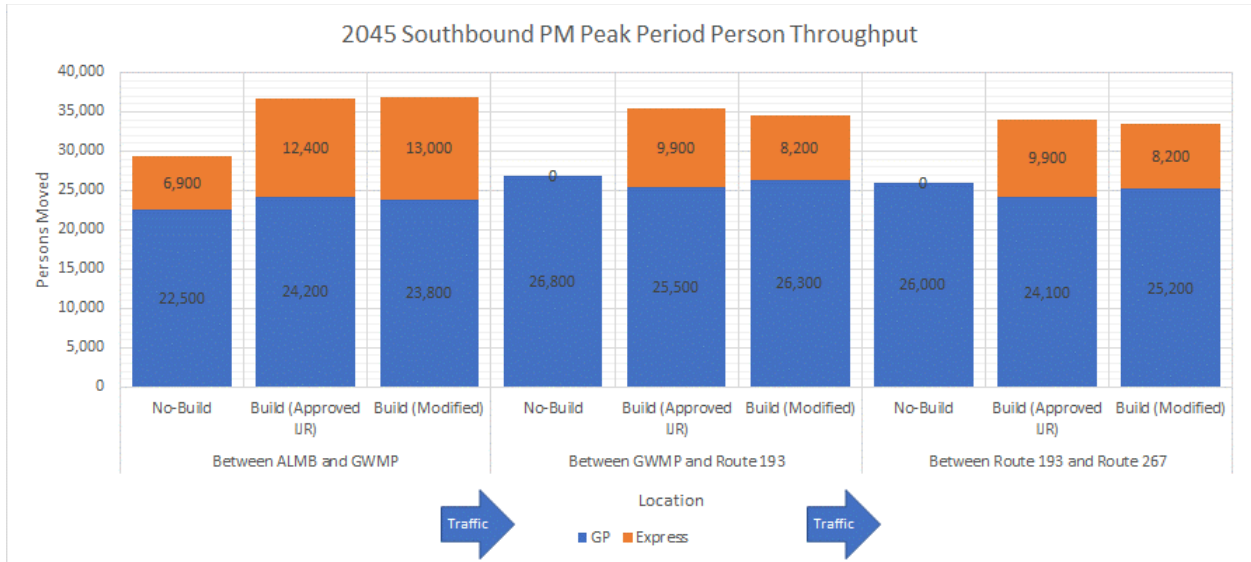
Ramp Name	2045 No Build			2045 Build (Approved IJR)			2045 Build (Modified)		
	95th % Average Ramp Queues (feet)	Ramp Storage (feet)	Storage Exceeded?	95th % Average Ramp Queues (feet)	Ramp Storage (feet)	Storage Exceeded?	95th % Average Ramp Queues (feet)	Ramp Storage (feet)	Storage Exceeded?
Clara Barton WB to I-495 SB GP	7,124	2,095	Yes	68	2,095	No	68	2,095	No

2045 PM Person Throughput

**Figure 6-15** and **Figure 6-16** display 2045 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. Person throughput generally remains consistent between Build (Modified) and Build (Approved IJR) conditions and represents an increase over person throughput from the No Build condition in the 2045 PM peak period.



**Figure 6-15. 2045 PM Peak Period Person Throughput, I-495 Northbound**



**Figure 6-16. 2045 PM Peak Period Person Throughput, I-495 Southbound**

### 6.2.4 2045 PM Peak Intersection Operations

#### 2045 PM Intersection Delay and Level of Service

**Table 6-15** compares the overall intersection HCM-analogous LOS among No Build, Build (Approved IJR), and Build (Modified) for each intersection along Route 193 for the 2045 PM peak hour. Consistent intersection operations are observed under Build (Approved IJR) and Build (Modified) conditions, with three of the five intersections showing a substantial reduction in delay and improvement in LOS as compared to No Build conditions.

**Table 6-15. VISSIM Intersection Microsimulation Delay and HCM-Analogous LOS – 2045 No Build vs. 2045 Build (Approved IJR) vs. 2045 Build (Modified) PM Peak Hour**

Intersection	2045 No Build		2045 Build (Approved IJR)		2045 Build (Modified)	
	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS
Route 193 and Helga Place/ Linganore Drive	125.6	F	15.9	C	15.7	C
Route 193 and I-495 Southbound Ramps	24.5	C	21.6	C	27.9	C
Route 193 and I-495 Northbound Ramps	60.3	E	63.6	E	63.5	E
Route 193 and Balls Hill Road	40.7	D	18.4	B	16.7	B
Route 193 and Dead Run Drive	40.6	E	13.8	B	13.5	B

### 2045 PM Intersection Queues

Within the IJR Addendum study area, while the 2045 PM Build (Modified) condition has intersection movement queues that exceed storage, there are no locations where this is not also the case under No Build conditions. Consistent with the Build (Approved IJR) condition, there are no locations in which intersection queues degrade as compared to No Build conditions. A full comparison of queuing at all intersection approach locations is provided in **Appendix E**.

## 6.3 UPDATED TRAFFIC ANALYSIS CONCLUSIONS

**Table 6-16** provides a comparison summary of traffic operations results across the 2025 and 2045 AM and PM peak periods, with results being compared for the Build (Modified) condition against both the Build (Approved IJR) and No Build condition.

- **2025 AM:** Freeway operations are consistent between Build (Modified) and Build (Approved IJR) conditions. GP lane operations improve as compared to No Build conditions in both directions. Consistent traffic operations are observed along Route 193 between Build (Modified) and Build (Approved IJR) conditions.

- 2025 PM:** Freeway operations are generally consistent between Build (Modified) and Build (Approved IJR) conditions, with the Build (Modified) conditions showing a slight improvement in travel times in the southbound GP lanes. GP lane operations improve as compared to No Build conditions in both directions. Improved traffic operations are observed along Route 193 in the Build (Modified) condition as compared to the Build (Approved IJR) condition due to the increased capacity provided at the Route 193 interchange. Both Build scenarios show improved operations on Route 193 as compared to the No Build condition.
- 2045 AM:** Freeway operations are generally consistent between Build (Modified) and Build (Approved IJR) conditions, with the Build (Modified) conditions showing slight improvements in travel times in both directions in the GP lanes due to reduced congestion over the ALMB. GP lane operations improve as compared to No Build conditions in both directions. Improved traffic operations are observed along Route 193 in the Build (Modified) condition as compared to the Build (Approved IJR) condition due to the increased capacity provided at the Route 193 interchange. Both Build scenarios show improved operations on Route 193 as compared to the No Build condition.
- 2045 PM:** Freeway operations are generally consistent between Build (Modified) and Build (Approved IJR) conditions, with the Build (Modified) conditions showing a slight increase in travel times (approximately 1.5 minutes) in the southbound GP lanes due to increased traffic demand south of Route 193 (south of the exchange ramp from the southbound Express Lanes). GP lane operations improve as compared to No Build conditions in both directions. Consistent traffic operations are observed along Route 193 between Build (Modified) and Build (Approved IJR) conditions.

**Table 6-16. Comparison of Traffic Operational MOEs for Build (Modified) Condition**

Measure of Effectiveness	Build (Modified) - 2025 AM		Build (Modified) - 2025 PM		Build (Modified) - 2045 AM		Build (Modified) - 2045 PM	
	vs. Build (Approved IJR)	vs. No Build	vs. Build (Approved IJR)	vs. No Build	vs. Build (Approved IJR)	vs. No Build	vs. Build (Approved IJR)	vs. No Build
Northbound GP Lanes Operations	Consistent	Improved	Consistent	Improved	Slightly Improved	Improved	Consistent	Improved
Southbound GP Lanes Operations	Consistent	Improved	Slightly Improved	Improved	Slightly Improved	Improved	Slightly Worse	Improved
Express Lanes Operations (Both Directions)	Consistent	-	Consistent	-	Consistent	-	Consistent	-
Route 193 Operations	Consistent	Consistent	Improved	Improved	Improved	Improved	Consistent	Improved

## 7. UPDATED SAFETY AND CRASH ANALYSIS

A safety analysis for the Build (Modified) condition was conducted consistent with the Approved IJR and with VDOT IIM-LD-200.9. The analysis for this IJR Addendum is focused on the predicted number of crashes for the 2045 design year in the IJR Addendum study area. The crash prediction methodology is consistent with the methodology described in Chapter 10 of the Approved IJR:

- **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 GP lanes and all study area ramps.
- **Developed Express Lane Safety Performance Function (SPF):** this I-495 Express Lanes-specific SPF was used to evaluate the Express Lanes mainline segments, as the HSM (First Edition) does not have a crash prediction methodology for estimating the safety performance of separated/managed lanes.

### 7.1 FUTURE CONDITIONS SAFETY ANALYSIS: 2045 NO BUILD VS. BUILD (APPROVED IJR) VS. BUILD (MODIFIED)

**Table 7-1** shows the predicted number of crashes along the I-495 GP lanes and all interchange ramps, as well as the I-495 Express Lanes and the three signalized intersections along Route 193, for the 2045 analysis year. Comparisons are provided across No Build, Build (Approved IJR), and Build (Modified) conditions and for Fatal and Injury crashes, Property Damage Only (PDO) crashes, and Total crashes.

In both the northbound and southbound GP lanes, the Build (Modified) condition would result in a slight increase in the predicted number of crashes as compared to the Build (IJR) condition. This is attributable to the increase in traffic demand in the GP lanes for both directions south of the GWMP in the Build (Modified) condition, as described previously in Section 5 and shown in **Exhibits 5-1** and **5-2**. In the northbound direction, the new access provided in this alternative is projected to result in some traffic demand utilizing the GP lanes south of GWMP and switching over to the Express Lanes at the new exchange ramp; the reverse direction is projected to see a similar shift in travel demand, with some southbound traffic using the Express Lanes across the ALMB and then switching over to the GP lanes at the exchange ramp. This increase in AADT is directly correlated with an increase in crashes.

Most of the increase in crashes in the GP lanes in the Build (Modified) condition would be in the PDO crash category. However, in the northbound GP lanes, there would be a projected increase in Fatal and Injury crashes as well. The northbound direction, unlike the southbound direction, does not feature a C-D road between Route 193 and GWMP interchanges to mitigate lane-change conflicts. The projected increase in crashes in the northbound direction, including the increase in fatal and injury crashes, would not be concentrated in any one segment but would generally apply to all freeway mainline segments south of GWMP, with the longer segments showing higher crash projections.

**Table 7-2** and **Table 7-3** provide a more detailed breakdown of total crashes along the mainline segments along the I-495 GP lanes between the Build (Approved IJR) and Build (Modified) conditions, showing the

segments that have the largest differences in predicted crashes. As shown, the increases in crashes south of Route 193 are forecasted across all segments and correlated with increases in AADT and segment lengths.

Overall, the Build (Modified) condition is projected to result in an approximately 4 percent increase in crashes as compared to the Build (Approved IJR) condition. However, the Build (Modified) condition still results in a nearly 19 percent decrease in total crashes in the IJR Addendum study area as compared to No Build conditions. Furthermore, it is important to note that the Build (Modified) condition provides additional access to and from the Express Lanes, resulting in increased travel choices for drivers, as well as a projected decrease in GP lanes traffic across the ALMB.

**Table 7-1. I-495 NEXT IJR Addendum Study Area Crash Predictions – 2045 Annual Crash Frequency**

Location	Predicted Annual Number of Fatal & Injury Crashes			Predicted Annual Number of Property Damage Only (PDO) Crashes			Predicted Annual Number of Total Crashes			Difference: Build (Modified) vs. Build (Approved IJR)	Difference: Build (Modified) vs. No Build
	2045 No Build	2045 Build (Approved IJR)	2045 Build (Modified)	2045 No Build	2045 Build (Approved IJR)	2045 Build (Modified)	2045 No Build	2045 Build (Approved IJR)	2045 Build (Modified)		
I-495 General Purpose Lanes and Ramps - Northbound	24.9	17.5	19.3	61.8	40.4	45.1	86.7	58.0	64.4	6.5	-22.2
I-495 General Purpose Lanes and Ramps - Southbound	42.8	30.9	30.9	102.9	70.4	72.6	145.8	101.3	103.5	2.2	-42.3
I-495 Express Lanes - Northbound	1.3	3.3	3.2	2.5	7.7	7.6	3.8	11.0	10.8	-0.2	7.0
I-495 Express Lanes - Southbound	2.2	5.8	5.7	3.4	10.7	10.6	5.6	16.5	16.3	-0.2	10.7
Route 193 (3 Signalized Intersections)	5.3	4.8	5.0	12.1	10.8	11.3	17.5	15.6	16.4	0.7	-1.1
<b>Total</b>	<b>76.6</b>	<b>62.4</b>	<b>64.2</b>	<b>182.7</b>	<b>140.1</b>	<b>147.2</b>	<b>259.3</b>	<b>202.4</b>	<b>211.4</b>	<b>9.0</b>	<b>-47.9</b>
										<b>4.4%</b>	<b>-18.5%</b>

**Table 7-2. 2045 Annual Crash Frequency Breakdown for Northbound I-495 GP Mainline**

Description	Length (mi)	Forecasted AADT (2045)			Predicted Number of Crashes per Year (2045)		
		Build (Approved IJR)	Build (Modified)	Difference	Build (Approved IJR)	Build (Modified)	Difference
North of DTR to Route 193	0.75	113,700	123,100	9,400	20.9	23.8	2.9
Between off-ramp to Route 193 and on-ramp from Route 193	0.34	104,400	113,100	8,700	11.8	13.5	1.7
Between Route 193 and GWMP	0.60	111,800	121,500	9,700	8.4	9.6	1.2
Between off-ramp to GWMP and on-ramp from GWMP	0.27	107,500	106,800	-700	11.4	11.3	-0.1
North of on-ramp from GWMP	0.20	128,300	127,800	-500	1.7	1.7	0.0



**Table 7-3. 2045 Annual Crash Frequency Breakdown for Southbound I-495 GP Mainline**

Description	Length (mi)	Forecasted AADT (2045)			Predicted Number of Crashes per Year (2045)		
		Build (Approved IJR)	Build (Modified)	Difference	Build (Approved IJR)	Build (Modified)	Difference
North of off-ramp to GWMP	0.25	136,100	135,000	-1,100	12.1	11.9	-0.2
Between off-ramp to GWMP and off-ramp to Route 193	0.67	121,000	119,500	-1,500	14.7	14.5	-0.2
Between off-ramp to Route 193 and on-ramp from GWMP/C-D Road	0.47	113,400	111,200	-2,200	11.3	11.0	-0.3
Between on-ramp from GWMP/C-D Road and on-ramp from Route 193	0.43	118,000	117,500	-500	9.5	9.5	-0.1
South of Route 193 to DTR	1.06	125,600	128,900	3,300	47.2	49.2	2.1

## 8. UPDATED ADDITIONAL SUPPORTING INFORMATION

A modified preliminary signing plan for the General Purpose lanes and the Express Lanes has been created for Phase 1 of the project. Where feasible, the type and location of signs were developed according to the MUTCD and the VDOT supplement to the MUTCD. Design development and constraints were coordinated with FHWA, VDOT Central Office, and with the National Park Service (for signing along or approaching the GWMP). Special focus was given to balancing the requirements of the MUTCD while retaining the visual setting and features of the GWMP.

Due to the historic designation of the GWMP, and the contributing views along the corridor, the location and frequency of dynamic message signs for advance toll pricing signs on the GWMP was iteratively refined and optimized as part of the Section 106 consultation process with Virginia Department of Historic Resources – State Historic Preservation Office (DHR--SHPO), the National Capital Region Office of the National Park Service, and the GWMP Superintendent’s Office. Dynamic Message Signing (DMS) for the south-facing ramps at the GWMP to and from Virginia were located outside of the park boundaries, in order to allow for a determination of No Adverse Effect by DHR-SHPO, and to be consistent with a Section 4(f) *de minimis* determination by FHWA. The preliminary signing plan is shown in roll plot format in **Appendix A**.

## **APPENDICES**

Appendix A: Preliminary Signing Plans (Modified) for IJR Addendum Study Area

Appendix B: Memorandum on No Build Modeling Considerations

Appendix C: Traffic Models

Appendix D: Freeway Segment Densities for IJR Addendum Study Area

Appendix E: Detailed Queueing Results for IJR Addendum Study Area

**Appendix A: Preliminary Signing Plans (Modified) for IJR Addendum  
Study Area**

## **Appendix B: Memorandum on No Build Modeling Considerations**

## **Appendix C: Traffic Models**

## **Appendix D: Freeway Segment Densities for IJR Addendum Study Area**

## **Appendix E: Detailed Queueing Results for IJR Addendum Study Area**





VDOT

# I-495 Express Lanes Northern Extension (NEXT) Interchange Justification Report Addendum

**EXHIBITS**



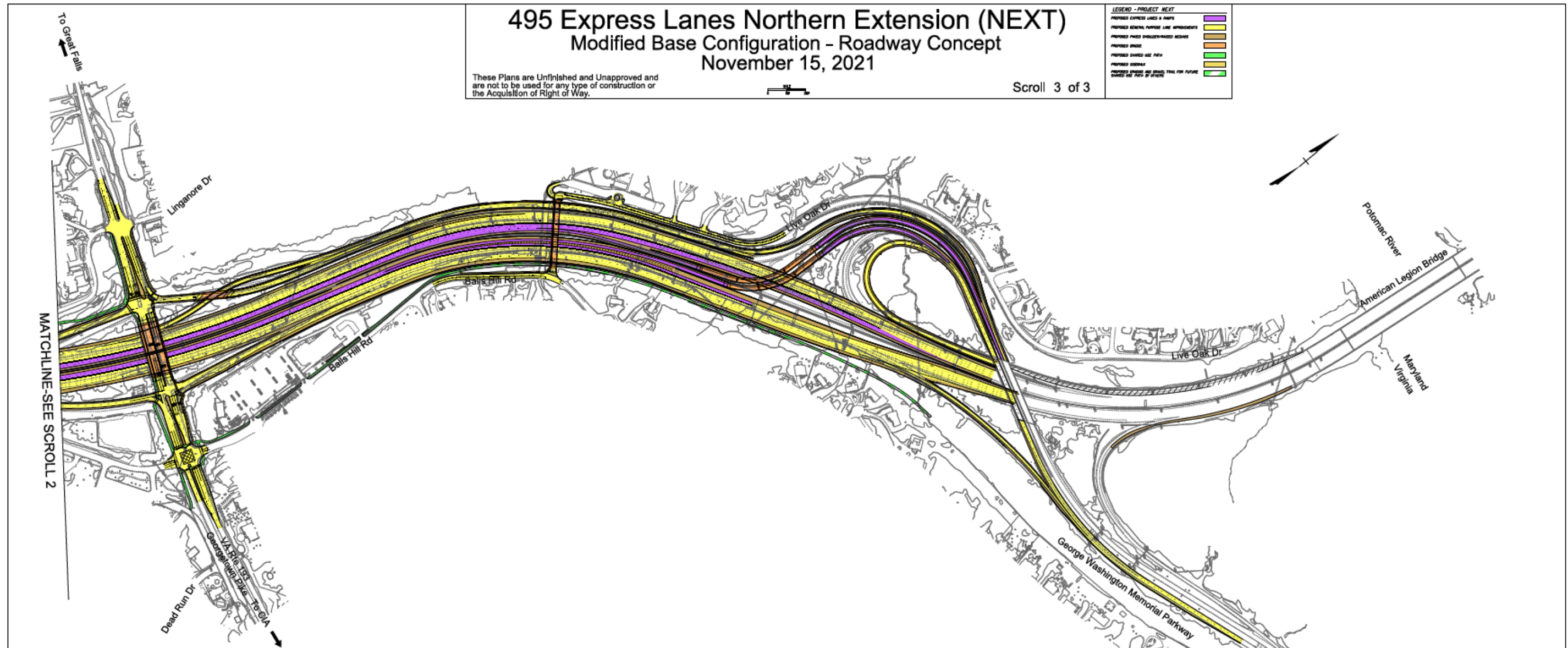


Exhibit 3-1. Modified Conceptual Plan for the Route 193 (Georgetown Pike) Interchange and George Washington Memorial Parkway Interchange: I-495 NEXT Project Only

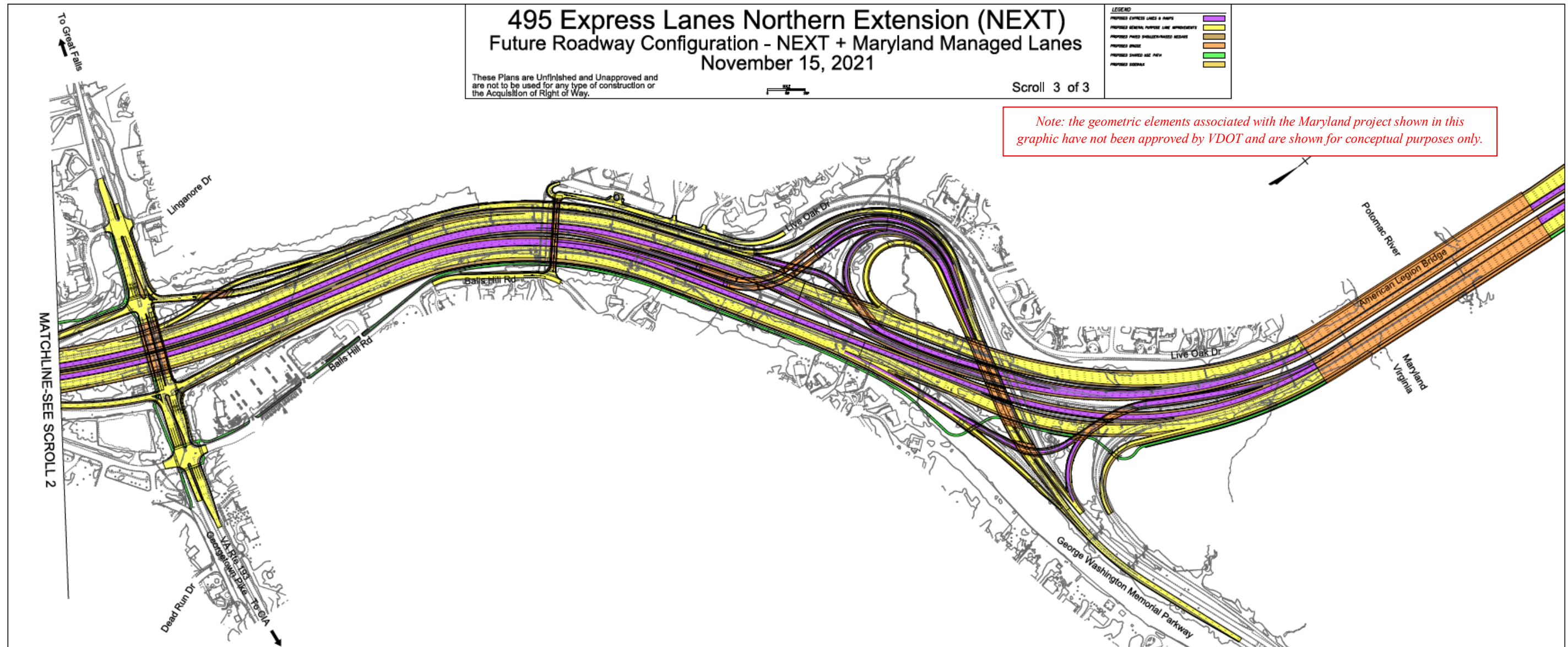


Exhibit 3-2. Modified Conceptual Plan for the Route 193 (Georgetown Pike) Interchange and George Washington Memorial Parkway Interchange: I-495 NEXT + Maryland Managed Lanes Project

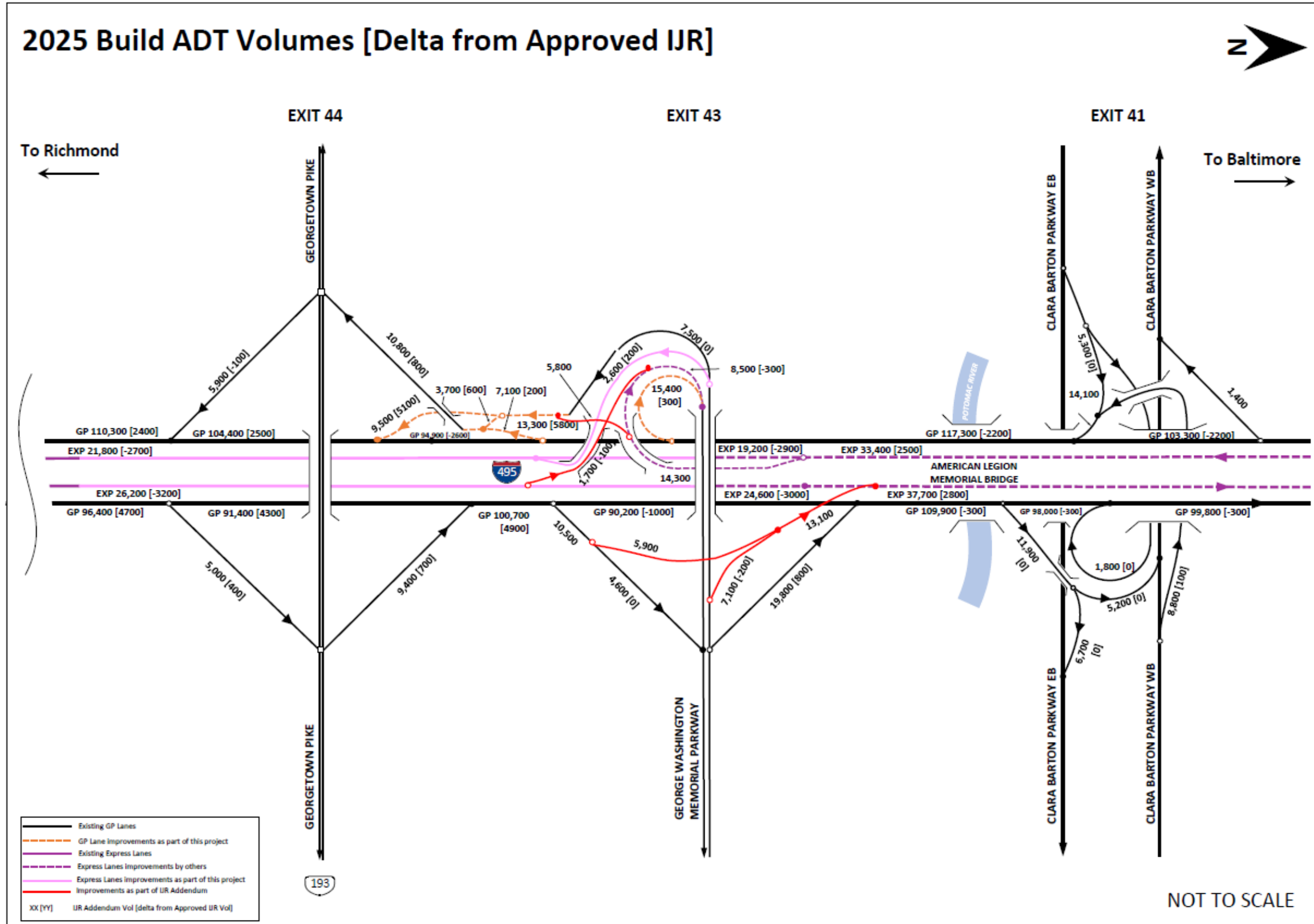


Exhibit 5-1a. 2025 Build (Modified) Freeway Traffic Volume Forecasts for IJR Addendum Study Area - ADTs

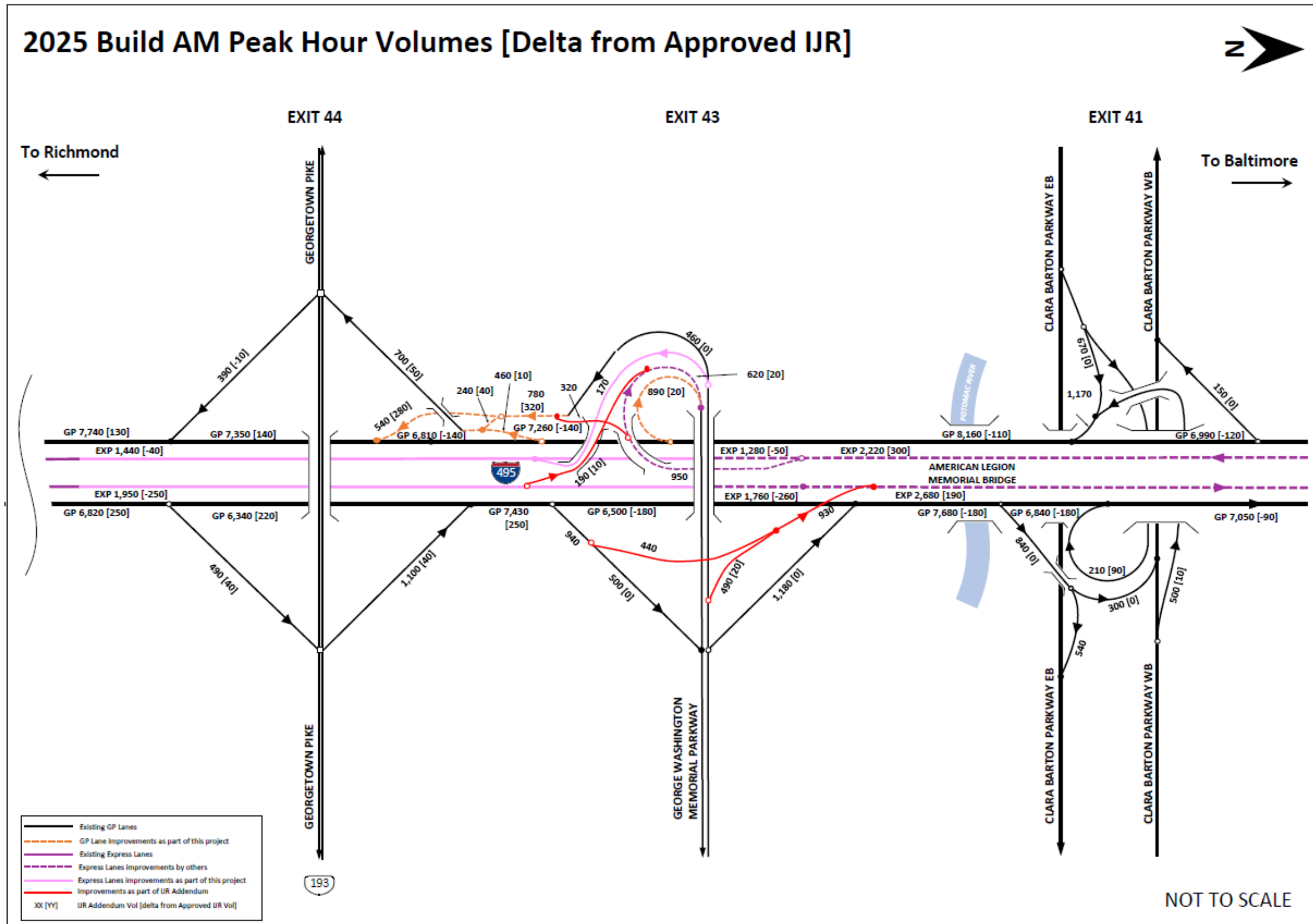


Exhibit 5-1b. 2025 Build (Modified) Freeway Traffic Volume Forecasts for IJR Addendum Study Area – AM Peak Hour

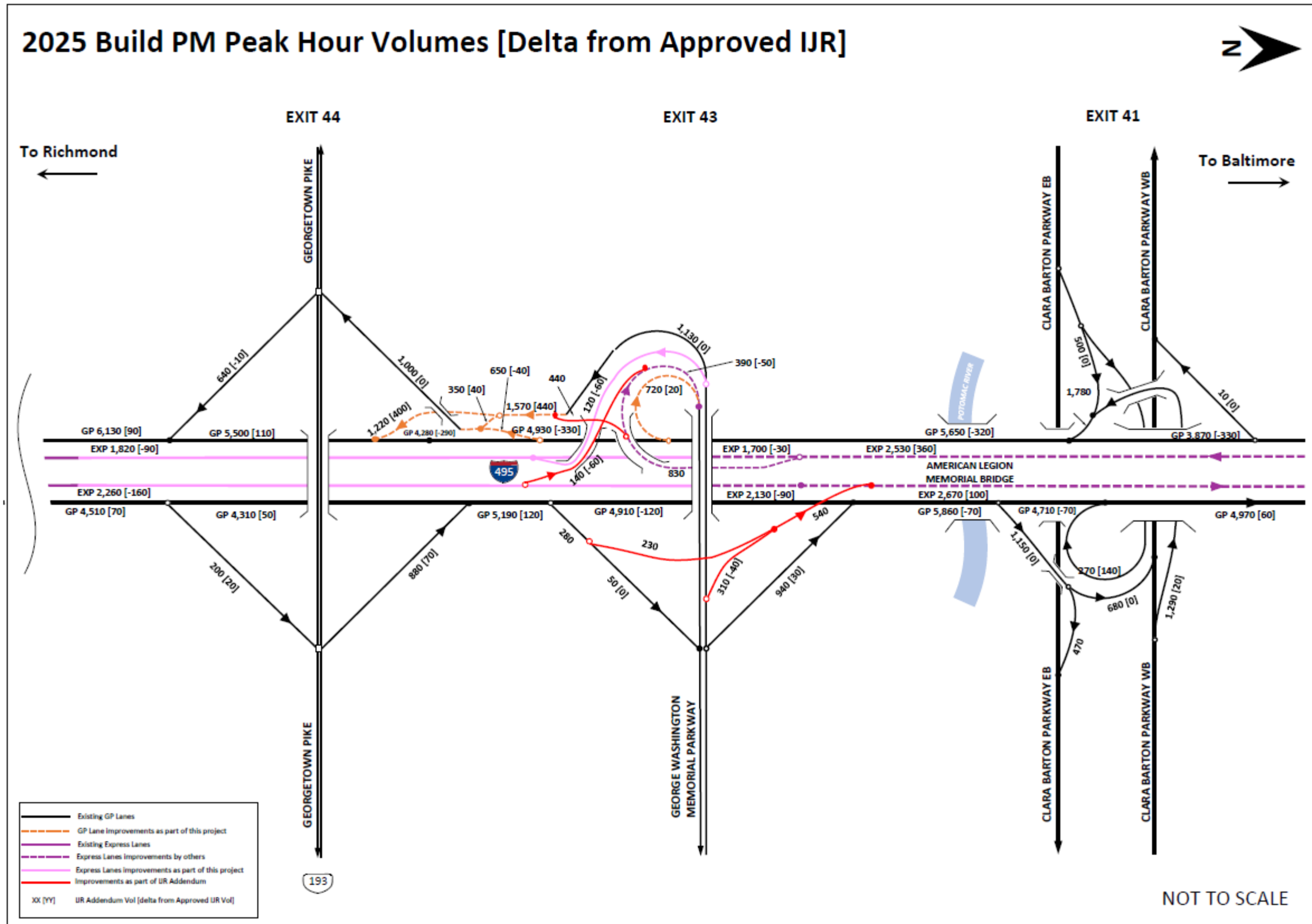


Exhibit 5-1c. 2025 Build (Modified) Freeway Traffic Volume Forecasts for IJR Addendum Study Area – PM Peak Hour

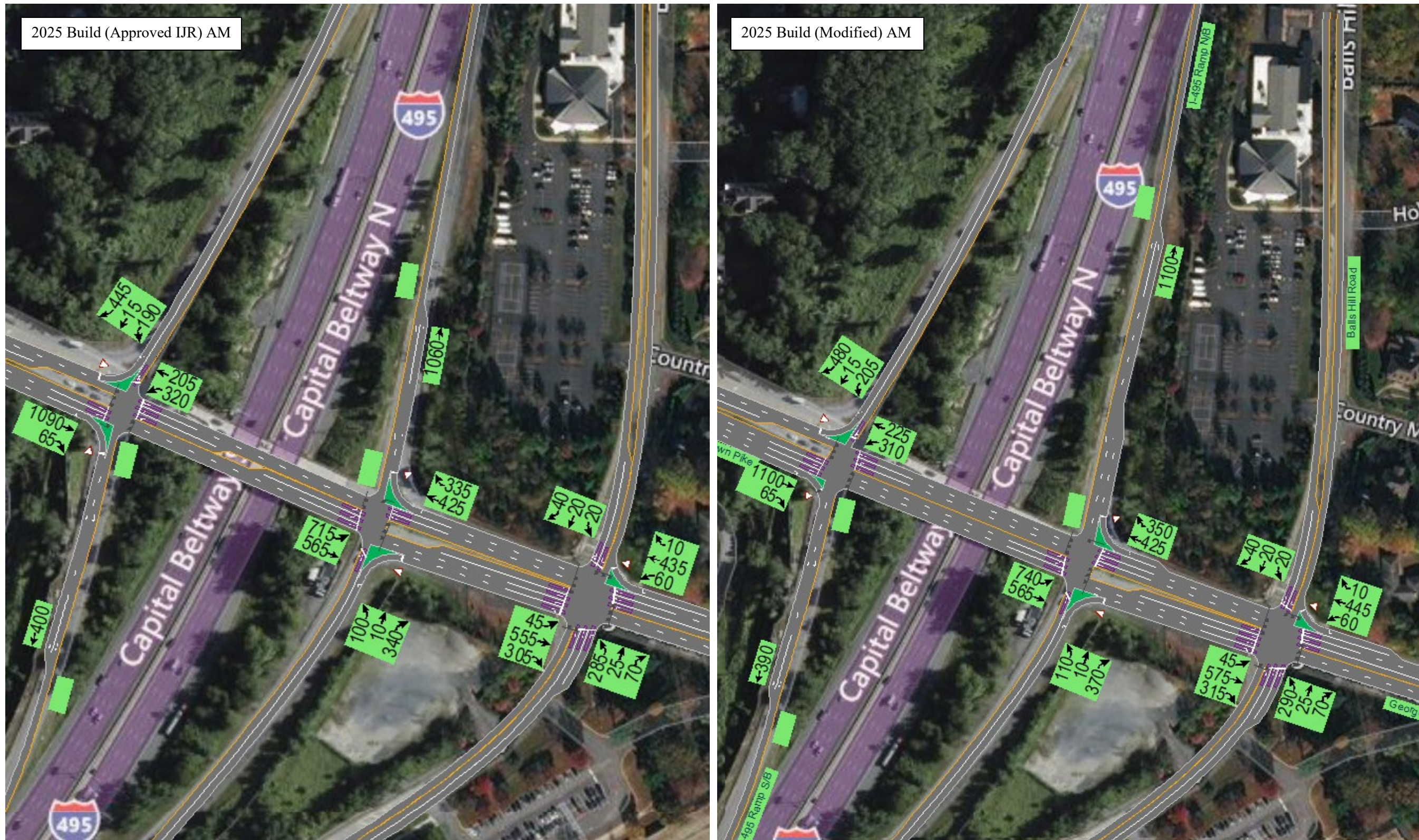


Exhibit 5-1d. 2025 Build (Approved IJR) vs. 2025 Build (Modified) Arterial Turning Movement Forecasts for IJR Addendum Study Area – AM Peak Hour



Exhibit 5-1e. 2025 Build (Approved IJR) vs. 2025 Build (Modified) Arterial Turning Movement Forecasts for IJR Addendum Study Area – PM Peak Hour



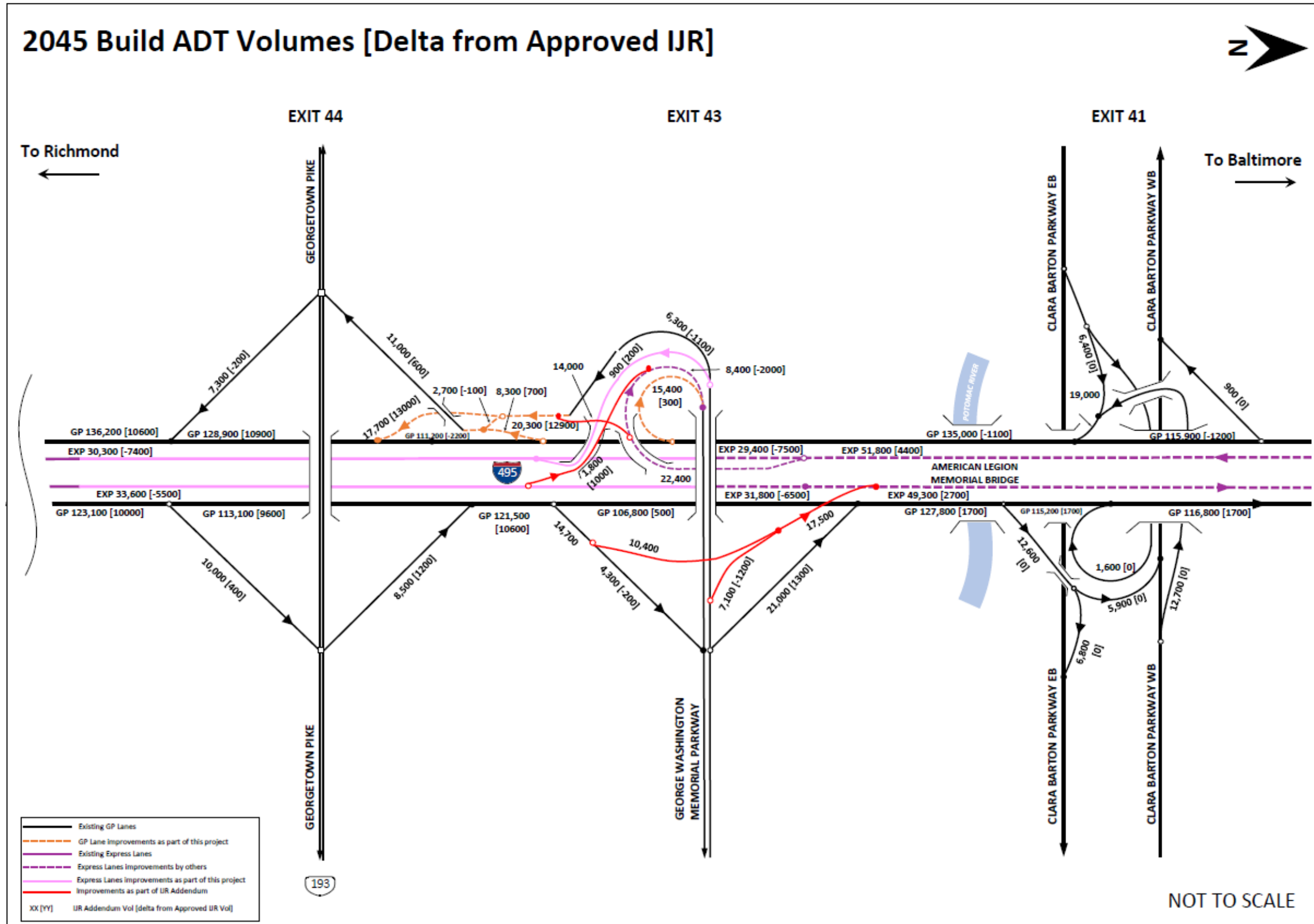


Exhibit 5-2a. 2045 Build (Modified) Freeway Traffic Volume Forecasts for IJR Addendum Study Area - ADTs

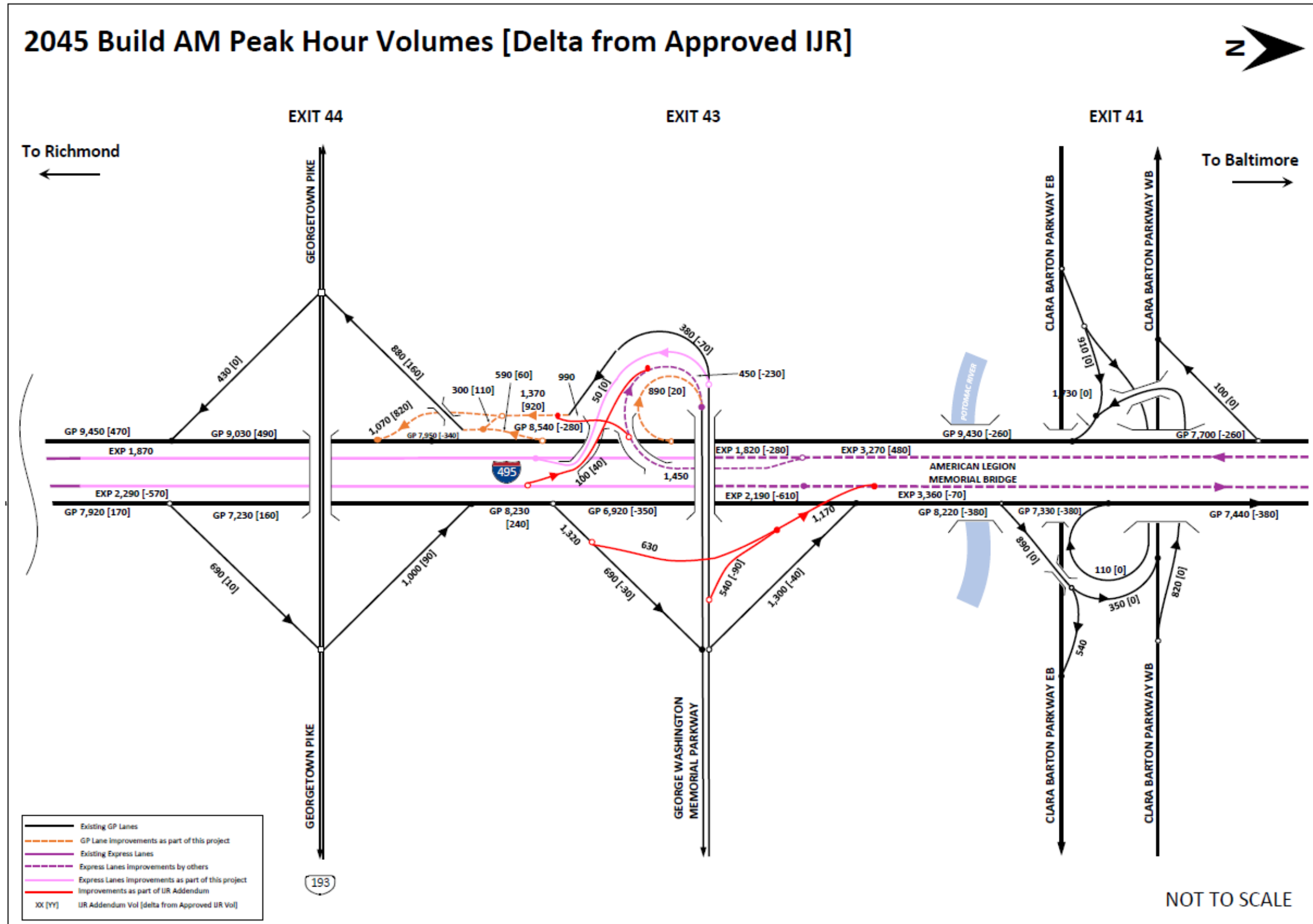


Exhibit 5-2b. 2045 Build (Modified) Freeway Traffic Volume Forecasts for IJR Addendum Study Area – AM Peak Hour

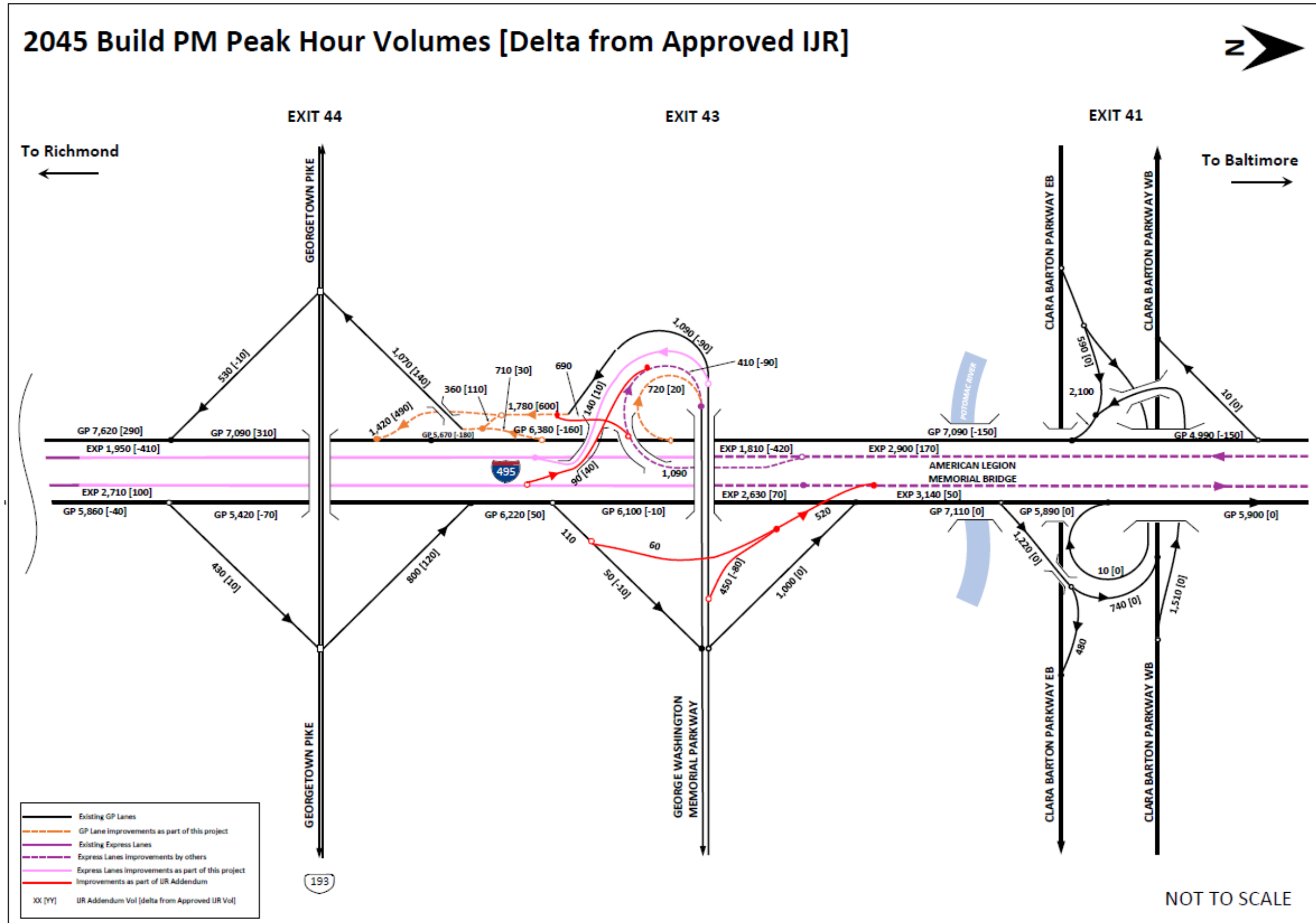


Exhibit 5-2c. 2045 Build (Modified) Freeway Traffic Volume Forecasts for IJR Addendum Study Area – PM Peak Hour



Exhibit 5-2d. 2045 Build (Approved IJR) vs. 2045 Build (Modified) Arterial Turning Movement Forecasts for IJR Addendum Study Area – AM Peak Hour



Exhibit 5-2e. 2045 Build (Approved IJR) vs. 2045 Build (Modified) Arterial Turning Movement Forecasts for IJR Addendum Study Area – PM Peak Hour

## **APPENDICES**

Appendix A: Preliminary Signing Plans (Modified) for IJR Addendum Study Area

Appendix B: Memorandum on No Build Modeling Considerations

Appendix C: Traffic Models

Appendix D: Freeway Segment Densities for IJR Addendum Study Area

Appendix E: Detailed Queueing Results for IJR Addendum Study Area

**Appendix A: Preliminary Signing Plans (Modified) for IJR Addendum  
Study Area**

## **Appendix B: Memorandum on No Build Modeling Considerations**



## **Appendix C: Traffic Models**

## **Appendix D: Freeway Segment Densities for IJR Addendum Study Area**

## **Appendix E: Detailed Queueing Results for IJR Addendum Study Area**