Chapter 1 - Background

Interstate 95 (I-95) serves as a major corridor for the movement of people and freight along the entire eastern seaboard. It also serves as a regional route for commuters to and from the Washington, DC metropolitan area and is a local route for traffic in the suburban areas of the City of Fredericksburg and southeastern Fairfax County/ northeastern Prince William County. This segment of the I-95 corridor is one of the most congested freeways in the region and in the Commonwealth of Virginia, based on regular freeway operations / congestion surveys performed by both the local Metropolitan Planning Organization (the Metropolitan Washington Council of Governments, or MWCOG) and the Virginia Department of Transportation.

The existing I-95 mainline freeway has three general purpose (GP) lanes in each direction, from the south-most project terminus at the Garrisonville interchange to the Route 123 interchange (Exit 160). Between the Route 123 interchange and the Fairfax County Parkway interchange, I-95 was just recently expanded to four GP lanes in each direction, with additional lanes in each direction developed to the north up to the Capital Beltway (I-495). These basic through lanes are supplemented in a number of locations with acceleration/deceleration lanes at on and off-ramps and auxiliary lanes between interchanges. Several previous studies in the corridor have shown that the existing corridor is heavily congested for many hours during the day, especially in the GP lanes.

The existing I-95 reversible High Occupancy Vehicle (HOV) facility through the study area is comprised of two lanes located in the center median, between the northbound and southbound GP lanes. The existing HOV lanes extend from Dumfries in Prince William County, just south of the Route 234 (Dumfries Road) interchange, to the Springfield Interchange at Interstate 495 (the Capital Beltway) /Interstate 395 in Fairfax County. North of the Capital Beltway, the reversible HOV lanes continue in the center median of Interstate 395 (I-395) through the City of Alexandria and Arlington County to the urban core of Washington, DC. [The mainline of I-95 makes a 90-degree turn at the Springfield Interchange and runs coincidental to I-495 around the eastern half of the Capital Beltway]. South of Dumfries to the southern terminus of the proposed project at the interchange with Route 610 (Garrisonville Road) in Garrisonville, a distance of approximately 9 miles, there are currently no HOV lanes.

Under provisions of Virginia's Public-Private Transportation Act of 1995 (PPTA), the Virginia Department of Transportation (VDOT) and private partners Fluor Virginia, Inc. and Transurban USA, Inc. (Fluor-Transurban) propose to make changes along the I-95 corridor, as outlined in the Proposed Action below.

1.1 Proposed Action

The I-95 HOV/HOT Lanes Project Northern Section proposes the following improvements to the I-95 corridor:

- Extend the new HOV/HOT lane facility approximately 9 miles to the south by constructing two lanes in the median of I-95 from the existing southern terminus to Garrisonville Road (VA 610) in Stafford County.
- Convert the existing two-lane HOV facility, from Prince William Parkway to south of the Town of Dumfries, to a two-lane HOV/HOT lane facility.
- Expand the current two-lane HOV facility, between the northern terminus (located approximately 2 miles north of Capital Beltway near Turkeycock Run) and Prince William Parkway, to a three-lane HOV/HOT lane facility.
- Add new entry/exit points into and out of the lanes.

Eight new entry/exit points into and out of the HOV/HOT lanes, as listed in Table 1-1, will be added along the corridor. All existing entry/exit points between 2 miles north of I-495 (including Turkeycock Run southbound HOV ramp) and south of the Town of Dumfries will be converted to HOV/HOT unless modified or deleted as indentified in Figure 1-1.

1.2 Project Development History

March 2004. Fluor-Transurban, as the proposed concessionaire, submitted a proposal to VDOT under provisions of Virginia's PPTA to develop, finance, design, and construct HOT lanes in the I-95 corridor from the Pentagon in Arlington County to south of Fredericksburg.

December 2005. Based upon recommendations of the Advisory Panel convened by VDOT to review the PPTA proposal, VDOT's Commissioner entered into negotiations with Fluor-Transurban to implement the proposal as two projects, the Northern Section (Phase 1) and the Southern Section (Phase 2), with the split occurring in the vicinity of the end of the existing interchange at Garrisonville Road.

2006–2010. Environmental studies were conducted for the two projects, but ultimately were suspended after the filing of a lawsuit.

February 2011. FHWA concurred that an EA is an appropriate level of NEPA documentation for the project as currently configured.

September 2011. FHWA approved the EA for public distribution in advance of Public Hearings.

Table 1-1. Modifications in Access

No.	Route	Connection Location:	Morning Connections	Evening Connections	Type of Modification
1	I - 95	Between VA 619 (Joplin Road) and VA 610 (Garrisonville Road)	NB general purpose lanes to NB HOV/HOT lanes	SB HOV/HOT Lanes to SB general purpose lanes	New – NB slip ramp and SB flyover
2	I - 95	Between US 234 (Dumfries Road) and VA 619 (Joplin Road)	N/A	SB HOV/HOT Lanes to SB general purpose lanes	Expanded – replace slip ramp with flyover
3	I - 95	Between Opitz and Dale Blvd	N/A	SB GP to SB HOV/HOT Lanes	New
4	I - 95	Between VA 123 (Gordon Road) and VA 3000 (Prince William County Parkway)	NB HOV/HOT Lanes to NB general purpose lanes	N/A	New
5	I - 95	Between VA 642 (Lorton Road) and Rt 1	N/A	SB GP to SB HOV/HOT Lanes	New
6	I - 95	Between VA 7100 (Fairfax County Pkwy) and VA 638 (Pohick Road)	N/A	SB HOV/HOT Lanes to SB general purpose lanes	Ramp Deleted (to accommodate No. 2 above)
7	I - 95	VA 7100 (Fairfax County Parkway) via Alban Rd / Boudinot Dr	NB HOV/HOT Lanes to Fairfax County Parkway (Alban Rd / Boudinot Dr)	Fairfax County Parkway (Alban Rd / Boudinot Dr) to SB HOV/HOT Lanes	New – (*REVERSIBLE*)
8	I - 395	Between VA 648 (Edsall Road) and Turkeycock Run	NB HOV/HOT Lanes to NB general purpose lanes	N/A	New

The project adds capacity to the current HOV facility, upgrades access/egress locations, and improves current bottlenecks. The project also provides a dedicated, performance based, computer aided incident management system. This project provides a funding mechanism for expanding the HOV/HOT Lanes network by connecting to the I-495 HOV/HOT Lanes project, which is currently under construction and to be completed by the end of 2012, to the I-95 corridor. [The region's CLRP and air quality conformity analyses have assumed adding a third HOV lane on I-395 and part of I-95 since 1994. That project was assumed to be accomplished by re-striping the existing pavement with no other modifications to access, egress, without any enhancements to transit services and or any new/improved incident management services. That project was assumed to be complete by 2010.]

The project also proposes to address traffic operational issues with the existing HOV system. During the PM peak period, traffic traveling in a southbound direction in the current HOV system is often congested at the point where the HOV lanes terminate and merge into the GP lanes at Dumfries. This project proposes to relieve the current congestion problem by both expanding the current merge point, and providing and extension of the HOV/HOT lanes south of the current merge to Route 610 (Garrisonville Road) in Stafford County. Under the proposed design, vehicles exiting at Route 234 would be merged into the GP lanes north of the exit. The remaining two HOV/HOT lanes would extend south of Quantico Creek. At a point south of

Quantico Creek, a single-lane fly-over will be provided from the southbound HOV/HOT lanes to the southbound GP lanes. This fly-over would service vehicles exiting to Route 619 (Joplin Road) and Russell Road. The fly-over lane would merge into a newly constructed GP auxiliary lane running between the ramp and Route 619. The remaining HOV/HOT lanes would continue south with a flyover into the southbound GP lanes just north of Route 610 (Garrisonville Road).

The Southern Section, which will be implemented as a separate project and IJR under Phase 2, will extend the two HOV/HOT lanes to south of the interchange with Route 17/Route 1 Massaponax in Spotsylvania County, with new entry/exit points into and out of the HOV/HOT lanes. This second phase of construction would add approximately 17 miles of additional capacity to the freeway system. The Southern Section update has been coordinated with the Fredericksburg area MPO (FAMPO) for inclusion in the air quality conformity analyses of its 2035 CLRP through the NEPA process.

Access to the HOV/HOT lanes would be available to automobiles, motorcycles, light-trucks, buses and transit vehicles only. Vehicles with three or more occupants would travel on the HOV/HOT lanes for free, as per the code of the Commonwealth of Virginia and Federal law. Buses, transit vehicles, and emergency response vehicles would also travel on the HOV/HOT lanes for free. Other vehicles not meeting the occupancy requirement would pay a toll, using electronic toll collection equipment, at a rate that would vary by time of day, day of week and level of congestion, to ensure the level of free-flow conditions as specified by Federal SAFE-TEA-LU regulations at a minimum. HOV occupancy and toll payment will be enforced on the facility in a manner that complies with the statutory requirements of the Commonwealth.

A private consortium led by Fluor Enterprises, Inc. and Transurban (USA) Inc. (together "FTU") has been selected to construct this and operate the entire facility as a system of High Occupancy Toll Lanes. In October 2006, VDOT and FTU signed an Interim Agreement to commence development activities on the project.

Once the I-95 HOV lanes have been converted into HOV/HOT lanes, traffic operations will be monitored and managed such that they will continue to be classified as "fixed guideway miles" for purposes of the transit funding formulas, in accordance with the Federal Transit Administration's (FTA) final policy statement on when HOT lanes shall be classified as fixed guideway miles, published in the January 11, 2007 Federal Register (Vol. 72, pages 1366-1372) ("FTA Policy"). The current FTA Policy references the performance standards and monitoring methods it will use in determining eligibility of HOT lanes to be classified as fixed guideway miles. The proposed project will implement plans to meet these standards and follow the prescribed methodology so as to preserve the facility's current eligibility in accordance with the current FTA policy. The standards and monitoring requirements will be included in the Comprehensive Agreement between VDOT and FTU. In the event that the implementation of the project fails to comply with the FTA's 2/11/07 Federal Register applicable requirements for considering HOT lanes as fixed guideway and results in loss of associated FTA revenue, the project will reimburse the current designated recipients for this lost revenue.

1.3 Previous Studies / Relationship to Other Highway Improvement Plans/Programs

As of early 2011, no significant system wide capacity or safety enhancements had been completed along the I-95 corridor IJR study area since the extension of the HOV lanes to

Dumfries Road in the early 1990's. The proposed project currently overlaps with a number of other new or recently completed projects or proposed improvement programs. The study area is adjacent to, or overlaps with, the following projects as listed and described in detail below:

- 14th Street Bridge (I-395 and US 1)
- I-395/Seminary Road Interchange ramp improvements – Mark Center
- I-495 Capital Beltway HOV/HOT Lanes
- I-95/I-395/I-495 Springfield Interchange Project
- Woodrow Wilson Bridge Improvement Project (I-95 and I-495)
- Fairfax County Parkway extension
- Fairfax County Parkway Engineer Proving Ground (EPG) Defense Access Roadways (DAR)
- I-95 Widening
- Russell Road Improvements
- I-95 HOV/HOT Lanes (Southern Portion)

14th Street Bridge (I-395 and US 1)
The Environmental Impact Statement (EIS) for the 14th Street Bridge Project began in July 2006. The EIS is a multi-year study that will address the current and future needs of the I-395 corridor in northern Arlington County, Virginia and southwest Washington DC. With increasing corridor traffic demands due to commuters, tourist/recreational travelers, public transit users, and regional through trips, the safety and mobility of this link has become a priority of FHWA Eastern Federal Lands Division. Various improvement alternatives are currently under consideration and are being evaluated as part of the NEPA process.

I-395/Seminary Road Interchange - New reversible lane HOV ramp
This project constructs a new single lane, reversible HOV ramp on I-395 HOV lanes to the third level of the Seminary Road interchange. The project adds ramp capacity to accommodate HOV and transit for the additional 6,400 employees of the Department of Defense - Washington Headquarters Services locating to Mark Center as part of the 2005 Base Realignment and Closure. An operational study is underway and a draft Interchange Modification Report will begin later this year. Environmental Reviews are expected to be underway in 2011. Project funding will be included in VDOT's FY 12-17 Six Year Improvement Program adopted by the Commonwealth Transportation Board in June 2011.

I-495 Capital Beltway HOV/HOT Lanes
The I-495 Capital Beltway HOV/HOT lanes project, currently under construction, will improve capacity and safety along the western portion of the Capital Beltway. The I-495 Capital Beltway HOV/HOT lanes project, located in Fairfax County, Virginia, includes the construction of two new HOV/HOT lanes in each direction from the I-95/I-395/I-495 (Springfield) interchange to just north of the Dulles Toll Road (14 miles total). When opened to traffic in early 2013, buses, carpools/vanpools with three or more people, and motorcycles can ride in the new lanes for free. All other vehicles carrying one or two people may use the HOT lanes by paying a toll that is based on dynamic pricing. In addition to providing new travel choices, this project will also replace about 50 aging bridges and overpasses, upgrade 10 interchanges, improve new bike and pedestrian access, and introduce (for the first time) transit options to the Beltway and Tysons Corner.

I-95/I-395/I-495 Springfield Interchange Project
Completed in 1997, the I-95/I-395/I-495 (Springfield Interchange) original IJR focused on improvements to relieve long-standing bottlenecks and safety issues at the Springfield

Interchange that will reduce congestion and enhance traffic operations and safety along the interstate. These improvements included the physical separation of through and local traffic on I-95, reconfiguration of interchange ramps for improved service, elimination of objectionable merging and weaving movements on the interstate mainline, and provisions for complete HOV facilities and connections between Shirley Highway (I-95/I-395) and the Capital Beltway (I-495).

Construction of improvements to the Springfield Interchange began in early 1999. Construction of the first seven phases of the Springfield Interchange Improvement Project was recently completed. The improvements included major modifications to the existing interchange that significantly increased the capacity and safety of one of the most traveled interchanges in Northern Virginia. The last phase of the interchange, known as the Phase VIII ramps, will provide direct connections between the HOT lanes on the Beltway (I-495) and HOV Lanes on I-95/I-395 and is currently being constructed as part of the I-495 Capital Beltway HOV/HOT lanes project. The anticipated completion date of construction is the end of 2012. These new direct connections will provide a seamless network for HOV vehicles traveling on I-95/I-395 and on the Beltway (I-495) between Springfield and Tysons Corner through a system of dedicated reversible HOV ramps, as shown in **Figure 1-1**. With the implementation of the I-95/I-395 HOV/HOT lanes project, the connections can provide a seamless network for HOT vehicles as well. This IJR assumes that the Phase VIII ramps are incorporated as part of the No-Build scenario [i.e. the new access associated with these ramp connections has already been approved as part of the previous IJR for the Springfield Interchange.] However, the conversion of these ramps from HOV to HOV/HOT operations in included as part of the proposed change in access addressed in this IJR, and supersedes previous change-in-access requests submitted to FHWA in draft form under an obsolete Interchange Modification Report.

Woodrow Wilson Bridge Improvement Project

The Woodrow Wilson Bridge project is currently under construction and will substantially improve capacity and safety along the southern portion of the Capital Beltway (I-495). The Woodrow Wilson Bridge Project is located in Northern Virginia and Prince George's County, Maryland. The project includes capacity enhancements to the mainline and interchanges between Virginia Route 241 (Telegraph Road) and Maryland Route 210 (Indian Head Highway). Several key components of this project are already complete that include the I-295 interchange, MD 210 interchange, US Route1 interchange, pedestrian/bike path, in addition to the replacement of the existing six-lane Woodrow Wilson Bridge with two bridges that provide 12 lanes of traffic over the Potomac River. The ongoing I-95/495 Telegraph Road interchange construction is expected to be completed by late 2012. The final configuration provides for barrier-separated express lanes that could eventually be incorporated into a larger Beltway (I-495) HOV/HOT Lane network, if additional improvements were constructed between the interchanges of Virginia Route 401 (Van Dorn Street) and Route 241 (Telegraph Road).

Fairfax County Parkway Extension

The Fairfax County Parkway project is currently under construction and will extend the Parkway between Rolling Road and Fullerton Road through the Fort Belvoir North Area (formerly the Engineer Proving Grounds – EPG). The approved Fairfax County Parkway improvements include the following:

- Four through lanes with right of way to expand to six lanes in the future (access from Fullerton Road to the Parkway will be eliminated);
- A partial cloverleaf interchange at Rolling Road with the future Fort Belvoir North Area access road;

- Access improvements at Franconia-Springfield Parkway, Hoes Road, and Rolling Road;
- Extension of Boudinot Drive to the Fairfax County Parkway including a grade-separated loop ramp.

This project will be built in four phases with the first and second phases completed and open to traffic in September 2010. [Portions of Phase 1 for the Fairfax County Parkway Extensions opened subsequent to the initiation of this IJR and the corresponding traffic counts for existing conditions, and after field-testing for calibration had begun]. The third and fourth phases are scheduled to be completed by Fall 2012.

Fairfax County Parkway Fort Belvoir North Area Access Roadways
The Fairfax County Parkway Fort Belvoir North Area Defense Access Roadways (DAR) project is currently under project development, review and coordination with VDOT. The project proposes a series of interstate ramp and local roadway improvements that are needed along I-95 and other key arterial roadways in the vicinity of the I-95/Fairfax County Parkway interchange. These improvements are proposed in preparation for the traffic influx expected at the Fort Belvoir North Area in Fairfax County, Virginia as a result of the recommendations made by the Defense Base Realignment and Closure Commission (BRAC). The primary purpose for providing the additional access points from I-95 to the Fort Belvoir North Area is to improve accessibility and localized mobility, and to relieve projected traffic congestion in the area transportation network surrounding the development site. Various access alternatives have been proposed, and a separate NEPA document and Interchange Modification Report (IMR) for the DAR ramps are currently under consideration and review by VDOT. The proposed improvements are shown in **Figure 1-2**, and included as a separate but concurrent project in the analysis of this IJR.

Fairfax County Parkway Interchange Improvement Project
This study is currently under evaluation and involves improvements at the existing interchange of I-95 with the Fairfax County Parkway, on the east side of I-95. The alternative currently being considered includes construction of a new single-lane flyover ramp that would carry northbound I-95 traffic that will exit at a single diverge point to access both northbound and southbound Fairfax County Parkway. Currently, northbound traffic exiting I-95 for northbound Fairfax County Parkway must weave across traffic entering from southbound Fairfax County Parkway headed to northbound I-95. To avoid potential weaving, the new flyover ramp is proposed to merge on the left side of the northbound Fairfax County Parkway lanes after the future Boudinot Drive access ramp and continue northbound as third lane on the future Fairfax County Parkway. The following two design options are currently being considered to provide interchange access to Backlick Road and Boudinot Drive:

- Option #1 would leave the existing northbound I-95 loop off-ramp open so that I-95 northbound traffic could continue to exit and get to northbound Backlick Road and the future Boudinot Drive interchange.
- Option #2 would eliminate the existing northbound I-95 loop off-ramp and construct left-turn lanes at the ramp terminal intersection of the northbound I-95 exit ramp with Loisdale Road/Fairfax County Parkway.

The project construction schedule will be developed once funding has been identified. According to the latest 2011 Financially CLRP, this project is slated to be open sometime before 2020. A separate NEPA document and IMR are currently being developed by VDOT. The

proposed improvements are shown in **Figure 1-3**, and included as a separate but concurrent project in the analysis of this IJR.

I-95 Widening
The I-95 Widening project was recently completed and improves capacity and safety along I-95 between Fairfax County Parkway and Gordon Boulevard (Route 123). The $123 million six-mile widening was opened to traffic in July 2011.The I-95 Widening project, which is located in Fairfax County, Virginia, included the construction of a fourth lane in each direction on I-95 between the Fairfax County Parkway and Route 123. The additional lane will relieves bottlenecks and congestion in this area, and provide improved traffic flow to and from the recently completed I-95/I-395/I-495 (Springfield) interchange.

Russell Road Improvements
The Marine Corp Base Quantico (MCBQ), Virginia is expected to receive new development as a result of recommendations made by BRAC; this will include the construction of new facilities west of I-95. The primary access point for the new development will be the I-95/Russell Road interchange. The ramp intersections at the Russell Road interchange are expected to be improved by 2015 to accommodate the additional traffic demand.

I-95 HOV/HOT Lanes (Southern Section)
An EA that includes the Southern Section of the I-95 HOV/HOT Lanes project has been completed to explore improvements south of the proposed Project. According to the National Capital Region CLRP, the project will include the continuation of two HOV/HOT lanes from Garrisonville Road south beyond the interim (Phase 1) southern terminus of the proposed Northern Section project in this IJR. According to the FAMPO CLRP, the project will include the addition of two (2) HOV/HOT lanes to I-95 from the Prince William County line to the Spotsylvania Interchange (Exit 126) and the project will be completed in 2015. It should be noted that the northern portion of the project limits for this Southern Section project overlaps with the study area of the proposed Northern Section project in this IJR.

1.4 Support & Commitment from VDOT, local jurisdictions

VDOT and private partners Fluor-Transurban (the project concessionaire) have developed a design solution to resolve the issues that were raised in the EA Purpose and Need Statement. Throughout the entire project development process for the improvements proposed in this IJR, VDOT and Fluor-Transurban have worked in partnership extensively with the counties and local municipalities affected, as well as with MWCOG and FAMPO, to advance conceptual engineering and analysis in support of the proposed improvements.

As previously mentioned, local and regional planning documents reference the project, including the MWCOG's and FAMPO's CLRP, which was amended in 2011 to include the updated project. The CLRP was adopted by MWCOG's Transportation Planning Board in a resolution that was approved in July 2011, as shown in Appendix A. The project is included in the Air Conformity Inputs for the both the CLRP and the Transportation Improvement Project (TIP), with conformity determination for both MPO's completed and anticipated approval by FHWA in September of 2011.

Fairfax County, Prince William County, and Stafford County have also been engaged in the project development process and support the project, as evidence by their votes in support of the project inclusion in the CLRP.

Chapter 2 - Purpose & Need

The purpose of the project is to expand highway capacity while also facilitating ridesharing and transit choices by providing dedicated lanes for multi-occupant vehicles. One of the objectives of the expansion and conversion of the HOV system to HOV/HOT is to be able to realize underutilized capacity on the existing HOV lanes while reducing congestion on the sections of the GP lanes that currently operate over capacity and that will continue to be oversaturated in the future.

2.1 Needs – Existing Conditions

Existing I-95 through the study area has three GP lanes in each direction, from the southern project terminus at the Garrisonville interchange to the Route 123 interchange (Exit 160) [1]. North of the Route 123 interchange, I-95 has four GP lanes in each direction to the Capital Beltway (I-495), supplemented in a number of locations with acceleration/deceleration lanes at on and off-ramps and auxiliary lanes between interchanges. The existing I-95/I-395 HOV facility through the study area is two lanes within the median of I-95 and extends from Dumfries just south of the Route 234 (Dumfries Road) interchange to the Capital Beltway. North of the Capital Beltway, the HOV lanes continue to Washington, DC. South of Dumfries to the southern terminus of the proposed I-95 HOV/HOT Lanes Southern Section project (Phase 2), a distance of approximately 28 miles, there are no HOV lanes.

Daily traffic volumes in the GP lanes range from approximately 77,900 vehicles per day (vpd) south of the U.S. Route 1 interchange (Jefferson Davis Highway, Exit 126) to approximately 172,900 vpd just south of the Capital Beltway (Exit 170), as shown in **Table 2-1**.

I-95 serves as a major corridor for the movement of people and freight along the entire eastern seaboard, but it also serves as a regional route for commuters to the Washington, DC metropolitan area and a local route for traffic in the urbanized areas of the City of Fredericksburg and southeastern Fairfax County/ northeastern Prince William County. This segment of the I-95 corridor is one of the most congested freeways in the region and in the Commonwealth of Virginia, based on regular freeway operations / congestion surveys performed by both the local Metropolitan Planning Organization (MWCOG) and VDOT. The existing high traffic volumes are due in part to the dramatic population growth in the study corridor. Data compiled by FAMPO shows a 400 percent increase in population from 1960 to 2006 in the area covered by the George Washington Regional Commission (GWRC), which includes the City of Fredericksburg and the counties of Caroline, King George, Spotsylvania, and Stafford, making it the fastest growing region in Virginia since 1980 when its growth rate surpassed that of Northern Virginia. Much of the growth is attributable to in-migration of new residents seeking affordable housing and lower-density suburban lifestyles while continuing to work at jobs in the Washington, DC region.

[1] As part of the I-95 4th Lane Project, a fourth general-purpose lane in the southbound direction of I-95 between the Fairfax County Parkway and Route 1 opened on October 31, 2010. The final piece of the widening project, a fourth lane in each direction on the Occoquan River Bridge, was completed July 3, 2011.

Table 2-1: Existing Daily Traffic Volumes

Location	2011 Daily Volumes	
	Southbound	Northbound
North of Capital Beltway (I-495, Exit 170)	80,300	82,500
North of Franconia/Old Keene Mill Roads (Route 644, Exit 169)	98,300	92,500
North of Fairfax County Parkway (Route 7100, Exit 166)	99,100	102,900
North of Lorton Road (Route 642, Exit 163)	75,800	88,500
North of Route 1 (Exit 161)	69,300	81,900
North of Gordon Boulevard (Route 123, Exit 160)	74,700	85,000
North of Prince William Parkway (Exit 158)	76,800	76,100
North of Dale Boulevard/Opitz Boulevard Collector/Distributor Road (Route 784/Route 642, Exit 156)	69,700	72,700
North of Dumfries Road (Route 234, Exit 152)	66,600	70,700
North of Joplin Road (Route 619, Exit 150)	71,200	77,200
North of Russell Road (Exit 148)	68,600	72,900
North of Garrisonville Road (Route 610, Exit 143)	70,000	73,100
North of Courthouse Road (Route 630, Exit 140)	64,200	68,000
North of Centreport Parkway (Route 8900, Exit 136)	64,700	68,300
North of Warrenton Road (U.S. Route 17, Exit 133)	63,000	66,400
North of Plank Road (Route 3, Exit 130)	60,400	67,200
North of Jefferson Davis Highway (U.S. Route 1, Exit 126)	54,100	49,300
South of Jefferson Davis Highway (U.S. Route 1, Exit 126)	39,000	38,900

A report prepared for VDOT in 2002 regarding the feasibility of implementing HOV lanes in the southern portion of the corridor indicated that approximately 38 percent of the Fredericksburg region's workforce commutes northward, using I-95 as their primary commuting route. Broken down by jurisdiction, 50 percent of Stafford County's workforce, 28 percent of Spotsylvania County's workforce, and 19 percent of Fredericksburg's workforce commute northward, according to the report. This commuting pattern, along with the availability of HOV lanes in the northern portion of the study area north of Dumfries, has led to extensive use of carpooling and private bus services in the corridor. For example, GWRC reports that there are nine commuter parking lots, eight of which are located along the I-95 corridor, with a total of more than 5,500 parking spaces available within the planning region. Moreover, there are 378 registered vanpools, large numbers of carpools (132 registered and hundreds not registered), and 25 private commuter bus runs along the corridor from Fredericksburg and Stafford County.[2] Approximately 95 commuter bus runs are also made on a daily basis along the I-95 corridor from Prince William County –which provides over 7,500 park-and-ride spaces, the majority of which are located along the I-95 corridor– to Tysons Corner, Arlington County (Crystal City, Rosslyn, Ballston), the Pentagon, and Washington, DC.[3] Finally, hundreds of "slug"-pools originate from various commuter lots in the region, especially the Route 610 commuter lots in Stafford County.[4]

While these ridesharing activities reduce the number of vehicles on the road and contribute to greater throughput of people, as opposed to just vehicles, the volumes of traffic are still near capacity throughout the corridor. The TransAction 2030 Plan, the long-range regional transportation plan prepared by the Northern Virginia Transportation Authority, reports that currently during the peak periods, one hour or more of stop-and-go traffic can be expected on I-95 from Washington, DC south to the Prince William County Line. Analysis by FAMPO as reported in its 2035 Long-Range Transportation Plan indicates that the LOS is E or F in the remainder of the project area, from the Prince William County Line south to Route 1 south of Fredericksburg.

Recurring daily congestion resulting from travel demand exceeding available highway capacity results in slower travel speeds and increased travel times. Average travel time along the I-95 corridor is increasing, and the variability of travel time is increasing as well. As traffic flows approach and exceed capacity, the higher traffic densities result in vehicles being more closely spaced, increasing the interaction among vehicles and distractions to drivers. The flow becomes unstable and abrupt stop-and-go traffic movements occur. Because of the unstable nature of the traffic flow, the exact onset, severity, and frequency of the congested conditions are difficult to predict and the actual travel time may vary considerably from the average from one day to the next, especially when crashes or breakdowns result in lane restrictions or closures. Such non-recurring congestion (non-recurring because it happens differently every day) increases the unreliability of travel times in the corridor. Because of the unreliable travel times, people must allow extra time for travel during more congested conditions to be sure that they will arrive at their destinations on time.

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[2] George Washington Regional Commission, May 2011.

[3] Potomac and Rappahannock Transportation Commission, OmniRide and Metro Direct schedules.

[4] Slugging, also referred to as "Instant Carpooling" or "Casual Carpooling", is a term used to describe a form of commuting found in the Washington, DC area where a car needing additional passengers to meet the required three- person HOV minimum pulls up to a known slug line and picks up passengers. The ride is provided for free on that one occasion, with no other commitment on the part of the driver or passenger.

In the absence of HOV lanes in the southern portion of the corridor, those participating in ridesharing and bus services still must contend with congestion and delays in the GP lanes and travel to north of Dumfries before deriving benefit from HOV lanes for trips oriented to northern Virginia and Washington, DC. Those HOV lanes enable bypassing of slow-moving traffic in the GP lanes and generally result in faster trips at higher speeds. Traffic during peak hours in the HOV lanes usually can travel at the posted speed limit of 65 mph for a majority of the distance while traffic in the GP lanes, where the posted speed limit is 55 to 60 mph, travels bumper-to-bumper in stop-and-go conditions.

2.2 Needs – Future Conditions

Forecasts compiled by FAMPO show continuing population growth in the GWRC region, with a doubling by the year 2035 from the current 315,000 to 600,000 residents, with the majority of growth projected in the areas immediately adjacent to and surrounding I-95 in Stafford and Spotsylvania Counties and the City of Fredericksburg. TransAction 2030, which is sponsored by the Northern Virginia Transportation Authority, and serves as a regional transportation planning effort to update Northern Virginia's long range transportation plan, reports the following findings:

- Within the next 25 years, Northern Virginia is expected to attract over 650,000 new jobs, or more than half of the new jobs expected to come to the metropolitan Washington region.
- Within the next 25 years, Northern Virginia is also projected to attract 918,500 new residents, or 56 percent of the total population increase expected in the metropolitan area.
- Northern Virginia's growth in jobs and population could contribute to a regional housing shortage that is anticipated by MWCOG, forcing residents to find housing outside of the metropolitan region, which will require longer commutes that compound congestion on area roads.

The travel generated by this continuing growth will further increase traffic volumes on I-95, as reflected in the travel demand forecasts shown in **Table 2-2**. These forecasts were prepared using the FAMPO and MWCOG regional travel demand forecasting models and cooperative forecasts, which are based on the local jurisdictions' projections of population, households, and employment.

Traditional highway capacity expansion is not an option to meet the growing interstate travel demand because such expansion has become increasingly expensive and unaffordable, and the human impacts and physical constraints in the highly urbanized areas in the northern section of the project corridor make it exceedingly difficult to implement. While it is commonly understood that people place a high value on reaching their destinations in a timely manner, it is also recognized that people place a high value on the ability to reach their destinations in a reliable manner. I-95 has become so congested in recent years that the GP lanes, and oftentimes the HOV lanes, cannot provide reliable travel times during the peak periods.

Traffic forecasts for 2035 show total daily volumes on the I-95 GP lanes increasing to approximately 114,100 vpd south of the U.S. Route 1 interchange to approximately 178,400 vpd just south of the Capital Beltway interchange. With these volumes, the LOS will deteriorate to F throughout most of the corridor. Clearly, future travel demand will exceed the available capacity of existing I-95.

Table 2-2: Future Daily Traffic Volumes

Location	**2035 Daily Volumes**	
	Southbound	Northbound
North of Capital Beltway (I-495, Exit 170)	80,500	84,800
North of Franconia/Old Keene Mill Roads (Route 644, Exit 169)	93,200	59,100
North of Fairfax County Parkway (Route 7100, Exit 166)	77,200	101,200
North of Lorton Road (Route 642, Exit 163)	76,200	100,300
North of Route 1 (Exit 161)	72,100	99,700
North of Gordon Boulevard (Route 123, Exit 160)	78,100	107,200
North of Prince William Parkway (Exit 158)	80,100	90,000
North of Dale Boulevard/Opitz Boulevard Collector/Distributor Road (Route 784/Route 642, Exit 156)	77,100	86,600
North of Dumfries Road (Route 234, Exit 152)	67,000	79,800
North of Joplin Road (Route 619, Exit 150)	71,800	87,000
North of Russell Road (Exit 148)	74,000	82,800
North of Garrisonville Road (Route 610, Exit 143)	78,000	84,100
North of Courthouse Road (Route 630, Exit 140)	79,000	84,500
North of Centreport Parkway (Route 8900, Exit 136)	83,700	87,700
North of Warrenton Road (U.S. Route 17, Exit 133)	81,400	87,300
North of Plank Road (Route 3, Exit 130)	76,200	88,900
North of Jefferson Davis Highway (U.S. Route 1, Exit 126)	66,800	62,200
South of Jefferson Davis Highway (U.S. Route 1, Exit 126)	55,000	59,100

Regional and statewide planning documents emphasize the need for both more overall transportation capacity and for ways to accommodate travel demands more efficiently and reliably and through a variety of travel choices. While convenient, the single-occupant motor vehicle is much less efficient in terms of roadway space requirements. Rideshare, where each vehicle can carry multiple occupants and effectively replace multiple vehicles with a single one, is a key element of an overall management plan toolkit for improving the efficiency of highly congested commuter corridors such as I-95. The George Washington Regional Commission explicitly seeks to promote ridesharing and transportation demand management techniques to assist persons seeking options for travel to their workplaces and other destinations. It is the goal of the Commission's program to promote, plan, and establish transportation alternatives to the use of the single-occupant vehicle.

Under existing conditions, all vehicles, whether SOV, HOV, or transit vehicles, traveling on I-95 must utilize the GP lanes south of Dumfries. Accordingly, no speed or travel time advantage is gained by ridesharing or using transit. While transit services and ridesharing are currently available in the corridor, they are oftentimes no more reliable than SOV travel because they use the same congested GP lanes, or HOV lanes that are becoming increasingly congested. Higher reliability of travel times could provide inducements to greater usage of transit and ridesharing. Likewise, SOV drivers currently have few if any choices available to avoid freeway congestion and the inevitable delays in reaching their destinations.

2.5 Summary

The purpose of the project is to expand highway capacity while also facilitating ridesharing and transit choices by providing dedicated lanes for multi-occupant vehicles. One of the objectives of the expansion and conversion of the HOV system to HOV/HOT is to be able to realize underutilized capacity on the existing HOV lanes while reducing congestion on the sections of the GP lanes that currently operate over capacity and that will continue to be oversaturated in the future.

Chapter 3 - FHWA Interstate Access Policy Compliance

3.1 Responses to FHWA 8-Point Policy on Interstate Highway Access Modifications

For every proposed highway system modification affecting Interstate Highway access, FHWA requires the preparation of an IJR that contains sufficient information to facilitate the agency's independent evaluation of the request, and to ensure that pertinent factors and alternatives have been appropriately considered. As the United States Department of Transportation's final reviewing agency and authority for all interstate access requests, FHWA has specified eight 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 each of the eight policy points for the proposed modifications to access on I-95.

1. **The need being addressed by the request cannot be adequately satisfied by existing interchanges to the Interstate, and/or local roads and streets in the corridor can neither provide the desired access, nor can they be reasonably improved (such as access control along surface streets, improving traffic control, modifying ramp terminals and intersections, adding turn bays or lengthening storage) to satisfactorily accommodate the design-year traffic demands.**

   Traffic forecasts for the design year (2035) show that future travel demand will exceed the available capacity of the existing I-95 mainline GP lanes. With these volumes, the level of service (LOS) will deteriorate to F throughout most of the corridor. Broken down by jurisdiction, 50 percent of Stafford County's workforce, 28 percent of Spotsylvania County's workforce, and 19 percent of Fredericksburg's workforce commute northward. This commuting pattern, along with the availability of existing capacity HOV lanes in the northern portion of the study area north of Route 234 in Dumfries, has encouraged extensive use of carpooling and private bus services in the corridor. However, additional unused capacity still remains on the HOV lanes.

   Under existing conditions, all vehicles traveling on I-95 south of Dumfries must utilize the GP lanes. Accordingly, no speed or travel time advantage is gained by ridesharing or using transit within this segment. While transit services and ridesharing are currently available in the corridor, they are oftentimes no more reliable than single-occupant vehicles (SOV) travel because they use the same congested GP lanes, or HOV lanes that are becoming increasingly congested.

   The proposed project addresses freeway system deficiencies by providing additional capacity and access for vehicles who wish to use the I-95 HOV/HOT lanes. The proposed access changes involve modifications to freeway system movements and travel patterns (for instance, conversion from HOV to HOT) rather than enhancing or adding to local access (with the exception of improvements within the vicinity of the Fairfax County Parkway interchange). The proposed I-95 HOV/HOT Lanes do not add traffic to the system – rather, it re-routes existing trips from the GP lanes to the modified HOV/HOT lane facility.

2. **The need being addressed by the request cannot be adequately satisfied by reasonable transportation system management (such as ramp metering, mass transit, and HOV facilities), geometric design, and alternative improvements to the Interstate without the proposed change(s) in access.**

   The project development process for the proposed plan considered a number of different iterations and options for transportation system management solutions, geometric design configuration and manner of existing and future access. Although transportation system management (TSM) strategies alone (such as ramp metering, mass transit, striping and signing) will not solve the access issues identified in the Purpose and Need, they are included as a component of the proposed plan for the implementation of HOT lanes on the project. Examples of TSM elements that are part of the project include modified traffic signals, additional/modified turn lanes at select intersections, and auxiliary lanes in isolated locations, including the follow:

   - Modified traffic signals and turn lanes:
     - Prince William Parkway HOT Lanes ramp terminal at Park-and-Ride entrance
     - Gordon Boulevard HOT Lanes ramp terminal
     - Alban Road / Boudinot Drive HOT Lanes ramp terminal
     - Franconia-Springfield Parkway HOT Lanes ramp terminals
   - Auxiliary lanes:
     - Southbound between the HOT Lanes flyover ramp at the southern terminus and the off-ramp to the Garrisonville Road interchange
     - Southbound between the HOT lanes flyover ramp south of Dumfries and the off-ramp to the Joplin Road interchange
     - Northbound and southbound between the HOT Lanes flyover ramps north of Optiz Boulevard and the Optiz / Dale Boulevard interchange ramp C-D roads
     - Northbound between the HOT lanes flyover ramp at the northern terminus and the off-ramps to Duke Street / Little River Turnpike

   Other elements that are proposed in parallel to the project include improvements to Park-and-Ride lots along the corridor, as well as improved transit access and routing. All options considered were for the treatment of existing conventional traffic.

3. **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 shall, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access. The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, shall 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. Requests for a proposed change in access must 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. Each request must also include a conceptual plan of the type and location of the signs proposed to support each design alternative.

The operational and safety analysis performed as part of the access request includes the GP mainline and reversible HOV or HOT freeway segments, associated ramps and C-D roads for the length of the project, plus the first adjacent interchange on each side of the proposed HOT Lanes termini for the Northern Project. At each of the interchanges, the crossroads included the ramp terminal intersections and adjacent local street intersections (within close proximity). At the Capital Beltway and at the Springfield-Franconia Parkway, the next adjacent interchanges on either side of I-95 were also included in the analysis.

The proposed plan should produce marked operational improvements to the overall system by increasing capacity and access on the reversible lanes and by transferring some of the traffic currently using the over-saturated GP Lanes to the proposed HOT Lanes, which operate with excess capacity if they are left to remain as operating under HOV-3+ only. The analysis using traffic simulation showed improvements in travel times, throughput, speeds, and congestion/queuing on a number of segments within the GP Lanes, without adversely impacting those same elements on the HOT Lanes. A detailed assessment of traffic operations using microsimulation (VISSIM) and deterministic methods (Highway Capacity Software HCS-2010) is presented in Chapter 9 of this document.

Traffic operational analyses and quantitative safety studies consistent with FHWA's policy are documented herein. The preliminary 2018 and 2035 traffic operational analyses do not show marked degradation between the No-Build and Build conditions. One exception is during the AM peak period at the northern terminus of the project, in the GP Lanes from Edsall Road to north of Duke Street. In both 2018 and 2035, the operations show some degradation of operations on the GP Lanes due to the proposed change in capacity of the HOT Lanes north of Edsall Road (transition from 3 lanes to 2 lanes) and transition of toll-paying traffic back to the GP lanes. A major contributing element to operations at the northern terminus which occurs in the Existing, No-Build and Build scenarios is the downstream congestion and queuing resulting from operations at Seminary Road interchange and the northbound freeway segment between Duke Street and Seminary Road. However, the proposed plan was also assessed with a sensitivity analysis which identified some downstream improvements that could be implemented at some point as a separate project, as deemed appropriate by FHWA and VDOT, to mitigate traffic operational or safety issues resulting from the existing spillback. A detailed discussion on mitigation for the northern terminus in Section 9.3 of this IJR provides a range of options to address the issues specific to the northbound traffic at the northern terminus mentioned above. This mitigation is focused on addressing potential traffic operational issues that could be associated with downstream conditions such that the proposed project can be implemented without adverse impacts to adjacent interchange and arterials.

A similar issue was observed under a "Phase 1 interim conditions" sensitivity analysis at the southern terminus for the Northern Section, for the 2018 horizon year only, assuming that all southbound HOT/HOV traffic must exit the reversible lanes and transition back to the GP Lanes at Garrisonville. This scenario is limited to the PM peak period in the near term, up until such time that the Southern Project is completed and HOT/HOV traffic may

continue south on the new HOT Lanes beyond Garrisonville and down to Massaponax (southern terminus for the Southern Section). Sensitivity analyses for this location show that bottle-neck congestion may be mitigated through the use of dynamic tolling on the south-most tolling segment, and that the total travel time and vehicle throughput improve for the Build Scenario. The analysis and results are discussed in detail in Section 9.3.

Supporting documentation also includes a functional signing plan (Appendix G) and assumptions used in developing a signing concept, as provided in Section 13 of this document.

4. **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 for 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.**

   A few partial interchanges are proposed [for those locations which constitute new access points] or retain and incorporated into the access configuration [for those locations where access already exists] because of special access conditions associated with HOV/HOT Lanes, transit service, and park-and-ride lot connections;

   The design of the proposed I-95 HOV/ HOT lanes, connecting freeways, and adjacent service interchanges is intended to meet or exceed American Association of State Highway and Transportation Officials (AASHTO) design standards, where feasible. However, it is acknowledged that there will be exceptions to standards to better meet the needs of the Project and to minimize impacts. These exceptions to standards are identified in Chapter 7 of this document and further documented in detail in the Exceptions to Standards Report to be submitted for review by VDOT and FHWA.

5. **The proposal considers and is consistent with local and regional land use and transportation plans. Prior to receiving final approval, all requests for new or revised access must be included in an adopted Metropolitan Transportation Plan, in the adopted Statewide or Metropolitan Transportation Improvement Program (STIP or TIP), and the Congestion Management Process within transportation management areas, as appropriate, and as specified in 23 CFR part 450, and the transportation conformity requirements of 40 CFR parts 51 and 93.**

   The proposed improvements to I-95 are consistent with local and regional land use plans including, the Stafford, Prince William, and Fairfax County Comprehensive Plans. The improvements are also consistent with the Constrained Long Range Transportation Plans (CLRPs) pertaining to the study area, including those from the Fredericksburg Area Metropolitan Planning Organization (FAMPO) -- the MPO for the Fredericksburg area and southern portion of the study area -- and the Metropolitan Washington Council of Governments (MWCOG) -- the MPO for the Washington metropolitan area and northern portion of the study the study area. The Northern Section of the project is included in the National Capital Region Transportation Planning Board's FY 2011-2016 Transportation Improvement Program (TIP) and 2010 CLRP, which were found to conform to the State Implementation Plan. The Southern Section (beginning south of the Prince William County/Stafford County line) has been included in FAMPO's FY 09-12 TIP and 2035 CLRP, which have also been found to conform to the State Implementation Plan. The most recent project scope update (as presented in this IJR and the NEPA documentation) has been

incorporated into the updated conformity determinations for MWCOG and FAMPO, with FHWA approval expected by the end of September 2011.

6. **In corridors where the potential exists for future multiple interchange additions, a comprehensive corridor or network study must accompany all requests for new or revised access with recommendations that address all of the proposed and desired access changes within the context of a longer-range system or network plan.**

   The improvements to I-95 in the Stafford County portion of the I-95 study limits are included in the FAMPO 2035 CLRP, the fiscally constrained plan for the Fredericksburg area. Improvements to I-95 located in Prince William County and Fairfax County are included in the National Capital Region CLRP, the fiscally constrained plan for the Washington metropolitan region.

   The CLRP's for the National Capital Region and FAMPO comprehensively look at the transportation needs throughout the region, including the I-95 corridor. The traffic analysis completed for this IJR considered all of the elements in these plans that affect the project corridor. All new and revised access points are supported by these comprehensive network study recommendations.

7. **When a new or revised access point is due to a new, expanded, or substantial change in current or planned future development or land use, requests must demonstrate appropriate coordination has occurred between the development and any proposed transportation system improvement. The request must describe the commitments agreed upon to assure adequate collection and dispersion of the traffic resulting from the development with the adjoining local street network and Interstate access point.**

   The new or modified access points included in the proposed Project are needed to provide access to the expanded and enhanced HOV lanes, which are converted to HOV/ HOT lanes; and the additional/extended HOV/ HOT lanes. They are not proposed as a result of new or expanded development. The proposed access points will not be used to provide access between any new or expanded development and the interstate facility.

8. **The proposal can be expected to be included as an alternative in the required environmental evaluation, review and processing. The proposal should include supporting information and current status of the environmental processing.**

   The proposed project is currently undergoing the environmental planning process with the preparation of an Environmental Assessment (EA). It has been recently determined that the proposed scope of the project represented in the Preferred Alternative will not result in significant environmental impacts. The EA was approved for public availability on September 8, 2011, and a Finding of No Significant Impact (FONSI) is expected to be completed by November 2011, following the conclusion of the public involvement process at the end of September.

Chapter 4 - Study Area

4.1 Overview

VDOT, in cooperation with FHWA, has prepared an EA of the impacts and environmental consequences of proposed improvements to I-95 in the form of HOV/HOT Lanes through the City of Fredericksburg and the Counties of Spotsylvania, Stafford, Prince William, and Fairfax. Under provisions of Virginia's PPTA, VDOT and private partners Fluor-Transurban propose to construct HOT lanes within the median of I-95 from Garrisonville in Stafford County to south of Dumfries (existing HOV Lanes terminus) in Prince William, and convert the existing HOV lanes to HOT lanes from Dumfries to the Capital Beltway (I-495) in Prince William and Fairfax Counties. This IJR is being prepared for the Northern Section of the project (Phase 1) only, with a southern terminus proposed just north of the interchange with Garrisonville Road. A separate IJR will be produced for the southern section (Phase 2) between Massaponax and Garrisonville at a later date. These project limits for the IJR extend approximately 40 miles, affect 23 interchanges and lie within Stafford County, Prince William County, the Town of Dumfries, Fairfax County, and the southern edge of the City of Alexandria.

Exhibit 4-1 shows the project location for the Northern Section (40 miles total) within the context of the larger EA Study Area that includes the Northern and Southern Sections, and which extends approximately 57 miles. The beginning of the study area is approximately 1.10 miles south of U.S. Route 17 (Mills Drive) near Spotsylvania, proceeds northward along existing I-95, and ends at the Capital Beltway in Fairfax County. At the northern terminus, the transition to the existing I-395 HOV lanes and GP lanes would occur just north of the I-395/Edsall Road interchange. The study area consists of lands within the I-95 median, where most of the proposed construction would occur, and lands adjacent to the I-95 corridor that could potentially incur direct or indirect impacts as a result of new or modified ramps associated with the proposed project.

4. 2 Project Location Map

Figure 4-1 shows the various components of the Northern and Southern project study areas.

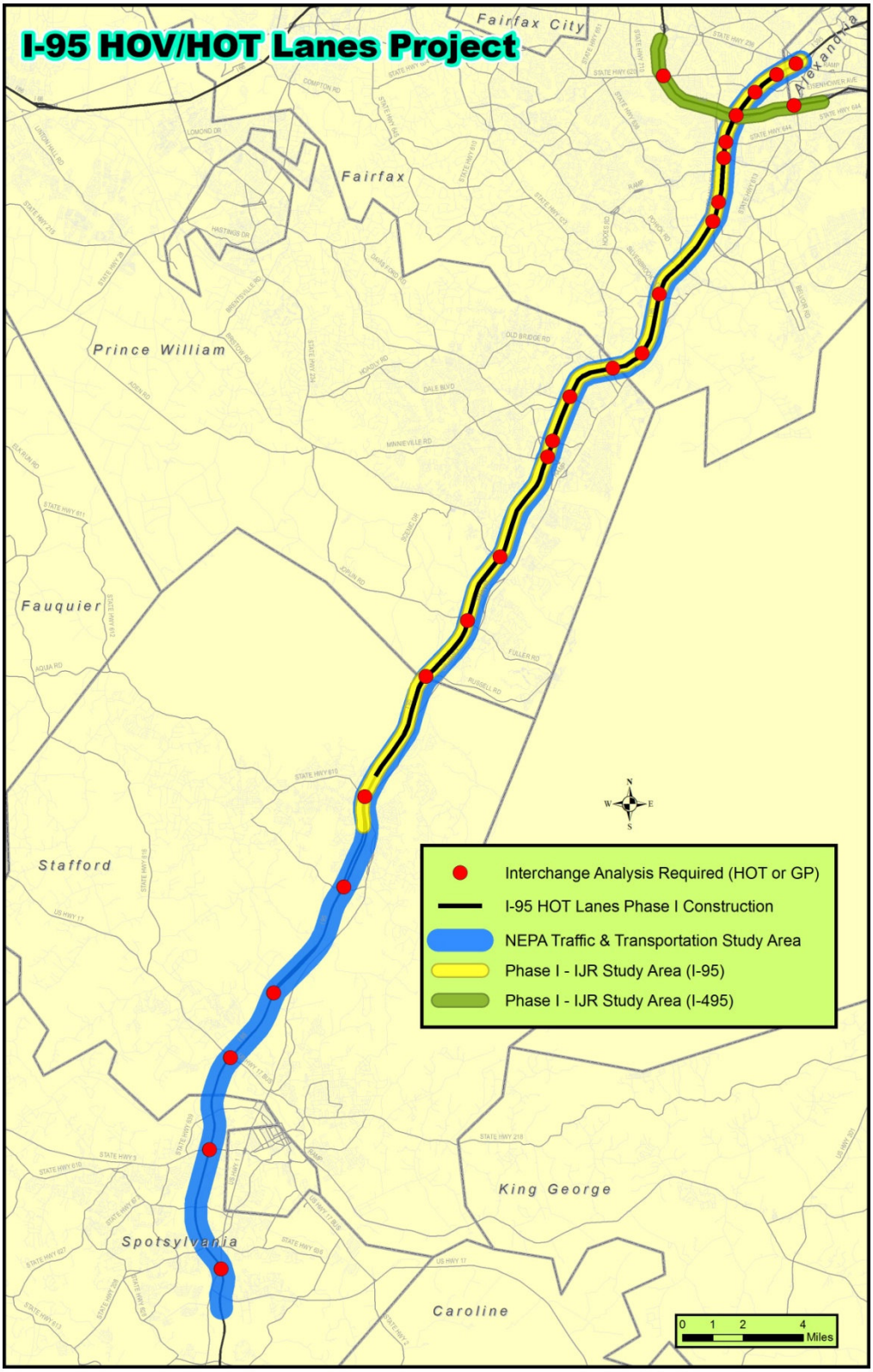

Exhibit 4-1. Project Location

4.3 Logical Termini

FHWA regulations implementing NEPA require that:

"In order to ensure meaningful evaluation of alternatives and to avoid commitments to transportation improvements before they are fully evaluated, the action evaluated in each Environmental Impact State (EIS) or Finding Of No Significant Impact (FONSI) shall:

1. Connect logical termini and be of sufficient length to address environmental matters on a broad scope;
2. Have independent utility or independent significance, i.e., be usable and be a reasonable expenditure even if no additional transportation improvements in the area are made; and
3. Not restrict consideration of alternatives for other reasonably foreseeable transportation improvements."

The central basis of all three of the above criteria is that projects have ***rational*** end points, that is, end points that are based on valid and sound reasoning. Among the factors considered in establishing the termini for this project are the following:

- The southern terminus of the Northern Section project is based on capturing potential HOV and HOT travel from the northern Stafford County (Garrisonville) and southern Prince William County area (northern portions of the FAMPO planning area). This area is known to be a substantial commuter base for employees in the Northern Virginia/Washington D.C. region. The next substantial urbanized area is the City of Fredericksburg, located 15 miles to the south. The area between Garrisonville and Dumfries also has been identified as an area underserved by transit, and therefore an area that would benefit from facilities, such as the proposed project, that would encourage transit and HOV use.
- The northern terminus of the project connects to the I-495 Capital Beltway HOT lanes infrastructure currently under construction, thereby expanding the regional reach and continuity of the HOT lanes system. Moreover, the Capital Beltway is a major crossroad that circumnavigates the Washington metropolitan region. As such, it collects traffic from throughout the region and feeds it to I-95 at the Springfield Interchange and I-395.
- The proposed project can stand alone without requiring other improvements on adjoining sections of I-95 and I-395. While the overall project in the EA envisions an additional 17 miles of HOT lanes extending south beyond Fredericksburg as the Southern Project (Phase 2), the Northern Project (Phase 1) can be constructed and operated as a stand-alone project with or without the Southern Section. The transition to the HOV and GP lanes systems north of the Capital Beltway has been designed such that additional improvements will not be required north of the transition area as a result of the project to specifically mitigate project-related impacts. In the northern terminus transition section north of Edsall Road, build volumes are slightly higher on the GP lanes than those in the No-build. This is the

result of additional HOT demand being priced out from the HOT lanes south of Springfield in order to keep the maximum existing hourly volume rate at the northern terminus flyover at Turkeycock not to exceed 1,100 vehicles per hour. Potential mitigation for these slightly higher volumes may include extending the acceleration/deceleration from the Turkeycock flyover to the westbound off-ramp to Duke Street. The project currently proposes to connect the acceleration/deceleration from the Turkeycock flyover to the eastbound off-ramp at Duke Street. A project with separate purpose and need, (and independent utility), the extension of merge and diverge lanes on northbound I-395 between Duke Street and Seminary Road to form a continuous auxiliary lane, has been identified by VDOT. This project will also reduce downstream congestion beyond the northern terminus, thus improving operations at the northern terminus interface with the GP lanes.

- The proposed project does not constrain the consideration of alternatives for other reasonably foreseeable alternatives beyond the project limits.
- The 40-mile length of the Northern Project study area corridor extends across multiple counties and the town of Dumfries / southern edge of City of Alexandria, and provides ample length to address transportation and environmental matters on a broad scale. Moreover, the extent of the project's environmental impacts is contained mostly within the existing footprint of the highway corridor, with little if any extension beyond the proposed limits of the project.

4.4 Study Area Boundaries and Facilities Included

While the traffic analysis conducted for the NEPA process covers the entire corridor from the Duke Street interchange to Massaponax (North and Southern Sections of the I-95 HOV/HOT Lanes Project), the IJR encompasses only the Northern Section of the project. This includes the I-95 corridor from the Duke Street interchange to the Garrisonville interchange and the corresponding ramp termini intersections.

The core communities in the vicinity of the study area are the Stafford, Prince William, and Fairfax Counties. These counties will most likely be affected by the build alternative considered as part of this study. **Table 4-1** summarizes the interchanging crossroads included in the study area and the intersections along these crossroads that have been analyzed.

Table 4-1: Intersection Analyzed

Crossroad Interchange Cross Street Intersections to be Considered	
Garrisonville Road Garrisonville Road, Salisbury Drive, and Stafford Market Place Garrisonville Road and I-95 SB Off-Ramp Jefferson Davis Highway and I-95 NB Off-Ramp Jefferson Davis Highway I-95 NB On-Ramp Garrisonville Road, Jefferson Davis Highway, and Washington Drive	**Gordon Boulevard** Gordon Boulevard and Old Bridge Road Gordon Boulevard and Devils Reach Road Gordon Boulevard and I-95 HOV/HOT On-Ramp/Off-Ramp Gordon Boulevard, Monroe Drive, and Annapolis Way Gordon Boulevard and Horner Road
Russell Road Russell Road and I-95 SB On-Ramp/Off-Ramp Russell Road and I-95 NB Off-Ramp Russell Road and I-95 NB On-Ramp	**Lorton Road** Lorton Road, Silverbrook Road, and Sanger Street Lorton Road and I-95 SB On-Ramp/Off-Ramp Lorton Road, I-95 NB On-Ramp/Off-Ramp, and Gunston Cove Road Lorton Road and Lorton Market Square
Joplin Road Joplin Road and Park Entrance Road Joplin Road and I-95 SB On-Ramp Joplin Road and I-95 NB On-Ramp/Off-Ramp Joplin Road, Jefferson Davis Highway, and Fuller Road	**Fairfax County Parkway** Backlick Road and Fullerton Road Fairfax County Parkway and Fullerton Road (existing conditions only) Boudinot Drive and Fullerton Road Alban Road, Boudinot Drive, and I-95 SB On-Ramp (I-95 HOV/HOT Reversible ramp in build conditions) Fairfax County Parkway, I-95 NB Off-Ramp, and Newington Road Fairfax County Parkway and Terminal Road
Dumfries Road Dumfries Road, Van Buren Road, and Old Stage Road Dumfries Road and I-95 SB On-Ramp Dumfries Road, Village Parkway, and I-95 NB On-Ramp Dumfries Road, Old Stage Coach Road, J. Davis Highway, and North Fraley Boulevard	**Franconia-Springfield Parkway** Franconia-Springfield Parkway and I-95 HOV/HOT On-Ramp/Off-Ramp
Dale Boulevard Dale Boulevard and Gideon Drive Dale Boulevard and Neabsco Mill Road	**Franconia Road** Franconia Road and Backlick Road Franconia Road and Commerce St/Loisdale Road I-95 NB Off-Ramp, Loisdale Road, and Spring Mall Drive
Opitz Boulevard Opitz Boulevard and Telegraph Road Potomac Mills Road and I-95 SB Off-Ramp Potomac Mills Road and Telegraph Road Opitz Boulevard and Potomac Hospital	**Edsall Road** Edsall Road and Cherokee Avenue/Shawnee Road Edsall Road and Industrial Drive Edsall Road, Bren Mar Drive, and I-395 NB Off-Ramp Edsall Road, Bloomfield Drive, and I-395 On-Ramp Edsall Road and Beryl Road
Prince William Parkway Prince William Parkway, I-95 SB On-Ramp and Horner Road Park & Ride Lot Prince William Parkway, York Drive, and Summerland Drive	**Duke Street** Duke Street/Little River Turnpike and Beauregard Street Duke Street and Oasis Drive/Bragg Street Duke Street and South Walker Street

Chapter 5 - Existing Conditions

5.1 Demographics

I-95 serves as a major commuting route connecting Washington DC and other major activity centers with suburban northern Virginia. The I-95/I-395/I-495 (Springfield) interchange in the northern portion of the I-95 corridor provides connections to the Capital Beltway, which connects major activity centers all around Washington DC. In addition, I-95 serves as a major route for interstate travel on the eastern part of the United States by connecting Maine with Florida.

Local communities directly adjacent to the corridor that are expected to be served by the proposed improvements to I-95/I-395 are listed in **Table 5-1**.

Table 5-1: Communities Served by the Proposed Project

Community	County	Population (2010)
Aquia Harbour	Stafford	6,727
Quantico Station	Prince William	4,452
Triangle	Prince William	8,188
Dumfries	Prince William	4,961
Montclair	Prince William	19,570
Dale City	Prince William	65,969
Woodbridge	Prince William	4,055
Lorton	Fairfax	18,610
Newington	Fairfax	12,943
Franconia	Fairfax	18,245
Springfield	Fairfax	30,484
Lincolnia	Fairfax	22,855

Source: US Census Bureau, 2010.

Fairfax County is the most populated county in the Commonwealth of Virginia and the metropolitan Washington DC area. In addition, it is the largest suburban office market in the metropolitan Washington, DC area, and the fourth largest in the nation, with more than 111.5 million square feet of office space. Fairfax County is also home to 43.3 million square feet of major retail and commercial development. Prince William County and Stafford County are both characterized by suburban and rural residential areas and are growing at above-average rates compared to the rest of the Commonwealth. Due to the impacts of BRAC, as well as other market conditions, the amount of federal and commercial office space has increased considerably, and will continue to do so in the foreseeable future. This has the effect of impacting regional trip making by drawing a greater number of jobs and employment destinations further to the south of the metropolitan Washington DC area.

5.2 Land Use

The parcels adjacent to the I-95 corridor are mostly built out. Adjacent land use is a mix of residential, industrial, office, and commercial and is typical of suburban development in close proximity to a major metropolitan city. A major industrial park is located adjacent to the Springfield Interchange. The I-95 corridor passes through are adjacent to a number of federal institutional areas, including Fort Belvoir U.S. Army Reservation and the Fort Belvoir Engineering Proving Grounds, Quantico Marine Corps Base, and the Federal Bureau of Investigations campus at Triangle. In addition to the built-out areas, there are a number of parks adjacent to the corridor.

The publicly owned Smith Lake Park (Stafford County), Prince William Forest Park (National Park Service), Forest Greens Golf Club (Prince William County), Locust Shade Park (Prince William County), the Dumfries Elementary School baseball field (Prince William County), Laurel Hill Park (Fairfax County), Pohick Stream Valley Park (Fairfax County), Accotink Stream Valley Park (Fairfax County), Loisdale Park (Fairfax County), Lynbrook Park (Fairfax County), Trailside Park (Fairfax County), and Turkeycock Run Stream Valley Park (Fairfax County) are all adjacent to the I-95 right-of-way. Other than potential noise impacts at Forest Greens Golf Club and the Dumfries Elementary School baseball field, these parks or recreation areas would not be impacted. Another Stafford County property (Chichester) that is designated as a future public park is located near I-95, but it is not adjacent to the I-95 right-of-way. No construction is planned outside of the existing right-of-way near these properties.

5.3 Existing Road Geometry & Access Locations

The existing I-95 freeway has three GP lanes in each direction, from the southern project terminus at the Garrisonville interchange to the Route 123 interchange (Exit 160). North of the Route 123 interchange, I-95 has four GP lanes in each direction to the Capital Beltway (I-495), supplemented in a number of locations with acceleration/deceleration lanes at on and off-ramps and auxiliary lanes between interchanges. Existing interchanges that provide access to the I-95 GP lanes exist at the following locations:

- Garrisonville Road
- Russell Road
- Joplin Road
- Dumfries Road
- Dale Boulevard
- Prince William Parkway
- Gordon Boulevard
- Richmond Highway (US-1)
- Lorton Road
- Fairfax County Parkway
- Franconia-Springfield Parkway
- Franconia Road
- Springfield Interchange (I-495)
- Edsall Road

- Duke Street

The existing I-95 reversible HOV facility through the study area is two lanes located in the center of the freeway between the northbound and southbound GP lanes. The HOV lanes extend from Dumfries just south of the Route 234 (Dumfries Road) interchange to the Capital Beltway. North of the Capital Beltway, the reversible HOV lanes continue to Washington, DC. South of Dumfries to the southern terminus of the project, a distance of approximately 28 miles, there are currently no HOV lanes. Existing ingress and egress points for the HOV lanes are in the following locations:

- Between the Joplin Road and Dumfries Road interchanges
- Between the Dumfries Road and Dale/Opitz Boulevard interchanges
- Between the Dale/Opitz Boulevard and Prince William Parkway interchanges (connections directly to/from the Dale/Opitz Boulevard ramps)
- Between the Prince William Parkway and Gordon Boulevard interchanges (connection directly to/from the Horner Road Commuter Parking Lot)
- Between the Gordon Boulevard and Richmond Highway interchanges (connection directly to/from the Gordon Boulevard interchange)
- Between the Richmond Highway and Lorton Road interchanges (connection directly to/from Richmond Highway)
- Between the Lorton Road and Fairfax County Parkway interchanges
- Between the Fairfax County Parkway and Franconia-Springfield Parkway interchanges (northbound connection directly to the Franconia-Springfield Parkway northbound off-ramp)
- Between the Franconia-Springfield Parkway and Franconia Road interchanges (southbound connection directly to the Franconia-Springfield Parkway southbound off-ramp)
- Between the Franconia Road and Springfield interchanges
- Between the Edsall Road and Duke Street interchanges (connections directly to/from the Edsall Road ramps, Turkeycock Run)

Figures 5-1 illustrates the number of lanes on both the mainline and HOV facilities throughout the study area for existing conditions. **Figure 5-2** illustrates the existing interchange spacing along the I-95 corridor.

5.4 Alternative Travel Modes

5.4.1 Regional Bus Service

The I-95 corridor and the portion of I-395 within the study area have a high level of bus transit during the morning and evening peak periods. Although there are several local, regional, and state transit agencies that operate buses within several jurisdictions in the Northern Virginia area, the following three transit providers operate their services on the I-95 HOV corridor.

- Washington Metropolitan Area Transit Authority (WMATA) - Metrobus
- Fairfax County - Fairfax Connector

- Potomac and Rappahannock Transportation Commission (PRTC) – OmniRide & OmniLink

Table 5-2 summarizes the various bus routes that currently use the I-95 HOV facility.

Table 5-2: Summary of Regional Bus Service in the Project Area

Transit Provider	Route Number	Route Name	Description of Route Within Study Area Corridor	Major Stops	Schedule
WMATA	17 A, B	Kings Park Line	Little River Tpk/Duke St/236 > I-395 > Pentagon Metro	Route 236 & Braddock, Landmark Center	Weekday AM & PM
WMATA	17 M	Kings Park Line	Little River Tpk/Duke St/236 > I-395 > Pentagon Metro	Route 236 & Braddock	Weekday AM & PM
WMATA	17 F	Kings Park Line	Pentagon Metro > I-395 > I-495		Weekday AM & PM
WMATA	17 G, H, K, L	Kings Park Express Line	Pentagon Metro > I-395 > I-495		Weekday AM & PM
WMATA	18 E	Springfield Line	Pentagon Metro > I-395 > Edsall		Weekday AM & PM
WMATA	18 F	Springfield Line	Pentagon Metro > I-395 > Duke	Duke & Walker	Weekday AM & PM
WMATA	18 G, H	Orange Hunt Line	Pentagon Metro > I-395 > Duke St > I-395		Weekday AM & PM
WMATA	18 J	Orange Hunt Line	Pentagon Metro > I-395 > I-95 > Old Keene Mill Rd		Weekday AM & PM
WMATA	18 P	Burke Centre Line	Pentagon Metro > I-395 > I-95 > Old Keene Mill Rd		Weekday AM & PM
Fairfax Connector	171	Richmond Highway Line	Franconia-Springfield Metro Station > I-95> Lorton Road	Lorton Market St, Lorton VRE	Weekday AM & PM, Weekend AM & PM
Fairfax Connector	306	GMU- Pentagon Line	Braddock Rd > Little River Tpk/Duke St/236 > I-395, North of 236	Landmark Center	Weekday AM & PM
Fairfax Connector	380-D	Franconia-Springfield/ Pentagon Express Route (Detour - no stop at Franconia-Springfield Metro due to parking garage work)	7900 > I-95 > Pentagon Metro	Backlick North Park and Ride	Weekday AM & PM
PRTC	R1-R	Route 1/South Route 1 OmniRide	Joplin Rd > I-95> I-395, North of Duke Street	Stops are shown on schedule maps	Weekday AM & PM
PRTC	MC-R	Montclair OmniRide	Dumfries Rd > I-95> I-395, North of Duke Street	Stops are shown on schedule maps	Weekday AM & PM
PRTC	RB-R	Rosslyn/Ballston OmniRide	Dale Blvd/Prince William Pkwy > I-95> I-395, North of Duke Street	Stops are shown on schedule maps	Weekday AM & PM
PRTC	P-MD	Prince William Metro Direct	Opitz Blvd > US 1 > I-95 > Franconia-Springfield Metro Station	Stops are shown on schedule maps	Weekday AM & PM
PRTC	DC-R	Dale City OmniRide	Dale Blvd > I-95> I-395, North of Duke Street	Stops are shown on schedule maps	Weekday AM & PM
PRTC	TY-R	Tysons Corner OmniRide	Tyson's Corner	Stops are shown on schedule maps	Weekday AM & PM
PRTC	LR-R	Lake Ridge OmniRide	North of Duke Street	Stops are shown on schedule maps	Weekday AM & PM

During the AM peak hour (7–8 AM), there are about 45 transit buses on the I-95 northbound HOV facility approaching the Springfield Interchange and a total of 60 transit buses on the I-395 northbound HOV facility, inside the I-495 Beltway. In the PM peak hour, the same number of buses use the I-95 HOV facility in the southbound direction.

The current I-95 HOV/HOT Lanes project is expected to improve transit use on the I-95 HOV/HOT corridor by adding new entry/exit points between the GP and the proposed managed lanes. In addition, several new transit access facilities and improvements to existing facilities have been planned according to the recently adopted 2011 CLRP for the Washington metropolitan area. These planned improvements will improve the overall operations within the I-95 multimodal corridor. Several of the planned improvements include improving existing park and ride lots, improving right-turn lanes at intersections, adding new park and ride lots, adding new transit service (on I-495 HOT lanes), etc. The completion of I-495 HOT Lanes project will add new transit services (as buses can use HOT lanes for free), which will then connect other points along I-95 corridor.

5.4.2 Regional Commuter Rail

The Virginia Railway Express (VRE) is a transportation partnership of:

- Northern Virginia Transportation Commission (NVTC)
- Potomac and Rappahannock Transportation Commission (PRTC).

VRE provides commuter rail service from the Northern Virginia suburbs to Alexandria, Crystal City and downtown Washington, D.C., along the I-66 and I-95 corridors. VRE services began in 1992, operating 16 trains from 18 stations and carried, on average, 5,800 passengers daily. Today, VRE operates 29 trains from 18 stations and carry, on average, 16,000 passengers daily.

VRE is overseen by an Operations Board, consisting of members from each of the jurisdictions that support VRE, which supervises all operating aspects of the Virginia Railway Express.

5.5 Environmental Conditions & Constraints

Within the Northern Section, all proposed improvements are within existing right-of-way. Minor amounts of temporary construction easements may be required along the project length for utility relocation, drainage, and construction access. No homes, businesses, farms, or nonprofit organizations would be displaced by the project; therefore, no relocations would be required. No privately owned structures are present within the right-of-way.

Land cover within the I-95 median in the southern portion (where HOV/HOT lanes will be added between Garrisonville and Dumfries) primarily consists of woods, grass, and landscape plantings. In the section north of Dumfries where the existing two-lane HOV facility is being converted to HOT lanes or restriped to three lanes, land cover within the median consists of narrow sections of grass, if any. In areas where temporary construction easements may be required, land cover consists of woods and cleared or paved areas.

The publicly owned Smith Lake Park (Stafford County), Prince William Forest Park (National Park Service), Forest Greens Golf Club (Prince William County), Locust Shade Park (Prince William County), the Dumfries Elementary School baseball field (Prince William County),

Laurel Hill Park (Fairfax County), Pohick Stream Valley Park (Fairfax County), Accotink Stream Valley Park (Fairfax County), Loisdale Park (Fairfax County), Lynbrook Park (Fairfax County), Trailside Park (Fairfax County), and Turkeycock Run Stream Valley Park (Fairfax County) are all adjacent to the I-95 right-of-way.

Based on a comprehensive review of historic property records in the corridor, previous coordination with the Virginia Department of Historic Resources, review of previous effect determinations, and review of current design plans, the project, as currently proposed, will have no effect on historic properties. Based on the most current plans available, the proposed project will not require any Section 4(f) uses of publicly owned public parks or recreation areas. No Section 6(f) (Land and Water Conservation Fund) resources would be impacted.

The proposed project crosses approximately 6.9 miles of stream and 7.7 acres of wetlands when considering the Northern and Southern Sections combined. Water quality in streams along the corridor is affected by surrounding development. Stormwater management facilities would be incorporated into the project to minimize long-term effects of the project on water quality.

During and after construction, pursuant to VDOT's Road and Bridge Specifications, the construction contractor will be required to minimize disturbances of vegetation, habitat, and wildlife, as well as stormwater discharge, to adjacent land uses. The project has been aligned and is being designed such that disturbances of floodplains and water resources will be as little as practicable. In addition, the implementation of temporary and permanent stormwater management measures will reduce pollution of adjacent waterways to the extent practicable and erosion will be mitigated with the application of stormwater management Best Management Practices (BMP).

5.6 Existing Data, Operational Performance and Safety conditions

Detailed information on existing traffic volumes, traffic operations, and safety characteristics are included in Chapters 8, 9, and 10 respectively. The data in these chapters is shown as a baseline for the purposes of understanding future traffic operations and safety considerations under future scenarios.

Chapter 6 - Alternatives Considered

This section describes the proposed project, which generally involves constructing a reversible two-lane HOT facility within the median of I-95 south of Dumfries to just north of Garrisonville Road (Route 610), and converting the existing two-lane HOV facility to a two to three-lane HOT facility north of Dumfries to the Capital Beltway (I-495). The no action or No-Build Alternative is also discussed since it serves as a baseline for comparison.

6.1 Alternative Development and NEPA Screening Process

Given the nature of this project and its location within the median of the existing interstate highway, a detailed alternatives comparison for environmental impacts was not considered necessary by FHWA. Instead, for purposes of the environmental analyses, computations for construction "footprint" impacts have been prepared assuming the entire median as the impact area, even though the entire median will not be impacted. Sufficient engineering has not yet been fully completed at this stage of project development to determine the exact finalized location of improvements within the median (as project plans have been developed to roughly 30 percent under a design-build contract utilized by Fluor-Transurban, the concessionaire). However, to illustrate what the actual impacts may be, computations also have been prepared for the actual footprint identified in the conceptual plans. This approach not only provides a maximum impact estimate, but also provides flexibility for design revisions, once more detailed design efforts are undertaken, without reopening the environmental analyses. In addition, the environmental analyses take into account areas of particular sensitivity, such as streams and wetlands, where conceptual design efforts have attempted to minimize impacts, or where additional efforts may need to be made during final design to further minimize impacts at select locations.

6.2 No Build Alternative

The No-Build Alternative provides a baseline of conditions against which to compare the Build Alternative. Under the No-Build Alternative, the proposed HOT lanes would not be constructed and I-95 would remain in its present configuration, with three to four GP lanes in each direction and a two-lane HOV facility within the median from Dumfries just south of the Route 234 (Dumfries Road) interchange to the Capital Beltway and a variable width vegetated-median ranging from 40 to 600 feet wide south of Dumfries to the southern project terminus.

Most other existing roads would also generally remain in their present configurations. However, the financially constrained long-range transportation plans of FAMPO and the National Capital Region Transportation Planning Board contain a number of other projects funded for construction in the region. These were assumed to be in place by the design year (2035) and were taken into account in the road network assumed for traffic forecasting efforts of the assumed future no-build conditions for this project. Several of these projects would connect with I-95 in the project corridor:

- 14th Street Bridge (I-395 and US-1)
- I-395/Seminary Road Interchange ramp improvements -- Mark Center
- I-495 Capital Beltway HOV/HOT Lanes
- I-95/I-395/I-495 Springfield Interchange Project
- Woodrow Wilson Bridge Improvement Project
- Fairfax County Parkway extension
- Fairfax County Parkway Engineer Proving Ground (EPG) access roadways
- I-95 Widening
- Russell Road Improvements
- I-95 HOV/HOT Lanes (Southern Portion)

In addition, as part of continuing efforts to provide transportation choices along the I-95 corridor, VDOT recently reaffirmed their commitment to funding and delivering the following transit and transportation demand management (TDM) options:

- Plans are advancing to construct a direct ramp from the existing HOV lanes on I-395 to Seminary Road, which will connect the growing Mark Center site to the expanded regional transit and HOV network. These improvements have been included in the Constrained Long Range Plan (CLRP) and an environmental study is underway.

- Park-and-ride capacity is being expanded in the corridor. Full or partial funding for previously identified park-and-ride needs has been included in VDOT's FY2012-2017 Six-Year Improvement Program. These improvements include the leasing of parking spaces to replace the spaces lost at Potomac Mills Mall and park-and-ride lot expansion at Horner Road, Staffordboro Boulevard, and Gordon Road.

- A study has been initiated by the Virginia Department of Rail and Public Transportation (VDRPT) to identify further opportunities to expand transit and TDM in the corridor. The I-95 Transit and TDM Plan will be largely limited to those jurisdictions within the I-95 HOV/HOT Lanes Project area, but will examine improvements such as bus bays at points north of the project's terminus to serve destinations including the Pentagon and the Mark Center.

6.3 TSM Options

Transportation System Management (TSM) focuses on improving the operational efficiency of transportation systems without major system improvements (such as adding lanes or new ramps). Freeway TSM strategies can include signing and pavement striping improvements, traffic surveillance and control equipment, incident management programs, HOV facilities, and ramp metering. Corridor and system-wide TSM strategies may incorporate improvements to mass transit service, multi-modal facilities, and intelligent transportation systems.

Due to the nature of the purpose and need of the project, TSM options alone will not address the system linkage and operational safety issues associated with the I-95 HOV/HOT Lanes Project. However, the Preferred Alternative identified in this IJR accounts for TSM strategies already in place as part of the I-95 HOV/HOT Lanes Project, and is configured to accommodate these strategies, consistent with FHWA's Policy Point 2 for Interstate Access.

6.4 Build Alternative

The proposed project would begin approximately 1.10 miles south of U.S. Route 17 (Mills Drive) in Spotsylvania County south of Fredericksburg. It would end at the Capital Beltway, with a transition to the existing I-395 HOV lanes and GP lanes in the vicinity of the I-395/Edsall Road interchange. The new facility would operate as HOT lanes within the median of I-95 and consist of a two-lane reversible, limited access express route from the southern terminus to just north of the Prince William Parkway interchange (Exit 158), where it would expand to three lanes until the transition to the existing I-395 HOV lanes. The facility would be constructed with 11 to 12-foot-wide travel lanes and variable shoulder widths, as shown in the typical cross-sections in **Exhibits 6-1, 6-2, and 6-3**. **Figure 6-1** illustrates the typical cross-sections along each segment of the project.

All other elements of the project, including ramps between the GP and HOT lanes to allow movement between the two facilities, would be constructed within existing right of way. With the exception of the following locations, at-grade slip ramps would enable access between the GP and HOT lanes:

- Between Route 610 and Russell Road and between Route 619 (Joplin Road) and Route 234 (Dumfries Road), flyovers would be constructed to enable traffic to exit the HOT lanes and enter the right-hand southbound GP lane.
- A reversible flyover would be constructed to provide direct access between Alban Road/Boudinot Drive and the HOT lanes.
- At the northern terminus of the project, a flyover would be constructed to enable traffic to exit the HOT lanes and enter the right-hand northbound GP lane.

Other appurtenances would include signage, electronic variable message displays, electronic toll collection equipment, traffic control gates, and storm water management facilities.

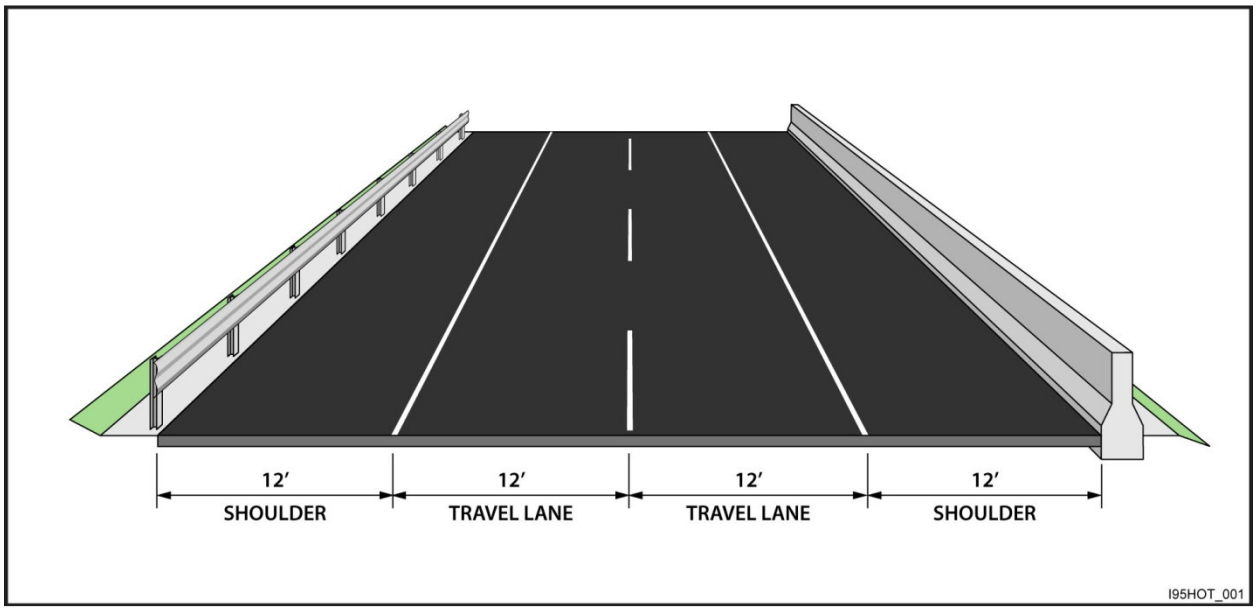

Exhibit 6-1. Typical Two-Lane Cross-Section – New Pavement
[Southern terminus of project to just south of Route 234 (Dumfries Road)]

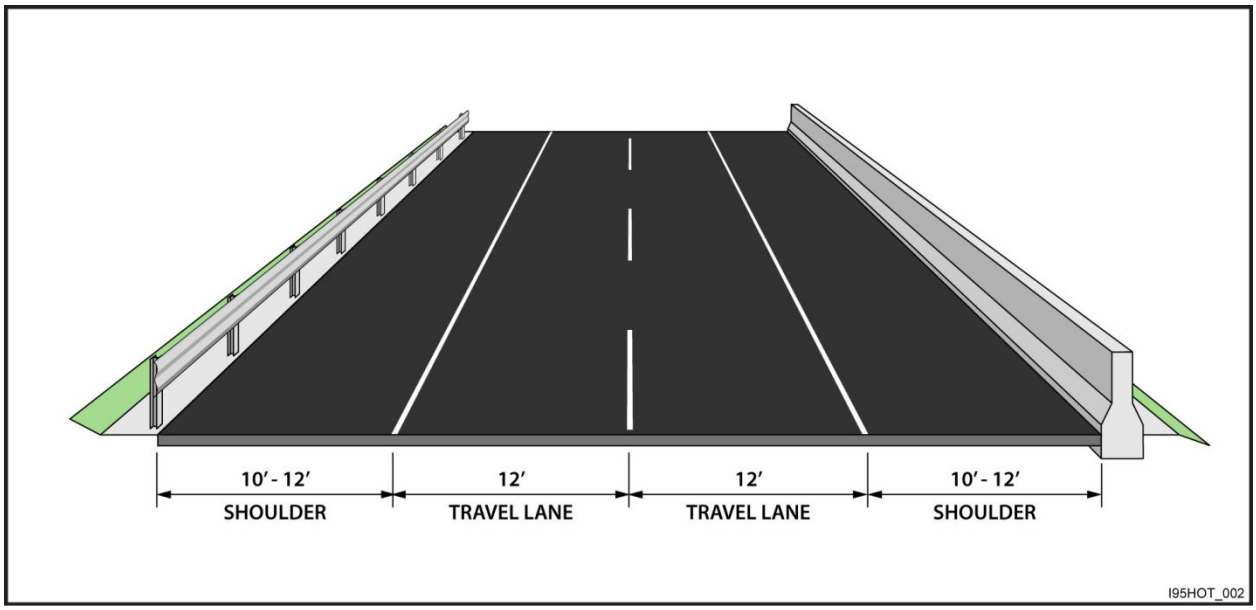

Exhibit 6-2. Typical Two-Lane Cross-Section – Existing Pavement
[Just south of Route 234 (Dumfries Road) to just north of Prince William Parkway]

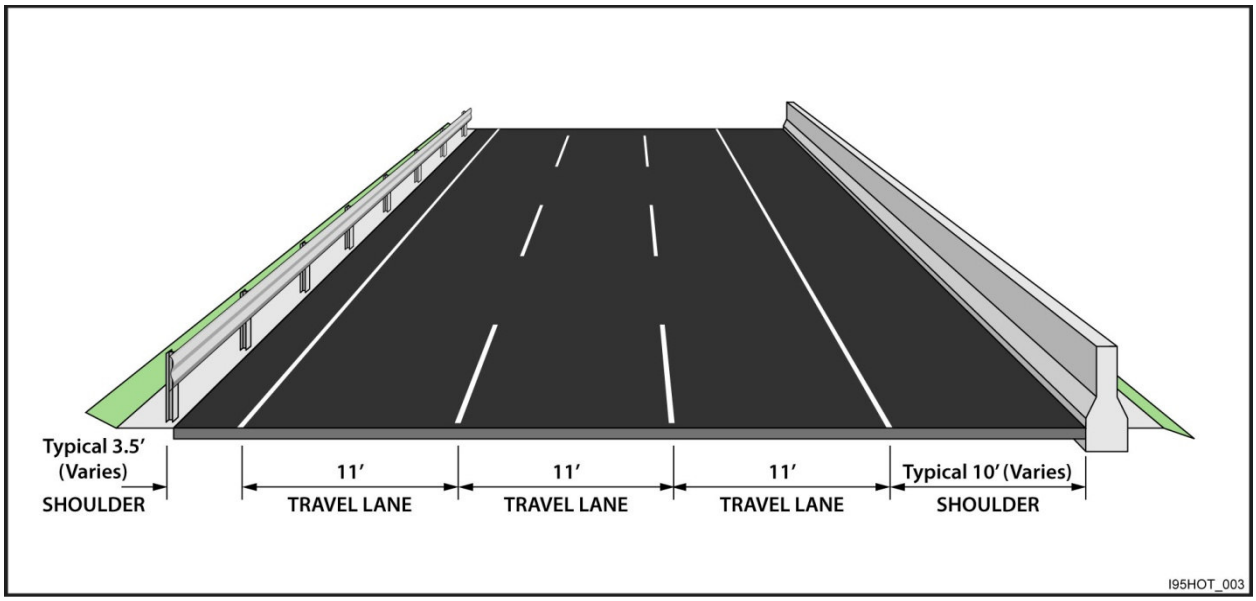

Exhibit 6-3. Typical Three-Lane Cross-Section – Existing Pavement
[Just north of Prince William Parkway to northern terminus of project]

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Chapter 7 – Roadway Geometry

The Preferred Alternative was developed to a level of detail to support detailed cost estimates, right-of-way needs, and confirm adherence to design criteria. Appendix B contains plan, profile, typical section and other design information. The alignments reflect AASHTO design criteria for freeways. **Table 7-1** summarizes design parameters:

TABLE 7-1
Design Parameters

	Design Speed	Functional Classification	Design Year Traffic – 2035 (vehicles per day)
I-395 HOT Lanes	65 mph (north of I-495)	Principal Arterial - Interstate	52,000 – 71,000 (varies)
I-95 HOT Lanes	70 mph (south of I-495)		31,000 – 84,000 (varies)

(ADDITIONAL DATA UPDATES MAY BE FORTHCOMING BASED ON DISCUSSIONS BETWEEN VDOT AND CONCESSIONAIRE'S D/B CONSULTANT)

7.1 Background

The geometry of the Preferred Alternative reflects a number of key constraints and planning decisions. Foremost among these is the desire for the improvements to 'not preclude' a long range plan that addresses all future needs of the I-95 corridor. Elements of future improvements that are considered in the context of a larger plan include the proposed flyover at I-95/Fairfax County Parkway interchange, ramp improvements associated with the DAR project at Fort Belvoir's Engineering Proving Grounds, future connections and slip ramps further to south as part of the Southern Section of the project, and improvements at the Russell Road interchange associated with Quantico Marine Base.

For the purposes of understanding the geometric design elements of the project, a set of design plans is included by reference, showing plan, profile, cross sections, bridge structures, and retaining walls. Refer to **Appendix B** which shows 30 percent design plans for the preferred alternative. Note that due to the volume of plan sheets in this plan set, Appendix B is incorporated by reference under separate cover.

7.2 Design Exceptions and Waivers

Completion of the Preferred Alternative requires approval of a number of design exceptions and design waivers. These are summarized in **Table 7-2** and locations can be seen in **Figure 7-1.** The design exceptions for the most part involve reductions in shoulder dimensions; accepting substandard vertical clearance dimensions on several segments where the existing vertical clearance is already substandard; and accepting substandard superelevation rates for selected segments due to existing bridge deck cross slopes and horizontal curves. The design exceptions occur at spot locations (vs. over significant lengths of highway); occur on lower volume HOT lane alignments (vs. higher volume GP lanes); and generally involve marginal reductions in dimensions.

VDOT is currently reviewing for consideration the proposed design exceptions and waivers. FHWA has not reviewed or approved any of the proposed design exceptions and waivers at the time this IJR was prepared.

TABLE 7-2
Design Exceptions and Waivers

DE or DW	No.		From Station	To Station	Design Feature	Proposed Design	Standard Required	Remarks	Required for Standard to be Fully Met
DE	1	Reduced HOV/HOT Lanes and Shoulder Widths	850+00	1536+00	Lane Width	11' Lanes	12' Lane	Existing two-lane reversible HOV lanes will be converted to three-lane reversible HOV/HOT system, without major roadway widening.	Relocate existing concrete barriers and bridge piers. Also, includes, but not limited to, the replacement of all existing bridges; realignment of NB/SB GP lanes and associated ramps; relocation of roadside structures and retaining walls; right-of-way acquisition; larger project footprint; impact on drainage system (Estimated $981.5 Million additional cost)
					Shoulder Width	Shoulder Width Varies 2'-10' NB Left & 10' NB Right Shoulder	10' Shoulders		
DE	2	Reduced HOV/HOT Lane and shoulder Width on 7 HOV/HOT Bridges	850+00	1536+00	Bridge Width	11' Lanes. Shoulder Width Varies: Min 2' NB Left & Min 10' NB Right Shoulder (Existing Bridge Width remains.)	12'Lane/10'Shoulder	Existing two-lane reversible HOV lanes will be converted to three-lane reversible HOV/HOT system, without major bridge widening lane. This DE is for reduced lane and shoulder widths for the seven existing bridges.	Widen all 7 existing bridges. Also, includes, but not limited to, replacement of the existing approach barrier; shifting NB/SB GP lanes and associated ramps; relocation of roadside structures & retaining walls; right-of-way acquisition; and larger project footprint. (Estimated $11.6 Million additional cost for seven bridges)
DE	3-1	Reduced NB GP Shoulder Widths at Franconia-Springfield Parkway	1342+90	1360+70	Shoulder Width	Min. 5' Shoulder	10' Shoulders	The purpose of this Design Exception is to request a reduced median (left) shoulder width for the I-95 (NB) GP Lanes adjacent to the existing, but proposed to be widened, Franconia-Springfield Parkway Interchange ramps.	Relocate existing bridge piers to the east on the Franconia-Springfield Parkway bridge. Also, includes, but not limited to partial replacement of existing bridge; realigning NB GP lanes and approach roads at both Loisdale Road and Backlick Road; right-of-way acquisition; utility relocation. (Estimated $28.6 Million additional cost)
DE	3-2	Substandard NB and SB GP Shoulders Widths From HOV/HOT Sta. 1458+00 (North of NSRR) To HOV/HOT Sta. 1559+00 (Northern Project Limit)	1458+00	1559+00	Shoulder Width	Varies Min. 2.1' Shoulder	10' Shoulders	The existing guardrail with curb and gutter is proposed to be replaced with median barrier. This Design Exception is to request that the existing I-395 GP substandard-width median shoulders be retained in the northern section (Section 4) of the Project were the guardrail is being replaced..	Widen GP pavement on both sides to shift GP lanes to provide standard shoulders. Also, includes, but is not limited to replacement of both Edsal Road Interchange bridges to relocate piers; right-of-way acquisition. (Estimated $15.9 Million additional cost for GP lane widening)
DE	4	Vertical Clearance Roadway over HOV/HOT Gordon Blvd. (Rte. 123)				15'11"	16'-0"	This design exception is a request to maintain the existing bridge clearance over the HOV/HOT Lanes at the Gordon Blvd. Bridge.	Remove and replace barrier, lower the roadway profile, and modify drainage system. Existing encroachment of the vertical clearance is isolated in a small portion of the shoulder. Main travel lanes meet 16'-0" clearance.

TABLE 7-2
Design Exceptions and Waivers

DE	5	Substandard Superelevation Rate on HOV/HOT Lanes. From north of the Occoquan River to the US 1 Interchange (Includes Two Bridges)	942+65	986+60	Superelevation	Curve 1: Varies 1.56-2.20%. Curve 2: 2.87%. Curve 3: 4.09%.	Curve 1: 2.30%. Curve 2: 3.30%. Curve 3: 1.60%.	This design exception is a request to maintain the existing bridge deck cross slope and horizontal curve to avoid structural modifications of the two existing bridges over Furnace Rd and Rte 1/Ramp C Interchange, respectively. (Design speed at these two locations was originally 60mph and now becomes 65mph.)	Reconstruct the bridge deck to the appropriate superelevation rate. Includes modification to the approaches to accommodate superelevation transitions and increases in profiles; MOT plans for several construction phases and lane shifts. (Estimated $7.2 Million additional cost for Bridge deck reconstruction.)
DE	6	HOV/HOT and GP Shoulder Width Reduction due to Bridge Piers at 16 Locations	910+00	1490+00	Shoulder Width	Varies (2' to 10'Shoulder)	10' Shoulders	Existing bridges crossing over the HOT and GP lanes will be retained throughout the project corridor to avoid costly interchange and bridge reconstruction as well as right-of-way acquisition. This results in a situation where the shoulder widths beneath the bridge are reduced due to the barrier blisters around the piers.	Relocate existing concrete barriers and bridge piers. Also, includes, but not limited to, the replacement of all existing bridges; realignment of NB/SB GP lanes and associated ramps; relocation of roadside structures and retaining walls; right-of-way acquisition; larger project footprint; impact on drainage system (Estimated $981.5 Million additional cost)
DE	7	**Deleted**						This design exception is no longer needed.	
DE	8	Substandard HOV/HOT Ramp Shoulder Widths (Seven Locations)	772+00	1531+00	Shoulder Width	Varies (2' to 7')	Min 1' (Lt.)/ 8' (Rt.) for non-reversible; Min 8' (Lt.)/ 8' (Rt.) for reversible.	This design exception is a request to allow HOV/HOT ramp shoulder widths on 7 existing ramps be maintained below the minimum required width by standards.	Relocate NB/SB GP lanes to expand median at restricted ramp shoulder locations. Also includes, but not limited to, bridge, ramp, & retaining wall reconstruction; right-of-way acquisition. (Estimated $64.6 Million additional cost)
DE	9	HOV/HOT and GP Shoulder Width Reduction due to Sign, Lighting, Traffic Management System (TMS), Toll Structures and Misc.	845+00	1536+00	Shoulder Width	Varies (2' to 10')	10 ft. Shoulder	This design exception is for the localized reduction in shoulder width due to barrier blisters to accommodate sign, lighting, TMS, and toll structures.	Relocate existing concrete barriers and bridge piers. Also, includes, but not limited to, the replacement of all existing bridges; realignment of NB/SB GP lanes and associated ramps; relocation of roadside structures and retaining walls; right-of-way acquisition; larger project footprint; impact on drainage system (Estimated $981.5 Million additional cost)
DW	1-1	Vertical Clearance Roadway under HOV/HOT Ramp C at US 1 Interchange	972+00	975+00	Vertical Clearance	16'-0"	Min 16'-6"	This design waiver is for the vertical clearance at the I-95 HOV/HOT bridge at Sta. 973+00 over Ramp C of the Route 1 Interchange, which will be reduced to 16'-0" from 16'-5".	To meet the minimum standard vertical clearance of 16'-6", Ramp C has to be lowered by 6".(Estimated $3.1 Million additional cost.)

TABLE 7-2
Design Exceptions and Waivers

DW	1-2	Vertical Clearance Roadway under HOV/HOT Furnace Road	949+76	950+98	Vertical Clearance	15'-4"	Min 16'-6" (Standard) Min 14'6" (Restricted Cond.)	This design waiver is requesting that the existing vertical clearance at the HOV/HOT bridge over Furnace Rd be retained at 15'-4".	Lower Furnace Road profile. Also, includes, but not limited to, full depth replacement of portions of roadway; replacement of impacted utilities; MOT constraints & significant traffic impact. (Estimated $3.3 Million additional cost for lowering Furnace Rd profile.)
DW	2	Vertical Clearance Roadway over HOT Franconia-Springfield Pkwy Bridge, and Franconia Rd (Rte 644)	910+30	1385+40	Vertical Clearance	Varies	Min 16'-6"	This Design Waiver is a request to allow the vertical clearance of 1) the Route 7900 overpass over the HOT Lanes to equal 16'-2"; 2) the Route 644 overpass over the HOT Lanes to equal 16'-4".	To meet the minimum standard vertical clearance of 16'-6", the Rte. 7900 bridge and Rte 644 bridge will have to be reconstructed or raised or the HOT Lanes lowered. (Estimated $7.8 Million additional cost for bridge reconstructions.)
DW	3	Reduced Ramp Recovery Areas (at Prince William Pkwy, Gordon Blvd, Fairfax County Pkwy, Franconia-Springfield Pkwy NB, Franconia-Springfield Pkwy SB and Old Keene Mill Rd.)	830+00	1405+00	Reduced Exit Ramp Recovery Area	Varies	VDOT IIM-LD-20	The design waiver is for reduced exit ramp recovery area at 6 of the locations along HOT lanes from approx. Sta. 830+00 to Sta. 1405+00.	To provide standard ramp gore areas, the following would be required: HOT Ramp alignment shifted to the east or west depending on the location; additional ramps (part of the interchange at some locations) relocated/reconstructed; approximately 2000' of I-95 SB or NB GP lanes on either side of the ramp recovery area relocated/reconstructed; right-of-way acquisition; major traffic disruption on one of the Virginia's busiest interstate highway; extensive MOT. (Estimated $77 Million additional cost.)
DW	4	HOT Lanes Compound Curves (with Radii Ratio > 1.5:1 between Sta. 1079+00 to Sta. 1110+00, Sta. 1142+00 to Sta. 1194+00, & Sta. 1339+00 to Sta. 1369+00.)	1079+00	1369+00	Compound Curve Radii Ratio	Varies	Compound Curves: ratio of flatter radius to sharper radius should not exceed 1.5:1	The proposed horizontal alignment for the HOT lanes closely follows the existing HOV alignment throughout the corridor. Compound curves are found throughout the corridor and several of the existing curves which do not meet standards for radii ratio will remain substandard in the proposed design.	Modify alignment to meet desirable curve ratio. This includes shifting HOT lanes alignment requiring reconstruction of NB GP lanes; ramp re-alignments, and replacement of bridge, etc. (Estimated $35 Million additional cost.)
DW	5	Reduced Shoulder Widths on Cross Road (Franconia Springfield Parkway Bridge Over I-95 GP & HOV/HOT Facility)	1346+00	1357+00	Reduced Shoulder Width on Bridge	Varies	10' Shoulders	This Design Waiver is for a reduced shoulder width on the eastbound side of the existing Franconia Springfield Parkway Bridge S.R. 7900 (Str. No. 6092/Plan No. 264-68) over the I-95 GP and HOV/HOT facility at approximately I-95 HOV/HOT Sta. 1351+00.	Bridge and ramp widening, and reconstruction of abutment wing wall and retaining wall. This required construction would also involve significant costs related to MOT on both the I-95/HOV corridor, Backlick Road and Loisdale Road as well as State Route 7900. (Estimated $6.4 Million additional cost.)

TABLE 7-2
Design Exceptions and Waivers

DW	6	Vertical Grade at Turkeycock Flyover Ramp	1505+00	1552+00	Ramp Vertical Grade	7%	4 to 6%	This design waiver is for the Turkeycock Flyover Ramp (THN) from NB HOV/HOT Lanes to I-395 NB GP Lanes, Sta. 211+10 to Sta. 215+00, for vertical alignment upgrade of 7.0%.	Realign and reconstruct NB I-395 GP lanes to the east to provide enough space to accommodate lengthened approach ramp; significant costs related to MOT on I-95/HOV corridor and Franconia Springfield Parkway Bridge. (Estimated $12.4 Million additional cost.)

Chapter 8 - Traffic Volumes

This section provides a broad overview of the assumptions and procedures used for travel demand modeling and post processing of modeling results for the I-95 HOV/HOT Lanes traffic analysis.

8.1 Traffic Forecasting Methodology

8.1.1 Travel Demand Modeling Methodology and Key Assumptions

The demand forecasting approach leverages a corridor/subarea highway assignment process. This assignment process uses an estimated trip table based on travel patterns implied by the National Capital Region Transportation Planning Board (TPB) model, further adjusted by link-level traffic assignments provided by the FAMPO model – effectively a merging of results from two separate travel demand models. The FAMPO model covers the southern portion of the study area (Stafford County and south). The TPB model covers the northern section of the study area (Prince William and Fairfax counties).

This approach provides a mechanized means of resolving volume differences between the two travel models that would otherwise require substantial manual adjustment and judgment that may not be as tractable or unbiased. Moreover, having one contiguous network provides a means to communicate consistent and balanced traffic volumes on a single platform to processes that will subsequently assess traffic operations.

Exhibit 8-1 summarizes the travel demand forecasting approach. Development of "existing" traffic volumes differs in that the subarea trip table is based only on observed link volumes and a seed matrix (Year 2011) from the TPB model. Approach features include:

- Implementation of subarea model in TransCAD for years 2011 (base year), 2018, and 2035
- Separate models by time-of-day: AM, PM, off-peak
- National Cooperative Highway Research Program (NCHRP) adjustment of observed travel volumes by growth implied by base year and forecast year demand from the travel models
- Trip assignment will include a toll diversion model similar to the one present in the FAMPO model

Exhibit 8-1 – Travel Demand Forecasting Process

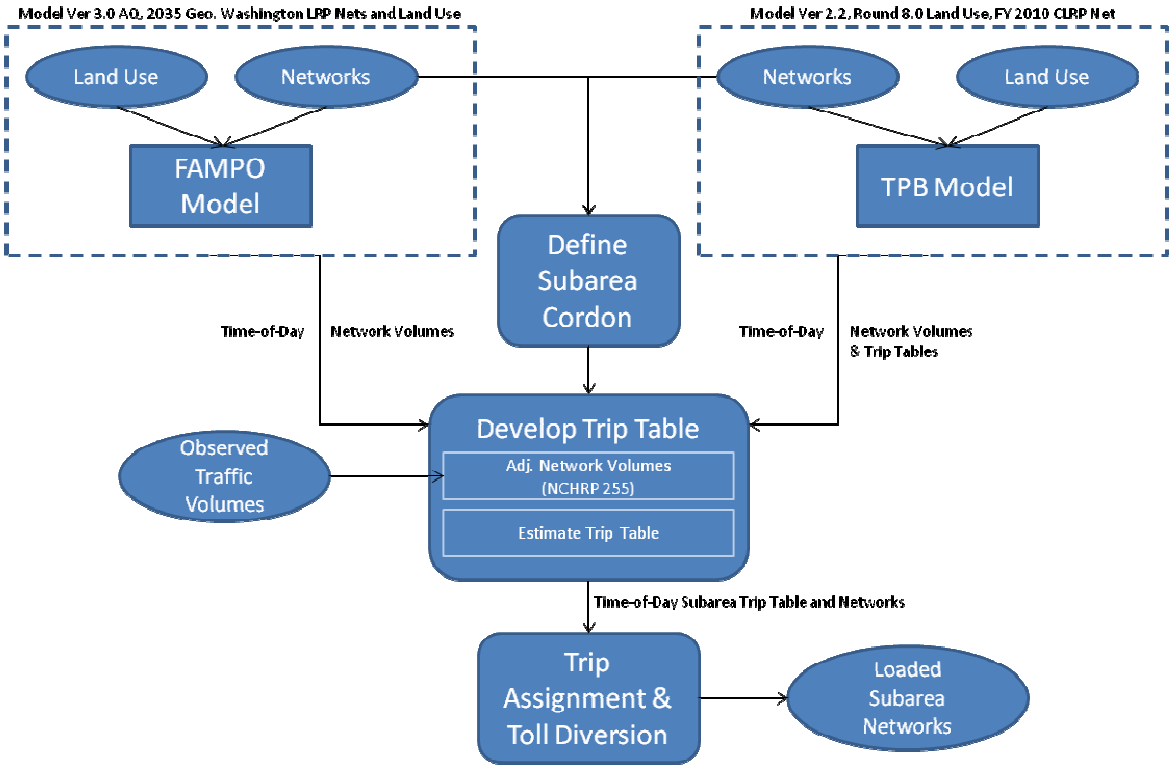


Table 8-1 lists key assumptions associated with the travel forecasting process.

Table 8-1 – Travel Demand Modeling Assumptions

<table>
<tr><th>Assumption</th><th colspan="2">Base Case</th><th>Comments</th></tr>
<tr><td colspan="4">Model</td></tr>
<tr><td>Analysis Years:
2011
2018
2035</td><td><u>TPB Model</u>
2005 (Validation year)
2010
2020
2030
2040</td><td><u>FAMPO Model</u>
2006 (Validation year)
2009
2015
2025
2035</td><td>Aligned with TPB and FAMPO model forecast years.</td></tr>
<tr><td>Time Periods Modeled</td><td colspan="2">Three time periods representing:
<table><tr><th>Period</th><th>Hours</th></tr><tr><td>AM</td><td>6am – 9am</td></tr><tr><td>PM</td><td>4pm – 7pm</td></tr><tr><td>Night Time</td><td>7 pm – 6am</td></tr></table></td><td>Hours split based on MWCOG household survey data (1994). Same time periods for both the TPB and FAMPO models.</td></tr>
<tr><td>Speeds</td><td colspan="2">• Consistent with current conditions in the HOV and GP lanes.</td><td>Consistent with existing conditions.</td></tr>
<tr><td>Link Capacity</td><td colspan="2">• Lane capacities are defined consistent with the TPB model approach.</td><td>The MWCOG facility and area type capacity tables are used to determine link capacities.</td></tr>
<tr><td>Peak Spreading</td><td colspan="2">• Peak Period to Peak Hour factors:
<table><tr><th>Period</th><th>2011</th><th>2018</th><th>2035</th></tr><tr><td>AM</td><td>0.38</td><td>0.36</td><td>0.34</td></tr><tr><td>PM</td><td>0.36</td><td>0.35</td><td>0.34</td></tr><tr><td>Night Time</td><td>0.44</td><td>0.44</td><td>0.44</td></tr></table></td><td>Peak period values were derived from traffic survey information included in the previous IJR, and decline in recognition of the increased congestion expected in the region. Other time periods were developed from the MWCOG household survey data.</td></tr>
</table>

Table 8-1 (Cont) – Travel Demand Modeling Assumptions

Assumption	Base Case	Comments
Value of Time (VoT)	1.0% escalation over inflation p.a.	Consistent with Capital Beltway project.
Land Use	TPB version v8.0.; FAMPO, consistent w/ 2035 Geo.Washington LRP	Land use assumptions in place for individual model forecasts
Network Assumptions		
General	TPB ver 2.2 with changes relating to current TIP and CLRP publications. FAMPO ver. 3.3 AQ with changes relating to current TIP and CLRP publications.	
Project Description (I95 HOT Lanes)	• Reversible HOT lanes. • 3 Lanes between Turkeycock Run and (approximately) Prince William Parkway (Northern Section) • 2 Lanes from Prince William Parkway to Dumfries Road Garrisonville Road (Northern Section) • 2 Lanes from Garrisonville Road to Massaponax Area (Southern Section)	Consistent with revised CLRP submission.
Project Extent	• Turkeycock Run to Southern terminus between the Massaponax Area	Consistent with revised CLRP submission.
I495 (Capital Beltway)	• HOT lanes on the beltway from 2013.	
Springfield Interchange	• Springfield Interchange Phase VIII complete. • HOT access allowed from I-95 and I-395 to/from HOT lanes on Capital Beltway via directional ramps.	Consistent with Capital Beltway project.
HOV	• All HOV facilities in the network are assumed to become HOV3+ prior to project opening.	

Table 8-1 (Cont) – Travel Demand Modeling Assumptions

Assumption	Base Case	Comments
Toll Assumptions		
Tolling Methodology	Toll Diversion Curves (TDC).	Similar in form to the FAMPO diversion model recalibrated for this application
Toll Approach	Variable toll rates by roadway segment, based on maintaining managed lane speed goal of 55 mph.	Adopted to account for vary demand levels along the length of the project.
Tolls	In 2005 minimum toll rate @ $0.05/mi; maximum toll rate @ $0.25/mi.	The toll rate ranges have been set to align with limits in the FAMPO model.
Mode Assumptions		
Vehicle Class	• HOV3+: Free • Other Cars: Tolled • Trucks: Banned	Consistent with project definition.
HOV Vehicles	• Modeled using the TPB Model HOV module.	The HOV estimates provided are an output of the *mode choice* and *carpool occupancy* models developed by MWCOG.
Hybrid/Violators	• Not modeled	
Buses	• Not assigned to the subarea model network	
Transit Capacity Constraint	• None.	

8.1.2 Methodology/Key Assumptions for Post Processing of Modeling Results

Post-processing of travel demand model output was necessary to analyze traffic operations during peak hour conditions using peak period model output. Post-processing followed NCHRP 255 guidelines for estimating balanced existing, no-build, and build peak hour volumes.

Extensive data collection occurred in early March 2011. This included:

- 24 hour traffic counts with vehicle classifications at all ramp locations within study area and along the mainline of I-95, I-395, and I-495.
- AM and PM 3-hour peak period turn movement traffic counts. Counts generally occurred between 6:00 AM and 8:30 AM for the morning peak period and between 4:30 PM and 6:30 PM for the evening peak period.
- Travel time runs along the entire corridor for the AM and PM peak periods. This information along with INRIX travel time data for I-95, I-395, and I-495 will be used to identify where ramp counts may be constrained due to mainline congestion.

Table 8-2 outlines the steps for estimating existing, no-build, and build, peak hour volumes.

Table 8-2 – Traffic Volume Estimation Steps

Step	Description
Existing Peak Hour Volumes	
1	Collect and review raw count information (ramps, mainline, and intersections).
2	Check for suspect/bad count data.
3	Calculate system peak hours.
4	Review volume-time profile to check for congestion-constrained locations.
5	Use Demand smoothing adjustments.
6	Balance adjustments.
7	Produce final rounded and balanced 2011 peak-hour volumes.
No-Build Peak Hour Volumes	
1	Apply peak period-to-peak hour factors to forecasted link demand from the travel model (base year and "no-build" future year)
2	Estimate future year peak-hour turn movement demand at intersections that are present in both base year model and future year "no-build" model using existing peak-hour turn movement counts and NCHRP 255 procedures
3	Balance between intersections where possible.
4	Produce final rounded and balanced 2018 and 2035 peak-hour "no-build" volumes.
Build Peak Hour Volumes	
1	Apply peak period-to-peak hour factors to forecasted "build" link demand from the travel model
2	Compute change between future year "no-build" and future year "build" link volumes.
3	Add computed change to "no-build" final rounded link volumes.
4	Adjust future year peak-hour turn movement demand at intersections in response to changes
5	Balance between intersections where possible.
6	Produce final rounded and balanced 2018 and 2035 "build" peak-hour volumes.

Table 8-3 summarizes proposed assumptions to be used in post processing.

Table 8-3 – Traffic Volume Post Processing Assumptions

Elements	Assumption
System-wide peak hour for developing balanced existing peak hour volumes	7:00 - 8:00 AM 4:45 - 5:45 PM
Peak period to peak hour factors	2018 No-Build and Build: 36% AM; 35% PM 2035 No-Build and Build: 34% AM; 34% PM
Ramp capacity	1,600 vehicles per lane per hour
HOV/HOT lane capacity	1,950 vehicles per lane per hour
Vehicle classifications	Existing classification data will be used for link specific vehicle classifications

8.2 Traffic Analysis Scenarios

The operational performance of the I-95 HOV/HOT Lanes Project was evaluated for three analysis years: existing conditions (2011), opening year (2018) and design year (2035). Construction for the Project is expected to start in 2012 and be completed in 2018. The analysis includes no-build and build conditions in both 2018 (opening year) and 2035 (design year).

The traffic demands used for the analysis of all scenarios were developed using the methods described in Section 8.1. The traffic demands used in the operational analysis for each roadway section for Existing, No-Build and Build scenarios are shown in **Figures 8-1 to 8-10**.

Chapter 10 - Crash & Safety Assessment

10.1 Introduction and Background

It has been recognized that the operations and design elements of the freeway system can affect safety performance. For example, the weaving area in a cloverleaf interchange has been associated with a higher crash risk, especially in situations with high weaving volumes, short weaving distances or a combination of both. Left-side ramps and narrow median widths are also regarded as elements that often result in more crashes. Recent research has been able to quantify the influence many roadway elements have on safety performance. With the recent release of the Highway Safety Manual, the highway safety industry now has the tools for applying a science-based technical approach to evaluating safety.

Traditional practices for evaluating the safety of freeways and interchanges rely heavily on crash rates, time-of-day analysis, crash type distribution and crash severity distribution. These are used to identify system-wide issues and location specific crash clusters. However, with the understanding that safety performance may vary based on inherent differences among highway types and contexts comes the responsibility for designers of roadway facilities to consider using a data-driven analytical approach. When applied appropriately, along with the growing knowledge regarding safety performance of freeway design attributes, traditional techniques can still be used to conduct an informative and data driven safety analysis for a corridor study.

As the knowledge base regarding highway safety increases, more information about countermeasure effectiveness has also been generated to accompany the growing understanding of the relationship between safety performance and design considerations. This knowledge allows designers to better able to understand the expected impacts decisions will have on the actual safety performance of the corridor. In situations where mitigation is needed, crash modification factors are now known for countermeasures like cable median barrier, shoulder rumble strips, freeway interchange lighting and shoulder widening.

While there are not yet any tools to analyze and predict freeway or interchange performance within the HSM, the application of a data driven approach to safety review focusing on evaluating elements with measurable safety implications is in line with current HSM practices. Initially crash rates and traditional methods were employed to provide a general overview comparable to past practices and available performance metrics (statewide crash rates). The review was taken a step further by evaluating the actual safety performance of the corridor in terms of types and frequency of crashes rather than by rates alone; this actual performance was used to rationalize the implications of the build on the corridor, by relating expected safety performance to elements with measurable safety effects. This combination of traditional and emerging methods of safety analysis coupled with knowledge of the corridor produced a comprehensive assessment of the existing I-95 corridor project area. The results of the review and evaluation are as follows.

10.2 Data Collection and Analysis Methodology

As noted previously, the Project Scope encompasses two sections of anticipated improvements. The northern section will include the capacity expansion and conversion of the existing two-lane HOV to three-lane HOT Lanes between Prince William Parkway and I-495 and the extension of the HOT facility further south via an additional two-lanes between Route 234 and

Garrisonville Road. The HOT would transition back to HOV north of the beltway. The southern section will extend the two-lane reversible lanes from Garrisonville south to Massaponax (Route 1). See Exhibit 4-1 for an illustration of the complete project study area.

For the purposes of this IJR, the safety study area encompasses the northern section only. The study area extends on I-95 from approximately milepost (MP) 142.1—south of Garrisonville Road—through the Springfield Interchange and to approximately MP 175.0 in Alexandria, VA in the Northern Virginia District. The study area also includes I-395 from the Springfield Interchange north to approximately MP 4.9 and I-495 from MP 53.0 to the Springfield Interchange. The intent of the safety study area was to extend slightly beyond the analysis study area and to provide for review of the inbound approaches to the outermost interchanges within the project study area. Build elements included in this analysis only encompassed the northern section build design; the southern section build design will be evaluated in future documents once further detailed design has been developed.

A review of the overall safety performance of the existing corridor using traditional methods such as crash rates and severity distribution for each analysis segment was performed for the entire corridor. Comparisons between the safety performance and Commonwealth averages allowed for identification of general areas where the crash frequency or severity was greater than might be expected.

A statewide crash database, including crash records from January 1, 2006 to December 31, 2008, was provided by the VDOT, Traffic Engineering Division. These were the most recent complete data sets that were available (2009 data was in the process of being entered into the statewide database, but was not scheduled to be complete in time for incorporation into this document). The crash data records included information on crash locations, date and time, types, severity levels and major contributing factors.

Three years of crash records for the safety study area were extracted from the VDOT crash database. The data extraction covered the mainline, ramps and collector roads (except the Springfield Interchange), and the reversible facility. The corridor was then broken into 13 analysis segments (10 on the mainline, 3 on I-495) where the crash data were separated by direction of travel, ramps and CD roads, and reversible facility when present. The segment breakpoints were placed approximately halfway between interchanges, such that each analysis segment included the approach to the interchange, the interchange area and the area downstream of the last ramp.

Next, overall crash locations for both general purpose and HOV/reversible facilities were graphically overlaid on a GIS base layer, with segmentation corresponding to the 13 analysis segments described above. Corresponding charts displaying crash type frequencies and crash severity frequencies by travel direction were developed for every 0.1 mile roadway increment within each of the segments. Similar charts displaying crash type frequencies by time-of-day were also prepared for each analysis segment. Locations with relatively high crash frequencies or distinct patterns were identified through the review of the GIS map and charts. Crash types and patterns were reviewed at each location to identify potential contributing factors, including geometric design features that might influence the safety performance of the corridor and inform the review of the proposed build for potential safety performance areas of concern.

A qualitative approach was used to evaluate the potential safety impacts of the preferred design on the general purpose lanes. This included comparing where design exceptions, design waivers, and new ramp locations to the HOV system coincide with the locations demonstrating disproportionate crash frequency or distinct crash patterns. The purpose was to determine if these exiting conditions will be directly or indirectly influenced by the preferred design.

It is important to note that the Springfield Interchange was under construction through most of the three-year study period. Therefore, reliable data representing the existing baseline condition for the Springfield Interchange ramps and collector roads were not available and therefore could not be included in this analysis. However, the I-95, I-395 and I-495 mainlines through the interchange were included as part of the analysis. For detailed information regarding the past and expected safety performance of the Springfield Interchange, please refer to the I-95/I-395/I-495 Springfield Interchange Modification Report.

10.3 Crash History and Safety Analysis

10.3.1 General Corridor Overview and Summary

10.3.1.1General Purpose Lane Corridor Observations

From 2006 to 2008, there were 5,948 reported crashes along I-95/395 from south of Garrisonville Road to north of Duke Street. There were also 892 reported crashes along I-495 from north of Braddock Road to east of Van Dorn Street. Several exhibits were prepared to summarize the crash history for the mainline corridor (I-95/395) by freeway direction and analysis segments. **Exhibits 10-1** and **10-2** show the total number of study area crashes by location and severity for the northbound and southbound GP lanes respectively. **Exhibits 10-3** and **10-4** show the total number of study area crashes by location and collision type for each travel direction.

Crashes peak between Gordon Boulevard and Fairfax County Parkway. It should be noted that the proportion of rear end crashes greatly increases at the northern end of the corridor. Overall, rear end (including sideswipe-same direction) plus lane departure (including fixed object crashes and non collisions) collisions account for over 95 percent of all crashes in the GP lanes. In the southern half of the corridor, approximately 60 percent of all crashes were rear end. However, in the northern half, rear end crashes represented nearly 80 percent of all collisions. Inspection of the data reveals that the crash increases seen in the northern corridor are predominately a result of growth in rear end crashes. This trend is expected to be directly related to existing congestion and degraded traffic operations that are concentrated around Gordon Boulevard and at the northern end of the corridor. The expectation is that higher volumes along with more frequent stop and go traffic operations result in more conflicts and related rear end collisions.

10.3.1.2HOV/Reversible Lane Corridor Observations

A total of 329 crashes were reported for the reversible HOV lanes within the project area. However, it should be noted that the crashes for reversible HOV lanes are reported without designation of direction. **Exhibit 10-5** shows the total number of study area crashes by location and severity for the reversible HOV lanes. **Exhibit 10-6** shows the total number of study area crashes by location and collision type for each travel direction.

Similar to the crashes in the GP lanes, the reversible HOV lane accidents peak at Gordon Boulevard (See Exhibits 10-5 and 10-6). Also, as shown in the GP lane accident summary, the northern section of the corridor has a much higher crash frequency than the southern section. However, while these are similar patterns for peaking the number of crashes reported for the reversible HOV lanes are much lower than for the GP lanes. Of course, the HOV volumes are considerably lower than the GP lanes. Lower volumes generally relate to less congestion, which is likely a major contributing factor to crashes in the study area. This supports the trend that proportionally less rear-end and more fixed object crashes occur in the reversible HOV lanes. Due to higher speeds and less congestion in the reversible HOV lanes, it is expected that the

accident history would reflect more fixed-object accidents than rear end collisions. Also, it is possible that the actual crash frequency on the reversible HOV lanes may have been underreported during the 2006-2008 data period. Per VDOTs Traffic Engineering section, prior to 2009 the reporting requirements for reversible HOV lane crashes were not specific to require that the crash be designated as a reversible facility crashes. It is likely that some crashes occurring on the reversible facility were recorded to the mainline GP facility and not specifically to the reversible HOV lanes.

Note: Segments shown on Figures 10-1 through 10-6 are not equidistant. Initially, segment breakpoints were established so that analysis segment included the approach to an interchange, the interchange area and the area downstream of the last ramp. In the southern portion of the corridor, it was possible to place breakpoints approximately halfway between interchanges. However, due to the complex nature of the northern section of the corridor it was necessary to include multiple interchanges where features of closely spaced interchanges overlapped. Overall, this approach produced segment lengths of approximately 2.5-3.5 miles with the exception of the section including the Gordon and Lorton interchanges.

EXHIBIT 10-1
Study Area Crashes by Analysis Segment and Severity – Northbound

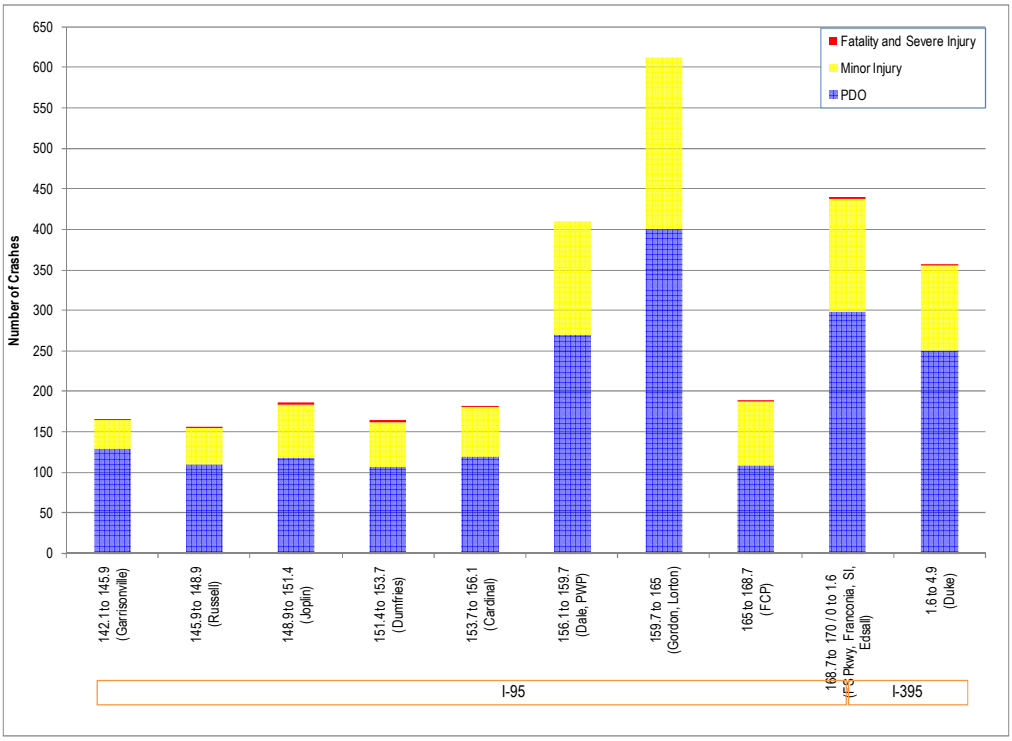


EXHIBIT 10-2
Study Area Crashes by Analysis Segment and Severity – Southbound

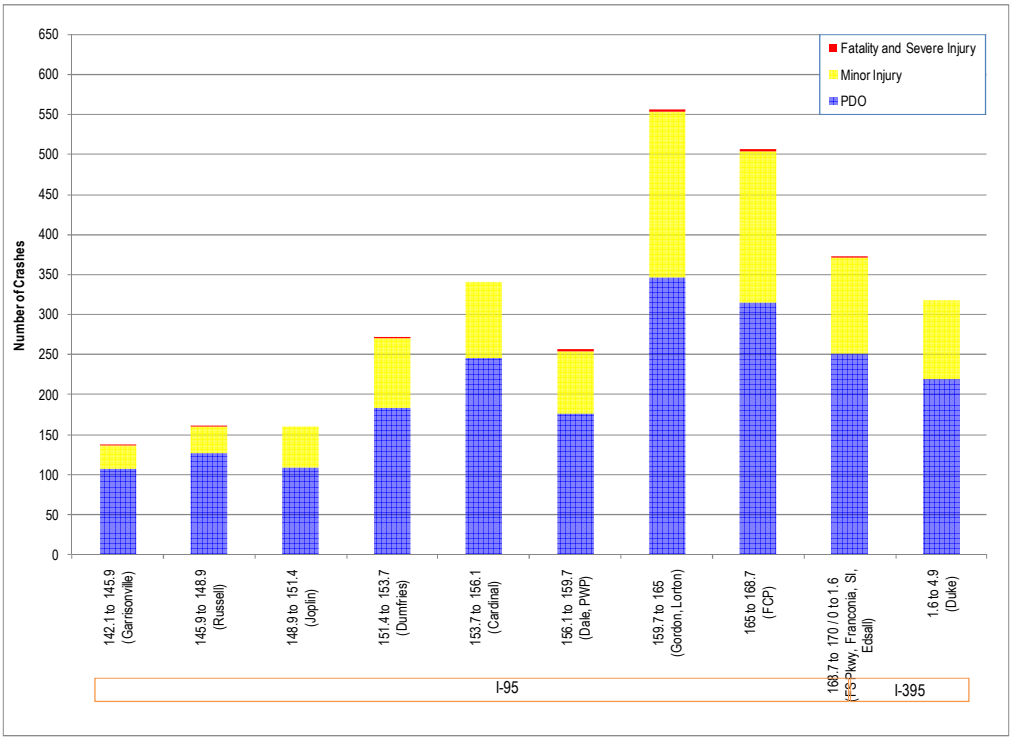


EXHIBIT 10-3
Study Area Crashes by Analysis Segment and Collision Type – Northbound

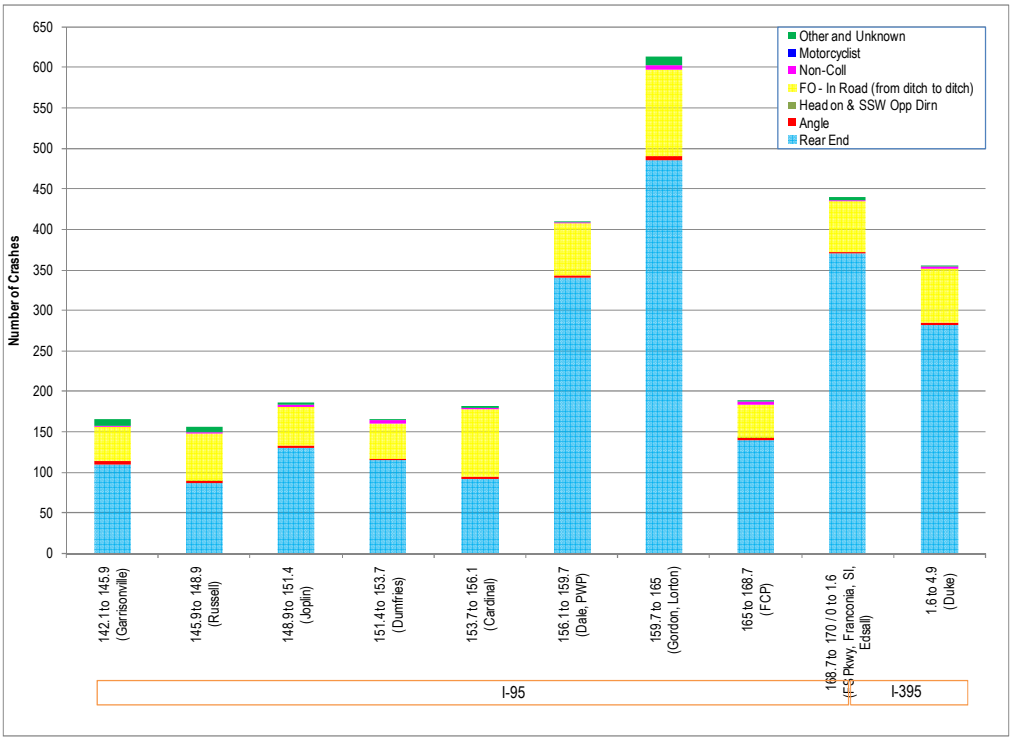


EXHIBIT 10-4
Study Area Crashes by Analysis Segment and Collision Type – Southbound

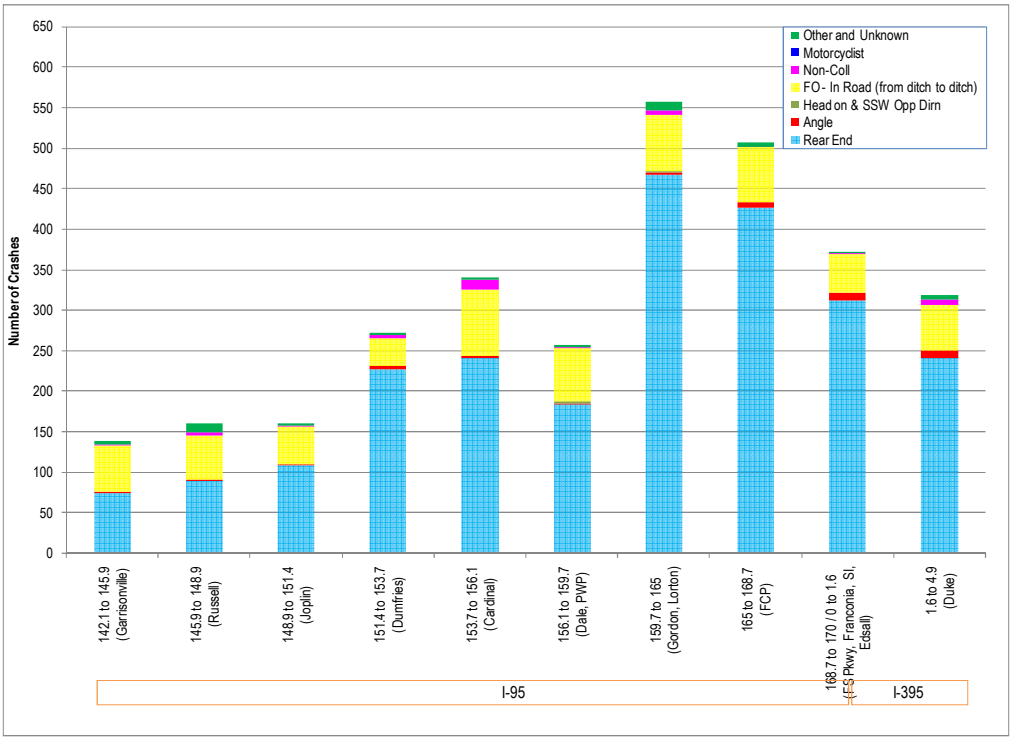


EXHIBIT 10-5
Reversible Lanes Crashes by Analysis Segment and Severity – Northbound and Southbound

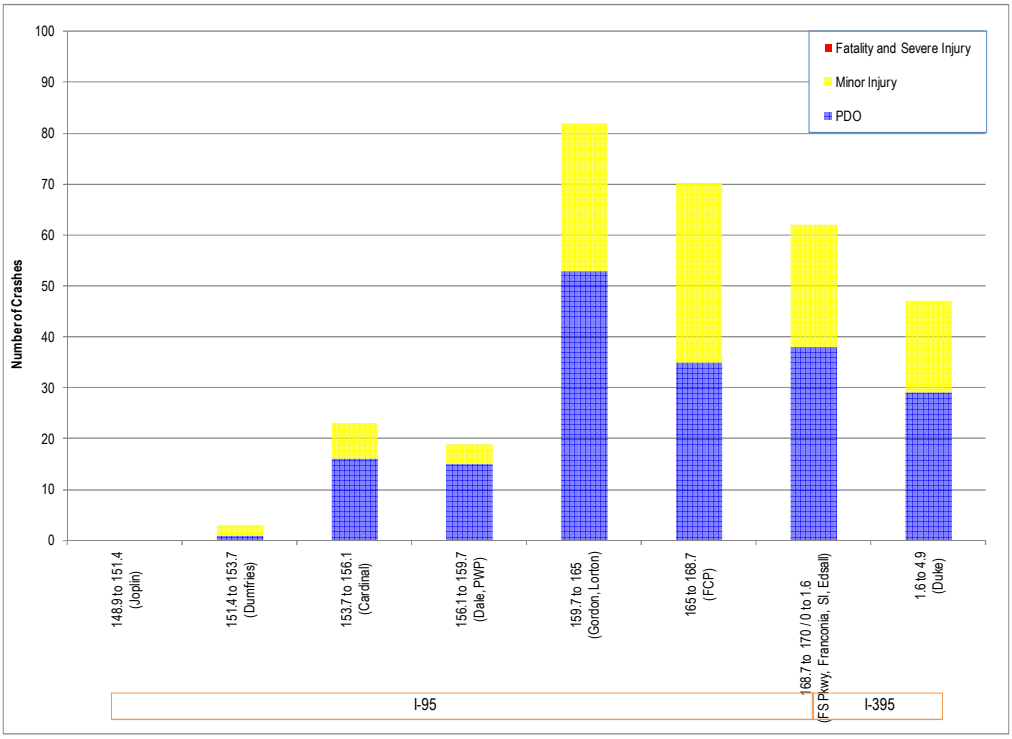
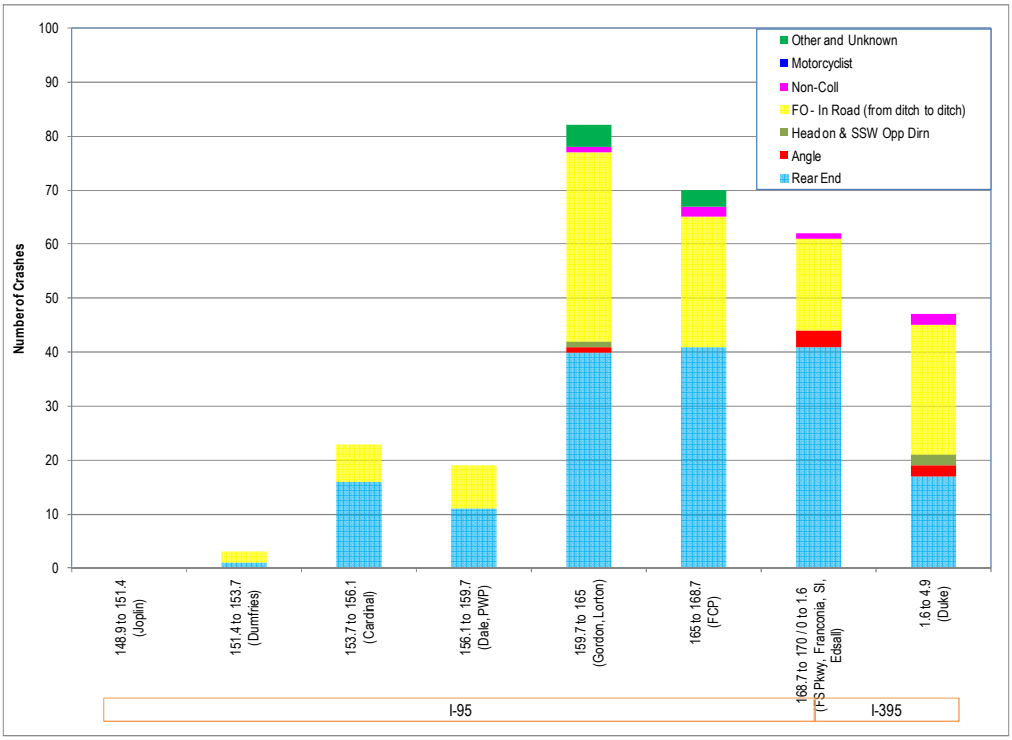


EXHIBIT 10-6
Reversible Lanes Crashes by Analysis Segment and Collision Type – Northbound and Southbound



10.3.2 Crash Rate Review

Crash rates (number of crashes per hundred-million vehicle miles of travel (HMVMT)) were calculated for each freeway segment based on the annual crash frequencies and Annual Average Daily Traffic (AADT). The calculated rates are shown in **Table 10-1.**

10.3.2.1 General Purpose Facilities

Statewide average crash rates for 2007 were compared to the calculated crash rates for the corridor as a metric of existing safety conditions. The statewide crash rate for all Virginia interstates was 77 crashes per HMVMT while all urban Virginia interstates averaged 93 crashes per HMVMT. For the entire I-95 corridor within Virginia, the 2007 average crash rate for I-95 northbound was 63 crashes per HMVMT and 74 crashes per HMVMT for all of I-95 southbound. **Exhibit 10-7** shows the comparison between the calculated and statewide crash rates.

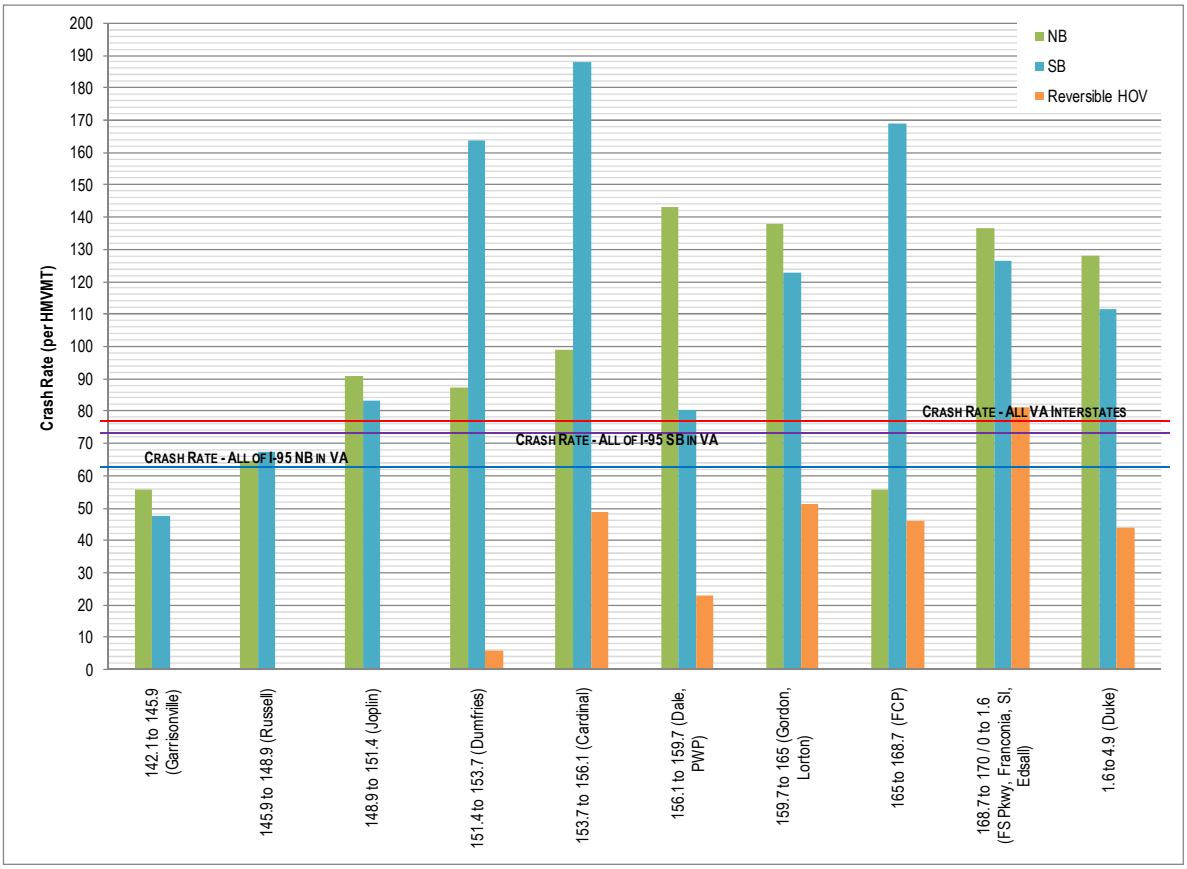
The crash rates on the southern I-95 GP lanes were mostly below the statewide average crash rate for urban interstate highways and for all Virginia interstate highways. When the study area is compared to the urban interstate average crash rate, the corridor's crash rates exceeded the statewide urban interstate rate beginning around the Cardinal Drive overpass and continuing to the north. When the study area was compared to the average crash rate for all Virginia interstates, the corridor rates exceed the statewide rates beginning at the Joplin Road interchange (and north). This pattern reinforces observations that the northern end of the project corridor exhibits higher crash frequencies. An association can be further drawn between this crash pattern and the higher volumes of traffic and congestion in the northern portions of the corridor, particularly during peak periods, resulting in a break down in traffic flow and greater opportunity for congestion related crashes.

TABLE 10-1
Study Area Crash Rates (2006-2008)

Segment / Route / Interchanges		Milepost Limits	Segment Length (Miles)	NB			SB			Reversible HOV		
				AADT	Number of Crashes	Crash Rate (per HMVMT)	AADT	Number of Crashes	Crash Rate (per HMVMT)	AADT	Number of Crashes	Crash Rate (per HMVMT)
	I-95/I-395											
1	Garrisonville Road (Rt 610)	142.1 to 145.9	3.8	71,500	166	55.8	70,000	138	47.4	--	--	--
2	Russell Road	145.9 to 148.9	3.0	74,000	157	64.6	73,000	162	67.6	--	--	--
3	Joplin Road	148.9 to 151.4	2.5	74,750	186	90.9	70,250	160	83.2	--	--	--
4	Dumfries Road	151.4 to 153.7	2.3	75,250	165	87.1	66,000	272	163.6	20,000	3	6.0
5	Cardinal Drive Overpass	153.7 to 156.1	2.4	70,000	182	98.9	69,000	341	188.1	18,000	23	48.6
6	Dale Boulevard & Prince William Parkway	156.1 to 159.7	3.6	72,750	410	143.0	81,250	257	80.2	21,000	19	23.0
7	Gordon Boulevard, US 1, & Lorton Road	159.7 to 165.0	5.3	76,750	613	137.6	78,250	557	122.7	27,500	82	51.3
8	Fairfax County Parkway	165.0 to 168.7	3.7	83,500	189*	55.9	74,000	507	169.1	37,500	70	46.1
9	Franconia Springfield Parkway to Edsall Road	168.7 to 170.0 / 0.0 to 1.6	2.9	101,500	440	136.5	92,500	372	126.6	24,000	62	81.4
10	Duke Street	1.6 to 4.9	3.3	77,000	356	127.9	79,000	318	111.4	29,500	47	44.1
	I-495											
11	Braddock Road	0.0 to 3.9	3.9	95,800	195	47.7	97,900	169	40.4	--	--	--
12	Springfield Interchange to Van Dorn Street	170.0 to 172.0	2.0	84,700	35	18.9	82,700	100	55.2	--	--	--
13	Van Dorn Street	172.0 to 175.0	3.0	87,600	221	76.8	80,900	172	64.7	--	--	--

* Segment 8 includes only one interchange, whereas the adjacent segments to both the north and south include several major interchanges; this difference in the characteristics of the segment accounts for the decrease in number of crashes.

EXHIBIT 10-7
Reversible Lanes Crashes by Analysis Segment and Collision Type – Northbound and Southbound



10.3.2.2HOV/Reversible Facilities

Statewide crash rates are not specifically provided for HOV/reversible facilities in Virginia. However, given that the characteristics of the HOV are similar by design to the general purpose facility, the statewide rates reflecting the average for freeway facilities would be comparable performance metrics. When comparing the reversible HOV lane crash rates and to statewide lane crash rates on I-95, the existing reversible HOV lanes have crash rates well under the average crash rate for both urban interstate highways and for all Virginia interstate highways.

10.3.3 FHWA 5 Percent Report Locations

As part of FHWA's Highway Safety Improvement Program (HSIP), states are required to submit an annual report describing not less than 5 percent of their highway locations exhibiting the most severe safety needs. The intent of this provision is to raise public awareness of the highway safety needs and challenges in the states.

In addition to listing the locations, the states' reports are to include potential remedies to the hazardous locations identified, estimated costs of the remedies and impediments to implementation of the remedies other than costs.

The data from the most recent available 5% report (2009) for Virginia shows that 2 of the 14 segments and 6 of the 24 intersections are located within the study area. These locations are as follows, and are shown in **Figure 10-1**.

Segments:

- Duke Street/ Little River Turnpike, just west of I-95
- US 1 between Joplin Road and Brady's Hill Road

Intersections:

- Braddock Road and Ravensworth
- Duke Street and Beauregard
- Loisdale Road and Loisdale Court (at Springfield Mall)
- Franconia Road and Loisdale Road
- Joplin Road and US 1
- US 1 and Inn Street, just north of Joplin

There are no proposed improvements as part of this project that are located at any of these specific segments or intersections; therefore, the implementation of mitigation measures outlined in the 5% Report does not fall under the responsibilities of nor is applicable to this project.

10.4 Detailed Review of Crashes by Location and Time-of-Day

Figures displaying the crash locations overlaid on a GIS base layer for the three year study period are included in Figure 10-1. Similarly, corresponding charts displaying crash type frequencies and crash severity frequencies by travel direction are also included in **Appendix F**. These graphics and charts correspond to the 13 analysis segments (10 on the mainline, 3 on I-495) and reflect the crash data separated by direction of travel, ramps and CD roads, and reversible facility (when present). The corridor is segmented on intervals similar to the overview analysis.

10.4.1 General Purpose Facilities

A review of the graphics and charts summarizing crash type and severity by location and crash type by time revealed several patterns in the corridor. Regarding the time-of-day review, crash frequency peaks were often observed to correspond with the morning and afternoon commute travel periods. When morning crash frequency peaks occurred, these tended to be only for the northbound travel direction and often concentrated into a two or three hour window. These morning peaks were more frequently observed in the northern portion of the corridor, but did occur in several southern analysis segments. Depending on the location, crash frequency peaks for the afternoon were instead observed to extend from early afternoon into evening. Afternoon peaking was frequently observed for both directions of travel, but more often in the northern half of the corridor.

Crash severity by location was reviewed to identify if severe crashes were concentrated in any particular analysis segment or at a specific location. The review found fatal and severe crashes spread throughout the corridor with no more than three severe crashes for one direction in an analysis segment. Additionally, an inspection of the severity charts did not find these crashes were unusually clustered in any one location.

The final review was crash type by location. This information did reveal two general patterns. First is that crashes, especially rear end crashes, were concentrated in the vicinity of

interchanges with increased frequency observed in the northern section of the corridor. The interchange areas included the approach to the off-ramps, the weave area for cloverleaf interchanges and the merge area for on-ramps. This pattern indicates that the merging and diverging of traffic at interchanges, especially in high volume areas, heavily influences the crash frequency. Considering the expected benefit to be achieved through the project by better balance in traffic flows and reduced congestion, the net effect of new access points to the HOV/HOT facility would be expected to be no worse, and likely better than the existing condition.

The second pattern is the occasional peak in fixed object collisions. While fixed object crashes occurred throughout the corridor, occasional peaks were identified in areas that included guardrail, especially approaching structures for over and underpasses. While the presence of any crash is an undesirable condition, the evidence of the fixed object crash with guardrail indicates that the guardrail performed as designed, likely preventing a crash with higher risk for injury or higher cost of damage to a valued freeway system asset.

10.4.2 HOV/Reversible Facilities

A similar review was performed for the crashes identified on the reversible facility. Like the general purpose lanes, several patterns and observations were identified from the graphics and charts summarizing crash type and severity by location and crash type by time. Regarding severity, all collisions on the reversible facility were property damage only or a minor injury collision. No significant injury crashes were reported on the reversible facility during the study period. As with the I-95 GP lanes, greater numbers of minor injury crashes occur on the reversible lanes at the northern end of the study corridor, presumably due to congested conditions in that area. Crashes increases near several HOV to GP ramp locations on the reversible lanes; higher crash incidences occurred just north of the US 1/Richmond Highway ramps, north of the Fairfax County Parkway ramp to I-95 NB, and at the Franconia Road HOV ramps.

The predominate crash types continued to be rear end and fixed object collisions. The crashes were generally spread throughout the corridor, with no locations having a substantial crash cluster, especially in comparison to the general purpose mainline crash history.

The time of day review did reveal that peaks in collision frequency were identified from 4:00 AM to 6:00 AM and 2:00 PM to 4:00 PM. These peaks generally align with the last few hours the facility is open to all traffic before restricting to HOV vehicles only.

10.5 Potential Future Safety Implications

10.5.1 Future No-Build Safety Considerations

Based on the observed crash patterns and frequencies the existing frequency would be expected to increase and patterns to be maintained or worsened with continued traffic growth along the corridor.

10.5.2 Future Build Safety Considerations

Table 10-2 summarizes locations identified during the review of crash where proposed build conditions may have an impact on safety.

TABLE 10-2
Build Condition Design Considerations

Route	Segment	Milepost Limits	Northbound	Southbound
I-95	Garrisonville Road (Rt 610)	142.1 to 145.9	Proposed design includes new ramp connecting the GP lanes to the reversible facility. The diverge area is located at approximately 145.0, which is an area that has relatively low frequency of existing crashes.	Proposed design includes new ramp connecting the reversible facility to the GP lanes. The merge area is located at approximately 144.1, which is an area that has relatively low frequency of existing crashes.
I-95	Joplin Road	148.9 to 151.4	--	Proposed project includes new ramp connecting the reversible facility to the GP lanes. The merge area is located at approximately 151.2, which is an area that has a relatively small peak in crash frequency on the approach to the Joplin Road interchange.
I-95	Dumfries Road	151.4 to 153.7	--	Proposed project includes removal of ramp connecting the reversible facility to the GP lanes. The merge area is located at approximately 152.3, which is an area that has a peak in crash frequency. Removal of ramp may reduce crash frequency in the localized area.
I-95	Dale Boulevard & Prince William Parkway	156.1 to 159.7	Proposed project includes an additional ramp connecting the reversible facility to the GP lanes. The ramp design is a left-entrance, with the merge located within the Prince William Parkway interchange, approximately underneath the overpass. The existing crash history shows peaks immediately upstream and downstream of the new location. However, the intent of the design is to reduce some of the demand on the existing ramp. This coupled with better traffic flow and reduced congestion on the mainline as a result of this project, is expected to produce an overall positive net effect to this area; fewer congestion related crashes would be expected as a result.	Proposed project includes an additional ramp connecting the GP lanes to the reversible facility. The ramp design is a left-exit, with the diverge located within the Dale Blvd interchange, approximately between the Opitz and Dale overpasses. The existing crash history does show peaks immediately upstream of the new location. Therefore, the possibility exists that the new diverge area could result in extending the crash peak. A similar pattern would be expected with the addition of a new access point. Therefore, the possibility exists that the new merge area could result in extending the crash peaking area. However, the intent of the design is to reduce some of the demand on the existing ramp which could have a net positive effect to offset some of this condition.

TABLE 10-2
Build Condition Design Considerations

Route	Segment	Milepost Limits	Northbound	Southbound
I-95	Gordon Boulevard & Lorton Road	159.7 to 165	--	Proposed project includes a new ramp connecting GP lanes to the reversible facility. The location of the new off-ramp is just upstream of the SB US 1 on-ramp and downstream of the US 1 left hand off-ramp. Location of the new off-ramp occurs in an area already with high crash frequencies—US 1 interchange. However, it appears from the crash data that the frequency of crashes are higher in the merge area downstream of the new access point. The new ramp is left-exit, following an existing left-exit to US 1, which is preferable to alternating exits (left and right) at this location and the original left-exit will be relocated to increase the distance between exits. Additionally, this new ramp adds a connection to HOT/HOV lanes in advance of a known pinch point where lanes reduce from 4 to 3. The net effect of this additional ramp coupled with the reduced congestion expected as a result of this project should offset any effects of an additional left-exit and would not be expected to result in a negative effect on safety.
I-95	Fairfax County Parkway	165 to 168.7	The northbound loop ramp will be removed under the ultimate build conditions, and replaced with a northbound flyover ramp. The new deceleration lane prior to the off ramps may reduce the risk for rear end crashes on the mainline in this area.	To accommodate a new ramp connecting the reversible facility to the arterial street, the FCP on-ramp will be realigned. The new gore will be moved approximately 400' to 500' downstream, increasing the distance from the merge area to the cloverleaf weave area. The increased distance will most likely have a net positive effect on safety.
I-395	Duke Street	1.6 to 4.9	Project includes a proposed ramp from the reversible facility to the GP lanes. The merge area on the GP lanes is located at approximately MP 2.2, which is approximately half-way from the reversible off-ramp and the Duke Street off-ramp. This analysis segment includes two crash peaks, the smaller of which ends approximately where the new ramp will merge. The possibility exists that the new merge area—already near an existing crash peak—could result in extending the crash peak.	--

General Purpose Facilities

As shown in Table 10-2, potential positive impacts due to ramp construction or removal may occur on southbound I-95 at Dumfries and southbound at Fairfax County Parkway. The removal of the ramp near Dumfries may reduce crash frequency, as that area currently has elevated crash frequencies. The relocation of the ramp at Fairfax County Parkway will increase the distance between a merge and a weaving area, which is anticipated to have a net positive effect on safety. Potential negative impacts due to ramp construction may occur on southbound I-95 at Joplin, northbound at Prince William Parkway, southbound between Opitz and Dale, southbound at US 1, and northbound at Duke Street. In most cases, the addition of ramps at these locations has the potential to extend the crash peak in an area with already elevated crash frequencies.

Additionally, the historical corridor performance revealed that in general, crashes were found to be concentrated in and around entrance and exit ramps. The build condition will likely create similar patterns where new ramp connections are added to the corridor. However, each new access point will also work to reduce congestion on the existing facility and as a result of this project, the net overall safety effect is expected to be positive and far outweigh any localized changes in crash patterns.

HOV/Reversible Facilities

With regards to the reversible facility, several new ramps are proposed, as well as the removal of existing ramps. The proposed ramp locations are in locations where the existing crash frequencies are low, especially in comparison to the mainline. No concerns were identified on the HOV/Reversible facilities as a result of the proposed project. This was determined based on existing crash patterns in combination with the revised access to/from the reversible facility.

10.5.3 Design Exception Process and Review

The expected safety performance of a proposed Design Exception process is included as a consideration when determining the appropriateness of approval of said Exception. Safety along with other determining factors such as impacts, design implications, and cost are considered when evaluating a design exception request for a proposed project. In conjunction with this safety evaluation, the proposed Design Exceptions for the I-95 HOV/HOT Lanes project were reviewed for appropriate application of mitigative safety measures where the proposed exception would be expected to affect safety performance of the build condition.

Included in Chapter 7 is a more detailed discussion on the design exception/waiver process conducted for the I-95 HOV/HOT Lanes project. As noted, several conditions are proposed, either newly with the design, or to retain an existing condition that cannot be addressed by design improvements with the potential build condition. Those that have potential safety implications on the safety performance of the corridor are addressed through mitigative design elements which are discussed in more detail in Table 7-2. These include edge line rumble strips, upgrades to guardrail and objects within clear zones to meet current MASH 350 guidance, and the incorporation of a corridor Incident Detection System to provide real-time monitoring of the conditions along the corridor.

10.6 Conclusion

Overall it can be concluded that the preferred design should not have significant adverse impacts on the safety of the freeway systems within the study area. Rather, with the proposed project and balancing of traffic flow and congestion within the corridor, it is expected that the anticipated operations improvements will have a positive effect on the corridor's safety

performance, such that the built corridor may be better than, and certainly no worse than, the no-build condition. While the safety performance review of the corridor indicates that crash frequency may increase at the points of new connections with the freeway facility, the improvement of traffic operations along the corridor, especially the northern half of the study corridor should have an overall positive effect on safety, thus reducing crash rates along the mainline sections. Though crashes may increase on the reversible lanes, the cumulative effect of this project on the safety of the corridor will be a positive impact.

Chapter 11 - Land Use Compatibility

11.1 Current Land Use

This section provides summaries of the existing land use conditions within the three counties that are included in the I-95 study area, followed by a discussion on the existing land use within the I-95 study area.

11.1.1 Stafford County

Stafford County encompasses approximately 179,149 acres. The largest land use in the county is residential (30 percent). More than half of the residential uses within the county are rural residential uses and the remaining are urban and suburban residential uses. The second largest land use includes agricultural land uses (26 percent), followed by federal lands (18 percent), resource protection (13 percent), industrial (6 percent), commercial (3 percent) and public use (1 percent). Urban development within Stafford County is limited to an urban service area that is located in the north-central, central, and south-central portions of the county. Almost all of the urban and suburban residential, industrial and commercial development is concentrated within the urban service area and almost all of the rural residential, agricultural, resource protection, and federal land uses are located outside of the urban service areas of Stafford County. The I- 95 study area is located in the central part of the county, where the large majority of the urban development is located. The high percentage of federal land uses within the county is due to the Quantico Marine Base that is located in the northern portion of the county.

11.1.2 Prince William County

Prince William County encompasses approximately 222,930 acres. The land use in Prince William County is primarily residential or undeveloped with several pockets of commercial and mixed use activity at major highway interchanges. Large federal and park land uses are located in the southern portion of the county and include the Quantico Marine Corps Base, the Quantico National Cemetery, and Prince William Forest Park. Urban development within Prince William County is concentrated in the southeastern and northern portions of the county, with semi-rural development in the south-central portions of the County. The I-95 study area is located in the southeastern portion of the county and is centrally located within areas where high concentrations of urban development are located.

11.1.3 Fairfax County

Fairfax County encompasses approximately 254,052 acres. Over the past 50 years, Fairfax County has changed from a primarily rural and agricultural area to an urbanized metropolitan area. The county, particularly the eastern portion, is now largely developed, and includes a mixture of low-density residential, commercial, industrial, and public land uses. The majority of the land in Fairfax County is used for residences. Industrial and commercial land uses are located along major corridors in the county with high concentrations at highway interchanges. The Shirley Industrial complex is a major industrial land use and is located to the northwest and northeast of the I-95/I-495/I-395 (Springfield) interchange. Other major land uses include parklands and public facilities that include the Fountainhead Regional Park, Mason Neck State Park and the Fort Belvoir Military reservation. About 16 percent of the land in Fairfax County is currently vacant or undevelopable open space. The I-95 study area is located in the eastern

portion of the county where high concentrations of residential, industrial and commercial development are located.

11.1.4 I-95 Study Area

This section provides seven summaries describing the land use within the I-95 study area (See **Figure 11-1**). The summaries are based on seven sections of the study area, starting at the Garrisonville Road interchange (southern study limit) to the Duke Street interchange (northern study limit).

- **Garrisonville Road to Camp Barrett Road (Stafford County) -** Land use development within the I-95 study area from Garrisonville Road to Camp Barrett Road is shown in **Figure 11-1** (Sheet 1 of 11). Between Garrisonville Road and Camp Barrett Road is a mixture of residential, commercial and federal lands with high intensity residential and commercial development located to the northwest of the Garrisonville Road interchange. Residential uses are interspersed among commercial developments on both sides of I-95 in the southern and northeastern portions of this area. The Quantico Marine Base is located in the northwestern portion of this area.

- **Camp Barrett Road to Dumfries Road (Stafford and Prince William County) -** Land use development within the I-95 study area from Camp Barrett Road to Dumfries Road is shown in **Figure 11-1** (Sheets 1 & 2 of 7). Between Camp Barrett Road and Dumfries Road is a mixture of residential, commercial, parks and federal lands with high intensity development at the Joplin Road and Dumfries Road interchanges. High intensity residential and commercial developments are interspersed with medium intensity development to the north of Graham Park Road in the northern portion of the area. The Quantico Marine Corps Base is located in the southwestern portion of this area and Fritter Park is located in the southeastern portion of this area. Locust Shade Park covers a large portion of the southern portion of this area and is located between Russell Road and Joplin Road. Prince William Forest Park is located to the northwest of the Joplin Road interchange.

- **Dumfries Road to Opitz Boulevard (Prince William County) -** Land use development within the I-95 study area from Dumfries Road to Opitz Boulevard is shown in **Figure 11-1** (Sheets 2 & 3 of 7). Between Dumfries Road and Opitz Boulevard is a mixture of residential, commercial and light industrial uses with high intensity commercial development to the southwest of the Opitz Boulevard interchange and low intensity residential, commercial and light industrial development in the remainder of this area. The southern portion of this area includes large portions of undeveloped land.

- **Opitz Boulevard to Lorton Road (Prince William and Fairfax Counties) -** Land use development within the I-95 study area from Opitz Boulevard to Lorton Road is shown in **Figure 11-1** (Sheets 3 & 4 of 7) . Between Opitz Boulevard and Lorton Road is a mixture of residential, commercial, heavy and light industrial uses with high intensity development to the northwest of the Opitz Boulevard interchange and to the west of the Potomac River on both sides of I-95. Light and heavy industrial land uses are located to the northwest of the Opitz Boulevard interchange and to the east of the corridor in the northern portion of this area. The study area is marked by commercial land uses at the Lorton Road interchange.

- **Lorton Road to Franconia Springfield Highway (Fairfax County) -** Land use development within the I-95 study area from Lorton Road to Franconia Springfield Highway is shown in **Figure 11-1** (Sheets 4 & 5 of 7). Between Lorton Road and Franconia Springfield Highway is a mixture of residential, commercial, heavy and light industrial uses with high intensity industrial development to the east of the corridor in the central portion of this area. High

intensity industrial development is also located to the southeast of the Franconia Springfield Highway interchange. Large parcels of undeveloped land are located to the northwest of the Lorton Road interchange.

- **Franconia Springfield Highway to Duke Street (Fairfax County) –** Land use development within the I-95 study area from Franconia Springfield Highway to Duke Street is shown in **Figure 11-1** (Sheets 5 & 6 of 7). Between Franconia Springfield Highway and Duke Street is a mixture of commercial and heavy and light industrial uses with residential uses interspersed among commercial and industrial developments on both sides of I-395. Large portions of high intensity commercial development are located at the Franconia Road interchange and large portions of commercial development are located at the I-495/I-95/I-395 (Springfield) interchange. The Duke Street interchange is marked by high intensity mixed use development. The Landmark Center regional shopping mall is located to the northwest of the Duke Street interchange.

11.2 Land Use Plans and Future Land Use

This section provides summaries of the land use plans and future land use conditions within the three counties that are included in the I-95 study area.

11.2.1 Stafford County

The Comprehensive Plan for Stafford County and County ordinances guides land use planning in Stafford County. The Plan has several components, including a policy plan, a land use classification system that contains specific development recommendations for vacant or underutilized lands. According to the Comprehensive plan, future residential, industrial, and commercial growth within Stafford County will be within the urban service area that is located in the north-central, central and south-central portions of the county. The entire I-95 study area within Stafford County is located within this urban service area. The plan designates four urban development areas for 2011 within the urban service area; two of these urban development areas are adjacent to the I-95 corridor to the southeast of the Garrisonville Road interchange and to the southeast of the Russell Street interchange.

11.2.2 Prince William County

Future land use within Prince William County is guided by the Long-Range Land Use plan. The plan subdivided the County into two general geographic areas categorized according to their present character and their potential character. The general geographic areas are the Development Area and the Rural Area. The Development Area is that portion of the County that has already been developed or is expected to be developed at residential densities greater than those in the Rural Area and includes established residential, commercial and industrial areas, as well as undeveloped or underdeveloped land expected to meet the County's projected growth. The Long-Range Land Use Plan encourages infill of the Development Area and redevelopment and revitalization of older areas of the County. The Development Areas are located within the southeastern and northern portions of the county. Large portions of the infill development are expected to occur in close proximity to the I-95 corridor that is located in the southeastern portion of the county.

11.2.3 Fairfax County

The Comprehensive Plan for Fairfax County and County ordinances guides land use planning in Fairfax County. The Plan has several components, including a policy plan, a land use classification system, and area plans for each planning district that contain specific development recommendations for vacant or underutilized lands. According to the Fairfax County

Comprehensive Plan (2007), the proposed I-95 improvements intersect portions of two of the four Fairfax County planning areas (Area IV and Area I) and three planning districts: Lower Potomac, Springfield, and Lincolnia. The Lower Potomac and Springfield planning districts are located in Planning Area IV and include the portion of the study area south of the I-495/I-95/I-395 (Springfield) interchange to the southern Fairfax County boundary with Prince William County. The Lincolnia planning district is located in Planning Area I and includes the portion of the study area north of the I-495/I-95/I-395 (Springfield) interchange to the northern Fairfax County boundary with the city of Alexandria.

Based on the County's current comprehensive plan, the established land use patterns in the Lower Potomac and Springfield planning districts (Area IV) along I-95 are expected to change in the future. The planning objectives in the Lower Potomac planning district include the development of a "Town Center" which includes retail business, office uses, cultural facilities and community services for the Lorton-South Route 1 area. The I-95 corridor is centrally located within the Lorton-South Route 1 area and is expected to be a major access point for the planned town center. The planning objectives for the Springfield planning district include several special developments that are expected to be accessed by I-95. These special developments include the Springfield Community Business Center, the Franconia-Springfield Transit Station Area, the Fort Belvoir Engineer Proving Ground Area, and the I-95 Corridor Industrial Area. The established land use patterns in the Lincolnia planning district (Area I) along I-395 are intensive and are not expected to change substantially in the future. The planning objectives in the Lincolnia planning district include the preservation of stable residential areas through infill development of a character and intensity/density that is compatible with existing residential uses and maintaining the predominantly industrial character of the of the southern portion of the district that includes the Beltway South Industrial Area.

11.3 Activity Centers

This section provides summaries of the activity centers within the three counties that are included in the I-95 study area.

11.3.1 Stafford County

The I-95 interchange at Garrisonville Road is an activity center that is located within the I-95 study area. According to the Stafford County Comprehensive Plan this activity center is located within the urban service area of the county (area designated for growth) and is designated for urban residential and commercial uses.

11.3.2 Prince William County

Prince William County identified six Centers of Commerce or activity centers. These Centers of Commerce are planned urban town centers and includes a variety of activities with a regional draw. Four of these designated Centers of Commerce within Prince William County are located within the I-95 study area and include:

- **Quantico Creek –** The Quantico Creek activity center is located to the west of the Dumfries Road interchange and is a regional employment and commercial center. Dumfries Road provides access to this center.
- **Potomac Mills –** The Potomac Mills activity center is located to the northwest of the Opitz Boulevard interchange and contains a regional shopping mall (Potomac Mills mall). The Potomac Mills mall is the second largest shopping mall in the Washington

D.C area, behind Tysons Corner Center. Opitz Boulevard and Prince William Parkway provide access to the shopping mall.

- **Caton Hill –** The Caton Hill activity center is located to the west of the Prince William Parkway interchange to the northeast of the Potomac Mills shopping mall and is a regional employment center. Prince William Parkway provides access to this employment center.
- **North Woodbridge –** The North Woodbridge activity center is located to south of the Gordon Boulevard interchange and include an urban mixed use area. Gordon Boulevard provides access to this mixed use area.

11.3.3 Fairfax County

As Fairfax County has evolved from a residential suburb to a multi-faceted urbanized area, concentrations of land use and economic activity have developed throughout the county, mostly along major regional roadways, such as the Beltway (I-495), I-95, Arlington Boulevard, I-66, and the Dulles Access/Toll Road. The Fairfax County Comprehensive plan identified two regional activity centers (Franconia-Springfield and Lorton-South Route 1) that are located within the I-95 study area. Continued development of these activity centers and increases in employment are anticipated in the future.

- **Franconia-Springfield Area –** The Franconia-Springfield area is located in the northern portion of Fairfax County and generally extends along I-95 from Commerce Street to the Newington Road interchange. The Fairfax County comprehensive plan designates this area as a suburban activity center. The area contains two established employment and retail centers, which includes the Franconia-Springfield Transit Station Area, and the Springfield Community Business Center. The area also contains the Fort Belvoir Engineer Proving Ground, which is expected to receive an influx of jobs as a result of recommendations made by BRAC. The Franconia- Springfield area is located in the southeast corner of the Franconia Road interchange and includes the Joe Alexander Transportation Center and the Springfield Mall, which is one of the County's largest shopping centers. The Springfield Community Business Center is located to the northwest and southwest of the Franconia Road interchange and offers a variety of community-serving retail goods and services. The Business Center contains some housing and has the potential for additional mixed-use development and is envisioned to function as the town center of the Franconia-Springfield Area.
- **Lorton-South Route 1 Area –** The Lorton-South Route 1 is a planned activity center that is located on approximately 3,000 acres of land around the Lorton Highway interchange in the southern portion of Fairfax County. The Fairfax County comprehensive plan designates this area as a suburban activity center. The majority of the central and northern portion of the area is developed with planned development housing and community-supporting uses and includes the Lorton Town Center, a 235 acre mixed use center, a commuter rail station, retail, light industrial and public uses such as a school and library. The eastern portion of the area contains the Noman M. Cole, Jr. Pollution Control Plant site and its expansion site and the southern portion is predominantly industrial and includes a large private land fill and a quarry. Some commercial and residential uses as well as a golf driving range are also included in the southern portion of the area.

11.4 Utilities

Electrical transmission lines, electrical substations and transformers, telecommunications lines and towers, and water and sewage delivery systems are located along the I-95 corridor. Through the preliminary engineering design process, and continuing through the design-build process, the concessionaire's design-build team has -- and will continue – to design the tolling system infrastructure, and electrical and communications equipment in a manner that is coordinated with existing utilities and telecommunications systems.

11.5 Right-of-Way

In two sections (in the vicinity of U.S. Route 17 south of U.S. Route 1 in Spotsylvania County and at Route 628 in the vicinity of the Stafford Regional Airport in Stafford County), the existing median is not wide enough to accommodate the new lanes. In these instances, the existing GP lanes would need to be shifted outward to make room, necessitating the acquisition of small amounts of right of way amounting to a total of approximately 8 acres, as shown in **Exhibits 6-4 and 6-5** (presented previously). All other elements of the project, including ramps between the GP and HOT lanes to allow movement between the two facilities, would be constructed within existing right of way.

11.6 Land Use Impacts

A summary of the land use effects of the Build Alternative and No-Build Alternative for the entire length of the Project is presented in this section.

11.6.1 Direct Land Use Conversions

The Build Alternative will require no new right-of-way adjacent to the I-95 corridor. **Table 11-1** shows the land use related effects for the Build Alternative.

TABLE 11-1
Summary of Land Use Related Effects

Effect	No-Build Alternative	Build Alternative
Direct Land Use Conversion (acres)	0	0
Compatible with Existing Land Use	X	X
Consistency with Local Plans		X
Consistency with Long-Range Transportation Plans		X
Compatibility with Other Planned Transportation Projects in Northern Virginia	X	X

11.6.2 Consistency with Plans and Policies

Improvements to I-95 are consistent with, Stafford, Prince William, and Fairfax County's Comprehensive Plans. Table 11-2 shows goals, objectives and policies in each of the various comprehensive plans covering the I-95 study limits that are consistent with the Build Alternative.

TABLE 11-2
Consistency with Plans and Policies

Local Plan	Goals, Objectives, and Policies Consistent with Build Alternative
Stafford County Comprehensive Plan	Create a safe road system to permit safe and efficient movement within and through Stafford County.
Prince William County Comprehensive Plan	Encourage planned transportation networks that support designated targeted industries and major activity centers.
Fairfax County Comprehensive Plan	Provide a transportation system that allows for efficient movement of people and goods, and that connects the various land uses in a way that promotes continued economic prosperity and quality of life.

The improvements to I-95 in the Stafford County portion of the study limits are included in the FAMPO 2030 and the CLRP for the Fredericksburg area. Improvements to I-95 located in Prince William and Fairfax Counties are included in the fiscally constrained National Capital Region Transportation Plan and the CLRP for the Washington metropolitan region over the next 25 years.

11.6.3 Potential for Induced Development

The relationship between roadway improvements and induced development has at times generated debate and a variety of opinions regarding sprawl. While it is clear that highways may directly induce development under certain circumstances, this cause and effect relationship does not always transpire when a roadway improvement is made. While it is easy to assert that transportation improvements will have this effect, it is more difficult to predict with confidence when, where, and how much, especially in a dynamic urban/suburban metropolis such as the northern Virginia region, where factors other than transportation influence residential and business location decisions.

Chapter 12 - Environmental Conditions and Compliance

12.1 Background

The proposed project is currently undergoing the environmental planning process with the preparation of an EA. It has been determined that the recent proposed scope of the project represented in the Preferred Alternative will not result in significant environmental impacts. The EA was approved for public availability on September 8, 2011, and a Finding of No Significant Impact (FONSI) is expected to be completed by November 2011.

12.2 Environmental Summary

This section describes the environmental consequences of the proposed project[7]. These consequences are reported at two levels: one assuming that the entire I-95 median plus the small areas of additional right-of-way acquisition constitute the impact zone, the other for illustrative purposes assuming a more conservative impact zone comprised of the conceptual plan construction limits plus the small areas of additional right-of-way. This approach identifies the maximum potential impact estimates while also illustrating a level of impacts that could be expected. Additional consideration has been given to areas of particular sensitivity, such as streams and wetlands, where conceptual design efforts have attempted to minimize impacts, or where additional efforts may need to be made during final design to further minimize impacts.

Table 12-1 summarizes environmental issues and their relevance to the project. **Table 12-2** quantifies the impacts for both impact zones.

[7] Note that for the discussion on Environmental Conditions and Compliance, all data and information on impacts is taken from the Environmental Assessment prepared for the entire project (Northern Section and Southern Section). In some cases, the impacts presented in Chapter 12 are less for Northern Section project alone.

Table 12-1: SUMMARY OF ENVIRONMENTAL ISSUES

Land Use/Land Cover	This project is consistent with local land use plans and is located almost entirely within the existing I-95 right-of-way footprint. Land cover within the I-95 median in the southern section where HOV lanes will be added primarily consists of woods, grass, and landscape plantings. In the section north of Dumfries where the existing two-lane HOV facility is being converted to HOT lanes or restriped to three lanes, land cover within the median consists of narrow sections of grass, if any. In areas where additional right-of-way is required, land cover consists of woods and cleared or paved areas.
Relocations/Right-of-way Acquisition	No homes, businesses, farms, or nonprofit organizations would be displaced by the project; therefore, no relocations would be required. Right-of-way acquisition would be minimal (approximately 8 acres, see Figures 3A and 3B) as most of the work will occur within the median of the existing highway. Minor amounts of temporary construction easements may be required along the project length for utility relocation, drainage, and construction access. No privately owned structures are present within the right-of-way.
Environmental Justice	The project has been developed in accordance with Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*. There are no minority or low income populations along the corridor that would suffer disproportionately high and adverse environmental effects from the project.
Community Facilities and Services	No community facilities or services (churches, schools, civic organizations, emergency or law enforcement services) would be displaced by the project.
Community Access	No changes to community access would result from the project.
Agriculture and Prime Farmland	There are no agricultural or forestal districts located in the project corridor. Soils categorized as prime farmland are present within the project corridor; however, the land is already converted or committed to urban development. It is not being actively farmed and no farmland would be affected.
Mines, Minerals, and Geology	There are no active mines or quarries and no mineral resources that would be affected by the project. There is no karst terrain in this part of the state.
Soils	The project area crosses approximately 113 acres of moderately to highly corrosive (acid) soil types that could be of some concern to water quality, vegetation establishment, and degradation of road structures.
Parks and Recreational Resources	The publicly owned Smith Lake Park (Stafford County), Prince William Forest Park (National Park Service), Forest Greens Golf Club (Prince William County), Locust Shade Park (Prince William County), the Dumfries Elementary School baseball field (Prince William County), Laurel Hill Park (Fairfax County), Pohick Stream Valley Park (Fairfax County), Accotink Stream Valley Park (Fairfax County), Loisdale Park (Fairfax County), Lynbrook Park (Fairfax County), Trailside Park (Fairfax County), and Turkeycock Run Stream Valley Park (Fairfax County) abut the I-95 right-of-way. Other than potential noise impacts at Forest Greens Golf Club and the Dumfries Elementary School baseball field, these parks or recreation areas would not be impacted. Another Stafford County property (Chichester) that is designated as a future public park is located near I-95, but it is not adjacent to the I-95 right-of-way. No construction is planned outside of the existing right-of-way near these properties. During and after construction, pursuant to VDOT's *Road and Bridge Specifications*, the construction contractor will be required to minimize disturbances of vegetation, habitat, and wildlife, as well as stormwater discharge, to adjacent land uses. The project has been aligned and is being designed such that disturbances of floodplains and water resources will be as little as practicable. In addition, the implementation of temporary and permanent stormwater management measures will reduce pollution of adjacent waterways to the extent practicable and erosion will be mitigated with the application of stormwater management Best Management Practices (BMP). According to the Virginia Department of Conservation and Recreation (VDCR) and Spotsylvania Parks and Recreation, there are three recreational trails in the I-95 vicinity. Two of these trails are to cross under I-95: one along the south side of the Rappahannock River (Embrey Dam Trail) and one along the old Virginia Central Rail system (Virginia Central Rail Trail). The bridges proposed to carry the I-95 HOV/HOT Lanes over the river and old rail line will also span the area of the proposed trails, thereby avoiding the trails. The third trail (North-South Trail) is located outside of the limits of disturbance for this project. Based on the most current plans available, the proposed project will not require any Section 4(f) uses of publicly owned public parks or recreation areas. No Section 6(f) (Land and Water Conservation Fund) resources would be impacted.

Table 12-1: SUMMARY OF ENVIRONMENTAL ISSUES

Historic Properties	VDOT completed efforts to identify historic properties within the area of potential effect for the I-95 HOV/HOT Lanes Project in accordance with Section 106 of the National Historic Preservation Act (NHPA) and 36 CFR 800 as part of the two previous projects in the I-95 corridor. Based on the Section 106 consultation previously conducted, no additional identification and evaluation efforts are warranted. Based on a comprehensive review of historic property records in the corridor, previous coordination with the Virginia Department of Historic Resources, review of previous effect determinations, and review of current design plans, the project, as currently proposed, will have **no effect** on historic properties.
State Scenic River	The Rappahannock River is a designated State Scenic River. The Virginia Department of Conservation and Recreation (VDCR) has requested that visual impacts be considered in the design of the proposed bridge carrying the HOT lanes over the Rappahannock. No substantial visual impacts to the river crossing are anticipated given the presence of the existing bridges carrying I-95 over the river.
Visual	The new roadway is to be placed between the existing northbound and southbound lanes of I-95 and therefore would not greatly alter the visual environment.
Hazardous Materials Sites	According to a review of available databases and observations during site visits, there are no National Priority List hazardous material sites or solid waste disposal sites located in the project vicinity. None of the sites located within the vicinity of the project pose any special risks or concern and mostly consist of fuel spills that have been closed or remediated. It is not expected that any materials of consequence will be encountered during the construction of this project. All solid waste material resulting from clearing and grubbing, demolition, or other construction operations will be removed from the project area and disposed of according to regulations. Undocumented hazardous materials may be uncovered during construction; if contaminated soils, water, or other hazardous materials are discovered, construction will stop and VDOT will assess the situation. Notification of appropriate authorities and proper removal, disposal, treatment, and/or remediation of the material will be evaluated and suitable measures taken, as necessary.
Waters of the U.S., including Wetlands	The proposed project crosses approximately 6.9 miles of stream and 7.7 acres of wetlands.
Water Quality	Water quality in streams along the corridor is affected by surrounding development. Stormwater management facilities would be incorporated into the project to minimize long-term effects of the project on water quality.
Public Water Supplies	Currently, most of the public drinking water supply for Stafford County comes from Abel Lake, which is located approximately 7 miles north of Fredericksburg on Potomac Creek. Another reservoir on Rocky Pen Run, located west of Fredericksburg off the Rappahannock River, is scheduled to be operational by 2013. Both of these reservoirs are located upstream of the proposed project and are not anticipated to be affected by construction activities. The project corridor contains no public drinking water supplies, raw water intakes downstream, treatment units, or distribution system components. There are no groundwater sources in the project corridor that will be directly impacted by the proposed project.
Floodplains	Twenty floodplain areas would be crossed by the project. No appreciable changes to 100-year floodplain elevations are expected.
Terrestrial and Aquatic Habitat and Wildlife	The majority of the proposed alignment has been previously disturbed by the construction of I-95; however, vegetation that has grown in the median includes woods, shrubs, and grasses that are inhabited by various wildlife species adapted to roadside environments.
Woodland	Portions of the I-95 median, particularly in the wider sections, have become wooded over time with lack of extensive vegetation maintenance within much of the highway right-of-way. These areas consist of mixed hardwoods and mixed hardwood/pine. Some portions of the areas needed for additional right-of-way also are wooded. Such areas within the construction limits would be logged, cleared, and grubbed to make way for the highway lanes.
Threatened and Endangered Species	No impacts to federally listed threatened or endangered species have been identified.
Invasive Species	In accordance with Executive Order 13112, *Invasive Species*, the potential for the establishment of invasive terrestrial or aquatic animal or plant species during construction of the proposed project will be minimized by following provisions in VDOT's *Road and Bridge Specifications*. These provisions require prompt seeding of disturbed areas with mixes that are tested in accordance with the Virginia Seed Law and VDOT's standards and

Table 12-1: SUMMARY OF ENVIRONMENTAL ISSUES

	specifications to ensure that seed mixes are free of noxious species. While the proposed right-of-way is vulnerable to the colonization of invasive plant species from other portions of the site and from adjacent properties, implementation of the stated provisions will reduce the potential for the establishment and proliferation of invasive species.
Wildlife and Waterfowl Refuges	This project is not located in the vicinity of any wildlife or waterfowl refuges and is not anticipated to have an effect on any of these resources.
Anadromous Fish, Trout Waters, and Shellfish	Quantico Creek, Occoquan River, Pohick Creek, Accotink Creek, Powells Creek, Neabsco Creek, Accokeek Creek, Potomac Creek, Hazel Run, Massaponax Creek, and the Rappahannock River have been identified as anadromous fish (e.g., yellow perch, alewife, American shad, hickory shad, striped bass, blueback herring) use waters. Accotink Creek is listed by the Virginia Department of Game and Inland Fisheries (VDGIF) as a stocked trout water. Time of year restrictions may apply depending on the type of work and its location relative to the water body in question. Exact restrictions would be determined during permitting and would be followed during construction of the project. There are no shellfish waters in the vicinity of the project.
Air Quality	An air quality analysis showed that the project would result in no violations of the National Ambient Air Quality Standards (NAAQS) for carbon monoxide (CO) or $PM_{2.5}$ particulate matter. Although the project is considered a type that may be of concern for mobile source air toxics, the analysis concluded that no meaningful changes are expected as a result of the project. On a regional basis, the U.S. Environmental Protection Agency's vehicle and fuel regulations, coupled with fleet turnover, will result in substantial reductions in emissions, and in almost all cases, will cause region-wide mobile source air toxics to be significantly lower than they are today. The northern portion of the project (north of the Prince William / Stafford County Line) is included in the National Capital Region Transportation Planning Board's 2010 Financially Constrained Long Range Transportation Plan (CLRP) and FY 2011-2016 Transportation Improvement Program (TIP), which were found to conform to the State Implementation Plan. The southern portion of the project (south of the Prince William / Stafford County line) has been included in FAMPO's 2035 CLRP and FY 09-12 TIP, which also have been found to conform to the State Implementation Plan.
Noise	There are 60 common noise environments (CNE) representing 980 noise receptor locations, consisting mostly of residential structures, along northbound and southbound I-95. Studies indicate that 44 of the 60 CNEs would be impacted and that noise abatement using noise barriers may be feasible and reasonable for 21 of them. Barriers evaluated for the other impacted receptors were not found to be feasible and reasonable. Additional studies will be necessary during the final design phase when more detailed design information is available.

Table 12-2. SUMMARY OF ENVIRONMENTAL IMPACTS

CATEGORY	IMPACTS		
	NO-BUILD	TOTAL WITHIN I-95 MEDIAN & AREAS OF ADDITIONAL PROPOSED RIGHT-OF-WAY	TOTAL WITHIN CONSTRUCTION LIMITS BASED ON CONCEPTUAL PLANS
Total area (acres)	-	1,137	392
Portion of total that is additional required right-of-way (acres)	-	8	8
Homes displaced	0	0	0
Businesses displaced	0	0	0
Farms displaced	0	0	0
Schools displaced	0	0	0
Churches displaced	0	0	0
Other community facilities displaced (rescue squads, fire stations, etc.)	0	0	0
Section 4(f) property used (acres)	0	0	0
Historic properties affected	0	0	0
Agricultural and forestal district land used (acres)	0	0	0
Prime, unique, or statewide-important farmland converted (acres)	0	0	0
Acidic rock/soil disturbance (acres)	0	113	58
Length of streams disturbed (miles)	0	6.9	4.2
Wetlands displaced (acres)	0	7.7	3.5
Floodplains crossed (acres)	0	58	42
Woodland displaced (acres)	0	651	281
Threatened or endangered species Impacted	0	0	0
Hazardous material sites impacted	0	0	0
Violations of National Ambient Air Quality Standards	0	0	0
Common noise environments (CNE) and facilities impacted	44 of 60 CNEs, representing 1,963 residential land uses, one church, three athletic fields, two tennis courts, Hammill Mill Park, the Forest Greens Golf Course, the Marine Corps Museum, and four areas of planned future development	44 of 60 CNEs, representing 1,963 residential land uses, one church, three athletic fields, two tennis courts, Hammill Mill Park, the Forest Greens Golf Course, the Marine Corps Museum, and four areas of planned future development	44 of 60 CNEs, representing 1,963 residential land uses, one church, three athletic fields, two tennis courts, Hammill Mill Park, the Forest Greens Golf Course, the Marine Corps Museum, and four areas of planned future development

12.3 Findings

12.3.1 Indirect Effects

Indirect effects are those that are caused by the proposed action but occur later in time or farther in distance than the direct impacts discussed elsewhere in this document. The most common indirect effects associated with highway projects have to do with induced development, that is, development and the impacts of such development that would not otherwise occur if the project were not constructed. Lands surrounding the proposed project corridor currently can be accessed by the existing road network. As such, they are subject to development even in the absence of implementation of this project. Indeed, privately owned lands adjacent to the entire project corridor are planned for residential, commercial, industrial, and institutional development and substantial development already has occurred in nearby areas without this project being implemented. Moreover, the project would not provide any new direct access to adjacent undeveloped lands where access does not currently exist. In summary, the proposed project would serve traffic generated by development on adjoining lands, but would not cause such development. Moreover, the project is consistent with local comprehensive planning regarding land use goals in the surrounding area and transportation in the project corridor.

12.3.2 Cumulative Effects

Cumulative effects are the incremental effects of the action when added to other past, present, and reasonably foreseeable future actions, regardless of the sponsor of those actions. The assessment of cumulative effects requires an assessment of the impact that past and present actions have had on the environmental resources in the project study area that would also be impacted by the proposed project; the current affected environment is a reflection of the impacts of those past and present actions over time. Additionally, a review of cumulative effects requires an assessment of how reasonably foreseeable future actions may affect the same environmental resources that would be directly affected by the project.

In this case, the project is located in a corridor that is heavily developed and past actions, including transportation projects and residential, commercial, and government development, have already impacted most of the historic cultural and natural resources. Potential future projects in the areas surrounding the project would affect the same resources that would be affected by this project. Present and reasonably foreseeable future actions include the following:

- I-495 HOT Lanes project from the I-95/I-395/I-495 (Springfield) Interchange to north of the Dulles Toll Road (Route 267) (Fairfax County), under construction at the time of preparation of this document.
- I-95/I-395/I-495 (Springfield) Interchange Phase VIII ramps to provide a direct connection between the HOT lanes on I-95/I-395 and I-495 (Fairfax County), under construction at the time of preparation of this document.
- I-95 4th lane widening project, which will add a fourth lane in each direction of I-95 between Route 123 and Fairfax County Parkway (Fairfax and Prince William Counties), construction recently completed.
- U.S. Route 1 widening from 4 to 8 lanes from Spotsylvania Parkway to Harrison Road (Spotsylvania County and City of Fredericksburg).

- An EA is underway to address the impacts of a proposed new limited access facility that would intersect with I-95 near the existing rest area in Fredericksburg and proceed west and connect with Route 3 near Gordon Road.
- Commercial and residential development on undeveloped lands along the project corridor, consistent with local comprehensive plans and zoning.

Despite the dramatic changes in the landscape that have occurred over time due to human settlement in the surrounding area, the intensity of the incremental impacts of this project are considered small when viewed in the context of impacts from other past, present, and reasonably foreseeable future actions and would not rise to a level that would cause significant cumulative impacts.

Table 12-3 summarizes the more prominent environmental resources in the project study area that would be impacted by the proposed project, the impact that these resources have experienced from past and present actions, the incremental impact expected from the proposed project, identification of potential reasonably foreseeable future actions, and the potential impact that may occur from other reasonably foreseeable future actions in or near the study area.

Table 12-3. SUMMARY OF CUMULATIVE ENVIRONMENTAL EFFECTS

ENVIRON-MENTAL RESOURCES IN STUDY AREA	IMPACTS FROM PAST AND PRESENT ACTIONS	IMPACT FROM PROPOSED PROJECT	POTENTIAL FUTURE ACTION	POTENTIAL IMPACT ON RESOURCES FROM POTENTIAL FUTURE ACTIONS
Air Quality	Decrease in air quality as area population, industry, and traffic increases, offset by improvements to air quality resulting from increasingly stringent emissions and fuel standards.	No violations of NAAQS; project in conformity with State Implementation Plan.	Continuing development in region, accompanied by increasing regional traffic volumes; construction of other roadway improvements as programmed in the Constrained Long-range Plan.	Continuing improvements in vehicle and fuel technology, and resulting cleaner emissions, anticipated to offset increases in volumes of vehicles on regional travel network and potential impacts from other road improvements.
Noise	Increase in noise levels as urbanization and traffic increase.	Impacts to 44 of 60 common noise environments.	Continued urbanization with accompanying increases in traffic volumes.	Impacts forecasted to 44 of 60 common noise environments even without the proposed project; cumulative effect not substantial.
Waters of the U.S., including Wetlands	Conversion or culverting of water resources to make way for development; degradation of water quality from agricultural and other runoff, impervious surfaces, increased runoff and sediment volumes.	Potential impacts to approximately 6.9 linear miles of stream and 7.7 acres of wetlands; temporary siltation during construction and increase in pollutant loadings, which would be minimized through implementation of best management practices and stormwater management measures.	Additional impervious surfaces and conversion of resources for growing urban area; long-term water quality effects could occur as a result of increased impervious surface; spills from vehicles; an increase in non-point source pollutants from asphalt, grease, oil, metals, nutrients, nitrogen, deicing salts, roadside vegetation management chemicals, and suspended solids and other elements associated with roadways.	Increased impervious surfaces may affect water tables and streamflow volume and quality; adverse effects offset by enforcement of stormwater management, erosion and sediment controls, and water quality permitting requirements under local, state, and federal laws, including compensation requirements; cumulative effect not substantial.
Terrestrial and Aquatic Habitat and Wildlife	Conversion of wildlife habitat to other uses, and degradation of remaining habitat from urban impacts and fragmentation.	Potential impacts to approximately 651 acres of wooded areas, 279 acres of grassed/ herbaceous areas, and 16 acres of aquatic habitat, all primarily within I-95 median.	Continued urbanization and population growth.	Continued degradation of remaining habitat due to urban influences; cumulative effect not substantial.

Chapter 13 - Additional Supporting Information

13.1 Projected Cost Estimate & Funding Source

A preliminary construction cost estimate was prepared for the build alternative. The estimate was based on the level of concept development shown in the Ready-for-Estimate Plans (RFE Plans) prepared by FTU. The design-build I-95 HOV/HOT Lanes Project was estimated to cost $620 million. The funding for this endeavor is being handled as a Public-Private Transportation Act (PPTA) project.

The following information was provided to MWCOG as part of the Financially Constrained Long-Range Transportation Plan Project Description Form:

> ***Financial Plan***
>
> *Construction cost for the proposed Project is estimated to be $ 1,010 million (in year of expenditure dollars, PE-$ 70 million, ROW-$ 10 million, CN-$ 680 million, and other- $ 250 million). This estimate includes the cost of constructing the third HOV/HOT lane, all additional entry/exit connections, and the nine mile extension at the southern terminus. Funding sources for the Project includes a combination of private and public equity and third party debt, including private bank loans and/or Private Activity Bonds, with the potential for TIFIA funding as a form of subordinated debt. As the Project progresses, FTU will explore all avenues of funding to ensure the lowest cost of capital for the Project. The Project will require public funds for the construction component.*
>
> *FTU will be fully authorized to toll the facility, which will serve to pay debt service, operating and maintenance costs and return on equity. Toll revenue will be the main source of revenue. The Commonwealth will enter into a Comprehensive Agreement with FTU, which will authorize FTU to raise the necessary funds to construct the Project.*

13.2 Projected Construction Schedule

Construction for the Northern Section project is projected to begin in 2012, with an estimated construction completion time of approximately three years. The facility is expected to enter operations in early 2015. The current schedule calls for environmental review in compliance with Federal (NEPA) and state regulations. The NEPA document for the Northern Section project, as well as the Southern Section project has been prepared as an EA and was approved by FHWA on September 8, 2011 for public distribution. FHWA has further conditioned environmental approval to the Project being included in a conforming Transportation Improvement Program ("TIP") and Constrained Long Range Plan ("CLRP") for construction; conformity determination approval by FHWA is anticipated by the end of September 2011. Financial close on the project is projected to occur in November of 2011.

13.3. Ramp Improvements Phasing

The current plan calls for completion and opening of new HOV/HOT ramps simultaneously with the conversion of the entire system from HOV lanes to HOT lanes.

13.4 Sequence of Construction as Design-Build Project

The sequence of construction for the project is still under development and will be more defined following completion of the Design Public Hearing and the final consensus between VDOT and FTU on the Technical Requirements as part of the Comprehensive Agreement for the project.

13.5 Preliminary Signing Plan

Concept signing plans for the proposed project are included in Appendix G. The signing plans were developed by the Concessionaire's Design-Build Team (Fluor-Transurban) and not VDOT or its consultants. The overall signing effort for the I-95 HOV/HOT Lanes project is ongoing, including staff from VDOT, and Fluor-Transurban. The conceptual signing plan for the I-95 HOV/HOT Lanes project, as submitted in roll-plot format, represents best efforts to establish locations of overhead sign structures and numbers of signs by size. It is expected that this plan would change over the next few months as a result of the ongoing coordination between the various stakeholders involved and final system-wide signing concept approval being vetted with FHWA.

The following assumptions apply to the signing roll plots produced for guide signing and overhead sign structures:

- Signs were designed using the 2009 Edition of the MUTCD.
- Placement and frequency of HOT Lanes regulatory and DMS signs incorporate lessons learned and "rules" developed for the I-495 Capital Beltway HOT Lanes project.
- "'EZ-Pass' Express" top cap branding is based on the approved design from the I-495 Capital Beltway HOT Lanes project.
- Each exit ramp is designed with a minimum of three guide signs per ramp gore.
- No structure has more than one Dynamic Message Sign.
- In general, structures were limited to three sign panels or less to contain the amount of information presented at one time to motorists; in a few instances, four sign panels are necessary only where close exit ramp spacing and configuration necessitate.
- Lane Use Management Signs (LUMS) are utilized at approximately 2300' spacing in sections 3 and 4. The use/placement of LUMS is subject to ongoing discussions between the stakeholders.

While the signing plan submitted as part of the 30 percent design package is anticipated to be the same or similar to the signing plan included in the IJR for FHWA approval, the configuration shown will not constrain or "lock down" the proposed signing scheme for the HOT Lanes, nor will it preclude the Concessionaire from developing alternatives to what has been assumed for the HOT Lanes signing. The main purpose and function of the signing plan for the IJR is to show that the proposed access can be adequately signed within the context of the surrounding interstate and freeway network.

13.6 Information on Comprehensive Agreement Performance Measures, Technical Requirements, Concept of Operations (ConOPS)

This section is still under development by VDOT and Transurban. Additional information will be forthcoming as an addendum to this draft document which summarizes the following:

- Operating conditions/parameters utilized in managed lane pricing methodology
- Existing roadway instrumentation/sensors plan and proposed plan (currently in conceptual development stage)
- Systems Engineering documents
- Tolling Agreement (between VDOT and FHWA)
- Technical Requirements
- Concept of Operations (ConOPS)

The following information was provided to MWCOG as part of the Financially Constrained Long-Range Transportation Plan Project Description Form:

Tolling Policy

HOT lanes use dynamic pricing to maintain free-flowing conditions for all users, even during rush hour. The toll rates will vary throughout the day with time of day and with day of week corresponding to demand and congestion levels. Toll prices will be adjusted in response to the level of traffic to ensure free flowing operations. There will be no price caps on the level of tolls.

SAFETEA-LU mandates strict performance standards which are intended to ensure free-flowing conditions on the HOV/HOT lanes. The proposed HOV/HOT lanes project will include performance monitoring as an integral part of the project and ensure that the SAFETEA-LU mandated performance standards are complied with as a minimum. These requirements will be included in the Comprehensive Agreement between VDOT and FTU.

Dynamic message signs will provide drivers with current toll rates so they can choose whether or not to use the lanes. Toll collection on the HOV/HOT lanes will be totally electronic. There will be no toll booths. The dynamic message signs will be supplemented by other notification/communications methods to insure all users, including transit operators, have as much advance knowledge of traffic conditions as is possible.

Incident Management

Engineering design of the Project will focus on the safety aspects of the facility including cross section layout (lane width and shoulders), operations and incident management. The design and operational features of the project will be integrated with and supported by a performance based, computer aided incident management system. The incident management system will provide 24/7 monitoring and surveillance of the facility and have dedicated motorists assistance equipment and personnel. This system will allow for a rapid detection of incidents that occur

within the facility. As transit will be a significant component of the traffic, specific response procedures plans will be in place for dealing with transit specific incidents. The Incident Management Plan developed for the project will be shared with the Commonwealth Transportation Board and Northern Virginia Transportation Authority for their review.

Chapter 14 - Summary & Conclusion

VDOT and private partners Fluor-Transurban have developed a design solution to resolve the issues raised in the Purpose and Need Statement for the I-95 HOV/HOT Lanes project, as documented in the EA prepared for the project. Throughout the entire project development process for the improvements proposed in this IJR, VDOT and Fluor-Transurban have worked in partnership to advance engineering and analysis in support of the proposed improvements. The Preferred Alternative has no significant impacts on the operations and safety of I-95 (i.e. no major degradation between No-Build and Build scenarios), and does not preclude implementation of an ultimate long range plan for the I-95 corridor.

This report demonstrates that the Preferred Alternative is consistent with eight policy points under FHWA's *Policy on Access to the Interstate System*. VDOT supports this Preferred Alternative as addressing the fundamental issues and concerns presented in this document and in the EA, and formally requests that FHWA find this plan to be geometrically and operationally acceptable.

Chapter 9 - Traffic Analysis

All traffic analyses were performed for the AM and PM peak hours for three analysis years: existing conditions (2011), opening year (2018) and design year (2035). Construction for the Project is expected to start in 2012 and be completed in 2018. The analysis includes no-build and build conditions in both 2018 (opening year) and 2035 (design year).

Per FHWA policies on IJR analysis methodology and documentation, the traffic operational analysis was performed using the Transportation Research Board's 2010 Highway Capacity Manual (HCM) methodologies. Traffic operational characteristics were identified by analyzing roadway capacity and traffic operations for the freeway mainline, weaving segments, and merge/diverge areas within the study corridor. Highway Capacity Software (HCS) 2010, which is based on 2010 Highway Capacity Manual (HCM) procedures, was used to assess freeway, weaving, and ramp operations, and to develop operating travel speeds along I-95. This software provides a macroscopic view of traffic operations and employs the HCM methodologies.

Per discussions with FHWA Headquarters, and in recognizing the limitations of HCS procedures in oversaturated highway systems in urban areas, additional microsimulation analyses were performed. To address the operational effects upstream and downstream of the study area, VISSIM software was used to provide this microscopic level of traffic operations. VISSIM simulates traffic operations on freeway segments and provides traffic operational data such as vehicle delay, density, and travel speeds on freeway networks. For the local surface street intersections, Synchro software was also used to determine future traffic signal configurations and settings for optimized intersection and arterial traffic operations. The analyses were reported using the signalized intersections methodology in the HCM. The purpose of traffic simulation modeling for this project is to evaluate the operational effects of converting the existing, reversible HOV lanes along I-95 through Northern Virginia to a HOT lane facility. Detailed Traffic Output (HCM, SYNCHRO and VISSIM) is provided in Appendix D in digital format on CD. Traffic input files are also included.

Exhibit 9-1: Study Area for the I-95 HOV/HOT Lanes Project

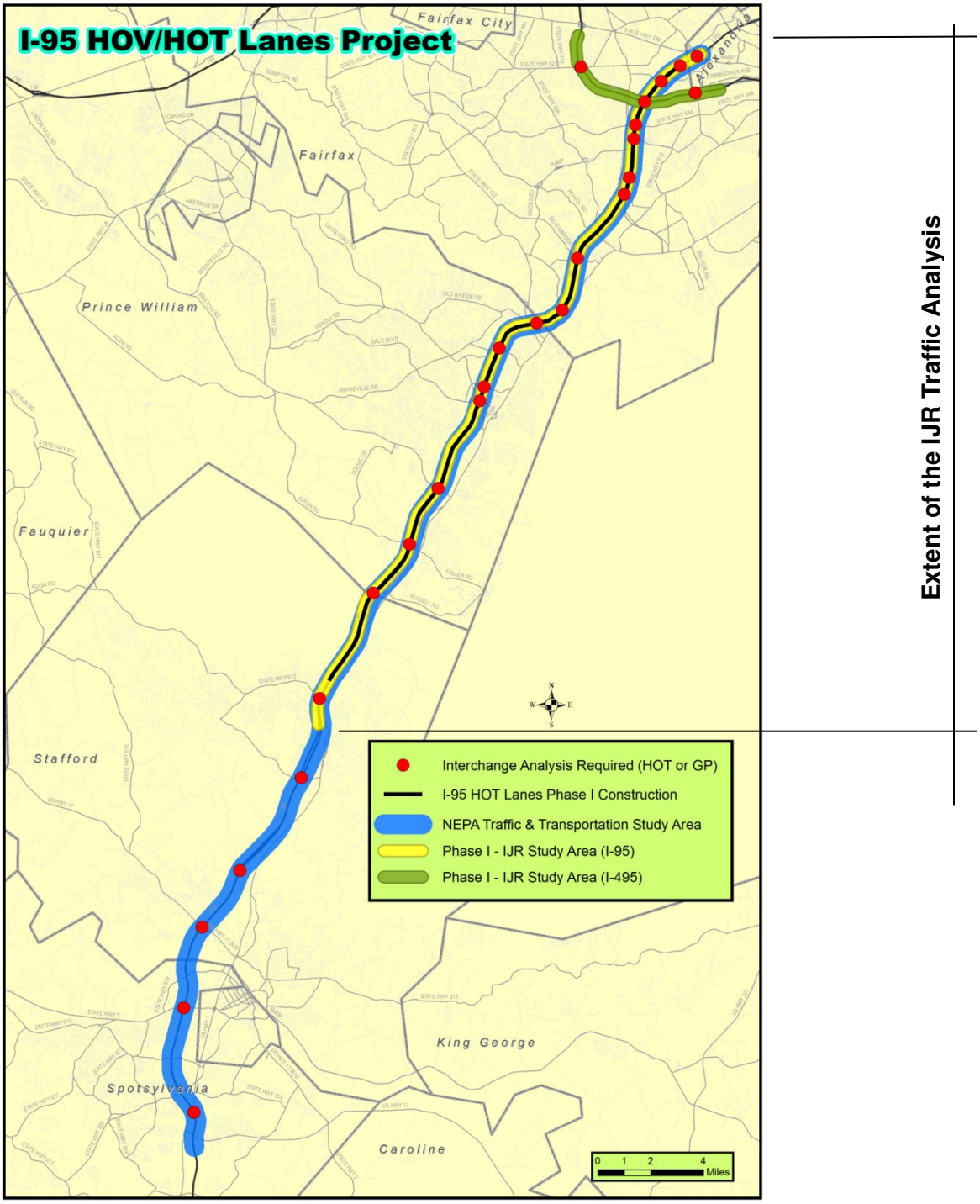


Exhibit 9-1 shows the various components of the project study area. The figure is color-coded as follows:

- Black - Actual footprint for the I-95 HOV/HOT Lanes Project – Northern Section (I-95 at Garrisonville to I-395 at the Turkeycock Run interchange ramps on the north side of Edsall Road interchange). This is the extent of the traffic simulation analysis (VISSIM)
- Blue - NEPA Study Area for I-95 HOV/HOT Lanes Project North and Southern Sections – I-95/395 from Massaponax (US 1) to Duke Street (Route 236) – Traffic operations of the southern section from the Garrisonville interchange to Massaponax is being conducted by using the HCS. No traffic simulation is being conducted in this section.
- Yellow - IJR Study Area for Phase 1 – I-95/I-395 corridor:
  - I-495 (Capital Beltway) from north of Braddock Road interchange to east of Van Dorn Street interchange.
  - I-395 (Shirley Highway) from the diverge point at I-95 to north of Duke Street interchange (to assess operations of the Turkeycock Run ramps);
  - I-95 from south of the Garrisonville interchange to the I-495 interchange for the IJR study, and south of Massaponax to I-495 for the EA Traffic Technical Report;
  - Study Area Intersections - 72 General Purpose (GP) intersections at the interchange ramp terminals included in the study area.

9.1 Methodology

It is important to note that given the different detail associated with both traffic analysis methodologies, there is the potential for some inconsistency of results between the HCM analysis and the VISSIM traffic simulation analysis. This is because traffic simulation is able to account for system-wide operation, including upstream and downstream conditions at any roadway segment. These differences are likely to occur where there is congestion and queuing. The potential for inconsistencies between both analyses has been discussed with VDOT and key VDOT staff is aware and in agreement with the scope, schedule, and methodologies for each analysis.

The methods and assumptions for each methodology are discussed in the following sections.

9.1.1 Microsimulation Methodology

The primary tool used for the microsimulation analysis in the IJR was the VISSIM microsimulation software package. VISSIM is a microscopic, behavior-based multi-purpose traffic simulation program. VISSIM was used to simulate operations along the I-95 Corridor, including mainline segments, ramps, interchanges, and freeway connections.

While HCS analyzes traffic conditions for a particular roadway element as an isolated location, VISSIM can assess the impacts on traffic operations resulting from traffic congestion or friction at other parts of the network. This capability of the micro-simulation model was important to portray adequately the traffic operations for existing conditions as well as for future conditions, and should be assessed in conjunction with the HCS analysis. One of the key benefits of the

VISSIM analysis package is the ability to visually simulate traffic operations to reveal the operational effects of various design solutions.

The VISSIM study area encompasses the Northern section of the project from the Duke Street interchange to the Garrisonville interchange. The model results for this IJR were based on the model outputs for links located within the study area.

Work was closely coordinated with FHWA Resource Center traffic operations experts to assure best modeling practices were used. The microsimulation analysis was calibrated to ensure the model accurately replicated existing conditions along the I-95 corridor. Calibration of the I-95 HOV/HOT lanes model occurred in three steps, following guidance from FHWA's *Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software.* In order of importance, the following approach was taken:

1. Calibrate the model to field freeway mainline and ramp volume data
2. Calibrate the model to field freeway mainline speed and travel time data
3. Visually review bottlenecks and queues between the model and the those observed in the field

These model measures of effectiveness (MOE) values were compared with field collected MOE values based on 2011 data. Modeled network travel times were targeted to be within 15 percent of field-measured network travel times. Modeled link volumes were targeted to be within the following GEH criteria:

- GEH Statistic[5]< 5 for Individual Link Flows>85 percent of all cases
- GEH Statistic[7]<5 for Individual Ramp Flows>85 percent of all cases

Appendix E has technical memorandums that provide detailed documentation on the methods/assumptions and calibration procedures that were used in the IJR VISSIM analysis.

Once the existing conditions model was calibrated, VISSIM models were created for the future no-build and build scenarios (2018 and 2035). Based on the VISSIM analysis, the following MOEs were used for the operational analysis of the roadway network under existing and future build and no-build scenarios:

Freeway Mainline segments:

- Average density (vehicles per mile per lane)
- Average speed (miles per hour)
- Average travel times between interchanges (minutes)
- Duration of congestion (hours at defined density, speed or flow rate)

[5] GEH statistic is computed as follows:

$$GEH = \frac{\sqrt{(E-V)^2}}{(E+V)/2}$$

Where:
E= Model estimated Volume
V=Field Count

- Congestion extent (segment miles congested)
- LOS as defined by HCM2000

Freeway Ramps

- Maximum Queue Length (feet)
- Average queue length (feet)
- Average speed (miles per hour)
- percent of demand served in peak hour
- percent of capacity used on signalized ramp terminals

Arterial MOEs

- Average intersection control delay (seconds per vehicle)
- Average intersection approach delay (seconds per vehicle)
- LOS as defined by HCM2000
- Average queue length by intersection approach (feet)
- Maximum queue length by intersection approach (feet)

Overall Network

- Travel Time on Network (vehicle-hours)
- Vehicles served (vehicle-miles)
- Average network speed (miles per hour)
- Average network delay (hours)

9.1.2 Deterministic Highway Capacity Methodology

The HCM contains concepts, guidelines, and computational procedures for calculating the capacity and LOS on transportation facilities. The traffic analysis conducted for the NEPA process, which also complements the IJR traffic analysis, used the HCM methodologies to determine LOS and other traffic data required for the air quality and noise modeling. The traffic analysis conducted for the NEPA process covers the entire corridor from the Duke Street interchange to Massaponax (North and Southern Sections of the I-95 HOV/HOT Lanes Project).

As the purpose of this project is to assess the operational impacts of converting the existing, reversible HOV lanes along I-95 to HOT lanes facility, the traffic analysis presented in this IJR focuses on these managed lanes. Per discussions with FHWA Headquarters and for the purpose of this IJR traffic analysis, this report includes HCS assessments of existing and future LOS for AM (in the northbound direction) and PM (in the southbound direction) peak hours with emphasis on merge, diverge, and weave segments on HOV/HOT lanes ingress/egress points and locations on mainline GP lanes where there is a ramp connection to/from HOV/HOT lanes. In other words, HCS analysis was performed on both ramp terminals of the HOV/HOT ramps.

The HCM defines three performance measures in characterizing freeway segments: density (passenger cars per mile per lane), speed (miles per hour), and volume-to-capacity (v/c) ratio. Each of these is an indication of how well traffic flow is being accommodated by the freeway. The measure used to determine LOS for merge, diverge, and weaving freeway segments is density. The density calculated at each freeway segment and ramp junction is assigned a LOS

ranging from A to F. A summary of each freeway segment LOS and the corresponding density is provided in **Table 9-2**.

TABLE 9-2
LOS Thresholds for HCM Freeway Analysis Based on Density

	Freeway Facility Type		
	Basic	**Merge/Diverge**	**Weaving**
LOS	**Density Range (pc/mi/ln)**	**Density Range (pc/mi/ln)**	**Density Range (pc/mi/ln)**
A	0 -11	≤ 10	≤ 10
B	> 11 - 18	> 10 – 20	> 10 - 20
C	> 18 - 26	> 20 – 28	> 20 – 28
D	> 26 – 35	> 28 – 35	> 28 – 35
E	> 35 – 45	> 35	> 35
F	> 45 (Demand exceeds capacity)	Demand exceeds capacity	Demand exceeds capacity

Source: HCM 2010, Chapters 11, 12, and 13

9.2 Highlights of Traffic Operations Analysis

The highlights of the AM peak hour analysis are summarized below:

- In general Build scenarios show an improvement in operation compared to the no-build in terms of travel time, percent of LOS F, average speeds, and total demand served.
- The exception is the northbound I-395 near the HOT Northern Terminus where the Build scenarios shows an increase in travel time and general degradation of the operation.

The highlights of the PM peak hour analysis are summarized below:

- The southern terminus to be constructed as part of the Northern Section (also known as the interim configuration of the southern terminus) will be at the Garrisonville Road interchange. The Southern Section project (to be documented in a separate IJR) will extend the two-lane reversible HOT lanes for another 17 additional miles, from Garrisonville down to Massaponax (also known as the final configuration of the southern terminus).
- In general Build scenarios show an improvement in operation compared to the no-build in terms of travel time, percent of LOS F, average speeds, and total demand served.
- The existing bottleneck at HOV termini at Dumfries is eliminated in the Build scenarios.

9.3 Microsimulation Analysis Findings

9.3.1 Existing Conditions

9.3.1.1 Travel Time Analysis

AM Peak

Table 9-2 and **Exhibit 9-2** compare free flow travel times, field travel times, and model travel times for Existing conditions in the AM peak hour. Travel time measures have been aggregated by direction of travel, and type of facility (GP and HOV lanes). The travel time summary is based on the following segment delineations:

- From Garrisonville Road to Dale Boulevard
- From Dale Boulevard to Fairfax County Parkway
- From Fairfax County Parkway to I-495 Capital Beltway (Springfield Interchange)
- From I-495 Capital Beltway to I-395 Duke Street

The travel time segments are measured at each interchange, typically either below an overpass or above an underpass of a bridge.

Table 9-2: Travel Times Summary for Existing AM Peak

	Travel Time (minutes)	Free Flow Travel Time	Existing AM Field Travel Time	Existing AM Model Travel Time
Northbound	I-95 Garrisonville to Dale Boulevard	*12.4*	13.3	14.2
	I-95 Dale Boulevard to Fairfax Co. Parkway	*10.0*	22.0	18.5
	I-95 Fairfax Co. Parkway to Springfield IC	*3.5*	6.5	6.2
	I-95 Springfield to I-395 Duke Street	*2.6*	9.7	10.5
	Total Northbound Mainline	***28.4***	*51.4*	*49.4*
Southbound	I-395 Duke Street to I-95 Springfield	*2.6*	2.6	2.6
	I-95 Springfield to I-95 Fairfax Co. Parkway	*3.4*	3.2	3.4
	I-95 Fairfax Co Parkway to Dale Boulevard	*9.3*	9.2	9.4
	I-95 Dale Boulevard to Garrisonville	*11.6*	11.0	12.0
	Total Southbound Mainline	***26.8***	*25.9*	*27.4*
Northbound HOV	I-95 Garrisonville to Dale Boulevard	*12.0*	11.1	13.7
	I-95 Dale Boulevard to Fairfax Co. Parkway	*8.7*	9.7	9.3
	I-95 Fairfax Co. Parkway to Springfield IC	*3.0*	3.2	3.2
	I-95 Springfield to I-395 Duke Street	*2.3*	2.6	2.4
	Total Northbound HOV/HOT lane facility	***26.0***	*26.5*	*28.6*

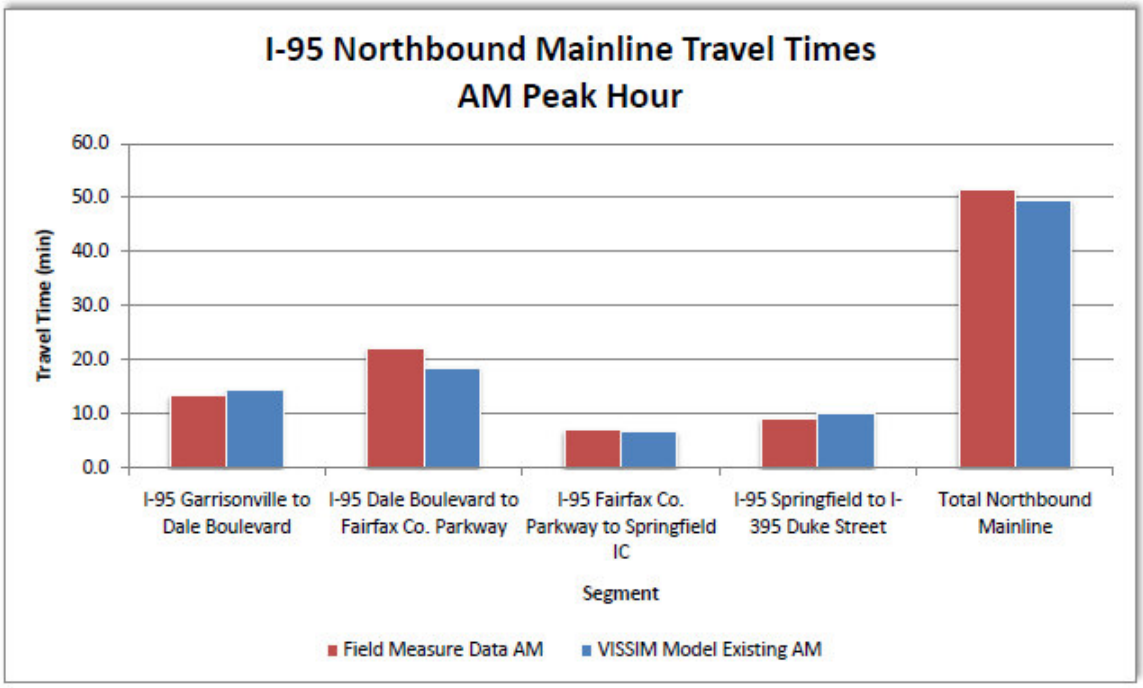
NOTE:

Highlighted cells indicate segments where HOV/HOT lane facility does not exist, therefore GP travel times are used.

In the morning peak hour in the northbound direction, the time to travel the entire corridor from Garrisonville Road to Duke Street in the model is 49.4 minutes and the field travel time is 51.4 minutes. The overall difference in travel time for the entire corridor is 4 percent, which is within the allowable calibration criteria. The modeled travel time in the southbound direction is approximately 28 minutes and the northbound HOV travel time is approximately 16 minutes. Both these facilities are matching field travel times within a minute which is less than a 5 percent difference and within the allowable calibration criteria. With the exception of one northbound segment from Dale Boulevard to Fairfax County Parkway, all other segments are within the allowable calibration criteria for travel time. It is important to note that during the period when field travel times were conducted, construction activities were going on between Gordon Boulevard and Fairfax County Parkway and there were construction work zone conditions along the corridor.

An additional comparison of field travel time and model travel time is shown in **Exhibit 9-3**. The corridor travel times were compared against field observed travel times as a function of distance traveled. Four lines are plotted on Exhibit 9-3. The blue solid line represents the average of six field measured travel times. The red line represents the modeled travel time. The two different dashed lines represent the minimum and maximum field observed travel times. The objective of this graphic is to have the red line match the blue line as closely as possible while a secondary objective is to have the red line within the minimum and maximum field observed travel times. As illustrated, the field travel time and the model travel time match well.

Exhibit 9-2: Travel Times Summary for Existing AM Peak



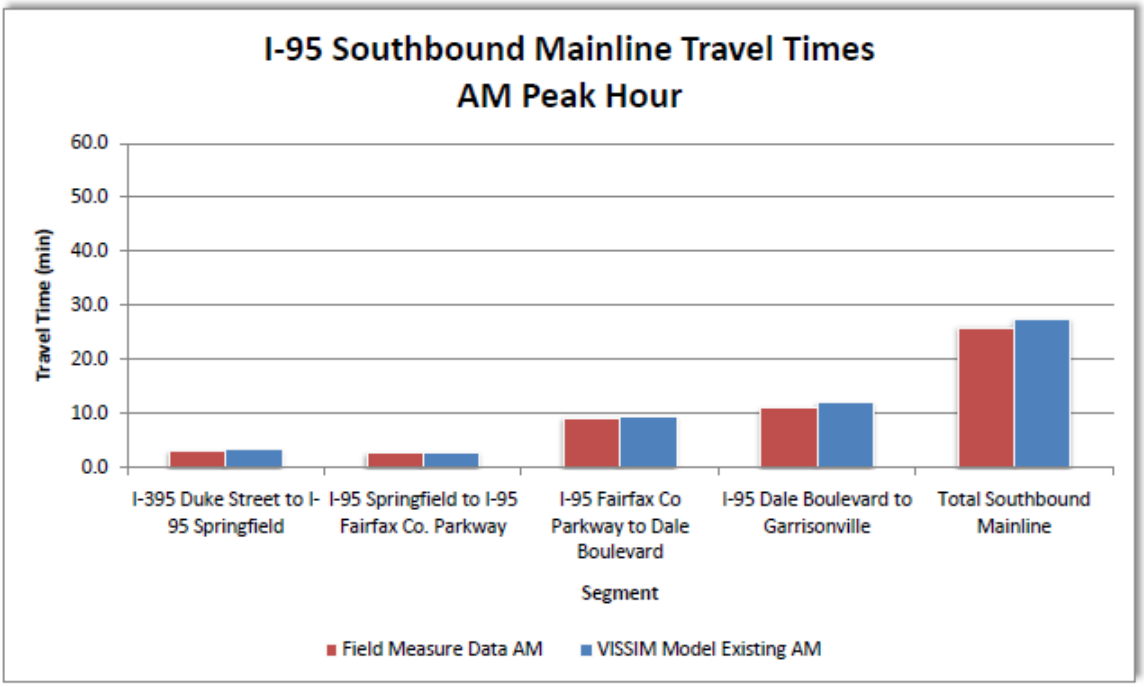
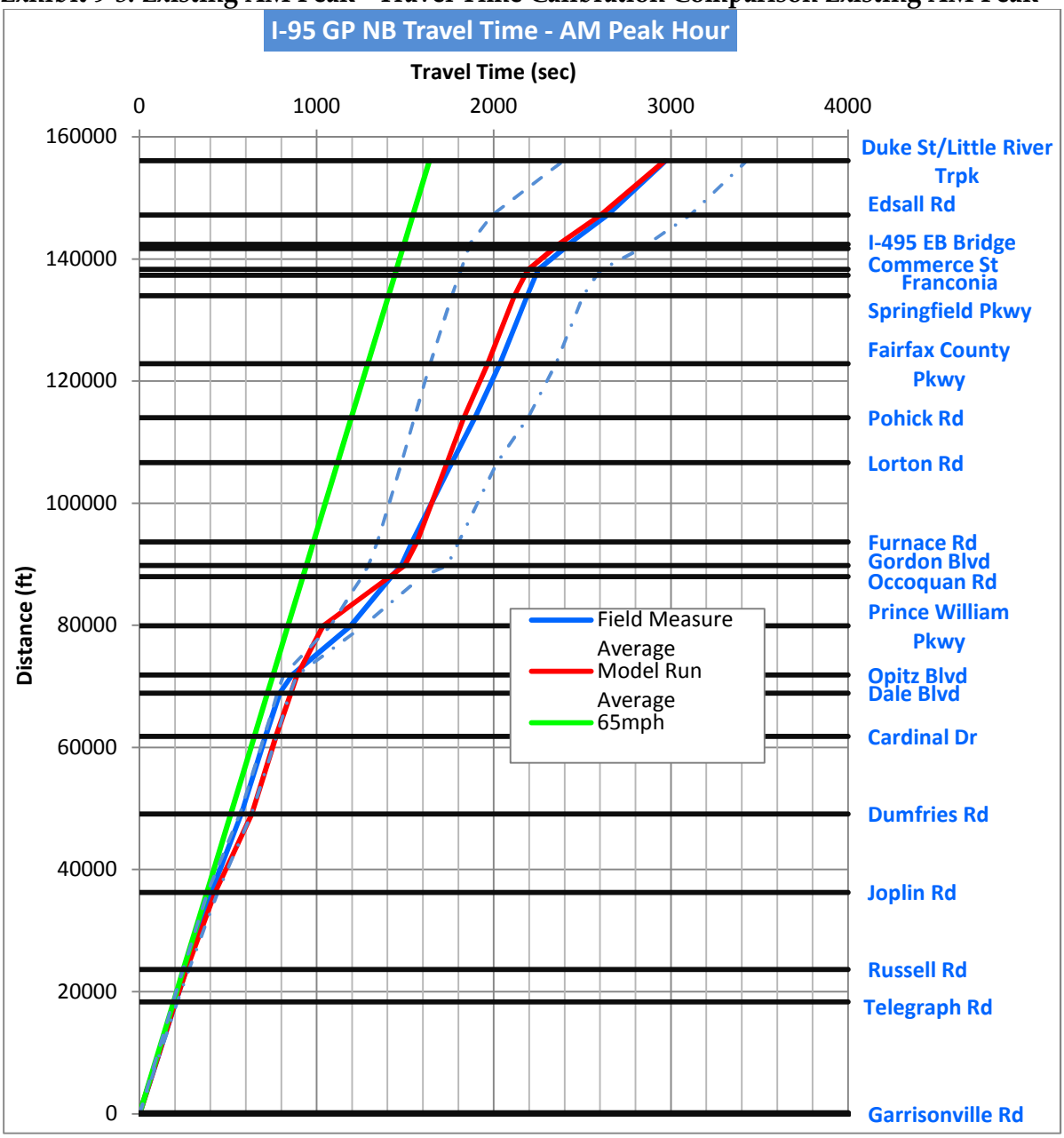


Exhibit 9-3: Existing AM Peak - Travel Time Calibration Comparison Existing AM Peak



In conclusion, the overall model travel time for the entire corridor is within the acceptable field travel times. As you can see from the table above to traverse the entire corridor under free flow conditions it takes about 28.4 minutes in the northbound GP lanes where as the field travel time is 51.4 minutes which is almost 80 percent more. This is because of high demand and less

capacity in the general purpose lanes and unused capacity in the HOV/HOT lane facility. As the demand increases in the future without any improvements travel times will keep increasing.

PM Peak

Table 9-3 and **Exhibit 9-4** compare free flow travel times, field travel times, and model travel times for Existing conditions in the PM peak hour. Travel time measures have been aggregated by direction of travel, and type of facility (GP and HOV lanes). The travel time summary is based on the following segment delineations:

- From Garrisonville Road to Dale Boulevard
- From Dale Boulevard to Fairfax County Parkway
- From Fairfax County Parkway to I-495 Capital Beltway (Springfield Interchange)
- From I-495 Capital Beltway to I-395 Duke Street

The overall travel time results from PM peak hour simulation model runs are very consistent with the field measurements through the entire study corridor. The differences between model outputs and the total travel times through the study area vary only from 0.5 - 6.1 percent which is well within the allowable calibration criteria. For five data collection sub-segments, the travel time differences between model and field data are also within acceptable level.

During PM peak hour, the southbound I-95 GP lanes experience severe and recurring congestion. The corresponding travel time trajectory is shown in **Exhibit 9-5**. In the peak direction of travel (southbound) on the GP lanes from Duke Street to Garrisonville Road, it takes nearly one hour (57 minutes based on both field measurement and VISSIM model) for an average driver to travel over this 30-mile freeway segment. This travel time is about as twice long as free flow conditions. Based on the travel time trajectory, southbound traffic flow significantly slows down and operates in stop-and-go conditions at two locations during the entire PM peak hour. These locations are:

- Between Fairfax County Parkway to Gordon Boulevard/Ox Road
- Between Dale Boulevard and Dumfries slip ramp

In the off-peak direction (northbound), the average travel time on northbound GP lanes is slightly less than 30 minutes for the entire mainline. Similarly, traffic on southbound HOV lanes experiences nearly free flow conditions, and the travel time from the Turkeycock slip ramp to the southern terminus near Dumfries Road is about 17 minutes. Based on the travel time trajectories of both facilities, there is no modeled speed slow down or congested segments which is consistent with field conditions.

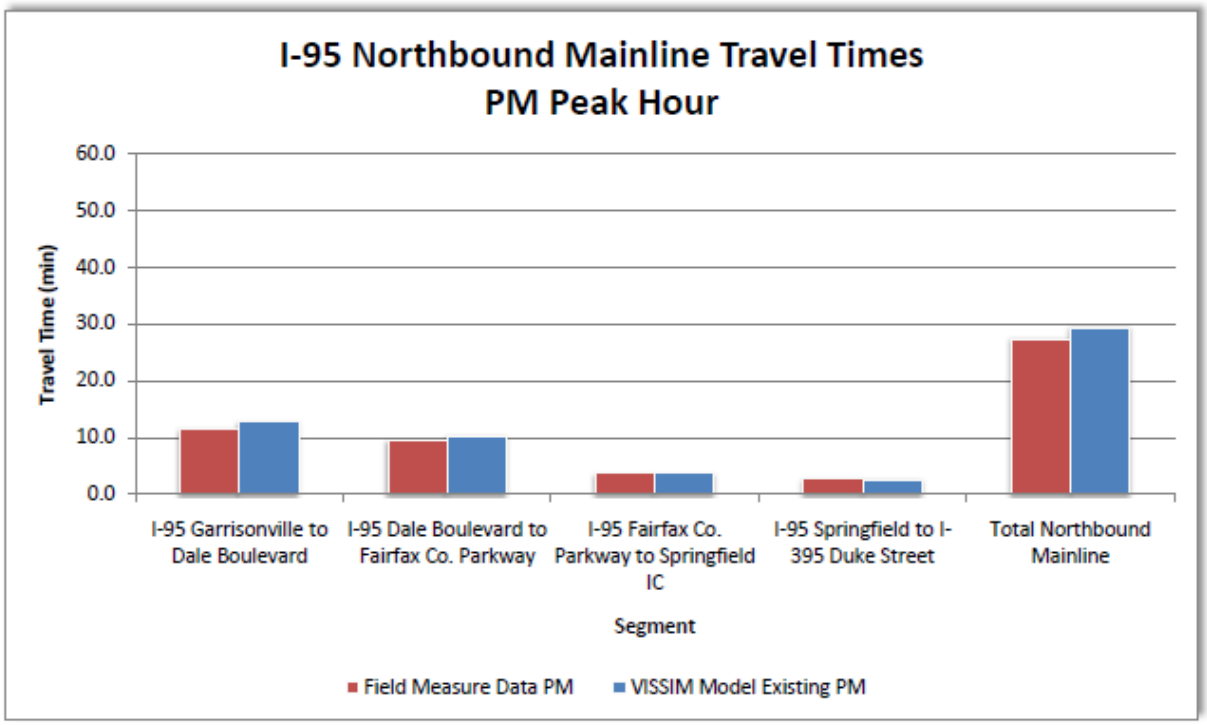
Table 9-3: Travel Times Summary for Existing PM Peak

	Travel Time (minutes)	Free Flow Travel Time	Existing PM Field Travel Time	Existing PM Model Travel Time
Northbound	I-95 Garrisonville to Dale Boulevard	*12.4*	11.5	12.8
	I-95 Dale Boulevard to Fairfax Co. Parkway	*10.0*	9.5	10.3
	I-95 Fairfax Co. Parkway to Springfield IC	*3.5*	3.5	3.6
	I-95 Springfield to I-395 Duke Street	*2.6*	2.8	2.7
	Total Northbound Mainline	***28.4***	*27.3*	*29.3*
Southbound	I-395 Duke Street to I-95 Springfield	*2.6*	3.2	3.6
	I-95 Springfield to I-95 Fairfax Co. Parkway	*3.4*	4.7	3.7
	I-95 Fairfax Co Parkway to Dale Boulevard	*9.3*	28.0	25.7
	I-95 Dale Boulevard to Garrisonville	*11.6*	21.5	24.6
	Total Southbound Mainline	***26.8***	*57.4*	*57.7*
Southbound HOV	I-395 Duke Street to I-95 Springfield	*1.7*	2.1	1.7
	I-95 Springfield to I-95 Fairfax Co. Parkway	*3.3*	3.8	3.4
	I-95 Fairfax Co Parkway to Dale Boulevard	*9.5*	9.7	9.7
	I-95 Dale Boulevard to Garrisonville	*12.0*	22.3	22.6
	Total Southbound HOV/HOT lane facility	***26.5***	*37.9*	*37.4*

NOTE:

Highlighted cells indicate segments where HOV/HOT lane facility does not exist, therefore GP travel times are used.

Exhibit 9-4: Travel Times Summary for Existing PM Peak



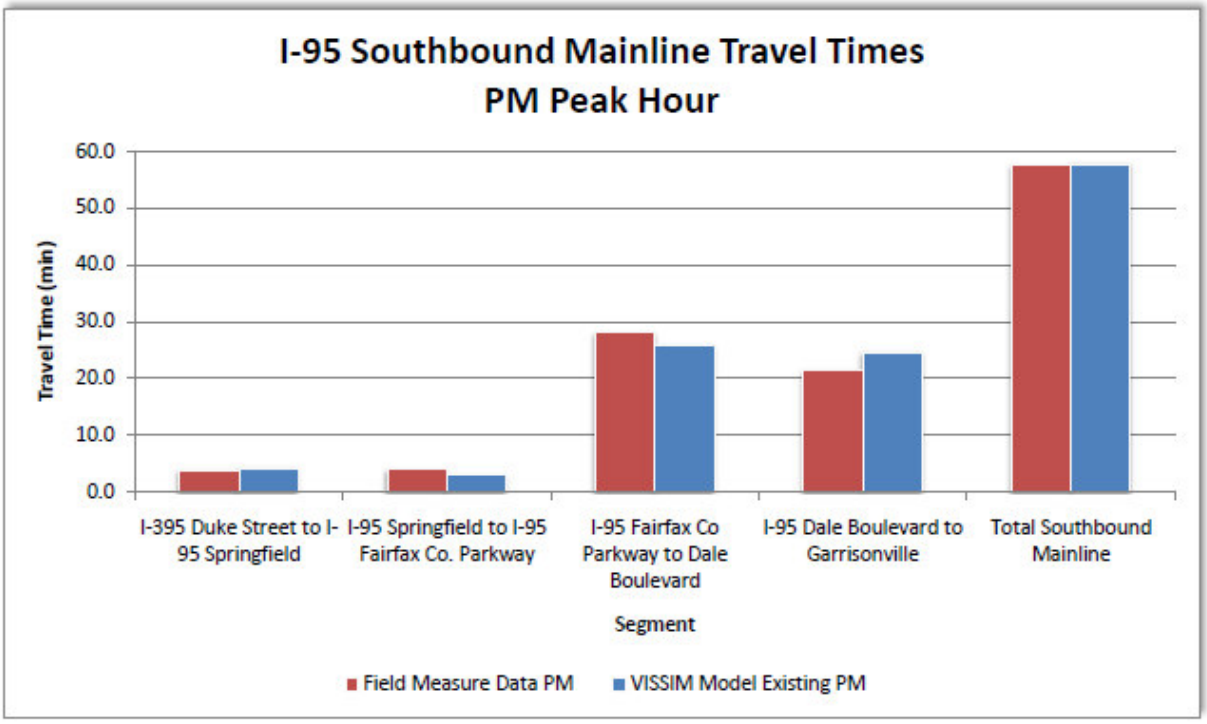


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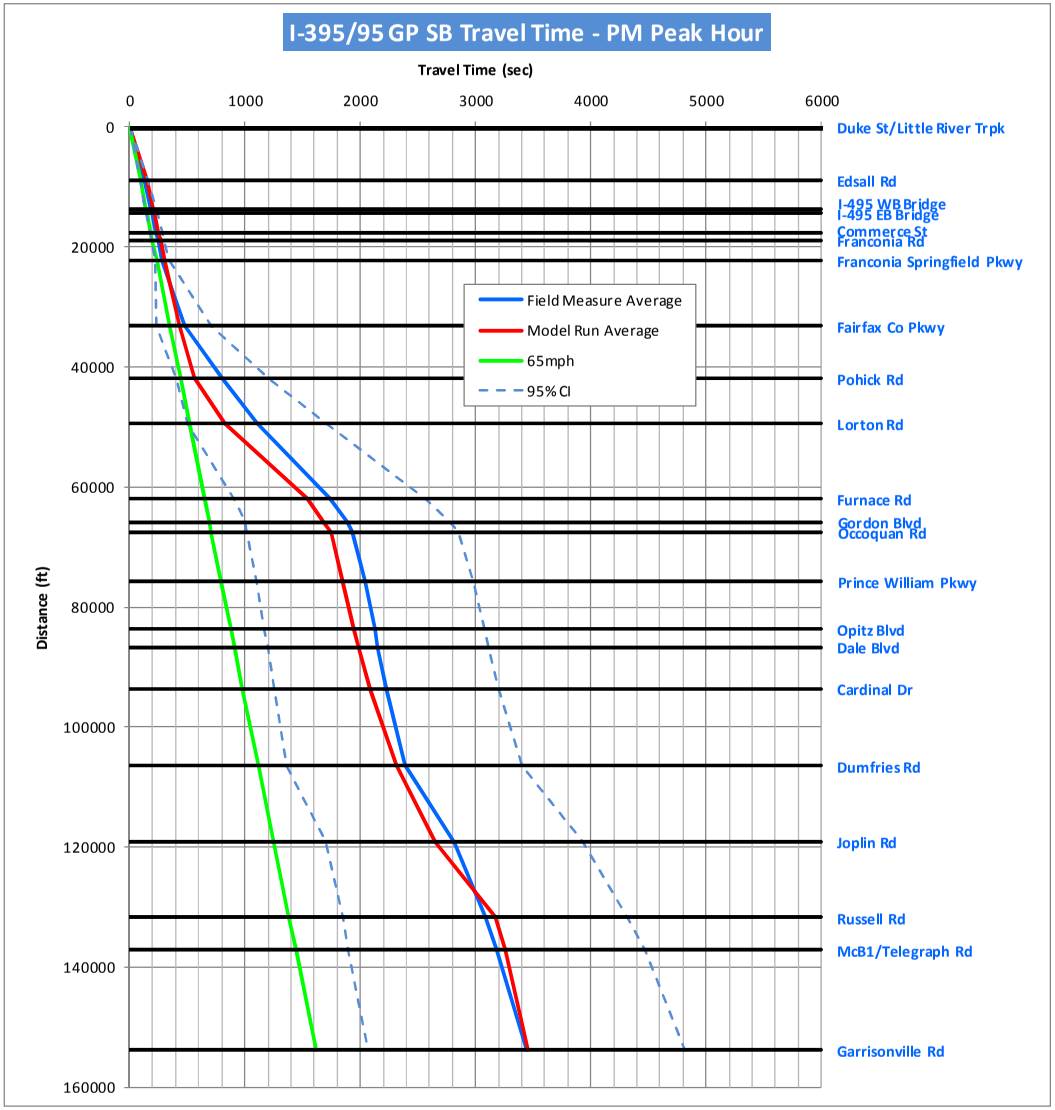
Exhibit 9-5: Existing PM Peak - Travel Time Calibration Comparison



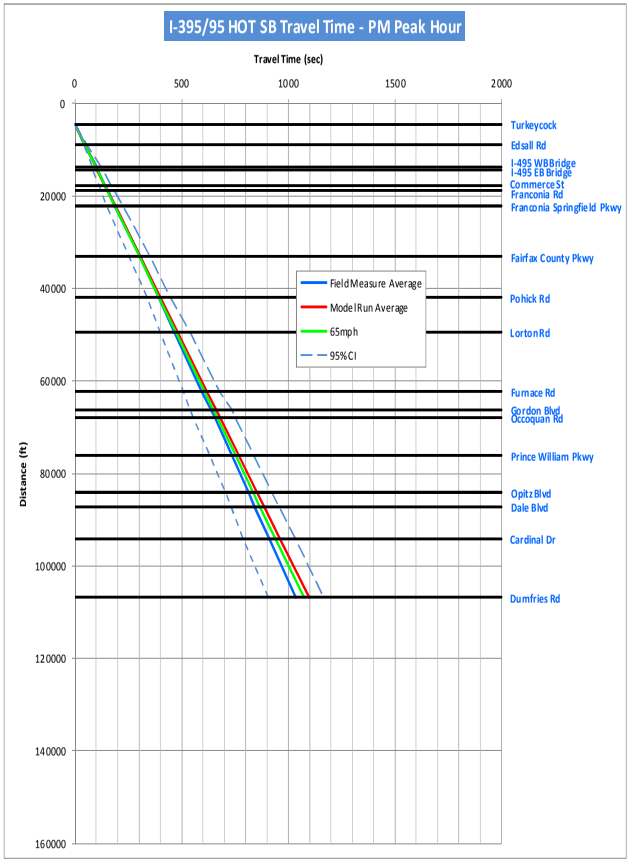
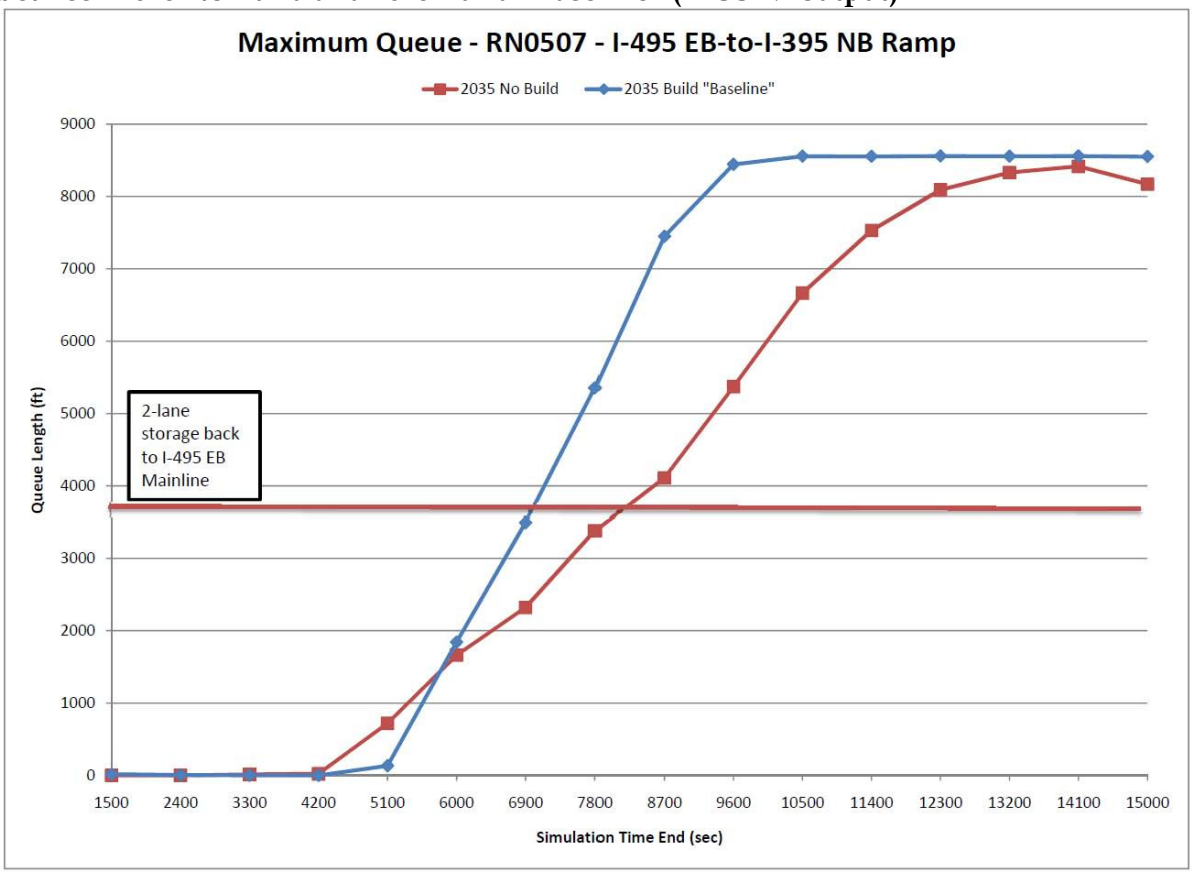


Exhibit 9-51: Northern Terminus – I-495 EB-to-I-395 NB ramp queue length comparison between 2018 No Build and 2018 Build "Baseline" (VISSIM output)



Mitigation

Several improvements were considered to mitigate the impacts of the Build "Baseline" scenario. Options considered included:

- Mitigation Option #1 - Extension of the northbound auxiliary lane at the Turkeycock HOT Flyover ramp 825 feet to the Duke Street westbound off-ramp
- Mitigation Option #2 – Option #1 plus a 4,200 feet northbound auxiliary lane between the Duke Street on-ramp and the Seminary Road off-ramp. The Seminary Road off-ramp would be converted to a two-lane off-ramp with a drop-option configuration
- Mitigation Option #3 – Aggressive toll rates that divert 50 percent of the Turkeycock HOT exit ramp demand (from 1,050 vph to 525 vph) to exit at the nearest upstream HOT exit ramp at Newington.

Option 1 and 2 are illustrated in **Exhibits 9-52** and **9-53** (Option 3 is not illustrated because it is a tolling option and the geometry is the same as the baseline). After preliminary analysis of the three options, mitigation options #1 and #3 were found to have minimal improvements

Exhibit 9-52: Northern Terminus – "Option 1" configuration of Northbound I-395 HOV/HOT Exit Ramp at Turkeycock IC

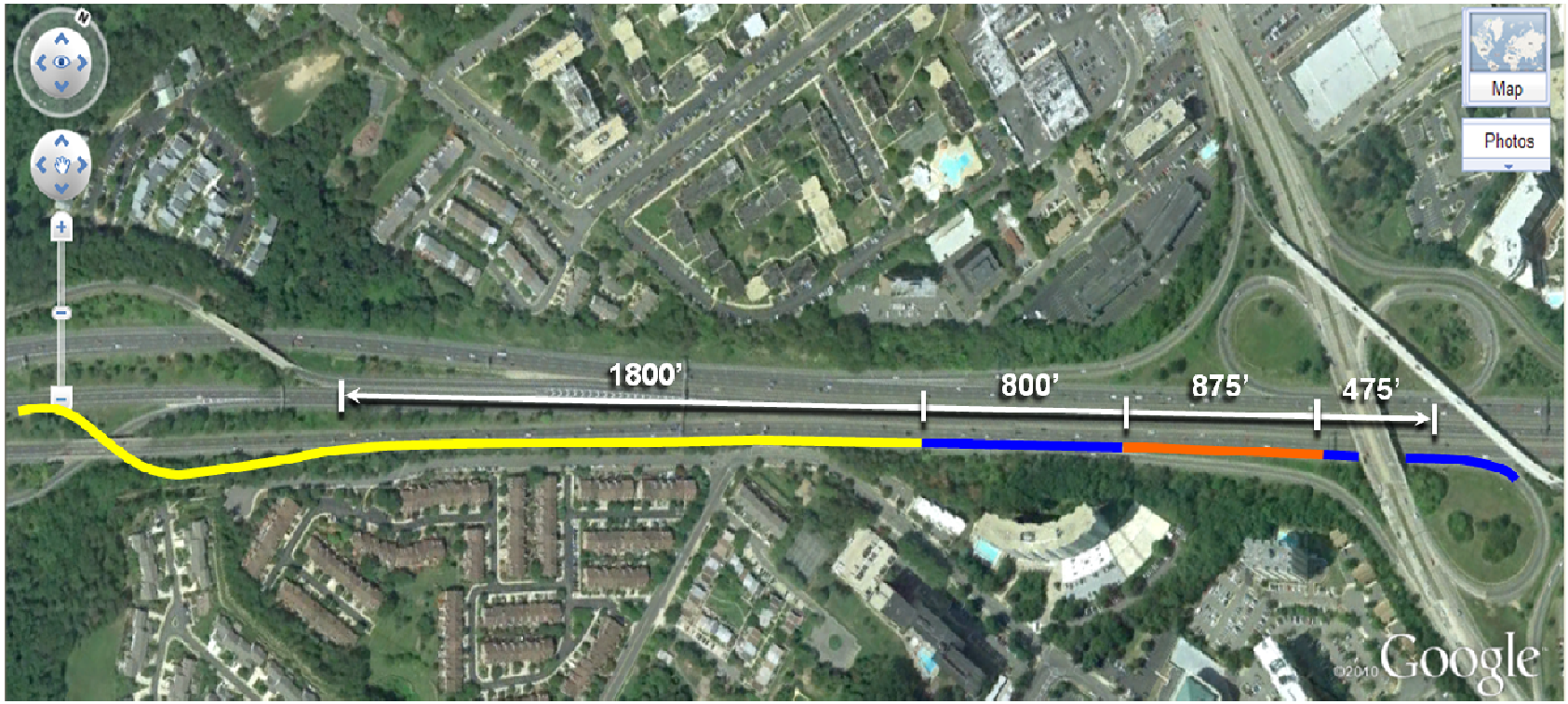


Exhibit 9-53: Northern Terminus – "Option 2" configuration of Northbound I-395 HOV/HOT Exit Ramp at Turkeycock IC

compared to the Baseline scenario and would not mitigate congestion levels back to the No Build scenario. Mitigation option #2 was found to significantly improve traffic conditions compared to the Build "Baseline" scenario.

Traffic conditions for the Build "Option 2" scenario are compared to the Build "Baseline" scenario for Design Year 2035 below for throughput volume (**Exhibit 9-54**), travel time (**Exhibit 9-55**), temporal speed diagrams (**Exhibit 9-56**), and I-495 EB-to-I-395 NB ramp queue length (**Exhibit 9-57**).

The additional capacity provided by the northbound auxiliary lane between Duke Street and Seminary Road would increase throughput north of Duke Street, reduce travel times and increase speeds throughout the study area, and eliminate the queue at the I-495 eastbound ramp.

Exhibit 9-54: Northern Terminus – Throughput volume comparison on I-395 NB GP Lanes north of Duke Street between 2035 Build "Baseline" and 2035 Build "Option 2" (VISSIM output)

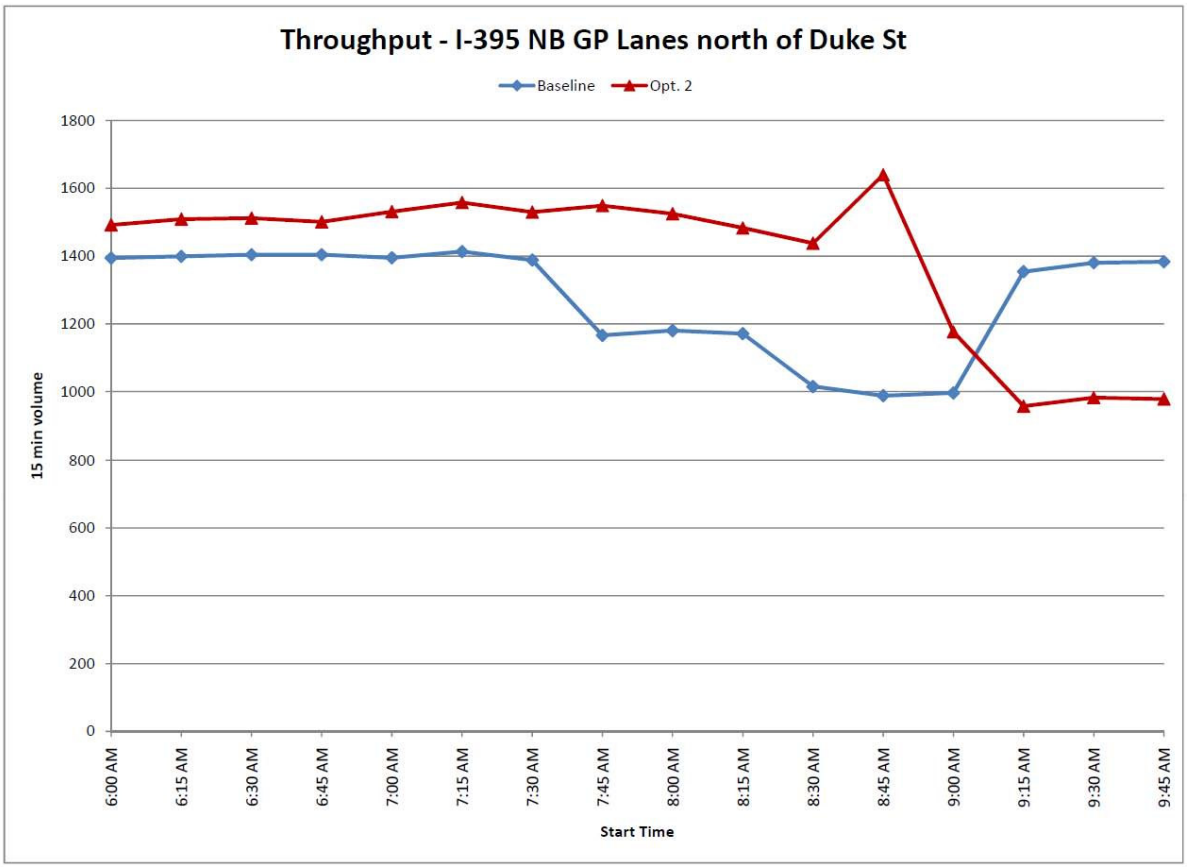
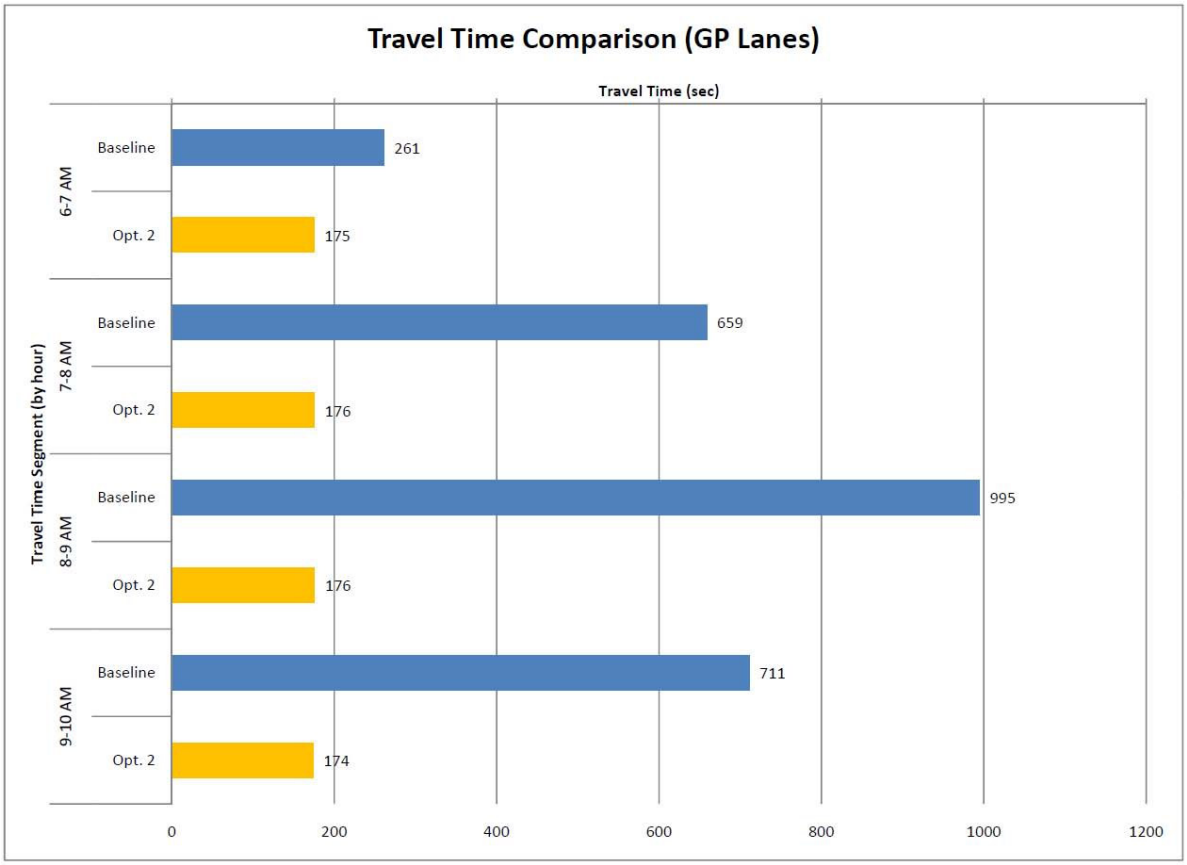


Exhibit 9-55: Northern Terminus – Travel time comparison between 2035 Build "Baseline" and 2035 Build "Option 2" (VISSIM output)



Note: Travel times measured from Springfield Interchange to the Northern Terminus (north of the Duke Street interchange).

Exhibit 9-56: Northern Terminus – Temporal speed diagram comparison between 2035 Build "Baseline" and 2035 Build "Option 2" (VISSIM output)

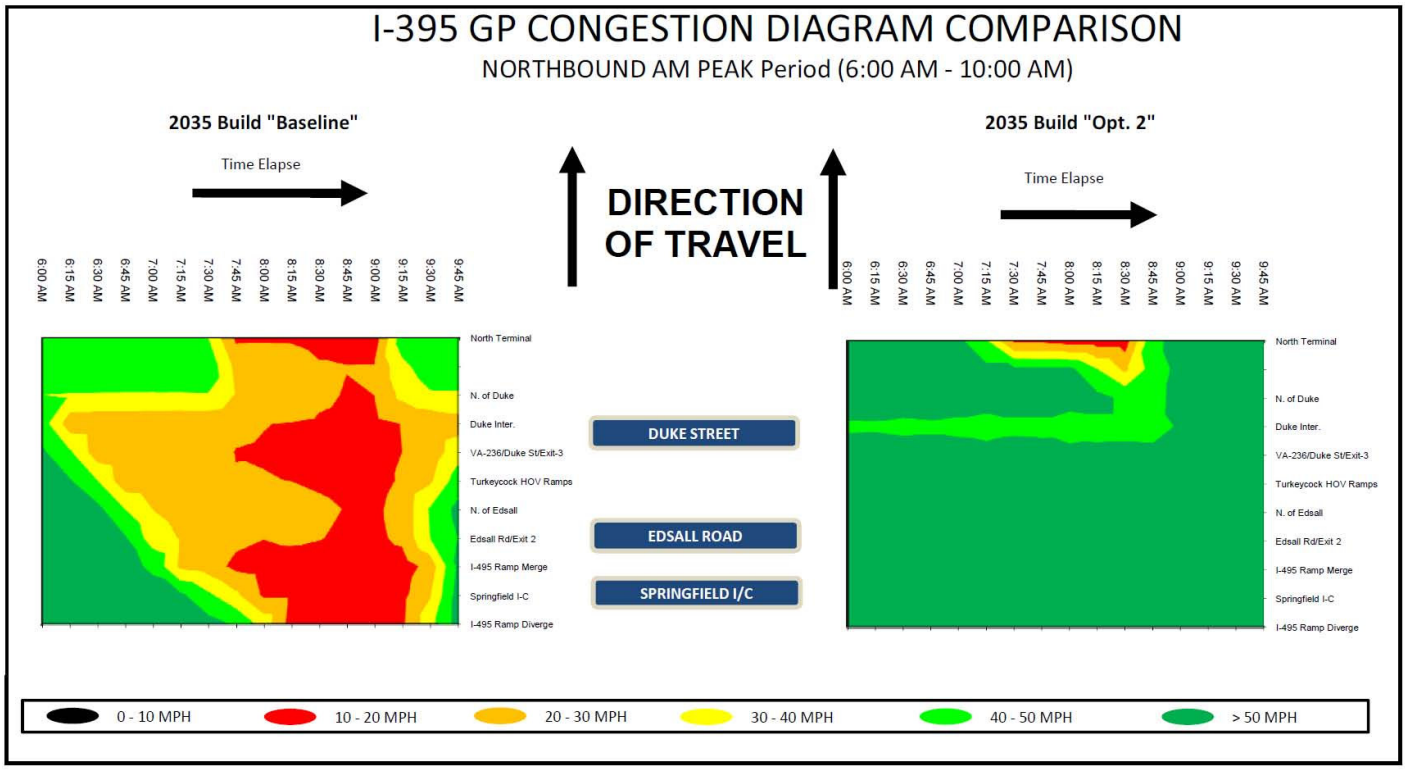
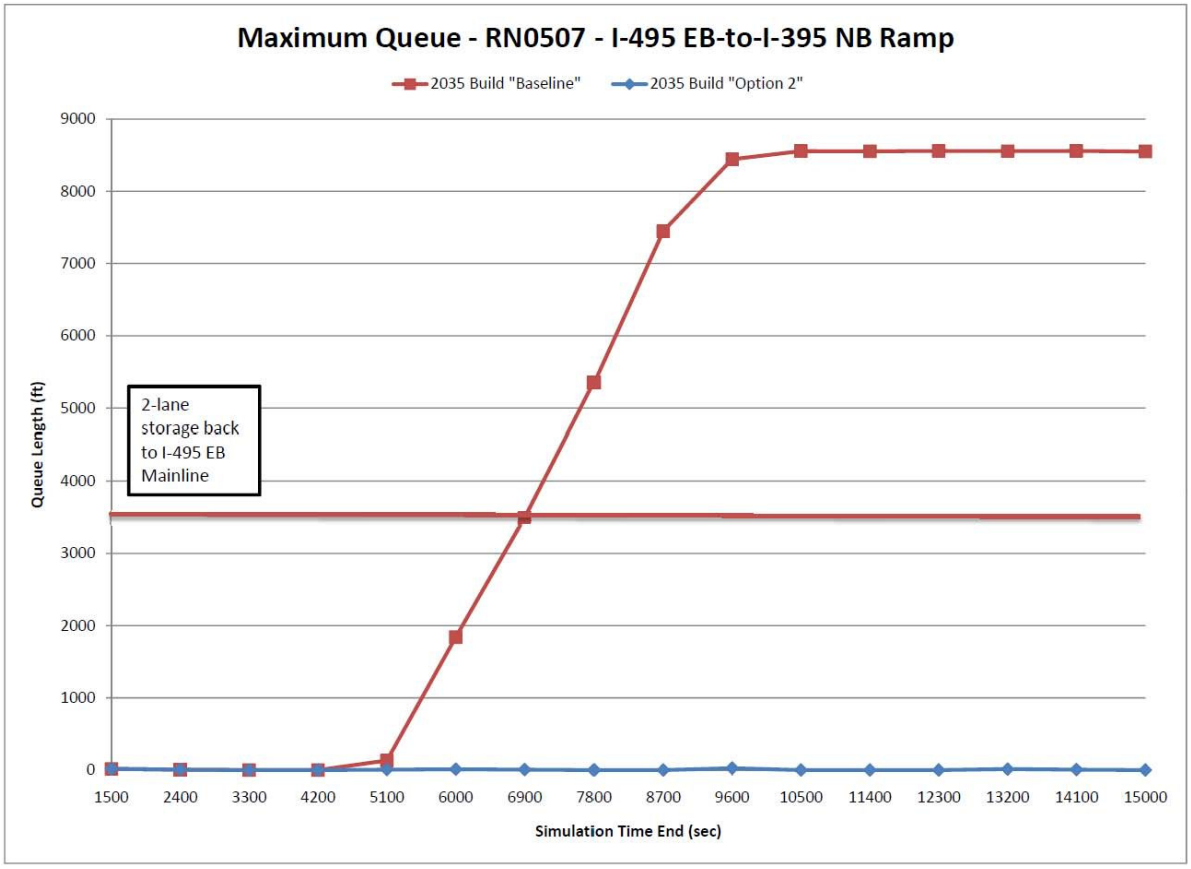


Exhibit 9-57: Northern Terminus – I-495 EB-to-I-395 NB ramp queue length comparison between 2035 Build "Baseline" and 2035 Build "Option 2" (VISSIM output)



9.3.4.3 HOT Lanes Interim Southern Terminus

Introduction

The entire I-95 HOV/HOT Lanes project is proposed to be constructed in two sections, with the Northern segment constructing the section between Garrisonville Road and the Turkeycock HOV Ramps. The Southern segment will construct the section between Garrisonville Road and Jefferson Davis Highway. An interim condition will exist on I-95 between the completion of the Northern and Southern segments, where the Southern Terminus of the I-95 HOV/HOT Lanes will be located just north of the Garrisonville Road interchange. Between the Russell Road and Garrisonville Road interchanges, the HOV/HOT lane facility will narrow to one lane and terminate in a flyover ramp that connects to the right side of the GP lanes just north of the Garrisonville Road westbound off-ramp. A southbound auxiliary lane would be constructed between the flyover connection and the Garrisonville Road westbound off-ramp. Also, the entrance ramp to the HOT lanes between Dale Boulevard and Dumfries Road would not be constructed in the Northern segment.

In order to analyze the impacts of the Southern Terminus under Interim Conditions, a sub-area VISSIM model was developed for the 2018 PM peak hour. The Southern Terminus VISSIM model includes the southbound I-95 GP lanes and HOV/HOT lane facility from just north of the Dale Boulevard to south of the Garrisonville Road interchange.

Existing Conditions

Existing Conditions were analyzed with the Southern Terminus VISSIM model to ensure consistency with the I-95 Corridor VISSIM model. The Southern Terminus VISSIM model was created from the I-95 Corridor VISSIM model by cutting out all areas outside of the Southern Terminus VISSIM model study limits. **Exhibit 9-58** shows the study area for the Southern Terminus VISSIM Model.

The Southern Terminus model was calibrated to Existing Conditions field data. **Exhibit 9-59** shows a temporal speed comparison diagram for the southbound I-95 GP lanes between field data (compiled by INRIX) and VISSIM model output. **Exhibit 9-60 and 9-61** shows a travel time comparison chart between field data and VISSIM model output for the GP lanes and HOV/HOT lane facility. In addition, throughput volumes counted south of the Garrisonville Road interchange were compared to throughput volumes measured from the VISSIM model and found to be within five percent of each other. The Existing Conditions VISSIM model contains two bottlenecks, one that forms at the Russell Road southbound on-ramp merge and another that forms at the existing Southern Terminus of the HOV/HOT lane facility just south of Dumfries Road. Based on the data presented, the Southern Terminus model is calibrated to field data.

Exhibit 9-58: Southern Terminus VISSIM Study Area

Exhibit 9-59: Southern Terminus VISSIM Temporal Speed Diagram for I-95 SB GP Lanes

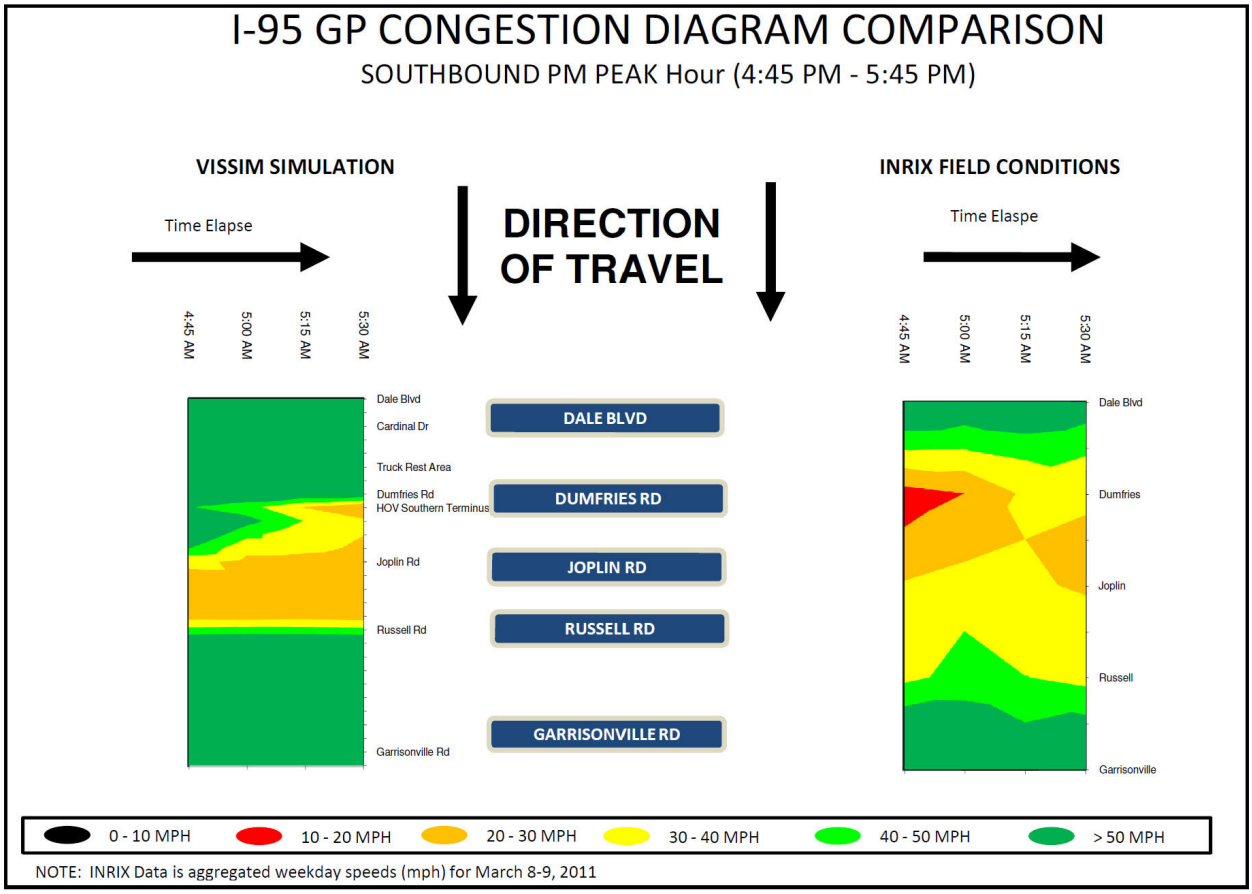


Exhibit 9-60: Southern Terminus VISSIM travel time comparison for I-95 SB GP Lanes

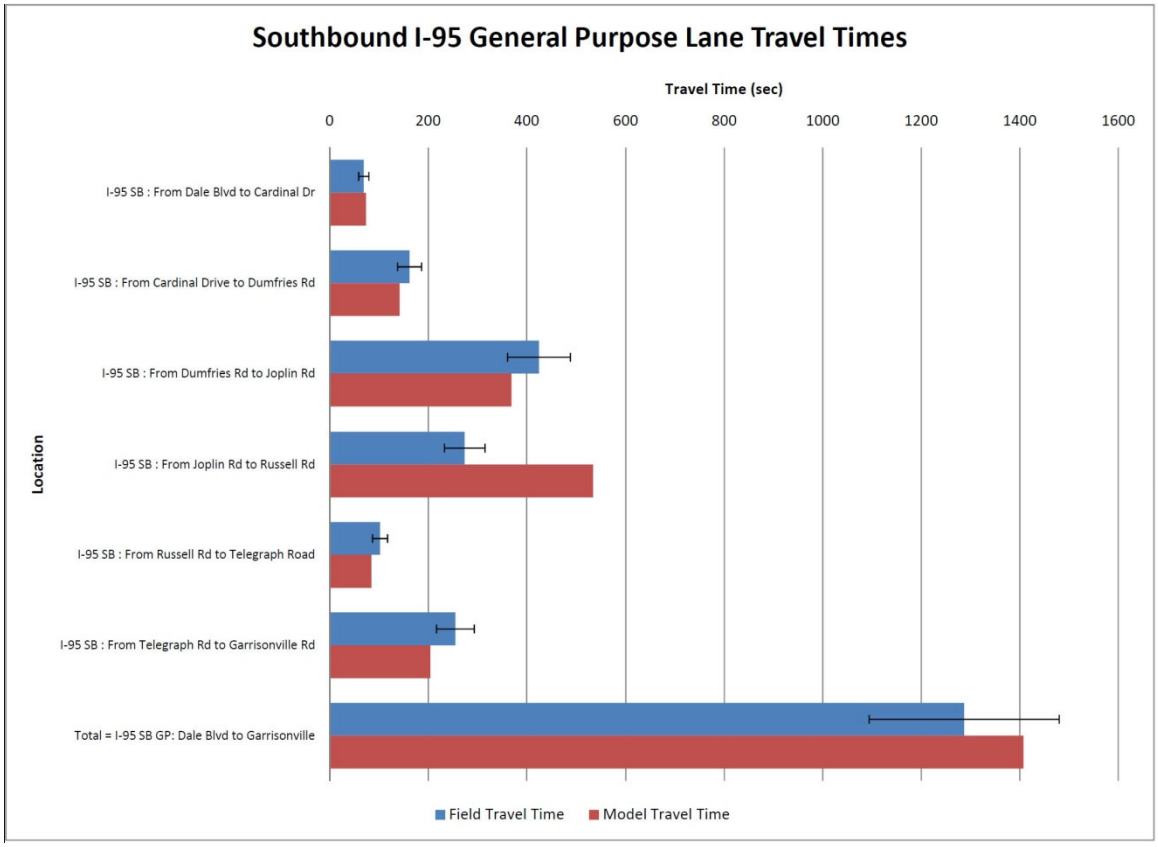
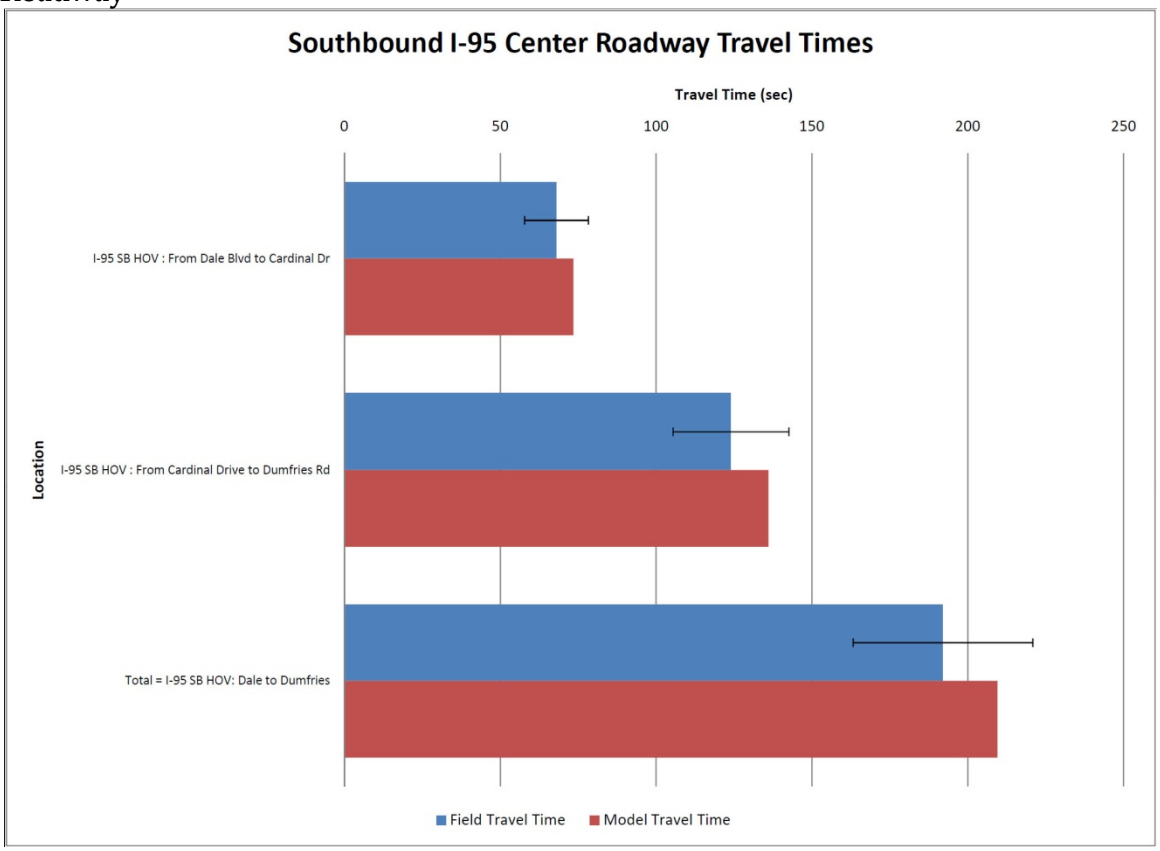


Exhibit 9-61: **Southern Terminus VISSIM travel time comparison for I-95 SB HOV Center Roadway**



2018 No Build

Exhibit 9-62 shows a temporal speed comparison diagram of the southbound I-95 GP lanes between Existing Conditions and 2018 No Build. **Exhibit 9-63 and 9-64** show travel time comparisons for the GP Lanes and HOV/HOT lane facility, respectively. **Exhibit 9-65** compares throughput volumes between Existing Conditions and 2018 No Build. In general, traffic operations are similar but slightly worse in 2018 No Build compared to Existing Conditions.

Exhibit 9-62: Southern Terminus VISSIM temporal speed diagram for Existing and 2018 No Build

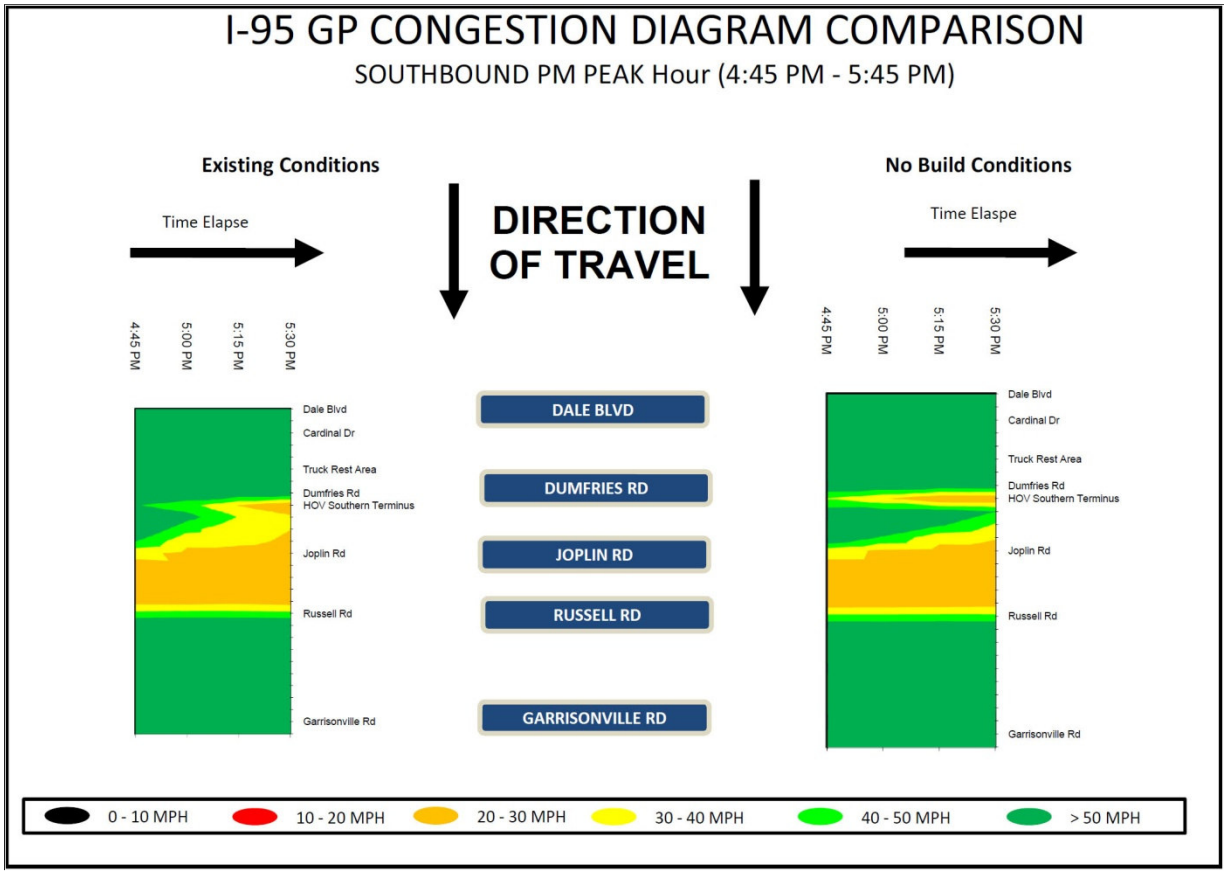


Exhibit 9-63: Southern Terminus VISSIM GP Lane travel time comparison for Existing and 2018 No Build

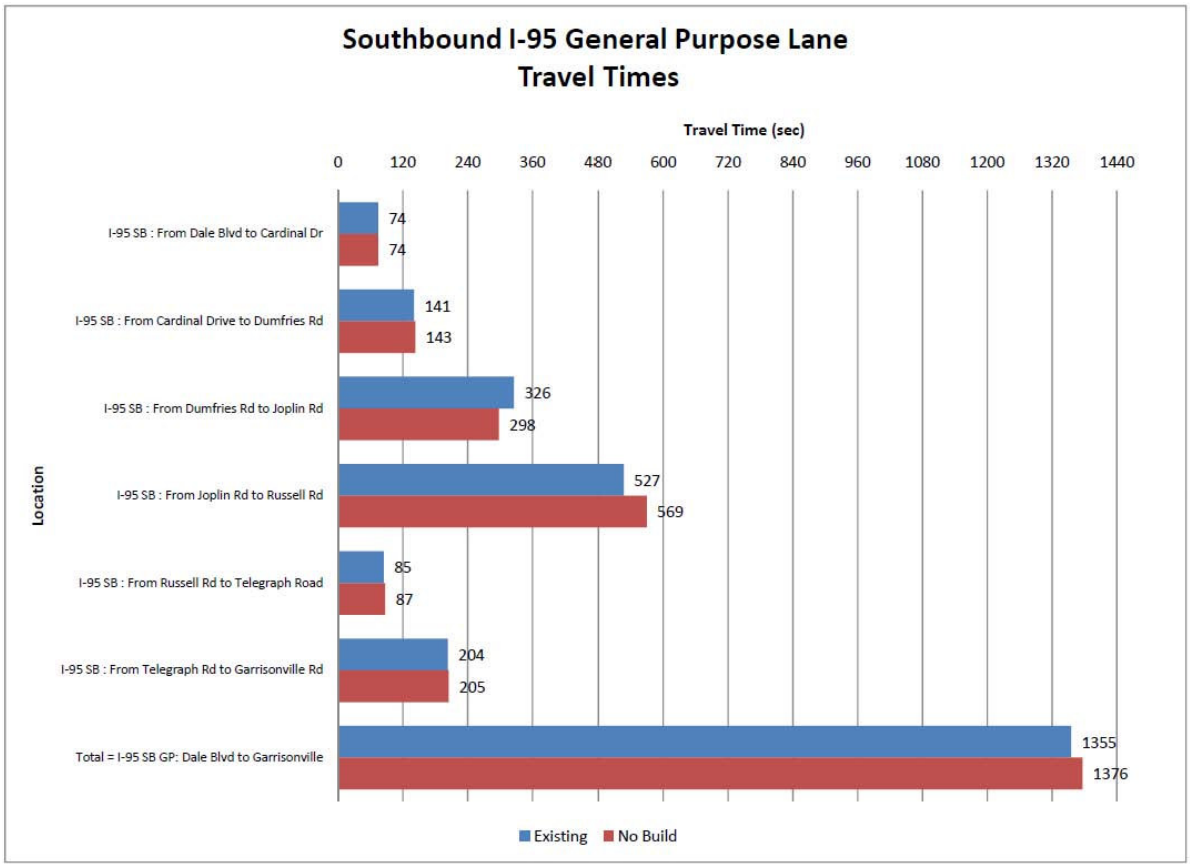


Exhibit 9-64: Southern Terminus VISSIM Center Roadway travel time comparison for Existing and 2018 No Build

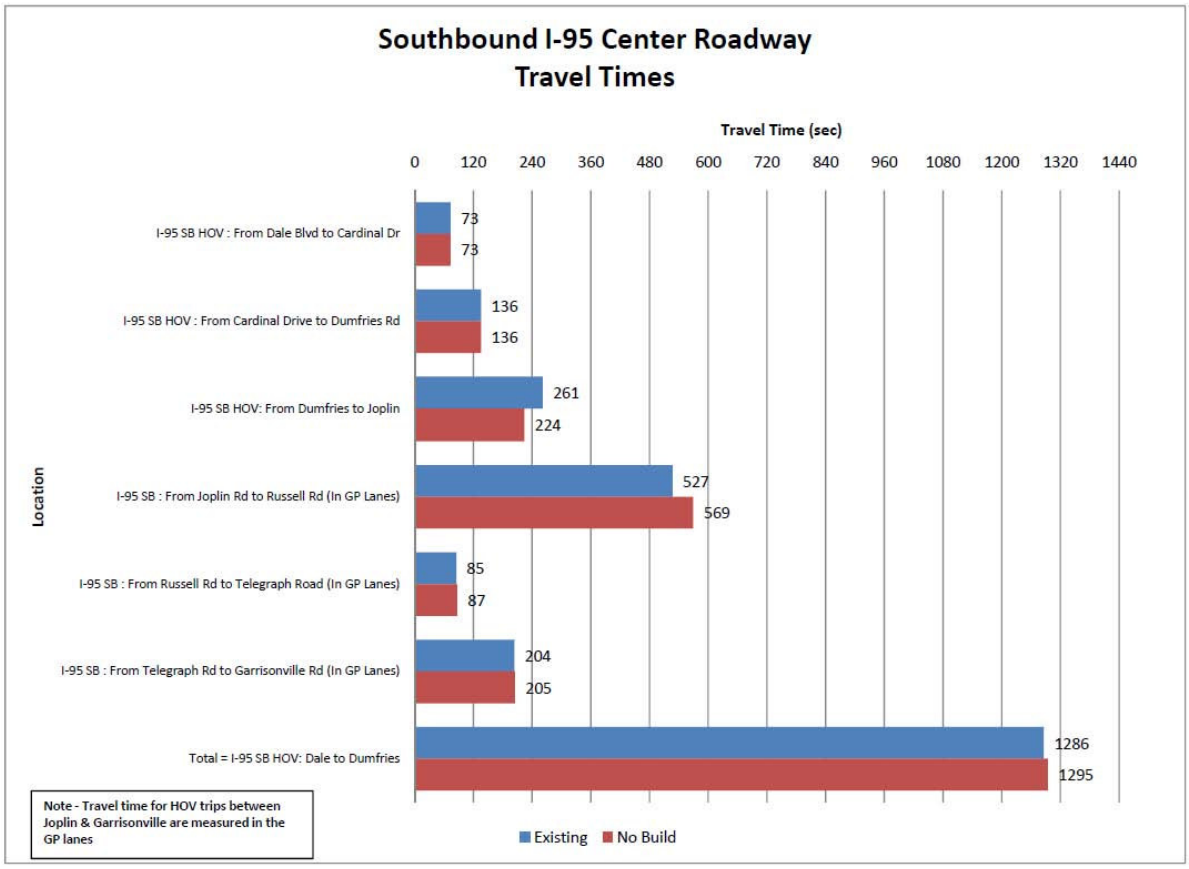
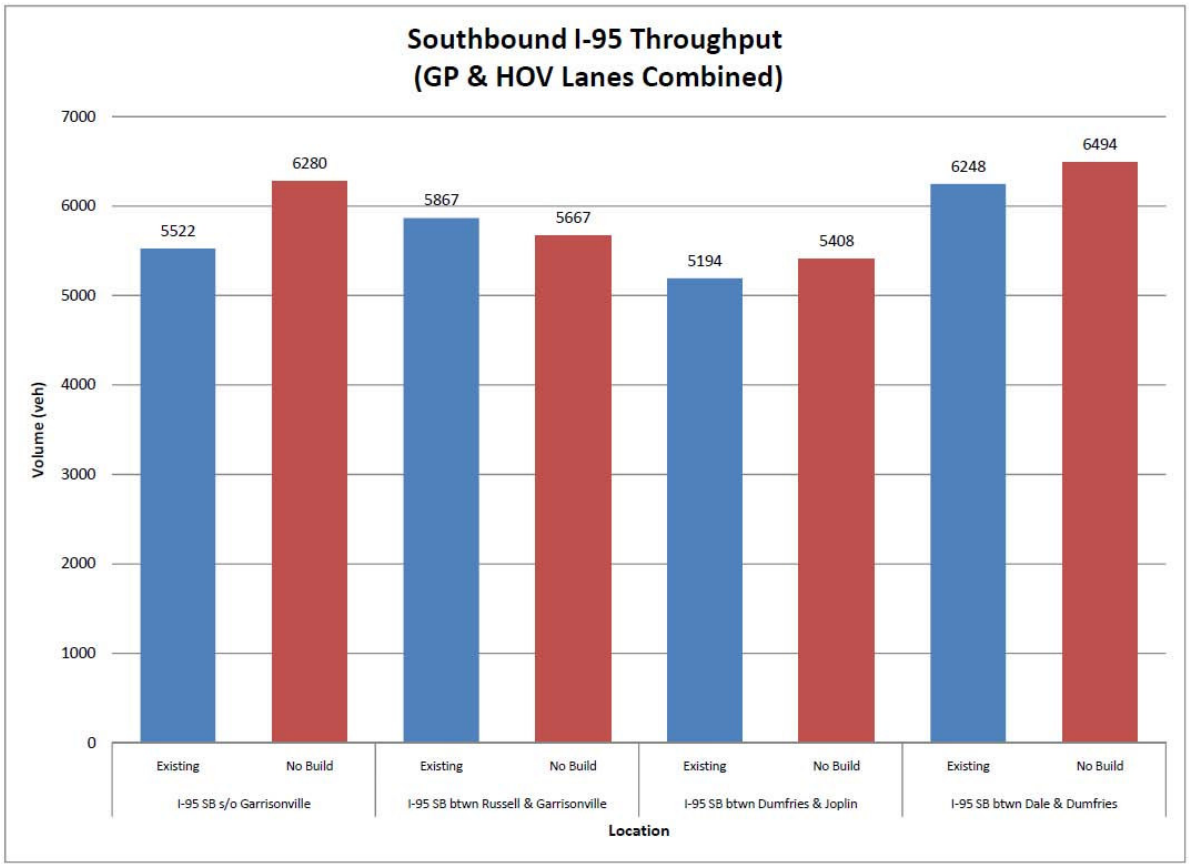


Exhibit 9-65: Southern Terminus VISSIM throughput volume comparison for Existing and 2018 No Build



Interim Condition Scenario 1

The 2018 Interim Conditions were analyzed using 100 percent of the demand from the 2018 Build PM scenario for both GP and HOV/HOT lanes. This assumption is conservative, as it is possible that the Interim Condition may attract less demand south of Garrisonville Road than the Build scenario. There were two scenarios analyzed to test the sensitivity of the Interim Condition to changes in HOT exit ramp location.

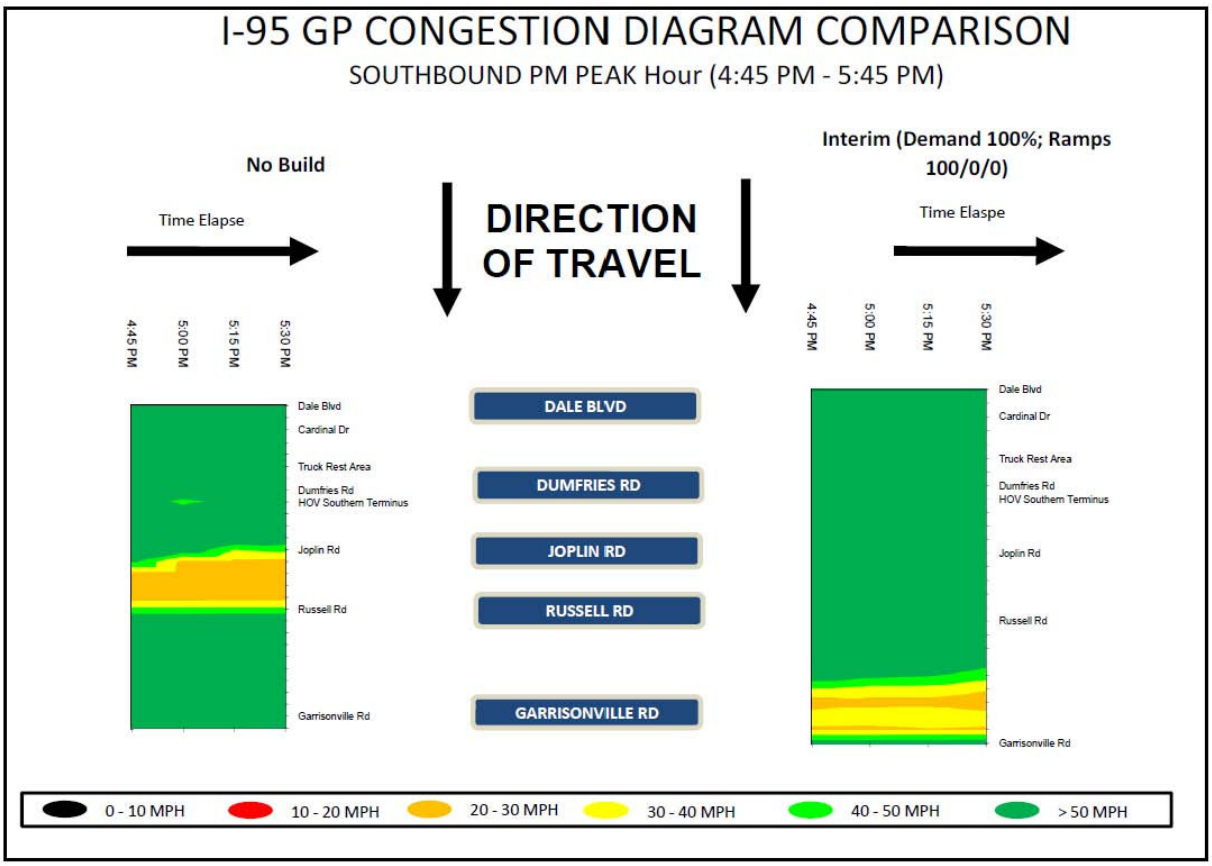
- Scenario 1: 100 percent of HOT roadway demand that is destined to continue south of Garrisonville will use the last ramp at Garrisonville
- Scenario 2: 50 percent of HOT demand exits at Garrisonville, 30 percent at Russell, and 20 percent at Dumfries

Temporal speed diagrams that compare No Build and Scenario 1 for the GP Lanes and HOV/HOT lanes are presented in **Exhibits 9-66 and 9-67**, respectively. When compared to the 2018 No Build condition, Scenario 1 would eliminate the bottleneck that occurs on the southbound GP Lanes at the Russell Road southbound on-ramp merge. However, a new bottleneck would form at the Garrisonville Road interchange. In addition, a bottleneck would

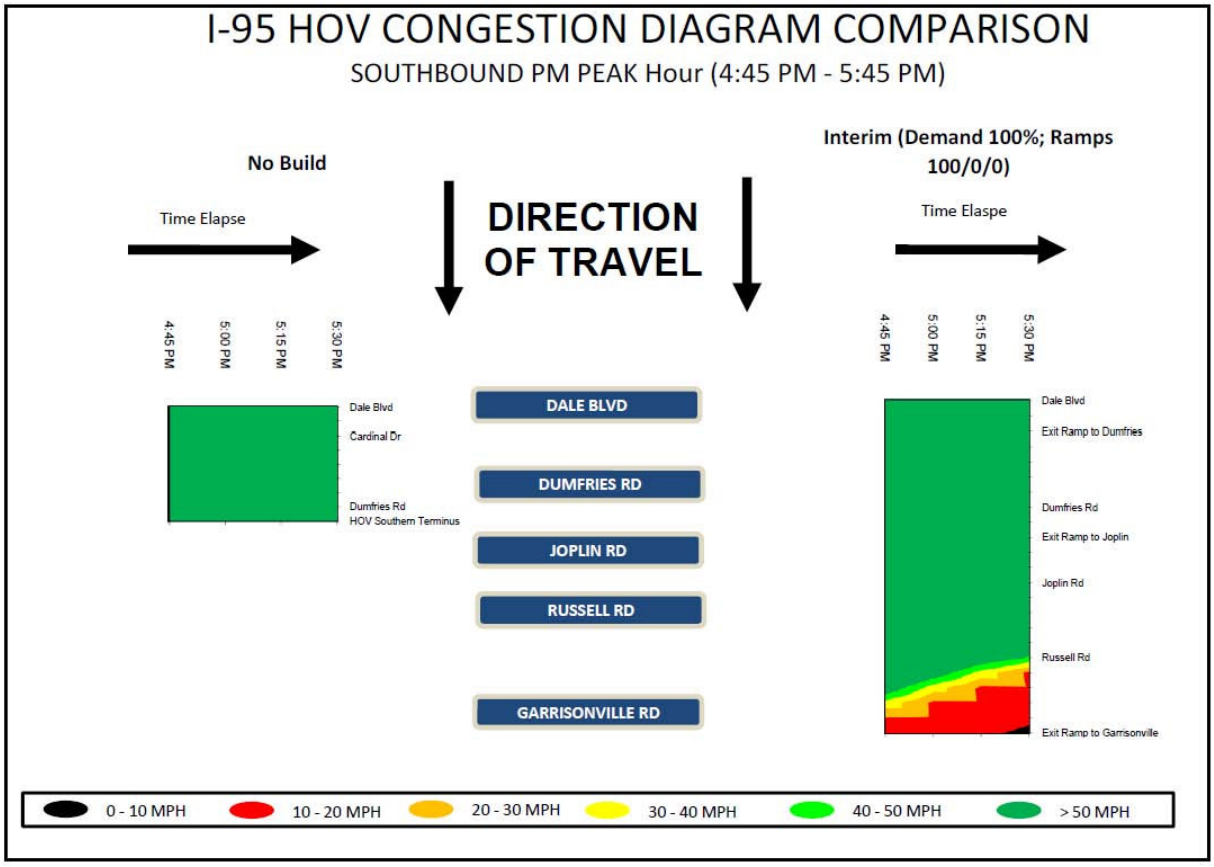
form on the HOV/HOT lanes at the Southern Terminus that would extend back to the Russell Road interchange.

Travel times charts that compare 2018 No Build and 2018 Interim Condition Scenario 1 for the GP Lanes and HOV/HOT lanes are presented in **Exhibits 9-68 and 9-69**, respectively. Scenario 1 would result in lower travel times in the GP lanes and longer travel times in the HOV/HOT lanes when compared to the No Build scenario. The longer travel times for the HOV/HOT lanes are due to the congestion originated at the exit ramp to Garrisonville Road when 100 percent of the HOV/HOT volume uses this ramp to exit the HOT/HOV facility. It is important to note that the assumption that 100 percent of the demand would use this single exit ramp in Scenario 1 is extremely conservative. In reality, if conditions on the GP lanes are adequate, as shown in Exhibit 9-66, for the freeway segments south of Dale Boulevard, vehicles traveling on the HOV/HOT facility will chose to use upstream exit options to avoid the congestion at the Garrisonville exit while saving time and money for additional tolls. In addition, toll rates would be set such that queues and delays in the Center Roadway would be minimized as vehicles are priced out from using the Garrisonville Road exit ramp. A more realistic assumption for HOT/HOV demand is analyzed below for Scenario 2.

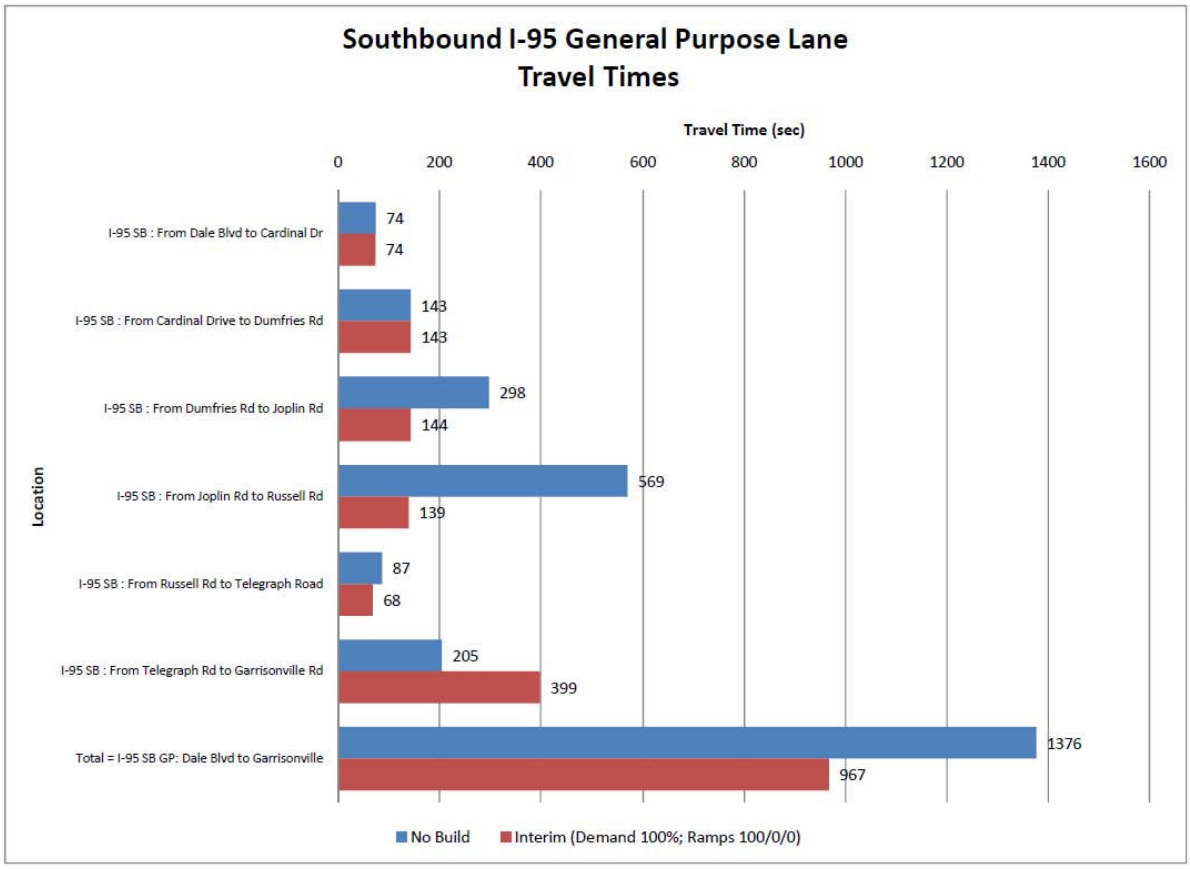
Exhibits 9-66: Southern Terminus VISSIM GP Lane temporal speed diagram for 2018 No Build and Interim Scenario 1



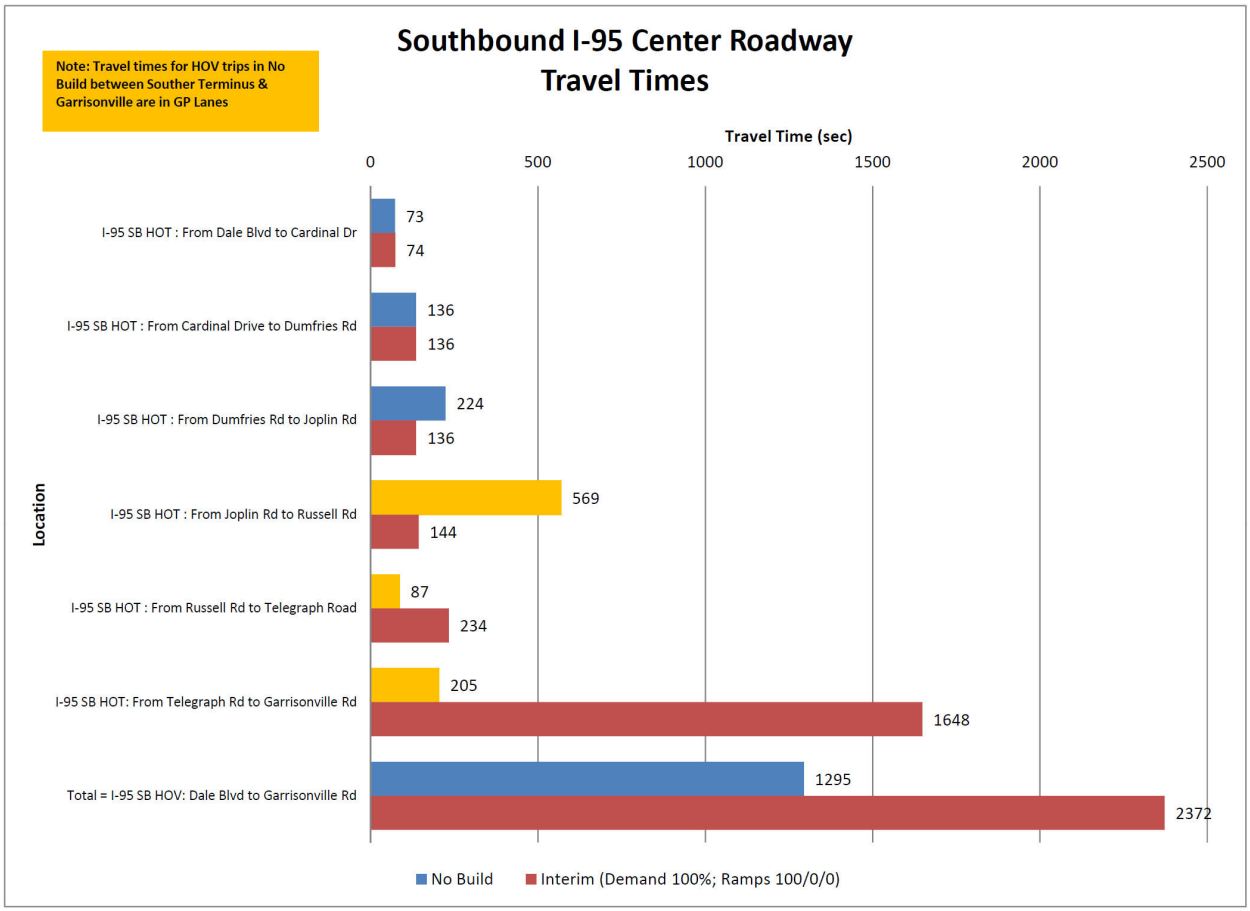
Exhibits 9-67: Southern Terminus VISSIM temporal speed diagram for 2018 Interim Scenario 1



Exhibits 9-68: Southern Terminus VISSIM GP Lane travel time comparison for 2018 No Build and Interim Scenario 1



Exhibits 9-69: Southern Terminus VISSIM Center Roadway travel time comparison for 2018 No Build and Interim Scenario 1



Interim Condition Scenario 2

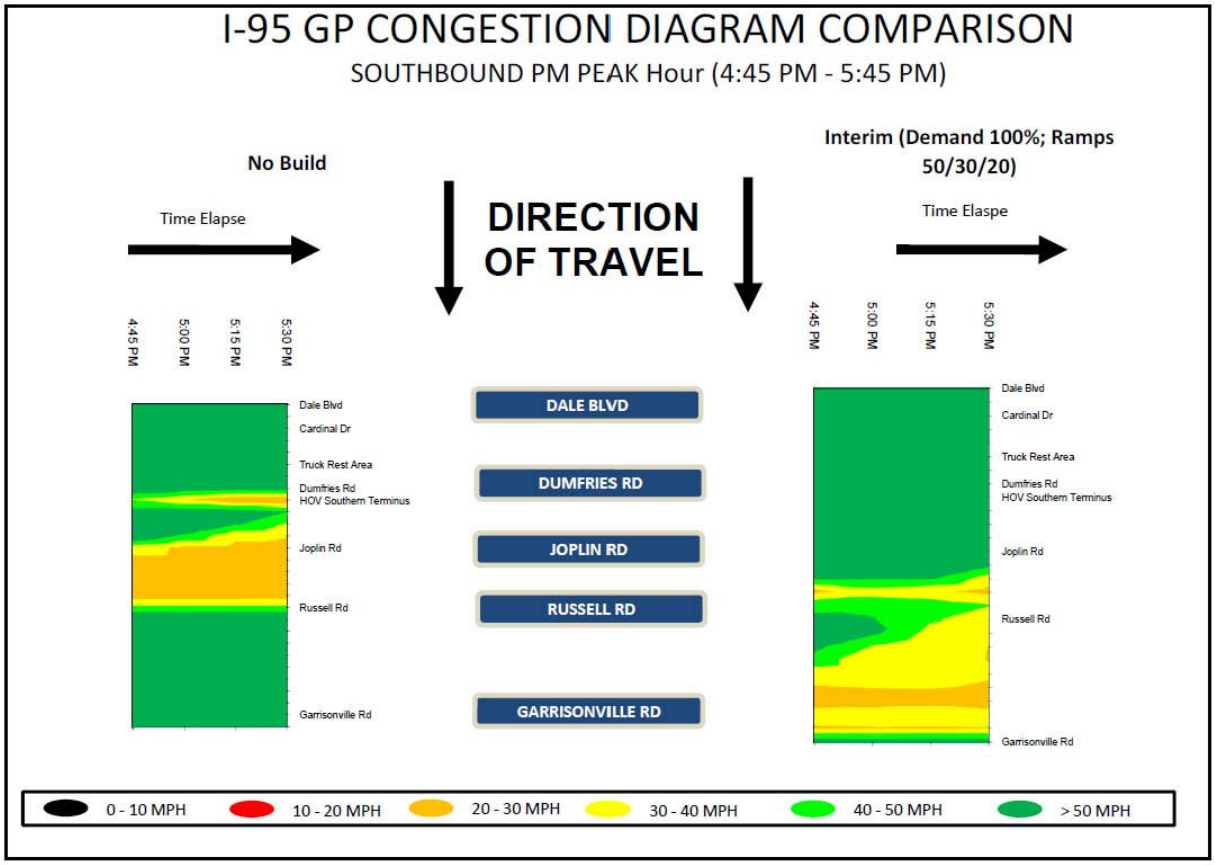
Interim Condition Scenario 2 assumes that 50 percent of all HOT demand continuing south of Garrisonville Road would exit at the last Garrisonville Roadramp, 30 percent at the Russell Road ramp, and 20 percent at the Dumfries Road ramp.

Temporal speed diagrams that compare No Build and Scenario 2 for the GP Lanes and HOV/HOT lanes are presented in **Exhibits 9-70 and 9-71**, respectively. When compared to the 2018 No Build condition, Scenario 2 would reduce the length of the bottleneck that occurs on the southbound GP Lanes at the Russell Road southbound on-ramp merge. In addition, a new bottleneck would form at the Garrisonville Road interchange, longer than the queue that forms under Scenario 1. The bottleneck that forms on the HOV/HOT lanes at the Southern Terminus in Scenario 1 would be significantly reduced in Scenario 2.

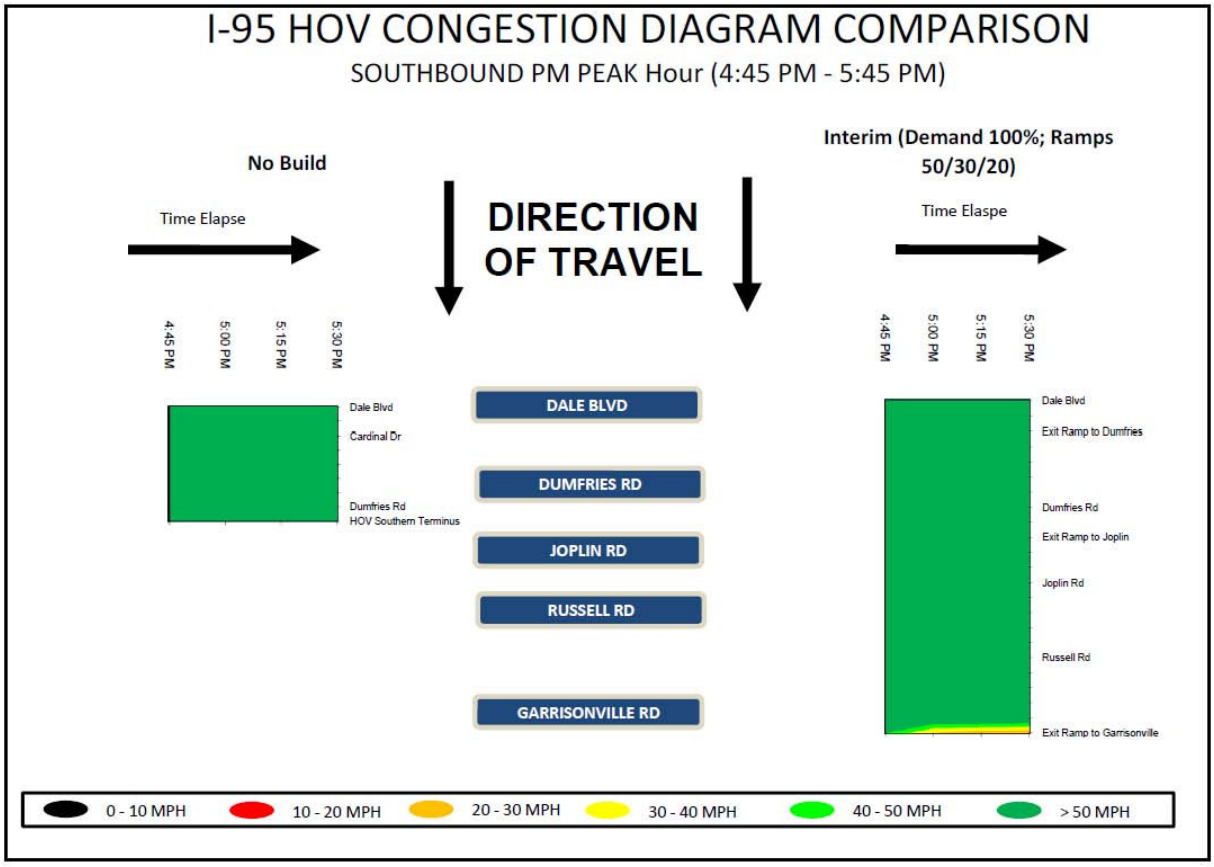
Travel times charts that compare 2018 No Build and 2018 Interim Condition Scenario 2 for the GP Lanes and HOV/HOT lanes are presented in **Exhibits 9-72 and 9-73**, respectively. Travel times in both the GP Lanes and HOV/HOT lanes would be similar between No Build and Scenario 2. As shown in Exhibit 9-72, the total travel time difference between No-Build and Build condition in Scenario 2 is less than 100 seconds. A substantially larger difference is not desirable as it would diminish the attractiveness of operating the HOT lanes.

When comparing Scenarios 1 and 2 together, Scenario 2 is more likely to represent Interim Conditions than Scenario 1. In the Interim Condition, toll rates would be set such that queues and delays in the Center Roadway would be closer to Scenario 2 than Scenario 1.

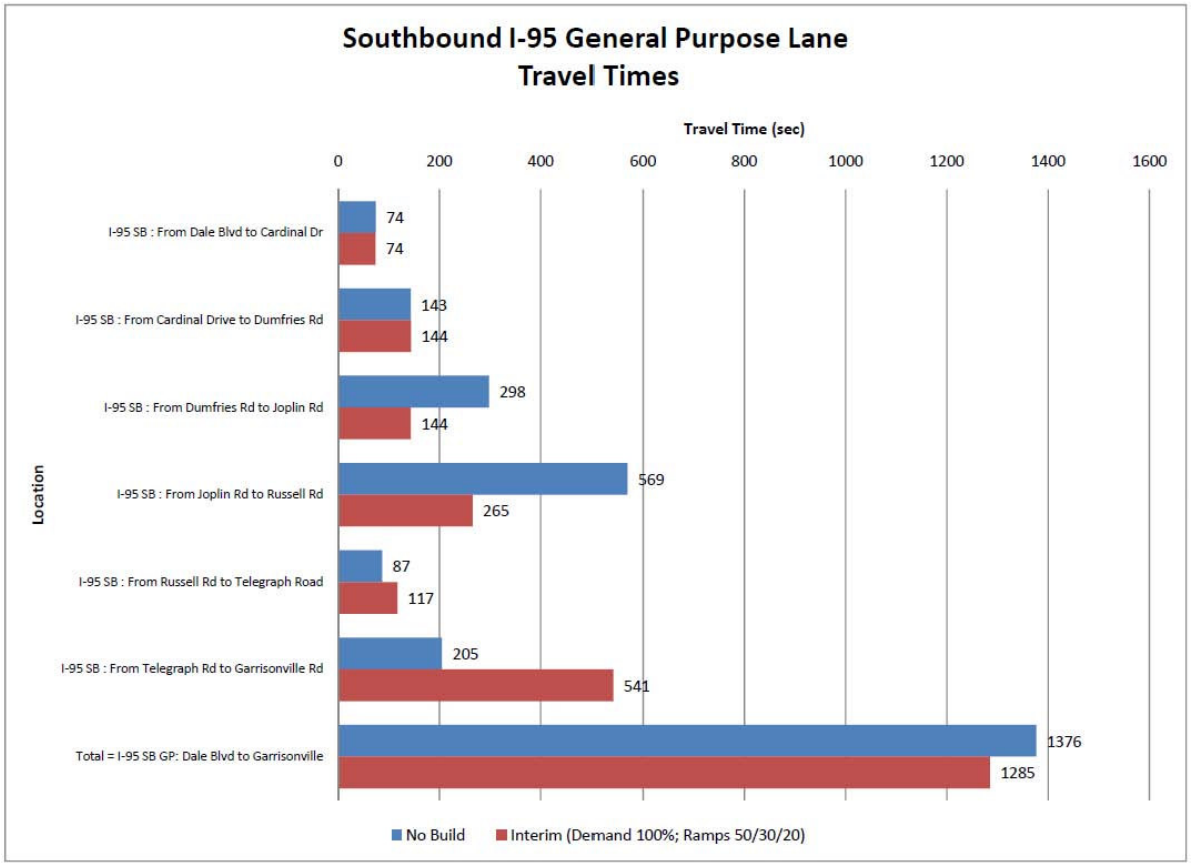
Exhibits 9-70: Southern Terminus VISSIM GP Lane temporal speed diagram for 2018 No Build and Interim Scenario 2



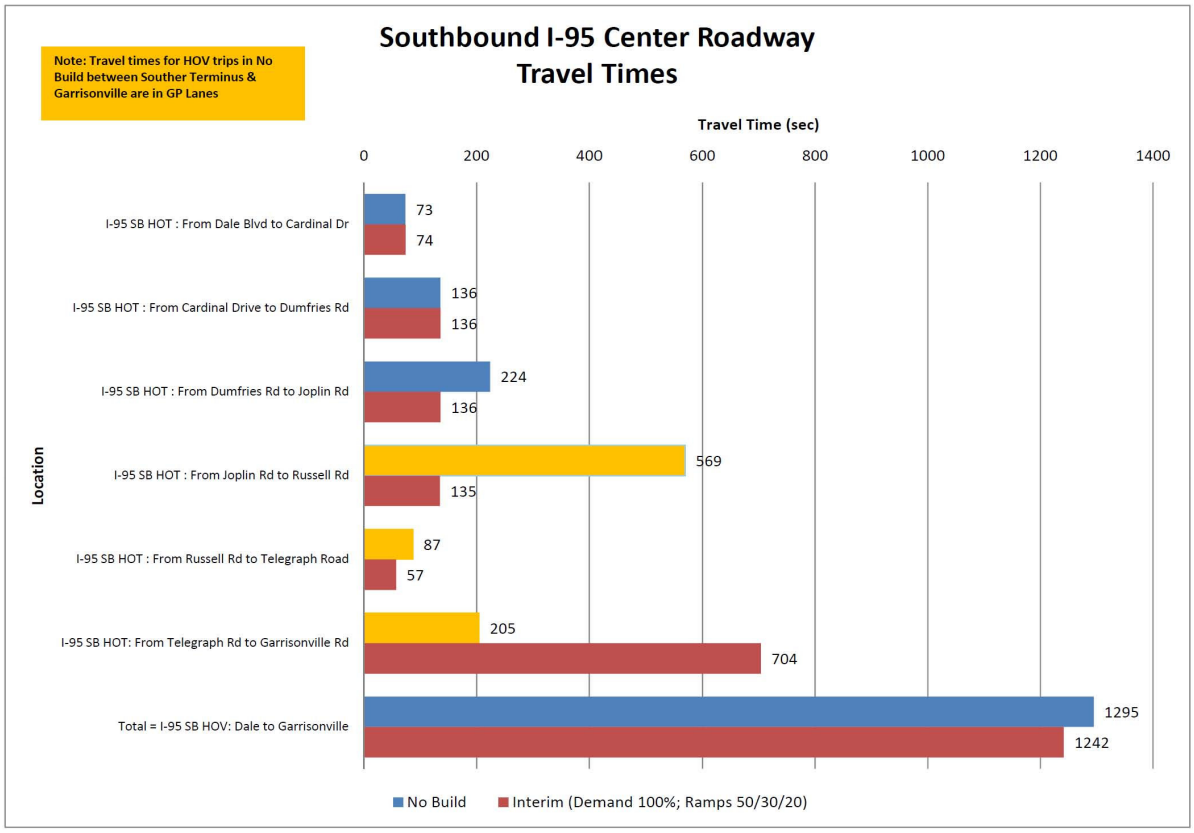
Exhibits 9-71: Southern Terminus VISSIM Center Roadway temporal speed diagram for 2018 No Build and Interim Scenario 2



Exhibits 9-72: Southern Terminus VISSIM GP Lane travel time comparison for 2018 No Build and Interim Scenario 2



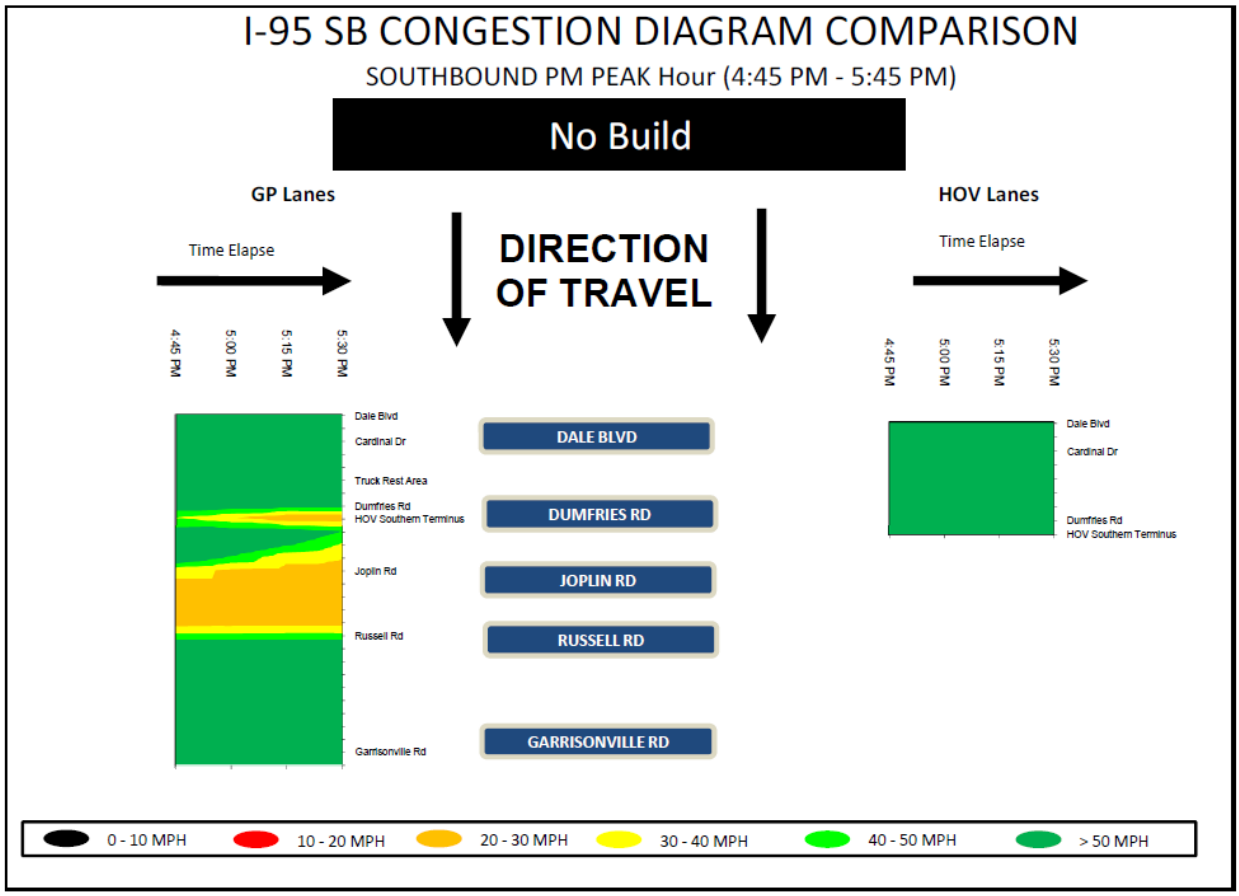
Exhibits 9-73: Southern Terminus VISSIM Center Roadway travel time comparison for 2018 No Build and Interim Scenario 2



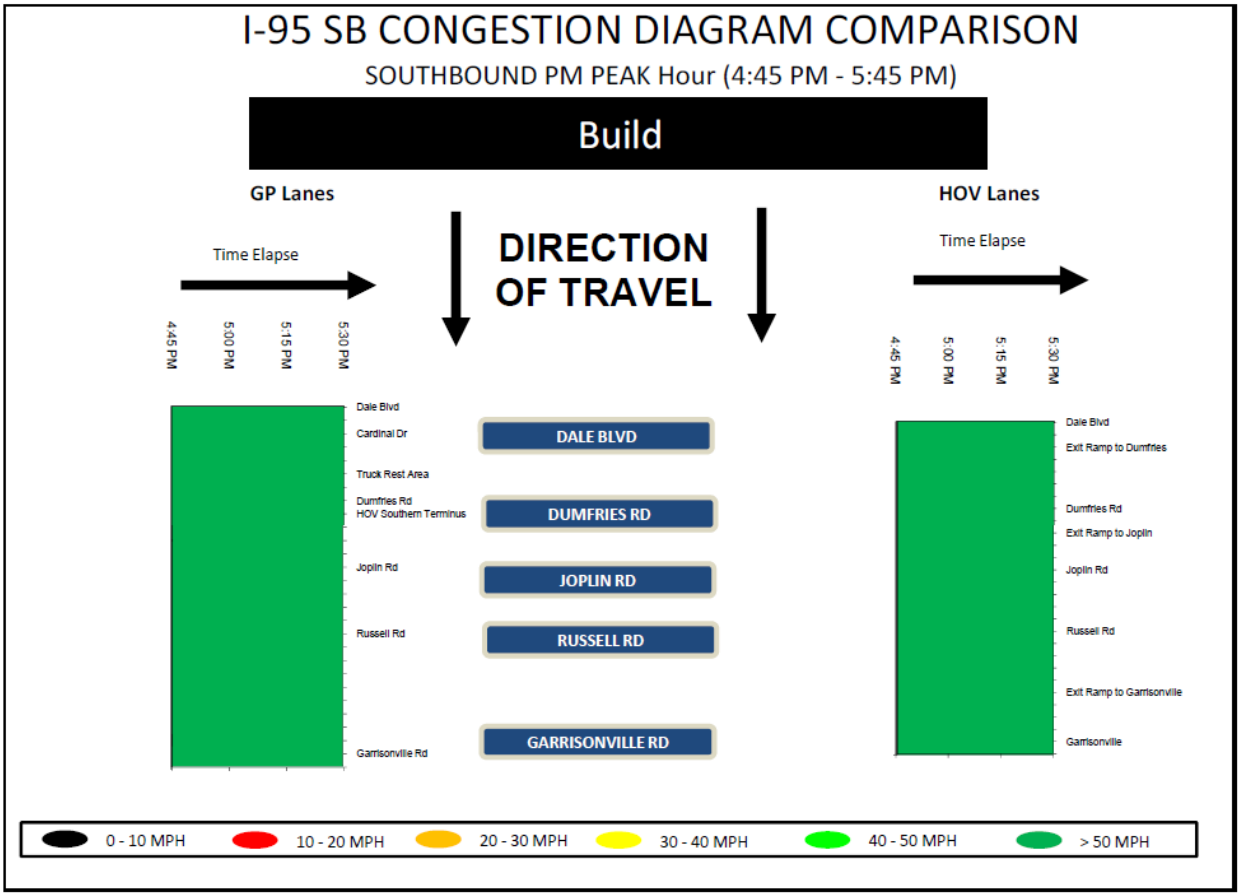
2018 Build Conditions

Temporal congestion diagrams of 2018 No Build and Build are presented in **Exhibits 9-74 and 9-75**, respectively. A comparison of travel times between 2018 No Build and Build is presented in **Exhibit 9-76**. A throughput volume comparison chart is presented in **Exhibit 9-77**. The 2018 No Build model shows the same two bottlenecks that occur in the Existing Conditions model will continue to occur. The 2018 Build condition assumes Phase 2 construction is completed, and results show the project will improve increase speeds, lower travel time, and increase throughput volumes within the study area.

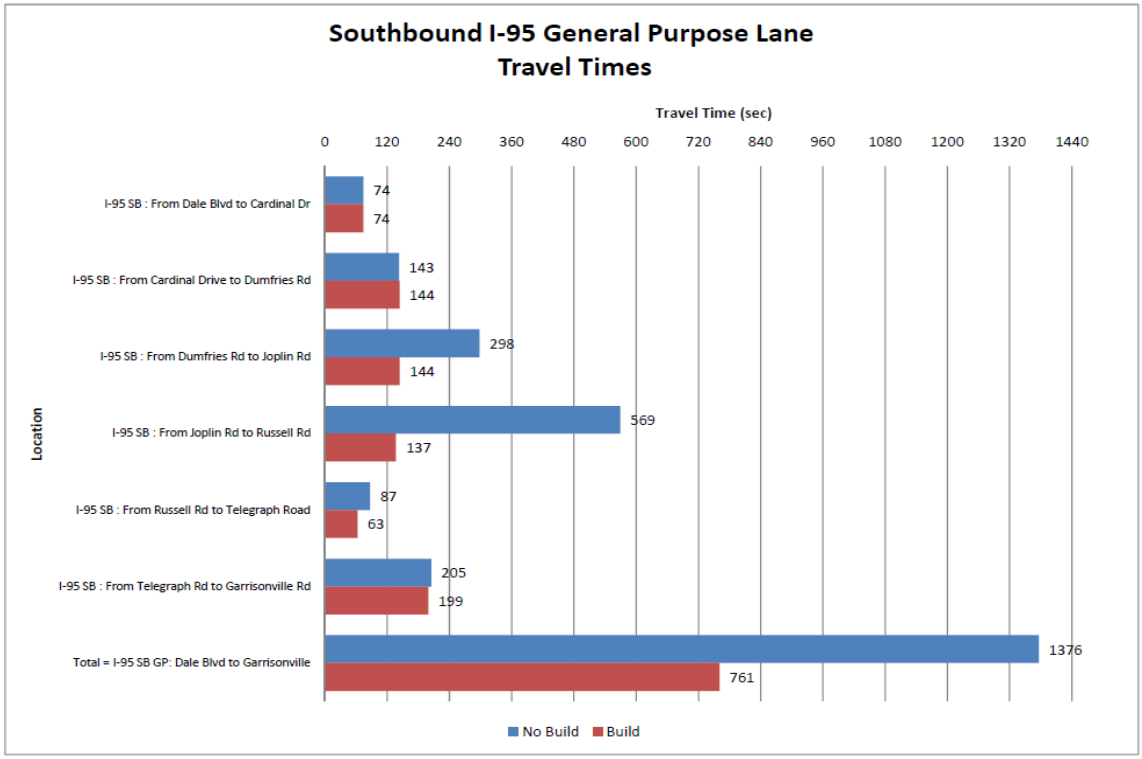
Exhibits 9-74: Southern Terminus VISSIM temporal speed diagram for 2018 No Build



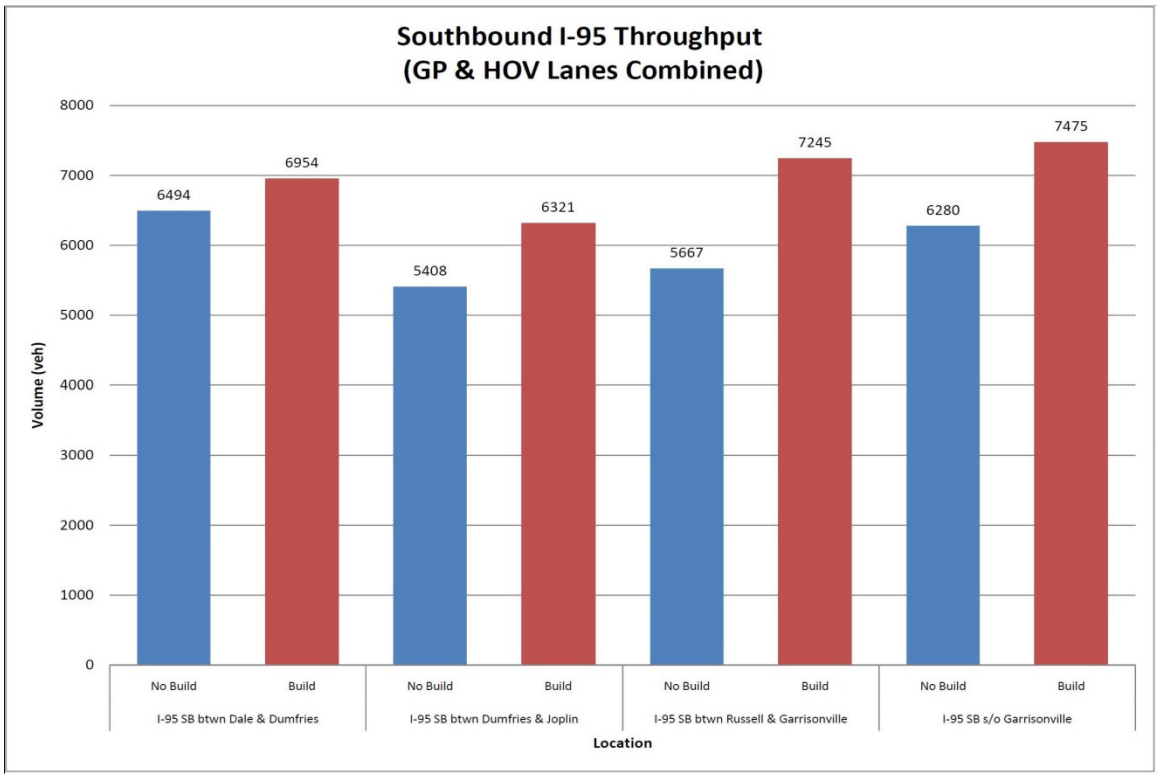
Exhibits 9-75: Southern Terminus VISSIM temporal speed diagram for 2018 Build



Exhibits 9-76: Southern Terminus VISSIM travel time comparison for 2018 No Build and Build



Exhibits 9-77: Southern Terminus VISSIM throughput comparison for 2018 No Build and Build



9.4 Deterministic Highway Capacity Analysis Findings

The HCM analysis results for all conditions (Existing, No-Build, and Build) are summarized in this section. The analysis is based on the methodology discussed in Section 9.1.2 and the traffic volumes developed as discussed in Chapter 8. Analysis was performed using HCS 2010 on merge, diverge, and weave segments on the I-95 HOV/HOT lanes for Existing, No-Build, and Build conditions. At locations where there is a HOV or HOT ramp connection and the criteria for a merge, diverge, or weave segment is not met, basic freeway analysis was performed. These locations include the following:

- The first diverge ramp from GP lanes to HOV (Existing and No-Build) in the northbound direction
- The last merge of HOV (Existing and No-Build) to GP lanes in the southbound direction
- The segment near Prince William Parkway where a third lane is added in the build conditions which provides add-on lane in northbound and drop-off lane in southbound directions, respectively.

In addition to the above, few locations on the GP lanes as well as HOV lanes were analyzed as basic freeway segments under Existing and No-Build conditions which are otherwise analyzed as merge or diverge segments due to the addition of new HOV/HOT ramps in the Build

conditions. In all scenarios, the results for the HOV/HOT segments are reported for northbound direction in the AM peak hour and for the southbound direction in the PM peak hour to reflect the reversible operation of the HOV/HOT lanes. LOS, density, and speed are reported for all analyzed segments. For segments whose forecasted peak hour demands exceed capacity, the HCM methodology is limited and therefore does not report density and speed.

9.4.1 Existing Conditions

The Existing conditions (2011) analysis on I-95 represents the baseline conditions and reflects the current traffic operations in the I-95 corridor. In the Existing conditions, the I-95 reversible facility is two lanes open to HOVs (three or more occupants).

The HCS results for each HOV ramp junction and the associated general purpose location in the AM and PM peak hour existing conditions analysis of the study area are summarized in **Tables 9-42** (northbound) and **9-43** (southbound), respectively. The HCS analysis worksheets for the basic/merge/diverge/weaving segments for existing conditions are provided in **Appendix C.**

AM Peak Hour

The reversible-flow HOV lanes on I-95 operate in the northbound direction during the morning peak period (6:00 AM to 9:00 AM). The HCS analysis for the AM peak hour shows that the northbound HOV lanes currently operate at LOS C or better on all basic, merge, diverge, and weaving segments throughout the entire study area.

All mainline GP segments with HOV connections operate at LOS D or better in the AM peak hour with the exception of the following four locations:

- Diverge segment on northbound I-95 GP lanes due to the slip ramp from GP lanes to HOV lanes, north of exit to Loisdale Road/Franconia Road (LOS E).
- Diverge segment on northbound I-95 GP lanes due to the start of HOV lanes, south of Dumfries Road interchange (LOS E).
- Basic segment on northbound I-95 GP lanes between Courthouse Road and Garrisonville Road interchanges (LOS E). Although the basic segment operates at LOS E, it should be noted that the density results are close to LOS D thresholds (35.4 pc/mi/ln).
- Basic segment on northbound I-95 GP lanes between Plank Road and Warrenton Road interchanges (LOS E). Although the basic segment operates at LOS E, it should be noted that the density results are close to LOS D thresholds (35.1 pc/mi/ln).

The LOS results reflect the congested conditions that are observed in the field and are also supported by traffic data (historic and latest traffic counts).

PM Peak Hour

The reversible-flow HOV lanes on I-95 operate in the southbound direction during the evening peak period (3:30 PM to 6:00 PM). The HCS analysis for the PM peak hour shows that the southbound HOV lanes currently operate at LOS D or better on all basic, merge, diverge, and weaving segments throughout the entire study area.

All mainline GP segments with HOV connections operate at LOS D or better in the PM peak hour with the exception of the following eight locations:

- Weave segment on southbound I-95 GP lanes between the on-ramp from Duke Street and the GP lanes to HOV lanes off-ramp to the HOV facility (LOS F)
- Diverge segment on southbound I-95 GP lanes due to the slip ramp from the GP lanes to HOV lanes, south of Franconia-Springfield Parkway (LOS E). It should be noted that, after the Turkeycock access ramp, this is the next GP-to-HOV access ramp in the southbound direction and within half mile of the HOV on-ramp from Franconia-Springfield Parkway.
- Weave segment on southbound I-95 GP lanes between the flyover HOV–to-GP on-ramp, south of Prince William Parkway to Dale Boulevard off-ramp (LOS F)
- Weave segment on southbound I-95 GP lanes between the HOV–to-GP on-ramp and off-ramp to Rest Area, south of Dale Boulevard interchange (LOS E)
- Merge segment on southbound I-95 GP lanes due to the merging of HOV lanes, south of Dumfries Road interchange (LOS E)
- Basic segment on southbound I-95 GP lanes between the merging of HOV lanes, south of Dumfries Road and Joplin Road interchange (LOS E)
- Diverge segment on southbound I-95 GP lanes between the merging of HOV lanes, south of Dumfries Road, and Joplin Road interchange (LOS E)
- Diverge segment on southbound I-95 GP lanes at the off-ramp exit to Plank Road interchange (LOS F)

The LOS results in the southbound direction reflect the congested conditions that are observed in the field and are also supported by traffic data (historic and latest traffic counts).

9.4.2 2018 No-Build Conditions

The 2018 No-Build conditions analysis on I-95 represents the resulting traffic operations if no improvements other than those currently programmed are implemented. There are several improvements, currently programmed, that will be implemented in the corridor and will affect the traffic operations on the I-95 GP lanes. These improvements are listed in Chapter 2 and are assumed to be in place in the 2018 No-Build condition. As in existing conditions, I-95 reversible HOV facility is two lanes and open to HOVs only (three or more occupants).

The HCS results for each HOV ramp junction and the associated general purpose location in the AM and PM peak hour of 2018 No-Build conditions analysis of the study area are summarized in **Tables 9-42** (northbound) and **9-43** (southbound), respectively. The HCS analysis worksheets for the basic/merge/diverge/weaving segments for 2018 No-Build conditions are provided in **Appendix C.**

AM Peak Hour

The reversible-flow HOV lanes on I-95 will continue to operate in the northbound direction during the morning peak period (6:00 AM to 9:00 AM) in the 2018 No-Build condition. The HCS analysis for the AM peak hour shows that the northbound HOV lanes operate at LOS D or better on all basic, merge, diverge, and weaving segments throughout the entire study area.

On the associated mainline GP segments with HOV connections in the northbound direction, all segments will operate at LOS D or better in the AM peak hour, with the exception of the following eight locations:

- Diverge segment on northbound I-95 GP lanes at the off-ramp exit to Duke Street interchange (LOS E). It should be noted that the density results for this diverge segment are close to LOS D thresholds (35.4 pc/mi/ln).
- Diverge segment on northbound I-95 GP lanes due to the slip ramp from GP lanes to HOV lanes, north of exit to Loisdale Road/Franconia Road (LOS E). It should be noted that the density results for this diverge segment are close to LOS D thresholds (35.7 pc/mi/ln).
- Diverge segment on northbound I-95 GP lanes due to the start of HOV lanes, south of Dumfries Road interchange (LOS F).
- Basic segment on northbound I-95 GP lanes between Courthouse Road and Garrisonville Road interchanges (LOS E).
- Merge segment on northbound I-95 GP lanes due to on-ramp from Centreport Parkway interchange (LOS F).
- Basic segment on northbound I-95 GP lanes between Warrenton Road and Centreport Parkway interchange (LOS F).
- Basic segment on northbound I-95 GP lanes between Plank Road and Warrenton Road interchanges (LOS E).
- Merge segment on northbound I-95 GP lanes due to on-ramp from Plank Road interchange (LOS F).

PM Peak Hour

The reversible-flow HOV lanes on I-95 will continue to operate in the southbound direction during the evening peak period (3:30 PM to 6:00 PM) in the 2018 No-Build condition. The HCS analysis for the PM peak hour shows that the southbound HOV lanes operate at LOS D or better on all basic, merge, diverge, and weaving segments throughout the entire study area.

All mainline GP segments with HOV connections will operate at LOS D or better in the PM peak hour with the exception of the following nine locations:

- Weave segment on southbound I-95 GP lanes between the on-ramp from Duke Street interchange and the GP-to-HOV off-ramp to HOV facility (LOS F)

- Weave segment on southbound I-95 GP lanes between the flyover HOV–to-GP on-ramp, south of Prince William Parkway to Dale Boulevard off-ramp (LOS F)
- Weave segment on southbound I-95 GP lanes between the HOV–to-GP on-ramp and off-ramp to Rest Area, south of Dale Boulevard interchange (LOS E)
- Merge segment on southbound I-95 GP lanes due to the merging of HOV lanes, south of Dumfries Road interchange (LOS E)
- Basic segment on southbound I-95 GP lanes between the merging of HOV lanes, south of Dumfries Road and Joplin Road interchanges (LOS E)
- Merge segment on southbound I-95 GP lanes due to the on-ramp from eastbound Garrisonville Road (LOS F)
- Diverge segment on southbound I-95 GP lanes at the off-ramp exit to Courthouse Road interchange (LOS F)
- Merge segment on southbound I-95 GP lanes due to the on-ramp from Centreport Parkway interchange (LOS E)
- Diverge segment on southbound I-95 GP lanes at the off-ramp exit to Plank Road interchange (LOS F)

9.4.3 2018 Build Conditions

The 2018 Build condition represents the opening year of the proposed improvements. Specific components of the Build Alternative include:

- Re-stripe the existing two-lane HOV facility to three reversible HOV/ HOT lanes;
- Construct two new HOV/HOT lanes in median from 1.10 miles south of U.S. Route 17 (Mills Drive, south of Fredericksburg) to the existing terminus south of VA Route 234;
- Modify, upgrade and/or add new entry/exit points including structures between the GP Lanes and the HOV/HOT Lanes.

These improvements are discussed in greater detail in Chapter 2 and are assumed to be in place in the 2018 Build condition. Motorcycles, Buses, and HOV-3+ can ride the upgraded HOV/HOT facility for free and all other vehicles will have to pay a toll to use the facility.

The HCS results for each HOV/HOT ramp junction and the associated general purpose location in the AM and PM peak hour of 2018 Build conditions analysis of the study area are summarized in **Tables 9-42** (northbound) and **9-43** (southbound), respectively. The HCS analysis worksheets for the basic/merge/diverge/weaving segments for 2018 Build conditions are provided in **Appendix C.**

AM Peak Hour

The reversible-flow HOV/HOT lanes on I-95 will operate in the northbound direction during the morning period in the 2018 Build condition. The HCS analysis for the AM peak hour shows that the northbound HOV/HOT lanes will operate at LOS D or better on all basic, merge, diverge, and weaving segments throughout the entire study area, with the exception of the following:

- Weave segment on northbound I-95 HOT lanes between the on-ramp from Franconia Road and off-ramp to I-495 HOT lanes via the Springfield Phase 8 Ramps (LOS F). This can be attributed to the increase in the weaving volume in Build conditions which provides a seamless connection between I-95 HOT lanes and I-495 HOT lanes for both free riders (HOV-3+) and as well as toll paying vehicles.

All northbound mainline GP segments with HOV/HOT connections will operate at LOS D or better in the AM peak hour with the exception of the following 11 locations:

- Weave segment on northbound I-95 GP lanes between the northern terminus HOT-to-GP ramp and off-ramp to Duke Street (LOS E). But the density in this weaving segment (35.3 pc/mi/ln) is at the LOS D thresholds.
- Diverge segment on northbound I-95 GP lanes due to the slip ramp from GP lanes to HOV lanes, north of exit to Loisdale Road/Franconia Road (LOS E). But the density in this weaving segment (35.2 pc/mi/ln) is at the LOS D thresholds.
- Diverge segment on northbound I-95 GP lanes due to the slip ramp from GP lanes to HOV lanes, north of Lorton Road interchange (LOS E). But the density in this weaving segment (35.6 pc/mi/ln) is at the LOS D thresholds.
- Weave segment on northbound I-95 GP lanes between the on-ramp from Garrisonville Road and slip ramp from the GP lanes to HOT lanes, south of Russell Road interchange (LOS E)
- Diverge segment on northbound I-95 GP lanes due to the slip ramp from the GP lanes to HOT lanes, south of Garrisonville Road interchange (LOS E). But the density in this diverge segment (35 pc/mi/ln) is at the LOS D thresholds.
- Merge segment on northbound I-95 GP lanes due to the slip ramp from the HOT lanes to GP lanes, north of Courthouse Road interchange (LOS E)
- Weave segment on northbound I-95 GP lanes between the on-ramp from Centreport Parkway and the GP lanes to HOT lanes ramp, south of Courthouse Road interchange (LOS F)
- Diverge segment on northbound I-95 GP lanes due to the slip ramp from the GP lanes to HOT lanes, south of Centerport Parkway interchange (LOS E)
- Merge segment on northbound I-95 GP lanes due to the slip ramp from the HOT lanes to GP lanes, north of Warrenton Road interchange (LOS E)

- Diverge segment on northbound I-95 GP lanes due to the slip ramp from the GP lanes to HOT lanes, south of Warrenton Road interchange (LOS E)
- Merge segment on northbound I-95 GP lanes due to the slip ramp from the HOT lanes to GP lanes, north of Plank Road interchange (LOS E)

The Build alternative introduces new HOT access points in the southern section of the study area (south of Joplin Road to Jefferson Davis Highway) where most of the above segments with LOS E/F are located. The LOS results reflect the expected additional turbulence on already congested I-95 GP lanes due to the new access points.

It is important to note that the toll pricing of the HOV/HOT lanes would be variable, such that the operational characteristics would generally be better than those of the general-purpose lanes. Accordingly, the actual volumes operating on the roadway would be less than the theoretical capacity[6] to maintain free-flow conditions, with a target volume of approximately 1,800 vehicles per lane per hour.

PM Peak Hour

The reversible-flow HOV/HOT lanes on I-95 will operate in the southbound direction during the evening period in the 2018 Build condition. The HCS analysis for the PM peak hour shows that the southbound HOV/HOT lanes operate at LOS D or better on all basic, merge, diverge, and weaving segments throughout the entire study area, with the exception of the following location:

- Weave segment on southbound I-95 HOT lanes between the on-ramp from I-495 HOT lanes via the Springfield Phase 8 Ramps and off-ramp to Franconia Road (LOS F). This can be attributed to the increase in the weaving volume in Build conditions which provides a seamless connection between I-495 HOT lanes and I-95 HOT lanes for both free riders (HOV-3+) and as well as toll paying vehicles.

All southbound mainline GP segments with HOV/HOT connections will operate at LOS D or better in the PM peak hour with the exception of the following 10 locations:

- Weave segment on southbound I-95 GP lanes between the on-ramp from Duke Street and the GP-to-HOT off-ramp to the HOT facility (LOS F)
- Weave segment on southbound I-95 GP lanes between the flyover HOT–to-GP on-ramp, south of Prince William Parkway to Dale Boulevard off-ramp (LOS F)
- Weave segment on southbound I-95 GP lanes between the HOT–to-GP on-ramp and off-ramp to Rest Area, south of Dale Boulevard (LOS F)
- Weave segment on southbound I-95 GP lanes between the HOT-to-GP on-ramp and off-ramp to Garrisonville Road (LOS F)
- Weave segment on southbound I-95 GP lanes between on-ramp from eastbound Garrisonville Road and GP-to-HOT off-ramp (LOS F)

[6] The capacity of an interstate highway like I-95 under ideal conditions is approximately 2,400 passenger cars per hour per lane..

- Weave segment on southbound I-95 GP lanes between the HOT-to-GP on-ramp and off-ramp to Courthouse Road (LOS F)
- Weave segment on southbound I-95 GP lanes between the HOT-to-GP on-ramp and off-ramp to Centreport Parkway (LOS F)
- Weave segment on southbound I-95 GP lanes between the on-ramp from Centreport Parkway and the GP-to-HOT off-ramp (LOS F)
- Weave segment on southbound I-95 GP lanes between the HOT-to-GP on-ramp and off-ramp to Warrenton Road (LOS F)
- Weave segment on southbound I-95 GP lanes between the HOT-to-GP on-ramp and off-ramp to Plank Road (LOS F)

Similar to the northbound direction (AM), the Build alternative introduces new HOT access points in the southbound direction (PM) in the southern section of the study area (south of Joplin Road to Jefferson Davis Highway) where most of the above segments with LOS F are located. The LOS results reflect the expected additional turbulence on already congested I-95 GP lanes due to the new access points.

9.4.4 2035 No-Build Conditions

The 2035 No-Build conditions analysis on I-95 represents the resulting traffic operations if no improvements other than those currently programmed are implemented. There are several improvements, currently programmed, that will be implemented in the corridor and will affect the traffic operations on the I-95 GP lanes. These improvements are listed in Chapter 2 and are assumed to be in place in the 2035 No-Build condition. Following are some of the programmed improvements in 2035 scenarios that are different from 2018 scenarios:

- Fairfax County Interchange (FCP/VA7100) Improvement Project:
    - Construct a new flyover ramp from northbound I-95 to northbound FCP/VA7100
- Eliminate the existing northbound I-95 to northbound FCP/VA7100 loop ramp and build left-turn lanes at the end of the ramp at FCP/VA7100 and Loisdale Road I-495 HOT Lanes and Braddock Road connector:
    - Provide new two-lane two-way ramp connection between Braddock Road and I-495 HOT Lanes to provide access to and from south of Braddock Interchange
- I-66 HOV-2 to HOV-3 conversion:
    - Beginning of 2020, all HOV facilities in the Northern Virginia area are planned to be converted to HOV-3+ facilities. This will provide a seamless connection between other HOV and HOT facilities in the region.

As in existing conditions, the I-95 reversible HOV facility is two lanes throughout, and open to HOV vehicles only (three or more occupants) during morning and evening peak periods.

The HCS results for each HOV ramp junction and the associated general purpose location in the AM and PM peak hour of 2035 No-Build conditions analysis of the study area are summarized in **Tables 9-42** (northbound) and **9-43** (southbound), respectively. The HCS analysis worksheets for the basic/merge/diverge/weaving segments for 2018 No-Build conditions are provided in **Appendix C.**

AM Peak Hour

The reversible-flow HOV lanes on I-95 will continue to operate in the northbound direction during the morning peak period (6:00 AM to 9:00 AM) in the 2035 No-Build condition. The HCS analysis for the AM peak hour shows that the northbound HOV lanes operate at LOS D or better on all basic, merge, diverge, and weaving segments throughout the entire study area.

On the associated mainline GP segments with HOV connections in the northbound direction, all segments will operate at LOS D or better in the AM peak hour, with the exception of the following 11 locations:

- Diverge segment on northbound I-95 GP lanes at the off-ramp exit to Duke Street interchange (LOS E). It should be noted that the density results for this diverge segment are close to LOS D thresholds (35.9 pc/mi/ln).
- Diverge segment on northbound I-95 GP lanes due to the slip ramp from GP lanes to HOV lanes, north of Lorton Road interchange (LOS E). But the density in this weaving segment (35.2 pc/mi/ln) is at the LOS D thresholds.
- Diverge segment on northbound I-95 GP lanes due to the start of HOV lanes, south of Dumfries Road interchange (LOS F).
- Diverge segment on northbound I-95 GP lanes at the off-ramp exit to Joplin Road interchange (LOS E).
- Merge segment on northbound I-95 GP lanes due to on-ramp from westbound Garrisonville Road and US-1 (LOS F).
- Basic segment on northbound I-95 GP lanes between Courthouse Road and Garrisonville Road interchanges (LOS F).
- Merge segment on northbound I-95 GP lanes due to on-ramp from Centreport Parkway interchange (LOS F).
- Basic segment on northbound I-95 GP lanes between Warrenton Road and Centreport Parkway interchange (LOS F).
- Merge segment on northbound I-95 GP lanes due to on-ramp from Warrenton Road interchange (LOS F).
- Basic segment on northbound I-95 GP lanes between Plank Road and Warrenton Road interchanges (LOS F).

- Merge segment on northbound I-95 GP lanes due to on-ramp from Plank Road interchange (LOS F).

PM Peak Hour

The reversible-flow HOV lanes on I-95 will continue to operate in the southbound direction during the evening peak period (3:30 PM to 6:00 PM) in the 2035 No-Build condition. The HCS analysis for the PM peak hour shows that the southbound HOV lanes operate at LOS D or better on all basic, merge, diverge, and weaving segments throughout the entire study area.

All southbound mainline GP segments with HOV connections will operate at LOS D or better in the PM peak hour with the exception of the following 12 locations:

- Weave segment on southbound I-95 GP lanes between the on-ramp from Duke Street and the GP-to-HOT off-ramp to HOT facility (LOS F)
- Weave segment on southbound I-95 GP lanes between the flyover HOT–to-GP on-ramp, south of Prince William Parkway to Dale Boulevard off-ramp (LOS F)
- Weave segment on southbound I-95 GP lanes between the HOT–to-GP on-ramp and off-ramp to Rest Area, south of Dale Boulevard (LOS F)
- Merge segment on southbound I-95 GP lanes due to the merging of HOV lanes, south of Dumfries Road interchange (LOS E)
- Basic segment on southbound I-95 GP lanes between the merging of HOV lanes, south of Dumfries Road and Joplin Road interchanges (LOS F)
- Diverge segment on southbound I-95 GP lanes at the off-ramp exit to Garrisonville Road interchange (LOS F)
- Merge segment on southbound I-95 GP lanes due to the on-ramp from eastbound Garrisonville Road (LOS F)
- Diverge segment on southbound I-95 GP lanes at the off-ramp exit to Courthouse Road interchange (LOS F)
- Diverge segment on southbound I-95 GP lanes at the off-ramp exit to Centreport Parkway interchange (LOS F)
- Merge segment on southbound I-95 GP lanes due to the on-ramp from Centreport Parkway interchange (LOS F)
- Diverge segment on southbound I-95 GP lanes at the off-ramp exit to Warrenton Road interchange (LOS F)
- Diverge segment on southbound I-95 GP lanes at the off-ramp exit to Plank Road interchange (LOS F)

9.4.5 2035 Build Conditions

The 2035 Build condition represents the opening year of the proposed improvements. Specific components of the Build Alternative include:

- Re-stripe the existing two-lane HOV facility to three reversible HOV/ HOT lanes;
- Construct two new HOV/HOT lanes in median from 1.10 miles south of U.S. Route 17 (Mills Drive, south of Fredericksburg) to the existing terminus south of VA Route 234;
- Modify, upgrade and/or add new entry/exit points including structures between the GP Lanes and the HOV/HOT Lanes.

These improvements are discussed in greater detail in Chapter 2 and are assumed to be in place in the 2035 Build condition. Motorcycles, Buses, and HOV-3+ can ride the upgraded HOV/HOT facility for free and all other vehicles will have to pay a toll to use the facility.

The HCS results for each HOV/HOT ramp junction and the associated general purpose location in the AM and PM peak hour of 2018 Build conditions analysis of the study area are summarized in **Tables 9-42** (northbound) and **9-43** (southbound), respectively. The HCS analysis worksheets for the basic/merge/diverge/weaving segments for 2018 Build conditions are provided in **Appendix C.**

AM Peak Hour

The reversible-flow HOV/HOT lanes on I-95 will operate in the northbound direction during the morning period in the 2035 Build condition. The HCS analysis for the AM peak hour shows that the northbound HOV/HOT lanes will operate at LOS D or better on all basic, merge, diverge, and weaving segments throughout the entire study area, with the exception of the following location:

- Weave segment on northbound I-95 HOT lanes between the on-ramp from Franconia Road and the off-ramp to I-495 HOT lanes via the Springfield Phase 8 Ramps (LOS F). This can be attributed to the increase in the weaving volume in Build conditions which provides a seamless connection between I-95 HOT lanes and I-495 HOT lanes for both free riders (HOV-3+) and as well as toll paying vehicles.

All northbound mainline GP segments with HOV/HOT connections will operate at LOS D or better in the AM peak hour with the exception of the following 10 locations:

- Weave segment on northbound I-95 GP lanes between the northern terminus HOT-to-GP ramp and off-ramp to Duke Street (LOS E).
- Diverge segment on northbound I-95 GP lanes due to the slip ramp from GP lanes to HOV lanes, north of Lorton Road interchange (LOS F).
- Weave segment on northbound I-95 GP lanes between the on-ramp from Garrisonville Road and slip ramp from the GP lanes to HOT lanes, south of Russell Road interchange (LOS F)

- Diverge segment on northbound I-95 GP lanes due to the slip ramp from the GP lanes to HOT lanes, south of Garrisonville Road interchange (LOS E).
- Merge segment on northbound I-95 GP lanes due to the slip ramp from the HOT lanes to GP lanes, north of Courthouse Road interchange (LOS E)
- Weave segment on northbound I-95 GP lanes between the on-ramp from Centreport Parkway and the GP lanes to HOT lanes ramp, south of Courthouse Road interchange (LOS F)
- Diverge segment on northbound I-95 GP lanes due to the slip ramp from the GP lanes to HOT lanes, south of Centerport Parkway interchange (LOS F)
- Merge segment on northbound I-95 GP lanes due to the slip ramp from the HOT lanes to GP lanes, north of Warrenton Road interchange (LOS F)
- Diverge segment on northbound I-95 GP lanes due to the slip ramp from the GP lanes to HOT lanes, south of Warrenton Road interchange (LOS F)
- Merge segment on northbound I-95 GP lanes due to the slip ramp from the HOT lanes to GP lanes, north of Plank Road interchange (LOS F)

The Build alternative introduces new HOT access points in the southern section of the study area (south of Joplin Road to Jefferson Davis Highway) where most of the above segments with LOS E/F are located. The LOS results reflect the expected additional turbulence on already congested I-95 GP lanes due to the new access points. This type of performance on the GP segments is expected as I-95 GP lanes will continue to operate at congested levels for a majority of study corridor in the northbound direction towards Washington DC in the morning in the 2035 scenarios.

PM Peak Hour

The reversible-flow HOV/HOT lanes on I-95 will operate in the southbound direction during the evening period in the 2035 Build condition. The HCS analysis for the PM peak hour shows that the southbound HOV/HOT lanes will operate at LOS D or better on a majority of basic, merge, diverge, and weaving segments throughout the entire study area, with the following exceptions:

- Diverge segment on southbound I-95 HOT lanes due to the northern terminus first HOT-to-GP slip ramp at Turkeycock Interchange (LOS E). But the density in this diverge segment (35.8 pc/mi/ln) is close to LOS D thresholds.
- Diverge segment on southbound I-95 HOT lanes due to the HOT-to-I-495 HOT ramp at Springfield Interchange (LOS E) via Phase 8 ramps.
- Weave segment on southbound I-95 HOT lanes between the on-ramp from I-495 HOT lanes via the Springfield Phase 8 Ramps and off-ramp to Franconia Road (LOS F). This can be attributed to the increase in the weaving volume in Build conditions which provides a seamless connection between I-495 HOT lanes and I-95 HOT lanes for both free riders (HOV-3+) and as well as toll paying vehicles.

All southbound mainline GP segments with HOV/HOT connections will operate at LOS D or better in the PM peak hour with the exception of the following 10 locations:

- Weave segment on southbound I-95 GP lanes between the on-ramp from Duke Street and the GP-to-HOT off-ramp to the HOT facility (LOS F)
- Weave segment on southbound I-95 GP lanes between the flyover HOT–to-GP on-ramp, south of Prince William Parkway to Dale Boulevard off-ramp (LOS F)
- Weave segment on southbound I-95 GP lanes between the HOT–to-GP on-ramp and off-ramp to Rest Area, south of Dale Boulevard (LOS F)
- Weave segment on southbound I-95 GP lanes between the HOT-to-GP on-ramp and off-ramp to Garrisonville Road (LOS F)
- Weave segment on southbound I-95 GP lanes between the on-ramp from eastbound Garrisonville Road and the GP-to-HOT off-ramp (LOS F)
- Weave segment on southbound I-95 GP lanes between the HOT-to-GP on-ramp and off-ramp to Courthouse Road (LOS F)
- Weave segment on southbound I-95 GP lanes between the HOT-to-GP on-ramp and the off-ramp to Centreport Parkway (LOS F)
- Weave segment on southbound I-95 GP lanes between the on-ramp from Centreport Parkway and the GP-to-HOT off-ramp (LOS F)
- Weave segment on southbound I-95 GP lanes between the HOT-to-GP on-ramp and off-ramp to Warrenton Road (LOS F)
- Weave segment on southbound I-95 GP lanes between the HOT-to-GP on-ramp and the off-ramp to Plank Road (LOS F)

Similar to the northbound direction (AM), the Build alternative introduces new HOT access points in the southbound direction (PM) in the southern section of the study area (south of Joplin Road to Jefferson Davis Highway) where most of the above segments with LOS F are located. The LOS results reflect the expected additional turbulence on already congested I-95 GP lanes due to the new access points.

It should also be noted that the toll pricing of the HOV/HOT lanes would be variable, such that the operational characteristics would generally be better than those of the general-purpose lanes. Accordingly, the actual volumes operating on the HOV/HOT roadway would be less than the theoretical capacity.

9.4.6 No-Build versus Build Comparison Summary

Comparisons of the no-build and alternatives were developed to determine the relative difference in system performance measures and the freeway segment LOS.

The proposed project would add capacity to the I-95 corridor and address major bottlenecks in the current system, provide new access points to the managed lanes system, enhance incident response, create a seamless connection to the other managed facilities in the Northern Virginia are, and improve enforcement. The effective people-moving capacity would be much greater with the anticipated expansion of carpooling and transit usage provided by the dedicated lanes. The proposed project would provide dedicated lanes for multi-occupant vehicles south of Dumfries where none exist today and add capacity to the existing HOV facility north of the Prince William Parkway. The tolling aspect of the proposed project would also add capacity for non-HOV vehicles whose drivers choose to pay for using the lanes. The pricing would be variable, such that the operational characteristics would generally be better than those of the general-purpose lanes. Accordingly, the actual volumes operating on the roadway would be less than the theoretical capacity in order to maintain free-flow conditions, with a target volume of approximately 1,800 vehicles per lane per hour (which would add a capacity of 3,600 vehicles per hour, for the two new lanes, and 1,800 vehicles per hour in the section of the facility north of the Prince William Parkway that would be expanded from two to three lanes, resulting in a capacity increase of 20 to 27 percent). Hence the HCM analysis presented in this IJR was performed on freeway segments where operational issues are most expected (basic, merge, diverge, and weave areas).

It is observed in many locations, the forecasted total volume in the GP lanes is lower in the build condition. This is because traffic will divert from the GP lanes into the newly added/upgraded HOV/HOT lanes in the build condition. But on the other hand, the Build alternative introduces additional access points, which is expected to create additional turbulence in the already congested I-95 corridor within the study area. Therefore, while delays will still be experienced during the peak hour, fewer vehicles in the general-purpose lanes in the build condition will result in shorter queues and the length of the peak period (i.e., the number of hours that congestion is experienced in the corridor, will be reduced as well).

Table 9-42: HCM LOS Summary - AM Peak Hour (Northbound) HOV/HOT Ingress & Egress Junction Analysis

Ramp ID	Filename	Northbound HOV/HOT	Existing 2011				No-Build 2018				Build 2018				No-Build 2035				Build 2035			
			Segment Type	LOS	Density (pc/mi/ln)	Speed (mi/hr)	Segment Type	LOS	Density (pc/mi/ln)	Speed (mi/hr)	Segment Type	LOS	Density (pc/mi/ln)	Speed (mi/hr)	Segment Type	LOS	Density (pc/mi/ln)	Speed (mi/hr)	Segment Type	LOS	Density (pc/mi/ln)	Speed (mi/hr)
RH0201	RH0201merge	I-95 NB GP-to-HOV/HOT Slip Ramp s/o Duke St	merge	C	25.2	60	merge	C	25.2	60	merge	C	26.1	60	merge	C	27.4	59	merge	D	28.3	58.6
RH0204	HN0602 (Exi.), HN0502 (NoB.), RH0204diverge_ (Build)	I-95 NB HOV/HOT-to-GP Slip Ramp s/o Duke St	basic [*]	C	21.1	72	basic [*]	C	20.8	72.2	diverge	D	29.6	55.5	basic [*]	C	23	70.6	diverge	D	32.1	55.1
RH0510	HN0602 (Exi.), RH0510merge_do (all Future)	I-95 NB OnRamp from I-495	basic [*]	C	21.1	72	merge	C	26.6	59	merge	C	26.3	59.4	merge	D	28.5	59	merge	C	26.9	59
RH0514	HN0602 (Exi.), HN0602weave (all Future)	I-95 NB Off Ramp to I-495	basic [*]	C	21.1	72	weave	C	22.7	55.2	weave	F	-	-	weave	C	27	52.5	weave	F	-	-
RH0607	RH0607merge_up (Exi.), HN0602weave (all Future)	I-95 NB On Ramp from Franconia Rd	merge	B	19.6	62	weave [a]	C	22.7	55.2	weave [a]	F	-	-	weave [a]	C	27	52.5	weave [a]	F	-	-
RH0703	RH0703merge_up, RH0703merge_do	I-95 NB GP-to-HOV/HOT Slip Ramp n/o Franconia-Springfield Pk	merge	C	22	60	merge	C	27.4	59	merge	C	22	60	merge	D	30.7	57	merge	C	24.2	60
RH0704	RH0704merge_up, RH0704merge_do	I-95 NB On Ramp from F-S Pkwy	merge	C	21.2	61	merge	C	26.5	59	merge	C	23.1	60	merge	D	29.8	58	merge	C	25.4	60
RH0705	RH0705diverge_do	I-95 NB Off Ramp to F-S Pkwy	diverge	B	17.6	57.3	diverge	C	21.3	57.3	diverge	B	19.3	56.4	diverge	C	23.4	57.3	diverge	C	21.3	56.5
RH0801	RH0801diverge_up	I-95 NB HOV/HOT-to-GP Slip Ramp to/from Heller Rd	diverge	B	16.8	56.6	diverge	C	20.8	56.4	diverge	B	18.4	55.6	diverge	C	23.9	56.1	diverge	C	20.8	55.4
RH0902	RH0902merge_do (Exi. & NoB.), HN1002weave (Build)	I-95 NB GP-to-HOV/HOT Slip Ramp n/o Lorton Rd	merge	C	26.1	60	merge	D	29.8	58	weave [b]	C	22.4	61.7	merge	D	32.6	57	weave [b]	C	25	61.2
RH0903	HN0901merge (Exi. & NoB.), HN1002weave (Build)	I-95 NB Off Ramp to Alban Rd	merge [*,a]	C	26.1	60	merge [*,a]	D	29.8	58	weave	C	22.4	61.7	merge [*,a]	D	32.6	57	weave	C	25	61.2
RH1002	RH1002merge	I-95 NB On Ramp from Richmond Hwy	merge	C	23.3	60	merge	C	27.4	59	merge	C	26.4	59.5	merge	D	29.7	58	merge	D	29.9	58
RH1113	RH1113merge	I-95 NB On Ramp from Gordon	merge	B	19.9	61	merge	C	23.4	59	merge	C	25.8	59.3	merge	C	25.4	58	merge	D	28.4	58
RH1205	RH1205merge (Exi. & NoB.), HN1201 (Build)	I-95 NB On Ramp from Prince William Pkwy	merge	B	14.5	62	merge	B	17.2	62	basic	B	17.5	74	merge	B	19.9	61	basic	C	19.8	72.8
RH1201	RH1301merge (Exi. & NoB.), HN1402weave (Build)	I-95 NB HOV/HOT-to-GP Slip Ramp at Prince William Pkwy	merge [*,b]	B	14	61	merge [*,b]	A	9	56.4	weave [b]	C	21.2	56.3	merge [*,b]	B	11.1	56.4	weave [b]	C	23.8	55.4
RH1301	RH1301merge (Exi. & NoB.), HN1402weave (Build)	I-95 NB On Ramp from Opitz/Dale Blvd	merge	B	14	61	merge	A	9	56.4	weave	C	21.2	56.3	merge	B	11.1	56.4	weave	C	23.8	55.4
RH1501	RH1501merge	I-95 NB GP-to-HOV/HOT Slip Ramp s/o Opitz/Dale Blvd	merge	A	9.7	62	merge	A	9.8	62	merge	C	23	60.5	merge	B	11.6	62	merge	C	25.4	60
RH1509	HN1501 (Exi. & NoB.), RH1509merge (Build)	I-95 NB GP-to-HOV/HOT Slip Ramp n/o Joplin Rd	basic	A	5.9	75	basic	A	6	75	merge	B	19.9	61.3	basic	A	7.5	75	merge	C	22.2	61
RH1703	RH1703diverge	I-95 NB HOV/HOT-to-GP Slip Ramp s/o Joplin Rd	*				*				diverge	B	19.3	57.6	*				diverge	C	22.1	57.5
RH1702	RH1702merge	I-95 NB GP-to-HOV/HOT Slip Ramp s/o Russell Rd	*				*				merge	B	19.2	61.3	*				merge	C	21.7	61
RH1903	RH1903diverge_do	I-95 NB HOV/HOT-to-GP Slip Ramp n/o Courthouse Rd	*				*				diverge	B	12.7	57.5	*				diverge	B	14.6	57.4
RH1904	RH1904merge_up	I-95 NB GP-to-HOV/HOT Slip Ramp s/o Garrisonville Rd	*				*				merge	B	16.8	61.4	*				merge	B	19	61
RH2001	RH2001merge	I-95 NB GP-to-HOV/HOT Slip Ramp s/o Courthouse Rd	*				*				merge	B	12.8	62	*				merge	B	14.5	62
RH2101	RH2101diverge	I-95 NB HOV/HOT-to-GP Slip Ramp n/o Warrenton Rd	*				*				diverge	B	10.2	57.9	*				diverge	B	11.8	57.8
RH2102	RH2102merge	I-95 NB GP-to-HOV/HOT Slip Ramp s/o Centreport Pkwy	*				*				merge	B	11	62	*				merge	B	12.5	62
RH2201	RH2201merge	I-95 NB GP-to-HOV/HOT Slip Ramp s/o Plank Rd	*				*				merge	A	9	62	*				merge	B	10.6	62.2
RH2202	RH2202diverge	I-95 NB HOV/HOT-to-GP Slip Ramp n/o Plank Rd	*				*				diverge	A	10	57.7	*				diverge	B	11.8	57.6
RH2203	RH2203merge	I-95 NB GP-to-HOV/HOT Slip Ramp s/o Warrenton Rd	*				*				merge	A	9.1	62	*				merge	B	10.5	62
RH2301	HN2301	I-95 NB GP-to-HOV/HOT Slip Ramp s/o Jefferson Davis Hwy	*				*				basic	A	3	75	*				basic	A	3.7	75

Table 9-42 (Cont): HCM LOS Summary - AM Peak Hour (Northbound) HOV/HOT Ingress & Egress Junction Analysis

Ramp ID	Filename	Northbound GP	Segment Type	LOS	Density (pc/mi/ln)	Speed (mi/hr)	Segment Type	LOS	Density (pc/mi/ln)	Speed (mi/hr)	Segment Type	LOS	Density (pc/mi/ln)	Speed (mi/hr)	Segment Type	LOS	Density (pc/mi/ln)	Speed (mi/hr)	Segment Type	LOS	Density (pc/mi/ln)	Speed (mi/hr)
RH0201	MN0204weave	I-95 NB GP-to-HOV/HOT Slip Ramp s/o Duke St	weave	D	30.7	56.1	weave	D	32.1	56.1	weave	D	28.5	57.3	weave	D	31.7	55.9	weave	D	28.6	57
RH0204	MN0101diverge (Exi. & NoB.), MN0101weave (Build)	I-95 NB HOV/HOT-to-GP Slip Ramp s/o Duke St	diverge *	D	33.1	56.9	diverge *	E	35.4	56.9	weave	E	35.3	51.3	diverge *	E	35.9	56.9	weave	E	36.8	50.2
RH0703	RH0703diverge_up, RH0703diverge_do	I-95 NB GP-to-HOV/HOT Slip Ramp n/o Franconia-Springfield Pk	diverge	E	36.3	54.3	diverge	E	35.7	54.3	diverge	E	35.2	53.9	diverge	D	34.2	54.3	diverge	D	34	53.9
RN0801	RN0801merge_up, RN0801merge_do	I-95 NB HOV/HOT-to-GP Slip Ramp with Heller Rd	merge	D	28.8	57.8	merge	D	28.9	57.8	merge	D	28.4	58.1	merge	D	28.8	57.8	merge	D	29.4	57.4
RH0902	MN0902diverge	I-95 NB GP-to-HOV/HOT Slip Ramp n/o Lorton Rd	diverge	D	32.7	57.7	diverge	D	32.6	57.7	diverge	E	35.6	57.2	diverge	E	35.2	57.7	diverge	F	39.1	57.3
RH1201	MN1201 (Exi. & NoB.), RH1201merge_ (Build)	I-95 NB HOV/HOT-to-GP Slip Ramp at Prince William Pkwy	basic *	C	24	69.9	basic *	C	25.9	68.4	merge	D	29.4	57.4	basic *	D	27.8	66.8	merge	D	31	56
RH1501	MN1506weave	I-95 NB GP-to-HOV/HOT Slip Ramp s/o Opitz/Dale Blvd	weave	D	31.3	60.8	weave	D	32.9	60.4	weave	D	29.7	61.2	weave	D	34.4	60	weave	D	30.9	60.9
RH1509	MN1602diverge	I-95 NB GP-to-HOV/HOT Slip Ramp s/o Dumfries Rd	diverge	E	36.6	55.7	diverge	F	39.1	55.7	diverge	D	30.8	57.2	diverge	F	44.2	55.1	diverge	D	32	57.1
RH1703	MN1702diverge (Exi. & NoB.), MN1703weave	I-95 NB HOV/HOT-to-GP Slip Ramp s/o Joplin Rd	diverge *	D	31.4	57.2	diverge *	D	32.7	56.9	weave	D	33.4	59.8	diverge *	E	36.8	56.4	weave	D	34.9	59.3
RH1702	MN1804merge (Exi. & NoB.), MN1804weave	I-95 NB GP-to-HOV/HOT Slip Ramp s/o Russell Rd	merge *	D	30.4	56.1	merge *	D	31.3	55.2	weave	E	36.6	55.4	merge *	F	41.9	30.9	weave	F	-	-
RH1904	MN1902 (Exi. & NoB.), RH1904diverge_do	I-95 NB GP-to-HOV/HOT Slip Ramp s/o Garrisonville Rd	basic *	E	35.4	60.5	basic *	E	43.7	54.3	diverge	E	35	56.5	basic *	F	52.5	48.5	diverge	E	36.3	56.2
RH1903	MN1902 (Exi. & NoB.), RH1903merge_do	I-95 NB HOV/HOT-to-GP Slip Ramp n/o Courthouse Rd	basic *,a	E	35.4	60.5	basic *,a	E	43.7	54.3	merge	E	43.9	43	basic *,a	F	52.5	48.5	merge	E	48.2	29.3
RH2001	MN2002merge (Exi. & NoB.), MN2002weave	I-95 NB GP-to-HOV/HOT Slip Ramp s/o Courthouse Rd	merge *	D	33.2	55.1	merge *	F	38.7	47.6	weave	F	-	-	merge *	F	43.5	34.8	weave	F	-	-
RH2102	MN2102 (Exi. & NoB.), RH2102diverge_do	I-95 NB GP-to-HOV/HOT Slip Ramp s/o Centreport Pkwy	basic *	D	34.7	61.1	basic *	F	48	51.3	diverge	E	39.3	57.2	basic *	F	63.6	42.6	diverge	F	45	57.2
RH2101	MN2102merge (Exi. & NoB.), RH2101merge_up	I-95 NB HOV/HOT-to-GP Slip Ramp n/o Warrenton Rd	merge *	D	29.6	55.7	merge *	D	34.7	48.2	merge	E	38.8	48.6	merge *	F	39.2	35.2	merge	F	44.3	34.4
RH2203	MN2204 (Exi. & NoB.), RH2203diverge_up	I-95 NB GP-to-HOV/HOT Slip Ramp s/o Warrenton Rd	basic *	E	35.1	60.8	basic *	F	49.4	50.4	diverge	E	41	57.7	basic *	F	61.9	43.5	diverge	F	44.7	57.7
RH2202	MN2204merge (Exi. & NoB.), RH2202merge_ (Build)	I-95 NB HOV/HOT-to-GP Slip Ramp n/o Plank Rd	merge *	D	33.4	55.5	merge *	F	38	50.1	merge	E	39.9	48	merge *	F	42.4	40.9	merge	F	43.5	40
RH2201	MN2304merge (Exi. & NoB.), MN2305weave	I-95 NB GP-to-HOV/HOT Slip Ramp s/o Plank Rd	merge *	C	22.6	60.5	merge *	C	26	59.2	weave	D	29.7	53.4	merge *	D	29.5	57	weave	D	33.5	51.6
RH2301	MN2301diverge (Exi. & NoB.), RH2301diverge_do	I-95 NB GP-to-HOV/HOT Slip Ramp s/o Jefferson Davis Hwy	diverge *	B	13	56.8	diverge *	B	16.5	57.1	diverge	C	23.2	56.9	diverge *	B	19.5	56.7	diverge	C	25.9	56.6

*	HOV/HOT Ramp does not exist in Existing and No-Build scenarios (corresponding freeway segments are analyzed on general purpose lanes)
**	Existing/No-Build Ramp removed in Build scenarios (corresponding freeway segments are analyzed on general purpose lanes)
a	Freeway segment same as 'above'
b	Freeway segment same as 'below'
	LOS 'F' defines operating conditions where demand exceeds capacitty. For weave segments with LOS 'F', density and speeds are not reported.

Table 9-43: HCM LOS Summary - PM Peak Hour (Southbound) HOV/HOT Ingress & Egress Junction Analysis

Ramp ID	Filename	Southbound HOV/HOT	Existing 2011				No-Build 2018				Build 2018				No-Build 2035				Build 2035			
			Segment Type	LOS	Density (pc/mi/ln)	Speed (mi/hr)	Segment Type	LOS	Density (pc/mi/ln)	Speed (mi/hr)	Segment Type	LOS	Density (pc/mi/ln)	Speed (mi/hr)	Segment Type	LOS	Density (pc/mi/ln)	Speed (mi/hr)	Segment Type	LOS	Density (pc/mi/ln)	Speed (mi/hr)
RH0202	RH0202diverge_do	I-95 SB HOV/HOT-to-GP Slip Ramp (Turkeycock)	diverge	D	29.3	57.4	diverge	D	29.6	57.6	diverge	D	32.9	57.7	diverge	D	30.1	57.7	diverge	E	35.8	57.6
RH0203	RH0203merge_do, RH0203merge_up	I-95 SB GP-to-HOV/HOT Slip Ramp (Turkeycock)	merge	C	26.1	60	merge	C	26	59.6	merge	C	25.5	60	merge	C	27	59	merge	C	27.9	59
RH0509	HS0601 (Exi.), RH509diverge_up (all future)	I-95 SB Off Ramp to I-495	basic [*]	C	23.3	70.5	diverge	D	29.2	52.4	diverge	D	33.3	52.2	diverge	D	30.2	53	diverge	E	36.3	52.3
RH0513	HS0601 (Exi.), HS0601weave (all Future)	I-95 SB On Ramp from I-495	basic [*,a]	C	23.3	70.5	weave [b]	C	25.4	52.6	weave [b]	F	-	-	weave [b]	C	27	54.3	weave [b]	F	-	-
RH0606	RH0606diverge_do (Exi.), HS0601weave (all Future)	I-95 SB Off Ramp to Franconia Rd	diverge	B	13.8	57.1	weave	C	25.4	52.6	weave	F	-	-	weave	C	27	54.3	weave	F	-	-
RH0706	RH0706diverge_up, RH0706diverge_do	I-95 SB HOV/HOT-to-GP Slip Ramp s/o Franconia Rd	diverge	C	24.5	54.3	diverge	D	29.7	53.9	diverge	C	26.5	53.4	diverge	D	32.7	53.8	diverge	D	29	53.3
RH0707	RH0707diverge_up, RH0707diverge_do	I-95 SB Off Ramp to F-S Pkwy	diverge	C	23.7	57	diverge	C	27.6	56.6	diverge	C	25.1	55.8	diverge	D	30.4	56.2	diverge	C	27.6	55.6
RH0708	RH0708merge_up, RH0708merge_do	I-95 SB On Ramp from F-S Pkwy	merge	C	22.6	60	merge	C	24	59	merge	C	21.8	61	merge	C	25.3	59	merge	C	22.5	61
RH0802	RH0802merge_up, RH0802merge_do	I-95 SB GP-to-HOV/HOT Slip Ramp s/o F-S Pkwy	merge	C	27.3	59	merge	C	27.5	59	merge	C	22.3	61	merge	D	28.3	59	merge	C	23.2	60.5
RH0803	HS0901 (Exi.), RH0803merge_ (all Future)	I-95 SB On Ramp from Heller Rd	basic [*]	C	25.2	69	merge	C	24.9	57.3	merge	C	21.5	61	merge	C	26	56	merge	C	22.6	60.7
RH0901	RH0901diverge (Exi. & NoB.), HS0901 (Build)	I-95 SB HOV/HOT-to-GP Slip Ramp n/o Lorton Rd	diverge	D	34.2	57.9	diverge	D	32	57	basic [**]	C	22.2	68.8	diverge	D	33.1	57	basic [**]	C	23.4	68.2
RH0904	HS1001 (Exi. & NoB.), RH0904merge_up (Build)	I-95 SB On Ramp from Alban Rd	basic [*]	C	24.8	69.3	basic [*]	D	26.6	67.8	merge	C	24.6	59.5	basic [*]	D	28.2	66.5	merge	C	27.6	57
RH1004	RH1004diverge_do	I-95 SB Off Ramp to SB Richmond Hwy	diverge	D	30.6	57.9	diverge	D	32.2	57.9	diverge	D	31.6	55.7	diverge	D	33.4	57.9	diverge	D	34.3	54.7
RH1005	RH1107diverge_ (Exi. & NoB.), RH1005merge_ (Build)	I-95 SB GP-to-HOV/HOT n/o Richmond Hwy	diverge [*,b]	C	23	57.3	diverge [*,b]	C	24.5	57.5	merge	C	27.1	59	diverge [*,b]	C	25.7	57.1	merge	D	29.1	57.7
RH1107	RH1107diverge_up	I-95 SB Off Ramp to Gordon	diverge	C	23	57.3	diverge	C	24.5	57.5	diverge	C	26.6	55.7	diverge	C	25.7	57.1	diverge	D	29.4	56
RH1216	RH1216diverge_do (Exi. & NoB.), HS1201 (Build)	I-95 SB Off Ramp to Prince William Pkwy	diverge	B	18.8	55.6	diverge	C	20.8	54.9	basic	C	20.4	72.4	diverge	C	20.8	55.1	basic	C	23.1	70.6
RH1302	RH1302diverge_up	I-95 SB HOV/HOT-to-GP Slip Ramp s/o Prince William Pkwy	diverge	B	15.4	56.8	diverge	B	15.2	56.4	diverge	B	19.8	56.7	diverge	B	15.7	56.6	diverge	C	23.2	56.7
RH1401	HS1401 (Exi. & NoB.), RH1401merge_up	I-95 SB GP-to-HOV/HOT Slip Ramp at Opitz/Dale Blvd	basic [*]	B	11.1	75	basic [*]	A	9.8	75	merge	B	19.8	61	basic [*]	A	10.8	75	merge	C	22.9	60.6
RH1502	RH1502diverge	I-95 SB HOV/HOT-to-GP Slip Ramp s/o Opitz/Dale Blvd	diverge	B	12.2	57.1	diverge	B	10.6	57.6	diverge	B	19.1	57.3	diverge	B	11.9	57.2	diverge	C	22.5	57.2
RH1503	HS1501 (Exi. & NoB.), RH1503diverge_do (Build)	I-95 SB HOV/HOT-to-GP Slip Ramp s/o Dumfries Rd	basic	A	8.5	75	basic	A	8.7	75	diverge	B	16.8	57.7	basic	A	9.7	75	diverge	B	19.8	57.9
RH1504	RH1504merge_up	I-95 SB GP-to-HOV/HOT Slip Ramp s/o Dumfries Rd	*				*				merge	C	20.7	61	*				merge	C	24	60.3
RH1701	RH1701diverge	I-95 SB HOV/HOT-to-GP Slip Ramp s/o Russell Rd	*				*				diverge	C	26.9	55.6	*				diverge	D	30.4	55.6
RH1902	HS1901weave	I-95 SB HOV/HOT-to-GP Slip Ramp s/o Garrisonville Rd	*				*				weave	B	16.8	56.7	*				weave	C	20	55.2
RH2002	RH2002diverge	I-95 SB HOV/HOT-to-GP Slip Ramp s/o Courthouse Rd	*				*				diverge	B	18	56.7	*				diverge	C	20.9	56.6
RH2104	HS2101weave	I-95 SB HOV/HOT-to-GP Slip Ramp s/o Centreport Pkwy	*				*				weave	B	18.3	54.8	*				weave	C	21.3	53.4
RH2204	RH2204diverge	I-95 SB HOV/HOT-to-GP Slip Ramp n/o Plank Rd	*				*				diverge	B	18.9	56.3	*				diverge	C	21.5	56.1
RH2205	RH2205diverge	I-95 SB HOV/HOT-to-GP Slip Ramp n/o Jefferson Davis Hwy	*				*				diverge	B	11.8	56.2	*				diverge	B	13.7	56
RH2302	HS2301	I-95 SB HOV/HOT-to-GP Slip Ramp s/o Jefferson Davis Hwy	*				*				basic	A	5	75	*				basic	A	5.7	75

Table 9-43 (Cont): HCM LOS Summary - PM Peak Hour (Southbound) HOV/HOT Ingress & Egress Junction Analysis

Ramp ID	Filename	Southbound GP	Segment Type	LOS	Density (pc/mi/ln)	Speed (mi/hr)	Segment Type	LOS	Density (pc/mi/ln)	Speed (mi/hr)	Segment Type	LOS	Density (pc/mi/ln)	Speed (mi/hr)	Segment Type	LOS	Density (pc/mi/ln)	Speed (mi/hr)	Segment Type	LOS	Density (pc/mi/ln)	Speed (mi/hr)
RH0203	MS0105weave	I-95 SB GP-to-HOV/HOT Slip Ramp (Turkeycock)	weave	F	-	-	weave	F	-	-	weave	F	-	-	weave	F	-	-	weave	F	-	-
RH0202	MS0202weave	I-95 SB HOV/HOT-to-GP Slip Ramp (Turkeycock)	weave	D	30.7	57.6	weave	D	30.3	56.7	weave	C	27.9	57	weave	D	30.3	56.6	weave	C	27.6	57.1
RH0706	MS0701weave	I-95 SB HOV/HOT-to-GP Slip Ramp s/o Franconia Rd	weave	D	34.4	54.4	weave	D	33.4	51.9	weave	D	33.1	52.1	weave	D	30.8	53.1	weave	D	31.5	53
RH0802	RH0802diverge_do, RH0802diverge_up	I-95 SB GP-to-HOV/HOT Slip Ramp s/o F-S Pkwy	diverge	E	38	56.4	diverge	D	32.3	56.8	diverge	D	33	56.7	diverge	D	31.4	57	diverge	D	33.7	56.7
RH0901	MS0901merge (Exi. & NoB.), MS0901 (Build)	I-95 SB HOV/HOT-to-GP Slip Ramp s/o Fairfax County Pkwy	merge	D	30.3	58.7	merge	D	31.4	58.1	basic **	D	28.5	66.2	merge	D	32.8	57.3	basic **	D	30.6	64.5
RH1005	MS1002	I-95 SB GP-to-HOV/HOT n/o Richmond Hwy	basic	C	22.4	71.1	basic	C	24..8	69.3	basic	C	18.9	73.3	basic	D	26.1	68.2	basic	C	20	72.7
RH1302	MS1302weave	I-95 SB HOV/HOT-to-GP Slip Ramp s/o Prince William Pkwy	weave	F	-	-	weave	F	-	-	weave	F	-	-	weave	F	-	-	weave	F	-	-
RH1401	MS1303 (Exi. & NoB.), RH1401diverge_up (Build)	I-95 SB GP-to-HOV/HOT Slip Ramp at Opitz/Dale Blvd	basic *	C	22	71.4	basic *	C	20.4	72.4	diverge	D	28.2	57.2	basic *	C	23.4	70.4	diverge	D	29.4	57.2
RH1502	MS1502weave	I-95 SB HOV/HOT-to-GP Slip Ramp s/o Opitz/Dale Blvd	weave	E	36.7	59.5	weave	E	35.8	59.6	weave	F	-	-	weave	F	-	-	weave	F	-	-
RH1503	MS1601merge (Exi. & NoB.), MS1601weave (Build)	I-95 SB HOV/HOT-to-GP Slip Ramp s/o Dumfries Rd	merge	E	35.9	50	merge	E	35.6	50.4	weave	C	21.2	62.8	merge	E	40.3	40	weave	C	22.7	62.1
RH1504	MS1601 (Exi. & NoB.), RH1504diverge_ (Build)	I-95 SB GP-to-HOV/HOT Slip Ramp s/o Dumfries Rd	basic *	E	36.7	59.5	basic *	E	36.2	59.9	diverge	D	31.8	56.6	basic *	F	47	52	diverge	D	33	56.6
RH1701	MS1801diverge (Exi. & NoB.), MS1802weave (Build)	I-95 SB HOV/HOT-to-GP Slip Ramp s/o Russell Rd	diverge *	E	36.3	53.8	diverge *	D	33.8	53.7	weave	F	-	-	diverge *	F	42.8	53.3	weave	F	-	-
RH1901	MS1901merge (Exi. & NoB.), MS1901weave (Build)	I-95 SB GP-to-HOV/HOT Slip Ramp s/o Garrisonville Rd	merge *	D	31.7	52.8	merge *	F	35.8	44.6	weave	F	-	-	merge *	F	36.7	42.6	weave	F	-	-
RH1902	MS1901diverge (Exi. & NoB.), MS1903weave (Build)	I-95 SB HOV/HOT-to-GP Slip Ramp s/o Garrisonville Rd	diverge *	D	30.9	56.7	diverge *	F	36.4	55	weave	F	-	-	diverge *	F	39.4	54.2	weave	F	-	-
RH2002	MS2001diverge (Exi. & NoB.), MS2002weave (Build)	I-95 SB HOV/HOT-to-GP Slip Ramp s/o Courthouse Rd	diverge *	D	31.8	56.7	diverge *	D	33.3	56.6	weave	F	-	-	diverge *	F	41.5	53.9	weave	F	-	-
RH2103	MS2101merge (Exi. & NoB.), MS2101weave (Build)	I-95 SB GP-to-HOV/HOT Slip Ramp s/o Centreport Pkwy	merge *	D	33.2	55.3	merge *	E	35.3	52.9	weave	E	39.6	55.1	merge *	F	40.1	44.1	weave	F	-	-
RH2104	MS2101diverge (Exi. & NoB.), MS2103weave (Build)	I-95 SB HOV/HOT-to-GP Slip Ramp s/o Centreport Pkwy	diverge *	D	30.9	56.4	diverge *	D	33.9	55.6	weave	E	37.5	54.4	diverge *	F	39.1	54.6	weave	F	-	-
RH2204	MS2203diverge (Exi. & NoB.), MS2204weave (Build)	I-95 SB HOV/HOT-to-GP Slip Ramp n/o Plank Rd	diverge *	F	39.8	51.9	diverge *	F	39.2	51.5	weave	F	-	-	diverge *	F	40.6	51.2	weave	F	-	-
RH2302	MS2303 (Exi. & NoB.), RH2302merge_up (Build)	I-95 SB HOV/HOT-to-GP Slip Ramp s/o Jefferson Davis Hwy	basic *	B	17.3	74.1	basic *	C	19.2	73.2	merge	A	1.7	67	basic *	C	25.7	68.5	merge	A	8.2	63.7

*	HOV/HOT Ramp does not exist in Existing and No-Build scenarios (corresponding freeway segments are analyzed on general purpose lanes)
**	Existing/No-Build Ramp removed in Build scenarios (corresponding freeway segments are analyzed on general purpose lanes)
a	Freeway segment same as 'above'
b	Freeway segment same as 'below'
	LOS 'F' defines operating conditions where demand exceeds capacitty. For weave segments with LOS 'F', density and speeds are not reported.

9.4.6.1 Evaluation of Operations based on Deterministic HCM Findings

Based exclusively on the draft IJR deterministic HCM LOS results presented to FHWA for review, the following segments along the I-95 corridor were identified by the FHWA Resource Center reviewers for additional evaluation of geometrics and design criteria in order to determine if there are any opportunities for operational improvements for both 2018 and 2035 design years. This section discusses constraints and other details that serve to further clarify the reason for maintaining certain geometric elements at the areas of interest identified.

AM Peak Hour

Based on the AM peak hour analysis (performed on segments in the northbound direction), four locations (three weave segments and one diverge area) were recommended by the FHWA Resource Center for re-evaluation. These segments are discussed in detail below:

- **Weave - Northbound I-95 HOV/HOT Lanes, between on-ramp from Franconia Road and off-ramp to I-495 (HCS filename: HN0602weave)**: This weaving segment is located within a geometrically constrained part of the fully-built system interchange, recently constructed within the past few months. Thus, the configuration of the No-Build and Build conditions are geometrically the same, but operational different in that the Build scenario proposed conversion from HOV to HOT. Due to MSE walls and piers for the I-95 viaduct which straddle this segment, there are no options for geometric changes at this location.

  HCS results show LOS F for both 2018 and 2035 AM Build scenarios. However, VISSIM microsimulation shows operations are adequate and density for the weave segment is equivalent to LOS D. The HCS analysis does not reflect the signing in place that will allow HOT/HOV vehicles to change lanes in advance and avoid last minute weaving to exit the facility. In addition, this weave condition could be managed by the operator through dynamic toll pricing to minimize the weaving and maintain free-flow operations.

- **Weave - Northbound I-95 GP Lanes, between Edsall Road on-ramp and GP-to-HOV Flyover off-ramp, south of Duke Street (HCS filename: MN0204weave)**: This segment does not include any new or modified access in the Build scenario and remains geometrically and operationally the same between No-Build and Build scenario. It is important to note that the downstream off-ramp is restricted to HOV vehicles only, since the proposed HOT lanes terminate at this point. This segment is not showing any LOS degradation in any of the future scenarios. HCS LOS for both No-Build and Build scenarios is D.

- **Weave - Northbound I-95 GP Lanes, between HOV/HOT-to-GP Flyover on-ramp to Duke Street off-ramp (HCS filename: MN0101weave):** Because weaving segments in this portion of the study area are complex and closely spaced, this segment was also evaluated by VDOT in case FHWA had concerns at this location. The segment operates as a diverge segment under existing and No-Build conditions, and as a weave under the Build conditions, with the introduction of the new merge point from proposed the HOT lanes flyover. HCS results show LOS E for both 2018 and 2035 AM Build scenarios. This perceived degradation in HCS is due mainly to two factors: the new weaving configuration in the Build scenario due to the HOT flyover exit ramp merging with the I-395 GP lanes and the pre-existing downstream congestion that affects this segment during the AM peak and is exacerbated in future scenarios with demand increase. This is a known operational issue today and is seen in the Build and No-Build conditions.

Mitigation option evaluations specific to this location, and additional proposed project elements constructed as part of an independent project, as related with improving the Northern Terminus operation are addressed in the IJR in Section 9.3.4.2. Based on the proposed auxiliary lane to be constructed downstream as a separate project by VDOT between Duke Street and Seminary Road, operational conditions in this area are expected to improve significantly, as demonstrated by the 4-hour peak period VISSIM microsimulation sub-area model results (based on the metrics evaluated including: travel time, vehicle throughput, speed profiles, and queuing).

- **Weave - Northbound I-95 GP Lanes, between Garrisonville Road on-ramp and GP-to-HOV/HOT slip ramp, south of Russell Road (HCS filename: MN1804weave):** The segment in question is constrained by environmental and potential right-of-way issues. HCS results show LOS E for both 2018 and 2035 AM Build scenarios. LOS from HCS results is D/E the 2018 No-Build and Build scenarios, respectively (absolute difference is less than 1 veh/mi/ln). Both 2035 No-Build and Build scenarios show LOS F for this segment. The VISSIM simulation results for 2035 Build show a density equivalent to LOS D. The HCS analysis does not reflect the signing in place that will allow potential HOT vehicles from upstream to change lanes and shift to the left in advance of the defined weave segment and avoid last minute weaving to enter the HOT facility south of Russell Road. This condition is reflected in the traffic simulation. The traffic demand in this weave can also be influenced or reduced by dynamic-pricing tolls. Finally, the projected volume demands coming from the Garrisonville Road interchange will be limited by the capacity of the adjacent signalized intersections along the arterial, which is not reflect in the HCS analysis, so the HCS results are more conservative than the capacity constraints of the local arterial network will produce.

- **Diverge - Northbound I-95 GP Lanes, GP-to-HOV/HOT slip ramp, north of Lorton Road (HCS filename: MN0902diverge):** This segment is located with Environmental Resource protection area, and is constrained on either side by substantial industrial parks. HCS results show LOS D and E for 2018 No-Build and Build scenarios. HCS results show LOS F for the 2035 Build scenario and LOS E for the 2035 No-Build scenario. However the absolute density difference is less than 4 veh/mi/ln, thus this is a borderline case. Both No-build and Build scenarios can be considered of a similar operations condition. In addition, the VISSIM model projects a density equivalent to LOS D for this segment under the Build scenario. It is important to note that based on the traffic simulation results for the entire network, only 86% of the total projected demand is able to go through this segment during the AM peak hour. There is significant metering conditions upstream of the segment, mostly the result of the arterial system over-saturation.

In general, the weave and diverge areas suggested for re-evaluation are located within constrained areas, either due to environmental considerations (as is the issue south of Russell Road and north of Lorton Road) or due to physical and geometric/land use constraints (at I-495 interchange, north of Lorton Road). It should be noted that south of Duke Street, the proposed northbound ramp from the HOT lanes to GP is a flyover, while the existing northbound ramp from the GP to the HOV lanes is also grade separated from the mainline and the HOT flyover.

PM Peak Hour

Based on the PM peak hour analysis (performed on segments in southbound direction), six weave and two diverge areas were recommended for re-evaluation. These segments are discussed in detail below:

- **Weave - Southbound I-95 GP Lanes, between HOV-to-GP Flyover on-ramp and Edsall Road off-ramp, south of Duke Street (HCS filename: MS0202weave)**: This segment does not include any new or modified access in the Build scenario and remains geometrically and operationally the same between No-Build and Build scenario. Thus, the configuration of the No-Build and Build conditions are geometrically the same, but operational different in that the Build scenario proposed conversion from HOV to HOT. HCS results show no degradation in LOS for this segment from the No-Build to the Build scenario. Both 2018 and 2035 Build conditions are at LOS C while 2018 and 2035 No-Build are at LOS D.

- **Weave - Southbound I-95 GP Lanes, between Duke Street on-ramp and GP-to-HOV/HOT slip ramp, south of Duke Street (HCS filename: MS0105weave):** This segment does not include any new or modified access in the Build scenario and remains geometrically and operationally the same between No-Build and Build scenario. Thus, the configuration of the No-Build and Build conditions are geometrically the same, but operational different in that the Build scenario proposed conversion from HOV to HOT. HCS results show LOS F for existing and all future scenarios in this segment. This is a pre-existing congestion that affects this segment during the PM peak, therefore, There are currently no geometric changes proposed in this segment by the HOT Lanes project.

- **Weave - Southbound I-95 HOV/HOT Lanes, between on-ramp from I-495 and off-ramp to Franconia Road (HCS filename: HS0601weave):** This weaving segment is located within a geometrically constrained part of the fully-built system interchange, recently constructed within the past few months. Thus, the configuration of the No-Build and Build conditions are geometrically the same, but operational different in that the Build scenario proposed conversion from HOV to HOT. Due to MSE walls and piers for the I-95 viaduct which straddle this segment, there are no options for geometric changes at this location.

  HCS results show LOS F for both 2018 and 2035 PM Build scenarios. However, VISSIM simulation shows operation is adequate and density for the weave segment is equivalent to LOS C. The HCS analysis does not reflect the signing in place that will allow HOT/HOV vehicles to change lanes in advance and avoid last minute weaving to exit the facility. In addition, this weave condition could be managed by the operator through toll pricing to minimize the weaving and maintain free-flow operations.

- **Weave - Southbound I-95 GP Lanes, between HOV/HOT-to-GP Flyover on-ramp and off-ramp to Opitz/Dale Boulevard, south of Prince William Parkway (HCS filename: MS1302weave):** This segment does not include any new or modified access in the Build scenario and remains geometrically and operationally the same between No-Build and Build scenario. Thus, the configuration of the No-Build and Build conditions are geometrically the same, but operational different in that the Build scenario proposed conversion from HOV to HOT. The segment is also located within a constrained area. HCS results show LOS F for existing and all future scenarios in this segment. VISSIM results show a density equivalent to LOS C. There is significant metering of traffic upstream this segment due to constrained capacity. The VISSIM model shows that only 84% of the total demand is able to go through this segment during the PM peak hour.

- **Weave - Southbound I-95 GP Lanes, between HOV/HOT-to-GP slip ramp and off-ramp to Car Rest Area, south of Dale Boulevard (HCS filename: MS1502weave):** This segment does not include any new or modified access in the Build scenario and remains geometrically and operationally the same between No-Build and Build scenario. Thus, the configuration of the No-Build and Build conditions are geometrically the same, but operational different in that the Build scenario proposed conversion from HOV to HOT. HCS results show LOS E for 2018 No-Build and LOS F for 2018 Build PM peak scenarios. Both 2035 Build and No-Build show LOS F. This is another location where the HCS analysis using 100% of the demand volumes may be overly conservative. VISSIM results show a density equivalent to LOS C. There is significant metering of traffic upstream of this segment. The VISSIM model shows that only 85% of the total demand is able to go through this segment during the PM peak hour.
- **Weave - Southbound I-95 GP Lanes, between HOV/HOT-to-GP Flyover ramp and off-ramp to Garrisonville Road, south of Russell Road (HCS filename: MS1802weave):** HCS results show LOS D for 2018 No-Build and LOS F for 2018 Build PM peak scenarios. Both 2035 Build and No-Build show LOS F. This is another location where the HCS analysis using 100% of the demand volumes may be overly conservative. VISSIM results show a density equivalent to LOS C. There is significant metering of traffic upstream of this segment. The VISSIM model shows that only 85% of the total demand is able to go through this segment during the PM peak hour. In addition, significant advanced guide signing for the exit ramps will be posted to help ensure that motorists are not changing lanes at the last minute to execute a maneuver in the interchange proper.
- **Diverge - Southbound I-95 HOV/HOT Lanes, HOV/HOT-to-GP Flyover ramp, south of Duke Street (HCS filename: RH0202diverge):** This segment does not include any new or modified access in the Build scenario and remains geometrically and operationally the same between No-Build and Build scenario. Thus, the configuration of the No-Build and Build conditions are geometrically the same, but operational different in that the Build scenario proposed conversion from HOV to HOT. While HCS results show degradation in 2035 Build PM from LOS D to LOS E, the absolute difference is roughly 5 veh/mi/ln. This is a marginal degradation. Operating speed is above 55mph. The VISSIM model shows adequate operation on this HOV segment with density equivalent to LOS C. Also, traffic demand in this segment can be influenced or reduced by dynamic-pricing tolls to maintain adequate operations.
- **Diverge - Southbound I-95 HOV/HOT Lanes, Off-ramp to I-495 (HCS filename: RH0509diverge):** While HCS results show degradation in 2035 Build PM from LOS D to LOS E, the absolute difference in density is only 6 veh/mi/ln. This is a marginal degradation. Operating speed is above 50mph. The VISSIM model shows adequate operation on this HOV/HOT segment with density equivalent to LOS C and operating speed of 66mph. In addition, significant metering is found upstream of this segment as indicated by the VISSIM model results. Also, traffic demand in this segment can be influenced or reduced by dynamic-pricing tolls to maintain adequate operations.

The weave and diverge areas suggested for re-evaluation are located within constrained areas, either due to environmental considerations (as is the issue at Turkeycock/Duke Street, Russell Road/Garrisonville Road) or due to geometric / land use constraints (at I-495 interchange, Franconia Road, Opitz/Dale Blvd, and Prince William Parkway). It should be noted that south of Duke Street, the southbound ramp from the HOT lanes to GP is a flyover, while the existing southbound ramp from the GP to the HOV lanes is a left-side slip ramp.

In general, for future conditions, the V/C ratios at many of the locations discussed above are overly conservative due to the fact that traffic forecasts are significantly higher than the available upstream capacity, especially along the interchanging arterials. As such, the minor street approaches and arterials at adjacent intersections, which feed traffic to the interchange on-ramps, are metering the amount of actual vehicle throughput that reaches the freeway segment in question. The resulting assessment in HCS 2010 is a LOS which shows higher degradation and a density which is greater than what would be expected under capacity constrained conditions and what is shown in the traffic simulation analysis results.

9.3.1.2 Speed Analysis

AM Peak

Exhibit 9-6 illustrates the model speed profiles in comparison to INRIX data for Existing AM peak hour conditions. As seen in the congestion diagram there are three bottleneck locations in the AM peak direction:

- Weave section between Gordon Road and Richmond Highway (US 1).
- Near the Fairfax County Parkway Eastbound Off-ramp
- North of the Duke Street Interchange (external to the VISSIM network)

As illustrated in Exhibit 9-6, the model shows slowing in two of the three bottleneck locations, but not to the same degree as the INRIX data. At the weave between Gordon Road and Richmond Highway, the model replicated the location where the traffic slows down, but it does not match the exact length of the speed reduction in this area. During the period when data collection was done this section of freeway was under construction and work zone traffic conditions for the I-95 Fourth Lane widening project were in place. Therefore, the queue caused by the bottleneck in the field at this location is longer than usual.

Based on the INRIX data, the second bottleneck location starts at the Fairfax County Parkway eastbound off-ramp where the ramp terminal queue spills back onto the I-95 mainline. However, during a field review of this bottleneck location, it was observed that this was not the case. Queues were observed to occasionally spill onto the mainline and them dissipate quickly and would not cause significant queuing. The VISSIM model was calibrated to replicate this observed condition (rather than the condition shown in the INRIX data). It is important to note that the segment from Fairfax County Parkway to Gordon Boulevard was under construction for the I-95 Fourth Lane Widening and traffic flow was severely affected in this area. This can be seen in the travel time segments as well.

The final northbound bottleneck location in the AM peak begins outside of the VISSIM study area and the queue extends from north of the Duke Street interchange to the Springfield Interchange during the AM peak hour. While the northern terminus of the HOV lanes is at the Turkeycock ramp, which is south of Duke Street, the study area extends to the Duke Street interchange to comply with FHWA guidelines. The downstream bottleneck (north of Duke Street) is due to the weaving volumes between the Duke Street and Seminary Road interchanges.

In the AM peak hour, the northbound HOV lanes operate at free flow conditions. The VISSIM model replicates the HOV lane conditions.

Speed data from the VISSIM model for Existing AM conditions is also geographically illustrated in **Figure 9-1** for all study segments along the I-95 study corridor.

Exhibit 9-6: Existing AM Peak- Congestion Speed Profile (GP Lanes)

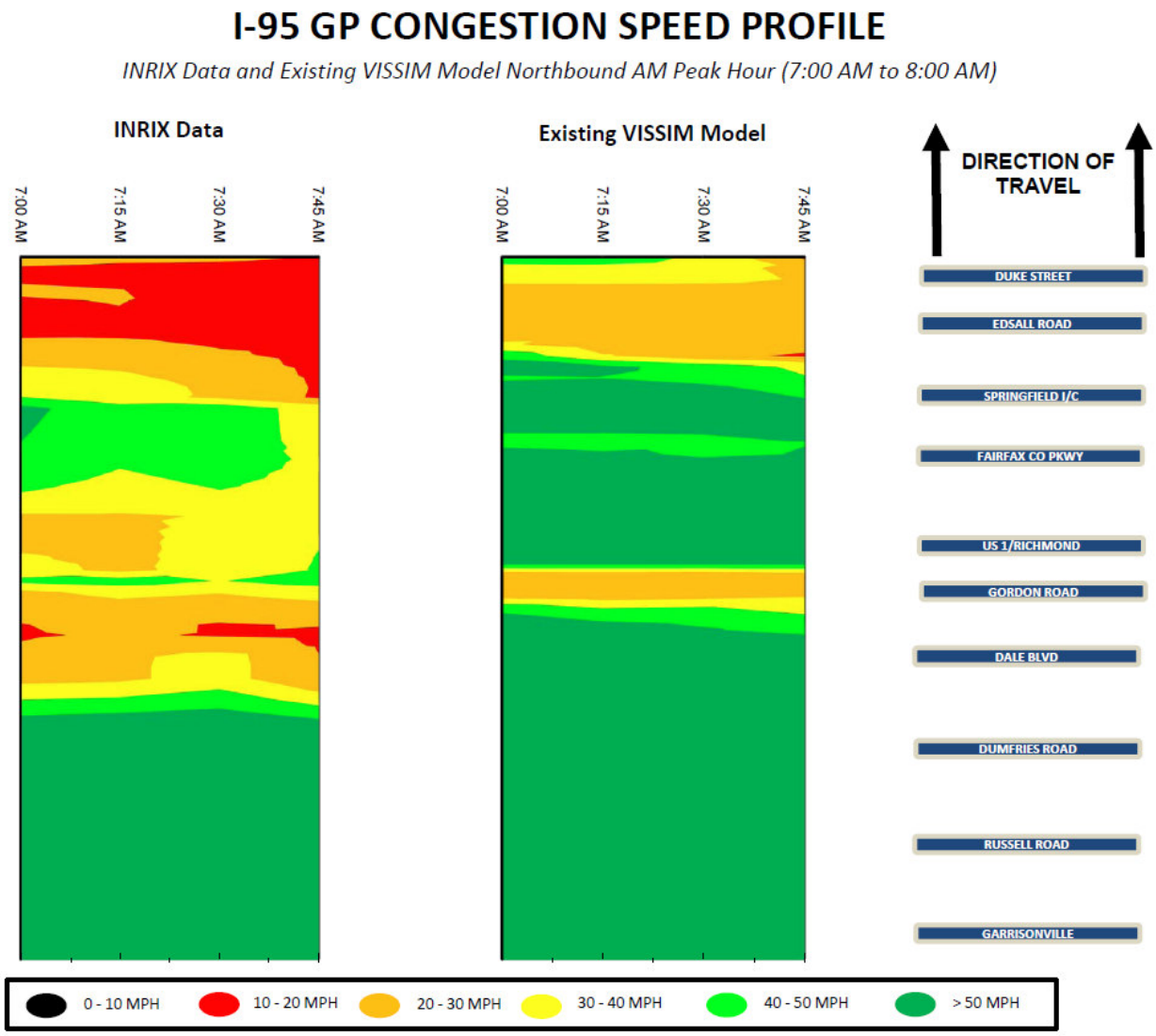
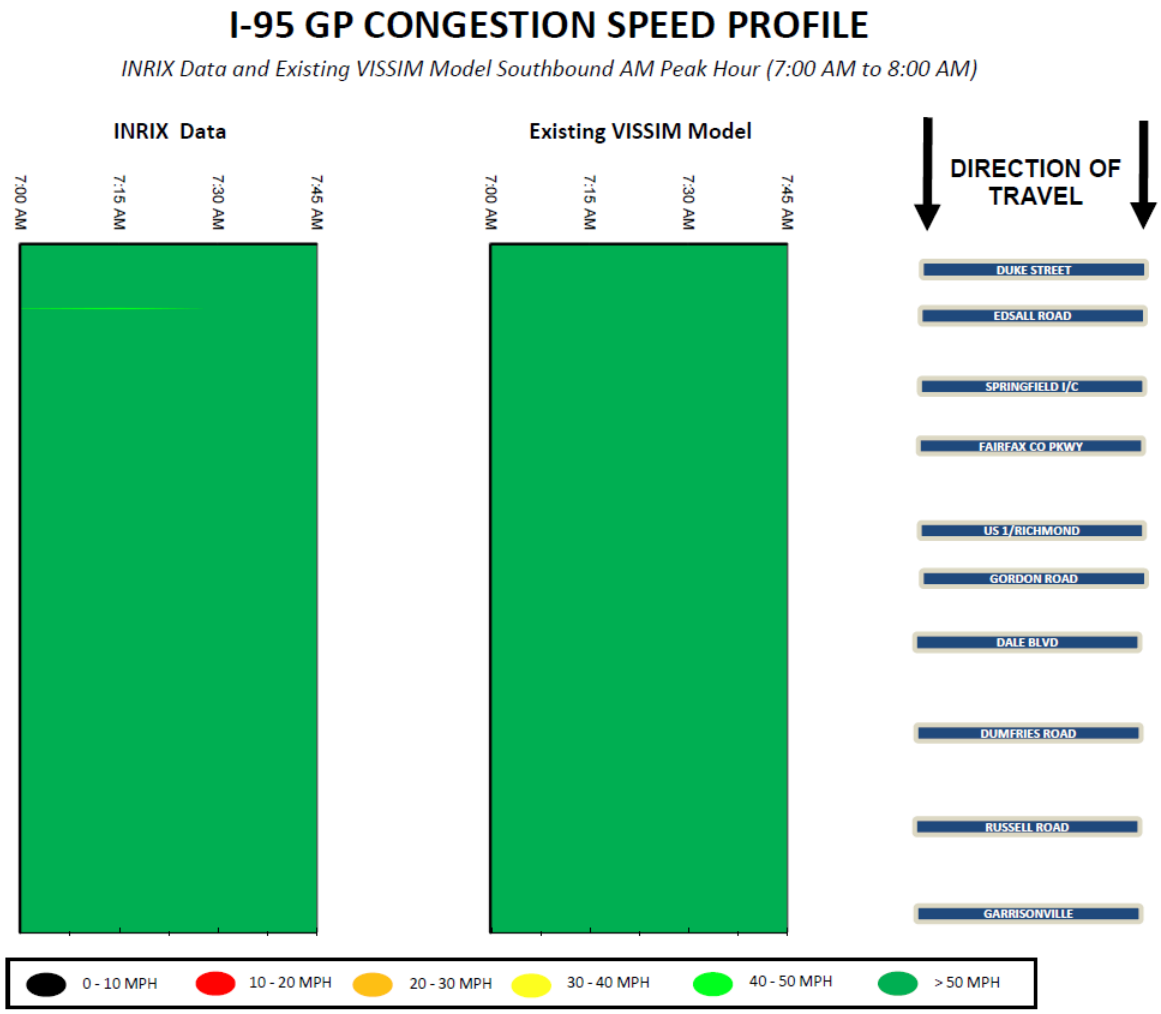


Exhibit 9-6: Existing AM Peak- Congestion Speed Profile (GP Lanes)



PM Peak

Exhibit 9-7 illustrates the model speed profiles in comparison to INRIX data for Existing PM peak hour conditions. The VISSIM model replicates bottleneck locations in the field during Existing PM peak hour conditions. However, the extent of the congestion areas is less than what is shown in the INRIX data.

In the southbound direction, there are three bottleneck locations shown on the speed profile diagram, which are located:

1) Turkeycock slip ramp near Edsall Road
2) Gordon Boulevard/Ox Road
3) Near Dumfries Road slip ramp and south of Russell Road

These locations largely match with the travel time analysis results. The first bottleneck is located near the Turkeycock slip ramp and Edsall Road interchange. It is mainly caused by the close spacing of the Duke Street interchange, Turkeycock slip ramp and Edsall Road interchange (all located within 9,000 feet of each other). Couple with the high traffic demand on southbound I-395 inside the Beltway, the result is frequent merging, diverging and weaving that lead to slow moving vehicles and queuing during the PM peak. The average traveling speed is around 20-30 mph in this section.

Based on INRIX data, the second bottleneck located at Gordon Road/Ox Road (Route 123) is the most severe bottleneck location on the I-95 corridor within the study area in PM peak hour. Traffic operations are regularly stop-and-go in the PM peak. The queue in this location is typically five to six miles in length, extending as far back as the Fairfax County Parkway interchange. Based on INRIX field data, the average travel speed is 10 to 20 mph throughout most of this section. Traffic is metered because of the lane reduction from four lanes to three lanes between Gordon Boulevard and Route 1. In addition, the construction activities of the I-95 Fourth Lane Widening project were found to further impede the traffic operations in this section.

The third bottleneck is located in the southern end of the study area near the Dumfries Road slip ramp and south of Russell Road. The HOV traffic merging to the GP lane from left side slip ramp at the southern terminus near Dumfries Road consistently causes congestion and queuing in this section of the corridor. In addition, the on-ramp at Russell Road adds additional traffic in this area which increases the severity of the bottleneck. Based on the field observations and INRIX data, the average speed of traffic stream between Russell Road and Dumfries Road ranges from 10 to 30 mph in the PM peak hour.

On the northbound GP lanes and southbound HOV lanes, traffic flow at free flow conditions. The overall average speeds on both facilities are above 50 mph cross the entire corridor.

Speed data from the VISSIM model for Existing PM conditions is also geographically illustrated in **Figure 9-3** for all study segments along the I-95 study corridor.

Exhibit 9-7: Existing PM Peak- Congestion Speed Profile (GP Lanes)

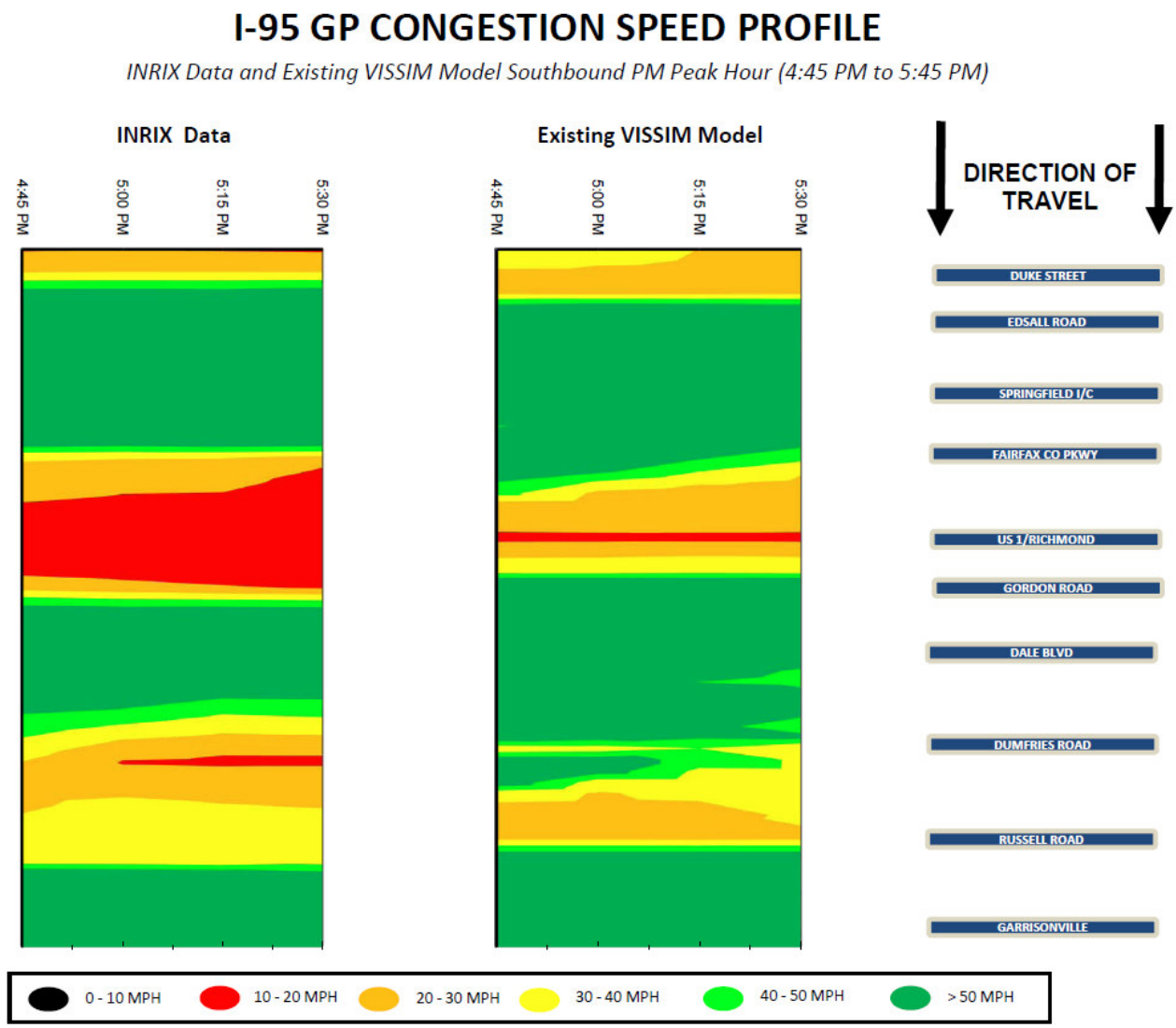
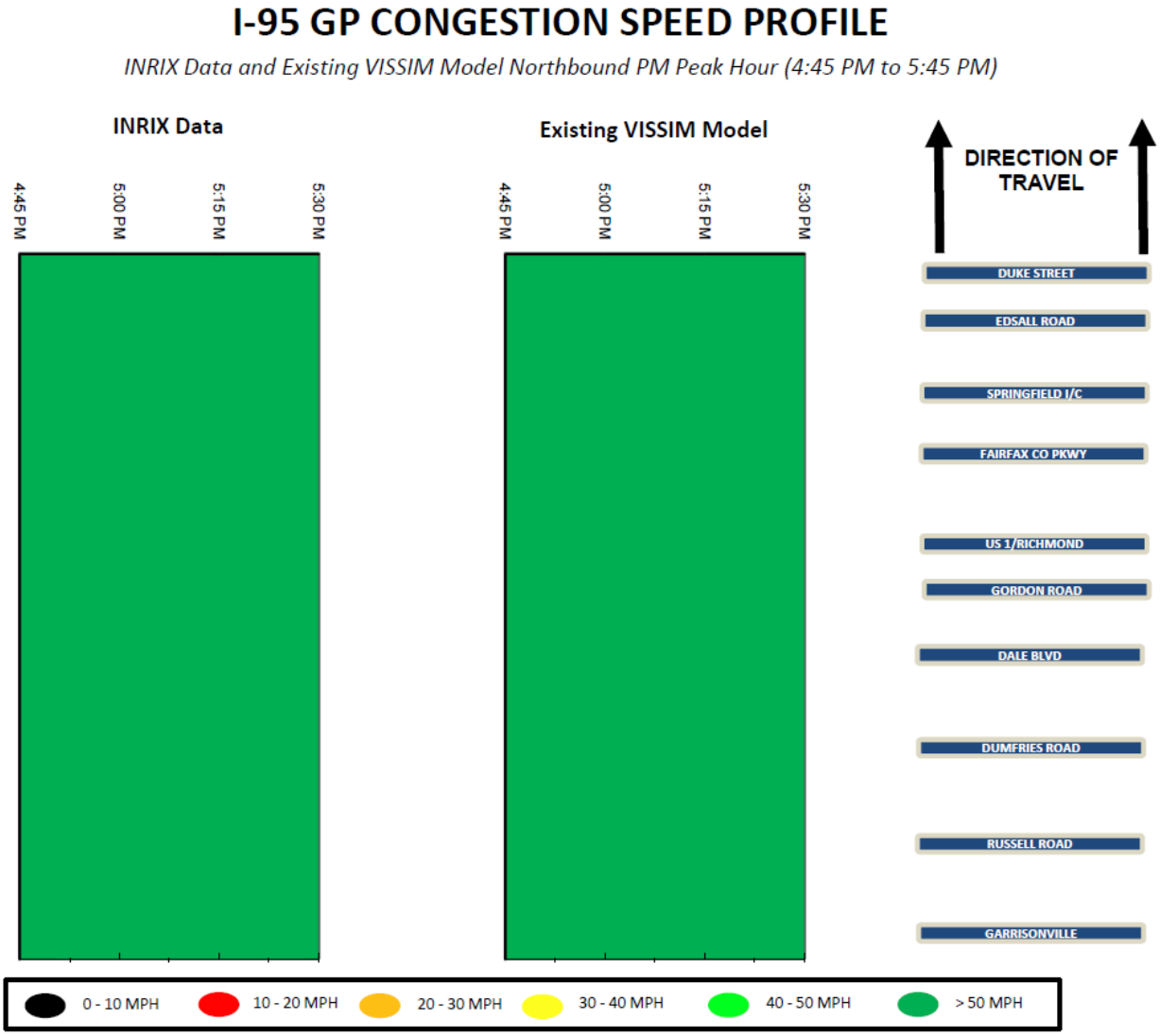


Exhibit 9-7: Existing PM Peak- Congestion Speed Profile (GP Lanes)



9.3.1.3 Volume Served Analysis

AM Peak

Table 9-4 shows the volume throughput from the model compared to the field throughput for the mainline and ramps in the study area in the AM peak hour. Table 9-4 also summarizes the detailed GEH statistics by facility types and directions.

For the entire corridor, 93 percent of all locations meet the required GEH value. 93 percent of all ramps locations and 92 percent of freeway mainline locations are within the required GEH value. Once again, GEH values greater than 85% mean the study segment or ramp are calibrated.

In the northbound direction, 90 percent of all ramp locations are within the required GEH value. For the combined mainline and ramp links, 91 percent meet the required GEH value. Similar to the travel time segments, the volume comparisons were grouped into four sub-sections. During the AM peak hour almost all subareas meet the GEH target, with the exception of two segments - northbound GP lanes between Fairfax County Parkway and the Springfield Interchange and northbound HOV lanes between Dumfries Road and Gordon Boulevard. This is primarily because the sample set for this particular sub-sections is smaller than the other segments.

PM Peak

Table 9-5 shows the volume throughput from the model compared to the field throughput for the mainline and ramps in the study area in the PM peak hour. Table 9-5 also summarizes the detailed GEH statistics by facility types and directions.

For the entire corridor, 95 percent of all locations meet the required GEH value. 96 percent of all ramps locations and 92 percent of freeway mainline locations are within the required GEH value. Once again, GEH values greater than 85% mean the study segment or ramp are calibrated.

Specifically, in the peak southbound direction for the overall corridor, 94 percent of all locations and 93 percent of all ramp locations are within the required GEH value. Almost all segments subarea meets this target as well, with the only exception in the northbound direction between Fairfax County Parkway and the Springfield Interchange. This is primarily because the sample set for this particular sub-section is smaller than other subsections.

In the off-peak direction, all the locations meet the target GEH value. For overall mainline links it is at 92 percent. Similar to the travel time segments volume comparisons were grouped into four sub-sections.

Table 9-4: Existing AM Peak – Volume Calibration Summary

Dir.	Segment	Number of Locations			Locations Meeting GEH			Percent Meeting GEH		
		Mainline	Ramps	Overall	Mainline	Ramps	Overall	Mainline	Ramps	Overall
	Overall Study Area	**12**	**144**	**156**	**11**	**134**	**145**	**92%**	**93%**	**93%**
NB	I-95 Garrisonville to Dale Boulevard	2	13	15	2	13	15	N/A	100%	100%
NB	I-95 Dale Boulevard to Fairfax Co. Parkway	0	25	25	0	23	23	N/A	92%	92%
NB	I-95 Fairfax Co. Parkway to Springfield IC	0	8	8	0	6	6	N/A	75%	75%
NB	I-95 Springfield to I-395 Duke Street	1	15	16	1	13	14	N/A	87%	88%
NB	**Total**	**3**	**61**	**64**	**3**	**55**	**58**	**N/A**	**90%**	**91%**
SB	I-95 Dale Boulevard to Garrisonville	1	11	12	1	11	12	N/A	100%	100%
SB	I-95 Fairfax Co Parkway to Dale Boulevard	3	23	26	3	22	25	N/A	96%	96%
SB	I-95 Springfield to I-95 Fairfax Co. Parkway	0	9	9	0	9	9	N/A	100%	100%
SB	I-395 Duke Street to I-95 Springfield	1	7	8	1	7	8	N/A	100%	100%
SB	**Total**	**5**	**50**	**55**	**5**	**49**	**54**	**N/A**	98%	98%
IL	I-495 Entire Corridor	2	9	11	1	9	10	N/A	100%	91%
OL	I-495 Entire Corridor	2	12	14	2	11	13	N/A	92%	93%
NB	I-95 HOV Lanes Dumfries - Gordon Blvd	0	4	4	0	3	3	N/A	75%	75%
NB	I-95 HOV Lanes Gordon Blvd - Springfield Int	0	7	7	0	6	6	N/A	86%	86%
NB	I-395 HOV Lanes Springfield - Seminary Rd	0	1	1	0	1	1	N/A	100%	100%

Notes:
1. The percent meeting GEH volumes are considered acceptable if 85 percent of all locations have a GEH value less than 5.
2. Percent meeting targets are shown for sections with 5 or more data points.

Table 9-5: Existing PM Peak – Volume Calibration Summary

Direction	Segment	Number of Locations			Locations Meeting GEH (Throughput)			Percent Meeting GEH (Throughput)[1]		
		Mainline	Ramps	Overall	Mainline	Ramps	Overall	Mainline[3]	Ramps	Overall
Overall Study Area		**12**	**141**	**153**	**11**	**135**	**146**	**92%**	**96%**	**95%**
NB	I-95 Garrisonville to Dale Boulevard	1	11	12	1	11	12	N/A	100%	100%
	I-95 Dale Boulevard to Fairfax Co. Parkway	1	27	28	1	27	28	N/A	100%	100%
	I-95 Fairfax Co. Parkway to Springfield IC	0	13	13	0	13	13	N/A	100%	100%
	I-95 Springfield to I-395 Duke Street	1	7	8	1	7	8	N/A	100%	100%
	Total	**3**	**58**	**61**	**3**	**58**	**61**	**N/A**	**100%**	**100%**
SB	I-395 Duke Street to I-95 Springfield	1	9	10	0	9	9	N/A	100%	90%
	I-95 Springfield to I-95 Fairfax Co. Parkway	0	8	8	0	6	6	N/A	75%	75%
	I-95 Fairfax Co Parkway to Dale Boulevard	1	27	28	1	26	27	N/A	96%	96%
	I-95 Dale Boulevard to Garrisonville	1	8	9	1	8	9	N/A	100%	100%
	Total	**3**	**52**	**55**	**2**	**49**	**51**	**N/A**	**94%**	**93%**
Inner Loop	I-495 Entire Corridor	2	8	10	2	8	10	N/A	100%	100%
Outer Loop	I-495 Entire Corridor	2	11	13	2	10	12	N/A	91%	92%
SB	I-395/I-95 HOV Lanes Entire Corridor	2	12	14	2	10	12	N/A	83%	86%

Notes:
1. The percent meeting GEH volumes are considered acceptable if 85 percent of all locations have a GEH value less than 5.
2. Percent meeting targets are shown for sections with 5 or more data points.

9.3.1.5 Freeway Density Analysis

AM Peak

Basic Freeway Segments

As summarized in **Table 9-6**, in the Existing AM scenario there are 43 basic segments in the GP lanes of I-95 in the northbound direction. Of these segments, nine operate with severe congestion, eight segments operate with heavy congestion and the remaining 26 segments operate at an acceptable level. There are 14 basic segments in the HOV lanes. All HOV segments currently operate at an acceptable level.

Weave Segments

Table 9-7 summarizes the weaving segment analysis results for Existing conditions. There are a total of seven weave segments on the GP lanes, out of which three segments operate with severe congestion and the remaining four operate with acceptable conditions. There are no weaving segments on the HOV facility.

Ramp Junctions

The ramp junction analysis is summarized in **Table 9-8**. The summary includes diverge and merge segments for Existing conditions. There are a total of 33 ramp junctions out of which ten segments operate with severe congestion, two segments with heavy congestion, and the remaining 21 segments operate at an acceptable level. All the ramp segments on the HOV facility are operating at an acceptable level.

Figure 9-2 illustrates the LOS results from the VISSIM modeling geographically along all segments of I-95 in the study area for Existing AM conditions.

Table 9-6: Northbound Freeway Basic Segments Density Analysis for Existing AM Peak

Basic Freeway Segments		Existing AM		
ID	Description	Average Density (veh/mi/ln)	Average Speed (mph)	HCM Equivalent LOS
FGN095Gar01#01	From south of Garrisonville Rd to I-95 NB Off-ramp to US-1	32	59	D
FGN095Gar02#03	Between I-95 NB Off-ramp to US-1 and I-95 NB On-ramp from Garrisonville Rd EB	27	62	D
FGN095Gar03#05	Between I-95 NB Off-ramp to Garrisonville Rd WB and I-95 NB On-ramp from US-1	29	61	D
FGN095Rus01#07	Between I-95 NB On-ramp from US-1 and I-95 NB Off ramp to Russell Rd	32	61	D
FGN095Rus02#9	Between I-95 NB Off ramp to Russell Rd and I-95 NB On ramp from Russell Rd	32	56	D
FGN095Jop01#11	Between I-95 NB On-ramp from Russell Rd and I-95 Off ramp to Joplin Rd	34	56	D
FGN095Jop02#13	Between I-95 NB Off ramp to Joplin Rd and I-95 NB On ramp from Joplin Rd	35	56	D
FGN095Dum01#15	Between I-95 NB On-ramp from Joplin Rd and GP-to-HOT ramp s/o Dumfries Rd	42	53	E
FGN095Dum02#17	Between GP-to-HOT ramp s/o Dumfries Rd and Off-ramp to Dumfries Rd EB (3 lanes)	40	52	E
FGN095Dum04#20	Between I-95 NB Off-ramp to Dumfries Rd WB and On-ramp from Dumfries Rd	20	60	C
FGN095Dum05#22	Between I-95 NB On-ramp from Dumfries Rd and Off-ramp to Truck Rest Area	24	65	C
FGN095Dal01#24	Between I-95 NB Off-ramp to Truck Rest Area and On-ramp from Truck Rest Area	24	65	C
FGN095Dal02#27	Between GP-to-HOT Off ramp s/o Dale Blvd and Off-ramp to Rest Area s/o Dale Blvd	25	61	C
FGN095Dal03#29	Between I-95 NB Off-ramp to Rest Area s/o Dale Blvd and On-ramp from Rest Area	27	57	D
FGN095Dal04#31	Between I-95 NB Off-ramp to Dale Blvd and On-ramp from Dale Blvd	20	57	C
FGN095PWP01#33	Between I-95 NB On-ramp from Opitz Blvd and Off-ramp to PWP	41	43	E
FGN095PWP02#35	Between I-95 NB Off-ramp to PWP and On ramp from PWP	75	26	F
FGN095Gdn01#37	Between I-95 NB On-ramp from PWP and Off-ramp to Gordon Blvd EB	109	14	F
FGN095Gdn02#39	Between I-95 NB Off-ramp to Gordon Blvd EB and On-ramp from Gordon Blvd EB	106	14	F
FGN095Gdn03#41	Between I-95 NB Off-ramp to Gordon Blvd WB and On-ramp from Gordon Blvd WB	34	48	D
FGN095Rt101#43	3-Lane segment between I-95 NB Off-ramp to Richmond Hwy and downstream 4-lane segment On-ramp from Richmond Hwy	27	51	D
FGN095Rt102#44	4-lane segment between upstream 3-lane segment and I-95 NB On ramp from Richmond Hwy	20	54	C
FGN095Lor01#46	5-lane Basic segment between I-95 NB On-ramp from NB Richmond Hwy and downstream 4-lane Basic segment	20	52	C
FGN095Lor02#46	4-lane Basic segment between upstream 5-lane Basic segment n/o Richmond Hwy and Off-ramp to Lorton Rd	25	53	C
FGN095Lor03#48	Between I-95 NB Off-ramp to Lorton Rd and On-ramp from Lorton Rd	24	53	C
FGN095FCP01#50	5-lane Basic segment between I-95 NB On-ramp from Lorton Rd and downstream 4-lane segment	25	51	C
FGN095FCP02#51	4-lane Basic segment between upstream 5-lane segment n/o Lorton Rd and GP-to-HOT ramp s/o FCP	31	52	D
FGN095FCP03#53	Between I-95 NB GP-to-HOT ramp s/o FCP and Off-ramp to FCP	37	48	E
FGN095FCP04#55	Between I-95 NB Off-ramp to EB FCP and On-ramp from EB FCP	28	50	D
FGN095FCP05#57	Between I-95 NB Off-ramp to WB FCP and On-ramp from WB FCP	27	53	D
FGN095FSP01#59	Between I-95 NB On-ramp from WB FCP and HOT-to-GP flyover n/o FCP	29	53	D
FGN095FSP02#61	Between I-95 NB HOT-to-GP flyover n/o FCP and Off-ramp to FSP	33	51	D
FGN095Fra01#63	Between I-95 NB Off-ramp to FSP and GP-to-HOT ramp s/o Franconia Rd	31	49	D
FGN095Fra02#65	Between I-95 NB GP-to-HOT Off ramp s/o Franconia Rd and Major Diverge at Franconia Rd	36	44	E
FGN095Fra03#66	Between Major Diverge at Franconia Rd and On-ramp from EB Franconia Rd (left side)	43	41	E
FGN095Spr01#67	Between On-ramps from EB Franconia Rd on left and right-sides of I-95 NB	41	39	E
FGN095Spr02#68	Between On-ramp from EB Franconia Rd on right-side of I-95 NB and Major Diverge s/o Springfield IC	38	40	E
FGN095Spr03#69	Between Major Diverge s/o Springfield IC and I-395 NB On-ramp from Franconia Rd	73	19	F
FGN095Spr03#71	Between Major Diverge s/o Springfield IC and I-395 NB On-ramp from Franconia Rd	87	15	F
FGN395Eds01#74	Between I-395 NB Off-ramp to WB Edsall Rd and On-ramp from Edsall Rd	98	15	F
FGN395Duk01#76	Between I-395 NB GP-to-HOT flyover s/o Duke St and I-95 Off ramp to Duke St EB	84	20	F
FGN395Duk02#79	Between I-395 NB Off-ramp to WB Duke St and On-ramp from Duke St	94	16	F
FGN395Sem01#81	Between I-395 NB On-ramp from Duke St and n/o Duke St	64	28	F

Table 9-7: Northbound Freeway Weave Segments Density Analysis for Existing AM Peak

Weave Segments		Existing AM		
ID	Description	Average Density (veh/mi/ln)	Average Speed (mph)	HCM Equivalent LOS
WGN095Gar01#04	Between I-95 NB On-ramp from EB Garrisonville Rd and Off-ramp to WB Garrisonville Rd	26	56	C
WGN095Dal01#30	Between I-95 NB On-ramp from Rest Area and Off ramp to Opitz Blvd	21	55	C
WGN095Gdn01#40	Between I-95 NB On-ramp from EB Gordon Blvd and Off-ramp to WB Gordon Blvd	84	18	F
WGN095Rt101#42	Between I-95 NB On-ramp from Gordon Blvd and Off-ramp to Richmond Hwy	27	50	C
WGN095FCP01#56	Between I-95 NB On-ramp from EB FCP and Off-ramp to WB FCP	25	48	C
WGN395Eds01#72	Between I-395 On-ramp from I-495 EB/WB and Off-ramp to Edsall Rd	113	11	F
WGN395Duk01#75	Between I-395 NB On-ramp from Edsall Rd and GP-to-HOT flyover s/o Duke St	90	16	F

Table 9-8: Northbound Freeway Ramp Junction Segments Density Analysis for Existing AM

Ramp Junctions		Existing AM		
ID	Description	Average Density (veh/mi/ln)	Average Speed (mph)	HCM Equivalent LOS
DGN095Gar01#02	I-95 NB Off-ramp to US-1	34	52	D
MGN095Gar01#06	I-95 NB On-ramp from US-1	24	59	C
DGN095Rus01#8	I-95 NB Off ramp to Russell Rd	32	51	D
MGN095Rus01#10	I-95 NB On-ramp from Russell Rd	29	52	D
DGN095Jop01#12	I-95 NB Off-ramp to Joplin Rd	30	56	D
MGN095Jop01#14	I-95 NB On-ramp from Joplin Rd	37	51	E
DGN095Dum01#16	I-95 NB GP-to-HOV/HOT Off ramp s/o Dumfries Rd	38	52	E
DGN095Dum02#18	I-95 NB Off-ramp to Dumfries Rd EB	35	51	D
DGN095Dum03#19	I-95 NB Off-ramp to Dumfries Rd WB	21	57	C
MGN095Dum01#21	I-95 NB On-ramp from Dumfries Rd	21	62	C
DGN095Dal01#23	I-95 NB Off-ramp to Truck Rest Area n/o Dumfries Rd	21	66	C
MGN095Dal01#25	I-95 NB On-ramp from Truck Rest Area n/o Dumfries Rd	18	59	B
DGN095Dal02#26	I-95 NB GP-to-HOV/HOT Off ramp s/o Dale Blvd	19	65	B
DGN095Dal03#28	I-95 NB Off-ramp to Rest Area s/o Dale Blvd	23	57	C
MGN095Opt01#32	I-95 NB On-ramp from Dale Blvd	30	41	D
DGN095PWP01#34	I-95 NB Off-ramp to Prince William Pkwy	44	41	F
MGN095PWP01#36	I-95 NB On-ramp from Prince William Pkwy	116	12	F
DGN095Gdn01#38	I-95 NB Off-ramp to Gordon Blvd EB	92	18	F
MGN095Rt101#45	I-95 NB On-ramp from Richmond Hwy NB	18	53	B
DGN095Lor01#47	I-95 NB Off-ramp to Lorton Rd	23	52	C
MGN095Lor01#49	I-95 NB On-ramp from Lorton Rd	23	51	C
DGN095FCP01#52	I-95 NB GP-to-HOV/HOT Off ramp s/o Fairfax County Pkwy	31	49	D
DGN095FCP02#54	I-95 NB Off-ramp to Fairfax County Pkwy EB	54	35	F
MGN095FCP01#58	I-95 NB On-ramp from Fairfax County Pkwy WB	26	52	C
MGN095FSP01#60	I-95 NB HOV/HOT-to-GP flyover n/o Fairfax County Pkwy	31	48	D
DGN095FSP01#62	I-95 NB Off-ramp to Franconia-Springfield Pkwy	30	51	D
DGN095Fra01#64	I-95 NB GP-to-HOV/HOT Off ramp s/o Franconia Rd	32	48	D
MGN095Spr01#70	I-395 NB On-ramp from Franconia Rd WB	99	13	F
DGN395Eds01#73	I-395 NB Off-ramp to Edsall Rd WB	94	16	F
DGN395Duk01#77	I-395 NB Off-ramp to Duke St EB	74	21	F
DGN395Duk02#78	I-395 NB Off-ramp to Duke St WB	81	19	F
MGN395Duk01#80	I-395 NB On-ramp from Duke St	88	21	F

PM Peak

Basic Freeway Segments

As summarized in **Table 9-9**, in the Existing PM scenario there are 46 basic segments in the GP lanes of I-95 in the southbound direction. Of these segments, sixteen operate with severe congestion, nine segments operate with heavy congestion, and the remaining 21 segments operate at an acceptable level. There are 17 basic segments in the HOV lanes. All HOV segments currently operate at an acceptable level.

Weave Segments

Table 9-10 summarizes the weaving segment analysis results for Existing conditions. There are a total six weave segments on the GP lanes, out of which four segments operate with severe congestion, one operates with heavy congestion and the remaining four operate at an acceptable level. There are no weaving segments on the HOV facility.

Ramp Junctions

The ramp junction analysis is summarized in **Table 9-11**. The summary includes all diverge and merge segments for Existing conditions. There are a total of 32 ramp junctions out of which sixteen segments operate with severe congestion, four segments with heavy congestion, and the remaining 12 segments operate at an acceptable level. All the ramp segments on the HOV facility are operating at an acceptable level.

Figure 9-4 illustrates the LOS results from the VISSIM modeling geographically along all segments of I-95 in the study area for Existing PM conditions.

Table 9-9: Southbound Freeway Basic Segments Density Analysis for Existing PM Peak

Basic Freeway Segments		Existing PM		
ID	Description	Average Density (veh/mi/ln)	Average Speed (mph)	HCM Equivalent LOS
FGS395Sem01#1	Between Seminary Rd and I-395 Off ramp to Duke St	91	21	F
FGS395Duk01#3	4-lane segment between I-395 SB Off ramp to Duke St and downstream 3-lane segment n/o Duke St	89	19	F
FGS395Duk02#4	3-lane segment between upstream 4-lane segment and I-395 On ramp from Duke St WB	82	26	F
FGS395Duk03#6	Between I-395 Off ramp to Duke St EB and I-395 On ramp from Duke St	77	26	F
FGS395Duk04#9	Between I-395 Off Ramp to HOV SB Off ramp and HOV SB On Ramp s/o Duke St	42	47	E
FGS395Eds01#11	Between I-395 Off ramp to Edsall Rd WB and I-395 On ramp from Edsall Rd WB	36	53	E
FGS395Eds02#13	3-lane segment between I-395 Off ramp to Edsall Rd EB and downstream 4-lane segment	40	52	E
FGS395Eds03#14	4-lane segment between upstream 3-lane segment and I-395 On ramp from Edsall Rd EB	28	57	D
FGS095Spr01#16	Between I-395 SB Off ramp to EB/WB I-495 and I-395 Off ramp to Franconia	26	59	C
FGS095Spr02#17	Between I-395 Off ramp to Franconia and I-95 On ramp from I-495 EB	25	61	C
FGS095Spr03#18	4-lane segment between I-95 On ramp from I-495 EB and I-95 On ramp from I-495 WB	24	58	C
FGS095Fra01#19	6-lane segment between I-95 On ramp from I-495 WB and downstream 5-lane segment s/o Franconia Rd	22	58	C
FGS095Fra02#20	5-lane segment between upstream 6-lane segment and I-95 On ramp from Franconia Rd	27	58	D
FGS095FSP01#22	Between I-95 On ramp from Franconia Rd and I-95 On ramp from HOV s/o Franconia Rd	28	57	D
FGS095FSP03#25	4-lane segment between HOV Off Ramp s/o Franconia Rd and downstream 5-lane segment n/o FCP	29	58	D
FGS095FSP04#26	4-lane segment between HOV Off Ramp s/o Franconia Rd and downstream 5-lane segment n/o FCP	29	58	D
FGS095FSP05#27	5-lane segment between upstream 4-lane segment and I-95 SB Off Ramp to FCP WB	23	60	C
FGS095FCP01#29	Between I-95 Off ramp to FCP WB and I-95 SB On ramp from FCP WB	29	58	D
FGS095FCP02#31	Between I-95 Off ramp to FCP EB and I-95 SB On ramp from FCP EB	27	58	D
FGS095FCP03#33	Between I-95 SB On ramp from FCP and I-95 SB HOV-to-GP On ramp s/o FCP	32	54	D
FGS095Lor01#35	Between I-95 SB On ramp from HOV On ramp s/o FCP and I-95 SB Off ramp to Lorton Rd	59	33	F
FGS095Lor02#37	Between I-95 SB Off ramp to Lorton Rd and I-95 SB On ramp from Lorton Rd	102	13	F
FGS095Rt101#39	Between I-95 SB On ramp from Lorton Rd and Off ramp to Richmond Hwy	117	12	F
FGS095Rt101#41	4-lane segment between I-95 SB Off Ramp to Richmond Hwy SB and downstream 3-lane segment s/o Richmond Hwy	115	11	F
FGS095Rt102#42	4-lane segment between I-95 SB Off Ramp to Richmond Hwy SB and downstream 3-lane segment s/o Richmond Hwy	95	14	F
FGS095Rt103#43	3-lane segment between upstream 4-lane segment and flyover On ramp from Richmond Hwy	80	21	F
FGS095Gdn01#45	Between I-95 SB Off ramp to Gordon Blvd WB and I-95 SB on ramp from Gordon Blvd WB	98	18	F
FGS095PWP01#48	Between I-95 SB On ramp from Gordon Blvd EB and I-95 SB Off ramp to PWP	36	57	E
FGS095PWP02#51	Between I-95 SB Off ramp to PWP EB and I-95 SB On ramp from PWP	28	58	D
FGS095PWP03#53	Between Prince William Pkwy and I-95 SB On ramp from HOV s/o PWP	36	52	E
FGS095Opt01#56	Between I-95 SB Off ramp to Potomac Mills Rd and I-95 Off ramp to HOV s/o Opitz Blvd	27	50	D
FGS095Dal01#57	Between I-95 SB Off ramp to Potomac Mills Rd and I-95 Off ramp to HOV s/o Opitz Blvd	31	45	D
FGS095Dal02#59	Between I-95 SB On ramp from Dale Blvd and HOV-to-GP On ramp s/o Dale Blvd	40	44	E
FGS095Dal03#61	Between I-95 SB HOV-to-GP On ramp s/o Dale Blvd and Off ramp to Truck rest area	39	51	E
FGS095Dal04#63	Between Truck rest area Off and On ramps	44	51	E
FGS095Dum01	Between Truck rest area On ramp and Dumfries Rd SB Off ramp	37	39	E
FGS095Dum02#67	Between I-95 SB Off ramp to Dumfries Rd EB and Dumfries Rd EB On ramp to I-95 SB	20	56	C
FGS095Dum03#69	Between I-95 SB On ramp from Dumfries Rd and HOV SB On ramp s/o Dumfries Rd	75	18	F
FGS095Dum03#71	Between I-95 SB HOV SB On ramp s/o Dumfries Rd and I-95 SB Off ramp to Joplin Rd WB	58	34	F
FGS095Jop01#74	Between I-95 SB Off ramp to Joplin Rd EB and I-95 On ramp from Joplin Rd	93	17	F
FGS095Jop02#76	Between I-95 On ramp from Joplin Rd and I-95 SB Off ramp to Russell Rd	100	17	F
FGS095Rus01#78	Between I-95 SB Off ramp to Russell Rd and I-95 SB On ramp from Russell Rd	101	17	F
FGS095Rus02#80	Between I-95 SB On ramp from Russell Rd and I-95 SB Off ramp to Garrinsonville Rd	32	61	D
FGS095Gar01#82	Between I-95 SB Off ramp to Garrinsonville Rd and I-95 SB On ramp from Russell Rd WB	24	62	C
FGS095Gar02#84	Between I-95 SB Off ramp to Garrisonville Rd EB and I-95 SB On ramp from Garrisonville Rd EB	24	63	C
FGS095Gar03#86	Downstream of I-95 On ramp from Garrisonville Rd EB	29	64	D

Table 9-10: Southbound Freeway Weave Segments Density Analysis for Existing PM Peak

Weave Segments		Existing PM		
ID	Description	Average Density (veh/mi/ln)	Average Speed (mph)	HCM Equivalent LOS
WGS395Duk01#5	Between I-395 On ramp from Duke St WB and Off ramp to Duke St EB	58	30	F
WGS395Duk02#7	Between I-395 SB On ramp from Duke St and Off Ramp to SB HOV	63	30	F
WGS395Duk02#8	Between I-395 SB On ramp from Duke St and Off Ramp to SB HOV	51	43	F
WGS395Eds01#10	Between I-395 SB On ramp from HOV s/o Duke St and Off ramp to Edsall Rd EB	29	55	D
WGS395Eds02#12	Between I-395 SB On ramp from Edsall Rd WB and Off ramp to Edsall Rd EB	37	45	E
WGS395Eds03#15	Between I-395 SB On ramp from Edsall Rd EB and Off ramp to I-495 EB/WB	23	60	C
WGS095FSP01#23	Between I-95 SB On ramp from HOV s/o Franconia Rd and Off ramp to Backlick Rd	29	53	D
WGS095FCP01#30	Between I-95 SB On ramp from FCP WB and Off ramp to FCP EB	30	49	D
WGS095Rt101#44	Between I-95 SB flyover On ramp from Richmond Hwy and Off ramp to Gordon Blvd WB	82	22	F
WGS095Gar01#83	Between I-95 SB On ramp from Garrisonville Rd WB and Off ramp to Garrisonville Rd EB	20	58	B

Table 9-11: Southbound Freeway Ramp Junction Segments Density Analysis for Existing PM

Ramp Junctions		Existing PM		
ID	Description	Average Density (veh/mi/ln)	Average Speed (mph)	HCM Equivalent LOS
DGS395Duk01#2	I-395 SB Off Ramp to Duke St WB	96	19	F
MGS095Fra01#21	I-95 SB On ramp from Franconia Rd	26	55	C
DGS095FSP01#24	I-95 SB Off Ramp to Franconia Springfield HOV SB	29	56	D
DGS095FCP01#28	I-95 SB Off Ramp to Fairfax County Pkwy WB	23	56	C
MGS095FCP01#32	I-95 SB On ramp from Fairfax County Pkwy	29	52	D
MGS095FCP02#34	I-95 SB On ramp from HOV On ramp s/o Fairfax County Pkwy	30	52	D
DGS095Lor01#36	I-95 SB Off Ramp to Lorton Rd	91	17	F
MGS095Lor01#38	I-95 SB On ramp from Lorton Rd	108	12	F
DGS095Rt101#40	I-95 SB Off Ramp to Richmond Hwy SB	103	15	F
MGS095Gdn01#46	I-95 SB On ramp from Gordon Blvd WB	89	17	F
MGS095Gdn02#47	I-95 SB On ramp from Gordon Blvd EB	55	35	F
DGS095PWP01#49	I-95 SB Off ramp to Prince William Pkwy WB	34	52	D
DGS095PWP02#50	I-95 SB Off ramp to Prince William Pkwy EB	25	55	C
MGS095PWP01#52	I-95 SB On ramp from Prince William Pkwy	30	51	D
MGS095PWP02#54	I-95 SB On ramp from HOV s/o PWP	29	53	D
DGS095Opt01#55	I-95 SB Off ramp to Potomac Mills Rd	27	51	C
MGS095Dal01#58	I-95 SB On ramp from Dale Blvd	36	42	E
MGS095Dal02#60	I-95 SB HOV-to-GP On ramp s/o Dale Blvd	36	46	E
DGS095Dal01#62	I-95 SB Off Ramp to Truck Rest Area	36	50	E
MGS095Dum01#64	I-95 SB On ramp from Truck rest area	45	43	F
DGS095Dum01#65	I-95 SB Off ramp to Dumfries Rd WB	44	43	F
DGS095Dum02#66	I-95 SB On ramp from Dumfries Rd	41	43	E
MGS095Dum02#68	I-95 SB On ramp from Dumfries Rd	58	28	F
MGS095Dum03#70	I-95 SB HOV SB On ramp s/o Dumfries Rd	82	18	F
DGS095Jop01#72	I-95 SB Off ramp to Joplin Rd WB	66	27	F
DGS095Jop02#73	I-95 SB Off ramp to Joplin Rd EB	82	21	F
MGS095Jop01#75	I-95 On ramp from Joplin Rd	104	15	F
DGS095Rus01#77	I-95 SB Off ramp to Russell Rd	87	20	F
MGS095Rus01#79	I-95 SB On ramp from Russell Rd	67	30	F
DGS095Gar01#81	I-95 SB Off ramp to Garrinsonville Rd	29	59	D
MGS095Gar01#85	I-95 SB On ramp from Garrinsonville Rd EB	25	61	C

9.3.1.6 Intersection Analysis

Exhibit 9-8 summarizes the intersection LOS for Existing conditions (AM and PM peak hour).

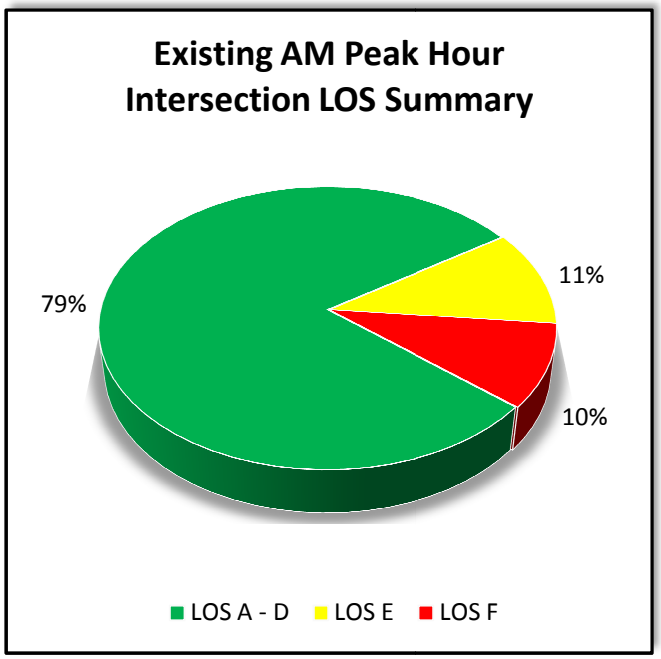
AM Peak

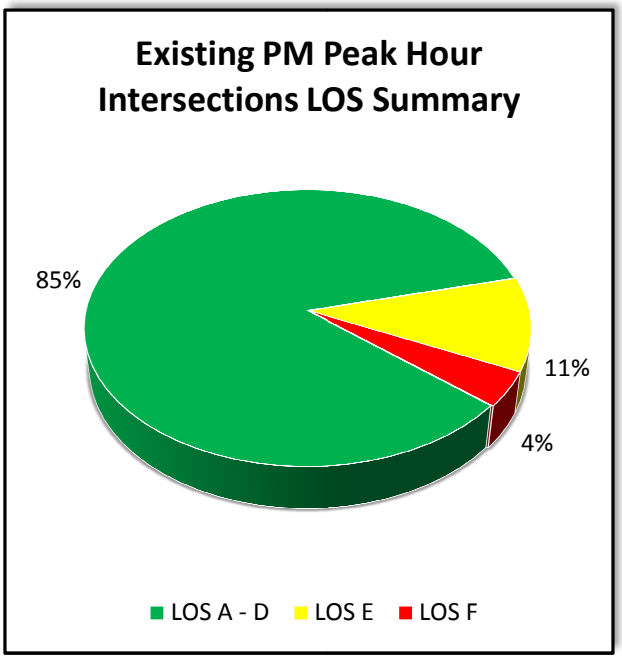
A total of 73 intersections were analyzed in the study area. The study intersections are either ramp terminal intersection or adjacent to them on either side of the interchange**.** In the AM peak hour, eight of them are operating at a LOS F, six are operating at a LOS E and the remaining intersections are operating at LOS D or better. Overall, most of the intersections are operating fairly well. Duke Street, Braddock Road, Fairfax County Parkway, Newington Road, Prince William Parkway, Dumfries Road and Garrisonville Road are the interchanges that have intersections operating at a LOS E or F in the AM peak hour.

PM Peak

In the PM peak hour, most of the study intersections operate at LOS D or better. Eight intersections operate at LOS E, and three intersections at LOS F. The remaining intersections operate at LOS D or better. The majority of the intersections that are operating at LOS E and F in the PM peak hour are on Duke Street/Little River Turnpike, Fairfax County Parkway, Richmond Highway, Dale Boulevard, Dumfries Road, Joplin and Garrisonville Road.

Exhibit 9-8: Intersection LOS Summary for Existing Conditions





9.3.1.7 Summary

AM Peak

In the AM peak, the northbound direction is the peak travel direction as commuters travel to Washington DC. There are three major bottlenecks in the study area which affects the overall traffic operations along the corridor. Speeds range between 20 and 30 mph at these bottleneck locations. There are several segments along the corridor which are operating under saturated traffic flow conditions. In the AM peak hour, HOV lanes are under-utilized and operate at free flow conditions. The results indicate severe traffic congestions along the northbound corridor. Some of the key points are summarized below:

- Along northbound I-95 in the GP lanes, the total travel time to traverse the entire corridor is 48.4 minutes which is approximately 75 percent more than the free flow travel time.
- The major bottleneck conditions are downstream of Duke Street, Fairfax County Parkway Off ramp and the weave section between Gordon Road and Richmond Highway.
- In the bottleneck locations, two to six miles of queues develop upstream of the bottlenecks and take several hours to dissipate them.
- Approximately 40 percent of the study segments on I-95 are operating at severely congested levels.

PM Peak

In the PM peak, the peak direction on I-95 is southbound as a vital route for commuters leaving Washington DC for key destinations in the surrounding suburban areas. Our simulation analysis well duplicated the overall field condition in terms of travel time, speed profiles and throughput volumes. The results indicate severe traffic congestions along the southbound corridor. Some of the key points are summarized below:

- Along southbound I-95 in the GP lanes, the total travel time to traverse the entire corridor is 57.7 minutes which is more than double the free flow speed.
- The major bottleneck conditions are Turckeycock slip ramp near Edsall Road, Gordon Boulevard/Ox Road, and Dumfries Road slip ramp and south of Russell Road
- Average speeds along the corridor at the congested locations range between 10 and 30 mph.
- In the bottleneck locations, two to six miles of queues develop upstream of the bottlenecks and takes several hours to dissipate them
- Approximately 60 percent of the segments are operating at severely congested levels.

9.3.2 2018 Conditions (No-Build vs. Build)

9.3.2.1 Travel Demand Differences

The traffic forecasting methodology described in Chapter 8 was used to develop the traffic volumes for the 2018 No-Build and 2018 Build conditions VISSIM models. Figures 8-3 through 8-6 show the forecasted traffic volumes for the 2018 No-Build and 2018 Build scenarios.

AM Peak

Overall, there is a growth in traffic volumes from Existing conditions to 2018 No-Build conditions on the GP travel lanes. In many locations, the volume in the GP lanes decreases from the 2018 No-Build scenario to the 2018 Build scenario due to the shift in traffic to the HOV/HOT facility. There are some locations where the 2018 Build scenario has higher volumes in the GP travel lanes as compared to the 2018 No-Build scenario. This determination was based on the travel demand model which takes into account additional factors that affect demand on the facilities and their attractiveness due to increased capacity. At certain locations, the future traffic volumes are lower than Existing traffic volumes. This is primarily because of the changes in HOV minimum occupancy requirements, increased ridesharing and increased transit utilization assumptions incorporated in the travel demand models.

Table 9-12 is a summary of projected demand for the 2018 AM peak hour for both No-Build and Build scenarios at key screen line locations in the network. The demand across all lanes (GP and HOV/HOT lanes combined) in the peak northbound direction is projected to be between two and 20 percent higher in the Build scenario than the No-Build scenario, depending on the location within the corridor. Every screen line location will have an increase in 2018 demand for the Build scenario, which is due to the increased capacity of the HOV/HOT lane facility. The increase in capacity causes shifts in travel demand along the I-95 corridor from either other alternative routes in the area or from other adjacent time periods within the AM peak period. Just outside of the project limits, the increase in demand is expected to be much lower. For example, demand north of the Duke Street Interchange expected to be two percent higher in the Build scenario. South of the Garrisonville Road interchange, demand is expected to be 16 percent higher in the Build scenario although the demand on the GP lanes is less in the Build scenario compared to the No-Build scenario.

Table: 9-12: 2018 AM Peak-hour Demand – Northbound Direction

Screenline Location	Demand Volumes (Vehicles/hour)						Abs Diff Overall	% Diff Overall
	2018 No Build AM			2018 Build AM				
	GP	HOV	Overall	GP	HOT/HOV	Overall		
South of Garrisonville Rd	6035	0	6035	5199	1776	6975	940	16%
Between Garrisonville Rd & Russell Rd	6028	0	6028	4838	2185	7023	995	17%
Between Russell Rd & Joplin Rd	5557	0	5557	4662	2027	6689	1132	20%
Between Joplin Rd & Dumfries Rd	5789	0	5789	4834	2027	6861	1072	19%
Between Dumfries Rd & Opitz Blvd	4922	970	5892	4495	2492	6987	1095	19%
Between Opitz Blvd & PWP	5040	1531	6571	4533	3241	7774	1203	18%
Between PWP & Gordon Blvd	5349	2388	7737	5478	3477	8955	1218	16%
Between Gordon Blvd & Richmond Hwy	6671	2886	9557	6705	4327	11032	1475	15%
Between Richmond Hwy & Lorton Rd	6487	2996	9483	6547	4677	11224	1741	18%
Between Lorton Rd & FCP	7410	3096	10506	7282	4999	12281	1775	17%
Between FCP & Franconia Rd	7554	2538	10092	7452	3262	10714	622	6%
Between Springfield IC & Edsall Rd	6672	2703	9375	6357	3579	9936	561	6%
Between Edsall Rd & Duke St	5955	2903	8858	6184	2998	9182	324	4%
North of Duke St	6489	2903	9392	6605	2998	9603	211	2%
							Average	**14%**

As shown in Table 9-12, between the Springfield Interchange and Duke Street, the increase in demand ranges from two to six percent. The highest demand increase in the corridor occurs between Garrisonville Road and Fairfax County Parkway ranging between 15 and 20 percent. Along the peak northbound direction of I-95, the increase in demand in the Build scenario is expected to occur in the HOV/HOT lanes, while demand on the GP lanes fluctuates depending on location but it is generally lower in the Build scenario. GP lane demand variation ranges from a decrease of approximately 20 percent near Russell Road to an increase of approximately 4.7 percent between Edsall Road and Duke Street. Demand in the HOV/HOT lanes for the Build scenario is significantly higher than in the No-Build scenario, ranging from 29 to 157 percent higher.

Along the I-495 Beltway, demand is generally similar between the No-Build and Build scenarios.

PM Peak

Table 9-13 is a summary of projected demand for the 2018 PM peak hour for both No-Build and Build scenarios at key screen line locations in the network. The demand across all lanes (GP and HOV/HOT lanes combined) in the peak southbound direction is projected to be between one percent lower and eight percent higher in the Build scenario than the No-Build scenario, depending on the location within the corridor. Most screen line locations will have an increase in 2018 demand for the Build scenario, which is due to the increased capacity of the HOV/HOT lane facility. The increase in capacity causes shifts in travel demand along the I-95 corridor from either other alternative routes in the area or from other adjacent time periods within the PM peak period. Just outside of the project limits, the changes in demand are expected to be the same or even lower. For example, demand south of the Jefferson Davis Highway Interchange is expected to be five percent higher in the Build scenario. North of the Duke Street Interchange, demand is expected to be one percent lower in the Build scenarios.

Table: 9-13: 2018 PM Peak-hour Demand – Southbound Direction

Screenline Location	Demand Volumes (Vehicles/hour)						Abs Diff Overall	% Diff Overall
	2018 No Build PM			2018 Build PM				
	GP	HOV	Overall	GP	HOT/HOV	Overall		
North of Duke St	7708	2648	10356	7208	2993	10201	-155	-1%
Between Duke St & Edsall Rd	6679	2648	9327	6533	2993	9526	199	2%
Between Edsall Rd & Springfield IC	6774	2938	9712	5943	4025	9968	256	3%
Between Franconia Rd & FCP	7815	2725	10540	7400	3365	10765	225	2%
Between FCP & Lorton Rd	7250	3292	10542	6405	4745	11150	608	6%
Between Lorton Rd & Richmond Hwy	6782	3241	10023	6017	4745	10762	739	7%
Between Richmond Hwy & Gordon Blvd	7730	3191	10921	7040	4556	11596	675	6%
Between Gordon Blvd & PWP	7491	2993	10484	6652	3973	10625	141	1%
Between PWP & Opitz Blvd	6685	1895	8580	6084	2369	8453	-127	-1%
Between Opitz Blvd & Dumfries Rd	5325	1321	6646	4841	2117	6958	312	5%
Between Dumfries Rd & Joplin Rd	6062	0	6062	4495	1886	6381	319	5%
Between Joplin Rd & Russell Rd	5857	0	5857	3975	2364	6339	482	8%
Between Russell Rd & Garrisonville Rd	6704	0	6704	4889	2364	7253	549	8%
South of Garrisonville Rd	7004	0	7004	5996	1508	7504	500	7%
							Average	**4%**

As shown in Table 9-13, between Duke Street and Springfield Interchange, the increase in demand ranges from one to three percent, representing negligible growth between the two scenarios. The highest demand increase in the corridor occurs between Joplin Road and Garrisonville Road ranging between seven and eight percent. Along the peak southbound direction of I-95, the increase in demand in the Build scenario is expected to occur in the HOV/HOT lanes, while demand on the GP lanes is lower compared with the No-Build scenario. GP lane demand variation ranges from a decrease of approximately 32 percent between Russell Road and Joplin Road to a decrease of approximately two percent between Duke Street and Edsall Road. Demand in the HOV/HOT lanes for the Build scenario is significantly higher than that in the No-Build scenario, ranging from 13 percent around the northern terminus of the HOT lanes to roughly 60 percent higher between Dumfries Road and Joplin Road.

Along the I-495 Beltway, demand is generally similar between the No-Build and Build scenarios.

9.3.2.2 Travel Time Analysis

AM Peak

Table 9-14 and **Exhibit 9-9** compare travel times between free flow, existing, 2018 No-Build, and 2018 Build conditions in the AM peak hour. Travel time measures have been aggregated by direction of travel, and type of facility (GP and HOV/HOT lanes). The travel time summary is based on the following segment delineations:

- From Garrisonville Road to Dale Boulevard
- From Dale Boulevard to Fairfax County Parkway
- From Fairfax County Parkway to I-495 Capital Beltway (Springfield Interchange)
- From I-495 Capital Beltway to I-395 Duke Street

Table 9-14: Travel Times Summary for 2018 AM Peak-hour Build and No-Build Scenarios

Travel Times Summary Table					
	Travel Time (minutes)	Free Flow Travel Time	Existing AM	2018 No Build AM	2018 Build AM
Northbound	I-95 Garrisonville Rd to Dale Boulevard	*12.4*	14.2	13.0	12.9
	I-95 Dale Boulevard to Fairfax Co. Parkway	*10.0*	18.5	17.3	13.8
	I-95 Fairfax Co. Parkway to Springfield IC	*3.5*	6.2	5.9	4.1
	I-95 Springfield to I-395 Duke Street	*2.6*	10.5	10.3	10.6
	Total Northbound Mainline	***28.4***	*49.4*	*46.5*	*41.4*
Southbound	I-395 Duke Street to I-95 Springfield	2.6	2.6	2.6	2.6
	I-95 Springfield to I-95 Fairfax Co. Parkway	3.4	3.4	3.4	3.5
	I-95 Fairfax Co Parkway to Dale Boulevard	9.3	9.4	9.3	9.4
	I-95 Dale Boulevard to Garrisonville Rd	11.6	12.0	11.6	11.6
	Total Southbound Mainline	**26.8**	**27.4**	**26.9**	**27.0**
Northbound HOV	I-95 Garrisonville Rd to Dale Boulevard	12.0	13.7	12.4	12.4
	I-95 Dale Boulevard to Fairfax Co. Parkway	8.7	9.3	9.3	9.6
	I-95 Fairfax Co. Parkway to Springfield IC	3.0	3.2	3.2	3.1
	I-95 Springfield to I-395 Duke Street	2.3	2.4	2.4	2.4
	Total Northbound HOV/HOT lane facility	***26.0***	*28.6*	*27.3*	*27.5*

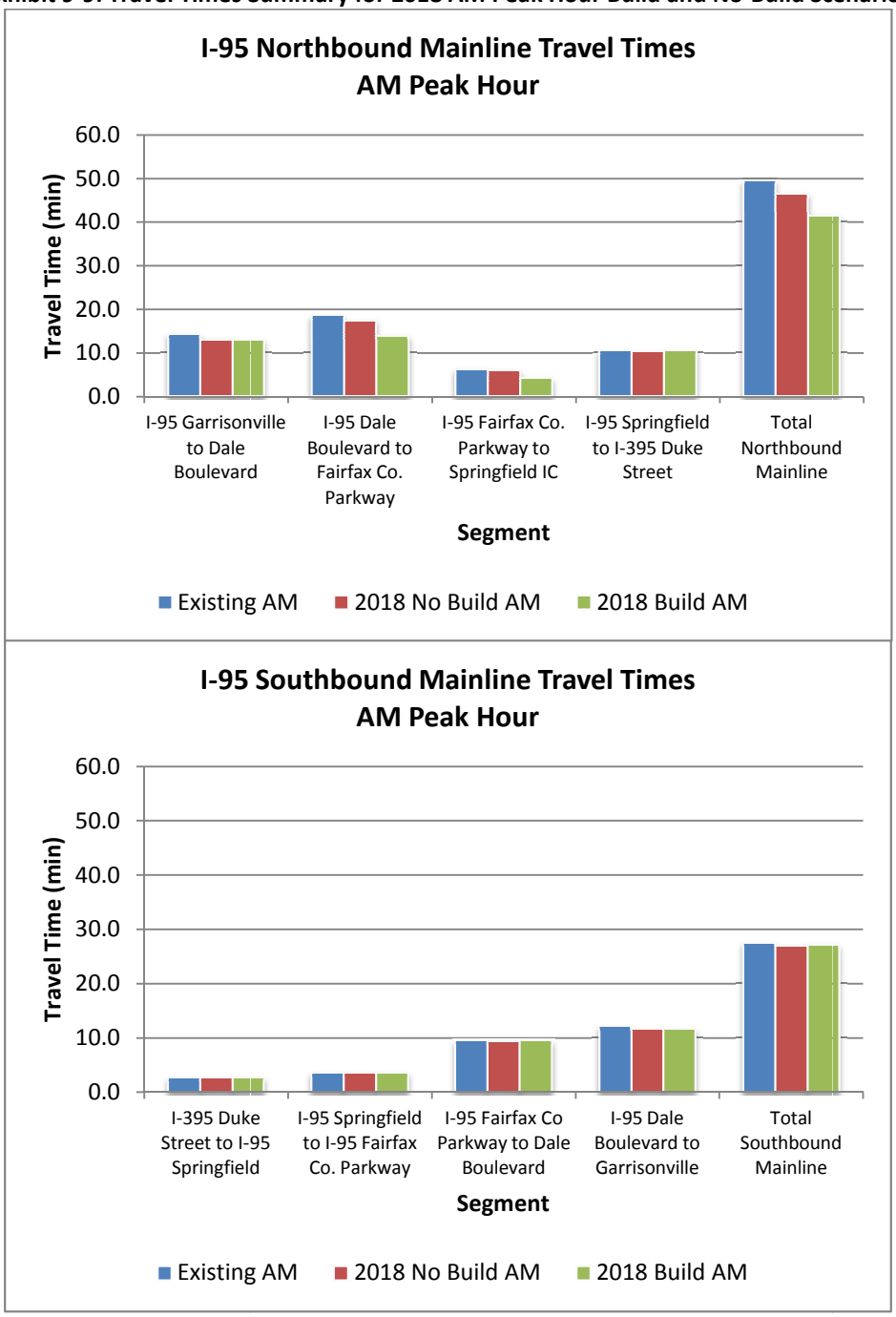
NOTE:

Highlighted cells indicate segments where HOV/HOT lane facility does not exist; therefore GP travel times are used.

Travel times for the entire corridor are less for the 2018 No-Build scenario compared to the Existing conditions during the AM peak hour. This is mainly due to the construction work zone conditions at the Gordon Road interchange in the Existing conditions and the increase in capacity due to the fourth lane widening along I-95 mainline under the future conditions scenarios. In the peak (northbound) direction in the 2018 No-Build scenario, the northbound GP drivers take an average of approximately 46.5 minutes to traverse the entire corridor from Garrisonville Road to Duke Street. In the southbound direction, the travel time is approximately 27 minutes between Duke Street and Garrisonville Road.

There are significant travel time savings in the peak (northbound) direction for the Build scenario. Travel times in the GP lanes are projected to decrease by approximately five minutes in the Build scenario when compared to No-build and almost eight minutes when compared to Existing conditions. This is an almost 11 percent savings in travel time for a vehicle traveling the entire corridor under the Build scenario. Most of the travel time savings is seen between the Garrisonville Road and Springfield interchanges. Between the Dale Boulevard and Springfield interchanges there is an almost 23 percent or 5.3 minute savings in travel time along the GP lanes. Similar travel time savings are projected for the HOT/HOV facility in the Build scenario.

Exhibit 9-9: Travel Times Summary for 2018 AM Peak Hour Build and No-Build Scenarios



The only segment that is projected to have a slight increase in travel time for the 2018 scenarios is northbound I-395 between I-495 and Duke Street. This increase of about three percent in travel time in this corridor is a result of the additional demand from the HOT lanes that exits on to the GP lanes between Edsall Road and Duke Street under the Build scenario. The weave segment between the northern terminus ramp of the HOT lanes and the Duke Street off-ramp causes a slight increase in congestion.

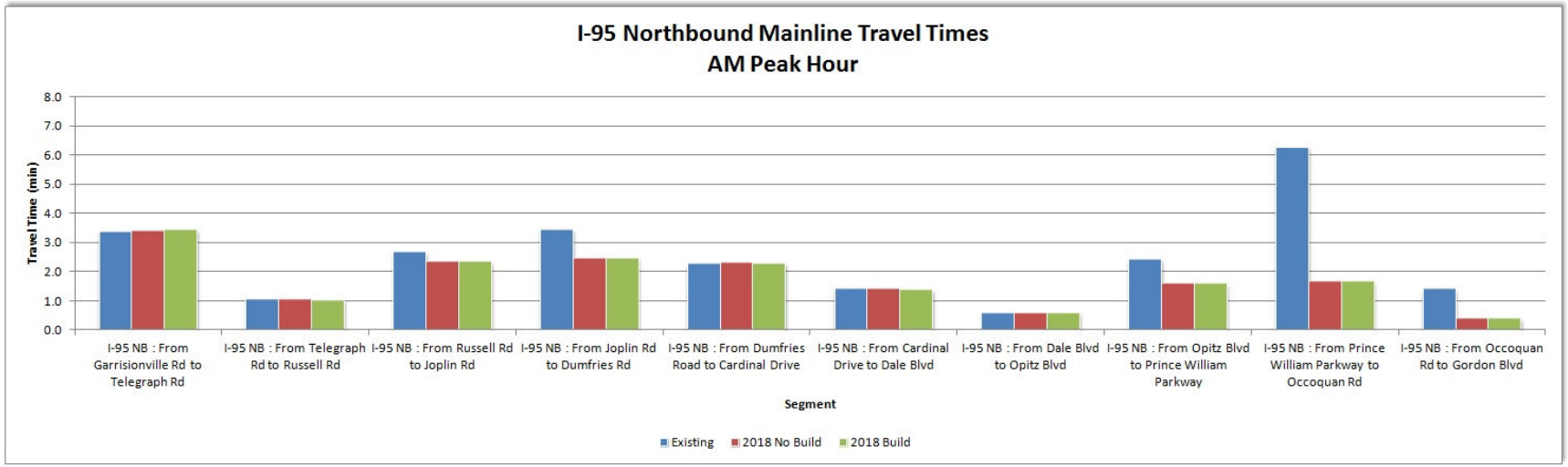
Exhibit 9-10 depicts the 2018 No-Build and 2018 Build travel times along the I-95 GP lanes for each freeway segment measured between adjacent interchanges in the northbound direction during the AM peak hour. There are a total of 21 individual segments along I-95 corridor in the northbound direction. As shown in this exhibit, most segments are projected to have similar travel times in Existing, 2018 No-Build, and 2018 Build conditions with the following exceptions:

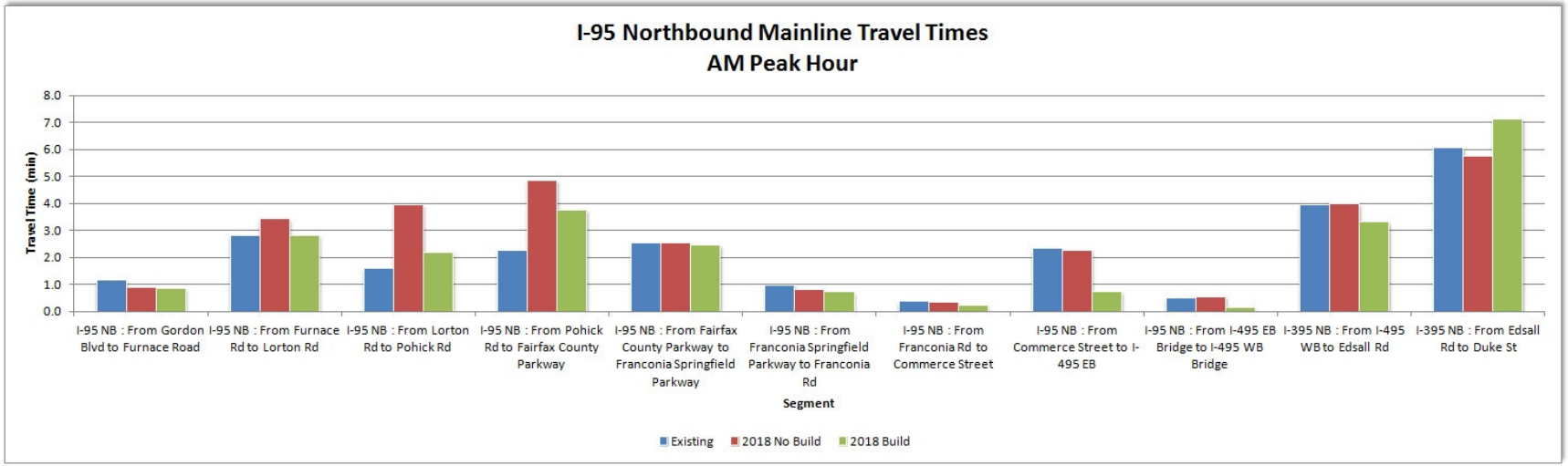
- The greatest difference between the Existing and the 2018 scenarios along the mainline is upstream of Gordon Boulevard where there is a savings of almost six minutes. Under existing conditions there is construction at Gordon Boulevard interchange due to which the shoulders are closed. This is a major corridor bottleneck and causes significant congestion on the northbound I-95 during the AM peak under existing conditions. In the future scenarios this construction condition does not exist and hence the travel time savings.
- The second bottleneck in the Existing conditions is at the Fairfax County Parkway. This condition is exacerbated in both the No-Build and Build scenarios given the higher demand. However under the Build scenario, with the additional capacity along the HOV/HOT lane facility and the shift of demand from the GP to HOV/HOT lanes, there is a travel time savings of approximately 3.5 minutes along the I-95 corridor at this bottleneck; improvements occur mainly between Furnace Road and Fairfax County Parkway due to increase in HOT/HOT lanes usage and corresponding reduction in demand and congestion on the GP lanes.
- There is an improvement in travel times upstream of the northern terminus of the HOT lanes in the Build conditions as compared to both the No-Build and Existing conditions; a reduction of approximately three minutes in travel time is realized between Commerce Street, south of I-495, and Edsall Road, north of I-495. However, there is an increase in travel time downstream of this merge at the northern terminus. This is mainly because upstream of this merge, the demand on the GP lanes is less because of the HOT traffic shifted on the HOV/HOT lane facility. Downstream, all the HOT traffic exits at the terminus ramp and merges on to the GP lanes increasing the travel delay. However, the overall travel time for the segment from Springfield to north of Duke Street remains approximately the same for both scenarios as under existing conditions. Mitigation for this area will be discussed later in this chapter.

Along southbound I-95 there is no difference in the travel times between 2018 No-Build and 2018 Build since this is not the peak travel direction (thus no HOV/HOT operations in that direction) and travel times are similar to free-flow conditions.

The HOV facility starts at the Dumfries Road interchange in the No-Build conditions while in the Build conditions it starts south of Garrisonville Road (HOV/HOT facility). Under the No-Build conditions, the HOV vehicles would have to travel along the GP lanes from Garrisonville to Dumfries and then use the on-ramp to access the HOV lanes. The travel times within this segment under the No-Build scenario would be the same as the GP lanes. We see the greatest travel time savings in the Build conditions in this segment. There is a 0.5 minutes savings for vehicles traveling on the HOV/HOT lane facility between Garrisonville Road and Dumfries Road, mainly because there is no congestion along the HOV/HOT lane facility and also the speed limit on the HOV/HOT lane facility is higher than the GP lanes.

Exhibit 9-10: Existing, 2018 No-Build, and 2018 Build Travel Times – AM Peak – GP Lanes - Northbound Direction





In conclusion, the overall travel time for the entire corridor improves for the Build scenario in the northbound peak direction for the GP lanes. The overall time savings in the 2018 Build scenarios and for the corridor is approximately five minutes for the GP lanes.

PM Peak

Table 9-15 and **Exhibit 9-11** compare travel times between free flow, existing, 2018 No-Build, and 2018 Build conditions in the PM peak hour. Travel time measures have been aggregated by direction of travel, and type of facility (GP and HOV/HOT lanes). The travel time summary is based on the segment delineations:

- From Garrisonville Road to Dale Boulevard
- From Dale Boulevard to Fairfax County Parkway
- From Fairfax County Parkway to I-495 Capital Beltway (Springfield Interchange)
- From I-495 Capital Beltway to I-395 Duke Street

Table 9-15: Travel Times Summary for 2018 PM Peak-hour Build and No-Build scenarios

Travel Times Summary Table					
	Travel Time (minutes)	Free Flow Travel Time	Existing PM	2018 No-Build PM	2018 Build PM
Northbound	I-95 Garrisonville to Dale Boulevard	*12.4*	12.8	12.8	12.8
	I-95 Dale Boulevard to Fairfax Co. Parkway	*10.0*	10.3	10.4	10.3
	I-95 Fairfax Co. Parkway to Springfield IC	*3.5*	3.6	3.6	3.6
	I-95 Springfield to I-395 Duke Street	*2.6*	2.7	2.8	2.8
	Total Northbound Mainline	***28.4***	*29.3*	*29.6*	*29.6*
Southbound	I-395 Duke Street to I-95 Springfield	*2.6*	3.6	6.0	3.4
	I-95 Springfield to I-95 Fairfax Co. Parkway	*3.4*	3.7	3.7	3.7
	I-95 Fairfax Co Parkway to Dale Boulevard	*9.3*	25.7	30.2	17.4
	I-95 Dale Boulevard to Garrisonville	*11.6*	24.6	16.8	13.3
	Total Southbound Mainline	***26.8***	*57.7*	*56.7*	*37.9*
Southbound HOV	I-395 Duke Street to I-95 Springfield	*1.7*	1.7	1.7	1.7
	I-95 Springfield to I-95 Fairfax Co. Parkway	*3.3*	3.4	3.4	3.4
	I-95 Fairfax Co Parkway to Dale Boulevard	*9.5*	9.7	9.7	9.7
	I-95 Dale Boulevard to Garrisonville	*12.0*	22.6	16.6	12.3
	Total Southbound HOV/HOT lane facility	***26.5***	*37.4*	*31.4*	*27.0*

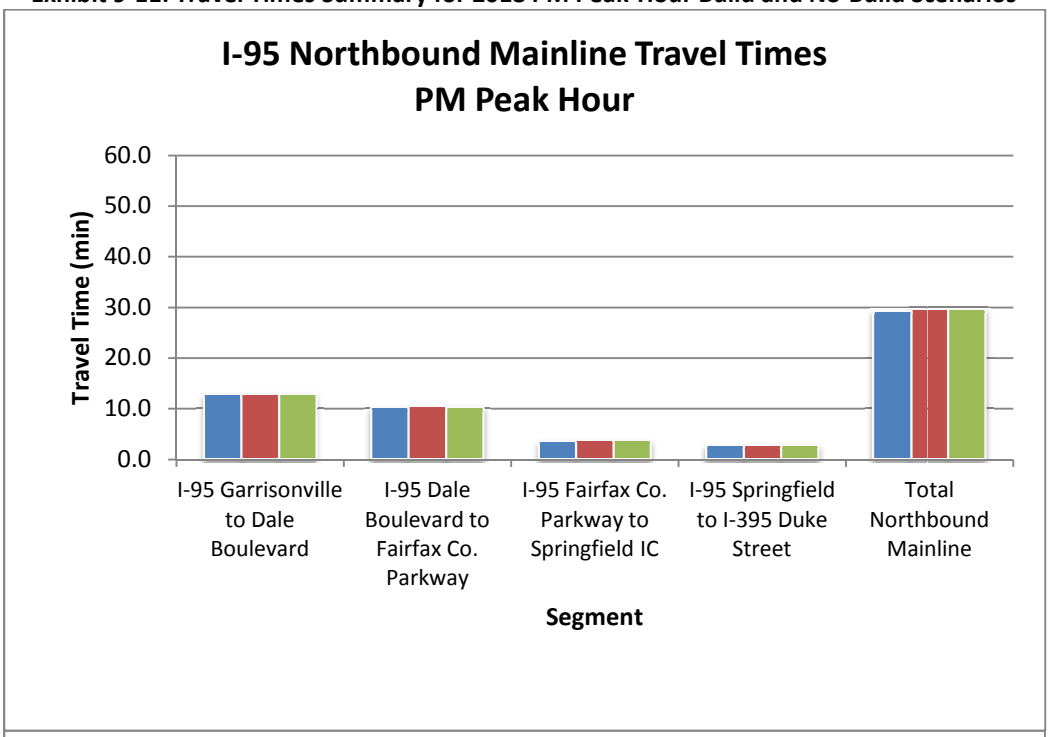
NOTE:

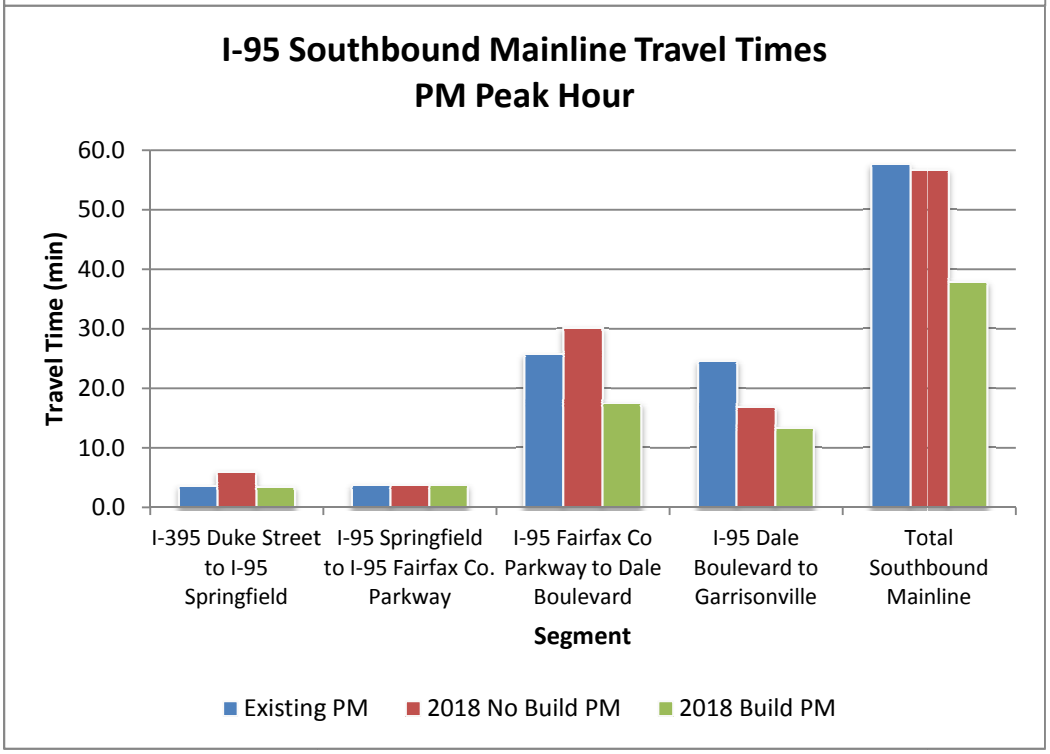
Highlighted cells indicate segments where HOV/HOT lane facility does not exist; therefore GP travel times are used.

Travel times for the entire corridor are very similar in the Existing and 2018 No-Build scenarios during the PM peak hour. The travel time results are consistent for the GP and HOV lanes in both the northbound and southbound directions. In both the Existing and 2018 No-Build scenarios, northbound GP drivers take an average of approximately 30 minutes to traverse the entire corridor from Garrisonville Road to Duke Street. In the peak (southbound) direction, the travel time is between 57 to 58 minutes to travel the between Duke Street and Garrisonville

Road. There are significant travel time savings in the peak (southbound) direction for the Build scenario. Travel times in the GP lanes are projected to decrease by approximately 20 minutes in the Build scenario when compared to No-build or Existing. Similar travel time savings are projected for the HOT/HOV facility in the Build scenarios.

Exhibit 9-11: Travel Times Summary for 2018 PM Peak-Hour Build and No-Build Scenarios





The only segment that is projected to have a significant increase in travel time is the southbound I-395 segment between Duke Street and I-495 in 2018. A more detailed review reveals that the

increase in travel time is due to higher traffic demand on the GP lanes north of Edsall Road in 2018 compared to Existing conditions. In addition, the future scenarios show different traffic patterns in this area generated by higher percentage of vehicles exiting to I-495 eastbound and westbound in both No-Build and Build scenarios. The weave segment between the on and off ramps at the Duke Street interchange is a major corridor bottleneck and causes significant congestion on southbound I-395 during the PM peak. This condition is exacerbated in both the No-Build and Build scenarios given the higher demand. Other segments indicate that both No-Build and Build travel times generally improve compared to Existing Conditions, with the exception of the Fairfax County Parkway to Dale Boulevard segment in the No-Build scenario. Interchange and mainline facility improvements to the I-95 mainline are the primary reason why travel times improve in the No-Build scenario. In the Build scenario, interchange and mainline facility improvements, in addition to the volume shift to the HOV/HOT roadway, contribute to the improved travel compared with Existing Conditions.

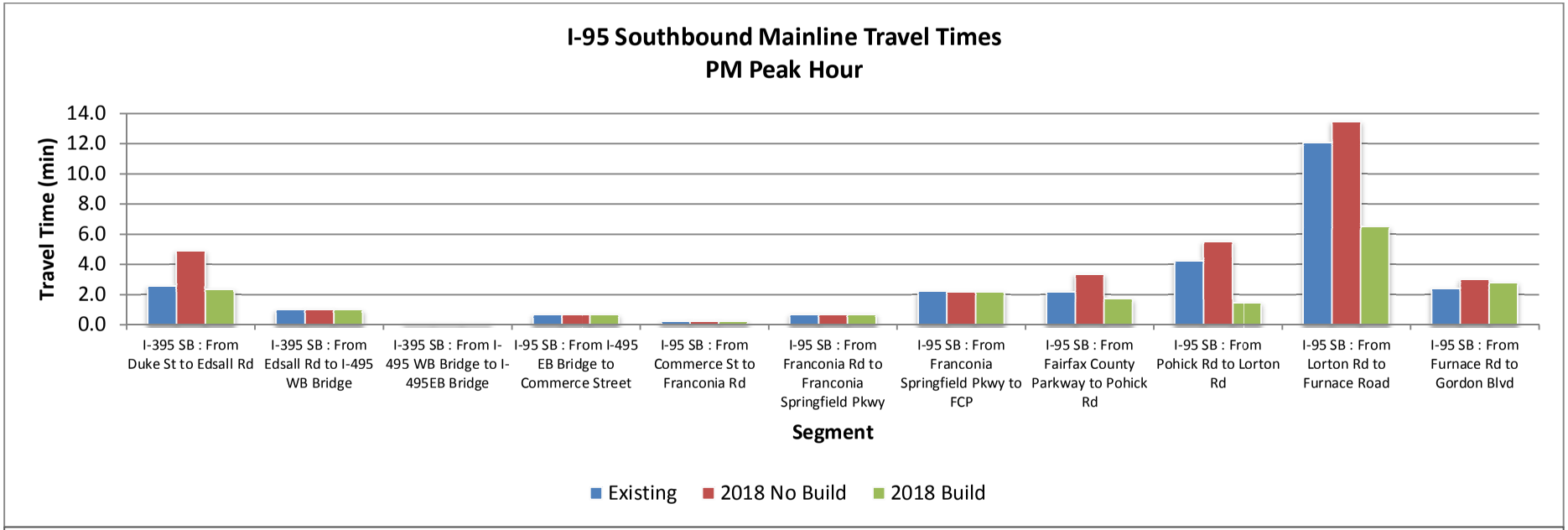
Exhibit 9-12 depicts the 2018 No-Build and 2018 Build travel times along the I-95 GP lanes for each freeway segment measured between adjacent interchanges in the southbound direction during the PM peak hour. As shown in this figure, most segments are projected to have similar travel times in Existing, 2018 No-Build, and 2018 Build conditions with the following exceptions:

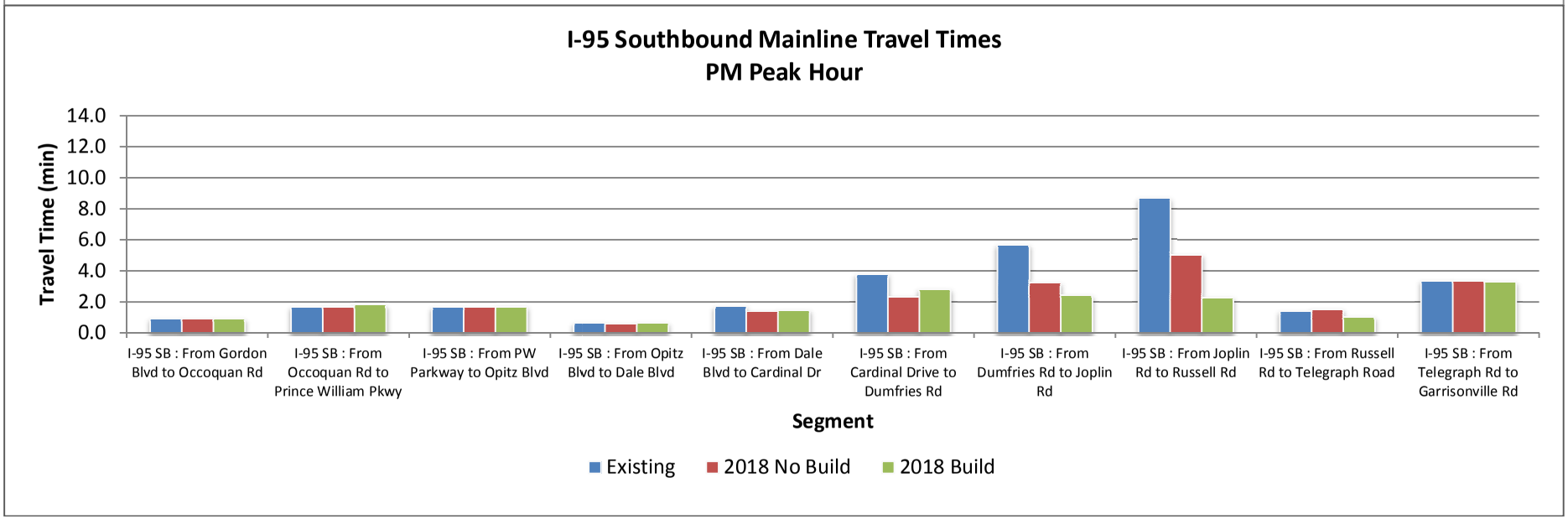
- I-95 GP lanes from Duke Street to Edsall Road - As explained in Section 9.3.2.1, demand is significantly higher in both No-build and Build scenarios compared to Existing conditions. The pre-existing congestion at Duke Street is exacerbated in the future with the increase in demand
- I-95 GP lanes from Fairfax County Parkway to Furnace Road - These segments show a reduction in travel time for Build scenario while showing an increase for the No-Build scenario compared to Existing conditions. The traffic operation in these segments is improved due to the widening of I-95 GP lanes from three lanes in the Existing conditions to four lanes in both future scenarios; however, demand increases and improved upstream vehicle throughput in the No-Build scenario offset any travel time savings due to the fourth lane widening. The Build scenario shows travel times lower than No-Build. This is due to lower demand on the general purpose lanes on the Build scenario which is shifted to the HOV/HOT facility.
- I-95 GP lanes from South of Dumfries Road to Russell Road - A significant travel time reduction is projected in these segments for the Build scenarios. As described before, this travel time savings are due to the elimination of the HOV Southern Terminus South of Dumfries Road and the replacement of the HOV slip ramp with a flyover, which improves merging conditions. Lower mainline traffic demand in the Build scenario also allows this section to operate under capacity, thus reducing travel times compared with the No-Build and Existing Conditions.

In conclusion, the overall travel time for the entire corridor improves significantly for the Build scenario in the southbound peak direction for both the GP lanes and the HOV/HOT lanes. This improvement is due mostly to the elimination of the existing bottleneck South of Dumfries Road (location of the existing southern HOV terminus). The merging condition of the existing

southern terminus is eliminated in the Build scenario as the HOV/HOT facility continues south of Dumfries Road and the existing slip ramp is replaced with a flyover ramp that will bring traffic from the HOV/HOT lanes to the GP lanes on the right side. The overall time savings in the 2018 Build scenario for the corridor is approximately 20 minutes for the GP lanes and four minutes in the HOV/HOT lanes compared to the No-Build scenario.

Exhibit 9-12: Existing, 2018 Build, and 2018 No-Build Travel Times – PM Peak – GP Lanes - Southbound Direction





9.3.2.3 Speed Analysis

Average speeds along the I-95 GP lanes were compared between the Existing, 2018 No-Build, and 2018 Build scenarios using temporal speed diagrams. The data are based on speed measurements taken from the VISSIM model every 0.5 miles and every 15 minutes of simulation.

AM Peak

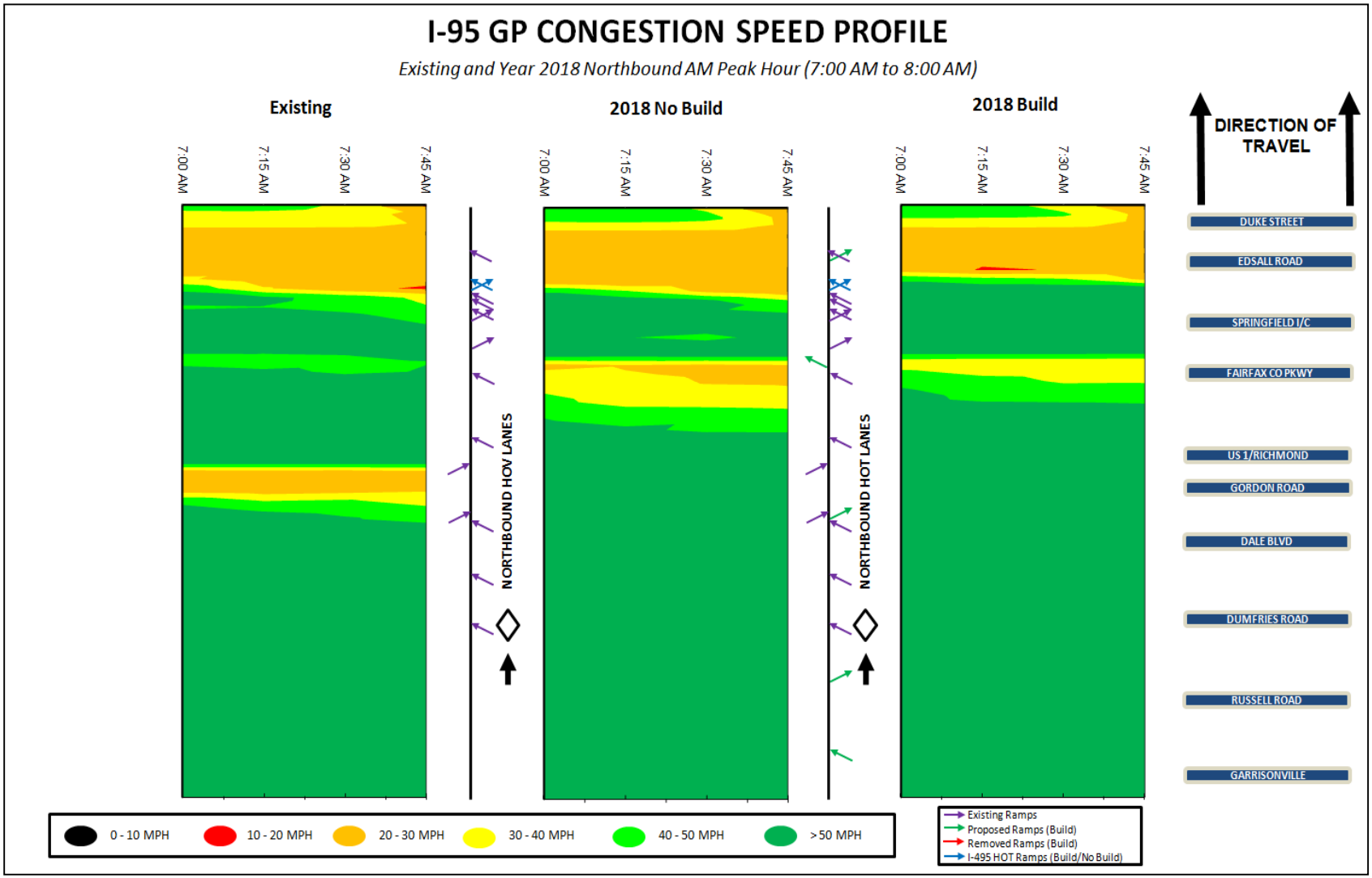
Exhibit 9-13 is an illustration of the average speed contours for the entire corridor. The contour plots are broken down into six different speed bins each assigned a different color and depict a profile of speeds along the corridor throughout the entire peak hour. The speed profiles make it easy to identify the beginning and end locations and intensity of the congestion within the corridors. They also help identify the length of queues in a particular direction. Speeds above 50 mph are considered free flow and are grouped into one speed bin.

For the AM peak hour, in the northbound direction, traffic speeds generally improve under the Build scenario in comparison to the No-Build scenario in 2018. With the exception of the northernmost bottleneck at Duke Street, average speeds improve at all other bottleneck locations. As discussed in Section 9.3.2.1, demand in the GP lanes is generally lower in the northbound direction in the 2018 Build scenario when compared to the No-Build scenario. This decrease in demand reduces the length, duration, and intensity of congestion at all bottlenecks south of the Springfield Interchange. The bottleneck near Gordon Boulevard is eliminated entirely and the congestion from the bottleneck at Fairfax County Parkway is reduced in the 2018 Build scenario.

As shown in Exhibit 9-13, average northbound travel speeds are above 50 mph up to Fairfax County Boulevard. At Fairfax County Parkway there is some congestion which causes the average speeds to drop by 20 to 40 mph. This is mainly due to the northbound I-95 off-ramp to eastbound Fairfax County Parkway and Loisdale Road. This ramp is known to spill over onto the mainline reducing the capacity on northbound I-95. This causes congested conditions upstream of this off-ramp reducing the average speeds. The 2018 Build scenario compares better than the 2018 No Build scenario. The average speeds within this congestion are between 30 to 50 mph in the 2018 Build scenario as compared to between 20 to 50 mph in the 2018 No-Build scenario.

The northernmost bottleneck near the Duke Street and the Edsall Road interchanges is caused by the same factors as seen under Existing Conditions. The spillback from Pentagon and the weaving caused by the Seminary off-ramp traffic downstream of the Duke Street interchange, is the primary reason for the congestion. In the 2018 No-Build scenario, the queues back up to the Springfield interchange. Under the 2018 Build scenario, the demand on the GP travel lanes on I-395 is less due to the HOT traffic using the HOV/HOT lane facility. This improves the conditions between Springfield interchange and Edsall Road interchange. The HOT lanes end between Edsall Road and Duke Street and this causes an increase in demand and additional weaving of the HOT vehicles traveling through onto the GP travel lanes. However, the HOT traffic that exists onto Duke Street to go east does not have to change lanes under the Build scenario.

Exhibit 9-13: Comparison between Existing, 2018 No-Build, and Build Average Speeds AM Peak (Northbound-GP Lanes)



Under the No-Build conditions, HOV vehicles would have to weave across the GP lanes to get into the right-most lane upstream of the off-ramp to Duke Street eastbound. The combined effect is that the congestion downstream of the merge at Turkeycock is the same intensity under both 2018 No-Build and Build scenarios. However, the queues are shorter in the 2018 Build conditions due to the lower demand upstream of the Turkeycock merge.

The speed profile of the I-95 GP lanes in the southbound direction (not included in this report) in the AM peak hour illustrates that there is no congestion or bottleneck in the southbound direction in the entire corridor. Average travel speeds are 50 mph or higher in both the 2018 No-Build and Build conditions. This is consistent with the other measures of effectiveness factors accessed for the southbound direction of this corridor.

The speed profile of the I-95 HOV/HOT lanes in the northbound direction (not included in this report) in the AM peak hour illustrates that under both 2018 No-Build and 2018 Build conditions the HOV/HOT lane facility operates at free-flow conditions throughout the corridor. There is no degradation in travel speeds in the Build conditions due to either the increased volume or the increase in ingress/egress locations along the HOV/HOT lane facility.

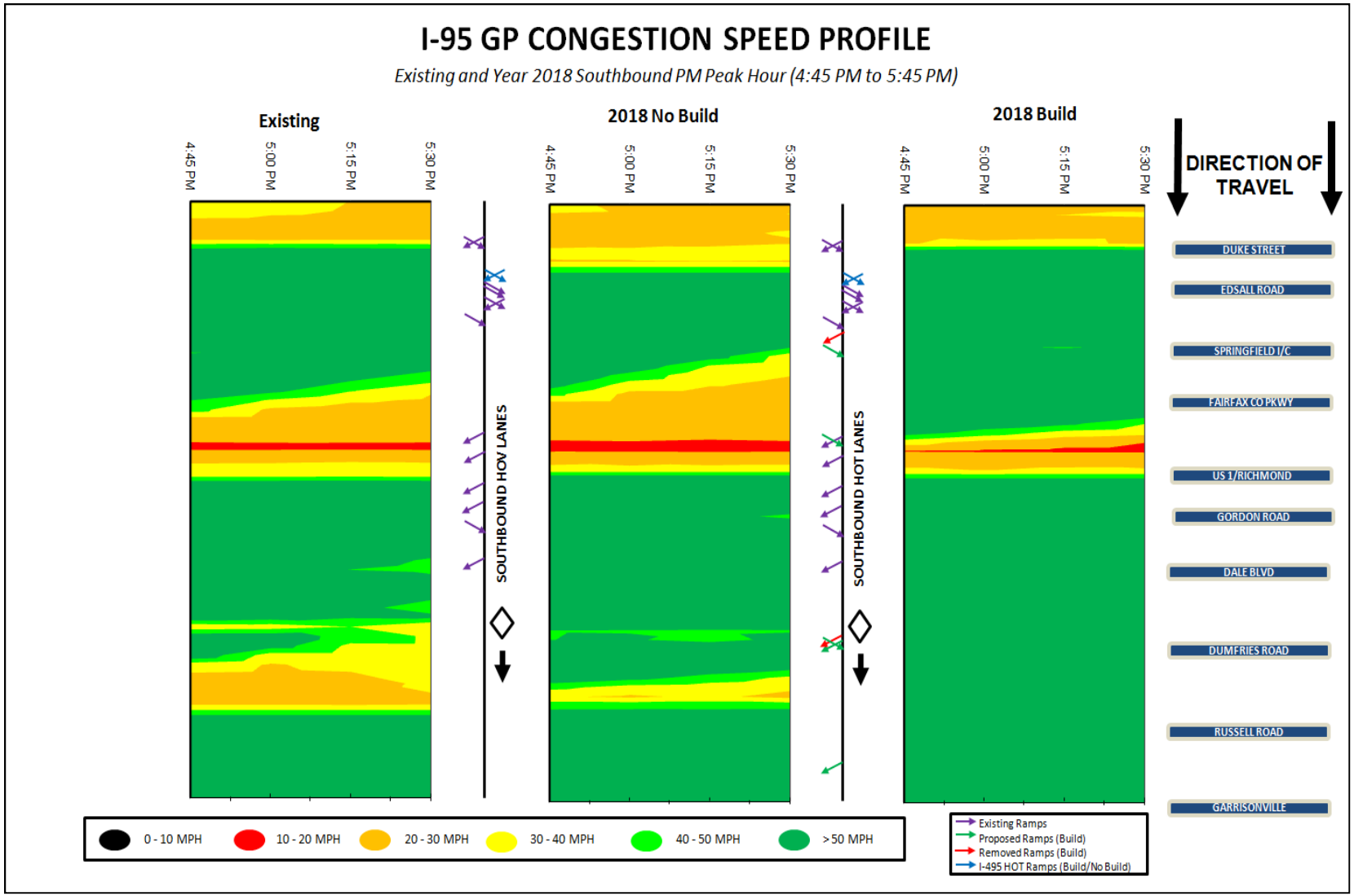
Speed data from the VISSIM model for 2018 AM conditions (No-Build and Build) is also geographically illustrated in **Figures 9-5 and 9-9** for all study segments along the I-95 study corridor.

PM Peak

Exhibit 9-14 is an illustration of the average speed contours for the entire corridor. For the PM peak hour, in the southbound direction, traffic speeds generally improve under the Build scenario in comparison to the No-Build scenario. As discussed in Section 9.3.2.1, demand in the GP lanes is generally lower in the southbound direction in the 2018 Build scenario when compared to the No-Build scenario. This decrease in demand reduces the length, duration, and intensity of congestion at all bottlenecks south of Springfield Interchange. The bottlenecks near Dumfries Road and Russell Road are eliminated entirely.

At the northernmost bottleneck near the Duke Street and the Edsall Road interchanges, weaving traffic volumes from the I-395 mainline to the I-495 Beltway corridor increases for both the No-Build and Build scenarios when compared to Existing conditions. This increase in demand and change in traffic patterns result in slightly more congestion at this location, measured in both duration and intensity. Therefore, vehicle speeds are lower through this section when compared to Existing conditions. When comparing 2018 scenarios, the No-Build scenario operates worse compared to the Build scenario, in particular between the I-495 off-ramp and the Edsall Road weave. Weaving traffic volumes through this segment are higher in the No-Build scenario compared with the Build scenario. This additional weaving volume forms congestion in the No-Build scenario that is not present in either Existing Conditions or the 2018 Build scenario.

Exhibit 9-14: Comparison between Existing, 2018 No-Build, and Build Average Speeds PM Peak (Southbound-GP Lanes)



The middle bottleneck, located at the Gordon Road slip ramp merge, will still be present in the 2018 No-Build and Build scenarios. However, the length, duration, and intensity of the congestion associated with this bottleneck are projected to reduce in the 2018 Build scenario; however, it is expected to be similar length, duration, and intensity in the 2018 No-Build scenario. This improvement at this bottleneck location is due to a decrease in vehicle demand along the I-95 southbound GP lanes (i.e., cars are shifting to the HOV/HOT lanes) in the Build scenario. This vehicle shift to the HOV/HOT lanes results in a benefit under the Build scenario while not degrading the HOV/HOT lane operations. During the PM peak hour, the queue through this location is estimated to be 3.5 miles shorter in the Build scenario when compared to the No-Build condition.

Average vehicle speeds are projected to range between 18 and 30 mph between the Gordon Road merge and the US 1 (Richmond Highway) weave section under both the 2018 No-Build and Build scenarios. Similarly, in both 2018 scenarios vehicle speeds will be close to free-flow speeds from south of the I-495 off-ramp to just north of the Fairfax County Parkway interchange.

The southernmost bottleneck in the study area is due to the Russell Road on-ramp merge combined with the HOV lane southern terminus merge in the No–Build condition. In the Build scenario, this bottleneck disappears due to two reasons:

- As described in section 9.3.2.1, traffic demand through the Russell Road on-ramp merge segment decrease by 27 percent compared to the No-Build scenario. This volume decrease allows the I-95 mainline to operate below capacity in the Build condition. Therefore, the bottleneck at Russell Road does not form in the Build scenario.
- The shift of the southern terminus in the Build scenario eliminates the friction that occurs in the No-Build condition at the Dumfries Road HOV merge area. Traffic speeds are anticipated to be near free-flow through this section under the Build scenario.

In the southbound direction, for the No-Build and Build scenarios, the HOV/HOT lanes are expected to operate near free-flow speeds along most segments of the corridor. Similar to Existing conditions, some reduction in speed is anticipated near the southern terminus at the Dumfries interchange under the No-Build scenario. However, this slowing would be localized to that short segment. No significant congestion is anticipated along the rest of the corridor. In the Build scenario, no degradation in travel speeds is expected due to either the increased volume or the increase in ingress/egress locations along the HOV/HOT lane facility.

In the northbound direction during the PM peak hour, both the No-Build and Build scenarios would operate comparably in 2018. No significant difference in travel speeds in anticipated in either the No-Build or Build scenarios.

Speed data from the VISSIM model for 2018 PM conditions (No-Build and Build) is also geographically illustrated in **Figures 9-7 and 9-11** for all study segments along the I-95 study corridor.

9.3.2.4 Volume Served Analysis

Throughput volumes and percent of demand unserved were compared between the 2018 No-Build and Build scenarios. Throughput volume and percent of demand unserved are both measured by combining the GP and HOV/HOT lanes along I-95 between Garrisonville Road and Duke Street in the AM northbound direction and from Duke Street to south of Garrisonville Road in the southbound (PM peak) direction.

AM Peak

In the AM peak hour, the 2018 Build scenario has higher throughput volumes than the 2018 No-Build scenario throughout the entire corridor. The main throughput volume differences are found in segments with little or no congestion while congested, over-saturated areas show much smaller differences.

Table 9-16 and **Exhibit 9-15** compare volume throughput and percent demand unserved between the 2018 No-Build and 2018 Build AM peak hour scenarios. As discussed in Section 9.3.2.1, the Build scenario has more demand (GP and HOV/HOT lane trips) in the peak northbound direction of travel when compared to the No-Build scenario. Under the Build scenario, the volume served is greater than the No-Build scenario throughout the entire study area along the peak direction of travel (northbound). Typically, the Build scenario is able to serve between 2 and 25 percent more vehicles per hour depending on the segment along the corridor. Furthermore, the percent unserved is typically less in the Build scenario compared to the No-Build. The conclusion is that the Build scenario is able to serve more vehicles while fewer vehicles are not able to enter the network. This represents a significant improvement in the overall efficiency of the system.

Table 9-16 shows that the throughput is much higher in the 2018 Build scenario for the AM peak direction all the way from the southern end of the network up to Edsall Road. Beyond that the throughput is the same as under the No-Build conditions. The table also shows that percentage of unserved demand is much higher in the No-Build compared to the Build scenario up to Fairfax County Parkway. Figure 9-15 clearly shows that the Build scenario is able to serve much more demand compared to the No-Build scenario.

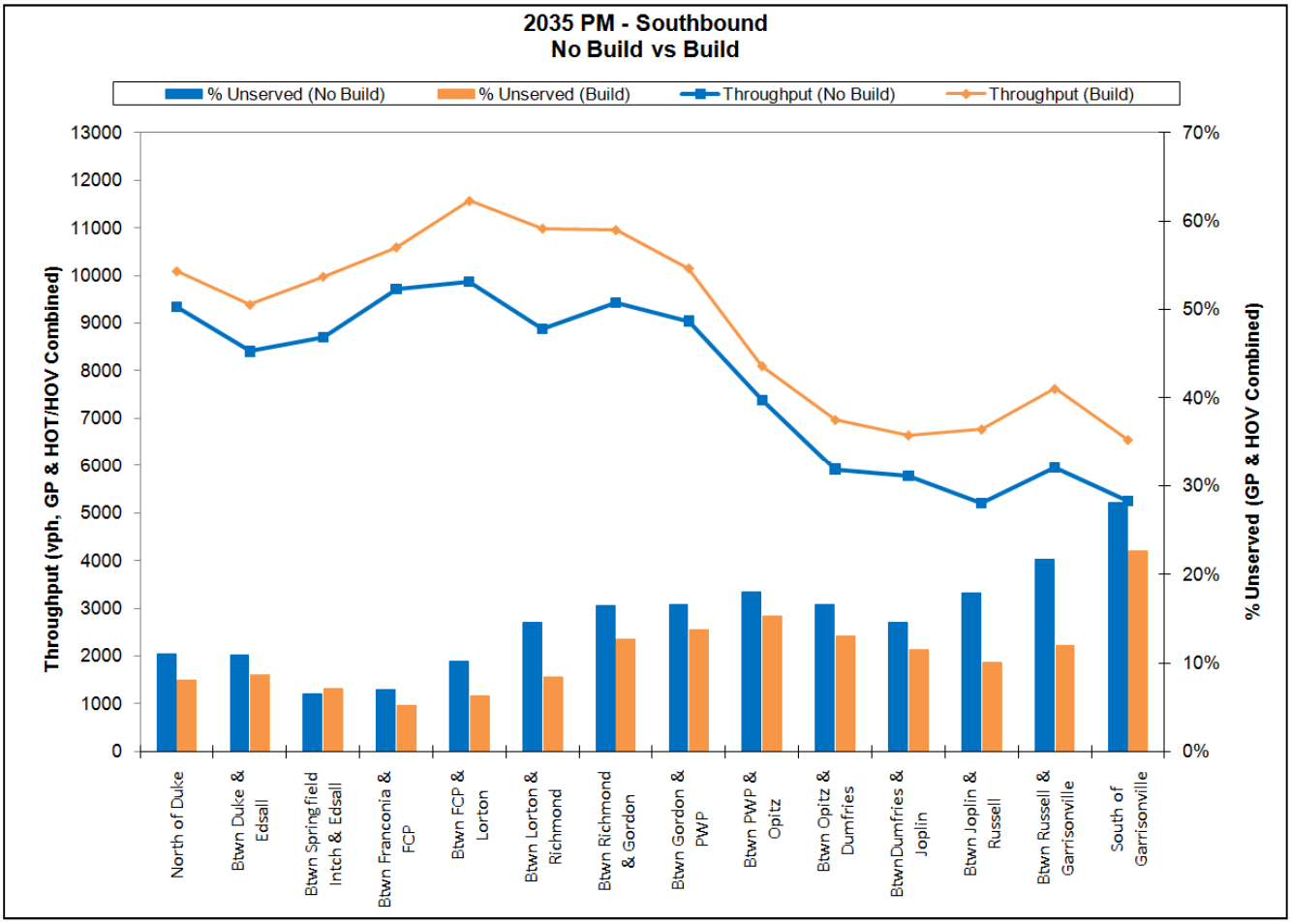
Along the southbound direction in the AM peak period, the percent served is same for both Build and No-Build scenarios since there is no congestion along this direction of the corridor.

On the HOV/HOT lane facility, the demand and throughput both increase in the Build conditions compared to the No-Build. There is an almost 60 percent increase in demand and throughput in the 2018 Build conditions. The percent of demand served decreases slightly in the Build conditions although this includes the increase in volume because of the HOT traffic. Overall more than 91 percent of the demand on the HOV/HOT lane facility gets served during the AM peak hour.

Table 9-16: Vehicle Throughput Comparison for 2018 Build and No-Build AM Northbound

Screenline Location	2018 No Build AM						2018 Build AM						Throughput Volume Difference	
	Throughput Volume (veh/hr)			Percent Unserved			Throughput Volume (veh/hr)			Percent Unserved				
	GP	HOV	Overall	GP	HOV	Overall	GP	HOV/HOT	Overall	GP	HOT/HOV	Overall	Abs Diff	% Diff
South of Garrisonville Rd	5985	0	5985	1%	0%	1%	5139	1778	6917	1%	0%	1%	932	16%
Between Garrisonville Rd & Russell	5677	0	5677	6%	0%	6%	4745	2184	6929	2%	0%	1%	1252	22%
Between Russell Rd & Joplin Rd	5306	0	5306	5%	0%	5%	4634	2007	6641	1%	0%	1%	1335	25%
Between Joplin Rd & Dumfries Rd	5581	0	5581	4%	0%	4%	4801	2007	6808	1%	0%	1%	1227	22%
Between Dumfries Rd & Opitz Blvd	4756	931	5687	3%	4%	3%	4379	2481	6860	3%	0%	2%	1173	21%
Between Opitz Blvd & PWP	4940	1491	6431	2%	3%	2%	4480	3249	7729	1%	0%	1%	1298	20%
Between PWP & Gordon Blvd	5227	2332	7559	2%	2%	2%	5403	3459	8862	1%	1%	1%	1303	17%
Between Gordon Blvd & Richmond H	6119	2716	8835	8%	6%	8%	6212	4130	10342	7%	5%	6%	1507	17%
Between Richmond Hwy & Lorton Rd	5794	2825	8619	11%	6%	9%	5991	4437	10428	8%	5%	7%	1809	21%
Between Lorton Rd & FCP	6524	2921	9445	12%	6%	10%	6490	4480	10970	11%	10%	11%	1525	16%
Between FCP & Franconia Rd	6762	2386	9148	10%	6%	9%	6723	2971	9694	10%	9%	10%	546	6%
Between Springfield IC & Edsall Rd	5410	2617	8027	19%	3%	14%	5062	3380	8442	20%	6%	15%	415	5%
Between Edsall Rd & Duke St	4867	2813	7680	18%	3%	13%	4982	2849	7831	19%	5%	15%	151	2%
North of Duke St	5342	2813	8155	18%	3%	13%	5320	2849	8169	19%	5%	15%	14	0%
													Average	15%

Exhibit 9-15: Vehicle Throughput and Unserved Demand Comparison for 2018 Build and No-Build AM Northbound



Along eastbound I-495 there is an increase in demand in the 2018 Build scenario which is primarily attributed to the mainline through volumes. The demand on the ramps is approximately the same between the no-build and build scenarios. This increase in mainline demand does not affect the percent of demand served and it therefore remains about the same. The decrease in percent served on the ramps is mainly due to the on-ramp from Braddock Road where the demand changes between the 2018 No-Build and 2018 Build, reducing the percentage of vehicles that go through during the AM peak hour.

On the westbound I-495 mainline, demand decreases by about four percent while the ramp demand increases by about 6.5 percent. Along the mainline, the percentage of demand served remains the same in the 2018 No-Build and 2018 Build scenarios. On the ramps, the percent served vehicles drops by nine percent, which amounts to approximately 500 vehicles less in the Build scenario. Overall the percent served along both eastbound and westbound I-495 are comparable in the No-Build and Build scenarios.

PM Peak

In the PM peak hour, the 2018 Build scenario has higher throughput volumes than the 2018 No-Build scenario throughout the entire corridor. The main throughput volume differences are found in segments with little or no congestion while congested, over-saturated areas show much smaller differences.

Table 9-17 and **Exhibit 9-16** show the comparison of volume throughput and percent demand unserved between the 2018 No-Build and 2018 Build PM peak hour scenarios. As discussed in section 9.3.2.1, the Build scenario has more demand (GP and HOV/HOT lane trips) in the peak southbound direction of travel when compared to the No-Build scenario. Under the Build scenario, the volume served is greater than the No-Build scenario throughout the entire study area along the peak direction of travel (southbound). Typically, the Build scenario is able to serve between five and 24 percent more vehicles per hour depending on the segment along the corridor. Furthermore, the percent unserved is typically less in the Build scenario compared to the No-Build. The conclusion is that the Build scenario is able to serve more vehicles while fewer vehicles are not able to enter the network. This represents a significant improvement in the overall efficiency of the system.

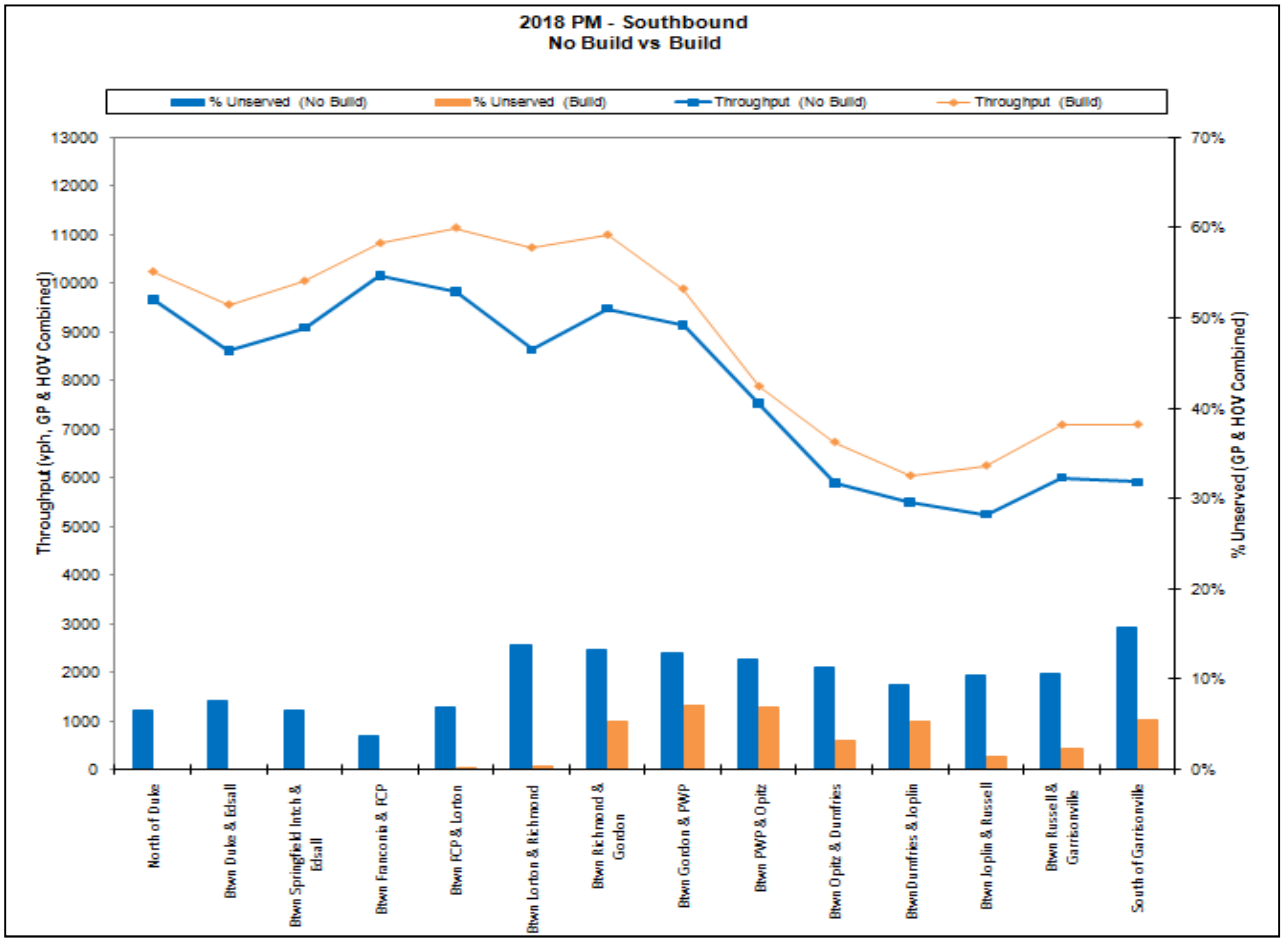
The segment between Fairfax County Parkway and Gordon Road shows the greatest project related benefit. Through this segment, the Build scenario is able to serve between 1,300 and 2,100 more vehicles per hour and the percent unserved is eight to 14 percent less than the No-Build scenario. This improvement is primarily the result of by toll-paying motorists shifting their trip from the GP lanes to the HOV/HOT lanes to avoid the congestion between Gordon Road and Fairfax County Parkway. Due to the increased capacity along the HOV/HOT facility, the facility as a whole is able to serve the increase in vehicle demand.

In the off-peak, northbound direction, the differences in throughput volumes and relative percent unserved are negligible between the two scenarios.

Table 9-17: Vehicle Throughput Comparison for 2018 Build and No-Build PM Southbound

Screenline Location	2018 No Build PM						2018 Build PM						Throughput Volume Difference	
	Throughput Volume (veh/hr			Percent Unserved			Throughput Volume (veh/hr			Percent Unserved				
	GP	HOV	Overall	GP	HOV	Overall	GP	HOV/HOT	Overall	GP	HOT/HOV	Overall	Abs Diff	% Diff
North of Duke St	7001	2671	9672	9%	0%	7%	7219	3011	10230	0%	0%	0%	558	6%
Between Duke St & Edsall Rd	5949	2671	8620	11%	0%	8%	6542	3011	9553	0%	0%	0%	933	11%
Between Edsall Rd & Springfield IC	6165	2918	9083	9%	1%	6%	6013	4029	10042	0%	0%	0%	959	11%
Between Franconia Rd & FCP	7464	2688	10152	4%	1%	4%	7526	3290	10816	0%	2%	0%	664	7%
Between FCP & Lorton Rd	6581	3242	9823	9%	2%	7%	6473	4659	11132	0%	2%	0%	1309	13%
Between Lorton Rd & Richmond Hw	5428	3206	8634	20%	1%	14%	6055	4669	10724	0%	2%	0%	2090	24%
Between Richmond Hwy & Gordon E	6344	3134	9478	18%	2%	13%	6547	4441	10988	7%	3%	5%	1510	16%
Between Gordon Blvd & PWP	6181	2956	9137	17%	1%	13%	6009	3870	9879	10%	3%	7%	742	8%
Between PWP & Opitz Blvd	5609	1920	7529	16%	0%	12%	5584	2292	7876	8%	3%	7%	347	5%
Between Opitz Blvd & Dumfries Rd	4595	1296	5891	14%	2%	11%	4707	2026	6733	3%	4%	3%	842	14%
Between Dumfries Rd & Joplin Rd	5493	0	5493	9%	0%	9%	4248	1793	6041	5%	0%	5%	548	10%
Between Joplin Rd & Russell Rd	5244	0	5244	10%	0%	10%	3984	2264	6248	0%	0%	1%	1004	19%
Between Russell Rd & Garrisonville R	5998	0	5998	11%	0%	11%	4820	2264	7084	1%	0%	2%	1086	18%
South of Garrisonville Rd	5908	0	5908	16%	0%	16%	5684	1410	7094	5%	0%	5%	1186	20%
													Average	**13%**

Exhibit 9-16: Vehicle Throughput and Unserved Demand Comparison for 2018 Build and No-Build PM Southbound



9.3.2.5 Freeway Density Analysis

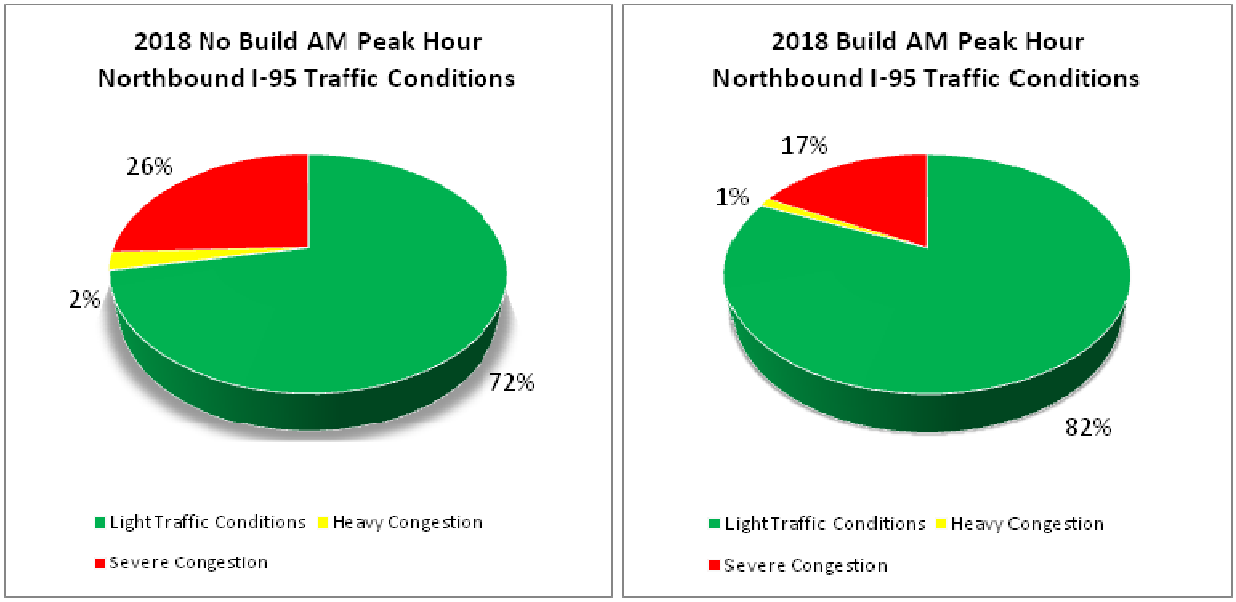
AM Peak

Exhibit 9-17 shows a summary of traffic operational conditions based on freeway segment density measured in vehicles per mile per lane along the I-95 mainline in the northbound AM peak direction. In the 2018 No-Build scenario, there are 38 basic, five weaving and 30 merge/diverge segments for a total of 73 segments in the northbound direction. In the 2018 Build scenario, there are 46 basic, nine weaving and 28 merge/diverge segments for a total of 83 segments in the northbound direction. The difference in the number of segments between the two scenarios is due to the additional access provided along the facility in the Build conditions.

Review of **Exhibit 9-17** and **Table 9-18** shows that almost 72 percent of the total mainline segments operate under acceptable traffic conditions in the 2018 No-Build scenario, which can be equated to HCM LOS A through D. In comparison, 82 percent are projected to operate under acceptable traffic conditions in the Build scenario. Also, the number of segments operating under heavy and severe congested conditions (comparable to HCM LOS F and E) drops from 28 percent in the No-Build scenario to 18 percent in the Build scenario.

Overall, Build conditions improve the operations along the entire corridor over the No-Build conditions.

Exhibit 9-17: Freeway Traffic Conditions Measured by Density - 2018 AM No-Build and Build Scenarios



Basic Freeway Segments

As shown in **Table 9-18**, in the 2018 No-Build scenario there are 38 basic segments out of which 10 operate under severe congested conditions, two segments operate under heavy congested conditions and the remaining 26 segments operate under acceptable traffic conditions. In comparison under the 2018 Build scenario, only seven freeway basic segments out of a total of 46 operate under severe congestion while only one segment operates under heavy congestion. The remaining 38 segments operate under acceptable traffic conditions. It can be seen that there is a significant improvement in the operating conditions of the freeway basic segments in the peak northbound direction under the Build conditions.

Weave Segments

Table 9-19 details the density analysis for the weave segments in the 2018 No-Build and Build scenarios. There are a total of five weaving segments in the 2018 No-Build scenario, and nine weaving segments in the 2018 Build scenario. There are two segments that operate under severe congested conditions in the No-Build while the remaining three operate under acceptable conditions. The number of segments operating under severe congested conditions increases in the Build conditions to three and the total number of weave segments that operate under acceptable conditions increases to six. Under No-Build conditions, almost 40 percent of the segments are projected to operate under severe congested conditions, while under Build conditions only 33 percent will operate under severe congested conditions.

Ramp Junctions

The density analysis for the ramp junctions includes all diverge and merge segments for the 2018 No-Build and Build scenarios. The results of the ramp junction analysis are shown in **Table 9-20**. There are a total of 30 ramp junction segments in the 2018 No-Build but only 28 under the 2018 Build scenario. In the 2018 No-Build scenario a total of nine or 30 percent of the ramp junction segments will operate under severe congested conditions while the remaining 21 segments will operate under acceptable operating conditions. It is projected that under the Build scenario, only 18 percent of the ramp junction segments (five segments) will operate under severe congested conditions. The remaining 23 segments will operate under acceptable conditions.

Table 9-18: Northbound Freeway Basic Segments Density Analysis for 2018 No-Build and Build AM

Basic Freeway Segments		2018 AM No Build			2018 AM Build		
ID	Description	Average Density (veh/mi/ln)	Average Speed (mph)	HCM Equivalent LOS	Average Density (veh/mi/ln)	Average Speed (mph)	HCM Equivalent LOS
FGN095Gar01#01	From south of Garrisonville Rd to I-95 NB Off-ramp to US-1	32	62	D	28	62	D
FGN095Gar02#03	Between I-95 NB Off-ramp to US-1 and I-95 NB On-ramp from Garrisonville Rd EB	29	61	D	24	62	C
FGN095Gar03#05	Between I-95 NB Off-ramp to Garrisonville Rd WB and I-95 NB On-ramp from US-1	29	58	D	27	58	D
FGN095Rus01#07	Between I-95 NB On-ramp from US-1 and GP-to-HOT ramp n/o Garrisonville Rd	31	61	D	27	63	D
FGN095Rus02#09	Between GP-to-HOT ramp n/o Garrisonville Rd and Off-ramp to Russell Rd	N/A	N/A	N/A	27	61	D
FGN095Rus02#9	Between I-95 NB Off-ramp to Russell Rd and On-ramp from Russell Rd	29	59	D	23	60	C
FGN095Jop01#11	Between I-95 NB On-ramp from Russell Rd and HOT-to-GP ramp n/o Russell Rd	29	62	D	24	62	C
FGN095Jop02#15	Between HOT-to-GP ramp n/o Russell Rd and I-95 NB Off-ramp to Joplin Rd	N/A	N/A	N/A	25	63	C
FGN095Jop02#13	Between I-95 NB Off-ramp to Joplin Rd and On-ramp from Joplin Rd	27	62	D	22	63	C
FGN095Dum01#15	Between I-95 NB On-ramp from Joplin Rd and GP-to-HOT ramp s/o Dumfries Rd	32	59	D	27	59	D
FGN095Dum02#17	Between GP-to-HOT ramp s/o Dumfries Rd and Off-ramp to Dumfries Rd EB (3 lanes)	28	58	D	26	58	C
FGN095Dum03#22	Between GP-to-HOT ramp s/o Dumfries Rd and Off-ramp to Dumfries Rd EB (4 lanes)	N/A	N/A	N/A	19	55	C
FGN095Dum04#20	Between I-95 NB Off-ramp to Dumfries Rd WB and On-ramp from Dumfries Rd	21	60	C	19	60	C
FGN095Dum05#22	Between I-95 NB On-ramp from Dumfries Rd and Off-ramp to Truck Rest Area	26	64	C	24	64	C
FGN095Dal01#24	Between I-95 NB Off-ramp to Truck Rest Area and On-ramp from Truck Rest Area	26	65	C	23	65	C
FGN095Dal02#27	Between GP-to-HOT ramp s/o Dale Blvd and Off-ramp to Rest Area s/o Dale Blvd	27	61	D	24	61	C
FGN095Dal03#29	Between I-95 NB Off-ramp to Rest Area s/o Dale Blvd and On-ramp from Rest Area	28	56	D	26	56	C
FGN095Dal04#31	Between I-95 NB Off-ramp to Dale Blvd and On-ramp from Opitz Blvd	22	58	C	19	58	C
FGN095PWP01#33	Between I-95 NB On-ramp from Opitz Blvd and Off-ramp to PWP	29	55	D	27	56	D
FGN095PWP02#35	Between I-95 NB Off-ramp to PWP and HOT-to-GP ramp at PWP	25	58	C	23	58	C
FGN095PWP03#40	Major merge from HOT-to-GP ramp at PWP	N/A	N/A	N/A	20	57	C
FGN095PWP04#41	Between I-95 NB HOT-to-GP Major Merge and On-ramp from PWP	N/A	N/A	N/A	27	57	D
FGN095Gdn01#37	Between I-95 NB On-ramp from PWP and Off-ramp to Gordon Blvd EB	32	55	D	33	55	D
FGN095Gdn02#39	Between I-95 NB Off-ramp to Gordon Blvd EB and On-ramp from Gordon Blvd EB	34	51	D	34	52	D
FGN095Gdn03#41	Between I-95 NB Off-ramp to Gordon Blvd WB and On-ramp from Gordon Blvd WB	27	52	D	27	53	D
FGN095Rt101#43	Between I-95 NB Off-ramp to NB Richmond Hwy and On-ramp from NB Richmond Hwy	23	52	C	24	52	C
FGN095Rt102#44	Between I-95 NB Off-ramp to NB Richmond Hwy and On-ramp from NB Richmond Hwy	23	53	C	24	52	C
FGN095Lor01#46	5-lane Basic segment between I-95 NB On-ramp from NB Richmond Hwy and downstream 4-lane Basic segment	31	46	D	23	51	C
FGN095Lor02#47	4-lane Basic segment between upstream 5-lane Basic segment n/o Richmond Hwy and Off-ramp to Lorton Rd	41	45	E	28	53	D
FGN095Lor03#49	Between I-95 NB Off-ramp to Lorton Rd and On-ramp from Lorton Rd	59	30	F	28	52	D
FGN095FCP01#51	5-lane Basic segment between I-95 NB On-ramp from Lorton Rd and downstream 4-lane Basic segment	69	22	F	45	39	E
FGN095FCP02#52	4-lane Basic segment between upstream 5-lane Basic segment n/o Lorton Rd and GP-to-HOT ramp s/o FCP	90	20	F	58	36	F
FGN095FCP03#54	Between I-95 NB GP-to-HOT ramp s/o FCP and Off-ramp to SB FCP	90	20	F	74	27	F
FGN095FCP04#56	Between I-95 NB Off-ramp to SB FCP and On-ramp from SB FCP	30	49	D	30	49	D
FGN095FCP05#58	Between I-95 NB Off-ramp to NB FCP and On-ramp from NB FCP	26	53	C	25	53	C
FGN095FSP01#60	Between I-95 NB On-ramp from NB FCP and HOT-to-GP flyover n/o FCP	32	50	D	29	53	D
FGN095FSP02#62	Between I-95 NB HOT-to-GP flyover n/o FCP and Off-ramp to FSP	32	53	D	32	53	D
FGN095Fra01#64	Between I-95 NB Off-ramp to FSP and GP-to-HOT ramp s/o Franconia Rd	27	53	D	26	54	C
FGN095Fra02#66	Between I-95 NB GP-to-HOT ramp s/o Franconia Rd and Major Diverge at Franconia Rd	29	50	D	25	53	C
FGN095Fra03#67	Between Major Diverge at Franconia Rd to On-ramp from EB Franconia Rd (left side)	35	45	D	26	53	C
FGN095Spr01#68	Between On-ramps from EB Franconia Rd on left and right-sides of I-95 NB	38	39	E	23	52	C
FGN095Spr02#69	Between On-ramp from EB Franconia Rd on right-side of I-95 NB and Major Diverge s/o Springfield IC	34	41	D	20	55	C
FGN095Spr03#70	Between Major Diverge s/o Springfield IC and I-395 NB On-ramp from Franconia Rd	77	20	F	21	55	C
FGN095Spr04#72	Between I-395 NB On-ramp from Franconia Rd and On-ramp from I-495 EB/WB	110	13	F	69	21	F
FGN395Eds01#75	Between I-395 NB Off-ramp to WB Edsall Rd and On-ramp from Edsall Rd	95	16	F	106	13	F
FGN395Duk01#77	Between I-395 NB GP-to-HOT flyover s/o Duke St and HOT-to-GP flyover s/o Duke St	82	20	F	96	15	F
FGN395Duk02#80	Between I-395 NB Off-ramp to WB Duke St and On-ramp from Duke St	92	17	F	92	17	F
FGN395Sem01#82	Between I-395 NB On-ramp from Duke St and n/o Duke St	54	34	F	55	33	F

Table 9-19: Northbound Freeway Weave Segments Density Analysis for 2018 No-Build and Build AM

Weave Segments		2018 AM No Build			2018 AM Build		
ID	Description	Average Density (veh/mi/ln)	Average Speed (mph)	HCM Equivalent LOS	Average Density (veh/mi/ln)	Average Speed (mph)	HCM Equivalent LOS
WGN095Gar01#04	Between I-95 NB On-ramp from EB Garrisonville Rd and Off-ramp to WB Garrisonville Rd	30	52	D	29	52	D
WGN095Dal01#30	Between I-95 NB On-ramp from Rest Area s/o Dale Blvd and Off-ramp to Dale Blvd	22	55	C	19	56	B
WGN095Gdn01#40	Between I-95 NB On-ramp from SB Gordon Blvd and Off-ramp to NB Gordon Blvd	33	41	D	27	49	C
WGN095Rt101#42	Between I-95 NB On-ramp from Gordon Blvd and Off-ramp to NB Richmond Hwy	24	51	C	25	51	C
WGN095FCP01#57	Between I-95 NB On-ramp from SB FCP and Off-ramp to NB FCP	32	43	D	35	41	D
WGN395Eds01#73	Between I-395 On-ramp from I-495 EB/WB and Off-ramp to Edsall Rd	117	11	F	103	12	F
WGN395Duk01#76	Between I-395 NB On-ramp from Edsall Rd and GP-to-HOT flyover s/o Duke St	87	18	F	97	14	F
WGN395Duk01#83	Between I-395 NB HOT-to-GP flyover s/o Duke St and Off-ramp to EB Duke St	N/A	N/A	N/A	93	16	F

Table 9-20: Northbound Freeway Ramp Junction Segments Density Analysis for 2018 No-Build and Build AM

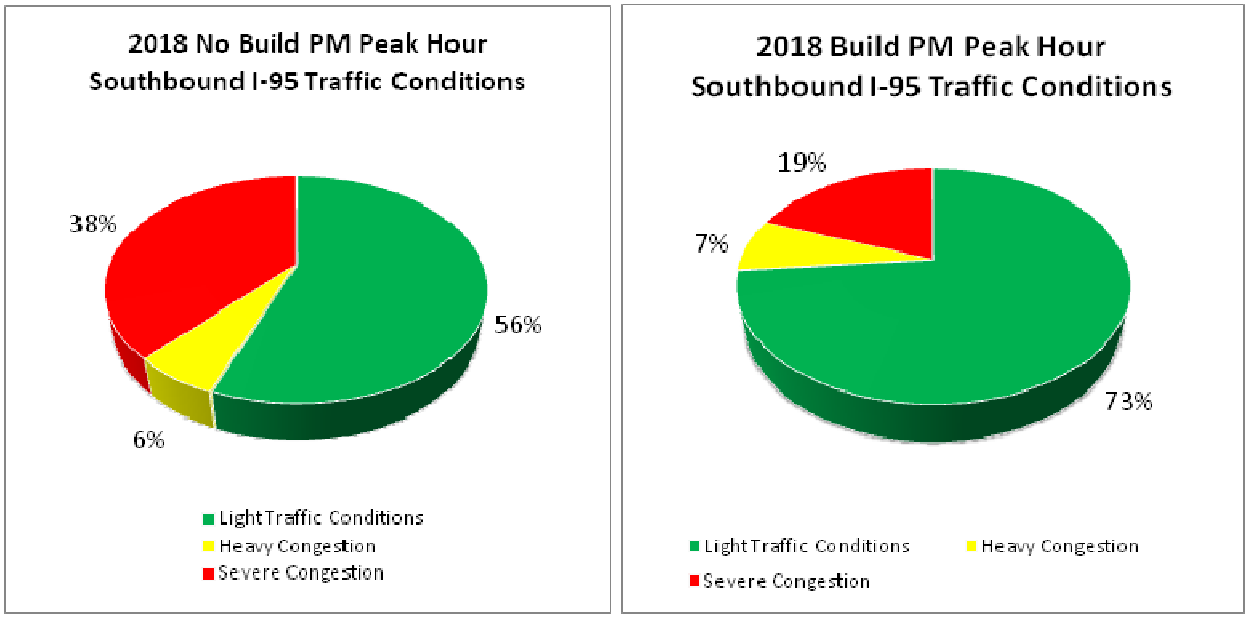
Ramp Junctions		2018 AM No Build			2018 AM Build		
ID	Description	Average Density (veh/mi/ln)	Average Speed (mph)	HCM Equivalent LOS	Average Density (veh/mi/ln)	Average Speed (mph)	HCM Equivalent LOS
DGN095Gar01#02	I-95 NB Off-ramp to US-1	29	60	D	26	59	C
MGN095Gar01#06	I-95 NB On-ramp from US-1	24	58	C	21	58	C
DGN095Rus01#08	I-95 NB GP-to-HOT ramp s/o Russell Rd	N/A	N/A	N/A	26	55	C
DGN095Rus01#8	I-95 NB Off-ramp to Russell Rd	30	54	D	24	55	C
MGN095Rus01#10	I-95 NB On-ramp from Russell Rd	27	55	C	22	56	C
MGN095Jop01#14	I-95 NB HOT-to-GP ramp s/o Joplin Rd	N/A	N/A	N/A	21	61	C
DGN095Jop01#12	I-95 NB Off-ramp to Joplin Rd	25	61	C	22	60	C
MGN095Jop01#14	I-95 NB On-ramp from Joplin Rd	27	57	C	23	58	C
DGN095Dum01#16	I-95 NB GP-to-HOV/HOT ramp s/o Dumfries Rd	28	58	C	24	58	C
DGN095Dum02#18	I-95 NB Off-ramp to Dumfries Rd EB	21	57	C	19	59	B
DGN095Dum03#19	I-95 NB Off-ramp to Dumfries Rd WB	22	57	C	21	57	C
MGN095Dum01#21	I-95 NB On-ramp from Dumfries Rd	23	61	C	21	61	C
DGN095Dal01#23	I-95 NB Off-ramp to Truck Rest Area n/o Dumfries Rd	22	64	C	21	64	C
MGN095Dal01#25	I-95 NB On-ramp fro Truck Rest Area n/o Dumfries Rd	19	58	B	N/A	N/A	N/A
DGN095Dal02#26	I-95 NB GP-to-HOV/HOT ramp s/o Dale Blvd	21	64	C	N/A	N/A	N/A
DGN095Dal03#28	I-95 NB Off-ramp to Rest Area s/o Dale Blvd	24	56	C	22	57	C
MGN095Opt01#32	I-95 NB On-ramp from Rest Area s/o Dale Blvd	21	52	C	18	53	B
DGN095PWP01#34	I-95 NB Off-ramp to Prince William Pkwy	25	58	C	22	58	C
MGN095PWP01#36	I-95 NB On-ramp from Prince William Pkwy	27	55	C	28	55	C
DGN095Gdn01#38	I-95 NB Off-ramp to Gordon Blvd SB	29	52	D	30	52	D
MGN095Rt101#45	I-95 NB On-ramp from Richmond Hwy NB	27	48	C	21	52	C
DGN095Lor01#48	I-95 NB Off-ramp to Lorton Rd	46	35	F	26	51	C
MGN095Lor01#50	I-95 NB On-ramp from Lorton Rd	67	24	F	33	42	D
DGN095FCP01#53	I-95 NB GP-to-HOV/HOT ramp s/o Fairfax County Pkwy	85	22	F	64	30	F
DGN095FCP02#55	I-95 NB Off-ramp to Fairfax County Pkwy SB	73	24	F	65	29	F
MGN095FCP01#59	I-95 NB On-ramp from Fairfax County Pkwy NB	26	53	C	25	53	C
MGN095FSP01#61	I-95 NB HOV/HOT-to-GP flyover n/o Fairfax County Pkwy	34	45	D	31	47	D
DGN095FSP01#63	I-95 NB Off-ramp to Franconia-Springfield Pkwy	29	53	D	29	54	D
DGN095Fra01#65	I-95 NB GP-to-HOV/HOT s/o Franconia Rd	27	52	C	25	54	C
MGN095Spr01#71	I-395 NB On-ramp from Franconia Rd WB	108	11	F	34	36	D
DGN395Eds01#74	I-395 NB Off-ramp to Edsall Rd WB	79	20	F	87	17	F
DGN395Duk01#78	I-395 NB Off-ramp to Duke St EB	72	21	F	N/A	N/A	N/A
DGN395Duk02#79	I-395 NB Off-ramp to Duke St WB	80	20	F	81	19	F
MGN395Duk01#81	I-395 NB On-ramp from Duke St	80	23	F	81	23	F

Figure 9-6 and 9-10 illustrates the LOS results from the VISSIM modeling geographically along all segments of I-95 in the study area for 2018 AM conditions (No-Build and Build).

PM Peak

Exhibit 9-18 is a summary of freeway segment density measured in vehicles per mile per lane along the I-95 mainline in the southbound PM peak direction. In the 2018 Build scenario, 73 percent of the total mainline segments operate under acceptable traffic conditions, LOS A through D. In comparison, only 56 percent are projected to operate under acceptable traffic conditions in the No-Build scenario.

Exhibit 9-18: Summary of Freeway Traffic Conditions Based Measured by Density – 2018 PM Build and No-Build Scenarios



Basic Segments

As shown in **Table 9-21**, in the 2018 No-Build scenario there are 43 basic segments out of which 16 operate under severe congested conditions, four segments operate under heavy congested conditions and the remaining 23 segments operate under acceptable traffic conditions. In comparison, the 2018 Build scenario operates with eight of the 44 basic segments will operate under severe congestion, while only three segments operates under heavy congestion. The remaining 33 segments operate under acceptable traffic conditions. It can be seen that there is a significant improvement in the operating conditions of the freeway basic segments in the peak southbound direction under the Build conditions.

Weave Segments

Table 9-22 summarizes the density analysis for the weave segments in the 2018 No-Build and Build scenarios. There are a total of ten weaving segments in the 2018 No-Build scenario and 11 weave segments in the 2018 Build scenario. There are six segments that operate under severe congested or heavy congested conditions in the No-Build while the remaining four operate under acceptable conditions. The number of segments operating under severe congested and heavy congested conditions decreases in the Build conditions to four, while seven segments operate under acceptable conditions. In the No-Build scenario, 60 percent of all segments operate under severe or heavy congested conditions; however, in the Build scenario, only 36 percent operate at this level.

Table 9-21: Southbound Freeway Basic Segments Density Analysis for 2018 No-Build and Build PM

Basic Freeway Segments		2018 PM No Build			2018 PM Build		
ID	Description	Average Density (veh/mi/ln)	Average Speed (mph)	HCM Equivalent LOS	Average Density (veh/mi/ln)	Average Speed (mph)	HCM Equivalent LOS
FGS395Sem01#1	Between Seminary Rd and I-395 Off ramp to Duke St	100	18	F	96	19	F
FGS395Duk01#3	4-lane segment between I-395 SB Off ramp to Duke St and downstream 3-lane segment n/o Duke St	90	17	F	86	19	F
FGS395Duk02#4	3-lane segment between upstream 4-lane segment and I-395 On ramp from Duke St WB	80	24	F	81	26	F
FGS395Duk03#6	Between I-395 Off ramp to Duke St EB and I-395 On ramp from Duke St	87	21	F	72	28	F
FGS395Duk04#8	Between I-395 Off Ramp to HOV/HOT SB Off and On Ramps	87	22	F	30	59	D
FGS395Eds01#10	Between I-395 Off ramp to Edsall Rd WB and I-395 On ramp from Edsall Rd WB	96	18	F	33	53	D
FGS395Eds02#12	3-lane segment between I-395 Off ramp to Edsall Rd EB and downstream 4-lane segment	46	41	F	39	47	E
FGS395Eds03#13	4-lane segment between upstream 3-lane segment and I-395 On ramp from Edsall Rd EB	27	51	D	25	54	C
FGS095Spr01#15	Between I-395 SB Off ramp to EB/WB I-495 and I-395 Off ramp to Franconia	21	60	C	20	60	C
FGS095Spr02#16	Between I-395 Off ramp to Franconia and I-95 On ramp from I-495 EB	19	61	C	19	61	C
FGS095Spr03#17	4-lane segment between I-95 On ramp from I-495 EB and I-95 On ramp from I-495 WB	21	57	C	20	58	C
FGS095Fra01#18	6-lane segment between I-95 On ramp from I-495 WB and downstream 5-lane segment s/o Franconia Rd	18	58	B	19	58	C
FGS095Fra03#20	5-lane segment between upstream 6-lane segment s/o Franconia Rd and I-95 On ramp from Franconia Rd	23	58	C	22	59	C
FGS095FSP01#22	Between I-95 On ramp from Franconia Rd and I-95 On ramp from HOT s/o Franconia Rd	25	57	C	24	58	C
FGS095FSP03#25	4-lane segment between HOT Off Ramp s/o Franconia Rd and downstream 5-lane segment n/o FCP	25	58	C	27	58	D
FGS095FSP04#26	5-lane segment between upstream 4-lane segment and I-95 SB Off Ramp to FCP WB	20	60	C	20	60	C
FGS095FCP01#28	Between I-95 Off ramp to FCP WB and I-95 SB On ramp from FCP WB	22	58	C	22	58	C
FGS095FCP02#30	Between I-95 Off ramp to FCP EB and I-95 SB On ramp from FCP EB	26	52	C	23	58	C
FGS095FCP03#32	Between I-95 SB On ramp from FCP and I-95 SB Off ramp to Lorton Rd	51	34	F	27	61	D
FGS095Lor01#34	Between I-95 SB On ramp from FCP and I-95 SB Off ramp to Lorton Rd	83	20	F	27	61	D
FGS095Lor02#36	Between I-95 SB Off ramp to Lorton Rd and I-95 SB On ramp from Lorton Rd	122	10	F	23	58	C
FGS095Rt101#38	Between Lorton Rd and Richmond Hwy	120	11	F	45	43	F
FGS095Rt102#40	Between I-95 SB Off ramp to HOT s/o Richmond Hwy and I-95 SB On ramp from Richmond Hwy SB	116	11	F	107	12	F
FGS095Gdn01#42	4-lane segment between I-95 SB Off ramp to Gordon Blvd WB and downstream 3-lane segment n/o Gordon Blvd	77	18	F	72	19	F
FGS095Gdn02#43	3-lane segment between upstream 4-lane segment and I-95 SB On ramp from Gordon Blvd WB	97	18	F	94	19	F
FGS095PWP01#46	Between I-95 SB On ramp from Gordon Blvd and I-95 SB Off ramp to PWP	36	57	E	36	56	E
FGS095PWP02#49	Between I-95 SB Off ramp to Prince William Pkwy EB and Prince William Pkwy SB On ramp	28	57	D	27	58	D
FGS095PWP03#51	Between Prince William Pkwy and HOV/HOT On ramp to I-95 SB	37	51	E	36	51	E
FGS095Opt01#51	Between I-95 SB Off ramp to Potomac Mills Rd and I-95 Off ramp to HOV/HOT s/o Opitz Blvd	N/A	N/A	N/A	25	48	C
FGS095Opt01#54	Between I-95 SB Off ramp to HOV/HOT s/o Opitz Blvd and Dale Blvd SB On ramp	21	56	C	21	53	C
FGS095Dal01#56	Between Dale Blvd SB On ramp and HOV/HOT SB Off ramp s/o Dale Blvd	27	56	D	29	52	D
FGS095Dal02#58	Between HOV/HOT On ramp s/o Rest Area and Truck Rest Area On ramp	24	63	C	27	60	D
FGS095Dal03#60	Between Truck rest area Off and On ramps	24	63	C	29	58	D
FGS095Dum01	Between Truck rest area On ramp and Dumfries Rd SB Off ramp	19	54	C	27	46	D
FGS095Dum02#64	Between I-95 SB Off ramp to Dumfries Rd EB and Dumfries Rd EB On ramp to I-95 SB	19	62	C	19	61	C
FGS095Dum03#66	Between Dumfries Rd and HOV/HOT SB On ramp s/o Dumfries Rd	33	40	D	23	60	C
FGS095Dum03#68	Between Dumfries Rd and HOV/HOT SB On ramp s/o Dumfries Rd	39	47	E	23	60	C
FGS095Jop01#71	Between I-95 SB Off ramp to Joplin Rd and I-95 On ramp from Joplin Rd	26	61	C	19	63	C
FGS095Jop02#73	Between Joplin Rd and Russell Rd	57	39	F	20	64	C
FGS095Rus01#75	Between I-95 SB Off ramp to Russel Rd and I-95 SB On ramp from Russell Rd	99	17	F	20	64	C
FGS095Rus02#77	Between I-95 SB On ramp from Russell Rd and HOV/HOT On ramp n/o Garrinsonville	36	57	E	27	61	D
FGS095Gar01#79	Between I-95 SB Off ramp to Russell Rd and I-95 SB On ramp from Russell Rd	23	63	C	22	62	C
FGS095Gar02#81	Between I-95 SB Off ramp to Garrisonville Rd EB and I-95 SB On ramp from Garrisonville Rd EB	27	61	D	25	60	C
FGS095Gar03#83	Downstream of I-95 On ramp from Garrisonville Rd EB	31	62	D	30	62	D

Ramp Junctions

The density analysis for the ramp junctions includes all diverge and merge segments for the 2018 No-Build and Build scenarios. The results of the ramp junction analysis are shown in **Table 9-23**. There are a total of 29 ramp junction segments in the 2018 No-Build and 30 in the 2018 Build scenario. In the 2018 No-Build scenario a total of eleven or 38 percent of the ramp junction segments operate under severe congested conditions while the remaining 18 segments operate under acceptable operating conditions. It is projected that under the Build scenario, only 17 percent of the ramp junction segments (five segments) will operate under severe congested conditions. Two segments will operate under heavy congestion conditions while the remaining 23 segments will operate under acceptable conditions.

Figure 9-8 and 9-12 illustrates the LOS results from the VISSIM modeling geographically along all segments of I-95 in the study area for 2018 PM conditions (No-Build and Build).

Table 9-22: Southbound Freeway Weave Segments Density Analysis for 2018 No-Build and Build PM

Weave Segments		2018 PM No Build			2018 PM Build		
ID	Description	Average Density (veh/mi/ln)	Average Speed (mph)	HCM Equivalent LOS	Average Density (veh/mi/ln)	Average Speed (mph)	HCM Equivalent LOS
WGS395Duk01#5	Between I-95 On ramp from Duke St WB and Off ramp to Duke St EB	62	26	F	55	31	F
WGS395Duk02#7	Between I-95 SB On ramp from Duke St and Off Ramp to SB HOV/HOT	79	23	F	57	36	F
WGS395Eds01#09	Between I-95 SB On ramp from HOV/HOT s/o Duke St and Off ramp to Edsall Rd EB	75	26	F	22	60	C
WGS395Eds02#11	Between I-95 SB On ramp from Edsall Rd WB and Off ramp to Edsall Rd EB	74	22	F	42	37	E
WGS395Eds03#14	Between I-95 SB On ramp from Edsall Rd EB and Off ramp to I-495 EB/WB	21	58	C	21	59	C
WGS095FSP01#23	Between I-95 SB On ramp from HOV/HOT s/o Franconia Rd and Off ramp to Backlick Rd	26	54	C	26	54	C
WGS095FCP01#29	Between I-95 SB On ramp from FCP WB and Off ramp to FCP EB	24	52	C	27	49	C
WGS095Rt101#41	Between I-95 SB On ramp from Richmond Highway and Off ramp to Gordon Blvd WB	83	20	F	78	21	F
WGS095PWP01#52	Between I-95 SB On ramp from HOV/HOT s/o Prince William Pkwy and Off ramp to Potomac Mills Rd	40	44	E	27	50	C
WGS095Jop01#67	Between I-95 SB On ramp from HOV/HOT SB s/o Dumfries Rd and Off ramp to HOV/HOT SB	N/A	N/A	N/A	16	56	B
WGS095Gar01#80	Between I-95 SB On ramp from Garrisonville Rd WB and Off ramp to Garrisonville Rd EB	22	56	C	22	54	C

Table 9-23: Southbound Freeway Ramp Junction Segments Density Analysis for 2018 No-Build and Build PM

Ramp Junctions		2018 PM No Build			2018 PM Build		
ID	Description	Average Density (veh/mi/ln)	Average Speed (mph)	HCM Equivalent LOS	Average Density (veh/mi/ln)	Average Speed (mph)	HCM Equivalent LOS
DGS395Duk01#2	I-395 SB Off Ramp to Duke St WB	96	97	F	92	20	F
MGS095Fra02#21	I-95 SB On ramp from Franconia Rd	23	24	C	23	55	C
DGS095FSP01#24	I-95 SB Off Ramp to Franconia Springfield HOV/HOT SB	24	25	C	25	57	C
DGS095FCP01#27	I-95 SB Off Ramp to Fairfax County Pkwy WB	19	20	B	19	56	B
MGS095FCP01#31	I-95 SB On ramp from Fairfax County Pkwy	45	46	F	24	60	C
MGS095FCP02#33	I-95 SB On ramp from HOV On ramp s/o Fairfax County Pkwy	50	50	F	N/A	N/A	N/A
DGS095Lor01#35	I-95 SB Off Ramp to Lorton Rd	98	99	F	29	51	D
MGS095Lor01#37	I-95 SB On ramp from Lorton Rd	131	131	F	21	57	C
DGS095Rt101#39	I-95 SB Off Ramp to Richmond Hwy SB	104	104	F	77	20	F
DGS095Rt102#37	I-95 SB Off Ramp to Richmond Highway HOV/HOT SB	N/A	N/A	N/A	87	14	F
MGS095Gdn01#44	I-95 SB On ramp from Gordon Blvd WB	83	83	F	80	20	F
MGS095Gdn02#45	I-95 SB On ramp from Gordon Blvd EB	54	54	F	54	31	F
DGS095PWP01#47	I-95 SB Off ramp to Prince William Pkwy WB	31	32	D	36	50	E
DGS095PWP02#48	I-95 SB Off ramp to Prince William Pkwy EB	25	26	C	25	54	C
MGS095PWP01#50	I-95 SB On ramp from Prince William Pkwy	29	29	D	30	51	D
DGS095Opt01#52	I-95 SB Off ramp to HOV/HOT SB s/o Optiz Blvd	N/A	N/A	N/A	21	52	C
MGS095Dal01#55	I-95 SB On ramp from Dale Blvd	23	23	C	26	50	C
MGS095Dal02#57	I-95 SB On ramp from HOV/HOT On ramp s/o Dale Blvd	22	22	C	24	55	C
DGS095Dal01#59	I-95 SB Off Ramp to Truck Rest Area	21	22	C	24	56	C
MGS095Dum01#61	I-95 SB On ramp from Truck rest area	23	23	C	31	48	D
DGS095Dum01#62	I-95 SB Off ramp to Dumfries Rd WB	20	20	C	29	52	D
DGS095Dum02#63	I-95 SB Off ramp to Dumfries Rd	20	20	C	36	47	E
MGS095Dum02#65	I-95 SB On ramp from Dumfries Rd	18	19	B	17	54	B
MGS095Dum03#67	I-95 SB On ramp from HOV On ramp s/o Dumfries Rd	54	54	F	N/A	N/A	N/A
DGS095Jop01#69	I-95 SB Off ramp to Joplin Rd WB	29	28	D	16	58	B
DGS095Jop02#70	I-95 SB Off ramp to Joplin Rd EB	30	30	D	22	59	C
MGS095Jop01#72	I-95 SB On ramp from Joplin Rd	29	30	D	18	61	B
DGS095Rus01#74	I-95 SB Off ramp to Russell Rd	80	80	F	17	63	B
MGS095Rus01#76	I-95 SB On ramp from Russell Rd	64	65	F	23	58	C
MGS095Gar01#77	I-95 SB On Ramp from HOV/HOT n/o Garrinsonville Rd	N/A	N/A	N/A	22	63	C
DGS095Gar01#78	I-95 SB Off ramp to Garrinsonville Rd	27	28	C	23	62	C
MGS095Gar01#82	I-95 SB On ramp from Garrinsonville Rd	27	27	C	26	59	C

9.3.2.6 Intersection Analysis

Exhibit 9-19 is a summary of the projected intersection LOS results for the AM and PM peak hour for the 2018 Build and No-Build scenarios.

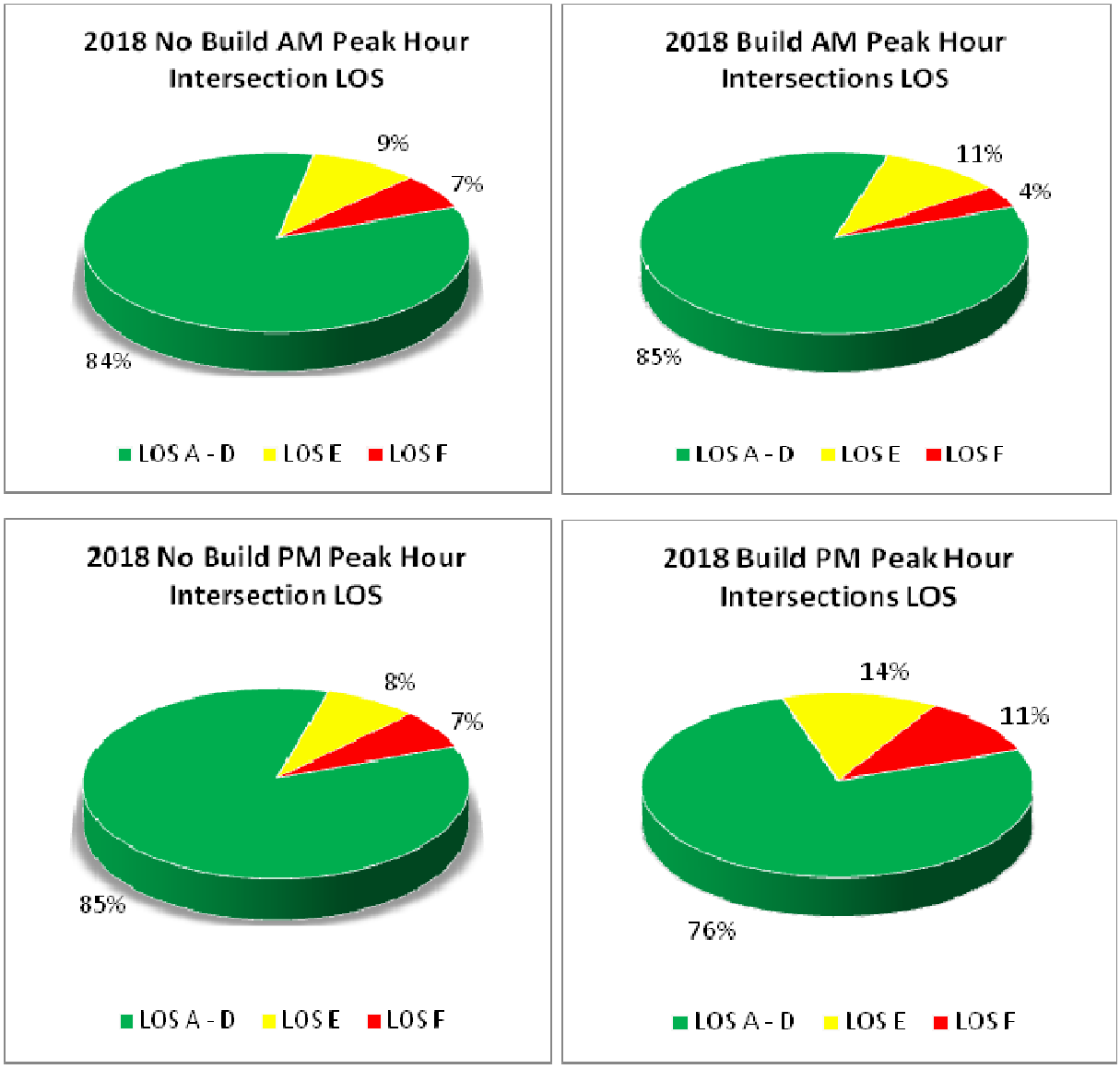
AM Peak

In both the No-Build and Build scenario, there are a total of 74 study intersections. There is a decrease of LOS E and LOS F intersections from 16 percent of total intersections in the No-Build scenario to 15 percent in the Build scenario.

There are five intersections that operate at LOS F in the 2018 No-Build scenario. Of these, the intersections of Prince William Pkwy and Crossing Pl and the intersection of Dumfries Rd and Van Buren Rd improves to a LOS C; the intersection of Dale Blvd and Asdale Plaza Shopping Center improves to LOS A and the intersection of Garrisonville Rd and Jefferson Davis Hwy improves to LOS D in the Build scenario. The remaining intersection of Loisdale Rd and Newington Rd will continue to operate at LOS F in the Build scenario.

There are two intersections that degrade from a LOS E under the No-Build scenario to LOS F in the Build scenario. There are six other intersections where the projected operations degrade from LOS D or better to LOS E in the Build scenario. There are three intersections where the operations in the Build conditions improves to LOS D or better from LOS E under the No-Build scenario. All other intersections operate at adequate LOS A to D both in the 2018 No-Build and 2018 Build scenarios.

Exhibit 9-19: Intersection LOS Summary for 2018 Build and No-Build Scenarios



PM Peak

In both the No-Build and Build scenario, there are a total of 74 study intersections. There is an increase of LOS E and LOS F intersections from 15 percent of total intersections in the No-Build scenario to 25 percent in the Build scenario. The main reason for LOS degradation is due to the travel demand increase in the Build scenario along arterial facilities.

There are five intersections that operate at LOS F in the 2018 No-Build scenario. The intersection of Duke Street and Walker Road improves to LOS C and the intersection of Richmond Road and Hassett Street improves to LOS C in the Build scenario. The remaining three intersections operating at LOS F in the No-Build scenario will continue to operate at LOS F in the Build scenario.

There are ten intersections where the projected operations degrade from LOS C or D to LOS E or LOS F in the Build scenario. All other intersections operate at adequate LOS A to D both in the 2018 No-Build and 2018 Build scenarios.

9.3.2.7 Summary

AM Peak

Table 9-24 is a summary of the MOE's used in the analysis and comparison of scenarios. Overall, the 2018 AM Build scenario typically operates better than the No-Build scenario, as shown by the following metrics:

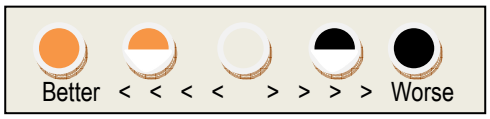
- Decrease in overall corridor travel time
- Reduction or elimination of bottlenecks
- Improved throughput and percent of vehicles served along the I-95 corridor
- Improved traffic operations (lower density and better LOS) at some freeway segments
- Increase in number of intersections operating at better LOS

Below are the key operational highlights of the proposed project in the 2018 AM peak hour:

- As highlighted in Section 9.3.2.1, traffic demand is expected to increase in the peak northbound direction comparing the Build and No-Build scenarios. The capacity increase of the HOV/HOT lanes and permitting toll-paying vehicles on the facility contribute to the increased attractiveness of the I-95 corridor. All existing HOV/HOT direct connect ramps to arterial facilities will have a significant increase in vehicle demand. Arterials in general should have a small volume increase due to the proposed modifications in the Build scenario.
- Along northbound I-95 in the GP lanes, travel times are expected to decrease by approximately five minutes in the Build scenario (compared to the No-Build scenario) in the section from Duke Street to Garrisonville Road. Even with the large increase in vehicle demand along the HOV/HOT lanes, travel times between the beginning of HOV lanes under existing conditions at Dumfries Road and Duke Street are expected to be approximately the same between the No-Build and Build scenario. An HOV (3+) driver can expect to save more than one minute traveling between Garrisonville Road and Dumfries Road mainly due to the proposed extension of the HOV/HOT facility and the elimination of the mainline congestion.
- The duration, intensity, and length of the queues associated with the bottleneck at Fairfax County Parkway will be reduced with the Build scenario. Travel speeds through this bottleneck will be faster as well. The length of queue associated with the bottleneck at Duke will also be reduced under the Build Scenario. Speeds along the HOV/HOT lanes should be comparable between the No-Build and Build scenarios.
- In the 2018 Build AM peak hour, all segments of northbound I-95 (GP and HOV/HOT lanes) are able to serve more vehicles than the No-Build scenario. Moreover, the percent unserved, that is the number of vehicles that cannot access the corridor but desire to, is lower through most segments.
- There is an overall improvement in the operating conditions of the freeway segments under the Build scenario compared to the No-Build. This can also be said about the intersections within the study area where the number of intersections that operate at LOS D or better increases from 64 to 67 under the Build scenario.
- Although the project is expected to attract more vehicle demand than the No-Build scenario, upstream and downstream corridor impacts are expected to be negligible to minor. Vehicles traversing arterials and intersections adjacent to the facility are expected to see a small increase in travel time and average delay.

Table 9-24: Overall Performance Comparison for 2018 AM Build and No Build Scenarios

Measure of Effectiveness	Description	Units	2018 AM No Build Value	2018 AM Build Value	Build Performance compared to No-Build
Travel Time GP	Measured for the entire corridor in the peak, southbound direction	Minutes	46.5	41.4	
Travel Time HOV/HOT	Measured from Duke Street to Garrisonville Road. Southern portion of HOV trip in No-Build from Dumfries to Garrisonville is measured on the GP lanes	Minutes	27.3	27.5	
Average Speed	Average for all measures taken every 0.5 mile and every 15-minute intervals along the corridor and in the peak direction	mph	51	53	
Number of main Bottlenecks	Locations along the corridor in the peak direction where traffic volumes are heavily constrained generating upstream congestion	Number	2	2	
Average Volume Throughput	Average for all measures taken at screenline locations along the corridor and in the peak direction. Includes both GP and HOV/HOT volumes	Veh/hr	7,295	8,330	
Average Un-served Demand	Average for all measures taken at screenline locations along the corridor and in the peak direction. Includes both GP and HOV/HOT Demand	%	7.1	6.1	
Intersections at LOS F	Summary for all intersections within the study area	%	7	4	
Intersections at LOS E	Summary for all intersections within the study area	%	9	11	
Basic Segments LOS E-F	Summary for all basic segments along the corridor and in the peak direction	%	32	17	
Weave Segment LOS E-F	Summary for all weaving segments along the corridor and in the peak direction	%	40	33	
Ramp Junctions LOS E-F	Summary for all merge and diverge segments along the corridor and in the peak direction	%	30	18	



PM Peak

Table 9-25 is a summary the measures of effectiveness used in the analysis and comparison of scenarios. Overall, the 2018 PM Build scenario typically operates better than the No-Build scenario, as shown by the following metrics:

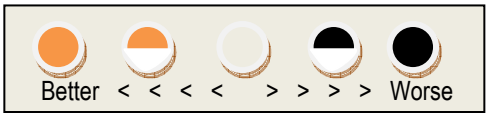
- Decrease in overall corridor travel time
- Reduction or elimination of several bottlenecks
- Improved throughput and percent of vehicles served along the I-95 corridor
- Improved traffic operations (lower density and better LOS) at some freeway segments

Intersection operations are the only component in the roadway network that is projected to degrade slightly in the Build condition due to an increase in travel demand.

Below are the key operational highlights of the proposed project in the 2018 PM peak hour:

- As highlighted in section 9.3.2.1, traffic demand is expected to increase in the peak southbound direction comparing the Build and No-Build scenarios. The capacity increase of the HOV/HOT lanes and permitting toll-paying vehicles on the facility contribute to the increased attractiveness of the entire I-95 corridor. All existing HOV/HOT direct connect ramps to arterial facilities will have a significant increase in vehicle demand. Arterials in general should have a small volume increase due to the proposed modifications in the Build scenario.
- Along southbound I-95 in the GP lanes, travel times are expected to decrease by approximately 20 minutes in the Build scenario (compared to the No-Build scenario) in the section from Duke Street to Garrisonville Road. Even with the large increase in vehicle demand along the HOV/HOT lanes, travel times between Duke Street and the existing southern terminus at Dumfries Road are expected to be approximately the same between the No-Build and Build scenario. An HOV (3+) driver can expect to save up to 4 minutes traveling between Duke Street and Garrisonville Road. This improvement is due to the proposed extension of the HOV/HOT facility and the elimination of the mainline congestion between Dumfries Road and Garrisonville Road.
- The proposed project is expected to reduce the duration, intensity, and length of two out of three bottlenecks located along the I-95 mainline through the study area. Furthermore, the southernmost bottleneck, located between Dumfries Road and Garrisonville Road, is expected to be eliminated with the completion of the Build scenario. Travel speeds through each of the bottlenecks will be faster under the Build scenario. Speeds along the HOV/HOT lanes should be comparable between the No-Build and Build scenarios.
- The southernmost bottleneck between Dumfries Road and Garrisonville Road is projected to be eliminated with the completion of the Build scenario. In the 2018 Build PM peak hour, all segments of southbound I-95 (GP and HOV/HOT lanes) are able to serve more vehicles than the No-Build scenario. Moreover, the percent unserved, that is the number of vehicles that cannot access the corridor but desire to, is lower through most segments.
- Freeway segments, including all basic, weave, and ramp junction (merge and diverge), are projected to operate better in the Build scenario compared with the No-Build scenario. In the 2018 No-Build PM peak hour scenario, 44 percent of segments are expected to operate with severe or heavy congested conditions. In the 2018 Build PM peak hour, the percentage of segments operating at severe or heavy conditions decreased to 26 percent.

- In general, study intersections operate slightly worse under the Build scenario compared with the No Build scenario due to increases in overall network demand. The number of intersections operating at LOS E or LOS F is expected to increase from 11 in the No-Build scenario to 18 in the Build scenario.
- Although the project is expected to attract more vehicle demand than the No-Build scenario, upstream and downstream corridor impacts are expected to be negligible to minor. Vehicles traversing arterials and intersections adjacent to the facility are expected to see a small increase in travel time and average delay.

Table 9-25: Overall Performance Comparison for 2018 Build and No Build Scenarios

Measure of Effectiveness	Description	Units	2018 PM No Build Value	2018 PM Build Value	Build Performance compared to No-Build
Travel Time GP	Measured for the entire corridor in the peak, southbound direction	Minutes	56.7	37.9	
Travel Time HOV/HOT	Measured from Duke Street to Garrisonville Road. Southern portion of HOV trip in No-Build from Dumfries to Garrisonville is measured on the GP lanes	Minutes	31.4	27.0	
Average Speed	Average for all measures taken every 0.5 mile and every 15-minute intervals along the corridor and in the peak direction	mph	49	54	
Number of main Bottlenecks	Locations along the corridor in the peak direction where traffic volumes are heavily constrained generating upstream congestion	Number	3	2	
Average Volume Throughput	Average for all measures taken at screenline locations along the corridor and in the peak direction. Includes both GP and HOV/HOT volumes	Veh/hr	7,900	8,890	
Average Un-served Demand	Average for all measures taken at screenline locations along the corridor and in the peak direction. Includes both GP and HOV/HOT Demand	%	10	3	
Intersections at LOS F	Summary for all intersections within the study area	%	7	11	
Intersections at LOS E	Summary for all intersections within the study area	%	8	14	
Basic Segments LOS E-F	Summary for all basic segments along the corridor and in the peak direction	%	47	25	
Weave Segment LOS E-F	Summary for all weaving segments along the corridor and in the peak direction	%	60	36	
Ramp Junctions LOS E-F	Summary for all merge and diverge segments along the corridor and in the peak direction	%	38	24