3. SAFETY

3. SAFETY

3.i Incident Reduction & Management

Summary

The Kiewit/AECOM Team is proposing Project improvements that will improve safety within the corridor. In general terms:

- Improvements in traffic flow and reductions in congestion provided by the Managed Lanes on Hard Shoulder Running are expected to lead to a decrease in crashes during peak periods.
- The Capacity Improvements are similarly expected to lead to a decrease in crashes, not only during peak periods but throughout the day.
- Provision of additional monitoring capabilities for CHART (through additional Closed Circuit Television Cameras (CCTV)) is expected to lead to a reduction in incident response times, thereby reducing the potential for secondary incidents.
- Provision of additional motorist information (through additional Dynamic Message Signs (DMS), both inside and outside the limits of HSR) will enable motorists to choose alternate routes when desirable, thereby further reducing congestion on IS-270 and enhancing safety.
- Advanced Origin Destination (O-D) and Connected Vehicle Infrastructure will enable CHART to surveil the corridor to a much greater extent than is currently possible, thereby further improving incident detection and response.

These topics are discussed in further detail below.

Safety: Relationship to Managed Lanes on Hard Shoulder Running

The Kiewit/AECOM Team is proposing the addition of a Managed Lane on Hard Shoulder Running (HSR) along both NB and SB IS-270 in addition to the existing Local HOV lanes during peak periods. The proposed Managed Lanes will typically be implemented on the existing median shoulders in both directions through HSR. HSR is the temporary operation of paved shoulders as running lanes during peak traffic flow times to alleviate congestion and temporarily increase highway capacity without major infrastructure reconstruction. The shoulder will be equipped with overhead signing that will indicate if drivers may use the hard shoulder as a through lane. The focus of this approach is to provide HOV and General Purpose (GP) lane balance along both northbound and southbound IS-270 in order to improve the bottlenecks along the IS-270 sections that have been identified as the most congested, between the Y-Split and MD-121 (Clarksburg Road). The use of Managed Lanes on HSR will increase throughput and ease congestion, hence addressing the project goals of improving mobility and providing a safer infrastructure for commuters. The additional capacity allows for a smoother, more consistent travel speed which improves safety. This improvement is quantified below. In addition, the "heat map" Figure 3.1, which depicts the locations of "CHART events" recorded during 2015, shows that the Project addresses the locations within the corridor with the greatest number of events, thus improving safety in those locations where it is most cost-effective to do so.

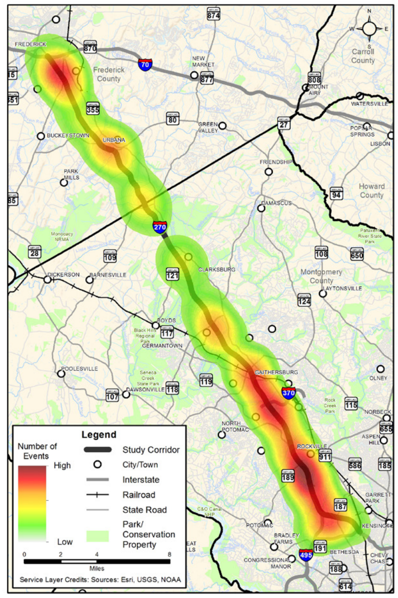


Figure 3.1 Heat Map

Safety: Relationship to Capacity Improvements

In addition to the corridor-wide improvements provided by Managed Lanes on HSR, the Kiewit/ AECOM Team is proposing capacity improvements in several critical locations. (The specific locations are discussed elsewhere in this Technical Proposal.) At these locations, adding auxiliary lanes and/or modifying striping will help to alleviate congestion and permanently increase highway capacity. The addition of auxiliary lanes and restriping are practical design solutions that add highway capacity without increasing the existing pavement footprint. This addresses both the mobility and safety goals by modifying existing lane configurations to better accommodate travel demand, and by allowing vehicles to accelerate and decelerate prior to merging with through-traffic. The improvement in mobility is expected to have a related improvement in safety, due to the reduction in congestion-related incidents.

Safety: Relationship to Technology Solutions and Additional Systems

The deployment of additional CCTV and DMS at select locations along the IS-270 corridor will enhance CHART's ability to surveil the corridor and respond to incidents, and will enhance motorist information along the corridor. These deployments will improve safety along the corridor. Additional CCTV are proposed beyond the limits of the Managed Lanes, because full CCTV coverage is proposed as part of the Managed Lanes implementation. Additional DMS are proposed both within the limits of the Managed Lanes and beyond those limits, because the small DMS proposed as part of the Managed Lanes Implementation are mission-specific; they will not be able to provide the robust level of general motorist information desired.

CHART and Montgomery County currently have 16 CCTV cameras along IS-270, with all of them concentrated in Montgomery County. There are six DMS, though none of them are on either leg of the Y split. Three provide information to northbound drivers, with the other three facing southbound traffic. Only one of the DMS is in Frederick County (northbound, approaching IS-70). The new devices will be identical to the devices currently being installed by CHART, in terms of manufacturer and model. The new devices will communicate with CHART in accordance with the current CHART communication architecture. That is, new CCTV will communicate with CHART via leased T-1 lines, and new DMS will communicate with CHART via cellular modems. Thus, there is no need for integration, and there is no risk to the Administration.

The Kiewit/AECOM team will deploy 25 connected vehicles technologies, data, and other advanced data collection sensors, and will enhance the corridor through:

- Leveraging lower-cost, real-time connected vehicle data streams that are readily available from over one-million vehicles already on U.S. highways including those within the IS-270 project limits. This technology will provide the Administration with real-time operational data on where vehicles are turning, braking heavily, where traction control is engaged, weather and temperature information, and immediate crash notifications to help the Administration respond quicker to incidents and thus minimize non-recurring delays that add to congestion and also minimize the occurrence of secondary incidents.
- Supplementing current microwave detection with roadside WiFi/Bluetooth (BT)/Dedicated Short Range Communication (DSRC) technologies in 25 locations along IS-270 to collect real-time operational data within the corridor. This will supplement volume, speed and occupancy corridor data by including origin-destination (O-D) and vehicle-specific data to provide real-time information of the corridor's operation. This data will notify the Administration in real-time which routes commuters are taking, how they are rerouting during events, and how they are responding to information from the Administration's traveler information systems. This data can also be shared with Montgomery County DOT to help that agency retime signals when drivers divert onto arterials such as MD 355.

The implementation of Advanced-Stage O-D & Connected Vehicle Data Infrastructure will "future-proof" new capacity provided by the Managed Lanes on HSR, and will provide the Administration with additional O-D and operational data to be utilized before, during and after the construction activities of the Project. By implementing this infrastructure, the Administration will be capable of enhancing the current corridor planning model, evaluating any potential solution compared to real-time data, creating the capability of utilizing the adjacent arterials more effectively and providing an additional method to determine real-time roadway operations, including potential incidents and roadway surface traction. Therefore, the implementation of the infrastructure will improve mobility, travel time reliability, safety and operability throughout the corridor.

Quantitative Safety Analyses

To quantitatively evaluate the safety impacts of the Project as proposed by the Kiewit/AECOM Team, an analysis using FHWA's Highway Safety Manual (HSM) was completed. The HSM freeway sections provide Safety Performance Functions (SPFs) for 4 to 10 lane freeway facilities that account for several variables that need to be considered when looking at cross-section alternatives, particularly for the Managed Lanes on HSR. The HSM freeway crash prediction model was used to assess the changes in crash frequency and severity associated with increasing the number of freeway lanes by reducing lane and shoulder widths. A similar and recent FHWA HSR safety report documented the safety studies of HSR implementations throughout the country, and the details are presented in an Appendix to this Technical Proposal.

The Project has been studied based on the crash prediction models of the HSM freeway chapters, using a spreadsheet procedure comparable to the Interactive Highway Safety Design Model (IHSDM). This procedure is called ISATe (Interchange Safety Analysis

Tool, Enhanced), a quantitative model to predict crash rates based on traffic volumes, ramp movements, and roadway cross section elements. The safety analysis was performed to compare safety measures between the existing operating conditions and the Project.

HSM (including ISATe/IHSDM) was constructed via a series of regression (statistics) equations/models which is all field-data based on historical (before/after) crash data. It should also be noted that the HSM field data is from only three states: California, Maine and Washington. That field data, and the resulting equations, might not be directly applicable throughout the rest of the country, including Maryland. The predicted crash rates are determined by those regression variables known as crash modification factors on different design scenarios. And, more related to the current context, HSM (Chapter 10,11,12) sets freeway crash predictions in 2 categories: Property Damage Only (PDO) and Fatal and Injury (FI). In our HSR analysis, the model inputs were reduced lane and shoulder widths, closer distances to barriers and more travel lanes etc. Those inputs generated higher FI and lower PDO through the built-in regression formula. In addition, the predicted FIs were at such small number scales that the predicted rate differences might have been exaggerated due to the HSM's exponential regression formula.

For the purposes of the analysis, it was assumed that the proposed Managed Lanes on HSR would operate only during peak periods. Thus, the ISATe model input and assumptions had to be adjusted. The adjustments are described in an Appendix to this Technical Proposal.

Crash Prediction Results

Based on model inputs and assumptions, the ISATe crash prediction model was performed for the Project to compare existing versus proposed conditions. The HSM analysis results of predicted crash rates are summarized in the following tables:

- Table 3.1 - NB, All Segments, Existing Volumes
- Table 3.2 - NB, All Segments, 2040 Volumes
- Table 3.3 - SB, All Segments, Existing Volumes
- Table 3.4 - SB, All Segments, 2040 Volumes

The detailed outputs are presented in the Appendix The data shown in that Appendix represent the non-adjusted HSM analysis results of predicted crash rates. The data shown in Tables 3.1 & 3.2 and 3.3 & 3.4 represent the adjusted HSM analysis results of predicted crash rates for the Project in the NB and SB directions, respectively.

Table 3.1: HSM Results Summary for the Project, NB, All Segments, Existing Volumes

PTC 1 - HSR NB (Existing Volumes)	Predicted Crashes Per Year				
	MD 187 to MD 121				
	No Build		Build		Increase / Decrease
	Crashes / Year	% of Total	Crashes / Year	% of Total	Crashes / Year
Fatal Crashes	0.542	0.297%	0.710	0.398%	0.169
Incapacitating Injury Crashes	1.770	0.971%	1.797	1.007%	0.027
Non-Incapacitating Injury Crashes	11.088	6.083%	11.694	6.554%	0.607
Possible Injury Crashes	50.821	27.880%	51.565	28.900%	0.744
Total Fatal and Injury Crashes	*64.220*	*35.231%*	*65.767*	*36.860%*	*1.547*
Property Damage Only Crashes	118.063	64.769%	112.657	63.140%	-5.405
Total Crashes	**182.283**	**100.000%**	**178.424**	**100.000%**	**-3.859**

Table 3.2: : HSM Results Summary for the Project, NB, All Segments, 2040 Volumes

PTC 1 - HSR NB (2040 Volumes)	Predicted Crashes Per Year				
	MD 187 to MD 121				
	No Build		Build		Increase / Decrease
	Crashes / Year	% of Total	Crashes / Year	% of Total	Crashes / Year
Fatal Crashes	0.631	0.295%	0.820	0.398%	0.189
Incapacitating Injury Crashes	2.024	0.946%	2.037	0.989%	0.013
Non-Incapacitating Injury Crashes	12.637	5.904%	13.210	6.415%	0.573
Possible Injury Crashes	57.968	27.084%	58.192	28.261%	0.224
Total Fatal and Injury Crashes	*73.260*	*34.229%*	*74.260*	*36.064%*	*1.000*
Property Damage Only Crashes	140.771	65.771%	131.650	63.936%	-9.121
Total Crashes	**214.031**	**100.000%**	**205.910**	**100.000%**	**-8.121**

Examination of Tables 3.1 & 3.2 reveals the following:

- Total crashes are expected to decrease, under both Existing Conditions and 2040 Conditions, with implementation of the Project.
- For individual crash severity categories, the relative change provided by the Project is similar in 2040 to what it is under Existing Conditions.
- PDO crashes are expected to decrease; all other categories are projected to increase. However, the decrease in PDOs is greater than the increase in all the other categories combined.

Table 3.3: HSM Results Summary for the Project, SB, All Segments, Existing Volumes

PTC 10 - HSR SB (Existing Volumes)	Predicted Crashes Per Year – Watkins Mill Road to Tuckerman Lane				
	No Build		Build		Increase / Decrease
	Crashes / Year	% of Total	Crashes / Year	% of Total	Crashes / Year
Fatal Crashes	0.328	0.282%	0.411	0.376%	0.083
Incapacitating Injury Crashes	1.047	0.900%	1.020	0.924%	-0.027
Non-Incapacitating Injury Crashes	6.933	5.959%	7.028	6.435%	0.096
Possible Injury Crashes	32.816	28.204%	31.952	29.253%	-0.864
Total Fatal and Injury Crashes	*41.124*	*35.345%*	*40.411*	*36.997%*	*-0.713*
Property Damage Only Crashes	75.227	64.655%	68.817	63.003%	-6.410
Total Crashes	**116.351**	**100.000%**	**109.228**	**100.000%**	**-7.123**

Table 3.4: HSM Results Summary for the Project, SB, All Segments, 2040 Volumes

PTC 10 - HSR SB (2040 Volumes)	Predicted Crashes Per Year – Watkins Mill Road to Tuckerman Lane				
	No Build		Build		Increase / Decrease
	Crashes / Year	% of Total	Crashes / Year	% of Total	Crashes / Year
Fatal Crashes	0.360	0.280%	0.450	0.374%	0.090
Incapacitating Injury Crashes	1.138	0.886%	1.104	0.919%	-0.033
Non-Incapacitating Injury Crashes	7.538	5.870%	7.623	6.342%	0.085
Possible Injury Crashes	35.739	27.831%	34.697	28.865%	-1.042
Total Fatal and Injury Crashes	*44.774*	*34.867%*	*43.874*	*36.499%*	*-0.900*
Property Damage Only Crashes	83.641	65.133%	76.331	63.501%	-7.310
Total Crashes	**128.415**	**100.000%**	**120.205**	**100.000%**	**-8.210**

Examination of Tables 3.3 & 3.4 reveals the following:

- Total crashes are expected to decrease, under both Existing Conditions and 2040 Conditions, with implementation of the Project.
- For individual crash severity categories, the relative change provided by the Project is similar in 2040 to what it is under Existing Conditions.
- PDO crashes and two of the categories of Injury crashes are expected to decrease; the other categories are projected to increase. However, the total decrease in the reduced categories is greater than the total increase in the other categories.

Globally speaking, the Project increases mobility and increases travel speeds and throughput, with a trade-off of a very slight increase in fatal and injury crashes.

HSM Safety Analysis –Historical Crash Data

Based on the Administration's historical crash data, NB IS-270 from MD 187 to MD 121 had experienced an average of 205 crashes per year, for the years of 2011 through 2013. To break up this segment into three sections, the section from MD 187 to Montrose Road experienced an average of 10 crashes per year, the section from Montrose Road to MD 124 experienced an average of 145 crashes per year, and the section from MD 124 to MD 121 experienced an average of 51 crashes per year. To separate crashes occurring on the express and local lanes, it was assumed that 64% of the crashes occurred on the express lanes, since this percentage is proportional to the traffic volumes. Therefore, 64% of the 145 total crashes on the section of NB IS-270 from Montrose Road to MD 124 results in an estimate of 93 crashes per year in the express lanes, only. This reduction is not necessary on the other two NB sections, since local lanes are not present throughout these sections. Therefore, a total of 154 (10+93+51) crashes per year were realized on the segment from MD 187 to MD 121. This number is approximately 15% lower than the ISATe prediction of 182 crashes/year. Thus, it is possible that the NB crash analyses cited in Tables 3.3 and 3.4 are overestimates.

The segment of SB IS-270 from Watkins Mill Road to Tuckerman Lane had experienced an average of 162 crashes per year, for the years of 2011 through 2013. To break up this segment into three sections, the section from Watkins Mill Road to IS-370 experienced an average of 41 crashes per year, the section from IS-370 to Montrose Road experienced an average of 114 crashes per year, and the section from Montrose Road to Tuckerman Lane experienced an average of 7 crashes per year. It was assumed that 61% of the crashes occurred on the express lanes, since this percentage is proportional to the traffic volumes. Therefore, 61% of the 114 total crashes on the section of SB IS-270 from IS-370 to Montrose Road results in an estimate of 70 crashes per year in the express lanes, only. This reduction is not necessary on the other two SB sections, since local lanes are not present throughout these sections. Therefore, a total of 118 (41+70+7) crashes per year were realized on the segment from Watkins Mill Road to Tuckerman Lane. This number is approximately 2% higher than the ISATe prediction of 116 crashes/year.

Qualitative Safety Analyses and Discussion

Qualitatively, the Kiewit/AECOM Team is comfortable with the potential safety results of the Project, for the following reasons:

- Reduced congestion levels provided by the Project will likely be accompanied by reduced crash experience.

- The Project will involve extensive use of lane-use control signals and small DMS over the Managed Lanes, providing a greater level of guidance than normally found on a freeway. This, too, should help reduce crash experience, particularly in the Managed Lanes themselves.
- Managed Lanes will be populated by vehicles traveling relatively long distances on IS-270. This is particularly true SB, where an Express HOV lane is proposed. The resulting reduction in lane-changing will likely reduce crash experience.

Incident Management

Incident management is a concern with HSR due to the lack of median shoulders during peak hours, which otherwise can be used as access lanes for emergency vehicles. First responders will use the right shoulder until the HSR lane is closed. Through most of the Project length, the right side shoulder will remain available at all times. Additional DMS will provide enhanced motorist information in the event that the HSR needs to be closed due to an incident.

As the pie chart below indicates, a broad range of incidents occur on IS-270. The majority of these are disabled vehicles, which need to be moved from travel lanes as quickly and efficiently as possible.

The Kiewit/AECOM Team recognizes that the Project requires a trade-off. The Project will result in less congestion and higher travel speeds, and a likely reduction in total crashes. However, because there will be no median shoulder to access incidents nor to allow for storage of disabled vehicles during the three-hour SB AM peak period and three-hour NB PM peak period, changes in incident management procedures will be required.

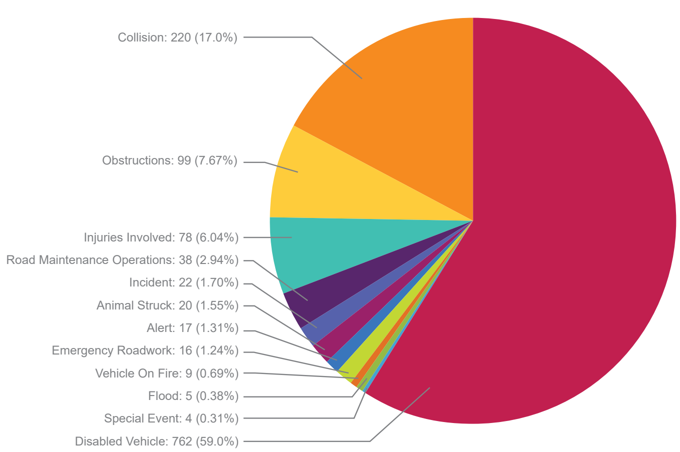


Figure 3.2 Events from MDOT CHART occurred between October and December of 2016 on IS-270

The availability of the right side shoulder throughout the vast majority of the Project length does help to reduce these issues, though not eliminate them. For the section of NB IS-270 between the Y-split and the start of the express/local lanes approximately 0.8 miles to the north, both shoulders will be used for HSR. The Team did investigate physical improvements to help address these concerns, most notably by constructing emergency pull-off areas along this 0.8 mile length, but found that they were not feasible within the confines of the corridor (particularly since the HSR will be adjacent to a median barrier). However, given the relatively short distance involved (a distance shorter than normally use for spacing of emergency pull-offs), the Team is confident that this issue can be addressed to the Administration's satisfaction, as discussed below.

The Kiewit/AECOM Team recognizes that CHART incident management practices will need to be modified in order to address the effects of the Project. Development of those modifications will require an iterative and cooperative effort between CHART and first responders within the limits of the Project. The Kiewit/AECOM Team will work with CHART to prepare a Concept of Operations (both Draft and Final). We will also develop draft and final revised detailed operating procedures (including enhanced enforcement), and will attend up to four working meetings with CHART and first responders.

In these efforts, the Team will build upon the experiences of other agencies which have implemented HSR. Of particular note is AECOM's work with Florida DOT District 4.

3.ii Innovations to Address Safety

Through the implementation of Advanced-Stage O-D & Connected Vehicle Data Infrastructure, the Administration will be capable of enhancing the current corridor planning model, evaluating any potential solution compared to real-time data, creating the capability of utilizing the adjacent arterials more effectively and providing an additional method to determine real-time roadway operations, including potential incidents and roadway surface traction. Therefore, the implementation of the infrastructure will improve mobility, travel time reliability, safety and operability throughout the corridor. Real-time data from vehicles will provide CHART operations staff faster incident detection. In addition, the infrastructure will allow for greater corridor video coverage and situational awareness. Verification of any incident detected by real-time data will provide quicker incident management response and clearance times. This will reduce the overall incident time line, incident delay and the potential of secondary incidents. This will have a positive impact on the IS-270 corridor and the adjacent arterials alike. Lastly, real-time data from vehicles will provide roadway surface information, such as traction conditions during wet or icing conditions. The Administration will be able to disseminate the information to motorists via DMS, 511, and Google/Waze.

IS-270 will be overlaid using Ultra-Thin Bonded Wearing Course (UTBWC) as an alternative surface treatment. The advantage associated with this treatment is the reduction in back spray, which decreases hydroplaning and improves visibility in wet weather conditions. Traffic safety is improved as there are limited bumps and dips created by multilane grinding and resurfacing passes causing uneven lanes. The bonded wearing course will provide the ability to install new reflective permanent markings in the new configuration on a brand-new monolithic pavement surface, effectively removing any sign of existing pavement markings or surface cracks in the existing pavement. The new pavement surface will restore and improve skid resistance. This will result in a safer IS-270.

The proposed auxiliary lanes between Shady Grove Road and IS-370 (Sam Eig Highway) in the northbound direction, and between MD 117 (W. Diamond Ave) and IS-370 (Sam Eig Highway) in the SB direction enhance safety by allowing vehicles to accelerate and decelerate prior to merging with through traffic in the Collector-Distributor Road or Express Lanes. We targeted specific locations of severe congestion and at the IS-270 and MD-80 (Fingerboard Road) interchange propose to improve safety by extending the acceleration and deceleration lanes, hence allowing for safer transitions between the ramps and mainline traffic.

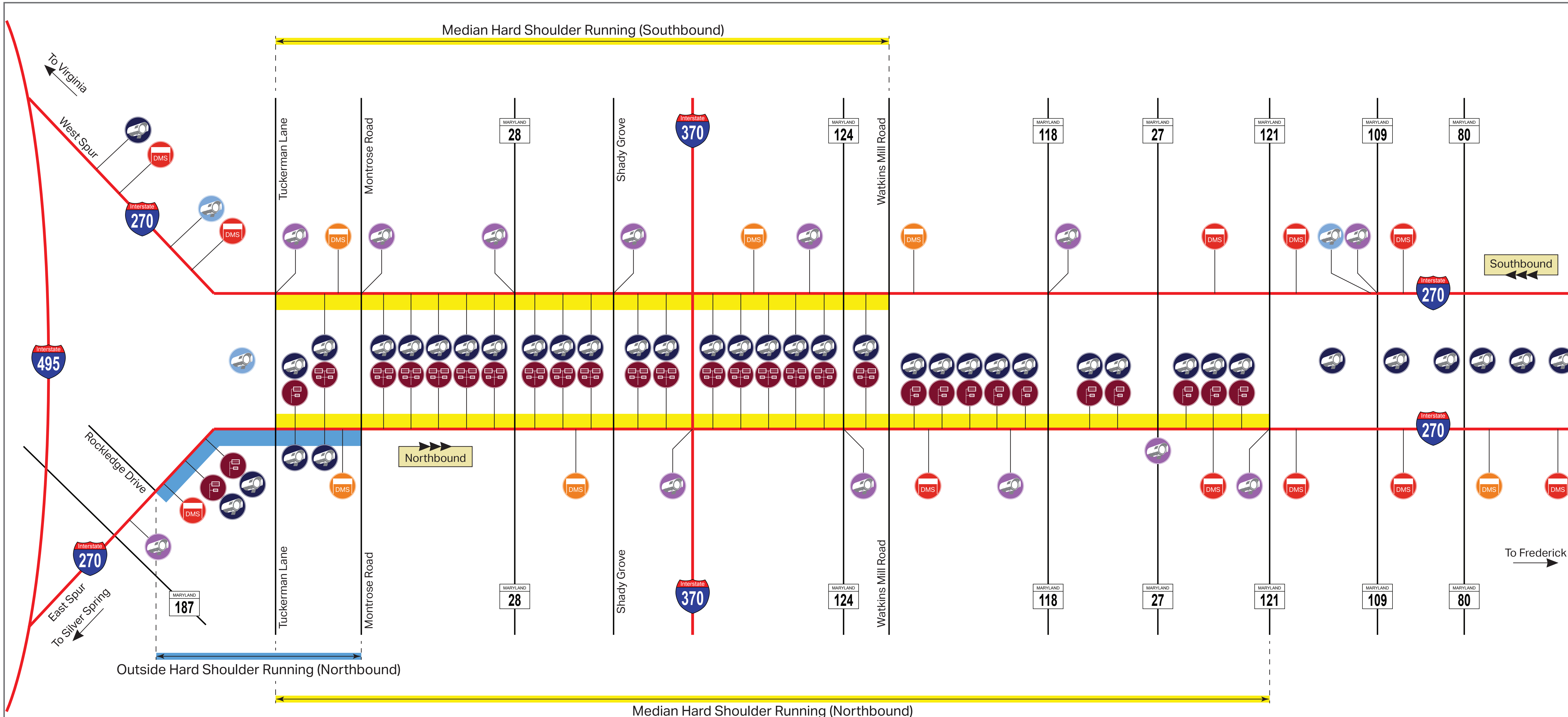
The deployment of additional CCTV and DMS along the entire IS-270 corridor will enhance CHART's ability to surveil the corridor, respond quicker to incidents and enhance motorist information along the corridor. As discussed earlier, this will improve safety along the corridor. Figure 3.3 illustrates the locations of each device.

3.iii Mitigating Safety Risks

As noted previously, the Managed Lanes on HSR portion of the Project and some of the portions of the project identified for Targeting Specific Locations of Severe Congestion rely on 11' wide lanes and use of shoulders to provide additional capacity. Other states such as Pennsylvania and Virginia operate interstates with 11' lanes. In Maryland, MDTA is reducing lanes on I-95 to 11' just north of the Fort McHenry Tunnel, a project for which AECOM performed design reviews of and related program management. Any concerns with regard to this within the Project limits are mitigated by the following:

- UTBWC offers a cost effective solution as a surface treatment/wearing course by providing: durable waterproof seal to existing surface micro cracks from oxidation; Restored and improved skid resistance; reduced user delays with quick, one-pass construction, allowing almost immediate reopening to traffic; quick and safe construction joints following end-of-day work with very minimal drop-offs between lanes; reduced back spray and improved visibility in wet weather and reduced tire noise. In addition, the team is proposing thermoplastic reflective pavement markings to enhance visibility, especially at nighttime.
- The team is upgrading the concrete barriers to 42 inch in the areas where the barrier is affected due to cross slope adjustments. This is a safety improvement compared to the existing, lower concrete barrier in those locations.
- The provision of additional capacity will improve mobility by reducing congestion. As indicated by the HSM analyses described above, total numbers of crashes are expected to decrease.
- The Managed Lanes on HSR will have lane-use control signals and small DMS dedicated to them. This level of traffic control and motorist information, not ordinarily found on a freeway, may help to reduce crash experience even further. The lane-use control signals and small DMS, along with proposed pavement markings, are shown in Figure 3.4.
- It is anticipated that most of the vehicles using the Managed Lanes will be comparatively long-distance travelers. This should minimize lane-changing behavior, and should further help to reduce crash experience.
- Our team will work with CHART and first responders to develop and implement revised incident management strategies.

Figure 3.3 Lane Control System / CCTV / DMS / BlueTOAD

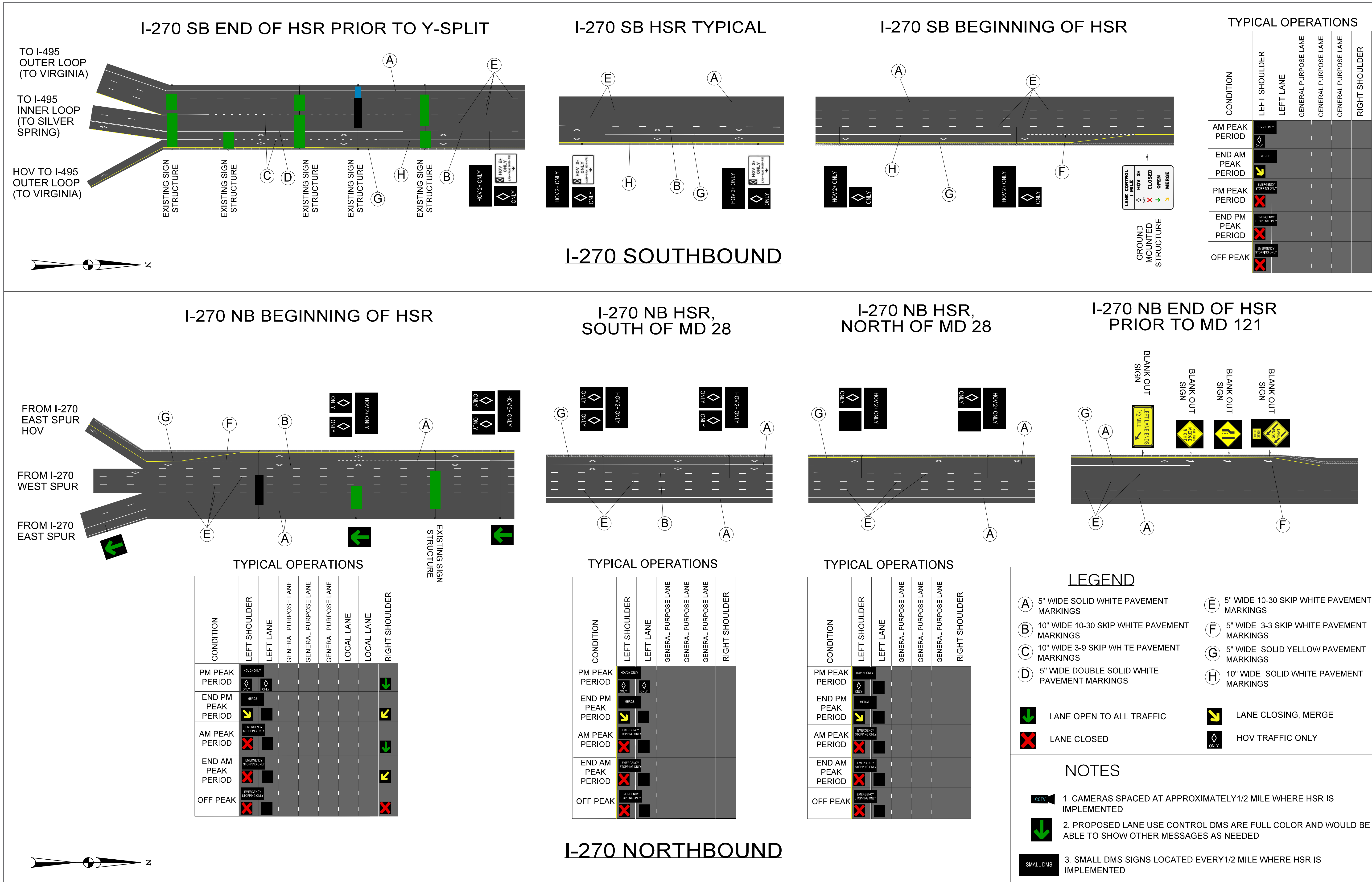


ITS Device	Quantity
New Full Size DMS	11
New CCTV	7
CCTV for HSR	32
Lane Control System	30
BlueTOAD Traffic Monitoring	25

- BlueTOAD advanced traffic monitoring system to be installed at 25 locations. WiFi / Bluetooth / DSRC equipment to be co-located with existing microwave vehicle detection units, or to be installed on existing structures.
- Additional information provided in PTC 8 Advanced Stage O-D Data & Connected Vehicles Infrastructure.

Not to Scale
Note: Not All Interchanges Shown

Figure 3.4 Pavement markings, signing and HSR lane designations



4. OPERABILITY / MAINTAINABILITY / ADAPTABILITY

4. OPERABILITY/ MAINTAINABILITY/ ADAPTABILITY

4.i Maintenance Requirements

Pavement-related Maintenance Requirements

The Team's solution includes both pavement and non-pavement related elements that are low maintenance for future operations.

The Kiewit/AECOM team is proposing to use Ultra-Thin Bonded Wearing Course (UTBWC) as a surface treatment for the proposed roadway resurfacing along the IS-270 corridor in areas of pavement marking alterations as a result of maintenance of traffic shifts for construction and for placement of lane lines in their final configuration. The process is comprised of a polymer modified asphalt emulsion spray followed directly by a pre-coated ultrathin (5/8" to 3/4") gap-graded asphalt pavement, providing a high quality durable skid resistant surface, whilst the polymer asphalt membrane seals and protects the surface of the existing pavement and provides superior bonding of the ultra-thin mix to the existing pavement. The use of UTBWC results in the need to provide proactive and more vigorous deicing strategies during inclement weather due to the rapid freeze potential of the open pavement structure. This however, has not deterred states, including Maryland, from utilizing this technology. Many states, including Maryland, are proactively pre-treating all of their interstates in advance of inclement weather regardless of the pavement type. In addition, the Administration has already advertised projects to implement UTBWC at various locations in Districts 1, 2, 4, and 5. Therefore, the pre-treatment activities are already set in place along state highways within Maryland.

An in-house study of surface treatment alternatives was performed by NHDOT in 2013 which compared estimated annual service life of different surface treatment options, including UTBWC. The results indicate that UTBWC and a conventional 1.5" grind and resurface operation have similar expected service lives at 12 and 13 years respectively. The actual cost of a bonded wearing course may be slightly lower with the higher quantities and increased use of this method. In conclusion, IS-270 will be subject to resurfacing and other pavement maintenance activities in the same timeframes as the rest of the roadways in the state which have been overlaid with traditional superpave asphalt, and it will not incur additional maintenance costs.

The managed lanes on HSR will be affected by snow events. HSR will be closed during and after snow events, to allow for snow storage. The opening of the HSR will be dependent on the snow being cleared off the shoulders. The LCS will indicate when the shoulder will be closed, and the associated DMS will display the closed condition and announce possible opening dates and times. There will be no modification to existing bridge structures within the limits of work, therefore, no additional structure maintenance personnel will be required.

Maintenance operations would not be able to occur along the median during peak hours. However, it is unlikely that the Administration would allow that in current conditions, due to heavy traffic during peak hours.

The Kiewit/AECOM team is proposing to use Thermoplastic Pavement Markings in the permanent condition and Pavement Marking Paint for Maintenance of Traffic. Permanent RPM's will be installed where necessary. These materials are compatible with the Ultra-Thin Bonded Wearing Course overlay and are being used in the areawide contracts advertised by SHA – District 1, 2, 4 and 5.

The maximum allowable spread has been reduced to allow for vehicles to safely travel on the shoulder. Approximately 50 sections between existing inlets will require additional drainage infrastructure. The additional infrastructure will result in additional maintenance, however it will consist of standard Type S inlet and reinforced concrete pipes which are already present on site in the current conditions. No special equipment or maintenance activities will be required to maintain the additional infrastructure.

The Project will require additional storm water quality management. The Team proposes to retro-fit existing stormwater quantity management ponds to manage quality as well. The team will also construct new environmental site design facilities within the ROW. These best management practices will be added to the Administration's inventory and be inspected accordingly. No special equipment or maintenance activities will be required to maintain the additional infrastructure.

Non-Pavement Maintenance Requirements

The Kiewit/AECOM team's technical solution has both Intelligent Transportation System (ITS) devices and associated control software to simply and efficiently operate Managed Lanes using Hard Shoulder Running (HSR) in areas along I-270 with minimal operator intervention required. This solution will help traffic to move more efficiently along I-270 and provide motorists with a more reliable travel time by utilizing a scheduled pre-configured plan for opening and closing managed lanes.

The HSR proposal includes specialized lane control Dynamic Message Signs (DMS), small general purpose DMS, Closed Circuit Television (CCTV) for corridor monitoring, and a Lane Control System (LCS) that will control the shoulder and HOV lanes in specific managed areas along the I-270 corridor.

The Team's proposal also includes other ITS elements that are not part of the HSR solution, but enhance CHART's capability in the Corridor. These include:

- The application of an Advanced Stage Origin and Destination (O-D) & Connected Vehicles Data Infrastructure. This will "future-proof" the additional capacity provided by the HSR and other improvements and provide data to be utilized before, during and after construction. The team will deploy connected vehicle technology and sensors (BlueTOAD devices) at 25 locations along the Corridor to collect real time traffic data for use by CHART.
- The installation of 11 conventional full size DMS in the Corridor. These DMS will supplement the traffic management capabilities throughout the IS-270 corridor.
- The installation of 7 additional CCTV traffic monitoring cameras in the Corridor. These CCTV sites will greatly enhance the traffic and incident management capabilities along the corridor.

Figure 4.1
BlueTOAD
Spectra Unit

These HSR and supplemental ITS systems are shown in Figure 4.1. The development and integration of these systems will be detailed in subsequent discussion in this section.

The ultimate deployment of these ITS systems will take into account the need for SHA Operation & Maintenance (O&M) of these systems. This can be easily broken down into both field and Statewide Operations Center (SOC) functions. For both areas, considerable effort will be given to align the O&M requirements of these new ITS systems with the practices currently in place within SHA and with standard industry practices, and to provide a maintenance friendly system.

The team proposes to deploy CCTV in the Corridor that is familiar to SHA (Cohu 3965 cameras with Impath i5110 H.264 encoders, and compatible with SHA CHART Impath H.264 decoders) to facilitate CCTV integration, operation and maintenance. CCTV control cabinets will be evaluated at each location for ease of access with minimal disruption to traffic during maintenance activities. The goal is to coordinate with SHA to provide the most convenient and safest condition possible for field maintenance. That may be control cabinets and poles in the I-270 median, with use of the full HSR shoulders for maintenance during non-HSR periods. In other cases, it may be preferable to locate control cabinets off the outside shoulder. These decisions will be made with maintenance in mind.

Both the specialized lane control DMS and small HSR DMS are expected to be front access units, from manufacturers familiar to the Administration. This will aid in familiarity of the maintenance staff in both preventative and on-call maintenance of the DMS. While many larger DMS used by SHA are walk-in units, the smaller DMS proposed for operating the HSR do not afford that opportunity. The benefit to the Team's proposal is that these units are located over the HOV and HSR lanes, and maintenance of these over the road units can be easily performed in off peak periods. Similar to the CCTV discussion, the location of control cabinets will be site decisions, but are expected to be mounted in the medians (likely mounted to sign structure posts) to keep all equipment in the same area.

The proposed full size DMS (non-HSR) will be traditional walk-in units that allow maintenance access from the outside shoulder, with all functions performed from within the DMS housing with no impact to traffic. This follows the standard practice for CHART DMS today.

As a result of the conformity of equipment, and compatibility with existing maintenance practices, it is expected that these new devices will have a maintenance profile similar to existing SHA DMS and CCTV. The notable exception is the lane control DMS will be full color matrix DMS, which will be a new maintenance requirement for the field technicians. The delivery of these new HSR and non-HSR systems will certainly expand the number of devices that CHART will be responsible to maintain. To assist the Administration in assuming maintenance of these systems, the Team will provide an inventory of spare parts for the newly deployed systems. The exact type and quantity of spare parts will be developed with CHART input and is expected to include the common items used in the field, such as power supplies, LED modules, and controllers.

An additional benefit to the SHA in deploying equipment familiar to maintenance is that the life cycle costs are understood from the years of experience and can be easily plugged into the capital replacement programs with confidence.

The Kiewit/AECOM team will deploy 25 connected vehicles technologies, data, and other advanced data collection sensors, and will enhance the corridor through:

- Leveraging lower-cost, real-time connected vehicle data streams that are readily available from over one-million vehicles already on U.S. highways including those within the IS-270 project limits. This technology will provide the Administration with real-time operational data on where vehicles are turning, braking heavily, where traction control is engaged, weather and temperature information, and immediate crash notifications to help the Administration respond quicker to incidents and thus minimize non-recurring delays that add to congestion.
- Supplementing current microwave detection with roadside WiFi/Bluetooth (BT)/Dedicated Short Range Communication (DSRC) technologies in 25 locations along IS-270 to collect real-time operational data within the corridor. This will supplement volume, speed and occupancy corridor data by including O-D and vehicle specific data to provide real-time information of the corridor's operation. This data will notify the Administration in real-time which routes commuters are taking, how they are rerouting during events, and how they are responding to information from the Administration's traveler information systems. This data can also be shared with Montgomery County DOT to help that agency retime signals when drivers divert onto arterials such as MD 355.

The implementation of Advanced-Stage O-D & Connected Vehicle Data Infrastructure is practically maintenance free. The data collection equipment is mounted to existing or otherwise proposed sign posts, and is supported by existing or proposed control cabinets with no additional power or communications infrastructure involved, merely a Power over Ethernet (POE) connection to the devices.

The O&M of these ITS devices will also be familiar to CHART operators at the SOC or other designated operations centers. These devices will be an expansion of their current maintenance program and equipment will be consistent with equipment which will not inflate cost. A full description of the proposed integration of the HSR program into the SOC environment is discussed in detail below, but the issue of O&M is made simple by a combination of integrating the new CCTV deployments into the existing CHART Advanced Traffic Management System (ATMS), and the provision of a stand alone operating system for the proposed LCS which will be an extension of the CHART DMS control interface to promote a consistent interface for the operators at the SOC.

There are no special personnel requirements for the proposed LCS (which will include the CCTV, small general purpose DMS, and lane control DMS). The daily operations of the LCS require no additional dedicated personnel and would be expected to be monitored by existing CHART operators. Automatically scheduled operations mean that no ongoing operator intervention is needed on a daily basis.

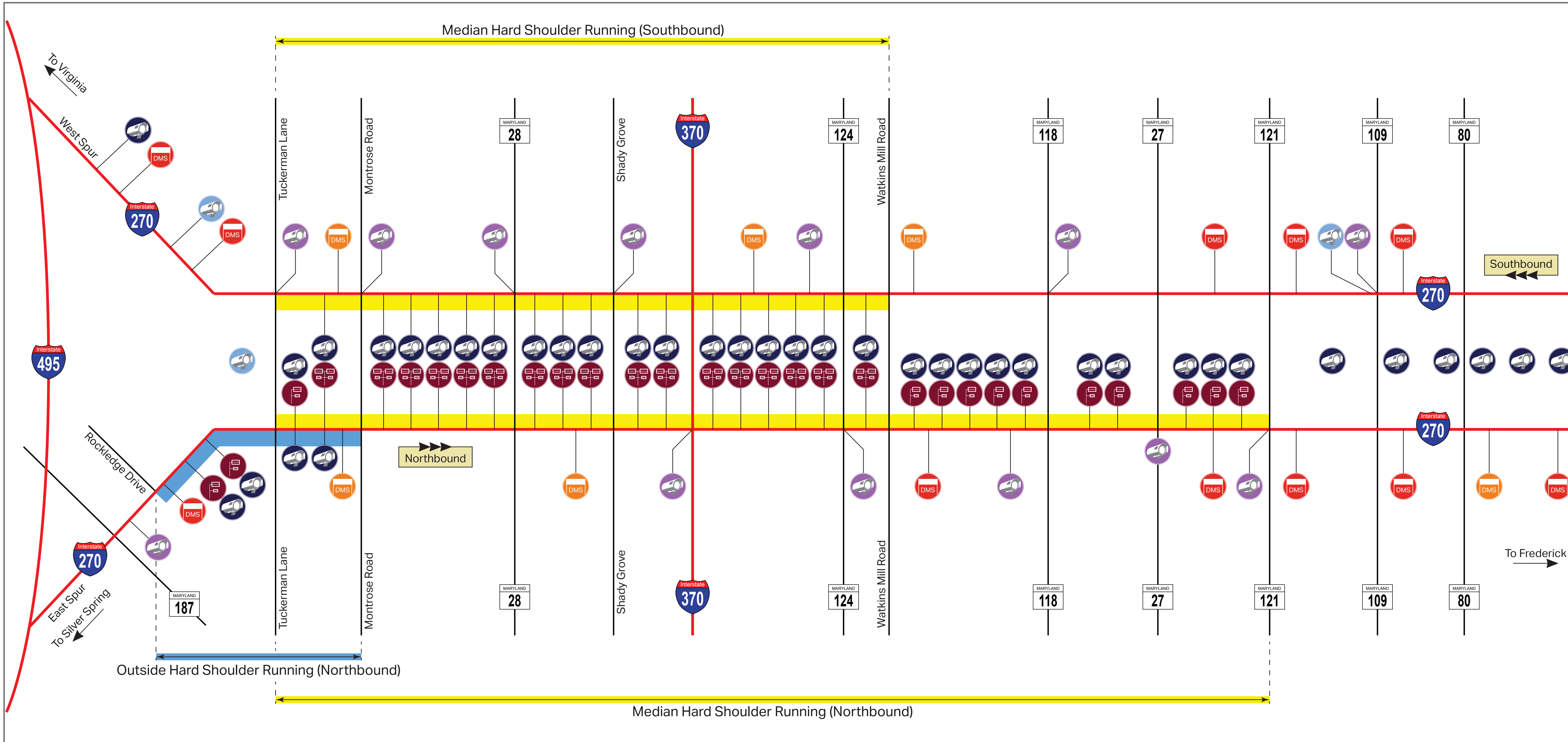
Additionally, there are no initial or annual licensing costs for the LCS beyond the development accounted for within this proposal. The LCS will be turned over to MD SHA outright and owned by MD SHA. This should help minimize software maintenance costs for MD SHA. The LCS will be a completely functioning system upon delivery and will have no scheduled additional features to be added.

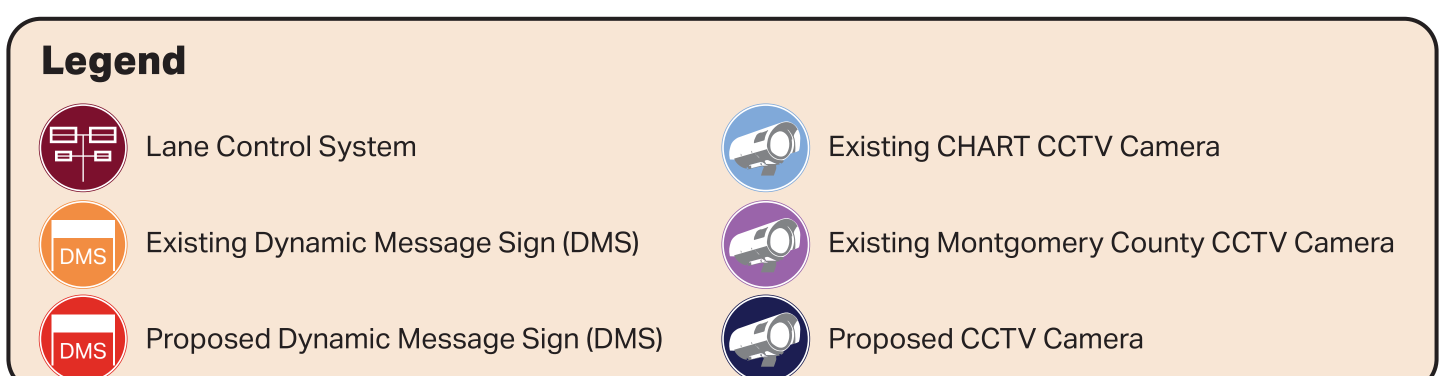
4.ii Integration & Compatibility of Improvements

The Team's proposal of an HSR program utilizing an LCS with specialized lane control DMS, conventional general purpose DMS, as well as CCTV for corridor monitoring is both highly compatible with, and will be effectively integrated into the current ATMS and CHART operation.

The additional CCTV equipment will be fully compatible with the CHART ATMS and will be directly configured into the ATMS for viewing by traffic operators for monitoring the I-270 corridor using existing CHART video viewing infrastructure. The new I-270 CCTV cameras, and DMSs will be compatible with current CHART standards with NTCIP control. The CCTV will be directly configured into CHART's existing ATMS system to allow CHART operators to monitor conditions along the I-270 corridor on their

Figure 4.2 Lane Control System / CCTV / DMS / BlueTOAD





ITS Device	Quantity
New Full Size DMS	11
New CCTV	7
CCTV for HSR	32
Lane Control System	30
BlueTOAD Traffic Monitoring	25

- BlueTOAD advanced traffic monitoring system to be installed at 25 locations. WiFi / Bluetooth / DSRC equipment to be co-located with existing microwave vehicle detection units, or to be installed on existing structures.
- Additional information provided in PTC 8 Advanced Stage O-D Data & Connected Vehicles Infrastructure.

Not to Scale
Note: Not All Interchanges Shown

current CCTV monitors without the need for additional monitoring assets. No software modifications will be necessary to incorporate the new CCTV cameras.

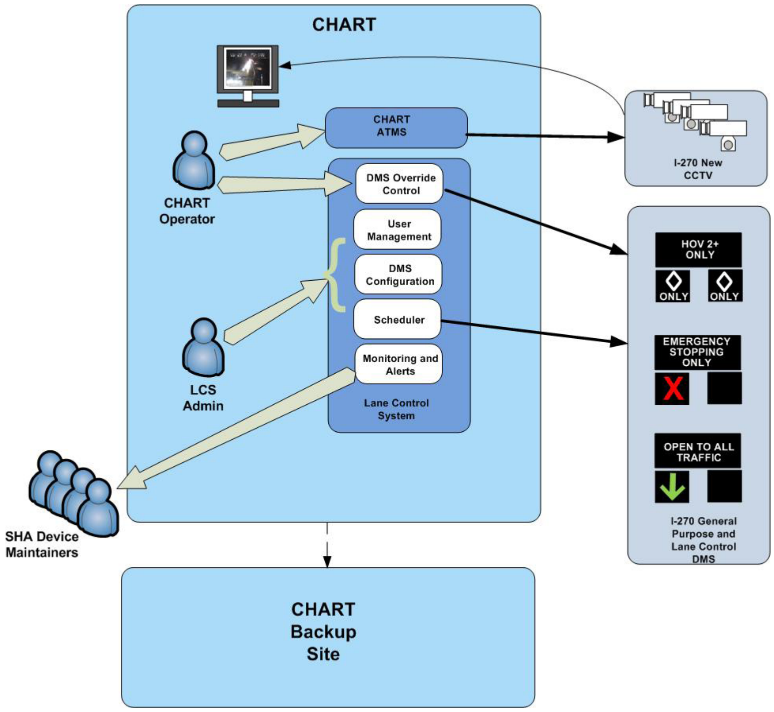


Figure 4.3 High level view of the LCS and relevant CHART components.

The LCS will be a standalone system to configure and control the new DMSs (both the specialized lane control signs and conventional general purpose signs), with scheduling and health monitoring and alerting capabilities. All new DMSs will communicate via NTCIP. The conventional general purpose DMSs will be fully compatible with the ATMS, but will be included in the LCS for scheduling and control purposes. The specialized lane control DMSs will be an extension of existing CHART ATMS DMS capabilities, and we will adapt the existing CHART ATMS DMS Control Module to display the necessary graphics on these DMSs. The LCS will have a browser based User Interface and the LCS server will be deployed along side other CHART servers and will benefit from the existing CHART backup and recovery solution. The LCS will have some similarities to the existing CHART ATMS, though it will be significantly stripped down to show only functions relevant to the LCS. The LCS will appear sufficiently different from the ATMS to avoid confusion of the two systems by CHART operators.

The LCS will be a custom built fully standalone system deployed inside the CHART environment that will provide secure, automated, redundant HSR control operations on a flexible, configurable schedule with health monitoring and alerting capabilities, along with the ability for operators to take control direct control of DMS. LCS will be built on existing, freely available (by request) CHART software components which will facilitate possible future integration directly into the CHART ATMS as an alternative to the fully operational standalone system initially deployed.

- The LCS User Management module will enable secure, authenticated access to LCS and will allow administrators to set up LCS user accounts with configurable roles that will allow different users to have different rights within the LCS. Administrators will have access to all capabilities of the LCS. Some users may be granted access to scheduling capabilities, while others may have access to only lane control DMS override capabilities.
- The LCS DMS Configuration module will allow Administrators and other users with sufficient rights the ability to fully configure both general purpose and lane control DMS into the system. All DMS communications to the I-270 general purpose and lane control DMSs will be done directly from the LCS. This includes NTCIP DMS communications with the ability to display text and colored pre-configured graphics necessary for the actual lane control: open, closed, and closing (merge) symbols, and HOV symbols. This also includes the capability to revert lane control and general purpose DMS to a default state, if there are no communications to the DMS for a configurable time (this is known as a "comm loss timeout"). This provides fault tolerance for network and systems failures.
- The LCS Scheduler module will allow operators to create the desired lane control configurations and attach them to a schedule for automatic execution. The scheduling capabilities will be flexible to allow for time of day and day of week, with the ability to make exceptions for holidays or other major events (inaugurations, etc.). This could include the ability to gradually close down HSR lanes when returning to non-rush hour operations. This flexibility will relieve SHA operators from the burden of daily operations.
- The LCS Message Utility Module will allow creation of predefined libraries and plans to allow activation of a specific "plan" (for instance, all or a specific range of northbound DMSs) in

one operation. This module will also provide rudimentary dictionary operations (spell checking, banned word checking) for textual messages destined for the conventional DMSs in the LCS.

- The LCS DMS Control Module will allow sufficiently privileged users, likely CHART operators, the ability to cancel any currently executing lane control configurations, manually start an existing lane control configuration, or manually command any or all of the general purpose or lane control DMSs configured into the LCS. This allows traffic managers the ability to better control traffic flow on I-270 based on actual current traffic conditions. This module will also execute plans scheduled within the scheduler.
- The Monitoring and Alerts module will monitor DMS communications and hardware status, identify problems and send out alerts by email or text to configurable groups, presumably SHA network and device maintainers. It will also be capable of sending alerts onscreen to LCS personnel logged into the system, but this is not intended to be relied upon for primary feedback, since LCS operators will not be monitoring the LCS most of the time. Monitoring and Alerts will also include "watchdog" functions, which will monitor the health of the LCS software itself, and restart, notify, and alert if necessary.

The LCS frees operations staff from routine daily operations of the I-270 managed lanes while allowing the flexibility to intervene when needed. By being built with existing CHART software components, the LCS could be incorporated directly into the ATMS in the future if desired. By deploying alongside existing CHART servers, LCS can benefit from the existing CHART backup and recovery solution. This solution includes primary deployment at the Glen Burnie Data Center, with a redundant backup deployment at SHA Headquarters in Baltimore. Table 1-1 highlights the Features and Benefits of the LCS.

TABLE 4.1 Features and Benefits of LCS

Feature	Benefit
Redundancy	Backup LCS capabilities can be housed at the existing CHART backup facility.
Lane control indicators	Lane control indicators displayed on DMS to indicate if lanes are open, closed, or are in a state of transition to closing.
General purpose motorist messaging	LCS user defined messages and symbols, such as HOV indicators on general purpose DMS, simple to use.
Security and role based access	LCS will feature authenticated, secure role based user login and secure application communications.
Flexible Scheduler	Schedule to open or gradually close shoulder lanes based on time of day and day of week along with matching general purpose messaging set up one time removes burden of daily operations from operators.
Manual DMS override capability	Allows operations flexibility to open or close lanes as traffic conditions dictate, including the ability to close lanes gradually (or suddenly), providing a tool for more active traffic management if desired.
LCS monitoring and alerts	Relieves operations from actively monitoring health of system by automatically generating alerts that can be received by email or text to defined distribution lists.
Built using existing CHART software components	By incorporating existing CHART software components, the LCS is built on a reliable foundation while providing a patch to incorporating the standalone LCS directly into the CHART ATMS if desired in the future.
Seamless CCTV integration into CHART ATMS for I-270 corridor monitoring	No additional systems needed. CCTV can be configured as tour and easily monitored on a single existing monitor at the SOC.
Fault tolerance	Lane control DMS reverts to configurable default state (e.g., Red X, closed) if communications problems with LCS. General purpose DMS revert to configurable default state (e.g., "SHOULDER CLOSED") if communications problems between LCS and DMS. Watchdog processes monitor health of software and restart software services as necessary.

Communication between the HSR field devices and the LCS will be provided over cellular IP based modems and T-1 communication lines. This is consistent with the communication systems currently in use by CHART. Likewise, all non-HSR devices deployed will also be integrated into the CHART system using T-1 lines (for CCTV) and cellular modems for low speed devices (DMS and BlueTOAD).

Because the HSR systems may be considered more critical than non-HSR systems, the TEAM would encourage SHA to consider cellular plans with the AT&T Dynamic Traffic Management emphasis. Entering into agreements to use the Enterprise or Public Safety networks would ensure a higher level of reliability, especially under high use periods that are often experienced during major events. The Team will coordinate with the Administration to ensure that the appropriate leased communications is provided for ease of use.

In addition to the technology additions and their integration with CHART, the Kiewit/AECOM Project is well integrated with the existing HOV infrastructure, since the addition of the SB HOV lane results in a total of two HOV lanes, which integrate well with the two existing receiving HOV lanes just south of Tuckerman Ln. In addition, the motorists that live and drive in the vicinity of the project are already familiar with the HSR concept as a means to additional capacity, since the Virginia Department of Transportation has already implemented this method along the right shoulder of IS-66, and more importantly, along the median shoulder of NB I-495, just north of the I-495 Express and Local Lanes merge, and just south of the IS-270 and I-495 lane merge. Therefore, the Project improvements integrate well with the existing infrastructure in the vicinity.

4.iii Implementing Innovations

The standalone LCS software will be developed using existing CHART ATMS software as a base. The system will look intimately familiar to CHART ATMS operators, reducing training costs. Although not necessary for operation of this HSR system, in the future the Administration will be able to incorporate the LCS into the ATMS directly, as a separate effort under the CHART development contract. Use of ATMS software for the LCS will allow ease of integration which cannot be matched with any other software solution. DMS and CCTV equipment will be the latest technology, while maintaining compatibility with existing CHART architecture.

Managed lanes enable the additional highway capacity on HSR to be utilized in a wide range of applications such as HOV Lanes, Express Lanes and Automated Vehicle Lanes. Managed lanes offer the flexibility to apply the right type of operation at the right time, thereby "future-proofing" this additional capacity, preventing it from filling up with traditional single occupant vehicles (SOVs) over time.

While the Project proposes HOV Lanes, a near-term future application for the Administration to consider is Automated Vehicle Lanes. The HSR would operate as HOV Lanes during the peak periods and as Automated Vehicles Lanes Only during non-peak periods. Automated Lanes offer Original Equipment Manufacturers (OEM) the opportunity to test, license and certify their vehicles under live conditions using their own lanes. This enables them to demonstrate their operational and safety performance within controlled lanes as they progress through the five levels of automation. This includes various operational scenarios such as platooning, headway spacing, interaction with non-automated vehicles, interaction with trucks and hazardous weather conditions. Before and after data would be collected to demonstrate their technical readiness to advance to the next level of automation. This data would be used to compare operational and safety performance over an extended period of time to provide the public assurances that automated vehicles are ready to be integrated into our roadway systems without degrading operations. Over time, the capacity of the Automated Lane would increase, as the allowable headways between the automated vehicles decrease, thereby "future-proofing" the capacity of these lanes. In addition, the Administration will be able to migrate General Purpose Lanes into Automated Vehicle Lanes in the future when there is a substantial turnover of vehicles where Automated Vehicles outnumber non-Automated Vehicles.

Figure 4.4 Operation center with advance traffic tools

The above application has minimal impact on the roadway infrastructure. DMS will be used to indicate the change in status from HOV Lanes to Automated Vehicle Lanes, back to HOV Lanes. Vehicle detectors will measure traffic volumes, speeds, and occupancies while Connected Vehicle DSRC (PTC8) will transmit additional data such as queueing, inclement weather, and pavement conditions. CCTV cameras will monitor traffic flow under various operational scenarios and support incident management within these lanes. This strategy will enable the Administration to collect performance data on other aspects of operations and maintenance such as high quality lane markings and signs to support Automated Vehicle operations. The Administration will be able to apply for FHWA grants such as Advanced Congestion Management and Technology Deployment Initiative to offset additional analysis, infrastructure, operations and maintenance costs associated with this strategy. Furthermore, the Administration will be able to charge a "lane-rental" fee to OEMs desiring to participate in the program.

The Kiewit/AECOM team will prepare the Concept of Operations (ConOps) as the next step to address these user requirements and operational scenarios in more detail. The ConOps will address the requirements of the Automated Lanes and how they are used in conjunction with other operational strategies such as Shared Mobility, Priced Managed Lanes, and Integrated Corridor Management. The ConOps will be followed by developing functional requirements, then detailed design documents (i.e., plans and specifications).

Additional Strategies not included in the Project

In addition to the "Automated Lanes" concept, the Administration can utilize the infrastructure installed as part of the Project to implement Transportation System Management & Operations (TSM&O), Transportation Demand Management (TDM), and Traffic Incident Management (TIM) in the future.

TSM&O strategies include utilizing Connected Vehicle and Enhanced ITS data provided by the infrastructure installed as part of this Project to establish performance measures to align with the Administration's goals for the IS-270 corridor. Selected performance measures are posted on the State Operations Center video wall and workstations in real-time to manage operations more proactively by keeping ahead of congestion rather than reacting to it. AECOM has supported the Florida DOT (District 4) in applying this strategy where real-time performance measures include the number and severity of lane-blocking events and incident clearance time (by county), number of ITS equipment malfunctions, and cuts in the fiber optic network. These more granular data streams can ultimately be fed into predictive models and decision support systems to be developed by CHART's Systems Integrator in future versions of the ATMS software.

TDM strategies include attracting shared mobility within the HOV/Express/Automated Vehicle Lanes to increase vehicle occupancy while augmenting existing transit systems and routes in serving the first and last legs of transit trips more efficiently. Mobility apps are developed by others to facilitate shared rides. As the IS-270 corridor includes many high-tech companies, an aggressive TDM outreach program is recommended to begin to change their employees' travel behavior during construction of improvements as well as post construction.

TIM strategies include assigning Severe Incident Response Vehicles (SIRV) within the HOV/Express/Automated Vehicle Lanes to improve their reliability and availability by reducing incident clearance times for lane-blocking events. The Florida DOT (District 4) designed the SIRV program to assist in the mitigation of delays caused by severe traffic incidents and to increase the safety of emergency responders. It was recognized there was a need for a Florida DOT presence on the scene of a severe incident or Level 3 incident, which includes multiple lane closures that last longer than two hours as well as any full highway closure and fatal crashes. The SIRV trucks are medium duty dual wheel diesel engine trucks. They have 11 foot long covered utility bodies with red safety light systems to expedite emergency response. Each truck has two telescoping high-intensity floodlights on the front and six fixed mounted scene work lights on the remaining three sides. The trucks are also equipped with computer docking stations in the front seat area so the staff can use a laptop computer during incident command. Each SIRV truck carries specialized equipment including: roof mounted arrow board for maintenance of traffic; spill pads and containment pools; over 300 standard flares; roadway repair supplies; emergency scene signs; high intensity lighting; brooms and shovels; 100 traffic cones; electronic flares; spill absorbent; bottled water; and extra fuel. The SIRV program has been in operations since 2005 resulting in 20-30% reduction in incident clearance of lane-blocking events.

Figure 4.5 Severe incident response vehicle and equipment

5. WELL-MANAGED PROJECT

5. WELL-MANAGED PROJECT

5.i Key Elements of the Project Management Plan

Goal: Provide a Project Management and Work Plan that addresses communications, coordination and risk management, achieves a collaborative partnership with all members of the project team and stakeholders, and successfully advances the project goals.

The project management plan (PMP) will address communications, coordination and risk management, achieves a collaborative partnership with all members of the project team and stakeholders, and successfully advances the project goals. The Kiewit/AECOM team will deliver a PMP at the outset of the project.

Our PMP is the foundation of how we will approach the I-270 project. In the following pages we present a detailed discussion regarding the key components of the PMP in response to the RFP.

Communications and Coordination

One of the greatest challenges of a large design-build project is effective communication among all of the entities involved. This coordination must play out at various levels:

- Internal coordination between Kiewit/AECOM and all subs including, interdisciplinary design coordination, and construction scheduling.
- Client Coordination with the Innovative Contracting Division (ICD), coordination with the independent cost estimator (ICE), as well as the Administration's offices and support divisions, such as OHD (including HDD, HHD, and PRD), OMT, OPPE (including travel forecasting), CHART and OOTS. We will also coordinate with District 3 and 7's traffic engineer, construction engineer, community liaison, and if necessary, both the utility engineer and ROW agent.
- Third Party coordination with stakeholders, community officials and agencies such as Montgomery County, Frederick County, MDE, USACE, various cities, first responders and the public.

Our key staff, including our D/B Project Manager, Frank Digilio, will be involved in the design phase immediately upon Notice to Proceed, and will be managing the construction through final completion. This consistency will aid in strong project communication.

Our experience has shown that successful communications will unfold through a series of regular, well-organized weekly meetings.

Partnering Meetings. The Kiewit/AECOM team will utilize partnering tools that have already been put in place by the Administration, through the Partnering in Planning and Design Manual and the Partnering in Construction Manual. The team will create a partnering agreement at the beginning of each CAP. We will hold a partnering kickoff meeting for the design and construction phases of the project and hold monthly partnering meetings.

These meetings will focus on early identification of issues and constant monitoring of the project to ensure that the project stays on time and within budget. These meetings will be initiated during the design phase and carry all the way through construction final completion.

We will use the four-square performance issues matrix which is a snapshot of performance. This tool is most effective when formulated and reviewed during discussions with the owner and project team. Using the four-square matrix results in the increased communication of project trends, a better understanding of the issues by the project team and prompt issue resolution:

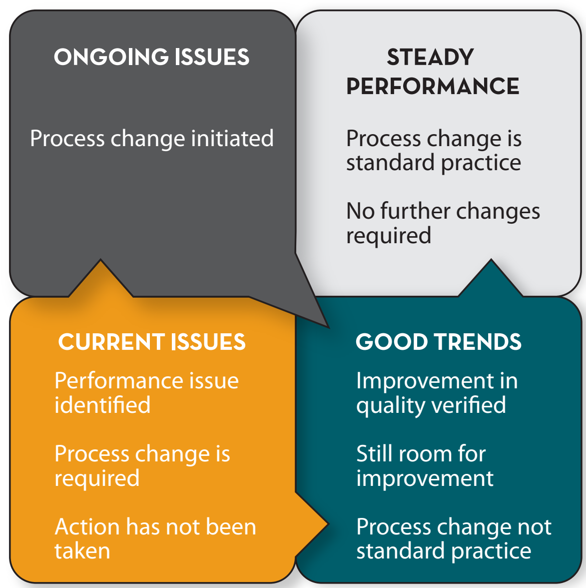


Figure 5.1 Four-Square Matrix

Utility Coordination Meetings. AECOM was the lead for utility investigation for the Corridor Cities Transitway (CCT) project, which provided experience within the limits of the IS 270 project corridor that can be immediately leveraged to efficiently identify issues. Utilities in the corridor consist of overhead and underground electric and telecommunications (fiber optic and copper cables) lines; as well as underground gas, water, and wastewater/sanitary sewer lines. Please refer to Table 5.1 Utility Owners for a list of utility owners, and the appendix for additional contact information.

Utility relocations are often long lead items that can have a great impact on the project schedule. In addition to potential relocations, we will also be tying power and communications into several existing sources throughout the corridor. We will Invite utility owners to the partnering meetings and kickoff meeting, hold quarterly meetings with utility owners, acquire as-built information and verify with physical testhole data, work with the D-B task forces and utility owners to identify potential conflicts, and assist with conflict resolution and coordination between SHA, Kiewit, and utility owners. To aid in coordination, we will prepare a comprehensive utility matrix and continuously update all potential relocations and assign a utility coordinator who will be responsible for reviewing project plans for conflicts, planning utility protection work, coordinating the construction team's work in and around utility crossings, maintaining the conflict log, directing the preparation of any necessary relocation plans, and working with the utility companies to construct relocations where necessary. The Utility Coordinator will conduct regularly scheduled meetings until all utilities are clear.

All utility coordination and design will be performed in accordance with SHA's Utility Policy. Utilities shall comply with the latest versions of the MDSHA - Standard Specifications for Construction and Materials, ASCE 38-02 - Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, and National Electrical Manufacturers Association (NEMA) Standard TC-10.

Table 5.1 Utility Owners

Utility Companies	
Montgomery County Planning Department	Zayo Fibergate (Fibergate, Inc)
WSSC Sewer	MCI (Verizon Business)
Crown Castle	Level 3 Communications
PEPCO	City of Rockville DPW
City of Rockville GIS	Star Power/RCN
City of Gaithersburg Storm Water Division	Verizon of MD (Bell Atlantic)
WSSC GIS	AT&T Transmission
Montgomery County Stormwater Division	Williams Natural Gas Pipeline (Transco)
WSSC Water	Comcast
AT&T	Washington Gas

No significant utility impacts are expected since the majority of the proposed improvements stay within the existing roadway footprint and the majority of Hard Shoulder Running pavement areas that are only overlaid or resurfaced. Full depth reconstruction will be limited to only the shoulder stretches that are non-traffic bearing, which also reduces the potential for impacts to utilities.

Permit Coordination. Kiewit/AECOM will coordinate with SHA's Environmental Planning Division (EPLD) for NEPA documentation. We will support SHA's HDD, who will lead the process, in the submittal to FHWA for any design exceptions and the Interstate Access Permit Approval (IAPA), and will perform a HOV equivalency analysis and submit to FHWA. We will prepare final reforestation site review approval from Maryland Department of Natural Resources, although we do not anticipate any forest impacts, and also prepare and coordinate the JPA. Lastly, we will coordinate with other state and local permitting agencies as described in Section 5.III.

Third-party Liaison and Stakeholder Coordination. During the course of design and construction, there will be significant interaction with the municipalities, utilities, and other affected agencies within the project area. A critical element to the project's overall success will be the ability of the project team, working in close coordination with SHA, to proactively respond to stakeholders' concerns.

From our experience on previous high-profile CMAR projects, we have identified the following BMPs that lead to successful stakeholder interaction:

- Involving major stakeholders in partnering meetings, task force meetings, or one-on-one meetings to discuss concerns.
- Communicating through weekly meetings to provide timely and accurate project scheduling updates.

Design Interface with Construction and Maintenance Organizations. The primary interface between the Kiewit and SHA Districts-Construction and maintenance as well as CHART, will occur in the task force meetings. SHA District Construction and Maintenance will review the design submittal packages. Similarly, Kiewit will bring other stakeholders with maintenance responsibilities (Montgomery County, Frederick County) into this process when appropriate, through either the task force or one-on-one meetings.

OPCC/CAP Development. The first step for this two-phase progressive design build project is to establish the baseline estimate early.

In order to manage the cost of construction to SHA's budget, the design will be continually checked against the initial proposal estimate for component compliance and design control. This allows our team to communicate how the design is tracking against the budget on a real-time basis thereby allowing informed decisions to be made during the process. Our collaborative approach helps minimize design delays and budget overruns.

At project kickoff, our team will work collaboratively with the Administration to determine any early design/construction packages. There are several design packages that do not require extensive permitting approval such as local congestion relief areas. In addition, there are several long lead ITS items such as DMS and lane control signs that can be procured during the design phase. With the permission of the administration, our team will pursue these as early CAP's.

Prior to developing CAP's, our team will develop OPCC estimates. These estimates will give the team confidence that the project is within budget. Similar to MD-97 and Greenbelt CMAR projects, our team will spend a lot of time with SHA and the ICE to properly coordinate our efforts prior to submitting our OPCC and CAP estimates. This coordination includes a clear schedule for estimate submissions, bid item coordination, quantity comparisons, and plug number comparisons. Proper coordination and communication ensures that our estimates are compared efficiently, and we are truly comparing "apples to apples" estimates.

The subcontractor procurement process starts during the early stages of preconstruction with the creation of bid packages, prequalification of subcontractors and the identification of long-lead items. We believe it is critical to establish a detailed subcontractor and MBE procurement plan with the Administration at the onset of the project, and our plan is in full compliance with COMAR 21.05.10.05.

Risk Management. Risk management begins by defining the risks associated with the project and by understanding a risk's potential impact which is essential to managing and mitigating it. On the I-270 project, risk management is particularly important, due to the fixed project budget of $100M for the entire project. At the onset of the project, Kiewit/AECOM will identify risks that could impact the project schedule and budget.

Working in partnership with the Administration, we will identify, analyze, innovate, and manage risks, we will develop a plan and strategy that identifies all potential risks that may arise on the project, determine the correct contingency amounts for those risks that cannot be eliminated, assign each risk item to the appropriate party, separate risk out of the CAP's, and develop approaches that either eliminate or minimize those risks. We accomplish risk mitigation by modifying design, or through innovative construction methods.

After identification of the risk on the matrix, Kiewit and SHA will go through a process of analyzing risk that leads to appropriate innovations and developing mitigation and innovative strategies, along with efficient allocation of risks. As a team, we will compare costs, schedule, and risk between different design alternatives and construction practices to develop the best overall approach that eliminates or reduce risk.

5.ii Work Plan Development & Design Quality Assurance

Design management is accomplished by a team of individuals, including the Design Build Project Manager, Design Manager, and the Discipline Task Leaders who guide the various portions of the design work. This team has to be cohesive, communicative, and possess leadership skills to guide a large staff through a short design period.

Key aspects in delivery of a design-build project include:

Co-Housing of the Team: The entire Kiewit/AECOM team will be co-located in AECOM's downtown Baltimore office. The office will be located walking distance from the Administration's headquarters, which will enable our team to efficiently hold our regular weekly meetings, and allow for impromptu brainstorms, issue resolution, and design reviews. As the design progresses, we will identify a suitable office site adjacent to the I-270 corridor, that will house the entire construction team, design staff, and owner staff.

Design Status Meeting is the first project meeting of each week, led by the Design Manager. Other attendees are the Design Task Managers, Design Oversight Managers, SHA staff and the Design-Build Project Manager. A typical agenda for the meeting consists of review of the design quality, schedule, completion reports from the design task managers, constructability review status and an updated action item list. Each design discipline will generally conduct a meeting each week.

Discipline Task Force Meetings. Task force meetings facilitate effective communication between disciplines, and promote early problem identification and resolution. Task force teams will be composed of design, construction, quality, the Administration and stakeholder staff, as well as subcontractors and suppliers. Key project stakeholders will be invited to topic specific meetings to provide valuable input. Task forces will address quality, design intent, constructability, materials, alternative technologies, integration of elements, overall design integration and over-the-shoulder reviews.

Over-the-Shoulder Reviews. Over-the-shoulder reviews can be requested by the designer, contractor or SHA at any point in the design. These reviews are used to build consensus on a design that is needed early or that requires an accelerated review. Reviews can encompass informal plans, specifications, processes, on-screen designer interaction or more formal formats. The goal is flexibility and reaching design direction early in the process to avoid rework and schedule impacts.

Milestone Meetings (30, 65, 100%). Packages are be distributed for review, comments collected and initial comment dispositions made and distributed, followed by a formal comment resolution meeting to establish final dispositions. Continuous coordination and close communication will significantly reduce the number of review comments, keeping the project on track. Once final RFC'd plans are completed, they will be signed and sealed by a Maryland Professional Engineer, our design manager, Chris McGuire.

For estimating purposes, we anticipate submitting CAP proposals around the 65% design milestone for each package, and will reconcile into a final CAP.

Submittal Reviews, Interdisciplinary Reviews and Constructability Reviews. Each package will undergo three concurrent reviews consisting of discipline reviews, inter-disciplinary reviews and constructability reviews. Chris McGuire, Tom Boyle, and Joe Chang, our Design Manager, D/B Coordinator, and Constructability Review Manager, will be responsible for passing resolutions to all design teams. Interdisciplinary reviews are performed at the discipline design lead level to make sure the design is fully integrated and free of interdisciplinary design conflicts. The same submittal process and comment process is used for the interdisciplinary reviews as for all other reviews. Aconex will be used to store all comments, which will be tracked in a database that will be updated until all comments are resolved. Reports regarding status and closure of design comments will be included with each subsequent review submittal and will be provided to SHA and other stakeholders as requested. Below are some specific coordination items that our team will address:

- **Drainage Coordination.** Our drainage designers will coordinate with the roadway designers, ITS designers, and our utility coordinator to identify and mitigate any utility conflicts. In particular, the drainage and existing utilities will be coordinated with sign and other pole foundations, electrical lines, and the ITS infrastructure.
- **ITS Coordination:** Our ITS designers will coordinate will all disciplines including roadway and drainage, to ensure the proposed conduit will not conflict with existing or new construction. We will also provide detailed coordination with the utility companies to provide for efficient tie-ins for power and communications for our new lane control, DMS, O-D Data, and Camera infrastructure.
- **Maintenance of Traffic Meetings (MOT).** Our MOT Task Force Lead will work with the construction team to determine the construction access points, working room requirements, and the planned construction sequence. During construction, MOT meetings will provide timely information about upcoming closures and traffic restrictions to give the Public Information team sufficient time to inform stakeholders. An important measure of success on this project will be the public's perception of the job. Our most visible interface with the public will be through our Phasing and Traffic Control Plan.

Design Development Process. The design management team will be responsible for the contract documents. The team will make sure that adequate time is allocated to prepare the designs, coordinate reviews, and obtain the appropriate approvals so the construction schedule is maintained. To accomplish this, we have already developed an integrated design and construction schedule into a single schedule that includes activities for all contract-related submittals and reviews and will drive our progress through the design development phase, CAP negotiations, RFC drawings and into construction. In order to accomplish our plan, we have divided the project into five logical design and construction packages as described below.

- Median Managed Lanes and Hard Shoulder Running (HSR) – NB and SB
- Outside Managed Lanes on HSR
- Local Congestion Relief Areas
- Additional ITS and DMS Technology (outside of HSR limits)
- Advanced Wireless O-D Data Collection

By dividing the project corridor into these packages, we capitalize on our ability to begin designing them concurrently, which will allow for greater efficiency in the design phase, and allow for start of early works construction in the Spring of 2017 and in entire corridor by Summer of 2018. We anticipate working concurrently on our 30% design development within the scope validation phase, as required in the RFP. We anticipate close coordination with the Administration on the addition or reduction of scope items to best accomplish the project goals.

No NEPA work or environmental documentation work has begun, and the northern portion of the corridor has no available field investigation data provided by SHA. Our design schedule allows for both field investigations and NEPA work to commence and run concurrent with 30% plan development. Field investigations will include surveys, subsurface utility investigation, geotechnical borings, environmental feature delineation, noise abatement measurements and analysis. We have identified the components of our proposed solution that have independent utility and can be streamlined through NEPA/MEPA approval using a Programmatic Categorical Exclusions (PCE) process, while a more robust Categorical Exclusion (CE) will be followed for the HSR improvements. Similarly and where applicable, approvals by PRD and/or MDE for SWM and E&S will follow these same component breakdowns.

Once the initial design packages are created, we will submit the E&S and SWM concept packages that include H&H analysis, drainage, and SWM calculations to the appropriate permitting agency. We anticipate minor SWM facilities, and any new facilities will be within the existing right of way.

We will perform a geotechnical exploration plan and analyze pavement performance to develop a pavement design for the corridor. The design approach will include resurfacing, pavement patching, or full depth reconstruction. The PTC #1 appendix includes our preliminary pavement results based on the Administrations existing pavement data. We will also perform a geotechnical exploration program which analyzes subsurface conditions for ITS and sign structure foundation design.

The following are other miscellaneous scope items that our team will perform as part of the design development. We will perform traffic engineering, MOT, MOTAA, signing, lighting, traffic signals, pavement markings, ITS, TMP, Traffic Operations Analysis report, safety analysis using the HSM, landscape architecture and forest impact analysis (if required).

Our schedule assumes receipt of NEPA approval from FHWA at the 65% design milestone. At this time, CAP negotiation will commence and a construction schedule will be set. Once PRD Final Approval is granted, 100% plans will be submitted for a final review before drawings are issued for construction.

The team will provide a traffic noise analysis through noise mitigation assessment, including feasibility and reasonableness (except for the viewpoints of benefited property owners and residents). Traffic noise measurements/traffic data collection will be performed for the purpose of model validation at up to 132 noise measurement sites during 27 Traffic Monitoring Sessions (20-minute duration). Excluded tasks are: designation of representative receptors, preparation of a technical noise report and community outreach activities such as noise public workshops and solicitation of votes for barrier approval.

Scope Management: The project was bid on certain key assumptions and requirements spelled out in the RFP and as detailed throughout this proposal. During the scope validation period, we will work with the Administration to verify and validate our understanding of the scope to ensure all parties start off with the same understanding.

The management team will periodically review key quantities and release packages and make comparisons to the as bid estimates. Deviations will be identified and researched so that they can be mitigated if necessary. It is imperative that the project be delivered as originally scoped by SHA unless additions are requested and authorized by SHA.

Resource Allocation: A design staffing plan has been prepared and the design budget has been set. It is the responsibility of the design management team to ensure adequate resources are applied to the project to support the project schedule. We will monitor design progress through detailed earned value analysis and ensure that the appropriate resources are assigned the project at all times. The design manager will track design progress and anticipate the various peaks in the staffing requirements to ensure that the project scheduled is maintained.

Post Design Services. Continuous design input supports the Construction Team in evaluating improvements to the product, expediting the construction, resolving field conflicts, and responding to unanticipated changes including requests for information, adjustments due to unknown field conditions, changes in construction sequence, interpretation of specifications, and evaluation of time and cost-saving ideas generated by the construction staff.

Quality Control/Quality Assurance

Our Project Quality Manager has primary responsibility for preparing, maintaining and confirming compliance with the Design Quality Management Plan (DQMP) and the Construction Quality Plan (CQP).

Design Quality Management Plan (DQMP)

The DQMP will include checklists and procedures for reviewing calculations, drawings, and specifications, and correcting, back-checking, and documenting all checks. These procedures are aligned with ISO 9001:2008 Standards. AECOM staff and sub consultants will comply with the project-specific QC and QA requirements outlined in the DQMP.

We will conduct a Design Quality Control Review on each major deliverable. Our Design QC Manager will either perform the review or identify a qualified senior engineer on the team to perform the review, which will confirm that: the product conforms to contract requirements, industry standards, Maryland guidelines; calculations, plans, and design analysis documentation are accurate and sufficient for the level of design being reviewed; constructability reviews and interdisciplinary reviews have been completed; technical special provisions have been prepared in accordance with Adminstration requirements and are coordinated with drawings.

Design Quality Coordination between Firms. All design sub consultants will be briefed and informed about the design quality control requirements of the project and will be required to prepare design documents in compliance with the DQMP, and report to an AECOM design Discipline Lead. Document control for all members will be in accordance with DQMP.

Corrective Process in Design. Corrective action requirements will be implemented in the event of a nonconforming design documents at no cost to the Administration. Upon completion of the corrective action the design document will be processed through the quality review process outlined herein.

Construction Quality Plan (CQP)

Our quality program is based on detailed planning, building the work in accordance with the correct plans and specifications, maintaining good documentation and record keeping, and establishing strong communication between the Administration and Kiewit's quality and construction personnel.

Kiewit will perform all quality control duties on the IS-270 Project. Our Quality Manager will manage all inspection and quality control functions. Our quality team will work with certified personnel to perform all testing and material sampling. The Quality Manager will assemble all tests and material sampling activities into a daily report and submit that report to SHA. In addition, our team will perform detailed inspections on all of the work. SHA will perform all quality assurance (QA) duties in accordance with the RFP. This will include all hold point inspections, additional sampling and testing, and any other independent assurance duties.

Lastly, our quality plan will follow the criteria, tests, and inspection requirements outlined in the RFP and SHA's Standard Specification. The plan will include the required tests and frequencies, as well as define any additional quality control tests deemed necessary to control production processes.

5.iii Minimizing Impacts

To reach the goals of minimizing environmental, ROW and utility impacts of the IS-270 Project, the Kiewit/AECOM Team will deliver by using the core of the same successful team that exceeded the requirements on the Intercounty Connector Contract B (ICC-B), including Bill Park and Linda Kelbaugh to lead our Environmental Compliance Team (ECT). The Kiewit/AECOM Team's Environmental Supervisor, Bill Park, and Environmental Compliance Manager, Mark Cheskey, will be involved during constructability and interdisciplinary reviews ensuring environmental compliance. The ECT's proven track record of avoiding and minimizing impacts and maintaining environmental compliance is attributed to our extensive knowledge, proactive approach and a trusted relationship with the regulatory agencies.

Avoidance and Minimization (A&M) of Impacts to Natural Resources

The IS-270 corridor traverses through and runs adjacent to many sensitive environmental areas, including streams, wetlands, 100-year floodplains, specimen trees, forested habitats, forest interior dwelling birds and cultural resources. A&M of parkland and other resources will be critical in streamlining permit approvals.

In the northern portion of the project study area, north and south of the IS-270 and MD 121 interchange lies the Clarksburg Special Protection Area (SPA). The ECT will work with SHA to coordinate with the necessary local agencies and stakeholders to ensure the proposed work will be in compliance with the Clarksburg SPA requirements and that impacts will be minimized.

Our solutions currently propose all work being performed within the existing roadway foot print and right-of-way so new field inventory of resources outside of the ROW is not part of our work scope. However, there may be instances where utility relocations may result in unavoidable impacts to natural resources.

Environmental Compliance Approach – Permit Acquisition and NEPA

Our environmental compliance approach is a comprehensive process and incorporates input to the SHA prepared NEPA/MEPA documents, design, acquisition of permit approvals, permit modifications, changes to the environmental commitments and any NEPA/MEPA document reevaluations that may occur as design progresses and/or if unforeseen construction issues arise. The ECT will be involved throughout the design and construction phases to work closely to develop solutions to avoid these resources wherever possible. Where impacts cannot be avoided, the Kiewit/AECOM Team will jointly develop avoidance and minimization strategies to minimize impacts.

- USACOE
- MDE Nontidal Wetlands & Waterways
- Water Quality Certification
- Reforestation Site Review
- Roadside Tree
- E&S Control (ESC)
- Stormwater Management (SWM)
- NPDES Permit
- NEPA/MEPA Documentation and Re-evaluations
- Local Grading and Access Permits
- FHWA, MDSHPO, SHA MOA Cultural and Archaeological Resources
- Local Public Outreach Commitments

Possible Required Environmental Permits / Authorizations

To ensure that environmental compliance is maintained, our approach process consists of four categories: NEPA/MEPA Analysis and Input, Design, Construction and Construction Punch List. Figure 5 shows the process how we will address NEPA/MEPA, permit/approvals or permit modifications, NEPA/MEPA Re-Evaluations, E&S Control Minor Plan Modifications through the OOC062 Field Modification Process or E&S Control Major Plan Modifications in order to minimize schedule risk.

NEPA/MEPA Analysis Process

Avoiding and minimizing environmental and community impacts is at the center of our approach with the objective of streamlining and expediting NEPA and related permits and approvals that will be obtained by SHA. Our Environmental Compliance Manager, Mr. Mark Cheskey has over 28 years of experience preparing NEPA documentation. He will be the primary liaison between our design, assessment and impact minimization efforts and the Administration that is securing the necessary NEPA documentation and approvals.

The nature of our proposed improvements and anticipated impacts likely fall within the FHWA guidelines of a Categorical Exclusion Evaluation (CEE). We will work with SHA in fully scoping the proposed improvements corridor wide and examining the potential range of impacts and resources potentially affected. We have examined our menu of improvements with an eye toward accelerating construction in a time efficient manner. This examination of our PTCs centered on a very important NEPA compliance topic- Independent Utility. The Kiewit/AECOM Team found that the Project Improvements fell into the following two distinct categories: improvements related to Mainline Hard Shoulder Running (HSR), and improvements that have complete Independent Utility from any other proposed improvement and that would have benefit whether or not HSR on the mainline or other improvements were ever constructed.

Below are improvements that we believe have Independent Utility from the additional Managed Lane capacity being adding through hard shoulder running and also appear to be great candidates for Programmatic Categorical Evaluation due to the very minor nature of the work all within ROW, further accelerating delivery of improvements in the corridor.

1. **Local Congestion Relief Areas:**
   - IS-270 NB Where Spurs Converge
   - IS-270 Spur SB to IS-495 OL
   - IS-270 CD Road NB onto IS-370 EB
   - IS-270/MD 80 Interchange
   - Montrose On-Ramp to IS-270 Local Road NB
   - IS-270 NB Off-Ramp to MD 124 EB
2. **ITS Field Devices beyond HSR Limits:** Deploy additional closed circuit television (CCTV) cameras and dynamic message signs (DMS) in the IS-270 corridor outside of the area of managed lanes on HSR operating as HOV 2+.
3. **Technology Solutions - Advanced O-D Data Collection:** Install BlueTOAD advanced traffic monitoring system at 25 locations.

With FHWA concurrence, the NEPA approvals for the improvements above would be on independent tracks as design is developed and approved. The remaining improvements are related to Mainline HSR and would very likely require a documented CEE.

A qualitative noise analysis was conducted within the limits of the Project. The existing development aligning IS-270 on both sides was analyzed to determine the eligibility for noise abatement. Further analysis was completed to determine whether the proposed noise barriers in each section would be reasonable and feasible. Fourteen (14) potential noise barrier locations were determined to be reasonable and feasible within the limits of the project. The appendix includes a list of potential noise barrier locations. Further analysis will be conducted post award to support the Administration in confirming the proposed noise barriers required as part of the Project. The Kiewit/AECOM Team will assist SHA in conducting public meetings to discuss the implementation of the noise barriers in each community, and implement community input into the final determination.

Based on the information provided at this time and the sensitive resources associated with parkland and Clarksburg SPA within the project study area, we anticipate mitigation efforts will be associated with in the form of noise walls and natural resource impacts associated with utility line relocations, stormwater management and E&S Control.

Design Compliance Process

The ECT will be involved throughout the design phase to identify and delineate natural resources and perform design coordination to ensure environmental commitments, environmental performance specifications, special provisions, and standard provisions are being implemented in a streamlined approach. Documentation in accordance with regulations and permits required as applicable to Maryland Roadside Tree Law, Reforestation Law and Maryland Forest Conservation Act. We have developed techniques and a process to investigate and document avoidance and minimization of forested habitats throughout the design process.

Construction Compliance Process

The Kiewit/AECOM Team will use our ECT during the construction phase to assist with technical issues, especially when working near wetlands and waterways, floodplains, trees, cultural resources and facilitate the preparation and approvals plan modifications and minimize the potential for non-compliances and stop work orders. The ECT will serve as a technical resource to the contractors by providing recommendations or plan interpretations in the field when questions arise.

Construction Punch List Compliance Process

The ECT will inspect any temporary wetland and waters of the US impact restoration to assure impacted areas have been restored satisfactorily. The ECT will finalize environmental impact tables and submit for review and approval to SHA EPD, MDE, and USACOE to obtain the final permit modification for impacts. Forest Impact Plates and Reforestation Plans will be submitted to SHA EPD and MD DNR for final approval. The ECT will monitor the removal of remnant E&S control measures and temporary sediment trap removal and site restorations.

Minimizing Right of Way Impacts

Our proposed solutions will be designed and built within the existing right of way. In those limited locations where a drainage easement may impact or SWM fall outside existing right of way, our team will coordinate with the Administration's Plats and Surveys Division and District ROW Engineer. For identified right of way impacts, we will obtain the metes and bounds survey, develop the ROW needs, and generate all plats. We will prepare all ROW related information using the Administration's CADD Standards. All Plats will be signed and sealed by a PLS registered in Maryland.

Minimizing Utility Impacts

Through coordination with the utility companies and a review of any utility designation provided by SHA, we will be able to note potential field conflicts and identify any locations where further investigation and/or utility designation may be necessary. If a potential utility impact is identified during the utility designation, then test hole data may be required to confirm based on the actual depth of the utility.

Interstate Access Point Approval (IAPA)

Coordination with FHWA will be necessary regarding the level of documentation needed for the portions of the Project Improvements requiring IAPA. The Project Improvements likely requiring IAPA are associated with the Local Congestion Relief Areas (see Section 2.Mobility for a full description of these Project Improvements).

HOV Equivalency Analysis

The Kiewit/AECOM Team's Project Improvements will actually improve the HOV level of service on IS-270. The Team understands that an HOV equivalency analysis will need to be submitted to FHWA for concurrence. The Kiewit/AECOM Team is confident our Project Improvements will pass this equivalency test.

5.iv Achieving Timely Implementation of Improvements

Kiewit's schedule has been developed to ensure the availability of resources for the work and maintain a high level of service for the traveling public during construction. The project will be staffed early with experienced construction personal committed to achieving planning and scheduling success. The realistic and detailed schedule approach we've taken will achieve the following:

- Obtain design completion in 19 months
- Begin construction 12 months after NTP
- Final completion achieved August 15, 2020 (1028 Calendar Days after NTP)

The schedule has been broken down into preconstruction and construction activities. In the preconstruction portion of the schedule, we have developed 5 major design packages. Also, we plan to submit our SWM & ESC submittals to PRD in the same breakdown of packages. Below are the anticpated design packages:

- Median HSR Managed Lanes
- Outside HSR Managed Lanes
- Local Congestion Relief Areas
- ITS & DMS (Outside of HSR Limits)
- Advanced OD collection

Each package is broken down to include three approval stages (concept, site, and final). Within each approval stage time has been allotted for preparation, two review periods, and associated revision periods. In addition to the environmental permitting packages, the preconstruction portion of the schedule includes a field survey to verify as-builts, geotechnical borings, programmatic categorical exclusions (PCE), and a noise analysis.

As necessary, stages of each design package have been tied into other preconstruction work to reflect the correct sequence and interfacing of activities. Overall, we have the ability to adjust our design schedule to meet changing circumstances throughout the project. For example, if a permit is delayed or an unknown utility is discovered, we can adjust our priorities to allow for design and construction in an area that is available. Once the RFC design is complete for a package, the respective construction work is able to begin. The first design package scheduled to complete is for local congestion relief areas allowing the respective construction work to begin less than a year after NTP. This design package is straight forward and will have a reduced duration compared to the median HSR package which will allow our team to start construction in small segments as early construction packages. Median HSR work design and construction will lag slightly behind the local congestion packages.

The additional ITS devices will be constructed concurrently during other median HSR construction.

To achieve timely implementation of proposed improvement, the Kiewit Team proposes to construct the I-270 Design-Build project in 8 segments described below. Breaking the construction work into segments allows us to smoothly and efficiently sequence the work.

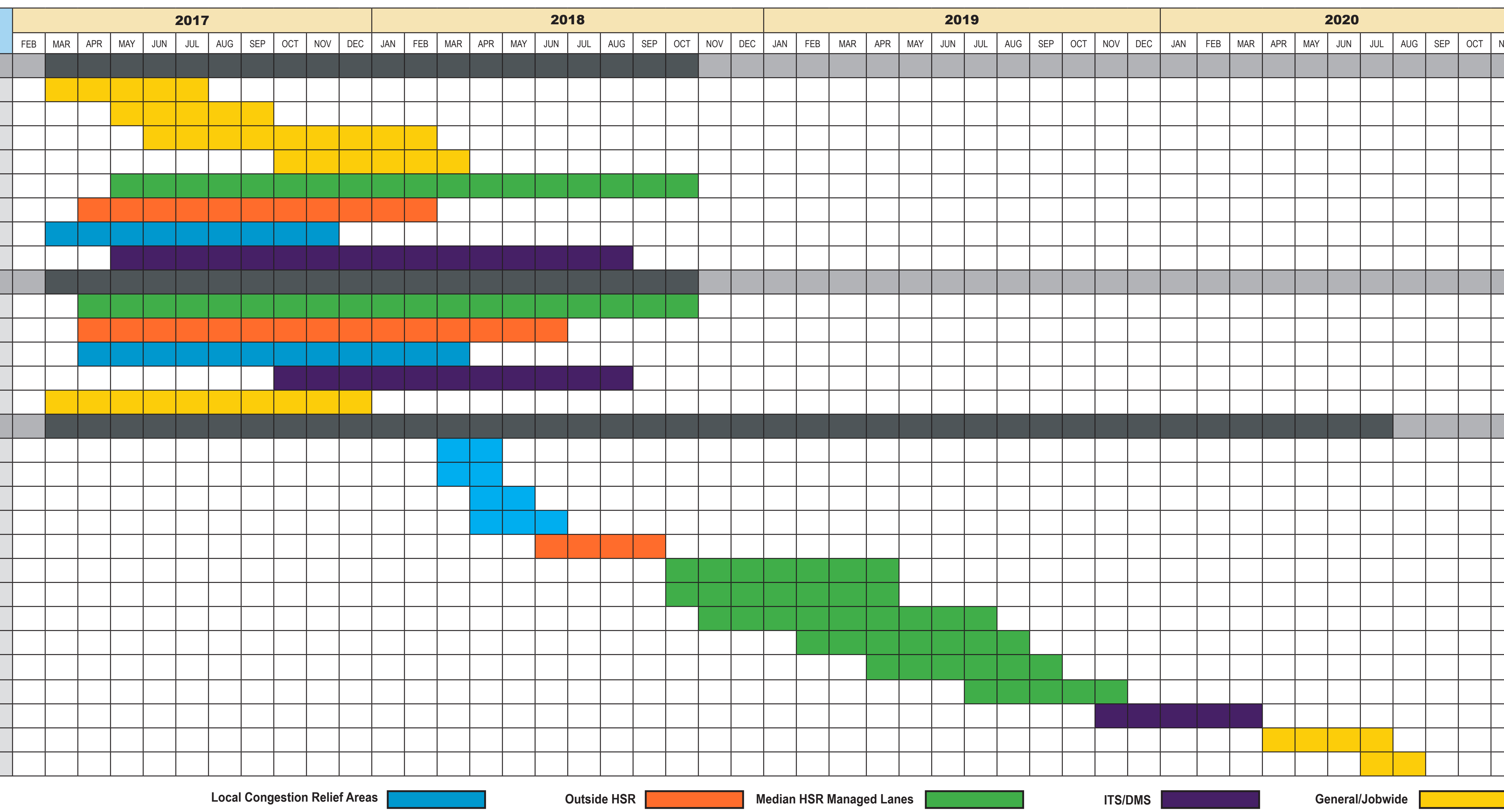
Segment Number and Name Location

- Segment 1 - Local Congestion Relief Areas
- Segment 2 - Outside HSR Northbound – Rockledge Dr. to Montrose Rd.
- Segment 3 - Median HSR Northbound and Southbound – Y-Split to Montrose Rd.
- Segment 4 - Median HSR Northbound and Southbound – Montrose Rd. to MD 189
- Segment 5 - Median HSR Northbound and Southbound – MD 189 to I-370
- Segment 6 - Median HSR Northbound and Southbound – 1-370 to Watkins Mill Rd.
- Segment 7 - Median HSR Northbound – Watkins Mill Rd. to MD 118
- Segment 8 - Median HSR Northbound - MD 118 to MD 121

Once the segment specific construction work is complete, an 80 day activity has been included in the schedule for ITS Integration & Testing to ensure the new construction is fully integrated with SHA's CHART system. Final wedge and level paving, UTBWC asphalt paving, and a 30 day closeout period follow the completion of the ITS integration resulting in an August 15, 2020 project completion. A detailed P6 schedule is included in the Appendix.

Figure 5.2 Summary Project Schedule

I-270 Congestion Management	2/6/17	8/15/20
Preconstruction	3/27/17	3/10/18
Field Survey	2/6/17	2/6/17
Geographical Borings/Reports	3/27/17	9/14/17
Programmatical Categorical Exclusions (PCE)	7/25/17	2/21/18
Noise Analysis	10/6/17	3/28/18
Environmental Permitting Median HSR Managed Lanes	5/22/17	9/5/18
Environmental Permitting Outside HSR Managed Lanes	4/24/17	5/21/18
Environmental Permitting Local Congestion Relief Areas	3/27/17	2/9/18
Environmental Permitting ITS & DMS (Outside of HSR Limits)	5/22/17	7/11/18
Design	3/27/17	10/3/18
Median HSR Managed Lanes	4/24/17	10/3/18
Outside HSR Managed Lanes	4/3/17	6/19/18
Local Congestion Relief Areas	4/3/17	3/9/18
ITS & DMS (Outside of HSR Limits)	10/6/17	8/8/18
Advanced OD Collection	3/27/17	12/29/17
Construction	3/10/18	7/16/20
PTC 5C - Extension of Accel/Decel Lanes at MD80	3/10/18	4/18/18
PTC 5D - NB Off Ramp to MD124 3rd Lane Eddition	3/24/18	4/12/18
PTC 5A - NB Switch of Lane Merge from I270 to I495	4/14/18	5/10/18
PTC 4A - Outside HSR - Shady Grove Road to I-370 - 2690 LF	4/28/18	6/4/18
Outside HSR	6/23/18	9/18/18
Median HSR NB and SB - Y-Split to Montrose - 7,400 LF	10/6/18	4/2/19
Median HSR NB and SB - Montrose to MD 189 - 7,200 LF	10/21/18	4/4/19
Median HSR NB and SB - MD 189 to I-370 - 20,118 LF	11/18/18	7/29/19
Median HSR NB and SB - I-370 to Watkins Mill 15,000 LF	2/9/19	8/27/19
Median HSR NB - Watkins Mill to MD 118 - 13,300 LF	4/7/19	9/23/19
Median HSR NB - MD 118 - MD 121 - 19,252 LF	6/1/19	11/4/19
Wedge/UTBWC Asphalt (Job Wide)	11/5/19	3/2/20
Wedge/UTBWC Asphalt (Job Wide)	4/15/20	7/16/20
Closeout and Punchlist	7/17/20	8/15/20



5.v Watkins Mill Interchange Modifications

The ICM improvements proposed by the Design-Build Team will have minimal impacts to the Administration's proposed Watkins Mill interchange project. The NB IS-270 HOV Lane on HSR utilizes the median shoulder through the limits of the interchange project. The SB IS-270 Express HOV Lane on HSR begins south of the new bridge over IS-270 and utilizes the median shoulder through the southern portion of the interchange project.

In reviewing the interchange plans provided by the Administration, we note that the bridge over IS-270 was designed to accommodate future widening of IS-270. As a result, the proposed HSR will have no impact on the bridge as currently designed.

The Design-Build Team proposes to minimize impacts to the interchange project,. ROW and SWM by implementing the HSR in the same method as we are using elsewhere along the IS-270 corridor. Widths of the through travel lanes will be reduced to 11 feet and the median cross slope will be flattened to 3% or match proposed superelevation to create the HSR lane in the median. Additional inlets will be required to reduce the width of the drainage spread into the HSR lane.

As depicted in the typical section, Figure 5.3 below, the additional width of the Watkins Mill Bridge Pier 4 located in the IS-270 median necessitates the reduction in width of all lanes to provide an offset between the barrier and the NB HSR.

The design of the Watkins Mill interchange will need to be modified to accommodate additional structure foundations in the median for HSR static signs, DMS, and LCS. The associated electrical and communication systems will require additional conduit in the median and/or across IS-270 to provide continuity with the overall HSR system.

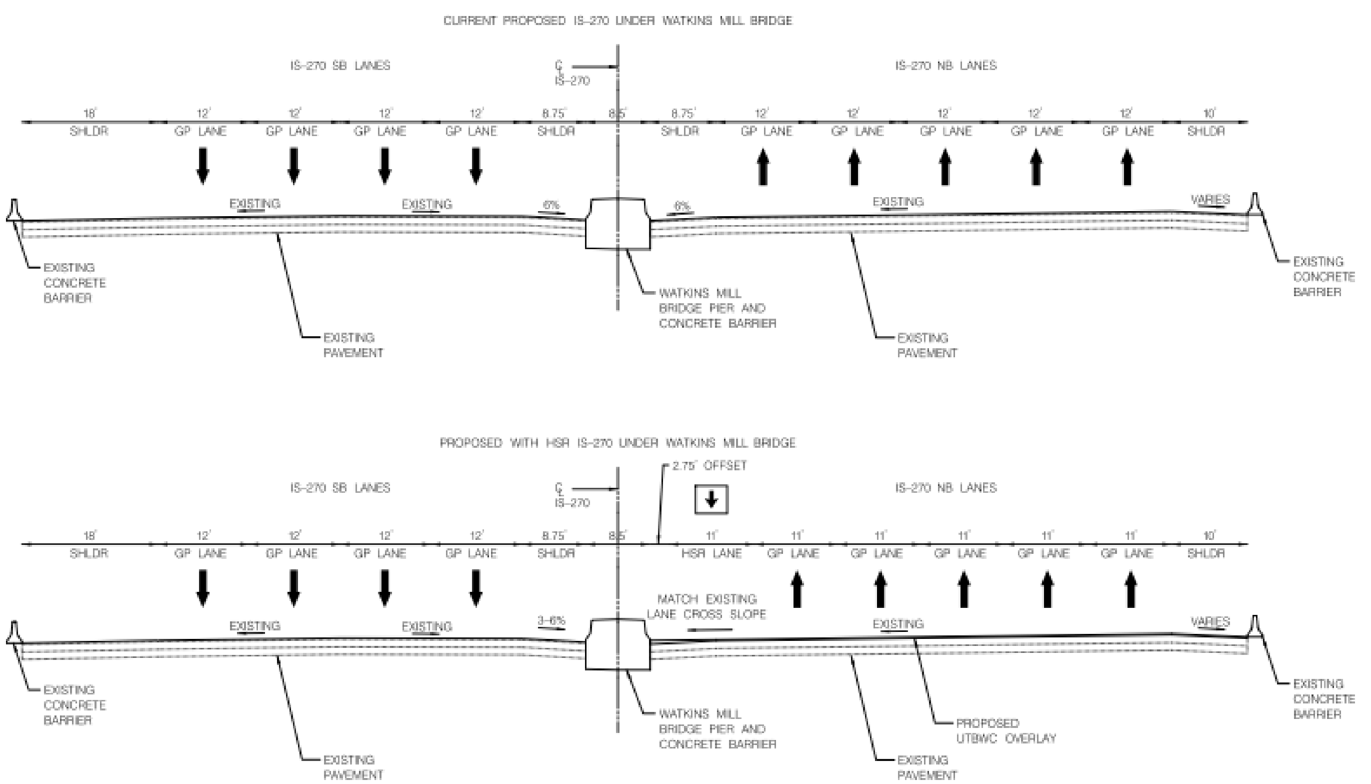


Figure 5.3 Proposed cross section through the Watkins Mill Road Interchange.

APPENDIX

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APPENDIX I
VISSIM ANALYSIS

I-270 Concept Evaluation (VISSIM Results)

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2016 Conditions

AM Peak

Table A.1: AM Peak - 2016 - I-270 Vehicle Travel Time

I-270 Northbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Build VISSIM Travel Time (seconds)	% Change	I-270 Southbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Build VISSIM Travel Time (seconds)	% Change
From I-495 interchange					From I-70				
to MD 187	1.8	109.0	108.9	0%	to MD 85	1.7	97.0	96.5	0%
to I-270 Split	0.6	37.5	34.9	-7%	to MD 80	5.4	414.5	319.2	-23%
to Montrose Rd	1.8	100.1	99.8	0%	to MD 109	3.7	390.6	311.4	-20%
to MD 189	1.0	57.6	57.6	0%	to MD 121	3.6	273.2	279.9	2%
to MD 28	1.0	55.1	55.3	0%	to MD 27	2.5	267.9	176.6	-34%
to Shady Grove Rd	1.9	108.4	108.9	0%	to MD 118	1.1	241.4	76.1	-68%
to I-370	0.9	53.0	53.0	0%	to Middlebrook Rd	1.1	211.7	85.7	-60%
to MD 117	1.5	85.5	85.5	0%	to MD 124	2.2	480.5	153.4	-68%
to MD 124	0.6	34.5	34.5	0%	to MD 117	0.9	148.4	124.9	-16%
to Middlebrook Rd	2.5	140.9	140.9	0%	to I-370	1.0	90.2	82.2	-9%
to MD 118	1.1	64.8	64.5	0%	to Shady Grove Rd	1.5	190.3	119.6	-37%
to MD 27	0.9	51.8	51.7	0%	to MD 28	1.9	431.1	350.5	-19%
to MD 121	2.4	135.3	135.4	0%	to MD 189	1.0	227.1	218.4	-4%
to MD 109	4.1	234.5	234.5	0%	to Montrose Rd	1.0	276.2	299.9	9%
to MD 80	3.7	213.8	213.2	0%	to I-270 Split	1.9	250.6	248.3	-1%
to MD 85	5.3	309.0	308.5	0%	to MD 187	0.4	30.0	30.1	0%
to I-70	1.4	79.9	79.8	0%	to I-495 interchange	1.9	131.8	132.1	0%
I-270 Total (miles/minutes)	**32.4**	**31.2**	**31.1**	**0%**	**I-270 Total (miles/minutes)**	**32.7**	**69.2**	**51.7**	**-25%**
I-270 Spur Northbound					**I-270 Spur Southbound**				
From Cabin John Pkwy					From I-70				
to MD 190	0.5	32.2	32.2	0%	to I-270 Split	30.3	3,990.6	2,942.6	-26%
to I-495	1.1	66.7	66.6	0%	to Democracy Blvd	0.7	88.4	50.7	-43%
to Democracy Blvd	1.4	91.2	91.3	0%	to I-495	1.3	183.1	93.3	-49%
to I-270 Split	0.9	51.0	51.0	0%	to MD 190	1.3	92.2	91.4	-1%
to I-70	30.0	1,724.3	1,723.2	0%	to Cabin John Pkwy	0.6	35.0	35.1	0%
I-270 Spur Total (miles/minutes)	**34.0**	**32.8**	**32.7**	**0%**	**I-270 Spur Total (miles/minutes)**	**34.2**	**73.2**	**53.6**	**-27%**

Table A.2: AM Peak - 2016 - I-270 Local Vehicle Travel Time

I-270 Northbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Build VISSIM Travel Time (seconds)	% Change	I-270 Southbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Build VISSIM Travel Time (seconds)	% Change
From C-D start					From C-D start				
to Montrose Rd	0.8	51.6	49.9	-3%	to Shady Grove	1.3	322.1	226.5	-30%
to MD 189	1.3	79.3	77.8	-2%	to MD 28	1.8	264.8	328.9	24%
to MD 28	1.0	60.7	61.3	1%	to MD 189	1.1	249.5	178.3	-29%
to Shady Grove	2.0	119.1	118.5	-1%	to Montrose	1.2	259.4	246.2	-5%
to I-370	1.0	56.3	55.1	-2%	to I-270 mainline	0.9	144.4	92.4	-36%
to MD 117	1.2	72.3	72.5	0%					
to MD 124	0.8	52.1	47.9	-8%	HOV Express	9.2		656.8	
to I-270 mainline	0.4	21.4	21.3	0%					
I-270 Local Total (miles/minutes)	**8.5**	**8.5**	**8.4**	**-2%**	**I-270 Local Total (miles/minutes)**	**6.3**	**20.7**	**17.9**	**-14%**

Figure A.1: AM Peak - 2016
I-270 Travel Time Graph - Northbound
(From Outer-Loop)

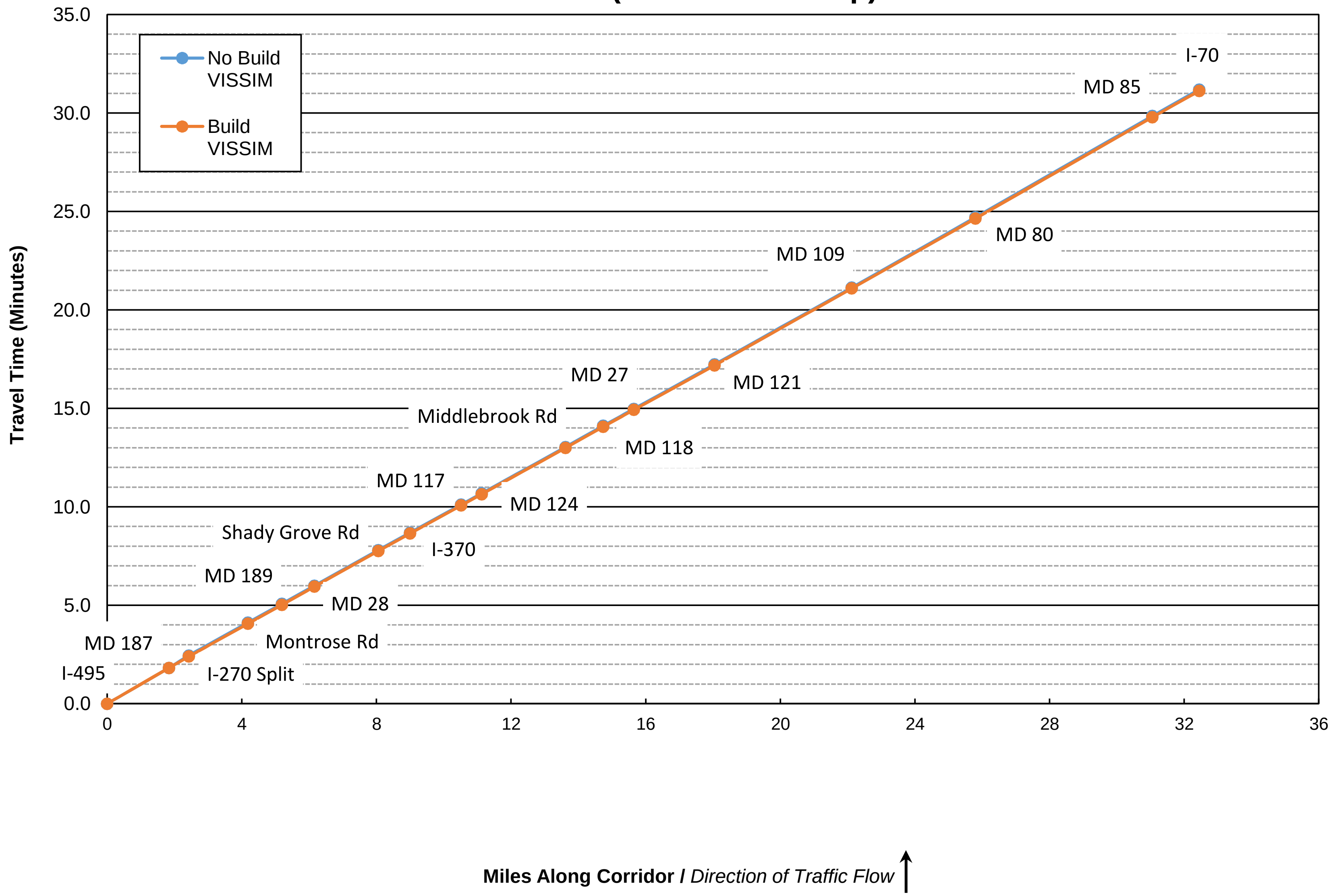
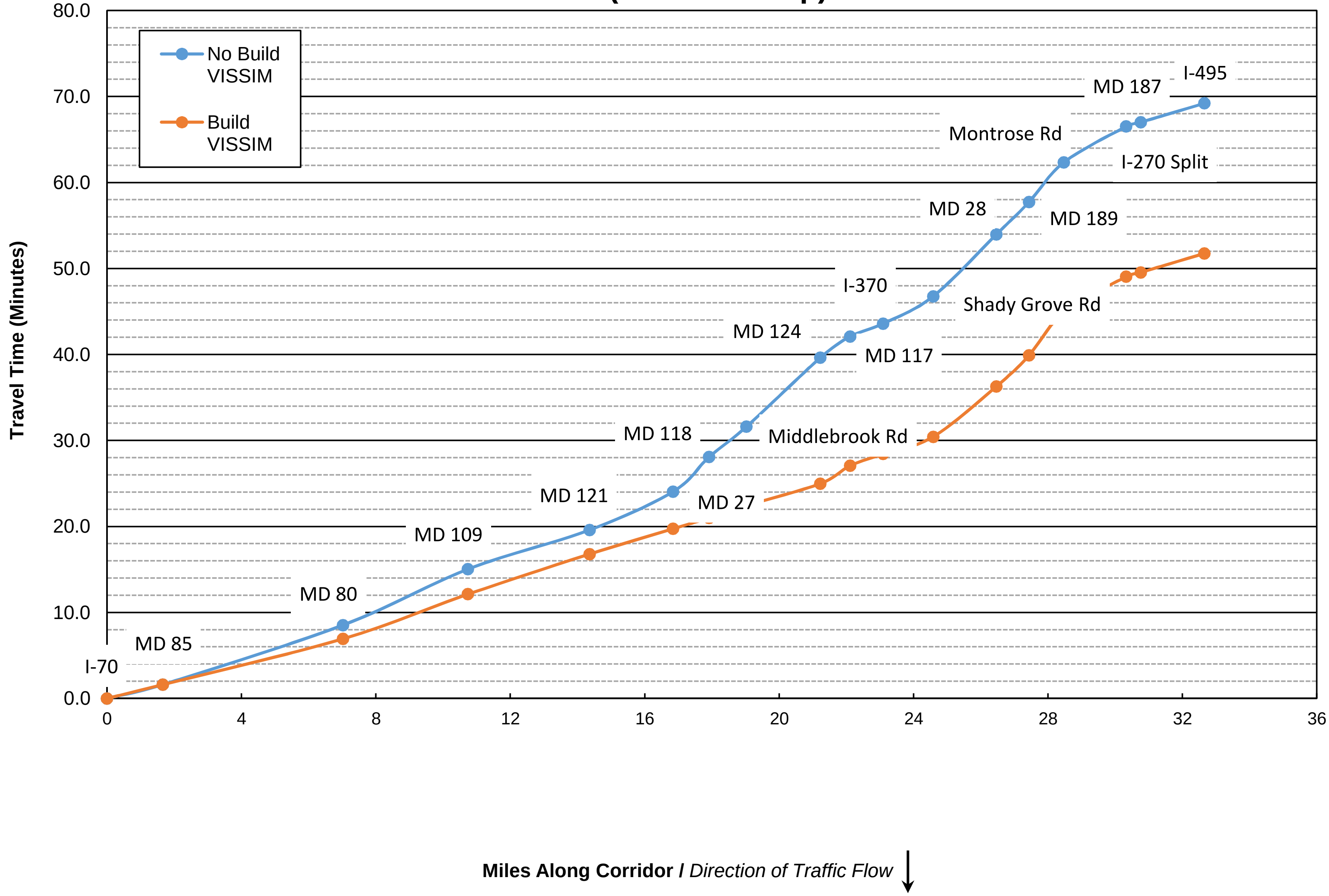


Figure A.2: AM Peak - 2016
I-270 Travel Time Graph - Southbound
(To Inner-Loop)



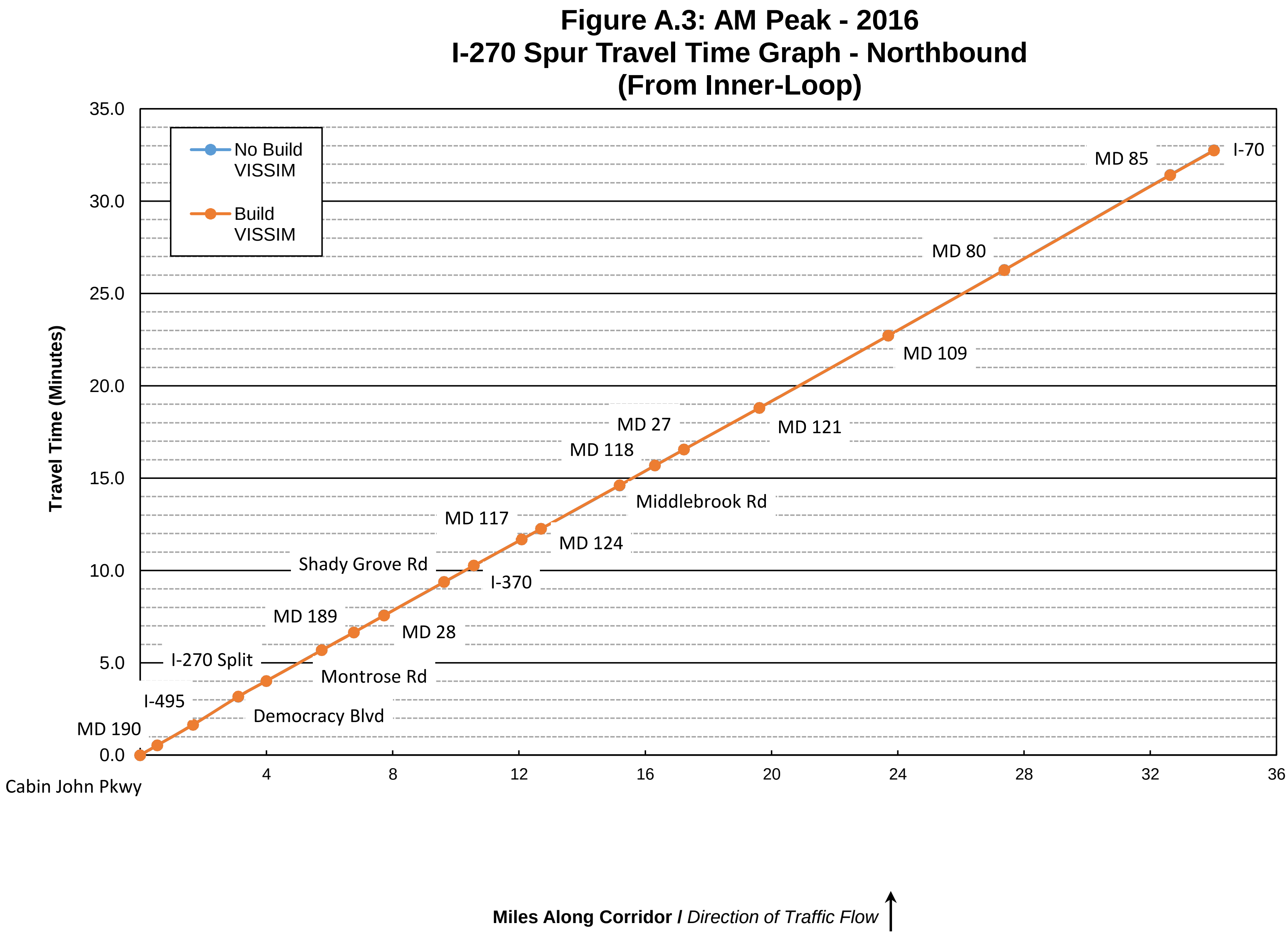


Figure A.3: AM Peak - 2016
I-270 Spur Travel Time Graph - Northbound
(From Inner-Loop)
Travel Time (Minutes)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
No Build VISSIM
Build VISSIM
I-70
MD 85
MD 80
MD 109
MD 121
MD 27
MD 118
Middlebrook Rd
MD 117
MD 124
Shady Grove Rd
I-370
MD 189
MD 28
I-270 Split
Montrose Rd
I-495
Democracy Blvd
MD 190
Cabin John Pkwy
4
8
12
16
20
24
28
32
36
Miles Along Corridor / Direction of Traffic Flow

Figure A.4: AM Peak - 2016
I-270 Spur Travel Time Graph - Southbound
(To Outer-Loop)

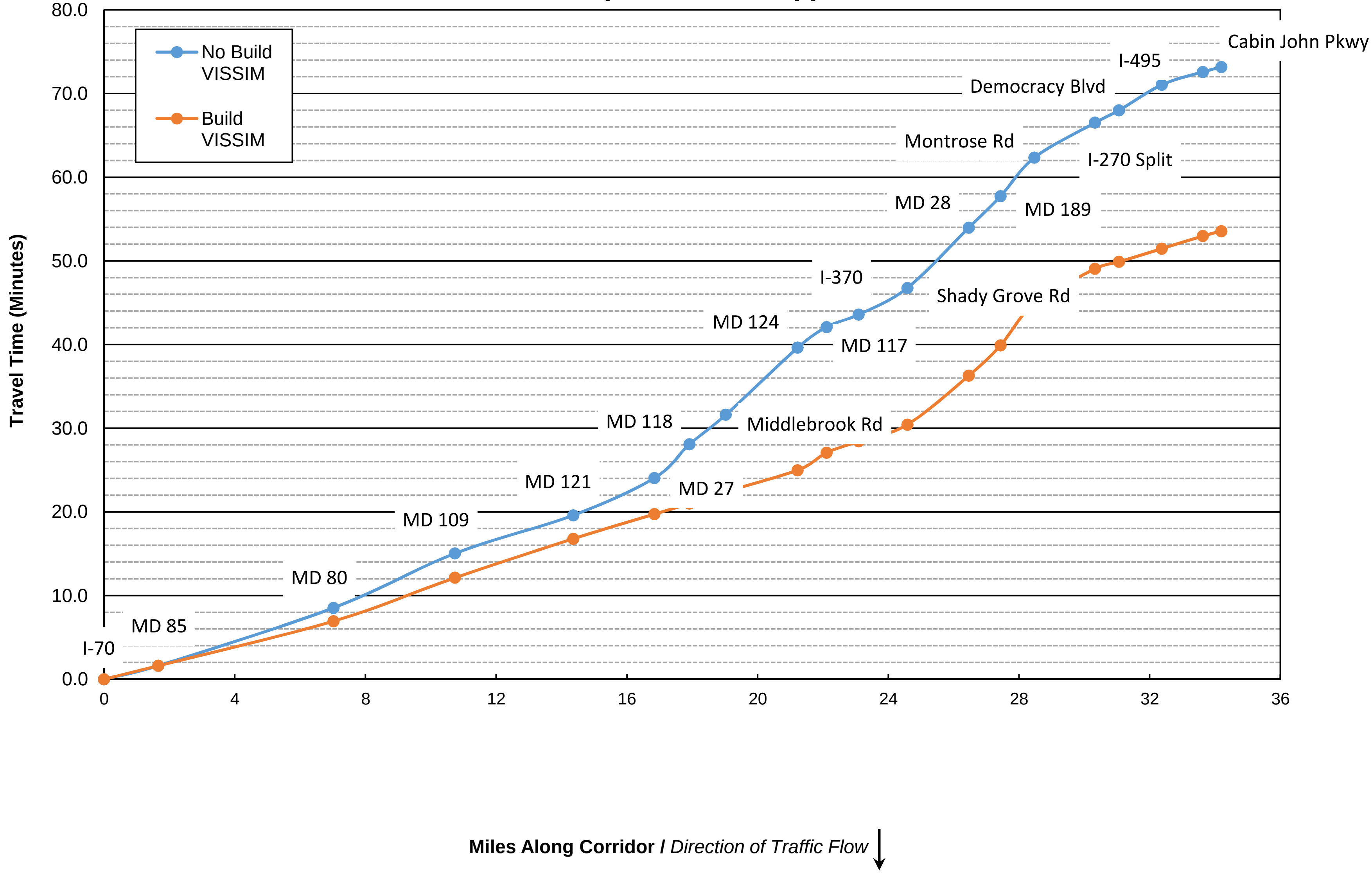
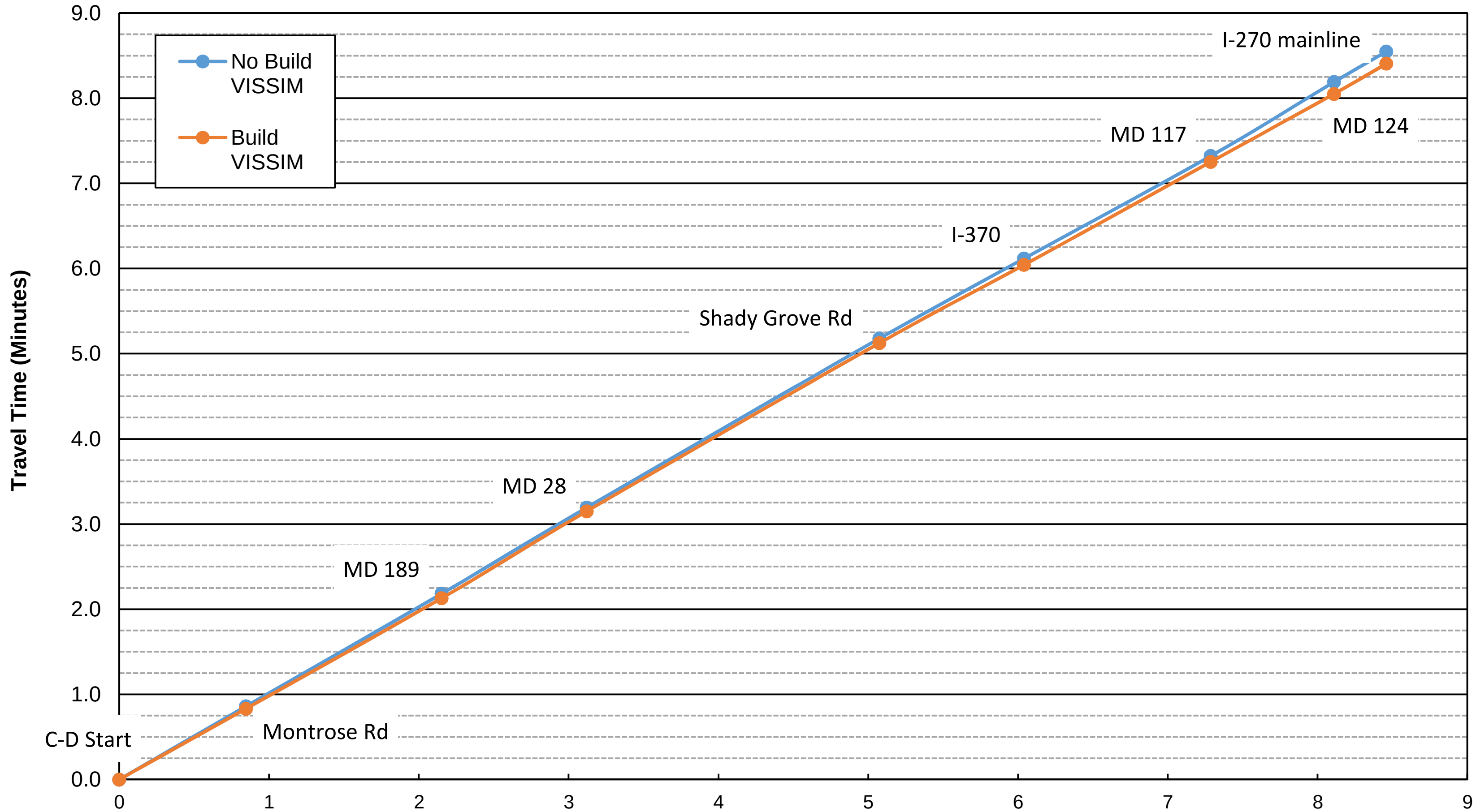
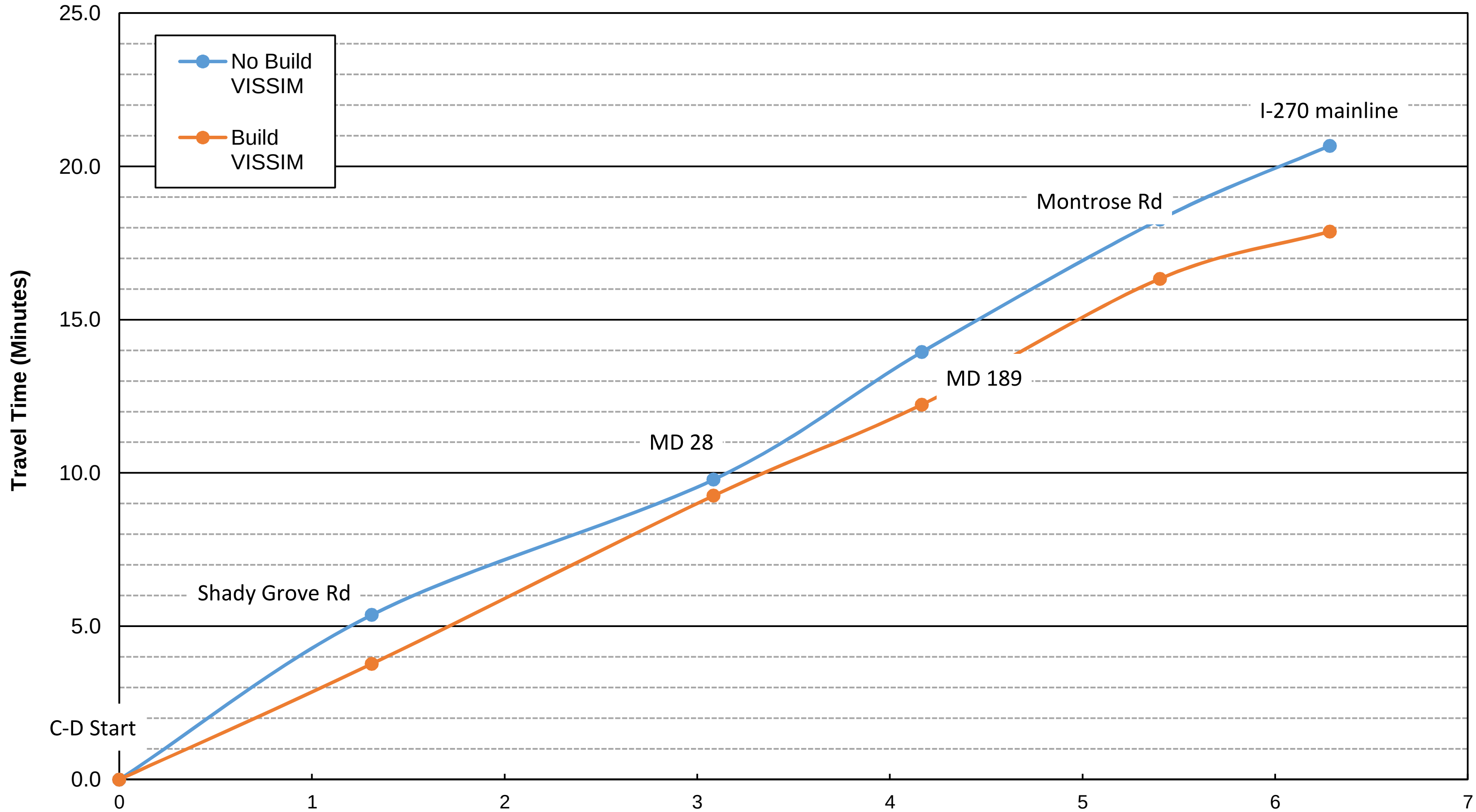


Figure A.5: AM Peak - 2016
I-270 Local Travel Time Graph - Northbound



Miles Along Corridor / *Direction of Traffic Flow* ↑

Figure A.6: AM Peak - 2016
I-270 Local Travel Time Graph - Southbound



Miles Along Corridor / *Direction of Traffic Flow*

Table A.3: AM Peak - 2016 - I-270 Vehicle Speed

I-270 Northbound	No Build VISSIM Speed (MPH)	Build VISSIM Speed (MPH)	% Change	I-270 Southbound	No Build VISSIM Speed (MPH)	Build VISSIM Speed (MPH)	% Change
From I-495 interchange				From I-70			
to MD 187	60.5	60.6	0%	to MD 85	61.7	62.0	0%
to I-270 Split	56.7	60.9	7%	to MD 80	46.5	60.4	30%
to Montrose Rd	63.0	63.2	0%	to MD 109	34.3	43.0	25%
to MD 189	63.3	63.3	0%	to MD 121	47.7	46.6	-2%
to MD 28	62.9	62.8	0%	to MD 27	33.4	50.6	52%
to Shady Grove Rd	63.0	62.7	0%	to MD 118	16.0	50.8	217%
to I-370	64.1	64.1	0%	to Middlebrook Rd	18.9	46.7	147%
to MD 117	63.8	63.8	0%	to MD 124	16.5	51.6	213%
to MD 124	63.9	64.0	0%	to MD 117	21.5	25.5	19%
to Middlebrook Rd	63.6	63.6	0%	to I-370	39.3	43.2	10%
to MD 118	62.3	62.6	0%	to Shady Grove Rd	28.1	44.8	59%
to MD 27	63.6	63.7	0%	to MD 28	15.7	19.3	23%
to MD 121	63.7	63.7	0%	to MD 189	15.5	16.1	4%
to MD 109	62.6	62.6	0%	to Montrose Rd	13.5	12.4	-8%
to MD 80	61.9	62.1	0%	to I-270 Split	26.7	26.9	1%
to MD 85	61.2	61.3	0%	to MD 187	52.3	52.1	0%
to I-70	62.7	62.8	0%	to I-495 interchange	51.7	51.5	0%
I-270 Total (miles/minutes)	**62.4**	**62.6**	**0%**	**I-270 Total (miles/minutes)**	**28.3**	**37.9**	**34%**
I-270 Spur Northbound				**I-270 Spur Southbound**			
From Cabin John Pkwy				From I-70			
to MD 190	60.3	60.3	0%	to I-270 Split	27.4	37.1	36%
to I-495	61.2	61.2	0%	to Democracy Blvd	29.8	51.9	74%
to Democracy Blvd	56.6	56.5	0%	to I-495	25.8	50.6	96%
to I-270 Split	62.9	62.9	0%	to MD 190	48.9	49.4	1%
to I-70	62.7	62.7	0%	to Cabin John Pkwy	58.6	58.4	0%

Table A.4: AM Peak - Existing - I-270 Local Vehicle Speed

I-270 Northbound	No Build VISSIM Speed (MPH)	Build VISSIM Speed (MPH)	% Change	I-270 Southbound	No Build VISSIM Speed (MPH)	Build VISSIM Speed (MPH)	% Change
From C-D start				From C-D start			
to Montrose Rd	59.0	61.0	3%	to Shady Grove	14.6	20.8	42%
to MD 189	59.3	60.5	2%	to MD 28	24.1	19.4	-19%
to MD 28	57.4	56.9	-1%	to MD 189	15.6	21.8	40%
to Shady Grove	59.1	59.4	1%	to Montrose	17.1	18.1	5%
to I-370	61.7	63.1	2%	to I-270 mainline	22.0	34.4	56%
to MD 117	62.1	61.8	0%				
to MD 124	56.8	61.8	9%				
to I-270 mainline	58.9	59.1	0%				

Figure A.7: HCM 2010 Density Level of Service Criteria (pc/mi/ln)

HCM 2010 Freeway LOS	
< 11	A
> 11 - 18	B
> 18 - 26	C
> 26 - 35	D
> 35 - 45	E
> 45	F
HCM 2010 Freeway Merge and Diverge Segment LOS	
< 10	A
> 10 - 20	B
> 20 - 28	C
> 28 - 35	D
> 35 - 40	E
> 40	F
HCM 2010 Freeway Weaving Segment LOS	
< 10	A
> 10 - 20	B
> 20 - 28	C
> 28 - 35	D
> 35 - 40	E
> 40	F
HCM 2010 C-D Weaving Segment LOS	
< 12	A
> 12 - 24	B
> 24 - 32	C
> 32 - 36	D
> 36 - 40	E
> 40	F

Table A.5: AM Peak - 2016 - I-270 Vehicle Density

I-270 Northbound	Type	2016 No Build Density (pc/mi/ln)	2016 No Build LOS	2016 Build Density (pc/mi/ln)	2016 Build LOS	% Change	I-270 Southbound	Type	2016 No Build Density (pc/mi/ln)	2016 No Build LOS	2016 Build Density (pc/mi/ln)	2016 Build LOS	% Change
I-270	Freeway	25	C	25	C	0%	I-270	Freeway	20	C	20	C	-4%
I-270 Diverge to MD 187	Diverge	19	B	15	B	-21%	I-270 Merge from WB I-70	Merge	13	B	13	B	-3%
I-270	Freeway	22	C	22	C	0%	I-270	Freeway	24	C	23	C	-4%
I-270 Diverge to Rockledge Rd	Diverge	19	B	15	B	-21%	I-270 Merge from EB I-70	Merge	20	B	19	B	-2%
I-270	Freeway	19	C	19	C	0%	I-270	Freeway	28	D	27	D	-3%
I-270 Weave from MD 187 to I-270 HOV	Weave	10	B	10	A	-5%	I-270 Diverge to SB MD 85	Diverge	31	D	29	D	-6%
I-270 Lane Drop	Merge	15	B	7	A	-50%	I-270	Freeway	27	D	26	D	-4%
I-270	Freeway	27	D	17	B	-37%	I-270 Diverge to NB MD 85	Diverge	15	B	15	B	-2%
I-270 Merge from I-270 Spur	Merge	24	C	13	B	-44%	I-270	Freeway	23	C	22	C	-4%
I-270 Weave from I-270 HOV to I-270 C-D	Weave	27	C	17	B	-36%	I-270 Merge from MD 85	Merge	14	B	14	B	-4%
I-270	Freeway	23	C	19	C	-17%	I-270	Freeway	36	E	26	D	-27%
I-270 Diverge to C-D (MD 189)	Diverge	21	C	21	C	0%	I-270 Diverge to MD 80	Diverge	39	E	13	B	-68%
I-270	Freeway	18	B	18	B	0%	I-270	Freeway	75	F	30	D	-61%
I-270 Diverge to C-D (MD 28)	Diverge	19	B	19	B	1%	I-270 Merge from MD 80	Merge	85	F	18	B	-79%
I-270	Freeway	15	B	15	B	0%	I-270	Freeway	55	F	43	E	-22%
I-270 Merge from C-D (MD 189)	Merge	18	B	18	B	1%	I-270 Diverge to MD 109	Diverge	33	D	26	C	-22%
I-270 Diverge to C-D (Shady Grove Rd)	Diverge	26	C	28	C	6%	I-270	Freeway	66	F	58	F	-12%
I-270	Freeway	14	B	14	B	0%	I-270 Merge from MD 109	Merge	55	F	42	F	-25%
I-270 Weave from C-D (MD 28) to C-D (Shady Grove Rd)	Weave	13	B	13	B	0%	I-270	Freeway	47	F	45	F	-4%
I-270	Freeway	11	B	11	B	0%	I-270 Diverge to SB Weigh Station	Diverge	19	B	17	B	-12%
I-270 Merge from C-D (Shady Grove Rd)	Merge	10	B	10	B	-1%	I-270	Freeway	39	E	38	E	-4%
I-270	Freeway	13	B	13	B	0%	I-270 Merge from SB Weigh Station	Merge	20	C	18	B	-13%
I-270 Merge from C-D (I-370)	Merge	11	B	11	B	0%	I-270	Freeway	41	E	43	E	5%
I-270 Diverge to C-D (MD 117)	Diverge	16	B	16	B	0%	I-270 Diverge to MD 121	Diverge	20	C	15	B	-24%
I-270	Freeway	13	B	13	B	0%	I-270	Freeway	31	D	26	D	-15%
I-270 Merge from C-D (MD 124)	Merge	14	B	14	B	-2%	I-270 Merge from MD 121	Merge	32	D	20	B	-38%
I-270	Freeway	17	B	16	B	-1%	I-270	Freeway	53	F	33	D	-37%
I-270 Diverge to EB Middlebrook Rd	Diverge	11	B	11	B	-1%	I-270 Diverge to MD 27	Diverge	55	F	20	B	-64%
I-270	Freeway	15	B	15	B	0%	I-270	Freeway	80	F	25	C	-69%
I-270 Diverge to WB Middlebrook Rd	Diverge	10	A	10	A	-1%	I-270 Merge from WB MD 27	Merge	83	F	21	C	-75%
I-270	Freeway	14	B	13	B	-1%	I-270	Freeway	78	F	33	D	-57%
I-270 Diverge to EB MD 118	Diverge	11	B	11	B	-4%	I-270 Weave from EB MD 27 to MD 118	Weave	76	F	23	C	-70%
I-270 Diverge to WB MD 118	Diverge	14	B	14	B	-1%	I-270	Freeway	89	F	32	D	-64%
I-270	Freeway	13	B	13	B	-1%	I-270 Merge from WB MD 118	Merge	70	F	24	C	-66%
I-270 Weave from MD 118 to MD 27	Weave	13	B	12	B	-1%	I-270	Freeway	85	F	41	E	-52%
I-270	Freeway	12	B	12	B	-1%	I-270 Merge from EB MD 118	Merge	70	F	35	D	-51%
I-270 Merge from EB MD 27	Merge	13	B	12	B	-1%	I-270	Freeway	75	F	39	E	-47%
I-270	Freeway	13	B	13	B	0%	I-270 Merge from Middlebrook Rd	Merge	99	F	35	E	-64%
I-270 Merge from WB MD 27	Merge	10	A	10	A	0%	I-270	Freeway	107	F	35	D	-68%
I-270	Freeway	14	B	13	B	0%	I-270 Diverge to MD 124	Diverge	93	F	25	C	-73%
I-270 Diverge to MD 121	Diverge	10	A	10	A	-1%	I-270	Freeway	92	F	41	E	-56%

Table A.5: AM Peak - 2016 - I-270 Vehicle Density

		2016 No Build		2016 Build					2016 No Build		2016 Build		
I-270 Northbound	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**	**I-270 Southbound**	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**
I-270	Freeway	12	B	12	B	0%	I-270 Merge from WB MD 124	Merge	119	F	93	F	-21%
I-270 Merge from EB MD 121	Merge	9	A	9	A	-1%	I-270	Freeway	47	F	49	F	5%
I-270 Lane Drop	Merge	13	B	13	B	-1%	I-270 Merge from MD 117	Merge	46	F	43	F	-8%
I-270	Freeway	18	C	18	C	0%	I-270	Freeway	48	F	38	E	-20%
I-270 Diverge to NB Weigh Station	Diverge	10	A	10	A	-2%	I-270 Diverge to I-370	Diverge	43	F	35	E	-18%
I-270	Freeway	20	C	20	C	0%	I-270	Freeway	51	F	35	D	-31%
I-270 Merge from NB Weight Station	Merge	10	B	10	A	-2%	I-270 Diverge to I-270 C-D	Diverge	81	F	56	F	-30%
I-270	Freeway	20	C	20	C	0%	I-270	Freeway	36	E	16	B	-57%
I-270 Diverge to MD 109	Diverge	11	B	10	B	-2%	I-270 Merge from I-270 (I-370)	Merge	94	F	31	D	-67%
I-270	Freeway	19	C	19	C	-1%	I-270 Diverge to I-270 C-D (Shady Grove Rd)	Diverge	87	F	44	F	-50%
I-270 Merge from MD 109	Merge	10	B	10	A	-2%	I-270	Freeway	90	F	59	F	-35%
I-270	Freeway	20	C	20	C	-1%	I-270 Merge from I-270 C-D (Shady Grove Rd Northern)	Merge	102	F	78	F	-23%
I-270 Diverge to MD 80	Diverge	12	B	11	B	-9%	I-270	Freeway	86	F	67	F	-22%
I-270	Freeway	18	B	18	B	-1%	I-270 Merge from I-270 C-D (Shady Grove Rd Southern)	Merge	107	F	88	F	-18%
I-270 Merge from MD 80	Merge	12	B	12	B	-3%	I-270 Diverge to I-270 C-D (MD 189)	Diverge	89	F	75	F	-16%
I-270	Freeway	22	C	22	C	-1%	I-270	Freeway	100	F	89	F	-11%
I-270 Diverge to Scenic View	Diverge	11	B	11	B	-1%	I-270 Merge from I-270 C-D (MD 189)	Merge	123	F	120	F	-2%
I-270	Freeway	22	C	22	C	-1%	I-270	Freeway	83	F	76	F	-9%
I-270 Merge from Scenic View	Merge	11	B	11	B	0%	I-270 Merge from I-270 C-D	Merge	41	F	39	E	-3%
I-270	Freeway	22	C	22	C	-1%	I-270 Diverge to I-270 HOV Lane	Diverge	21	C	29	D	41%
I-270 Diverge to NB MD 85	Diverge	12	B	13	B	1%	I-270 Diverge to I-270 Spur	Diverge	40	E	34	D	-14%
I-270	Freeway	21	C	21	C	0%	I-270	Freeway	24	C	25	C	8%
I-270 Diverge to SB MD 85	Diverge	16	B	16	B	1%	I-270 Diverge to Rockledge Dr / MD 187	Diverge	16	B	18	B	7%
I-270	Freeway	17	B	17	B	-1%	I-270	Freeway	25	C	26	D	8%
I-270 Weave from MD 85 to I-70	Weave	11	B	11	B	-1%	I-270 Merge from Rockledge Dr	Merge	20	B	20	C	3%
I-270	Freeway	15	B	15	B	-1%	I-270	Freeway	25	C	27	D	8%
							I-270 Merge from Rockledge Dr / MD 187	Merge	22	C	23	C	3%
							I-270	Freeway	27	D	29	D	8%

Table A.6: AM Peak - 2016 - I-270 Spur Vehicle Density

		2016 No Build		2016 Build					2016 No Build		2016 Build		
I-270 Spur Northbound	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**	**I-270 Southbound**	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**
I-270 Spur	Freeway	34	D	34	D	0%	I-270 Spur	Freeway	48	F	28	D	-41%
I-270 Spur Merge from Clara Barton Parkway	Merge	24	C	24	C	0%	I-270 Spur Weave from I-270 HOV to Democracy Blvd	Weave	53	F	30	D	-43%
I-270 Spur	Freeway	37	E	37	E	0%	I-270 Spur	Freeway	52	F	30	D	-43%
I-270 Diverge to MD 190	Diverge	27	C	27	C	0%	I-270 Merge from Democracy Blvd	Merge	28	D	15	B	-47%
I-270 Spur	Freeway	32	D	32	D	0%	I-270 Spur Lane Drop	Merge	52	F	32	D	-38%
I-270 Spur Merge from Cabin John Parkway	Merge	23	C	23	C	0%	I-270 Spur	Freeway	72	F	32	D	-55%
I-270 Spur Merge from MD 190	Merge	23	C	23	C	0%	I-270 Spur Merge from I-495	Merge	37	E	37	E	0%
I-270 Spur	Freeway	30	D	30	D	0%	I-270 Spur	Freeway	39	E	39	E	0%
I-270 Spur Diverge to I-495	Merge	32	D	32	D	-1%	I-270 Spur Diverve to EB MD 190	Diverge	46	F	45	F	-2%
I-270 Spur	Freeway	31	D	31	D	0%	I-270 Spur Diverve to Cabin John Pkwy	Diverge	27	C	28	C	5%
I-270 Spur Diverge to Democracy Blvd	Diverge	25	C	24	C	-1%	I-270 Spur	Freeway	28	D	29	D	3%
I-270 Spur	Freeway	23	C	23	C	0%	I-270 Merge from MD 190	Merge	25	C	26	C	2%
I-270 Spur Merge from EB Democracy Blvd	Merge	15	B	15	B	1%	I-270 Spur	Freeway	33	D	34	D	2%
I-270 Spur	Freeway	23	C	23	C	0%	I-270 Diverge to WB Clara Barton Pkwy	Diverge	22	C	23	C	2%
I-270 Spur Merge from WB Democracy Blvd	Merge	15	B	15	B	0%	I-270 Spur	Freeway	32	D	33	D	2%
I-270 Spur	Freeway	23	C	23	C	0%	I-270 Merge from Clara Barton Pkwy	Merge	28	D	29	D	2%
I-270 Spur Merge from Westlake Terrace	Merge	23	C	23	C	0%							
I-270 Spur	Freeway	24	C	24	C	0%							

Table A.7: AM Peak - 2016 - I-270 Local Vehicle Density

		2016 No Build		2016 Build					2016 No Build		2016 Build		
I-270 Northbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change	I-270 Souhbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change
I-270 C-D	Freeway	33	D	20	C	-39%	I-270 C-D	Freeway	87	F	53	F	-39%
I-270 C-D Diverge to EB Montrose Rd	Diverge	21	C	21	C	0%	I-270 C-D Weave from I-370 EB to I-270	Weave	88	F	58	F	-34%
I-270 C-D	Freeway	19	C	19	C	-1%	I-270 C-D Diverge to Shady Grove Rd	Diverge	53	F	60	F	14%
I-270 C-D Weave between Montrose Rd Loop Ramps	Weave	13	B	14	B	11%	I-270 C-D	Freeway	76	F	89	F	16%
I-270 C-D	Freeway	18	B	18	B	0%	I-270 C-D Merge from WB Shady Grove Rd	Merge	62	F	76	F	24%
I-270 C-D Merge from WB Montrose Rd	Merge	20	B	16	C	-19%	I-270 C-D	Freeway	75	F	100	F	34%
I-270 C-D	Freeway	28	D	26	D	-5%	I-270 C-D Merge from EB Shady Grove Rd	Merge	53	F	71	F	34%
I-270 C-D Merge from I-270	Merge	28	D	28	D	-1%	I-270 C-D	Freeway	68	F	91	F	33%
I-270 C-D	Freeway	29	D	29	D	-1%	I-270 C-D Merge from I-270	Merge	75	F	94	F	25%
I-270 C-D Diverge to MD 189	Diverge	16	B	16	B	-1%	I-270 C-D Diverge to I-270	Diverge	42	F	42	F	0%
I-270 C-D	Freeway	22	C	22	C	0%	I-270 C-D Diverge to I-270	Diverge	29	D	28	C	-3%
I-270 C-D Merge from MD 189	Merge	15	B	16	B	5%	I-270 C-D	Freeway	20	C	20	C	-4%
I-270 C-D	Freeway	29	D	29	D	1%	I-270 C-D Diverge to MD 28	Diverge	13	B	13	B	-2%
I-270 C-D Weave between I-270 (to MD 28 from MD 189)	Weave	28	C	28	C	-1%	I-270 C-D	Freeway	20	C	13	B	-35%
I-270 C-D	Freeway	30	D	30	D	1%	I-270 C-D Merge from WB MD 28	Merge	36	E	12	B	-66%
I-270 C-D Diverge to MD 28	Diverge	21	C	21	C	-1%	I-270 C-D	Freeway	64	F	23	C	-64%
I-270 C-D	Freeway	26	C	25	C	-1%	I-270 C-D Merge from EB MD 28	Merge	134	F	89	F	-33%
I-270 C-D Weave between MD 28 Ramps	Weave	35	D	35	E	0%	I-270 C-D	Freeway	109	F	93	F	-15%
I-270 C-D	Freeway	10	A	10	A	2%	I-270 C-D Merge from I-270	Merge	112	F	106	F	-6%
I-270 C-D Merge from MD 28 WB	Merge	7	A	7	A	2%	I-270 C-D	Freeway	79	F	75	F	-6%
I-270 C-D Merge from I-270 and Drop Lane	Merge	9	A	9	A	1%	I-270 C-D Diverge to MD 189	Diverge	48	F	44	F	-9%
I-270 C-D Diverge to I-270	Diverge	14	B	14	B	0%	I-270 C-D	Freeway	113	F	112	F	-1%
I-270 C-D	Freeway	23	C	23	C	-1%	I-270 C-D Merge from MD 189	Merge	110	F	111	F	1%
I-270 C-D Diverge to Shady Grove Rd	Diverge	19	B	19	B	0%	I-270 C-D Diverge to I-270	Diverge	68	F	68	F	1%
I-270 C-D	Freeway	5	A	5	A	1%	I-270 C-D	Freeway	40	E	26	C	-36%
I-270 C- D Merge from I-270 and EB Shady Grove Rd	Merge	9	A	9	A	0%	I-270 C-D Diverge to WB Montrose Rd	Diverge	26	C	16	B	-38%
I-270 C-D	Freeway	9	A	9	A	0%	I-270 C-D	Freeway	53	F	28	C	-48%
I-270 C-D Merge from WB Shady Grove Rd	Merge	10	B	10	A	-8%	I-270 Weave between Montrose Rd Loops	Weave	61	F	39	C	-36%
I-270 C-D Diverge to I-270	Diverge	15	B	12	B	-23%	I-270 C-D	Freeway	67	F	37	D	-44%
I-270 C-D	Freeway	14	B	9	A	-36%	I-270 C-D Merge from EB Montrose Rd	Merge	54	F	30	C	-44%
I-270 C-D Diverge to I-370	Diverge	13	B	14	B	1%	I-270 C-D	Freeway	59	F	50	F	-15%
I-270 C-D	Freeway	3	A	3	A	2%							
I-270 Merge from I-370 EB	Merge	6	A	6	A	0%							
I-270 C-D	Freeway	7	A	7	A	0%	SB Express HOV (Mile Post 3)	Freeway			28	C	
I-270 C-D Weave from I-370 to I-270	Weave	16	B	16	B	0%	SB Express HOV (Mile Post 5)	Freeway			28	C	
I-270 C-D	Freeway	11	A	11	A	0%	SB Express HOV (Mile Post 8)	Freeway			28	C	
I-270 C-D Weave from I-270 to MD 117	Weave	16	B	17	B	4%	SB Express HOV (Mile Post 9)	Freeway			28	C	
I-270 C-D Diverge to MD 124	Diverge	11	B	9	A	-19%							
I-270 C-D	Freeway	2	A	2	A	2%							
I-270 C-D Merge from EB MD 124	Merge	5	A	5	A	-2%							
I-270 C-D Merge From WB MD 124	Merge	8	A	7	A	-6%							

Table A.8: AM Peak - 2016 - I-270 Vehicle Throughput

I-270 Northbound	No Build VISSIM Throughput	Build VISSIM Throughput	% Change	I-270 Southbound	No Build VISSIM Throughput	Build VISSIM Throughput	% Change
Between I-495 and MD 187	4495	4495	0%	North of I-70	2502	2392	-4%
Between MD 187 on and off ramps	3999	4000	0%	Between I-70 on ramps	2857	2744	-4%
Between Rockledge Blvd on and off ramps	3361	3362	0%	From I-70 interchange to MD-85	4925	4816	-2%
Between Rockledge Dr and I-270 Spur	3094	3093	0%	Between MD-85 on and off ramps	2771	2664	-4%
Between I-270 Spur and Montrose Rd	8311	8304	0%	Between MD-85 and MD-80	3221	3115	-3%
Between Montrose Rd on and off ramps	4705	4697	0%	Between MD-80 on and off ramps	3185	2884	-9%
Between Montrose Rd and MD 189	4376	4372	0%	Between MD-80 and Md-109	3861	3628	-6%
Between MD 189 and MD 28	4381	4373	0%	Between MD-109 on and off ramps	3800	3657	-4%
Between MD 28 on and off ramps	4677	4679	0%	Between MD-109 and MD-121	4257	4159	-2%
Between MD 28 and Shady Grove Rd	3378	3377	0%	Between MD-121 on and off ramps	4043	4003	-1%
Between Shady Grove Rd and I-370	2853	2854	0%	Between MD-121 and MD-27	4694	4870	4%
Between I-370 on and off ramps	3129	3130	0%	Between MD-27 on and off ramps	4342	4772	10%
Between I-370 and MD 117	4195	4195	0%	Between MD-27 and MD-118	4665	5223	12%
Between MD 117 and MD 124	3275	3277	0%	Between MD-118 on and off ramps	4480	5054	13%
Between MD-124 on and off ramps	3278	3275	0%	Between MD-118 and Middlebrook Rd	5032	5630	12%
Between MD 124 and Middlebrook Rd	4082	4060	-1%	Between Middlebrook Rd on and off ramps	5031	5631	12%
Between Middlebrook Rd on and off ramps	3784	3760	-1%	Between Middlebrook Rd and MD-124	6737	7394	10%
Between Middlebrook Rd and MD 118	3344	3329	0%	Between MD-124 on and off ramps	5818	5007	-14%
Between MD-118 on and off ramps	3008	2994	0%	Between MD-124 and MD-117	6930	6097	-12%
Between MD 118 and MD 27	2831	2819	0%	Between MD-117 and I-370	8479	7730	-9%
Between MD-27 on and off ramps	2232	2224	0%	Between I-370 on and off ramps	3024	3011	0%
Between MD 27 and MD 121	2515	2504	0%	Between I-370 on ramp to Shady Grove Rd	4111	4373	6%
Between MD-121 on and off ramps	2211	2213	0%	Between Shady Grove Rd and MD 28	3568	3648	2%
Between MD 121 and MD 109	2420	2405	-1%	Between MD 28 on and off ramps	4420	4521	2%
Between MD-109 on and off ramps	2263	2250	-1%	Between MD 28 and MD 189	3950	4035	2%
Between MD 109 and MD 80	2363	2351	-1%	Between MD 189 and Montrose Rd	3941	4068	3%
Between MD-80 on and off ramps	2126	2119	0%	Between Montrose Rd on and off ramps	4968	5162	4%
Between MD 80 and MD 85	2656	2643	0%	Between Montose Rd and I-270 Spur	8098	8186	1%
Between MD-85 on and off ramps	2016	2005	-1%	Between I-270 Spur and Rockledge Blvd	3901	4078	5%
Between MD 85 and I-70	2858	2846	0%	Between Rockledge Blvd on and off ramps	2845	2915	2%
North of I-70	1832	1824	0%	Between MD 187 on and off ramps	2986	3062	3%
				Between MD 187 and I-495	3083	3222	5%
I-270 Spur Northbound				**I-270 Spur Southbound**			
Between I-495 and Democracy Blvd	5178	5182	0%	Between I-270 Split and HOV on ramp	4233	4301	2%
Between Democracy Blvd on and off ramps	4035	4034	0%	Between HOV on ramp and Democracy Blvd	4165	4299	3%
Between Democracy Blvd and I-270 Split	4304	4297	0%	Between Democracy Blvd on and off ramps	3636	3733	3%
				Between Democracy Blvd and I-495	4140	4267	3%

Table A.9: AM Peak - 2016 - I-270 Local Vehicle Throughput

I-270 Local Northbound	No Build VISSIM Throughput	Build VISSIM Throughput	% Change	I-270 Local Southbound	No Build VISSIM Throughput	Build VISSIM Throughput	% Change
Between Montrose Rd EB off ramp and and EB on ramp	2355	2347	0%	Between I-370 on ramp and I-270 off ramp	4068	4409	8%
Between Montrose Rd EB on ramp and WB off ramp	2567	2563	0%	Between I-270 off ramp and Shady Grove off ramp	2942	3029	3%
Between Montrose Rd WB off ramp and on ramp	2151	2146	0%	Between Shady Grove off ramp and Shady Grove WB on ramp	1759	1667	-5%
Between Montrose Rd WB on ramp and I-270 on ramp	3067	3058	0%	Between Shady Grove WB and EB on ramps	2398	2254	-6%
Between I-270 on ramp and MD 189 off ramp	3387	3382	0%	Between Shady Grove on ramp and I-270 on ramp	2797	2609	-7%
Between MD 189 ramps	2705	2701	0%	Between I-270 on ramp and I-270 off ramp1	3423	3347	-2%
Between MD 189 off ramp and I-270 on ramp	3252	3250	0%	Between I-270 off ramp1 and I-270 off ramp2	2902	2827	-3%
Between I-270 on ramp and I-270 off ramp	3988	3984	0%	Between I-270 off ramp2 and MD 28 off ramp	2031	1940	-4%
Between I-270 off ramp and MD 28 EB off ramp	2948	2951	0%	Between MD 28 off ramp and MD 28 WB on ramp	1466	1336	-9%
Between MD 28 EB off ramp to MD 28 EB on ramp	2599	2599	0%	Between MD 28 WB on ramp and MD 28 EB on ramp	1781	1632	-8%
Between MD 28 EB on ramp and MD 28 WB off ramp	2664	2675	0%	Between MD 28 EB on ramp and I-270 on ramp	2841	2879	1%
Between MD 28 WB off ramp and MD 28 WB on ramp	1160	1169	1%	Between I-270 on ramp and MD 189 off ramp	3310	3364	2%
Between MD 28 WB on ramp and I-270 on ramp	1631	1639	0%	Between MD 189 on and off ramps	2671	2656	-1%
Between I-270 on ramp and I-270 off ramp	2926	2932	0%	Between MD 189 on ramp and I-270 off ramp	3800	3758	-1%
Between I-270 off ramp and Shady Grove off ramp	2518	2527	0%	Between I-270 off ramp and Montrose Rd off ramp	2573	2447	-5%
Between Shady Grove off ramp and I-270 on ramp	321	321	0%	Between Montrose Rd off ramp and Montrose Rd WB on ramp	2455	2319	-6%
Between I-270 on ramp and Shady Grove WB on ramp	1562	1562	0%	Between Montrose Rd WB on ramp and EB off ramp	3375	3222	-5%
Between Shady Grove WB on ramp and I-270 off ramp	1887	1891	0%	Between Montrose Rd EB off and on ramps	2652	2487	-6%
Between I-270 off ramp and I-370 off ramp	1609	1615	0%	Between Montrose Rd EB off ramp and I-270	3384	3223	-5%
Between I-370 off ramp and I-370 EB on ramp	332	334	1%				
Between I-370 EB and WB on ramps	826	828	0%	HOV Express - Northern Terminus	0	1416	
Between I-370 WB on ramp and I-270 off ramp	2397	2399	0%	Local HOV (I-370 to Shady Grove)	1111	89	
Between I-270 off ramp and I-270 on ramp	1334	1335	0%	Local HOV (Shady Grove to MD-28)	1298	461	
Between I-270 on ramp and MD 117 off ramp	2251	2254	0%	Local HOV (MD-28 to MD-189)	1294	462	
Between MD 117 off ramp and MD 124 off ramp	1034	1036	0%	Local HOV (MD-189 to Montrose)	1471	692	
Between MD 124 off ramp and MD 124 EB on ramp	98	100	2%	Local HOV (Montrose to I-270 Split)	1681	903	
Between MD 124 EB and WB on ramps	487	475	-2%	HOV Express - Southern Terminus	0	1393	
Between MD 124 on ramp I-270	815	786	-4%				

Table A.10: AM Peak - 2016 - I-270 On Ramp Queue Length - Northbound

I-270 Northbound	No Build VISSIM Average Queue (feet)	Build VISSIM Average Queue (feet)	% Change / Abs Difference	No Build VISSIM Maximum Queue (feet)	Build VISSIM Maximum Queue (feet)	% Change / Abs Difference
Rockledge Dr on ramp	0	0	0%	0	0	0%
MD 189 C-D on ramp	0	0	0%	0	0	0%
MD 28 C-D on ramp	0	0	0%	0	0	0%
Shady Grove Rd C-D on ramp	0	0	0%	0	0	0%
I-370 C-D on ramp	0	0	0%	0	0	0%
MD 124 C-D on ramp	0	0	0%	0	0	0%
MD 118 on ramp	0	0	0%	0	0	0%
MD 27 EB on ramp	0	0	0%	0	0	0%
MD 27 WB on ramp	0	0	0%	0	0	0%
MD 121 on ramp	0	0	0%	0	0	0%
MD 109 on ramp	0	0	0%	0	0	0%
MD 80 on ramp	0	0	0%	0	0	0%
MD 85 on ramp	0	0	0%	0	0	0%
I-270 Spur Northbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change / Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change / Abs Difference**
Democracy Blvd EB on ramp	0	0	0%	0	0	0%
Democracy Blvd WB on ramp	0	0	0%	0	0	0%
I-495 Northbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change / Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change / Abs Difference**
Cabin John Pkwy on ramp	0	0	0%	0	0	0%
MD 190 on ramp	0	0	0%	0	0	0%
I-270 C-D Northbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change / Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change / Abs Difference**
Montrose Rd EB on ramp	0	0	0%	0	0	0%
Montrose Rd WB on ramp	0	0	0%	0	0	0%
I-270 on ramp	0	0	0%	0	0	0%
MD 189 on ramp	0	0	0%	0	34	34
I-270 on ramp	0	0	0%	0	0	0%
MD 28 EB on ramp	0	0	0%	17	0	-17
MD 28 WB on ramp	0	0	0%	0	0	0%
Shady Grove Rd EB on ramp	0	0	0%	0	0	0%
I-270 on ramp	0	0	0%	0	0	0%
Shady Grove Rd WB on ramp	0	0	0%	0	0	0%
I-370 EB on ramp	0	0	0%	0	0	0%
I-370 WB on ramp	0	0	0%	0	0	0%
I-270 on ramp	0	0	0%	0	0	0%
MD 124 EB on ramp	0	0	0%	0	0	0%
MD 124 WB on ramp	0	0	0%	0	0	0%

Table A.11: AM Peak - 2016 - I-270 Off Ramp Queue Length - Northbound

I-270 Northbound	No Build VISSIM Average Queue (feet)	Build VISSIM Average Queue (feet)	% Change/ Abs Difference	No Build VISSIM Maximum Queue (feet)	Build VISSIM Maximum Queue (feet)	% Change/ Abs Difference
MD 187 off ramp NB	56	69	24%	347	404	17%
MD 187 off ramp SB	87	84	-4%	439	336	-24%
Rockledge Dr off ramp	5	2	-47%	316	186	-41%
Tower Oaks Blvd off ramp	14	15	7%	165	149	-10%
Montrose Rd off ramp EB	0	0	0%	0	0	0%
Montrose Rd off ramp WB	0	0	0%	0	0	0%
MD 189 off ramp WB	11	11	4%	97	109	12%
MD 189 off ramp EB	1	3	2	131	255	95%
MD 28 off ramp EB	48	48	1%	296	303	2%
MD 28 off ramp WB	1	0	-100%	119	0	-100%
Shady Grove Rd off ramp - Redland Blvd	0	0	0%	0	0	0%
Shady Grove Rd off ramp WB	191	188	-2%	620	690	11%
Shady Grove Rd off ramp EB	0	0	0%	0	0	0%
I-370 off ramp WB	0	0	0%	0	0	0%
I-370 off ramp EB	0	0	0%	0	0	0%
MD 117 off ramp	218	266	22%	793	921	16%
MD 124 off ramp	340	139	-59%	957	400	-58%
Watkins Mill Rd off ramp*						
Middlebrook Rd EB off ramp	0	0	0%	0	0	0%
Middlebrook Rd WB off ramp	0	0	0%	0	0	0%
MD 118 WB off ramp - Seneca Meadows	0	0	0%	19	0	-100%
MD 118 WB off ramp	0	0	0%	0	0	0%
MD 118 EB off ramp	0	0	0%	0	0	0%
MD 27 off ramp WB	5	5	-4%	83	78	-6%
MD 27 off ramp EB	0	0	0%	0	0	0%
MD 121 off ramp WB	0	0	-46%	37	36	-2%
MD 121 off ramp EB	0	0	0%	0	0	0%
MD 109 off ramp EB	3	3	0%	97	105	8%
MD 109 off ramp WB	0	0	0%	0	0	0%
MD 80 off ramp EB	5	5	-5%	110	87	-21%
MD 80 off ramp WB	2	0	-100%	34	5	-85%
MD 85 NB off ramp	0	0	0%	0	0	0%
MD 85 SB off ramp	0	0	-45%	66	56	-14%
I-270 Spur Northbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change/ Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change/ Abs Difference**
Clara Barton Pkwy off ramp EB	1	1	-1%	157	157	0%
Clara Barton Pkwy off ramp WB	0	0	0%	0	0	0%
MD 190 off ramp EB	0	0	0%	0	0	0%
MD 190 off ramp WB	0	0	0%	0	0	0%
Democracy Blvd off ramp WB	108	106	-2%	589	596	1%
Democracy Blvd off ramp EB	16	16	-6%	149	114	-23%

* Ramp in Future Scenario

Table A.12: AM Peak - 2016 - I-270 On Ramp Queue Length - Southbound

I-270 Southbound	No Build VISSIM Average Queue (feet)	Build VISSIM Average Queue (feet)	% Change/ Abs Difference	No Build VISSIM Maximum Queue (feet)	Build VISSIM Maximum Queue (feet)	% Change/ Abs Difference
MD 85 on ramp	0	0	0%	0	0	0%
MD 80 on ramp	575	0	-100%	2307	0	-100%
MD 109 on ramp	66	5	-93%	841	139	-84%
MD 121 WB on ramp	8	0	-100%	263	0	-100%
MD 121 EB on ramp*						
MD 27 WB on ramp	145	0	-100%	1297	0	-100%
MD 27 EB on ramp	1	0	-100%	89	0	-100%
MD 118 WB on ramp	0	0	0%	0	0	0%
MD 118 EB on ramp	0	0	-100%	9	0	-100%
Middlebrook Rd on ramp	161	0	-100%	1641	0	-100%
MD 124 WB on ramp	254	1170	916	2615	3014	15%
MD 117 on ramp	94	101	7%	1640	1529	-7%
I-370 C-D on ramp	805	69	-91%	1861	374	-80%
Shady Grove Rd C-D on ramp North	2	2	14%	160	113	-30%
Shady Grove Rd C-D on ramp South	68	31	-55%	927	563	-39%
MD 189 C-D on ramp	1393	2381	71%	3991	5049	26%
Montrose Rd C-D on ramp	2	67	65	246	1055	809
Rockledge Dr on ramp	0	0	0%	0	0	0%
MD 187 on ramp	0	0	0%	0	0	0%
I-270 Spur Southbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change/ Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change/ Abs Difference**
Democracy Blvd on ramp	0	0	0%	0	0	0%
I-495 Southbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change/ Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change/ Abs Difference**
I-270 Spur on ramp	260	3	-99%	1015	188	-81%
MD 190 on ramp	0	0	0%	0	0	0%
I-270 C-D Southbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change/ Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change/ Abs Difference**
I-270 on ramp	2305	1182	-49%	5053	2892	-43%
I-370 on ramp	1241	527	-58%	2914	1766	-39%
Shady Grove Rd WB on ramp	1	1	23%	150	104	-31%
Shady Grove Rd EB on ramp	0	0	-100%	29	0	-100%
I-270 on ramp	0	0	4%	39	28	-26%
MD 28 WB on ramp	6	0	-100%	121	10	-92%
MD 28 EB on ramp	3166	1468	-54%	3877	3511	-9%
I-270 on ramp	0	0	-65%	55	46	-16%
MD 189 on ramp	111	118	6%	1104	941	-15%
Montrose Rd WB on ramp	8	6	-29%	440	284	-36%
Montrose Rd EB on ramp	0	0	-70%	95	46	-52%

* Ramp in Future Scenario

Table A.13: AM Peak - 2016 - I-270 Off Ramp Queue Length - Southbound

I-270 Southbound	No Build VISSIM Average Queue (feet)	Build VISSIM Average Queue (feet)	% Change/ Abs Difference	No Build VISSIM Maximum Queue (feet)	Build VISSIM Maximum Queue (feet)	% Change/ Abs Difference
MD 85 SB off ramp	0	0	0%	0	0	0%
MD 85 NB off ramp	0	0	0%	0	0	0%
MD 80 off ramp	0	0	0%	69	33	-52%
MD 109 off ramp WB	0	0	0%	7	29	309%
MD 109 off ramp EB	0	0	0%	0	0	0%
MD 121 off ramp EB	1	3	67%	93	118	27%
MD 121 off ramp WB	0	0	0%	0	0	0%
MD 27 off ramp EB	53	58	9%	279	256	-8%
MD 27 off ramp WB	45	1	-97%	289	71	-75%
MD 118 off ramp EB	31	34	11%	161	154	-4%
MD 118 off ramp WB	0	0	0%	0	0	0%
Watkins Mill Rd off ramp*						
MD 124 off ramp EB	75	287	212	342	1078	736
MD 124 off ramp WB	18	206	188	405	1055	650
I-370 off ramp WB	0	0	0%	0	0	0%
I-370 off ramp EB	0	0	0%	0	0	0%
Shady Grove Rd off ramp - Omega Drive	6	7	20%	194	204	5%
Shady Grove Rd off ramp	0	0	0%	0	0	0%
MD 28 off ramp	3	4	63%	132	146	10%
MD 189 off ramp EB	40	41	3%	296	287	-3%
MD 189 off ramp WB	0	0	0%	0	0	0%
Montrose Rd off ramp WB	0	0	0%	0	0	0%
Montrose Rd off ramp EB	0	0	0%	0	0	0%
Rockledge Dr off ramp	18	29	59%	261	267	2%
I-270 Spur Southbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change/ Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change/ Abs Difference**
Democracy Blvd off ramp EB	51	56	11%	230	269	17%
Democracy Blvd off ramp WB	0	0	0%	0	0	0%
MD 190 off ramp WB	995	909	-9%	2271	2849	25%
MD 190 off ramp EB	0	0	0%	0	0	0%
Clara Barton Pkwy WB off ramp	0	0	0%	0	0	0%

* Ramp in Future Scenario

Table A.14: AM Peak - 2016 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
1- MD 85 at Sam's Club Drive											
				NB Left	103	76	57	282	E		
	NB	18.8	B	NB Through	312	24	57	282	C		
				NB Right	581	6	6	284	A		
				SB Left	110	57	123	552	E		
	SB	42.4	D	SB Through	535	41	123	552	D		
				SB Right	52	24	123	552	C		
1				EB Left	81	70	42	165	E	33.3	C
	EB	44.4	D	EB Through	47	81	42	165	F		
				EB Right	102	7	42	165	A		
				WB Left	204	72	75	302	E		
	WB	50.7	D	WB Through	12	61	75	302	E		
				WB Right	100	6	75	302	A		
2- MD 85 at I-270 NB on and off ramp											
				NB Left	560	43	155	745	D		
	NB	42.6	D	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB	14.6	B	SB Through	547	15	36	483	B		
				SB Right	0	0	0	0	A		
2				EB Left	0	0	0	0	A	28.8	C
	EB			EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB			WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
3- MD 85 at I-270 SB on and off ramp											
				NB Left	0	0	0	0	A		
	NB	4.3	A	NB Through	812	4	12	316	A		
				NB Right	0	0	0	0	A		
				SB Left	154	41	37	267	D		
	SB	41.3	D	SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
3				EB Left	0	0	0	0	A	10.2	B
	EB			EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB			WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
4- MD 85 at Crestwood Blvd											
				NB Left	10	57	34	262	E		
	NB	15.8	C	NB Through	585	15	34	262	B		
				NB U-Turn	0	0	0	0	A		
				SB Left	57	68	23	146	E		
	SB	13.7	B	SB Through	1657	14	55	477	B		
				SB Right	751	9	43	467	A		
4				EB Left	481	51	70	208	D	19.8	B
	EB	49.1	D	EB Through	19	62	70	208	E		
				EB Right	32	10	70	208	A		
				WB Left	37	56	17	111	E		
	WB	43.1	D	WB Through	15	59	17	111	E		
				WB Right	19	6	17	111	A		
5- MD 80 at I-270 NB on and ramp											
				NB Left	3	0	0	0	A		
	NB	-1.1	A	NB Through	2	0	0	0	A		
				NB Right	4	-2	0	0	A		
				SB Left	183	15	12	115	B		
	SB	12.8	B	SB Through	5	17	12	115	B		
				SB Right	52	4	1	16	A		
5				EB Left	38	8	6	165	A	16.1	B
	EB	7.0	A	EB Through	0	0	8	0	A		
				EB Right	7	4	13	196	A		
				WB Left	31	13	1	48	B		
	WB	17.2	B	WB Through	684	24	94	544	C		
				WB Right	504	8	6	182	A		
6- MD 80 at I-270 SB on and off ramp											
				NB Left	22	25	1	113	C		
	NB	4.1	A	NB Through	0	0	0	0	A		
				NB Right	262	2	1	113	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
6				EB Left	0	0	0	0	A	22.2	C
	EB	23.0	C	EB Through	241	22	26	226	C		
				EB Right	133	25	26	235	D		
				WB Left	0	0	0	0	A		
	WB	47.1	E	WB Through	194	47	126	641	E		
				WB Right	0	0	0	0	A		
7- MD 109 at I-270 NB on and off ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	118	11	7	116	B		
	SB	8.3	A	SB Through	0	0	0	0	A		
				SB Right	38	1	0	0	A		
7				EB Left	59	3	0	36	A	2.5	A
	EB	3.2	A	EB Through	0	0	0	0	A		
				EB Right	40	3	0	0	A		
				WB Left	0	0	0	0	A		
	WB	0.4	A	WB Through	462	0	0	54	A		
				WB Right	0	0	0	0	A		
8- MD 80 at I-270 SB on and off ramp											
				NB Left	15	10	1	65	B		
	NB	2.5	A	NB Through	0	0	0	0	A		
				NB Right	41	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
8				EB Left	0	0	0	0	A	3.5	A
	EB	3.4	A	EB Through	59	0	0	34	A		
				EB Right	70	6	1	34	A		
				WB Left	393	3	8	292	A		
	WB	3.6	A	WB Through	109	5	8	269	A		
				WB Right	0	0	0	0	A		
9- MD 121 at Gateway Center Dr											
				NB Left	95	11	13	147	B		
	NB	8.4	A	NB Through	279	12	13	147	B		
				NB Right	198	2	17	173	A		
				SB Left	47	11	31	312	B		
	SB	16.8	C	SB Through	577	17	41	312	B		
				SB Right	6	13	46	333	B		
9				EB Left	7	37	86	427	D	20.7	C
	EB	33.6	D	EB Through	88	44	93	427	D		
				EB Right	547	32	117	459	C		
				WB Left	96	35	19	123	D		
	WB	30.3	D	WB Through	12	33	19	123	C		
				WB Right	21	7	13	142	A		
10- MD 121 at I-270 NB on and off ramp											
				NB Left	40	10	2	86	A		
	NB	1.7	A	NB Through	0	0	0	0	A		
				NB Right	253	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
10				EB Left	0	0	0	0	A	0.7	A
	EB	0.1	A	EB Through	318	0	0	0	A		
				EB Right	49	0	0	0	A		
				WB Left	151	2	1	87	A		
	WB	0.6	A	WB Through	1070	0	0	58	A		
				WB Right	0	0	0	0	A		

Table A.14: AM Peak - 2016 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
11- MD 121 at I-270 SB on and off ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	123	10	6	120	B		
	SB	7.7	A	SB Through	0	0	0	0	A		
11				SB Right	46	1	0	0	A	1.3	A
				EB Left	25	2	0	35	A		
	EB	0.4	A	EB Through	0	0	0	0	A		
				EB Right	833	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	0.1	A	WB Through	277	0	0	0	A		
				WB Right	0	0	0	0	A		
12- MD 27 at Observation Dr											
				NB U-Turn	0	0	0	0	A		
	NB	48.0	D	NB Through	34	63	10	64	E		
				NB Right	12	7	10	64	A		
				SB Left	75	52	23	142	D		
	SB	40.9	D	SB Through	43	60	30	226	E		
12				SB Right	157	30	52	263	C	19.3	B
				EB Left	149	30	29	290	C		
	EB	13.0	B	EB Through	1202	11	31	291	B		
				EB Right	50	9	38	329	A		
				WB Left	83	15	138	788	B		
	WB	20.1	C	WB Through	2047	21	138	788	C		
				WB Right	94	10	138	788	A		
13- MD 27 at I-270 NB off ramp											
				NB Left	89	31	12	90	C		
	NB	30.7	C	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
13				SB Right	0	0	0	0	A	11.6	B
				EB Left	0	0	0	0	A		
	EB	0.1	A	EB Through	891	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	15.7	B	WB Through	2110	16	194	1341	B		
				WB Right	0	0	0	0	A		
14- MD 27 at I-270 SB off ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	376	50	64	293	D		
	SB	49.6	D	SB Through	0	0	0	0	A		
14				SB Right	0	0	0	0	A	24.7	C
				EB Left	0	0	0	0	A		
	EB	9.0	A	EB Through	657	9	12	192	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	25.5	C	WB Through	1263	25	195	645	C		
				WB Right	0	0	0	0	A		
15- MD 27 at Crystal Rock Dr											
				NB Left	22	18	31	405	B		
	NB	17.8	B	NB Through	819	18	57	405	B		
				NB Right	72	16	60	418	B		
				SB Left	407	69	356	1190	E		
	SB	46.4	D	SB Through	1333	40	356	1190	D		
15				SB Right	40	27	320	1184	C	38.3	D
				EB Left	177	49	47	169	D		
	EB	44.6	D	EB Through	74	49	43	164	D		
				EB Right	60	27	44	196	C		
				WB Left	8	63	85	273	E		
	WB	56.0	E	WB Through	21	302	85	273	F		
				WB Right	104	6	85	273	A		
16- MD 118 at Seneca Meadows Pkwy											
				NB Left	123	10	1	70	A		
	NB	3.4	A	NB Through	727	3	4	119	A		
				NB Right	79	1	8	171	A		
				SB Left	25	5	5	169	A		
	SB	3.7	A	SB Through	808	4	8	169	A		
16				SB Right	32	2	9	202	A	5.5	A
				EB Left	15	64	8	69	E		
	EB	16.9	B	EB Through	6	59	8	69	E		
				EB Right	96	7	8	69	A		
				WB Left	30	65	12	94	E		
	WB	44.2	D	WB Through	5	68	8	94	E		
				WB Right	21	9	11	113	A		
17- MD 118 at I-270 NB on ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
17				SB Right	0	0	0	0	A	11.1	B
				EB Left	222	33	44	277	C		
	EB	33.0	C	EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	6.0	A	WB Through	155	1	0	4	A		
				WB Right	778	7	16	276	A		
18- MD 118 at I-270 SB off ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0.0	0	0	A		
				NB Right	0	0.0	0	0	A		
				SB Left	193	41.5	34	164	D		
	SB	41.5	D	SB Through	0	0.0	0	0	A		
18				SB Right	0	0.0	0	0	A	7.4	A
				EB Left	0	0.0	0	0	A		
	EB	3.1	A	EB Through	615	3.1	4	135	A		
				EB Right	0	0.0	0	0	A		
				WB Left	0	0.0	0	0	A		
	WB	3.6	A	WB Through	1036	3.6	7	209	A		
				WB Right	0	0.0	0	0	A		
19- MD 118 at Aircraft Dr											
				NB Left	7	70	8	75	E		
	NB	45.2	D	NB Through	12	80	8	75	F		
				NB Right	14	3	0	22	A		
				SB Left	241	58	98	368	E		
	SB	60.7	E	SB Through	41	66	98	368	E		
19				SB Right	81	67	98	368	E	18.1	B
				EB Left	102	13	28	310	B		
	EB	10.4	B	EB Through	932	10	28	310	B		
				EB Right	27	9	28	310	A		
				WB Left	73	17	31	246	B		
	WB	11.5	B	WB Through	899	14	31	246	B		
				WB Right	277	4	31	246	A		
20- Middlebrook Rd at Observation Dr											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	22	35	4	44	D		
	SB	18.7	B	SB Through	0	0	0	0	A		
20				SB Right	25	4	4	44	A	16.1	B
				EB Left	240	21	31	226	C		
	EB	14.2	B	EB Through	865	12	31	226	B		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	17.7	B	WB Through	1072	19	69	381	B		
				WB Right	215	13	92	431	B		

Table A.14: AM Peak - 2016 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
21- Middlebrook Rd at I-270 SB on ramp											
21	NB			NB Left	0	0	0	0	A	16.0	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	11.2	B	EB Left	0	0	0	0	A		
				EB Through	805	11	26	186	B		
				EB Right	0	0	0	0	A		
	WB	21.3	C	WB Left	743	21	64	867	C		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
22- Middlebrook Rd at Waring Station Rd											
22	NB	63.1	E	NB Left	147	52	145	449	D	25.3	C
				NB Through	6	52	145	449	D		
				NB Right	342	68	145	449	E		
	SB	21.9	C	SB Left	3	37	1	29	D		
				SB Through	0	0	1	29	A		
				SB Right	3	7	2	67	A		
	EB	18.2	B	EB Left	28	12	124	845	B		
				EB Through	1483	19	124	845	B		
				EB Right	76	10	124	845	A		
	WB	16.1	B	WB Left	78	20	28	213	C		
				WB Through	682	16	28	213	B		
				WB Right	35	4	28	213	A		
23- MD 124 at MD 355											
23	NB	50.5	D	NB Left	229	69	72	198	E	83.6	F
				NB Through	306	42	70	196	D		
				NB Right	37	2	0	0	A		
	SB	33.5	C	SB Left	49	86	121	406	F		
				SB Through	966	50	121	406	D		
				SB Right	619	3	34	375	A		
	EB	99.1	F	EB Left	615	255	1024	1207	F		
				EB Through	528	22	1024	1207	C		
				EB Right	582	5	921	1184	A		
	WB	122.0	F	WB Left	0	0	0	0	A		
				WB Through	1884	123	727	1112	F		
				WB Right	42	68	0	0	E		
24- MD 124 at I-270 SB on and off											
24	NB	65.0	F	NB Left	15	66	15	78	E	22.2	C
				NB Through	29	64	15	78	E		
				NB U-Turn	0	0	0	0	A		
	SB	27.6	C	SB Left	306	67	81	347	E		
				SB Through	4	87	81	347	F		
				SB Right	572	6	13	335	A		
	EB	15.7	B	EB Left	0	0	0	0	A		
				EB Through	904	16	41	321	B		
				EB Right	67	12	50	345	B		
	WB	22.0	C	WB Left	33	27	116	1390	C		
				WB Through	1193	22	116	1390	C		
				WB Right	0	0	0	0	A		
25- MD 117 at MD 124											
25	NB	42.7	D	NB Left	16	65	95	577	E	43.0	D
				NB Through	421	58	95	577	E		
				NB Right	407	26	61	641	C		
	SB	37.8	D	SB Left	181	47	126	605	D		
				SB Through	839	40	126	605	D		
				SB Right	95	2	0	0	A		
	EB	48.4	D	EB Left	80	108	175	722	F		
				EB Through	1383	45	174	723	D		
				EB Right	66	44	187	750	D		
	WB	40.7	D	WB Left	314	73	108	332	E		
				WB Through	480	27	108	332	C		
				WB Right	95	0	0	0	A		
26- MD 117 at Bureau Dr											
26	NB	52.3	D	NB Left	18	70	16	93	E	42.3	D
				NB Through	17	79	16	93	E		
				NB Right	25	21	16	93	C		
	SB	63.4	E	SB Left	191	70	80	297	E		
				SB Through	43	68	80	297	E		
				SB Right	28	13	80	297	B		
	EB	47.0	D	EB Left	28	36	314	962	D		
				EB Through	1928	47	322	962	D		
				EB Right	20	59	315	951	E		
	WB	31.8	C	WB Left	298	93	195	602	F		
				WB Through	852	19	195	603	B		
				WB Right	316	8	169	651	A		
27- MD 117 at I-270 SB off ramp											
27	NB			NB Left	0	0	0	0	A	8.0	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	1.8	A	EB Left	0	0	0	0	A		
				EB Through	799	2	1	180	A		
				EB Right	0	0	0	0	A		
	WB	24.0	C	WB Left	310	24	45	344	C		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
28- MD 117 at I-270 NB off ramp											
28	NB			NB Left	0	0	0	0	A	30.5	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	49.1	D	SB Left	307	54	230	811	D		
				SB Through	0	0	0	0	A		
				SB Right	915	48	236	813	D		
	EB	19.4	B	EB Left	10	111	80	888	F		
				EB Through	782	18	80	888	B		
				EB Right	0	0	0	0	A		
	WB	14.2	B	WB Left	0	0	0	0	A		
				WB Through	860	14	51	343	B		
				WB Right	9	5	55	373	A		
29- MD 117 at Perry Pkwy											
29	NB	42.5	D	NB Left	35	67	14	97	E	13.6	B
				NB Through	6	61	14	96	E		
				NB Right	31	11	23	117	B		
	SB	33.8	C	SB Left	91	72	37	167	E		
				SB Through	13	72	37	167	E		
				SB Right	124	2	37	167	A		
	EB	10.3	B	EB Left	119	69	42	237	E		
				EB Through	957	3	42	237	A		
				EB Right	9	1	29	221	A		
	WB	9.9	A	WB Left	5	87	20	261	F		
				WB Through	709	10	20	261	A		
				WB Right	104	5	20	261	A		
30- Shady Grove Rd at I-270 NB off ramp											
30	NB	9.5	A	NB Left	0	0	0	0	A	24.6	C
				NB Through	917	9	21	216	A		
				NB Right	0	0	0	0	A		
	SB	10.1	B	SB Left	0	0	0	0	A		
				SB Through	1284	10	31	344	B		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	56.8	E	WB Left	1008	57	201	631	E		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table A.14: AM Peak - 2016 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
31- Shady Grove Rd at I-270 SB off ramp											
				NB Left	0	0	0	0	A		
	NB	14.6	B	NB Through	920	15	41	379	B		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB	11.4	B	SB Through	1692	11	46	658	B		
				SB Right	0	0	0	0	A		
31				EB Left	313	37	42	360	D	21.0	C
	EB	44.2	D	EB Through	0	0	0	0	A		
				EB Right	642	48	102	463	D		
				WB Left	0	0	0	0	A		
	WB			WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
32- MD 28 at I-270 SB off ramp											
				NB U-Turn	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	456	44	72	304	D		
	SB	35.9	D	SB Through	0	0	0	0	A		
				SB Right	108	3	0	59	A		
32				EB Left	0	0	0	0	A	32.6	C
	EB	57.4	E	EB Through	1050	87	1521	2131	F		
				EB Right	663	11	1050	2134	B		
				WB Left	0	0	0	0	A		
	WB	9.1	A	WB Through	1879	9	32	405	A		
				WB Right	0	0	0	0	A		
33- MD 28 at I-270 on and off ramps											
				NB Left	0	0	54	306	A		
	NB	34.9	C	NB Through	213	51	62	315	D		
				NB Right	139	11	62	315	B		
				SB Left	25	60	19	169	E		
	SB	21.1	C	SB Through	0	0	0	0	A		
				SB Right	260	17	19	169	B		
33				EB Left	224	28	46	333	C	17.4	B
	EB	15.0	B	EB Through	829	11	46	333	B		
				EB Right	0	0	0	0	A		
				WB Left	22	11	41	286	B		
	WB	12.3	B	WB Through	887	12	29	249	B		
				WB Right	0	0	0	0	A		
34- MD 189 at Great Falls Rd											
				NB Left	62	45	16	111	D		
	NB	40.7	D	NB Through	6	42	13	110	D		
				NB Right	8	8	15	121	A		
				SB Left	66	46	20	162	D		
	SB	5.2	A	SB Through	7	40	20	162	D		
				SB Right	601	0	0	0	A		
34				EB Left	325	16	14	215	B	10.0	B
	EB	10.2	B	EB Through	920	8	18	229	A		
				EB Right	13	6	26	265	A		
				WB Left	3	21	16	184	C		
	WB	12.1	B	WB Through	315	12	16	184	B		
				WB Right	10	9	27	218	A		
35- MD 189 at I-270 Ramps											
				NB Left	133	51	25	119	D		
	NB	50.5	D	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	184	48	54	316	D		
	SB	48.3	D	SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
35				EB Left	384	20	81	458	B	41.6	D
	EB	23.2	C	EB Through	529	26	81	458	C		
				EB Right	0	0	0	0	A		
				WB Left	533	50	137	497	D		
	WB	59.1	E	WB Through	284	76	137	497	E		
				WB Right	0	0	0	0	A		
36- MD 189 at Wooton Pkwy											
				NB Left	129	52	52	178	D		
	NB	43.1	D	NB Through	100	80	52	178	E		
				NB Right	151	12	52	178	B		
				SB Left	385	105	294	792	F		
	SB	91.5	F	SB Through	516	81	218	720	F		
				SB Right	0	0	0	0	A		
36				EB Left	132	75	214	884	E	58.1	E
	EB	48.8	D	EB Through	958	48	214	884	D		
				EB Right	95	23	214	884	C		
				WB Left	423	62	108	314	E		
	WB	42.6	D	WB Through	390	27	108	314	C		
				WB Right	58	5	108	314	A		
37- Montrose Rd at Tower Oaks Blvd											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	126	40	201	957	D		
	SB	106.3	F	SB Through	0	0	0	0	A		
				SB Right	521	122	323	955	F		
37				EB Left	28	16	25	421	B	26.1	C
	EB	7.9	A	EB Through	1424	8	25	421	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	9.2	A	WB Through	1443	9	26	286	A		
				WB Right	62	4	26	286	A		
38- Tower Oaks Blvd at I-270 off rmap											
				NB Left	475	16	25	187	B		
	NB	15.7	B	NB Through	12	17.0	19	179	B		
				NB Right	26	4.9	25	187	A		
				SB Left	2	-0.2	0	16	A		
	SB	0.1	A	SB Through	0	0.0	0	16	A		
				SB Right	2	0.5	0	0	A		
38				EB Left	7	11.4	39	282	B	14.8	B
	EB	14.6	B	EB Through	621	15.1	39	282	B		
				EB Right	91	11.5	32	272	B		
				WB Left	0	0.0	4	71	A		
	WB	11.9	B	WB Through	84	12.6	4	71	B		
				WB Right	7	4.2	0	0	A		
39- Montrose Rd at Tower Oaks Blvd											
				NB Left	26	45	21	127	D		
	NB	9.6	A	NB Through	188	30	21	127	C		
				NB Right	507	0	0	0	A		
				SB Left	297	70	128	520	E		
	SB	38.9	D	SB Through	605	26	127	519	C		
				SB Right	64	18	130	533	B		
39				EB Left	56	123	558	723	F	61.8	E
	EB	144.4	F	EB Through	816	146	559	724	F		
				EB Right	45	147	582	747	F		
				WB Left	362	48	77	299	D		
	WB	39.8	D	WB Through	231	46	77	299	D		
				WB Right	134	7	91	329	A		
40- Rockledge Blvd at I-270 NB on and off ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	85	32	30	146	C		
				NB Right	195	34	30	146	C		
				SB Left	0	0	6	75	A		
	SB	2.3	A	SB Through	986	2	6	75	A		
				SB Right	0	0	0	0	A		
40				EB Left	5	35	109	424	C	16.0	B
	EB	24.3	C	EB Through	501	50	109	424	D		
				EB Right	550	1	0	0	A		
				WB Left	0	0	0	0	A		
	WB			WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table A.14: AM Peak - 2016 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
41- Rockledge Blvd at I-270 SB on and off ramps											
41	NB	2.6	A	NB Left	89	3	1	25	A	20.5	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	21.6	C	WB Left	986	23	98	664	C		
				WB Through	452	19	98	664	B		
				WB Right	0	0	0	0	A		
42- MD 187 at Tuckerman Ln											
42	NB	290.3	F	NB Left	184	172	1149	1512	F	195.3	F
				NB Through	1181	240	1149	1512	F		
				NB Right	143	859	1149	1512	F		
	SB	172.4	F	SB Left	60	147	2547	2696	F		
				SB Through	1511	171	2547	2696	F		
				SB Right	177	192	2547	2696	F		
	EB	65.2	E	EB Left	185	47	206	895	D		
				EB Through	548	73	207	896	E		
				EB Right	135	58	228	920	E		
	WB	203.3	F	WB Left	702	243	1957	2147	F		
				WB Through	354	165	1957	2147	F		
				WB Right	135	100	1957	2147	F		
43- MD 187 at I-270 NB on and off ramps											
43	NB	67.1	E	NB Left	153	90	240	435	F	44.4	D
				NB Through	1250	64	240	435	E		
				NB Right	0	0	0	0	A		
	SB	24.4	C	SB Left	0	0	0	0	A		
				SB Through	1718	24	91	590	C		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	64.9	E	WB Left	120	64	63	355	E		
				WB Through	10	75	63	355	E		
				WB Right	0	0	0	0	A		
44- MD 187 at I-270 NB on and off ramps											
44	NB	131.6	F	NB Left	0	0	0	0	A	62.8	E
				NB Through	1241	132	392	892	F		
				NB Right	0	0	0	0	A		
	SB	7.5	A	SB Left	193	56	63	268	E		
				SB Through	1641	2	63	268	A		
				SB Right	0	0	0	0	A		
	EB	91.6	F	EB Left	190	98	179	700	F		
				EB Through	0	0	179	700	A		
				EB Right	370	88	218	693	F		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
45- MD 187 at Rock Spring Dr											
45	NB	19.7	B	NB Left	192	61	84	380	E	22.2	C
				NB Through	1193	13	84	381	B		
				NB Right	6	16	104	414	B		
	SB	21.0	C	SB Left	12	25	104	666	C		
				SB Through	1837	23	104	666	C		
				SB Right	160	1	74	661	A		
	EB	38.3	D	EB Left	160	64	45	180	E		
				EB Through	22	54	45	180	D		
				EB Right	197	16	45	180	B		
	WB	4.8	A	WB Left	1	14	0	19	B		
				WB Through	8	6	0	19	A		
				WB Right	4	-1	0	0	A		
47-Democracy Blvd at I-270 NB off ramp											
47	NB	31.2	C	NB Left	212	31	26	165	C	14.0	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	13.5	B	EB Left	0	0	0	0	A		
				EB Through	1585	13	52	439	B		
				EB Right	0	0	0	0	A		
	WB	10.1	B	WB Left	0	0	0	0	A		
				WB Through	736	10	21	176	B		
				WB Right	0	0	0	0	A		
48- Democracy Blvd at I-270 SB on ramp											
48	NB			NB Left	0	0	0	0	A	6.3	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	5.0	A	EB Left	0	0	0	0	A		
				EB Through	1691	5	20	274	A		
				EB Right	0	0	0	0	A		
	WB	8.6	A	WB Left	210	37	30	188	D		
				WB Through	733	1	19	167	A		
				WB Right	0	0	0	0	A		
49- Democracy Blvd at I-270 SB off ramp											
49	NB			NB Left	0	0	0	0	A	12.4	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	33.1	C	SB Left	334	49	58	237	D		
				SB Through	0	0	0	0	A		
				SB Right	173	2	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	2.5	A	WB Left	0	0	0	0	A		
				WB Through	732	3	4	112	A		
				WB Right	323	2	0	103	A		
50- MD 190 at Burdette Rd											
50	NB	76.6	E	NB Left	19	69	12	111	E	11.8	B
				NB Through	3	74	12	111	E		
				NB Right	8	95	12	111	F		
	SB	33.2	C	SB Left	41	84	27	151	F		
				SB Through	13	84	27	151	F		
				SB Right	113	9	27	151	A		
	EB	9.6	A	EB Left	47	98	53	454	F		
				EB Through	1709	7	52	453	A		
				EB Right	15	5	42	477	A		
	WB	10.7	B	WB Left	0	87	45	661	F		
				WB Through	1437	11	46	662	B		
				WB Right	18	3	41	702	A		

Table A.14: AM Peak - 2016 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
51- MD 190 at I-270 NB on ramp											
51	NB			NB Left	0	0	0	0	A	37.1	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	81.7	F	EB Left	493	82	233	519	F		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	14.6	B	WB Left	0	0	0	0	A		
				WB Through	975	15	62	601	B		
				WB Right	0	0	0	0	A		
52- MD 190 at I-270 SB off ramp											
52	NB	78.7	E	NB Left	251	79	996	2228	E	14.3	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.9	A	EB Left	0	0	0	0	A		
				EB Through	864	3	6	140	A		
				EB Right	0	0	0	0	A		
	WB	4.8	A	WB Left	0	0	0	0	A		
				WB Through	675	5	6	147	A		
				WB Right	0	0	0	0	A		
53- MD 190 at Seven Locks Rd											
53	NB	66.4	E	NB Left	17	67	16	123	E	43.0	D
				NB Through	44	66	19	123	E		
				NB Right	0	0	0	0	A		
	SB	67.6	E	SB Left	581	67	199	696	E		
				SB Through	145	68	199	696	E		
				SB Right	13	73	198	696	E		
	EB	29.4	C	EB Left	18	25	93	480	C		
				EB Through	781	29	93	480	C		
				EB Right	32	30	93	480	C		
	WB	34.1	C	WB Left	121	113	109	329	F		
				WB Through	642	27	112	331	C		
				WB Right	159	1	2	57	A		
54- MD 124 at I-270 NB off ramp											
54	NB	84.3	F	NB Left	0	0	0	0	A	95.4	F
				NB Through	0	0	0	0	A		
				NB Right	920	84	345	963	F		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	107.9	F	EB Left	0	0	0	0	A		
				EB Through	813	108	473	1086	F		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
55- Democracy Blvd at I-270 NB off ramp											
55	NB	37.9	D	NB Left	0	0	0	0	A	16.9	B
				NB Through	0	0	0	0	A		
				NB Right	926	38	117	601	D		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	4.6	A	EB Left	0	0	0	0	A		
				EB Through	1586	5	18	88	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table A.15: AM Peak - 2016 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
1- MD 85 at Sam's Club Drive											
1	NB	19.9	B	NB Left	102	80	65	384	E	34.7	C
				NB Through	313	25	65	384	C		
				NB Right	579	7	6	338	A		
	SB	44.2	D	SB Left	110	60	132	652	E		
				SB Through	530	43	132	652	D		
				SB Right	52	23	132	652	C		
	EB	44.1	D	EB Left	81	72	44	163	E		
				EB Through	47	76	44	163	E		
				EB Right	102	7	44	163	A		
	WB	52.9	D	WB Left	208	75	78	317	E		
				WB Through	13	63	78	317	E		
				WB Right	100	6	78	317	A		
2- MD 85 at I-270 NB on and off ramp											
2	NB	42.6	D	NB Left	557	43	153	655	D	28.3	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	13.8	B	SB Left	0	0	0	0	A		
				SB Through	546	14	34	472	B		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
3- MD 85 at I-270 SB on and off ramp											
3	NB	4.4	A	NB Left	0	0	0	0	A	10.8	B
				NB Through	812	4	12	324	A		
				NB Right	0	0	0	0	A		
	SB	44.3	D	SB Left	154	44	41	269	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
4- MD 85 at Crestwood Blvd											
4	NB	15.6	C	NB Left	10	57	33	267	E	19.9	B
				NB Through	585	15	33	267	B		
				NB U-Turn	0	0	0	0	A		
	SB	14.0	B	SB Left	58	67	23	151	E		
				SB Through	1655	14	55	429	B		
				SB Right	754	9	44	419	A		
	EB	49.3	D	EB Left	482	52	70	231	D		
				EB Through	19	59	70	231	E		
				EB Right	32	11	70	231	B		
	WB	43.0	D	WB Left	37	56	17	111	E		
				WB Through	15	59	17	111	E		
				WB Right	19	6	17	111	A		
5- MD 80 at I-270 NB on and ramp											
5	NB	-1.3	A	NB Left	3	0	0	0	A	6.5	A
				NB Through	2	0	0	0	A		
				NB Right	5	-3	0	0	A		
	SB	11.7	B	SB Left	183	14	11	93	B		
				SB Through	5	14	11	93	B		
				SB Right	52	2	0	0	A		
	EB	7.2	A	EB Left	37	8	6	115	A		
				EB Through	0	0	8	0	A		
				EB Right	7	5	13	145	A		
	WB	5.6	A	WB Left	31	8	0	32	A		
				WB Through	683	9	26	356	A		
				WB Right	503	1	0	0	A		
6- MD 80 at I-270 SB on and off ramp											
6	NB	2.4	A	NB Left	21	6	0	64	A	6.5	A
				NB Through	0	0	0	0	A		
				NB Right	248	2	0	64	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	8.3	A	EB Left	0	0	0	0	A		
				EB Through	241	9	6	129	A		
				EB Right	133	7	6	137	A		
	WB	8.9	A	WB Left	0	0	0	0	A		
				WB Through	192	9	5	265	A		
				WB Right	0	0	0	0	A		
7- MD 109 at I-270 NB on and off ramp											
7	NB			NB Left	0	0	0	0	A	2.4	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	8.1	A	SB Left	118	10	7	122	B		
				SB Through	0	0	0	0	A		
				SB Right	37	1	0	42	A		
	EB	3.3	A	EB Left	59	3	0	47	A		
				EB Through	0	0	0	0	A		
				EB Right	40	3	0	0	A		
	WB	0.3	A	WB Left	0	0	0	0	A		
				WB Through	462	0	0	0	A		
				WB Right	0	0	0	0	A		
8- MD 80 at I-270 SB on and off ramp											
8	NB	2.2	A	NB Left	14	10	1	72	A	2.0	A
				NB Through	0	0	0	0	A		
				NB Right	42	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.8	A	EB Left	0	0	0	0	A		
				EB Through	59	0	0	30	A		
				EB Right	70	5	0	30	A		
	WB	1.7	A	WB Left	393	1	0	108	A		
				WB Through	109	3	0	85	A		
				WB Right	0	0	0	0	A		
9- MD 121 at Gateway Center Dr											
9	NB	7.8	A	NB Left	95	11	13	141	B	21.1	C
				NB Through	280	11	13	141	B		
				NB Right	198	2	16	167	A		
	SB	16.4	C	SB Left	47	10	33	360	B		
				SB Through	574	17	42	360	B		
				SB Right	6	16	47	381	B		
	EB	35.3	E	EB Left	7	37	94	411	D		
				EB Through	88	43	101	411	D		
				EB Right	550	34	125	443	C		
	WB	31.5	D	WB Left	97	37	20	121	D		
				WB Through	12	32	20	121	C		
				WB Right	21	5	15	142	A		
10- MD 121 at I-270 NB on and off ramp											
10	NB	1.7	A	NB Left	40	10	2	80	A	0.7	A
				NB Through	0	0	0	0	A		
				NB Right	253	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.1	A	EB Left	0	0	0	0	A		
				EB Through	321	0	0	0	A		
				EB Right	49	0	0	0	A		
	WB	0.7	A	WB Left	152	2	1	92	A		
				WB Through	1071	0	0	63	A		
				WB Right	0	0	0	0	A		

Table A.15: AM Peak - 2016 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
11- MD 121 at I-270 SB on and off ramp											
11	NB			NB Left	0	0	0	0	A	1.5	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	8.7	A	SB Left	125	12	8	145	B		
				SB Through	0	0	0	0	A		
				SB Right	48	1	0	0	A		
	EB	0.4	A	EB Left	26	2	0	27	A		
				EB Through	0	0	0	0	A		
				EB Right	835	0	0	0	A		
	WB	0.1	A	WB Left	0	0	0	0	A		
				WB Through	278	0	0	0	A		
				WB Right	0	0	0	0	A		
12- MD 27 at Observation Dr											
12	NB	48.2	D	NB U-Turn	0	0	0	0	A	19.4	B
				NB Through	34	63	10	64	E		
				NB Right	12	7	10	64	A		
	SB	40.8	D	SB Left	75	53	23	142	D		
				SB Through	43	59	30	226	E		
				SB Right	157	30	52	263	C		
	EB	13.3	B	EB Left	154	29	31	289	C		
				EB Through	1243	11	32	290	B		
				EB Right	50	10	40	328	A		
	WB	20.2	C	WB Left	83	15	137	784	B		
				WB Through	2048	21	137	784	C		
				WB Right	94	10	137	784	B		
13- MD 27 at I-270 NB off ramp											
13	NB	30.9	C	NB Left	89	31	12	87	C	7.8	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.1	A	EB Left	0	0	0	0	A		
				EB Through	945	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	10.3	B	WB Left	0	0	0	0	A		
				WB Through	2108	10	153	1328	B		
				WB Right	0	0	0	0	A		
14- MD 27 at I-270 SB off ramp											
14	NB			NB Left	0	0	0	0	A	16.4	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	45.9	D	SB Left	429	46	69	269	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	9.4	A	EB Left	0	0	0	0	A		
				EB Through	655	9	12	196	A		
				EB Right	0	0	0	0	A		
	WB	10.0	A	WB Left	0	0	0	0	A		
				WB Through	1271	10	39	536	A		
				WB Right	0	0	0	0	A		
15- MD 27 at Crystal Rock Dr											
15	NB	18.6	B	NB Left	23	21	33	414	C	33.7	C
				NB Through	817	19	60	416	B		
				NB Right	72	18	63	429	B		
	SB	37.6	D	SB Left	440	62	246	1320	E		
				SB Through	1417	31	246	1320	C		
				SB Right	43	17	211	1314	B		
	EB	44.4	D	EB Left	177	49	47	169	D		
				EB Through	73	50	43	164	D		
				EB Right	60	26	44	196	C		
	WB	56.2	E	WB Left	8	66	85	273	E		
				WB Through	21	302	85	273	F		
				WB Right	104	6	85	273	A		
16- MD 118 at Seneca Meadows Pkwy											
16	NB	3.3	A	NB Left	122	9	1	69	A	5.3	A
				NB Through	756	3	4	132	A		
				NB Right	82	1	8	185	A		
	SB	3.7	A	SB Left	25	5	5	174	A		
				SB Through	808	4	8	174	A		
				SB Right	32	2	9	198	A		
	EB	16.6	B	EB Left	15	62	8	69	E		
				EB Through	6	59	8	69	E		
				EB Right	96	7	8	69	A		
	WB	43.1	D	WB Left	30	63	12	94	E		
				WB Through	5	69	8	93	E		
				WB Right	21	9	11	113	A		
17- MD 118 at I-270 NB on ramp											
17	NB			NB Left	0	0	0	0	A	10.8	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	32.3	C	EB Left	222	32	43	278	C		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	5.7	A	WB Left	0	0	0	0	A		
				WB Through	155	1	0	0	A		
				WB Right	778	7	15	299	A		
18- MD 118 at I-270 SB off ramp											
18	NB			NB Left	0	0	0	0	A	8.2	A
				NB Through	0	0.0	0	0	A		
				NB Right	0	0.0	0	0	A		
	SB	38.8	D	SB Left	229	38.8	37	158	D		
				SB Through	0	0.0	0	0	A		
				SB Right	0	0.0	0	0	A		
	EB	3.6	A	EB Left	0	0.0	0	0	A		
				EB Through	615	3.6	5	159	A		
				EB Right	0	0.0	0	0	A		
	WB	4.2	A	WB Left	0	0.0	0	0	A		
				WB Through	1035	4.2	8	157	A		
				WB Right	0	0.0	0	0	A		
19- MD 118 at Aircraft Dr											
19	NB	45.2	D	NB Left	7	70	8	75	E	18.1	B
				NB Through	12	80	8	75	F		
				NB Right	14	3	0	22	A		
	SB	60.7	E	SB Left	241	58	98	368	E		
				SB Through	41	66	98	368	E		
				SB Right	81	67	98	368	E		
	EB	10.4	B	EB Left	102	13	28	310	B		
				EB Through	932	10	28	310	B		
				EB Right	27	9	28	310	A		
	WB	11.7	B	WB Left	73	19	32	263	B		
				WB Through	915	14	32	263	B		
				WB Right	278	4	32	263	A		
20- Middlebrook Rd at Observation Dr											
20	NB			NB Left	0	0	0	0	A	16.1	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	18.7	B	SB Left	22	35	4	43	D		
				SB Through	0	0	0	0	A		
				SB Right	25	4	4	43	A		
	EB	14.3	B	EB Left	238	21	32	238	C		
				EB Through	864	12	32	238	B		
				EB Right	0	0	0	0	A		
	WB	17.6	B	WB Left	0	0	0	0	A		
				WB Through	1073	18	68	372	B		
				WB Right	214	13	92	421	B		

Table A.15: AM Peak - 2016 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
21- Middlebrook Rd at I-270 SB on ramp											
21	NB			NB Left	0	0	0	0	A	16.1	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	11.3	B	EB Left	0	0	0	0	A		
				EB Through	803	11	26	193	B		
				EB Right	0	0	0	0	A		
	WB	21.4	C	WB Left	744	21	68	858	C		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
22- Middlebrook Rd at Waring Station Rd											
22	NB	63.3	E	NB Left	147	53	146	449	D	25.3	C
				NB Through	6	52	146	449	D		
				NB Right	342	68	146	449	E		
	SB	21.5	C	SB Left	3	37	1	29	D		
				SB Through	0	0	1	29	A		
				SB Right	3	6	2	67	A		
	EB	18.2	B	EB Left	28	12	125	834	B		
				EB Through	1487	19	125	834	B		
				EB Right	76	10	125	834	A		
	WB	15.8	B	WB Left	77	21	28	211	C		
				WB Through	678	16	28	211	B		
				WB Right	34	4	28	211	A		
23- MD 124 at MD 355											
23	NB	51.5	D	NB Left	229	72	72	200	E	91.4	F
				NB Through	306	42	70	198	D		
				NB Right	37	2	0	0	A		
	SB	58.6	E	SB Left	47	97	231	593	F		
				SB Through	924	64	231	593	E		
				SB Right	591	47	145	555	D		
	EB	83.4	F	EB Left	611	214	1094	1215	F		
				EB Through	520	19	1094	1215	B		
				EB Right	580	4	1047	1198	A		
	WB	140.3	F	WB Left	0	0	0	0	A		
				WB Through	1755	142	751	1117	F		
				WB Right	41	75	0	0	E		
24- MD 124 at I-270 SB on and off											
24	NB	65.0	F	NB Left	15	66	15	78	E	45.9	D
				NB Through	29	64	15	78	E		
				NB U-Turn	0	0	0	0	A		
	SB	52.6	D	SB Left	316	135	293	1083	F		
				SB Through	5	110	293	1083	F		
				SB Right	620	10	193	985	A		
	EB	57.7	E	EB Left	0	0	0	0	A		
				EB Through	855	59	203	834	E		
				EB Right	65	35	216	857	C		
	WB	30.3	C	WB Left	31	43	645	1748	D		
				WB Through	1130	30	645	1748	C		
				WB Right	0	0	0	0	A		
25- MD 117 at MD 124											
25	NB	37.4	D	NB Left	16	57	88	549	E	42.4	D
				NB Through	421	54	88	549	D		
				NB Right	408	19	41	506	B		
	SB	37.3	D	SB Left	182	47	122	574	D		
				SB Through	841	39	122	574	D		
				SB Right	95	3	0	0	A		
	EB	47.2	D	EB Left	80	109	171	658	F		
				EB Through	1386	44	170	660	D		
				EB Right	65	43	180	687	D		
	WB	45.2	D	WB Left	318	82	120	391	F		
				WB Through	481	30	120	391	C		
				WB Right	96	0	0	0	A		
26- MD 117 at Bureau Dr											
26	NB	51.4	D	NB Left	18	64	15	90	E	43.3	D
				NB Through	17	76	15	90	E		
				NB Right	25	25	15	90	C		
	SB	61.3	E	SB Left	193	68	77	297	E		
				SB Through	43	63	77	297	E		
				SB Right	28	13	77	297	B		
	EB	48.8	D	EB Left	28	35	306	956	D		
				EB Through	1957	49	314	956	D		
				EB Right	20	61	306	945	E		
	WB	32.3	C	WB Left	296	92	196	633	F		
				WB Through	853	20	196	634	C		
				WB Right	316	9	172	682	A		
27- MD 117 at I-270 SB off ramp											
27	NB			NB Left	0	0	0	0	A	8.0	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.3	A	EB Left	0	0	0	0	A		
				EB Through	808	2	1	159	A		
				EB Right	0	0	0	0	A		
	WB	23.0	C	WB Left	308	23	42	309	C		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
28- MD 117 at I-270 NB off ramp											
28	NB			NB Left	0	0	0	0	A	33.6	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	56.2	E	SB Left	307	57	280	938	E		
				SB Through	0	0	0	0	A		
				SB Right	920	56	285	940	E		
	EB	19.9	B	EB Left	10	122	83	913	F		
				EB Through	789	19	83	913	B		
				EB Right	0	0	0	0	A		
	WB	14.2	B	WB Left	0	0	0	0	A		
				WB Through	860	14	51	349	B		
				WB Right	9	5	55	379	A		
29- MD 117 at Perry Pkwy											
29	NB	44.6	D	NB Left	35	71	15	99	E	13.9	B
				NB Through	6	64	14	98	E		
				NB Right	31	11	25	119	B		
	SB	33.2	C	SB Left	90	72	37	161	E		
				SB Through	13	66	37	161	E		
				SB Right	124	2	37	161	A		
	EB	10.9	B	EB Left	117	75	46	251	E		
				EB Through	961	3	46	251	A		
				EB Right	9	2	32	235	A		
	WB	9.8	A	WB Left	5	82	19	236	F		
				WB Through	709	10	19	236	A		
				WB Right	104	5	19	236	A		
30- Shady Grove Rd at I-270 NB off ramp											
30	NB	9.0	A	NB Left	0	0	0	0	A	24.2	C
				NB Through	949	9	21	264	A		
				NB Right	0	0	0	0	A		
	SB	10.1	B	SB Left	0	0	0	0	A		
				SB Through	1284	10	31	344	B		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	56.5	E	WB Left	1013	56	198	701	E		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table A.15: AM Peak - 2016 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
31- Shady Grove Rd at I-270 SB off ramp											
31	NB	16.6	B	NB Left	0	0	0	0	A	22.5	C
				NB Through	920	17	46	361	B		
				NB Right	0	0	0	0	A		
	SB	12.9	B	SB Left	0	0	0	0	A		
				SB Through	1696	13	53	635	B		
				SB Right	0	0	0	0	A		
	EB	42.9	D	EB Left	344	36	47	403	D		
				EB Through	0	0	0	0	A		
				EB Right	708	46	111	473	D		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
32- MD 28 at I-270 SB off ramp											
32	NB			NB U-Turn	0	0	0	0	A	18.0	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	35.5	D	SB Left	488	43	78	318	D		
				SB Through	0	0	0	0	A		
				SB Right	118	3	0	61	A		
	EB	20.8	C	EB Left	0	0	0	0	A		
				EB Through	1293	29	578	1766	C		
				EB Right	843	9	247	1763	A		
	WB	9.3	A	WB Left	0	0	0	0	A		
				WB Through	1886	9	33	435	A		
				WB Right	0	0	0	0	A		
33- MD 28 at I-270 on and off ramps											
33	NB	35.1	D	NB Left	0	0	54	314	A	19.0	B
				NB Through	210	50	62	323	D		
				NB Right	139	13	62	323	B		
	SB	21.2	C	SB Left	26	63	19	143	E		
				SB Through	0	0	0	0	A		
				SB Right	259	17	19	143	B		
	EB	19.1	B	EB Left	271	34	72	426	C		
				EB Through	985	15	72	426	B		
				EB Right	0	0	0	0	A		
	WB	12.0	B	WB Left	22	11	41	287	B		
				WB Through	887	12	28	250	B		
				WB Right	0	0	0	0	A		
34- MD 189 at Great Falls Rd											
34	NB	40.7	D	NB Left	62	45	16	111	D	10.3	B
				NB Through	6	42	13	110	D		
				NB Right	8	8	15	121	A		
	SB	5.1	A	SB Left	67	45	20	162	D		
				SB Through	7	40	20	162	D		
				SB Right	601	0	0	0	A		
	EB	10.7	B	EB Left	327	16	13	221	B		
				EB Through	924	9	18	210	A		
				EB Right	14	7	27	246	A		
	WB	12.3	B	WB Left	3	18	17	181	B		
				WB Through	315	12	17	181	B		
				WB Right	10	8	27	215	A		
35- MD 189 at I-270 Ramps											
35	NB	48.9	D	NB Left	133	49	25	131	D	41.1	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	48.3	D	SB Left	189	48	55	307	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	24.8	C	EB Left	385	22	88	469	C		
				EB Through	530	27	88	469	C		
				EB Right	0	0	0	0	A		
	WB	56.5	E	WB Left	534	49	129	408	D		
				WB Through	280	72	129	408	E		
				WB Right	0	0	0	0	A		
36- MD 189 at Wooton Pkwy											
36	NB	43.1	D	NB Left	129	50	51	182	D	59.0	E
				NB Through	100	81	51	182	F		
				NB Right	151	11	51	182	B		
	SB	97.9	F	SB Left	384	113	317	747	F		
				SB Through	515	86	251	731	F		
				SB Right	0	0	0	0	A		
	EB	47.6	D	EB Left	131	73	208	834	E		
				EB Through	971	47	208	834	D		
				EB Right	96	22	208	834	C		
	WB	41.9	D	WB Left	431	63	112	359	E		
				WB Through	406	25	112	359	C		
				WB Right	61	5	112	359	A		
37- Montrose Rd at Tower Oaks Blvd											
37	NB			NB Left	0	0	0	0	A	32.2	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	142.0	F	SB Left	125	48	445	947	D		
				SB Through	0	0	0	0	A		
				SB Right	510	165	545	1054	F		
	EB	8.0	A	EB Left	27	20	26	385	B		
				EB Through	1445	8	26	385	A		
				EB Right	0	0	0	0	A		
	WB	9.5	A	WB Left	0	0	0	0	A		
				WB Through	1443	10	27	289	A		
				WB Right	62	4	27	289	A		
38- Tower Oaks Blvd at I-270 off rmap											
38	NB	16.2	B	NB Left	474	17	26	170	B	22.9	C
				NB Through	12	14.4	20	162	B		
				NB Right	26	7.6	26	170	A		
	SB	2.1	A	SB Left	2	3.6	0	16	A		
				SB Through	0	0.0	0	16	A		
				SB Right	2	0.6	0	0	A		
	EB	29.4	C	EB Left	7	22.4	81	309	C		
				EB Through	619	30.0	81	309	C		
				EB Right	90	25.8	74	300	C		
	WB	9.9	A	WB Left	0	0.0	3	72	A		
				WB Through	83	10.3	3	72	B		
				WB Right	6	3.5	0	5	A		
39- Montrose Rd at Tower Oaks Blvd											
39	NB	9.5	A	NB Left	26	44	21	129	D	61.3	E
				NB Through	188	30	21	129	C		
				NB Right	507	0	0	0	A		
	SB	36.9	D	SB Left	298	68	119	479	E		
				SB Through	606	24	118	478	C		
				SB Right	64	16	118	512	B		
	EB	143.9	F	EB Left	57	121	556	719	F		
				EB Through	816	145	557	720	F		
				EB Right	45	146	580	743	F		
	WB	41.0	D	WB Left	362	49	78	277	D		
				WB Through	231	48	78	277	D		
				WB Right	133	7	91	307	A		
40- Rockledge Blvd at I-270 NB on and off ramp											
40	NB			NB Left	0	0	0	0	A	16.9	B
				NB Through	85	33	31	156	C		
				NB Right	195	35	31	156	D		
	SB	2.0	A	SB Left	0	0	5	74	A		
				SB Through	982	2	5	74	A		
				SB Right	0	0	0	0	A		
	EB	25.4	C	EB Left	5	50	128	429	D		
				EB Through	535	52	128	429	D		
				EB Right	595	1	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table A.15: AM Peak - 2016 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
41- Rockledge Blvd at I-270 SB on and off ramps											
41	NB	2.6	A	NB Left	89	3	1	29	A	19.1	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	20.1	C	WB Left	981	21	85	575	C		
				WB Through	449	18	85	575	B		
				WB Right	0	0	0	0	A		
42- MD 187 at Tuckerman Ln											
42	NB	275.0	F	NB Left	180	145	1079	1501	F	187.9	F
				NB Through	1121	229	1079	1501	F		
				NB Right	138	820	1079	1501	F		
	SB	168.3	F	SB Left	60	136	2538	2702	F		
				SB Through	1535	167	2538	2702	F		
				SB Right	178	189	2538	2702	F		
	EB	64.0	E	EB Left	185	47	201	904	D		
				EB Through	548	71	203	905	E		
				EB Right	135	57	223	929	E		
	WB	201.9	F	WB Left	705	242	1941	2155	F		
				WB Through	354	162	1941	2155	F		
				WB Right	135	99	1941	2155	F		
43- MD 187 at I-270 NB on and off ramps											
43	NB	63.5	E	NB Left	141	91	222	424	F	42.7	D
				NB Through	1194	60	222	424	E		
				NB Right	0	0	0	0	A		
	SB	25.2	C	SB Left	0	0	0	0	A		
				SB Through	1739	25	91	628	C		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	62.6	E	WB Left	119	62	76	412	E		
				WB Through	10	66	76	412	E		
				WB Right	0	0	0	0	A		
44- MD 187 at I-270 NB on and off ramps											
44	NB	141.5	F	NB Left	0	0	0	0	A	68.6	E
				NB Through	1162	141	406	814	F		
				NB Right	0	0	0	0	A		
	SB	8.6	A	SB Left	199	59	70	328	E		
				SB Through	1659	3	70	328	A		
				SB Right	0	0	0	0	A		
	EB	114.6	F	EB Left	196	115	267	897	F		
				EB Through	0	0	267	897	A		
				EB Right	387	114	323	891	F		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
45- MD 187 at Rock Spring Dr											
45	NB	34.3	C	NB Left	184	70	161	503	E	27.9	C
				NB Through	1147	29	162	503	C		
				NB Right	6	34	182	536	C		
	SB	21.2	C	SB Left	13	37	108	674	D		
				SB Through	1868	23	108	674	C		
				SB Right	164	1	71	660	A		
	EB	42.5	D	EB Left	157	73	47	179	E		
				EB Through	22	55	47	179	D		
				EB Right	196	17	47	179	B		
	WB	5.0	A	WB Left	1	15	0	19	B		
				WB Through	8	7	0	19	A		
				WB Right	4	-1	0	0	A		
47-Democracy Blvd at I-270 NB off ramp											
47	NB	31.5	C	NB Left	211	32	26	130	C	14.3	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	14.0	B	EB Left	0	0	0	0	A		
				EB Through	1629	14	55	447	B		
				EB Right	0	0	0	0	A		
	WB	10.2	B	WB Left	0	0	0	0	A		
				WB Through	736	10	21	176	B		
				WB Right	0	0	0	0	A		
48- Democracy Blvd at I-270 SB on ramp											
48	NB			NB Left	0	0	0	0	A	6.3	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	5.1	A	EB Left	0	0	0	0	A		
				EB Through	1737	5	21	271	A		
				EB Right	0	0	0	0	A		
	WB	8.6	A	WB Left	211	37	30	188	D		
				WB Through	733	1	19	167	A		
				WB Right	0	0	0	0	A		
49- Democracy Blvd at I-270 SB off ramp											
49	NB			NB Left	0	0	0	0	A	13.3	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	33.3	C	SB Left	371	49	64	276	D		
				SB Through	0	0	0	0	A		
				SB Right	193	2	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	2.7	A	WB Left	0	0	0	0	A		
				WB Through	734	3	4	119	A		
				WB Right	324	2	0	120	A		
50- MD 190 at Burdette Rd											
50	NB	76.6	E	NB Left	19	69	12	111	E	11.9	B
				NB Through	3	74	12	111	E		
				NB Right	8	95	12	111	F		
	SB	33.8	C	SB Left	42	84	28	151	F		
				SB Through	13	84	28	151	F		
				SB Right	113	9	28	151	A		
	EB	9.6	A	EB Left	51	89	53	485	F		
				EB Through	1763	7	51	485	A		
				EB Right	16	5	43	508	A		
	WB	10.9	B	WB Left	0	87	47	704	F		
				WB Through	1435	11	48	704	B		
				WB Right	18	3	42	744	A		

Table A.15: AM Peak - 2016 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
51- MD 190 at I-270 NB on ramp											
51	NB			NB Left	0	0	0	0	A	35.6	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	77.4	E	EB Left	495	77	223	531	E		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	14.4	B	WB Left	0	0	0	0	A		
				WB Through	974	14	64	653	B		
				WB Right	0	0	0	0	A		
52- MD 190 at I-270 SB off ramp											
52	NB	80.2	F	NB Left	266	80	912	2852	F	15.1	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	3.0	A	EB Left	0	0	0	0	A		
				EB Through	863	3	6	133	A		
				EB Right	0	0	0	0	A		
	WB	5.0	A	WB Left	0	0	0	0	A		
				WB Through	675	5	7	160	A		
				WB Right	0	0	0	0	A		
53- MD 190 at Seven Locks Rd											
53	NB	66.4	E	NB Left	17	67	16	123	E	43.3	D
				NB Through	44	66	19	123	E		
				NB Right	0	0	0	0	A		
	SB	68.1	E	SB Left	579	68	201	695	E		
				SB Through	144	69	202	696	E		
				SB Right	13	73	201	696	E		
	EB	29.4	C	EB Left	18	25	93	480	C		
				EB Through	781	29	93	480	C		
				EB Right	32	30	93	480	C		
	WB	34.6	C	WB Left	124	111	110	352	F		
				WB Through	651	28	112	355	C		
				WB Right	162	1	0	10	A		
54- MD 124 at I-270 NB off ramp											
54	NB	66.6	E	NB Left	0	0	0	0	A	121.4	F
				NB Through	0	0	0	0	A		
				NB Right	938	67	144	405	E		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	188.2	F	EB Left	0	0	0	0	A		
				EB Through	769	188	870	1275	F		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
55- Democracy Blvd at I-270 NB off ramp											
55	NB	37.5	D	NB Left	0	0	0	0	A	16.6	B
				NB Through	0	0	0	0	A		
				NB Right	930	38	115	608	D		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	4.6	A	EB Left	0	0	0	0	A		
				EB Through	1627	5	19	96	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table A.16: AM Peak - 2016 - I-270 Vehicle Network Performance

	2016 No Build	2016 Build	% Change
Total Delay (sec.)	21,906,753	14,562,468	-34%
Average Delay per Vehicle (sec.)	227	153	-33%
Total Travel Time (sec.)	51,252,838	44,560,506	-13%
Vehicles (Arrived)	81,275	82,754	2%
Latent Demand	4,969	4,305	-13%
Latent Delay (sec.)	13,122,672	11,728,745	-11%
Total Distance (mi.)	467,210	476,632	2%
Average Speed (mph)	33	39	17%

PM Peak

Table B.1: PM Peak - 2016 - I-270 Vehicle Travel Time

I-270 Northbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Build VISSIM Travel Time (seconds)	% Change	I-270 Southbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Build VISSIM Travel Time (seconds)	% Change
From I-495 interchange					From I-70				
to MD 187	1.8	290.1	120.2	-59%	to MD 85	1.7	92.4	92.4	0%
to I-270 Split	0.6	89.3	37.9	-58%	to MD 80	5.4	301.4	301.2	0%
to Montrose Rd	1.8	113.6	111.8	-2%	to MD 109	3.7	207.9	207.7	0%
to MD 189	1.0	66.0	66.3	1%	to MD 121	3.6	201.4	201.8	0%
to MD 28	1.0	67.1	71.1	6%	to MD 27	2.5	133.7	133.8	0%
to Shady Grove Rd	1.9	123.3	122.0	-1%	to MD 118	1.1	57.6	57.7	0%
to I-370	0.9	61.3	60.6	-1%	to Middlebrook Rd	1.1	60.4	60.5	0%
to MD 117	1.5	145.0	98.5	-32%	to MD 124	2.2	120.9	121.4	0%
to MD 124	0.6	104.3	38.9	-63%	to MD 117	0.9	66.4	68.0	2%
to Middlebrook Rd	2.5	246.0	161.9	-34%	to I-370	1.0	55.8	56.1	1%
to MD 118	1.1	83.6	74.8	-11%	to Shady Grove Rd	1.5	79.7	79.7	0%
to MD 27	0.9	72.2	73.8	2%	to MD 28	1.9	109.5	109.6	0%
to MD 121	2.4	157.6	154.8	-2%	to MD 189	1.0	60.1	60.2	0%
to MD 109	4.1	274.2	274.3	0%	to Montrose Rd	1.0	62.9	62.9	0%
to MD 80	3.7	244.9	242.5	-1%	to I-270 Split	1.9	111.5	111.2	0%
to MD 85	5.3	346.9	346.1	0%	to MD 187	0.4	22.8	22.9	0%
to I-70	1.4	180.2	179.0	-1%	to I-495 interchange	1.9	154.8	155.1	0%
I-270 Total (miles/minutes)	**32.4**	**44.4**	**37.2**	**-16%**	**I-270 Total (miles/minutes)**	**32.6**	**31.7**	**31.7**	**0%**
I-270 Spur Northbound					**I-270 Spur Southbound**				
From Cabin John Pkwy					From I-70				
to MD 190	0.5	105.6	53.1	-50%	to I-270 Split	30.3	1,721.6	1,724.2	0%
to I-495	1.1	259.8	176.8	-32%	to Democracy Blvd	0.7	135.0	39.6	-71%
to Democracy Blvd	1.4	222.8	199.9	-10%	to I-495	1.3	466.2	111.0	-76%
to I-270 Split	0.9	76.3	78.5	3%	to MD 190	1.3	196.3	202.4	3%
to I-70	30.0	2,286.1	2,076.3	-9%	to Cabin John Pkwy	0.6	158.2	158.0	0%
I-270 Spur Total (miles/minutes)	**34.0**	**49.2**	**43.1**	**-12%**	**I-270 Spur Total (miles/minutes)**	**34.2**	**44.6**	**37.3**	**-17%**

Table B.2: PM Peak - 2016 - I-270 Local Vehicle Travel Time

I-270 Northbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Build VISSIM Travel Time (seconds)	% Change	I-270 Southbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Build VISSIM Travel Time (seconds)	% Change
From C-D start					From C-D start				
to Montrose Rd	0.8	59.3	72.7	23%	to Shady Grove	1.3	81.2	81.1	0%
to MD 189	1.3	159.8	190.7	19%	to MD 28	1.8	119.8	119.9	0%
to MD 28	1.0	87.2	85.0	-3%	to MD 189	1.1	77.1	79.2	3%
to Shady Grove	2.0	388.8	125.0	-68%	to Montrose	1.2	86.4	86.6	0%
to I-370	1.0	92.6	63.3	-32%	to I-270 mainline	0.9	59.4	59.4	0%
to MD 117	1.2	88.2	92.5	5%					
to MD 124	0.8	232.8	56.9	-76%					
to I-270 mainline	0.4	91.1	59.1	-35%					
I-270 Local Total (miles/minutes)	**8.5**	**20.0**	**12.4**	**-38%**	**I-270 Local Total (miles/minutes)**	**6.3**	**7.1**	**7.1**	**1%**

Figure B.1: PM Peak - 2016
I-270 Travel Time Graph - Northbound
(From Outer-Loop)

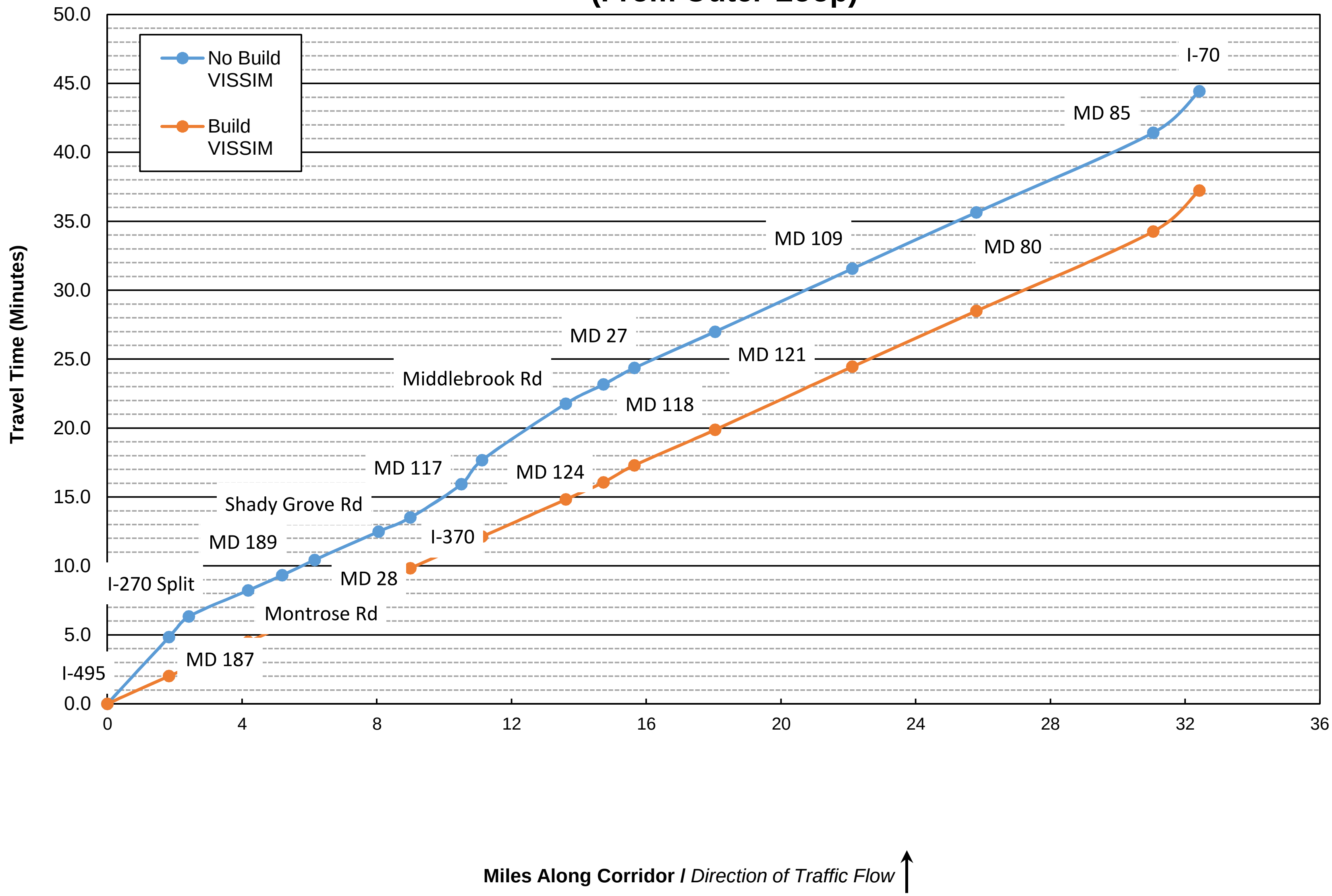


Figure B.2: PM Peak - 2016
I-270 Travel Time Graph - Southbound
(To Inner-Loop)

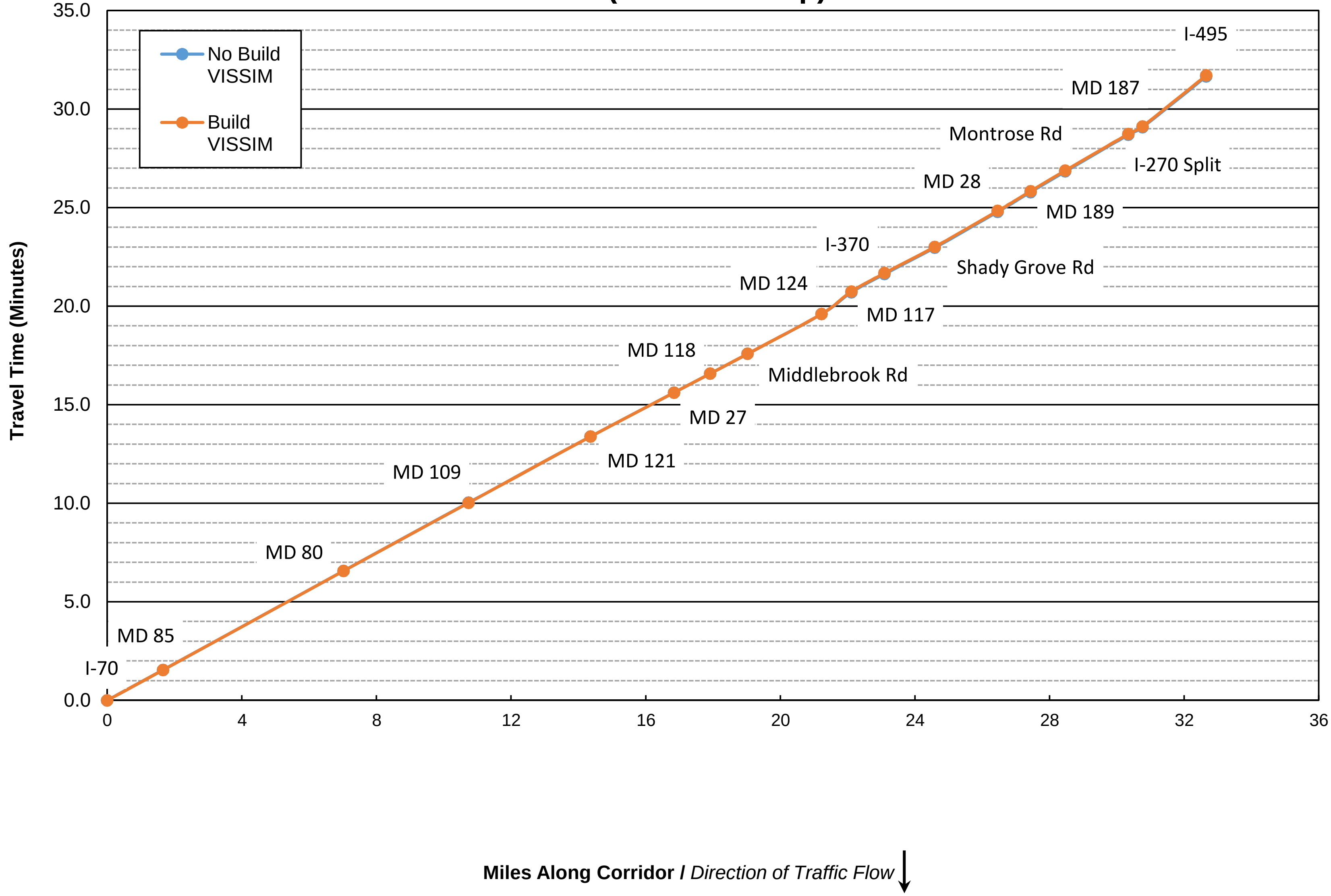
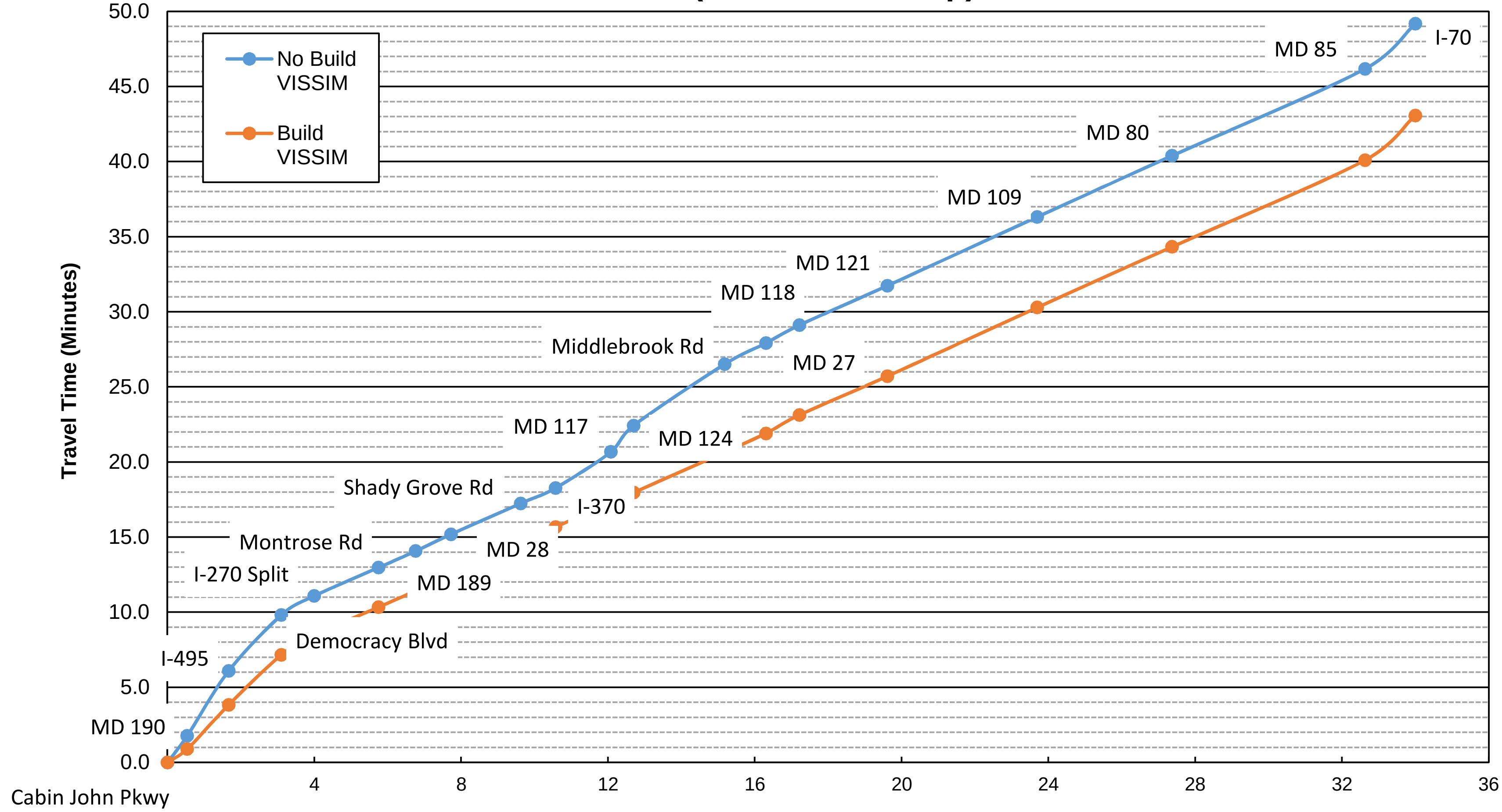
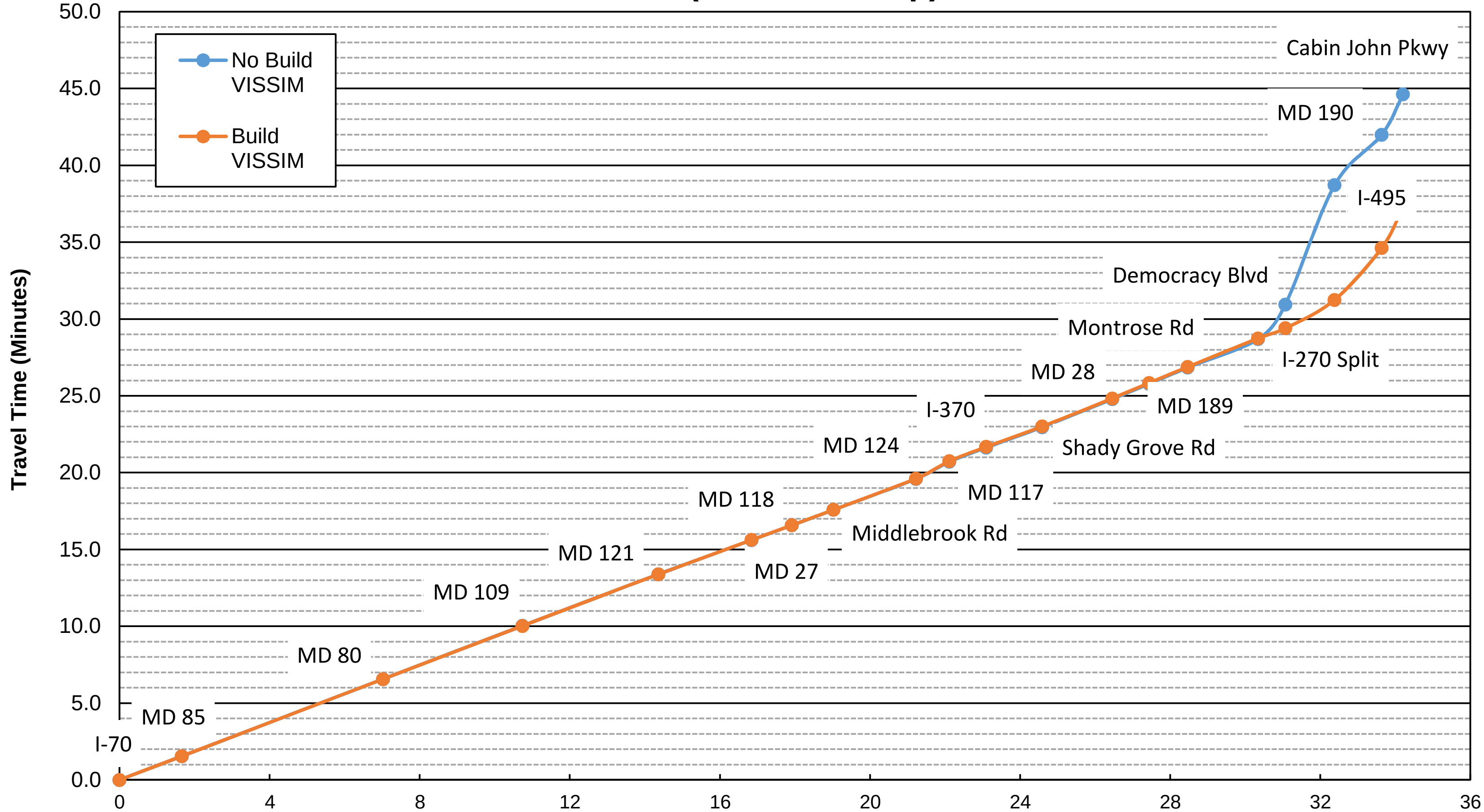


Figure B.3: PM Peak - 2016
I-270 Spur Travel Time Graph - Northbound
(From Inner-Loop)



Miles Along Corridor / *Direction of Traffic Flow*

Figure B4: PM Peak - 2016
I-270 Spur Travel Time Graph - Southbound
(To Outer-Loop)



Miles Along Corridor / *Direction of Traffic Flow*

Figure B.5: PM Peak - 2016
I-270 Local Travel Time Graph - Northbound

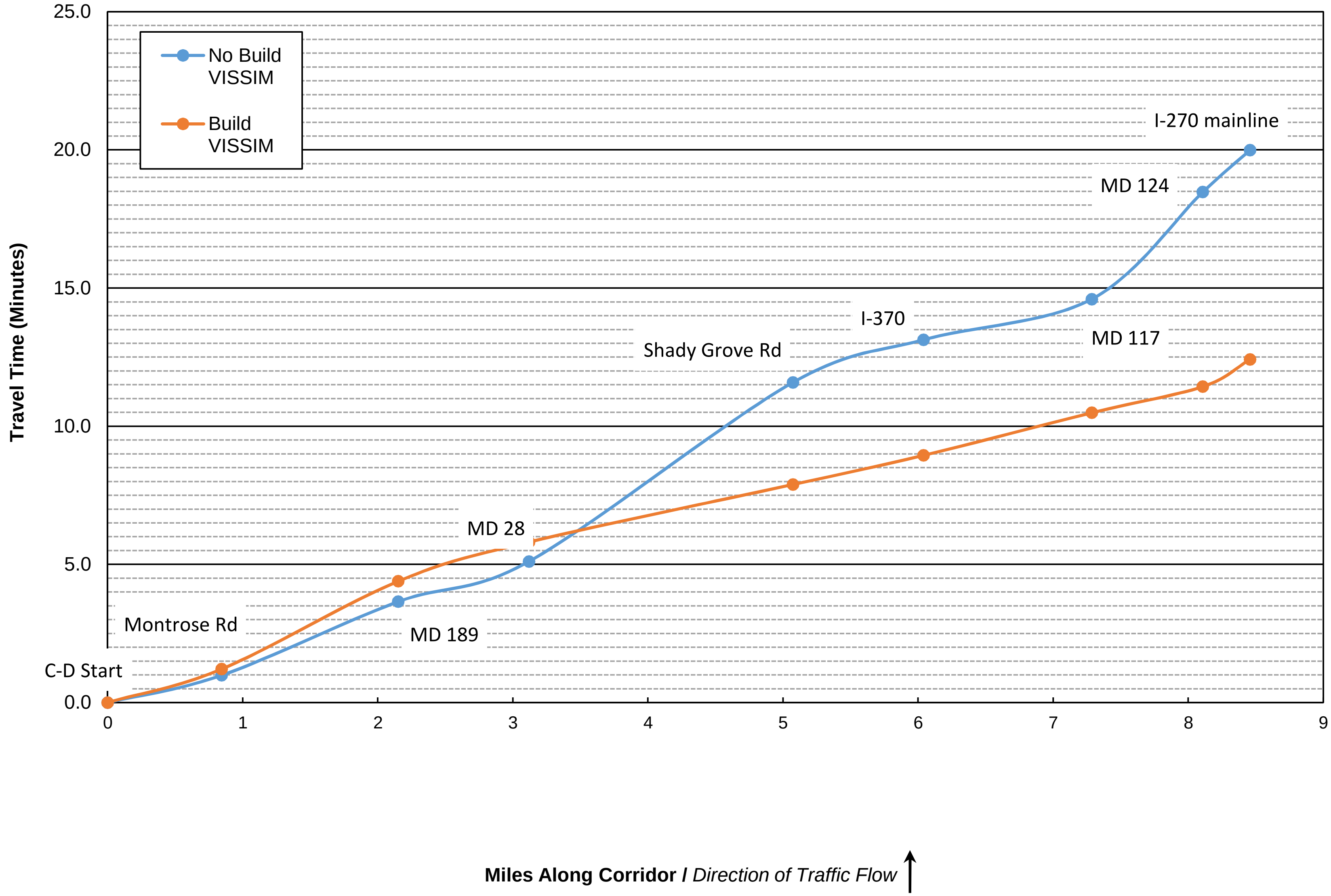


Figure B.6: PM Peak - 2016
I-270 Local Travel Time Graph - Southbound

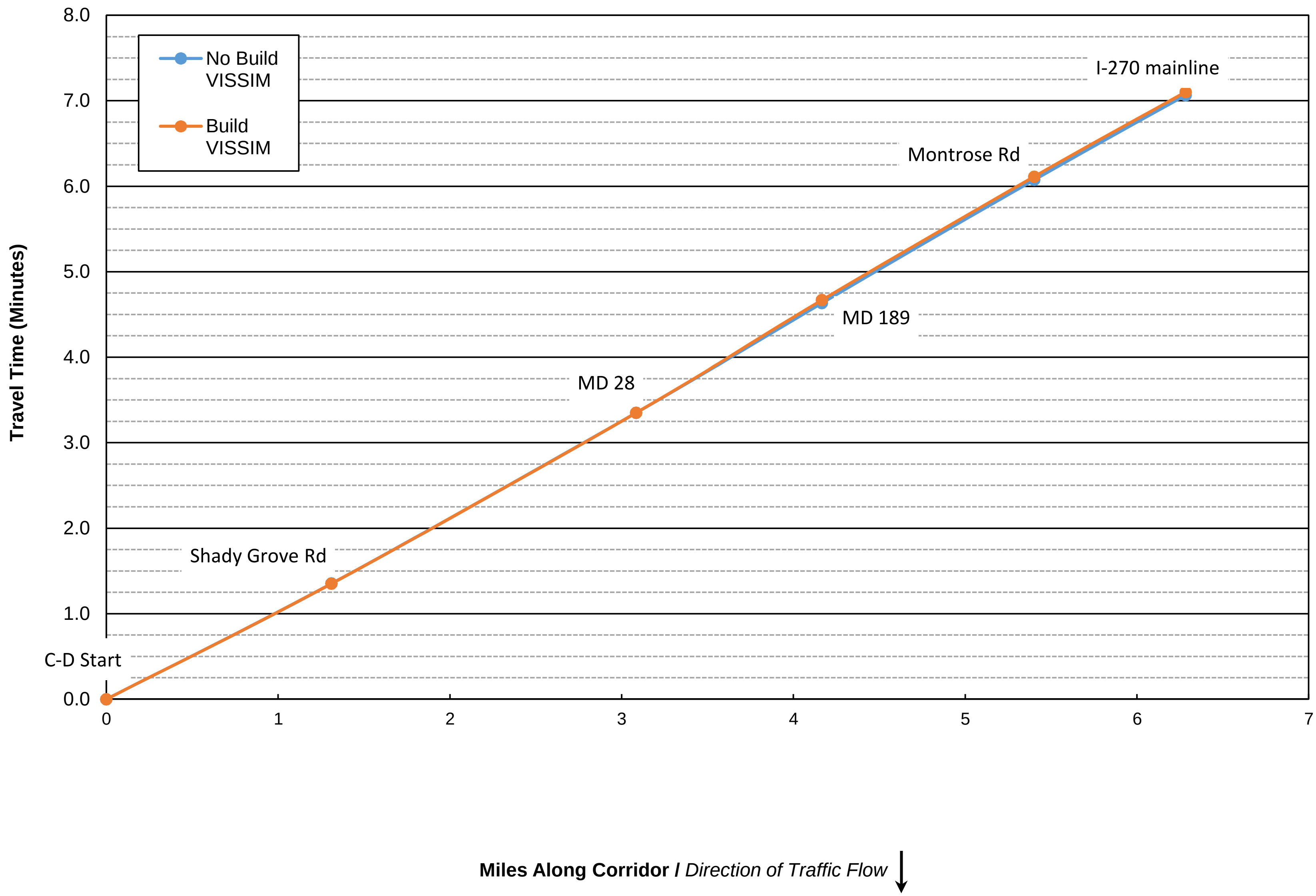


Table B.3: PM Peak - 2016 - I-270 Vehicle Speed

I-270 Northbound	No Build VISSIM Speed (MPH)	Build VISSIM Speed (MPH)	% Change	I-270 Southbound	No Build VISSIM Speed (MPH)	Build VISSIM Speed (MPH)	% Change
From I-495 interchange				From I-70			
to MD 187	22.8	54.9	141%	to MD 85	64.8	64.8	0%
to I-270 Split	23.8	56.1	136%	to MD 80	64.0	64.0	0%
to Montrose Rd	55.6	56.5	2%	to MD 109	64.4	64.5	0%
to MD 189	55.3	55.0	-1%	to MD 121	64.7	64.6	0%
to MD 28	51.8	48.8	-6%	to MD 27	66.9	66.9	0%
to Shady Grove Rd	55.4	56.0	1%	to MD 118	67.0	66.9	0%
to I-370	55.5	56.1	1%	to Middlebrook Rd	66.2	66.1	0%
to MD 117	37.6	55.4	47%	to MD 124	65.4	65.1	0%
to MD 124	21.1	56.6	168%	to MD 117	48.1	47.0	-2%
to Middlebrook Rd	36.4	55.3	52%	to I-370	63.6	63.2	-1%
to MD 118	48.3	54.0	12%	to Shady Grove Rd	67.2	67.2	0%
to MD 27	45.7	44.6	-2%	to MD 28	61.6	61.5	0%
to MD 121	54.7	55.7	2%	to MD 189	58.6	58.5	0%
to MD 109	53.5	53.5	0%	to Montrose Rd	59.1	59.1	0%
to MD 80	54.1	54.6	1%	to I-270 Split	60.4	60.6	0%
to MD 85	54.5	54.7	0%	to MD 187	66.4	66.2	0%
to I-70	27.4	27.6	1%	to I-495 interchange	44.0	43.9	0%
I-270 Total (miles/minutes)	**43.8**	**52.2**	**19%**	**I-270 Total (miles/minutes)**	**61.9**	**61.8**	**0%**
I-270 Spur Northbound				**I-270 Spur Southbound**			
From Cabin John Pkwy				From I-70			
to MD 190	18.4	36.5	99%	to I-270 Split	63.4	63.3	0%
to I-495	15.7	23.1	47%	to Democracy Blvd	19.5	66.4	241%
to Democracy Blvd	23.2	25.8	11%	to I-495	10.1	42.5	320%
to I-270 Split	42.1	40.9	-3%	to MD 190	23.0	22.3	-3%
to I-70	47.2	52.0	10%	to Cabin John Pkwy	13.0	13.0	0%

Table B.4: PM Peak - 2016 - I-270 Local Vehicle Speed

I-270 Northbound	No Build VISSIM Speed (MPH)	Build VISSIM Speed (MPH)	% Change	I-270 Southbound	No Build VISSIM Speed (MPH)	Build VISSIM Speed (MPH)	% Change
From C-D start				From C-D start			
to Montrose Rd	51.3	41.9	-18%	to Shady Grove	58.1	58.2	0%
to MD 189	29.4	24.7	-16%	to MD 28	53.3	53.3	0%
to MD 28	40.0	41.0	3%	to MD 189	50.5	49.2	-3%
to Shady Grove	18.1	56.3	211%	to Montrose	51.4	51.3	0%
to I-370	37.5	54.9	46%	to I-270 mainline	53.5	53.4	0%
to MD 117	50.9	48.5	-5%				
to MD 124	12.7	52.0	309%				
to I-270 mainline	13.8	21.3	54%				

Figure B.7: HCM 2010 Density Level of Service Criteria (pc/mi/ln)

HCM 2010 Freeway LOS	
< 11	A
> 11 - 18	B
> 18 - 26	C
> 26 - 35	D
> 35 - 45	E
> 45	F
HCM 2010 Freeway Merge and Diverge Segment LOS	
< 10	A
> 10 - 20	B
> 20 - 28	C
> 28 - 35	D
> 35 - 40	E
> 40	F
HCM 2010 Freeway Weaving Segment LOS	
< 10	A
> 10 - 20	B
> 20 - 28	C
> 28 - 35	D
> 35 - 40	E
> 40	F
HCM 2010 C-D Weaving Segment LOS	
< 12	A
> 12 - 24	B
> 24 - 32	C
> 32 - 36	D
> 36 - 40	E
> 40	F

Table B.5: PM Peak - 2016 - I-270 Vehicle Density

		2016 No Build		2016 Build					2016 No Build		2016 Build		
I-270 Northbound	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**	**I-270 Southbound**	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**
I-270	Freeway	47	F	27	D	-42%	I-270	Freeway	16	B	16	B	0%
I-270 Diverge to MD 187	Diverge	69	F	16	B	-77%	I-270 Merge from WB I-70	Merge	13	B	13	B	0%
I-270	Freeway	73	F	25	C	-66%	I-270	Freeway	19	C	19	C	0%
I-270 Diverge to Rockledge Rd	Diverge	69	F	16	B	-77%	I-270 Merge from EB I-70	Merge	14	B	14	B	0%
I-270	Freeway	82	F	23	C	-71%	I-270	Freeway	18	C	18	C	0%
I-270 Weave from MD 187 to I-270 HOV	Weave	56	F	15	B	-74%	I-270 Diverge to SB MD 85	Diverge	19	B	19	B	0%
I-270 Lane Drop	Merge	65	F	9	A	-86%	I-270	Freeway	20	C	20	C	0%
I-270	Freeway	51	F	22	C	-56%	I-270 Diverge to NB MD 85	Diverge	12	B	12	B	0%
I-270 Merge from I-270 Spur	Merge	37	E	21	C	-43%	I-270	Freeway	16	B	16	B	0%
I-270 Weave from I-270 HOV to I-270 C-D	Weave	33	D	22	C	-32%	I-270 Merge from MD 85	Merge	14	B	14	B	0%
I-270	Freeway	32	D	25	C	-22%	I-270	Freeway	21	C	21	C	0%
I-270 Diverge to C-D (MD 189)	Diverge	37	E	31	D	-17%	I-270 Diverge to MD 80	Diverge	13	B	13	B	-3%
I-270	Freeway	32	D	27	D	-17%	I-270	Freeway	17	B	17	B	-1%
I-270 Diverge to C-D (MD 28)	Diverge	38	E	46	F	19%	I-270 Merge from MD 80	Merge	11	B	10	A	-11%
I-270	Freeway	30	D	25	C	-15%	I-270	Freeway	20	C	20	C	0%
I-270 Merge from C-D (MD 189)	Merge	41	F	42	F	1%	I-270 Diverge to MD 109	Diverge	10	B	10	A	0%
I-270 Diverge to C-D (Shady Grove Rd)	Diverge	42	F	41	F	-3%	I-270	Freeway	19	C	19	C	0%
I-270	Freeway	30	D	24	C	-17%	I-270 Merge from MD 109	Merge	11	B	11	B	0%
I-270 Weave from C-D (MD 28) to C-D (Shady Grove Rd)	Weave	32	D	29	D	-10%	I-270	Freeway	20	C	20	C	0%
I-270	Freeway	26	D	21	C	-19%	I-270 Diverge to SB Weigh Station	Diverge	10	B	10	B	0%
I-270 Merge from C-D (Shady Grove Rd)	Merge	21	C	16	B	-24%	I-270	Freeway	20	C	20	C	1%
I-270	Freeway	33	D	21	C	-37%	I-270 Merge from SB Weigh Station	Merge	10	B	10	B	0%
I-270 Merge from C-D (I-370)	Merge	32	D	20	B	-39%	I-270	Freeway	19	C	19	C	0%
I-270 Diverge to C-D (MD 117)	Diverge	53	F	26	C	-51%	I-270 Diverge to MD 121	Diverge	7	A	7	A	0%
I-270	Freeway	74	F	23	C	-69%	I-270	Freeway	12	B	12	B	0%
I-270 Merge from C-D (MD 124)	Merge	101	F	22	C	-78%	I-270 Merge from MD 121	Merge	9	A	9	A	0%
I-270	Freeway	36	E	29	D	-20%	I-270	Freeway	14	B	14	B	0%
I-270 Diverge to EB Middlebrook Rd	Diverge	28	D	23	C	-18%	I-270 Diverge to MD 27	Diverge	10	A	9	A	0%
I-270	Freeway	34	D	28	D	-17%	I-270	Freeway	12	B	12	B	0%
I-270 Diverge to WB Middlebrook Rd	Diverge	30	D	26	C	-15%	I-270 Merge from WB MD 27	Merge	11	B	11	B	0%
I-270	Freeway	27	D	23	C	-17%	I-270	Freeway	15	B	15	B	0%
I-270 Diverge to EB MD 118	Diverge	24	C	17	B	-29%	I-270 Weave from EB MD 27 to MD 118	Weave	12	B	12	B	0%
I-270 Diverge to WB MD 118	Diverge	42	F	21	C	-49%	I-270	Freeway	14	B	14	B	0%
I-270	Freeway	33	D	23	C	-28%	I-270 Merge from WB MD 118	Merge	12	B	12	B	0%
I-270 Weave from MD 118 to MD 27	Weave	46	F	44	F	-5%	I-270	Freeway	17	B	17	B	0%
I-270	Freeway	26	D	20	C	-25%	I-270 Merge from EB MD 118	Merge	15	B	15	B	0%
I-270 Merge from EB MD 27	Merge	46	F	44	F	-5%	I-270	Freeway	20	C	20	C	0%
I-270	Freeway	26	C	19	C	-26%	I-270 Merge from Middlebrook Rd	Merge	21	C	21	C	0%
I-270 Merge from WB MD 27	Merge	20	C	12	B	-39%	I-270	Freeway	21	C	21	C	0%
I-270	Freeway	27	D	20	C	-26%	I-270 Diverge to MD 124	Diverge	18	B	19	C	3%
I-270 Diverge to MD 121	Diverge	21	C	14	B	-34%	I-270	Freeway	22	C	23	C	4%

Table B.5: PM Peak - 2016 - I-270 Vehicle Density

		2016 No Build		2016 Build					2016 No Build		2016 Build		
I-270 Northbound	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**	**I-270 Southbound**	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**
I-270	Freeway	22	C	18	B	-20%	I-270 Merge from WB MD 124	Merge	44	F	46	F	5%
I-270 Merge from EB MD 121	Merge	16	B	16	B	-2%	I-270	Freeway	21	C	21	C	1%
I-270 Lane Drop	Merge	27	C	27	C	1%	I-270 Merge from MD 117	Merge	25	C	25	C	2%
I-270	Freeway	40	E	33	D	-17%	I-270	Freeway	21	C	21	C	1%
I-270 Diverge to NB Weigh Station	Diverge	17	B	17	B	0%	I-270 Diverge to I-370	Diverge	19	B	19	B	0%
I-270	Freeway	35	D	35	D	0%	I-270	Freeway	16	B	16	B	0%
I-270 Merge from NB Weight Station	Merge	17	B	18	B	1%	I-270 Diverge to I-270 C-D	Diverge	13	B	13	B	-1%
I-270	Freeway	36	E	36	E	-1%	I-270	Freeway	13	B	13	B	0%
I-270 Diverge to MD 109	Diverge	20	B	20	B	0%	I-270 Merge from I-270 (I-370)	Merge	18	B	18	B	0%
I-270	Freeway	33	D	33	D	0%	I-270 Diverge to I-270 C-D (Shady Grove Rd)	Diverge	22	C	22	C	0%
I-270 Merge from MD 109	Merge	17	B	17	B	2%	I-270	Freeway	17	B	17	B	0%
I-270	Freeway	34	D	34	D	-2%	I-270 Merge from I-270 C-D (Shady Grove Rd Northern)	Merge	16	B	16	B	1%
I-270 Diverge to MD 80	Diverge	24	C	21	C	-13%	I-270	Freeway	22	C	22	C	0%
I-270	Freeway	29	D	28	D	-3%	I-270 Merge from I-270 C-D (Shady Grove Rd Southern)	Merge	17	B	17	B	1%
I-270 Merge from MD 80	Merge	16	B	15	B	-6%	I-270 Diverge to I-270 C-D (MD 189)	Diverge	23	C	23	C	1%
I-270	Freeway	33	D	33	D	-1%	I-270	Freeway	20	C	20	C	0%
I-270 Diverge to Scenic View	Diverge	17	B	17	B	0%	I-270 Merge from I-270 C-D (MD 189)	Merge	18	B	19	B	0%
I-270	Freeway	33	D	33	D	-2%	I-270	Freeway	24	C	24	C	0%
I-270 Merge from Scenic View	Merge	17	B	17	B	-1%	I-270 Merge from I-270 C-D	Merge	20	C	18	B	-10%
I-270	Freeway	33	D	33	D	-2%	I-270 Diverge to I-270 HOV Lane	Diverge	17	B	17	B	2%
I-270 Diverge to NB MD 85	Diverge	19	B	18	B	-7%	I-270 Diverge to I-270 Spur	Diverge	33	D	19	B	-41%
I-270	Freeway	32	D	31	D	-4%	I-270	Freeway	13	B	13	B	0%
I-270 Diverge to SB MD 85	Diverge	18	B	17	B	-3%	I-270 Diverge to Rockledge Dr / MD 187	Diverge	9	A	9	A	4%
I-270	Freeway	28	D	27	D	-3%	I-270	Freeway	13	B	13	B	0%
I-270 Weave from MD 85 to I-70	Weave	21	C	20	C	-1%	I-270 Merge from Rockledge Dr	Merge	11	B	11	B	0%
I-270	Freeway	59	F	56	F	-6%	I-270	Freeway	16	B	16	B	0%
							I-270 Merge from Rockledge Dr / MD 187	Merge	14	B	13	B	-1%
							I-270	Freeway	35	D	35	D	0%

Table B.6: PM Peak - 2016 - I-270 Spur Vehicle Density

		2016 No Build		2016 Build					2016 No Build		2016 Build		
I-270 Spur Northbound	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**	**I-270 Southbound**	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**
I-270 Spur	Freeway	45	F	28	D	-37%	I-270 Spur	Freeway	53	F	17	B	-68%
I-270 Spur Merge from Clara Barton Parkway	Merge	51	F	23	C	-54%	I-270 Spur Weave from I-270 HOV to Democracy Blvd	Weave	76	F	17	B	-78%
I-270 Spur	Freeway	66	F	38	E	-43%	I-270 Spur	Freeway	95	F	19	C	-80%
I-270 Diverge to MD 190	Diverge	43	F	26	C	-38%	I-270 Merge from Democracy Blvd	Merge	134	F	12	B	-91%
I-270 Spur	Freeway	78	F	44	E	-43%	I-270 Spur Lane Drop	Merge	131	F	22	C	-83%
I-270 Spur Merge from Cabin John Parkway	Merge	95	F	54	F	-43%	I-270 Spur	Freeway	123	F	42	E	-66%
I-270 Spur Merge from MD 190	Merge	94	F	65	F	-31%	I-270 Spur Merge from I-495	Merge	124	F	131	F	5%
I-270 Spur	Freeway	83	F	69	F	-17%	I-270 Spur	Freeway	48	F	49	F	3%
I-270 Spur Diverge to I-495	Merge	65	F	62	F	-4%	I-270 Spur Diverve to EB MD 190	Diverge	49	F	50	F	3%
I-270 Spur	Freeway	45	E	41	E	-8%	I-270 Spur Diverve to Cabin John Pkwy	Diverge	66	F	68	F	3%
I-270 Spur Diverge to Democracy Blvd	Diverge	49	F	42	F	-13%	I-270 Spur	Freeway	93	F	93	F	0%
I-270 Spur	Freeway	58	F	55	F	-6%	I-270 Merge from MD 190	Merge	111	F	110	F	-1%
I-270 Spur Merge from EB Democracy Blvd	Merge	98	F	93	F	-5%	I-270 Spur	Freeway	94	F	94	F	0%
I-270 Spur	Freeway	58	F	58	F	0%	I-270 Diverge to WB Clara Barton Pkwy	Diverge	60	F	60	F	0%
I-270 Spur Merge from WB Democracy Blvd	Merge	65	F	63	F	-2%	I-270 Spur	Freeway	83	F	83	F	0%
I-270 Spur	Freeway	39	E	41	E	6%	I-270 Merge from Clara Barton Pkwy	Merge	72	F	72	F	0%
I-270 Spur Merge from Westlake Terrace	Merge	31	D	39	E	25%							
I-270 Spur	Freeway	35	D	38	E	11%							

Table B.7: PM Peak - 2016 - I-270 Local Vehicle Density

		2016 No Build		2016 Build					2016 No Build		2016 Build		
I-270 Northbound	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**	**I-270 Souhbound**	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**
I-270 C-D	Freeway	29	D	19	C	-33%	I-270 C-D	Freeway	8	A	8	A	0%
I-270 C-D Diverge to EB Montrose Rd	Diverge	20	B	24	C	19%	I-270 C-D Weave from I-370 EB to I-270	Weave	15	B	15	B	-1%
I-270 C-D	Freeway	17	B	20	C	15%	I-270 C-D Diverge to Shady Grove Rd	Diverge	10	A	10	A	1%
I-270 C-D Weave between Montrose Rd Loop Ramps	Weave	12	A	17	B	41%	I-270 C-D	Freeway	7	A	7	A	0%
I-270 C-D	Freeway	20	C	34	D	67%	I-270 C-D Merge from WB Shady Grove Rd	Merge	9	A	10	A	1%
I-270 C-D Merge from WB Montrose Rd	Merge	52	F	84	F	61%	I-270 C-D	Freeway	15	B	15	B	0%
I-270 C-D	Freeway	51	F	71	F	39%	I-270 C-D Merge from EB Shady Grove Rd	Merge	11	B	11	B	0%
I-270 C-D Merge from I-270	Merge	66	F	87	F	32%	I-270 C-D	Freeway	21	C	21	C	0%
I-270 C-D	Freeway	51	F	56	F	9%	I-270 C-D Merge from I-270	Merge	25	C	24	C	-2%
I-270 C-D Diverge to MD 189	Diverge	31	D	30	D	-6%	I-270 C-D Diverge to I-270	Diverge	26	C	26	C	0%
I-270 C-D	Freeway	67	F	68	F	2%	I-270 C-D Diverge to I-270	Diverge	18	B	18	B	0%
I-270 C-D Merge from MD 189	Merge	94	F	95	F	0%	I-270 C-D	Freeway	16	B	16	B	0%
I-270 C-D	Freeway	49	F	48	F	-4%	I-270 C-D Diverge to MD 28	Diverge	12	B	12	B	0%
I-270 C-D Weave between I-270 (to MD 28 from MD 189)	Weave	57	F	53	F	-7%	I-270 C-D	Freeway	11	A	11	A	0%
I-270 C-D	Freeway	48	F	49	F	2%	I-270 C-D Merge from WB MD 28	Merge	13	B	12	B	-4%
I-270 C-D Diverge to MD 28	Diverge	20	B	21	C	4%	I-270 C-D	Freeway	13	B	13	B	0%
I-270 C-D	Freeway	31	D	31	D	1%	I-270 C-D Merge from EB MD 28	Merge	25	C	25	C	0%
I-270 C-D Weave between MD 28 Ramps	Weave	28	C	29	C	1%	I-270 C-D	Freeway	29	D	30	D	3%
I-270 C-D	Freeway	18	C	18	C	0%	I-270 C-D Merge from I-270	Merge	35	E	38	E	9%
I-270 C-D Merge from MD 28 WB	Merge	13	B	13	B	-5%	I-270 C-D	Freeway	40	E	42	E	4%
I-270 C-D Merge from I-270 and Drop Lane	Merge	18	B	17	B	-2%	I-270 C-D Diverge to MD 189	Diverge	24	C	25	C	4%
I-270 C-D Diverge to I-270	Diverge	25	C	25	C	-4%	I-270 C-D	Freeway	25	C	25	C	0%
I-270 C-D	Freeway	39	E	20	C	-49%	I-270 C-D Merge from MD 189	Merge	23	C	23	C	0%
I-270 C-D Diverge to Shady Grove Rd	Diverge	14	B	13	B	-5%	I-270 C-D Diverge to I-270	Diverge	32	D	32	D	0%
I-270 C-D	Freeway	111	F	13	B	-88%	I-270 C-D	Freeway	22	C	22	C	0%
I-270 C- D Merge from I-270 and EB Shady Grove Rd	Merge	116	F	16	B	-86%	I-270 C-D Diverge to WB Montrose Rd	Diverge	16	B	16	B	1%
I-270 C-D	Freeway	112	F	22	C	-80%	I-270 C-D	Freeway	20	C	20	C	0%
I-270 C-D Merge from WB Shady Grove Rd	Merge	108	F	24	C	-77%	I-270 Weave between Montrose Rd Loops	Weave	35	D	34	D	-2%
I-270 C-D Diverge to I-270	Diverge	90	F	23	C	-74%	I-270 C-D	Freeway	15	B	15	B	-1%
I-270 C-D	Freeway	60	F	26	C	-57%	I-270 C-D Merge from EB Montrose Rd	Merge	9	A	9	A	-1%
I-270 C-D Diverge to I-370	Diverge	28	C	32	D	16%	I-270 C-D	Freeway	18	B	17	B	-1%
I-270 C-D	Freeway	10	A	10	A	-1%							
I-270 Merge from I-370 EB	Merge	11	B	11	B	2%							
I-270 C-D	Freeway	19	C	19	C	-1%							
I-270 C-D Weave from I-370 to I-270	Weave	27	C	27	C	-1%							
I-270 C-D	Freeway	22	C	23	C	3%							
I-270 C-D Weave from I-270 to MD 117	Weave	33	D	40	F	21%							
I-270 C-D Diverge to MD 124	Diverge	39	E	24	C	-38%							
I-270 C-D	Freeway	55	F	8	A	-86%							
I-270 C-D Merge from EB MD 124	Merge	96	F	10	A	-90%							
I-270 C-D Merge From WB MD 124	Merge	81	F	18	B	-78%							

Table B.8: PM Peak - 2016 - I-270 Vehicle Throughput

I-270 Northbound	No Build VISSIM Throughput	Build VISSIM Throughput	% Change	Data Collection Measurement	I-270 Southbound	No Build VISSIM Throughput	Build VISSIM Throughput	% Change
Between I-495 and MD 187	4350	4410	1%	100	North of I-70	1975	1975	0%
Between MD 187 on and off ramps	3888	4006	3%	102	Between I-70 on ramps	2287	2287	0%
Between Rockledge Blvd on and off ramps	3666	3821	4%	105	From I-70 interchange to MD-85	3429	3429	0%
Between Rockledge Dr and I-270 Spur	3880	3535	-9%	108	Between MD-85 on and off ramps	2006	2006	0%
Between I-270 Spur and Montrose Rd	8718	7981	-8%	110	Between MD-85 and MD-80	2633	2633	0%
Between Montrose Rd on and off ramps	5750	4920	-14%	112	Between MD-80 on and off ramps	2093	2095	0%
Between Montrose Rd and MD 189	5477	5158	-6%	114	Between MD-80 and Md-109	2457	2455	0%
Between MD 189 and MD 28	5905	5798	-2%	116	Between MD-109 on and off ramps	2395	2401	0%
Between MD 28 on and off ramps	6240	6095	-2%	118	Between MD-109 and MD-121	2521	2521	0%
Between MD 28 and Shady Grove Rd	5494	5323	-3%	120	Between MD-121 on and off ramps	2351	2352	0%
Between Shady Grove Rd and I-370	4789	4521	-6%	123	Between MD-121 and MD-27	2723	2724	0%
Between I-370 on and off ramps	4814	4605	-4%	126	Between MD-27 on and off ramps	2890	2892	0%
Between I-370 and MD 117	6142	6069	-1%	129	Between MD-27 and MD-118	3164	3163	0%
Between MD 117 and MD 124	4713	4765	1%	133	Between MD-118 on and off ramps	3197	3199	0%
Between MD-124 on and off ramps	4706	4865	3%	136	Between MD-118 and Middlebrook Rd	3798	3805	0%
Between MD 124 and Middlebrook Rd	6115	6287	3%	139	Between Middlebrook Rd on and off ramps	3796	3800	0%
Between Middlebrook Rd on and off ramps	5713	5825	2%	142	Between Middlebrook Rd and MD-124	4826	4825	0%
Between Middlebrook Rd and MD 118	4798	4814	0%	146	Between MD-124 on and off ramps	3765	3765	0%
Between MD-118 on and off ramps	4409	4382	-1%	150	Between MD-124 and MD-117	4938	4949	0%
Between MD 118 and MD 27	4456	4348	-2%	154	Between MD-117 and I-370	6461	6466	0%
Between MD-27 on and off ramps	2842	2594	-9%	159	Between I-370 on and off ramps	3327	3331	0%
Between MD 27 and MD 121	3330	3086	-7%	163	Between I-370 on ramp to Shady Grove Rd	4663	4667	0%
Between MD-121 on and off ramps	2574	2284	-11%	167	Between Shady Grove Rd and MD 28	4984	4986	0%
Between MD 121 and MD 109	3787	3803	0%	171	Between MD 28 on and off ramps	5158	5160	0%
Between MD-109 on and off ramps	3547	3539	0%	175	Between MD 28 and MD 189	4536	4537	0%
Between MD 109 and MD 80	3657	3621	-1%	179	Between MD 189 and Montrose Rd	4527	4530	0%
Between MD-80 on and off ramps	3096	3054	-1%	183	Between Montrose Rd on and off ramps	5414	5416	0%
Between MD 80 and MD 85	3596	3539	-2%	187	Between Montose Rd and I-270 Spur	7201	7236	0%
Between MD-85 on and off ramps	3046	2961	-3%	193	Between I-270 Spur and Rockledge Blvd	3293	3290	0%
Between MD 85 and I-70	4867	4782	-2%	197	Between Rockledge Blvd on and off ramps	2549	2544	0%
North of I-70	2562	2441	-5%	200	Between MD 187 on and off ramps	3017	3006	0%
				203	Between MD 187 and I-495	3372	3355	-1%
I-270 Spur Northbound					**I-270 Spur Southbound**			
Between I-495 and Democracy Blvd	4608	4942	7%	600	Between I-270 Split and HOV on ramp	3113	3360	8%
Between Democracy Blvd on and off ramps	4128	4424	7%	603	Between HOV on ramp and Democracy Blvd	2461	3134	27%
Between Democracy Blvd and I-270 Split	4849	5131	6%	607	Between Democracy Blvd on and off ramps	1970	2669	35%
				610	Between Democracy Blvd and I-495	2297	3291	43%

Table B.9: PM Peak - 2016 - I-270 Local Vehicle Throughput

I-270 Local Northbound	No Build VISSIM Throughput	Build VISSIM Throughput	% Change	Data Collection Measurement	I-270 Local Southbound	No Build VISSIM Throughput	Build VISSIM Throughput	% Change
Between Montrose Rd EB off ramp and and EB on ramp	1881	1961	4%	800	Between I-370 on ramp and I-270 off ramp	2740	2736	0%
Between Montrose Rd EB on ramp and WB off ramp	2172	2249	4%	804	Between I-270 off ramp and Shady Grove off ramp	1420	1416	0%
Between Montrose Rd WB off ramp and on ramp	1921	1996	4%	807	Between Shady Grove off ramp and Shady Grove WB on ramp	764	766	0%
Between Montrose Rd WB on ramp and I-270 on ramp	3366	3375	0%	809	Between Shady Grove WB and EB on ramps	1543	1539	0%
Between I-270 on ramp and MD 189 off ramp	3611	3653	1%	811	Between Shady Grove on ramp and I-270 on ramp	2168	2166	0%
Between MD 189 ramps	2908	2936	1%	813	Between I-270 on ramp and I-270 off ramp1	2660	2658	0%
Between MD 189 off ramp and I-270 on ramp	3782	3796	0%	815	Between I-270 off ramp1 and I-270 off ramp2	1854	1854	0%
Between I-270 on ramp and I-270 off ramp	4472	4532	1%	817	Between I-270 off ramp2 and MD 28 off ramp	1681	1680	0%
Between I-270 off ramp and MD 28 EB off ramp	3481	3538	2%	819	Between MD 28 off ramp and MD 28 WB on ramp	1149	1147	0%
Between MD 28 EB off ramp to MD 28 EB on ramp	3133	3179	1%	821	Between MD 28 WB on ramp and MD 28 EB on ramp	1401	1396	0%
Between MD 28 EB on ramp and MD 28 WB off ramp	3262	3307	1%	823	Between MD 28 EB on ramp and I-270 on ramp	2908	2905	0%
Between MD 28 WB off ramp and MD 28 WB on ramp	2023	2044	1%	825	Between I-270 on ramp and MD 189 off ramp	3530	3530	0%
Between MD 28 WB on ramp and I-270 on ramp	2725	2694	-1%	827	Between MD 189 on and off ramps	2601	2598	0%
Between I-270 on ramp and I-270 off ramp	3565	3582	0%	829	Between MD 189 on ramp and I-270 off ramp	3166	3160	0%
Between I-270 off ramp and Shady Grove off ramp	2136	2174	2%	831	Between I-270 off ramp and Montrose Rd off ramp	2280	2274	0%
Between Shady Grove off ramp and I-270 on ramp	673	715	6%	833	Between Montrose Rd off ramp and Montrose Rd WB on ramp	2039	2036	0%
Between I-270 on ramp and Shady Grove WB on ramp	3348	3585	7%	835	Between Montrose Rd WB on ramp and EB off ramp	2605	2584	-1%
Between Shady Grove WB on ramp and I-270 off ramp	4148	4373	5%	838	Between Montrose Rd EB off and on ramps	1525	1508	-1%
Between I-270 off ramp and I-370 off ramp	3663	3858	5%	840	Between Montrose Rd EB off ramp and I-270	1846	1826	-1%
Between I-370 off ramp and I-370 EB on ramp	1138	1125	-1%					
Between I-370 EB and WB on ramps	2096	2081	-1%					
Between I-370 WB on ramp and I-270 off ramp	3687	3667	-1%					
Between I-270 off ramp and I-270 on ramp	2254	2198	-2%					
Between I-270 on ramp and MD 117 off ramp	3661	3700	1%					
Between MD 117 off ramp and MD 124 off ramp	2448	2445	0%					
Between MD 124 off ramp and MD 124 EB on ramp	479	404	-16%					
Between MD 124 EB and WB on ramps	943	907	-4%					
Between MD 124 on ramp I-270	1427	1401	-2%					

Table B.10: PM Peak - 2016 - I-270 On Ramp Queue Length - Northbound

I-270 Northbound	No Build VISSIM Average Queue (feet)	Build VISSIM Average Queue (feet)	% Change/ Abs Difference	No Build VISSIM Maximum Queue (feet)	Build VISSIM Maximum Queue (feet)	% Change / Abs Difference
Rockledge Dr on ramp	1	0	-100%	181	0	-100%
MD 189 C-D on ramp	0	0	0%	33	50	50%
MD 28 C-D on ramp	0	0	0%	0	0	0%
Shady Grove Rd C-D on ramp	0	0	0%	0	0	0%
I-370 C-D on ramp	2	0	-100%	233	0	-100%
MD 124 C-D on ramp	2459	0	-100%	3978	0	-100%
MD 118 on ramp	0	0	-100%	37	0	-100%
MD 27 EB on ramp	0	0	0%	0	0	0%
MD 27 WB on ramp	0	0	0%	0	0	0%
MD 121 on ramp	0	0	0%	0	0	0%
MD 109 on ramp	0	0	0%	0	0	0%
MD 80 on ramp	0	0	0%	0	0	0%
MD 85 on ramp	0	0	0%	0	0	0%
I-270 Spur Northbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change/ Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change / Abs Difference**
Democracy Blvd EB on ramp	0	0	0%	0	0	0%
Democracy Blvd WB on ramp	0	0	0%	0	0	0%
I-495 Northbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change/ Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change / Abs Difference**
Cabin John Pkwy on ramp	16	4	-77%	661	371	-44%
MD 190 on ramp	0	0	0%	0	0	0%
I-270 C-D Northbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change/ Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change / Abs Difference**
Montrose Rd EB on ramp	0	0	0%	0	0	0%
Montrose Rd WB on ramp	265	630	365	1386	2358	70%
I-270 on ramp	0	0	0%	0	0	0%
MD 189 on ramp	15	22	48%	555	453	0%
I-270 on ramp	0	0	-100%	23	0	-100%
MD 28 EB on ramp	0	0	0%	0	0	0%
MD 28 WB on ramp	0	0	0%	0	0	0%
Shady Grove Rd EB on ramp	78	0	-100%	836	0	-100%
I-270 on ramp	178	0	-100%	1103	0	-100%
Shady Grove Rd WB on ramp	12	0	-100%	340	0	-100%
I-370 EB on ramp	0	0	0%	0	0	0%
I-370 WB on ramp	0	0	0%	0	0	0%
I-270 on ramp	12	29	17	658	755	15%
MD 124 EB on ramp	257	0	-100%	1230	0	-100%
MD 124 WB on ramp	1	0	-100%	63	0	-100%

Table B.11: PM Peak - 2016 - I-270 Off Ramp Queue Length - Northbound

I-270 Northbound	No Build VISSIM Average Queue (feet)	Build VISSIM Average Queue (feet)	% Change/ Abs Difference	No Build VISSIM Maximum Queue (feet)	Build VISSIM Maximum Queue (feet)	% Change/ Abs Difference
MD 187 off ramp NB	42	42	0%	278	297	6%
MD 187 off ramp SB	0	0	0%	0	0	0%
Rockledge Dr off ramp	1	0	-48%	73	69	-6%
Tower Oaks Blvd off ramp	32	37	14%	235	240	2%
Montrose Rd off ramp EB	0	0	0%	0	0	0%
Montrose Rd off ramp WB	0	0	0%	0	0	0%
MD 189 off ramp WB	29	30	3%	168	161	-4%
MD 189 off ramp EB	1	1	-31%	122	115	-5%
MD 28 off ramp EB	37	39	4%	231	219	-5%
MD 28 off ramp WB	0	0	0%	0	0	0%
Shady Grove Rd off ramp - Redland Blvd	0	0	0%	0	0	0%
Shady Grove Rd off ramp WB	49	54	10%	248	243	-2%
Shady Grove Rd off ramp EB	0	0	0%	0	0	0%
I-370 off ramp WB	0	0	0%	0	28	0%
I-370 off ramp EB	0	0	0%	0	0	0%
MD 117 off ramp	205	468	264	859	1880	1021
MD 124 off ramp	799	253	-68%	2471	1172	-53%
Watkins Mill Rd off ramp*						
Middlebrook Rd EB off ramp	0	0	0%	0	0	0%
Middlebrook Rd WB off ramp	0	0	0%	0	0	0%
MD 118 WB off ramp - Seneca Meadows	0	0	0%	20	0	-100%
MD 118 WB off ramp	0	0	0%	0	0	0%
MD 118 EB off ramp	0	0	0%	0	0	0%
MD 27 off ramp WB	56	61	9%	290	263	-9%
MD 27 off ramp EB	0	0	0%	0	0	0%
MD 121 off ramp WB	0	0	0%	0	7	0%
MD 121 off ramp EB	0	0	0%	0	0	0%
MD 109 off ramp EB	9	10	6%	158	142	-10%
MD 109 off ramp WB	0	0	0%	0	0	0%
MD 80 off ramp EB	15	17	16%	140	198	42%
MD 80 off ramp WB	0	0	0%	11	15	30%
MD 85 NB off ramp	0	0	0%	0	0	0%
MD 85 SB off ramp	0	1	1	72	81	12%
I-270 Spur Northbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change/ Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change/ Abs Difference**
Clara Barton Pkwy off ramp EB	0	0	0%	0	4	4
Clara Barton Pkwy off ramp WB	0	0	0%	0	0	0%
MD 190 off ramp EB	0	0	0%	0	0	0%
MD 190 off ramp WB	2	30	28	287	670	383
Democracy Blvd off ramp WB	42	46	11%	188	231	23%
Democracy Blvd off ramp EB	18	19	3%	143	126	-12%

* Ramp in Future Scenario

Table B.12: PM Peak - 2016 - I-270 On Ramp Queue Length - Southbound

I-270 Southbound	No Build VISSIM Average Queue (feet)	Build VISSIM Average Queue (feet)	% Change / Abs Difference	No Build VISSIM Maximum Queue (feet)	Build VISSIM Maximum Queue (feet)	% Change / Abs Difference
MD 85 on ramp	0	0	0%	0	0	0%
MD 80 on ramp	0	0	0%	0	0	0%
MD 109 on ramp	0	0	0%	0	0	0%
MD 121 WB on ramp	0	0	0%	0	0	0%
MD 121 EB on ramp*						
MD 27 WB on ramp	0	0	0%	0	0	0%
MD 27 EB on ramp	0	0	0%	0	0	0%
MD 118 WB on ramp	0	0	0%	0	0	0%
MD 118 EB on ramp	0	0	0%	0	0	0%
Middlebrook Rd on ramp	0	0	0%	0	0	0%
MD 124 WB on ramp	5	25	20	332	730	398
MD 117 on ramp	0	0	0%	0	0	0%
I-370 C-D on ramp	0	0	0%	0	0	0%
Shady Grove Rd C-D on ramp North	0	0	0%	0	0	0%
Shady Grove Rd C-D on ramp South	0	0	0%	0	0	0%
MD 189 C-D on ramp	0	0	0%	0	0	0%
Montrose Rd C-D on ramp	0	0	0%	0	0	0%
Rockledge Dr on ramp	0	0	0%	0	0	0%
MD 187 on ramp	0	0	0%	0	0	0%
I-270 Spur Southbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change / Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change / Abs Difference**
Democracy Blvd on ramp	335	0	-100%	1366	0	-100%
I-495 Southbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change / Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change / Abs Difference**
I-270 Spur on ramp	4212	365	-91%	5058	2461	-51%
MD 190 on ramp	1	2	50%	107	108	1%
I-270 C-D Southbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change / Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change / Abs Difference**
I-270 on ramp	0	0	0%	0	0	0%
I-370 on ramp	0	0	0%	0	0	0%
Shady Grove Rd WB on ramp	0	0	0%	0	0	0%
Shady Grove Rd EB on ramp	0	0	0%	0	0	0%
I-270 on ramp	0	0	0%	0	0	0%
MD 28 WB on ramp	0	0	-100%	14	0	-100%
MD 28 EB on ramp	2	0	-100%	219	0	-100%
I-270 on ramp	0	0	0%	0	0	0%
MD 189 on ramp	0	0	0%	0	0	0%
Montrose Rd WB on ramp	1	0	-92%	107	22	-80%
Montrose Rd EB on ramp	0	0	0%	0	0	0%

* Ramp in Future Scenario

Table B.13: PM Peak - 2016 - I-270 Off Ramp Queue Length - Southbound

I-270 Southbound	No Build VISSIM Average Queue (feet)	Build VISSIM Average Queue (feet)	% Change/ Abs Difference	No Build VISSIM Maximum Queue (feet)	Build VISSIM Maximum Queue (feet)	% Change/ Abs Difference
MD 85 SB off ramp	0	0	0%	0	0	0%
MD 85 NB off ramp	0	0	-29%	114	85	-25%
MD 80 off ramp	1	0	-63%	154	88	-43%
MD 109 off ramp WB	0	0	-18%	58	50	-13%
MD 109 off ramp EB	0	0	0%	0	0	0%
MD 121 off ramp EB	2	2	-19%	98	98	0%
MD 121 off ramp WB	0	0	0%	0	0	0%
MD 27 off ramp EB	23	21	-11%	149	173	17%
MD 27 off ramp WB	0	0	0%	0	0	0%
MD 118 off ramp EB	19	19	4%	110	136	23%
MD 118 off ramp WB	0	0	0%	0	0	0%
Watkins Mill Rd off ramp*						
MD 124 off ramp EB	310	461	48%	1658	2371	43%
MD 124 off ramp WB	147	43	-71%	1129	496	-56%
I-370 off ramp WB	0	0	0%	0	0	0%
I-370 off ramp EB	0	0	0%	0	0	0%
Shady Grove Rd off ramp - Omega Drive	1	0	-17%	42	42	0%
Shady Grove Rd off ramp	0	0	0%	0	0	0%
MD 28 off ramp	3	3	-8%	127	148	16%
MD 189 off ramp EB	123	149	21%	849	1014	19%
MD 189 off ramp WB	0	0	0%	0	0	0%
Montrose Rd off ramp WB	0	0	0%	0	0	0%
Montrose Rd off ramp EB	0	1	0%	0	134	0%
Rockledge Dr off ramp	51	14	-73%	295	195	-34%
I-270 Spur Southbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change/ Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change/ Abs Difference**
Democracy Blvd off ramp EB	24	28	15%	157	154	-2%
Democracy Blvd off ramp WB	0	0	0%	0	0	0%
MD 190 off ramp WB	85	95	11%	826	819	-1%
MD 190 off ramp EB	0	0	0%	0	0	0%
Clara Barton Pkwy WB off ramp	0	0	0%	0	0	0%

* Ramp in Future Scenario

Table B.14: PM Peak - 2016 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
1- MD 85 at Sam's Club Drive											
1	NB	28.2	C	NB Left	115	79	116	611	E	53.2	D
				NB Through	503	33	116	611	C		
				NB Right	824	18	55	634	B		
	SB	82.9	F	SB Left	142	77	401	1055	E		
				SB Through	875	84	401	1055	F		
				SB Right	67	87	401	1055	F		
	EB	33.5	C	EB Left	43	83	26	115	F		
				EB Through	20	91	26	115	F		
				EB Right	144	11	26	115	B		
	WB	63.9	E	WB Left	508	77	221	686	E		
				WB Through	27	67	221	686	E		
				WB Right	192	29	221	686	C		
2- MD 85 at I-270 NB on and off ramp											
2	NB	36.0	D	NB Left	977	36	187	908	D	32.7	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	27.9	C	SB Left	0	0	0	0	A		
				SB Through	671	28	100	634	C		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
3- MD 85 at I-270 SB on and off ramp											
3	NB	6.0	A	NB Left	0	0	0	0	A	9.4	A
				NB Through	1699	6	41	829	A		
				NB Right	0	0	0	0	A		
	SB	43.8	D	SB Left	170	44	46	320	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
4- MD 85 at Crestwood Blvd											
4	NB	33.3	D	NB Left	60	70	154	653	E	33.5	C
				NB Through	1255	32	154	654	C		
				NB U-Turn	0	0	0	0	A		
	SB	22.0	C	SB Left	91	80	45	208	E		
				SB Through	810	25	59	445	C		
				SB Right	796	12	45	436	B		
	EB	54.8	D	EB Left	802	57	133	610	E		
				EB Through	31	44	133	610	D		
				EB Right	22	0	133	610	A		
	WB	43.4	D	WB Left	36	75	39	162	E		
				WB Through	61	65	39	162	E		
				WB Right	81	13	39	162	B		
5- MD 80 at I-270 NB on and ramp											
5	NB	-1.8	A	NB Left	1	0	0	0	A	8.6	A
				NB Through	2	0	0	0	A		
				NB Right	8	-3	0	0	A		
	SB	12.2	B	SB Left	385	15	21	145	B		
				SB Through	17	17	21	145	B		
				SB Right	122	2	0	0	A		
	EB	8.9	A	EB Left	70	9	13	171	A		
				EB Through	0	0	8	0	A		
				EB Right	6	5	24	202	A		
	WB	6.9	A	WB Left	16	10	0	40	B		
				WB Through	510	12	28	281	B		
				WB Right	482	1	0	0	A		
6- MD 80 at I-270 SB on and off ramp											
6	NB	2.3	A	NB Left	47	3	1	190	A	4.2	A
				NB Through	0	0	0	0	A		
				NB Right	491	2	1	190	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	5.0	A	EB Left	0	0	0	0	A		
				EB Through	271	5	2	61	A		
				EB Right	53	3	1	69	A		
	WB	6.6	A	WB Left	0	0	0	0	A		
				WB Through	316	7	1	89	A		
				WB Right	0	0	0	0	A		
7- MD 109 at I-270 NB on and off ramp											
7	NB			NB Left	0	0	0	0	A	5.3	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	10.2	B	SB Left	224	11	14	175	B		
				SB Through	0	0	0	0	A		
				SB Right	17	2	0	67	A		
	EB	2.2	A	EB Left	56	1	0	37	A		
				EB Through	0	0	0	0	A		
				EB Right	59	3	0	0	A		
	WB	0.3	A	WB Left	0	0	0	0	A		
				WB Through	160	0	0	0	A		
				WB Right	0	0	0	0	A		
8- MD 80 at I-270 SB on and off ramp											
8	NB	4.0	A	NB Left	44	7	2	115	A	1.6	A
				NB Through	0	0	0	0	A		
				NB Right	29	0	0	43	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.8	A	EB Left	0	0	0	0	A		
				EB Through	114	0	0	0	A		
				EB Right	24	4	0	0	A		
	WB	1.2	A	WB Left	98	1	0	42	A		
				WB Through	78	1	0	19	A		
				WB Right	0	0	0	0	A		
9- MD 121 at Gateway Center Dr											
9	NB	10.6	B	NB Left	471	13	31	242	B	17.0	B
				NB Through	638	10	31	242	A		
				NB Right	54	2	36	268	A		
	SB	17.8	C	SB Left	20	13	5	143	B		
				SB Through	169	19	14	163	B		
				SB Right	8	4	13	184	A		
	EB	16.6	C	EB Left	2	50	3	93	D		
				EB Through	19	51	11	170	D		
				EB Right	142	12	21	202	B		
	WB	34.8	D	WB Left	214	46	57	220	D		
				WB Through	56	41	57	219	D		
				WB Right	140	16	71	244	B		
10- MD 121 at I-270 NB on and off ramp											
10	NB	0.8	A	NB Left	25	9	1	67	A	0.6	A
				NB Through	0	0	0	0	A		
				NB Right	718	1	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.1	A	EB Left	0	0	0	0	A		
				EB Through	447	0	0	0	A		
				EB Right	58	0	0	0	A		
	WB	0.8	A	WB Left	100	3	1	73	A		
				WB Through	423	0	0	48	A		
				WB Right	0	0	0	0	A		

Table B.14: PM Peak - 2016 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
11- MD 121 at I-270 SB on and off ramp											
11	NB			NB Left	0	0	0	0	A	2.2	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	7.7	A	SB Left	136	10	8	125	A		
				SB Through	0	0	0	0	A		
				SB Right	36	0	0	0	A		
	EB	0.3	A	EB Left	29	1	0	23	A		
				EB Through	0	0	0	0	A		
				EB Right	349	0	0	0	A		
	WB	0.1	A	WB Left	0	0	0	0	A		
				WB Through	99	0	0	0	A		
				WB Right	0	0	0	0	A		
12- MD 27 at Observation Dr											
12	NB	40.1	D	NB U-Turn	0	0	0	0	A	22.2	C
				NB Through	73	57	19	86	E		
				NB Right	47	13	19	86	B		
	SB	39.7	D	SB Left	114	46	31	182	D		
				SB Through	41	62	35	244	E		
				SB Right	173	30	57	281	C		
	EB	16.8	B	EB Left	208	27	68	502	C		
				EB Through	2223	16	70	503	B		
				EB Right	106	15	82	541	B		
	WB	25.8	C	WB Left	31	22	123	627	C		
				WB Through	1503	26	123	627	C		
				WB Right	54	9	123	627	A		
13- MD 27 at I-270 NB off ramp											
13	NB	44.8	D	NB Left	390	45	63	297	D	8.1	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.1	A	EB Left	0	0	0	0	A		
				EB Through	1284	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	5.5	A	WB Left	0	0	0	0	A		
				WB Through	1582	6	41	680	A		
				WB Right	0	0	0	0	A		
14- MD 27 at I-270 SB off ramp											
14	NB			NB Left	0	0	0	0	A	5.4	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	52.2	D	SB Left	171	52	35	162	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.3	A	EB Left	0	0	0	0	A		
				EB Through	1351	2	4	149	A		
				EB Right	0	0	0	0	A		
	WB	2.7	A	WB Left	0	0	0	0	A		
				WB Through	1433	3	7	257	A		
				WB Right	0	0	0	0	A		
15- MD 27 at Crystal Rock Dr											
15	NB	22.6	C	NB Left	58	20	55	379	C	29.8	C
				NB Through	965	23	68	379	C		
				NB Right	43	20	72	391	B		
	SB	33.9	C	SB Left	140	57	185	770	E		
				SB Through	1310	35	185	770	D		
				SB Right	196	9	164	764	A		
	EB	43.0	D	EB Left	103	54	28	120	D		
				EB Through	37	46	25	115	D		
				EB Right	47	17	17	141	B		
	WB	27.6	C	WB Left	83	49	70	297	D		
				WB Through	102	43	70	297	D		
				WB Right	552	22	70	297	C		
16- MD 118 at Seneca Meadows Pkwy											
16	NB	4.0	A	NB Left	90	12	1	82	B	8.2	A
				NB Through	1174	3	7	154	A		
				NB Right	0	0	15	207	A		
	SB	6.5	A	SB Left	11	6	14	270	A		
				SB Through	1091	7	18	270	A		
				SB Right	9	3	21	302	A		
	EB	13.1	B	EB Left	18	55	12	130	E		
				EB Through	1	76	12	130	E		
				EB Right	275	10	12	130	B		
	WB	53.5	D	WB Left	93	64	37	199	E		
				WB Through	6	61	33	198	E		
				WB Right	25	13	42	218	B		
17- MD 118 at I-270 NB on ramp											
17	NB			NB Left	0	0	0	0	A	16.1	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	33.9	C	EB Left	435	34	90	501	C		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	10.8	B	WB Left	0	0	0	0	A		
				WB Through	246	2	1	116	A		
				WB Right	1216	13	46	480	B		
18- MD 118 at I-270 SB off ramp											
18	NB			NB Left	0	0	0	0	A	6.1	A
				NB Through	0	0.0	0	0	A		
				NB Right	0	0.0	0	0	A		
	SB	37.1	D	SB Left	129	37.1	22	114	D		
				SB Through	0	0.0	0	0	A		
				SB Right	0	0.0	0	0	A		
	EB	4.8	A	EB Left	0	0.0	0	0	A		
				EB Through	1182	4.8	10	322	A		
				EB Right	0	0.0	0	0	A		
	WB	4.5	A	WB Left	0	0.0	0	0	A		
				WB Through	1465	4.5	8	237	A		
				WB Right	0	0.0	0	0	A		
19- MD 118 at Aircraft Dr											
19	NB	24.0	C	NB Left	42	69	33	176	E	27.5	C
				NB Through	43	70	33	176	E		
				NB Right	196	4	3	77	A		
	SB	90.2	F	SB Left	381	90	221	577	F		
				SB Through	12	82	221	577	F		
				SB Right	97	91	221	577	F		
	EB	17.8	B	EB Left	98	22	60	395	C		
				EB Through	1215	17	60	395	B		
				EB Right	17	15	60	395	B		
	WB	17.6	B	WB Left	12	17	66	441	B		
				WB Through	1324	21	66	441	C		
				WB Right	351	5	66	441	A		
20- Middlebrook Rd at Observation Dr											
20	NB			NB Left	0	0	0	0	A	8.5	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	18.0	B	SB Left	96	35	18	131	D		
				SB Through	0	0	0	0	A		
				SB Right	179	9	18	131	A		
	EB	6.4	A	EB Left	15	9	17	155	A		
				EB Through	1180	6	17	155	A		
				EB Right	0	0	0	0	A		
	WB	8.4	A	WB Left	0	0	0	0	A		
				WB Through	1238	8	24	251	A		
				WB Right	12	6	39	300	A		

Table B.14: PM Peak - 2016 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
21- Middlebrook Rd at I-270 SB on ramp											
21	NB			NB Left	0	0	0	0	A	4.4	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.8	A	EB Left	0	0	0	0	A		
				EB Through	686	3	4	96	A		
				EB Right	0	0	0	0	A		
	WB	7.1	A	WB Left	429	7	4	194	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
22- Middlebrook Rd at Waring Station Rd											
22	NB	48.4	D	NB Left	156	45	75	316	D	12.5	B
				NB Through	0	0	75	316	A		
				NB Right	219	51	75	316	D		
	SB	30.6	C	SB Left	30	44	7	66	D		
				SB Through	2	37	7	66	D		
				SB Right	19	9	18	104	A		
	EB	7.3	A	EB Left	3	10	23	262	B		
				EB Through	1035	7	23	262	A		
				EB Right	160	7	23	262	A		
	WB	8.3	A	WB Left	242	20	33	332	C		
				WB Through	1650	7	33	332	A		
				WB Right	4	2	33	332	A		
23- MD 124 at MD 355											
23	NB	51.6	D	NB Left	507	63	186	529	E	63.0	E
				NB Through	942	46	183	527	D		
				NB Right	6	12	0	0	B		
	SB	30.7	C	SB Left	141	71	99	395	E		
				SB Through	554	53	99	395	D		
				SB Right	736	6	20	339	A		
	EB	42.4	D	EB Left	468	93	363	1176	F		
				EB Through	2720	41	363	1176	D		
				EB Right	575	7	160	1150	A		
	WB	153.9	F	WB Left	0	0	0	0	A		
				WB Through	1481	156	718	950	F		
				WB Right	65	101	0	0	F		
24- MD 124 at I-270 SB on and off											
24	NB	64.4	F	NB Left	55	65	23	98	E	40.8	D
				NB Through	23	64	23	98	E		
				NB U-Turn	0	0	0	0	A		
	SB	57.0	E	SB Left	572	94	316	1663	F		
				SB Through	10	80	316	1663	F		
				SB Right	452	9	141	1059	A		
	EB	43.4	D	EB Left	0	0	0	0	A		
				EB Through	1738	44	307	1098	D		
				EB Right	31	34	323	1121	C		
	WB	18.7	B	WB Left	4	66	77	588	E		
				WB Through	1046	19	77	588	B		
				WB Right	0	0	0	0	A		
25- MD 117 at MD 124											
25	NB	36.4	D	NB Left	45	63	116	666	E	40.6	D
				NB Through	545	54	116	666	D		
				NB Right	447	13	4	216	B		
	SB	32.8	C	SB Left	119	44	98	447	D		
				SB Through	762	37	98	447	D		
				SB Right	144	2	0	0	A		
	EB	46.1	D	EB Left	120	82	142	477	F		
				EB Through	1092	42	142	478	D		
				EB Right	43	39	149	506	D		
	WB	43.5	D	WB Left	402	70	280	1027	E		
				WB Through	1338	39	280	1027	D		
				WB Right	129	2	0	0	A		
26- MD 117 at Bureau Dr											
26	NB	45.7	D	NB Left	78	79	65	281	E	38.8	D
				NB Through	27	75	65	281	E		
				NB Right	260	33	65	281	C		
	SB	71.9	E	SB Left	274	83	109	351	F		
				SB Through	17	82	109	351	F		
				SB Right	65	21	109	351	C		
	EB	31.4	C	EB Left	41	80	156	829	F		
				EB Through	1593	30	157	829	C		
				EB Right	3	13	151	818	B		
	WB	37.7	D	WB Left	19	43	337	1058	D		
				WB Through	1703	40	337	1059	D		
				WB Right	292	26	368	1107	C		
27- MD 117 at I-270 SB off ramp											
27	NB			NB Left	0	0	0	0	A	13.3	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	4.6	A	EB Left	0	0	0	0	A		
				EB Through	896	5	10	466	A		
				EB Right	0	0	0	0	A		
	WB	39.8	E	WB Left	294	40	140	1068	E		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
28- MD 117 at I-270 NB off ramp											
28	NB			NB Left	0	0	0	0	A	30.5	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	52.1	D	SB Left	256	46	214	871	D		
				SB Through	0	0	0	0	A		
				SB Right	951	54	214	870	D		
	EB	27.6	C	EB Left	3	125	152	980	F		
				EB Through	897	27	152	980	C		
				EB Right	0	0	0	0	A		
	WB	13.3	B	WB Left	0	0	0	0	A		
				WB Through	1359	13	87	383	B		
				WB Right	0	0	87	383	A		
29- MD 117 at Perry Pkwy											
29	NB	42.6	D	NB Left	18	69	13	110	E	37.0	D
				NB Through	21	50	13	109	D		
				NB Right	23	15	21	129	B		
	SB	57.1	E	SB Left	194	85	89	332	F		
				SB Through	14	84	89	332	F		
				SB Right	112	6	89	332	A		
	EB	20.8	C	EB Left	240	69	84	355	E		
				EB Through	864	8	84	355	A		
				EB Right	32	6	69	339	A		
	WB	44.4	D	WB Left	36	105	245	752	F		
				WB Through	1228	46	245	752	D		
				WB Right	300	33	245	752	C		
30- Shady Grove Rd at I-270 NB off ramp											
30	NB	7.1	A	NB Left	0	0	0	0	A	13.8	B
				NB Through	1025	7	16	209	A		
				NB Right	0	0	0	0	A		
	SB	9.5	A	SB Left	0	0	0	0	A		
				SB Through	1280	9	41	481	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	52.9	D	WB Left	317	53	58	260	D		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table B.14: PM Peak - 2016 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
31- Shady Grove Rd at I-270 SB off ramp											
31	NB	6.8	A	NB Left	0	0	0	0	A	15.9	B
				NB Through	1463	7	28	378	A		
				NB Right	0	0	0	0	A		
	SB	5.5	A	SB Left	0	0	0	0	A		
				SB Through	817	5	8	156	A		
				SB Right	0	0	0	0	A		
	EB	57.5	E	EB Left	229	55	44	200	D		
				EB Through	0	0	0	0	A		
				EB Right	295	60	63	241	E		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
32- MD 28 at I-270 SB off ramp											
32	NB			NB U-Turn	0	0	0	0	A	8.0	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	36.5	D	SB Left	440	44	74	300	D		
				SB Through	0	0	0	0	A		
				SB Right	98	3	1	70	A		
	EB	2.7	A	EB Left	0	0	0	0	A		
				EB Through	1505	1	0	0	A		
				EB Right	830	6	14	245	A		
	WB	6.1	A	WB Left	0	0	0	0	A		
				WB Through	1693	6	18	227	A		
				WB Right	0	0	0	0	A		
33- MD 28 at I-270 on and off ramps											
33	NB	34.9	C	NB Left	0	0	43	241	A	21.5	C
				NB Through	208	47	51	250	D		
				NB Right	134	16	51	250	B		
	SB	33.6	C	SB Left	11	101	175	288	F		
				SB Through	0	0	0	0	A		
				SB Right	164	29	175	288	C		
	EB	12.7	B	EB Left	254	38	53	287	D		
				EB Through	885	5	53	287	A		
				EB Right	0	0	0	0	A		
	WB	24.1	C	WB Left	36	20	96	383	B		
				WB Through	1241	24	77	346	C		
				WB Right	0	0	0	0	A		
34- MD 189 at Great Falls Rd											
34	NB	38.6	D	NB Left	45	44	12	86	D	13.4	B
				NB Through	11	50	8	84	D		
				NB Right	12	10	8	94	A		
	SB	3.3	A	SB Left	14	51	7	73	D		
				SB Through	11	51	7	73	D		
				SB Right	401	0	0	0	A		
	EB	12.0	B	EB Left	425	24	38	464	C		
				EB Through	669	5	5	161	A		
				EB Right	58	4	9	198	A		
	WB	18.4	B	WB Left	11	18	48	405	B		
				WB Through	827	18	48	405	B		
				WB Right	14	17	63	439	B		
35- MD 189 at I-270 Ramps											
35	NB	46.1	D	NB Left	250	46	44	190	D	41.7	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	55.4	E	SB Left	350	55	139	869	E		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	27.5	C	EB Left	480	31	89	371	C		
				EB Through	367	23	89	371	C		
				EB Right	0	0	0	0	A		
	WB	48.9	D	WB Left	440	54	106	299	D		
				WB Through	417	43	106	299	D		
				WB Right	0	0	0	0	A		
36- MD 189 at Wooton Pkwy											
36	NB	45.1	D	NB Left	187	57	113	410	E	43.8	D
				NB Through	536	52	113	410	D		
				NB Right	174	10	113	410	B		
	SB	62.3	E	SB Left	247	79	151	606	E		
				SB Through	729	57	154	631	E		
				SB Right	0	0	0	0	A		
	EB	34.6	C	EB Left	118	71	101	438	E		
				EB Through	543	34	101	438	C		
				EB Right	160	10	101	438	B		
	WB	34.5	C	WB Left	160	71	123	603	E		
				WB Through	781	35	123	603	C		
				WB Right	317	15	123	603	B		
37- Montrose Rd at Tower Oaks Blvd											
37	NB	0.4	A	NB Left	0	0	0	0	A	16.2	B
				NB Through	0	0	0	0	A		
				NB Right	490	0	0	0	A		
	SB	71.2	E	SB Left	68	48	37	256	D		
				SB Through	0	0	0	0	A		
				SB Right	270	77	97	348	E		
	EB	6.1	A	EB Left	0	0	0	0	A		
				EB Through	1685	6	30	360	A		
				EB Right	0	0	0	0	A		
	WB	18.3	B	WB Left	69	35	30	360	C		
				WB Through	2563	18	105	727	B		
				WB Right	244	12	105	727	B		
38- Tower Oaks Blvd at I-270 off rmap											
38	NB	22.9	C	NB Left	650	23	46	257	C	17.4	B
				NB Through	0	0.0	39	249	A		
				NB Right	21	6.3	46	257	A		
	SB	15.4	B	SB Left	8	24.8	1	43	C		
				SB Through	0	0.0	1	43	A		
				SB Right	7	4.7	0	30	A		
	EB	11.1	B	EB Left	1	11.0	14	153	B		
				EB Through	310	11.6	14	153	B		
				EB Right	33	6.4	9	144	A		
	WB	12.7	B	WB Left	121	15.9	14	122	B		
				WB Through	192	10.8	14	122	B		
				WB Right	1	3.7	2	78	A		
39- Montrose Rd at Tower Oaks Blvd											
39	NB	17.3	B	NB Left	76	34	62	288	C	55.3	E
				NB Through	606	30	62	288	C		
				NB Right	572	1	0	0	A		
	SB	30.3	C	SB Left	193	62	61	206	E		
				SB Through	394	20	59	205	C		
				SB Right	105	11	54	250	B		
	EB	216.7	F	EB Left	81	178	517	714	F		
				EB Through	458	222	518	715	F		
				EB Right	32	240	542	739	F		
	WB	35.5	D	WB Left	565	44	110	402	D		
				WB Through	473	41	111	402	D		
				WB Right	330	13	130	433	B		
40- Rockledge Blvd at I-270 NB on and off ramp											
40	NB	124.2	F	NB Left	0	0	0	0	A	98.5	F
				NB Through	335	113	520	837	F		
				NB Right	854	129	520	837	F		
	SB	86.6	F	SB Left	0	0	86	220	A		
				SB Through	346	87	86	220	F		
				SB Right	0	0	0	0	A		
	EB	62.2	E	EB Left	5	127	169	458	F		
				EB Through	428	103	169	458	F		
				EB Right	297	2	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table B.14: PM Peak - 2016 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
41- Rockledge Blvd at I-270 SB on and off ramps											
				NB Left	341	30	76	261	C		
	NB	30.2	C	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
41				EB Left	0	0	0	0	A	49.5	D
	EB			EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	345	59	193	786	E		
	WB	54.7	D	WB Through	894	53	193	786	D		
				WB Right	0	0	0	0	A		
42- MD 187 at Tuckerman Ln											
				NB Left	198	21	316	1253	C		
	NB	43.7	D	NB Through	2133	43	316	1253	D		
				NB Right	188	73	316	1253	E		
				SB Left	185	168	2553	2702	F		
	SB	201.4	F	SB Through	1122	201	2553	2702	F		
				SB Right	270	226	2553	2702	F		
42				EB Left	238	52	94	407	D	120.3	F
	EB	51.7	D	EB Through	409	54	95	408	D		
				EB Right	103	43	113	432	D		
				WB Left	459	211	1918	2138	F		
	WB	215.4	F	WB Through	614	233	1918	2138	F		
				WB Right	151	158	1918	2138	F		
43- MD 187 at I-270 NB on and off ramps											
				NB Left	552	34	103	399	C		
	NB	14.8	B	NB Through	2291	10	103	399	B		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB	22.7	C	SB Through	1247	23	57	248	C		
				SB Right	0	0	0	0	A		
43				EB Left	0	0	0	0	A	18.5	B
	EB			EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	65	60	50	290	E		
	WB	61.4	E	WB Through	65	63	50	290	E		
				WB Right	0	0	0	0	A		
44- MD 187 at I-270 NB on and off ramps											
				NB Left	0	0	0	0	A		
	NB	32.2	D	NB Through	2211	32	103	485	C		
				NB Right	0	0	0	0	A		
				SB Left	150	59	74	305	E		
	SB	20.4	C	SB Through	1163	15	74	305	B		
				SB Right	0	0	0	0	A		
44				EB Left	636	57	137	558	E	33.3	C
	EB	57.1	E	EB Through	0	0	137	558	A		
				EB Right	185	57	77	519	E		
				WB Left	0	0	0	0	A		
	WB			WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
45- MD 187 at Rock Spring Dr											
				NB Left	383	34	90	614	C		
	NB	16.8	B	NB Through	2000	14	91	614	B		
				NB Right	14	12	111	647	B		
				SB Left	20	47	82	400	D		
	SB	26.7	C	SB Through	1160	30	82	400	C		
				SB Right	172	1	54	356	A		
45				EB Left	396	59	98	362	E	23.8	C
	EB	40.2	D	EB Through	37	63	98	362	E		
				EB Right	375	18	98	362	B		
				WB Left	5	32	3	77	C		
	WB	11.6	B	WB Through	12	25	3	77	C		
				WB Right	32	4	1	67	A		
47-Democracy Blvd at I-270 NB off ramp											
				NB Left	152	46	29	159	D		
	NB	45.7	D	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
47				EB Left	0	0	0	0	A	3.0	A
	EB	1.2	A	EB Through	1114	1	3	51	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	0.9	A	WB Through	2129	1	2	62	A		
				WB Right	0	0	0	0	A		
48- Democracy Blvd at I-270 SB on ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
48				EB Left	0	0	0	0	A	6.3	A
	EB	5.0	A	EB Through	1326	5	17	250	A		
				EB Right	0	0	0	0	A		
				WB Left	531	24	39	287	C		
	WB	7.0	A	WB Through	1748	2	30	266	A		
				WB Right	0	0	0	0	A		
49- Democracy Blvd at I-270 SB off ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	159	53	31	164	D		
	SB	38.9	D	SB Through	0	0	0	0	A		
				SB Right	60	2	0	0	A		
49				EB Left	0	0	0	0	A	7.4	A
	EB			EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	3.8	A	WB Through	1748	4	16	274	A		
				WB Right	168	3	12	305	A		
50- MD 190 at Burdette Rd											
				NB Left	26	74	15	100	E		
	NB	72.8	E	NB Through	4	84	15	100	F		
				NB Right	5	56	15	100	E		
				SB Left	34	78	19	122	E		
	SB	32.1	C	SB Through	7	56	19	122	E		
				SB Right	118	18	19	122	B		
50				EB Left	122	85	82	513	F	31.1	C
	EB	17.6	B	EB Through	1151	11	82	513	B		
				EB Right	28	4	68	540	A		
				WB Left	11	113	334	1111	F		
	WB	38.3	D	WB Through	2146	38	334	1111	D		
				WB Right	52	28	334	1111	C		

Table B.14: PM Peak - 2016 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
51- MD 190 at I-270 NB on ramp											
51	NB			NB Left	0	0	0	0	A	16.9	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	70.2	E	EB Left	233	70	101	369	E		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	8.4	A	WB Left	0	0	0	0	A		
				WB Through	1464	8	42	713	A		
				WB Right	0	0	0	0	A		
52- MD 190 at I-270 SB off ramp											
52	NB	73.8	E	NB Left	222	74	89	830	E	12.4	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.9	A	EB Left	0	0	0	0	A		
				EB Through	840	3	6	143	A		
				EB Right	0	0	0	0	A		
	WB	9.1	A	WB Left	0	0	0	0	A		
				WB Through	1705	9	26	545	A		
				WB Right	0	0	0	0	A		
53- MD 190 at Seven Locks Rd											
53	NB	0.3	A	NB Left	21	1	0	0	A	24.7	C
				NB Through	243	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	55.7	E	SB Left	306	56	103	375	E		
				SB Through	180	56	103	375	E		
				SB Right	17	56	103	375	E		
	EB	27.1	C	EB Left	22	33	66	355	C		
				EB Through	664	27	66	355	C		
				EB Right	34	25	66	355	C		
	WB	19.0	B	WB Left	262	75	125	534	E		
				WB Through	935	15	125	534	B		
				WB Right	715	4	125	534	A		
54- MD 124 at I-270 NB off ramp											
54	NB	59.5	E	NB Left	0	0	0	0	A	64.0	E
				NB Through	0	0	0	0	A		
				NB Right	1911	59	802	2475	E		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	68.6	E	EB Left	0	0	0	0	A		
				EB Through	1874	69	579	1267	E		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
55- Democracy Blvd at I-270 NB off ramp											
55	NB	47.0	D	NB Left	0	0	0	0	A	11.5	B
				NB Through	0	0	0	0	A		
				NB Right	314	47	51	199	D		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	1.5	A	EB Left	0	0	0	0	A		
				EB Through	1113	2	4	65	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table B.15: PM Peak - 2016 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
1- MD 85 at Sam's Club Drive											
1	NB	26.3	C	NB Left	114	78	102	567	E	52.1	D
				NB Through	504	33	102	567	C		
				NB Right	834	15	44	589	B		
	SB	84.2	F	SB Left	143	77	414	1059	E		
				SB Through	878	85	414	1059	F		
				SB Right	67	90	414	1059	F		
	EB	33.6	C	EB Left	43	83	26	115	F		
				EB Through	20	92	26	115	F		
				EB Right	144	11	26	115	B		
	WB	60.7	E	WB Left	509	74	213	684	E		
				WB Through	28	67	213	684	E		
				WB Right	193	25	213	684	C		
2- MD 85 at I-270 NB on and off ramp											
2	NB	37.8	D	NB Left	976	38	205	1059	D	32.9	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	25.7	C	SB Left	0	0	0	0	A		
				SB Through	677	26	88	681	C		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
3- MD 85 at I-270 SB on and off ramp											
3	NB	6.0	A	NB Left	0	0	0	0	A	9.5	A
				NB Through	1701	6	42	788	A		
				NB Right	0	0	0	0	A		
	SB	43.6	D	SB Left	173	44	46	322	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
4- MD 85 at Crestwood Blvd											
4	NB	33.3	D	NB Left	60	70	154	645	E	34.2	C
				NB Through	1255	32	154	645	C		
				NB U-Turn	0	0	0	0	A		
	SB	23.5	C	SB Left	93	78	43	214	E		
				SB Through	819	26	66	647	C		
				SB Right	805	15	55	638	B		
	EB	55.0	D	EB Left	803	57	135	623	E		
				EB Through	31	45	135	623	D		
				EB Right	22	0	135	623	A		
	WB	43.1	D	WB Left	35	74	39	162	E		
				WB Through	61	65	39	162	E		
				WB Right	81	13	39	162	B		
5- MD 80 at I-270 NB on and ramp											
5	NB	-2.4	A	NB Left	1	0	0	0	A	9.0	A
				NB Through	1	0	0	0	A		
				NB Right	9	-3	0	0	A		
	SB	12.4	B	SB Left	408	15	23	203	B		
				SB Through	19	15	23	203	B		
				SB Right	126	3	0	0	A		
	EB	10.9	B	EB Left	70	11	14	167	B		
				EB Through	0	0	8	0	A		
				EB Right	6	7	23	198	A		
	WB	7.1	A	WB Left	16	12	0	50	B		
				WB Through	510	13	29	271	B		
				WB Right	482	1	0	0	A		
6- MD 80 at I-270 SB on and off ramp											
6	NB	2.1	A	NB Left	47	2	1	124	A	4.1	A
				NB Through	0	0	0	0	A		
				NB Right	491	2	1	124	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	5.1	A	EB Left	0	0	0	0	A		
				EB Through	272	5	2	79	A		
				EB Right	54	3	1	86	A		
	WB	6.4	A	WB Left	0	0	0	0	A		
				WB Through	321	6	1	82	A		
				WB Right	0	0	0	0	A		
7- MD 109 at I-270 NB on and off ramp											
7	NB			NB Left	0	0	0	0	A	5.5	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	10.3	B	SB Left	239	11	15	159	B		
				SB Through	0	0	0	0	A		
				SB Right	19	2	0	40	A		
	EB	2.2	A	EB Left	56	1	0	36	A		
				EB Through	0	0	0	0	A		
				EB Right	59	3	0	0	A		
	WB	0.3	A	WB Left	0	0	0	0	A		
				WB Through	160	0	0	0	A		
				WB Right	0	0	0	0	A		
8- MD 80 at I-270 SB on and off ramp											
8	NB	3.8	A	NB Left	44	7	2	93	A	1.6	A
				NB Through	0	0	0	0	A		
				NB Right	29	0	0	11	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.8	A	EB Left	0	0	0	0	A		
				EB Through	114	0	0	0	A		
				EB Right	24	4	0	0	A		
	WB	1.3	A	WB Left	98	1	0	41	A		
				WB Through	80	2	0	18	A		
				WB Right	0	0	0	0	A		
9- MD 121 at Gateway Center Dr											
9	NB	11.5	B	NB Left	495	14	35	272	B	17.4	B
				NB Through	674	11	35	272	B		
				NB Right	57	2	41	298	A		
	SB	18.3	C	SB Left	20	13	5	148	B		
				SB Through	169	19	16	169	B		
				SB Right	8	10	13	187	B		
	EB	12.5	B	EB Left	2	32	3	81	C		
				EB Through	19	37	7	173	D		
				EB Right	142	9	16	205	A		
	WB	36.6	E	WB Left	212	48	59	218	D		
				WB Through	59	41	59	218	D		
				WB Right	142	18	73	242	B		
10- MD 121 at I-270 NB on and off ramp											
10	NB	0.9	A	NB Left	28	8	1	82	A	0.7	A
				NB Through	0	0	0	0	A		
				NB Right	780	1	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.1	A	EB Left	0	0	0	0	A		
				EB Through	448	0	0	0	A		
				EB Right	58	0	0	0	A		
	WB	0.9	A	WB Left	99	3	1	82	A		
				WB Through	421	0	0	52	A		
				WB Right	0	0	0	0	A		

Table B.15: PM Peak - 2016 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
11- MD 121 at I-270 SB on and off ramp											
11	NB			NB Left	0	0	0	0	A	2.1	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	7.3	A	SB Left	137	9	7	123	A		
				SB Through	0	0	0	0	A		
				SB Right	36	0	0	0	A		
	EB	0.3	A	EB Left	29	1	0	15	A		
				EB Through	0	0	0	0	A		
				EB Right	348	0	0	0	A		
	WB	0.1	A	WB Left	0	0	0	0	A		
				WB Through	99	0	0	0	A		
				WB Right	0	0	0	0	A		
12- MD 27 at Observation Dr											
12	NB	40.9	D	NB U-Turn	0	0	0	0	A	22.3	C
				NB Through	73	57	19	86	E		
				NB Right	47	15	19	86	B		
	SB	39.7	D	SB Left	114	46	31	182	D		
				SB Through	41	62	36	244	E		
				SB Right	173	30	58	281	C		
	EB	17.5	B	EB Left	217	27	75	532	C		
				EB Through	2313	17	77	533	B		
				EB Right	111	16	89	571	B		
	WB	25.4	C	WB Left	31	22	120	574	C		
				WB Through	1503	26	120	574	C		
				WB Right	54	8	120	574	A		
13- MD 27 at I-270 NB off ramp											
13	NB	44.0	D	NB Left	434	44	68	271	D	8.6	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.1	A	EB Left	0	0	0	0	A		
				EB Through	1282	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	5.8	A	WB Left	0	0	0	0	A		
				WB Through	1584	6	41	659	A		
				WB Right	0	0	0	0	A		
14- MD 27 at I-270 SB off ramp											
14	NB			NB Left	0	0	0	0	A	4.9	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	47.0	D	SB Left	169	47	33	187	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.3	A	EB Left	0	0	0	0	A		
				EB Through	1353	2	4	144	A		
				EB Right	0	0	0	0	A		
	WB	2.6	A	WB Left	0	0	0	0	A		
				WB Through	1479	3	7	287	A		
				WB Right	0	0	0	0	A		
15- MD 27 at Crystal Rock Dr											
15	NB	22.6	C	NB Left	58	20	55	390	B	30.4	C
				NB Through	967	23	68	390	C		
				NB Right	43	19	72	403	B		
	SB	35.2	D	SB Left	143	61	200	791	E		
				SB Through	1347	36	200	791	D		
				SB Right	203	9	179	785	A		
	EB	42.8	D	EB Left	103	54	28	120	D		
				EB Through	37	46	25	115	D		
				EB Right	47	16	17	141	B		
	WB	27.6	C	WB Left	83	49	70	297	D		
				WB Through	102	43	70	297	D		
				WB Right	552	22	70	297	C		
16- MD 118 at Seneca Meadows Pkwy											
16	NB	3.9	A	NB Left	96	12	1	69	B	8.0	A
				NB Through	1221	3	7	150	A		
				NB Right	0	0	14	203	A		
	SB	6.5	A	SB Left	11	6	14	280	A		
				SB Through	1091	6	17	280	A		
				SB Right	9	3	21	312	A		
	EB	13.2	B	EB Left	18	55	12	140	E		
				EB Through	1	76	12	140	E		
				EB Right	275	10	12	140	B		
	WB	53.6	D	WB Left	93	64	37	199	E		
				WB Through	6	61	33	198	E		
				WB Right	25	13	42	218	B		
17- MD 118 at I-270 NB on ramp											
17	NB			NB Left	0	0	0	0	A	16.2	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	33.9	C	EB Left	436	34	90	505	C		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	10.9	B	WB Left	0	0	0	0	A		
				WB Through	246	2	1	136	A		
				WB Right	1217	13	46	506	B		
18- MD 118 at I-270 SB off ramp											
18	NB			NB Left	0	0	0	0	A	6.0	A
				NB Through	0	0.0	0	0	A		
				NB Right	0	0.0	0	0	A		
	SB	37.2	D	SB Left	130	37.2	22	139	D		
				SB Through	0	0.0	0	0	A		
				SB Right	0	0.0	0	0	A		
	EB	4.7	A	EB Left	0	0.0	0	0	A		
				EB Through	1183	4.7	10	315	A		
				EB Right	0	0.0	0	0	A		
	WB	4.4	A	WB Left	0	0.0	0	0	A		
				WB Through	1540	4.4	9	168	A		
				WB Right	0	0.0	0	0	A		
19- MD 118 at Aircraft Dr											
19	NB	24.3	C	NB Left	42	69	33	176	E	28.0	C
				NB Through	43	70	33	176	E		
				NB Right	195	5	3	79	A		
	SB	91.9	F	SB Left	383	92	223	592	F		
				SB Through	12	85	223	592	F		
				SB Right	96	93	223	592	F		
	EB	17.5	B	EB Left	98	23	58	364	C		
				EB Through	1215	17	58	364	B		
				EB Right	17	14	58	364	B		
	WB	18.8	B	WB Left	14	19	76	498	B		
				WB Through	1384	22	76	498	C		
				WB Right	365	6	76	498	A		
20- Middlebrook Rd at Observation Dr											
20	NB			NB Left	0	0	0	0	A	8.6	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	18.0	B	SB Left	96	35	18	126	D		
				SB Through	0	0	0	0	A		
				SB Right	179	9	18	126	A		
	EB	6.7	A	EB Left	16	8	17	173	A		
				EB Through	1242	7	17	173	A		
				EB Right	0	0	0	0	A		
	WB	8.4	A	WB Left	0	0	0	0	A		
				WB Through	1238	8	24	246	A		
				WB Right	12	6	39	295	A		

Table B.15: PM Peak - 2016 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
21- Middlebrook Rd at I-270 SB on ramp											
21				NB Left	0	0	0	0	A	4.4	A
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
				EB Left	0	0	0	0	A		
	EB	2.7	A	EB Through	685	3	4	105	A		
				EB Right	0	0	0	0	A		
				WB Left	430	7	4	203	A		
	WB	7.1	A	WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
22- Middlebrook Rd at Waring Station Rd											
22				NB Left	156	45	75	316	D	12.8	B
	NB	48.3	D	NB Through	0	0	75	316	A		
				NB Right	219	51	75	316	D		
				SB Left	30	45	7	66	D		
	SB	31.2	C	SB Through	2	37	7	66	D		
				SB Right	19	9	19	104	A		
				EB Left	3	12	23	262	B		
	EB	7.4	A	EB Through	1035	7	23	262	A		
				EB Right	160	7	23	262	A		
				WB Left	256	22	38	359	C		
	WB	9.0	A	WB Through	1740	7	38	359	A		
				WB Right	4	3	38	359	A		
23- MD 124 at MD 355											
23				NB Left	508	65	190	526	E	66.3	E
	NB	52.3	D	NB Through	930	46	188	524	D		
				NB Right	6	10	0	0	B		
				SB Left	143	71	99	347	E		
	SB	30.8	C	SB Through	552	54	99	347	D		
				SB Right	734	5	21	284	A		
				EB Left	481	100	493	1202	F		
	EB	50.1	D	EB Through	2788	50	493	1202	D		
				EB Right	592	10	234	1176	B		
				WB Left	0	0	0	0	A		
	WB	152.1	F	WB Through	1485	154	713	949	F		
				WB Right	65	102	0	0	F		
24- MD 124 at I-270 SB on and off											
24				NB Left	55	67	24	104	E	48.2	D
	NB	66.2	F	NB Through	22	65	24	104	E		
				NB U-Turn	0	0	0	0	A		
				SB Left	559	128	466	2376	F		
	SB	78.4	E	SB Through	9	141	466	2376	F		
				SB Right	444	14	39	424	B		
				EB Left	0	0	0	0	A		
	EB	47.7	D	EB Through	1719	48	338	1095	D		
				EB Right	30	34	353	1118	C		
				WB Left	4	41	76	629	D		
	WB	18.5	B	WB Through	1041	18	76	629	B		
				WB Right	0	0	0	0	A		
25- MD 117 at MD 124											
25				NB Left	45	63	105	606	E	40.1	D
	NB	33.7	C	NB Through	543	50	105	606	D		
				NB Right	446	11	2	138	B		
				SB Left	120	43	100	472	D		
	SB	32.9	C	SB Through	765	37	100	472	D		
				SB Right	144	2	0	0	A		
				EB Left	119	84	143	504	F		
	EB	46.2	D	EB Through	1093	42	142	505	D		
				EB Right	43	40	151	532	D		
				WB Left	402	72	276	1027	E		
	WB	43.3	D	WB Through	1344	39	276	1027	D		
				WB Right	130	1	0	0	A		
26- MD 117 at Bureau Dr											
26				NB Left	78	74	63	260	E	39.2	D
	NB	44.0	D	NB Through	27	74	63	260	E		
				NB Right	260	32	63	260	C		
				SB Left	275	82	106	363	F		
	SB	71.4	E	SB Through	17	89	106	363	F		
				SB Right	66	22	106	363	C		
				EB Left	42	83	154	808	F		
	EB	30.5	C	EB Through	1604	29	156	807	C		
				EB Right	3	24	149	797	C		
				WB Left	19	45	358	1067	D		
	WB	39.7	D	WB Through	1721	42	359	1068	D		
				WB Right	292	28	390	1116	C		
27- MD 117 at I-270 SB off ramp											
27				NB Left	0	0	0	0	A	13.0	B
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
				EB Left	0	0	0	0	A		
	EB	4.7	A	EB Through	905	5	9	409	A		
				EB Right	0	0	0	0	A		
				WB Left	287	39	165	1087	E		
	WB	39.2	E	WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
28- MD 117 at I-270 NB off ramp											
28				NB Left	0	0	0	0	A	38.6	D
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	263	59	479	1892	E		
	SB	71.8	E	SB Through	0	0	0	0	A		
				SB Right	987	75	479	1891	E		
				EB Left	3	140	155	977	F		
	EB	27.5	C	EB Through	902	27	155	977	C		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	15.1	B	WB Through	1331	15	96	380	B		
				WB Right	0	0	96	380	A		
29- MD 117 at Perry Pkwy											
29				NB Left	18	68	13	99	E	40.6	D
	NB	44.8	D	NB Through	21	58	13	98	E		
				NB Right	23	14	22	118	B		
				SB Left	194	83	86	336	F		
	SB	55.1	E	SB Through	14	76	86	336	E		
				SB Right	112	5	86	336	A		
				EB Left	243	68	83	352	E		
	EB	20.7	C	EB Through	873	8	83	352	A		
				EB Right	32	5	68	336	A		
				WB Left	36	109	289	746	F		
	WB	52.4	D	WB Through	1197	54	289	746	D		
				WB Right	291	40	289	746	D		
30- Shady Grove Rd at I-270 NB off ramp											
30				NB Left	0	0	0	0	A	13.9	B
	NB	7.1	A	NB Through	1023	7	16	193	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB	8.7	A	SB Through	1277	9	42	587	A		
				SB Right	0	0	0	0	A		
				EB Left	0	0	0	0	A		
	EB			EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	337	54	63	254	D		
	WB	54.4	D	WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table B.15: PM Peak - 2016 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
31- Shady Grove Rd at I-270 SB off ramp											
31	NB	6.7	A	NB Left	0	0	0	0	A	15.9	B
				NB Through	1463	7	27	391	A		
				NB Right	0	0	0	0	A		
	SB	5.7	A	SB Left	0	0	0	0	A		
				SB Through	839	6	9	190	A		
				SB Right	0	0	0	0	A		
	EB	58.0	E	EB Left	228	56	46	206	E		
				EB Through	0	0	0	0	A		
				EB Right	294	60	63	256	E		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
32- MD 28 at I-270 SB off ramp											
32	NB			NB U-Turn	0	0	0	0	A	8.1	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	36.9	D	SB Left	438	44	73	320	D		
				SB Through	0	0	0	0	A		
				SB Right	98	3	0	47	A		
	EB	2.7	A	EB Left	0	0	0	0	A		
				EB Through	1505	1	0	0	A		
				EB Right	829	6	14	214	A		
	WB	6.5	A	WB Left	0	0	0	0	A		
				WB Through	1721	7	20	224	A		
				WB Right	0	0	0	0	A		
33- MD 28 at I-270 on and off ramps											
33	NB	35.2	D	NB Left	0	0	45	230	A	19.3	B
				NB Through	215	47	53	239	D		
				NB Right	139	17	53	239	B		
	SB	30.9	C	SB Left	11	114	173	270	F		
				SB Through	0	0	0	0	A		
				SB Right	164	25	173	270	C		
	EB	10.3	B	EB Left	257	29	40	253	C		
				EB Through	884	5	40	253	A		
				EB Right	0	0	0	0	A		
	WB	21.4	C	WB Left	38	18	84	375	B		
				WB Through	1180	21	66	339	C		
				WB Right	0	0	0	0	A		
34- MD 189 at Great Falls Rd											
34	NB	39.8	D	NB Left	44	46	12	83	D	13.0	B
				NB Through	11	50	9	81	D		
				NB Right	12	10	9	92	A		
	SB	3.0	A	SB Left	14	50	7	71	D		
				SB Through	11	46	7	71	D		
				SB Right	401	0	0	0	A		
	EB	11.2	B	EB Left	427	22	32	320	C		
				EB Through	670	5	5	142	A		
				EB Right	58	4	10	178	A		
	WB	18.5	B	WB Left	12	22	47	316	C		
				WB Through	803	18	47	315	B		
				WB Right	13	16	63	349	B		
35- MD 189 at I-270 Ramps											
35	NB	46.3	D	NB Left	254	46	45	183	D	42.4	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	59.9	E	SB Left	348	60	166	1034	E		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	27.0	C	EB Left	479	30	88	358	C		
				EB Through	367	24	88	358	C		
				EB Right	0	0	0	0	A		
	WB	49.3	D	WB Left	443	55	106	258	D		
				WB Through	415	44	106	258	D		
				WB Right	0	0	0	0	A		
36- MD 189 at Wooton Pkwy											
36	NB	45.5	D	NB Left	186	58	114	412	E	44.2	D
				NB Through	536	53	114	412	D		
				NB Right	174	10	114	412	B		
	SB	63.5	E	SB Left	248	81	157	660	F		
				SB Through	730	57	160	685	E		
				SB Right	0	0	0	0	A		
	EB	34.8	C	EB Left	118	71	101	427	E		
				EB Through	543	34	101	427	C		
				EB Right	160	11	101	427	B		
	WB	34.3	C	WB Left	160	71	122	610	E		
				WB Through	780	35	122	610	C		
				WB Right	317	15	122	610	B		
37- Montrose Rd at Tower Oaks Blvd											
37	NB	0.4	A	NB Left	0	0	0	0	A	21.0	C
				NB Through	0	0	0	0	A		
				NB Right	520	0	0	0	A		
	SB	96.5	F	SB Left	69	49	78	554	D		
				SB Through	0	0	0	0	A		
				SB Right	271	109	169	601	F		
	EB	6.3	A	EB Left	0	0	0	0	A		
				EB Through	1672	6	30	399	A		
				EB Right	0	0	0	0	A		
	WB	24.3	C	WB Left	70	33	30	399	C		
				WB Through	2502	25	151	770	C		
				WB Right	239	18	151	770	B		
38- Tower Oaks Blvd at I-270 off rmap											
38	NB	24.0	C	NB Left	683	25	51	261	C	18.2	B
				NB Through	0	0.0	44	253	A		
				NB Right	26	7.4	51	261	A		
	SB	17.5	B	SB Left	8	28.8	1	43	C		
				SB Through	0	0.0	1	43	A		
				SB Right	7	4.7	0	30	A		
	EB	11.4	B	EB Left	1	17.7	15	168	B		
				EB Through	309	11.9	15	168	B		
				EB Right	33	6.4	10	159	A		
	WB	12.6	B	WB Left	120	15.6	14	141	B		
				WB Through	188	10.7	14	141	B		
				WB Right	1	2.1	2	97	A		
39- Montrose Rd at Tower Oaks Blvd											
39	NB	17.2	B	NB Left	76	33	62	274	C	57.2	E
				NB Through	606	30	62	274	C		
				NB Right	572	1	0	0	A		
	SB	28.9	C	SB Left	192	59	57	222	E		
				SB Through	395	19	55	222	B		
				SB Right	105	11	49	259	B		
	EB	236.7	F	EB Left	79	194	557	724	F		
				EB Through	443	243	558	725	F		
				EB Right	30	261	581	749	F		
	WB	35.5	D	WB Left	558	43	109	401	D		
				WB Through	466	42	110	401	D		
				WB Right	324	13	130	432	B		
40- Rockledge Blvd at I-270 NB on and off ramp											
40	NB	129.5	F	NB Left	0	0	0	0	A	91.9	F
				NB Through	330	127	533	843	F		
				NB Right	851	130	533	843	F		
	SB	74.8	E	SB Left	0	0	76	205	A		
				SB Through	347	75	76	205	E		
				SB Right	0	0	0	0	A		
	EB	39.7	D	EB Left	5	65	106	357	E		
				EB Through	431	66	106	357	E		
				EB Right	301	1	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table B.15: PM Peak - 2016 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
41- Rockledge Blvd at I-270 SB on and off ramps											
				NB Left	340	36	45	241	D		
	NB	35.6	D	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
41				EB Left	0	0	0	0	A	38.3	D
	EB			EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	343	42	134	635	D		
	WB	39.0	D	WB Through	898	38	134	635	D		
				WB Right	0	0	0	0	A		
42- MD 187 at Tuckerman Ln											
				NB Left	198	15	302	1191	B		
	NB	42.1	D	NB Through	2142	42	302	1191	D		
				NB Right	186	71	302	1191	E		
				SB Left	182	168	2549	2709	F		
	SB	203.6	F	SB Through	1117	203	2549	2709	F		
				SB Right	268	230	2549	2709	F		
42				EB Left	238	52	94	407	D	119.9	F
	EB	51.6	D	EB Through	409	54	95	408	D		
				EB Right	103	43	113	432	D		
				WB Left	463	213	1904	2132	F		
	WB	214.8	F	WB Through	615	231	1904	2132	F		
				WB Right	152	155	1904	2132	F		
43- MD 187 at I-270 NB on and off ramps											
				NB Left	551	32	101	386	C		
	NB	13.7	B	NB Through	2292	9	101	386	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB	23.1	C	SB Through	1246	23	59	229	C		
				SB Right	0	0	0	0	A		
43				EB Left	0	0	0	0	A	17.8	B
	EB			EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	66	58	49	304	E		
	WB	55.0	D	WB Through	71	52	49	304	D		
				WB Right	0	0	0	0	A		
44- MD 187 at I-270 NB on and off ramps											
				NB Left	0	0	0	0	A		
	NB	32.8	D	NB Through	2208	33	105	536	C		
				NB Right	0	0	0	0	A		
				SB Left	149	61	73	295	E		
	SB	20.2	C	SB Through	1163	15	73	295	B		
				SB Right	0	0	0	0	A		
44				EB Left	635	61	148	608	E	34.3	C
	EB	60.9	E	EB Through	0	0	148	608	A		
				EB Right	184	60	90	541	E		
				WB Left	0	0	0	0	A		
	WB			WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
45- MD 187 at Rock Spring Dr											
				NB Left	383	34	90	658	C		
	NB	16.9	B	NB Through	1998	14	91	659	B		
				NB Right	14	12	110	692	B		
				SB Left	20	53	87	450	D		
	SB	28.0	C	SB Through	1159	32	87	450	C		
				SB Right	171	1	58	445	A		
45				EB Left	396	59	97	359	E	24.1	C
	EB	39.8	D	EB Through	37	63	97	359	E		
				EB Right	375	18	97	359	B		
				WB Left	5	32	3	77	C		
	WB	11.4	B	WB Through	12	24	3	77	C		
				WB Right	32	4	1	67	A		
47-Democracy Blvd at I-270 NB off ramp											
				NB Left	165	43	30	142	D		
	NB	43.3	D	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
47				EB Left	0	0	0	0	A	3.1	A
	EB	1.3	A	EB Through	1137	1	3	48	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	0.9	A	WB Through	2129	1	2	62	A		
				WB Right	0	0	0	0	A		
48- Democracy Blvd at I-270 SB on ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
48				EB Left	0	0	0	0	A	6.2	A
	EB	5.1	A	EB Through	1356	5	18	222	A		
				EB Right	0	0	0	0	A		
				WB Left	534	23	38	282	C		
	WB	6.9	A	WB Through	1761	2	30	261	A		
				WB Right	0	0	0	0	A		
49- Democracy Blvd at I-270 SB off ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	182	49	36	161	D		
	SB	36.5	D	SB Through	0	0	0	0	A		
				SB Right	69	2	0	0	A		
49				EB Left	0	0	0	0	A	7.6	A
	EB			EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	3.9	A	WB Through	1761	4	19	275	A		
				WB Right	175	1	0	0	A		
50- MD 190 at Burdette Rd											
				NB Left	26	76	15	100	E		
	NB	73.7	E	NB Through	4	84	15	100	F		
				NB Right	5	56	15	100	E		
				SB Left	34	78	19	140	E		
	SB	31.1	C	SB Through	7	54	19	140	D		
				SB Right	118	16	19	140	B		
50				EB Left	124	89	86	511	F	29.0	C
	EB	17.8	B	EB Through	1164	11	86	511	B		
				EB Right	28	3	71	538	A		
				WB Left	11	113	313	1109	F		
	WB	34.8	C	WB Through	2148	35	313	1109	C		
				WB Right	51	24	313	1109	C		

Table B.15: PM Peak - 2016 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
51- MD 190 at I-270 NB on ramp											
51	NB			NB Left	0	0	0	0	A	18.0	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	71.3	E	EB Left	233	71	104	388	E		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	9.5	A	WB Left	0	0	0	0	A		
				WB Through	1467	10	45	709	A		
				WB Right	0	0	0	0	A		
52- MD 190 at I-270 SB off ramp											
52	NB	74.4	E	NB Left	228	74	99	823	E	14.3	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	3.1	A	EB Left	0	0	0	0	A		
				EB Through	840	3	6	136	A		
				EB Right	0	0	0	0	A		
	WB	11.9	B	WB Left	0	0	0	0	A		
				WB Through	1755	12	38	763	B		
				WB Right	0	0	0	0	A		
53- MD 190 at Seven Locks Rd											
53	NB	0.4	A	NB Left	21	1	0	0	A	24.8	C
				NB Through	243	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	55.7	E	SB Left	306	56	103	369	E		
				SB Through	180	55	103	369	E		
				SB Right	17	55	103	369	E		
	EB	27.5	C	EB Left	22	33	67	377	C		
				EB Through	664	28	67	377	C		
				EB Right	34	25	67	377	C		
	WB	19.3	B	WB Left	270	79	130	534	E		
				WB Through	962	14	130	534	B		
				WB Right	738	4	130	534	A		
54- MD 124 at I-270 NB off ramp											
54	NB	46.7	D	NB Left	0	0	0	0	A	61.2	E
				NB Through	0	0	0	0	A		
				NB Right	2062	47	256	1175	D		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	77.7	E	EB Left	0	0	0	0	A		
				EB Through	1825	78	606	1270	E		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
55- Democracy Blvd at I-270 NB off ramp											
55	NB	48.0	D	NB Left	0	0	0	0	A	12.2	B
				NB Through	0	0	0	0	A		
				NB Right	337	48	55	241	D		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	1.6	A	EB Left	0	0	0	0	A		
				EB Through	1137	2	4	66	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table B.16: PM Peak - 2016 - I-270 Vehicle Network Performance

	2016 No Build	2016 Build	% Change
Total Delay (sec.)	21,792,153	15,965,330	-27%
Average Delay per Vehicle (sec.)	206	153	-26%
Total Travel Time (sec.)	53,628,278	48,319,981	-10%
Vehicles (Arrived)	88,401	89,792	2%
Latent Demand	1,544	2,336	51%
Latent Delay (sec.)	2,650,217	3,468,590	31%
Total Distance (mi.)	484,473	493,212	2%
Average Speed (mph)	33	37	13%

2040 Conditions

AM Peak

Table C.1: AM Peak - 2040- I-270 Vehicle Travel Time

I-270 Northbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Build VISSIM Travel Time (seconds)	% Change	I-270 Southbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Build VISSIM Travel Time (seconds)	% Change
From I-495 interchange					From I-70				
to MD 187	1.8	115.1	109.9	-5%	to MD 85	1.7	260.9	141.6	-46%
to I-270 Split	0.6	47.5	35.5	-25%	to MD 80	5.4	1,374.0	1,260.2	-8%
to Montrose Rd	1.8	139.0	100.2	-28%	to MD 109	3.7	583.2	596.3	2%
to MD 189	1.0	77.0	57.9	-25%	to MD 121	3.6	284.4	280.0	-2%
to MD 28	1.0	61.0	55.5	-9%	to MD 27	2.5	266.9	180.4	-32%
to Shady Grove Rd	1.9	108.7	109.8	1%	to MD 118	1.1	254.6	94.9	-63%
to I-370	0.9	53.0	53.1	0%	to Middlebrook Rd	1.1	206.2	120.5	-42%
to MD 117	1.5	85.5	85.9	0%	to MD 124	2.2	528.0	335.2	-37%
to MD 124	0.6	34.5	34.6	0%	to MD 117	0.9	180.6	199.1	10%
to Middlebrook Rd	2.5	140.8	141.3	0%	to I-370	1.0	94.3	86.4	-8%
to MD 118	1.1	64.7	65.0	0%	to Shady Grove Rd	1.5	124.1	111.5	-10%
to MD 27	0.9	52.0	52.1	0%	to MD 28	1.9	141.9	160.9	13%
to MD 121	2.4	135.6	135.8	0%	to MD 189	1.0	157.8	173.5	10%
to MD 109	4.1	235.2	235.8	0%	to Montrose Rd	1.0	251.0	293.5	17%
to MD 80	3.7	214.0	214.0	0%	to I-270 Split	1.9	243.1	257.0	6%
to MD 85	5.3	310.9	311.1	0%	to MD 187	0.4	30.7	30.6	0%
to I-70	1.4	80.1	80.3	0%	to I-495 interchange	1.9	134.0	134.4	0%
I-270 Total (miles/minutes)	**32.4**	**32.6**	**31.3**	**-4%**	**I-270 Total (miles/minutes)**	**32.7**	**85.3**	**74.3**	**-13%**
I-270 Spur Northbound					**I-270 Spur Southbound**				
From Cabin John Pkwy					From I-70				
to MD 190	0.5	32.4	32.4	0%	to I-270 Split	30.3	4,951.1	4,290.9	-13%
to I-495	1.1	68.6	66.7	-3%	to Democracy Blvd	0.7	91.3	51.8	-43%
to Democracy Blvd	1.4	102.7	93.0	-9%	to I-495	1.3	191.0	99.2	-48%
to I-270 Split	0.9	77.7	51.2	-34%	to MD 190	1.3	101.6	116.5	15%
to I-70	30.0	1,792.1	1,732.2	-3%	to Cabin John Pkwy	0.6	35.1	35.1	0%
I-270 Spur Total (miles/minutes)	**34.0**	**34.6**	**32.9**	**-5%**	**I-270 Spur Total (miles/minutes)**	**34.2**	**89.5**	**76.6**	**-14%**

Table C.2: AM Peak - 2040 - I-270 Local Vehicle Travel Time

I-270 Northbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Build VISSIM Travel Time (seconds)	% Change	I-270 Southbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Build VISSIM Travel Time (seconds)	% Change
From C-D start					From C-D start				
to Montrose Rd	0.8	256.2	51.1	-80%	to Shady Grove	1.3	490.1	355.6	-27%
to MD 189	1.3	471.8	79.1	-83%	to MD 28	1.8	491.5	394.9	-20%
to MD 28	1.0	250.0	61.5	-75%	to MD 189	1.1	481.0	282.1	-41%
to Shady Grove	2.0	117.6	119.5	2%	to Montrose	1.2	344.5	312.9	-9%
to I-370	1.0	56.5	55.3	-2%	to I-270 mainline	0.9	197.1	200.2	2%
to MD 117	1.2	74.0	74.5	1%					
to MD 124	0.8	49.5	50.2	1%					
to I-270 mainline	0.8	49.7	49.9	0%					
I-270 Local Total (miles/minutes)	**8.9**	**22.1**	**9.0**	**-59%**	**I-270 Local Total (miles/minutes)**	**6.3**	**33.4**	**25.8**	**-23%**

Figure C.1: AM Peak - 2040
I-270 Travel Time Graph - Northbound
(From Outer-Loop)

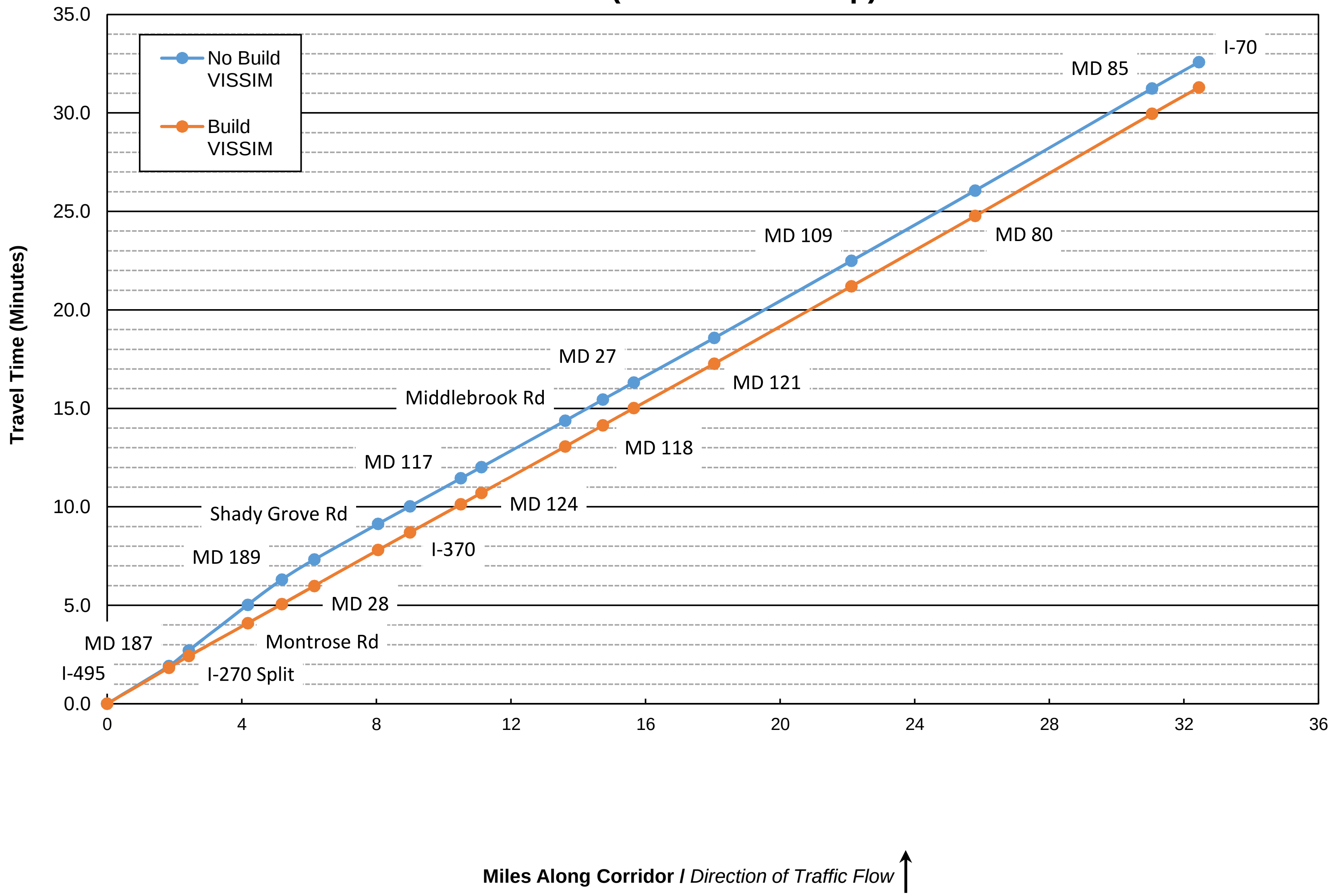
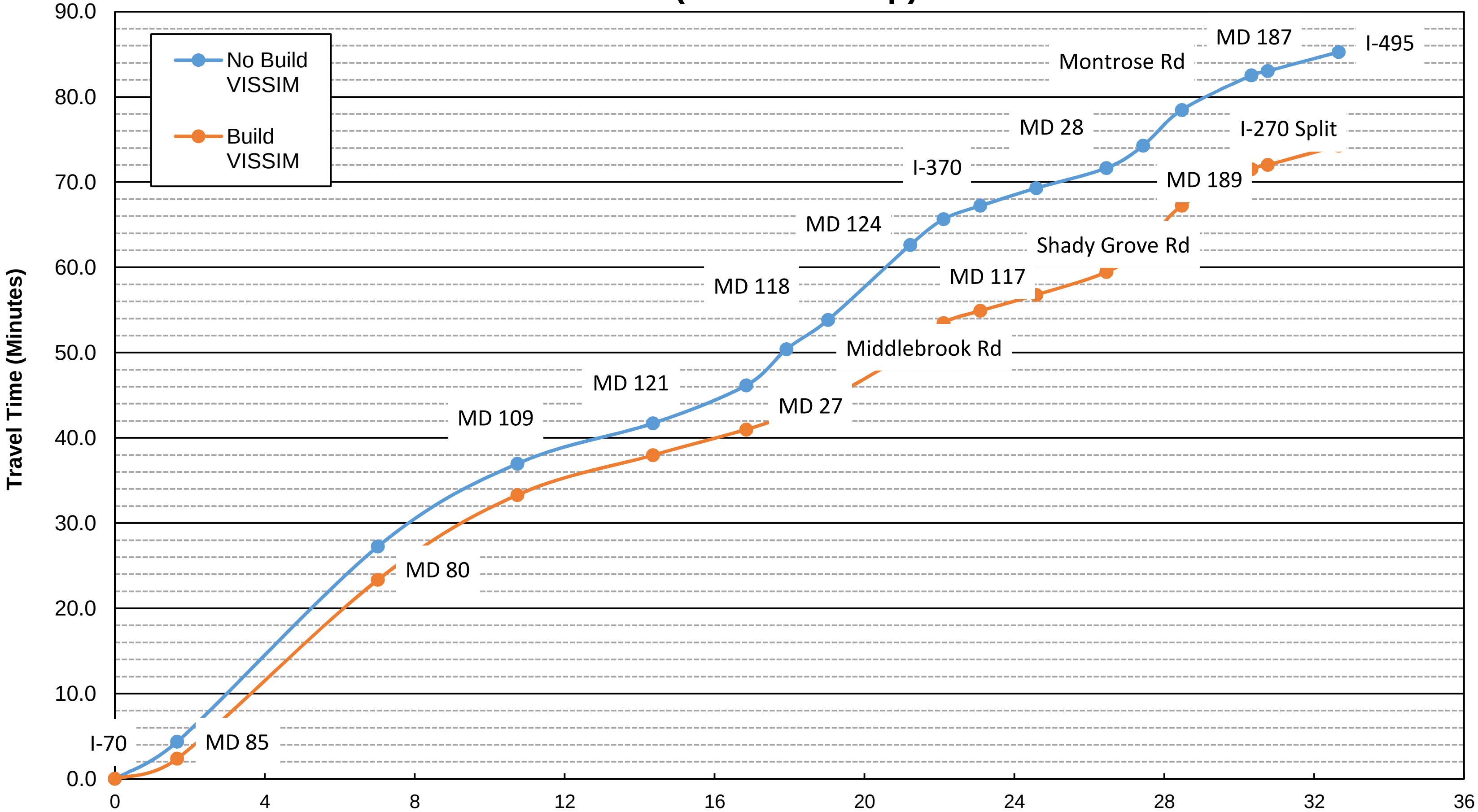
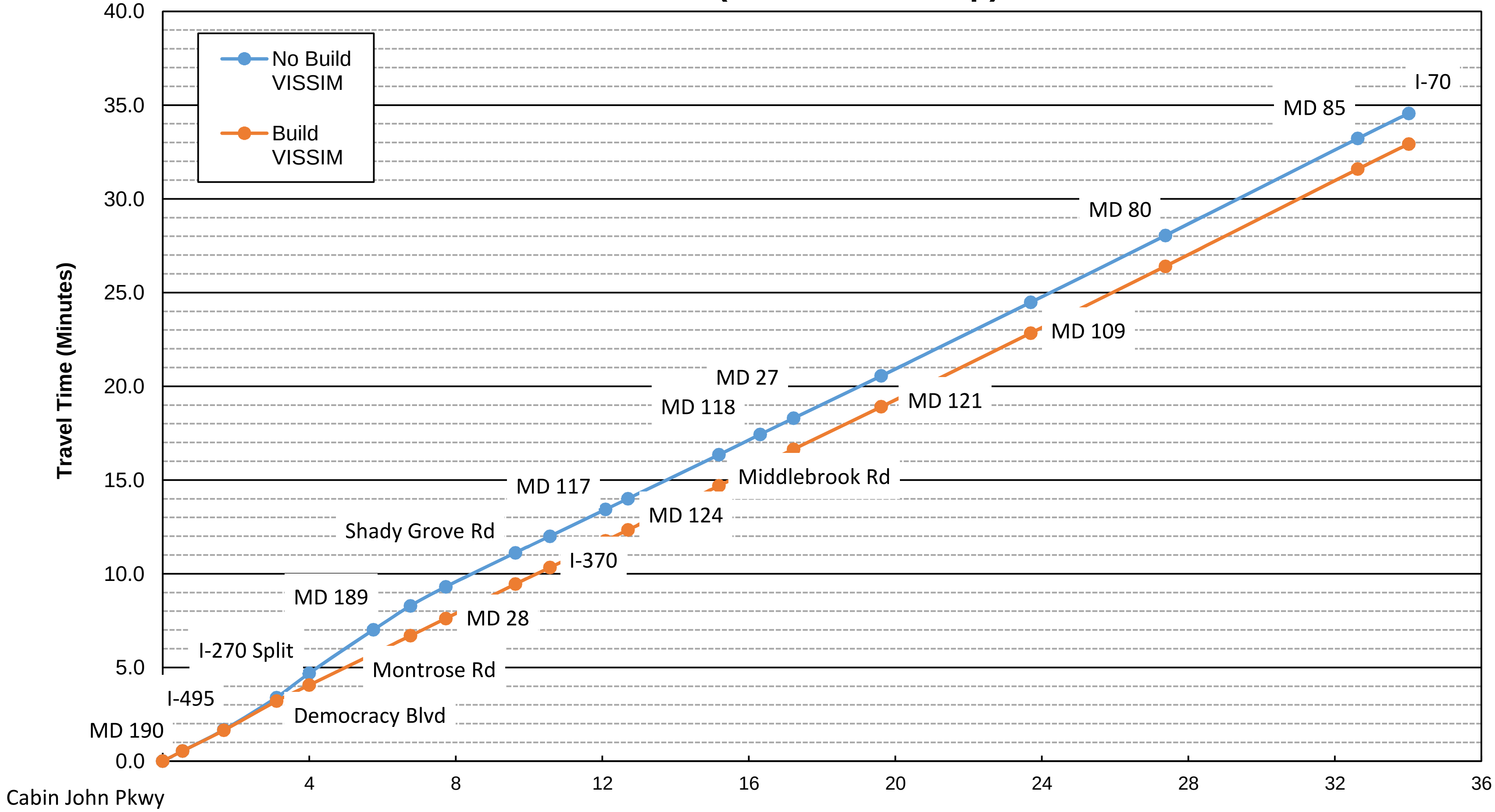


Figure C.2: AM Peak - 2040
I-270 Travel Time Graph - Southbound
(To Inner-Loop)



Miles Along Corridor / *Direction of Traffic Flow*

Figure C.3: AM Peak - 2040
I-270 Spur Travel Time Graph - Northbound
(From Inner-Loop)



Miles Along Corridor / *Direction of Traffic Flow*

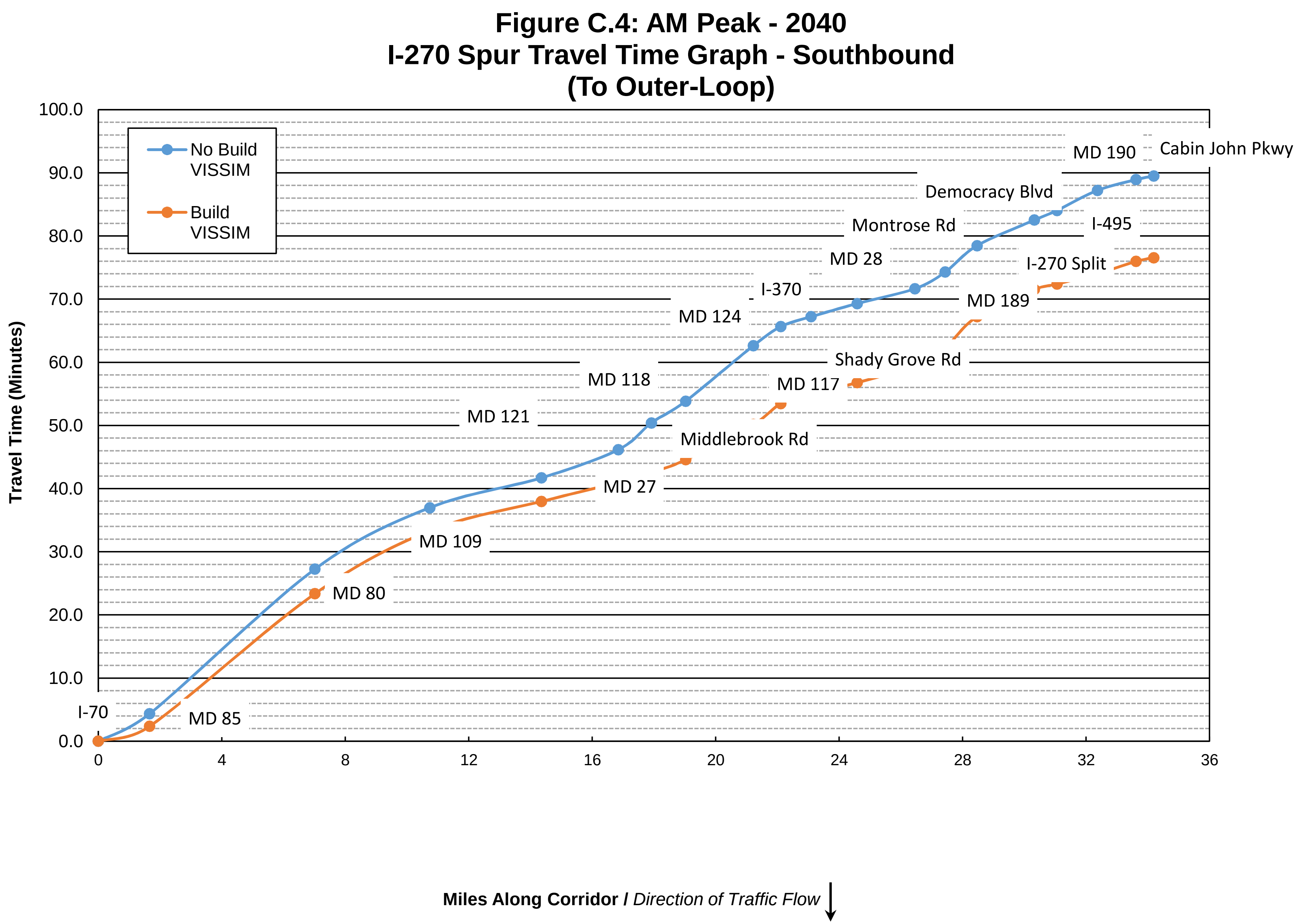
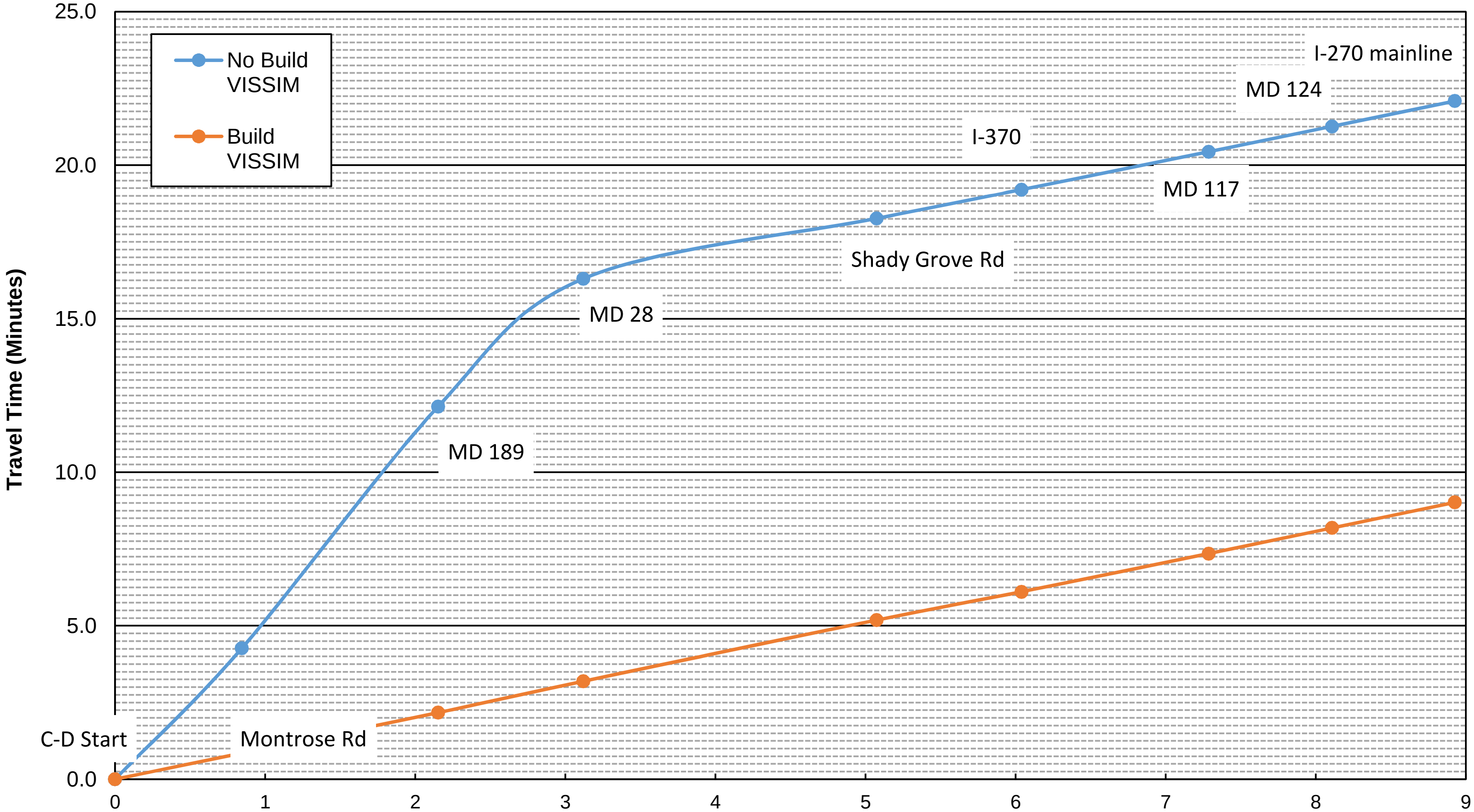


Figure C.4: AM Peak - 2040
I-270 Spur Travel Time Graph - Southbound
(To Outer-Loop)
Travel Time (Minutes)
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
No Build VISSIM
Build VISSIM
I-70
MD 85
MD 80
MD 109
MD 121
MD 27
MD 118
Middlebrook Rd
MD 124
MD 117
I-370
Shady Grove Rd
MD 28
MD 189
Montrose Rd
I-270 Split
Democracy Blvd
I-495
MD 190
Cabin John Pkwy
0
4
8
12
16
20
24
28
32
36
Miles Along Corridor / Direction of Traffic Flow

Figure C.5: AM Peak - 2040
I-270 Local Travel Time Graph - Northbound



Miles Along Corridor / *Direction of Traffic Flow* ↑

Figure C.6: AM Peak - 2040
I-270 Local Travel Time Graph - Southbound

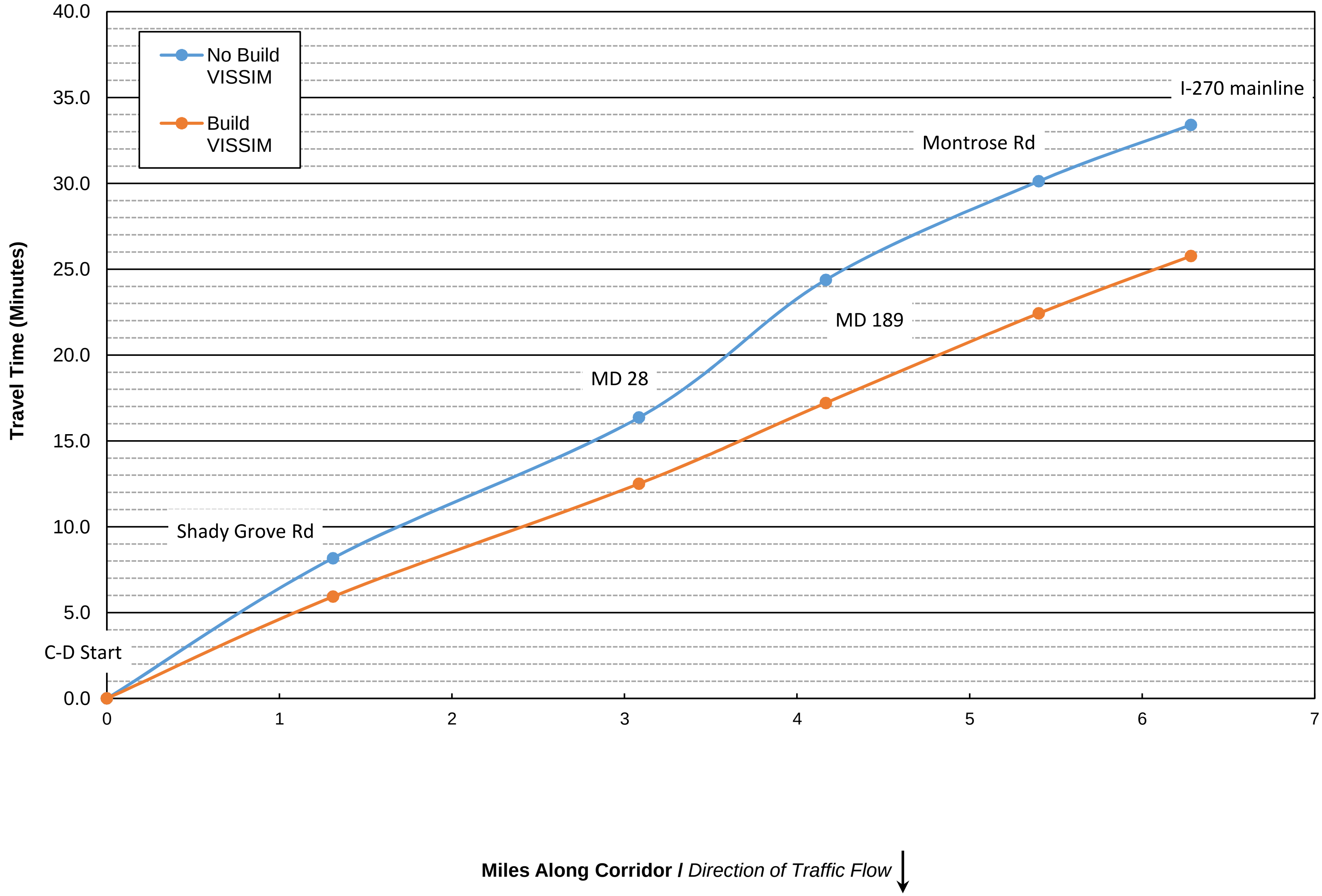


Table C.3: AM Peak - 2040 - I-270 Vehicle Speed

I-270 Northbound	No Build VISSIM Speed (MPH)	Build VISSIM Speed (MPH)	% Change	I-270 Southbound	No Build VISSIM Speed (MPH)	Build VISSIM Speed (MPH)	% Change
From I-495 interchange				From I-70			
to MD 187	57.4	60.1	5%	to MD 85	22.9	42.3	84%
to I-270 Split	44.8	59.9	34%	to MD 80	14.0	15.3	9%
to Montrose Rd	45.4	63.0	39%	to MD 109	23.0	22.5	-2%
to MD 189	47.4	63.0	33%	to MD 121	45.8	46.6	2%
to MD 28	56.9	62.6	10%	to MD 27	33.5	49.6	48%
to Shady Grove Rd	62.9	62.3	-1%	to MD 118	15.2	40.7	168%
to I-370	64.1	64.0	0%	to Middlebrook Rd	19.4	33.2	71%
to MD 117	63.8	63.5	0%	to MD 124	15.0	23.6	58%
to MD 124	64.0	63.8	0%	to MD 117	17.7	16.0	-9%
to Middlebrook Rd	63.6	63.4	0%	to I-370	37.6	41.1	9%
to MD 118	62.3	62.1	0%	to Shady Grove Rd	43.1	48.0	11%
to MD 27	63.4	63.3	0%	to MD 28	47.6	42.0	-12%
to MD 121	63.6	63.5	0%	to MD 189	22.3	20.3	-9%
to MD 109	62.4	62.3	0%	to Montrose Rd	14.8	12.7	-14%
to MD 80	61.9	61.9	0%	to I-270 Split	27.5	26.0	-5%
to MD 85	60.8	60.8	0%	to MD 187	51.0	51.2	0%
to I-70	62.5	62.4	0%	to I-495 interchange	50.8	50.6	0%
I-270 Total (miles/minutes)	**59.8**	**62.2**	**4%**	**I-270 Total (miles/minutes)**	**23.0**	**26.4**	**15%**
I-270 Spur Northbound				**I-270 Spur Southbound**			
From Cabin John Pkwy				From I-70			
to MD 190	59.9	59.9	0%	to I-270 Split	22.1	25.4	15%
to I-495	59.5	61.1	3%	to Democracy Blvd	28.8	50.8	76%
to Democracy Blvd	50.3	55.5	10%	to I-495	24.7	47.6	92%
to I-270 Split	41.3	62.7	52%	to MD 190	44.4	38.7	-13%
to I-70	60.3	62.4	3%	to Cabin John Pkwy	58.5	58.5	0%

Table C.4: AM Peak - 2040 - I-270 Local Vehicle Speed

I-270 Northbound	No Build VISSIM Speed (MPH)	Build VISSIM Speed (MPH)	% Change	I-270 Southbound	No Build VISSIM Speed (MPH)	Build VISSIM Speed (MPH)	% Change
From C-D start				From C-D start			
to Montrose Rd	11.9	59.5	401%	to Shady Grove	9.6	13.3	38%
to MD 189	10.0	59.5	497%	to MD 28	13.0	16.2	24%
to MD 28	13.9	56.7	307%	to MD 189	8.1	13.8	71%
to Shady Grove	59.8	58.9	-2%	to Montrose	12.9	14.2	10%
to I-370	61.5	62.8	2%	to I-270 mainline	16.1	15.9	-2%
to MD 117	60.6	60.2	-1%				
to MD 124	59.8	59.0	-1%				
to I-270 mainline	59.3	59.0	0%				
I-270 Local Total (miles/minutes)	**24.2**			**I-270 Local Total (miles/minutes)**	**11.3**		

Figure C.7: HCM 2010 Density Level of Service Criteria (pc/mi/ln)

HCM 2010 Freeway LOS	
< 11	A
> 11 - 18	B
> 18 - 26	C
> 26 - 35	D
> 35 - 45	E
> 45	F
HCM 2010 Freeway Merge and Diverge Segment LOS	
< 10	A
> 10 - 20	B
> 20 - 28	C
> 28 - 35	D
> 35 - 40	E
> 40	F
HCM 2010 Freeway Weaving Segment LOS	
< 10	A
> 10 - 20	B
> 20 - 28	C
> 28 - 35	D
> 35 - 40	E
> 40	F
HCM 2010 C-D Weaving Segment LOS	
< 12	A
> 12 - 24	B
> 24 - 32	C
> 32 - 36	D
> 36 - 40	E
> 40	F

Table C.5: AM Peak - 2040 - I-270 Vehicle Density

		2040 No Build		2040 Build					2040 No Build		2040 Build		
I-270 Northbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change	I-270 Southbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change
I-270	Freeway	40	E	27	D	-31%	I-270	Freeway	45	F	21	C	-54%
I-270 Diverge to MD 187	Diverge	35	D	21	C	-40%	I-270 Merge from WB I-70	Merge	62	F	18	B	-71%
I-270	Freeway	45	F	24	C	-46%	I-270	Freeway	67	F	34	D	-50%
I-270 Diverge to Rockledge Rd	Diverge	35	D	21	C	-40%	I-270 Merge from EB I-70	Merge	57	F	30	D	-47%
I-270	Freeway	48	F	20	C	-58%	I-270	Freeway	67	F	45	E	-33%
I-270 Weave from MD 187 to I-270 HOV	Weave	30	D	11	B	-63%	I-270 Diverge to SB MD 85	Diverge	70	F	51	F	-27%
I-270 Lane Drop	Merge	47	F	8	A	-82%	I-270	Freeway	92	F	63	F	-32%
I-270	Freeway	64	F	18	C	-72%	I-270 Diverge to NB MD 85	Diverge	56	F	39	E	-31%
I-270 Merge from I-270 Spur	Merge	63	F	14	B	-77%	I-270	Freeway	119	F	81	F	-32%
I-270 Weave from I-270 HOV to I-270 C-D	Weave	68	F	22	C	-68%	I-270 Merge from MD 85	Merge	104	F	68	F	-35%
I-270	Freeway	38	E	21	C	-45%	I-270	Freeway	112	F	110	F	-2%
I-270 Diverge to C-D (MD 189)	Diverge	31	D	23	C	-25%	I-270 Diverge to MD 80	Diverge	61	F	44	F	-27%
I-270	Freeway	23	C	19	C	-16%	I-270	Freeway	108	F	103	F	-5%
I-270 Diverge to C-D (MD 28)	Diverge	50	F	21	C	-58%	I-270 Merge from MD 80	Merge	111	F	58	F	-48%
I-270	Freeway	14	B	16	B	14%	I-270	Freeway	75	F	76	F	1%
I-270 Merge from C-D (MD 189)	Merge	14	B	19	B	37%	I-270 Diverge to MD 109	Diverge	41	F	39	E	-5%
I-270 Diverge to C-D (Shady Grove Rd)	Diverge	18	B	22	C	22%	I-270	Freeway	80	F	78	F	-2%
I-270	Freeway	12	B	16	B	30%	I-270 Merge from MD 109	Merge	87	F	78	F	-10%
I-270 Weave from C-D (MD 28) to C-D (Shady Grove Rd)	Weave	10	B	14	B	32%	I-270	Freeway	44	E	45	E	1%
I-270	Freeway	10	A	13	B	28%	I-270 Diverge to SB Weigh Station	Diverge	19	B	18	B	-4%
I-270 Merge from C-D (Shady Grove Rd)	Merge	9	A	11	B	28%	I-270	Freeway	38	E	38	E	0%
I-270	Freeway	12	B	14	B	26%	I-270 Merge from SB Weigh Station	Merge	20	B	19	B	-7%
I-270 Merge from C-D (I-370)	Merge	10	B	12	B	15%	I-270	Freeway	41	E	40	E	-1%
I-270 Diverge to C-D (MD 117)	Diverge	16	B	19	B	18%	I-270 Diverge to MD 121	Diverge	20	B	16	B	-17%
I-270	Freeway	12	B	14	B	16%	I-270	Freeway	28	D	23	C	-18%
I-270 Merge from C-D (MD 124)	Merge	14	B	15	B	5%	I-270 Merge from WB MD 121	Merge	33	D	20	B	-39%
I-270	Freeway	16	B	18	B	10%	I-270	Freeway	43	E	34	D	-22%
I-270 Diverge to EB Middlebrook Rd	Diverge	10	B	11	B	8%	I-270 Merge from EB MD 121	Merge	37	E	27	D	-26%
I-270	Freeway	15	B	16	B	9%	I-270	Freeway	55	F	35	E	-36%
I-270 Diverge to WB Middlebrook Rd	Diverge	10	A	10	B	8%	I-270 Diverge to MD 27	Diverge	57	F	22	C	-61%
I-270	Freeway	13	B	14	B	8%	I-270	Freeway	81	F	25	C	-69%
I-270 Diverge to EB MD 118	Diverge	11	B	12	B	11%	I-270 Merge from WB MD 27	Merge	90	F	28	C	-69%
I-270 Diverge to WB MD 118	Diverge	15	B	16	B	6%	I-270	Freeway	82	F	41	E	-50%
I-270	Freeway	13	B	14	B	8%	I-270 Weave from EB MD 27 to MD 118	Weave	81	F	38	E	-53%
I-270 Weave from MD 118 to MD 27	Weave	13	B	13	B	6%	I-270	Freeway	91	F	53	F	-42%
I-270	Freeway	12	B	13	B	7%	I-270 Merge from WB MD 118	Merge	73	F	45	F	-38%
I-270 Merge from EB MD 27	Merge	13	B	13	B	6%	I-270	Freeway	85	F	60	F	-29%
I-270	Freeway	14	B	14	B	6%	I-270 Merge from EB MD 118	Merge	73	F	54	F	-26%
I-270 Merge from WB MD 27	Merge	11	B	11	B	5%	I-270	Freeway	70	F	48	F	-32%
I-270	Freeway	14	B	15	B	5%	I-270 Merge from Middlebrook Rd	Merge	113	F	70	F	-38%
I-270 Diverge to MD 121	Diverge	11	B	12	B	5%	I-270	Freeway	86	F	63	F	-26%

Table C.5: AM Peak - 2040 - I-270 Vehicle Density

		2040 No Build		2040 Build					2040 No Build		2040 Build		
I-270 Northbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change	I-270 Southbound	Type	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	% Change
I-270	Freeway	11	A	11	B	5%	I-270 Diverge to Watkins Mill Rd	Diverge	81	F	66	F	-18%
I-270 Merge from EB MD 121	Merge	10	A	10	B	4%	I-270	Freeway	124	F	56	F	-55%
I-270 Lane Drop	Merge	13	B	14	B	5%	I-270 Diverge to MD 124	Diverge	89	F	35	D	-61%
I-270	Freeway	19	C	20	C	5%	I-270	Freeway	133	F	90	F	-33%
I-270 Diverge to NB Weigh Station	Diverge	10	B	11	B	5%	I-270 Merge from Watkins Mill	Merge	158	F	160	F	1%
I-270	Freeway	21	C	22	C	4%	I-270	Freeway	99	F	103	F	4%
I-270 Merge from NB Weight Station	Merge	10	B	11	B	4%	I-270 Merge from WB MD 124	Merge	132	F	139	F	5%
I-270	Freeway	21	C	22	C	3%	I-270	Freeway	53	F	55	F	5%
I-270 Diverge to MD 109	Diverge	11	B	12	B	3%	I-270 Merge from MD 117	Merge	49	F	46	F	-5%
I-270	Freeway	19	C	20	C	3%	I-270	Freeway	48	F	38	E	-20%
I-270 Merge from MD 109	Merge	11	B	11	B	4%	I-270 Diverge to I-370	Diverge	41	F	32	D	-22%
I-270	Freeway	21	C	21	C	3%	I-270	Freeway	49	F	32	D	-35%
I-270 Diverge to MD 80	Diverge	12	B	11	B	-6%	I-270 Diverge to I-270 C-D	Diverge	96	F	63	F	-34%
I-270	Freeway	19	C	19	C	1%	I-270	Freeway	20	C	17	B	-12%
I-270 Merge from MD 80	Merge	14	B	14	B	1%	I-270 Merge from I-270 (I-370)	Merge	20	C	22	C	8%
I-270	Freeway	24	C	25	C	2%	I-270 Diverge to I-270 C-D (Shady Grove Rd)	Diverge	27	C	28	C	4%
I-270 Diverge to Scenic View	Diverge	12	B	12	B	0%	I-270	Freeway	21	C	20	C	-3%
I-270	Freeway	24	C	25	C	1%	I-270 Merge from I-270 C-D (Shady Grove Rd Northern)	Merge	18	B	20	C	13%
I-270 Merge from Scenic View	Merge	12	B	12	B	2%	I-270	Freeway	26	C	34	D	33%
I-270	Freeway	25	C	25	C	1%	I-270 Merge from I-270 C-D (Shady Grove Rd Southern)	Merge	32	D	54	F	71%
I-270 Diverge to NB MD 85	Diverge	14	B	14	B	2%	I-270 Diverge to I-270 C-D (MD 189)	Diverge	46	F	60	F	30%
I-270	Freeway	23	C	24	C	2%	I-270	Freeway	82	F	89	F	9%
I-270 Diverge to SB MD 85	Diverge	17	B	18	B	5%	I-270 Merge from I-270 C-D (MD 189)	Merge	106	F	121	F	14%
I-270	Freeway	19	C	19	C	1%	I-270	Freeway	77	F	82	F	6%
I-270 Weave from MD 85 to I-70	Weave	13	B	13	B	2%	I-270 Merge from I-270 C-D	Merge	39	E	38	E	-2%
I-270	Freeway	17	B	17	B	1%	I-270 Diverge to I-270 HOV Lane	Diverge	19	B	27	C	43%
							I-270 Diverge to I-270 Spur	Diverge	40	E	35	D	-12%
							I-270	Freeway	23	C	25	C	7%
							I-270 Diverge to Rockledge Dr / MD 187	Diverge	17	B	18	B	6%
							I-270	Freeway	23	C	25	C	7%
							I-270 Merge from Rockledge Dr	Merge	19	B	20	B	2%
							I-270	Freeway	24	C	26	C	7%
							I-270 Merge from Rockledge Dr / MD 187	Merge	22	C	22	C	2%
							I-270	Freeway	26	C	28	D	7%

Table C.6: AM Peak - 2040 - I-270 Spur Vehicle Density

		2040 No Build		2040 Build					2040 No Build		2040 Build		
I-270 Spur Northbound	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**	**I-270 Southbound**	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**
I-270 Spur	Freeway	57	F	57	F	0%	I-270 Spur	Freeway	49	F	28	D	-41%
I-270 Spur Merge from Clara Barton Parkway	Merge	25	C	25	C	0%	I-270 Spur Weave from I-270 HOV to Democracy Blvd	Weave	60	F	31	D	-49%
I-270 Spur	Freeway	39	E	39	E	0%	I-270 Spur	Freeway	54	F	30	D	-46%
I-270 Diverge to MD 190	Diverge	28	D	28	D	0%	I-270 Merge from Democracy Blvd	Merge	30	D	16	B	-47%
I-270 Spur	Freeway	34	D	34	D	0%	I-270 Spur Lane Drop	Merge	54	F	34	D	-37%
I-270 Spur Merge from Cabin John Parkway	Merge	25	C	25	C	-3%	I-270 Spur	Freeway	75	F	33	D	-56%
I-270 Spur Merge from MD 190	Merge	26	C	24	C	-6%	I-270 Spur Merge from I-495	Merge	37	E	66	F	79%
I-270 Spur	Freeway	35	D	32	D	-9%	I-270 Spur	Freeway	45	F	53	F	17%
I-270 Spur Diverge to I-495	Merge	38	E	34	D	-11%	I-270 Spur Diverve to EB MD 190	Diverge	56	F	68	F	22%
I-270 Spur	Freeway	40	E	33	D	-17%	I-270 Spur Diverve to Cabin John Pkwy	Diverge	27	C	27	C	-2%
I-270 Spur Diverge to Democracy Blvd	Diverge	33	D	27	C	-17%	I-270 Spur	Freeway	29	D	29	D	-1%
I-270 Spur	Freeway	36	E	26	C	-30%	I-270 Merge from MD 190	Merge	26	C	25	C	-2%
I-270 Spur Merge from EB Democracy Blvd	Merge	30	D	16	B	-48%	I-270 Spur	Freeway	34	D	34	D	0%
I-270 Spur	Freeway	39	E	24	C	-39%	I-270 Diverge to WB Clara Barton Pkwy	Diverge	23	C	23	C	0%
I-270 Spur Merge from WB Democracy Blvd	Merge	30	D	16	B	-46%	I-270 Spur	Freeway	33	D	33	D	0%
I-270 Spur	Freeway	43	E	25	C	-42%	I-270 Merge from Clara Barton Pkwy	Merge	30	D	30	D	-1%
I-270 Spur Merge from Westlake Terrace	Merge	45	F	25	C	-45%							
I-270 Spur	Freeway	50	F	26	C	-49%							

Table C.7: AM Peak - 2040 - I-270 Local Vehicle Density

		2040 No Build		2040 Build					2040 No Build		2040 Build		
I-270 Northbound	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**	**I-270 Souhbound**	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**
I-270 C-D	Freeway	84	F	21	C	-75%	I-270 C-D	Freeway	107	F	81	F	-25%
I-270 C-D Diverge to EB Montrose Rd	Diverge	48	F	23	C	-52%	I-270 C-D Weave from I-370 EB to I-270	Weave	128	F	101	F	-21%
I-270 C-D	Freeway	80	F	19	C	-76%	I-270 C-D Diverge to Shady Grove Rd	Diverge	115	F	105	F	-9%
I-270 C-D Weave between Montrose Rd Loop Ramps	Weave	69	F	15	B	-79%	I-270 C-D	Freeway	137	F	136	F	-1%
I-270 C-D	Freeway	84	F	18	C	-78%	I-270 C-D Merge from WB Shady Grove Rd	Merge	106	F	104	F	-2%
I-270 C-D Merge from WB Montrose Rd	Merge	89	F	18	B	-80%	I-270 C-D	Freeway	113	F	112	F	-1%
I-270 C-D	Freeway	98	F	29	D	-71%	I-270 C-D Merge from EB Shady Grove Rd	Merge	77	F	73	F	-6%
I-270 C-D Merge from I-270	Merge	96	F	31	D	-67%	I-270 C-D	Freeway	93	F	91	F	-2%
I-270 C-D	Freeway	104	F	31	D	-70%	I-270 C-D Merge from I-270	Merge	98	F	93	F	-4%
I-270 C-D Diverge to MD 189	Diverge	58	F	17	B	-71%	I-270 C-D Diverge to I-270	Diverge	56	F	42	F	-25%
I-270 C-D	Freeway	111	F	24	C	-78%	I-270 C-D Diverge to I-270	Diverge	64	F	30	D	-53%
I-270 C-D Merge from MD 189	Merge	101	F	18	B	-82%	I-270 C-D	Freeway	75	F	19	C	-74%
I-270 C-D	Freeway	114	F	32	D	-72%	I-270 C-D Diverge to MD 28	Diverge	62	F	13	B	-80%
I-270 C-D Weave between I-270 (to MD 28 from MD 189)	Weave	108	F	30	C	-72%	I-270 C-D	Freeway	128	F	14	B	-89%
I-270 C-D	Freeway	106	F	32	D	-70%	I-270 C-D Merge from WB MD 28	Merge	160	F	30	D	-81%
I-270 C-D Diverge to MD 28	Diverge	64	F	22	C	-66%	I-270 C-D	Freeway	132	F	66	F	-50%
I-270 C-D	Freeway	87	F	27	D	-69%	I-270 C-D Merge from EB MD 28	Merge	152	F	142	F	-7%
I-270 C-D Weave between MD 28 Ramps	Weave	109	F	33	D	-70%	I-270 C-D	Freeway	123	F	118	F	-4%
I-270 C-D	Freeway	7	A	10	A	61%	I-270 C-D Merge from I-270	Merge	124	F	119	F	-4%
I-270 C-D Merge from MD 28 WB	Merge	6	A	7	A	15%	I-270 C-D	Freeway	95	F	88	F	-8%
I-270 C-D Merge from I-270 and Drop Lane	Merge	7	A	10	A	37%	I-270 C-D Diverge to MD 189	Diverge	60	F	56	F	-7%
I-270 C-D Diverge to I-270	Diverge	12	B	15	B	32%	I-270 C-D	Freeway	117	F	119	F	2%
I-270 C-D	Freeway	19	C	25	C	29%	I-270 C-D Merge from MD 189	Merge	120	F	118	F	-2%
I-270 C-D Diverge to Shady Grove Rd	Diverge	15	B	19	B	26%	I-270 C-D Diverge to I-270	Diverge	84	F	75	F	-11%
I-270 C-D	Freeway	5	A	6	A	24%	I-270 C-D	Freeway	92	F	68	F	-26%
I-270 C- D Merge from I-270 and EB Shady Grove Rd	Merge	8	A	10	A	19%	I-270 C-D Diverge to WB Montrose Rd	Diverge	55	F	45	F	-18%
I-270 C-D	Freeway	8	A	9	A	19%	I-270 C-D	Freeway	98	F	90	F	-9%
I-270 C-D Merge from WB Shady Grove Rd	Merge	10	A	11	B	6%	I-270 Weave between Montrose Rd Loops	Weave	94	F	89	F	-6%
I-270 C-D Diverge to I-270	Diverge	14	B	13	B	-12%	I-270 C-D	Freeway	76	F	84	F	12%
I-270 C-D	Freeway	13	B	10	A	-26%	I-270 C-D Merge from EB Montrose Rd	Merge	56	F	66	F	18%
I-270 C-D Diverge to I-370	Diverge	13	B	15	B	18%	I-270 C-D	Freeway	54	F	62	F	14%
I-270 C-D	Freeway	2	A	3	A	17%							
I-270 Merge from I-370 EB	Merge	7	A	8	A	3%							
I-270 C-D	Freeway	8	A	8	A	5%							
I-270 C-D Weave from I-370 to I-270	Weave	19	B	19	B	0%							
I-270 C-D	Freeway	14	B	14	B	2%							
I-270 C-D Weave from I-270 to MD 117	Weave	19	B	22	B	15%							
I-270 C-D Diverge to MD 124	Diverge	13	B	14	B	11%							
I-270 C-D	Freeway	13	B	15	B	10%							
I-270 C-D Merge from EB MD 124	Merge	12	B	13	B	8%							
I-270 C-D Merge From WB MD 124	Merge	12	B	13	B	4%							
I-270 C-D	Freeway	10	A	9	A	-5%							
I-270 C-D Merge fromWatkins Mill	Merge	10	A	9	A	-11%							

Table C.8: AM Peak - 2040 - I-270 Vehicle Throughput

I-270 Northbound	No Build VISSIM Throughput	Build VISSIM Throughput	% Change	I-270 Southbound	No Build VISSIM Throughput	Build VISSIM Throughput	% Change
Between I-495 and MD 187	4485	4861	8%	North of I-70	2514	2527	1%
Between MD 187 on and off ramps	3881	4320	11%	Between I-70 on ramps	2842	2928	3%
Between Rockledge Blvd on and off ramps	3138	3624	15%	From I-70 interchange to MD-85	4882	5155	6%
Between Rockledge Dr and I-270 Spur	2720	3293	21%	Between MD-85 on and off ramps	2530	2639	4%
Between I-270 Spur and Montrose Rd	7422	8821	19%	Between MD-85 and MD-80	3043	2967	-2%
Between Montrose Rd on and off ramps	4321	5079	18%	Between MD-80 on and off ramps	2724	2725	0%
Between Montrose Rd and MD 189	4064	4732	16%	Between MD-80 and Md-109	3532	3563	1%
Between MD 189 and MD 28	4018	4740	18%	Between MD-109 on and off ramps	3430	3509	2%
Between MD 28 on and off ramps	4122	5146	25%	Between MD-109 and MD-121	4100	4121	1%
Between MD 28 and Shady Grove Rd	2980	3803	28%	Between MD-121 on and off ramps	3551	3587	1%
Between Shady Grove Rd and I-370	2552	3270	28%	Between MD-121 and MD-27	4802	5121	7%
Between I-370 on and off ramps	2849	3575	25%	Between MD-27 on and off ramps	4223	4733	12%
Between I-370 and MD 117	3979	4716	19%	Between MD-27 and MD-118	4688	5276	13%
Between MD 117 and MD 124	3010	3495	16%	Between MD-118 on and off ramps	4542	5071	12%
Between MD-124 on and off ramps	3023	3492	16%	Between MD-118 and Middlebrook Rd	5199	5732	10%
Between Watkins Mill Rd and Middlebrook Rd	3974	4357	10%	Between Middlebrook Rd on and off ramps	5197	5717	10%
Between Middlebrook Rd on and off ramps	3705	4031	9%	Between Middlebrook Rd and MD-124	6832	7528	10%
Between Middlebrook Rd and MD 118	3293	3576	9%	Between MD-124 on and off ramps	5415	5212	-4%
Between MD-118 on and off ramps	2981	3231	8%	Between MD-124 and MD-117	6469	6112	-6%
Between MD 118 and MD 27	2827	3018	7%	Between MD-117 and I-370	8146	7829	-4%
Between MD-27 on and off ramps	2280	2438	7%	Between I-370 on and off ramps	2997	2948	-2%
Between MD 27 and MD 121	2687	2833	5%	Between I-370 on ramp to Shady Grove Rd	3871	4172	8%
Between MD-121 on and off ramps	1970	2074	5%	Between Shady Grove Rd and MD 28	3552	3638	2%
Between MD 121 and MD 109	2497	2604	4%	Between MD 28 on and off ramps	4372	4458	2%
Between MD-109 on and off ramps	2327	2403	3%	Between MD 28 and MD 189	3946	3897	-1%
Between MD 109 and MD 80	2487	2555	3%	Between MD 189 and Montrose Rd	4070	3891	-4%
Between MD-80 on and off ramps	2222	2274	2%	Between Montrose Rd on and off ramps	5046	4919	-3%
Between MD 80 and MD 85	2916	2953	1%	Between Montose Rd and I-270 Spur	8064	8051	0%
Between MD-85 on and off ramps	2213	2233	1%	Between I-270 Spur and Rockledge Blvd	3823	3940	3%
Between MD 85 and I-70	3227	3248	1%	Between Rockledge Blvd on and off ramps	2733	2759	1%
North of I-70	2081	2091	0%	Between MD 187 on and off ramps	2887	2913	1%
				Between MD 187 and I-495	2902	3008	4%
I-270 Spur Northbound				**I-270 Spur Southbound**			
Between I-495 and Democracy Blvd	5264	5477	4%	Between I-270 Split and HOV on ramp	4251	4272	0%
Between Democracy Blvd on and off ramps	4077	4271	5%	Between HOV on ramp and Democracy Blvd	4186	4268	2%
Between Democracy Blvd and I-270 Split	4219	4558	8%	Between Democracy Blvd on and off ramps	3670	3724	1%
				Between Democracy Blvd and I-495	4194	4284	2%

Table C.9: AM Peak - 2040 - I-270 Local Vehicle Throughput

I-270 Local Northbound	No Build VISSIM Throughput	Build VISSIM Throughput	% Change	I-270 Local Southbound	No Build VISSIM Throughput	Build VISSIM Throughput	% Change
Between Montrose Rd EB off ramp and and EB on ramp	1707	2363	38%	Between I-370 on ramp and I-270 off ramp	3627	4122	14%
Between Montrose Rd EB on ramp and WB off ramp	1884	2616	39%	Between I-270 off ramp and Shady Grove off ramp	2767	2891	4%
Between Montrose Rd WB off ramp and on ramp	1556	2196	41%	Between Shady Grove off ramp and Shady Grove WB on ramp	1593	1568	-2%
Between Montrose Rd WB on ramp and I-270 on ramp	2215	3294	49%	Between Shady Grove WB and EB on ramps	2225	2204	-1%
Between I-270 on ramp and MD 189 off ramp	2316	3630	57%	Between Shady Grove on ramp and I-270 on ramp	2594	2586	0%
Between MD 189 ramps	1739	2930	68%	Between I-270 on ramp and I-270 off ramp1	3272	3328	2%
Between MD 189 off ramp and I-270 on ramp	2036	3516	73%	Between I-270 off ramp1 and I-270 off ramp2	2767	2772	0%
Between I-270 on ramp and I-270 off ramp	2547	4292	69%	Between I-270 off ramp2 and MD 28 off ramp	1961	1888	-4%
Between I-270 off ramp and MD 28 EB off ramp	1823	3108	70%	Between MD 28 off ramp and MD 28 WB on ramp	1428	1318	-8%
Between MD 28 EB off ramp to MD 28 EB on ramp	1585	2745	73%	Between MD 28 WB on ramp and MD 28 EB on ramp	1700	1629	-4%
Between MD 28 EB on ramp and MD 28 WB off ramp	1616	2798	73%	Between MD 28 EB on ramp and I-270 on ramp	2375	2529	6%
Between MD 28 WB off ramp and MD 28 WB on ramp	751	1259	68%	Between I-270 on ramp and MD 189 off ramp	2871	3064	7%
Between MD 28 WB on ramp and I-270 on ramp	1263	1780	41%	Between MD 189 on and off ramps	2353	2474	5%
Between I-270 on ramp and I-270 off ramp	2439	3113	28%	Between MD 189 on ramp and I-270 off ramp	3387	3652	8%
Between I-270 off ramp and Shady Grove off ramp	2131	2668	25%	Between I-270 off ramp and Montrose Rd off ramp	2357	2450	4%
Between Shady Grove off ramp and I-270 on ramp	322	400	24%	Between Montrose Rd off ramp and Montrose Rd WB on ramp	2251	2316	3%
Between I-270 on ramp and Shady Grove WB on ramp	1448	1720	19%	Between Montrose Rd WB on ramp and EB off ramp	2992	3340	12%
Between Shady Grove WB on ramp and I-270 off ramp	1788	2062	15%	Between Montrose Rd EB off and on ramps	2336	2575	10%
Between I-270 off ramp and I-370 off ramp	1515	1770	17%	Between Montrose Rd EB off ramp and I-270	3139	3359	7%
Between I-370 off ramp and I-370 EB on ramp	286	335	17%				
Between I-370 EB and WB on ramps	919	968	5%	HOV Express - Northern Terminus	0	707	
Between I-370 WB on ramp and I-270 off ramp	2785	2835	2%	Local HOV (I-370 to Shady Grove)	907	524	
Between I-270 off ramp and I-270 on ramp	1670	1697	2%	Local HOV (Shady Grove to MD-28)	1120	923	
Between I-270 on ramp and MD 117 off ramp	2654	2930	10%	Local HOV (MD-28 to MD-189)	1131	930	
Between MD 117 off ramp and MD 124 off ramp	1509	1659	10%	Local HOV (MD-189 to Montrose)	1253	1108	
Between MD 124 off ramp and MD 124 EB on ramp	789	862	9%	Local HOV (Montrose to I-270 Split)	1412	1339	
Between MD 124 EB and WB on ramps	1183	1253	6%	HOV Express - Southern Terminus	0	588	
Between MD 124 on ramp I-270	573	540	-6%				

Table C.10: AM Peak - 2040 - I-270 On Ramp Queue Length - Northbound

I-270 Northbound	No Build VISSIM Average Queue (feet)	Build VISSIM Average Queue (feet)	% Change / Abs Difference	No Build VISSIM Maximum Queue (feet)	Build VISSIM Maximum Queue (feet)	% Change / Abs Difference
Rockledge Dr on ramp	67	0	-100%	421	0	-100%
MD 189 C-D on ramp	0	0	0%	0	0	0%
MD 28 C-D on ramp	0	0	0%	0	0	0%
Shady Grove Rd C-D on ramp	0	0	0%	0	0	0%
I-370 C-D on ramp	0	0	0%	0	0	0%
MD 124 C-D on ramp	0	0	0%	0	0	0%
MD 118 on ramp	0	0	0%	0	0	0%
MD 27 EB on ramp	0	0	0%	0	0	0%
MD 27 WB on ramp	0	0	0%	0	0	0%
MD 121 on ramp	0	0	0%	0	0	0%
MD 109 on ramp	0	0	0%	0	0	0%
MD 80 on ramp	0	0	0%	0	0	0%
MD 85 on ramp	0	0	0%	0	0	0%
I-270 Spur Northbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change / Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change / Abs Difference**
Democracy Blvd EB on ramp	4	0	-100%	57	0	-100%
Democracy Blvd WB on ramp	0	0	0%	5	0	-100%
I-495 Northbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change / Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change / Abs Difference**
Cabin John Pkwy on ramp	0	0	0%	0	0	0%
MD 190 on ramp	0	0	0%	0	0	0%
I-270 C-D Northbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change / Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change / Abs Difference**
Montrose Rd EB on ramp	436	0	-100%	1548	0	-100%
Montrose Rd WB on ramp	1047	0	-100%	2581	0	-100%
I-270 on ramp	409	0	-100%	1171	0	-100%
MD 189 on ramp	1304	0	-100%	2877	0	-100%
I-270 on ramp	1354	0	-100%	3378	0	-100%
MD 28 EB on ramp	3	0	-100%	55	0	-100%
MD 28 WB on ramp	0	0	0%	0	0	0%
Shady Grove Rd EB on ramp	0	0	0%	0	0	0%
I-270 on ramp	0	0	0%	0	0	0%
Shady Grove Rd WB on ramp	0	0	0%	0	0	0%
I-370 EB on ramp	0	0	0%	0	0	0%
I-370 WB on ramp	0	0	0%	0	0	0%
I-270 on ramp	0	5	5	29	275	247
MD 124 EB on ramp	0	0	0%	0	0	0%
MD 124 WB on ramp	0	0	0%	0	0	0%
Watkins Mill Rd on ramp	0	0	0%	24	0	-100%

Table C.11: AM Peak - 2040 - I-270 Off Ramp Queue Length - Northbound

I-270 Northbound	No Build VISSIM Average Queue (feet)	Build VISSIM Average Queue (feet)	% Change/ Abs Difference	No Build VISSIM Maximum Queue (feet)	Build VISSIM Maximum Queue (feet)	% Change/ Abs Difference
MD 187 off ramp NB	28	34	20%	242	276	14%
MD 187 off ramp SB	0	0	0%	0	0	0%
Rockledge Dr off ramp	6	6	0%	359	286	-20%
Tower Oaks Blvd off ramp	19	25	36%	179	181	1%
Montrose Rd off ramp EB	0	0	0%	0	0	0%
Montrose Rd off ramp WB	0	0	0%	0	0	0%
MD 189 off ramp WB	8	12	51%	99	102	3%
MD 189 off ramp EB	60	3	-95%	1148	242	-79%
MD 28 off ramp EB	28	54	94%	227	309	36%
MD 28 off ramp WB	2636	0	-100%	5046	0	-100%
Shady Grove Rd off ramp - Redland Blvd	0	0	0%	0	0	0%
Shady Grove Rd off ramp WB	151	205	36%	605	702	16%
Shady Grove Rd off ramp EB	0	0	0%	0	0	0%
I-370 off ramp WB	0	0	0%	0	0	0%
I-370 off ramp EB	0	0	0%	0	0	0%
MD 117 off ramp	311	434	40%	1011	1457	44%
MD 124 off ramp	95	80	-16%	453	369	-19%
Watkins Mill Rd off ramp	78	92	18%	366	451	23%
Middlebrook Rd EB off ramp	0	0	0%	0	0	0%
Middlebrook Rd WB off ramp	0	0	0%	0	0	0%
MD 118 WB off ramp - Seneca Meadows	0	0	0%	0	0	0%
MD 118 WB off ramp	0	0	0%	0	0	0%
MD 118 EB off ramp	0	0	0%	0	0	0%
MD 27 off ramp WB	7	7	7%	81	94	16%
MD 27 off ramp EB	0	0	0%	0	0	0%
MD 121 off ramp WB	62	62	1%	250	262	5%
MD 121 off ramp EB	0	0	0%	0	0	0%
MD 109 off ramp EB	29	10	-65%	228	152	-33%
MD 109 off ramp WB	8	0	-100%	84	0	-100%
MD 80 off ramp EB	7	7	2%	102	107	5%
MD 80 off ramp WB	0	0	-95%	26	10	-63%
MD 85 NB off ramp	0	0	0%	0	0	0%
MD 85 SB off ramp	1	1	32%	126	153	22%
I-270 Spur Northbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change/ Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change/ Abs Difference**
Clara Barton Pkwy off ramp EB	1	1	0%	214	214	0%
Clara Barton Pkwy off ramp WB	0	0	0%	0	0	0%
MD 190 off ramp EB	0	0	-100%	10	5	-53%
MD 190 off ramp WB	0	0	0%	0	0	0%
Democracy Blvd off ramp WB	104	108	4%	563	571	2%
Democracy Blvd off ramp EB	15	18	15%	143	141	-1%

Table C.12: AM Peak - 2040 - I-270 On Ramp Queue Length - Southbound

I-270 Southbound	No Build VISSIM Average Queue (feet)	Build VISSIM Average Queue (feet)	% Change/ Abs Difference	No Build VISSIM Maximum Queue (feet)	Build VISSIM Maximum Queue (feet)	% Change/ Abs Difference
MD 85 on ramp	41	15	-63%	528	317	-40%
MD 80 on ramp	1039	0	-100%	2688	0	-100%
MD 109 on ramp	995	307	-69%	1914	1982	4%
MD 121 WB on ramp	135	0	-100%	972	0	-100%
MD 121 EB on ramp	0	0	0%	0	0	0%
MD 27 WB on ramp	552	1	-100%	2591	143	-94%
MD 27 EB on ramp	3	0	-96%	173	29	-83%
MD 118 WB on ramp	0	0	0%	0	0	0%
MD 118 EB on ramp	0	0	28%	44	33	-25%
Middlebrook Rd on ramp	2842	297	-90%	4433	1699	-62%
Watkins Mill Rd on ramp	3066	3065	0%	3136	3133	0%
MD 124 WB on ramp	2789	3516	26%	4158	4257	2%
MD 117 on ramp	293	83	-72%	1898	1477	-22%
I-370 C-D on ramp	0	0	0%	0	0	0%
Shady Grove Rd C-D on ramp North	0	0	0%	0	0	0%
Shady Grove Rd C-D on ramp South	2	116	114	127	940	813
MD 189 C-D on ramp	1787	3780	1993	3610	5059	40%
Montrose Rd C-D on ramp	2	324	322	227	1397	1170
Rockledge Dr on ramp	0	0	0%	0	0	0%
MD 187 on ramp	0	0	0%	0	0	0%
I-270 Spur Southbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change/ Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change/ Abs Difference**
Democracy Blvd on ramp	0	0	0%	0	0	0%
I-495 Southbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change/ Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change/ Abs Difference**
I-270 Spur on ramp	147	17	-88%	1557	715	-54%
MD 190 on ramp	0	0	0%	0	0	0%
I-270 C-D Southbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change/ Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change/ Abs Difference**
I-270 on ramp	2947	1901	-35%	4900	3811	-22%
I-370 on ramp	2511	1485	-41%	2932	2922	0%
Shady Grove Rd WB on ramp	28	3	-87%	597	291	-51%
Shady Grove Rd EB on ramp	0	0	-100%	37	0	-100%
I-270 on ramp	0	0	-100%	42	0	-100%
MD 28 WB on ramp	1406	10	-99%	2299	165	-93%
MD 28 EB on ramp	3724	3341	-10%	3882	3884	0%
I-270 on ramp	1	0	-95%	74	22	-70%
MD 189 on ramp	3725	323	-91%	4200	1222	-71%
Montrose Rd WB on ramp	68	49	-28%	926	696	-25%
Montrose Rd EB on ramp	0	2	2	69	218	149

Table C.13: AM Peak - 2040 - I-270 Off Ramp Queue Length - Southbound

I-270 Southbound	No Build VISSIM Average Queue (feet)	Build VISSIM Average Queue (feet)	% Change/ Abs Difference	No Build VISSIM Maximum Queue (feet)	Build VISSIM Maximum Queue (feet)	% Change/ Abs Difference
MD 85 SB off ramp	297	13	-96%	1410	567	-60%
MD 85 NB off ramp	0	0	-86%	43	13	-69%
MD 80 off ramp	1	0	-79%	99	50	-49%
MD 109 off ramp WB	0	0	-55%	25	24	-3%
MD 109 off ramp EB	0	0	0%	0	0	0%
MD 121 off ramp EB	219	223	2%	946	1010	7%
MD 121 off ramp WB	10	12	20%	519	568	9%
MD 27 off ramp EB	50	58	17%	262	262	0%
MD 27 off ramp WB	881	219	-75%	3309	1340	-60%
MD 118 off ramp EB	31	36	16%	160	183	14%
MD 118 off ramp WB	0	0	0%	0	0	0%
Watkins Mill Rd off ramp	2034	2140	5%	5055	5044	0%
MD 124 off ramp EB	70	75	6%	368	366	-1%
MD 124 off ramp WB	19	11	-44%	419	368	-12%
I-370 off ramp WB	0	0	0%	0	0	0%
I-370 off ramp EB	0	0	0%	0	0	0%
Shady Grove Rd off ramp - Omega Drive	4	7	63%	172	208	21%
Shady Grove Rd off ramp	0	0	0%	0	0	0%
MD 28 off ramp	4	3	-28%	154	135	-12%
MD 189 off ramp EB	35	36	2%	238	250	5%
MD 189 off ramp WB	0	0	0%	0	0	0%
Montrose Rd off ramp WB	0	0	0%	0	0	0%
Montrose Rd off ramp EB	382	0	-100%	1566	0	-100%
Rockledge Dr off ramp	27	36	33%	343	356	4%
I-270 Spur Southbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change/ Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change/ Abs Difference**
Democracy Blvd off ramp EB	50	53	7%	219	220	0%
Democracy Blvd off ramp WB	0	0	0%	0	0	0%
MD 190 off ramp WB	1389	1785	28%	3571	4341	22%
MD 190 off ramp EB	0	0	0%	0	0	0%
Clara Barton Pkwy WB off ramp	0	0	-100%	5	0	-100%

Table C.14: AM Peak - 2040 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
1- MD 85 at Sam's Club Drive											
				NB Left	119	77	82	496	E		
	NB	23.0	C	NB Through	365	28	82	496	C		
				NB Right	664	11	22	438	B		
				SB Left	137	63	174	771	E		
	SB	50.1	D	SB Through	599	50	174	771	D		
1				SB Right	68	26	174	771	C	38.6	D
				EB Left	105	78	56	182	E		
	EB	50.9	D	EB Through	62	81	56	182	F		
				EB Right	113	9	56	182	A		
				WB Left	230	77	90	355	E		
	WB	52.7	D	WB Through	15	67	90	355	E		
				WB Right	126	7	90	355	A		
2- MD 85 at I-270 NB on and off ramp											
				NB Left	683	52	265	1136	D		
	NB	52.1	D	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB	18.8	B	SB Through	611	19	56	562	B		
2				SB Right	0	0	0	0	A	36.3	D
				EB Left	0	0	0	0	A		
	EB			EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB			WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
3- MD 85 at I-270 SB on and off ramp											
				NB Left	0	0	0	0	A		
	NB	5.3	A	NB Through	1071	5	19	413	A		
				NB Right	0	0	0	0	A		
				SB Left	172	41	43	440	D		
	SB	40.9	D	SB Through	0	0	0	0	A		
3				SB Right	0	0	0	0	A	10.2	B
				EB Left	0	0	0	0	A		
	EB			EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB			WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
4- MD 85 at Crestwood Blvd											
				NB Left	13	71	54	382	E		
	NB	19.4	C	NB Through	762	19	54	382	B		
				NB U-Turn	0	0	0	0	A		
				SB Left	64	69	25	156	E		
	SB	18.8	B	SB Through	1783	18	80	627	B		
4				SB Right	808	16	68	617	B	25.0	C
				EB Left	621	54	91	276	D		
	EB	52.7	D	EB Through	28	68	91	276	E		
				EB Right	42	17	91	276	B		
				WB Left	52	53	21	137	D		
	WB	44.1	D	WB Through	18	56	21	137	E		
				WB Right	19	9	21	137	A		
5- MD 80 at I-270 NB on and ramp											
				NB Left	3	1	0	4	A		
	NB	-1.0	A	NB Through	1	1	0	4	A		
				NB Right	5	-3	0	4	A		
				SB Left	204	16	14	108	B		
	SB	13.0	B	SB Through	6	20	14	108	B		
5				SB Right	59	2	0	0	A	21.2	C
				EB Left	54	12	11	183	B		
	EB	11.3	B	EB Through	0	0	8	0	A		
				EB Right	5	5	19	213	A		
				WB Left	35	24	1	56	C		
	WB	23.1	C	WB Through	879	31	182	786	C		
				WB Right	639	12	11	442	B		
6- MD 80 at I-270 SB on and off ramp											
				NB Left	24	37	2	134	E		
	NB	6.2	A	NB Through	0	0	0	0	A		
				NB Right	258	3	2	134	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
6				SB Right	0	0	0	0	A	31.6	D
				EB Left	0	0	0	0	A		
	EB	36.7	E	EB Through	360	36	67	436	E		
				EB Right	161	38	68	446	E		
				WB Left	0	0	0	0	A		
	WB	47.8	E	WB Through	278	48	157	758	E		
				WB Right	0	0	0	0	A		
7- MD 109 at I-270 NB on and off ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	143	37	37	244	E		
	SB	33.1	D	SB Through	0	0	0	0	A		
7				SB Right	47	20	17	177	C	29.9	D
				EB Left	88	11	5	149	B		
	EB	15.7	C	EB Through	0	0	0	0	A		
				EB Right	63	22	0	0	C		
				WB Left	0	0	0	0	A		
	WB	32.2	D	WB Through	671	32	399	555	D		
				WB Right	0	0	0	0	A		
8- MD 80 at I-270 SB on and off ramp											
				NB Left	17	36	4	78	E		
	NB	9.3	A	NB Through	0	0	0	0	A		
				NB Right	48	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
8				SB Right	0	0	0	0	A	33.7	D
				EB Left	0	0	0	0	A		
	EB	50.0	E	EB Through	92	34	58	270	D		
				EB Right	102	64	60	268	F		
				WB Left	570	29	158	594	D		
	WB	31.6	D	WB Through	156	39	152	571	E		
				WB Right	0	0	0	0	A		
9- MD 121 at Gateway Center Dr											
				NB Left	154	27	43	285	C		
	NB	17.8	C	NB Through	434	22	43	285	C		
				NB Right	327	8	52	311	A		
				SB Left	55	22	113	555	C		
	SB	32.3	D	SB Through	792	33	123	555	C		
9				SB Right	8	26	131	576	C	51.2	D
				EB Left	8	97	421	525	F		
	EB	120.4	F	EB Through	99	125	422	525	F		
				EB Right	646	120	452	557	F		
				WB Left	137	25	18	147	C		
	WB	21.8	C	WB Through	17	22	18	147	C		
				WB Right	28	6	16	171	A		
10- MD 121 at I-270 NB on and off ramp											
				NB Left	324	59	67	255	F		
	NB	28.3	D	NB Through	0	0	0	0	A		
				NB Right	402	3	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
10				SB Right	0	0	0	0	A	19.0	B
				EB Left	0	0	0	0	A		
	EB	11.5	B	EB Through	513	18	32	325	C		
				EB Right	285	1	0	0	A		
				WB Left	233	63	145	805	F		
	WB	18.6	C	WB Through	1337	11	145	805	B		
				WB Right	0	0	0	0	A		

Table C.14: AM Peak - 2040 No Build - Intersection Delay and Level of Service

11- MD 121 at I-270 SB on and off ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	218	94	225	953	F		
	SB	62.8	E	SB Through	0	0	0	0	A		
				SB Right	304	40	8	439	E		
11				EB Left	0	0	0	0	A	18.3	B
	EB	5.2	A	EB Through	578	5	12	206	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	8.8	A	WB Through	642	18	61	438	C		
				WB Right	1010	3	30	185	A		
12- MD 27 at Observation Dr											
				NB U-Turn	0	0	0	0	A		
	NB	48.1	D	NB Through	48	58	14	72	E		
				NB Right	12	7	14	72	A		
				SB Left	91	52	29	192	D		
	SB	44.0	D	SB Through	54	52	39	261	D		
				SB Right	178	38	64	298	D		
12				EB Left	151	40	40	324	D	37.1	D
	EB	16.9	B	EB Through	1217	14	42	325	B		
				EB Right	48	10	49	363	B		
				WB Left	100	32	333	847	C		
	WB	48.1	D	WB Through	2130	50	333	847	D		
				WB Right	109	30	333	847	C		
13- MD 27 at I-270 NB off ramp											
				NB Left	106	36	15	88	D		
	NB	35.6	D	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
13				EB Left	0	0	0	0	A	52.4	D
	EB	0.1	A	EB Through	973	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	76.7	E	WB Through	2166	77	1092	2164	E		
				WB Right	0	0	0	0	A		
14- MD 27 at I-270 SB off ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	384	49	61	275	D		
	SB	49.4	D	SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
14				EB Left	0	0	0	0	A	70.6	E
	EB	2.6	A	EB Through	840	3	2	62	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	118.3	F	WB Through	1365	118	1106	1497	F		
				WB Right	0	0	0	0	A		
15- MD 27 at Crystal Rock Dr											
				NB Left	30	38	296	736	D		
	NB	64.8	E	NB Through	1051	65	316	736	E		
				NB Right	92	70	327	748	E		
				SB Left	514	118	1842	3792	F		
	SB	119.1	F	SB Through	1620	121	1842	3792	F		
				SB Right	51	81	1836	3787	F		
15				EB Left	224	50	59	199	D	92.0	F
	EB	44.2	D	EB Through	97	43	55	194	D		
				EB Right	75	29	60	228	C		
				WB Left	11	56	32	103	E		
	WB	46.8	D	WB Through	32	224	32	103	F		
				WB Right	142	6	32	103	A		
16- MD 118 at Seneca Meadows Pkwy											
				NB Left	109	11	1	72	B		
	NB	3.6	A	NB Through	725	3	4	134	A		
				NB Right	60	1	9	187	A		
				SB Left	31	4	7	238	A		
	SB	4.0	A	SB Through	948	4	10	238	A		
				SB Right	41	2	12	271	A		
16				EB Left	20	65	10	77	E	6.1	A
	EB	18.4	B	EB Through	6	82	10	77	F		
				EB Right	115	7	10	77	A		
				WB Left	35	71	16	102	E		
	WB	44.2	D	WB Through	6	55	11	101	D		
				WB Right	27	7	14	111	A		
17- MD 118 at I-270 NB on ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
17				EB Left	274	30	31	194	C	10.2	B
	EB	29.6	C	EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	5.4	A	WB Through	188	1	0	0	A		
				WB Right	911	6	15	309	A		
18- MD 118 at I-270 SB off ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0.0	0	0	A		
				NB Right	0	0.0	0	0	A		
				SB Left	215	38.1	34	163	D		
	SB	38.1	D	SB Through	0	0.0	0	0	A		
				SB Right	0	0.0	0	0	A		
18				EB Left	0	0.0	0	0	A	7.5	A
	EB	3.7	A	EB Through	631	3.7	5	194	A		
				EB Right	0	0.0	0	0	A		
				WB Left	0	0.0	0	0	A		
	WB	4.1	A	WB Through	1214	4.1	9	173	A		
				WB Right	0	0.0	0	0	A		
19- MD 118 at Aircraft Dr											
				NB Left	9	78	9	75	E		
	NB	46.2	D	NB Through	13	80	9	75	F		
				NB Right	17	3	0	24	A		
				SB Left	267	55	112	418	E		
	SB	60.5	E	SB Through	53	72	112	418	E		
				SB Right	96	68	112	418	E		
19				EB Left	132	16	37	329	B	20.6	C
	EB	12.4	B	EB Through	1019	12	37	329	B		
				EB Right	34	12	37	329	B		
				WB Left	83	23	47	310	C		
	WB	15.1	B	WB Through	1046	17	47	310	B		
				WB Right	324	6	47	310	A		
20- Middlebrook Rd at Observation Dr											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	26	36	5	63	D		
	SB	20.4	C	SB Through	0	0	0	0	A		
				SB Right	27	5	5	63	A		
20				EB Left	231	21	29	249	C	16.4	B
	EB	14.1	B	EB Through	825	12	29	249	B		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	18.0	B	WB Through	1141	19	72	392	B		
				WB Right	275	15	97	441	B		

Table C.14: AM Peak - 2040 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
21- Middlebrook Rd at I-270 SB on ramp											
21	NB			NB Left	0	0	0	0	A	19.5	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	13.7	B	EB Left	0	0	0	0	A		
				EB Through	763	14	31	203	B		
				EB Right	0	0	0	0	A		
	WB	25.4	C	WB Left	761	25	104	893	C		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
22- Middlebrook Rd at Waring Station Rd											
22	NB	179.6	F	NB Left	145	136	348	485	F	70.4	E
				NB Through	6	133	348	485	F		
				NB Right	268	204	348	485	F		
	SB	17.6	B	SB Left	3	39	1	29	D		
				SB Through	0	0	1	29	A		
				SB Right	5	5	2	67	A		
	EB	69.3	E	EB Left	31	21	645	1297	C		
				EB Through	1448	71	645	1297	E		
				EB Right	80	62	645	1297	E		
	WB	18.4	B	WB Left	80	23	33	237	C		
				WB Through	719	19	33	237	B		
				WB Right	41	4	33	237	A		
23- MD 124 at MD 355											
23	NB	52.9	D	NB Left	228	73	86	264	E	96.2	F
				NB Through	390	48	84	262	D		
				NB Right	54	3	0	0	A		
	SB	104.2	F	SB Left	64	166	490	804	F		
				SB Through	1188	124	490	804	F		
				SB Right	559	54	284	780	D		
	EB	54.5	D	EB Left	610	130	444	1095	F		
				EB Through	494	17	444	1095	B		
				EB Right	555	5	236	1008	A		
	WB	143.6	F	WB Left	0	0	0	0	A		
				WB Through	1717	146	760	1115	F		
				WB Right	52	73	0	0	E		
24- MD 124 at I-270 SB on and off											
24	NB	65.3	F	NB Left	16	62	18	95	E	29.3	C
				NB Through	37	67	18	95	E		
				NB U-Turn	0	0	0	0	A		
	SB	26.0	C	SB Left	285	65	77	373	E		
				SB Through	11	65	77	373	E		
				SB Right	588	6	14	350	A		
	EB	17.0	B	EB Left	0	0	0	0	A		
				EB Through	1037	17	50	409	B		
				EB Right	67	14	60	433	B		
	WB	41.6	D	WB Left	43	47	1679	2437	D		
				WB Through	1136	41	1679	2437	D		
				WB Right	0	0	0	0	A		
25- MD 117 at MD 124											
25	NB	49.7	D	NB Left	20	108	157	726	F	48.5	D
				NB Through	541	64	157	726	E		
				NB Right	433	30	76	717	C		
	SB	47.0	D	SB Left	181	69	221	826	E		
				SB Through	1072	48	221	826	D		
				SB Right	131	9	0	0	A		
	EB	54.0	D	EB Left	102	119	217	782	F		
				EB Through	1470	50	217	783	D		
				EB Right	82	47	229	811	D		
	WB	39.4	D	WB Left	319	70	103	304	E		
				WB Through	478	27	103	304	C		
				WB Right	99	0	0	0	A		
26- MD 117 at Bureau Dr											
26	NB	50.3	D	NB Left	25	64	19	125	E	41.1	D
				NB Through	24	65	19	125	E		
				NB Right	26	23	19	125	C		
	SB	174.5	F	SB Left	197	177	223	397	F		
				SB Through	55	190	223	397	F		
				SB Right	32	130	223	397	F		
	EB	36.8	D	EB Left	33	26	272	958	C		
				EB Through	2020	37	278	958	D		
				EB Right	29	43	271	948	D		
	WB	20.8	C	WB Left	299	67	134	543	E		
				WB Through	840	10	134	544	A		
				WB Right	314	6	100	582	A		
27- MD 117 at I-270 SB off ramp											
27	NB			NB Left	0	0	0	0	A	9.3	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.0	A	EB Left	0	0	0	0	A		
				EB Through	835	2	1	180	A		
				EB Right	0	0	0	0	A		
	WB	28.1	D	WB Left	328	28	59	453	D		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
28- MD 117 at I-270 NB off ramp											
28	NB			NB Left	0	0	0	0	A	34.5	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	60.5	E	SB Left	287	63	325	1037	E		
				SB Through	0	0	0	0	A		
				SB Right	871	60	329	1039	E		
	EB	19.2	B	EB Left	14	123	74	848	F		
				EB Through	821	17	74	848	B		
				EB Right	0	0	0	0	A		
	WB	15.6	B	WB Left	0	0	0	0	A		
				WB Through	909	16	60	360	B		
				WB Right	9	8	66	390	A		
29- MD 117 at Perry Pkwy											
29	NB	44.5	D	NB Left	36	76	17	120	E	15.9	B
				NB Through	7	58	17	119	E		
				NB Right	38	12	27	140	B		
	SB	48.7	D	SB Left	112	96	60	247	F		
				SB Through	14	102	60	247	F		
				SB Right	133	3	60	247	A		
	EB	10.6	B	EB Left	119	70	44	269	E		
				EB Through	975	3	44	269	A		
				EB Right	10	1	31	254	A		
	WB	10.4	B	WB Left	8	89	21	297	F		
				WB Through	747	10	21	297	B		
				WB Right	136	6	21	297	A		
30- Shady Grove Rd at I-270 NB off ramp											
30	NB	9.8	A	NB Left	0	0	0	0	A	22.3	C
				NB Through	959	10	22	267	A		
				NB Right	0	0	0	0	A		
	SB	10.4	B	SB Left	0	0	0	0	A		
				SB Through	1349	10	34	334	B		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	55.7	E	WB Left	846	56	160	616	E		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table C.14: AM Peak - 2040 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
31- Shady Grove Rd at I-270 SB off ramp											
31	NB	12.7	B	NB Left	0	0	0	0	A	19.9	B
				NB Through	1004	13	37	399	B		
				NB Right	0	0	0	0	A		
	SB	9.3	A	SB Left	0	0	0	0	A		
				SB Through	1565	9	32	563	A		
				SB Right	0	0	0	0	A		
	EB	47.4	D	EB Left	286	41	42	360	D		
				EB Through	0	0	0	0	A		
				EB Right	576	51	98	441	D		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
32- MD 28 at I-270 SB off ramp											
32	NB			NB U-Turn	0	0	0	0	A	67.9	E
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	35.7	D	SB Left	426	44	68	327	D		
				SB Through	0	0	0	0	A		
				SB Right	103	3	0	36	A		
	EB	131.7	F	EB Left	0	0	0	0	A		
				EB Through	683	200	1979	2136	F		
				EB Right	409	18	1925	2144	B		
	WB	25.4	C	WB Left	0	0	0	0	A		
				WB Through	1235	25	23	384	C		
				WB Right	0	0	0	0	A		
33- MD 28 at I-270 on and off ramps											
33	NB	36.5	D	NB Left	0	0	32	238	A	36.3	D
				NB Through	128	53	38	247	D		
				NB Right	80	10	38	247	A		
	SB	84.5	F	SB Left	26	102	128	357	F		
				SB Through	0	0	0	0	A		
				SB Right	273	83	128	357	F		
	EB	21.4	C	EB Left	177	45	57	407	D		
				EB Through	599	15	57	407	B		
				EB Right	0	0	0	0	A		
	WB	33.3	C	WB Left	26	37	101	391	D		
				WB Through	944	33	83	354	C		
				WB Right	0	0	0	0	A		
34- MD 189 at Great Falls Rd											
34	NB	37.3	D	NB Left	63	42	17	117	D	23.3	C
				NB Through	8	40	14	117	D		
				NB Right	10	8	16	128	A		
	SB	17.3	B	SB Left	63	45	19	229	D		
				SB Through	6	45	19	229	D		
				SB Right	478	13	54	147	B		
	EB	24.6	C	EB Left	227	55	111	1165	E		
				EB Through	680	15	17	199	B		
				EB Right	10	10	26	236	A		
	WB	26.4	C	WB Left	4	26	64	389	C		
				WB Through	311	27	63	388	C		
				WB Right	11	13	77	422	B		
35- MD 189 at I-270 Ramps											
35	NB	60.5	E	NB Left	88	61	18	121	E	79.7	E
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	55.9	E	SB Left	150	56	48	258	E		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	106.2	F	EB Left	284	138	627	1494	F		
				EB Through	436	85	627	1494	F		
				EB Right	0	0	0	0	A		
	WB	60.0	E	WB Left	457	53	107	429	D		
				WB Through	244	73	107	429	E		
				WB Right	0	0	0	0	A		
36- MD 189 at Wooton Pkwy											
36	NB	71.9	E	NB Left	161	48	85	311	D	117.9	F
				NB Through	125	95	85	311	F		
				NB Right	155	78	85	311	E		
	SB	142.8	F	SB Left	325	210	509	805	F		
				SB Through	593	106	482	792	F		
				SB Right	0	0	0	0	A		
	EB	162.3	F	EB Left	137	157	650	1047	F		
				EB Through	803	170	650	1047	F		
				EB Right	101	106	650	1047	F		
	WB	49.3	D	WB Left	346	69	104	353	E		
				WB Through	318	34	104	353	C		
				WB Right	47	6	104	353	A		
37- Montrose Rd at Tower Oaks Blvd											
37	NB			NB Left	0	0	0	0	A	104.5	F
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	235.8	F	SB Left	123	49	1098	1406	D		
				SB Through	0	0	0	0	A		
				SB Right	435	289	1123	1402	F		
	EB	25.5	C	EB Left	28	65	136	923	E		
				EB Through	1513	25	136	923	C		
				EB Right	0	0	0	0	A		
	WB	141.4	F	WB Left	0	0	0	0	A		
				WB Through	1255	145	491	850	F		
				WB Right	58	60	491	850	E		
38- Tower Oaks Blvd at I-270 off rmap											
38	NB	24.1	C	NB Left	385	22	30	200	C	78.2	E
				NB Through	8	22.5	25	192	C		
				NB Right	22	64.1	30	200	E		
	SB	0.6	A	SB Left	0	800.1	0	20	F		
				SB Through	0	0.0	0	20	A		
				SB Right	4	0.6	0	0	A		
	EB	122.8	F	EB Left	6	113.7	347	465	F		
				EB Through	558	122.3	347	465	F		
				EB Right	82	126.7	338	456	F		
	WB	9.5	A	WB Left	0	0.0	3	80	A		
				WB Through	81	9.9	3	80	A		
				WB Right	6	5.0	0	25	A		
39- Montrose Rd at Tower Oaks Blvd											
39	NB	17.9	B	NB Left	37	71	49	285	E	50.9	D
				NB Through	240	42	49	285	D		
				NB Right	555	4	12	151	A		
	SB	41.1	D	SB Left	334	54	163	619	D		
				SB Through	778	37	163	618	D		
				SB Right	78	29	124	658	C		
	EB	90.2	F	EB Left	76	74	416	718	E		
				EB Through	971	92	418	718	F		
				EB Right	62	89	439	742	F		
	WB	43.4	D	WB Left	300	52	68	290	D		
				WB Through	188	50	68	290	D		
				WB Right	109	7	77	321	A		
40- Rockledge Blvd at I-270 NB on and off ramp											
40	NB	34.1	C	NB Left	0	0	0	0	A	18.0	B
				NB Through	92	32	33	165	C		
				NB Right	216	35	33	165	C		
	SB	2.0	A	SB Left	0	0	4	61	A		
				SB Through	923	2	4	61	A		
				SB Right	0	0	0	0	A		
	EB	26.9	C	EB Left	7	48	126	506	D		
				EB Through	529	54	126	506	D		
				EB Right	563	1	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table C.14: AM Peak - 2040 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
41- Rockledge Blvd at I-270 SB on and off ramps											
41	NB	2.6	A	NB Left	97	3	5	72	A	20.4	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	21.7	C	WB Left	923	23	92	655	C		
				WB Through	403	20	92	655	B		
				WB Right	0	0	0	0	A		
42- MD 187 at Tuckerman Ln											
42	NB	58.8	E	NB Left	230	25	265	793	C	153.0	F
				NB Through	1468	55	265	793	D		
				NB Right	213	124	265	793	F		
	SB	224.9	F	SB Left	60	164	2605	2704	F		
				SB Through	1204	225	2605	2704	F		
				SB Right	162	247	2605	2704	F		
	EB	186.0	F	EB Left	223	128	1864	1988	F		
				EB Through	624	205	1865	1989	F		
				EB Right	129	194	1889	2013	F		
	WB	188.4	F	WB Left	721	229	1921	2147	F		
				WB Through	393	152	1921	2147	F		
				WB Right	159	92	1921	2147	F		
43- MD 187 at I-270 NB on and off ramps											
43	NB	11.2	B	NB Left	163	76	57	257	E	19.1	B
				NB Through	1541	4	57	257	A		
				NB Right	0	0	0	0	A		
	SB	25.4	C	SB Left	0	0	0	0	A		
				SB Through	1529	25	81	553	C		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	49.5	D	WB Left	114	50	35	250	D		
				WB Through	10	47	35	250	D		
				WB Right	0	0	0	0	A		
44- MD 187 at I-270 NB on and off ramps											
44	NB	23.9	C	NB Left	0	0	0	0	A	25.9	C
				NB Through	1478	24	68	404	C		
				NB Right	0	0	0	0	A		
	SB	7.7	A	SB Left	178	49	58	295	D		
				SB Through	1465	3	58	295	A		
				SB Right	0	0	0	0	A		
	EB	80.8	F	EB Left	228	58	187	740	E		
				EB Through	0	0	187	740	A		
				EB Right	371	95	232	784	F		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
45- MD 187 at Rock Spring Dr											
45	NB	14.9	B	NB Left	255	57	68	257	E	20.8	C
				NB Through	1383	7	69	258	A		
				NB Right	10	6	93	291	A		
	SB	21.9	C	SB Left	13	25	98	632	C		
				SB Through	1668	24	98	632	C		
				SB Right	144	1	63	619	A		
	EB	37.9	D	EB Left	190	59	56	222	E		
				EB Through	26	54	56	222	D		
				EB Right	251	20	56	222	C		
	WB	7.2	A	WB Left	1	7	1	29	A		
				WB Through	9	11	1	29	B		
				WB Right	5	0	0	7	A		
47-Democracy Blvd at I-270 NB off ramp											
47	NB	29.7	C	NB Left	217	30	24	159	C	13.4	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	12.7	B	EB Left	0	0	0	0	A		
				EB Through	1654	13	50	446	B		
				EB Right	0	0	0	0	A		
	WB	10.4	B	WB Left	0	0	0	0	A		
				WB Through	778	10	23	187	B		
				WB Right	0	0	0	0	A		
48- Democracy Blvd at I-270 SB on ramp											
48	NB			NB Left	0	0	0	0	A	6.6	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	5.4	A	EB Left	0	0	0	0	A		
				EB Through	1768	5	23	270	A		
				EB Right	0	0	0	0	A		
	WB	8.7	A	WB Left	223	37	31	173	D		
				WB Through	771	1	21	152	A		
				WB Right	0	0	0	0	A		
49- Democracy Blvd at I-270 SB off ramp											
49	NB			NB Left	0	0	0	0	A	12.1	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	32.9	C	SB Left	329	49	57	226	D		
				SB Through	0	0	0	0	A		
				SB Right	171	2	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	2.6	A	WB Left	0	0	0	0	A		
				WB Through	770	3	4	133	A		
				WB Right	334	2	1	163	A		
50- MD 190 at Burdette Rd											
50	NB	73.2	E	NB Left	20	80	15	118	E	13.2	B
				NB Through	4	59	15	118	E		
				NB Right	11	67	15	118	E		
	SB	34.4	C	SB Left	50	79	31	151	E		
				SB Through	17	64	31	151	E		
				SB Right	120	12	31	151	B		
	EB	10.5	B	EB Left	53	93	61	561	F		
				EB Through	1814	8	60	561	A		
				EB Right	15	6	51	584	A		
	WB	12.5	B	WB Left	1	106	61	828	F		
				WB Through	1494	13	62	828	B		
				WB Right	21	2	55	834	A		

Table C.14: AM Peak - 2040 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
51- MD 190 at I-270 NB on ramp											
51	NB			NB Left	0	0	0	0	A	53.3	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	123.2	F	EB Left	531	123	347	715	F		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	15.9	B	WB Left	0	0	0	0	A		
				WB Through	994	16	76	747	B		
				WB Right	0	0	0	0	A		
52- MD 190 at I-270 SB off ramp											
52	NB	79.3	E	NB Left	258	79	1392	3574	E	14.2	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.9	A	EB Left	0	0	0	0	A		
				EB Through	982	3	6	151	A		
				EB Right	0	0	0	0	A		
	WB	5.7	A	WB Left	0	0	0	0	A		
				WB Through	667	6	8	160	A		
				WB Right	0	0	0	0	A		
53- MD 190 at Seven Locks Rd											
53	NB	68.2	E	NB Left	21	67	23	149	E	45.0	D
				NB Through	59	69	25	148	E		
				NB Right	0	0	0	0	A		
	SB	56.9	E	SB Left	624	56	184	777	E		
				SB Through	183	59	185	778	E		
				SB Right	18	54	184	777	D		
	EB	37.5	D	EB Left	24	30	135	584	C		
				EB Through	846	38	135	584	D		
				EB Right	42	42	135	584	D		
	WB	39.7	D	WB Left	119	127	125	418	F		
				WB Through	639	33	128	421	C		
				WB Right	157	1	4	127	A		
54- MD 124 at I-270 NB off ramp											
54	NB	40.6	D	NB Left	0	0	0	0	A	26.5	C
				NB Through	0	0	0	0	A		
				NB Right	723	41	100	459	D		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	15.6	B	EB Left	0	0	0	0	A		
				EB Through	933	16	37	359	B		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
55- Democracy Blvd at I-270 NB off ramp											
55	NB	37.1	D	NB Left	0	0	0	0	A	16.2	B
				NB Through	0	0	0	0	A		
				NB Right	928	37	113	575	D		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	4.5	A	EB Left	0	0	0	0	A		
				EB Through	1657	5	18	95	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
56- Watkins Mill Rd at I-270 SB off ramp/Parkview Ave											
56	NB	747.0	F	NB Left	46	222	668	726	F	174.0	F
				NB Through	0	0	0	0	A		
				NB Right	86	1028	668	726	F		
	SB	83.5	F	SB Left	552	113	2037	5048	F		
				SB Through	131	109	2037	5048	F		
				SB Right	447	39	2037	5048	D		
	EB	463.4	F	EB Left	0	0	0	0	A		
				EB Through	494	463	1163	1232	F		
				EB Right	2	599	1163	1232	F		
	WB	41.8	D	WB Left	116	87	120	459	F		
				WB Through	769	35	117	457	D		
				WB Right	0	0	0	0	A		
57- Watkins Mill Rd at I-270 NB on ramp											
57	NB	35.2	D	NB Left	386	51	92	383	D	70.0	E
				NB Through	0	0	0	0	A		
				NB Right	478	23	92	383	C		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	19.1	B	EB Left	190	61	49	301	E		
				EB Through	749	8	49	301	A		
				EB Right	0	0	0	0	A		
	WB	139.2	F	WB Left	0	0	0	0	A		
				WB Through	954	150	640	849	F		
				WB Right	174	78	640	849	E		
58- Watkins Mill Rd at I-270 SB on ramp											
58	NB			NB Left	0	0	0	0	A	60.7	E
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	73.4	E	EB Left	0	0	0	0	A		
				EB Through	938	30	483	620	C		
				EB Right	182	299	483	620	F		
	WB	50.0	D	WB Left	456	142	273	516	F		
				WB Through	883	2	273	516	A		
				WB Right	0	0	0	0	A		

Table C.15: AM Peak - 2040 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
1- MD 85 at Sam's Club Drive											
1	NB	22.4	C	NB Left	120	78	79	440	E	37.3	D
				NB Through	375	26	79	440	C		
				NB Right	691	11	19	393	B		
	SB	48.7	D	SB Left	138	62	162	748	E		
				SB Through	598	48	162	748	D		
				SB Right	69	27	162	748	C		
	EB	49.6	D	EB Left	105	77	55	204	E		
				EB Through	62	77	55	204	E		
				EB Right	113	9	55	204	A		
	WB	51.1	D	WB Left	231	74	90	317	E		
				WB Through	15	66	90	317	E		
				WB Right	126	7	90	317	A		
2- MD 85 at I-270 NB on and off ramp											
2	NB	50.6	D	NB Left	681	51	253	1103	D	35.8	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	19.2	B	SB Left	0	0	0	0	A		
				SB Through	612	19	55	506	B		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
3- MD 85 at I-270 SB on and off ramp											
3	NB	5.4	A	NB Left	0	0	0	0	A	10.9	B
				NB Through	1069	5	20	439	A		
				NB Right	0	0	0	0	A		
	SB	44.5	D	SB Left	174	44	57	814	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
4- MD 85 at Crestwood Blvd											
4	NB	19.2	C	NB Left	13	52	53	373	D	25.6	C
				NB Through	762	19	53	373	B		
				NB U-Turn	0	0	0	0	A		
	SB	19.7	B	SB Left	67	67	25	156	E		
				SB Through	1871	19	94	741	B		
				SB Right	845	18	78	688	B		
	EB	54.0	D	EB Left	622	55	94	295	E		
				EB Through	28	76	94	295	E		
				EB Right	43	21	94	295	C		
	WB	44.2	D	WB Left	52	53	21	140	D		
				WB Through	18	56	21	140	E		
				WB Right	19	9	21	140	A		
5- MD 80 at I-270 NB on and ramp											
5	NB	-1.2	A	NB Left	4	0	0	0	A	10.5	B
				NB Through	1	0	0	0	A		
				NB Right	4	-3	0	0	A		
	SB	13.0	B	SB Left	211	16	14	113	B		
				SB Through	6	15	14	113	B		
				SB Right	61	2	0	0	A		
	EB	9.6	A	EB Left	55	10	10	169	A		
				EB Through	0	0	8	0	A		
				EB Right	5	6	18	200	A		
	WB	10.1	B	WB Left	35	11	1	47	B		
				WB Through	880	15	79	611	B		
				WB Right	637	3	0	5	A		
6- MD 80 at I-270 SB on and off ramp											
6	NB	3.2	A	NB Left	25	9	1	90	A	9.7	A
				NB Through	0	0	0	0	A		
				NB Right	279	3	1	90	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	12.1	B	EB Left	0	0	0	0	A		
				EB Through	360	12	15	156	B		
				EB Right	162	11	15	165	B		
	WB	12.4	B	WB Left	0	0	0	0	A		
				WB Through	276	12	13	369	B		
				WB Right	0	0	0	0	A		
7- MD 109 at I-270 NB on and off ramp											
7	NB			NB Left	0	0	0	0	A	7.3	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	14.8	B	SB Left	149	19	18	168	C		
				SB Through	0	0	0	0	A		
				SB Right	49	3	1	134	A		
	EB	5.6	A	EB Left	85	6	1	83	A		
				EB Through	0	0	0	0	A		
				EB Right	62	6	0	0	A		
	WB	5.4	A	WB Left	0	0	0	0	A		
				WB Through	649	5	40	655	A		
				WB Right	0	0	0	0	A		
8- MD 80 at I-270 SB on and off ramp											
8	NB	5.8	A	NB Left	17	24	3	86	C	9.4	A
				NB Through	0	0	0	0	A		
				NB Right	51	0	0	14	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	4.4	A	EB Left	0	0	0	0	A		
				EB Through	89	1	2	96	A		
				EB Right	98	8	3	95	A		
	WB	11.1	B	WB Left	544	11	53	584	B		
				WB Through	152	11	50	561	B		
				WB Right	0	0	0	0	A		
9- MD 121 at Gateway Center Dr											
9	NB	19.1	C	NB Left	160	28	48	323	C	51.0	D
				NB Through	449	25	48	323	C		
				NB Right	342	8	58	349	A		
	SB	31.5	D	SB Left	57	20	105	508	B		
				SB Through	802	32	115	508	C		
				SB Right	9	31	127	529	C		
	EB	119.4	F	EB Left	9	98	416	517	F		
				EB Through	101	125	419	517	F		
				EB Right	660	119	448	549	F		
	WB	21.0	C	WB Left	138	24	18	142	C		
				WB Through	17	18	18	142	B		
				WB Right	28	6	14	165	A		
10- MD 121 at I-270 NB on and off ramp											
10	NB	27.7	D	NB Left	339	58	69	268	F	18.2	B
				NB Through	0	0	0	0	A		
				NB Right	426	3	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	11.6	B	EB Left	0	0	0	0	A		
				EB Through	522	18	35	320	C		
				EB Right	285	1	0	0	A		
	WB	17.1	C	WB Left	234	63	125	832	F		
				WB Through	1359	9	125	832	A		
				WB Right	0	0	0	0	A		

Table C.15: AM Peak - 2040 Build - Intersection Delay and Level of Service

11- MD 121 at I-270 SB on and off ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	227	88	231	1016	F		
	SB	60.0	E	SB Through	0	0	0	0	A		
11				SB Right	316	40	9	478	E	17.3	B
				EB Left	0	0	0	0	A		
	EB	5.5	A	EB Through	578	5	13	238	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	7.6	A	WB Through	662	19	41	354	C		
				WB Right	1040	1	0	0	A		
12- MD 27 at Observation Dr											
				NB U-Turn	0	0	0	0	A		
	NB	47.9	D	NB Through	48	58	13	72	E		
				NB Right	12	8	13	72	A		
				SB Left	92	53	30	192	D		
	SB	42.6	D	SB Through	54	52	38	271	D		
12				SB Right	178	34	62	308	C	30.1	C
				EB Left	162	41	47	355	D		
	EB	17.7	B	EB Through	1289	15	48	356	B		
				EB Right	50	11	55	394	B		
				WB Left	104	28	266	826	C		
	WB	35.7	D	WB Through	2217	37	266	826	D		
				WB Right	113	19	266	826	B		
13- MD 27 at I-270 NB off ramp											
				NB Left	111	33	14	101	C		
	NB	32.9	C	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
13				SB Right	0	0	0	0	A	37.8	D
				EB Left	0	0	0	0	A		
	EB	0.1	A	EB Through	1027	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	55.5	E	WB Through	2227	55	667	1962	E		
				WB Right	0	0	0	0	A		
14- MD 27 at I-270 SB off ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	441	46	69	275	D		
	SB	46.0	D	SB Through	0	0	0	0	A		
14				SB Right	0	0	0	0	A	72.2	E
				EB Left	0	0	0	0	A		
	EB	2.6	A	EB Through	836	3	2	61	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	123.2	F	WB Through	1368	123	1186	1647	F		
				WB Right	0	0	0	0	A		
15- MD 27 at Crystal Rock Dr											
				NB Left	30	37	271	728	D		
	NB	60.5	E	NB Through	1041	61	295	728	E		
				NB Right	93	67	303	741	E		
				SB Left	528	116	1506	2184	F		
	SB	119.0	F	SB Through	1652	121	1506	2184	F		
15				SB Right	54	81	1500	2178	F	91.3	F
				EB Left	224	49	58	201	D		
	EB	43.7	D	EB Through	97	43	54	196	D		
				EB Right	75	28	58	226	C		
				WB Left	11	56	36	112	E		
	WB	53.1	D	WB Through	32	260	36	112	F		
				WB Right	142	6	36	112	A		
16- MD 118 at Seneca Meadows Pkwy											
				NB Left	117	11	1	69	B		
	NB	3.7	A	NB Through	773	3	5	155	A		
				NB Right	64	1	9	208	A		
				SB Left	31	4	7	236	A		
	SB	4.3	A	SB Through	948	4	11	236	A		
16				SB Right	41	3	13	269	A	6.2	A
				EB Left	20	65	10	77	E		
	EB	18.5	B	EB Through	6	82	10	77	F		
				EB Right	115	7	10	77	A		
				WB Left	35	72	16	102	E		
	WB	44.7	D	WB Through	6	55	11	101	D		
				WB Right	27	8	14	111	A		
17- MD 118 at I-270 NB on ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
17				SB Right	0	0	0	0	A	10.1	B
				EB Left	274	29	30	198	C		
	EB	29.1	C	EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	5.4	A	WB Through	188	1	0	0	A		
				WB Right	911	6	15	304	A		
18- MD 118 at I-270 SB off ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0.0	0	0	A		
				NB Right	0	0.0	0	0	A		
				SB Left	249	38.2	39	186	D		
	SB	38.2	D	SB Through	0	0.0	0	0	A		
18				SB Right	0	0.0	0	0	A	8.4	A
				EB Left	0	0.0	0	0	A		
	EB	4.1	A	EB Through	631	4.1	6	195	A		
				EB Right	0	0.0	0	0	A		
				WB Left	0	0.0	0	0	A		
	WB	4.6	A	WB Through	1264	4.6	11	240	A		
				WB Right	0	0.0	0	0	A		
19- MD 118 at Aircraft Dr											
				NB Left	9	78	9	75	E		
	NB	46.2	D	NB Through	13	80	9	75	F		
				NB Right	17	3	0	24	A		
				SB Left	267	55	112	418	E		
	SB	60.5	E	SB Through	53	72	112	418	E		
19				SB Right	96	68	112	418	E	20.4	C
				EB Left	132	17	37	329	B		
	EB	12.4	B	EB Through	1019	12	37	329	B		
				EB Right	34	12	37	329	B		
				WB Left	87	24	48	291	C		
	WB	15.0	B	WB Through	1105	17	48	291	B		
				WB Right	341	6	48	291	A		
20- Middlebrook Rd at Observation Dr											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	26	36	6	63	D		
	SB	20.5	C	SB Through	0	0	0	0	A		
20				SB Right	27	5	6	63	A	17.0	B
				EB Left	259	24	37	292	C		
	EB	15.0	B	EB Through	928	12	37	292	B		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	18.6	B	WB Through	1141	19	76	414	B		
				WB Right	275	15	101	463	B		

Table C.15: AM Peak - 2040 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
21- Middlebrook Rd at I-270 SB on ramp											
21	NB			NB Left	0	0	0	0	A	17.5	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	12.0	B	EB Left	0	0	0	0	A		
				EB Through	867	12	30	192	B		
				EB Right	0	0	0	0	A		
	WB	23.8	C	WB Left	760	24	93	912	C		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
22- Middlebrook Rd at Waring Station Rd											
22	NB	73.6	E	NB Left	188	61	181	446	E	30.6	C
				NB Through	8	57	181	446	E		
				NB Right	358	80	181	446	F		
	SB	18.1	B	SB Left	3	39	1	29	D		
				SB Through	0	0	1	29	A		
				SB Right	5	5	2	67	A		
	EB	23.1	C	EB Left	34	12	189	1053	B		
				EB Through	1610	24	189	1053	C		
				EB Right	91	16	189	1053	B		
	WB	18.5	B	WB Left	82	23	34	241	C		
				WB Through	750	19	34	241	B		
				WB Right	43	4	34	241	A		
23- MD 124 at MD 355											
23	NB	56.6	E	NB Left	228	85	86	257	F	123.1	F
				NB Through	390	47	84	254	D		
				NB Right	54	3	0	0	A		
	SB	148.8	F	SB Left	52	174	584	795	F		
				SB Through	968	140	584	795	F		
				SB Right	475	165	508	781	F		
	EB	61.0	E	EB Left	641	150	633	1190	F		
				EB Through	524	16	633	1190	B		
				EB Right	584	4	404	1172	A		
	WB	203.4	F	WB Left	0	0	0	0	A		
				WB Through	1387	206	841	1111	F		
				WB Right	40	102	0	0	F		
24- MD 124 at I-270 SB on and off											
24	NB	64.9	F	NB Left	16	61	18	95	E	30.7	C
				NB Through	37	67	18	95	E		
				NB U-Turn	0	0	0	0	A		
	SB	25.2	C	SB Left	307	65	81	371	E		
				SB Through	17	60	81	371	E		
				SB Right	641	5	8	307	A		
	EB	16.5	B	EB Left	0	0	0	0	A		
				EB Through	1038	17	49	394	B		
				EB Right	67	13	59	418	B		
	WB	50.2	D	WB Left	36	54	2108	2462	D		
				WB Through	940	50	2108	2462	D		
				WB Right	0	0	0	0	A		
25- MD 117 at MD 124											
25	NB	50.2	D	NB Left	21	106	155	707	F	49.2	D
				NB Through	546	65	155	707	E		
				NB Right	433	29	60	665	C		
	SB	49.6	D	SB Left	183	76	234	821	E		
				SB Through	1076	50	234	821	D		
				SB Right	131	11	0	0	B		
	EB	52.6	D	EB Left	101	119	212	769	F		
				EB Through	1475	49	212	770	D		
				EB Right	82	44	223	797	D		
	WB	41.8	D	WB Left	331	76	111	352	E		
				WB Through	501	28	111	352	C		
				WB Right	103	0	0	0	A		
26- MD 117 at Bureau Dr											
26	NB	49.9	D	NB Left	25	64	19	121	E	42.8	D
				NB Through	24	65	19	121	E		
				NB Right	25	22	19	121	C		
	SB	203.2	F	SB Left	199	204	251	401	F		
				SB Through	57	212	251	401	F		
				SB Right	31	179	251	401	F		
	EB	36.7	D	EB Left	34	27	261	960	C		
				EB Through	1998	37	270	959	D		
				EB Right	29	45	263	949	D		
	WB	20.7	C	WB Left	319	63	133	526	E		
				WB Through	885	11	133	527	B		
				WB Right	329	6	104	575	A		
27- MD 117 at I-270 SB off ramp											
27	NB			NB Left	0	0	0	0	A	7.9	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.0	A	EB Left	0	0	0	0	A		
				EB Through	825	2	1	147	A		
				EB Right	0	0	0	0	A		
	WB	22.6	C	WB Left	329	23	45	389	C		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
28- MD 117 at I-270 NB off ramp											
28	NB			NB Left	0	0	0	0	A	42.4	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	75.7	E	SB Left	318	69	454	1634	E		
				SB Through	0	0	0	0	A		
				SB Right	949	78	459	1636	E		
	EB	19.2	B	EB Left	14	110	75	682	F		
				EB Through	812	18	75	682	B		
				EB Right	0	0	0	0	A		
	WB	17.3	B	WB Left	0	0	0	0	A		
				WB Through	909	17	69	361	B		
				WB Right	9	8	76	391	A		
29- MD 117 at Perry Pkwy											
29	NB	46.7	D	NB Left	36	79	19	133	E	16.8	B
				NB Through	7	68	18	133	E		
				NB Right	38	13	29	153	B		
	SB	54.0	D	SB Left	112	106	67	257	F		
				SB Through	14	119	67	257	F		
				SB Right	133	3	67	257	A		
	EB	10.4	B	EB Left	120	70	45	236	E		
				EB Through	995	3	45	236	A		
				EB Right	10	3	31	220	A		
	WB	11.4	B	WB Left	8	70	21	278	E		
				WB Through	748	12	21	278	B		
				WB Right	136	6	21	278	A		
30- Shady Grove Rd at I-270 NB off ramp											
30	NB	9.2	A	NB Left	0	0	0	0	A	24.8	C
				NB Through	989	9	21	233	A		
				NB Right	0	0	0	0	A		
	SB	10.4	B	SB Left	0	0	0	0	A		
				SB Through	1349	10	34	335	B		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	58.5	E	WB Left	1039	58	215	713	E		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table C.15: AM Peak - 2040 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
31- Shady Grove Rd at I-270 SB off ramp											
31				NB Left	0	0	0	0	A	21.1	C
	NB	14.6	B	NB Through	1004	15	43	411	B		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB	11.2	B	SB Through	1758	11	47	649	B		
				SB Right	0	0	0	0	A		
				EB Left	317	38	42	283	D		
	EB	45.8	D	EB Through	0	0	0	0	A		
				EB Right	641	50	108	476	D		
				WB Left	0	0	0	0	A		
	WB			WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
32- MD 28 at I-270 SB off ramp											
32				NB U-Turn	0	0	0	0	A	38.2	D
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	458	43	72	310	D		
	SB	35.5	D	SB Through	0	0	0	0	A		
				SB Right	112	4	1	77	A		
				EB Left	0	0	0	0	A		
	EB	79.5	E	EB Through	899	123	1672	2139	F		
				EB Right	573	12	1058	2145	B		
				WB Left	0	0	0	0	A		
	WB	8.4	A	WB Through	1985	8	38	390	A		
				WB Right	0	0	0	0	A		
33- MD 28 at I-270 on and off ramps											
33				NB Left	0	0	60	319	A	20.9	C
	NB	36.3	D	NB Through	221	53	69	328	D		
				NB Right	143	11	69	328	B		
				SB Left	30	63	33	255	E		
	SB	26.8	C	SB Through	0	0	0	0	A		
				SB Right	316	23	33	255	C		
				EB Left	231	39	61	340	D		
	EB	19.8	B	EB Through	742	14	61	340	B		
				EB Right	0	0	0	0	A		
				WB Left	26	14	51	311	B		
	WB	14.4	B	WB Through	965	14	37	274	B		
				WB Right	0	0	0	0	A		
34- MD 189 at Great Falls Rd											
34				NB Left	65	42	15	107	D	10.9	B
	NB	38.0	D	NB Through	8	42	12	107	D		
				NB Right	10	8	14	117	A		
				SB Left	83	44	25	224	D		
	SB	6.3	A	SB Through	8	48	25	224	D		
				SB Right	619	1	0	0	A		
				EB Left	331	16	14	232	B		
	EB	11.1	B	EB Through	959	9	21	219	A		
				EB Right	14	8	30	255	A		
				WB Left	5	16	19	217	B		
	WB	13.0	B	WB Through	329	13	19	217	B		
				WB Right	11	9	30	251	A		
35- MD 189 at I-270 Ramps											
35				NB Left	140	48	26	124	D	40.9	D
	NB	47.8	D	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	170	48	49	270	D		
	SB	47.7	D	SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
				EB Left	418	21	86	434	C		
	EB	22.7	C	EB Through	569	24	86	434	C		
				EB Right	0	0	0	0	A		
				WB Left	554	50	139	474	D		
	WB	59.6	E	WB Through	291	79	139	474	E		
				WB Right	0	0	0	0	A		
36- MD 189 at Wooton Pkwy											
36				NB Left	160	55	59	236	D	62.7	E
	NB	40.2	D	NB Through	125	57	59	236	E		
				NB Right	160	12	59	236	B		
				SB Left	475	90	366	797	F		
	SB	82.6	F	SB Through	822	78	337	784	E		
				SB Right	0	0	0	0	A		
				EB Left	164	84	268	938	F		
	EB	57.6	E	EB Through	977	57	268	938	E		
				EB Right	125	29	268	938	C		
				WB Left	412	71	126	369	E		
	WB	51.6	D	WB Through	376	38	126	369	D		
				WB Right	59	7	126	369	A		
37- Montrose Rd at Tower Oaks Blvd											
37				NB Left	0	0	0	0	A	78.7	E
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	159	41	1101	1400	D		
	SB	196.5	F	SB Through	0	0	0	0	A		
				SB Right	605	238	1097	1395	F		
				EB Left	31	40	192	1090	D		
	EB	29.5	C	EB Through	1649	29	192	1090	C		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	74.6	E	WB Through	1742	77	383	841	E		
				WB Right	84	26	383	841	C		
38- Tower Oaks Blvd at I-270 off rmap											
38				NB Left	534	22	38	203	C	60.9	E
	NB	21.6	C	NB Through	10	18.1	32	195	B		
				NB Right	28	16.1	38	203	B		
				SB Left	0	2.7	0	24	A		
	SB	0.7	A	SB Through	0	0.0	0	23	A		
				SB Right	4	0.7	0	0	A		
				EB Left	8	64.0	322	467	E		
	EB	94.3	F	EB Through	742	95.6	322	467	F		
				EB Right	106	87.4	313	457	F		
				WB Left	0	0.0	4	80	A		
	WB	9.0	A	WB Through	106	9.3	4	80	A		
				WB Right	8	4.1	0	19	A		
39- Montrose Rd at Tower Oaks Blvd											
39				NB Left	37	73	41	179	E	46.7	D
	NB	16.4	B	NB Through	240	45	41	179	D		
				NB Right	560	0	0	0	A		
				SB Left	331	53	172	633	D		
	SB	42.1	D	SB Through	772	38	171	632	D		
				SB Right	77	32	134	654	C		
				EB Left	78	68	359	717	E		
	EB	77.7	E	EB Through	992	79	362	718	E		
				EB Right	64	75	382	742	E		
				WB Left	399	49	87	305	D		
	WB	41.0	D	WB Through	249	48	87	305	D		
				WB Right	144	7	103	335	A		
40- Rockledge Blvd at I-270 NB on and off ramp											
40				NB Left	0	0	0	0	A	18.9	B
	NB	34.8	C	NB Through	93	34	34	171	C		
				NB Right	216	35	34	171	D		
				SB Left	0	0	4	62	A		
	SB	2.1	A	SB Through	980	2	4	62	A		
				SB Right	0	0	0	0	A		
				EB Left	3	55	143	519	D		
	EB	28.7	C	EB Through	557	58	143	519	E		
				EB Right	605	1	0	0	A		
				WB Left	0	0	0	0	A		
	WB			WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table C.15: AM Peak - 2040 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
41- Rockledge Blvd at I-270 SB on and off ramps											
41	NB	2.2	A	NB Left	96	2	1	34	A	20.5	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	21.8	C	WB Left	980	22	97	605	C		
				WB Through	431	20	97	605	C		
				WB Right	0	0	0	0	A		
42- MD 187 at Tuckerman Ln											
42	NB	62.9	E	NB Left	231	24	288	831	C	152.9	F
				NB Through	1497	62	288	831	E		
				NB Right	219	112	288	831	F		
	SB	225.2	F	SB Left	59	163	2600	2706	F		
				SB Through	1200	225	2600	2706	F		
				SB Right	160	249	2600	2706	F		
	EB	186.5	F	EB Left	222	132	1867	1982	F		
				EB Through	629	204	1868	1983	F		
				EB Right	130	197	1892	2007	F		
	WB	183.6	F	WB Left	736	222	1905	2152	F		
				WB Through	404	149	1905	2152	F		
				WB Right	161	93	1905	2152	F		
43- MD 187 at I-270 NB on and off ramps											
43	NB	11.6	B	NB Left	163	90	64	247	F	18.9	B
				NB Through	1550	3	64	247	A		
				NB Right	0	0	0	0	A		
	SB	24.3	C	SB Left	0	0	0	0	A		
				SB Through	1543	24	78	547	C		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	50.9	D	WB Left	125	52	41	283	D		
				WB Through	10	42	41	283	D		
				WB Right	0	0	0	0	A		
44- MD 187 at I-270 NB on and off ramps											
44	NB	22.9	C	NB Left	0	0	0	0	A	27.2	C
				NB Through	1481	23	65	377	C		
				NB Right	0	0	0	0	A		
	SB	7.5	A	SB Left	179	53	58	267	D		
				SB Through	1484	2	58	267	A		
				SB Right	0	0	0	0	A		
	EB	89.5	F	EB Left	237	60	269	822	E		
				EB Through	0	0	269	822	A		
				EB Right	387	107	289	811	F		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
45- MD 187 at Rock Spring Dr											
45	NB	14.9	B	NB Left	255	57	68	231	E	21.1	C
				NB Through	1382	7	69	231	A		
				NB Right	10	6	93	264	A		
	SB	22.6	C	SB Left	12	28	103	644	C		
				SB Through	1708	25	103	644	C		
				SB Right	149	1	71	613	A		
	EB	37.1	D	EB Left	190	59	54	209	E		
				EB Through	26	56	54	209	E		
				EB Right	251	19	54	209	B		
	WB	7.3	A	WB Left	1	8	1	29	A		
				WB Through	9	11	1	29	B		
				WB Right	5	0	0	7	A		
47-Democracy Blvd at I-270 NB off ramp											
47	NB	31.1	C	NB Left	227	31	27	157	C	14.2	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	13.5	B	EB Left	0	0	0	0	A		
				EB Through	1682	13	56	496	B		
				EB Right	0	0	0	0	A		
	WB	10.8	B	WB Left	0	0	0	0	A		
				WB Through	778	11	24	187	B		
				WB Right	0	0	0	0	A		
48- Democracy Blvd at I-270 SB on ramp											
48	NB			NB Left	0	0	0	0	A	6.5	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	5.4	A	EB Left	0	0	0	0	A		
				EB Through	1794	5	24	278	A		
				EB Right	0	0	0	0	A		
	WB	8.5	A	WB Left	223	36	31	173	D		
				WB Through	781	1	20	152	A		
				WB Right	0	0	0	0	A		
49- Democracy Blvd at I-270 SB off ramp											
49	NB			NB Left	0	0	0	0	A	12.5	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	32.1	C	SB Left	360	47	60	227	D		
				SB Through	0	0	0	0	A		
				SB Right	185	2	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	2.9	A	WB Left	0	0	0	0	A		
				WB Through	778	3	5	136	A		
				WB Right	335	2	1	145	A		
50- MD 190 at Burdette Rd											
50	NB	73.2	E	NB Left	20	80	15	118	E	13.6	B
				NB Through	4	59	15	118	E		
				NB Right	11	67	15	118	E		
	SB	34.8	C	SB Left	50	78	31	150	E		
				SB Through	17	64	31	150	E		
				SB Right	120	13	31	150	B		
	EB	10.9	B	EB Left	53	92	61	522	F		
				EB Through	1816	9	61	522	A		
				EB Right	14	7	55	545	A		
	WB	13.0	B	WB Left	1	106	65	859	F		
				WB Through	1501	13	66	859	B		
				WB Right	21	2	58	882	A		

Table C.15: AM Peak - 2040 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
51- MD 190 at I-270 NB on ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
51				EB Left	535	119	341	721	F	52.1	D
	EB	118.9	F	EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	16.1	B	WB Through	995	16	77	700	B		
				WB Right	0	0	0	0	A		
52- MD 190 at I-270 SB off ramp											
				NB Left	255	86	1786	4342	F		
	NB	86.1	F	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
52				EB Left	0	0	0	0	A	15.2	B
	EB	3.3	A	EB Through	982	3	8	203	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	5.6	A	WB Through	667	6	8	181	A		
				WB Right	0	0	0	0	A		
53- MD 190 at Seven Locks Rd											
				NB Left	21	67	23	149	E		
	NB	68.2	E	NB Through	59	69	25	148	E		
				NB Right	0	0	0	0	A		
				SB Left	624	56	184	777	E		
	SB	56.9	E	SB Through	183	59	185	778	E		
				SB Right	18	54	184	777	D		
53				EB Left	24	30	135	584	C	44.4	D
	EB	37.5	D	EB Through	846	37	135	584	D		
				EB Right	42	42	135	584	D		
				WB Left	119	116	116	359	F		
	WB	38.0	D	WB Through	640	32	118	362	C		
				WB Right	156	1	2	157	A		
54- MD 124 at I-270 NB off ramp											
				NB Left	0	0	0	0	A		
	NB	43.2	D	NB Through	0	0	0	0	A		
				NB Right	789	43	85	375	D		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
54				EB Left	0	0	0	0	A	32.2	C
	EB	23.1	C	EB Through	956	23	57	410	C		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB			WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
55- Democracy Blvd at I-270 NB off ramp											
				NB Left	0	0	0	0	A		
	NB	37.0	D	NB Through	0	0	0	0	A		
				NB Right	967	37	117	583	D		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
55				EB Left	0	0	0	0	A	16.5	B
	EB	4.7	A	EB Through	1682	5	20	86	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB			WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
56- Watkins Mill Rd at I-270 SB off ramp/Parkview Ave											
				NB Left	34	261	679	727	F		
	NB	916.1	F	NB Through	0	0	0	0	A		
				NB Right	71	1230	679	727	F		
				SB Left	599	130	2144	5048	F		
	SB	98.9	F	SB Through	141	123	2144	5048	F		
				SB Right	489	54	2144	5048	D		
56				EB Left	0	0	0	0	A	182.7	F
	EB	505.8	F	EB Through	470	506	1165	1228	F		
				EB Right	2	344	1165	1228	F		
				WB Left	114	77	103	475	E		
	WB	37.2	D	WB Through	755	31	100	474	C		
				WB Right	0	0	0	0	A		
57- Watkins Mill Rd at I-270 NB on ramp											
				NB Left	411	51	105	468	D		
	NB	37.7	D	NB Through	0	0	0	0	A		
				NB Right	515	27	105	468	C		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
57				EB Left	172	63	49	336	E	75.1	E
	EB	19.6	B	EB Through	783	10	49	336	B		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	158.9	F	WB Through	887	172	661	860	F		
				WB Right	160	88	661	860	F		
58- Watkins Mill Rd at I-270 SB on ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
58				EB Left	0	0	0	0	A	64.4	E
	EB	76.3	E	EB Through	954	32	491	615	C		
				EB Right	177	315	491	615	F		
				WB Left	430	159	296	512	F		
	WB	54.2	D	WB Through	871	2	296	512	A		
				WB Right	0	0	0	0	A		

AM Peak - 2040 - I-270 Vehicle Network Performance

	2040 No Build	2040 Build	% Change
Total Delay (sec.)	35,032,576	25,663,805	-27%
Average Delay per Vehicle (sec.)	326	235	-28%
Total Travel Time (sec.)	64,317,886	56,784,362	-12%
Vehicles (Arrived)	87,894	92,787	6%
Latent Demand	44,530	41,717	-6%
Latent Delay (sec.)	120,600,723	116,673,147	-3%
Total Distance (mi.)	463,125	492,650	6%
Average Speed (mph)	26	31	20%

PM Peak

Table D.1: PM Peak - 2040 - I-270 Vehicle Travel Time

I-270 Northbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Build VISSIM Travel Time (seconds)	% Change	I-270 Southbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Build VISSIM Travel Time (seconds)	% Change
From I-495 interchange					From I-70				
to MD 187	1.8	432.3	122.5	-72%	to MD 85	1.7	94.6	94.6	0%
to I-270 Split	0.6	90.3	38.1	-58%	to MD 80	5.4	307.1	306.2	0%
to Montrose Rd	1.8	115.8	112.1	-3%	to MD 109	3.7	210.7	209.9	0%
to MD 189	1.0	76.0	65.8	-13%	to MD 121	3.6	204.4	204.1	0%
to MD 28	1.0	92.5	72.4	-22%	to MD 27	2.5	146.4	146.1	0%
to Shady Grove Rd	1.9	211.0	122.0	-42%	to MD 118	1.1	65.1	65.2	0%
to I-370	0.9	185.6	77.2	-58%	to Middlebrook Rd	1.1	71.2	71.1	0%
to MD 117	1.5	158.7	110.9	-30%	to MD 124	2.2	137.5	139.3	1%
to MD 124	0.6	38.8	38.8	0%	to MD 117	0.9	117.3	129.6	10%
to Middlebrook Rd	2.5	214.3	161.1	-25%	to I-370	1.0	72.5	98.6	36%
to MD 118	1.1	80.3	74.7	-7%	to Shady Grove Rd	1.5	83.4	83.4	0%
to MD 27	0.9	69.9	63.4	-9%	to MD 28	1.9	114.1	114.0	0%
to MD 121	2.4	161.1	204.1	27%	to MD 189	1.0	62.7	62.8	0%
to MD 109	4.1	337.8	384.1	14%	to Montrose Rd	1.0	64.8	64.8	0%
to MD 80	3.7	247.0	244.4	-1%	to I-270 Split	1.9	114.7	113.0	-1%
to MD 85	5.3	348.1	347.0	0%	to MD 187	0.4	23.0	22.9	-1%
to I-70	1.4	182.3	179.6	-1%	to I-495 interchange	1.9	155.6	156.4	1%
I-270 Total (miles/minutes)	**32.4**	**50.7**	**40.3**	**-20%**	**I-270 Total (miles/minutes)**	**32.6**	**34.1**	**34.7**	**2%**
I-270 Spur Northbound					**I-270 Spur Southbound**				
From Cabin John Pkwy					From I-70				
to MD 190	0.5	125.4	84.9	-32%	to I-270 Split	30.3	1,866.3	1,902.6	2%
to I-495	1.1	271.9	225.1	-17%	to Democracy Blvd	0.7	183.2	39.7	-78%
to Democracy Blvd	1.4	226.8	209.1	-8%	to I-495	1.3	509.9	119.1	-77%
to I-270 Split	0.9	76.4	75.4	-1%	to MD 190	1.3	199.4	206.2	3%
to I-70	30.0	2,519.1	2,257.6	-10%	to Cabin John Pkwy	0.6	164.4	163.4	-1%
I-270 Spur Total (miles/minutes)	**34.0**	**53.7**	**47.5**	**-11%**	**I-270 Spur Total (miles/minutes)**	**34.2**	**48.7**	**40.5**	**-17%**

Table D.2: PM Peak - 2040 - I-270 Local Vehicle Travel Time

I-270 Northbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Build VISSIM Travel Time (seconds)	% Change	I-270 Southbound	Segment Length (miles)	No Build VISSIM Travel Time (seconds)	Build VISSIM Travel Time (seconds)	% Change
From C-D start					From C-D start				
to Montrose Rd	0.8	68.8	91.5	33%	to Shady Grove	1.3	87.5	92.5	6%
to MD 189	1.3	212.1	224.1	6%	to MD 28	1.8	120.3	120.9	0%
to MD 28	1.0	96.2	81.6	-15%	to MD 189	1.1	80.2	98.5	23%
to Shady Grove	2.0	420.6	125.7	-70%	to Montrose	1.2	88.8	88.8	0%
to I-370	1.0	346.7	145.1	-58%	to I-270 mainline	0.9	59.7	59.7	0%
to MD 117	1.2	819.0	234.0	-71%					
to MD 124	0.8	1,033.2	164.0	-84%					
to I-270 mainline	0.8	555.0	280.1	-50%					
I-270 Local Total (miles/minutes)	**8.9**	**59.2**	**22.4**	**-62%**	**I-270 Local Total (miles/minutes)**	**6.3**	**7.3**	**7.7**	**5%**

Figure D.1: PM Peak - 2040
I-270 Travel Time Graph - Northbound
(From Outer-Loop)

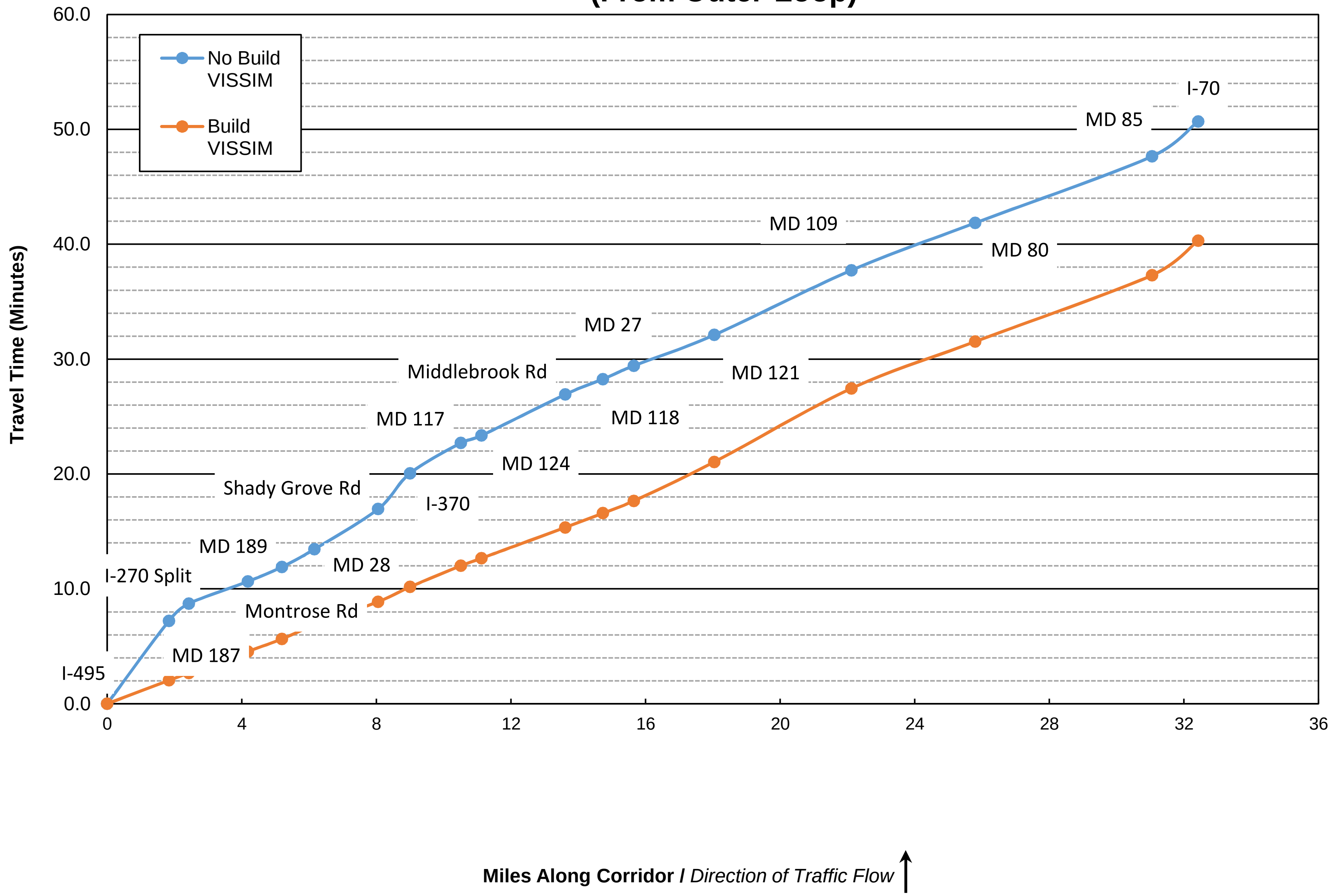
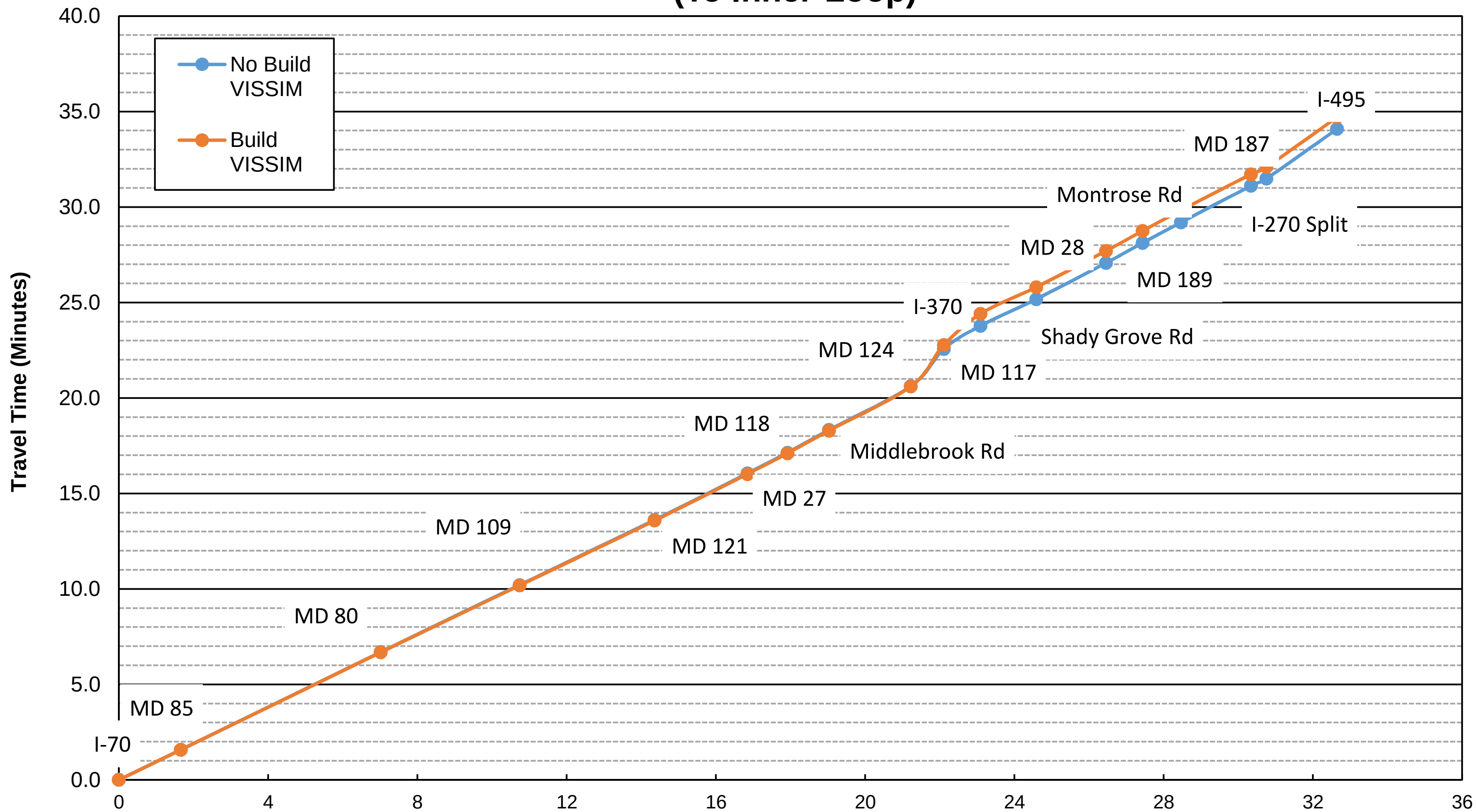


Figure D.2: PM Peak - 2040
I-270 Travel Time Graph - Southbound
(To Inner-Loop)



Miles Along Corridor / *Direction of Traffic Flow*

Figure D.3: PM Peak - 2040
I-270 Spur Travel Time Graph - Northbound
(From Inner-Loop)

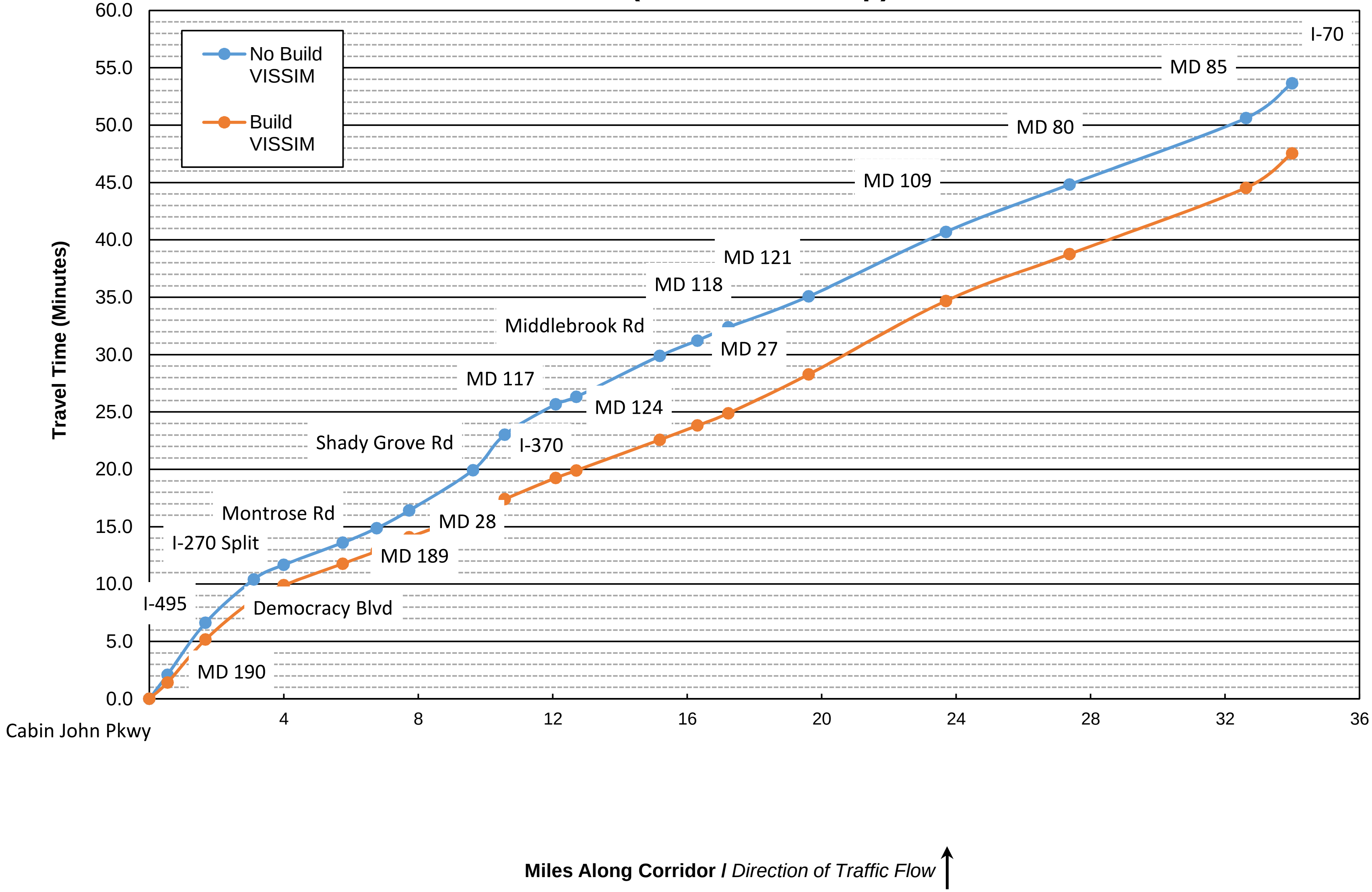
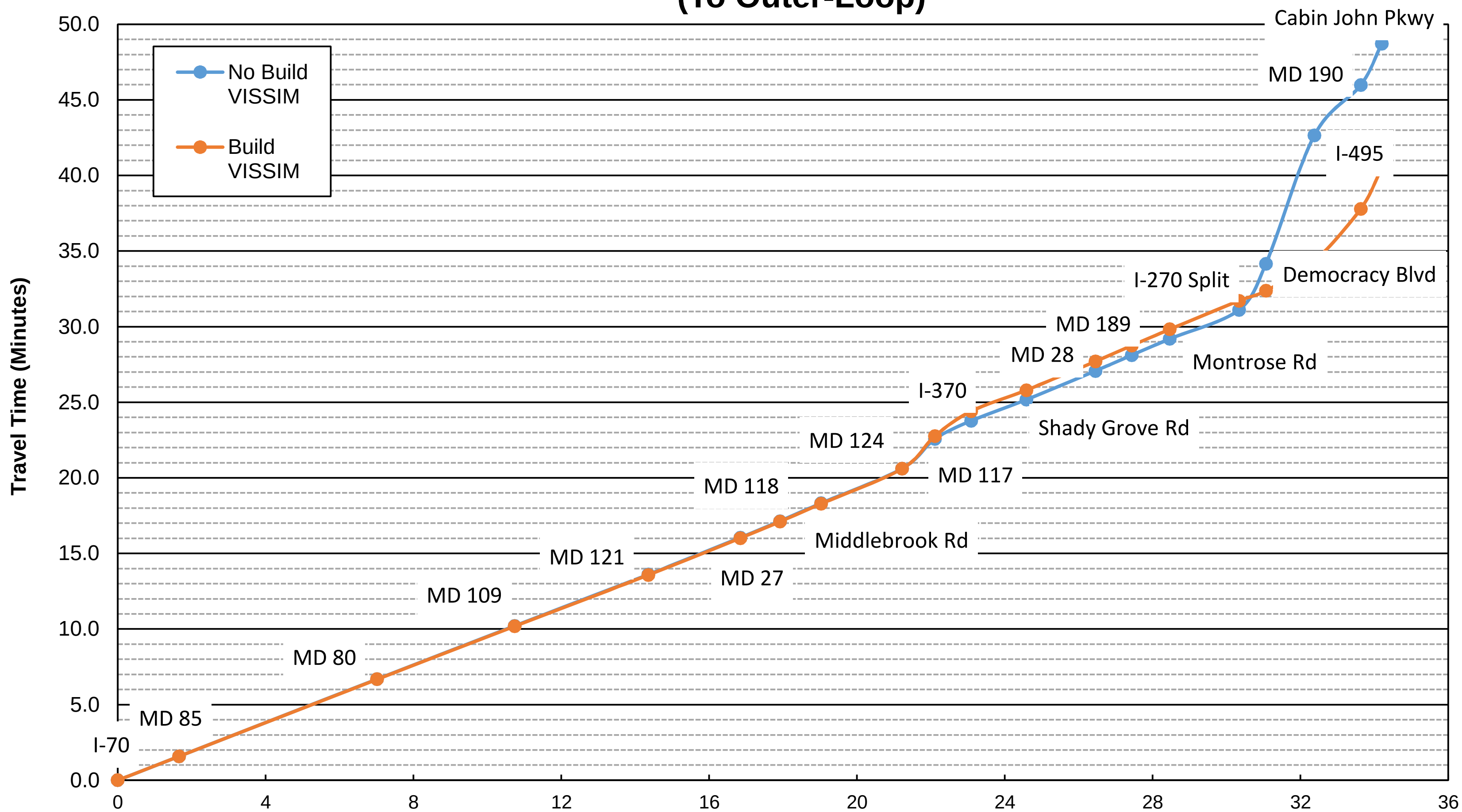


Figure D.4: PM Peak - 2040
I-270 Spur Travel Time Graph - Southbound
(To Outer-Loop)



Miles Along Corridor / *Direction of Traffic Flow*

Figure D.5: PM Peak - 2040
I-270 Local Travel Time Graph - Northbound

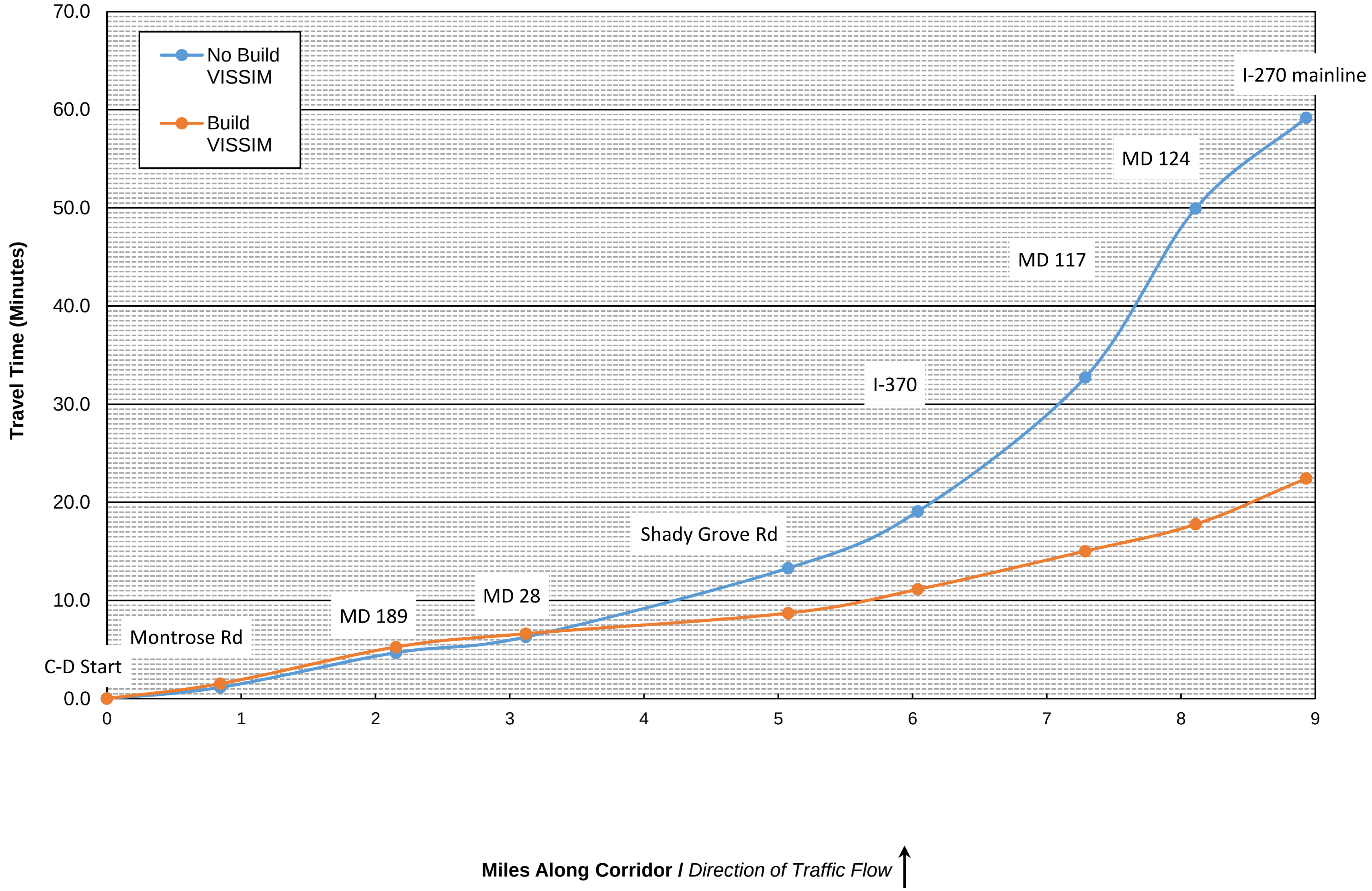


Figure D.6: PM Peak - 2040
I-270 Local Travel Time Graph - Southbound

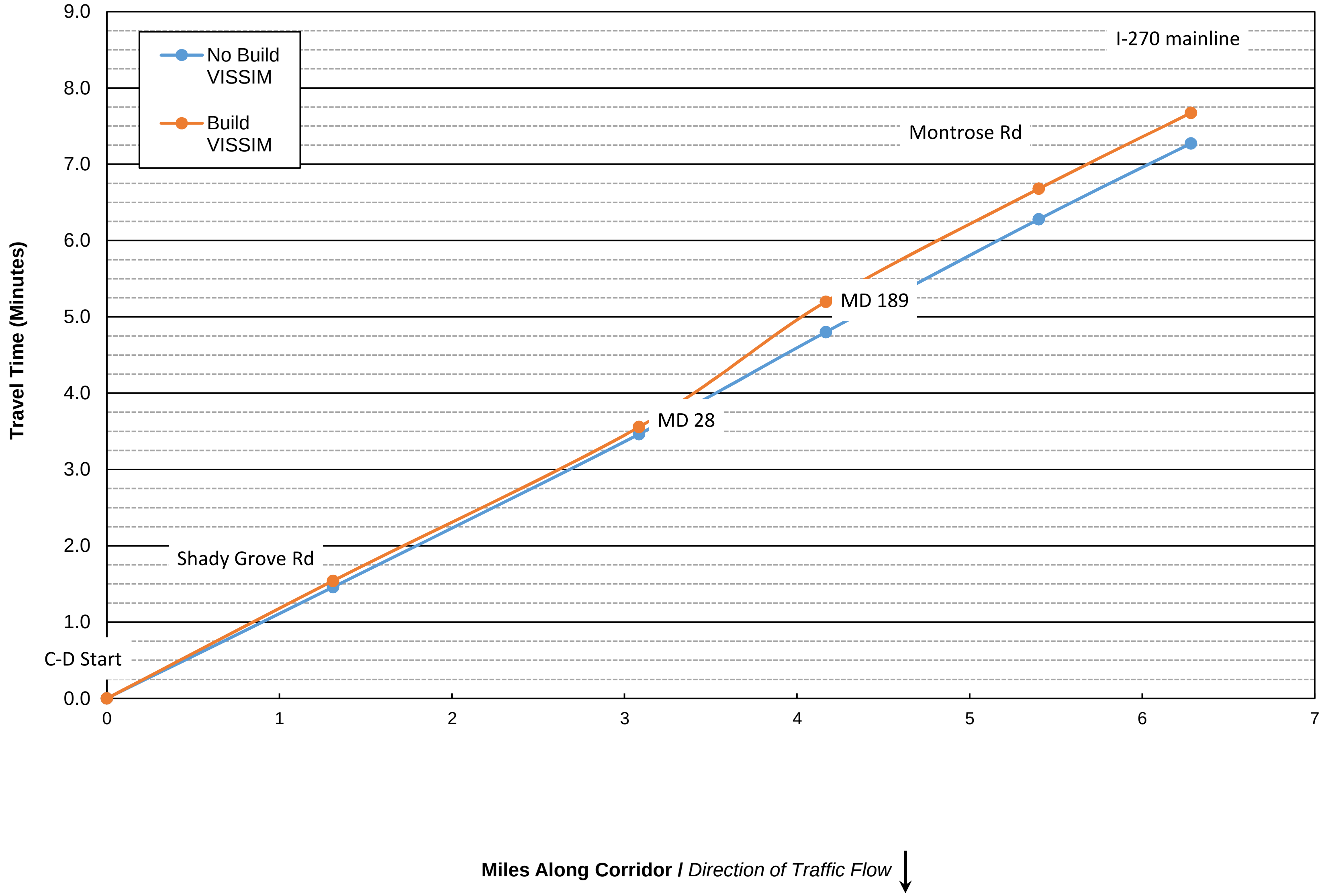


Table D.3: PM Peak - 2040 - I-270 Vehicle Speed

I-270 Northbound	No Build VISSIM Speed (MPH)	Build VISSIM Speed (MPH)	% Change	I-270 Southbound	No Build VISSIM Speed (MPH)	Build VISSIM Speed (MPH)	% Change
From I-495 interchange				From I-70			
to MD 187	15.3	53.9	253%	to MD 85	63.3	63.3	0%
to I-270 Split	23.6	55.8	137%	to MD 80	62.8	63.0	0%
to Montrose Rd	54.5	56.3	3%	to MD 109	63.6	63.8	0%
to MD 189	48.0	55.5	15%	to MD 121	63.8	63.9	0%
to MD 28	37.5	48.0	28%	to MD 27	61.1	61.2	0%
to Shady Grove Rd	32.4	56.0	73%	to MD 118	59.3	59.2	0%
to I-370	18.3	44.0	140%	to Middlebrook Rd	56.2	56.3	0%
to MD 117	34.4	49.2	43%	to MD 124	57.5	56.8	-1%
to MD 124	56.9	56.9	0%	to MD 117	27.2	24.6	-9%
to Middlebrook Rd	41.8	55.6	33%	to I-370	48.9	36.0	-26%
to MD 118	50.2	54.0	8%	to Shady Grove Rd	64.2	64.2	0%
to MD 27	47.2	52.0	10%	to MD 28	59.1	59.1	0%
to MD 121	53.5	42.2	-21%	to MD 189	56.2	56.1	0%
to MD 109	43.5	38.2	-12%	to Montrose Rd	57.4	57.3	0%
to MD 80	53.6	54.2	1%	to I-270 Split	58.7	59.6	1%
to MD 85	54.3	54.5	0%	to MD 187	65.7	66.2	1%
to I-70	27.1	27.5	1%	to I-495 interchange	43.7	43.5	-1%
I-270 Total (miles/minutes)	**38.4**	**48.3**	**26%**	**I-270 Total (miles/minutes)**	**57.5**	**56.5**	**-2%**
I-270 Spur Northbound				**I-270 Spur Southbound**			
From Cabin John Pkwy				From I-70			
to MD 190	15.5	22.9	48%	to I-270 Split	58.5	57.4	-2%
to I-495	15.0	18.1	21%	to Democracy Blvd	14.4	66.3	362%
to Democracy Blvd	22.8	24.7	8%	to I-495	9.3	39.6	328%
to I-270 Split	42.0	42.6	1%	to MD 190	22.6	21.9	-3%
to I-70	42.9	47.8	12%	to Cabin John Pkwy	12.5	12.6	1%
I-270 Spur Total (miles/minutes)	**38.0**	**42.9**	**13%**	**I-270 Spur Total (miles/minutes)**	**42.1**	**50.7**	**20%**

Table D.4: PM Peak - 2040 - I-270 Local Vehicle Speed

I-270 Northbound	No Build VISSIM Speed (MPH)	Build VISSIM Speed (MPH)	% Change	I-270 Southbound	No Build VISSIM Speed (MPH)	Build VISSIM Speed (MPH)	% Change
From C-D start				From C-D start			
to Montrose Rd	44.2	33.3	-25%	to Shady Grove	53.9	51.0	-5%
to MD 189	22.2	21.0	-5%	to MD 28	53.1	52.8	0%
to MD 28	36.2	42.7	18%	to MD 189	48.6	39.5	-19%
to Shady Grove	16.7	56.0	235%	to Montrose	50.1	50.1	0%
to I-370	10.0	24.0	139%	to I-270 mainline	53.2	53.2	0%
to MD 117	5.5	19.2	250%				
to MD 124	2.9	18.1	530%				
to I-270 mainline	5.3	10.6	98%				
I-270 Local Total (miles/minutes)	**9.1**			**I-270 Local Total (miles/minutes)**	**51.8**		

Figure D.7: HCM 2010 Density Level of Service Criteria (pc/mi/ln)

HCM 2010 Freeway LOS	
< 11	A
> 11 - 18	B
> 18 - 26	C
> 26 - 35	D
> 35 - 45	E
> 45	F
HCM 2010 Freeway Merge and Diverge Segment LOS	
< 10	A
> 10 - 20	B
> 20 - 28	C
> 28 - 35	D
> 35 - 40	E
> 40	F
HCM 2010 Freeway Weaving Segment LOS	
< 10	A
> 10 - 20	B
> 20 - 28	C
> 28 - 35	D
> 35 - 40	E
> 40	F
HCM 2010 C-D Weaving Segment LOS	
< 12	A
> 12 - 24	B
> 24 - 32	C
> 32 - 36	D
> 36 - 40	E
> 40	F

Table D.5: PM Peak - 2040 - I-270 Vehicle Density

		2040 No Build		2040 Build					2040 No Build		2040 Build		
I-270 Northbound	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**	**I-270 Southbound**	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**
I-270	Freeway	91	F	30	D	-68%	I-270	Freeway	19	C	19	C	0%
I-270 Diverge to MD 187	Diverge	77	F	18	B	-77%	I-270 Merge from WB I-70	Merge	17	B	17	B	0%
I-270	Freeway	84	F	27	D	-68%	I-270	Freeway	24	C	24	C	0%
I-270 Diverge to Rockledge Rd	Diverge	77	F	18	B	-77%	I-270 Merge from EB I-70	Merge	16	B	16	B	0%
I-270	Freeway	85	F	25	C	-71%	I-270	Freeway	22	C	22	C	0%
I-270 Weave from MD 187 to I-270 HOV	Weave	57	F	15	B	-73%	I-270 Diverge to SB MD 85	Diverge	23	C	23	C	0%
I-270 Lane Drop	Merge	65	F	10	A	-85%	I-270	Freeway	24	C	24	C	0%
I-270	Freeway	51	F	24	C	-53%	I-270 Diverge to NB MD 85	Diverge	15	B	15	B	0%
I-270 Merge from I-270 Spur	Merge	37	E	23	C	-40%	I-270	Freeway	19	C	19	C	0%
I-270 Weave from I-270 HOV to I-270 C-D	Weave	34	D	23	C	-31%	I-270 Merge from MD 85	Merge	20	C	20	C	-1%
I-270	Freeway	34	D	25	C	-26%	I-270	Freeway	25	C	25	C	0%
I-270 Diverge to C-D (MD 189)	Diverge	46	F	32	D	-30%	I-270 Diverge to MD 80	Diverge	17	B	15	B	-7%
I-270	Freeway	46	F	27	D	-42%	I-270	Freeway	20	C	20	C	-1%
I-270 Diverge to C-D (MD 28)	Diverge	62	F	38	E	-38%	I-270 Merge from MD 80	Merge	14	B	11	B	-19%
I-270	Freeway	55	F	28	D	-48%	I-270	Freeway	23	C	23	C	0%
I-270 Merge from C-D (MD 189)	Merge	72	F	54	F	-26%	I-270 Diverge to MD 109	Diverge	12	B	12	B	0%
I-270 Diverge to C-D (Shady Grove Rd)	Diverge	77	F	43	F	-45%	I-270	Freeway	22	C	22	C	0%
I-270	Freeway	65	F	25	C	-62%	I-270 Merge from MD 109	Merge	13	B	14	B	2%
I-270 Weave from C-D (MD 28) to C-D (Shady Grove Rd)	Weave	90	F	29	D	-67%	I-270	Freeway	24	C	24	C	0%
I-270	Freeway	90	F	25	C	-72%	I-270 Diverge to SB Weigh Station	Diverge	12	B	12	B	0%
I-270 Merge from C-D (Shady Grove Rd)	Merge	124	F	28	C	-78%	I-270	Freeway	24	C	24	C	0%
I-270	Freeway	88	F	53	F	-40%	I-270 Merge from SB Weigh Station	Merge	12	B	12	B	-1%
I-270 Merge from C-D (I-370)	Merge	155	F	109	F	-30%	I-270	Freeway	23	C	22	C	0%
I-270 Diverge to C-D (MD 117)	Diverge	159	F	106	F	-33%	I-270 Diverge to MD 121	Diverge	9	A	9	A	0%
I-270	Freeway	21	C	20	C	-5%	I-270	Freeway	12	B	12	B	0%
I-270 Merge from C-D (MD 124)	Merge	47	F	25	C	-47%	I-270 Merge from WB MD 121	Merge	10	B	10	B	0%
I-270	Freeway	27	D	29	D	8%	I-270	Freeway	15	B	15	B	0%
I-270 Diverge to EB Middlebrook Rd	Diverge	20	B	22	C	8%	I-270 Merge from EB MD 121	Merge	13	B	13	B	0%
I-270	Freeway	25	C	27	D	10%	I-270	Freeway	20	C	20	C	0%
I-270 Diverge to WB Middlebrook Rd	Diverge	20	C	23	C	12%	I-270 Diverge to MD 27	Diverge	13	B	13	B	-1%
I-270	Freeway	22	C	24	C	10%	I-270	Freeway	16	B	17	B	0%
I-270 Diverge to EB MD 118	Diverge	17	B	19	B	7%	I-270 Merge from WB MD 27	Merge	14	B	14	B	1%
I-270 Diverge to WB MD 118	Diverge	31	D	23	C	-24%	I-270	Freeway	20	C	20	C	0%
I-270	Freeway	27	D	24	C	-9%	I-270 Weave from EB MD 27 to MD 118	Weave	15	B	15	B	0%
I-270 Weave from MD 118 to MD 27	Weave	36	E	28	D	-22%	I-270	Freeway	19	C	19	C	0%
I-270	Freeway	25	C	23	C	-8%	I-270 Merge from WB MD 118	Merge	15	B	15	B	-1%
I-270 Merge from EB MD 27	Merge	36	E	28	D	-22%	I-270	Freeway	22	C	22	C	0%
I-270	Freeway	26	C	22	C	-12%	I-270 Merge from EB MD 118	Merge	18	B	19	B	1%
I-270 Merge from WB MD 27	Merge	22	C	16	B	-27%	I-270	Freeway	28	D	28	D	-1%
I-270	Freeway	28	D	27	D	-3%	I-270 Merge from Middlebrook Rd	Merge	30	D	30	D	0%
I-270 Diverge to MD 121	Diverge	22	C	20	B	-10%	I-270 Diverge to Watkins Mill Rd	Diverge	24	C	24	C	1%

Table D.5: PM Peak - 2040 - I-270 Vehicle Density

		2040 No Build		2040 Build					2040 No Build		2040 Build		
I-270 Northbound	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**	**I-270 Southbound**	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**
I-270	Freeway	22	C	56	F	152%	I-270	Freeway	19	C	20	C	1%
I-270 Merge from EB MD 121	Merge	35	E	94	F	166%	I-270 Diverge to MD 124	Diverge	17	B	17	B	0%
I-270 Lane Drop	Merge	78	F	110	F	40%	I-270	Freeway	14	B	14	B	1%
I-270	Freeway	37	E	37	E	-2%	I-270 Merge from Watkins Mill	Merge	17	B	17	B	0%
I-270 Diverge to NB Weigh Station	Diverge	18	B	19	B	5%	I-270	Freeway	58	F	61	F	5%
I-270	Freeway	36	E	38	E	5%	I-270 Merge from WB MD 124	Merge	96	F	101	F	5%
I-270 Merge from NB Weight Station	Merge	18	B	19	B	6%	I-270	Freeway	0	A	0	A	0%
I-270	Freeway	38	E	39	E	4%	I-270 Merge from MD 117	Merge	39	E	51	F	30%
I-270 Diverge to MD 109	Diverge	22	C	22	C	1%	I-270	Freeway	28	D	35	E	27%
I-270	Freeway	34	D	34	D	2%	I-270 Diverge to I-370	Diverge	22	C	47	F	119%
I-270 Merge from MD 109	Merge	19	B	19	B	2%	I-270	Freeway	18	B	18	B	-2%
I-270	Freeway	36	E	36	E	1%	I-270 Diverge to I-270 C-D	Diverge	14	B	13	B	-6%
I-270 Diverge to MD 80	Diverge	27	C	23	C	-17%	I-270	Freeway	14	B	13	B	-3%
I-270	Freeway	30	D	29	D	-3%	I-270 Merge from I-270 (I-370)	Merge	21	C	20	B	-4%
I-270 Merge from MD 80	Merge	18	B	17	B	-5%	I-270 Diverge to I-270 C-D (Shady Grove Rd)	Diverge	23	C	23	C	-2%
I-270	Freeway	36	E	36	E	-1%	I-270	Freeway	19	C	19	C	-2%
I-270 Diverge to Scenic View	Diverge	19	B	18	B	-3%	I-270 Merge from I-270 C-D (Shady Grove Rd Northern)	Merge	18	B	19	B	2%
I-270	Freeway	36	E	35	E	-2%	I-270	Freeway	23	C	23	C	1%
I-270 Merge from Scenic View	Merge	18	B	18	B	-3%	I-270 Merge from I-270 C-D (Shady Grove Rd Southern)	Merge	18	B	19	B	3%
I-270	Freeway	36	E	35	E	-2%	I-270 Diverge to I-270 C-D (MD 189)	Diverge	25	C	26	C	2%
I-270 Diverge to NB MD 85	Diverge	20	C	20	C	0%	I-270	Freeway	21	C	22	C	1%
I-270	Freeway	34	D	33	D	-4%	I-270 Merge from I-270 C-D (MD 189)	Merge	20	C	21	C	2%
I-270 Diverge to SB MD 85	Diverge	20	C	19	B	-5%	I-270	Freeway	26	C	26	D	1%
I-270	Freeway	30	D	29	D	-4%	I-270 Merge from I-270 C-D	Merge	25	C	19	B	-24%
I-270 Weave from MD 85 to I-70	Weave	22	C	22	C	-2%	I-270 Diverge to I-270 HOV Lane	Diverge	17	B	17	B	-5%
I-270	Freeway	64	F	60	F	-6%	I-270 Diverge to I-270 Spur	Diverge	47	F	20	C	-57%
							I-270	Freeway	13	B	13	B	1%
							I-270 Diverge to Rockledge Dr / MD 187	Diverge	9	A	10	A	3%
							I-270	Freeway	13	B	13	B	1%
							I-270 Merge from Rockledge Dr	Merge	11	B	12	B	1%
							I-270	Freeway	16	B	16	B	1%
							I-270 Merge from Rockledge Dr / MD 187	Merge	14	B	14	B	1%
							I-270	Freeway	35	E	36	E	1%

Table D.6: PM Peak - 2040 - I-270 Spur Vehicle Density

		2040 No Build		2040 Build					2040 No Build		2040 Build		
I-270 Spur Northbound	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**	**I-270 Southbound**	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**
I-270 Spur	Freeway	62	F	38	E	-39%	I-270 Spur	Freeway	72	F	18	C	-75%
I-270 Spur Merge from Clara Barton Parkway	Merge	64	F	45	F	-31%	I-270 Spur Weave from I-270 HOV to Democracy Blvd	Weave	94	F	18	B	-81%
I-270 Spur	Freeway	78	F	57	F	-26%	I-270 Spur	Freeway	108	F	19	C	-82%
I-270 Diverge to MD 190	Diverge	49	F	37	E	-25%	I-270 Merge from Democracy Blvd	Merge	152	F	13	B	-92%
I-270 Spur	Freeway	89	F	66	F	-25%	I-270 Spur Lane Drop	Merge	144	F	23	C	-84%
I-270 Spur Merge from Cabin John Parkway	Merge	105	F	83	F	-21%	I-270 Spur	Freeway	125	F	50	F	-60%
I-270 Spur Merge from MD 190	Merge	97	F	89	F	-8%	I-270 Spur Merge from I-495	Merge	124	F	132	F	6%
I-270 Spur	Freeway	84	F	76	F	-9%	I-270 Spur	Freeway	49	F	51	F	4%
I-270 Spur Diverge to I-495	Merge	66	F	64	F	-3%	I-270 Spur Diverve to EB MD 190	Diverge	50	F	51	F	3%
I-270 Spur	Freeway	45	F	43	E	-5%	I-270 Spur Diverve to Cabin John Pkwy	Diverge	67	F	70	F	4%
I-270 Spur Diverge to Democracy Blvd	Diverge	50	F	45	F	-10%	I-270 Spur	Freeway	95	F	95	F	0%
I-270 Spur	Freeway	58	F	57	F	-2%	I-270 Merge from MD 190	Merge	120	F	119	F	-1%
I-270 Spur Merge from EB Democracy Blvd	Merge	97	F	95	F	-2%	I-270 Spur	Freeway	93	F	94	F	0%
I-270 Spur	Freeway	58	F	58	F	1%	I-270 Diverge to WB Clara Barton Pkwy	Diverge	60	F	61	F	0%
I-270 Spur Merge from WB Democracy Blvd	Merge	65	F	65	F	-1%	I-270 Spur	Freeway	83	F	83	F	0%
I-270 Spur	Freeway	39	E	40	E	5%	I-270 Merge from Clara Barton Pkwy	Merge	77	F	76	F	0%
I-270 Spur Merge from Westlake Terrace	Merge	31	D	32	D	4%							
I-270 Spur	Freeway	34	D	35	E	3%							

Table D.7: PM Peak - 2040 - I-270 Local Vehicle Density

		2040 No Build		2040 Build					2040 No Build		2040 Build		
I-270 Northbound	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**	**I-270 Souhbound**	**Type**	**Density (pc/mi/ln)**	**LOS**	**Density (pc/mi/ln)**	**LOS**	**% Change**
I-270 C-D	Freeway	29	D	20	C	-30%	I-270 C-D	Freeway	8	A	8	A	-3%
I-270 C-D Diverge to EB Montrose Rd	Diverge	21	C	26	C	22%	I-270 C-D Weave from I-370 EB to I-270	Weave	21	B	21	B	2%
I-270 C-D	Freeway	16	B	19	C	17%	I-270 C-D Diverge to Shady Grove Rd	Diverge	11	B	11	B	0%
I-270 C-D Weave between Montrose Rd Loop Ramps	Weave	13	B	19	B	47%	I-270 C-D	Freeway	8	A	8	A	-1%
I-270 C-D	Freeway	28	D	51	F	80%	I-270 C-D Merge from WB Shady Grove Rd	Merge	8	A	10	B	21%
I-270 C-D Merge from WB Montrose Rd	Merge	83	F	111	F	34%	I-270 C-D	Freeway	14	B	15	B	13%
I-270 C-D	Freeway	67	F	79	F	19%	I-270 C-D Merge from EB Shady Grove Rd	Merge	10	A	12	B	19%
I-270 C-D Merge from I-270	Merge	84	F	97	F	15%	I-270 C-D	Freeway	19	C	22	C	17%
I-270 C-D	Freeway	65	F	60	F	-9%	I-270 C-D Merge from I-270	Merge	24	C	27	C	16%
I-270 C-D Diverge to MD 189	Diverge	43	F	37	E	-14%	I-270 C-D Diverge to I-270	Diverge	25	C	29	D	13%
I-270 C-D	Freeway	91	F	81	F	-11%	I-270 C-D Diverge to I-270	Diverge	17	B	19	B	10%
I-270 C-D Merge from MD 189	Merge	112	F	101	F	-9%	I-270 C-D	Freeway	16	B	17	B	9%
I-270 C-D	Freeway	62	F	47	F	-24%	I-270 C-D Diverge to MD 28	Diverge	11	B	12	B	10%
I-270 C-D Weave between I-270 (to MD 28 from MD 189)	Weave	67	F	44	F	-34%	I-270 C-D	Freeway	11	A	12	B	9%
I-270 C-D	Freeway	42	E	42	E	0%	I-270 C-D Merge from WB MD 28	Merge	12	B	14	B	12%
I-270 C-D Diverge to MD 28	Diverge	18	B	20	B	10%	I-270 C-D	Freeway	14	B	15	B	8%
I-270 C-D	Freeway	28	D	30	D	6%	I-270 C-D Merge from EB MD 28	Merge	26	C	38	E	47%
I-270 C-D Weave between MD 28 Ramps	Weave	28	C	28	C	2%	I-270 C-D	Freeway	32	D	50	F	57%
I-270 C-D	Freeway	26	D	18	C	-31%	I-270 C-D Merge from I-270	Merge	41	F	62	F	51%
I-270 C-D Merge from MD 28 WB	Merge	28	C	13	B	-52%	I-270 C-D	Freeway	44	E	49	F	10%
I-270 C-D Merge from I-270 and Drop Lane	Merge	34	D	17	B	-49%	I-270 C-D Diverge to MD 189	Diverge	25	C	26	C	3%
I-270 C-D Diverge to I-270	Diverge	53	F	25	C	-54%	I-270 C-D	Freeway	27	D	28	D	3%
I-270 C-D	Freeway	48	F	20	C	-59%	I-270 C-D Merge from MD 189	Merge	27	C	27	C	0%
I-270 C-D Diverge to Shady Grove Rd	Diverge	14	B	13	B	-6%	I-270 C-D Diverge to I-270	Diverge	34	D	35	D	2%
I-270 C-D	Freeway	130	F	13	B	-90%	I-270 C-D	Freeway	24	C	25	C	2%
I-270 C- D Merge from I-270 and EB Shady Grove Rd	Merge	140	F	18	B	-87%	I-270 C-D Diverge to WB Montrose Rd	Diverge	18	B	18	B	2%
I-270 C-D	Freeway	144	F	25	C	-83%	I-270 C-D	Freeway	23	C	23	C	2%
I-270 C-D Merge from WB Shady Grove Rd	Merge	146	F	28	C	-81%	I-270 Weave between Montrose Rd Loops	Weave	41	F	41	F	0%
I-270 C-D Diverge to I-270	Diverge	129	F	27	C	-79%	I-270 C-D	Freeway	15	B	15	B	-1%
I-270 C-D	Freeway	94	F	31	D	-67%	I-270 C-D Merge from EB Montrose Rd	Merge	9	A	9	A	-1%
I-270 C-D Diverge to I-370	Diverge	64	F	39	E	-38%	I-270 C-D	Freeway	18	B	17	B	-1%
I-270 C-D	Freeway	120	F	30	D	-75%							
I-270 Merge from I-370 EB	Merge	129	F	58	F	-55%							
I-270 C-D	Freeway	139	F	73	F	-47%	SB Express HOV (Mile Post 3)	Freeway			13	B	
I-270 C-D Weave from I-370 to I-270	Weave	134	F	84	F	-37%	SB Express HOV (Mile Post 5)	Freeway			13	B	
I-270 C-D	Freeway	110	F	48	F	-56%	SB Express HOV (Mile Post 8)	Freeway			12	B	
I-270 C-D Weave from I-270 to MD 117	Weave	114	F	78	F	-31%	SB Express HOV (Mile Post 9)	Freeway			12	B	
I-270 C-D Diverge to MD 124	Diverge	142	F	44	F	-69%							
I-270 C-D	Freeway	178	F	60	F	-66%							
I-270 C-D Merge from EB MD 124	Merge	168	F	57	F	-66%							
I-270 C-D Merge From WB MD 124	Merge	154	F	86	F	-44%							
I-270 C-D	Freeway	144	F	112	F	-22%							
I-270 C-D Merge from Watkins Mill	Merge	133	F	101	F	-24%							

Table D.8: PM Peak - 2040 - I-270 Vehicle Throughput

I-270 Northbound	No Build VISSIM Throughput	Build VISSIM Throughput	% Change	I-270 Southbound	No Build VISSIM Throughput	Build VISSIM Throughput	% Change
Between I-495 and MD 187	4113	4703	14%	North of I-70	2366	2366	0%
Between MD 187 on and off ramps	3710	4261	15%	Between I-70 on ramps	2703	2703	0%
Between Rockledge Blvd on and off ramps	3540	4060	15%	From I-70 interchange to MD-85	4047	4047	0%
Between Rockledge Dr and I-270 Spur	3873	3742	-3%	Between MD-85 on and off ramps	2379	2379	0%
Between I-270 Spur and Montrose Rd	8718	8219	-6%	Between MD-85 and MD-80	3075	3071	0%
Between Montrose Rd on and off ramps	5582	5078	-9%	Between MD-80 on and off ramps	2415	2412	0%
Between Montrose Rd and MD 189	5102	5348	5%	Between MD-80 and Md-109	2866	2861	0%
Between MD 189 and MD 28	5078	5782	14%	Between MD-109 on and off ramps	2767	2763	0%
Between MD 28 on and off ramps	5014	6244	25%	Between MD-109 and MD-121	2935	2936	0%
Between MD 28 and Shady Grove Rd	4214	5433	29%	Between MD-121 on and off ramps	2413	2409	0%
Between Shady Grove Rd and I-370	3243	3538	9%	Between MD-121 and MD-27	3354	3346	0%
Between I-370 on and off ramps	2749	3276	19%	Between MD-27 on and off ramps	3458	3455	0%
Between I-370 and MD 117	2851	3878	36%	Between MD-27 and MD-118	3773	3766	0%
Between MD 117 and MD 124	2432	2720	12%	Between MD-118 on and off ramps	3719	3708	0%
Between MD-124 on and off ramps	2547	2904	14%	Between MD-118 and Middlebrook Rd	4384	4367	0%
Between Watkins Mill Rd and Middlebrook Rd	4564	4897	7%	Between Middlebrook Rd on and off ramps	4382	4370	0%
Between Middlebrook Rd on and off ramps	4337	4490	4%	Between Middlebrook Rd and MD-124	5462	5470	0%
Between Middlebrook Rd and MD 118	3776	3697	-2%	Between MD-124 on and off ramps	4179	4186	0%
Between MD-118 on and off ramps	3479	3435	-1%	Between MD-124 and MD-117	5347	5238	-2%
Between MD 118 and MD 27	3770	3751	-1%	Between MD-117 and I-370	6905	6555	-5%
Between MD-27 on and off ramps	2754	2112	-23%	Between I-370 on and off ramps	3456	3355	-3%
Between MD 27 and MD 121	3428	2524	-26%	Between I-370 on ramp to Shady Grove Rd	4990	4908	-2%
Between MD-121 on and off ramps	2299	1774	-23%	Between Shady Grove Rd and MD 28	5157	5198	1%
Between MD 121 and MD 109	3931	4118	5%	Between MD 28 on and off ramps	5327	5394	1%
Between MD-109 on and off ramps	3643	3745	3%	Between MD 28 and MD 189	4678	4727	1%
Between MD 109 and MD 80	3831	3893	2%	Between MD 189 and Montrose Rd	4678	4728	1%
Between MD-80 on and off ramps	3186	3179	0%	Between Montrose Rd on and off ramps	5599	5664	1%
Between MD 80 and MD 85	3875	3833	-1%	Between Montose Rd and I-270 Spur	7355	7506	2%
Between MD-85 on and off ramps	3257	3157	-3%	Between I-270 Spur and Rockledge Blvd	3320	3355	1%
Between MD 85 and I-70	5239	5125	-2%	Between Rockledge Blvd on and off ramps	2542	2560	1%
North of I-70	2739	2608	-5%	Between MD 187 on and off ramps	3011	3022	0%
				Between MD 187 and I-495	3393	3393	0%
I-270 Spur Northbound				**I-270 Spur Southbound**			
Between I-495 and Democracy Blvd	4568	4868	7%	Between I-270 Split and HOV on ramp	3187	3523	11%
Between Democracy Blvd on and off ramps	4101	4355	6%	Between HOV on ramp and Democracy Blvd	2329	3241	39%
Between Democracy Blvd and I-270 Split	4833	5093	5%	Between Democracy Blvd on and off ramps	1856	2720	47%
				Between Democracy Blvd and I-495	2227	3381	52%

Table D.9: PM Peak - 2040 - I-270 Local Vehicle Throughput

I-270 Local Northbound	No Build VISSIM Throughput	Build VISSIM Throughput	% Change	I-270 Local Southbound	No Build VISSIM Throughput	Build VISSIM Throughput	% Change
Between Montrose Rd EB off ramp and and EB on ramp	1766	1908	8%	Between I-370 on ramp and I-270 off ramp	3064	3027	-1%
Between Montrose Rd EB on ramp and WB off ramp	2079	2227	7%	Between I-270 off ramp and Shady Grove off ramp	1525	1498	-2%
Between Montrose Rd WB off ramp and on ramp	1811	1958	8%	Between Shady Grove off ramp and Shady Grove WB on ramp	811	799	-1%
Between Montrose Rd WB on ramp and I-270 on ramp	3211	3293	3%	Between Shady Grove WB and EB on ramps	1431	1617	13%
Between I-270 on ramp and MD 189 off ramp	3392	3577	5%	Between Shady Grove on ramp and I-270 on ramp	1957	2272	16%
Between MD 189 ramps	2697	2918	8%	Between I-270 on ramp and I-270 off ramp1	2571	2865	11%
Between MD 189 off ramp and I-270 on ramp	3503	3795	8%	Between I-270 off ramp1 and I-270 off ramp2	1808	1984	10%
Between I-270 on ramp and I-270 off ramp	4032	4375	9%	Between I-270 off ramp2 and MD 28 off ramp	1648	1800	9%
Between I-270 off ramp and MD 28 EB off ramp	3156	3376	7%	Between MD 28 off ramp and MD 28 WB on ramp	1153	1253	9%
Between MD 28 EB off ramp to MD 28 EB on ramp	2855	3043	7%	Between MD 28 WB on ramp and MD 28 EB on ramp	1423	1513	6%
Between MD 28 EB on ramp and MD 28 WB off ramp	2994	3176	6%	Between MD 28 EB on ramp and I-270 on ramp	2987	3058	2%
Between MD 28 WB off ramp and MD 28 WB on ramp	1879	1988	6%	Between I-270 on ramp and MD 189 off ramp	3660	3736	2%
Between MD 28 WB on ramp and I-270 on ramp	2552	2663	4%	Between MD 189 on and off ramps	2740	2799	2%
Between I-270 on ramp and I-270 off ramp	3027	3585	18%	Between MD 189 on ramp and I-270 off ramp	3316	3379	2%
Between I-270 off ramp and Shady Grove off ramp	1718	2147	25%	Between I-270 off ramp and Montrose Rd off ramp	2399	2444	2%
Between Shady Grove off ramp and I-270 on ramp	468	708	51%	Between Montrose Rd off ramp and Montrose Rd WB on ramp	2155	2194	2%
Between I-270 on ramp and Shady Grove WB on ramp	2182	3582	64%	Between Montrose Rd WB on ramp and EB off ramp	2705	2709	0%
Between Shady Grove WB on ramp and I-270 off ramp	2671	4374	64%	Between Montrose Rd EB off and on ramps	1525	1506	-1%
Between I-270 off ramp and I-370 off ramp	2310	3823	65%	Between Montrose Rd EB off ramp and I-270	1845	1830	-1%
Between I-370 off ramp and I-370 EB on ramp	529	912	72%				
Between I-370 EB and WB on ramps	896	1764	97%				
Between I-370 WB on ramp and I-270 off ramp	1577	3090	96%				
Between I-270 off ramp and I-270 on ramp	1008	1902	89%				
Between I-270 on ramp and MD 117 off ramp	1386	3382	144%				
Between MD 117 off ramp and MD 124 off ramp	920	2362	157%				
Between MD 124 off ramp and MD 124 EB on ramp	346	929	168%				
Between MD 124 EB and WB on ramps	651	1441	121%				
Between MD 124 on ramp I-270	812	1059	30%				

Table D.10: PM Peak - 2040 - I-270 On Ramp Queue Length - Northbound

I-270 Northbound	No Build VISSIM Average Queue (feet)	Build VISSIM Average Queue (feet)	% Change / Abs Difference	No Build VISSIM Maximum Queue (feet)	Build VISSIM Maximum Queue (feet)	% Change / Abs Difference
Rockledge Dr on ramp	1	0	-100%	192	0	-100%
MD 189 C-D on ramp	610	2	-100%	4780	207	-96%
MD 28 C-D on ramp	994	0	-100%	4333	0	-100%
Shady Grove Rd C-D on ramp	1762	74	-96%	4090	718	-82%
I-370 C-D on ramp	3386	2023	-40%	5049	4866	-4%
MD 124 C-D on ramp	4875	0	-100%	5069	0	-100%
MD 118 on ramp	0	0	-100%	43	0	-100%
MD 27 EB on ramp	0	0	0%	0	0	0%
MD 27 WB on ramp	0	0	0%	0	0	0%
MD 121 on ramp	0	2	2	4	249	245
MD 109 on ramp	0	0	0%	0	0	0%
MD 80 on ramp	0	0	0%	0	0	0%
MD 85 on ramp	0	0	0%	0	0	0%
I-270 Spur Northbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change / Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change / Abs Difference**
Democracy Blvd EB on ramp	0	0	0%	9	35	26
Democracy Blvd WB on ramp	0	0	0%	0	0	0%
I-495 Northbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change / Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change / Abs Difference**
Cabin John Pkwy on ramp	46	13	-73%	903	696	-23%
MD 190 on ramp	0	0	-100%	48	0	-100%
I-270 C-D Northbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change / Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change / Abs Difference**
Montrose Rd EB on ramp	0	0	0%	0	17	0%
Montrose Rd WB on ramp	916	1662	81%	2556	3189	25%
I-270 on ramp	0	0	0%	0	0	0%
MD 189 on ramp	104	27	-74%	1084	554	-49%
I-270 on ramp	1	0	-100%	109	0	-100%
MD 28 EB on ramp	0	0	0%	0	4	4
MD 28 WB on ramp	38	0	-100%	652	0	-100%
Shady Grove Rd EB on ramp	1396	0	-100%	4077	11	-100%
I-270 on ramp	1555	3	-100%	5058	230	-95%
Shady Grove Rd WB on ramp	739	2	-100%	1949	74	-96%
I-370 EB on ramp	1319	441	-67%	2422	2421	0%
I-370 WB on ramp	1606	959	-40%	2548	2545	0%
I-270 on ramp	4357	4208	-3%	5055	5062	0%
MD 124 EB on ramp	1831	8	-100%	2796	180	-94%
MD 124 WB on ramp	98	2	-98%	700	149	-79%

Table D.11: PM Peak - 2040 - I-270 Off Ramp Queue Length - Northbound

I-270 Northbound	No Build VISSIM Average Queue (feet)	Build VISSIM Average Queue (feet)	% Change/ Abs Difference	No Build VISSIM Maximum Queue (feet)	Build VISSIM Maximum Queue (feet)	% Change/ Abs Difference
MD 187 off ramp NB	39	45	15%	309	394	27%
MD 187 off ramp SB	0	0	0%	0	0	0%
Rockledge Dr off ramp	1	0	-74%	88	47	-47%
Tower Oaks Blvd off ramp	37	44	20%	219	256	17%
Montrose Rd off ramp EB	0	0	0%	0	0	0%
Montrose Rd off ramp WB	0	0	0%	0	0	0%
MD 189 off ramp WB	26	28	8%	174	172	-1%
MD 189 off ramp EB	0	1	79%	78	123	57%
MD 28 off ramp EB	35	36	4%	215	194	-10%
MD 28 off ramp WB	0	0	0%	0	0	0%
Shady Grove Rd off ramp - Redland Blvd	0	0	0%	0	0	0%
Shady Grove Rd off ramp WB	40	52	32%	253	215	-15%
Shady Grove Rd off ramp EB	0	0	0%	0	0	0%
I-370 off ramp WB	8	54	46	162	757	594
I-370 off ramp EB	0	0	0%	0	0	0%
MD 117 off ramp	1835	2697	47%	2770	4973	80%
MD 124 off ramp	55	96	76%	626	572	-9%
Watkins Mill Rd off ramp	45	1141	1096	627	3309	2682
Middlebrook Rd EB off ramp	0	0	0%	0	0	0%
Middlebrook Rd WB off ramp	0	0	0%	0	0	0%
MD 118 WB off ramp - Seneca Meadows	0	0	-100%	8	4	-55%
MD 118 WB off ramp	0	0	0%	0	0	0%
MD 118 EB off ramp	0	0	-100%	16	0	-100%
MD 27 off ramp WB	44	57	30%	252	247	-2%
MD 27 off ramp EB	0	0	0%	0	0	0%
MD 121 off ramp WB	70	91	30%	314	710	396
MD 121 off ramp EB	2	20	18	94	571	477
MD 109 off ramp EB	26	27	3%	251	234	-7%
MD 109 off ramp WB	0	0	0%	0	0	0%
MD 80 off ramp EB	21	24	14%	233	209	-10%
MD 80 off ramp WB	0	0	0%	24	37	54%
MD 85 NB off ramp	1	0	-76%	53	29	-44%
MD 85 SB off ramp	1	1	-24%	141	55	-61%
I-270 Spur Northbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change/ Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change/ Abs Difference**
Clara Barton Pkwy off ramp EB	0	0	0%	0	4	0%
Clara Barton Pkwy off ramp WB	0	0	0%	0	0	0%
MD 190 off ramp EB	0	0	0%	0	0	0%
MD 190 off ramp WB	5	9	84%	354	429	21%
Democracy Blvd off ramp WB	41	45	9%	194	196	1%
Democracy Blvd off ramp EB	17	17	0%	120	117	-3%

Table D.12: PM Peak - 2040 - I-270 On Ramp Queue Length - Southbound

I-270 Southbound	No Build VISSIM Average Queue (feet)	Build VISSIM Average Queue (feet)	% Change/ Abs Difference	No Build VISSIM Maximum Queue (feet)	Build VISSIM Maximum Queue (feet)	% Change/ Abs Difference
MD 85 on ramp	0	0	-100%	12	0	-100%
MD 80 on ramp	0	0	0%	0	0	0%
MD 109 on ramp	0	0	0%	0	0	0%
MD 121 WB on ramp	0	0	0%	0	0	0%
MD 121 EB on ramp	0	0	0%	0	0	0%
MD 27 WB on ramp	0	0	0%	0	0	0%
MD 27 EB on ramp	0	0	0%	0	0	0%
MD 118 WB on ramp	0	0	0%	0	0	0%
MD 118 EB on ramp	0	0	0%	0	0	0%
Middlebrook Rd on ramp	0	0	0%	0	0	0%
Watkins Mill Rd on ramp	0	1	0%	0	108	108
MD 124 WB on ramp	1368	1180	-14%	3492	3882	11%
MD 117 on ramp	29	534	505	837	3153	2316
I-370 C-D on ramp	0	0	0%	0	0	0%
Shady Grove Rd C-D on ramp North	0	0	0%	0	0	0%
Shady Grove Rd C-D on ramp South	0	0	0%	0	0	0%
MD 189 C-D on ramp	0	0	0%	0	0	0%
Montrose Rd C-D on ramp	0	0	0%	0	0	0%
Rockledge Dr on ramp	0	0	0%	0	0	0%
MD 187 on ramp	0	0	0%	0	0	0%
I-270 Spur Southbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change/ Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change/ Abs Difference**
Democracy Blvd on ramp	698	0	-100%	1919	0	-100%
I-495 Southbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change/ Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change/ Abs Difference**
I-270 Spur on ramp	4555	509	-89%	5065	2640	-48%
MD 190 on ramp	184	38	-79%	956	692	-28%
I-270 C-D Southbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change/ Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change/ Abs Difference**
I-270 on ramp	0	0	0%	10	34	24
I-370 on ramp	0	0	0%	80	0	-100%
Shady Grove Rd WB on ramp	0	0	0%	0	0	0%
Shady Grove Rd EB on ramp	0	0	0%	0	0	0%
I-270 on ramp	0	0	0%	0	0	0%
MD 28 WB on ramp	0	0	0%	0	44	44
MD 28 EB on ramp	0	218	218	63	1153	1090
I-270 on ramp	0	0	0%	0	0	0%
MD 189 on ramp	0	0	0%	0	0	0%
Montrose Rd WB on ramp	1	3	2	115	186	61%
Montrose Rd EB on ramp	0	0	0%	0	0	0%

Table D.13: PM Peak - 2040 - I-270 Off Ramp Queue Length - Southbound

I-270 Southbound	No Build VISSIM Average Queue (feet)	Build VISSIM Average Queue (feet)	% Change/ Abs Difference	No Build VISSIM Maximum Queue (feet)	Build VISSIM Maximum Queue (feet)	% Change/ Abs Difference
MD 85 SB off ramp	22	1	-96%	383	140	-63%
MD 85 NB off ramp	17	23	41%	354	495	40%
MD 80 off ramp	2	3	67%	204	237	17%
MD 109 off ramp WB	1	0	-49%	88	59	-32%
MD 109 off ramp EB	0	0	0%	0	4	0%
MD 121 off ramp EB	217	207	-4%	970	919	-5%
MD 121 off ramp WB	0	0	-20%	137	90	-34%
MD 27 off ramp EB	22	23	6%	137	168	23%
MD 27 off ramp WB	1	0	-100%	65	0	-100%
MD 118 off ramp EB	24	24	1%	142	138	-2%
MD 118 off ramp WB	0	0	-100%	23	0	-100%
Watkins Mill Rd off ramp	103	107	4%	384	486	27%
MD 124 off ramp EB	185	115	-38%	731	462	-37%
MD 124 off ramp WB	17	8	-52%	445	321	-28%
I-370 off ramp WB	147	2025	1878	725	5048	4324
I-370 off ramp EB	0	0	0%	0	0	0%
Shady Grove Rd off ramp - Omega Drive	1	1	2%	52	60	16%
Shady Grove Rd off ramp	0	0	0%	0	0	0%
MD 28 off ramp	3	5	98%	149	184	24%
MD 189 off ramp EB	108	105	-3%	433	440	2%
MD 189 off ramp WB	0	0	0%	0	0	0%
Montrose Rd off ramp WB	0	0	0%	0	0	0%
Montrose Rd off ramp EB	4	4	9%	337	448	33%
Rockledge Dr off ramp	155	30	-81%	641	247	-62%
I-270 Spur Southbound	**No Build VISSIM Average Queue (feet)**	**Build VISSIM Average Queue (feet)**	**% Change/ Abs Difference**	**No Build VISSIM Maximum Queue (feet)**	**Build VISSIM Maximum Queue (feet)**	**% Change/ Abs Difference**
Democracy Blvd off ramp EB	20	32	54%	136	155	14%
Democracy Blvd off ramp WB	0	0	0%	0	0	0%
MD 190 off ramp WB	80	85	7%	797	668	-16%
MD 190 off ramp EB	0	0	0%	0	0	0%
Clara Barton Pkwy WB off ramp	0	0	0%	6	16	10

Table D.14: PM Peak - 2040 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
1- MD 85 at Sam's Club Drive											
1	NB	60.8	E	NB Left	134	78	463	889	E	115.6	F
				NB Through	570	38	463	889	D		
				NB Right	935	72	443	912	E		
	SB	179.8	F	SB Left	153	131	1021	1231	F		
				SB Through	874	186	1021	1231	F		
				SB Right	74	209	1021	1231	F		
	EB	35.0	C	EB Left	55	84	32	144	F		
				EB Through	24	81	32	144	F		
				EB Right	169	13	32	144	B		
	WB	163.6	F	WB Left	561	181	536	762	F		
				WB Through	30	166	536	762	F		
				WB Right	224	119	536	762	F		
2- MD 85 at I-270 NB on and off ramp											
2	NB	58.5	E	NB Left	1136	58	700	1857	E	48.2	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	32.6	C	SB Left	0	0	0	0	A		
				SB Through	743	33	132	737	C		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
3- MD 85 at I-270 SB on and off ramp											
3	NB	17.3	B	NB Left	0	0	0	0	A	19.5	B
				NB Through	1975	17	181	1210	B		
				NB Right	0	0	0	0	A		
	SB	44.0	D	SB Left	173	44	74	582	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
4- MD 85 at Crestwood Blvd											
4	NB	68.0	F	NB Left	74	103	368	830	F	51.3	D
				NB Through	1450	66	367	830	E		
				NB U-Turn	0	0	0	0	A		
	SB	31.9	C	SB Left	105	83	53	246	F		
				SB Through	940	30	105	1039	C		
				SB Right	923	28	92	1030	C		
	EB	63.3	E	EB Left	949	66	196	744	E		
				EB Through	43	51	196	744	D		
				EB Right	28	1	196	744	A		
	WB	53.0	D	WB Left	44	78	60	230	E		
				WB Through	79	81	60	230	F		
				WB Right	94	18	60	230	B		
5- MD 80 at I-270 NB on and ramp											
5	NB	-0.9	A	NB Left	1	9	0	4	A	11.5	B
				NB Through	2	0	0	4	A		
				NB Right	7	-3	0	4	A		
	SB	12.8	B	SB Left	479	16	27	238	B		
				SB Through	22	16	27	238	B		
				SB Right	149	3	0	0	A		
	EB	13.6	B	EB Left	97	14	24	208	B		
				EB Through	0	0	8	0	A		
				EB Right	5	10	37	239	B		
	WB	10.7	B	WB Left	15	14	0	38	B		
				WB Through	670	18	66	419	B		
				WB Right	612	2	0	0	A		
6- MD 80 at I-270 SB on and off ramp											
6	NB	3.4	A	NB Left	55	5	3	239	A	5.9	A
				NB Through	0	0	0	0	A		
				NB Right	605	3	3	239	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	7.1	A	EB Left	0	0	0	0	A		
				EB Through	382	8	4	111	A		
				EB Right	66	4	4	119	A		
	WB	8.4	A	WB Left	0	0	0	0	A		
				WB Through	446	8	3	163	A		
				WB Right	0	0	0	0	A		
7- MD 109 at I-270 NB on and off ramp											
7	NB			NB Left	0	0	0	0	A	7.9	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	15.2	C	SB Left	317	16	34	268	C		
				SB Through	0	0	0	0	A		
				SB Right	25	6	1	162	A		
	EB	2.5	A	EB Left	80	2	0	47	A		
				EB Through	0	0	0	0	A		
				EB Right	83	3	0	0	A		
	WB	0.4	A	WB Left	0	0	0	0	A		
				WB Through	222	0	0	0	A		
				WB Right	0	0	0	0	A		
8- MD 80 at I-270 SB on and off ramp											
8	NB	4.9	A	NB Left	63	8	3	120	A	1.8	A
				NB Through	0	0	0	0	A		
				NB Right	36	0	0	63	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.9	A	EB Left	0	0	0	0	A		
				EB Through	166	0	0	0	A		
				EB Right	34	4	0	0	A		
	WB	1.4	A	WB Left	137	1	0	58	A		
				WB Through	110	2	0	30	A		
				WB Right	0	0	0	0	A		
9- MD 121 at Gateway Center Dr											
9	NB	29.4	D	NB Left	590	33	112	604	C	47.0	D
				NB Through	795	28	112	604	C		
				NB Right	64	16	119	630	B		
	SB	22.6	C	SB Left	28	15	19	219	B		
				SB Through	300	24	31	223	C		
				SB Right	9	13	34	244	B		
	EB	14.9	B	EB Left	4	40	8	196	D		
				EB Through	24	41	15	229	D		
				EB Right	248	12	27	261	B		
	WB	117.1	F	WB Left	349	162	304	715	F		
				WB Through	75	73	304	714	E		
				WB Right	186	51	327	739	D		
10- MD 121 at I-270 NB on and off ramp											
10	NB	22.1	C	NB Left	372	59	77	320	F	18.1	B
				NB Through	0	0	0	0	A		
				NB Right	785	4	1	73	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	11.8	B	EB Left	0	0	0	0	A		
				EB Through	651	18	38	367	C		
				EB Right	336	1	0	0	A		
	WB	20.0	C	WB Left	219	60	86	412	F		
				WB Through	682	7	86	412	A		
				WB Right	0	0	0	0	A		

Table D.14: PM Peak - 2040 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
11- MD 121 at I-270 SB on and off ramp											
11	NB			NB Left	0	0	0	0	A	22.3	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	62.3	E	SB Left	271	85	226	977	F		
				SB Through	0	0	0	0	A		
				SB Right	254	39	0	49	E		
	EB	6.5	A	EB Left	0	0	0	0	A		
				EB Through	717	6	16	229	A		
				EB Right	0	0	0	0	A		
	WB	13.2	B	WB Left	0	0	0	0	A		
				WB Through	520	27	46	382	D		
				WB Right	538	0	0	0	A		
12- MD 27 at Observation Dr											
12	NB	37.7	D	NB U-Turn	0	0	0	0	A	24.8	C
				NB Through	94	55	22	98	E		
				NB Right	61	11	22	98	B		
	SB	41.3	D	SB Left	146	44	38	216	D		
				SB Through	57	62	43	250	E		
				SB Right	188	33	69	287	C		
	EB	18.6	B	EB Left	189	33	70	458	C		
				EB Through	2012	17	71	459	B		
				EB Right	97	16	84	497	B		
	WB	27.9	C	WB Left	41	24	149	731	C		
				WB Through	1695	29	149	731	C		
				WB Right	69	9	149	731	A		
13- MD 27 at I-270 NB off ramp											
13	NB	47.2	D	NB Left	303	47	52	260	D	6.5	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.1	A	EB Left	0	0	0	0	A		
				EB Through	1512	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	4.9	A	WB Left	0	0	0	0	A		
				WB Through	1791	5	37	726	A		
				WB Right	0	0	0	0	A		
14- MD 27 at I-270 SB off ramp											
14	NB			NB Left	0	0	0	0	A	5.2	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	50.1	D	SB Left	174	50	33	150	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	1.8	A	EB Left	0	0	0	0	A		
				EB Through	1677	2	4	89	A		
				EB Right	0	0	0	0	A		
	WB	3.7	A	WB Left	0	0	0	0	A		
				WB Through	1541	4	12	384	A		
				WB Right	0	0	0	0	A		
15- MD 27 at Crystal Rock Dr											
15	NB	31.1	C	NB Left	77	30	107	545	C	70.1	E
				NB Through	1196	31	116	545	C		
				NB Right	55	29	123	558	C		
	SB	56.5	E	SB Left	157	74	381	1298	E		
				SB Through	1468	58	381	1298	E		
				SB Right	225	33	368	1291	C		
	EB	40.4	D	EB Left	125	53	34	129	D		
				EB Through	49	36	30	124	D		
				EB Right	62	18	23	156	B		
	WB	163.8	F	WB Left	104	99	1056	1511	F		
				WB Through	127	110	1056	1511	F		
				WB Right	665	184	1056	1511	F		
16- MD 118 at Seneca Meadows Pkwy											
16	NB	4.9	A	NB Left	97	14	2	77	B	9.0	A
				NB Through	1309	4	11	182	A		
				NB Right	1	-1	19	235	A		
	SB	7.4	A	SB Left	15	8	19	307	A		
				SB Through	1226	7	22	307	A		
				SB Right	11	5	25	340	A		
	EB	14.0	B	EB Left	23	59	14	138	E		
				EB Through	0	65	14	138	E		
				EB Right	312	11	14	138	B		
	WB	53.8	D	WB Left	103	65	43	243	E		
				WB Through	7	69	39	242	E		
				WB Right	30	13	48	262	B		
17- MD 118 at I-270 NB on ramp											
17	NB			NB Left	0	0	0	0	A	13.8	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	26.5	C	EB Left	493	26	43	299	C		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	10.0	A	WB Left	0	0	0	0	A		
				WB Through	283	2	1	139	A		
				WB Right	1361	12	46	611	B		
18- MD 118 at I-270 SB off ramp											
18	NB			NB Left	0	0	0	0	A	7.1	A
				NB Through	0	0.0	0	0	A		
				NB Right	0	0.0	0	0	A		
	SB	37.7	D	SB Left	169	37.7	27	145	D		
				SB Through	0	0.0	0	0	A		
				SB Right	0	0.0	0	0	A		
	EB	5.5	A	EB Left	0	0.0	0	0	A		
				EB Through	1407	5.5	13	384	A		
				EB Right	0	0.0	0	0	A		
	WB	5.1	A	WB Left	0	0.0	0	0	A		
				WB Through	1499	5.1	10	218	A		
				WB Right	0	0.0	0	0	A		
19- MD 118 at Aircraft Dr											
19	NB	26.2	C	NB Left	53	72	43	241	E	43.0	D
				NB Through	53	70	43	241	E		
				NB Right	227	5	5	87	A		
	SB	165.9	F	SB Left	436	156	419	656	F		
				SB Through	14	205	419	656	F		
				SB Right	126	195	419	656	F		
	EB	22.6	C	EB Left	125	31	89	536	C		
				EB Through	1415	22	89	536	C		
				EB Right	21	20	89	536	B		
	WB	24.3	C	WB Left	15	30	107	749	C		
				WB Through	1399	28	107	749	C		
				WB Right	367	8	107	749	A		
20- Middlebrook Rd at Observation Dr											
20	NB			NB Left	0	0	0	0	A	9.0	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	20.5	C	SB Left	124	36	23	150	D		
				SB Through	0	0	0	0	A		
				SB Right	186	10	23	150	B		
	EB	6.0	A	EB Left	14	11	15	149	B		
				EB Through	1053	6	15	149	A		
				EB Right	0	0	0	0	A		
	WB	8.8	A	WB Left	0	0	0	0	A		
				WB Through	1313	9	27	253	A		
				WB Right	17	7	42	302	A		

Table D.14: PM Peak - 2040 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
21- Middlebrook Rd at I-270 SB on ramp											
21	NB			NB Left	0	0	0	0	A	4.6	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	2.7	A	EB Left	0	0	0	0	A		
				EB Through	742	3	4	110	A		
				EB Right	0	0	0	0	A		
	WB	7.8	A	WB Left	438	8	5	236	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
22- Middlebrook Rd at Waring Station Rd											
22	NB	48.4	D	NB Left	200	46	83	309	D	13.7	B
				NB Through	1	55	83	309	D		
				NB Right	236	50	83	309	D		
	SB	30.1	C	SB Left	32	47	8	72	D		
				SB Through	2	38	8	72	D		
				SB Right	24	7	19	110	A		
	EB	8.0	A	EB Left	4	11	28	285	B		
				EB Through	1125	8	28	285	A		
				EB Right	198	7	28	285	A		
	WB	8.6	A	WB Left	210	21	28	289	C		
				WB Through	1437	7	28	289	A		
				WB Right	3	3	28	289	A		
23- MD 124 at MD 355											
23	NB	130.8	F	NB Left	490	115	682	1082	F	78.6	E
				NB Through	1162	138	680	1079	F		
				NB Right	7	85	0	0	F		
	SB	44.6	D	SB Left	180	92	146	490	F		
				SB Through	698	66	146	490	E		
				SB Right	720	12	44	383	B		
	EB	27.2	C	EB Left	291	68	108	598	E		
				EB Through	1615	25	108	598	C		
				EB Right	338	3	28	551	A		
	WB	126.4	F	WB Left	0	0	0	0	A		
				WB Through	1645	129	683	946	F		
				WB Right	88	83	0	3	F		
24- MD 124 at I-270 SB on and off											
24	NB	95.9	F	NB Left	55	84	67	182	F	63.0	E
				NB Through	21	127	67	182	F		
				NB U-Turn	0	0	0	0	A		
	SB	55.4	E	SB Left	547	95	190	736	F		
				SB Through	8	98	190	736	F		
				SB Right	456	7	13	379	A		
	EB	101.1	F	EB Left	0	0	0	0	A		
				EB Through	1409	100	584	1113	F		
				EB Right	22	162	604	1137	F		
	WB	21.7	C	WB Left	5	78	653	2194	E		
				WB Through	1192	22	653	2194	C		
				WB Right	0	0	0	0	A		
25- MD 117 at MD 124											
25	NB	78.5	E	NB Left	54	158	328	743	F	50.1	D
				NB Through	686	93	328	743	F		
				NB Right	461	48	29	665	D		
	SB	37.8	D	SB Left	134	61	153	737	E		
				SB Through	969	41	153	737	D		
				SB Right	182	5	0	0	A		
	EB	44.9	D	EB Left	153	80	152	574	E		
				EB Through	1156	41	152	576	D		
				EB Right	57	37	156	603	D		
	WB	42.6	D	WB Left	315	71	205	1006	E		
				WB Through	1069	38	205	1006	D		
				WB Right	99	1	0	0	A		
26- MD 117 at Bureau Dr											
26	NB	50.3	D	NB Left	98	76	81	296	E	37.8	D
				NB Through	35	77	81	296	E		
				NB Right	272	38	81	296	D		
	SB	80.7	F	SB Left	284	95	132	405	F		
				SB Through	23	83	132	405	F		
				SB Right	83	32	132	405	C		
	EB	30.3	C	EB Left	52	54	165	806	D		
				EB Through	1683	30	166	806	C		
				EB Right	6	18	160	795	B		
	WB	31.9	C	WB Left	14	35	185	997	D		
				WB Through	1272	34	186	998	C		
				WB Right	213	19	211	1046	B		
27- MD 117 at I-270 SB off ramp											
27	NB			NB Left	0	0	0	0	A	12.8	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	3.7	A	EB Left	0	0	0	0	A		
				EB Through	944	4	6	464	A		
				EB Right	0	0	0	0	A		
	WB	40.7	E	WB Left	306	41	98	848	E		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
28- MD 117 at I-270 NB off ramp											
28	NB			NB Left	0	0	0	0	A	24.3	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	89.3	F	SB Left	97	91	1950	2779	F		
				SB Through	0	0	0	0	A		
				SB Right	374	89	1949	2779	F		
	EB	17.3	B	EB Left	3	120	90	983	F		
				EB Through	947	17	90	983	B		
				EB Right	0	0	0	0	A		
	WB	7.3	A	WB Left	0	0	0	0	A		
				WB Through	1403	7	52	390	A		
				WB Right	0	0	52	390	A		
29- MD 117 at Perry Pkwy											
29	NB	40.8	D	NB Left	19	59	17	125	E	49.4	D
				NB Through	26	59	17	124	E		
				NB Right	34	17	27	145	B		
	SB	162.4	F	SB Left	241	198	280	446	F		
				SB Through	21	220	280	446	F		
				SB Right	121	82	280	446	F		
	EB	21.1	C	EB Left	223	69	74	337	E		
				EB Through	778	8	74	337	A		
				EB Right	30	7	60	321	A		
	WB	41.4	D	WB Left	37	108	248	736	F		
				WB Through	1260	42	248	736	D		
				WB Right	382	33	248	736	C		
30- Shady Grove Rd at I-270 NB off ramp											
30	NB	7.6	A	NB Left	0	0	0	0	A	30.1	C
				NB Through	914	8	87	483	A		
				NB Right	0	0	0	0	A		
	SB	44.7	D	SB Left	0	0	0	0	A		
				SB Through	1013	45	163	681	D		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	51.6	D	WB Left	267	52	48	264	D		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table D.14: PM Peak - 2040 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
31- Shady Grove Rd at I-270 SB off ramp											
31	NB	31.3	C	NB Left	0	0	0	0	A	29.5	C
				NB Through	1229	31	435	1759	C		
				NB Right	0	0	0	0	A		
	SB	5.6	A	SB Left	0	0	0	0	A		
				SB Through	676	6	7	154	A		
				SB Right	0	0	0	0	A		
	EB	55.6	E	EB Left	232	54	43	211	D		
				EB Through	0	0	0	0	A		
				EB Right	304	57	62	297	E		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
32- MD 28 at I-270 SB off ramp											
32	NB			NB U-Turn	0	0	0	0	A	7.9	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	37.2	D	SB Left	406	46	71	322	D		
				SB Through	0	0	0	0	A		
				SB Right	97	3	0	28	A		
	EB	2.8	A	EB Left	0	0	0	0	A		
				EB Through	1560	1	0	0	A		
				EB Right	932	6	16	224	A		
	WB	6.7	A	WB Left	0	0	0	0	A		
				WB Through	1642	7	20	253	A		
				WB Right	0	0	0	0	A		
33- MD 28 at I-270 on and off ramps											
33	NB	36.9	D	NB Left	0	0	41	226	A	39.9	D
				NB Through	185	49	49	235	D		
				NB Right	123	18	49	235	B		
	SB	137.2	F	SB Left	14	160	361	412	F		
				SB Through	0	0	0	0	A		
				SB Right	219	136	361	412	F		
	EB	20.0	B	EB Left	283	61	94	334	E		
				EB Through	920	7	94	334	A		
				EB Right	0	0	0	0	A		
	WB	41.7	D	WB Left	40	37	168	432	D		
				WB Through	1279	42	144	396	D		
				WB Right	0	0	0	0	A		
34- MD 189 at Great Falls Rd											
34	NB	36.7	D	NB Left	43	45	12	90	D	13.2	B
				NB Through	14	48	9	90	D		
				NB Right	19	9	9	101	A		
	SB	3.4	A	SB Left	18	41	7	83	D		
				SB Through	13	48	7	83	D		
				SB Right	408	0	3	48	A		
	EB	11.6	B	EB Left	410	23	37	417	C		
				EB Through	644	5	6	200	A		
				EB Right	55	5	10	236	A		
	WB	18.0	B	WB Left	14	19	52	406	B		
				WB Through	842	18	51	406	B		
				WB Right	18	12	67	440	B		
35- MD 189 at I-270 Ramps											
35	NB	47.1	D	NB Left	225	47	41	196	D	42.5	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	54.4	D	SB Left	348	54	124	453	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	28.0	C	EB Left	479	32	91	341	C		
				EB Through	373	23	91	341	C		
				EB Right	0	0	0	0	A		
	WB	50.8	D	WB Left	443	54	111	336	D		
				WB Through	428	47	111	336	D		
				WB Right	0	0	0	0	A		
36- MD 189 at Wooton Pkwy											
36	NB	45.9	D	NB Left	238	57	142	506	E	52.4	D
				NB Through	694	51	142	506	D		
				NB Right	176	12	142	506	B		
	SB	82.8	F	SB Left	250	101	295	794	F		
				SB Through	926	78	312	780	E		
				SB Right	0	0	0	0	A		
	EB	38.7	D	EB Left	153	72	123	486	E		
				EB Through	552	38	123	486	D		
				EB Right	204	15	123	486	B		
	WB	39.5	D	WB Left	157	72	141	743	E		
				WB Through	775	41	141	743	D		
				WB Right	315	19	141	743	B		
37- Montrose Rd at Tower Oaks Blvd											
37	NB	0.4	A	NB Left	0	0	0	0	A	32.4	C
				NB Through	0	0	0	0	A		
				NB Right	537	0	0	0	A		
	SB	143.6	F	SB Left	87	49	213	902	D		
				SB Through	0	0	0	0	A		
				SB Right	305	171	269	899	F		
	EB	6.9	A	EB Left	0	0	0	0	A		
				EB Through	1868	7	39	520	A		
				EB Right	0	0	0	0	A		
	WB	40.0	D	WB Left	79	37	39	520	D		
				WB Through	2426	41	277	780	D		
				WB Right	261	30	277	780	C		
38- Tower Oaks Blvd at I-270 off rmap											
38	NB	23.3	C	NB Left	707	24	50	240	C	17.3	B
				NB Through	0	0.0	43	232	A		
				NB Right	26	7.0	50	240	A		
	SB	9.8	A	SB Left	8	18.4	1	39	B		
				SB Through	0	0.0	1	39	A		
				SB Right	9	2.2	0	23	A		
	EB	10.8	B	EB Left	1	11.5	16	177	B		
				EB Through	363	11.2	16	177	B		
				EB Right	37	7.0	11	167	A		
	WB	12.7	B	WB Left	139	16.3	16	145	B		
				WB Through	203	10.4	16	145	B		
				WB Right	3	3.4	3	100	A		
39- Montrose Rd at Tower Oaks Blvd											
39	NB	20.0	C	NB Left	97	42	83	387	D	45.0	D
				NB Through	773	32	83	387	C		
				NB Right	621	2	0	0	A		
	SB	32.1	C	SB Left	210	63	76	334	E		
				SB Through	506	23	74	333	C		
				SB Right	131	15	72	340	B		
	EB	133.4	F	EB Left	104	112	358	697	F		
				EB Through	518	136	360	698	F		
				EB Right	44	149	382	722	F		
	WB	36.9	D	WB Left	542	46	109	374	D		
				WB Through	456	42	110	374	D		
				WB Right	315	13	129	404	B		
40- Rockledge Blvd at I-270 NB on and off ramp											
40	NB	132.4	F	NB Left	0	0	0	0	A	112.4	F
				NB Through	335	121	557	836	F		
				NB Right	854	137	557	836	F		
	SB	85.9	F	SB Left	0	0	89	217	A		
				SB Through	352	86	89	217	F		
				SB Right	0	0	0	0	A		
	EB	93.5	F	EB Left	6	184	288	804	F		
				EB Through	459	148	288	804	F		
				EB Right	304	10	0	0	B		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table D.14: PM Peak - 2040 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
41- Rockledge Blvd at I-270 SB on and off ramps											
				NB Left	343	30	76	273	C		
	NB	30.3	C	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
41				EB Left	0	0	0	0	A	48.1	D
	EB			EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	355	59	195	867	E		
	WB	53.0	D	WB Through	890	51	195	867	D		
				WB Right	0	0	0	0	A		
42- MD 187 at Tuckerman Ln											
				NB Left	216	39	567	1282	D		
	NB	66.6	E	NB Through	2309	68	567	1282	E		
				NB Right	200	76	567	1282	E		
				SB Left	205	172	2555	2693	F		
	SB	187.6	F	SB Through	1151	185	2555	2693	F		
				SB Right	306	209	2555	2693	F		
42				EB Left	302	66	540	1403	E	128.7	F
	EB	112.4	F	EB Through	534	136	541	1404	F		
				EB Right	118	121	564	1428	F		
				WB Left	465	191	1941	2142	F		
	WB	195.5	F	WB Through	674	211	1941	2142	F		
				WB Right	166	145	1941	2142	F		
43- MD 187 at I-270 NB on and off ramps											
				NB Left	566	35	117	404	C		
	NB	16.8	B	NB Through	2515	13	117	404	B		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB	25.1	C	SB Through	1290	25	66	269	C		
				SB Right	0	0	0	0	A		
43				EB Left	0	0	0	0	A	20.4	C
	EB			EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	59	60	47	317	E		
	WB	60.3	E	WB Through	67	60	47	317	E		
				WB Right	0	0	0	0	A		
44- MD 187 at I-270 NB on and off ramps											
				NB Left	0	0	0	0	A		
	NB	40.0	E	NB Through	2426	40	155	739	D		
				NB Right	0	0	0	0	A		
				SB Left	147	56	67	271	E		
	SB	18.1	B	SB Through	1203	13	67	271	B		
				SB Right	0	0	0	0	A		
44				EB Left	652	60	143	560	E	36.9	D
	EB	58.2	E	EB Through	0	0	143	560	A		
				EB Right	179	53	82	486	D		
				WB Left	0	0	0	0	A		
	WB			WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
45- MD 187 at Rock Spring Dr											
				NB Left	492	37	123	826	D		
	NB	20.6	C	NB Through	2174	17	124	827	B		
				NB Right	18	14	145	860	B		
				SB Left	21	62	111	472	E		
	SB	34.2	C	SB Through	1186	39	111	472	D		
				SB Right	173	1	69	465	A		
45				EB Left	431	60	146	519	E	29.8	C
	EB	50.0	D	EB Through	50	68	146	519	E		
				EB Right	484	39	146	519	D		
				WB Left	7	29	6	108	C		
	WB	17.1	B	WB Through	16	33	6	108	C		
				WB Right	36	8	3	97	A		
47-Democracy Blvd at I-270 NB off ramp											
				NB Left	154	45	28	136	D		
	NB	45.3	D	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
47				EB Left	0	0	0	0	A	3.0	A
	EB	1.2	A	EB Through	1127	1	3	66	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	1.1	A	WB Through	2241	1	3	84	A		
				WB Right	0	0	0	0	A		
48- Democracy Blvd at I-270 SB on ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
48				EB Left	0	0	0	0	A	8.4	A
	EB	5.5	A	EB Through	1336	5	19	232	A		
				EB Right	0	0	0	0	A		
				WB Left	543	35	59	404	D		
	WB	10.1	B	WB Through	1827	3	49	383	A		
				WB Right	0	0	0	0	A		
49- Democracy Blvd at I-270 SB off ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	154	51	28	143	D		
	SB	37.4	D	SB Through	0	0	0	0	A		
				SB Right	59	2	0	0	A		
49				EB Left	0	0	0	0	A	8.8	A
	EB			EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	5.8	A	WB Through	1827	4	19	305	A		
				WB Right	156	29	116	746	C		
50- MD 190 at Burdette Rd											
				NB Left	27	79	18	118	E		
	NB	76.4	E	NB Through	7	69	18	118	E		
				NB Right	6	75	18	118	E		
				SB Left	45	77	25	148	E		
	SB	37.5	D	SB Through	9	72	25	148	E		
				SB Right	122	20	25	148	C		
50				EB Left	138	99	113	625	F	36.6	D
	EB	21.6	C	EB Through	1297	14	113	625	B		
				EB Right	31	4	99	653	A		
				WB Left	13	114	390	1119	F		
	WB	45.7	D	WB Through	2161	46	390	1119	D		
				WB Right	65	35	390	1119	C		

Table D.14: PM Peak - 2040 No Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
51- MD 190 at I-270 NB on ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
51				SB Right	0	0	0	0	A	17.6	B
				EB Left	254	66	101	343	E		
	EB	65.7	E	EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	9.3	A	WB Through	1471	9	49	692	A		
				WB Right	0	0	0	0	A		
52- MD 190 at I-270 SB off ramp											
				NB Left	225	70	84	800	E		
	NB	70.5	E	NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
52				SB Right	0	0	0	0	A	12.3	B
				EB Left	0	0	0	0	A		
	EB	3.6	A	EB Through	1062	4	8	176	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	10.0	A	WB Through	1641	10	30	635	A		
				WB Right	0	0	0	0	A		
53- MD 190 at Seven Locks Rd											
				NB Left	28	1	0	0	A		
	NB	0.5	A	NB Through	314	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	364	52	120	414	D		
	SB	52.6	D	SB Through	232	53	120	414	D		
53				SB Right	20	50	120	414	D	26.9	C
				EB Left	27	30	95	436	C		
	EB	32.0	C	EB Through	800	32	95	436	C		
				EB Right	45	32	95	436	C		
				WB Left	255	75	124	491	E		
	WB	20.8	C	WB Through	914	18	124	491	B		
				WB Right	693	5	124	491	A		
54- MD 124 at I-270 NB off ramp											
				NB Left	0	0	0	0	A		
	NB	31.3	C	NB Through	0	0	0	0	A		
				NB Right	556	31	56	630	C		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
54				SB Right	0	0	0	0	A	23.6	C
				EB Left	0	0	0	0	A		
	EB	21.1	C	EB Through	1661	21	57	938	C		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB			WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
55- Democracy Blvd at I-270 NB off ramp											
				NB Left	0	0	0	0	A		
	NB	46.2	D	NB Through	0	0	0	0	A		
				NB Right	313	46	51	205	D		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
55				SB Right	0	0	0	0	A	11.2	B
				EB Left	0	0	0	0	A		
	EB	1.5	A	EB Through	1128	2	4	59	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB			WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
56- Watkins Mill Rd at I-270 SB off ramp/Parkview Ave											
				NB Left	145	53	170	656	D		
	NB	71.3	E	NB Through	0	0	0	0	A		
				NB Right	342	79	170	656	E		
				SB Left	410	63	107	388	E		
	SB	42.7	D	SB Through	110	59	107	388	E		
56				SB Right	441	20	107	388	C	87.9	F
				EB Left	0	0	0	0	A		
	EB	143.5	F	EB Through	1216	144	961	1246	F		
				EB Right	4	136	961	1246	F		
				WB Left	62	85	49	220	F		
	WB	41.9	D	WB Through	295	33	47	219	C		
				WB Right	0	0	0	0	A		
57- Watkins Mill Rd at I-270 NB on ramp											
				NB Left	77	65	56	638	E		
	NB	40.5	D	NB Through	0	0	0	0	A		
				NB Right	193	31	56	638	C		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
57				SB Right	0	0	0	0	A	72.4	E
				EB Left	644	66	146	438	E		
	EB	26.1	C	EB Through	1051	2	146	438	A		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	157.1	F	WB Through	684	122	651	866	F		
				WB Right	343	227	651	866	F		
58- Watkins Mill Rd at I-270 SB on ramp											
				NB Left	0	0	0	0	A		
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
58				SB Right	0	0	0	0	A	16.5	B
				EB Left	0	0	0	0	A		
	EB	17.2	B	EB Through	1691	19	150	598	B		
				EB Right	286	8	150	598	A		
				WB Left	409	27	46	464	C		
	WB	14.8	B	WB Through	352	1	46	464	A		
				WB Right	0	0	0	0	A		

Table D.15: PM Peak - 2040 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
1- MD 85 at Sam's Club Drive											
1	NB	67.0	E	NB Left	132	81	524	914	F	118.6	F
				NB Through	570	40	524	914	D		
				NB Right	927	82	500	938	F		
	SB	181.5	F	SB Left	154	131	1026	1226	F		
				SB Through	866	188	1026	1226	F		
				SB Right	74	208	1026	1226	F		
	EB	35.1	D	EB Left	55	85	32	144	F		
				EB Through	24	81	32	144	F		
				EB Right	169	13	32	144	B		
	WB	162.5	F	WB Left	564	180	539	756	F		
				WB Through	29	152	539	756	F		
				WB Right	224	120	539	756	F		
2- MD 85 at I-270 NB on and off ramp											
2	NB	54.8	D	NB Left	1112	55	684	1929	D	45.0	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	30.2	C	SB Left	0	0	0	0	A		
				SB Through	741	30	121	708	C		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
3- MD 85 at I-270 SB on and off ramp											
3	NB	20.5	C	NB Left	0	0	0	0	A	22.3	C
				NB Through	1940	20	212	1335	C		
				NB Right	0	0	0	0	A		
	SB	42.3	D	SB Left	173	42	47	403	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
4- MD 85 at Crestwood Blvd											
4	NB	79.9	F	NB Left	72	106	433	920	F	55.3	E
				NB Through	1422	79	433	920	E		
				NB U-Turn	0	0	0	0	A		
	SB	31.2	C	SB Left	105	80	52	244	F		
				SB Through	950	30	96	893	C		
				SB Right	931	27	82	884	C		
	EB	66.5	E	EB Left	947	69	210	768	E		
				EB Through	43	53	210	768	D		
				EB Right	28	2	210	768	A		
	WB	54.6	D	WB Left	45	80	61	225	F		
				WB Through	77	80	61	225	E		
				WB Right	94	22	61	225	C		
5- MD 80 at I-270 NB on and ramp											
5	NB	0.4	A	NB Left	2	0	0	11	A	12.0	B
				NB Through	2	7	0	11	A		
				NB Right	6	-2	0	11	A		
	SB	13.1	B	SB Left	521	16	29	215	B		
				SB Through	23	17	29	215	B		
				SB Right	160	3	0	6	A		
	EB	13.3	B	EB Left	97	14	26	268	B		
				EB Through	0	0	8	0	A		
				EB Right	5	6	39	299	A		
	WB	11.3	B	WB Left	15	12	0	30	B		
				WB Through	673	19	71	480	B		
				WB Right	613	3	0	67	A		
6- MD 80 at I-270 SB on and off ramp											
6	NB	3.6	A	NB Left	55	4	4	273	A	5.9	A
				NB Through	0	0	0	0	A		
				NB Right	605	4	4	273	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	6.8	A	EB Left	0	0	0	0	A		
				EB Through	382	7	4	85	A		
				EB Right	66	5	3	91	A		
	WB	8.4	A	WB Left	0	0	0	0	A		
				WB Through	455	8	3	175	A		
				WB Right	0	0	0	0	A		
7- MD 109 at I-270 NB on and off ramp											
7	NB			NB Left	0	0	0	0	A	8.2	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	15.2	C	SB Left	346	16	36	250	C		
				SB Through	0	0	0	0	A		
				SB Right	26	5	0	168	A		
	EB	2.6	A	EB Left	80	2	0	49	A		
				EB Through	0	0	0	0	A		
				EB Right	83	3	0	0	A		
	WB	0.5	A	WB Left	0	0	0	0	A		
				WB Through	222	0	0	6	A		
				WB Right	0	0	0	0	A		
8- MD 80 at I-270 SB on and off ramp											
8	NB	4.8	A	NB Left	64	8	3	92	A	1.8	A
				NB Through	0	0	0	0	A		
				NB Right	37	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.9	A	EB Left	0	0	0	0	A		
				EB Through	166	0	0	0	A		
				EB Right	34	4	0	0	A		
	WB	1.4	A	WB Left	137	1	0	55	A		
				WB Through	111	2	0	32	A		
				WB Right	0	0	0	0	A		
9- MD 121 at Gateway Center Dr											
9	NB	42.8	E	NB Left	657	45	200	792	D	56.0	E
				NB Through	902	42	200	792	D		
				NB Right	73	27	212	818	C		
	SB	21.2	C	SB Left	27	19	18	212	B		
				SB Through	301	22	29	217	C		
				SB Right	9	8	31	238	A		
	EB	15.9	C	EB Left	4	51	9	257	D		
				EB Through	24	41	17	264	D		
				EB Right	248	13	30	297	B		
	WB	129.4	F	WB Left	345	175	322	693	F		
				WB Through	74	86	322	693	F		
				WB Right	182	61	346	717	E		
10- MD 121 at I-270 NB on and off ramp											
10	NB	23.9	C	NB Left	464	58	98	716	F	20.6	C
				NB Through	0	0	0	0	A		
				NB Right	972	7	18	510	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	14.2	B	EB Left	0	0	0	0	A		
				EB Through	649	21	46	365	C		
				EB Right	336	1	0	30	A		
	WB	22.4	C	WB Left	217	63	92	481	F		
				WB Through	676	9	92	481	A		
				WB Right	0	0	0	0	A		

Table D.15: PM Peak - 2040 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
11- MD 121 at I-270 SB on and off ramp											
11	NB			NB Left	0	0	0	0	A	22.2	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	59.8	E	SB Left	269	82	215	925	F		
				SB Through	0	0	0	0	A		
				SB Right	252	36	0	11	E		
	EB	6.4	A	EB Left	0	0	0	0	A		
				EB Through	717	6	16	213	A		
				EB Right	0	0	0	0	A		
	WB	14.8	B	WB Left	0	0	0	0	A		
				WB Through	604	28	56	413	D		
				WB Right	536	0	0	0	A		
12- MD 27 at Observation Dr											
12	NB	38.4	D	NB U-Turn	0	0	0	0	A	25.6	C
				NB Through	94	55	22	98	E		
				NB Right	61	13	22	98	B		
	SB	41.2	D	SB Left	146	44	38	216	D		
				SB Through	57	62	43	250	E		
				SB Right	188	33	69	287	C		
	EB	19.7	B	EB Left	210	34	87	536	C		
				EB Through	2247	18	89	537	B		
				EB Right	108	17	101	575	B		
	WB	29.6	C	WB Left	41	24	158	709	C		
				WB Through	1695	31	158	709	C		
				WB Right	69	9	158	709	A		
13- MD 27 at I-270 NB off ramp											
13	NB	47.2	D	NB Left	379	47	65	255	D	7.8	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	0.1	A	EB Left	0	0	0	0	A		
				EB Through	1514	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	6.0	A	WB Left	0	0	0	0	A		
				WB Through	1792	6	51	780	A		
				WB Right	0	0	0	0	A		
14- MD 27 at I-270 SB off ramp											
14	NB			NB Left	0	0	0	0	A	5.2	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	50.7	D	SB Left	175	51	34	182	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	1.9	A	EB Left	0	0	0	0	A		
				EB Through	1677	2	4	82	A		
				EB Right	0	0	0	0	A		
	WB	3.7	A	WB Left	0	0	0	0	A		
				WB Through	1619	4	12	343	A		
				WB Right	0	0	0	0	A		
15- MD 27 at Crystal Rock Dr											
15	NB	31.5	C	NB Left	77	33	108	580	C	70.7	E
				NB Through	1196	32	117	579	C		
				NB Right	55	30	124	592	C		
	SB	59.6	E	SB Left	163	78	441	1264	E		
				SB Through	1518	62	441	1264	E		
				SB Right	233	31	429	1258	C		
	EB	40.9	D	EB Left	125	54	35	132	D		
				EB Through	49	36	30	127	D		
				EB Right	62	19	24	157	B		
	WB	160.6	F	WB Left	104	92	1022	1546	F		
				WB Through	126	103	1022	1546	F		
				WB Right	664	182	1022	1546	F		
16- MD 118 at Seneca Meadows Pkwy											
16	NB	5.1	A	NB Left	109	14	2	93	B	9.1	A
				NB Through	1414	4	12	193	A		
				NB Right	1	2	20	246	A		
	SB	7.6	A	SB Left	15	9	20	320	A		
				SB Through	1226	8	23	320	A		
				SB Right	11	5	27	353	A		
	EB	14.0	B	EB Left	23	58	14	146	E		
				EB Through	0	65	14	146	E		
				EB Right	312	11	14	146	B		
	WB	53.9	D	WB Left	103	65	43	243	E		
				WB Through	7	69	39	242	E		
				WB Right	30	13	48	262	B		
17- MD 118 at I-270 NB on ramp											
17	NB			NB Left	0	0	0	0	A	13.3	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	25.8	C	EB Left	492	26	42	357	C		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	9.6	A	WB Left	0	0	0	0	A		
				WB Through	283	2	0	6	A		
				WB Right	1362	11	42	504	B		
18- MD 118 at I-270 SB off ramp											
18	NB			NB Left	0	0	0	0	A	7.8	A
				NB Through	0	0.0	0	0	A		
				NB Right	0	0.0	0	0	A		
	SB	37.1	D	SB Left	168	37.1	27	142	D		
				SB Through	0	0.0	0	0	A		
				SB Right	0	0.0	0	0	A		
	EB	5.9	A	EB Left	0	0.0	0	0	A		
				EB Through	1408	5.9	14	377	A		
				EB Right	0	0.0	0	0	A		
	WB	6.6	A	WB Left	0	0.0	0	0	A		
				WB Through	1738	6.6	16	375	A		
				WB Right	0	0.0	0	0	A		
19- MD 118 at Aircraft Dr											
19	NB	26.0	C	NB Left	53	71	43	242	E	41.9	D
				NB Through	52	69	43	242	E		
				NB Right	227	6	5	118	A		
	SB	155.5	F	SB Left	437	142	399	657	F		
				SB Through	14	214	399	657	F		
				SB Right	128	196	399	657	F		
	EB	23.6	C	EB Left	125	36	94	574	D		
				EB Through	1415	23	94	574	C		
				EB Right	20	20	94	574	B		
	WB	26.1	C	WB Left	16	31	133	807	C		
				WB Through	1585	30	133	807	C		
				WB Right	413	10	133	807	A		
20- Middlebrook Rd at Observation Dr											
20	NB			NB Left	0	0	0	0	A	9.0	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	20.6	C	SB Left	124	36	23	150	D		
				SB Through	0	0	0	0	A		
				SB Right	186	10	23	150	B		
	EB	6.2	A	EB Left	15	11	16	162	B		
				EB Through	1188	6	16	162	A		
				EB Right	0	0	0	0	A		
	WB	8.7	A	WB Left	0	0	0	0	A		
				WB Through	1313	9	27	264	A		
				WB Right	17	7	42	313	A		

Table D.15: PM Peak - 2040 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
21- Middlebrook Rd at I-270 SB on ramp											
21				NB Left	0	0	0	0	A	4.6	A
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
				EB Left	0	0	0	0	A		
	EB	2.8	A	EB Through	742	3	4	108	A		
				EB Right	0	0	0	0	A		
				WB Left	438	8	5	238	A		
	WB	7.8	A	WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
22- Middlebrook Rd at Waring Station Rd											
22				NB Left	200	46	83	303	D	13.9	B
	NB	48.4	D	NB Through	1	55	83	303	D		
				NB Right	236	50	83	303	D		
				SB Left	32	47	8	72	D		
	SB	30.3	C	SB Through	2	39	8	72	D		
				SB Right	24	8	20	110	A		
				EB Left	4	13	28	301	B		
	EB	8.2	A	EB Through	1125	8	28	301	A		
				EB Right	198	8	28	301	A		
				WB Left	245	26	40	311	C		
	WB	9.4	A	WB Through	1654	7	40	311	A		
				WB Right	4	3	40	311	A		
23- MD 124 at MD 355											
23				NB Left	465	137	820	1145	F	80.1	F
	NB	157.5	F	NB Through	1119	166	817	1143	F		
				NB Right	7	107	0	0	F		
				SB Left	184	95	171	508	F		
	SB	50.4	D	SB Through	699	70	171	508	E		
				SB Right	703	19	80	478	B		
				EB Left	435	75	188	924	E		
	EB	31.2	C	EB Through	2488	29	188	924	C		
				EB Right	517	4	73	837	A		
				WB Left	0	0	0	0	A		
	WB	137.3	F	WB Through	1529	140	701	955	F		
				WB Right	82	91	5	190	F		
24- MD 124 at I-270 SB on and off											
24				NB Left	52	59	22	107	E	27.3	C
	NB	60.5	F	NB Through	21	63	22	107	E		
				NB U-Turn	0	0	0	0	A		
				SB Left	560	61	120	467	E		
	SB	36.0	D	SB Through	8	59	120	467	E		
				SB Right	454	5	5	252	A		
				EB Left	0	0	0	0	A		
	EB	24.4	C	EB Through	1887	24	170	1053	C		
				EB Right	37	24	183	1077	C		
				WB Left	5	72	545	2375	E		
	WB	22.2	C	WB Through	1126	22	545	2375	C		
				WB Right	0	0	0	0	A		
25- MD 117 at MD 124											
25				NB Left	55	161	314	743	F	50.8	D
	NB	75.2	E	NB Through	668	89	314	743	F		
				NB Right	451	44	45	673	D		
				SB Left	133	66	155	684	E		
	SB	38.6	D	SB Through	963	41	155	684	D		
				SB Right	182	4	0	0	A		
				EB Left	152	82	171	640	F		
	EB	49.3	D	EB Through	1145	45	171	641	D		
				EB Right	55	43	179	668	D		
				WB Left	387	72	277	1029	E		
	WB	44.8	D	WB Through	1295	41	277	1029	D		
				WB Right	123	1	0	0	A		
26- MD 117 at Bureau Dr											
26				NB Left	96	79	98	295	E	44.7	D
	NB	59.2	E	NB Through	34	91	98	295	F		
				NB Right	253	47	98	295	D		
				SB Left	286	101	141	408	F		
	SB	88.1	F	SB Through	23	102	141	408	F		
				SB Right	83	38	141	408	D		
				EB Left	50	77	221	929	E		
	EB	38.4	D	EB Through	1620	37	230	929	D		
				EB Right	5	68	223	918	E		
				WB Left	18	38	314	1067	D		
	WB	38.4	D	WB Through	1595	41	315	1068	D		
				WB Right	271	25	345	1116	C		
27- MD 117 at I-270 SB off ramp											
27				NB Left	0	0	0	0	A	13.1	B
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB			SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
				EB Left	0	0	0	0	A		
	EB	4.1	A	EB Through	916	4	22	420	A		
				EB Right	0	0	0	0	A		
				WB Left	293	41	127	799	E		
	WB	41.4	E	WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
28- MD 117 at I-270 NB off ramp											
28				NB Left	0	0	0	0	A	53.6	D
	NB			NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
				SB Left	224	140	4586	5058	F		
	SB	145.8	F	SB Through	0	0	0	0	A		
				SB Right	820	147	4586	5057	F		
				EB Left	4	93	77	946	F		
	EB	17.5	B	EB Through	928	17	77	946	B		
				EB Right	0	0	0	0	A		
				WB Left	0	0	0	0	A		
	WB	8.0	A	WB Through	1370	8	53	379	A		
				WB Right	0	0	53	379	A		
29- MD 117 at Perry Pkwy											
29				NB Left	18	59	15	127	E	49.7	D
	NB	39.1	D	NB Through	25	54	15	126	D		
				NB Right	33	17	24	146	B		
				SB Left	236	212	302	474	F		
	SB	172.7	F	SB Through	20	228	302	474	F		
				SB Right	119	85	302	474	F		
				EB Left	242	71	90	359	E		
	EB	21.9	C	EB Through	859	9	90	359	A		
				EB Right	31	7	75	343	A		
				WB Left	34	104	244	734	F		
	WB	41.2	D	WB Through	1233	42	244	734	D		
				WB Right	376	32	244	734	C		
30- Shady Grove Rd at I-270 NB off ramp											
30				NB Left	0	0	0	0	A	13.6	B
	NB	6.7	A	NB Through	1054	7	15	194	A		
				NB Right	0	0	0	0	A		
				SB Left	0	0	0	0	A		
	SB	9.3	A	SB Through	1357	9	43	506	A		
				SB Right	0	0	0	0	A		
				EB Left	0	0	0	0	A		
	EB			EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
				WB Left	334	53	62	226	D		
	WB	53.0	D	WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table D.15: PM Peak - 2040 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
31- Shady Grove Rd at I-270 SB off ramp											
31	NB	6.9	A	NB Left	0	0	0	0	A	15.7	B
				NB Through	1529	7	30	403	A		
				NB Right	0	0	0	0	A		
	SB	5.1	A	SB Left	0	0	0	0	A		
				SB Through	873	5	8	166	A		
				SB Right	0	0	0	0	A		
	EB	59.1	E	EB Left	226	57	46	185	E		
				EB Through	0	0	0	0	A		
				EB Right	298	61	65	282	E		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
32- MD 28 at I-270 SB off ramp											
32	NB			NB U-Turn	0	0	0	0	A	9.3	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	39.2	D	SB Left	441	48	81	357	D		
				SB Through	0	0	0	0	A		
				SB Right	103	3	1	80	A		
	EB	4.5	A	EB Left	0	0	0	0	A		
				EB Through	1554	3	98	612	A		
				EB Right	930	6	16	237	A		
	WB	6.9	A	WB Left	0	0	0	0	A		
				WB Through	1750	7	21	272	A		
				WB Right	0	0	0	0	A		
33- MD 28 at I-270 on and off ramps											
33	NB	36.0	D	NB Left	0	0	42	205	A	42.7	D
				NB Through	199	47	50	214	D		
				NB Right	129	19	50	214	B		
	SB	133.2	F	SB Left	18	162	358	419	F		
				SB Through	0	0	0	0	A		
				SB Right	261	131	358	419	F		
	EB	24.3	C	EB Left	287	77	123	361	E		
				EB Through	946	8	123	361	A		
				EB Right	0	0	0	0	A		
	WB	42.3	D	WB Left	40	36	171	420	D		
				WB Through	1238	43	147	383	D		
				WB Right	0	0	0	0	A		
34- MD 189 at Great Falls Rd											
34	NB	37.1	D	NB Left	43	46	12	95	D	13.6	B
				NB Through	14	49	9	94	D		
				NB Right	19	9	10	105	A		
	SB	3.3	A	SB Left	18	44	7	94	D		
				SB Through	13	44	7	94	D		
				SB Right	414	0	0	0	A		
	EB	11.9	B	EB Left	420	23	39	447	C		
				EB Through	658	5	6	194	A		
				EB Right	57	4	11	230	A		
	WB	19.0	B	WB Left	14	24	50	373	C		
				WB Through	829	19	50	373	B		
				WB Right	17	17	65	407	B		
35- MD 189 at I-270 Ramps											
35	NB	47.5	D	NB Left	235	48	44	194	D	41.2	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	52.0	D	SB Left	352	52	121	460	D		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	27.3	C	EB Left	483	31	92	361	C		
				EB Through	373	23	92	361	C		
				EB Right	0	0	0	0	A		
	WB	48.7	D	WB Left	451	53	110	264	D		
				WB Through	438	44	110	264	D		
				WB Right	0	0	0	0	A		
36- MD 189 at Wooton Pkwy											
36	NB	46.9	D	NB Left	238	59	146	500	E	53.3	D
				NB Through	694	51	146	500	D		
				NB Right	176	12	146	500	B		
	SB	84.5	F	SB Left	249	107	291	792	F		
				SB Through	925	79	317	780	E		
				SB Right	0	0	0	0	A		
	EB	39.1	D	EB Left	152	73	127	477	E		
				EB Through	553	39	127	477	D		
				EB Right	204	15	127	477	B		
	WB	40.0	D	WB Left	161	71	148	727	E		
				WB Through	785	42	148	727	D		
				WB Right	320	20	148	727	C		
37- Montrose Rd at Tower Oaks Blvd											
37	NB	0.4	A	NB Left	0	0	0	0	A	35.6	D
				NB Through	0	0	0	0	A		
				NB Right	587	0	0	0	A		
	SB	158.6	F	SB Left	86	65	226	734	E		
				SB Through	0	0	0	0	A		
				SB Right	288	187	318	748	F		
	EB	7.1	A	EB Left	0	0	0	0	A		
				EB Through	1889	7	42	495	A		
				EB Right	0	0	0	0	A		
	WB	46.3	D	WB Left	79	37	42	495	D		
				WB Through	2308	48	309	782	D		
				WB Right	249	33	309	782	C		
38- Tower Oaks Blvd at I-270 off rmap											
38	NB	25.1	C	NB Left	756	26	58	277	C	19.5	B
				NB Through	0	0.0	51	269	A		
				NB Right	33	16.3	58	277	B		
	SB	12.0	B	SB Left	8	22.6	1	39	C		
				SB Through	0	0.0	1	39	A		
				SB Right	9	2.7	0	23	A		
	EB	14.4	B	EB Left	1	9.2	21	211	A		
				EB Through	360	14.7	21	211	B		
				EB Right	36	11.1	16	201	B		
	WB	12.5	B	WB Left	135	16.3	15	142	B		
				WB Through	192	9.9	15	142	A		
				WB Right	2	7.7	3	98	A		
39- Montrose Rd at Tower Oaks Blvd											
39	NB	19.6	B	NB Left	97	40	81	370	D	42.8	D
				NB Through	773	31	81	370	C		
				NB Right	621	2	0	0	A		
	SB	31.3	C	SB Left	211	63	73	319	E		
				SB Through	506	23	72	318	C		
				SB Right	131	14	67	330	B		
	EB	119.1	F	EB Left	104	101	319	682	F		
				EB Through	524	122	321	683	F		
				EB Right	44	125	343	707	F		
	WB	37.5	D	WB Left	527	46	109	406	D		
				WB Through	439	43	110	406	D		
				WB Right	307	14	129	436	B		
40- Rockledge Blvd at I-270 NB on and off ramp											
40	NB	144.5	F	NB Left	0	0	0	0	A	100.7	F
				NB Through	327	152	591	829	F		
				NB Right	839	142	591	829	F		
	SB	72.8	E	SB Left	0	0	78	232	A		
				SB Through	357	73	78	232	E		
				SB Right	0	0	0	0	A		
	EB	48.5	D	EB Left	6	87	139	409	F		
				EB Through	470	79	139	409	E		
				EB Right	311	1	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		

Table D.15: PM Peak - 2040 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
41- Rockledge Blvd at I-270 SB on and off ramps											
41	NB	38.1	D	NB Left	332	38	49	259	D	39.5	D
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	39.9	D	WB Left	359	45	140	727	D		
				WB Through	910	38	140	727	D		
				WB Right	0	0	0	0	A		
42- MD 187 at Tuckerman Ln											
42	NB	81.8	F	NB Left	216	55	708	1333	E	136.8	F
				NB Through	2261	84	708	1333	F		
				NB Right	197	80	708	1333	F		
	SB	190.8	F	SB Left	203	174	2563	2697	F		
				SB Through	1144	188	2563	2697	F		
				SB Right	306	211	2563	2697	F		
	EB	114.7	F	EB Left	302	68	542	1451	E		
				EB Through	534	138	544	1452	F		
				EB Right	118	131	567	1476	F		
	WB	197.2	F	WB Left	463	190	1945	2131	F		
				WB Through	672	215	1945	2131	F		
				WB Right	166	148	1945	2131	F		
43- MD 187 at I-270 NB on and off ramps											
43	NB	22.3	C	NB Left	553	33	149	436	C	24.0	C
				NB Through	2453	20	149	436	B		
				NB Right	0	0	0	0	A		
	SB	24.1	C	SB Left	0	0	0	0	A		
				SB Through	1281	24	63	268	C		
				SB Right	0	0	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	57.0	E	WB Left	71	55	54	401	E		
				WB Through	77	58	54	401	E		
				WB Right	0	0	0	0	A		
44- MD 187 at I-270 NB on and off ramps											
44	NB	54.1	F	NB Left	0	0	0	0	A	49.1	D
				NB Through	2373	54	253	995	D		
				NB Right	0	0	0	0	A		
	SB	18.1	B	SB Left	147	54	68	294	D		
				SB Through	1205	14	68	294	B		
				SB Right	0	0	0	0	A		
	EB	85.7	F	EB Left	636	87	244	922	F		
				EB Through	0	0	244	922	A		
				EB Right	178	80	158	885	E		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
45- MD 187 at Rock Spring Dr											
45	NB	20.3	C	NB Left	492	36	118	752	D	29.5	C
				NB Through	2176	17	118	753	B		
				NB Right	18	13	139	786	B		
	SB	34.5	C	SB Left	21	62	113	530	E		
				SB Through	1189	39	113	530	D		
				SB Right	174	1	71	525	A		
	EB	49.0	D	EB Left	432	60	141	513	E		
				EB Through	50	67	141	513	E		
				EB Right	484	37	141	513	D		
	WB	16.7	B	WB Left	7	28	6	108	C		
				WB Through	16	33	6	108	C		
				WB Right	36	8	3	97	A		
47-Democracy Blvd at I-270 NB off ramp											
47	NB	42.8	D	NB Left	164	43	28	133	D	3.0	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	1.3	A	EB Left	0	0	0	0	A		
				EB Through	1189	1	3	59	A		
				EB Right	0	0	0	0	A		
	WB	1.0	A	WB Left	0	0	0	0	A		
				WB Through	2240	1	3	53	A		
				WB Right	0	0	0	0	A		
48- Democracy Blvd at I-270 SB on ramp											
48	NB			NB Left	0	0	0	0	A	6.6	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	5.3	A	EB Left	0	0	0	0	A		
				EB Through	1420	5	20	241	A		
				EB Right	0	0	0	0	A		
	WB	7.4	A	WB Left	567	22	40	294	C		
				WB Through	1838	3	32	273	A		
				WB Right	0	0	0	0	A		
49- Democracy Blvd at I-270 SB off ramp											
49	NB			NB Left	0	0	0	0	A	8.0	A
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	39.8	D	SB Left	184	54	40	162	D		
				SB Through	0	0	0	0	A		
				SB Right	71	2	0	0	A		
	EB			EB Left	0	0	0	0	A		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	4.0	A	WB Left	0	0	0	0	A		
				WB Through	1838	4	22	297	A		
				WB Right	184	1	0	16	A		
50- MD 190 at Burdette Rd											
50	NB	76.3	E	NB Left	27	78	18	118	E	36.5	D
				NB Through	7	69	18	118	E		
				NB Right	6	75	18	118	E		
	SB	36.9	D	SB Left	45	78	25	158	E		
				SB Through	9	73	25	158	E		
				SB Right	122	19	25	158	B		
	EB	23.4	C	EB Left	139	107	127	615	F		
				EB Through	1299	15	127	615	B		
				EB Right	31	4	116	642	A		
	WB	44.5	D	WB Left	13	115	379	1124	F		
				WB Through	2161	44	379	1124	D		
				WB Right	64	35	379	1124	C		

Table D.15: PM Peak - 2040 Build - Intersection Delay and Level of Service

Intersection	Approach	Approach Delay	Approach LOS	Movement	Volume	Delay	Ave. Queue	Max Queue	LOS	Intersection Delay	Intersection LOS
51- MD 190 at I-270 NB on ramp											
51	NB			NB Left	0	0	0	0	A	17.9	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	67.0	E	EB Left	254	67	103	362	E		
				EB Through	0	0	0	0	A		
				EB Right	0	0	0	0	A		
	WB	9.5	A	WB Left	0	0	0	0	A		
				WB Through	1471	9	46	632	A		
				WB Right	0	0	0	0	A		
52- MD 190 at I-270 SB off ramp											
52	NB	73.1	E	NB Left	232	73	89	672	E	13.6	B
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	3.5	A	EB Left	0	0	0	0	A		
				EB Through	1062	3	8	165	A		
				EB Right	0	0	0	0	A		
	WB	11.8	B	WB Left	0	0	0	0	A		
				WB Through	1684	12	25	548	B		
				WB Right	0	0	0	0	A		
53- MD 190 at Seven Locks Rd											
53	NB	0.5	A	NB Left	28	1	0	0	A	27.0	C
				NB Through	314	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB	52.5	D	SB Left	364	52	119	414	D		
				SB Through	232	53	119	414	D		
				SB Right	20	51	119	414	D		
	EB	32.0	C	EB Left	27	29	95	437	C		
				EB Through	800	32	95	437	C		
				EB Right	45	32	95	437	C		
	WB	21.2	C	WB Left	260	78	132	569	E		
				WB Through	933	18	132	569	B		
				WB Right	709	5	132	569	A		
54- MD 124 at I-270 NB off ramp											
54	NB	23.8	C	NB Left	0	0	0	0	A	26.4	C
				NB Through	0	0	0	0	A		
				NB Right	2005	24	140	1096	C		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	30.0	C	EB Left	0	0	0	0	A		
				EB Through	1425	30	99	576	C		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
55- Democracy Blvd at I-270 NB off ramp											
55	NB	46.4	D	NB Left	0	0	0	0	A	11.4	B
				NB Through	0	0	0	0	A		
				NB Right	337	46	54	207	D		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	1.5	A	EB Left	0	0	0	0	A		
				EB Through	1190	1	4	59	A		
				EB Right	0	0	0	0	A		
	WB			WB Left	0	0	0	0	A		
				WB Through	0	0	0	0	A		
				WB Right	0	0	0	0	A		
56- Watkins Mill Rd at I-270 SB off ramp/Parkview Ave											
56	NB	135.7	F	NB Left	142	67	404	688	E	108.5	F
				NB Through	0	0	0	0	A		
				NB Right	330	165	404	688	F		
	SB	45.1	D	SB Left	403	68	111	490	E		
				SB Through	112	60	111	490	E		
				SB Right	441	21	111	490	C		
	EB	187.2	F	EB Left	0	0	0	0	A		
				EB Through	1020	187	1018	1250	F		
				EB Right	3	125	1018	1250	F		
	WB	49.0	D	WB Left	92	87	85	299	F		
				WB Through	458	41	82	297	D		
				WB Right	0	0	0	0	A		
57- Watkins Mill Rd at I-270 NB on ramp											
57	NB	90.4	F	NB Left	218	57	1151	3318	E	79.1	E
				NB Through	0	0	0	0	A		
				NB Right	562	103	1151	3318	F		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	42.7	D	EB Left	542	100	245	436	F		
				EB Through	966	10	245	436	B		
				EB Right	0	0	0	0	A		
	WB	116.2	F	WB Left	0	0	0	0	A		
				WB Through	812	132	609	862	F		
				WB Right	429	87	609	862	F		
58- Watkins Mill Rd at I-270 SB on ramp											
58	NB			NB Left	0	0	0	0	A	23.8	C
				NB Through	0	0	0	0	A		
				NB Right	0	0	0	0	A		
	SB			SB Left	0	0	0	0	A		
				SB Through	0	0	0	0	A		
				SB Right	0	0	0	0	A		
	EB	29.8	C	EB Left	0	0	0	0	A		
				EB Through	1505	33	254	599	C		
				EB Right	249	10	254	599	B		
	WB	13.5	B	WB Left	486	28	60	472	C		
				WB Through	543	1	60	472	A		
				WB Right	0	0	0	0	A		

PM Peak - 2040 - I-270 Vehicle Network Performance

	2040 No Build	2040 Build	% Change
Total Delay (sec.)	36,237,078	25,486,332	-30%
Average Delay per Vehicle (sec.)	307	214	-30%
Total Travel Time (sec.)	67,865,560	59,670,766	-12%
Vehicles (Arrived)	95,124	100,618	6%
Latent Demand	8,861	6,635	-25%
Latent Delay (sec.)	13,484,325	11,606,317	-14%
Total Distance (mi.)	477,455	518,219	9%
Average Speed (mph)	25	31	23%

APPENDIX II
PROPOSED TECHNICAL CONCEPTS (PTCS)
AND RESPONSES TO COMMENTS

Appendix ii

Proposed Technical Concepts (PTCs)

and Responses to SHA Comments

PTCs included in “The Project”

and Technical Proposal

PTC # 1, 4, 5, 6, 7, 8, 10

PTC 1 – IS-270 Northbound Managed Lane using Hard Shoulder Running Operating as HOV 2+

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January 19, 2017

Mr. Jason A. Ridgway, P.E.
Director, Office of Highway Development
Maryland Department of Transportation
State Highway Administration
707 N. Calvert Street
Baltimore, MD 21202

Subject: **Proposed Technical Concept No. 1** Comment Responses
IS-270 - Innovative Congestion Management Progressive Design Build
Contract No. MO0695172

Dear Mr. Ridgway

The Kiewit/AECOM team is in receipt of the first round of comments that the Maryland Department of Transportation's State Highway Administration (SHA) provided on October 6, 2016, and the second round of comments provided on January 3, 2017 on Proposed Technical Concept (PTC) No. 1 for the IS-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by our team on September 22, 2016 and December 19, 2016 respectively. We appreciate the opportunity to provide point-by-point responses to both rounds of your comments, and address them in the revised PTC No. 1 that is included as an Appendix of the Technical Proposal. Your comments have been repeated for convenience, and the responses are in bold.

THE KIEWIT/AECOM TEAM IS INCLUDING PTC 10 IN "THE PROJECT" AND TECHNICAL PROPOSAL.

Round 1 of comments (October 6, 2016)

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract.

   Response: No response required.

2. Please clarify if the Hard Shoulder Running (HSR) is proposed to be dynamic, adapting to congestion levels, or implemented by time of day.

   Response: The proposed Hard Shoulder Running is proposed to be implemented by time of day as part of the project. However, in events of snow or incidents, the lane control units can be used to close the shoulder.

3. To achieve the project goals, the Design-Builder must provide a fully functional system at project completion. The PTC does not address how HSR will be integrated. Section D, Potential Impacts, does not address impacts to CHART.

   Response: The PTC has been revised to discuss the integration with CHART under Potential Impacts.

4. Please clarify if the HSR is proposed to be open or closed during rain events.

   Response: The HSR will be open during rain events.

5. Travel lane widths on 1-270 less than 12 feet and shoulder widths less than AASHTO standards will require an approved design exception, including a safety analysis, prior to establishing a Construction Agreed Price (CAP).

   Response: The design exceptions will be submitted to FHWA post-award. The safety analysis has been included in the technical proposal under Section 3 – SAFETY.

6. A National Environmental Policy (NEPA) document and an Interstate Access Point Approval (IAPA) approved by the Federal Highway Administration (FHWA) will be required prior to establishing a CAP. In preparation of the IAPA, the Design-Builder must meet the requirements of the FHWA Interstate System Access Informational Guide.

   Response: An IAPA package will be prepared and submitted to FHWA for approval prior to the establishment of a CAP. The Kiewit/AECOM team will provide all supporting documentation to the Administration required for the NEPA document.

7. This would be considered a Type I project and require a noise analysis and appropriate mitigation as required by the SHA Noise Policy and the Code of Federal Regulations.

   Response: The Kiewit/AECOM team will prepare a noise analysis to assist the Administration in determining which noise barriers are reasonable and feasible. The design and construction of Noise Barriers will not be included in the Project, per direction on Addendum 3 of the RFP.

8. Narrowing and/or shifting the HOV lane(s) will require an equivalency study, to be approved by FHWA, prior to establishing a CAP.

   Response: The equivalency study will be submitted to FHWA prior to establishing a CAP.

9. The PTC notes the roadway will be resurfaced where restriping will occur to reconfigure lanes. Exhibit 1 and the typical sections are inconsistent. The exhibit depicts only partial resurfacing where the typicals depict reduced lane widths. Please clarify. Additionally, some areas in the exhibit show no resurfacing where there is HSR on the outside near ramps. Will restriping at ramps not be required to implement HSR on the outside?

   Response: The existing pavement will be resurfaced in the areas where restriping is necessary.

10. On page 5, last sentence, the PTC notes the existing median barrier needs to be replaced or modified in needed in other areas, such as tangents, to create a safe and usable cross slope for the HSR when operating as a travel lane. While concrete traffic barriers offer some flexibility for overlays, the cross slope adjustments may reduce the barrier height to less than required heights depending on the extent of the cross slope adjustment, whether the existing roadway has already been overlaid, etc.

    Response: In the areas where shoulder cross slope adjustment is necessary, the existing median barrier will be either rehabilitated to have the required reveal at gutter, modified to have a sloped face, demolished and reconstructed in part or replaced in its entirety. The existing concrete median barrier is less than 42" in height. The team is proposing 42" barrier in the sections where the median barrier needs to be replaced, but not replacing the existing median barrier that is not impacted by the change in the shoulder cross slope. Since the traffic will run closer to the barrier compared to the existing conditions, the approach angle is reduced, lowering the risk of cars rolling over upon impact.

11. Page 7 notes infrastructure costs for the implementation of HSR will be developed based on the shoulder full depth reconstruction, grinding and resurfacing, restriping, and the lane control system; however, other significant costs (e.g. potential noise barriers) are not mentioned.

    Response: Per Addendum 3 to the RFP, the noise barriers will not be included in the $100M for the project. Other potential significant costs have been included in the PTC.

12. Section D, Potential Impacts, does not address impacts to existing traffic during construction. Discuss how traffic will be maintained during construction.

    Response: The PTC has been revised to include the description of maintenance of traffic during construction and a typical MOT section.

13. Section D, Potential Impacts, states right-of-way impacts will include emergency pull- offs. Please specify the number of pull-offs to be provided, or the spacing. Please specify the minimum length of the pull-off (including tapers), or provide a sketch/detail.

    Response: No pull-offs will be provided as part of the project.

14. Discuss the potential fiber requirements needed for this PTC.

    Response: The PTC has been revised to include discussions on the use of enhanced cellular modem technology, since using the fiber option would not be a cost-effective solution, and it would not be in line with the main project goal to improve mobility.

15. If the PTC is resubmitted, please provide detailed information for the following PTC sections: Other Projects, Design-Builder Risk, Cost/Schedule Benefits, and Miscellaneous.

    Response: The sections have been updated.

Round 2 of comments (January 3, 2017)

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract. There are no additional comments for this revised PTC.

We appreciate the opportunity to provide responses and revise PTC No. 1 accordingly.

Yours sincerely,

Chris McGuire, PE
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A. Description

Detailed descriptive information and other appropriate information as appropriate such as conceptual drawings, production details, standards, specifications, and traffic operations analysis.

This Proposed Technical Concept (PTC) includes the use of median and outside Hard Shoulder Running (HSR) to create a northbound managed lane along the existing IS-270 NB median shoulder. HSR is the temporary operation of paved shoulders as running lanes to alleviate congestion and temporarily increase highway capacity without major infrastructure reconstruction. The shoulder will be equipped with overhead signing that will indicate if drivers may use the hard shoulder as a through lane (Figure 1). The focus of this approach is to improve the bottlenecks along NB IS-270 along the segment that has been identified as the most problematic, between Tuckerman Lane and MD 121 (Clarksburg Road). Appendix vii contains a layout of the roadway improvements within the limits of work. The proposed Hard Shoulder Running will be implemented by time of day as part of the project. However, in events of snow or incidents, the lane control units can be used to close the shoulder.

The traditional method of adding highway capacity is to widen existing roads to add through lanes, which often results in additional right of way needs, adverse impacts to the community and the environment, and high construction costs. As a result, several European countries and several states in the US have initiated efforts to add highway capacity while maintaining the footprint of the existing pavement. HSR is one of the methods that provide congestion relief with relatively minimal environmental and construction cost impacts.

A managed lane includes operational strategies that are proactively implemented and managed in response to changing conditions. This type of facility incorporates a high degree of operational flexibility, so that the purpose can change to respond to future growth and needs (FHWA, 2008). As part of this PTC, the managed lane on the NB median HSR will operate as a High Occupancy Vehicle (HOV) lane during the PM peak period. During off-peak hours and weekends, the Administration can dynamically control the use of the managed lane and designate it for other purposes. In addition, the Administration can adapt the role of the managed lane to future needs. Potential future uses include continued HOV use, connected vehicles, electric vehicles and automated vehicles. In addition, the Administration can use the managed lane as an asset in order to submit for technology grants and use the lane capacity during off peak hours for pilot programs to test out emerging technologies.

One of the goals of this PTC is to improve mobility by HOV balancing and sizing the HOV facility to meet demand. Currently, the HOV lanes are not balanced, with higher volumes in the NB direction than in the SB direction. The addition of the NB HOV Lane on HSR during PM peak hours creates HOV lane balance along SB and NB IS-270.

<u>Traffic Analysis</u>

Traffic analysis is performed with assumption that two northbound HOV lanes from I-270 split to Maryland 28 interchange will be provided and evaluated under existing and 2040 scenarios. The existing HOV lane is assumed to turn into a general purpose lane right after Maryland 28 interchange in the northbound direction to provide more capacity to general purpose traffic. The location of the HOV to GP lane conversion was determined based on the HOV traffic demand that were obtained from existing traffic volumes developed by the SHA. The second HOV lane is assumed to operate on the HSR starting from I-270 split to Maryland 121. The existing northbound HOV lane limits are unchanged, but we propose shifting laterally the existing HOV lane onto the HSR from MD28 (Montgomery Ave) to MD 121 (Clarksburg Road).

In addition to aforementioned changes, the following proposed improvements were included in the VISSIM model:

1. Provision of right-side HSR from Rockledge Drive to off-ramp to Montrose Road interchange (PTC 1).
2. Provision of northbound auxiliary lane on the local road between Shady Grove interchange westbound on-ramp and the off-ramp to I-370 interchange (PTC 4A).
3. Provision of a third lane on the off-ramp to Maryland 124 interchange (PTC 5D).
4. Extension of deceleration and acceleration lanes leading to and from the off and on ramps connecting to Maryland 80 (PTC 5C).

The traffic volume suggests that a portion of the HOV traffic destined from Inner-loop, outer-loop and Westlake Terrace choose to avoid HOV lanes once they arrive at I-270 split due to the high demand and insufficient capacity on HOV lane at this segment. Provision of second HOV lane that starts at this location allows this unserved HOV demand to continue traveling on HOV lane and provide travel time saving. Additionally, the additional HOV demand switched to travel on HOV lane instead of general purpose lane showed significant operational improvement at I-270 split, one of the major bottlenecks of the corridor on northbound direction.

HOV traffic destinations were obtained from MWCOG travel demand model. The portion of HOV traffic that have destination north of Montrose interchange is assumed to use the second HOV lane. According to the travel demand model, approximately 20% of the HOV traffic exit the corridor at Montrose interchange, and this portion was assumed to stay on general purpose lanes at I-270 split.

In additional to lane utilization assumption described above, single occupancy volume was reduced by 580 and HOV volume was increased by 290. This assumption was made in accordance to AM southbound calculation for PTC10. Basically, those people who go to work using HOV mode will come back using the same mode. The travel time graphs included in the technical proposal depict the travel time savings obtained by the overall Project improvements during the 2016 and 2040 scenarios.

Figure 1 - I-66 Hard Shoulder Running during off-peak
Source – Virginia Department of Transportation

The proposed advanced data collection in PTC 8 will allow the Administration to monitor changes in travel patterns, mode choice (SOV vs HOV), and path selection. PTC 8 will also provide the Administration with a powerful tool to increase its adaptability by performing a smart "Before and After" study to fully understand the impact of HSR on increased HOV demand (induced demand), reduction of SOVs from the corridor and parallel facilities, and utilization of the existing HOV lane as well as HSR.

HSR command and control will be accomplished by developing a self-contained, standalone lane use control system using existing CHART ATMS software components, which are publicly available from SHA (upon request). HSR status will be communicated to the public via conventional general purpose Dynamic Message Signs (DMSs) and more specialized HSR DMSs. The vendor will incorporate and adapt CHART ATMS software components to control both types of new DMSs into a standalone Lane Control System (LCS). The HSR DMSs will either have the option to be "On" (Green Arrow), "Closing" (Angled Yellow Arrow) or "Off" (Red X), or will be capable of displaying the Diamond HOV symbol. The DB team will create a manual user interface to schedule and control all of the new signs within the LCS, as described. The scheduler will allow for scheduling based on day of week and time of day, and will allow for pre-scheduling of deviations to normal operations, such as for holidays or special events.

In addition to the dynamic lane use control signs, additional CCTV coverage and additional DMS will be installed within the limits of the proposed improvements, in order to verify the HSR lane is clear of disabled vehicles before opening and also to confirm incidents, at which time CHART will close the HSR for first responder access. All new CCTV and DMS devices will be similar to the devices currently being installed by CHART, in terms of manufacturer and model. The new devices will communicate with CHART in accordance with the current CHART architecture. That is, new CCTV will communicate with CHART via leased T-1 lines, and new DMS will communicate with CHART via cellular modems. The new lane control system will communicate with CHART using a similar cellular modem methodology. The system may be considered more of a critical system than standard DMS. As such, the rollout of the AT&T Dynamic Traffic Management solution may be optimal for this program. The DB team proposes interfacing the lane control system to CHART using this enhanced cellular modem technology. Using the fiber option would not be a cost-effective solution, and it would not be in line with the main project goal to improve mobility.

B. Location

The locations where, and an explanation of how, the PTC will be used on the Project.

Dynamic overhead lane control signs will be provided above the HSR and they will display symbols selected from a library to indicate whether the shoulder is available for use or closed (Figure 1). The signs will be spaced approximately 0.5 miles apart throughout the HSR limits. They will be mounted on a T-shaped structure supported at the median as shown in Appendix A.

Table 1 includes the limits and length of each section, and the design exceptions that will be required in order to successfully implement HSR in each section. Figures 3 through 5 include typical sections of NB IS-270 in the sections listed below. Figures 6 and 7 depict the typical section during snow events and when the HOV lanes are not operational.

Roadway	Shoulder Location	Limits	Figure	Design Exception Required
NB IS-270	Median/ Outside Shoulder	South of Montrose Rd	2	11' Lane Width and reduced shoulder width
	Median	Montrose Rd to MD 28	3	11' Lane Width and reduced shoulder width
	Median	MD 28 to Watkins Mill Rd	4	11' Lane Width and reduced shoulder width
	Median	Watkins Mill Rd to MD 121	5	11' Lane Width and reduced shoulder width

Table 1 – Proposed HSR locations

The sections represent the typical lane configuration through these three sections. There are also existing locations where the shoulder is reduced (pinch points) at bridges and sign structures, however along the majority of the roadway, the proposed shoulder will be wider than 3 feet and vary, due to variations in existing total northbound roadway width between the two concrete barriers.

IS-270 Northbound Managed Lane using Hard Shoulder Running Operating as HOV 2+

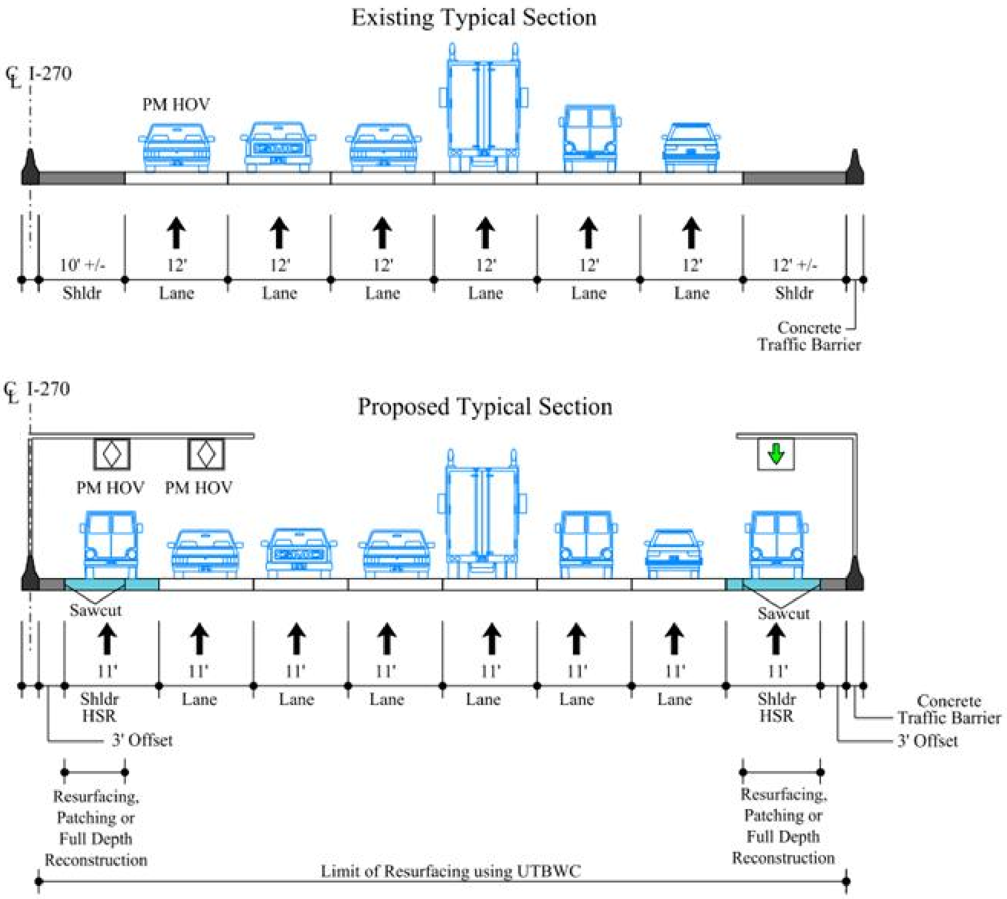


Figure 2 – Existing and Proposed Typical Sections
NB IS-270 South of Montrose Road

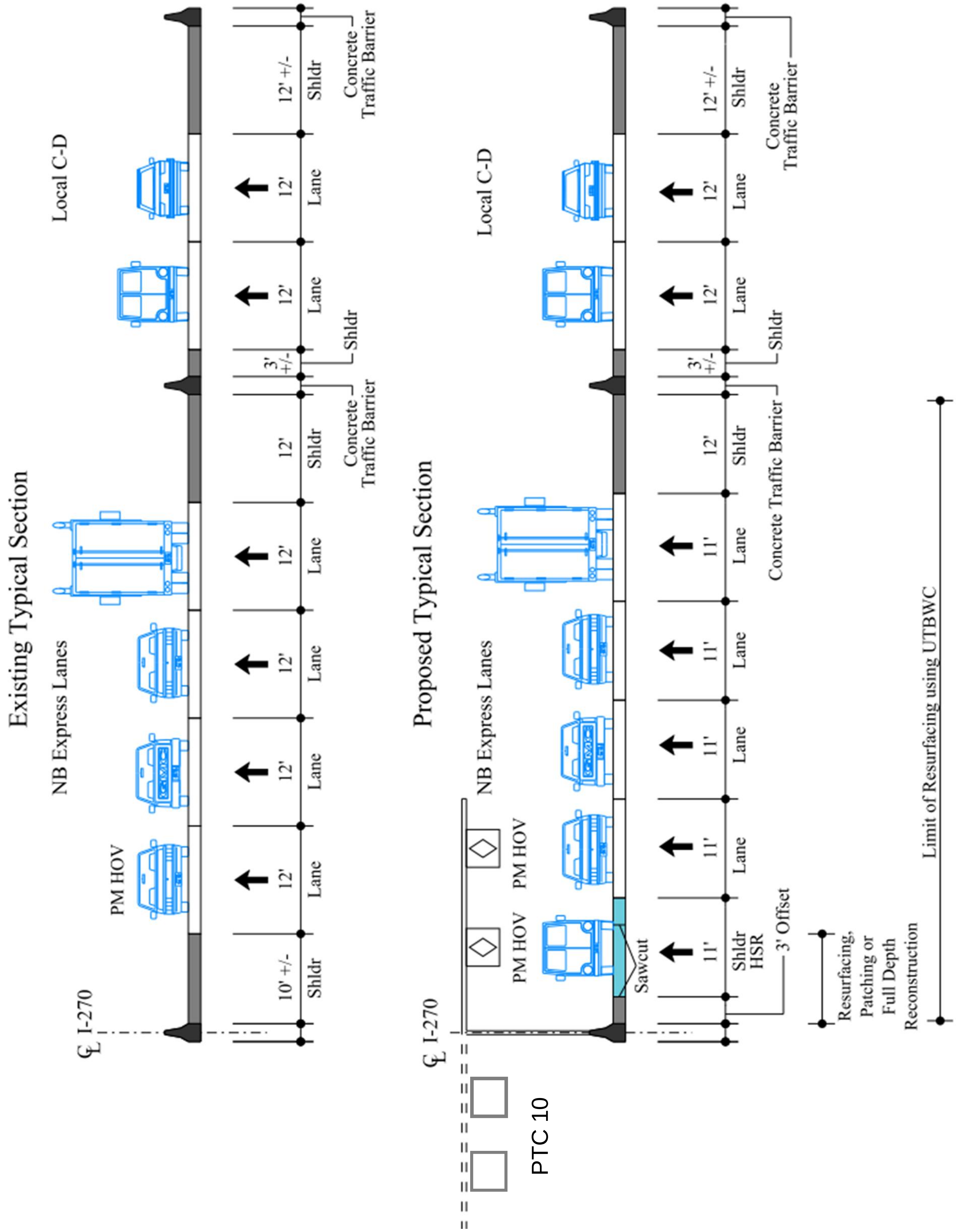


Figure 3 – Existing and Proposed Typical Sections
NB IS-270 between Montrose Road and MD 28 (W. Montgomery Ave)

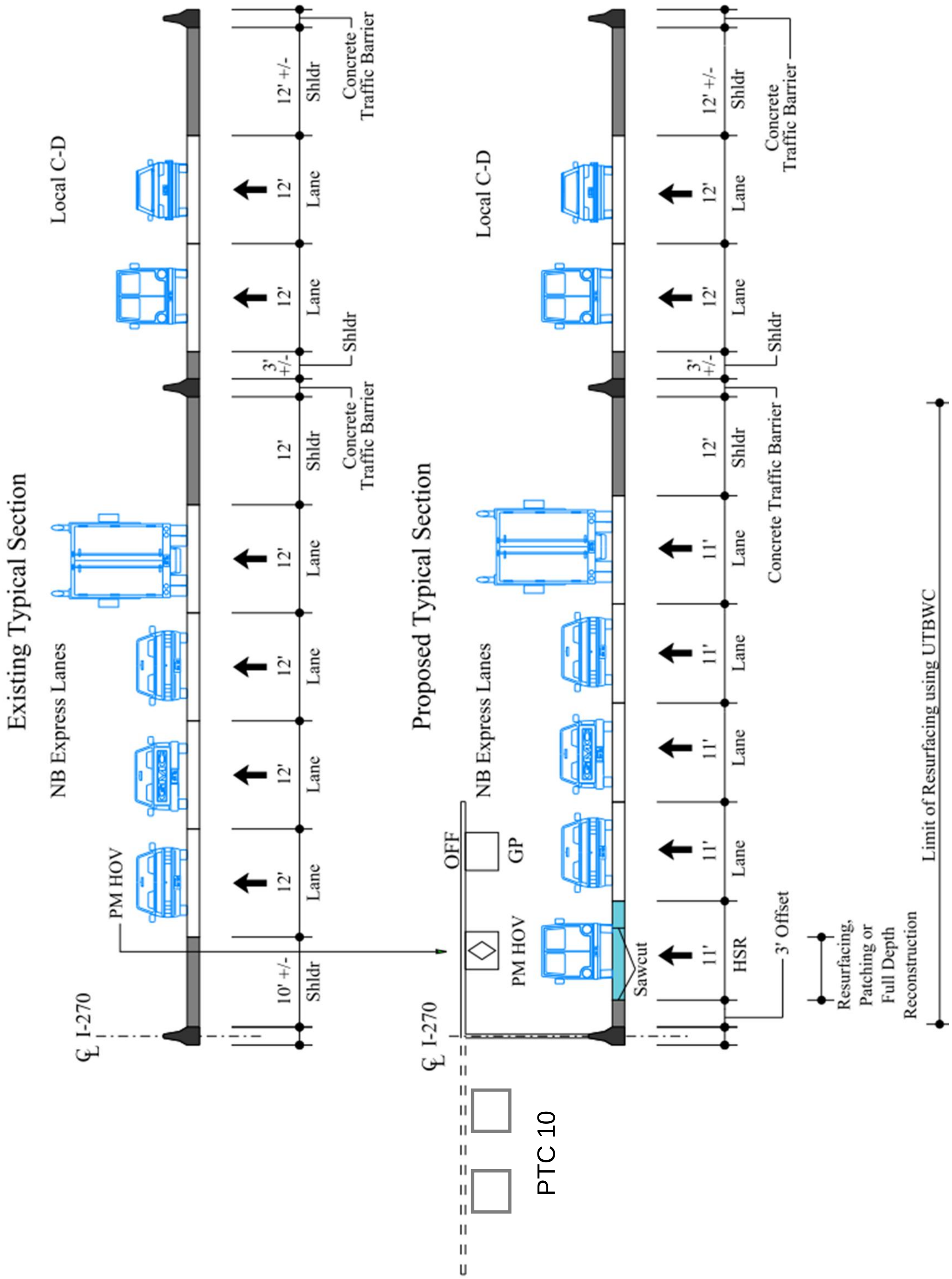


Figure 4 – Existing and Proposed Typical Sections
NB IS-270 between MD 28 (W. Montgomery Ave) and Watkins Mill Road

IS-270 Northbound Managed Lane using Hard Shoulder Running Operating as HOV 2+

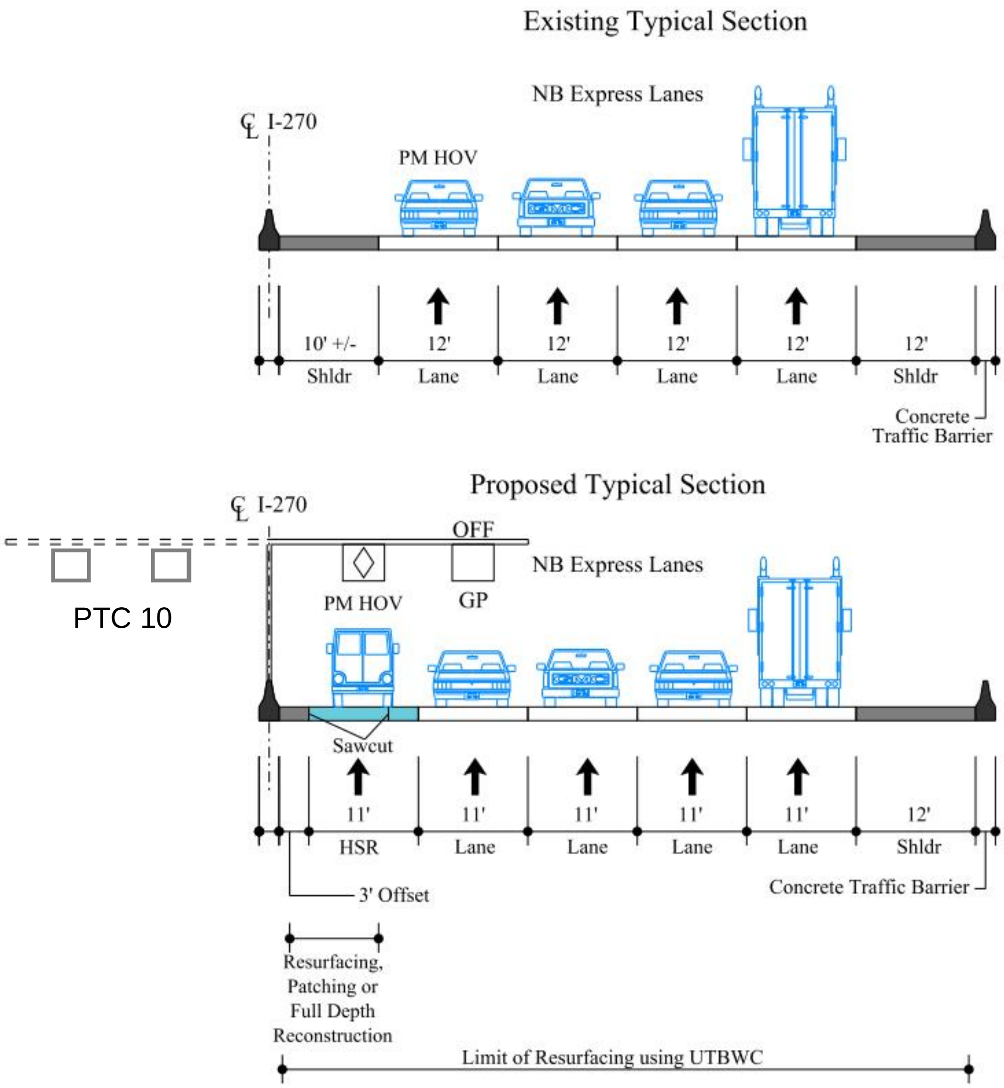


Figure 5 – Existing and Proposed Typical Sections
NB IS-270 between Watkins Mill Road and MD 121 (Clarksburg Road)

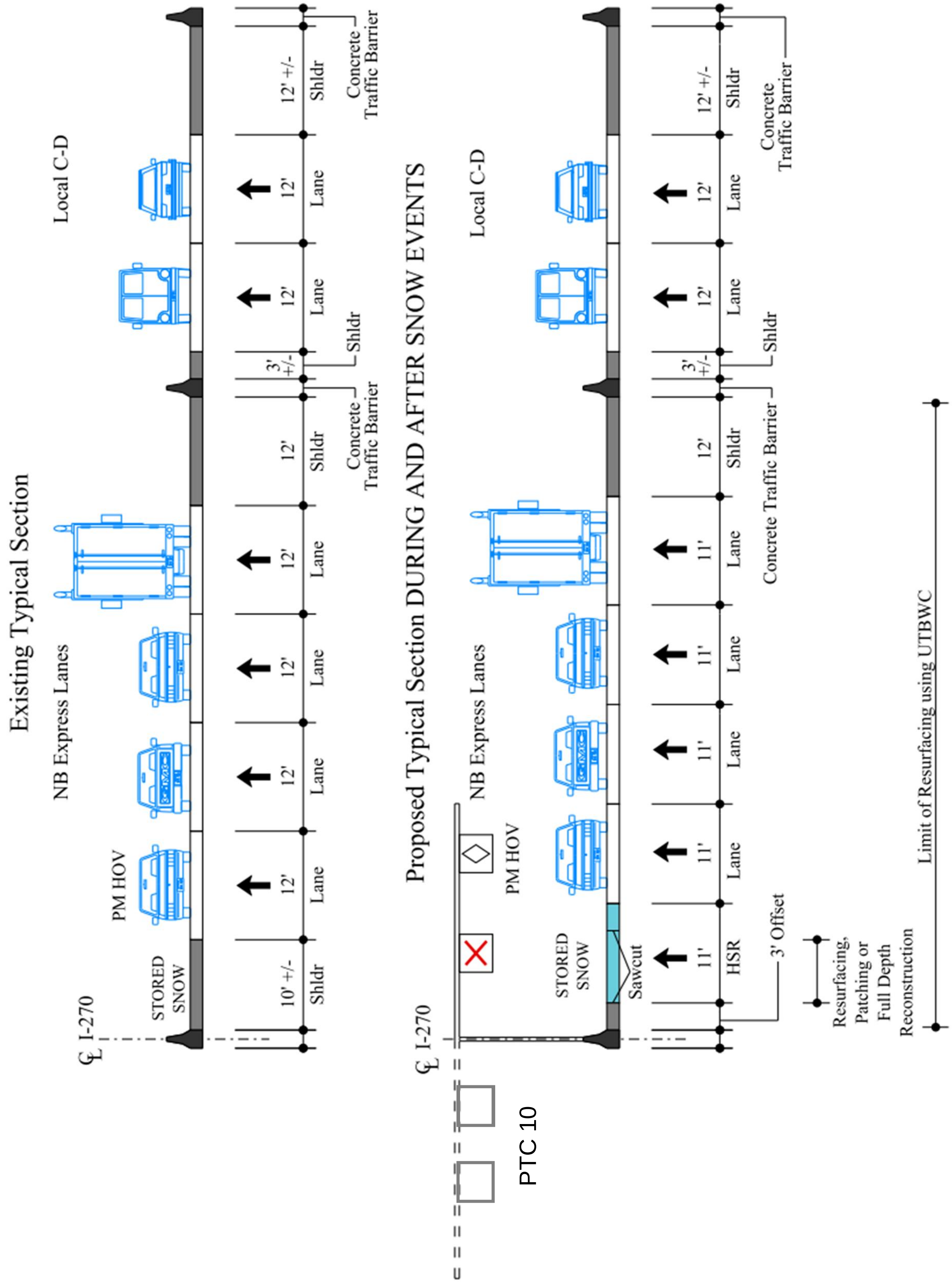


Figure 6 – Existing and Proposed Typical Sections
NB IS-270 During and After Snow Events

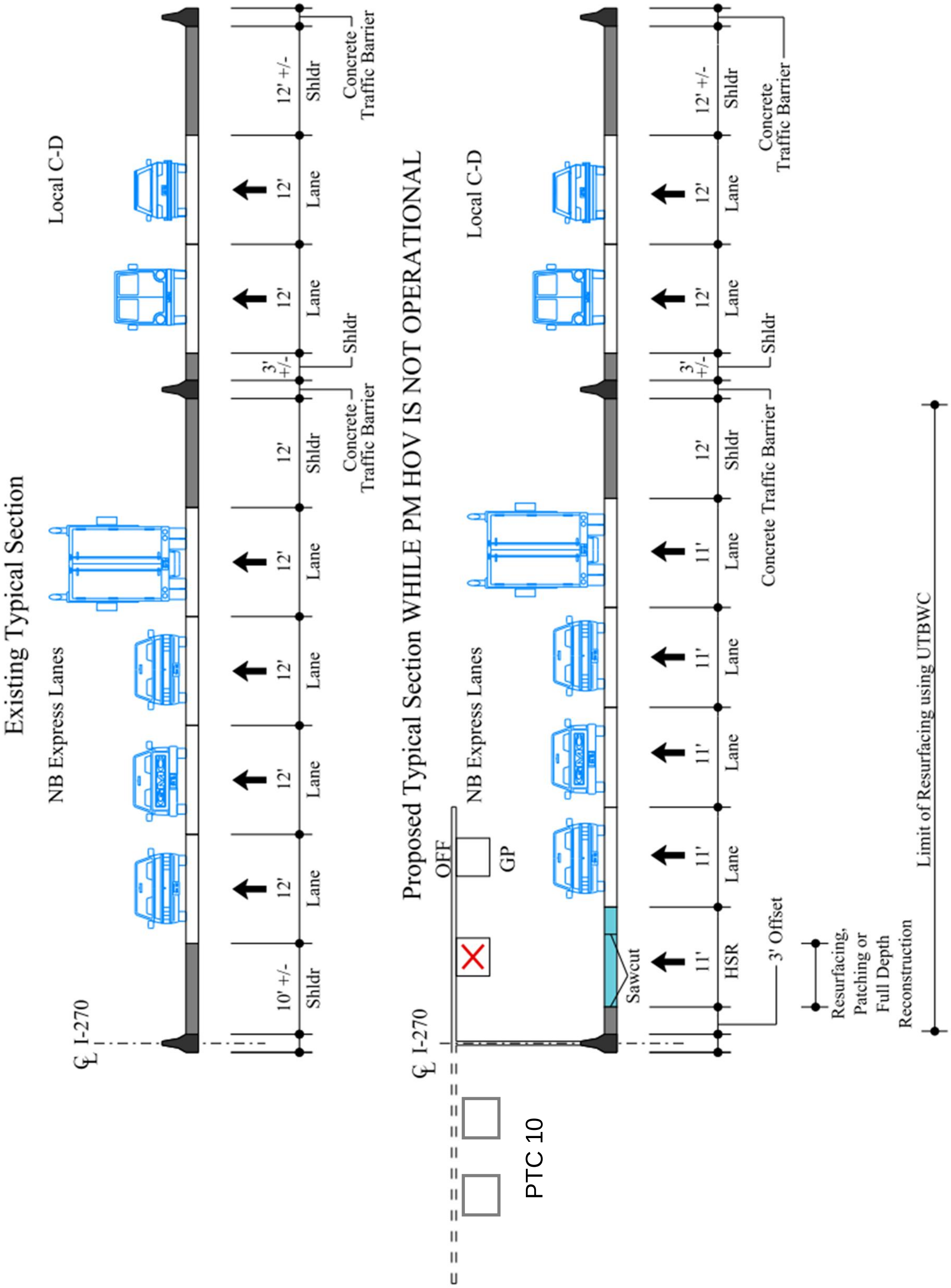


Figure 7 – Existing and Proposed Typical Sections
NB IS-270 While PM HOV Is Not Operational

C. Analysis

Analysis justifying the use of the PTC including how it advances the project goals.

Roadway Design

There are certain requirements that must be met prior to using shoulders as travel lanes to receive the benefits described in this PTC. The shoulder should have adequate width based on the roadway classification to act as a full travel lane, have no adverse superelevation, be continuous, and be able to withstand vehicle loading.

Appendix vii illustrates the locations of the proposed managed lane on HSR limits in blue. NB IS-270 will be restriped and existing travel lane widths will be reduced to 11'. An 11'-wide HSR lane with a 3' offset to concrete median barrier will be provided along NB IS-270.

Due to the reduction of the lane widths from 12' to 11', there is a shift of the theoretical existing crown into the proposed lane. However, the existing crown constantly transitions between existing lane markings along the tangents between each existing horizontal curve, placing it between two existing marking lines. The existing Digital Terrain Model (DTM) provided by the administration indicates that there are various sections along IS-270 that lack a clear break in cross slope, and existing breaklines (indicating a crown) are not always along existing marking lines. Therefore, since the existing roadway lacks a clear location of the existing crown along a lane marking, the DB team proposes to maintain the existing crown location by placing a uniform UTBWC surface layer (PTC 7).

The shoulder sections with cross slope steeper than 3% will be adjusted to 3%. The shoulder sections with adverse cross slope will be adjusted to meet the existing superelevation rate of the travel lanes. Shoulders will be adjusted to ensure adequate drainage.

In the areas where shoulder cross slope adjustment is necessary, the existing median barrier will be either rehabilitated to have the required reveal at gutter, modified to have a sloped face, demolished and reconstructed in part or replaced in its entirety. The existing concrete median barrier is less than 42" in height. The team is proposing 42" barrier in the sections where the median barrier needs to be replaced, but not replacing the existing median barrier that is not impacted by the change in the shoulder cross slope. Since the traffic will run closer to the barrier compared to the existing conditions, the approach angle is reduced, lowering the risk of cars rolling over upon impact. No existing sign foundations and light pole foundations will be reconstructed. The face of the concrete barrier will be retrofitted at pole structures. A detail for the modified median barrier is included in Appendix B.

Pavement Design

A structural analysis of the existing pavement structure was conducted to determine the existing structural capacity and means to improve structural capacity to accommodate the expected future design traffic on the HSR. The proposed capacity improvements include use of the existing right shoulder lane between Rockledge Drive and Montrose Road, and the median shoulder between Tuckerman Lane and MD 121 (Clarksburg Road).

The assumptions based on traffic analysis were as follows:

Median HSR / HOV lane

a. No General Purpose (GP) use outside of HOV hours
b. Vehicle classes - only 1 to 4; cars and busses; full truck exclusion
c. AADT = 2,000 vph @ 10 hr/day for 7 day use
d. 30 busses per hour @ 10 hr/day = 1.5%
e. Busses will be considered FULL Wt. 100% capacity
f. Growth in AADT = 1.0%.
g. ESAL factors will be based on SHA if available.
h. Design analysis period = 20 year design

Outside/Right HSR between Rockledge Drive and Montrose Road

i. No General Purpose (GP) use outside of HOV hours
j. All vehicles including trucks
k. MD SHA heavy traffic data percentages on IS 270 to be used in calculations. (average of 5.13% shown for single unit trucks and 2.23 for combination units)
l. AADT = 2000 vph/lane @ 10 hrs/day
m. Growth in AADT = 1%.
n. ESAL factors will be based on SHA if available.
o. Design analysis period = 20 year design

The Administration provided Ground Penetration Radar results that included information on the existing pavement composition of the shoulders just north of MD 124. The DB team is proposing pavement improvements to the existing HSR based on the existing GPR information. In summary, the sections that have a minimum of 8” of AC thickness are structurally adequate and do not require additional structural strengthening. The sections that have an AC thickness below 8” are subject to overlay, full depth patching or full depth reconstruction to achieve the required pavement structural strength. Additional information is included in Appendix v.

Pavement Summary Table - Median HSR / HOV lane

	Design Option	Calculated design traffic	DARWin calculated required SN	DARWin calculated existing SN	Additional structural improvement required (SN)	Effective overlay thickness required (inches)
1	**Base design** : use of typical / recommended material design inputs; use assumed traffic & assumptions	1.158E+06	4.92	5.09	***none***	***none***
3	Use **adjusted subgrade strength** properties (MR = 4500 psi); use base design traffic volumes	1.158E+06	4.28	5.09	***none***	***none***

Pavement Summary Table - Outside/Right HSR between Rockledge Dr and Montrose Rd

	Design Option	Calculated design traffic	DARWin calculated required SN	DARWin calculated existing SN	Additional structural improvement required (increase in existing SN)	Effective overlay thickness required (inches)
1	**Base design** : use of typical / recommended material design inputs; use assumed traffic & assumptions	9.557E+06	6.54	6.39	0.15	⅜
2	Use typical / recommended material design inputs; assume **restriction on use by Combination Units**	5.611E+06	6.11	6.39	***none***	***none***
3	Use **adjusted subgrade strength** properties (MR = 4500 psi); use base design traffic volumes	9.557E+06	5.78	6.39	***none***	***none***

Drainage Design

Spread computations were completed based on the proposed typical section. The team will prepare a detailed hydraulic analysis during the post award phase to ensure that the spread during rain events will not cause any safety concerns for vehicles traveling in the HSR lane.

For preliminary computations, the maximum allowable spread identified for the northbound lanes was 7' (the sum of the width of the proposed 3' shoulder and 4' of the proposed 11' travel lane). Approximate drainage areas to existing inlets were computed based on average road width and measured distance between inlets. The rational method and subsequently the spread calculation included in the Maryland State Highway Administration Guidelines for Development Adjacent to State Highways were used to determine the managed lane on HSR areas impacted by insufficient drainage. Analyses accounting for the proposed 3% cross slopes were completed. Approximately 50 sections between existing inlets will require additional drainage infrastructure. The standard for a Type S inlet is included in Appendix C.

Computations completed with the aforementioned equation were verified using Flowmaster. For the Flowmaster analysis, conservative input data was used where possible. Specifically, 50% clogging and 85% efficiency were assumed. The analysis utilized 2-year storm data from the Highway Drainage Manual. A rainfall intensity of 5.4 in/hr was used for computation purposes. In general, variation between the Flowmaster findings and the equation was ±5%. Therefore, a reasonable inference was made that the computations completed for this analysis were appropriately cautious.

Additionally, during this assessment, the proposed drainage scenario was compared to the existing drainage scenario. The decrease in cross slope (from 6% to 3%) greatly increases the risk of ponding during large storm events. This safety concern will be mitigated with the installation of more inlets. Because no additional impervious is proposed for this project, it is assumed that the hydraulic capacity of pipes and the storage provided at outfalls is sufficient.

Drainage infrastructure alternatives such as trench drains were investigated and may be a viable option for reducing construction costs while managing ponding and spread. With the additional drainage infrastructure provided, the managed lane on HSR may only need to be closed during extremely large storm events such as the 50 and 100 year storms.

Pavement Markings

The DB team is proposing to use Thermoplastic Pavement Markings in the permanent condition and Pavement Marking Paint for Maintenance of Traffic. Permanent RPM's will be installed where necessary. These materials are compatible with the Ultra-Thin Bonded Wearing Course overlay and are being used in the areawide contracts advertised by SHA – District 1, 2, 4 and 5.

D. Potential Impacts

A preliminary analysis of potential impacts (both during and after construction) including but not limited to use impacts, Right-of-Way, geotechnical, utilities, environmental permitting, local community, safety, and life-cycle project and infrastructure costs, including impacts on the cost of repair, maintenance, and operation.

User Impacts - There will be positive impacts on traffic operations along NB IS-270, due to the increased capacity. Reduced lane widths may have an impact on driver speeds. An equivalency study will be completed and submitted to FHWA post award for any narrowing or shifting of lanes.

During construction, the existing NB IS-270 express lanes will be restriped to 11' wide, to make room for the temporary concrete traffic barrier. The existing outside shoulder will remain as-is, to avoid reconstruction to make the pavement traffic-bearing. The existing median shoulder will be sawcut before the shoulder pavement is patched or reconstructed. All express lanes will be maintained throughout construction. Lighting will not be maintained during construction. Due to the majority of the work being contained within the existing shoulder, minimal adverse impacts are anticipated during construction.

Right of way (ROW) – One of the advantages of using HSR is the ability to provide added capacity during the peak period while remaining within the existing pavement footprint. However, if a full depth patch of the HSR is not possible, there may be a need for full depth reconstruction requiring additional SWM facilities which may result in additional ROW. Additional ROW will be required to accommodate the required noise barrier systems (by others), signage, stormwater and erosion and sediment control facilities.

Geotechnical – The shoulder pavement composition will be strengthened using resurfacing, a full depth patch or full depth reconstruction where necessary. Shoulder sections that only require an overlay or full depth patch will not result in any disturbance of the existing soil, and therefore will not require stormwater management. The 3' offset between the edge of the HSR and the existing concrete barrier will not be reconstructed, since it will not need to be traffic bearing. Therefore the limits of full depth patching and full depth reconstruction will be sawcut prior to pavement removal, to avoid impact to the adjacent pavement composition. The DB team will use construction methods that will preserve the integrity of the adjacent existing pavement composition.

The Administration provided Ground Penetration Radar results that included information on the existing pavement composition of the shoulders. In locations where a full depth patch will not yield sufficient pavement strength, full depth reconstruction will be required. The remainder of the HSR will be overlaid. In addition, the through lanes along NB IS-270 will be resurfaced to allow for restriping of the existing lanes. The detailed pavement design has been outlined in Appendix v. The DB team will only resurface roadway sections where restriping is necessary.

Utilities – No significant impacts are expected since the majority of the proposed improvements stay within the existing roadway footprint. Coordination with utility companies will be required in order to provide electricity and fiber optic feed to the lane control system.

Environmental Permitting – Appropriate mitigation strategies will be implemented to comply with all third party regulations and to meet the National Environmental Policy Act (NEPA) requirements. Due to the potential full depth reconstruction of the existing shoulder in certain areas, SWM facilities may be required.

An Interstate Access Point Approval (IAPA) will be required by FHWA for this project. The DB team will meet all criteria set forth by the FHWA Interstate System Access Informational Guide, and will coordinate with the appropriate SHA and FHWA representatives to obtain the approval.

The addition of the HSR increases capacity along NB IS-270 and therefore meets the FHWA Type I Highway Traffic Noise project criteria. As a result, FHWA requires that a noise analysis be conducted in a manner similar to a conventional widening project. If the design year build condition noise levels approach or exceed the 23 CFR Part 772 Noise Abatement Criteria for the future build conditions, there will be traffic noise impacts and investigation of noise mitigation will be warranted.

A qualitative noise analysis was conducted in the section where the managed lane on HSR is proposed, between Rockledge Drive and MD 121 (Clarksburg Road). Barrier systems were evaluated between these two limits based on FHWA and SHA policy and guidelines. Based on the preliminary analysis, 14 of those systems were deemed reasonable and feasible. The DB team will prepare a comprehensive noise analysis post-award, to assist the Administration in determining which noise barriers are reasonable and feasiblePer Addendum 3 of the RFP, the design and construction of noise barriers will not be included as part of the Project.

Local Community – There will be minimal impact to residential and commercial communities during construction due to the majority of the work taking place closer to the median along IS-270.

Safety – A traffic safety impact analysis will be completed for this PTC. The Highway Safety Manual (HSM) methodologies will be applied to the analysis.

Incident management is a concern with HSR due to the lack of median shoulders during peak hours, which otherwise can be used as access lanes for emergency vehicles. First responders will use the right shoulder until the HSR lane is closed. The right side shoulder will remain available at all times. In addition, the Administration can assign dedicated Safety Service Patrol units to patrol the HOV Lanes during peak periods when the HSR is activated. Another option includes staging a flatbed truck at a potential high incident location to rapidly tow away a disabled vehicle. Lastly, lane control signals can be applied to overhead gantries to close blocked lanes and merge traffic into open lanes.

Infrastructure costs – Infrastructure costs for the implementation of HSR will be developed based on SWM, shoulder full depth patch and full depth reconstruction, resurfacing, restriping, lane control system, utility coordination and ROW acquisitions.

Maintenance – In the existing conditions, the shoulder is used by maintenance crews to store the snow after inclement weather events. HSR could not be implemented after a winter storm event until the shoulder was completely cleared of snowpack. Normal maintenance operations that typically use the existing shoulders for work zones would need to schedule the work during off peak hours when HSR is not in use. In addition, the Administration will have the flexibility to keep the shoulders closed to through traffic when deemed necessary, such as during inclement weather and major incidents.

CHART - Current CHART software can continue to be utilized for operations during construction and development of the LCS. The DB team will develop a standalone LCS on a separate server that allows for “open” (green arrow), “closing” (angled yellow merge arrow) “closed” (red X) or HOV Diamond and includes a scheduler for automatic operations based on time and day. Once tested, this will be integrated into the current CHART operations environment, where operators will utilize the standalone LCS alongside the CHART ATMS. Because the LCS will incorporate a scheduler, the new DMSs will operate autonomously, and the role of CHART operators will be to monitor operations and override or adapt the scheduled usage as traffic conditions dictate. Additional cameras will facilitate monitoring. Where possible, cameras will be positioned such that the new DMSs are in view of the new cameras.

E. Other projects

A description of other projects on which the PTC has been used, the degree of success or failure of such usage, and the names and contact information (including telephone numbers and e-mail addresses) of project owner representative who can confirm such statements.

MD 42 – West Midlands - United Kingdom – Junction 3a to Junction 7

AECOM has been working with Managed Motorways in the United Kingdom for over ten years. The company’s involvement in Managed Motorways concepts started with research on narrow lanes, hard shoulder running, the use of emergency refuge areas and travel demand. Subsequently, AECOM was involved in the M42 Active Traffic Management (ATM) pilot, supporting the Highways Agency and lead consultant for key aspects of the ATM scheme and design. In 2006, the Highways Agency piloted Dynamic Hard Shoulder running via a pilot scheme on a 10.5 mile stretch of the M42 motorway near Birmingham. The following were the results (Kamnitzer, 2012):

- a reduction in personal injury accidents from 5.08 to 2.25 per month and reduction in the “accident severity index from 0.16 to 0.072
- a reduction in journey times during peak periods of 9% in the northbound direction and 24% in the southbound direction
- a reduction of 22% in journey time variability
- compliance with speed limits of 94% or better for speed limits between 50 and 70 mph
- reductions of approximately 4% in CO, HC, CO2 and NOX and of 10% in particulate matter and a marked improvement in the perception of long distance users of the level of service of the highway

I-66 – Virginia – US 50 to I-495

Due to congestion during peak periods along I-66 between US 50 and I-495, the Virginia Department of Transportation implemented an active traffic management system with dynamic hard shoulder running. A 2007 investigation into system performance showed that the V/C ratios were 0.90-1.0 for the eastbound movement and 0.83-1.0 for the westbound movement, resulting in an overall improved highway capacity during peak hours when the shoulder is open to through traffic. A similar investigation was completed with regards to the safety effects of the hard shoulder running, which resulted in no significant effects on crash frequency. (FHWA, 2016)

F. Administration Risk

A description of risk to the Administration or third parties associated with implementing the PTC.

The managed lane will result in capacity enhancement and therefore will require noise mitigation. The size, location, feasibility and reasonableness of the proposed barrier systems may change during the post-award phase. Based on Addendum 3 of the RFP, the design and construction cost of noise barrier systems and associated improvements are not included in the $100M CAP.

The HSR method will result in reduced width for the existing travel lanes, to offset the narrow width of the existing NB median shoulder in certain locations. A design exception will be submitted for lanes less than 12’ wide and for reduced shoulder widths. The FHWA Safety program mentions that there is a potential adverse impact to safety and operations of freeways when the travel lane width is reduced to less than 12’. However, to date, there are no studies showing that this is the case for freeways. Therefore this is an unknown, but potential risk to the Administration.

During peak traffic flow time periods when HSR is in operation, there will be no inside shoulder along the majority of the NB IS-270 sections listed in Table 1. This presents a risk to the owner, since they will not be able to rely on the benefits that a shoulder provides, such as emergency responses and providing a pull-off area for broken down vehicles. The Administration can use the lane control system to close shoulders to through traffic during inclement weather and major incidents. CCTV cameras will be installed to monitor this particular location for incidents.

Due to the nature of the contract, all proposed improvements are subject to third party approvals such as FHWA (including IAPA), DNR, MDE and other associated environmental agencies. Once design is finalized, the administration will seek approval from the aforementioned agencies, or vary the scope to address their comments. In addition, community involvement and input may affect the NEPA permitting process and final configuration of the proposed solutions.

G. Design-Builder Risk

A description of risk to the Design-Builder associated with implementing the PTC.

The existing conditions of the pavement and drainage conveyance system are a risk. The shoulder pavement structure is not consistent. The condition of the existing drainage systems is not known. In locations where shoulder full depth reconstruction is required, SWM facilities will be proposed. There is limited existing right-of-way to locate these new facilities.

Risks during construction include contractor access, ability to close lanes, lack of staging areas and heavy traffic adjacent to work zones.

H. Cost/Schedule Benefits

Discussion of any cost or schedule benefits to this contract from usage of this PTC

The implementation of HSR is a practical design solution that adds highway capacity without increasing the existing pavement footprint of the roadway. The following are the cost and schedule benefits of the HSR method when compared to a conventional widening project.

- HSR provides a temporary increase in highway capacity without the need to widen the existing roadway. This method results in construction cost savings due to the reduced cost in ROW, structures, excavation and ramp modifications.
- This method does not require major infrastructure widening, resulting in shorter construction periods and reduced maintenance of traffic and erosion and sediment control costs.
- Compared to other conventional reconstruction methods, there are minimal additional ROW needs/costs.
- Compared to other conventional reconstruction methods, the DB team is anticipating minimal utility impacts. Therefore, the HSR method results in cost and schedule benefits due to minimal coordination time with utility companies, and minimal utility relocation timeframes that would need to occur prior to the start of any construction activity.
- Due to the lack of roadway widening required, this method results in no impacts to existing overpasses and underpasses, hence significantly reducing the cost and the timeframes required for widening or replacement of existing structures.

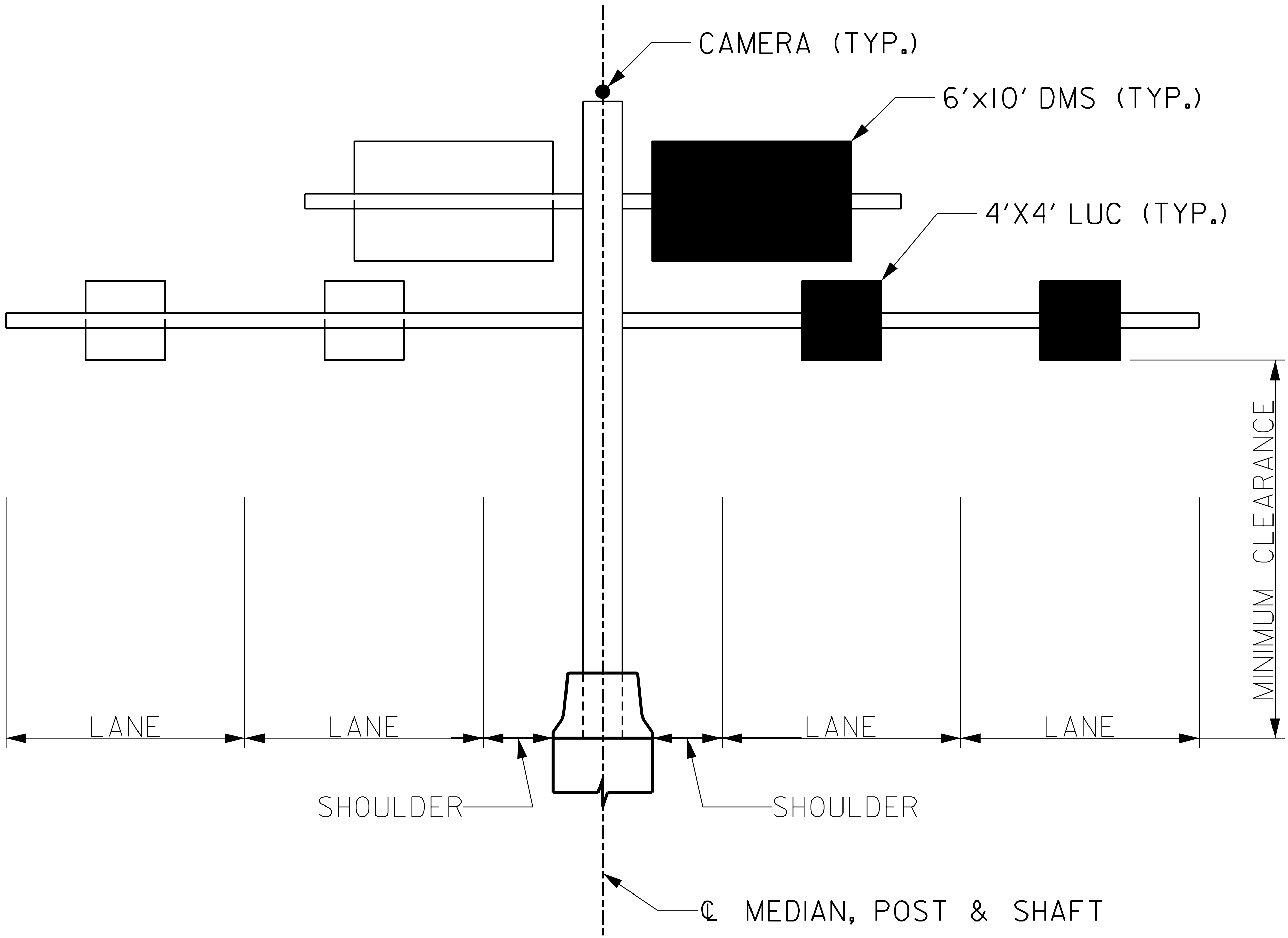
I. Miscellaneous

Any additional information that would assist the Administration in the review of this PTC.

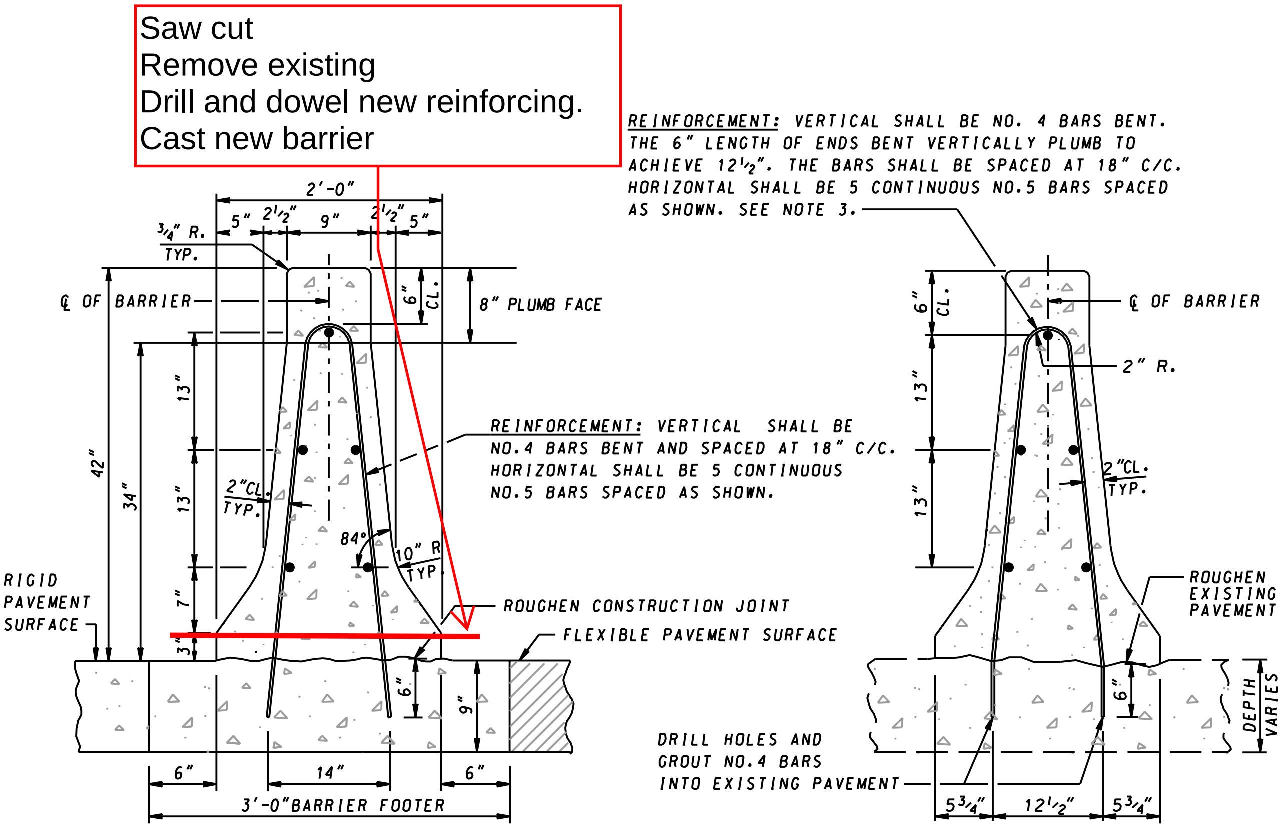
The Administration can adapt the role of the managed lane to future needs and therefore the HSR can be used to accommodate electric vehicles exclusively. Recent legislation was passed announcing federal and private sector action to accelerate electric vehicle adoption in the country. IS-270 can be used a pilot highway to dedicate the managed lane to electric vehicles, and set a precedence for other highways in the state of Maryland.

The proposed advanced data collection in PTC8 provides the Administration with best opportunity to monitor drivers' behavior, change in travel patterns, and path selection due to added HOV capacity in the corridor. PTC 10 in combination with PTC8 will increase the Administration adaptability to make informed policy decisions to increase corridor throughput.

Appendix A
Sign Structure Typical Detail


CAMERA (TYP.)
6'x10' DMS (TYP.)
4'X4' LUC (TYP.)
MINIMUM CLEARANCE
LANE
LANE
LANE
LANE
SHOULDER
SHOULDER
℄ MEDIAN, POST & SHAFT

Appendix B
Modified Median Barrier Detail



RIGID PAVING
(HALF SECTION)

FLEXIBLE PAVING
(HALF SECTION, SEE NOTE 9)

NEW CONSTRUCTION
(OR CONSTRUCTION ON EXISTING FLEXIBLE PAVEMENT)

CONSTRUCTION ON EXISTING RIGID PAVEMENT
(BARRIER FOOTER IS REQUIRED FOR EXISTING FLEXIBLE PAVEMENT)

NOTES

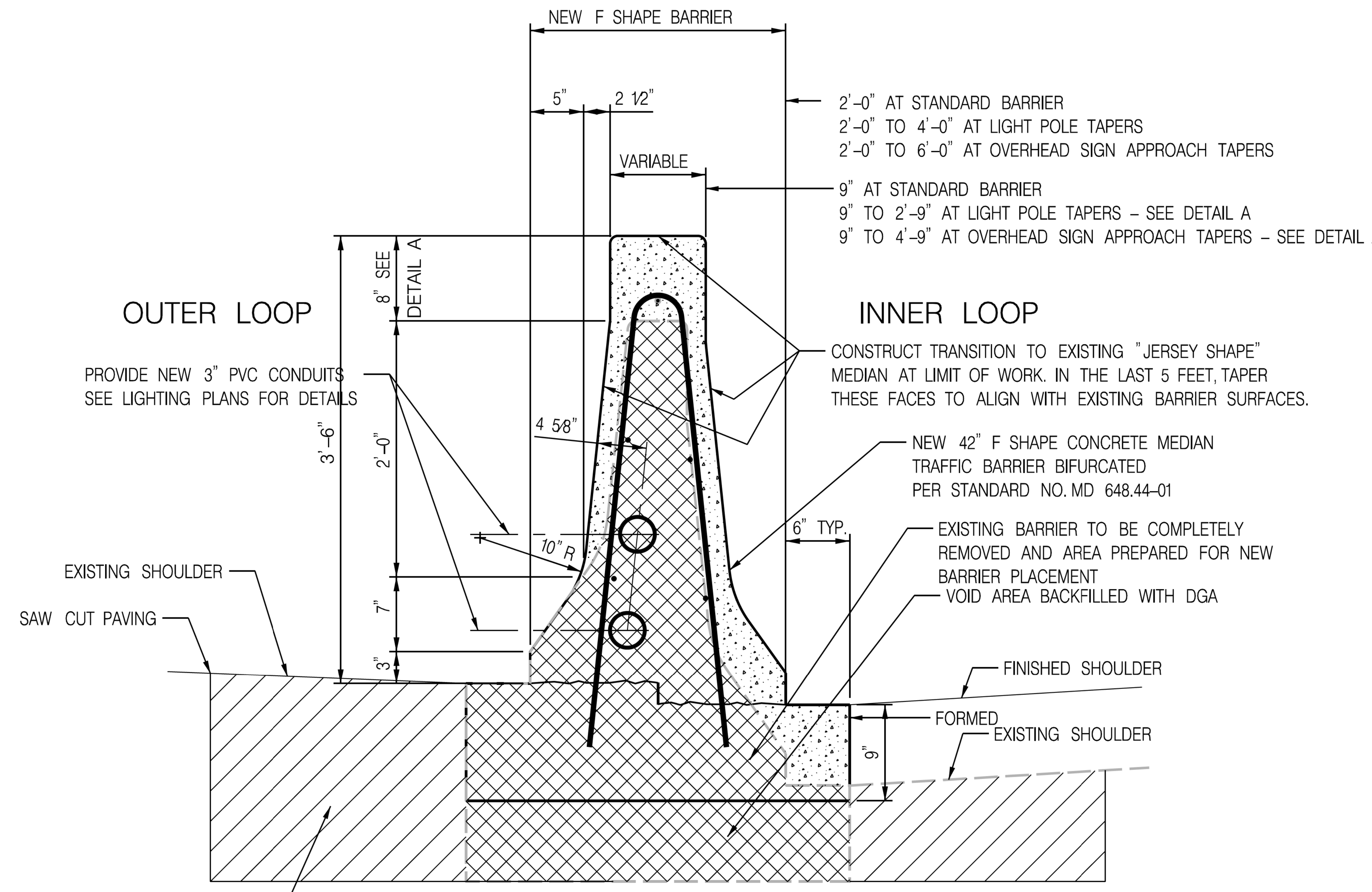
1. THE BARRIER AND FOOTER SHALL BE CAST SEPARATELY USING THE FIXED FORM OR THE SLIP FORM CONSTRUCTION METHOD USING CONCRETE MIX NO.6 (4500 PSI).
2. THE CONTRACTOR HAS THE OPTION TO CONSTRUCT THE BARRIER FOOTER AND BARRIER AFTER CONSTRUCTION OF THE PAVEMENT. THE FOOTER FORMS, IF USED, SHALL BE REMOVED IF THE BARRIER AND FOOTER ARE CONSTRUCTED BEFORE THE PAVEMENT.
3. WHEN THE BARRIER IS CONSTRUCTED USING THE SLIP FORM METHOD DIAGONAL NO. 4 REINFORCEMENT BARS ARE REQUIRED. SEE STD. NO. 648.44-04.
4. ALL REINFORCEMENT BARS, INCLUDING ENDS, SHALL BE EPOXY COATED. ALL BAR LAPS TO BE 30 BAR DIAMETERS. TIE BARS TOGETHER. ALL REINFORCEMENT BARS SHALL BE ASTM A 615, GRADE 60.
5. SPACING OF CONTRACTION JOINTS SHALL BE 20 FEET REGARDLESS OF CONSTRUCTION METHOD.
6. COST OF THE CONCRETE FOOTER, ALL REINFORCEMENT, AND EXCAVATION SHALL BE INCIDENTAL TO THE CONTRACT UNIT PRICE PER LINEAR FOOT FOR 42 INCH F SHAPE CONCRETE MEDIAN TRAFFIC BARRIER.
7. WHEN THE BARRIER IS CONSTRUCTED ON EXISTING RIGID PAVEMENT THE COST OF ALL REINFORCEMENT, DRILLED HOLES, GROUT, LABOR, TOOLS, EQUIPMENT, ETC., SHALL BE INCIDENTAL TO THE PRICE PER LINEAR FOOT FOR THE ITEM SPECIFIED IN NOTE 6.
8. TOLERANCES IN DIMENSIONS SHOWN SHALL BE WITHIN ¼"
9. WHEN THE BARRIER IS TO BE CONSTRUCTED ON EXISTING FLEXIBLE PAVEMENT THE PAVEMENT SHALL BE SAW CUT FULL DEPTH. THE WIDTH FOR THE CONCRETE FOOTER SHALL BE AS INDICATED. THE COST FOR ALL SAW CUTS, PAVEMENT REMOVAL, AND ALL INCIDENTALS AND LABOR SHALL BE INCIDENTAL TO THE PRICE PER LINEAR FOOT FOR THE ITEM SPECIFIED IN NOTE 6.

SPECIFICATION	CATEGORY CODE ITEMS	
604		
APPROVED	Kirk G. McClelland (signature) DIRECTOR – OFFICE OF HIGHWAY DEVELOPMENT	
SHA State Highway Administration — Driven to Excel	APPROVAL • SHA REVISIONS	APPROVAL • FEDERAL HIGHWAY ADMINISTRATION
	APPROVAL 3-1-01	APPROVAL 3-28-01
	REVISED 2-10-04	REVISED 3-31-04
	REVISED	REVISED
	REVISED	REVISED

Maryland Department of Transportation
STATE HIGHWAY ADMINISTRATION
STANDARDS FOR HIGHWAYS AND INCIDENTAL STRUCTURES

42 INCH F SHAPE CONCRETE MEDIAN TRAFFIC BARRIER

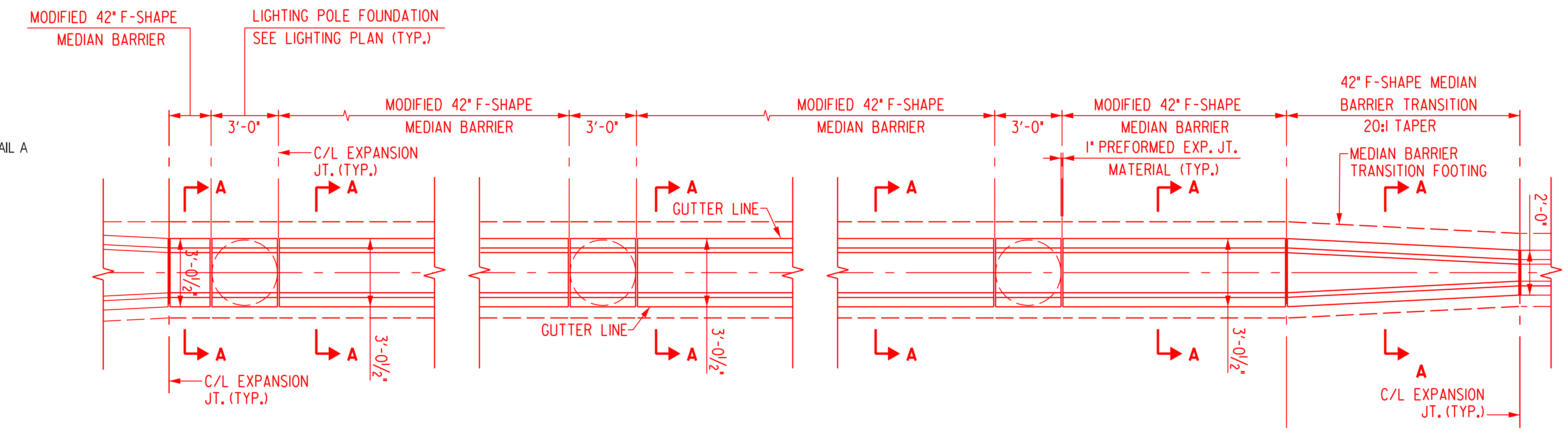
STANDARD NO. MD 648.44



I-695 MEDIAN BARRIER REPLACEMENT

TYPICAL SECTION - A

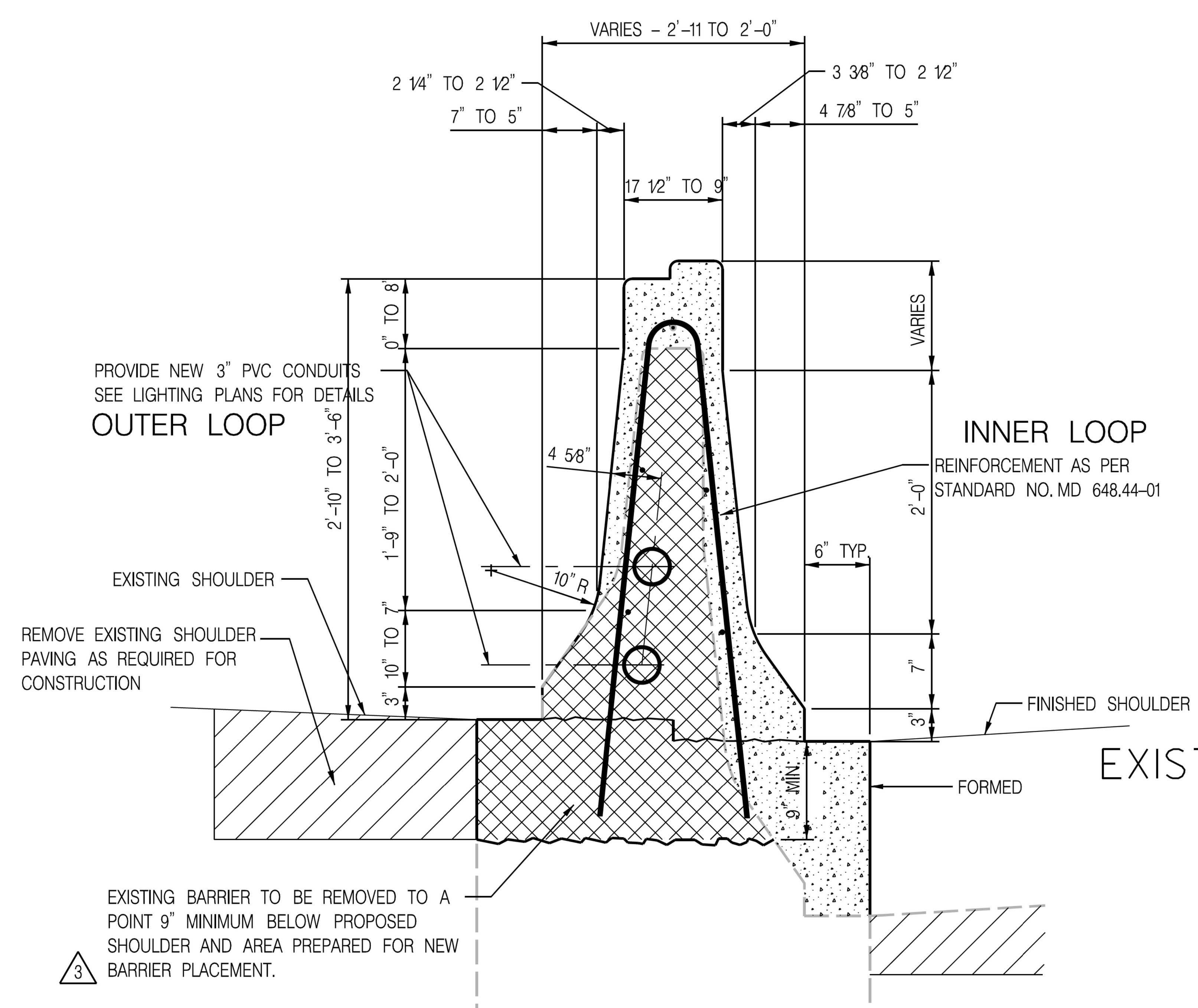
STA. 244+07 TO STA. 244+17
STA. 244+23 TO STA. 248+90
STA. 248+97 TO STA. 250+59
STA. 250+69 TO STA. 258+62
STA. 260+11 TO STA. 263+95
STA. 264+05 TO STA. 265+67
STA. 272+30 TO STA. 272+68
STA. 272+72 TO STA. 273+50



4 PLAN - MODIFIED MEDIAN BARRIER AND MEDIAN BARRIER TRANSITION

SCALE: 1/4" = 1'-0"

STA. 251+21 TO STA. 256+14

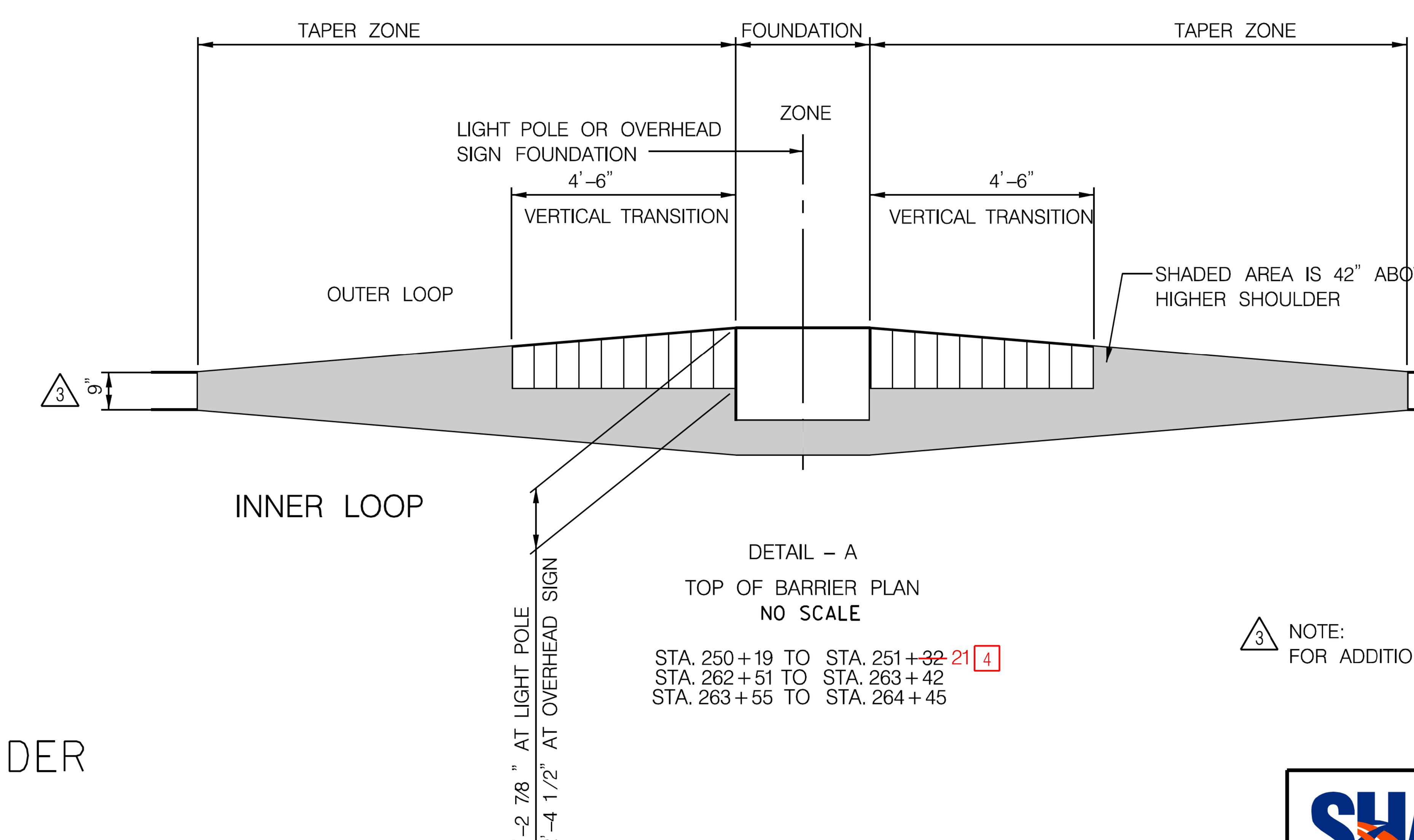


EXISTING SHOULDER

I-695 MEDIAN BARRIER REPLACEMENT (TRANSITION TO BRIDGE WING WALL)

TYPICAL SECTION - B

STA. 258+62 TO STA. 258+71
STA. 260+02 TO STA. 260+11
STA. 265+67 TO STA. 265+76
STA. 272+21 TO STA. 272+30



DETAIL - A

TOP OF BARRIER PLAN

NO SCALE

STA. 250+19 TO STA. 251+~~32~~ 21 4
STA. 262+51 TO STA. 263+42
STA. 263+55 TO STA. 264+45

3 NOTE:
FOR ADDITIONAL INFORMATION, REFER TO NOTES ON DRAWING NO. RD-04

CONSTRUCTION NOTE

THE TOP OF BARRIER ELEVATION IS CONTROLLED FROM THE HIGHER OF THE FINISHED GRADES OF THE INNER OR OUTER LOOP SHOULDER. SET 42" ABOVE THAT PROFILE.

PREPARED BY
URS
HUNT VALLEY, MARYLAND

BY: cheri_wyckoff -

SHA
STATE OF MARYLAND
DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION
HIGHWAY DESIGN DIVISION

REPLACEMENT OF I-695 INNER LOOP BRIDGES OVER BENSON AVENUE, AMTRAK, US 1, AND LEEDS AVENUE, AND REALIGNMENT OF I-695 INNER LOOP RAMP 8 FROM US 1 OVER LEEDS AVENUE

REVISIONS
3 ADDENDUM NO. 3 AUG. 13, 2014
4 REDLINE NO.4 04-29-2016

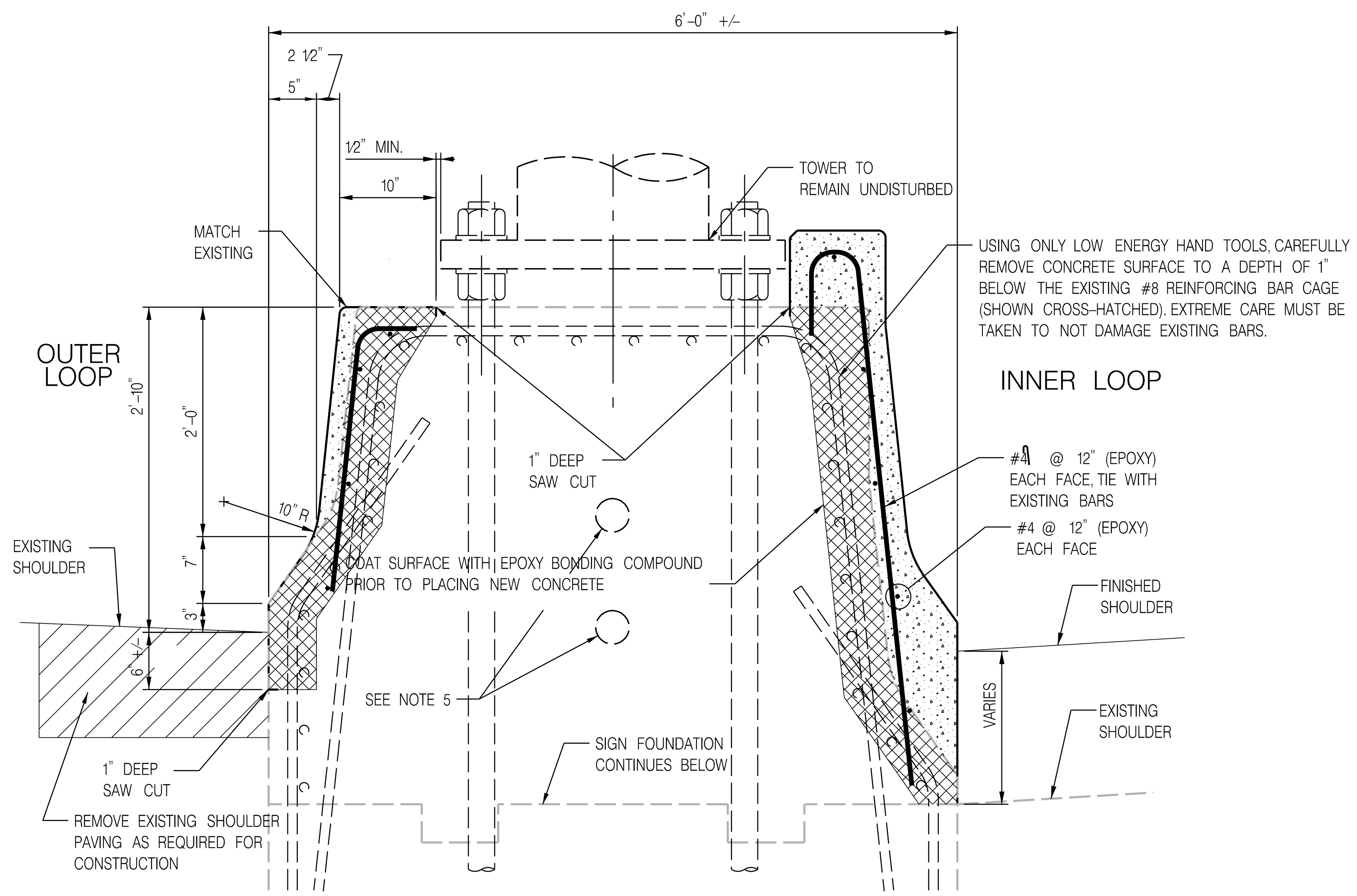
MEDIAN BARRIER DETAILS

SCALE 1" = 5' ADVERTISED DATE JULY 2014 CONTRACT NO. BA3665170

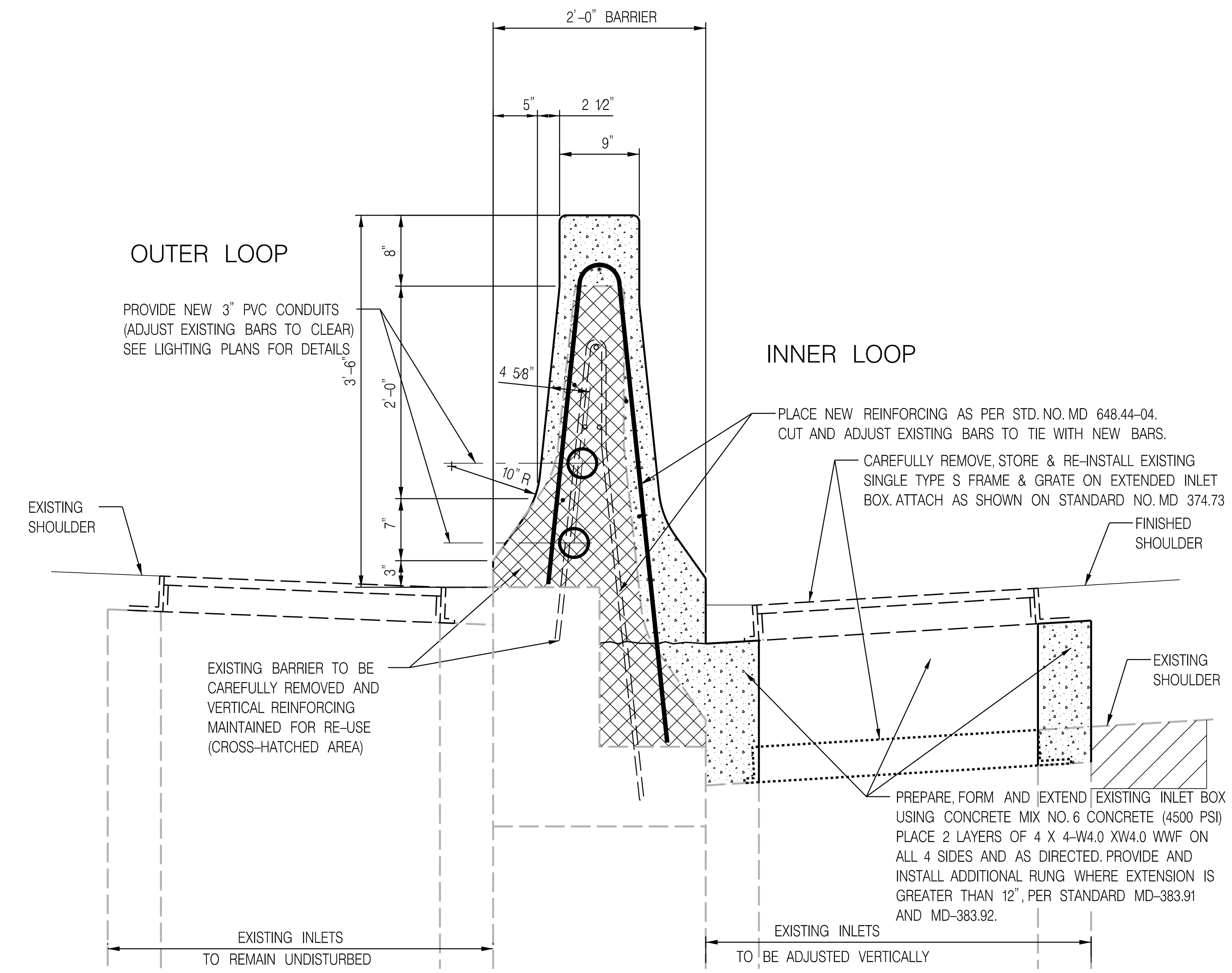
DESIGNED BY	DJS	COUNTY	BALTIMORE
DRAWN BY	CDF	LOGMILE	
CHECKED BY	JEH	HORIZONTAL SCALE	
F.A.P. NO.	SEE TITLE SHEET	VERTICAL SCALE	

DRAWING NO. RD-03 OF 04 SHEET NO. 16 OF 410

PLOTTED: Monday, August 11, 2014 AT 04:27 PM
FILE: u:\projects\ia\20834780\cad\PlanSet\pHD-D003_I-695.dgn



I-695 MEDIAN BARRIER REPLACEMENT
STA. 263+95 TO STA. 264+05
STA. 250+59 TO STA. 250+69
(MODIFICATION AT SIGN FOUNDATIONS)



I-695 MEDIAN BARRIER REPLACEMENT (AT INLET LOCATIONS)

TYPICAL SECTION – C

STA. 244+17 TO STA. 244+23
STA. 248+90 TO STA. 248+97
STA. 272+68 TO STA. 272+72

NOTES

1. THE BARRIER AND FOOTER, IN HORIZONTAL TRANSITION AREAS, SHALL BE CAST SEPARATELY USING FIXED FORM CONSTRUCTION METHOD, SLIP FORM MAY BE USED ELSEWHERE, ALL USING CONCRETE MIX NO. 6 (4500 PSI).

2. THE BARRIER FOOTER AND BARRIER FORMS SHALL BE REMOVED BEFORE PLACING PAVEMENT.

3. ALL REINFORCEMENT BARS, INCLUDING ENDS, SHALL BE EPOXY COATED. ALL BAR LAPS TO BE 30 BAR DIAMETERS. TIE BARS TOGETHER. ALL REINFORCEMENT BARS SHALL BE ASTM A 615, GRADE 60.

3 4. SPACING OF CONTRACTION JOINTS SHALL BE 20 FEET. 1/2" EXPANSION JOINT MATERIAL SHALL BE PLACED ON EITHER SIDE OF LIGHT POLE FOUNDATIONS, SIGN FOUNDATION AND BOTH ENDS OF BRIDGE WING WALL INTERFACE.

5. COORDINATE PLACEMENT OF NEW JUNCTION BOXES WITH EXISTING LOCATIONS AND AS SHOWN ON THE LIGHTING PLANS. WHEN REMOVING EXISTING BARRIER ADJACENT TO PORTIONS THAT REMAIN (LIMIT OF WORK, BRIDGE WING WALL, SIGN & LIGHT POLE FOUNDATIONS) CAREFULLY EXPOSE THE EXISTING CONDUITS LEAVING ENOUGH FOR JOINING THE NEW CONDUIT SYSTEM.

3 6. TOLERANCES IN DIMENSIONS SHOWN SHALL BE WITHIN 1/4-INCH.

3 7. THE COST OF ALL WORK SHOWN HEREIN SHALL BE INCLUDED IN THE PERTINENT CONCRETE MEDIAN TRAFFIC BARRIER TRANSITION ITEM IN THE PROPOSAL.

3 8. THE TOP OF BARRIER ELEVATION IS CONTROLLED FROM THE HIGHER OF THE FINISHED GRADES OF INNER OR OUTER LOOP SHOULDER, SET 42 INCHES ABOVE THE GUTTER LINE ELEVATION.

PREPARED BY
URS
HUNT VALLEY, MARYLAND

BY: cheri_wyckoff –

REVISIONS
3 ADDENDUM NO. 3
AUG. 13, 2014

SHA
STATE OF MARYLAND
DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION
HIGHWAY DESIGN DIVISION

REPLACEMENT OF I-695 INNER LOOP BRIDGES OVER BENSON AVENUE, AMTRAK, US 1, AND LEEDS AVENUE, AND REALIGNMENT OF I-695 INNER LOOP RAMP 8 FROM US 1 OVER LEEDS AVENUE

MEDIAN BARRIER DETAILS

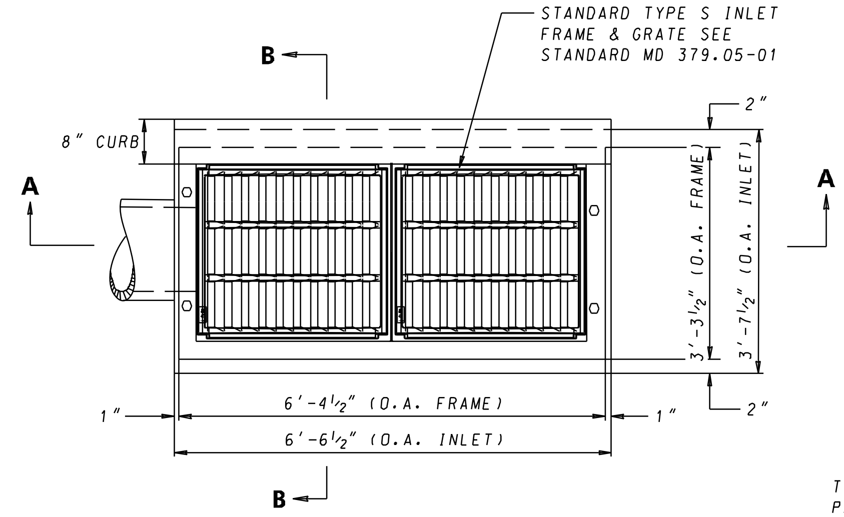
SCALE 1" = 5' ADVERTISED DATE JULY 2014 CONTRACT NO. BA3665170

DESIGNED BY	DJS	COUNTY	BALTIMORE
DRAWN BY	CDF	LOGMILE	
CHECKED BY	JEH	HORIZONTAL SCALE	
F.A.P. NO.	SEE TITLE SHEET	VERTICAL SCALE	

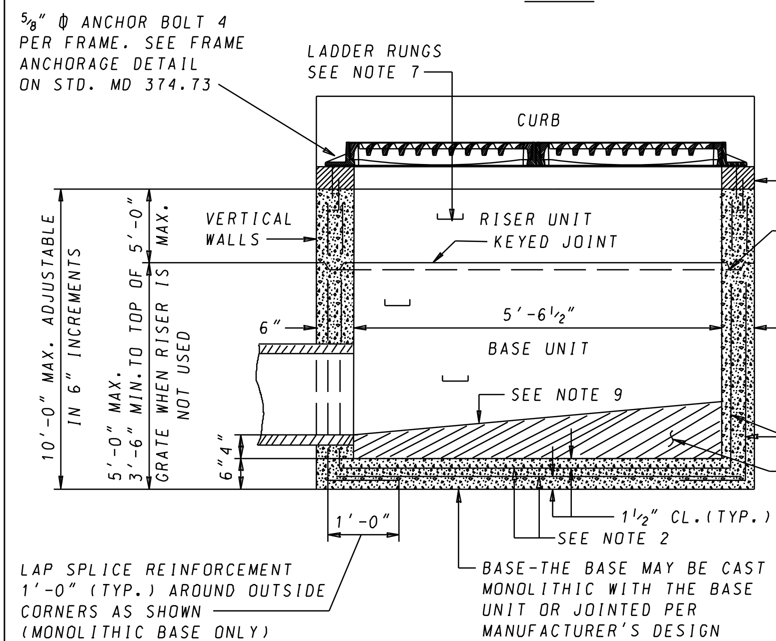
DRAWING NO. RD-04 OF 04 SHEET NO. 17 OF 410

PLOTTED: Monday, August 11, 2014 AT 04:27 PM
FILE: u:\projects\aa\20834780\cad\PlanSet\pHD-D004_I-695.dgn

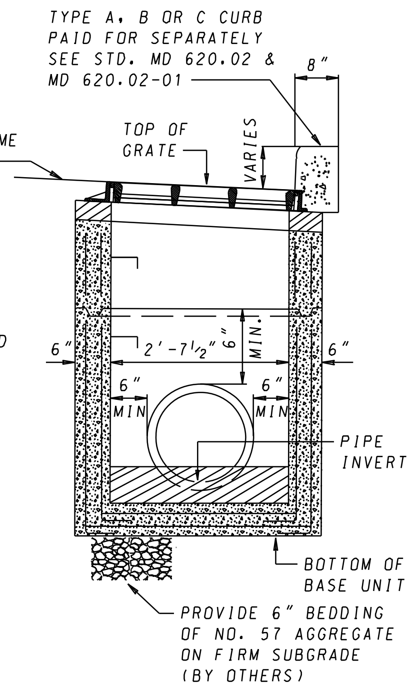
Appendix C
Standard for Type S Inlet



PLAN



SECTION A–A



SECTION B–B

NOTES

1. CONCRETE TO BE MIX NO. 6 (4500 PSI).
2. REINFORCING: WALLS – 2 LAYERS OF 4X4-W6.0 X W6.0 WELDED WIRE FABRIC; BASE – 2 LAYERS OF 4X4 – W7.0 X W7.0 WELDED WIRE FABRIC
3. THREADED PLASTIC INSERTS TO BE PROVIDED FOR HANDLING.
4. GRADE AND SLOPE ADJUSTMENTS MIN. 2″, MAX. 9″ SHALL BE COMPLETED IN THE FIELD USING CONCRETE MIX NO. 6.
5. PIPE OPENINGS TO BE PROVIDED AS REQUIRED. FOR SIZE, LOCATION AND INVERT ELEVATIONS REFER TO THE CONSTRUCTION PLANS.
6. PLACEMENT OF SUBGRADE DRAINAGE WILL BE AS DIRECTED BY THE ENGINEER OR AS NOTED ON THE CONSTRUCTION PLANS.
7. LADDER RUNGS SHALL BE IN ACCORDANCE WITH STANDARD MD 383.91 OR 383.92. RUNGS ARE INCIDENTAL TO THE COST OF THE INLET.
8. MINIMUM DEPTH PAYMENT PER EACH SHALL BE 3′-6″ MEASURED FROM THE PIPE INVERT TO THE TOP OF THE GRATE AT ITS HIGHEST POINT. VERTICAL DEPTH PAYMENT PER LINEAR FOOT SHALL INCLUDE ALL DEPTHS IN EXCESS OF 3′-6″ INCLUDING ALL APPURTENANCES.
9. CONCRETE OR BRICK INVERT TO BE PROVIDED IN THE FIELD AND SHALL SLOPE 2 IN./FT TOWARD OUTLET OR AS DIRECTED.
10. BASE WALLS UNIT MAY TAPER PER MANUFACTURER'S DESIGN.
11. FROM CURB LINE, INLET HAS BEEN DESIGNED FOR HS-25 LOADING, ACCORDING TO AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS.

SPECIFICATION 305	CATEGORY CODE ITEMS	
APPROVED	DIRECTOR – OFFICE OF HIGHWAY DEVELOPMENT	
SHA State Highway Administration	APPROVAL • SHA REVISIONS	APPROVAL • FEDERAL HIGHWAY ADMINISTRATION
	APPROVAL 2-22-91	APPROVAL 1-2-91
	REVISED 8-3-10	REVISED 7-26-10
	REVISED 10-7-14	REVISED 9-29-14
	REVISED –	REVISED

Maryland Department of Transportation
STATE HIGHWAY ADMINISTRATION
STANDARDS FOR HIGHWAYS AND INCIDENTAL STRUCTURES

PRECAST STANDARD TYPE S INLET DOUBLE GRATE TANDEM

STANDARD NO. MD 374.70

Larry Hogan, *Governor*
Boyd K. Rutherford, *Lt. Governor*

State Highway Administration
Maryland Department of Transportation

Pete K. Rahn, *Secretary*
Gregory C. Johnson, P.E., *Administrator*

October 6, 2016

Mr. Benjamin J. Carnazzo
Kiewit Infrastructure Co.
7250 Parkway Drive, Suite 310
Hanover MD 21076

Dear Mr. Carnazzo:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 1 for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on September 22, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract.
2. Please clarify if the Hard Shoulder Running (HSR) is proposed to be dynamic, adapting to congestion levels, or implemented by time of day.
3. To achieve the project goals, the Design-Builder must provide a fully functional system at project completion. The PTC does not address how HSR will be integrated. Section D, Potential Impacts, does not address impacts to CHART.
4. Please clarify if the HSR is proposed to be open or closed during rain events.
5. Travel lane widths on I-270 less than 12 feet and shoulder widths less than AASHTO standards will require an approved design exception, including a safety analysis, prior to establishing a Construction Agreed Price (CAP).
6. A National Environmental Policy (NEPA) document and an Interstate Access Point Approval (IAPA) approved by the Federal Highway Administration (FHWA) will be required prior to establishing a CAP. In preparation of the IAPA, the Design-Builder must meet the requirements of the FHWA Interstate System Access Informational Guide.
7. This would be considered a Type I project and require a noise analysis and appropriate mitigation as required by the SHA Noise Policy and the Code of Federal Regulations.
8. Narrowing and/or shifting the HOV lane(s) will require an equivalency study, to be approved by FHWA, prior to establishing a CAP.

9. The PTC notes the roadway will be resurfaced where restriping will occur to reconfigure lanes. Exhibit 1 and the typical sections are inconsistent. The exhibit depicts only partial resurfacing where the typicals depict reduced lane widths. Please clarify. Additionally, some areas in the exhibit show no resurfacing where there is HSR on the outside near ramps. Will restriping at ramps not be required to implement HSR on the outside?
10. On page 5, last sentence, the PTC notes the existing median barrier needs to be replaced or modified in areas where existing shoulder cross slope is adverse to the existing lane. Cross slope adjustments may be needed in other areas, such as tangents, to create a safe and usable cross slope for the HSR when operating as a travel lane. While concrete traffic barriers offer some flexibility for overlays, the cross slope adjustments may reduce the barrier height to less than required heights depending on the extent of the cross slope adjustment, whether the existing roadway has already been overlaid, etc.
11. Page 7 notes infrastructure costs for the implementation of HSR will be developed based on the shoulder full depth reconstruction, grinding and resurfacing, restriping, and the lane control system; however, other significant costs (e.g. potential noise barriers) are not mentioned.
12. Section D, Potential Impacts, does not address impacts to existing traffic during construction. Discuss how traffic will be maintained during construction.
13. Section D, Potential Impacts, states right-of-way impacts will include emergency pull-offs. Please specify the number of pull-offs to be provided, or the spacing. Please specify the minimum length of the pull-off (including tapers), or provide a sketch/detail.
14. Discuss the potential fiber requirements needed for this PTC.
15. If the PTC is resubmitted, please provide detailed information for the following PTC sections: Other Projects, Design-Builder Risk, Cost/Schedule Benefits, and Miscellaneous.

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Frank DiGilio, Kiewit Infrastructure Co.

Larry Hogan, *Governor*
Boyd K. Rutherford, *Lt. Governor*

State Highway Administration
Maryland Department of Transportation

Pete K. Rahn, *Secretary*
Gregory C. Johnson, P.E., *Administrator*

January 3, 2017

Mr. Benjamin J. Carnazzo
Kiewit Infrastructure Co.
7250 Parkway Drive, Suite 310
Hanover MD 21076

Dear Mr. Carnazzo:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 1 (Revised) for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on December 19, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract. There are no additional comments for this revised PTC.

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Frank DiGilio, Kiewit Infrastructure Co.

PTC 4 – Targeting Specific Local Relief Areas of Severe Congestion: Capacity Improvements via Auxiliary Lanes

AECOM

AECOM
7 St. Paul Street, 17th Floor
Baltimore, MD 21202, USA
aecom.com

January 19, 2017

Mr. Jason A. Ridgway, P.E.
Director, Office of Highway Development
Maryland Department of Transportation
State Highway Administration
707 N. Calvert Street
Baltimore, MD 21202

Subject: **Proposed Technical Concept No. 4** Comment Responses
IS-270 - Innovative Congestion Management Progressive Design Build
Contract No. MO0695172

Dear Mr. Ridgway

The Kiewit/AECOM team is in receipt of the comments that the Maryland Department of Transportation's State Highway Administration (SHA) provided on October 31, 2016 on Proposed Technical Concept (PTC) No. 4 for the IS-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by our team on October 20, 2016. We appreciate the opportunity to provide point-by-point responses to your comments, and address them in the revised PTC No. 4 that is included as an Appendix of the Technical Proposal. Your comments have been repeated for convenience, and the responses are in bold.

THE KIEWIT/AECOM TEAM IS INCLUDING PTC 4A AND 4C IN "THE PROJECT" AND TECHNICAL PROPOSAL. 4B IS NOT INCLUDED IN THE PROJECT.

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract.

   Response: No response required.

2. Travel lane widths on the I-270 less than 12 feet and shoulder widths less than AASHTO standards will require an approved design exception, including a safety analysis, prior to establishing a cap.

   Response: The Kiewit/AECOM team will submit design exceptions for lane and shoulder widths which do not meet AASHTO recommendations and will include safety analysis in each location, prior to establishing a CAP.

3. Figure 1 proposes 5-foot shoulders, which may mislead motorists to a potentially inadequate refuge area. Refer to page 24, second paragraph, in SHA's Guidelines for Traffic Barrier Placement and End Treatment Design (March 2006).

   Response: The Kiewit/AECOM team will maintain the existing left shoulder and the existing 12 foot wide lanes. The team will convert the 13' wide right shoulder into an 11 foot wide additional northbound auxiliary lane, with a 2 foot wide right shoulder.

We appreciate the opportunity to provide responses and revise PTC No. 4 accordingly.

Yours sincerely,

Chris McGuire, PE
Vice President, Maryland Surface Transportation
AECOM
T: 410-637-1720
M: 443-386-6286
E: chris.mcguire@aecom.com

A. Description

Detailed descriptive information and other appropriate information as appropriate such as conceptual drawings, production details, standards, specifications, and traffic operations analysis.

Capacity Improvements are proposed to add an auxiliary lane along certain sections of IS-270 to improve traffic flow. The focus of the capacity improvements is to alleviate congestion and permanently increase the highway capacity in three sections between adjacent interchanges that were identified as problematic in the existing traffic models. The auxiliary lane shall be achieved primarily through restriping the travel lanes and reconstructing the paved shoulders. The locations will be between south of I-370 (Shady Grove Road) and MD 121 in both the northbound and southbound directions of travel. Depending on available budget after assessing the cost of other PTC's, we will propose to implement PTC 4A, 4B, or 4C in our final proposal.

The traditional method of adding highway capacity is to widen existing roads to add through lanes which often results in additional right of way needs, adverse impacts to the community and the environment, and high construction costs. Therefore, it is proposed to add highway capacity while maintaining the footprint of the existing pavement and provide congestion relief with relatively minimal environmental and construction cost impacts.

Detailed VISSIM analysis of the Capacity Improvements has been completed for the Project. Highway Capacity Manual (HCM) analyses have been performed, to provide some indication of the improvements likely to be yielded by the Capacity Improvements; these are discussed further below.

B. Location

The locations where, and an explanation of how, the PTC will be used on the Project.

Capacity Improvements will be implemented in the following sections along IS-270. These sections provide adequate shoulder width and shoulder continuity to allow their use as auxiliary lanes. Table 1 includes the limits and length of each section, and the design exceptions that will be required in order to successfully implement the Capacity Improvements in each section.

PTC #	Roadway	Direction	Limits	Distance	Figure	Design Exception Required
INCLUDED IN "THE PROJECT" AND TECHNICAL PROPOSAL						
4A	IS-270	NB	Shady Grove Road to I-370	0.4 mi	1	11' Lane Width
4C	IS-270	SB	MD 117 to I-370	0.8 mi	2	11' Lane Width
NOT INCLUDED IN THE PROJECT AND TECHNICAL PROPOSAL						
4B	IS-270	NB	MD 27 to MD 121	2.0 mi	3	11' Lane Width
		SB	MD 121 to MD 27			

Table 1 – Proposed Capacity Improvement Locations

FIGURE 1 AND 2 IMPROVEMENTS ARE INCLUDED IN "THE PROJECT" AND TECHNICAL PROPOSAL

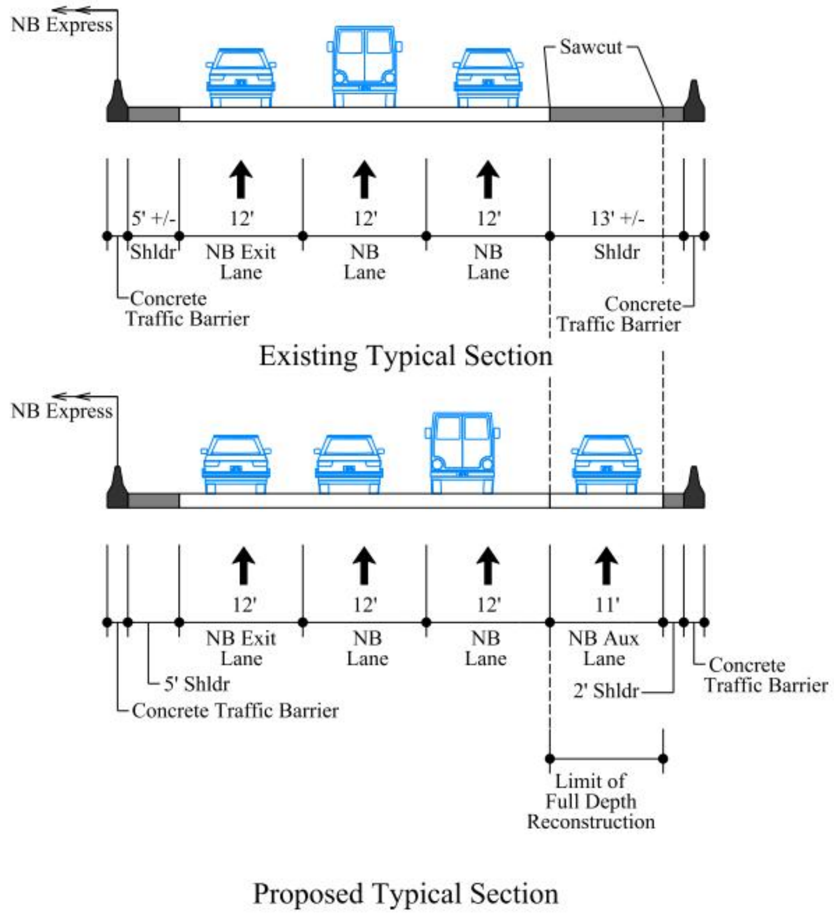


Figure 1 – Location 4A Existing and Proposed Typical Sections
NB IS-270 between Shady Grove Road and I-370

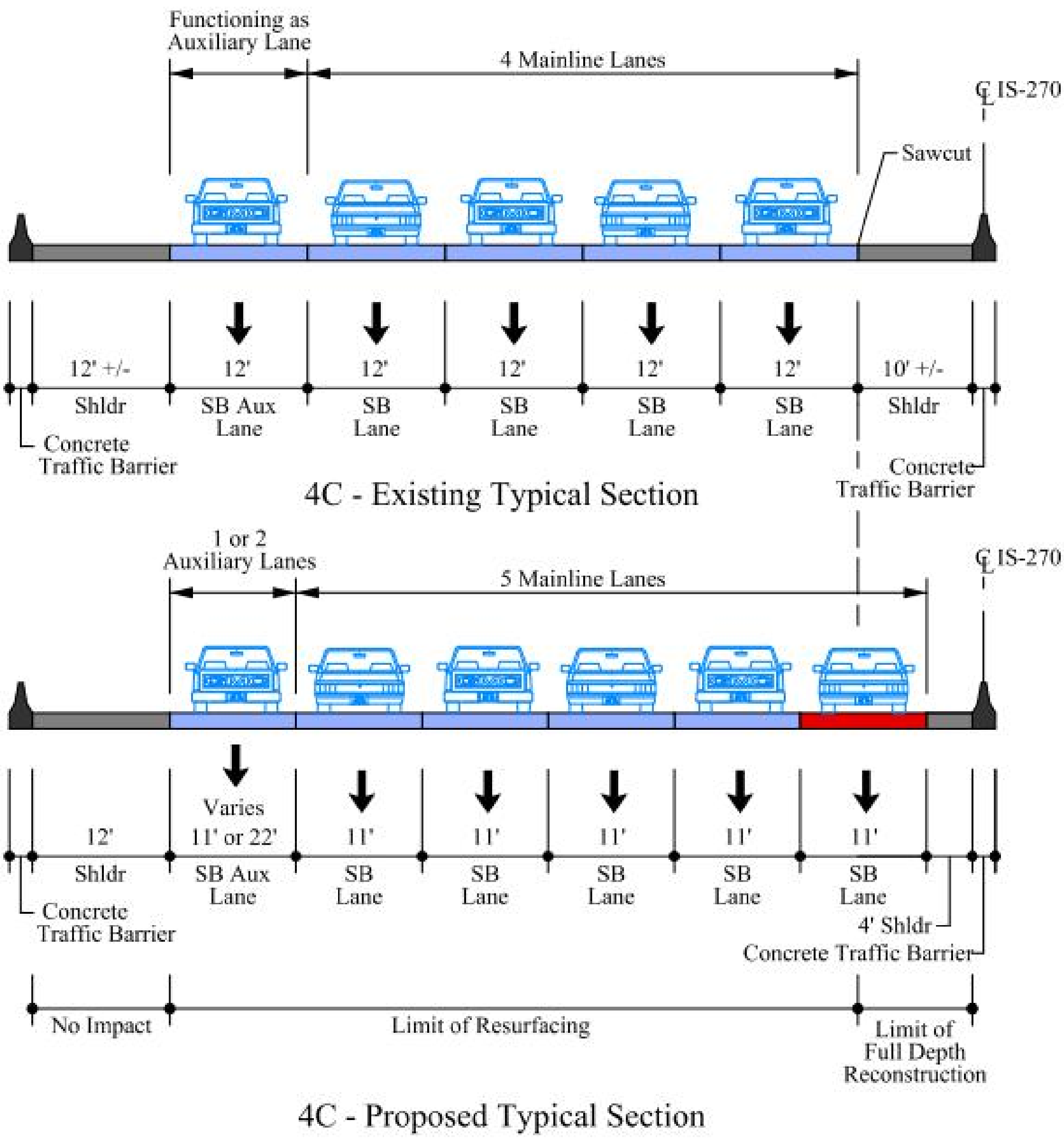


Figure 2 – Location 4C Existing and Proposed Typical Sections
SB IS-270 between MD 117 and I-370

FIGURE 3 IMPROVEMENTS ARE NOT INCLUDED IN "THE PROJECT" AND TECHNICAL PROPOSAL

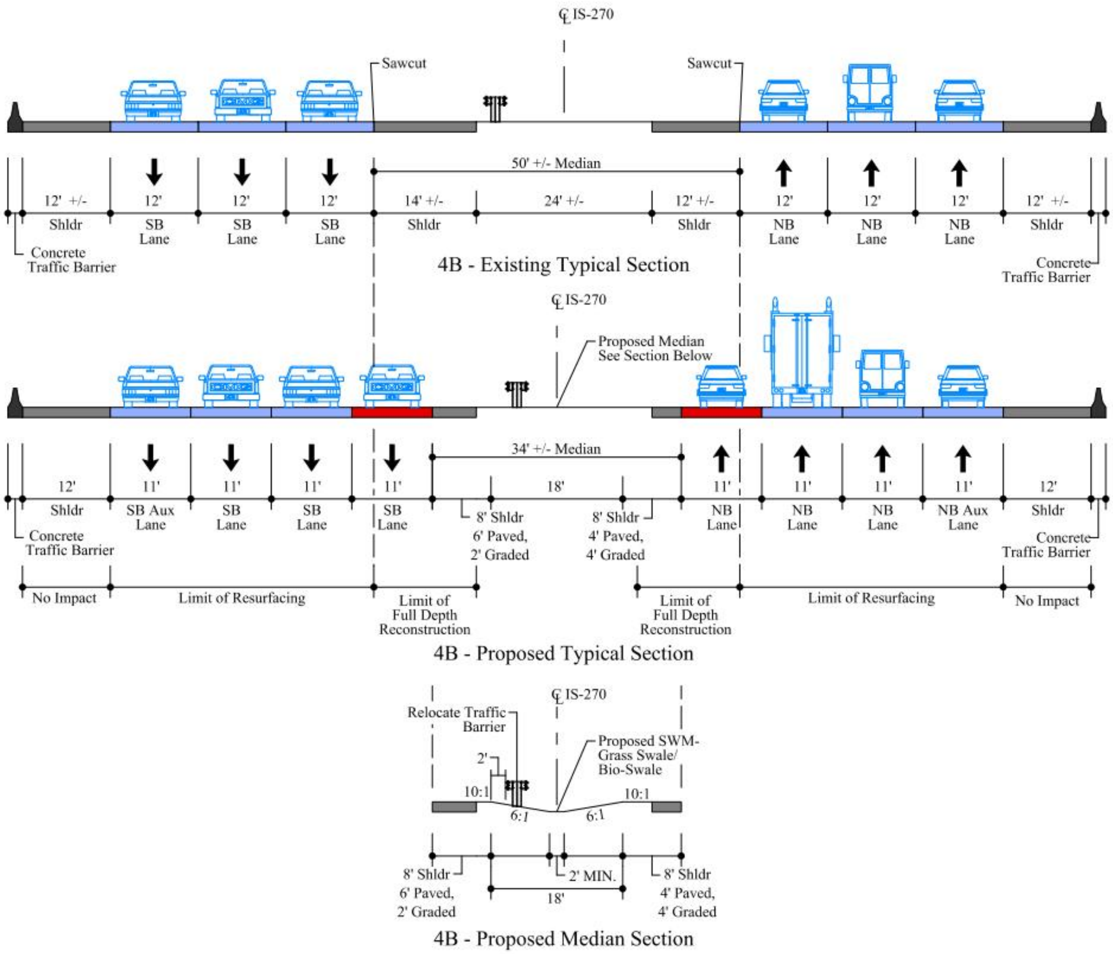


Figure 3 – Location 4B Existing and Proposed Typical Sections
NB and SB IS-270 between MD 121 and MD 27

C. Analysis

Analysis justifying the use of the PTC including how it advances the project goals.

The figures above illustrate the locations of the proposed targeted specific local relief area of severe congestion through Capacity Improvements via Auxiliary Lanes. The proposed improvements are based on the topographic information provided by the Administration and aerial imagery where topographic information was not available. IS-270 will be restriped and existing travel lane widths will be reduced to 11’ where necessary (PTC 4C).

The full depth reconstruction along the entire stretch of existing shoulders is the anticipated approach to shoulder pavement treatment. The Administration provided Ground Penetration Radar results that included information on the existing pavement composition of the shoulders. Existing shoulders do not appear to be traffic bearing and are assumed to require full depth reconstruction. Shoulders will be overlaid if they do not require full depth reconstruction. The Kiewit/AECOM team will work with the Administration to reduce shoulder reconstruction limits during the CAP process.

As is illustrated in Figures 1 and 2, the limits of resurfacing and full depth reconstruction is shown as is anticipated. For PTC #4A, the existing right shoulder will consist of both resurfacing and full depth reconstruction, while no impacts will be made to the median shoulder and adjacent lanes. The existing 13’-wide right shoulder will be converted into a 11’ lane and 2’ shoulder. For PTC #4C, the median shoulder will be reconstructed while the outside shoulder will not be impacted.

The through lanes along IS-270 will be resurfaced to allow for restriping of the existing lanes. The through lane transition will be designed per AASHTO design standards based on a 70 mph design speed. Once the lane configuration along each section has been finalized, the resurfacing of the through lanes will be limited to sections where restriping will occur.

Table 2 indicates the Existing Volumes for the SB AM Peak and NB PM Peak hours on the specific sections identified for Capacity Improvements. On-Ramp and Off-Ramp volumes are provided. The use of the Capacity Improvements via auxiliary lanes will allow existing traffic to enter into and more quickly exit from the auxiliary lane for PTCs #4A. The additional mainline lane proposed in PTC #4C will improve mainline continuity as the 5th lane will match the existing roadway section to the south. The Capacity Improvements will increase throughput and ease congestion, hence addressing the project goals of improving mobility and providing a safer infrastructure for commuters.

A Capacity Analysis was completed based on the HSM, and the results are included in Appendix iii.

For PTC #4B, **which is NOT INCLUDED IN “THE PROJECT”**, the median shoulders would be fully reconstructed while the outside shoulders would not be impacted.

PTC #	Roadway	Limits	Existing Volume (NB PM Peak, SB AM Peak)		Comments
			On-Ramp	Off-Ramp	
INCLUDED IN "THE PROJECT" AND TECHNICAL PROPOSAL					
4A	IS-270 NB	Shady Grove Road to I-370	825	2,810	New Auxiliary Lane Proposed to Connect Shady Grove Rd On-Ramp to I-370 Off-Ramp
4C	IS-270 SB	MD 117 to I-370	1,665	2,625	Additional Mainline Lane Added to Add Capacity and Connect to 5 Lane Existing Section prior to IS-270 SB Express Local Split
NOT INCLUDED IN "THE PROJECT" AND TECHNICAL PROPOSAL					
4B	IS-270 NB	MD 27 to MD 121	250	730	New Auxiliary Lane Proposed to Connect MD 27 and MD 121 On-Ramps and Off-Ramps
	IS-270 SB	MD 121 to MD 27	850	1,025	

Table 2 – Auxiliary Lane Traffic Volumes

D. Potential Impacts

A preliminary analysis of potential impacts (both during and after construction) including but not limited to use impacts, Right-of-Way, geotechnical, utilities, environmental permitting, local community, safety, and life-cycle project and infrastructure costs, including impacts on the cost of repair, maintenance, and operation.

User Impacts - There will be positive impacts on traffic operations along IS-270, due to the increased capacity. Vehicle densities will be reduced in all cases, and levels of service will be improved in some instances. Reduced lane widths may have an impact on driver speeds.

Right of way (ROW) – One of the advantages of the Capacity Improvements via auxiliary lane is the ability to provide added capacity while remaining within the existing pavement footprint. Additional ROW needs will be minimal relative to conventional roadway widening reconstruction methods, and it will include areas for Stormwater and Erosion and Sediment Control facilities.

Pavement & Geotechnical – Full depth pavement reconstruction of non-traffic bearing shoulders will be required. Resurfacing of the through lanes will be required where lane widths are narrowed and restriping is required. There are no anticipated geotechnical impacts due to the implementation of the Capacity Improvements but geotechnical investigations will need to be performed.

Utilities – No significant impacts are expected since the majority of the proposed improvements stay within the existing roadway footprint.

Environmental Permitting – Due to the anticipated full depth reconstruction of the existing shoulder in certain areas, SWM facilities will be provided if required, to meet all SWM criteria to the maximum extent practicable (MEP). The team will put every effort towards minimizing impacts to existing wetlands, Waters of the US and vegetation. Appropriate mitigation strategies will be implemented to comply with all third party regulations and to meet the National Environmental Policy Act (NEPA) requirements.

Noise –FHWA guidance indicates that noise analyses should typically be conducted in a manner similar to a conventional widening project (FHWA, 2016.) Restriping is occurring for the purpose of adding through-traffic or auxiliary lanes. As a result, a noise analysis has been conducted in the sections where Capacity Improvements are proposed. Per Addendum 3 of the RFP, noise abatement will not be constructed as part of the Project. However, noise analysis will be provided to the Administration by the Kiewit/AECOM team.

Local Community – The residential and commercial communities will be impacted during construction due to the close proximity of the residences to IS-270. However, minimal to no impacts to private property are anticipated, due to the majority of the work being confined within the roadway footprint.

Safety – Incident management is a concern with Capacity Improvements due to the permanent reduced shoulder width, which otherwise can be used as access lanes for emergency vehicles. To mitigate this risk, the outside shoulder for PTC #4C will be maintained at its current width to allow for broken down vehicles or vehicles involved in an incident to clear the travel lanes without affecting through traffic.

Under non-incident conditions, there will be an impact on safety, due to the reduced lane widths and reduced shoulder width. The extent of these impacts has been discussed in the Safety section of the Technical Proposal.

Infrastructure costs – Infrastructure costs for the implementation of the Capacity Improvements will be developed based on the shoulder full depth reconstruction, resurfacing, restriping, and stormwater management.

Maintenance – In the existing conditions, the shoulder is used by maintenance crews to store the snow after inclement weather events. The reduction of the shoulder will impact the snow removal operations. Normal maintenance operations would also be impacted that typically use the existing shoulders for work zones. Maintenance operations in areas with reduced shoulder widths will result in a lane closure to accommodate the work. Normal maintenance operations should be scheduled during off peak hours when a lane closure will not severely impact traffic operations.

E. Other projects

A description of other projects on which the PTC has been used, the degree of success or failure of such usage, and the names and contact information (including telephone numbers and e-mail addresses) of project owner representative who can confirm such statements.

The use of auxiliary lanes is well documented throughout Maryland and in other states and its use provides several benefits. AASHTO 2011 offers the following:

- Auxiliary lanes are warranted on high-speed and on high-volume highways where a change in speed is needed for vehicles entering or leaving the through-traffic lanes.
- All drivers do not use auxiliary lanes in the same manner; some use little of the available facility and some increase or decrease speeds outside the auxiliary lanes. As a whole, however, these lanes are used significantly to improve highway operations.
- Use of auxiliary lanes varies with volume, the majority of drivers using them at high volumes.

I-695 Baltimore Beltway Outerloop - Frederick Road Onramp to I-95

To alleviate congestion along the Southwest Outerloop of the Baltimore Beltway, an auxiliary lane has been implemented from Frederick Road to the I-95 Onramp. The auxiliary lane addition improves the traffic flow, provides congestion relief, and improves highway operations. The use of auxiliary lanes is commonplace in Maryland and similar applications are used throughout the state.

F. Administration Risk

A description of risk to the Administration or third parties associated with implementing the PTC.

The Capacity Improvements with the added auxiliary/through lane will result in reduced width for the existing travel lanes. The reduced lane width will minimize the areas with reduced shoulder width. A design exception will be submitted for lanes less than 12' wide and shoulders less than the minimum widths recommended by AASHTO.

There will be reduced shoulder widths along the three IS-270 sections listed in Table 1. This presents a risk to the roadway users, since users will not be able to rely on the benefits that a shoulder provides, such as emergency responses and providing a pull-off area for broken down vehicles.

Due to the nature of the contract, all proposed improvements are subject to third party input such as Emergency operations (including local EMS and the State/County Police), and approvals from FHWA (including IAPA), DNR, MDE and other associated environmental agencies. Once design is finalized, the administration will seek input and approval from the aforementioned agencies, or vary the scope to address their comments, where necessary. In addition, community involvement and input may affect the NEPA permitting process and final configuration of the proposed solutions.

G. Design-Builder Risk

A description of risk to the Design-Builder associated with implementing the PTC.

The use of auxiliary lanes is common in Maryland; therefore the design and construction should be straightforward as design standards are available.

H. Cost/Schedule Benefits

Discussion of any cost or schedule benefits to this contract from usage of this PTC

The implementation of the Capacity Improvements is a practical design solution that adds highway capacity without increasing the existing pavement footprint of the roadway. The following are the cost and schedule benefits of the Capacity Improvements when compared to a conventional widening project.

- Capacity Improvements provides a permanent increase in highway capacity without the need to widen the existing roadway. This method results in construction cost savings due to the reduced cost in ROW, structures, excavation and ramp modifications.
- This method does not require major infrastructure widening, resulting in shorter construction periods and reduced maintenance of traffic and erosion and sediment control costs.
- Compared to other conventional reconstruction methods, there are minimal additional ROW needs/costs.

- Compared to other conventional reconstruction methods, the Kiewit/AECOM team is anticipating minimal to no utility impacts. Therefore, the Capacity Improvements result in cost and schedule benefits due to minimal coordination time with utility companies, and minimal utility relocation timeframes that would need to occur prior to the start of any construction activity.
- Due to the lack of roadway widening required, this method results in no impacts to existing overpasses and underpasses, hence significantly reducing the cost and the timeframes required for widening or replacement of existing structures.

I. Miscellaneous

Any additional information that would assist the Administration in the review of this PTC.

SHA State Highway Administration
Maryland Department of Transportation

LEGEND

FULL DEPTH RECONSTRUCTION

RESURFACING

200' 0 200' 400'
SCALE: 1" = 200'

PROPOSED TECHNICAL CONCEPT 4A – EXHIBIT 1
I–270 – INNOVATIVE CONGESTION MANAGEMENT CONTRACT
LANE AND SHOULDER SCHEMATIC
SHEET 1 OF 1

State Highway Administration
Maryland Department of Transportation

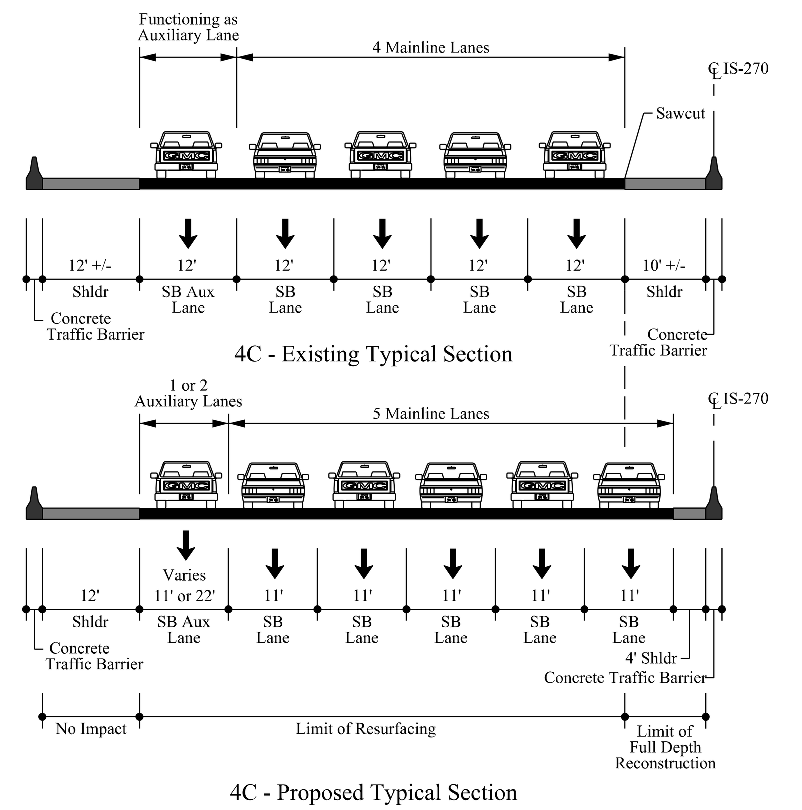
LEGEND

FULL DEPTH RECONSTRUCTION

RESURFACING

200' 0 200' 400'
SCALE: 1" = 200'

PROPOSED TECHNICAL CONCEPT 4C – EXHIBIT 3
I-270 – INNOVATIVE CONGESTION MANAGEMENT CONTRACT
LANE AND SHOULDER SCHEMATIC
SHEET 1 OF 1



SECTION A–A

Larry Hogan, *Governor*
Boyd K. Rutherford, *Lt. Governor*

State Highway Administration
Maryland Department of Transportation

Pete K. Rahn, *Secretary*
Gregory C. Johnson, P.E., *Administrator*

October 31, 2016

Mr. Benjamin J. Carnazzo
Kiewit Infrastructure Co.
7250 Parkway Drive, Suite 310
Hanover MD 21076

Dear Mr. Carnazzo:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 4 for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on October 20, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract.
2. Travel lane widths on I-270 less than 12 feet and shoulder widths less than AASHTO standards will require an approved design exception, including a safety analysis, prior to establishing a CAP.
3. Figure 1 proposes 5-foot shoulders, which may mislead motorists to a potentially inadequate refuge area. Refer to page 24, second paragraph, in SHA's Guidelines for Traffic Barrier Placement and End Treatment Design (March 2006).

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Frank DiGilio, Kiewit Infrastructure Co.

PTC 5 – Targeting Specific Local Relief Areas of Severe Congestion: Spot Geometric Improvements via Restriping

AECOM

AECOM
7 St. Paul Street, 17th Floor
Baltimore, MD 21202, USA
aecom.com

January 19, 2017

Mr. Jason A. Ridgway, P.E.
Director, Office of Highway Development
Maryland Department of Transportation
State Highway Administration
707 N. Calvert Street
Baltimore, MD 21202

Subject: **Proposed Technical Concept No. 5** Comment Responses
IS-270 - Innovative Congestion Management Progressive Design Build
Contract No. MO0695172

Dear Mr. Ridgway

The Kiewit/AECOM team is in receipt of the comments that the Maryland Department of Transportation's State Highway Administration (SHA) provided on October 31, 2016 on Proposed Technical Concept (PTC) No. 5 for the IS-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by our team on October 20, 2016. We appreciate the opportunity to provide point-by-point responses to your comments, and address them in the revised PTC No. 5 that is included as an Appendix of the Technical Proposal. Your comments have been repeated for convenience, and the responses are in bold.

THE KIEWIT/AECOM TEAM IS INCLUDING PTC 5A, 5C and 5D IN "THE PROJECT" AND TECHNICAL PROPOSAL. PTC 5B IS NOT INCLUDED IN THE PROJECT.

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract.

   Response: No response required.

2. Travel lane widths on the I-270 less than 12 feet and shoulder widths less than AASHTO standards will require an approved design exception, including a safety analysis, prior to establishing a cap.

   Response: The Kiewit/AECOM team will submit design exceptions for lane and shoulder widths which do not meet AASHTO recommendations and will include safety analysis in each location, prior to establishing a CAP.

3. Typical Sections for PTCs 5A and 5C may enhance comprehension of what is proposed.

   Response: A typical section for 5A has been included in the PTC. Due to the nature of 5C, since the lengths and width of the four ramps vary greatly, there is no one "typical" section that represents the improvements.

We appreciate the opportunity to provide responses and revise PTC No. 5 accordingly.

Yours sincerely,

Chris McGuire, PE
Vice President, Maryland Surface Transportation
AECOM
T: 410-637-1720
M: 443-386-6286
E: chris.mcguire@aecom.com

A. Description

Detailed descriptive information and other appropriate information as appropriate such as conceptual drawings, production details, standards, specifications, and traffic operations analysis.

Spot Geometric Improvements via Restriping are proposed to alleviate congestion and permanently improve the highway geometrics in the sections discussed below. These sections were chosen to modify the existing lane configurations to better accommodate the traffic demand. The sections were also selected to add additional queueing volume and to add additional acceleration and deceleration length. The spot geometric improvements will be constructed primarily through restriping the travel, acceleration, and deceleration lanes. The locations will be scattered throughout IS-270 from the IS-270 western spur at the I-495 OL Interchange to the MD 80 Interchange.

The traditional method of improving highway operations is to widen existing roadways to add through lanes which often results in additional right of way needs, adverse impacts to the community and the environment, and high construction costs. Understanding the financial constraints of this project, it is proposed to improve highway operations through spot geometric improvements while maintaining the footprint of the existing pavement and provide congestion relief with relatively minimal environmental and construction cost impacts.

B. Location

The locations where, and an explanation of how, the PTC will be used on the Project.

Spot Geometric Improvements will be implemented in the following sections along IS-270. Table 1 includes the limits and length of each section.

PTC #	Roadway	Direction	Limits	Distance
INCLUDED IN "THE PROJECT" AND TECHNICAL PROPOSAL				
5A	IS-270 Spur	SB	IS-270 Western Spur and I-495 OL Interchange	0.3 mi
5C-1	IS-270	NB	MD 80 Interchange	0.5 mi
5C-2				
5C-3		SB		
5C-4				
5D	IS-270	NB	IS-270 NB to MD 124	0.2 mi
NOT INCLUDED IN THE PROJECT AND TECHNICAL PROPOSAL				
5B-1	IS-270 at I-370	SB	Sam Eig Highway to IS-270 SB	0.3 mi
5B-2		NB	IS-270 NB to Sam Eig Highway	0.3 mi

Table 1 – Proposed Spot Geometric Improvement Locations

C. Analysis

Analysis justifying the use of the PTC including how it advances the project goals.

The figures below illustrate the locations of the proposed Spot Geometric Improvements. The proposed improvements are based on the topographic information provided by the Administration and aerial imagery where topographic information was not available.

THESE IMPROVEMENTS ARE INCLUDED IN "THE PROJECT" AND TECHNICAL PROPOSAL

PTC 5A

5A proposes to restripe the Western Spur of IS-270 at the I-495 OL Interchange. The current lane configuration joins three lanes from IS-270 and three lanes from I-495 OL Interchange into five lanes on I-495 OL. Under existing conditions, the left lane of IS-270 merges to the right.

IS-270 SB Western Spur experiences 5,435 vehicles during the AM peak hour and 4,315 vehicles during the PM peak hour; however, I-495 OL carries 4,480 vehicles during the AM peak hour and 3,635 vehicles during the PM peak hour.

Due to the lower volumes on I-495 OL, it is proposed to shift the lane merge to the furthest right lane of I-495 OL merging into I-270 SB. This improvement would provide three continuous lanes from IS-270 SB Western Spur and is expected to increase traffic flow in the I-270 SB / I-495 OL merge area. The modified lane configuration will better accommodate current traffic volumes.

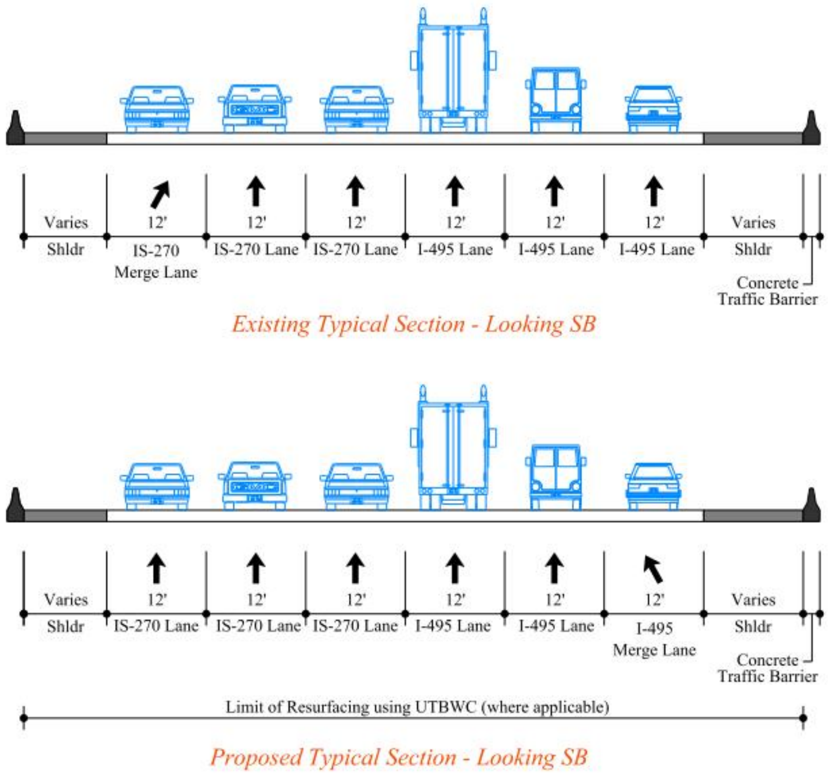


Figure 1 – Location 5A Existing and Proposed Typical Sections
IS-270 Spur to I-495 OL

PTC 5C

5C proposes to restripe the acceleration and deceleration lanes along IS-270 at the MD 80 Interchange. The current acceleration and deceleration lane striping does not meet AASHTO based on the ramp and IS-270 design speeds. The acceleration and deceleration lanes will be restriped without widening the existing pavement by utilizing the existing shoulders to provide additional weave length. The acceleration and deceleration lanes would be lengthened to meet AASHTO design standards for PTC 5C-2, 5C-3, and 5C-4. PTC 5C-1 would require a design exception for acceleration length since there is not enough existing pavement available to restripe and meet the design standards. However, 5C-1 will increase the existing acceleration length by over 200'.

PTC 5D

5D proposes to add a third exit ramp lane at the IS-270 NB offramp at MD 124 (See Figure 1). The new lane would provide additional storage to reduce ramp queueing on IS-270. The exit ramp is signalized and MD 124 EB has three through lanes. The new lane would require full depth pavement.

Critical Lane Analysis was performed in order to provide a quantitative comparison between existing and proposed conditions for the improvement to the ramp from IS-270 NB to MD 124 EB. Under existing conditions, this ramp experiences a v/c ratio of 0.53 (LOS A) during the AM peak hour and a v/c ratio of 1.19 (LOS F) during the PM peak hour. Under proposed conditions, this ramp experiences a v/c ratio of 0.45 (LOS A) during the AM peak hour and a v/c ratio of 1.00 (LOS E) during the PM peak hour.

In summary, the addition of the third lane to the ramp from IS-270 NB to MD 124 EB will decrease the v/c ratios in both peak hours and decrease the LOS from F to E during the PM peak hour.

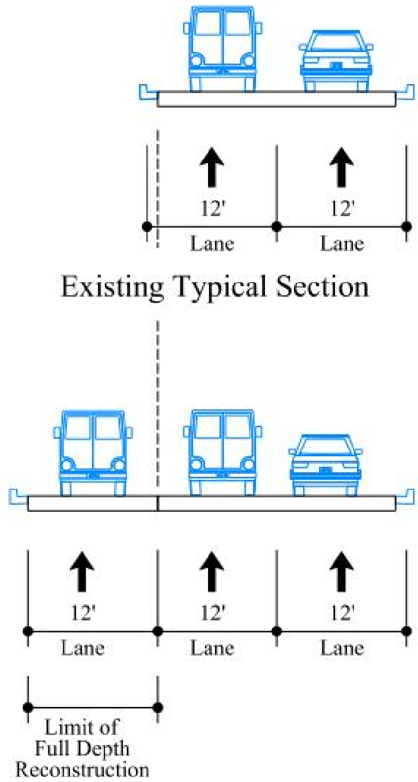


Figure 2 – Location 5D Existing and Proposed Typical Sections
NB IS-270 to MD 124 EB Off-Ramp

The resurfacing of the through lanes will be limited to sections where restriping will occur. Minimal full depth reconstruction will be required as the majority of the spot geometric improvements will only require resurfacing.

The use of the Spot Geometric Improvements will increase throughput and ease congestion, hence addressing the project goals of improving mobility and providing a safer roadway for commuters.

THESE IMPROVEMENTS ARE NOT INCLUDED IN "THE PROJECT" AND TECHNICAL PROPOSAL

PTC 5B-1

5B-1 proposes to restripe the ramp from Sam Eig Highway EB to IS-270 SB and the ramp from I-370 WB to IS-270 SB. The current lane configuration provides two lanes from Sam Eig Highway EB to IS-270 SB and one lane from I-370 WB to IS-270 SB.

The ramp from Sam Eig Highway EB to IS-270 SB experiences 975 vehicles during the AM peak hour and 790 vehicles during the PM peak hour; however, the ramp from I-370 WB to IS-270 SB carries 1,700 vehicles during the AM peak hour and 1,100 vehicles during the PM peak hour.

Due to the lower volumes on the ramp from Sam Eig Highway EB, it is proposed that the lanes be re-striped to accommodate only one lane on the ramp from Sam Eig Highway EB and to provide two lanes on the ramp from I-370 WB. This improvement would increase the capacity of the ramp from I-370 WB, where traffic volumes are higher in both peak hours. This improvement is also expected to reduce congestion on the ramp from I-370 WB, which is currently shown in the existing VISSIM model.

PTC 5B-2

5B-2 proposes to restripe Sam Eig Highway EB to I-370 EB, the ramp from IS-270 NB to I-370 EB, and the ramp from IS-270 SB to I-370 EB. The current lane configuration provides two lanes from Sam Eig Highway EB to I-370 EB from the left, one lane from IS-270 NB to I-370 EB in the middle, and two lanes from IS-270 SB to I-370 EB on the right. The two lanes from IS-270 SB quickly merge into one lane. The right most lane of I-370 EB then must exit at the Shady Grove Road exit in approximately 1,500 feet resulting in minimal weave distance.

Sam Eig Highway EB to I-370 EB experiences 1,445 vehicles during the AM peak hour and 1,705 vehicles during the PM peak hour; the ramp from IS-270 NB to I-370 EB carries 550 vehicles during the AM peak hour and 1,510 vehicles during the PM peak hour; and the ramp from IS-270 SB to I-370 EB carries 2,050 vehicles during the AM peak hour and 1,700 vehicles during the PM peak hour.

Due to the higher volumes on the ramp from IS-270 SB to I-370 EB, it is proposed that the lanes be re-striped to accommodate two lanes on the ramp from IS-270 SB to I-370 EB, one lane from Sam Eig Highway EB to I-370 EB and one lane from IS-270 NB to I-370 EB. This improvement would shift traffic over one lane and eliminate the lane merge at the end of the IS-270 SB to I-370 EB ramp. By shifting traffic one lane the weaving would be improved and would better accommodate the higher traffic volumes from IS-270 SB. This improvement is expected to reduce congestion on the ramp from IS-270 SB.

D. Potential Impacts

A preliminary analysis of potential impacts (both during and after construction) including but not limited to use impacts, Right-of-Way, geotechnical, utilities, environmental permitting, local community, safety, and life-cycle project and infrastructure costs, including impacts on the cost of repair, maintenance, and operation.

User Impacts - There will be positive impacts on traffic operations along IS-270, due to the improved roadway geometrics. Improved acceleration and deceleration lengths will increase driver speeds when merging.

Right of way (ROW) – One of the advantages of the Spot Geometric Improvements is the ability to provide improved traffic operations while staying within the existing pavement footprint. Additional ROW needs will be minimal relative to the conventional roadway reconstruction methods, and will be limited to areas for stormwater and erosion and sediment control facilities.

Pavement & Geotechnical – Resurfacing and some full depth pavement widening and reconstruction of non-traffic bearing shoulders will be required. There are no anticipated geotechnical impacts due to the implementation of the Spot Geometric Improvements but geotechnical investigations will need to be performed.

Utilities – No significant impacts are expected since the majority of the proposed improvements are within the existing roadway footprint.

Environmental Permitting – Due to the anticipated full depth pavement widening and reconstruction, SWM facilities will be provided if required to meet all SWM criteria to the maximum extent practicable (MEP). The team will put every effort towards minimizing impacts to existing wetlands, Waters of the US and vegetation. Appropriate mitigation strategies will be implemented to comply with all third party regulations and to meet the National Environmental Policy Act (NEPA) requirements. A noise analysis is not required since these PTCs do not increase capacity.

Local Community – The residential and commercial communities will be impacted during construction due to the close proximity of the residences to IS-270. The Spot Geometric Improvements will have a short construction duration. The impacts should be minimal to the local community.

Safety – Modified driver expectations is a safety concern for the Spot Geometric Improvements. With the implementation of each geometric modification the drivers will need to adjust to the modified lane configurations. No design exceptions will be required as the spot geometric improvements will be designed to meet AASHTO standards.

Infrastructure costs – Infrastructure costs for the implementation of the Spot Geometric Improvements will be developed based on the full depth widening and reconstruction, resurfacing, and restriping.

Maintenance – No significant impacts are expected since the majority of the proposed improvements stay within the existing roadway footprint and will not modify lane and shoulder widths.

E. Other projects

A description of other projects on which the PTC has been used, the degree of success or failure of such usage, and the names and contact information (including telephone numbers and e-mail addresses) of project owner representative who can confirm such statements.

The use of spot geometric improvements is common and the implementation is well documented throughout Maryland and in other states. The implementation will provide congestion relief to better accommodate current traffic demands.

F. Administration Risk

A description of risk to the Administration or third parties associated with implementing the PTC.

The Spot Geometric Improvements will result in minimal risk to the Administration. The spot geometric improvements will be designed to meet AASHTO requirements. Existing conditions that are substandard will be improved upon. No design exceptions are anticipated.

All proposed improvements are subject to third party input such as Emergency operations (including local EMS and the State/County Police), and approvals from FHWA (including IAPA), DNR, MDE and other associated environmental agencies. Once design is finalized, the administration will seek input and approval from the aforementioned agencies, or vary the scope to address their comments. In addition, community involvement and input may affect the NEPA permitting process and final configuration of the proposed solutions.

G. Design-Builder Risk

A description of risk to the Design-Builder associated with implementing the PTC.

None anticipated. The design and construction should be straightforward.

H. Cost/Schedule Benefits

Discussion of any cost or schedule benefits to this contract from usage of this PTC

The implementation of the Spot Geometric Improvements is a practical design solution that improves traffic operations without increasing the existing pavement footprint of the roadway. The following are the cost and schedule benefits of the Spot Geometric Improvements when compared to a conventional widening project.

- Spot Geometric Improvements provide a permanent solution to better meet the current traffic volume demands without the need to widen the existing roadway. This method results in relatively low construction costs for tangible benefits in traffic operations.
- Minimal roadway widening is needed, resulting in shorter construction periods and reduced maintenance of traffic and erosion and sediment control costs.
- There are minimal additional ROW needs/costs identified for stormwater management facilities if they are required outside of existing ROW.
- The Design Build team is anticipating minimal to no utility impacts.
- No widening or replacement of existing structures is anticipated.

I. Miscellaneous

Any additional information that would assist the Administration in the review of this PTC.

Related to PTC 5A, the IS-270 HOV lane currently terminates along the western spur of IS-270 SB. Currently, the HOV lane merges into a general purpose lane. While PTC #5A does not propose to modify the termination point of the HOV lane, the implementation of 5A would allow the Administration to extend the HOV lane onto I-495 OL if desired since the lane merge would be shifted from IS-270 to I-495. The HOV lane could be extended to the American Legion Bridge where Virginia's express lanes begin.

Adding HOV capacity to the IS-270 corridor through the extension of the HOV lane would have significant benefit for existing transit services in the I-270 corridor as well as potential future transit services.

Figure 2 provided below was developed for the MD 355 Bus Rapid Transit (BRT) Corridor Planning Study currently underway and shows significant park and ride capacity north of the northern limits of the proposed HOV expansion (Refer to PTC 10). These park and rides could become potential terminal points for additional commuter service.

The southbound HOV-Express (PTC 10) in conjunction with the added capacity along the IS-270 west spur (PTC 5A) and potential extension of the HOV lane up to the American Legion Bridge will result in benefits for transit, due to the regional interest in a cross-Potomac transit service that would provide an alternative to the automobile for trips between Maryland and northern Virginia. WMATA began a pilot service that attempted to utilize shoulders to provide transit exclusivity. The bus-on-shoulder element of the service did not prove feasible and the service was terminated. However, the ability of transit services to bypass congestion in the general purpose lanes has the potential to make this type of transit service more attractive.

Two key factors that make transit service more attractive to riders are travel speeds and reliability. Additional HOV-Lane capacity will improve these two factors, hence making the express bus services in the IS-270 corridor more competitive with the automobile.

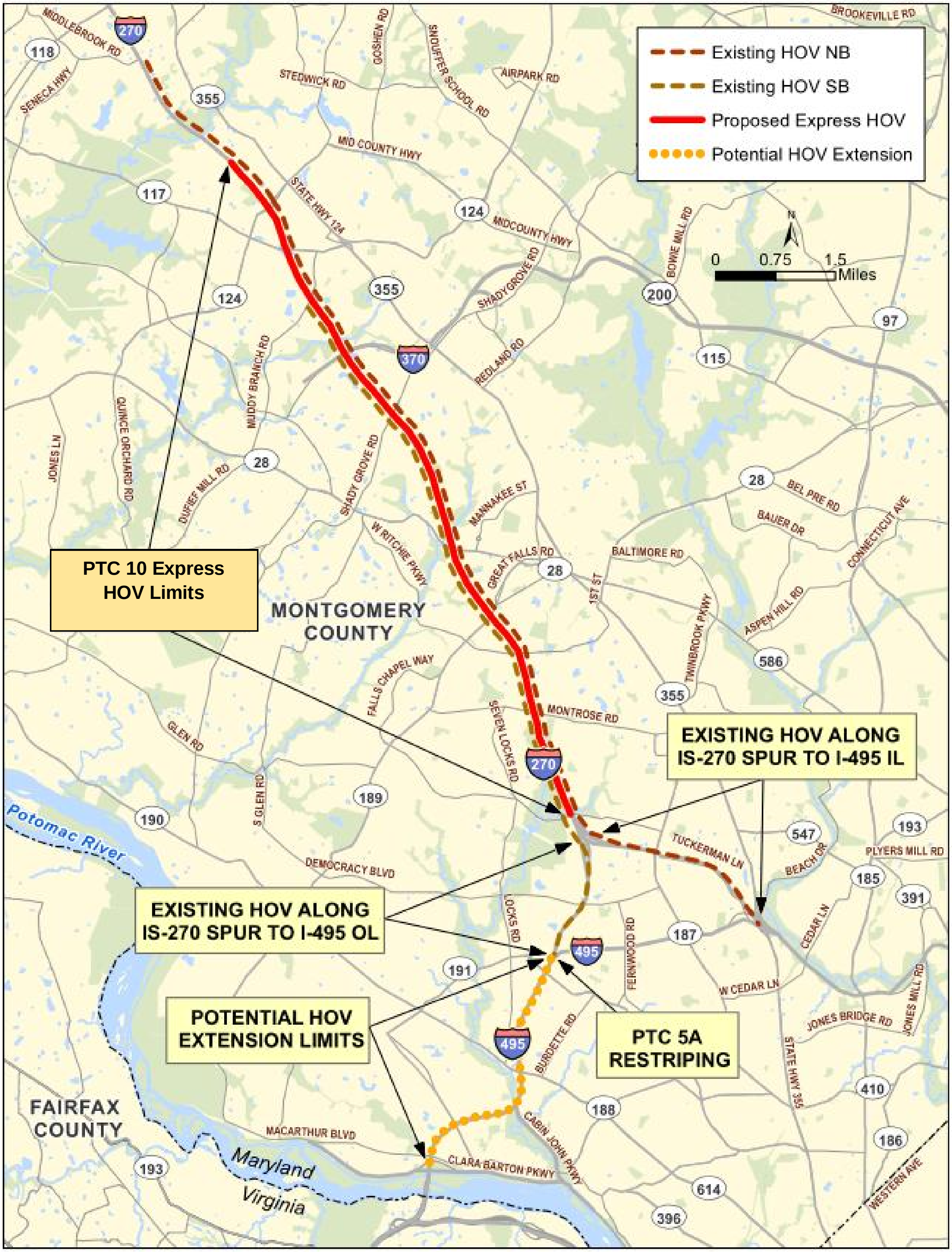


Figure 2 – Existing, Proposed, and Potential HOV Facilities

SHA
State Highway
Administration
Maryland Department of Transportation

LEGEND

FULL DEPTH RECONSTRUCTION

RESURFACING

200' 0 200' 400'
SCALE: 1" = 200'

PROPOSED TECHNICAL CONCEPT 5A – EXHIBIT 1
I–270 – INNOVATIVE CONGESTION MANAGEMENT CONTRACT
LANE AND SHOULDER SCHEMATIC
SHEET 1 OF 1

PROPOSED TECHNICAL CONCEPT 5C – EXHIBIT 3
I–270 – INNOVATIVE CONGESTION MANAGEMENT CONTRACT
LANE AND SHOULDER SCHEMATIC
SHEET 1 OF 1

SHA
State Highway Administration
Maryland Department of Transportation

LEGEND

FULL DEPTH RECONSTRUCTION

RESURFACING

200' 0 200' 400'
SCALE: 1" = 200'

PROPOSED TECHNICAL CONCEPT 5D – EXHIBIT 4
I–270 – INNOVATIVE CONGESTION MANAGEMENT CONTRACT
LANE AND SHOULDER SCHEMATIC
SHEET 1 OF 1

State Highway Administration
Maryland Department of Transportation

LEGEND

FULL DEPTH RECONSTRUCTION

RESURFACING

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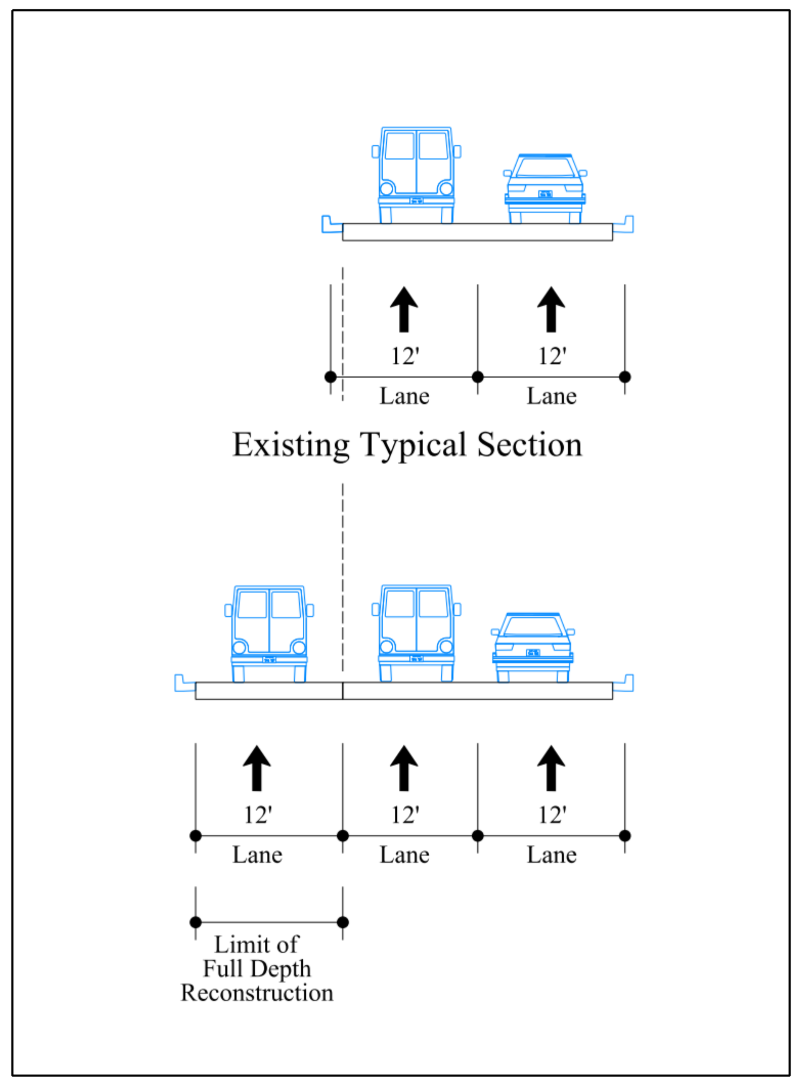
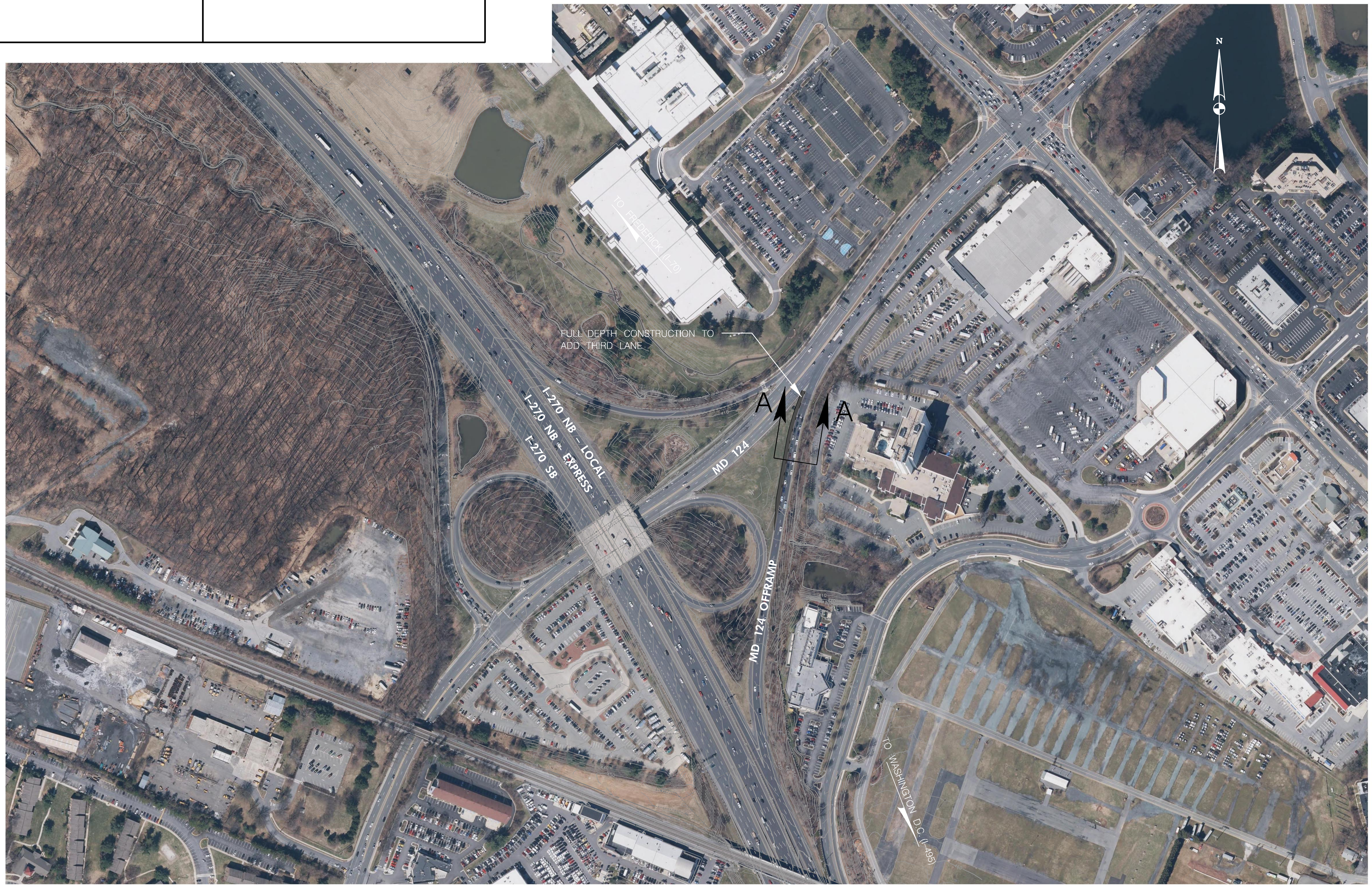
SCALE: 1" = 200'



SECTION A–A



Larry Hogan, *Governor*
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SHA State Highway Administration
Maryland Department of Transportation

Pete K. Rahn, *Secretary*
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October 31, 2016

Mr. Benjamin J. Carnazzo
Kiewit Infrastructure Co.
7250 Parkway Drive, Suite 310
Hanover MD 21076

Dear Mr. Carnazzo:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 5 for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on October 20, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract.
2. Typical sections for PTCs 5A to 5C may enhance comprehension of what is proposed.

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Frank DiGilio, Kiewit Infrastructure Co.

PTC 6 – Additional ITS Field Devices

AECOM
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Baltimore, MD 21202, USA
aecom.com

January 2, 2017

Mr. Jason A. Ridgway, P.E.
Director, Office of Highway Development
Maryland Department of Transportation
State Highway Administration
707 N. Calvert Street
Baltimore, MD 21202

Subject: **Proposed Technical Concept No. 6** Comment Responses
IS-270 - Innovative Congestion Management Progressive Design Build
Contract No. MO0695172

Dear Mr. Ridgway

The Kiewit/AECOM team is in receipt of the comments that the Maryland Department of Transportation's State Highway Administration (SHA) provided on November 16, 2016 on Proposed Technical Concept (PTC) No. 6 for the IS-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by our team on November 4, 2016. We appreciate the opportunity to provide point-by-point responses to your comments, and address them in the revised PTC No. 6 that is included as an Appendix of the Technical Proposal. Your comments have been repeated for convenience, and the responses are in bold.

THE KIEWIT/AECOM TEAM IS INCLUDING PTC 6 IN "THE PROJECT" AND TECHNICAL PROPOSAL.

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract and there is no objection to installing additional traffic management devices that are compatible with the CHART system.

   Response: No response required.

2. Section B, Location: Please address the current sign inventory on 1-270 and assure the proposed locations can be built in compliance with the sign spacing standards of the Manual of Uniform Traffic Control Devices.

   Response: Specific locations for proposed DMS will be identified during design; sign spacing standards will be met.

3. Please address how the identified OMS locations would work as an integral part of the overall corridor solutions being proposed in other PTCs, such as PTC 1B.

   Response: DMS for Managed Lanes on Hard Shoulder Running (which includes some of the elements of previous PTC 1B) would be relatively small, and mission-specific for Hard Shoulder Running. The additional DMS proposed in PTC No. 6 would be full-sized DMS, and would provide more general motorist information.

4. Section C, Potential Impacts: Under User Impacts, one of the objectives listed is "quicker detection." In the CHART Traffic Incident Management process, cameras are not used to detect incidents, they are used to monitor the progress of incident response. The intended use of the cameras drives the design process.

   Response: Agreed. The additional cameras would assist with Incident Verification, in the same manner as current CCTV cameras used by CHART.

5. Section E, Administration Risk: Since the PTC indicates that these devices will be added to the CHART system, the Administration would need to confirm that the current CHART architecture can support the additional devices. Also, the Administration would need to assure that all communication protocols are fully compatible with CHART. Although there are standards, there can be subtle protocol inconsistencies with certain products that can make integration difficult. The Administration has had this issue with new ITS devices in the past.

   Response: The intent is that new CCTV and DMS would be of the same manufacturers/models as those currently being installed by CHART, in order to minimize these risks.

6. Page 5, CCTV Map: If this PTC is resubmitted, please identify Montgomery County cameras as separate from CHART cameras, since the Administration does not have Pan, Tilt, Zoom (PTZ) control of these sites.

   Response: Our Technical Proposal addresses this comment.

We appreciate the opportunity to provide responses and revise PTC No. 6 accordingly.

Yours sincerely,

Chris McGuire, PE
Vice President, Maryland Surface Transportation
AECOM
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M: 443-386-6286
E: chris.mcguire@aecom.com

A. Description

Detailed descriptive information and other appropriate information as appropriate such as conceptual drawings, production details, standards, specifications, and traffic operations analysis.

This Proposed Technical Proposal (PTC) includes the deployment of additional closed circuit television (CCTV) cameras and dynamic message signs (DMS) in the IS-270 corridor. The purpose of these new field devices would be to enhance CHART's ability to surveil the corridor (and thus verify and respond more quickly to incidents) and to enhance motorist information in the corridor.

There are currently 16 CCTV cameras along the corridor, with all of them concentrated in Montgomery County. Three of these are CHART cameras; the other 13 are Montgomery County cameras. There are six DMS, though none of them are on either leg of the Y split. Three provide information to northbound drivers, with the other three facing southbound traffic. Only one of the DMS is in Frederick County (northbound, approaching IS-70). Two RWIS stations exist in the corridor, one at IS-370 and the other at MD 109.

These new devices will be identical to the devices currently being installed by CHART, in terms of manufacturer and model. The new devices will communicate with CHART in accordance with the current CHART architecture. That is, new CCTV will communicate with CHART via leased T-1 lines, and new DMS will communicate with CHART via cellular modems.

B. Location

The locations where, and an explanation of how, the PTC will be used on the Project.

It is anticipated that this PTC 6 would be implemented as an adjunct to PTCs 1 and 10. PTCs 1 and 10 call for the provision of:

- Hard Shoulder Running (HSR) in the northbound direction during the PM peak hour. HSR would be provided on the right shoulder of the eastern spur from MD 187 to a lane drop at Montrose Road. From the Y-split to MD 121, HSR would also be provided on the left shoulder of the express lanes.
- HSR in the southbound direction during the AM peak hour, from Watkins Mill Road to the Y-split.

Implementation of PTCs 1 and 10 will require additional ITS field devices, including CCTV, lane-use control signals and DMS within their physical limits. As part of PTC 6, additional CCTV are proposed only beyond the limits of PTCs 1 and 10, because full CCTV coverage is proposed as part of the HSR implementation. As part of PTC 6, additional DMS are proposed both within the limits of HSR and beyond those limits, because the small DMS proposed as part of the Managed Lanes Implementation are mission-specific; they will not be able to provide the robust level of general motorist information desired.

The priority order in which CCTV would be installed along the mainline of IS-270 would be:

- Between MD 85 and I-70
- At MD 80
- At MD 85
- West Spur, south of Democracy Boulevard
- Between MD 80 and MD 85
- Between MD 109 and MD 80
- Between MD 121 and MD 109

The basis of this priority order is the congestion approaching I-70, the lack of current coverage in Frederick County, and a desire to ultimately provide full coverage of the corridor. Specific locations for proposed CCTV will be identified during design.

The priority order in which DMS would be installed along the mainline of IS-270 would be:

- Northbound, between MD 85 and I-70
- Both northbound and southbound between MD 121 and MD 109
- Northbound approaching Middlebrook Road
- West Spur southbound, approaching Democracy Boulevard
- West Spur northbound, approaching Democracy Boulevard
- East Spur southbound, approaching MD 187
- Both northbound and southbound, between MD 27 and MD 121
- Both northbound and southbound, between MD 109 and MD 80

The basis of this priority order is similar to that used for the additional CCTV. Specific locations for proposed DMS will be identified during design; sign spacing standards will be met.

The locations of the ITS field devices proposed under PTC 6 are shown in the two attached figures. The additional ITS field devices proposed under PTCs 1 and 10 are not shown in these figures.

Analysis justifying the use of the PTC including how it advances the project goals.

The benefits of enhanced incident detection and response through CCTV are well-documented in CHART's own annual assessments. The benefits of improved motorist communication through DMS are similarly documented.

C. Potential Impacts

A preliminary analysis of potential impacts (both during and after construction) including but not limited to use impacts, Right-of-Way, geotechnical, utilities, environmental permitting, local community, safety, and life-cycle project and infrastructure costs, including impacts on the cost of repair, maintenance, and operation.

User Impacts - There will be positive impacts on traffic operations, through quicker verification and response to incidents, through the provision of additional capability to monitor incident response, and through the providing of additional information to motorists, to let them alter their trips or their routes. During construction, shoulder closures and occasional lane closures may be required.

Right of way (ROW) – Since there is great flexibility available in the siting of CCTV, no right-of-way will need to be acquired. Similarly, since DMS will be mounted over the roadway, no right-of-way will be required for their foundations and supports.

Utilities – No significant impacts to existing utilities are expected. CCTV can be sited to avoid utility impacts and DMS supports are constructed in such close proximity to the mainline that minimal impacts can be expected. Coordination with telephone service providers will be required for installation of the T-1 lines—and CHART will need to factor the monthly cost of those lines into its ongoing budgets.

Environmental Permitting – Since each construction site will be small, no environmental permits are expected to be required.

Local Community – There will no impacts on the local community.

Safety – As noted above, safety is typically enhanced through the provision of additional CCTV and DMS.

Infrastructure costs – Infrastructure costs will consist of the field devices themselves and their supports. These can generally be approximated on a "per location" basis.

Maintenance – The new field devices will be maintained by CHART in the same fashion as existing CCTV and DMS.

D. Other projects

A description of other projects on which the PTC has been used, the degree of success or failure of such usage, and the names and contact information (including telephone numbers and e-mail addresses) of project owner representative who can confirm such statements.

Complete CCTV coverage and "each interchange" DMS are fairly common throughout the country. In Maryland, the Transportation Authority has such coverage throughout the length of MD 200 (the Intercounty Connector) and the John F. Kennedy Highway (I-95 from the Delaware line to the I-895 interchange).

E. Administration Risk

A description of risk to the Administration or third parties associated with implementing the PTC.

Since CCTV and DMS are long-established components of CHART, there is almost no risk to the Administration in implementing PTC 6. (It is anticipated that the current CHART architecture can support this relatively small number of additional devices.) The intent is that the additional CCTV and DMS will be of the same manufacturers/models as those currently being installed by CHART, in order to further minimize risks. The field devices would be designed, constructed and tested in accordance with current CHART procedures, and would be turned over to CHART for use once accepted. Beyond the normal practices of adding devices to the CHART program, no integration will be required.

F. Design-Builder Risk

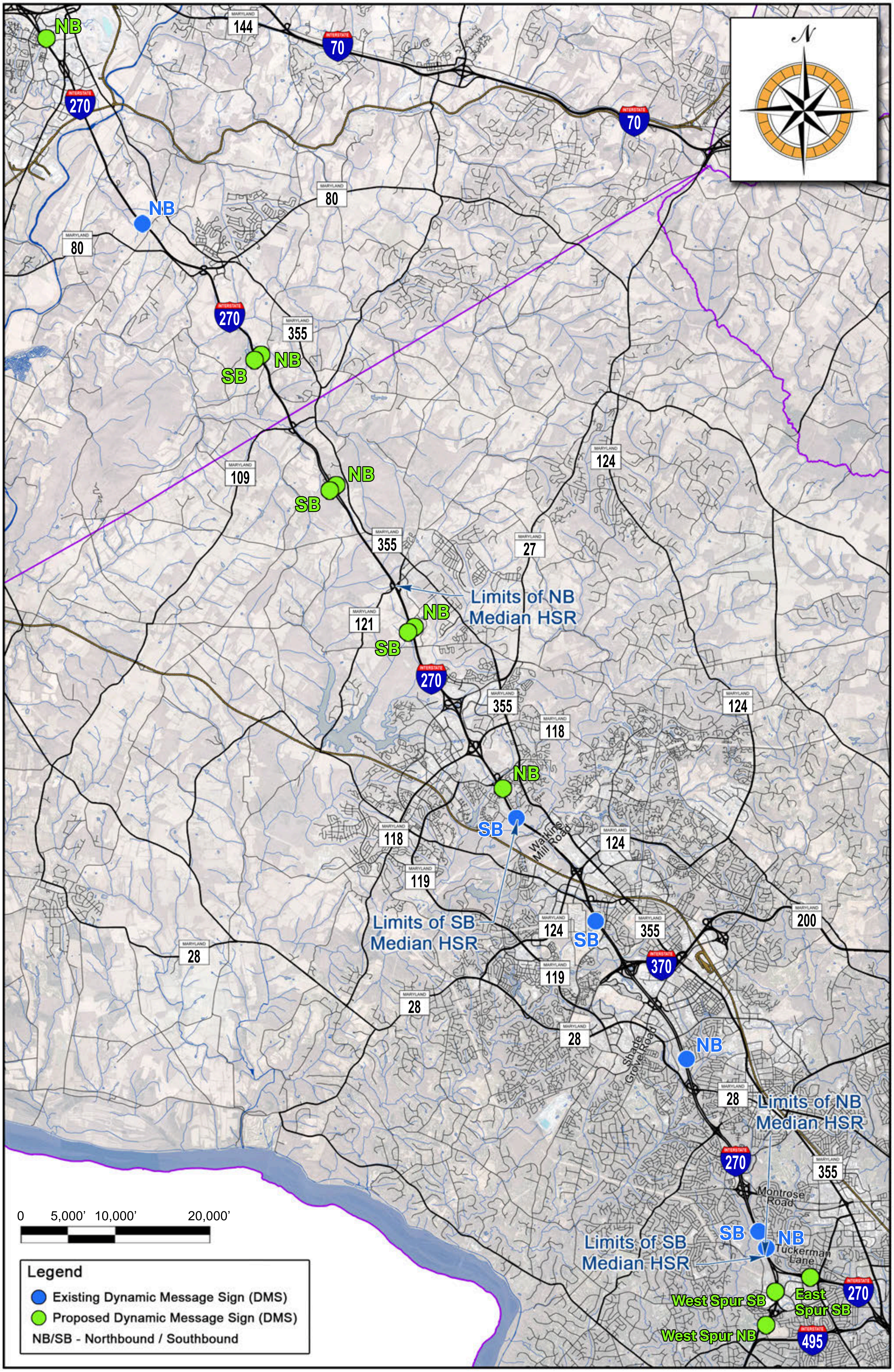
A description of risk to the Design-Builder associated with implementing the PTC.

Since CCTV and DMS are long-established components of CHART, there is virtually no risk to the Design-Builder in implementing PTC 6.

G. Cost/Schedule Benefits

Discussion of any cost or schedule benefits to this contract from usage of this PTC

Ideally, additional CCTV and DMS would be installed very early in the construction process of other PTCs, so that the benefits of PTC 6 could be realized during that construction.



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Montrose Road
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Median HSR
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Existing Dynamic Message Sign (DMS)
Proposed Dynamic Message Sign (DMS)
NB/SB - Northbound / Southbound
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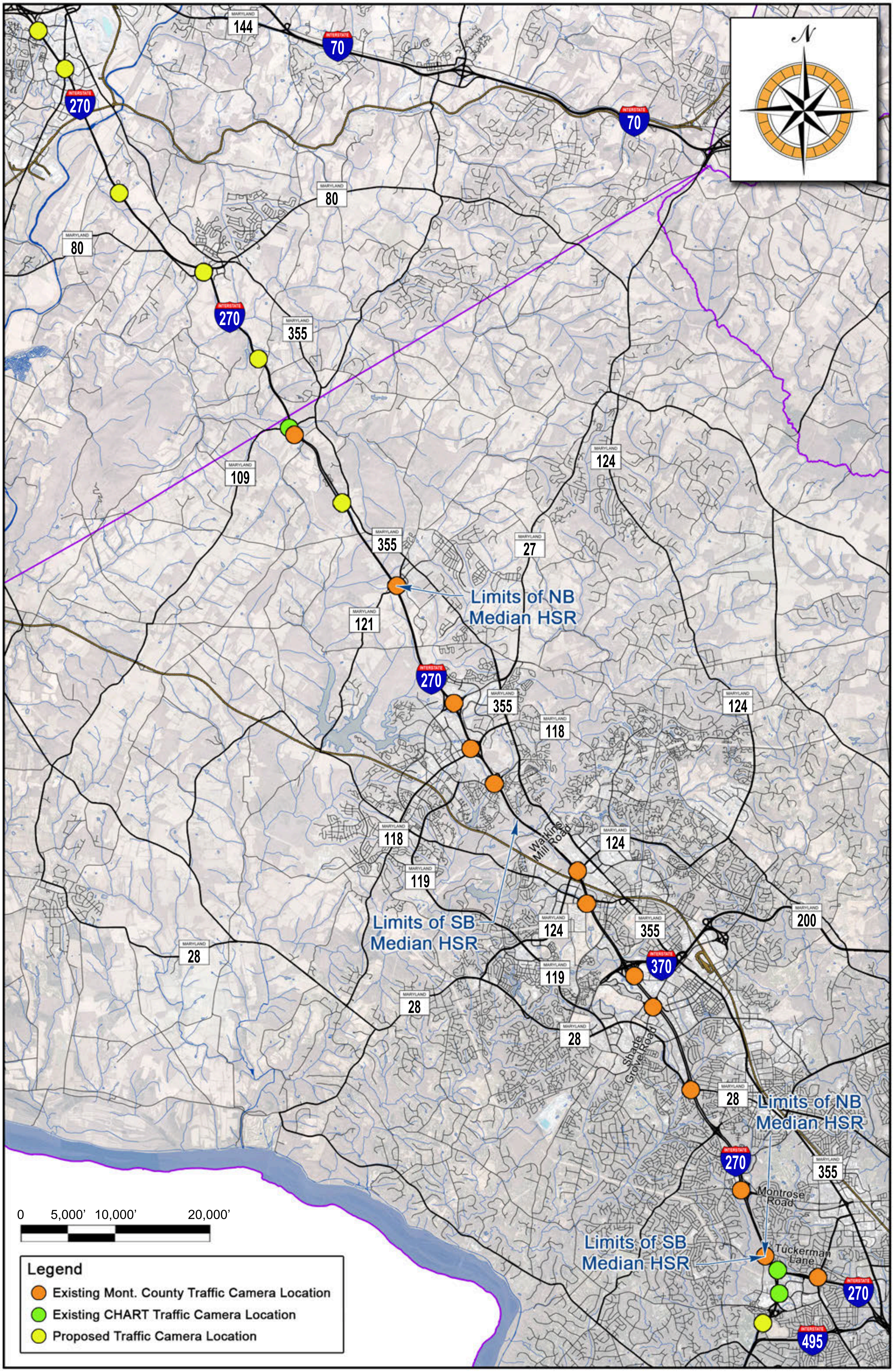
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Tuckerman Lane
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Legend
Existing Mont. County Traffic Camera Location
Existing CHART Traffic Camera Location
Proposed Traffic Camera Location

Larry Hogan, *Governor*
Boyd K. Rutherford, *Lt. Governor*

State Highway Administration
Maryland Department of Transportation

Pete K. Rahn, *Secretary*
Gregory C. Johnson, P.E., *Administrator*

November 16, 2016

Mr. Benjamin J. Carnazzo
Kiewit Infrastructure Co.
7250 Parkway Drive, Suite 310
Hanover MD 21076

Dear Mr. Carnazzo:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 6 for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on November 4, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract and there is no objection to installing additional traffic management devices that are compatible with the CHART system.
2. Section B, Location: Please address the current sign inventory on I-270 and assure the proposed locations can be built in compliance with the sign spacing standards of the Manual of Uniform Traffic Control Devices.
3. Please address how the identified DMS locations would work as an integral part of the overall corridor solutions being proposed in other PTCs, such as PTC 1B.
4. Section C, Potential Impacts: Under User Impacts, one of the objectives listed is "quicker detection." In the CHART Traffic Incident Management process, cameras are not used to detect incidents, they are used to monitor the progress of incident response. The intended use of the cameras drives the design process.
5. Section E, Administration Risk: Since the PTC indicates that these devices will be added to the CHART system, the Administration would need to confirm that the current CHART architecture can support the additional devices. Also, the Administration would need to assure that all communication protocols are fully compatible with CHART. Although there are standards, there can be subtle protocol inconsistencies with certain products that can make integration difficult. The Administration has had this issue with new ITS devices in the past.
6. Page 5, CCTV Map: If this PTC is resubmitted, please identify Montgomery County cameras as separate from CHART cameras, since the Administration does not have Pan, Tilt, Zoom (PTZ) control of these sites.

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Frank DiGilio, Kiewit Infrastructure Co.

PTC 7 – Ultra-Thin Bonded Wearing Course (UTBWC) as an Alternative Surface Treatment

AECOM

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January 19, 2017

Mr. Jason A. Ridgway, P.E.
Director, Office of Highway Development
Maryland Department of Transportation
State Highway Administration
707 N. Calvert Street
Baltimore, MD 21202

Subject: **Proposed Technical Concept No. 7** Comment Responses
IS-270 - Innovative Congestion Management Progressive Design Build
Contract No. MO0695172

Dear Mr. Ridgway

The Kiewit/AECOM team is in receipt of the comments that the Maryland Department of Transportation's State Highway Administration (SHA) provided on November 16, 2016 on Proposed Technical Concept (PTC) No. 7 for the IS-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by our team on November 4, 2016. We appreciate the opportunity to provide point-by-point responses to your comments, and address them in the revised PTC No. 7 that is included as an Appendix of the Technical Proposal. Your comments have been repeated for convenience, and the responses are in bold.

THE KIEWIT/AECOM TEAM IS INCLUDING PTC 7 IN "THE PROJECT" AND TECHNICAL PROPOSAL.

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract; however, the use of an Ultra-Thin Bonded Wearing Course (UTBWC) as a surface course will be subject to the condition of the existing surface course as specified in the MDSHA Pavement and Geotechnical Design Guide.

   Response: The Kiewit/AECOM team understands that the use of UTBWC will be subject to the condition of the existing surface course as specified in the MDSHA Pavement and Geotechnical Design Guide.

2. Please identify what type of permanent pavement markings will be used on the UTBWC.

   Response: The Kiewit/AECOM team is proposing to use thermoplastic pavement markings in the permanent condition.

3. Based on the narrative provided in Section A (Description) and Section B (Location), the UTBWC is proposed in the express and local lanes. However, the typical sections (Figure 1 to 3) shows the use of UTBWC on the express lanes only.

   Response: The roadway will be resurfaced in areas where restriping is necessary only. The words "as applicable" limit the use of UTBWC to only areas where restriping is necessary.

We appreciate the opportunity to provide responses and revise PTC No. 7 accordingly.

Yours sincerely,

Chris McGuire, PE
Vice President, Maryland Surface Transportation
AECOM
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E: chris.mcguire@aecom.com

A. Description

Detailed descriptive information and other appropriate information as appropriate such as conceptual drawings, production details, standards, specifications, and traffic operations analysis.

This Proposed Technical Proposal (PTC) includes the use of an Ultra-Thin Bonded Wearing Course (UTBWC) surface treatment for the proposed roadway resurfacing along the IS-270 corridor, including express and local lanes. This PTC only applies in areas of pavement marking alterations as a result of maintenance of traffic shifts for construction and for placement of lane lines in their final configuration. Thermoplastic pavement markings can be applied to this surface treatment, and the Kiewit/AECOM team is proposing to use them in the permanent condition. IS-270 (express lanes or C-D lanes) will be resurfaces using UTBWC only in sections of the roadway where restriping is necessary.

UTBWC is an innovative, technically sound and industry accepted alternative to the conventional 1.5” to 2” grinding and resurfacing of existing asphalt pavement. The proposed alternative will offer substantial savings both in terms of direct construction costs and associated road user costs as a result of shorter construction timeframes.

The process is comprised of a polymer modified asphalt emulsion spray followed directly by a pre-coated ultrathin (5/8” to 3/4“) gap-graded asphalt pavement, providing a high quality durable skid resistant surface, whilst the polymer asphalt membrane seals and protects the surface of the existing pavement and provides superior bonding of the ultra thin mix to the existing pavement. The superior bonding is established by embedding the pre-coated gap graded mixture into the asphalt membrane, eliminating the potential for debonding and delamination typically associated with open graded friction course (OGFC) surface treatments.

Construction duration for installation is significantly reduced due to the minimal grinding required, the thin cross section resulting in high yields, and inherent nature of a wearing course which requires reduced compaction effort. Traffic safety is improved as there are limited bumps and dips created by multilane grinding and resurfacing passes causing uneven lanes. Traffic can be returned to the pavement within hours of placing, thus reducing user delays by reducing the need for extended road closures. UTBWC retains clearances under bridges and overpasses thus eliminating the need for additional construction operations typically associated with traditional overlays. Finally, the bonded wearing course will provide the ability to install the permanent markings in the new configuration on a brand-new monolithic pavement surface.

Another advantage associated with this alternative surface treatment is a reduction in tire noise and a reduction in back spray, decreasing hydroplaning and improving visibility in wet weather conditions. A disadvantage of any surface treatment of this type or treatments serving similar functions is the need to provide proactive and more vigorous deicing strategies during inclement weather due to the rapid freeze potential of the open pavement structure. This however, has not deterred states, including Maryland, from utilizing this technology. Many states, including Maryland, are proactively pre-treating all of their interstates in advance of inclement weather regardless of the pavement type.

The proposed process has been used with great success by various road authorities such as Caltrans, TXDOT, and MASSDOT on high volume roadways with some sections that were constructed 9 to 12 years ago and which are still performing well. In fact, Maryland State Highway Administration (SHA), as recently as this year, has advertised projects to implement UTBWC at various locations in Districts 1, 2, 4, and 5. The use of this alternative by SHA confirms that it is an approved alternative when utilized on properly selected candidate roadways, of which IS-270 is due to its recent rehabilitations and hence, it's perceived residual structural capacity. Appendix A includes specifications from the Invitation for Bid book for SHA Areawide Contract XY2495E77 – Ultra-Thin Bonded Wearing Course (UTBWC) at Various Locations in Anne Arundel, Calvert, Charles and St. Mary's Counties.

Conceptual Typical Sections showing UTBWC versus conventional grind and resurface options are shown in Figures 1-3.

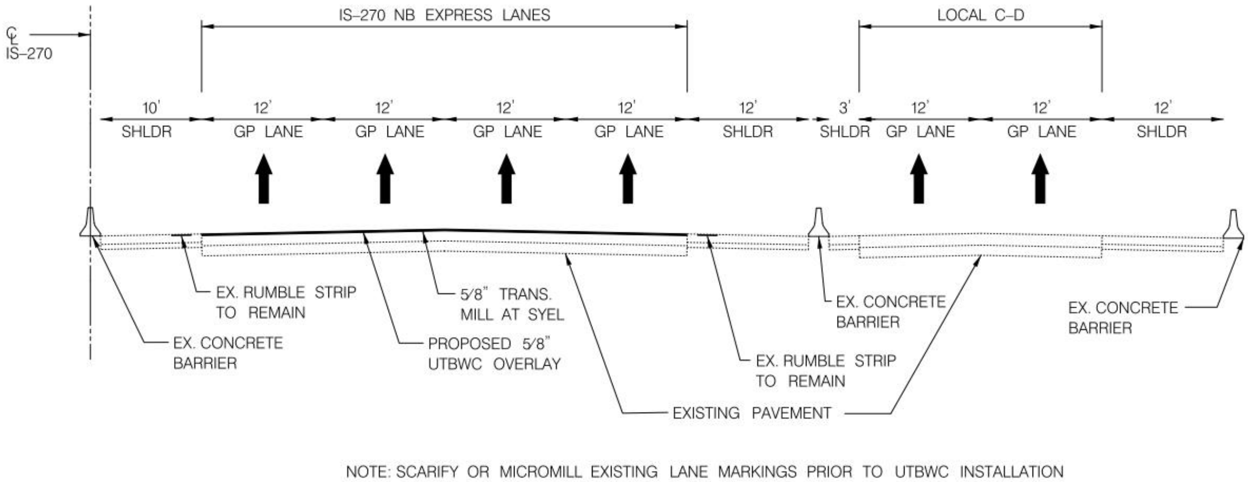


Figure 1 - UTBWC Typical Section - Retain Existing Shoulders

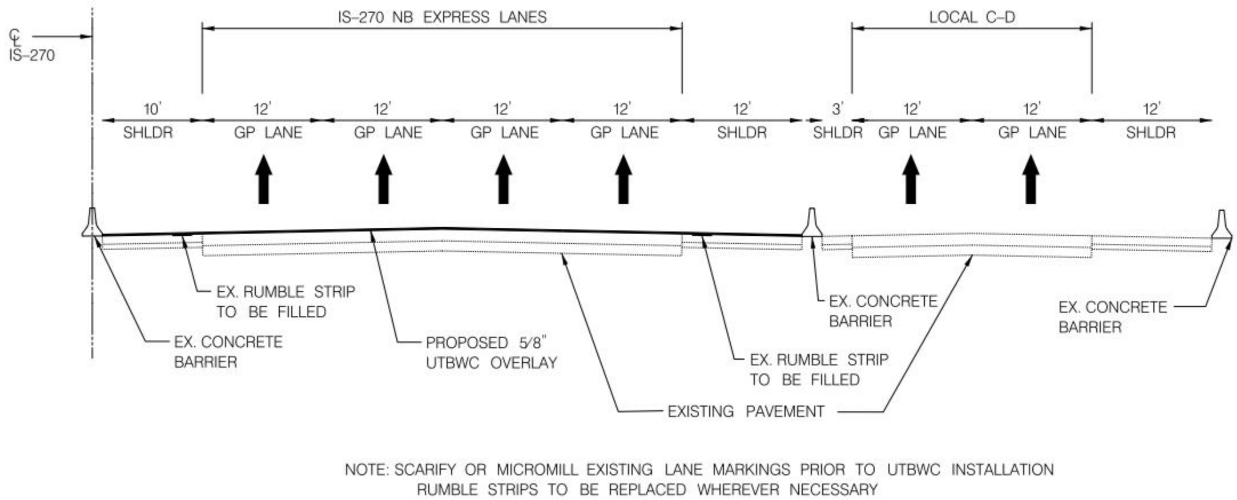


Figure 2 - UTBWC Typical Section - Resurface Existing Shoulders

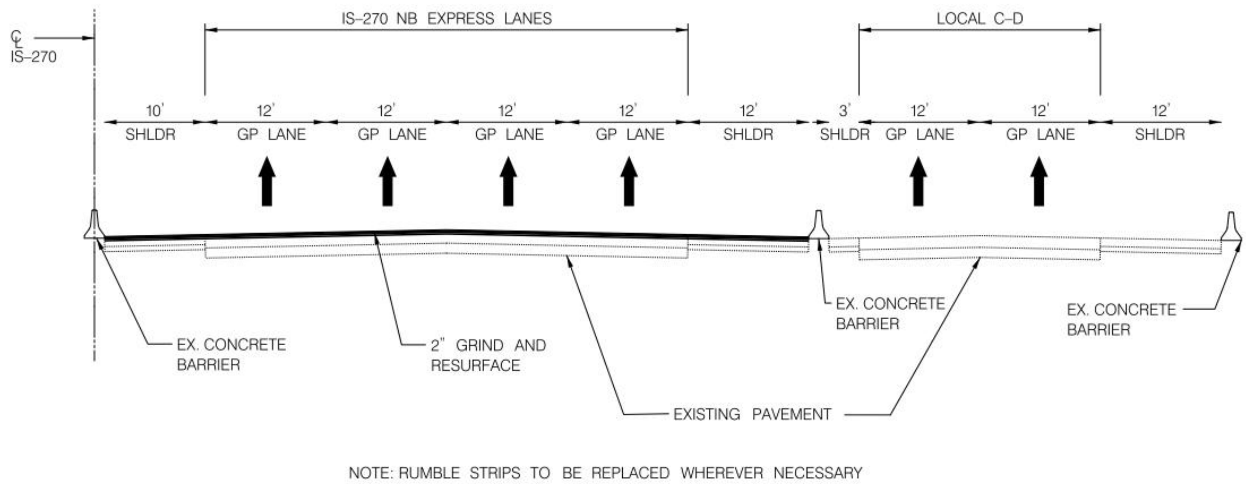


Figure 3- Conventional Grind and Resurface Typical Section

B. Location

The locations where, and an explanation of how, the PTC will be used on the Project.

The UTBWC surface treatment will be implemented along the existing northbound and southbound travel lanes and hard running shoulders from south of Watkins Mills to north of Tuckerman Lane and possible other locations where resurfacing associated with auxiliary lanes and pavement marking changes to improve traffic flow. The UTBWC will be used for all the Proposed Technical Concepts. The treatment is also expected to be utilized, as applicable, on the C-D lanes adjacent to IS-270. In a location where the existing shoulder is not traffic bearing and needs a full depth patch, the UTBWC will be placed on top of the patch to provide a homogenous surface across all lanes.

C. Analysis

Analysis justifying the use of the PTC including how it advances the project goals.

UTBWC offers a cost effective solution as a surface treatment/wearing course by providing the following benefits:

- Durable waterproof seal to existing surface micro cracks from oxidation
- Restores and improves skid resistance
- Reduces user delays with quick, one-pass construction, allowing almost immediate reopening to traffic
- Retains curb and concrete barrier reveals and clearances under bridges and overpasses, due to need for minimal grinding
- Facilitates quick and safe construction joints following end-of-day work with very minimal drop-offs between lanes
- Reduces back spray and improves visibility in wet weather
- Reduces tire noise

Some of the disadvantages of using UTBWC include the need for proactive and more vigorous deicing strategies during inclement weather, and specialty contractors and equipment for installation. Although both issues are addressed by current Administration practices and/or contracts.

D. Potential Impacts

A preliminary analysis of potential impacts (both during and after construction) including but not limited to use impacts, Right-of-Way, geotechnical, utilities, environmental permitting, local community, safety, and life-cycle project and infrastructure costs, including impacts on the cost of repair, maintenance, and operation.

User Impacts - There will be positive impacts on traffic operations along IS-270, due to the expedited construction activities and the fact that roadway can be reopened to traffic almost immediately after construction. Work can be executed during off-peak periods and at nighttime, further reducing the potential impact of road user delays.

Right of way (ROW) – There are no associated ROW impacts with this method, since all activities will take place within the existing roadway footprint.

Geotechnical – Paramount to the successful implementation of UTBWC surface treatments is the need for such treatments to be placed on structurally sound pavement structures. The state's thorough design process and preventative maintenance program indicate that IS-270 should be structurally sufficient and it visually appears to be in good condition.

In areas where the existing pavement depths are insufficient or the structural support is inadequate for the proposed traffic volumes, such as along the existing shoulders, structural improvement will be required before the final UTBWC surface is applied.

Utilities – In a conventional grind and resurface process, grinding at utility structures, inlets and manholes impede the use of large scale grinding equipment and are often reset. Due to the thin section, UTBWC eliminates the need for grinding around the utility structures. Grinding around catch basins is not necessary.

Environmental Permitting – UTBWC reduces road noise (some instances could be as much as 5 dBA), which is significant, even though it does not meet FHWA requirements for noise abatement. The gap graded structure will reduce the rate of run-off during a rain event.

Local Community – There will be minimal impact to residential and commercial communities during construction, since the work will take place within the existing roadway footprint.

Safety – Safety during construction is improved due to the reduced construction timeline, and reduced 'step' thickness during uneven lane situations. Safety in the permanent conditions is improved due to the increased frictional benefits and reduced back spray during rain events. During snow events, there is a need for pre-treatment to prevent snow bonding and early freeze events.

Infrastructure costs – Costs are project specific and highly dependent on experience and use of UTBWC in the state. Costs will be based on the recently advertised SHA contracts in four districts throughout the state. User delay cost is lower compared to a conventional asphalt overlay, due to the expedited construction timeframes.

Maintenance – Maintenance of UTBWC is a process similar to any asphalt concrete wearing courses.

- Patching can be completed using traditional asphalt products. A damming effect may occur if extensive runs of patches are necessary, but can be overcome by extending the patch to the adjacent lane towards the crown.
- Cleaning is often restricted to the shoulders as the high traffic volumes and speed typically will remove much of the debris due to pore pressure development from the vehicles tires; however, along shoulders where traffic is minimal, regenerative vacuum sweeping can be utilized.
- Chemical spills of petroleum products can degrade the surface, however the thick asphalt membrane will generally protect the underlying asphalt pavement from deterioration if a quick response and clean-up can be performed.

E. Other projects

A description of other projects on which the PTC has been used, the degree of success or failure of such usage, and the names and contact information (including telephone numbers and e-mail addresses) of project owner representative who can confirm such statements.

- MDSHA – D1 - Contract No. XY2495C77 – Various Locations (Dorchester, Somerset, Wicomico and Worcester) - 2016
- MDSHA – D2 - Contract No. XY2495A77 – Various Locations (Caroline, Cecil, Kent, Queen Anne's and Talbot) - 2016
- MDSHA – D4 - Contract No. XY2495B77 – Various Locations (Baltimore and Harford) – 2016
- MDSHA– D5 - Contract No. XY2495E77 – Various Locations (Anne Arundel, Calvert, Charles and St. Mary's Counties) – 2016
- CALTRANS - District 7 - Rt 66 - Constructed in 2005 – still performing satisfactory.
- CAL TRANS – Various Locations - extensive use since the mid 1990's.
- TX DOT - US 281 - constructed early 2002
- MassDOT – State Route 3 (I-95 in Burlington, MA to NH State Line) - 120 lane miles in 2015
  Point of Contact: Edmund Naras (Chief Pavement Engineer)

  MassDOT Highway Engineering
  Pavement Management Section
  10 Park Plaza, Room 4210
  Boston MA 02116
  Tel.: (857) 368-8989
  E-mail: Edmund.Naras@dot.state.ma.us

  Kevin Fitzgerald (Pavement Engineer)

  MassDOT Highway Engineering
  Pavement Management Section
  10 Park Plaza Room 4210
  Boston MA 02116
  Tel.: (857) 368-8990
  Email: Kevin.FitzGerald@dot.state.ma.us

- NH DOT – Interstate I-93/I-293 (Manchester, NH) - 20 lane miles in 2016
- NH DOT – various projects on state primary and arterial routes from 2012-2016

Point of contact: Eric Thibodeau (Chief Engineer - Pavement Management)

New Hampshire Department of Transportation
Bureau of Materials and Research
P.O. Box 483, 5 Hazen Drive
Concord, New Hampshire 03302-0483
Email: ethibodeau@dot.state.nh.us

Deirdre Nash (Pavement Data Management Engineer)

Tel.: (603) 271-1662
Fax: (603) 271-8700
Email: dnash@dot.state.nh.us

F. Administration Risk

A description of risk to the Administration or third parties associated with implementing the PTC.

No risk to the Administration is anticipated, since SHA is already using UTBWC in four districts across the state.

G. Design-Builder Risk

A description of risk to the Design-Builder associated with implementing the PTC.

Although BWC's were constructed since late 1990's early 2000 use in all states have been limited albeit increasing in recent years with the termination of the nova chip patent in 2013. The installation process is simple and straight forward, but requires specialist surfacing contractors with specialized equipment to be installed.

Local contractors are available and technical experience within AECOM exists to facilitate design, specifications and construction oversight. AECOM pavement engineers have had first-hand experience in both the NHDOT and MassDOT projects due to their proximity to each location and ongoing collaboration with both state's pavement management groups.

H. Cost/Schedule Benefits

Discussion of any cost or schedule benefits to this contract from usage of this PTC

An in-house study of surface treatment alternatives was performed by NHDOT in 2013 which compared estimated annual service life of different surface treatment options, including UTBWC. The results indicate that UTBWC and a conventional 1.5" grind and resurface operation have similar expected service lives at 12 and 13 years respectively. Based upon conceptual costs a lane mile of UTBWC would cost $7.50/SY while the conventional approach would cost $8.51/SY. Thus the surface treatment has an annualized cost of $0.63/SY/year versus $0.85/SY/year, which results in 35% saving. The actual cost of a bonded wearing course may be slightly lower with the higher quantities and increased use of this method. Unit costs from SHA's Areawide contracts in Districts 1, 2, 4 and 5 will be utilized to develop a more complete cost comparison.

Construction duration for installation is significantly reduced due to the minimal grinding required, the thin cross section resulting in high yields, and inherent nature of a wearing course which requires reduced compaction effort. In addition, user delay cost is lower compared to a conventional asphalt overlay, due to shorter construction duration.

I. Miscellaneous

Any additional information that would assist the Administration in the review of this PTC.

Asphalt Rubber Ultra-Thin Bonded Wearing Courses (AR-UTBWC) is a technology that has been used across the country with great success. Recent termination of proprietary patents has led to increased use of the technology. The reduction to cost, schedule, and user impacts over conventional methods are not in-question and the benefits largely outweigh the disadvantages.

Additionally, SHA advertised 4 contracts including this item in the current fiscal year for various locations in Districts 1, 2, 4, and 5. This indicates that SHA has high levels of confidence in the alternative when used on appropriate candidate roadways.

Appendix A

UTBWC Specifications

CATEGORY 500
PAVING

SECTION 500 — ULTRA THIN BONDED WEARING COURSE

DESCRIPTION. Apply a Polymer Modified Emulsion Membrane then overlay immediately with a thin Gap-Graded Stone Matrix Asphalt (GGSMA) mix. The application of these two materials per this Special Provision is referred as an Ultra Thin Bonded Wearing Course.

MATERIALS.

Asphalt Pavement	504
Gap-Graded Stone Mix Asphalt	506
Ultra Thin Bonded Wearing Course	900
Aggregate	901
Performance Graded Asphalt Binders and Asphalt Mixes	904
Crack Filler/Sealer	911.01
Production Plants	915

Mix Design. Submit a mix design for the Ultra Thin Bonded Wearing Course for approval to the Office Materials Technology's (OMT) Asphalt Technology Division at least 30 days prior to placement. Work will not be allowed to commence without approval.

CONSTRUCTION

Quality Control Plan. Submit a Quality Control Plan (QCP) to the Engineer and the OMT's Asphalt Technology Division for approval at least 30 days prior to construction. The QCP shall contain the following:

(a) A list of technicians working on the project and their qualifications

(b) Equipment to be used and current equipment calibration data

(c) Method used to calculate the Mean Texture Depth of the existing pavement

(d) Other requirements per 504.03.

The QCP shall show the methods proposed to control the equipment, materials, and overall operation to ensure conformance with these specifications. Discuss the QCP requirements in the pre-pave meeting.

Demonstration Strip. Construct a demonstration strip of at least 100 tons outside the project limits to demonstrate that a satisfactory Ultra Thin Bonded Wearing Course can be produced and placed before proceeding with the actual work. Construct a new strip if a project carries over to a new season or whenever there is a change in the mix design.

Equipment. Refer to 504.03.01 and the following.

(a) Paver. Use a self-priming paver that consists of the following, minimum:

(1) receiving hopper,

(2) feed conveyor,

(3) storage tank and measuring system for polymer modified emulsion membrane,

(4) high-metered pressure spray bar,

(5) a variable width, heated, vibratory-tamping bar screed.

The self-priming paving machine must be capable of spraying the polymer modified emulsion membrane, applying the GGSMA, and screed the surface of the mat to the required profile in one pass at a rate between 30 and 100 feet per minute.

(1) The paver must be able to apply the GGSMA within 5 seconds of the application of the polymer modified emulsion membrane.

(2) The spraying system must be able to continuously monitor the application of the polymer modified emulsion membrane at the desired application rate to ensure a uniform application across the entire width of the paving and paving speeds.

(3) The screed must be able to provide positive and negative cross-slopes and have vertically and horizontally adjustable extensions to meet the desired pavement profile.

(b) Rollers. Use steel-wheeled double-drum rollers weighing at least 10 tons equipped with functioning water systems and scrapers to prevent material from adhering to the drums.

Weather Restrictions. Refer to 504.03.02. Placement of Ultra Thin Bonded Wearing Course will be permitted only when the ambient and surface temperatures are at least 50 F.

Surface Preparation. Refer to 504.03.03. Remove thermoplastic pavement markings in accordance to 565. Fill and seal cracks greater than 3/8” in width and apply asphalt repair mastic as specified in 510. Remove existing raised and recessed pavement markers. Protect and cover manhole covers, drains, grates catch basins and other such utility structures with plastic or building felt prior to paving and adjust their grade as directed. The surface of the area to be overlaid shall be dry and free of dirt, oil, and other foreign materials.

Placement. Apply the polymer modified emulsion membrane and the Ultra Thin Bonded Wearing course as specified and as follows:

(a) Spray the polymer modified emulsion membrane immediately prior to the application of the GGSMA.

(b) Use a metered mechanical pressure spray bar at a temperature of 140 to 180 F to apply the polymer modified emulsion membrane uniformly across the entire pavement width.

(c) The Contractor may use Mean Texture Depth results in conjunction with recommendations from the emulsion supplier to determine the design application rate of the polymer modified emulsion membrane so that pavement texture conditions are considered. Spray the polymer modified emulsion membrane at the rate specified in the mix design submission (typical ranges vary between 0.20 gal/yd² ± 0.07 gal/yd²).

(d) Monitor the emulsion storage tank, measurement equipment, spraying bar, and application rate of polymer modified emulsion membrane at all times Make adjustments based upon the existing pavement surface conditions and recommendations of the polymer modified emulsion membrane supplier.

(e) Do not allow wheels, other parts of the paving machine, or any vehicles to operate on the polymer modified emulsion membrane before the application of the GGSMA.

(f) Use a material transfer vehicle for the GGSMA during the paving operations.

(g) Apply the GGSMA at the specified temperature per the mix design submission and at the specified thickness. Measure the minimum placement temperature (275 F) in front of the screed.

Cease all paving operations if a stoppage results in improper application or breaking of the polymer modified emulsion membrane, or if the mat cannot be compacted appropriately. Paving operations may proceed only with approval.

Rolling. Roll the Ultra Thin Bonded Wearing Course in static mode and as follows:

(a) Roll the course a minimum of two passes and a maximum of three before the material temperature falls below 185 F. Do not allow the rollers to stop on freshly placed courses.

(b) An approved release agent may be required to prevent adhesion to the roller drum and wheels.

(c) Open pavement to traffic after the rolling is completed and the material has cooled below 140 F or as directed.

Pavement Profile. Refer to Section 535.

Sampling and Testing for Mixture. Refer to 504.03.11.

Sampling and Testing for Density. Sampling and testing for density is not required. Conduct rolling operations as specified to achieve density.

Sampling and Testing of Polymer Modified Emulsion Membrane. Sample the polymer modified emulsion at least once a day during paving. Polymer modified emulsion membrane material must meet the specified properties. Cease paving operations if two consecutive samples fail until sampled polymer modified asphalt emulsion meets all required properties. Paving operations may proceed only with approval.

MEASUREMENT AND PAYMENT. Ultra Thin Bonded Wearing Course will be measured and paid for as follows:

Payment will be full compensation for furnishing, hauling, placing all materials, setting of lines and guides where specified, removal of pavement markings, removal of raised and recessed pavement markings, covering and adjusting utilities, pavement texture measurement, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

(a) The GGSMA for Ultra Thin Bonded Wearing Course will be measured and paid for at the Contract unit price per ton, complete and in place.

(b) The Polymer Modified Emulsion Membrane for the Ultra Thin Bonded Wearing Course will be measured and paid for at the Contract unit price per gallon, complete and in place.

(c) Crack sealing, crack filling, and asphalt repair mastic will be measured and paid for as specified in 510.

(d) Material produced for the control strips will not be measured but the cost will be incidental to the item Ultra Thin Bonded Wearing Course.

Price Adjustment for Asphalt Binder in Gap-Graded Stone Mix Asphalt. Refer to 506.04.01.

Payment Adjustments for Asphalt Mixture. Refer to 504.04.02

Payment Adjustments for Polymer Modified Emulsion Membrane. The Contract unit price per gallon of polymer modified emulsion membrane will be reduced 10 percent for each ±0.04 gal/yd^2 that the application rate deviates from the approved design application rate for polymer modified emulsion membrane as determined. Remove and replace any Ultra Thin Bonded Wearing Course that deviates more than ±0.09 gal/yd^2 from the design application rate or when the application rate falls below 0.10 gal/yd^2 at no cost.

Dispute Resolution. Refer to 915.02.03.

CATEGORY 900
MATERIALS

SECTION 900 —ULTRA-THIN BONDED WEARING COURSE

Ultra Thin Bonded Wearing Course (UTBWC) shall conform to the applicable sections of 901, 904, and the following:

Mix Design Approval. Submit mix design data and appropriate amount of materials to be used at least 30 days prior to beginning paving operations. The mix design must contain a target application rate for the polymer modified emulsion membrane that takes into account both the mix design and the texture of the pavement surface to be paved.

Polymer Modified Emulsion Membrane. Provide a polymer modified emulsion membrane meeting the following requirements:

Polymer Modified Emulsion Membrane			
Property	**Test Method**	**Minimum**	**Maximum**
Viscosity, Saybolt Furol at 77 °F, s	T 59	20	100
Storage stability test[A], 24h, %	T 59	—	1.0
Sieve test, %	T 59	—	0.05
Residue by distillation[B] , %	T 59	63	—
Oil distillate by distillation, %	T 59	—	2.0
Demulsibility %, 12 oz, 0.8% dioctyl sodium sulfosuccinate	T 59	60	—
Tests on residue from distillation:			
Penetration, at 77 °F	T 49	60	150
Solubility in trichloroethylene, %	T 44	97.5	—
Elastic recovery, at 77 °F, %	T 301	60	—

[A] After standing undisturbed for 24 h, ensure the surface has a smooth, homogenous color.
[B] T 59, except at no greater than 392 °F ± 9 °F for 15 min

Gap-Graded Stone Matrix Asphalt (GGSMA) for UTBWC. Provide a GGSMA mix meeting the following requirements:

Aggregate Gradation

Sieve Size	Mixture Control Tolerance, %	Design Gradation Limits, % Passing	
		Type B, 9.5 mm Size	Type C, 12.5 mm Size
3/4 inch [19.0 mm]	–	100*	100*
1/2 inch [12.5 mm]	–	100*	85 – 100
3/8 inch [9.5 mm]	±6	85 – 100	60 – 80
No. 4 [4.75 mm]	±5	28 – 42	28 – 38
No 8 [2.36 mm]	±4	21 – 33	25 – 32
No. 16 [1.18 mm]	±4	14 – 24	15 – 23
No. 30 [600 μm]	±4	9 – 20	10 – 18
No. 50 [300 μm]	±3	6 – 15	8 – 13

No. 100 [150 µm]	±2	5 – 11	6 – 10
No. 200 [75 µm]	±2	3 – 7	4 – 7

*Control Tolerance not applicable to this sieve for this mix.

Aggregate Physical Properties. Supply aggregate meeting the physical properties listed in Section 901 Table D. Fine aggregate (passing the 4.75mm sieve) shall also meet the following:

Fine Aggregate Requirements
GGSMA (Ultra Thin Bonded Wearing Course)

Test	Method	Limit
Sand Equivalent	T 176	≥ 45
Uncompacted Void Content	T 304	≥ 40
Bulk Specific Gravity	T 84	–

Crushed glass, roofing shingles, RAP or other recycled materials are not allowed in Ultra Thin Bonded Wearing Course.

Asphalt Binder and GGSMA Properties

Property	Test Method	Tolerance	Requirement	
			9.5 mm Size	12.5 mm Size
Asphalt Binder Grade	M 332	–	PG 76-22[1] or PG64E-22[1]	
Asphalt Content, %	T 308	±0.4	10µm of film thickness[2]	
Drain-down, %	T 305	–	<0.10	
Moisture Susceptibility, %	T 283	–	80 Min[3]	

[1] Mineral Fibers used at 0.4% of total mix, Cellulose, 0.3% of total mix, or approved stabilizer system per 904.05
[2] Asphalt content target for Gap-graded mix design shall aim for an estimated film thickness of 10µm (per Asphalt Institute MS 2, Table 6.1). Typical asphalt contents vary from 4.8 to 6% for 9.5mm mixes (Type B), and 4.6 to 5.6% for 12.5mm mixes (Type C).
[3] Specimens compacted in accordance with AASHTO TP 4 @ 100 gyrations

Larry Hogan, *Governor*
Boyd K. Rutherford, *Lt. Governor*

SHA State Highway Administration
Maryland Department of Transportation

Pete K. Rahn, *Secretary*
Gregory C. Johnson, P.E., *Administrator*

November 16, 2016

Mr. Benjamin J. Carnazzo
Kiewit Infrastructure Co.
7250 Parkway Drive, Suite 310
Hanover MD 21076

Dear Mr. Carnazzo:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 7 for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on November 4, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract; however, the use of an Ultra-Thin Bonded Wearing Course (UTBWC) as a surface course will be subject to the condition of the existing surface course as specified in the MDSHA Pavement and Geotechnical Design Guide.
2. Please identify what type of permanent pavement markings will be used on the UTBWC.
3. Based on the narrative provided in Section A (Description) and Section B (Location), the UTBWC course is proposed in the express and local lanes. However, the typical sections (Figure 1 to 3) shows the use of UTWBC on the express lanes only.

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Frank DiGilio, Kiewit Infrastructure Co.

PTC 8 – Advanced-Stage O-D Data & Connected Vehicles Infrastructure

AECOM

AECOM
7 St. Paul Street, 17th Floor
Baltimore, MD 21202, USA
aecom.com

January 19, 2017

Mr. Jason A. Ridgway, P.E.
Director, Office of Highway Development
Maryland Department of Transportation
State Highway Administration
707 N. Calvert Street
Baltimore, MD 21202

Subject: **Proposed Technical Concept No. 8** Comment Responses
IS-270 - Innovative Congestion Management Progressive Design Build
Contract No. MO0695172

Dear Mr. Ridgway

The Kiewit/AECOM team is in receipt of the comments that the Maryland Department of Transportation's State Highway Administration (SHA) provided on October 20, 2016, as well as on January 5, 2017 on Proposed Technical Concept (PTC) No. 8 for the IS-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by our team on October 13, 2016 and December 27, 2016, respectively. We appreciate the opportunity to provide point-by-point responses to your comments, and address them in the revised PTC No. 8 that is included as an Appendix of the Technical Proposal. Your comments have been repeated for convenience, and the responses are in bold.

THE KIEWIT/AECOM TEAM IS INCLUDING PTC 8 IN "THE PROJECT" AND TECHNICAL PROPOSAL.

Responses to October 20, 2016 Comments

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract.

   Response: No response required.

2. Please investigate and discuss any potential issues related to Invasion of Privacy. Ensure this type of data collection would be consistent with Maryland law, considering factors related to public awareness, education and perception. The SHA is concerned drivers unaware of data being collected from their phones, vehicles, devices, etc. could be deemed an invasion of privacy, rendering the data unusable.

   Response: Discussions with the WiFi/Bluetooth/DSRC manufacture have concluded that an additional level of encryption can, and will be added to the data collection that removes any personnel data being collected. Media Access Control (MAC) addresses collected are turned into arbitrary codes utilized for pairing analysis only. Actual MAC addresses have no ability to be made available to any users of the data collection/analysis process. We believe that personnel data will not be possible to be share or be viewed.

3. Some benefits/improvements in this PTC are to be rolled out in the future, after project completion. Please clearly distinguish between what would be rolled out later and what the Design-Build Team will deliver.

Response:

Final deliverables of this PTC include:

(1) Create an agreement with vehicle data provider Telogis to supply vehicle data, including, but not limited to speed, traction control, braking, ambient and pavement temperatures, wiper and emission, to both CHART and the University of Maryland CATT Lab. The agreement would span the length of the IS-270 Corridor Improvement Project.
   - **a. Integrate data into CATT Lab for corridor operational analysis.**
   - **b. Send potential corridor operational alerts from the CATT Lab / RITIS to the existing CHART ATMS for operator use. Alarm/Data transfer would be through existing data sharing agreements. Our System Integrator would work with CHART and the CATT LAB should any slight modifications are required for alarm integration.**
   - **c. Through an XML data feed, input to the CHART ATMS of vehicles along the IS-270 corridor that exhibit excessive braking, use of windshield wipers, and average pavement temperature and speed.**

(2) Installation of approximately 25 locations to co-locate WiFi/Bluetooth/DSRC equipment along with current microwave vehicle detection units along the corridor. These locations will be installed for approximately 5 years.
   - **a. Utilize existing cellular network connectivity to transmit data to the vender who is providing the field equipment.**
   - **b. Collect data for the first 3-6 months of the project and amend the current VISSIM model, based on O-D information.**
   - **c. O-D and link/segment data can be accessed by the Team and CHART through the vender's web page. No integration into CHART is required, just web access.**
   - **d. Determine fixed times for hard shoulder running (HSR) and reversible lanes, based on the data collected. Dynamic HSR would not be a part of the endeavor.**
   - **e. Continue to collect data for one-year after the installation of the HSR system. (We anticipate the HSR will be operational at NTP+4 years.) After one year, the data collected could be used to refine the HSR model and fixed times. We anticipate that the equipment will either be removed by the contractor, or operations and maintenance will be taken over by CHART.**

(3) Through our partner Systems Integrator, data from the field devices and Telogis will be integrated into the CATT Lab. Data integration will begin within the first 3 months of the project, or once an agreement with Telogis is created, and after the field devices are installed.

(4) Create a Memorandum of Understanding with adjacent counties to share O-D data for their use for potential signal timing enhancements. Signal timing enhancements are not covered under this project.

(5) At the end of the project, the team will transfer ownership of the WiFi/Bluetooth/DSRC field equipment to CHART for their use, after the 5-year period. The team will not be responsible for removing the devices. CHART would be responsible for any future payments to continue the analysis of O-D data and Telogis after this time frame.

4. Section C, Analysis, Mobility, second bullet: Please define "traffic signal changes." Also, CHART is unable to implement "traffic signal changes."

Response: This section has been updated as follows: "The information collected will also provide key data for true ICM applications, in which CHART will have the ability to share data with corridor counties to aide in their implementation of traffic signal changes/optimization along feeder arterials to IS-270, as well as balance freeway and arterial traffic. "

5. To achieve the project goals, the Design-Builder must provide a fully functional system at project completion. Integration is a critical component for the success of this PTC. Please discuss in detail how this PTC will be integrated. Section D. Potential Impacts should address impacts to CHART.

Response: Refer to response 3.

6. Section E, Other Projects: The projects listed have not implemented this PTC. For this section the RFP requests a description of other projects on which the PTC has been used and the degree of success it had. If this PTC has not been implemented on any other projects and its first use will be on I-270, please state this. However, during our PTC one- on-one meeting on October 17, 2016, your team noted the PTC appears to have been used in the state of Massachusetts, as well as in Maryland (albeit temporarily).

   Response: Our team has provided an additional list of 12 agencies who are currently utilizing this technology successfully. The list is included in PTC 8.

7. The Office of CHART & ITS Development, through its Statewide Operations Center (SOC) and regional District 3 Traffic Operations Center (TOC 3), acknowledges it will likely have a role in supporting the operations of any elements of an Advanced Traffic Management System (ATMS). This role will need to be consistent with technical capabilities of MDOT SHA's operations program. For the project to be a success, any PTC should reflect these capabilities.

   Response: Our System Integrator will work with CHART to verify that any data feeds / alarms will be in a format that can be integrated into the current ATMS. Meetings with SHA's ATMS provider would occur to verify the data is formatted correctly for proper system integration. It will be the responsibility of our System Integrator to work with the ATMS provider to assure proper integration.

8. Clearly describe how any ATMS system elements will operate to facilitate the overall solution's ability to meet the goals of the project.

   Response: It is envisioned that the O-D data, will be used to verify the HSR model, define appropriate times of use, and denote travel patterns. The O-D data will not be integrated into the CHART ATMS, but will operate as a stand-alone system, accessible by the team and CHART operations staff. Access will be web based, and utilize user log-in and password credential to review the O-D data. SHA would be able to access this data for their own use during device deployment. Refer to response 3 for further details.

   Telogis data will be used to alert CHART staff of potential and actual incidents. This notification will be utilized to provide faster response times and reduce incident duration, which helps increase the safety and mobility of the corridor.

9. The existing CHART ATMS resides within the security firewalls of the Maryland Department of Transportation (MDOT) Enterprise network. As such, any integration and data sharing between ATMS elements of the I-270 PTCs will need to comply with network security and system integration requirements as identified by MDOT and the Maryland Department of Information Technology (DoIT).

   Response: Refer to response 3. Our system integrator will work with CHART and DoIT to verify that if any data is transmitted to the ATMS, will be in compliance with current requirements. Currently, the CATT Lab has approved data sharing with CHART. Alarm data, based on Telogis data, will be generated and transmitted from RITIS, which already has access to share data with the ATMS software.

10. The development of the CHART ATMS software is conducted under a contract managed by the Office of CHART & ITS Development, with specific goals and separate contract requirements. Any modifications to the CHART ATMS software will be conducted under the CHART ATMS contract. Although integration between the CHART ATMS and I- 270 ATMS elements is feasible, proposers should not make the success of the I-270 Innovative Congestion Management project contingent on adding functionality to the CHART ATMS. Also note, the CHART ATMS is an information management and advisory system for coordination of response to events on the roadway system. As such, it has not been developed to operate safety sensitive devices (e.g. traffic signals) in real time, which would require robust, instantaneous communications and frequent feedback on device and system status.

    Response: Any data integrated within the CHART ATMS, would be strictly advisory/alarm based to notify operators of conditions that could produce potential roadway incidents. This information would be available to enhance the current CHART roadway operations and incident detection capabilities. At no time will the information from this PTC be utilized to operate safety sensitive devices, such as traffic signals.

11. The CHART system communicates with field infrastructure in two ways: through wireless modems for Dynamic Message Signs, Highway Advisory Radios, Roadway Weather Information Systems and Traffic Speed Sensors, and through a combination of T-1 and fiber optics for cameras streams. CHART accesses fiber optic communication as a customer of Network Maryland and T-1 services from local telecommunications providers. The telecommunications architecture of the CHART system does not currently utilize dedicated circuits for point-to-point connectivity between central servers and field devices. It is also important to note that the CHART system central servers currently reside in an MDOT data center in Glen Burnie; not at the Statewide Operations Center in Hanover, MD.

    Response: O-D and other data from this PTC, collected form proposed field devices will not use CHART telecommunication infrastructure.

Responses to January 5, 2017 Comments

1. The PTC should address coordination with the "Maryland Autonomous and Connected Vehicle Working Group". This group, headed by the Motor Vehicle Administration, has the Governor's charge to lead CV/AV policy development for Maryland. More information on this group is available at http://www.mva.maryland.gov/safety/Maryland-AC-CV.htm.

    Response: The team will definitely work with the Maryland Autonomous and Connected Vehicle Working Group to ensure that the goals of State of Maryland are also incorporated into the IS-270 project goals presented by our team, under this proposal. The working groups goals listed below are in-line with our proposals goals.

    - **Economic development**
    - **Innovation and technical advances**
    - **Safety**
    - **Resources and Partnerships**
    - **Academic Partnerships**
    - **Policy**

2. The I-95 Baltimore-Washington (B-W) Corridor concept mentioned on page 6 has already evolved into a formal application entitled "MDOT'S AUTOMATED VEHICLE RESEARCH AND PRODUCTION CORRIDOR Application for Designation of Automated Vehicle Proving Grounds Pilot", submitted to the USDOT on December 19, 2016. The corridor identified in the application extends from the Washington, DC city line up to Aberdeen, MD.

    Response: Our team is aware of the application for MDOT'S AUTOMATED VEHICLE RESEARCH AND PRODUCTION CORRIDOR. We look forward to working with, collaborating, sharing best practices, lessons learned, and experiences with the I-95 team to help Maryland becoming a world leader in AV-CV. Upon project award, we will immediately reach out the I-95 team and this collaborative partnership.

We appreciate the opportunity to provide responses and revise PTC No. 8 accordingly.

Yours sincerely,

Chris McGuire, PE
Vice President, Maryland Surface Transportation
AECOM
T: 410-637-1720
M: 443-386-6286
E: chris.mcguire@aecom.com

A. Description

Detailed descriptive information and other appropriate information as appropriate such as conceptual drawings, production details, standards, specifications, and traffic operations analysis.

The Kiewit-AECOM team is proposing the concept of an Advanced-Stage Origin and Destination (O-D) & Connected Vehicles Data Infrastructure implementation. The purpose of this concept is to "future-proof" new capacity provided by other PTCs and provide SHA and our team additional O-D and operational data to be utilized before, during and after any implementation of construction solutions. By implementing this PTC, SHA will enhance its current corridor planning model, be capable of evaluating any potential solution compared to real-time data, create the capability of utilizing the adjacent arterials more effectively, as well as to provide an additional method to determine real-time roadway operations, including potential incidents and roadway surface traction. All of these benefits promote mobility, safety, and operability throughout the corridor.

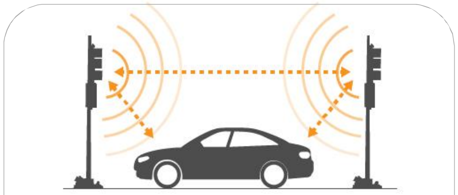
This implementation will establish SHA as a leader in Integrated Corridor Management (ICM) and Connected Vehicles/Smart Cities Transportation Technologies, and position SHA for the receipt of future FHWA grants that require these types of investments in connected/autonomous vehicles (CV/AV) technologies. While SHA is already a national leader in performance management, this prescribed data and performance driven solution will enable SHA to meet even more agency goals in serving customers through innovations in data and information, technology, and private sector partnerships.

This PTC will begin to deploy connected vehicles technologies, data, and other advanced data collection sensors in a cost-effective manner requiring less risk and investment than would otherwise be necessary. To achieve these goals, we will enhance the corridor through:

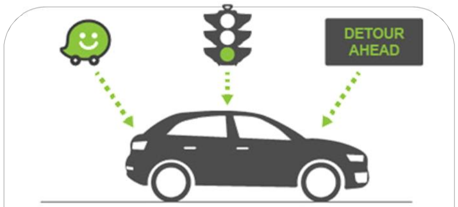
(1) Leveraging lower-cost, real-time *connected vehicle* data streams that are readily available from over one-million vehicles already on U.S. highways including those within the IS-270 project limits. This technology will provide SHA *real-time operational* data on where vehicles are turning, braking heavily, where traction control is engaged, weather and temperature information, and immediate crash notifications to help SHA respond quicker to incidents and thus minimize non-recurring delays that add to congestion.

1. Instant awareness from Connected Vehicles

(2) Supplementing current microwave detection with *affordable* roadside WiFi/Bluetooth (BT)/Dedicated Short Range Communication (DSRC) technologies at approximately 20 locations along I-270 to collect *real-time operational* data within the corridor. This will supplement volume, speed and occupancy corridor data by including O-D and vehicle specific data to provide real-time information of the corridor's operation. This data will allow SHA to know in real-time which routes commuters are taking, how they are rerouting during events, and how they are responding to information from SHA traveler information systems. This data can also be shared with Montgomery County DOT to help that agency retime signals when drivers divert onto arterials such as MD 355.



2. Wi-Fi/Bluetooth/DSRC probes for travel times, queuing, & O-D



3. Control flow and influence choices

(3) Adding the ability to change traffic flows with alerts and commands more quickly by:
   a. Advising drivers over improved information channels (e.g. partnerships with Google/Waze/INRIX/TomTom/HERE),
   b. Providing enhanced data to Montgomery County to aid in decision making for changing signal phasing and timing, and
   c. Integrating these new data sources with SHA's existing RITIS data platform for ingestion by CHART.

4. Archive, retrieve, report ROI & performance measures

(4) Archiving all incoming data flows, actions, etc., and provide data, tools, and intelligence in an open environment to planners, 3rd party developers and researchers. This will enable ongoing rate of return revisions, validation and improvement, continuous performance monitoring, and research activities for the entire IS-270 corridor to researchers at SHA and around the world.

Final deliverables of this PTC include:
(1) Create an agreement with vehicle data provider Telogis to supply vehicle data, including, but not limited to speed, traction control, braking, ambient and pavement temperatures, wiper and emission, to both CHART and the University of Maryland CATT Lab. The agreement would span the length of the IS-270 Corridor Improvement Project.
   a. Integrate data into the existing CHART ATMS as specific corridor operational alerts for staff.
   b. Integrate data into CATT Lab for corridor operational analysis.
   c. Through an XML data feed, input to the CHART ATMS of vehicles along the IS-270 corridor that exhibit excessive braking, use of windshield wipers, and average pavement temperature and speed.
(2) Installation of approximately 25 locations to co-locate WiFi/Bluetooth/DSRC equipment (Phased with WiFi/BT O-D equipment first being installed and then a combined WiFi/Bluetooth/DSRC unit replacing the original unit.) along with current microwave vehicle detection units along the corridor. These locations will be installed for approximately 5 years.
   a. Utilize existing cellular and network connectivity to transmit data back to CHART. Any new device locations will utilize wireless services.
   b. Collect data for the first 3-6 months of the project and amend the current VISSIM model, based on O-D information.
   c. Determine fixed times for hard shoulder running (HSR) and reversible lanes, based on the data collected. Dynamic HSR would not be a part of the endeavor.
   d. Continue to collect data for one-year after the installation of the HSR system. (We anticipate the HSR will be operational at NTP+4 years.) After one year, the data collected could be used to refine the HSR model and fixed times. We anticipate that the equipment will either be removed by the contractor, or operations and maintenance will be taken over by CHART.
(3) Through our partner Systems Integrator, integration of the data from the field devices and the CATT Lab (Telogis) data will begin within the first 3 months of the project, or once an agreement with Telogis is created, and after the field devices are installed.
(4) Create a Memorandum of Understanding with adjacent counties to share O-D data for their use for potential signal timing enhancements. Signal timing enhancements are not covered under this project.
(5) At the end of the project, the team will transfer ownership of the WiFi/Bluetooth/DSRC field equipment to CHART for their use, after the 5-year period. The team will not be responsible for removing the devices. CHART would be responsible for any future payments to continue the analysis of O-D data and Telogis after this time frame.

(6) The team will work with the Maryland Autonomous and Connected Vehicle Working Group to ensure that the goals of State of Maryland are also incorporated into the IS-270 project goals presented by our team, under this proposal. The working groups goals listed below are in-line with our proposals goals.

(7) Our team is aware of the application for MDOT'S AUTOMATED VEHICLE RESEARCH AND PRODUCTION CORRIDOR. We look forward to working with, collaborating, sharing best practices, lessons learned, and experiences with the I-95 team to help Maryland becoming a world leader in AV-CV. Upon project award, we will immediately reach out the I-95 team and this collaborative partnership.

B. Location

The locations where, and an explanation of how, the PTC will be used on the Project.

The below figure indicates current locations of SHA microwave vehicle detection system (MVDS) devices along I-270. Our team will augment current device locations by installing the WiFi/BT/DSRC unit at the same location or by installing the units on existing structures. Due to their low power consumption, these devices may run on DC/solar power, if adjacent power is not available. Combining equipment on existing infrastructure will reduce the overall installation cost.

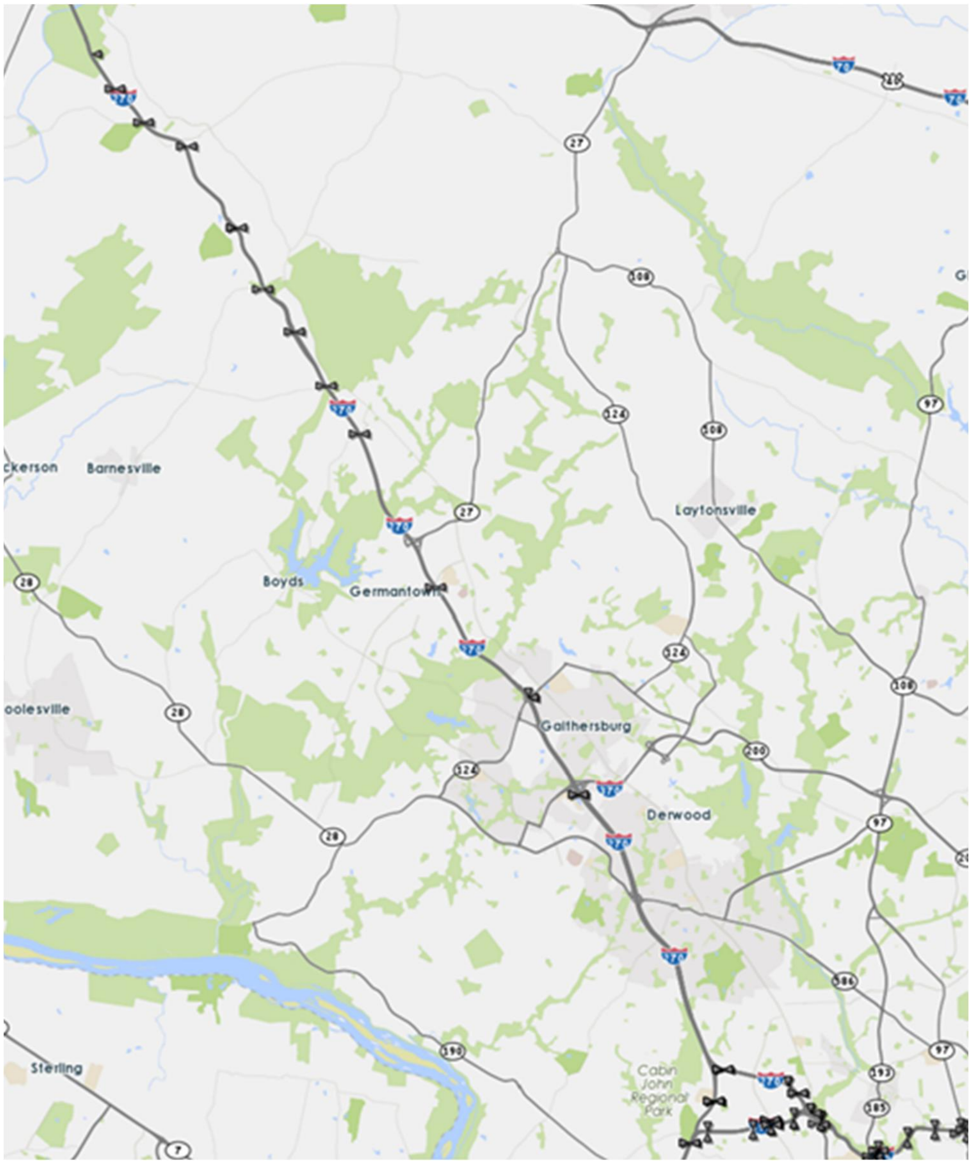


Figure 1 – Proposed Connected Vehicles and O-D Data Collection Locations

It is anticipated that these devices would be installed within the first few months after NTP on the project. The units would be operated and maintained by the Team during any construction and would be transferred to SHA at the conclusion of this contract.

The addition of real-time connected vehicle data streams do not require any field device installation, as data is received from cloud transfer services.

C. Analysis

Analysis justifying the use of the PTC including how it advances the project goals.

Through the use of this PTC, the Kiewit/AECOM team will be able to capitalize on the following 3 of 4 project goals:

- Mobility
  - o CHART will be able to better understand current operational conditions along the corridor, based on the real-time O-D data provided. From this, operational strategies, such as alternative route options, can be disseminated to motorists via dynamic message signs (DMS), 511, and Google/Waze.
  - o The information collected will also provide key data for true ICM applications, in which CHART will have the ability to share data with corridor counties to aide in the implementation of traffic signal changes/optimization along feeder arterials to IS-270, as well as balance freeway and arterial traffic.
  - o Reduction in delays. Conservative estimates that show approximately $84,000,000 is wasted in annual user delay cost on I-270 (based on Probe Data Analytics Suite – year 2015, assuming passenger vehicle value of time is $16.79/hour, and the commercial vehicle value of time of $86.81/hour (not including any ramps or adjoining arterials). The most modest increase in throughput and speeds has the potential to see a significant reduction in user delay cost well beyond the cost of this project in just a few years. This reduction would then further propagate to feeder/adjoining routes that would show even more benefits in the many tens of millions of dollars annually.
- Safety
  - o Real-time data from vehicles will provide CHART operations staff faster incident detection. In conjunction with previous PTCs, our team is looking to provide greater corridor video coverage, for situational awareness. Verification of any incident detected by real-time data provides quicker incident management response and clearance times. This reduces the overall incident time line, incident delay and the potential of secondary incidents. Not only will this have an impact on the corridor, but the adjacent arterials as well.
  - o Real-time data from vehicles will also provide roadway surface information, such as traction conditions during wet or icing conditions. This information would also be disseminated to motorists via DMS, 511, and Google/Waze.
- Operability
  - o The data collected will provide operability enhancements for planning staff. Planning personnel can track the change of vehicle volume and O-D in real-time to make current and future models more accurate, as well as to determine the effect of new development along the corridor.
  - o CHART operations staff will be automatically alerted to potential roadway surface conditions, a feature they currently do no possess, to provide quicker operations response.
- Privacy
  - o Discussions with the WiFi/Bluetooth/DSRC manufacture have concluded that an additional level of encryption can be added to the data collection that removes any personnel data being collected. Media Access Control (MAC) addresses collected are turned into arbitrary codes utilized for pairing analysis only. Actual MAC addresses have no ability to be made available to any users of the data collection/analysis process.

D. Potential Impacts

A preliminary analysis of potential impacts (both during and after construction) including but not limited to use impacts, Right-of-Way, geotechnical, utilities, environmental permitting, local community, safety, and life-cycle project and infrastructure costs, including impacts on the cost of repair, maintenance, and operation.

Operational Impacts

As noted above, useful data collected will enhance operations, safety and corridor mobility.

Shoulder closures, or temporary lane closures may be required for the installation of WiFi/BT/DSRC units.

This PTC will be installed in advanced of any major construction to determine existing base travel patterns, which then can be utilized during near-future roadway enhancements and construction monitoring. The deployment of this PTC is not expected to impact facility use during installation. Enhanced understanding of how users respond to construction will help SHA coordinate with local agencies and employers, understand work zone impacts, better respond to public information requests, and measure the positive impacts of PTC deployments after construction is complete.

Additional Metrics

The following are additional performance metrics that are inherent to or byproducts of the technologies we will be deploying. These will help inform SHA and its customers, and they will be part of the overall effort to fully quantify the benefits of our deployment:

Travel Time & Travel Time Reliability

Travel time and travel time reliability as experienced by the end user can be directly sampled by re-identification data from our Bluetooth/Wi-Fi technologies, while central tendencies are reflected by probe data. The data and approach provide the ability to benchmark performance by the hour and across time, show the portion of the travelers that experience good versus poor performance, and support all major forms of travel time and reliability metrics, such as Travel Time Index (TTI), Planning Time Index (PTI) and Buffer Time Index (BTI).

Driver Compliance Rates with Routing Advice

By combining O-D data with commercial connected vehicles data, CHART will be able to coordinate with local agencies through integrated, shared information. Network flows, rerouting, and the impacts of incidents and events are examples of such shared information. These data will be shared with commercial route guidance systems like Google/Waze—offering alternate route suggestions, and then actually measure what percentage of vehicles are taking their advice (or making up their own paths).

Secondary and Back-of-Queue Collision Reduction

SHA will be able to share its real-time data with 3rd party traveler information and navigation providers to alert users of impending queues ahead, slick spots, incidents, etc. (This is already being piloted by WAZE and others in smaller regions.)

Understanding the impacts of Operations Decisions

SHA will be able to understand the impacts of various operations decisions like notifying the public of lane closures, incidents ahead, suggesting alternative routes, etc. on actual travelers in real-time. The re-identification O-D technology will make it easy to see real-time diversions from typical routes which will enable SHA to make better decisions on what types of information and guidance to provide to motorists.

Energy Usage and Greenhouse Gas Monitoring

In the future, SHA may coordinate with the CATT Lab and the National Renewable Energy Lab (NREL) to add RITIS-based tools for energy and emissions monitoring so that agencies can analyze environmental impacts of congestion, in concert with safety, health, financial and mobility impacts.

E. Other projects

A description of other projects on which the PTC has been used, the degree of success or failure of such usage, and the names and contact information (including telephone numbers and e-mail addresses) of project owner representative who can confirm such statements.

This proposed technical concept is visionary in the way in which it is proposed to advance mobility and safety on I-270.

I-95 Baltimore-Washington (B-W) Corridor

Similar concepts have been proposed in Maryland along the I-95 B-W Corridor, and are awaiting funding. This deployment would further the deployment into the I-270 corridor—building upon the anticipated successes to the east.

Smart Cities/Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Deployments

US Department of Transportation Secretary Foxx has stated that the ATCMTD program will "take technological innovation to a new level and help to make the entire transportation network more reliable for commuters, businesses and freight shippers." This PTC is in-line with the core of the official ATCMTD program visions: to deploy advanced technologies and strategies to address the broad challenges mentioned above, and provide widespread benefits that also further social goals where possible.

Other WiFi/Bluetooth deployments are included in the below table.

Agency Name and Contact Person	Summary of Services
Memphis, TN Randall Tatum, Division of Engineering 125 North Main, Suite 668, Memphis TN p. (901) 576-6710 e. Randall.Tatum@memphistn.gov	~100 BlueTOAD units are being used to measure the effectiveness of their city wide signal upgrade projects. They also use the system for real-time operations monitoring congestion through the network.
Florida DOT District 2 Mr. Pete Vega, Chief ITS Engineer 2198 Edison Avenue, Jacksonville, FL p. 813-319-3790 e. peter.vega@dot.state.fl.us	282 BlueTOAD units for freeway, alternative arterial routes and evacuation routes monitoring. Data also being used for signal retiming efforts and to validate the MPO models.
Tamp Bay, Florida Mr. Jeff Gerken, President, Albeck-Gerken 1911 US-301 #410, Tampa, FL p. 904-360-5463 e. jeff@albeckgerken.com	65 BlueTOAD units for arterial monitoring on contracts throughout FL and VA. Reports provide weekly, quarterly and annual data to view how good or bad the arterials are running.
Georgia DOT Frederick Mathis Jr., Regional Traffic Operations Manager 935 E. Confederate Avenue Atlanta, GA 30316 p. (404) 635-2906 e. fmathis@dot.ga.gov	~500 BlueTOAD units for arterial travel-times. All major routes within the Atlanta metro area are being monitored in real-time for congestion and the historical reports are being used to measure the effectiveness of their RTOP (Regional Traffic Operations Program) initiative.
Florida DOT District 4 Ms. Melissa Ackert, Traffic Operations 3400 W Commercial Blvd. Ft. Lauderdale, FL p. 954-777-4156 e. melissa.ackert@dot.state.fl.us	83 BlueTOAD units for corridor ATMS management and space mean calculations. In addition, BlueTOAD is being used to monitor real-time arterial conditions.
Seminole County, FL Charles Wetzel, PE, PTOE, County Traffic Eng. 140 Bush Loop Sanford, FL p. (407) 665-5686 e. cwetzel@seminolecountyfl.gov	95 BlueTOAD units on major arterials for real-time traffic congestion information as well measuring effectiveness of new traffic signal system.
Alabama DOT Mr. Stacy Glass, P.E., Assistant Bureau Chief Traffic 1409 Coliseum Blvd. Montgomery, AL 332-242-6275 e. glass@dot.state.al.us	110 BlueTOAD units for major cities adaptive real-time monitoring and performance analysis. Also being used for monitoring of construction projects.
TX Tollway Jason JonMichael, National Tech Leader, HNTB 701 Brazos, Suite 450, Austin, TX p. (816) 591-1396 e. jjonmichael@HNTB.com	24 BlueTOAD system deployed in TX Tollway in Austin for real-time travel-times and alerts, along with historical comparisons.
Douglas County, CO Duane Cleere 100 Third St. Castle Rock, CO 80104 p. (303-660-7490 e. dcleere@douglas.co.us	38 BlueTOAD project for arterial travel-time system. CDOT COTRIP integration.
Cobb County, GA David Montanye, P.E., Operations Division Mng. 1890 County Services Pkwy Marietta, GA p. (770) 528-1684 e. david.montanye@cobbcounty.org	~100 BlueTOAD project being used for adaptive control verification, along with real-time congestion alarms. The real-time speed map is displayed on their TMC video wall as a source for incident management. Cobb County uses the historical reports often to compare signal timing, along with special events.
City of Fort Collins, CO Joe Olson, Traffic Engineer 281 N College Ave, Fort Collins, CO p. (970) 224-6062 e. jolson@fcgov.com	25 BlueTOAD Project for arterial travel-time, delay, CDOT COTRIP integration.
Mississippi DOT Mr. john Gilligan, ITS Engineer 401 North West Street, Jackson, Mississippi p. 601-359-1993 e. jgilligan@mdot.ms.gov	11 BlueTOAD units for adaptive signal monitoring and incident detection.

F. Administration Risk

A description of risk to the Administration or third parties associated with implementing the PTC.

Local vs. State Interests in Traffic Diversion

Past ICM deployments have faced issues with local authorities who did not want diverted freeway trips backing up their local grid. SHA will need to have early discussions with Montgomery County and other local agencies at the planning table to show that 1) this will be rare for any single location; 2) it is already happening today, but with our data deployments and connected vehicles technologies, it can be expected to clear diverted overflows faster. As aside benefit, this will reduce the cost of data collection for locals needed to understand impacts on their arterials and signalized intersections.

Potential Unintended Consequence that may Reduce Safety & Mobility

Distributing advisory messages via smart phone apps and other mobile devices encourages drivers to look at their phones, increasing the probability of crashes. The CATT Lab has begun a partnership with Google/Waze who provides user alerts in a safe and effective manner via voice. Waze has a strong market share of drivers in Maryland. The CATT Lab is also working with this partner to look at the impacts of rerouting too many individuals onto arterials, to understand how we might compound problems if our communications strategy is too successful.

G. Design-Builder Risk

A description of risk to the Design-Builder associated with implementing the PTC.

There are two risks involved with implementing this PTC:

- Integration into CHART – Data from lower-cost, real-time *connected vehicle* data streams as well as any new field devices will need to be integrated into the current CHART software. Our team would work with CHART to test/prove data conveyance and compatibility prior to field installation or data integration.
- Field connectivity to the existing locations and communications network – Confirmation of field device installation at the specific locations, as well as integration into the current field device communications system (fiber/wireless).
- Maintenance of Traffic (MOT) – It is assumed that all field installations will occur with just shoulder closures. There is a possibility that a temporary right-lane closure maybe required.

H. Cost/Schedule Benefits

Discussion of any cost or schedule benefits to this contract from usage of this PTC

Implementation of this PTC can occur over phases:

1. NTP +60 Days. Lower-cost, real-time connected vehicle data streams can be purchased at a monthly or annual subscription. Providing this data will allow the team and SHA immediate operational (roadway conditions, surface/traction, braking) and planning (O-D) data.
2. Based on the data collected by the connected vehicle data stream, the additional WiFi/BT/DSRC units can be tested for compatibly with CHART's software. Field locations for equipment installation can be determined. Subsequently, plans for and the installation of the equipment can occur. Upon completion, SHA would have complete O-D and vehicle data collection/dissemination capabilities, as described above.

I. Miscellaneous

Any additional information that would assist the Administration in the review of this PTC.

October 20, 2016

Mr. Benjamin J. Carnazzo
Kiewit Infrastructure Co.
7250 Parkway Drive, Suite 310
Hanover MD 21076

Dear Mr. Carnazzo:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 8 for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on October 13, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract.
2. Please investigate and discuss any potential issues related to Invasion of Privacy. Ensure this type of data collection would be consistent with Maryland law, considering factors related to public awareness, education and perception. The SHA is concerned drivers unaware of data being collected from their phones, vehicles, devices, etc. could be deemed an invasion of privacy, rendering the data unusable.
3. Some benefits/improvements in this PTC are to be rolled out in the future, after project completion. Please clearly distinguish between what would be rolled out later and what the Design-Build Team will deliver.
4. Section C, Analysis, Mobility, second bullet: Please define "traffic signal changes." Also, CHART is unable to implement "traffic signal changes."
5. To achieve the project goals, the Design-Builder must provide a fully functional system at project completion. Integration is a critical component for the success of this PTC. Please discuss in detail how this PTC will be integrated. Section D. Potential Impacts should address impacts to CHART.
6. Section E, Other Projects: The projects listed have not implemented this PTC. For this section the RFP requests a description of other projects on which the PTC has been used and the degree of success it had. If this PTC has not been implemented on any other projects and its first use will be on I-270, please state this. However, during our PTC one-on-one meeting on October 17, 2016, your team noted the PTC appears to have been used in the state of Massachusetts, as well as in Maryland (albeit temporarily).

7. The Office of CHART & ITS Development, through its Statewide Operations Center (SOC) and regional District 3 Traffic Operations Center (TOC 3), acknowledges it will likely have a role in supporting the operations of any elements of an Advanced Traffic Management System (ATMS). This role will need to be consistent with technical capabilities of MDOT SHA's operations program. For the project to be a success, any PTC should reflect these capabilities.
8. Clearly describe how any ATMS system elements will operate to facilitate the overall solution's ability to meet the goals of the project.
9. The existing CHART ATMS resides within the security firewalls of the Maryland Department of Transportation (MDOT) Enterprise network. As such, any integration and data sharing between ATMS elements of the I-270 PTCs will need to comply with network security and system integration requirements as identified by MDOT and the Maryland Department of Information Technology (DoIT).
10. The development of the CHART ATMS software is conducted under a contract managed by the Office of CHART & ITS Development, with specific goals and separate contract requirements. Any modifications to the CHART ATMS software will be conducted under the CHART ATMS contract. Although integration between the CHART ATMS and I-270 ATMS elements is feasible, proposers should not make the success of the I-270 Innovative Congestion Management project contingent on adding functionality to the CHART ATMS. Also note, the CHART ATMS is an information management and advisory system for coordination of response to events on the roadway system. As such, it has not been developed to operate safety sensitive devices (e.g. traffic signals) in real time, which would require robust, instantaneous communications and frequent feedback on device and system status.
11. The CHART system communicates with field infrastructure in two ways: through wireless modems for Dynamic Message Signs, Highway Advisory Radios, Roadway Weather Information Systems and Traffic Speed Sensors, and through a combination of T-1 and fiber optics for cameras streams. CHART accesses fiber optic communication as a customer of Network Maryland and T-1 services from local telecommunications providers. The telecommunications architecture of the CHART system does not currently utilize dedicated circuits for point-to-point connectivity between central servers and field devices. It is also important to note that the CHART system central servers currently reside in an MDOT data center in Glen Burnie; not at the Statewide Operations Center in Hanover, MD.

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Frank DiGilio, Kiewit Infrastructure Co.

January 5, 2017

Mr. Benjamin J. Carnazzo
Kiewit Infrastructure Co.
7250 Parkway Drive, Suite 310
Hanover MD 21076

Dear Mr. Carnazzo:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 8 (Revised) for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on December 27, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

Generally, the concept appears to be a reasonable solution to address the goals of this contract, and will likely be compatible with the larger Maryland Connected and Automated Vehicle (CV/AV) program. There is a great deal of attention, and efforts are evolving quickly, regarding CV/AV technology in Maryland. We would recommend that the PTC include language that acknowledges that any system elements deployed on I-270 will need to be coordinated and compatible with other statewide CV/AV deployments. It would strengthen PTC #8 to incorporate a general plan for continued coordination with the key stakeholders. As examples, two key initiatives have already changed, and should be updated in the PTC:

1) The PTC should address coordination with the "Maryland Autonomous and Connected Vehicle Working Group". This group, headed by the Motor Vehicle Administration, has the Governor's charge to lead CV/AV policy development for Maryland. More information on this group is available at http://www.mva.maryland.gov/safety/Maryland-AC-CV.htm.

2) The I-95 Baltimore-Washington (B-W) Corridor concept mentioned on page 6 has already evolved into a formal application entitled "MDOT'S AUTOMATED VEHICLE RESEARCH AND PRODUCTION CORRIDOR Application for Designation of Automated Vehicle Proving Grounds Pilot," submitted to the USDOT on December 19, 2016. The corridor identified in the application extends from the Washington, DC city line up to Aberdeen, MD.

In summary, the general comment is that the contract team should assure that any technology and strategy they propose to deploy will be consistent with the overall CV/AV program in Maryland.

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Frank DiGilio, Kiewit Infrastructure Co.

PTC 10 - IS-270 Southbound Managed Lane using Hard Shoulder Running Operating as HOV 2+

AECOM
7 St. Paul Street, 17th Floor
Baltimore, MD 21202, USA
aecom.com

January 19, 2017

Mr. Jason A. Ridgway, P.E.
Director, Office of Highway Development
Maryland Department of Transportation
State Highway Administration
707 N. Calvert Street
Baltimore, MD 21202

Subject: **Proposed Technical Concept No. 10** Comment Responses
IS-270 - Innovative Congestion Management Progressive Design Build
Contract No. MO0695172

Dear Mr. Ridgway

The Kiewit/AECOM team is in receipt of the comments that the Maryland Department of Transportation's State Highway Administration (SHA) provided on November 22, 2016 on Proposed Technical Concept (PTC) No. 10 for the IS-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by our team on November 14, 2016. We appreciate the opportunity to provide point-by-point responses to your comments, and address them in the revised PTC No. 10 that is included as an Appendix of the Technical Proposal. Your comments have been repeated for convenience, and the responses are in bold.

THE KIEWIT/AECOM TEAM IS INCLUDING PTC 10 IN "THE PROJECT" AND TECHNICAL PROPOSAL.

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract.

   Response: No response required.

2. Page 2, Section A, Description: The section on PTC 8 and the data from that PTC will allow the Administration to monitor changes in travel patterns, is interesting. Please clarify how this data might be actively used to address the effectiveness (or impact the operation) of hard shoulder running (HSR) in this context.

   Response: The use of PTC 8 and how it would allow the Administration to monitor changes in travel patterns has been discussed in Section A - Description of the revised PTC 10.

3. Page 2, Section A, Description: The third paragraph has some language that is not clear regarding whether the proposal would be for the CHART system to take primary control of the lane control signals, or would eventually interface to an autonomous operating system that manages the ATM on 1-270. There are significant challenges in making the success of the 1-270 ATM contingent on an existing and separate contract. As mentioned previously:

- The existing CHART ATMS resides within the security firewalls of the Maryland Department of Transportation (MOOT) Enterprise network. As such, any integration and data sharing between ATMS elements of the 1-270 proposed technical concepts will need to comply with network security and system integration requirements as identified by MOOT and the Maryland Department of Information Technology (DoIT).

- The development of the CHART ATMS software is conducted under a contract managed by the Office of CHART & ITS Development, with specific goals and separate contract requirements. Any modifications to the CHART ATMS software will be conducted under the CHART ATMS contract. Although integration between the CHART ATMS and 1- 270 ATMS elements is feasible, contractors should not make the success of the 1-270 Innovative Congestion Management project contingent on adding functionality to the CHART ATMS. Also note, the CHART ATMS is an information management and advisory system for coordination of response to events on the roadway system. As such, it has not been developed to operate safety sensitive devices (e.g. traffic signals) in real time, which would require robust, instantaneous communications and frequent feedback on device and system status.

We would recommend that the discussion of the command and control of the traffic management elements include more specifics on:

- Configuration management: From the PTC, it is agreed that the CHART system and possibly other systems (e.g. the Montgomery County Signal System?) will need to share key data as triggers (e.g. when and where an incident occurs, specific lanes blocked, etc.) The PTC needs to address how changes to one system, impacting the format of how data is output and/or input, will be coordinated in order to prevent "breakage" of the integrated connection of systems.
- Security: As mentioned in previous comments, the CHART system resides inside the secured firewalls of the MOOT Enterprise Network. As such, data passed into the CHART system needs to meet the security requirements of the DoIT. This does not apply to data passing out of the CHART system. CHART provides a Representation State Transfer (REST) feed for real-time incident information.
- Hosting: There are various potential hosting strategies for the ATM system, and the PTC would be strengthened with additional information on the proposed approach.
- Business Process: The CHART Program has specific responsibilities in coordinating the response of various agencies at highway incident scenes and providing traveler information. ATM systems represent another tool, but also additional responsibilities in the incident management process. We would like the proposer to describe how the existing Traffic Incident Management (TIM) process will be coordinated in the Operations Center, and in the software, with managing ATM tools as well.

  Response: Section A – Description has been updated to discuss the HSR command and control. It will be a stand-alone system using existing CHART ATMS software components.

4. Page 3, Section A, Description: We would have some concerns regarding whether cellular communications would be reliable enough for a safety-sensitive application such as lane control elements of an ATM system.

   Response: Section A – Description has been updated to discuss the cellular modem technology. The new lane control system will communicate with CHART using a cellular modem methodology. The system is considered more of a critical system than standard DMS. As such, the rollout of the AT&T Dynamic Traffic Management solution is optimal for this program. The DB team proposes interfacing the lane control system to CHART using this enhanced cellular modem technology. Using the fiber option would not be a cost-effective solution, and it would not be in line with the main project goal to improve mobility.

5. Page 4, Section B, Location: From an incident management and operations perspective, we concur and appreciate the proposed cross-section maintaining a useable outside shoulder.

   Response: No response required.

6. Page 8, Section C, Analysis: We would like additional information, from an intuitive perspective, on why the analyses indicate that property damage only crashes would be reduced, while injury and fatal crashes would increase slightly. On the surface, because of the relative importance of safety, this would appear to be an undesirable trade-off (i.e. injuries and/or fatalities should at least remain the same or be reduced).

   Response: HSM (ISATe/IHSDM) was constructed via a series of regression (statistics) equations/models which is all field-data based on historical (before/after) crash data. The predicted crash rates are determined by those regression variables known as crash modification factors on different design scenarios. And, more related to the current context, HSM (Chapter 10,11,12) sets freeway crash predictions in 2 categories: Property Damage Only (PDO) and Fatal and injury (FI). In our HSR analysis, the model inputs were reduced lane and shoulder widths, closer distances to barriers and more travel lanes etc. Those inputs generated higher FI and lower PDO through the built-in regression formula. This is an undesirable trade-off, but unfortunately the HSM model was statistically set that way. It should be noted that the HSM "field-data" was from the states of CA, ME and WA only that might not universally fit everywhere else in the nation, including Maryland. In addition, the predicted FIs were at very small number scales that the predicted rate differences might have been exaggerated due to the HSM's exponential regression formula.

7. Page 9, Section D, Potential Impacts, Safety: The proposal should address alterations to operational procedures that might be necessary. Changes to shoulder areas will influence traffic incident management in the following ways:

   a. Providing a safe buffer zone for emergency responders. Managed lanes can facilitate lane use and advanced warning, but full shoulders provide a work area for emergency responders which, by vehicular regulation and driver behavior, motorist don't use. Managed lanes can help, but positive guidance and physical barriers (e.g. cones) will be the only protection in a normally traveled lane (i.e. hard shoulder).
   b. Use as a staging area for vehicle recovery. In Maryland, by policy and regulation in support of the towing and recovery industry, public agencies only relocate damaged and disabled vehicles to the shoulder, to stage them for final removal by industry towers. Limited shoulder availability would likely require new policies and procedures to minimize the blockage time impact while preparing for private towers to arrive.
   c. Access to the incident scene. The CHART patrols, in Maryland, function as an extension of staff for the Maryland State Police, in the area of Traffic Incident Management. However, CHART patrols are not enforcement vehicles and do not have the authority of a "blue light" (police) or a "red light" (fire and rescue) emergency responders in traveling through traffic (even though they are equipped with lights and sirens). Consequently motorists may, or may not, yield right of way to CHART vehicles.
   d. Impacts of more complex incidents. Procedures and impacts need to be analyzed and addressed for more complex incidents that require more complex recovery procedures and other public safety impacts. Some of these complicating factors include: heavy/large vehicles, injuries, hazardous materials, fires, criminal activities, significant debris (e.g. a load of mulch) etc. Each of these scenarios requires different personnel and equipment on scene: fire trucks, ambulances, police vehicles, heavy equipment, etc. Shoulders provide the additional geometry to stage and maneuver these resources.

   Response: The Kiewit/AECOM Team recognizes that CHART incident management practices will need to be modified in order to address the effects of the Project. Development of those modifications will require an iterative and cooperative effort between CHART and first responders within the limits of the Project. The Kiewit/AECOM Team will work with CHART to prepare a Concept of Operations (both Draft and Final). We will also develop draft and final revised detailed operating procedures (including enhanced enforcement).

8. Page 11, Potential Impacts, CHART: There is another paragraph referring to the integration with CHART. Please see the comments under A. Description, regarding considerations for the eventual integration with the CHART system.

   Response: The Potential Impacts, CHART section has been revised to address the Administration's comment in the revised PTC 10.

9. Page 12, Administration Risk: We concur that the HSR lane management system will be important to allow SHA to close the shoulder and provide motorists advanced warning.

   Response: No response required.

10. Page 12, Administration Risk: The last paragraph indicates that SHA may need to obtain approval from Emergency Operations personnel on the proposed improvements. Although coordination will be important, we're not aware of any approval process with local fire, EMS and police that would be necessary.

    Response: Understood. The language has been changed to say "Input" instead of "approval" in the PTC write up.

11. Please state that the design shall adhere to the recommendations/suggestions in the following guide: Use of Freeway Shoulders for Travel (FHWA, February 2016).

    Response: The statement has been added to the revised PTC 10, under Section A – Description.

We appreciate the opportunity to provide responses and revise PTC No. 10 accordingly.

Yours sincerely,

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A. Description

Detailed descriptive information and other appropriate information as appropriate such as conceptual drawings, production details, standards, specifications, and traffic operations analysis.

This Proposed Technical Concept (PTC) includes the use of median Hard Shoulder Running (HSR) to create a SB managed lane along the existing IS-270 SB median shoulder. HSR is the temporary operation of paved shoulders as running lanes to alleviate congestion and temporarily increase highway capacity without major infrastructure reconstruction. The shoulder will be equipped with overhead signing that will indicate if drivers may use the hard shoulder as a through lane (Figure 1). The focus of this approach is to improve the bottlenecks along the IS-270 southbound stretch that have been identified as the most problematic, between Watkins Mill Road and Tuckerman Lane. Appendix vii contains a layout of the roadway improvements within the limits of work.

The traditional method of adding highway capacity is to widen existing roads to add through lanes, which often results in additional right of way needs, adverse impacts to the community and the environment, and high construction costs. As a result, several European countries and several states in the US have initiated efforts to add highway capacity while maintaining the footprint of the existing pavement. HSR is one of the methods that provide congestion relief with relatively minimal environmental and construction cost impacts.

A managed lane includes operational strategies that are proactively implemented and managed in response to changing conditions. This type of facility incorporates a high degree of operational flexibility, so that the purpose can change to respond to future growth and needs (FHWA, 2008). As part of this PTC, the managed lane on HSR will operate as an Express Southbound High Occupancy Vehicle (HOV) lane during the AM peak period. During off-peak hours and weekends, the Administration can dynamically control the use of the managed lane and designate it for other purposes. In addition, the Administration can adapt the role of the managed lane to future needs. Recommended future uses include continued HOV use, connected vehicles, electric vehicles and automated vehicles. In addition, the Administration can use the managed lane as an asset in order to submit for technology grants and use the lane capacity during off peak hours for pilot programs to test out emerging technologies.

One of the goals of this PTC is to improve mobility by HOV optimization. Currently, the HOV lanes are not balanced, with higher volumes in the NB direction than in the SB direction. The addition of the SB Express HOV Lane on HSR during AM peak hours creates HOV lane balance along SB and NB IS-270. The design shall adhere to the recommendations and suggestions in the following guide: Use of Freeway Shoulders for Travel (FHWA, February 2016).

Figure 1 - I-66 Hard Shoulder Running during off-peak
Source – Virginia Department of Transportation

The MWCOG 2.3 v57a model with Round 8.4 land use data was used to estimate the new HOV demand for the IS-270 corridor due to the addition of the SB HSR next to the existing HOV lane. The MWCOG model indicates that 69 percent of HOVs driving SB on IS-270 in AM have origin points north of Watkins Mill and destination points south of Tuckerman Lane. In the proposed condition, these vehicles would use the HSR lane. This would relieve traffic congestion on the existing HOV lane and result in higher travel speeds. This improvement in HOV operations and added HOV capacity create enough incentives for existing HOVs using other parallel facilities to change their paths and use IS-270. It would also encourage drivers to carpool, giving them the ability to use HOV lanes instead of general purpose lanes. The proposed ITS operations and the VISSIM analysis results are included in Appendix iii.

The proposed advanced data collection in PTC 8 will allow the Administration to monitor changes in travel patterns, mode choice (SOV vs HOV), and path selection. PTC 8 will also provide the Administration with a powerful tool to increase its adaptability by performing a smart “Before and After” study to fully understand the impact of HSR on increased HOV demand (induced demand), reduction of SOVs from the corridor and parallel facilities, and utilization of the existing HOV lane as well as HSR.

HSR command and control will be accomplished by developing a self-contained, standalone lane use control system using existing CHART ATMS software components, which are publicly available from SHA (upon request). HSR status will be communicated to the public via conventional general purpose Dynamic Message Signs (DMSs) and more specialized HSR DMSs. The vendor will incorporate and adapt CHART ATMS software components to control both types of new DMSs into a standalone Lane Control System (LCS). The HSR DMSs will either have the option to be “On” (Green Arrow), “Closing” (Angled Yellow Arrow) or “Off” (Red X), or will be capable of displaying the Diamond HOV symbol. The DB team will create a manual user interface to schedule and control all of the new signs within the LCS, as described. The scheduler will allow for scheduling based on day of week and time of day, and will allow for pre-scheduling of deviations to normal operations, such as for holidays or special events.

In addition to the dynamic lane use control signs, additional CCTV coverage and additional DMS will be installed within the limits of the proposed improvements, in order to verify the HSR lane is clear of disabled vehicles before opening and also to confirm incidents, at which time CHART will close the HSR for first responder access. All new CCTV and DMS devices will be similar to the devices currently being installed by CHART, in terms of manufacturer and model. The new devices will communicate with CHART in accordance with the current CHART architecture. That is, new CCTV will communicate with CHART via leased T-1 lines, and new DMS will communicate with CHART via cellular modems. The new lane control system will communicate with CHART using a similar cellular modem methodology. The system may be considered more of a critical system than standard DMS. As such, the rollout of the AT&T Dynamic Traffic Management solution may be optimal for this program. The DB team proposes interfacing the lane control system to CHART using this enhanced cellular modem technology. Using the fiber option would not be a cost-effective solution, and it would not be in line with the main project goal to improve mobility.

B. Location

The locations where, and an explanation of how, the PTC will be used on the Project.

Dynamic overhead lane control signs will be provided above the HSR starting north of Watkins Mill Road, and they will display a green arrow or HOV symbol when the shoulder is available for use as a through lane and a red X when it is closed (Figure 1). During the AM peak period signs will indicate that the SB Managed lane along the HSR connects directly to points south of Tuckerman Lane. During the AM peak period, the existing HOV lane will be converted to HOV Local and the managed lane along the median HSR will function as a HOV Express lane. Two solid markings will divide the two HOV lanes (Figure 2).

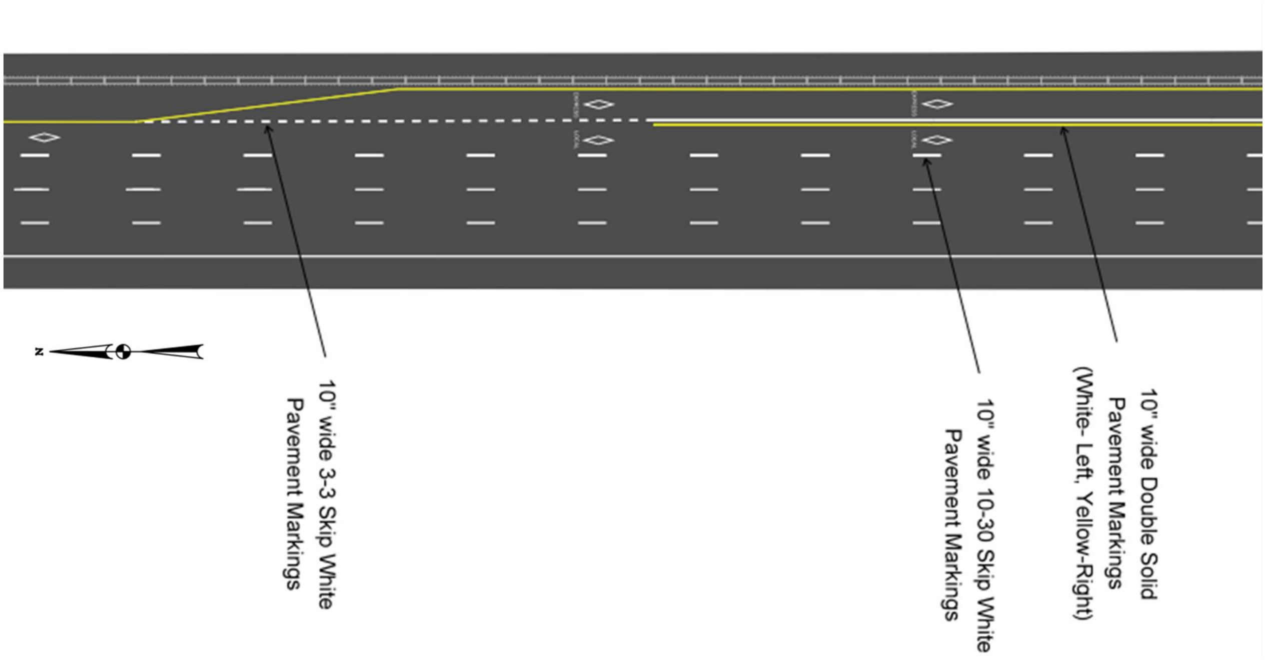

Figure 2 – Starting taper of SB Managed Lane

Table 1 includes the limits and length of each section, and the design exceptions that will be required in order to successfully implement HSR in each section. Figures 3 through 5 include typical sections of SB IS-270 in the three sections listed below. The sections depict the typical lane configuration through these three sections. There are also existing locations where the shoulder is reduced (pinch points) at bridges and sign structures.

Shoulder Location	Roadway	Limits	Distance	Figure	Design Exception Required
Median	SB IS-270	Watkins Mill Road to Muddy Branch Road	2.2 mi	2	11' Lane Width and reduced shoulder width
		Muddy Branch Road to Montrose Road	6.0 mi	3	11' Lane Width and reduced shoulder width
		Montrose Road to Tuckerman Lane	1.2 mi	4	11' Lane Width and reduced shoulder width

Table 1 – Proposed HSR locations

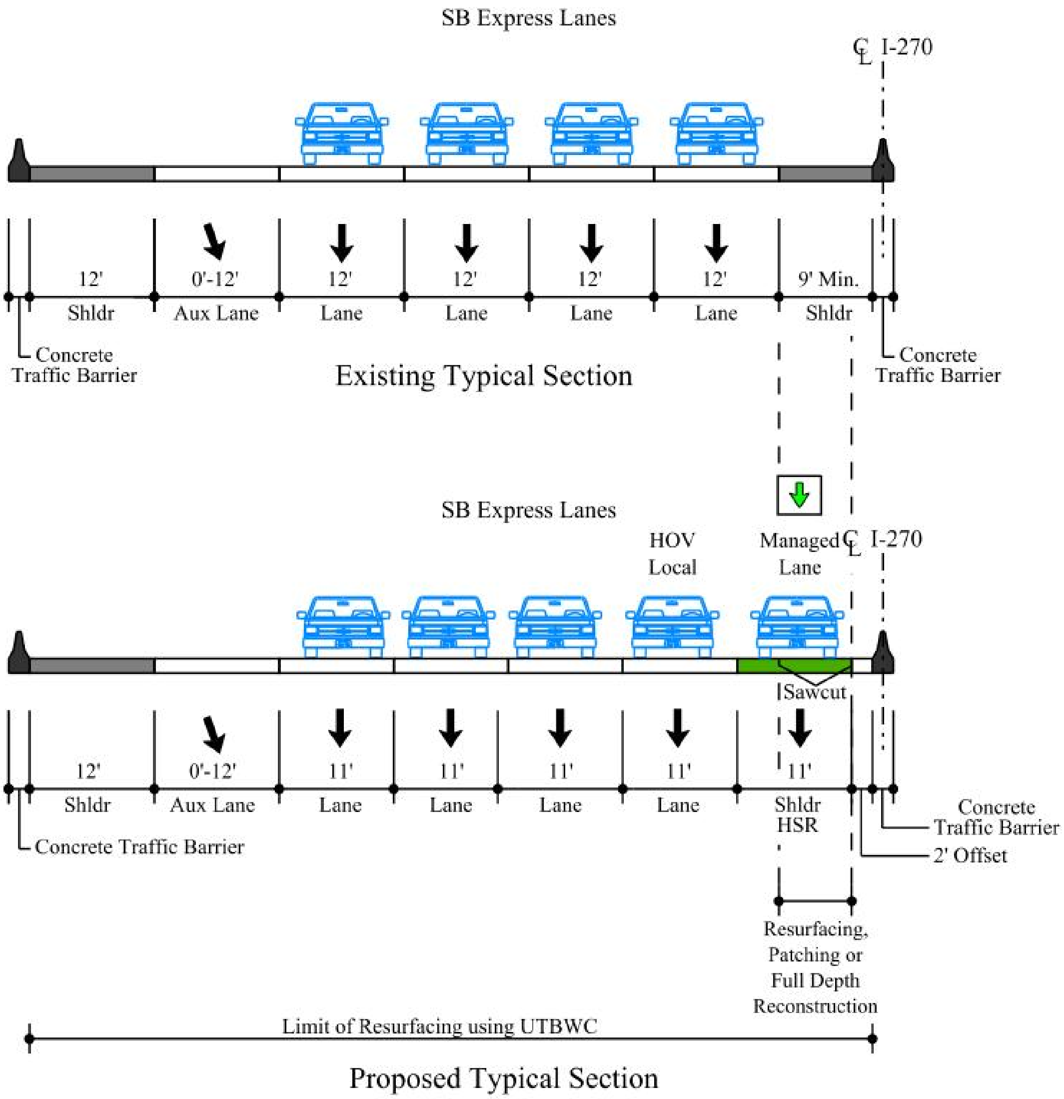

Figure 3 – Existing and Proposed Typical Sections
SB IS-270 between Watkins Mill Road and Muddy Branch Road

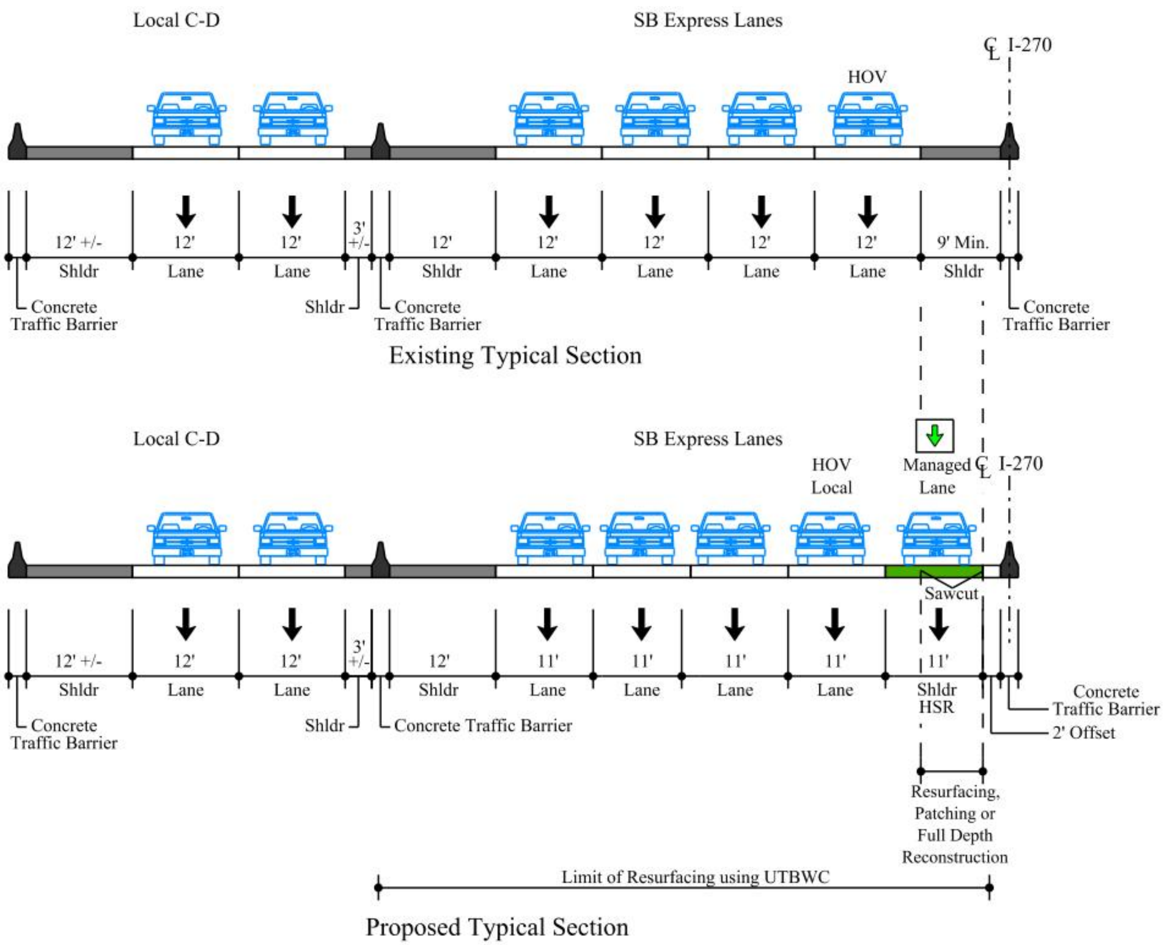

Figure 4 – Existing and Proposed Typical Sections
SB IS-270 between Muddy Branch Road and Montrose Road

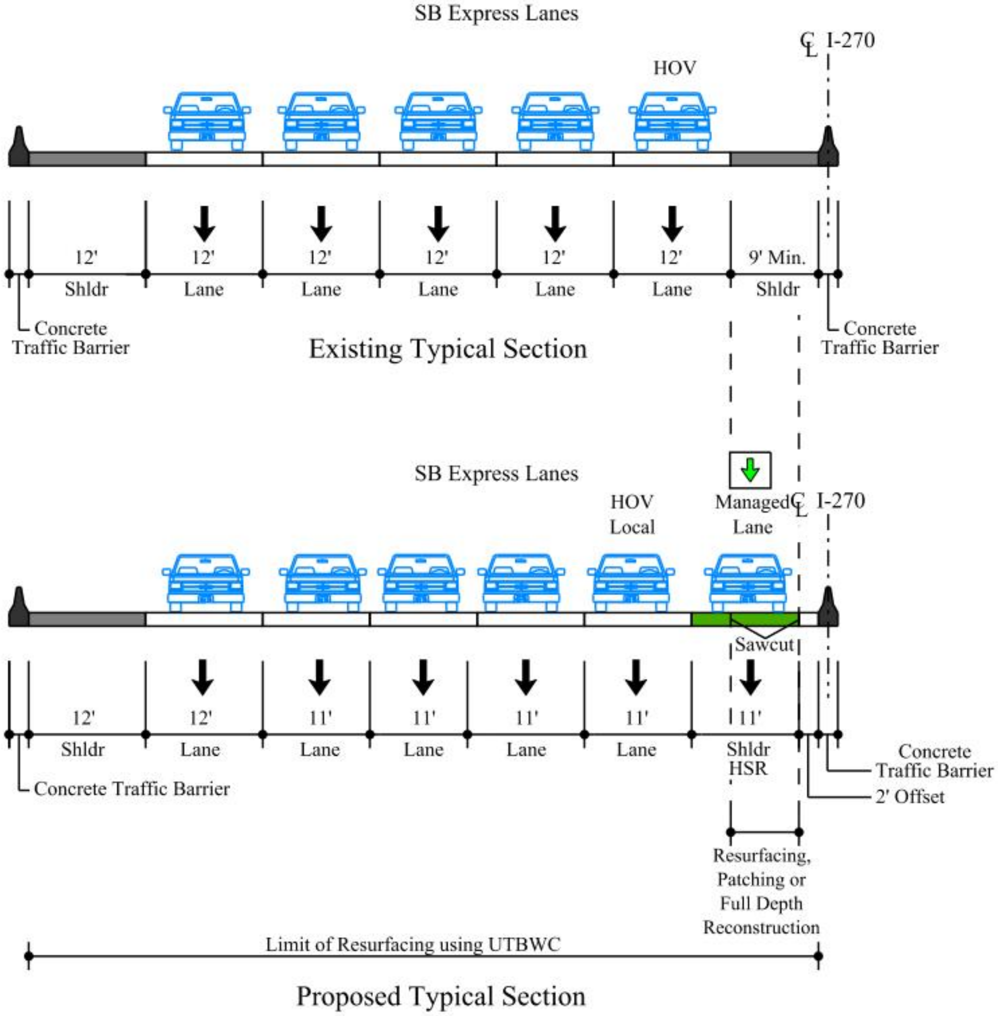

Figure 5 – Existing and Proposed Typical Sections
SB IS-270 between South of Montrose Road and Montrose Road Interchange

C. Analysis

Analysis justifying the use of the PTC including how it advances the project goals.

<u>Roadway Design</u>

There are certain requirements that must be met prior to using shoulders as travel lanes to receive the benefits described in this PTC. The shoulder should have adequate width based on the roadway classification to act as a full travel lane, have no adverse superelevation, be continuous, and be able to withstand vehicle loading. (Sisiopiku et al., 2009).

Appendix vii illustrates the locations of the proposed managed lane on HSR limits in green. SB IS-270 will be restriped and existing travel lane widths will be reduced to 11’. An 11’-wide HSR lane with a 2’ offset to concrete median barrier will be provided along SB IS-270.

The shoulder sections with cross slope steeper than 3% will be reconstructed to meet the normal cross slope of the existing roadway travel lanes. The shoulder sections with adverse cross slope will be reconstructed to meet the required superelevation rate of the existing roadway travel lanes.

In the areas where shoulder cross slope adjustment is necessary, the existing median barrier will be either rehabilitated to have the required reveal at gutter, modified to have a sloped face, demolished and reconstructed in part or replaced in its entirety. Limits of barrier modification or replacement will be determined during the post-award phase. The existing concrete median barrier is less than 42" in height. The team is proposing 42" barrier in the sections where the median barrier needs to be replaced, but not replacing the existing median barrier that is not impacted by the change in the shoulder cross slope. Since the traffic will run closer to the barrier compared to the existing conditions, the approach angle is reduced, lowering the risk of cars rolling over upon impact.

Drainage Design

Spread computations were completed based on the proposed typical section. The team will prepare a detailed hydraulic analysis during the post award phase to ensure that the spread during rain events will not cause any safety concerns for vehicles traveling in the HSR lane.

For preliminary computations, the maximum allowable spread identified for the southbound lanes was 6' (the sum of the width of the proposed 2' shoulder and 4' of the proposed 11' travel lane). Approximate drainage areas to existing inlets were computed based on average road width and measured distance between inlets. The rational method and subsequently the spread calculation included in the Maryland State Highway Administration Guidelines for Development Adjacent to State Highways were used to determine the managed lane on HSR areas impacted by insufficient drainage. Analyses accounting for the proposed 3% cross slopes were completed. With a 3% cross slope, approximately 50 sections between existing inlets will require additional drainage infrastructure.

Computations completed with the aforementioned equation were verified using Flowmaster. For the Flowmaster analysis, conservative input data was used where possible. Specifically, 50% clogging and 85% efficiency were assumed. The analysis utilized 2-year storm data for Montgomery County, Maryland (Montgomery County Drainage Criteria Manual). A rainfall intensity of 6.5 in/hr was used for computation purposes as it is more conservative than the frequency prescribed in the Highway Drainage Manual (5.4 in/hr). In general, variation between the Flowmaster findings and the equation was ±5%. Therefore, a reasonable inference was made that the computations completed for this analysis were appropriately cautious.

Additionally, during this assessment, the proposed drainage scenario was compared to the existing drainage scenario. The decrease in cross slope (from 6% to 3%) greatly increases the risk of ponding during large storm events. This safety concern will be mitigated with the installation of more inlets. Because no additional impervious is proposed for this project, it is assumed that the hydraulic capacity of pipes and the storage provided at outfalls is sufficient.

Due to the increased frequency of major rain events as a result of ongoing climate change, consideration was given to the safety of the proposed concept design and proposed drainage improvements. Drainage infrastructure alternatives such as trench drains were investigated and may be a viable option for reducing construction costs while managing ponding and spread. With the additional drainage infrastructure provided, the managed lane on HSR may only need to be closed during extremely large storm events such as the 50 and 100 year storms.

Origin-Destination of HOVs

The MWCOG 2.3 v57a model was used to estimate the impact of adding the HSR. Rather than using the raw model results to analyze the impact of this change, this study followed the methodology recommended by TRB's National Cooperative Highway Research Program (NCHRP) Report 765: Analytical Travel Forecasting Approaches for Project-Level Planning and Design. The idea is to post process the raw model results by applying the estimated travel patterns on the observed counts. Based on this methodology, the number of HOVs on the IS-270 corridor increases by 655 vehicles on top of the observed 1,310 HOVs at MD-121. This added HOV demand includes shifting 580 SOVs to 290 HOVs (conversion factor of 2:1) and attracting portion of existing HOVs (365 vehicles) currently using other parallel facilities (MD355, 185, and 97) due to improved HOV operations along the corridor. The shift from single occupancy vehicles to HOVs show a 7.3 percent reduction in the number of single occupancy vehicles on IS-270, providing a more reliable travel time. It should also be noted that the model did not suggest that the overall vehicle occupancy ratio of the corridor changes from 1.4. Our analysis suggests that 1,355 of HOVs on IS-270 SB will take the HSR lane (69 percent) and the remaining 610 HOVs will use the existing HOV lane. The 610 is a conservative count. The extra capacity on the existing HOV lane provides opportunities to promote faster and more frequent transit service, carpooling, and allowing automated or clean vehicles to use the remaining capacity, resulting in more congestion relief for general purpose lanes. The proposed advanced data collection in PTC8 will help the Administration to fully understand the impact of this alternative and provide higher adaptability to choose the best approach to utilize the extra capacity.

The safety analyses were performed using the Highway Safety Manual (HSM). The results are included in Appendix iii and discussed in the Technical Proposal.

D. Potential Impacts

A preliminary analysis of potential impacts (both during and after construction) including but not limited to use impacts, Right-of-Way, geotechnical, utilities, environmental permitting, local community, safety, and life-cycle project and infrastructure costs, including impacts on the cost of repair, maintenance, and operation.

User Impacts - There will be positive impacts on traffic operations along southbound IS-270, due to the increased capacity. Reduced lane widths may have an impact on driver speeds. An equivalency study will be completed and submitted to FHWA post award for any narrowing or shifting of lanes.

During construction, the existing southbound express lanes will be restriped to 11' wide, to make room for the temporary concrete traffic barrier. The existing outside shoulder will remain as-is, to avoid reconstruction to make the pavement traffic-bearing. The left lane will be offset 2 feet from the temporary concrete barrier. Both sides of the existing median shoulder will be sawcut before the shoulder pavement is patched or reconstructed. All express lanes will be maintained throughout construction. Due to the majority of the work being contained within the existing shoulder, the Maintenance of Traffic (MOT) typical section (Figure 6) is similar to the proposed typical section. Therefore, minimal adverse impacts are anticipated during construction.

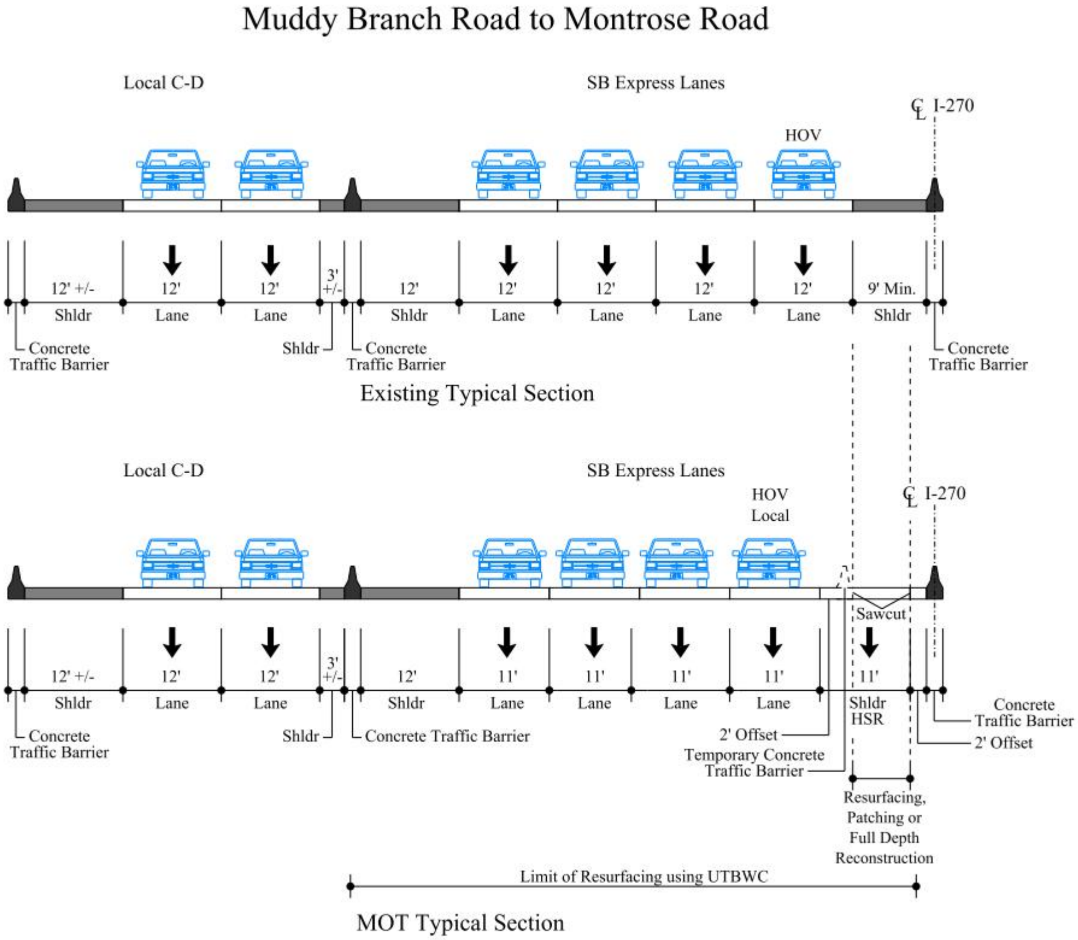

Figure 6 – Existing and MOT Typical Sections
SB IS-270 between Muddy Branch Road and Montrose Road

Right of way (ROW) – One of the advantages of using HSR is the ability to provide added capacity during the peak period while remaining within the existing pavement footprint. However, if a full depth patch of the HSR is not possible, there may be a need for full depth reconstruction requiring additional SWM facilities which may result in additional ROW. Additional ROW will be required to accommodate the required noise barrier systems (by others), signage, stormwater and erosion and sediment control facilities.

Geotechnical – The shoulder pavement composition will be strengthened using resurfacing, a full depth patch or full depth reconstruction where necessary. Shoulder sections that only require an overlay or full depth patch will not result in any disturbance of the existing soil, and therefore will not require stormwater management. The 2' offset between the edge of the HSR and the existing concrete barrier will not be reconstructed, since it will not need to be traffic bearing. Therefore the limits of full depth patching will be sawcut prior to pavement removal, to avoid impact to the adjacent pavement composition. The Administration provided Ground Penetration Radar results that included information on the existing pavement composition of the shoulders. The team has evaluated the existing pavement sections within the HSR limits, and will limit the full depth patching only to the shoulder stretches that are non-traffic bearing. In locations where a full depth patch will not yield sufficient pavement strength, full depth reconstruction will be required. The remainder of the HSR will be overlaid. In addition, the through lanes along SB IS-270 will be resurfaced to allow for restriping of the existing lanes.

Utilities – No significant impacts are expected since the majority of the proposed improvements stay within the existing roadway footprint. Coordination with utility companies will be required in order to provide electricity feed to the lane control system.

Environmental Permitting – Appropriate mitigation strategies will be implemented to comply with all third party regulations and to meet the National Environmental Policy Act (NEPA) requirements. Due to the potential full depth reconstruction of the existing shoulder in certain areas, SWM facilities may be required.

An Interstate Access Point Approval (IAPA) will be required by FHWA for this project. The DB team will meet all criteria set forth by the FHWA Interstate System Access Informational Guide, and will coordinate with the appropriate SHA and FHWA representatives to obtain the approval.

The addition of the HSR increases capacity along southbound IS-270 and therefore meets the FHWA Type I Highway Traffic Noise project criteria. As a result, FHWA requires that a noise analysis be conducted in a manner similar to a conventional widening project. If the design year build condition noise levels approach or exceed the 23 CFR Part 772 Noise Abatement Criteria for the future build conditions, there will be traffic noise impacts and investigation of noise mitigation will be warranted and implemented if found to be feasible and reasonable.

A qualitative noise analysis was conducted in the section where the managed lane on HSR is proposed, between Tuckerman Lane and Watkins Mill. A total of 39 barrier systems were evaluated between these two limits based on FHWA and SHA policy and guidelines (Appendix vi). Seven of those systems were deemed reasonable and feasible, a total of 13,000 feet in length.

Local Community – There will be minimal impact to residential and commercial communities during construction due to the majority of the work taking place closer to the median along IS-270.

Safety – A traffic safety impact analysis was completed for this PTC. The Highway Safety Manual (HSM) methodologies were applied to the analysis. Refer to Appendix iii for additional information.

Incident management is a concern with HSR due to the lack of median shoulders during peak hours, which otherwise can be used as access lanes for emergency vehicles. The right side shoulder will remain available at all times. Some of the options that the Administration can consider, but are not included in The Project are as follows:

The Administration can assign dedicated Safety Service Patrol units to patrol the HOV Express and Local Lanes during peak periods when the HSR is activated. Another option includes staging a flatbed truck at a potential high incident location to rapidly tow away a disabled vehicle. Lastly, lane control signals can be applied to overhead gantries to close blocked lanes and merge traffic into open lanes.

The Kiewit/AECOM Team recognizes that CHART incident management practices will need to be modified in order to address the effects of the Project. Development of those modifications will require an iterative and cooperative effort between CHART and first responders within the limits of the Project. The Kiewit/AECOM Team will work with CHART to prepare a Concept of

Operations (both Draft and Final). We will also develop draft and final revised detailed operating procedures (including enhanced enforcement).

Infrastructure costs – Infrastructure costs for the implementation of HSR will be developed based on SWM, shoulder full depth patch and full depth reconstruction, resurfacing, restriping, lane control system, utility coordination and ROW acquisitions.

Maintenance – In the existing conditions, the shoulder is used by maintenance crews to store the snow after inclement weather events. HSR could not be implemented after a winter storm event until the shoulder was completely cleared of snowpack. Normal maintenance operations that typically use the existing shoulders for work zones would need to schedule the work during off peak hours when HSR is not in use. In addition, the Administration will have the flexibility to keep the shoulders closed to through traffic when deemed necessary, such as during inclement weather and major incidents.

CHART - Current CHART software can continue to be utilized for operations during construction and development of the LCS. The DB team will develop a standalone LCS on a separate server that allows for “open” (green arrow), “closing” (angled yellow merge arrow) “closed” (red X) or HOV Diamond and includes a scheduler for automatic operations based on time and day. Once tested, this will be integrated into the current CHART operations environment, where operators will utilize the standalone LCS alongside the CHART ATMS. Because the LCS will incorporate a scheduler, the new DMSs will operate autonomously, and the role of CHART operators will be to monitor operations and override or adapt the scheduled usage as traffic conditions dictate. Additional cameras will facilitate monitoring. Where possible, cameras will be positioned such that the new DMSs are in view of the new cameras.

E. Other projects

A description of other projects on which the PTC has been used, the degree of success or failure of such usage, and the names and contact information (including telephone numbers and e-mail addresses) of project owner representative who can confirm such statements.

MD 42 – West Midlands - United Kingdom – Junction 3a to Junction 7

AECOM has been working with Managed Motorways in the United Kingdom for over ten years. The company’s involvement in Managed Motorways concepts started with research on narrow lanes, hard shoulder running, the use of emergency refuge areas and travel demand. Subsequently, AECOM was involved in the M42 Active Traffic Management (ATM) pilot, supporting the Highways Agency and lead consultant for key aspects of the ATM scheme and design. In 2006, the Highways Agency piloted Dynamic Hard Shoulder running via a pilot scheme on a 10.5 mile stretch of the M42 motorway near Birmingham. The following were the results (Kamnitzer, 2012):

- a reduction in personal injury accidents from 5.08 to 2.25 per month and reduction in the “accident severity index from 0.16 to 0.072
- a reduction in journey times during peak periods of 9% in the northbound direction and 24% in the southbound direction
- a reduction of 22% in journey time variability
- compliance with speed limits of 94% or better for speed limits between 50 and 70 mph

- reductions of approximately 4% in CO, HC, CO2 and NOX and of 10% in particulate matter and a marked improvement in the perception of long distance users of the level of service of the highway

I-66 – Virginia – US 50 to I-495

Due to congestion during peak periods along I-66 between US 50 and I-495, the Virginia Department of Transportation implemented an active traffic management system with dynamic hard shoulder running. A 2007 investigation into system performance showed that the V/C ratios were 0.90-1.0 for the eastbound movement and 0.83-1.0 for the westbound movement, resulting in an overall improved highway capacity during peak hours when the shoulder is open to through traffic. A similar investigation was completed with regards to the safety effects of the hard shoulder running, which resulted in no significant effects on crash frequency. (FHWA, 2016)

F. Administration Risk

A description of risk to the Administration or third parties associated with implementing the PTC.

The managed lane will result in capacity enhancement and therefore will require noise mitigation. The size, location, feasibility and reasonableness of the proposed barrier systems shown in Appendix vi may change during the post-award phase. Based on Addendum 3 of the RFP, the cost of noise barrier systems and associated improvements are not included in the $100M CAP.

The HSR method will result in reduced width for the existing travel lanes, to offset the narrow width of the existing inside SB shoulder in certain locations. A design exception will be submitted for lanes less than 12’ wide and for reduced shoulder widths. The FHWA Safety program mentions that there is a potential adverse impact to safety and operations of freeways when the travel lane width is reduced to less than 12’. However, to date, there are no studies showing that this is the case for freeways. Therefore this is an unknown, but potential risk to the Administration.

During peak traffic flow time periods when HSR is in operation, there will be no inside shoulder along the majority of the SB IS-270 sections listed in Table 1. This presents a risk to the owner, since they will not be able to rely on the benefits that a shoulder provides, such as emergency responses and providing a pull-off area for broken down vehicles. The Administration can use the lane control system to close shoulders to through traffic during inclement weather and major incidents. CCTV cameras will be installed to monitor this particular location for incidents.

Due to the nature of the contract, all proposed improvements are subject to third party input such as Emergency operations (including local EMS and the State/County Police), and approval from FHWA (including IAPA), DNR, MDE and other associated environmental agencies. Once design is finalized, the administration will seek approval from the aforementioned agencies, or vary the scope to address their comments. In addition, community involvement and input may affect the NEPA permitting process and final configuration of the proposed solutions.

G. Design-Builder Risk

A description of risk to the Design-Builder associated with implementing the PTC.

The existing conditions of the pavement and drainage conveyance system are a risk. The shoulder pavement structure is not consistent. The condition of the existing drainage systems is not known. In locations where shoulder full depth reconstruction is required, SWM facilities will be proposed. There is limited existing right-of-way to locate these new facilities.

Risks during construction include contractor access, ability to close lanes, lack of staging areas and heavy traffic adjacent to work zones.

H. Cost/Schedule Benefits

Discussion of any cost or schedule benefits to this contract from usage of this PTC

The implementation of HSR is a practical design solution that adds highway capacity without increasing the existing pavement footprint of the roadway. The following are the cost and schedule benefits of the HSR method when compared to a conventional widening project.

- HSR provides a temporary increase in highway capacity without the need to widen the existing roadway. This method results in construction cost savings due to the reduced cost in ROW, structures, excavation and ramp modifications.
- This method does not require major infrastructure widening, resulting in shorter construction periods and reduced maintenance of traffic and erosion and sediment control costs.
- Compared to other conventional reconstruction methods, there are minimal additional ROW needs/costs.
- Compared to other conventional reconstruction methods, the DB team is anticipating minimal utility impacts. Therefore, the HSR method results in cost and schedule benefits due to minimal coordination time with utility companies, and minimal utility relocation timeframes that would need to occur prior to the start of any construction activity.
- Due to the lack of roadway widening required, this method results in no impacts to existing overpasses and underpasses, hence significantly reducing the cost and the timeframes required for widening or replacement of existing structures.

I. Miscellaneous

Any additional information that would assist the Administration in the review of this PTC.

The Administration can adapt the role of the managed lane to future needs and therefore the HSR can be used to accommodate electric vehicles exclusively. Recent legislation was passed announcing federal and private sector action to accelerate electric vehicle adoption in the country. IS-270 can be used a pilot highway to dedicate the managed lane to electric vehicles, and set a precedence for other highways in the state of Maryland.

The proposed advanced data collection in PTC8 provides the Administration with best opportunity to monitor drivers' behavior, change in travel patterns, and path selection due to added HOV capacity in the corridor. PTC 10 in combination with PTC8 will increase the Administration adaptability to make informed policy decisions to increase corridor throughput and simultaneously reduces traffic congestion on parallel facilities.

There are currently three commuter/express bus services that would directly benefit from the increased HOV capacity. Maryland Transit Administration (MTA) operates Route 505 and 515. MTA Route 505 runs between Hagerstown and the Rock Spring Business Park via IS-270 (Figure 7). There are eight total trips in the AM southbound direction. Five of these terminate at the Shady Grove Metrorail Station, and would benefit from the decreased volume in the local HOV lane. The other three run all the way to the Business Park and would use the SB Express HOV lane along the median HSR.

MTA Route 515 runs between Frederick and the Rock Spring Business Park via IS-270. There are 13 AM peak southbound trips.

The Montgomery County Ride-On Route 70 runs express between Germantown and Bethesda via the IS-270 and MD 355 (Wisconsin Avenue). There are three AM peak southbound trips.

Two of the key factors that make transit service more attractive to riders are travel speeds and reliability. Additional HOV-Express capacity will improve these two factors, hence making the express bus services in the IS-270 corridor more competitive with the automobile.

The map provided below was developed for the MD 355 Bus Rapid Transit (BRT) Corridor Planning Study currently underway and shows significant park and ride capacity north of the northern limits of the proposed HOV expansion. These park and rides could become potential terminal points for additional commuter service.

The southbound HOV-Express lane in conjunction with the added capacity along the IS-270 west spur (PTC 5A) and the potential extension of the existing HOV lane along I-495 up to the American Legion Bridge will result in benefits for transit, due to the regional interest in a cross-Potomac transit service that would provide an alternative to the automobile for trips between Maryland and northern Virginia. WMATA began a pilot service that attempted to utilize shoulders to provide transit exclusivity. The bus-on-shoulder element of the service did not prove feasible and the service was terminated. However, the ability of transit services to bypass congestion in the general purpose lanes has the potential to make this type of transit service more attractive.

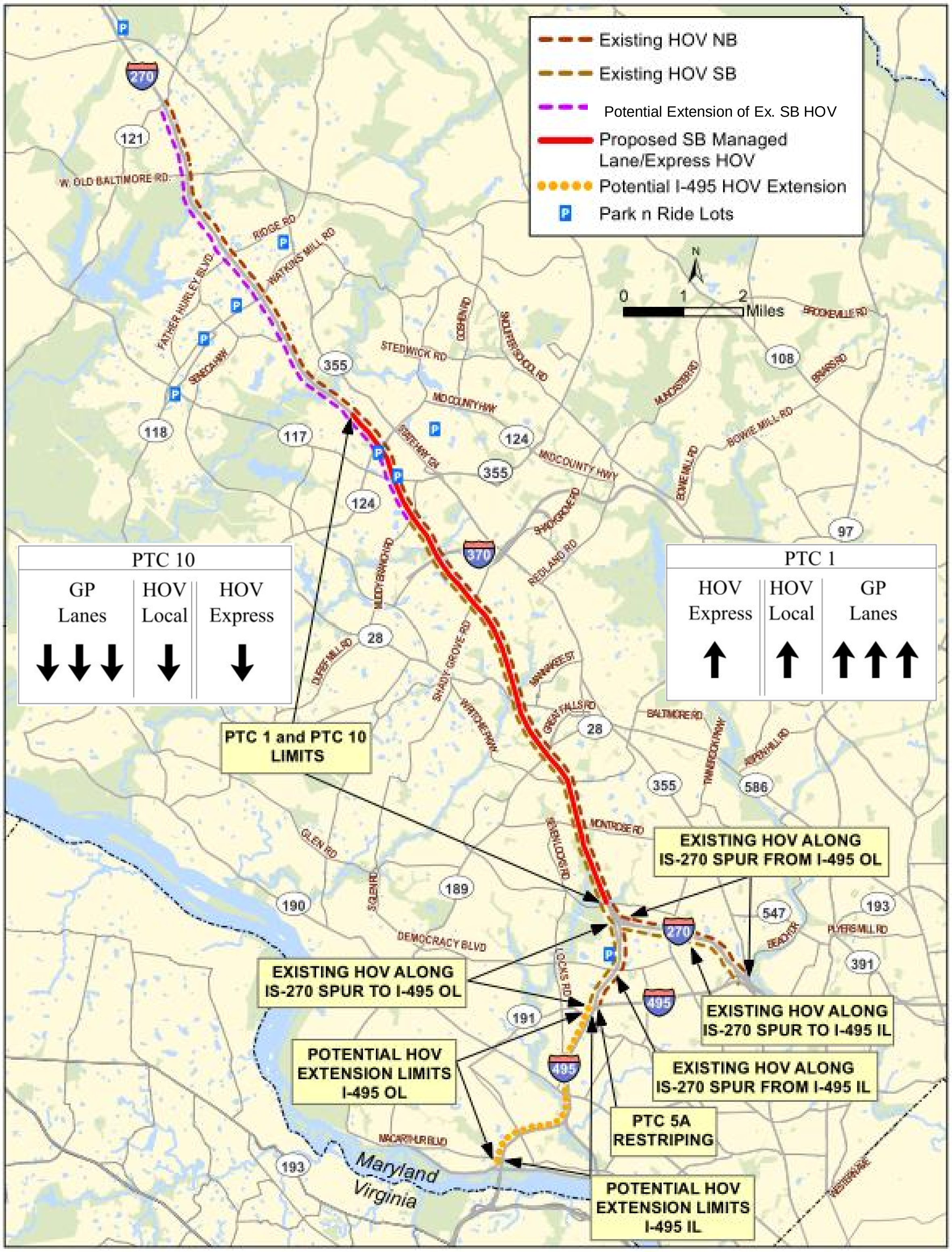

Figure 7 – HOV facilities map

Larry Hogan, *Governor*
Boyd K. Rutherford, *Lt. Governor*

State Highway Administration
Maryland Department of Transportation

Pete K. Rahn, *Secretary*
Gregory C. Johnson, P.E., *Administrator*

November 22, 2016

Mr. Benjamin J. Carnazzo
Kiewit Infrastructure Co.
7250 Parkway Drive, Suite 310
Hanover MD 21076

Dear Mr. Carnazzo:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 10 for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on November 14, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract.
2. Page 2, Section A, Description: The section on PTC 8 and the data from that PTC will allow the Administration to monitor changes in travel patterns, is interesting. Please clarify how this data might be actively used to address the effectiveness (or impact the operation) of hard shoulder running (HSR) in this context.
3. Page 2, Section A, Description: The third paragraph has some language that is not clear regarding whether the proposal would be for the CHART system to take primary control of the lane control signals, or would eventually interface to an autonomous operating system that manages the ATM on I-270. There are significant challenges in making the success of the I-270 ATM contingent on an existing and separate contract. As mentioned previously:

    - The existing CHART ATMS resides within the security firewalls of the Maryland Department of Transportation (MDOT) Enterprise network. As such, any integration and data sharing between ATMS elements of the I-270 proposed technical concepts will need to comply with network security and system integration requirements as identified by MDOT and the Maryland Department of Information Technology (DoIT).

- The development of the CHART ATMS software is conducted under a contract managed by the Office of CHART & ITS Development, with specific goals and separate contract requirements. Any modifications to the CHART ATMS software will be conducted under the CHART ATMS contract. Although integration between the CHART ATMS and I-270 ATMS elements is feasible, contractors should not make the success of the I-270 Innovative Congestion Management project contingent on adding functionality to the CHART ATMS. Also note, the CHART ATMS is an information management and advisory system for coordination of response to events on the roadway system. As such, it has not been developed to operate safety sensitive devices (e.g. traffic signals) in real time, which would require robust, instantaneous communications and frequent feedback on device and system status.

We would recommend that the discussion of the command and control of the traffic management elements include more specifics on:

- Configuration management: From the PTC, it is agreed that the CHART system and possibly other systems (e.g. the Montgomery County Signal System?) will need to share key data as triggers (e.g. when and where an incident occurs, specific lanes blocked, etc.) The PTC needs to address how changes to one system, impacting the format of how data is output and/or input, will be coordinated in order to prevent "breakage" of the integrated connection of systems.
- Security: As mentioned in previous comments, the CHART system resides inside the secured firewalls of the MDOT Enterprise Network. As such, data passed into the CHART system needs to meet the security requirements of the DoIT. This does not apply to data passing out of the CHART system. CHART provides a Representation State Transfer (REST) feed for real-time incident information.
- Hosting: There are various potential hosting strategies for the ATM system, and the PTC would be strengthened with additional information on the proposed approach.
- Business Process: The CHART Program has specific responsibilities in coordinating the response of various agencies at highway incident scenes and providing traveler information. ATM systems represent another tool, but also additional responsibilities in the incident management process. We would like the proposer to describe how the existing Traffic Incident Management (TIM) process will be coordinated in the Operations Center, and in the software, with managing ATM tools as well.

4. Page 3, Section A, Description: We would have some concerns regarding whether cellular communications would be reliable enough for a safety-sensitive application such as lane control elements of an ATM system.
5. Page 4, Section B, Location: From an incident management and operations perspective, we concur and appreciate the proposed cross-section maintaining a useable outside shoulder.

6. Page 8, Section C, Analysis: We would like additional information, from an intuitive perspective, on why the analyses indicate that property damage only crashes would be reduced, while injury and fatal crashes would increase slightly. On the surface, because of the relative importance of safety, this would appear to be an undesirable trade-off (i.e. injuries and/or fatalities should at least remain the same or be reduced).
7. Page 9, Section D, Potential Impacts, Safety: The proposal should address alterations to operational procedures that might be necessary. Changes to shoulder areas will influence traffic incident management in the following ways:
    a. Providing a safe buffer zone for emergency responders. Managed lanes can facilitate lane use and advanced warning, but full shoulders provide a work area for emergency responders which, by vehicular regulation and driver behavior, motorist don't use. Managed lanes can help, but positive guidance and physical barriers (e.g. cones) will be the only protection in a normally traveled lane (i.e. hard shoulder).
    b. Use as a staging area for vehicle recovery. In Maryland, by policy and regulation in support of the towing and recovery industry, public agencies only relocate damaged and disabled vehicles to the shoulder, to stage them for final removal by industry towers. Limited shoulder availability would likely require new policies and procedures to minimize the blockage time impact while preparing for private towers to arrive.
    c. Access to the incident scene. The CHART patrols, in Maryland, function as an extension of staff for the Maryland State Police, in the area of Traffic Incident Management. However, CHART patrols are not enforcement vehicles and do not have the authority of a "blue light" (police) or a "red light" (fire and rescue) emergency responders in traveling through traffic (even though they are equipped with lights and sirens). Consequently motorists may, or may not, yield right of way to CHART vehicles.
    d. Impacts of more complex incidents. Procedures and impacts need to be analyzed and addressed for more complex incidents that require more complex recovery procedures and other public safety impacts. Some of these complicating factors include: heavy/large vehicles, injuries, hazardous materials, fires, criminal activities, significant debris (e.g. a load of mulch) etc. Each of these scenarios requires different personnel and equipment on scene: fire trucks, ambulances, police vehicles, heavy equipment, etc. Shoulders provide the additional geometry to stage and maneuver these resources.
8. Page 11, Potential Impacts, CHART: There is another paragraph referring to the integration with CHART. Please see the comments under A. Description, regarding considerations for the eventual integration with the CHART system.
9. Page 12, Administration Risk: We concur that the HSR lane management system will be important to allow SHA to close the shoulder and provide motorists advanced warning.
10. Page 12, Administration Risk: The last paragraph indicates that SHA may need to obtain approval from Emergency Operations personnel on the proposed improvements. Although coordination will be important, we're not aware of any approval process with local fire, EMS and police that would be necessary.
11. Please state that the design shall adhere to the recommendations/suggestions in the following guide: Use of Freeway Shoulders for Travel (FHWA, February 2016).

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Frank DiGilio, Kiewit Infrastructure Co.

Appendix ii

Proposed Technical Concepts (PTCs)

and Responses to SHA Comments

PTCs not included in “The Project”

and Technical Proposal

PTC # 1B, 2, 3, 9

PTC 1B – Contraflow Southbound Express HOV Lane using Movable Barrier with Hard Shoulder Running

AECOM

AECOM
7 St. Paul Street, 17th Floor
Baltimore, MD 21202, USA
aecom.com

January 19, 2017

Mr. Jason A. Ridgway, P.E.
Director, Office of Highway Development
Maryland Department of Transportation
State Highway Administration
707 N. Calvert Street
Baltimore, MD 21202

Subject: **Proposed Technical Concept No. 1B** Comment Responses
IS-270 - Innovative Congestion Management Progressive Design Build
Contract No. MO0695172

Dear Mr. Ridgway

The Kiewit/AECOM team is **not including PTC 1B** in "the Project" and technical proposal. We appreciate the opportunity to submit this PTC and receive your feedback during the review process.

Yours sincerely,

Chris McGuire, PE
Vice President, Maryland Surface Transportation
AECOM
T: 410-637-1720
M: 443-386-6286
E: chris.mcguire@aecom.com

A. Description

Detailed descriptive information and other appropriate information as appropriate such as conceptual drawings, production details, standards, specifications, and traffic operations analysis.

This Proposed Technical Proposal (PTC) includes the use of movable barrier to create a contraflow SB Express HOV lane along the existing IS-270 NB median during the AM peak period. Contraflow lanes are appropriate for corridors with high directional splits, which makes it a good solution for the congestion along IS-270 during peak periods. This PTC also includes Hard Shoulder Running (HSR) to create an additional lane utilizing the IS-270 NB median during the PM peak period. In addition, HSR will run along the northbound right shoulder all the way to Montrose Road.

The PTC proposes the use of concrete movable barrier, which can be shifted up to 24' laterally through the use of a Barrier Transfer Machine (BTM). The BTM can be detached from the movable barrier once the shift is complete. The BTM will be stored behind the concrete barrier when not in use.

PTC 1 which has been submitted to SHA included the reconstruction of the NB median shoulder between Tuckerman Lane and Watkins Mill, to allow for Hard Shoulder Running during the PM peak period in the NB direction. This PTC is submitted as an extension of PTC 1, to provide the advantage of using the reconstruction of the NB median shoulder to provide an additional lane southbound during the AM peak period and an additional lane northbound during the PM peak period.

A VISSIM analysis has been completed, to show the results of adding a contraflow SB Express HOV lane during the AM peak period. This analysis has shown that operations along NB IS-270 will not be significantly impacted by the loss of a lane during the AM peak period, except for the section just south of Montrose Road. To mitigate this, HSR will be provided along the northbound right shoulder between Old Georgetown Road and Montrose Road for a distance of 1.8 miles.

Travel time and vehicle speed results for the entire corridor are summarized in Table A.1 to A.4 for the AM peak hour. Table A.2 and Table A.4 summarizes local road travel time and speed respectively. Express HOV travel time and speed are added at end of Table A.2 and A.4 as well. Travel time results are also depicted with graphs on Figure A.1 to Figure A.6.

Table A.5 to A.7 summarize density results for each segment for AM peak hour. To better evaluate the new Express HOV operation, the density results for this lane were also included at the end of Table A.5. Table A.5 and A.6 summarize express lane results and Table A.7 includes local road vehicle densities.

AM peak hour throughput results are included in Table A.8 to Table A.9. Table A.8 includes express lane and Table A.9 summarizes local road throughput results. Local and Express HOV throughput results were added also to Table A.9 for more comprehensive assessment.

The PM peak hour travel time and speed results for the entire corridor are included in Table B.1 to B.4. Table B.2 and B.4 include for local road. Travel time results are also depicted by graphs on Figure B.1, B.3 and B.5. Density results are included in Table B.5 to B.7. Table B.8 and B.9 summarizes vehicle throughput results for PM peak hour.

The origin-destination data for HOVs that were obtained from the MWCOG travel demand forecasting model indicate that approximately 966 vehicles on the existing SB HOV lane have origin points north of Watkins Mill and destination points south of Tuckerman Lane. In the proposed condition, these vehicles would use the contraflow SB Express HOV lane. This would relieve traffic congestion on the local HOV lane and result in higher travel speeds. This improvement in HOV operations would encourage drivers to carpool, giving them the ability to use HOV lanes instead of general purpose lanes.

B. Location

The locations where, and an explanation of how, the PTC will be used on the Project.

The southbound contraflow lane using a movable barrier system will be implemented along the existing northbound median shoulder of IS-270 from south of the future Watkins Mill overpass bridge to north of Tuckerman Lane. Dynamic cantilevered overhead lane control signs will be provided north of Watkins Mill before the median crossover. During the AM peak period signs will indicate that the contraflow lane is SB Express HOV connecting directly to points south of Tuckerman Lane. No intermediate access / egress will be provided.

Figures 1 through 4 depict the AM and PM peak period configurations of northbound IS-270 where the SB Express HOV lane runs along the existing northbound median shoulder and works in conjunction with PTC 1 – Hard Shoulder Running. The movable barrier is shifted to define and accommodate the contraflow lane in the AM peak period, and it is stored adjacent to the existing concrete median barrier all other times. When the movable barrier is deployed, there is a minimum of 21 foot clear width between the two barriers, which meets AASHTO recommendations for one-lane, one-way operation – with provision for passing stalled vehicle. (*A Policy on Geometric Design of Highways and Streets,* 2011, Table 3-29, Case II-C)

Contraflow SB Express HOV Lane using Movable Barrier with Hard Shoulder Running

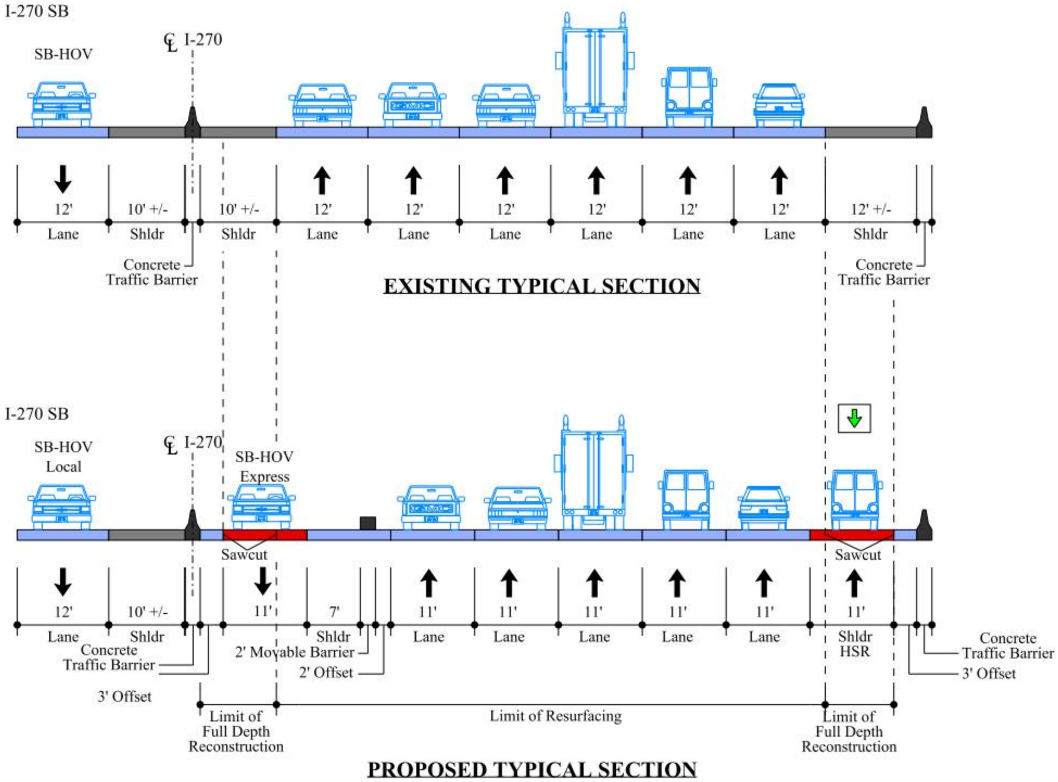

Figure 1 - AM Peak Period – Old Georgetown Road to Montrose Road

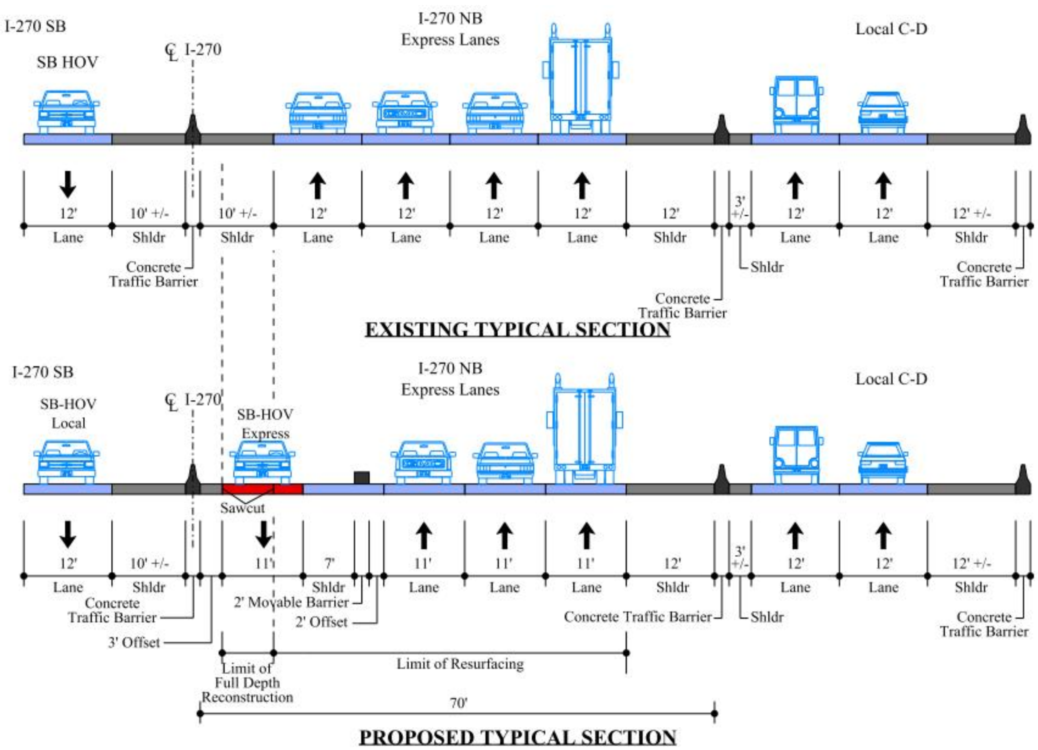

Figure 2 - AM Peak Period – Montrose Road to Watkins Mill Road

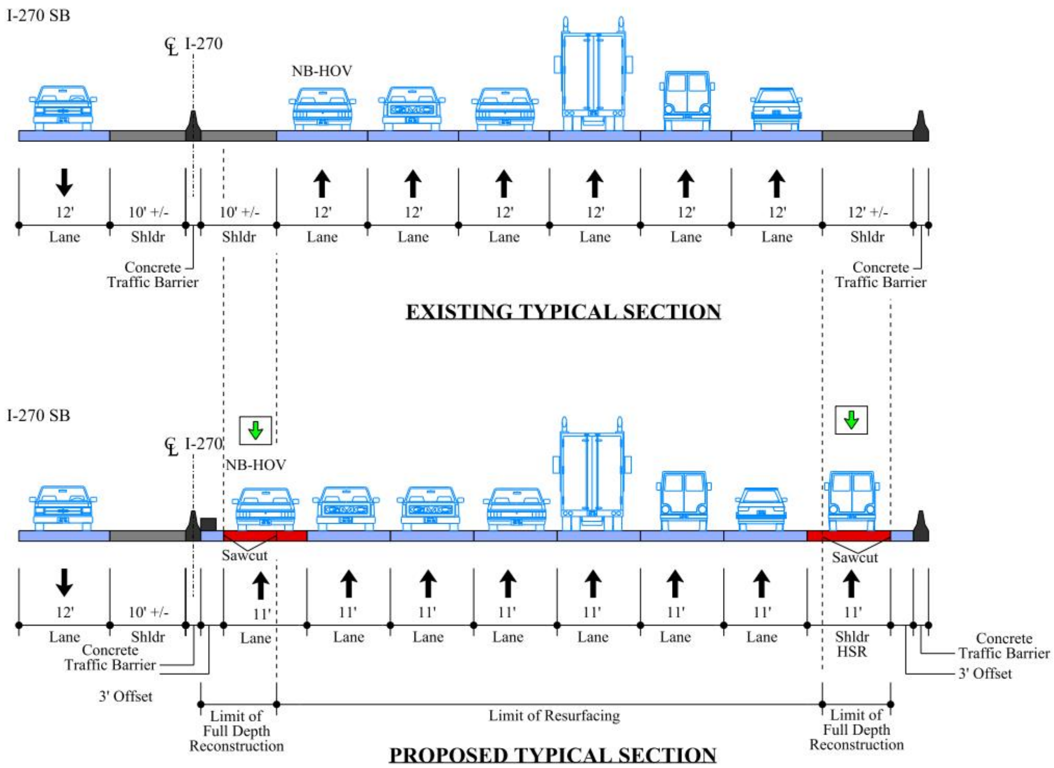

Figure 3 - PM Peak Period – Old Georgetown Road to Montrose Road

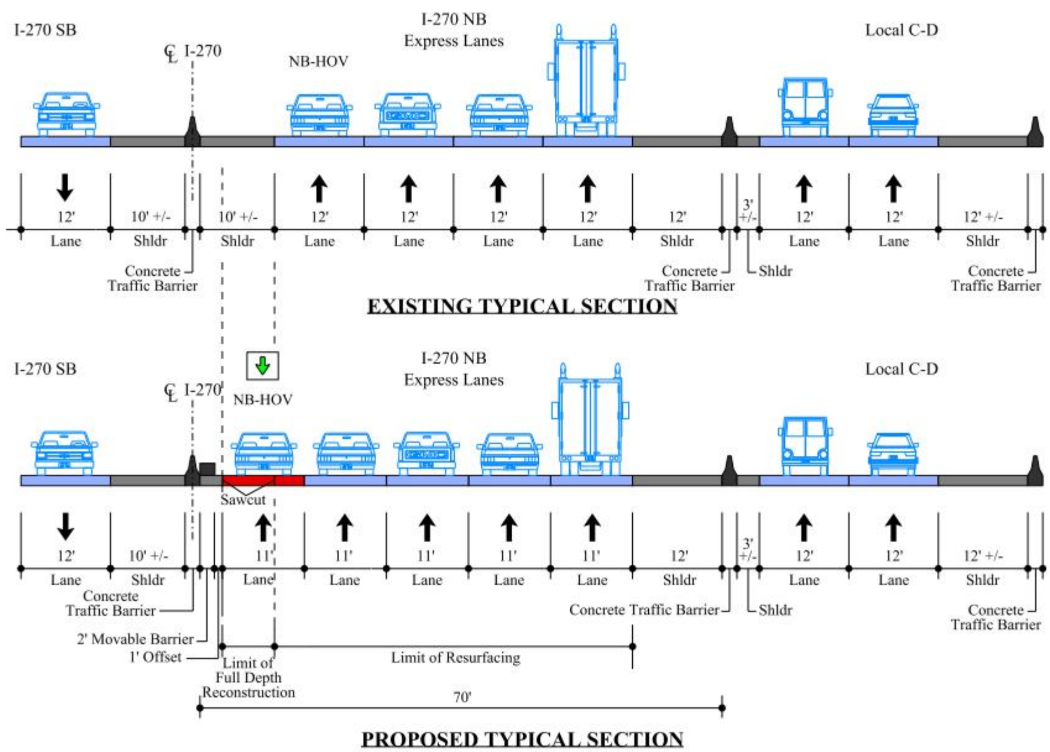

Figure 4 – PM Peak Period – Montrose Road to Watkins Mill Road

C. Analysis

Analysis justifying the use of the PTC including how it advances the project goals.

Appendices C and D illustrate the northern and southern crossovers of the contraflow lane. A 3' offset will be provided between the edge of the contraflow lane and existing median concrete barrier during the AM peak period.

The Northern Crossing begins just south of Watkins Mill Road, and extends 2000' south. Figure 5 includes proposed signing north of the crossover, to guide drivers into the correct lane in advance of the lane split.

The length of the lane shift taper was calculated using the formula from AASHTO shown below, for speeds 45 mph or more:

L = WS = 17'x70mph = 1190' ≈ 1200' where;

L=Length of Transition in feet; W = Offset Distance in feet, and S= 85th Percentile Speed in mph

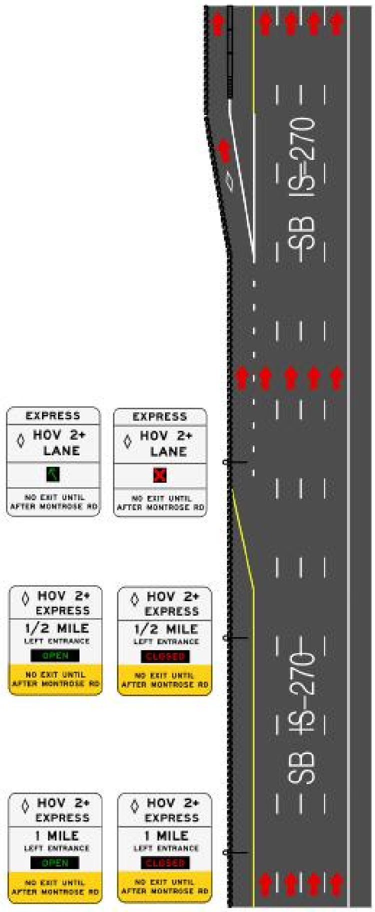

Figure 5 – Northern Crossing Lane Split

The southern crossing begins approximately 2200' north of Tuckerman Lane, and ends just south of Tuckerman Lane. The contraflow SB HOV lane terminates in the SB median shoulder, which will be reconstructed to become traffic bearing. In addition, a 1000' two-lane section is provided just south of the crossover, to allow for weaving of SB HOV vehicles before the decision point of heading towards I-495 East or I-495 West (Figure 6).

Figure 6 – HOV lane split to I-495

The length of the lane shift taper was calculated using the AASHTO formula shown below, for speeds 45 mph or more: L = WS = 16'x70mph = 1120' ≈ 1200' where;

L=Length of Transition in feet; W = Offset Distance in feet, and S= 85th Percentile Speed in mph

The shoulder sections with cross slope steeper than 3% will be reconstructed to meet the required superelevation rate of the existing roadway travel lanes. In addition the shoulders will be reconstructed to full depth where necessary. The 3' offset between the edge of the HSR and the existing concrete barrier will not be reconstructed, since it will not need to be traffic bearing. Therefore the limits of full depth reconstruction will be saw cut, to avoid impact to the adjacent pavement composition.

The contraflow lane will be opened during rain events. Spread computations were completed based on the proposed typical section. The team will prepare a detailed hydraulic analysis during the post award phase to ensure that the spread during rain events will not cause any safety concerns for vehicles traveling in the contraflow lane.

The provision of the express HOV lane is likely to attract existing HOV traffic on arterials, such as MD 355, to this lane. Preliminary calculations indicate that approximately 300 vehicles per hour could divert to the express HOV lane. This would lead to decreased congestion on the arterials, which would be likely to result in traffic diverting from the general purpose lanes along southbound IS-270 back to the arterials. Preliminary calculations indicate that approximately 3% of the vehicles on the general purpose lanes might divert in this fashion, thereby improving operations on southbound IS-270, even if no mode shift from general purpose lanes to HOV occurs. In addition, some mode shift can occur. With improved travel time in the local HOV lane, Single Occupant Vehicles (SOVs) would have an incentive to carpool and use the HOV lane instead. Even though each new HOV lane would reduce SOVs at a minimum rate of 2:1, we have assumed a reduction of 1.5:1 be conservative.

D. Potential Impacts

A preliminary analysis of potential impacts (both during and after construction) including but not limited to use impacts, Right-of-Way, geotechnical, utilities, environmental permitting, local community, safety, and life-cycle project and infrastructure costs, including impacts on the cost of repair, maintenance, and operation.

User Impacts - There will be positive impacts on traffic operations along southbound IS-270, due to the increased HOV capacity during peak hours. Reduced lane widths may have an impact on driver speeds. An equivalency study will be completed and submitted to FHWA post award for any narrowing or shifting of lanes.

Right of way (ROW) – One of the advantages of using a contraflow lane is the ability to provide added capacity during the peak period while remaining within the existing pavement footprint. There are no anticipated additional ROW needs associated with the implementation of the contraflow lane method. However, due to the full depth reconstruction of the HSR and the median crossings for the SB contraflow lane, there's a need for additional SWM facilities which may result in additional ROW. In addition, ROW may be required to accommodate the required noise barrier systems.

Geotechnical – The shoulder will be reconstructed to full depth where pavement depths are insufficient to support the proposed traffic volumes. The Administration provided Ground Penetration Radar results that included information on the existing pavement composition of the median shoulder within the limits of the contraflow lane. The team has identified the existing pavement sections that are not traffic bearing and will require full depth reconstruction. The remainder of the median shoulder will be overlaid. In addition, the through lanes along NB IS-270 will be resurfaced to allow for restriping of the existing lanes; resurfacing will be limited to sections where lane restriping is required.

Utilities – No significant impacts are expected since the majority of the proposed improvements are within the existing roadway footprint.

Environmental Permitting – Appropriate mitigation strategies will be implemented to comply with all third party regulations and to meet the National Environmental Policy Act (NEPA) requirements. Due to the anticipated full depth reconstruction of the existing shoulder in certain areas, SWM facilities will be provided to meet all SWM criteria to the maximum extent practicable.

The addition of the contraflow lane increases capacity along southbound IS-270 and therefore meets the FHWA Type I Highway Traffic Noise project criteria. As a result, FHWA requires that a noise analysis be conducted in a manner similar to a conventional widening project. If the design year build condition noise levels approach or exceed the 23 CFR Part 772 Noise Abatement Criteria for the future build conditions, there will be traffic noise impacts and investigation of noise mitigation will be warranted and implemented if found to be feasible and reasonable.

A qualitative noise analysis was conducted in the section where the contraflow lane is proposed, between Tuckerman Lane and Watkins Mill. A total of approximately 13,000 feet of potential noise barrier was identified between these two limits.

Local Community – There will be minimal impact to residential and commercial communities during construction due to the majority of the work taking place closer to the median along IS-270.

Safety – Incident management is a concern with the contraflow lane due to the lack of northbound median shoulder during peak hours, which otherwise can be used as an access lane for emergency vehicles. In addition, there are existing median crossovers in several locations within the limits of the contraflow lane that will be closed once the movable barrier is stored against the existing median concrete barrier.

Infrastructure costs – Infrastructure costs for the implementation of the contraflow lane will be developed based on supplying the movable barrier and the barrier transfer machine, shoulder full depth reconstruction, grinding and resurfacing, lane control systems, signing, restriping, drainage improvements, SWM facilities, noise barrier systems and additional ROW acquisitions.

Maintenance – In the existing conditions, the median shoulder is used by maintenance crews to store snow after inclement weather events. Assuming this practice continues, the contraflow lane could not be implemented after a winter snow storm event, and the movable barrier will remain stored adjacent to the concrete median until the shoulder was completely cleared of snowpack.

E. Other projects

A description of other projects on which the PTC has been used, the degree of success or failure of such usage, and the names and contact information (including telephone numbers and e-mail addresses) of project owner representative who can confirm such statements.

Route 101 – Golden Gate Bridge – San Francisco, California

AECOM was the lead design engineering firm in the Golden Gate Bridge (GGB) Movable Barrier project. The project has won several awards, including the Award of Merit from ENR California.

In July 2011, AECOM prepared the Operations and Maintenance Report for the Golden Gate Bridge (GGB) Movable Barrier Study. The GGB is under the jurisdiction of the Golden Gate Bridge Highway and Transportation District (District). The Average Daily Traffic is approximately 120,000. The GGB serves as the main transportation corridor for US Highway 101 between Marin County and the City of San Francisco. It is a six-lane highway that spans nearly 9,000 feet. The District installed a movable barrier system in order to increase motorist safety and accommodate peak hour traffic demands. The system provided a semi-rigid barrier between opposite traffic lanes, and allowed the District the flexibility to reconfigure the lanes on the bridge at different times during the day

AECOM completed the Transportation Management Plan (TMP) in December 2014. The report includes traffic plans for the different lane configurations depending on the location of the proposed movable barrier, and traffic control plans for the installation of the movable barrier.

The project was completed in early 2015. It includes approximately 13,340 feet of barrier, made up of approximately 3,500 concrete units.

F. Administration Risk

A description of risk to the Administration or third parties associated with implementing the PTC.

The contraflow lane method in combination with HSR will result in reduced width for the existing travel lanes in the northbound direction, to offset the narrow width of the existing left shoulder. A design exception will be submitted for travel lanes less than 12' wide.

During the AM peak period when the contraflow lane is in operation, and during the PM peak period when the HSR is in operation, there is no median shoulder along NB IS-270. This presents a risk to the owner, since they will not be able to rely on the benefits that a shoulder provides, such as emergency responses and providing a pull-off area for broken down vehicles. The Administration can use the lane control system to close the contraflow lane and the HSR to through traffic during snow events and major incidents.

Due to the nature of the contract, all proposed improvements are subject to third party approvals such as Emergency operations (including local EMS and the State/County Police), FHWA, MDE and other associated environmental agencies. Once design is finalized, the administration will seek approval from the aforementioned agencies, or vary the scope to address their comments. In addition, community involvement and input may affect the NEPA permitting process and final configuration of the proposed solutions.

G. Design-Builder Risk

A description of risk to the Design-Builder associated with implementing the PTC.

Since this is the first use of permanent movable barrier in Maryland, there are no state design criteria to follow; therefore, gaining the Administration's acceptance of the design standards obtained from other states could be a challenge.

The contraflow lane will result in capacity enhancement and therefore will require noise mitigation. The size, location, feasibility and reasonableness of the proposed barrier systems shown in Appendices A and E may change during the post-award phase.

The existing conditions of the pavement and drainage conveyance system are a risk. The shoulder pavement structure is not consistent. The condition of the existing drainage systems is not known. Pavement reconstruction will require storm water management best management practices (BMPs). There is limited existing right-of-way to locate new BMPs.

Risks during construction include contractor access, ability to close lanes, lack of staging areas and heavy traffic adjacent to work zones.

H. Cost/Schedule Benefits

Discussion of any cost or schedule benefits to this contract from usage of this PTC

The implementation of a contraflow lane is a practical design solution that adds HOV capacity during the AM peak period in the southbound direction without increasing the existing pavement footprint of the roadway. The following are the cost and schedule benefits of the contraflow lane method when compared to a conventional widening project.

- The contraflow lane provides a temporary increase in HOV capacity during the peak period without the need to widen the existing roadway. This method results in construction cost savings due to the reduced cost in ROW, structures, excavation and ramp modifications
- This method does not require major infrastructure widening, resulting in shorter construction periods and reduced maintenance of traffic and erosion and sediment control costs.
- Compared to other conventional reconstruction methods, there are very minimal ROW needs/costs.
- Compared to other conventional reconstruction methods, the DB team is anticipating minimal to no utility impacts. Therefore, the contraflow lane method results in cost and schedule benefits due to minimal coordination time with utility companies, and minimal utility relocation timeframes that would need to occur prior to the start of any construction activity.
- Due to the lack of roadway widening required, this method results in no impacts to existing overpasses and underpasses, hence significantly reducing the cost and the timeframes required for widening or replacement of existing structures.

I. Miscellaneous

Any additional information that would assist the Administration in the review of this PTC.

Adding HOV capacity to IS-270 using movable barriers would have significant benefit for existing transit services in the I-270 corridor as well as potential future services.

There are currently three commuter/express bus services that would directly benefit from the increased HOV capacity. Maryland Transit Administration (MTA) operates Route 505 and 515. MTA Route 505 runs between Hagerstown and the Rock Spring Business Park via IS-270 (Figure 7). There are eight total trips in the AM southbound direction. Five of these terminate at the Shady Grove Metrorail Station, and would benefit from the decreased volume in the local HOV lane. The other three run all the way to the Business Park and would use the contraflow SB Express HOV lane.

MTA Route 515 runs between Frederick and the Rock Spring Business Park via IS-270. There are 13 AM peak southbound trips.

The Montgomery County Ride-On Route 70 runs express between Germantown and Bethesda via the IS-270 and MD 355 (Wisconsin Avenue). There are three AM peak southbound trips.

Two of the key factors that make transit service more attractive to riders are travel speeds and reliability. Additional HOV-Express capacity will improve these two factors, hence making the express bus services in the IS-270 corridor more competitive with the automobile.

The map provided below was developed for the MD 355 Bus Rapid Transit (BRT) Corridor Planning Study currently underway and shows significant park and ride capacity north of the northern limits of the proposed HOV expansion. These park and rides could become potential terminal points for additional commuter service.

The southbound HOV-Express contraflow lane in conjunction with the added capacity along the IS-270 west spur (PTC 5A) and the extended HOV lane along I-495 up to the American Legion Bridge will result in benefits for transit, due to the regional interest in a cross-Potomac transit service that would provide an alternative to the automobile for trips between Maryland and northern Virginia. WMATA began a pilot service that attempted to utilize shoulders to provide transit exclusivity. The bus-on-shoulder element of the service did not prove feasible and the service was terminated. However, the ability of transit services to bypass congestion in the general purpose lanes has the potential to make this type of transit service more attractive.

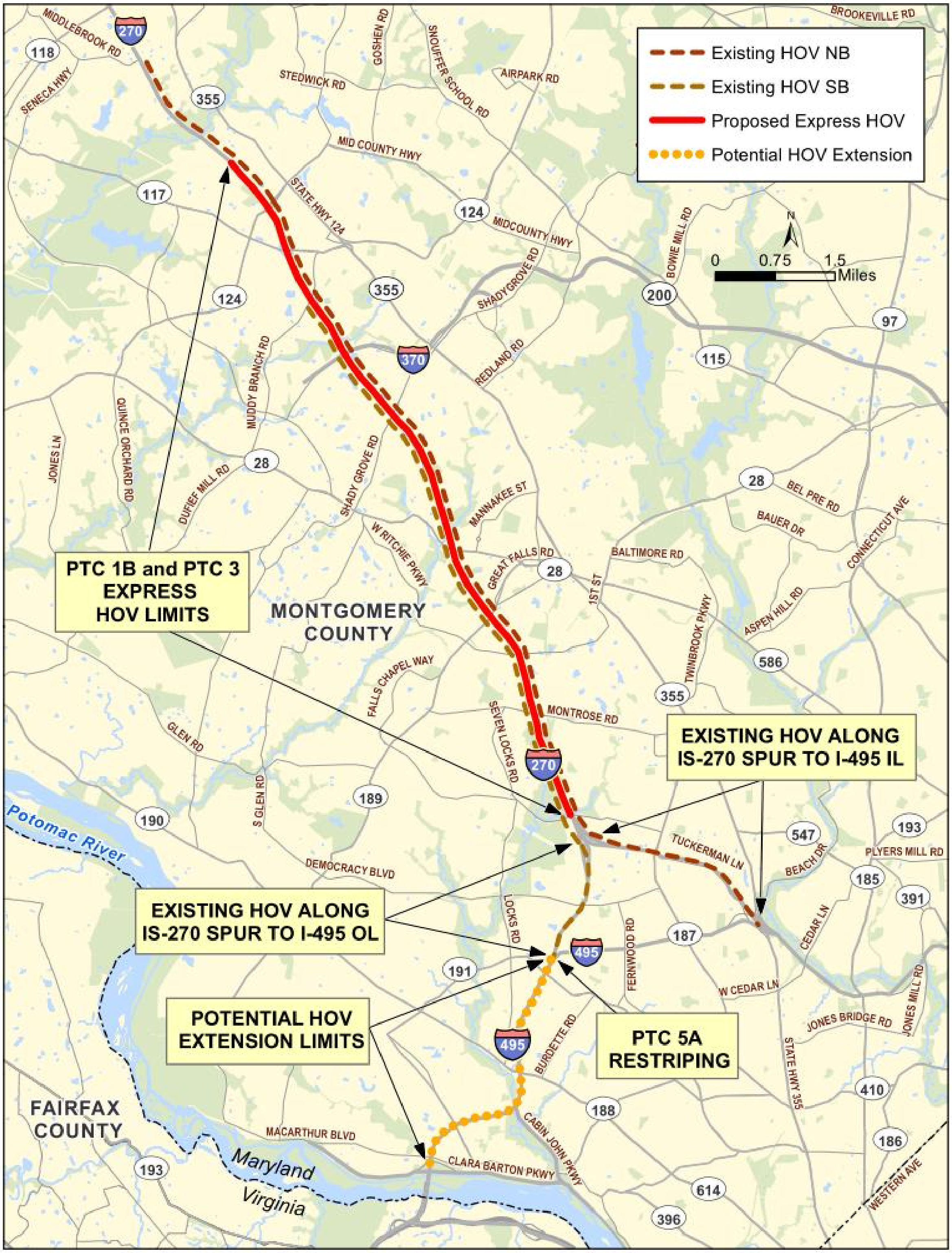

Figure 7 – HOV facilities map

October 31, 2016

Mr. Benjamin J. Carnazzo
Kiewit Infrastructure Co.
7250 Parkway Drive, Suite 310
Hanover MD 21076

Dear Mr. Carnazzo:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 1B for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on October 19, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. Generally, the concept appears to be a reasonable solution to address the Mobility goal of this contract.
2. The Safety goal is largely unaddressed in this PTC. The discussions on safety (pages 8 and 9) appear to imply that safety will become worse. How does this PTC provide for a safer I-270 corridor?
3. Except for touching on Barrier Transfer Machine (BTM) storage and snow events, this PTC is silent regarding Operations and Maintenance (O&M). The Administration values a project that will provide for ease of O&M. Please address the Operability/ Maintainability/Adaptability goal in detail.
4. Each new HOV lane was assumed to reduce SOVs at a rate of 1.5:1. For the COG travel demand model output usage for HOV demand estimation, the PTC assumptions should be clearly stated and justified. Please provide good documentation of induced demand/mode shifts, diverted demand to justify projected demand, and describe the calibration/validation efforts undertaken as the raw MPO model outputs could be misleading. The COG MPO model is ideal for regional analysis and trend determination; caution should be taken to interpret model outputs along with appropriate post processing techniques.
5. Please clarify where the BTM will be stored at times other than the AM peak period.
6. It is noted on page 6 that some spread computations were completed for the proposed typical section. Please note that for the PM peak period the flow line would be at the face of the moveable barrier, not at the face of the permanent median barrier.
7. To achieve the project goals, the Design-Builder must provide a fully functional system at project completion. Integration is a critical component for the success of this PTC. Please discuss in detail how this PTC will be integrated. Section D. Potential Impacts should address impacts to CHART.

8. Section E, Other Projects: Please include the degree of success the Golden Gate Bridge Project had and contact information for owner representatives. Also, the Golden Gate Bridge project did not have a permanent median barrier. If project information on a successful application of moveable barrier as a managed lane is available, please provide.
9. A National Environmental Policy (NEPA) document and an Interstate Access Point Approval (IAPA) approved by the Federal Highway Administration (FHWA) will be required prior to establishing a Construction Agreed Price (CAP). In preparation of the IAPA, the Design-Builder must meet the requirements of the FHWA Interstate System Access Informational Guide.
10. Please provide more specificity in the signing needs for the contraflow and hard shoulder running segments, including approximate spacing. Entry signing is good, yet motorists may need spaced signs along the segment to provide positive guidance and reassurance that the operations are under active control.
11. How will training and tools be provided to "break" and restore the barrier to access incidents between the moveable and permanent barriers?
12. Changes to shoulder areas may influence the following elements of traffic incident management:
    - Providing a safe buffer zone for emergency responders. Although managed lanes can facilitate lane use and advanced warning, full shoulders provide a work area for emergency responders which, by vehicular regulation and driver behavior, motorist do not use. Managed lanes can help, but positive guidance and physical barriers (e.g. cones) will be the only protection in a normally traveled lane (i.e. hard shoulder). This raises the following questions: Would managed lane signals be advisory, or regulatory, since they become safety essential in this scenario? How will field operations and managed lane operations be coordinated to maximize the safety of the emergency responders?
    - Use as a staging area for vehicle recovery. In Maryland, by policy and regulation in support of the towing and recovery industry, public agencies only relocate damaged and disabled vehicles to the shoulder, to stage them for final removal by industry towers. Limited shoulder availability would likely require new policies and procedures to minimize the blockage time impact while preparing for private towers to arrive.
    - Access to the incident scene. The CHART patrols, in Maryland, function as an extension of staff for the Maryland State Police, in the area of Traffic Incident Management. However, CHART patrols are not enforcement vehicles and do not have the authority of a "blue light" (police) or a "red light" (fire and rescue) emergency responders in traveling through traffic. Consequently, although managed lanes may help, motorists may, or may not, yield right of way to CHART vehicles.

- Impacts of more complex incidents. The managed lane model work fairly well in the case of disabled vehicles or two vehicle collisions in a single lane. Procedures and impacts need to be analyzed and addressed for more complex incident, that require more complex recovery procedures and other public safety impacts. Some of these complicating factors include: heavy/large vehicles, injuries, hazardous materials, fires, criminal activities, significant debris (e.g. a load of mulch) etc. Each of these scenarios requires different personnel and equipment on scene: fire trucks, ambulances, police vehicles, heavy equipment, etc. Shoulders provide the additional geometry to stage and maneuver these resources.

Please address the above issues and potential alterations to operational procedures that might be necessary to effectively implement this PTC.

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Frank DiGilio, Kiewit Infrastructure Co.

PTC 2 – Adaptive Ramp Metering

AECOM

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January 19, 2017

Mr. Jason A. Ridgway, P.E.
Director, Office of Highway Development
Maryland Department of Transportation
State Highway Administration
707 N. Calvert Street
Baltimore, MD 21202

Subject: **Proposed Technical Concept No. 2** Comment Responses
IS-270 - Innovative Congestion Management Progressive Design Build
Contract No. MO0695172

Dear Mr. Ridgway

The Kiewit/AECOM team is **not including PTC 2** in "the Project" and technical proposal. We appreciate the opportunity to submit this PTC and receive your feedback during the review process.

Yours sincerely,

Chris McGuire, PE
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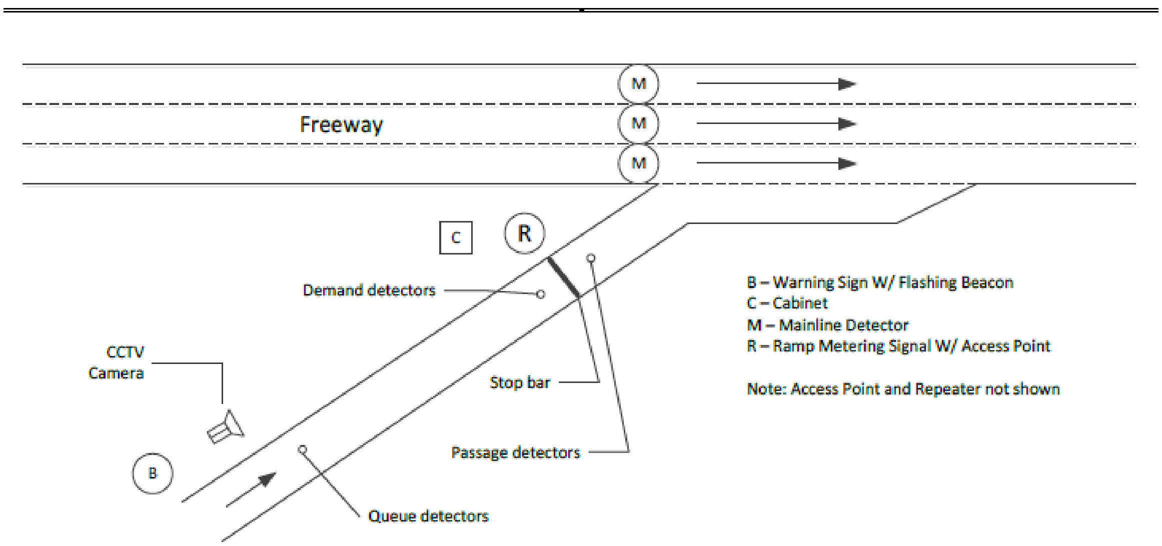
A. Description

Detailed descriptive information and other appropriate information as appropriate such as conceptual drawings, production details, standards, specifications, and traffic operations analysis.

Ramp metering is a traffic management strategy in which traffic control signals are placed on freeway entrance ramps, in order to regulate the frequency with which vehicles enter the freeway. Use of this strategy is proposed under this Proposed Technical Concept (PTC). Adaptive Ramp Metering (ARM), a dynamic application of ramp metering in which metering rates are responsive to operating conditions on the freeway, may be proposed, depending upon the results of further analysis. This PTC is intended to improve freeway throughput, travel time, travel time reliability, safety, fuel use, and emissions.



Typical Single Lane Magnetic Detector Ramp Metering Configuration

Ramp metering systems have been deployed in 26 metropolitan areas across the United States, with 12 using at least one High Occupancy Vehicle (HOV) bypass lane. Approximately 2,370 ramps are now being managed, with more being brought into service each year. There does not appear to be one overarching standard for the construction and operation of ramp metering systems. In an effort to develop a project-appropriate set of standards and guidelines, the following publications were utilized:

- AASHTO's "A Policy on Geometric Design of Highways and Streets" (sixth edition). This document discusses ramp metering but with limited design guidance and minimum acceleration lane lengths.
- NCHRP Report 687, "Guidelines for Ramp and Interchange Spacing"
- TRB's Highway Capacity Manual (which includes an example of ramp metering and its effect on demand volume)
- FHWA's Ramp Management and Control Handbook

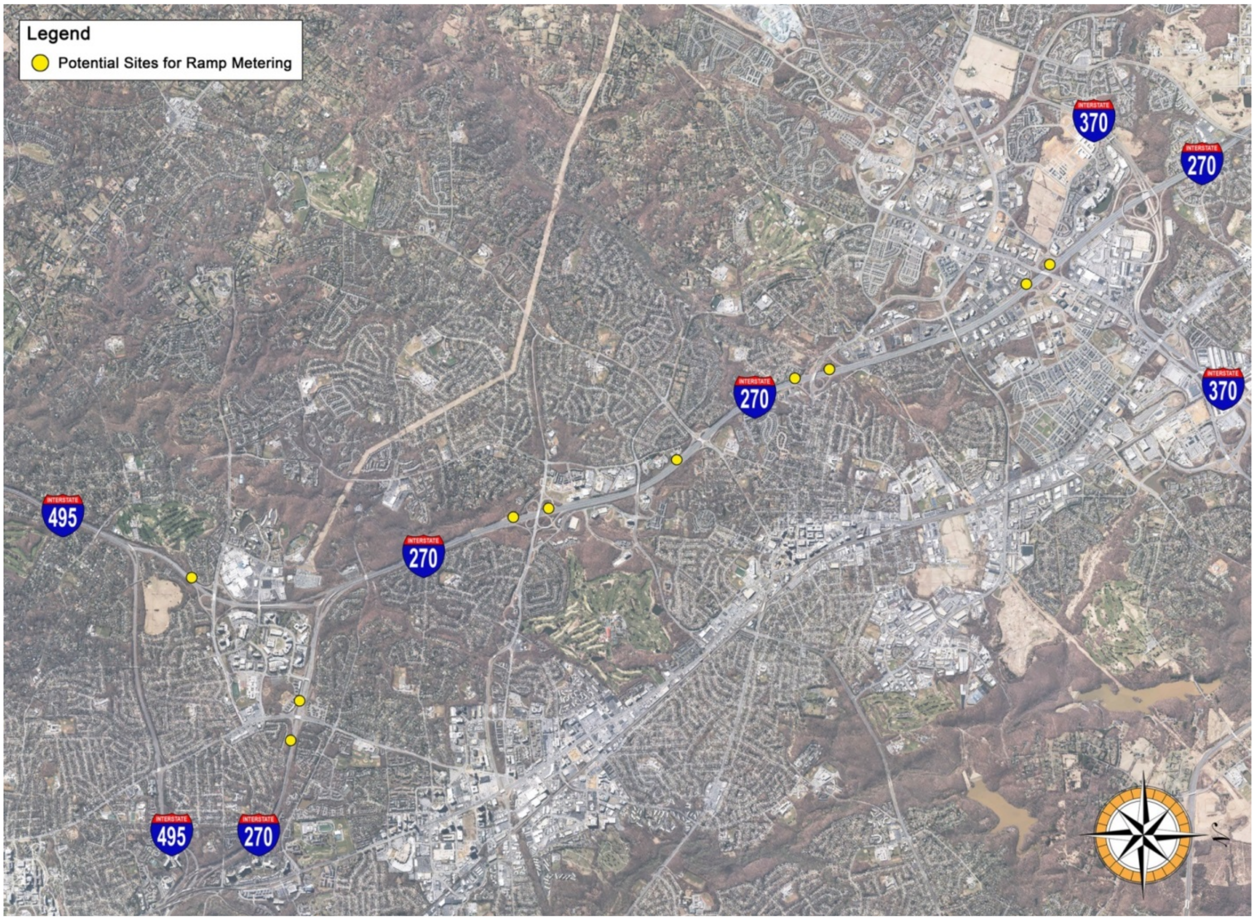
For the purposes of this PTC, the following general ramp metering design criteria and standards have been identified. The specific application of these criteria and standards to individual locations is under refinement at this time.

- Types of Ramp Metering Operation
  - Single Lane with One Car per Green: One vehicle is permitted to enter the freeway during each signal cycle. The length of green plus yellow is set to ensure sufficient time for one vehicle to cross the stop line and the length of red interval is chosen to ensure that the following vehicle completely stops before proceeding. The smallest possible cycle is 4 seconds with 1 second green, 1 second yellow, and 2 seconds red. This produces a meter capacity of 900 vehicles per hour (vph).
  - Single Lane with Two Cars per Green: Two vehicles are allowed to enter the freeway during each signal cycle. The required cycle length is around 6.5 seconds and provides a metering capacity of approximately 1200 vph.
  - Dual Lane Metering: This concept provides two lanes at the location of the ramp metering signal, with traffic merging into one lane at the freeway merge. The metering capacity is dependent upon the timing plan used for the signal, but could be as high as 1600 vph.
- Ramp Meter Placement
  - Acceleration after stop bar
      - AASHTO provides speed-distance profiles for various classes of vehicles as they accelerate from a stop to speed for various ramp grades. The merge distance varies by truck % and grade. Assuming 2% trucks and a 0% grade, the required distance is 600 feet for 55 mph, although 500 feet may apply due to assumed slower mainline speeds during periods where the ramp meter is in operation.
  - Queue Storage before stop bar
    - The queue storage distance is calculated based on
      - Entrance ramp design flow rate (vph)
      - Design metering rate (vph)
      - Design period that ramp metering operates at design metering rate
      - Average car plus gap length (assumed to be 28 feet/vehicle)
      - Average truck plus gap length (assumed to be 75 feet/vehicle)
      - Percentage of trucks in entrance ramp traffic
    - A minimum of 300-400 feet is commonly applied
    - All queuing should be accommodated on the ramp, in order to avoid any impacts on the arterial.

B. Location

The locations where, and an explanation of how, the PTC will be used on the Project.

Ramp metering is proposed at all entrance ramps to southbound I-270 starting at Shady Grove Road and ending at the Y-split. The locations of the interchanges proposed for ramp metering are shown in Exhibit 1, below.



The following locations are proposed for ramp metering. Displays depicting the proposed improvements are included in the Appendix.

- Shady Grove Road
  - Loop ramp from SB Shady Grove Road to I-270 SB
  - Directional ramp from NB Shady Grove Road to I-270 SB
- West Montgomery Avenue
  - Loop ramp from WB West Montgomery Avenue to I-270 SB
  - Directional ramp from EB West Montgomery Avenue to I-270 SB
- Great Falls Road
  - Directional ramp from EB & WB Great Falls Road to I-270 SB
- Montrose Road
  - Loop ramp from WB Montrose Road to I-270 SB
  - Directional ramp from EB Montrose Road to I-270 SB

This section of southbound I-270 was selected for ramp metering for the following reasons:

- Metering of all entrance ramps within an implementation area was felt to be necessary, in order to avoid diversion from one interchange to another (and resultant impacts on the arterial system)

- Freeway-to-freeway ramp metering would be required if the system was extended to I-370 (the first interchange north of Shady Grove Road), and this was felt to be undesirable for an initial application of ramp metering in Maryland
- Southbound traffic is generally heavier in this area than to the north of I-370

Ideally, ramp metering would be continued to I-495. However:

- The operational challenges with implementing ramp metering at the Rockledge Boulevard/MD 187 interchange are significant enough that this location was removed from the list of candidate sites.
- Since the Democracy Boulevard ramp to southbound I-270 provides two additional lanes on I-270, use of ramp meters here was felt to be inefficient (even though those two lanes eventually merge with mainline I-270).

C. Analysis

Analysis justifying the use of the PTC including how it advances the project goals.

Preliminary VISSIM analyses have been performed for ramp metering at the locations described in “B” above. These analyses were based on the following operational assumptions:

- Ramp meters were considered fixed time signals, providing 2 seconds of green time and 4 seconds of red time.
  - Ramp meters were placed on the two-lane segments of the ramps (where applicable) for better queue storage.

The preliminary results of the analyses, which are subject to change upon refinement of some key parameters as design efforts proceed, are shown in the Tables A.1 – Table A.9, which are provided in the Appendix. Examination of these tables reveals the following, for the segments of the study area between Shady Grove Road and the Y-split:

- Travel time on the express lanes improves from 27.1 – 69.5 percent, depending on the link. Travel time on the local lanes is mixed, with some increases and some decreases.
- Density improves substantially, not only on the local lanes but on the express lanes.
- Throughput on the express lanes improves from 1.1 – 11.7 percent, depending on the link. Throughput on the local lanes is mixed, with some increases and some decreases.

D. Potential Impacts

A preliminary analysis of potential impacts (both during and after construction) including but not limited to use impacts, Right-of-Way, geotechnical, utilities, environmental permitting, local community, safety, and life-cycle project and infrastructure costs, including impacts on the coast of repair, maintenance, and operation.

There are a number of potential impacts of this PTC. A preliminary analysis of these potential impacts reveals the following:

<u>User Impacts</u>: While there would be a positive impact on traffic operations on the mainline of I-270 (as discussed above), additional delays would occur on the metered ramps. The extent of these additional delays, and the potential for queuing to extend back to the arterial (and thus impact traffic operations on the arterial) are under analyses at this time. Typically, there is a net travel time savings considering the improved flow on the mainline versus the wait time on the ramp. Preliminary analyses indicate that the ramps at MD 28 and MD 189 would be the most

likely to experience significant queuing. Analyses are also underway to mitigate those queuing impacts by widening the ramps in question to provide additional storage, with the goal of completely avoiding operational impacts on the arterial. A preliminary assessment of the challenges involved with widening all of the metered ramps (should this be necessary) are shown in the Appendix, in Table A.10.

With regard to construction, installation of ramp meters (signals, detectors, signage, communications and control cabinets) would have a minor impact on traffic operations of the ramps and freeway mainline where temporarily closures may be required for construction. Users may experience minor delay during the ramp meter installation. No impact is expected after the installation.

Potential Inducement for HOV

As noted above, a number of ramp metering systems across the country offer bypass lanes for HOV, as an added incentive for ridesharing. This option could be investigated further for at least some of the ramps to be metered.

Right-of-Way: At this time, it appears that all physical devices needed to implement ramp metering, including power and communication runs, can be located within existing right-of-way. Where widening is required to accommodate queues, further investigation of the need for additional right-of-way will be necessary. However, as shown in Table 10, additional right-of-way is generally not expected to be required.

Geotechnical: At this time, no geotechnical impacts are anticipated, either from ramp metering field devices or widening to accommodate queuing.

Utilities: Minimal utility impacts are anticipated, since all of the construction will occur within existing interchange areas. Power is available at all interchanges, and communications are expected to be provided with minimal problems.

Environmental Permits: In locations where ramps are to be widened, environmental permits would be required. If no widening is required for a given ramp, no environmental permits are anticipated for that ramp.

Local Communities: If the queues can be contained such that no operational impact on the arterial roadways occur, minimal impact to local communities would be anticipated. Typically, queue detectors would be located at the end of ramp to flush out the queue so as not to impact arterials. Furthermore, the ramp signal should be coordinated with nearby traffic signals to avoid queueing.

Safety: Ramp metering would reduce overall crash rates by smoothing freeway traffic flows, according to FHWA studies. Rear-end collisions due to queuing on the ramps may increase; however, due to the low speeds involved, crash severity should be very low.

Life-cycle: It is estimated that the useful life of the ramp metering equipment would be approximately 30 years. (This is similar to the useful life of traffic signals.) However, there are ramp signal knock-downs where drivers hit the signals, which would decrease the average life-cycle. In Miami, one knock down per month on a 22 ramp signal project has been experienced.

Infrastructure Costs: Metering equipment for non-adaptive operation for an individual ramp can be provided and installed for a relatively small cost. Construction costs for any required ramp widening is under analysis at this time.
Maintenance and Operation Costs: Annual maintenance and operational costs for each ramp meter installation would become part of ongoing SHA or Montgomery County operations costs, depending upon which agency operates and maintains the system.

Operational Start-up: New ramp metering programs typically require a significant enforcement program at operational start-up, which then tapers off after the first few weeks.

E. Other projects

A description of other projects on which the PTC has been used, the degree of success or failure of such usage, and the names and contact information (including telephone numbers and e-mail addresses) of project owner representative who can confirm such statements.

Perhaps the best example of AECOM's involvement with ramp metering is a project on I-95 in Florida. This project is described below.

AECOM prepared a feasibility study and preliminary design of a ramp metering system along I-95 within Broward and Palm Beach Counties, Florida. The study was prepared for FDOT District 4. A total of 67 entrance ramps were analyzed, over the 40-mile corridor, to determine if they meet warrants in accordance with a methodology developed by our firm. Specifically, the project included the following tasks: data collection; development of future traffic volumes; pre-selection of preliminary ramp metering locations; development of diverted traffic volumes; preparation and validation of traffic simulation models; detailed analysis of pre-selected ramp metering locations; preparation of an enforcement plan; development of 30% design plans; benefit-cost analyses; implementation and roll-out plan; concept of operations; ramp metering systems integration plan; public outreach plan; and presentations to the FDOT, MPO and municipalities. The recommended locations for ramp metering are being integrated into the I-95 Managed Lane Expansion Program.
AECOM has also supported FDOT District 6 during the implementation and operation of the I-95 ramp metering program in Miami-Dade County where our role included the following assignments:
Ramp Metering Best Practices – AECOM organized and conducted a best practices workshop with representatives from other DOTs that have extensive state-of-the-art experience in implementing, operating and maintaining ramp metering systems (i.e., MnDOT, WSDOT, TxDOT). Subsequently, AECOM conducted a workshop session with the media and the panel of experts from these DOTs to address questions and concerns.
Ramp Metering Implementation – AECOM provided CEI services for the installation of the ramp metering system along I-95 within Miami-Dade County and the integration of the system within the TMC. This included analysis of software, firmware and hardware configurations; system acceptance testing; day-to-day inspection of all field hardware; coordination of field observation of system operation; coordination of enforcement during initial operation; and before and after system launch study.
Ramp Metering Operations – AECOM has provided operations of the ramp metering system since inception. This has included development of training materials, recruitment and training of operations staff; development of ramp metering operation strategies and guidelines, monitoring each ramp meter location during peak periods to address operational, safety and queuing issues, and preparing daily, weekly operational reports and ramp metering performance MOE studies.

Ramp Metering GIS – AECOM and FIU have supported the FDOT Research Center in developing a web-based GIS for the evaluation of both existing and potential ramp signal locations. This effort included review of the existing ramp metering guidelines and recommendation of warrants

for ramp metering application in Florida and development of a GIS system to evaluate freeway ramps utilizing the adopted warrants. The system integrates several existing databases such as: (1) roadway inventory that provides the detailed roadway geometric information, including number of mainline lanes, number of ramp lanes, lane width, acceleration lane length, ramp length, grades, existence of frontage roads, speed limits, etc.; (2) detector data that provide the volume, speed, and occupancy; (3) accident data that provide the detailed traffic crash records; (4) incident data that provide freeway incident information; and (5) traffic counts from both portable and permanent traffic monitoring sites that provide both mainline and ramp traffic volumes.

Ramp Metering Public Outreach – AECOM developed and implemented a proactive public outreach plan in advance of ramp meter operational start-up. This included individual meetings with each municipality along the corridor; development of media kits, interviews, presentation to various agencies (e.g., MPO); and continuous response to inquiries and concerns by the public. AECOM also provided.

F. Administration Risk

A description of risk to the Administration or third parties associated with implementing the PTC.

The risks to the Administration of implementing a ramp metering program would include the following:

Traffic Operations on Arterials

If queues from the metered ramps are not fully contained on the ramps themselves, impacts to the arterial roadways will result. These impacts would consist of increased delays and possibly increased crashes. It is thus imperative that the ramps completely accommodate the queued vehicles.

With a comprehensive system of ramp metering, there would be no incentive for a vehicle to divert from one interchange to another. However, it is possible that some vehicles now entering I-270 from the ramps that would be metered would divert to other roadways (such as MD 355).

Public Reaction

The ramp metering program could be perceived negatively by the traveling public, particularly those whose trips will now be metered. In any event, a public outreach and education program should be considered.

Coordination with Montgomery County Signal System and/or CHART

The signals to be used on the ramps will need to be operated by either Montgomery County or CHART. The decision as to which of the two--or both--will depend upon the level of complexity of the ramp metering system. If the ramp meters operate in a fixed time mode, Montgomery County might logically monitor and control the ramp meters, without SHA involvement on a day-to-day basis. If the ramp meters operate in a demand-responsive mode, involving the collection and /processing of traffic flow from the mainline of I-270, CHART would need to be involved.

G. Design-Builder Risk

A description of risk to the Design-Builder associated with implementing the PTC.

The primary risk to the Design-Builder is that, as noted above, there are no national standards for the design and operation of ramp metering systems. Building on its experience in other jurisdictions across the country, the Design-Builder will need to develop those standards.

A second risk to the Design-Builder is the potential for resistance to the concept of ramp metering from other agencies and the public. The extent of coordination activities to gain acceptance for the concept is uncertain at this time.

A third risk is the need to individually assess the capability of each ramp to accommodate the anticipated queues, and the possible complications involved (right-of-way, stormwater management, etc.) if widening of one or more ramps is required. Based upon preliminary analyses, it is almost certain that several ramps will require such widening.

H. Cost/Schedule Benefits

Discussion of any cost of schedule benefits to this contract from usage of this PTC

One of major advantages of a ramp metering program is the technical ease with which it can be implemented (in its simplest, fixed-time operation format). If geometric changes are not required for a ramp, the signals and their associated equipment can be installed for approximately $75,000 per ramp. Even if widening is required, however, the length of the construction zone(s) will be comparatively small.

I. Miscellaneous

Any additional information that would assist the Administration in the review of this PTC.

Please see the table attached to the email for additional information.

Larry Hogan, *Governor*
Boyd K. Rutherford, *Lt. Governor*

State Highway Administration
Maryland Department of Transportation

Pete K. Rahn, *Secretary*
Gregory C. Johnson, P.E., *Administrator*

October 6, 2016

Mr. Benjamin J. Carnazzo
Kiewit Infrastructure Co.
7250 Parkway Drive, Suite 310
Hanover MD 21076

Dear Mr. Carnazzo:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 2 for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on September 22, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. Generally, the concept appears to be a reasonable solution to address the goals of this contract.
2. Please clarify if the ramp metering is proposed to be dynamic, adapting to congestion levels, or implemented by time of day.
3. To achieve the project goals, the Design-Builder must provide a fully functional system at project completion. The PTC does not address how ramp metering will be integrated. Section D, Potential Impacts, does not address impacts to CHART.
4. Page 4, 1st bullet: Decisions about the application of a PTC should not be based on whether the proposed strategy had been previously implemented in Maryland. This is an innovative project with the expectation that some or all proposed solutions will be a first for Maryland.
5. Section D, Potential Impacts, states communications are expected to be provided with minimal problems, yet it does not discuss the potential fiber requirements needed for this PTC.

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Frank DiGilio, Kiewit Infrastructure Co.

PTC 3 – Contraflow SB Express HOV Lane using Movable Barrier

AECOM

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January 19, 2017

Mr. Jason A. Ridgway, P.E.
Director, Office of Highway Development
Maryland Department of Transportation
State Highway Administration
707 N. Calvert Street
Baltimore, MD 21202

Subject: **Proposed Technical Concept No. 3** Comment Responses
IS-270 - Innovative Congestion Management Progressive Design Build
Contract No. MO0695172

Dear Mr. Ridgway

The Kiewit/AECOM team is **not including PTC 3** in "the Project" and technical proposal. We appreciate the opportunity to submit this PTC and receive your feedback during the review process.

Yours sincerely,

Chris McGuire, PE
Vice President, Maryland Surface Transportation
AECOM
T: 410-637-1720
M: 443-386-6286
E: chris.mcguire@aecom.com

A. Description

Detailed descriptive information and other appropriate information as appropriate such as conceptual drawings, production details, standards, specifications, and traffic operations analysis.

This Proposed Technical Proposal (PTC) includes the use of movable barrier to create a contraflow SB Express HOV lane along the existing IS-270 NB left lane during the AM peak period. Contraflow lanes are appropriate for corridors with high directional splits, which makes them a good solution for the congestion along IS-270 during peak periods. In addition, Hard Shoulder Running (HSR) is being proposed along the northbound right shoulder all the way to Montrose Road, to account for the loss of the northbound left lane.

The PTC proposes the use of concrete movable barrier, which can be shifted up to 24’ laterally through the use of a Barrier Transfer Machine (BTM). The BTM can be detached from the movable barrier once the shift is complete. The BTM will be stored behind the concrete barrier when not in use.

A VISSIM analysis has been completed, to show the results of adding a contraflow SB Express HOV lane during the AM peak period. This analysis has shown that operations along NB IS-270 will not be significantly impacted by the loss of a lane during the AM peak period, except for the section just south of Montrose Road. To mitigate this, HSR will be provided along the northbound right shoulder between Old Georgetown Road and Montrose Road for a distance of 1.8 miles.

Travel time and vehicle speed results for the entire corridor are summarized in Table A.1 to A.4 for the AM peak hour. Table A.2 and Table A.4 summarizes local road travel time and speed respectively. Express HOV travel time and speed are added to the end of Table A.2 and A.4 as well. Travel time results are also depicted with graphs on Figure A.1 to Figure A.6.

Table A.5 to A.7 summarize density results for each segment for AM peak hour. To better evaluate the new Express HOV operation, the density results for this lane were also included at the end of Table A.5. Table A.5 and A.6 summarize express lane results and Table A.7 includes local road vehicle densities.

AM peak hour throughput results are included in Table A.8 to Table A.9. Table A.8 includes express lane and Table A.9 summarizes local road throughput results. Local and Express HOV throughput results were added also to Table A.9 for more comprehensive assessment.

The origin-destination data for HOVs that were obtained from the MWCOG travel demand forecasting model indicate that approximately 966 vehicles on the existing SB HOV lane have origin points north of Watkins Mill and destination points south of Tuckerman Lane. In the proposed condition, these vehicles would use the contraflow SB Express HOV lane. This would relieve traffic congestion on the local HOV lane and result in higher travel speeds. This improvement in HOV operations would encourage drivers to carpool, giving them the ability to use HOV lanes instead of general purpose lanes.

B. Location

The locations where, and an explanation of how, the PTC will be used on the Project.

The southbound contraflow lane using a movable barrier system will be implemented along the existing northbound left lane along IS-270 from south of the future Watkins Mill overpass bridge to north of Tuckerman Lane. Dynamic cantilevered overhead lane control signs will be provided north of Watkins Mill before the median crossover. During the AM peak period signs will indicate that the contraflow lane is SB Express HOV connecting directly to points south of Tuckerman Lane. No intermediate access / egress will be provided.

Figures 1 through 4 depict the AM and PM peak period configurations of northbound IS-270 where the SB Express HOV lane runs along the existing northbound left lane. The movable barrier is shifted to define and accommodate the contraflow lane in the AM peak period, and it is stored adjacent to the existing concrete median barrier all other times. When the movable barrier is deployed, there is a minimum of 21 foot clear width between the two barriers, which meets AASHTO recommendations for one-lane, one-way operation – with provision for passing stalled vehicle. (*A Policy on Geometric Design of Highways and Streets,* 2011, Table 3-29, Case II-C)

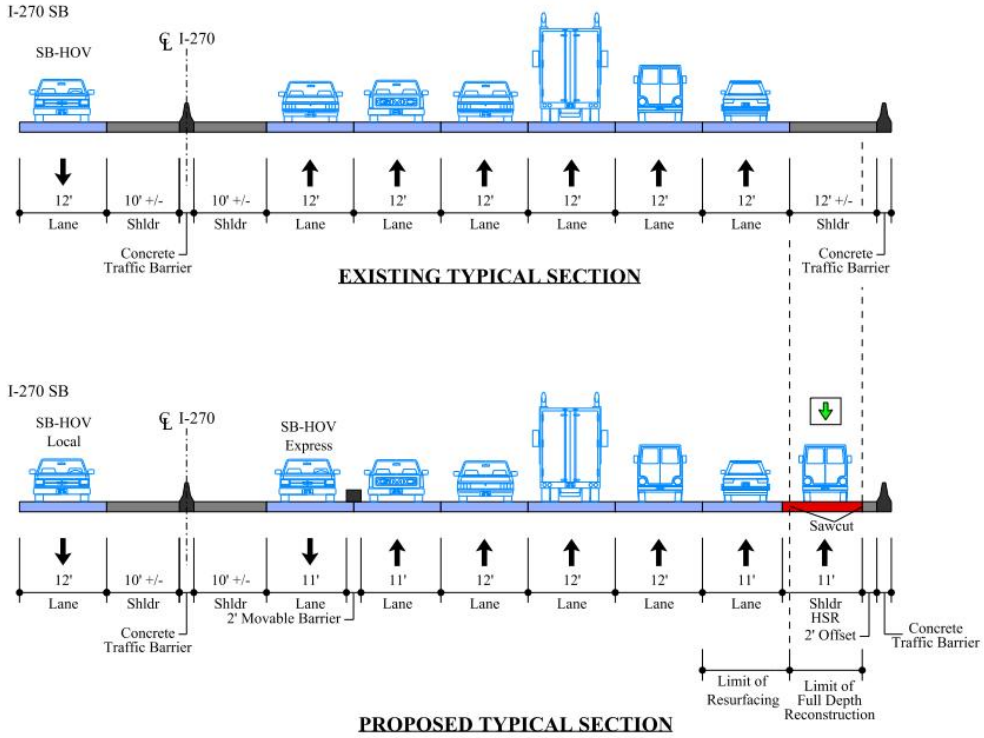

Figure 1 - AM Peak Period – Old Georgetown Road to Montrose Road

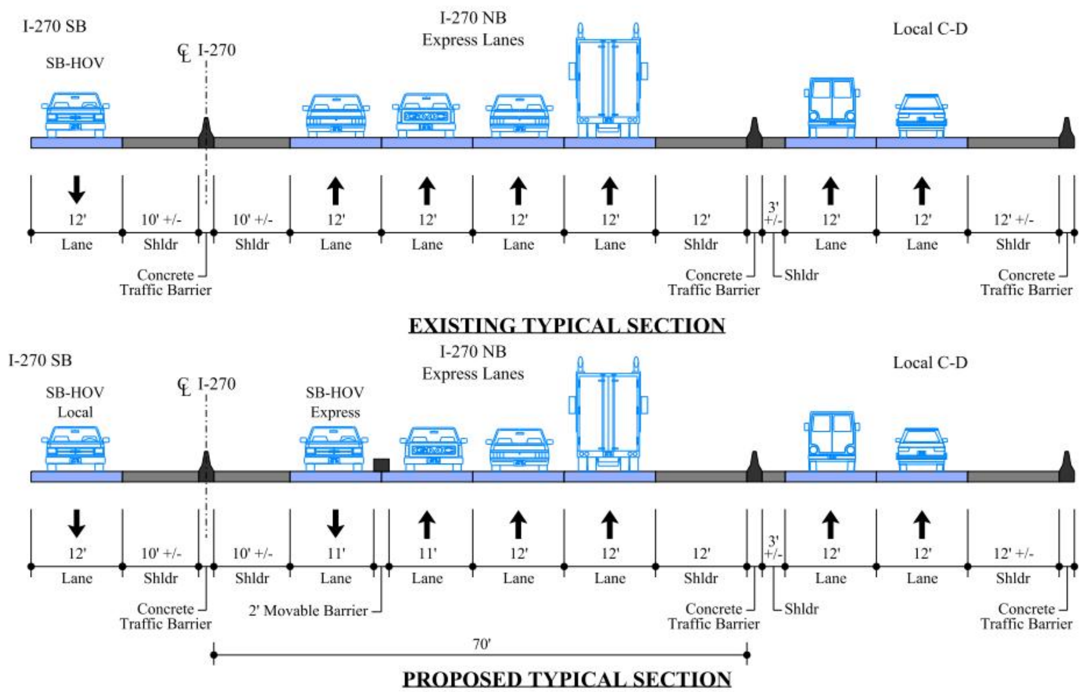

Figure 2 - AM Peak Period – Montrose Road to Watkins Mill Road

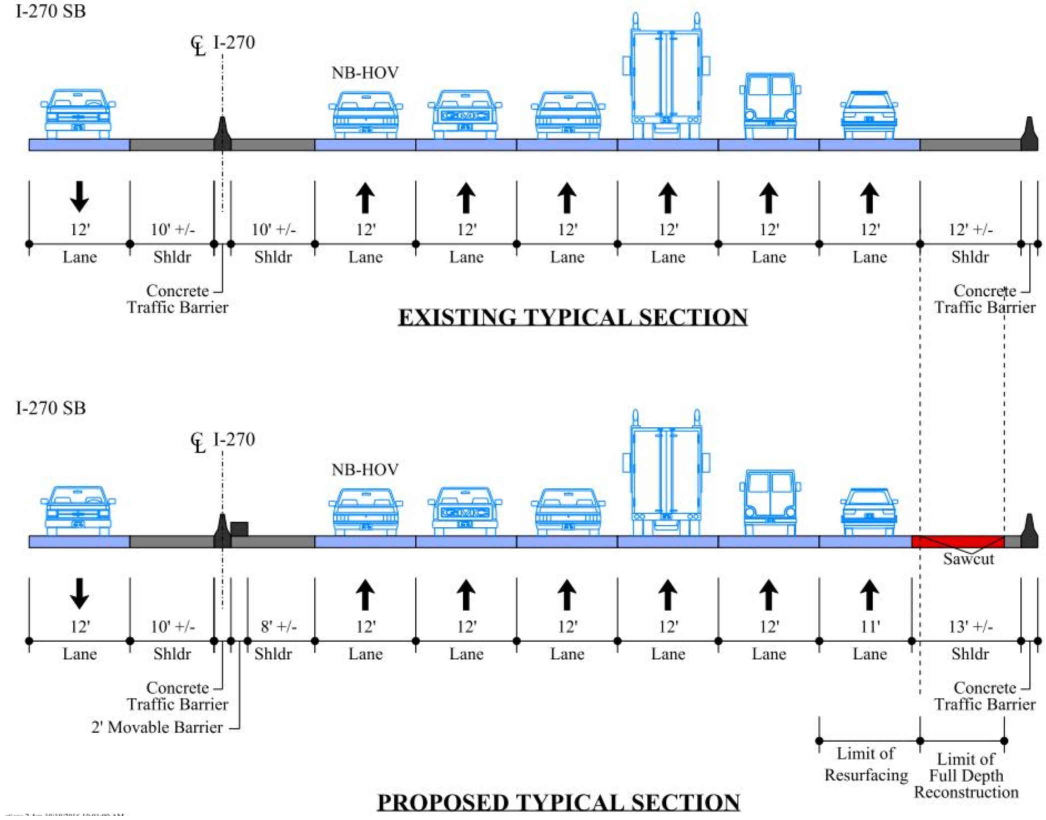

Figure 3 - PM Peak Period – Old Georgetown Road to Montrose Road

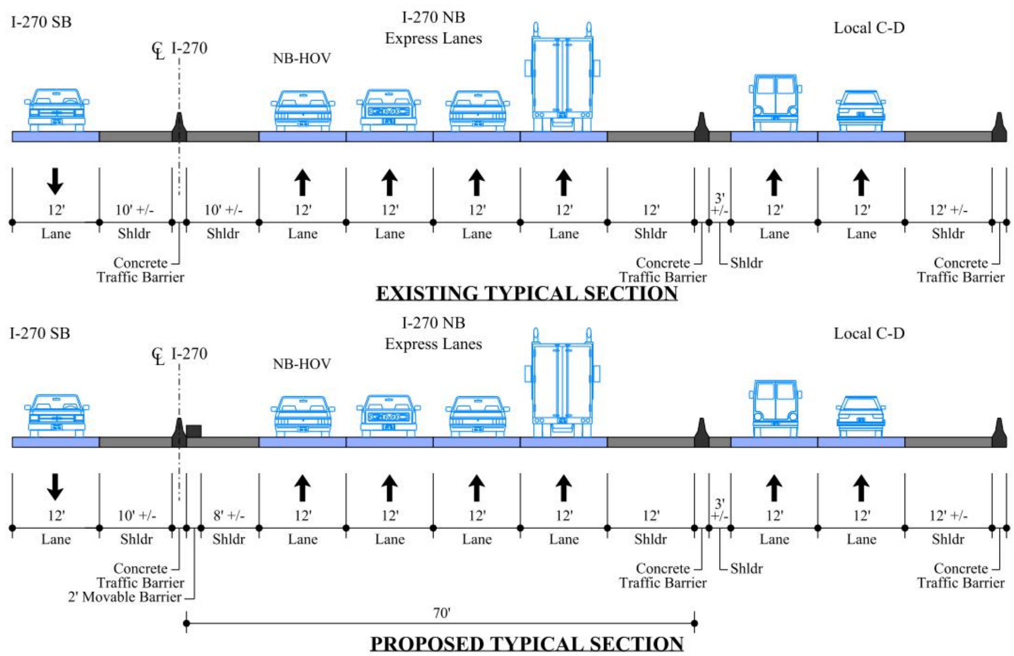

Figure 4 – PM Peak Period – Montrose Road to Watkins Mill Road

C. Analysis

Analysis justifying the use of the PTC including how it advances the project goals.

Appendices B and C illustrate the northern and southern crossovers of the contraflow lane. A 8' offset will be provided between the edge of the contraflow lane and existing median concrete barrier during the AM peak period.

The Northern Crossing begins just south of Watkins Mill Road, and extends 2820' south. Figure 5 includes proposed signing north of the crossover, to guide drivers into the correct lane in advance of the lane split.

The length of the lane shift taper was calculated using the AASHTO formula below, for speeds 45 mph or more:

L = WS = 26'x70mph = 1820' where;

L=Length of Transition in feet; W = Offset Distance in feet, and S= 85th Percentile Speed in mph

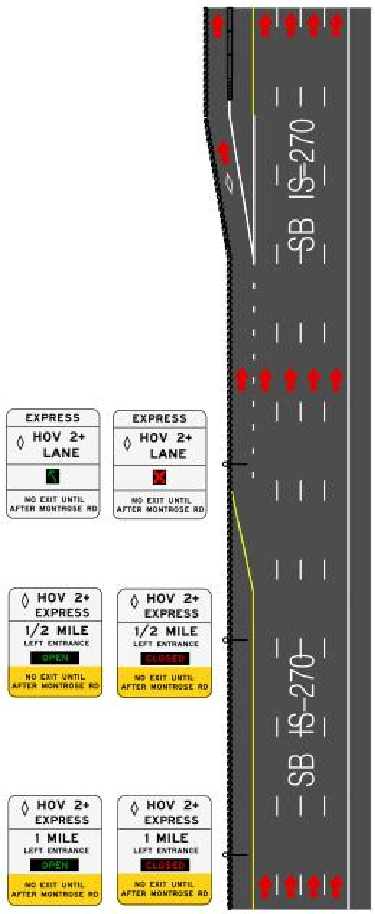

Figure 5 – Northern Crossing Lane Split

The southern crossing begins approximately 2200’ north of Tuckerman Lane, and ends just south of Tuckerman Lane. The contraflow SB HOV lane terminates in the SB median shoulder, which will be reconstructed to become traffic bearing. In addition, a 1000’ two-lane section is provided just south of the crossover, to allow for weaving of SB HOV vehicles before the decision point of heading towards I-495 East or I-495 West (Figure 6).

Figure 6 – HOV lane split to I-495

The length of the lane shift taper was calculated using the AASHTO formula shown below, for speeds 45 mph or more:

L = WS = 23’x70mph = 1610’ where;

L=Length of Transition in feet; W = Offset Distance in feet, and S= 85th Percentile Speed in mph

The shoulders will be reconstructed to full depth where necessary at the crossings. The limits of full depth reconstruction will be saw cut, to avoid impact to the adjacent pavement composition.

The contraflow lane will be opened during rain events. Spread computations were completed based on the proposed typical section. The team will prepare a detailed hydraulic analysis during the post award phase to ensure that the spread during rain events will not cause any safety concerns for vehicles traveling in the contraflow lane.

The provision of the express HOV lane is likely to attract existing HOV traffic on arterials, such as MD 355, to this lane. Preliminary calculations indicate that approximately 300 vehicles per hour could divert to the express HOV lane. This would lead to decreased congestion on the arterials, which would be likely to result in traffic diverting from the general purpose lanes along southbound IS-270 back to the arterials. Preliminary calculations indicate that approximately 3% of the vehicles on the general purpose lanes might divert in this fashion, thereby improving operations on southbound IS-270, even if no mode shift from general purpose lanes to HOV occurs. In addition, some mode shift can occur. With improved travel time in the local HOV lane, Single Occupant Vehicles (SOVs) would have an incentive to carpool and use the HOV lane instead. Even though each new HOV lane would reduce SOVs at a minimum rate of 2:1, we have assumed a reduction of 1.5:1 be conservative.

D. Potential Impacts

A preliminary analysis of potential impacts (both during and after construction) including but not limited to use impacts, Right-of-Way, geotechnical, utilities, environmental permitting, local community, safety, and life-cycle project and infrastructure costs, including impacts on the cost of repair, maintenance, and operation.

User Impacts - There will be positive impacts on traffic operations along southbound IS-270, due to the increased HOV capacity during peak hours. Reduced lane widths may have an impact on driver speeds. An equivalency study will be completed and submitted to FHWA post award for any narrowing or shifting of lanes.

Right of way (ROW) – One of the advantages of using a contraflow lane is the ability to provide added capacity during the peak period while remaining within the existing pavement footprint. There are no anticipated additional ROW needs associated with the implementation of the contraflow lane method. However, due to the full depth reconstruction for the HSR on the northbound right shoulder and at the crossings, there’s a need for minimal SWM mitigation which may result in additional ROW. In addition, ROW may be required to accommodate the required noise barrier systems.

Geotechnical – The shoulder will be reconstructed to full depth where pavement depths are insufficient to support the proposed traffic volumes along the northbound right shoulder south of Montrose Road and at each crossing. The Administration provided Ground Penetration Radar results that included information on the existing pavement composition. The team has identified the existing pavement sections that are not traffic bearing and will require full depth reconstruction. There will be limited resurfacing of northbound and southbound lanes, since the movable barrier will not require additional offsets from the traveled way (Figure 1)

Utilities – No significant impacts are expected since the majority of the proposed improvements are within the existing roadway footprint.

Environmental Permitting – Appropriate mitigation strategies will be implemented to comply with all third party regulations and to meet the National Environmental Policy Act (NEPA) requirements. Due to the anticipated full depth reconstruction of the existing shoulder in certain areas, SWM facilities will be provided to meet all SWM criteria to the maximum extent practicable.

The addition of the contraflow lane increases capacity along southbound IS-270 and therefore meets the FHWA Type I Highway Traffic Noise project criteria. As a result, FHWA requires that a noise analysis be conducted in a manner similar to a conventional widening project. If the design year build condition noise levels approach or exceed the 23 CFR Part 772 Noise Abatement Criteria for the future build conditions, there will be traffic noise impacts and investigation of noise mitigation will be warranted and implemented if found to be feasible and reasonable.

A qualitative noise analysis was conducted in the section where the contraflow lane is proposed, between Tuckerman Lane and Watkins Mill. A total of approximately 13,000 feet of potential noise barrier was identified between these two limits.

<u>Local Community</u> – There will be minimal impact to residential and commercial communities during construction due to the majority of the work taking place closer to the median along IS-270.

<u>Safety</u> – Incident management is a concern with the contraflow lane due to the lack of northbound median shoulder during peak hours, which otherwise can be used as an access lane for emergency vehicles. In addition, there are existing median crossovers in several locations within the limits of the contraflow lane that will be closed once the movable barrier is stored against the existing median concrete barrier.

<u>Infrastructure costs</u> – Infrastructure costs for the implementation of the contraflow lane will be developed based on supplying the movable barrier and the barrier transfer machine, shoulder full depth reconstruction, grinding and resurfacing, lane control systems, signing, restriping, drainage improvements, SWM facilities, noise barrier systems and additional ROW acquisitions.

<u>Maintenance</u> – In the existing conditions, the northbound median shoulder is used by maintenance crews to store snow after inclement weather events. Assuming this practice continues, the contraflow lane could not be implemented after a winter snow storm event, and the movable barrier will remain stored adjacent to the concrete median until the shoulder was completely cleared of snowpack.

E. Other projects

A description of other projects on which the PTC has been used, the degree of success or failure of such usage, and the names and contact information (including telephone numbers and e-mail addresses) of project owner representative who can confirm such statements.

<u>Route 101 – Golden Gate Bridge – San Francisco, California</u>

AECOM was the lead design engineering firm in the Golden Gate Bridge (GGB) Movable Barrier project. The project has won several awards, including the Award of Merit from ENR California.

In July 2011, AECOM prepared the Operations and Maintenance Report for the Golden Gate Bridge (GGB) Movable Barrier Study. The GGB is under the jurisdiction of the Golden Gate Bridge Highway and Transportation District (District). The Average Daily Traffic is approximately 120,000. The GGB serves as the main transportation corridor for US Highway 101 between Marin County and the City of San Francisco. It is a six-lane highway that spans nearly 9,000 feet. The District installed a movable barrier system in order to increase motorist safety and accommodate peak hour traffic demands. The system provided a semi-rigid barrier between opposite traffic lanes, and allowed the District the flexibility to reconfigure the lanes on the bridge at different times during the day

AECOM completed the Transportation Management Plan (TMP) in December 2014. The report includes traffic plans for the different lane configurations depending on the location of the proposed movable barrier, and traffic control plans for the installation of the movable barrier.

The project was completed in early 2015. It includes approximately 13,340 feet of barrier, made up of approximately 3,500 concrete units.

F. Administration Risk

A description of risk to the Administration or third parties associated with implementing the PTC.

The contraflow lane method will result in reduced width to 11’ for the two existing travel lanes on either side of the movable barrier. A design exception and equivalency study will be submitted for travel lanes less than 12’ wide.

During the AM peak period when the contraflow lane is in operation, there is no median shoulder along NB IS-270. This presents a risk to the owner, since they will not be able to rely on the benefits that a shoulder provides, such as emergency responses and providing a pull-off area for broken down vehicles. The Administration can use the lane control system to close the contraflow lane to through traffic during snow events and major incidents.

Due to the nature of the contract, all proposed improvements are subject to third party approvals such as Emergency operations (including local EMS and the State/County Police), FHWA, MDE and other associated environmental agencies. Once design is finalized, the administration will seek approval from the aforementioned agencies, or vary the scope to address their comments. In addition, community involvement and input may affect the NEPA permitting process and final configuration of the proposed solutions.

G. Design-Builder Risk

A description of risk to the Design-Builder associated with implementing the PTC.

Since this is the first use of permanent movable barrier in Maryland, there are no state design criteria to follow; therefore, gaining the Administration’s acceptance of the design standards obtained from other states could be a challenge.

The contraflow lane will result in capacity enhancement and therefore will require noise mitigation. The size, location, feasibility and reasonableness of the proposed barrier systems may change during the post-award phase.

The existing conditions of the pavement and drainage conveyance system are a risk. The shoulder pavement structure is not consistent. The condition of the existing drainage systems is not known. Pavement reconstruction will require storm water management best management practices (BMPs). There is limited existing right-of-way to locate new BMPs.

Risks during construction include contractor access, ability to close lanes, lack of staging areas and heavy traffic adjacent to work zones.

H. Cost/Schedule Benefits

Discussion of any cost or schedule benefits to this contract from usage of this PTC

The implementation of a contraflow lane is a practical design solution that adds HOV capacity during the AM peak period in the southbound direction without increasing the existing pavement footprint of the roadway. The following are the cost and schedule benefits of the contraflow lane method when compared to a conventional widening project.

- The contraflow lane provides a temporary increase in HOV capacity during the peak period without the need to widen the existing roadway. This method results in construction cost savings due to the reduced cost in ROW, structures, excavation and ramp modifications
- This method does not require major infrastructure widening, resulting in shorter construction periods and reduced maintenance of traffic and erosion and sediment control costs.
- Compared to other conventional reconstruction methods, there are very minimal ROW needs/costs.
- Compared to other conventional reconstruction methods, the DB team is anticipating minimal to no utility impacts. Therefore, the contraflow lane method results in cost and schedule benefits due to minimal coordination time with utility companies, and minimal utility relocation timeframes that would need to occur prior to the start of any construction activity.
- Due to the lack of roadway widening required, this method results in no impacts to existing overpasses and underpasses, hence significantly reducing the cost and the timeframes required for widening or replacement of existing structures.

I. Miscellaneous

Any additional information that would assist the Administration in the review of this PTC.

Adding HOV capacity to IS-270 using movable barriers would have significant benefit for existing transit services in the I-270 corridor as well as potential future services.

There are currently three commuter/express bus services that would directly benefit from the increased HOV capacity. Maryland Transit Administration (MTA) operates Route 505 and 515. MTA Route 505 runs between Hagerstown and the Rock Spring Business Park via IS-270 (Figure 7). There are eight total trips in the AM southbound direction. Five of these terminate at the Shady Grove Metrorail Station, and would benefit from the decreased volume in the local HOV lane. The other three run all the way to the Business Park and would use the contraflow SB Express HOV lane.

MTA Route 515 runs between Frederick and the Rock Spring Business Park via IS-270. There are 13 AM peak southbound trips.

The Montgomery County Ride-On Route 70 runs express between Germantown and Bethesda via the IS-270 and MD 355 (Wisconsin Avenue). There are three AM peak southbound trips.

Two of the key factors that make transit service more attractive to riders are travel speeds and reliability. Additional HOV-Express capacity will improve these two factors, hence making the express bus services in the IS-270 corridor more competitive with the automobile.

The map provided below was developed for the MD 355 Bus Rapid Transit (BRT) Corridor Planning Study currently underway and shows significant park and ride capacity north of the northern limits of the proposed HOV expansion. These park and rides could become potential terminal points for additional commuter service.

The southbound HOV-Express contraflow lane in conjunction with the added capacity along the IS-270 west spur (PTC 5A) and the extended HOV lane along I-495 up to the American Legion

Bridge will result in benefits for transit, due to the regional interest in a cross-Potomac transit service that would provide an alternative to the automobile for trips between Maryland and northern Virginia. WMATA began a pilot service that attempted to utilize shoulders to provide transit exclusivity. The bus-on-shoulder element of the service did not prove feasible and the service was terminated. However, the ability of transit services to bypass congestion in the general purpose lanes has the potential to make this type of transit service more attractive.

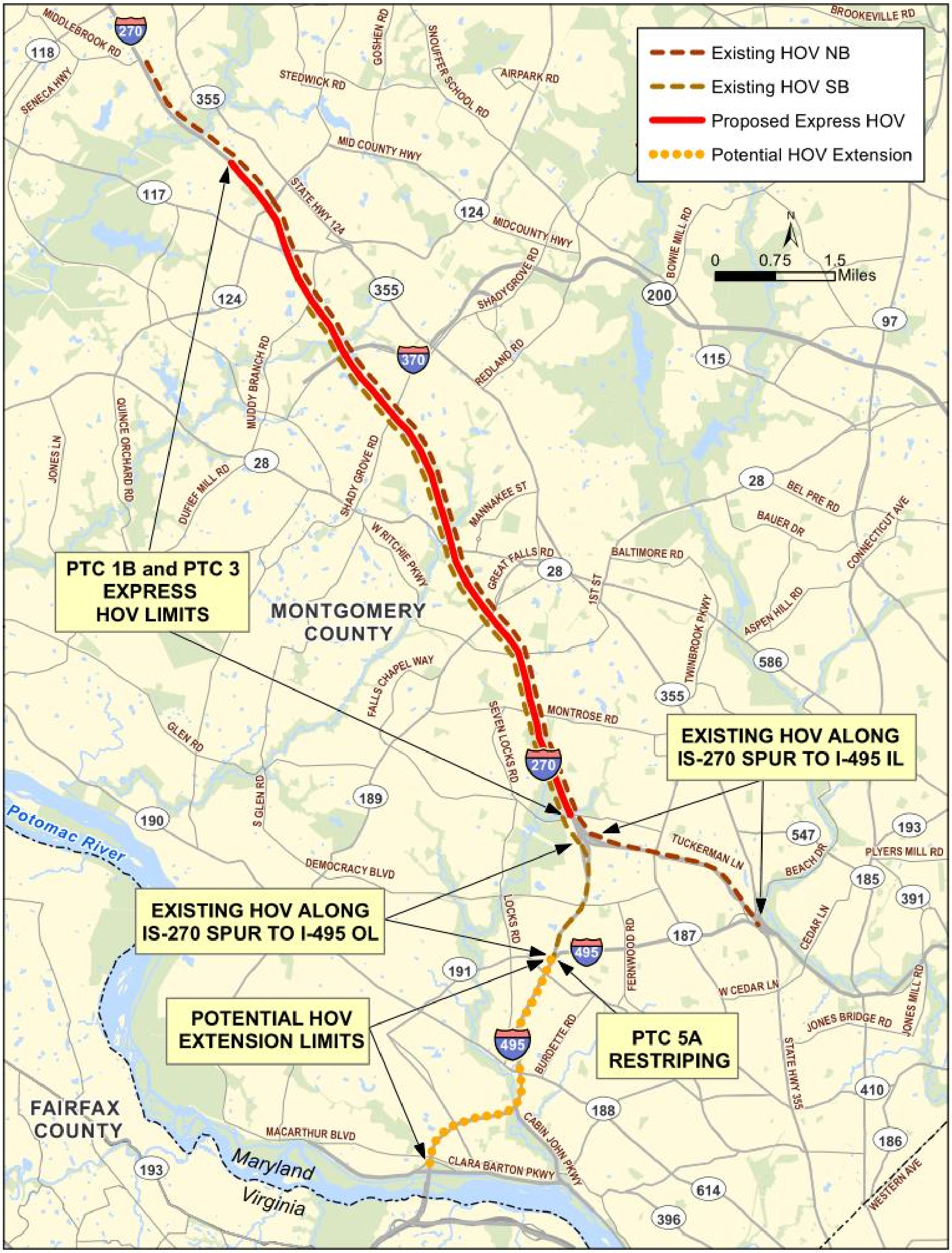

Figure 7 – HOV facilities map

Larry Hogan, *Governor*
Boyd K. Rutherford, *Lt. Governor*

State Highway Administration
Maryland Department of Transportation

Pete K. Rahn, *Secretary*
Gregory C. Johnson, P.E., *Administrator*

October 31, 2016

Mr. Benjamin J. Carnazzo
Kiewit Infrastructure Co.
7250 Parkway Drive, Suite 310
Hanover MD 21076

Dear Mr. Carnazzo:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 3 for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on October 19, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. Generally, the concept appears to be a reasonable solution to address the Mobility goal of this contract.
2. The Safety goal is largely unaddressed in this PTC. The discussions on safety (pages 8 and 9) appear to imply that safety will become worse. How does this PTC provide for a safer I-270 corridor?
3. Except for touching on Barrier Transfer Machine (BTM) storage and snow events, this PTC is silent regarding Operations and Maintenance (O&M). The Administration values a project that will provide for ease of O&M. Please address the Operability/ Maintainability/Adaptability goal in detail.
4. Each new HOV lane was assumed to reduce SOVs at a rate of 1.5:1. For the COG travel demand model output usage for HOV demand estimation, the PTC assumptions should be clearly stated and justified. Please provide good documentation of induced demand/mode shifts, diverted demand to justify projected demand, and describe the calibration/validation efforts undertaken as the raw MPO model outputs could be misleading. The COG MPO model is ideal for regional analysis and trend determination; caution should be taken to interpret model outputs along with appropriate post processing techniques.
5. Please clarify where the BTM will be stored at times other than the AM peak period.
6. It is noted on page 6 that some spread computations were completed for the proposed typical section. Please note that for the PM peak period the flow line would be at the face of the moveable barrier, not at the face of the permanent median barrier.
7. To achieve the project goals, the Design-Builder must provide a fully functional system at project completion. Integration is a critical component for the success of this PTC. Please discuss in detail how this PTC will be integrated. Section D. Potential Impacts should address impacts to CHART.

8. Section E, Other Projects: Please include the degree of success the Golden Gate Bridge Project had and contact information for owner representatives. Also, the Golden Gate Bridge project did not have a permanent median barrier. If project information on a successful application of moveable barrier as a managed lane is available, please provide.
9. A National Environmental Policy (NEPA) document and an Interstate Access Point Approval (IAPA) approved by the Federal Highway Administration (FHWA) will be required prior to establishing a Construction Agreed Price (CAP). In preparation of the IAPA, the Design-Builder must meet the requirements of the FHWA Interstate System Access Informational Guide.
10. Please provide more specificity in the signing needs for the contraflow segments, including approximate spacing. Entry signing is good, yet motorists may need spaced signs along the segment to provide positive guidance and reassurance that the operations are under active control.
11. How will training and tools be provided to "break" and restore the barrier to access incidents between the moveable and permanent barriers?
12. Changes to shoulder areas may influence the following elements of traffic incident management:
    - Providing a safe buffer zone for emergency responders. Although managed lanes can facilitate lane use and advanced warning, full shoulders provide a work area for emergency responders which, by vehicular regulation and driver behavior, motorist do not use. Managed lanes can help, but positive guidance and physical barriers (e.g. cones) will be the only protection in a normally traveled lane (i.e. hard shoulder). This raises the following questions: Would managed lane signals be advisory, or regulatory, since they become safety essential in this scenario? How will field operations and managed lane operations be coordinated to maximize the safety of the emergency responders?
    - Use as a staging area for vehicle recovery. In Maryland, by policy and regulation in support of the towing and recovery industry, public agencies only relocate damaged and disabled vehicles to the shoulder, to stage them for final removal by industry towers. Limited shoulder availability would likely require new policies and procedures to minimize the blockage time impact while preparing for private towers to arrive.
    - Access to the incident scene. The CHART patrols, in Maryland, function as an extension of staff for the Maryland State Police, in the area of Traffic Incident Management. However, CHART patrols are not enforcement vehicles and do not have the authority of a "blue light" (police) or a "red light" (fire and rescue) emergency responders in traveling through traffic. Consequently, although managed lanes may help, motorists may, or may not, yield right of way to CHART vehicles.

- Impacts of more complex incidents. The managed lane model work fairly well in the case of disabled vehicles or two vehicle collisions in a single lane. Procedures and impacts need to be analyzed and addressed for more complex incident, that require more complex recovery procedures and other public safety impacts. Some of these complicating factors include: heavy/large vehicles, injuries, hazardous materials, fires, criminal activities, significant debris (e.g. a load of mulch) etc. Each of these scenarios requires different personnel and equipment on scene: fire trucks, ambulances, police vehicles, heavy equipment, etc. Shoulders provide the additional geometry to stage and maneuver these resources.

Please address the above issues and potential alterations to operational procedures that might be necessary to effectively implement this PTC.

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Frank DiGilio, Kiewit Infrastructure Co.

PTC 9 – Concrete Patch in Lieu of Full Depth Asphalt

AECOM
7 St. Paul Street, 17th Floor
Baltimore, MD 21202, USA
aecom.com

January 19, 2017

Mr. Jason A. Ridgway, P.E.
Director, Office of Highway Development
Maryland Department of Transportation
State Highway Administration
707 N. Calvert Street
Baltimore, MD 21202

Subject: **Proposed Technical Concept No. 9** Comment Responses
IS-270 - Innovative Congestion Management Progressive Design Build
Contract No. MO0695172

Dear Mr. Ridgway

The Kiewit/AECOM team is **not including PTC 9** in “the Project” and technical proposal. We appreciate the opportunity to submit this PTC and receive your feedback during the review process.

Yours sincerely,

Chris McGuire, PE
Vice President, Maryland Surface Transportation
AECOM
T: 410-637-1720
M: 443-386-6286
E: chris.mcguire@aecom.com

A. Description

Detailed descriptive information and other appropriate information as appropriate such as conceptual drawings, production details, standards, specifications, and traffic operations analysis.

This Proposed Technical Concept (PTC) includes the use of concrete or asphalt to patch the existing shoulder to make it traffic bearing to support Hard Shoulder Running (HSR). The shoulder pavement composition will be strengthened using one of three options:

1. Resurfacing
2. a full depth patch using concrete or asphalt, or
3. full depth reconstruction where necessary.

Shoulder sections that only require an overlay or full depth patch will not result in any disturbance of the existing soil, and therefore will not require stormwater management. Figure 1 depicts Option 2, patching using concrete.

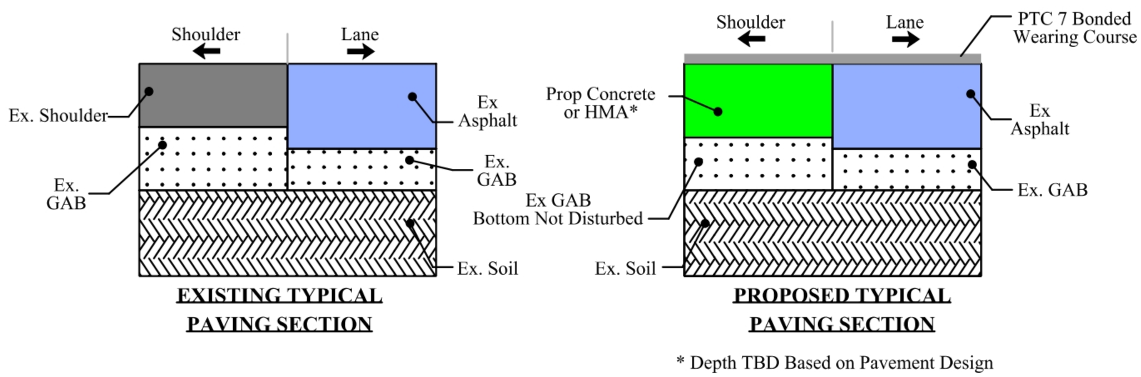

Figure 1 – Proposed patching along HSR – No SWM requirements

B. Location

The locations where, and an explanation of how, the PTC will be used on the Project.

The concrete or asphalt patching will be implemented in all HSR sections along the median and outside shoulders that are not currently traffic bearing. The 2'-3' offset between the edge of the HSR and the existing concrete barrier will not be reconstructed, since it will not need to be traffic bearing. Therefore the limits of full depth patching will be sawcut prior to pavement removal, to avoid impact to the adjacent pavement composition. In a location where the existing shoulder is non-traffic bearing and requires a full depth patch, the UTBWC will be placed on top of the patch to provide a homogenous surface across all lanes (see PTC 7). Figure 2 shows a sample typical section from PTC 1 and 10 where a portion of the existing NB shoulder is rehabbed sawcutting to define the limits of the patching or reconstruction

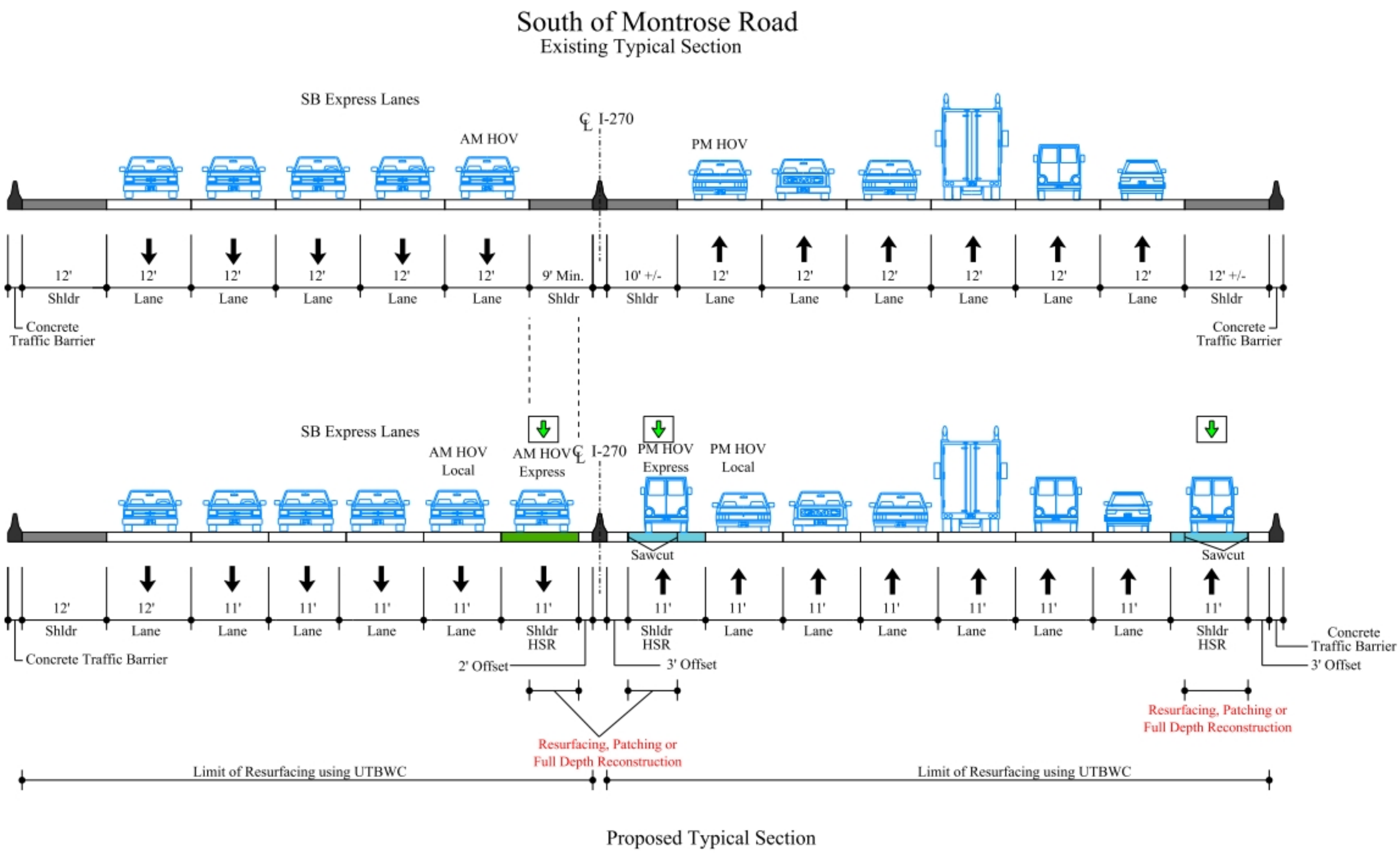

Figure 2 – PTC 1 and 10 Typical Section - South of Montrose Road

Resurfacing, Patching or Full Depth Reconstruction Sections

C. Analysis

Analysis justifying the use of the PTC including how it advances the project goals.

The Administration provided Ground Penetration Radar results that included information on the existing pavement composition of the shoulders. The team has evaluated the existing pavement sections within the HSR limits, and will limit the full depth patching only to the shoulder stretches that are non-traffic bearing. In locations where a full depth patch will not yield sufficient pavement strength, full depth reconstruction will be required. The longitudinal limits of the HSR will be overlaid. In addition, the through lanes along SB IS-270 will be resurfaced to allow for restriping of the existing lanes.

D. Potential Impacts

A preliminary analysis of potential impacts (both during and after construction) including but not limited to use impacts, Right-of-Way, geotechnical, utilities, environmental permitting, local community, safety, and life-cycle project and infrastructure costs, including impacts on the cost of repair, maintenance, and operation.

User Impacts - Concrete patching needs longer curing times, which may result in the shoulder being closed for longer periods of time compared to asphalt treatment.

Right of way (ROW) – There are no associated ROW impacts with this method, since all activities will take place within the existing roadway footprint.

Geotechnical – In areas where the existing pavement depths are insufficient or the structural support is inadequate for the proposed traffic volumes, such as along portions of the existing shoulders, structural improvement will be required before the final UTBWC surface is applied. A section of the existing graded aggregate base will be retained to avoid soil exposure, eliminating the need for SWM.

The borings provided by SHA indicated that the existing subbase material was better than the SHA Pavement Manual assumed value. Therefore, during the post award phase, the team will perform an extensive soil boring plan. If the borings are indicative of better subgrade support conditions, the existing pavement may require little to no structural strengthening, thereby eliminating the need for SWM.

Utilities –Due to the potential lack of full depth reconstruction, no utility impacts are anticipated along the median HSR sections on each side of the existing concrete median barrier.

Environmental Permitting – In sections where concrete or asphalt patching is sufficient along HSR, a portion of the existing graded aggregate base will be left in place to avoid soil exposure or disturbance. This will eliminate the need for any stormwater management. In sections where full depth reconstruction of the HSR is required, which will result in soil exposure and disturbance, stormwater management will be provided.

Local Community – There will be minimal impact to residential and commercial communities during construction, since the work will take place within the existing roadway footprint.

Safety – There are no anticipated safety impacts due to the use of patching along the existing shoulders.

Infrastructure costs – The overall cost of reconstructing existing shoulders to make them traffic bearing is reduced, due to the lack of need for stormwater management facilities and additional ROW.

Maintenance – There are no maintenance impacts anticipated due to the implementation of this PTC.

E. Other projects

A description of other projects on which the PTC has been used, the degree of success or failure of such usage, and the names and contact information (including telephone numbers and e-mail addresses) of project owner representative who can confirm such statements.

The Administration constantly uses patching to restore the pavement structure after a utility or pipe replacement. The team will evaluate the thickness of the proposed asphalt or concrete patching to ensure that the pavement section along HSR has the adequate strength to support traffic, excluding trucks.

F. Administration Risk

A description of risk to the Administration or third parties associated with implementing the PTC.

No risk to the Administration is anticipated based on concrete or asphalt patching.

G. Design-Builder Risk

A description of risk to the Design-Builder associated with implementing the PTC.

The proposed patching is assumed to eliminate the need for SWM. This may change during the post-award phase, and it is a risk to the design-build team.

H. Cost/Schedule Benefits

Discussion of any cost or schedule benefits to this contract from usage of this PTC

The curing process for concrete is longer compared to the conventional asphalt patching. However, concrete has a long life cycle, and therefore will benefit the administration with maintenance costs.

I. Miscellaneous

Any additional information that would assist the Administration in the review of this PTC.

Larry Hogan, *Governor*
Boyd K. Rutherford, *Lt. Governor*

SHA State Highway Administration
Maryland Department of Transportation

Pete K. Rahn, *Secretary*
Gregory C. Johnson, P.E., *Administrator*

December 1, 2016

Mr. Benjamin J. Carnazzo
Kiewit Infrastructure Co.
7250 Parkway Drive, Suite 310
Hanover MD 21076

Dear Mr. Carnazzo:

The Maryland Department of Transportation's State Highway Administration's (SHA) is in receipt of Proposed Technical Concept (PTC) No. 9 for the I-270 Innovative Congestion Management Progressive Design-Build contract (Contract No. MO0695172), submitted by your Design-Build Team on November 17, 2016. The SHA has completed our review of the PTC and offers the following comments for your consideration in the further development of your technical concepts and proposal:

1. The use of a patch as described in this PTC will likely be considered redevelopment as the usage of shoulder will change to a traffic lane. Even though there may be flexibility that may be further evaluated in final design, it is recommended that this be considered redevelopment for stormwater purposes in the development of your Proposal.
2. Figure 1 depicts Ultra-Thin Bonded Wearing Course (UTBWC) from PTC 7 over the proposed concrete or asphalt patching. As per the MDSHA Design Guide, there should be a minimum of 4" asphalt thickness on top of jointed concrete pavement to delay reflective cracking, so UTBWC placement on top of concrete patching is unacceptable.
3. To make the existing shoulder traffic bearing to support Hard Shoulder Running (HSR), it is proposed that the 2' – 3' offset between the edge of the HSR and the concrete barrier will not be reconstructed. While it is proposed that the limits of patching will be saw cut prior to pavement removal to avoid impact to the adjacent pavement composition, SHA expects that the adjacent pavement might still be disturbed due to this operation.
4. The "Geotechnical" section in Item D references the "SHA Pavement Manual assumed value." Please clarify what is the assumed value, as SHA has not provided any strength values as part of the RFP.
5. Please note that as per the MDSHA Design Guide, a minimum of 4" GAB thickness is needed between the asphalt materials and the subgrade for drainage purposes.
6. The combination of concrete pavement and asphalt pavement sections poses maintenance challenges for SHA in the future.

Mr. Benjamin J. Carnazzo
Page Two

Any questions or communications regarding the response to this PTC should be directed to Mr. Jason A. Ridgway, Director, Office of Highway Development at the project specific email address, MO069_IS_270@sha.state.md.us.

Sincerely,

Jason A. Ridgway, P.E.
Director, Office of Highway Development

cc: Mr. Frank DiGilio, Kiewit Infrastructure Co.

APPENDIX III
SAFETY

APPENDIX III - SAFETY

a) FHWA's Historical HSR Projects and HSM Crash Prediction

There were two HSR projects similar to the proposed HSR. A summary of the safety impacts is presented as below (Sources from FHWA HOP-16-060):

1. Houston, Texas US 59
    a. Configuration: Narrowed shoulders
        i. 3- 12’ lanes to 4-10.5’ lanes
        ii. 4- 12’ lanes to 5-10.5’ lanes
    b. Results
        i. The number of crashes and the crash rates declined in the altered sections during the two years following modification for each of the four time periods studied (24 hour, peak, daytime, nighttime).
        ii. The larger reductions in crash frequencies occurred during the peak periods (the same period as the greatest operational benefits).
        iii. No significant change in the number or rate of severe accidents.
        iv. The upstream segment entering the modified section (with narrow lanes and shoulders) also experienced a reduction in crashes and crash rate – likely attributed to the better operations in the downstream segments where capacity had been increased by the additional lane.
        v. The crash rate in the section downstream from the modified segments experienced a significant increase in the crash rate, with the greatest increase occurring the two peak hours – likely attributed to an increase in demand and flow (from the modified segments) but with no increase in capacity.

2. Los Angeles, California – Multiple segments
    a. Configuration: Narrowed shoulders, 12’ lanes to 11’ lanes
        i. 5 lanes converted to 6 lanes
        ii. 4 lanes converted to 5 lanes
    b. Results
        i. The projects converting four lanes to five lanes, on average, resulted in increases of 10 to 11 percent in crash frequency, which was found to be statistically significant.
        ii. The five- to six-lane conversion projects resulted in an increase in crash frequency of 3 to 7 percent, not statistically significant.
        iii. The use of the added lanes as HOV lanes --- and the associated increase in speed differential between the HOV and general purpose lanes – may be an explanation for the increase crash frequency.

3. FHWA HSM crash prediction for 6 to 8 lanes and 8 to 10 lanes freeway narrowing lanes and shoulders:

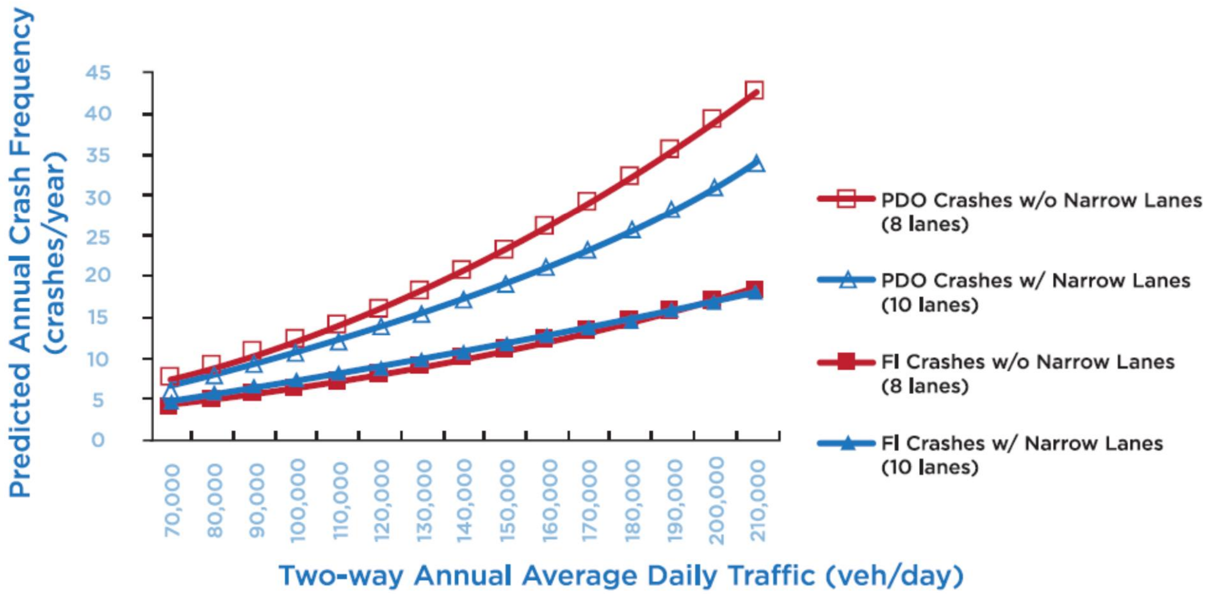

Figure 20. Graph. Predicted Crash Frequency With and Without Narrow Lanes and Narrow Shoulders (Conversion from 8-lane Freeway to 10-lane Freeway).

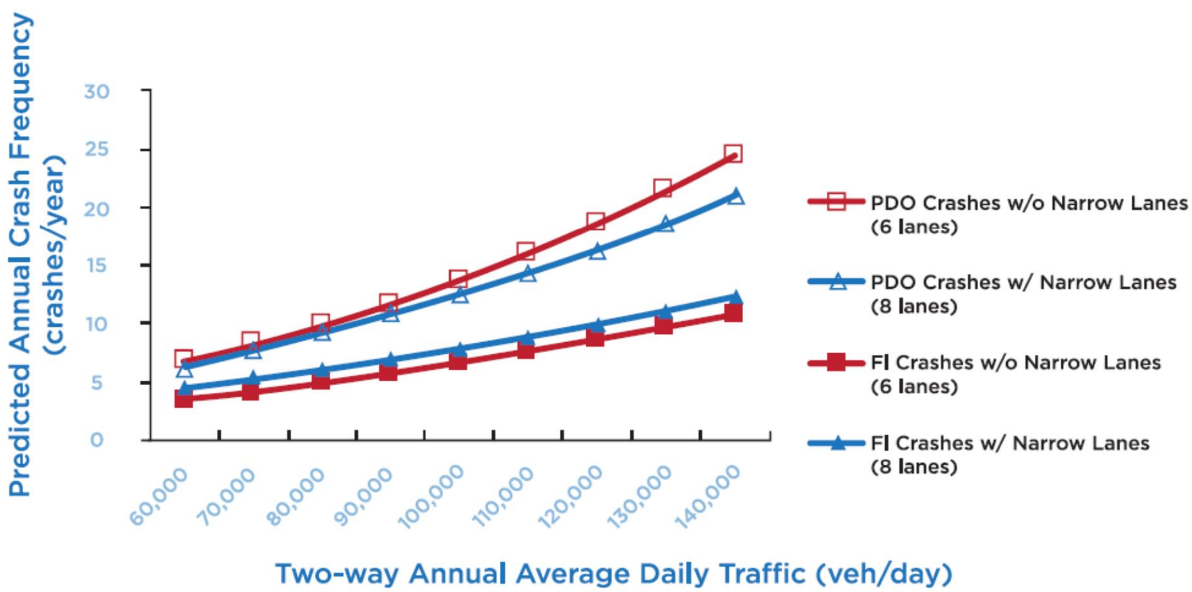

Figure 19. Graph. Predicted Crash Frequency With and Without Narrow Lanes and Narrow Shoulders (Conversion from 6-lane Freeway to 8-lane Freeway).

b) ISATe Details and Assumptions

ISATe List of Details & Assumptions

- Number of Through Lanes were doubled to represent two directions of travel, as required by ISATe.
- AM and PM peak hour traffic volume inputs were multiplied by 24 to develop corresponding ADTs, as required by ISATe.
- All "Estimated Number of Crashes During the Study Period" provided through ISATe were divided by 2 to obtain the number of crashes for only one direction, and then divided by 8 to obtain the number of crashes for either the AM or PM peak period. To summarize, the numbers of crashes were divided by 16 to get from number of crashes in both directions during all 24 hours, to number of crashes in only one direction during either the AM or PM peak period.
- A reduction of 290 vehicles during the AM peak hour in the southbound direction and the PM peak hour in the northbound direction was applied to the build condition scenarios to represent the shift to HOV, as further explained in the Mobility section of the proposal.

c) ISATe Inputs

Northbound: AM Peak Period, Existing Conditions, Existing Volumes, MD 187 to Montrose Rd

		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
		Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period
Basic Roadway Data																					
Number of through lanes (n):		6	4	8	8																
Freeway segment description:		Existing AM	Existing AM	Existing AM	Existing AM																
Segment length (L), mi:		0.11	0.41	0.87	0.25																
Alignment Data																					
Horizontal Curve Data																					
1 Horizontal curve in segment?:		No	No	No	No																
Cross Section Data																					
Lane width (W_l), ft:		12	12	12	12																
Outside shoulder width (W_s), ft:		12	12	12	12																
Inside shoulder width (W_{is}), ft:		10	10	10	10																
Median width (W_m), ft:		23	23	23	23																
Rumble strips on outside shoulders?:		No	No	No	No																
Length of rumble strips for travel in increasing milepost direction, mi:																					
Length of rumble strips for travel in decreasing milepost direction, mi:																					
Rumble strips on inside shoulders?:		No	No	No	No																
Length of rumble strips for travel in increasing milepost direction, mi:																					
Length of rumble strips for travel in decreasing milepost direction, mi:																					
Presence of barrier in median:		Center	Center	Center	Center																
Median barrier width (W_{ib}), ft:		3	3	3	3																
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																					
Roadside Data																					
Clear zone width (W_{hc}), ft:		30	30	30	30																
Presence of barrier on roadside:		Full	Full	Full	Full																
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:		12	12	12	12																
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:		12	12	12	12																
Ramp Access Data																					
Travel in Increasing Milepost Direction																					
Entrance Ramp: Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:			999		999																
Length of ramp entrance ($L_{en,inc}$), mi:		0.11																			
Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:		0.11																			
Entrance side?:		Right																			
Exit Ramp: Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:		999		999																	
Length of ramp exit ($L_{ex,inc}$), mi:																					
Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:																					
Exit side?:																					
Weave: Type B weave in segment?:		No	No	No	No																
Length of weaving section ($L_{wev,inc}$), mi:																					
Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																					
Entrance Ramp: Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:			999		999																
Length of ramp entrance ($L_{en,dec}$), mi:		0.11																			
Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:		0.11																			
Entrance side?:		Right																			
Exit Ramp: Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:		999		999																	
Length of ramp exit ($L_{ex,dec}$), mi:																					
Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:																					
Exit side?:																					
Weave: Type B weave in segment?:		No	No	No	No																
Length of weaving section ($L_{wev,dec}$), mi:																					
Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data	**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):		1	1	1	1																
Freeway Segment Data	2016	80880	94240	75720	199080																
Entrance Ramp Data for Travel in Increasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:	2016	14020		123360																	
Exit Ramp Data for Travel in Increasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:	2016		11760		87240																
Entrance Ramp Data for Travel in Decreasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:	2016	14020		123360																	
Exit Ramp Data for Travel in Decreasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:	2016		11760		87240																

Northbound: PM Peak Period, Existing Conditions, Existing Volumes, MD 187 to Montrose Rd

		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
		Study Period	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**
Basic Roadway Data																					
Number of through lanes (n):		6	4	8	8																
Freeway segment description:		Existing PM	Existing PM	Existing PM	Existing PM																
Segment length (L), mi:		0.11	0.41	0.87	0.25																
Alignment Data																					
Horizontal Curve Data																					
1 Horizontal curve in segment?:		No	No	No	No																
Cross Section Data																					
Lane width (W_l), ft:		12	12	12	12																
Outside shoulder width (W_s), ft:		10	10	10	10																
Inside shoulder width (W_{is}), ft:		10	10	10	10																
Median width (W_m), ft:		23	23	23	23																
Rumble strips on outside shoulders?:		No	No	No	No																
Length of rumble strips for travel in increasing milepost direction, mi:																					
Length of rumble strips for travel in decreasing milepost direction, mi:																					
Rumble strips on inside shoulders?:		No	No	No	No																
Length of rumble strips for travel in increasing milepost direction, mi:																					
Length of rumble strips for travel in decreasing milepost direction, mi:																					
Presence of barrier in median:		Center	Center	Center	Center																
Median barrier width (W_{ib}), ft:		3	3	3	3																
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																					
Roadside Data																					
Clear zone width (W_{hc}), ft:		30	30	30	30																
Presence of barrier on roadside:		Full	Full	Full	Full																
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:		12	12	12	12																
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:		12	12	12	12																
Ramp Access Data																					
Travel in Increasing Milepost Direction																					
Entrance Ramp — Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:			999		999																
Length of ramp entrance ($L_{en,inc}$), mi:		0.11																			
Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:		0.11																			
Entrance side?:		Right																			
Exit Ramp — Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:		999		999																	
Length of ramp exit ($L_{ex,inc}$), mi:																					
Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:																					
Exit side?:																					
Weave — Type B weave in segment?:		No	No	No	No																
Length of weaving section ($L_{wev,inc}$), mi:																					
Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																					
Entrance Ramp — Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:			999		999																
Length of ramp entrance ($L_{en,dec}$), mi:		0.11																			
Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:		0.11																			
Entrance side?:		Right																			
Exit — Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
Ramp — Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:		999		999																	
Length of ramp exit ($L_{ex,dec}$), mi:																					
Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:																					
Exit side?:																					
Weave — Type B weave in segment?:		No	No	No	No																
Length of weaving section ($L_{wev,dec}$), mi:																					
Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data	**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):		1	1	1	1																
Freeway Segment Data	2016	86760	119040	95040	264960																
Entrance Ramp Data for Travel in Increasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:	2016	32280		169920																	
Exit Ramp Data for Travel in Increasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:	2016		24000		79680																
Entrance Ramp Data for Travel in Decreasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:	2016	32280		169920																	
Exit Ramp Data for Travel in Decreasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:	2016		24000		79680																

Northbound: OFF Peak Period, Existing Conditions, Existing Volumes, MD 187 to Montrose Rd

			Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
			Study Period	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**
Basic Roadway Data																						
Number of through lanes (n):			6	4	8	8																
Freeway segment description:			Existing OFF	Existing OFF	Existing OFF	Existing OFF																
Segment length (L), mi:			0.11	0.41	0.87	0.25																
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No																
Cross Section Data																						
Lane width (W_l), ft:			12	12	12	12																
Outside shoulder width (W_s), ft:			12	12	12	12																
Inside shoulder width (W_{is}), ft:			10	10	10	10																
Median width (W_m), ft:			23	23	23	23																
Rumble strips on outside shoulders?:			No	No	No	No																
	Length of rumble strips for travel in increasing milepost direction, mi:																					
	Length of rumble strips for travel in decreasing milepost direction, mi:																					
Rumble strips on inside shoulders?:			No	No	No	No																
	Length of rumble strips for travel in increasing milepost direction, mi:																					
	Length of rumble strips for travel in decreasing milepost direction, mi:																					
Presence of barrier in median:			Center	Center	Center	Center																
Median barrier width (W_{ib}), ft:			3	3	3	3																
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30																
Presence of barrier on roadside:			Full	Full	Full	Full																
Distance from edge of traveled w ay to barrier face, increasing milepost ($W_{off,inc}$), ft:			12	12	12	12																
Distance from edge of traveled w ay to barrier face, decreasing milepost ($W_{off,dec}$), ft:			12	12	12	12																
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:			999		999																
	Length of ramp entrance ($L_{en,inc}$), mi:		0.11																			
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:		0.11																			
	Entrance side?:		Right																			
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
	Distance from end milepost to dow nstream exit ramp gore ($X_{e,ext}$), mi:		999		999																	
	Length of ramp exit ($L_{ex,inc}$), mi:																					
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:																					
	Exit side?:																					
Weave	Type B weave in segment?:		No	No	No	No																
	Length of weaving section ($L_{wev,inc}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:			999		999																
	Length of ramp entrance ($L_{en,dec}$), mi:		0.11																			
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:		0.11																			
	Entrance side?:		Right																			
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
	Distance from begin milepost to dow nstream exit ramp gore ($X_{b,ext}$), mi:		999		999																	
	Length of ramp exit ($L_{ex,dec}$), mi:																					
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:																					
	Exit side?:																					
Weave	Type B weave in segment?:		No	No	No	No																
	Length of weaving section ($L_{wev,dec}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1																
Freeway Segment Data		2016	25055	31365	22365	71330																
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016	6310		48965																	
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016		9000		27210																
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016	6310		48965																	
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016		9000		27210																

Northbound: AM Peak Period, Proposed Conditions, Existing Volumes, MD 187 to Montrose Rd

		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
		Study Period	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**
Basic Roadway Data																					
Number of through lanes (n):		8	6	10	10																
Freeway segment description:		Proposed AM	Proposed AM	Proposed AM	Proposed AM																
Segment length (L), mi:		0.11	0.41	0.87	0.25																
Alignment Data																					
Horizontal Curve Data																					
1 Horizontal curve in segment?:		No	No	No	No																
Cross Section Data																					
Lane width (W_l), ft:		11	11	11	11																
Outside shoulder width (W_s), ft:		4	4	4	4																
Inside shoulder width (W_{is}), ft:		10	10	2	2																
Median width (W_m), ft:		23	23	7	7																
Rumble strips on outside shoulders?:		No	No	No	No																
Length of rumble strips for travel in increasing milepost direction, mi:																					
Length of rumble strips for travel in decreasing milepost direction, mi:																					
Rumble strips on inside shoulders?:		No	No	No	No																
Length of rumble strips for travel in increasing milepost direction, mi:																					
Length of rumble strips for travel in decreasing milepost direction, mi:																					
Presence of barrier in median:		Center	Center	Center	Center																
Median barrier width (W_{ib}), ft:		3	3	3	3																
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																					
Roadside Data																					
Clear zone width (W_{hc}), ft:		30	30	30	30																
Presence of barrier on roadside:		Full	Full	Full	Full																
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:		4	4	4	4																
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:		4	4	4	4																
Ramp Access Data																					
Travel in Increasing Milepost Direction																					
Entrance Ramp — Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:			999		999																
Length of ramp entrance ($L_{en,inc}$), mi:		0.11																			
Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:		0.11																			
Entrance side?:		Right																			
Exit Ramp — Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:		999		999																	
Length of ramp exit ($L_{ex,inc}$), mi:																					
Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:																					
Exit side?:																					
Weave — Type B weave in segment?:		No	No	No	No																
Length of weaving section ($L_{wev,inc}$), mi:																					
Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																					
Entrance Ramp — Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:			999		999																
Length of ramp entrance ($L_{en,dec}$), mi:		0.11																			
Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:		0.11																			
Entrance side?:		Right																			
Exit Ramp — Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:		999		999																	
Length of ramp exit ($L_{ex,dec}$), mi:																					
Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:																					
Exit side?:																					
Weave — Type B weave in segment?:		No	No	No	No																
Length of weaving section ($L_{wev,dec}$), mi:																					
Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data	**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):		1	1	1	1																
Freeway Segment Data	2016	80880	94240	75720	199080																
Entrance Ramp Data for Travel in Increasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:	2016	14020		123360																	
Exit Ramp Data for Travel in Increasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:	2016		11760		87240																
Entrance Ramp Data for Travel in Decreasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:	2016	14020		123360																	
Exit Ramp Data for Travel in Decreasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:	2016		11760		87240																

Northbound: PM Peak Period, Proposed Conditions, Existing Volumes, MD 187 to Montrose Rd

		Segment 1 Study Period	Segment 2 Study Period	Segment 3 Study Period	Segment 4 Study Period	Segment 5 Study Period	Segment 6 Study Period	Segment 7 Study Period	Segment 8 Study Period	Segment 9 Study Period	Segment 10 Study Period	Segment 11 Study Period	Segment 12 Study Period	Segment 13 Study Period	Segment 14 Study Period	Segment 15 Study Period	Segment 16 Study Period	Segment 17 Study Period	Segment 18 Study Period	Segment 19 Study Period	Segment 20 Study Period
Basic Roadway Data																					
Number of through lanes (n):		8	6	10	10																
Freeway segment description:		Proposed PM	Proposed PM	Proposed PM	Proposed PM																
Segment length (L), mi:		0.11	0.41	0.87	0.25																
Alignment Data																					
Horizontal Curve Data																					
1 Horizontal curve in segment?:		No	No	No	No																
Cross Section Data																					
Lane width (W_l), ft:		11	11	11	11																
Outside shoulder width (W_s), ft:		4	4	4	4																
Inside shoulder width (W_{is}), ft:		10	10	2	2																
Median width (W_m), ft:		23	23	7	7																
Rumble strips on outside shoulders?:		No	No	No	No																
Length of rumble strips for travel in increasing milepost direction, mi:																					
Length of rumble strips for travel in decreasing milepost direction, mi:																					
Rumble strips on inside shoulders?:		No	No	No	No																
Length of rumble strips for travel in increasing milepost direction, mi:																					
Length of rumble strips for travel in decreasing milepost direction, mi:																					
Presence of barrier in median:		Center	Center	Center	Center																
Median barrier width (W_{ib}), ft:		3	3	3	3																
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																					
Roadside Data																					
Clear zone width (W_{hc}), ft:		30	30	30	30																
Presence of barrier on roadside:		Full	Full	Full	Full																
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:		4	4	4	4																
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:		4	4	4	4																
Ramp Access Data																					
Travel in Increasing Milepost Direction																					
Entrance Ramp: Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:			999		999																
Length of ramp entrance ($L_{en,inc}$), mi:		0.11																			
Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:		0.11																			
Entrance side?:		Right																			
Exit Ramp: Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:		999		999																	
Length of ramp exit ($L_{ex,inc}$), mi:																					
Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:																					
Exit side?:																					
Weave: Type B weave in segment?:		No	No	No	No																
Length of weaving section ($L_{wev,inc}$), mi:																					
Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																					
Entrance Ramp: Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:			999		999																
Length of ramp entrance ($L_{en,dec}$), mi:		0.11																			
Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:		0.11																			
Entrance side?:		Right																			
Exit Ramp: Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:		999		999																	
Length of ramp exit ($L_{ex,dec}$), mi:																					
Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:																					
Exit side?:																					
Weave: Type B weave in segment?:		No	No	No	No																
Length of weaving section ($L_{wev,dec}$), mi:																					
Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data	**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):		1	1	1	1																
Freeway Segment Data	2016	86760	119040	95040	264960																
Entrance Ramp Data for Travel in Increasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:	2016	32280		169920																	
Exit Ramp Data for Travel in Increasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:	2016		24000		79680																
Entrance Ramp Data for Travel in Decreasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:	2016	32280		169920																	
Exit Ramp Data for Travel in Decreasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:	2016		24000		79680																

Northbound: OFF Peak Period, Proposed Conditions, Existing Volumes, MD 187 to Montrose Rd

			Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
			Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period
Basic Roadway Data																						
Number of through lanes (n):			6	4	8	8																
Freeway segment description:			Proposed OFF	Proposed OFF	Proposed OFF	Proposed OFF																
Segment length (L), mi:			0.11	0.41	0.87	0.25																
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No																
Cross Section Data																						
Lane width (W_l), ft:			11	11	11	11																
Outside shoulder width (W_s), ft:			13	13	13	13																
Inside shoulder width (W_{is}), ft:			10	10	12	12																
Median width (W_m), ft:			23	23	27	27																
Rumble strips on outside shoulders?:			No	No	No	No																
	Length of rumble strips for travel in increasing milepost direction, mi:																					
	Length of rumble strips for travel in decreasing milepost direction, mi:																					
Rumble strips on inside shoulders?:			No	No	No	No																
	Length of rumble strips for travel in increasing milepost direction, mi:																					
	Length of rumble strips for travel in decreasing milepost direction, mi:																					
Presence of barrier in median:			Center	Center	Center	Center																
Median barrier width (W_{ib}), ft:			3	3	3	3																
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30																
Presence of barrier on roadside:			Full	Full	Full	Full																
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:			13	13	13	13																
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:			13	13	13	13																
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:			999		999																
	Length of ramp entrance ($L_{en,inc}$), mi:		0.11																			
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:		0.11																			
	Entrance side?:		Right																			
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
	Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:		999		999																	
	Length of ramp exit ($L_{ex,inc}$), mi:																					
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:																					
	Exit side?:																					
Weave	Type B weave in segment?:		No	No	No	No																
	Length of weaving section ($L_{wev,inc}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:			999		999																
	Length of ramp entrance ($L_{en,dec}$), mi:		0.11																			
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:		0.11																			
	Entrance side?:		Right																			
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
	Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:		999		999																	
	Length of ramp exit ($L_{ex,dec}$), mi:																					
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:																					
	Exit side?:																					
Weave	Type B weave in segment?:		No	No	No	No																
	Length of weaving section ($L_{wev,dec}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1																
Freeway Segment Data		2016	25055	31365	22365	71330																
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016	6310		48965																	
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016		9000		27210																
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016	6310		48965																	
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016		9000		27210																

Northbound: AM Peak Period, Existing Conditions, 2040 Volumes, MD 187 to Montrose Rd

		Year	Segment 1 Study Period	Segment 2 Study Period	Segment 3 Study Period	Segment 4 Study Period	Segment 5 Study Period	Segment 6 Study Period	Segment 7 Study Period	Segment 8 Study Period	Segment 9 Study Period	Segment 10 Study Period	Segment 11 Study Period	Segment 12 Study Period	Segment 13 Study Period	Segment 14 Study Period	Segment 15 Study Period	Segment 16 Study Period	Segment 17 Study Period	Segment 18 Study Period	Segment 19 Study Period	Segment 20 Study Period
Basic Roadway Data																						
Number of through lanes (n):			6	4	8	8																
Freeway segment description:			Existing AM	Existing AM	Existing AM	Existing AM																
Segment length (L), mi:			0.11	0.41	0.87	0.25																
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No																
Cross Section Data																						
Lane width (W_l), ft:			12	12	12	12																
Outside shoulder width (W_s), ft:			12	12	12	12																
Inside shoulder width (W_{is}), ft:			10	10	10	10																
Median width (W_m), ft:			23	23	23	23																
Rumble strips on outside shoulders?:			No	No	No	No																
	Length of rumble strips for travel in increasing milepost direction, mi:																					
	Length of rumble strips for travel in decreasing milepost direction, mi:																					
Rumble strips on inside shoulders?:			No	No	No	No																
	Length of rumble strips for travel in increasing milepost direction, mi:																					
	Length of rumble strips for travel in decreasing milepost direction, mi:																					
Presence of barrier in median:			Center	Center	Center	Center																
Median barrier width (W_{ib}), ft:			3	3	3	3																
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30																
Presence of barrier on roadside:			Full	Full	Full	Full																
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:			12	12	12	12																
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:			12	12	12	12																
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:			999		999																
	Length of ramp entrance ($L_{en,inc}$), mi:		0.11																			
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:		0.11																			
	Entrance side?:		Right																			
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
	Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:		999		999																	
	Length of ramp exit ($L_{ex,inc}$), mi:																					
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:																					
	Exit side?:																					
Weave	Type B weave in segment?:		No	No	No	No																
	Length of weaving section ($L_{wev,inc}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:			999		999																
	Length of ramp entrance ($L_{en,dec}$), mi:		0.11																			
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:		0.11																			
	Entrance side?:		Right																			
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
	Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:		999		999																	
	Length of ramp exit ($L_{ex,dec}$), mi:																					
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:																					
	Exit side?:																					
Weave	Type B weave in segment?:		No	No	No	No																
	Length of weaving section ($L_{wev,dec}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1																
Freeway Segment Data		2016	87240	102240	81600	215880																
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016	15000		134280																	
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016		20640		92880																
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016	15000		134280																	
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016		20640		92880																

Northbound: PM Peak Period, Existing Conditions, 2040 Volumes, MD 187 to Montrose Rd

			Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
			Study Period	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**
Basic Roadway Data																						
Number of through lanes (n):			6	4	8	8																
Freeway segment description:			Existing PM	Existing PM	Existing PM	Existing PM																
Segment length (L), mi:			0.11	0.41	0.87	0.25																
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No																
Cross Section Data																						
Lane width (W_l), ft:			12	12	12	12																
Outside shoulder width (W_s), ft:			12	12	12	12																
Inside shoulder width (W_{is}), ft:			10	10	10	10																
Median width (W_m), ft:			23	23	23	23																
Rumble strips on outside shoulders?:			No	No	No	No																
	Length of rumble strips for travel in increasing milepost direction, mi:																					
	Length of rumble strips for travel in decreasing milepost direction, mi:																					
Rumble strips on inside shoulders?:			No	No	No	No																
	Length of rumble strips for travel in increasing milepost direction, mi:																					
	Length of rumble strips for travel in decreasing milepost direction, mi:																					
Presence of barrier in median:			Center	Center	Center	Center																
Median barrier width (W_{ib}), ft:			3	3	3	3																
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30																
Presence of barrier on roadside:			Full	Full	Full	Full																
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:			12	12	12	12																
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:			12	12	12	12																
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:			999		999																
	Length of ramp entrance ($L_{en,inc}$), mi:		0.11																			
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:		0.11																			
	Entrance side?:		Right																			
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
	Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:		999		999																	
	Length of ramp exit ($L_{ex,inc}$), mi:																					
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:																					
	Exit side?:																					
Weave	Type B weave in segment?:		No	No	No	No																
	Length of weaving section ($L_{wev,inc}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:			999		999																
	Length of ramp entrance ($L_{en,dec}$), mi:		0.11																			
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:		0.11																			
	Entrance side?:		Right																			
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
	Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:		999		999																	
	Length of ramp exit ($L_{ex,dec}$), mi:																					
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:																					
	Exit side?:																					
Weave	Type B weave in segment?:		No	No	No	No																
	Length of weaving section ($L_{wev,dec}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1																
Freeway Segment Data		2016	92520	127200	101640	280200																
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016	34680		178560																	
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016		25560		84240																
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016	34680		178560																	
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016		25560		84240																

Northbound: OFF Peak Period, Existing Conditions, 2040 Volumes, MD 187 to Montrose Rd

			Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
			Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period
Basic Roadway Data																						
Number of through lanes (n):			6	4	8	8																
Freeway segment description:			Existing OFF	Existing OFF	Existing OFF	Existing OFF																
Segment length (L), mi:			0.11	0.41	0.87	0.25																
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No																
Cross Section Data																						
Lane width (W_l), ft:			12	12	12	12																
Outside shoulder width (W_s), ft:			12	12	12	12																
Inside shoulder width (W_{is}), ft:			10	10	10	10																
Median width (W_m), ft:			23	23	23	23																
Rumble strips on outside shoulders?:			No	No	No	No																
	Length of rumble strips for travel in increasing milepost direction, mi:																					
	Length of rumble strips for travel in decreasing milepost direction, mi:																					
Rumble strips on inside shoulders?:			No	No	No	No																
	Length of rumble strips for travel in increasing milepost direction, mi:																					
	Length of rumble strips for travel in decreasing milepost direction, mi:																					
Presence of barrier in median:			Center	Center	Center	Center																
Median barrier width (W_{ib}), ft:			3	3	3	3																
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30																
Presence of barrier on roadside:			Full	Full	Full	Full																
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:			12	12	12	12																
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:			12	12	12	12																
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:			999		999																
	Length of ramp entrance ($L_{en,inc}$), mi:		0.11																			
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:		0.11																			
	Entrance side?:		Right																			
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
	Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:		999		999																	
	Length of ramp exit ($L_{ex,inc}$), mi:																					
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:																					
	Exit side?:																					
Weave	Type B weave in segment?:		No	No	No	No																
	Length of weaving section ($L_{wev,inc}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:			999		999																
	Length of ramp entrance ($L_{en,dec}$), mi:		0.11																			
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:		0.11																			
	Entrance side?:		Right																			
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
	Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:		999		999																	
	Length of ramp exit ($L_{ex,dec}$), mi:																					
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:																					
	Exit side?:																					
Weave	Type B weave in segment?:		No	No	No	No																
	Length of weaving section ($L_{wev,dec}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1																
Freeway Segment Data		2016	27265	35105	25030	80125																
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016	7840		55095																	
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016		10075		29110																
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016	7840		55095																	
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016		10075		29110																

Northbound: AM Peak Period, Proposed Conditions, 2040 Volumes, MD 187 to Montrose Rd

			Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
			Study Period	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**
Basic Roadway Data																						
Number of through lanes (n):			8	6	10	10																
Freeway segment description:			Proposed AM	Proposed AM	Proposed AM	Proposed AM																
Segment length (L), mi:			0.11	0.41	0.87	0.25																
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No																
Cross Section Data																						
Lane width (W_l), ft:			11	11	11	11																
Outside shoulder width (W_s), ft:			4	4	4	4																
Inside shoulder width (W_{is}), ft:			10	10	2	2																
Median width (W_m), ft:			23	23	7	7																
Rumble strips on outside shoulders?:			No	No	No	No																
	Length of rumble strips for travel in increasing milepost direction, mi:																					
	Length of rumble strips for travel in decreasing milepost direction, mi:																					
Rumble strips on inside shoulders?:			No	No	No	No																
	Length of rumble strips for travel in increasing milepost direction, mi:																					
	Length of rumble strips for travel in decreasing milepost direction, mi:																					
Presence of barrier in median:			Center	Center	Center	Center																
Median barrier width (W_{ib}), ft:			3	3	3	3																
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30																
Presence of barrier on roadside:			Full	Full	Full	Full																
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:			4	4	4	4																
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:			4	4	4	4																
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:			999		999																
	Length of ramp entrance ($L_{en,inc}$), mi:		0.11																			
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:		0.11																			
	Entrance side?:		Right																			
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
	Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:		999		999																	
	Length of ramp exit ($L_{ex,inc}$), mi:																					
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:																					
	Exit side?:																					
Weave	Type B weave in segment?:		No	No	No	No																
	Length of weaving section ($L_{wev,inc}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:			999		999																
	Length of ramp entrance ($L_{en,dec}$), mi:		0.11																			
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:		0.11																			
	Entrance side?:		Right																			
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
	Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:		999		999																	
	Length of ramp exit ($L_{ex,dec}$), mi:																					
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:																					
	Exit side?:																					
Weave	Type B weave in segment?:		No	No	No	No																
	Length of weaving section ($L_{wev,dec}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1																
Freeway Segment Data		2016	87240	102240	81600	215880																
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016	15000		134280																	
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016		20640		92880																
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016	15000		134280																	
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016		20640		92880																

Northbound: PM Peak Period, Proposed Conditions, 2040 Volumes, MD 187 to Montrose Rd

			Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
			Study Period	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**
Basic Roadway Data																						
Number of through lanes (n):			8	6	10	10																
Freeway segment description:			Proposed PM	Proposed PM	Proposed PM	Proposed PM																
Segment length (L), mi:			0.11	0.41	0.87	0.25																
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No																
Cross Section Data																						
Lane width (W_l), ft:			11	11	11	11																
Outside shoulder width (W_s), ft:			4	4	4	4																
Inside shoulder width (W_{is}), ft:			10	10	2	2																
Median width (W_m), ft:			23	23	7	7																
Rumble strips on outside shoulders?:			No	No	No	No																
	Length of rumble strips for travel in increasing milepost direction, mi:																					
	Length of rumble strips for travel in decreasing milepost direction, mi:																					
Rumble strips on inside shoulders?:			No	No	No	No																
	Length of rumble strips for travel in increasing milepost direction, mi:																					
	Length of rumble strips for travel in decreasing milepost direction, mi:																					
Presence of barrier in median:			Center	Center	Center	Center																
Median barrier width (W_{ib}), ft:			3	3	3	3																
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30																
Presence of barrier on roadside:			Full	Full	Full	Full																
Distance from edge of traveled w ay to barrier face, increasing milepost ($W_{off,inc}$), ft:			4	4	4	4																
Distance from edge of traveled w ay to barrier face, decreasing milepost ($W_{off,dec}$), ft:			4	4	4	4																
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:			999		999																
	Length of ramp entrance ($L_{en,inc}$), mi:		0.11																			
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:		0.11																			
	Entrance side?:		Right																			
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
	Distance from end milepost to dow nstream exit ramp gore ($X_{e,ext}$), mi:		999		999																	
	Length of ramp exit ($L_{ex,inc}$), mi:																					
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:																					
	Exit side?:																					
Weave	Type B weave in segment?:		No	No	No	No																
	Length of weaving section ($L_{wev,inc}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:			999		999																
	Length of ramp entrance ($L_{en,dec}$), mi:		0.11																			
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:		0.11																			
	Entrance side?:		Right																			
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
	Distance from begin milepost to dow nstream exit ramp gore ($X_{b,ext}$), mi:		999		999																	
	Length of ramp exit ($L_{ex,dec}$), mi:																					
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:																					
	Exit side?:																					
Weave	Type B weave in segment?:		No	No	No	No																
	Length of weaving section ($L_{wev,dec}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1																
Freeway Segment Data		2016	92520	127200	101640	280200																
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016	34680		178560																	
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016		25560		84240																
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016	34680		178560																	
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016		25560		84240																

Northbound: OFF Peak Period, Proposed Conditions, 2040 Volumes, MD 187 to Montrose Rd

		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
		Study Period	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**
Basic Roadway Data																					
Number of through lanes (n):		6	4	8	8																
Freeway segment description:		Proposed OFF	Proposed OFF	Proposed OFF	Proposed OFF																
Segment length (L), mi:		0.11	0.41	0.87	0.25																
Alignment Data																					
Horizontal Curve Data																					
1 Horizontal curve in segment?:		No	No	No	No																
Cross Section Data																					
Lane width (W_l), ft:		11	11	11	11																
Outside shoulder width (W_s), ft:		13	13	13	13																
Inside shoulder width (W_{is}), ft:		10	10	12	12																
Median width (W_m), ft:		23	23	27	27																
Rumble strips on outside shoulders?:		No	No	No	No																
Length of rumble strips for travel in increasing milepost direction, mi:																					
Length of rumble strips for travel in decreasing milepost direction, mi:																					
Rumble strips on inside shoulders?:		No	No	No	No																
Length of rumble strips for travel in increasing milepost direction, mi:																					
Length of rumble strips for travel in decreasing milepost direction, mi:																					
Presence of barrier in median:		Center	Center	Center	Center																
Median barrier width (W_{ib}), ft:		3	3	3	3																
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																					
Roadside Data																					
Clear zone width (W_{hc}), ft:		30	30	30	30																
Presence of barrier on roadside:		Full	Full	Full	Full																
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:		13	13	13	13																
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:		13	13	13	13																
Ramp Access Data																					
Travel in Increasing Milepost Direction																					
Entrance Ramp: Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:			999		999																
Length of ramp entrance ($L_{en,inc}$), mi:		0.11																			
Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:		0.11																			
Entrance side?:		Right																			
Exit Ramp: Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:		999		999																	
Length of ramp exit ($L_{ex,inc}$), mi:																					
Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:																					
Exit side?:																					
Weave: Type B weave in segment?:		No	No	No	No																
Length of weaving section ($L_{wev,inc}$), mi:																					
Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																					
Entrance Ramp: Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	No	Lane Add	No																
Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:			999		999																
Length of ramp entrance ($L_{en,dec}$), mi:		0.11																			
Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:		0.11																			
Entrance side?:		Right																			
Exit Ramp: Ramp exit in segment? (If yes, indicate type.):		No	Lane Drop	No	Lane Drop																
Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:		999		999																	
Length of ramp exit ($L_{ex,dec}$), mi:																					
Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:																					
Exit side?:																					
Weave: Type B weave in segment?:		No	No	No	No																
Length of weaving section ($L_{wev,dec}$), mi:																					
Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data	**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):		1	1	1	1																
Freeway Segment Data	2016	27265	35105	25030	80125																
Entrance Ramp Data for Travel in Increasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:	2016	7840		55095																	
Exit Ramp Data for Travel in Increasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:	2016		10075		29110																
Entrance Ramp Data for Travel in Decreasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:	2016	7840		55095																	
Exit Ramp Data for Travel in Decreasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:	2016		10075		29110																

Northbound: AM Peak Period, Existing Conditions, Existing Volumes, Montrose Rd to MD 121

			Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
			Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period
Basic Roadway Data																						
Number of through lanes (n):			8	8	8	8	8	8	8	8	8	8	6	6	6	6	6	6	6	6	6	6
Freeway segment description:			Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM
Segment length (L), mi:			0.95	1.33	0.35	0.39	0.8	0.85	0.71	1.1	0.51	1.55	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Cross Section Data																						
Lane width (W_l), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Outside shoulder width (W_s), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Inside shoulder width (W_{is}), ft:			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Median width (W_m), ft:			23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Rumble strips on outside shoulders?:			No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Length of rumble strips for travel in increasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
	Length of rumble strips for travel in decreasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Rumble strips on inside shoulders?:			No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Length of rumble strips for travel in increasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
	Length of rumble strips for travel in decreasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Presence of barrier in median:			Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center
Median barrier width (W_{ib}), ft:			3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Presence of barrier on roadside:			Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
	Length of ramp entrance ($L_{en,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
	Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:				999		999		999	999		999					999		999	999		999
	Length of ramp exit ($L_{ex,inc}$), mi:		0.05	0.04		0.07							0.19	0.19	0.19	0.19					0.17	
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:		0.05	0.04		0.07							0.19	0.19	0.19	0.19					0.17	
	Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
	Length of weaving section ($L_{wev,inc}$), mi:										0.51						0.16	0.16				
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:										0.51						0.16	0.16				
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
	Length of ramp entrance ($L_{en,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
	Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:				999		999		999	999		999					999		999	999		999
	Length of ramp exit ($L_{ex,dec}$), mi:		0.05	0.04		0.07							0.19	0.19	0.19	0.19					0.17	
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:		0.05	0.04		0.07							0.19	0.19	0.19	0.19					0.17	
	Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
	Length of weaving section ($L_{wev,dec}$), mi:										0.51						0.16	0.16				
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:										0.51						0.16	0.16				
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Freeway Segment Data		2016	111840	104280	86880	112080	81120	91080	68640	75120	100680	79080	100800	93120	82320	74280	60240	69480	54840	58320	61560	54480
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016			25200		9960		6480	25560		21720					9240		3480	3240		4800
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016	7560	17400		30960		22440			21600		7680	10800	8040	14040		14640			7080	
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016			25200		9960		6480	25560		21720					9240		3480	3240		4800
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016	7560	17400		30960		22440			21600		7680	10800	8040	14040		14640			7080	

Northbound: PM Peak Period, Existing Conditions, Existing Volumes, Montrose Rd to MD 121

			Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
			Study Period	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**
Basic Roadway Data																						
Number of through lanes (n):			8	8	8	8	8	8	8	8	8	8	6	6	6	6	6	6	6	6	6	6
Freeway segment description:			Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM
Segment length (L), mi:			0.95	1.33	0.35	0.39	0.8	0.85	0.71	1.1	0.51	1.55	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Cross Section Data																						
Lane width (W_l), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Outside shoulder width (W_s), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Inside shoulder width (W_{is}), ft:			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Median width (W_m), ft:			23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Rumble strips on outside shoulders?:			No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Length of rumble strips for travel in increasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
	Length of rumble strips for travel in decreasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Rumble strips on inside shoulders?:			No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Length of rumble strips for travel in increasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
	Length of rumble strips for travel in decreasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Presence of barrier in median:			Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center
Median barrier width (W_{ib}), ft:			3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Presence of barrier on roadside:			Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
	Length of ramp entrance ($L_{en,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
	Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:				999		999		999	999		999					999		999	999		999
	Length of ramp exit ($L_{ex,inc}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
	Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
	Length of weaving section ($L_{wev,inc}$), mi:										0.51						0.16	0.16				
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:										0.51						0.16	0.16				
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
	Length of ramp entrance ($L_{en,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
	Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:				999		999		999	999		999					999		999	999		999
	Length of ramp exit ($L_{ex,dec}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
	Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
	Length of weaving section ($L_{wev,dec}$), mi:										0.51						0.16	0.16				
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:										0.51						0.16	0.16				
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Freeway Segment Data		2016	185280	178080	159600	183960	161520	196560	141840	154200	189720	152640	191040	178920	158520	147720	130080	146160	107280	112800	118800	101280
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016			24360		35040		12360	35520		38400					16080		5520	6000		3720
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016	7200	18480		22440		54720			37080		12120	20400	10800	17640		38880			17520	
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016			24360		35040		12360	35520		38400					16080		5520	6000		3720
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016	7200	18480		22440		54720			37080		12120	20400	10800	17640		38880			17520	

Northbound: OFF Peak Period, Existing Conditions, Existing Volumes, Montrose Rd to MD 121

		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
		Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period
Basic Roadway Data																					
Number of through lanes (n):		8	8	8	8	8	8	8	8	8	8	6	6	6	6	6	6	6	6	6	6
Freeway segment description:		Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF
Segment length (L), mi:		0.95	1.33	0.35	0.39	0.8	0.85	0.71	1.1	0.51	1.55	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Alignment Data																					
Horizontal Curve Data																					
1 Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Cross Section Data																					
Lane width (W_l), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Outside shoulder width (W_s), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Inside shoulder width (W_{is}), ft:		10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Median width (W_m), ft:		23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Rumble strips on outside shoulders?:		No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Length of rumble strips for travel in increasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Length of rumble strips for travel in decreasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Rumble strips on inside shoulders?:		No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Length of rumble strips for travel in increasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Length of rumble strips for travel in decreasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Presence of barrier in median:		Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center
Median barrier width (W_{ib}), ft:		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																					
Roadside Data																					
Clear zone width (W_{hc}), ft:		30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Presence of barrier on roadside:		Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Ramp Access Data																					
Travel in Increasing Milepost Direction																					
Entrance Ramp: Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
Length of ramp entrance ($L_{en,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp: Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:				999		999		999	999		999					999		999	999		999
Length of ramp exit ($L_{ex,inc}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave: Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
Length of weaving section ($L_{wev,inc}$), mi:										0.51						0.16	0.16				
Length of weaving section in segment ($L_{wev,seg,inc}$), mi:										0.51						0.16	0.16				
Travel in Decreasing Milepost Direction																					
Entrance Ramp: Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
Length of ramp entrance ($L_{en,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp: Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:				999		999		999	999		999					999		999	999		999
Length of ramp exit ($L_{ex,dec}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave: Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
Length of weaving section ($L_{wev,dec}$), mi:										0.51						0.16	0.16				
Length of weaving section in segment ($L_{wev,seg,dec}$), mi:										0.51						0.16	0.16				
Traffic Data	**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Freeway Segment Data	2016	44410	42605	37815	47920	42245	43870	34290	38410	47800	40035	59205	42770	37130	35680	30865	36835	24340	28155	29470	24480
Entrance Ramp Data for Travel in Increasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:	2016			10105		1625		4120	9390		6860					4215		1985	1315		1610
Exit Ramp Data for Travel in Increasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:	2016	1805	4790		5675		9580			7765		3835	5640	1450	4815		11340			4585	
Entrance Ramp Data for Travel in Decreasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:	2016			10105		1625		4120	9390		6860					4215		1985	1315		1610
Exit Ramp Data for Travel in Decreasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:	2016	1805	4790		5675		9580			7765		3835	5640	1450	4815		11340			4585	

Northbound: AM Peak Period, Proposed Conditions, Existing Volumes, Montrose Rd to MD 121

			Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
			Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period
Basic Roadway Data																						
Number of through lanes (n):			8	8	8	8	8	8	8	8	8	8	6	6	6	6	6	6	6	6	6	6
Freeway segment description:			Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM
Segment length (L), mi:			0.95	1.33	0.35	0.39	0.8	0.85	0.71	1.1	0.51	1.55	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Cross Section Data																						
Lane width (W_l), ft:			11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Outside shoulder width (W_s), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Inside shoulder width (W_{is}), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Median width (W_m), ft:			29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
Rumble strips on outside shoulders?:			No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Length of rumble strips for travel in increasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
	Length of rumble strips for travel in decreasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Rumble strips on inside shoulders?:			No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Length of rumble strips for travel in increasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
	Length of rumble strips for travel in decreasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Presence of barrier in median:			Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center
Median barrier width (W_{ib}), ft:			3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Presence of barrier on roadside:			Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
	Length of ramp entrance ($L_{en,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
	Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:				999		999		999	999		999					999		999	999		999
	Length of ramp exit ($L_{ex,inc}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
	Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
	Length of weaving section ($L_{wev,inc}$), mi:										0.51						0.16	0.16				
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:										0.51						0.16	0.16				
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
	Length of ramp entrance ($L_{en,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
	Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:				999		999		999	999		999					999		999	999		999
	Length of ramp exit ($L_{ex,dec}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
	Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
	Length of weaving section ($L_{wev,dec}$), mi:										0.51						0.16	0.16				
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:										0.51						0.16	0.16				
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Freeway Segment Data		2016	111840	104280	86880	112080	81120	91080	68640	75120	100680	79080	100800	93120	82320	74280	60240	69480	54840	58320	61560	54480
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016			25200		9960		6480	25560		21720					9240		3480	3240		4800
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016	7560	17400		30960		22440			21600		7680	10800	8040	14040		14640			7080	
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016			25200		9960		6480	25560		21720					9240		3480	3240		4800
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016	7560	17400		30960		22440			21600		7680	10800	8040	14040		14640			7080	

Northbound: PM Peak Period, Proposed Conditions, Existing Volumes, Montrose Rd to MD 121

			Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
			Study Period	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**
Basic Roadway Data																						
Number of through lanes (n):			10	10	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8	8	8
Freeway segment description:			Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM
Segment length (L), mi:			0.95	1.33	0.35	0.39	0.8	0.85	0.71	1.1	0.51	1.55	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Cross Section Data																						
Lane width (W_l), ft:			11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Outside shoulder width (W_s), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Inside shoulder width (W_{is}), ft:			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Median width (W_m), ft:			7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Rumble strips on outside shoulders?:			No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Length of rumble strips for travel in increasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
	Length of rumble strips for travel in decreasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Rumble strips on inside shoulders?:			No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Length of rumble strips for travel in increasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
	Length of rumble strips for travel in decreasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Presence of barrier in median:			Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center
Median barrier width (W_{ib}), ft:			3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Presence of barrier on roadside:			Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
	Length of ramp entrance ($L_{en,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
	Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:				999		999		999	999		999					999		999	999		999
	Length of ramp exit ($L_{ex,inc}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
	Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
	Length of weaving section ($L_{wev,inc}$), mi:										0.51						0.16	0.16				
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:										0.51						0.16	0.16				
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
	Length of ramp entrance ($L_{en,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
	Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:				999		999		999	999		999					999		999	999		999
	Length of ramp exit ($L_{ex,dec}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
	Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
	Length of weaving section ($L_{wev,dec}$), mi:										0.51						0.16	0.16				
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:										0.51						0.16	0.16				
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Freeway Segment Data		2016	185280	178080	159600	183960	161520	196560	141840	154200	189720	152640	191040	178920	158520	147720	130080	146160	107280	112800	118800	101280
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016			24360		35040		12360	35520		38400					16080		5520	6000		3720
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016	7200	18480		22440	54720	54720			37080		12120	20400	10800	17640		38880			17520	
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016			24360		35040		12360	35520		38400					16080		5520	6000		3720
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016	7200	18480		22440		54720			37080		12120	20400	10800	17640		38880			17520	

Northbound: OFF Peak Period, Proposed Conditions, Existing Volumes, Montrose Rd to MD 121

		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
		Study Period	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**
Basic Roadway Data																					
Number of through lanes (n):		8	8	8	8	8	8	8	8	8	8	6	6	6	6	6	6	6	6	6	6
Freeway segment description:		Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF
Segment length (L), mi:		0.95	1.33	0.35	0.39	0.8	0.85	0.71	1.1	0.51	1.55	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Alignment Data																					
Horizontal Curve Data																					
1 Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Cross Section Data																					
Lane width (W_l), ft:		11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Outside shoulder width (W_s), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Inside shoulder width (W_{is}), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Median width (W_m), ft:		23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Rumble strips on outside shoulders?:		No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Length of rumble strips for travel in increasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Length of rumble strips for travel in decreasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Rumble strips on inside shoulders?:		No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Length of rumble strips for travel in increasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Length of rumble strips for travel in decreasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Presence of barrier in median:		Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center
Median barrier width (W_{ib}), ft:		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																					
Roadside Data																					
Clear zone width (W_{hc}), ft:		30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Presence of barrier on roadside:		Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Ramp Access Data																					
Travel in Increasing Milepost Direction																					
Entrance Ramp: Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
Length of ramp entrance ($L_{en,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp: Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:				999		999		999	999		999					999		999	999		999
Length of ramp exit ($L_{ex,inc}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave: Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
Length of weaving section ($L_{wev,inc}$), mi:										0.51						0.16	0.16				
Length of weaving section in segment ($L_{wev,seg,inc}$), mi:										0.51						0.16	0.16				
Travel in Decreasing Milepost Direction																					
Entrance Ramp: Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
Length of ramp entrance ($L_{en,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp: Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:				999		999		999	999		999					999		999	999		999
Length of ramp exit ($L_{ex,dec}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave: Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
Length of weaving section ($L_{wev,dec}$), mi:										0.51						0.16	0.16				
Length of weaving section in segment ($L_{wev,seg,dec}$), mi:										0.51						0.16	0.16				
Traffic Data	**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Freeway Segment Data	2016	44410	42605	37815	47920	42245	43870	34290	38410	47800	40035	59205	42770	37130	35680	30865	36835	24340	28155	29470	24480
Entrance Ramp Data for Travel in Increasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:	2016			10105		1625		4120	9390		6860					4215		1985	1315		1610
Exit Ramp Data for Travel in Increasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:	2016	1805	4790		5675		9580			7765		3835	5640	1450	4815		11340			4585	
Entrance Ramp Data for Travel in Decreasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:	2016			10105		1625		4120	9390		6860					4215		1985	1315		1610
Exit Ramp Data for Travel in Decreasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:	2016	1805	4790		5675		9580			7765		3835	5640	1450	4815		11340			4585	

Northbound: AM Peak Period, Existing Conditions, 2040 Volumes, Montrose Rd to MD 121

			Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
			Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period
Basic Roadway Data																						
Number of through lanes (n):			8	8	8	8	8	8	8	8	8	8	6	6	6	6	6	6	6	6	6	6
Freeway segment description:			Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM
Segment length (L), mi:			0.95	1.33	0.35	0.39	0.8	0.85	0.71	1.1	0.51	1.55	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Cross Section Data																						
Lane width (W_l), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Outside shoulder width (W_s), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Inside shoulder width (W_{is}), ft:			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Median width (W_m), ft:			23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Rumble strips on outside shoulders?:			No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Length of rumble strips for travel in increasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
	Length of rumble strips for travel in decreasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Rumble strips on inside shoulders?:			No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Length of rumble strips for travel in increasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
	Length of rumble strips for travel in decreasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Presence of barrier in median:			Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center
Median barrier width (W_{ib}), ft:			3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Presence of barrier on roadside:			Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
	Length of ramp entrance ($L_{en,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
	Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:				999		999		999	999		999					999		999	999		999
	Length of ramp exit ($L_{ex,inc}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
	Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
	Length of weaving section ($L_{wev,inc}$), mi:										0.51						0.16	0.16				
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:										0.51						0.16	0.16				
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
	Length of ramp entrance ($L_{en,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
	Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:				999		999		999	999		999					999		999	999		999
	Length of ramp exit ($L_{ex,dec}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
	Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
	Length of weaving section ($L_{wev,dec}$), mi:										0.51						0.16	0.16				
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:										0.51						0.16	0.16				
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Freeway Segment Data		2016	123000	114960	96240	125520	93000	104280	80040	86880	114480	85320	116160	108240	97200	88200	71880	83040	67200	73320	77040	56040
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016			29280		11280		6840	27600		15840					11160		6120	3720		13200
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016	8040	18720		32520		24240			29160		7920	11040	9000	16320		15840			21000	
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016			29280		11280		6840	27600		15840					11160		6120	3720		13200
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016	8040	18720		32520		24240			29160		7920	11040	9000	16320		15840			21000	

Northbound: PM Peak Period, Existing Conditions, 2040 Volumes, Montrose Rd to MD 121

		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
		Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period
Basic Roadway Data																					
Number of through lanes (n):		8	8	8	8	8	8	8	8	8	8	6	6	6	6	6	6	6	6	6	6
Freeway segment description:		Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM
Segment length (L), mi:		0.95	1.33	0.35	0.39	0.8	0.85	0.71	1.1	0.51	1.55	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Alignment Data																					
Horizontal Curve Data																					
1 Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Cross Section Data																					
Lane width (W_l), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Outside shoulder width (W_s), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Inside shoulder width (W_{is}), ft:		10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Median width (W_m), ft:		23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Rumble strips on outside shoulders?:		No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Length of rumble strips for travel in increasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Length of rumble strips for travel in decreasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Rumble strips on inside shoulders?:		No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Length of rumble strips for travel in increasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Length of rumble strips for travel in decreasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Presence of barrier in median:		Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center
Median barrier width (W_{ib}), ft:		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																					
Roadside Data																					
Clear zone width (W_{hc}), ft:		30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Presence of barrier on roadside:		Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Ramp Access Data																					
Travel in Increasing Milepost Direction																					
Entrance Ramp: Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
Length of ramp entrance ($L_{en,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp: Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:				999		999		999	999		999					999		999	999		999
Length of ramp exit ($L_{ex,inc}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave: Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
Length of weaving section ($L_{wev,inc}$), mi:										0.51						0.16	0.16				
Length of weaving section in segment ($L_{wev,seg,inc}$), mi:										0.51						0.16	0.16				
Travel in Decreasing Milepost Direction																					
Entrance Ramp: Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
Length of ramp entrance ($L_{en,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp: Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:				999		999		999	999		999					999		999	999		999
Length of ramp exit ($L_{ex,dec}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave: Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
Length of weaving section ($L_{wev,dec}$), mi:										0.51						0.16	0.16				
Length of weaving section in segment ($L_{wev,seg,dec}$), mi:										0.51						0.16	0.16				
Traffic Data	**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Freeway Segment Data	2016	195960	188280	168840	194760	171120	290880	152400	165720	203040	155520	217800	205320	183360	171720	151680	170400	128280	136320	142800	102000
Entrance Ramp Data for Travel in Increasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:	2016			25920		38760		13320	37320		30480					18720		8040	6480		13200
Exit Ramp Data for Travel in Increasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:	2016	7680	19440		23640		57480			47520		12480	21960	11640	20040		42120			40800	
Entrance Ramp Data for Travel in Decreasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:	2016			25920		38760		13320	37320		30480					18720		8040	6480		13200
Exit Ramp Data for Travel in Decreasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:	2016	7680	19440		23640		57480			47520		12480	21960	11640	20040		42120			40800	

Northbound: OFF Peak Period, Existing Conditions, 2040 Volumes, Montrose Rd to MD 121

		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
		Study Period	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**
Basic Roadway Data																					
Number of through lanes (n):		8	8	8	8	8	8	8	8	8	8	6	6	6	6	6	6	6	6	6	6
Freeway segment description:		Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF
Segment length (L), mi:		0.95	1.33	0.35	0.39	0.8	0.85	0.71	1.1	0.51	1.55	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Alignment Data																					
Horizontal Curve Data																					
1 Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Cross Section Data																					
Lane width (W_l), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Outside shoulder width (W_s), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Inside shoulder width (W_{is}), ft:		10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Median width (W_m), ft:		23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Rumble strips on outside shoulders?:		No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Length of rumble strips for travel in increasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Length of rumble strips for travel in decreasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Rumble strips on inside shoulders?:		No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Length of rumble strips for travel in increasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Length of rumble strips for travel in decreasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Presence of barrier in median:		Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center
Median barrier width (W_{ib}), ft:		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																					
Roadside Data																					
Clear zone width (W_{hc}), ft:		30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Presence of barrier on roadside:		Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Ramp Access Data																					
Travel in Increasing Milepost Direction																					
Entrance Ramp — Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
Length of ramp entrance ($L_{en,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp — Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:				999		999		999	999		999					999		999	999		999
Length of ramp exit ($L_{ex,inc}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave — Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
Length of weaving section ($L_{wev,inc}$), mi:										0.51						0.16	0.16				
Length of weaving section in segment ($L_{wev,seg,inc}$), mi:										0.51						0.16	0.16				
Travel in Decreasing Milepost Direction																					
Entrance Ramp — Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
Length of ramp entrance ($L_{en,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp — Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:				999		999		999	999		999					999		999	999		999
Length of ramp exit ($L_{ex,dec}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave — Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
Length of weaving section ($L_{wev,dec}$), mi:										0.51						0.16	0.16				
Length of weaving section in segment ($L_{wev,seg,dec}$), mi:										0.51						0.16	0.16				
Traffic Data	**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Freeway Segment Data	2016	51305	49170	43740	55090	48410	50255	37420	42000	52585	41770	69560	51150	44385	42570	36000	43550	29420	35495	36670	25805
Entrance Ramp Data for Travel in Increasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:	2016			11350		1845		4580	10585		6210					5510		4095	1175		5250
Exit Ramp Data for Travel in Increasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:	2016	2135	5430		6680		12835			10815		3890	6765	1815	6570		12735			10400	
Entrance Ramp Data for Travel in Decreasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:	2016			11350		1845		4580	10585		6210					5510		4095	1175		5250
Exit Ramp Data for Travel in Decreasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:	2016	2135	5430		6680		12835			10815		3890	6765	1815	6570		12735			10400	

Northbound: AM Peak Period, Proposed Conditions, 2040 Volumes, Montrose Rd to MD 121

			Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
			Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period
Basic Roadway Data																						
Number of through lanes (n):			8	8	8	8	8	8	8	8	8	8	6	6	6	6	6	6	6	6	6	6
Freeway segment description:			Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM
Segment length (L), mi:			0.95	1.33	0.35	0.39	0.8	0.85	0.71	1.1	0.51	1.55	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Cross Section Data																						
Lane width (W_l), ft:			11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Outside shoulder width (W_s), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Inside shoulder width (W_{is}), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Median width (W_m), ft:			29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
Rumble strips on outside shoulders?:			No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Length of rumble strips for travel in increasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
	Length of rumble strips for travel in decreasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Rumble strips on inside shoulders?:			No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Length of rumble strips for travel in increasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
	Length of rumble strips for travel in decreasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Presence of barrier in median:			Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center
Median barrier width (W_{ib}), ft:			3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Presence of barrier on roadside:			Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
	Length of ramp entrance ($L_{en,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
	Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:				999		999		999	999		999					999		999	999		999
	Length of ramp exit ($L_{ex,inc}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
	Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
	Length of weaving section ($L_{wev,inc}$), mi:										0.51						0.16	0.16				
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:										0.51						0.16	0.16				
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
	Length of ramp entrance ($L_{en,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
	Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
	Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:				999		999		999	999		999					999		999	999		999
	Length of ramp exit ($L_{ex,dec}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
	Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
	Length of weaving section ($L_{wev,dec}$), mi:										0.51						0.16	0.16				
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:										0.51						0.16	0.16				
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Freeway Segment Data		2016	123000	114960	96240	125520	93000	104280	80040	86880	114480	85320	116160	108240	97200	88200	71880	83040	67200	73320	77040	56040
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016			29280		11280		6840	27600		15840					11160		6120	3720		13200
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016	8040	18720		32520		24240			29160		7920	11040	9000	16320		15840			21000	
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016			29280		11280		6840	27600		15840					11160		6120	3720		13200
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016	8040	18720		32520		24240			29160		7920	11040	9000	16320		15840			21000	

Northbound: PM Peak Period, Proposed Conditions, 2040 Volumes, Montrose Rd to MD 121

		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
		Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period
Basic Roadway Data																					
Number of through lanes (n):		10	10	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8	8	8
Freeway segment description:		Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM
Segment length (L), mi:		0.95	1.33	0.35	0.39	0.8	0.85	0.71	1.1	0.51	1.55	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Alignment Data																					
Horizontal Curve Data																					
1 Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Cross Section Data																					
Lane width (W_l), ft:		11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Outside shoulder width (W_s), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Inside shoulder width (W_{is}), ft:		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Median width (W_m), ft:		7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Rumble strips on outside shoulders?:		No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Length of rumble strips for travel in increasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Length of rumble strips for travel in decreasing milepost direction, mi:									1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Rumble strips on inside shoulders?:		No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Length of rumble strips for travel in increasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Length of rumble strips for travel in decreasing milepost direction, mi:										0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Presence of barrier in median:		Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center
Median barrier width (W_{ib}), ft:		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																					
Roadside Data																					
Clear zone width (W_{hc}), ft:		30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Presence of barrier on roadside:		Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Ramp Access Data																					
Travel in Increasing Milepost Direction																					
Entrance Ramp: Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
Length of ramp entrance ($L_{en,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp: Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:				999		999		999	999		999					999		999	999		999
Length of ramp exit ($L_{ex,inc}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave: Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
Length of weaving section ($L_{wev,inc}$), mi:										0.51						0.16	0.16				
Length of weaving section in segment ($L_{wev,seg,inc}$), mi:										0.51						0.16	0.16				
Travel in Decreasing Milepost Direction																					
Entrance Ramp: Ramp entrance in segment? (If yes, indicate type.):		No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:		999	999		999		999			999		999	999	999	999		999			999	
Length of ramp entrance ($L_{en,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:				0.18				0.19			0.19							0.15	0.15		0.17
Entrance side?:				Right				Right			Right							Right	Right		Right
Exit Ramp: Ramp exit in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:				999		999		999	999		999					999		999	999		999
Length of ramp exit ($L_{ex,dec}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:		0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
Exit side?:		Right	Right		Right							Right	Right	Right	Right					Right	
Weave: Type B weave in segment?:		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
Length of weaving section ($L_{wev,dec}$), mi:										0.51						0.16	0.16				
Length of weaving section in segment ($L_{wev,seg,dec}$), mi:										0.51						0.16	0.16				
Traffic Data	**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Freeway Segment Data	2016	195960	188280	168840	194760	171120	209880	152400	165720	203040	155520	217800	205320	183360	171720	151680	170400	128280	136320	142800	102000
Entrance Ramp Data for Travel in Increasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:	2016			25920		38760		13320	37320		30480					18720		8040	6480		13200
Exit Ramp Data for Travel in Increasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:	2016	7680	19440		23640	54720	57480			47520		12480	21960	11640	20040		42120			40800	
Entrance Ramp Data for Travel in Decreasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:	2016			25920		38760		13320	37320		30480					18720		8040	6480		13200
Exit Ramp Data for Travel in Decreasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:	2016	7680	19440		23640		57480			47520		12480	21960	11640	20040		42120			40800	

Northbound: OFF Peak Period, Proposed Conditions, 2040 Volumes, Montrose Rd to MD 121

		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
		Study Period	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**
Basic Roadway Data																					
Number of through lanes (n):		8	8	8	8	8	8	8	8	8	8	6	6	6	6	6	6	6	6	6	6
Freeway segment description:		roposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	ProposedOF	Proposed OF	Proposed OF	Proposed OF	ProposedOF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF
Segment length (L), mi:		0.95	1.33	0.35	0.39	0.8	0.85	0.71	1.1	0.51	1.55	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Alignment Data																					
Horizontal Curve Data																					
1	Horizontal curve in segment?:	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Cross Section Data																					
Lane width (W_l), ft:		11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Outside shoulder width (W_s), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Inside shoulder width (W_{is}), ft:		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Median width (W_m), ft:		7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Rumble strips on outside shoulders?:		No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Length of rumble strips for travel in increasing milepost direction, mi:								1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
	Length of rumble strips for travel in decreasing milepost direction, mi:								1.1	0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Rumble strips on inside shoulders?:		No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Length of rumble strips for travel in increasing milepost direction, mi:									0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
	Length of rumble strips for travel in decreasing milepost direction, mi:									0.51	1.42	1.73	0.23	0.46	0.29	0.3	0.34	0.35	0.23	2.21	0.23
Presence of barrier in median:		Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center
Median barrier width (W_{ib}), ft:		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																					
Roadside Data																					
Clear zone width (W_{hc}), ft:		30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Presence of barrier on roadside:		Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Ramp Access Data																					
Travel in Increasing Milepost Direction																					
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):	No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:	999	999		999		999			999		999	999	999	999		999			999	
	Length of ramp entrance ($L_{en,inc}$), mi:			0.18				0.19			0.19							0.15	0.15		0.17
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:			0.18				0.19			0.19							0.15	0.15		0.17
	Entrance side?:			Right				Right			Right							Right	Right		Right
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):	S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
	Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:			999		999		999	999		999					999		999	999		999
	Length of ramp exit ($L_{ex,inc}$), mi:	0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:	0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
	Exit side?:	Right	Right		Right							Right	Right	Right	Right					Right	
Weave	Type B weave in segment?:	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
	Length of weaving section ($L_{wev,inc}$), mi:									0.51						0.16	0.16				
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:									0.51						0.16	0.16				
Travel in Decreasing Milepost Direction																					
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):	No	No	S-C Lane	No	Lane Add	No	S-C Lane	Lane Add	No	S-C Lane	No	No	No	No	Lane Add	No	S-C Lane	S-C Lane	No	S-C Lane
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:	999	999		999		999			999		999	999	999	999		999			999	
	Length of ramp entrance ($L_{en,dec}$), mi:			0.18				0.19			0.19							0.15	0.15		0.17
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:			0.18				0.19			0.19							0.15	0.15		0.17
	Entrance side?:			Right				Right			Right							Right	Right		Right
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):	S-C Lane	S-C Lane	No	S-C Lane	No	Lane Drop	No	No	Lane Drop	No	S-C Lane	S-C Lane	S-C Lane	S-C Lane	No	Lane Drop	No	No	S-C Lane	No
	Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:			999		999		999	999		999					999		999	999		999
	Length of ramp exit ($L_{ex,dec}$), mi:	0.05	0.04		0.07							0.19	0.14	0.11	0.3					0.17	
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:	0.05	0.04		0.07							0.19	0.14	0.11	0.29					0.17	
	Exit side?:	Right	Right		Right							Right	Right	Right	Right					Right	
Weave	Type B weave in segment?:	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
	Length of weaving section ($L_{wev,dec}$), mi:									0.51						0.16	0.16				
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:									0.51						0.16	0.16				
Traffic Data	**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Freeway Segment Data	2016	51305	49170	43740	55090	48410	50255	37420	42000	52585	41770	69560	51150	44385	42570	36000	43550	29420	35495	36670	25805
Entrance Ramp Data for Travel in Increasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:	2016			11350		1845		4580	10585		6210					5510		4095	1175		5250
Exit Ramp Data for Travel in Increasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:	2016	2135	5430		6680		12835			10815		3890	6765	1815	6570		12735			10400	
Entrance Ramp Data for Travel in Decreasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:	2016			11350		1845		4580	10585		6210					5510		4095	1175		5250
Exit Ramp Data for Travel in Decreasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:	2016	2135	5430		6680		12835			10815		3890	6765	1815	6570		12735			10400	

Southbound: AM Peak Period, Existing Conditions, Existing Volumes

			Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
			Study Period	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**
Basic Roadway Data																						
Number of through lanes (n):			8	8	8	8	8	8	8	8	8	8	8	8	8							
Freeway segment description:			Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM							
Segment length (L), mi:			0.46	0.23	0.87	0.79	0.57	0.61	0.68	0.64	0.61	0.63	1.6	0.91	0.8							
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
Cross Section Data																						
Lane width (W_l), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Outside shoulder width (W_s), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Inside shoulder width (W_{is}), ft:			9	9	9	9	9	9	9	9	9	9	9	9	9							
Median width (W_m), ft:			21	21	21	21	21	21	21	21	21	21	21	21	21							
Rumble strips on outside shoulders?:			Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No							
	Length of rumble strips for travel in increasing milepost direction, mi:		0.46	0.23	0.87	0.79	0.57															
	Length of rumble strips for travel in decreasing milepost direction, mi:		0.46	0.23	0.87	0.79	0.57															
Rumble strips on inside shoulders?:			Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No							
	Length of rumble strips for travel in increasing milepost direction, mi:		0.46	0.23	0.87	0.46																
	Length of rumble strips for travel in decreasing milepost direction, mi:		0.46	0.23	0.87	0.46																
Presence of barrier in median:			Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center							
Median barrier width (W_{ib}), ft:			3	3	3	3	3	3	3	3	3	3	3	3	3							
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30	30	30	30	30	30	30	30	30	30							
Presence of barrier on roadside:			Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full							
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:		999			999	999		999			999			999							
	Length of ramp entrance ($L_{en,inc}$), mi:			0.21				0.27		0.16	0.19		0.19									
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:			0.21				0.27		0.16	0.19		0.19									
	Entrance side?:			Right				Right		Right	Right		Right									
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		Lane Drop	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
	Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:			999	999		999	999		999	999		999	999	999							
	Length of ramp exit ($L_{ex,inc}$), mi:						0.3		0.05			0.04										
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:						0.3		0.05			0.04										
	Exit side?:						Right		Right			Right										
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
	Length of weaving section ($L_{wev,inc}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:		999			999	999		999			999			999							
	Length of ramp entrance ($L_{en,dec}$), mi:			0.21				0.27		0.16	0.19		0.19									
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:			0.21				0.27		0.16	0.19		0.19									
	Entrance side?:			Right				Right		Right	Right		Right									
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		Lane Drop	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
	Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:			999	999		999	999		999	999		999	999	999							
	Length of ramp exit ($L_{ex,dec}$), mi:						0.3		0.05			0.04										
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:						0.3		0.05			0.04										
	Exit side?:						Right		Right			Right										
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
	Length of weaving section ($L_{wev,dec}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1	1	1	1	1	1	1	1	1	1							
Freeway Segment Data		2016	165000	141480	175800	215760	152760	97800	131280	112560	126360	150000	136800	171240	258720							
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016		34320	39960			33480		13800	23640		34440	87480								
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016	23520			63000	54960		18720			13200										
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016		34320	39960			33480		13800	23640		34440	87480								
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016	23520			63000	54960		18720			13200										

Southbound: PM Peak Period, Existing Conditions, Existing Volumes

			Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
			Study Period	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**
Basic Roadway Data																						
Number of through lanes (n):			8	8	8	8	8	8	8	8	8	8	8	8	8							
Freeway segment description:			Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM							
Segment length (L), mi:			0.46	0.23	0.87	0.79	0.57	0.61	0.68	0.64	0.61	0.63	1.6	0.91	0.8							
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
Cross Section Data																						
Lane width (W_l), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Outside shoulder width (W_s), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Inside shoulder width (W_{is}), ft:			9	9	9	9	9	9	9	9	9	9	9	9	9							
Median width (W_m), ft:			21	21	21	21	21	21	21	21	21	21	21	21	21							
Rumble strips on outside shoulders?:			Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No							
	Length of rumble strips for travel in increasing milepost direction, mi:		0.46	0.23	0.87	0.79	0.57															
	Length of rumble strips for travel in decreasing milepost direction, mi:		0.46	0.23	0.87	0.79	0.57															
Rumble strips on inside shoulders?:			Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No							
	Length of rumble strips for travel in increasing milepost direction, mi:		0.46	0.23	0.87	0.46																
	Length of rumble strips for travel in decreasing milepost direction, mi:		0.46	0.23	0.87	0.46																
Presence of barrier in median:			Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center							
Median barrier width (W_{ib}), ft:			3	3	3	3	3	3	3	3	3	3	3	3	3							
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30	30	30	30	30	30	30	30	30	30							
Presence of barrier on roadside:			Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full							
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:		999			999	999		999			999			999							
	Length of ramp entrance ($L_{en,inc}$), mi:			0.21				0.27		0.16	0.19		0.19									
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:			0.21				0.27		0.16	0.19		0.19									
	Entrance side?:			Right				Right		Right	Right		Right									
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		Lane Drop	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
	Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:			999	999		999	999		999	999		999	999	999							
	Length of ramp exit ($L_{ex,inc}$), mi:						0.3		0.05			0.04										
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:						0.3		0.05			0.04										
	Exit side?:						Right		Right			Right										
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
	Length of weaving section ($L_{wev,inc}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:		999			999	999		999			999			999							
	Length of ramp entrance ($L_{en,dec}$), mi:			0.21				0.27		0.16	0.19		0.19									
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:			0.21				0.27		0.16	0.19		0.19									
	Entrance side?:			Right				Right		Right	Right		Right									
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		Lane Drop	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
	Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:			999	999		999	999		999	999		999	999	999							
	Length of ramp exit ($L_{ex,dec}$), mi:						0.3		0.05			0.04										
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:						0.3		0.05			0.04										
	Exit side?:						Right		Right			Right										
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
	Length of weaving section ($L_{wev,dec}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1	1	1	1	1	1	1	1	1	1							
Freeway Segment Data		2016	115800	90840	122880	159240	103440	81600	113880	101520	121200	125640	110760	132360	177600							
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016		32040	36360			32280		19680	4440		21600	45240								
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016	24960			55800	21840		12360			14880										
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016		32040	36360			32280		19680	4440		21600	45240								
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016	24960			55800	21840		12360			14880										

Southbound: OFF Peak Period, Existing Conditions, Existing Volumes

			Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
			Study Period	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**
Basic Roadway Data																						
Number of through lanes (n):			8	8	8	8	8	8	8	8	8	8	8	8	8							
Freeway segment description:			Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF							
Segment length (L), mi:			0.46	0.23	0.87	0.79	0.57	0.61	0.68	0.64	0.61	0.63	1.6	0.91	0.8							
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
Cross Section Data																						
Lane width (W_l), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Outside shoulder width (W_s), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Inside shoulder width (W_{is}), ft:			9	9	9	9	9	9	9	9	9	9	9	9	9							
Median width (W_m), ft:			21	21	21	21	21	21	21	21	21	21	21	21	21							
Rumble strips on outside shoulders?:			Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No							
	Length of rumble strips for travel in increasing milepost direction, mi:		0.46	0.23	0.87	0.79	0.57															
	Length of rumble strips for travel in decreasing milepost direction, mi:		0.46	0.23	0.87	0.79	0.57															
Rumble strips on inside shoulders?:			Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No							
	Length of rumble strips for travel in increasing milepost direction, mi:		0.46	0.23	0.87	0.46																
	Length of rumble strips for travel in decreasing milepost direction, mi:		0.46	0.23	0.87	0.46																
Presence of barrier in median:			Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center							
Median barrier width (W_{ib}), ft:			3	3	3	3	3	3	3	3	3	3	3	3	3							
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30	30	30	30	30	30	30	30	30	30							
Presence of barrier on roadside:			Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full							
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:		999			999	999		999			999			999							
	Length of ramp entrance ($L_{en,inc}$), mi:			0.21				0.27		0.16	0.19		0.19									
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:			0.21				0.27		0.16	0.19		0.19									
	Entrance side?:			Right				Right		Right	Right		Right									
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		Lane Drop	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
	Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:			999	999		999	999		999	999		999	999	999							
	Length of ramp exit ($L_{ex,inc}$), mi:						0.3		0.05			0.04										
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:						0.3		0.05			0.04										
	Exit side?:						Right		Right			Right										
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
	Length of weaving section ($L_{wev,inc}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:		999			999	999		999			999			999							
	Length of ramp entrance ($L_{en,dec}$), mi:			0.21				0.27		0.16	0.19		0.19									
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:			0.21				0.27		0.16	0.19		0.19									
	Entrance side?:			Right				Right		Right	Right		Right									
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		Lane Drop	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
	Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:			999	999		999	999		999	999		999	999	999							
	Length of ramp exit ($L_{ex,dec}$), mi:						0.3		0.05			0.04										
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:						0.3		0.05			0.04										
	Exit side?:						Right		Right			Right										
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
	Length of weaving section ($L_{wev,dec}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1	1	1	1	1	1	1	1	1	1							
Freeway Segment Data		2016	42400	34685	45665	53900	42350	37150	43205	40090	45205	45995	41455	49650	67385							
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016		10980	8235			6055		5115	790		8195	17735								
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016	7715			11550	5200		3115			4540										
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016		10980	8235			6055		5115	790		8195	17735								
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016	7715			11550	5200		3115			4540										

Southbound: AM Peak Period, Proposed Conditions, Existing Volumes

		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
		Study Period	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**
Basic Roadway Data																					
Number of through lanes (n):		10	10	10	10	10	10	10	10	10	10	10	10	10							
Freeway segment description:		Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM							
Segment length (L), mi:		0.46	0.23	0.87	0.79	0.57	0.61	0.68	0.64	0.61	0.63	1.6	0.91	0.8							
Alignment Data																					
Horizontal Curve Data																					
1 Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
Cross Section Data																					
Lane width (W_l), ft:		11	11	11	11	11	11	11	11	11	11	11	11	11							
Outside shoulder width (W_s), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12							
Inside shoulder width (W_{is}), ft:		2	2	2	2	2	2	2	2	2	2	2	2	2							
Median width (W_m), ft:		7	7	7	7	7	7	7	7	7	7	7	7	7							
Rumble strips on outside shoulders?:		Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No							
Length of rumble strips for travel in increasing milepost direction, mi:		0.46	0.23	0.87	0.79	0.57															
Length of rumble strips for travel in decreasing milepost direction, mi:		0.46	0.23	0.87	0.79	0.57															
Rumble strips on inside shoulders?:		Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No							
Length of rumble strips for travel in increasing milepost direction, mi:		0.46	0.23	0.87	0.46																
Length of rumble strips for travel in decreasing milepost direction, mi:		0.46	0.23	0.87	0.46																
Presence of barrier in median:		Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center							
Median barrier width (W_{ib}), ft:		3	3	3	3	3	3	3	3	3	3	3	3	3							
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																					
Roadside Data																					
Clear zone width (W_{hc}), ft:		30	30	30	30	30	30	30	30	30	30	30	30	30							
Presence of barrier on roadside:		Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full							
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12							
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12							
Ramp Access Data																					
Travel in Increasing Milepost Direction																					
Entrance Ramp — Ramp entrance in segment? (If yes, indicate type.):		No	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:		999			999	999		999			999			999							
Length of ramp entrance ($L_{en,inc}$), mi:			0.21				0.27		0.16	0.19		0.19									
Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:			0.21				0.27		0.16	0.19		0.19									
Entrance side?:			Right				Right		Right	Right		Right									
Exit Ramp — Ramp exit in segment? (If yes, indicate type.):		Lane Drop	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:			999	999		999	999		999	999		999	999	999							
Length of ramp exit ($L_{ex,inc}$), mi:						0.3		0.05			0.04										
Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:						0.3		0.05			0.04										
Exit side?:						Right		Right			Right										
Weave — Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
Length of weaving section ($L_{wev,inc}$), mi:																					
Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																					
Entrance Ramp — Ramp entrance in segment? (If yes, indicate type.):		No	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:		999			999	999		999			999			999							
Length of ramp entrance ($L_{en,dec}$), mi:			0.21				0.27		0.16	0.19		0.19									
Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:			0.21				0.27		0.16	0.19		0.19									
Entrance side?:			Right				Right		Right	Right		Right									
Exit Ramp — Ramp exit in segment? (If yes, indicate type.):		Lane Drop	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:			999	999		999	999		999	999		999	999	999							
Length of ramp exit ($L_{ex,dec}$), mi:						0.3		0.05			0.04										
Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:						0.3		0.05			0.04										
Exit side?:						Right		Right			Right										
Weave — Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
Length of weaving section ($L_{wev,dec}$), mi:																					
Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data	**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):		1	1	1	1	1	1	1	1	1	1	1	1	1							
Freeway Segment Data	2016	165000	141480	175800	215760	152760	97800	131280	112560	126360	150000	136800	171240	258720							
Entrance Ramp Data for Travel in Increasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:	2016		34320	39960			33480		13800	23640		34440	87480								
Exit Ramp Data for Travel in Increasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:	2016	23520			63000	54960		18720			13200										
Entrance Ramp Data for Travel in Decreasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:	2016		34320	39960			33480		13800	23640		34440	87480								
Exit Ramp Data for Travel in Decreasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:	2016	23520			63000	54960		18720			13200										

Southbound: PM Peak Period, Proposed Conditions, Existing Volumes

			Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
			Study Period	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**
Basic Roadway Data																						
Number of through lanes (n):			10	10	10	10	10	10	10	10	10	10	10	10	10							
Freeway segment description:			Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM							
Segment length (L), mi:			0.46	0.23	0.87	0.79	0.57	0.61	0.68	0.64	0.61	0.63	1.6	0.91	0.8							
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
Cross Section Data																						
Lane width (W_l), ft:			11	11	11	11	11	11	11	11	11	11	11	11	11							
Outside shoulder width (W_s), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Inside shoulder width (W_{is}), ft:			2	2	2	2	2	2	2	2	2	2	2	2	2							
Median width (W_m), ft:			7	7	7	7	7	7	7	7	7	7	7	7	7							
Rumble strips on outside shoulders?:			Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No							
	Length of rumble strips for travel in increasing milepost direction, mi:		0.46	0.23	0.87	0.79	0.57															
	Length of rumble strips for travel in decreasing milepost direction, mi:		0.46	0.23	0.87	0.79	0.57															
Rumble strips on inside shoulders?:			Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No							
	Length of rumble strips for travel in increasing milepost direction, mi:		0.46	0.23	0.87	0.46																
	Length of rumble strips for travel in decreasing milepost direction, mi:		0.46	0.23	0.87	0.46																
Presence of barrier in median:			Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center							
Median barrier width (W_{ib}), ft:			3	3	3	3	3	3	3	3	3	3	3	3	3							
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30	30	30	30	30	30	30	30	30	30							
Presence of barrier on roadside:			Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full							
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:		999			999	999		999			999			999							
	Length of ramp entrance ($L_{en,inc}$), mi:			0.21				0.27		0.16	0.19		0.19									
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:			0.21				0.27		0.16	0.19		0.19									
	Entrance side?:			Right				Right		Right	Right		Right									
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		Lane Drop	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
	Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:			999	999		999	999		999	999		999	999	999							
	Length of ramp exit ($L_{ex,inc}$), mi:						0.3		0.05			0.04										
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:						0.3		0.05			0.04										
	Exit side?:						Right		Right			Right										
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
	Length of weaving section ($L_{wev,inc}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:		999			999	999		999			999			999							
	Length of ramp entrance ($L_{en,dec}$), mi:			0.21				0.27		0.16	0.19		0.19									
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:			0.21				0.27		0.16	0.19		0.19									
	Entrance side?:			Right				Right		Right	Right		Right									
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		Lane Drop	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
	Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:			999	999		999	999		999	999		999	999	999							
	Length of ramp exit ($L_{ex,dec}$), mi:						0.3		0.05			0.04										
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:						0.3		0.05			0.04										
	Exit side?:						Right		Right			Right										
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
	Length of weaving section ($L_{wev,dec}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1	1	1	1	1	1	1	1	1	1							
Freeway Segment Data		2016	115800	90840	122880	159240	103440	81600	113880	101520	121200	125640	110760	132360	177600							
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016		32040	36360			32280		19680	4440		21600	45240								
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016	24960			55800	21840		12360			14880										
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016		32040	36360			32280		19680	4440		21600	45240								
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016	24960			55800	21840		12360			14880										

Southbound: OFF Peak Period, Proposed Conditions, Existing Volumes

			Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
			Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period
Basic Roadway Data																						
Number of through lanes (n):			8	8	8	8	8	8	8	8	8	8	8	8	8							
Freeway segment description:			Proposed OFF	Proposed OFF	Proposed OFF	Proposed OFF	Proposed OFF	Proposed OFF	Proposed OFF	Proposed OFF	Proposed OFF	Proposed OFF	Proposed OFF	Proposed OFF	Proposed OFF							
Segment length (L), mi:			0.46	0.23	0.87	0.79	0.57	0.61	0.68	0.64	0.61	0.63	1.6	0.91	0.8							
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
Cross Section Data																						
Lane width (W_l), ft:			11	11	11	11	11	11	11	11	11	11	11	11	11							
Outside shoulder width (W_s), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Inside shoulder width (W_{is}), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Median width (W_m), ft:			29	29	29	29	29	29	29	29	29	29	29	29	29							
Rumble strips on outside shoulders?:			Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No							
	Length of rumble strips for travel in increasing milepost direction, mi:		0.46	0.23	0.87	0.79	0.57															
	Length of rumble strips for travel in decreasing milepost direction, mi:		0.46	0.23	0.87	0.79	0.57															
Rumble strips on inside shoulders?:			Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No							
	Length of rumble strips for travel in increasing milepost direction, mi:		0.46	0.23	0.87	0.46																
	Length of rumble strips for travel in decreasing milepost direction, mi:		0.46	0.23	0.87	0.46																
Presence of barrier in median:			Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center							
Median barrier width (W_{ib}), ft:			3	3	3	3	3	3	3	3	3	3	3	3	3							
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30	30	30	30	30	30	30	30	30	30							
Presence of barrier on roadside:			Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full							
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:		999			999	999		999			999			999							
	Length of ramp entrance ($L_{en,inc}$), mi:			0.21				0.27		0.16	0.19		0.19									
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:			0.21				0.27		0.16	0.19		0.19									
	Entrance side?:			Right				Right		Right	Right		Right									
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		Lane Drop	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
	Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:			999	999		999	999		999	999		999	999	999							
	Length of ramp exit ($L_{ex,inc}$), mi:						0.3		0.05			0.04										
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:						0.3		0.05			0.04										
	Exit side?:						Right		Right			Right										
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
	Length of weaving section ($L_{wev,inc}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		No	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:		999			999	999		999			999			999							
	Length of ramp entrance ($L_{en,dec}$), mi:			0.21				0.27		0.16	0.19		0.19									
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:			0.21				0.27		0.16	0.19		0.19									
	Entrance side?:			Right				Right		Right	Right		Right									
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		Lane Drop	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
	Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:			999	999		999	999		999	999		999	999	999							
	Length of ramp exit ($L_{ex,dec}$), mi:						0.3		0.05			0.04										
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:						0.3		0.05			0.04										
	Exit side?:						Right		Right			Right										
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
	Length of weaving section ($L_{wev,dec}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1	1	1	1	1	1	1	1	1	1							
Freeway Segment Data		2016	42400	34685	45665	53900	42350	37150	43205	40090	45205	45995	41455	49650	67385							
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016		10980	8235			6055		5115	790		8195	17735								
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016	7715			11550	5200		3115			4540										
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016		10980	8235			6055		5115	790		8195	17735								
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016	7715			11550	5200		3115			4540										

Southbound: AM Peak Period, Existing Conditions, 2040 Volumes

			Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
			Study Period	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**
Basic Roadway Data																						
Number of through lanes (n):			8	8	8	8	8	8	8	8	8	8	8	8	8							
Freeway segment description:			Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM	Existing AM							
Segment length (L), mi:			0.19	0.49	0.87	0.79	0.57	0.61	0.68	0.64	0.61	0.63	1.6	0.91	0.8							
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
Cross Section Data																						
Lane width (W_l), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Outside shoulder width (W_s), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Inside shoulder width (W_{is}), ft:			9	9	9	9	9	9	9	9	9	9	9	9	9							
Median width (W_m), ft:			21	21	21	21	21	21	21	21	21	21	21	21	21							
Rumble strips on outside shoulders?:			Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No							
	Length of rumble strips for travel in increasing milepost direction, mi:		0.19	0.49	0.87	0.79	0.57															
	Length of rumble strips for travel in decreasing milepost direction, mi:		0.19	0.49	0.87	0.79	0.57															
Rumble strips on inside shoulders?:			Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No							
	Length of rumble strips for travel in increasing milepost direction, mi:		0.19	0.49	0.87	0.46																
	Length of rumble strips for travel in decreasing milepost direction, mi:		0.19	0.49	0.87	0.46																
Presence of barrier in median:			Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center							
Median barrier width (W_{ib}), ft:			3	3	3	3	3	3	3	3	3	3	3	3	3							
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30	30	30	30	30	30	30	30	30	30							
Presence of barrier on roadside:			Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full							
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:					999	999		999			999			999							
	Length of ramp entrance ($L_{en,inc}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
	Entrance side?:		Right	Right				Right		Right	Right		Right									
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		No	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
	Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:		999	999	999		999	999		999	999		999	999	999							
	Length of ramp exit ($L_{ex,inc}$), mi:						0.3		0.05			0.04										
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:						0.3		0.05			0.04										
	Exit side?:						Right		Right			Right										
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
	Length of weaving section ($L_{wev,inc}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:					999	999		999			999			999							
	Length of ramp entrance ($L_{en,dec}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
	Entrance side?:		Right	Right				Right		Right	Right		Right									
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		No	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
	Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:		999	999	999		999	999		999	999		999	999	999							
	Length of ramp exit ($L_{ex,dec}$), mi:						0.3		0.05			0.04										
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:						0.3		0.05			0.04										
	Exit side?:						Right		Right			Right										
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
	Length of weaving section ($L_{wev,dec}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1	1	1	1	1	1	1	1	1	1							
Freeway Segment Data		2016	124680	150720	184560	226560	156840	102600	139560	117840	133080	158520	143760	180000	274680							
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016	26040	33840	42000			36960		15240	25440		36240	94680								
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016				69720	54240		21720			14760										
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016	26040	33840	42000			36960		15240	25440		36240	94680								
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016				69720	54240		21720			14760										

Southbound: PM Peak Period, Existing Conditions, 2040 Volumes

			Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
			Study Period	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**
Basic Roadway Data																						
Number of through lanes (n):			8	8	8	8	8	8	8	8	8	8	8	8	8							
Freeway segment description:			Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM	Existing PM							
Segment length (L), mi:			0.19	0.49	0.87	0.79	0.57	0.61	0.68	0.64	0.61	0.63	1.6	0.91	0.8							
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
Cross Section Data																						
Lane width (W_l), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Outside shoulder width (W_s), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Inside shoulder width (W_{is}), ft:			9	9	9	9	9	9	9	9	9	9	9	9	9							
Median width (W_m), ft:			21	21	21	21	21	21	21	21	21	21	21	21	21							
Rumble strips on outside shoulders?:			Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No							
	Length of rumble strips for travel in increasing milepost direction, mi:		0.19	0.49	0.87	0.79	0.57															
	Length of rumble strips for travel in decreasing milepost direction, mi:		0.19	0.49	0.87	0.79	0.57															
Rumble strips on inside shoulders?:			Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No							
	Length of rumble strips for travel in increasing milepost direction, mi:		0.19	0.49	0.87	0.46																
	Length of rumble strips for travel in decreasing milepost direction, mi:		0.19	0.49	0.87	0.46																
Presence of barrier in median:			Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center							
Median barrier width (W_{ib}), ft:			3	3	3	3	3	3	3	3	3	3	3	3	3							
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30	30	30	30	30	30	30	30	30	30							
Presence of barrier on roadside:			Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full							
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:					999	999		999			999			999							
	Length of ramp entrance ($L_{en,inc}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
	Entrance side?:		Right	Right				Right		Right	Right		Right									
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		No	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
	Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:		999	999	999		999	999		999	999		999	999	999							
	Length of ramp exit ($L_{ex,inc}$), mi:						0.3		0.05			0.04										
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:						0.3		0.05			0.04										
	Exit side?:						Right		Right			Right										
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
	Length of weaving section ($L_{wev,inc}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:					999	999		999			999			999							
	Length of ramp entrance ($L_{en,dec}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
	Entrance side?:		Right	Right				Right		Right	Right		Right									
Exit	Ramp exit in segment? (If yes, indicate type.):		No	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
Ramp	Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:		999	999	999		999	999		999	999		999	999	999							
	Length of ramp exit ($L_{ex,dec}$), mi:						0.3		0.05			0.04										
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:						0.3		0.05			0.04										
	Exit side?:						Right		Right			Right										
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
	Length of weaving section ($L_{wev,dec}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1	1	1	1	1	1	1	1	1	1							
Freeway Segment Data		2016	85080	109080	140400	178680	111720	88200	125640	110160	132120	136800	120000	143160	192120							
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016	24000	31320	38280			37440		21960	4680		23160	48960								
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016				66960	23520		15480			16800										
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016	24000	31320	38280			37440		21960	4680		23160	48960								
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016				66960	23520		15480			16800										

Southbound: OFF Peak Period, Existing Conditions, 2040 Volumes

		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
		Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period	Study Period
Basic Roadway Data																					
Number of through lanes (n):		8	8	8	8	8	8	8	8	8	8	8	8	8							
Freeway segment description:		Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF	Existing OFF							
Segment length (L), mi:		0.19	0.49	0.87	0.79	0.57	0.61	0.68	0.64	0.61	0.63	1.6	0.91	0.8							
Alignment Data																					
Horizontal Curve Data																					
1 Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
Cross Section Data																					
Lane width (W_l), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12							
Outside shoulder width (W_s), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12							
Inside shoulder width (W_{is}), ft:		9	9	9	9	9	9	9	9	9	9	9	9	9							
Median width (W_m), ft:		21	21	21	21	21	21	21	21	21	21	21	21	21							
Rumble strips on outside shoulders?:		Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No							
Length of rumble strips for travel in increasing milepost direction, mi:		0.19	0.49	0.87	0.79	0.57															
Length of rumble strips for travel in decreasing milepost direction, mi:		0.19	0.49	0.87	0.79	0.57															
Rumble strips on inside shoulders?:		Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No							
Length of rumble strips for travel in increasing milepost direction, mi:		0.19	0.49	0.87	0.46																
Length of rumble strips for travel in decreasing milepost direction, mi:		0.19	0.49	0.87	0.46																
Presence of barrier in median:		Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center							
Median barrier width (W_{ib}), ft:		3	3	3	3	3	3	3	3	3	3	3	3	3							
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																					
Roadside Data																					
Clear zone width (W_{hc}), ft:		30	30	30	30	30	30	30	30	30	30	30	30	30							
Presence of barrier on roadside:		Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full							
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12							
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12							
Ramp Access Data																					
Travel in Increasing Milepost Direction																					
Entrance Ramp: Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:					999	999		999			999			999							
Length of ramp entrance ($L_{en,inc}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
Entrance side?:		Right	Right				Right		Right	Right		Right									
Exit Ramp: Ramp exit in segment? (If yes, indicate type.):		No	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:		999	999	999		999	999		999	999		999	999	999							
Length of ramp exit ($L_{ex,inc}$), mi:						0.3		0.05			0.04										
Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:						0.3		0.05			0.04										
Exit side?:						Right		Right			Right										
Weave: Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
Length of weaving section ($L_{wev,inc}$), mi:																					
Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																					
Entrance Ramp: Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:					999	999		999			999			999							
Length of ramp entrance ($L_{en,dec}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
Entrance side?:		Right	Right				Right		Right	Right		Right									
Exit Ramp: Ramp exit in segment? (If yes, indicate type.):		No	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:		999	999	999		999	999		999	999		999	999	999							
Length of ramp exit ($L_{ex,dec}$), mi:						0.3		0.05			0.04										
Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:						0.3		0.05			0.04										
Exit side?:						Right		Right			Right										
Weave: Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
Length of weaving section ($L_{wev,dec}$), mi:																					
Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data	**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):		1	1	1	1	1	1	1	1	1	1	1	1	1							
Freeway Segment Data	2016	34880	41625	52280	61245	44630	40600	49150	44700	50300	51535	46280	54905	74250							
Entrance Ramp Data for Travel in Increasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:	2016	6745	10655	8965			8550		5600	1235		8625	19345								
Exit Ramp Data for Travel in Increasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:	2016				16615	4030		4450			5255										
Entrance Ramp Data for Travel in Decreasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:	2016	6745	10655	8965			8550		5600	1235		8625	19345								
Exit Ramp Data for Travel in Decreasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:	2016				16615	4030		4450			5255										

Southbound: AM Peak Period, Proposed Conditions, 2040 Volumes

	Year	Segment 1 Study Period	Segment 2 Study Period	Segment 3 Study Period	Segment 4 Study Period	Segment 5 Study Period	Segment 6 Study Period	Segment 7 Study Period	Segment 8 Study Period	Segment 9 Study Period	Segment 10 Study Period	Segment 11 Study Period	Segment 12 Study Period	Segment 13 Study Period	Segment 14 Study Period	Segment 15 Study Period	Segment 16 Study Period	Segment 17 Study Period	Segment 18 Study Period	Segment 19 Study Period	Segment 20 Study Period
Basic Roadway Data																					
Number of through lanes (n):		10	10	10	10	10	10	10	10	10	10	10	10	10							
Freeway segment description:		Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM	Proposed AM							
Segment length (L), mi:		0.19	0.49	0.87	0.79	0.57	0.61	0.68	0.64	0.61	0.63	1.6	0.91	0.8							
Alignment Data																					
Horizontal Curve Data																					
1 Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
Cross Section Data																					
Lane width (W_l), ft:		11	11	11	11	11	11	11	11	11	11	11	11	11							
Outside shoulder width (W_s), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12							
Inside shoulder width (W_{is}), ft:		2	2	2	2	2	2	2	2	2	2	2	2	2							
Median width (W_m), ft:		7	7	7	7	7	7	7	7	7	7	7	7	7							
Rumble strips on outside shoulders?:		Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No							
Length of rumble strips for travel in increasing milepost direction, mi:		0.19	0.49	0.87	0.79	0.57															
Length of rumble strips for travel in decreasing milepost direction, mi:		0.19	0.49	0.87	0.79	0.57															
Rumble strips on inside shoulders?:		Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No							
Length of rumble strips for travel in increasing milepost direction, mi:		0.19	0.49	0.87	0.46																
Length of rumble strips for travel in decreasing milepost direction, mi:		0.19	0.49	0.87	0.46																
Presence of barrier in median:		Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center							
Median barrier width (W_{ib}), ft:		3	3	3	3	3	3	3	3	3	3	3	3	3							
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																					
Roadside Data																					
Clear zone width (W_{hc}), ft:		30	30	30	30	30	30	30	30	30	30	30	30	30							
Presence of barrier on roadside:		Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full							
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12							
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12							
Ramp Access Data																					
Travel in Increasing Milepost Direction																					
Entrance Ramp: Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:					999	999		999			999			999							
Length of ramp entrance ($L_{en,inc}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
Entrance side?:		Right	Right				Right		Right	Right		Right									
Exit Ramp: Ramp exit in segment? (If yes, indicate type.):		No	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:		999	999	999		999	999		999	999		999	999	999							
Length of ramp exit ($L_{ex,inc}$), mi:						0.3		0.05			0.04										
Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:						0.3		0.05			0.04										
Exit side?:						Right		Right			Right										
Weave: Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
Length of weaving section ($L_{wev,inc}$), mi:																					
Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																					
Entrance Ramp: Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:					999	999		999			999			999							
Length of ramp entrance ($L_{en,dec}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
Entrance side?:		Right	Right				Right		Right	Right		Right									
Exit Ramp: Ramp exit in segment? (If yes, indicate type.):		No	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:		999	999	999		999	999		999	999		999	999	999							
Length of ramp exit ($L_{ex,dec}$), mi:						0.3		0.05			0.04										
Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:						0.3		0.05			0.04										
Exit side?:						Right		Right			Right										
Weave: Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
Length of weaving section ($L_{wev,dec}$), mi:																					
Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data	**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):		1	1	1	1	1	1	1	1	1	1	1	1	1							
Freeway Segment Data	2016	124680	150720	184560	226560	156840	102600	139560	117840	133080	158520	143760	180000	274680							
Entrance Ramp Data for Travel in Increasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:	2016	26040	33840	42000			36960		15240	25440		36240	94680								
Exit Ramp Data for Travel in Increasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:	2016				69720	54240		21720			14760										
Entrance Ramp Data for Travel in Decreasing Milepost Dir.	**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:	2016	26040	33840	42000			36960		15240	25440		36240	94680								
Exit Ramp Data for Travel in Decreasing Milepost Direction	**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:	2016				69720	54240		21720			14760										

Southbound: PM Peak Period, Proposed Conditions, 2040 Volumes

			Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
			Study Period	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**
Basic Roadway Data																						
Number of through lanes (n):			10	10	10	10	10	10	10	10	10	10	10	10	10							
Freeway segment description:			Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM	Proposed PM							
Segment length (L), mi:			0.19	0.49	0.87	0.79	0.57	0.61	0.68	0.64	0.61	0.63	1.6	0.91	0.8							
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
Cross Section Data																						
Lane width (W_l), ft:			11	11	11	11	11	11	11	11	11	11	11	11	11							
Outside shoulder width (W_s), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Inside shoulder width (W_{is}), ft:			2	2	2	2	2	2	2	2	2	2	2	2	2							
Median width (W_m), ft:			7	7	7	7	7	7	7	7	7	7	7	7	7							
Rumble strips on outside shoulders?:			Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No							
	Length of rumble strips for travel in increasing milepost direction, mi:		0.19	0.49	0.87	0.79	0.57															
	Length of rumble strips for travel in decreasing milepost direction, mi:		0.19	0.49	0.87	0.79	0.57															
Rumble strips on inside shoulders?:			Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No							
	Length of rumble strips for travel in increasing milepost direction, mi:		0.19	0.49	0.87	0.46																
	Length of rumble strips for travel in decreasing milepost direction, mi:		0.19	0.49	0.87	0.46																
Presence of barrier in median:			Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center							
Median barrier width (W_{ib}), ft:			3	3	3	3	3	3	3	3	3	3	3	3	3							
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30	30	30	30	30	30	30	30	30	30							
Presence of barrier on roadside:			Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full							
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:					999	999		999			999			999							
	Length of ramp entrance ($L_{en,inc}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
	Entrance side?:		Right	Right				Right		Right	Right		Right									
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		No	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
	Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:		999	999	999		999	999		999	999		999	999	999							
	Length of ramp exit ($L_{ex,inc}$), mi:						0.3		0.05			0.04										
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:						0.3		0.05			0.04										
	Exit side?:						Right		Right			Right										
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
	Length of weaving section ($L_{wev,inc}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:					999	999		999			999			999							
	Length of ramp entrance ($L_{en,dec}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
	Entrance side?:		Right	Right				Right		Right	Right		Right									
Exit	Ramp exit in segment? (If yes, indicate type.):		No	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
Ramp	Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:		999	999	999		999	999		999	999		999	999	999							
	Length of ramp exit ($L_{ex,dec}$), mi:						0.3		0.05			0.04										
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:						0.3		0.05			0.04										
	Exit side?:						Right		Right			Right										
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
	Length of weaving section ($L_{wev,dec}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1	1	1	1	1	1	1	1	1	1							
Freeway Segment Data		2016	85080	109080	140400	178680	111720	88200	125640	110160	132120	136800	120000	143160	192120							
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016	24000	31320	38280			37440		21960	4680		23160	48960								
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016				66960	23520		15480			16800										
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016	24000	31320	38280			37440		21960	4680		23160	48960								
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016				66960	23520		15480			16800										

Southbound: OFF Peak Period, Proposed Conditions, 2040 Volumes

			Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12	Segment 13	Segment 14	Segment 15	Segment 16	Segment 17	Segment 18	Segment 19	Segment 20
			Study Period	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**	**Study Period**
Basic Roadway Data																						
Number of through lanes (n):			8	8	8	8	8	8	8	8	8	8	8	8	8							
Freeway segment description:			roposed OFF	Proposed OFF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OF	Proposed OFF							
Segment length (L), mi:			0.19	0.49	0.87	0.79	0.57	0.61	0.68	0.64	0.61	0.63	1.6	0.91	0.8							
Alignment Data																						
Horizontal Curve Data																						
1	Horizontal curve in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
Cross Section Data																						
Lane width (W_l), ft:			11	11	11	11	11	11	11	11	11	11	11	11	11							
Outside shoulder width (W_s), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Inside shoulder width (W_{is}), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Median width (W_m), ft:			29	29	29	29	29	29	29	29	29	29	29	29	29							
Rumble strips on outside shoulders?:			Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No							
	Length of rumble strips for travel in increasing milepost direction, mi:		0.19	0.49	0.87	0.79	0.57															
	Length of rumble strips for travel in decreasing milepost direction, mi:		0.19	0.49	0.87	0.79	0.57															
Rumble strips on inside shoulders?:			Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No							
	Length of rumble strips for travel in increasing milepost direction, mi:		0.19	0.49	0.87	0.46																
	Length of rumble strips for travel in decreasing milepost direction, mi:		0.19	0.49	0.87	0.46																
Presence of barrier in median:			Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center							
Median barrier width (W_{ib}), ft:			3	3	3	3	3	3	3	3	3	3	3	3	3							
Nearest distance from edge of traveled way to barrier face (W_{near}), ft:																						
Roadside Data																						
Clear zone width (W_{hc}), ft:			30	30	30	30	30	30	30	30	30	30	30	30	30							
Presence of barrier on roadside:			Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full							
Distance from edge of traveled way to barrier face, increasing milepost ($W_{off,inc}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Distance from edge of traveled way to barrier face, decreasing milepost ($W_{off,dec}$), ft:			12	12	12	12	12	12	12	12	12	12	12	12	12							
Ramp Access Data																						
Travel in Increasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
	Distance from begin milepost to upstream entrance ramp gore ($X_{b,ent}$), mi:					999	999		999			999			999							
	Length of ramp entrance ($L_{en,inc}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
	Length of ramp entrance in segment ($L_{en,seg,inc}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
	Entrance side?:		Right	Right				Right		Right	Right		Right									
Exit Ramp	Ramp exit in segment? (If yes, indicate type.):		No	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
	Distance from end milepost to downstream exit ramp gore ($X_{e,ext}$), mi:		999	999	999		999	999		999	999		999	999	999							
	Length of ramp exit ($L_{ex,inc}$), mi:						0.3		0.05			0.04										
	Length of ramp exit in segment ($L_{ex,seg,inc}$), mi:						0.3		0.05			0.04										
	Exit side?:						Right		Right			Right										
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
	Length of weaving section ($L_{wev,inc}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,inc}$), mi:																					
Travel in Decreasing Milepost Direction																						
Entrance Ramp	Ramp entrance in segment? (If yes, indicate type.):		S-C Lane	S-C Lane	Lane Add	No	No	S-C Lane	No	S-C Lane	S-C Lane	No	S-C Lane	Lane Add	No							
	Distance from end milepost to upstream entrance ramp gore ($X_{e,ent}$), mi:					999	999		999			999			999							
	Length of ramp entrance ($L_{en,dec}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
	Length of ramp entrance in segment ($L_{en,seg,dec}$), mi:		0.19	0.21				0.27		0.16	0.19		0.19									
	Entrance side?:		Right	Right				Right		Right	Right		Right									
Exit	Ramp exit in segment? (If yes, indicate type.):		No	No	No	Lane Drop	S-C Lane	No	S-C Lane	No	No	S-C Lane	No	No	No							
Ramp	Distance from begin milepost to downstream exit ramp gore ($X_{b,ext}$), mi:		999	999	999		999	999		999	999		999	999	999							
	Length of ramp exit ($L_{ex,dec}$), mi:						0.3		0.05			0.04										
	Length of ramp exit in segment ($L_{ex,seg,dec}$), mi:						0.3		0.05			0.04										
	Exit side?:						Right		Right			Right										
Weave	Type B weave in segment?:		No	No	No	No	No	No	No	No	No	No	No	No	No							
	Length of weaving section ($L_{wev,dec}$), mi:																					
	Length of weaving section in segment ($L_{wev,seg,dec}$), mi:																					
Traffic Data		**Year**																				
Proportion of AADT during high-volume hours (P_{hv}):			1	1	1	1	1	1	1	1	1	1	1	1	1							
Freeway Segment Data		2016	34880	41625	52280	61245	44630	40600	49150	44700	50300	51535	46280	54905	74250							
Entrance Ramp Data for Travel in Increasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{b,ent}$) by year, veh/d:		2016	6745	10655	8965			8550		5600	1235		8625	19345								
Exit Ramp Data for Travel in Increasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{e,ext}$) by year, veh/d:		2016				16615	4030		4450			5255										
Entrance Ramp Data for Travel in Decreasing Milepost Dir.		**Year**																				
Average daily traffic ($AADT_{e,ent}$) by year, veh/d:		2016	6745	10655	8965			8550		5600	1235		8625	19345								
Exit Ramp Data for Travel in Decreasing Milepost Direction		**Year**																				
Average daily traffic ($AADT_{b,ext}$) by year, veh/d:		2016				16615	4030		4450			5255										