Appendix A


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Transform 66
Inside the Beltway Project
Eastbound Widening

Framework Document for
EA Traffic and Transportation Technical Report

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Table of Contents

Project Overview ...................................................................................................................... 3
Purpose and Need ................................................................................................................... 4
Study Area Limits .................................................................................................................... 6
Data Collection ......................................................................................................................... 9
   AM/PM Peak Hours ................................................................................................................. 9
Analysis Years and Conditions ..............................................................................................11
   No-Build Conditions .............................................................................................................11
   Build Conditions ....................................................................................................................12
Travel Demand Modeling ........................................................................................................12
Traffic Operational Analysis ................................................................................................13
   Traffic Analysis Tools ............................................................................................................13
   Measures of Effectiveness ....................................................................................................13
      Freeway Performance Measures .......................................................................................13
      Arterial/Intersection Performance Measures .......................................................................14
   Simulation Model Parameters .............................................................................................14
   Calibration Thresholds ..........................................................................................................15
Safety Analysis .......................................................................................................................16
Traffic Data for Noise and Air Analysis (NEPA) .....................................................................17
   Project-Level Noise Analysis (ENTRADA) .........................................................................17
   Project-Level Air Quality Analysis ......................................................................................20
      Particulate Matter (PM<sub>2.5</sub>) ......................................................................................20
      Carbon Monoxide (CO) ..................................................................................................21
      Mobile Source Air Toxics (MSAT) ..................................................................................21
Proposed Traffic and Transportation Technical Report Content and Outline (TATTR) ....21
This document outlines the scope, assumptions, and methodology for the traffic and safety analysis of Transform 66 Inside the Beltway Project - Eastbound Widening (hereinafter referred to as the Project) to support an Environmental Assessment (EA) Traffic and Transportation Technical Report.

The traffic study area for I-66 Inside the Beltway is the segment between I-495 (Capital Beltway) in Fairfax County and US 29 (Lee Highway – Spout Run) in the Rosslyn area of Arlington County, Virginia. It also includes Route 267 (Dulles Connector Road) between I-495 and I-66 at its merge point adjacent to West Falls Church Metro Station.

PROJECT OVERVIEW

The Transform 66 Inside the Beltway program includes a package of proposed improvements to improve overall person-throughput across all modes, and to improve reliability of the corridor. In 2012 and 2013, the Virginia Department of Transportation (VDOT) and the Department of Rail and Public Transportation (DRPT) formed a partnership in cooperation with local jurisdictions, transit agencies and federal and other stakeholders to complete the I-66 Multimodal Study, in order to address long-term multimodal needs within the I-66 inside the Beltway. This study recommended the following multimodal improvements to the corridor:

- Improved transit service
- Enhanced Bicycle and pedestrian access
- Transportation demand management strategies to manage travel demand and promote alternative travel options
- Integrated Corridor Management
- Tolling non-HOV-3+ vehicles during peak travel-time in order to manage demand for the lanes and keep them free-flowing at all times, while providing a seamless connection to the region’s network of Express Lanes
- Consideration of future widening

As part of these improvements, two interstate improvement projects have been initiated to advance forward by VDOT. The first project, which is currently under construction, will implement dynamic tolling on I-66 Inside the Beltway in the peak direction during the peak periods. The revenue from tolling will be used to implement recommended multimodal improvements to the corridor. Transportation technical reports and environmental documentation were prepared to support NEPA compliance through a Categorical Exclusion (CE) for the dynamic tolling project. Tolling on I-66 inside the beltway is expected to begin in 2017, upon completion of the tolling infrastructure construction, and commencement of an operations center by a toll integrator.

The second project will widen eastbound I-66 from two to three lanes from the Dulles Connector Road to Fairfax Drive near Ballston. The exit ramps to N Washington Street (US 29) /

1 http://inside.transform66.org/learn_more/documents.asp
Washington Boulevard (Exit 69) and Fairfax Drive – Ballston (Exit 71) will also be widened as part of this project. The widening project is expected to be completed by 2019.

**Figure 1** illustrates the numbers of lanes within the project limits for the existing and proposed roadway configurations.

This framework document addresses the traffic and transportation assumptions for the second project, the eastbound I-66 widening.

**PURPOSE AND NEED**

VDOT and DRPT, in coordination with the Federal Highway Administration (FHWA), have undertaken detailed multi-year studies between 2011 and 2013. These studies have been utilized as the foundation for the proposed project.

The segment of eastbound I-66 between the Dulles Connector Road and Ballston is a major congestion point in the I-66 corridor. This segment is the merge point of two commuter freeways: I-66 and the VA-267/Dulles Connector Road. Traffic from both the facilities merge into a single two lane facility, causing severe congestion in both the AM and PM peak periods and resulting in gridlock conditions on the freeways with queues spilling back as far as the Capital Beltway (I-495) on both I-66 and the Dulles Connector Road.

The purpose and need for widening eastbound I-66 is to provide the additional capacity that is needed on eastbound I-66 between the Dulles Connector Road and Ballston during the peak periods.

The proposed widening will provide an additional lane for approximately four miles for the traffic merging from the Dulles Connector Road to either exit at Ballston or continue on eastbound I-66, thereby improving the safety conditions along this segment.

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2 Various needs in the I-66 Corridor have been highlighted since the DRPT I-66 Transit/TDM Study was produced in 2009. A more focused Multi-modal Study for the Inside the Beltway portion of I-66 was released initially in 2012 and in a Supplemental Report in 2013 providing direction for the corridor addressing transit, bicycle and pedestrians, TDM, corridor-wide technology enhancements, tolling, and highway improvement elements.
Figure 1: Existing and Proposed Lane Configurations for Transform 66 Inside the Beltway Eastbound Widening Project
STUDY AREA LIMITS

FHWA guidelines indicate that the study area include all roadways within the area of influence of the project, and, at a minimum, include interchanges on either side of the project.

Figure 2 shows the project study area. The widening construction footprints are eastbound I-66 between the Dulles Connector Road and Ballston. The project study area includes I-66 from west of the Beltway at Nutley Street (Route 243) to eastern Arlington County at Route 29 (Lee Highway). The study area also includes the Dulles Connector Road from west of the Beltway at Spring Hill Road (VA-684) to the I-66 merge point.

The following roadways, ramps, and intersections in the area are proposed to be analyzed as a part of this study effort:

- I-66 from Nutley Street (Route 243) outside the Beltway to Lee Highway (Route 29) inside the beltway.
- Dulles Toll Road (VA-267) and the Dulles Connector Road from Spring Hill Road (VA-684) to I-66 inside the Beltway.
- Interchanges of I-66 with the following roadways:
  - Capital Beltway (I-495)
  - Leesburg Pike (Route 7)
  - N Washington Street (VA-237)
  - N Sycamore Street
  - N Glebe Road (VA-120)
  - Lee Highway (Route 29)
- Interchanges of Dulles Toll Road/ Connector Road with the following roadways:
  - Capital Beltway (I-495)
  - Chain Bridge Road (Route 123)
- All ramps serving I-66 and Dulles Toll Road/ Connector Road within the study area.
- Intersections on the interchanging arterials within the study area listed below:
  1. VA-7 and Pimmit Drive
  2. VA-7 and Idylwood Road
  3. VA-7 and WB I-66 Off-ramp
  4. VA-7 and Shreve Road/Haycock Road
  5. Westmoreland Street and 28th Street N
  6. Westmoreland Street and EB I-66 Off-ramp
  7. Westmoreland Street and Fairfax Drive
  8. Washington Boulevard and 25th Street N
  9. US-29 (Lee Highway) and Washington Boulevard
  10. US-29 (Washington Street) and Fairfax Drive
  11. US-29 (Washington Street) and N Westmoreland Street
  12. Washington Boulevard and N Sycamore Street
  13. N Sycamore Street and WB I-66 Off-ramp
  15. N Glebe Road and 15th Street N
  16. N Glebe Road and WB I-66 Off-ramp
  17. N Glebe Road and EB I-66 On-ramp
  18. N Glebe Road and Washington Boulevard
19. Fairfax Drive and N Wakefield Street  
20. Fairfax Drive and N Glebe Road  
21. US-29 (near Spout Run Pkwy) and WB I-66 On-ramp  
22. US-29 (near Spout Run Pkwy) and EB I-66 Off-ramp  
23. US-29 (near Spout Run Pkwy) and N Kirkwood Road  
24. VA-123 and Great Falls Street  
25. VA-123 and Anderson Road
Figure 2: Microsimulation Study Area for Transform 66 Inside the Beltway Eastbound Widening Project
DATA COLLECTION

Data collection for the analysis consisted of conducting traffic counts, performing travel time runs, and assembling signal timing, speed congestion, and historical crash data. Field data collection was performed during March and April 2016. Data collected for the study are listed below:

- Freeway counts: Three weekdays (Tuesday through Thursday) of continuous, directional, vehicle classification counts were conducted on freeway mainlines and at interchange ramps.
- Intersection counts: For all intersections in the study area, 13-hour turning movement counts were conducted from 6:00 AM to 7:00 PM on weekdays.
- Travel time runs: Travel time runs were conducted on the I-66 mainline in each direction during the peak periods of 6:00 to 10:00 AM and 3:00 PM to 7:00 PM on weekdays.
- Speed congestion data: INRIX speed data for the freeway segments in the study area were obtained through the University of Maryland CATT Lab’s RITIS system (https://www.ritis.org/) for weekdays in March and April, 2016.
- Traffic signal timing plans: The current signal timing plans at all signalized intersections within the study area were obtained from VDOT and local jurisdictions.
- Historical crash data: The most recent four-year crash data (2011 to 2015) within the study area were obtained from VDOT’s crash database.

AM/PM Peak Hours

Figure 3 shows aggregated bi-directional diurnal traffic volumes from freeway count data and they were used initially to determine the peak hour to be used in the analysis. The peak hour when the volumes were highest within the restricted HOV period was selected as the analysis peak hour.

In the AM period, the peak hour for both eastbound I-66 and westbound I-66 occurs between 7:15 AM and 8:15 AM. This hour is therefore assumed to be the AM peak hour.
In the PM period, eastbound and westbound peaks occur at different hours. Eastbound I-66 peaks between 4:00 PM and 5:00 PM whereas westbound I-66 peaks between 2:45 PM and 3:45 PM. To identify a common system peak hour for PM period, it was decided, in discussion with VDOT, to review the total traffic volumes on intersections adjacent to I-66 during the peak period and determine the PM peak hour.

Figure 4 below shows the total volumes of intersections along the corridor. It can be seen that the peak hour for most of the intersections occurs between 5:00 PM and 6:00 PM. In addition, from Figure 3 above, it can be seen that the volume on eastbound and westbound I-66 mainlines during this hour is very close to the true peak hour as well. Therefore, it was decided that the PM peak hour to be analyzed for this project is 5:00 PM to 6:00 PM.
Figure 4: PM peak period total volumes on Intersections adjacent to I-66

ANALYSIS YEARS AND CONDITIONS

The traffic analysis years for the study include the current year (2016) and two future years (interim year 2025 and design year 2040). The traffic analyses will include assessments of typical weekday AM and PM peak hour operations.

No-Build Conditions

The No-Build conditions assume all improvements planned and programmed in the study area. These improvements and their anticipated opening year are listed below:

1. Transform 66 Inside the Beltway tolling, 2017. Tolling on I-66 inside the Beltway will be implemented in the peak period peak period (eastbound in the AM and westbound in the PM). Currently, the high occupancy vehicle (HOV) restrictions are enforced on I-66 inside the Beltway between 6:30-9:00 AM (all eastbound travel lanes) and 4:00-6:30 PM (all westbound travel lanes). The Inside the Beltway tolling project will convert the existing HOV lanes to high occupancy toll (HOT) lanes during an extended AM and PM peak period. The HOT restrictions will be 5:30-9:30 AM (all EB travel lanes) and 3:00 – 7:00 PM (all WB travel lanes) in the future years.

2. Transform 66 Outside the Beltway Express Lanes project, 2021. This project will improve I-66 outside the Beltway to add two express lanes in each direction, maintain three general purpose lanes in each direction and provide travel choices such as express transit buses, park and ride facilities along the corridor.

3. Regional HOV/HOT requirements, 2020. The vehicle occupancy requirement for all HOV/HOT facilities in the region will change from 2 or more (2+) to 3 or more (3+). The exemption for clean fuel and hybrid vehicles to use HOV lanes will also expire by 2020.

As mentioned above, the I-66 outside the Beltway project, which is expected to influence traffic on I-66 inside the beltway, is anticipated to open with express lanes beyond 2021. Typically, a
Transform 66 Inside the Beltway Project – Eastbound Widening

September 9, 2016

A three-year period is needed for traffic to stabilize on the dynamic tolled express lanes. After accounting for all the above, it was decided to use year 2025 as the interim year for analysis as a conservative worst case scenario. Note that 2019, the opening year of the eastbound I-66 widening, will not be used as an analysis year.

**Build Conditions**

The 2025 and 2040 build conditions includes all improvements assumed in No-Build and the proposed widening project inside the Beltway. The eastbound widening is expected to be completed by 2019. This will result in three travel lanes on eastbound I-66 between the Dulles Connector Road and Fairfax Drive near Ballston.

The 2040 build conditions will also include widening on westbound I-66 between the Sycamore Street off-ramp and the Washington Boulevard on-ramp. HOT-3 restrictions will also be incorporated in the off-peak directions (westbound in the AM and eastbound in the PM).

*Table 1* summarizes the years and scenarios that will be analyzed in this study.

<table>
<thead>
<tr>
<th>Direction</th>
<th>Time Period*</th>
<th>Existing Year 2016</th>
<th>Interim Year 2025</th>
<th>Design Year 2040</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No-Build</td>
<td>Build</td>
<td>No-Build</td>
</tr>
<tr>
<td>Eastbound</td>
<td>AM Peak</td>
<td>HOV-2 only</td>
<td>HOT-3 only</td>
<td>HOT-3 only</td>
</tr>
<tr>
<td>I-66</td>
<td>Period</td>
<td></td>
<td>HOT-3 with EB widening</td>
<td>HOT-3 with EB widening</td>
</tr>
</tbody>
</table>
| PM Peak   | No restrictions | No restrictions | No restrictions with EB widening | HOT-3 only |=
| Period    |              |                    |                   | HOT-3 with EB widening |
| Westbound | AM Peak      | No restrictions    | No restrictions   | HOT-3 only      |
| I-66      | Period       |                    |                   | HOT-3 with WB widening |
| PM Peak   | HOV-2 only   | HOT-3 only         | HOT-3 only        | HOT-3 with WB widening |

Table 1: Summary of Traffic Analysis Years and Conditions

Note*  Existing (2016) HOV restriction periods = 6:30 to 9:00 AM and 4:00 to 6:30 PM
2025 and 2040 HOV restriction periods = 5:30 to 9:30 AM and 3:00 to 7:00 PM
HOV-2: High occupancy lane - 2 or more occupant vehicles only
HOT-3: High occupancy toll lane - 3 or more occupant vehicles ride free, others pay a toll

Trucks are currently not allowed on I-66 inside the Beltway at all times. This restriction will be maintained in the future for all scenarios. In addition, there are many single-occupant vehicles using I-66 during the HOV restricted hours including HOV violators, hybrid vehicles, and vehicles traveling to/from the Dulles International Airport. It is assumed that in the future Build scenarios, these vehicles will have to comply with tolling unless they meet the HOT-3 occupancy requirement.

**TRAVEL DEMAND MODELING**

The MWCOG/TPB (Metropolitan Washington Council of Governments/ Transportation Planning Board) travel demand model Version 2.3, Build 58 will be the basis of development for travel forecasts for the I-66 Inside the Beltway widening project. The model is a sub-area extraction of the MWCOG regional model to improve run times and will be modified with other specific alterations to improve the accuracy and reliability of forecasts for the I-66 corridor, roadways.
connected to the corridor, and transit services in the vicinity of the corridor. Other modifications include:

- Additional time of day periods to better correspond to the existing HOV periods and the future restricted tolling periods.
- Network modifications to reflect the operations of the corridor
- Logit toll diversion assignment algorithm as opposed to the MWCOG/TPB generalized cost assignment methodology.

This version of the model is also being used to develop the Level 2 (Preliminary or Concept level) traffic and revenue forecasts in coordination with the Virginia P3 Office. The calibration targets will be based on guidance from the FHWA Transportation Model Improvement Program (TMIP) Travel Model Validation and Reasonableness Checking Manual and the Virginia Travel Demand Modeling Policies and Procedures Manual.

Because the MWCOG/TPB Model is already subject to scrutiny as a regional model which has been a subject of FHWA’s Travel Model Improvement Program (TMIP) Peer Review process, the validation process for this study will focus on highway and transit assignment results and will compare the model results to observed traffic counts, travel times, and transit ridership by time of day.

Post-processing of travel demand model output is necessary to develop traffic volume forecasts for analysis of operations during peak periods/peak hours. Post-processing of travel demand forecasts for vehicular volumes will follow NCHRP 765 guidelines for estimating balanced existing, no-build, and build peak hour volumes.

**TRAFFIC OPERATIONAL ANALYSIS**

**Traffic Analysis Tools**

VISSIM version 8.0, Build 8 will be used for a comprehensive network traffic analysis of the study area limits. Calibration, based on simulated volume processed, travel times, queues, and speed profiles, will be performed against measured field conditions and traffic data in 2016.

**Measures of Effectiveness**

The following measures of effectiveness (MOEs) will be used for the operational analysis of the roadway network under existing, no-build and future build conditions.

**Freeway Performance Measures**

- Simulated average speed (mph)
- Simulated average density (pc/ln/mile, color-coded similar to the equivalent Density-Based LOS Thresholds)
- Simulated volume (vehicles per hour)
- Percent of demand served: simulated volume (processed volumes) divided by actual demand volume (input volumes)
- Simulated ramp queue lengths: reported for 50th and 95th percentiles (feet)
• Simulated travel time: reported for key freeway segments (seconds)
• Congestion heat maps: incremental speeds reported along the corridor for aggregated lanes, by time interval (mph)

Arterial/Intersection Performance Measures
- Simulated Intersection Level of Service (LOS) and Average Control Delay: reported by approach and by intersection (sec/vehicle, color-coded in similar fashion as the equivalent HCM delay-based LOS thresholds)
- Simulated ramp queue lengths: reported for 50th and 95th percentiles (feet)
- Percent of demand served: simulated volume (processed volumes) divided by actual demand volume (input volumes)

Simulation Model Parameters
FHWA guidelines will be followed for VISSIM microsimulation modeling, including model calibration methodology, seeding time, determination of the number of simulation runs, simulation parameters, and MOE outputs. Table 2 summarizes the VISSIM model parameters and assumptions.

Table 2: VISSIM Model Parameters and Assumptions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Existing (2016)</th>
<th>Future No-Build (2025, 2040)</th>
<th>Future Build (2025, 2040)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VISSIM Version</td>
<td>Version 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simulation Resolution</td>
<td>10 time steps/second</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simulation Duration</td>
<td>6000 seconds, 2400 seeding, 3600 evaluation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Simulation Runs</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle Types</td>
<td>Car, HGV and Bus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle Fleet</td>
<td>Based on MWCOG’s 2014 regional vehicle &quot;census&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle Compositions</td>
<td>From existing volumes</td>
<td>From travel demand forecasts</td>
<td></td>
</tr>
<tr>
<td>Arterial Car Following Model</td>
<td>Wiedemann 74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freeway Car Following Model</td>
<td>Wiedemann 99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driver Behavior</td>
<td>Default or adjusted for calibration</td>
<td>If No-Build improvements significantly changes segment, use engineering judgment to roll back calibration adjustment; otherwise same as existing</td>
<td>If proposed Alternative significantly changes segment, use engineering judgment to roll back calibration adjustment; otherwise same as No-Build</td>
</tr>
<tr>
<td>Signal Controller Type</td>
<td>Based on timing sheet data (RBC)</td>
<td>Same as existing. New/Modified intersections will assume actuated-coordinated (RBC)</td>
<td></td>
</tr>
<tr>
<td>Signal Controller Frequency</td>
<td>10 per second</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signal Timings/Offsets</td>
<td>Existing signal timing data obtained from</td>
<td>Optimized plans from Synchro</td>
<td></td>
</tr>
<tr>
<td>Desired Speed on Freeways</td>
<td>VDOT and local jurisdictions</td>
<td>Desired Speed on Arterials</td>
<td>Based on future No-Build improvement plans; otherwise same as existing</td>
</tr>
<tr>
<td>----------------------------</td>
<td>----------------------------</td>
<td>---------------------------</td>
<td>-------------------------------------------------</td>
</tr>
<tr>
<td>Posted speed +10/-3 mph</td>
<td>Based on future No-Build improvement plans; otherwise same as existing</td>
<td>Based on future No-Build improvement plans; otherwise same as existing</td>
<td>Based on proposed Build plans; otherwise same as No-Build</td>
</tr>
<tr>
<td>Desired Speed on Arterials</td>
<td>Posted speed +5/-3 mph</td>
<td>Based on future No-Build improvement plans; otherwise same as existing</td>
<td>Based on proposed Build plans; otherwise same as No-Build</td>
</tr>
<tr>
<td>Ramp Curve Speed</td>
<td>Use Reduced Speed Areas as per as-built plans or based on field observations; otherwise use AASHTO Exhibit 3-16</td>
<td>For future No-Build improvements use AASHTO Exhibit 3-16; otherwise same as existing</td>
<td>For future No-Build improvements use AASHTO Exhibit 3-16; otherwise same as No-Build</td>
</tr>
<tr>
<td>Intersection Turning Speed</td>
<td>Use Reduced Speed Areas for right (11-13 mph) and left (13-17 mph) turns. For non-standard radius use AASHTO Exhibit 3-16 or based on field observations.</td>
<td>For future No-Build improvements use AASHTO Exhibit 3-16; otherwise same as existing</td>
<td>For future No-Build improvements use AASHTO Exhibit 3-16; otherwise same as No-Build</td>
</tr>
<tr>
<td>Lane Change Distance</td>
<td>Freeways based on exit sign location and arterials default 656 ft. Adjust for calibration.</td>
<td>If No-Build improvement significantly changes segment, use engineering judgment to roll back calibration adjustment; otherwise same as Existing</td>
<td>If proposed design significantly changes segment, use engineering judgment to roll back calibration adjustment; otherwise same as No-Build</td>
</tr>
</tbody>
</table>

**Calibration Thresholds**

VISSIM models that were developed as part of the I-66 Tier 2 NEPA studies and the Transform 66 IJR will be modified and used for the traffic operational analysis of this project. Base models were previously calibrated following guidance from FHWA’s Traffic Analysis Toolbox. To ensure that the model accurately replicates the conditions in the field, additional model calibration will be carried out to validate against the newer collected traffic data such as travel times, INRIX speeds, and counts.

The calibration met the FHWA and VDOT criteria that were in place at that time. The VDOT Traffic Operations and Safety Analysis Manual (TOSAM) Version 1.0 was released in November 2015 with revised calibration criteria. Therefore, some of the original calibration criteria were modified to align with TOSAM criteria. **Table 3** shows the calibration thresholds that will be used in this study.
### Table 3: Calibration Criteria

<table>
<thead>
<tr>
<th>Simulated Measure</th>
<th>Calibration Threshold</th>
</tr>
</thead>
</table>
| Simulated traffic volume (vph) 85% of the I-66 freeway and ramp links in the study area | Within ±20% for < 100 vph  
Within ±15% for ≥ 100 vph to < 300 vph  
Within ±10% for ≥ 300 vph |
| Simulated travel time (seconds) 85% of the I-66 freeway travel time segments in either direction | Within ± 20% of observed travel times |
| Simulated average speed (mph) 85% of the I-66 freeway and ramp links in the study area | Within ± 7 mph of observed speeds |
| Simulated queue lengths (ft) I-66 freeway queues (as determined by INRIX congestion heat maps) and ramp queues (as determined by google typical traffic congestion plots) | Visual calibration to ensure queues and bottleneck locations are matching with INRIX plots and google typical traffic plots |

The following MOEs will be used to verify the adequacy of the calibration:

- Mainline travel times measured for the entire corridor (both directions) and between consecutive interchanges (center of interchange to center of interchange).
- Traffic flow rates measured at selected locations in the corridor (mainline and ramps) and compared with traffic counts through the GEH statistic index.
- Bottleneck locations and length of backups.

### SAFETY ANALYSIS

Using data provided for the study area by VDOT, crash analysis will be performed for existing conditions to reflect the most recent five-year period for which data is available. Crash analysis will include interstate mainline, ramp termini, and adjacent interchanges or intersections on crossroads within the study area, similar area as documented for traffic data collection.

A combination of qualitative and quantitative analyses will be used to evaluate safety in the corridor. Qualitative analyses, such as documenting existing crash rates/densities and predominant crash types on the I-66 mainline, ramps, ramp termini intersections, and intersecting arterials, will be used to determine the existing issues on I-66 inside the Beltway. Crash data will be analyzed based on location, type, severity, time, and day to identify existing crash patterns and safety concerns in the study area. Computed crash rates will be compared with statewide rates for similar roadway types established and documented by VDOT.

Quantitative analyses, using AASHTO Highway Safety Manual (HSM) methodologies within the Enhanced Interchange Safety Analysis Tool (ISATe) process, will then be used to evaluate safety throughout the widening project area. The predictive crash methods detailed in the HSM will be used to provide input into the roadway design process to improve safety through various design options.
TRAFFIC DATA FOR NOISE AND AIR ANALYSIS (NEPA)

The locations for project-level Noise and Air analysis will be identified and selected per all applicable EPA and FHWA regulations and/or guidance and consistent with VDOT’s practice. This section outlines how the traffic data needed for the Noise and Air analysis will be developed. A detailed description of the project and detailed traffic analysis for the existing (2016) year, Build and No-Build scenarios for both the interim (2025) and design (2040) years will be provided for each of the following:

- Mainline roadways
- Cross streets associated with existing interchanges
- Intersections/Interchanges

The project team will prepare regional travel demand modeling (TDM) output files encompassing the I-66 study corridor and affected transportation network for the base year and the build and no-build scenarios for the interim and design years. Travel demand forecasts developed as outlined in the Travel Demand Modeling Methodology and Key Assumptions section of this document will be post-processed using NCHRP 765 guidelines. Each link within the TDM output files will contain a link identifier, link length (miles), AADT, number of lanes, HPMS area type, HPMS functional classification, free-flow speed, and hourly lane capacity (vehicles/hour/lane). In combination with existing traffic count data, travel demand modeling, and traffic operational modeling (from both Synchro and VISSIM), following is a general list of overall post-processed traffic data that can be provided for project-level Noise and Air analysis:

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

A more detailed description of the data needs for project-level Noise and Air Quality analysis is described in the subsequent sections.

Project-Level Noise Analysis (ENTRADA)

Traffic data needed for project-level Noise analysis will be developed using VDOT’s ENTRADA tool, Version 2014-04, which is a program that standardizes the production of environmental traffic data. As per FHWA and VDOT policy, the traffic data used in the noise analysis must
produce sound levels that are representative of worst (loudest) hour of the day. In addition to the traffic data listed above, information about the corridor including facility geometry, access locations, and facility setting are also needed as input for the ENTRADA tool. An overall process flowchart for ENTRADA tool along with input and output data is illustrated in Figure 5.

![Figure 5: ENTRADA Processing Flowchart](image)

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

The following characteristics and inputs for each specific segment will be developed for the creation of the ENTRADA files; some of the data will be sourced from the TDM. Any adjustments and post-processing of volumes made for the peak period characteristics used for the detailed traffic operational analysis for the TTR will be consistently applied for those values in ENTRADA:

- **Segment length (miles):** The segment length will be the length of the segment in the 2040 design year.
- **Area type:** Will be verified by field observations and confirmed with VDOT.
- **Directional percent hourly truck traffic**: Using existing traffic count data, will be sourced from the MWCOG model and consistent with the peak hour characteristics being modeled in VISSIM. They will be verified with the available existing traffic data.

- **Existing hourly speeds by direction**: Will be verified by existing traffic data and consistent with the peak hour characteristics being modeled in VISSIM.

- **Capacity (per hour per lane)**.

- **Facility type**.

- **ADT**: Will be verified with existing traffic data.

- **Hour-by-hour percent trucks of the ADT**: Will be derived from existing traffic classification count data.

- **Hour-by-hour K-factors**: Will be derived from existing traffic data as a basis and adjusted for future conditions based on factors used for the MWCOG model.

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

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

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

The following characteristics of a signalized facility will be collected and entered as input (by individual segment) for the existing scenario for the creation of ENTRADA files. Any adjustments and post-processing of volumes made for the peak period characteristics used for the detailed traffic operational analysis for the TTR will be consistently applied for those values in ENTRADA:

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

To manage the amount of data that will be needed to compile and generate ENTRADA files, a master database will be developed that can store input data for every roadway segment. A spreadsheet-based macro will be developed to automatically read the information from the database and create ENTRADA spreadsheets for every single identified segment. A schematic graphic illustrating each of the unique link identifier for each of the roadway segment will also be provided to reference the generated ENTRADA spreadsheets.
To ensure that ENTRADA produced reasonable results, hourly speed distribution outputs for the existing year will be compared to available speed data (INRIX or field-collected) to determine the appropriate calibration parameter values. Where speed data is not available to calibrate certain roadway segments, the calibration parameters from adjacent segments will be utilized. After calibration, the output from each ENTRADA file, estimated hourly speed distributions for uninterrupted and interrupted conditions for existing and design year No-Build and Build, will be used as input for a quantitative project-level noise analysis.

Project-Level Air Quality Analysis

Traffic data required to support air quality analysis for PM$_{2.5}$, CO, and Mobile Source Air Toxins (MSAT) will be provided in consultation with VDOT.

As described in Traffic Modeling Methodology and Main Assumptions section, travel demand forecast models will be developed, based on the regional MWCOG model, for both the Build and No-Build conditions associated with the project. Every effort will be made to coordinate with VDOT to identify how much of the traffic data from the modeling work can be made available for air quality analysis purposes, as more is known about the scope of the air quality analysis study requirements and proposed air quality impacts study area. If specific data is not readily available for a particular analysis input, additional efforts to estimate the data will be made under VDOT’s guidance. Below is a list of traffic data that will be provided for air quality analysis:

- **Existing raw traffic count information** (including intersection turning movement counts and detailed bus/truck data) by time period.
- **TDM outputs for all scenarios**—both loaded networks, and exported to GIS database with linked shapefiles. Complete output from TDM modeling runs will be provided and at a minimum include HPMS area type, HPMS functional classification, ADT, percent trucks, VMT, peak/off-peak period factors for AM, midday, PM, and nighttime periods:
  - 2040 No-Build
  - 2040 Build
  - 2025 No-Build
  - 2025 Build

The following sections describe the additional traffic data inputs that the I-66 IJR/TTR team can provide to support project-level air quality analysis.

Particulate Matter (PM$_{2.5}$)

Given that the location of the study corridor falls within a non-attainment area for fine particulate matter (PM$_{2.5}$) and given the magnitude of the expected traffic and truck volumes in the corridor, it is anticipated that the ICG will concur that a quantitative analysis be completed for the project. This analysis would be required for year(s) of highest expected emissions which will be advised/determined in coordination with VDOT’s Environmental Division.

To support the quantitative PM2.5 “hotspot” analysis, EPA’s Office of Transportation and Air Quality (OTAQ) has developed the **MOtor Vehicle Emission Simulator (MOVES)** – an emissions rate model that estimates rates covering a broad range of pollutants, including PM2.5. The TDM
efforts being performed for this IJR/TTR will provide additional traffic and speed information to develop the inputs for MOVES. In conjunction with MOVES, air quality (dispersion) modeling will be required to estimate peak pollutant concentrations across the to-be-determined subsection of the study area. As it is defined, the air quality team will inform the project members performing the traffic analysis of the anticipated limits in order to minimize the data development required.

**Carbon Monoxide (CO)**

VDOT indicated that all areas of the State of Virginia are currently well below CO air quality standards. A worst-case screening analysis at worst intersections can be performed by using Synchro outputs described above combined with MOVES developed emission rates. TDM outputs will be provided by the traffic analysis team to support the analysis of the project level CO Hot-spot analysis.

**Mobile Source Air Toxics (MSAT)**

To support the project-level air quality analysis, regional travel demand modeling output files encompassing the project corridor and “affected transportation network” also will be provided for the base year and for the build and no-build scenarios for the interim and design years for each alternative to support the quantitative MSAT analysis. Regional travel demand model output files are typically preferred and will be provided.

It is anticipated that the air quality analysis team will use regional TDM output files to prepare a quantitative MSAT analysis for each alternative within the I-66 study corridor for the existing (2015), interim year (2025, no-build and build), and design year (2040, no-build and build). For purposes of the MSAT analysis, the affected transportation network could include roadways located miles away from the project corridor, based on the anticipated guidance from FHWA. Regional model outputs depicting changes in traffic volumes between Build and No-Build scenarios will be generated and provided to the air quality team for determining MSAT impacts.

**PROPOSED TRAFFIC AND TRANSPORTATION TECHNICAL REPORT CONTENT AND OUTLINE (TATTR)**

- Executive Summary
- 1. Introduction
- 2. Methodology
- 3. Existing Transportation Networks
- 4. Existing Traffic Operational Conditions
- 5. Preferred Alternative
- 6. Assessment of Future Conditions
- 7. Safety and Crash Analysis

APPENDICES