Appendix A: Traffic Data Collection Locations

I-395 Express Lanes

Figure 2: Traffic Count Locations

Sheet 1 of 15

VDOT Virginia Department of Transportation

VDOT Project No. 0395-969-205, P101
UPC 108313

Source: VDOT, ESRI

48 Hour Classification Count Location

Turning Movement Count Location

I-395 Traffic Operations Analysis Study Area

I-395 Express Lanes

Figure 2: Traffic Count Locations

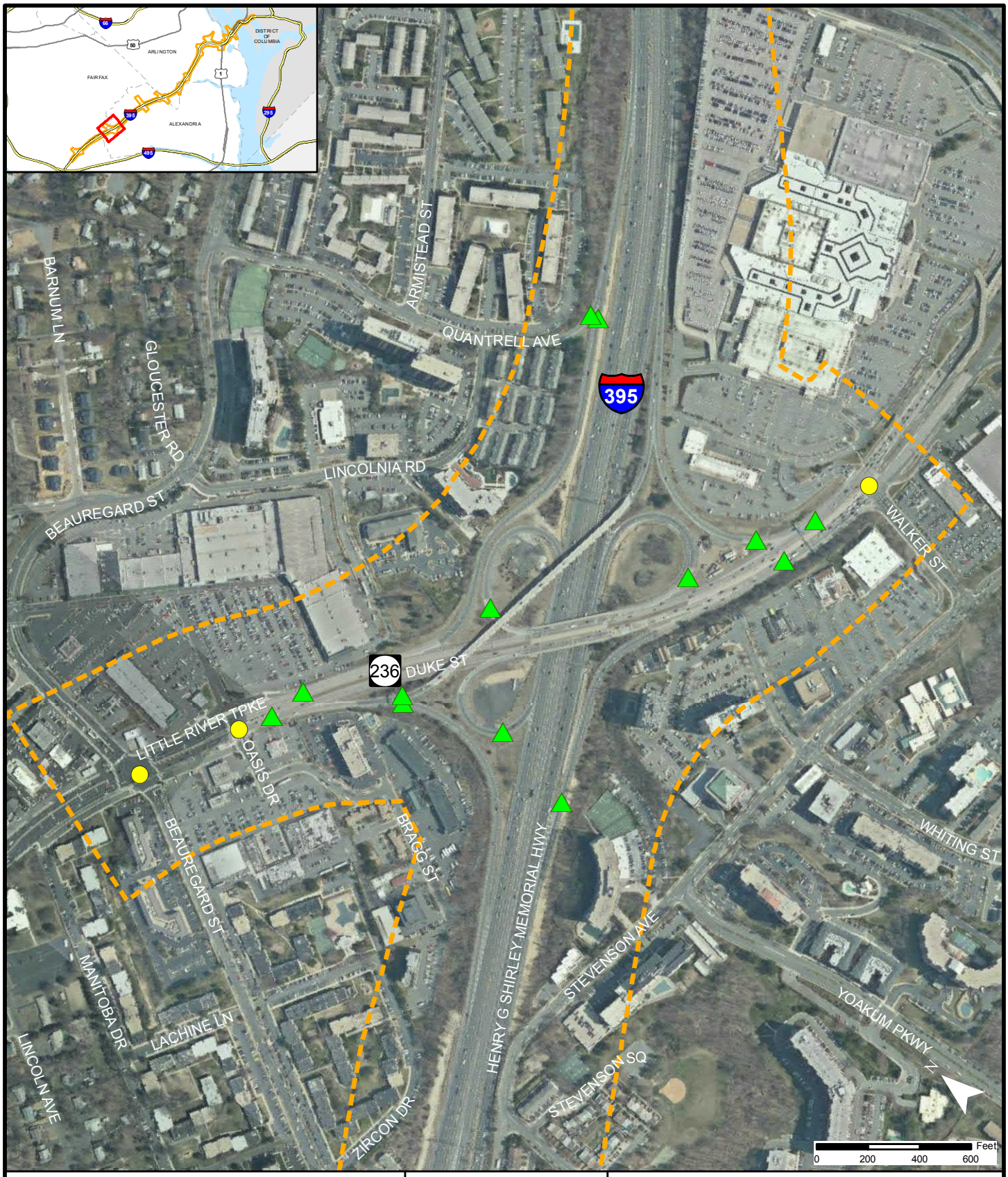
Sheet 2 of 15

VDOT Virginia Department of Transportation

VDOT Project No. 0395-969-205, P101
UPC 108313

Source: VDOT, ESRI

- 48 Hour Classification Count Location
- Turning Movement Count Location
- I-395 Traffic Operations Analysis Study Area



I-395 Express Lanes

Figure 2: Traffic Count Locations

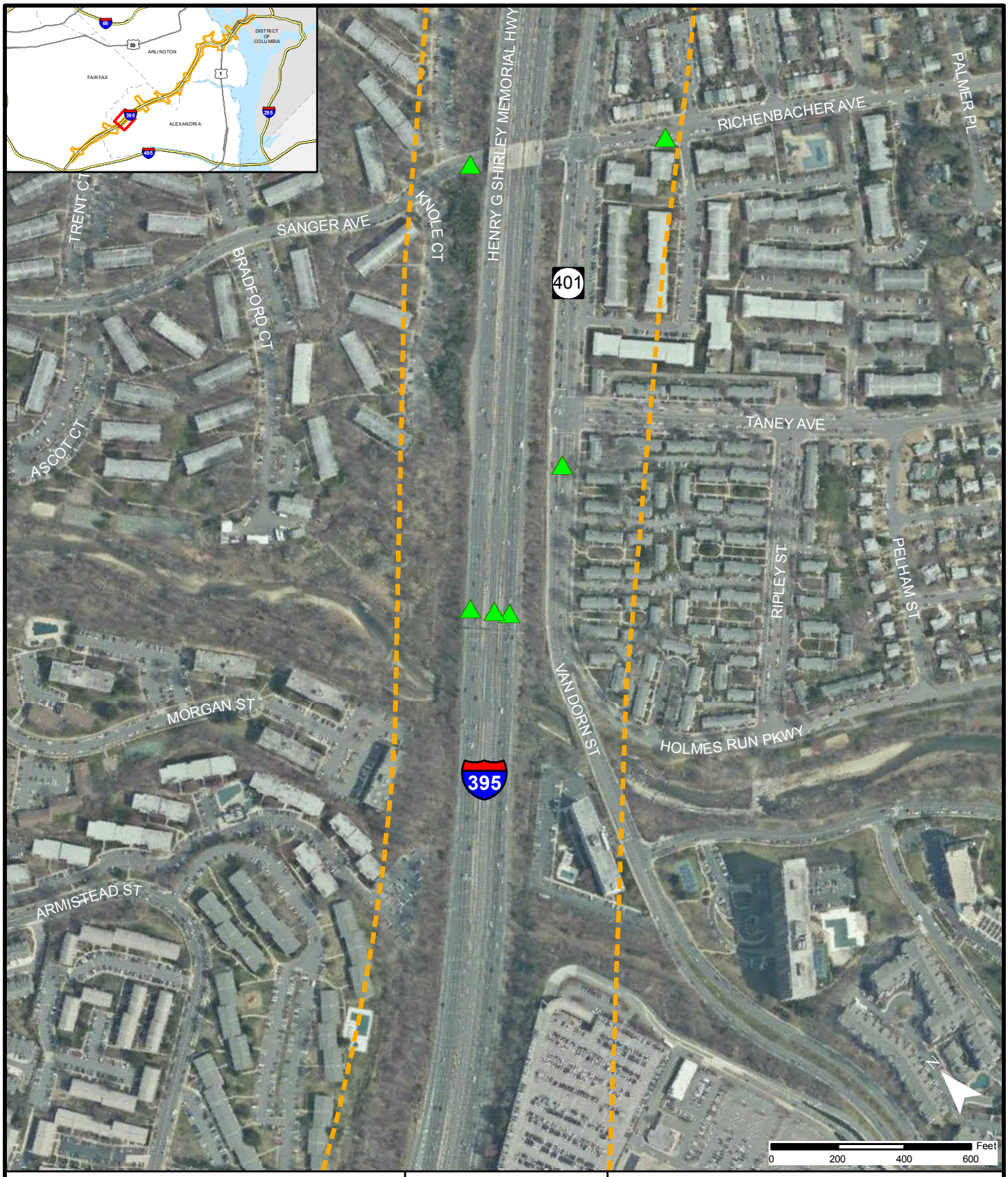
Sheet 3 of 15

VDOT
Virginia Department of Transportation

VDOT Project No. 0395-969-205, P101
UPC 108313

Source: VDOT, ESRI

- 48 Hour Classification Count Location
- Turning Movement Count Location
- I-395 Traffic Operations Analysis Study Area



I-395 Express Lanes

Figure 2: Traffic Count Locations

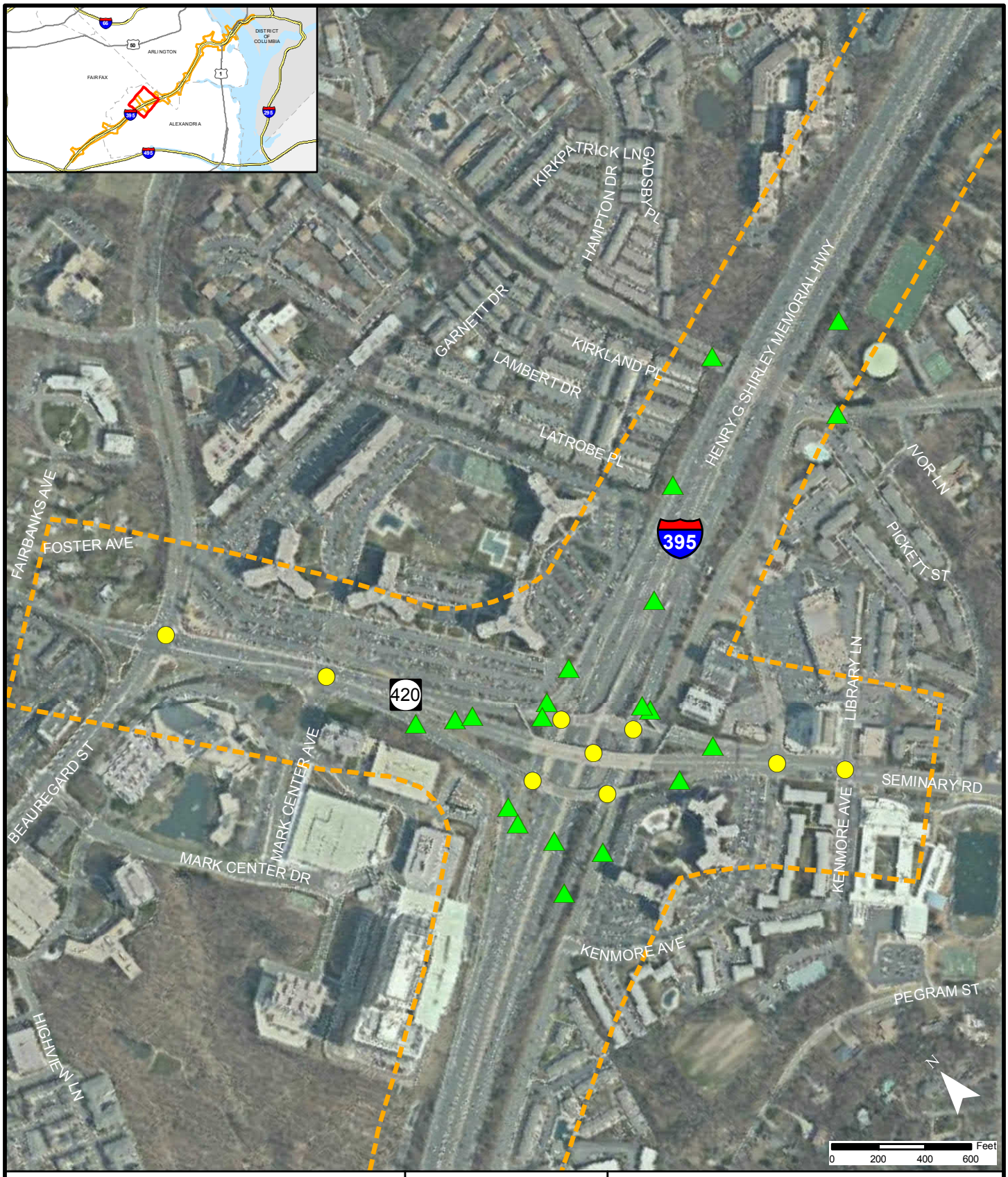
Sheet 4 of 15

VDOT Virginia Department of Transportation

VDOT Project No. 0395-969-205, P101
UPC 108313

Source: VDOT, ESRI

- 48 Hour Classification Count Location
- Turning Movement Count Location
- I-395 Traffic Operations Analysis Study Area



I-395 Express Lanes

Figure 2: Traffic Count Locations

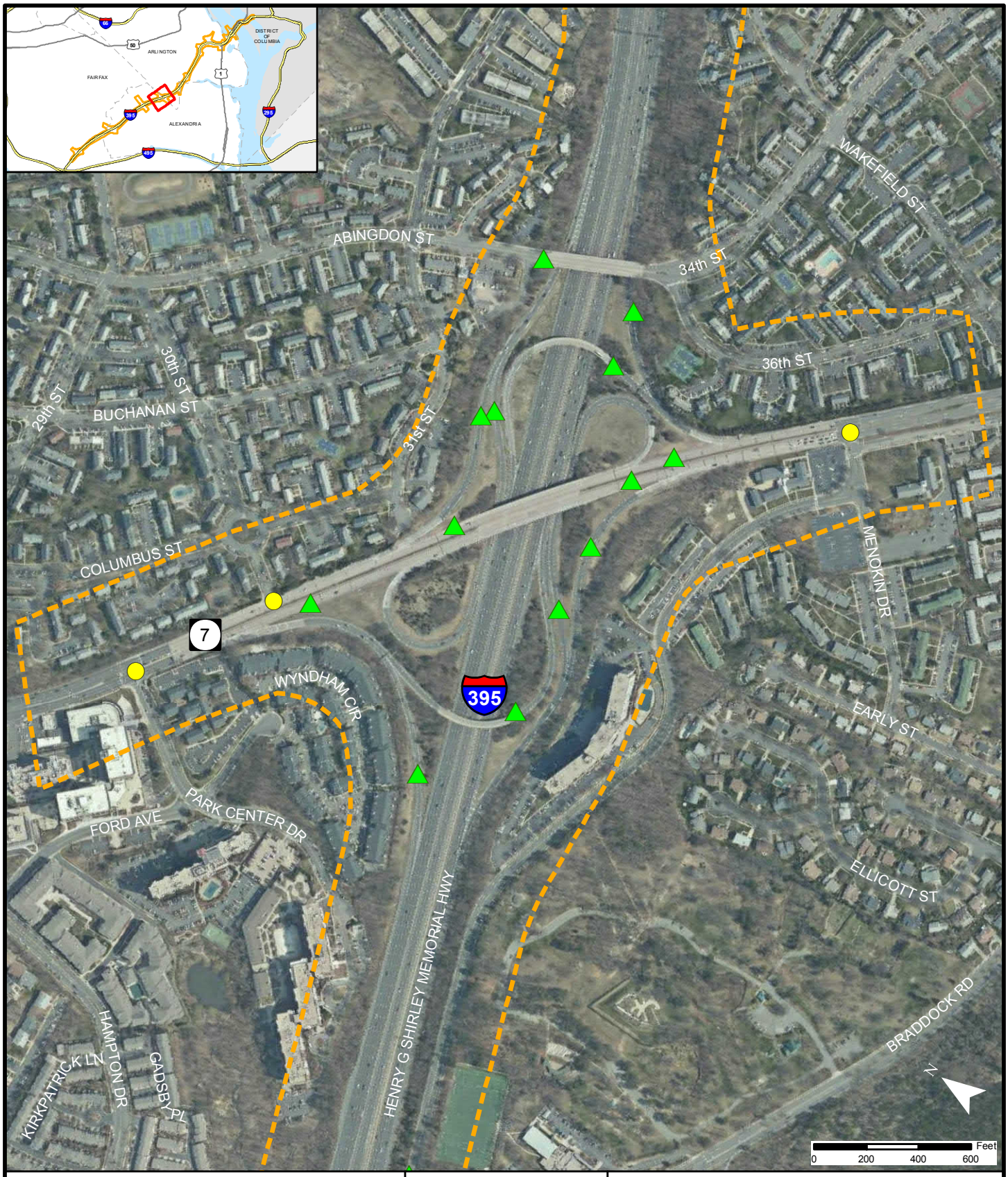
Sheet 5 of 15

VDOT Virginia Department of Transportation

VDOT Project No. 0395-969-205, P101
UPC 108313

Source: VDOT, ESRI

- 48 Hour Classification Count Location
- Turning Movement Count Location
- I-395 Traffic Operations Analysis Study Area



I-395 Express Lanes

Figure 2: Traffic Count Locations

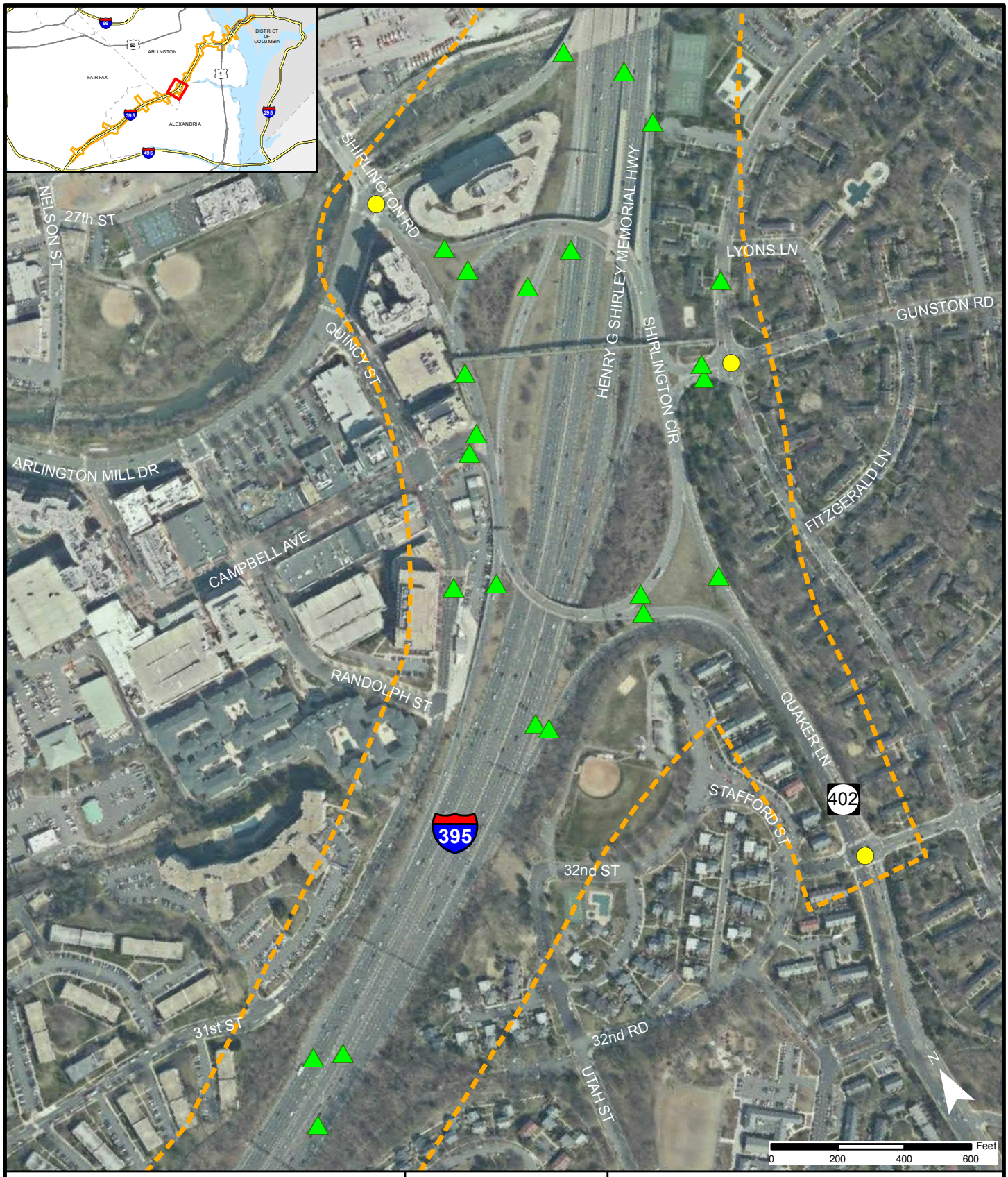
Sheet 6 of 15

VDOT
Virginia Department of Transportation

VDOT Project No. 0395-969-205, P101
UPC 108313

Source: VDOT, ESRI

- 48 Hour Classification Count Location
- Turning Movement Count Location
- I-395 Traffic Operations Analysis Study Area



I-395 Express Lanes

Figure 2: Traffic Count Locations

Sheet 7 of 15

VDOT Virginia Department of Transportation

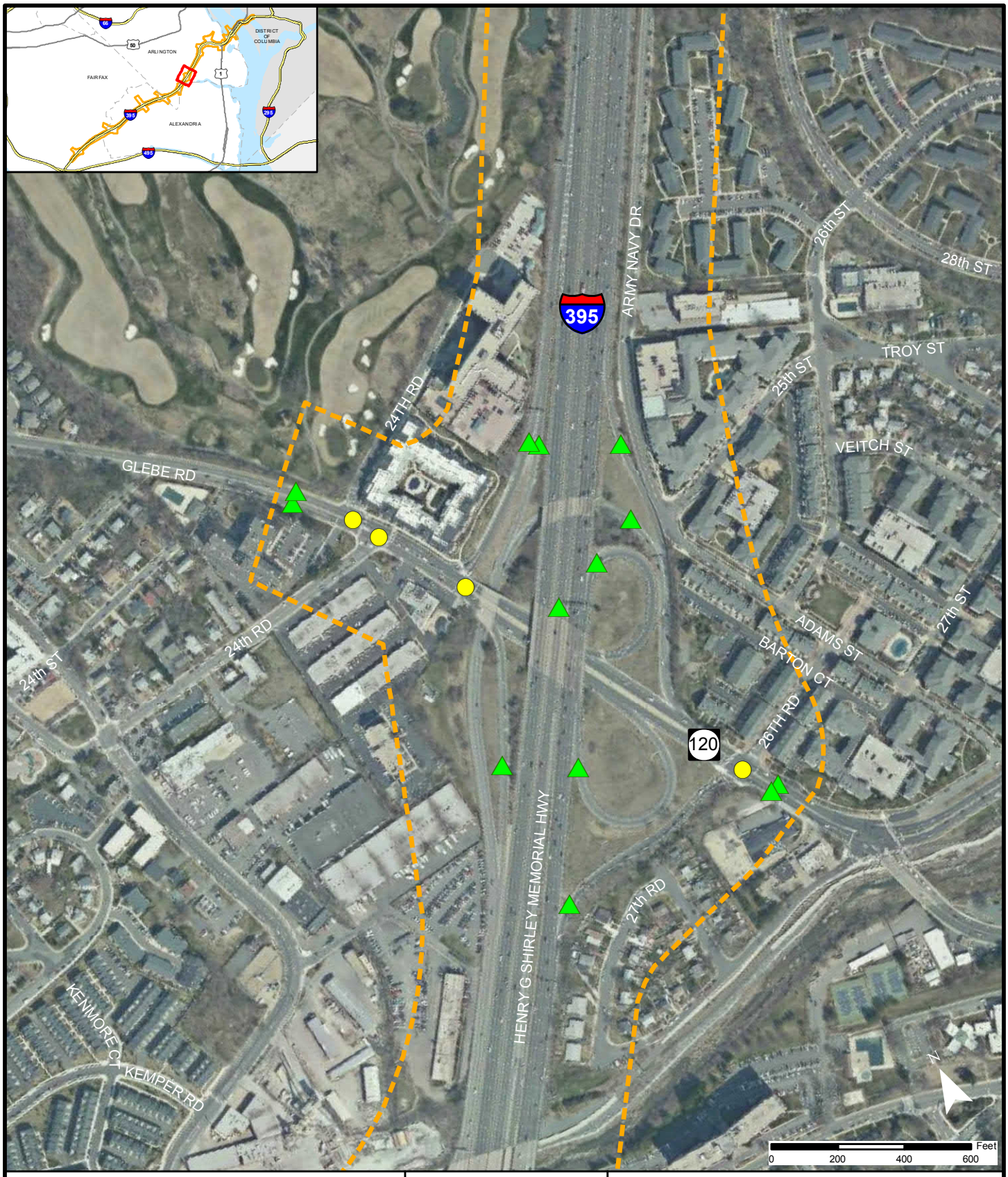
VDOT Project No. 0395-969-205, P101
UPC 108313

Source: VDOT, ESRI

48 Hour Classification Count Location

Turning Movement Count Location

I-395 Traffic Operations Analysis Study Area



I-395 Express Lanes

Figure 2: Traffic Count Locations

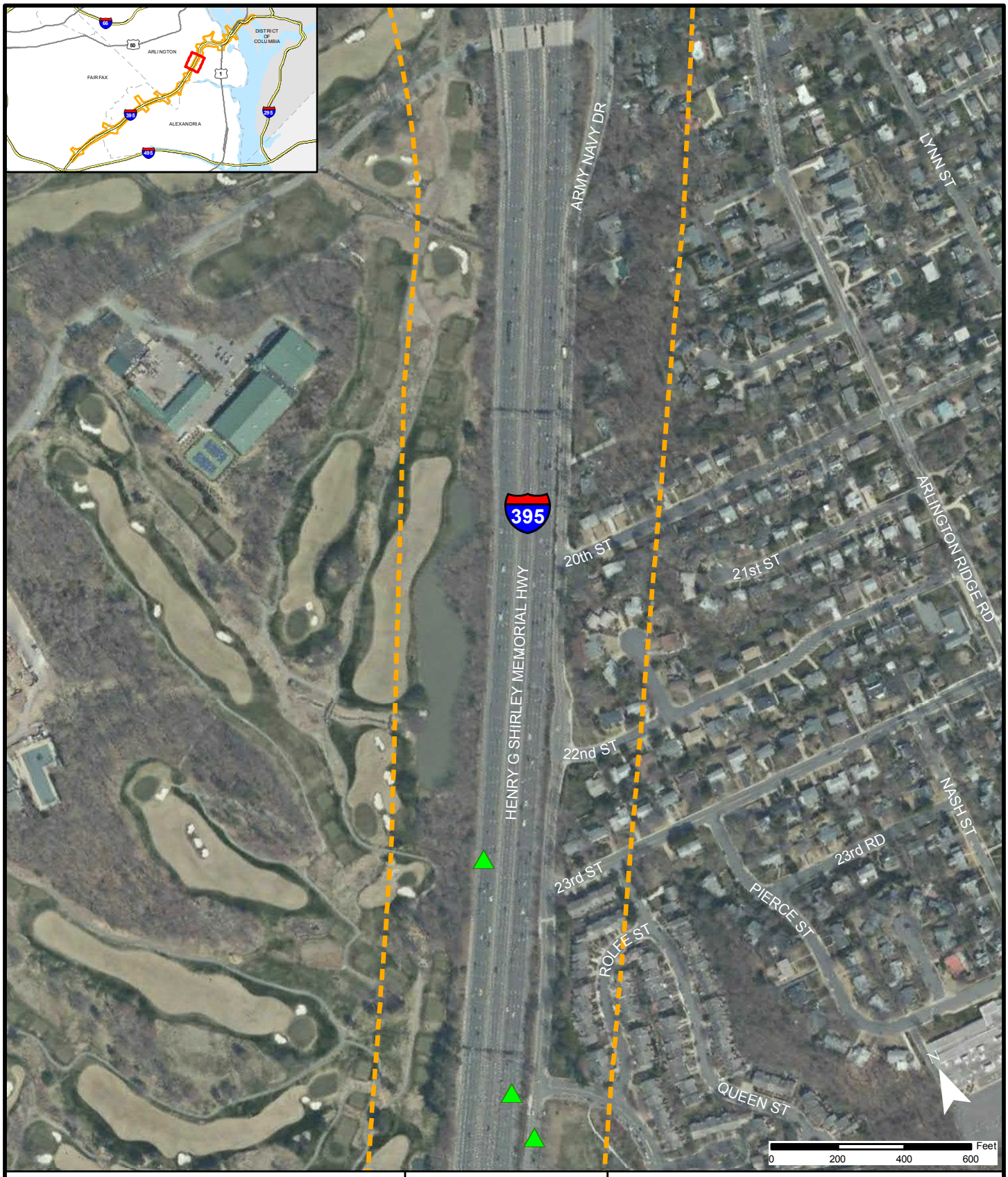
Sheet 8 of 15

VDOT Virginia Department of Transportation

VDOT Project No. 0395-969-205, P101
UPC 108313

Source: VDOT, ESRI

- 48 Hour Classification Count Location
- Turning Movement Count Location
- I-395 Traffic Operations Analysis Study Area



I-395 Express Lanes

Figure 2: Traffic Count Locations

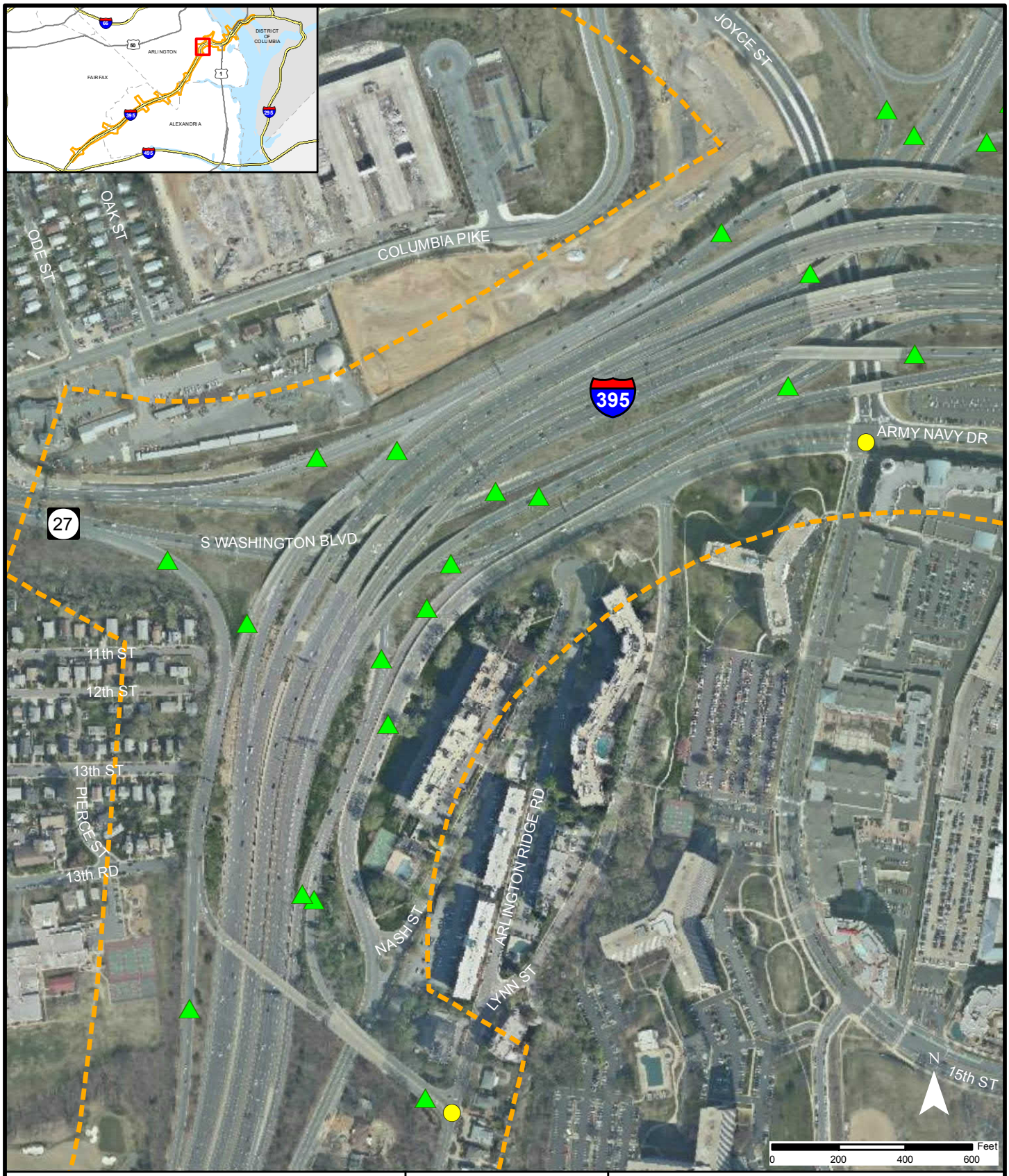
Sheet 9 of 15

VDOT Virginia Department of Transportation

VDOT Project No. 0395-969-205, P101
UPC 108313

Source: VDOT, ESRI

- 48 Hour Classification Count Location
- Turning Movement Count Location
- I-395 Traffic Operations Analysis Study Area



I-395 Express Lanes

Figure 2: Traffic Count Locations

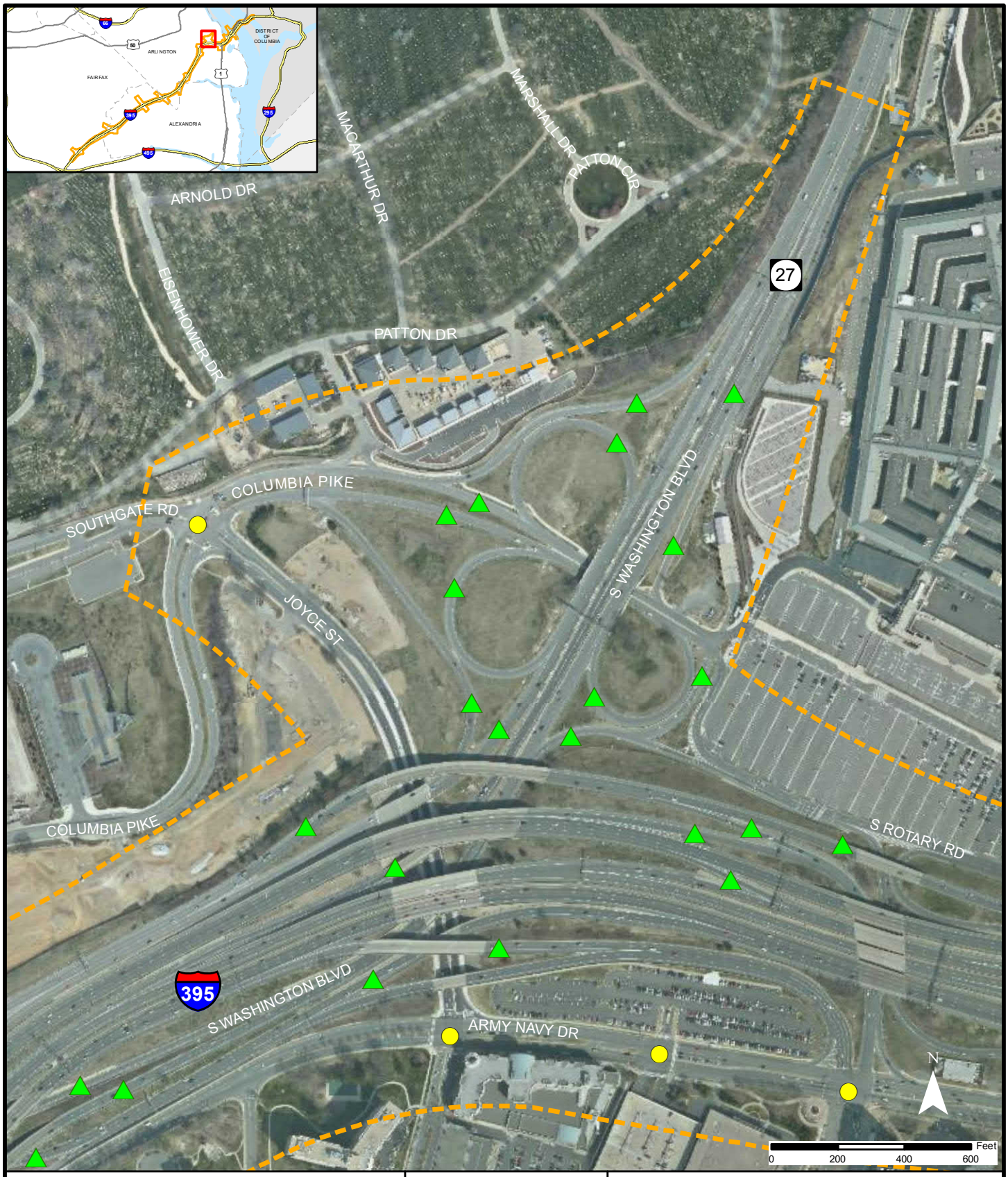
Sheet 10 of 15

VDOT
Virginia Department of Transportation

VDOT Project No. 0395-969-205, P101
UPC 108313

Source: VDOT, ESRI

- 48 Hour Classification Count Location
- Turning Movement Count Location
- I-395 Traffic Operations Analysis Study Area



I-395 Express Lanes

Figure 2: Traffic Count Locations

Sheet 11 of 15

VDOT
Virginia Department of Transportation

VDOT Project No. 0395-969-205, P101
UPC 108313

Source: VDOT, ESRI

48 Hour Classification Count Location

Turning Movement Count Location

I-395 Traffic Operations Analysis Study Area

I-395 Express Lanes

Figure 2: Traffic Count Locations

Sheet 12 of 15

VDOT Virginia Department of Transportation

VDOT Project No. 0395-969-205, P101
UPC 108313

Source: VDOT, ESRI

- 48 Hour Classification Count Location
- Turning Movement Count Location
- I-395 Traffic Operations Analysis Study Area

I-395 Express Lanes

Figure 2: Traffic Count Locations

Sheet 13 of 15

VDOT
Virginia Department of Transportation

VDOT Project No. 0395-969-205, P101
UPC 108313

Source: VDOT, ESRI

- 48 Hour Classification Count Location
- Turning Movement Count Location
- I-395 Traffic Operations Analysis Study Area

I-395 Express Lanes

Figure 2: Traffic Count Locations

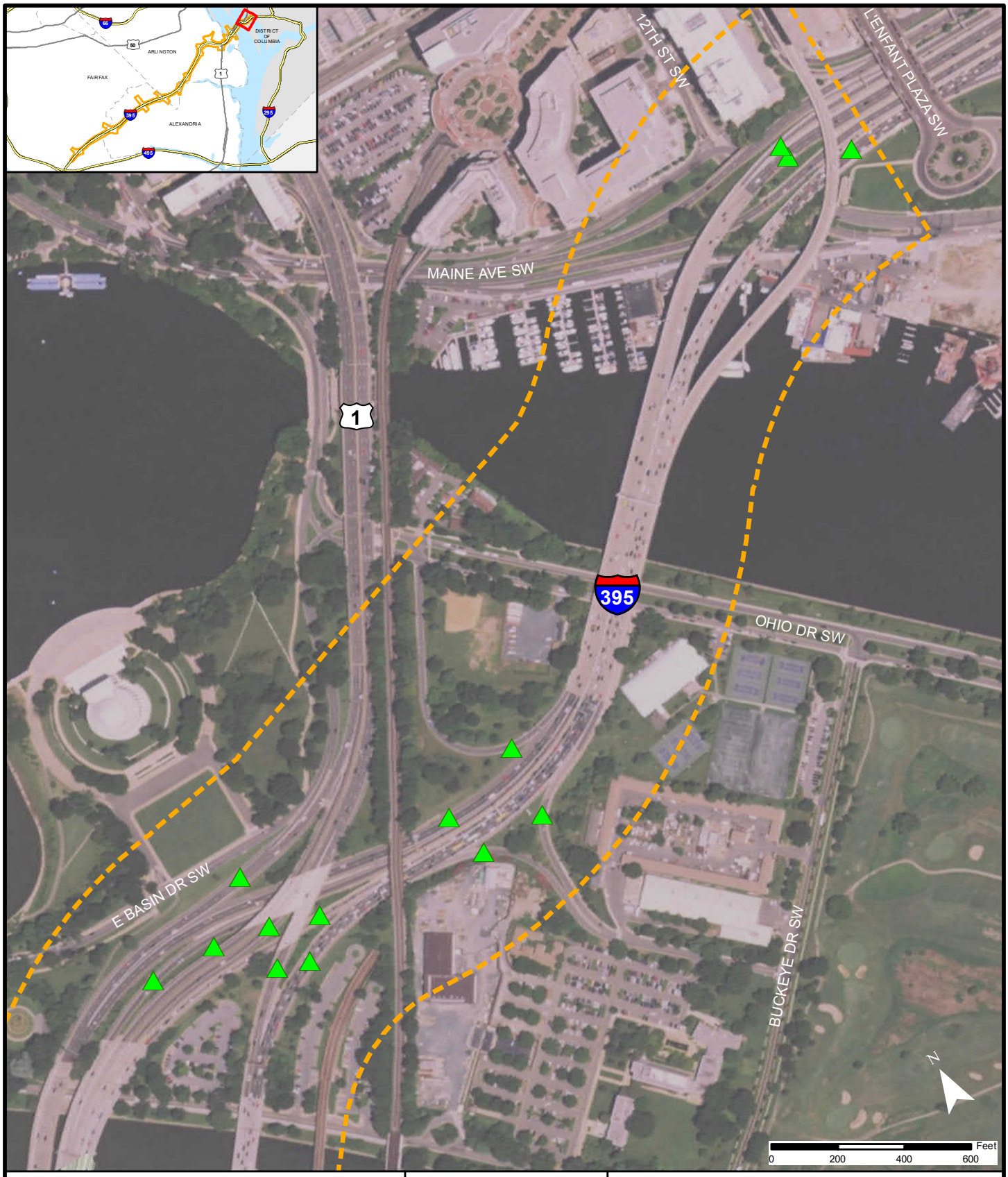
Sheet 14 of 15

VDOT
Virginia Department of Transportation

VDOT Project No. 0395-969-205, P101
UPC 108313

Source: VDOT, ESRI

- 48 Hour Classification Count Location
- Turning Movement Count Location
- I-395 Traffic Operations Analysis Study Area



I-395 Express Lanes

Figure 2: Traffic Count Locations

Sheet 15 of 15

VDOT Virginia Department of Transportation

VDOT Project No. 0395-969-205, P101
UPC 108313

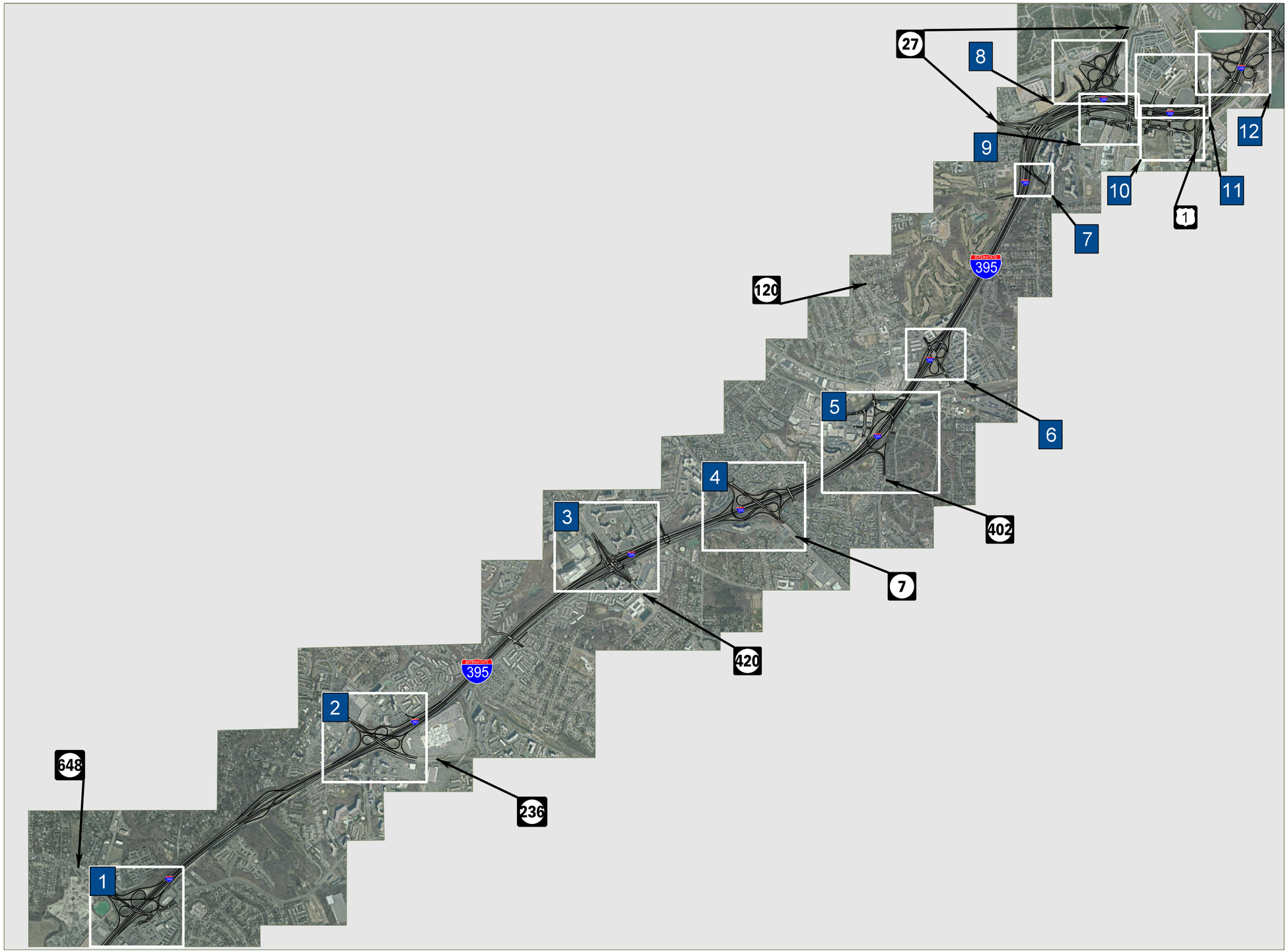
Source: VDOT, ESRI

48 Hour Classification Count Location

Turning Movement Count Location

I-395 Traffic Operations Analysis Study Area

Appendix B: Existing (2015) Intersection Peak Hour Volumes

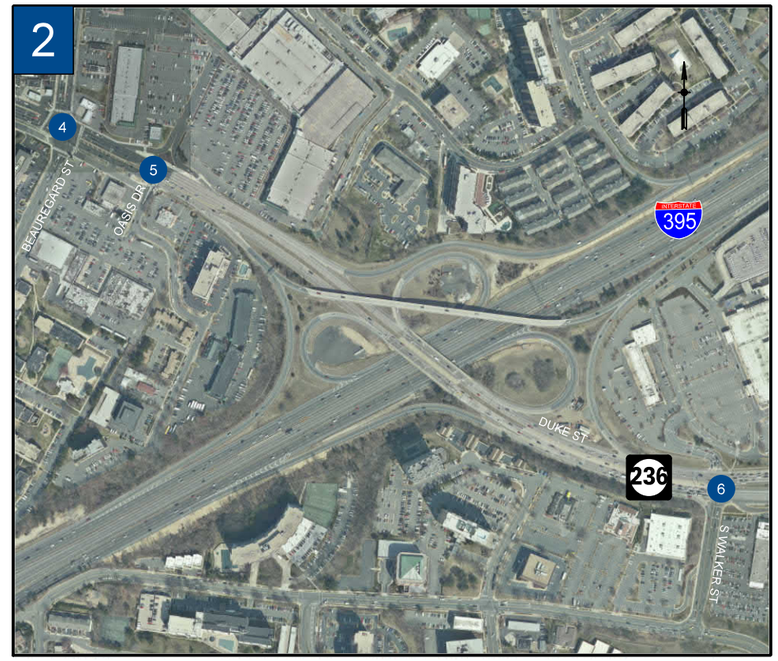


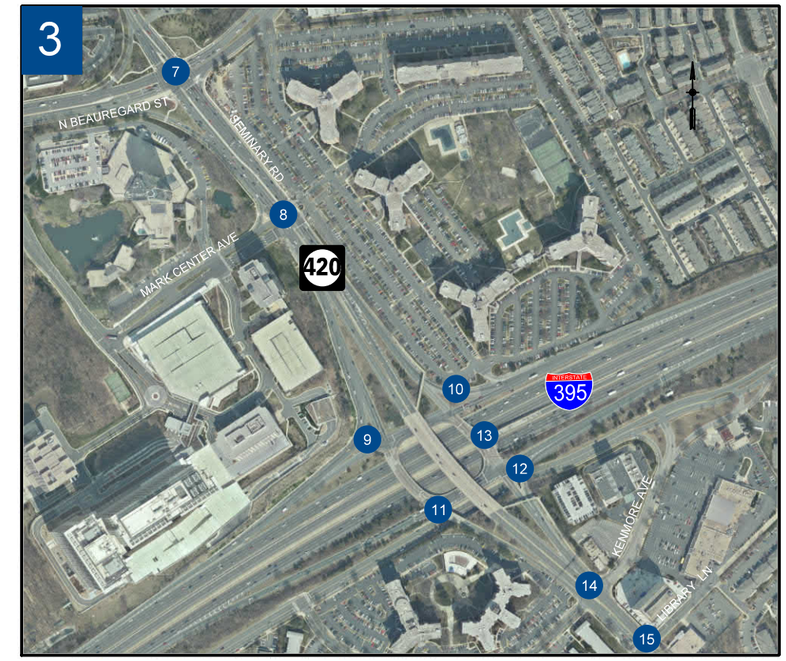
I-395 EXPRESS LANES NORTHERN EXTENSION

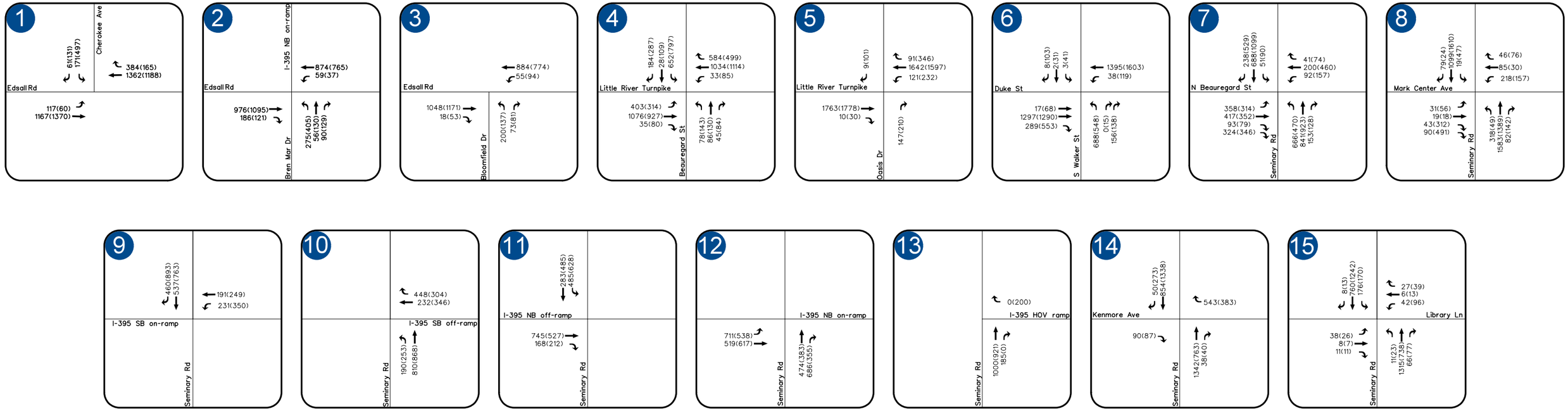
LEGEND

XX INSET NUMBER

2015 AM (PM) Peak Hour Volumes
KEY MAP







I-395 EXPRESS LANES NORTHERN EXTENSION

LEGEND

- XX — INSET NUMBER
- XX — EXISTING INTERSECTION NUMBER
- ← xx(xx) — AM(PM) PEAK HOUR TRAFFIC VOLUMES

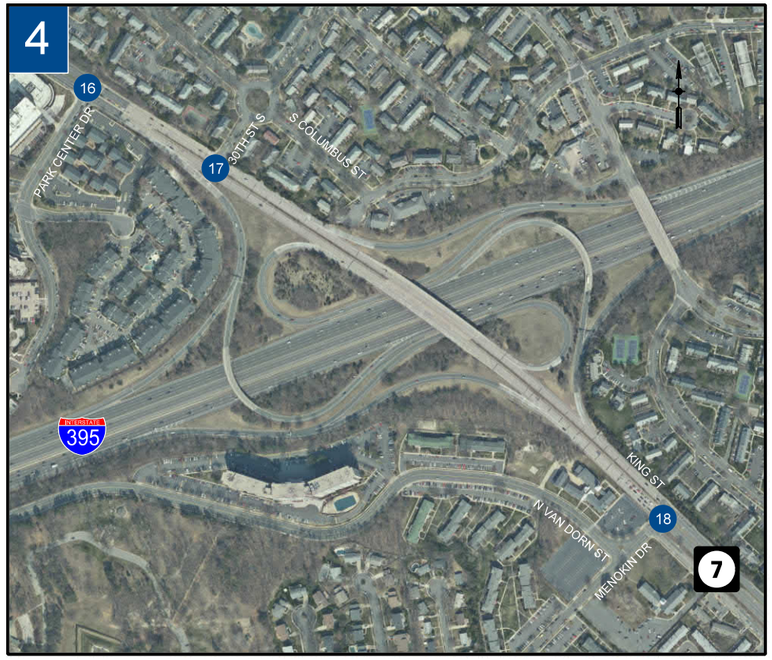
395 ExpressLanes

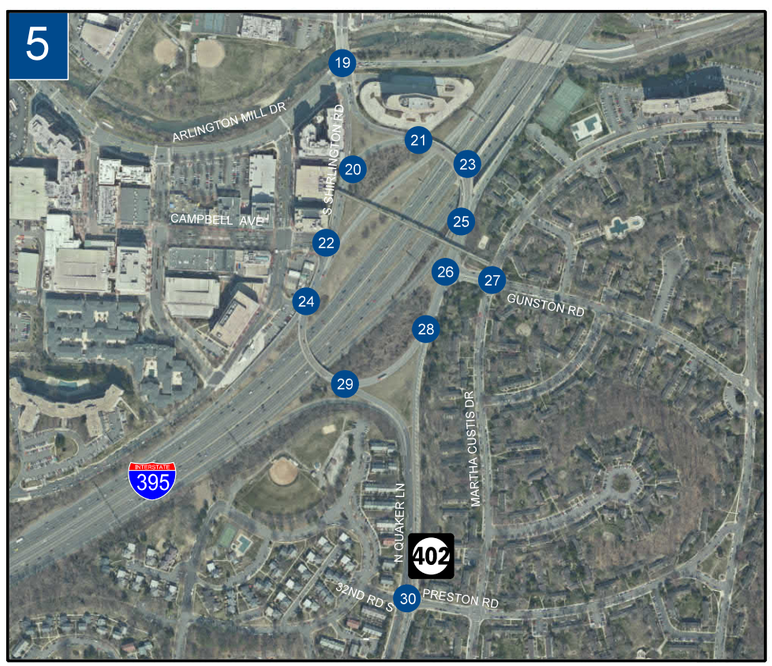
VDOT

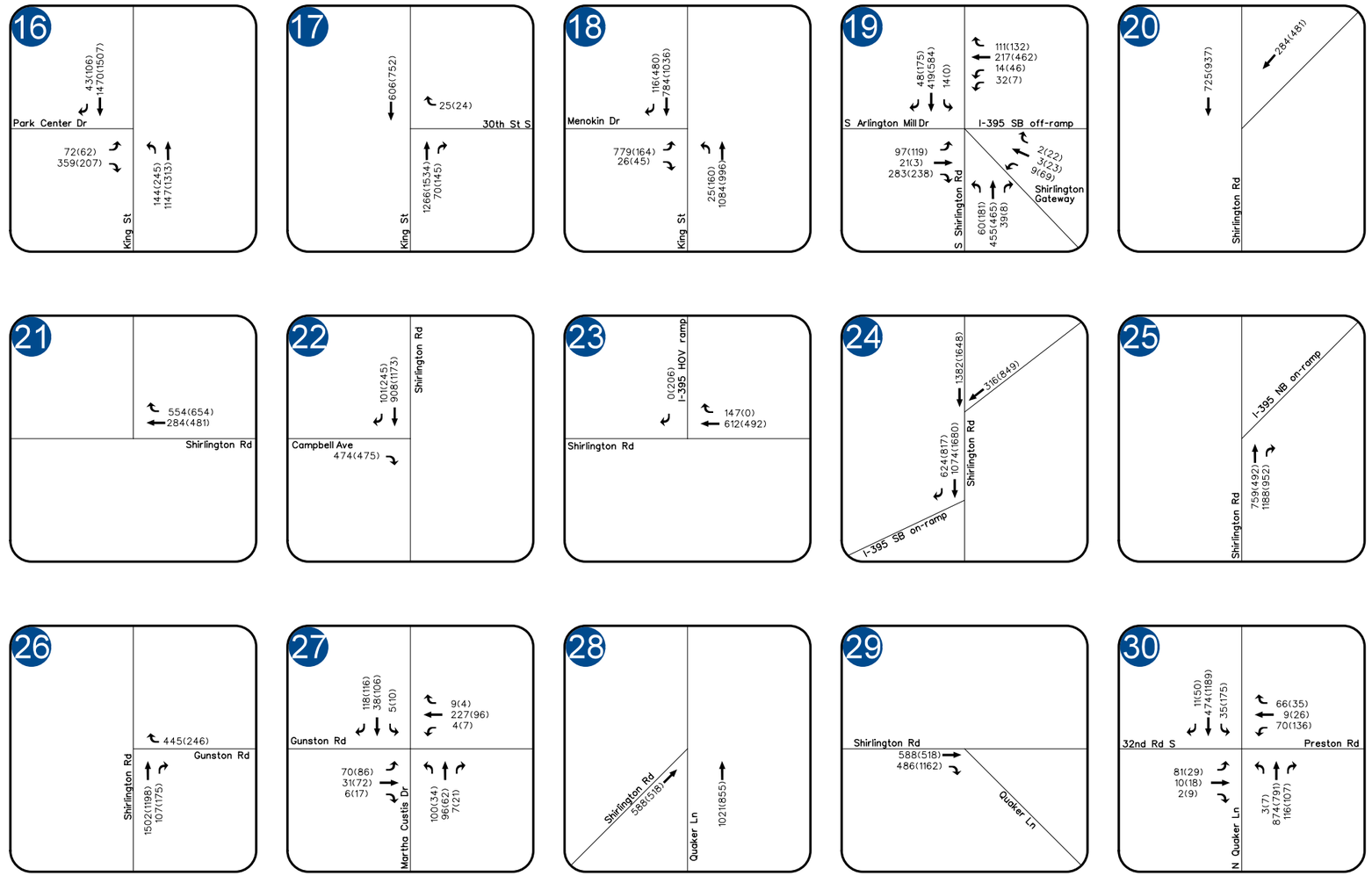
DRPT

2015 AM (PM) Peak Hour Volumes

Sheet 1 of 4







I-395 EXPRESS LANES NORTHERN EXTENSION

LEGEND

- XX — INSET NUMBER
- XX — EXISTING INTERSECTION NUMBER
- ← xx(xx) — AM(PM) PEAK HOUR TRAFFIC VOLUMES

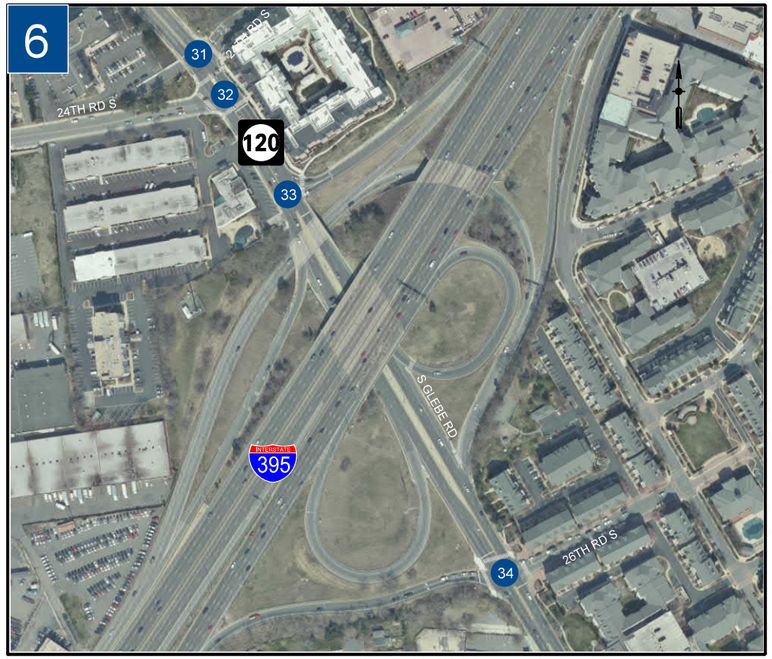
395 ExpressLanes

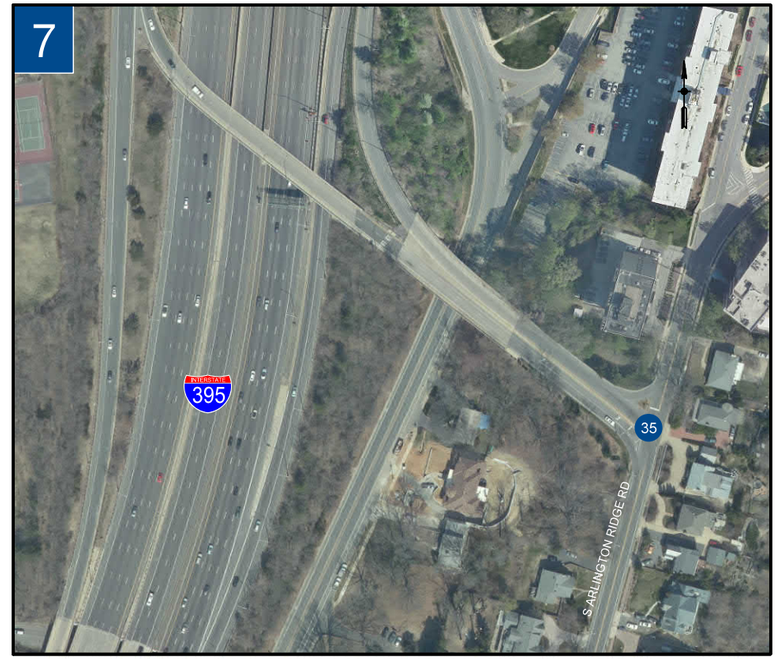
VDOT

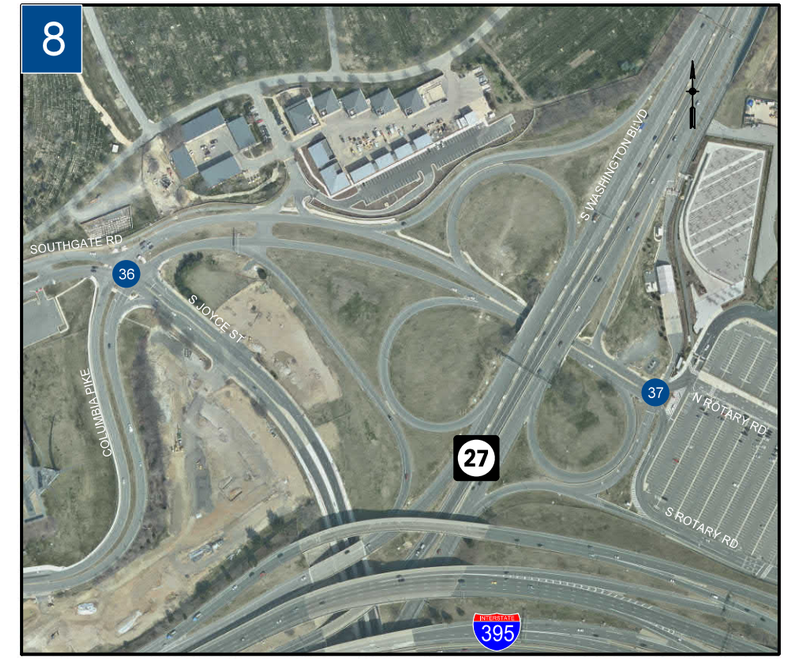
DRPT

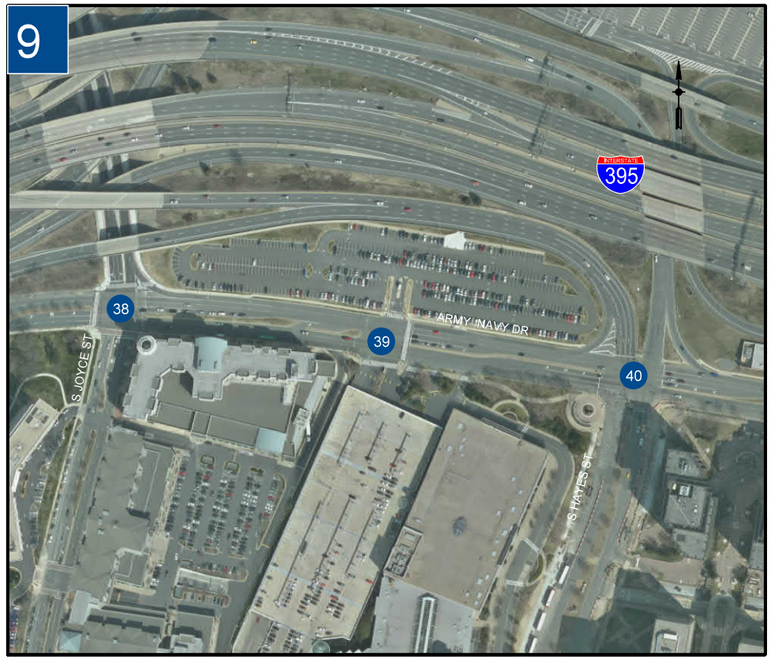
2015 AM (PM) Peak Hour Volumes

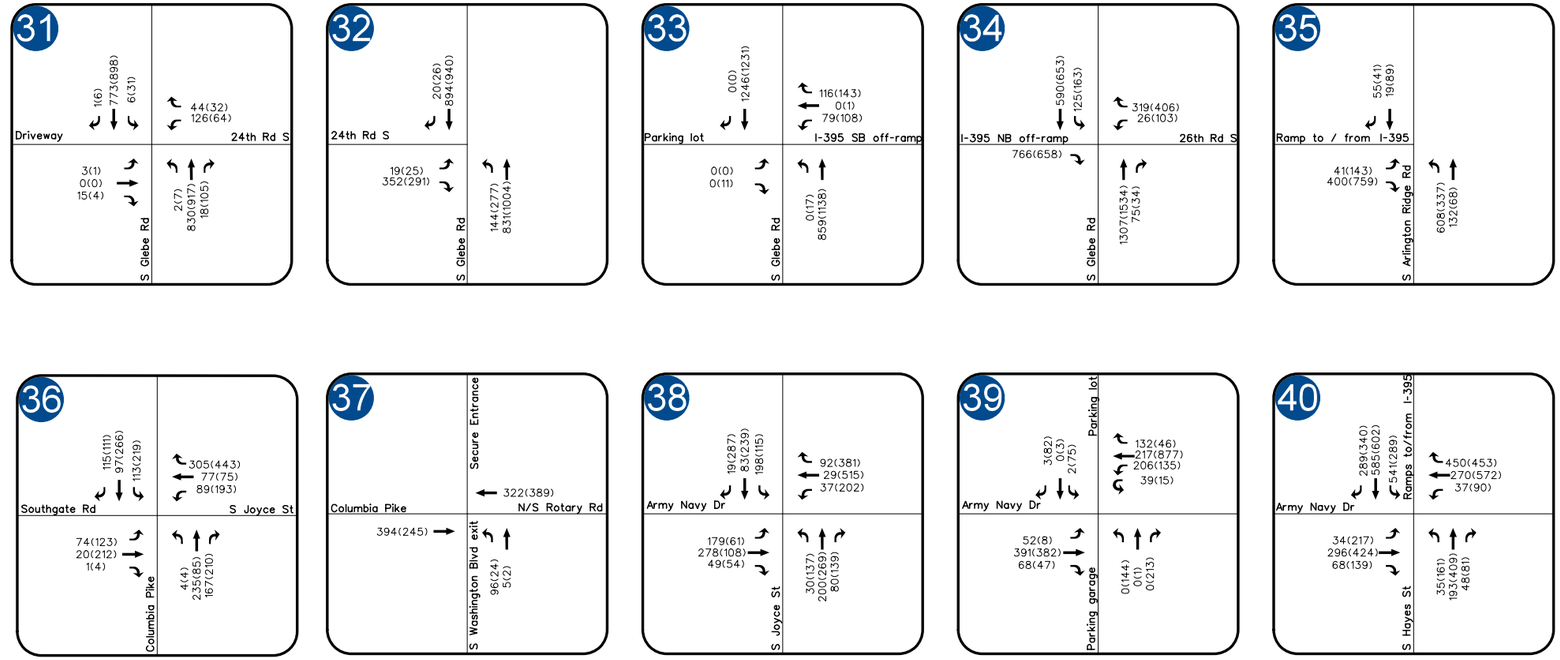
Sheet 2 of 4











I-395 EXPRESS LANES NORTHERN EXTENSION

LEGEND

- XX — INSET NUMBER
- XX — EXISTING INTERSECTION NUMBER
- ← xx(xx) — AM(PM) PEAK HOUR TRAFFIC VOLUMES

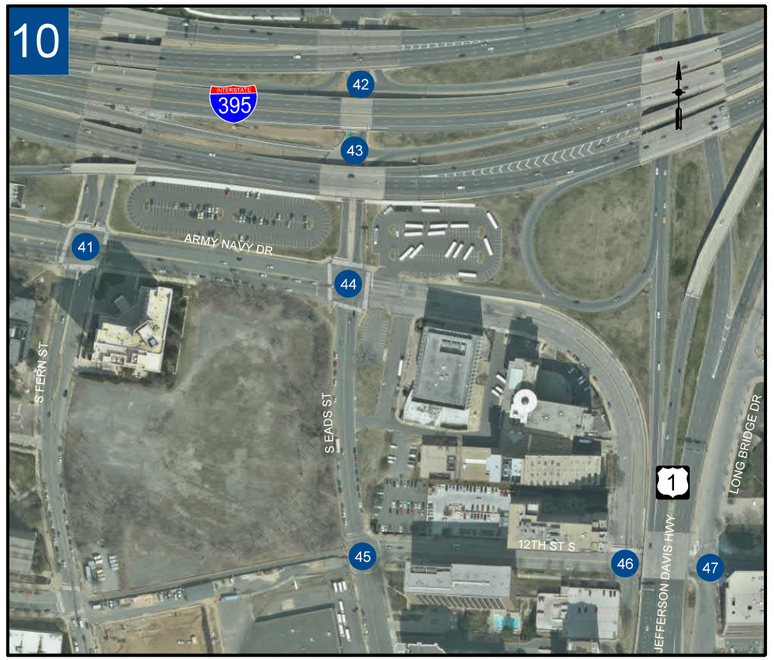
395 ExpressLanes

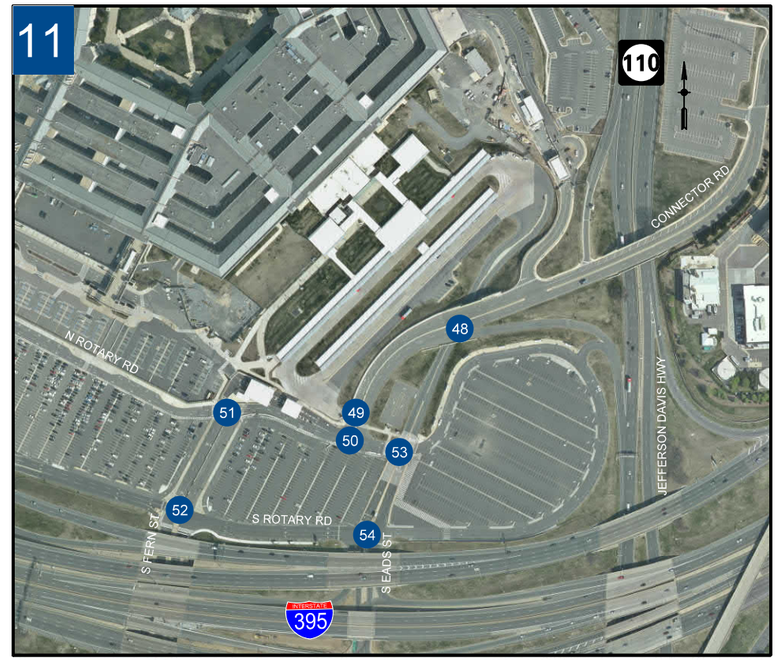
VDOT

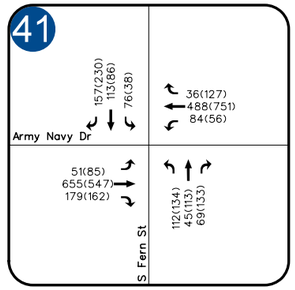
DRPT

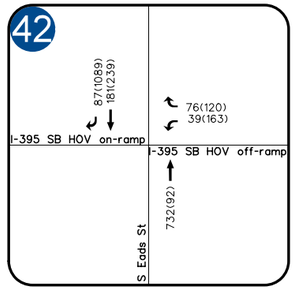
2015 AM (PM) Peak Hour Volumes

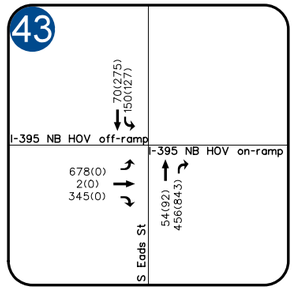
Sheet 3 of 4

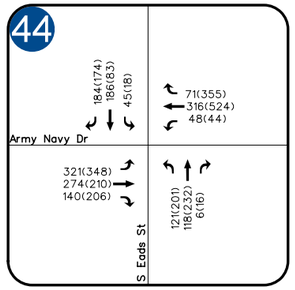


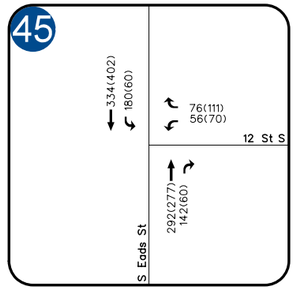


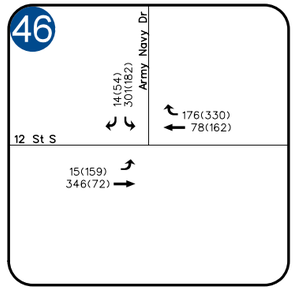


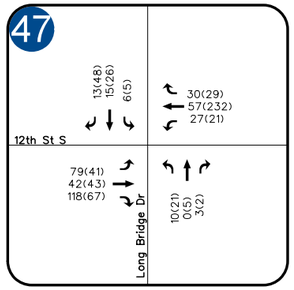


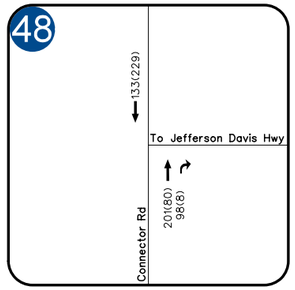


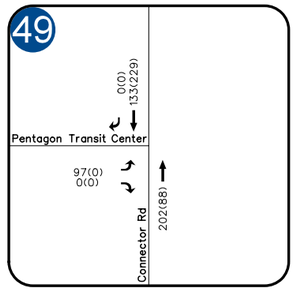


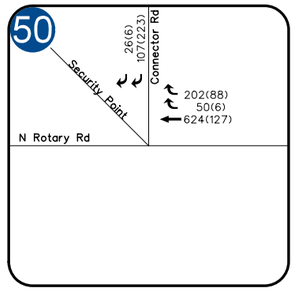


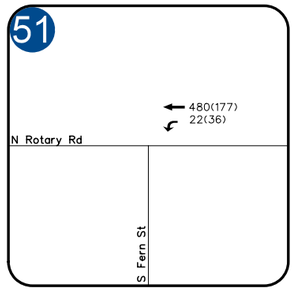


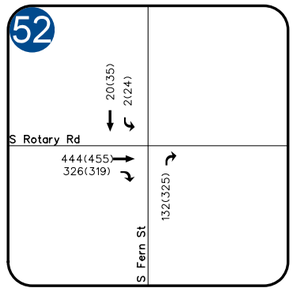


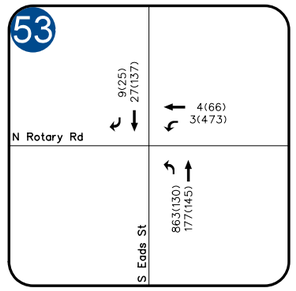


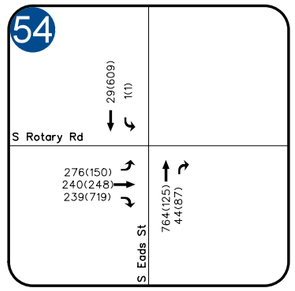


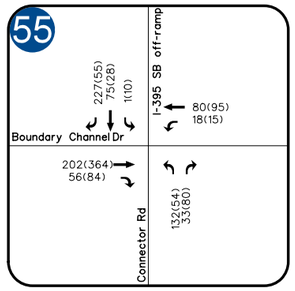


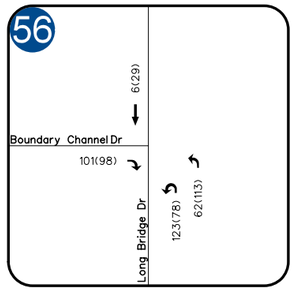












I-395 EXPRESS LANES NORTHERN EXTENSION

LEGEND

- XX — INSET NUMBER
- XX — EXISTING INTERSECTION NUMBER
- ← xx(xx) — AM(PM) PEAK HOUR TRAFFIC VOLUMES

395 ExpressLanes

VDOT

DRPT

2015 AM (PM) Peak Hour Volumes

Sheet 4 of 4

Appendix C: VISUM/VISSIM Calibration Memorandum

TECHNICAL MEMORANDUM

Subject: **VISUM / VISSIM Base Model Development, Calibration and Validation to Support the Environmental Assessment for the I-395 Express Lanes**

Date: **August 1, 2016**

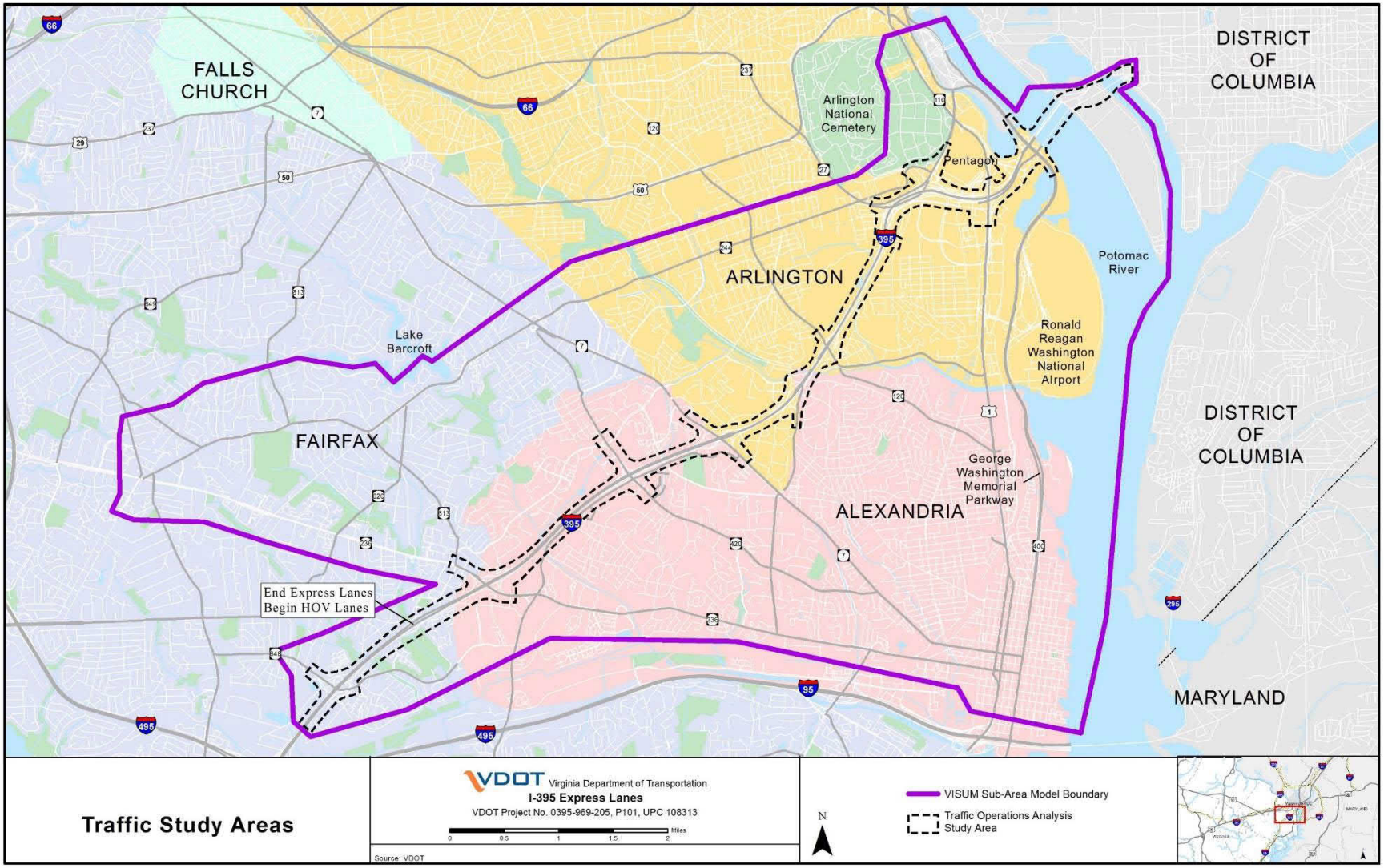
Introduction

To provide consistency with the regional planning efforts, the MWCOG Travel Demand Forecasting Model, Version 2.3 Build 57a (adopted on October 21, 2015), also known as the Version 2.3.57a Travel Model was used as the basis for the development of traffic forecasts. Memoranda summarizing the travel demand model methodology, calibration, and validation are contained in **Appendices F and G** of the ***Traffic and Transportation Technical Report***, respectively. The purpose of this memorandum is to describe the development of the base VISUM model used to produce daily, AM peak period, and PM peak period forecasts and the VISSIM mesoscopic model used to generate measures of effectiveness to support the ***Environmental Assessment*** for the I-395 Express Lanes project.

VISUM Model Development

A VISUM model was established to produce daily, AM, and PM peak period traffic volumes at a more detailed level than the MWCOG model and to produce the input files needed for VISSIM mesoscopic analysis. The traffic study area encompasses approximately ten miles of existing I-395 from south of the Edsall Road interchange to the 12th Street Expressway in Washington, D.C. which is located just north of the entry and exit points of the existing HOV facility along I-395. The study area along the arterials interchanging with I-395 generally includes one major signalized intersection (where applicable) on either side of the interstate and all general purpose and HOV ramps serving I-395. For the purposes of traffic forecasting, the VISUM study area was extended beyond the traffic analysis study area to account for potential shifts in traffic between competing roadways within the project area vicinity (**Figure 1**).

Figure 1: Traffic Study Areas



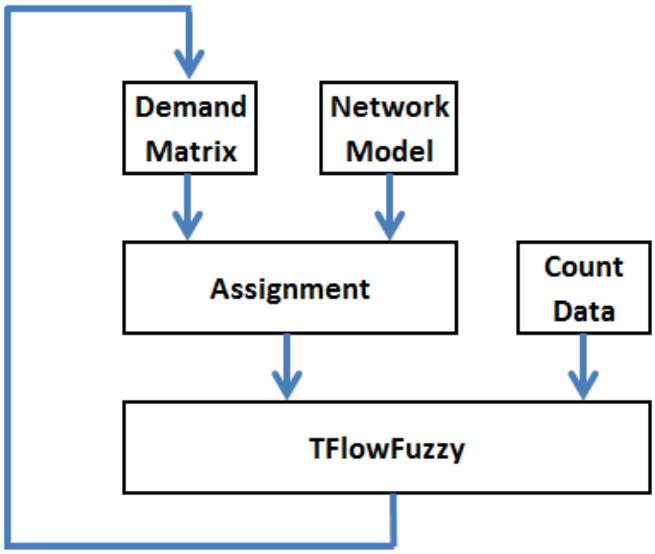
The MWCOG model network was imported into VISUM and refined to include the detailed geometry of all roadway and intersections within the study area, including signalized intersections and key unsignalized intersections. Existing signal timing data provided by VDOT, Arlington County, and the City of Alexandria was coded into VISUM at signalized intersections. Traffic analysis zones (TAZs) that serve multiple driveways/developments were subdivided to ensure an accurate traffic assignment at the peak hour level. The MWCOG subarea origin and destination (O-D) matrices were exported as daily, AM, and PM peak period matrices and used as a seed matrix for the initial VISUM traffic assignment: the starting point of the VISUM model calibration and validation process. The MWCOG matrices were exported to align with the time periods of the HOV restrictions. The MWCOG matrices were aggregated appropriately to produce SOV/HOV-2, HOV-3, and Truck matrices for assignment in VISUM.

VISUM Model Calibration and Validation

Model calibration and validation refers to the process that confirms the model provides a reasonable approximation of reality (validation) and makes any adjustments to the model to bring it within desired validation targets (calibration). This ensures that the model accurately represents existing traffic conditions.

Traffic counts were the primary data used in assessing the validity of a VISUM trip assignment step. Raw traffic counts were adjusted and balanced to reflect traffic demand along the I-395 corridor and its arterial cross streets. These balanced counts for each segment and turning movement counts were imported into the appropriate links and turns in VISUM. VISUM was then calibrated to match the existing link and turning movement demand volumes using its matrix estimation tool, TFlowFuzzy. This built-in procedure adjusts a demand matrix so that its assignment results match observed traffic counts (i.e., demand volumes). An iterative process shown in **Figure 2** was utilized for the I-395 model to estimate the peak hour O-D matrices using TFlowFuzzy.

Figure 2: VISUM Trip Assignment Iterative Process



The first step of the iterative process is to establish the known traffic volumes within the network and set a tolerance for how closely the process should match those counts. TFlowFuzzy evaluates the assigned demand matrix, possible route choices, the count value, and the set tolerance and mathematically solves for a new demand matrix. After this, the new matrix is checked for reasonableness, assigned, and solved again until the desired tolerance is reached. TFlowFuzzy often provides assigned volumes much closer than the specified tolerance. This process was iterated until the link and turning movement volumes were in line with the demand volumes for the average weekday daily traffic (AWDT) and each hour within the 10-hour analysis period (5 – 10 AM and 2 – 7 PM). A discussion regarding the selection of the analysis periods is included in the VISSIM Model section of this memorandum.

According to the *VTM Policies and Procedures Manual*, the Percent Root Mean Square Error (%RMSE) and the Coefficient of Determination (R^2) are two main highway assignment validation procedures for Virginia travel demand models. A third industry-standard validation criterion commonly used is the Geoffrey E. Havers statistic formula (GEH). All three criteria measure the differences between the traffic volumes predicted by the model and the traffic volumes observed and collected in the field. The thresholds for these target values are the same for both links and turns (**Table 1**).

Table 1: VISUM Validation Criteria Thresholds

Criteria and Measures	Validation Acceptance Targets
%RMSE Statistic	< 20%
R^2 Statistic	> 0.98
GEH Statistic < 5	> 85% of count locations

Calibration Results

The TFlowFuzzy process produced a VISUM assignment that closely matched the desired demand volumes within the network. All hours within the 10-hour analysis period and the AWDT well exceeded the three validation acceptance targets (**Tables 2 and 3**). The corresponding goodness-of-fit regression plots for both links and turns of each hour are show in **Figures 3 through 25**.

Following validation of the VISUM peak hour models, the finalized demand matrices were imported into PTV's VISSIM 8 mesoscopic simulation software. The mesoscopic model was used to generate traffic operations measures of effectiveness (MOEs).

Table 2: Overall Links Validation Summary

Criteria and Measures	Validation Acceptance Targets	AWDT	5-6 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM	2-3 PM	3-3:30 PM	3:30-4 PM	4-5 PM	5-6 PM	6-7 PM
%RMSE Statistic	< 20%	1.73	6.22	1.70	1.83	3.21	2.51	1.27	2.31	2.15	2.02	2.20	2.15
R^2 Statistic	> 0.92	0.9999	0.9986	0.9999	0.9998	0.9993	0.9996	0.9999	0.9997	0.9997	0.9997	0.9996	0.9997
GEH Statistic < 5	> 85%	93	94	99	99	94	97	100	100	100	99	99	100

Figure 3: Roadway Link R-Squared Plot – AWDT

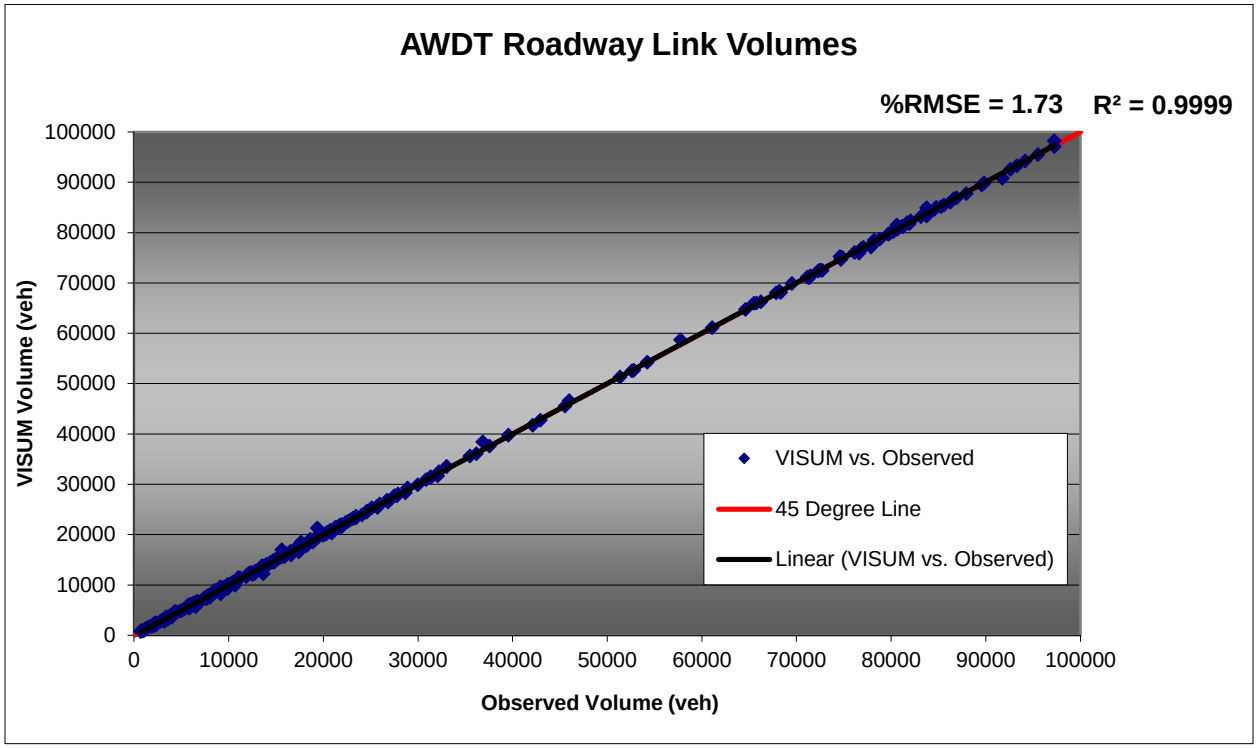


Figure 4: Roadway Link R-Squared Plot – 5-6 AM

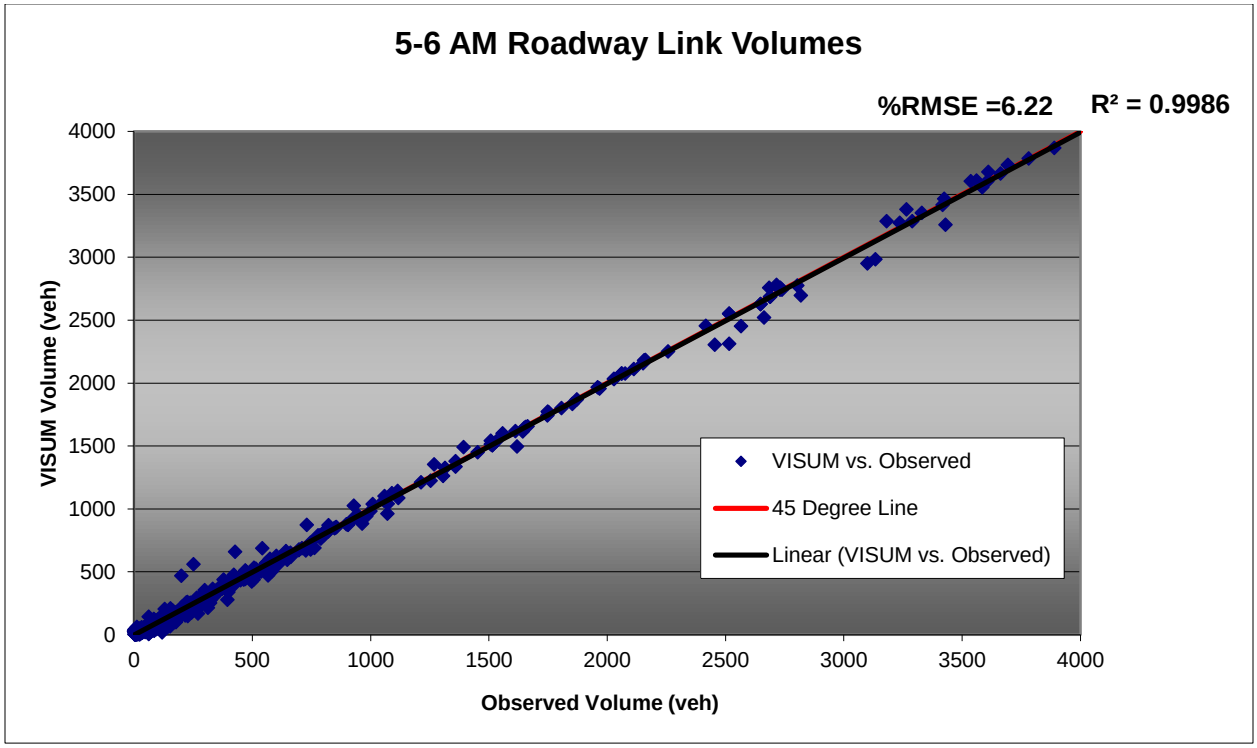


Figure 5: Roadway Link R-Squared Plot – 6-7 AM

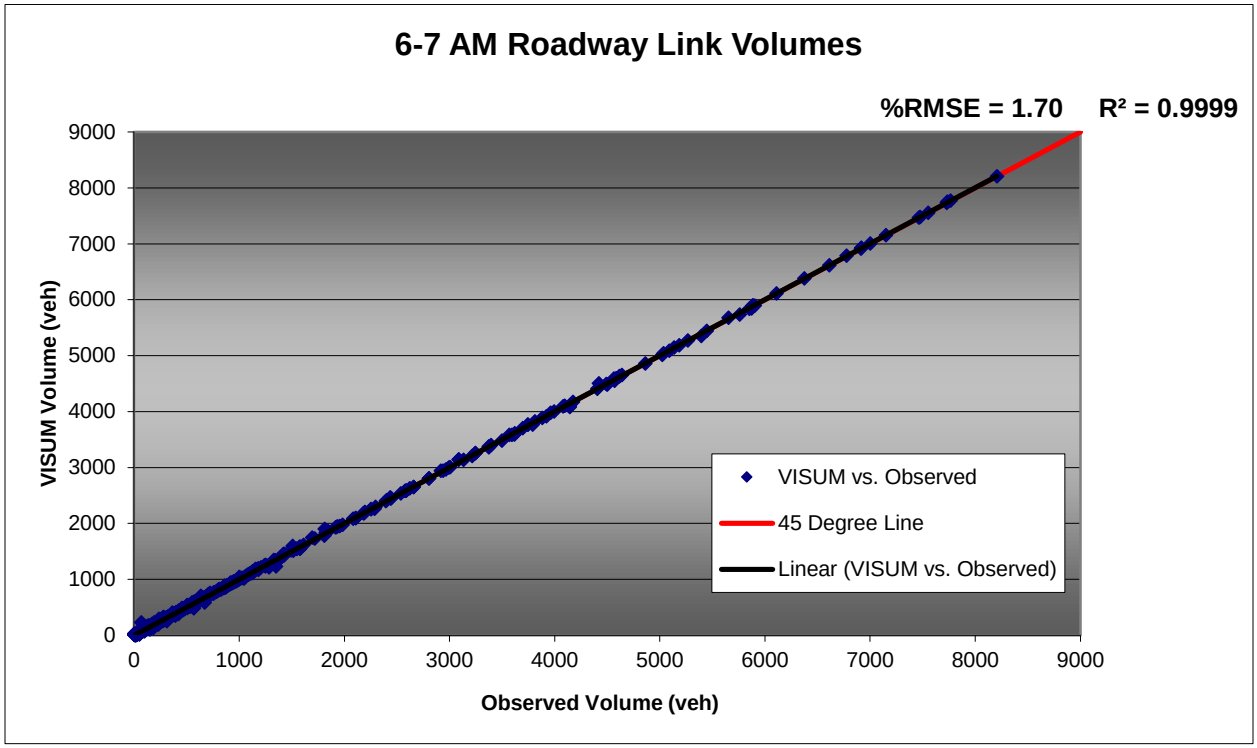


Figure 6: Roadway Link R-Squared Plot – 7-8 AM

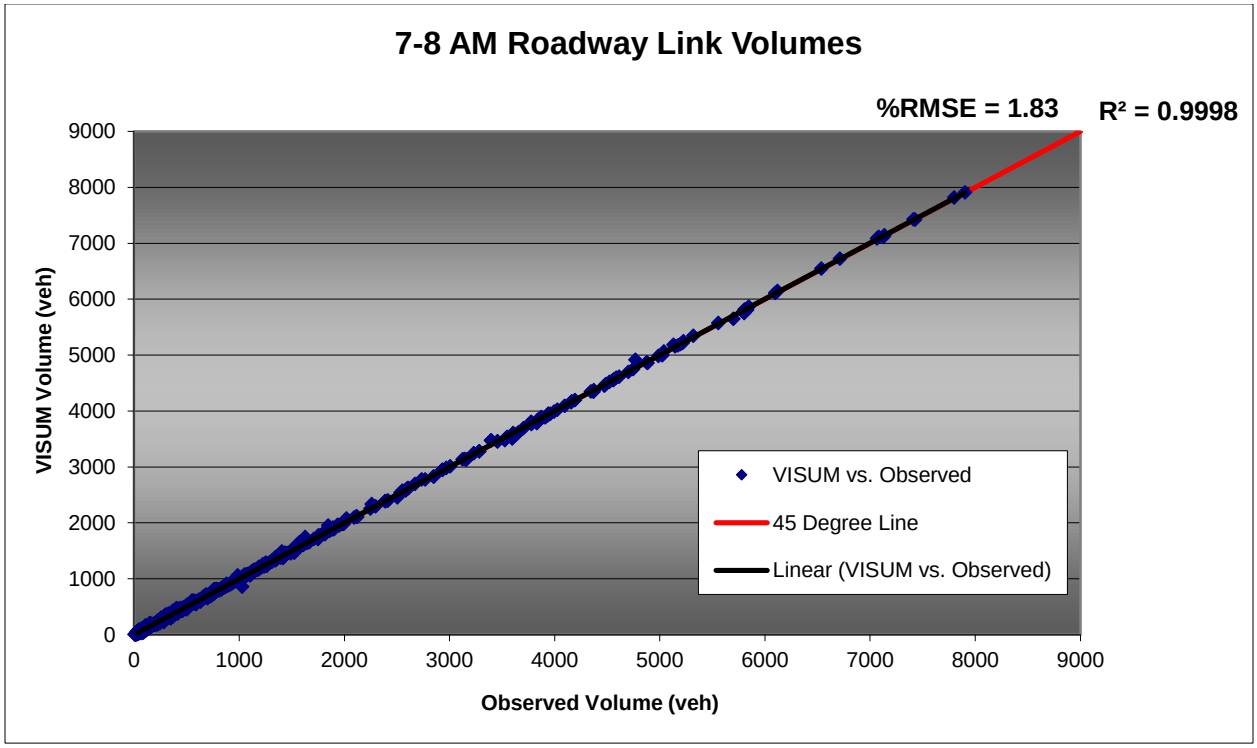


Figure 7: Roadway Link R-Squared Plot – 8-9 AM

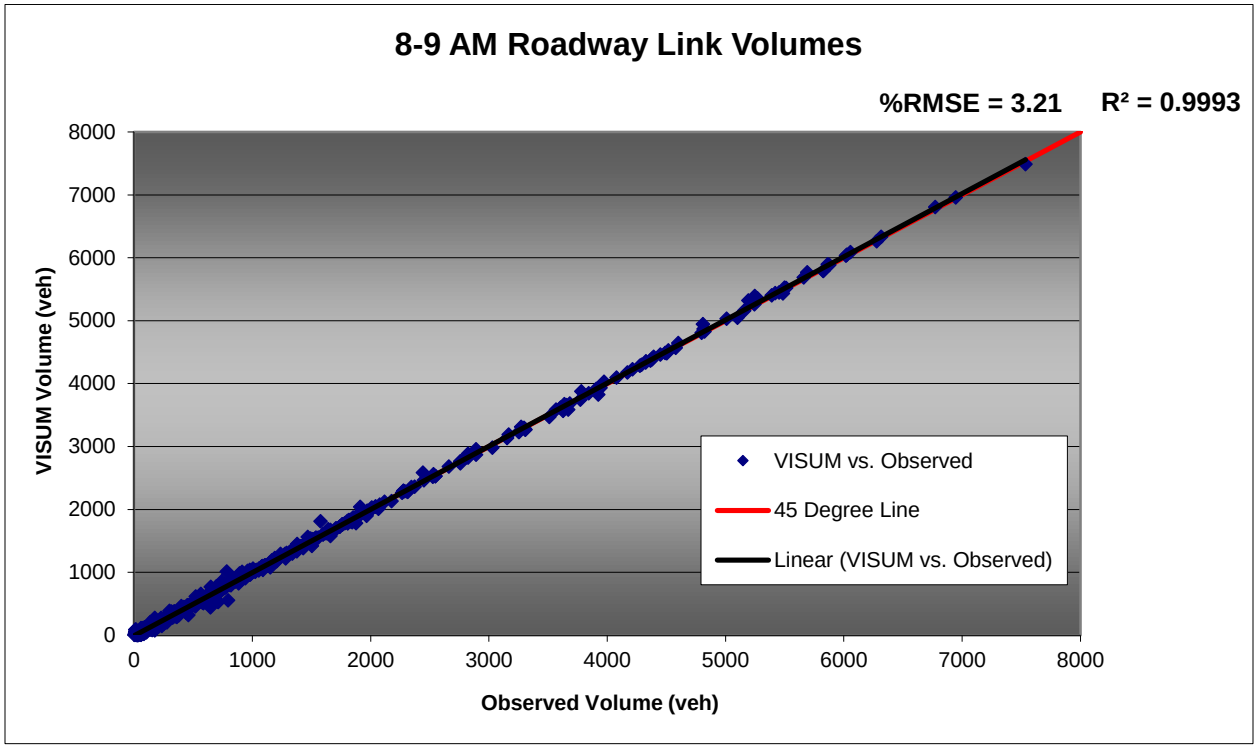


Figure 8: Roadway Link R-Squared Plot – 9-10 AM

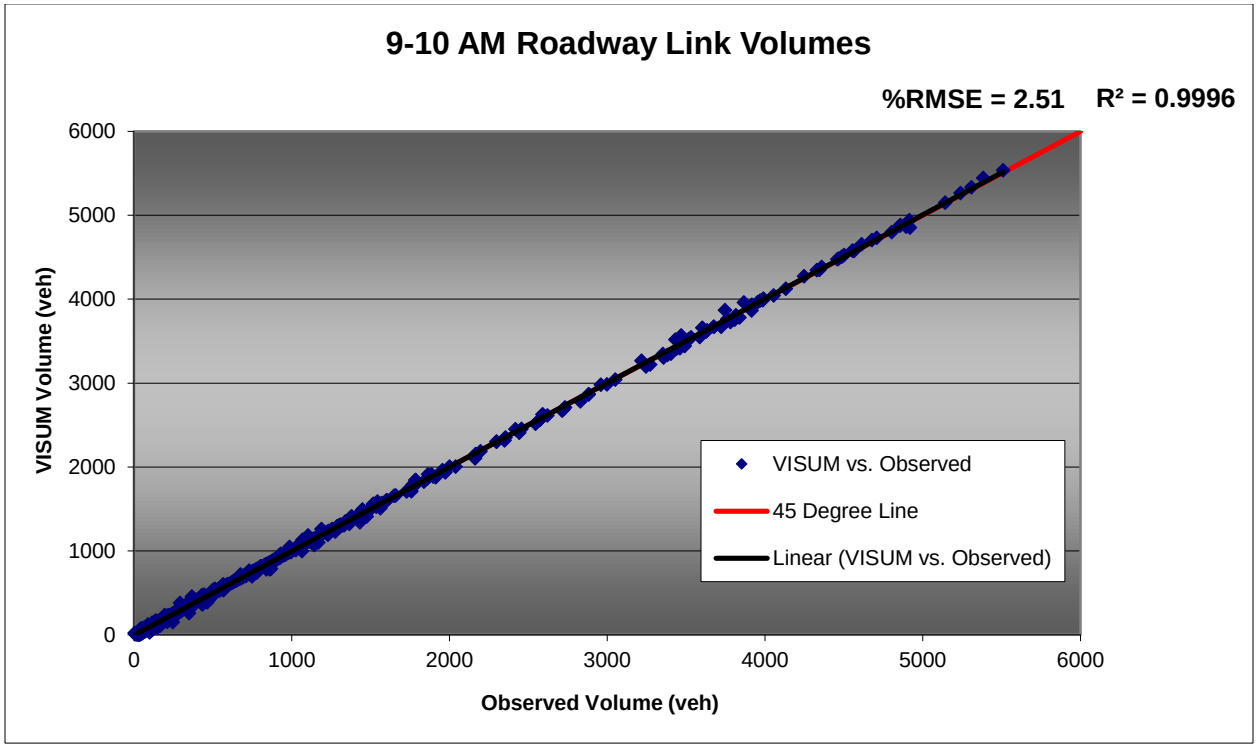


Figure 9: Roadway Link R-Squared Plot – 2-3 PM

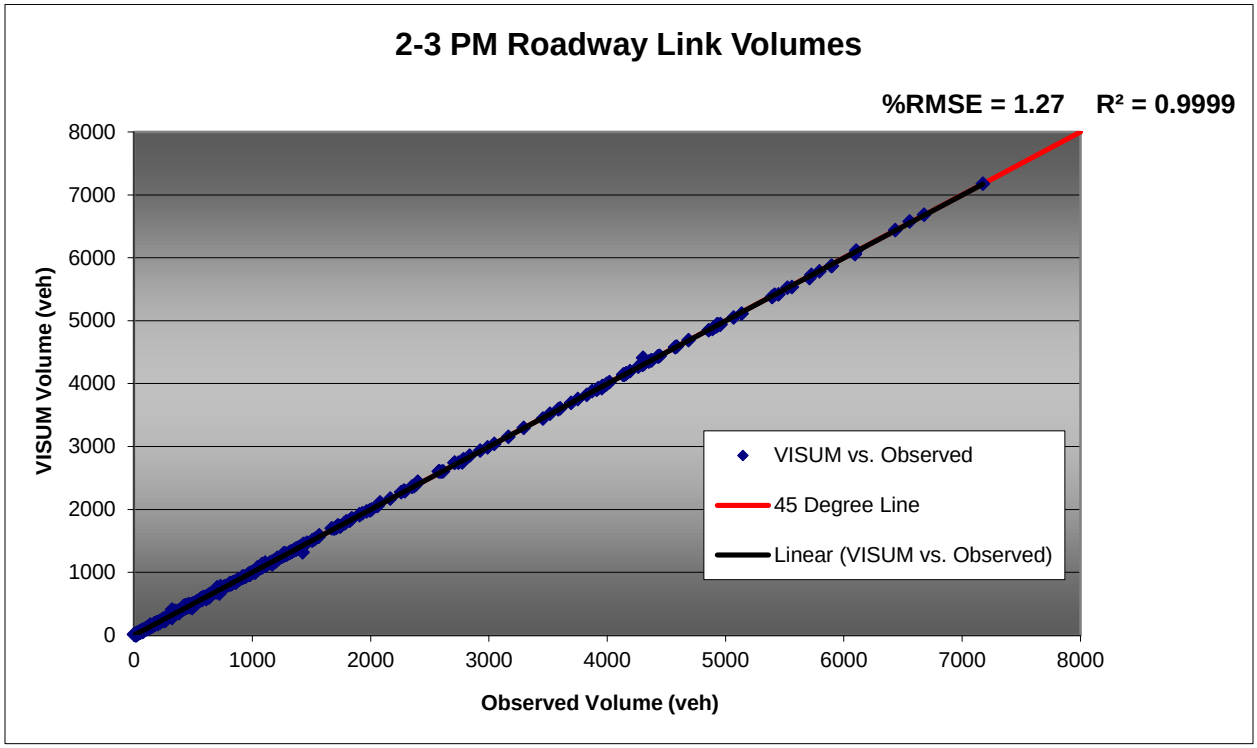


Figure 10: Roadway Link R-Squared Plot – 3-3:30 PM

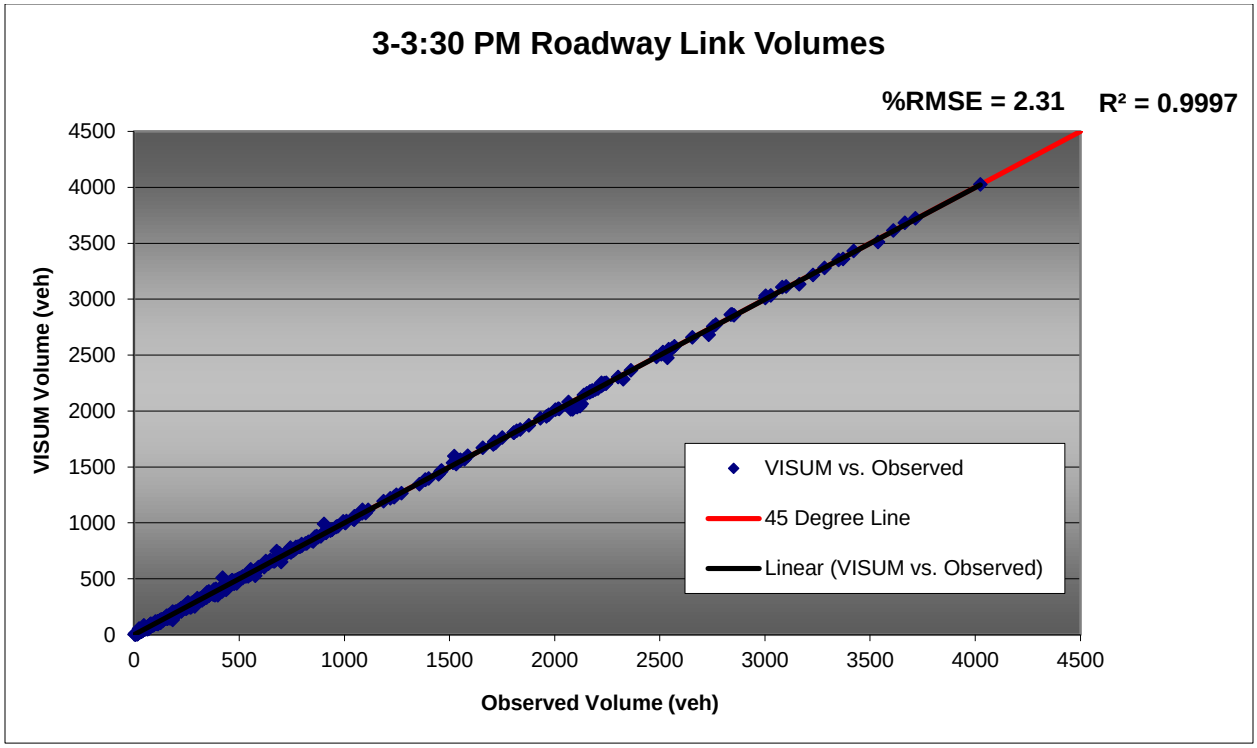


Figure 11: Roadway Link R-Squared Plot – 3:30-4 PM

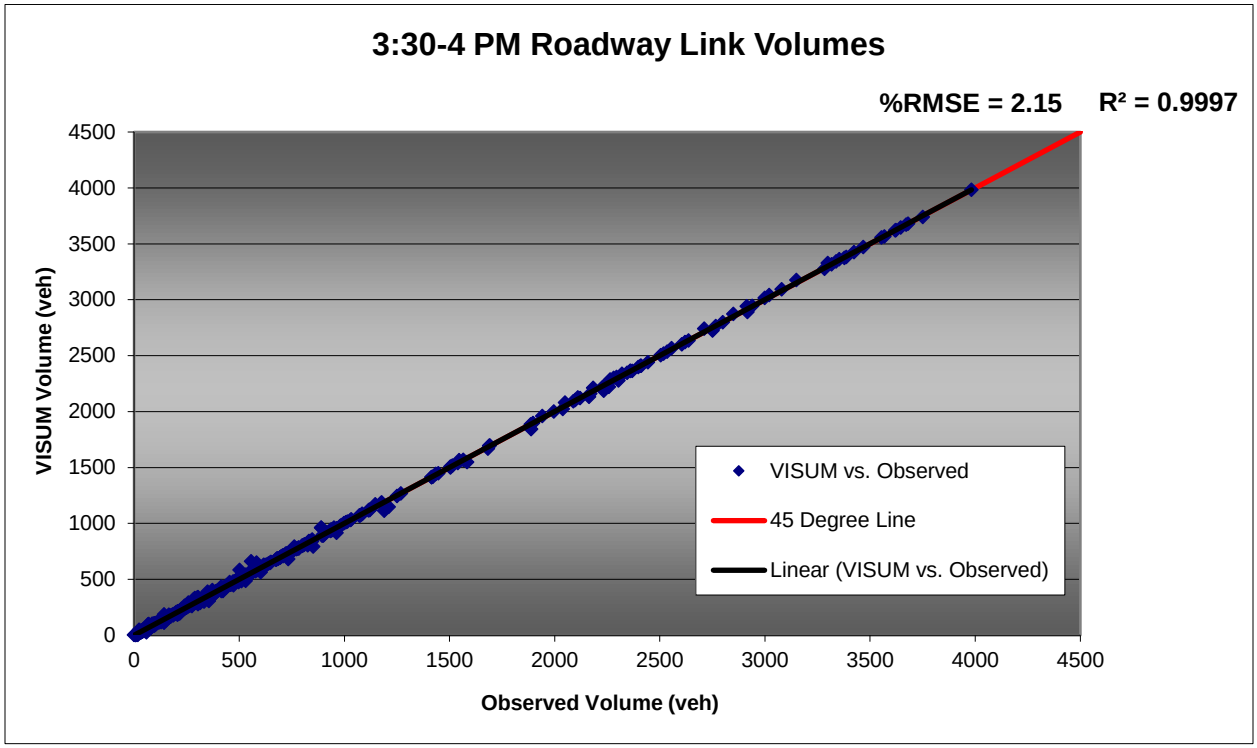


Figure 12: Roadway Link R-Squared Plot – 4-5 PM

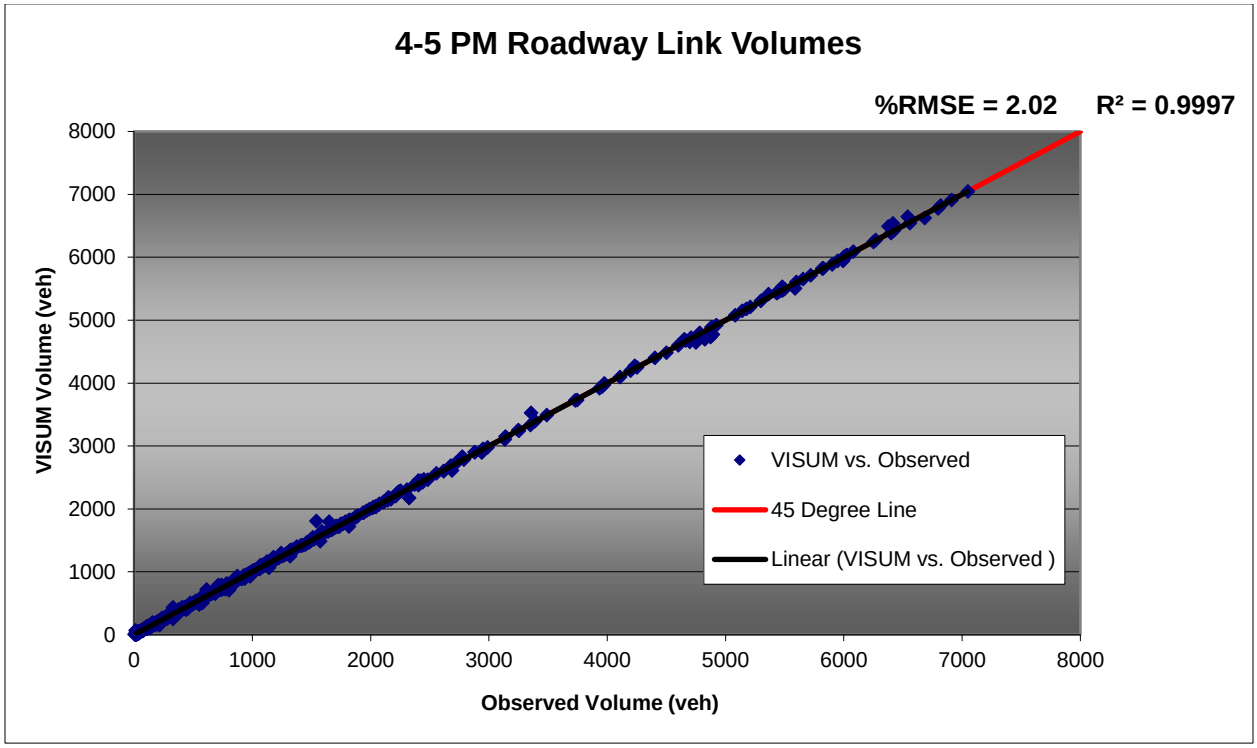


Figure 13: Roadway Link R-Squared Plot – 5-6 PM

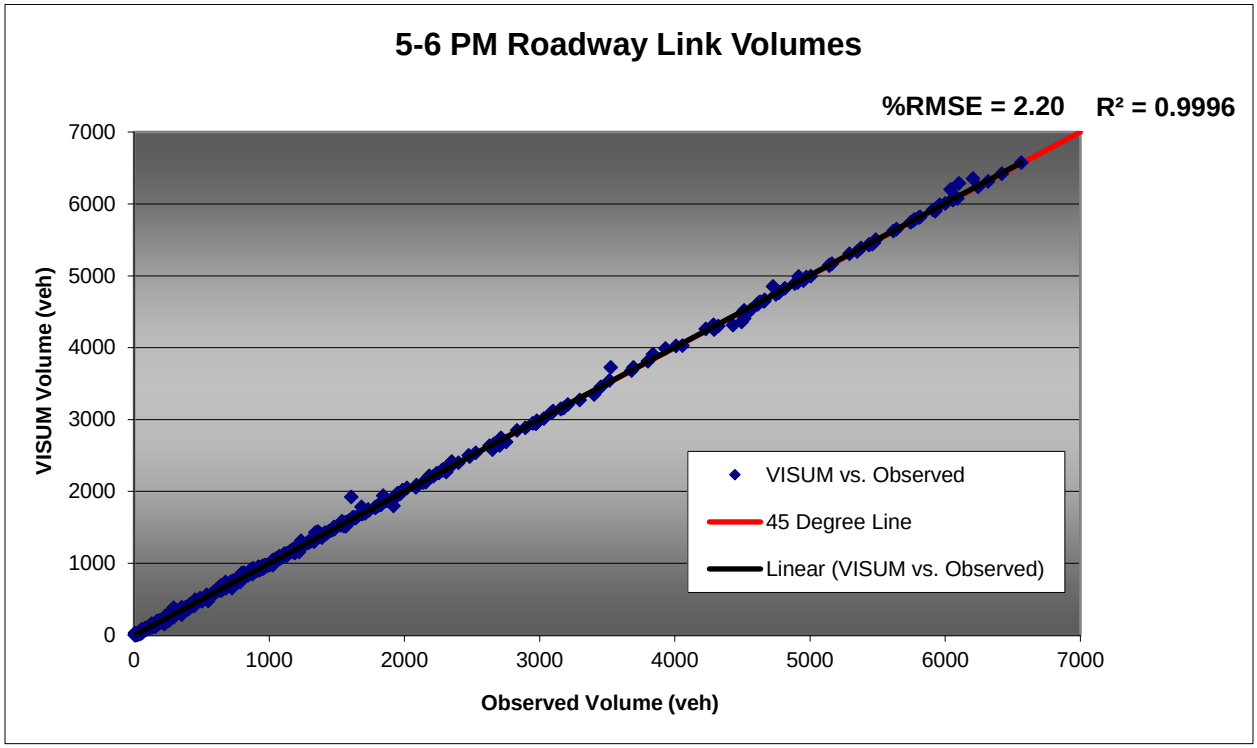


Figure 14: Roadway Link R-Squared Plot – 6-7 PM

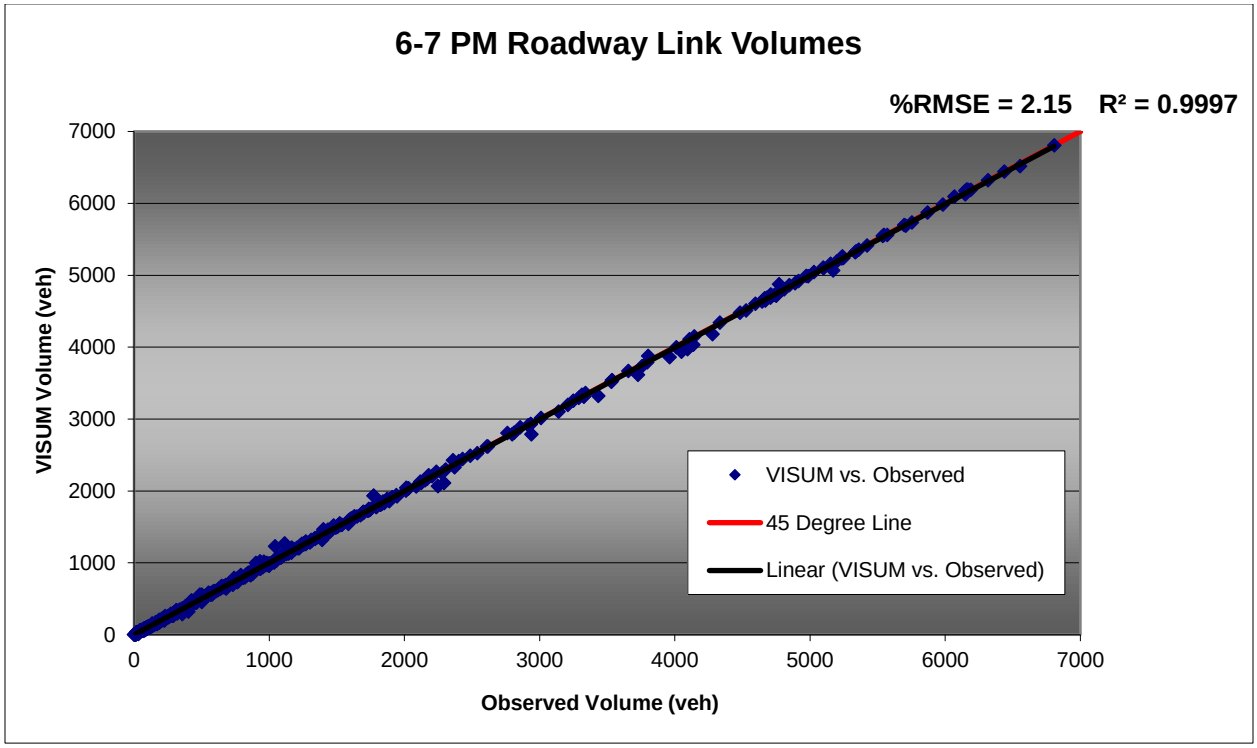


Table 3: Overall Turns Validation Summary

Criteria and Measures	Validation Acceptance Targets	5-6 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM	2-3 PM	3-3:30 PM	3:30-4 PM	4-5 PM	5-6 PM	6-7 PM
%RMSE Statistic	< 20%	11.64	5.16	5.13	8.95	6.35	4.72	5.03	4.70	3.99	3.83	4.49
R^2 Statistic	> 0.92	0.9948	0.9989	0.9988	0.9954	0.9977	0.9990	0.9988	0.9990	0.9992	0.9992	0.9991
GEH Statistic < 5	> 85%	98	98	97	92	97	100	100	100	98	99	99

Figure 15: Turning Movement R-Squared Plot – 5-6 AM

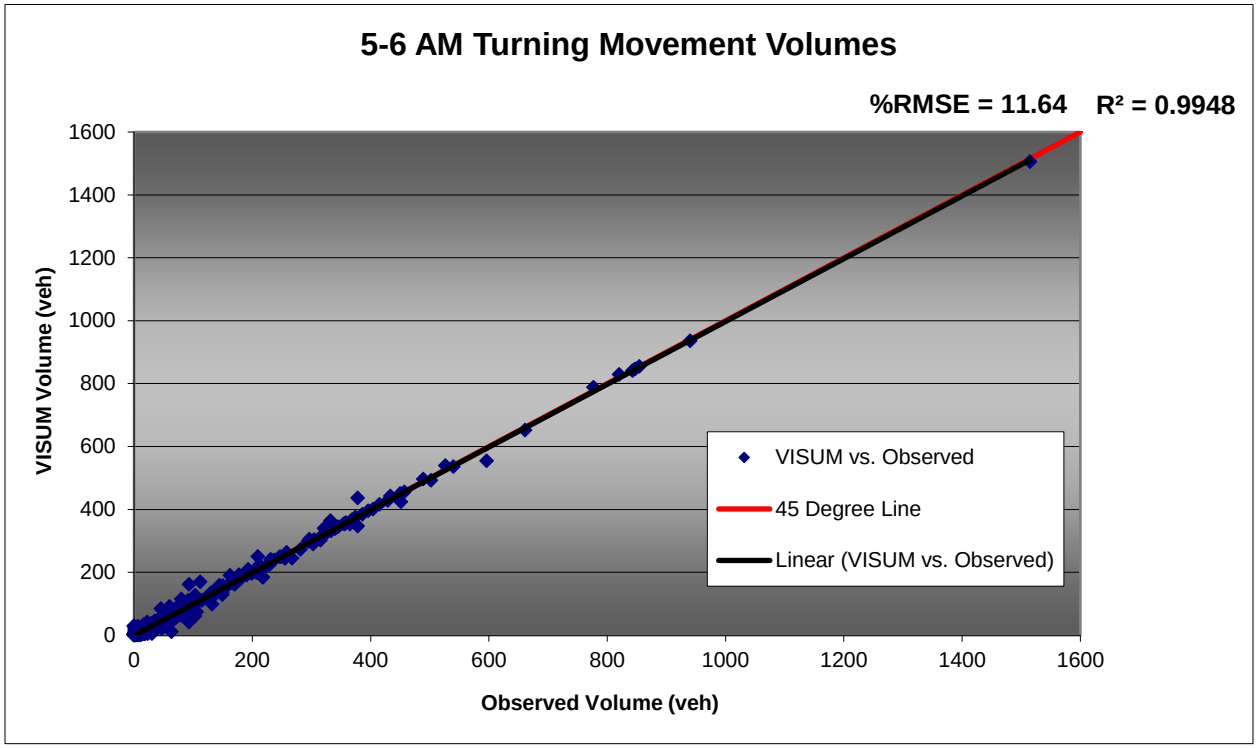


Figure 16: Turning Movement R-Squared Plot – 6-7 AM

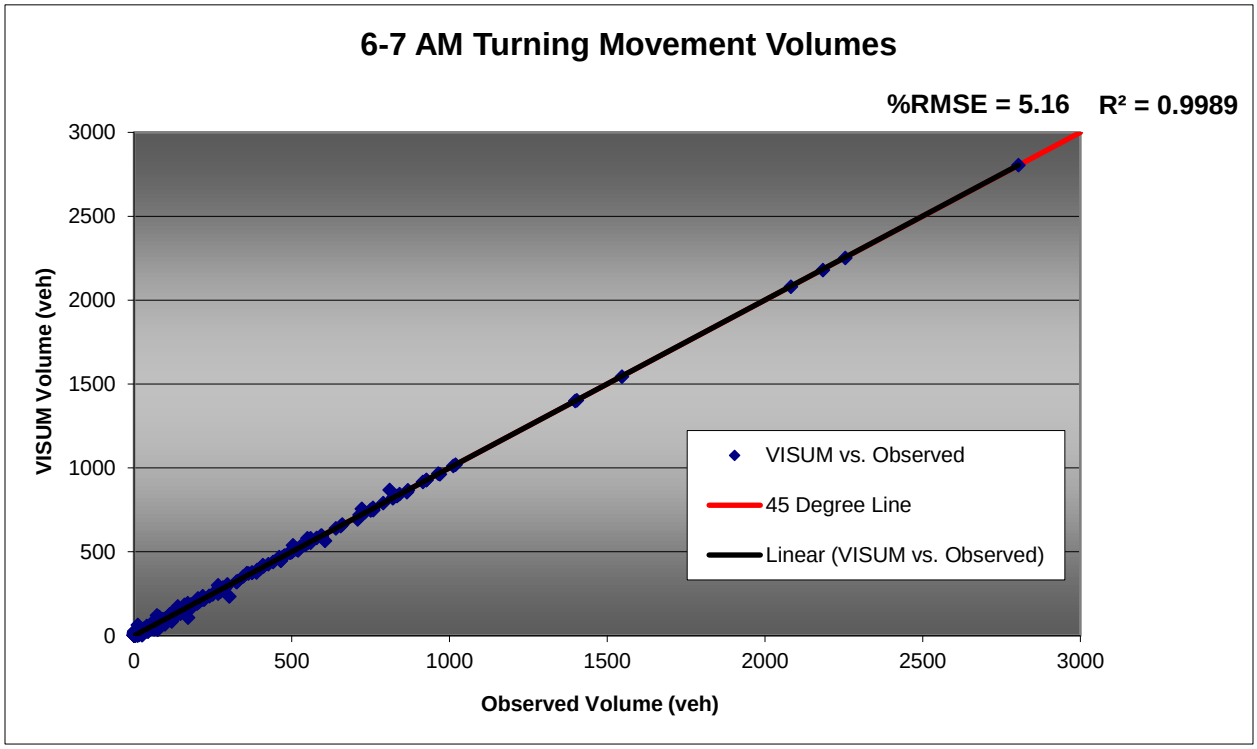


Figure 17: Turning Movement R-Squared Plot – 7-8 AM

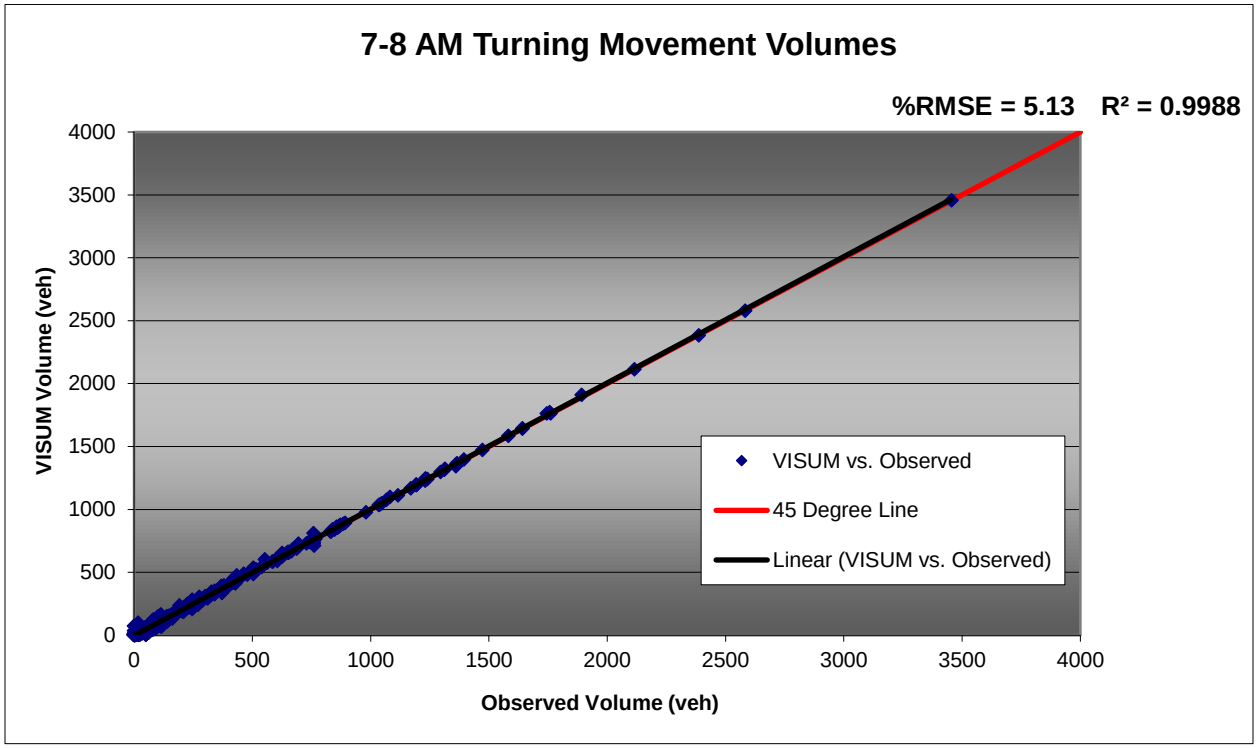


Figure 18: Turning Movement R-Squared Plot – 8-9 AM

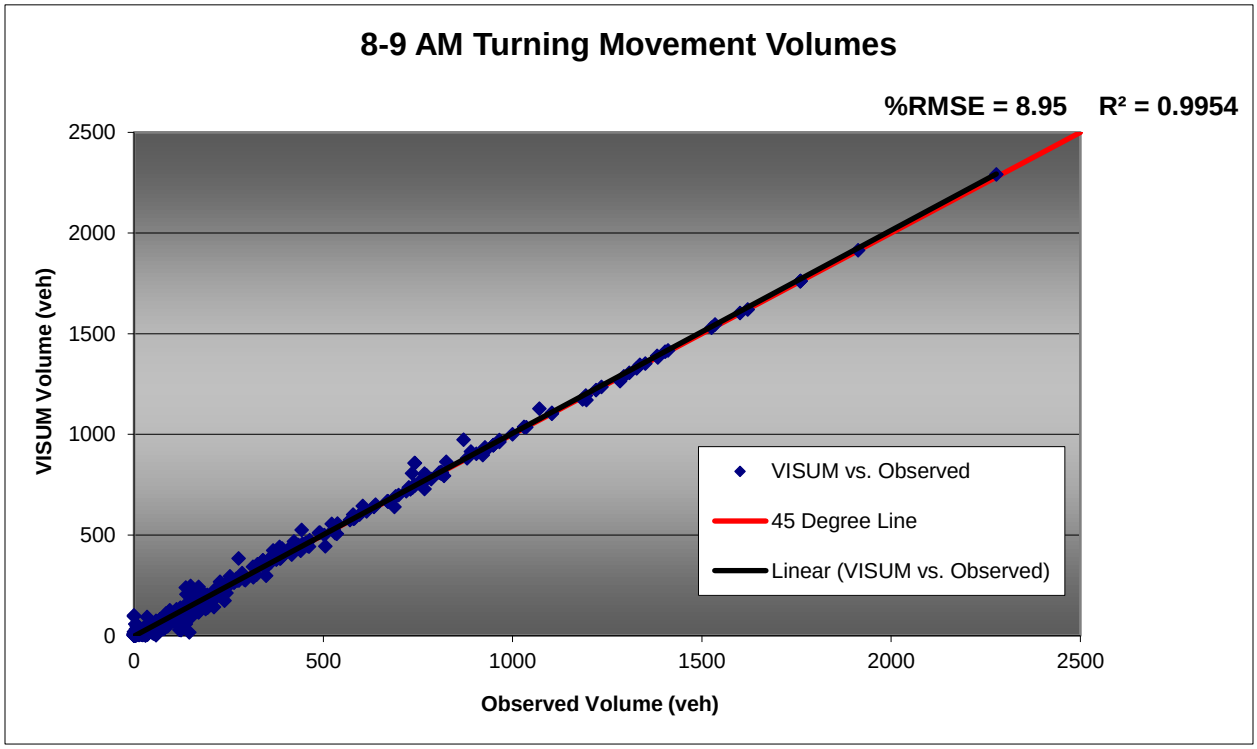


Figure 19: Turning Movement R-Squared Plot – 9-10 AM

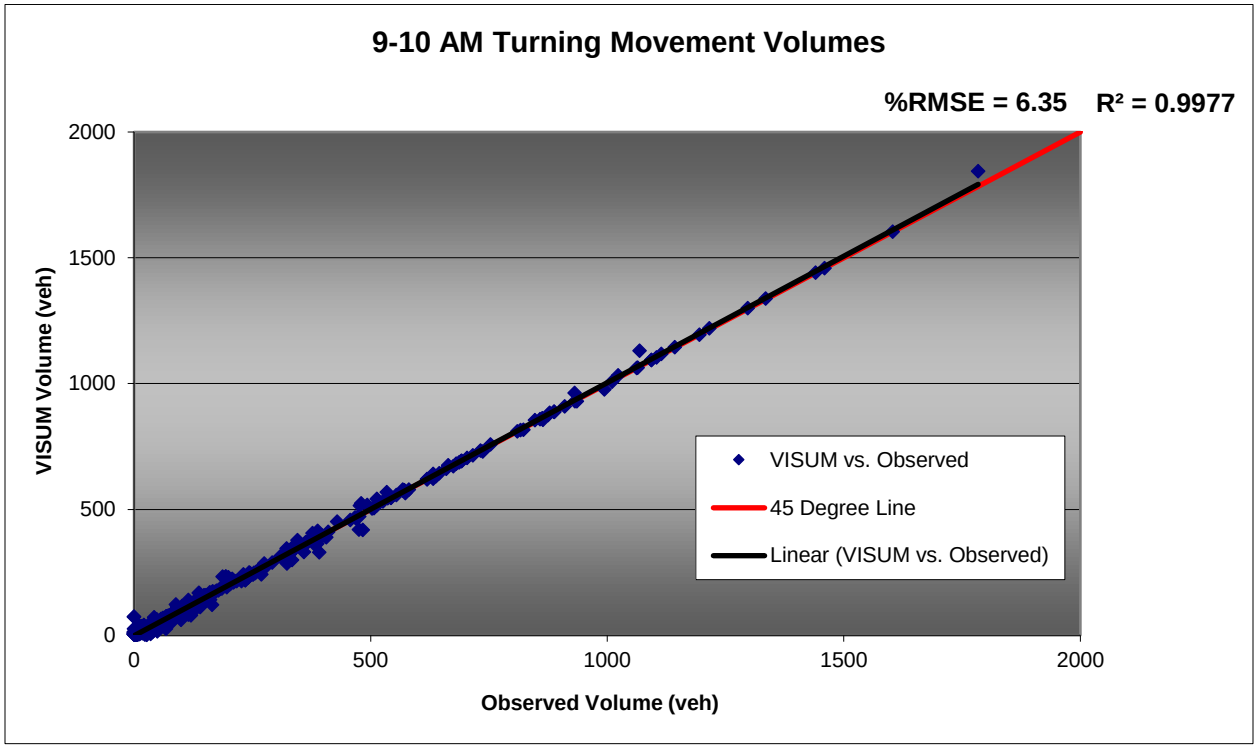


Figure 20: Turning Movement R-Squared Plot – 2-3 PM

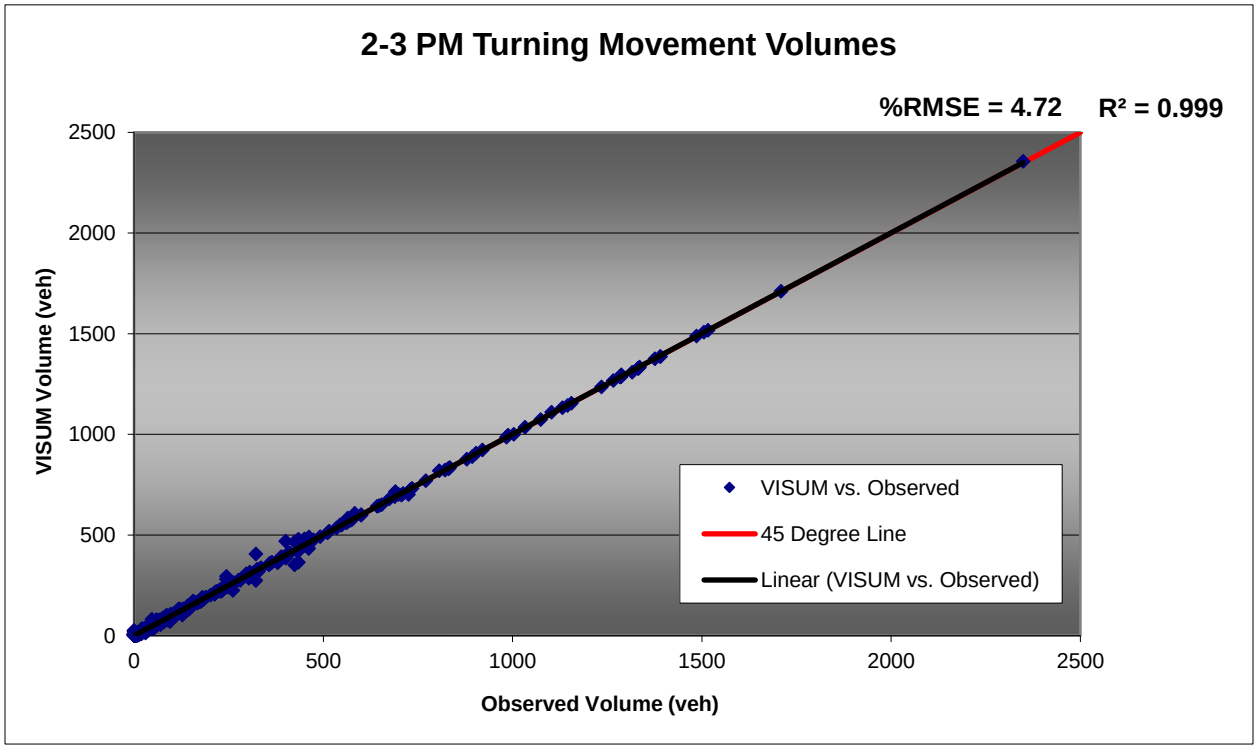


Figure 21: Turning Movement R-Squared Plot – 3-3:30 PM

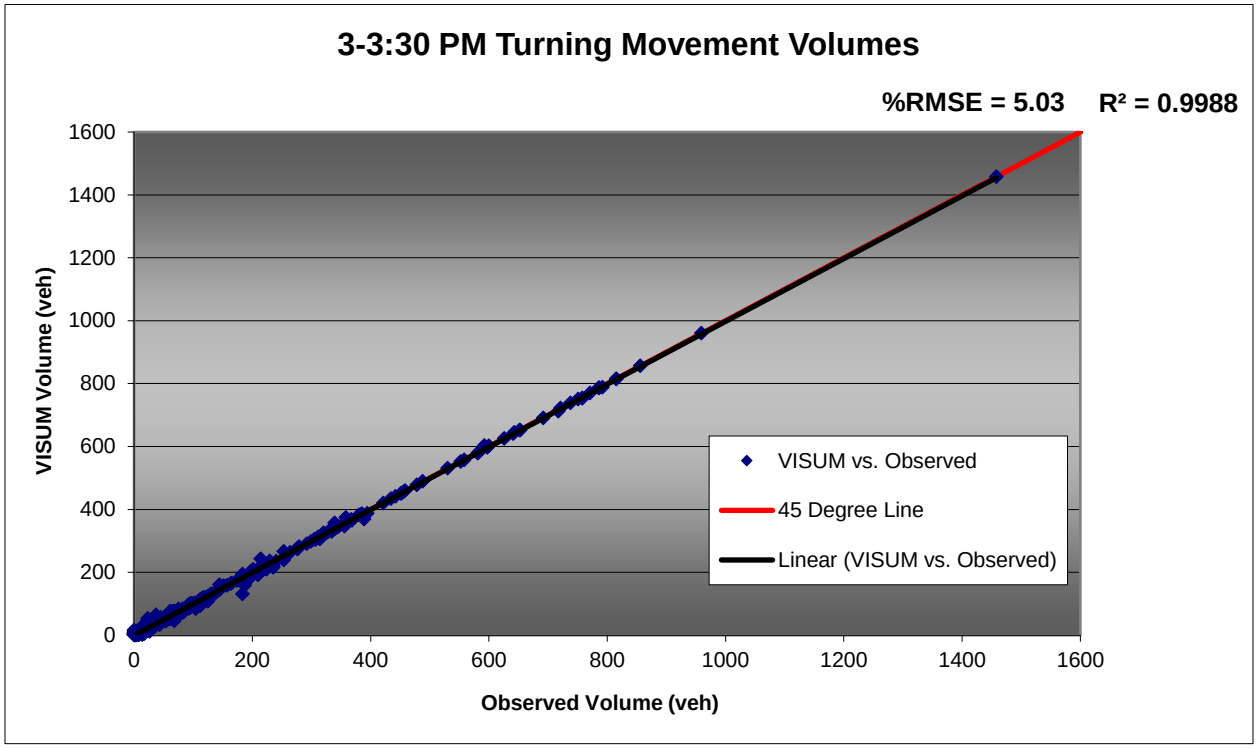


Figure 22: Turning Movement R-Squared Plot – 3:30-4 PM

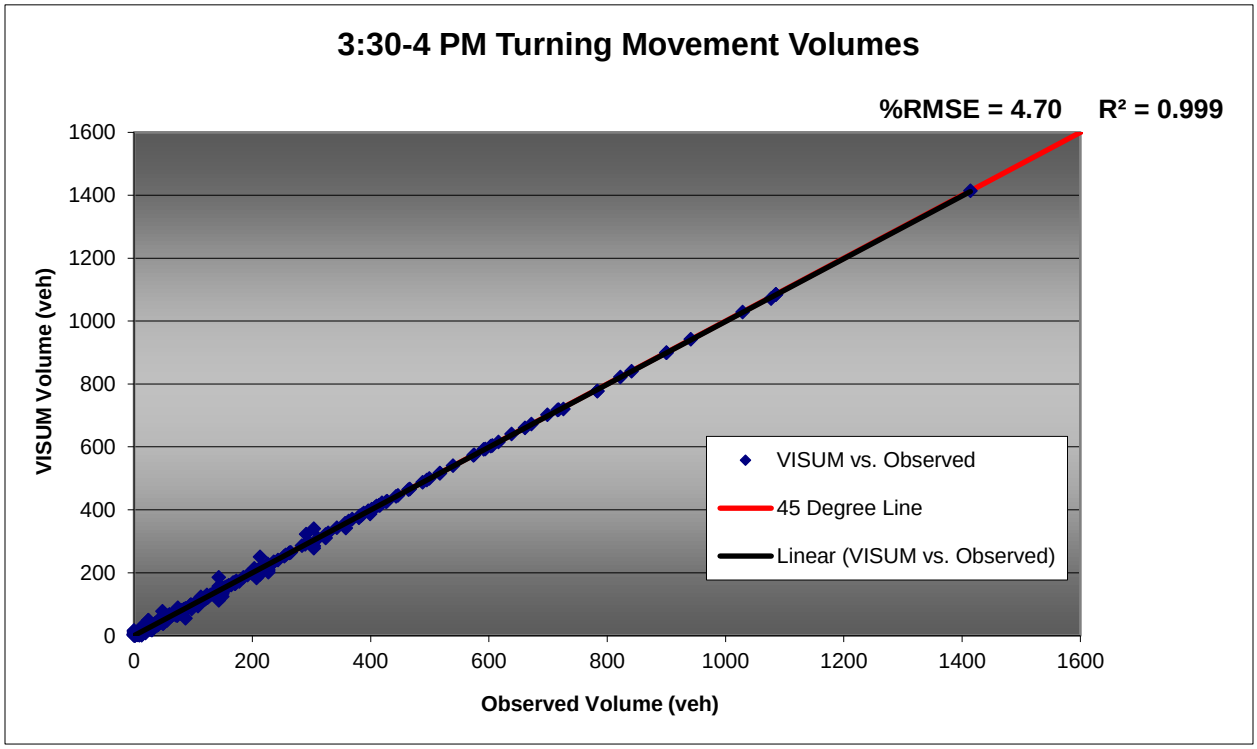


Figure 23: Turning Movement R-Squared Plot – 4-5 PM

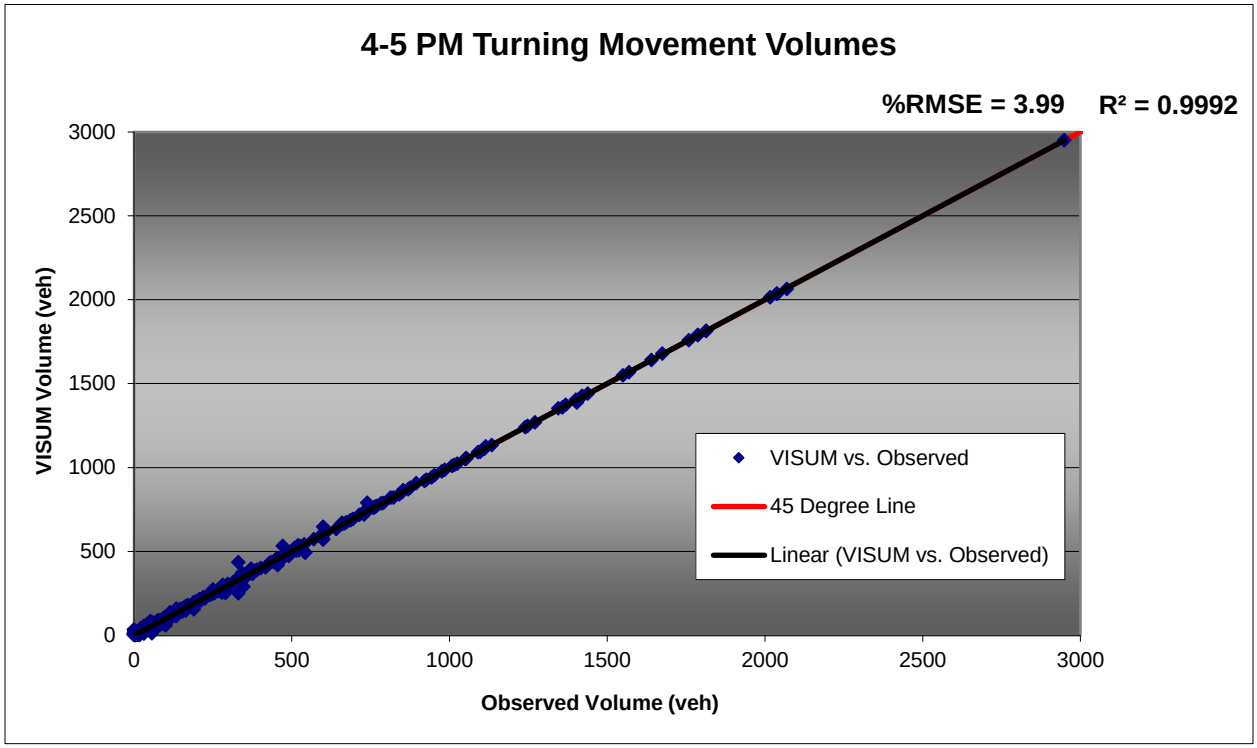


Figure 24: Turning Movement R-Squared Plot – 5-6 PM

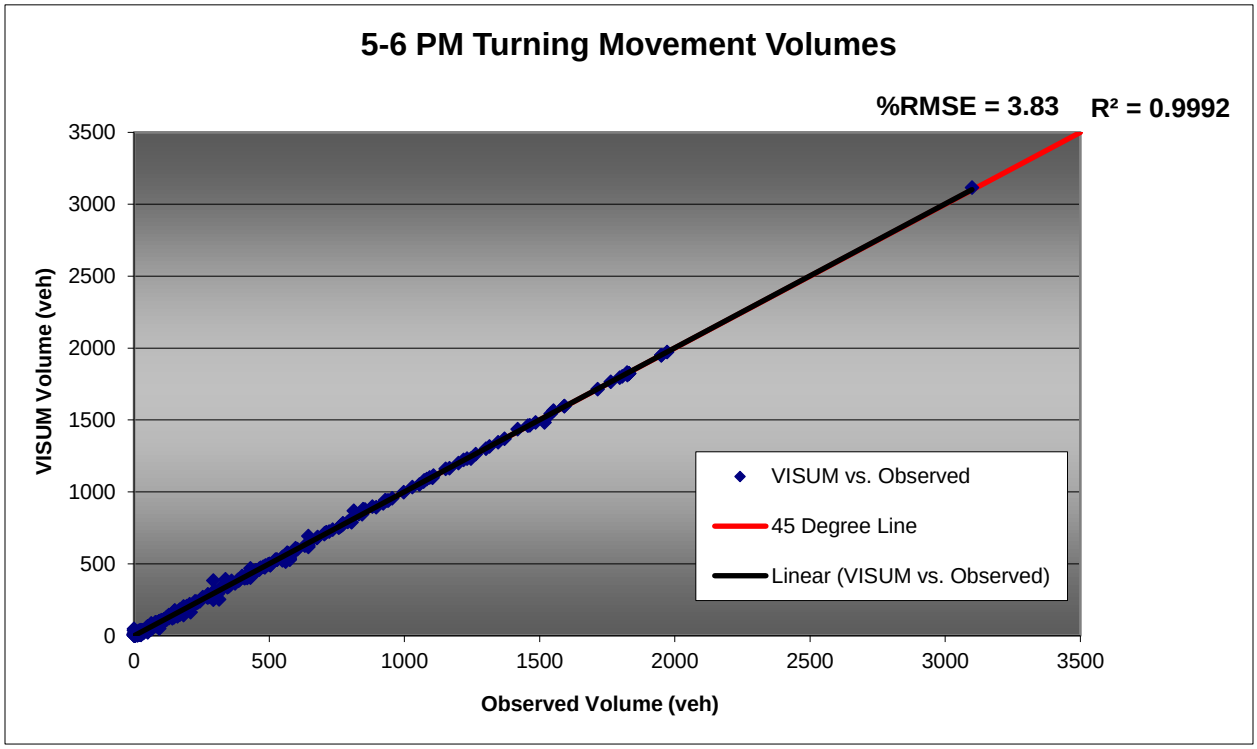
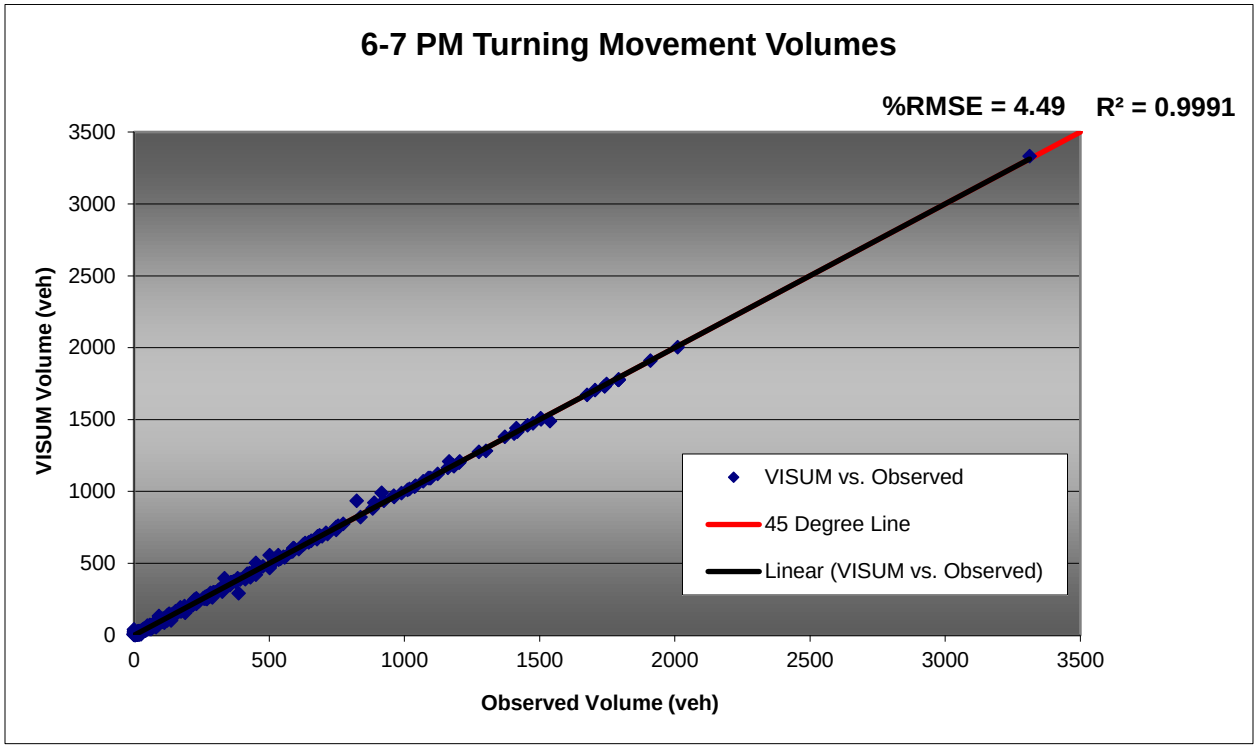


Figure 25: Turning Movement R-Squared Plot – 6-7 PM



VISSIM Model (Mesoscopic Module) Development

The purpose of a traffic model is to produce measures of effectiveness that represent the impacts that improvement alternatives have on future conditions. VISSIM's mesoscopic module was used to produce the freeway measures of effectiveness along the I-395 mainline corridor to support the ***Environmental Assessment***. This methodology is more robust than traditional Highway Capacity Manual (HCM) based freeway analysis, but significantly reduces the processing time and calibration parameters (compared to VISSIM micro-simulation). It also allows the ability to simulate multiple hours during a peak period, which is necessary in an over-capacity corridor such as I-395 to appropriately reflect congestion levels and identify benefits in periods outside the peak hour. The use of models other than micro-simulation models is typical for NEPA documentation purposes and is supported by VDOT's Traffic Operations and Safety Analysis Manual (TOSAM). Additionally, Synchro analysis (HCM methodology) was utilized to analyze the intersections along the arterials intersecting the I-395 corridor. VISSIM's microscopic module will be utilized to document measures of effectiveness to be reported in the Interchange Modification Report for both the mainline I-395 freeway operations and the arterial operations.

Due to over-capacity conditions along I-395 that are experienced for several hours during the morning and evening peak periods, speed data in combination with diurnal traffic volume data along I-395 was used to establish morning and evening peak periods and hours corresponding to the most congested conditions along I-395 rather than when volumes are at their highest. During the highest-volume periods, downstream bottlenecks have not yet reached their capacity allowing for higher flow rates through the study area.

Based on a review of diurnal traffic volumes and speeds along the northbound and southbound I-395 general purpose lanes (see **Figures 26 and 27**) in combination with the time periods for the HOV restrictions (AM period: 6:00 AM – 9:00 AM; PM period: 3:30 PM – 6:00 PM), the AM peak period was evaluated for four hours from 6:00 AM to 10:00 AM and the PM peak period was evaluated for four hours from 3:00 PM to 7:00 PM. The identified peak hours for the traffic analysis are 7:00 AM to 8:00 AM and 5:00 PM to 6:00 PM.

The VISSIM model was developed along the I-395 mainline freeway corridor for the AM and PM peak periods. The VISSIM analysis includes a seeding period to ensure that the model was properly loaded prior to producing measures of effectiveness. The seeding period should generally be based on the time it takes for a vehicle to travel the entire corridor during the peak hour. The seeding period should also allow time for traffic congestion to build before the analysis hours begin. Based on the average of the travel time runs during the peak hours (approximately 35 minutes in the AM peak and 40 minutes in the PM peak), a one-hour seeding period was selected. **Figures 26 and 27** depict the analysis and seeding periods. The AM peak period consists of five hours of simulation from 5 AM to 10 AM including a one-hour seeding period from 5 AM to 6 AM and a four-hour analysis period from 6 AM to 10 AM. Similarly, the PM peak period consists of five hours of simulation from 2 PM to 7 PM including a one-hour seeding period from 2 PM to 3 PM and a four-hour analysis period from 3 PM to 7 PM.

The O-D matrices that produced the calibrated VISUM assignment for each hour were imported into the VISSIM model and used for dynamic traffic assignment.

Figure 26: Northbound I-395 General Purpose Lanes – South of Seminary Road AM Peak Period – Traffic Flow Patterns

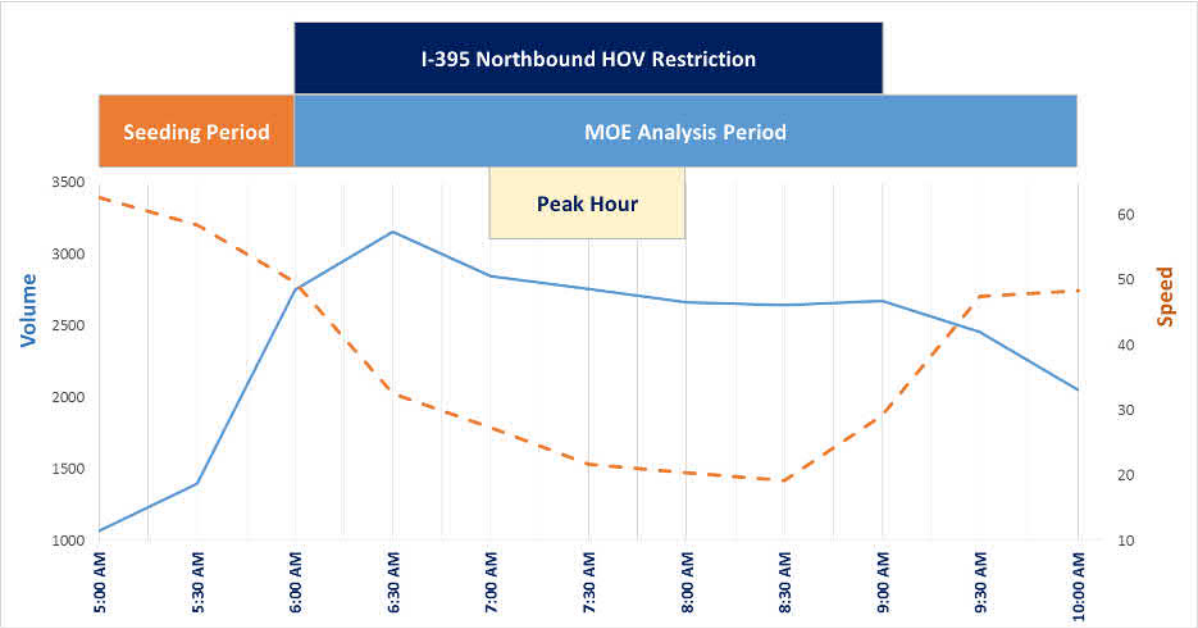
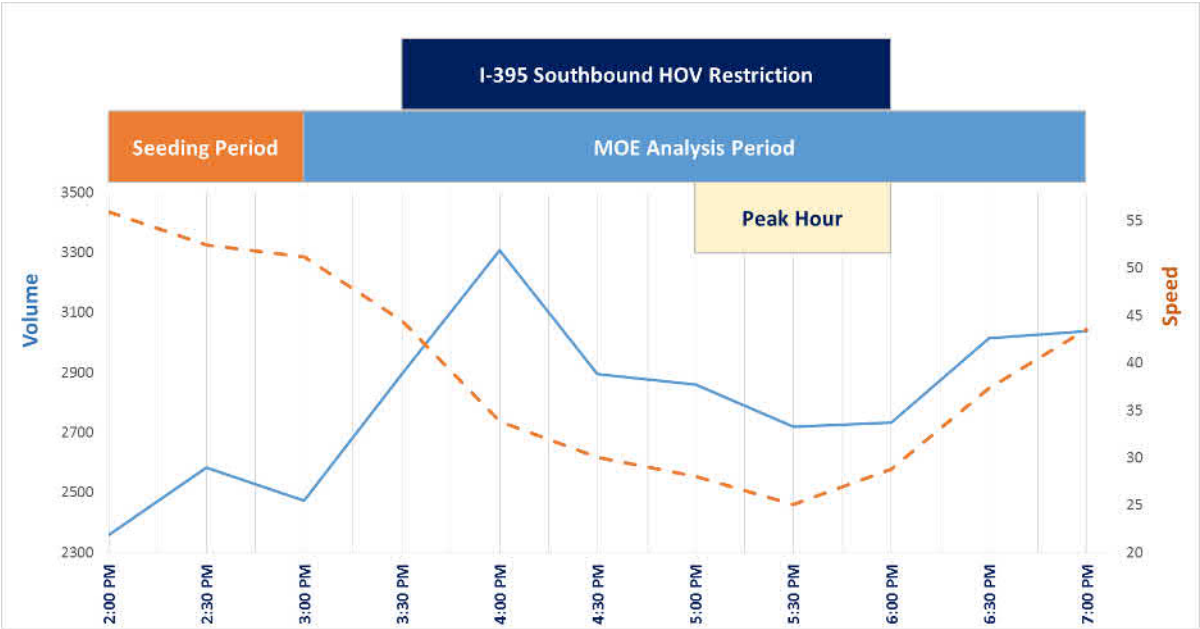


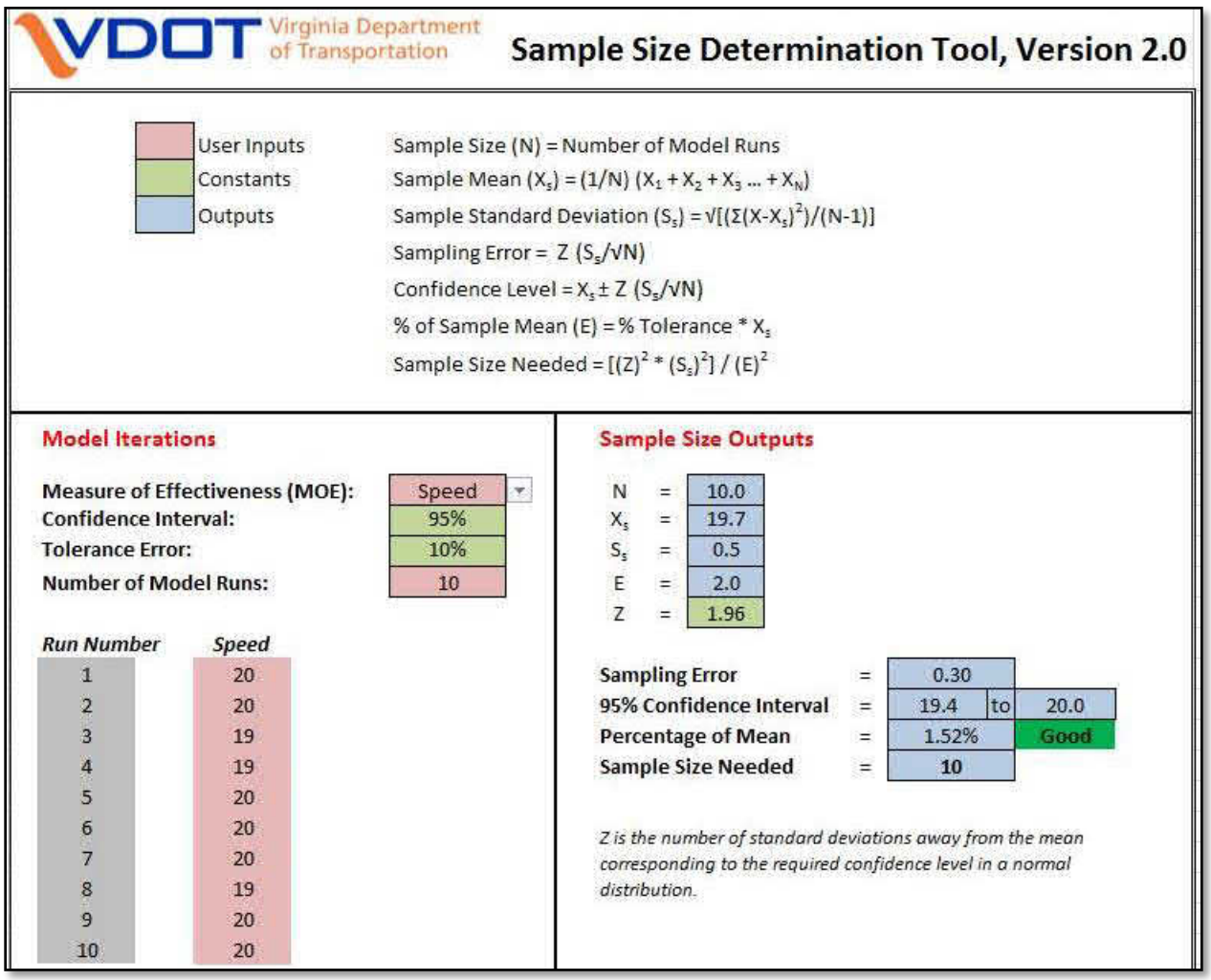
Figure 27: Southbound I-395 General Purpose Lanes – North of King Street PM Peak Period – Traffic Flow Patterns



VISSIM Model Number of Runs

According to VDOT's TOSAM, "determining and applying the appropriate number of microsimulation runs is a very important step in developing accurate microsimulation results. Using too few microsimulation runs will not fully account for microsimulation variance, while using too many runs will become overly time-intensive for analysis purposes." Appendix F of the TOSAM provides guidance on the use of the VDOT Sample Size Determination Tool, which is based on the FHWA 95th percentile confidence level sample size determination methodology. This tool was used to determine the appropriate number of runs for VISSIM's mesoscopic module. An overall corridor average speed was the MOE criterion selected for the sample size determination. The resulting average speed (per run) was calculated from smaller, consecutive general purpose lane-segments that span the entire corridor in the peak direction (i.e., AM peak – northbound; PM peak – southbound). **Figures 28 and 29** show the passing sample size of 10 runs for both the AM and PM peak hours, respectively.

Figure 28: AM Peak – Overall Corridor Average Speed – Sample Size Determination



VDOT Virginia Department of Transportation — Sample Size Determination Tool, Version 2.0

User Inputs
Constants
Outputs

Sample Size (N) = Number of Model Runs
Sample Mean (X_s) = (1/N) ($X_1 + X_2 + X_3 \ldots + X_N$)
Sample Standard Deviation (S_s) = $\sqrt{[(\Sigma(X-X_s)^2)/(N-1)]}$
Sampling Error = Z ($S_s/\sqrt{N}$)
Confidence Level = $X_s \pm$ Z ($S_s/\sqrt{N}$)
% of Sample Mean (E) = % Tolerance * X_s
Sample Size Needed = $[(Z)^2 * (S_s)^2] / (E)^2$

Model Iterations

Measure of Effectiveness (MOE):	Speed
Confidence Interval:	95%
Tolerance Error:	10%
Number of Model Runs:	10

Run Number	*Speed*
1	20
2	20
3	19
4	19
5	20
6	20
7	20
8	19
9	20
10	20

Sample Size Outputs

N	=	10.0
X_s	=	19.7
S_s	=	0.5
E	=	2.0
Z	=	1.96

Sampling Error	=	0.30		
95% Confidence Interval	=	19.4	to	20.0
Percentage of Mean	=	1.52%		Good
Sample Size Needed	=	10		

Z is the number of standard deviations away from the mean corresponding to the required confidence level in a normal distribution.

Figure 29: PM Peak – Overall Corridor Average Speed – Sample Size Determination

VDOT Virginia Department of Transportation

Sample Size Determination Tool, Version 2.0

User Inputs
Constants
Outputs

Sample Size (N) = Number of Model Runs
Sample Mean (X_s) = (1/N) ($X_1 + X_2 + X_3 \ldots + X_N$)
Sample Standard Deviation (S_s) = $\sqrt{[(\Sigma(X-X_s)^2)/(N-1)]}$
Sampling Error = Z ($S_s/\sqrt{N}$)
Confidence Level = $X_s \pm$ Z ($S_s/\sqrt{N}$)
% of Sample Mean (E) = % Tolerance * X_s
Sample Size Needed = $[(Z)^2 * (S_s)^2] / (E)^2$

Model Iterations

Measure of Effectiveness (MOE):	Speed
Confidence Interval:	95%
Tolerance Error:	10%
Number of Model Runs:	10

Run Number	*Speed*
1	16
2	16
3	16
4	16
5	16
6	15
7	16
8	15
9	16
10	16

Sample Size Outputs

N	=	10.0
X_s	=	15.8
S_s	=	0.4
E	=	1.6
Z	=	1.96

Sampling Error	=	0.26		
95% Confidence Interval	=	15.5	to	16.1
Percentage of Mean	=	1.65%		Good
Sample Size Needed	=	10		

Z is the number of standard deviations away from the mean corresponding to the required confidence level in a normal distribution.

VISSIM Model Calibration

Developing a model to accurately depict existing conditions is a vital step to effectively evaluate future traffic operations along the I-395 corridor. I-395 operates in an oversaturated condition in the peak direction for most of the peak period. During the calibration process, priority was given to corridor travel speeds given the amount of congestion experienced along the I-395 corridor. Travel time data along the general purpose and HOV/HOT lanes were used to produce the target speeds. Traffic counts were also used as a secondary measure. Due to the oversaturated conditions along the corridor, traffic count data is very volatile and can change rapidly from day to day.

The source of the calibration came from two primary data collection efforts. The target speeds were based on floating car travel times that were collected during the AM and PM peak hour in each direction for the general purpose and HOV/HOT lanes. INRIX speed data was also obtained from the Regional Integrated Transportation Information System (RITIS) database to provide a reasonableness check of the travel time speeds. Target volume data was based on collected automatic recorder counts throughout the general purpose, HOV/HOT, and ramp facilities along the corridor. In congested areas in the peak direction, the volume targets were based on raw count data, prior to count balancing. It should be noted that due to the severely over-capacity conditions, there are frequently high variations in the speeds and volumes experienced by motorists along the corridor, especially traveling in the peak direction of the general purpose lanes.

Calibration of the AM and PM peak period I-395 corridor VISSIM mesoscopic model involved adjusting parameters to achieve target speeds and volumes. The two parameters that were adjusted during the calibration process were the driving behavior meso reaction time and the link meso follow-up time attributes. These parameters adjust driver aggressiveness and the gap between two vehicles in the same traffic flow.

The calibration criteria used for the VISSIM mesoscopic model for speeds and volumes is shown in **Table 4**.

Table 4: Calibration Criteria for Speed and Volume

Attribute	Criterion	Difference (Simulated vs. Observed)	Validation Acceptance Targets
Speed	I-395 GP and HOV/HOT Segments	Within + / - 10 mph	85% of travel time segments
Volume	I-395 GP and HOV/HOT Segments	Within 10 %	> 85% of count locations
	I-395 GP, HOV/HOT, and Ramp Segments	%RMSE	< 20%
		R^2 Statistic	> 0.98
		GEH Statistic < 5	> 85% of count locations

Calibration Results

The tables and figures in this section show the model calibration results for each validation target shown in the above criteria table.

Travel speeds from the VISSIM model were compared to the speeds traveled during the travel time runs. The travel time segments are split at each ramp merge or diverge location throughout the I-395 corridor. **Tables 5, 6, 7 and 8** summarize the AM and PM peak hour results for the northbound and southbound direction of the general purpose and HOV/HOT lanes.

The tables show that there is a close match between the VISSIM speeds and the field speeds for individual segments and the entire corridor in both directions for the general purpose and HOV/HOT lanes. The few segments that fall outside of the calibration criteria are closer to the INRIX speeds, which are also shown in the tables.

Table 5: AM Peak Vehicle Speed Summary – Northbound

I-395 General Purpose	VISSIM (mph)	Field (mph)	Difference (mph)	INRIX (mph)
From I-495 interchange				
to Exit Ramp To Edsall Rd	52	47	5	22
to Entrance Ramp from Edsall Rd	15	18	-3	22
to Exit Ramp to HOV NB	9	14	-5	21
to Entrance Ramp from HOV NB	10	17	-7	21
to Exit Ramp to Little River Tnpk	13	12	1	21
to Exit Ramp to Little River Tnpk	19	17	2	21
to Entrance Ramp from Little River Tnpk	16	14	2	21
to Exit Ramp to Seminary Rd	16	14	2	24
to Entrance Ramp from Seminary Rd	19	20	-1	26
to Exit Ramp to King St	13	20	-7	27
to Entrance Ramp from King St	26	22	4	30
to Entrance Ramp from King St	30	23	7	30
to Exit Ramp to Shirlington Rd/Quaker Ln	30	33	-3	35
to Entrance Ramp from Quaker Ln	32	22	10	36
to Exit Ramp to Glebe Rd	26	26	0	34
to Entrance Ramp from Glebe Rd	27	28	-1	35
to Exit Ramp to Glebe Rd	39	33	6	35
to Entrance Ramp from Glebe Rd	43	36	7	35
to Exit Ramp to Columbia Pike	50	46	4	38
to Exit Ramp to Washington Blvd	56	54	2	42
to Exit Ramp to Route 1 South	55	53	2	29
to Entrance Ramp from Washington Blvd	25	19	6	29
to Exit Ramp to HOV NB	20	14	6	29
to Entrance Ramp from S Rotary Rd	17	11	6	22
to Entrance Ramp from Jefferson Davis Hwy	14	6	8	20
to Entrance Ramp from Jefferson Davis Hwy	13	7	6	22
to Entrance Ramp from Boundary Channel Dr	15	7	9	18
to Exit Ramp to Boundary Channel Dr	17	10	7	21
to Exit Ramp to George Washington Memorial Pkwy	14	14	0	21
to Entrance Ramp from George Washington Memorial Pkwy	15	26	-11	21
to Exit Ramp to Route 1 North	37	28	9	25
to Exit Ramp to Potomac Park	25	31	-6	29
to Entrance Ramp from HOV NB	27	19	8	30
to Exit Ramp to 12th Street Expressway	28	23	5	31
I-395 General Purpose Total Speed (mph)	**20**	**18**	**2**	
I-395 HOV/HOT	**VISSIM (mph)**	**Field (mph)**	**Difference (mph)**	**INRIX (mph)**
From I-495 interchange				
to Exit Ramp to General Purpose NB	68	68	0	65
to Entrance Ramp from General Purpose NB	67	68	-1	65
to Entrance Ramp from Seminary Road	67	67	0	63
to Entrance Ramp from Shirlington Rd	65	69	-4	60
to Exit Ramp to Washington Blvd (Memorial Bridge)	64	65	-1	56
to Reversible HOV to NB HOV Split	53	56	-3	32
to Exit Ramp to S. Eads St	34	56	-22	34
to Entrance Ramp from S. Eads St	26	21	5	23
to Entrance Ramp from General Purpose NB	31	10	21	24
I-395 HOV Total Speed (mph)	**58**	**54**	**4**	

Table 6: AM Peak Vehicle Speed Summary – Southbound

I-395 General Purpose	VISSIM (mph)	Field (mph)	Difference (mph)	INRIX (mph)
From 9th St Expressway				
to Entrance Ramp from 9th St Expressway	27	20	7	30
to Exit Ramp to Ohio Dr SW	26	19	7	31
to Exit Ramp to Beginning of HOV	28	21	7	31
to Entrance Ramp from Route 1	28	32	-4	36
to Exit Ramp to George Washington Memorial Pkwy	47	41	6	44
to Exit/Entrance Ramp weave to George Washington Memorial Pkwy	48	50	-2	52
to Entrance Ramp from George Washington Memorial Pkwy	48	53	-5	52
to Exit Ramp to Boundary Channel Dr	48	57	-9	52
to Entrance Ramp from Boundary Channel Dr	48	55	-7	51
to Exit Ramp to Boundary Channel Dr	48	50	-2	51
to Entrance Ramp from Boundary Channel Dr / Exit to Route 1	47	47	0	51
to Exit Ramp to Jefferson Davis Hwy	52	51	1	51
to Exit Ramp to Washington Blvd	50	53	-3	54
to Entrance Ramp from End of Southbound HOV	56	54	2	54
to Entrance Ramp from Army Navy Dr	56	56	0	55
to Entrance Ramp from Washington Blvd	56	57	-1	55
to Entrance Ramp from Washington Blvd	63	62	1	59
to Exit Ramp to Glebe Rd	56	63	-7	59
to Entrance Ramp from Glebe Rd C-D road	58	58	0	59
to Entrance Ramp from Shirlington Rd	55	60	-5	58
to Exit Ramp to King St	56	56	0	57
to Entrance Ramp from King St	55	57	-2	57
to Entrance Ramp from King St	54	58	-4	57
to Exit Ramp to Seminary Rd	58	59	-1	57
to Entrance Ramp from Seminary Rd	57	61	-4	58
to Exit Ramp to Little River Tnpk	56	63	-7	58
to Entrance Ramp from Little River Tnpk	56	58	-2	58
to Exit Ramp to Little River Tnpk	53	60	-7	58
to Entrance Ramp from Little River Tnpk	54	57	-3	58
to Exit Ramp to HOV Southbound	56	59	-3	61
to Entrance Ramp from HOV Southbound	55	60	-5	61
to Exit Ramp to Edsall Rd	55	62	-7	61
to Entrance Ramp from Edsall Rd	54	59	-5	61
to Exit Ramp to Edsall Rd	54	56	-2	59
to Entrance Ramp from Edsall Rd	54	55	-1	59
I-395 General Purpose Total Speed (mph)	**51**	**52**	**-1**	
I-395 HOV	**VISSIM (mph)**	**Field (mph)**	**Difference (mph)**	**INRIX (mph)**
From 9th St Expressway				
to Exit Ramp to Beginning of HOV	39	34	5	44
to Entrance Ramp from Route 1	46	46	0	52
to Exit Ramp to Southbound General Purpose	48	52	-4	56
to Exit Ramp to S. Eads St	56	59	-3	56
to Exit Ramp from S. Eads St	57	59	-2	52
I-395 HOV Total Speed (mph)	**50**	**52**	**-2**	

Table 7: PM Peak Speed Summary – Northbound

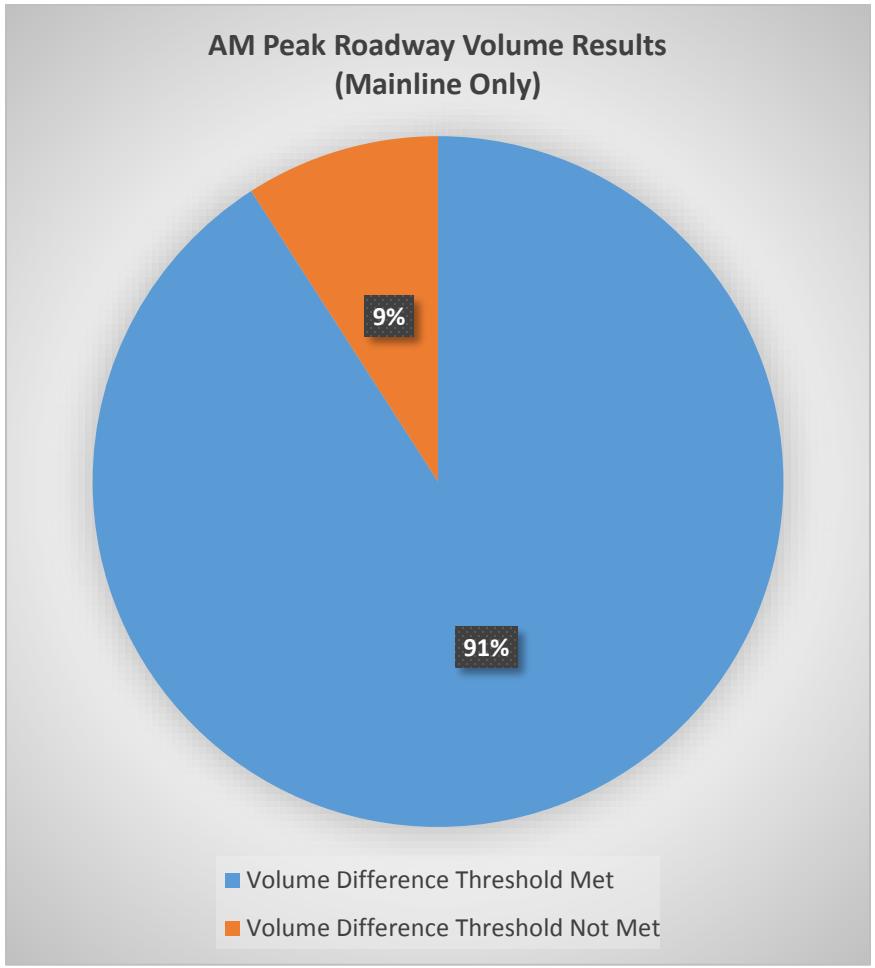
I-395 General Purpose	VISSIM (mph)	Field (mph)	Difference (mph)	INRIX (mph)
From I-495 interchange				
to Exit Ramp To Edsall Rd	54	56	-2	48
to Entrance Ramp from Edsall Rd	55	60	-5	48
to Exit Ramp to HOV NB	53	59	-6	51
to Entrance Ramp from HOV NB	54	56	-2	51
to Exit Ramp to Little River Tnpk	55	58	-3	51
to Exit Ramp to Little River Tnpk	55	61	-6	55
to Entrance Ramp from Little River Tnpk	54	60	-6	55
to Exit Ramp to Seminary Rd	53	58	-5	53
to Entrance Ramp from Seminary Rd	54	56	-2	53
to Exit Ramp to King St	54	62	-8	57
to Entrance Ramp from King St	53	62	-9	57
to Entrance Ramp from King St	53	61	-8	57
to Exit Ramp to Shirlington Rd/Quaker Ln	54	60	-6	54
to Entrance Ramp from Quaker Ln	55	62	-7	55
to Exit Ramp to Glebe Rd	55	62	-7	53
to Entrance Ramp from Glebe Rd	55	58	-3	52
to Exit Ramp to Glebe Rd	55	59	-4	52
to Entrance Ramp from Glebe Rd	55	59	-4	52
to Exit Ramp to Columbia Pike	54	61	-7	55
to Exit Ramp to Washington Blvd	56	59	-3	53
to Exit Ramp to Route 1 South	56	56	0	54
to Entrance Ramp from Washington Blvd	56	57	-1	54
to Exit Ramp to HOV NB	54	59	-5	54
to Entrance Ramp from S Rotary Rd	56	59	-3	48
to Entrance Ramp from Jefferson Davis Hwy	55	57	-2	46
to Entrance Ramp from Jefferson Davis Hwy	50	57	-7	48
to Entrance Ramp from Boundary Channel Dr	53	54	-1	35
to Exit Ramp to Boundary Channel Dr	43	51	-8	33
to Exit Ramp to George Washington Memorial Pkwy	34	44	-10	28
to Entrance Ramp from George Washington Memorial Pkwy	29	26	3	28
to Exit Ramp to Route 1 North	20	23	-3	26
to Exit Ramp to Potomac Park	11	14	-3	23
to Entrance Ramp from HOV NB	12	16	-4	22
to Exit Ramp to 12th Street Expressway	19	17	2	22
I-395 General Purpose Total Speed (mph)	**43**	**49**	**-6**	
I-395 HOV	**VISSIM (mph)**	**Field (mph)**	**Difference (mph)**	**INRIX (mph)**
From I-495 interchange				
to Entrance Ramp from General Purpose NB	43	53	-10	45
to Exit Ramp to Route 1 North	42	35	7	45
to End HOV Ramp to General Purpose NB	20	20	0	24
I-395 HOV Total Speed (mph)	**34**	**32**	**2**	

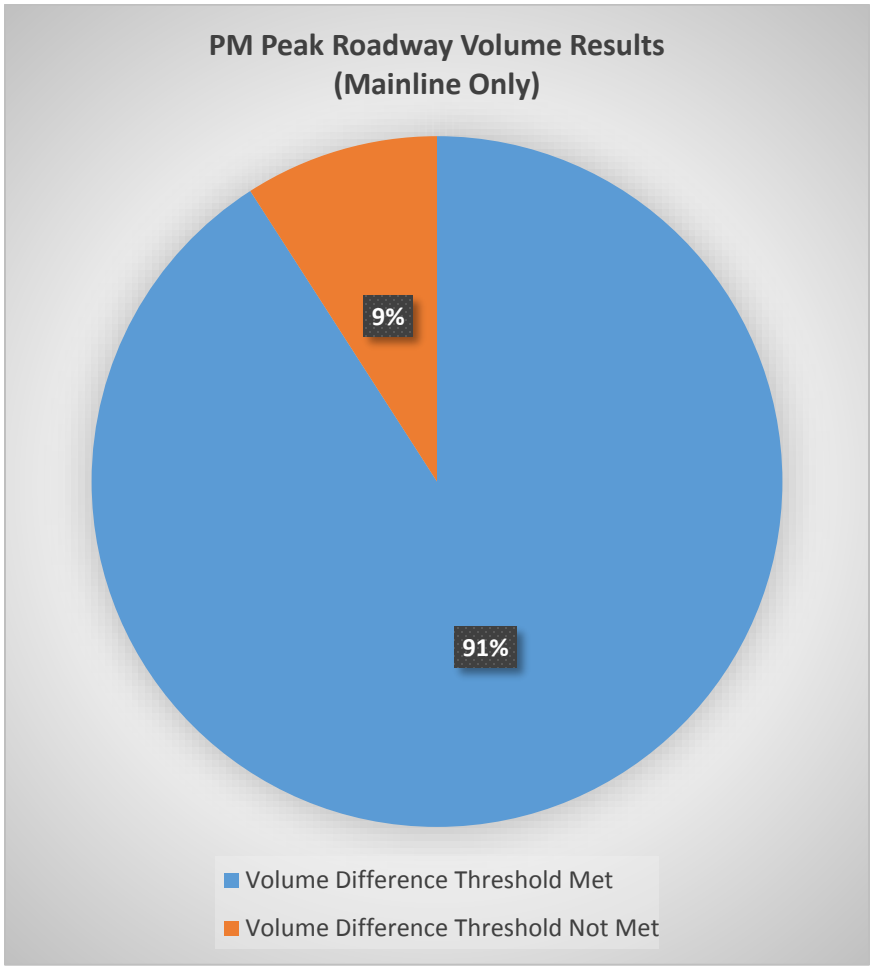
Table 8: PM Peak Vehicle Speed Summary – Southbound

I-395 General Purpose	VISSIM (mph)	Field (mph)	Difference (mph)	INRIX (mph)
From 9th St Expressway				
to Entrance Ramp from 9th St Expressway	14	16	-2	18
to Exit Ramp to Ohio Dr SW	19	18	1	22
to Exit Ramp to Beginning of HOV	38	29	9	22
to Entrance Ramp from Route 1	37	28	9	25
to Exit Ramp to George Washington Memorial Pkwy	40	35	5	31
to Exit/Entrance Ramp weave to George Washington Memorial Pkwy	42	41	1	43
to Entrance Ramp from George Washington Memorial Pkwy	44	43	1	43
to Exit Ramp to Boundary Channel Dr	48	41	7	43
to Entrance Ramp from Boundary Channel Dr	35	41	-6	45
to Exit Ramp to Boundary Channel Dr	32	37	-5	45
to Entrance Ramp from Boundary Channel Dr / Exit to Route 1	39	35	4	45
to Exit Ramp to Jefferson Davis Hwy	37	33	4	43
to Exit Ramp to Washington Blvd	30	35	-5	43
to Entrance Ramp from End of Southbound HOV	11	6	5	36
to Entrance Ramp from Army Navy Dr	12	6	6	19
to Entrance Ramp from Washington Blvd	8	7	1	19
to Entrance Ramp from Washington Blvd	9	10	-1	17
to Exit Ramp to Glebe Rd	15	13	2	17
to Entrance Ramp from Glebe Rd C-D road	10	12	-2	23
to Entrance Ramp from Shirlington Rd	10	12	-2	23
to Exit Ramp to King St	10	12	-2	26
to Entrance Ramp from King St	8	12	-4	27
to Entrance Ramp from King St	9	13	-4	27
to Exit Ramp to Seminary Rd	18	12	6	24
to Entrance Ramp from Seminary Rd	15	17	-2	21
to Exit Ramp to Little River Tnpk	22	19	3	23
to Entrance Ramp from Little River Tnpk	20	23	-3	31
to Exit Ramp to Little River Tnpk	33	29	4	31
to Entrance Ramp from Little River Tnpk	32	27	5	31
to Exit Ramp to HOV Southbound	53	45	8	51
to Entrance Ramp from HOV Southbound	56	53	3	51
to Exit Ramp to Edsall Rd	55	46	9	51
to Entrance Ramp from Edsall Rd	54	48	6	51
to Exit Ramp to Edsall Rd	54	42	12	55
to Entrance Ramp from Edsall Rd	54	43	11	55
I-395 General Purpose Total Speed (mph)	**16**	**15**	**1**	
I-395 HOV/HOT	**VISSIM (mph)**	**Field (mph)**	**Difference (mph)**	**INRIX (mph)**
From 9th St Expressway				
to Entrance Ramp from Route 1	42	31	11	45
to Exit Ramp to Southbound General Purpose	43	33	10	55
to Exit Ramp to S. Eads St	53	54	-1	55
to Exit Ramp from S. Eads St	53	56	-3	55
to Exit Ramp to Southbound General Purpose	54	50	4	46
to SB HOV Merge to Reversible HOV	54	51	3	46
to Entrance Ramp from Washington Blvd	52	52	0	59
to Exit Ramp to Shirlington Rd	64	60	4	63
to Exit Ramp to Seminary Rd	64	60	4	60
to Exit Ramp to Southbound General Purpose	65	62	3	64
to Entrance Ramp from Southbound General Purpose	65	67	-2	67
I-395 HOV Total Speed (mph)	**59**	**54**	**5**	

Figure 30 shows the percentage of the mainline links (I-395 general purpose and HOV/HOT lanes) that are within 10 percent of the field count data. The results show 91% of the model links are within 10 percent for both the AM and PM peak hours.

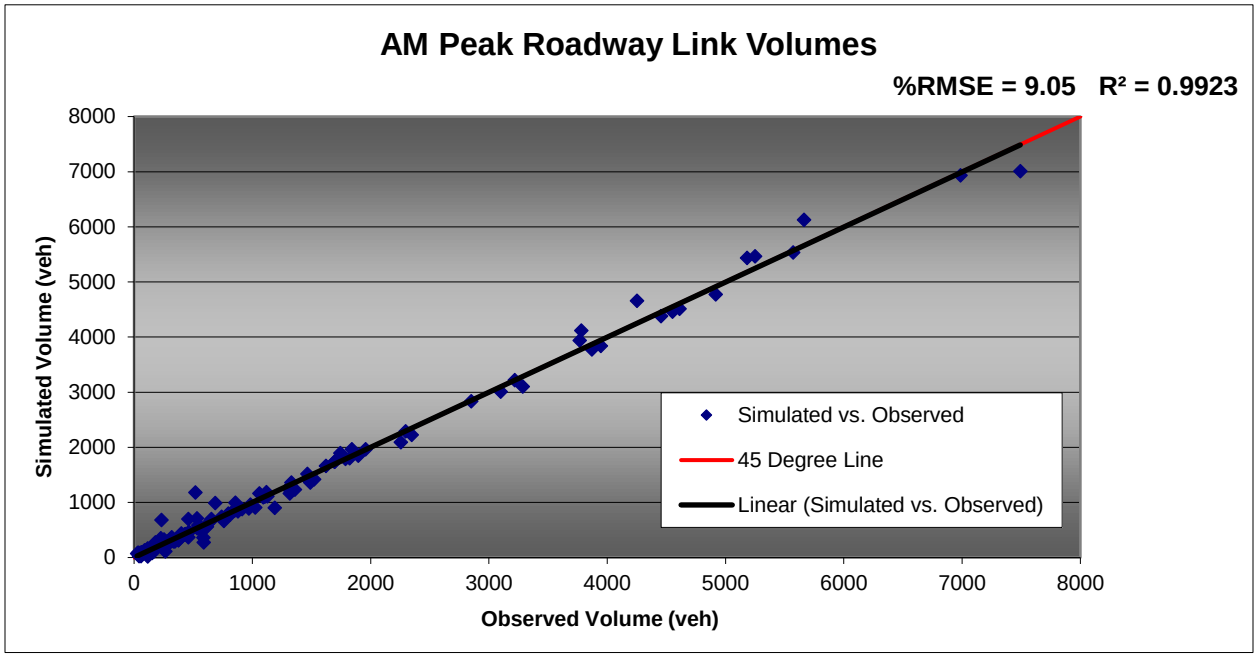
Figure 30: Roadway Volume Results – AM and PM Calibration – Volume Difference Statistic (Mainline Only)





R-squared plots were created to display the correlation between VISSIM model volumes and the field count data for general purpose and HOV/HOT mainline and ramp segments. **Figure 31** shows that the R-squared results are greater than 0.98, which confirm a good fit between model volumes and count data. In addition, %RMSE was calculated to show another comparison between model volumes and count data. The model volume data statistics exceeded the validation acceptance targets.

Figure 31: Roadway R-Squared Plots – AM and PM Calibration (All Link Segments)



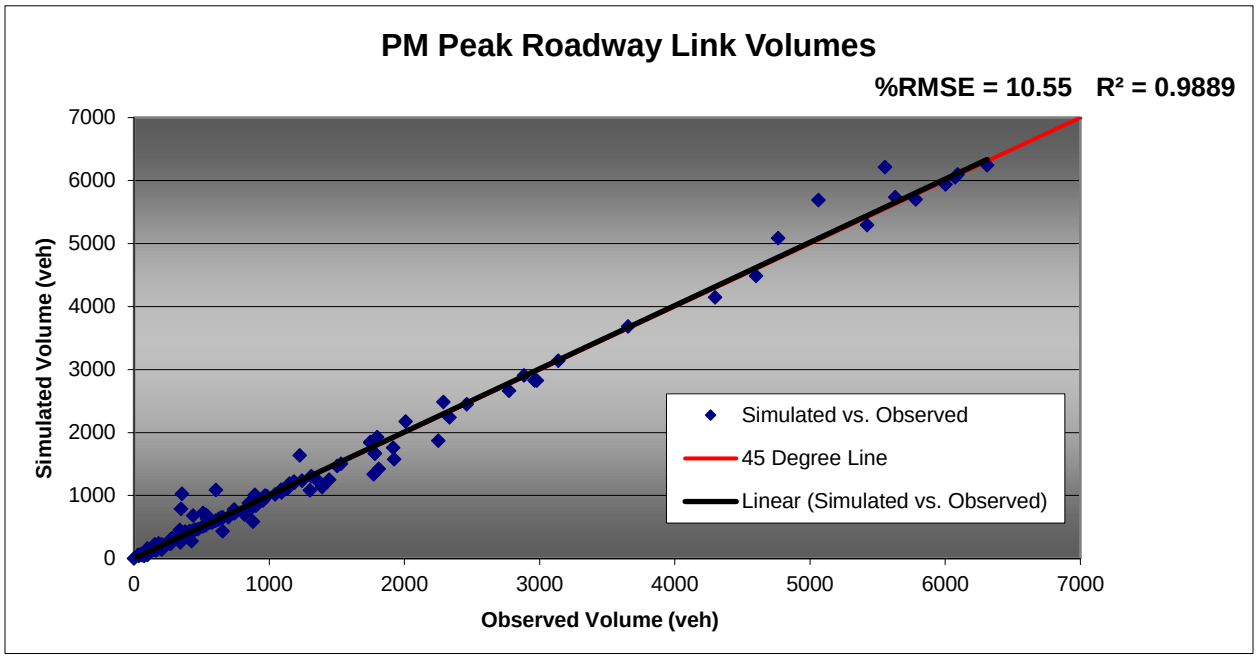


Figure 32 shows the percentage of general purpose and HOV/HOT mainline and ramp segments that meet the GEH criteria. The results show 87% and 86% of the model links meet the criteria for the AM and PM peak hours, respectively.

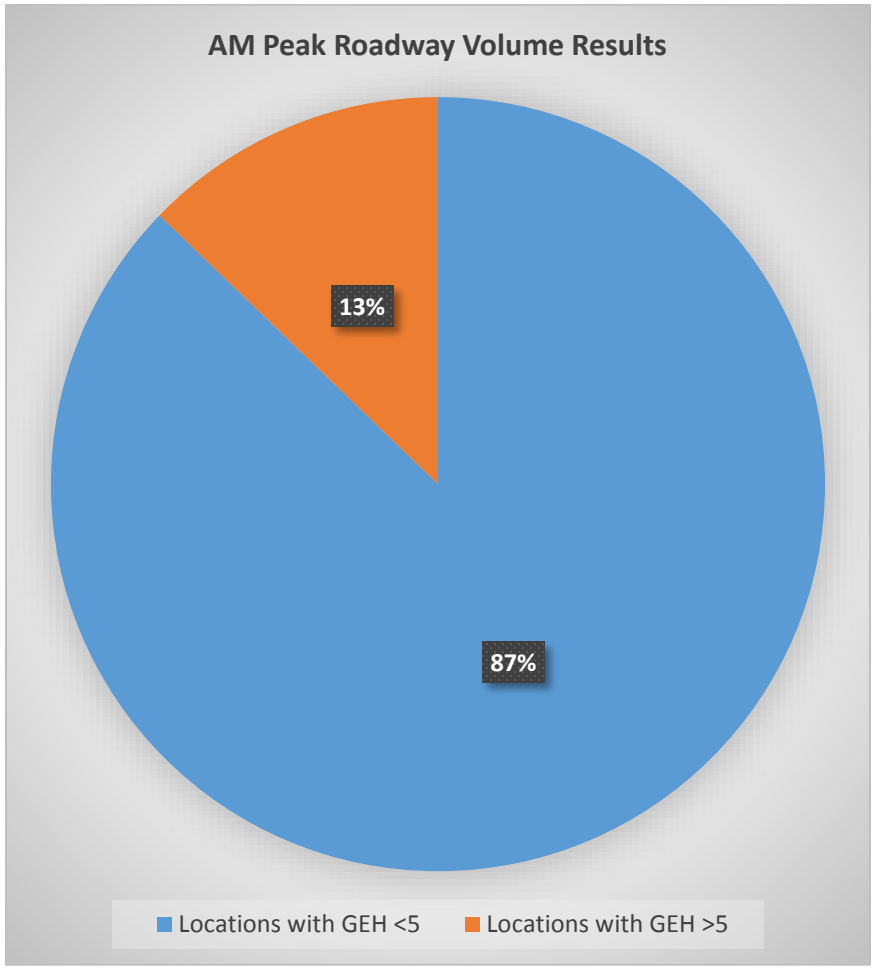
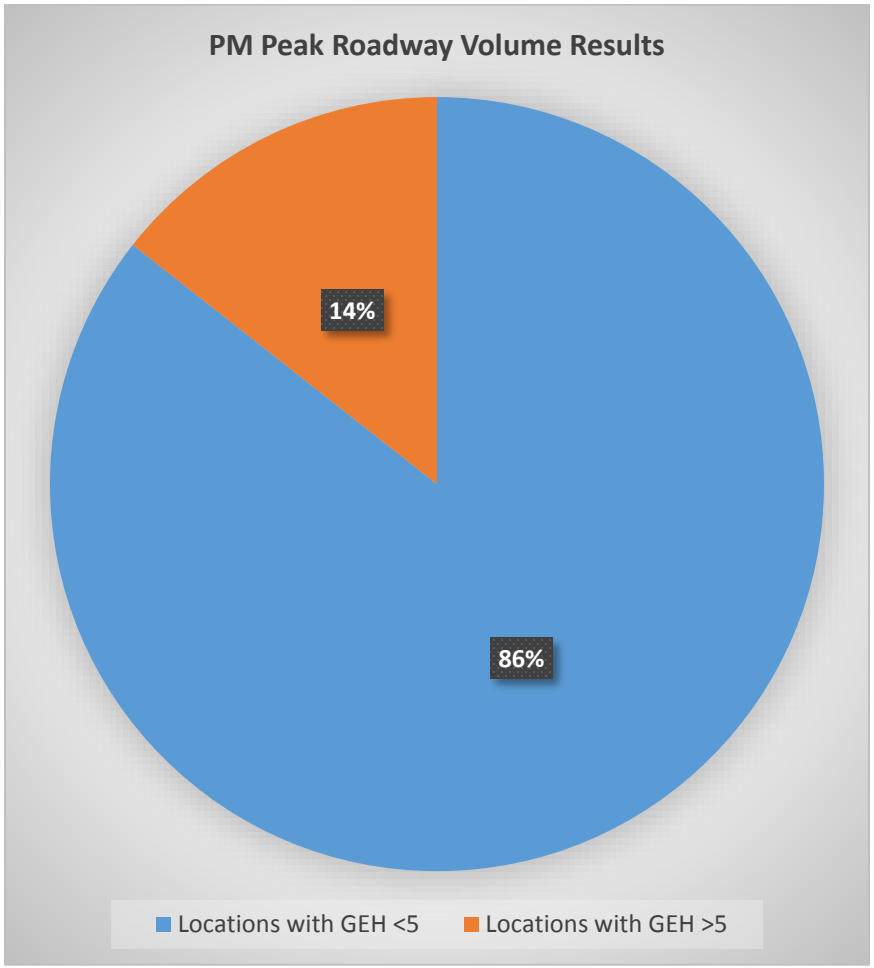



Figure 32: Roadway Volume Results – AM and PM Calibration – GEH Statistic (All Link Segments)