



I-95 Corridor Coalition

I-95 Corridor Coalition Vehicle Probe Project: Validation of INRIX Data

Monthly Report: Virginia



May 2015

I-95 CORRIDOR COALITION VEHICLE PROBE PROJECT VALIDATION OF INRIX DATA MAY 2015

Monthly Report

Prepared for:

I-95 Corridor Coalition

Sponsored by:

I-95 Corridor Coalition

Prepared by:

Ali Haghani, Masoud Hamed, Xuechi Zhang, Kiana Roshan Zamir, Arezoo Samimi Abianeh
University of Maryland, College Park

Acknowledgements:

The research team would like to express its gratitude for the assistance it received from the state highway officials in Virginia during the course of this study. Their effort was instrumental during the data collection phase of the project. This report would not have been completed without their help.

May 2015

Evaluation Results for the State of Virginia

Executive Summary

The data from the Vehicle Probe Project is validated using Bluetooth™ Traffic Monitoring (BTM) technology on a near monthly basis. The validation of arterial data is similar to that of freeway data, however the following should be noted. The boundaries of the speed bins used for arterials are different than those used for freeways to accommodate the lower speeds on this type of corridor.

BTMs sensor were deployed at the beginning and ending points of thirteen different segments along the US-1 corridor. Number of lanes varies between 2 and 3 per direction with average signal density of 3 signal per mile. Average Annual Daily Traffic (AADT) along the corridor is 38,933 and the speed limit is 45 MPH.

The Bluetooth sensor deployment covers the range from Huntington Avenue to Joplin Road along US-1. Travel time data was collected for both directions along the arterial, between December 4 and December 18, 2014. The dataset collected represents approximately 6068 hours of observations along 13 arterial segments, totaling approximately 49 miles. The total number of effective five-minute travel time samples observed was 72,811.

ES Table 1, below summarizes the results of the comparison between the BTM reference data and the INRIX data for arterial segments during the above noted time period. As shown, the average absolute speed error (AASE) was within specification in all speed bins. The Speed Error Bias (SEB) was within specifications for all speed bins except 0-15 MPH when compared with the Standard Error of the Mean (SEM) Band. Although the data are compared to these specifications, caution should be used when using probe data on arterial roadways. Other factors including signal density and traffic volume should be considered.

ES Table 1 - Virginia Evaluation Summary for Arterial						
Speed Bin	Absolute Speed Error (<10mph)		Speed Error Bias (<5mph)		Number of 5 Minute Samples	Hours of Data Collection
	Comparison with SEM Band	Comparison with Mean	Comparison with SEM Band	Comparison with Mean		
0-15 MPH	6.4	9.5	6.4	9.5	5684	474
15-25 MPH	2.8	6.6	2.6	5.7	24594	2050
25-35 MPH	1.7	5.1	0.2	0.6	25736	2145
>35 MPH	3.2	6.9	-2.6	-5.1	16797	1400
All Speeds	2.8	6.4	0.9	1.7	72811	6068

Based upon data collected from Dec 4th, 2014 through Dec 18th, 2014 across 49.1 miles of roadway.

Data Collection

Travel time samples were collected along 13 arterial segments with the assistance of Virginia Department of Transportation (VDOT) personnel. Arterial segments studied were located along the US-1 corridor from Huntington Avenue to Joplin Road. Travel time data was collected for both directions along the US-1 arterial between December 4 and December 18, 2014. Segment locations were chosen with a high-likelihood of observing recurrent and non-recurrent congestion during peak and off-peak periods.

Figure 1 presents an overview snapshot of the placement of sensors for the collection of data on the US-1 corridor in Virginia. Red segments represent arterial segments selected for analysis. Number of lanes varies between 2 and 3 per direction with average signal density of 3 signal per mile. Average Annual Daily Traffic (AADT) along the corridor is 38,933 and the speed limit is 45 MPH.

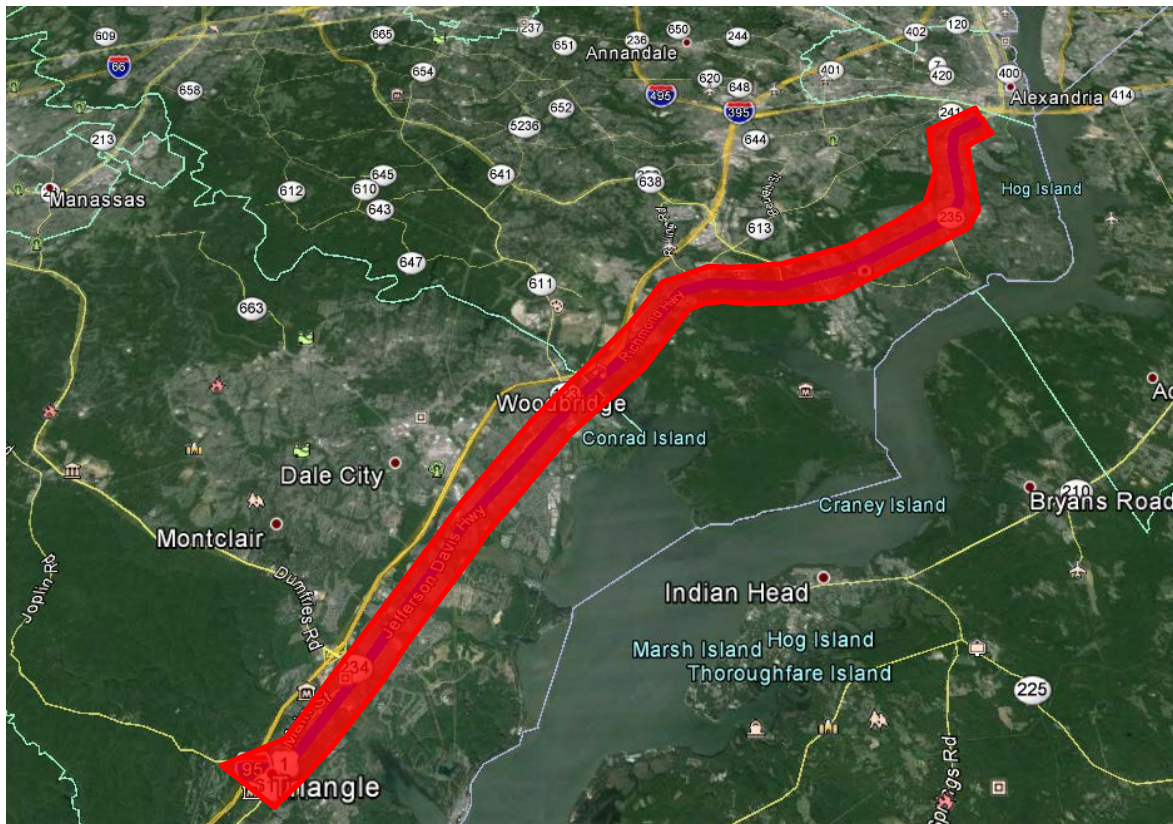


Figure 1 — Locations of all segments selected for analysis in Virginia

TMC segments selected for validation in Virginia

Table 1 presents a list of data collection segments from Virginia. In total, these segments cover a total length of 49.1 arterial miles. Data collection segments are comprised of one or more Traffic Message Channel (TMC) base segments, such that the total length of the data collection segment is one mile long or greater for arterials. When appropriate, consecutive TMC segments are combined to form a data collection segment longer than one mile. The results of the validation performed on 13 arterial segments are included in this report. Table 1 contains the summary information on each data collection segment. The latitude/longitude coordinates of the locations at which the Bluetooth sensors were deployed along the US-1 in Northern Virginia are provided in Table 1 as well as an active map link to view the data collection segment in detail. Click on the map link to see a detailed map for the respective data collection segment. It should be noted that the configuration of the test segments is often such that the endpoint of one segment coincides with the start point of the next segment, so that one Bluetooth sensor covers both data collection segments.

Table 1 also provides data on the precise length of the TMCs comprising the test segment as compared to the measured length between BluetoothTM Traffic Monitoring (BTM) sensors placed on the roadway. An algorithm was developed and documented in a separate report¹ as part of the initial VPP project and is being used for the validation of all vendors in VPPII. Details of the algorithm used to estimate equivalent path travel times based on INRIX data feeds for individual data collection segments are provided in this separate report. This algorithm finds an equivalent INRIX travel time (and therefore travel speed) corresponding to each sample BTM travel time observation on the test segment of interest.

¹ Ali Haghani, Masoud Hamed, Kaveh Farokhi Sadabadi, Estimation of Travel Times for Multiple TMC Segments, prepared for I-95 Corridor Coalition, February 2010 ([link](#))

Table 1
Segments selected for validation in Virginia

SEGMENT (Map Link)	DESCRIPTION			TMC CODES		Deployment		All Lengths in Miles
	Highway Virginia	State County	Starting at Ending at	Begin End	Number Length	Begin Lat/Lon End Lat/Lon	Length % Diff	
Arterials								
A1 VA09-0001	US-1 Southbound	Virginia Fairfax	Huntington Ave Kings Hwy	110-05646 110-05645	3 0.97	38.789658 38.781161	-77.063998 -77.078587	1 3.08%
A2 VA09-0002	US-1 Southbound	Virginia Fairfax	Kings Hwy Beacon Hill Rd	110-05644 110-05644	1 0.65	38.781161 38.772466	-77.078587 -77.081094	0.63 -3.10%
A3 VA09-0003	US-1 Southbound	Virginia Fairfax	Beacon Hill Rd Fordson Rd	110-05643 110-05643	1 1.68	38.772466 38.748301	-77.081094 -77.083248	1.7 1.19%
A4 VA09-0004	US-1 Southbound	Virginia Fairfax	Fordson Rd VA-235/Mount Vernon Hwy	110-05642 110-05641	2 0.72	38.748301 38.739076	-77.083248 -77.088943	0.73 1.39%
A5 VA09-0005	US-1 Southbound	Virginia Fairfax	VA-235/Mount Vernon Hwy VA-235/Mount Vernon Memorial Hwy	110N05641 110-05640	2 2.85	38.739076 38.716995	-77.088943 -77.132755	2.83 -0.70%
A6 VA09-0006	US-1 Southbound	Virginia Fairfax	VA-235/Mount Vernon Memorial Hwy VA-7100/Fairfax County Pkwy	110N05640 110N05639	3 1.85	38.716995 38.707844	-77.132755 -77.163858	1.83 -1.08%
A9 VA09-0009	US-1 Southbound	Virginia Fairfax	Lorton Rd I-95 (Lorton)	110-05635 110-05634	3 2.33	38.705713 38.677623	-77.205011 -77.230068	2.4 3.00%
A10 VA09-0010	US-1 Southbound	Virginia Prince William	I-95 (Lorton) VA-123/Gordon Blvd	110N05634 110N09532	3 1.57	38.677623 38.661743	-77.230068 -77.247195	1.51 -3.82%

Table 1 (Cont'd)
Segments selected for validation in Virginia

SEGMENT (Map Link)	DESCRIPTION			TMC CODES		Deployment		All Lengths in Miles
	Highway Virginia	State County	Starting at Ending at	Begin End	Number Length	Begin Lat/Lon End Lat/Lon	Length % Diff	
Arterials								
A11 VA09-0011	US-1 Southbound	Virginia Prince William	VA-123/Gordon Blvd Opitz Blvd	110-09531 110N09531	2 2.43	38.661743 38.633286	-77.247195 -77.271854	2.44 0.41%
A12 VA09-0012	US-1 Southbound	Virginia Prince William	Opitz Blvd Dale Blvd	110-09530 110N09530	2 1.14	38.633286 38.621449	-77.271854 -77.282669	1.01 -11.39%
A13 VA09-0013	US-1 Southbound	Virginia Prince William	Dale Blvd Cardinal Dr	110-09529 110N09529	2 0.88	38.621449 38.608768	-77.282669 -77.291518	1.01 14.73%
A14 VA09-0014	US-1 Southbound	Virginia Prince William	Cardinal Dr VA-234/Dumfries Rd	110-09528 110N09528	2 2.71	38.608768 38.574986	-77.291518 -77.314884	2.68 -1.11%
A15 VA09-0015	US-1 Southbound	Virginia Prince William	VA-234/Dumfries Rd Joplin Rd	110-09527 110N09527	2 2.53	38.574986 38.545718	-77.314884 -77.33684	2.53 0.00%
A16 VA09-0016	US-1 Northbound	Virginia Prince William	Joplin Rd VA-234/Dumfries Rd	110P09527 110+09528	2 2.43	38.545718 38.574986	-77.33684 -77.314884	2.41 -0.82%
A17 VA09-0017	US-1 Northbound	Virginia Prince William	VA-234/Dumfries Rd Cardinal Dr	110P09528 110+09529	2 2.67	38.574986 38.608768	-77.314884 -77.291518	2.67 0.00%
A18 VA09-0018	US-1 Northbound	Virginia Prince William	Cardinal Dr Dale Blvd	110P09529 110P09530	3 1.13	38.608768 38.621449	-77.291518 -77.282669	1.01 -9.98%
A19 VA09-0019	US-1 Northbound	Virginia Prince William	Dale Blvd Opitz Blvd	110+09531 110+09531	1 0.9	38.621449 38.633286	-77.282669 -77.271854	1.01 12.47%
A20 VA09-0020	US-1 Northbound	Virginia Prince William	Opitz Blvd VA-123/Gordon Blvd	110P09531 110+09532	2 2.42	38.633286 38.661743	-77.271854 -77.247195	2.43 0.41%

Table 1 (Cont'd)
Segments selected for validation in Virginia

SEGMENT (Map Link)	DESCRIPTION			TMC CODES		Deployment		Length % Diff
	Highway Virginia	State County	Starting at Ending at	Begin End	Number Length	Begin Lat/Lon End Lat/Lon		
Arterials								All Lengths in Miles
A21 VA09-0021	US-1 Northbound	Virginia Fairfax	VA-123/Gordon Blvd I-95 (Lorton)	110P09532 110P05634	3 1.44	38.661743 38.677623	-77.247195 -77.230068	1.43 -0.69%
A22 VA09-0022	US-1 Northbound	Virginia Fairfax	I-95 (Lorton) Lorton Rd	110+05635 110P05636	4 2.39	38.677623 38.705713	-77.230068 -77.205011	2.4 0.51%
A25 VA09-0025	US-1 Northbound	Virginia Fairfax	VA-7100/Fairfax County Pkwy VA-235/Mount Vernon Memorial Hwy	110+05640 110P05640	2 1.86	38.707844 38.716995	-77.163858 -77.132755	1.85 -0.54%
A26 VA09-0026	US-1 Northbound	Virginia Fairfax	VA-235/Mount Vernon Memorial Hwy VA-235/Mount Vernon Hwy	110+05641 110P05641	2 2.85	38.716995 38.739076	-77.132755 -77.088943	2.82 -1.05%
A27 VA09-0027	US-1 Northbound	Virginia Fairfax	VA-235/Mount Vernon Hwy Fordson Rd	110+05642 110+05643	2 0.72	38.739076 38.748301	-77.088943 -77.083248	0.73 1.39%
A28 VA09-0028	US-1 Northbound	Virginia Fairfax	Fordson Rd Beacon Hill Rd	110+05644 110+05644	1 1.68	38.748301 38.772466	-77.083248 -77.081094	1.7 1.19%
A29 VA09-0029	US-1 Northbound	Virginia Fairfax	Beacon Hill Rd Kings Hwy	110+05645 110+05645	1 0.64	38.772466 38.781161	-77.081094 -77.078587	0.62 -3.12%
A30 VA09-0030	US-1 Northbound	Virginia Fairfax	Kings Hwy Huntington Ave	110+05646 110+05647	3 1.00	38.781161 38.789658	-77.078587 -77.063998	0.99 -1.00%

Analysis of Arterial Results

Table 2 summarizes the data quality measures obtained as a result of comparison between Bluetooth and all reported INRIX speeds. Specifications used for comparison include the Average Absolute Speed Error (AASE) and the Speed Error Bias (SEB).

Average Absolute Speed Error (AASE)

The AASE is defined as the mean absolute value of the difference between the mean speed reported from the VPP and the ground truth mean speed for a specified time period. The AASE is the primary accuracy metric. Based on the contract specifications, the speed data from the VPP shall have a maximum average absolute error of 10 miles per hour (MPH) in each of four speed ranges: 0-15 MPH, 15-25 MPH, 25-35 MPH, and > 35 MPH.

Speed Error Bias (SEB)

The SEB is defined as the average speed error (not the absolute value) in each speed range. SEB is a measure of whether the speed reported in the VPP consistently under or over estimates speed as compared to ground truth speed. Based on the contract specifications, the VPP data shall have a maximum SEB of +/- 5 MPH in each of speed ranges as defined above.

The results are presented as compared against the mean of the ground truth data as well as the 95th percent confidence interval for the mean, referred to as the Standard Error of the Mean (SEM) band. The SEM band takes into account any uncertainty in the ground truth speed as measured by BTM equipment due to limited samples and/or data variance. Contract specifications are assessed against the SEM band. (See the *Vehicle Probe Project: Data Use and Application Guide* for additional details on the validation process.) The AASE in the lower two speed bands have proven to be the critical specification (and most difficult) to attain. As shown, the average absolute speed error (AASE) was within specification for all the speed bins. The Speed Error Bias (SEB) was within specifications for all speed bins except for 0-15 MPH when compared with the Standard Error of the Mean (SEM) Band.

TABLE 2 Data quality measures for arterial segments in Virginia

SPEED BIN	Data Quality Measures for				No. of 5 Minute Samples	Hours of Data Collection
	1.96 SEM Band		Mean			
	SEB 5 mph (contract specifications)	AASE 10 mph	SEB	AASE		
0-15	6.4	6.4	9.5	9.5	5684	474
15-25	2.6	2.8	5.7	6.6	24594	2050
25-35	0.2	1.7	0.6	5.1	25736	2145
35+	-2.6	3.2	-5.1	6.9	16797	1400

Table 3 shows the percentage of the time INRIX data falls within 5 mph of the SEM band and the mean for each speed bin for all arterial data segments in this validation report.

Table 3 Percent observations meeting data quality criteria for arterial segments in Virginia

SPEED BIN	Data Quality Measures for				No. of Obs.
	1.96 SEM Band		Mean		
	Percentage falling inside the band	Percentage falling within 5 mph of the band	Percentage equal to the mean	Percentage within 5 mph of the mean	
0-15	12%	48%	0%	24%	5684
15-25	46%	78%	0%	46%	24594
25-35	57%	87%	0%	57%	25736
35+	47%	75%	0%	45%	16797

Tables 4 and 5 present detailed data for individual TMC segments in this validation in a similar format as Tables 2 and 3, respectively. Note that for some segments and in some speed bins the comparison results may not be reliable due to the small number of observations.

**Table 4
Data quality measures for individual arterial validation segments in the state of
Virginia**

TMC	Standard TMC length	Bluetooth distance	SPEED BIN	Data Quality Measures for				No. of Obs.
				1.96 SEM Band		Mean		
				Speed Error Bias	Average Absolute Speed Error	Speed Error Bias	Average Absolute Speed Error	
VA09-0001	0.97	1.00	0-15	6.9	7.0	9.5	9.5	572
			15-25	2.7	2.8	6.0	6.6	1315
			25-35	-0.2	1.4	-0.5	4.9	424
			35+	-4.9	5.2	-9.5	10.7	68
VA09-0002	0.65	0.63	0-15	6.4	6.4	11.5	11.5	132
			15-25	1.8	2.0	5.0	6.4	1861
			25-35	-0.7	1.7	-2.1	5.8	1847
			35+	-5.6	5.8	-11.8	12.1	493
VA09-0003	1.68	1.70	0-15	6.4	6.4	11.0	11.0	289
			15-25	2.4	2.6	5.0	5.8	1481
			25-35	0.0	1.6	-0.3	4.8	1114
			35+	-4.4	4.5	-7.9	8.4	436
VA09-0004	0.74	0.73	0-15	6.1	6.1	8.7	8.7	793
			15-25	2.3	2.4	5.1	6.1	1705
			25-35	0.0	1.0	-0.2	4.6	571
			35+	-4.0	4.0	-10.7	10.8	96
VA09-0005	2.83	2.83	0-15	9.3	9.3	17.3	17.3	103
			15-25	2.3	2.3	8.9	9.0	581
			25-35	0.5	1.4	1.0	3.8	1277
			35+	-2.5	2.6	-5.5	6.0	320
VA09-0006	1.85	1.83	0-15	4.0	4.1	4.9	5.0	98
			15-25	2.3	2.8	3.3	4.5	174
			25-35	1.3	2.6	2.6	6.0	765
			35+	-1.3	1.8	-2.6	5.0	2795
VA09-0009	2.33	2.40	0-15	3.4	3.4	4.9	5.0	152
			15-25	2.0	2.8	3.4	5.2	120
			25-35	0.8	2.1	2.9	5.4	228
			35+	-2.5	3.1	-4.3	6.2	1664

Table 4 (Cont'd)
Data quality measures for individual arterial validation segments in the state of Virginia

TMC	Standard TMC length	Bluetooth distance	SPEED BIN	Data Quality Measures for				No. of Obs.
				1.96 SEM Band		Mean		
				Speed Error Bias	Average Absolute Speed Error	Speed Error Bias	Average Absolute Speed Error	
VA09-0010	1.57	1.51	0-15	2.5	2.6	3.0	3.3	178
			15-25	2.6	3.0	3.6	5.1	184
			25-35	1.1	2.7	2.2	6.2	566
			35+	-2.2	3.6	-3.9	7.1	738
VA09-0011	2.43	2.44	0-15	4.6	4.6	7.3	7.3	459
			15-25	1.9	2.3	4.1	5.2	721
			25-35	-0.7	1.7	-2.2	4.8	644
			35+	-6.2	6.2	-9.4	9.4	92
VA09-0012	1.14	1.01	0-15	9.9	9.9	13.8	13.8	64
			15-25	3.3	3.3	7.4	8.0	974
			25-35	0.0	1.2	0.2	4.7	1210
			35+	-4.7	4.8	-8.4	9.2	414
VA09-0013	0.88	1.01	0-15	5.2	5.3	6.8	7.3	190
			15-25	3.5	4.3	6.4	8.8	757
			25-35	0.3	2.2	1.5	7.4	1241
			35+	-4.0	4.5	-7.2	8.9	601
VA09-0014	2.71	2.68	0-15	9.0	9.0	12.5	12.5	119
			15-25	2.6	3.2	5.3	6.9	451
			25-35	-0.3	2.1	-1.1	5.1	712
			35+	-6.9	7.0	-10.3	10.5	147
VA09-0015	2.53	2.53	0-15	7.5	7.5	11.3	11.3	60
			15-25	2.1	2.3	4.7	5.5	441
			25-35	-0.3	1.7	-0.6	4.2	731
			35+	-5.5	5.5	-7.9	8.1	55
VA09-0016	2.43	2.41	0-15	8.9	8.9	14.3	14.3	93
			15-25	1.6	1.9	5.5	6.8	331
			25-35	-0.9	2.3	-1.4	5.3	566
			35+	-4.6	4.6	-8.7	8.8	73

Table 4 (Cont'd)
Data quality measures for individual arterial validation segments in the state of Virginia

TMC	Standard TMC length	Bluetooth distance	SPEED BIN	Data Quality Measures for				No. of Obs.
				1.96 SEM Band		Mean		
				Speed Error Bias	Average Absolute Speed Error	Speed Error Bias	Average Absolute Speed Error	
VA09-0017	2.67	2.67	0-15	7.6	7.6	13.0	13.0	117
			15-25	2.2	2.3	6.1	6.7	501
			25-35	0.4	2.0	0.2	4.6	801
			35+	-3.7	4.3	-6.2	7.4	111
VA09-0018	1.13	1.01	0-15	7.9	7.9	11.3	11.3	69
			15-25	3.1	3.1	7.9	8.3	1288
			25-35	0.4	0.9	1.6	5.5	1303
			35+	-3.5	3.5	-9.0	9.7	442
VA09-0019	1.21	1.01	0-15	8.5	8.5	12.0	12.0	108
			15-25	2.9	3.1	5.7	6.3	1545
			25-35	0.0	1.5	-0.2	4.7	965
			35+	-3.0	3.1	-6.9	7.1	71
VA09-0020	2.42	2.43	0-15	8.9	8.9	10.2	10.2	525
			15-25	4.2	4.6	6.2	6.8	952
			25-35	-0.9	3.2	-1.2	4.3	1540
			35+	-8.2	8.4	-8.9	9.1	446
VA09-0021	1.44	1.43	0-15	9.1	9.1	9.9	10.3	22*
			15-25	4.3	4.3	9.1	9.1	6*
			25-35	0.7	1.4	2.2	4.4	177
			35+	-2.6	2.9	-5.1	6.3	2120
VA09-0022	2.39	2.40	0-15	-	-	-	-	-
			15-25	2.6	2.6	3.9	3.9	164
			25-35	3.7	4.1	6.2	7.0	216
			35+	-0.4	1.8	-1.0	4.7	1418
VA09-0025	1.84	1.85	0-15	8.2	8.2	9.1	9.1	2*
			15-25	4.9	5.1	8.1	8.8	148
			25-35	1.7	2.0	4.1	5.2	2126
			35+	-0.7	1.4	-1.8	4.4	1596
VA09-0026	2.85	2.82	0-15	9.2	9.2	16.8	16.8	136
			15-25	3.2	3.2	8.1	8.2	928
			25-35	1.0	1.5	2.4	3.7	1084
			35+	-1.9	2.5	-4.6	5.8	159

*Results in the specified row may not be reliable due to small number of observations

Table 4 (Cont'd)
Data quality measures for individual arterial validation segments in the state of Virginia

TMC	Standard TMC length	Bluetooth distance	SPEED BIN	Data Quality Measures for				No. of Obs.
				1.96 SEM Band		Mean		
				Speed Error Bias	Average Absolute Speed Error	Speed Error Bias	Average Absolute Speed Error	
VA09-0027	0.77	0.73	0-15	5.7	5.7	9.1	9.1	817
			15-25	2.7	2.7	6.3	6.8	1479
			25-35	0.3	1.3	1.1	5.4	703
			35+	-3.5	4.1	-6.6	9.0	275
VA09-0028	1.68	1.70	0-15	5.1	5.1	9.1	9.1	233
			15-25	2.2	2.4	4.3	5.2	2078
			25-35	0.1	1.3	0.0	4.3	1013
			35+	-3.4	3.5	-6.9	7.8	212
VA09-0029	0.64	0.62	0-15	5.9	5.9	8.9	8.9	167
			15-25	1.8	1.9	4.0	5.6	2317
			25-35	0.0	1.1	-0.5	5.6	1633
			35+	-4.0	4.1	-10.3	11.4	852
VA09-0030	1.01	0.99	0-15	6.5	6.5	9.6	9.7	186
			15-25	3.4	3.4	6.7	7.3	2092
			25-35	0.3	1.3	1.1	5.6	2279
			35+	-3.2	3.6	-6.1	7.7	1103

Table 5
Observations meeting data quality criteria for individual arterial validation segments
in the state of Virginia

TMC	SPEED BIN	Data Quality Measures for								No. of Obs.
		1.96 SEM Band				Mean				
		Speed Error Bias		Average Absolute Speed Error		Speed Error Bias		Average Absolute Speed Error		
		No. falling inside the band	% falling inside the band	No. falling within 5 mph of the band	% falling within 5 mph of the band	No. equal to the mean	% equal to the mean	No. within 5 mph of the mean	% within 5 mph of the mean	
VA09-0001	0-15	9	2%	128	22%	24	4%	155	27%	572
	15-25	187	14%	755	57%	357	27%	856	65%	1315
	25-35	95	22%	304	72%	166	39%	330	78%	424
	35+	1	1%	14	21%	6	9%	26	38%	68
VA09-0002	0-15	2	2%	33	25%	12	9%	52	39%	132
	15-25	402	22%	1153	62%	744	40%	1343	72%	1861
	25-35	316	17%	1177	64%	614	33%	1385	75%	1847
	35+	26	5%	114	23%	51	10%	145	29%	493
VA09-0003	0-15	0	0%	21	7%	2	1%	47	16%	289
	15-25	192	13%	911	62%	370	25%	1035	70%	1481
	25-35	202	18%	795	71%	380	34%	879	79%	1114
	35+	30	7%	149	34%	52	12%	192	44%	436
VA09-0004	0-15	22	3%	232	29%	52	7%	284	36%	793
	15-25	298	17%	1040	61%	569	33%	1189	70%	1705
	25-35	153	27%	454	80%	293	51%	482	84%	571
	35+	5	5%	22	23%	11	11%	32	33%	96
VA09-0005	0-15	0	0%	0	0%	0	0%	4	4%	103
	15-25	36	6%	209	36%	86	15%	309	53%	581
	25-35	211	17%	1012	79%	412	32%	1066	83%	1277
	35+	23	7%	165	52%	52	16%	208	65%	320
VA09-0006	0-15	2	2%	60	61%	8	8%	62	63%	98
	15-25	18	10%	127	73%	31	18%	128	74%	174
	25-35	89	12%	458	60%	203	27%	524	69%	765
	35+	454	16%	1948	70%	874	31%	2162	77%	2795
VA09-0009	0-15	7	5%	100	66%	16	11%	108	71%	152
	15-25	13	11%	75	63%	22	18%	84	70%	120
	25-35	24	11%	154	68%	52	23%	180	79%	228
	35+	194	12%	976	59%	409	25%	1077	65%	1664
VA09-0010	0-15	12	7%	141	79%	20	11%	145	81%	178
	15-25	17	9%	111	60%	33	18%	120	65%	184
	25-35	51	9%	321	57%	107	19%	365	64%	566
	35+	84	11%	397	54%	159	22%	441	60%	738

Table 5 (Cont'd)
Observations meeting data quality criteria for individual arterial validation segments
in the state of Virginia

TMC	SPEED BIN	Data Quality Measures for								No. of Obs.
		1.96 SEM Band				Mean				
		Speed Error Bias		Average Absolute Speed Error		Speed Error Bias		Average Absolute Speed Error		
		No. falling inside the band	% falling inside the band	No. falling within 5 mph of the band	% falling within 5 mph of the band	No. equal to the mean	% equal to the mean	No. within 5 mph of the mean	% within 5 mph of the mean	
VA09-0011	0-15	9	2%	167	36%	18	4%	211	46%	459
	15-25	59	8%	468	65%	125	17%	508	70%	721
	25-35	89	14%	427	66%	167	26%	473	73%	644
	35+	1	1%	31	34%	6	7%	34	37%	92
VA09-0012	0-15	0	0%	2	3%	1	2%	6	9%	64
	15-25	127	13%	419	43%	231	24%	550	56%	974
	25-35	299	25%	881	73%	532	44%	999	83%	1210
	35+	24	6%	139	34%	50	12%	178	43%	414
VA09-0013	0-15	6	3%	96	51%	16	8%	107	56%	190
	15-25	90	12%	338	45%	193	26%	408	54%	757
	25-35	230	19%	684	55%	394	32%	822	66%	1241
	35+	61	10%	257	43%	130	22%	305	51%	601
VA09-0014	0-15	3	3%	19	16%	4	3%	22	18%	119
	15-25	46	10%	231	51%	94	21%	257	57%	451
	25-35	106	15%	473	66%	192	27%	512	72%	712
	35+	6	4%	39	27%	12	8%	47	32%	147
VA09-0015	0-15	0	0%	9	15%	2	3%	14	23%	60
	15-25	40	9%	285	65%	85	19%	321	73%	441
	25-35	116	16%	530	73%	218	30%	578	79%	731
	35+	3	5%	20	36%	6	11%	20	36%	55
VA09-0016	0-15	0	0%	7	8%	2	2%	10	11%	93
	15-25	36	11%	176	53%	81	24%	224	68%	331
	25-35	66	12%	331	58%	134	24%	389	69%	566
	35+	6	8%	24	33%	7	10%	27	37%	73
VA09-0017	0-15	0	0%	17	15%	6	5%	30	26%	117
	15-25	48	10%	269	54%	94	19%	322	64%	501
	25-35	116	14%	532	66%	226	28%	587	73%	801
	35+	12	11%	52	47%	28	25%	58	52%	111
VA09-0018	0-15	3	4%	7	10%	6	9%	9	13%	69
	15-25	196	15%	646	50%	403	31%	796	62%	1288
	25-35	398	31%	933	72%	721	55%	1096	84%	1303
	35+	55	12%	192	43%	114	26%	236	53%	442

Table 5 (Cont'd)
Observations meeting data quality criteria for individual arterial validation segments
in the state of Virginia

TMC	SPEED BIN	Data Quality Measures for								No. of Obs.
		1.96 SEM Band				Mean				
		Speed Error Bias		Average Absolute Speed Error		Speed Error Bias		Average Absolute Speed Error		
		No. falling inside the band	% falling inside the band	No. falling within 5 mph of the band	% falling within 5 mph of the band	No. equal to the mean	% equal to the mean	No. within 5 mph of the mean	% within 5 mph of the mean	
VA09-0019	0-15	0	0%	13	12%	1	1%	17	16%	108
	15-25	216	14%	863	56%	401	26%	973	63%	1545
	25-35	174	18%	693	72%	314	33%	759	79%	965
	35+	8	11%	32	45%	14	20%	43	61%	71
VA09-0020	0-15	7	1%	136	26%	8	2%	161	31%	525
	15-25	40	4%	485	51%	93	10%	546	57%	952
	25-35	114	7%	1064	69%	218	14%	1115	72%	1540
	35+	11	2%	111	25%	15	3%	122	27%	446
VA09-0021	0-15	4	18%	8	36%	5	23%	8	36%	22*
	15-25	1	17%	2	33%	1	17%	2	33%	6*
	25-35	35	20%	133	75%	66	37%	144	81%	177
	35+	249	12%	1169	55%	510	24%	1319	62%	2120
VA09-0022	0-15	-	-	-	-	-	-	-	-	-
	15-25	3	2%	123	75%	4	2%	126	77%	164
	25-35	14	6%	98	45%	26	12%	111	51%	216
	35+	241	17%	994	70%	405	29%	1087	77%	1418
VA09-0025	0-15	0	0%	0	0%	0	0%	0	0%	2*
	15-25	4	3%	45	30%	9	6%	53	36%	148
	25-35	346	16%	1425	67%	659	31%	1587	75%	2126
	35+	295	18%	1187	74%	511	32%	1290	81%	1596
VA09-0026	0-15	0	0%	0	0%	0	0%	2	1%	136
	15-25	18	2%	329	35%	60	6%	446	48%	928
	25-35	170	16%	866	80%	328	30%	915	84%	1084
	35+	29	18%	90	57%	40	25%	101	64%	159
VA09-0027	0-15	20	2%	257	31%	54	7%	332	41%	817
	15-25	248	17%	822	56%	450	30%	950	64%	1479
	25-35	181	26%	496	71%	347	49%	564	80%	703
	35+	35	13%	114	41%	71	26%	143	52%	275

*Results in the specified row may not be reliable due to small number of observations

Table 5 (Cont'd)
Observations meeting data quality criteria for individual arterial validation segments
in the state of Virginia

TMC	SPEED BIN	Data Quality Measures for								No. of Obs.
		1.96 SEM Band				Mean				
		Speed Error Bias		Average Absolute Speed Error		Speed Error Bias		Average Absolute Speed Error		
		No. falling inside the band	% falling inside the band	No. falling within 5 mph of the band	% falling within 5 mph of the band	No. equal to the mean	% equal to the mean	No. within 5 mph of the mean	% within 5 mph of the mean	
VA09-0028	0-15	0	0%	70	30%	5	2%	94	40%	233
	15-25	249	12%	1347	65%	488	23%	1489	72%	2078
	25-35	176	17%	774	76%	392	39%	837	83%	1013
	35+	24	11%	88	42%	42	20%	113	53%	212
VA09-0029	0-15	5	3%	59	35%	16	10%	80	48%	167
	15-25	562	24%	1630	70%	979	42%	1804	78%	2317
	25-35	435	27%	1199	73%	835	51%	1372	84%	1633
	35+	111	13%	348	41%	240	28%	446	52%	852
VA09-0030	0-15	2	1%	57	31%	9	5%	67	36%	186
	15-25	321	15%	1119	53%	593	28%	1279	61%	2092
	25-35	503	22%	1553	68%	923	41%	1801	79%	2279
	35+	111	10%	483	44%	223	20%	595	54%	1103