



I-95 Corridor Coalition

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

Monthly Report: Virginia



May 2015

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

Monthly Report

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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 2923 hours of observations along 13 arterial segments, totaling approximately 49 miles. The total number of effective five-minute travel time samples observed was 35,077.

ES Table 1, below summarizes the results of the comparison between the BTM reference data and the TomTom 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 when compared with the Standard Error of the Mean (SEM) Band. The Speed Error Bias (SEB) was within specifications for speed bins 25-35 MPH and >35 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	9.0	12.3	9.0	12.3	2822	235
15-25 MPH	6.1	11.3	6.1	11.2	12055	1005
25-35 MPH	3.3	7.6	3.1	6.8	12264	1022
>35 MPH	1.8	5.2	-0.2	0.1	7936	661
All Speeds	4.4	8.7	3.9	7.2	35077	2923

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

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 VPII. Details of the algorithm used to estimate equivalent path travel times based on TomTom data feeds for individual data collection segments are provided in this separate report. This algorithm finds an equivalent TomTom 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 a comparison between Bluetooth and all reported TomTom 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 when compared with the Standard Error of the Mean (SEM) Band. The Speed Error Bias (SEB) was within specifications for speed bins 25-35 MPH and >35 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	9.0	9.0	12.3	12.3	2822	235
15-25	6.1	6.1	11.2	11.3	12055	1005
25-35	3.1	3.3	6.8	7.6	12264	1022
35+	-0.2	1.8	0.1	5.2	7936	661

Table 3 shows the percentage of the time TomTom data falls within 5 mph of the SEM band and the mean for each speed bin for all the 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	5%	34%	0%	19%	2822
15-25	21%	47%	0%	14%	12055
25-35	42%	70%	0%	34%	12264
35+	53%	87%	0%	55%	7936

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	8.9	8.9	11.7	11.7	532
			15-25	5.3	5.3	10.4	10.4	1232
			25-35	0.6	0.9	3.0	4.5	378
			35+	-2.4	2.4	-5.5	5.5	63
VA09-0002	0.65	0.63	0-15	11.8	11.8	17.4	17.4	61
			15-25	4.5	4.5	10.6	10.7	886
			25-35	1.1	1.4	3.8	5.3	871
			35+	-0.7	1.4	-2.6	5.6	229
VA09-0003	1.68	1.70	0-15	11.0	11.0	15.9	15.9	112
			15-25	7.2	7.2	11.8	11.9	700
			25-35	3.5	3.5	7.8	8.2	543
			35+	0.3	1.7	0.9	4.3	197
VA09-0004	0.74	0.73	0-15	6.9	6.9	9.9	9.9	349
			15-25	3.4	3.5	7.7	8.0	808
			25-35	0.6	1.0	2.3	5.0	272
			35+	-1.4	1.6	-5.1	6.6	45
VA09-0005	2.83	2.83	0-15	18.3	18.3	26.6	26.6	49
			15-25	9.0	9.0	18.1	18.1	270
			25-35	5.6	5.7	9.4	9.5	595
			35+	0.6	1.6	2.6	4.5	156
VA09-0006	1.85	1.83	0-15	3.2	3.2	4.0	4.1	49
			15-25	6.2	6.4	7.8	8.4	72
			25-35	5.5	5.7	9.9	10.4	336
			35+	0.5	1.0	2.7	4.3	1343
VA09-0009	2.33	2.40	0-15	4.9	4.9	6.5	6.5	76
			15-25	5.5	5.5	8.0	8.2	60
			25-35	5.6	5.8	8.9	9.7	109
			35+	0.9	1.6	2.5	4.5	802

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	2.2	2.2	2.9	3.1	65
			15-25	4.2	4.2	5.9	6.5	87
			25-35	5.3	5.4	9.3	9.7	273
			35+	1.2	1.8	3.6	5.1	352
VA09-0011	2.43	2.44	0-15	4.3	4.3	7.0	7.1	204
			15-25	3.8	3.8	7.6	7.7	347
			25-35	1.5	1.6	3.9	4.7	294
			35+	-1.5	1.5	-3.6	3.6	43
VA09-0012	1.14	1.01	0-15	9.4	9.4	12.4	12.8	29*
			15-25	5.5	5.5	11.2	11.4	459
			25-35	1.2	1.6	4.0	5.9	583
			35+	-2.0	2.5	-4.2	5.5	184
VA09-0013	0.88	1.01	0-15	7.4	7.4	10.2	10.3	71
			15-25	7.4	7.4	13.2	13.3	361
			25-35	2.4	2.7	7.6	8.6	598
			35+	-0.4	2.5	-0.8	6.2	273
VA09-0014	2.71	2.68	0-15	9.7	9.7	13.2	13.2	66
			15-25	6.7	6.8	12.3	12.5	197
			25-35	3.2	3.4	6.5	7.0	329
			35+	-0.8	1.9	-0.7	4.2	70
VA09-0015	2.53	2.53	0-15	7.8	7.8	11.0	11.0	34
			15-25	6.2	6.2	10.8	10.8	196
			25-35	3.4	3.5	6.9	7.1	336
			35+	-0.5	0.8	0.0	2.2	27*
VA09-0016	2.43	2.41	0-15	10.0	10.0	14.5	14.6	53
			15-25	6.4	6.6	14.0	14.1	131
			25-35	3.4	3.7	6.9	7.5	257
			35+	-0.6	0.9	-0.9	3.0	34

*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	
VA09-0017	2.67	2.67	0-15	13.5	13.5	19.3	19.3	48
			15-25	7.3	7.3	13.5	13.5	228
			25-35	4.5	4.6	8.0	8.3	362
			35+	-0.8	1.7	-0.5	3.5	54
VA09-0018	1.13	1.01	0-15	8.9	8.9	12.2	12.3	34
			15-25	6.9	6.9	14.2	14.2	592
			25-35	1.7	1.8	7.2	8.2	607
			35+	-1.4	1.8	-4.0	6.6	202
VA09-0019	1.21	1.01	0-15	7.3	7.3	11.1	11.1	51
			15-25	5.7	5.7	9.8	10.0	718
			25-35	2.0	2.3	4.8	6.4	452
			35+	-0.7	0.9	-1.8	3.9	33
VA09-0020	2.42	2.43	0-15	12.4	12.5	13.7	13.8	235
			15-25	8.3	8.4	10.8	10.9	449
			25-35	3.1	3.6	4.1	4.8	730
			35+	-4.4	4.4	-5.0	5.0	212
VA09-0021	1.44	1.43	0-15	2.1	2.1	1.9	3.7	11*
			15-25	7.7	7.7	8.9	11.8	3*
			25-35	1.6	2.0	5.3	5.7	74
			35+	-2.3	2.3	-5.2	5.6	988
VA09-0022	2.39	2.40	0-15	-	-	-	-	-
			15-25	3.2	3.2	4.7	4.7	62
			25-35	7.0	7.0	10.5	10.6	103
			35+	2.0	2.2	5.1	5.8	674
VA09-0025	1.84	1.85	0-15	6.2	6.2	7.1	7.1	1*
			15-25	10.8	10.8	14.8	14.8	72
			25-35	7.0	7.0	11.7	11.8	987
			35+	1.6	1.9	4.3	5.4	743
VA09-0026	2.85	2.82	0-15	15.7	15.7	23.6	23.6	65
			15-25	8.8	8.8	14.4	14.4	427
			25-35	6.0	6.1	9.6	9.7	500
			35+	-0.6	1.7	0.2	4.8	76

*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	9.8	9.8	13.6	13.6	376
			15-25	5.1	5.1	10.4	10.5	686
			25-35	0.8	1.0	3.6	4.8	311
			35+	-1.9	2.0	-5.8	6.7	121
VA09-0028	1.68	1.70	0-15	10.8	10.8	15.1	15.1	100
			15-25	7.5	7.5	11.3	11.3	963
			25-35	3.5	3.5	7.5	7.6	483
			35+	-0.3	1.2	-0.5	4.2	95
VA09-0029	0.64	0.62	0-15	11.2	11.2	14.3	14.3	79
			15-25	5.0	5.0	10.3	10.3	1075
			25-35	1.4	1.5	5.4	6.3	780
			35+	-2.0	2.2	-5.8	8.1	402
VA09-0030	1.01	0.99	0-15	10.1	10.1	13.3	13.3	72
			15-25	7.9	7.9	13.3	13.3	974
			25-35	2.3	2.4	7.5	8.0	1101
			35+	-0.4	1.1	-0.9	4.0	518

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	1	0%	69	13%	4	1%	83	16%	532
	15-25	42	3%	249	20%	89	7%	372	30%	1232
	25-35	73	19%	290	77%	142	38%	325	86%	378
	35+	12	19%	42	67%	23	37%	48	76%	63
VA09-0002	0-15	0	0%	1	2%	1	2%	3	5%	61
	15-25	46	5%	234	26%	101	11%	345	39%	886
	25-35	199	23%	604	69%	349	40%	700	80%	871
	35+	30	13%	149	65%	77	34%	173	76%	229
VA09-0003	0-15	0	0%	5	4%	0	0%	5	4%	112
	15-25	7	1%	96	14%	18	3%	143	20%	700
	25-35	29	5%	219	40%	75	14%	269	50%	543
	35+	26	13%	136	69%	59	30%	153	78%	197
VA09-0004	0-15	6	2%	87	25%	13	4%	107	31%	349
	15-25	69	9%	339	42%	171	21%	436	54%	808
	25-35	68	25%	205	75%	132	49%	228	84%	272
	35+	3	7%	29	64%	8	18%	34	76%	45
VA09-0005	0-15	0	0%	0	0%	0	0%	0	0%	49
	15-25	0	0%	3	1%	1	0%	16	6%	270
	25-35	22	4%	135	23%	41	7%	170	29%	595
	35+	20	13%	106	68%	32	21%	117	75%	156
VA09-0006	0-15	0	0%	37	76%	5	10%	39	80%	49
	15-25	2	3%	29	40%	6	8%	31	43%	72
	25-35	10	3%	42	13%	15	4%	76	23%	336
	35+	188	14%	1012	75%	370	28%	1167	87%	1343
VA09-0009	0-15	1	1%	42	55%	2	3%	45	59%	76
	15-25	3	5%	23	38%	6	10%	24	40%	60
	25-35	5	5%	20	18%	8	7%	29	27%	109
	35+	101	13%	571	71%	213	27%	635	79%	802
VA09-0010	0-15	0	0%	59	91%	2	3%	59	91%	65
	15-25	5	6%	48	55%	8	9%	53	61%	87
	25-35	12	4%	62	23%	17	6%	80	29%	273
	35+	33	9%	223	63%	68	19%	255	72%	352

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	1	0%	97	48%	3	1%	109	53%	204
	15-25	6	2%	142	41%	15	4%	155	45%	347
	25-35	39	13%	184	63%	72	24%	217	74%	294
	35+	5	12%	34	79%	15	35%	35	81%	43
VA09-0012	0-15	1	3%	10	34%	4	14%	11	38%	29*
	15-25	27	6%	107	23%	54	12%	143	31%	459
	25-35	79	14%	369	63%	200	34%	441	76%	583
	35+	36	20%	127	69%	54	29%	136	74%	184
VA09-0013	0-15	1	1%	25	35%	2	3%	27	38%	71
	15-25	14	4%	62	17%	31	9%	90	25%	361
	25-35	75	13%	271	45%	152	25%	352	59%	598
	35+	33	12%	165	60%	81	30%	185	68%	273
VA09-0014	0-15	0	0%	21	32%	3	5%	22	33%	66
	15-25	3	2%	23	12%	5	3%	36	18%	197
	25-35	26	8%	163	50%	54	16%	188	57%	329
	35+	7	10%	51	73%	19	27%	53	76%	70
VA09-0015	0-15	1	3%	13	38%	1	3%	14	41%	34
	15-25	1	1%	43	22%	6	3%	52	27%	196
	25-35	5	1%	109	32%	13	4%	153	46%	336
	35+	3	11%	25	93%	9	33%	25	93%	27*
VA09-0016	0-15	7	13%	19	36%	10	19%	19	36%	53
	15-25	1	1%	13	10%	4	3%	22	17%	131
	25-35	13	5%	84	33%	25	10%	105	41%	257
	35+	10	29%	31	91%	17	50%	31	91%	34
VA09-0017	0-15	0	0%	6	13%	0	0%	9	19%	48
	15-25	2	1%	30	13%	5	2%	37	16%	228
	25-35	17	5%	125	35%	32	9%	158	44%	362
	35+	22	41%	43	80%	30	56%	43	80%	54
VA09-0018	0-15	2	6%	12	35%	3	9%	12	35%	34
	15-25	17	3%	87	15%	41	7%	129	22%	592
	25-35	100	16%	299	49%	192	32%	399	66%	607
	35+	42	21%	132	65%	80	40%	147	73%	202

*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	
VA09-0019	0-15	0	0%	12	24%	1	2%	12	24%	51
	15-25	28	4%	204	28%	61	9%	248	35%	718
	25-35	46	10%	225	50%	94	21%	283	63%	452
	35+	5	15%	26	79%	9	27%	27	82%	33
VA09-0020	0-15	0	0%	52	22%	0	0%	56	24%	235
	15-25	3	1%	79	18%	9	2%	96	21%	449
	25-35	28	4%	430	59%	67	9%	459	63%	730
	35+	9	4%	139	66%	22	10%	141	67%	212
VA09-0021	0-15	1	9%	9	82%	4	36%	9	82%	11*
	15-25	0	0%	1	33%	1	33%	1	33%	3*
	25-35	0	0%	44	59%	9	12%	57	77%	74
	35+	158	16%	570	58%	279	28%	660	67%	988
VA09-0022	0-15	-	-	-	-	-	-	-	-	-
	15-25	0	0%	47	76%	1	2%	49	79%	62
	25-35	0	0%	31	30%	2	2%	37	36%	103
	35+	63	9%	380	56%	126	19%	428	64%	674
VA09-0025	0-15	0	0%	0	0%	0	0%	0	0%	1*
	15-25	1	1%	12	17%	2	3%	14	19%	72
	25-35	13	1%	63	6%	28	3%	116	12%	987
	35+	71	10%	437	59%	147	20%	525	71%	743
VA09-0026	0-15	0	0%	0	0%	0	0%	0	0%	65
	15-25	0	0%	25	6%	2	0%	37	9%	427
	25-35	11	2%	112	22%	21	4%	149	30%	500
	35+	10	13%	53	70%	22	29%	54	71%	76
VA09-0027	0-15	1	0%	19	5%	3	1%	36	10%	376
	15-25	31	5%	148	22%	64	9%	236	34%	686
	25-35	93	30%	238	77%	160	51%	270	87%	311
	35+	17	14%	74	61%	35	29%	85	70%	121

*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%	3	3%	0	0%	5	5%	100
	15-25	6	1%	112	12%	19	2%	184	19%	963
	25-35	28	6%	208	43%	66	14%	275	57%	483
	35+	23	24%	72	76%	40	42%	80	84%	95
VA09-0029	0-15	0	0%	5	6%	1	1%	9	11%	79
	15-25	59	5%	279	26%	141	13%	441	41%	1075
	25-35	201	26%	521	67%	365	47%	618	79%	780
	35+	91	23%	230	57%	177	44%	283	70%	402
VA09-0030	0-15	0	0%	14	19%	1	1%	15	21%	72
	15-25	16	2%	111	11%	39	4%	172	18%	974
	25-35	109	10%	505	46%	265	24%	662	60%	1101
	35+	122	24%	413	80%	199	38%	450	87%	518