I-95 Corridor Coalition

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

Report for Georgia (#2)
GA-141, US-19, and US-41

I-95 CORRIDOR COALITION

April 2016

I-95 CORRIDOR COALITION VEHICLE PROBE PROJECT VALIDATION OF HERE DATA APRIL 2016

Report for Georgia (#2)
GA-141, US-19, and US-41

Prepared for:

I-95 Corridor Coalition

Sponsored by:

I-95 Corridor Coalition

Prepared by:

Masoud Hamedi, Ali Haghani, Kiana Roshan Zamir, Zhongxiang Wang
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 Georgia 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.

April 2016

Evaluation Results for the State of Georgia

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 16 different segments along the GA-141, US-19, and US-41 corridors. The number of lanes for GA-141 and US-41 varies between two and three per direction. For US-19, the number of lanes per direction varies between two and four. Average signal density is around two signals per mile for both GA-141 and US-41. Average Annual Daily Traffic (AADT) is 43,207 along GA-141, 146,516 along US-19, and 30,830 along US-41. The speed limit is 55 MPH for GA-141, 65 MPH for US-19, and 45 MPH for US-41.

The Bluetooth sensor deployment covers the range from McGinnis Ferry Rd to Holcomb Bridge Rd along GA-141, McFarland Rd/Exit 12 to I-285/Exit 4 along US-19, and GA-120 Loop to Windy Hill Rd along US-41. Travel time data was collected for both directions along each arterial, between February 3 and February 18, 2016. During this period, the area experienced three days with rain and three days with snow. The dataset collected represents approximately 3,695 hours of observations along 16 arterial segments, totaling approximately 29 miles. The total number of effective five-minute travel time samples observed was 44,340.

ES Table 1, below summarizes the results of the comparison between the BTM reference data and the HERE 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 also within specifications for all speed bins. 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 - Georgia Evaluation Summary for Arterial						
Speed Bin	**Average 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	3.7	5.3	3.6	5.1	981	82
15-25 MPH	2.3	5.3	2.1	4.7	3918	327
25-35 MPH	0.7	3.6	0.3	1.2	6072	506
>35 MPH	1.7	4.8	-1.5	-3.9	33369	2781
All Speeds	1.6	4.7	-0.8	-2.2	44340	3695
Based upon data collected from February 3, 2016 through February 18, 2016 across 29 miles of roadway.						

Data Collection

Travel time samples were collected along 16 arterial segments with the assistance of Georgia Department of Transportation (GDOT) personnel. Arterial segments studied were located on the GA-141 corridor from McGinnis Ferry Rd to Holcomb Bridge Rd, on US-19 from McFarland Rd/Exit 12 to I-285/Exit 4, and on US-41 corridor from GA-120 Loop to Windy Hill Rd. Travel time data was collected for both directions along GA-141, US-19, and US-41 between February 3 and February 18, 2016. Segment locations were chosen with a high-likelihood of observing recurrent and non-recurrent congestion during peak and off-peak periods.

Figures 1, 2, and 3 present an overview snapshot of the placement of sensors for the collection of data on the GA-141, US-19, and US-41 corridors, respectively. Blue segments represent arterial segments selected for analysis. The number of lanes for GA-141 and US-41 corridors varies between two and three per direction with average signal density of around 2 signal per mile. For US-19, the number of lanes varies between two and four per direction. Average Annual Daily Traffic (AADT) is 43,207 along GA-141, 146,516 along US-19, and 30,830 along US-41. The speed limit is 55 MPH for GA-141, 65 MPH for US-19, and 45 MPH for US-41.

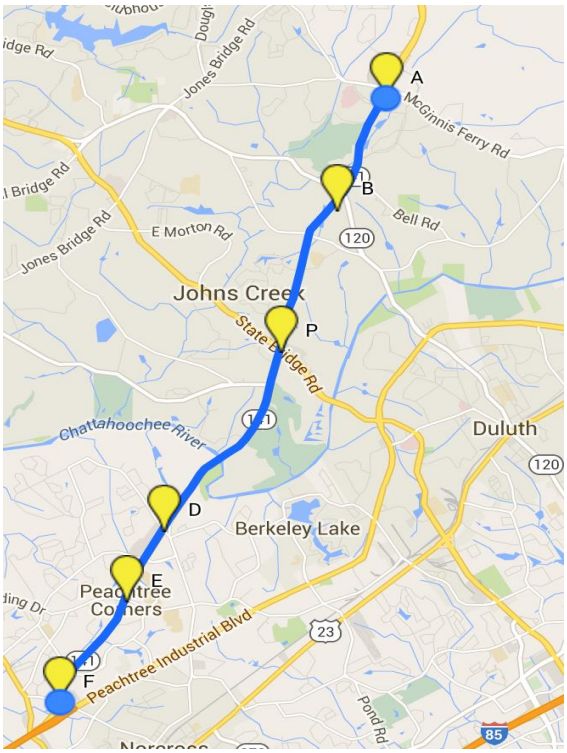

Figure 1 — Locations of all segments selected on GA-141 for analysis in Georgia

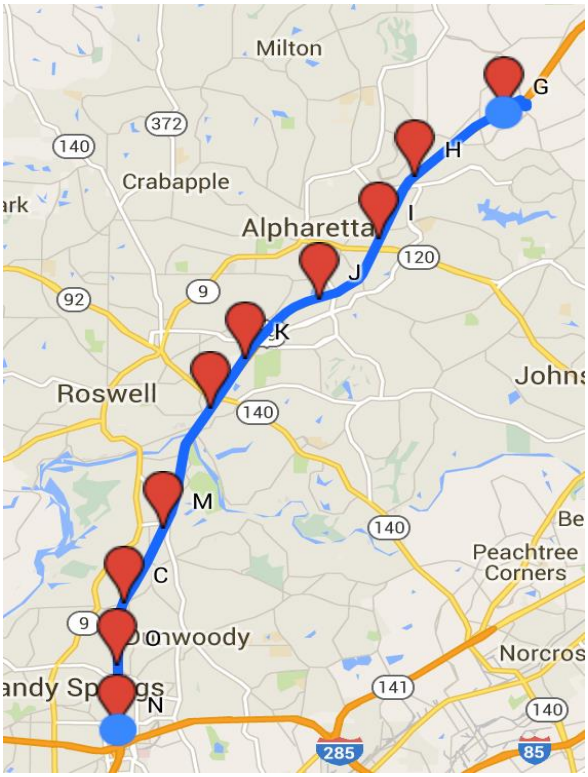

Figure 2 — Locations of all segments selected on US-19 for analysis in Georgia

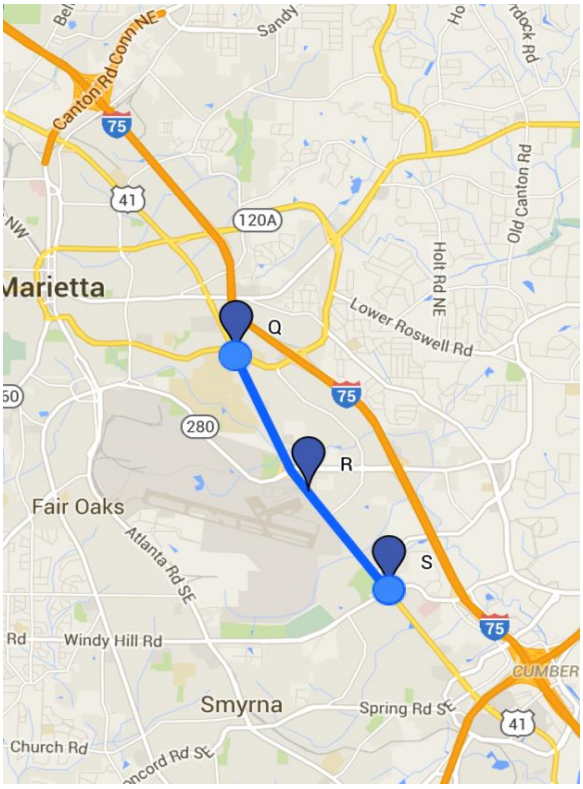

Figure 3 — Locations of all segments selected on US-41 for analysis in Georgia

TMC segments selected for validation in Georgia

Table 1 presents the data collection segments from Georgia. As a whole, these segments cover a total length of 29 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 in most cases 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 16 bidirectional arterial segments are included in this report. Table 1 contains the summary information on each data collection segment including the latitude/longitude coordinates of the locations at which the Bluetooth sensors were deployed along GA-141, US-19, and US-41 in Georgia 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 Bluetooth™ Traffic Monitoring (BTM) sensors placed on the roadway. An algorithm was developed and documented in a separate report[1] 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 HERE data feeds for individual data collection segments are provided in this separate report. This algorithm finds an equivalent HERE travel time (and therefore travel speed) corresponding to each sample BTM travel time observation on the test segment of interest.

[1] Ali Haghani, Masoud Hamedi, 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 Georgia

SEGMENT (Map Link)	DESCRIPTION Highway Georgia	State County	Starting at Ending at	TMC CODES Begin End	Length Number	Deployment Begin Lat/Lon End Lat/Lon		Length % Diff
Arterials								All Lengths in Miles
A1	GA-141	Georgia	McGinnis Ferry Rd	101N05325	1.50	34.067770	-84.168335	1.49
GA02-0001	Southbound	Fulton	GA-120/Abbotts Bridge Rd	101N05325	1	34.047667	-84.177651	-0.70%
A2	GA-141	Georgia	GA-120/Abbotts Bridge Rd	101N05324	2.23	34.047667	-84.177651	2.25
GA02-0002	Southbound	Fulton	State Bridge Rd	101N05324	1	34.017889	-84.190105	0.90%
A3	GA-141	Georgia	State Bridge Rd	101N05323	2.82	34.017889	-84.190105	2.82
GA02-0003	Southbound	Fulton	Medlock Bridge Rd	101N05322	2	33.983319	-84.213912	0.00%
A4	GA-141	Georgia	Medlock Bridge Rd	101N05321	1.03	33.983319	-84.213912	1.03
GA02-0004	Southbound	Gwinnett	Spalding Dr	101N05320	2	33.969906	-84.221566	0.00%
A5	GA-141	Georgia	Spalding Dr	101N05319	1.54	33.969906	-84.221566	1.56
GA02-0005	Southbound	Gwinnett	Holcomb Bridge Rd	101N05319	1	33.950248	-84.235174	1.72%
A6	GA-141	Georgia	Holcomb Bridge Rd	101P05320	1.62	33.950248	-84.235174	1.60
GA02-0006	Northbound	Gwinnett	Spalding Dr	101P05320	1	33.970252	-84.221168	-1.24%
A7	GA-141	Georgia	Spalding Dr	101P05321	0.99	33.970252	-84.221168	1.01
GA02-0007	Northbound	Gwinnett	Medlock Bridge Rd	101P05322	2	33.983181	-84.213746	2.02%
A8	GA-141	Georgia	Medlock Bridge Rd	101P05322	2.84	33.983181	-84.213746	2.81
GA02-0008	Northbound	Fulton	State Bridge Rd	101P05324	3	34.018014	-84.189926	-1.06%
A9	GA-141	Georgia	State Bridge Rd	101P05325	2.23	34.018014	-84.189926	2.23
GA02-0009	Northbound	Fulton	GA-120/Abbotts Bridge Rd	101P05325	1	34.047800	-84.177379	0.19%
A10	GA-141	Georgia	GA-120/Abbotts Bridge Rd	101P05326	1.50	34.047800	-84.177379	1.50
GA02-0010	Northbound	Fulton	McGinnis Ferry Rd	101P05326	1	34.067891	-84.168133	0.39%
A11	US-19	Georgia	McFarland Rd/Exit 12	101N04223	2.54	34.112405	-84.228050	2.19
GA02-0011	Southbound	Fulton	Windward Pkwy/Exit 11	101N04223	1	34.088774	-84.261583	-13.95%

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

SEGMENT (Map Link)	DESCRIPTION Freeway Georgia	State County	Starting at Ending at	TMC CODES Begin End	Length Number	Deployment Begin Lat/Lon End Lat/Lon		Length % Diff
Arterials								All Lengths in Miles
A12	US-19	Georgia	Windward Pkwy/Exit 11	101N04223	1.26	34.071962	-84.270373	1.53
GA02-0012	Southbound	Fulton	GA-120 /Exit 10	101N04222	2	34.053000	-84.290916	21.36%
A13	US-19	Georgia	GA-120/ /Exit 10	101N04222	1.87	34.053000	-84.290916	1.86
GA02-0013	Southbound	Fulton	Haynes Bridge Rd/Exit 9	101N04221	2	34.033876	-84.315628	-0.54%
A14	US-19	Georgia	Haynes Bridge Rd/Exit 9	101N04220	1.99	34.033876	-84.315628	1.97
GA02-0014	Southbound	Fulton	Mansell Rd/Exit 8	101N04220	1	34.016804	-84.328026	-1.00%
A15	US-19	Georgia	Mansell Rd/Exit 8	101N0419	1.38	34.016804	-84.328026	1.27
GA02-0015	Southbound	Fulton	GA-140 /Exit 7	101N0419	1	33.981744	-84.342161	-8.00%
A16	US-19	Georgia	GA-140/ Exit 7	101N0419	2.58	33.981744	-84.342161	2.79
GA02-0016	Southbound	Fulton	Northridge Rd/Exit 6	101N04218	2	33.957061	-84.356395	8.13%
A17	US-19	Georgia	Northridge Rd/Exit 6	101N04218	3.29	33.957061	-84.356395	1.80
GA02-0017	Southbound	Fulton	Spalding Dr	101N04217	2	33.936931	-84.357943	-45.31%
A18	US-19	Georgia	Spalding Dr	101N04217	2.94	33.936931	-84.357943	1.39
GA02-0018	Southbound	Fulton	Abernathy Rd/Exit 5	101N04217	1	33.914983	-84.357797	-52.76%
A19	US-19	Georgia	Abernathy Rd/Exit 5	101N04217	1.51	33.914983	-84.357797	1.40
GA02-0019	Southbound	Fulton	I-285/Exit 4	101N04216	3	33.937871	-84.357735	-7.27%
A20	US-19	Georgia	I-285/Exit 4	101P04216	1.33	33.937871	-84.357735	1.44
GA02-0020	Northbound	Fulton	Abernathy Rd/Exit 5	101P04217	3	33.957061	-84.356395	8.29%
A21	US-19	Georgia	Abernathy Rd/Exit 5	101P04218	3.30	33.957061	-84.356395	1.40
GA02-0021	Northbound	Fulton	Spalding Dr	101P04218	1	34.112405	-84.228050	-57.60%
A22	US-19	Georgia	Spalding Dr	101P04218	3.30	33.982782	-84.341420	1.79
GA02-0022	Northbound	Fulton	Northridge Rd/Exit 6	101P04218	1	33.982782	-84.341420	-45.79%

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

SEGMENT (Map Link)	DESCRIPTION Freeway Georgia	State County	Starting at Ending at	TMC CODES Begin End	Length Number	Deployment Begin Lat/Lon End Lat/Lon		Length % Diff
Arterials								All Lengths in Miles
A23	US-19	Georgia	Northridge Rd/Exit 6	101P04218	2.55	34.017312	-84.327398	2.78
GA02-0023	Northbound	Fulton	GA-140/ Exit 7	101P04219	2	34.017312	-84.327398	9.10%
A24	US-19	Georgia	GA-140 /Exit 7	101P04219	1.36	34.034233	-84.315100	1.27
GA02-0024	Northbound	Fulton	Mansell Rd/Exit 8	101P04220	2	34.034233	-84.315100	-6.60%
A25	US-19	Georgia	Mansell Rd/Exit 8	101P04220	1.84	34.052313	-84.292477	1.96
GA02-0025	Northbound	Fulton	Haynes Bridge Rd/Exit 9	101P04221	2	34.052313	-84.292477	6.51%
A26	US-19	Georgia	Haynes Bridge Rd/Exit 9	101P04221	2.00	34.072086	-84.270005	1.88
GA02-0026	Northbound	Fulton	GA-120/Exit 10	101P04222	2	34.072086	-84.270005	-6.01%
A27	US-19	Georgia	GA-120/ Exit 10	101P04222	1.20	34.088063	-84.261716	1.52
GA02-0027	Northbound	Fulton	Windward Pkwy/Exit 11	101P04223	2	34.088063	-84.261716	26.68%
A28	US-19	Georgia	Windward Pkwy/Exit 11	101P04223	2.56	34.112083	-84.228182	2.20
GA02-0028	Northbound	Fulton	McFarland Rd/Exit 12	101P04224	2	34.112083	-84.228182	14.08%
A29	US-41	Georgia	GA-120 Loop/S Marietta Pkwy SE	101N04589	1.84	33.942754	-84.516202	1.74
GA02-0029	Southbound	Cobb	GA-280/Cobb Dr	101N04589	1	33.918840	-84.502125	-5.42%
A30	US-41	Georgia	GA-280/Cobb Dr	101N04588	1.40	33.918840	-84.502125	1.41
GA02-0030	Southbound	Cobb	Windy Hill Rd	101N04587	2	33.902789	-84.487262	0.89%
A31	US-41	Georgia	Windy Hill Rd	101P04588	1.40	33.902789	-84.487262	1.41
GA02-0031	Northbound	Cobb	GA-280/Cobb Dr	101P04589	2	33.918840	-84.502125	0.89%
A32	US-41	Georgia	GA-280/Cobb Dr	101P04589	1.84	33.918840	-84.502125	1.74
GA02-0032	Northbound	Cobb	GA-120 Loop/S Marietta Pkwy SE	101P04590	2	33.942754	-84.516202	-5.43%

Analysis of Arterial Results

Table 2 summarizes the data quality measures obtained as a result of comparison between Bluetooth and all reported HERE 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 also within specifications for all speed bins.

TABLE 2 Data quality measures for arterial segments in Georgia

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 (contract specifications)	SEB	AASE		
0-15	3.6	3.7	5.1	5.3	981	82
15-25	2.1	2.3	4.7	5.3	3918	327
25-35	0.3	0.7	1.2	3.6	6072	506
35+	-1.5	1.7	-3.9	4.8	33369	2781

Table 3 shows the percentage of the time HERE 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 Georgia

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%	71%	0%	54%	981
15-25	42%	83%	0%	56%	3918
25-35	73%	96%	0%	74%	6072
35+	52%	89%	0%	60%	33369

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 Georgia

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	
GA02-0001	1.49	1.49	0-15	4.8	4.8	8.1	8.1	27*
			15-25	2.1	2.1	5.3	5.7	462
			25-35	0.5	0.8	2.3	4.0	516
			35+	-0.7	0.8	-2.8	4.7	165
GA02-0002	2.25	2.25	0-15	3.2	3.2	5.2	5.2	94
			15-25	2.0	2.1	4.8	5.3	240
			25-35	0.6	1.0	2.2	3.8	490
			35+	-0.8	0.9	-3.2	4.4	328
GA02-0003	2.83	2.82	0-15	3.4	3.4	4.4	4.4	41
			15-25	2.7	2.7	4.3	4.6	102
			25-35	0.3	0.6	2.5	3.6	238
			35+	-1.6	1.7	-4.5	5.1	1049
GA02-0004	1.03	1.03	0-15	5.8	5.8	10.9	10.9	30*
			15-25	1.8	1.8	4.9	5.2	598
			25-35	0.2	0.4	1.0	3.5	481
			35+	-1.9	2.0	-4.0	5.8	170
GA02-0005	1.57	1.56	0-15	4.5	4.5	6.4	6.4	35
			15-25	3.0	3.1	5.6	6.2	97
			25-35	0.1	0.7	0.0	3.9	344
			35+	-2.7	2.8	-7.0	7.8	752
GA02-0006	1.59	1.60	0-15	10.2	10.2	12.0	12.0	6*
			15-25	1.1	1.6	2.4	4.0	50
			25-35	0.0	0.7	0.3	3.7	225
			35+	-2.4	2.5	-6.3	7.0	1226
GA02-0007	1.01	1.01	0-15	6.0	6.0	7.3	7.3	168
			15-25	4.7	4.7	9.0	9.1	569
			25-35	1.1	1.2	4.5	5.7	552
			35+	-1.3	1.5	-3.4	6.1	175
GA02-0008	2.80	2.81	0-15	3.7	3.7	4.3	4.3	21*
			15-25	1.6	1.6	2.6	2.8	171
			25-35	0.3	0.9	0.8	3.3	344
			35+	-1.2	1.3	-3.3	4.1	1017
GA02-0009	2.23	2.23	0-15	3.5	3.5	4.9	4.9	60
			15-25	1.6	1.7	3.3	3.8	246
			25-35	0.4	0.7	1.2	3.1	648
			35+	-0.6	0.9	-2.7	4.2	231
GA02-0010	1.51	1.50	0-15	3.3	3.3	5.1	5.1	26*
			15-25	1.3	1.4	3.4	4.1	306
			25-35	0.1	0.4	-0.3	3.0	767
			35+	-1.4	1.5	-5.0	5.6	251
GA02-0011	2.19	2.19	0-15	-	-	-	-	-
			15-25	-	-	-	-	-
			25-35	-	-	-	-	-
			35+	-2.4	2.4	-5.4	5.7	2203

*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 Georgia

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	
GA02-0012	1.53	1.53	0-15	38.9	38.9	43.6	43.6	1*
			15-25	-	-	-	-	-
			25-35	5.6	5.6	7.7	7.7	1*
			35+	-1.1	1.2	-3.2	3.9	2465
GA02-0013	1.86	1.86	0-15	0.3	0.4	0.8	1.3	21*
			15-25	0.3	1.0	0.5	2.4	39
			25-35	-1.1	1.4	-2.2	3.4	21*
			35+	-1.8	1.8	-3.9	4.6	1647
GA02-0014	1.97	1.97	0-15	1.1	1.4	1.4	2.0	108
			15-25	0.8	1.1	1.3	2.0	72
			25-35	0.9	2.0	1.6	3.3	40
			35+	-1.0	1.3	-1.9	3.5	1767
GA02-0015	1.26	1.27	0-15	1.1	1.3	1.5	2.3	55
			15-25	0.2	0.6	0.7	1.9	68
			25-35	-0.1	1.3	-0.3	2.7	81
			35+	-2.2	2.3	-4.7	5.3	2594
GA02-0016	2.88	2.79	0-15	0.0	0.6	-0.1	1.1	15*
			15-25	-0.3	1.1	-0.5	1.8	93
			25-35	-0.9	1.8	-1.3	2.9	34
			35+	-0.8	1.0	-2.0	3.1	2305
GA02-0017	1.80	1.80	0-15	-	-	-	-	-
			15-25	-2.5	2.5	-3.5	3.5	6*
			25-35	-3.2	3.4	-4.2	4.7	16*
			35+	-3.6	3.7	-7.0	7.3	250
GA02-0018	1.39	1.39	0-15	-	-	-	-	-
			15-25	0.0	0.0	0.0	0.0	1*
			25-35	0.0	0.0	-2.6	3.4	2*
			35+	0.4	1.1	1.1	3.8	119
GA02-0019	1.40	1.40	0-15	1.2	1.2	2.0	2.0	3*
			15-25	2.5	2.5	4.0	4.0	8*
			25-35	0.9	1.3	1.6	3.1	7*
			35+	-2.1	2.1	-6.6	7.1	109
GA02-0020	1.44	1.44	0-15	-	-	-	-	-
			15-25	-0.9	1.3	-1.4	2.6	7*
			25-35	-2.1	2.1	-4.3	4.8	11*
			35+	-10.2	10.2	-16.4	16.5	98
GA02-0021	1.40	1.40	0-15	-	-	-	-	-
			15-25	1.7	1.7	2.4	2.6	8*
			25-35	2.3	2.3	3.5	4.2	16*
			35+	1.7	2.1	4.2	5.0	103
GA02-0022	1.79	1.79	0-15	-0.1	0.1	-0.6	1.3	3*
			15-25	-0.3	4.1	-1.7	7.6	3*
			25-35	-1.8	1.8	-3.2	3.4	20*
			35+	-2.5	2.5	-5.1	5.4	284

*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 Georgia

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	
GA02-0023	2.78	2.78	0-15	3.1	3.1	4.2	4.2	3*
			15-25	10.2	10.8	13.6	14.9	5*
			25-35	-0.3	1.9	0.3	3.9	18*
			35+	-1.2	1.2	-3.8	4.3	2294
GA02-0024	1.27	1.27	0-15	4.6	4.6	5.6	5.6	2*
			15-25	4.4	5.6	4.2	6.7	16*
			25-35	0.0	0.0	-3.3	3.3	3*
			35+	-1.3	1.4	-3.7	4.8	2624
GA02-0025	1.96	1.96	0-15	22.2	22.2	24.9	24.9	5*
			15-25	4.4	4.4	8.9	9.1	8*
			25-35	0.8	0.8	13.9	13.9	4*
			35+	-0.9	1.1	-2.0	3.6	1902
GA02-0026	1.88	1.88	0-15	-	-	-	-	-
			15-25	-1.5	1.5	-3.4	3.4	2*
			25-35	-1.7	1.7	-3.1	3.1	3*
			35+	-2.0	2.0	-6.1	6.4	1694
GA02-0027	1.52	1.52	0-15	-	-	-	-	-
			15-25	3.4	4.3	2.7	6.2	3*
			25-35	1.9	2.9	2.6	6.1	13*
			35+	-0.9	1.2	-2.1	4.3	2469
GA02-0028	2.20	2.20	0-15	0.9	1.5	1.1	2.2	36
			15-25	-1.3	1.3	-2.0	2.3	74
			25-35	-3.3	3.4	-4.3	5.3	23*
			35+	-1.8	1.8	-4.4	4.9	2059
GA02-0029	1.75	1.74	0-15	-	-	-	-	-
			15-25	2.0	2.0	6.9	6.9	13*
			25-35	0.3	0.4	2.0	3.2	285
			35+	-1.6	1.7	-4.1	4.6	521
GA02-0030	1.41	1.41	0-15	4.1	4.1	6.0	6.0	175
			15-25	1.0	1.0	2.7	3.3	282
			25-35	-0.2	0.6	-1.2	3.3	123
			35+	-4.8	4.8	-8.3	8.3	19*
GA02-0031	1.41	1.41	0-15	4.5	4.5	14.9	14.9	8*
			15-25	2.8	2.8	7.9	8.0	262
			25-35	0.4	0.4	2.1	3.5	410
			35+	-1.6	1.6	-4.8	5.4	77
GA02-0032	1.75	1.74	0-15	2.0	2.0	3.1	3.1	38
			15-25	1.7	1.8	3.5	4.0	107
			25-35	-0.3	0.4	-1.2	2.8	336
			35+	-2.5	2.5	-6.2	6.3	402

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

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

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	
GA02-0001	0-15	0	0%	12	44%	0	0%	8	30%	27*
	15-25	36	8%	278	60%	0	0%	224	48%	462
	25-35	121	23%	427	83%	0	0%	353	68%	516
	35+	47	28%	124	75%	0	0%	99	60%	165
GA02-0002	0-15	1	1%	53	56%	0	0%	43	46%	94
	15-25	27	11%	158	66%	0	0%	130	54%	240
	25-35	110	22%	401	82%	0	0%	354	72%	490
	35+	92	28%	258	79%	0	0%	221	67%	328
GA02-0003	0-15	0	0%	32	78%	0	0%	31	76%	41
	15-25	10	10%	67	66%	0	0%	57	56%	102
	25-35	77	32%	211	89%	0	0%	173	73%	238
	35+	210	20%	724	69%	0	0%	589	56%	1049
GA02-0004	0-15	0	0%	2	7%	0	0%	2	7%	30*
	15-25	85	14%	410	69%	0	0%	337	56%	598
	25-35	173	36%	426	89%	0	0%	360	75%	481
	35+	42	25%	109	64%	0	0%	81	48%	170
GA02-0005	0-15	0	0%	14	40%	0	0%	10	29%	35
	15-25	16	16%	61	63%	0	0%	49	51%	97
	25-35	96	28%	298	87%	0	0%	239	69%	344
	35+	103	14%	362	48%	0	0%	253	34%	752
GA02-0006	0-15	0	0%	3	50%	0	0%	2	33%	6*
	15-25	7	14%	36	72%	0	0%	33	66%	50
	25-35	49	22%	193	86%	0	0%	167	74%	225
	35+	210	17%	716	58%	0	0%	537	44%	1226
GA02-0007	0-15	1	1%	48	29%	0	0%	40	24%	168
	15-25	35	6%	195	34%	0	0%	136	24%	569
	25-35	131	24%	369	67%	0	0%	271	49%	552
	35+	41	23%	115	66%	0	0%	81	46%	175
GA02-0008	0-15	0	0%	16	76%	0	0%	13	62%	21*
	15-25	22	13%	149	87%	0	0%	143	84%	171
	25-35	78	23%	290	84%	0	0%	259	75%	344
	35+	208	20%	784	77%	0	0%	681	67%	1017
GA02-0009	0-15	0	0%	39	65%	0	0%	36	60%	60
	15-25	25	10%	189	77%	0	0%	172	70%	246
	25-35	168	26%	571	88%	0	0%	525	81%	648
	35+	48	21%	187	81%	0	0%	162	70%	231
GA02-0010	0-15	0	0%	17	65%	0	0%	14	54%	26*
	15-25	49	16%	235	77%	1	0%	201	66%	306
	25-35	259	34%	700	91%	1	0%	631	82%	767
	35+	50	20%	160	64%	0	0%	128	51%	251
GA02-0011	0-15	-	-	-	-	-	-	-	-	-
	15-25	-	-	-	-	-	-	-	-	-
	25-35	-	-	-	-	-	-	-	-	-
	35+	255	12%	1379	63%	0	0%	980	44%	2203

*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 Georgia

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	
GA02-0012	0-15	0	0%	0	0%	0	0%	0	0%	1*
	15-25	-	-	-	-	-	-	-	-	-
	25-35	0	0%	0	0%	0	0%	0	0%	1*
	35+	595	24%	2052	83%	3	0%	1725	70%	2465
GA02-0013	0-15	5	24%	21	100%	0	0%	21	100%	21*
	15-25	10	26%	36	92%	0	0%	34	87%	39
	25-35	6	29%	18	86%	0	0%	18	86%	21*
	35+	329	20%	1249	76%	1	0%	1014	62%	1647
GA02-0014	0-15	12	11%	102	94%	0	0%	101	94%	108
	15-25	10	14%	71	99%	0	0%	65	90%	72
	25-35	3	8%	34	85%	0	0%	33	83%	40
	35+	497	28%	1540	87%	0	0%	1401	79%	1767
GA02-0015	0-15	12	22%	50	91%	0	0%	50	91%	55
	15-25	20	29%	68	100%	0	0%	67	99%	68
	25-35	15	19%	76	94%	0	0%	72	89%	81
	35+	388	15%	1758	68%	0	0%	1381	53%	2594
GA02-0016	0-15	4	27%	15	100%	0	0%	15	100%	15*
	15-25	20	22%	91	98%	0	0%	88	95%	93
	25-35	7	21%	30	88%	0	0%	28	82%	34
	35+	653	28%	2046	89%	0	0%	1856	81%	2305
GA02-0017	0-15	-	-	-	-	-	-	-	-	-
	15-25	0	0%	5	83%	0	0%	5	83%	6*
	25-35	2	13%	12	75%	0	0%	12	75%	16*
	35+	10	4%	116	46%	0	0%	63	25%	250
GA02-0018	0-15	-	-	-	-	-	-	-	-	-
	15-25	1	100%	1	100%	0	0%	1	100%	1*
	25-35	1	50%	2	100%	0	0%	1	50%	2*
	35+	36	30%	103	87%	0	0%	88	74%	119
GA02-0019	0-15	1	33%	3	100%	0	0%	3	100%	3*
	15-25	2	25%	6	75%	0	0%	6	75%	8*
	25-35	2	29%	6	86%	0	0%	6	86%	7*
	35+	14	13%	65	60%	0	0%	37	34%	109
GA02-0020	0-15	-	-	-	-	-	-	-	-	-
	15-25	0	0%	6	86%	0	0%	6	86%	7*
	25-35	1	9%	6	55%	0	0%	5	45%	11*
	35+	1	1%	3	3%	0	0%	1	1%	98
GA02-0021	0-15	-	-	-	-	-	-	-	-	-
	15-25	2	25%	8	100%	0	0%	8	100%	8*
	25-35	1	6%	13	81%	0	0%	8	50%	16*
	35+	16	16%	72	70%	0	0%	53	51%	103
GA02-0022	0-15	2	67%	3	100%	0	0%	3	100%	3*
	15-25	0	0%	1	33%	0	0%	1	33%	3*
	25-35	2	10%	17	85%	0	0%	16	80%	20*
	35+	23	8%	196	69%	0	0%	141	50%	284

*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 Georgia

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	
GA02-0023	0-15	0	0%	2	67%	0	0%	1	33%	3*
	15-25	0	0%	1	20%	0	0%	1	20%	5*
	25-35	4	22%	15	83%	0	0%	15	83%	18*
	35+	443	19%	1856	81%	0	0%	1493	65%	2294
GA02-0024	0-15	0	0%	1	50%	0	0%	1	50%	2*
	15-25	6	38%	14	88%	0	0%	12	75%	16*
	25-35	2	67%	3	100%	0	0%	2	67%	3*
	35+	708	27%	2050	78%	0	0%	1653	63%	2624
GA02-0025	0-15	0	0%	0	0%	0	0%	0	0%	5*
	15-25	1	13%	3	38%	0	0%	2	25%	8*
	25-35	1	25%	2	50%	0	0%	2	50%	4*
	35+	559	29%	1652	87%	0	0%	1455	77%	1902
GA02-0026	0-15	-	-	-	-	-	-	-	-	-
	15-25	0	0%	2	100%	0	0%	2	100%	2*
	25-35	1	33%	2	67%	0	0%	2	67%	3*
	35+	211	12%	1029	61%	0	0%	687	41%	1694
GA02-0027	0-15	-	-	-	-	-	-	-	-	-
	15-25	0	0%	2	67%	0	0%	2	67%	3*
	25-35	1	8%	9	69%	0	0%	7	54%	13*
	35+	673	27%	1984	80%	4	0%	1632	66%	2469
GA02-0028	0-15	4	11%	34	94%	0	0%	32	89%	36
	15-25	16	22%	74	100%	0	0%	68	92%	74
	25-35	1	4%	15	65%	0	0%	11	48%	23*
	35+	313	15%	1483	72%	0	0%	1142	55%	2059
GA02-0029	0-15	-	-	-	-	-	-	-	-	-
	15-25	1	8%	8	62%	0	0%	4	31%	13*
	25-35	95	33%	256	90%	0	0%	225	79%	285
	35+	123	24%	370	71%	0	0%	317	61%	521
GA02-0030	0-15	2	1%	84	48%	0	0%	73	42%	175
	15-25	68	24%	236	84%	0	0%	219	78%	282
	25-35	39	32%	108	88%	0	0%	91	74%	123
	35+	2	11%	7	37%	0	0%	7	37%	19*
GA02-0031	0-15	0	0%	0	0%	0	0%	0	0%	8*
	15-25	6	2%	104	40%	0	0%	45	17%	262
	25-35	127	31%	362	88%	0	0%	315	77%	410
	35+	11	14%	52	68%	0	0%	38	49%	77
GA02-0032	0-15	1	3%	35	92%	0	0%	35	92%	38
	15-25	15	14%	84	79%	0	0%	75	70%	107
	25-35	95	28%	315	94%	0	0%	283	84%	336
	35+	17	4%	209	52%	1	0%	157	39%	402