



I-95 Corridor Coalition

I-95 Corridor Coalition Vehicle
Probe Project: Validation of
INRIX Data
Monthly Report
North Carolina



February 2009

I-95 CORRIDOR COALITION VEHICLE PROBE PROJECT: VALIDATION OF INRIX DATA FEBRUARY 2009

Monthly Report

Prepared for:

I-95 Corridor Coalition

Sponsored by:

I-95 Corridor Coalition

Prepared by:

Ali Haghani, Masoud Hamedi, Kaveh Farokhi Sadabadi
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 Delaware, Maryland, New Jersey, North Carolina, and 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.

February 2009

Evaluation Results for the State of North Carolina

Summary

Travel time samples were collected along approximately 40 miles of freeways in North Carolina from Friday, October 24, 2008 to Thursday, November 6, 2008 and compared against travel time and speed data reported by INRIX as part of the I-95 Vehicle Probe project. The validation data represents approximately 330 hours of observations along 11 freeway segments in North Carolina. The table below summarizes the result of the comparison between the validation data and the INRIX data for the same period. Due to the uncongested nature of the roadways, the vast majority of the observations (approximately 320 hours) indicated speeds greater than 60mph with a limited sampling of data at speeds less than 45mph. Although the absolute average speed error and the speed error bias as measured against the SEM band fall outside contract specification for the lower two speed bins, the amount of data in these bins accounts for only 3.4 hours of observations combined, and are the result of only two congestion events observed during the entire data collection period. This minimal amount of data is insufficient to characterize overall accuracy, but the data will be combined with other validation efforts prior to and after North Carolina to assess overall data quality in the various speed bins.

North Carolina Evaluation Summary					
State	Absolute Speed Error (<10mph)		Speed Error Bias (<5mph)		Hours of Data Collection
	Comparison with SEM Band	Comparison with Mean	Comparison with SEM Band	Comparison with Mean	
0-30 MPH	16.10	17.10	14.60	15.20	1.6
30-45 MPH	12.20	14.20	7.50	8.40	1.8
45-60 MPH	3.80	8.30	3.30	7.20	3.2
> 60 MPH	1.90	5.00	-1.70	-4.00	320.2
All Speeds	2.04	5.14	-1.52	-3.73	326.7

Based upon data collected in October 2008

Data Collection

Bluetooth sensor deployments in North Carolina started on Friday, October 24, 2008. The actual deployments in North Carolina were performed by North Carolina Department of Transportation (NCDOT) personnel. Sensors remained in the same position until they were retrieved the following week on Thursday, October 30, 2008. After recharging the batteries overnight, the sensors were redeployed on Friday, October 31, 2008 for the second week of data collection ending on Thursday, November 6, 2009. This round of data collections in North Carolina was designed to cover segments of the highways along which both recurrent and non-recurrent congestions could be expected during both peak and off-peak periods.

Figure 1 presents snapshots of the roadway segments over which Bluetooth sensors were deployed in North Carolina.

The coordinates of the locations at which the Bluetooth sensors were deployed throughout the state of North Carolina are reported in Table 2 which also presents the distances that have been used in the estimation of Bluetooth speeds based on travel times. Table 1 presents a list of specific TMC segments that were selected as the validation sample in North Carolina. In total, results of validation on eleven freeway TMC segments are reported in this document. These segments cover a total length of over 40 miles.

Analysis of Results

Table 3 summarizes the data quality measures obtained as a result of comparison between Bluetooth and all reported INRIX speeds. In speed bins over 45 mph, INRIX data passes the data quality measures set forth in the contract when errors are measured as a distance from the 1.96 times the standard error band. INRIX speeds do not meet the requirements of the contract in the two slowest speed bins. However, one should note that the Bluetooth average speeds are based on a very limited number of observations in these two speed bins. In the 0-30 mph speed bin, there were only 19 valid Bluetooth records in the two-week data collection period. Of these, 18 records belong to TMC number 125+05268 (see Table 5). In the 30-45 mph speed bin, there were 21 Bluetooth records. Of these, 20 records belong to two TMC's (see Table 5). In the 45-60 mph speed bin although the number of Bluetooth records is not very high (38), the records are spread across many TMC's.

Table 4 shows the percentage of the time intervals that fall within 5 mph of the SEM band and the mean for each speed bin for all TMCs in North Carolina. Tables 5 and 6 present detailed data for individual TMC segments in North Carolina in similar format as Tables 3 and 4, respectively.

Figures 2 and 3 show the overall speed error bias for different speed bins, and the average absolute speed errors for all segments in North Carolina, respectively. These figures correspond to Table 2.

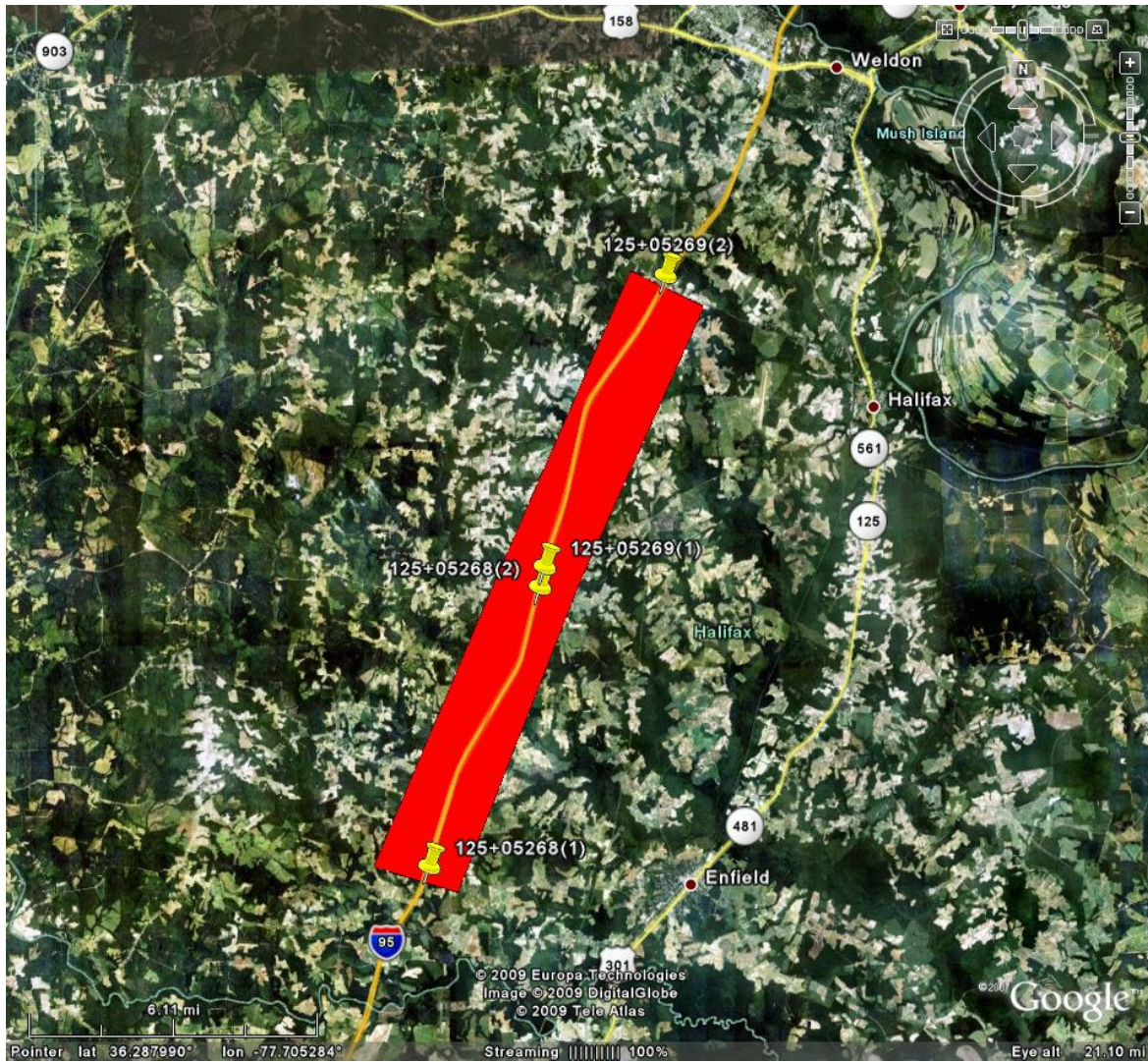


Figure 1
TMC segments selected for validation in North Carolina

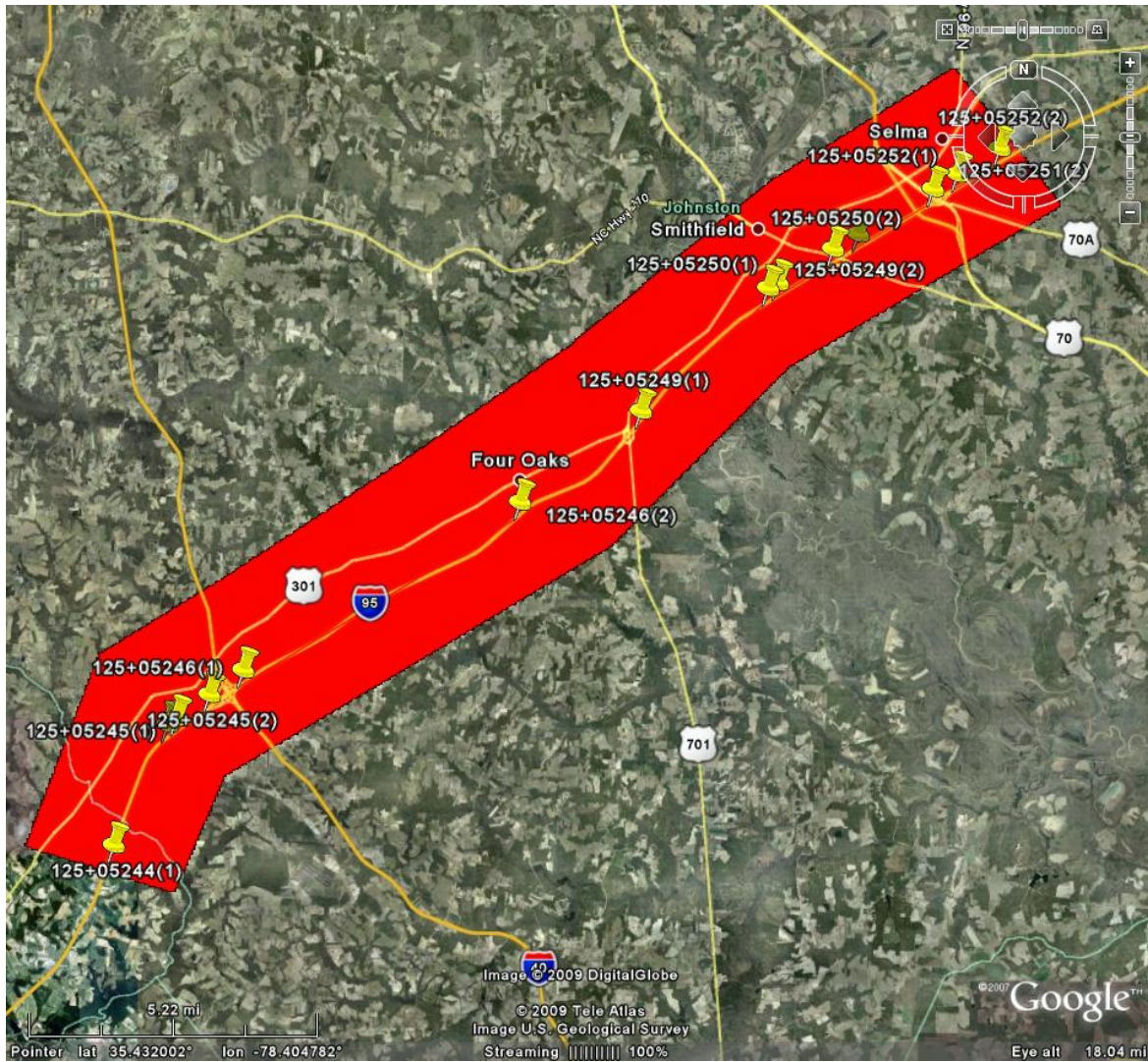


Figure 1 (Cont'd)
TMC segments selected for validation in North Carolina

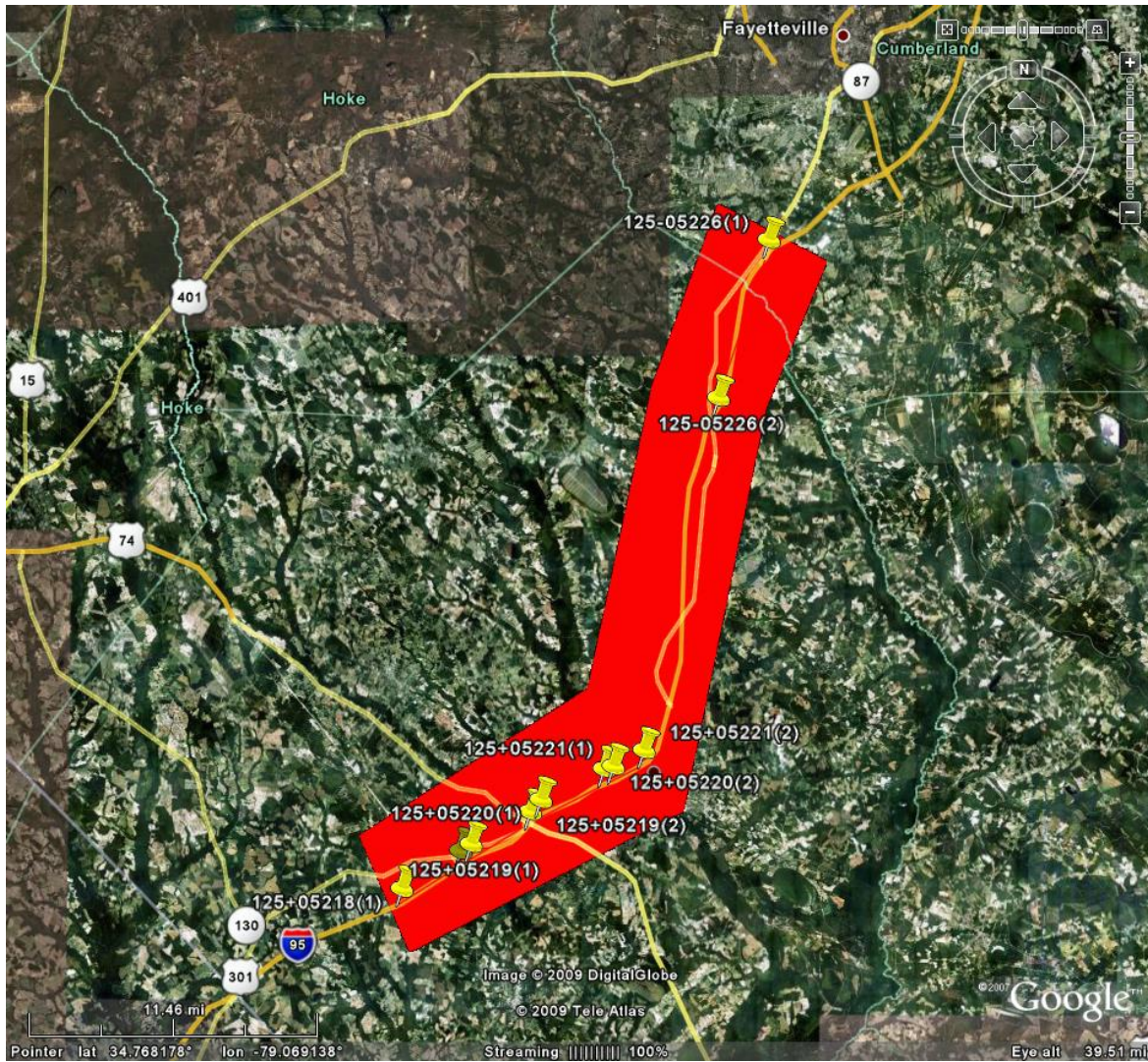


Figure 1 (Cont'd)
TMC segments selected for validation in North Carolina

Table 1
Traffic Message Channel segments picked for validation in North Carolina

TYPE	TMC	HIGHWAY	STARTING AT	ENDING AT	COUNTY	DIRECTION	LENGTH (mile)
Freeway	125+05268	I 95	HWY 481/EXIT 154	HWY 561/EXIT 160	HALIFAX	NORTHBOUND	6.5
Freeway	125-05226	I 95	I 95 BUS/US 301 SERVICE RD	US 301/EXIT 33	ROBESON	SOUTHBOUND	6.7
Freeway	125+05269	I 95	HWY 561/EXIT 160	HWY 903/EXIT 168	HALIFAX	NORTHBOUND	6.8
Freeway	125+05251	I 95	US 70 BUS/EXIT 95	US 70/EXIT 97	JOHNSTON	NORTHBOUND	1.5
Freeway	125+05246	I 95	I 40/EXIT 81	HWY 1162/S MAIN ST/EXIT 87	JOHNSTON	NORTHBOUND	5.9
Freeway	125+05249	I 95	US 301/US 701/HWY 96/EXIT 90	BROGDEN RD/EXIT 93	JOHNSTON	NORTHBOUND	3.2
Freeway	125+05244	I 95	PARKER RD/EXIT 77	HWY 242/EXIT 79	JOHNSTON	NORTHBOUND	2.5
Freeway	125+05220	I 95	US 74/EXIT 14	HWY 72/CATON RD/EXIT 17	ROBESON	NORTHBOUND	2.8
Freeway	125+05219	I 95	US 301/EXIT 10	US 74/EXIT 14	ROBESON	NORTHBOUND	2.7
Freeway	125+05218	I 95	RAYNHAM RD/EXIT 7	US 301/EXIT 10	ROBESON	NORTHBOUND	2.7
Freeway	125+05250	I 95	BROGDEN RD/EXIT 93	US 70 BUS/EXIT 95	JOHNSTON	NORTHBOUND	1.1
TOTAL							42.3

Table 2
TMC segment lengths and distances between sensor deployment locations in the state of North Carolina

SEGMENT TYPE	TMC	STANDARD TMC					SENSOR DEPLOYMENT					ERROR IN SEGMENT LENGTH (%)
		Endpoint (1)		Endpoint (2)		Length (mile)	Endpoint (1)		Endpoint (2)		Length (mile)	
		Lat	Long	Lat	Long		Lat	Long	Lat	Long		
Freeway	125+05268	36.18054	-77.76637	36.26677	-77.72358	6.46	36.18119	-77.76544	36.26512	-77.72322	6.29	-2.6%
Freeway	125-05226	34.92562	-78.94111	34.83658	-78.97739	6.67	34.92472	-78.94404	34.83693	-78.97607	6.42	-3.8%
Freeway	125+05269	36.27227	-77.72078	36.36146	-77.67429	6.76	36.27419	-77.72071	36.36086	-77.67478	6.58	-2.7%
Freeway	125+05251	35.50636	-78.31668	35.51782	-78.29326	1.54	35.50707	-78.31454	35.51671	-78.29485	1.29	-15.9%
Freeway	125+05246	35.39163	-78.51464	35.43545	-78.42609	5.87	35.39299	-78.51234	35.43649	-78.42464	5.82	-0.8%
Freeway	125+05249	35.45946	-78.38681	35.49162	-78.34642	3.19	35.45927	-78.38726	35.49165	-78.34609	3.24	1.4%
Freeway	125+05244	35.34516	-78.55677	35.37746	-78.53926	2.46	35.34611	-78.55648	35.37720	-78.53934	2.38	-3.3%
Freeway	125+05220	34.60314	-79.09848	34.62204	-79.05485	2.81	34.60334	-79.10053	34.62172	-79.05753	2.78	-1.4%
Freeway	125+05219	34.5785	-79.14741	34.59866	-79.10801	2.66	34.58002	-79.14475	34.58644	-79.12595	1.16	-56.3%
Freeway	125+05218	34.55323	-79.19559	34.57434	-79.15553	2.71	34.55459	-79.19100	34.57413	-79.15573	2.42	-10.8%
Freeway	125+05250	35.49342	-78.34279	35.50199	-78.32555	1.1	35.49452	-78.34021	35.50096	-78.32693	0.87	-23.2%
TOTAL		42.28					39.24					

Table 3
Data quality measures for freeway segments greater than one mile in North Carolina

SPEED BIN	Data Quality Measures for				No. of Obs.
	1.96 SE Band		Mean		
	Speed Error Bias	Average Absolute Speed Error	Speed Error Bias	Average Absolute Speed Error	
0-30	14.6	16.1	15.2	17.1	19
30-45	7.5	12.2	8.4	14.2	21
45-60	3.3	3.8	7.2	8.3	38
60+	-1.7	1.9	-4.0	5.0	3842

Table 4
Percent observations meeting data quality criteria for freeway segments greater than one mile in North Carolina

SPEED BIN	Data Quality Measures for				No. of Obs.
	1.96 SE 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	
0-30	0%	32%	0%	32%	19
30-45	14%	48%	0%	38%	21
45-60	32%	66%	0%	18%	38
60+	51%	85%	0%	57%	3842

Table 5
Data quality measures for individual freeway segments greater than one mile in the
state of North Carolina

TMC	Standard TMC length	Bluetooth distance	SPEED BIN	Data Quality Measures for				No. of Obs.
				1.96 SE Band		Mean		
				Speed Error Bias	Average Absolute Speed Error	Speed Error Bias	Average Absolute Speed Error	
125+05218	2.71	2.42	0-30					
			30-45	4.3	11.2	4.8	13.0	14
			45-60	4.2	4.9	7.0	8.5	18
			60+	-1.3	1.5	-3.3	4.5	266
125+05219	2.66	1.16	0-30					
			30-45					
			45-60	1.3	1.3	5.6	5.6	2
			60+	-1.1	1.3	-3.0	4.1	150
125+05220	2.81	2.78	0-30					
			30-45					
			45-60	5.2	5.2	5.2	5.2	1
			60+	-0.6	0.9	-2.3	3.5	169
125+05244	2.46	2.38	0-30					
			30-45					
			45-60	2.1	2.1	9.1	9.1	3
			60+	-1.4	1.6	-3.4	4.5	619
125+05246	5.87	5.82	0-30					
			30-45					
			45-60					
			60+	-1.9	2.0	-4.3	5.2	520
125+05249	3.19	3.24	0-30					
			30-45					
			45-60					
			60+	-1.0	1.1	-2.1	3.8	93
125+05250	1.13	0.87	0-30					
			30-45					
			45-60	2.0	2.0	8.3	8.3	6
			60+	0.0	0.9	-0.6	3.3	157
125+05251	1.54	1.29	0-30					
			30-45					
			45-60	3.1	3.1	6.7	6.7	3
			60+	-0.9	1.2	-3.1	4.3	295
125+05268	6.46	6.29	0-30	14.8	16.4	15.3	17.4	18
			30-45	33.0	33.0	34.1	34.1	1
			45-60	6.3	6.3	12.7	12.7	1
			60+	-3.0	3.0	-5.7	6.1	701
125+05269	6.76	6.58	0-30	11.6	11.6	12.8	12.8	1
			30-45	10.7	11.3	12.4	13.6	6
			45-60	-4.3	4.3	-8.5	8.5	1
			60+	-2.5	2.7	-5.2	5.9	482
125-05226	6.67	6.42	0-30					
			30-45					
			45-60	3.5	3.5	9.3	9.3	3
			60+	-1.5	1.6	-4.0	4.8	390

Table 6
Observations meeting data quality criteria for individual freeway segments greater than one mile in the state of North Carolina

TMC	SPEED BIN	Data Quality Measures for								No. of Obs.
		1.96 SE 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	
125+05218	0-30									
	30-45	2	14%	7	50%	0	0%	5	36%	
	45-60	5	28%	10	56%	0	0%	6	33%	
	60+	152	57%	234	88%	0	0%	166	62%	
125+05219	0-30									
	30-45									
	45-60	1	50%	2	100%	0	0%	0	0%	
	60+	100	67%	135	90%	0	0%	105	70%	
125+05220	0-30									
	30-45									
	45-60	0	0%	0	0%	0	0%	0	0%	
	60+	103	61%	164	97%	0	0%	124	73%	
125+05244	0-30									
	30-45									
	45-60	1	33%	3	100%	0	0%	1	33%	
	60+	325	53%	544	88%	0	0%	375	61%	
125+05246	0-30									
	30-45									
	45-60									
	60+	242	47%	443	85%	0	0%	275	53%	
125+05249	0-30									
	30-45									
	45-60									
	60+	57	61%	86	92%	0	0%	65	70%	
125+05250	0-30									
	30-45									
	45-60	2	33%	5	83%	0	0%	0	0%	
	60+	114	73%	147	94%	0	0%	122	78%	
125+05251	0-30									
	30-45									
	45-60	1	33%	2	67%	0	0%	0	0%	
	60+	182	62%	269	91%	0	0%	187	63%	
125+05268	0-30	0	0%	6	33%	0	0%	6	33%	
	30-45	0	0%	0	0%	0	0%	0	0%	
	45-60	0	0%	0	0%	0	0%	0	0%	
	60+	259	37%	516	74%	0	0%	297	42%	
125+05269	0-30	0	0%	0	0%	0	0%	0	0%	
	30-45	1	17%	3	50%	0	0%	3	50%	
	45-60	0	0%	1	100%	0	0%	0	0%	
	60+	211	44%	370	77%	0	0%	224	46%	
125-05226	0-30									
	30-45									
	45-60	2	67%	2	67%	0	0%	0	0%	
	60+	206	53%	348	89%	0	0%	234	60%	

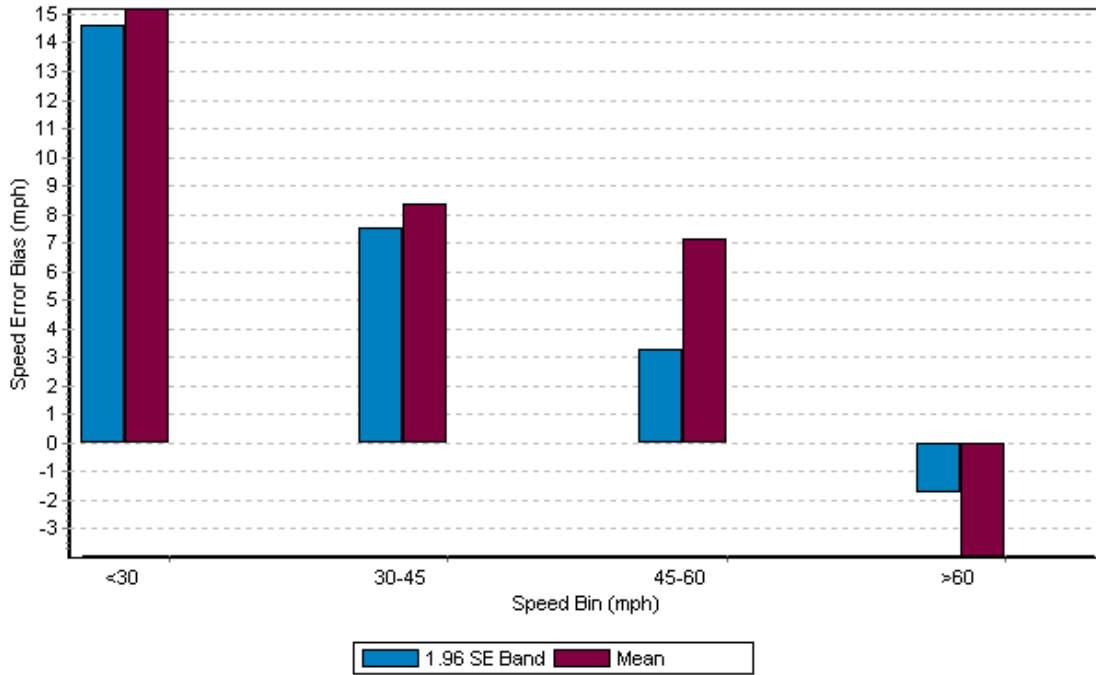


Figure 2
Speed error bias for freeway segments greater than one mile in North Carolina

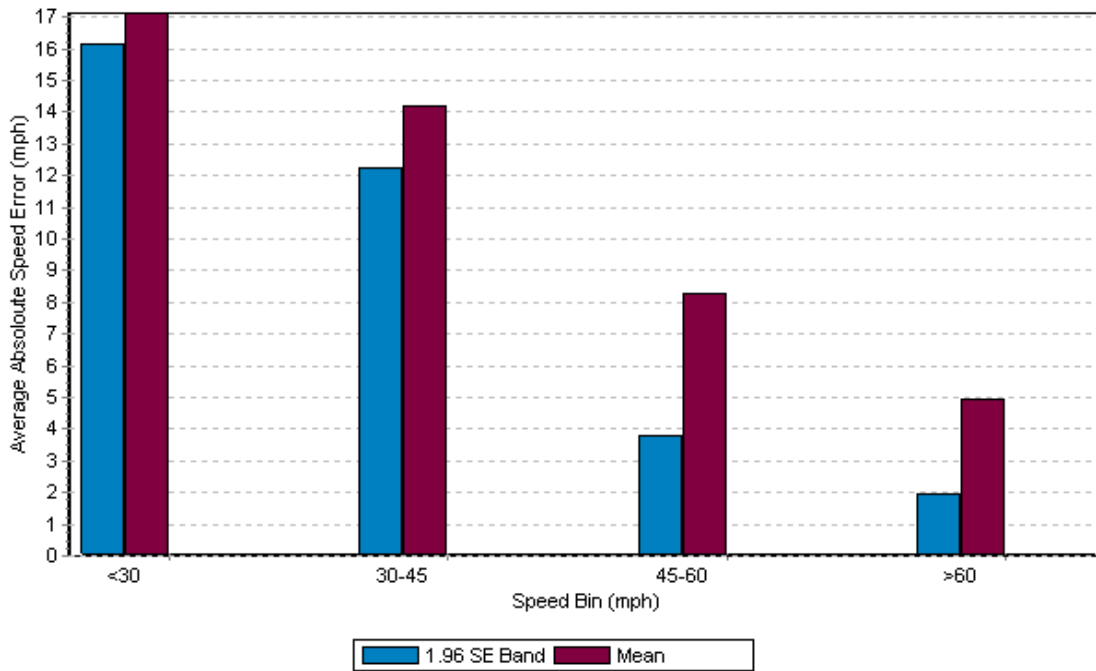


Figure 3
Average absolute speed error for freeway segments greater than one mile in North Carolina