



## I-95 Corridor Coalition

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



*June 2009*

---

# **I-95 CORRIDOR COALITION VEHICLE PROBE PROJECT: VALIDATION OF INRIX DATA JUNE 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.

*June 2009*

# Evaluation Results for the State of Virginia

## Summary

Travel time samples were collected along approximately 14 miles of freeways in Virginia from Thursday, May 7, 2009 to Wednesday, May 20, 2009 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 1415 hours of observations along nine freeway segments in Northern Virginia. The table below summarizes the result of the comparison between the validation data and the INRIX data for the same period. Both the absolute average speed error and the speed error bias as measured against the SEM band are within the acceptable limits of the contract specifications.

| Northern VA Evaluation Summary |                                  |                         |                             |                         |                                  |                                |
|--------------------------------|----------------------------------|-------------------------|-----------------------------|-------------------------|----------------------------------|--------------------------------|
| State                          | Absolute Speed Error<br>(<10mph) |                         | Speed Error Bias<br>(<5mph) |                         | Number of<br>5 Minute<br>Samples | Hours of<br>Data<br>Collection |
|                                | Comparison with<br>SEM Band      | Comparison with<br>Mean | Comparison with<br>SEM Band | Comparison with<br>Mean |                                  |                                |
| 0-30 MPH                       | 4.20                             | 5.20                    | 1.90                        | 2.00                    | 942                              | 78.5                           |
| 30-45 MPH                      | 7.00                             | 8.50                    | 2.00                        | 2.40                    | 936                              | 78.0                           |
| 45-60 MPH                      | 2.40                             | 4.10                    | -0.10                       | 0.50                    | 5399                             | 449.9                          |
| > 60 MPH                       | 2.00                             | 3.80                    | -1.80                       | -3.00                   | 9698                             | 808.2                          |
| All Speeds                     | 2.53                             | 4.23                    | -0.84                       | -1.31                   | 16975                            | 1414.6                         |

Based upon data collected in May 2009

## Data Collection

Bluetooth sensor deployments in Virginia started on Thursday, May 7, 2009. The actual deployments in Virginia were performed with the assistance of Virginia Department of Transportation (VDOT) personnel. Due to lack of shoulder and or existence of blocked construction zones at some locations of interest along I-66 and parts of the beltway, deployment locations had to be readjusted in the field to maintain the required level of safety in deployments and also to minimize the interference with the operations of passing traffic. In fact, one segment (TMC id 110+04176) on westbound I-66 had to be eventually skipped because of the lack of shoulder. Sensors remained in the same position until they were retrieved two weeks later on Wednesday, May 20, 2009. This round of data collections in Virginia 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 Virginia.

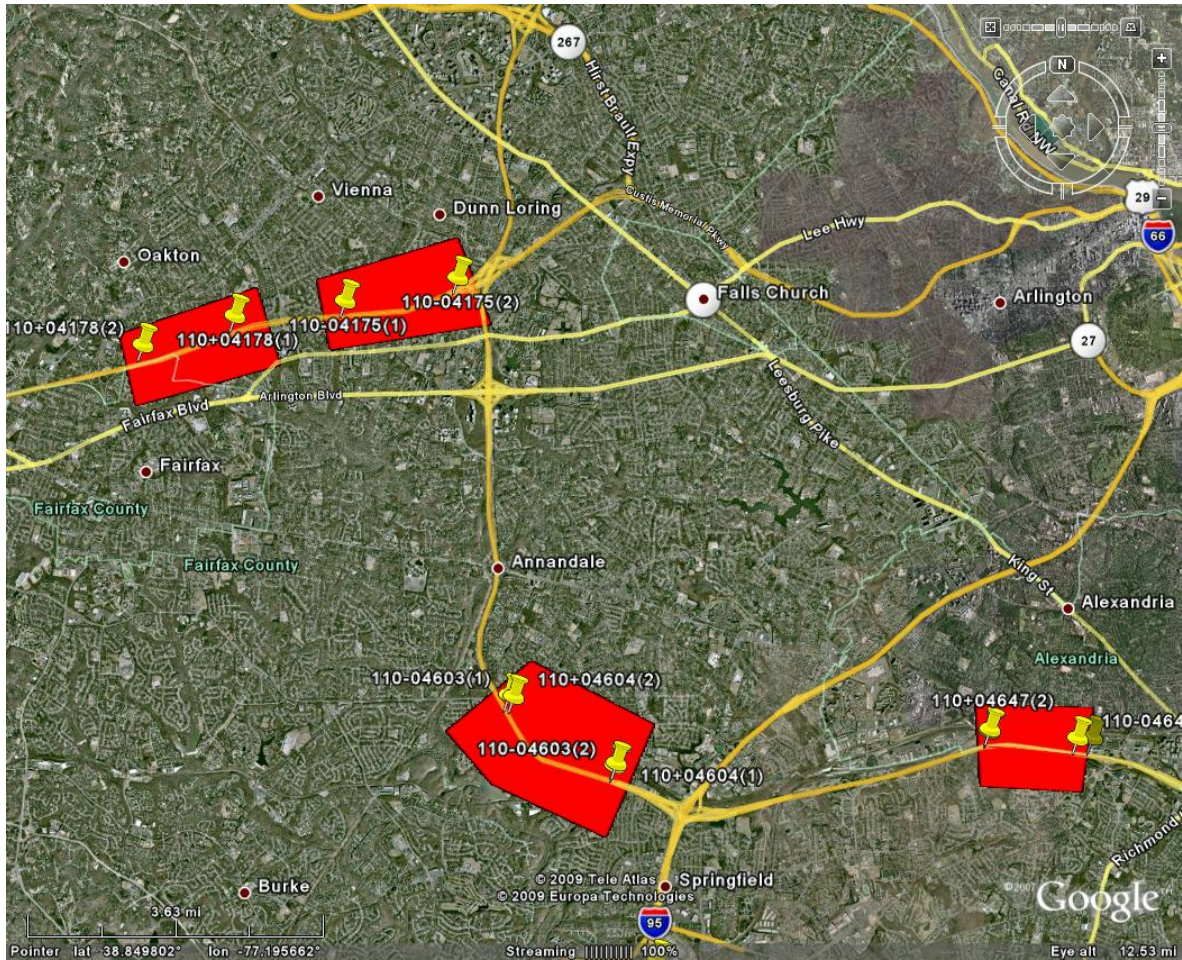
Table 1 presents a list of specific TMC segments that were selected as the validation sample in Virginia. In total, results of validation on nine freeway TMC segments are reported in this document. These segments cover a total length of about 14 miles. The coordinates of the locations at which the Bluetooth sensors were deployed throughout the state of Virginia are reported in Table 2 which also presents the distances that have been used in the estimation of Bluetooth speeds based on travel times.

### ***Analysis of Results***

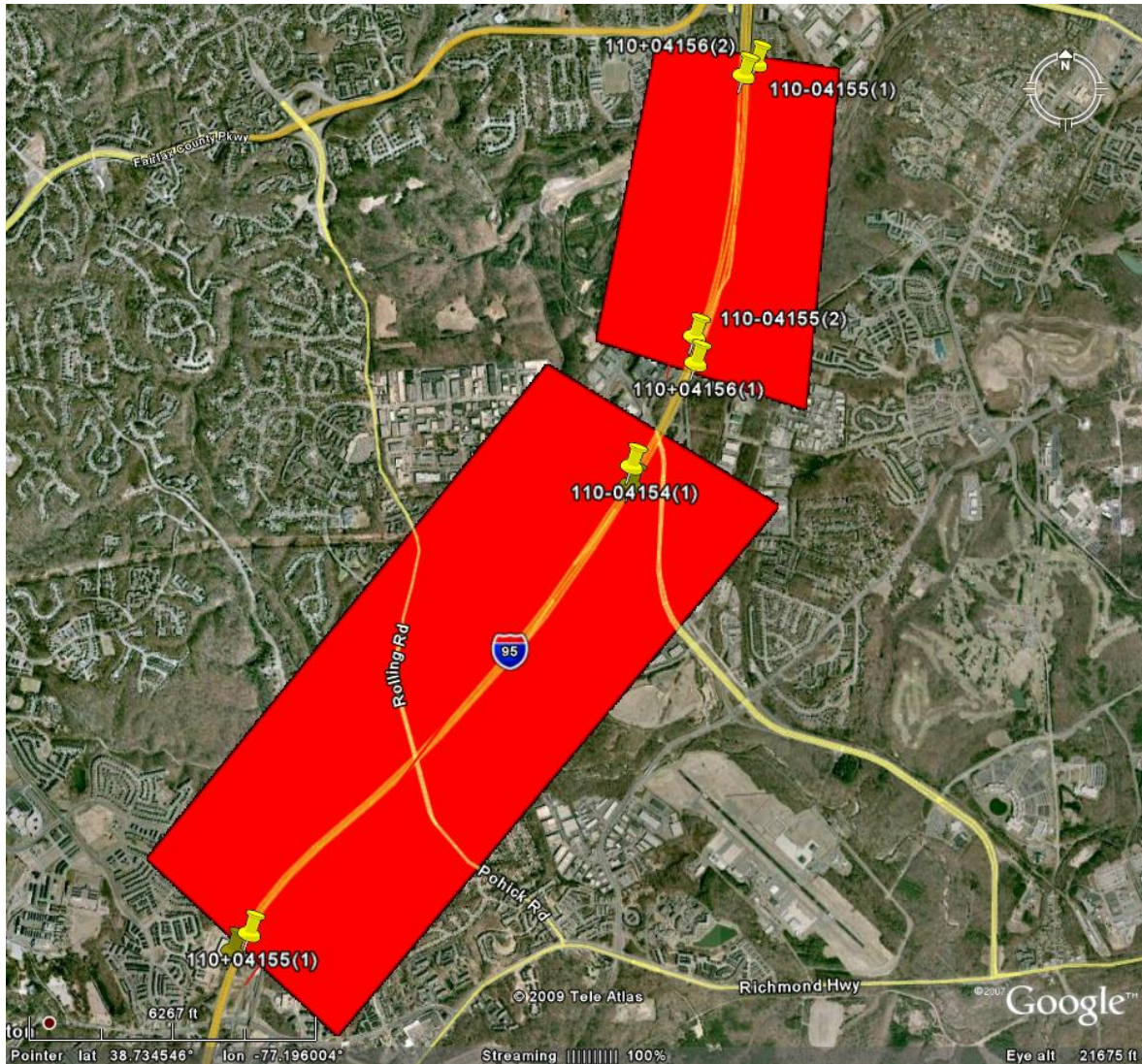
Table 3 summarizes the data quality measures obtained as a result of comparison between Bluetooth and all reported INRIX speeds. In all speed bins, INRIX data passes the data quality measures set forth in the contract when errors are measured as a distance from the 1.96 times the standard error band.

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 TMC segments in Virginia. Tables 5 and 6 present detailed data for individual TMC segments in Virginia in similar format as Tables 3 and 4 respectively. Note that for some TMC segments in some speed bins the comparison results may not be reliable due to small number of observations.

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



**Figure 1**  
**TMC segments selected for validation in Virginia**



**Figure 1 (Cont'd)**  
**TMC segments selected for validation in Virginia**

**Table 1**  
**Traffic Message Channel segments picked for validation in Virginia**

| <b>TYPE</b>  | <b>TMC</b> | <b>HIGHWAY</b> | <b>STARTING AT</b>             | <b>ENDING AT</b>            | <b>COUNTY</b> | <b>DIRECTION</b> | <b>LENGTH<br/>(mile)</b> |
|--------------|------------|----------------|--------------------------------|-----------------------------|---------------|------------------|--------------------------|
| Freeway      | 110+04155  | I 95           | EXIT 163                       | HWY 7100/EXIT 166           | FAIRFAX       | NORTHBOUND       | 2.4                      |
| Freeway      | 110+04156  | I 95           | HWY 7100/EXIT 166              | BACKLICK RD/EXIT 167        | FAIRFAX       | NORTHBOUND       | 1.2                      |
| Freeway      | 110-04154  | I 95           | HWY 7100/EXIT 166              | EXIT 163                    | FAIRFAX       | SOUTHBOUND       | 2.6                      |
| Freeway      | 110-04155  | I 95           | BACKLICK RD/EXIT 167           | HWY 7100/EXIT 166           | FAIRFAX       | SOUTHBOUND       | 1.1                      |
| Freeway      | 110-04175  | I 66           | HWY 243/NUTLEY<br>ST/EXIT 62   | I 495/EXIT 64               | FAIRFAX       | EASTBOUND        | 1.4                      |
| Freeway      | 110+04604  | I 495          | I 95/EXIT 57                   | BRADDOCK RD/EXIT 5          | FAIRFAX       | CLOCKWISE        | 1.3                      |
| Freeway      | 110+04647  | I 495          | HWY 241/TELEGRAPH<br>RD/EXIT 2 | EISENHOWER AVE/EXIT 3       | ALEXANDRIA    | CLOCKWISE        | 1.3                      |
| Freeway      | 110-04603  | I 495          | BRADDOCK RD/EXIT 5             | I 95/EXIT 57                | FAIRFAX       | COUNTERCLOCKWISE | 1.4                      |
| Freeway      | 110-04646  | I 495          | EISENHOWER AVE/EXIT 3          | HWY 241/TELEGRAPH RD/EXIT 2 | ALEXANDRIA    | COUNTERCLOCKWISE | 1.1                      |
| <b>TOTAL</b> |            |                |                                |                             |               |                  | <b>13.9</b>              |

**Table 2**  
**TMC segment lengths and distances between sensor deployment locations in the state of Virginia**

| 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      | 110+04155 | 38.70962     | -77.22181 | 38.73634     | -77.19261 | 2.44          | 38.71002          | -77.22145 | 38.73637     | -77.19245 | 2.41          | -1.1%                       |
| Freeway      | 110+04156 | 38.74354     | -77.18765 | 38.76081     | -77.18312 | 1.23          | 38.74327          | -77.18768 | 38.76353     | -77.18285 | 1.43          | 16.5%                       |
| Freeway      | 110-04154 | 38.73751     | -77.19230 | 38.70868     | -77.22274 | 2.60          | 38.73720          | -77.19270 | 38.70850     | -77.22300 | 2.58          | -0.6%                       |
| Freeway      | 110-04155 | 38.76081     | -77.18365 | 38.74515     | -77.18735 | 1.11          | 38.75830          | -77.18392 | 38.74523     | -77.18755 | 0.93          | -16.2%                      |
| Freeway      | 110-04175 | 38.87901     | -77.25402 | 38.88316     | -77.22807 | 1.44          | 38.87905          | -77.25158 | 38.88355     | -77.22635 | 1.40          | -2.3%                       |
| Freeway      | 110+04604 | 38.79682     | -77.19216 | 38.80468     | -77.21274 | 1.28          | 38.79805          | -77.19687 | 38.80530     | -77.21305 | 1.05          | -17.4%                      |
| Freeway      | 110+04647 | 38.80128     | -77.08362 | 38.80289     | -77.10689 | 1.26          | 38.80143          | -77.08375 | 38.80048     | -77.11762 | 1.86          | 47.0%                       |
| Freeway      | 110-04603 | 38.80610     | -77.21410 | 38.79664     | -77.19220 | 1.41          | 38.80162          | -77.21048 | 38.79572     | -77.18990 | 1.18          | -16.0%                      |
| Freeway      | 110-04646 | 38.80266     | -77.10707 | 38.80147     | -77.08692 | 1.09          | 38.80295          | -77.10355 | 38.80127     | -77.08565 | 1.00          | -8.5%                       |
| <b>TOTAL</b> |           | <b>13.85</b> |           |              |           |               | <b>13.84</b>      |           |              |           |               |                             |



**Table 3**  
**Data quality measures for freeway segments greater than one mile in Virginia**

| 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      | 1.9                       | 4.2                          | 2.0              | 5.2                          | 942         |
| 30-45     | 2.0                       | 7.0                          | 2.4              | 8.5                          | 936         |
| 45-60     | -0.1                      | 2.4                          | 0.5              | 4.1                          | 5399        |
| 60+       | -1.8                      | 2.0                          | -3.0             | 3.8                          | 9698        |

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

| 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      | 19%                                | 72%   | 0%                           | 64%                                 | 942         |
| 30-45     | 9%                                 | 42%   | 0%                           | 34%                                 | 936         |
| 45-60     | 38%                                | 85%   | 0%                           | 73%                                 | 5399        |
| 60+       | 40%                                | 87%   | 0%                           | 73%                                 | 9698        |

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

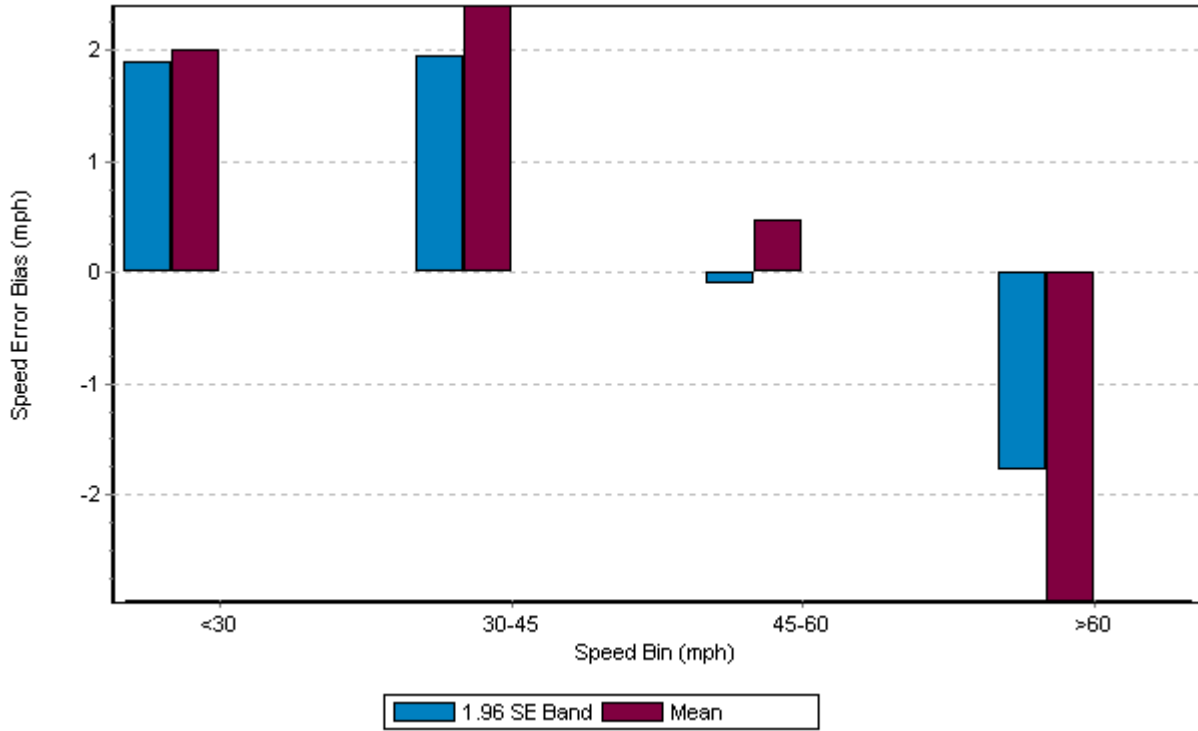
| TMC       | Standard TMC length | Bluetooth distance | SPEED BIN | Data Quality Measures for |                              |                  |                              | No. of Obs. |
|-----------|---------------------|--------------------|-----------|---------------------------|------------------------------|------------------|------------------------------|-------------|
|           |                     |                    |           | 1.96 SE Band              |                              | Mean             |                              |             |
|           |                     |                    |           | Speed Error Bias          | Average Absolute Speed Error | Speed Error Bias | Average Absolute Speed Error |             |
| 110+04155 | 2.44                | 2.41               | 0-30      | -1.6                      | 4.6                          | -1.8             | 5.5                          | 68          |
|           |                     |                    | 30-45     | 0.3                       | 6.1                          | 0.5              | 7.1                          | 144         |
|           |                     |                    | 45-60     | -0.7                      | 3.6                          | -0.3             | 4.9                          | 754         |
|           |                     |                    | 60+       | -1.9                      | 2.1                          | -2.8             | 3.7                          | 2272        |
| 110+04156 | 1.23                | 1.43               | 0-30      | 3.4                       | 4.3                          | 3.5              | 4.9                          | 16          |
|           |                     |                    | 30-45     | 2.7                       | 5.8                          | 3.3              | 7.0                          | 47          |
|           |                     |                    | 45-60     | -0.1                      | 1.2                          | 0.3              | 2.4                          | 768         |
|           |                     |                    | 60+       | -0.9                      | 1.0                          | -2.0             | 2.4                          | 979         |
| 110+04604 | 1.28                | 1.05               | 0-30      | 32.7                      | 32.7                         | 38.7             | 38.7                         | 1*          |
|           |                     |                    | 30-45     | 14.7                      | 14.7                         | 20.3             | 20.3                         | 14          |
|           |                     |                    | 45-60     | 1.8                       | 2.5                          | 3.2              | 4.9                          | 85          |
|           |                     |                    | 60+       | -0.4                      | 1.5                          | -0.8             | 3.3                          | 264         |
| 110+04647 | 1.26                | 1.86               | 0-30      | -0.7                      | 6.2                          | -1.1             | 7.3                          | 35          |
|           |                     |                    | 30-45     | -2.1                      | 5.3                          | -2.7             | 6.9                          | 69          |
|           |                     |                    | 45-60     | -0.7                      | 2.4                          | -0.7             | 4.3                          | 688         |
|           |                     |                    | 60+       | -1.6                      | 1.9                          | -2.8             | 4.1                          | 576         |
| 110-04154 | 2.60                | 2.58               | 0-30      | 2.9                       | 4.5                          | 3.2              | 5.2                          | 238         |
|           |                     |                    | 30-45     | 0.7                       | 4.8                          | 0.9              | 5.8                          | 234         |
|           |                     |                    | 45-60     | -0.6                      | 2.7                          | -0.5             | 4.1                          | 410         |
|           |                     |                    | 60+       | -1.8                      | 2.0                          | -3.1             | 3.8                          | 2213        |
| 110-04155 | 1.11                | 0.93               | 0-30      | 3.1                       | 4.8                          | 3.2              | 6.1                          | 266         |
|           |                     |                    | 30-45     | 3.3                       | 9.4                          | 4.1              | 12.6                         | 37          |
|           |                     |                    | 45-60     | -2.4                      | 4.1                          | -2.4             | 6.2                          | 184         |
|           |                     |                    | 60+       | -2.3                      | 2.6                          | -3.8             | 4.6                          | 1656        |
| 110-04175 | 1.44                | 1.40               | 0-30      | 1.2                       | 2.5                          | 1.3              | 3.4                          | 265         |
|           |                     |                    | 30-45     | 6.2                       | 7.6                          | 7.4              | 9.1                          | 299         |
|           |                     |                    | 45-60     | 0.6                       | 2.0                          | 1.6              | 3.8                          | 1757        |
|           |                     |                    | 60+       | -1.7                      | 1.9                          | -3.4             | 4.2                          | 530         |
| 110-04603 | 1.41                | 1.18               | 0-30      |                           |                              |                  |                              |             |
|           |                     |                    | 30-45     | -3.9                      | 3.9                          | -5.1             | 5.1                          | 2*          |
|           |                     |                    | 45-60     | -0.4                      | 2.0                          | 0.1              | 4.1                          | 205         |
|           |                     |                    | 60+       | -1.8                      | 2.3                          | -2.9             | 4.1                          | 1012        |
| 110-04646 | 1.09                | 1.00               | 0-30      | 0.0                       | 6.6                          | -0.2             | 8.0                          | 53          |
|           |                     |                    | 30-45     | -6.1                      | 12.1                         | -7.0             | 14.4                         | 90          |
|           |                     |                    | 45-60     | 0.1                       | 3.0                          | 1.0              | 5.3                          | 548         |
|           |                     |                    | 60+       | -1.9                      | 2.4                          | -3.0             | 4.8                          | 196         |

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

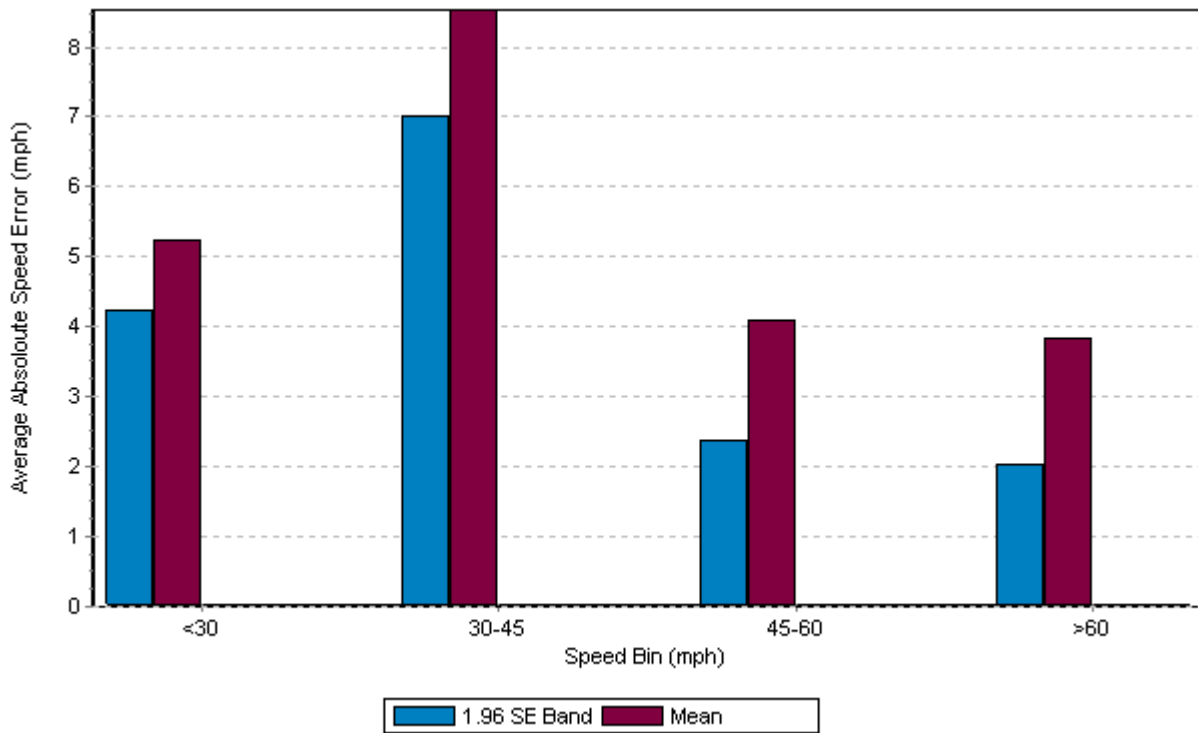
**Table 6**  
**Observations meeting data quality criteria for individual freeway segments greater than one mile in the state of Virginia**

| 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 |             |
| 110+04155 | 0-30      | 10                          | 15%                       | 41                                   | 60%                                | 0                     | 0%                  | 38                           | 56%                        | 68          |
|           | 30-45     | 13                          | 9%                        | 70                                   | 49%                                | 0                     | 0%                  | 63                           | 44%                        | 144         |
|           | 45-60     | 176                         | 23%                       | 584                                  | 77%                                | 0                     | 0%                  | 509                          | 68%                        | 754         |
|           | 60+       | 801                         | 35%                       | 1993                                 | 88%                                | 0                     | 0%                  | 1710                         | 75%                        | 2272        |
| 110+04156 | 0-30      | 4                           | 25%                       | 12                                   | 75%                                | 0                     | 0%                  | 11                           | 69%                        | 16          |
|           | 30-45     | 7                           | 15%                       | 25                                   | 53%                                | 0                     | 0%                  | 21                           | 45%                        | 47          |
|           | 45-60     | 418                         | 54%                       | 727                                  | 95%                                | 1                     | 0%                  | 703                          | 92%                        | 768         |
|           | 60+       | 526                         | 54%                       | 940                                  | 96%                                | 0                     | 0%                  | 882                          | 90%                        | 979         |
| 110+04604 | 0-30      | 0                           | 0%                        | 0                                    | 0%                                 | 0                     | 0%                  | 0                            | 0%                         | 1*          |
|           | 30-45     | 0                           | 0%                        | 1                                    | 7%                                 | 0                     | 0%                  | 0                            | 0%                         | 14          |
|           | 45-60     | 31                          | 36%                       | 71                                   | 84%                                | 0                     | 0%                  | 52                           | 61%                        | 85          |
|           | 60+       | 124                         | 47%                       | 237                                  | 90%                                | 2                     | 1%                  | 206                          | 78%                        | 264         |
| 110+04647 | 0-30      | 3                           | 9%                        | 21                                   | 60%                                | 0                     | 0%                  | 18                           | 51%                        | 35          |
|           | 30-45     | 10                          | 14%                       | 38                                   | 55%                                | 0                     | 0%                  | 33                           | 48%                        | 69          |
|           | 45-60     | 276                         | 40%                       | 596                                  | 87%                                | 0                     | 0%                  | 490                          | 71%                        | 688         |
|           | 60+       | 276                         | 48%                       | 508                                  | 88%                                | 1                     | 0%                  | 397                          | 69%                        | 576         |
| 110-04154 | 0-30      | 26                          | 11%                       | 153                                  | 64%                                | 0                     | 0%                  | 137                          | 58%                        | 238         |
|           | 30-45     | 22                          | 9%                        | 144                                  | 62%                                | 0                     | 0%                  | 120                          | 51%                        | 234         |
|           | 45-60     | 122                         | 30%                       | 324                                  | 79%                                | 0                     | 0%                  | 287                          | 70%                        | 410         |
|           | 60+       | 880                         | 40%                       | 1940                                 | 88%                                | 0                     | 0%                  | 1604                         | 72%                        | 2213        |
| 110-04155 | 0-30      | 59                          | 22%                       | 192                                  | 72%                                | 0                     | 0%                  | 164                          | 62%                        | 266         |
|           | 30-45     | 9                           | 24%                       | 15                                   | 41%                                | 0                     | 0%                  | 11                           | 30%                        | 37          |
|           | 45-60     | 59                          | 32%                       | 137                                  | 74%                                | 0                     | 0%                  | 104                          | 57%                        | 184         |
|           | 60+       | 577                         | 35%                       | 1376                                 | 83%                                | 2                     | 0%                  | 1067                         | 64%                        | 1656        |
| 110-04175 | 0-30      | 70                          | 26%                       | 229                                  | 86%                                | 0                     | 0%                  | 212                          | 80%                        | 265         |
|           | 30-45     | 13                          | 4%                        | 64                                   | 21%                                | 0                     | 0%                  | 41                           | 14%                        | 299         |
|           | 45-60     | 723                         | 41%                       | 1535                                 | 87%                                | 2                     | 0%                  | 1317                         | 75%                        | 1757        |
|           | 60+       | 260                         | 49%                       | 458                                  | 86%                                | 0                     | 0%                  | 376                          | 71%                        | 530         |
| 110-04603 | 0-30      |                             |                           |                                      |                                    |                       |                     |                              |                            |             |
|           | 30-45     | 1                           | 50%                       | 1                                    | 50%                                | 0                     | 0%                  | 1                            | 50%                        | 2*          |
|           | 45-60     | 74                          | 36%                       | 177                                  | 86%                                | 2                     | 1%                  | 144                          | 70%                        | 205         |
|           | 60+       | 380                         | 38%                       | 843                                  | 83%                                | 0                     | 0%                  | 690                          | 68%                        | 1012        |
| 110-04646 | 0-30      | 6                           | 11%                       | 32                                   | 60%                                | 0                     | 0%                  | 26                           | 49%                        | 53          |
|           | 30-45     | 10                          | 11%                       | 37                                   | 41%                                | 0                     | 0%                  | 31                           | 34%                        | 90          |
|           | 45-60     | 192                         | 35%                       | 452                                  | 82%                                | 0                     | 0%                  | 345                          | 63%                        | 548         |
|           | 60+       | 90                          | 46%                       | 165                                  | 84%                                | 0                     | 0%                  | 125                          | 64%                        | 196         |

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



**Figure 2**  
Speed error bias for freeway segments greater than one mile in Virginia



**Figure 3**  
Average absolute speed error for freeway segments greater than one mile in Virginia