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

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

Monthly Report

Prepared for:

I-95 Corridor Coalition

Sponsored by:

I-95 Corridor Coalition

Prepared by:

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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.

October 2009
Evaluation Results for the State of New Jersey

Summary
Travel time samples were collected along nearly 17 miles of freeways in New Jersey from Tuesday, September 8, 2009 to Thursday, September 17, 2009 and compared with travel time and speed data reported by INRIX as part of the I-95 Vehicle Probe project. The validation data represents approximately 770 hours of observations along seven freeway segments in New Jersey. Table 1, below summarizes the results of the comparison between the validation data and the INRIX data for the same period. The absolute average speed error as measured against the SEM band is within the acceptable limits of the contract specifications for all speed bins. The speed error bias as measured against the SEM band is within the acceptable limits for all bins except the 0 – 30 MPH bin.

<table>
<thead>
<tr>
<th>State</th>
<th>Absolute Speed Error (&lt;10mph)</th>
<th>Speed Error Bias (&lt;5mph)</th>
<th>Number of 5 Minute Samples</th>
<th>Hours of Data Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Comparison with SEM Band</td>
<td>Comparison with Mean</td>
<td>Comparison with SEM Band</td>
<td>Comparison with Mean</td>
</tr>
<tr>
<td>0-30 MPH</td>
<td>8.20</td>
<td>10.20</td>
<td>6.00</td>
<td>7.10</td>
</tr>
<tr>
<td>30-45 MPH</td>
<td>6.90</td>
<td>10.80</td>
<td>2.20</td>
<td>5.00</td>
</tr>
<tr>
<td>45-60 MPH</td>
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<td>5.30</td>
<td>1.60</td>
<td>4.00</td>
</tr>
<tr>
<td>&gt; 60 MPH</td>
<td>1.90</td>
<td>4.60</td>
<td>-1.60</td>
<td>-3.40</td>
</tr>
<tr>
<td>All Speeds</td>
<td>1.95</td>
<td>4.66</td>
<td>-1.40</td>
<td>-2.98</td>
</tr>
</tbody>
</table>

Table ES-1 New Jersey Evaluation Summary – September 2009

Based upon data collected from Sept 8, 2009 through Sept 17, 2009 across 17 miles of roadway.

As part of the on-going validation process, vehicle probe data from each state is validated on a rotating basis. Since the inception of the validation process, data on roadways in the State of New Jersey were validated on four occasions: September/October 2008, April 2009, June 2009 and September 2009. This represents nearly 4800 hours of observations along 123 miles of freeway segments in New Jersey. Table 2, below provides a summary of the cumulative validation effort. As shown, the absolute average speed error as measured against the SEM band is within the acceptable limits of the contract specifications for all speed bins. The speed error bias as measured against the SEM band is within the acceptable limits for the 45 – 60 MPH bin and the > 60 MPH bin.
Table ES-2 – New Jersey Cumulative Validation Results (through September 2009)

<table>
<thead>
<tr>
<th>State</th>
<th>Absolute Speed Error</th>
<th>Speed Error Bias</th>
<th>Number of 5 Minute Samples</th>
<th>Hours of Data Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Comparison with SEM Band</td>
<td>Comparison with Mean</td>
<td>Comparison with SEM Band</td>
<td>Comparison with Mean</td>
</tr>
<tr>
<td>0-30 MPH</td>
<td>9.3</td>
<td>11.2</td>
<td>7.4</td>
<td>8.7</td>
</tr>
<tr>
<td>30-45 MPH</td>
<td>9.6</td>
<td>12.4</td>
<td>5.9</td>
<td>7.8</td>
</tr>
<tr>
<td>45-60 MPH</td>
<td>2.4</td>
<td>5.1</td>
<td>0.8</td>
<td>2.4</td>
</tr>
<tr>
<td>&gt; 60 MPH</td>
<td>2.5</td>
<td>5.0</td>
<td>-2.3</td>
<td>-4.2</td>
</tr>
<tr>
<td>All Speeds</td>
<td>2.5</td>
<td>5.0</td>
<td>-2.1</td>
<td>-3.7</td>
</tr>
</tbody>
</table>


Data Collection

Bluetooth sensor deployments in New Jersey started on Tuesday, September 8, 2009. The actual deployments in New Jersey were performed with the assistance of New Jersey Department of Transportation (NJDOT) personnel. Sensors remained in the same position until they were retrieved a week later on Thursday, September 17, 2009. This round of data collections in New Jersey 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 New Jersey.

Table 1 presents a list of specific TMC segments that were selected as the validation sample in New Jersey. In total, results of validation on seven freeway TMC segments are reported in this document. These segments cover a total length of approximately 17 miles. The coordinates of the locations at which the Bluetooth sensors were deployed throughout the state of New Jersey 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 less than 30 mph speed bin, INRIX data fails to meet 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 for the speed error bias. In the rest of speed bins, INRIX data quality is deemed as satisfactory based on the same requirements for both the absolute average speed error and the speed error bias. It should be noted that while the total number of observations in the low speed bins across all TMC segments are reasonable, as Table 5 indicates, the number of observations in low speed bins for some individual TMC segments are low.

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 New Jersey. Tables 5 and 6
present detailed data for individual TMC segments in New Jersey 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 New Jersey, respectively. These figures correspond to Table 3.

Figure 1
TMC segments selected for validation in New Jersey
Table 1
Traffic Message Channel segments picked for validation in New Jersey

<table>
<thead>
<tr>
<th>TYPE</th>
<th>TMC</th>
<th>HIGHWAY</th>
<th>STARTING AT</th>
<th>ENDING AT</th>
<th>COUNTY</th>
<th>DIRECTION</th>
<th>LENGTH (mile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeway</td>
<td>103+04308</td>
<td>NJ-55</td>
<td>EXIT 48</td>
<td>US-322/EXIT 50</td>
<td>GLOUCESTER</td>
<td>NORTHBOUND</td>
<td>1.2</td>
</tr>
<tr>
<td>Freeway</td>
<td>103+04309</td>
<td>NJ-55</td>
<td>US 322/EXIT 50</td>
<td>EXIT 53</td>
<td>GLOUCESTER</td>
<td>NORTHBOUND</td>
<td>2.8</td>
</tr>
<tr>
<td>Freeway</td>
<td>103+04310</td>
<td>NJ-55</td>
<td>EXIT 53</td>
<td>NJ-47/EXIT 56</td>
<td>GLOUCESTER</td>
<td>NORTHBOUND</td>
<td>2.4</td>
</tr>
<tr>
<td>Freeway</td>
<td>103+04311</td>
<td>NJ-55</td>
<td>HWY 47/EXIT 56</td>
<td>DEPTFORD CENTER RD/EXIT 58</td>
<td>GLOUCESTER</td>
<td>NORTHBOUND</td>
<td>2.1</td>
</tr>
<tr>
<td>Freeway</td>
<td>103-04308</td>
<td>NJ-55</td>
<td>EXIT 53</td>
<td>US-322/EXIT 50</td>
<td>GLOUCESTER</td>
<td>SOUTHBOUND</td>
<td>2.6</td>
</tr>
<tr>
<td>Freeway</td>
<td>103-04309</td>
<td>NJ-55</td>
<td>HWY 47/EXIT 56</td>
<td>EXIT 53</td>
<td>GLOUCESTER</td>
<td>SOUTHBOUND</td>
<td>2.4</td>
</tr>
<tr>
<td>Freeway</td>
<td>103-04310</td>
<td>NJ-55</td>
<td>DEPTFORD CENTER RD/EXIT 58</td>
<td>NJ-47/EXIT 56</td>
<td>GLOUCESTER</td>
<td>SOUTHBOUND</td>
<td>2.2</td>
</tr>
<tr>
<td>Freeway</td>
<td>103-04941</td>
<td>NJ-55</td>
<td>US 322/EXIT 50</td>
<td>EXIT 48</td>
<td>GLOUCESTER</td>
<td>SOUTHBOUND</td>
<td>1.2</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.9</td>
</tr>
</tbody>
</table>
Table 2
TMC segment lengths and distances between sensor deployment locations in the state of New Jersey

<table>
<thead>
<tr>
<th>SEGMENT TYPE</th>
<th>TMC</th>
<th>STANDARD TMC</th>
<th>SENSOR DEPLOYMENT</th>
<th>ERROR IN SEGMENT LENGTH (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lat Long</td>
<td>Length (mile)</td>
<td>Lat Long</td>
<td></td>
</tr>
<tr>
<td>Freeway</td>
<td>103+04308</td>
<td>39.699389 -75.149128</td>
<td>39.716468 -75.154888</td>
<td>1.23</td>
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<tr>
<td>Freeway</td>
<td>103+04309</td>
<td>39.722391 -75.153026</td>
<td>39.756200 -75.129984</td>
<td>2.75</td>
</tr>
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<td>Freeway</td>
<td>103+04310</td>
<td>39.757922 -75.126924</td>
<td>39.790741 -75.115525</td>
<td>2.43</td>
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<tr>
<td>Freeway</td>
<td>103+04311</td>
<td>39.797155 -75.111688</td>
<td>39.826202 -75.104072</td>
<td>2.14</td>
</tr>
<tr>
<td>Freeway</td>
<td>103+04308</td>
<td>39.754641 -75.133842</td>
<td>39.721996 -75.153564</td>
<td>2.57</td>
</tr>
<tr>
<td>Freeway</td>
<td>103+04309</td>
<td>39.791555 -75.115967</td>
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<td>Freeway</td>
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<td>39.827749 -75.104661</td>
<td>39.797434 -75.112206</td>
<td>2.23</td>
</tr>
<tr>
<td>Freeway</td>
<td>103+04941</td>
<td>39.716282 -75.155323</td>
<td>39.699584 -75.149894</td>
<td>1.20</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td>16.97</td>
</tr>
</tbody>
</table>
Table 3
Data quality measures for freeway segments greater than one mile in New Jersey

<table>
<thead>
<tr>
<th>SPEED BIN</th>
<th>Data Quality Measures for No. of Obs.</th>
<th>1.96 SE Band</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Speed Error Bias</td>
<td>Average Absolute Speed Error</td>
</tr>
<tr>
<td>0-30</td>
<td>6.0</td>
<td>8.2</td>
<td>7.1</td>
</tr>
<tr>
<td>30-45</td>
<td>2.2</td>
<td>6.9</td>
<td>5.0</td>
</tr>
<tr>
<td>45-60</td>
<td>1.6</td>
<td>2.2</td>
<td>4.0</td>
</tr>
<tr>
<td>60+</td>
<td>-1.6</td>
<td>1.9</td>
<td>-3.4</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>SPEED BIN</th>
<th>Data Quality Measures for No. of Obs.</th>
<th>1.96 SE Band</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Percentage falling inside the band</td>
<td>Percentage falling within 5 mph of the band</td>
</tr>
<tr>
<td>0-30</td>
<td>16%</td>
<td>50%</td>
<td>0%</td>
</tr>
<tr>
<td>30-45</td>
<td>10%</td>
<td>40%</td>
<td>0%</td>
</tr>
<tr>
<td>45-60</td>
<td>38%</td>
<td>84%</td>
<td>0%</td>
</tr>
<tr>
<td>60+</td>
<td>50%</td>
<td>87%</td>
<td>0%</td>
</tr>
</tbody>
</table>
Table 5
Data quality measures for individual freeway segments greater than one mile in the state of New Jersey

<table>
<thead>
<tr>
<th>TMC</th>
<th>Standard TMC length</th>
<th>Bluetooth distance</th>
<th>SPEED BIN</th>
<th>1.96 SE Band</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Speed Error Bias</td>
<td>Average Absolute Speed Error</td>
</tr>
<tr>
<td>103+04308</td>
<td>1.23</td>
<td>1.20</td>
<td>0-30</td>
<td>1.9</td>
<td>4.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>30-45</td>
<td>-1.5</td>
<td>1.8</td>
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<td></td>
<td>45-60</td>
<td>1.9</td>
<td>4.4</td>
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<td></td>
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<td>60+</td>
<td>-1.5</td>
<td>1.8</td>
</tr>
<tr>
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<td>2.75</td>
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<td>-2.0</td>
<td>2.1</td>
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<td></td>
<td>45-60</td>
<td>1.7</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>60+</td>
<td>-2.0</td>
<td>2.1</td>
</tr>
<tr>
<td>103+04310</td>
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<td>2.37</td>
<td>0-30</td>
<td>1.3</td>
<td>3.7</td>
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<td>-1.8</td>
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<td>45-60</td>
<td>1.3</td>
<td>3.7</td>
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<td>60+</td>
<td>-1.8</td>
<td>2.0</td>
</tr>
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<td>1.6</td>
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<td>60+</td>
<td>-2.0</td>
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<td>30-45</td>
<td>-1.3</td>
<td>1.5</td>
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<td>45-60</td>
<td>1.6</td>
<td>5.3</td>
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<td></td>
<td>60+</td>
<td>-1.3</td>
<td>1.5</td>
</tr>
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<td>2.17</td>
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<td>15.1</td>
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<td>-7.2</td>
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<td>1.9</td>
<td>4.3</td>
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<td></td>
<td></td>
<td>60+</td>
<td>-0.8</td>
<td>-2.5</td>
</tr>
</tbody>
</table>

*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 New Jersey

<table>
<thead>
<tr>
<th>TMC</th>
<th>Speed Bin</th>
<th>Data Quality Measures for 1.96 SE Band</th>
<th>Mean</th>
<th>No. of Obs.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Speed Error Bias</td>
<td>Average Absolute Speed Error</td>
<td>Speed Error Bias</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. falling inside the band</td>
<td>% falling inside the band</td>
<td>No. falling within 5 mph of the band</td>
</tr>
<tr>
<td>103+04308</td>
<td>0-30</td>
<td>16</td>
<td>44%</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>30-45</td>
<td>464</td>
<td>55%</td>
<td>737</td>
</tr>
<tr>
<td></td>
<td>45-60</td>
<td>475</td>
<td>46%</td>
<td>873</td>
</tr>
<tr>
<td></td>
<td>60+</td>
<td>594</td>
<td>49%</td>
<td>1060</td>
</tr>
<tr>
<td>103+04309</td>
<td>0-30</td>
<td>6</td>
<td>19%</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>30-45</td>
<td>1</td>
<td>11%</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>45-60</td>
<td>26</td>
<td>50%</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>60+</td>
<td>595</td>
<td>41%</td>
<td>1193</td>
</tr>
<tr>
<td>103-04308</td>
<td>0-30</td>
<td>7</td>
<td>58%</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>30-45</td>
<td>554</td>
<td>47%</td>
<td>997</td>
</tr>
<tr>
<td></td>
<td>45-60</td>
<td>12</td>
<td>52%</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>60+</td>
<td>545</td>
<td>56%</td>
<td>878</td>
</tr>
<tr>
<td>103-04309</td>
<td>0-30</td>
<td>0</td>
<td>0%</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>30-45</td>
<td>0</td>
<td>0%</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>45-60</td>
<td>65</td>
<td>30%</td>
<td>178</td>
</tr>
<tr>
<td></td>
<td>60+</td>
<td>871</td>
<td>56%</td>
<td>1451</td>
</tr>
<tr>
<td>103-04310</td>
<td>0-30</td>
<td>23</td>
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<td>39</td>
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<td>30-45</td>
<td>291</td>
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<td>416</td>
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<td>45-60</td>
<td>47</td>
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<td>105</td>
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<tr>
<td></td>
<td>60+</td>
<td>545</td>
<td>56%</td>
<td>878</td>
</tr>
</tbody>
</table>

*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 New Jersey

Figure 3
Average absolute speed error for freeway segments greater than one mile in New Jersey