

## **An Early Look at the 2010 Urban Mobility Report: “Change” is Improving the Information**

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### **Introduction**

TTI's 2010 Urban Mobility Report will be the most comprehensive look yet at the nation's traffic problems, incorporating more roads, more cities, and more up-to-date congestion information thanks to a new partnership between TTI and INRIX. The 2010 Urban Mobility Report, the 20th edition since its beginning in 1984, will combine INRIX historical traffic speed data with public agency traffic count data to produce the latest congestion trends. The report has evolved over the years, with at least 14 significant methodology and data changes, but with a consistent focus on providing technical information in an easily understood format.

TTI's partnership with INRIX will significantly improve the report's traffic congestion analysis for urban areas across the country in several ways:

- Increase the detailed dataset analysis from 90 cities to 101 cities.
- The congestion analysis is expanded to all hours of all days. The 24/7 nature of the INRIX speed data allows estimates of midday and weekend congestion. There is delay in high-volume corridors during these periods and the 2010 Urban Mobility Report will include estimates of this problem.
- The new data will be combined with previous estimates to create a seamless 1982 to 2009 trend. Users of the Urban Mobility Report have consistently valued the trend data. This feature will not be lost in the 2010 report.
- Provide congestion data analysis nearly a year faster than previous reports. INRIX provided TTI with its calendar year 2009 traffic data early in 2010. TTI focused its research efforts on analysis rather than time-consuming process of reviewing information from many sources.
- Estimation procedures have been developed to provide volume and speed for all hours on all sections of roadway. The speed values for some hours on minor arterial streets are not included in the INRIX dataset. These values are estimated from the provided data.

### **First – The Important Stuff**

Everyone wants “the numbers.” This paper does not have the numbers. What we can tell you is delay and congestion cost will be different in most cases than with the old estimation procedure. The differences are not in the same direction; some regions have more delay, others have less.

Previous Urban Mobility Reports included the best estimates we could develop using available data and methods. For 2010, however, the “best available data” is much better and the procedures and estimates have been adapted to take advantage of those improvements. It appears that several factors cause estimated traffic speeds to be different than actual speeds.

1. Speeds on many congested sections of road are not as bad as previously estimated. There are severe bottlenecks with very low speeds, but most sections are not congested for more than four to five hours each day.
2. The true effects of incidents are not as significant as previously estimated. When crashes occur, congestion increases, but in most cases not as much as previous estimates. The bottleneck delay that crashes cause is partially offset by free-flowing traffic once the crash scene has been passed.
3. Off-peak direction delay is not a significant problem on most roads. High daily traffic volumes were previously estimated to create travel delay in the “minor” direction. The real speeds indicate the congested time may be only half as much as previously estimated.

Just as technology has helped map-makers create more accurate and more detailed maps in the past several centuries, directly measured traffic speeds from mobile device and navigation technologies are helping TTI create a more accurate, detailed, and up-to-date report of traffic congestion and its effects.

### **The INRIX Dataset and the Advantage It Provides**

TTI has conducted several evaluations of INRIX historical travel speeds and has confirmed the accuracy of the archived information included in the datasets. These evaluations compared the INRIX datasets to speed data obtained independently from a variety of other sources and showed good correlation in both the peak and off-peak periods. Other independent evaluations of INRIX real-time data have documented its quality. For example, as of mid-2010, more than 22,000 hours and 475 miles of INRIX travel speed data have been evaluated by the University of Maryland in the I-95 corridor. Based on these independent evaluations, INRIX has never failed to meet the contract requirements for accuracy.

INRIX uses sophisticated statistical analysis techniques, originally developed by Microsoft Research, to aggregate and enhance traffic-related information from hundreds of public and private sources and traditional road sensors. Traffic speed information is collected from more than 2 million GPS-enabled vehicles and mobile devices (referred to as “crowd-sourcing”). They provide real-time and historical traffic information for every major U.S. metropolitan area and 15 other countries across North America and Europe. Their information is delivered to a variety of private companies, mobile devices (including 8 of the top 10 iPhone navigation apps) and for real-time conditions in the I-95 corridor in several U.S. states.

The methodology used in previous Urban Mobility Reports was a combination of data from several freeway speed monitoring systems and empirically derived procedures. Sources such as the Highway Capacity Manual and travel time and speed studies conducted in several cities were adapted for use with the base dataset obtained from the states and FHWA.

In summary, the large amount of speed data directly collected from vehicles using the roads provides a much better source of speed data than the previous estimation process. These actual speeds will be combined with estimated hourly volumes to create the travel delay estimates used in the 2010 Urban Mobility Report.

### **What Data is INRIX Providing?**

The location and time data that INRIX collects for the entire U.S. is compiled into a dataset of speed for each hour of each day of the week. The 168 cells of this matrix (7 days, 24 hours) have data for the entire year with the following characteristics:

- All high volume roads and many low volume streets
- All daylight hours and most nighttime hours
- All major urban areas
- Data on heavier volume road sections in small urban regions and rural areas

The speed data is less prevalent, although still much better than previous estimates, in the following situations:

- Late-night and early-morning hours
- Low volume minor streets
- Small urban areas

In most cases, these “less covered” portions of the network are not congested sections of road.

### **Travel Time and Traffic Counts: Two Essential Ingredients**

One of the unique elements of TTI’s 2010 Urban Mobility Report is the integration of INRIX historical traffic speed data with public agency traffic count data to present a more accurate citywide view of traffic conditions. Higher volume roads will “count for more” in the regional averages than low-volume roads. An eight-lane freeway carrying 250,000 vehicles each day, for example, will receive twice the weight of a 125,000 vehicle per day freeway and five times the weight of a 50,000 vehicle per day street. Most of the slow speed road sections have more people traveling on them. The best way to assess regional travel experiences is to include each person’s experience; this means higher volume roads should get more weight.

This same principle applies to citywide traffic congestion. To accurately represent average travel times and speeds across many different roads, one has to know how many people or vehicles are traveling at that speed. Table 1 shows the range of differences in the travel time index that occur when travel times are not weighted by the traffic counts (vehicles-miles of travel, or VMT). In cities that have fairly even and distributed traffic flow across all area roadways, the difference in travel time index could be small, such as 3 points for City 4. However, for other cities in which a few roadways carry a much larger share of the congested traffic (City 3), the difference in the travel time index value is 16 points. When weighting the travel times by the number of vehicles stuck in traffic, the areawide weighted index value for City 3 is 1.48 (travel times are 48% longer during peak times) as opposed to an un-weighted index value of 1.32 (travel times are 32% longer during peak times).

### Exhibit 1. Differences In VMT-Weighted And Length-Weighted Travel Time Index Values

City	Travel Time Index		Difference (in points)
	Weighted by VMT	Weighted by Length	
City 1	1.33	1.22	+11
City 2	1.27	1.19	+ 8
City 3	1.48	1.32	+16
City 4	1.19	1.16	+ 3
City 5	1.14	1.08	+ 6

VMT=vehicle-miles traveled (vehicle count × segment length)

Travel time index is the ratio of the travel time in the peak period to travel time during light traffic flow.

### Overview of the Analytical Process

This section provides a summary of the analytical process used to calculate the congestion measures in the 2010 Urban Mobility Report. A detailed description of these procedures will be included with the report.

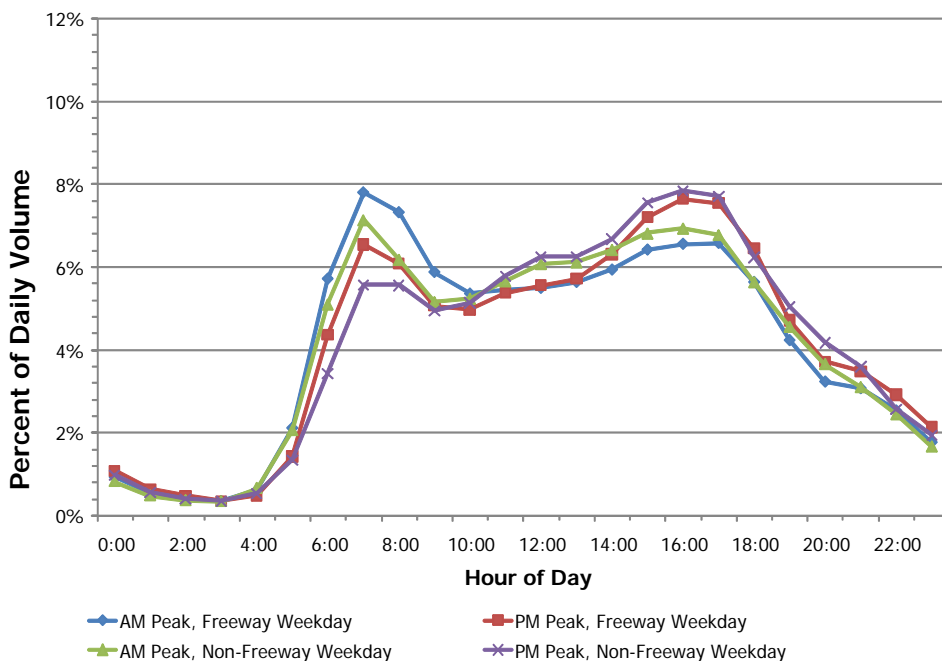
The following steps are being used to integrate travel time and traffic count data for calculating the congestion performance measures in the 2010 Urban Mobility Report.

1. **Obtain a complete traffic count or roadway inventory geodatabase that provides traffic count data for individual road segments.** For a national count database, we relied on a beta GIS version of the Federal Highway Administration's Highway Performance Monitoring System (HPMS) database. This same HPMS database with traffic counts and roadway inventory data has served as the basis for estimating congestion measures in the Urban Mobility Report for the past 20 years.
2. **Conflate (combine) the traffic count network with the private sector travel time network.** In our case, the private sector network is the traffic message channel (TMC) network as defined by the NAVTEQ-TeleAtlas TMC Consortium. Therefore, we merged the HPMS traffic counts onto the TMC network, such that we had a traffic count estimate for each TMC path (directional link). This conflation was performed using multiple steps with automated and manual quality control in ESRI's ArcGIS.
3. **Estimate traffic counts for each hourly interval from the daily HPMS traffic counts.** The INRIX travel time and speed data are provided in hourly day-of-week annual averages, but the merged HPMS traffic counts are only annual average daily traffic (AADT) counts. Therefore, it was necessary to estimate hourly volumes from AADT counts for each TMC path. Based on the INRIX speed profile, we assigned representative time-of-day traffic volume profiles (see Exhibit 2 for an example) to each TMC path, which were used to estimate the hourly volumes that could then be paired one-to-one with INRIX's hourly travel times and speeds.
4. **Establish free-flow travel speeds for each TMC path for measure calculation.** Several of the congestion performance measures require an estimate of free-flow speed (i.e., the speed during

light traffic). INRIX provides a “reference speed” with each TMC path that is their best estimate of the free-flow speed. Therefore, we used the INRIX reference speed as the free-flow speed in our calculation of congestion measures. If INRIX had not provided the reference speed, we could have calculated the free-flow speed for each TMC path by using speeds during overnight or other periods of light traffic. It should be noted that INRIX reference speeds are capped at 65 mph (i.e., if free-flow speeds are higher than 65 mph, the reference speeds are limited to a maximum value of 65 mph).

5. **Calculate congestion performance measures.** Once these three data elements (i.e., hourly average speed, hourly traffic count, reference speed) have been integrated for each TMC path, many different travel time-based performance measures can be calculated, such as travel time index, total delay, delay per traveler, delay per mile of road, etc.

**Exhibit 2. Example of Traffic Volume Profile Used to Estimate Hourly Traffic Counts**  
(for weekday traffic counts for severe congestion)



### A New Measure: Commuter Stress Index (CSI)

The 20<sup>th</sup> edition of the Urban Mobility Report marks the debut of a new measure designed to replicate the experiences of people who commute through congested conditions. The Commuter Stress Index (CSI) uses the same concept as the Travel Time Index – comparing travel time per mile during the peak to free-flow conditions – with a focus on conditions in the worst travel direction. The CSI measure uses the travel speed from the direction with the most congestion in each peak period to illustrate the conditions experienced by the commuters traveling in the predominant directions (for example, inbound

from suburbs in the morning and outbound to the suburbs in the evening). The calculation is conducted with the Travel Time Index formula, but only for the peak directions.

With the INRIX dataset, the Urban Mobility Report can calculate congestion levels in each direction separately. In the past, the data only allowed an average congestion level to be estimated for both directions. The CSI better matches the perception of traditional commuters. Averaging the conditions for both directions in both peaks (as with the Travel Time Index) provides an accurate measure of roadway congestion, but does not always match the perception of the majority of commuters who do not have the advantage of traveling in the uncongested off-peak direction conditions.

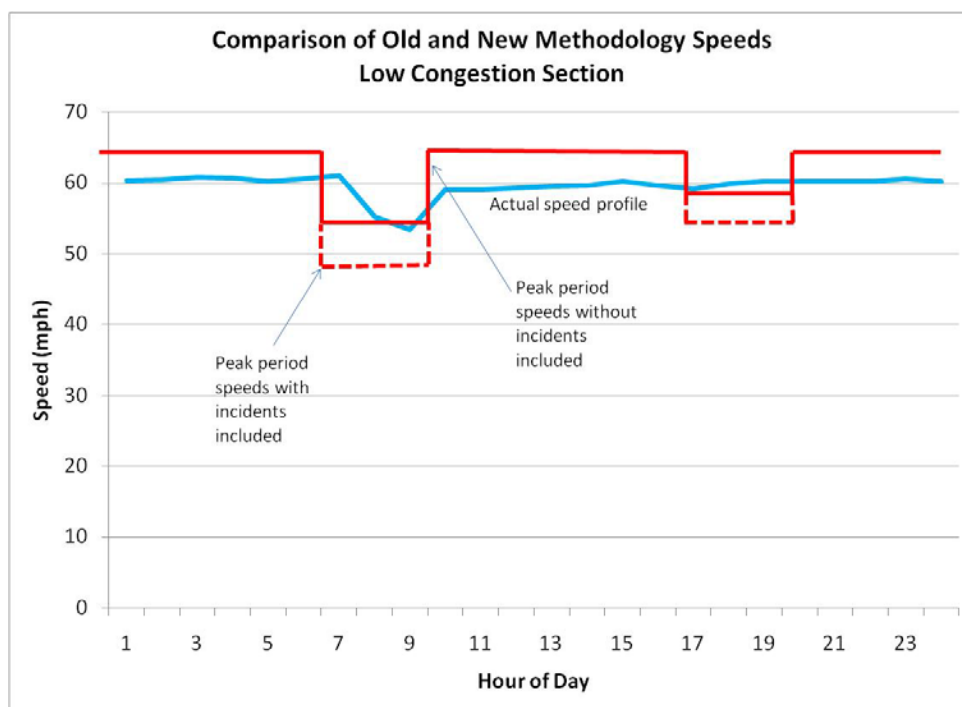
As with the Travel Time Index, the Commuter Stress Index is a length-neutral measure. It provides a method to compare the congestion penalty between streets and freeways (which have different speeds) and for corridors and road segments (where measures like total delay and annual delay per traveler are difficult to understand). The urban area average Commuter Stress Index values include the effect of volume (sections with more volume are given more importance than low volume sections, as with the Travel Time Index), but do not reveal the effect of trip length differences. Commuters who travel long distances at the speed limit will see a low CSI value, even if their commute trip takes a relatively long time.

## What We Are Finding

The easiest way to describe the congestion measures differences between the 2009 report and the 2010 report is to show the speeds on road sections of varying volume per lane. Exhibits 3, 4 and 5 present three freeway cases comparing the old methodology speed estimates (used in the 2009 report) with those seen in the INRIX data.

- The low congestion section (Exhibit 3) has an average daily traffic volume per lane of 17,000. The free-flow speed is lower than the 65 mph used in the 2009 report and there is basically zero delay in the evening peak period. Morning delay is less than the old process produce, especially when the incident congestion factor was included in the 2009 process.

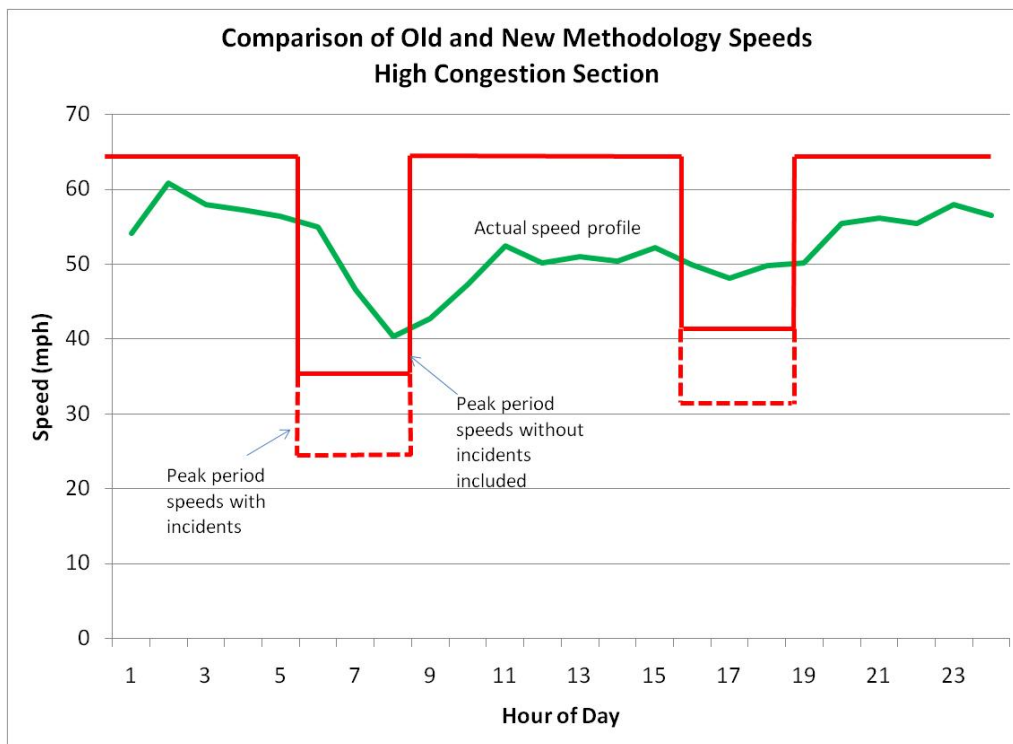
### Exhibit 3. Speed Comparison (Old versus New) for Low Congestion Freeway Section



- The high congestion section (Exhibit 4) illustrates a pattern seen increasingly on urban freeways. There is some slowdown during all daylight hours. Peak period speeds do not decline to the levels estimated with the 2009 process, however, and do not remain low for as long as predicted. Delay in the “other peak period” is also not as serious as estimated in 2009. Midday delay, however, partially compensates for the “missing” peak delay. This midday delay is typically an average of several days with no delay and a few days where speeds are much slower due to higher volume, vehicle crashes, special events, weather problems or other unexpected events.
- Exhibit 5 illustrates a freeway segment at a bottleneck location, a point where the roadway design or traffic volume causes a serious constriction and low speeds. The 2009 method

typically underestimates delay at these locations. While the off-peak period delay using the new method is much less than would have been estimated, there is more midday delay and the evening peak period congestion begins sooner, lasts longer and results in much worse travel times than the 2009 report would show.

#### Exhibit 4. Speed Comparison (Old versus New) for High Congestion Freeway Section

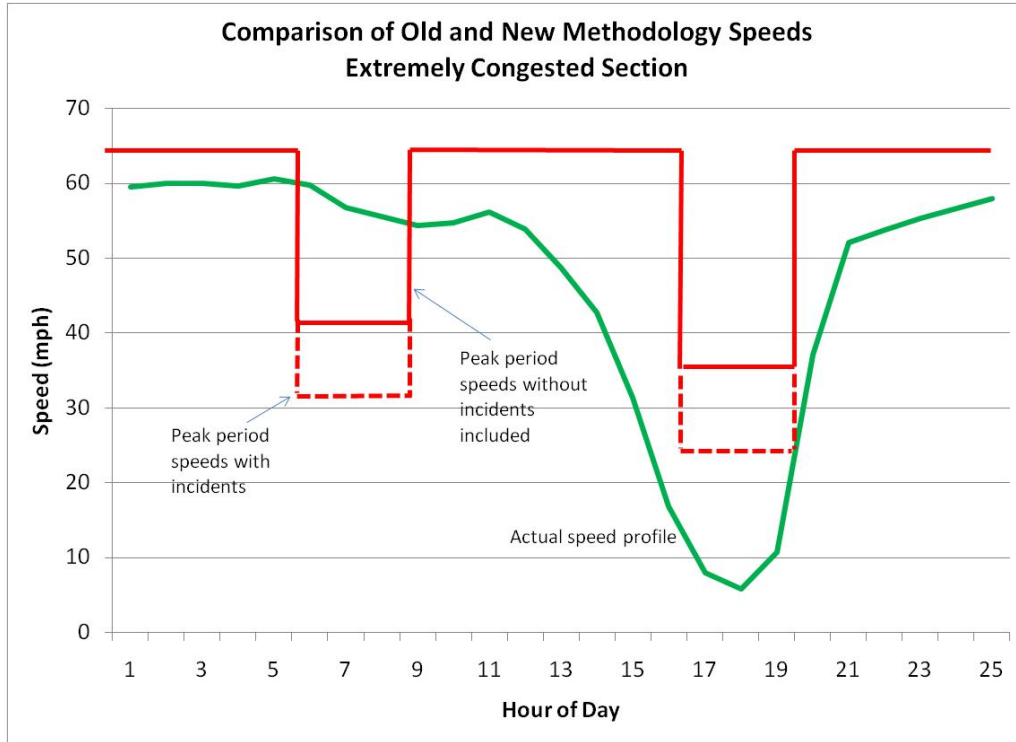


Similar results are seen in the arterial street analysis. Exhibits 6, 7 and 8 are all illustrations of traffic speed for six-lane street sections with approximately 8,000 daily vehicles per lane. This is a medium congestion level.

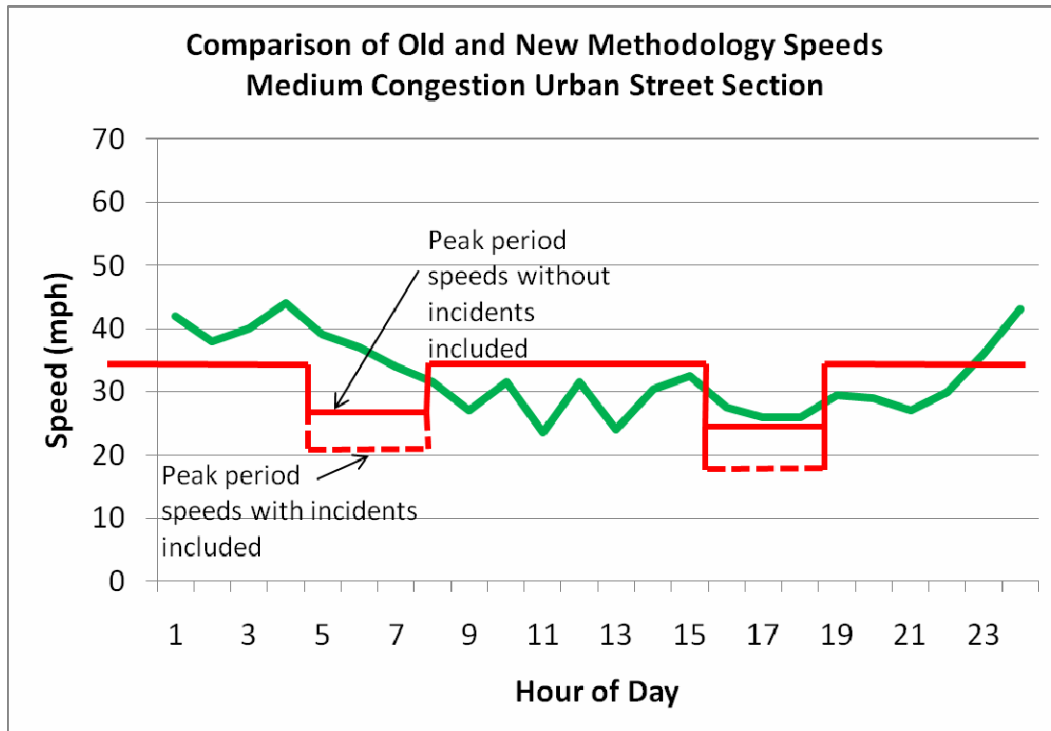
Exhibit 6 is for an urban section (moderate density, some adjacent commercial development) with a 40 mph speed limit and an evening peaking direction. Speeds in the morning are higher than estimated in the 2009 method; the evening peak speeds decline to about the level of the estimation without the incident delay addition. The evening slow speeds extend beyond the end of the 2009 peak period (7 p.m.) Speeds in the midday period are lower than would have been estimated and jump around between 23 and 31 mph.



**Exhibit 5. Speed Comparison (Old versus New) for a “Bottleneck” Freeway Section**



**Exhibit 6. Speed Comparison (Old versus New) for an Urban Street Section**

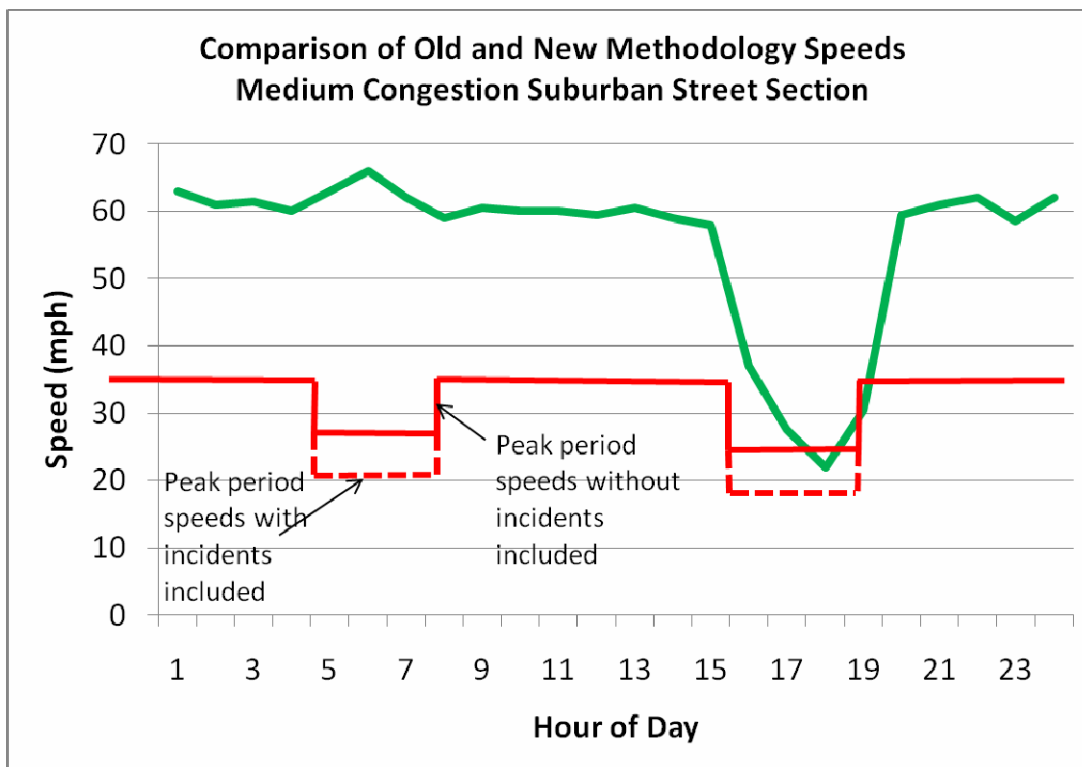


Exhibits 7 and 8 are two versions of delay estimates for the same suburban road section. Exhibit 7 compares the typical application of the 2009 method using the 35 mph assumed free-flow speed. The morning peak actual speeds are much higher than estimated and the evening peak speeds only drop to the “without delay” speed estimate for a short time. These differences are clearly caused by the high free-flow speeds on this road. Exhibit 8 adjusts the speed estimation equation to the free-flow speed, suggesting that the 2009 method dramatically underestimated delay on this road section.

### **Summary**

The 2010 Urban Mobility Report will be a dramatic improvement over previous versions due to the use of traffic speeds from INRIX. The report will have a familiar “feel” to it – the figures and tables will be similar to recent reports. The performance measures will remain tied to the commitment to provide information that is easily understood by non-technical audiences. The data and commentary will be provided for a range of decision-makers and analysts to use. And the trends will be adjusted to meet the new congestion levels in each region. Solutions to the congestion problem will not change; the Urban Mobility Report analysis indicates that many strategies are needed in most urban regions. No single strategy has been successful in addressing mobility problems over the long-term.

**Exhibit 7. Speed Comparison (Old versus New) for a Suburban Street Section**



**Exhibit 8. Adjusted Speed Comparison (Old versus New) for a Suburban Street Section**

