Appendix WAS – Washington, DC
2003 Annual Report on Freeway Mobility and Reliability

This report is a supplement to: *Monitoring Urban Freeways in 2003: Current Conditions and Trends from Archived Operations Data*. Texas Transportation Institute and Cambridge Systematics, Inc., Report No. FHWA-HOP-05-018, December 2004, available at http://mobility.tamu.edu/mmp.

Exhibit WAS-1: Current Measures and Trends

Measures	Current Year	Last Year		Two Years Ago	
	2003	2002	Change	2001	Change
Performance Measures					
Travel Time Index	1.29	1.17	+10% ↑	n.a.	n.a. —
Planning Time Index	1.62	1.41	+15% ↑	n.a.	n.a. —
Buffer Index	21%	17%	+4% ↑	n.a.	n.a. —
% Congested Travel	45%	49%	-4% ↓	n.a.	n.a. —
Total Delay (veh-hours) per 1000 VMT	4.86	5.85	-17% ↓	n.a.	n.a. —
Explanatory Measures					
Peak Period VMT (000)	2,030	710	+186% ↑	n.a.	n.a. —
Avg. Annual DVMT (000)	9,700	7,770	+25% ↑	n.a.	n.a. —
Data Quality Measures					
% complete	33%	16%	+17% ↑	n.a.	n.a. —
% valid	98%	71%	+27% ↑	n.a.	n.a. —
% of VMT covered	26%	21%	+5% ↑	n.a.	n.a. —
% of freeway miles	24%	19%	+5% ↑	n.a.	n.a. —

* See pages 7 and 8 for maps of freeway coverage, measure definitions, and further documentation.

Exhibit WAS-2: 2000 to 2003 Annual Trends

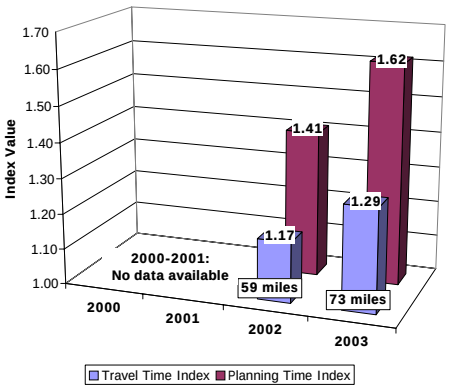
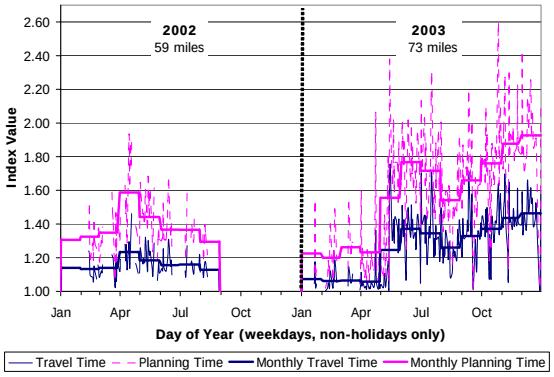


Exhibit WAS-3: Daily and Monthly Trends



Comments

- The travel time index rose sharply (10%) from 1.17 to 1.29, while the buffer index increased 4%. The weekday trends chart (Exhibit 3) indicates dramatic changes to traffic in May 2003.
- This is the first year for reporting data from Washington, DC; it was reported in 2002 as Northern Virginia (which contains about 2/3 of the reported freeway mileage).

Data Source(s): Virginia Smart Travel Lab in cooperation with Virginia DOT; also University of Maryland in cooperation with CHART, Maryland State Highway Administration
Includes 73 of 309 (24%) total freeway miles in Washington, DC; collected using mostly loop detectors; see page 7 for additional information on the data source

Data Analysis: Texas Transportation Institute, analysis completed September 2004

Time of Day Patterns and Trends

The charts on this page illustrate average weekday (no holidays included) traffic patterns and trends that were measured on the freeway sections instrumented with operations-based traffic sensors.

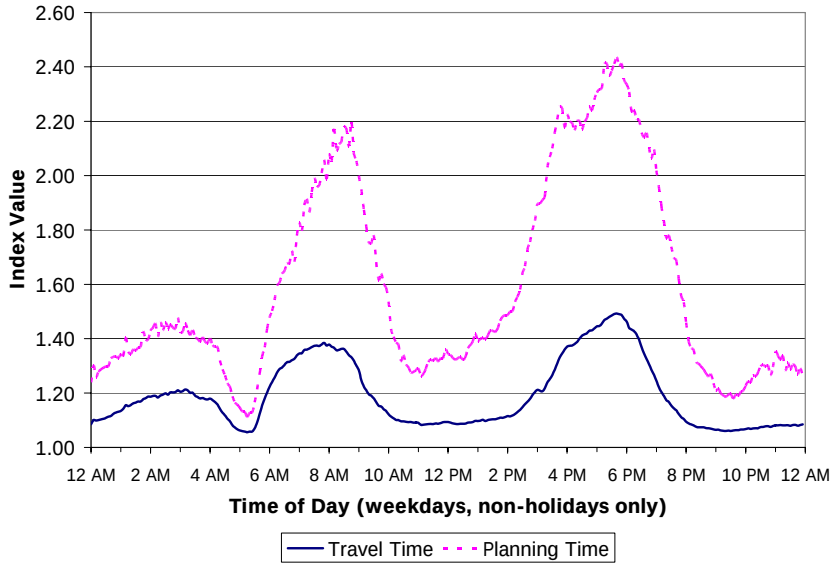


Exhibit WAS-4: Mobility and Reliability by Time of Average Weekday

Comments

- This chart shows areawide congestion and reliability patterns. The difference between the solid line (travel time index) and the dashed line (planning time index) is the additional "buffer" or "time cushion" that travelers must add to average trip times to ensure 95% on-time arrival.
- The evening peak period is slightly more severe and longer than the morning peak period.
- There appear to be slow speeds during the early morning hours.

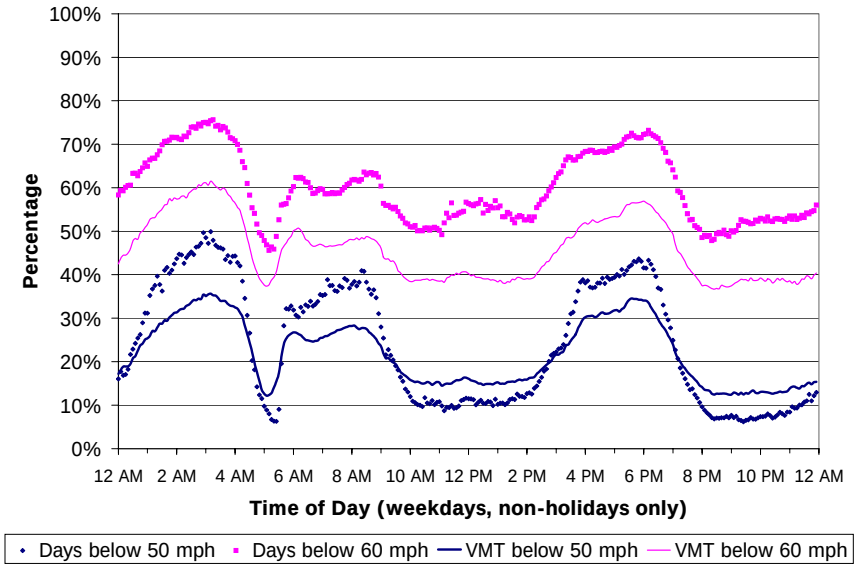


Exhibit WAS-5: Frequency and Percentage of Congested Travel by Time of Average Weekday

Comments

- This chart illustrates the difference in using two different speed thresholds (50 and 60 mph) to compute the percent of congested days as well as the percent of congested travel.
- The slow speeds in the early morning hours are more evident in this chart.
- This chart shows a significant difference between using the 50 mph and 60 mph threshold.

Time Period of the Day Patterns and Trends

The charts on this page illustrate average weekday (no holidays included) traffic patterns and trends that were measured on the freeway sections instrumented with operations-based traffic sensors. The time periods are defined uniformly for all cities to facilitate trend analysis over time and between cities. The time periods are defined as follows:

- Early AM: 12 to 6 am
- AM Peak: 6 to 9 am
- Mid-day: 9 am to 4 pm
- PM Peak: 4 to 7 pm
- Late PM: 7 pm to 12 am

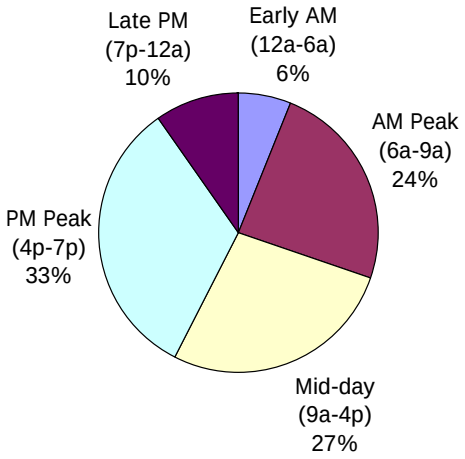


Exhibit WAS-6: Percent of Delay by Time Period

Comments

- This chart shows the percent of delay that occurred during different time periods of an average weekday. Note that the AM and PM peak periods are the same duration, but that the other time periods have different lengths.
- The delay in the evening peak period is slightly greater than delay in the mid-day period, which in turn is slightly greater than delay in the morning peak period.

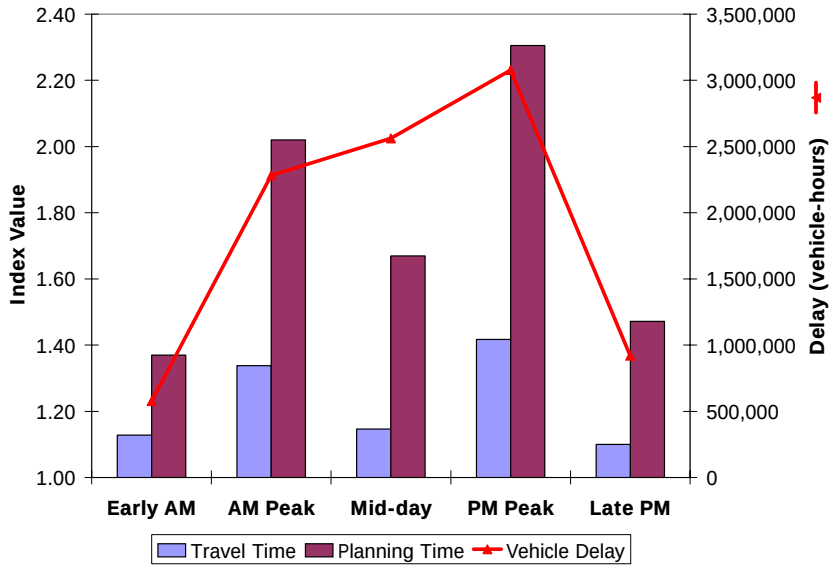


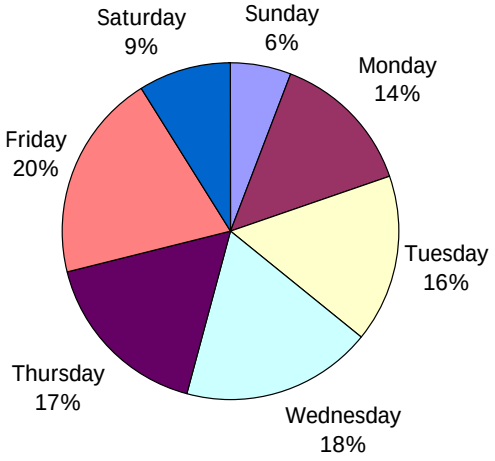
Exhibit WAS-7: Mobility, Reliability, and Delay by Time Period

Comments

- This chart shows congestion and reliability (shown as bars) as well as delay (shown as a line) during different time periods of an average weekday.
- The trends in this chart follow closely those shown in Exhibit 6.

Day of Week Patterns and Trends

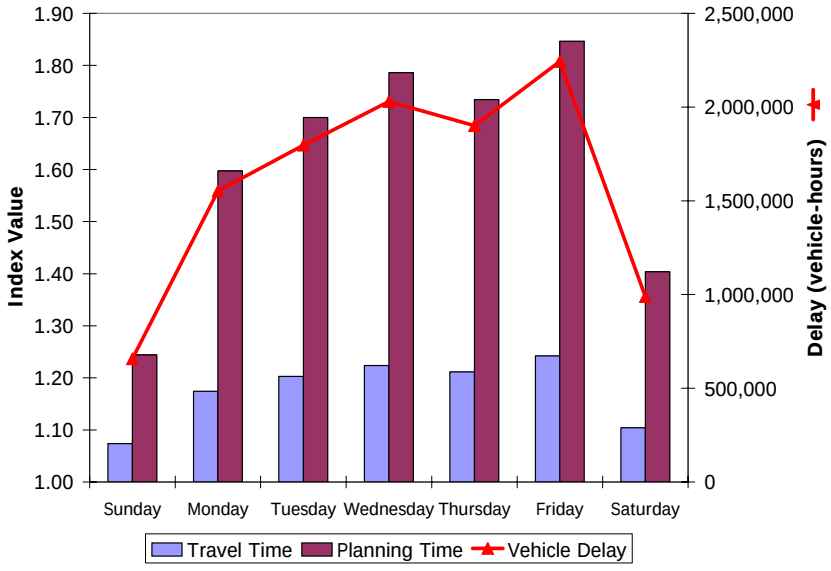
The charts on this page illustrate average traffic patterns and trends that were measured on the freeway sections instrumented with operations-based traffic sensors. Because of different peak period times and lengths on weekdays and weekends, the statistics presented on this page are 24-hour daily totals or averages.



Comments

- This chart shows the percent of total daily delay that occurred during each day of the week.
- Friday has the largest share of delay, with Monday the least delay among all weekdays.
- The data indicate that both weekend days combined have nearly as much delay as a typical weekday.

Exhibit WAS-8: Percent of Daily Vehicle Delay by Day of Week



Comments

- This chart shows average daily congestion and reliability (shown as bars) as well as total daily delay (shown as a line) during each day of the week.
- The trends in this chart follow closely those shown in Exhibit 8.
- Friday has the most delay and is the least reliable (highest planning time index value).

Exhibit WAS-9: Mobility, Reliability, and Delay by Day of Week

Other Traffic Data Patterns and Trends

The chart on this page illustrates average traffic patterns and trends that were measured on the freeway sections instrumented with operations-based traffic sensors.

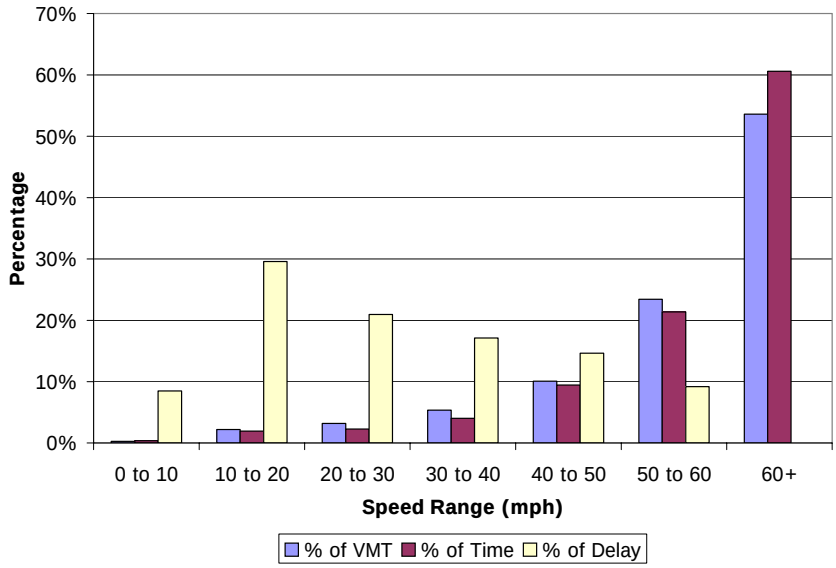


Exhibit WAS-10: Percent of VMT, Delay and Time Periods in Different Speed Ranges

Comments

- This chart shows the percent of VMT, time, and delay in different speed ranges. This chart is useful to determine how much VMT and delay occurred at different congestion levels.
- Only 55% of the VMT is at speeds greater than 60 mph, with another 25% between 50 and 60 mph.
- Nearly 40% of the delay occurred at speeds less than 20 mph.

Mobility and Reliability Statistics for Specific Freeway Sections

The table in this section illustrates average weekday (no holidays included) statistics from the freeway sections instrumented with operations-based traffic sensors. Where possible, the freeway sections have been defined to begin and end at major interchanges, streets, or other locations where traffic conditions are likely to change. The freeway sections are typically between 5 and 10 miles in length.

Exhibit WAS-11. Mobility and Reliability by Section and Time Period

Freeway Section (sorted from most congested to least congested sections)	Length (mi)	Travel Time Index				Buffer Index			
		Morning Peak (6a-9a)	Midday (9a-4p)	Evening Peak (4p-7p)	Average peak period	Morning Peak (6a-9a)	Midday (9a-4p)	Evening Peak (4p-7p)	Average peak period
I-95 SB: I-495 to Rt 123	10.22	1.07	1.25	2.24	1.75	6%	54%	55%	35%
I-66 WB: I-495 to Rt 50 Lee Jadson Mem Hwy	5.11	1.03	1.33	2.30	1.68	0%	89%	64%	33%
I-95 NB: Rt 619 to Rt 123	8.79	2.07	1.15	1.11	1.58	93%	34%	27%	59%
I-95 NB: Rt 123 to I-495	10.45	1.89	1.24	1.12	1.56	55%	48%	30%	44%
I-66 WB: SR 28 to Rt 29/Catharpin Rd	6.52	1.00	1.08	1.80	1.54	0%	35%	99%	66%
I-66 EB: Rt 50 Lee Jadson Mem Hwy to I-495	5.28	1.87	1.25	1.15	1.51	90%	91%	41%	66%
I-95 SB: Rt 123 to Rt 619	7.93	1.06	1.27	1.79	1.50	13%	82%	137%	88%
I-395 NB: I-495 to Rt 1	8.90	1.56	1.18	1.42	1.49	85%	52%	92%	88%
I-66 EB: SR 28 to Rt 50 Lee Jadson Mem Hwy	5.91	1.71	1.06	1.11	1.47	61%	33%	47%	55%
I-495 SB: Milepost 14.6 to 12	3.75	1.15	1.12	1.82	1.47	49%	55%	58%	54%
I-66 HOV WB: Capital Beltway to Rt 50 Lee Jadson Mem Hwy	5.30	1.02	1.26	1.91	1.46	0%	85%	66%	33%
I-395 SB: Rt 1 to I-495	9.03	1.11	1.14	1.63	1.43	27%	36%	68%	53%
I-66 HOV EB: Rt 50 Lee Jadson Mem Hwy to Capital Beltway	5.36	1.63	1.16	1.11	1.34	101%	68%	43%	69%
I-495 NB: Milepost 11.9 to 14.5	3.60	1.07	1.09	1.61	1.33	36%	54%	115%	73%
I-66 HOV EB: Rt 29 to Rt 50 Lee Jadson Mem Hwy	11.70	1.32	1.01	1.03	1.21	52%	2%	12%	36%
I-66 HOV WB: Rt 50 Lee Jadson Mem Hwy to Rt 29	12.61	1.00	1.03	1.27	1.19	0%	10%	78%	55%
I-66 EB: Rt 29/Catharpin Rd to SR 28	6.84	1.27	1.02	1.00	1.18	66%	0%	0%	43%
I-95 Reversible HOV: Rt 123 to Int 495	10.44	1.10	1.09	1.20	1.16	41%	35%	61%	52%
I-95 Reversible HOV: Rt 234 to Rt 123	7.63	1.06	1.17	1.21	1.15	37%	108%	132%	91%
I-66 WB: Rt 50 Arlington Blvd to I-495	10.38	1.15	1.14	1.14	1.15	51%	56%	47%	49%
I-66 WB: Rt 50 Lee Jadson Mem Hwy to SR 28	6.09	1.00	1.03	1.20	1.13	0%	11%	57%	37%
I-66 EB: I-495 to Rt 50 Arlington Blvd	10.53	1.15	1.04	1.07	1.11	70%	11%	38%	56%
I-270 SB: MD 85 to SR 95	13.18	1.15	1.02	1.02	1.10	48%	8%	4%	31%
I-395 Reversible HOV: I-495 to Rt 27	8.09	1.06	1.08	1.12	1.09	27%	38%	44%	36%
I-270 NB: MD 121 to MD 85	14.23	1.01	1.02	1.11	1.08	6%	8%	38%	27%
Average for all Sections		1.34	1.15	1.42	1.38	45%	44%	58%	52%

Comments

- This table shows average weekday congestion (travel time index) and reliability (buffer index) for specific routes for different time periods of the day.

Source and Coverage of Data

This report was produced using data collected by the Virginia Department of Transportation and archived by the Virginia Smart Travel Lab (http://cts.virginia.edu/stl_index.htm), as well as data collected by the CHART program of the Maryland State Highway Administration (http://www.chart.state.md.us) and archived by the University of Maryland (http://www.cattlab.umd.edu). A map of the freeway routes on which traffic data was collected is shown below (most (but not all) dots indicate routes on which sensors are located—the blue dots in the District of Columbia should be ignored).

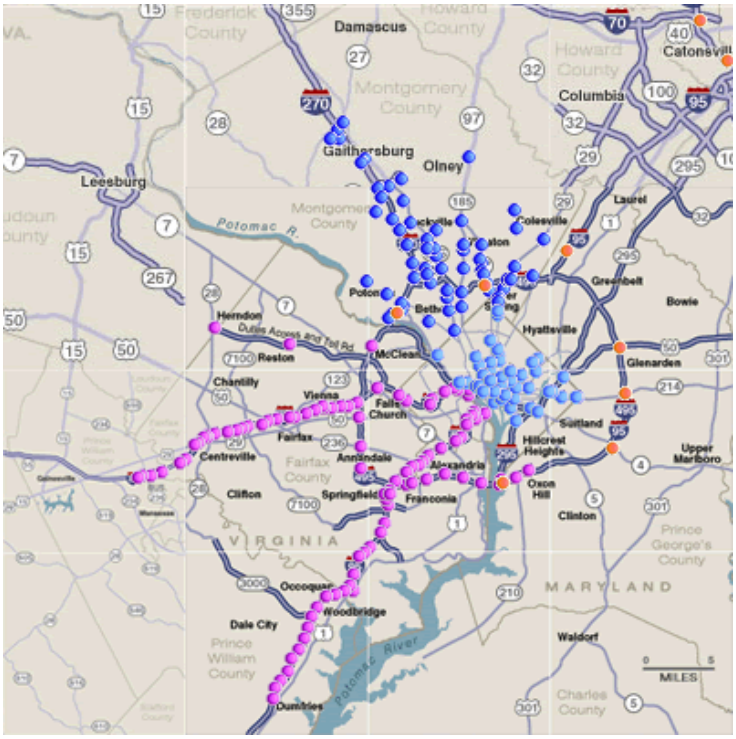


Exhibit WAS-12: 2003 Freeway Routes with Traffic Sensors in Washington, DC
(Source of graphic: TrafficLand, Inc., http://www.trafficland.com/)

Exhibit WAS-13: Instrumented Freeway Coverage in Washington, DC

Coverage Measures	Year	Instrumented Freeway Routes	Total Freeway System[1]	Percent Coverage
Lane-miles	2000	n.a.	1960	n.a.
	2001	n.a.	1970	n.a.
	2002	533	1970	27%
	2003	468	1975	24%
Centerline-miles	2000	n.a.	306	n.a.
	2001	n.a.	309	n.a.
	2002	59	309	19%
	2003	73	309	24%
Average annual daily vehicle-miles of travel (DVMT) (1000)	2000	n.a.	34,535	n.a.
	2001	n.a.	35,770	n.a.
	2002	7,770	36,200	21%
	2003	9,700	37,033	26%

[1]Source is FHWA's Highway Performance Monitoring System and the Texas Transportation Institute's Urban Mobility Study (http://mobility/tamu.edu/ums).

Documentation and Definitions

Performance Measures

- **Travel Time Index:** ratio of the average peak period travel time to an off-peak travel time. For example, a value of 1.20 means that average peak travel times are 20% longer than off-peak travel times. In this report, the morning peak period is from 6 to 9 a.m. and the evening peak period is from 4 to 7 p.m. The off-peak travel time is calculated by assuming a free-flow speed of 60 mph.
- **Planning Time Index:** statistically defined as the 95th percentile Travel Time Index, this measure also represents the extra time most travelers include when planning peak period trips. For example, a value of 1.60 means that travelers plan for an additional 60% travel time above the off-peak travel times to ensure 95% on-time arrival.
- **Buffer Index:** the extra time (or buffer) needed to ensure on-time arrival for most trips. For example, a value of 40% means that a traveler should budget an additional 8 minute buffer for a 20-minute average peak trip time to ensure 95% on-time arrival. In this report, the buffer index is a VMT-weighted average of the buffer index for each route for the morning and evening peak period. The buffer index is calculated for each route and time period as follows: buffer index = (95^{th} percentile travel time – average travel time) / average travel time.
- **% Congested Travel:** the congested peak period vehicle-miles of travel (VMT) divided by total VMT in the peak period. This is a relative measure of the amount of peak period travel affected by congestion.
- **Total Delay per 1000 VMT:** the total vehicle delay (in vehicle-hours) divided by the amount of VMT. This is a relative measure of the total delay and will not be as affected by changes in the level of sensor instrumentation for a particular city.
- **Vehicle Delay:** the delay (in vehicle-hours) experienced by vehicles traveling less than free-flow speeds (assumed to be 60 mph in this report).

Explanatory Measures

- **Peak Period VMT:** the average amount of VMT within the defined peak periods (weekdays from 6 to 9 a.m. and 4 to 7 p.m.) for the year. Peak period VMT is reported by 1000s.
- **Average Annual VMT (000):** the average annual amount of daily VMT (DVMT) for all days and times for the year. Average annual DVMT is reported by 1000s.

Data Quality Measures

- **% complete:** the number of valid reported data values divided by the number of total expected data values (given the number of active sensors and time periods). In this report, % complete is reported as the lowest value of either traffic volume or speed data.
- **% valid:** the number of reported data values that passed defined acceptance criteria divided by the total number of reported data values. In this report, % valid is reported as the lowest value of either traffic volume or speed data.
- **% of DVMT covered:** the amount of average annual DVMT reported by sensors divided by the areawide average annual DVMT as estimated in FHWA's Highway Performance Monitoring System and TTI's Urban Mobility Study. This measure characterizes the relative amount of areawide travel that has the performance indicated in this report.
- **% coverage of freeway mileage:** the amount of freeway lane-miles containing sensors divided by the areawide freeway lane-miles as estimated in FHWA's Highway Performance Monitoring System and TTI's Urban Mobility Study. This measure characterizes the relative amount of areawide freeways that has the performance indicated in this report.