

Appendix DET – Detroit, Michigan 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 DET-1: Current Measures and Trends

Measures	Current Year	Last Year		Two Years Ago	
	2003	2002	Change	2001	Change
Performance Measures					
Travel Time Index	1.12	1.11	+1% ↑	1.12	0% —
Planning Time Index	1.33	1.31	+2% ↑	1.31	+2% ↑
Buffer Index	17%	20%	-3% ↓	15%	+2% ↑
% Congested Travel	27%	27%	0% —	25%	+2% ↑
Total Delay (veh-hours) per 1000 VMT	2.27	2.17	+4% ↑	2.21	+2% ↑
Explanatory Measures					
Peak Period VMT (000)	3,240	3,350	-3% ↓	2,840	+14% ↑
Avg. Annual DVMT (000)	10,400	15,470	-33% ↓	10,930	-5% ↓
Data Quality Measures					
% complete	61%	43%	18% ↑	13%	48% ↑
% valid	99%	69%	30% ↑	96%	3% ↓
% of VMT covered	33%	49%	-16% ↓	35%	-2% ↓
% of freeway miles	39%	39%	0% —	39%	0% —

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

Exhibit DET-2: 2000 to 2003 Annual Trends

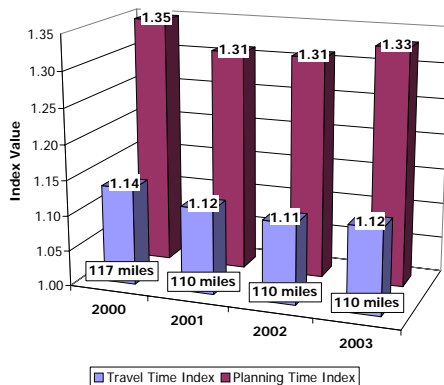
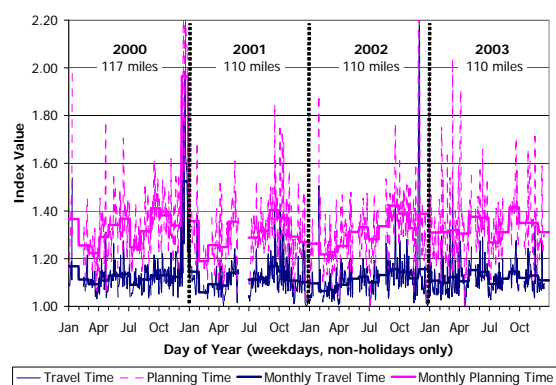


Exhibit DET-3: Daily and Monthly Trends



Comments

- The 2003 congestion level appears to be slightly worse than in 2002 and 2001. The reliability (buffer index) in 2003 showed a 3% improvement over 2002 levels, but a 2% decline over 2001.
- Peak period travel (VMT) is down slightly (3%), whereas daily vehicle travel is down significantly (33%) over 2002 levels.
- Most data quality measures remained stable.

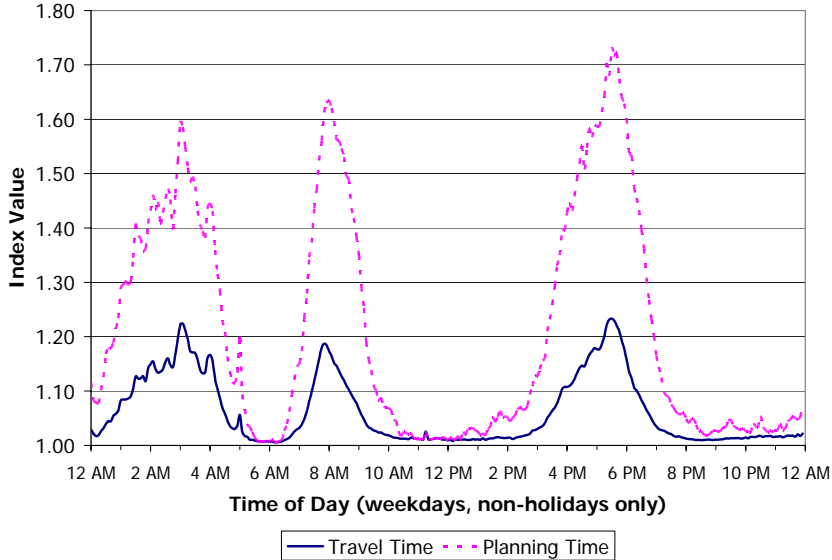
Data Source(s): Michigan Department of Transportation (<http://www.michigan.gov/mdot>)

Includes 110 of 282 (39%) total freeway miles in Detroit; collected using loop detectors; see page 7 for additional information on the data source

Data Analysis: Cambridge Systematics, Inc., analysis completed October 2004

Time of Day Patterns and Trends

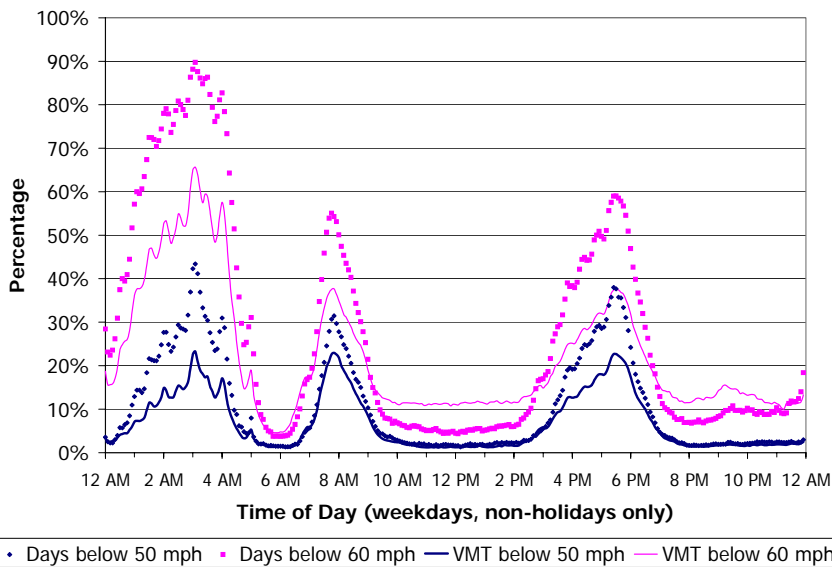
The charts on this page illustrate average weekday (no holidays included) traffic patterns and trends that were measured on the freeway sections instrumented with operations-based traffic sensors.



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 congestion is slightly higher and longer than in the morning.
- There appear to be slow speeds during the early morning hours.

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



Comments

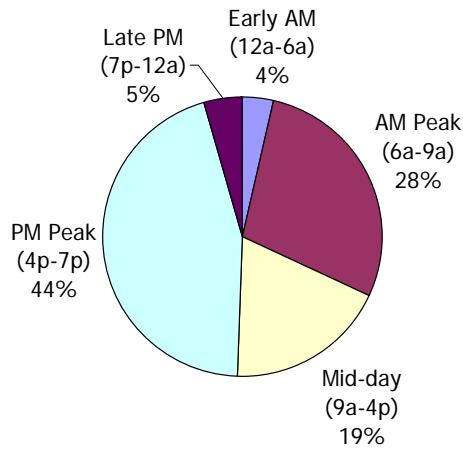
- This chart illustrates the difference in using two different speed thresholds (50 and 60 mph) to compute the percent of congested days as well as the percent of congested travel.
- There does not appear to be much difference between a 50 mph and 60 mph threshold, except during the early morning hours.

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

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:

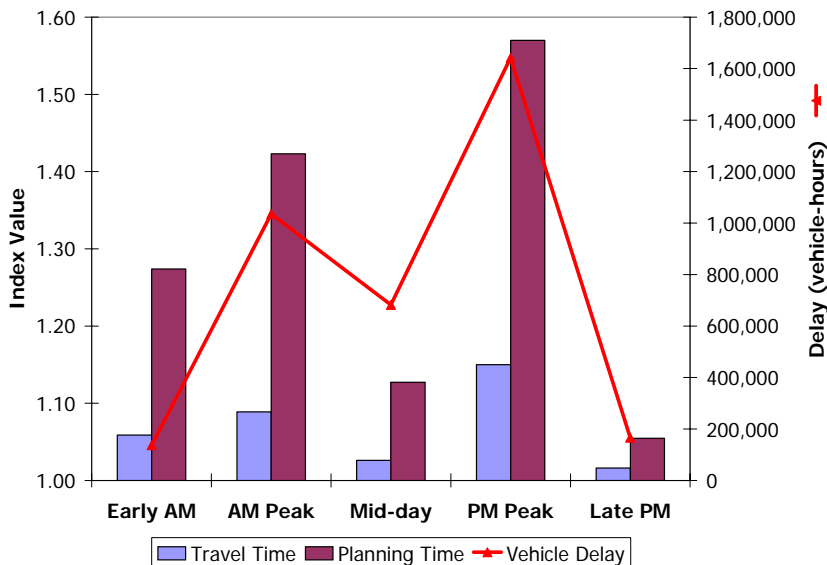
- Early AM: 12 to 6 am
- AM Peak: 6 to 9 am
- Mid-day: 9 am to 4 pm
- PM Peak: 4 to 7 pm
- Late PM: 7 pm to 12 am



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.
- Delay in the evening peak period is greater than during the morning peak period.

Exhibit DET-6: Percent of Delay by Time Period



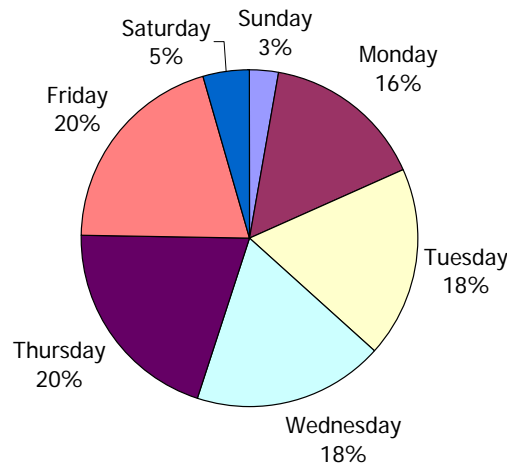
Comments

- 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.

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

Day of Week Patterns and Trends

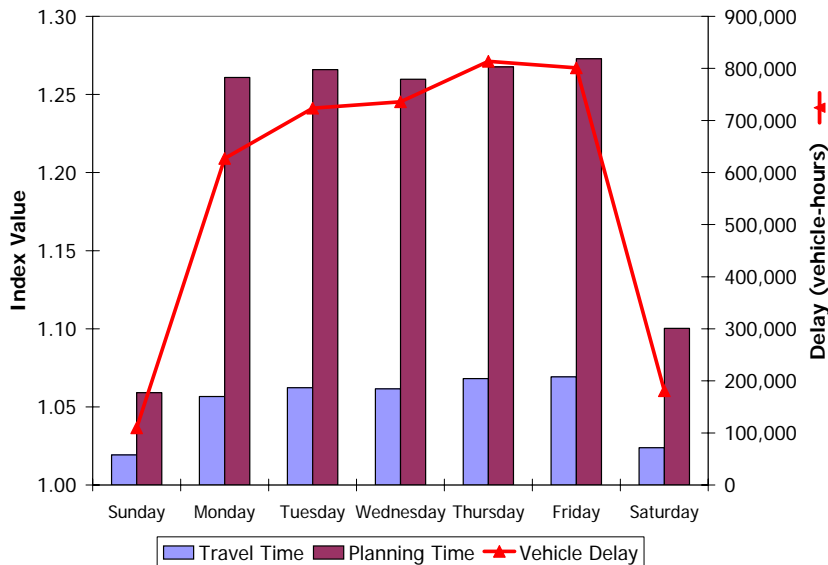
The charts on this page illustrate average traffic patterns and trends that were measured on the freeway sections instrumented with operations-based traffic sensors. Because of different peak period times and lengths on weekdays and weekends, the statistics presented on this page are 24-hour daily totals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



Comments

- This chart shows the percent of total daily delay that occurred during each day of the week.
- Thursday and Friday have the most delay and Monday has the least delay.
- Both weekend days combined have less than one-half of the normal weekday delay.

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



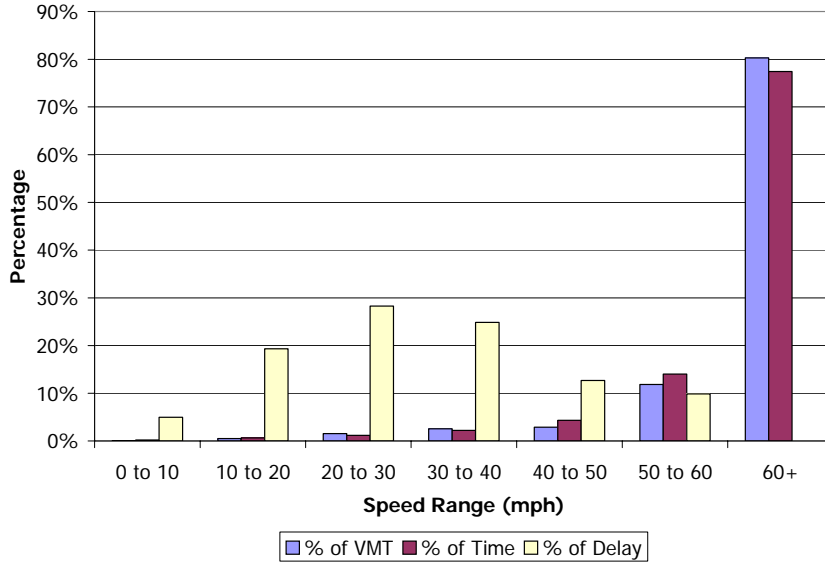
Comments

- 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.
- Thursday has the most delay but Friday is the least reliable day (highest planning time index).

Exhibit DET-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.



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.
- More than 80% of the VMT occurred at speeds greater than 60 mph.
- Only 5% of the VMT occurred at speeds less than 40 mph, but 77% of the delay is at speeds less than 40 mph.

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

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 DET-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-75 NB: N of Walton to S of Clay	27.55	1.16	1.06	1.32	1.25	51%	33%	56%	54%
I-696 WB: E of I-75 to E of I-275	16.80	1.09	1.02	1.34	1.21	31%	8%	76%	53%
I-75 SB: S of Clay to N of Walton	26.54	1.19	1.06	1.18	1.19	56%	26%	30%	44%
M-39 NB: S of Vanborn (N of I-94) to S of M-10	13.51	1.08	1.05	1.29	1.18	34%	30%	36%	35%
M-39 SB: N of 7 Mile to S of Vanborn (N of I-94)	11.70	1.21	1.02	1.15	1.18	43%	11%	30%	36%
I-96 WB: S of 6 Mile to E of Beck	8.67	1.02	1.03	1.28	1.17	12%	8%	86%	54%
I-696 EB: E of I-275 to W of I-75	16.62	1.04	1.02	1.20	1.12	21%	3%	51%	36%
I-696 EB: W of Barkman to E of Dequindre	7.00	1.01	1.01	1.14	1.09	0%	4%	36%	24%
I-696 WB: E of Dequindre to W of Barkman	7.00	1.13	1.01	1.01	1.08	46%	0%	0%	28%
I-94 WB: N of 10 Mile to S of M- 102 (8-Mile)	2.36	1.10	1.01	1.03	1.07	39%	0%	3%	22%
I-94 WB: Lonyo to E of I-275	16.71	1.02	1.02	1.08	1.06	4%	4%	33%	21%
I-96 EB: E of Beck to S of 6 Mile	8.68	1.04	1.01	1.08	1.06	20%	0%	40%	30%
I-96 EB: E of Levan to W of Wyoming	16.70	1.09	1.01	1.01	1.05	34%	0%	1%	20%
M-10 NB: N of 9 mile to E of Lahser	2.41	1.04	1.02	1.05	1.05	14%	0%	21%	18%
I-94 EB: E of I-275 to Lonyo	16.77	1.05	1.02	1.02	1.04	28%	7%	7%	18%
I-94 EB: S of M-102 (8 Mile) to N of 10 Mile	2.35	1.01	1.04	1.05	1.04	4%	1%	13%	9%
I-96 WB: E of McGraw to E of Levan	16.70	1.01	1.01	1.03	1.02	0%	0%	15%	9%
M-10 SB: E of Lahser to N of 9 Mile	2.48	1.03	1.01	1.01	1.02	0%	0%	0%	0%
Average for all Sections		1.09	1.03	1.15	1.12	30%	10%	34%	32%

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 and archived by the Michigan Department of Transportation (<http://www.michigan.gov/mdot>). A map of the freeway routes on which traffic data was collected is shown below.

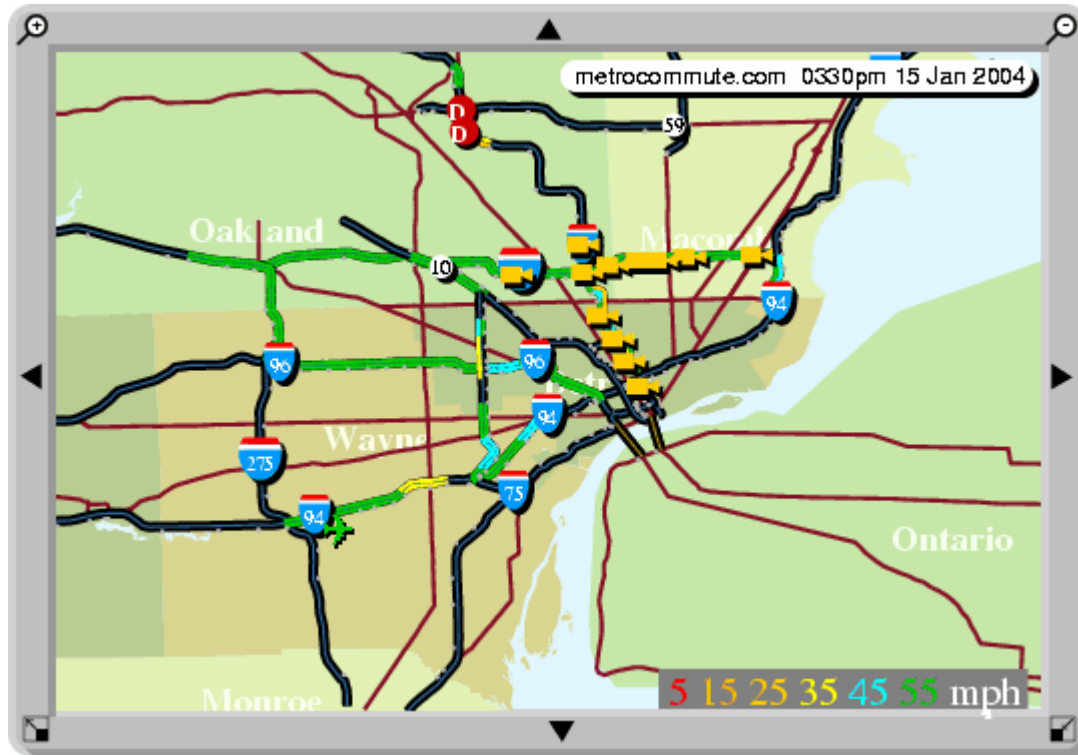


Exhibit DET-12: Freeway Routes with Traffic Sensors in Detroit
 (Source of graphic: MetroCommute, <http://metrocommute.com/>)

Exhibit DET-13: Instrumented Freeway Coverage in Detroit

Coverage Measures	Year	Instrumented Freeway Routes	Total Freeway System ¹	Percent Coverage
Lane-miles	2000	833	1,810	46%
	2001	752	1,810	42%
	2002	855	1,810	47%
	2003	751	1,810	41%
Centerline-miles	2000	117	283	41%
	2001	110	282	39%
	2002	110	282	39%
	2003	110	282	39%
Average annual daily vehicle-miles of travel (DVMT) (1000)	2000	15,270	31,125	49%
	2001	10,930	30,955	35%
	2002	15,470	31,610	49%
	2003	10,400	31,853	33%

¹Source 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: $\text{buffer index} = (95^{\text{th}} \text{ percentile travel time} - \text{average travel time}) / \text{average travel time}$.
- **% 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 DVMT (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.