THE 2003 ANNUAL
URBAN MOBILITY REPORT

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Assessment Basics about Congestion

The Information You Need to Know

The Annual Urban Mobility Report provides an easy-to-understand view of urban transportation congestion issues. This should not confuse the reader into thinking that the problems and solutions are easy to understand or analyze. The issues are complicated, the analyses complex at times, and the solutions can be easy to identify and hard to implement. Congestion issues touch many others in the world of transportation, the environment, politics as well as urban quality of life in general.

The 20 years of data in this Urban Mobility Report identify several significant trends and provide information to the discussion of problems and solutions at the local, state and national levels. Previous reports have been used to inform the debates about transportation priorities, funding needs and broad strategic directions. The measures are only a tool, however, and they should not be interpreted as indicating specific projects or technologies as solutions. The data may guide the amount of improvements required, and they can be a useful measure of progress toward mobility goals, but the data in this report do not replace more detailed information or project evaluations.

Major transportation system improvements require time for planning, design and implementation, and often a significant amount of funding as well. Communicating the congestion levels and the need for improvements is a goal of this report. The decisions about which, and how much, improvement to fund will be made at the local level according to a variety of goals, but there are some broad conclusions that can be drawn from this research database that apply to the areas studied.

The Trends

- **Congestion has grown in areas of every size.** Measures in all of the population size categories show more severe congestion that lasts a longer period of time and affects more of the transportation network in 2001 than in 1982. The average annual delay for every person in the 75 urban areas studied climbed from 7 hours in 1982 to 26 hours in 2001. This is an increase of 4 hours in the last 5 years.
- **On the positive side, roads and public transportation systems handled more trips.** From 1982 to 2001 in the 75 urban areas studied, passenger-miles of travel increased over 91 percent on the freeways and major streets and about 100 percent on the transit systems. Additional travel contributes to rising congestion but it also represents increased economic activity—individuals and businesses pursuing improvements in quality of life and business opportunities.

- **Congestion costs are increasing.** The total congestion "invoice" for the 75 areas in 2001 came to $69.5 billion, which was the value of 3.5 billion hours of delay and 5.7 billion gallons of excess fuel consumed. The 75 U.S. urban areas used in the analysis include a range of populations from 100,000 to 17 million for the years 1982 to 2001.

The Solutions

- A vision and goals are important. A target congestion level and a set of plans, programs, strategies and projects are necessary to identify the actions and develop the funding sources necessary to accomplish the goals. A consensus about how the urban area should arrange the jobs, schools, homes, shops, parks and other land uses is difficult to achieve, but is an important component of a viable congestion management strategy.
- The solutions will vary not only by the state or city they are implemented in, but also by the type of development, the level of activity and constraints in particular sub-regions, neighborhoods and activity centers. Portions of a city might be more amenable to construction solutions, other areas might use more demand management, efficiency improvements and land use pattern or redevelopment solutions.
- The programs and strategies that are widely accepted by agencies and the public should be implemented, even when there is disagreement about individual project proposals. Focusing on the relatively few issues of disagreement can halt progress on addressing the congestion relief possibilities of the typically longer list of programs and strategies.
- The actions required to stop the growth of congestion are significant and indicate that a mix of solutions is required. As a "ballpark" estimate of the amount of treatment needed to keep congestion from growing, the travel growth rate should equal the amount of new facilities or operational improvements. The traffic growth rate **in one year** would have required 1,725 new lane-miles of freeway and 2,475 new lane-miles of streets—OR—an average of six million additional new trips per day taken by either carpool or transit –OR–operational improvements that allow three percent more efficient travel on the existing systems or travel by some non-motorized or electronic means. But this level of solution was not implemented in most regions, nor was any combination that added to these improvement levels.
- **The "Solution" is really a diverse set of options that require funding commitments, as well as a variety of changes in the ways that transportation systems are used.** The effectiveness of options will vary from area to area, but the growth in congestion over the past 20 years suggests that more needs to be done.
  - More capacity—More roads and more transit are part of the equation. Some of the growth will need to be accommodated with new systems and expansions of existing systems.
  - Greater efficiency—More efficient operations of roads and transit can provide more productivity from the existing system at relatively low cost. Some of these can be accelerated by information technology, some are the result of educating travelers about their options, and some are the result of providing a more diverse set of travel and development options than are currently available. This year the Urban Mobility Report estimates the effect of some of these treatments on congestion levels.

  - ➢ Manage the demand—The way that travelers use the transportation network can be modified to accommodate more demand. The longer periods of high travel volume (the "peak period" instead of one "rush hour") already accomplish this. Projects that use tolls or pricing incentives can be tailored to meet both transportation needs and economic equity concerns. The key will be to provide better conditions for travel to shopping, school, health care and a variety of other activities.
  - ➢ Development patterns—There are a variety of techniques that are being tested in urban areas to change the way that developments occur. These also appear to be part, but not all, of the solution. Sustaining the urban "quality of life" and gaining an increment of economic developments without the typical increment of mobility decline is one way to state this goal.
  - ➢ Realistic expectations are also part of the solution. Large cities will be congested. Some locations in smaller cities around key activity centers will also be congested. But congestion does not have to be an all-day event. Identifying solutions and funding sources that meet a variety of community goals is challenging enough without attempting to eliminate congestion in all locations.

- **Improving the reliability of the transportation system is an important emerging issue.** Predictable and regular travel times have a certain value for urban travelers and businesses. Crashes, vehicle breakdowns, weather, special events, construction and maintenance activities greatly affect the reliability of transportation systems; these delays account for about 50 percent of all delay on the roads. There are many programs and strategies that may not significantly change the average mobility levels, but can reduce travel time variations and frustration with transportation services.

Analysis Changes

- Mobility solutions can be evaluated at a modest level of detail if the amount of the treatment is known and the effect of individual treatment elements can be estimated. Unfortunately, to get more accurate values, the analysis must be performed at much greater levels of detail where system effects, demand changes and other factors can be included. The operational treatment effect analysis included in this year's report should be considered as a first phase product, rather than as an established methodology.

- The effect of three operational treatments was estimated in the 2003 Urban Mobility Report using generally available statistics at the national level. These data do not provide as detailed or accurate a view of the effect as local or regional studies, but as a way to incorporate more of the solutions that are being pursued by national, state and local agencies this is a good first phase approach.

  - ➢ Ramp metering, traffic signals on freeway entrance ramps that regulate the flow of vehicles onto the mainlanes, was estimated to provide a savings of 73 million hours of reduced delay in 2001 in 26 cities.

  - ➢ Freeway incident management, service patrols and detection devices, was estimated to provide 117 million hours of delay savings in 56 cities in 2001.

  - Traffic signal coordination, smoothing the flow of traffic on streets, was estimated to provide 16 million hours of delay savings in 75 cities in 2001.

- Public transportation service provides many benefits in the corridors and areas it serves. Access to jobs, shops, medical, school and other destinations for those who do not have access to private transportation may provide more societal benefits than the congestion relief, but this report only examined part of the mobility aspect. Typically, in contrast to roads, the ridership is concentrated in a relatively small portion of the urban area. Attempting to analyze public transportation service with a road-based analytical technique will not provide useful information; the Urban Mobility Report developed a new method to quantify a portion of the benefits that relate to mobility improvements.

  - Regular route public transportation service on buses and trains provides a significant amount of peak period travel in the most congested corridors and cities in the U.S. If that service (public transportation) was discontinued and the riders traveled in private vehicles, the regions would have suffered an additional 1.1 billion hours of delay in 2001 for the 75 urban areas in the Annual Mobility Report.

  - High-occupancy vehicle lanes, which provide high-speed service for buses and carpools in (mostly) freeway corridors, were estimated to provide 11 million hours of delay savings on the 28 corridors in 8 urban areas for which the detailed data needed were available.

More information is available on the study website: http://mobility.tamu.edu

CAUTION: See http://mobility.tamu.edu/ums for improved performance measures and updated data.

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Disclaimer

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LIST OF EXHIBITS

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INTRODUCTION

The Annual Report of the Urban Mobility Study provides some information about congestion and mobility issues in ways that everyone can understand. This report focuses on the trends from 1982 to 2000 and analyzes issues that the motoring public, transportation officials, and policy makers often raise regarding traffic congestion and urban mobility in a way that is useful to these different "information markets."

Brief Overview of Urban Mobility Research Studies

The Annual Urban Mobility Report uses statistics from generally available data sources and provides information about mobility trends at the urban area level of detail. The report includes information about how traffic congestion has changed over the last 20 years, as well as some relatively uncomplicated explanations about ways to improve mobility. The study also provides more data for individual cities at the website: http://mobility.tamu.edu/ums.

The 2003 Annual Report includes an estimate of the effects of several common solutions to congestion problems. The study method has always included an estimate of the beneficial effects of additional road lanes and some estimate of the effect of demand management and demand reduction programs. This year sees the addition of several other treatments.

- Freeway Entrance Ramp Metering – Regulates the flow of vehicles onto the freeway mainlanes; can slow the onset of congestion or, in the right situation, prevent congestion from beginning.

- Freeway Incident Management – Uses detection devices and vehicles to rapidly remove disabled vehicle and collisions from the freeways; reduces delay due to incidents and reduces the number of secondary collisions that occur in unexpected congestion situations near incidents.

- Traffic Signal Coordination – Provides smoother traffic flow and higher travel speeds due to connections between the signals in an area or a corridor.

- Public Transportation Service – Provides a number of benefits that are not included in a mobility analysis, so the values in this report should not be seen as a compilation of transit benefits. The benefits in this report are judged according to service reliability and ridership. These concepts are consistent with the roadway analysis, but also recognize the differences in the travel modes.

- High-Occupancy Vehicle Lane – Provides a high-speed travel option for buses and carpools to bypass congestion. The service is typically more reliable, also.

These and other operational treatments are important aspects of transportation system improvement programs being pursued by cities, regions and states. The continuing challenge will be to document and monitor the effect of the various strategies, programs and projects that are being implemented. This "real-world" data can improve the technical tools and the ability to communicate the resulting message to many different participants in the transportation decision-making process.

The 2003 Annual Report also includes information about the nature and importance of reliable and predictable transportation service. It does this using information developed in the Mobility Monitoring Program, a research study sponsored by FHWA and conducted by TTI and Cambridge Systematics (1). The study is conducted using databases from the freeway monitoring systems in 21 cities. Average travel times and the variation in travel times are studied for directional sections of freeway. More information, a final report, data quality and analysis procedures and analyses of each of the 21 study cities is available at the website: http://mobility.tamu.edu/mmp.

WHAT IS NEW FOR THIS YEAR?

1. **We have added the effect of three widely implemented operational treatments, public transportation service and high-occupancy vehicle lanes to the 2000 and 2001 mobility estimates.** This change allows an examination of the effect of more types of improvements, allows a more thorough use of the available data and is another step in improving the mobility statistics. A separate report details these analyses and is posted on the Mobility Report website.

2. **We have chosen to present the data in population groups to better illustrate the mobility trends for areas of similar population.** The mobility levels that might be expected in urban areas are more related to cities of similar size than to the full group of 75 cities. The statistics and methodology descriptions are still included along with much more information in Appendix A and on the website: http://mobility.tamu.edu.

3. **We present more information about the reliability side of urban mobility.** This is not a comprehensive treatment, and more information is available in the 2001 Mobility Monitoring Report (http://mobility.tamu.edu/mmp) (1). The variation in travel times is an important element of congestion, and might be a more solvable problem than the regular overcrowding of roadways. Data to inform this discussion, however, is not as available as it is for average or estimated conditions.

4. **We have improved the speed estimation procedure and the incident delay factors.** New computer simulations have been used to estimate the effect of vehicle breakdowns and collisions. Future changes in estimating the effects of operational improvements (see #2) will also likely affect the methods we use to estimate speeds and delay in the next several years. But simplifying assumptions and estimating procedures will be needed until more data collection programs are deployed.

5. **Delay per person and the travel time index indicate somewhat different conclusions about mobility.** This trend will be watched to see if it continues and the potential causes will be examined, but it appears that there are some differences that are the result of actions and policies rather than random occurrences.

WHAT IS THE SOURCE OF DATA FOR THIS REPORT?

This report uses data from federal, state, and local agencies to develop estimates of congestion and mobility within an urban area. The methodology developed by several previous research studies (2,3,4,5,6) yields a quantitative estimate of urbanized area mobility levels, utilizing generally available data, while minimizing the need for extensive data collection.

The methodology primarily uses the Federal Highway Administration's Highway Performance Monitoring System (HPMS) database, with supporting information from various state and local agencies (7). The HPMS database is used because of its relative consistency and comprehensive nature. State departments of transportation collect, review, and report the data annually. Since each state classifies roadways in a slightly different manner, TTI reviews and adjusts the data to make it comparable and then state and local agencies familiar with each urban area review the data.

The Urban Mobility Study procedures have been modified to take advantage of special issue studies that provide more detailed information, but the assumptions used in the Annual Mobility Report do not fully account for the effect of all operational improvements. Comparisons between cities are always difficult and the local and state studies are typically more detailed and relevant for specific areas. The Annual Mobility Report is more applicable for comparisons of trends for individual cities, rather than any value for a particular year.

Urban Area Boundary Effects

Urban boundaries are redrawn at different intervals in the study states. Official realignments and local agency boundary updates are sometimes made to reflect urban growth. These changes may significantly change the size of the urban area, which also causes a change in system length, travel and mobility estimates. The effect in the Urban Mobility Study database is that travel and roadways that previously existed in rural areas are added to the urban area statistics. It is important to recognize that newly constructed roads are only a portion of the "added" roads.

When the urban boundary is not altered every year in fast growth areas, the HPMS data items take on a "stair-step appearance." Each year the Annual Report process closely re-examines the most recent years to see if any of the trends or data should be altered (e.g., smoothing some of the stair steps into more continuous curves) to more closely reflect actual experience. This changes some data and measures for previous years. Any analysis should use the most recent report and data—they include the best estimates of the mobility statistics.

Why Is Free-Flow Travel Speed the Congestion Threshold?

The conditions in the middle of the day (or middle of the night) are the ones that travelers generally identify as desirable and use for comparison purposes. It is also relatively easy to understand that those conditions are not achievable during the peak travel periods without significant funding, environmental concerns and social effects. The decisions to make substantial improvements to achieve some desirable condition using investments in road, transit, operations, demand management or other strategies are products of detailed studies—studies that are not replicated in this report.

For the purposes of a national study, therefore, it is reasonable to set a congestion measurement baseline that everyone generally understands. Free-flow speed—which we estimate is 60 mph on freeways and 35 mph on major streets—is such a baseline. Speeds less than that will be an indication of delay. It is not intended to be the target for peak-hour conditions in urban corridors. The target setting exercise is discussed in more detail in a report section addressing "acceptable conditions" as targets.

Why Use Traffic Counts and Estimates Instead of "Real" Traffic Speeds?

Because there are not enough cities collecting enough high quality traffic speed data on enough roads, estimates are necessary. The Urban Mobility Report series seeks to understand congestion and mobility levels in many urban areas, and unfortunately, the best common database is one that has roadway design and traffic information. The estimation procedures are used to develop travel time and speed measures that can be used to communicate to a variety of audiences. This Annual Report also has some travel speed data from urban traffic operations centers, but until that information is more widely available, estimates will be required.

In the near future, these reports will also include estimates of the effects from several key improvements such as incident management, ramp metering, traffic signal coordination and high-occupancy vehicles lanes. The benefits of these projects are only indirectly included in the current methodology. When more cities and states conduct thorough evaluation studies and the comparison techniques are improved, the operations and demand management programs will be more completely characterized.

Detailed Speed Data and Reliability Information

The high quality speed data that are available were collected as part of the Mobility Monitoring Program (http://mobility.tamu.edu/mmp), a joint research effort of Texas Transportation Institute and Cambridge Systematics for the Federal Highway Administration (1). The MMP collected and analyzed detailed traffic volume and speed data for freeways in 21 cities for 2001. The data are prepared for 5-minute time intervals for sections of freeway between one-half and three miles in length. The base data sets were examined for quality and reasonable values and analyzed for a few key performance measures.

The continuous nature of this database provides a very good picture of the variation in conditions through the year—significantly better information than was available before. Variation or reliability in transportation conditions was studied with 2001 data. Some of that data is used in this report.

The detailed traffic operations center data also does not cover very much of the transportation system of the travel even in the most highly monitored cities. The percentage of the freeway system that was monitored during 2001 in the 21 Mobility Monitoring Program cities varied from 10 to 100 percent. There was very little arterial street condition data. It is difficult to construct a set of city to city comparison measures or interpret the meaning of data under these conditions. While the data are very useful for examining issues, they are less useful for area or trend comparisons. Even the evaluation of incidents is hampered by the lack of arterial street data. Traffic that changes route from the freeway to a street experiences delay, but that delay is not counted because there is no monitoring equipment. So the "real" traffic data does not include all of the delay that occurs. Estimates are required to obtain a full picture of the congestion situation.

Measures and Rankings Within Population Groups—Which Measure Should Be Used?

We recommend that several measures, as well as the trend in the measures over several years, be considered before any "official rank" is determined. Just as the report indicates there is no single "solution" to the mobility problems in most areas, there is also no single "best" measure. The measures illustrate different aspects of the congestion problems and improvement strategies.

There is a temptation to choose one measure to make the interpretations and message easy. As a minimum two of the "intensity" measures and one "magnitude" measure should be used to assess the mobility situation at an areawide level. At the corridor level, where solutions are frequently implemented, more measures and more detailed analyses are needed to identify the most appropriate solution and evaluate the effects. The measures reflect travel time concerns and can be applied to a variety of evaluation cases. More information on these measures is available on the website: http://mobility.tamu.edu.

- Travel Time Index—the ratio of peak period travel time to free-flow travel time. The TTI expresses the average amount of extra time it takes to travel in the peak relative to free-flow travel. A TTI of 1.3, for example, indicates a 20-minute free-flow trip will take 26 minutes during the peak travel periods, a 6-minute (30 percent) travel time penalty. Free-flow travel speeds are used because they are an easy and familiar comparison standard, not because they should be the goal for urban transportation system improvements.

- Delay per Person—the hours of extra travel time divided by the number of urban area residents. This is an annual measure indicating the sum of all the extra travel time that would occur during the year for the average person. All urban residents are used as the comparison device to better relate the delay statistics to other information produced on a per capita basis.
- Cost of Congestion—the value of the extra time and fuel that is consumed during congested travel. The value of time for 2001 is estimated for passenger vehicles and trucks and the fuel costs are the per-gallon average price for each state. The value of a person's time is derived from the perspective of the individual's value of their time, rather than being based on the wage rate. Only the value of truck operating time is included; the value of the commodities is not. The value of time is the same for all urban areas.
- Change in Congestion—not a particular measure, but a concept used in many analyses. The trends in congestion are often more important than the absolute mobility levels, because they indicate if the right amount of improvement is being funded.
- Percent of Congestion—is expressed for three elements—travel, lane-miles and time. Each element examines a different dimension of declining mobility levels. Congested travel examines the miles of travel that occur on congested roads during the peak periods. Congested lane-miles indicate the road space that operates at less than free-flow speeds during the peak. Congested time refers to an estimate of how long "rush hour" conditions exist (i.e., the amount of time that travelers might find congestion on area roadways).

The mobility performance measures and the rankings based on them are useful for a variety of purposes. They are especially good at identifying multi-year trends and in comparing relative levels of congestion. As evidenced by the continual refinement of the measures, estimation procedures and data, however, this series of reports is still a "work-in-progress."

One element of this uncertainty is that the measure values have an element of variation in them. All estimation procedures have simplifying assumptions that are not correct for every situation. And traffic data reflects the day-to-day variation in activity that affects traveler experiences. There are also locations or corridors in each urban area, especially those over one million population, where mobility levels are much lower than any average value. Those who frequently travel in these places may get a biased view of the urban areawide mobility level.

How Should the Measures and Rankings With the Improvements Strategies be Interpreted?

Most of the measures presented in the report address roadway systems. While the problems and solutions are not solely focused on roads, much of the data that are available relate to roads and vehicle travel. This year's report also includes operational improvement information and public transportation data at an areawide level. While this expands the scope of the data and measures, the effect of these strategies is often at a corridor or activity center area level where they are applied. So, while the road statistics may provide a picture of urban mobility levels, the addition of the public transportation data and operational treatment effects improve the usefulness of the comparisons.

On the "solution" side of the measures, the current database and methodology include roadway lanes, public transportation and traffic volumes for the database years, and statistics on a few operational improvements and HOV lanes for 2000 and 2001. Most larger urban areas are expanding their use of these improvements and are also increasing the data and evaluation studies. The methodologies and more detailed description of estimating the mobility effect of the operational solutions and public transportation service is also investigated in a separate report also on the Mobility Report website.

The estimates are not a replacement, a substitute or a better method of evaluating these strategies at the corridor or project level. The estimates included in this report are a way to understand the comparative mobility contributions of various strategies using a consistent methodology.

Another key manifestation of uncertainty is the ranking of the measures. Estimating the measures creates one set of variations—the "real" measure could be higher or lower—and the relatively close spacing of the measures mean that the rankings should be considered as an indication of the range within which the true measure lies. There are many instances where one or two hours of delay or one or two index points could move an urban area several ranking spots.

Rankings, whether with or without the operational improvements or public transportation service, should be examined by comparing the values for cities with similar population, density, geography or other key elements. The rankings of values with strategies are available for only the most recent year, and the performance measures are presented for mobility levels with and without the strategy contributions.

HOW CONGESTED ARE THE ROADS? ARE THEY GETTING WORSE?

Congestion levels and the trends in congestion growth are important aspects of the database. Where and when congestion occurs is important within an urban network, as well as for comparing urban areas to each other. Comparisons should include considerations such as, areawide congestion levels tend to be worse in the larger urban areas, but there are some isolated pockets of very bad traffic congestion in smaller urban areas that rival some locations in larger cities. Comparisons with areas of similar population are usually more informative than broader comparisons.

Conclusions

In general, traffic congestion is worse in the larger urban areas than in the smaller ones. Traffic congestion levels have increased in every area since 1982. Congestion extends to more time of the day, more roads, affects more of the travel and creates more extra travel time than in the past. And congestion levels have risen in all size categories, indicating that even the smaller areas are not able to keep pace with rising demand.

The need for attention to transportation projects is illustrated in these trends. Major projects or programs require a significant planning and development time—10 years is not an unrealistic timeframe to go from an idea to a completed project or to an accepted program. At recent growth rates, the urban area average congestion values will jump to the next highest classification—medium areas in 2011 will have congestion problems of large areas in 2001.

See Exhibits A-2 to A-5 for more information on individual urban areas.

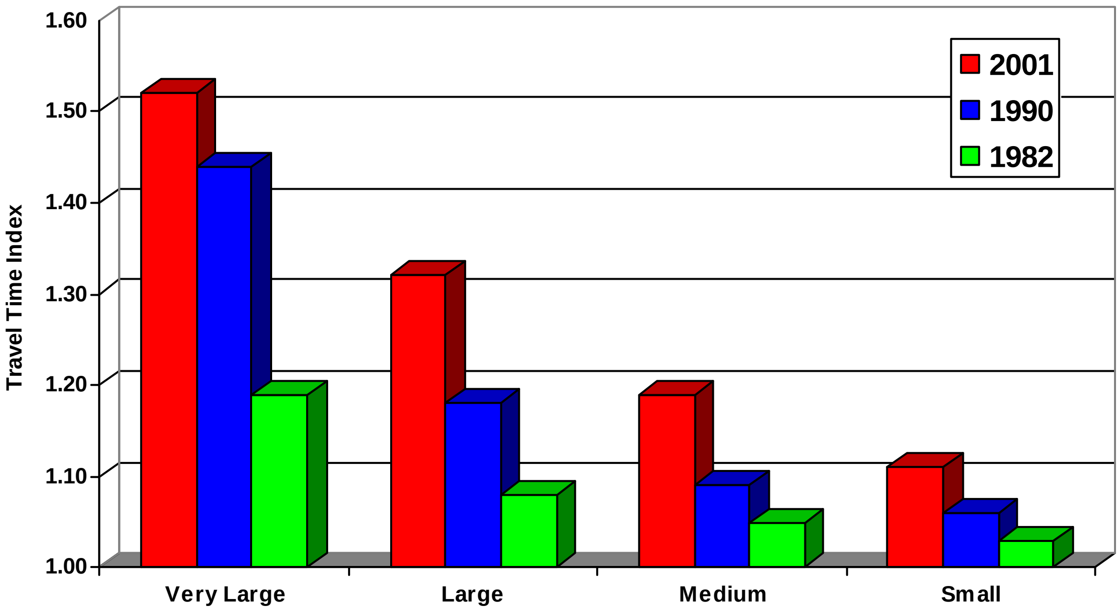
The Travel Time Index is one of two primary measures of extra travel time for travelers. (See Exhibit 1). It measures the amount of additional time needed to make a trip during a typical peak travel period in comparison to traveling at free-flow speeds.

Travel delay per person is the other individual measure that provides estimates of the mobility levels (see Exhibit 2). The extra travel time per year can be related to many other activities and may be more relevant for some discussions.

The extra travel time each year is a combination of the extra travel time for each trip (as measured by the TTI), the trip distance and the number of trips. The effect of this difference is relatively modest in most areas – that is, the TTI and delay per capita tell basically the same story. The rankings are similar and the pattern of growth or decline are about the same. In some areas, however, the two values lead to different conclusions.

Portland is one area where the multiple performance measures help illustrate the effect of the transportation and land use policies that are being pursued to create a denser urban area that is better served by public transportation. The Travel Time Index and the delay per capita values have both increased since 1982, indicating an increase in congestion. The Travel Time Index for Portland grew faster from 1982 to 2001 than it has for other areas in the Large urban group. Delay per capita, however, has grown at a rate closer to the Large area average, indicating that delay has not grown as rapidly as the per-minute travel time penalties have declined. Perhaps the urban growth and transportation policies are encouraging shorter trips and travel on light rail and other modes.

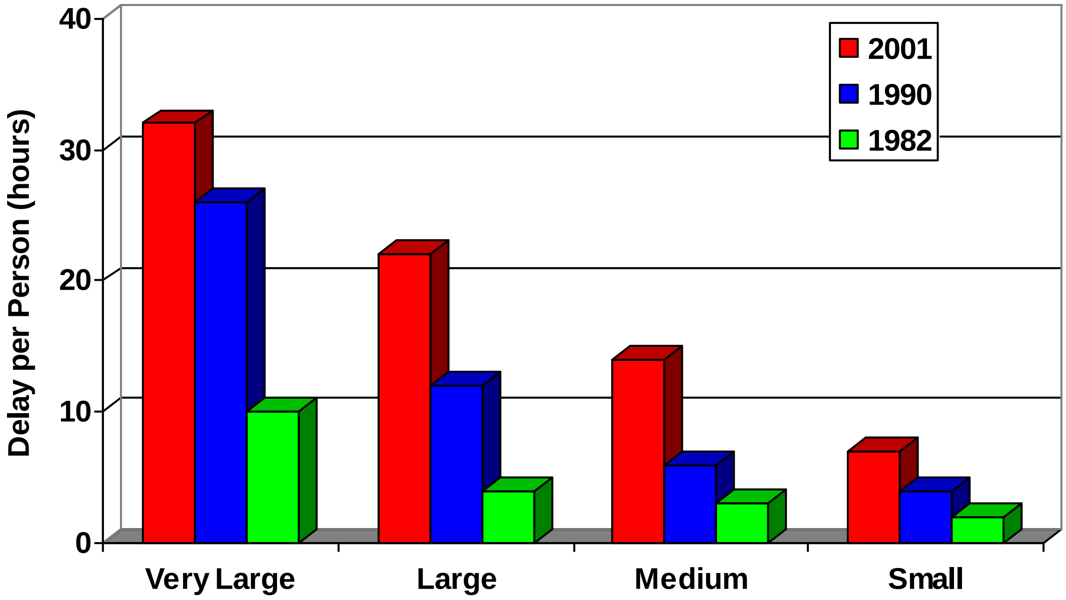
Exhibit 1. Travel Time Index Trends



Note: See Exhibit A-3 for more information.
Note: The Travel Time Index is a ratio of average peak period to free-flow travel time. A value of 1.30 indicates a free-flow trip of 20 minutes takes 26 minutes in the peak due to heavy traffic demand and incidents.

- The average TTI for all 75 urban areas is 1.39. Thus, an average 20-minute off-peak trip takes almost 28 minutes to complete during the peak due to heavy traffic demand and incidents.
- Congestion problems tend to be more severe in larger cities. The average TTI for each individual population group ranges from 1.52 in the Very Large areas down to 1.11 in the Small urban areas.
- The average increase in the travel time penalty was 26 points (1.13 to 1.39) between 1982 and 2000. This gap ranges from 33 points in the Very Large group to 8 points in the Small population group.
- 27 of the 75 urban areas have a TTI of at least 1.30. Twenty-six of these urban areas are in the Very Large and Large population groups—they have populations greater than one million. Austin, TX is the only area with fewer than one million people and a TTI more than 1.30.

Exhibit 2. Delay per Person Trends



- The average delay per person in the 75 urban areas is 26 hours.
- There are 13 urban areas with delay per person values in excess of 30 hours, showing the effect of the very large delays in the areas with populations larger than 3 million.
- The average delay per person in the Large population group is about the same as the average delay in the Very Large population group in 1987.
- The average delay per person in the Medium population group is about the same as the average delay in the Large group in 1989.

WHAT CONGESTION LEVEL SHOULD WE EXPECT?

Congestion travel time penalties are related to size of the area, and Exhibit 3 illustrates this. The Travel Time Index values decrease as population does, but there is a significant amount of variation within the groups. Areas that have seen high rates of growth in recent years are more likely to be near the top of their population group because demand will increase much faster than the roadway, public transportation service, operational treatments and land use patterns.

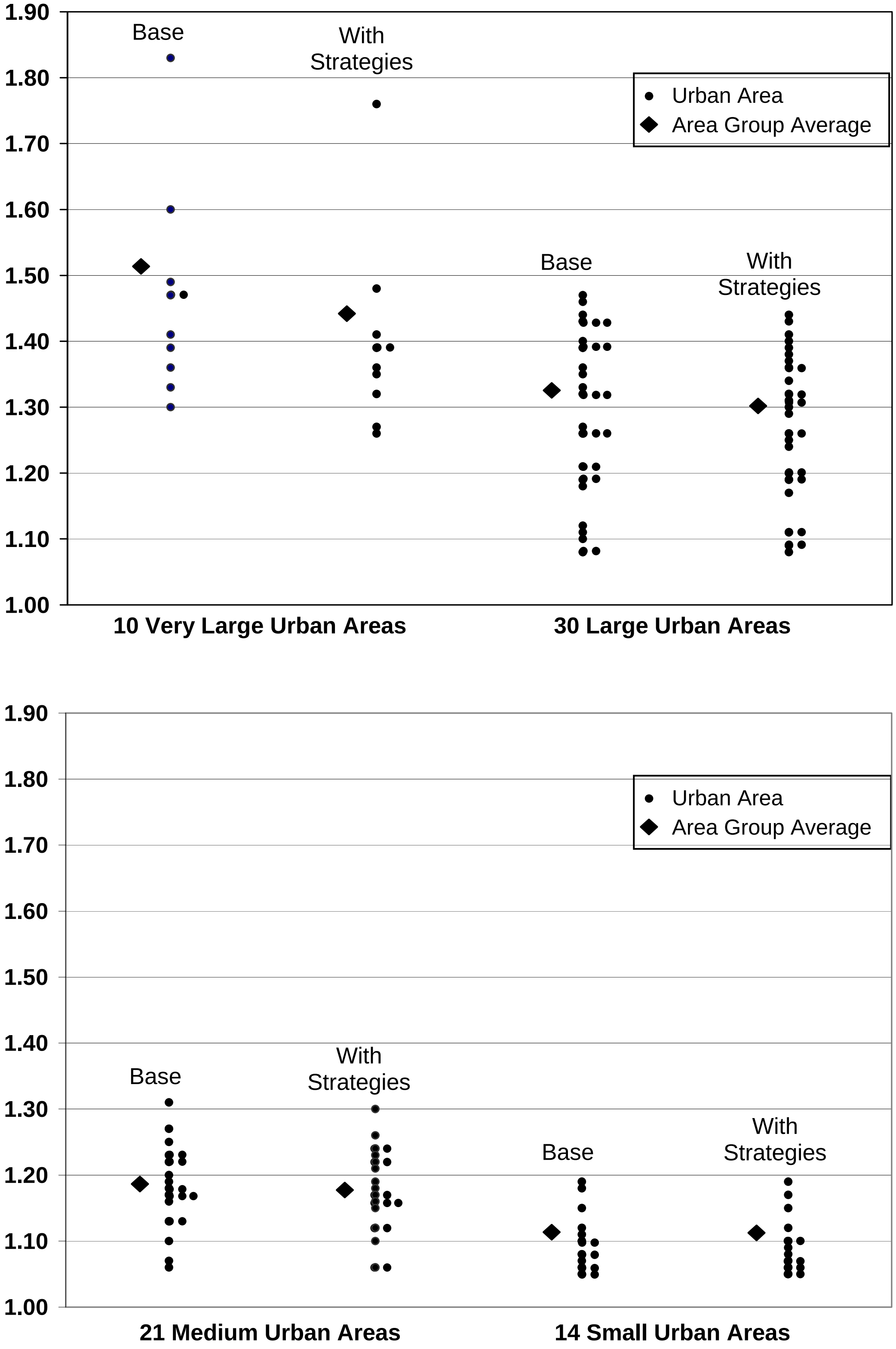
- Areas with populations over 3 million (Very Large) should expect a minimum peak period travel time penalty of 30 percent.
- Areas over 1 million (Large and Very Large) should expect a time penalty of at least 15 percent with a more likely value being 25 to 30 percent.
- Areas over one-half million (all except Small) should expect at least a 10 percent time penalty in the peak with typical values being closer to 15 or 20 percent.
- Areas less than a half million (Small) should expect a time penalty of up to 20 percent.

The delay per person statistics mirror the Travel Time Index distribution (see Exhibit A-4). There is a significant amount of variation within groups, but a clear trend toward lower delays in smaller areas. These delays are calculated by dividing total areawide delay by the total urban area population. If the delays are estimated for just the people traveling during the peak periods, the values are more than twice the per-person values.

- Areas with populations over 3 million (Very Large) should expect at least 20 hours of delay each year per person and many are above 30 hours.
- Areas over 1 million (Large and Very Large) should expect a time penalty of at least 15 hours and values above 20 hours are common.
- Areas between one-half million and one million should expect at least 10 hours of delay per person, with values between 15 and 25 hours are common.
- Areas less than a half million (Small) should expect delays up to 15 hours per year.

CAUTION: See http://mobility.tamu.edu/ums for improved performance measures and updated data.

Exhibit 3. What Congestion Level Should We Expect?
(Range of Travel Time Index Values in Each Group)



HOW FAR HAS CONGESTION SPREAD?

Traffic congestion affects a broader segment of the transportation system each year. Several dimensions are explored within this report. Congestion has spread to **more cities** to **more** of the **road system** and **trips** in cities to **more time** during the day and to **more days** of the week in some locations.

Conclusions

Congestion has spread significantly over the 20 years of the study. A few notable changes from 1982 to 2001 include:

- 27 urban areas have a Travel Time Index above 1.30 compared with one such area in 1982.
- 67 percent of the peak period travel is congested compared to 33 percent in 1982.
- 59 percent of the major road system is congested compared to 34 percent in 1982.
- The number of hours of the day when congestion might be encountered has grown from about 4.5 hours to about 7 hours.

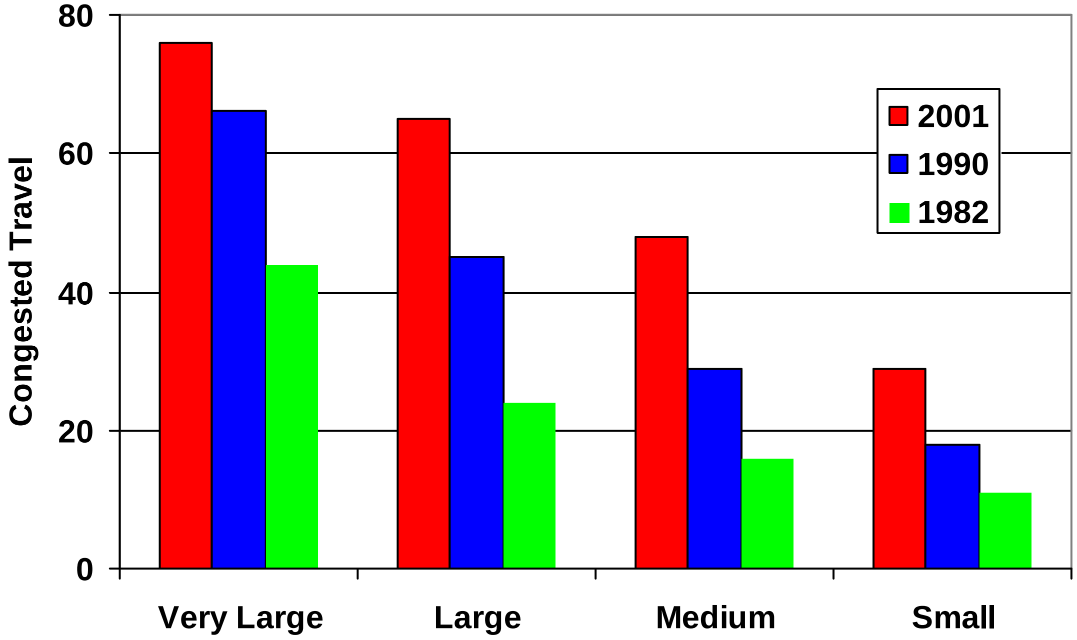
Most of the trend information indicates that the 2001average values for each population group are near the 1990 value for the next highest population group. This is also the case for the 1990 and 1982 comparison. This suggests that each group will attain congestion levels of the next highest approximately each decade if trends are not reversed.

See Exhibits A-3, A-13, A-14, A-15 in the Appendix for more information. See Introduction section for an explanation about the definition of congestion used in this study.

Congested Travel

The amount of traffic experiencing congested conditions in the peak travel periods (three hours in the morning and three hours in the afternoon) has doubled in 20 years of the study from 33 percent in 1982 to 67 percent in 2001. This means that two of every three cars experience congestion in their morning or evening trip. Exhibit 4 provides more information on this trend.

Exhibit 4. Percent of Travel in Congested Conditions

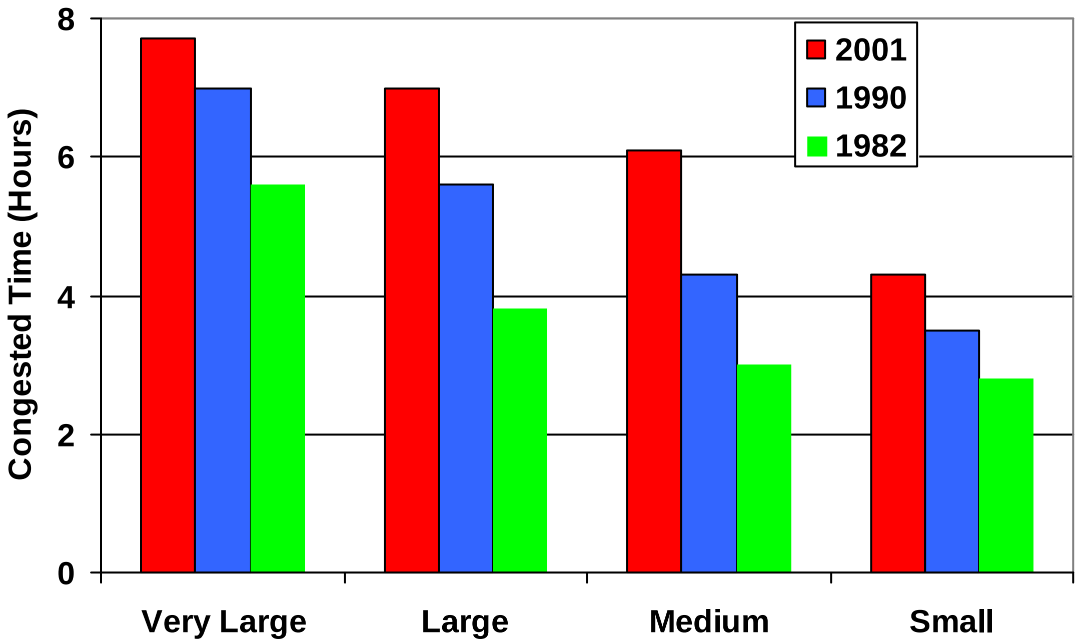


- The range of travel experiencing congestion grew from between 11 percent and 44 percent in 1982 to between 29 percent and 76 percent in 2001.
- The average percentage has increased to the next highest population group approximately each decade.

Congested Time

From the traffic database that is used for this study, it is uncertain exactly how long the congested periods last in each urban area. We can estimate, however, the amount of travel that occurs during times of the day when travelers **may** encounter congestion. This is not the amount of time when congestion occurs on a particular segment of road, but rather is the time when congestion occurs on some part of the road system. Exhibit 5 shows the average length of the congested periods for each population group for 1982, 1990 and 2001.

Exhibit 5. Hours of Day When Congestion May Occur



- The time when congestion might be encountered on major urban roads has grown in all population categories
- The time is near 3 hours in even the Small group—indicating that in many areas the term “rush hour” does not convey the length of time travelers may suffer slowdowns.
- Slow conditions might be encountered for 3 hours in each peak period in areas above 500,000. The amount of slowdown does not appear to be as great in the smaller areas.
- Three hours of congestion in each peak does not extend to the entire urban area, but some travelers must allow for extra time during a substantially longer portion of the day.

Congested Roads

The amount of roadways (freeways and principal arterial streets) that is congested during the peak period is shown in Exhibit 6 for 1982, 1990 and 2001. The percentage of the major roadway system that is congested has risen from 34 percent in 1982 to 59 percent in 2001.

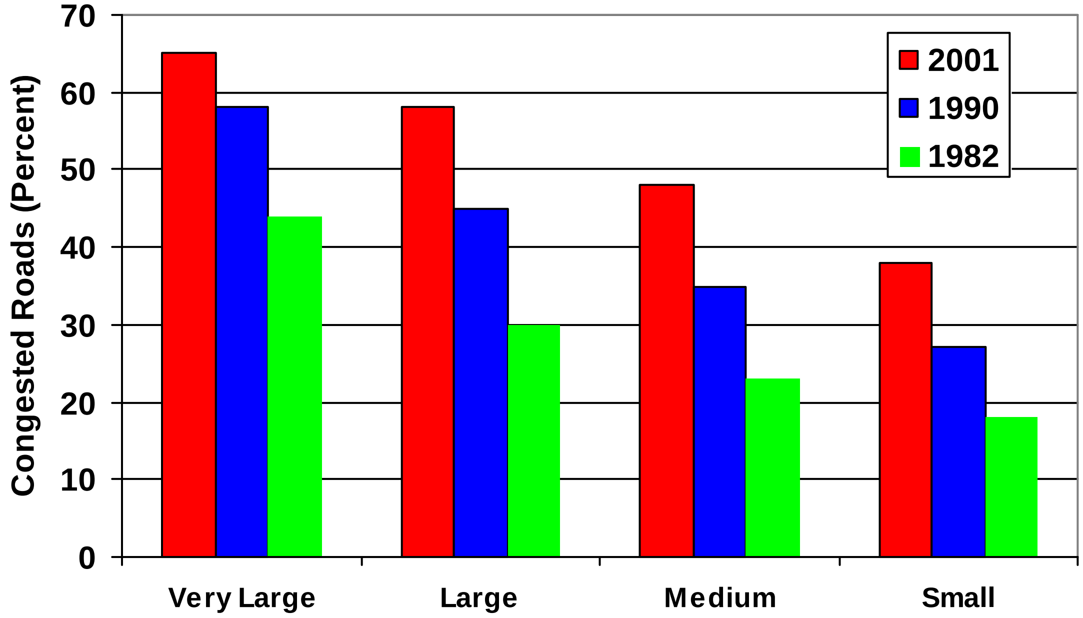


Exhibit 6. Percentage of Roads that Experience Some Congestion During Peak Periods

- The percentage of roads where congestion might occur in the peak period has more than doubled in the Small and Medium areas since 1982.
- The largest percentage point increase has occurred in the Large areas.
- Each of the population groups has a 2001 value close to the 1990 value for the next highest population group. This is similar to the condition in 1990 when compared to 1982 data.

Growth in Delay and Congested Travel

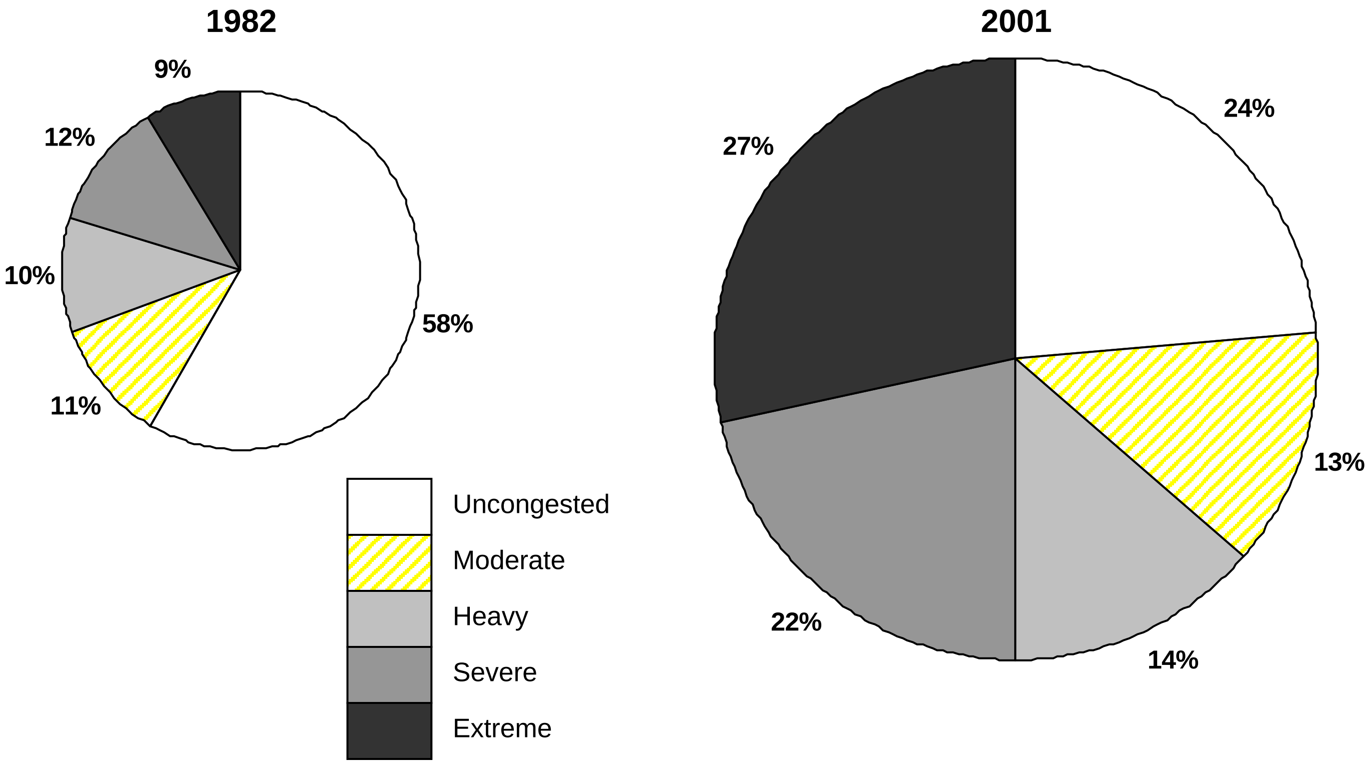
This section provides a graphical comparison for each of the four population groups in the Urban Mobility Report. There are two circles on each page representing conditions in 1982 and 2001.

- The growth in the area of the circle represents the growth in travel delay for all the cities in the group from 1982 to 2001.
- The amount of miles traveled during the peak period in each of five congestion levels is also displayed for each year to give a perspective on the change in conditions experienced by travelers.

Exhibits 7 through 10 illustrate conditions for the four population groups.

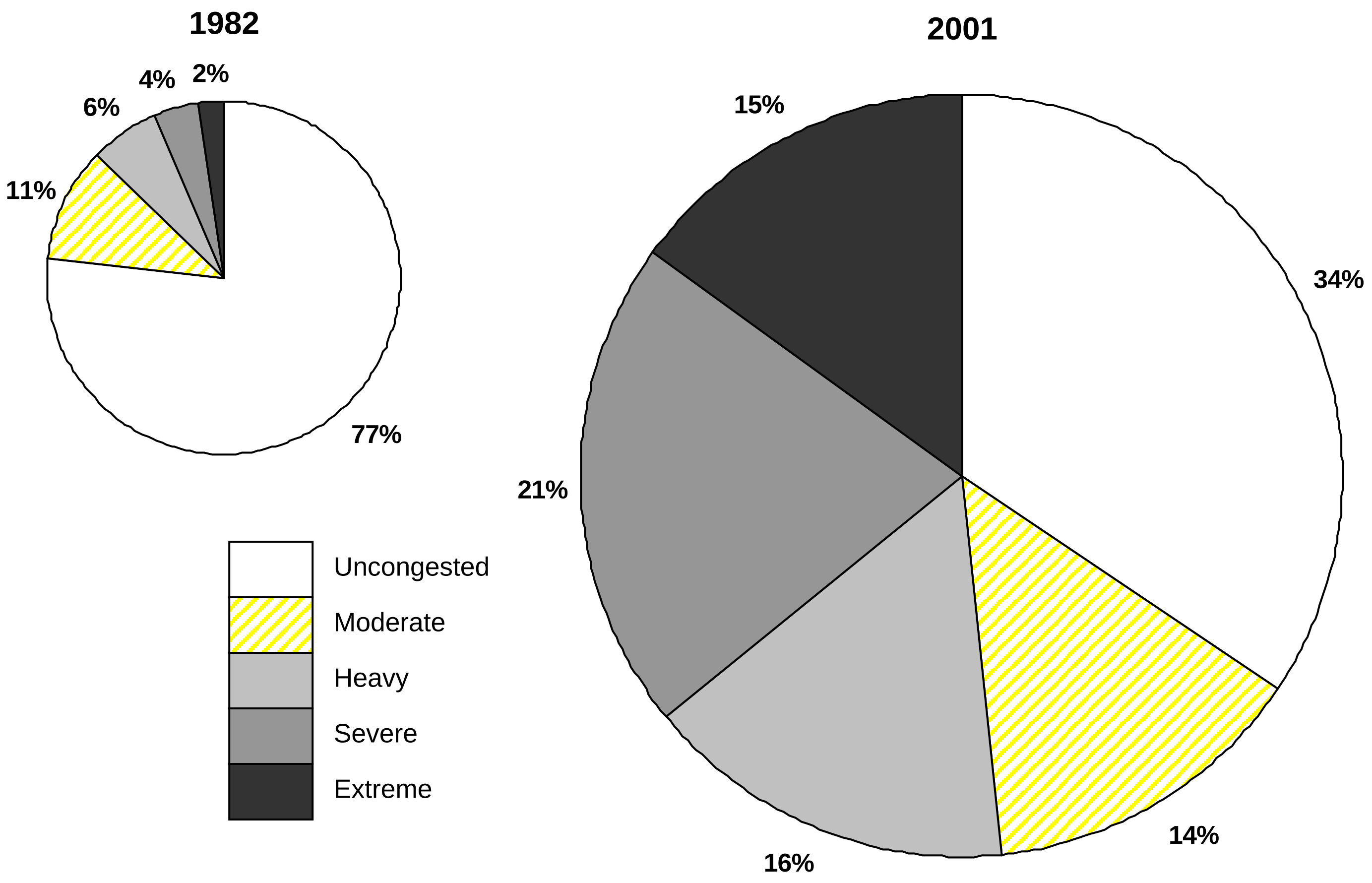
CAUTION: See http://mobility.tamu.edu/ums for improved performance measures and updated data.

Exhibit 7. Very Large Urban Area Travel Conditions



- 10 urban areas are included in this group representing 48 percent of the population and 60 percent of the travel delay in 2001.
- Delay grew 300 percent from 1982 to 2001.
- There was significant growth in the severely and extremely congested volume ranges with travel increasing from 20 percent to 50 percent.

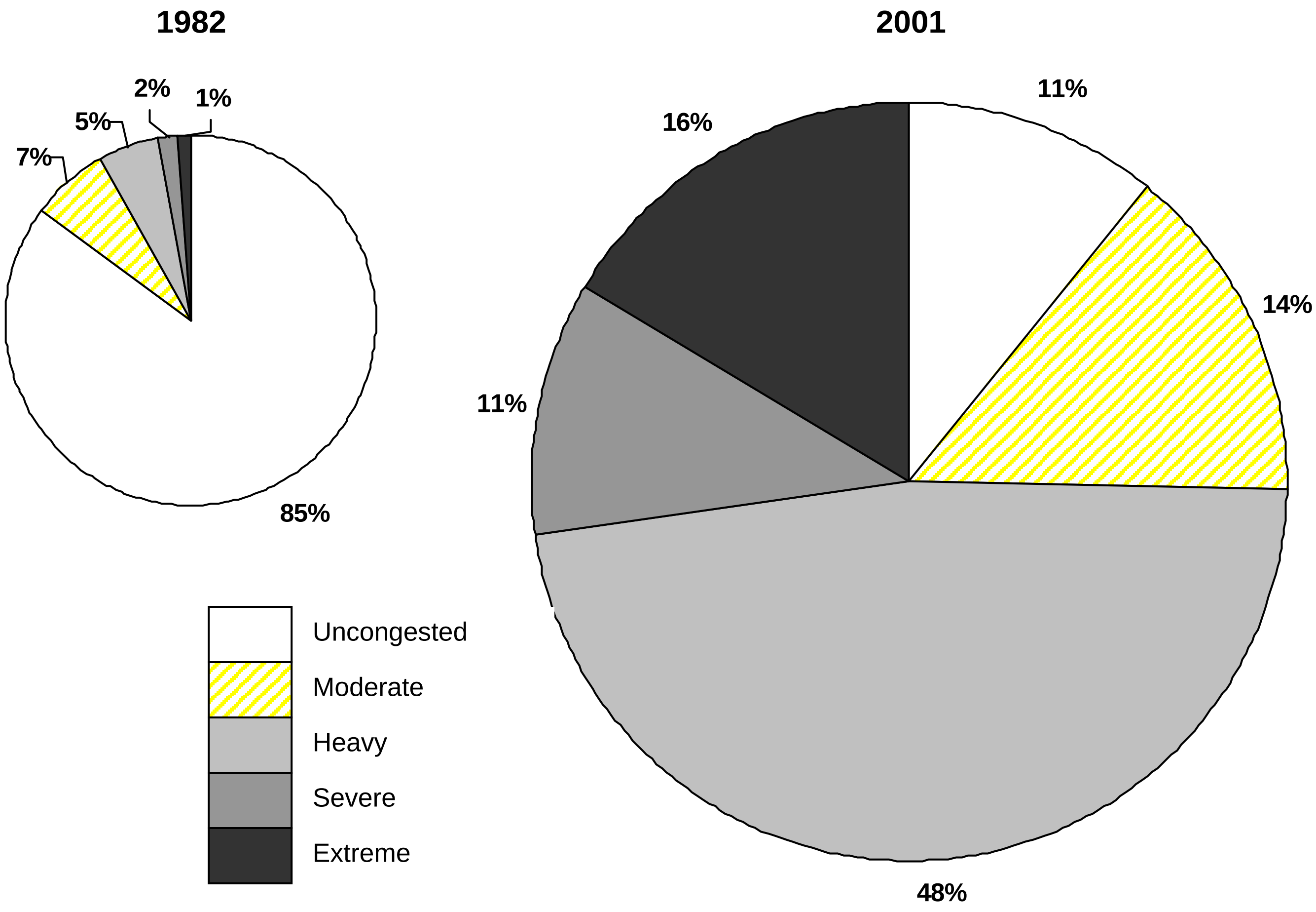
Exhibit 8. Large Urban Area Travel Conditions



- 30 urban areas are included in this group representing 38 percent of the population and 33 percent of the travel delay in 2001.
- Delay grew 650 percent from 1982 to 2001.
- There was almost no travel in the two most congested categories in 1982, while those ranges now account for 1/3 of peak travel.

CAUTION: See http://mobility.tamu.edu/ums for improved performance measures and updated data.

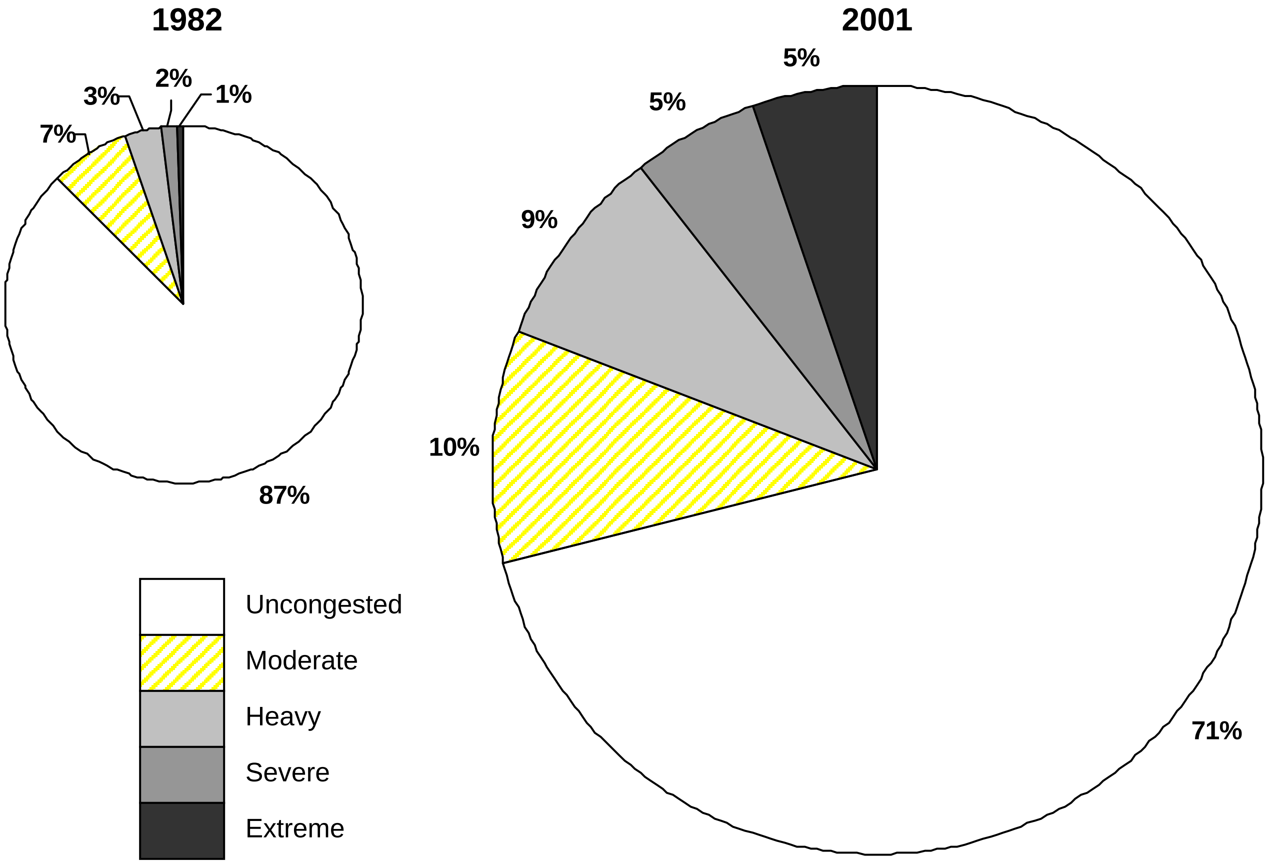
Exhibit 9. Medium Urban Area Travel Conditions



- 21 urban areas are included in this group representing 11 percent of the population and 6 percent of the travel delay in 2001.
- Delay grew 650 percent from 1982 to 2001.
- Travel in the congested regions now accounts for almost half of travel during the peak, compared to less than 20 percent in 1982.

CAUTION: See http://mobility.tamu.edu/ums for improved performance measures and updated data.

Exhibit 10. Small Urban Area Travel Conditions



- 14 urban areas are included in this group representing 3 percent of the population and 1 percent of the travel delay in 2001.
- Delay grew 480 percent from 1982 to 2001.
- Congestion, although not a significant problem for most peak period travel, has increased to more than 25 percent of peak travel miles.

WHAT DOES CONGESTION COST US?

Congestion has several effects on travelers, businesses, agencies and cities. One significant element is the value of the additional time and wasted fuel. The 75 areas do not include all of the congestion in the U.S., but a substantial portion of the delay and extra fuel consumed in congested conditions is included. Of the 75 urban areas in the study, the top 12 include about two-thirds of the delay estimated for 2001, and the top 20 areas account for 80 percent of annual delay. Some other highlights include:

- In 2001, congestion (based on wasted time and fuel) cost about $69.5 billion in the 75 urban areas, compared to $65 billion in 2000. (See Exhibits 11, A-7 for more information).
- The average cost per person in the 75 urban areas was $520 in 2001, up from $515 in 2000 (using constant dollars). The cost ranged from $650 per person in Very Large urban areas down to $130 per person in the Small areas.
- Exhibit A-10 shows that 5.7 billion gallons of fuel were wasted in the 75 urban areas. This amount of fuel would fill 114 super-tankers or 570,000 gasoline tank trucks. If you placed 570,000 gasoline tank trucks end-to-end, they would stretch from New York to Las Vegas and back.
- The urban areas with populations greater than 3 million accounted for 3.4 billion gallons (more than 60 percent) of wasted fuel.
- The amount of wasted fuel per person ranges from 52 gallons per year in the Very Large urban areas to 10 gallons per year in the Small areas (Exhibit A-10).

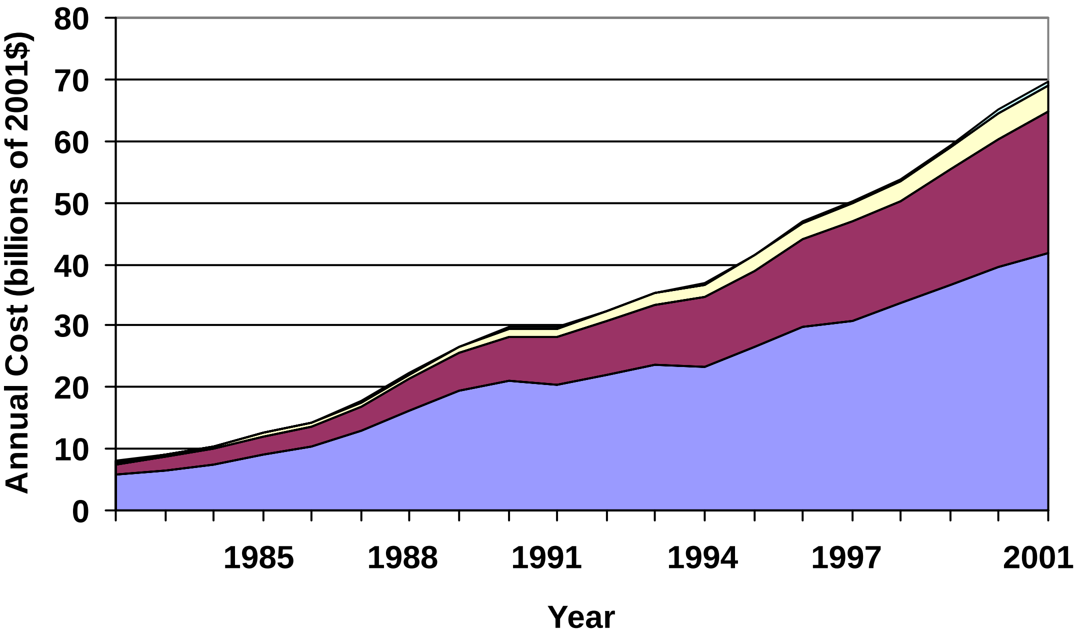
Exhibit 11. Congestion Effects on the Average Person – 2001

	Congestion Statistics per Person		
Population Group	**Average Cost ($)**	**Average Delay (hours)**	**Average Fuel (gallons)**
Very Large areas	650	33	52
Large areas	450	23	37
Medium areas	290	15	24
Small areas	130	7	10
75 area average	520	26	42
75 area total	$69.5 Billion	3.5 Billion	5.6 Billion

What is the Total Cost of Congestion in the 75 Areas?

The total cost of congestion for each population size group is shown in Exhibit 12. This cost accounts for the amount of wasted time and fuel due to traffic congestion. The total cost of congestion in the 75 urban areas is $69.5 billion in 2001 or an average of $520 per person—each year. (See Exhibit A-8 for more information).

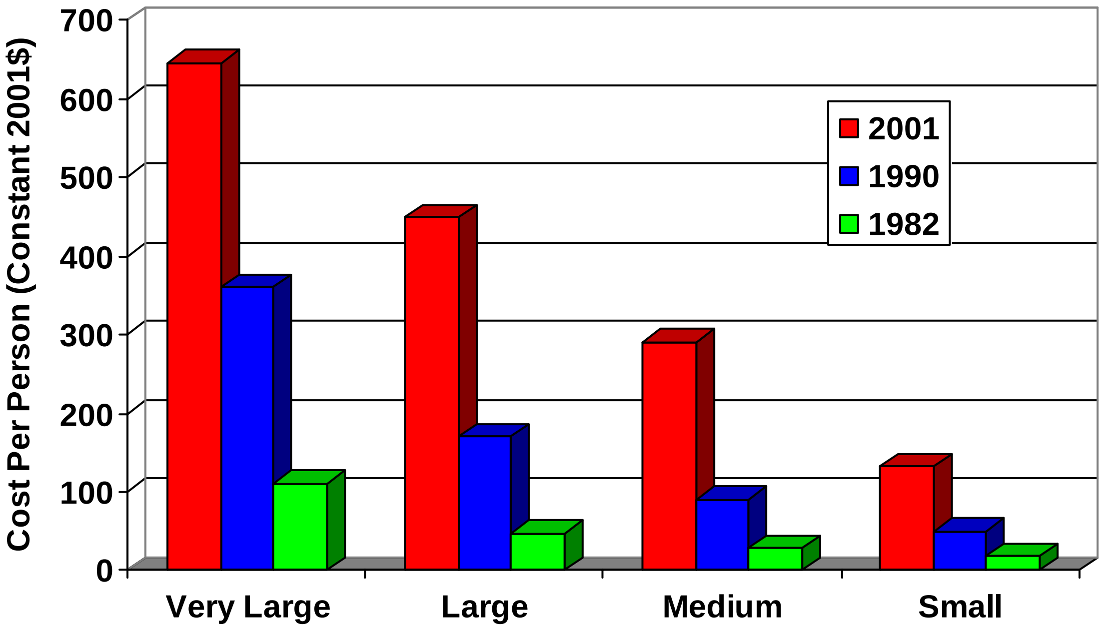
Exhibit 12. Annual Cost of Congestion



Note: Only 75 of the more than 400 urbanized areas are included. See Exhibit A-1 for a complete list.

- Twenty urban areas had a total annual congestion cost of at least $1 billion each.
- The areas with populations over 3 million persons account for more than 60 pecent of the congestion cost.

Exhibit 13. Annual Cost of Congestion per Person



What is the cost of congestion for me?

The total cost of congestion is divided by the number of urban residents—adults and children—to determine the effect of congestion on an individual (Exhibit 13). The average annual cost to each of these residents is about $520. (See Exhibit A-8 for more information).

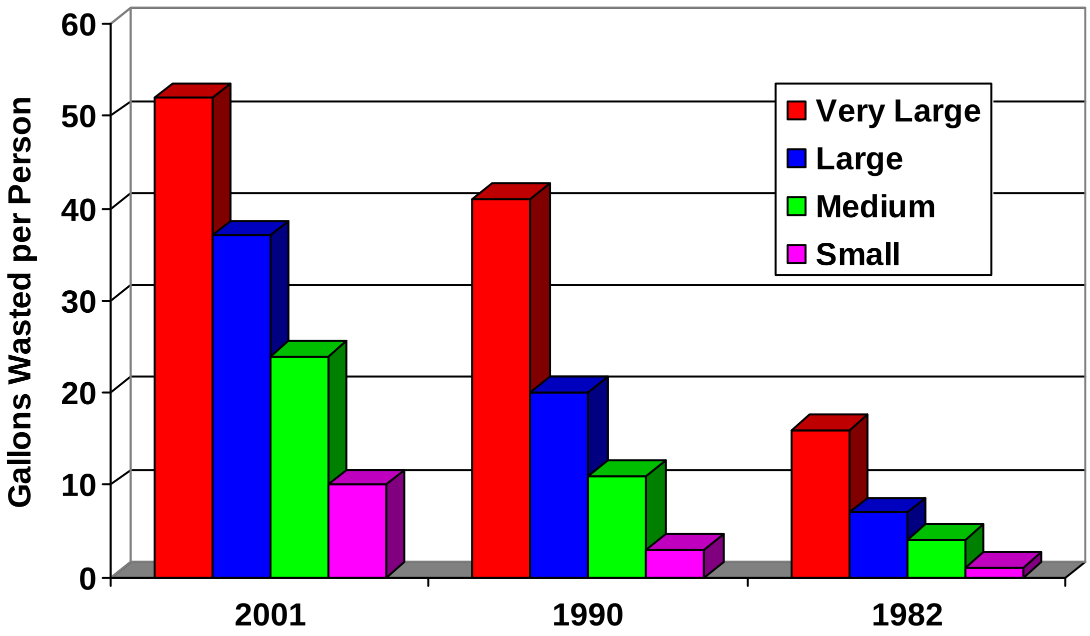
- Residents of 45 areas are "paying" more than $1 per workday in congestion costs; 20 areas have a congestion value exceeding $2 per workday.

- The average cost of congestion per person ranged from $650 in the Very Large population group to $130 in the Small population group in 2001.

How Much Fuel is Wasted in Congestion?

As with cost, the amount of fuel wasted in congestion is divided by the estimated number of persons in the urban area. This provides an estimate of the amount of fuel consumed for each individual because of congestion (Exhibit 14), a quantity that can be compared to other per capita consumptions. More than 40 gallons are wasted per person in the 75 urban areas. (See Exhibit A-10 for more information).

Exhibit 14. Wasted Fuel per Person



- The average amount of wasted fuel per person in 2001 in the 75 study areas was 42 gallons, up from 41 gallons in 2000.
- The amount of wasted fuel per person ranged from 10 gallons in the Small population group to 52 gallons in the Very Large population group in 2001.
- The total amount of wasted fuel in the 75 urban areas was approximately 5.7 billion gallons in 2001. To put this in perspective, if you filled tanker trucks with this wasted fuel and placed them end-to-end, they would stretch from New York City to Las Vegas and back again.

Communicating Mobility and Reliability Issues

The transportation profession is adopting a distinction between mobility—the ease of getting to a destination—and reliability—the predictability of travel times for usual trips. Travelers, elected leaders, the media and decision-makers may question the relevance of this distinction since problems with both elements cause increases in travel times and costs. The two concepts are clearly related, but the difference is useful when discussing solutions. Most of the computerized simulation and planning tools are not equipped to fully handle this issue, and so a significant amount of the data on congestion relates to the average of fairly good conditions—midweek day, clear weather and pavement, no collisions or lane-blocking roadwork, etc.—rather than the conditions that travelers and shippers must allow for to arrive on-time for important trips.

There are some strategies that focus on improving "mobility"—improving travel time—by adding capacity, improving the operational efficiency or managing demand in such way as to reduce the peak load. But there are also transportation improvements that reduce average travel time by reducing the amount of irregular problems or the influence of them on travel time. Incident management is the most obvious of these, but others such as providing bus or road routing information, improving interagency or interjurisdictional cooperation and communication and partnerships with private companies can pay huge benefits in reduction of incident clearance times and travel time variations.

The ability to predict travel times is highly valued by travelers and businesses. It affects the starting time and route used by travelers on a day-to-day basis, and the decisions about travel mode for typical trips and for day-to-day variations in decisions. Reliability problems can be traced to seven sources of travel time variation in both road and transit operations. Some are more easily addressed than others and some, such as weather problems, might be addressed by communicating information, rather than by agency design or operations actions.

- Incidents—collisions and vehicle breakdowns causing lane blockages and driver distractions.

- Work Zones—construction and maintenance activity that can cause added travel time in locations and times where congestion is not normally present.

- Weather—reduced visibility, road surface problems and uncertain waiting conditions result in extra travel time and altered trip patterns.

- Demand Changes—traffic volume varies from hour-to-hour and day-to-day and this causes travel time, crowding and congestion patterns to disappear or to significantly worsen for no apparent reason in some locations.

- Special Events—an identifiable case of demand changes where the volume and pattern of the change can frequently be predicted or anticipated.

- Traffic Control Devices—poorly timed of inoperable traffic signals, drawbridges, railroad grade crossing signals or traveler information systems contribute to irregularities in travel time.

- Inadequate Road or Transit Capacity—actually the interaction of capacity problems with the other six sources causes travel time to expand much faster than demand.

The profession is only at the start of understanding the precise mechanisms by which these sources contribute to congestion problems. Both public and private sectors undoubtedly see a cost from unreliable travel times, but those values can be very different for many situations. It is clear that there are several strategies to reduce the problem. There are construction, operations, management, operational practices, education and information components to these strategies. As more research is performed, there will be more detail about the effectiveness of the solutions as well as an idea of how much of the problem has a “solution.” If drivers insist on slowing down to look at a collision on the other direction, incident management techniques will be less effective. If road construction zones are allowed to close busy rural roads, there will be problems during holiday travel. There will always be trade-offs between operational efficiencies and the costs necessary to obtain them.

Measuring Reliability

If travelers assume each trip will take the average travel time, they will be late for half of their trips. It has not been determined what level of certainty should be used for trip planning purposes, but it seems reasonable to start with an assumption that a supervisor might allow an employee to be late one day per month. This translates into a need to be on time for approximately 19 out of 20 days, or 95 percent of the time.

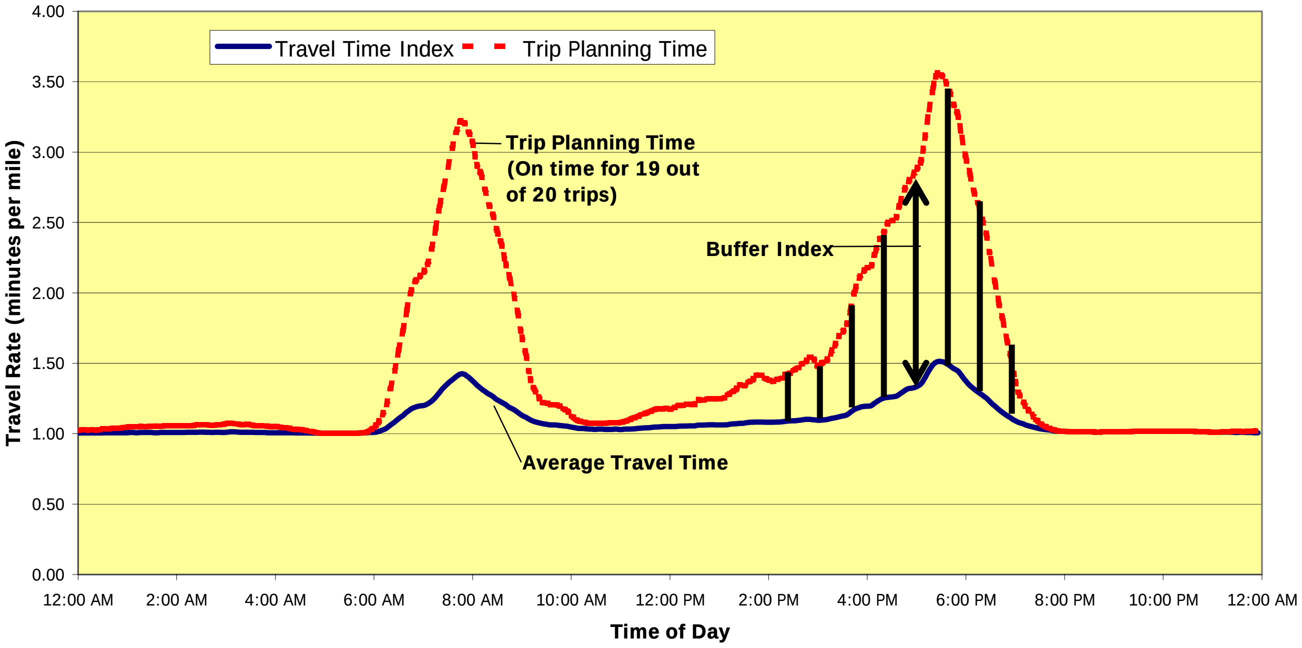
The difference between the average conditions and the 95th percentile conditions is the extra time that has to be budgeted, an illustration of the Buffer Time Index measure (Equation 1). In the middle of the peak in most cities studied in the Mobility Monitoring Program, the sources of travel time variation are more significant than in the midday.

$$\begin{array}{c}\text{Buffer}\\ \text{Time}\\ \text{Index (BTI)}\end{array} = \frac{\begin{array}{c}\text{95th percentile travel rate - Average travel rate}\\ \text{(in minutes per mile)} \qquad \text{(in minutes per mile)}\end{array}}{\begin{array}{c}\text{Average travel rate}\\ \text{(in minutes per mile)}\end{array}} \times 100\% \qquad \text{Equation 1}$$

What does all this mean? If you are a commuter who travels between about 7:00 a.m. and 9:00 a.m., Exhibit 15 indicates your trip takes an average of about 30 percent longer (that is, the TTI value is 1.3) than in the off peak. A 20-mile, 20-minute trip in the off-peak would take an average of 26 minutes in a typical home-to-work trip. The Buffer Time Index during this time is between 50 and 100 percent resulting in a Trip Planning Time of 2.1 minutes per mile. So if your boss wants you to begin work on time 95 percent of the days, you should plan on 42 minutes of travel time (20 miles times an average of 2.1 minutes per mile of trip for the peak period). But, to arrive by 8:00 a.m., you might have to leave your home around 7:00 a.m. because the system is even less reliable in the period between 7:30 a.m. and 8:00 a.m.

CAUTION: See http://mobility.tamu.edu/ums for improved performance measures and updated data.

Exhibit 15. Houston Freeway System Average Time and Trip Planning Travel Times

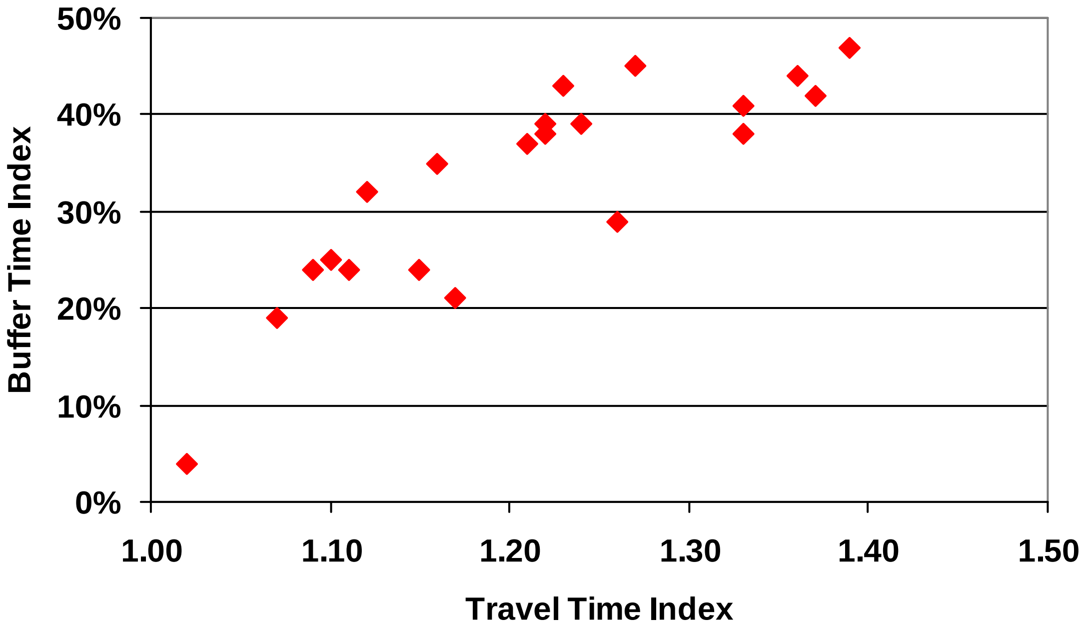


The mobility measure, the Travel Time Index, can be thought of as the time penalty for traveling in the peak period. The reliability measure, the Buffer Time Index, describes how much more time above the average should be budgeted to make an on-time trip. Reliability problems can be caused by simple variations in demand, as well as by vehicle crashes or breakdowns, weather, special events, construction, maintenance and other regular and irregular events. It can present difficulties for commuters and off-peak travelers, and for individuals and businesses (8).

With both of these measures one can tell how congested a transportation system is and how much variation there is in the congestion. This is particularly important when evaluating the wide range of improvement types that are being implemented. Traditional roadway and transit line construction and some operating improvements such as traffic signal system enhancements are oriented toward the typical, daily congestion levels. Others, such as crash and vehicle breakdown detection and removal programs, address the reliability issue. Most projects, programs and strategies have some benefits for each aspect of urban transportation problems.

Exhibit 16 indicates that there is a general consistency between mobility and reliability measures. That is, at the urban area level, places that are congested are also relatively unreliable. The data are for some freeways in a few cities selected because their archived databases were relatively complete and readily accessible for year 2001 data. The statistics developed from this database should not be used to compare systems or cities to each other. But, the data are used in the next section to analyze some aspects of reliability. Future reports will explore the subject in greater depth. For more information about the reliability database, see: http://mobility.tamu.edu/mmp.

Exhibit 16. Mobility and Reliability



CAUTION: See http://mobility.tamu.edu/ums for improved performance measures and updated data.

CAN MORE ROAD SPACE REDUCE CONGESTION GROWTH?

The analysis in this section (shown in Exhibit 17) addresses the issue of whether or not roadway additions made significant differences in the delay experienced by drivers in urban areas between 1982 and 2001. These years saw a range of economic conditions but a relatively consistent pattern between demand or population growth and increase in congestion. Rapid population growth was usually accompanied by significant congestion growth, while slow growth saw less congestion growth. The length of time needed to plan and construct major transportation improvements, however, means that very few areas see a rapid increase in economic activity and population without a significant growth in congestion. It also reinforces the idea that congestion is not a problem that can be addressed and then ignored for a decade.

Two measures are used to answer this question.

1. The Travel Time Index (TTI) is a mobility measure that shows the additional time required to complete a trip during congested times versus other times of the day. The TTI accounts for both recurrent delay and delay caused by roadway incidents.
2. The difference between lane-mile increases and traffic growth compares the change in supply and demand. If roadway capacity has been added at the same rate as travel, the deficit will be zero. The two changes are expressed in percentage terms to make them easily comparable. The changes are oriented toward road supply because transportation agencies have more control over changes in roadway supply than over demand changes. In most cases in the UMS database, traffic volume grows faster than lane-miles.

Conclusions

The analysis shows that **changes** in roadway supply have an effect on the **change** in delay. Additional roadways reduce the rate of increase in the amount of time it takes travelers to make congested period trips. In general, as the lane-mile "deficit" gets smaller, meaning that urban areas come closer to matching capacity growth and travel growth, the travel time increase is smaller. It appears that the growth in facilities has to be at a rate slightly greater than travel growth in order to maintain constant travel times, if additional roads are the only solution used to address mobility concerns. It is clear that adding roadway at about the same rate as traffic grows will slow the growth of congestion.

It is equally clear, however, that only five of the 75 areas studied were able to accomplish that rate. There must be a broader set of solutions applied to the problem, as well as more of each solution than has been implemented in the past, if more areas are to move into the "maintaining conditions or making progress on mobility" category.

Analyses that only examine comparisons such as travel growth vs. delay change or roadway growth vs. delay change are missing the point. The only comparison relevant to the question of road, traffic volume and congestion growth is the relationship between all three factors. Comparisons of only two of these elements will provide misleading answers.

See Exhibits A-3 and A-16 for individual urban area values.

Exhibit 17 shows the ratio of changes in demand (miles traveled) and supply (roadway) and the resulting change in the mobility level measured by the Travel Time Index. If road growth is a useful strategy for reducing the growth of congestion, lane-mileage increases that are faster than the traffic growth should improve conditions. If adding roads is not an effective strategy, the relationship between added roads and added demand will not indicate lower congestion growth for a demand-supply balance.

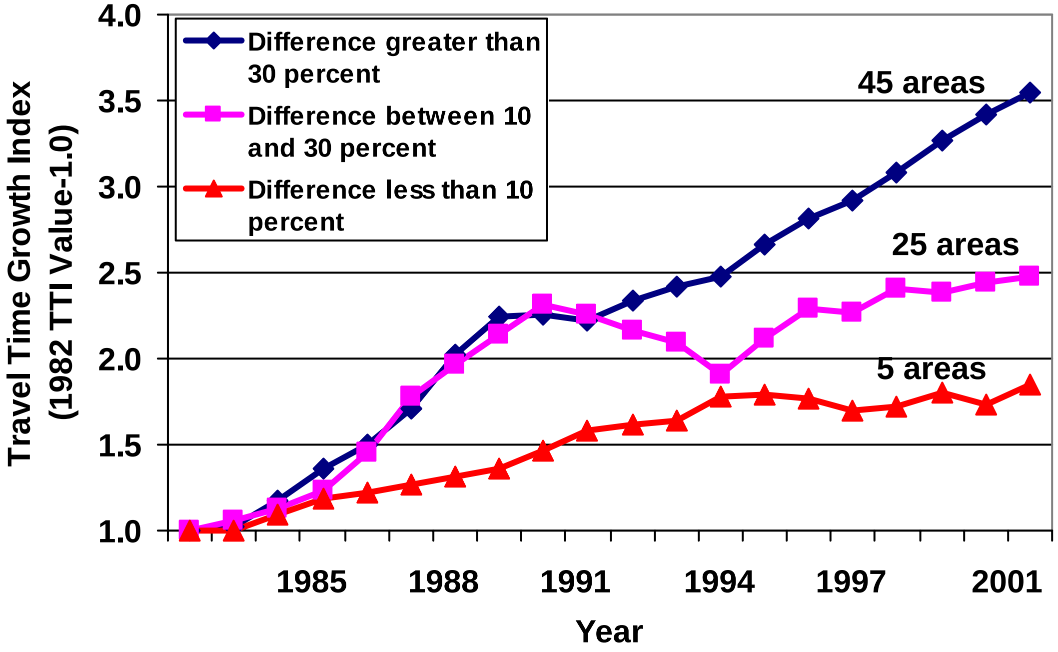
The 75 urban areas were divided into three groups based on the differences between lane-mile growth and traffic growth. If an area's traffic volume grew relatively slowly, the road capacity would need to only grow slowly to maintain a balance. Faster traffic growth rates would require more road capacity growth. The key analysis point is to examine the **change** in demand, the **change** in supply and the **change** in congestion levels. This allows fast growth cities that have built roads in approximately the same rate that demand has grown to be judged against other areas where demand and supply changes have been balanced.

The three groups were arranged using data from 1982 to 2001:

- Significant mismatch—Traffic growth was 30 percent or more greater than the growth in road capacity for the 45 urban areas in this group.
- Closer match—Traffic growth was between 10 percent and 30 percent more than road capacity growth. There were 25 urban areas in this group.
- Narrow gap—Road growth was within 10 percent of traffic growth for the five urban areas in this group.

The resulting growth in the average Travel Time Index values is charted in Exhibit 17. The average 1982 values were assigned a value of 1.0 so that the increases could be compared (in a manner similar to the Consumer Price Index).

Exhibit 17. Road Growth and Mobility Level



Note: See Exhibit A-14 for individual urban area values.
Note: Legend represents difference between traffic growth and road additions.

- A general trend appears to hold—the more that travel growth outpaced roadway expansion, the more the overall mobility level declined.
- The five urban areas with a demand-supply growth balance had their congestion levels increase at a much lower rate than those areas where travel increased at a much higher rate than capacity expansion. The demand increases in some of these areas was also relatively low compared to other areas in the study, which made it easier to add roads at the needed rate.
- The recession in California in the early 1990s and the combination of the economy and increased road construction efforts in Texas in the late 1980s and early 1990s affects the "middle" line congestion levels.
- The number of areas in each group is another significant finding. Only five urban areas were in the Narrow Gap group. Three of those, New Orleans, Pittsburgh and Tampa had populations greater than 1 million. Charleston, SC and Anchorage were the other two areas.

HOW MUCH MORE ROAD CONSTRUCTION WOULD BE NEEDED?

This is a difficult question to answer for at least two reasons.

- Most urban areas implement a wide variety of projects and programs to deal with traffic congestion. Each of these projects or programs can add to the overall mobility level for the area. Thus, isolating the effects of roadway construction is difficult because these other programs and projects are making a contribution at the same time.
- The relevancy of the analysis is questionable. Many areas focus on managing the growth of congestion, particularly in rapid growth areas. The analysis presented here is not intended to suggest that road construction is the best or only method to address congestion, but some readers will interpret it that way.

Conclusions

This analysis shows that it would be almost impossible to attempt to maintain a constant congestion level with road construction only. Over the past 2 decades, only about 50 percent of the needed mileage was actually added. This means that it would require at least twice the level of current-day road expansion funding to attempt this road construction strategy. An even larger problem would be to find suitable roads that can be widened, or areas where roads can be added, year after year. Most urban areas are pursuing a range of congestion management strategies, with road widening or construction being one of them.

See Exhibit A-16 for individual urban area values.

How Much Roadway has been Added?

Before we discuss the road growth issue, a word about our data. One answer to the road addition question is "not as much as our statistics indicate." The roadway growth in the UMS database includes the roads that were added because the urban boundary grew to include areas that previously were classified as rural. These existing, but newly urbanized, roads appear as additions to the urban databases, but do not have the same effect as new roadway. Even including these redesignated roads, however, the amount of added roadway is considerably less than that needed to match travel volume growth.

Examining Road Growth

This analysis uses the premise that enough road construction should take place so that the areawide congestion level is kept constant. For every percent increase in vehicle-miles of travel, it is assumed that there should be a similar percent increase in the lane-miles of roadway. Based on these assumptions, the percentage of the "Needed" roadway that has been "Added" can be calculated (Exhibit 18). The 1982 to 2001 statistics show:

- Over the 20-year period, less than half of the roadway that was needed to maintain a constant congestion level was actually added. These percentages are actually a little higher than the amount that was "constructed" since they also include roadway mileage that was added through shifting urban boundaries and not just new construction.
- Exhibit 19 also shows that the larger urban areas have done a little better, on average, at maintaining pace with the growth of travel.

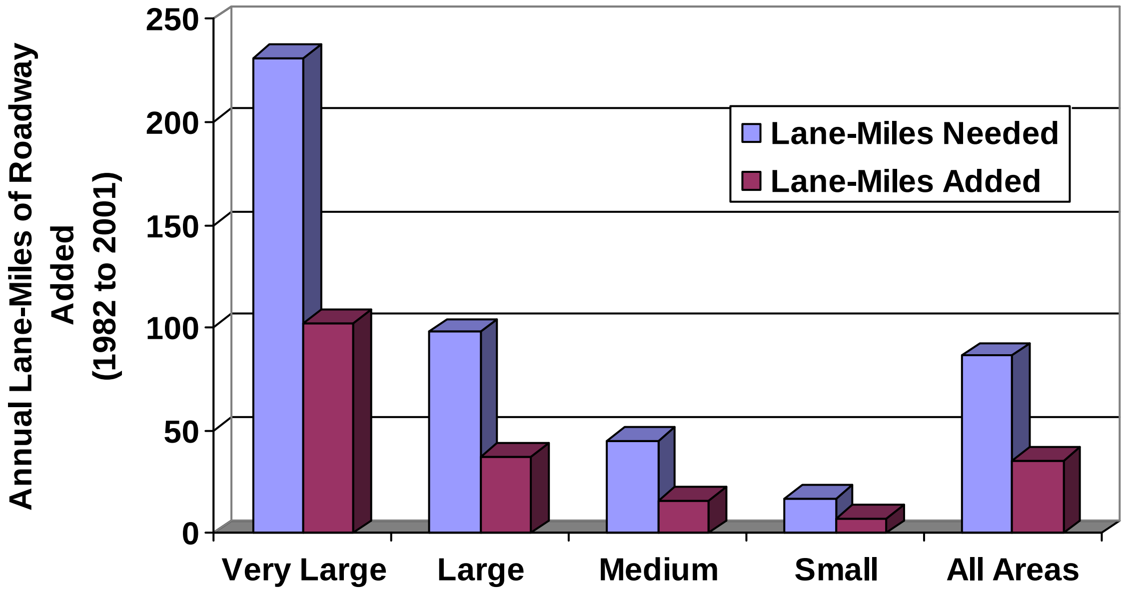
Exhibit 18. Vehicle Travel and Roadway Additions

2001 Population Group Average	Avg. Annual Growth in Vehicle-Miles of Travel (1982 to 2001)	Percentage of Needed Roadway Added[1]
Very Large areas	3.0	44
Large areas	3.9	38
Medium areas	4.0	36
Small areas	3.6	37
75 area average	3.5	40

[1] Lane-miles added divided by lane-miles needed. "Lane-miles needed" are based on matching the VMT growth rate.

Note: Assumes that all added lane-miles are roadway system expansion. The database does not include data concerning the number of lane-miles added because of changing urban boundaries.

Exhibit 19. Comparison of Roadway Added to Needed



- Over the 20-year period, only half (49 percent) of the roadway that was needed to maintain a constant congestion level was actually added.
- There is very little difference between the roadway added percentage values for any of the population groups. Areas of all sizes are approximately equal in ability to add lane-miles.

INCORPORATING THE EFFECT OF OPERATIONAL TREATMENTS

Previous Urban Mobility Reports have included speed improvements from additional roadways and decreased volume, but no specific inclusion of operational or demand management improvements. For some of these techniques, in fact, the goal is to increase volume past a point on the road and if that is successful, the Mobility Report procedures would indicate more delay, rather than less. There is relatively little information to estimate the effect of some of the operational treatments, and the data collection and analysis procedures are not standardized. Most congestion analysis performed in government, private sector and research studies provide estimates of speed and delay for normal conditions.

Many state and local transportation agencies, as well as the federal transportation program, have invested substantial funding in these operational treatments and the future will include more of these programs in more cities. Technologies, operating practices, programs and strategies provide methods to get the most efficiency out of the road or transit capacity that is built, typically for relatively modest costs and low environmental effects. In some cases, the operational improvements are some of the few strategies that can be approved, funded and implemented.

For the Urban Mobility Report database, the operational treatments were assessed for the delay reduction that results from the strategy as implemented in the urban area. A separate report, *2003 Annual Mobility Report, Volume 2, Five Congestion Reduction Strategies and Their Effects on Mobility* (9), describes the process of estimating the delay reduction in more detail. The ITS deployment analysis system (10) model was used as the basis for the estimates of the effect of the operational treatments. The ITS deployment database (11) and the Highway Performance Monitoring System (7) include data on the deployment of several operational improvements. These two databases provide the most comprehensive and consistent picture of where and what has been implemented on freeways and streets in urban areas.

The delay reduction estimates are determined by a combination of factors:

- extent of the treatments
- congestion level of the location
- density of the treatment (if it applies)
- effect of the treatment

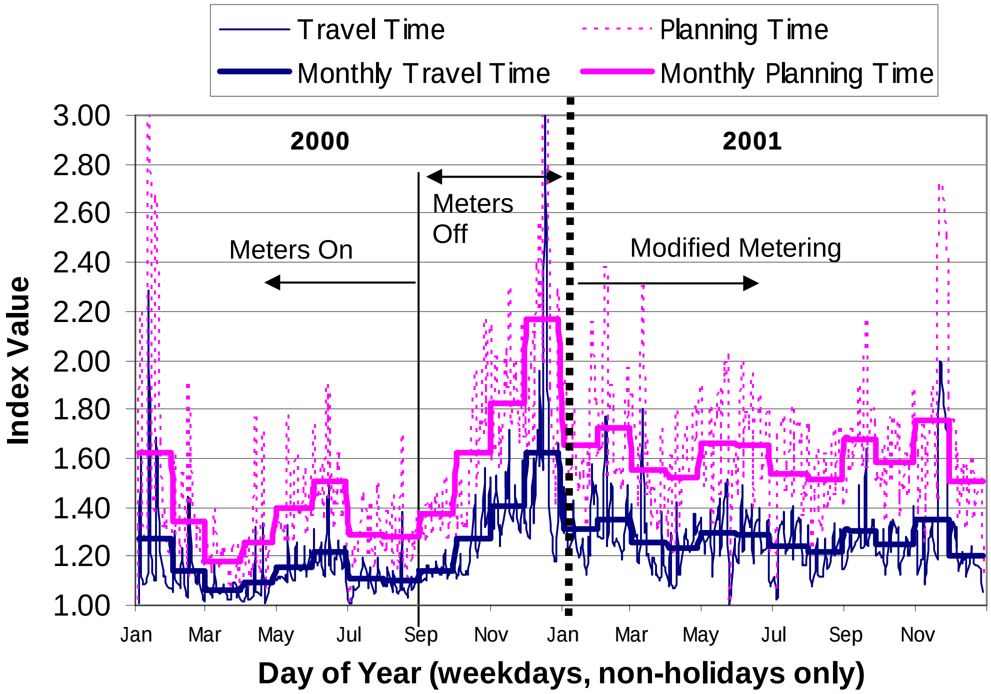
These factors are estimated from the databases, the inventory information found and applied within the existing Urban Mobility Report structure, and the delay reduction has been incorporated into several of measures calculated in the study.

Freeway Entrance Ramp Metering

Entrance ramp meters regulate the flow of traffic on freeway entrance ramps. They are designed to create more space between entering vehicles so those vehicles do not disrupt the mainlane traffic flow. The signals, just as traffic signals at street intersections, allow one vehicle to enter the freeway at some interval (for example, every two to five seconds) They also somewhat reduce the number of entering vehicles due to the short distance trips that are encouraged to use the parallel streets to avoid the ramp wait time.

The effect of ramp metering was tested in Minneapolis-St. Paul in October 2000 when the extensive metering system was turned off and the freeway operated as it does in most other cities. The basic system was relatively aggressive in that ramp wait times of five minutes were not uncommon. The results of this systemwide experiment are clearly visible in the peak period data in Exhibit 20. The Travel Time Index (average travel time) and the Planning Time Index (travel time that includes 19 out of every 20 trips) are plotted with each monthly average highlighted. Except for snowstorms, the highest values are during the shut-off experiment period. The metering experiment report produced by Cambridge Systematics (12) refers to a 22 percent increase in freeway travel time and the freeway system travel time becoming twice as unpredictable without the ramp meters. Congestion reductions are seen in January 2001 when a modified, less aggressive metering program was implemented. It might be interpreted that turning off the ramp meter system had the effect of a small snowstorm.

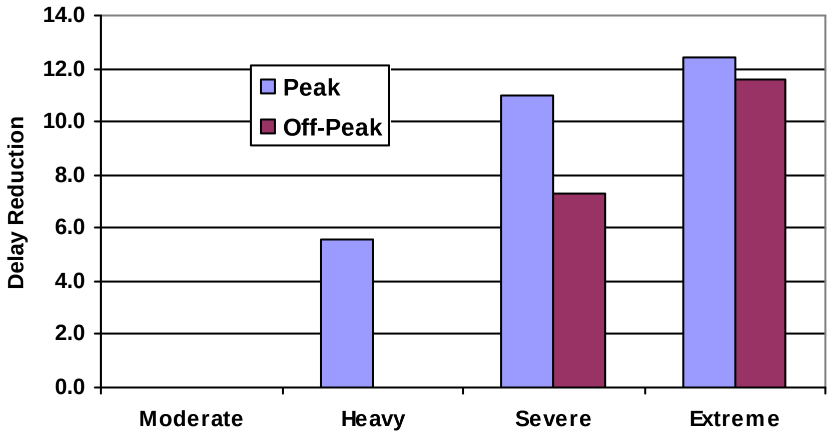
Exhibit 20. Minneapolis-St. Paul Freeway System Congestion Levels



Delay Reduction Effects

The results of the Minneapolis experiment and simulation modeling performed for the Intelligent Transportation System Deployment Analysis System (IDAS) (10) have been combined into a relatively simple delay reduction estimation procedure for use in the Annual Mobility Report. Exhibit 21 illustrates the delay reduction percentage for each of the four congestion ranges. More delay is subtracted from the more congested sections because there is more effect, particularly if the metering program can delay the beginning of stop-and-go conditions for some period of time.

Exhibit 21. Ramp Metering Delay Reduction



Twenty-six of the urban areas reported ramp metering on some portion of their freeway system in 2001 (7,11). The average metered distance was 80 miles which represents less than one-quarter of all the miles in the 26 cities. The effect was to reduce delay by 73 million person hours, approximately four percent of the freeway delay (Exhibit 22). This value is combined in the operational effects summary at the end of this section.

- Los Angeles and San Francisco have the largest delay reduction estimate in the Very Large group.
- Minneapolis-St. Paul and San Diego have the most extensive metering benefits in the Large group.
- Of the 35 areas studied with under one million population, only five reported any metering.

Exhibit 22. Freeway Ramp Metering Delay Reduction Benefits

Population Group	Average Covered Freeway Centerline-miles		Freeway Hours of Delay (million)
	Miles	Percentage	Reduction
Very Large (9)	80	16	46
Large (12)	105	40	27
Medium (5)	30	11	1
Small (0)	--	--	--
26 Area Average	80	23	--
26 Area Total	2,115	--	73

Source: HPMS, IDAS, and TTI Analysis

Note: This analysis uses nationally consistent data and relatively simplistic estimation procedures. Local or more detailed evaluations should be used where available. These estimates should be considered preliminary pending more extensive review and revision of base inventory information obtained from source databases.

Freeway Incident Management Programs

Freeway Service Patrol, Highway Angel, Highway Helper, The Minutemen and Motorists Assistance Patrol are all names that have been applied to the operations that attempt to remove crashed and disabled vehicles from the freeway lanes and shoulders. They work in conjunction with surveillance cameras, cell phone reported incident call-in programs and other elements to remove these disruptions and decrease delay and improve the reliability of the system. The benefits of these programs can be significant. Benefit/cost ratios from the reduction in delay between 3:1 and 10:1 are common for freeway service patrols (13). An incident management program can also reduce “secondary” crashes—collisions within the stop-and-go traffic caused by the initial incident. The range of benefits is related to traffic flow characteristics as well as to the aggressiveness and timeliness of the service.

Addressing these problems requires a program of monitoring, evaluation and action.

- Monitoring—Motorists calling on their cell phones are often the way a stalled vehicle or a crash is reported, but closed circuit cameras enable the responses to be more effective and targeted. Shortening the time to detect a disabled vehicle can greatly reduce the total delay due to an incident.

- Evaluation—An experienced team of transportation and emergency response staff provide ways for the incident to be quickly and appropriately addressed. Cameras and on-scene personnel are key elements in this evaluation phase.

- Action—Freeway service patrols and tow trucks are two well-known response mechanisms that not only reduce the time of the blockage but can also remove the incident from the area and begin to return the traffic flow to normal. Even in states where a motorist can legally move a wrecked vehicle from the travel lanes, many drivers wait for enforcement personnel dramatically increasing the delay. Public information campaigns that are effective at changing motorists’ behavior (that is, move vehicles from the travel lanes when allowed by law) are particularly important.

An active management program is a part of many cities comprehensive strategy to get as much productivity out of the system as possible. Removing incidents in the off-peak periods may also be important particularly in heavily traveled corridors or those with a high volume of freight movement. Commercial trucks generally try to avoid peak traffic hours, but the value of their time and commodities, as well as the effect on the manufacturing and service industries they supply can be much greater than simple additional minutes of travel time.

Delay Reduction Effects

The basic Urban Mobility Report methodology includes an estimate of the delay due to incidents. This estimate is based on roadway design characteristics and incident rates and durations from a few detailed studies. These give a broad overview, but an incomplete picture of the effect of the temporary roadway blockages. They also use the same incident duration patterns for all urban areas. Incidents are estimated to cause somewhere between 52 and 58 percent of total delay experienced by motorists in all urban area population groups. A more complete understanding of how incidents affect travelers will be possible as continuous travel speed and traffic count monitoring equipment is deployed on freeways and major streets in U.S. cities. Unfortunately, that equipment is in place and recording data in only a few cities. These can, however, give us a view of how travel speeds and volumes change during incidents.

The results of incident management program evaluations conducted in several cities and simulation modeling performed for the Intelligent Transportation System Deployment Analysis System (IDAS) (10) have been used to develop a delay reduction estimation procedure. The process estimates benefits for monitoring cameras and service patrol vehicles (Exhibits 23 and 24) with the cameras receiving less benefit from the identification and verification actions they assist with than the removal efforts of the service patrol. As with the ramp metering programs, more delay is subtracted from the more congested sections because there is more effect.

Exhibit 23. Benefits of Freeway Service Patrols

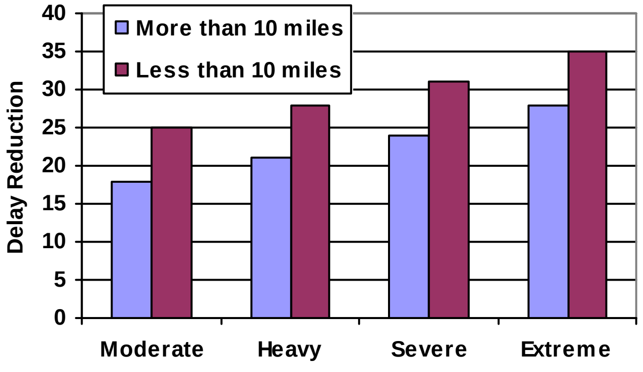
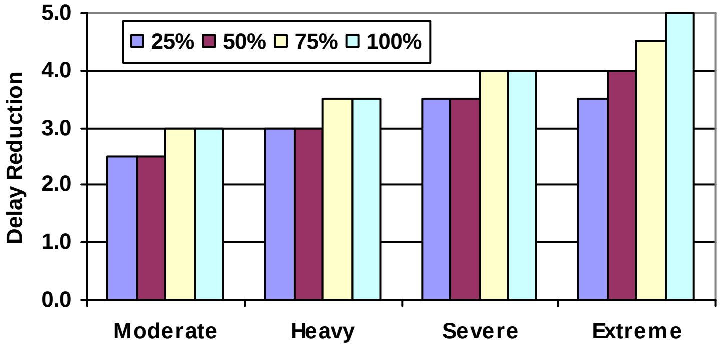


Exhibit 24. Benefits of Freeway Surveillance Cameras



More than 40 areas reported one or both treatments in 2001, with the coverage representing from one-quarter to one-half of the freeway miles in the cities (7,11). The effect was to reduce delay by 117 million person hours, approximately five percent of the freeway delay (Exhibit 25). This value is combined in the operational effects summary at the end of this section.

Incident Management

- The New York City and San Francisco-Oakland regions are estimated to derive the most benefit from incident management.
- Miami, Atlanta, Baltimore and Phoenix are estimated to have the most benefit in the Large group.
- Austin and Memphis are the areas within the Medium group with the highest delay reduction benefit.

Exhibit 25. Freeway Incident Management Delay Reduction Benefits

Population Group	Average Covered Freeway Centerline-miles		Freeway Hours of Delay (million)
	Miles	Percentage	Delay Reduction
Surveillance Cameras			
Very Large (9)	165	28	Delay Reduction Included Below
Large (22)	50	24	
Medium (12)	35	29	
Small (2)	20	38	
45 Area Average	70	27	
45 Area Total	3,110	27	
Service Patrols			
Very Large (10)	305	51	79
Large (26)	125	58	33
Medium (15)	60	58	5
Small (2)	10	25	0.1
53 Area Average	135	54	--
53 Area Total	7,210	--	117

Source: HPMS, IDAS, and TTI Analysis

Note: This analysis uses nationally consistent data and relatively simplistic estimation procedures. Local or more detailed evaluations should be used where available. These estimates should be considered preliminary pending more extensive review and revision of base inventory information obtained from source databases.

Traffic Signal Coordination Programs

Traffic signal timing can be a significant source of delay on the major street system. Much of this delay is the result of the managing the flow of intersecting traffic, but some of the delay can be reduced if the streams arrive at the intersection when the traffic signal is green instead of red. This is difficult in a complex urban environment, and when traffic volumes are very high, coordinating the signals does not work as well due to the long lines of cars already waiting to get through the intersection.

There are different types of coordination programs and methods to determine the arrival of vehicles, but they all basically seek to keep moving the vehicles that approach intersections on the major roads, somewhat at the expense of the minor roads. On a system basis, then, the major road intersections are the potential bottlenecks.

Delay Reduction Estimates

Some of the delay reduction from signal coordination efforts that have been undertaken in the U.S. is the attention that is given to setting the signal timing to correspond to the current volume patterns and levels and to recalibrate the equipment. It is often difficult to identify how much of the benefit is due to this "maintenance" function and how much is due to the coordination program itself. The Annual Mobility Report methodology draws on the evaluations and simulation modeling performed for the Intelligent Transportation System Deployment Analysis System (IDAS) (10) to develop the delay reduction estimation procedure shown in Exhibits 26 and 27. There is less benefit for the more heavily congested sections of the street system due to the conflicting traffic flows and vehicle queues. The benefits of an actuated system (where the signals respond to demand) are about one-third of the benefits of a centrally controlled system that monitors and adapts the signals to changes in demand.

Exhibit 26. Signal Coordination Benefits (actuated)

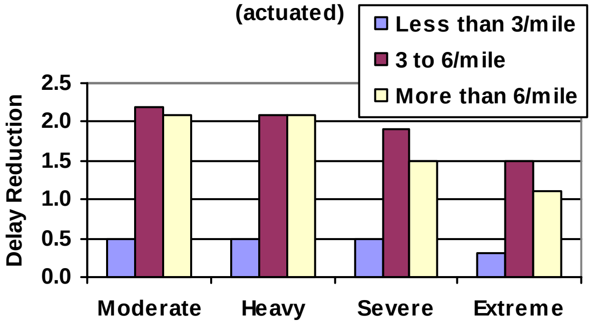
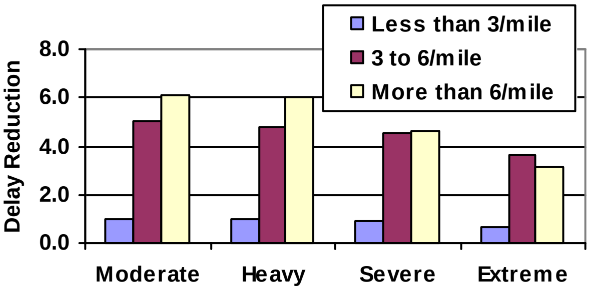


Exhibit 27. Signal Coordination Benefits (progressive)



All 75 areas reported some level of traffic signal coordination in 2001, with the coverage representing slightly over half of the street miles in the cities (7,11). Signal coordination projects, because the technology has been proven, the cost is relatively low and the government institutions are familiar with the implementation methods, have the highest percentage of cities and road miles with a program. The evolution of programs is also evident in the lower percentage of advanced progressive systems. These systems require more planning, infrastructure, and agency coordination.

The effect of the signal coordination projects was to reduce delay by 16 million person hours, approximately one and one-half percent of the street delay (Exhibit 28). The percentage is slightly higher in the Large population group where there is less congestion in the severely and extremely congested ranges. This value is combined in the operational effects summary at the end of this section.

While the total effect is relatively modest, the relatively low percentage of implementation should be recognized, as should the relatively low cost and the amount of benefit on any particular road section. The modest effect does not indicate that the treatment should not be implemented—why would a driver wish to encounter a red light if it were not necessary? The estimates do indicate that the benefits are not at the same level as a new travel lane, but neither are the costs or the implementation difficulties or time. It also demonstrates that if there are specific routes that should be favored—due to high bus ridership, an important freight route or parallel route road construction—there may be reasons to ignore the system or intersecting route effects.

- Los Angeles, New York and Chicago are the Very large areas with the highest benefits.
- Miami and Denver are the Large areas with the most hours of delay benefit from signal coordination in areas between one and three million population.
- Austin and Louisville in the Medium areas and Colorado Springs in the Small areas lead their population group.

Exhibit 28. Principal Arterial Street Traffic Signal Coordination Delay Reduction Benefits

Population Group	Average Covered Centerline-miles		Principal Arterial Hours of Delay (million)
	Miles	Percentage	Reduction
Very Large (10)	625	53	7
Large (30)	165	57	7
Medium (21)	80	53	2
Small (14)	35	47	0.3
75 Area Average	180	54	--
75 Area Total	13,345	--	16

Source: HPMS, IDAS, and TTI Analysis

Note: This analysis uses nationally consistent data and relatively simplistic estimation procedures. Local or more detailed evaluations should be used where available. These estimates should be considered preliminary pending more extensive review and revision of base inventory information obtained from source databases.

Combined Effect of Operational Treatments

The delay reduction benefits of three operational treatments analyzed in this edition of the Urban Mobility Report are combined into an estimate of the total effect of the deployed projects in the 75 urban areas. The inventory of all projects is identified in Exhibit 29 by the percentage of miles on freeways and streets that have one of the programs or projects implemented. Exhibit 29 shows the relatively low percentage of not only cities that have some treatments but also the low percentage of roads that have any treatment.

The total effect of the delay reduction programs represents 3.9 percent of the delay in the treated areas and 3.5 percent of the delay in the 75 cities. Again, the value seems low but when the low percentage of implementation is factored in, the benefit estimates are reasonable. The programs are also important in that the benefits are on facilities that have been constructed. The operating improvements represent important efficiencies from significant expenditures that have already been made.

Exhibit 29. Total Operational Improvement Delay Reduction

Operations Treatment	Number of Cities	Percent of System Covered	Delay Reduction Hours (millions)
Ramp Metering	26	23	73
Incident Management	45-53	27-54	117
Signal Coordination	75	54	16

Note: This analysis uses nationally consistent data and relatively simplistic estimation procedures. Local or more detailed evaluations should be used where available. These estimates should be considered preliminary pending more extensive review and revision of base inventory information obtained from source databases.

MOBILITY FROM PUBLIC TRANSPORTATION SERVICE AND HIGH-OCCUPANCY VEHICLE FACILITIES

Previous Annual Mobility Reports have included examples of the amount of public transportation improvements needed to address congestion. The next step, initiated in this report, is the inclusion of public transportation service in the general measures and analysis. Buses and trains carry a significant amount of trips in many large areas, and provide some important benefits in smaller areas. Peak period public transportation service during congested hours can improve the transportation capacity, provide options for travel mode and allows those without a vehicle to gain access to jobs, school, medical facilities or other destinations. In the case of public transportation lines that do not intersect roads, the service can be particularly reliable as they are not affected by the collisions and vehicle breakdowns that plague the roadway system, and are not as affected by weather, road work and other unreliability producing events. This section provides an estimate of the benefits of general public transportation service and high-occupancy vehicle lane operations.

Public Transportation Service

The mobility report methodology uses person volume and speed as the two main elements of the measurement analysis. While this is consistent with the goals of public transportation service, there are differences between several aspects of road and transit operations. Regular route bus transit service stops frequently to allow riders to enter and leave the vehicles. Train service in many cases also makes more than one stop per mile. The goal of the service is to provide access to the area near the stops as well as move passengers to other destinations. A useful comparison with road transportation systems, therefore, cannot use the same standards or same comparison methods.

The data sources for this type of analysis are a combination of locally collected and nationally consistent information. The nationally consistent data is available for ridership, passenger miles of travel, service mileage and hours. Consistent roadway data is available for similar statistics, but the relationship between volume and speed on the roadway side is more studied and more easily estimated than for transit service. Some simplifying assumptions, therefore, have been made to initiate the analysis this year. The next few years will see additional investigations of these statistics and the data that might be available with a goal of reducing the number of assumptions that are needed as well as improving the estimates that are made.

The method used in this analysis to estimate a revised Travel Time Index focused on similar expectations. Transit service, while the average speed may be slower, is operated according to a schedule. Riders and potential riders evaluate the service and make mode choices according to either the departure and arrival times or in the case of operations that run very frequently, the travel time to the destination with the expectation that the departure time will be relatively soon after arrival in the station. In transit operations this can be thought of as similar to an uncongested trip. Public transportation service that operates on-time according to the schedule, then, would be classified as uncongested travel.

It may seem odd to disregard travel speed in this sense, but the service differences are important. Attempting to estimate the slower speeds on transit routes and incorporating them into the analysis would, in essence, double penalize the service. Travelers already use the travel times to make their decisions and the longer times are the reason ridership is relatively low during off-peak hours. Transit routes could gain speed by decreasing stops, but at the risk of losing ridership. This relationship between speed and convenience is constantly adjusted by transit agencies seeking to increase transit service and ridership. And this approach to defining a different standard speed for transit routes is similar to the different threshold used for streets and freeways.

The "penalty" or "reward" for public transportation in this revised Travel Time Index estimate comes from gain or loss in ridership. If the route travel times become unreasonably long, ridership will decline, and the amount of "uncongested" passenger-miles contributed by public transportation will also decline. The beneficial effects of faster route times, better access or improved service from interconnected networks or high-speed bus or rail links would result in higher ridership values, which would increase the amount of "uncongested" travel in the mobility measure calculations.

The delay benefits were calculated using the "what if transit riders were in the general traffic flow" case. Additional traffic on already crowded road networks would affect all the other peak period travelers as well. This is an artificial case in the sense that the effects of a transit service shutdown would be much more significant and affect more than just the transit riders or roadway travelers. Public transportation patrons who rely on the service for their basic transportation needs would find travel much more difficult, making jobs, school, medical or other trip destinations much harder to achieve. And the businesses that count on the reliable service and access to consumers and workers that public transportation provides would suffer as well.

Delay Effect Estimate

In the 75 urban areas studied, Exhibit 30 shows that there were approximately 43 billion passenger-miles of travel on public transportation systems in 2001. The annual ridership ranged from about 19 million in the Small urban areas to about 3.4 billion in the Very Large areas. Overall, if these riders were not handled on public transportation systems they would contribute an additional roadway delay of approximately one billion hours or 30 percent of total delay. Some additional effects include:

- The Very Large areas would experience an increase in delay of about 850 million hours per year (40 percent of total delay). This is the result of the significant public transportation ridership in these areas. Most of the urban areas over 3 million population have extensive rail systems and all have very large bus systems.
- The Large urban areas would experience the second largest increase in delay with 189 million additional hours of delay per year. While the average Large area transit system carried only 8 percent of the ridership of the Very Large area systems, the delay increase would represent 22 percent of the Very Large group because there are 30 Large areas.
- The New York urban area accounted for almost one-third of the delay increase estimated in the report.

- The Los Angeles, Chicago and San Francisco-Oakland systems are estimated to provide more than 80 million hours of benefit each year.
- The largest benefits in the Large population group are in Atlanta and Seattle.
- Honolulu, Austin and Tacoma have the highest delay increase in the Medium group if public transportation service were eliminated.
- Colorado Springs, Spokane and Eugene-Springfield are estimated to have the most delay increase of the Small urban area group. Only 14 cities of that size were studied, however, which should be accounted for if a broad conclusion is required.

Exhibit 30. Delay Increase if Public Transportation Service Were Eliminated – 75 Areas

Population Group & Number of Areas	Population Group Average Annual Passenger-Miles of Travel (million)	Delay Reduction Due to Public Transportation	
		Hours of Delay (million)	Percent of Base Delay
Very Large (10)	3,403	849	40
Large (30)	257	189	16
Medium (21)	74	23	10
Small (14)	19	2	6
75 Area Total	43,557	1,062	30

Source: APTA Operating Statistics and TTI Review

Future Improvements to Public Transportation Analysis

A longer-term approach will be to develop links with the system operations databases that some agencies have. These include travel time, speed and passenger volume data automatically collected by transit vehicle monitoring systems. Linking this data with the roadway performance data in public transportation corridors would be the logical extension of the archived roadway data inclusion efforts being funded by the Federal Highway Administration (1). An alternative to the real-time data would be to estimate public transportation vehicle travel time and speed information from route schedules, and combine them with the passenger loading information collected by the public transportation systems. While these data are not reported in nationally consistent formats, most public transportation systems have some of this information; the challenge is to develop comparable datasets.

High-Occupancy Vehicle Lanes

High-occupancy vehicle lanes (also known as diamond lanes, bus and carpool lanes, transitways) provide high-speed travel option to buses and carpools as an incentive to share a vehicle and reduce the number of vehicle trips. The lanes are most used during the peak travel periods when congestion is worst and the time savings compared to the general travel lanes the most significant. In addition to saving time on an average trip, the HOV lanes also provide more reliable service as they are less affected by collisions or vehicle breakdowns.

The HOV lanes provide service similar to freeway mainlanes in that there are relatively few lanes that have stations on the route. The buses on the lanes can either pickup patrons in ways that regular route buses operate before entering the HOV lane, or they can provide service to park-and-ride lot that allow patrons to drive their private vehicle to a parking lot and use a bus to their destination. The high-speed lanes are also open to use by carpools (although there are some bus-only lanes) which provide additional flexibility for use by travelers.

Delay Reduction Estimate

The Urban Mobility Report has not included the mobility provided by HOV lanes in the regular reporting in the past. Because the HOV lanes service is similar to the general freeway operation, the operating statistics can be added to the freeway and street data using the speed and person volume on the lanes. Exhibit 31 is a summary of the effect of HOV lane operations in several urban corridors. While this is only a partial list of HOV projects, it provides a view of the usefulness of the data, as well as an idea of the mobility contribution provided by the facilities. The exhibit includes information about the typical peak period operating conditions (three hours in the morning and evening) on the HOV lane and freeway mainlanes. The statistics from six peak hours of operation may appear to show relatively low effects, but in some corridors the significant benefits may only be for one hour in each peak. Some other aspects of the corridor operations such as the variation in travel time and the effects of park-and-ride service or transit operations are also not fully explored in these statistics.

Most of the mainlane TTI values are above 1.30 (a speed of 45 mph) while only four of the HOV operations exceed that value. Consequently, there are significant differences in the Travel Time Index values for HOV lanes and freeways. The TTI values are averaged by including the number of persons using each facility; those values are shown in the Combined TTI column.

The greatest index point improvements are found for those projects where the peak-period mainlane speeds are very low and the HOV lane usage is relatively high compared to the mainlanes. The relatively fast and reliable speeds (indicated by the lower TTI values) attract riders into the HOV lanes causing the HOV travel time index values to be a larger part of the combined index. Ten of the projects have index point improvements of 20 or more. But many of the other projects are also identified as “good” projects by the residents of those areas and the users of the facilities.

The data for corridors in a city or region can be combined to produce an average “with and without” Travel Time Index. Exhibit 32 illustrates the averages for the six urban areas with several HOV projects. There are more HOV projects in the United States, but the travel time and person volume data needed to incorporate the mobility effects are not available for 2000 or 2001.

Assessing the effect of a few HOV projects on the urban areawide Travel Time Index, however, is not a particularly useful exercise. Any small set of transportation projects will have a relatively small effect on the areawide average mobility statistics in a large urban area. The significance of the improvements is at the corridor level where the difference in travel conditions is focused.

In addition to the two listed facilities, the Minneapolis-St. Paul area has a program that allows buses to use the freeway shoulders to bypass congested traffic. This improves the travel speed and schedule reliability with a relatively inexpensive treatment. The travel time savings are highly variable due to the operating procedures that control the difference in speed between the mainlanes and buses. The routes that use the shoulders had a 9.2 percent ridership increase over a two-year period when the overall system ridership decreased 6.5 percent, illustrating the favorable passenger reaction to improved speed and reliability attributes (15).

Exhibit 31. Mobility Levels in HOV Corridors

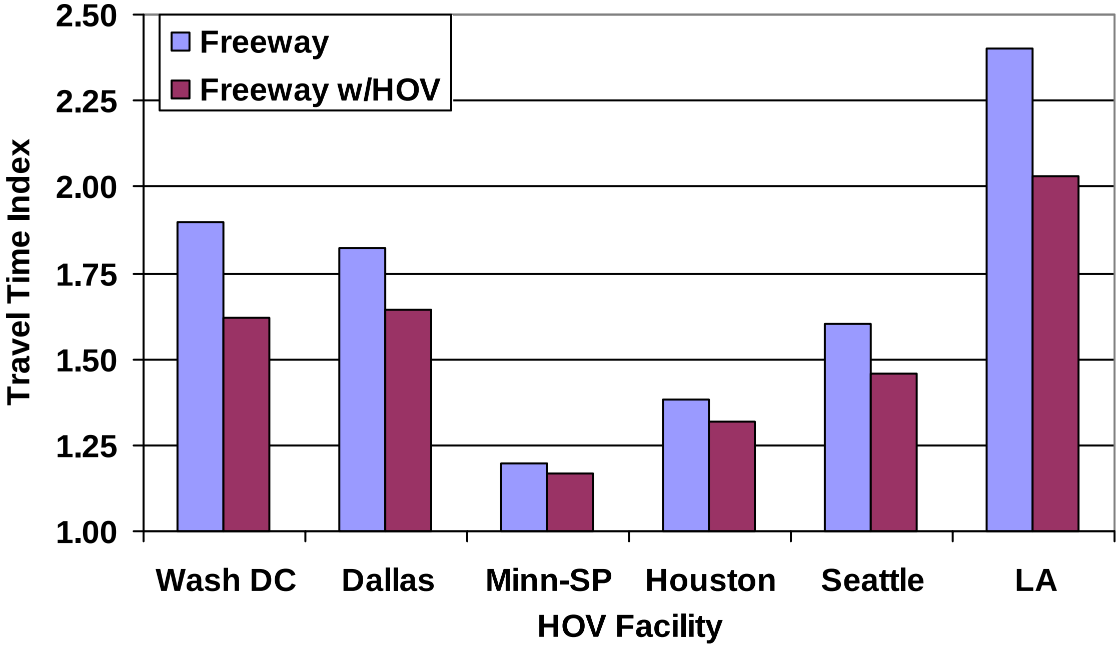
	High-Occupancy Vehicle Lanes		Mainlanes			
Segment[1]	**Passengers**	**TTI**	**Passengers**	**TTI**	**Combined TTI**	**Index Point Improvement[2]**
Washington DC						
I-95 Shirley Hwy	16,600	1.01	19,800	2.17	1.64	53
I-66	9,500	1.31	19,800	2.35	2.01	34
VA267	5,200	1.19	14,000	1.76	1.60	16
I-270	4,400	1.26	13,600	1.87	1.72	15
New York						
Long Island Expwy	15,770	1.00	44,875	1.35	1.24	11
Miami-Dade County						
I-95	3,170	1.40	7,950	1.94	1.79	15
Minneapolis-St. Paul						
I-394	7,120	1.09	14,260	1.20	1.16	4
I-35W	5,170	1.09	12,920	1.20	1.17	3
Houston						
I-10W	9,370	1.03	16,000	1.60	1.39	21
I-45N	8,820	1.09	22,000	1.28	1.22	6
I-45S	5,800	1.09	21,000	1.30	1.25	5
US290	7,045	1.05	18,000	1.38	1.29	9
US59S	8,200	1.18	28,000	1.44	1.38	6
Dallas						
I-30 E	8,040	1.08	23,250	1.60	1.47	13
I-35N	5,270	1.04	17,110	1.75	1.58	17
I-635	5,660	1.03	20,030	1.94	1.74	20
Seattle						
I-5 N of CBD	9,580	1.18	17,960	1.59	1.45	14
I-5 S of CBD	13,440	1.18	24,880	1.53	1.42	11
I-405 N of I-90	6,020	1.26	15,725	1.91	1.73	18
I-405 S of I-90	8,920	1.13	11,230	1.91	1.56	35
I-90	3,365	1.00	15,010	1.25	1.20	5
SR 167	4,250	1.05	9,035	1.69	1.48	21
SR 520	2,725	1.00	8,180	1.30	1.23	7
Los Angeles County						
I-10	6,100	1.15	9,060	2.78	2.12	66
SR 91	3,350	1.25	7,385	2.33	1.99	34
I-110	6,625	1.23	8,100	2.56	1.96	60
I-210	3,440	1.32	8,750	1.96	1.78	18
I-405	3,430	1.51	7,390	2.34	2.08	26

[1] Not all U.S. HOV areas are shown due to data availability problems.

[2] Mainlane TTI minus Combined TTI.

Note: Speeds in excess of 60 miles per hour were entered as 60. That speed is considered the freeflow speed for this analysis.

Exhibit 32. Effects of HOV Lanes in Freeway Corridors



COMBINED EFFECT OF PUBLIC TRANSPORTATION AND OPERATIONAL IMPROVEMENTS

The analytical improvements initiated in this year's Annual Mobility Report will be refined over the next few years under a project supervised by the National Cooperative Research Program (NCHRP), a component of the Transportation Research Board. The values and approach may change, but the estimates included in this year's report represent an important first step in including all the types of transportation improvements in a comprehensive areawide mobility assessment. The use of the information may also encourage local and state transportation officials to develop their own databases and procedures to maximize the flexibility and inclusiveness of corridor and sub-regional evaluations, as some agencies are doing now.

The expanded version of the methodology used in this report is available in a companion report, *2003 Annual Mobility Report, Volume 2, Five Congestion Reduction Strategies and Their Effects on Mobility* (9). The summary statistics at the population group level for 2001 are illustrated in Exhibit 33. Benefit data for each urban area is included in Exhibit A-16. Most of the delay in the 75 urban areas is in the 10 areas with populations above three million, so it should not be surprising that the majority of the operational treatment benefits are in those areas as well. Large areas not only have had large problems for longer, and thus more incentive to pursue a range of solutions, but the expertise needed to plan and implement innovative or complex programs are also more likely to be readily accessible.

Several of the areas with populations between one million and three million also have significant contributions from three or four of the five treatments identified in the report. Some of the delay reduction estimates are as large or larger than the above three million population areas. The medium group areas have relatively small overall contributions due to the low congestion level, but they are also implementing and refining techniques that will be more valuable as congestion grows.

The Travel Time Index change from the base value to the "inclusive" value follows the same pattern as the delay reduction—much more change in the Very Large group than in the others. The TTI values are presented with three decimal places to better illustrate the amount of change. The amount of change should be gauged against the base TTI value—small areas with less congestion that have implemented more operational treatments or a more extensive transit system may have larger changes as a percentage of the base value than larger areas that have not used these options.

Several other observations about this initial attempt to include a broader set of mobility treatments in the regular mobility data reporting are listed below.

- The significant investment in operations treatments in states that are widely judged to be among the leaders in these technologies is evident. California, Minnesota, Illinois, Arizona, Oregon and Washington have relatively large delay reductions, in several case for cities outside the "most congested" list.

- The delay reduction estimate for public transportation service and HOV lanes should be considered as "delay avoided" because the calculation involves comparing current operations to conditions that might exist if the service were not in operation.

- Almost three-fourths of delay reduction from incident management and ramp meters is in the Very Large group. Less than half of the signal coordination delay, however, is in that group, illustrating the more extensive deployment of that technique.

- Although the percentage of "treated" streets and freeways is relatively low, the combined effects are equal to several years of growth in the Very Large group, and to one or two years in the Large and some of the Medium group cities.

Exhibit 33. Summary of Public Transportation and Operational Improvement Delay Reduction Effects - 2001

	Population Group – Annual Hours Saved (000)				
	Very Large	**Large**	**Medium**	**Small**	**All 75**
Number of Cities	10	30	21	14	75
Delay Reduction from					
Ramp Metering	45,680	26,685	585	0	72,950
Incident Management	79,055	32,730	4,960	40	116,785
Signal Coordination	7,275	7,155	1,405	340	16,175
Delay Savings from					
High-Occupancy Vehicles	9,653	1,264	0	0	10,917
Public Transportation	848,455	189,190	22,615	1,670	1,061,930
Travel Time Index					
With treatments	1.44	1.30	1.18	1.11	1.34
Without treatments	1.51	1.32	1.19	1.11	1.39

HOW MANY NEW CARPOOLS OR BUS RIDERS WOULD BE NEEDED IF THEY WERE THE ONLY SOLUTION?

Another method of examining the role and potential of public transportation is to examine the amount of service that would be required to address the growing delay problem if this were the only solution. Just as with the "roadway construction" only solution, this analysis will focus on the changes in occupancy level needed to accommodate travel growth. The results from this analysis show the increase in occupancy level in order to maintain existing congestion levels. But they are not intended to suggest that this is a realistic solution.

Conclusions

The 75 urban areas in the Urban Mobility Study added more than 46.9 million additional miles of daily person travel in 2001. To accomplish a goal of maintaining a constant congestion level in these areas by only adding transit riders of carpoolers, there would have to be a substantial growth in these modes. The growth would be equivalent to an additional 3 or 4 percent of all vehicles becoming carpools, or expanding transit systems by more than one-third of the current ridership each year.

It may be very difficult to convince this many persons to begin ridesharing or riding transit. As indicated elsewhere in this report, some success with this solution, in conjunction with other techniques may give an urban area the opportunity to slow the mobility decline.

See Exhibit A-17 for individual urban area values.

Vehicle travel volume growth is estimated with the annual growth rate for the previous five years. Passenger-miles of travel are estimated using the standard 1.25 persons per vehicle value used elsewhere in the study. The growth in demand is estimated and the number of added passenger-miles of travel is divided by a simple national average trip length to estimate the number of additional trips that would have to be made by carpool or transit. Average trip lengths vary by metropolitan area. The length of a trip can have an effect on how much exposure a traveler has to congestion. For purposes of comparison, however, this report assumes one trip length for all areas. The following observations result from the 2001 statistics shown in Exhibit A-17.

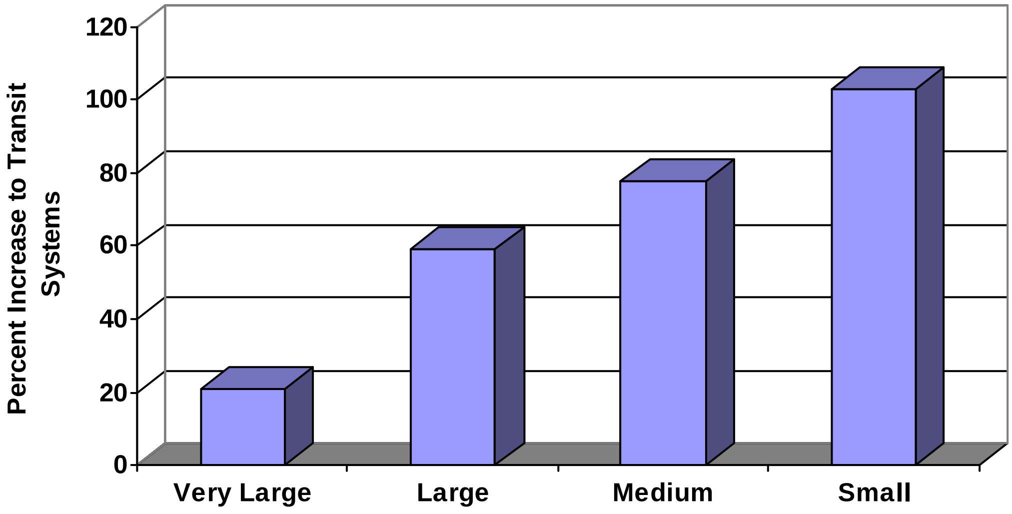
- 6.1 million trips per day would have to be made as carpools or bus trips in the 75 urban areas to handle the 46.9 million additional person-miles of travel if congestion levels are to remain constant.
- On average, the occupancy of each vehicle in the 75 urban areas would have to rise by about 0.03 persons or, in other words, 3 out of every 100 vehicles would have to become a new 2-person carpool to handle one year's growth.

How Many Trips Would be Needed on Transit?

Transit, like ridesharing, park-and-ride lots and high-occupancy vehicle lanes, typically have a greater effect on the congestion statistics in a corridor, rather than across a region. Transit and these other elements "compete" very well with the single-occupant vehicle in serving dense activity centers and congested travel corridors. But it is also useful to examine the data at the urban area level. Ridership statistics were gathered for the 75 urban areas to determine how much more travel the systems would have to handle to offset congestion growth—again, if transit expansion was the only method to address travel growth. The additional passenger-miles of travel (or estimated trips) from the roadway were compared with the number of trips from existing transit service.

There are no other U.S. cities with ridership like New York City. Approximately one out of five U.S. transit trips are made in the New York area. Including these statistics would not present a useful comparison for typical cities over 3 million population; the New York data were removed from this comparison. The transit ridership increase that would be needed for each year in the remaining areas is shown in Exhibit 34.

Exhibit 34. Increase in Existing Transit System to Hold Congestion Constant



Note: The New York urban area statistics have been removed from the calculation.

- The Very Large urban areas would have to increase transit trips by over 20 percent to maintain a constant congestion level.
- The Large and Medium urban areas would have to add more than half as many transit trips as they already have to maintain a constant congestion level.
- The Small urban areas would have to more than double their existing transit ridership to maintain their congestion level.

HOW SHOULD WE ADDRESS THE MOBILITY PROBLEM?

Just as congestion has a number of potential causes, there are several ways to address the problem. Generally, the approaches can be grouped under four main strategies – adding capacity, increasing the efficiency of the existing system, better management of construction and maintenance projects, and managing the demand. The benefits associated with these improvements include reduced delay, and more predictable and lower trip times. Emissions may be reduced due to the reduction in demand or congestion, improved efficiencies and the change in the way travelers use the system. The locations of congestion may also move over time due to the new development that occurs or is encouraged by the new transportation facilities.

More Travel Options

While not a specific improvement, providing more options for how a trip is made, the time of travel and the way that transportation service is paid for may be a useful mobility improvement framework for urban areas. For many trips and in many cities, the alternatives for a peak period trip are to travel earlier or later, avoid the trip or travel in congestion. Given the range of choices that Americans enjoy in many other aspects of daily life, these are relatively few and not entirely satisfying options.

The Internet has facilitated electronic "trips." There are a variety of time-shift methods that involve relationships between communication and transportation. Using a computer or phone to work at home for a day, or just one or two hours, can reduce the peak system demand levels without dramatically altering lifestyles.

Using information and pricing options can improve the usefulness of road space as well as offering a service that some residents find very valuable. People who are late for a meeting, a family gathering or other important event could use a priced lane to show that importance on a few or many occasions – a choice that does not exist for most trips.

The diversity of transportation needs is not matched by the number of travel alternatives. The private auto offers flexibility in time of travel, route and comfort level. Transit can offer some advantages in avoiding congestion or unreliable travel conditions. But many of the mobility improvements below can be part of creating a broader set of options.

Add Capacity

Adding capacity is the best known, and probably most frequently used, improvement option. Pursuing an "add capacity" strategy can mean more traffic lanes, additional buses or new bus routes, new roadways or improved design components as well as a number of other options. Grade separations and better roadway intersection design, along with managed lanes and dedicated bus and carpool priority lanes, can also contribute to moving more traffic through a given spot in the same or less time. The addition of, or improvements to heavy rail, commuter rail, bus system, and improvement in the freight rail system all can assist in adding capacity to varying degrees. In growing areas, adding capacity of all types is essential to handle the growing demand and avoid rapidly rising congestion.

Manage the Demand

Demand management strategies include a variety of methods to move trips away from the peak travel periods. These are either a function of making it easier to combine trips via ridesharing or transit use, or providing methods to reduce vehicle trips via tele-travel or different development designs.

The fact is, transportation system demand and land use patterns are linked and influence each other. There is a variety of strategies that can be implemented to either change the way that travelers affect the system or the approaches used to plan and design the shops, offices, homes, schools, medical facilities and other land uses.

Relatively few neighborhoods, office parks, etc. will be developed for auto-free characteristics—that is not the goal of most of these treatments. The idea is that some characteristics can be incorporated into new developments so that new economic development does not generate the same amount of traffic volume as existing developments. Among the tools that can be employed are better management of arterial street access, incorporating bicycle and pedestrian elements, better parking strategies, assessing transportation impact before a development is approved for construction, and encouraging more diverse development patterns. These changes are not a congestion panacea, but they are part of a package of techniques that are being used to address "quality-of-life" concerns—congestion being only one of many.

Increase Efficiency of the System

Sometimes, the more traditional approach of simply adding more capacity is not possible or not desirable. However, improvements can still be made by increasing the efficiency of the existing system. These treatments are particularly effective in three ways. They are relatively low cost and high benefit which is efficient from a funding perspective. They can usually be implemented quickly and can be tailored to individual situations making them more useful because they are flexible. They are usually a distinct, visible change; it is obvious that the operating agencies are reacting to the situation and attempting improvements.

In many cases, the operations improvements also represent a "stretching" of the system to the point where the margin of error is relatively low. It is important to capitalize on the potential efficiencies – no one wants to sit through more traffic signal cycles or behind a disabled vehicle if it is not necessary – but the efficiency improvements also have limits. The basic transportation system—the roads, transit vehicles and facilities, sidewalks and more—is designed to accommodate a certain amount of use. Some locations, however, present bottlenecks, or constraints, to smooth flow. At other times, high volume congests the entire system, so strategies to improve system efficiency by improving peak hour mobility are in order. The community and travelers can benefit from reduced congestion and reduced emissions, as well as more efficiently utilizing the infrastructure already in place.

Among the strategies that fall into this category are tools that make improvements in intersections, traffic signals, freeway entrance ramps, special event management (e.g., managing traffic before and after large sporting or entertainment events) and incident management. In addition such strategies as one-way streets, electronic toll collection systems, and changeable lane assignments are often helpful.

Freeway entrance ramp metering (i.e., traffic signals that regulate the traffic flow entering the freeway) and incident management (i.e., finding and removing stalled or crashed vehicles) are two operations treatments highlighted in this report. When properly implemented, monitored and aggressively managed, they can decrease the average travel time and significantly improve the predictability of transportation service. Both can decrease vehicle crashes by smoothing traffic flow and reducing unexpected stop-and-go conditions. Both treatments can also enhance conditions for both private vehicles and transit.

Manage Construction and Maintenance Projects

When construction takes place to provide more lanes, new roadways, or improved intersections, or during maintenance of the existing road system, the effort to improve mobility can itself cause congestion. Better techniques in managing construction and maintenance programs can make a difference. Some of the strategies involve methods to improve the construction phase by shortening duration of construction, or moving the construction to periods where traffic volume is relatively low. Among the strategies that might be considered include providing contractor incentives for completing work ahead of schedule or penalties for missed construction milestones, adjustments in the contract working day, using design-build strategies, or maintenance of traffic strategies during construction to minimize delays.

Role of Pricing

Urban travelers pay for congestion by sitting in traffic or on crowded transit vehicles. Anthony Downs (16), among many, has suggested this is the price that Americans are willing to pay for the benefits that they derive from the land development and activity arrangements that cause the congestion. But for most Americans there is no mechanism that allows them to show that they place a higher value on certain trips. Finding a way to incorporate a pricing mechanism into some travel corridors could provide an important option for urban residents and freight shippers.

A fee has been charged on some transportation projects for a long time. Toll highways and transit routes are two familiar examples. An extension of this concept would treat transportation services like most other aspects of society. There would be a direct charge for using more important system elements. Price is used to regulate the use and demand patterns of telephones, movie seats, electricity, food and many other elements of the economy. In addition to direct charges, transportation facilities and operations are typically paid for by per-gallon fees, sales taxes or property taxes. One could also include the extra time spent in congestion as another way to pay for transportation.

Electronic tolling methods provide a way for travelers to pay for their travel without being penalized by stopping to pay a fee. Electronics can also be used to reduce the fee for travelers in certain social programs (e.g., welfare to work) or to vary the fee by time of day or congestion level. Implementing these special lanes as an addition to roads (rather than converting existing lanes) has been the most common method of instituting pricing options in a corridor. This offers a choice of a premium service for a fee, or lower speed, less reliable travel with no additional fee.

Importance of Evaluating Transportation Systems

Providing the public and decision-makers with a sufficient amount of understandable information can help "make the case" for transportation. Part of the implementation and operation of transportation projects and programs should be a commitment to collecting evaluation data. These statistics not only improve the effectiveness of individual projects, but they also provide the comparative data needed to balance transportation needs and opportunities with other societal imperatives whether those are other infrastructure assets or other programs.

THE BIG PICTURE

There are many statistics in the Annual Mobility Study that can be applied to the search for solutions to mobility problems. It is very important, however, that the role of transportation in American cities be understood as one of many elements that determine the concept of "quality of life." Road congestion is slow speeds caused by heavy traffic and/or narrow roadways due to construction, incidents, or too few lanes for the demand. It has corollaries in transit, sidewalks and the Internet. Over the last 20 years, traffic volumes have increased faster than road capacity. Alternative modes, new technologies, innovative land-use patterns, demand management techniques and operating treatments have not provided the needed relief either because they are not extensive enough, or they are not used for enough trips.

Urban residents trade off a variety of factors and cost elements in the search for the best situation. Transportation professionals, as well as developers, land planners, government officials, and others, are realizing that these trade-offs are made across a spectrum that might best be represented as several niche markets, rather than one or two large ones. Schools, shops, jobs, parking, health care and many other issues "compete" in some sense with transportation issues for attention and investment.

Some general conclusions can be drawn from the 1982 to 2001 database.

1. **There is some good news --** The urban road and transit systems have handled a lot more travel. Congestion time penalties are three to four times greater than in 1982, but almost double the amount of travel has been accommodated.

2. **We are not doing enough**—There aren't enough improvements to the system to keep congestion from growing. Hours of delay, the time of day and the miles of road that are congested have grown every year.

3. **Roads are part of the solution.** Areas that have added roads have seen congestion levels grow more slowly than other cities. More than 90 percent of urban peak-period person travel is on roads, and a significant amount of freight moves on roads.

4. **But, roads cannot be the only solution in most cities.** It will be difficult for most big cities to address their mobility needs by only constructing more roads. This is partly a funding issue—transportation spending should probably double in larger cities if there is an interest in reducing congestion. In some corridors or some activity centers, the additional transportation needed is for walk, bike, and public transportation modes that are more consistent with the nearby developments. It is also; however, an issue of project approval. Many Americans do not want major transportation projects near their home or neighborhood. It is difficult to imagine many urban street and freeway corridors with an extra 4, 6 or 8 lanes, but it may be required if the goal is to significantly reduce congestion by adding roads.

5. **Transit improvements, better traffic signal operations, aggressive incident management programs, adjusted work hours, telecommuting and a range of other efficiency options are absolutely vital components of an overall solution.** Individually they do not seem to offer the promise of large increases in person carrying capacity for the current system. But their cumulative effects can be a substantial improvement and may represent feasible strategies in areas where no other solutions are viable. The effect of some of these treatments was included in the Annual Mobility Report for the first time this year.

6. **Policy options, including value pricing, peak-travel restrictions, education programs, innovative mortgage arrangements, and a variety of other strategies not evaluated in this report present opportunities for improving transportation**. Some of these are difficult to get approved in the political and/or public approval stages. They require some changes in the way transportation services are viewed and some changes in the way we live and travel. But for some travel markets in some areas, they may provide the right combination of service and price.

7. **Reliability in transportation service is emerging as an important issue.** The Annual Mobility Report database will be expanded in the future to include estimates and directly collected data about the variations in travel time, as well as the averages.

Some of the solution lies in better management—improving on practices that are already known and utilized and developing new expertise. In the 1950s and 1960s, state highway agencies managed the construction of a large highway system. In the 1970s transportation agencies tried to improve the system by managing the supply, and in the 1980s a variety of transportation and planning agencies and private sector companies started to manage the demand patterns. In the 1990s, the management effort was focused on better system operations for roads and transit.

- Most large city transportation agencies are pursuing all of these traditional projects and programs. The mix may be different in each city and the pace of implementation varies according to overall funding, commitment, location of problems, public support and other factors. It seems that these same agencies could also provide some information about the expected outcome of the transportation system improvements. Big city residents should expect congestion on roads for 1 or 2 hours in the morning and in the evening. The agencies should be able to improve the performance and reliability of the service at other hours and they may be able to slow the growth of congestion, but they cannot expand the system or improve the operation enough to eliminate congestion.

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CAUTION: See http://mobility.tamu.edu/ums for improved performance measures and updated data.

Exhibit A-1. Urban Area Information

Population Group	Urban Area	2001 Population	Population Growth` 1982 to 2001 Change (%)	Population Growth` 1996 to 2001 Change (%)	2001 Urban Area Size (sq. mi.)	2001 Urban Area Population Density (pers/sq.mi.)
Vlg	New York, NY-Northeastern, NJ	17,160	11	5	4,070	4,215
Vlg	Los Angeles, CA	12,770	29	5	2,230	5,725
Vlg	Chicago, IL-Northwestern, IN	8,110	15	3	2,780	2,915
Vlg	Philadelphia, PA-NJ	4,600	12	2	1,390	3,310
Vlg	San Francisco-Oakland, CA	4,045	23	4	1,260	3,210
Vlg	Detroit, MI	4,030	6	0	1,320	3,055
Vlg	Dallas-Fort Worth, TX	3,840	57	9	1,870	2,055
Vlg	Washington, DC-MD-VA	3,730	38	8	1,040	3,585
Vlg	Houston, TX	3,475	45	13	1,765	1,970
Vlg	Boston, MA	3,030	6	1	1,165	2,600
Lrg	Atlanta, GA	2,990	86	21	1,820	1,645
Lrg	Phoenix, AZ	2,900	103	24	1,130	2,565
Lrg	San Diego, CA	2,695	51	5	760	3,545
Lrg	Minneapolis-St. Paul, MN	2,440	39	8	1,240	1,970
Lrg	Miami-Hialeah, FL	2,265	31	10	565	4,010
Lrg	Baltimore, MD	2,210	30	3	755	2,925
Lrg	Seattle-Everett, WA	2,065	43	6	880	2,345
Lrg	St. Louis, MO-IL	2,055	10	3	1,135	1,810
Lrg	Denver, CO	2,025	50	14	850	2,380
Lrg	Tampa-St Petersburg-Clearwater, FL	2,000	41	9	1,340	1,495
Lrg	Cleveland, OH	1,870	7	1	840	2,225
Lrg	Pittsburgh, PA	1,790	-1	1	1,010	1,770
Lrg	San Jose, CA	1,680	29	5	390	4,310
Lrg	Ft. Lauderdale-Hollywood-Pompano Bch, FL	1,625	53	12	530	3,065
Lrg	Portland-Vancouver, OR-WA	1,590	41	17	500	3,180
Lrg	Norfolk-Newport News-Virginia Beach, VA	1,520	38	6	985	1,545
Lrg	San Bernardino-Riverside, CA	1,445	61	7	550	2,625
Lrg	Kansas City, MO-KS	1,425	31	6	1,030	1,385
Lrg	Sacramento, CA	1,405	69	12	415	3,385
Lrg	Milwaukee, WI	1,400	16	10	580	2,415
Lrg	Cincinnati, OH-KY	1,290	14	2	665	1,940
Lrg	San Antonio, TX	1,260	31	3	505	2,495
Lrg	Las Vegas, NV	1,255	179	26	295	4,255
Lrg	Orlando, FL	1,220	100	15	670	1,820
Lrg	Buffalo-Niagara Falls, NY	1,115	4	4	580	1,920
Lrg	New Orleans, LA	1,095	7	1	370	2,960
Lrg	Oklahoma City, OK	1,085	70	11	690	1,570
Lrg	W Palm Bch-Boca Raton-Delray Bch, FL	1,075	87	19	600	1,790
Lrg	Columbus, OH	1,050	26	3	490	2,145
Lrg	Indianapolis, IN	1,030	20	2	500	2,060
Med	Memphis, TN-AR-MS	980	29	3	425	2,305
Med	Providence-Pawtucket, RI-MA	930	13	3	530	1,755
Med	Salt Lake City, UT	910	34	6	395	2,305
Med	Jacksonville, FL	890	45	9	740	1,205
Med	Louisville, KY-IN	840	9	2	410	2,050
Med	Tulsa, OK	805	68	9	405	1,990
Med	Austin, TX	760	85	21	415	1,830
Med	Tucson, AZ	705	57	10	320	2,205
Med	Richmond, VA	700	43	13	420	1,665
Med	Honolulu, HI	700	23	-1	140	5,000
Med	Nashville, TN	670	28	4	600	1,115
Med	Birmingham, AL	670	12	2	605	1,105
Med	Charlotte, NC	665	90	17	330	2,015
Med	El Paso, TX-NM	660	47	9	250	2,640
Med	Rochester, NY	655	2	5	345	1,900
Med	Hartford-Middletown, CT	645	14	2	380	1,695
Med	Omaha, NE-IA	630	26	12	245	2,570
Med	Tacoma, WA	615	46	4	355	1,730
Med	Albuquerque, NM	590	34	5	285	2,070
Med	Fresno, CA	560	62	6	190	2,945
Med	Albany-Schenectady-Troy, NY	520	4	5	375	1,385
Sml	Colorado Springs, CO	470	68	18	250	1,880
Sml	Charleston, SC	460	35	8	280	1,645
Sml	Bakersfield, CA	410	78	12	185	2,215
Sml	Spokane, WA	335	22	5	175	1,915
Sml	Corpus Christi, TX	320	28	3	200	1,600
Sml	Pensacola, FL	305	36	7	195	1,565
Sml	Fort Myers-Cape Coral, FL	300	54	13	275	1,090
Sml	Anchorage, AK	260	18	4	190	1,370
Sml	Eugene-Springfield, OR	230	21	10	110	2,090
Sml	Salem, OR	210	31	17	80	2,625
Sml	Laredo, TX	190	100	27	50	3,800
Sml	Brownsville, TX	160	78	19	55	2,910
Sml	Beaumont, TX	145	21	7	110	1,320
Sml	Boulder, CO	110	38	5	45	2,445
	75 area average	1,796	29	7	692	2,375
	Very large area average	6,479	20	5	1,889	3,264
	Large area average	1,696	40	9	756	2,452
	Medium area average	719	33	7	389	2,070
	Small area average	279	20	10	157	2,034

Notes: Vlg – Very Large urban areas—over 3 million population.
Lrg – Large urban areas—over 1 million and less than 3 million population.
Med – Medium urban areas—over 500,000 and less than 1 million population.
Sml – Small urban areas—less than 500,000 population.

CAUTION: See http://mobility.tamu.edu/ums for improved performance measures and updated data.

Exhibit A-2. 2001 Urban Mobility Conditions

Population Group	Urban Area	*Travel Time Index*		*Annual Hours of Delay*			Percentage of Freeway and Principal Arterial Street Travel Covered by Operational Treatments
		With Strategies	*Base*	*per Person (base)*	*Reduction due to Operations*	*Savings due to Public Transportation*	
Vlg	Los Angeles, CA	1.76	1.83	52	2.4	9.8	34.4
Vlg	San Francisco-Oakland, CA	1.48	1.60	42	4.5	20.8	49.5
Vlg	Chicago, IL-Northwestern, IN	1.41	1.49	27	1.1	9.9	43.2
Vlg	Washington, DC-MD-VA	1.39	1.47	34	1.5	14.8	46.8
Vlg	Boston, MA	1.39	1.47	29	1.6	20.6	22.5
Vlg	Houston, TX	1.36	1.39	37	2.2	6.2	54.9
Vlg	Detroit, MI	1.35	1.36	27	0.6	1.5	31.3
Vlg	Dallas-Fort Worth, TX	1.32	1.33	36	1.4	2.9	29.6
Vlg	Philadelphia, PA-NJ	1.27	1.30	17	1.0	6.8	31.2
Vlg	New York, NY-Northeastern, NJ	1.26	1.41	25	2.5	22.4	34.8
Lrg	Denver, CO	1.44	1.47	36	0.3	5.6	14.8
Lrg	Miami-Hialeah, FL	1.43	1.46	33	2.3	5.0	49.5
Lrg	Phoenix, AZ	1.41	1.43	28	2.0	1.7	71.7
Lrg	San Jose, CA	1.40	1.43	34	3.2	4.1	51.9
Lrg	Portland-Vancouver, OR-WA	1.39	1.44	24	1.8	8.1	39.3
Lrg	Ft. Lauderdale-Hollywood-Pompano Bch, FL	1.38	1.40	28	1.2	3.8	45.1
Lrg	Seattle-Everett, WA	1.37	1.43	32	1.5	14.0	45.0
Lrg	Atlanta, GA	1.36	1.39	34	2.1	8.3	36.6
Lrg	San Bernardino-Riverside, CA	1.36	1.39	34	2.2	2.6	38.5
Lrg	Minneapolis-St. Paul, MN	1.34	1.39	28	3.6	4.7	62.1
Lrg	Las Vegas, NV	1.32	1.35	16	0.3	3.6	20.2
Lrg	San Diego, CA	1.32	1.36	25	2.9	4.6	73.4
Lrg	Tampa-St Petersburg-Clearwater, FL	1.32	1.32	24	0.2	0.7	26.0
Lrg	Orlando, FL	1.31	1.32	33	0.9	2.1	47.8
Lrg	Sacramento, CA	1.30	1.33	19	1.8	2.1	63.5
Lrg	Baltimore, MD	1.29	1.32	22	1.5	7.3	34.7
Lrg	W Palm Bch-Boca Raton-Delray Bch, FL	1.26	1.26	19	0.5	0.6	33.8
Lrg	Indianapolis, IN	1.26	1.27	23	0.5	0.7	18.3
Lrg	Cincinnati, OH-KY	1.25	1.26	20	0.9	2.4	29.7
Lrg	Milwaukee, WI	1.24	1.26	14	1.2	2.9	51.7
Lrg	San Antonio, TX	1.20	1.21	18	0.1	2.8	18.9
Lrg	St. Louis, MO-IL	1.20	1.21	18	0.4	1.6	20.2
Lrg	Columbus, OH	1.19	1.19	17	0.0	1.3	6.2
Lrg	Norfolk-Newport News-Virginia Beach, VA	1.19	1.19	13	0.6	1.1	38.6
Lrg	New Orleans, LA	1.17	1.18	10	0.1	1.9	10.8
Lrg	Cleveland, OH	1.11	1.12	7	0.3	1.6	23.2
Lrg	Kansas City, MO-KS	1.11	1.11	9	0.3	0.3	18.3
Lrg	Pittsburgh, PA	1.09	1.10	7	0.2	2.2	14.0
Lrg	Oklahoma City, OK	1.09	1.10	6	0.0	0.1	4.9
Lrg	Buffalo-Niagara Falls, NY	1.08	1.08	5	0.3	0.7	31.4
Med	Austin, TX	1.30	1.31	30	1.6	3.3	38.6
Med	Charlotte, NC	1.26	1.27	21	0.8	2.2	31.9
Med	Tacoma, WA	1.24	1.27	15	0.7	3.6	48.5
Med	Tucson, AZ	1.24	1.25	14	0.1	1.1	47.0
Med	Albuquerque, NM	1.23	1.23	18	0.2	0.8	23.4
Med	Providence-Pawtucket, RI-MA	1.22	1.23	21	0.1	0.9	7.4
Med	Louisville, KY-IN	1.22	1.22	19	0.6	1.2	25.7
Med	Memphis, TN-AR-MS	1.21	1.22	17	1.1	1.2	26.0
Med	Salt Lake City, UT	1.19	1.20	11	0.3	2.3	53.4
Med	Nashville, TN	1.18	1.18	21	1.0	0.6	20.3
Med	El Paso, TX-NM	1.17	1.18	11	0.6	1.7	50.0
Med	Birmingham, AL	1.17	1.17	15	0.6	0.2	32.6
Med	Omaha, NE-IA	1.16	1.17	12	0.2	0.3	41.2
Med	Fresno, CA	1.16	1.17	9	0.2	0.9	49.0
Med	Honolulu, HI	1.16	1.19	10	0.1	7.6	7.0
Med	Jacksonville, FL	1.15	1.16	15	0.4	0.6	37.0
Med	Tulsa, OK	1.12	1.13	8	0.0	0.4	2.0
Med	Hartford-Middletown, CT	1.12	1.13	10	0.6	1.0	26.8
Med	Richmond, VA	1.10	1.10	10	0.0	0.7	5.6
Med	Albany-Schenectady-Troy, NY	1.06	1.07	6	0.0	0.4	23.1
Med	Rochester, NY	1.06	1.06	3	0.0	0.3	10.2
Sml	Colorado Springs, CO	1.19	1.19	13	0.2	0.4	23.7
Sml	Charleston, SC	1.17	1.18	11	0.2	0.4	20.8
Sml	Fort Myers-Cape Coral, FL	1.15	1.15	7	0.1	0.4	49.1
Sml	Pensacola, FL	1.12	1.12	10	0.1	0.2	34.2
Sml	Eugene-Springfield, OR	1.10	1.11	5	0.1	0.9	8.4
Sml	Salem, OR	1.10	1.10	7	0.0	0.4	9.1
Sml	Boulder, CO	1.09	1.10	5	0.0	0.5	19.7
Sml	Laredo, TX	1.08	1.08	4	0.1	0.4	29.4
Sml	Brownsville, TX	1.07	1.08	3	0.1	0.4	32.1
Sml	Spokane, WA	1.07	1.07	5	0.1	0.6	27.7
Sml	Bakersfield, CA	1.06	1.06	4	0.0	0.4	40.4
Sml	Beaumont, TX	1.06	1.06	6	0.0	0.2	5.1
Sml	Corpus Christi, TX	1.05	1.05	4	0.0	0.6	12.6
Sml	Anchorage, AK	1.05	1.05	3	0.1	0.1	13.0
	75 area average	1.34	1.39	26	1.5	8.0	36.3
	Very large area average	1.44	1.52	32	2.0	13.3	37.4
	Large area average	1.30	1.32	22	1.3	3.8	38.2
	Medium area average	1.18	1.19	14	0.5	1.5	28.3
	Small area average	1.11	1.11	7	0.1	0.4	24.0

Notes: Only includes estimated freeway and principal arterial street travel conditions.
Vlg – Very Large urban areas—over 3 million population.
Lrg – Large urban areas—over 1 million and less than 3 million population.
Med – Medium urban areas—over 500,000 and less than 1 million population.
Sml – Small urban areas—less than 500,000 population.

CAUTION: See http://mobility.tamu.edu/ums for improved performance measures and updated data.

Exhibit A-3. Point Change in Travel Time Index, 1982 to 2001

Population Group	*Urban Area*	*Travel Time Index*						*Point Change in Peak-Period Time Penalty*	
		1982	*1986*	*1990*	*1996*	*2000*	*2001*	*Long-Term 1982 to 2001 Points*	*Short-Term 1996 to 2001 Points*
Vlg	San Francisco-Oakland, CA	1.21	1.42	1.50	1.45	1.59	1.60	39	15
Vlg	Dallas-Fort Worth, TX	1.07	1.15	1.18	1.22	1.33	1.33	26	11
Vlg	Boston, MA	1.14	1.19	1.27	1.37	1.45	1.47	33	10
Vlg	Houston, TX	1.28	1.42	1.30	1.30	1.38	1.39	11	9
Vlg	New York, NY-Northeastern, NJ	1.13	1.15	1.31	1.34	1.41	1.41	28	7
Vlg	Chicago, IL-Northwestern, IN	1.19	1.30	1.36	1.44	1.46	1.49	30	5
Vlg	Los Angeles, CA	1.30	1.44	1.80	1.78	1.82	1.83	53	5
Vlg	Philadelphia, PA-NJ	1.11	1.16	1.18	1.25	1.28	1.30	19	5
Vlg	Detroit, MI	1.12	1.15	1.28	1.33	1.34	1.36	24	3
Vlg	Washington, DC-MD-VA	1.18	1.24	1.33	1.44	1.45	1.47	29	3
Lrg	Ft. Lauderdale-Hollywood-Pompano Bch, FL	1.07	1.10	1.14	1.22	1.35	1.40	33	18
Lrg	Minneapolis-St. Paul, MN	1.03	1.08	1.12	1.23	1.38	1.39	36	16
Lrg	Denver, CO	1.10	1.13	1.17	1.33	1.42	1.47	37	14
Lrg	Phoenix, AZ	1.13	1.19	1.22	1.30	1.40	1.43	30	13
Lrg	Portland-Vancouver, OR-WA	1.05	1.08	1.16	1.31	1.40	1.44	39	13
Lrg	San Diego, CA	1.06	1.11	1.24	1.23	1.36	1.36	30	13
Lrg	San Bernardino-Riverside, CA	1.04	1.10	1.24	1.28	1.36	1.39	35	11
Lrg	Atlanta, GA	1.08	1.12	1.14	1.29	1.37	1.39	31	10
Lrg	Orlando, FL	1.09	1.14	1.16	1.22	1.29	1.32	23	10
Lrg	San Jose, CA	1.18	1.29	1.44	1.33	1.42	1.43	25	10
Lrg	Miami-Hialeah, FL	1.16	1.20	1.32	1.37	1.46	1.46	30	9
Lrg	Sacramento, CA	1.07	1.11	1.20	1.24	1.31	1.33	26	9
Lrg	San Antonio, TX	1.05	1.09	1.08	1.12	1.23	1.21	16	9
Lrg	Baltimore, MD	1.07	1.12	1.21	1.24	1.29	1.31	24	7
Lrg	Cincinnati, OH-KY	1.04	1.05	1.12	1.20	1.26	1.26	22	6
Lrg	Milwaukee, WI	1.05	1.08	1.12	1.20	1.27	1.26	21	6
Lrg	W Palm Bch-Boca Raton-Delray Bch, FL	1.04	1.07	1.12	1.21	1.25	1.26	22	5
Lrg	Buffalo-Niagara Falls, NY	1.03	1.02	1.04	1.04	1.08	1.08	5	4
Lrg	Las Vegas, NV	1.07	1.11	1.23	1.30	1.35	1.34	27	4
Lrg	Kansas City, MO-KS	1.01	1.03	1.04	1.08	1.11	1.11	10	3
Lrg	Oklahoma City, OK	1.02	1.03	1.03	1.07	1.09	1.10	8	3
Lrg	St. Louis, MO-IL	1.08	1.11	1.11	1.19	1.24	1.21	13	2
Lrg	Indianapolis, IN	1.03	1.03	1.06	1.25	1.25	1.26	23	1
Lrg	Norfolk-Newport News-Virginia Beach, VA	1.08	1.12	1.15	1.18	1.17	1.19	11	1
Lrg	Tampa-St Petersburg-Clearwater, FL	1.19	1.22	1.26	1.31	1.29	1.32	13	1
Lrg	Pittsburgh, PA	1.08	1.09	1.10	1.10	1.10	1.10	2	0
Lrg	Columbus, OH	1.03	1.04	1.10	1.20	1.19	1.19	16	-1
Lrg	New Orleans, LA	1.10	1.14	1.16	1.20	1.18	1.18	8	-2
Lrg	Seattle-Everett, WA	1.09	1.20	1.33	1.45	1.41	1.43	34	-2
Lrg	Cleveland, OH	1.02	1.02	1.06	1.15	1.13	1.12	10	-3
Med	El Paso, TX-NM	1.02	1.03	1.04	1.07	1.17	1.18	16	11
Med	Tucson, AZ	1.06	1.07	1.11	1.16	1.21	1.25	19	9
Med	Austin, TX	1.08	1.10	1.12	1.23	1.27	1.31	23	8
Med	Tacoma, WA	1.04	1.07	1.11	1.19	1.23	1.27	23	8
Med	Charlotte, NC	1.08	1.14	1.16	1.20	1.27	1.27	19	7
Med	Providence-Pawtucket, RI-MA	1.04	1.08	1.12	1.16	1.21	1.22	18	6
Med	Tulsa, OK	1.02	1.03	1.05	1.07	1.12	1.13	11	6
Med	Hartford-Middletown, CT	1.05	1.08	1.09	1.07	1.12	1.12	7	5
Med	Birmingham, AL	1.05	1.06	1.06	1.13	1.17	1.17	12	4
Med	Fresno, CA	1.05	1.06	1.13	1.13	1.20	1.17	12	4
Med	Memphis, TN-AR-MS	1.03	1.05	1.09	1.18	1.21	1.22	19	4
Med	Nashville, TN	1.07	1.09	1.10	1.14	1.18	1.18	11	4
Med	Louisville, KY-IN	1.09	1.09	1.08	1.19	1.24	1.22	13	3
Med	Omaha, NE-IA	1.04	1.08	1.09	1.14	1.15	1.17	13	3
Med	Salt Lake City, UT	1.03	1.05	1.08	1.17	1.19	1.20	17	3
Med	Albany-Schenectady-Troy, NY	1.06	1.02	1.04	1.05	1.06	1.07	1	2
Med	Rochester, NY	1.01	1.02	1.03	1.05	1.06	1.06	5	1
Med	Albuquerque, NM	1.04	1.07	1.10	1.23	1.24	1.23	19	0
Med	Richmond, VA	1.02	1.04	1.05	1.10	1.10	1.10	8	0
Med	Jacksonville, FL	1.04	1.05	1.11	1.17	1.15	1.16	12	-1
Med	Honolulu, HI	1.10	1.13	1.21	1.23	1.18	1.19	9	-4
Sml	Colorado Springs, CO	1.02	1.03	1.04	1.11	1.20	1.19	17	8
Sml	Charleston, SC	1.08	1.10	1.15	1.13	1.19	1.18	10	5
Sml	Eugene-Springfield, OR	1.02	1.03	1.04	1.06	1.12	1.11	9	5
Sml	Boulder, CO	1.02	1.03	1.03	1.06	1.09	1.10	8	4
Sml	Brownsville, TX	1.02	1.03	1.04	1.05	1.08	1.08	6	3
Sml	Anchorage, AK	1.04	1.05	1.05	1.03	1.04	1.05	1	2
Sml	Beaumont, TX	1.03	1.03	1.03	1.04	1.05	1.06	3	2
Sml	Corpus Christi, TX	1.03	1.03	1.03	1.03	1.04	1.05	2	2
Sml	Fort Myers-Cape Coral, FL	1.04	1.07	1.09	1.13	1.15	1.15	11	2
Sml	Laredo, TX	1.02	1.03	1.03	1.06	1.07	1.08	6	2
Sml	Pensacola, FL	1.03	1.05	1.08	1.10	1.14	1.12	9	2
Sml	Salem, OR	1.02	1.03	1.04	1.08	1.10	1.10	8	2
Sml	Bakersfield, CA	1.01	1.01	1.03	1.05	1.06	1.06	5	1
Sml	Spokane, WA	1.02	1.03	1.03	1.06	1.08	1.07	5	1
	75 area average	1.13	1.19	1.29	1.33	1.38	1.39	26	6
	Very large area average	1.19	1.29	1.44	1.46	1.51	1.52	33	6
	Large area average	1.08	1.12	1.18	1.24	1.30	1.32	24	8
	Medium area average	1.05	1.07	1.09	1.15	1.18	1.19	14	4
	Small area average	1.03	1.04	1.06	1.08	1.11	1.11	8	3

Notes: Vlg – Very Large urban areas—over 3 million population.
Lrg – Large urban areas—over 1 million and less than 3 million population.
Med – Medium urban areas—over 500,000 and less than 1 million population.
Sml – Small urban areas—less than 500,000 population.

CAUTION: See http://mobility.tamu.edu/ums for improved performance measures and updated data.

Exhibit A-4. Hours Change in Annual Delay per Person, 1982 to 2001

Population Group	*Urban Area*	*Annual Hours of Delay per Person*						*Long-Term Change 1982 to 2001*	*Short-Term Change 1996 to 2001*
		1982	*1986*	*1990*	*1996*	*2000*	*2001*	*Hours*	*Hours*
Vlg	Dallas-Fort Worth, TX	6	16	18	24	37	36	30	12
Vlg	San Francisco-Oakland, CA	12	28	37	31	40	42	30	11
Vlg	Houston, TX	19	30	23	27	36	37	18	10
Vlg	New York, NY-Northeastern, NJ	6	7	18	18	23	25	19	7
Vlg	Boston, MA	9	13	18	23	28	29	20	6
Vlg	Philadelphia, PA-NJ	5	8	9	13	15	17	12	4
Vlg	Washington, DC-MD-VA	10	14	21	31	33	34	24	3
Vlg	Chicago, IL-Northwestern, IN	6	12	17	26	26	27	21	1
Vlg	Detroit, MI	7	9	20	26	25	27	20	1
Vlg	Los Angeles, CA	19	29	53	54	55	52	33	-2
Lrg	Ft. Lauderdale-Hollywood-Pompano Bch, FL	3	5	8	15	26	28	25	13
Lrg	Orlando, FL	5	8	11	21	32	33	28	12
Lrg	Minneapolis-St. Paul, MN	1	5	8	17	26	28	27	11
Lrg	San Diego, CA	3	7	16	14	23	25	22	11
Lrg	Denver, CO	7	8	12	26	35	36	29	10
Lrg	San Bernardino-Riverside, CA	4	8	20	24	32	34	30	10
Lrg	San Jose, CA	10	21	43	25	33	34	24	9
Lrg	San Antonio, TX	3	8	6	10	20	18	15	8
Lrg	Phoenix, AZ	7	10	15	21	26	28	21	7
Lrg	Cincinnati, OH-KY	2	3	7	14	20	20	18	6
Lrg	Miami-Hialeah, FL	9	12	21	27	34	33	24	6
Lrg	Portland-Vancouver, OR-WA	3	4	8	19	22	24	21	5
Lrg	Atlanta, GA	6	11	11	30	33	34	28	4
Lrg	Baltimore, MD	4	7	15	18	20	22	18	4
Lrg	W Palm Bch-Boca Raton-Delray Bch, FL	1	4	7	15	19	19	18	4
Lrg	Buffalo-Niagara Falls, NY	1	1	2	2	5	5	4	3
Lrg	Las Vegas, NV	3	5	12	14	18	16	13	2
Lrg	Milwaukee, WI	2	4	5	12	15	14	12	2
Lrg	Sacramento, CA	5	8	14	17	19	19	14	2
Lrg	St. Louis, MO-IL	5	8	9	16	21	18	13	2
Lrg	Tampa-St Petersburg-Clearwater, FL	8	10	14	22	21	24	16	2
Lrg	Indianapolis, IN	2	2	4	22	21	23	21	1
Lrg	Kansas City, MO-KS	1	2	3	8	9	9	8	1
Lrg	Norfolk-Newport News-Virginia Beach, VA	5	7	9	12	11	13	8	1
Lrg	Oklahoma City, OK	1	2	2	5	6	6	5	1
Lrg	Columbus, OH	2	3	8	17	17	17	15	0
Lrg	Pittsburgh, PA	4	5	7	7	7	7	3	0
Lrg	New Orleans, LA	4	5	6	11	10	10	6	-1
Lrg	Cleveland, OH	1	1	3	10	8	7	6	-3
Lrg	Seattle-Everett, WA	6	14	25	37	31	32	26	-5
Med	Austin, TX	4	7	9	21	28	30	26	9
Med	Charlotte, NC	4	8	11	14	22	21	17	7
Med	El Paso, TX-NM	1	1	2	4	10	11	10	7
Med	Providence-Pawtucket, RI-MA	2	4	8	14	19	21	19	7
Med	Memphis, TN-AR-MS	1	2	5	11	16	17	16	6
Med	Nashville, TN	6	9	9	15	21	21	15	6
Med	Tucson, AZ	2	3	5	8	12	14	12	6
Med	Birmingham, AL	3	5	5	11	14	15	12	4
Med	Hartford-Middletown, CT	3	6	7	6	11	10	7	4
Med	Tacoma, WA	2	4	9	11	14	15	13	4
Med	Tulsa, OK	1	2	3	4	9	8	7	4
Med	Fresno, CA	3	3	8	6	11	9	6	3
Med	Omaha, NE-IA	2	4	5	9	11	12	10	3
Med	Salt Lake City, UT	1	2	4	8	10	11	10	3
Med	Albany-Schenectady-Troy, NY	3	2	4	4	6	6	3	2
Med	Louisville, KY-IN	4	5	5	17	21	19	15	2
Med	Richmond, VA	1	3	4	10	10	10	9	0
Med	Rochester, NY	0	1	2	3	3	3	3	0
Med	Jacksonville, FL	3	5	9	17	15	15	12	-2
Med	Albuquerque, NM	2	5	8	21	19	18	16	-3
Med	Honolulu, HI	4	7	13	13	10	10	6	-3
Sml	Colorado Springs, CO	1	2	2	6	13	13	12	7
Sml	Beaumont, TX	2	3	3	3	6	6	4	3
Sml	Boulder, CO	1	2	2	3	5	5	4	2
Sml	Charleston, SC	5	6	10	9	12	11	6	2
Sml	Corpus Christi, TX	2	2	2	2	3	4	2	2
Sml	Eugene-Springfield, OR	1	1	2	3	7	5	4	2
Sml	Laredo, TX	1	1	1	2	3	4	3	2
Sml	Pensacola, FL	1	3	6	8	11	10	9	2
Sml	Anchorage, AK	2	3	3	2	2	3	1	1
Sml	Bakersfield, CA	1	1	2	3	4	4	3	1
Sml	Brownsville, TX	1	1	1	2	3	3	2	1
Sml	Fort Myers-Cape Coral, FL	1	2	3	6	7	7	6	1
Sml	Salem, OR	1	2	3	6	7	7	6	1
Sml	Spokane, WA	1	2	2	4	5	5	4	1
	75 area average	7	11	18	22	26	26	19	4
	Very large area average	10	16	26	29	33	32	22	3
	Large area average	4	7	12	18	22	22	18	4
	Medium area average	3	4	6	11	14	14	11	3
	Small area average	2	3	4	5	7	7	5	2

Notes: Vlg – Very Large urban areas—over 3 million population.
Lrg – Large urban areas—over 1 million and less than 3 million population.
Med – Medium urban areas—over 500,000 and less than 1 million population.
Sml – Small urban areas—less than 500,000 population.

Exhibit A-5. Annual Hours of Delay, 2001

Population Group	Urban Area	Annual Hours of Delay (000)			Annual Hours of Delay per Person		
		Base	Reduction due to Operations	Savings due to Public Transportation	Base	Reduction due to Operations	Savings due to Public Transportation
Vlg	Los Angeles, CA	667,352	30,585	124,331	52	2.4	9.8
Vlg	New York, NY-Northeastern, NJ	421,856	43,320	383,084	25	2.5	22.4
Vlg	Chicago, IL-Northwestern, IN	220,265	9,505	80,365	27	1.1	9.9
Vlg	San Francisco-Oakland, CA	168,681	18,285	84,080	42	4.5	20.8
Vlg	Dallas-Fort Worth, TX	139,571	5,275	11,092	36	1.4	2.9
Vlg	Houston, TX	127,590	7,745	21,300	37	2.2	6.2
Vlg	Washington, DC-MD-VA	125,332	5,580	53,936	34	1.5	14.8
Vlg	Detroit, MI	108,253	2,610	6,215	27	0.6	1.5
Vlg	Boston, MA	86,778	4,880	62,330	29	1.6	20.6
Vlg	Philadelphia, PA-NJ	77,463	4,225	31,375	17	1.0	6.8
Lrg	Atlanta, GA	101,169	6,355	24,765	34	2.1	8.3
Lrg	Phoenix, AZ	80,603	5,680	4,860	28	2.0	1.7
Lrg	Miami-Hialeah, FL	75,269	5,095	11,283	33	2.3	5.0
Lrg	Denver, CO	73,019	705	11,350	36	0.3	5.6
Lrg	Minneapolis-St. Paul, MN	68,454	8,990	11,366	28	3.6	4.7
Lrg	San Diego, CA	67,887	7,970	12,300	25	2.9	4.6
Lrg	Seattle-Everett, WA	65,173	3,120	28,430	32	1.5	14.0
Lrg	San Jose, CA	56,524	5,350	6,930	34	3.2	4.1
Lrg	Baltimore, MD	49,671	3,185	16,130	22	1.5	7.3
Lrg	San Bernardino-Riverside, CA	49,285	3,195	3,765	34	2.2	2.6
Lrg	Tampa-St Petersburg-Clearwater, FL	48,097	485	1,370	24	0.2	0.7
Lrg	Ft. Lauderdale-Hollywood-Pompano Bch, FL	46,292	1,850	6,235	28	1.2	3.8
Lrg	Orlando, FL	40,417	1,130	2,545	33	0.9	2.1
Lrg	Portland-Vancouver, OR-WA	37,975	2,935	12,820	24	1.8	8.1
Lrg	St. Louis, MO-IL	36,761	900	3,370	18	0.4	1.6
Lrg	Sacramento, CA	26,993	2,440	2,910	19	1.8	2.1
Lrg	Cincinnati, OH-KY	26,000	1,130	3,145	20	0.9	2.4
Lrg	Indianapolis, IN	23,231	450	750	23	0.5	0.7
Lrg	San Antonio, TX	22,544	140	3,555	18	0.1	2.8
Lrg	W Palm Bch-Boca Raton-Delray Bch, FL	20,824	550	625	19	0.5	0.6
Lrg	Norfolk-Newport News-Virginia Beach, VA	20,094	1,005	1,660	13	0.6	1.1
Lrg	Milwaukee, WI	19,852	1,720	4,110	14	1.2	2.9
Lrg	Las Vegas, NV	19,828	355	4,515	16	0.3	3.6
Lrg	Columbus, OH	17,719	60	1,355	17	0.0	1.3
Lrg	Cleveland, OH	13,704	535	2,995	7	0.3	1.6
Lrg	Pittsburgh, PA	13,205	335	4,020	7	0.2	2.2
Lrg	Kansas City, MO-KS	12,939	460	385	9	0.3	0.3
Lrg	New Orleans, LA	11,406	110	2,065	10	0.1	1.9
Lrg	Oklahoma City, OK	6,818	30	80	6	0.0	0.1
Lrg	Buffalo-Niagara Falls, NY	5,487	305	765	5	0.3	0.7
Med	Austin, TX	22,627	1,255	2,555	30	1.6	3.3
Med	Providence-Pawtucket, RI-MA	19,129	75	860	21	0.1	0.9
Med	Memphis, TN-AR-MS	16,758	1,005	1,210	17	1.1	1.2
Med	Louisville, KY-IN	15,733	560	1,015	19	0.6	1.2
Med	Charlotte, NC	14,267	530	1,470	21	0.8	2.2
Med	Nashville, TN	14,103	640	370	21	1.0	0.6
Med	Jacksonville, FL	13,709	330	530	15	0.4	0.6
Med	Albuquerque, NM	10,835	110	470	18	0.2	0.8
Med	Salt Lake City, UT	10,169	305	2,080	11	0.3	2.3
Med	Birmingham, AL	9,889	395	100	15	0.6	0.2
Med	Tucson, AZ	9,728	105	760	14	0.1	1.1
Med	Tacoma, WA	9,526	485	2,235	15	0.7	3.6
Med	Omaha, NE-IA	7,674	115	210	12	0.2	0.3
Med	El Paso, TX-NM	7,410	390	1,120	11	0.6	1.7
Med	Honolulu, HI	7,329	70	5,300	10	0.1	7.6
Med	Richmond, VA	7,118	10	505	10	0.0	0.7
Med	Hartford-Middletown, CT	6,622	390	615	10	0.6	1.0
Med	Tulsa, OK	6,192	5	300	8	0.0	0.4
Med	Fresno, CA	4,930	95	490	9	0.2	0.9
Med	Albany-Schenectady-Troy, NY	3,194	35	185	6	0.0	0.4
Med	Rochester, NY	2,144	45	235	3	0.0	0.3
Sml	Colorado Springs, CO	5,988	105	210	13	0.2	0.4
Sml	Charleston, SC	5,244	75	175	11	0.2	0.4
Sml	Pensacola, FL	3,042	35	65	10	0.1	0.2
Sml	Fort Myers-Cape Coral, FL	2,183	40	100	7	0.1	0.4
Sml	Bakersfield, CA	1,624	20	175	4	0.0	0.4
Sml	Spokane, WA	1,534	20	190	5	0.1	0.6
Sml	Salem, OR	1,432	10	90	7	0.0	0.4
Sml	Corpus Christi, TX	1,286	5	180	4	0.0	0.6
Sml	Eugene-Springfield, OR	1,236	25	185	5	0.1	0.9
Sml	Beaumont, TX	871	0	35	6	0.0	0.2
Sml	Laredo, TX	803	20	80	4	0.1	0.4
Sml	Anchorage, AK	676	15	45	3	0.1	0.1
Sml	Boulder, CO	566	0	65	5	0.0	0.5
Sml	Brownsville, TX	448	10	75	3	0.1	0.4
	75 area total	3,546,400	205,910	1,072,847	--	--	--
	75 area average	47,285	2,745.5	14,304.6	26	1.5	8.0
	Very large area average	214,314	13,201.0	85,810.8	32	2.0	13.3
	Large area average	38,575	2,219.0	6,348.5	22	1.3	3.8
	Medium area average	10,433	331.0	1,076.9	14	0.5	1.5
	Small area average	1,924	27.1	119.3	7	0.1	0.4

Notes: Vlg – Very Large urban areas—over 3 million population.
Lrg – Large urban areas—over 1 million and less than 3 million population.
Med – Medium urban areas—over 500,000 and less than 1 million population.
Sml – Small urban areas—less than 500,000 population.

CAUTION: See http://mobility.tamu.edu/ums for improved performance measures and updated data.

Exhibit A-6. Annual Delay Savings by Strategy, 2001

		Annual Delay Savings by Strategy (000)						
		Operational Treatments				*Public Transportation Strategies*		
Population Group	*Urban Area*	*Ramp Metering*	*Incident Management*	*Signal Coordination*	*Total*	*Public Trans.*	*HOV*	*Total*
Vlg	New York, NY-Northeastern, NJ	3,885	37,880	1,555	43,320	380,035	3049	383,084
Vlg	Los Angeles, CA	25,135	2,790	2,660	30,585	122,280	2051	124,331
Vlg	San Francisco-Oakland, CA	9,265	8,580	440	18,285	84,080	--	84,080
Vlg	Chicago, IL-Northwestern, IN	3,460	5,220	825	9,505	80,365	--	80,365
Vlg	Houston, TX	2,135	5,290	320	7,745	19,795	1505	21,300
Vlg	Washington, DC-MD-VA	595	4,485	500	5,580	51,260	2676	53,936
Vlg	Dallas-Fort Worth, TX	50	4,990	235	5,275	10,720	372	11,092
Vlg	Boston, MA	--	4,875	5	4,880	62,330	--	62,330
Vlg	Philadelphia, PA-NJ	245	3,730	250	4,225	31,375	--	31,375
Vlg	Detroit, MI	910	1,215	485	2,610	6,215	--	6,215
Lrg	Minneapolis-St. Paul, MN	7,125	1,765	100	8,990	11,105	261	11,366
Lrg	San Diego, CA	6,020	1,620	330	7,970	12,300	--	12,300
Lrg	Atlanta, GA	20	5,725	610	6,355	24,765	--	24,765
Lrg	Phoenix, AZ	2,175	2,865	640	5,680	4,860	--	4,860
Lrg	San Jose, CA	2,715	2,470	165	5,350	6,930	--	6,930
Lrg	Miami-Hialeah, FL	--	3,740	1,355	5,095	11,255	28	11,283
Lrg	San Bernardino-Riverside, CA	2,465	215	515	3,195	3,765	--	3,765
Lrg	Baltimore, MD	--	3,070	115	3,185	16,130	--	16,130
Lrg	Seattle-Everett, WA	2,025	815	280	3,120	27,455	975	28,430
Lrg	Portland-Vancouver, OR-WA	1,715	1,170	50	2,935	12,820	--	12,820
Lrg	Sacramento, CA	1,515	700	225	2,440	2,910	--	2,910
Lrg	Ft. Lauderdale-Hollywood-Pompano Bch, FL	--	1,595	255	1,850	6,235	--	6,235
Lrg	Milwaukee, WI	810	895	15	1,720	4,110	--	4,110
Lrg	Cincinnati, OH-KY	--	1,015	115	1,130	3,145	--	3,145
Lrg	Orlando, FL	95	740	295	1,130	2,545	--	2,545
Lrg	Norfolk-Newport News-Virginia Beach, VA	--	950	55	1,005	1,660	--	1,660
Lrg	St. Louis, MO-IL	--	490	410	900	3,370	--	3,370
Lrg	Denver, CO	--	--	705	705	11,350	--	11,350
Lrg	W Palm Bch-Boca Raton-Delray Bch, FL	--	435	115	550	625	--	625
Lrg	Cleveland, OH	--	475	60	535	2,995	--	2,995
Lrg	Tampa-St Petersburg-Clearwater, FL	--	260	225	485	1,370	--	1,370
Lrg	Kansas City, MO-KS	--	390	70	460	385	--	385
Lrg	Indianapolis, IN	--	280	170	450	750	--	750
Lrg	Las Vegas, NV	--	265	90	355	4,515	--	4,515
Lrg	Pittsburgh, PA	--	335	0	335	4,020	--	4,020
Lrg	Buffalo-Niagara Falls, NY	--	285	20	305	765	--	765
Lrg	San Antonio, TX	--	40	100	140	3,555	--	3,555
Lrg	New Orleans, LA	--	105	5	110	2,065	--	2,065
Lrg	Columbus, OH	5	20	35	60	1,355	--	1,355
Lrg	Oklahoma City, OK	--	--	30	30	80	--	80
Med	Austin, TX	--	1,095	160	1255	2,555	--	2,555
Med	Memphis, TN-AR-MS	--	940	65	1005	1,210	--	1,210
Med	Nashville, TN	--	605	35	640	370	--	370
Med	Louisville, KY-IN	--	435	125	560	1,015	--	1,015
Med	Charlotte, NC	--	420	110	530	1,470	--	1,470
Med	Tacoma, WA	330	85	70	485	2,235	--	2,235
Med	Birmingham, AL	--	350	45	395	100	--	100
Med	El Paso, TX-NM	5	335	50	390	1,120	--	1,120
Med	Hartford-Middletown, CT	--	330	60	390	615	--	615
Med	Jacksonville, FL	--	230	100	330	530	--	530
Med	Salt Lake City, UT	220	55	30	305	2,080	--	2,080
Med	Omaha, NE-IA	--	--	115	115	210	--	210
Med	Albuquerque, NM	--	--	110	110	470	--	470
Med	Tucson, AZ	--	5	100	105	760	--	760
Med	Fresno, CA	30	20	45	95	490	--	490
Med	Providence-Pawtucket, RI-MA	--	10	65	75	860	--	860
Med	Honolulu, HI	--	--	70	70	5,300	--	5,300
Med	Rochester, NY	--	25	20	45	235	--	235
Med	Albany-Schenectady-Troy, NY	--	20	15	35	185	--	185
Med	Richmond, VA	--	--	10	10	505	--	505
Med	Tulsa, OK	--	--	5	5	300	--	300
Sml	Colorado Springs, CO	--	--	105	105	210	--	210
Sml	Charleston, SC	--	40	35	75	175	--	175
Sml	Fort Myers-Cape Coral, FL	--	--	40	40	100	--	100
Sml	Pensacola, FL	--	--	35	35	65	--	65
Sml	Eugene-Springfield, OR	--	--	25	25	185	--	185
Sml	Bakersfield, CA	--	0	20	20	175	--	175
Sml	Laredo, TX	--	--	20	20	80	--	80
Sml	Spokane, WA	--	--	20	20	190	--	190
Sml	Anchorage, AK	--	--	15	15	45	--	45
Sml	Brownsville, TX	--	--	10	10	75	--	75
Sml	Salem, OR	--	--	10	10	90	--	90
Sml	Corpus Christi, TX	--	--	5	5	180	--	180
Sml	Beaumont, TX	--	--	0	0	35	--	35
Sml	Boulder, CO	--	--	0	0	65	--	65
	75 area total	72,950	116,785	16,175	205,910	1,061,930	1,0917	1,072,847
	75 area average	972.7	1,557.1	215.6	2745.5	14,159.1	145.6	14,304.6
	Very large area average	4,568.0	7,905.5	727.5	13,201.0	84,845.5	965.3	85,810.8
	Large area average	889.5	1,091.0	238.5	2,219.0	6,306.3	42.1	6,348.5
	Medium area average	27.9	236.2	66.9	331.0	1,076.9	0.0	1,076.9
	Small area average	0.0	2.9	24.3	27.1	119.3	0.0	119.3

-- Symbolizes no data.

Notes: Vlg – Very Large urban areas—over 3 million population.
Lrg – Large urban areas—over 1 million and less than 3 million population
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CAUTION: See http://mobility.tamu.edu/ums for improved performance measures and updated data.

Exhibit A-7. Annual Cost of Congestion and Congestion Strategy Savings, 2001

Population Group	Urban Area	*Annual Cost of Congestion ($ million)* Delay	Fuel	Total	*Annual Savings due to Strategies* Operations Treatments	Public Transportaton Strategies	*Percentage of Freeway and Principal Arterial Street Travel covered by Operational Treatments*
Vlg	Los Angeles, CA	10,920	1,920	12,840	589	2,392	34.4
Vlg	New York, NY-Northeastern, NJ	7,240	1,195	8,435	866	7,660	34.8
Vlg	Chicago, IL-Northwestern, IN	3,655	515	4,170	181	1,521	43.2
Vlg	San Francisco-Oakland, CA	2,855	525	3,380	367	1,685	49.5
Vlg	Dallas-Fort Worth, TX	2,400	335	2,735	104	217	29.6
Vlg	Washington, DC-MD-VA	2,130	360	2,490	111	1,072	46.8
Vlg	Houston, TX	2,165	300	2,465	149	412	54.9
Vlg	Detroit, MI	1,845	265	2,110	51	121	31.3
Vlg	Boston, MA	1,465	235	1,700	96	1,221	22.5
Vlg	Philadelphia, PA-NJ	1,325	190	1,515	83	614	31.2
Lrg	Atlanta, GA	1,775	240	2,015	126	493	36.6
Lrg	Phoenix, AZ	1,355	205	1,560	109	94	71.7
Lrg	Denver, CO	1,220	195	1,415	14	220	14.8
Lrg	Miami-Hialeah, FL	1,240	175	1,415	95	212	49.5
Lrg	San Diego, CA	1,195	220	1,415	166	256	73.4
Lrg	Minneapolis-St. Paul, MN	1,200	170	1,370	180	227	62.1
Lrg	Seattle-Everett, WA	1,135	175	1,310	63	571	45.0
Lrg	San Jose, CA	950	175	1,125	106	138	51.9
Lrg	Baltimore, MD	865	140	1,005	64	326	34.7
Lrg	San Bernardino-Riverside, CA	845	155	1,000	64	76	38.5
Lrg	Tampa-St Petersburg-Clearwater, FL	780	105	885	9	25	26.0
Lrg	Ft. Lauderdale-Hollywood-Pompano Bch, FL	760	105	865	35	117	45.1
Lrg	Orlando, FL	670	95	765	22	48	47.8
Lrg	Portland-Vancouver, OR-WA	650	105	755	58	255	39.3
Lrg	St. Louis, MO-IL	655	85	740	18	68	20.2
Lrg	Sacramento, CA	475	90	565	52	61	63.5
Lrg	Cincinnati, OH-KY	465	60	525	22	64	29.7
Lrg	Indianapolis, IN	410	55	465	9	15	18.3
Lrg	San Antonio, TX	395	55	450	3	71	18.9
Lrg	W Palm Bch-Boca Raton-Delray Bch, FL	350	55	405	10	12	33.8
Lrg	Las Vegas, NV	340	55	395	7	90	20.2
Lrg	Milwaukee, WI	345	50	395	34	82	51.7
Lrg	Norfolk-Newport News-Virginia Beach, VA	345	50	395	20	33	38.6
Lrg	Columbus, OH	315	35	350	1	27	6.2
Lrg	Cleveland, OH	245	30	275	11	60	23.2
Lrg	Kansas City, MO-KS	235	35	270	9	8	18.3
Lrg	Pittsburgh, PA	220	35	255	6	78	14.0
Lrg	New Orleans, LA	195	30	225	2	41	10.8
Lrg	Oklahoma City, OK	120	15	135	1	2	4.9
Lrg	Buffalo-Niagara Falls, NY	90	15	105	5	15	31.4
Med	Austin, TX	395	55	450	25	51	38.6
Med	Providence-Pawtucket, RI-MA	330	55	385	1	17	7.4
Med	Memphis, TN-AR-MS	285	35	320	19	23	26.0
Med	Louisville, KY-IN	280	35	315	12	20	25.7
Med	Charlotte, NC	250	30	280	10	29	31.9
Med	Nashville, TN	245	35	280	13	7	20.3
Med	Jacksonville, FL	240	30	270	7	10	37.0
Med	Albuquerque, NM	180	30	210	2	9	23.4
Med	Salt Lake City, UT	180	30	210	7	43	53.4
Med	Birmingham, AL	170	25	195	8	2	32.6
Med	Tacoma, WA	165	30	195	10	46	48.5
Med	Tucson, AZ	160	25	185	2	14	47.0
Med	Omaha, NE-IA	130	20	150	2	4	41.2
Med	Richmond, VA	130	20	150	0	11	5.6
Med	Hartford-Middletown, CT	120	25	145	8	13	26.8
Med	Honolulu, HI	120	25	145	1	105	7.0
Med	El Paso, TX-NM	125	15	140	7	21	50.0
Med	Tulsa, OK	110	15	125	0	6	2.0
Med	Fresno, CA	85	15	100	2	10	49.0
Med	Albany-Schenectady-Troy, NY	55	10	65	0	4	23.1
Med	Rochester, NY	40	5	45	1	5	10.2
Sml	Colorado Springs, CO	100	15	115	2	4	23.7
Sml	Charleston, SC	90	10	100	2	3	20.8
Sml	Pensacola, FL	50	0	50	1	1	34.2
Sml	Bakersfield, CA	30	0	30	0	3	40.4
Sml	Fort Myers-Cape Coral, FL	30	0	30	1	1	49.1
Sml	Spokane, WA	30	0	30	0	4	27.7
Sml	Eugene-Springfield, OR	25	0	25	1	4	8.4
Sml	Salem, OR	25	0	25	0	2	9.1
Sml	Corpus Christi, TX	20	0	20	0	3	12.6
Sml	Beaumont, TX	15	0	15	0	1	5.1
Sml	Anchorage, AK	10	0	10	0	1	13.0
Sml	Boulder ,CO	10	0	10	0	1	19.7
Sml	Laredo, TX	10	0	10	0	1	29.4
Sml	Brownsville, TX	0	0	0	0	1	32.1
	75 area total	60,075	9,450	69,525	4,062	21,180	--
	75 area average	801	126	927	54.2	282.4	36.3
	Very large area average	3,599	584	4,183	259.7	1,691.5	37.4
	Large area average	662	100	762	44.0	126.2	38.2
	Medium area average	181	27	208	6.5	21.4	28.3
	Small area average	32	5	37	0.5	2.1	24.0

Notes: Vlg – Very Large urban areas—over 3 million population.
Lrg – Large urban areas—over 1 million and less than 3 million population.
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Sml – Small urban areas—less than 500,000 population.

CAUTION: See http://mobility.tamu.edu/ums for improved performance measures and updated data.

Exhibit A-8. Annual Congestion Cost per Person and Cost Savings per Person due to Strategies, 2001

Population Group	Urban Area	*Annual Congestion Cost ($ million)* Total	*Annual Savings due to Strategies* Operations	Public Trans. Strategies	*Annual Congestion Cost per Person ($)* Base	*Savings due to* Operations	Public Trans. Strategies
Vlg	Los Angeles, CA	12,840	589	2,392	1,005	46	187
Vlg	San Francisco-Oakland, CA	3,380	367	1,685	835	91	417
Vlg	Dallas-Fort Worth, TX	2,735	104	217	710	27	57
Vlg	Houston, TX	2,465	149	412	710	43	119
Vlg	Washington, DC-MD-VA	2,490	111	1,072	670	30	287
Vlg	Boston, MA	1,700	96	1,221	560	32	403
Vlg	Detroit, MI	2,110	51	121	525	13	30
Vlg	Chicago, IL-Northwestern, IN	4,170	181	1,521	515	22	188
Vlg	New York, NY-Northeastern, NJ	8,435	866	7,660	490	50	446
Vlg	Philadelphia, PA-NJ	1,515	83	614	330	18	133
Lrg	Denver, CO	1,415	14	220	700	7	109
Lrg	San Bernardino-Riverside, CA	1,000	64	76	690	44	53
Lrg	Atlanta, GA	2,015	126	493	675	42	165
Lrg	San Jose, CA	1,125	106	138	670	63	82
Lrg	Seattle-Everett, WA	1,310	63	571	635	31	277
Lrg	Miami-Hialeah, FL	1,415	95	212	625	42	94
Lrg	Orlando, FL	765	22	48	625	18	40
Lrg	Minneapolis-St. Paul, MN	1,370	180	227	560	74	93
Lrg	Phoenix, AZ	1,560	109	94	540	38	32
Lrg	Ft. Lauderdale-Hollywood-Pompano Bch, FL	865	35	117	530	22	72
Lrg	San Diego, CA	1,415	166	256	525	62	95
Lrg	Portland-Vancouver, OR-WA	755	58	255	475	37	160
Lrg	Baltimore, MD	1,005	64	326	455	29	148
Lrg	Indianapolis, IN	465	9	15	450	9	15
Lrg	Tampa-St Petersburg-Clearwater, FL	885	9	25	445	5	13
Lrg	Cincinnati, OH-KY	525	22	64	405	17	49
Lrg	Sacramento, CA	565	52	61	400	37	43
Lrg	W Palm Bch-Boca Raton-Delray Bch, FL	405	10	12	375	9	11
Lrg	St. Louis, MO-IL	740	18	68	360	9	33
Lrg	San Antonio, TX	450	3	71	355	2	56
Lrg	Columbus, OH	350	1	27	335	1	26
Lrg	Las Vegas, NV	395	7	90	315	6	72
Lrg	Milwaukee, WI	395	34	82	280	24	58
Lrg	Norfolk-Newport News-Virginia Beach, VA	395	20	33	260	13	22
Lrg	New Orleans, LA	225	2	41	205	2	37
Lrg	Kansas City, MO-KS	270	9	8	190	6	6
Lrg	Cleveland, OH	275	11	60	145	6	32
Lrg	Pittsburgh, PA	255	6	78	140	3	43
Lrg	Oklahoma City, OK	135	1	2	125	1	2
Lrg	Buffalo-Niagara Falls, NY	105	5	15	95	5	13
Med	Austin, TX	450	25	51	590	33	67
Med	Charlotte, NC	280	10	29	420	15	43
Med	Nashville, TN	280	13	7	420	19	11
Med	Providence-Pawtucket, RI-MA	385	1	17	415	1	19
Med	Louisville, KY-IN	315	12	20	375	14	24
Med	Albuquerque, NM	210	2	9	355	3	15
Med	Memphis, TN-AR-MS	320	19	23	325	19	24
Med	Tacoma, WA	195	10	46	315	16	74
Med	Jacksonville, FL	270	7	10	305	8	12
Med	Birmingham, AL	195	8	2	290	12	3
Med	Tucson, AZ	185	2	14	260	3	21
Med	Omaha, NE-IA	150	2	4	240	3	7
Med	Salt Lake City, UT	210	7	43	230	8	47
Med	Hartford-Middletown, CT	145	8	13	225	13	21
Med	Richmond, VA	150	0	11	215	0	15
Med	El Paso, TX-NM	140	7	21	210	11	32
Med	Honolulu, HI	145	1	105	205	1	150
Med	Fresno, CA	100	2	10	180	4	18
Med	Tulsa, OK	125	0	6	155	0	8
Med	Albany-Schenectady-Troy, NY	65	0	4	125	0	7
Med	Rochester, NY	45	1	5	70	2	8
Sml	Colorado Springs, CO	115	2	4	245	4	9
Sml	Charleston, SC	100	2	3	215	4	7
Sml	Pensacola, FL	50	1	1	165	3	4
Sml	Salem, OR	25	0	2	120	0	8
Sml	Eugene-Springfield, OR	25	1	4	110	4	16
Sml	Beaumont, TX	15	0	1	105	0	4
Sml	Fort Myers-Cape Coral, FL	30	1	1	100	3	5
Sml	Boulder, CO	10	0	1	90	0	11
Sml	Spokane, WA	30	0	4	90	0	11
Sml	Bakersfield, CA	30	0	3	75	0	8
Sml	Corpus Christi, TX	20	0	3	65	0	9
Sml	Laredo, TX	10	0	1	55	0	5
Sml	Anchorage, AK	10	0	1	40	0	3
Sml	Brownsville, TX	0	0	1	0	0	9
	75 area total	69,525	4,062	21,180	--	--	--
	75 area average	927	54.2	282.4	517	30.2	157.3
	Very large area average	4,183	259.7	1,691.5	646	40.1	261.1
	Large area average	762	44.0	126.2	449	26.0	74.4
	Medium area average	208	6.5	21.4	290	9.1	29.8
	Small area average	37	0.5	2.1	132	1.8	7.7

Notes: Vlg – Very Large urban areas—over 3 million population.
Lrg – Large urban areas—over 1 million and less than 3 million population.
Med – Medium urban areas—over 500,000 and less than 1 million population.
Sml – Small urban areas—less than 500,000 population.

CAUTION: See http://mobility.tamu.edu/ums for improved performance measures and updated data.

Exhibit A-9. Annual Congestion Cost Savings by Strategy, 2001

		Annual Congestion Cost Savings by Strategy ($ million)						
		Operational Treatments				*Public Transportation Strategies*		
Population Group	*Urban Area*	*Ramp Metering*	*Incident Management*	*Signal Coordination*	*Total*	*Public Trans.*	*HOV*	*Total*
Vlg	New York, NY-Northeastern, NJ	78	757	31	866	7,599	61	7,660
Vlg	Los Angeles, CA	484	54	51	589	2,353	39	2,392
Vlg	San Francisco-Oakland, CA	186	172	9	367	1,685	0	1,685
Vlg	Chicago, IL-Northwestern, IN	66	99	16	181	1,521	0	1,521
Vlg	Houston, TX	41	102	6	149	382	29	411
Vlg	Washington, DC-MD-VA	12	89	10	111	1,018	53	1,071
Vlg	Dallas-Fort Worth, TX	1	98	5	104	210	7	217
Vlg	Boston, MA	--	96	0	96	1,221	0	1,221
Vlg	Philadelphia, PA-NJ	5	73	5	83	614	0	614
Vlg	Detroit, MI	18	24	9	51	121	0	121
Lrg	Minneapolis-St. Paul, MN	143	35	2	180	222	5	227
Lrg	San Diego, CA	125	34	7	166	256	0	256
Lrg	Atlanta, GA	--	114	12	126	493	0	493
Lrg	Phoenix, AZ	42	55	12	109	94	0	94
Lrg	San Jose, CA	54	49	3	106	138	0	138
Lrg	Miami-Hialeah, FL	--	70	25	95	212	1	213
Lrg	Baltimore, MD	--	62	2	64	326	0	326
Lrg	San Bernardino-Riverside, CA	50	4	10	64	76	0	76
Lrg	Seattle-Everett, WA	41	16	6	63	552	20	572
Lrg	Portland-Vancouver, OR-WA	34	23	1	58	255	0	255
Lrg	Sacramento, CA	32	15	5	52	61	0	61
Lrg	Ft. Lauderdale-Hollywood-Pompano Bch, FL	--	30	5	35	117	0	117
Lrg	Milwaukee, WI	16	18	0	34	82	0	82
Lrg	Cincinnati, OH-KY	--	20	2	22	64	0	64
Lrg	Orlando, FL	2	14	6	22	48	0	48
Lrg	Norfolk-Newport News-Virginia Beach, VA	--	19	1	20	33	0	33
Lrg	St. Louis, MO-IL	--	10	8	18	68	0	68
Lrg	Denver, CO	--	--	14	14	220	0	220
Lrg	Cleveland, OH	--	10	1	11	60	0	60
Lrg	W Palm Bch-Boca Raton-Delray Bch, FL	--	8	2	10	12	0	12
Lrg	Indianapolis, IN	--	6	3	9	15	0	15
Lrg	Kansas City, MO-KS	--	8	1	9	8	0	8
Lrg	Tampa-St Petersburg-Clearwater, FL	--	5	4	9	25	0	25
Lrg	Las Vegas, NV	--	5	2	7	90	0	90
Lrg	Pittsburgh, PA	--	6	0	6	78	0	78
Lrg	Buffalo-Niagara Falls, NY	--	5	0	5	15	0	15
Lrg	San Antonio, TX	--	1	2	3	71	0	71
Lrg	New Orleans, LA	--	2	0	2	41	0	41
Lrg	Columbus, OH	--	0	1	1	27	0	27
Lrg	Oklahoma City, OK	--	--	1	1	2	0	2
Med	Austin, TX	--	22	3	25	51	0	51
Med	Memphis, TN-AR-MS	--	18	1	19	23	0	23
Med	Nashville, TN	--	12	1	13	7	0	7
Med	Louisville, KY-IN	--	9	3	12	20	0	20
Med	Charlotte, NC	--	8	2	10	29	0	29
Med	Tacoma, WA	7	2	1	10	46	0	46
Med	Birmingham, AL	--	7	1	8	2	0	2
Med	Hartford-Middletown, CT	0	7	1	8	13	0	13
Med	El Paso, TX-NM	--	6	1	7	21	0	21
Med	Jacksonville, FL	--	5	2	7	10	0	10
Med	Salt Lake City, UT	5	1	1	7	43	0	43
Med	Albuquerque, NM	--	--	2	2	9	0	9
Med	Fresno, CA	1	0	1	2	10	0	10
Med	Omaha, NE-IA	--	--	2	2	4	0	4
Med	Tucson, AZ	--	0	2	2	14	0	14
Med	Honolulu, HI	--	--	1	1	105	0	105
Med	Providence-Pawtucket, RI-MA	--	0	1	1	17	0	17
Med	Rochester, NY	--	1	0	1	5	0	5
Med	Albany-Schenectady-Troy, NY	--	0	0	0	4	0	4
Med	Richmond, VA	--	--	0	0	11	0	11
Med	Tulsa, OK	--	--	0	0	6	0	6
Sml	Charleston, SC	--	1	1	2	3	0	3
Sml	Colorado Springs, CO	--	--	2	2	4	0	4
Sml	Eugene-Springfield, OR	--	--	1	1	4	0	4
Sml	Fort Myers-Cape Coral, FL	--	--	1	1	1	0	1
Sml	Pensacola, FL	--	--	1	1	1	0	1
Sml	Anchorage, AK	--	--	0	0	1	0	1
Sml	Bakersfield, CA	--	--	0	0	3	0	3
Sml	Beaumont, TX	--	--	0	0	1	0	1
Sml	Boulder, CO	--	--	0	0	1	0	1
Sml	Brownsville, TX	--	--	0	0	1	0	1
Sml	Corpus Christi, TX	--	--	0	0	3	0	3
Sml	Laredo, TX	--	--	0	0	1	0	1
Sml	Salem, OR	--	--	0	0	2	0	2
Sml	Spokane, WA	--	--	0	0	4	0	4
	75 area total	1,443	2,307	312	4,062	20,964	215	21,180
	75 area average	19.2	30.8	4.2	54.2	279.5	2.9	282.4
	Very large area average	89.1	156.4	14.2	259.7	1,672.4	19.0	1,691.5
	Large area average	18.0	21.5	41.6	44.0	125.3	0.8	126.2
	Medium area average	0.7	4.7	1.2	6.5	21.5	0.0	21.5
	Small area average	0.0	0.1	0.4	0.5	2.1	0.0	2.1

-- Symbolizes no data.

Notes: Vlg – Very Large urban areas—over 3 million population.
Lrg – Large urban areas—over 1 million and less than 3 million population
Med – Medium urban areas—over 500,000 and less than 1 million population.
Sml – Small urban areas—less than 500,000 population.

Exhibit A-10. Wasted Fuel, 2001

Population Group	Urban Area	*Annual Gallons of Fuel Wasted (million)*			Annual Excess Fuel Consumed per Person (Gallons)
		Recurring Delay[1]	*Incident Delay*[1]	*Total*[1]	
Vlg	Los Angeles, CA	565	431	996	78
Vlg	San Francisco-Oakland, CA	140	131	271	67
Vlg	Dallas-Fort Worth, TX	106	124	230	60
Vlg	Houston, TX	106	100	206	59
Vlg	Washington, DC-MD-VA	107	96	203	54
Vlg	Boston, MA	60	79	139	46
Vlg	Detroit, MI	79	96	175	43
Vlg	Chicago, IL-Northwestern, IN	185	155	340	42
Vlg	New York, NY-Northeastern, NJ	237	459	696	41
Vlg	Philadelphia, PA-NJ	49	77	126	27
Lrg	Atlanta, GA	83	91	174	58
Lrg	San Bernardino-Riverside, CA	42	40	82	57
Lrg	Denver, CO	54	60	114	56
Lrg	San Jose, CA	42	48	90	54
Lrg	Seattle-Everett, WA	51	59	110	53
Lrg	Miami-Hialeah, FL	54	61	115	51
Lrg	Orlando, FL	29	33	62	51
Lrg	Minneapolis-St. Paul, MN	48	68	116	48
Lrg	Phoenix, AZ	67	60	127	44
Lrg	Ft. Lauderdale-Hollywood-Pompano Bch, FL	41	29	70	43
Lrg	San Diego, CA	68	48	116	43
Lrg	Portland-Vancouver, OR-WA	29	33	62	39
Lrg	Indianapolis, IN	19	21	40	39
Lrg	Baltimore, MD	37	48	85	38
Lrg	Tampa-St Petersburg-Clearwater, FL	33	39	72	36
Lrg	Cincinnati, OH-KY	21	25	46	36
Lrg	Sacramento, CA	23	23	46	33
Lrg	W Palm Bch-Boca Raton-Delray Bch, FL	17	16	33	31
Lrg	St. Louis, MO-IL	30	34	64	31
Lrg	San Antonio, TX	21	17	38	30
Lrg	Columbus, OH	13	17	30	29
Lrg	Las Vegas, NV	17	15	32	25
Lrg	Milwaukee, WI	16	17	33	24
Lrg	Norfolk-Newport News-Virginia Beach, VA	13	20	33	22
Lrg	New Orleans, LA	9	10	19	17
Lrg	Kansas City, MO-KS	9	15	24	17
Lrg	Cleveland, OH	10	14	24	13
Lrg	Pittsburgh, PA	9	13	22	12
Lrg	Oklahoma City, OK	5	7	12	11
Lrg	Buffalo-Niagara Falls, NY	3	6	9	8
Med	Austin, TX	16	22	38	50
Med	Charlotte, NC	12	12	24	36
Med	Nashville, TN	10	14	24	36
Med	Providence-Pawtucket, RI-MA	12	19	31	33
Med	Louisville, KY-IN	11	15	26	31
Med	Albuquerque, NM	8	9	17	29
Med	Memphis, TN-AR-MS	11	16	27	28
Med	Jacksonville, FL	11	12	23	26
Med	Tacoma, WA	7	9	16	26
Med	Birmingham, AL	7	10	17	25
Med	Tucson, AZ	8	8	16	23
Med	Salt Lake City, UT	9	10	19	21
Med	El Paso, TX-NM	6	7	13	20
Med	Omaha, NE-IA	5	7	12	19
Med	Hartford-Middletown, CT	5	7	12	19
Med	Honolulu, HI	7	5	12	17
Med	Richmond, VA	5	7	12	17
Med	Fresno, CA	3	5	8	14
Med	Tulsa, OK	4	7	11	14
Med	Albany-Schenectady-Troy, NY	3	3	6	12
Med	Rochester, NY	1	3	4	6
Sml	Charleston, SC	4	5	9	20
Sml	Colorado Springs, CO	3	6	9	19
Sml	Pensacola, FL	2	2	4	13
Sml	Fort Myers-Cape Coral, FL	2	2	4	13
Sml	Salem, OR	1	1	2	10
Sml	Eugene-Springfield, OR	1	1	2	9
Sml	Beaumont, TX	0	1	1	7
Sml	Bakersfield, CA	1	2	3	7
Sml	Spokane, WA	1	1	2	6
Sml	Corpus Christi, TX	1	1	2	6
Sml	Boulder, CO	0	0	0	0
Sml	Laredo, TX	0	0	0	0
Sml	Anchorage, AK	0	0	0	0
Sml	Brownsville, TX	0	0	0	0
	75 area total	2,724	2,964	5,688	-
	75 area average	36	40	76	42
	Very large area average	163	175	338	52
	Large area average	30	33	63	37
	Medium area average	8	10	18	24
	Small area average	1	2	3	10

[1] Zero indicates less than 1 million gallons wasted.

Notes: Vlg – Very Large urban areas—over 3 million population.
Lrg – Large urban areas—over 1 million and less than 3 million population.
Med – Medium urban areas—over 500,000 and less than 1 million population.
Sml – Small urban areas—less than 500,000 population.

Exhibit A-11. Congested Lane-Miles of Roadway, Freeways and Principal Arterial Streets, 1982 to 2001

Population Group	*Urban Area*	*Percentage of Lane-Miles of Roadway That are Congested in the Peak Period*					
		Freeway			*Principal Arterial Street*		
		1982	*1990*	*2001*	*1982*	*1990*	*2001*
Vlg	Boston, MA	15	45	60	60	70	75
Vlg	Chicago, IL-Northwestern, IN	40	60	65	50	60	75
Vlg	Dallas-Fort Worth, TX	20	40	55	20	25	50
Vlg	Detroit, MI	25	45	65	50	55	65
Vlg	Houston, TX	50	55	60	40	35	55
Vlg	Los Angeles, CA	70	85	85	35	55	65
Vlg	New York, NY-Northeastern, NJ	30	45	55	55	65	65
Vlg	Philadelphia, PA-NJ	15	30	45	55	60	65
Vlg	San Francisco-Oakland, CA	45	70	75	50	65	60
Vlg	Washington, DC-MD-VA	40	65	70	60	75	75
Lrg	Atlanta, GA	30	40	75	45	60	75
Lrg	Baltimore, MD	20	35	55	40	55	60
Lrg	Buffalo-Niagara Falls, NY	5	15	30	15	30	35
Lrg	Cincinnati, OH-KY	20	40	55	30	40	40
Lrg	Cleveland, OH	10	20	35	15	40	40
Lrg	Columbus, OH	10	30	40	20	45	60
Lrg	Denver, CO	30	45	60	45	45	80
Lrg	Ft. Lauderdale-Hollywood-Pompano Bch, FL	50	40	50	30	45	60
Lrg	Indianapolis, IN	5	25	60	20	35	70
Lrg	Kansas City, MO-KS	5	10	30	20	35	55
Lrg	Las Vegas, NV	5	50	60	40	50	60
Lrg	Miami-Hialeah, FL	30	55	65	50	55	65
Lrg	Milwaukee, WI	15	45	60	30	30	40
Lrg	Minneapolis-St. Paul, MN	15	30	60	30	50	65
Lrg	New Orleans, LA	35	50	40	40	45	50
Lrg	Norfolk-Newport News-Virginia Beach, VA	25	40	35	20	35	55
Lrg	Oklahoma City, OK	10	15	30	15	20	40
Lrg	Orlando, FL	25	50	45	40	45	65
Lrg	Phoenix, AZ	55	50	70	35	50	55
Lrg	Pittsburgh, PA	5	10	20	45	50	55
Lrg	Portland-Vancouver, OR-WA	15	50	70	20	30	65
Lrg	Sacramento, CA	20	40	75	50	70	60
Lrg	San Antonio, TX	10	25	45	15	25	45
Lrg	San Bernardino-Riverside, CA	30	60	75	25	40	60
Lrg	San Diego, CA	35	70	75	50	65	60
Lrg	San Jose, CA	40	50	60	55	70	65
Lrg	Seattle-Everett, WA	35	75	70	30	50	65
Lrg	St. Louis, MO-IL	15	25	50	40	45	65
Lrg	Tampa-St Petersburg-Clearwater, FL	20	35	30	55	60	70
Lrg	W Palm Bch-Boca Raton-Delray Bch, FL	40	50	50	35	45	55
Med	Albany-Schenectady-Troy, NY	5	5	15	20	40	55
Med	Albuquerque, NM	5	25	50	30	45	50
Med	Austin, TX	25	30	55	30	45	65
Med	Birmingham, AL	5	15	25	40	60	75
Med	Charlotte, NC	10	45	50	40	45	65
Med	El Paso, TX-NM	15	25	45	15	20	35
Med	Fresno, CA	5	15	20	25	50	55
Med	Hartford-Middletown, CT	20	15	40	35	45	55
Med	Honolulu, HI	15	35	35	70	75	75
Med	Jacksonville, FL	5	30	35	20	40	55
Med	Louisville, KY-IN	10	20	40	60	55	65
Med	Memphis, TN-AR-MS	5	15	40	25	45	50
Med	Nashville, TN	15	25	35	40	60	65
Med	Omaha, NE-IA	10	20	30	30	45	55
Med	Providence-Pawtucket, RI-MA	10	25	40	25	45	60
Med	Richmond, VA	5	10	30	25	35	50
Med	Rochester, NY	5	10	25	30	40	45
Med	Salt Lake City, UT	10	25	50	45	65	70
Med	Tacoma, WA	20	55	65	20	30	40
Med	Tucson, AZ	10	40	40	35	45	70
Med	Tulsa, OK	10	10	25	15	40	50
Sml	Anchorage, AK	0	0	5	35	45	70
Sml	Bakersfield, CA	5	5	30	10	25	30
Sml	Beaumont, TX	5	5	15	25	20	30
Sml	Boulder, CO	5	5	5	10	25	65
Sml	Brownsville, TX	5	5	5	10	25	45
Sml	Charleston, SC	10	25	25	40	60	75
Sml	Colorado Springs, CO	5	10	18	20	30	55
Sml	Corpus Christi, TX	5	10	15	25	30	35
Sml	Eugene-Springfield, OR	0	0	15	35	50	70
Sml	Fort Myers-Cape Coral, FL	0	0	5	15	30	50
Sml	Laredo, TX	5	5	5	20	30	55
Sml	Pensacola, FL	0	0	5	25	40	50
Sml	Salem, OR	0	5	25	10	20	35
Sml	Spokane, WA	0	5	25	15	20	35
	75 area average	27	43	55	39	50	61
	Very large area average	38	56	65	47	57	65
	Large area average	21	38	54	35	47	60
	Medium area average	10	21	37	30	45	57
	Small area average	3	7	17	22	33	47

Notes: Vlg – Very Large urban areas—over 3 million population.
Lrg – Large urban areas—over 1 million and less than 3 million population.
Med – Medium urban areas—over 500,000 and less than 1 million population.
Sml – Small urban areas—less than 500,000 population.

CAUTION: See http://mobility.tamu.edu/ums for improved performance measures and updated data.

Exhibit A-12. Congested Person-Miles of Travel, Freeways and Principal Arterial Streets, 1982 to 2001

Population Group	Urban Area	*Percentage of Peak Period Person-Miles of Travel that are Congested*					
		Freeway			*Principal Arterial Street*		
		1982	*1990*	*2001*	*1982*	*1990*	*2001*
Vlg	Boston, MA	20	53	73	47	71	82
Vlg	Chicago, IL-Northwestern, IN	41	69	78	53	69	83
Vlg	Dallas-Fort Worth, TX	17	42	63	17	30	63
Vlg	Detroit, MI	21	53	71	45	66	76
Vlg	Houston, TX	54	59	70	50	46	65
Vlg	Los Angeles, CA	77	95	95	43	65	75
Vlg	New York, NY-Northeastern, NJ	21	47	64	39	67	78
Vlg	Philadelphia, PA-NJ	15	33	54	42	56	72
Vlg	San Francisco-Oakland, CA	52	84	85	60	74	75
Vlg	Washington, DC-MD-VA	40	69	83	63	78	83
Lrg	Atlanta, GA	21	39	83	32	55	83
Lrg	Baltimore, MD	18	38	64	30	56	69
Lrg	Buffalo-Niagara Falls, NY	4	10	20	12	18	25
Lrg	Cincinnati, OH-KY	14	40	63	23	40	54
Lrg	Cleveland, OH	7	18	37	14	33	41
Lrg	Columbus, OH	8	29	48	13	35	66
Lrg	Denver, CO	27	43	72	39	47	86
Lrg	Ft. Lauderdale-Hollywood-Pompano Bch, FL	30	39	62	21	42	67
Lrg	Indianapolis, IN	6	24	65	17	27	74
Lrg	Kansas City, MO-KS	4	9	28	11	20	47
Lrg	Las Vegas, NV	7	52	65	25	56	70
Lrg	Miami-Hialeah, FL	34	65	77	49	70	77
Lrg	Milwaukee, WI	14	44	66	21	33	48
Lrg	Minneapolis-St. Paul, MN	11	27	71	20	45	71
Lrg	New Orleans, LA	32	44	39	43	48	54
Lrg	Norfolk-Newport News-Virginia Beach, VA	25	36	38	25	39	53
Lrg	Oklahoma City, OK	7	12	29	13	17	36
Lrg	Orlando, FL	24	49	55	36	45	69
Lrg	Phoenix, AZ	49	53	77	41	57	67
Lrg	Pittsburgh, PA	7	10	16	30	35	38
Lrg	Portland-Vancouver, OR-WA	15	53	77	23	41	82
Lrg	Sacramento, CA	15	47	82	33	68	72
Lrg	San Antonio, TX	12	20	50	14	22	55
Lrg	San Bernardino-Riverside, CA	24	69	82	22	41	68
Lrg	San Diego, CA	25	74	84	33	70	69
Lrg	San Jose, CA	48	61	69	61	76	79
Lrg	Seattle-Everett, WA	30	78	80	33	60	76
Lrg	St. Louis, MO-IL	17	25	53	40	46	70
Lrg	Tampa-St Petersburg-Clearwater, FL	30	45	41	57	63	74
Lrg	W Palm Bch-Boca Raton-Delray Bch, FL	19	41	62	17	35	62
Med	Albany-Schenectady-Troy, NY	2	2	11	39	25	40
Med	Albuquerque, NM	4	25	51	17	35	55
Med	Austin, TX	19	32	65	22	42	74
Med	Birmingham, AL	5	11	32	28	41	68
Med	Charlotte, NC	13	47	60	32	47	74
Med	El Paso, TX-NM	10	19	47	10	15	43
Med	Fresno, CA	4	16	23	20	45	58
Med	Hartford-Middletown, CT	14	18	39	20	36	55
Med	Honolulu, HI	17	42	42	44	71	71
Med	Jacksonville, FL	5	33	41	18	37	57
Med	Louisville, KY-IN	11	20	44	41	40	70
Med	Memphis, TN-AR-MS	5	17	46	21	40	54
Med	Nashville, TN	15	22	42	30	44	66
Med	Omaha, NE-IA	8	18	29	19	33	54
Med	Providence-Pawtucket, RI-MA	9	24	44	19	45	60
Med	Richmond, VA	2	10	24	16	25	39
Med	Rochester, NY	3	9	20	15	28	37
Med	Salt Lake City, UT	7	22	57	24	47	70
Med	Tacoma, WA	13	46	72	18	36	57
Med	Tucson, AZ	8	31	49	24	38	71
Med	Tulsa, OK	7	8	27	17	31	47
Sml	Anchorage, AK	0	0	2	19	23	37
Sml	Bakersfield, CA	2	4	18	7	17	24
Sml	Beaumont, TX	4	5	13	17	15	29
Sml	Boulder, CO	2	2	3	9	15	47
Sml	Brownsville, TX	2	2	3	9	17	33
Sml	Charleston, SC	10	23	26	32	53	64
Sml	Colorado Springs, CO	3	6	27	13	21	50
Sml	Corpus Christi, TX	2	7	9	15	20	24
Sml	Eugene-Springfield, OR	0	0	18	18	27	58
Sml	Fort Myers-Cape Coral, FL	0	0	8	15	30	45
Sml	Laredo, TX	2	2	4	11	15	29
Sml	Pensacola, FL	0	0	7	14	31	43
Sml	Salem, OR	0	6	23	9	19	36
Sml	Spokane, WA	0	2	20	11	14	26
	75 area average	30	52	66	37	54	69
	Very large area average	43	67	77	45	65	76
	Large area average	20	42	63	32	49	67
	Medium area average	9	22	42	23	38	59
	Small area average	2	6	16	16	26	40

Notes: Vlg – Very Large urban areas—over 3 million population.
Lrg – Large urban areas—over 1 million and less than 3 million population.
Med – Medium urban areas—over 500,000 and less than 1 million population.
Sml – Small urban areas—less than 500,000 population.

CAUTION: See http://mobility.tamu.edu/ums for improved performance measures and updated data.

Exhibit A-13. Congested Peak-Period Travel, Roadway System, 1982 to 2001

Population Group	Urban Area	Percent of Peak Period Travel in Congestion[1]					Percentage Point Change	
		1982	1990	1996	2000	2001	Long-Term 1982 to 2001 Points	Short-Term 1996 to 2001 Points
Vlg	Dallas-Fort Worth, TX	17	39	46	59	63	46	17
Vlg	Houston, TX	53	56	56	68	68	15	12
Vlg	Philadelphia, PA-NJ	31	45	54	60	63	32	9
Vlg	New York, NY-Northeastern, NJ	28	54	62	69	69	41	7
Vlg	Detroit, MI	33	59	67	71	73	40	6
Vlg	Boston, MA	32	60	72	77	77	45	5
Vlg	Chicago, IL-Northwestern, IN	46	69	76	80	81	35	5
Vlg	Washington, DC-MD-VA	51	73	78	79	83	32	5
Vlg	San Francisco-Oakland, CA	54	81	81	83	83	29	2
Vlg	Los Angeles, CA	62	83	87	90	88	26	1
Lrg	Atlanta, GA	24	44	64	79	83	59	19
Lrg	Minneapolis-St. Paul, MN	13	32	54	71	71	58	17
Lrg	San Antonio, TX	12	21	36	52	51	39	15
Lrg	Denver, CO	32	45	65	75	79	47	14
Lrg	Orlando, FL	30	47	50	59	63	33	13
Lrg	Cincinnati, OH-KY	17	40	50	62	62	45	12
Lrg	Baltimore, MD	23	45	54	61	65	42	11
Lrg	Ft. Lauderdale-Hollywood-Pompano Bch, FL	24	40	54	61	64	40	10
Lrg	San Bernardino-Riverside, CA	23	56	66	72	76	53	10
Lrg	W Palm Bch-Boca Raton-Delray Bch, FL	18	38	52	59	62	44	10
Lrg	Indianapolis, IN	11	25	60	65	69	58	9
Lrg	Kansas City, MO-KS	6	12	23	31	32	26	9
Lrg	Portland-Vancouver, OR-WA	18	49	69	76	78	60	9
Lrg	Sacramento, CA	24	56	69	74	78	54	9
Lrg	Buffalo-Niagara Falls, NY	8	14	14	23	22	14	8
Lrg	San Jose, CA	52	66	65	72	73	21	8
Lrg	Miami-Hialeah, FL	44	68	70	78	77	33	7
Lrg	Milwaukee, WI	17	40	52	60	59	42	7
Lrg	Phoenix, AZ	43	55	66	72	73	30	7
Lrg	San Diego, CA	27	73	73	79	80	53	7
Lrg	St. Louis, MO-IL	26	33	51	60	58	32	7
Lrg	Las Vegas, NV	20	54	62	65	67	47	5
Lrg	Seattle-Everett, WA	31	72	74	79	79	48	5
Lrg	Oklahoma City, OK	9	14	27	31	31	22	4
Lrg	Columbus, OH	10	30	49	47	52	42	3
Lrg	Pittsburgh, PA	21	24	25	25	26	5	1
Lrg	New Orleans, LA	37	46	47	46	46	9	-1
Lrg	Tampa-St Petersburg-Clearwater, FL	49	58	64	60	63	14	-1
Lrg	Cleveland, OH	8	22	40	43	38	30	-2
Lrg	Norfolk-Newport News-Virginia Beach, VA	25	37	47	42	44	19	-3
Med	El Paso, TX-NM	10	17	26	43	46	36	20
Med	Austin, TX	20	35	49	62	68	48	19
Med	Tucson, AZ	19	36	45	56	64	45	19
Med	Hartford-Middletown, CT	16	24	25	39	42	26	17
Med	Providence-Pawtucket, RI-MA	14	33	35	49	50	36	15
Med	Charlotte, NC	25	47	50	64	64	39	14
Med	Tulsa, OK	11	16	21	29	33	22	12
Med	Nashville, TN	23	31	38	43	49	26	11
Med	Salt Lake City, UT	12	29	51	56	61	49	10
Med	Albany-Schenectady-Troy, NY	18	12	13	19	22	4	9
Med	Tacoma, WA	15	41	57	62	66	51	9
Med	Birmingham, AL	15	20	35	42	42	27	7
Med	Omaha, NE-IA	14	26	36	40	43	29	7
Med	Fresno, CA	16	36	36	46	42	26	6
Med	Rochester, NY	5	12	17	20	23	18	6
Med	Louisville, KY-IN	23	26	47	56	52	29	5
Med	Albuquerque, NM	12	31	49	53	53	41	4
Med	Richmond, VA	8	16	25	29	29	21	4
Med	Jacksonville, FL	12	35	47	49	48	36	1
Med	Memphis, TN-AR-MS	12	29	49	48	49	37	0
Med	Honolulu, HI	24	48	53	49	49	25	-4
Sml	Eugene-Springfield, OR	8	12	19	33	33	25	14
Sml	Charleston, SC	26	41	35	49	45	19	10
Sml	Colorado Springs, CO	8	13	28	38	38	30	10
Sml	Boulder, CO	6	10	18	24	26	20	8
Sml	Brownsville, TX	7	11	15	23	23	16	8
Sml	Fort Myers-Cape Coral, FL	13	25	33	39	39	26	6
Sml	Beaumont, TX	9	9	14	17	19	10	5
Sml	Laredo, TX	8	11	17	19	22	14	5
Sml	Anchorage, AK	11	13	10	12	14	3	4
Sml	Bakersfield, CA	5	12	17	20	21	16	4
Sml	Pensacola, FL	10	23	29	37	33	23	4
Sml	Salem, OR	6	13	26	30	30	24	4
Sml	Corpus Christi, TX	10	13	11	12	14	4	3
Sml	Spokane, WA	7	11	21	26	24	17	3
	75 area average	33	53	60	66	67	34	7
	Very large area average	44	66	71	76	76	32	5
	Large area average	25	45	56	63	65	40	9
	Medium area average	16	29	39	46	48	32	9
	Small area average	11	18	23	29	29	18	6

[1] Travel measured in person-miles.

Notes: Vlg – Very Large urban areas—over 3 million population.
Lrg – Large urban areas—over 1 million and less than 3 million population
Med – Medium urban areas—over 500,000 and less than 1 million population.
Sml – Small urban areas—less than 500,000 population.

CAUTION: See http://mobility.tamu.edu/ums for improved performance measures and updated data.

Exhibit A-14. Congested Daily Travel, 1982 to 2001

Population Group	*Urban Area*	*Percent of Daily Travel in Congestion*[1] *1982*	*1990*	*1996*	*2000*	*2001*	*Percentage Point Change* *Long-Term 1982 to 2001 Points*	*Short-Term 1996 to 2001 Points*
Vlg	Dallas-Fort Worth, TX	9	19	23	29	32	23	9
Vlg	Houston, TX	26	28	28	34	34	8	6
Vlg	Philadelphia, PA-NJ	16	23	27	30	31	15	4
Vlg	Detroit, MI	17	30	34	35	37	20	3
Vlg	New York, NY-Northeastern, NJ	14	27	31	35	34	20	3
Vlg	Washington, DC-MD-VA	25	36	39	40	42	17	3
Vlg	Boston, MA	16	30	36	38	38	22	2
Vlg	Chicago, IL-Northwestern, IN	23	35	38	40	40	17	2
Vlg	Los Angeles, CA	31	42	44	45	44	13	0
Vlg	San Francisco-Oakland, CA	27	41	41	41	41	14	0
Lrg	Atlanta, GA	12	22	32	40	41	29	9
Lrg	Minneapolis-St. Paul, MN	7	16	27	35	36	29	9
Lrg	San Antonio, TX	6	10	18	26	26	20	8
Lrg	Denver, CO	16	22	32	38	39	23	7
Lrg	Baltimore, MD	12	22	27	31	33	21	6
Lrg	Cincinnati, OH-KY	8	20	25	31	31	23	6
Lrg	Orlando, FL	15	23	25	30	31	16	6
Lrg	Ft. Lauderdale-Hollywood-Pompano Bch, FL	12	20	27	31	32	20	5
Lrg	Portland-Vancouver, OR-WA	9	25	34	38	39	30	5
Lrg	Sacramento, CA	12	28	34	37	39	27	5
Lrg	San Bernardino-Riverside, CA	11	28	33	36	38	27	5
Lrg	W Palm Bch-Boca Raton-Delray Bch, FL	9	19	26	30	31	22	5
Lrg	Buffalo-Niagara Falls, NY	4	7	7	11	11	7	4
Lrg	Indianapolis, IN	5	13	30	33	34	29	4
Lrg	Kansas City, MO-KS	3	6	12	16	16	13	4
Lrg	Miami-Hialeah, FL	22	34	35	39	39	17	4
Lrg	San Diego, CA	14	37	36	40	40	26	4
Lrg	San Jose, CA	26	33	32	36	36	10	4
Lrg	Milwaukee, WI	9	20	26	30	29	20	3
Lrg	Phoenix, AZ	21	28	33	36	36	15	3
Lrg	St. Louis, MO-IL	13	17	26	30	29	16	3
Lrg	Las Vegas, NV	10	27	31	32	33	23	2
Lrg	Oklahoma City, OK	4	7	14	15	16	12	2
Lrg	Seattle-Everett, WA	15	36	37	39	39	24	2
Lrg	Columbus, OH	5	15	25	24	26	21	1
Lrg	Pittsburgh, PA	11	12	13	13	13	2	0
Lrg	Tampa-St Petersburg-Clearwater, FL	25	29	32	30	32	7	0
Lrg	Cleveland, OH	4	11	20	22	19	15	-1
Lrg	New Orleans, LA	19	23	24	23	23	4	-1
Lrg	Norfolk-Newport News-Virginia Beach, VA	12	19	23	21	22	10	-1
Med	Austin, TX	10	18	24	31	34	24	10
Med	El Paso, TX-NM	5	9	13	21	23	18	10
Med	Tucson, AZ	10	18	23	28	32	22	9
Med	Hartford-Middletown, CT	8	12	13	19	21	13	8
Med	Charlotte, NC	12	23	25	32	32	20	7
Med	Providence-Pawtucket, RI-MA	7	17	18	24	25	18	7
Med	Nashville, TN	12	15	19	22	24	12	5
Med	Salt Lake City, UT	6	14	25	28	30	24	5
Med	Tulsa, OK	5	8	11	14	16	11	5
Med	Albany-Schenectady-Troy, NY	9	6	7	10	11	2	4
Med	Birmingham, AL	8	10	17	21	21	13	4
Med	Tacoma, WA	7	21	29	31	33	26	4
Med	Fresno, CA	8	18	18	23	21	13	3
Med	Louisville, KY-IN	11	13	23	28	26	15	3
Med	Omaha, NE-IA	7	13	18	20	21	14	3
Med	Richmond, VA	4	8	12	14	15	11	3
Med	Albuquerque, NM	6	16	25	26	27	21	2
Med	Rochester, NY	3	6	9	10	11	8	2
Med	Jacksonville, FL	6	18	23	24	24	18	1
Med	Memphis, TN-AR-MS	6	15	24	24	25	19	1
Med	Honolulu, HI	12	24	26	25	25	13	-1
Sml	Eugene-Springfield, OR	4	6	9	16	16	12	7
Sml	Charleston, SC	13	21	18	25	23	10	5
Sml	Colorado Springs, CO	4	7	14	19	19	15	5
Sml	Boulder, CO	3	5	9	12	13	10	4
Sml	Beaumont, TX	5	4	7	8	10	5	3
Sml	Brownsville, TX	4	6	8	12	11	7	3
Sml	Laredo, TX	4	5	8	10	11	7	3
Sml	Pensacola, FL	5	12	14	18	17	12	3
Sml	Anchorage, AK	5	6	5	6	7	2	2
Sml	Bakersfield, CA	2	6	9	10	11	9	2
Sml	Fort Myers-Cape Coral, FL	6	12	17	19	19	13	2
Sml	Salem, OR	3	7	13	15	15	12	2
Sml	Corpus Christi, TX	5	6	6	6	7	2	1
Sml	Spokane, WA	3	5	11	13	12	9	1
	75 area average	16	26	30	33	34	18	4
	Very large area average	22	33	36	38	38	16	2
	Large area average	12	23	28	32	32	20	4
	Medium area average	8	14	20	23	24	16	4
	Small area average	5	9	12	15	15	10	3

[1] Travel measured in person-miles.

Notes: Vlg – Very Large urban areas—over 3 million population.
Lrg – Large urban areas—over 1 million and less than 3 million population.
Med – Medium urban areas—over 500,000 and less than 1 million population.
Sml – Small urban areas—less than 500,000 population.

CAUTION: See http://mobility.tamu.edu/ums for improved performance measures and updated data.

Exhibit A-15. Travel that May Encounter Congestion, 1982 to 2001

		Percent of Daily Travel During Congested Times[1]					Percentage Point Change	
Population Group	Urban Area	1982	1990	1996	2000	2001	Long-Term 1982 to 2001 Points	Short-Term 1996 to 2001 Points
Vlg	Dallas-Fort Worth, TX	24	38	39	45	46	22	7
Vlg	Houston, TX	42	42	41	46	47	5	6
Vlg	Philadelphia, PA-NJ	30	37	41	45	46	16	5
Vlg	New York, NY-Northeastern, NJ	26	40	43	46	46	20	3
Vlg	Boston, MA	34	45	47	48	49	15	2
Vlg	Detroit, MI	34	44	46	47	48	14	2
Vlg	San Francisco-Oakland, CA	43	49	49	50	50	8	2
Vlg	Chicago, IL-Northwestern, IN	38	46	48	49	49	11	1
Vlg	Los Angeles, CA	48	50	50	50	50	3	1
Vlg	Washington, DC-MD-VA	40	46	48	48	49	9	1
Lrg	San Antonio, TX	23	25	34	43	42	19	8
Lrg	Orlando, FL	30	38	40	45	46	16	6
Lrg	Kansas City, MO-KS	18	22	26	30	31	13	5
Lrg	San Jose, CA	44	47	45	49	50	6	5
Lrg	Baltimore, MD	25	38	42	45	46	21	4
Lrg	Cincinnati, OH-KY	23	36	42	46	46	23	4
Lrg	Columbus, OH	21	32	40	41	44	23	4
Lrg	Ft. Lauderdale-Hollywood-Pompano Bch, FL	23	35	44	47	48	25	4
Lrg	Milwaukee, WI	24	37	40	45	44	20	4
Lrg	Minneapolis-St. Paul, MN	22	34	44	47	48	26	4
Lrg	San Diego, CA	28	47	46	49	50	22	4
Lrg	W Palm Bch-Boca Raton-Delray Bch, FL	19	32	44	47	48	29	4
Lrg	Atlanta, GA	26	39	46	49	49	23	3
Lrg	Buffalo-Niagara Falls, NY	18	20	22	26	25	7	3
Lrg	Denver, CO	30	36	45	47	48	18	3
Lrg	Phoenix, AZ	38	41	46	48	49	11	3
Lrg	San Bernardino-Riverside, CA	27	46	46	48	49	22	3
Lrg	Las Vegas, NV	23	43	45	47	47	24	2
Lrg	Miami-Hialeah, FL	38	47	47	49	49	11	2
Lrg	Oklahoma City, OK	22	24	31	33	33	11	2
Lrg	Sacramento, CA	26	43	46	48	48	22	2
Lrg	Indianapolis, IN	21	30	46	46	47	26	1
Lrg	New Orleans, LA	36	37	38	39	39	3	1
Lrg	Norfolk-Newport News-Virginia Beach, VA	31	36	37	38	38	7	1
Lrg	Pittsburgh, PA	23	25	26	26	27	4	1
Lrg	Portland-Vancouver, OR-WA	29	41	47	48	48	19	1
Lrg	Seattle-Everett, WA	33	46	47	47	48	15	1
Lrg	Cleveland, OH	23	30	37	39	37	14	0
Lrg	St. Louis, MO-IL	33	36	41	42	41	8	0
Lrg	Tampa-St Petersburg-Clearwater, FL	44	45	46	46	46	2	0
Med	El Paso, TX-NM	21	24	31	39	40	19	9
Med	Austin, TX	24	35	39	45	47	23	8
Med	Providence-Pawtucket, RI-MA	24	34	32	39	40	16	8
Med	Charlotte, NC	32	43	41	46	47	15	6
Med	Hartford-Middletown, CT	20	30	33	39	39	19	6
Med	Tucson, AZ	27	34	39	44	45	18	6
Med	Tulsa, OK	24	26	28	33	34	10	6
Med	Birmingham, AL	23	27	35	40	40	17	5
Med	Fresno, CA	22	32	34	40	39	17	5
Med	Nashville, TN	30	32	37	39	42	12	5
Med	Omaha, NE-IA	21	25	31	35	36	15	5
Med	Albany-Schenectady-Troy, NY	15	23	25	27	29	14	4
Med	Louisville, KY-IN	27	28	41	45	44	17	3
Med	Memphis, TN-AR-MS	24	34	39	40	42	18	3
Med	Richmond, VA	22	25	28	30	31	9	3
Med	Rochester, NY	17	23	26	28	29	12	3
Med	Salt Lake City, UT	22	31	42	42	44	22	2
Med	Tacoma, WA	25	36	46	47	48	23	2
Med	Albuquerque, NM	21	32	43	44	43	22	0
Med	Jacksonville, FL	25	37	41	42	41	16	0
Med	Honolulu, HI	28	42	44	42	42	14	-2
Sml	Colorado Springs, CO	17	21	26	32	33	16	7
Sml	Eugene-Springfield, OR	18	23	30	37	36	18	6
Sml	Boulder, CO	18	22	26	29	31	13	5
Sml	Salem, OR	19	28	28	33	33	14	5
Sml	Brownsville, TX	18	21	24	27	28	10	4
Sml	Laredo, TX	18	19	19	21	23	5	4
Sml	Pensacola, FL	20	31	32	36	36	16	4
Sml	Anchorage, AK	19	21	20	21	22	3	2
Sml	Bakersfield, CA	18	21	25	26	27	9	2
Sml	Beaumont, TX	22	25	31	31	33	11	2
Sml	Charleston, SC	32	38	36	39	38	6	2
Sml	Corpus Christi, TX	19	22	22	24	24	5	2
Sml	Fort Myers-Cape Coral, FL	30	38	36	38	38	8	2
Sml	Spokane, WA	18	21	27	30	29	11	2
	75 area average	32	40	43	45	45	13	2
	Very large area average	37	45	46	48	48	11	2
	Large area average	28	38	42	44	45	17	3
	Medium area average	24	31	36	40	40	16	4
	Small area average	21	26	28	31	31	10	3

[1] Person-miles of travel during times when any portion of the system may experience congestion.

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CAUTION: See http://mobility.tamu.edu/ums for improved performance measures and updated data.

Exhibit A-16. Illustration of Annual Capacity Increase Required to Prevent Congestion Growth

Population Group	Urban Area	Average Annual VMT Growth (%)[1]	Annual Lane-Miles Needed		Lane-Mile "Deficiency"		2001 Travel Time Index
			Freeway	PAS	Freeway	PAS	
Vlg	Dallas-Fort Worth, TX	4.0	126	160	102	126	1.33
Vlg	New York, NY-Northeastern, NJ	2.2	147	162	104	116	1.41
Vlg	Houston, TX	4.6	113	131	105	49	1.39
Vlg	Chicago, IL-Northwestern, IN	1.6	43	92	38	70	1.49
Vlg	Philadelphia, PA-NJ	1.6	27	48	23	60	1.30
Vlg	Detroit, MI	1.6	29	71	25	49	1.36
Vlg	Washington, DC-MD-VA	1.6	32	41	23	35	1.47
Vlg	Boston, MA	1.1	15	23	14	27	1.47
Vlg	San Francisco-Oakland, CA	1.4	32	29	19	-3	1.60
Vlg	Los Angeles, CA	0.8	46	93	-42	-4	1.83
Lrg	Phoenix, AZ	4.5	52	134	-11	135	1.43
Lrg	Atlanta, GA	3.7	84	82	60	52	1.39
Lrg	San Diego, CA	3.3	58	61	49	51	1.36
Lrg	Minneapolis-St. Paul, MN	3.9	63	51	45	48	1.39
Lrg	Denver, CO	4.2	44	75	38	42	1.47
Lrg	San Antonio, TX	2.9	31	26	31	32	1.21
Lrg	Orlando, FL	5.1	37	85	26	35	1.32
Lrg	W Palm Bch-Boca Raton-Delray Bch, FL	4.6	21	59	20	39	1.26
Lrg	Ft. Lauderdale-Hollywood-Pompano Bch, FL	3.4	24	47	22	31	1.40
Lrg	Baltimore, MD	2.2	32	31	23	28	1.31
Lrg	Kansas City, MO-KS	2.0	34	18	25	21	1.11
Lrg	San Bernardino-Riverside, CA	2.0	18	45	11	34	1.39
Lrg	San Jose, CA	2.6	23	37	67	-24	1.43
Lrg	Buffalo-Niagara Falls, NY	2.6	17	27	17	24	1.08
Lrg	St. Louis, MO-IL	0.3	5	5	-16	55	1.21
Lrg	Cincinnati, OH-KY	2.4	24	20	13	15	1.26
Lrg	Las Vegas, NV	5.1	24	25	2	23	1.34
Lrg	Columbus, OH	2.7	23	16	9	15	1.19
Lrg	Indianapolis, IN	1.4	10	14	5	16	1.26
Lrg	Norfolk-Newport News-Virginia Beach, VA	2.1	19	23	1	19	1.19
Lrg	Tampa-St Petersburg-Clearwater, FL	2.6	17	63	2	18	1.32
Lrg	Milwaukee, WI	1.5	9	20	10	9	1.26
Lrg	Portland-Vancouver, OR-WA	1.9	14	18	12	7	1.44
Lrg	Seattle-Everett, WA	1.9	27	26	9	10	1.43
Lrg	Miami-Hialeah, FL	1.9	14	53	10	7	1.46
Lrg	Pittsburgh, PA	0.3	4	5	4	13	1.10
Lrg	Sacramento, CA	0.8	5	9	3	12	1.33
Lrg	Oklahoma City, OK	1.7	13	19	6	6	1.10
Lrg	New Orleans, LA	1.0	4	10	3	-6	1.18
Lrg	Cleveland, OH	0.3	4	3	-4	-2	1.12
Med	Austin, TX	5.3	31	39	22	31	1.31
Med	Providence-Pawtucket, RI-MA	3.7	24	31	20	26	1.22
Med	El Paso, TX-NM	3.3	9	24	8	25	1.18
Med	Charlotte, NC	6.1	30	31	12	20	1.27
Med	Tucson, AZ	4.2	8	31	1	29	1.25
Med	Nashville, TN	2.7	21	17	13	16	1.18
Med	Birmingham, AL	2.3	16	10	16	7	1.17
Med	Hartford-Middletown, CT	2.6	17	11	14	9	1.12
Med	Omaha, NE-IA	3.0	9	21	5	16	1.17
Med	Tulsa, OK	2.6	14	10	12	9	1.13
Med	Fresno, CA	4.7	10	22	2	17	1.17
Med	Albany-Schenectady-Troy, NY	2.2	12	12	7	10	1.07
Med	Jacksonville, FL	2.6	19	29	-5	22	1.16
Med	Tacoma, WA	2.2	6	13	6	11	1.27
Med	Memphis, TN-AR-MS	2.4	12	25	0	13	1.22
Med	Louisville, KY-IN	1.6	11	10	10	2	1.22
Med	Richmond, VA	4.5	32	28	14	-5	1.10
Med	Salt Lake City, UT	2.7	14	13	5	4	1.20
Med	Rochester, NY	0.8	4	2	4	1	1.06
Med	Albuquerque, NM	0.4	1	4	0	-2	1.23
Med	Honolulu, HI	-0.2	-1	-1	-4	0	1.19
Sml	Colorado Springs, CO	3.7	9	15	8	10	1.19
Sml	Bakersfield, CA	3.8	7	22	0	14	1.06
Sml	Laredo, TX	9.4	7	21	4	7	1.08
Sml	Corpus Christi, TX	1.1	3	3	1	8	1.05
Sml	Charleston, SC	2.4	6	10	-1	9	1.18
Sml	Salem, OR	2.3	2	6	1	7	1.10
Sml	Spokane, WA	1.8	2	10	-1	9	1.07
Sml	Anchorage, AK	2.3	5	2	4	2	1.05
Sml	Pensacola, FL	3.0	3	16	2	4	1.12
Sml	Eugene-Springfield, OR	2.2	2	3	2	3	1.11
Sml	Brownsville, TX	3.6	1	4	0	4	1.08
Sml	Boulder, CO	2.0	1	2	1	2	1.10
Sml	Beaumont, TX	5.2	7	11	3	-1	1.06
Sml	Fort Myers-Cape Coral, FL	2.4	1	8	1	1	1.15
	75 area total	-	1,725	2,475	1,125	1,650	
	75 area average	2.7	23	33	15	22	1.39
	Very large area average	2.1	61	85	41	53	1.52
	Large area average	2.5	25	37	16	26	1.32
	Medium area average	2.8	14	18	8	12	1.19
	Small area average	3.2	4	10	2	6	1.11

[1] VMT and lane-mile increases include urban area land size increases. These rates are much higher than the "true" increase rates—that is, those based on new travel or road construction. The rates shown are the average annual growth rates for freeways and principal arterial streets between 1996 and 2001.

Notes: Vlg – Very Large urban areas—over 3 million population.
Lrg – Large urban areas—over 1 million and less than 3 million population.
Med – Medium urban areas—over 500,000 and less than 1 million population.
Sml – Small urban areas—less than 500,000 population.

Exhibit A-17. Illustration of Annual Occupancy Increase Needed to Prevent Mobility Decline

Population Group	*Urban Area*	*Growth in Daily Person Travel*[1]			*Occupancy Level Increase to Maintain 2001 Mobility Level*[4] *(persons per vehicle)*
		Percent[2]	*Additional Miles*	*Estimated Trips*[3]	
Vlg	Houston, TX	4.6	3,442,000	382,445	1.31
Vlg	Dallas-Fort Worth, TX	4.0	3,712,000	412,445	1.30
Vlg	New York, NY-Northeastern, NJ	2.2	4,373,000	485,890	1.28
Vlg	Chicago, IL-Northwestern, IN	1.6	1,858,000	206,445	1.27
Vlg	Detroit, MI	1.6	1,267,000	140,780	1.27
Vlg	Philadelphia, PA-NJ	1.6	923,000	102,555	1.27
Vlg	Washington, DC-MD-VA	1.6	1,163,000	129,220	1.27
Vlg	San Francisco-Oakland, CA	1.4	1,058,000	117,555	1.27
Vlg	Boston, MA	1.1	552,000	61,335	1.26
Vlg	Los Angeles, CA	0.8	2,073,000	230,335	1.26
Lrg	Las Vegas, NV	5.1	738,000	82,000	1.31
Lrg	Orlando, FL	5.1	1,491,000	165,665	1.31
Lrg	W Palm Bch-Boca Raton-Delray Bch, FL	4.6	928,000	103,110	1.31
Lrg	Phoenix, AZ	4.5	2,226,000	247,335	1.31
Lrg	Denver, CO	4.2	1,704,000	189,335	1.30
Lrg	Minneapolis-St. Paul, MN	3.9	1,801,000	200,110	1.30
Lrg	Atlanta, GA	3.7	2,709,000	301,000	1.30
Lrg	Ft. Lauderdale-Hollywood-Pompano Bch, FL	3.4	921,000	102,335	1.29
Lrg	San Diego, CA	3.3	1,881,000	209,000	1.29
Lrg	San Antonio, TX	2.9	751,000	83,445	1.29
Lrg	Columbus, OH	2.7	566,000	62,890	1.28
Lrg	Buffalo-Niagara Falls, NY	2.6	370,000	41,110	1.28
Lrg	San Jose, CA	2.6	899,000	99,890	1.28
Lrg	Tampa-St Petersburg-Clearwater, FL	2.6	888,000	98,665	1.28
Lrg	Cincinnati, OH-KY	2.4	598,000	66,445	1.28
Lrg	Baltimore, MD	2.2	886,000	98,445	1.28
Lrg	Norfolk-Newport News-Virginia Beach, VA	2.1	492,000	54,665	1.28
Lrg	Kansas City, MO-KS	2.0	609,000	67,665	1.27
Lrg	San Bernardino-Riverside, CA	2.0	741,000	82,335	1.28
Lrg	Miami-Hialeah, FL	1.9	786,000	87,335	1.27
Lrg	Portland-Vancouver, OR-WA	1.9	461,000	51,220	1.27
Lrg	Seattle-Everett, WA	1.9	799,000	88,780	1.27
Lrg	Oklahoma City, OK	1.7	308,000	34,220	1.27
Lrg	Milwaukee, WI	1.5	307,000	34,110	1.27
Lrg	Indianapolis, IN	1.4	327,000	36,335	1.27
Lrg	New Orleans, LA	1.0	142,000	15,780	1.26
Lrg	Sacramento, CA	0.8	189,000	21,000	1.26
Lrg	Cleveland, OH	0.3	83,000	9,220	1.25
Lrg	Pittsburgh, PA	0.3	87,000	9,665	1.25
Lrg	St. Louis, MO-IL	0.3	122,000	13,555	1.25
Med	Charlotte, NC	6.1	865,000	96,110	1.33
Med	Austin, TX	5.3	969,000	107,665	1.32
Med	Fresno, CA	4.7	330,000	36,665	1.31
Med	Richmond, VA	4.5	656,000	72,890	1.31
Med	Tucson, AZ	4.2	408,000	45,335	1.30
Med	Providence-Pawtucket, RI-MA	3.7	653,000	72,555	1.30
Med	El Paso, TX-NM	3.3	314,000	34,890	1.29
Med	Omaha, NE-IA	3.0	292,000	32,445	1.29
Med	Nashville, TN	2.7	507,000	56,335	1.28
Med	Salt Lake City, UT	2.7	369,000	41,000	1.28
Med	Hartford-Middletown, CT	2.6	358,000	39,780	1.28
Med	Jacksonville, FL	2.6	559,000	62,110	1.28
Med	Tulsa, OK	2.6	287,000	31,890	1.28
Med	Memphis, TN-AR-MS	2.4	405,000	45,000	1.28
Med	Birmingham, AL	2.3	356,000	39,555	1.28
Med	Albany-Schenectady-Troy, NY	2.2	247,000	27,445	1.28
Med	Tacoma, WA	2.2	235,000	26,110	1.28
Med	Louisville, KY-IN	1.6	280,000	31,110	1.27
Med	Rochester, NY	0.8	64,000	7,110	1.26
Med	Albuquerque, NM	0.4	47,000	5,220	1.26
Med	Honolulu, HI	-0.2	-22,000	-2,445	1.25
Sml	Laredo, TX	9.4	182,000	20,220	1.37
Sml	Beaumont, TX	5.2	171,000	19,000	1.32
Sml	Bakersfield, CA	3.8	223,000	24,780	1.30
Sml	Colorado Springs, CO	3.7	233,000	25,890	1.30
Sml	Brownsville, TX	3.6	43,000	4,780	1.30
Sml	Pensacola, FL	3.0	164,000	18,220	1.29
Sml	Charleston, SC	2.4	176,000	19,555	1.28
Sml	Fort Myers-Cape Coral, FL	2.4	74,000	8,220	1.28
Sml	Anchorage, AK	2.3	63,000	7,000	1.28
Sml	Salem, OR	2.3	74,000	8,220	1.28
Sml	Eugene-Springfield, OR	2.2	59,000	6,555	1.28
Sml	Boulder, CO	2.0	27,000	3,000	1.28
Sml	Spokane, WA	1.8	90,000	10,000	1.27
Sml	Corpus Christi, TX	1.1	58,000	6,445	1.26
	75 area total	-	55,047,000	6,116,330	
	75 area average	2.7	733,960	81,551	1.28
	Very large area average	2.1	2,042,100	226,901	1.28
	Large area average	2.5	827,000	91,889	1.28
	Medium area average	2.8	389,476	43,275	1.29
	Small area average	3.2	116,929	12,992	1.29

[1] Travel measured in person-miles.

[2] VMT increase includes 1996 to 2001 urban area land size increases. These rates are much higher than the true vehicle travel increase rates.

[3] Calculated using an average trip length of 9 miles. These are the number of new carpool or transit trips that would be needed each year to maintain current mobility level.

[4] The average vehicle occupancy rate would have to increase this much to accommodate the new person trips with no new vehicle trips to maintain current mobility level.

Notes: Vlg – Very Large urban areas—over 3 million population.
Lrg – Large urban areas—over 1 million and less than 3 million population.
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Sml – Small urban areas—less than 500,000 population.

Exhibit A-18. 2001 Roadway Congestion Index

Population Group	Urban Area	*Freeway/Expressway*		*Principal Arterial Street*		Roadway Congestion Index
		Daily VMT (000)	*Daily VMT per Lane-Mile*	*Daily VMT (000)*	*Daily VMT per Lane-Mile*	
Vlg	Los Angeles, CA	129,755	23,130	72,180	6,380	1.56
Vlg	San Francisco-Oakland, CA	46,700	20,000	15,000	7,025	1.41
Vlg	Chicago, IL-Northwestern, IN	49,865	18,780	42,235	7,425	1.34
Vlg	Washington, DC-MD-VA	35,770	18,155	20,640	8,325	1.34
Vlg	Boston, MA	23,370	17,855	16,005	7,885	1.31
Vlg	Detroit, MI	30,955	17,100	31,535	7,165	1.24
Vlg	Houston, TX	41,000	16,665	18,700	6,585	1.19
Vlg	New York, NY-Northeastern, NJ	103,675	15,335	57,000	7,680	1.15
Vlg	Dallas-Fort Worth, TX	49,410	15,685	25,015	6,255	1.12
Vlg	Philadelphia, PA-NJ	25,605	14,630	21,600	7,095	1.11
Lrg	San Jose, CA	16,775	18,850	11,210	7,705	1.36
Lrg	San Diego, CA	34,590	19,270	11,600	6,235	1.35
Lrg	Atlanta, GA	43,000	18,695	16,200	7,200	1.33
Lrg	San Bernardino-Riverside, CA	17,400	19,440	11,575	5,250	1.30
Lrg	Miami-Hialeah, FL	13,330	18,260	19,000	6,960	1.29
Lrg	Phoenix, AZ	21,600	18,945	17,665	5,970	1.29
Lrg	Denver, CO	17,250	16,750	14,825	8,425	1.28
Lrg	Ft. Lauderdale-Hollywood-Pompano Bch, FL	13,340	18,400	8,590	6,180	1.28
Lrg	Portland-Vancouver, OR-WA	12,670	18,100	6,260	6,840	1.28
Lrg	Sacramento, CA	12,650	18,335	7,320	6,260	1.28
Lrg	Minneapolis-St. Paul, MN	28,185	17,615	8,400	6,435	1.25
Lrg	W Palm Bch-Boca Raton-Delray Bch, FL	8,395	18,250	7,795	6,090	1.25
Lrg	Seattle-Everett, WA	24,450	17,220	9,000	6,740	1.23
Lrg	Las Vegas, NV	7,730	16,105	3,870	7,900	1.20
Lrg	Indianapolis, IN	12,000	16,440	7,310	7,030	1.19
Lrg	Tampa-St Petersburg-Clearwater, FL	8,900	13,485	18,800	7,690	1.16
Lrg	Baltimore, MD	23,555	15,915	9,125	6,335	1.14
Lrg	Orlando, FL	9,950	13,535	13,600	8,095	1.14
Lrg	Cincinnati, OH-KY	15,945	15,945	4,255	5,125	1.12
Lrg	Columbus, OH	13,285	15,095	3,740	6,285	1.08
Lrg	Milwaukee, WI	9,545	15,775	6,605	5,040	1.08
Lrg	San Antonio, TX	15,600	14,650	5,125	5,630	1.04
Lrg	St. Louis, MO-IL	25,155	14,170	11,220	5,755	1.02
Lrg	New Orleans, LA	5,585	13,460	5,365	5,530	0.97
Lrg	Norfolk-Newport News-Virginia Beach, VA	11,635	12,715	7,295	6,570	0.96
Lrg	Cleveland, OH	16,750	13,085	6,000	5,240	0.94
Lrg	Oklahoma City, OK	9,060	11,845	5,450	4,975	0.86
Lrg	Kansas City, MO-KS	19,350	11,250	5,625	6,150	0.84
Lrg	Pittsburgh, PA	11,310	9,505	9,285	5,990	0.78
Lrg	Buffalo-Niagara Falls, NY	6,380	10,045	4,960	4,790	0.75
Med	Tacoma, WA	5,505	18,660	3,020	5,120	1.26
Med	Austin, TX	9,400	16,070	5,100	6,940	1.17
Med	Charlotte, NC	7,815	16,115	3,500	6,865	1.17
Med	Tucson, AZ	2,450	12,565	5,365	7,250	1.09
Med	Louisville, KY-IN	10,000	14,925	4,200	6,460	1.08
Med	Salt Lake City, UT	7,800	14,855	3,150	6,775	1.08
Med	Albuquerque, NM	3,650	15,210	5,010	5,445	1.05
Med	Honolulu, HI	5,740	14,000	1,850	7,255	1.04
Med	Memphis, TN-AR-MS	7,170	14,060	6,165	6,045	1.03
Med	Nashville, TN	10,485	13,795	4,305	7,055	1.03
Med	Jacksonville, FL	9,750	13,540	7,400	6,580	1.02
Med	Birmingham, AL	8,685	12,865	3,575	8,125	1.00
Med	Providence-Pawtucket, RI-MA	8,765	13,485	5,350	6,485	1.00
Med	El Paso, TX-NM	4,115	14,440	3,505	4,770	0.99
Med	Hartford-Middletown, CT	8,445	13,510	2,385	5,965	0.98
Med	Fresno, CA	2,520	12,295	3,050	6,420	0.97
Med	Omaha, NE-IA	3,420	11,400	4,375	6,295	0.92
Med	Tulsa, OK	6,325	11,715	2,525	6,475	0.88
Med	Richmond, VA	7,975	11,000	3,770	5,935	0.83
Med	Albany-Schenectady-Troy, NY	5,730	10,420	3,285	5,815	0.80
Med	Rochester, NY	5,490	10,980	1,090	5,590	0.80
Sml	Charleston, SC	2,865	11,460	2,935	6,990	0.95
Sml	Fort Myers-Cape Coral, FL	405	9,000	2,100	6,085	0.95
Sml	Eugene-Springfield, OR	1,325	12,045	790	6,320	0.92
Sml	Pensacola, FL	1,150	10,455	3,175	5,880	0.91
Sml	Colorado Springs, CO	2,530	10,765	2,465	6,165	0.87
Sml	Salem, OR	1,190	11,900	1,385	5,035	0.87
Sml	Beaumont, TX	1,620	12,,000	1,000	4,880	0.86
Sml	Boulder, CO	490	9,800	570	6,335	0.84
Sml	Spokane, WA	1,525	10,895	2,545	4,715	0.81
Sml	Brownsville, TX	325	9,285	630	5,250	0.79
Sml	Bakersfield, CA	1,985	10,180	2,725	4,700	0.77
Sml	Corpus Christi, TX	2,915	9,880	1,300	4,195	0.71
Sml	Laredo, TX	430	5,735	1,115	5,070	0.67
Sml	Anchorage, AK	1,455	7,460	715	6,810	0.65
	75 area average	15,772	14,337	9,365	6,324	1.06
	Very large area average	53,611	17,734	31,991	7,182	1.28
	Large area average	16,179	15,705	9,236	6,347	1.13
	Medium area average	6,725	13,615	3,904	6,365	1.01
	Small area average	1,444	10,061	1,675	5,602	0.83

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CAUTION: See http://mobility.tamu.edu/ums for improved performance measures and updated data.

Exhibit A-19. Roadway Congestion Index, 1982 to 2001

Population Group	Urban Area	Roadway Congestion Index					Short-Term Change 1996 to 2001	Long-Term Change 1982 to 2001
		1982	1990	1996	2000	2001	Points	Points
Vlg	Houston, TX	1.03	1.04	1.02	1.17	1.19	17	16
Vlg	Dallas-Fort Worth, TX	0.73	0.96	0.98	1.11	1.12	14	39
Vlg	Philadelphia, PA-NJ	0.82	0.94	1.01	1.10	1.11	10	29
Vlg	Boston, MA	0.88	1.09	1.22	1.30	1.31	9	43
Vlg	New York, NY-Northeastern, NJ	0.77	0.99	1.06	1.15	1.15	9	38
Vlg	Washington, DC-MD-VA	0.99	1.16	1.26	1.30	1.34	8	35
Vlg	Chicago, IL-Northwestern, IN	0.95	1.18	1.27	1.33	1.34	7	39
Vlg	Detroit, MI	0.89	1.08	1.18	1.23	1.24	6	35
Vlg	San Francisco-Oakland, CA	1.06	1.35	1.35	1.41	1.41	6	35
Vlg	Los Angeles, CA	1.29	1.59	1.56	1.59	1.56	0	27
Lrg	San Jose, CA	1.07	1.24	1.11	1.34	1.36	25	29
Lrg	Ft. Lauderdale-Hollywood-Pompano Bch, FL	0.69	0.90	1.07	1.23	1.28	21	59
Lrg	San Diego, CA	0.79	1.19	1.17	1.32	1.35	18	56
Lrg	W Palm Bch-Boca Raton-Delray Bch, FL	0.57	0.85	1.07	1.24	1.25	18	68
Lrg	Minneapolis-St. Paul, MN	0.66	0.89	1.08	1.22	1.25	17	59
Lrg	Atlanta, GA	0.77	0.98	1.17	1.33	1.33	16	56
Lrg	Denver, CO	0.82	0.92	1.12	1.23	1.28	16	46
Lrg	Phoenix, AZ	0.95	1.01	1.14	1.27	1.29	15	34
Lrg	San Antonio, TX	0.69	0.74	0.89	1.05	1.04	15	35
Lrg	Orlando, FL	0.82	0.95	1.00	1.11	1.14	14	32
Lrg	San Bernardino-Riverside, CA	0.78	1.14	1.18	1.26	1.30	12	52
Lrg	Baltimore, MD	0.75	0.95	1.03	1.10	1.14	11	39
Lrg	Sacramento, CA	0.76	1.05	1.17	1.25	1.28	11	52
Lrg	Buffalo-Niagara Falls, NY	0.53	0.60	0.66	0.76	0.75	9	22
Lrg	Milwaukee, WI	0.71	0.93	0.99	1.10	1.08	9	37
Lrg	Cincinnati, OH-KY	0.70	0.92	1.04	1.13	1.12	8	42
Lrg	Columbus, OH	0.63	0.85	1.00	1.02	1.08	8	45
Lrg	Las Vegas, NV	0.69	1.06	1.12	1.23	1.20	8	51
Lrg	Portland-Vancouver, OR-WA	0.81	1.02	1.20	1.27	1.28	8	47
Lrg	Kansas City, MO-KS	0.53	0.66	0.77	0.83	0.84	7	31
Lrg	Indianapolis, IN	0.64	0.83	1.13	1.16	1.19	6	55
Lrg	Miami-Hialeah, FL	0.95	1.20	1.23	1.31	1.29	6	34
Lrg	Seattle-Everett, WA	0.87	1.15	1.19	1.23	1.23	4	36
Lrg	Norfolk-Newport News-Virginia Beach, VA	0.84	0.91	0.94	0.95	0.96	2	12
Lrg	Oklahoma City, OK	0.65	0.73	0.84	0.87	0.86	2	21
Lrg	Pittsburgh, PA	0.70	0.75	0.76	0.77	0.78	2	8
Lrg	Tampa-St Petersburg-Clearwater, FL	1.07	1.10	1.14	1.13	1.16	2	9
Lrg	New Orleans, LA	0.92	0.94	0.96	0.97	0.97	1	5
Lrg	St. Louis, MO-IL	0.87	0.91	1.01	1.04	1.02	1	15
Lrg	Cleveland, OH	0.68	0.83	0.94	0.97	0.94	0	26
Med	Austin, TX	0.73	0.90	0.97	1.12	1.17	20	44
Med	Charlotte, NC	0.86	1.05	1.01	1.15	1.17	16	31
Med	El Paso, TX-NM	0.62	0.73	0.84	0.98	0.99	15	37
Med	Providence-Pawtucket, RI-MA	0.71	0.89	0.86	0.98	1.00	14	29
Med	Tacoma, WA	0.75	0.91	1.13	1.22	1.26	13	51
Med	Tucson, AZ	0.78	0.89	0.97	1.07	1.09	12	31
Med	Hartford-Middletown, CT	0.61	0.82	0.87	0.97	0.98	11	37
Med	Birmingham, AL	0.69	0.78	0.90	0.99	1.00	10	31
Med	Nashville, TN	0.83	0.85	0.93	0.98	1.03	10	20
Med	Tulsa, OK	0.73	0.76	0.79	0.87	0.88	9	15
Med	Fresno, CA	0.67	0.86	0.89	1.00	0.97	8	30
Med	Omaha, NE-IA	0.62	0.75	0.84	0.90	0.92	8	30
Med	Louisville, KY-IN	0.78	0.80	1.01	1.09	1.08	7	30
Med	Albany-Schenectady-Troy, NY	0.46	0.68	0.74	0.78	0.80	6	34
Med	Memphis, TN-AR-MS	0.71	0.88	0.98	1.00	1.03	5	32
Med	Salt Lake City, UT	0.66	0.84	1.04	1.04	1.08	4	42
Med	Richmond, VA	0.67	0.75	0.80	0.83	0.83	3	16
Med	Rochester, NY	0.51	0.69	0.77	0.80	0.80	3	29
Med	Albuquerque, NM	0.62	0.85	1.05	1.07	1.05	0	43
Med	Jacksonville, FL	0.75	0.94	1.02	1.03	1.02	0	27
Med	Honolulu, HI	0.79	1.03	1.07	1.04	1.04	-3	25
Sml	Colorado Springs, CO	0.50	0.62	0.76	0.86	0.87	11	37
Sml	Laredo, TX	0.55	0.56	0.56	0.63	0.67	11	12
Sml	Eugene-Springfield, OR	0.53	0.68	0.82	0.94	0.92	10	39
Sml	Boulder, CO	0.55	0.65	0.76	0.81	0.84	8	29
Sml	Brownsville, TX	0.54	0.62	0.71	0.78	0.79	8	25
Sml	Salem, OR	0.56	0.79	0.79	0.87	0.87	8	31
Sml	Anchorage, AK	0.58	0.62	0.59	0.62	0.65	6	7
Sml	Corpus Christi, TX	0.57	0.67	0.66	0.71	0.71	5	14
Sml	Pensacola, FL	0.61	0.84	0.86	0.92	0.91	5	30
Sml	Bakersfield, CA	0.54	0.64	0.74	0.76	0.77	3	23
Sml	Charleston, SC	0.85	0.96	0.92	0.98	0.95	3	10
Sml	Fort Myers-Cape Coral, FL	0.83	0.95	0.92	0.96	0.95	3	12
Sml	Spokane, WA	0.53	0.62	0.78	0.82	0.81	3	28
Sml	Beaumont, TX	0.65	0.74	0.84	0.84	0.86	2	21
	75 area average	0.82	1.01	1.08	1.16	1.17		
	Very large area average	0.95	1.17	1.20	1.28	1.28		
	Large area average	0.75	0.93	1.04	1.12	1.14		
	Medium area average	0.68	0.83	0.92	0.99	1.00		
	Small area average	0.59	0.71	0.76	0.81	0.82		

Notes: Vlg – Very Large urban areas—over 3 million population.
Lrg – Large urban areas—over 1 million and less than 3 million population.
Med – Medium urban areas—over 500,000 and less than 1 million population.
Sml – Small urban areas—less than 500,000 population.