CRASHES VS. CONGESTION

What's the Cost to Society?

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CAMBRIDGE SYSTEMATICS

Crashes vs. Congestion – What's the Cost to Society?

prepared for

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Executive Summary

Executive Summary

When American motorists talk about transportation problems, they generally key in on traffic. Snarled highways, epic commutes, and gridlocked business and commercial districts mar our suburban existence, weighing heavily upon our elected leaders, our policy-makers, and our families. Yet there's a more costly problem to be addressed on America's roads: motor vehicle crashes. In 2006, traffic crashes killed 42,642 people in the United States – about 117 deaths per day, and nearly 5 every hour. Most Americans would be surprised to learn the societal costs associated with motor vehicle crashes significantly exceed the costs of congestion.

AAA commissioned this study to examine the costs of crashes to society. The study, along with recommendations for improvements, is designed to raise awareness of the importance of transportation investments, and provide policy-makers, departments of transportation, and the public with information on the magnitude of the safety problem.

■ Methodology

The AAA study compares the costs of crashes to the costs of congestion by calculating a per person cost for crashes and multiplying by the population figures in the same 85 urban areas used by the Texas Transportation Institute (TTI) in the annual *Urban Mobility Report*. The costs of crashes are based on the Federal Highway Administration's (FHWA) comprehensive costs for traffic fatalities and injuries which place a dollar value on 11 components.

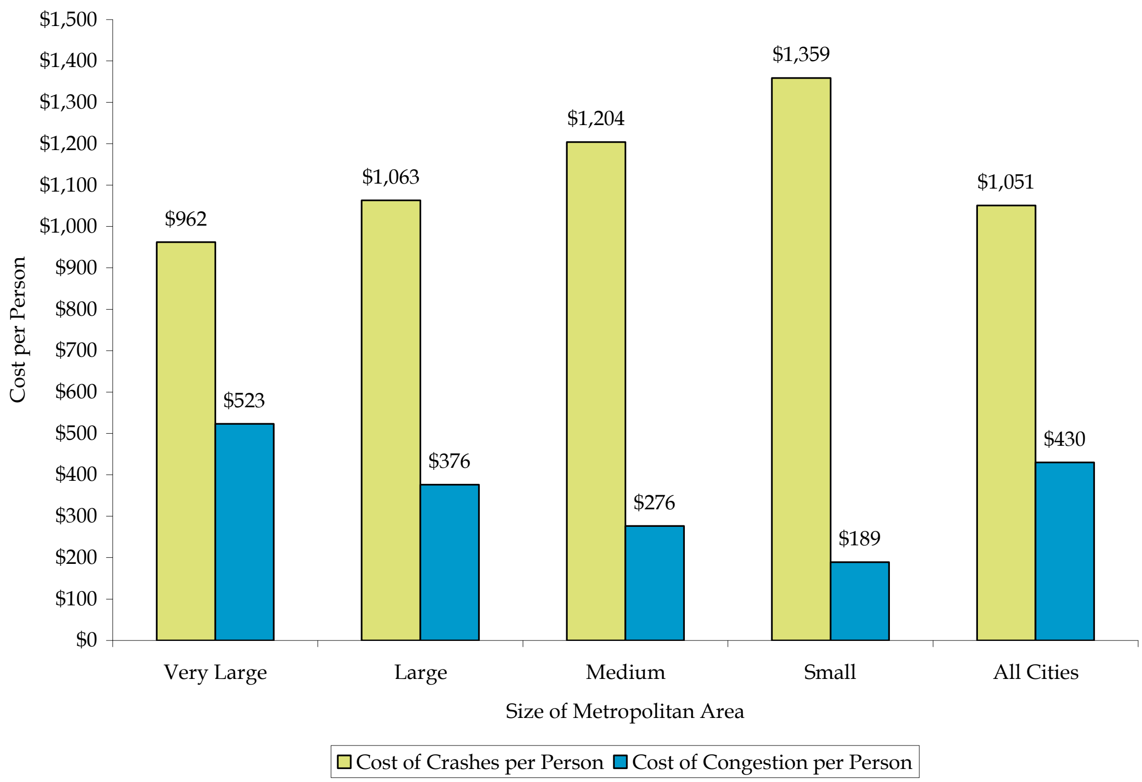
The 11 comprehensive cost components include property damage; lost earnings; lost household production (non-market activities occurring in the home); medical costs; emergency services; travel delay; vocational rehabilitation; workplace costs; administrative; legal; and pain and lost quality of life. According to FHWA, in 2005 dollars, the per person cost of a fatality is $3,246,192 and the cost for an injury is $68,170. Congestion costs, as reported in the *Urban Mobility Report*, are based on delay estimates combined with value of time and fuel costs.

To ensure the accuracy of the study, results are not provided for Atlanta, Georgia, and for cities in Massachusetts and Texas. In the case of Atlanta only one of the two required comparison factors was available; Massachusetts was eliminated due to lack of good data; and Texas did not have recent data available during the course of this study.

■ Crash Costs Summary Results

Figure ES.1 shows data from 2005. The yellow bar graph shows, in 2005 dollars, the total cost of fatal and injury crashes for very large metropolitan areas (population over 3 million); large urban areas (population of 1 million but less than 3 million); medium areas (over 500,000 and less than 1 million); and small areas (less than 500,000). The blue bar shows the costs of congestion as reported by TTI in their 2007 *Urban Mobility Report.*

Figure ES.1 Per Person Cost of Crashes and Congestion
Cost of Crashes includes Fatality and Injury Costs and excludes Property Damage Only (PDO) Crashes

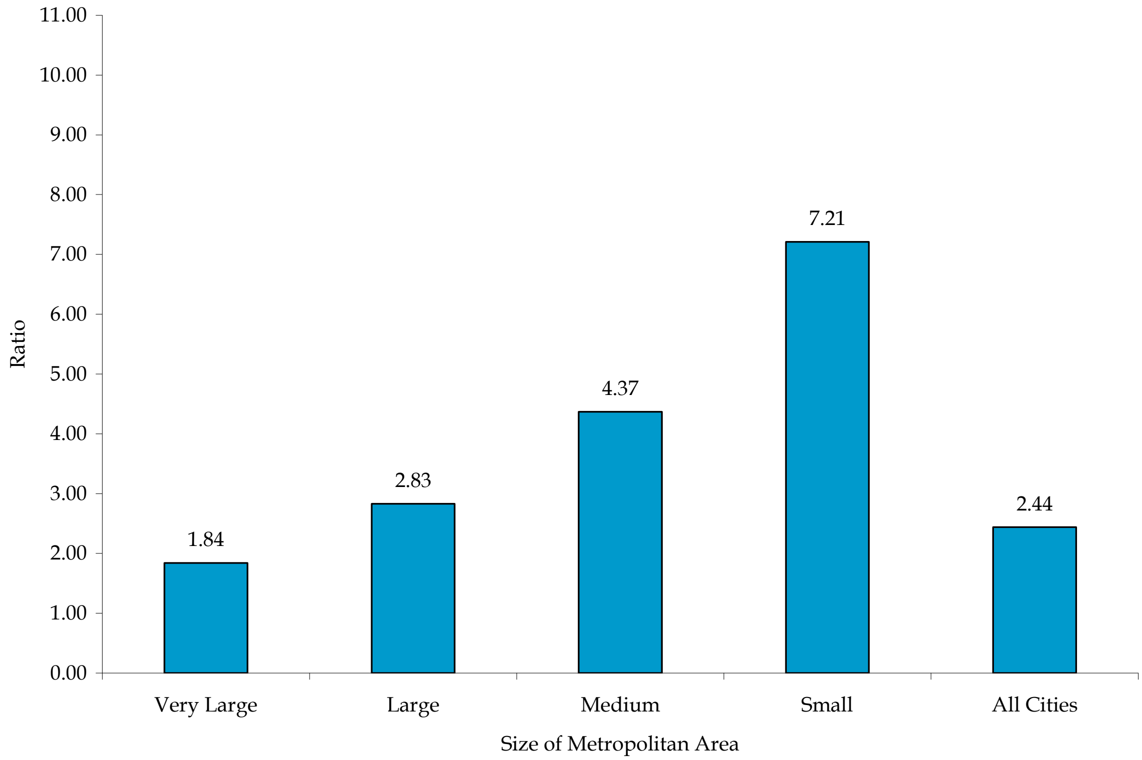


Key Findings

- In the urban areas studied, the cost of traffic crashes is nearly two and a half times the cost of congestion – $164.2 billion for traffic crashes and $67.6 billion for congestion.
- The crash costs include property damage; lost earnings; lost household production (non-market activities occurring in the home); medical costs; emergency services; travel delay; vocational rehabilitation; workplace costs; administrative; legal; and pain and lost quality of life. The economy and the environment also are impacted but those costs are not quantified in the study. According to FHWA, in 2005 dollars, the average cost of a fatality is $3,246,192 and the average cost of an injury is $68,170.
- Improving safety may improve congestion. Forty to 50 percent of all nonrecurring congestion is associated with traffic incidents.
- The cost of crashes on a per person basis decreases as the size of the metropolitan area increases. This is the inverse of the cost of congestion, which increases with an increase in the size of the metropolitan area.

Figure ES.2 shows the relationship between crash and congestion costs for very large, large, medium, and small urban areas along with the average for all cities in the study. For example, in the case of very large cities, for every dollar of congestion costs, the crash costs are $1.84.

Figure ES.2 Crash Costs Compared to Congestion Costs

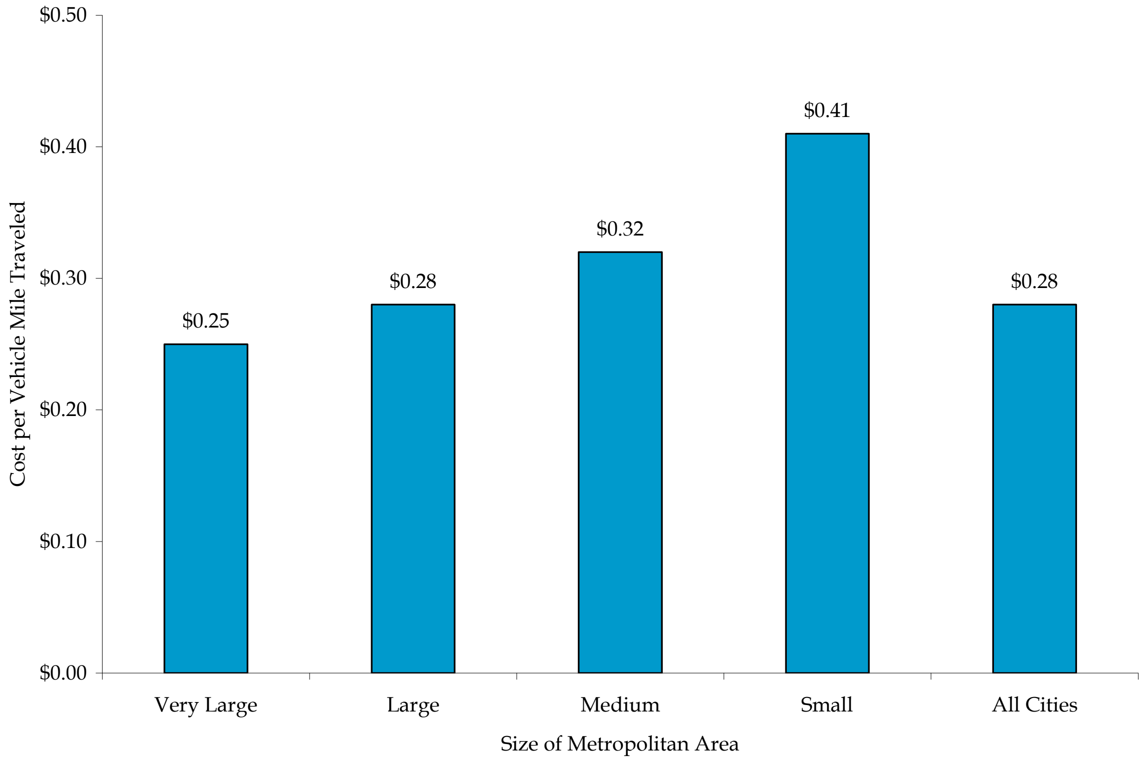


■ Key Findings

- In every city, the crash costs on a per person basis exceed the congestion costs. Overall, crash costs are nearly two and half times those of congestion. For very large urban areas (over 3 million), crash costs are nearly double those of congestion; for large urban areas (1 million to less than 3 million), crash costs are nearly two and a half times more than congestion; for medium-sized urban areas (500,000 to less than 1 million), crash costs are over four times more than congestion; and for small urban areas (less than 500,000), crashes are seven times more costly than congestion.

Figure ES.3 shows the cost of crashes and congestion per vehicle miles of travel. According to the FHWA, the average per vehicle miles traveled in 2005 was 12,084. Based on 28 cents per mile for the average city, this translates to a cost of over $3,000 per year for all Americans. For individuals living in very large urban areas, crashes cost $3,021; in large urban areas the crash costs are $3,384; for medium urban areas the costs are $3,867; and for small urban areas crashes cost $4,954.

Figure ES.3 Cost of Crashes and Congestion per Vehicle Mile Traveled



■ Report Recommendations

Further progress on traffic safety is going to take all the "tools" in the traffic safety toolbox, plus some new thinking about approaches. Among the most significant challenges going forward will be how to change our culture of complacency as it relates to traffic safety. There is no single action or strategy that will bring about a cultural change. Rather, it will take new approaches to enhance public support for increased funding and help transportation planners focus on areas that will have the greatest safety benefits.

Leadership

- Leadership and commitment are needed at the Federal, state, and local levels to make safety a priority in all transportation planning. Focusing planning and resources on safety improvements will not only save lives and prevent injuries, but can also reduce congestion.
- Greater political will is needed to pass legislation and enforce laws that can have a positive impact on safety such as primary safety belt requirements, impaired driving countermeasures, and full implementation of graduated driver licensing systems.

- Congress and the U.S. Department of Transportation should ensure states follow through on implementation of their strategic highway safety plans and evaluate the results to determine effectiveness.[1]
- National safety goals should be established and strategies implemented to cut surface transportation fatalities in half by 2025, as recommended by the National Surface Transportation Policy and Revenue Study Commission.

Communication & Collaboration

- The transportation safety community needs to develop more effective ways of getting the public to understand the impact of traffic crashes, the need for effective countermeasures, and the role their own behavior plays in safety.
- Increased collaboration among traffic safety professionals, public health specialists, and health communications experts is needed to incorporate the best available science on behavior modification.

Research & Evaluation

- Increased funding for testing and evaluation of safety interventions should be a priority. Programs should be based on sound scientific principles rather than "conventional wisdom," populist fervor, or political expediency. Systematic evaluation allows identification and expansion of successful programs and interventions so that limited resources can be applied more effectively.
- Further testing and implementation of a road risk assessment tool, e.g., U.S. Road Assessment Program (usRAP), should be encouraged to ensure dollars are spent on roads and bridges with the greatest safety problems. Understanding road safety risks will help state DOTs focus on solutions that will have the greatest safety benefits and should result in broader public support for needed improvements. [2]

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[1] In 1997, the American Association of State Highway & Transportation Officials (AASHTO) developed a Strategic Highway Safety Plan (SHSP) and identified 22 of the nation's most pressing highway safety problems. The plan focused on drivers, special users, vehicles, highways, emergency medical services, and management. In 2005, Congress passed the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) which directed states to use data to determine their most serious transportation safety problems and develop a SHSP to address them.

[2] The U.S. Road Assessment Program (usRAP) is a pilot program of the AAA Foundation for Traffic Safety, built upon successful programs already established in Europe (EuroRAP) and Australia (AusRAP). usRAP produces color-coded risk maps that display the crash rates and crash densities of roads, derived from historical crash data and traffic volume data, and also "star ratings" that communicate the relative safety of the physical characteristics and safety features of the roads, which are assessed through physical inspection of the roads. The pilot program has developed risk maps of rural primary roads in four states, and is expanding into several additional states in 2008.

1.0 Introduction

The American public and elected officials increasingly are concerned about the costs and consequences of congestion; however, this study commissioned by AAA suggests that the costs of congestion are not nearly as great as the costs and consequences of motor vehicle crashes. The study examines the relationship between congestion and crashes to determine the relative *economic* impact.

The study, along with recommendations for improvement, is designed to provide elected officials, Federal, state, and local agencies with road safety responsibilities, and the public with information on the comparative magnitude and possible interactive effects of crashes and congestion.

This study was able to compare the costs of crashes with the costs of congestion by calculating a per person cost for crashes and multiplying that figure by the population figures in the same 85 urban areas used by the Texas Transportation Institute (TTI) in their annual *Urban Mobility Report* as shown in Table 1.1. The costs of crashes are based on the Federal Highway Administration's (FHWA) comprehensive costs for traffic fatalities and injuries that assigns a dollar value to 11 components, including property damage; lost earnings; lost household production (non-market activities occurring in the home); medical costs; emergency services; travel delay; vocational rehabilitation; workplace costs; administrative; legal; and pain and lost quality of life. According to FHWA, in 2005 dollars, the average cost of a fatality is $3,246,192 and the average cost of an injury is $68,170.

To ensure the accuracy of the study, results were not provided for Atlanta, Georgia, and for cities in Massachusetts and Texas due to the lack of crash data. In Atlanta only one of the two required comparison factors was available; Massachusetts was eliminated due to lack of good data; and Texas did not have recent data available during the course of this study.

The cost of crashes exceeds the cost of congestion in each of the TTI urban areas we compared. Results from the study show that large cities incur the largest total crash costs because the number of fatalities and injuries is larger than in smaller cities. However, if the total cost of crashes is calculated on a per person basis (necessary for a comparison with the costs of congestion), smaller cities have greater per person costs.

As with the total cost of crashes, the total cost of congestion increases as city size increases. However, on a per person basis, an inverse relationship occurs: while crash costs per person *increase* according to the declining size of the city, the cost of congestion per person *declines* along with declining city size. This indicates the relative cost of crashes is greater than the cost of congestion in smaller cities.

Table 1.1 Metropolitan Areas Analyzed

Akron, OH	Detroit-Warren-Livonia, MI	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
Albany-Schenectady-Troy, NY	El Paso, TX	Phoenix-Mesa-Scottsdale, AZ
Albuquerque, NM	Eugene-Springfield, OR	Pittsburgh, PA
Allentown-Bethlehem-Easton, PA-NJ	Fresno, CA	Portland-Vancouver-Beaverton, OR-WA
Anchorage, AK	Grand Rapids-Wyoming, MI	Providence-New Bedford-Fall River, RI-MA
Atlanta-Sandy Springs-Marietta, GA	Hartford-West Hartford-East Hartford, CT	Raleigh-Cary, Durham, NC
Austin-Round Rock, TX	Honolulu, HI	Richmond, VA
Bakersfield, CA	Houston-Baytown-Sugar Land, TX	Riverside-San Bernardino-Ontario, CA
Baltimore-Towson, MD	Indianapolis, IN	Rochester, NY
Beaumont-Port Arthur, TX	Jacksonville, FL	Sacramento-Arden-Arcade-Roseville, CA
Birmingham-Hoover, AL	Kansas City, MO-KS	Salem, OR
Boston-Cambridge-Quincy, MA-NH	Laredo, TX	Salt Lake City, UT
Boulder, CO	Las Vegas-Paradise, NV	San Antonio, TX
Bridgeport-Stamford-Norwalk", CT	Little Rock-North Little Rock, AR	San Diego-Carlsbad-San Marcos, CA
Brownsville-Harlingen, TX	Los Angeles-Long Beach-Santa Ana, CA	San Francisco-Oakland-Fremont, CA
Buffalo-Cheektowaga-Tonawanda, NY	Louisville, KY-IN	San Jose-Sunnyvale-Santa Clara, CA
Cape Coral-Fort Myers, FL	Memphis, TN-MS-AR	Sarasota-Bradenton-Venice, FL
Charleston-North Charleston, SC	Miami-Fort Lauderdale-Miami Beach, FL	Seattle-Tacoma-Bellevue, WA
Charlotte-Gastonia-Concord, NC-SC	Milwaukee-Waukesha-West Allis, WI	Spokane, WA
Chicago-Naperville-Joliet, IL-IN-WI	Minneapolis-St. Paul-Bloomington, MN-WI	Springfield, MA
Cincinnati-Middletown, OH-KY-IN	Nashville-Davidson-Murfreesboro, TN	St. Louis, MO-IL
Cleveland-Elyria-Mentor, OH	New Haven-Milford, CT	Tampa-St. Petersburg-Clearwater, FL
Colorado Springs, CO	New Orleans-Metairie-Kenner, LA	Toledo, OH
Columbia, SC	New York-Newark-Edison, NY-NJ-PA	Tucson, AZ
Columbus, OH	Oklahoma City, OK	Tulsa, OK
Corpus Christi, TX	Omaha-Council Bluffs, NE-IA	Virginia Beach-Norfolk-Newport News, VA-NC
Dallas-Fort Worth-Arlington, TX	Orlando, FL	Washington-Arlington-Alexandria, DC-VA-MD-WV
Dayton, OH	Oxnard-Thousand Oaks-Ventura, CA	
Denver-Aurora, CO	Pensacola-Ferry Pass-Brent, FL	

Section 2 of this report provides a review of the conventional wisdom on the relationship between crashes and congestion. Section 3 discusses the methodology for data collection and the technical approach used to determine crash costs. Section 4 discusses the final tabulated crash costs and the relationship to congestion costs. Section 5 summarizes the conclusions and recommendations of the study.

2.0 Crashes and Congestion – The Conventional Wisdom

Traffic congestion is not only exasperating, it is costly. In *Optimizing the System*, the American Association of State Highway Transportation Officials (AASHTO) references the 2001 Texas Transportation Institute report examining the costs of congestion in America's 85 largest urban areas. "An astronomical 3.5 billion hours of people's time and 5.7 billion gallons of fuel were wasted in 2001 because of congestion. The cost of these squandered resources is a staggering $69.5 billion," the report noted. However the AASHTO report goes on to say, "But as bad as this is, there's an immeasurably more costly and tragic measure of the system's performance: the human toll. Every year, more than 43,000 people are killed and nearly 3 million are injured in crashes on our nation's roads and highways. The economic cost of vehicle crashes annually is over $230 billion dollars." (1)

Federal and state departments of transportation (DOT) publicly refer to congestion management and road safety as their stated goals, as do metropolitan planning organizations (MPO), and other local transportation agencies. Safety is nearly always a goal in transportation planning at any level, particularly because of the Federal transportation bills TEA-21, and SAFETEA-LU which establish safety as a priority transportation planning factor. Given the unacceptable number of deaths and injuries, safety is increasingly stated as "the most important goal." On the other hand, congestion receives very high levels of attention in the national media as well as in government circles as one of the most critical challenges facing urban America.

After the goal statements in transportation plans, safety is likely to receive less attention than congestion except for temporary interest following highly publicized crashes such as the bus crash in Atlanta in which six members of a college baseball team died, or when high-visibility enforcement campaigns are launched, e.g., Click It or Ticket, the national safety belt campaign. Except for these events, safety does not receive the same level of public or political attention and concern as does the annual release of the TTI congestion index. According to the FHWA, the reasons are obvious:

> *Demand for highway travel by Americans continues to grow as population increases, particularly in metropolitan areas. Construction of new highway capacity to accommodate this growth in travel has not kept pace. Between 1980 and 1999, route miles of highways increased 1.5 percent while vehicle miles of travel increased 76 percent. The Texas Transportation Institute estimates that, in 2003, the 85 largest metropolitan areas experienced 3.7 billion vehicle-hours of delay, resulting in 2.3 billion gallons in wasted fuel and a congestion cost of $63 billion (Source: 2005 Urban Mobility Report, TTI). And traffic volumes are projected to continue growing. The volume of freight movement alone is forecast to nearly double by 2020. Congestion is largely thought of as a big city*

problem, but delays are becoming increasingly common in small cities and some rural areas as well. (2)

The obvious reason is elected and appointed officials frequently hear concerns expressed by their constituents and the media about congestion. Safety, on the other hand, receives far less attention despite the fact that literally millions of crashes occur each year. Crashes occur randomly and usually affect only a few people each time they do occur. Studies show that the vast majority of Americans think they are good drivers; hence, they do not believe they will be involved in a crash.

The purpose of this section is to provide a brief overview of the conventional wisdom regarding the relationship between safety and congestion. Sparse literature exists examining the congestion-safety relationship. A search of the Transportation Research Information System (TRIS) on "safety management and congestion management" produces nearly 700 references. However, the abstracts show none of the articles directly address the interaction effect of crashes and congestion. The closest accounting may be research that examines the impact of incident management on safety. Overall, the research is almost always about something other than an examination of the statistical relationship between safety and congestion. There also is, as evidenced from the statements below, a lack of consensus on the most frequently suggested hypotheses:

- Congested roadways lead to a decrease in crashes;
- Congested roadways lead to an increase in crashes; and
- Congested roadways lead to an increase in crashes but severity is reduced.

2.1 Crashes, Congestion, and System Performance

Little research is available on the relationship between crashes and congestion as it relates to the performance of the transportation system. The research that does exist can be organized into four categories: congestion-related crashes, nonrecurring congestion crashes, secondary crashes, and volume-related crashes.

Congestion-Related Crashes

The evidence is mixed on the degree to which congestion reduces the number of crashes that occur on congested road segments. In some cases, crash statistics show the number of crashes is reduced when the road is less congested. A study by the Victoria Transport Policy Institute examined the relationships among safety, congestion, and system performance by focusing on mode shift as a method for reducing congestion. The study found:

Safety impacts depend on types of travel changes that occur. Reductions in total vehicle mileage are likely to cause proportionate or greater reductions in crashes. The safety impact of mode shifting depends on the relative risks of each mode. Shifting vehicle

> *travel from congested roads to less-congested conditions tends to reduce crashes but increases crash severity. Strategies that reduce trip distance and traffic speed can provide significant safety benefits.* (3)

The conventional wisdom seems to be that increasing mobility, e.g., adding lane miles, results in safety improvement. The argument frequently is made to stimulate more interest and funding to support capacity increases. Research on Nevada's future mobility needs concluded that at least $2 billion in additional funding is needed for highway projects due to the tremendous growth in population and vehicle miles of travel in that state. According to The Road Information Program and the Nevada Highway Users Alliance, "These projects would help relieve traffic congestion, *improve traffic safety*, and improve pavement quality statewide." (4) There is little doubt that congestion and pavement quality would be improved. The impact on safety is not as clear because there is no consensus in the scientific literature on which to base the statement.

In summary, although the evidence is mixed, less congested roadways appear to lead to fewer, but more severe, crashes. This relationship is especially strong in the case of crash severity; that is, more severe crashes occur on less congested roadways due in large part to faster speeds. On more congested roadways, the number of crashes may increase, but they may be primarily minor crashes reflecting the increased weaving and access/egress movements that often occur on congested road segments.

Nonrecurring Congestion Crashes

Urban road congestion is caused by two phenomena:

- Recurring congestion reflecting the normal, day-to-day delays caused by bottlenecks and large volumes; and

- Nonrecurring congestion caused when something unexpected happens. According to FHWA:

  > *…Nonrecurring congestion includes the development and deployment of strategies designed to mitigate traffic congestion due to nonrecurring causes, such as crashes, disabled vehicles, work zones, adverse weather events, and planned special events. About half of congestion is caused by temporary disruptions that take away part of the roadway from use – or "nonrecurring" congestion. The three main causes of nonrecurring congestion are: incidents ranging from a flat tire to an overturned hazardous material truck (25 percent of congestion), work zones (10 percent of congestion), and weather (15 percent of congestion). Nonrecurring events dramatically reduce the available capacity and reliability of the entire transportation system. This is the type of congestion that surprises us. We plan for a trip of 20 minutes and we experience a trip of 40 minutes. Travelers and shippers are especially sensitive to the unanticipated disruptions to tightly scheduled personal activities and manufacturing distribution procedures.* (5)

Although national data suggest that approximately 25 percent of nonrecurring congestion is due to crashes, it may be underreported.

Secondary Crashes

Strong evidence exists indicating the number of upstream crashes increases when congestion occurs downstream. This is not surprising especially on high-speed roads. Suddenly approaching stopped traffic can lead to rear-end collisions. According to the FHWA's *Freeway Management and Operations Handbook*:

> *Although the problems most often associated with traffic incidents are congestion and associated traveler delay, increased fuel consumption, and reduced air quality, the most serious problem is the occurrence of secondary crashes. Another related issue is the danger posed by traffic incidents to the response personnel serving the public at the scene.* (6)

In severe crash-induced congestion, this phenomenon can result in more than one additional secondary crash. For example, in a study of freeway secondary crashes conducted by the Eno Foundation for Transportation, 60 percent occurred within 600 feet of the original crash. (7) For this reason, many DOTs have instituted incident management programs and freeway service patrols. These programs are designed to notify drivers as quickly as possible of crash-related congestion ahead and to manage the incident using methods that restore normal traffic conditions as quickly as possible. The phenomenon of secondary crashes also is one that is important for urban arterial roads. (8) Several journal articles make the case that improved incident management leads to safety improvements due to reductions in secondary crashes and lessening of harm to incident management personnel. (9 to 17)

Volume-Related Crashes

At intersections in particular, there is a strong relationship between volume of traffic (especially turning traffic) and the number of crashes. Higher volumes usually correspond with a larger number of crashes simply because the probability of a crash occurring is greater when more vehicles are present. However, higher volumes do not necessarily equate to increased congestion, and there is little research on the relationship between congested intersection conditions and crash incidents.

Summary

The conventional wisdom related to the operational relationship between congestion and safety is that the relationship depends on the geometric design of the road, the types of vehicle operations occurring on the road, and the volume of traffic. It is fair to conclude there *is* a relationship between congestion and safety, but that it is often understated and misunderstood.

■ 2.2 Crashes, Congestion, and Institutional Capacity

The manner in which states organize their transportation programs is often an indication of the underlying assumptions upon which the program is structured. In most cases, state transportation safety programs are not closely tied to the state DOT traffic operations unit, which is the group primarily responsible for managing congestion through road management and operations. Part of the problem may be that in the minds of many state DOT officials, everything the agency does, e.g., engineering design, operations, maintenance, etc., improves road safety.

For many years, it was assumed that following the standards established by the AASHTO *Policy on Geometric Design of Highways and Streets* (Green Book) and the *Manual on Uniform Traffic Control Devices* (MUTCD) automatically results in safety improvements. Only in recent years have engineers, researchers, statisticians, and others realized that many of the standards and guidelines have not been scientifically evaluated for their impact on safety. Fortunately, the FHWA and AASHTO have increased efforts to evaluate the effectiveness of these design practices and guidelines.

To what extent do DOT and MPO transportation planners address safety in the traditional planning process and documents? The findings in several studies that addressed this question were limited. (18 to 20) Safety was often noted in the vision and perhaps in a goals statement, but the subject was rarely addressed beyond that point in the plan development process. There is an interesting institutional relationship, however, between congestion and safety that could be developed. Every metropolitan area with a population over 200,000 (referred to as a transportation management area) must have a congestion management process that identifies the most congested roads in the region. This road network is then part of the prioritization process for investment decision-making. In many cases, the defined network for the congestion management process also includes those roads with the largest number of crashes. A substantial percentage (40-50%) of non-recurring congestion is caused by one-time incidents, including traffic crashes. Thus, there is a potential database in many metropolitan areas that could be tapped showing the congested roads and corresponding crash statistics (although this work has not been done).

Also, as mandated by the Federal transportation bill, SAFETEA-LU, State DOTs are required to identify the most hazardous locations based on a data review of crashes, fatalities, and injuries as part of their Highway Safety Improvement Program (HSIP). States must submit an annual report to the Federal government describing not less than five percent of these locations exhibiting the most severe safety needs to raise public awareness of the highway safety needs and challenges in the states. Unfortunately, most of the state reports are limited to state road systems since crash data on other public roads is often unavailable or unreliable. Provisions in SAFETEA-LU require that the hazardous location designation apply to "all public roads" (state and local) to ensure resources are targeted at the state's most serious transportation safety problems regardless of where they occur.

Several additional Federal, state, and local agencies exist other than DOTs or MPOs, with specific responsibilities for safety. These include state highway safety offices managed by the Governors Highway Safety Representatives. In some cases, these offices are located in the

DOT, but they may be independent or part of other agencies such as Departments of Public Safety, Motor Vehicles, or the State Police. These offices focus mainly on behavioral safety and seek to reduce traffic-related crashes, fatalities, and injuries through enforcement, education, and prevention initiatives. To that end, the Federal mandate for states to develop HSIPs was, to a large extent, designed to get the various elements of the state highway transportation agencies and departments to collaborate by jointly developing common goals and objectives.

State DOTs tend to focus on engineering-related safety improvements rather that assuming responsibility for safety from a broader "4E" perspective, i.e., engineering, education, enforcement, and emergency response. However, research by Hendren and Niemeier shows the relationship between safety and congestion is complex, and missing variables from congestion and safety models provide an incomplete picture. In their study, which attempted to link performance measures to resource allocation, the authors concluded that transportation system performance is clearly influenced by factors besides government expenditure categories. For example, between 1985 and 2000, safety belt use increased saving approximately 133,549 lives. (21) Increasing safety belt use may not reduce crashes but it effectively reduces severity. A study of the relationship between safety and congestion over time would have to take this phenomenon and others into account.

Congestion, on the other hand, is a public issue and is repeatedly ranked as number one or two in urban polls. The public expects the DOT to address the issue and judges its effectiveness on its ability to alleviate congestion; therefore, substantial funding is devoted to highway construction aimed at reducing congestion. Although state DOTs influence road safety, it is often viewed as an implicit part of the job, and a DOT's performance is rarely rated according to an explicit safety standard by the public.

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3.0 Methodology

This section describes the methodology used to conduct the data analysis for this study. There were four key steps in the process:

- Collecting fatality and injury data;
- Assembling data with respect to metropolitan area boundaries;
- Monetizing fatalities and injuries to determine total costs; and
- Comparing crash costs to congestion costs.

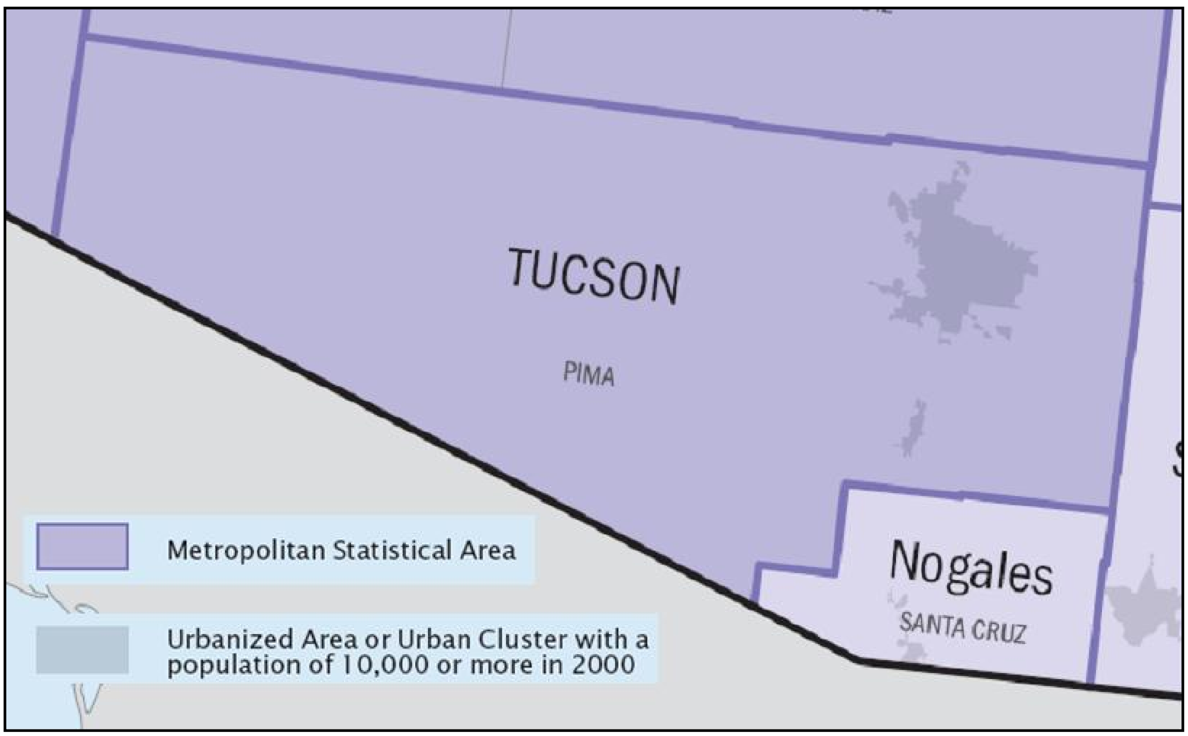
The key components in determining estimates for crash costs for this study were the numbers of fatalities and injuries. Fatality and injury statistics are primarily summarized at the county level; therefore, it was determined that analyses would be conducted at the metropolitan statistical area (MSA) level as MSAs are defined based on county boundaries. As a result, it was necessary to assemble crash data for all constituent counties in an MSA. Steps were taken to contact all appropriate state agencies to obtain fatality and injury data. The inclusion of Property Damage Only (PDO) crashes was considered; however, data for such crashes is inconsistent. PDO crashes are reported only if they meet a certain damage threshold level, which differs from state to state. Because of the thresholds, about half of all PDO crashes are unreported.

The definition of a MSA differs from the definition of an urbanized area used in the *Urban Mobility Report*. The *Urban Mobility Report* (UMR) provides information on congestion based on data collected from the Highway Performance Monitoring System (HPMS). Since the UMR is focused on roadways within urban areas, a filter is used to isolate specific roadways in the HPMS database for the analysis. Filtering uses the urban or non-urban variable that is coded for each roadway in the HPMS dataset. The classification of urban or non-urban is based on "urbanized area" definitions provided by the Bureau of the Census. Such definitions are provided for hundreds of urban agglomerations across the country, many more than those covered in the UMR. Urbanized areas are density-based, and include census blocks in the urban core with a population density exceeding 1,000 persons per square-mile, and census blocks in the surrounding areas that have a population density exceeding 500 persons per square-mile.

Crash data is coded with sufficient location information to identify the urban or rural location of the crash; however, to obtain and process database information from all the states and to juxtapose this information with urbanized area definitions would have been extremely costly and difficult to process. As a result, the study used the MSA definitions provided by the Bureau of the Census as an appropriate method of determining the size of a metropolitan area. Unlike the urbanized area definitions which are based on density, MSAs are based on county boundaries. A county is grouped with an MSA if it has a high degree of social and economic integration with the urban core of the MSA.

The benefit of using MSA definitions is that crash data are summarized at the county level by all states. The drawback of using MSA definitions is that a direct geographical comparison of crash statistics with the congestion statistics based on the urbanized area definitions used by TTI cannot be made. Figure 3.1 provides a comparison of urbanized area and MSA definitions for Tucson, Arizona. The grey shape at the northeastern corner of Pima County is the urbanized area definition used by TTI. The MSA of Tucson is Pima County, which is colored purple in the figure. As the figure clearly shows, the MSA covers additional area that would not be classified as urban; therefore, the safety statistics covered within the MSA would overestimate the cost of crashes in a direct comparison with the TTI statistics. It should be noted, however, more vehicular travel in an MSA is located in urbanized areas than in rural areas.

Figure 3.1 Urbanized Area versus Metropolitan Statistical Area in Tucson



Source: U.S. Bureau of the Census, 2008.

Because MSAs differ in size due to the sprawl and population of a metropolitan area and the size of counties, a normalization procedure of dividing the cost of crashes on a per person basis was conducted.

After compiling data for each MSA, a cost was applied to monetize fatalities and injuries. The FHWA Technical Advisory (Technical Advisory T7570.2: Motor Vehicle Accident Costs) from 1994 was used as a basis to determine the comprehensive costs of motor vehicle traffic accidents. As stated in the report, Comprehensive Cost is:

> *…a method of measuring motor vehicle accident costs that include the effects of injury on people's entire lives. This is the most useful measure of accident cost since it includes all cost components and places a dollar value on each one. Comprehensive life values are estimated by examining risk reduction costs from which the market value of safety is inferred. The 11 components of the comprehensive cost are: property damage; lost earnings; lost household production (non-market activities occurring in the home); medical costs; emergency services; travel delay; vocational rehabilitation; workplace costs; administrative; legal; and pain and lost quality of life.*

The FHWA report provided comprehensive cost values for fatalities and injuries in 1994 dollars. Using economic deflators from the Bureau of Economic Analysis, these values were adjusted to year 2005 to correspond with the year of crash data obtained for this study. In 2005 dollars, the cost of a fatality is $3,246,192 and the cost for an injury is $68,170. These 2005 comprehensive cost values were then multiplied by the number of fatalities and injuries to determine the total cost of crashes for a MSA.[3]

The 2005 cost of crashes was tabulated for all cities and comparisons were conducted with congestion costs. As with the *Urban Mobility Report*, data also were summarized according to metropolitan area population size: very large metropolitan areas (population over 3 million); large urban areas (population of 1 million but less than 3 million); medium areas (over 500,000 and less than 1 million); and small areas (less than 500,000). Table 3.2 shows the metropolitan area groupings by population size.

Table 3.2 Metropolitan Area Groupings by Population Size

Very Large (Over 3,000,000)
Atlanta-Sandy Springs-Marietta, GA
Boston-Cambridge-Quincy, MA-NH
Chicago-Naperville-Joliet, IL-IN-WI
Dallas-Fort Worth-Arlington, TX
Detroit-Warren-Livonia, MI
Houston-Baytown-Sugar Land, TX
Los Angeles-Long Beach-Santa Ana, CA
Miami-Fort Lauderdale-Miami Beach, FL
New York-Newark-Edison, NY-NJ-PA
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
Phoenix-Mesa-Scottsdale, AZ
San Francisco-Oakland-Fremont, CA
Seattle-Tacoma-Bellevue, WA
Washington-Arlington-Alexandria, DC-VA-MD-WV

[3] The Federal Highway Administration is currently reviewing the economic value for statistical life and injury and will revise analytical premises accordingly.

Table 3.2 Metropolitan Area Groupings by Population Size (continued)

Large (1,000,000 to less than 3,000,000)
Baltimore-Towson, MD
Buffalo-Cheektowaga-Tonawanda, NY
Cincinnati-Middletown, OH-KY-IN
Cleveland-Elyria-Mentor, OH
Columbus, OH
Denver-Aurora, CO
Indianapolis, IN
Kansas City, MO-KS
Las Vegas-Paradise, NV
Memphis, TN-MS-AR
Milwaukee-Waukesha-West Allis, WI
Minneapolis-St. Paul-Bloomington, MN-WI
New Orleans-Metairie-Kenner, LA
Orlando, FL
Pittsburgh, PA
Portland-Vancouver-Beaverton, OR-WA
Providence-New Bedford-Fall River, RI-MA
Riverside-San Bernardino-Ontario, CA
Sacramento-Arden-Arcade-Roseville, CA
San Antonio, TX
San Diego-Carlsbad-San Marcos, CA
San Jose-Sunnyvale-Santa Clara, CA
St. Louis, MO-IL
Tampa-St. Petersburg-Clearwater, FL
Virginia Beach-Norfolk-Newport News, VA-NC
Medium (500,000 to less than 1,000,000)
Akron, OH
Albany-Schenectady-Troy, NY
Albuquerque, NM
Allentown-Bethlehem-Easton, PA-NJ
Austin-Round Rock, TX
Birmingham-Hoover, AL
Bridgeport-Stamford-Norwalk, CT
Charlotte-Gastonia-Concord, NC-SC
Dayton, OH
El Paso, TX
Fresno, CA

Table 3.2 Metropolitan Area Groupings by Population Size (continued)

Medium (500,000 to less than 1,000,000) (continued)
Grand Rapids-Wyoming, MI
Hartford-West Hartford-East Hartford, CT
Honolulu, HI
Jacksonville, FL
Louisville, KY-IN
Nashville-Davidson-Murfreesboro, TN
New Haven-Milford, CT
Oklahoma City, OK
Omaha-Council Bluffs, NE-IA
Oxnard-Thousand Oaks-Ventura, CA
Raleigh-Cary, Durham, NC
Richmond, VA
Rochester, NY
Salt Lake City, UT
Sarasota-Bradenton-Venice, FL
Springfield, MA
Toledo, OH
Tucson, AZ
Tulsa, OK
Small (Under 500,000)
Anchorage, AK
Bakersfield, CA
Beaumont-Port Arthur, TX
Boulder, CO
Brownsville-Harlingen, TX
Cape Coral-Fort Myers, FL
Charleston-North Charleston, SC
Colorado Springs, CO
Columbia, SC
Corpus Christi, TX
Eugene-Springfield, OR
Laredo, TX
Little Rock-North Little Rock, AR
Pensacola-Ferry Pass-Brent, FL
Salem, OR
Spokane, WA

4.0 Costs of Crashes and Congestion

Note: Complete results can be found in Appendix A.

4.1 Total Cost of Crashes

The key finding here is that the larger the city, the larger the total cost of crashes. Table 4.1 below shows the range of total crash costs by metropolitan area population category.

Table 4.1 Ranges in the Total Cost of Crashes by Population Category

	Very Large	Cost (Millions)	Large	Cost (Millions)	Medium	Cost (Millions)	Small	Cost (Millions)
High	New York-Newark-Edison, NY-NJ-PA	$18,042	Riverside-San Bernardino-Ontario, CA	$4,703	Nashville-Davidson-Murfreesboro, TN	$2,238	Little Rock-North Little Rock, AR	$1,453
Low	San Francisco-Oakland-Fremont, CA	$2,733	Buffalo-Cheektowaga-Tonawanda, NY	$1,091	Honolulu, HI	$608	Boulder, CO	$201

Source: Cambridge Systematics, Inc., 2008.

4.2 Cost of Crashes per Person

When total crash costs are examined on a per person basis, figures for smaller cities are greater than those in larger cities. Table 4.2 shows crash costs on a per person basis for the highest-cost and lowest-cost city, as well as the average, in each metropolitan area category.

Table 4.2 Ranges in the Cost of Crashes on a per Person Basis by Population Category

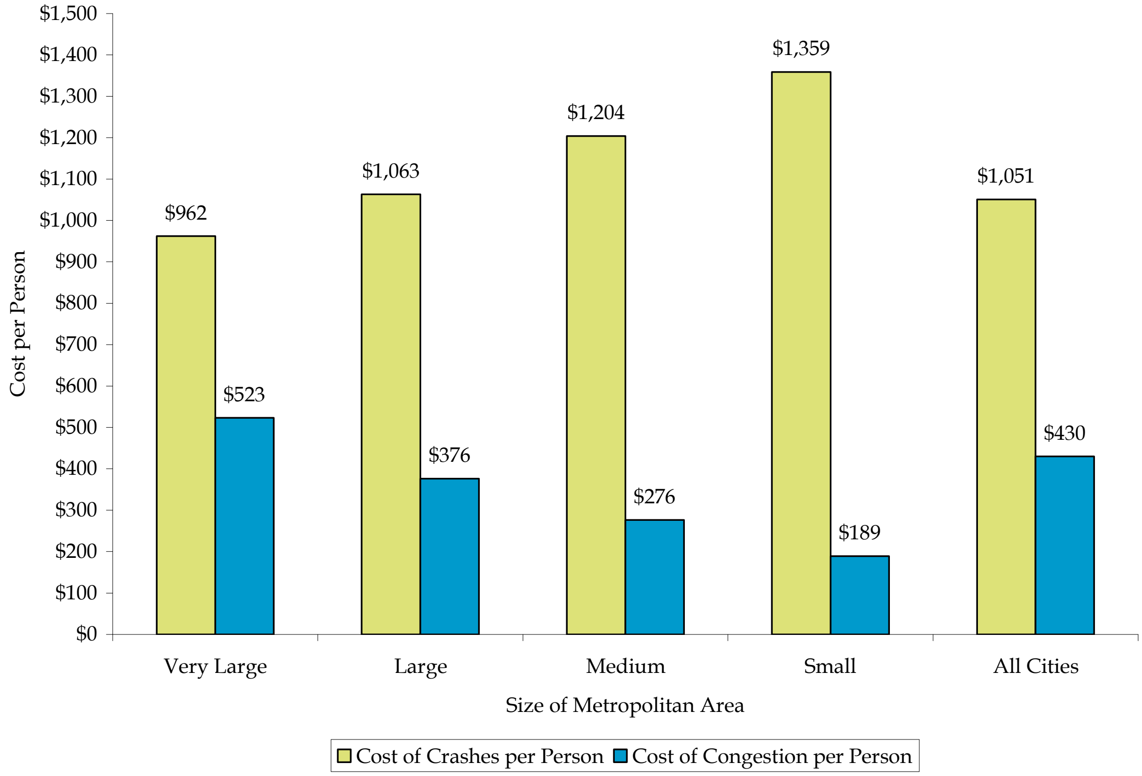
	Very Large	Cost	Large	Cost	Medium	Cost	Small	Cost
High	Miami-Fort Lauderdale-Miami Beach, FL	$1,439	Tampa-St. Petersburg-Clearwater, FL	$1,599	Nashville-Davidson-Murfreesboro, TN	$1,574	Little Rock-North Little Rock, AR	$2,258
Low	San Francisco-Oakland-Fremont, CA	$658	San Jose-Sunnyvale-Santa Clara, CA	$641	Honolulu, HI	$672	Eugene-Springfield, OR	$685
Average		$962		$1,063		$1,204		$1,359

Source: Cambridge Systematics, Inc., 2008.

■ 4.3 Cost of Crashes per Person and Cost of Congestion per Person

When the average per person cost of crashes is compared to the average per person cost of congestion, smaller cities have larger crash costs, while larger cities have larger congestion costs. Figure 4.1 shows the relationship between the two per person costs. In Figure 4.1 the yellow bars show the total cost of fatal and injury crashes for very large metropolitan areas (population over 3 million); large urban areas (population of 1 million but less than 3 million); medium areas (over 500,000 and less than 1 million); and small areas (less than 500,000). The blue bars show the cost of congestion as reported by the Texas Transportation Institute (TTI) in its annual *Urban Mobility Report*.

Figure 4.1 Annual Cost of Crashes and Congestion per Person
2005



Key Findings

- In the urban areas studied, the cost of traffic crashes is more than two and one-half times the cost of congestion – $164.2 billion for traffic crashes and $67.6 billion for congestion.
- The safety costs include property damage; lost earnings; lost household production (non-market activities occurring in the home); medical costs; emergency services; travel delay; vocational rehabilitation; workplace costs; administrative; legal; and pain and lost quality of life. The economy and the environment also are impacted but those costs are not quantified in the study. According to FHWA, in 2005 dollars, the average cost of a fatality is $3,246,192 and the average cost of an injury is $68,170.
- Improving safety may improve congestion. Forty to 50 percent of all nonrecurring congestion is associated with traffic incidents.
- The cost of crashes on a per person basis decreases as the size of the metropolitan area increases. An inverse relationship occurs with the cost of congestion, which becomes worse with an increase in the size of the metropolitan area.

To further underscore the impact of safety, it is possible to calculate the health care impact of traffic crashes in selected states. For instance, Maryland, which has the Crash Outcome Data and Evaluation System (CODES), can determine how much traffic crashes are costing the health care system, specifically Medicare and Medicaid.[4]

For example, in 2004, 7,283 persons were admitted to a Maryland hospital because of a traffic crash. Their collective hospital charges totaled $99,986,245.46. Of those, 393 (5.4 percent) used Medicare, totaling $5,032,976.63 (5.0 percent of total Medicare costs). In addition, 893 (12.3 percent) used Medicaid, totaling $16,200,085.52 (16.2 percent of total Medicaid costs). In 2004, 78,674 persons went to a Maryland emergency department because of a traffic crash. Their hospital charges totaled $27,049,265.23. Of those, 1,528 (1.9 percent) used Medicare, totaling $647,423.65 (2.4 of Medicare costs). In addition, 3,903 (5.0 percent) used Medicaid, totaling $1,391,833.86 (5.1 of Medicaid costs).

4.4 Cost of Crashes and Congestion per Person

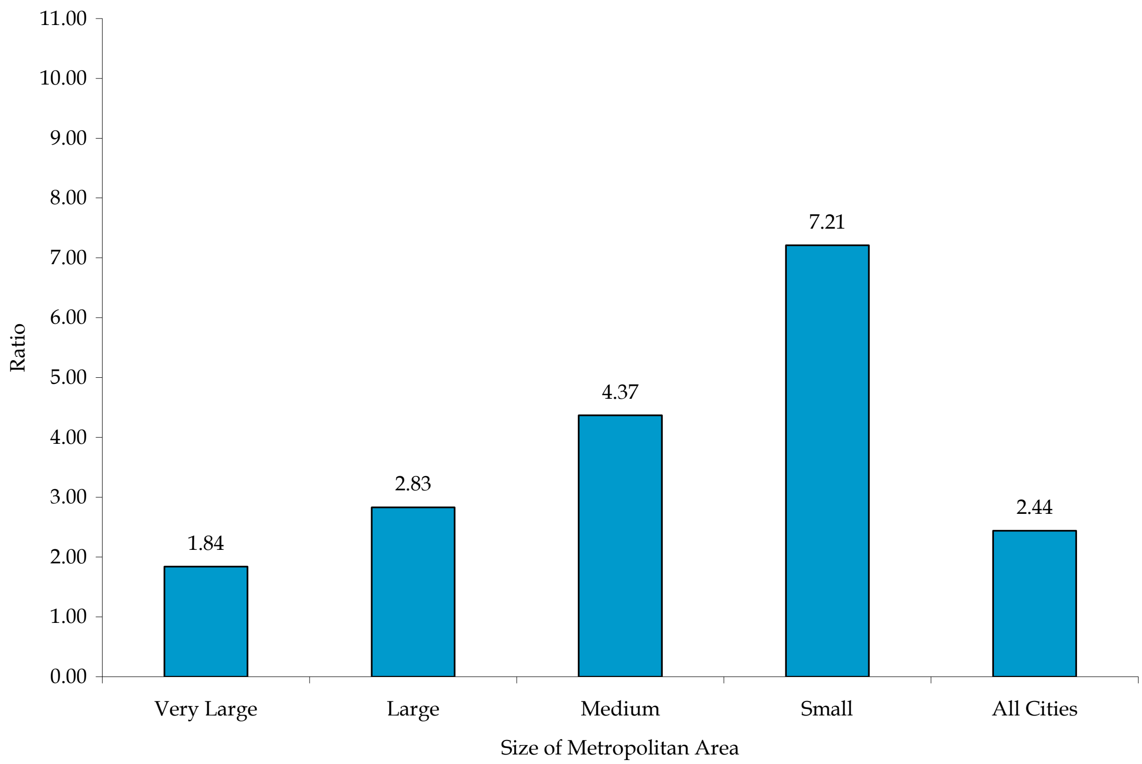
In every city, the crash costs on a per person basis exceed the congestion costs. For very large urban areas, crash costs are nearly double those of congestion. In other words, for every dollar spent on congestion in very large urban areas, $1.84 is spent on safety. In large urban areas, crash costs are nearly three times more than congestion; for medium areas, crash costs are over four times more than congestion; and for small urban areas, crashes are seven times more costly than congestion. Table 4.3 and Figure 4.2 show the ratio between the per person cost of crashes and the per person cost of congestion.

Table 4.3 Crash Cost versus Congestion Cost per Person Ratios

	Very Large	Ratio	Large	Ratio	Medium	Ratio	Small	Cost
High	Miami-Fort Lauderdale-Miami Beach, FL	2.81	Buffalo-Cheektowaga-Tonawanda, NY	9.59	Akron, OH	10.36	Little Rock-North Little Rock, AR	13.66
Low	Los Angeles-Long Beach-Santa Ana, CA	1.10	San Jose-Sunnyvale-Santa Clara, CA	1.19	Oxnard-Thousand Oaks-Ventura, CA	2.09	Colorado Springs, CO	2.77
Average		1.84		2.83		4.37		7.21

[4] CODES is an enhanced state-based crash data system in which police crash data are linked with detailed information on the medical consequences of the crash.

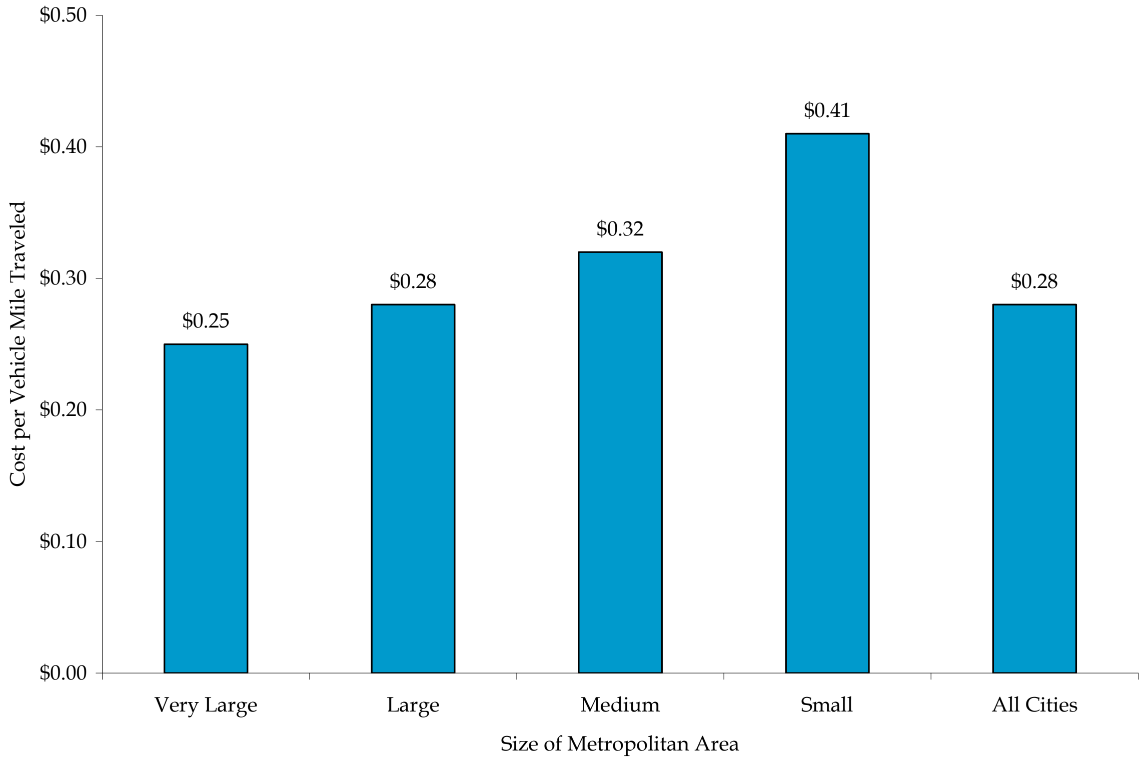
Figure 4.2 Ratio of Cost of Crashes per Person to Cost of Congestion per Person



■ 4.5 Cost of Crashes per Vehicle Mile Traveled

Figure 4.3 shows the cost of crashes for every mile driven. According to the Federal Highway Administration, the average vehicle miles traveled per person in 2005 was 12,084. For individuals living in very large urban areas, the annual cost of crashes is $3,021; in large urban areas the annual safety costs are $3,384; for medium urban areas the annual cost of crashes is $3,867; and for small urban areas crashes cost $4,954. Therefore, the cost of crashes per mile driven ranges from 25 cents to 41 cents depending on the size of the metropolitan area.

Figure 4.3 Cost of Crashes per Vehicle Mile Traveled



5.0 Report Recommendations

Further progress on traffic safety is going to take all the "tools" in the traffic safety toolbox, plus some new thinking about approaches. Among the most significant challenges going forward will be how to change our culture of complacency as it relates to traffic safety. There is no single action or strategy that will bring about a cultural change. Rather, it will take new approaches to enhance public support for increased funding and help transportation planners focus on areas that will have the greatest safety benefits.

Leadership

- Leadership and commitment are needed at the Federal, state, and local levels to make safety a priority in all transportation planning. Focusing planning and resources on safety improvements will not only save lives and prevent injuries, but can also reduce congestion.
- Greater political will is needed to pass legislation and enforce laws that can have a positive impact on safety such as primary safety belt requirements, impaired driving countermeasures, and full implementation of graduated driver licensing systems.
- Congress and the U.S. Department of Transportation should ensure states follow through on implementation of their strategic highway safety plans and evaluate the results to determine effectiveness.[5]
- National safety goals should be established and strategies implemented to cut surface transportation fatalities in half by 2025, as recommended by the National Surface Transportation Policy and Revenue Study Commission.

Communication & Collaboration

- The transportation safety community needs to develop more effective ways of getting the public to understand the impact of traffic crashes, the need for effective countermeasures, and the role their own behavior plays in safety.
- Increased collaboration among traffic safety professionals, public health specialists, and health communications experts is needed to incorporate the best available science on behavior modification.

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[5] In 1997, the American Association of State Highway & Transportation Officials (AASHTO) developed a Strategic Highway Safety Plan (SHSP) and identified 22 of the nation's most pressing highway safety problems. The plan focused on drivers, special users, vehicles, highways, emergency medical services, and management. In 2005, Congress passed the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) which directed states to use data to determine their most serious transportation safety problems and develop a SHSP to address them.

Research & Evaluation

- Increased funding for testing and evaluation of safety interventions should be a priority. Programs should be based on sound scientific principles rather than "conventional wisdom," populist fervor, or political expediency. Systematic evaluation allows identification and expansion of successful programs and interventions so that limited resources can be applied more effectively.
- Further testing and implementation of a road risk assessment tool, e.g., U.S. Road Assessment Program (usRAP), should be encouraged to ensure dollars are spent on roads and bridges with the greatest safety problems. Understanding road safety risks will help state DOTs focus on solutions that will have the greatest safety benefits and should result in broader public support for needed improvements.[6]

[6] The U.S. Road Assessment Program (usRAP) is a pilot program of the AAA Foundation for Traffic Safety, built upon successful programs already established in Europe (EuroRAP) and Australia (AusRAP). usRAP produces color-coded risk maps that display the crash rates and crash densities of roads, derived from historical crash data and traffic volume data, and also "star ratings" that communicate the relative safety of the physical characteristics and safety features of the roads, which are assessed through physical inspection of the roads. The pilot program has developed risk maps of rural primary roads in four states, and is expanding into several additional states in 2008.

Appendix A

Complete Statistics

Appendix A – Complete Statistics

Table A.1 Fatalities and Injuries by City in Alphabetical Order

Metropolitan Area	Metro Area Size	Number of Fatalities	Number of Injuries	Cost of Fatalities (in Millions)	Cost of Injuries (in Millions)	Total Cost of Crashes (in Millions)
Akron, OH	Med	60	7,904	$195	$539	$734
Albany-Schenectady-Troy, NY	Med	63	8,933	$205	$609	$813
Albuquerque, NM	Med	129	11,575	$419	$789	$1,208
Allentown-Bethlehem-Easton, PA-NJ	Med	117	7,736	$380	$527	$907
Anchorage, AK	Sml	38	4,274	$123	$291	$415
Atlanta-Sandy Springs-Marietta, GA	Vlg					
Austin-Round Rock, TX	Med					
Bakersfield, CA	Sml	177	6,236	$575	$425	$1,000
Baltimore-Towson, MD	Lrg	229	26,578	$743	$1,812	$2,555
Beaumont-Port Arthur, TX	Sml					
Birmingham-Hoover, AL	Med	170	9,616	$552	$656	$1,207
Boston-Cambridge-Quincy, MA-NH	Vlg					
Boulder, CO	Sml	20	2,003	$65	$137	$201
Bridgeport-Stamford-Norwalk, CT	Med	56	10,877	$182	$741	$923
Brownsville-Harlingen, TX	Sml					
Buffalo-Cheektowaga-Tonawanda, NY	Lrg	66	12,862	$214	$877	$1,091
Cape Coral-Fort Myers, FL	Sml	150	5,686	$487	$388	$875
Charleston-North Charleston, SC	Sml	123	7,686	$399	$524	$923
Charlotte-Gastonia-Concord, NC-SC	Med	185	23,727	$601	$1,617	$2,218
Chicago-Naperville-Joliet, IL-IN-WI	Vlg	794	85,089	$2,577	$5,801	$8,378
Cincinnati-Middletown, OH-KY-IN	Lrg	242	22,204	$786	$1,514	$2,299
Cleveland-Elyria-Mentor, OH	Lrg	114	21,739	$370	$1,482	$1,852
Colorado Springs, CO	Sml	52	3,900	$169	$266	$435
Columbia, SC	Sml	154	8,538	$500	$582	$1,082
Columbus, OH	Lrg	193	21,339	$627	$1,455	$2,081
Corpus Christi, TX	Sml					
Dallas-Fort Worth-Arlington, TX	Vlg					
Dayton, OH	Med	111	9,025	$360	$615	$976
Denver-Aurora, CO	Lrg	219	16,420	$711	$1,119	$1,830
Detroit-Warren-Livonia, MI	Vlg	364	39,821	$1,182	$2,715	$3,896
El Paso, TX	Med					

Key:

- Cities with insufficient crash data. (blue)
- Cities with unavailable crash data. (orange)
- Cities utilizing 2004 data in lieu of unavailable 2005 crash data. (green)

Source: Cambridge Systematics, Inc., 2008.

Table A.1 Fatalities and Injuries by City in Alphabetical Order (continued)

Metropolitan Area	Metro Area Size	Number of Fatalities	Number of Injuries	Cost of Fatalities (in Millions)	Cost of Injuries (in Millions)	Total Cost of Crashes (in Millions)
Eugene-Springfield, OR	Sml	35	1,700	$114	$116	$230
Fresno, CA	Med	166	6,594	$539	$450	$988
Grand Rapids-Wyoming, MI	Med	80	7,205	$260	$491	$751
Hartford-West Hartford-East Hartford, CT	Med	95	13,883	$308	$946	$1,255
Honolulu, HI	Med	76	5,304	$247	$362	$608
Houston-Baytown-Sugar Land, TX	Vlg					
Indianapolis, IN	Lrg	195	14,577	$633	$994	$1,627
Jacksonville, FL	Med	254	15,369	$825	$1,048	$1,872
Kansas City, MO-KS	Lrg	245	19,396	$795	$1,322	$2,118
Laredo, TX	Sml					
Las Vegas-Paradise, NV	Lrg	280	26,102	$909	$1,779	$2,688
Little Rock-North Little Rock, AR	Sml	114	15,879	$370	$1,082	$1,453
Los Angeles-Long Beach-Santa Ana, CA	Vlg	950	109,610	$3,084	$7,472	$10,556
Louisville, KY-IN	Med	181	13,113	$588	$894	$1,481
Memphis, TN-MS-AR	Lrg	222	17,676	$721	$1,205	$1,926
Miami-Fort Lauderdale-Miami Beach, FL	Vlg	794	76,653	$2,577	$5,225	$7,803
Milwaukee-Waukesha-West Allis, WI	Lrg	114	15,973	$370	$1,089	$1,459
Minneapolis-St. Paul-Bloomington, MN-WI	Lrg	227	24,084	$737	$1,642	$2,379
Nashville-Davidson-Murfreesboro, TN	Med	252	20,837	$818	$1,420	$2,238
New Haven-Milford, CT	Med	69	11,713	$224	$798	$1,022
New Orleans-Metairie-Kenner, LA	Lrg	160	20,873	$519	$1,423	$1,942
New York-Newark-Edison, NY-NJ-PA	Vlg	1,122	211,228	$3,642	$14,399	$18,042
Oklahoma City, OK	Med	153	14,533	$497	$991	$1,487
Omaha-Council Bluffs, NE-IA	Med	94	9,541	$305	$650	$956
Orlando, FL	Lrg	376	24,263	$1,221	$1,654	$2,875
Oxnard-Thousand Oaks-Ventura, CA	Med	71	6,266	$230	$427	$658
Pensacola-Ferry Pass-Brent, FL	Sml	89	7,199	$289	$491	$780
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	Vlg	520	54,134	$1,688	$3,690	$5,378
Phoenix-Mesa-Scottsdale, AZ	Vlg	609	48,572	$1,977	$3,311	$5,288
Pittsburgh, PA	Lrg	261	16,187	$847	$1,103	$1,951
Portland-Vancouver-Beaverton, OR-WA	Lrg	174	17,566	$565	$1,197	$1,762
Providence-New Bedford-Fall River, RI-MA	Lrg	147	13,319	$477	$908	$1,385
Raleigh-Cary, Durham, NC	Med	176	17,979	$571	$1,226	$1,797
Richmond, VA	Med	158	12,822	$513	$874	$1,387
Riverside-San Bernardino-Ontario, CA	Lrg	758	32,895	$2,461	$2,242	$4,703
Rochester, NY	Med	98	10,217	$318	$696	$1,015
Sacramento-Arden-Arcade-Roseville, CA	Lrg	250	19,239	$812	$1,312	$2,123
Salem, OR	Sml	44	3,618	$143	$247	$389
Salt Lake City, UT	Med	82	13,502	$266	$920	$1,187
San Antonio, TX	Lrg					

Key:

- Cities with insufficient crash data.
- Cities with unavailable crash data.
- Cities utilizing 2004 data in lieu of unavailable 2005 crash data.

Source: Cambridge Systematics, Inc., 2008.

Table A.1 Fatalities and Injuries by City in Alphabetical Order (continued)

Metropolitan Area	Metro Area Size	Number of Fatalities	Number of Injuries	Cost of Fatalities (in Millions)	Cost of Injuries (in Millions)	Total Cost of Crashes (in Millions)
San Diego-Carlsbad-San Marcos, CA	Lrg	308	23,248	$1,000	$1,585	$2,585
San Francisco-Oakland-Fremont, CA	Vlg	261	27,659	$847	$1,886	$2,733
San Jose-Sunnyvale-Santa Clara, CA	Lrg	118	10,882	$383	$742	$1,125
Sarasota-Bradenton-Venice, FL	Med	128	6,622	$416	$451	$867
Seattle-Tacoma-Bellevue, WA	Vlg	244	38,115	$792	$2,598	$3,390
Spokane, WA	Sml	34	4,681	$110	$319	$429
Springfield, MA	Med					
St. Louis, MO-IL	Lrg	390	30,608	$1,266	$2,087	$3,353
Tampa-St. Petersburg-Clearwater, FL	Lrg	428	41,721	$1,389	$2,844	$4,233
Toledo, OH	Med	91	8,933	$295	$609	$904
Tucson, AZ	Med	137	11,265	$445	$768	$1,213
Tulsa, OK	Med	151	11,385	$490	$776	$1,266
Virginia Beach-Norfolk-Newport News, VA-NC	Lrg	138	17,007	$448	$1,159	$1,607
Washington-Arlington-Alexandria, DC-VA-MD-WV	Vlg	500	50,360	$1,623	$3,433	$5,056

Key:

Cities with insufficient crash data.

Cities with unavailable crash data.

Cities utilizing 2004 data in lieu of unavailable 2005 crash data.

Source: Cambridge Systematics, Inc., 2008.

Tables A.2 through A.5 show the total cost of crashes and cost per person sorted in order of declining total crash costs.

Table A.2 Total Cost of Crashes and Cost per Person
Very Large Metropolitan Areas

Metropolitan Area	MSA Population	Total Cost of Crashes (in Millions)	Total Cost of Crashes per Person
New York-Newark-Edison, NY-NJ-PA	18,747,320	$18,042	$962
Los Angeles-Long Beach-Santa Ana, CA	12,923,547	$10,556	$817
Chicago-Naperville-Joliet, IL-IN-WI	9,443,356	$8,378	$ 887
Miami-Fort Lauderdale-Miami Beach, FL	5,422,200	$7,803	$1,439
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	5,823,233	$5,378	$924
Phoenix-Mesa-Scottsdale, AZ	3,865,077	$5,288	$1,368
Washington-Arlington-Alexandria, DC-VA-MD-WV	5,214,666	$5,056	$970
Detroit-Warren-Livonia, MI	4,488,335	$3,896	$868
Seattle-Tacoma-Bellevue, WA	3,203,314	$3,390	$1,058
San Francisco-Oakland-Fremont, CA	4,152,688	$2,733	$658
Atlanta-Sandy Springs-Marietta, GA	4,917,717	–	–
Boston-Cambridge-Quincy, MA-NH	4,411,835	–	–
Dallas-Fort Worth-Arlington, TX	5,819,475	–	–
Houston-Baytown-Sugar Land, TX	5,280,077	–	–

Key:

Cities with insufficient crash data.

Cities with unavailable crash data.

Cities utilizing 2004 data in lieu of unavailable 2005 crash data.

Source: Cambridge Systematics, Inc., 2008.

Table A.3 Total Cost of Crashes and Cost per Person
Large Metropolitan Areas

Metropolitan Area	MSA Population	Total Cost of Crashes (in Millions)	Total Cost of Crashes per Person
Riverside-San Bernardino-Ontario, CA	3,909,954	$4,703	$1,203
Tampa-St. Petersburg-Clearwater, FL	2,647,658	$4,233	$1,599
St. Louis, MO-IL	2,778,518	$3,353	$1,207
Orlando, FL	1,933,255	$2,875	$1,487

Key:

Cities with insufficient crash data.

Cities with unavailable crash data.

Cities utilizing 2004 data in lieu of unavailable 2005 crash data.

Source: Cambridge Systematics, Inc., 2008.

Table A.3 Total Cost of Crashes and Cost per Person (continued)
Large Metropolitan Areas

Metropolitan Area	MSA Population	Total Cost of Crashes (in Millions)	Total Cost of Crashes per Person
Las Vegas-Paradise, NV	1,710,551	$2,688	$1,572
San Diego-Carlsbad-San Marcos, CA	2,933,462	$2,585	$881
Baltimore-Towson, MD	2,655,675	$2,555	$962
Minneapolis-St. Paul-Bloomington, MN-WI	3,142,779	$2,379	$757
Cincinnati-Middletown, OH-KY-IN	2,070,441	$2,299	$1,111
Sacramento-Arden-Arcade-Roseville, CA	2,042,283	$2,123	$1,040
Kansas City, MO-KS	1,947,694	$2,118	$1,087
Columbus, OH	1,708,625	$2,081	$1,218
Pittsburgh, PA	2,386,074	$1,951	$818
New Orleans-Metairie-Kenner, LA	1,319,367	$1,942	$1,472
Memphis, TN-MS-AR	1,260,905	$1,926	$1,527
Cleveland-Elyria-Mentor, OH	2,126,318	$1,852	$871
Denver-Aurora, CO	2,359,994	$1,830	$776
Portland-Vancouver-Beaverton, OR-WA	2,095,861	$1,762	$841
Indianapolis, IN	1,640,591	$1,627	$992
Virginia Beach-Norfolk-Newport News, VA-NC	1,647,346	$1,607	$976
Milwaukee-Waukesha-West Allis, WI	1,512,855	$1,459	$964
Providence-New Bedford-Fall River, RI-MA	1,622,520	$1,385	$854
San Jose-Sunnyvale-Santa Clara, CA	1,754,988	$1,125	$641
Buffalo-Cheektowaga-Tonawanda, NY	1,147,711	$1,091	$951
San Antonio, TX	1,889,797	–	–

Key:

Cities with insufficient crash data. (blue)

Cities with unavailable crash data. (orange)

Cities utilizing 2004 data in lieu of unavailable 2005 crash data. (green)

Source: Cambridge Systematics, Inc., 2008.

Table A.4 Total Cost of Crashes and Cost per Person
Medium Metropolitan Areas

Metropolitan Area	MSA Population	Total Cost of Crashes (in Millions)	Total Cost of Crashes per Person
Nashville-Davidson-Murfreesboro, TN	1,422,544	$2,238	$1,574
Charlotte-Gastonia-Concord, NC-SC	1,521,278	$2,218	$1,458
Jacksonville, FL	1,248,371	$1,872	$1,500
Raleigh-Cary, Durham, NC	1,405,868	$1,797	$1,278
Oklahoma City, OK	1,156,812	$1,487	$1,286
Louisville, KY-IN	1,208,452	$1,481	$1,226
Richmond, VA	1,175,654	$1,387	$1,180
Tulsa, OK	887,715	$1,266	$1,426
Hartford-West Hartford-East Hartford, CT	1,188,241	$1,255	$1,056
Tucson, AZ	924,786	$1,213	$1,311
Albuquerque, NM	797,940	$1,208	$1,514
Birmingham-Hoover, AL	1,090,126	$1,207	$1,108
Salt Lake City, UT	1,034,484	$1,187	$1,147
New Haven-Milford, CT	846,766	$1,022	$1,207
Rochester, NY	1,039,028	$1,015	$977
Fresno, CA	877,584	$988	$1,126
Dayton, OH	843,577	$976	$1,156
Omaha-Council Bluffs, NE-IA	813,170	$956	$1,175
Bridgeport-Stamford-Norwalk, CT	902,775	$923	$1,023
Allentown-Bethlehem-Easton, PA-NJ	790,535	$907	$1,148
Toledo, OH	656,696	$904	$1,377
Sarasota-Bradenton-Venice, FL	673,035	$867	$1,288
Albany-Schenectady-Troy, NY	848,879	$813	$958
Grand Rapids-Wyoming, MI	771,185	$751	$974
Akron, OH	702,235	$734	$1,045
Oxnard-Thousand Oaks-Ventura, CA	796,106	$658	$826
Honolulu, HI	905,266	$608	$672
Springfield, MA	687,264	–	–
Austin-Round Rock, TX	1,452,529	–	–
El Paso, TX	721,598	–	–

Key:

Cities with insufficient crash data.

Cities with unavailable crash data.

Cities utilizing 2004 data in lieu of unavailable 2005 crash data.

Source: Cambridge Systematics, Inc., 2008.

Table A.5 Total Cost of Crashes and Cost per Person
Small Metropolitan Areas

Metropolitan Area	MSA Population	Total Cost of Crashes (in Millions)	Total Cost of Crashes per Person
Little Rock-North Little Rock, AR	643,272	$1,453	$2,258
Columbia, SC	689,878	$1,082	$1,568
Bakersfield, CA	756,825	$1,000	$1,321
Charleston-North Charleston, SC	594,899	$923	$1,552
Cape Coral-Fort Myers, FL	544,758	$875	$1,605
Pensacola-Ferry Pass-Brent, FL	439,877	$780	$1,772
Colorado Springs, CO	587,500	$435	$740
Spokane, WA	440,706	$429	$975
Anchorage, AK	351,049	$415	$1,181
Salem, OR	375,560	$389	$1,037
Eugene-Springfield, OR	335,180	$230	$685
Boulder, CO	280,440	$201	$718
Corpus Christi, TX	413,553	–	–
Beaumont-Port Arthur, TX	383,530	–	–
Laredo, TX	224,695	–	–
Brownsville-Harlingen, TX	378,311	–	–

Key:

Cities with insufficient crash data.

Cities with unavailable crash data.

Cities utilizing 2004 data in lieu of unavailable 2005 crash data.

Source: Cambridge Systematics, Inc., 2008.

Tables A.6 through A.9 show the total cost of congestion and cost per person sorted in order of declining total congestion costs.

Table A.6 Total Cost of Congestion and Cost per Person
Very Large Metropolitan Areas

Metropolitan Area	Urbanized Area Population	Cost of Congestion (in Millions)	Cost of Congestion per Person
Los Angeles-Long Beach-Santa Ana, CA	12,540,000	$9,325	$744
New York-Newark-Edison, NY-NJ-PA	17,775,000	$7,383	$415
Chicago-Naperville-Joliet, IL-IN-WI	8,140,000	$3,968	$487
Dallas-Fort Worth-Arlington, TX	4,445,000	$2,747	$618
Miami-Fort Lauderdale-Miami Beach, FL	5,330,000	$2,730	$512
Atlanta-Sandy Springs-Marietta, GA	4,170,000	$2,581	$619
San Francisco-Oakland-Fremont, CA	4,140,000	$2,414	$583
Washington-Arlington-Alexandria, DC-VA-MD-WV	4,280,000	$2,331	$545
Houston-Baytown-Sugar Land, TX	3,790,000	$2,225	$587
Detroit-Warren-Livonia, MI	4,055,000	$2,174	$536
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	5,300,000	$2,076	$392
Boston-Cambridge-Quincy, MA-NH	4,075,000	$1,820	$447
Phoenix-Mesa-Scottsdale, AZ	3,270,000	$1,687	$516
Seattle-Tacoma-Bellevue, WA	3,005,000	$1,413	$470

Key:

Cities with insufficient crash data.

Cities with unavailable crash data.

Cities utilizing 2004 data in lieu of unavailable 2005 crash data.

Source: Texas Transportation Institute, 2007.

Table A.7 Total Cost of Congestion and Cost per Person
Large Metropolitan Areas

Metropolitan Area	Urbanized Area Population	Cost of Congestion (in Millions)	Cost of Congestion per Person
San Diego-Carlsbad-San Marcos, CA	2,905,000	$1,708	$588
Denver-Aurora, CO	2,090,000	$1,176	$563
Baltimore-Towson, MD	2,315,000	$1,126	$486
Minneapolis-St. Paul-Bloomington, MN-WI	2,520,000	$1,099	$436
Tampa-St. Petersburg-Clearwater, FL	2,250,000	$1,005	$447
Riverside-San Bernardino-Ontario, CA	1,800,000	$955	$531
San Jose-Sunnyvale-Santa Clara, CA	1,675,000	$899	$537
Orlando, FL	1,360,000	$738	$543

Key:

Cities with insufficient crash data.

Cities with unavailable crash data.

Cities utilizing 2004 data in lieu of unavailable 2005 crash data.

Source: Texas Transportation Institute, 2007.

Table A.7 Total Cost of Congestion and Cost per Person (continued)
Large Metropolitan Areas

Metropolitan Area	Urbanized Area Population	Cost of Congestion (in Millions)	Cost of Congestion per Person
Sacramento-Arden-Arcade-Roseville, CA	1,750,000	$729	$417
St. Louis, MO-IL	2,105,000	$711	$338
Portland-Vancouver-Beaverton, OR-WA	1,730,000	$625	$361
Las Vegas-Paradise, NV	1,365,000	$543	$398
San Antonio, TX	1,360,000	$530	$390
Indianapolis, IN	1,035,000	$478	$462
Virginia Beach-Norfolk-Newport News, VA-NC	1,540,000	$467	$303
Cincinnati-Middletown, OH-KY-IN	1,620,000	$459	$283
Columbus, OH	1,195,000	$409	$342
Providence-New Bedford-Fall River, RI-MA	1,245,000	$343	$276
Memphis, TN-MS-AR	1,020,000	$317	$311
Pittsburgh, PA	1,800,000	$285	$158
Milwaukee-Waukesha-West Allis, WI	1,460,000	$282	$193
Kansas City, MO-KS	1,500,000	$256	$171
Cleveland-Elyria-Mentor, OH	1,790,000	$236	$132
New Orleans-Metairie-Kenner, LA	1,090,000	$207	$190
Buffalo-Cheektowaga-Tonawanda, NY	1,130,000	$112	$99

Key:

Cities with insufficient crash data.

Cities with unavailable crash data.

Cities utilizing 2004 data in lieu of unavailable 2005 crash data.

Source: Texas Transportation Institute, 2007.

Table A.8 Total Cost of Congestion and Cost per Person
Medium Metropolitan Areas

Metropolitan Area	Urbanized Area Population	Cost of Congestion (in Millions)	Cost of Congestion per Person
Austin-Round Rock, TX	855,000	$422	$494
Charlotte-Gastonia-Concord, NC-SC	860,000	$409	$476
Nashville-Davidson-Murfreesboro, TN	990,000	$404	$408
Louisville, KY-IN	905,000	$395	$436
Jacksonville, FL	990,000	$376	$380
Raleigh-Cary, Durham, NC	950,000	$346	$364
Tucson, AZ	750,000	$338	$451
Bridgeport-Stamford-Norwalk, CT	870,000	$280	$322
Salt Lake City, UT	970,000	$250	$258
Birmingham-Hoover, AL	690,000	$234	$339
Oxnard-Thousand Oaks-Ventura, CA	580,000	$229	$395
Albuquerque, NM	575,000	$200	$348
Richmond, VA	920,000	$181	$197
Oklahoma City, OK	850,000	$171	$201
Hartford-West Hartford-East Hartford, CT	890,000	$166	$187
Honolulu, HI	705,000	$166	$235
El Paso, TX	675,000	$159	$236
Sarasota-Bradenton-Venice, FL	640,000	$156	$244
Omaha-Council Bluffs, NE-IA	640,000	$154	$241
Tulsa, OK	810,000	$149	$184
Grand Rapids-Wyoming, MI	595,000	$138	$232
Allentown-Bethlehem-Easton, PA-NJ	620,000	$137	$221
Fresno, CA	615,000	$127	$207
Dayton, OH	745,000	$127	$170
New Haven-Milford, CT	560,000	$104	$186
Albany-Schenectady-Troy, NY	530,000	$86	$162
Toledo, OH	520,000	$78	$150
Springfield, MA	660,000	$71	$108
Rochester, NY	665,000	$64	$96
Akron, OH	615,000	$62	$101

Key:

- Cities with insufficient crash data. (blue)
- Cities with unavailable crash data. (orange)
- Cities utilizing 2004 data in lieu of unavailable 2005 crash data. (green)

Source: Texas Transportation Institute, 2007.

Table A.9 Total Cost of Congestion and Cost per Person
Small Metropolitan Areas

Metropolitan Area	Urbanized Area Population	Cost of Congestion (in Millions)	Cost of Congestion per Person
Charleston-North Charleston, SC	475,000	$148	$312
Colorado Springs, CO	490,000	$131	$267
Cape Coral-Fort Myers, FL	410,000	$98	$239
Pensacola-Ferry Pass-Brent, FL	345,000	$84	$243
Columbia, SC	440,000	$73	$166
Bakersfield, CA	470,000	$66	$140
Little Rock-North Little Rock, AR	375,000	$62	$165
Eugene-Springfield, OR	240,000	$32	$133
Corpus Christi, TX	325,000	$32	$98
Salem, OR	225,000	$31	$138
Spokane, WA	360,000	$28	$78
Anchorage, AK	280,000	$27	$96
Beaumont-Port Arthur, TX	225,000	$25	$111
Laredo, TX	200,000	$23	$115
Boulder, CO	115,000	$17	$148
Brownsville-Harlingen, TX	165,000	$12	$73

Key:

Cities with insufficient crash data.

Cities with unavailable crash data.

Cities utilizing 2004 data in lieu of unavailable 2005 crash data.

Source: Texas Transportation Institute, 2007.

Tables A.10 through A.13 show the total cost of crashes versus Cost of Congestion sorted in order of declining total cost ratios. Ratios are determined by dividing the cost of crashes by the cost of congestion.

Table A.10 Cost of Crashes versus Cost of Congestion
Very Large Metropolitan Areas

Metropolitan Area	Total Cost Ratio	Per Person Cost Ratio
Phoenix-Mesa-Scottsdale, AZ	3.13	2.65
Miami-Fort Lauderdale-Miami Beach, FL	2.86	2.81
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	2.59	2.36
New York-Newark-Edison, NY-NJ-PA	2.44	2.32
Seattle-Tacoma-Bellevue, WA	2.40	2.25
Washington-Arlington-Alexandria, DC-VA-MD-WV	2.17	1.78
Chicago-Naperville-Joliet, IL-IN-WI	2.11	1.82
Detroit-Warren-Livonia, MI	1.79	1.62
Los Angeles-Long Beach-Santa Ana, CA	1.13	1.10
San Francisco-Oakland-Fremont, CA	1.13	1.13
Atlanta-Sandy Springs-Marietta, GA	–	–
Boston-Cambridge-Quincy, MA-NH	–	–
Dallas-Fort Worth-Arlington, TX	–	–
Houston-Baytown-Sugar Land, TX	–	–

Key:

Cities with insufficient crash data.

Cities with unavailable crash data.

Cities utilizing 2004 data in lieu of unavailable 2005 crash data.

Source: Cambridge Systematics, Inc., 2008.

Table A.11 Cost of Crashes versus Cost of Congestion
Large Metropolitan Areas

Metropolitan Area	Total Cost Ratio	Per Person Cost Ratio
Buffalo-Cheektowaga-Tonawanda, NY	9.74	9.59
New Orleans-Metairie-Kenner, LA	9.38	7.75
Kansas City, MO-KS	8.27	6.37
Cleveland-Elyria-Mentor, OH	7.85	6.61
Pittsburgh, PA	6.84	5.16
Memphis, TN-MS-AR	6.07	4.91
Milwaukee-Waukesha-West Allis, WI	5.17	4.99
Columbus, OH	5.09	3.56
Cincinnati-Middletown, OH-KY-IN	5.01	3.92

Key:

Cities with insufficient crash data.

Cities with unavailable crash data.

Cities utilizing 2004 data in lieu of unavailable 2005 crash data.

Source: Cambridge Systematics, Inc., 2008.

Table A.11 Cost of Crashes versus Cost of Congestion (continued)
Large Metropolitan Areas

Metropolitan Area	Total Cost Ratio	Per Person Cost Ratio
Las Vegas-Paradise, NV	4.95	3.95
Riverside-San Bernardino-Ontario, CA	4.92	2.27
St. Louis, MO-IL	4.72	3.57
Tampa-St. Petersburg-Clearwater, FL	4.21	3.58
Providence-New Bedford-Fall River, RI-MA	4.04	3.10
Orlando, FL	3.90	2.74
Virginia Beach-Norfolk-Newport News, VA-NC	3.44	3.22
Indianapolis, IN	3.40	2.15
Sacramento-Arden-Arcade-Roseville, CA	2.91	2.50
Portland-Vancouver-Beaverton, OR-WA	2.82	2.33
Baltimore-Towson, MD	2.27	1.98
Minneapolis-St. Paul-Bloomington, MN-WI	2.16	1.74
Denver-Aurora, CO	1.56	1.38
San Diego-Carlsbad-San Marcos, CA	1.51	1.50
San Jose-Sunnyvale-Santa Clara, CA	1.25	1.19
San Antonio, TX	–	–

Key:

Cities with insufficient crash data.

Cities with unavailable crash data.

Cities utilizing 2004 data in lieu of unavailable 2005 crash data.

Source: Cambridge Systematics, Inc., 2008.

Table A.12 Cost of Crashes versus Cost of Congestion
Medium Metropolitan Areas

Metropolitan Area	Total Cost Ratio	Per Person Cost Ratio
Rochester, NY	15.85	10.15
Akron, OH	11.83	10.36
Toledo, OH	11.59	9.18
New Haven-Milford, CT	9.83	6.50

Key:

Cities with insufficient crash data.

Cities with unavailable crash data.

Cities utilizing 2004 data in lieu of unavailable 2005 crash data.

Source: Cambridge Systematics, Inc., 2008.

Table A.12 Cost of Crashes versus Cost of Congestion (continued)
Medium Metropolitan Areas

Metropolitan Area	Total Cost Ratio	Per Person Cost Ratio
Albany-Schenectady-Troy, NY	9.46	5.91
Oklahoma City, OK	8.70	6.39
Tulsa, OK	8.50	7.75
Fresno, CA	7.78	5.45
Dayton, OH	7.68	6.78
Richmond, VA	7.66	6.00
Hartford-West Hartford-East Hartford, CT	7.56	5.66
Allentown-Bethlehem-Easton, PA-NJ	6.62	5.19
Omaha-Council Bluffs, NE-IA	6.20	4.88
Albuquerque, NM	6.04	4.35
Sarasota-Bradenton-Venice, FL	5.56	5.28
Nashville-Davidson-Murfreesboro, TN	5.54	3.86
Grand Rapids-Wyoming, MI	5.44	4.20
Charlotte-Gastonia-Concord, NC-SC	5.42	3.07
Raleigh-Cary, Durham, NC	5.19	3.51
Birmingham-Hoover, AL	5.16	3.27
Jacksonville, FL	4.98	3.95
Salt Lake City, UT	4.75	4.45
Louisville, KY-IN	3.75	2.81
Honolulu, HI	3.66	2.85
Tucson, AZ	3.59	2.91
Bridgeport-Stamford-Norwalk, CT	3.30	3.18
Oxnard-Thousand Oaks-Ventura, CA	2.87	2.09
Springfield, MA	–	–
Austin-Round Rock, TX	–	–
El Paso, TX	–	–

Key:

Cities with insufficient crash data. (blue)

Cities with unavailable crash data. (orange)

Cities utilizing 2004 data in lieu of unavailable 2005 crash data. (green)

Source: Cambridge Systematics, Inc., 2008.

Table A.13 Cost of Crashes versus Cost of Congestion
Small Metropolitan Areas

Metropolitan Area	Total Cost Ratio	Per Person Cost Ratio
Little Rock-North Little Rock, AR	23.43	13.66
Anchorage, AK	15.36	12.25
Spokane, WA	15.34	12.53
Bakersfield, CA	15.15	9.41
Columbia, SC	14.82	9.45
Salem, OR	12.56	7.53
Boulder, CO	11.85	4.86
Pensacola-Ferry Pass-Brent, FL	9.28	7.28
Cape Coral-Fort Myers, FL	8.92	6.72
Eugene-Springfield, OR	7.17	5.14
Charleston-North Charleston, SC	6.24	4.98
Colorado Springs, CO	3.32	2.77
Corpus Christi, TX	–	–
Beaumont-Port Arthur, TX	–	–
Laredo, TX	–	–
Brownsville-Harlingen, TX	–	–

Key:

Cities with insufficient crash data.

Cities with unavailable crash data.

Cities utilizing 2004 data in lieu of unavailable 2005 crash data.

Source: Cambridge Systematics, Inc., 2008.

Tables A.14 through A.17 show the cost of crashes per vehicle miles traveled sorted in order of declining cost ratios. Ratios are determined by dividing the total cost of crashes by the number of vehicle miles traveled on freeways and arterials in the metropolitan area.

Table A.14 Cost of Crashes per VMT
Very Large Metropolitan Areas

Metropolitan Area	Total Cost of Crashes (in Millions)	VMT (in Thousands)	Cost of Crashes by VMT
Miami-Fort Lauderdale-Miami Beach, FL	$7,803	91,925	$0.34
New York-Newark-Edison, NY-NJ-PA	$18,042	212,500	$0.34
Phoenix-Mesa-Scottsdale, AZ	$5,288	62,475	$0.34
Chicago-Naperville-Joliet, IL-IN-WI	$8,378	105,550	$0.32
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	$5,378	83,560	$0.26
Washington-Arlington-Alexandria, DC-VA-MD-WV	$5,056	79,775	$0.25
Seattle-Tacoma-Bellevue, WA	$3,390	57,000	$0.24
Detroit-Warren-Livonia, MI	$3,896	86,245	$0.18
Los Angeles-Long Beach-Santa Ana, CA	$10,556	266,000	$0.16
San Francisco-Oakland-Fremont, CA	$2,733	81,100	$0.13
Atlanta-Sandy Springs-Marietta, GA	–	94,200	–
Boston-Cambridge-Quincy, MA-NH	–	76,415	–
Dallas-Fort Worth-Arlington, TX	–	103,050	–
Houston-Baytown-Sugar Land, TX	–	85,705	–

Key:

Cities with insufficient crash data.

Cities with unavailable crash data.

Cities utilizing 2004 data in lieu of unavailable 2005 crash data.

Source: Cambridge Systematics, Inc., 2008.

Table A.15 Cost of Crashes per VMT
Large Metropolitan Areas

Metropolitan Area	Total Cost of Crashes (in Millions)	VMT (in Thousands)	Cost of Crashes by VMT
New Orleans-Metairie-Kenner, LA	$1,942	13,900	$0.56
Riverside-San Bernardino-Ontario, CA	$4,703	36,985	$0.51
Las Vegas-Paradise, NV	$2,688	21,900	$0.49
Tampa-St. Petersburg-Clearwater, FL	$4,233	41,050	$0.41

Key:

Cities with insufficient crash data.

Cities with unavailable crash data.

Cities utilizing 2004 data in lieu of unavailable 2005 crash data.

Source: Cambridge Systematics, Inc., 2008.

Table A.15 Cost of Crashes per VMT (continued)
Large Metropolitan Areas

Metropolitan Area	Total Cost of Crashes (in Millions)	VMT (in Thousands)	Cost of Crashes by VMT
Orlando, FL	$2,875	29,240	$0.39
Memphis, TN-MS-AR	$1,926	22,490	$0.34
Columbus, OH	$2,081	25,400	$0.33
Buffalo-Cheektowaga-Tonawanda, NY	$1,091	14,770	$0.30
Cincinnati-Middletown, OH-KY-IN	$2,299	30,590	$0.30
St. Louis, MO-IL	$3,353	44,700	$0.30
Sacramento-Arden-Arcade-Roseville, CA	$2,123	29,720	$0.29
Indianapolis, IN	$1,627	23,750	$0.27
Pittsburgh, PA	$1,951	30,090	$0.26
Portland-Vancouver-Beaverton, OR-WA	$1,762	27,470	$0.26
Kansas City, MO-KS	$2,118	33,645	$0.25
Providence-New Bedford-Fall River, RI-MA	$1,385	22,605	$0.25
Cleveland-Elyria-Mentor, OH	$1,852	30,335	$0.24
Baltimore-Towson, MD	$2,555	45,175	$0.23
Milwaukee-Waukesha-West Allis, WI	$1,459	25,150	$0.23
Virginia Beach-Norfolk-Newport News, VA-NC	$1,607	29,110	$0.22
Minneapolis-St. Paul-Bloomington, MN-WI	$2,379	51,970	$0.18
Denver-Aurora, CO	$1,830	43,280	$0.17
San Diego-Carlsbad-San Marcos, CA	$2,585	61,550	$0.17
San Jose-Sunnyvale-Santa Clara, CA	$1,125	33,820	$0.13
San Antonio, TX	–	28,310	–

Key:

Cities with insufficient crash data.

Cities with unavailable crash data.

Cities utilizing 2004 data in lieu of unavailable 2005 crash data.

Source: Cambridge Systematics, Inc., 2008.

Table A.16 Cost of Crashes per VMT
Medium Metropolitan Areas

Metropolitan Area	Total Cost of Crashes (in Millions)	VMT (in Thousands)	Cost of Crashes by VMT
Charlotte-Gastonia-Concord, NC-SC	$2,218	20,000	$0.44
Rochester, NY	$1,015	9,665	$0.42
Albuquerque, NM	$1,208	12,000	$0.40
Toledo, OH	$904	8,970	$0.40
Fresno, CA	$988	10,335	$0.38
Sarasota-Bradenton-Venice, FL	$867	9,085	$0.38
Omaha-Council Bluffs, NE-IA	$956	10,295	$0.37
Nashville-Davidson-Murfreesboro, TN	$2,238	25,050	$0.36
Allentown-Bethlehem-Easton, PA-NJ	$907	10,510	$0.35
Jacksonville, FL	$1,872	21,190	$0.35
New Haven-Milford, CT	$1,022	11,775	$0.35
Raleigh-Cary, Durham, NC	$1,797	20,950	$0.34
Tucson, AZ	$1,213	14,640	$0.33
Akron, OH	$734	9,515	$0.31
Salt Lake City, UT	$1,187	15,515	$0.31
Albany-Schenectady-Troy, NY	$813	10,870	$0.30
Tulsa, OK	$1,266	16,960	$0.30
Louisville, KY-IN	$1,481	20,130	$0.29
Oklahoma City, OK	$1,487	20,745	$0.29
Birmingham-Hoover, AL	$1,207	17,150	$0.28
Dayton, OH	$976	13,850	$0.28
Hartford-West Hartford-East Hartford, CT	$1,255	18,085	$0.28
Honolulu, HI	$608	9,265	$0.26
Richmond, VA	$1,387	21,440	$0.26
Grand Rapids-Wyoming, MI	$751	13,035	$0.23
Oxnard-Thousand Oaks-Ventura, CA	$658	11,455	$0.23
Bridgeport-Stamford-Norwalk, CT	$923	16,560	$0.22
Austin-Round Rock, TX	–	16,505	–
El Paso, TX	–	10,655	–
Springfield, MA	–	11,450	–

Key:

Cities with insufficient crash data.

Cities with unavailable crash data.

Cities utilizing 2004 data in lieu of unavailable 2005 crash data.

Source: Cambridge Systematics, 2008.

Table A.17 Cost of Crashes per VMT
Small Metropolitan Areas

Metropolitan Area	Total Cost of Crashes (in Millions)	VMT (in Thousands)	Cost of Crashes by VMT
Bakersfield, CA	$1,000	6,995	$0.57
Little Rock-North Little Rock, AR	$1,453	10,400	$0.56
Cape Coral-Fort Myers, FL	$875	7,540	$0.46
Anchorage, AK	$415	3,775	$0.44
Boulder, CO	$201	1,835	$0.44
Salem, OR	$389	3,510	$0.44
Pensacola-Ferry Pass-Brent, FL	$780	7,200	$0.43
Columbia, SC	$1,082	10,575	$0.41
Charleston-North Charleston, SC	$923	9,295	$0.40
Spokane, WA	$429	6,480	$0.27
Eugene-Springfield, OR	$230	3,485	$0.26
Colorado Springs, CO	$435	9,540	$0.18
Beaumont-Port Arthur, TX	–	5,170	–
Brownsville-Harlingen, TX	–	1,775	–
Corpus Christi, TX	–	5,775	–
Laredo, TX	–	2,265	–

Key:

Cities with insufficient crash data.

Cities with unavailable crash data.

Cities utilizing 2004 data in lieu of unavailable 2005 crash data.

Source: Cambridge Systematics, 2008.

Crashes vs. Congestion
What's The Cost to Society?

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