NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

Office of Research and Engineering
Safety Studies and Statistical Analysis Division

August 6, 2008

Study of Rural Travel Risk Factors for Large Buses: Fatal Accidents, Emergency Response, and Highway Safety Improvements

PREPARED BY:

Bruce G. Coury, Ph.D.
Transportation Research Analyst
Office of Research and Engineering
Safety Studies and Statistical Analysis Division, RE-10
Washington, DC 20594

INTRODUCTION

A disproportionate number of fatal accidents occur on rural roads. According to a recent National Highway Traffic Safety Administration (NHTSA) report that compared rural and urban accidents in 1994 – 2003, rural roads accounted for almost 60% of the fatal crashes, but only 39% of the total vehicle miles traveled.[1] During that period there were 218,539 fatal rural road accidents resulting in 249,986 fatalities. The report highlighted the differences between rural and urban roads, emphasizing the relatively greater number of fatal accidents and fatalities, and the higher rural road fatal accident and fatality rates. One risk factor cited in the report was the longer emergency response times in rural areas.

A recent charter bus accident investigated by the Safety Board highlighted a number of rural road risk factors. On January 6, 2008, at 8:02 PM, a motorcoach with 53 occupants failed to negotiate a curve on a two-lane rural highway north of Mexican Hat, Utah. The motorcoach departed the roadway, striking the guardrail with the right rear wheel, then rotating counterclockwise as it descended an embankment. During the descent, the motorcoach overturned, struck several rocks in a creek bed at the bottom of the embankment, and the bus roof separated from the bus body. During the rollover, 51 of the occupants were ejected. Nine passengers were fatally injured, and 43 passengers and the driver received various degrees of injuries from minor to critical.

The accident occurred on a remote section of highway where cell phone coverage did not exist, and the closest emergency medical services (EMS) assets were approximately 18 miles away at a volunteer fire department. Consequently, the first notification of the accident did not occur for more than 35 minutes, and the first EMS ambulance did not arrive on scene for almost an hour. Although two calls went out for EMS helicopters, the weather conditions grounded both helicopters, thereby requiring all accident victims to be transported by ground ambulance.

A substantial, coordinated effort involving EMS assets from Utah, Arizona, Colorado, and New Mexico was organized to transport accident victims by ground over long distances. A total of 13 ambulances were used to transport the injured to hospitals, but some of the ambulances came from distant medical facilities to pick up accident victims and deliver them to hospitals. Six Advanced Life Support (ALS) ambulances responded to the accident, with one traveling 166 miles from Grand Junction, Colorado, three traveling 117 miles from Moab, Utah, and two driving more than 60 miles from Cortez, Colorado. The closest hospital to the accident scene was 70 miles away, and the nearest trauma center was approximately 230 miles away in Grand Junction. Several critically injured passengers were driven from the accident scene a distance of 117 miles to a hospital in Moab, and then transferred to an EMS airplane and flown to a trauma center in Salt Lake City. One of the victims being driven by ALS ambulance to the trauma center in Grand Junction died enroute, and a second victim died in hospital the next day.

This accident showed that factors beyond road design or bus design could significantly effect the outcome of a serious bus accident. Accident notification and emergency response in rural areas is a serious concern, and given the higher accident fatality rates in rural areas, these

[1] U.S. Department of Transportation, National Highway Traffic Safety Administration, *Contrasting Rural and Urban Fatal Crashes, 1994 – 2003*, DOT HS 809 896 (Washington, DC: NHTSA, 2005).

factors can substantially affect travel risk for buses in rural areas. The purpose of this study was to explore that risk in more detail by determining the types of rural fatal accidents involving large buses[2] and the consequences of delayed accident notification and lengthy emergency response times for accident victims. Also of particular concern was the way in which federal highway safety legislation addresses risk factors found in rural fatal accidents involving large buses. Accordingly, this study focuses on two aspects of large-bus travel risk on rural roads:

- fatal accident data that characterize the type of large bus accidents in rural areas, and the demands placed on rural EMS to provide emergent care to bus occupants and transport them to medical facilities; and

- the criteria used in current federal highway safety legislation to identify high-risk rural roads and to select rural highway safety improvement projects.

The demands placed on rural EMS are well understood in the EMS community. In a recent National Academy of Science (NAS) report,[3] the issues facing rural EMS are presented in detail and include the problems of potentially lengthy response times, long distances to medical facilities, the move to regionalization of medical services that has resulted in a loss of medical care facilities and emergency departments in rural areas, and a major shift to air ambulance services to overcome the long patient transport distances. The American Association of State Highway and Transportation Officials (AASHTO) Strategic Highway Safety Plan also cites as one of its 22 goals enhancement of emergency medical capabilities to increase survivability of highway crashes.[4] The issues relevant to rural travel will be briefly discussed to help characterize the demands placed on rural EMS and its ability to adequately respond to a large bus accident.

The discussion will then turn to fatal accident data to establish the risk of large bus travel in rural areas. These data were presented in the NTSB Data Report, *Large Bus Accidents and Injuries in Rural and Urban Areas, 2000-2006,* and are reproduced in Appendix A. Finally, the study considers how the 2005 Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) identifies and selects Highway Safety Improvement Projects (HSIP) that target high-risk rural roads, and is implemented under the guidance of the Federal Highway Administration (FHWA).

---

[2] In this report, large buses are defined using criteria from NHTSA's Fatality Analysis Reporting System (FARS). Briefly, a large bus is defined in this report as a bus used in charter or tours, in scheduled service, in commuter service, or as a shuttle bus, that has a Gross Vehicle Weight Rating (GVWR) greater than 10,000 pounds, and is configured to carry more than 15 passengers. For more detailed definitions and criteria, see Appendix A or NTSB Data Report, *Large Bus Accidents and Injuries in Rural and Urban Areas, 2000-2006*.

[3] The National Academy of Science, Institute of Medicine, Committee on the Future of Emergency Care in the United States Health System, *Emergency Medical Services: At the Crossroads* (Washington, DC: The National Academies Press, 2007).

[4] American Association of State Highway and Transportation Officials (AASHTO) Transportation Research Board, National Cooperative Highway Research Program (NCHRP) Report 500, Volume 15: *A Guide for Enhancing Rural Emergency Medical Services* (Washington, DC: TRB, 2005).

APPROACH

Two approaches were used in this study: analysis of fatal accident data, and a review of the legislation, policy, and literature associated with EMS and with highway safety. Each approach is briefly described below.

Analysis of Fatal Accident Data

The purpose of the analysis of fatal accidents was to determine if the pattern of accidents for large buses was consistent with established patterns for rural fatal accidents. As previously discussed, analyses have shown that rural fatal accidents account for a greater proportion of all fatal accidents, and produce more fatalities than urban fatal accidents. In this analysis, rural fatal accidents involving large buses was compared to urban fatal accidents involving large buses to determine if the relative proportion of accidents, fatalities, and injuries was the same for these types of rural and urban accidents.

Charter and tour buses were of special interest in this analysis. Accordingly, the way in which a bus was being used at the time of the accident was a critical variable. Of particular concern was whether charter and tour buses represented a greater proportion of the rural fatal accidents involving large buses, and if any rural or urban differences occurred in the pattern of fatalities and injuries, especially for bus occupants.

Characterizing the demands placed on EMS capabilities was another objective of the data analysis. Data variables that could identify EMS requirements were considered in the analysis, with emphasis placed on the need to transport accident victims to a medical facility.

The fatal accident data was drawn from NHTSA's Fatality Analysis Reporting System (FARS). A description of the FARS database and how it was used in the analysis, along with the criteria used for selecting fatal accident cases, is described in Appendix A.

Review of Legislation, Policy, and Literature

The purpose of the review of legislation, policy, and literature was to identify the issues recognized by the transportation community as relevant to rural travel. The review focused on two areas of interest to large bus travel in rural areas: rural EMS; and the criteria used at the federal level to identify high risk rural roads.

A number of important sources of EMS research and evaluation were identified. The NAS report *Emergency Medical Services: At the Crossroads* outlined many of issues facing rural EMS, and is discussed in more detail in the next section. The NAS Report was the product of a 4-year effort, begun in 2003, by The Institute of Medicine's Committee on the Future of Emergency Care in the United States Health System. The study team was comprised of 40 members representing a broad range of expertise in health care and public policy. The scope and breadth of the NAS report provided significant material for the rural EMS review.

The Federal Interagency Committee on Emergency Medical Services (FICEMS) was created in 2005 as a consequence of SAFETEA-LU. The purpose of FICEMS is to provide coordination across federal agencies involved with EMS. NHTSA is one of the committee members, and provides a repository for FICEMS activities and reports, as well as the Department of Transportation agency responsible for EMS efforts. FICEMS reports and activities provided another source for the EMS review.

The 2005 SAFETEA-LU legislation established the criteria for identifying high risk rural roads. The High Risk Rural Roads Program contained within the SAFETEA-LU legislation allows states, with oversight by FHWA, to identify high risk rural roads and include them in highway safety improvement projects. The SAFETEA-LU legislation, and the specific provisions relevant to the High Risk Rural Roads Program, was reviewed to determine current federal policy related to rural road travel risk.

ISSUES FACING RURAL EMS

The NAS Report defines EMS as prehospital and out-of-hospital emergency medical services, including 9-1-1 and dispatch, emergency medical response, field triage and stabilization, and transport by ground or air (helicopter or airplane) ambulance to a hospital and between facilities. The report defines an EMS system as an organized EMS delivery system within a specified local, regional, state or national geographic area. To place EMS activity in perspective, more than 15,000 EMS systems and upwards of 800,000 EMS personnel respond annually to more than 16 million transport calls.

The level of care provided by prehospital EMS can be classified into three categories:

- Basic Life Support (BLS) medical service provided by personnel trained to be Emergency Medical Technicians (EMTs).
- Advanced Life Support (ALS) medical service provided by personnel trained to be paramedics.
- Specialty Care Transport (SCT) medical service provided by personnel trained to conduct procedures normally beyond the scope of a paramedic; also known as critical care service.

The challenges facing rural EMS are widely understood. Much of the attention has focused on reducing response times through improved accident notification (enhanced 9-1-1), and more rapid delivery of emergent care. This focus is in response to data that indicate the difficulties associated with delivering rural, emergent care over long distances that sometimes involve difficult terrain. For example, the NAS Report cites NHTSA data showing that 30% of rural accident victims (compared with 8% percent of urban accident victims) arrived at the hospital more than 60 minutes after the crash.[5] Often the delay in accident notification and the timely activation of an EMS response produces lengthy response times (as was the case in the

[5] NAS Report, p. 63.

Mexican Hat accident), but studies have shown that delays in rural areas are significantly longer than urban areas for all segments of the EMS response. Air ambulance providers play a key role in reducing response times in rural areas, especially where trauma centers are located far from the scene of an accident.

There are, however, a number of less obvious challenges for rural EMS that are especially relevant to travel in rural areas. First are limited resources, and the lower level of care available in rural EMS. Beginning in the 1990s, in response to reduced state and federal funding for medical services in rural areas, a strategy to regionalize emergency care resulted in a centralization of costly critical and urgent care in populated areas. An advantage of regionalization, according to the NAS Report, is to improve patient outcomes by directing patients to facilities with experience in and optimal capabilities for any given type of illness or injury. A disadvantage of regionalization, according to NAS, is the closing of critical care and trauma centers in rural areas. Such closures and restructuring of many rural hospital facilities increase the demand on rural EMS agencies by creating an environment that requires long-distance, time-consuming, or high-risk transports between facilities.

Second, an indirect effect of regionalization is to limit EMS assets in rural areas. In general, the level of rural EMS care provided is BLS delivered by EMTs, and the majority of this rural EMS workforce is voluntary.[6] Although all EMTs are certified and required to maintain their skills, the low volume of calls and longer transport times in rural areas result in less frequent in-the-field experience. Accordingly, both NAS and AASHTO concluded that rural EMS resources are severely limited, that the rural EMS workforce has limited opportunities for training, that rural EMS providers have difficulty maintaining their specialized skills, and that the rural EMS workforce relies on hard-to-find volunteers. In addition, rural EMS faces additional challenges related to funding, aging equipment, lack of nearby training opportunities, and regional communication and coordination. In the Mexican Hat accident, EMS response was typical for a rural area: all of the first ambulances dispatched to the scene provided only BLS care, and the initial EMS response was provided by the nearest volunteer fire department.

Finally, the higher level of care needed by severely injured bus accident victims may not be readily available near the accident site. As a result, such care may have to be provided by a distant medical facility that sends an EMS team directly to the accident scene or to another medical facility in order to transport patients to the appropriate facility. The Mexican Hat accident illustrates well the long distances that EMS teams must travel in rural areas to provide higher levels of care. As previously discussed, six ALS ambulances responded to the accident, with one traveling 166 miles from Grand Junction, three traveling 117 miles from Moab, and two driving more than 60 miles from Cortez. The ALS ambulance from Grand Junction carried a physician, nurse, and paramedic, and the additional equipment and supplies required to provide critical care during transport. Note that all of the ALS ambulances traveled to the hospital in Monticello to pick up accident victims, not the accident site which was approximately 70 miles farther away. Furthermore, St. Mary’s Hospital in Grand Junction, approximately 230 miles away, was the closest trauma center.

[6] NAS Report, p. 42.

One EMS solution to long distances in rural areas is air EMS. The NAS Report states that air EMS, both helicopters and airplanes, can improve patient care in two ways: by reducing transport time to definitive care, and by providing a higher skill mix of medical flight crew (most EMS helicopters carry at least a paramedic and a flight nurse).[7] Accordingly, helicopters have become an integral and necessary part of rural EMS, providing rapid transport of specialized care and equipment to an accident scene, and fast, direct transport of accident victims to the appropriate emergent care facility. The growth of air EMS parallels regionalization; according to industry data, air EMS grew from 174 operators flying 231 helicopters in 1990, to 272 operators flying 753 helicopters and 150 dedicated airplanes in 2005.[8] Both NAS and AASHTO reports point out that helicopter EMS can be a cost effective alternative to ground ambulances, especially in rural areas.

In addition, certain types of injuries appear to be best served by an EMS helicopter, including moderate-to-severe traumatic brain injury, out-of-hospital intubation, and the most severe injuries. This advantage is generally due to the higher level of care that can be provided by the helicopter and its medical crew.[9] A growing trend in the air medical industry is to use an EMS helicopter to bring more of the assets of a trauma center – including physician-level skills, hospital-type equipment, and advanced drugs – directly to the accident scene.[10]

There are a number of limitations to the effectiveness of an EMS helicopter. The first is weather. In the Mexican Hat accident, weather grounded the two helicopters requested from Grand Junction and Phoenix, Arizona, thereby precluding rapid air EMS transport for the most severely injured bus occupants. Consequently, all transport from the accident scene, and a number of the transfers between medical facilities, had to be accomplished by ground ambulance.

The second limitation is discussed in the NAS Report. One of the greatest challenges facing rural EMS is response coordination, especially to a mass casualty event. According to NAS, EMS care is highly fragmented and poorly coordinated, and these problems are often encountered near municipal, county, and state borders (for example, the Mexican Hat accident required coordination of EMS responses from Utah, Arizona, New Mexico, and Colorado). These problems are compounded by limited communication among EMS and other public safety and health care providers, especially between air medical providers and hospital and trauma centers. In the Mexican Hat accident, two helicopters were requested from Phoenix and Grand Junction. However, in the Atlas and Database of Air Medical Services (ADAMS), an industry database of air EMS assets by state, an additional five EMS helicopters are listed at other locations in the region.[11] This investigation found no evidence that these other helicopters were requested, or if attempts were made to arrange intermediate transfer points outside the adverse weather area for EMS helicopters to meet ground ambulances. Transfers to a fixed-wing air

---

[7] NAS Report, p. 61.
[8] Foundation for Air-medical Research and Education, *Air Medicine: Accessing the Future Health Care* (Arlington, VA: FARE, 2006).
[9] NAS Report, p. 62.
[10] FARE, pp. 4-6.
[11] More information about ADAMS can be found at www.adamsairmed.org

ambulance were made in Moab, but these transfers required a 117-mile trip by ground ambulance from the accident scene.

The fragmented nature of EMS and the lack of coordination for EMS programs extends all the way to the federal level, in terms of both funding and leadership. According to the NAS Report, "The federal government is extremely fragmented in its approach to regulating EMS. A host of departments, divisions, and agencies at the federal level play a role in various aspects of EMS, but none is officially designated as the lead agency."[12] The report goes on to point out that EMS is widely viewed as an essential public service, but

> Unlike other such services—electricity, highways, airports, and telephone service, for example—all of which were created and are actively maintained through major national infrastructure investments, access to timely and high-quality emergency and trauma care has largely been relegated to local and state initiatives.[13]

Accordingly, the variation among emergency and trauma care systems at the state and local level is substantial, and the differences in coordination among fire departments, EMS, hospitals, trauma centers, and emergency management are significant.

Recent developments have been enacted at the federal level to coordinate EMS efforts. SAFETEA-LU recognized the need for federal-level coordination and, as a result, FICEMS was created in 2005. FICEMS is made up of representatives from NHTSA and the Departments of Health and Human Services, Homeland Security, and Defense. The purpose of this committee is to ensure coordination among the federal agencies involved with state, local, or regional EMS and 9-1-1 systems, and to identify ways to streamline support from federal agencies in an effort to develop efficient and well organized EMS systems for the future.

In summary, the EMS community recognizes that rural EMS faces a number of important issues. Long travel distances and widely dispersed EMS assets presents rural EMS with formidable challenges when faced with a mass casualty event like a large bus accident. Efforts have been made to provide better rural EMS response – such as the use of air EMS to bring high-level care to the accident site and to provide rapid transport to emergent care facilities – but these efforts can suffer from ineffective communication and poor coordination. In the next section, an analysis of fatal accident data involving large buses is used to characterize the risk of rural bus travel before turning to FHWA's approach to identifying high-risk rural roads.

ACCIDENT DATA ANALYSIS

Large Bus Fatal Accidents

An analysis of rural and urban fatal accidents involving large buses for the period 2000–2006 using data from NHTSA's FARS was conducted. The results are summarized here in tables 1–5, and more detail is provided in Appendix A. Fatal accidents involving charter/tour

[12] NAS Report, p. 43.
[13] NAS Report, p. 41.

Table 1: Accidents, Fatalities and Nonfatal Injuries in Fatal Accidents Involving Large Buses, 2000-2006

	Bus Use[14]				
	Charter or Tour	**Scheduled**	**Commuter**	**Shuttle**	**Total**
Fatal Accidents					
Total All Accidents	202	547	158	47	954
Rural	96	48	21	17	182
Urban	99	483	132	27	741
Fatalities					
Total All Accidents	298	582	184	87	1151
Rural	169	58	40	31	298
Urban	127	517	143	56	843
Nonfatal Injuries					
Total All Accidents	1402	1041	199	231	2873
Rural	920	227	66	81	1294
Urban	470	804	132	150	1556
Uninjured					
Total All Accidents	260	508	156	46	970
Rural	108	41	21	18	188
Urban	149	460	131	28	768

[14] Bus Use is defined in this report using the definitions in NHTSA's FARS. A *charter/tour bus* is used in any charter or tour for sightseeing or pleasure trips, but does not include school-sponsored functions or activities. A bus in *scheduled* service is used for regular municipal transit service and cross-country or intercity scheduled service (for example, scheduled Greyhound bus service between major cities). It also includes scheduled inner-city mass transit bus service. A bus in *commuter* service is used for commuting between home and work or school beyond the 12th grade (for example, college commuting), or direct point-to-point service (for example, a parking lot or a pick-up location near home to a drop-off location near work). A bus in *shuttle* service is used to shuttle people other than for commuting, school, tours, or scheduled travel. Examples are shuttles from airport, hotels, churches, community-sponsored HeadStart/day care, rental cars, business facility-to-facility shuttling, and prison or military or other governmental shuttling.

buses[15] accounted for 202 of the accidents (21% of the total 954 accidents), and resulted in 298 fatalities and 1,402 nonfatal injuries (table 1). Of the total number of accidents, 96 were rural fatal accidents that involved charter/tour buses and resulted in 169 fatalities and 920 nonfatal injuries. These charter and tour bus rural accidents accounted for more than half of all rural fatal bus accidents and fatalities, and almost three-quarters of the rural nonfatal injuries. In addition, these accidents were dominated by motorcoaches,[16] accounting for 92% (88 of 96) of the rural fatal accidents involving charter/tour buses (table 2). Bus occupants accounted for almost all of the nonfatal injuries in rural fatal accidents (table 3).

These results were in contrast to urban bus accidents where the majority of the fatal accidents, fatalities, and nonfatal injuries occurred when a transit/city bus[17] operating in scheduled service was involved (tables 1 and 2). Rural charter/tour bus fatal accidents resulted in more fatalities and nonfatal injuries than urban charter/tour bus accidents, a pattern that is exactly the reverse for accidents involving buses in any other type of service or use. The proportion of charter/tour bus occupants fatally injured in rural accidents represented a greater proportion of the total number of rural fatalities (25%, 73 of 298) when compared to the proportion of urban fatalities attributable to urban charter/tour bus occupants (2%, 20 of 843). In fact, rural charter/tour bus accidents produced more than three times the number of bus occupant fatalities and more than twice the number of bus occupant nonfatal injuries (rural = 832, and urban = 389) than the same type of urban accident. Note, too, that bus occupants involved in rural fatal accidents were less likely to escape injury than their urban counterparts.

The analysis of fatal accidents involving large buses showed that rural accidents primarily involved motorcoaches used in a charter or tour. Overall, rural accidents involving charter or tour buses accounted for only 10% (96 of 954) of the total number of fatal accidents, but produced 15% (169 of 1,151) of the total fatalities and 32% (920 of 2,873) of the total nonfatal injuries. In fact, rural accidents involving charter/tour buses resulted in proportionally more bus occupants sustaining fatal and nonfatal injuries than the same type of urban accident. This result indicates the potentially higher risk of charter and tour bus travel in rural areas. In addition, bus occupants in rural fatal accidents involving charter/tour buses accounted for more than 40% (73 of 169) of the fatalities and almost all (90%, 832 of 920) of the nonfatal injuries in these types of accidents. The analysis of large bus accident data showed that the risk of a fatal accident and subsequent injury to charter and tour bus occupants was greater in rural areas than in urban areas. This pattern was consistent with the overall pattern in rural fatal accidents: rural accidents account for more fatal accidents and more fatalities than urban accidents.

---

[15] See table 1 for a definitions of buses used in a charter or tour, or in scheduled, commuter, or shuttle service.
[16] In the analysis, a motorcoach was defined using FARS criteria, and is discussed in more detail in Appendix A and the NTSB Data Report *Large Bus Accidents and Injuries in Rural and Urban Areas, 2000-2006*. Briefly, a *motorcoach* is any intercity/cross-country bus, or any other type of bus being used like a motorcoach (traveling at highway speeds over long distances) that is configured to carry more than 15 passengers, has a GVWR greater than 26,000 pounds, and is being used as a charter/tour bus, in scheduled or commuter service, or as a shuttle bus.
[17] A transit/city bus was defined using FARS criteria. In general, a transit/city bus is designed for slow speeds, frequent stops, and to accommodate both seated and standing passengers. For more details see Appendix A.

Table 2: Fatal Accidents Involving Large Buses by Type of Bus, 2000-2006

	Bus Use				
	Charter or Tour	Scheduled	Commuter	Shuttle	Total
Motorcoach					
Rural	88	14	3	8	113
Urban	89	54	10	11	164
Transit/City Bus					
Rural	3	33	16	1	53
Urban	7	426	117	6	556
Bus GVWR 10k – 26k					
Rural	5	1	2	8	16
Urban	3	3	5	10	21

Table 3: Bus Occupants Fatalities and Nonfatal Injuries in Fatal Accidents Involving Large Buses, 2000-2006

	Bus Use				
	Charter or Tour	Scheduled	Commuter	Shuttle	Total
Bus Occupant Fatalities					
Total All Accidents	93	14	9	52	168
Rural	73	6	7	8	94
Urban	20	8	2	34	64
Bus occupant Nonfatal Injuries					
Total All Accidents	1230	763	149	198	2340
Rural	832	187	55	68	1142
Urban	389	571	94	130	1099

Emergency Medical Services Analysis

The demands placed on emergency response and emergency medical services can be estimated by the number of accident victims transported to a hospital. FARS provides hospital transport data for all injured and indicates whether the injured person was an occupant of the bus. Almost 75% (2,948 of 4,024) of all the injured in both rural and urban fatal accidents involving large buses were transported to a hospital (table 4). In addition, a large proportion of the injured who were transported to a hospital (66%, 1,932 of 2,948) were bus occupants (table 5).

In rural fatal accidents involving large buses, most of the transported injured were bus occupants (84%, 979 of 1,170). When only rural accidents involving charter/tour buses were considered, the proportion was slightly higher (88%, 740 of 843). Almost all (98%, 729 of 740) of these bus occupant transports had suffered nonfatal injuries. In urban fatal accidents involving large buses only 54% of the accident victims transported were bus occupants.

In summary, the analysis of the number of persons transported to hospitals provides a way to estimate the demands placed on rural EMS by accidents involving large buses. The accident data for rural accidents involving charter or tour buses, where almost all of the transported accident victims were bus occupants, showed that these types of accidents can place substantial demands on rural EMS. The Mexican Hat motorcoach accident well illustrates how substantial the demands can be. The first emergency response units arrived on scene almost an hour after the accident occurred, with a total of 13 ambulances transporting injured from the scene over the next 3.5 hours, or conducting between-hospital transfers throughout the night. Of the 53 bus occupants, 46 were transported to 7 different medical facilities, with injuries ranging from minor to fatal.

Table 4: Injured Transported to Hospital
in Fatal Accidents Involving Large Buses, 2000-2006

	Bus Use				
	Charter or Tour	**Scheduled**	**Commuter**	**Shuttle**	**Total**
Fatalities Transported					
Total All Accidents	98	363	93	25	579
Rural	44	18	7	7	76
Urban	53	340	85	18	496
Nonfatal Injuries Transported					
Total All Accidents	1204	802	173	190	2369
Rural	799	164	58	73	1094
Urban	399	632	114	117	1262

Table 5: Injured Bus Occupants Transported to Hospital
in Fatal Accidents Involving Large Buses, 2000-2006

	Bus Use				
	Charter or Tour	**Scheduled**	**Commuter**	**Shuttle**	**Total**
Bus Occupant Fatalities Transported					
Total All Accidents	15	8	2	8	33
Rural	11	2	0	4	17
Urban	4	6	2	4	16
Bus Occupant Nonfatal Injuries Transported					
Total All Accidents	1065	550	125	159	1899
Rural	729	124	47	62	962
Urban	333	425	76	97	931

SAFETEA-LU High Risk Rural Roads Program

FHWA targets rural road safety through the High Risk Rural Roads Program funded by SAFETEA-LU. The High Risk Rural Roads Program treats safety improvements as candidate Highway Safety Improvement Projects (HSIP), which are part of SAFETEA-LU's new core Highway Safety Improvement Program. The purpose of this program, according to the legislation, is to "achieve a significant reduction in traffic fatalities and serious injuries on public roads" through HSIPs.

SAFETEA-LU establishes, in law, the requirements and funding for highway safety programs at the federal and state levels. An HSIP can be defined in a number of ways, but must correct or improve a hazardous highway location or feature, or address a highway safety problem. Many of these safety improvements target highway infrastructure, and can span a wide range of improvements, including lane and shoulder widening, rumble strips, skid-resistant road surfaces, traffic calming, or removal of a roadside obstacle. Not all projects must be related to infrastructure improvement or highway construction; for example, one type of HSIP can be to improve the collection and analysis of crash data.

A state's response to SAFETEA-LU's High Risk Rural Roads Program is in the form of an HSIP that targets a high-risk rural road. The program defines a high-risk rural road as any roadway functionally classified as a rural major, rural minor collector, or a rural local road—

- on which the accident rate for fatalities and incapacitating injuries exceeds the statewide average for those functional classes of roadway; or

- that will likely have increases in traffic volume that are likely to create an accident rate for fatalities and incapacitating injuries that exceeds the statewide average.

The program emphasizes accidents that are severe enough to produce fatalities and incapacitating injuries. Although these accidents can represent worst-case scenarios, they may not adequately identify all of the important high-risk rural roads for two important reasons. First, fatal accidents account for a very small proportion (typically less than 1%) of the total number of highway accidents in any given year, and second, as the analysis of rural fatal accidents involving large buses showed, they do not account for the demand placed on rural emergency medical services by nonfatally injured accident victims. The analysis shows that almost all of the accident victims transported to hospitals were bus occupants, and almost all of those transported were nonfatally injured. Without an accurate assessment of all nonfatal injury accidents the extent of the demands placed on EMS in rural areas cannot be adequately determined.

Characterizing a road as rural is a fundamental part of the selection and prioritization process. Consequently, an accurate characterization of the functional classification of a road segment is important part of the process. FHWA functionally classifies roads using a population census definition. In that classification, an urban road is defined as any road or street within the boundaries of an urban area with a population of 5,000 or more, and a rural road is any road not classified as urban. The boundaries of urban areas are fixed by state highway departments, subject to the approval of the FHWA, for purposes of the Federal-Aid Highway Program. Studies of rural and urban roads use the FHWA functional classification to identify rural roads. This characterization of "ruralness" based on population reasonably assumes that traffic volume in urban areas will be greater than in rural areas. However, that functional classification does not consider factors such as population distribution, travel patterns, and seasonal traffic volume.

In addition, any analysis of rural road travel risk must include good measures of exposure. Some western states, such as Utah, have many more rural than urban roads, especially when compared to more densely populated eastern states. Consequently, exposure to rural roads is much greater in some states (and regions within states) than in others. Such differences can have a substantial impact on the analysis of rural road accident risk factors.

In the High Risk Rural Roads Program, traffic volume is used as a standard measure of highway activity and as a way to identify rural road segments that meet high-risk criteria. Unfortunately, rural traffic volume alone cannot accurately characterize large bus activity in rural areas unless detailed traffic studies are conducted, especially for charter/tour bus operations where travel patterns, travel characteristics, driver and passenger demographics, and seasonal variations are unknown. Industry estimates of the number of passengers carried by buses are typically aggregated and contain insufficient detail to support detailed analyses of charter and tour bus routes and travel patterns. Furthermore, the source of estimates and the validity of the methods used to obtain the data cannot be adequately verified. States do collect measures of vehicle miles traveled, and are required to use such measures to calculate accident rates in the development of an HSIP, but the detail in these measures is typically insufficient to determine the routes and travel characteristics of charter and tour buses in specific areas, especially for those states where travel between population centers and recreation areas may include long distances through remote areas. Consequently, the lack of adequate data on large bus travel in rural areas, especially data related to charter and tour bus activity and travel patterns, severely limits a state's ability to assess high-risk rural roads, especially roads in remote areas where accident notification and EMS may be an issue.

The importance of adequate accident and activity data is reflected in the SAFETEA-LU requirement for each state to incorporate a data-driven, analytic approach in its development of an annual Strategic Highway Safety Plan (SHSP). SAFETEA-LU requires each state to include the following in its SHSP:

- a crash data system for identifying and analyzing safety problems,
- an analysis that identifies hazardous locations, roadway sections, and road elements,
- criteria that a state determines to be appropriate to establish the relative severity of locations based on accidents, injuries, fatalities, traffic volumes, and other relevant data,
- priorities for correcting hazardous locations, sections, or features based on crash data analysis, and for identifying opportunities to prevent the development of such hazardous conditions, and
- a data-driven means for evaluating the effectiveness of HSIPs in reducing the number and severity of accidents and potential accidents.

In its published guidance, FHWA outlines a two-step process for identifying high-risk rural roads and selecting projects to be included in a state's SHSP. The first step requires a state to identify eligible roadways with accident rates for fatalities and incapacitating injuries that exceed statewide averages for respective roadway functional classifications. Accident rates must be based on crash data and exposure data. Vehicle miles traveled (VMT), average daily traffic (ADT), and lane miles are typical exposure data, although states working towards a comprehensive statewide data system may use other sources for exposure data. States may also consider roads with a potential for increased traffic volumes that could result in an increase in accidents and fatalities.

The second step in the identification and selection process requires a state to use the eligible set of roadways identified in the first step to determine appropriate safety improvements and select projects. These projects form the basis for the High Risk Rural Road Program HSIPs that appear in a state's Strategic Highway Safety Plan.

The guidance leaves some discretion to states, but the emphasis is on fatal accidents, fatalities, incapacitating injuries, and aggregated activity data. As this accident and the analysis of fatal accidents involving large buses has shown, establishing criteria based on these types of data may not be sufficient for identifying all high-risk rural roads. Such a reliance on fatal accident and aggregated activity data (such as vehicle miles traveled, average daily traffic, and lane miles) to identify and select high-risk rural road HSIPs cannot adequately characterize the accident risk of rural travel, especially in rural areas that may experience relatively high volumes of charter or tour bus traffic.

The High Risk Rural Roads Program appears to be especially deficient in its ability to identify rural areas where accident notification may be problematic and local emergency medical response capabilities may be hampered by travel distances or overwhelmed by a large number of accident victims. The program does not include such assessment of both fatal and nonfatal accidents involving large buses in all types of service and use, the travel routes, travel activity, and travel characteristics of these buses, and the potential problems of a large bus accident for rural EMS related to lengthy response times, travel distances, and the potentially overwhelming demands on EMS capabilities. In addition, the development of the High Risk Rural Roads Program does not appear to be coordinated at the federal level with AASHTO's efforts in its Strategic Highway Safety Plan to enhance rural EMS or efforts by FICEMS to address the challenges facing rural EMS.

Much of the attention in the High Risk Rural Roads Program, and HSIPs in general, focuses on highway design features and infrastructure characteristics. Safety improvement projects that are not highway construction-related focus primarily on the collection and analysis of accident data. The only mention made of the need to consider emergency response is in the context of work zones. However, the accident at Mexican Hat, and the data analysis showing the extent of fatal accidents involving charter/tour buses in rural areas, indicate that the risks of rural roads are not limited to highway design features, and may also be associated with difficulties in accident notification and providing timely and adequate EMS.

Although the FHWA's High Risk Rural Roads Program recognizes the risks of rural travel, the safety improvement projects emphasized in the program focus on highway design features and correcting roadway problems found in specific locations. As a result, the program does not provide for projects that can adequately mitigate the systemic risks of inadequate rural EMS. These risks are especially evident in rural accidents involving large buses where accident notification may be problematic and local EMS capabilities may be hampered by travel distances or overwhelmed by the large number of accident victims. Of particular concern is the need for a coordinated EMS response in remote areas to deal with these types of large-bus accidents. One potential approach to coordination is to include provisions in the SAFETEA-LU High Risk Rural Roads Program that allow states to propose HSIPs that target planning, optimizing, coordinating, and implementing EMS in rural areas that have been identified as at risk for large bus travel.

SUMMARY OF KEY POINTS

The analysis of fatal accidents involving large buses, and the review of the legislation, policy, and literature associated with highway safety and with EMS revealed the following key points related to rural road travel risk for large buses. Some of these points identify potential rural road risk factors for further research.

- The analysis of fatal accident data involving large buses showed that rural accidents primarily involved motorcoaches used in a charter or tour. The risk of a fatal accident and subsequent injury to charter and tour bus occupants was greater in rural areas than in urban areas, and that this pattern was consistent with the overall pattern in rural fatal accidents.

- The accident data for rural accidents involving charter or tour buses, where almost all of the transported accident victims were bus occupants, showed that these types of accidents can place substantial demands on rural EMS.

- An accurate assessment of all nonfatal injury accidents is necessary to determine the extent of the demands placed on EMS in rural areas.

- Long travel distances and widely dispersed EMS assets present rural EMS with formidable challenges during a mass casualty event like a large bus accident.

- Efforts have been made to provide better rural EMS response – such as the use of air EMS to bring high-level care to the accident site and to provide rapid transport to emergent care facilities – but these efforts can suffer from ineffective communication and poor coordination.

- Closures and restructuring of many rural hospital facilities, as part of a regionalization strategy, increase the demand on rural EMS agencies by creating an environment that requires long-distance, time-consuming, or high-risk transports between facilities.

- In general, rural EMS resources are severely limited, the rural EMS workforce has limited opportunities for training, rural EMS providers have difficulty maintaining their specialized skills, and the rural EMS workforce relies on hard-to-find volunteers. The typical level of rural EMS care is BLS delivered by volunteer EMTs.

- One EMS solution to long distances in rural areas is air EMS, because it can reduce transport time to definitive care and provide a higher skill mix of medical flight crew. The growth of air EMS parallels regionalization.

- A growing trend in the air medical industry is to use an EMS helicopter to bring more of the assets of a trauma center – including physician-level skills, hospital-type equipment, and advanced drugs – directly to the accident scene.

- One of the greatest challenges facing rural EMS is response coordination, especially to a mass casualty event.

- The fragmented nature of EMS and the lack of coordination for EMS programs extends all the way to the federal level, in terms of both funding and leadership. This situation results in substantial variation among emergency and trauma care systems at the state and local level, and significant differences in coordination among fire departments, EMS, hospitals, trauma centers, and emergency management.

- FHWA targets rural road safety through the High Risk Rural Roads Program funded by SAFETEA-LU.

- FHWA's functional roadway classification system does not consider factors such as population distribution, travel patterns, or seasonal traffic volume.

- The High Risk Rural Roads Program appears to be especially deficient in its ability to identify rural areas where accident notification may be problematic and local EMS may be hampered by travel distances or overwhelmed by a large number of accident victims. Identification is especially difficult because of inadequate data on large bus travel in rural areas, especially data related to charter and tour bus activity and travel patterns.

- The High Risk Rural Roads Program does not appear to be coordinated at the federal level with AASHTO's efforts in its Strategic Highway Safety Plan to enhance rural EMS or efforts by FICEMS to address the challenges facing rural EMS.

- The High Risk Rural Roads Program recognizes the risks of rural travel, but the safety improvement projects emphasized in the program focus on highway design features and correcting roadway problems found in specific locations. As a result, the program does not provide for projects that can adequately mitigate the systemic risks of inadequate rural EMS.

APPENDIX A
LARGE BUS ACCIDENTS AND INJURIES IN RURAL AND URBAN AREAS, 2000-2006

A.1 DETAILS OF THE DATA REPORT

This Data Report focuses on charter/tour bus travel on rural roads. The report uses fatal accident data from NHTSA's FARS to determine the scope of charter/tour bus accidents in rural areas. The report places the scope of the problem in the context of fatal accidents involving large buses engaged in charter and tour operations, scheduled service, commuter service, and shuttle bus service for the period 2000 – 2006. The report begins with an overview of the large bus fatal accident data, then uses these data to show:

- Differences between rural and urban charter/tour bus accidents
- The extent of fatal accidents involving charter/tour buses in rural areas
- Fatalities and injuries for both bus occupants and occupants of other vehicles
- Number of injured transported to hospitals

A.1.1 Fatality Analysis Reporting System (FARS)

This report begins with accident data drawn from NHTSA's FARS database. FARS provides a census of all fatal crashes within the United States, including the District of Columbia and Puerto Rico. A fatal crash is included in FARS if it involved "a motor vehicle traveling on a traffic way customarily open to the public, and must result in the death of a person (occupant of a vehicle or a nonmotorist) within 30 days of the crash."[18] FARS has documented fatal highway crashes since 1975, and provides data for each crash in terms of accident event characteristics, the people and vehicles involved, and the extent and type of injuries suffered by vehicle occupants and nonmotorists. Data in FARS are based on State police accident reports, and FARS analysts will verify the data and find as much of the missing data as possible. Because FARS is a census of all fatal accidents, and its accuracy is verified by a FARS analyst, researchers treat FARS data with confidence that it can be used to accurately characterize fatal highway accidents. The latest data is from calendar year 2006, and is available, with documentation, from the FARS website at http://www-fars.nhtsa.dot.gov/Main/index.aspx.

Although FARS is a census of all fatal highway accidents in any given year back to 1975, it represents only a very small subset of all accidents in a year. For example, in 2005, there were 39,252 fatal accidents, representing less than 1% of all the accidents that occurred in that year.[19] As a result, large bus accidents involving injuries, but no fatalities, are not included in this analysis.

---

[18] U.S. Department of Transportation, National Highway Traffic Safety Administration, National Center for Statistics and Analysis, *FARS Analytic Reference Guide 1975 – 2006* (Washington, DC: DOT), p. F-i.

[19] U.S. Department of Transportation, Bureau of Transportation Statistics, Table 2-17: *Motor Vehicle Safety Data*. See www.bts.gov/publications/national_transportation_statistics/

A.1.2 Selecting Fatal Accidents Involving Large Buses from FARS

Fatal accidents involving large buses were selected from FARS for the period 2000 – 2006. The specific criteria for the set of accidents are described in detail in Section A.5. Briefly, a large bus is defined in this report as a bus used in tours, in scheduled service, in commuter service, or as a shuttle bus, has a Gross Vehicle Weight Rating (GVWR) greater than 10,000 lb, and is configured to carry more than 15 passengers. This analysis specifically uses FARS criteria related to Bus Use, Bus Body Type, Gross Vehicle Weight Rating (GVWR), and Vehicle Configuration.[20] No school buses, either in type or use, are included in this data analysis.

The period 2000 – 2006 was chosen for a specific reason. Prior to 2000, Bus Use was not accurately recorded, and any analysis of bus activity relied on existing FARS criteria related to the Bus Body Type, GVWR, and Vehicle Configuration. As a result, prior to 2000, accurately determining how a bus was being used was difficult. Given the requirement to accurately identify accidents involving charter/tour buses in this analysis, no data prior to 2000 was used.

The data is subdivided into three bus types: motorcoaches, transit/city buses, and buses with a GVWR between 10,000lb and 26,000 lb. There is no definitive definition of a "motorcoach" in FARS or in NHTSA regulations. In previous analyses of "motorcoach"[21] accidents this type of bus was typically treated as a cross-country/intercity bus, implying that the bus was capable of carrying upwards of 55 passengers or more over long distances at highway speeds. Consequently, the bus could be of type "motorcoach," or being used in a motorcoach way.

However, FARS and police accident reports allow other types of bus body-type codes, even when the bus was operating as if it was a motorcoach. Consequently, use of only one of the bus criteria in FARS to identify motorcoaches can result in an underestimation of the total number of fatal accidents involving a large bus that can be used to carry upwards of 55 passengers or more over long distances. Such a bus must have a GVWR greater than 26,000 lb, be configured to carry more than 15 passengers, and be used as a charter/tour bus, in scheduled or commuter service, or as a shuttle bus. These criteria defined a "motorcoach" in this analysis, and emphasized both the type of bus and the way in which it was being used. More specific details about the motorcoach selection criteria are presented in Section A.5. Large buses with a GVWR between 10,000 lb and 26,000 lb are typically comprised of a medium or heavy duty truck cab-chassis with a passenger-carrying body added to it.

Finally, injury data were compiled for all of the fatal accidents used in this report. One purpose of this report was to show the extent of injuries in fatal accidents involving large buses as a way to illustrate the need for accident notification and EMS. Consequently, fatal and nonfatal injury data, and data indicating transport to a hospital, are shown for bus occupants, occupants of other vehicles, and nonmotorists involved in the accident.

---

[20] See *FARS Analytic Reference Guide 1975 – 2006* for more details.

[21] For example, see U.S. Department of Transportation, National Highway Traffic Safety Administration, National Center for Statistics and Analysis, *NHTSA's Approach to Motorcoach Safety* (Washington, DC: DOT, 2007).

A.2 RESULTS

There were a total of 954 fatal accidents involving large buses in 2000-2006 (Table A.1), resulting in 1,151 fatalities and 2,873 nonfatal injuries (Table A.3). Fatal accidents involving charter/tour buses accounted for 202 of the accidents (representing 21% of the total), resulting in 298 fatalities and 1,402 nonfatal injuries. The following sections discuss fatal accidents and injuries in more detail, with specific focus on comparisons between rural and urban accidents.

Table A.1: Fatal Accidents Involving Large Buses, 2000-2006

Bus Use	2000	2001	2002	2003	2004	2005	2006	Total
Charter/Tour	27	33	30	20	37	36	19	202
Scheduled Service	110	80	73	82	65	57	80	547
Commuter	21	28	21	22	14	22	30	158
Shuttle	6	5	9	7	8	10	2	47
Total	164	146	133	131	124	125	131	954

A.2.1 Fatal Accidents Involving Large Buses

The 954 fatal accidents involving large buses occurred primarily in urban areas (Table A.2). There were 741 urban fatal accidents, resulting in 843 fatalities and 1,556 nonfatal injuries, accounting for 78% of the fatal accidents, 73% of the fatalities, and 54% of the nonfatal injuries (Table A.3). Accidents involving buses in scheduled service accounted for the majority (65%) of the urban accidents, followed by buses in commuter service (18%), charter/tour buses (13%), and shuttle buses (4%). Almost all of the scheduled service bus accidents (88%) occurred in urban areas, and almost all of these types of urban accidents (88%) involved transit buses. The large number of urban accidents involving buses in scheduled and in commuter service reflect the high level of public transport provided by buses in populated areas.

In rural areas, charter/tour buses, rather than scheduled service buses, accounted for the greatest proportion of accidents. Charter/tour buses were involved in more than half (53%) of the fatal rural accidents, with the remaining accidents divided among scheduled (26%), commuter (12%), and shuttle bus services (9%). Motorcoaches were involved in more than 60% of all these rural accidents, and almost all of the rural accidents involved charter/tour buses.

These data show that rural fatal accidents involving large buses are primarily comprised of motorcoaches being used in a tour or as a charter. This result is in contrast to urban accidents that are dominated by transit/city buses in scheduled service.

A.2.2 Fatalities and Injuries

A.2.2.1. All Fatalities and Injuries. Fatalities and injuries resulting from the fatal accidents involving large buses is shown in shown in Table A.3. As might be expected, the large number of urban accidents produced the greatest number of fatalities and nonfatal injuries. However, nonfatal injuries were more evenly distributed between urban and rural accidents.

Table A.2: Fatal Bus Accidents by Rural or Urban Location and Type of Bus, 2000-2006

	Rural	Urban
Charter/Tour		
Motorcoach	88	89
Transit/City Bus	3	7
GVWR 10-26K	5	3
Scheduled Service		
Motorcoach	14	54
Transit/City Bus	33	426
GVWR 10-26K	1	3
Commuter Service		
Motorcoach	3	10
Transit/City Bus	16	117
GVWR 10-26K	2	5
Shuttle Service		
Motorcoach	8	11
Transit/City Bus	1	6
GVWR 10-26K	8	10
Total	182	741

In urban areas, there were 843 fatalities and 1,556 nonfatal injuries in fatal accidents involving large buses. Accidents involving buses in scheduled service accounted for most of the urban fatalities (61%) and nonfatal injuries (52%).

In rural areas, there were 298 fatalities and 1,294 nonfatal injuries. Rural fatal accidents involving charter/tour buses accounted for 57% of the rural fatalities and 71% of the rural nonfatal injuries. It is interesting to note that rural charter/tour bus fatal accidents resulted in

Table A.3: Fatalities and Nonfatal Injuries in Fatal Accidents Involving Large Buses, 2000-2006

	Total	Rural	Urban
Fatalities			
Charter/Tour	298	169	127
Scheduled Service	582	58	517
Commuter	184	40	143
Shuttle	87	31	56
Total	1151	298	843
Nonfatal Injuries			
Charter/Tour	1402	920	470
Scheduled Service	1041	227	804
Commuter	199	66	132
Shuttle	231	81	150
Total	2873	1294	1556
Total Fatalities & Injuries	4024	1592	2399
Uninjured			
Charter/Tour	260	108	149
Scheduled Service	508	41	460
Commuter	156	21	131
Shuttle	46	18	28
Total Uninjured	970	188	768

more fatalities and nonfatal injuries than urban charter/tour bus accidents, a pattern that is exactly the reverse for accidents involving buses in any other type of service or use. In fact, rural accidents involving charter/tour buses resulted in almost twice the number of nonfatal injuries as the same type of urban accidents.

A.2.2.2. Bus Occupants. Overall, bus occupants accounted for a small percentage (15%) of the total number of fatalities in fatal accidents involving large buses (Table A.4). However, a greater number of bus occupants were fatally injured in rural accidents than in urban

Table A.4: Bus Occupant Fatalities and Nonfatal Injuries
in Fatal Accidents Involving Large Buses, 2000-2006

	Total	Rural	Urban
Fatalities			
Charter/Tour	93	73	20
Scheduled Service	14	6	8
Commuter	9	7	2
Shuttle	52	8	34
Total	168	94	64
Nonfatal Injuries			
Charter/Tour	1230	832	389
Scheduled Service	763	187	571
Commuter	149	55	94
Shuttle	198	68	130
Total	2340	1142	1184
Total Fatalities & Injuries	2508	1236	1248
Uninjured			
Charter/Tour	156	53	101
Scheduled Service	417	29	382
Commuter	129	16	112
Shuttle	32	10	22
Total Uninjured	734	108	617

accidents, with these fatalities accounting for almost a third of the total number of people killed in rural accidents. In contrast, bus occupants accounted for only 8% of the fatalities in urban accidents. The proportion of charter/tour bus occupants fatally injured in rural accidents (25%) represented a greater proportion of the total number of rural fatalities than did the corresponding proportion of urban charter/tour bus occupants fatally injured in urban accidents (2%).

Furthermore, bus occupants were more likely to be nonfatally than fatally injured in these accidents involving large buses (Table A.4). Bus occupants accounted for 88% of the nonfatal injuries in rural accidents, and 76% of the nonfatal injuries in urban accidents.

Rural accidents involving charter/tour buses accounted for the largest proportion of all rural nonfatal injuries (71%). In fact, almost all (90%) of the nonfatal injuries in these rural charter/tour bus accidents occurred on the bus. Furthermore, rural fatal accidents involving charter/tour buses accounted for only 10% of the total number of fatal accidents involving large buses, but resulted in 15% of the total fatalities and 32% of the total nonfatal injuries. In addition, passengers of buses involved in rural fatal accidents were less likely to escape injury than their urban counterparts; only 8% of bus occupants in rural accidents were reported uninjured, whereas 33% of bus occupants in urban areas were uninjured.

A.2.3 Injured Transported to Hospitals

The demands placed on EMS can be estimated by the number injured in the accident who were transported to a hospital. FARS provides hospital transport data for all injured, and indicates whether the injured person was an occupant of the bus. Almost 75% of all the people injured in fatal accidents involving large buses were transported to a hospital (Table A.5). This was the case for both rural and urban areas.

As might be expected, a greater proportion of the nonfatally injured were transported to a hospital (82%) than the fatally injured (50%). In rural areas, a much smaller proportion of the fatally injured (26%) were transported, perhaps reflecting the much greater severity of rural accidents and the greater emergency medical response times in rural areas.

For all accidents, a large proportion of the injured who were transported to a hospital (66%) were bus occupants (Table A.6). In rural fatal accidents involving large buses, most of the transported injured were bus occupants (84%). In urban accidents, a much smaller proportion of the transported injured were bus occupants (54%).

When only rural accidents involving charter/tour buses were considered, bus occupants accounted for almost all (88%) of the accident victims transported to a hospital. Almost all (98%) of these bus occupant transports had suffered nonfatal injuries.

Table A.5: Injured Transported to Hospital, 2000-2006

	Total	Rural	Urban
Fatalities Transported			
Charter/Tour	98	44	53
Scheduled Service	363	18	340
Commuter	93	7	85
Shuttle	25	7	18
Total	579	76	496
Nonfatal Injuries Transported			
Charter/Tour	1204	799	399
Scheduled Service	802	164	632
Commuter	173	58	114
Shuttle	190	73	117
Total	2369	1094	1262
Total Transported	2948	1170	1758

Table A.6: Injured Bus Occupants Transported to Hospital, 2000-2006

	Total	Rural	Urban
Fatalities Transported			
Charter/Tour	15	11	4
Scheduled Service	8	2	6
Commuter	2	0	2
Shuttle	8	4	4
Total	33	17	16
Nonfatal Injuries Transported			
Charter/Tour	1065	729	333
Scheduled Service	550	124	425
Commuter	125	47	78
Shuttle	159	62	97
Total	1899	962	933
Total Transported	1932	979	949

A.3 SUMMARY

Rural fatal accidents involving large buses are primarily comprised of motorcoaches being used as a charter or in a tour. Overall, rural fatal accidents involving charter/tour buses accounted for only 10% of the total number of fatal accidents involving large buses, but resulted in 15% of the total fatalities and 32% of the total nonfatal injuries. Charter/tour buses were involved in more than half (53%) of the fatal rural accidents, with the remaining bus accidents divided among scheduled service (26%), commuter service (12%), and shuttle bus service (9%). This result is in contrast to urban accidents that are dominated by transit/city buses in scheduled service.

Rural fatal accidents involving charter/tour buses accounted for more than half of the rural fatalities and almost three quarters of the rural nonfatal injuries, with almost all of the nonfatal injuries suffered by the occupants of the bus. The number of charter/tour bus occupants fatally injured in rural accidents was also proportionally higher (25% of rural large bus accident fatalities) than the charter/tour bus occupants fatally injured in urban accidents (2% of urban large bus accident fatalities). It is also interesting to note that passengers of buses involved in rural fatal accidents were less likely to escape injury than their urban counterparts.

The number of persons transported to hospitals was used as an estimate of the demands placed on rural emergency response. The data showed that in rural accidents involving large buses, most of the people transported to hospitals were bus occupants. When only those accidents involving charter/tour buses were considered, almost all of the transported accident victims were bus occupants.

A.4 DATA LIMITATIONS AND CONSTRAINTS

A.4.1 Accidents in FARS

As previously discussed, FARS includes only those accidents where at least one fatality occurred. FARS is a census of all fatal crashes within the United States, District of Columbia, and Puerto Rico, and a candidate crash is included in FARS if it involved a motor vehicle traveling on a public roadway and the death of a vehicle occupant or nonmotorist occurred within 30 days of the accident. Consequently, crashes that result only in nonfatal injuries or property damage are not included in FARS data.

This characteristic of FARS is an important limitation in this Data Report because the full extent of the risk of injury during rural travel cannot be determined using only FARS data. In fact, fatal accidents account for a very small proportion of the total number of highway accidents in any given year. For example, fatal accidents accounted for less than 1% of the total number of accidents in 2005. Although fatal accidents can be viewed as the worst case scenario where the severity of the crash is sufficient to produce fatal injuries, they may not adequately characterize the kinds of accidents where nonfatal, but severe, injuries can occur. An accurate estimate of these types of accidents would be needed to adequately assess many of the risks of rural road travel (for example, the demands placed on emergency medical response and services).

In addition, fatal rural accidents involving large buses represent a small proportion of all fatal rural accidents. Given the fact that almost 60% of all fatal accidents occur on rural roads, the magnitude of rural road travel risk may be substantially higher than shown in this report.

A.4.2 Charter/Tour Bus Activity in Rural Areas

The calculation of accident rates to characterize accident risk is dependent upon accurate measures of activity. Measures of activity, such as vehicle miles traveled or passenger populations, are used as the basis for exposure measures to risk. These measures of exposure are used by federal and state highway agencies in safety programs to calculate accident rates, and to evaluate accident risk and help pinpoint areas of high risk on highways.

Accident rates are missing from this Data Report because accurate estimates of large bus activity are not readily available or reported. This is especially true for charter/tour bus operations in rural areas where travel patterns, travel characteristics, driver and passenger demographics, and seasonal variations are unknown. For example, the charter bus involved in the Mexican Hat accident was one of 17 buses traveling between a population center and a recreational area. Whether this was a rare, single trip or a regularly occurring trip is unknown, and the frequency with which the route is taken by such buses cannot be easily determined.

There are industry estimates of the number of passengers carried by buses, but these estimates are typically aggregated and contain insufficient detail to support the kinds of analyses found in this report. Furthermore, the source estimates and the validity of the methods used to obtain the data underlying the estimates cannot be adequately determined. This is especially problematic for assessing the risks of rural road travel, because there does not appear to be any data collected on large bus travel in rural areas, especially in those areas where accident notification and emergency response might be an issue.

A.5 FARS Codes, Definitions, and Selection Criteria

FARS has documented fatal highway crashes since 1975, and provides data for each crash in terms of accident event characteristics, the people and vehicles involved, and the extent and type of injuries suffered by vehicle occupants and nonmotorists. Data in FARS are drawn from state police accident reports, and verified by a FARS analysts.

The FARS database is organized into three principle files: Accident, Vehicle, and Person. Each of these files contains variables that code the characteristics of a fatal crash (called a *case*). In this analysis all three files were used. The variables from each of these files that were used in this Data Report and their respective codes and definitions are shown in Table A.7.

Note that only those accidents meeting the specific criteria shown in Table A.7 were included. Almost all the variables in the table have an “unknown” code; consequently in any analysis where an unknown was possible in a critical variable, the case was excluded from the analysis. For example, in 31 of the 954 fatal accidents, Roadway Function Class was coded as

Table A.7: FARS Variables, Codes, and Code Definitions Used in the Data Report

Variable	FARS Variable Name	FARS Codes Used In Analysis & Definitions
Accident File		
Year	YEAR	2000-2006
Fatalities	FATAL	Count of total fatalities in an accident
Roadway Function Class (using FHWA classification guidelines)	ROAD_FNC	01 - Rural Principal Arterial - Interstate 02 - Rural Principal Arterial - Other 03 - Rural Minor Arterial 04 - Rural Major Collector 05 - Rural Minor Collector 06 - Rural Local Road or Street 09 - Rural Unknown 11 - Urban Principal Arterial - Interstate 12 - Urban Principal Arterial - Other Freeways or Expressways 13 - Urban Principal Arterial 14 - Urban Minor Arterial 15 - Urban Collector 16 - Urban Local Road or Street 19 - Urban Unknown
Vehicle File		
Way in Which Bus Is Being Used in Transport	BUS_USE	4 - Used as a Scheduled Service Bus 5 - Used as a Tour Bus 6 - Used as a Commuter Bus 7 - Used as a Shuttle Bus
Type of Bus Body	BODY_TYP	51 - Cross-Country/Intercity Bus (i.e., Greyhound) 52 - Transit Bus (city Bus) 58 - Other Bus Type 59 - Unknown Bus Type
Gross Vehicle Weight Rating (GVWR) is the maximum allowable total weight of the bus, including the weight of the vehicle plus fuel, passengers, and cargo	GVWR	2 - 10,000 lbs-26,000 lbs 3 - 26,000 lbs or more
Configuration of the Vehicle	V_CONFIG	21 - Bus (seats for more than 15 people, including driver)

Variable	FARS Variable Name	FARS Codes Used In Analysis & Definitions
Person File		
Body Type of the Vehicle Occupied by Injured and Uninjured Persons		Following codes used to determine if person was a bus occupant: 51 - Cross-Country/Intercity Bus (i.e., Greyhound) 52 - Transit Bus (city Bus) 58 - Other Bus Type 59 - Unknown Bus Type
Severity of Injuries	INJ_SEV	0 - No Injury (O) 1 - Possible Injury (C) 2 - Nonincapacitating Evident Injury (B) 3 - Incapacity Injury (A) 4 - Fatal Injury (K) 5 - Injured, Severity Unknown
Person's Type in Accident	PER_TYP	01 - Driver 02 - Passenger of a Motor Vehicle in Transport 03 - Occupant of a Motor Vehicle Not in Transport 04 - Occupant of a Non-Motor Vehicle Transport Device 05 - Pedestrian 06 - Bicyclist 07 - Other Cyclist 08 - Other Pedestrian (includes Persons on Personal Conveyances) 09 - Unknown Occupant Type in a Motor Vehicle in Transport 19 - Unknown Type of Nonmotorist
Transported to Hospital	HOSPITAL	For years 2001-2006: 0 - No 1 – Yes For year 2000: 0 - No 1 - Yes 7 - Died at the Scene 8 - Died En Route

"unknown." As a result, these 31 accident cases were excluded from any analysis that compared rural to urban accidents.

The basic steps used to select specific accidents, types of buses, and bus occupants, and rural or urban accidents are described below.

Step 1: Select the period of time for the accidents. As previously discussed, calendar years 2000 – 2006 were chosen for this analysis because one of the important variables, Bus Use, was not universally coded before 2000. Before 2000, finding accidents involving buses that were being used in a tour or charter would have been difficult.

Step 2: Select fatal accidents involving large buses. In this step of the analysis, accidents involving large buses being used in scheduled service, commuter service, or as a charter/tour or shuttle bus were selected. Consequently, the selected accidents had to meet the following criteria:

a. A vehicle with a bus body type had to be involved in the accident. Accidents with a FARS Body Type code of 51, 52, 58, or 59 were selected. These codes excluded school bus body types.

b. The bus was being used in scheduled or commuter service, or as a charter/tour or shuttle bus. The set of accidents involving buses was further limited to those that met FARS BUS_USE code equal to 4, 5, 6 or 7. These codes excluded any type of bus being used as a school bus.

c. All buses had a Gross Vehicle Weight Rating (GVWR) greater than 10,000 lb. The set of accidents involving large buses being used in scheduled or commuter service, or as a charter/tour or shuttle bus was further restricted to those with a FARS GVWR code of 2 or 3.

d. Finally, all the buses were required to be configured to hold more than 15 passengers. This required that all the fatal accidents in the final set be equal to FARS V_CONFIG code 21.

These criteria excluded all school buses, any type of bus being used as a school bus, and small passengers vans configured to carry 15 passengers or less.

Step 3: Identify different types of buses. In the analysis, buses were characterized as motorcoaches, transit/city buses, and large buses with a GVWR between 10,000 lb and 26,000 lb. These distinctions allowed comparisons among buses of different types that may be used in a similar way. For example, there are motorcoaches and smaller truck cab-chassis based buses that are being used for tours and charters. This is also the case for buses used in shuttle service. In addition, transit/city buses are specifically designed for use in urban areas requiring slow speeds, frequent stops, and to accommodate both seated and standing passengers.

a. Transit/City buses that were in the final set of fatal accidents derived from Steps 1 and 2 were identified by the FARS BODY_TYP code 52 (Transit/City Bus).

b. Large buses with a GVWR between 10,000 lb and 26,000 lb were identified by the FARS GVWR code 2.

Motorcoaches required multiple criteria. As previously discussed, there is no FARS definition of a motorcoach, or a motorcoach definition in NHTSA regulations. In practice, a number of definitions have been used. In this Data Report, a motorcoach was defined in this analysis as any large bus with a GVWR greater than 26,000 lb and configured to carry more than 15 passengers that was being used as a charter/tour bus, in scheduled service, in commuter service, or as a shuttle bus. This definition would include the cross/country intercity bus type used in previous NHTSA and industry analyses, and any other types of buses that were being used in a motorcoach way. Given that all large buses in the set of fatal accidents met the FARS V_CONFIG code equal to 21 (seats for more than 15 people, including driver), the following criteria were used in this report to characterize motorcoaches.

a. All buses that met FARS BODY_TYP code 51 (Cross-Country/Intercity Bus).

b. All buses with a FARS BODY_TYP code of 58 or 59 that met FARS BUS_USE code 4, 5, 6 or 7, and FARS GVWR code 3.

Step 4: Identify bus occupants. The analysis required evaluating bus occupant injuries and transport to hospital of bus occupants. Injured transported to a hospital were identified by using FARS INJ_SEV codes 1, 2, 3, 4 or 5 and FARS HOSPITAL code 1 (1, 7 or 8 for year 2000).

Bus occupants can be identified by using the FARS BODY_TYP variable in the Person File to determine the type of vehicle in which the person was an occupant. Bus occupants were identified by using the Person File FARS Body_TYP codes of 51, 52, 58 or 59.

Step 5: Identify rural or urban accident. Many of the analyses in this report compared rural and urban accidents. Selecting rural and urban accidents involving large buses was based on FHWA’s Roadway Function Classification system, a method typically used in the analysis of highway accident data to characterize rural or urban accidents. In this report, rural and urban accidents involving large buses were identified using FARS ROAD_FNC codes 1 through 9 for rural accidents, and codes 11 through 19 for urban accidents.