

Strategic Plan for Highway Incident Management in Tennessee

Prepared for:

Tennessee Department of Safety
Tennessee Department of Transportation
Tennessee Department of Commerce & Insurance
Tennessee Emergency Management Agency

and

Other Public and Private Organizations
with Responsibilities for
Highway Incident Management

August 2003

Coordinated by:

Office of Incident Management
Tennessee Department of Transportation
Transportation Management Center
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Box 1831, Station B
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Nashville, Tennessee 37235

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INTRODUCTION

The *Strategic Plan for Highway Incident Management in Tennessee* establishes the framework for a systematic, statewide, multi-agency effort to improve the management of highway incidents—crashes, disabled and abandoned vehicles, debris in the roadway, work zones, adverse weather, and other events and emergencies that impact the transportation system. The plan is a joint effort by governmental and private organizations that have responsibilities for highway incident management and public safety. The plan is part of the foundation for ongoing planning and coordination.

Highway incidents have a significant impact on the capacity and safety of the state's transportation system and lead to costly travel delays, secondary crashes, hazards for involved motorists and incident responders, air pollution, and wasted fuel. These adverse consequences are examined in more detail later in the report, but the following information highlights the national importance of highway incident management:

- Traffic congestion is widely recognized as a serious and growing problem, but the direct link between congestion and highway incidents is sometimes overlooked—**more than 50 percent of urban traffic congestion is caused by non-recurring incidents rather than inadequate capacity. In rural areas, virtually 100 percent of traffic congestion is caused by incidents.**¹
- “Secondary crashes,” following incidents that have not been cleared, cause additional property damage, injuries, and fatalities. Determining the frequency of secondary crashes on a specific roadway is difficult, but a frequently used national estimate is that **approximately 20% of all freeway crashes are secondary.**² A California study found that **each time an accident occurs the potential for another accident increases by at least 600%.**³
- Virtually every highway user has first hand experience with incidents—traffic backed up for miles without explanation, trucks struggling up long grades, cars on the shoulders overheated or out of gas, motorists switching lanes and driving on the shoulders or medians to escape the backup, and bumper-to-bumper, stop-and-go traffic that adds more harmful emissions to the air. Sometimes, the problem is a disabled vehicle, a rear-end collision, a ladder in the roadway, or some other minor incident. Other times, the incident involves serious injuries, overturned vehicles, or hazardous materials. Still other times, the backup is caused by highway construction or repair. **Regardless of the cause, time is wasted, appointments are missed, productivity is lost, and travelers experience frustration, anger, and road rage.**

From the traveler's perspective, the situation is made worse by slow or inadequate measures to “manage” the incident. The responsibilities for incident management are shared among a multitude of organizations with different, and sometimes conflicting, priorities. The central themes of the recommended plan and the ongoing planning process are to make “quick clearance” a shared priority for all incident responders, promote safety for motorists and incident responders, and reduce the direct and indirect costs of highway incidents.

Organization of the Report

The report is divided into six chapters:

- Chapter 1 provides definitions, a generic list of stakeholders, and an overview of the major components of highway incident management.
- Chapter 2 examines the importance of highway incident management for Tennessee in more detail by describing the large number of stakeholders, the frequency and severity of incidents, and the problems caused by incidents.
- Chapter 3 highlights recent accomplishments and progress made toward more effective highway incident management.
- Chapter 4 describes the ongoing process for planning and coordination and the steps that were followed to develop the strategic plan.
- Chapter 5 presents the recommended strategic plan, with 10 major goals and more than 150 action tasks.
- The final chapter, Chapter 6, offers suggestions for implementation of the recommended plan and discusses costs and possible funding sources.

CHAPTER 1

COMPONENTS OF HIGHWAY INCIDENT MANAGEMENT

What do we mean by “highway incidents”? What “incidents” need to be “managed”? The definition used in this report for “highway incident” is *any non-recurring event or circumstance that disrupts the normal flow of traffic or threatens the safety of motorists, residents, or businesses in the vicinity of the highway.*

Examples of such events or circumstances include all of the following:

- Motor vehicle crashes (including minor “fender benders” as well as multi-vehicle collisions involving fatalities, injuries, extensive property damage, or hazardous materials)
- Disabled or abandoned vehicles
- Debris on or near the roadway
- Work zones for construction, maintenance, utility, or emergency repair work
- Special events that generate high traffic volumes or unusual movements
- Adverse weather conditions
- Other non-recurring conditions, such as law enforcement activity, smoke from a nearby fire, pedestrians near the roadway, stray animals, vandalism, flooding, and acts of terrorism directed against the highway infrastructure or highway users or that create exceptional transportation demands

As every motorist knows, any of the situations listed above can quickly lead to traffic backups, long delays, secondary crashes, and a host of other problems, all exasperated by rubbernecking and unsafe driving.

Stakeholders

Highway incident management involves a large group of agencies and disciplines, including all of the following:

- | | |
|-------------------------------------|--|
| • Law enforcement | • Highway and public works agencies |
| • Fire services | • Utility companies |
| • Emergency communication services | • Highway contractors |
| • Emergency medical services | • Transportation planning organizations |
| • Hospitals and trauma centers | • Traffic engineers |
| • Rescue squads | • Highway neighbors |
| • Towing and recovery operators | • Motorists/truckers |
| • Transportation management centers | • Trucking companies, shippers, insurance companies, and other businesses that serve or depend on highway transportation |
| • Hazardous material responders | |
| • Traffic reporters | |

All of these stakeholders have different perspectives and priorities and all have important roles to play in highway incident management. Coordination among all of the stakeholders is one of the primary challenges for strategic planning and for improvement of day-to-day incident management.

Components of Highway Incident Management

Incident management includes all of the activities undertaken to assist involved motorists, protect public health and safety, conduct necessary investigations, minimize travel disruptions and delays, remove the damaged vehicles or cargo, and restore the roadway to normal conditions. Effective incident management also requires planning, preparation, and measures to educate and inform motorists prior to and during incidents.

Each incident and each scene is different, but certain steps or phases are common to the management of most highway incidents. Improvements in highway incident management must recognize these steps and their interrelationships. For this report, the steps involved in highway incident management are categorized as follows:

- Detection
- Verification
- Notification and response
- Motorist information
- Emergency action
- Scene management and traffic control
- Investigation
- Scene clearance
- Traffic resumption

These are illustrated in Exhibit 1 and described below.

Detection

The necessary first step in incident management is detection, the process by which one of the responsible agencies in the network of incident responders is made aware that a problem exists. In the best situations, the incident is detected almost as soon as it occurs, but that is not always the case. Within a few years incidents will be detected automatically on Tennessee's highest volume urban freeways through the use of sensors, computers, and other technologies.

In the meantime, and for a much longer time on the outlying and rural highways, the system will have to depend on information from persons at the scene. Information may enter the system from phone calls to the 911 center or other public safety answering points (e.g., *THP), observation by a public safety officer, HELP operator, or other fleet operator with two-way communication, relay of information heard on a citizens band radio, or other indirect sources. Regardless, responses cannot begin until the incident has been detected.

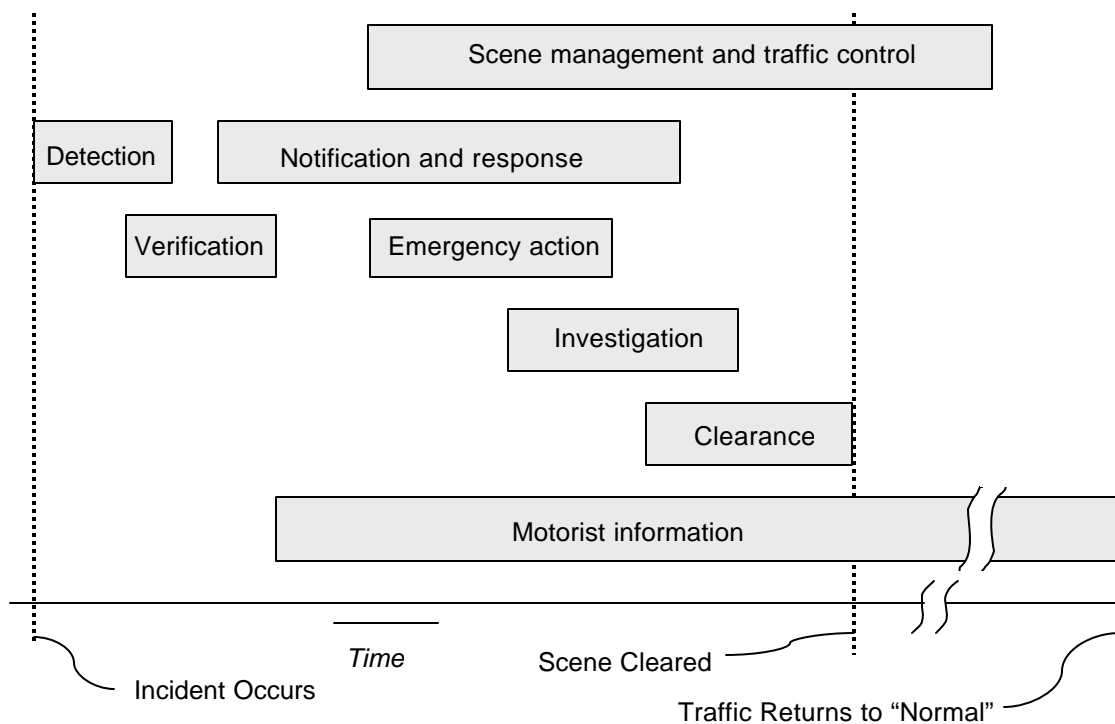


Exhibit 1: Critical Components of Effective Highway Incident Management

Verification

Verification includes all of the actions taken to confirm the exact location of the incident and to gather as much information as possible about the characteristics of the incident and the incident scene. The goal is to ensure that all responders have the information they need to mobilize and dispatch the proper equipment in a timely manner. Verification begins as soon as possible after incident detection and usually continues at least until the first responders reach the scene. Verification can be accomplished by combining information from multiple phone calls, viewing the scene or the vicinity with a closed circuit television (CCTV) camera, or by aerial surveillance. The verification process is usually complete after the first responders reach the scene, but not always. The presence of hazardous materials or unknown substances may extend the time required for complete verification, and, of course, circumstances can change before the incident is brought under control.

Notification and response

Once the incident is detected, and often before verification is complete, the notification and response process begins—activating the communication links among responsible agencies, receiving notification that a response is needed, dispatching, mobilizing equipment and personnel, selecting access routes, and moving to the scene. Timely notification and orderly response are critical for incident management, recognizing that the verification process may still be underway and that the responses may have to be modified mid-process. Notification

and response may involve just one or two agencies to handle a simple problem or a large number of agencies from multiple jurisdictions to manage a more complex situation. The coordination challenges begin as soon as the first responders begin moving to the incident scene.

Motorist information

The motorist information phase includes gathering and analyzing information about the incident, the incident scene, and possible alternate routes and then disseminating that information to motorists in a timely manner. By using all available outlets (e.g., commercial radio and TV, Web pages, changeable message signs, highway advisory radio), the adverse system-wide impacts on travel and safety can be minimized along with the traffic problems at the immediate scene. The motorist information process should begin as soon as the incident has been verified, and the process of gathering, analyzing, and disseminating reliable, real time information should continue until traffic has returned to normal flow, which is often long after the scene has been cleared.

Emergency action

At some incident scenes, emergency action is necessary, and must begin as soon as the first responders reach the scene. Examples include fire fighting, emergency medical treatment, extrication, evacuation, containment of hazardous materials, removal of explosive materials, apprehension of dangerous persons, and any other activities needed to assist injured parties or to eliminate threats to public health or safety. Emergency action must receive priority, but other steps can usually proceed in parallel.

Scene management and traffic control

Ensuring the safety of responders and others at the incident scene is the first step in what is often the most challenging phase of incident management—scene management and traffic control. This involves accurately assessing the situation, establishing priorities, ensuring proper coordination and communication among responders, and allocating resources. Tasks to be accomplished include staging, positioning and re-positioning of people and equipment, scheduling activities, directing traffic around or through the scene, and managing traffic throughout the impacted corridor. In many cases, the most dangerous locations may be many miles away from the incident scene—at the back of the traffic queue. Coordination among agencies and unified command are essential, and traffic control must be in accordance with applicable rules and regulations.

Investigation

Investigation encompasses all of the activities and tasks that must be performed at the incident scene (e.g., measuring and recording distances, taking pictures) to help determine the cause of the incident and to serve as a basis for subsequent legal actions or financial settlements. Law enforcement investigations are not always needed, and, when needed, the extent may vary from simple observation and recording of the relative positions of vehicles to extensive

collection of information for criminal prosecution. In the best situations, investigators have clear guidelines for the level of investigative detail needed for each type of incident. Ideally, the investigators also have the technology and training to gather data with minimum impact on traffic. Most other responders also record information about their respective actions, but usually do not need to gather as much information as law enforcement officers.

Scene clearance

Clearance involves the removal of damaged vehicles, spilled cargo, debris, hazardous materials, and any other obstructions to the normal flow of traffic. In some cases, damaged signs, light poles, or other roadway infrastructure may also have to be removed from the scene or temporarily repaired. This stage of the incident management process also involves removal of traffic cones, signs, and other temporary traffic control devices used for scene management, the departure of emergency vehicles, and other “demobilization” activities. The hazards for incident responders increase as traffic speeds begin to increase and the presence of emergency vehicles and workers becomes less apparent.

Traffic resumption

After the scene is completely clear and the responders have moved on, traffic begins to flow past the site at a more normal rate, and the traffic backup slowly begins to dissipate. However, hours may pass before the queue has fully dissipated and complete recovery is achieved. Providing accurate information to motorists should continue until traffic has returned to normal, and during part of the recovery period traffic control may be needed at locations far distant from the original scene. The factors that help determine the recovery time include the time of day, roadway capacity and grades, and effectiveness of the motorist information phase of incident management, but the single most important factor is the duration of the incident, especially the time that lanes were partially or completely blocked.

Reducing the Time Required for Each Step

Under most conditions, blocking a roadway for even a few minutes will cause long term disruptions in traffic flow. Even a vehicle on the shoulder causes traffic flow problems, not to mention the implications for highway safety. The goal of effective incident management is for each step in Exhibit 1 to begin as soon as possible and then be completed as soon as possible—with as many steps as possible carried out in parallel rather than in sequence. A widely used rule of thumb is: for every minute a lane of traffic is blocked, recovery to normal traffic flow will require an additional four to five minutes.⁴ Of course, safety is always an overriding priority, but quick clearance can be accomplished without compromising safety.

Broader Context

To describe the broader context for highway incident management, two other exhibits are offered. Exhibit 2, from the Wisconsin TIME (Traffic Incident Management Enhancement) program, is another way of depicting the steps in incident management. This version recognizes two additional, very important components for effective incident management.

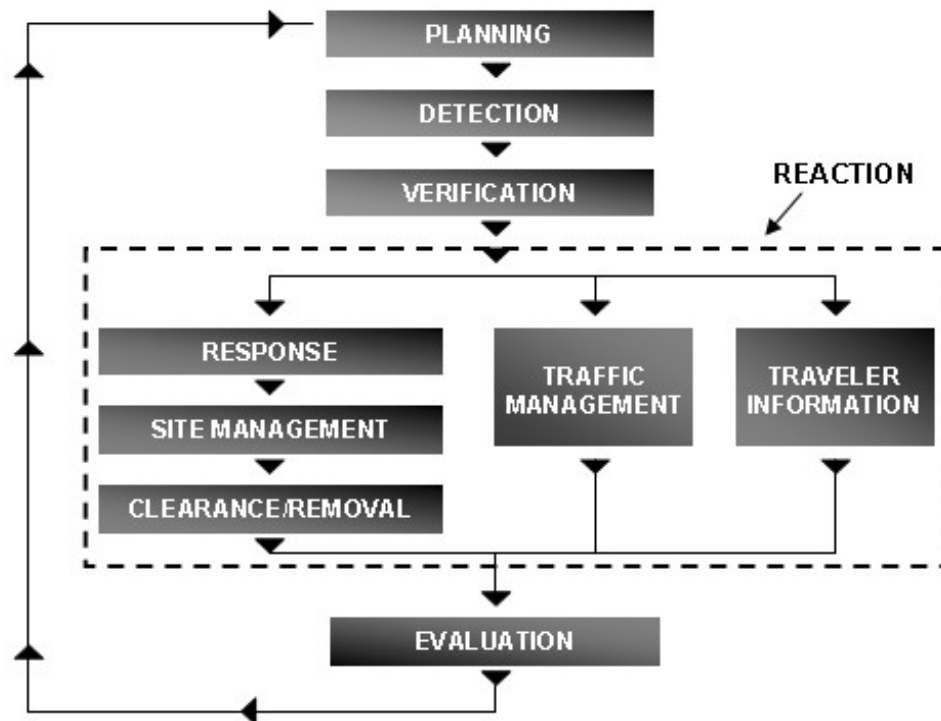


Exhibit 2: Depiction of Highway Incident Management from the Wisconsin TIME Program⁵

The first additional component, *planning*, must be accomplished long before “detection” occurs. Careful planning is necessary to prepare for events that may occur anywhere on the highway system (e.g., crashes, disabled vehicles, debris in the roadway, localized flooding, emergency work zones) as well as for events that are more predictable or have system-wide implications (e.g., a large sporting or entertainment event, a long-term construction work zone, or snow and ice).

The second important recognition is that *evaluation and feedback* are needed for effective incident management. Incident responders are very aware that “every incident is different.” Rules and clear directions cannot be established in advance of every situation, so continuous learning and adaptation is required. Debriefings, case studies, performance reports, and other forms of evaluation and feedback are essential learning tools for individual agencies and for the collective efforts of all the incident responders. The experience gained at each major incident should be an integral part of planning and preparation for the next incident.

Exhibit 3 illustrates some of the links between highway incident management and other important programs and services provided by state and local governments. Many of these other programs and services are more comprehensive and far reaching than highway incident management, but the interrelationships are nonetheless significant. Many of the goals are the same for highway incident management as for the other illustrated programs and services. Success in one program will facilitate success in another.

Resources committed to highway incident management should prove useful to other programs and services. Vehicles and equipment to help manage routine highway incidents should also be useful during other emergencies. Likewise, investments to improve the interoperability of communication systems for emergency management and homeland security will have day-to-day benefits for highway incident management.



Exhibit 3: Links Between Highway Incident Management and Other Programs and Services

Planning and preparation for any one of the identified programs/services will help with planning and preparation for the others. Many of the tools and techniques for planning and coordination are interchangeable, and the needed data is virtually the same. For example, planning for all of these programs/services requires information about the base location, capacity, and demands on the transportation infrastructure and the availability of transportation services. Similarly, having accurate and readily available information about the location of incident responders and their respective capabilities and resources is valuable for highway incident management, all-hazards emergency management, homeland security, and other programs/services illustrated below.

Finally, many of the stakeholders are the same. Effective highway incident management requires coordination among transportation and emergency management organizations, law enforcement agencies, fire and emergency medical services, highway contractors, trucking companies, metropolitan transportation planning organizations, and other federal, state, and local agencies. All of those same organizations, and many of the people in those organizations who work on highway incident management, also work together as part of the other important programs and services shown in Exhibit 3.

CHAPTER 2

IMPORTANCE OF HIGHWAY INCIDENT MANAGEMENT FOR TENNESSEE

This chapter addresses the importance of highway incident management for Tennessee in more detail, beginning with an inventory of the organizations that share responsibilities for incident management and some indicators of the frequency and severity of incidents. The chapter ends with data and examples to better describe the adverse consequences of highway incidents.

Tennessee Incident Responders

Responsibilities for highway incident management in Tennessee are shared by a large number of state, local, and private organizations. The state agencies include all of the following:

- Department of Safety (including the Tennessee Highway Patrol, Commercial Vehicle Enforcement, and the Tennessee Law Enforcement Training Academy)
- Department of Transportation (including HELP, the Nashville Transportation Management Center, Headquarters, Region, District, and County offices)
- Tennessee Emergency Management Agency
- Department of Commerce and Insurance (including Division of Fire Protection, Tennessee Fire and Codes Training Academy, and the Tennessee Emergency Communications Board)
- Department of Health (including the Emergency Medical Services Division)
- Office of Homeland Security
- Department of Finance and Administration (including the Office of Criminal Justice Programs)

The local and private sector resources include all of the following:⁶

- More than 350 police and sheriffs departments
- Approximately 650 fire services organizations, some with paid firefighters, some entirely volunteer, and some with a combination of paid and volunteer firefighters
- More than 100 emergency ambulance services with a total of approximately 1,000 ambulances and more than a dozen helicopters used for medical emergencies
- Thirteen designated trauma centers, including six “level one” centers (in Chattanooga, Kingsport, Knoxville, Johnson City, Memphis, and Nashville) and 89 hospitals with licensed heliports

- More than 110 local rescue squads, virtually all volunteer
- Approximately 1,570 towing and recovery vehicles on the approved call list for the Department of Safety (plus an undetermined number of other towing and recovery vehicles that are approved or licensed by local governments)
- More than 100 city and county emergency management agencies
- More than 200 city and county highway and public works agencies
- Eleven metropolitan transportation planning organizations (MPOs)

Finally, state and local agencies in the eight adjacent states are important partners for management of incidents that impact traffic on both sides of the respective state lines. Most of the state and local agencies that respond to incidents in Tennessee have counterparts in Georgia, Alabama, Mississippi, Arkansas, Missouri, Kentucky, Virginia, and North Carolina.

Frequency and Severity of Incidents

One of the recommendations presented in Chapter 5 is to establish an integrated information system to keep track of the incidents that occur on Tennessee highways and to measure the time and resources required to manage those incidents. Currently, agencies record information about their own activities, but no comprehensive picture is available to measure the overall frequency or severity of incidents. However, the following information provides a general indication:

- Law enforcement and other public safety and emergency services organizations in Tennessee respond to more than 170,000 motor vehicle crashes each year, an average of more than 460 crashes every day. Approximately 140 of those daily crashes involve personal injuries. Three of those daily crashes involve a fatality.⁷
- A truck overturns on a major highway in Tennessee almost every day. On some days, multiple rollovers occur. Frequently, the cargo spills and fuel leaks onto the roadway.⁸
- A review of records from the Tennessee Emergency Management Agency (TEMA) Operations Center for the first nine months of 2002 identified 260 reported incidents that occurred on or near a federal or state highway. Of the total, more than 100 involved spilled fuel, oil, or a hazardous material. More than 130 of the 260 entailed closure of at least one lane of travel. Almost 100 of the incidents led to complete closure of at least one direction of travel for periods of up to 16 hours.⁹
- TDOT estimates that their field maintenance forces were “called out” at night and on weekends more than 950 times in 2002, not including ice and snow events, to deal with problems such as rock slides, settlements, local flooding, downed signs, and other situations that impede traffic or endanger public safety, or to help with traffic control and cleanup following major crashes.¹⁰
- On an average day in 2002 the HELP operators in the four cities removed debris from the roadway more than 20 times, changed more than 30 flat tires, refueled more than 20

vehicles, and helped motorists with mechanical problems almost 40 times. They moved damaged or disabled vehicles from travel lanes 15 times each day, and they “tagged” more than 40 abandoned vehicles. They also jump-started 9 vehicles, transported 5 stranded motorists to the nearest exit, and helped secure the loads on 3 vehicles. In an average week, they performed first aid 11 times, put absorbent on spilled fuel or oil at 11 locations, and extinguished 3 vehicle fires.

- Each summer in Tennessee, an average of more than 1,100 miles of state and federal highways have to be resurfaced to maintain a 12-year rehabilitation cycle. During the winter months, ice and snow conditions affect travel throughout the state. Other times, heavy rain, fog, and high winds cause problems that snarl traffic.
- Several dozen times each year travel demands increase dramatically at specific locations because of sporting events, concerts, celebrations, and other special events.

In addition, other especially challenging events can be expected on a seemingly random basis. Several times each year, for example, cattle or other livestock will run loose following a freeway incident. More often, a stray dog will disrupt traffic or cause a secondary crash.

At least monthly, an escaped prisoner, car chase, or attempted suicide will cause law enforcement officers to block lanes or close an entire roadway. A disoriented motorist will drive in the wrong direction on a ramp or travel lane. Vandals will throw rocks at passing motorists. Angry motorists or truckers will purposely slow traffic. A vehicle with an oversized load will get stuck under an overhead structure. An unknown but suspicious substance will be found on the side of the road. A barge will strike a bridge pier. Or some other safety or security concern will require that highway traffic be halted until the concern can be resolved. Other law enforcement activities near the roadway, nearby fires, and other visible distractions will also disrupt normal traffic.

Problems Caused by Highway Incidents

Highway incidents cause a multitude of problems—for travelers directly involved in the incident and its aftermath, for the transportation system, and for the affected businesses. Ultimately, highway incidents hurt Tennessee’s economy, environment, and quality of life.

From a highway engineering perspective, incidents significantly reduce the effective capacity of the roadway. Even a minor incident has a disproportionate impact on capacity. For example, a crash that has been moved to the *shoulder* of a two-lane freeway reduces the capacity of the facility by almost 20%. As another example, if a stalled car blocks one lane of a three-lane freeway, the capacity is reduced, not by 33.3% as might be expected, but by 50%. Two blocked lanes on a three-lane section will reduce the capacity by more than 80%.¹¹

If the traffic demand (the number of vehicles trying to pass a given point in a given time period) exceeds the reduced capacity, a queue begins to form. As time passes, the queue grows longer and keeps growing until capacity is restored or traffic is diverted to another route. Once the scene is cleared, the queue begins to diminish but traffic flow may not return to normal for up to several hours, depending on roadway capacity and the traffic volumes.

These adverse effects on the transportation system are just precursors to the ultimate consequences (i.e., outcomes) that are so costly and that justify investment of more resources to improve highway incident management. The worst of these negative consequences can be described under three broad categories:

- **Economic costs of travel delays**
- **Safety for highway users and incident responders**
- **Air pollution and wasted fuel**

Data and examples are offered below to help describe these adverse consequences that could be mitigated by more effective highway incident management.

Economic Costs of Travel Delays

Every incident is different, and the extent of the economic impact of a particular incident depends on many variables. Each person in each vehicle and each package in each truckload are affected differently, depending on the duration of the incident, trip purposes, time of day, availability of alternate routes, and ability to adapt to the change in travel time. To illustrate, consider all of the vehicles in the traffic jams shown in the pictures below (Exhibits 4 and 5).

For some of the trapped motorists, their travel delay is little more than an annoying inconvenience. Others may be able to adjust their schedules or find an alternate route at the next interchange. For many others, however, appointments are missed, productive time is wasted, and opportunities are lost. Business and personal schedules are disrupted, and the direct or indirect costs may be substantial.

For truckers and trucking companies and for businesses that need the critical packages or material on those trucks, time is money. The same applies for workers and companies in service industries and for the households and businesses that need those services. Farmers and grocery stores may suffer when food products are delayed or spoil during transport. For intermodal and package express shipments, the time lost on the highway may cause a missed connection at the next hub or terminal. Other businesses and industries and their customers may suffer for similar reasons.



Exhibit 4: Rural Delays

In spite of all these variables, the economic costs of highway incidents can be estimated using simplified assumptions about traffic conditions and the value of the time lost in congested traffic. The Texas Transportation Institute (TTI) has developed a methodology to estimate and track congestion, including the costs of congestion, in 75 urban areas in the United States, including Memphis and Nashville. The TTI methodology can be reviewed at this address: <http://mobility.tamu.edu/ums/study/methods/>.

TTI's 2002 *Urban Mobility Study* estimated that approximately 60% of the congestion (measured in person-hours of delay) in both Memphis and Nashville during the year 2000 was due to incidents, and 40% was due to recurring (usual) circumstances. **In Memphis, approximately 9,200,000 person-hours were lost because of incidents. Another 8,400,000 person-hours were lost due to incidents in Nashville.** To put this in perspective, the total lost hours for the two cities combined during 2000 is equivalent to the hours that could have been worked by approximately 8,800 people employed for a full year.



The TTI study also calculated an economic cost for those hours of delay, based on lost time for passenger vehicles and increased operating costs for commercial vehicles. Using the TTI methodology, **the costs of delays caused by highway incidents in Memphis during the year 2000 was more than \$149 million. The cost of delays caused by incidents in Nashville was approximately \$140 million, totaling to approximately \$289 million for the two cities for the year 2000.**¹² To put these costs in perspective, the entire annual budget for the HELP program in the four largest cities is approximately \$4.0 million.

Exhibit 5: Urban Delays

Although traffic volumes are lower outside the largest urban areas, incidents can still have significant economic costs. Rural incidents often take longer to clear and thus may impact as many travelers as an incident on an urban route. The urban routes serve more vehicles per hour, but more resources are available to accomplish quick clearance. Further, the longer delays on rural routes are more likely to use up the time “margin of safety” built into critical schedules by motorists, truckers, and businesses.

Safety for Highway Users and Incident Responders

Another reason to invest in more effective incident management is to improve safety—safety for all highway users, for drivers and passengers involved in incidents, and for incident responders.

Secondary Crashes

For all highway users, the probability of a “secondary” crash goes up immediately when an incident occurs, and the risks remain high until the incident is cleared. Often the secondary crash is more severe than the initial incident when, for instance, a vehicle operating at freeway speed suddenly encounters stopped or very slow moving traffic and strikes another vehicle. Even at slower speeds, a “rubbernecker” looking at a disabled vehicle on the shoulder can cause serious damage.

The frequency of secondary crashes is difficult to quantify because standard accident reporting systems do not capture the necessary information. As noted previously, research studies based on different data sets and assumptions have found that secondary crashes

account for as few as 13% and as many as 35% of all freeway crashes.¹³ No studies of secondary crashes in Tennessee could be found; however, 20% is frequently used as an approximate national average. TDOT and the Department of Safety believe that 20% is also a reasonable estimate for Tennessee—that approximately 20% of all freeway crashes in Tennessee are “secondary” to a previous incident.



Exhibit 6: Secondary Crash

Unintended Pedestrians

Every person involved in a freeway incident, even a minor incident such as a disabled vehicle or a fender-bender, is at risk. Freeways are not designed for pedestrians, and are not safe for pedestrians. The noise, wind, high-speed traffic, and general confusion can turn a minor problem into a life-threatening situation.

In 1995, the AAA Foundation for Traffic Safety examined three years of accident reports for pedestrian fatalities in Texas, Missouri, and North Carolina and found that 32% of the incidents involved “unintended pedestrians”—people pushing or working on a vehicle, involved in a previous crash, or walking or standing on the shoulder (not counting hitchhikers).¹⁴

For the three years from 1999-2001, 52 pedestrians were killed on Interstate highways in Tennessee. Based on the findings from the AAA study, approximately one-third of those fatalities involved people who did not intend to be pedestrians. A single incident on I-40 in Memphis in early 2003 resulted in three pedestrian fatalities.¹⁵ Clearly, the risks are high for people trying to fix problems with their cars, exchanging information after a minor crash, inspecting damage, waiting for help, or walking to the next interchange to get help.

Responder Safety

Freeway incidents are also hazardous for incident responders. The risks to responders begin while they are en route to the scene and continue while they work to care for victims, extinguish fires, control spills, conduct investigations, control traffic, and clear damaged vehicles and debris.

For the three-year period, 1999-2001, a total of 390 law enforcement officers were killed in the line of duty in the United States, not including the 72 officers who were killed on September 11, 2001. Of the 390 officers killed in the line of duty, 58% were killed in “accidents,” as defined in the FBI’s reporting system. Of those killed in accidents, more than 50% involved automobile accidents. Approximately 20% of the officers died after being accidentally struck by a vehicle.¹⁶

Focusing on Tennessee, approximately 2% of the U.S. population lives in Tennessee, and Tennessee has approximately 2% of all the U.S. sworn state and local law enforcement officers.¹⁷ However, during the three years from 1999-2001, Tennessee accounted for almost

9% of the sworn officers killed in automobile and motorcycle accidents and for more than 7% of the officers killed when struck by a vehicle.¹⁸

According to the National Institute for Occupational Safety and Health (NIOSH):

During the 5-year period between 1995 and 1999, 17 fire fighters were struck and killed by motorists. This represents an 89% increase in the number of line-of-duty deaths over the previous 5-year period . . . Under the Fire Fighter Fatality Investigation and Prevention Program, NIOSH investigated two separate incidents involving fire fighters who were struck and killed while providing emergency services along roadways during 1999 [NIOSH 1999, 2000]. These incidents and data demonstrate that hazards to the fire service are not limited to structural or wildland fires. Motorists accustomed to a clear, unobstructed roadway may not recognize and avoid closed lanes or emergency workers on or near the roadway. In some cases, conditions can reduce a motorist's ability to see and avoid fire fighters and apparatus. Some examples include weather, time of day, scene lighting (i.e., area lighting and optical warning devices), traffic speed and volume, and road configuration (i.e., hills, curves, and other obstructions that limit visibility). These hazards are not limited to the fire service alone. Other emergency service providers such as law enforcement officers, paramedics, and vehicle recovery personnel are also exposed to these hazards.¹⁹

In Tennessee, a tow truck operator was struck and killed in August 2000 while assisting a motorist on the shoulder of I-65 in Giles County. The stranded motorist, who had run out of gas, was also killed when a vehicle veered from the travel lane. A state trooper at the scene narrowly escaped serious injury or death.²⁰



Exhibit 7: Incident Scene

Virtually every law enforcement officer, fire fighter, emergency medical responder, HELP operator, rescue squad member, and towing and recovery operator has experienced at least one “near miss.” The risks are high en route to an incident (sometimes a “false alarm”) and while working at the scene. Effective incident management includes measures to improve responder safety en route and at the scene, as well as measures to reduce the duration of the incident and the time of exposure for responders.

Air Pollution and Wasted Fuel

Traffic congestion adds to air pollution by increasing the volume of harmful emissions—carbon monoxide, volatile organic compounds (VOCs), nitrous oxides (NOx), and particulate matter (PM). These pollutants cause human health problems as well as damage to trees, plants, and property.

The EPA’s model for highway vehicle emissions (MOBILE 5b) indicates that emission rates for VOC and CO are higher at lower vehicle speeds typical of congested conditions and then

steadily improve up to about 55 miles per hour. Also, according to the Federal Highway Administration, **“Emission rates are higher during stop-and-go, congested traffic conditions than during free flow conditions operating at the same average speed.”**²¹ Obviously, idling vehicles trapped in a traffic jam produce harmful emissions without accomplishing any useful work.

The fuel wasted because of highway incidents is another reason for concern. In addition to polluting the air, automobiles and trucks waste millions of gallons of fuel while idling and creeping forward in stop-and-go traffic. The TTI *Urban Mobility Report* estimates that **highway incidents waste approximately 15 million gallons of fuel each year in Memphis and another 14 million gallons each year in Nashville.** For comparison, the total wasted fuel in the two cities is equal to the total number of gallons needed per year for a fleet of more than 60,000 vehicles (assuming 12,000 miles per year per vehicle and average fuel efficiency of 25 miles per gallon).

At an average price of \$1.50 per gallon, the **wasted fuel adds another \$43.5 million dollars annually to the combined costs of highway incidents in Memphis and Nashville. This pushes the total annual costs in the two cities to more than \$330 million.**

CHAPTER 3

RECENT ACCOMPLISHMENTS

This chapter describes some of the advances Tennessee has made in highway incident management since 1996. These accomplishments provide the foundation for more comprehensive improvements in the future. Tennessee is ahead of many other states in recognizing and responding to some of the challenges surrounding highway incident management, but many problems and opportunities remain.

Benchmark Accomplishments

Exhibit 8 lists a few of Tennessee's benchmark accomplishments, beginning with the *Regional Incident Management Plan for the Nashville Area* completed in 1996. That plan, sponsored by the Metropolitan Transportation Planning Organization, did not offer many specific recommendations, but the multi-agency planning process raised awareness and influenced TDOT's Statewide *ITS Strategic Plan*. The ITS plan, first published in 1998 and now updated annually, called for the implementation of freeway service patrols in the state's four largest metropolitan areas.

The freeway service patrols, subsequently named HELP, were envisioned as the first step toward a broader statewide incident management program that would develop in parallel with TDOT's ITS program. HELP has been perhaps the most visible component of either program to date, but the chronology in Exhibit 8 shows that a number of related activities have moved forward along with the HELP program.

For instance, the installation of "emergency reference markers" (at 2/10 mile intervals) in Knoxville and Nashville occurred just prior to the startup of the HELP program. TDOT suggested the markers during discussions with local officials about ITS and the soon-to-be-implemented HELP program. With local endorsement, TDOT had the markers installed as a pilot project. The markers proved useful for the HELP program as well as for the 911 centers, police, fire, and other incident responders. As a result, markers were installed in Chattanooga and Memphis just before the HELP patrols began in those cities.

In 2000, after about nine months of HELP operation in the first two cities, the Tennessee General Assembly approved "quick clearance" legislation directing motorists on controlled-access highways to move their vehicles following minor crashes and clarifying the authority of the HELP operators and law enforcement officers to remove or "cause to be removed" vehicles or spilled cargo. The popularity of the HELP program and the increased awareness of incident management issues helped gain support from members of the legislature and to resolve some initial concerns expressed by the trucking and insurance industries.

Also in the year 2000, local incident management teams were established in Chattanooga and Memphis. In Chattanooga, the initial leadership came from the Chattanooga Metropolitan

Action	Year Accomplished
Regional Incident Management Plan for the Nashville area completed	1996
TDOT Statewide ITS Strategic Plan completed with recommendations for freeway service patrols and incident management	1998
TDOT's internal Freeway Service Patrol Task Force established	1998
Emergency reference markers installed on Interstate highways in Knoxville and Nashville	1999
HELP patrols started in Knoxville and Nashville	1999
"Quick clearance" legislation enacted by the General Assembly	2000
Emergency reference markers and overhead structure reference signs installed on Interstate highways in Chattanooga and Memphis	2000
HELP patrols started in Chattanooga and Memphis	2000
Office of Incident Management established within TDOT	2000
Incident management team established in Chattanooga with leadership from the Chattanooga Metropolitan Planning Agency (MPO)	2000
Incident management team established in Memphis with leadership from the Memphis Police Department	2000
Incident management Memorandum of Understanding signed between the Tennessee Department of Safety and TDOT	2001
HELP patrols expanded to seven days a week in all four cities	2001
Statewide Policy Committee and Steering Committee established for incident management; initial meeting of Policy Committee	2001
Initial meetings of Statewide Steering Committee to establish ongoing planning and coordination and begin work on state incident management plan	2002
Signs installed on controlled-access highways at 117 locations with the message: "Move Damaged Vehicles to Shoulder if No Serious Injury"	2002
Sixteen CCTV cameras installed along Nashville freeways, as the first step toward a total of 58 cameras to help monitor and guide freeway traffic	2002
Initial group of "Ready Response Trailers" deployed by TDOT at 15 strategic locations in suburban and rural areas	2002
TDOT's Traffic Management Center (TMC) for Nashville scheduled to begin operation	2003
Statewide Traffic Incident Management Plan, 2003-2008, scheduled for review and approval	2003

Exhibit 8: Advances in Highway Incident Management in Tennessee, 1996-2003

Planning Organization. Regular meetings were held with all of the stakeholders in the Chattanooga area, and sub-teams were formed to tackle specific issues. Also, the team adopted a regional plan for incident management. In Memphis, the initial leadership came from the Memphis Police Department. To facilitate mutual understanding and interagency coordination, team meetings have been hosted by several of the key agencies in the Memphis area.

Another important event in 2000 was the decision by TDOT to establish an Office of Incident Management with responsibility for the HELP program and for building a statewide incident management program. In 2001, the Office of Incident Management became a separate unit reporting to the Assistant Chief Engineer for Operations.

In 2001, TDOT and the Tennessee Department of Safety (DOS), which includes the Tennessee Highway Patrol (THP) and the Tennessee Commercial Vehicle Enforcement (CVE) division, signed a memorandum of understanding entitled, “Urgent Clearance of Highway Incidents and Safety at Incident Scenes.” The agreements identified specific responsibilities and action that the two agencies would undertake to improve highway incident management.

The memorandum was the culmination of discussions that began during TDOT’s first meeting with THP to introduce the idea of the HELP program, and the subsequent discussions spanned more than a year. The agreement sets out 30 specific actions to be undertaken by TDOT, THP, CVE, or some combination of the three “to ensure public safety, promote safe and orderly flow of traffic, protect the safety of emergency responders, and restore the roadway to full capacity as soon as possible following an incident.”

The first meeting of the policy committee for the statewide incident management planning process was held in late 2001. Work began and the steering committee held its initial meeting in 2002. (The planning process is discussed in more detail in the next chapter.)

Many other initiatives that had been underway for months or years also reached more publicly visible stages in 2002. The first CCTV cameras were installed in Nashville, with the images available to anyone with access to the Internet. Also, more than 100 signs were installed at key locations along Tennessee’s freeway system with the message “Move Damaged Vehicles to Shoulder if No Serious Injury.” Less visible to the public but still important, TDOT deployed “Ready Response Trailers” to assist with incident management at 15 strategic locations outside of the normal HELP service areas.

One of the most visible accomplishments since the beginning of the HELP program will occur in 2003 when TDOT’s Transportation Management Center (TMC) for the Nashville area begins full-scale operation. The TMC will integrate roadway sensors, computer algorithms, additional CCTV cameras, and changeable message signs along 36 miles of the Interstate system in Nashville. Design work is nearing completion for a TMC and related technologies and services in Knoxville, and the planning and design work for Memphis and Chattanooga also began in 2003.

Other Recent Accomplishments

The chronology in Exhibit 8 does not include all of the important accomplishments by state and local governments or the private sector partners in highway incident management. Other examples include the following:

- Franklin, Johnson City, and Murfreesboro have established their own transportation management center (TMC) or traffic operations center (TOC).
- The Memphis Police Department has focused on quicker removal of abandoned vehicles to reduce the hazards for other motorists and the negative impacts on traffic flow.
- In 2000 and 2001, the Chattanooga Police Department conducted a 12-month demonstration of photogrammetry (using digital photographs taken from multiple angles) to reduce the time required for investigative measurements at the scene of major crashes.
- In 2001 TDOT and the Department of Safety began holding debriefings following incidents that cause long-term delays or secondary crashes with serious injuries.
- Meetings have been held between incident management stakeholders in Nashville and Knoxville, and TDOT's HELP supervisors report excellent cooperation from other agencies. Discussions are underway in both cities to establish more formal teams.

Status of the HELP Program

Since the HELP program is such a high-profile component of highway incident management, a brief status report is provided here. As noted in Exhibit 8, implementation began in June 1999 when TDOT started the HELP patrols in Knoxville and Nashville. Service began in Chattanooga and Memphis one year later. Initially, the service operated on weekdays from early morning to about 8:00 p.m. In September 2001, service in all four cities was expanded to seven days a week with longer hours.



Exhibit 9: HELP Logo

The lime yellow HELP trucks operate on designated routes. The patrols normally cover about 180 highway route miles in the four cities combined, with some of the patrols overlapping where traffic volumes are the highest. Traffic volumes on most of the routes are in the range of 80,000 to 120,000 average annual daily traffic (AADT). On several sections the volumes are greater than 160,000 AADT, and on a few sections the volumes are as low as 50,000 AADT. The patrolling supervisors can (and do) authorize responses to off-route locations when requested by law enforcement agencies, depending on circumstances within the core patrol areas.

Collectively, the HELP patrols make more than 90,000 stops per year, and provide more than 135,000 services annually. The most frequent services provided by HELP are traffic control, tagging abandoned vehicles, changing tires, and providing fuel and mechanical assistance. However, during the twelve month period ending in December 2002, the HELP operators also moved damaged or stalled vehicles from travel lanes almost 5,300 times, moved another

3,600 vehicles that were in unsafe locations, provided first aid 543 times, and extinguished 148 vehicle fires.



Exhibit 10: Traffic Control

The uniformed HELP operators are very aggressive in dealing with incidents and working to restore traffic to normal conditions as soon as possible. The HELP trucks, which are designated emergency vehicles, are four-wheel drive and are equipped to quickly push, pull, or drag disabled vehicles from the travel lanes. Each operator has two-way radio communication with a HELP dispatcher and the other operating personnel, and each shift supervisor has a police radio to facilitate a coordinated response to incidents. The operators

and patrolling supervisors are all certified as emergency medical “First Responders.”

All of the uniformed HELP operators and shift supervisors receive nine weeks of initial training and subsequent recurrent training to deal with traffic control, medical emergencies, fires, hazardous materials, and the many types of minor incidents that have the potential to become major problems. “Quick clearance” and safety are central themes throughout the training.

The HELP personnel work closely with law enforcement, fire and emergency medical services, towing and recovery operators, and other incident responders. The Tennessee Highway Patrol does not normally respond to incidents inside the boundaries of the major cities, so TDOT works most closely with local law enforcement agencies, especially the state’s four largest police departments.

HELP operates with three shifts and has a total of 62 specially equipped trucks, 52 operators, 16 patrolling supervisors, 17 dispatchers, and 4 region incident management coordinators. The HELP personnel are all TDOT employees. During the week, at least four trucks and as many as seven are on patrol during each shift in each city. Normally, fewer trucks operate on the weekends except during special events.

HELP has been well-received in each of the four cities, and HELP seems to be highly regarded by every stakeholder group, including motorists, law enforcement, fire and emergency medical responders, towing and recovery operators, traffic reporters, the general news media, and state and local elected officials. Newspaper articles have referred to HELP as “courtesy commandos” and the “trucks from heaven.” Traffic reporters tell listeners that HELP is “on the scene,” and the problem will soon be fixed.

The department has collected information from two of the most important stakeholder groups—motorists and police officers. The results indicate that these two groups consider HELP a resounding success.

Since the beginning of the program, assisted motorists have been asked to fill out and return a postage-paid “comment card,” and more than 12,500 cards have been returned. More than 99% of the respondents gave an “Excellent” rating to the HELP program overall, to the specific service received, and to the performance of the HELP operator. Almost 85% of the respondents offered written comments, virtually all favorable, and 70% signed their names.

In the spring of 2001, TDOT worked with the police departments in the four cities to survey police officers that had first hand experiences with the HELP program. The officers were asked 29 questions about different aspects of the program, and the responses were overwhelmingly positive. Of the 121 officers who responded to the survey, 70% rated the “overall HELP program” as “Excellent,” another 25% rated the program as “Good,” and the remaining 5% as “Adequate.” None of the officers selected “Fair” or “Poor.”

The officers were even more positive in response to questions about HELP’s improving safety at incident scenes, removing disabled or damaged vehicles, and reducing the time required for police investigations. The officers believe that they are 70% safer when a HELP truck is present at an accident scene. The officers judged that HELP has reduced the time required to investigate crashes by an average of 31%. The only negative comments were that HELP operators were sometimes too aggressive in moving damaged vehicles and too impatient about reopening lanes. However, most of the officers who made such comments gave the program an overall high rating.

CHAPTER 4

THE PLANNING PROCESS

The purpose of this chapter is to describe the planning process established for highway incident management in Tennessee and to explain how the recommendations for the strategic plan were developed. The first part of the chapter describes the organizational arrangement. The second part of the chapter focuses on the development of recommendations in the plan.

Organizational Structure

The organizational structure described below was established not just to oversee preparation of the initial strategic plan but also to facilitate continued planning and coordination. The committees are expected to provide leadership and support for implementation and to continue the planning process. The structure is illustrated in Exhibit 11.

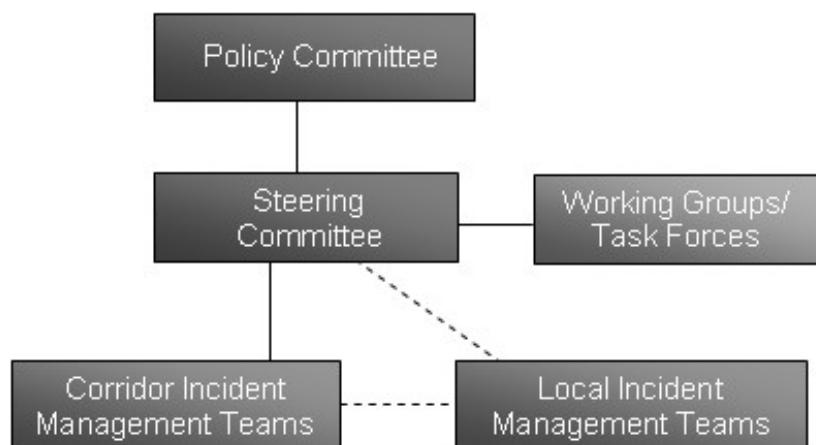


Exhibit 11: Organization for Highway Incident Management Planning and Coordination

The responsibilities of each group within the structure are described in Exhibit 12, except for the “working groups/task forces.” When the structure was established at the beginning of the process in 2001, the committees anticipated that some issues would require more focused attention, but no specific proposals were advanced. The recommendations presented in Chapter 5 include a number of working groups to address specific topics.

As shown in Exhibit 13, the representatives on the Policy Committee are all state officials. However, the Steering Committee includes representatives of numerous other organizations, from all levels of government and the private sector. In addition to the designated representatives, other interested parties have attended committee meetings and participated in the discussions.

Incident Management Committee Responsibilities

Each of the committees has the same basic mission—to minimize the impacts of highway incidents (e.g., wasted time, lost productivity, air pollution, energy consumption, road rage, secondary crashes, and vicinity risks) and improve safety for emergency responders and motorists. Each committee’s unique responsibilities are described below.

Policy Committee

This committee has three primary responsibilities: (1) establish policies and direction for statewide highway incident management initiatives, (2) promote coordination among state agencies and between state and local agencies to ensure success of these efforts, and (3) provide direction and support for any state legislative, regulatory, or funding actions. The Commissioners of Transportation and Safety serve as the co-chairs of this committee, which meets at least annually.

Steering Committee

This committee has five interrelated responsibilities: (1) identify and analyze problems related to highway incident management, (2) develop solutions and actions, ensuring that the views of all stakeholder groups are considered, (3) promote and facilitate implementation of recommendations, (4) provide a forum for discussion of ideas, promote better understanding among the different stakeholders, and resolve any disagreements, and (5) promote effective communication of statewide initiatives to and within the different state and local stakeholder groups. The Steering Committee may establish working groups as needed—to focus on specific problems or opportunities.

Corridor Teams

Corridor Teams may be established to focus the operational resources of state and local agencies along a particular corridor or location based on the frequency of incidents, severity of the impacts, inadequacy of existing resources, or other factors that call for extra attention. The committee’s responsibilities will depend on the circumstances, but the focus will be on marshalling all available resources to avoid incidents, and, when incidents occur, to respond with maximum effectiveness, efficiency, and safety.

Local Highway Incident Management Teams

These teams would facilitate improvements in highway incident management in a local area, especially in the urbanized areas with high-volume Interstate traffic. Such teams have already been formed in Chattanooga and Memphis, and some interagency meetings have been held in Knoxville and Nashville.

Exhibit 12: Responsibilities for Statewide Highway Incident Management Planning and Coordination

Statewide Highway Incident Management Planning and Coordination

Policy Committee

- Commissioner, Tennessee Department of Safety
- Commissioner, Tennessee Department of Transportation
- Commissioner, Tennessee Department of Commerce and Insurance
- Director, Tennessee Emergency Management Agency
- Colonel, Tennessee Highway Patrol
- Chief Engineer, Tennessee Department of Transportation

Steering Committee

- American Automobile Association
- Chattanooga-Hamilton County Planning Agency*
- Emergency Management Association of Tennessee
- Federal Highway Administration, Tennessee Division
- Knoxville Metropolitan Transportation Planning Organization*
- Memphis Police Department*
- Nashville Metropolitan Transportation Planning Organization*
- Tennessee Association of Chiefs of Police
- Tennessee Association of Fire Chiefs
- Tennessee Association of Rescue Squads
- Tennessee Road Builders Association
- Tennessee Sheriffs Association
- Tennessee Trucking Association
- Tennessee Towing and Recovery Association
- Director, Emergency Medical Services Division, Tennessee Department of Health
- Domestic Preparedness Manager, Tennessee Emergency Management Agency
- Executive Director, Tennessee Emergency Communications Board, Department of Commerce and Insurance
- Assistant Commissioner (State Fire Marshall), Department of Commerce and Insurance
- Assistant Commissioner, Division of Insurance, Department of Commerce and Insurance
- Planning and Research Division, Tennessee Highway Patrol
- Tennessee Commercial Vehicle Enforcement, Department of Safety
- Director of Training, Tennessee Highway Patrol, Tennessee Department of Safety
- Director, Tennessee Law Enforcement Training Academy, Department of Safety
- Chief of Planning and Environment, TDOT
- Director, Community Relations Division, TDOT
- Assistant Chief Engineer (Operations), TDOT
- Director, Governors Highway Safety Office, TDOT
- Intelligent Transportation System (ITS) Director, Design Division, TDOT
- Director, Office of Incident Management, TDOT

**Representing local incident management teams*

Exhibit 13: Representation on the Policy and Steering Committees

Development of the Strategic Plan and Action Items

The recommendations in the plan are the result of an iterative process of compiling possible recommendations, obtaining comments and suggestions from the Policy and Steering Committees, and, finally, obtaining approval of the plan and the component action tasks. The process used to develop the recommendations is illustrated in Exhibit 14. The primary sources for ideas and preliminary recommendations are summarized below.

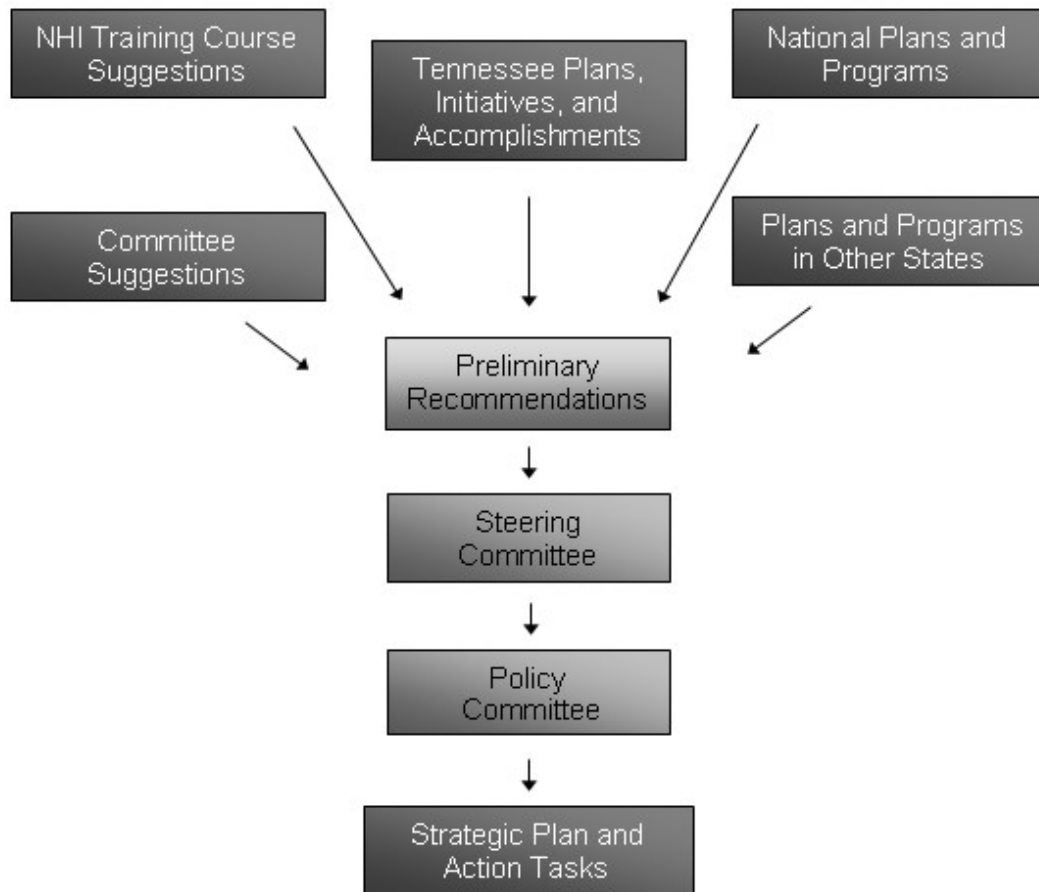


Exhibit 14: Development of the Recommended Strategic Plan and Action Tasks

National Highway Institute (NHI) Training Course Suggestions

The National Highway Institute (NHI) offers a two-day course on highway incident management, and TDOT has hosted that course at least once in each of the four largest metropolitan areas and once in Jackson. The participants have included law enforcement officers, fire service and EMS personnel, emergency managers, transportation planners, towing and recovery operators, TDOT personnel, and other stakeholders. During some of those training sessions the participants were asked to brainstorm a list of problems and

opportunities regarding highway incident management in Tennessee. The notes from three of those sessions, in Chattanooga and Memphis in 1999 and in Jackson in 2000, were reviewed, compared, and incorporated in the planning process.

National Plans and Programs

Several documents produced or funded by the U.S. Department of Transportation were used as guidelines for the Tennessee plan, including the following:

- *Traffic Incident Management Handbook* (November 2000) by P.B. Faradyne, Inc.
- *Incident Management Successful Practices: A Cross-Cutting Study* (April 2000)
- *Regional Traffic Incident Management Programs* (May 2000)
- *Incident Management Workshop Handouts* (NHI Course No. 13348)(1998)

Another useful document was *Incident Management: Challenges, Strategies, and Solutions for Advancing Safety and Roadway Efficiency, Final Technical Report* (1997) by the ATA Foundation and Cambridge Systematics, Inc. for the National Incident Management Coalition. Also, the recommendations for Tennessee were influenced by several current initiatives at the national level. Incident management is receiving increased attention from transportation organizations such as the Federal Highway Administration (FHWA) and the American Association of State Highway and Transportation Officials (AASHTO), but also from other national organizations with important links to highway incident management.

For instance, the National Fire Service Incident Management System Consortium (NFSIMSC) has been working for more than a year on a *Model Procedures Guide for Highway Incidents*, to complement six previous guides that were primarily for the fire services community. The new guide for highway incidents will specify command and control procedures for managing on-scene resources at major highway incidents. The potential audience for this guide includes law enforcement, fire services, rescue squads, emergency medical services, transportation, towing and recovery operators, hazardous materials responders, and others who are called to help manage incidents. Since the NFSIMC focuses primarily on large-scale events, the recommendations may not be applicable to routine highway incidents, but the guide should be a valuable addition to the body of knowledge.

The Towing and Recovery Association of America (TRAA) has started work on a project to address incident management from the perspective of the towing industry. The project, known as the Traffic Incident Management Towing Operator Work Plan (TIMTOW), will develop guidelines and describe how towing operators can and should work within the framework of a traffic incident management program.²²

Other current initiatives include development of performance measures for incident management, revisions to the Manual on Uniform Traffic Control Devices (MUTCD), and a self-assessment tool for local and regional incident management programs. Also, work is underway to establish new communication standards and to demonstrate the integration of law enforcement Computer Aided Dispatch (CAD) systems with transportation management systems.²³

Incident Management Plans and Programs in Other States

Information was gathered from several other states to take advantage of their experiences with highway incident management. Sources that were especially useful in formulating alternatives for Tennessee included:

- *Arizona Statewide Incident Management Plan* (July 2000), prepared for the Arizona Department of Transportation by PB Faradyne, Inc.
- *Duluth/Superior Area Incident Management Plan* (1999), prepared for the Duluth TOCC Incident Management Work Team by BRW, Inc.
- *Statewide Incident Management Program Including the Detroit Metropolitan Area* (1995), Michigan Department of Transportation, and *Blueprint for Action* (1995) Metropolitan Detroit Incident Management Coordinating Committee
- *I-70 Mountain Corridor Incident Management Program, Final Report* (2000), prepared for the Colorado Department of Transportation by CH2MHILL and Pat Noyes & Associates

Also, several of the recommendations for Tennessee were influenced by the Incident Response Team (IRT) program operated by the Washington State DOT. An overview of the IRT program can be found at <http://www.wsdot.wa.gov/traffic/incidentresponse/>. Numerous other Web sites related to state and local incident management programs were also reviewed.

Tennessee Plans, Initiatives, and Accomplishments

The already completed plans, underway initiatives, and recent accomplishments in Tennessee were all reviewed to ensure that the state incident management plan will be consistent with other efforts and will build on the momentum of previous successes. The major accomplishments and underway initiatives have already been described in Chapter 3.

The following incident management plans were reviewed, and many of the recommendations from these plans were incorporated in the state plan:

- *Regional Incident Management Plan*, Nashville Area (October 1996) prepared by Gresham, Smith and Partners, et al for the Nashville Metropolitan Planning Organization
- *Chattanooga Urban Area Highway Incident Management Plan* (2002) by the Chattanooga Metropolitan Planning Organization—Chattanooga-Hamilton County Regional Planning Agency
- *Goodlettsville Incident Management Action Plan* (May 2002) by Bucher, Willis, and Ratliff and Tochnell and Associates for the City of Goodlettsville
- *Tennessee Department of Transportation Intelligent Transportation System (ITS) Plan* (first adopted in 1998 and updated annually)

Also, staff from TDOT's Office of Incident Management provided important insight based on their work with local officials and participation in meetings with the local incident management committees.

Policy and Steering Committee Suggestions

The policy and steering committees influenced the recommendation in several ways. First, both committees held discussions and brainstorming sessions to identify problems and opportunities at the beginning of the process. Many of the agency representatives also offered specific suggestions during personal interviews and telephone conversations.

Subsequently the Steering Committee helped “rank” the many possible recommendations and assign priorities for implementation. Each representative on the committee was asked to review a list of potential recommendations and then evaluate three different aspects: (1) potential benefit, (2) relative difficulty, and (3) proposed timing. A fourth choice was also offered with a box that could be checked to indicate “Bad Idea/Not Workable.”

Review and Approval

The final step in the process was for both committees to review and approve the recommendations that are presented in Chapter 5, beginning on the following page. The recommended goals and action tasks were adopted in August 2003 as the foundation for ongoing planning and coordination of highway incident management in Tennessee, subject to annual review and updating. One of the most important recommendations is to continue the statewide planning and coordination process.

CHAPTER 5

STRATEGIC PLAN AND ACTION TASKS

This chapter presents the recommended strategic plan to improve highway incident management in Tennessee over the next five years, 2003-2008. The plan includes more than 150 specific tasks to accomplish 10 overarching goals. The 10 goals are as follows:

1. Reduce the number and severity of highway incidents
2. Better inform and educate motorists to reduce congestion and improve safety
3. Expand and enhance resources for systematic management of highway incidents
4. Expand and enhance training for highway incident responders
5. Support highway incident management teams in metropolitan and urban areas
6. Sponsor highway incident management teams in rural areas
7. Accelerate deployment of new technologies to improve incident management
8. Reduce traffic congestion caused by highway work zones
9. Establish working groups to focus on specific issues and recommend actions
10. Promote ongoing interagency planning and coordination

Some of these goals and tasks are overlapping, but each is important enough to warrant separate consideration.

The recommended tasks are described below under the ten goal headings, and each task is assigned to one of three time-based priority groups.

- Immediate (Year One)
- Short term (Years Two-Three)
- Longer term (Years Three-Five)

Each of the proposed tasks is described below under the headings that correspond to respective goals. The tasks are itemized in Tables 1-10. Table 11 at the end of this chapter provides a consolidated listing of all the recommendations.

Some of the recommended tasks described are very specific, and the responsibilities for implementation are clear. Implementation of those tasks should begin immediately. Some of the recommendations are more general and will require ongoing attention. Others will require more study, and the specific actions and responsibilities for implementation will have to be defined before implementation can begin.

Most of the recommendations for immediate implementation will require significant amounts of time and attention but not large capital investments. For the subsequent years, a number of pilot projects are suggested for improvements that can be tested and adjusted before making

long-term commitments. A few of the recommendations will require significant capital investments. Costs and potential funding sources are discussed in the next chapter.

1. Reduce the Number and Severity of Highway Incidents

The first group of recommendations would reduce the number and severity of highway incidents and help mitigate some of the resulting consequences. The proposed tasks are listed in Table 1 and described below.

Removal of Disabled and Abandoned Vehicles (Tasks 1.1-1.3)

Disabled and abandoned vehicles are a safety hazard and have an adverse impact on traffic flow, even when the vehicle is not directly blocking a travel lane. Significant investments have been made to eliminate obstacles within freeway rights-of-way, and a parked vehicle anywhere within that area defeats these safety investments. Also, traffic flow is impacted by rubbernecking, impeded sight distances, and drivers slowing to determine if the vehicle on the shoulder is about to merge. Further, when traffic backups occur, emergency vehicles may be blocked or slowed by abandoned vehicles left on the shoulder. Abandoned vehicles may also be security risks.

Law enforcement agencies and TDOT have the authority to immediately remove vehicles or other objects that represent “an obstruction or hazard to traffic” on freeways (TCA 54-16-113). Law enforcement officers also have authority under other provisions of state law (e.g., TCA 55-8-159 and TCA 55-16-104). However, in practice, many vehicles are simply “tagged” and allowed to remain for at least 48 hours—the minimum period prescribed by state law for abandoned vehicles that are not considered a hazard.

The recommendation is to develop and implement a plan for more aggressive action to keep the shoulders clear and to reduce the average time that vehicles are left on Tennessee freeways. Law enforcement officers and TDOT personnel need some discretion to assist stranded motorists, but every disabled or abandoned vehicle should be treated as an immediate hazard that warrants immediate removal. As part of this effort, the public should be made aware of the need for more immediate removal and the importance of leaving their vehicles as far from the travel lanes as possible regardless of circumstance.

Warning Signs and Devices at Locations with High Frequency of Disruptive Incidents (1.4-1.6)

This recommendation is for TDOT to undertake pilot projects for innovative use of signs or other warning devices at locations with a high frequency of especially disruptive incidents. Candidate locations should include those with frequent truck rollovers, collisions in merge or weaving areas, run-off-the-road incidents, and locations that are especially difficult or time consuming to reach with towing and recovery equipment. State and local law enforcement officials and traffic engineers should be included in the selection of the sites and the design and evaluation of the projects.

Table 1: Promote Measures to Reduce the Number and Severity of Highway Incidents

Immediate (Year 1)	Short Term (Years 2-3)	Longer Term (Years 3-5)
1.1 Develop plans for more immediate removal of disabled and abandoned vehicles on Tennessee freeways, including a public information campaign	1.2 Implement policies and programs for more immediate removal of disabled and abandoned vehicles	1.3 Evaluate and refine policies and programs
1.4 Select two-four sites for pilot projects to evaluate and improve warning signs and devices at locations with a high frequency of especially disruptive crashes	1.5 Design and implement pilot projects	1.6 Evaluate impact of pilot projects and consider additional sites
1.7 Select two-four sites for pilot law enforcement initiatives to reduce the frequency of especially disruptive incidents	1.8 Design and implement pilot projects	1.9 Evaluate impact of pilot projects and consider additional sites
1.10 Identify candidate locations for construction of accident investigation sites in one or two cities	1.11 Construct pilot accident investigation sites in one or two cities and evaluate results	1.12 Construct accident investigation sites statewide based on results of the pilot projects
1.13 Evaluate ongoing efforts to promote effective loading of trucks through training and regulatory enforcement	1.14 Emphasize proper loading of trucks through training and regulatory enforcement; improve/enhance programs as needed	
	1.15 Develop procedures for design of freeway improvements to address shoulder widths, emergency vehicle access, crash investigation sites, median openings, and other features	1.16 Implement, evaluate, and refine standards and procedures
	1.17 Develop guidelines for major highway projects to reduce the life-cycle impacts of traffic congestion and safety (i.e., disruptions caused by maintenance and re-construction)	1.18 Implement, evaluate, and refine standards and procedures
	1.19 Evaluate policies and practices regarding the movement of over-dimensional vehicles during peak travel periods	1.20 Propose enforcement, legislation, or other action as needed

Law Enforcement Initiatives at Locations with High Frequency of Disruptive Incidents (1.7-1.9)

Concurrent with the development of pilot projects for signing and warning devices, sites should be selected for pilot law enforcement initiatives to reduce incidents at critical locations. In some cases, the law enforcement and signing/warning device initiatives (1.4-1.6) might be at the same location. However, priority for the law enforcement initiatives should be

given to sites where transportation officials believe that no improvements are feasible through signing or warning devices, and vice-versa.

Accident Investigation Sites (1.10-1.12)

Some states and communities report success with designated “accident investigation sites” as a way to move minor crashes away from the main travel lanes. This can reduce rubbernecking and improve safety for motorists and investigators. However, such sites can be difficult to secure and require ongoing maintenance. To gain first hand experience in Tennessee, TDOT should work with local police departments to identify locations for pilot projects, either as additions to existing roadways or as part of future construction projects. Pilot sites should be constructed in selected cities and then statewide if the initial sites are successful.

Proper Loading of Trucks (1.13-1.14)

Overtaken trucks have a major impact on traffic flow and highway safety, even when no other vehicles are involved and no serious injuries have occurred. Because of their length, overturned trucks frequently block multiple lanes. The needed towing and recovery equipment may have to travel long distances to reach the scene. Spilled cargo may require extra time to clear the travel lanes. Fuel may spill from truck’s fuel tanks and add to the cleanup time. The recommendation is for the Department of Safety to intensify ongoing efforts, working in cooperation with the trucking industry, to ensure that trucks are properly loaded and that loads are secured to minimize the potential for overturning. Training and other voluntary measures should receive first priority, but more stringent regulatory enforcement should not be precluded.

Design Freeways to Minimize Future Disruptions (1.15-1.18)

Two aspects of highway design are important to incident management. First, the physical layout of the roadway and associated features can either impede or facilitate the management of incidents. Highway designers should anticipate incidents and design the facility to function as well as possible under incident conditions. During design, consideration should be given to median breaks and emergency crossovers or gates, accident investigation sites, safety areas for law enforcement purposes, access to water for firefighting, storage areas for incident response equipment, and pre-designated locations for emergency through-the-fence operations.

Another important aspect of highway design is to consider the impacts of necessary maintenance and repair on traffic flow and operational safety. TDOT should develop procedures to ensure that decisions made during roadway and bridge design, including the selection of products and materials, will minimize future disruptions for maintenance, repair, and replacement. The goal is to gain longer time gaps between repairs, maintenance, and reconstruction even if the initial costs of materials or construction are higher.

Evaluate Policies and Practices Regarding the Movement of Over-Dimensional Vehicles During Peak Travel Periods (1.19-1.20)

State laws, in Tennessee and adjacent states, allow the movement of certain vehicles that exceed the normal limits on height, width, and/or weight, e.g., equipment or machines carried

on flat bed trucks, manufactured housing, or other special configurations that are taller, wider or heavier than normally allowed. Such vehicles must have a “permit” issued by TDOT. Many different classifications of permits are allowed, and TDOT has the authority to impose certain kinds of conditions on some of the permits.

The issue from an incident management perspective is that such vehicles and loads, especially those that are exceptionally wide, often obstruct two or more travel lanes. This can cause major traffic problems. TDOT has received complaints about such vehicles blocking multiple lanes, especially during peak travel periods, and both TDOT and DOS have worked to minimize those problems within the bounds of their authority and resources.

The recommendation is to review, from an incident management and traffic flow perspective, all of the policies and practices regarding movement of over-dimensional vehicles and loads. If needed, changes should be made in legislation, administrative procedures, or enforcement practices.

2. Better Inform and Educate Motorists to Reduce Incident-Related Congestion and Improve Safety

The second group of recommendations would provide more accurate and timely information to help motorists adapt their own routes and schedules during specific incidents. Also, steps would be taken to improve driver responses to all incidents through education and public information. The proposed tasks are listed in Table 2 and described below.

Improve Information Delivered to Traffic Reporters and Motorists (2.1-2.5)

For real-time information about traffic conditions, most motorists rely on traffic reporters, and most of the reporters in turn rely heavily on information received from police, fire, HELP and other indirect sources. All of the parties try to pass on accurate information, but motorists still complain about inaccurate or inadequate information. The recommendation is to execute a pilot project in one or two of the four metropolitan areas to improve the exchange of information from incident responders to traffic reporters and from traffic reporters on to the motorists. The projects should be guided by a representative group of public agencies and traffic reporters.

Building on the results of the first pilot(s), similar initiatives should be launched in the other metropolitan areas, smaller urban areas, and along rural corridors. Of course, different strategies will be needed, especially for the rural corridors, where media resources are more limited.

Coordinate Incident Management Strategies and Plans with Local and State TMCs (2.6-2.7)

Traffic management centers (TMCs), also called traffic operations centers (TOCs), are operated by at least three Tennessee cities (Franklin, Johnson City, and Murfreesboro), and TDOT's first TMC began operating in Nashville in early 2003. Other local governments, including Metropolitan Nashville, plan to build local centers, and TDOT plans to add centers

Table 2: Inform and Educate Motorists to Reduce Incident-Related Congestion and Improve Safety

Immediate (Year 1)	Short Term (Years 2-3)	Longer Term (Years 3-5)
2.1 Develop strategies and plans to improve information delivered to traffic reporters and motorists in one or two of the largest metro areas	2.2 Work with local news media and traffic reporters to implement pilot projects and programs in the selected metropolitan area(s)	2.3 Implement projects and programs in the other metropolitan areas
	2.4 Develop a strategy and plan to improve information delivered to motorists by traffic reporters in smaller urban areas/rural corridors	2.5 Implement pilot projects in urban areas and along critical corridors
2.6 Coordinate incident management strategies and plans with local and state TMCs (existing and under development)	2.7 Implement joint programs and work with new TMCs (planned and under construction)	
	2.8 Expand and enhance TDOT's Web page to provide statewide access to traffic CCTV cameras in all cities as well as information from TMCs	
2.9 Develop strategy and plans to improve motorist response to traffic incidents (e.g., move damaged vehicles, anti-gawking, yield to emergency vehicle)	2.10 Issue periodic press releases and sponsor media events to heighten motorist awareness of how to deal with traffic incidents; develop plans and funding sources for a paid media campaign to promote safer and more appropriate driver reactions when incidents occur; monitor plan implementation and refine as needed	
2.11 Add incident management information to the Official Highway Map and the TDOT and DOS Web pages	2.12 Add similar information to the web pages for local law enforcement agencies, the Tennessee Department of Insurance, and the AAA (South and East Tennessee)	2.13 Add information to the <i>Tennessee Driver License Handbook and Study Guide</i> and add question(s) to the test
	2.14 Add information to the State Highway Map explaining how to accurately report a freeway incident	2.15 Add a special section on freeway driving and incident response to the state Web pages
2.16 Develop an overall strategy and plan to integrate incident management topics with ongoing driver education, training, and safety programs	2.17 Develop a brochure, training aids, and a suggested script to address incident-related subjects during driver education, training, and safety courses	2.18 Encourage driver education and safety programs and instructors to cover incident management as part of ongoing education, training, and safety programs
	2.19 Evaluate the effectiveness of the freeway quick clearance signs ("Move Damaged Vehicles...")	2.20 Propose additional actions as needed to promote prompt removal of vehicles following minor crashes
	2.21 Develop plans for enhanced delivery of critical weather information to motorists	2.22 Implement enhanced weather information systems for motorists
	2.23 Develop and implement "511" traveler information system(s)	

in Knoxville, Memphis, and Chattanooga, in that order. Incident management is a core function of the state and local TMCs, and the state's incident management strategies, plans, and projects should be closely coordinated with TMCs. At the operational level, regular exchange of information, frequent meetings, and periodic exercises should be scheduled to promote coordination between incident responders and TMC personnel.

Expand TDOT's Web Page for Public Access to CCTV Images (2.8)

TDOT's web page currently allows other agencies and the public to view images from the 16 CCTVs in the Nashville area. These images have been very useful for emergency responders, and the images allow the public to make informed decisions about travel times and routes of travel. With more cameras installed statewide, providing user-friendly access to the images will become more challenging. TDOT should try to provide the same high level of access for the new images as for the original group of cameras in Nashville. Work should begin early in the two-three year time frame, and continuing enhancements will be needed for several years as more images and other travel information becomes available.

Strategy and Plan to Educate Motorists on the Proper Response to Traffic Incidents (2.9-2.10)

Many of the problems caused by highway incidents are made worse by motorists' responses, e.g. failure to move damaged vehicles, rubbernecking, not yielding to emergency vehicles, not reporting the correct location, and disregarding warning devices and instructions at incident scenes. Several specific actions are listed in Table 2 to address these problems, including a paid media campaign, but the first year's priority is to develop an overall strategy and plan to improve driver responses in a coordinated, efficient manner using clear messages. All of the partner state agencies should participate in developing and implementing the strategy.

Promote Better Motorist Response to Incidents by Using Existing Communication Resources (2.11-2.15)

A number of existing information sources could be enhanced to promote improved driver responses to freeway incidents. These include:

- *Tennessee Official Highway Map*
- TDOT and Department of Safety Web pages
- Web pages operated by other state and local agencies and private organizations
- *Tennessee Driver License Handbook and Study Guide*

Information should be added to these information sources to explain why vehicles should be moved following minor crashes, discourage rubbernecking, remind motorists that they must yield to emergency vehicles, explain how to report a freeway incident, and encourage safe driving practices at incident scenes.

Integrate Incident Management Topics into Driver Education and Training and Highway Safety Programs (2.16-2.18)

Promoting correct motorist responses during highway incidents should be an integral part of driver education and training and of ongoing highway safety programs. Driver education,

training, and safety programs must give priority to the basics of safe driving, and limited time is available to address all of the special situations that drivers encounter. However, freeway incidents, congestion, secondary crashes, and all of the related problems are growing in frequency and severity, and drivers encounter such problems on a daily basis.

The recommendation is that the Department of Safety and the Department of Transportation develop a strategy for integrating incident management topics into ongoing programs, including development of training aids and promoting the new topics within the organizations and individuals that deliver driver education and training and highway safety programs.

Evaluate the Freeway “Quick Clearance” Signs and Propose Additional Action if Needed (2.19-2.20)

TDOT should evaluate the effectiveness of the freeway signs reading “MOVE DAMAGED VEHICLES TO THE SHOULDER IF NO SERIOUS INJURY.” Information should be gathered from auto drivers, truckers, law enforcement officers, and organizations such as the AAA and the Tennessee Trucking Association. If needed, additional legislation or regulation should be proposed to facilitate prompt relocation of vehicles following minor crashes.

Enhanced Delivery of Weather Information (2.21-2.22)

Knowing about adverse weather conditions, existing and predicted, allows motorists to adjust their travel routes and schedules accordingly. Weather information is already available from several sources, but improvements in the availability, accuracy, and timeliness of the information will allow motorists to make even better decisions and to reduce traffic problems for others.

Current information sources, in addition to commercial radio and television, include the Department of Safety (DOS) toll-free “road condition” number and TDOT’s Web site. TDOT displays current road conditions on line, and the department is working to make the information more specific. Weather information is displayed on monitors in all except one of Tennessee’s 32 rest areas or welcome stations.

Opportunities for improvement include further enhancements to the TDOT Web page, larger display monitors and more information in rest areas and welcome centers, CCTV cameras at locations where winter weather problems are the most frequent, and use of changeable message signs. Also, TDOT should pursue arrangements with adjacent states to share specific road condition information at Tennessee rest areas and welcome centers. Kentucky information is already available at Tennessee welcome centers and rest areas.

Finally, TDOT gathers information from automated weather observation system (AWOS) stations at 39 general aviation airports and from roadway weather information systems (RWIS) stations at 10 locations. An additional 27 RWIS stations are planned. Information from those airport and highway sources should be integrated to provide more precise information for travelers, or simply made available for direct viewing such as in this Iowa DOT example: <http://www.dotweatherview.com/>.

Develop and Implement “511” Traveler Information Systems (2.23)

The Federal Communications Commission (FCC) has set aside the number “511” to provide access to travel information, just as “911” provides access to emergency assistance. Several regions and states, including Kentucky, have launched 511 projects, and TDOT has been monitoring the results.

Establishing a system to receive and answer the 511 calls is only part of the requirement for a successful system. From the caller’s perspective, the most important measure of success will be whether the needed information is available and reliable. Thus, the implementation of 511 must be tied to the implementation of other ITS and travel information projects, including the preceding tasks (2.21-2.22).

State and local agencies should remain alert to the results of 511 projects in other states. Also, the potential for future implementation of 511 systems in Tennessee should influence intervening decisions about other travel information projects. For each decision, one of the questions should be, “How can we ensure that this information can be easily delivered to motorists through future 511 systems?”

3. Expand and Enhance Resources for Systematic Management of Highway Incidents

Even if the number of incidents can be reduced and motorists’ responses can be improved, incidents will continue to occur, and public resources will still be needed to minimize the impacts. This group of recommendations would expand and enhance the resources for effective management of highway incidents. The proposed tasks are listed in Table 3 and described below.

Inventory Resources Available for Emergency Response on Tennessee’s Freeways (3.1-3.2)

This recommendation focuses on the freeway corridors outside of metropolitan areas. Along those corridors, the resources available for incident response vary greatly, depending on whether the Interstate route is close to a major urban area with significant resources or on the edge of a rural county many miles from the county seat. The recommendation is to conduct an inventory of the resources available along each freeway segment. Information should be gathered about the agencies, personnel, and equipment that can respond to different types of incidents and the approximate time required to respond. (TEMA already has some of the needed information relative to major incident response, but information is needed about the resources available for the full range of events that disrupt freeway traffic.)

With that information in hand, state agencies should develop basic and desired minimum standards and begin adding or enhancing resources to ensure that at least the minimum basic levels are available along all segments of Tennessee’s freeway system. Most likely, some of the needs can be met by reallocating existing state resources and providing training or other technical assistance for local agencies. However, additional funding will almost certainly be needed in some areas to expand state resources or to help pay for expansion of local emergency response and incident management services.

Table 3: Expand and Enhance Resources for Systematic Management of Highway Incidents

Immediate (Year 1)	Short Term (Years 2-3)	Longer Term (Years 3-5)
3.1 Begin identifying resources available for emergency response—police, fire, medical, rescue, towing and recovery, hazardous material response, etc.	3.2 Establish standards for availability of emergency response along Tennessee freeways and begin adding or enhancing resources to ensure minimum level of emergency response capability along all freeway corridors	
3.3 Begin evaluating 911 and other aspects of emergency communication along all freeway corridors and identify problems and opportunities for improvement	3.4 Work with the Tennessee Emergency Communications Board (ECB) and local boards and agencies to improve communication as part of highway incident management	
	3.5 Evaluate needs for increased law enforcement resources for incident management and traffic control—focused on reducing vehicle hours of delay and secondary crashes — and begin allocating additional officers/equipment	
	3.6 Upgrade the Department of Safety radio communications system	
	3.7 Implement computer assisted dispatch (CAD) for the Department of Safety	
3.8 Develop pilot projects for 24/7 on-call “Incident Response Units” along rural Interstate corridors	3.9 Implement pilot projects	3.10 Evaluate results, revise practices as needed, and deploy statewide
	3.11 Expand HELP coverage (route miles) in the four largest metropolitan areas	3.12 Expand HELP hours of service in the four metropolitan areas to 24/7
		3.13 Plan and implement, in conjunction with local agencies, HELP-type service on freeways in smaller urban areas
	3.14 Develop a recommended list of equipment and supplies that should be carried by all emergency responders for scene management and traffic control	3.15 Establish program to ensure that the recommended items are readily available and affordable for all incident responders
3.16 Design and implement a pilot project in one area of the state for integrated data collection to track the time and resources required for highway incident management	3.17 Establish an integrated data collection system to track major freeway closures and disruptions, the incident response, and the costs to responders and highway users	3.18 Analyze information from the incident database and use the information to improve planning and allocation of resources

	3.19 Survey emergency communication and incident response agencies to determine effectiveness of the Interstate emergency reference markers and overhead structure signs	3.20 Modify reference marker program as needed; add signs on more overhead structures if warranted
	3.21 Institutionalize effective incident management practices through agreements, General Orders, policies and procedures manuals, and other documents that guide or prescribe agency practices	

Evaluate 911 and Other Aspects of Emergency Communication Along Freeway Corridors (3.3-3.4)

Concurrent with the inventory of resources for incident response along the rural Interstate corridors, information should be gathered about emergency communications (including every stage of communication from the first calls to the 911 system(s), to agency notification, dispatching, and on-scene communication. Identified problems and opportunities should be prioritized and then addressed in conjunction with other corridor improvements as described above. (This should be coordinated with Task 9.1)

Increase Law Enforcement Resources for Incident Management and Allocate Additional Officers and Equipment (3.5)

The availability of law enforcement resources should be evaluated for the state's entire freeway system, focusing not just on crash investigation but also on the availability of officers and equipment for scene management and traffic control. Of course, many different law enforcement agencies are involved, and any decisions to allocate more resources will require multi-agency coordination and funding from multiple sources. The first step, however, is to have statewide and community-specific information about the level of resources committed to crash investigation, reducing vehicle hours of delay, and avoiding secondary crashes.

Upgrade the Department of Safety's Radio Communication System and Implement Computer Assisted Dispatching (CAD) (3.6-3.7)

Upgrading the Department of Safety's radio and dispatching systems to take advantage of new technologies would significantly improve statewide highway incident management. Each phase of incident management (e.g., notification, verification, response, scene management and traffic control, final clearance) would be improved by more timely and accurate information. Further, the Department of Safety would be better able to share information with other state and local agencies and to receive information from those same agencies.

Additional benefits could be realized from a statewide "shared land mobile radio system" to meet the voice and digital communication needs of state and local and even federal agencies. The emphasis on homeland security has highlighted the need for "interoperability" of communication systems between emergency responders and other public safety and public works agencies, and interoperability would improve routine highway incident management. Of course, such a system would be more expensive than a system to serve just DOS, and

establishing the necessary coordination and cooperation among agencies would be an ambitious and time consuming task.

Develop Pilot Projects for 24/7 On-Call “Incident Response Units” Along Rural Interstate Corridors (3.8-3.10)

The HELP program is cost effective on the freeways in metropolitan core areas where traffic volumes are as high as 160,000 average annual daily traffic (AADT). The program is effective because the trucks patrol only the highest volume roadways and are always just a few minutes away from those incidents that have the greatest impact on the entire freeway system. The HELP program was designed to meet those specific needs and to work under those specific conditions.

When major incidents occur on the metropolitan fringes, the HELP trucks can usually respond, and, on a few occasions, the HELP trucks have been sent to outlying counties. As discussed under the next heading, consideration should be given to some additional route miles and hours of service for HELP in the metropolitan areas and to adding service in other urban areas.

However, a different approach is needed to meet the different needs and conditions along the rural Interstate highways. On most rural segments the traffic volumes are lower, and when incidents occur the impacts are usually confined to one corridor. On the other hand, fewer resources are available for incident response and, by the time resources can be mobilized and moved to the scene, traffic can be backed up for many miles and secondary problems have already developed.

TDOT has personnel and equipment in all of Tennessee’s 95 counties, and those field resources are frequently mobilized to assist with traffic control, cleanup, or other tasks following major incidents on rural Interstates. However, incident response is not a primary responsibility for TDOT’s field offices and garages, and the department’s ability to respond quickly and with the proper equipment depends on many factors (e.g., whether the incident occurs during normal work hours, whether equipment is being used for other purposes or is even in working order, and whether people with the proper training are available to mobilize and operate the equipment).

TDOT should enhance its response capabilities by implementing pilot projects for 24/7 rapid response with trained personnel and the needed equipment. At least one other state transportation agency, the Washington State DOT (WSDOT), has a statewide program that could be adapted for Tennessee. Specially equipped WSDOT vehicles are positioned around the state and certain field personnel are cross-trained for incident management. Outside of normal work hours, a rotating on-call system is used, and the on-call personnel have the equipment at their homes or nearby facilities, ensuring prompt response 24 hours a day, seven days a week.

Expand the HELP Program (3.11-3.13)

Beginning in the two-three year time period TDOT should consider expanding the HELP program, in the following order of priority— first adding route miles of coverage in the four

largest metropolitan areas, then hours of service in the metropolitan areas, and then HELP-type service on freeways that serve other large urban areas. Of course, the highest priority should be to continue the current routes, which focus on the highest volume roadways in the core of the largest metropolitan areas. The greatest payoff from the HELP program occurs when a truck can respond within minutes or seconds to an incident that would otherwise disrupt traffic throughout the system at a rate that increases exponentially with every minute that passes. Extending the routes to cover more area without adding more trucks to patrol the longer routes would reduce the program's effectiveness.

Develop a Recommended List of Incident Management Equipment for All Emergency Responders (3.14-3.15)

All emergency responders, especially police, fire, emergency medical, and rescue squads, should carry basic traffic control and incident management equipment in their vehicles and apparatus. TDOT and the Department of Safety should develop a list of basic equipment for agencies that respond to freeway incidents. Concurrently, the partner state agencies should evaluate group-purchasing options, possible grants programs, or other means to ensure that all Tennessee responders have access to the basic equipment.

Establish an Integrated Information System for Major Freeway Disruptions (3.16-3.18)

An integrated information system is needed to support the systematic improvement of incident management. Currently, many different state and local agencies collect and store information about their respective responses to freeway incidents, often recording identical information. However, the various information systems are not integrated. Also, much of the information is recorded manually and is difficult to retrieve.

As a first step, TDOT, TEMA, and the THP could conduct a pilot project for one area of the state. The information collected and reported should include the times required for the key phases of incident response, most importantly the elapsed time from incident occurrence to clearance of the scene.

Survey Emergency Communication and Incident Response Agencies to Determine the Effectiveness of Interstate Emergency Reference Markers and Overhead Structure Signs (3.19-3.20)

Without a street numbering system, reporting the location of a freeway incident can be very difficult and is frequently confusing for motorists and for emergency responders. To compensate for the lack of addresses, TDOT has installed emergency reference markers at 2/10-mile intervals on Interstate highways in Chattanooga, Knoxville, Memphis, and Nashville. Also, in Chattanooga and Memphis, signs have been placed on structures over the Interstate to identify the cross street. Similar signs are being installed in Knoxville and Nashville.

TDOT should survey the 911 centers, other public safety answering points, and incident response agencies in the four metropolitan areas to determine the effectiveness of both types of signs, the emergency reference markers and overhead structure signs. Depending on the results, TDOT should consider adding similar signs on non-Interstate freeways in the

metropolitan areas, on Interstates in some of the other urban areas, and on selected segments of the rural Interstate system.

Institutionalize Effective Incident Management Practices (3.21)

As noted in Chapter 3, interagency coordination for incident management in Tennessee has improved significantly in recent years. However, much of that improvement can be attributed to the work of a few individuals within each organization. Those “champions” have promoted new ways of doing business and have used their influence to facilitate better incident management. However, when those people move on to other positions, other employers, or to retirement, what will happen?

As much as possible, the policies, procedures, and practices that support incident management, quick clearance, and the associated benefits need to be incorporated in formal job descriptions, manuals, guidelines, general orders, and other documents that guide or control daily operations. By institutionalizing these policies, procedures, and practices, the improved organizational performance will continue even after the initial champions have moved on.

4. Expand and Enhance Training for Highway Incident Responders

The recommendations heard most often in meetings and discussions about incident management in Tennessee all relate to training—more and better, interagency and interdisciplinary. The recommendations listed in Table 4 and described below would improve training for highway incident responders.

Develop Tennessee Highway Incident Management Reference Manual (4.1-4.2)

To support all of the following recommendations for training, a basic resource document is needed to set forth key concepts and principles, definitions that are meaningful for all responders, descriptions of partner organizations and their respective roles and responsibilities, copies of applicable state laws, regulations, and operating procedures, and sources for additional information and assistance. The manual should be regularly updated and supplemented to address current topics.

Incorporate Incident Management Training in Law Enforcement and Fire Academy Courses (4.3-4.7)

The basic concepts of highway incident management should be part of the initial training for all Tennessee law enforcement officers and fire fighters, and those basic concepts should be reinforced during in-service and other recurrent training. TDOT has already worked with several of the law enforcement training academies and, with assistance from the Department of Safety, should develop formal arrangements with all of the state’s law enforcement academies. The Tennessee Fire Service and Codes Enforcement Academy has offered to work with TDOT to develop concepts and techniques for fire services and then develop training materials and begin using those materials as part of fire services training.

Table 4: Expand and Enhance Training for Highway Incident Responders

Immediate (Year 1)	Short Term (Years 2-3)	Longer Term (Years 3-5)
4.1 Develop a <i>Tennessee Highway Incident Management Reference Manual</i> as a training and information resource for incident responders	4.2 Update and revise the manual as needed	
4.3 Develop and test training materials to introduce basic incident management concepts in all state and local police academies (initial officer and recurrent training)	4.4 Integrate basic incident management training in all law enforcement training	
4.5 Work with the Tennessee Fire Service and Codes Enforcement Academy to develop effective training concepts and techniques to deliver basic incident management training for fire services	4.6 Develop and test training materials to introduce basic incident management concepts in all state and local fire academies (initial and recurrent training)	4.7 Integrate incident management training in all training for fire services
	4.8 Develop and offer “Train the Trainer” programs for the state and local police and fire academies	4.9 Develop and offer “Train the Trainer” programs for Tennessee rescue squads and volunteer fire departments
		4.10 Develop and test “Scene Management” and other advanced topic training courses for all incident responders
4.11 Develop a pilot “Train Together” course in one urban area—for towing and recovery operators, fire, police, law enforcement, and transportation	4.12 Implement the pilot course, adjust as needed, and offer in other areas	
		4.13 Sponsor training for towing and recovery operators

Develop Train-the-Trainer Programs (4.8-4.9)

The NHI Incident Management course has been offered numerous times in Tennessee, and all of those sessions have been well received, with full classes and positive evaluations. Also, as noted above, TDOT has conducted or sponsored incident management training as “special topics” at state and local law enforcement academies, and the feedback from officers and troopers has been very positive.

However, the NHI and TDOT sessions have reached only a small percentage of Tennessee’s law enforcement officers, and an even smaller percentage of fire fighters, rescue squad members, and other incident responders. Information about incident management could be

delivered more effectively and efficiently through train-the-trainer initiatives—relying on the network of experienced trainers within the law enforcement, fire services, emergency medical, and rescue squad communities.

One of the challenges is that many trainers feel pressed to force too many subjects and too much material into too few hours of allotted training time. Accordingly, the incident management course(s) and materials should be concise and easily integrated with other curriculum. A representative group of trainers should be actively involved in developing the new training resources.

Develop Advanced Training Programs for Incident Responders (4.10)

As soon as the basic components of incident management training are in place or moving forward on a broad front, work should begin on advanced-level training courses. The advanced training should address topics such as scene management, application of the Incident Command System for highway incidents, use of emergency lights, quicker handling of hazardous materials and spilled cargo, implementing detours, improved tools and procedures for investigations, major evacuations, and other topics identified by incident responders and trainers.

Develop “Train Together” Programs for All Incident Responders (4.11-4.12)

Incident management cannot be effective unless all of the responders *work together*. To learn how to work together more efficiently, especially at incident scenes, responders need to *train together*. The lead state agencies should develop a course that brings together law enforcement, transportation agencies, fire and emergency medical services, and towing and recovery operators. The course should focus on the aspects of incident management that require interaction, and one of the goals should be that each group of stakeholders leaves the training with a better understanding of the priorities and challenges faced by each of the other stakeholder groups.

Support Training for Towing and Recovery Operators (4.13)

Towing and recovery operators are essential partners for effective highway incident management. To strengthen the working relationships, state agencies should support basic incident management training for towing and recovery operators. To some extent the training could address effective use of towing and recovery equipment, but training on those topics is available through commercial sources. The recommendation here is to focus on safety, scene management, and the importance of quick clearance.

5. Support Highway Incident Management Teams in Metropolitan and Urban Areas

In Tennessee’s metropolitan and large urban areas, local agencies have considerable resources for incident management and for overall transportation planning, management, and operations. Under most circumstances, leadership for incident management teams in these areas should come from local agencies. However, state agencies also have important roles as part of the incident management teams in the respective metropolitan and large urban areas, and state agencies will need to take the lead on some issues. The state agencies should

encourage and support the local incident management teams in all of the ways described below in Table 5.

Table 5: Support Highway Incident Management Teams in Metropolitan and Urban Areas

Immediate (Year 1)	Short Term (Years 2-3)	Longer Term (Years 3-5)
5.1 Actively participate with established teams in Chattanooga and Memphis; encourage more formal coordination among state and local agencies in Knoxville and Nashville	5.2 Encourage multi-year incident management plans for the four largest metropolitan areas; negotiate and execute interagency agreements among state and local agencies	5.3 Consult with metro incident management teams on all major transportation issues; help establish teams as needed in smaller urban areas, beginning with Jackson and Tri-Cities
	5.4 Expand and enhance incident management coordination with state and local agencies in Georgia, Arkansas, and Mississippi	5.5 Expand and enhance incident management coordination with state and local agencies in Kentucky and Virginia
5.6 Develop guidelines and procedures to prepare for long-term freeway closures in urban areas, e.g., communication plans and alternate routes	5.7 Identify alternate routes for freeway closures and prepare rerouting plans in Chattanooga and Memphis	5.8 Identify alternate routes for freeway closures and prepare rerouting plans in Knoxville and Nashville
	5.9 Begin making improvements to alternate routes as warranted (e.g., signing, intersection modifications, traffic signal timing)	
5.10 Develop and conduct a pilot incident management exercise for one metropolitan area	5.11 Conduct at least one incident management exercise in Chattanooga, Knoxville, Memphis, and Nashville	5.12 Conduct biennial incident management exercises in all urban areas over 50,000 population
5.13 Facilitate coordination among HELP, DOS, TEMA, other state agencies, local law enforcement agencies, Traffic Management Centers (TMCs), traffic reporters, towing and recovery operators, fire and emergency medical services, emergency management agencies, hazardous material responders, and other stakeholders		

Actively Participate with Teams in the Metropolitan and Large Urban Areas (5.1-5.3)

State agencies should actively participate with local and regional incident management teams in the metropolitan and large urban areas. The state agencies should be active members of the established teams in Chattanooga and Memphis and should encourage more formal coordination among state and local agencies in Knoxville and Nashville. The state agencies should assist in preparing multi-year incident management plans for at least the four largest metropolitan areas, and should negotiate and execute formal agreements with local agencies when requested. Also, the state agencies should consult with the local and regional incident management teams on all major transportation issues with implications for incident management. In the three-five year time frame, the state agencies should help establish teams in smaller urban areas.

Coordinate with Adjacent States (5.4-5.5)

Tennessee shares common borders with eight states, and Interstate highways cross all eight of those borders. Five of those connections are in urban areas. In Chattanooga (Tennessee and Georgia) and in Memphis (Tennessee and Mississippi), heavily developed urban areas have obscured the boundaries between the states. The same patterns are developing in the Clarksville and the Tri-Cities areas. The boundary between Tennessee and Arkansas intersects two major bridges spanning the Mississippi River. In all five cases, incidents in one state quickly impact the neighboring state. Incidents “on the line” often require responses from both states.

TDOT, DOS, TEMA and all of the Tennessee agencies have counterparts in the adjacent states and should seek support from their counterparts for their respective incident management programs. Where appropriate, formal agreements should be developed. The Tennessee state agencies should use the local incident management team meetings and planning processes to develop and maintain close working relationships with their operational counterparts in the other states.

Prepare for Long-Term Freeway Closures (5.6-5.8)

Traffic volumes in the metropolitan areas have grown to the point that even short-term closures cause long traffic backups. Transportation and law enforcement officials must decide whether to let the backup grow indefinitely or to divert the traffic off the freeway to surface streets. That decision can mitigate the problem or make matters worse from a corridor or area-wide perspective. Adding freeway traffic to surface streets will introduce new problems.

To help guide those decisions and to facilitate safe implementation, guidelines and procedures should be developed for long-term freeway closures in the urban areas. The components should include criteria for selecting alternate routes, methods for implementing diversions, ways to mitigate problems on surface streets, and a template for communicating with the media and the public during such events.

The first application of these guidelines and procedures should be for a segment-by-segment evaluation of the freeways in Chattanooga and Memphis. The end product should include rerouting and communication plans. Based on the experiences in these two cities, the guidelines and procedures should be adjusted and then applied in Knoxville and Nashville.

Improve Alternate Routes (5.9)

Spot improvements along alternate routes can pay large dividends under emergency conditions. Roadway or intersection features that are minor annoyances under normal conditions can become major bottlenecks when traffic volumes increase to several times the normal levels. Adding a turn lane, upgrading traffic signals, improved signing, or more extensive improvements may be warranted based simply on the improved traffic flow and safety during emergencies. In other cases the emergency benefits may be enough additional justification for an improvement needed for day-to-day operations.

Once the alternate routes have been identified (5.6-5.8), work should begin to improve those routes for emergency operations. In some cases, plans will already be available for specific

projects that can be added to the priority lists for funding. In other cases, alternatives will have to be developed and evaluated.

Develop and Implement Exercises and Drills (5.10-5.12)

Periodic drills and exercises should be conducted in each metropolitan area to test the practicability of the planning and coordination work described above. A pilot project should be launched in the first year, and a routine cycle should be established for at least a “table top” exercise in each area during each year and more extensive exercises every two-three years in each urban area. Also, the state and local agencies responsible for transportation should be active participants in all emergency preparedness drills and exercises.

Facilitate State-Local Coordination (5.13)

The final recommendation under this category is by far the broadest but nonetheless important. Regardless of local or regional incident management teams, formal agreements, alternate route plans, or other institutional arrangements, all of the stakeholders, state and local, should work to facilitate state-local coordination. Sharing of information and resources should be encouraged on a day-to-day basis as well as during emergencies. Part of each team meeting should be devoted to general briefings and sharing of information of mutual interest.

6. Sponsor Highway Incident Management Teams in Rural Areas

For the rural Interstate corridors, state agencies should sponsor and lead highway incident management teams. In most of the rural areas, local governments have limited resources for major incidents, and the available resources are clustered near local population centers and not necessarily near the Interstate highway. The proposed tasks are listed in Table 6 and described below.

Identify Highest Priority Corridors and Establish Teams (6.1-6.3)

One or two priority corridors should be selected to develop and test approaches that can then be used on a statewide basis. State agencies should establish a system to prioritize the rural freeway corridors. The system should be continually adjusted based on experience and the best available information, considering:

- Traffic volumes
- Frequency and severity of incidents
- Resources available for incident management
- Previous difficulties with coordinated incident management
- Potential for secondary impacts (e.g., backups that affect other highways)
- Security implications

In selecting the first corridors, an additional factor should be considered—local officials and incident responders should be convinced of the need for a team approach and committed to active participation.

Corridor team members will vary depending on the corridor, but normally should include at least representatives from the following:

- Law enforcement agencies
- Fire services
- Emergency medical services
- Rescue squads
- Towing and recovery operators
- Emergency communications agencies
- Emergency management agencies
- Hospitals
- Public works agencies
- News media

In some cases, the team might include city or county managers, representatives from businesses at major interchanges, schools and other institutions along alternate routes, other land owners, or utility companies. The state agencies on the team should include at least the Department of Safety, the Department of Transportation, and TEMA.

Table 6: Sponsor Highway Incident Management Teams in Rural Areas

Immediate (Year 1)	Short Term (Years 2-3)	Longer Term (Years 3-5)
6.1 Identify highest priority corridors/locations in rural areas and establish formal teams for one or two corridors	6.2 Develop communications and response plans for the first one or two priority corridors	6.3 Establish teams and response plans in other corridors
6.4 Sponsor NHI course(s) for the priority corridor(s)	6.5 Sponsor NHI courses for other corridors	6.6 Provide or sponsor on-site training to meet unique corridor needs
	6.7 Develop and maintain a 24/7 roster of emergency response agencies and other incident responders for the priority corridors	6.8 Develop and maintain 24/7 rosters for all corridors
	6.9 Identify alternate routes for freeway closures and prepare rerouting and incident response plans for the highest priority corridors	6.10 For all corridors identify alternate routes for freeway closures and prepare rerouting and incident response plans
	6.11 Begin improvements to alternate routes as needed (e.g., signing, intersection modifications, traffic signal timing)	
	6.12 Specify, acquire, and pre-position incident response equipment for each corridor	
	6.13 Expand and enhance incident management coordination with state and local agencies in Alabama, North Carolina, and Missouri	
	6.14 Develop and conduct a pilot incident management exercise for one corridor	6.15 Conduct incident management exercises for other priority corridors

Promote Incident Management Training and Exchange of Information (6.4-6.6)

Training has already been discussed as a statewide priority, but the focus here is on delivering training as soon as possible using resources that already exist as well as new resources that may be developed over time. As soon as the priority corridors are selected and team members are identified, the National Highway Institute (NHI) Incident Management Workshop, or a similar introduction to incident management, should be offered for all stakeholders. Immediately following the NHI course, local stakeholders should identify other needs for training and exchange of information.

Develop and Maintain 24/7 Rosters and Inventories of Resources Available for Incident Response (6.7-6.8)

Most 911 centers as well as emergency management and law enforcement agencies already maintain a 24/7 contact list for emergencies within their jurisdiction. The recommendation is to ensure that such lists are available along all segments of the rural Interstate highway system regardless of city and county boundaries. The lists should be frequently updated and widely distributed among all incident responders along the corridor, and the list should include information about the equipment and other resources available through each organization or private company. The list should be accessible to authorized personnel via the Web and should use utilize Geographic Information System (GIS) technology.

Prepare for Long-Term Freeway Closures (6.9-6.10)

Just as for the metropolitan areas, detailed contingency plans should be prepared for major closures along all segments of the rural Interstate system. Beginning with the priority corridors, alternate routes should be identified for closures of each segment (i.e., between each set of interchanges), including step-by-step instructions for the placement (and subsequent removal) of traffic control devices and detour signs, communication plans, assignment of agency responsibilities, procedures to mitigate the adverse impacts, and contingencies based on the duration of the closure. The plans should be well documented and reviewed at least annually.

Begin Improvements to Alternate Routes as Needed (e.g., Signing, Traffic Signal Timing, and Intersection Modifications) (6.11)

For the same reasons as in the metropolitan and urban areas, spot improvements along alternate routes can pay huge dividends under emergency conditions. Potential problems and opportunities should be identified during the planning for each corridor, and improvements should begin as soon as possible.

Acquire and Pre-Position Incident Response Equipment (6.12)

Based on the preceding tasks (6.9-6.11), equipment and supplies should be purchased and pre-positioned to mitigate the impacts of freeway closures. The types and quantities of equipment and supplies should meet the unique needs of each corridor, but might include:

- Traffic signs, cones, barricades, and flares
- Customized detour signs and trailblazers

- Temporary warning and directional signs
- Portable changeable message signs
- Highway advisory radio transmitters
- Work and emergency warning lights
- Generators
- Fuel and fuel containers
- Spill containment equipment
- All-terrain vehicles, boats, or other vehicles for critical access

Coordinate with Adjacent States (6.13)

Three of Tennessee's Interstate highway connections with other states are in primarily rural areas, and incident management is important for all three. The I40 connection between Tennessee and North Carolina, with an average daily traffic of approximately 25,000 vehicles, has seen numerous closures, some long-term, because of snow and ice, rockslides, and crashes. The I-65 connection with Alabama is the only situation where the major land use and economic development is on the other state's side of the line (Athens, Decatur, and Huntsville), but major incidents have significant impacts in Tennessee. The I-155 link with Missouri has the lowest traffic volumes of the three (approximately 10,000 vehicles per day), but problems on the bridge over the Mississippi River require coordinated action in both states, and the effectiveness of the response can impact traffic in Arkansas and Kentucky as well as in Missouri and Tennessee.

Develop and Implement Exercises and Drills (6.14-6.15)

Just as in the metropolitan areas, periodic drills and exercises should be conducted for rural corridors, beginning with one pilot project in a priority corridor during the two-three year time frame. State agencies should provide leadership as needed, but all of the local agencies that would respond to an actual incident should be encouraged to participate in planning as well as in executing the exercise.

7. Accelerate Deployment of New Technologies to Improve Incident Management

New and emerging technologies, especially information technologies, can improve the effectiveness and the efficiency of highway incident management. Recognizing that the technologies should not drive the programs, a number of tasks to improve incident management are listed in Table 7 and described below.

Coordinate with ITS Plans and the Technology Plans for THP, CVE, TEMA, and Local Agencies (7.1-7.2)

Planning for technology to support highway incident management should be closely coordinated with other initiatives that involve the same or related technologies. These other initiatives include Intelligent Transportation System (ITS) planning for TDOT and MPOs as well as technology planning for the Department of Safety, TEMA, local traffic management centers, law enforcement, and fire services. Technology should be one of the topics for the conferences recommended under Tasks 10.8-10.9, and the state agencies should regularly share information as part of the ongoing planning process for highway incident management.

Table 7: Accelerate Deployment of New Technologies to Improve Incident Management

Immediate (Year 1)	Short Term (Years 2-3)	Longer Term (Years 3-5)
7.1 Coordinate with ITS plans and technology plans for THP, CVE, TEMA, local agencies	7.2 Promote ongoing coordination and integration of existing and proposed technologies that impact incident management	
7.3 Install CCTVs at strategic locations in Chattanooga, Knoxville, and Memphis	7.4 Expand CCTV coverage in Knoxville and Nashville	7.5 Establish CCTV coverage on all urban routes with traffic in excess of 40,000 AADT
	7.6 Install CCTVs at three-four rural locations to be selected	7.7 Install CCTVs at other strategic locations in rural areas
	7.8 Extend CCTV control capability to 911 centers and other PSAPs	
	7.9 Develop plans to integrate law enforcement CAD systems with TMCs in Chattanooga, Knoxville, Memphis, and Nashville	7.10 Begin integration of CAD and TMC systems
		7.11 Establish a statewide transportation management center with links to other state and local TMCs, TDOT, TEMA, and THP
7.12 Investigate benefits and costs of ITS applications at “Tennessee Gateways” and other non-urban locations	7.13 Develop plans for permanent CMSs at strategic locations outside of urban areas (e.g., major gateways and critical decision points)	7.14 Install CMSs at selected sites and evaluate effectiveness
7.15 Develop guidelines and procedures for use of portable Changeable Message Signs (CMSs)	7.16 Deploy 8-10 portable CMSs for incident management and evaluate performance	7.17 Deploy additional CMSs as warranted
	7.18 Develop guidelines for use of portable Highway Advisory Radios (HARs) for incident management	7.19 Deploy 3-5 portable HARS and evaluate performance
	7.20 Evaluate “photogrammetry” and other technologies for fatal and felony crash investigations	7.21 Deploy or test other new technologies/procedures to facilitate accident investigation on Tennessee highways
		7.22 Evaluate experiences in other states with the use of CCTVs for law enforcement and security on major highways
		7.23 Sponsor a set of coordinated demonstration projects using GIS and GPS technologies to assist law enforcement agencies, TDOT, TEMA, and other responders

Install Additional Closed Circuit Television Cameras (CCTVs) and Gain Maximum Advantages from CCTV (7.3-7.8)

TDOT reports that the CCTVs installed in Nashville have improved the effectiveness and the efficiency of the HELP program and overall incident management, even without the other advantages of a fully implemented TMC. When a HELP operator or a police officer encounters a traffic backup, the CCTVs can be used to identify the problem and ensure appropriate response. Likewise, when a cell phone caller or other source identifies a problem, the cameras allow immediate confirmation of the exact location, severity, and other circumstances of the incident. The cameras can also be used to identify the best approach route for responders and to monitor progress at the incident scene.

TDOT does not yet have TMCs in the other cities, but CCTV images could be monitored and controlled in the HELP dispatch offices in Chattanooga, Knoxville, and Memphis until full-scale TMCs are in operation. Currently, using telephones and two-way radios, the HELP dispatchers in those offices send and receive incident information with the local 911 centers, police, fire and emergency medical services, towing and recovery operators, traffic reporters, the Tennessee Highway Patrol, TDOT maintenance forces, and, of course, the HELP operators. In fact, the Nashville CCTVs were controlled in the HELP dispatch office for almost a year before the TMC opened.

The CCTV images available in Nashville have also proven useful for motorists and are frequently used as part of traffic reports on commercial TV stations. TDOT reports that the cameras have been visited on the department's web page more than 500,000 times through the end of February 2003. Also, the Web pages for all of the commercial television stations in the Nashville area have links to the cameras, and all four stations plan to use live feeds from the cameras in the future. Similar levels of use should be expected in Chattanooga, Knoxville, and Memphis. Also, having real-time information from all four cities would allow an almost instantaneous assessment of statewide traffic and weather conditions.

In the three-five year period, TDOT's CCTV coverage should be expanded to include more of the heavily traveled sections of urban freeways, using 40,000-50,000 annual daily traffic as the threshold for coverage. This would add cameras in the four largest metropolitan areas as well as some sections of the Interstate highway in other cities, possibly including Clarksville, Cleveland, Cookeville, Jackson, Johnson City, Murfreesboro, Smyrna, and others.

In the meantime, the benefits of CCTV in rural areas should be tested by installing cameras at three or four pilot locations. TDOT and Department of Safety (DOS) field personnel should identify candidate locations, and the pilot sites should be selected to gain experience with a variety of circumstances. Possibilities include all of the following:

- I-24 on Monteagle Mountain
- I-40 in the Monterey and Rockwood areas
- I-75 in Campbell County
- I-40/I-81 Interchange
- I-40/Tennessee River in West Tennessee
- I-40 at Paul Barrett Parkway
- I-65 at Saturn Parkway
- I-75/Hiwassee River
- I-155 at the Mississippi River
- I-24 in Cheatham County

More than one camera might be needed at some locations. Monitoring and control of the images should be carried out at local TDOT or DOS facilities until the statewide traffic center is operational. (See Task 7.11 below.) The images should also be available to the public via the Web (See Task 2.8).

TDOT should establish standard protocols for law enforcement, emergency communication, and emergency management agencies to pan, tilt, and zoom the CCTV cameras when not being used by TDOT. TDOT should have first priority use of the cameras, but other agencies should be able to use the cameras for their purposes subject to limitations regarding personal privacy.

Integrate Law Enforcement Computer Aided Dispatching Systems with Traffic Management Centers in Metropolitan Areas (7.9-7.10)

By integrating the law enforcement computer aided dispatch (CAD) systems in the metropolitan areas with the traffic management systems operated by TDOT and local agencies, all of the agencies can have immediate access to data needed for more effective incident management and to support other important missions. Of course, the CAD data needs to be screened to provide only traffic-related information, and law enforcement agencies will only want selected data from the traffic management centers. Planning should begin in the two-three year period with the first steps toward integration in the three-five year period. (Note: the Metro Nashville Police Department currently posts CAD information about traffic accidents on the department's Web page.)

Establish a Statewide Traffic Management Center (7.11)

Within the five year planning period a statewide traffic management center will be needed to receive, analyze, and distribute information from the numerous sources that are already in place, in the planning or design stages, or included in other parts of this plan. The center is envisioned as a location where information from state and local sources can be brought together, evaluated from a statewide perspective, and used to assist in statewide decision making. Information would be collected from the local TMCs, the remote CCTVs, weather monitoring sites, TDOT field offices, TEMA, and other sources. Information with statewide significance would then be processed and packaged to meet the specific needs of different stakeholders and shared with the local TMCs, rest areas and welcome centers, Tennessee Emergency Management Agency (TEMA), and other agencies. The state center would also support statewide 511 services (Task 2.23) and would provide 24/7 dispatching services for TDOT's radio communications.

Expand the Use of Changeable Message Signs, Highway Advisory Radios, and Other ITS Technology to Serve "Gateways" and Other Decision Points on the Rural Interstate System (7.12-7.14)

Currently, Interstate backups can exist for hours without motorists receiving any advance notice. The first indication of a problem is when they reach the back of the queue and, hopefully, come to a safe stop. In some cases, if motorists had known about the problem in advance they could have adjusted schedules or routes to minimize their own delay and thereby reduce congestion and related problems at the incident scene.

The recommendation is to evaluate each of the Interstate gateways to Tennessee along with critical decision points on the rural Interstate system (e.g., points where motorist could decide to choose an alternate route) and evaluate the benefits and costs of using ITS to provide information for motorists. One component would be the installation of changeable message signs (CMSs) in the three to five year time period to provide traffic information to motorists as soon as they enter Tennessee and/or at locations where they can make informed decisions in response to incidents.

Deploy Portable Changeable Message Signs (7.15-7.17)

In addition to the permanent CMSs, portable versions should be deployed statewide for use during freeway closures or long delays and for other emergency situations and special events. The recommendation is to deploy eight-ten units during the two-three year period, using the first year to develop guidelines for use of portable CMSs.

Deploy Portable Highway Advisory Radios (7.18-7.19)

Highway Advisory Radio (HAR) uses FCC-licensed, low-power radio transmitters to deliver site-specific information via AM radio. Permanent HARs are in place (e.g., for airport information) at a few locations in Tennessee, and TDOT plans to install several permanent HAR units as part of the Knoxville ITS project.

The recommendation here is to acquire three to five portable HARs for deployment at major incidents that require extended closures and use of alternate routes. The portable HARs could also be used for special events, emergencies, or other situation where motorists need more information than can be displayed on signs. The recommended first step is to develop guidelines for the use and maintenance of the HARs as well as procedures to evaluate their effectiveness when deployed.

Evaluate “Photogrammetry” and Other Technologies for Fatal Crash and Felony Investigations (7.20-7.21)

Another potential application of new technologies is in the investigation of major traffic crashes where law enforcement officers must collect precise and detailed information. Already, some agencies in Tennessee report success with the use of “Total Station.” In other states, agencies report that “photogrammetry” allows an even greater reduction in the time required to gather data and corresponding reductions in the time that traffic is snarled and officers are exposed to traffic hazards. However, photogrammetry usually requires more “office time.” Other improvements may be possible through global positioning system technology, geographic information systems, hand-held data collectors, or other technology. The recommendation is for a systematic effort to identify potential technologies, conduct field tests that will be meaningful to law enforcement agencies statewide, and promote wide scale deployment.

Evaluate Experiences of Other States with Video Enforcement (7.22)

The technology is available to enforce traffic laws using video cameras. From the law enforcement perspective this would be a more efficient and much less hazardous way to

enforce traffic laws. From a transportation perspective this would reduce the impact on traffic flow. Also, the additional cameras and higher quality images would enhance security.

Some citizens and elected officials have expressed reservations about “video enforcement,” but law enforcement and transportation officials should evaluate and remain current with experiences in other states and other countries. Those experiences and changing circumstances could lead to more support for the use of cameras for traffic law enforcement.

Sponsor Demonstration Projects Using GIS, GPS and Other Technologies (7.23)

Almost all of the information needed for incident management relates to “location”—the site of the incident, location of potential incident responders, location of fire hydrants, drainage inlets, median crossovers, or other infrastructure, proximity of hospitals, the back of the traffic queue, and the location of responders in-route or at the scene. New technologies and new applications of technology can save time in collecting data with spatial components and can improve the accuracy of that data. Geographic positioning systems (GPS), geographic information systems (GIS) technology, and other information technologies, coupled with ever improving communications technologies, could be used by every response agency to better perform their respective tasks and to improve overall incident management.

The state agencies should look for ways to combine resources, pursue grants from federal agencies, and provide technical and financial support for pilot projects to use GPS, GIS, other information technologies, and digital communications for improved incident management. Sponsored projects might involve only one or two state agencies, but priority should go to projects that involve multiple agencies at all levels of government.

8. Reduce Traffic Congestion Caused by Highway Work Zones

Highway work zones—for construction, maintenance, and emergency repair—cause congestion and are often hazardous to motorists as well as highway workers. Motorists seem to have a low tolerance for congestion caused by work zones, especially when the delays are unexpected and appear to have been unnecessary. Transportation agencies quickly lose their credibility when, on one hand, they fight to reduce congestion caused by crashes, debris, special events, and other causes, but, on the other hand, neglect the management of a work zone and tolerate the resulting delays. The recommended tasks are listed in Table 8 and described below.

Make the Mitigation of Adverse Work Zone Impacts a Top Priority (8.1-8.2)

The overarching recommendation is for TDOT and other state and local agencies to focus their resources on reducing the adverse impacts of work zones—unnecessary delays, unreliable travel times, motor vehicle crashes, and worker casualties. To quantify the importance of these adverse impacts and to measure progress, TDOT should publish and distribute an annual report on the statewide impacts of work zones on highway user costs, motor vehicle crashes, and worker safety. The first step is to begin collecting that information as part of all projects or through sampling of representative projects.

Table 8: Reduce Traffic Congestion Caused by Highway Work Zones

Immediate (Year 1)	Short Term (Years 2-3)	Longer Term (Years 3-5)
8.1 Intensify efforts to reduce the impact of highway work zones on congestion and travel time reliability and to improve work zone safety for motorists and workers		8.2 Prepare an annual report on the statewide impacts of work zones on highway user costs, motor vehicle crashes, and worker safety
8.3 Involve law enforcement officers in “Pre-Construction Meetings” for all freeway projects	8.4 Develop standard procedures for effective involvement of law enforcement agencies in all stages of highway project planning, design, and construction	8.5 Implement and refine procedures; assign ongoing responsibilities to TDOT managers and law enforcement personnel
8.6 Survey other states to identify best practices for involvement of <i>all</i> emergency response agencies in work zone planning and management	8.7 Implement pilot projects to involve all emergency response agencies in planning for work zone incidents, including on-site inspections and drills	8.8 Based on results of pilot projects, establish procedures to involve incident responders in planning for work zone incidents
8.9 Develop guidelines for specifying night and weekend construction as well as contractor incentives and disincentives to minimize traffic disruptions	8.10 Implement standard procedures for work zone planning, design, and operation; incorporate those procedures in specifications, contract provisions, job responsibilities, and other documents	8.11 Incorporate penalties in construction contracts for unapproved lane closures, inaccurate signing, and other disruptive or unsafe practices
8.12 Evaluate alternative decision support tools and procedures for work zone planning and scheduling (e.g., Quick Zone)		8.13 Enhance and refine procedures and requirements as needed
8.14 Support TDOT’s Community Relations Division and ITS initiatives to provide timely and accurate information about work zones		8.15 Require contractors on major projects to provide real-time information about lane closures
		8.16 Implement work zone incident management training for TDOT, contractor, and police personnel

Involve Law Enforcement and Other Emergency Response Agencies in Work Zone Planning and Management (8.3-8.8)

Law enforcement agencies, fire and emergency medical services, towing and recovery operators, and other incident responders should be actively involved in every stage of work zone planning and management. As the first step in that direction, local law enforcement officers should participate in “pre-construction” meetings on all freeway projects. All of the participants should agree on details for incident management within and near the work zone during each phase of the project. Law enforcement representatives should be consulted, during the meeting and subsequently, on all matters related to lane closures.

Building on the initial work with law enforcement agencies during the pre-construction meetings and actual work zone management, procedures should be developed to involve all

emergency response agencies in all phases of highway planning, design, and management. Experience with different approaches can be found in other states, and pilot projects should be used to adapt those practices to situations in Tennessee.

Improve the Planning and Management Processes for Work Zones and Implement Contractor Incentives to Minimize Adverse Impacts (8.9-8.13)

Standards, procedures, and tools are needed to improve the planning and management of highway work zones. Alternative designs, construction techniques, and scheduling should be thoroughly evaluated, recognizing tradeoffs between construction costs and the costs of lane closures during construction. For each major project, consideration should be given to provisions that would minimize disruptions, e.g.:

- Allowing only night, weekend, or other off-peak work
- “Lane rental” provisions to discourage unnecessary blockages
- Incentives for the contractor to finish the job ahead of schedule and disincentives for late completion
- Requirements for contractors to always provide adequate notice before blocking traffic

Contract specifications for traffic control should be comprehensive and consistently enforced. Other issues that need to be addressed and then revisited on a periodic basis include:

- Effective use of law enforcement officers in or near work zones
- Effective use of tow trucks stationed at work zones to handle incidents
- Comprehensive scheduling of projects in the same corridor to avoid cumulative effects
- Guidelines for when to use and how to implement “rolling” road blocks
- Contingency planning for incidents within work zones

Improve the Accuracy and Timeliness of Work Zone Information Needed by Motorists (8.14-8.15)

TDOT is already moving forward with the application of new technologies and more widespread dissemination of information about work zone locations and scheduled lane closures as well as traffic incidents. Those advances, using GIS and the Web, should be supported and continued. Motorists’ expectations for accurate and timely information about work zones will continue to increase as they see improvements in the information available to help manage other aspects of their business and personal lives.

The end goal is to provide real-time information about work zones. In the three-five year time frame, TDOT should require contractors on major projects to provide real-time information about traffic conditions at their freeway work sites and require immediate notification of any unscheduled disruptions, using state-of-the-art technology.

Implement Work Zone Incident Management Training for TDOT, Contractor, and Police Personnel (8.16)

All of the above notwithstanding, each work zone is unique, and problems sometimes cannot be avoided. The people on the scene, primarily the people representing the contractors, TDOT, and law enforcement, must make important decisions without time to consult with

superiors, contract documents, or specifications. Therefore, training is needed to ensure that on-scene project managers understand the impacts of lane blockages and other disruptions and that these managers know how to mitigate problems that cannot be avoided. (Coordinate with Tasks 4.1-4.13)

9. Establish Working Groups to Focus on Specific Issues and Recommend Actions

Some of the most important incident management issues identified during the statewide planning process need more focused study and more intensive involvement by key stakeholders before specific recommendations are advanced. To develop those recommendations, working groups should be formed to address the following topics:

- Notification of highway incidents and communication among incident responders
- Management of hazardous material spills
- Communication between incident responders and the news/traffic media and from the media to motorists and the public
- Towing and recovery response to major incidents
- Links between incident management and emergency medical care
- Coordination with the trucking industry
- Traffic law enforcement on freeways

All of these topics are important, but addressing them all at the same time would be very difficult for agencies that need to be involved with all of the groups. Accordingly, Table 9 shows the recommended staging for the groups. However, the final decisions about which groups to convene immediately should be influenced by the level of interest among the respective stakeholders and their willingness to be active participants.

Notification of Highway Incidents and Communication among Incident Responders (9.1)

Communication is a key component in every phase of incident management, from the initial notification and verification of the incident, through dispatching, initial arrival at the scene, on-scene communication, traffic control at the scene and throughout the corridor, and the eventual clearance of the scene. Technology, including interoperability of radio systems, is one of the challenges, but many others are also significant. Institutional, procedural, training, and funding issues, as well as competing priorities can affect the effectiveness of incident communication. Many of the issues can best be resolved by the local incident management teams, but a statewide group is needed to set direction and priorities on a statewide basis and to support the local initiatives. This group should also provide a base of support for statewide implementation of E911, radio communication improvements, and other technological, funding, or regulatory improvements.

The membership of this group should include representatives from the Tennessee Emergency Communications Board, TEMA, the Department of Safety, TDOT, and a representative group of 911 centers, wireline and wireless communication carriers, emergency medical services, police and sheriff's departments, fire services, rescue squads, and towing and recovery operators.

Table 9: Establish Working Groups to Address Statewide Issues and Recommend Actions

Immediate (Year 1)	Short Term (Years 2-3)	Longer Term (Years 3-5)
<p>Convene groups to evaluate issues and make recommendations regarding:</p> <p>9.1 Incident notification and communication among incident responders</p> <p>9.2 Traffic impacts of hazardous material spills</p> <p>9.3 Best practices and guidelines for using police officers in work zones</p>	<p>Convene groups to evaluate issues and make recommendations regarding:</p> <p>9.4 Towing and recovery response to major incidents</p> <p>9.5 Links between incident management and emergency medical services</p> <p>9.6 Communication between incident management agencies and the news/traffic media and from the media to motorists and the public</p>	<p>Convene groups to evaluate issues and make recommendations regarding:</p> <p>9.7 Incident management coordination with the trucking industry</p> <p>9.8 Best practices for traffic law enforcement on freeways</p> <p>9.9 Other issues as needed</p>

Traffic Impacts of Hazardous Material Spills (9.2)

Incident management becomes much more complex and much more time consuming when a highway incident involves hazardous materials. Sometimes large-scale evacuations are necessary and sometimes the material is so hazardous that specialists must travel long distances before clearance can even begin. In the meantime, other responders must stand back to ensure their own safety.

These are all proper responses, but sometimes the material is not what it is was thought to be, was not as hazardous as originally thought, or different responders have different interpretations about the degree of risk and the most appropriate response. For instance, one persistent issue involves spilled diesel fuel. When a tractor-trailer overturns, diesel fuel frequently spills from the tractor’s “saddle tanks,” and such spills are sometimes treated as a “hazardous material” which requires special handling and longer closures.

These issues need to be addressed and resolved by a group including representatives from TEMA, a local EMA, the State Fire Marshall’s office, TDOT, DOS, Department of Environment and Conservation, and local responders. One of the goals should be to find solutions that balance the risks associated with expedited removal of the spilled material against the risks of leaving the roadway blocked.

Best Practices and Guidelines for Using Police Officers in Work Zones (9.3)

Law enforcement officers are frequently employed by transportation and public works agencies, highway contractors, utility companies, and others to work in or near construction work zones. The usual assumption is that the presence of officers will cause traffic to slow

down and make the work zone safer. In some cases the officers take a more active role in stopping or slowing traffic for temporary closures.

However, the agencies employing the officers are not always certain of what the officers' roles will be, and the officers are not clear on what is expected of them. Further, the officers may not have been consulted about traffic control practices within the work zone or know whether they have responsibility or accountability for traffic control. Some officers may not have received training in work zone traffic control.

The recommendation is to form a working group to address all of the issues surrounding the use of officers in work zones. The members of this group should include TDOT, the Department of Safety, and representatives from the Tennessee Road Builders Association, a utility company, and one or two local law enforcement agencies.

Towing and Recovery Response to Major Incidents (9.4)

Towing and recovery is a critical part of incident management, especially at scenes involving multiple vehicles, overturned trucks, extensive debris, complicated lifting or winching, or hazardous materials. Effective incident management requires that towing and recovery operators arrive when needed and with the proper equipment and well-trained personnel to operate the equipment. Other incident responders need to provide accurate information about the incident and provide support and cooperation during the towing and recovery process. Those basic goals are sometimes hard to achieve for many different reasons.

A group should be formed to focus on problems and opportunities and recommend actions. Questions to be addressed include the following. How can we ensure that the towing and recovery operators receive all of the needed information to mobilize the proper equipment and that the call for assistance is made as far in advance as possible? How can we better get the towing and recovery equipment around or through the traffic backup? What changes are needed to ensure that only towing and recovery operators with adequate equipment and well-trained operators are called to the scene of major incidents? What alternatives could be developed to replace the practice of "pay by the hour" and ensure that the towing and recovery operators can afford the equipment needed for freeway incidents?

The working group should include representatives from the towing and recovery industry, the trucking industry, emergency communications, the Department of Safety, and TDOT.

Links between Incident Management and Emergency Medical Services (9.5)

Motor vehicle crashes are among the leading causes of death in the United States, especially in age groups up to the mid-40s. Almost 1,200 fatal crashes and more than 50,000 injury crashes occurred in Tennessee in the year 2000. Important interactions must occur each day between the agencies and organizations responsible for emergency communications, emergency medical services, trauma care, and highway incident management. New and emerging technologies and practices may be able to improve those interactions, for the benefit of people with traumatic injuries as well as for more effective incident management.

The recommendation is to establish a group to identify and explore the most important opportunities and issues related to emergency medical services, trauma care, and incident management. Possible questions include the following: How might communications be improved between people at the scene of major incidents, responders in route, and the emergency rooms and trauma centers—to improve patient care and to facilitate scene management and clearance? What new technology, policies, or practices should be adopted? What is the feasibility of transmitting video images and digital information from the scene of major crashes directly to the nearest trauma center? What could be done to improve emergency medical response time along rural Interstates that are not close to population centers? What guidelines should local officials follow when deciding to request helicopter evacuations? What should we expect from “telematics” and what will be required to interface with emergency communication services? Are any new medications, techniques, or devices on the horizon that could speed extrication? Or, on the other hand, will more effort be made in the future to stabilize or treat patients at the scene, requiring more time at the scene?

The membership of this group should include the Division of Emergency Medical Services in the Department of Health, Tennessee Emergency Communications Board, TDOT, DOS, and a representative group of emergency medical service agencies, rescues squads, hospitals and trauma centers, and ambulance and air medical services.

Communication between Incident Management Agencies and the News/Traffic Media and Between the Media and Motorists (9.6)

Depending on the results of the pilot project (Tasks 2.1-2.5), a state-level working group may be needed to facilitate more widespread implementation of new procedures, working arrangements, or technologies to improve the accuracy, completeness, and timeliness of the information flow from responders to the media to motorists in their vehicles. If so, the group should include representatives from the news media, companies that provide traffic reports, traffic reporters, local law enforcement agencies, the Department of Safety, and TDOT.

Incident Management Coordination with the Trucking Industry (9.7)

Reliable travel time is critical to truckers and to their customers, especially those customers who rely on just-in-time delivery. Delays caused by highway incidents have a direct and significant impact on the trucking industry, on companies that do not receive timely delivery, and on the overall economy. (In the year 2000, trucks moved 78 percent of the nation’s domestic freight tonnage and accounted for 88 percent of its value.¹⁷)

The trucking industry, through the American Trucking Associations Foundation, has been a strong proponent for more effective incident management on the national level. In January 1997, the foundation published *Incident Management: Challenges, Strategies, and Solutions for Advancing Safety and Roadway Efficiency*.

On the other hand, when an incident involves a truck, the most directly affected parties—the trucking company, owner of the cargo, and insurers—are interested in salvaging as much of the cargo as possible, avoiding additional damage to the truck, and finding low cost alternatives for clearance and cleanup. Those interests and the need for quick clearance can be at odds, and incident responders must sort through those competing priorities.

The working group should explore ways to involve the Tennessee trucking industry in the efforts for improved highway incident management. In general, the goal would be to ensure that the needs and priorities of the trucking industry are well understood by the public agencies and vice versa. Specific questions to be addressed might include, how can truckers and trucking companies receive better information about incidents, alternate routes, and expected clearance times? How can public agencies receive better information from truckers? How can the number of rollovers be reduced? What could be done to expedite clearance at scenes involving trucks?

The group to examine mutual interests with the trucking industry should include representatives from the trucking industry, insurance companies, towing and recovery companies, Department of Safety (DOS), TDOT, and TEMA.

Best Practices for Traffic Law Enforcement on Freeways (9.8)

Motorists who violate traffic laws on high volume freeways put themselves and others at great risk. However, *enforcing* traffic laws, especially during peak travel periods, can also put other motorists, as well as the enforcing officer, at risk, and can lead to additional problems. The mere presence of a patrol car causes traffic to slow. Motorists gawk, and sometimes crashes occur. Violations of other laws such as motor vehicle registration and emission testing can be easier to enforce under slow traffic conditions when tags are more easily seen, but with the same negative impacts. Enforcement of HOV restrictions is a special problem. Without enforcement, violations become epidemic, but enforcing the restrictions can be especially hazardous without safe areas to stop the violators.

The use of video cameras and other technology for law enforcement (Task 7.22) would resolve many of these problems. In the meantime, however, a group should be formed to seek solutions that do not require new legislation. The group would be advisory only but should conduct an impartial assessment of the issues, solicit input from transportation and law enforcement agencies, and recommend best practices or guidelines. This group should include representatives from local law enforcement agencies, DOS, TDOT, and the AAA.

10. Promote Ongoing Interagency Planning and Coordination

The final set of recommendations would promote ongoing interagency planning, sharing of information and resources, and a high level of on-scene cooperation. The responsibilities and resources for highway incident management are shared among many different state and local agencies, and each agency has a different priority. The recommendations listed in Table 10 should allow each agency to be successful in achieving their own priorities, as part of a joint effort where quick clearance and safety are shared priorities.

Share the Plan and Invite Participation (10.1-10.6)

The plan should be widely distributed to help ensure that as many stakeholders as possible are aware of the results and of the ongoing process. Stakeholders should also receive periodic updates on plan implementation and should have an opportunity to suggest future additions or

Table 10: Promote Ongoing Interagency Planning and Coordination

Immediate (Year 1)	Short Term (Years 2-3)	Longer Term (Years 3-5)
10.1 Inform all incident response organizations about the <i>Strategic Plan for Highway Incident Management in Tennessee</i>	10.2 Keep incident management organizations apprised of progress toward implementation of the plan	10.3 Invite suggestions for the next update of the plan
10.4 Inform the state’s Metropolitan Transportation Planning Organizations, Development Districts, and other stakeholders about the plan and planning process	10.5 Keep stakeholder organizations apprised of progress toward implementation of the plan	10.6 Invite suggestions for the next update of the plan
10.7 In all contacts with incident response agencies, emphasize the advantages of “Unified Command” and teamwork, focusing on each agency’s unique abilities, roles, and responsibilities for incident management, i.e., not “Who’s in charge?” but “Who’s in charge of what?”		
	10.8 Sponsor a state conference on highway incident management with visible support from elected officials and agency heads	10.9 Sponsor biennial statewide and/or regional conference(s) on highway incident management
	10.10 Periodically send material to all Tennessee incident response organizations—emphasizing the overall public interest in quick clearance, the costs of congestion, and avoiding secondary crashes	
	10.11 Establish a Web page to facilitate exchange of information among incident responders	10.12 Add features to the Web page based on user response
	10.13 Develop incident management self-assessment tools for law enforcement agencies, fire services, and transportation agencies	10.14 Develop incident management self-assessment tools for towing and recovery operators, rescue squads, and emergency medical services
	10.15 Conduct debriefings with all incident responders following incidents that cause long term disruptions or secondary crashes	10.16 Begin preparing and distributing case studies of major incidents in Tennessee, highlighting lessons learned
	10.17 Work with the Governor’s Highway Safety Office and other organizations that promote highway safety to identify and pursue mutual interest (e.g., avoiding secondary crashes, yielding to emergency vehicles, moving damaged vehicles)	
	10.18 Work with TEMA, Office of Homeland Security, local EMAs, and law enforcement agencies to integrate highway incident management with all-hazards emergency planning, evacuation planning, and homeland security initiatives	
10.19 Continue statewide planning and coordination; annually review and update the <i>Strategic Plan for Highway Incident Management in Tennessee</i>		

changes. The plan and the planning process should be integrated with other transportation planning efforts, and the state's eleven Metropolitan Transportation Planning Organizations and nine Development Districts can be instrumental in accomplishing that integration.

Promote the Principles of Unified Command and the Incident Command System (10.7)

Many of the participants in the state planning process pointed to turf issues as the major impediment to effective incident management, expressed in terms of “Who’s in charge?” Incident scenes are often difficult to manage, sometimes chaotic. Law enforcement officers, fire services, emergency medical, HELP operators, towing and recovery operators, people with an interest in the involved vehicles or cargo, news media, and well-meaning citizens arrive at the scene at different times, from different directions, and with different ideas about who should be “in charge” at the scene.

One way to address the turf issues is to change the question to “Who’s in charge of what.” Other states and communities have made progress in this area by emphasizing “unified command” and other concepts and principles of the Incident Command System (ICS). ICS was developed primarily by the fire services community, but may be adaptable to highway incident management. Many other agencies within the law enforcement and emergency management communities use similar approaches for many types of incidents.

State agencies should lead a comprehensive effort to overcome turf issues that interfere with effective incident management. As part of that effort, unified command principles should be incorporated in all aspects of planning, training, drills and exercises, and on-scene incident management.

The state agencies should each appoint a representative to focus specifically on improved coordination among their agencies and between state and local agencies. That group of state liaisons should meet periodically to review progress, identify and address opportunities for improvement, and help resolve any problems that have been identified through debriefings (tasks 10.15-10.16) or other means.

Sponsor Statewide Conferences (10.8-10.9)

State government should sponsor a pilot statewide conference on traffic incident management and, depending on the results, then sponsor periodic statewide or regional conferences. The conferences should be designed to facilitate sharing of information, advance new ideas and best practices, improve interagency communication, and demonstrate the support of key elected officials and agency heads. State and local agencies in Tennessee should encourage their counterparts in adjacent states to participate in the conferences.

Facilitate Information Sharing (10.10-10.12)

Ongoing measures are needed to make sure that information about incident management is readily available to all stakeholders. Methods to accomplish that goal include periodic mailings, an informational Web page, list serve, and the manual called for in tasks 4.1-4.2.

Develop Self-Assessment Tools (10.13-10.14)

Another way to promote interagency planning and coordination without dictating to other agencies or levels of government is through self-assessment tools. Such tools can be used in a constructive way to evaluate current conditions and to suggest an agenda for improvements. In fact, the Federal Highway Administration (FHWA) has developed three self-assessment tools related to highway incident management: Roadway Operations Self Assessment, Work Zone Self Assessment, and Traffic Incident Management (TIM) Self-Assessment.

State agencies should build on FHWA's work and develop customized self-assessment tools for use in Tennessee. Such tools have imbedded value judgments about what constitutes "successful" highway incident management, so other stakeholders (local law enforcement, fire services, towing and recovery operators, and others) should be involved in developing and field-testing the tools.

Sponsor Debriefings Following Major Incidents (10.15-10.16)

If every incident is different, then something new can be learned from every incident. Therefore, debriefings should be held following major incidents to review the processes that were followed and identify opportunities for improvement.

The format of the debriefings should be simple and straightforward, with a single goal—improve future responses to similar incidents. Care should be taken to avoid negative comments, recrimination, or blame. All of the agencies that were involved in the key stages of incident management (i.e., detection, verification, notification and response, and the other stages through clearance and traffic resumption) should participate. The meeting should focus on lessons learned and actions needed to prepare for similar incidents in the future. The decisions reached by the group should be documented and disseminated in a brief memorandum.

Each of the local and corridor incident management teams should agree in advance on criteria for automatic debriefings (e.g., incidents with lane closures lasting more than a certain time period, incidents involving secondary crashes). The teams should also agree on procedures for a debriefing anytime a team member sees a potential benefit.

Pursue Mutual Interests with the Governor's Highway Safety Office and Other Organizations that Promote Highway Safety (10.17)

Efforts to improve highway safety are sometimes described as falling under one of three categories—engineering, education, and enforcement. Improvements in highway incident management would improve highway safety under all three of these categories, and support for incident management should be sought from agencies and organizations involved with highway safety. Some of these potential partners have interests and responsibilities in just one of the three categories, but others, such as the Governor's Highway Safety Office, have much broader interest and responsibilities. Also, state and local law enforcement agencies sponsor comprehensive safety education programs, as do private organizations such as the AAA.

The recommendation is first to ensure that the organizations and programs with interest and responsibilities for highway safety recognize the safety implications of highway incident management. These organizations and programs should then be asked to help frame the message(s) about safety at incident scenes as part of broader safety campaigns and education programs. The goal would be to deliver the messages to as many motorists as possible in as many ways as possible.

Integrate Highway Incident Management with All-Hazards Emergency Planning and Management, Evacuation Planning, and Homeland Security (10.18)

The core objectives of highway incident management—quick clearance, minimizing congestion and the related problems, and improving safety—overlap with the objectives of all-hazards emergency management, evacuation planning, and homeland security. Many of the stakeholders for highway incident management are the same as for those for other aspects of emergency planning and management. The resources needed are similar, in type if not in magnitude, and the principles and best practices are essentially the same.

Virtually every improvement in highway incident management also improves state and local capabilities for emergency management, evacuations, and homeland security. In many ways, day-to-day highway incident management is an ongoing exercise to help prepare state and local agencies for response to more catastrophic events. During such events, successful response could be enhanced by effective use of the resources already deployed for highway incident management and by taking advantage of the experience and expertise developed as part of highway incident management. Likewise, taking advantage of the knowledge and resources developed and maintained for emergency management, evacuation planning, and homeland security will enhance ongoing highway incident management.

Some coordination is already occurring at the operational level, but a more comprehensive effort is recommended to ensure effective integration of highway incident management with all-hazards emergency management, evacuation planning, and homeland security. Among the key stakeholder organizations, opportunities should be identified and explored to share resources, conduct joint training, and develop joint operating procedures.

Continue Statewide Planning and Coordination (10.19)

The final recommendation is to continue and strengthen the planning process that led to these recommendations. As part of that process, the plan should be reviewed and updated each year, with opportunities for comments and suggestions from all interested organizations and individuals.

Closing

The recommended goals and tasks, consolidated in Table 11, provide the framework for a comprehensive approach to highway incident management in Tennessee, but the ongoing process of planning and coordination is as important as the specific recommendations. All of the goals, tasks, and priorities should be reexamined and adjusted annually, adding more details and additional tasks based on the previous year's experience.

Table 11: Highway Incident Management Strategic Plan, 2003-2008: Action Tasks

Goal	Immediate (Year 1)	Short Term (Years 2-3)	Longer Term (Years 3-5)
1. Promote measures to reduce the number and severity of highway incidents	1.1 Develop plans for more immediate removal of disabled and abandoned vehicles on Tennessee freeways, including a public information campaign	1.2 Implement policies and programs for more immediate removal of disabled and abandoned vehicles	1.3 Evaluate and refine policies and programs
	1.4 Select two-four sites for pilot projects to evaluate and improve warning signs and devices at locations with a high frequency of especially disruptive crashes	1.5 Design and implement pilot projects	1.6 Evaluate impact of pilot projects and consider additional sites
	1.7 Select two-four sites for pilot law enforcement initiatives to reduce the frequency of especially disruptive incidents	1.8 Design and implement pilot projects	1.9 Evaluate impact of pilot projects and consider additional sites
	1.10 Identify candidate locations for construction of accident investigation sites in one or two cities	1.11 Construct pilot accident investigation sites in one or two cities and evaluate results	1.12 Construct accident investigation sites statewide based on results of the pilot projects
	1.13 Evaluate ongoing efforts to promote effective loading of trucks through training and regulatory enforcement	1.14 Emphasize proper loading of trucks through training and regulatory enforcement; improve/enhance programs as needed	
		1.15 Develop procedures for design of freeway improvements to address shoulder widths, emergency vehicle access, crash investigation sites, median openings, and other features	1.16 Implement, evaluate, and refine standards and procedures
		1.17 Develop guidelines for major highway projects to reduce the life-cycle impacts of traffic congestion and safety (i.e., disruptions caused by maintenance and re-construction)	1.18 Implement, evaluate, and refine standards and procedures
		1.19 Evaluate policies and practices regarding the movement of over-dimensional vehicles during peak travel periods	1.20 Propose enforcement, legislation, or other action as needed

2. Better inform and educate motorists to reduce incident-related congestion and improve safety	2.1 Develop strategies and plans to improve information delivered to traffic reporters and motorists in one or two of the largest metro areas	2.2 Work with local news media and traffic reporters to implement pilot projects and programs in the selected metropolitan area(s)	2.3 Implement projects and programs in the other metropolitan areas
		2.4 Develop a strategy and plan to improve information delivered to motorists by traffic reporters in smaller urban areas/rural corridors	2.5 Implement pilot projects in urban areas and along critical corridors
	2.6 Coordinate incident management strategies and plans with local and state TMCs (existing and under development)	2.7 Implement joint programs and work with new TMCs (planned and under construction)	
		2.8 Expand and enhance TDOT's Web page to provide statewide access to traffic CCTV cameras in all cities as well as information from TMCs	
	2.9 Develop strategies and plans to improve motorist response to traffic incidents (e.g., move damaged vehicles, anti-gawking, yield to emergency vehicle)	2.10 Issue periodic press releases and sponsor media events to heighten motorist awareness of how to deal with traffic incidents; develop plans and funding sources for a paid media campaign to promote safer and more appropriate driver reactions when incidents occur; monitor plan implementation, and refine as needed	
	2.11 Add incident management information to the Official Highway Map and the TDOT and DOS Web pages	2.12 Add similar information to the web pages for local law enforcement agencies, the Tennessee Department of Insurance, and the AAA (South and East Tennessee)	2.13 Add information to the <i>Tennessee Driver License Handbook and Study Guide</i> and add question(s) to the test
		2.14 Add information to the State Highway Map explaining how to accurately report a freeway incident	2.15 Add a special section on freeway driving and incident response to the state Web pages
	2.16 Develop an overall strategy and plan to integrate incident management topics with ongoing driver education, training, and safety programs	2.17 Develop a brochure, training aids, and a suggested script to address incident-related subjects during driver education, training, and safety courses	2.18 Encourage driver education and safety programs and instructors to cover incident management as part of ongoing education, training, and safety programs
		2.19 Evaluate the effectiveness of the freeway quick clearance signs ("Move Damaged Vehicles...")	2.20 Propose additional actions as needed to promote prompt removal of vehicles following minor crashes

		2.21 Develop plans for enhanced delivery of critical weather information to motorists	2.22 Implement enhanced weather information systems for motorists
		2.23 Develop and implement “511” traveler information system(s)	
3. Expand and enhance resources for systematic management of highway incidents	3.1 Begin identifying resources available for emergency response along segments of the Tennessee freeway system—police, fire, medical, rescue, hazardous material response, towing and recovery, etc.	3.2 Establish standards for availability of emergency response along Tennessee freeways and begin adding or enhancing resources to ensure minimum level of emergency response capability along all freeway corridors	
	3.3 Begin evaluating 911 and other aspects of emergency communication along all freeway corridors and identify problems and opportunities for improvement	3.4 Work with the Tennessee Emergency Communications Board (ECB) and local boards and agencies to improve communication as part of highway incident management	
		3.5 Evaluate needs for increased law enforcement resources for incident management and traffic control—focused on reducing vehicle hours of delay and secondary crashes— and begin allocating additional officers/equipment	
		3.6 Upgrade the Department of Safety radio communications system	
		3.7 Implement computer assisted dispatch (CAD) for the Department of Safety	
	3.8 Develop pilot projects for 24/7 on-call “Incident Response Units” along rural Interstate corridors	3.9 Implement pilot projects	3.10 Evaluate results, revise practices as needed, and deploy statewide
		3.11 Expand HELP coverage (route miles) in the four largest metropolitan areas	3.12 Expand HELP hours of service in the four metropolitan areas to 24/7
			3.13 Plan and implement, in conjunction with local agencies, HELP-type service on freeways in smaller urban areas

		3.14 Develop a recommended list of equipment and supplies that should be carried by all emergency responders for scene management and traffic control	3.15 Establish program to ensure that the recommended items are readily available and affordable for all incident responders
	3.16 Design and implement a pilot project in one area of the state for integrated data collection to track the time and resources required for highway incident management	3.17 Establish an integrated data collection system to track major freeway closures and disruptions, the incident response, and the costs to responders and highway users	3.18 Analyze information from the incident database and use the information to improve planning and allocation of resources
		3.19 Survey emergency communication and incident response agencies to determine the effectiveness of the Interstate emergency reference markers and overhead structure signs	3.20 Modify reference marker program as needed; add signs on more overhead structures if warranted
		3.21 Institutionalize effective incident management practices through agreements, General Orders, policies and procedures manuals, and other documents that guide or prescribe agency practices	
4. Expand and enhance training for highway incident responders	4.1 Develop a <i>Tennessee Highway Incident Management Reference Manual</i> as a training and information resource for incident responders	4.2 Update and revise the manual as needed	
	4.3 Develop and test training materials to introduce basic incident management concepts in all state and local police academies (initial officer and recurrent training)	4.4 Integrate basic incident management topics in all law enforcement training	
	4.5 Work with the Tennessee Fire Service and Codes Enforcement Academy to develop effective training concepts and techniques to deliver basic incident management training for fire services	4.6 Develop and test training materials to introduce basic incident management concepts in all state and local fire academies (initial and recurrent training)	4.7 Integrate incident management training in all training for fire services
		4.8 Develop and offer “Train the Trainer” programs for the state and local police and fire academies	4.9 Develop and offer “Train the Trainer” programs for Tennessee rescue squads and volunteer fire departments

			4.10 Develop and test “Scene Management” and other advanced topic training courses for all incident responders
	4.11 Develop a pilot “Train Together” course in one urban area—for towing and recovery operators, fire, police, law enforcement, and transportation	4.12 Implement the pilot course, adjust as needed, and offer in other areas	
			4.13 Sponsor training for towing and recovery operators
5. Support highway incident management teams in metropolitan and urban areas	5.1 Actively participate with established teams in Chattanooga and Memphis; encourage more formal coordination among state and local agencies in Knoxville and Nashville	5.2 Encourage multi-year incident management plans for the four largest metropolitan areas; negotiate and execute interagency agreements among state and local agencies	5.3 Consult with metro incident management teams on all major transportation issues; help establish teams as needed in smaller urban areas, beginning with Jackson and Tri-Cities
		5.4 Expand and enhance incident management coordination with state and local agencies in Georgia, Arkansas, and Mississippi	5.5 Expand and enhance incident management coordination with state and local agencies in Kentucky and Virginia
	5.6 Develop guidelines and procedures to prepare for long-term freeway closures in urban areas, e.g., communication plans and alternate routes	5.7 Identify alternate routes for freeway closures and prepare rerouting plans in Chattanooga and Memphis	5.8 Identify alternate routes for freeway closures and prepare rerouting plans in Knoxville and Nashville
		5.9 Begin making improvements to alternate routes as warranted (e.g., signing, intersection modifications, traffic signal timing)	
	5.10 Develop and conduct a pilot incident management exercise for one metropolitan area	5.11 Conduct at least one incident management exercise in Chattanooga, Knoxville, Memphis, and Nashville	5.12 Conduct biennial incident management exercises in all urban areas over 50,000 population
	5.13 Facilitate coordination among HELP, DOS, TEMA, other state agencies, local law enforcement agencies, Traffic Management Centers (TMCs), traffic reporters, towing and recovery operators, fire and emergency medical services, emergency management agencies, hazardous material responders, and other stakeholders		

6. Sponsor highway incident management teams in rural areas	6.1 Identify highest priority corridors/ locations in rural areas and establish formal teams for one or two corridors	6.2 Develop communications and response plans for the first one or two priority corridors	6.3 Establish teams and response plans in other corridors
	6.4 Sponsor NHI course(s) for the priority corridor(s)	6.5 Sponsor NHI courses for other corridors	6.6 Provide or sponsor on-site training to meet unique corridor needs
		6.7 Develop and maintain a 24/7 roster of emergency response agencies and other incident responders for the priority corridors	6.8 Develop and maintain 24/7 rosters for all corridors
		6.9 Identify alternate routes for freeway closures and prepare rerouting and incident response plans for the highest priority corridors	6.10 For all corridors identify alternate routes for freeway closures and prepare rerouting and incident response plans
		6.11 Begin improvements to alternate routes as needed (e.g., signing, intersection modifications, traffic signal timing)	
		6.12 Specify, acquire, and pre-position incident response equipment for each corridor	
		6.13 Expand and enhance incident management coordination with state and local agencies in Alabama, North Carolina, and Missouri	
		6.14 Develop and conduct a pilot incident management exercise for one corridor	6.15 Conduct incident management exercises for other priority corridors
7. Accelerate deployment of new technologies to improve incident management	7.1 Coordinate with ITS plans and technology plans for THP, CVE, TEMA, local agencies	7.2 Promote ongoing coordination and integration of existing and proposed technologies that impact incident management	
	7.3 Install CCTVs at strategic locations in Chattanooga, Knoxville, and Memphis	7.4 Expand CCTV coverage in Knoxville and Nashville	7.5 Establish CCTV coverage on all urban routes with traffic in excess of 40,000 AADT
		7.6 Install CCTVs at three-four rural locations to be selected	7.7 Install CCTVs at other strategic locations in rural areas

		7.8 Extend CCTV control capability to 911 centers and other PSAPs	
		7.9 Develop plans to integrate law enforcement CAD systems with TMCs in Chattanooga, Knoxville, Memphis, and Nashville	7.10 Begin integration of CAD and TMC systems
			7.11 Establish a statewide transportation management center with links to other state and local TMCs, TDOT, TEMA, and THP
7.12 Investigate benefits and costs of ITS applications at “Tennessee Gateways” and other non-urban locations	7.13 Develop plans for permanent CMSs at strategic locations outside of urban areas (e.g., major gateways and critical decision points)		7.14 Install CMSs at selected sites and evaluate effectiveness
7.15 Develop guidelines and procedures for use of portable Changeable Message Signs (CMSs)	7.16 Deploy 8-10 portable CMSs for incident management and evaluate performance		7.17 Deploy additional CMSs as warranted
	7.18 Develop guidelines for use of portable Highway Advisory Radios (HARs) for incident management		7.19 Deploy 3-5 portable HARS and evaluate performance
	7.20 Evaluate “photogrammetry” and other technologies for fatal and felony crash investigations		7.21 Deploy or test other new technologies/procedures to facilitate accident investigation on Tennessee highways
			7.22 Evaluate experiences in other states with the use of CCTVs for law enforcement and security on major highways
			7.23 Sponsor a set of coordinated demonstration projects using GIS and GPS technologies to assist law enforcement agencies, TDOT, TEMA, and other responders

8. Reduce traffic congestion caused by highway work zones	8.1 Intensify efforts to reduce the impact of highway work zones on congestion and travel time reliability and to improve work zone safety for motorists and workers		8.2 Prepare an annual report on the statewide impacts of work zones on highway user costs, motor vehicle crashes, and worker safety
	8.3 Involve law enforcement officers in “Pre-Construction Meetings” for all freeway projects	8.4 Develop standard procedures for effective involvement of law enforcement agencies in all stages of highway project planning, design, and construction	8.5 Implement and refine procedures; assign ongoing responsibilities to TDOT managers and law enforcement personnel
	8.6 Survey other states to identify best practices for involvement of <i>all</i> emergency response agencies in work zone planning and management	8.7 Implement pilot projects to involve all emergency response agencies in planning for work zone incidents, including on-site inspections and drills	8.8 Based on results of pilot projects, establish procedures to involve incident responders in planning for work zone incidents
	8.9 Develop guidelines for specifying night and weekend construction as well as contractor incentives and disincentives to minimize traffic disruptions	8.10 Implement standard procedures for work zone planning, design, and operation; incorporate those procedures in specifications, contract provisions, job responsibilities, and other documents	8.11 Incorporate penalties in construction contracts for unapproved lane closures, inaccurate signing, and other disruptive or unsafe practices
	8.12 Evaluate alternative decision support tools and procedures for work zone planning and scheduling (e.g., Quick Zone)		8.13 Enhance and refine procedures and requirements as needed
	8.14 Support TDOT’s Community Relations Division and ITS initiatives to provide timely and accurate information about work zones		8.15 Require contractors on major projects to provide real-time information about lane closures
			8.16 Implement work zone incident management training for TDOT, contractor, and police personnel
9. Establish working groups to address statewide issues and recommend actions	Convene groups to evaluate issues and make recommendations regarding: 9.1 Incident notification and communication among incident responders 9.2 Traffic impacts of hazardous material spills 9.3 Best practices and guidelines for using police officers in work zones	Convene groups to evaluate issues and make recommendations regarding: 9.4 Towing and recovery response to major incidents 9.5 Links between incident management and emergency medical services 9.6 Communication between incident management agencies and the news/traffic media and from the media to motorists and the public	Convene groups to evaluate issues and make recommendations regarding: 9.7 Incident management coordination with the trucking industry 9.8 Best practices for traffic law enforcement on freeways 9.9 Other issues as needed

10. Promote ongoing interagency planning and coordination	10.1 Inform all incident response organizations about the <i>Strategic Plan for Highway Incident Management in Tennessee</i>	10.2 Keep incident management organizations apprised of progress toward implementation of the plan	10.3 Invite suggestions for the next update of the plan
	10.4 Inform the state’s Metropolitan Transportation Planning Organizations, Development Districts, and other stakeholders about the plan and planning process	10.5 Keep stakeholder organizations apprised of progress toward implementation of the plan	10.6 Invite suggestions for the next update of the plan
	10.7 In all contacts with incident response agencies, emphasize the advantages of “Unified Command” and teamwork, focusing on each agency’s unique abilities, roles, and responsibilities for incident management, i.e., not “Who’s in charge?” but “Who’s in charge of what?”		
		10.8 Sponsor a conference on highway incident management with visible support from elected officials and agency heads	10.9 Sponsor biennial statewide and/or regional conference(s) on highway incident management
		10.10 Periodically send material to all Tennessee incident response organizations—emphasizing the overall public interest in quick clearance, the costs of congestion, and avoiding secondary crashes	
		10.11 Establish a Web page to facilitate exchange of information among incident responders	10.12 Add features to the Web page based on user response
		10.13 Develop incident management self-assessment tools for law enforcement agencies, fire services, and transportation agencies	10.14 Develop incident management self-assessment tools for towing and recovery operators, rescue squads, and emergency medical services
		10.15 Conduct debriefings with all incident responders following incidents that cause long term disruptions or secondary crashes	10.16 Begin preparing and distributing case studies of major incidents in Tennessee, highlighting lessons learned
		10.17 Work with the Governor’s Highway Safety Office and other organizations that promote highway safety to identify and pursue mutual interest (e.g., avoiding secondary crashes, yielding to emergency vehicles, moving damaged vehicles)	
		10.18 Work with TEMA, Office of Homeland Security, local EMAs, and law enforcement agencies to integrate highway incident management with all-hazards emergency planning, evacuation planning, and homeland security	
	10.19 Continue statewide planning and coordination; annually review and update the <i>Strategic Plan for Highway Incident Management in Tennessee</i>		

CHAPTER 6

IMPLEMENTATION

This final chapter addresses key issues related to implementation of the strategic plan and the ongoing planning process. The first section of the chapter offers an overview of the suggested implementation process. The second section addresses costs and potential funding sources.

Overview

Continued leadership and direction from the Policy Committee and the Steering Committee will be important for successful implementation of the plan. The committees provide the broad perspective and the high level emphasis on ultimate consequences—the economic costs of travel delays, creation of hazardous conditions, wasted fuel, environmental damage, and a lessened quality of life. Also, coordination of all the tasks as part of a systematic approach will promote efficiency as well as effectiveness.

All of this notwithstanding, the committees have no direct authority or resources for implementation. Each of the recommended tasks will have to be implemented by a specific agency or group of agencies. In most cases, those implementing agencies will have to rely on the same personnel, revenue sources, and other resources that are used to support ongoing programs and projects. The basic keys to success are with those implementing agencies.

Implementation Plans

Implementation plans should be prepared by the responsible agencies, and those plans should be shared with stakeholders to ensure common expectations. The “plans” do not have to be lengthy or detailed. The focus should be on a clear description of the expected results, the estimated time that will be required to accomplish those results, and the types and levels of support that will be needed from other stakeholders.

Pilot Projects

More than a dozen “pilot projects” are recommended as ways to test, refine, or demonstrate new approaches before committing to statewide implementation. These projects will not require major capital investments, displacement of people or businesses, or environmental disruption and, therefore, can be implemented relatively quickly and without making long-term commitments.

In many cases, the recommendation is to launch pilot projects in “one or two of the four largest metropolitan areas” or along “one or two of the priority (rural) corridors.” The following tasks include such recommendations:

- Warning signs and devices at locations with high frequency of disruptive incidents (1.4-1.6)

- Law enforcement initiatives at locations with a high frequency of disruptive incidents (1.7-1.9)
- Accident investigation sites (1.10-1.12)
- Information delivered to traffic reporters and motorists (2.1-2.5)
- 24/7 on-call “incident response units” along rural interstate corridors (3.8-3.10)
- Establish an integrated information system for major freeway disruptions (3.16-3.18)
- Prepare for long-term freeway closures (urban areas) (5.6-5.8)
- Exercises and drills (urban areas) (5.10-5.12)
- Identify highest priority corridors and establish teams (6.1-6.3)
- Prepare for long-term freeway closures (rural areas) (6.9-6.10)
- Exercises and drills (rural areas) (6.14-6.15)
- Install additional CCTV cameras and gain maximize advantages from CCTV (7.3-7.8)
- Use of GIS, GPS, and other information technologies (7.23)

The selection of the metropolitan sites and rural corridors for these pilot projects should be coordinated with local officials to ensure the best possible matches with local needs and priorities and to involve as many regions of the state as possible, i.e. to avoid concentrating all of the pilot projects in a small number of areas.

Use of Existing Resources

Many of the recommendations rely heavily on adding new information, criteria, or priorities to *existing* resources and processes. For example:

- Adding new information to existing publications and Web sites (e.g. adding information to the *Official Highway Map* and the *Driver License Handbook and Study Guide*)
- Introducing new criteria or steps in existing processes (e.g., adding criteria for design of highway improvements, adding considerations to transportation planning)
- Delivering new or enhanced information to motorists through existing mechanisms (e.g., providing more reliable, timely information to motorist through commercial television and radio stations)
- Adding new topics to existing training and education programs (e.g., adding topics to responder training and to driver training and education)

Most of these recommendations can be implemented with minimal costs, but the organizations that “own” the existing resources must be convinced of the importance of incident management and of the benefits to be gained by sharing and adapting their existing resources and processes.

Measures of Success

All of the state and local agencies should begin working toward a comprehensive set of performance measures for highway incident management. The most important measures from

the highway user perspective are all related to *time* and *safety*. However, other stakeholders will also look for measures of efficiency, cost effectiveness, and economic benefits.

Tasks 3.16-3.17 will begin the development of performance measures for the overall incident management system, but each stakeholder agency should be measuring and reporting the times required performing their respective tasks and the costs associated with those tasks. Those organizational measurements should be used for two purposes. The first purpose would be to analyze and better understand the organization's role in incident management. The second purpose would be to improve the organization's performance, i.e. to reduce the time required for completion of key steps and to promote efficient use of resources.

Costs and Potential Funding Sources

This section addresses the costs and potential funding sources for the recommended improvements in highway incident management. For most of the action tasks, detailed cost estimates cannot be prepared until more planning and design has been accomplished, but general cost information is offered below along with suggested sources for unit cost data. Potential funding sources are discussed and sources are identified for more in depth information.

Implementation Costs

Most of the immediate priority (year one) tasks will require significant time and attention from managers and supervisors in state and local agencies and possibly some expenditures for external consulting, training, or research. However, only one immediate priority task (CCTV cameras, Task 7.3) calls for capital expenditures. Those costs are discussed below. Several pilot projects will be developed during the first year, leading to startup costs during the two-three year time frame.

Beyond those immediate priorities, many of the tasks will require changes in priority or increased expenditures. For instance, one of the goals, "expand and enhance resources for systematic management of highway incidents," could lead to significant increases in operating costs for many different state and local agencies and/or to reallocate resources currently assigned to other activities. Also, training recommendations are key to the success of other recommendations, and the direct costs to develop and deliver new training will increase. Also, more training time away from normal duties will be required.

Capital Intensive Projects

With a few notable exceptions, most of the recommendations in the plan are not capital intensive. The most capital-intensive recommendations are: (1) the new radio communication and computer aided dispatch systems for the Department of Safety (DOS), (2) deployment of CCTV cameras and other ITS technology, (3) the statewide transportation management center, (4) the 511 traveler information system, and (5) highway improvements to facilitate incident management. The exact costs of these improvements will depend on many factors

that will be addressed in the first year of the plan, but special efforts will almost certainly be required to secure funding for these improvements.

A new statewide communication and dispatching system for the Department of Safety will cost millions of dollars, perhaps hundreds of millions, depending on the features and capabilities. A more comprehensive system to meet the land mobile radio communication needs of multiple agencies would be even more expensive, but would have additional benefits for highway incident management and for many other public safety, emergency management, and homeland security functions.

The number and associated costs of CCTV cameras, highway advisory radios, changeable message signs, and other ITS components will depend on the results of the pilot projects. Also, some of the recommended components may be funded as part of TDOT's metropolitan ITS projects. Typical unit costs (capital and operating) for these technologies can be reviewed at the following site, which is operated by Mitretek Systems Inc. for the U.S. Department of Transportation (U.S. DOT): <http://www.mitretek.org/ITS/benecost.nsf/ByLink/CostHome>.

The above-cited U.S. DOT Web source also provides information regarding the capital and operating costs of transportation management centers. However, the recommended statewide center could begin on a limited-scale and, even for the long term, would rely heavily on information sources developed and funded through other initiatives. The new investments required for the center would be primarily for working space, computers, communications equipment, software, and operating costs.

Cost information regarding 511 traveler information systems is available in a publication entitled *Deployment Assistance Report #1: Business Models and Cost Considerations*, which is available at http://www.its.dot.gov/511/511_Costs.htm#Costs. The costs will depend on the number of systems, the scope of services offered, and the extent the systems rely on data and information from other sources versus investing in new data collection and analysis capabilities.

Several of the recommendations would add to the costs of highway construction and rehabilitation. For instance, adding incentives or disincentives for highway contractors, requiring night work, and other measures to reduce the impact of work zones will add to the project costs. Adding accident investigation sites or emergency vehicle turnarounds to a highway widening project or using longer-lasting materials will also add to project costs. On alternate routes, adding turning lanes, signalization, special signing, or more extensive improvements might be undertaken specifically for incident management or as part of more extensive projects.

Finally, some of the pilot projects will have capital components, but the operating costs will be more significant over the long term. For instance, new vehicles and equipment will have to be purchased for the statewide 24/7 Incident Response Units. Expansion of the HELP service will also require new vehicles and equipment. New technology will have to be purchased for accident investigation, GIS, GPS, and other technology innovations.

Potential Funding Sources

Currently, highway incident management is funded from a number of sources. These include:

- State and local general fund revenues
- Dedicated revenues such as the gasoline tax for transportation and the state and local fees on telephone service to help pay for 911 services
- Federal grants from various sources
- “Fees for service” charged by emergency medical services, towing and recovery companies, and hazardous material responders

Establishing a new, dedicated source of state or local tax revenue *specifically* for incident management would be difficult, and implementation of the plan will have to rely on existing sources for the immediate future. However, some of the recommended improvements may be eligible for federal funding under one or more of the programs described below, and some additional “fees for service” may be feasible.

Federal Transportation Funds

Many of the recommendations in the plan are eligible for federal-aid highway funds. Most of those federal funds are allocated to Tennessee on a formula basis and administered by TDOT. The current federal surface transportation authorizations expire in October 2003, and the federal funding programs and eligibility criteria are all subject to change. However, all signs point toward even stronger federal support for incident management under the new bill.

Under the current legislation, the Transportation Equity Act for the 21st Century (TEA-21), most of the recommended capital improvements as well as most of the operating costs would be eligible for funding under the two funding categories with the largest authorizations—the National Highway System (NHS) program and the Surface Transportation Program (STP). Also, some of the safety improvements would be eligible under safety “set asides.”

Other federal transportation programs could be used for specific incident management projects and activities. For instance, outreach, education, some training activities, and other non-construction costs of safety-targeted improvements would be eligible under the State and Community Highway Safety Grants program, administered by the Governor’s Highway Safety Office. Congestion Mitigation and Air Quality (CMAQ) program funds are available for projects or programs in the Knoxville, Memphis, and Nashville areas. (CMAQ funds were used for the first four years of the HELP program in those cities.) Funding for technology enhancements would be eligible under Intelligent Transportation Systems (ITS) programs, although those funds currently are not allocated on a formula basis.

Of course, eligibility for funding does not ensure that funds will be available for a specific program or project at a specific time. Also, federal-aid highway funds are subject to a number of requirements, including special requirements for use in the “urbanized areas.” More information is available at these sites:

- <http://www.ops.fhwa.dot.gov/Travel/Ops-guide.htm>
- <http://www.fhwa.dot.gov/tea21/factsheets/index.htm>
- <http://www.nhtsa.dot.gov/nhtsa/whatsup/tea21/tea21programs/index.html>
- <http://www.its.dot.gov/>

Other Federal Funds

Other federal sources should be considered. Many of the resources needed for effective highway incident management are also needed for other law enforcement, fire services, other emergency response, all-hazards emergency management, and homeland security purposes. Federal grant programs are available to support all of those activities.

The United States Department of Justice (DOJ) offers funding to conduct research, to support law enforcement activities in state and local jurisdictions, to provide training and technical assistance, to implement programs that improve the criminal justice system, and to support emergency preparedness. More information about funding from the Office of Community Oriented Policing Services (COPS) and from the Office of Justice Programs (OJP) can be found at <http://www.usdoj.gov/10grants/index.html>.

In Tennessee, most of these DOJ funds are administered by the Office of Criminal Justice Programs, Division of Resource Development and Support, in the Department of Finance and Administration. Information is available at <http://www.state.tn.us/finance/rds/programs.html>.

Federal grants to purchase equipment for homeland security purposes could also be beneficial for highway incident management. The Office of Domestic Preparedness program, formerly in the Department of Justice, has been transferred to the Department of Homeland Security. As of April 2003, information was available at this DOJ site: <http://www.ojp.usdoj.gov/odp/>.

Another possible funding source is the Assistance to Firefighters Grant Program which awards one-year grants directly to fire departments “for the purpose of enhancing the departments’ ability to protect the health and safety of the public as well as that of firefighting personnel facing fire and fire-related hazards.” The Fire Administration in the Federal Emergency Management Agency in the Department of Homeland Security administers this program. More details are available at <http://www.usfa.fema.gov/dhtml/inside-sfa/grants.cfm>.

For the most expensive communication needs, such as for a shared multi-agency land mobile radio (LMR) system, other states have pursued a variety of funding arrangements, including bonds, leases, various public-private partnerships, and combinations of sources. Also, some communication needs can be provided by commercial services (e.g., cell phones, individual and group paging, and data transmission). More information about funding for LMR systems can be found in reports by the Public Safety Wireless Network, including reports available at these addresses:

- http://www.pswn.gov/admin/librarydocs/fund_strats.pdf
- http://www.pswn.gov/admin/librarydocs11/Funding_Strategy_Best_Practices_Report.pdf
- http://www.pswn.gov/admin/librarydocs6/report_card_on_funding_mech.pdf

A report from the Virginia Department of Technology Planning is available at this address:
<http://www.dtp.state.va.us/pubs/special/LMRS%20FINAL.pdf>

Finally, additional increases in federal funding seem likely for enhancement of all-hazards emergency management, land mobile radio interoperability, and other homeland security initiatives. Such funds could help support more effective highway incident management. As noted at the beginning of this report, highway incident management shares with all-hazards emergency management and homeland security many of the same goals, stakeholders, and tools for planning and coordination.

Fees for Service

Towing and recovery operators, private hazardous material responders, and most components of emergency medical service rely heavily on fees that are directly related to the services provided. For many of the other incident responders, the costs and benefits of their services are not so easily assigned to a single individual or company. Also, the costs of administering and collecting fees must be taken into account. However, the concept of additional “fees for service” should not be excluded from consideration.

Annual Progress Review and Update of the Strategic Plan

As suggested in the previous chapter, the Strategic Plan should be reviewed and updated annually. Based on progress to date, new priorities should be established for implementation during the upcoming year, more details should be added for tasks in the two-three year time period, and new tasks added. Experience and changing circumstances will require revisions or deletions to ensure that the plan remains relevant and workable, and new tasks may be added for immediate implementation in response to unforeseen circumstances.

The Steering Committee should solicit comments and suggestions from other stakeholders and then propose additions and amendments to the plan, especially the priority tasks for the upcoming year. The Policy Committee should approve changes to the plan. The committee should also ensure that progress is widely reported.

Conclusion

Tennessee has made significant advances in highway incident management in recent years, but many problems and opportunities remain. The *Strategic Plan for Highway Incident Management in Tennessee* provides a framework for a systematic, multi-agency approach to solving the problems and taking advantage of the opportunities.

The recommended plan will improve the effectiveness and efficiency of Tennessee’s transportation system, improve safety, and make the system more reliable and more responsive to customer needs and priorities. The plan will help highway users and businesses avoid wasted time, wasted fuel, polluted air, and economic losses.

NOTES

- ¹ “Congestion” is usually quantified in terms of “vehicle hours of delay.” For instance, 1,000 vehicle hours of delay could result from 2,000 vehicles being delayed for 30 minutes each or from 1,000 vehicles being delayed for one hour each.

For urban freeways, estimates of the delays caused by incidents (i.e., “non-recurring” events) range from 50 to 60 percent of the total delays. The other 40 to 50 percent of delays are “recurring,” caused by inadequate capacity to meet normal demands (i.e., “bottlenecks”). For most rural highways, adequate capacity exists for normal traffic demands. Thus, almost all travel delays are caused by incidents that obstruct traffic, special events that create exceptional demand, and other non-recurring events.

A 1986 study by the Federal Highway Administration (FHWA) concluded that incidents accounted for 61% of total delay on urban freeways. (Jeffrey Lindley, *Quantification of Urban Freeway Congestion and Analysis of Remedial Measures*, Report No. FHWA/RD-87/052, October 1986).

The 2002 *Urban Mobility Study* by the Texas Transportation Institute estimates that incidents account for a national average of between 52 and 58 percent of all travel delays in urban areas, depending on the population size of the area. Memphis and Nashville are part of the group of 75 cities examined by TTI, and the study estimates that incidents account for approximately 60 percent of travel delays in each of the two Tennessee cities. (http://mobility.tamu.edu/ums/study/issues_measures/effect_incidents.stm)

- ² Studies of specific freeways segments have found percentages ranging from 13 percent (Minnesota Department of Transportation, *I-35 Incident Management and the Impacts of Incidents on Freeway Operations*, January 1982) to 35 percent (Kumares Sinha et al, Purdue University, *Evaluation of the Impacts of ITS Technologies on the Borman Expressway Network*, for the Indiana Department of Transportation, October 1998).

Source of the national estimate of 20% is David Helman, Traffic Incident Management Program, Federal Highway Administration.

- ³ Volpe National Transportation Systems Center, *Intelligent Transportation Systems Impact Assessment Framework: Final Report*, September 1995.

- ⁴ The actual recovery time depends on several factors, including the capacity of the roadway under normal circumstances, the capacity during the incident, and the traffic volume trying to pass the incident scene during and after the incident. However, many organizations use four to five minutes of delay per minute of blockage as a rule of thumb.

At least one agency estimates an even higher ratio. According to the Ohio DOT, “For every minute a single lane is blocked, the result is 8 minutes of delay. For every 5 minutes of a lane blocked, the result is 1 mile of backup.”

<http://www.dot.state.oh.us/quickclear/quickclear.asp>

- ⁵ Wisconsin Department of Transportation, *T.I.M.E. Executive Summary*, June 1998.
- ⁶ Based on information from the following sources:
- Directories of Tennessee law enforcement agencies, fire departments, rescue squads, emergency medical services, and emergency management agencies, all accessible from a Web page provided by the Tennessee Emergency Management Agency (TEMA) at http://www.tnema.org/Misc/TN_ES_List.htm.
 - Directories provided by the Municipal Technical Advisory Service (MTAS) and the County Technical Assistance Service (CTAS), at <http://www.mtas.utk.edu/gml-mtas.nsf> and <http://www.ctas.utk.edu/>, respectively.
 - Conversations with Mr. Joe Philips, Director, Emergency Medical Services Division, Tennessee Department of Health; Mr. Brian Caldwell, Aviation Manager, Aeronautics Division, Tennessee Department of Transportation; and Major Lee Chaffin, Tennessee Department of Safety.
- ⁷ Based on a three-year average (1998-2000), using data from *HIT: Health Information Tennessee*, an online database provided by the Tennessee Department of Health and the University of Tennessee Knoxville Community Health Research Group at <http://hitspot.utk.edu/crashform.htm>.
- ⁸ Based on conversations with Tennessee Highway Patrol (THP) troopers, Commercial Vehicle Enforcement (CVE) officers, and TDOT officials.
- ⁹ Compiled from incident reports filed at the TEMA State Operations Center, covering the period from January 1, 2002 through August 31, 2002.
- ¹⁰ Information from Mr. Carl Cobble, Director of Field Maintenance, Maintenance Division, Tennessee Department of Transportation.
- ¹¹ *Highway Capacity Manual (HCM 2000)*, Transportation Research Board, 2000. (See also M.E. Goolsby, Influence of Incidents on Freeway Quality of Service, *Highway Research Record 349*, TRB, 1971; and Jeffrey Lindley, Quantification of Urban Freeway Congestion and Analysis of Remedial Measures, Report No. FHWA/RD-87/052, 1986.) The *HCM 2000* describes the impact in terms of the portion of capacity available rather than the portion lost. To illustrate, the following is an excerpt from *HCM 2000* (p. 22-11):

Proportion of Freeway Segment Capacity Available Under Incident Conditions

Number of Freeway Lanes in Each Direction	Incident Condition				
	Shoulder Disablement	Shoulder Accident	Lanes Blocked		
			One	Two	Three
2	.95	.81	.35	.00	N/A
3	.99	.83	.49	.17	.00
4	.99	.85	.58	.25	.13

- ¹² Texas Transportation Institute, *2002 Urban Mobility Study*, and e-mail from Dave Schrank, TTI Assistant Research Scientist, April, 2003.
- ¹³ Minnesota Department of Transportation, *I-35 Incident Management and the Impacts of Incidents on Freeway Operations*, January 1982; and
Kumares Sinha et al, Purdue University, *Evaluation of the Impacts of ITS Technologies on the Borman Expressway Network*, for the Indiana Department of Transportation, October 1998.
- ¹⁴ Christopher D. Johnson, Pedestrian Fatalities on Interstate Highways: Characteristics and Countermeasures, *Transportation Research Record 1578*, TRB, 1997.
- ¹⁵ Kevin McKenzie, Wreck Kills 3 on I-40 Bridge, *Commercial Appeal*, January 25, 2003.
- ¹⁶ Federal Bureau of Investigation, *Law Enforcement Officers Killed and Assaulted*, Annual Reports for 1999-2001, Uniform Crime Reports, U.S. Department of Justice.
- ¹⁷ Bureau of Justice Statistics, *Sourcebook of Criminal Justice Statistics 2001*, U.S. Department of Justice, 2001. <http://www.albany.edu/sourcebook/1995/pdf/t123.pdf>
- ¹⁸ Federal Bureau of Investigation, *Law Enforcement Officers Killed and Assaulted*, Annual Reports for 1999-2001, Uniform Crime Reports, U.S. Department of Justice.
- ¹⁹ National Institute for Occupational Safety and Health, *Traffic Hazards to Fire Fighters While Working Along Roadways*, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services, HID12, June 2001.
- ²⁰ Claudia Johnson, Truck Kills Two on I65, *The Pulaski Citizen*, August 8, 2000; and Tennessee Uniform Traffic Crash Report, Reference Number 7387153.
- ²¹ *Transportation Air Quality: Selected Facts and Figures*, Federal Highway Administration, Publication No. FHWA-EP-02-006, January 2002.
- ²² Federal Highway Administration, US DOT Traffic Incident Management Initiatives, presented at the Transportation Research Board Annual Meeting, Washington, D.C., January 2003.
- ²³ Federal Highway Administration, US DOT Traffic Incident Management Initiatives, presented at the Transportation Research Board Annual Meeting, Washington, D.C., January 2003.



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