TDOT 25-YEAR LONG-RANGE TRANSPORTATION POLICY PLAN

SAFETY, SECURITY, AND TRANSPORTATION RESILIENCE

POLICY PAPER

TDOT
Department of Transportation

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The 25-Year Long-Range Transportation Policy Plan was developed prior to the passage of Fixing America's Surface Transportation Act (FAST Act) signed into law December 4, 2015.

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1.0 INTRODUCTION

Tennessee has grown increasingly dependent on a complex and diverse multimodal transportation infrastructure. It is vital that these elements are kept safe, secure, and resilient. In the context of this policy paper, safety, security, and resilience are defined as follows:

- Safety is the protection of life and property associated with the transportation system.
- Security addresses threats to the transportation system and its users.
- Resilience is the ability of the transportation system to withstand and recover from incidents.

The purpose of this policy paper is to document current policies, programs, and resources available to the Tennessee Department of Transportation (TDOT) for safety, security, and transportation resiliency, and to develop recommendations for programs and policies that are consistent with the guiding principles of the Department's 25-Year Policy Plan. A brief description of each of these topics and their relevance to the guiding principles is provided below:

1.1 Safety

The protection of life and property for all transportation modes in Tennessee is the most important element of TDOT's mission. This protection is generally accomplished through planning (including data collection, analysis, and performance management), regulation, enforcement, management, operations, design, and maintenance. TDOT is responsible for a number of programs related to multimodal transportation safety and supports other agencies in their transportation safety activities. The relevance of safety to the guiding principles of the Transportation Plan is provided below:

- Maximize Safety and Security – Reduce injuries and fatalities for all transportation modes and improve transportation security for critical infrastructure.
- Provide for the Efficient Movement of People and Freight – Recognition of the change in system users' abilities, behavior, and attitudes towards transportation safety and security and how those may impact policies and projects.
- Emphasize Financial Responsibility – Strategic investment in programs and projects that improve safety and security for existing facilities, which includes the identification of programs and policies that will result in a safe, secure, and resilient transportation system.

1.2 Security

It is important that security plans, policies, and programs are in place to help protect the transportation system. Failure to provide the necessary security could result in a situation in which the destruction or exploitation of these facilities would lead to severe consequences. Therefore, security goes beyond safety and includes additional plans that help to prevent, manage, or respond to threats that could negatively impact the transportation system and its users. There are many programs in place to help manage security concerns and emergency issues. The relevance of security to the guiding principles of the Transportation Plan is provided below:

- Maximize Safety and Security – Reduce injuries and fatalities for all transportation modes and improve transportation security for critical infrastructure.
- Provide for the Efficient Movement of People and Freight – Recognition of the change in

system users' abilities, behavior, and attitudes towards transportation safety and security and how those may impact policies and projects.

1.3 Transportation Resiliency

A resilient transportation system can anticipate, continue to function, and recover from external disruptions. Disruptions are defined as a significant, unexpected and/or unpredictable change, which have serious consequences for a system. If resilient, the transportation system can withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents. Securing critical infrastructure and ensuring its resilience is a shared responsibility of federal, state, local, private sector partners, and individual citizens. Transportation resiliency is also inherently interconnected with safety and security. The relevance of resilience to the guiding principles of the Transportation Plan is provided below:

- Preserve and Manage the Existing System – Protection of existing assets through programs and policies can result in a more resilient transportation system.

2.0 SUMMARY OF FINDINGS

TDOT has many programs and policies devoted to safety, security and resiliency for all modes of transportation. The Department works in conjunction with other agencies and divisions to promote and coordinate safety, security, and resiliency. Compared to many other states in the country, TDOT takes great care to address safety, in terms of its programs, policies, and the implementation of new technologies. The following section summarizes some of the key findings discussed as part of this policy paper:

Summary of Findings

- Tennessee makes crash information available to member agencies and some information is also published for the public (i.e., annual reports, daily online updates of the number of fatal crashes, etc.).
- Tennessee uses this crash information to help evaluate and track safety-related performance measures.
- Current safety performance measures include:
    - Reducing the rate and number of fatal traffic crashes on Tennessee roads
    - Reducing the rate and number of serious injury traffic crashes on Tennessee roads
    - Increasing seatbelt usage
    - Reducing rail grade crossing fatalities
    - Reducing crashes in work zones
    - Increasing incoming "511" calls
- Over the past 10 years, all fatal crashes have been trending downward:
    - A high of 1,339 fatal crashes in 2004
    - A low of 937 in 2011
- Over the past 10 years, the number of injury crashes has been trending downward:
    - A high of 55,677 in 2008
    - A low of 43,445 in 2013
- Tennessee ranks 26th in the nation for pedestrian fatalities with a rate of 1.25 fatalities per 100,000 population, compared to the national average of 1.42.
- Over the past 10 years, fatal crashes involving bicyclists and pedestrians have remained steady at 70 to 100 fatalities per year.
- TDOT is conducting a pilot study with the Federal Highway Administration (FHWA) to complete a climate change and extreme weather vulnerability assessment of the transportation infrastructure across the state.
- Research is also being conducted for TDOT by the University of Tennessee at Chattanooga to assess critical infrastructure in terms of security.

- The United States Department of Transportation (USDOT) is currently in the process of reviewing the performance management rulemaking. Within one year of the USDOT final rule on performance measures, states will be required to set performance targets in support of those measures.
    - Metropolitan Planning Organizations (MPOs) will be required to establish and use a performance-based approach to transportation decision making and development of transportation plans. Each MPO will have 180 days from the time state performance targets are established to identify their own performance targets that address federal surface transportation performance measures, first established by the Moving Ahead for Progress in the 21st Century Act (MAP-21) legislation.
    - States and MPOs will have the responsibility of coordinating with transit agencies regarding performance management and reporting to the USDOT on progress in achieving targets. If a state's report shows inadequate progress, then the state must undertake corrective actions.

Recommendations

- Enhance data sharing among and between all agencies including local and regional governments.
- TDOT should continue to further enhance partnerships with local and regional agencies to better evaluate behavioral safety needs.
- TDOT should continue to further enhance partnerships with local and regional agencies to better evaluate engineering safety needs.
- TDOT should continue to utilize peer exchange forums to advance best practices in behavioral and engineering roadway safety in Tennessee.
- TDOT should continue to implement the use of the American Association of State Highway and Transportation Officials (AASHTO) Highway Safety Manual to increase the effectiveness of safety analysis and evaluation of Tennessee's highways.
- TDOT, through Tennessee's Local Transportation Assistance Program (LTAP), should promote training opportunities for local governments on the AASHTO Highway Safety Manual to increase the effectiveness of safety analysis and evaluation of Tennessee's state highways.
- TDOT should continue to explore and implement emerging technologies (e.g., Intelligent Transportation Systems (ITS), Transportation Systems Management and Operations (TSM&O), Active Transportation Demand Management (ATDM), etc.) that enhance safety and security for all modes of transportation.
- TDOT should continue to seek opportunities to educate elected officials regarding legislation impacting roadway safety.
- TDOT should continue to strengthen the Department's understanding and capabilities of extreme weather impacts to reduce vulnerability risks of the State's physical assets.
- TDOT should continue to strengthen the Department's understanding and capabilities of security threats to reduce vulnerability risks of the State's physical assets.

3.0 EXISTING TDOT POLICIES, PLANS, AND DATA ANALYSIS

The following sections describe existing policies, plans, and data analysis tools that are available for providing a safe, secure, and resilient transportation system for multiple modes of transportation and that are consistent with TDOT's guiding principles. Together, TDOT and the Tennessee Department of Safety and Homeland Security (TDOSHS) are responsible for many of the State's programs devoted to safety, security, and resiliency.

1.1 Safety

1.1.1 Highway Safety

Safety, in the context of this policy paper, is the protection of life and property for all transportation modes in Tennessee. This protection is generally accomplished through planning (including data collection, analysis, and performance management), regulation, enforcement, management, operations, design, and maintenance. TDOT is responsible for a number of programs related to multimodal transportation safety and supports other agencies in their transportation safety activities.

Strategic Transportation Investments Division (STID)

The Strategic Transportation Investments Division provides strategic support for projects that addresses safety, congestion, and economic development needs. STID also conducts operational analysis of non-highway transportation projects as they impact the highway system. The responsibilities of the STID include[1]:

- Provide strategic support for projects
- Develop Expedited Project Delivery (EPD) Projects
- Analysis of economic development opportunities
- Operational analysis of non-highway transportation projects
- Determine new investments
- Prioritization of projects for the 3-Year State Transportation Program
- Determine level of study through a "Needs Assessment" process
- Conduct system and traffic analysis
- Manage and develop projects for the Roadway Safety Audit Program
- Implement projects for the Highway Safety Improvement Program
- Provide location identification and analyses of the crash database
- Implement Transportation Planning Report (TPR) Manual
- Prepare conceptual design plans and cost estimates
- Conduct, facilitate, and support various types of public involvement opportunities during project development processes

1 TDOT Strategic Transportation Investments Division http://www.tdot.state.tn.us/STI/default.shtml

The STID includes a Project Safety Office that is responsible for safety related projects and programs. The Project Safety Office is divided into two sections: Safety Projects and Safety Data. The following projects and programs are under the responsibility of the STID:

- Highway Safety Improvement Program (HSIP)
- Road Safety Audit
- Spot Safety
- Ramp Queue
- Corridor Study
- Roadway Median Cable Barrier
- Intersection Action Plan (IAP)
- Roadway Departure Action Plan
- Fatality Reduction Initiative
- Shoulder Widening Initiative and High-Friction Surface Initiative
- Centerline and Shoulder Safety Initiative

Expedited Project Delivery (EPD)

An important initiative falling under STID's responsibilities is project development for TDOT's Expedited Project Delivery (EPD) process. The goal of this process is to address immediate safety issues on the highway system and propose proper long-term solutions in an expedited manner. During the development of the EPD process, TDOT's existing cost-estimation tool was identified as a barrier for releasing projects for completion. A new, user-friendly tool was developed that calculates costs on a per-item cost basis (versus cost-per-mile), which is then included in the planning-level estimate. The new tool allows for variables in the formula to be easily updated as the project development phases progresses and imports TDOT's most up-to-date average-unit bid prices. This has allowed for more accurate cost estimates for identified projects and a better long-term understanding of the EPD program for TDOT. The FY2015 EPD program will provide a cost-savings of $171,148,300 on 5 projects alone, aside from the additional 25 projects up for consideration under the program this year.

Highway Safety Improvement Program (HSIP)

The current federal transportation legislation continued the HSIP as a core Federal-aid program for the distribution of funding. The goal of the program is to achieve a significant reduction in traffic fatalities and serious injuries on all public roads, including non-State-owned public roads and roads on tribal lands. The HSIP requires a data-driven, strategic approach to improving highway safety on all public roads that focuses on performance.

The specific provisions pertaining to the HSIP are defined in Section 148 of Title 23, United States Code (23 USC 148). MAP-21 changed some aspects of the HSIP and include the following:

- The Strategic Highway Safety Plans are required to be updated and evaluated regularly by each State.
- The $90 million High Risk Rural Roads (HRRR) set-aside was eliminated, but a HRRR Special

Rule requires States to obligate funds on HRRRs if the fatality rate is increasing on these facilities.

- The Transparency Reports are no longer required.
- The annual reports from the States will be posted on the Federal Highway Administration (FHWA) website.
- FHWA is required to establish performance measures for the states to use in assessing the number and rate of fatalities and serious injuries.

Strategic Highway Safety Plan (SHSP) and Highway Safety Performance Plan (HSPP)

A SHSP is a major component and requirement of the HSIP (23 USC 148) that helps to identify and analyze highway safety problems and opportunities on all public roads. It is a statewide-coordinated safety plan that provides a comprehensive framework for reducing highway fatalities and serious injuries on all public roads. A SHSP identifies a state's key safety needs and guides investment decisions towards strategies and countermeasures with the most potential to save lives and prevent injuries.

A SHSP is developed by the state DOT with input generated from local, state, federal, and private sector safety stakeholders. The SHSP provides an opportunity for highway safety programs and partners in the state to work together in an effort to align goals, leverage resources, and collectively address safety challenges across the state. The development of Tennessee's SHSP occurred through a data-driven, multi-year comprehensive planning effort that established statewide goals, objectives, and key emphasis areas.

The current Tennessee SHSP was developed in 2014 through a collaborative effort between the Strategic Transportation Investments Division (STIP) of TDOT and the Governor's Highway Safety Office (GHSO). Input from a variety of stakeholders was also gathered throughout the plan's development through a steering committee consisting of representatives from TDOT, TDOSHS, FHWA, THP, Federal Motor Carrier Safety Administration (FMCSA), MPOs and RPOs, Tennessee Regional Safety Council (TRSC), Tennessee Transportation Assistance Program (TTAP), American Automobile Association (AAA) and the Governor's Highway Safety Office (GHSO). The following insert briefly summarizes the mission, vision, and goals contained in Tennessee's 2014 SHSP:

MISSION: Using education, enforcement, engineering, and emergency response initiatives, work toward zero deaths and serious injuries by reducing the number and severity of crashes on Tennessee's roadways.

VISION: Federal, state, and local agencies, civic groups, and private industries unified as safety partners and all working together toward zero fatalities and serious injuries on Tennessee roadways.

GOALS:

- **Fatalities** - Reduce the number of fatalities by 10% within the next five years.
- **Fatality Rate** - Reduce the rate of fatalities by 10% within the next five years.
- **Serious Injuries** - Reduce the current trend of increasing serious injuries by not exceeding the 2012 total value of 7,574 as an average over the next five years.
- **Serious Injury Rate** - Reduce the current trend of an increasing serious injury rate by not exceeding the 2012 total value of 10.65 serious injuries per hundred million vehicle miles traveled as an average over the next five years.

Source: Tennessee Strategic Highway Safety Plan. TDOT 2014

The 2014 SHSP also includes the following emphasis areas which were established by the steering committee for improving safety on Tennessee's roads:

- Data Collection and Analysis
- Driver Behavior
- Infrastructure Improvements
- Vulnerable Road Users
- Operational Improvements
- Motor Carrier Safety

The development of the SHSP is continuous and recurring, as goals and objectives evolve over time. As part of the process to provide a dynamic document, Tennessee develops a Highway Safety Performance Plan (HSPP), which is based on the Tennessee SHSP, and serves as the State's "up-to-date action plan". The HSPP helps prioritize the behavioral safety programs to receive federal highway safety funds during the federal fiscal year.

The focus of the current HSPP is to address the behavioral aspects of highway safety that affect the knowledge, attitudes, and behaviors of highway users and safety professionals. The following insert briefly summarizes the mission, vision, and goals contained in the HSPP:

MISSION: To save lives and reduce injuries on Tennessee roads through leadership, innovation, coordination, and program support in partnership with other public and private organizations.

VISION: Have all highway users arrive at their destination and look forward to a time when there will be no loss of life on Tennessee's roadways

GOALS:

- **Traffic Fatalities** - To reduce traffic fatalities by 3.1% from a 2012 baseline of 1,014 to 983 in 2015.
- **Serious Traffic Injuries** - To reduce the number of serious traffic Injuries by 1.3% from a 2012 baseline of 7,596 to 7,498 in 2015.
- **Overall Fatalities/Vehicle Miles Traveled (VMT)** - To reduce the rate of traffic fatalities per Hundred Million Vehicle Miles Traveled (HMVMT) by 2.9% from a 2012 baseline of 1.425 to 1.385 in 2015.
- **Rural Fatalities/VMT** - To reduce the rate of rural traffic fatalities per HMVMT by 15.6% from a 2012 baseline of 2.050 to 1.730 in 2015.
- **Urban Fatalities/VMT** - To reduce the rate of urban traffic fatalities per HMVMT by 2.0% from a 2012 baseline of 1.020 to 1.000 in 2015.
- **Unrestrained Passenger Vehicle Occupant Fatalities** - To reduce the number of unrestrained passenger vehicle occupant fatalities 14.7% from a 2012 baseline of 398 to 340 in 2015.
- **Alcohol-Impaired Driving Fatalities** - To reduce the number of alcohol impaired driving fatalities by 9.6% from a 2012 baseline of 295 to 267 in 2015.
- **Speeding-Related Fatalities** - To reduce the number of speeding involved fatalities by 6.1% from a 2012 baseline of 197 to 185 in 2015.
- **Motorcyclist Fatalities** - To reduce the motorcyclist fatalities by 6.5% from a 2012 baseline of 139 to 130 in 2015.
- **Unhelmeted Motorcyclist Fatalities** – To reduce the unhelmeted motorcyclist fatalities by 33.3% from a 4-year average baseline (2009 - 2012) of 16 to 10 in 2015.
- **Drivers Age 20 or Younger Involved in Fatal Crashes** – To reduce the number of drivers under age 21 involved in fatal crashes by 4.2% from a 2012 baseline of 144 to 138 in 2015.
- **Pedestrian Fatalities** – To reduce the pedestrian fatalities by 2.9% from a 2012 baseline of 68 to 66 in 2015.
- **Bicycle Fatalities** – To reduce the bicycle fatalities by 12.5% from a 2012 baseline of 8 to 7 in 2015.
- **Observed Seatbelt Use for Passenger Vehicles** – To increase the observed seat belt usage rate for passenger vehicle occupants by 2.7 percentage points from a 2012 baseline of 85.1% to 87.9% in 2015.

Source: Highway Safety Performance Plan. Governor's Highway Safety Office. TDOT 2014

Road Safety Audits Reviews

Road Safety Audits Reviews (RSARs) are another important safety tool that TDOT uses. The goal of a RSAR is to reduce injuries and fatalities at the identified locations using low-cost and quickly-implemented improvements. RSARs are conducted at locations where improvements may be needed to reduce injuries and fatalities. RSAR projects are developed through three different processes:

- Sites identified from the HSIP List
- Requests from internal and external stakeholders
- Sections of roadway identified through the project development process

Local Roads Safety Initiative

The Local Roads Safety Initiative (LRSI) provides assistance to local governments outside MPO planning areas (i.e. non-metropolitan areas) in Tennessee to improve safety issues on non-state routes in their jurisdictions. The LRSI program provides funding for safety audits and projects for the welfare of the local communities and the traveling public. TDOT communicates with local officials on safety issues and problem spots.

Governor's Highway Safety Office

The Governor's Highway Safety Office (GHSO) operates as TDOT's primary advocate for highway safety. The GHSO works with law enforcement officials, judicial personnel, and civic leaders to coordinate activities and initiatives relating to improving highway safety. TDOT and the GHSO maintain a traffic safety website that operates as a center for information for current safety programs and events (http://tntrafficsafety.org/).

The mission of the GHSO is to develop, execute, and evaluate safety programs that will reduce the number of fatalities, injuries, and related economic losses resulting from traffic crashes. The office also works with the National Highway Traffic Safety Administration (NHTSA) to help implement programs that focus on occupant protection, impaired driving, speed enforcement, truck and school bus safety, pedestrian and bicycle safety, and crash data collection and analysis. It should be noted that the safety related programs administered by the GHSO are also 100% federally funded.

The GHSO is responsible for Tennessee's Highway Safety Performance Plan (HSPP) and maintaining safety and educational programs, community involvement efforts, and training programs across the state. Some examples of these programs involve:

- Child passenger safety
- Teen driver education
- Senior driver safety
- Motorcycle safety
- Bicycle & pedestrian safety
- Hispanic/Latino outreach

Traffic Operations

The Traffic Operations Division of TDOT also strives to improve safety. The Traffic Operations Division includes the Traffic Engineering, Transportation Management, and Intelligent Transportation System (ITS) Offices. The Traffic Operations Division provides policy and guidance to the regional Traffic Management Centers (TMCs), Traffic Incident Management (TIM), and Traffic Engineering offices.

All of these entities work in collaboration under TDOT's Intelligent Transportation System,

SmartWay, with the purpose of reducing congestion, minimizing problems caused by congestion, and improving operational efficiency, effectiveness, and safety on Tennessee's transportation system. SmartWay's advanced information technologies directly and indirectly enhance public safety. Taking many forms, SmartWay includes 164 Dynamic Message Signs, 1,254 congestion monitoring devices, 58 highway advisory radio transmitters, and 418 urban and 59 rural cameras used to visually monitor Tennessee's roadways. In addition, this includes freeway service patrols (described below), 4 TMCs, construction information in work zones, and the TDOT Smartway Information System (TSIS). TSIS gathers and distributes traffic and roadway information, which is accessible to the public via TDOT's website.

TDOT's TIM program, also known as HELP, is a part of the TDOT "SmartWay" system. TIM consists of a planned and coordinated multi-disciplinary process to detect, respond to, and clear traffic incidents so that traffic flow may be restored as safely and quickly as possible. Effective TIM reduces the duration and impacts of traffic incidents and improves the safety of motorists, crash victims, and emergency responders. The TDOT HELP trucks can be dispatched to any of the major state routes and interstates in the major urban areas seven days a week in an effort to mitigate congestion caused by roadway incidents. The HELP program also works in conjunction with emergency response agencies and other TDOT units. All of the HELP operators are specially trained to help assist with the different kinds of emergencies that occur on public roadways, and the HELP trucks operate as official emergency vehicles. Some operations included as part of the HELP program services include:

- Provide traffic control
- Tag abandoned vehicles
- Vehicle assistance
- Remove debris from travel lanes
- Provide medical assistance
- Extinguish fires
- Provide some mechanical repairs
- Provide services for crash vehicles
- Help secure loads
- Assistance with communication services
- Transport motorists or pedestrians
- Notify TDOT for road repair
- Notify law enforcement

Maintenance Division

The Maintenance Division is responsible for the administration of statewide highway and bridge maintenance services that help address safety issues, user convenience, and conservation of aesthetic qualities. The Maintenance Division has a *Maintenance Rating Program Manual* that provides the methodology of conducting surveys of all maintenance assets on randomly-selected roadway segments to determine the overall condition of the roadway network. The information obtained from these surveys is used to schedule and prioritize routine or contracted maintenance activities in order to provide a uniform level-of-service across the state which meets established Departmental policies and provides safer facilities for users.

Other Divisions

While many divisions within the Department have dedicated programs to address safety issues on the system, there are a number of other ongoing safety-related activities within the Department

that may or may not fall under a specific program, for example, TDOT's oversight of the safe movement of oversize and overweight freight shipments in Tennessee. TDOT's Central Services Office is responsible for such movements, which includes a Section solely dedicated to overweight/over dimensional (OW/OD) permits. This Section coordinates with the THP to ensure the safety of motorists while overweight and oversized cargos are efficiently moved. Beyond these programs, each of the TDOT Regions examines opportunities to improve safety of roadway users on a daily basis.

3.1.2 Multimodal Safety

For other modes of transportation, the TDOT Division of Multimodal Transportation Resources is responsible for programs and polices pertaining to:

- Rail and Waterways
- Public Transportation
- Rail Inspection and Safety
- Bicycle and Pedestrian Program

Rail and Waterways

The Division of Multimodal Transportation Resources has two offices that focus on rail transportation. These offices and corresponding responsibilities are described below.

Office of Freight & Rail - provides grants for track and bridge rehabilitation for Shortline Railroad Authorities who have applied for and have been accepted into the Shortline Railroad program. An assessment of the state's current track conditions was conducted in 2005 and is available online (http://www.tdot.state.tn.us/publictrans/trackassessment.htm). Elements that are part of this Office's oversight include:[2]

- Shortline railroad track rehabilitation
- Shortline railroad bridge rehabilitation
- Waterway assistance
- Federal Railroad Administration – Local Rail Freight Assistance (LRFA) Grant Program
- Freight transportation
- Waterway assistance
- Rail Safety/Regulatory Unit
- Highway-Railroad Grade Crossing Program

Office of Rail Safety/Regulatory – focuses on reducing and eliminating dangerous/hazardous conditions for railroad employees and the general public. In addition to overseeing freight and commuter rail, the Tennessee Department of Transportation is also responsible for Rail Fixed Guideway Systems (RFGS). Commonly referred to as Rail Transit agencies (RTA), RFGS include any heavy, light or rapid transit system, inclined plane railway, trolley, or automated guideway for the movement of passengers that is not regulated by the Federal Railroad Administration(FRA). This

2 TDOT Office of Freight & Rail http://www.tdot.state.tn.us/publictrans/railtrans.htm

office consists of three main components and is responsible for:

- Rail Regulation
    - Partner with FRA to enforce Federal Law (Code of Federal Regulations (CFR) Part 49)
    - Monitor railroad worker safety
    - Conduct rail yard inspections
    - Conduct highway-rail crossing inspections
- Rail Safety (Inspection)
    - Review new railroad construction
    - Conduct industrial site walkway & close clearance inspection
    - Coordinate with Tennessee Emergency Management Agency (TEMA) responders for railroad emergencies
- RTA Fixed Rail Oversight
    - TDOT has developed a System Safety Program Standard (SSPS) that governs the conduct of the oversight program and provides guidance to the regulated rail transit properties concerning processes and procedures they must have in place in order to be in compliance with the state safety oversight program.[3] More information pertaining to the SSPS is provided below in this section.

System Safety Program Plan - TDOT is required to prepare a System Safety Program Standard that describes Tennessee's program for addressing regulations established by the Federal Transit Administration (FTA). These regulations establish minimum requirements for safety and security programs for each RTA within the State's jurisdiction. Included in the System Safety Program Standard is the System Safety Program Plan (SSPP) that contains the following:

- Endorsement of the SSPP by top management of the transit agency;
- Establishment of the safety and security goals and objectives of the transit agency;
- Identification of the safety roles and responsibilities of all RTA departments/functions;
- Required cooperation within the transit agency and the accountability of executive leadership for addressing identified safety issues;
- Identification of the hazard management process to be managed by the RTA;
- Identification of the internal safety audit process to be managed by the RTA and overseen by TDOT;
- Identification of the notification, investigation and reporting procedures to be used jointly by the RTA and TDOT in managing accidents meeting thresholds specified by FTA's rule;
- Communication and coordination with TDOT in all State Safety Oversight (SSO) program provisions; and
- Scheduling the implementation and revision of the SSPP.

3 TDOT System Safety Program Standards http://www.tdot.state.tn.us/publictrans/docs/TDOT-SSPS%20.pdf

Highway-Railroad Grade Crossing Program[4]– focuses on improving safety and reducing the crash risk at public highway-railroad grade crossings. Tennessee's Highway-Railroad Crossing Program is a federal-aid program authorized by United States Code Title 23, Section 130, funded by the Federal Highway Administration (FHWA) and administered through the state. Typically, Section 130 funds are used to install warning devices, such as train-activated flashing lights, automatic gates, and warning bells. However, these funds may also be used to provide various other safety improvements at existing crossings and to assist in the closure of unnecessary crossings.

Tennessee typically receives about $4,600,000 in Section 130 funds annually. The typical cost of a Section 130 Program safety improvement project ranges from $180,000 to $280,000. Priority for the available funds is given to crossings with the greatest likelihood of a collision occurring. This is determined using the U.S. Department of Transportation's accident prediction model, which takes into consideration many factors including:

- Average daily traffic on the highway;
- Number of train movements per day;
- Maximum train speed; and
- Crash history, if any.

The Highway-Railroad Crossing Program maintains a crossing inventory database, including information about warning devices and signage, for each public crossing in Tennessee. The information is used to prioritize crossings for projects and to update the national crossing inventory database maintained by the Federal Railroad Administration (FRA).

Operation Lifesaver -Tennessee is also active in Operation Lifesaver, which is a national public information and education program to help prevent and reduce crashes, injuries and fatalities and improve driver performance across the nation's public and private grade crossings.[5]

Public Transportation

The Office of Passenger Transportation is another office of the Multimodal Transportation Resources Division, which focuses on public transportation and is responsible for:

- Transit Planning, Capital, and Operating Assistance in Urbanized and Non-Urbanized areas;
- Elderly/Disabled Transportation Program;
- Statewide Ridesharing Program;
- Statewide Student Internship Program;
- Park-and-Ride Lot Development;
- Promotion of efficient transit systems through the coordination of all available resources; and
- Research and technical assistance on all aspects of public transportation

Each state Department of Transportation is required to have an approved state management plan for the Section 5310, 5311, 5316 and 5317 programs on file with the Federal Transit Administration regional office and to update it regularly to incorporate any changes in program management and

4 TDOT Highway-Railroad Grade Crossing Program http://www.tdot.state.tn.us/publictrans/section130.htm
5 Tennessee Operation Lifesaver http://www.tnol.org/

new requirements. The plan documents TDOT's policies and procedures for the state-managed Federal Transit Administration program.[6] According to TDOT's State Management Plan:

"Safety is paramount and inherent in the provision of Division of Multimodal Transportation Resources services both at the organizational level as well as to the ultimate customer - the transit passenger.

As the designated recipient for federal funds in Tennessee, TDOT is empowered to carry out the authority indicated above. TDOT will also exercise authority to remove vehicles and facilities from service if it is deemed that identified vehicles or facilities present an unsafe environment for employees and transit customers. In this regard, Division of Multimodal Transportation Resources may engage the safety resources of TDOT's Office of Occupational Safety for assistance in ensuring compliance with all issues relevant to employee and customer safety.[7]"

Active Transportation Safety

Active transportation, which includes bicycle and pedestrians, has been a growing focus of TDOT. TDOT maintains a Bicycle and Pedestrian Program under the Division of Multimodal Transportation Resources that helps promote increased opportunities for implementing more choices in the transportation system. A Bicycle and Pedestrian plan was included as part of the previous TDOT long-range transportation plan (TDOT Plan Go) and provided recommendations on maximizing safety and security for pedestrians and bicyclists through the following categories:

- Enhancing the Data Collection System
- Collecting and Maintaining Bicycle and Pedestrian Counts
- Improving the Accuracy of Crash Data
- Pedestrian and Bicycle Safety Programs
- Building Partnerships for Livable Communities
- Promoting Stewardship of the Environment
- Emphasizing Financial Responsibility

The Division's Bicycle and Pedestrian Program provides coordination with TDOT resurfacing projects, awards the Multimodal Access Grants to local governments and transit agencies, and serves as a liaison between the Department and bicycle and pedestrian stakeholders. The Multimodal Access Grant provides up to 95% in State grant funds with a minimum local match of 5% for projects that seek to meet the needs of transit users, pedestrians, and bicyclists by providing infrastructure connections that address existing gaps along state routes. Up to $950,000 of state funds are available for projects that meet the following requirements: ADA accessibility standards and are located along a state route, within ¼ of a mile of a state route *and* provides a direct connection to a state route, or, finally, provides direct access to a transit hub. Grant monies may be used for project scoping and design, acquisition of right-of-way, and construction of such projects that support multimodal transportation options, connectivity, and most importantly, enhance the safety of pedestrians and bicyclists.

Safe Routes to School (SRTS) is also a program managed by TDOT for safety improvement projects for bicyclists and pedestrians. SRTS is a federally-funded program that focuses on the benefits

6 TDOT Division of Multimodal Transportation Resources http://www.tdot.state.tn.us/publictrans/smp.htm
7 TDOT State Management Plan (2011)

of children walking and biking to school. The program aims to improve safety for children and the community and provide opportunities to increase physical activity. SRTS funds activities and infrastructure in addition to efforts that encourage healthy options for children. While the federal SRTS Program was discontinued under MAP-21, state SRTS projects were eligible for funding under the Transportation Alternatives Program (TAP). From 2005 to January 2015, TDOT has received 350 applications requesting over $50 million under its SRTS program. The applications represented a diverse mix of educational activities, major projects such as sidewalk segments and shared-use paths, and minor improvements such as sign packages, crosswalks, and pedestrian signals. To date, Tennessee's SRTS Program has awarded 88 projects totaling over $12.3million.[8]

3.1.3 Tennessee Department of Safety and Homeland Security

The Tennessee Department of Safety (TDOSHS) was established in 1939 by the Tennessee General Assembly to exercise authority over the Tennessee Highway Patrol (THP). While TDOSHS operates separately from TDOT, each department is tasked with working together toward the common goal of ensuring the public's safety through various safety programs and public campaigns. The two Departments also have an interagency memorandum of understanding for coordinating incident-response efforts 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."

TDOSHS is comprised of three divisions, the Tennessee Highway Patrol (THP), Driver License Services, and the Office of Homeland Security, and is primarily responsible for law enforcement, safety education, motorist services, and disaster preparedness and prevention. THP, in particular, conducts a wide range of activities aimed at saving lives and reducing injuries on Tennessee's roadways. THP's Safety Education division is charged with increasing public awareness of transportation-related safety issues through various public campaigns, presentations, and collaboration with various stakeholders. The Commercial Vehicle Enforcement Division is charged with addressing public safety through commercial vehicle inspections, driver log inspections, and ensuring appropriate weight and size permits have been acquired for trucks. Finally, THP provides checkpoint enforcement in order to minimize the number of alcohol-related crashes, increase seatbelt usage, and decrease the number of un-licensed drivers on the roadways.

3.1.4 Data Collection

As part of any safety program, it is important to have access to up-to date data that allows for the evaluation of existing conditions and identifies potential problem areas. Additionally, having access to this data can allow for the ability to track the implementation of safety initiatives over time to see the impact of implementation. These measures of effectiveness (MOEs) can provide impact assessment for many safety programs and policies. This section summarizes some of the data currently collected and maintained by the State related to safety for all modes of transportation.

Governor's Highway Safety Office (GHSO)

As mentioned previously, safety related issues are the primary responsibility of the GHSO under TDOT. To this end, GHSO helps manage and share the information, data, and maps related to vehicle operators, safety, and crashes. This data is available at the statewide level and sometimes the county level (http://tntrafficsafety.org/data-statistics). Available data includes:

8 TDOT Bicycle and Pedestrian Program, Safe Routes to School http://www.tdot.state.tn.us/bikeped/saferoutes.htm

- Motorcycle Crashes
- Teen Crash Rate
- Senior Crash Rate
- Injury Rate
- Fatality Rate
- Total Crash Rate
- Total Crashes
- Teen Crashes
- Senior Crashes
- Motorcycle Crash Rate
- Crashes Involving Children
- Restraint Use by Children
- Alcohol Fatalities
- Alcohol Crashes
- Crashes While Speeding
- Speeding Crash Rate
- Total Fatalities
- Age 15-24 Crashes Involving Alcohol
- Pedalcyclist Fatalities and Injuries
- Pedestrian Fatalities and Injuries

Tennessee's Integrated Traffic Analysis Network (TITAN)

Another key source of safety data comes from Tennessee's Integrated Traffic Analysis Network (TITAN). TITAN is a tool that provides for the electronic collection, submission, and management of all crash data in Tennessee that law enforcement agencies use on a daily basis. It consists of a centralized database and document repository for public safety information that is ultimately managed by the TDOSHS and the THP.

TITAN has been designed to manage reports submitted by law enforcement agencies, validate the data contained within the report for completion and accuracy, and then store the information. The TITAN repository is also capable of directly displaying the information from submitted reports and retains them for future access and records retention requirements. The TITAN online services are for the exclusive use of law enforcement agencies in the state of Tennessee with required membership; unauthorized access to the site is prohibited.

Tennessee Department of Safety and Homeland Security (TDOSHS)

TDOSHS also publishes additional crash data online (www.tn.gov/safety/stats/CrashData/default.shtml) at the state and county level. It includes information regarding traffic fatalities, injury and property damage crashes, as well as crashes involving teens, seniors, alcohol, deer, and other contributing factors.

Fatality Analysis Reporting System (FARS)

Another source of crash data that is available comes from the National Highway Traffic Safety Administration (NHTSA). The NHTSA provides reports and data on the number of vehicle-related fatalities from the Fatality Analysis Reporting System (FARS) (http://www-fars.nhtsa.dot.gov). This includes multimodal-related fatal crashes that can involve vehicles, motorcycles, pedestrian, bicycles, etc. FARS is a nationwide database providing NHTSA, Congress and the American public yearly data regarding fatal injuries suffered in motor vehicle traffic crashes. Data is available in many types and includes tables, maps, and interactive GIS maps at the state and county level.

Federal Railroad Administration (FRA)

The Federal Railroad Administration Office of Safety Analysis has railroad safety information available online (http://safetydata.fra.dot.gov/OfficeofSafety/Default.aspx) for the public related to[9]:

- Deaths or injuries
    - Death of a rail passenger or a railroad employee;
    - Death of an employee of a contractor to a railroad performing work for the railroad on property owned, leased, or maintained by the contracting railroad; or
    - Death or injury of five or more persons.
- Train accidents or train incidents
    - A train accident that results in serious injury to two or more train crewmembers or passengers requiring their admission to a hospital;
    - A train accident resulting in evacuation of a passenger train;
    - A fatality resulting from a train accident or train incident at a highway-rail grade crossing when death occurs within 24 hours of the accident/incident;
    - A train accident resulting in damage (based on a preliminary gross estimate) of $150,000 or more to railroad and non-railroad property; or
    - A train accident resulting in damage of $25,000 or more to a passenger train, including railroad and non-railroad property.
- Train accidents on or fouling passenger service main lines
    - That involves a collision or derailment on a main line that is used for scheduled passenger service; or
    - That fouls a main line used for scheduled passenger service.

3.1.5 Assessment of Data Collection Program

Data collection for use in safety assessments for TDOT consists of count data, roadway information management data, and crash reports. Count data is critical in crash analysis due to the impact of exposure in estimating the crash rate. TDOT also manages two databases that track traffic data and roadway conditions that are useful when evaluating safety issues. These databases are:

- Advanced Traffic Data Analysis & Management (ADAM) – database that contains statewide vehicle volume, classification, and vehicle weight data.
- Tennessee Roadway Information Management System (TRIMS) - is a database that enables TDOT to capture, maintain, and view critical roadway data. The TRIMS application also contains roadway data, traffic, bridges, crashes, railroad grade crossings, pavement conditions, and photolog digital images.

Based on an assessment of the data collection programs related to safety, TDOT and its collaborative partners are collecting the same, if not more data, when compared to other states

9 Federal Railroad Administration, Accident Data & Reporting, Investigations http://www.fra.dot.gov/Page/P0037

in the southeast region. In addition, TDOT provides much of this same data online for the public, or will make the data available to the public following an official "Data Request Form". TDOT also makes efforts to share this data with other public and private stakeholders when appropriate. For example, MPOs and RPOs in Tennessee have access to TRIMS via the Department's eTRIMS which allows for these entities to access TRIMS remotely via a virtual private network (VPN) connection.

3.1.6 Tennessee Statewide Information for Travelers (SWIFT)

SWIFT is a data collection tool used to disseminate traffic information to the public through the TDOT SmartWay, Tennessee 511, and 3rd party data consumers. This system is currently under development to include an incident management database and a performance measurement tool.

3.1.7 Technology Impacts

New technologies can make it easier to collect, manage, analyze, and share safety-related data. As discussed previously, TDOT is currently using many different types of tools to collect, process, manage, and analyze a wide variety of transportation-related data across the state. In addition, intelligent transportation system (ITS) programs have been implemented across the state that also provide TDOT with even more data collection tools. The TDOT Smartway program uses advanced information technologies to improve the safety and operation of highways and other transportation modes, such as public transit. Components of the Smartway include:

- Roadway Traffic Sensors
- Camera Video Surveillance
- Dynamic Message Signs
- HELP Freeway Service Patrols
- Transportation Management Centers (TMC)
- Incident Management
- Construction Information
- Tennessee Statewide Information for Travelers (SWIFT)
- Information on Weather-Related Road Conditions

3.1.8 Coordination

With the wealth of data available pertaining to safety, it is critical that channels are known and established to allow for the transfer of information between departments, divisions, and agencies. Coordination between the groups will allow for the sharing of information that can be used to help improve safety conditions. An example is the aforementioned Steering Committee who assisted in the development of the 2014 SHSP. Sharing data across disciplines helped to reduce the amount of time and effort required for the data collection process allowing for the focus to instead be on identifying safety strategies and countermeasures. Use of the steering committee also allowed for the coordination of efforts to avoid duplication while maximizing available resources.

Coordination is also an integral part in meeting requirements under federal transportation

legislation. In its effort to move the Federal-aid highway program towards a performance-based program, national goals were established with the purpose of helping to identify the most efficient investments. These national goals include safety, infrastructure condition, congestion reduction, environmental sustainability, system reliability, freight movement and economic vitality, and reduced project delivery delays. In turn, national performance measures for each goal were identified by the U.S. DOT in consultation with state DOTs, MPOs, and transit agencies. Following coordination with MPOs and transit agencies, state DOTs will be required to establish state surface transportation performance targets in support of reaching national performance goals. These targets as they relate to safety include fatality rate, reduction in fatality rate, number of fatalities on Tennessee roadways, seat belt usage, number of crashes in Tennessee work zones, highway rail grade crossing fatal crashes, and the number of incoming "511" calls. To ensure consistency across the state, TDOT will have to coordinate with MPOs, in addition to transit agencies, in setting their own targets to meet identified state targets. As part of the Federal requirements, each state must report on the condition and performance of the transportation network as they relate to the performance targets, further requiring TDOT to coordinate with MPOs and transit agencies across the state. If a state's report shows inadequate progress, then the state must undertake corrective actions.

3.2 Security

Incorporating security and emergency management considerations into the planning process results in increased safety for the public. Since the transportation system is one of the defined sectors of critical infrastructure, it is important that security plans, policies, and programs are in place. Failure to provide the necessary security could result in a situation in which the destruction or exploitation of these facilities could result in the following:

- Adverse health effects or large casualties
- Impair federal departments and agencies functions
- Undermine state and local government capability
- Damage to the private sector's capability to deliver essential services
- Negatively affect the economy
- Undermine the public's morale and confidence

Transportation agencies can influence security in various ways. Examples of how security risks might be interpreted in terms of the role of a transportation agency and the implications on transportation planning are shown in Table 1.

Table 1 Responsibilities of Transportation Agencies in Addressing Security Risks[10]

Security Risk Component	Possible Role of Transportation Agency	Implications for Transportation Planning
Probability of Incident Attempt: Presence of individuals who have the motivation to plan and carryout acts of terrorism.	Utilize regulatory and oversight capabilities to help identify/ capture or exclude entry of possible terrorists (via licensing, border crossing enforcement, routine traffic enforcement, etc.). Carry out responsibilities in a manner that will minimize the prospect that employees, or affected parties (land owners, contractors, system users etc.) will be motivated to seek revenge through terrorism.	Enhance transportation agency capabilities in the areas of regulation and enforcement. Enhance customer interface capabilities of transportation workforce.
Vulnerability: Prospect that a transportation target could be successfully terrorized	Limit the information availability that might influence the choice of transportation as a terrorist target. Ensure the transportation work-force is screened and monitored to reduce likelihood of internal terrorism. Limit the access to sensitive targets. Secure critical elements in transportation system.	Evaluate knowledge sharing/ dissemination strategies. Upgrade employee and contractor screening and control capabilities. Explore physical and operational controls on access to sensitive locations. Reconsider alignment and service location criteria to include security concerns.
Damage: The direct and indirect magnitude of the consequences in personal and economic terms	Design systems and facilities so as to be resistant to attack. Have incident response capability to minimize loss of life and restore functioning of transportation system. Provide redundancies to enable system robustness after an incident.	Evaluate/modify system and facility design standards. Consider network robustness in project design and selection. Support investments to enable rapid incident response.

Therefore, security goes beyond safety and includes additional plans that help to prevent, manage, or respond to threats that could negatively impact the transportation system and its users.

Emergency management is also a vital public safety role for state DOTs and is a continuous process by which all agencies levels of government seek to manage hazards in order to reduce or avoid the impact of disasters on roadway, rail, waterway, and air infrastructure. The emergency management process is commonly broken down into four phases: mitigation, preparedness, response, and recovery. The mitigation phase focuses on long-term measures aiming to reduce or eliminate risks, such as retrofitting bridges to withstand earthquakes. Preparedness involves developing plans of action for when a disaster does strike and includes additional actions such as completing risk assessments, response training, and conducting exercises to practice response plans. In May

10 Polzin, Steven E., P.E., Ph.D. *Security Consideration in Transportation Planning: A White Paper.* 2004. (http://www.planning.dot.gov/documents/SecurityPapers/SecurityConsiderations_Polzin.htm)

2014, TDOT and TDOSHS broke ground on the nation's first Traffic Incident Management Training Facility to teach and practice best practices for clearance techniques. While focused upon major highway incidents, the facility provides a training ground for implementing response procedures on a smaller scale involving the various agencies tasked with disaster response: TDOT, THP and other law enforcement agencies, fire and EMS, emergency management agencies, towing and recovery, and hazardous materials (HAZ-MAT) companies. The response phase of emergency management includes the identified tasks in the National Response Framework, further described in the TEMA section. Transportation infrastructure plays an integral role in evacuating citizens from disaster areas, while supplying resources to the disaster area. The final phase, recovery, necessitates the Department to support local agencies in repairing or rebuilding infrastructure and to analyze elements of the response for identifying where improvements can be made.

There are many programs in place to help manage security concerns and emergency issues. The following section provides a review of the state's security programs that help manage these situations and the coordination efforts required by TDOT.

Department of Safety and Homeland Security

The Office of Homeland Security is responsible for enhancing the protection of Tennessee's critical infrastructure and key resources. Working cooperatively with federal, state and local government agencies, as well as the private sector, the Office of Homeland Security strives to build a safer, more secure environment through its Critical Infrastructure Protection Program. The Tennessee Office of Homeland Security (TOHS) is the primary responsible authority for directing statewide activities pertaining to the prevention of and protection from terrorist-related events. This responsibility also includes the development and implementation of a comprehensive and coordinated strategy to secure the state from terrorist threats and attacks. In addition, TOHS also serves as a liaison between federal, state, and local agencies, as well as the private sector, on matters relating to security.

Tennessee Emergency Management Agency (TEMA)

The TEMA coordinates emergency management response and recovery to reduce loss of life and property in the State of Tennessee. TEMA is also responsible for the development of the Tennessee Emergency Management Plan (TEMP). TEMP provides the foundation for all disaster and emergency response plans and operations conducted within the State of Tennessee. All local emergency management plans are required to emulate the TEMP in terms of structure and purpose.

The Tennessee Emergency Management Plan (TEMP) outlines responsibilities of each state agency during a disaster or emergency event, except those for which military forces have primary responsibility. TEMP outlines several Emergency Support Functions (ESFs) which identify basic needs during a disaster. In the TEMP, TDOT serves as the lead agency for Emergency Support Function 1 (ESF-1) "Transportation Networking". In addition to this role, TDOT also serves as a support agency for other ESF activities listed below:

- Transportation
    - Transportation networking
    - Coordinating with Federal Emergency Management Agency (FEMA) (ESF-1 Transportation)

- Infrastructure
    - Route Clearance and Bridge Inspection
    - Debris Removal
    - Coordinating with FEMA (ESF-3 Public Works & Engineering)

3.2.1 Multimodal Security

TDOT developed System Safety and System Security Programs Standards (SSPS) that provide guidance for the regulations issued by the FTA. The security portion of the System Safety Program Standard includes the development of a Security and Emergency Preparedness Plan (SEPP). The RTA prepares the SEPP as a separate document from the SSPP. At a minimum, the SEPP developed by the RTA must:

- Identify the policies, goals, and objectives for the security program endorsed by the Chief Executive of the RTA
- Document the RTA process for managing threats and vulnerabilities during operations and for major projects, extensions, new vehicles and equipment, including integration with the safety certification process
- Identify controls in place that address the personal security of passengers and employees
- Determine TDOT System Safety Program Standards
- Document the RTA process for conducting internal security audits to evaluate compliance and measure the effectiveness of the SEPP
- Document the RTA process for making available its SEPP and accompanying procedures to TDOT for review and approval.[11]

The Office of Passenger Transportation (OPT) also offers various technical assistance and training classes that focus on preventive maintenance, transit safety and security, customer service/ diversity, effective radio communications, ITS, and managing transit emergencies.

3.3 Transportation Resiliency

A resilient transportation system can anticipate, function, and recover from external disruptions as well as withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents. Disruption is defined as a significant, unexpected, and/or unpredictable change, which has serious consequences for a system. Disruptions to the transportation system can be defined as:

- Threats caused by internal, societal factors – this mainly applies to terrorist-related incidents but could equally well apply to a sudden change in how the users of a system interact with it, economic turmoil, political upheaval, demographic changes, etc.
- Hazards caused by external, environmental factors - these are factors such as flooding, storms, heat waves, freezing conditions, etc. Climate change – or more properly, changes in the frequency and severity of disruptive weather events – is often considered as a hazard in itself.

11 TDOT Rail Fixed Guideway System Safety Oversight Program, System Safety Program Standard, January 2011.

Some notable examples of potential impacts due to these environmental factors include:

- More frequent/severe flooding of underground tunnels and low-lying infrastructure, requiring drainage and pumping, due to more intense precipitation, sea level rise, and storm surge.
- Increased numbers and magnitude of storm surges and/or relative sea level rise potentially shorten infrastructure life.
- Increased thermal expansion of bridge joints and paved surfaces, potentially causing possible degradation, due to higher temperatures and increased duration of heat waves.
- Higher maintenance/construction costs for roads and bridges, due to increased temperatures, or exposure to storm surge.
- Asphalt degradation and shorter replacement cycles; leading to limited access, congestion, and higher costs, due to higher temperatures.
- Culvert and drainage infrastructure damage, due to changes in precipitation intensity, or snow melt timing.
- Decreased driver/operator performance and decision-making skills, due to adverse weather.
- Increased risk of vehicle crashes from improperly maintained vehicles, due to severe weather.
- System downtime, derailments, and slower travel times, due to rail buckling during extremely hot days.
- Reduced aircraft performance leading to limited range capabilities and reduced payloads.
- Air traffic disruptions, due to severe weather and precipitation events that impact arrival and departure rates.
- Reduced shipping access to docks and shore equipment and navigational aid damage.
- Restricted access to local economies

Recent examples of these transportation system disruptions and the resulting impacts have been seen in events such as the 9/11 terrorist attacks and recent severe storm events of Hurricanes Katrina and Sandy. Transportation infrastructure is often on the receiving end of these disruptions which result in impacts that are not only costly to repair, but can result in the injury or loss of life. The National Oceanic and Atmospheric Administration (NOAA) reported that in 2012 there were 11 different weather and climate disaster events with estimated losses exceeding $1 billion each across the United States. Taken together, these 11 events resulted in over $110 billion in estimated damages, which would make it the second most costly year on record.

The federal government emphasized infrastructure protection as one of the core focus areas of homeland security with the National Infrastructure Protection Plan (NIPP). This plan outlines how government and private sector participants in the critical infrastructure community work together to manage risks and achieve security and resilience outcomes. The NIPP identifies the need to manage the risks from significant threats and hazards to physical and cyber critical infrastructure and requires an integrated approach across this diverse community to:

- Identify, deter, detect, disrupt, and prepare for threats and hazards to the Nation's critical infrastructure;
- Reduce vulnerabilities of critical assets, systems, and networks; and
- Mitigate the potential consequences to critical infrastructure of incidents or adverse events that do occur.

The FHWA has developed plans, resources, and publication that address the need for a resilient transportation system, developed out of concern driven by climate changes and extreme weather (https://www.fhwa.dot.gov/environment/climate_change/adaptation/publications_and_tools/).

Transportation resiliency is interconnected with safety and security. As previously discussed, there are already programs and policies in place in Tennessee that overlap with the ideas and concepts of resiliency. However, TDOT does not have any specific plans or policies dedicated solely to resiliency, as it is described here.

Specific areas of concerns for TDOT that can impact the transportation system's resiliency that deal with the natural environment and disasters can include:

- Severe Weather (tornados, blizzards, etc.)
- Flooding
- Seismic Events
- Rockslides
- Train wrecks

Examples of events that have impacted the transportation system and subsequently, the movement of goods and services across the state include: the record flooding along the Mississippi River in 2011 followed by subsequent near all-time low measurements in 2012 that temporarily brought barge traffic to a standstill; the 2010 Nashville flood which impacted travel on numerous interstates; the 2013 rockslide that shut down 20 miles of I-40 near the Tennessee/North Carolina state line; and the 2010 sinkhole that shut down eastbound lanes of I-24 in Grundy County.

As a result of many of these events, the Department undertook a research effort by way of a FHWA grant to perform an extreme weather vulnerability assessment of transportation infrastructure in the state. The primary goal of this study was to identify transportation infrastructure assets that are critical to both the state and nation and then to determine the impacts that extreme weather events could potentially have on these assets using historical and predicted analysis of weather events. There were several important findings that resulted from this study and that can be used by TDOT to plan for the needed resiliency of the transportation system; they are as follows:

- As expected, various regions of the state are more prone to certain types of extreme weather events.
- High winds and heavy precipitation (flooding) are the events of greatest concern across the state and to multiple transportation asset classes.
- Winter weather is primarily an issue for certain counties in East Tennessee; however, future climate projections suggest that this may become a declining concern.
- Shelby County (Memphis) and Davidson County (Nashville) are the locations in the state

with the most vulnerability to extreme weather.

- The greatest single concern is the potential for flooding in the Memphis area. The area has "dodged a bullet" in the past because local streams have not been at capacity when the Mississippi River has flooded. Coupled with higher precipitation levels projected for this area, a future flooding event could have serious implications for passenger and freight transport, both locally and more widespread given the importance of Memphis to the regional and national transportation system.
- There is a propensity for rockslides in the state, particularly in Middle and East Tennessee, where steep slopes and limestone formations are prevalent. Areas with relatively high hydrologic vulnerability scores in locations with significant rockslide potential warrant special consideration.

One division of TDOT that assists with responding to issues impacting system resiliency is the Maintenance Division. The Maintenance Division is responsible for the administration of statewide highway and bridge maintenance services ensuring safety, user convenience, and conservation of aesthetic qualities. Additionally, TDOT's Office of Emergency Operations, which falls under the Maintenance Division, is responsible for the emergency preparedness program (including planning, training, and exercises) and for coordinating statewide emergency response activities.

TDOT's Office of Emergency Operations is manned by a primary Emergency Services Coordinator (ESC) and Alternate ESCs. The Departmental ESCs coordinate responses to incidents which may include earthquakes, floods, tornados, nuclear reactor emergencies, hazardous material spills, and many other situations. TEMA may also request assistance from TDOT to provide traffic control, manpower, or equipment during these emergencies. The ESC's primary duty is to coordinate field personnel during emergencies which require the Department's resources. In more widespread or serious incidents, the Department's ESC is called upon through TEMA to coordinate the Department's response within the combined statewide emergency response plan.

It should be noted that any emergency involving railroads uses a separate ESC than that of TDOT's. The primary ESC for railroad transportation coordinates information to TEMA relative to class 1 through class 3 railroads within Tennessee.

4.0 FUTURE GROWTH, TRENDS, AND TECHNOLOGY

4.1 Comparisons to Surrounding, Peer, and Other Noteworthy States

The following section describes some of the plans, policies, and data pertaining to safety, security, and transportation resiliency of the states shown in Figure 1. The peer states shown in Figure 1 were chosen to align with those identified as peers in TDOT's 2013 Customer Survey, as they were similar to Tennessee in the areas of geographic size, demographics, growth trends, and/or DOT practices.

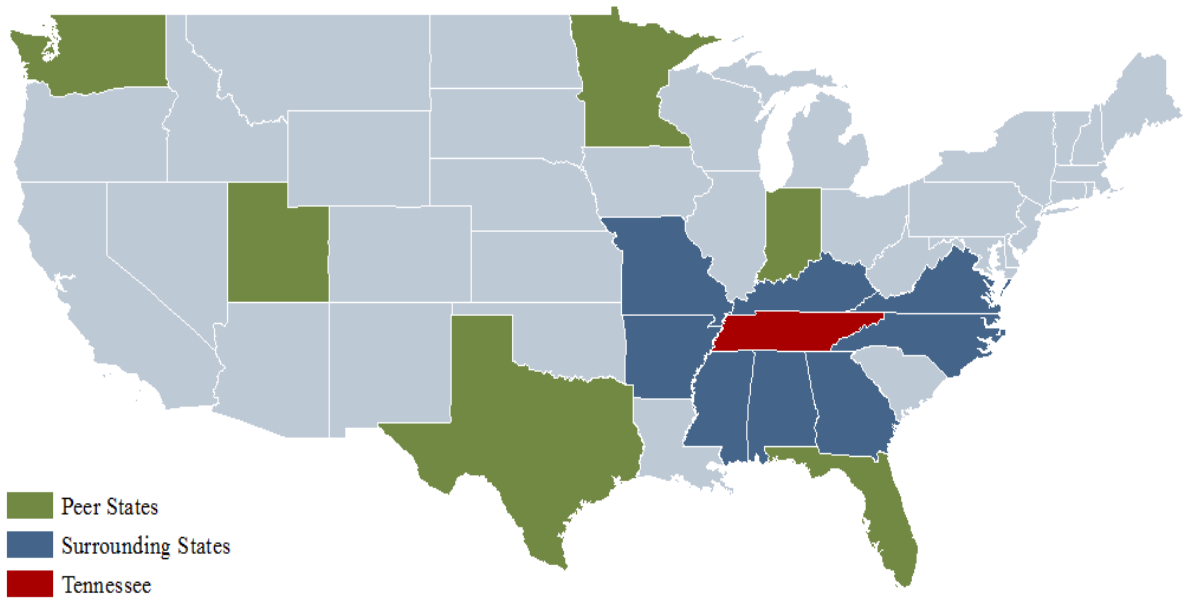


Figure 1 Peer States

A summary table of the peer states' plans, programs, and policies that were found as part of the development of this policy paper is shown in Table 2.

Table 2 Surrounding and Peer State Comparison

Plans, Policies, and Programs	Tennessee	Alabama	Mississippi	Kentucky	Virginia	North Carolina	Georgia	Arkansas	Missouri	Florida	Indiana	Minnesota	Washington	Utah	Texas
Safety															
Programs, Policies, and Plans	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Online Crash Database (Detailed)	✓		✓			✓								✓	
Online Crash Reports (Summary)	✓	✓		✓		✓	✓	✓	✓	✓		✓	✓	✓	
Written Request for Crash Data	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Implementation of Highway Safety Manual					✓	✓			✓	✓			✓	✓	
ITS Programs and Technologies	✓	✓	✓		✓	✓			✓	✓	✓	✓	✓	✓	✓
Security															
Assessment of Critical Infrastructure	✓				✓					✓		✓	✓		✓
Resiliency															
Plans and Policies					✓										✓
Ongoing Research	✓	✓			✓								✓		

Alabama

The Alabama Department of Transportation (ALDOT) maintains many safety programs. Through these safety programs, ALDOT develops and implements safety-related activities including the Strategic Highway Safety Plan, reviews and analyzes crash data, and coordinates statewide safety interests with agencies to reduce highway crashes. ALDOT publishes recent crash data in an annual report called the "Alabama Traffic Crash Facts Booklet" that illustrates historic trends and status of performance measures. ALDOT also uses ITS in its traffic information and camera systems that provides information online to help improve congestion mitigation and incident management.

In addition, the State of Alabama has a program called, "Safe Home Alabama", that provides a resource to help unify all of Alabama's traffic safety efforts. This program provides information on ongoing state safety initiatives, federal safety initiatives, current legislation, and current research efforts.

Some efforts in the coastal areas of Alabama have begun to focus on the impacts that climate change has had on the transportation system. Specifically, as it pertains to the Gulf Coast, studies have been conducted by the USDOT to better understand impacts of climate change on the transportation system by assessing its critical components.

Mississippi

The Mississippi Department of Transportation (MDOT) has a Division of Traffic Safety. The Safety Section of MDOT was created to help provide safer roads and reduce the number of fatal and serious injury crashes. MDOT also uses and sponsors various safety programs and educational efforts. MDOT's data collection efforts track crash data using its Safety Analysis Management System (SAMS). Much like TITAN, MDOT uses the SAMS program to study the safety performance of the roads in Mississippi through the collection of crash data. Through a partnership with the Mississippi Department of Public Safety (MDPS), all crashes reported to the MDPS are automatically entered into the SAMS program to allow MDOT the ability to perform safety analysis. These analyses include:

- The ability to study all information related to a traffic crash, including all pertinent technical data on the Mississippi Uniform Crash Report (i.e., location, weather at the time of the crash, driver's injury severity, etc.) and crash diagrams
- The ability to look at all intersections/sections of the roadway with similar characteristics to determine if a particular intersection/section exhibits the need for safety improvements
- The ability to "drive" a highway to find crashes along sections of road and the ability to analyze those crashes and sections
- The ability to track safety projects and perform before/after analysis on a given safety project
- The ability to perform a Benefit-to-Cost Analysis to determine the best utilization of the funds from the Highway Safety Improvement Program (HSIP)

Like TDOT, MDOT does not have a specific resiliency plan in place. It does have its Emergency Services Section under the Office of Enforcement that oversees and administers MDOT emergency services. This includes emergency plan development and maintenance, coordination of emergency response operations, coordination of state and federal emergency preparedness and response programs, and coordination of Homeland Security initiatives. MDOT uses a Comprehensive Emergency Transportation Response Plan (CETRP) that identifies the responsibilities, policies and procedures of MDOT relating to highway traffic regulations and control when the CETRP is implemented in a national or state emergency and during natural, man-made or technological disasters. The CETRP also names and outlines the functions of the principal state and federal agencies, whose cooperation is essential to the effective implementation of this plan. Additional information regarding MDOT's CETRP can be found on their website (http://mdot.ms.gov/portal/emergency_services.aspx). MDOT also has in place a plan to address contraflow on the interstate to assist during hurricane evacuation.

Kentucky

The Kentucky Transportation Cabinet (KYTC) manages its safety related programs through the Kentucky Office of Highway Safety. Traffic crash data is available for public use and is provided through the Kentucky State Police. KYTC also summarizes data on crashes around the state in its yearly "Kentucky Traffic Collision Facts Book". KYTC does not have any programs or plans that directly refer to the transportation system's resiliency.

Virginia

The Virginia Department of Transportation (VDOT) manages and implements many safety programs that include:

- Highway safety corridors
- Traffic engineering programs
- Highway Safety Improvement Program
- Work zone safety
- Motorcycle safety
- Safety service patrol
- Smart road
- Strategic Highway Safety Plan
- Safe Routes to School

VDOT identifies safety programs under the HSIP that include highway safety, bicycle and pedestrian safety, and Highway-Rail Grade Crossing safety. However, VDOT does not publish crash data on its website and requests for data need to be submitted in writing.

VDOT uses ITS and traffic management centers (TMC) to help improve congestion mitigation, incident management, and traffic planning efforts. Technologies that are used as part of the VDOT TMCs include traffic cameras, variable message signs, highway advisory radio, and safety service patrols.

For resiliency, VDOT was selected in 2010 to participate in a pilot study that tested a climate change vulnerability assessment model. This conceptual model was used to guide transportation agencies through the process of collecting and integrating climate and asset data in order to identify critical vulnerabilities. FHWA used the feedback and lessons learned from the pilot projects to revise the draft conceptual model into the *Climate Change & Extreme Weather Vulnerability Assessment Framework*.

VDOT has developed the VA-Transportation Sector Specific Plan (VA-TSSP), which requires the implementation of the Virginia Critical Infrastructure Protection and Resiliency Strategic Plan. As part of these programs, VDOT hopes to identify, prioritize and assess transportation critical infrastructure (TCI) on a statewide, regional, and district basis. This effort will include:

- Partnering with the Regional and District stakeholders to prioritize, by criticality, VDOT's TCI and identify vulnerabilities;
- Developing a "Baseline" assessment of existing critical infrastructure sites to assist in development of additional mitigation strategies; and
- Establishing a uniform and systematic mitigation program for designated TCI sites

North Carolina

The North Carolina Department of Transportation (NCDOT) provides crash data, organized by type, ranking, overall cost, and maps on its website. This data is published for all counties and some major cities. In addition, NCDOT has The Traffic Engineering Accident Analysis System (TEAAS), which is a crash analysis software system downloadable from the internet and available free of charge to state government personnel, municipalities, law enforcement agencies, planning organizations, and research entities. The TEAAS contains information on all reportable traffic

crashes occurring in North Carolina since 1990. It also contains all ordinance information for all state-maintained roads and highways.

The NCDOT uses ITS to help improve traffic conditions, minimizing delays and improving safety. The ITS program is focused into the eight following categories[12]:

- Signal Systems
- Traveler information including traffic information management system and 5-1-1
- Incident Management Assistance Patrols
- Transportation Management Centers
- Commercial Vehicle Operations
- Transit Management
- Traffic Management and Information Devices

Georgia

Like TDOT, the Georgia Department of Transportation (GDOT) provides some public crash data through online resources. This data from GDOT includes the Crash Analysis Statistics & Information (CASI), County Level Data, and Fatality Analysis Reporting System (FARS). Additional crash data is available for free for law enforcement agencies through the Georgia Electronic Accident Reporting System (GEARS). Individual crash reports can also be requested and purchased. The Georgia Governor's Office of Highway Safety publishes traffic safety performance measures that include summaries of crash statistics.

Arkansas

The Arkansas State Highway and Transportation Department (AHTD) manages traffic safety thorough its Planning and Research Division. Duties of this division include:

- Maintaining a railroad crossing inventory database and ranking all public crossings by a hazard rating;
- Reviewing and submitting selected railroad crossings for safety improvements and to coordinate crossing involvement in highway construction projects;
- Reviewing motor vehicle crash reports to identify possible safety hazards on the highway system;
- Conducting crash analyses on selected locations and submit projects for safety improvements;
- Reviewing all crash reports in the state for correct road system and forward the information to the Arkansas State Police for entry into the state computer system;
- Identifying crash reports on the State system for correct highway, section and log mile; and
- Computing crash rates by roadway type.

The Arkansas State Police manages the Arkansas crash database and publishes annual reports on its website. The Highway Safety Office develops the Highway Safety Plan that identifies the

12 NCDOT ITS (http://www.ncdot.gov/travel/trafficsystems/)

traffic-related safety problems in Arkansas and recommends programs that are most effective in reducing traffic fatalities, injuries, and crashes.

Missouri

The Missouri Department of Transportation (MoDOT) manages many safety programs to help reduce the number of transportation related injuries and fatalities. MoDOT provides an annual report on the statistics of crashes in Missouri. MoDOT is also one of the lead states reviewing the implementation of the *Highway Safety Manual* (HSM).

In 2004, a partnership of Missouri safety advocates including law enforcement agencies, health care providers, courts, local, state and federal government agencies, advocacy groups, planning organizations, concerned citizens, and others banded together to form the Missouri Coalition for Roadway Safety (MCRS).[13] Through this effort, guides were created to help improve safety through the following eight guiding principles during the development and implementation process of documents:

1. Focus on fatalities and serious injuries
2. Consider education, enforcement, emergency response, engineering and public policy strategies
3. Collaborate with all safety partners
4. Use evidence-based strategies
5. Support system-wide safety enhancements
6. Implement countermeasures at both state and regional levels
7. Monitor and evaluate progress
8. Apply to all roadways

MoDOT also uses ITS and traffic management centers (TMC) to monitor the roadways, respond to congestion and incidents, and deliver information to travelers via a number of means, including web sites, dynamic message signs, and highway advisory radio.

Florida

The Florida Department of Transportation (FDOT) maintains a State Safety Office that identifies and helps resolve traffic safety issues, gathers, analyzes, and reports data on traffic crashes, injuries and deaths, distributes state and federal traffic safety funds, and conducts public education campaigns. According to the FDOT website[14], the following safety programs are supported:

13 Missouri's Blueprint to Save More Lives 2012-2016

14 FDOT Safety Programs (http://www.dot.state.fl.us/safety/2A-Programs/Programs.shtm)

- Aggressive Driving
- Safe Routes to Schools
- Aging Road Users
- Safety Engineering
- Bicycle and Pedestrian Safety
- School Crossing Guard Training
- Community Traffic Safety Teams
- Teen Drivers
- Child and Occupant Protection
- Traffic Records Data
- Distracted Driving
- Traffic Records Coordinating Committee
- Impaired Driving
- Motorcycle Safety
- Police/Traffic/Speeding
- Industrial Safety (worker safety)

Crash data for the state of Florida is maintained by the Department of Highway Safety and Motor Vehicles (DHSMV) which is responsible for statewide crash data collection and dissemination. DHSMV can provide crash data for a county, multiple counties, or the entire state and can also provide non-site specific data queries based on the information contained on the traffic crash report form. In addition, periodic reports on the crash data are published on FDOT website (http://www.flhsmv.gov/html/safety.html) through Florida's Integrated Report Exchange System (FIRES). Additionally, as part of Florida's HSIP, maps are created and available online that show the location of the largest 5% of the combined high crashes.

Using DHSMV crash data and other FDOT data, the Safety Office Crash Records Section processes crash records to determine exact locations and can provide location-based crash analyses and listings or summaries of crash data. In addition, the Safety Office can provide geo-located data for crashes on the State Highway System and for crashes on public roads.

The FDOT is also one of 13 states currently in the process of implementing the AASHTO *Highway Safety Manual (HSM)*. The HSM is a toolbox for assessing quantitative safety effects of decisions or actions. The HSM provides the user with the tools to assess different alternatives to reduce crash frequency or severity.

FDOT uses an ITS program to help provide a safe transportation system that focuses on the mobility of people and goods, enhances economic prosperity, and preserves the quality of the environment and communities. One innovative area the FDOT ITS program is currently implementing pertains to "Connected Vehicle". Connected vehicle is communication of data from vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and infrastructure-to-vehicle (I2V). Each of these communication paths provide the ability to send and receive real-time traffic conditions to/from surrounding vehicles, traffic management centers, and other transportation agencies. The connected vehicle initiative uses leading edge technologies to quickly identify roadway hazards and alert drivers. These technologies include:

- Wireless communications
- Vehicle sensors
- Global positioning system navigation

Indiana

The Indiana Department of Transportation's (INDOT) Office of Traffic Safety administers safety programs that are focused on meeting state and federal safety goals on both the state highway system and local roads. INDOT's Program Development Division is responsible for the collection, analysis and reporting of traffic statistical data and traffic projection, crash data, bridge inspection data, road physical feature's inventory including local road inventory, roadway functional classification, Highway Performance Monitoring System (HPMS), and road life history. It also oversees the development and implementation of statewide management systems of pavement, bridge, congestion, safety and traffic monitoring. As a part of this division, the Roadway Data Section processes the collection, analysis, summary, and retention of highway-related data to be used to support FHWA requirements, INDOT project scoping and highway design functions, and the various management systems. However, INDOT does not publish crash data on its website and requests for data need to be submitted in writing. Safety related data collection efforts under this program include:

Safety Management System Unit

- Cooperates with agencies and organizations to reduce the number and severity of traffic crashes.
- Identifies and investigates hazardous locations, ensuring early consideration of highway safety in projects.
- Identifies safety needs of special users.

Crash Analysis Unit

- Provides collision diagrams and various crash summaries by location upon request. These reports aid in determining project improvements and priorities.

INDOT uses ITS to assist in the efforts to reduce traffic congestion and improve safety, security, and resilience. The Statewide TrafficWise traveler information webpage includes updated reports for all State Roads, U.S. highways and Interstates across Indiana. Motorists can learn about traffic conditions, road closures, construction information, and current crash events.

Minnesota

The Minnesota Department of Transportation (MnDOT) Office of Traffic Safety (OTS) designs and implements public education and traffic-law enforcement programs with the goal of reducing crashes, deaths and injuries on Minnesota roads by improving driver behavior. OTS also anchors the state's Toward Zero Deaths (TZD) traffic safety initiative. The TZD approach is based on the belief that even one traffic-related death on the roadway system is unacceptable. This "zero deaths" idea was first adopted in Sweden in 1997 as "Vision Zero" and since then has evolved to several state DOTs, including Minnesota and Washington, which have identified zero deaths as a core objective in their Strategic Highway Safety Plans. TZD uses a data-driven, interdisciplinary approach that targets areas for improvement and employs proven countermeasures, integrating application of education, enforcement, engineering, and emergency medical and trauma services (the "4Es").

MnDOT also uses ITS to help improve safety conditions through use of the Minnesota Guidestar program. This program uses a broad range of ITS activities including needs assessments, research and development, full-scale operational testing, and deployment of ITS strategies and technologies. A list of Guidestar ITS projects are provided on MnDOT's website (http://www.dot.

state.mn.us/guidestar/projects.html).

The Minnesota Department of Public Safety publishes summary crash reports for each year. These reports contain a summary of statistical information about the crashes reported to the state each year and provide the estimated costs attributed to these crashes.

The Minnesota Department of Homeland Security and Emergency Management leads the state effort to keep Minnesota secure and help prevent acts of terrorism. Part of that effort includes assessing and prioritizing critical infrastructure and key resources across the state.

Washington

The Washington State DOT's (WSDOT) Strategic Highway Safety Plan: Target Zero strives to reduce instances of fatalities and serious injuries down to a goal of zero by 2030. WSDOT publishes summary crash reports for each year. These reports contain a summary of statistical information about the crashes reported to the state each year by county and severity.

WSDOT also uses the following ITS programs to help address safety, security, and resilience:

- Active Traffic Management
- Traffic Camera
- Variable Message Signs
- Highway Advisory Radios
- Road/Weather Information Systems
- Ramp Meters
- Traffic Data Collectors
- Traffic Management Centers

As part of WSDOT's 2011-2013 strategic goals to address transportation resilience, research was conducted that reviewed the potential impacts of climate change and a vulnerability assessment. This "phase 1" work reviewed a conceptual climate risk assessment model developed for transportation infrastructure. WSDOT applied the model using scenario planning in a series of statewide workshops, using local experts, to create a qualitative assessment of climate vulnerability on its assets in each region and mode across Washington. Following this research, WSDOT is now undergoing the "phase 2" effort to understand how prepared the state's transportation infrastructure is for sustaining the increasing effects of climate change, through a statewide vulnerability study funded by the FHWA. This research will help identify which roads, bridges, and other facilities throughout the state are most vulnerable.

Utah

The Utah Department of Transportation (UDOT) Traffic & Safety Division is responsible for overseeing the research and programs that help improve transportation safety statewide. These responsibilities include safety improvement programs for work zones, school zones, traffic signals, and pedestrians. Traffic & Safety personnel also supervise studies that determine the causes of crashes and other traffic hazards as well as discuss how these dangers can be minimized[15]. UDOT also uses a "zero fatality" mentality when approaching traffic safety goals.

15 UDOT Traffic and Safety Divisions (http://www.udot.utah.gov/main/f?p=100:pg:0::::V,T:,187)

The Crash Studies Team of the Traffic & Safety Division maintains a detailed database of crash statistics and an online mapping tool for all public roadways within Utah. The Web-based mapping service shows crash rates, safety index, severe crash rate, crash per million vehicles, and safety projects. Maps can be printed or emailed but data cannot be exported. These statistics are used to identify safety issues, prioritize potential safety projects, and allocate limited funding to the locations most in need of improvements. Two documents are prepared that summarizes crash statistics for Utah:

- Fatal Crash Graphs - show monthly fatal vehicle crashes, cumulative vehicles fatalities, cumulative fatalities per 100 million vehicle-miles-traveled, and cumulative pedestrian fatalities over the past few years.
- Traffic Fatality Comparison Chart - shows monthly and cumulative fatal crash statistics for the most recent 10-year period. Fatalities for motorists, pedestrians, bicyclists, and motorcyclists are broken out separately.

Utah also has a *Comprehensive Safety Plan* which was developed by the Utah Safety Leadership Team. This team consisted of approximately 20 different private and governmental groups (including UDOT) interested in promoting roadway safety. The plan outlines a number of different roadway safety emphasis areas and notes what needs to be done from an engineering, education, and enforcement standpoint to achieve a reduction in fatalities for each emphasis area. Implementation and evaluation of the plan are also discussed as part of this plan.

The Traffic Management Division is a division within UDOT that consolidates the Intelligent Transportation Systems (ITS) Division and the Traffic Operations Center (TOC) into one technology-oriented division. The Traffic Management Division has five key missions: to improve highway safety, to improve the efficiency of Utah's highways, to provide timely and accurate real-time traffic information, to facilitate cooperative public and private partnerships that integrate transportation services, and to provide customer service directly to the public on the operation of the transportation system. Services provided by the Traffic Management Division include computer-controlled coordinated traffic signals, management of traffic incidents on state highways, operation of ramp meters, control of electronic variable message signs, operation of the state's 511 traveler information telephone system, and the traffic information website.

Texas

The Texas Department of Transportation (TxDOT) has developed safety campaigns to raise awareness about safe driving, sharing the road, ensuring the safety of kids and teens, and traveling in inclement weather. TxDOT is responsible for the collection and analysis of crash data submitted by law enforcement and maintains a statewide automated database for all reported motor vehicle traffic crashes.

Crash Reporting and Analysis for Safer Highways system (CRASH) is an Internet application for law enforcement agencies to process Texas Peace Officer's crash reports electronically. It is a component of the Crash Records Information System (CRIS). The CRASH system includes the following features[16]:

- Ability to enter crash data over any Internet connection
- Process supplement reports easily
- Integrated diagramming tool

16 TxDOT (http://www.txdot.gov/inside-txdot/division/traffic/crash-system.html)

- Auto population of fields
- Touch-screen capability for Toughbooks, which are computers designed for field work conditions
- Use of intersection templates
- Embedded help

The Texas Homeland Security Strategic Plan 2010–2015 serves as a high-level road map for Texas homeland security efforts for the next 5 years. Texas has enhanced the public-private partnership that incorporates the power of business and industry, private citizens, and all levels of government to achieve unprecedented synergies in all areas of homeland security, particularly in prevention and community resilience.

Texas also has a resilience plan in place that focuses on freight mobility. The *Texas Statewide Freight Resiliency* (SFR) Plan considers national, state, local, and private plans for infrastructure protection, emergency management, and incident response. TxDOT developed this plan to provide a comprehensive framework for identifying key freight infrastructure corridors and strategies to ensure a resilient freight transportation network in the State of Texas.

TxDOT and local transportation agencies have employed the use of ITS to reduce congestion, enhance safety, monitor incident management, and communicate hazardous weather conditions. Some examples of ITS programs TxDOT utilizes are:

- Traffic Management Centers
- Closed-Circuit Television (CCTV) cameras
- Dynamic Message Signs (DMS)
- Red Light Cameras
- Roadway Weather Information Systems

4.2 Safety Programs

4.2.1 Highway Safety Manual

The AASHTO Highway Safety Manual (HSM), published in 2010, was developed by an international team of safety experts, academics, and practitioners. The HSM captures the knowledge base associated with the proven relationship between crashes and their outcomes and actions or implemented decisions. The HSM is intended for use by professionals charged with planning, design, construction, operations, and maintenance of a road or highway system. The HSM can also be used as an analysis tool for crash frequency prediction. The HSM integrates quantitative crash frequency and severity performance measures into roadway planning, design, operations, and maintenance decisions. The primary focus of the HSM is the increased application of analytical tools for assessing the safety impacts of transportation project and program decisions[17]. The HSM helps:

- Identify sites with the most potential for crash frequency or severity reduction
- Identify factors contributing to crashes and associated potential countermeasures to address these issues

17 FHWA Highway Safety Manual http://safety.fhwa.dot.gov/hsm/factsheet/

- Evaluate the crash reduction benefits of implemented treatments
- Conduct economic appraisals of improvements to prioritize projects
- Calculate the effect of various design alternatives on crash frequency and severity
- Estimate potential crash frequency and severity on highway networks, and the potential effects of transportation decisions on crashes

As discussed previously, state DOTs have been in the process of implementing the HSM into current plans and policies. NCHRP 17-50, an AASHTO-sponsored HSM Lead State Initiative, kicked off in 2011 to support and encourage the implementation of the HSM. The project allows for sharing of lessons learned and a forum for discussion among states participating in the initiative, as shown in Figure 2. The lead states shown below actually provide assistance to the support states in implementing the HSM.

Figure 2 HSM Implementation: Lead and Support States

4.2.2 National Trends in Transportation Safety

Many states are passing new legislation to improve transportation safety standards. The National Conference of State Legislatures published the following list that summarizes recent developments pertaining to state transportation safety legislation in 2012.

- Occupant Protection - Nearly 25 states considered bills to strengthen seat belt laws in 2012. These proposals included efforts to enact primary enforcement of existing seatbelt laws and to change requirements for child restraint use.
- Impaired Driving Issues - In 2012, lawmakers in 44 states introduced more than 400 bills related to impaired-driving. They considered legislation related to stricter penalties for high blood alcohol concentration (BAC), ignition interlocks, breath testing procedures, treatment and drugged driving.
- Distracted Driving - Since 2000, legislatures in every state, the District of Columbia and Puerto Rico have considered legislation related to distracted-driving and driver cell phone use. In 2012, legislators in 36 states considered 165 driver distraction bills. Tennessee currently bans text messaging for all drivers.
- Driver Licensing - Each year, state legislatures debate hundreds of bills relating to various

aspects of driver licensing, including REAL ID, unlicensed driving, older drivers and teen drivers. In 2012, states debated more than 400 bills relating to driver's licensing. Tennessee is currently in compliance with REAL ID, which is a law that set forth standardized requirements for state driver licenses in an effort to prevent terrorists from abusing the system.

- Speed Limits - In 2011, 23 states considered bills regarding speed, including increasing fines for speeding, setting speed limits, and punishing serious speeding offenders in school or work zones.
- Aggressive Driving - Laws in 10 states penalize aggressive drivers. Hand gestures, shouting, speeding, tailgating, driving on the shoulder, weaving in and out of traffic, or any combination of these activities may fall within the definition of aggressive driving.
- Automated Enforcement - Because law enforcement agencies struggle with limited resources, many municipal governments have turned to automated enforcement to control speed and reduce red light violations without diverting law enforcement resources from other areas. During 2012, legislators in 22 states debated more than 100 bills regarding automated enforcement.
- Motorcycle Safety - During the 2012 legislative session, 40 states considered more than 180 bills related to motorcycle helmets or rider training.
- School Bus Safety - In 2012, nearly 150 bills regarding school bus safety were considered in state legislatures across the country. Many dealt with penalties for drivers who illegally pass school buses and licensing procedures for school bus drivers.
- Pedestrian and Bicycle Safety - Pedestrians and bicyclists are among the most vulnerable users of roadways. In 2012, 39 states considered more than 200 bills regarding pedestrian and bicycle safety. The most prevalent approaches in 2012 included increased fines for injuring or killing a vulnerable user, education requirements for motorists on interacting with pedestrians and bicyclists, strategies to increase safety near schools and safe bicycle passing laws.

4.3 Tennessee Crash Trends

4.3.1 Crash Fatalities

In April 2012, Tennessee became the first state in the nation to post fatality numbers daily on its Dynamic Message Signs (DMS). This decision was made by TDOT after an observed sharp increase in fatalities in the first quarter of 2012 compared to 2011 totals over the same period. This information helped raise the public's awareness towards traffic safety. By the end of 2012 the rate of fatal crashes was reduced.

As can be seen in Table 3, Tennessee ranks 11th out of the 15 peer and surrounding states when examining the fatality rate per 100 million vehicle-miles-traveled (VMT). In Tennessee 43% of these fatalities occurred in urban areas while a corresponding 57% of all fatalities occurred in rural areas of the state.

Table 3 Comparison of Peer and Surrounding State Fatality Rates for 2012

Rank	State	Urban	Rural	Total	Fatality Rate per 100 Million VMT
1	MN	126	269	395	0.69
2	WA	171	273	444	0.78
3	UT	122	95	217	0.82
4	VA	406	371	777	0.96
5	IN	257	522	779	0.99
6	GA	603	589	1,192	1.11
7	MO	350	476	826	1.21
8	NC	391	901	1,292	1.23
9	FL	1,551	873	2,424	1.27
10	AL	346	519	865	1.33
11	**TN**	**437**	**577**	**1,014**	**1.42**
12	TX	1,703	1,695	3,398	1.43
13	MS	175	407	582	1.51
14	KY	164	582	746	1.58
15	AR	121	431	552	1.65

Source: FARS 2012

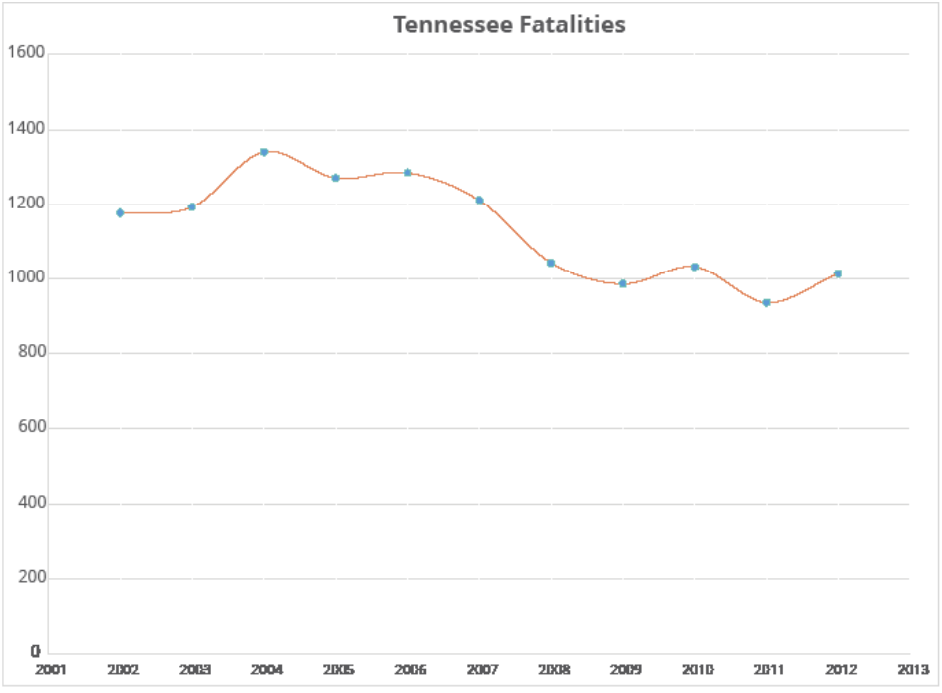
As evident by Table 3, there are a number of peer states that are outperforming Tennessee in terms of their total number of fatalities, the urban and rural split of these crashes, and their overall fatality rate. For example, Washington, a peer state similar in population, has nearly half the fatality crash rate as Tennessee. The northwestern state has developed a Strategic Highway Safety Plan, similar to that of Tennessee; however, in contrast to Tennessee, Washington develops three priority levels for addressing safety issues statewide. These are based on the percentage of traffic fatalities and serious injuries associated with each factor. Examples of these factors include impaired driving, pedestrians, work zones, drivers of age 75+, etc. This plan ultimately helps guide investments in an effort to reach a fatality and severe injury crash 'Target Zero' by 2030. In order to continue keeping safety as the top priority for TDOT, the Department will likely need to set higher goals for reductions in fatalities and severe injuries and take a more aggressive approach to combatting the known safety factors contributing to these crashes. This approach could entail education efforts, increased enforcement, engineering solutions, and policy changes among other tactics.

Unlike many of the peer states, Virginia has a higher percentage of fatalities that occur in urban areas as opposed to rural areas of the state. Given that 70% of Virginia's state-maintained roadways are rural, this peer state stands to be a good comparison as 73% of state-maintained facilities in Tennessee are rural. However, Virginia has 10% less fatalities occurring on rural facilities than Tennessee. It's likely that VDOT's rural planning process is partly responsible for this decreased crash rate. Virginia has planning district commissions (PDCs) that function similar to Tennessee's rural planning organizations (RPOs). However, unlike the RPOs, Virginia's PDCs provide a variety of technical and program services to member local governments including grant application assistance, management services for program implementation, land use planning services, mapping and transportation planning. They are required to have rural long range transportation plans, similar to plans required of MPOs, which help prioritize goals for the region, involve the public in the planning process, and make data-driven recommendations for programs and projects. Specifically with regard to safety, this planning process uses forecasted population and economic growth to identify specific roadway segments where safety is an anticipated concern in the future; field visits are then conducted to determine possible mitigation measures. This is one area of safety that Tennessee can

improve on given its high percentage of rural facilities. In the future, the evolution of Tennessee's rural planning process could include identification and proposed remediation of relatively minor safety issues in rural areas by RPOs; this process would take advantage of regional and local knowledge of rural areas and allow TDOT the resources to address larger or more complex safety issues statewide.

Historic crash data involving all fatalities (motorist, pedestrian, bicyclist, etc.) are shown in Figure 3. Since 2002, fatal crashes have been steadily declining. TDOT was close to reaching its goal of reducing fatal crashes to 900 by 2011, recording its lowest number of highway fatalities since 1950 with 937. In 2012 however, Tennessee recorded 1,014 fatalities and had a fatal crash rate of 1.43 per 100 million vehicle miles traveled, compared to the USA average of 1.13. Fatality numbers again fell below 1,000 in both 2013 and 2014 recording 937 and 995 fatalities respectively. While this goal has not been met in past years, TDOT continues its commitment to safety by establishing the vision statement of "Towards Zero Deaths" for its newest Strategic Highway Safety Plan (2014). This plan's primary goal is to reduce the number and rate of fatalities by 10% within the next five years.

Year	Fatalities	Fatality Rate per 100 Million VMT
2002	1,177	1.73
2003	1,193	1.73
2004	1,339	1.89
2005	1,270	1.79
2006	1,284	1.82
2007	1,211	1.70
2008	1,043	1.50
2009	986	1.40
2010	1,032	1.47
2011	937	1.34
2012	1,014	1.43
2013	995	1.40

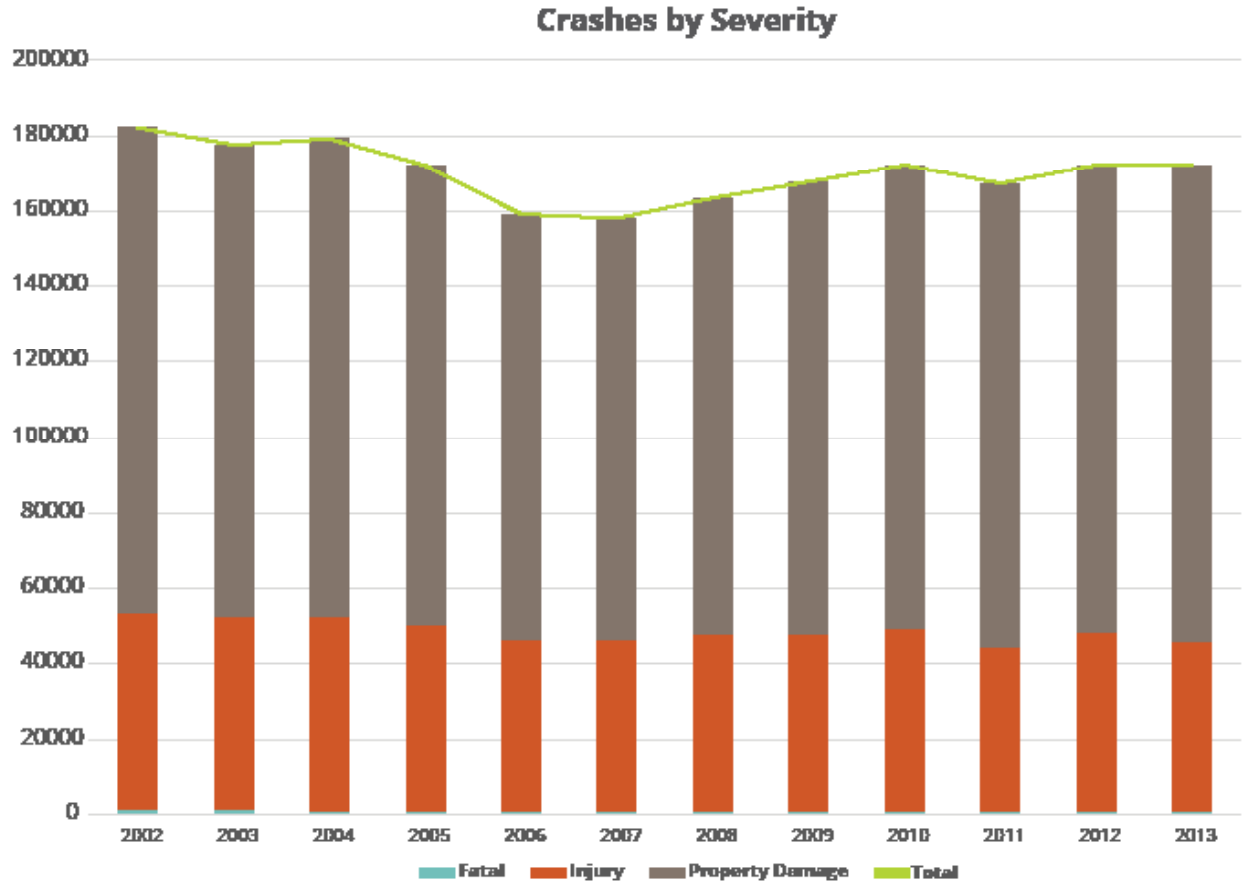


Source: TDOT Measurement Report 2013

Figure 3 Tennessee Fatalities and Fatality Rates (2002-2013)

Overall crash data by severity type as reported by TDOSHS is shown in Figure 4. In the last few years the number of crashes has been increasing; however, the total number of crashes has been trending downward for the last decade. It is important to note that the numbers of fatalities in Figure 4 are different than those shown in Figure 3; this results from the exclusion of fatalities that occurred in parking lots and on private property by the Tennessee Department of Safety when reporting crash totals.

Year	Fatal	Injury	Property Damage	Total
2002	1,191	52,618	128,328	182,137
2003	1,172	51,608	124,852	177,632
2004	1,141	51,507	126,538	179,186
2005	1,013	49,463	121,732	172,208
2006	877	45,677	112,659	159,213
2007	896	45,425	111,718	158,039
2008	980	46,747	115,818	163,545
2009	884	46,875	120,067	167,826
2010	944	48,285	123,098	172,327
2011	899	43,445	123,108	167,452
2012	944	47,646	123,734	172,324
2013	925	45,222	126,014	172,161

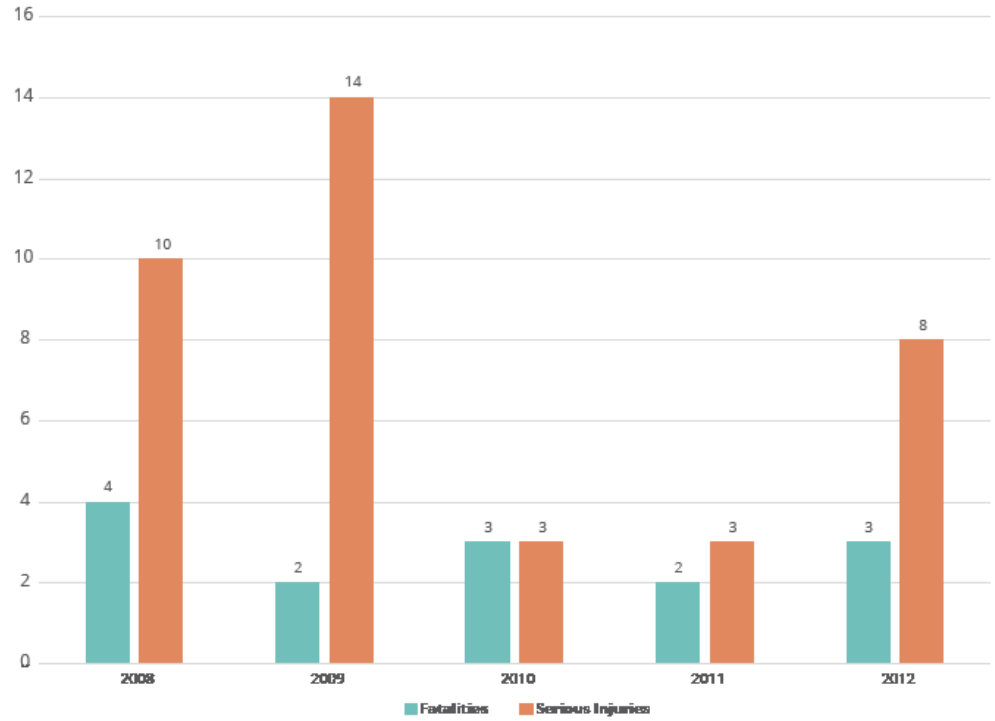


Source: TDOSHS

Figure 4 Tennessee Crashes by Severity (2004-2013)

4.3.2 Railroad Related Fatalities

The FRA Office of Safety Analysis maintains a database of railroad related fatalities. Figure 5 illustrates the data on railroad crossing-related fatalities and serious injuries for Tennessee. Based on recent data, fatal railroad-related incidents in Tennessee have been trending downwards.



Source: TDOT's 2014 Strategic Highway Safety Plan

Figure 5 Tennessee Railroad Crossing-Related Fatalities and Serious Injuries

4.3.3 Bicycle and Pedestrian Fatalities

Fatal crashes involving bicyclist and pedestrians during the time period of 2002 to 2011 are illustrated in Figure 6. The number of fatal crashes has remained relatively constant with no significant trends. The 2011 pedestrian fatality rate for Tennessee was 1.25, as shown in Table 4. Tennessee was ranked 26th in terms of pedestrian fatalities and the fatality rate was less than the national rate of 1.42. The state ranked 39th in terms of the pedalcyclist fatality rate, which was less than the national rate of 2.17 (Table 5).

Table 4 2011 Ranking of State Pedestrian Fatality Rates

Overall Rank	State	Pedestrians Killed	Population (Thousands)	Pedestrian Fatality Rate per 100,000 Population
26	Tennessee	80	6,403	1.25
-	USA	4,432	311,592	1.42

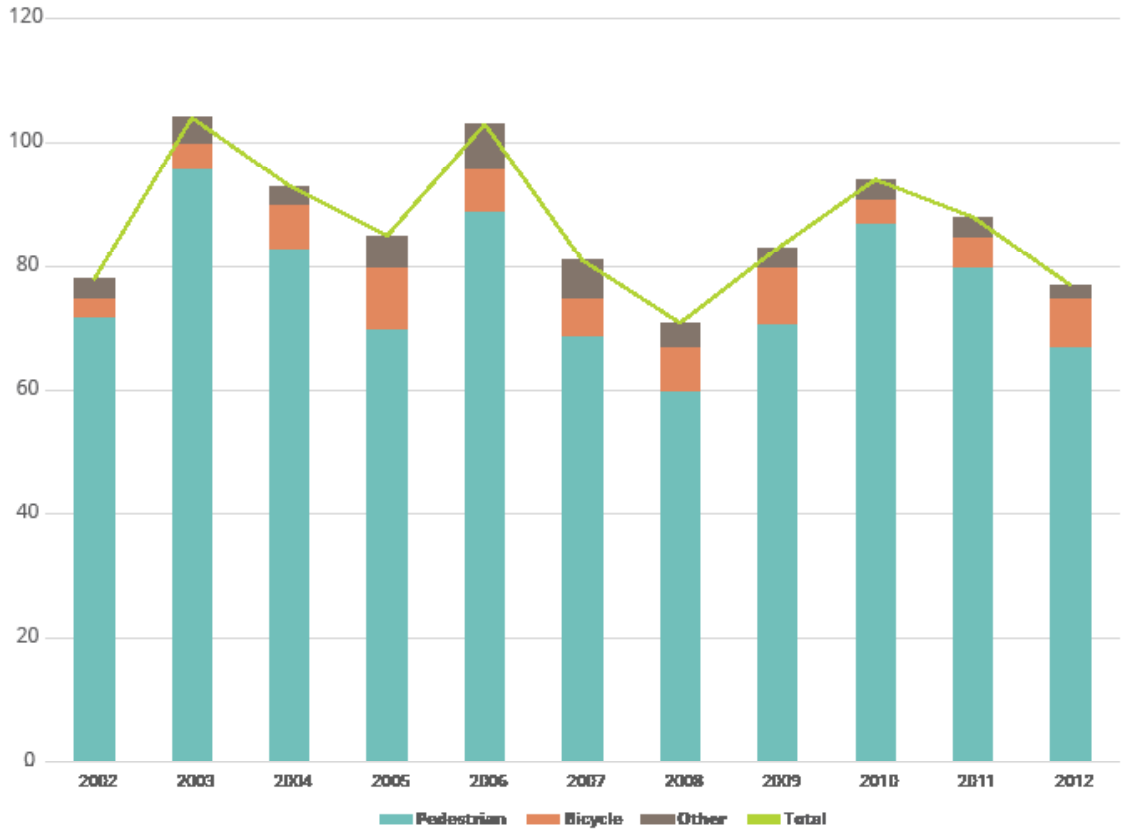
Source: FARS http://www-fars.nhtsa.dot.gov/States/StatesPedestrians.aspx

Table 5 2011 Ranking of State Pedalcyclist Fatality Rates

Overall Rank	State	Pedalcyclists Killed	Population (Thousands)	Pedalcyclist Fatality Rate per 1,000,000 Population
	Tennessee	5	6,403	0.78
-	USA	677	311,592	2.17

Source: FARS http://www-fars.nhtsa.dot.gov

Year	Pedestrian	Bicycle	Other Non-Motorized Travelers/Unknown	Total
2002	72	3	3	78
2003	96	4	4	104
2004	83	7	3	93
2005	70	10	5	85
2006	89	7	7	103
2007	69	6	6	81
2008	60	7	4	71
2009	71	9	3	83
2010	87	4	3	94
2011	80	5	3	88
2012	67	8	2	77



Source: FARS

Figure 6 Tennessee Non-Motorist Fatalities (2002-2012)

4.4 Changes in Driver Behavior

Research that was sponsored by the AAA Foundation evaluated key indicators of the country's current traffic safety culture. Surveys were conducted between 2008 and 2012 and measured aspects of traffic safety culture that looked at social norms, driving behaviors, attitudes toward crash countermeasures and driving behaviors and experience. Key findings from this survey are provided below:

Distracted Driving

- 81-83% of drivers felt texting while driving was completely unacceptable

- 80-87% of drivers support having laws to prevent distracting driving
- Approximately 50% of drivers supported having laws that completely banned any type of phone use while driving

Drinking and Driving

- Nearly all drivers responded that it is completely unacceptable to drink and drive
- 88-90% of drivers supported a law requiring alcohol ignition interlock for drivers who have been convicted of more than one Driving While Intoxicated (DWI)

Drowsy Driving

- Nearly all drivers responded that it is completely unacceptable to drive when they are too tired to keep their eyes open

Red Light Running

- 70% of drivers state that it is completely unacceptable to run a red light
- The percentage of drivers running red lights between 2009 and 2012 increased from 29% to 38%

Speeding

- 75% of drivers responded that it is completely unacceptable to drive 15 mph over the speed limit on residential streets
- 46% of drivers responded that it is completely unacceptable to drive 15 mph over the speed limit on freeways
- 47% of drivers reported to have driven 10 mph or more over the speed limit on residential streets

Overall, during the survey's study time frame, the perceptions in safety related driver trends remained constant. However, the survey did report that drivers' behavior towards the risks associated with drinking and driving and fatigued driving had been decreasing.

Aging Population Safety Trends

According to the Insurance Institute for Highway Safety (IIHS), 4,079 people ages 70 and older died in crashes in 2012. This was a 31 percent reduction when compared to 1997, when older driver fatal crash involvements peaked in the United States. In this study, IIHS researchers compared trends for drivers ages 70 and older with those ages 35-54 for national fatal passenger vehicle crash involvements per 100,000 licensed drivers during 1997-2012 and per vehicle miles traveled from 1995 to 2008.

The state data indicated that crash involvement rates per licensed driver for adults 70 and older also decreased in nonfatal crashes, and the declines were bigger as driver age increased. From 1997 to 2008, involvement rates in nonfatal injury crashes fell by 30 percent for drivers 35-54, 36 percent for drivers 70-74, 38 percent for drivers 75-79 and 45 percent for drivers 80 and older. The pattern held when examining declines in property- damage-only crash involvement rates for older drivers vs. middle-age drivers.[18]

To address the issues that come with an aging population, many states have created coordination

18 IIHS (http://www.iihs.org/iihs/sr/statusreport/article/49/1/1)

groups to help implement strategies for improving older driver safety. Florida, as an example established the Florida At-Risk Driver Council (FADC) in 2003 as a means establish action items with respect to prevention, early recognition, and education of at-risk drivers as well as assessments of alternatives and accommodations for transportation. Stakeholders of the group implement action items through the government agency or nongovernmental organization that they represent[19].

4.5 Impact of MAP-21

In July 2012, MAP-21 was signed into law which provides funding and transforms the policy and programmatic framework for investments to guide the growth and development of the country's vital transportation infrastructure. MAP-21 created a streamlined, performance-based, and multimodal program to address the many challenges facing the U.S. transportation system. These challenges include improving safety, maintaining infrastructure condition, reducing traffic congestion, improving efficiency of the system and freight movement, protecting the environment, and reducing delays in project delivery as stated in the MAP-21 goals (Table 6).

Table 6 MAP-21 Goals

Goal Area	National Goal
Safety	To achieve a significant reduction in traffic fatalities and serious injuries on all public roads
Infrastructure condition	To maintain the highway infrastructure asset system in a state of good repair
Congestion reduction	To achieve a significant reduction in congestion on the National Highway System
System reliability	To improve the efficiency of the surface transportation system
Freight movement and economic vitality	To improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development
Environmental sustain-ability	To enhance the performance of the transportation system while protecting and enhancing the natural environment
Reduced project delivery delays	To reduce project costs, promote jobs and the economy, and expedite the movement of people and goods by accelerating project completion through eliminating delays in the project development and delivery process, including reducing regulatory burdens and improving agencies' work practices

Source: FHWA

Current federal transportation legislation continues the HSIP and doubles funding for infrastructure safety, strengthening the linkage among modal safety programs and creating a positive agenda to make significant progress in reducing highway fatalities. It also continues to build on other aggressive safety efforts, including its focus on distracted driving and its push to improve transit and motor carrier safety. Specific safety provisions and programs that were identified as part of MAP-21 are shown in Table 7.

19 *U.S. Government Accountability Office* (http://www.gao.gov/products/GAO-07-413)

Table 7 Summary MAP-21 Safety Provisions

Highway Safety Improvement Program ($2.24B)

- Increases size of existing program
- Maintains current structure; adds requirement for regular update of the strategic highway safety plan
- Keeps $220M/year set aside for rail-highway grade crossings
- No high risk rural roads unless safety statistics worsen
- Secretary to establish measures and States to set targets for number of injuries and fatalities
- Strengthens link between HSIP and NHTSA programs

State HSIP

- Advance the capabilities of the State for safety data collection, analysis and integration in a manner that complements State highway safety program and commercial vehicle safety plan
- Use that safety data system to perform safety problem identification and countermeasure analysis
    - Identify hazardous locations, sections, and elements
    - Establish relative severity of those locations
    - Identify number of fatalities and serious injuries on all public roads by location in State
    - Consider which projects maximize opportunities to advance safety
- Adopt strategic and performance-based goals that:
    - Addresses traffic safety, including behavioral and infrastructure problems and opportunities on all public roads
    - Focus resources on areas of greatest need
    - Coordinate with other State highway safety programs
- Determine priorities
- Establish and implement a schedule of highway safety improvement projects
- Establish an evaluation process

Strategic Highway Safety Plan (SHSP)

- Requires regular updates
- Expands list of participants
    - County transportation officials
    - State representatives of non-motorized users
    - Other major Federal, State, tribal, and local safety stakeholders
- Highway Safety Plan (NHTSA) coordinated with SHSP

Data Improvement

- Activities
    - Highway base map of all public roads
    - Collect safety data
    - Store and maintain safety data
    - Develop analytical processes for safety data elements
    - Roadway safety analysis tools
    - Analytical use of safety data
- Model Inventory of Roadway Elements – Secretary shall
    - Establish a subset of model inventory of roadway elements that are useful for inventory of roadway safety
    - Ensure that States adopt and use subset to improve data collection

Coordination with NHTSA Programs

- Ensure the State coordinates the Highway Safety Plan (HSP) with the State SHSP
- Ensure the State coordinates data collection and information systems with the State SHSP
- Aligns performance measures for SHSP and HSP

Source: FHWA Safety Provisions in Moving Ahead for Progress in the 21st Century (MAP-21)

4.6 Emerging Resiliency Efforts

The USDOT has developed a *Climate Adaptation Plan*[20] that lays out the steps it will take to fully integrate considerations of climate change and variability in its policies, programs and operations. The USDOT identified three general vulnerabilities to climate change, which it plans to address through its climate adaptation action items that focus on infrastructure and systems of infrastructure to foster a resilient transportation system related to existing infrastructure, new infrastructure, and system reliance.

The FHWA is partnering with State Departments of Transportation (DOTs), Metropolitan Planning Organizations (MPOs), and Federal Land Management Agencies (FLMAs) to pilot approaches to conduct climate change and extreme weather vulnerability assessments of transportation infrastructure and to analyze options for adapting and improving resiliency. This pilot program is being jointly sponsored by the FHWA Office of Environment, Planning and Realty, and the Office of Infrastructure. TDOT, in conjunction with the MPOs throughout the state, is participating in this pilot program that will be conducting a systematic evaluation of the vulnerability of the State's multimodal infrastructure. It will consider both existing and planned transportation assets. The project will be a statewide vulnerability assessment for all transportation infrastructure (roads, rivers, rail, transit, aviation) and will assess the following for their associated impacts on transportation assets across the state of Tennessee:

- Extreme weather (flooding, drought, and less-studied inland extreme weather risks (e.g., tornadoes, fog) and
- The impacts of those extreme weather events (e.g., rock slides, sinkholes, river navigation)

Through this project, TDOT expects to achieve several outcomes:

- Understand and characterize vulnerability of the state's transportation system to current and anticipated extreme weather events
- Identify those highway segments and transportation facilities that are critical to transportation mobility and highly vulnerable to extreme weather
- Inform the development of short-term and long-term adaptation strategies
- Promote greater stakeholder awareness, collaboration and coordination in dealing with extreme weather risks and impacts

The University of Tennessee at Chattanooga is in the process of conducting an all hazard assessment of critical infrastructure across the state. This research uses the Risk Analysis and Management for Critical Asset Protection (RAMCAP™) software model that was developed by the U.S. Department of Homeland Security. This model, which is a seven-step process, as outlined below, characterizes the risk associated with a critical infrastructure asset or key resource. The result of this research is anticipated to be completed November 2014.

1. Asset characterization
2. Threat characterization
3. Consequence analysis
4. Vulnerability analysis
5. Threat assessment

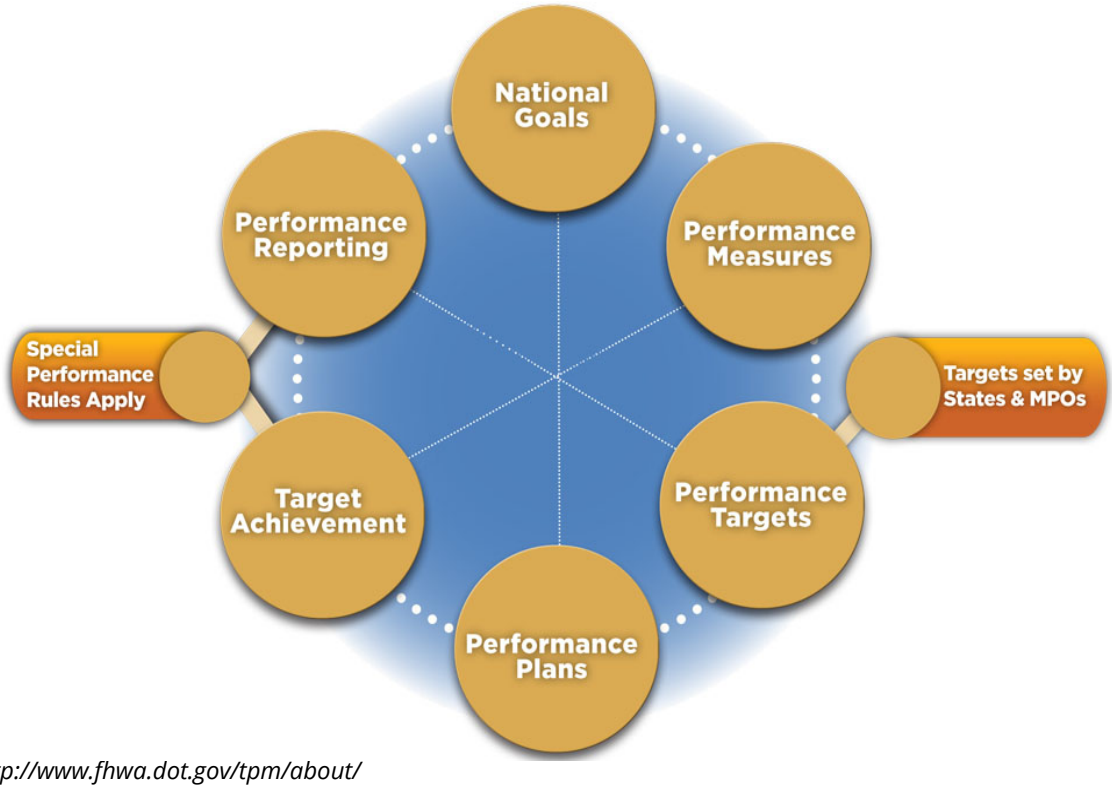
20 US DOT Climate Adaptation Plan - http://climate.dot.gov/impacts-adaptations/planning.html

6. Risk assessment
7. Risk management

4.7 Performance Measures

First emphasized in MAP-21, the establishment of a performance- and outcome-based program became a key focus. Performance management will transform Federal highway programs and provide a means to more efficient investment of Federal transportation funds by focusing on national transportation goals, increasing the accountability and transparency of the Federal highway programs, and improving transportation investment decision-making through performance-based planning and programming. The State and Metropolitan Planning Organizations (MPOs), in consultation with transit agencies, are tasked with establishing performance targets. Additionally, it is requested that DOTs and MPOs work together to establish these targets.

Under federal transportation legislation, the USDOT will establish performance measures and state DOTs will develop performance targets in consultation with metropolitan planning organizations (MPOs) and others, such as the transit agencies. State investments must make progress toward these performance targets, and MPOs must incorporate these performance measures and targets into their Transportation Improvement Programs (TIPs) and Long Range Transportation Plans. Within one year of the USDOT final rule on performance measures, the States will be required to set performance targets in support of those measures.



Source: http://www.fhwa.dot.gov/tpm/about/

In addition, Metropolitan Planning Organizations (MPOs) will be required to establish and use a performance-based approach to transportation decision making and development of transportation plans. Each MPO will establish performance targets that address surface transportation performance measures, first called for in MAP-21. The resulting performance targets selected by an MPO will also be coordinated with the States to ensure consistency to the maximum extent practicable. MPOs will establish performance targets no later than 180 days after the date that the State or public transportation provider establishes performance targets. States and MPOs will report to the USDOT

on progress in achieving targets. If a State's report shows inadequate progress in some areas – most notably the condition of the NHS or key safety measures the State must undertake corrective actions, such as the following:

- NHPP: If no significant progress is made toward targets for NHS pavement and bridge condition, the State must document in its next report the actions it will take to achieve the targets.
- HSIP: If no significant progress is made toward targets for fatalities or serious injuries, the State must dedicate a specified amount of obligation to safety projects and prepare an annual implementation plan.

In June 2013, the AASHTO Standing Committee on Performance Management (SCOPM) conducted a Task Force Workshop on MAP-21 target-setting for performance measures. The purpose of the workshop was to identify and asses specific target-setting issues and to inform FHWA of states' concerns with the overall goal of helping states prepare for target setting. TDOT was a key participant in the workshop. Safety performance management was one of six management areas discussed as part of the workshop. The general concerns associated with safety identified in the workshop were:

- Evaluation, analysis and diagnosis capability is key for target setting process to be effective; requires substantial resources and expertise.
- States with zero-based goals shouldn't be discouraged from also setting less aggressive interim targets.
- Targets should not be linked to funding. Target achievement dependent on factors unrelated to what can be addressed via engineering fixes.
- Recognize random variation in results in evaluating target achievement – consider targets in the form of a range around a report mean (e.g. +- 5 percent).
- Performance holding steady, or in some situations declining, may be acceptable.
- Targets need to be set in the context of available funding and agency funding allocation decisions.
- Recognize time lag between funding/initiating countermeasures and resulting impacts.
- USDOT should consider a state's current safety performance before assessing consequences of missed targets: long-term progress, fatality/ injury rates relative to national average, best use of available resources, etc. Contextual information including trends in VMT, population, demographics, economic changes, licensing & registration, changes to crash reporting, and funding important for understanding results.

Data availability was also a concern due to the time lag issues in availability of final fatality and injury numbers, incomplete traffic data on local roads to use to estimate crash rates, and the states' needs for certified vehicle miles traveled (VMT) data at least three months prior to the due date of the performance report.

Current TDOT performance measures pertaining to safety are shown in Table 8.

Table 8 Current TDOT Safety Performance Measures

Safety-Related Performance Measures	2011	2012	2012 Target	% Variance from Target
Fatality Rate	1.34	1.43	1.32	-8%
Reduction in Fatality Rate	9%	0%	2%	-100%
Number of Traffic Fatalities on TN Roadways	937	1,014	N/A	N/A
Seat Belt Usage	84%	85%	88%	-3%
Number of Crashes in TN Work Zones	3,064	3,098	N/A	N/A
Highway/Rail Grade Crossing Fatal Crashes	2	2	N/A	N/A

Source: TDOT Measurement Report (2013)

5.0 CONCLUSIONS AND RECOMMENDATIONS

The purpose of this policy paper is to describe current policies and programs of the State for safety, security and resiliency and to provide recommendations for programs and policies that are consistent with the Guiding Principles of TDOT's 25-Year Policy Plan.

5.1 Summary of Findings

In conclusion, the following summarizes existing plans, policies, and programs, future growth, trends, and technology related to safety, security, and transportation resilience.

- Tennessee makes crash information available to member agencies and some information is also published for the public (i.e., annual reports, daily online updates of the number of fatal crashes, etc.).
- Tennessee uses this crash information to help evaluate and track safety-related performance measures.
- Current safety performance measures include:
    - Reducing the rate and number of fatal traffic crashes on Tennessee roads
    - Reducing the rate and number of serious injury traffic crashes on Tennessee roads
    - Increasing seat belt usage
    - Reducing rail grade crossing fatalities
    - Reducing crashes in work zones
    - Increasing incoming "511" calls
- Over the past 10 years, all fatal crashes have been trending downward:
    - A high of 1,339 fatal crashes in 2004
    - A low of 937 in 2011
- Over the past 10 years, the number of injury crashes has been trending downward:
    - A high of 55,677 in 2008
    - A low of 43,445 in 2013Tennessee ranks 26th in the nation for pedestrian fatalities with a rate of 1.25 fatalities per 100,000 population, compared to the national average of 1.42.
- Over the past 10 years, fatal crashes involving bicyclists and pedestrians have remained steady at 70 to 100 fatalities per year.
- TDOT is conducting a pilot study with the Federal Highway Administration (FHWA) to complete a climate change and extreme weather vulnerability assessment of the transportation infrastructure across the state.
- Research is also being conducted for TDOT by the University of Tennessee at Chattanooga to assess critical infrastructure in terms of security.
- The United States Department of Transportation (USDOT) is currently in the process of

reviewing the performance management rulemaking. Within one year of the USDOT final rule on performance measures, states will be required to set performance targets in support of those measures.

- Metropolitan Planning Organizations (MPOs) will be required to establish and use a performance-based approach to transportation decision making and development of transportation plans. Each MPO will have 18 months from the time state performance targets are established to identify their own performance targets that address the Moving Ahead for Progress in the 21st Century Act (MAP-21) surface transportation performance measures.
- States and MPOs will have the responsibility of coordinating with transit agencies regarding performance management and reporting to the USDOT on progress in achieving targets. If a state's report shows inadequate progress, then the state must undertake corrective actions.

5.2 Recommendations

In conclusion, the following recommendations are proposed as they relate to safety, security, and transportation resilience.

- Enhance data sharing among and between all agencies including local and regional governments.
- TDOT should continue to further enhance partnerships with local and regional agencies to better evaluate behavioral safety needs.
- TDOT should continue to further enhance partnerships with local and regional agencies to better evaluate engineering safety needs.
- TDOT should continue to utilize peer exchange forums to advance best practices in behavioral and engineering roadway safety in Tennessee.
- TDOT should continue to implement the use of the AASHTO Highway Safety Manual to increase the effectiveness of safety analysis and evaluation of Tennessee's highways.
- TDOT, through Tennessee's Local Transportation Assistance Program (LTAP), should promote training opportunities for local governments on the AASHTO Highway Safety Manual to increase the effectiveness of safety analysis and evaluation of Tennessee's state highways.
- TDOT should continue to explore and implement emerging technologies (e.g., ITS, TSM&O, ATDM, etc.) that enhance safety and security for all modes of transportation.
- TDOT should continue to seek opportunities to educate elected officials regarding legislation impacting roadway safety.
- TDOT should continue to strengthen the Department's understanding and capabilities of extreme weather impacts to reduce vulnerability risks of the State's physical assets.
- TDOT should continue to strengthen the Department's understanding and capabilities of security threats to reduce vulnerability risks of the State's physical assets.