STATE OF TENNESSEE
HAZARD MITIGATION PLAN

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State of Tennessee

Standard State Hazard Mitigation Plan

Tennessee Emergency Management Agency

Patrick C. Sheehan, Director
3041 Sidco Drive
Nashville, TN 37204

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Executive Summary

The State of Tennessee Hazard Mitigation Plan documents the efforts and intentions of the Tennessee Hazard Mitigation Program in reducing the vulnerability of the state to all hazards. The plan is organized using the “bottom line up front” principle. The action items are presented in the first section of the plan, followed by sections containing supporting information and analysis. The plan is designed to be accessible to both subject-matter experts and general readership.

Section 1 – Mitigation Program and Strategy presents a unified approach to lessening the impact of disasters. The Tennessee Hazard Mitigation Program is defined dynamically by commonly held Vision, Mission, and Values, rather than a static membership. The program seeks to accomplish its Mission along three lines of effort, a Red Strategy, White Strategy, and Blue Strategy. Each strategy is supported by multiple goals, objectives, and actions, which operationalize each strategy and the overall approach.

Section 2 – The State of Tennessee describes the geography, populace, infrastructure, capabilities, and vulnerabilities unique to Tennessee. This state-level plan supports many of these unique characteristics. In addition, this section includes the summary of the Tennessee Silver Jackets team, which is an important multi-agency risk management group in the state.

Section 3 – Local Plan Integration highlights the primacy of local planning in the accomplishment of hazard mitigation. Local planning and implementation is the single most important aspect of hazard mitigation. The Tennessee Hazard Mitigation Program supports and participates in local planning efforts, statewide. In addition, this section of the plan ensures alignment between state and local vulnerabilities and capabilities.

Section 4 – Hazard Profiles and Risk Assessment defines and analyzes the natural, manmade, and technological hazards that impact Tennessee. This section describes the 13 hazards of prime concern, which are the basis for much of emergency management planning in the state. Those hazards are listed below:

Natural Hazards

1. Droughts
2. Earthquakes
3. Extreme Temperatures
4. Floods
5. Geologic Hazards
6. Severe Storms
7. Tornadoes
8. Wildfires

Man-Made and Technological Hazards

9. Communicable Diseases
10. Dam/Levee Failure
11. Hazardous Materials Release
12. Infrastructure Incidences
13. Terrorism

This section is organized by hazard as listed, above, and presents a significant amount of data about each of these hazards. Data is organized narratively, graphically, and spatially. Each hazard profile also includes probability analysis, incorporating changing future conditions and future risk. Section 4 is also supported by Appendices 1 and 2.

Section 5 – Planning Process and Plan Maintenance describes the process for the maintenance and update of this plan. The section lists stakeholders involved, meetings conducted, and resources utilized. In addition, this section explains the interrelationships between this planning process and other planning processes. This section is also supported by Appendix 4.

Appendices 1-7 contain supporting documentation that may not be essential for every reader or user of the plan. It is available for review, but is not critical for use and implementation of the plan and program. Appendices were used to ensure the document was not overly cumbersome, but still supported all planning requirements.

The State of Tennessee Hazard Mitigation Plan is designed to be a living document, growing and changing as Tennessee grows and changes. The plan must reflect reality for Tennessee and Tennesseans. Most importantly, the plan is designed to be a resource for all levels of government, private sector, and the public.

For questions, comments, or more information, please visit www.tn.gov/tema or contact the Tennessee Emergency Management Agency at (615) 741-0001.

Letter from Director

Naturally occurring atmospheric, geologic, hydrologic, and seismic hazards and a broad range of human-caused and technological hazards occur throughout the State of Tennessee (TN) threatening damage to property and exposing its citizens to risk of injury or death. The Tennessee Emergency Management Agency (TEMA) is empowered by state law and by the governor's executive authority to protect the public from disasters and emergencies. The foundation for this authority is Tennessee Code Annotated (TCA) 58 – 2 – 101 through TCA 58 – 2 – 124. It is under this authority that TEMA is charged with overseeing the development of a Federal Emergency Management Agency (FEMA) approved standard state hazard mitigation plan (HMP).

The State of Tennessee Standard Hazard Mitigation Plan was developed in cooperation with state, federal, and local government agencies. The Tennessee Emergency Management Agency served as the coordinating entity and plan developer.

The State of Tennessee Standard Hazard Mitigation Plan's risk and vulnerability assessment was performed with the aid of advanced geographic information systems (GIS) technologies, comprehensive regional hazard studies, and streamlined analysis methodologies. The assessment incorporates new and updated data made available by federal and state agencies as well as scientific modeling methods which were unavailable during the previous plan's development.

The State of Tennessee Standard Hazard Mitigation Plan is the primary document detailing the state's mitigation strategy targeting all natural hazards adversely affecting its citizens and their property. The state's mitigation actions and projects directly correspond to its mitigation objectives and focus on the greatest risk hazards established in the plan's risk assessment.

TEMA has taken aggressive steps toward improving its coordination with and technical assistance programs for local mitigation plan development. The programs in place have proven to be efficient, robust, and highly successful in their implementation. However, this plan outlines improvements for TEMA's mitigation programs by expanding their scope and enhancing program designs to meet the future needs of Tennessee's citizens.

This plan is a living document and will continually evolve to keep pace with changing concerns, technology, best practices, lessons learned, and all applicable state and federal laws, statutes and orders. While adapting to the challenges of today and tomorrow, the state, via the plan, will continue to comply with all applicable federal statutes and regulations during the periods for which it receives grant funding, in compliance with 44 CFR 13.11(c), and will be amended whenever necessary to reflect changes in state or federal laws and statutes as required by 44 CFR 13.11(d).

Patrick C. Sheehan, Director
Tennessee Emergency Management Agency
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Nashville, Tennessee 37204

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Adoption Resolution

TN Department of Military | TEMA

Patrick C. Sheehan
Director

Major General
Terry Max Haston
The Adjutant General

State Hazard Mitigation Plan Adoption

In accordance with 44 C.F.R. Part 201; Title 58 Chapter 2 Part 103 of the Tennessee Code Annotated; and with the full support of the State Hazard Mitigation Plan Committee, the Tennessee Emergency Management Agency, and the Tennessee Department of Military, the State of Tennessee Hazard Mitigation Plan 2018 is hereby adopted by the State of Tennessee.

The State of Tennessee Hazard Mitigation Plan 2018 meets the requirements of Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288) enacted under the Disaster Mitigation Act of 2000. The plan describes the planning process, identifies and prioritizes statewide hazard mitigation actions, encourages the development of local plans and projects, and describes technical support mechanisms to promote these efforts.

The newly updated plan illustrates that the State of Tennessee has a comprehensive hazard mitigation program that effectively uses and manages all available mitigation funding. The plan includes assurances that the State of Tennessee does will continue to comply, with all related and applicable federal statutes and regulations.

The State of Tennessee will continue to fulfill objectives outlined in this plan and has assigned the Tennessee Emergency Management Agency with the responsibility for maintaining and updating this plan, as required, in coordination with the appropriate departments, agencies, and the community at large.

Patrick C. Sheehan, Director
Tennessee Emergency Management Agency
Governor's Authorized Representative

28 September 2018
Date

Major General Terry M. Haston, Adjutant General
Commissioner, Tennessee Department of Military
Governor's Authorized Representative

1 Oct 2018
Date

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Introduction to Mitigation

This plan represents the primary planning document to fulfilling the State of Tennessee's mitigation mission under the National Preparedness Goal, released in September, 2011. The new National Preparedness Goal, defines what it means for the whole community to be prepared for all types of disasters and emergencies. The goal itself is succinct:

"A secure and resilient nation with the capabilities required across the whole community to prevent, protect against, mitigate, respond to, and recover from the threats and hazards that pose the greatest risk."

These risks include events such as natural disasters, disease pandemics, chemical spills and other manmade hazards, terrorist attacks and cyber-attacks. The graphic below illustrates the missions of the National Preparedness Goal.

Prevention	Protection	Mitigation	Response	Recovery
				
Preventing, avoiding, or stopping potential or actual acts of terrorism.	Protecting the homeland *(people, assets, systems, networks, etc.)* against terrorism and man-made or natural disasters.	Mitigating the loss of life and property by lessening the impact of future disasters.	Responding quickly to save lives, protect property, and meet basic human needs.	Recovering through timely restoration, strengthening, and revitalization of infrastructure, housing, the economy, etc. affected by a disaster.

Mitigation planning is the process of determining how to reduce or eliminate the loss of life and property damage resulting from natural, man-made, and technological hazards. It is carried out as any sustained action to reduce or eliminate long-term risk to life and property from a hazard event. Mitigation encourages long-term reduction of hazard vulnerability. As is the goal of emergency management, the goal of mitigation is to save lives and reduce property damage.

Engaging in mitigation planning provides the State of Tennessee with a number of benefits, including reduced loss of life, property, essential services, critical facilities and economic hardship, and reduced short-term and long-term recovery and reconstruction costs. The dramatic increase in the costs associated with natural disasters over the past decades has fostered interest in identifying and implementing effective means of reducing vulnerability.

The Tennessee Emergency Management Agency has the responsibility to coordinate all state activities relating to hazard evaluation and mitigation, and to prepare and submit to FEMA a standard hazard mitigation plan, following the criteria established in 44 CFR 201.4 and Section 322 of the Disaster Mitigation Act of 2000 (Public Law 106-390).

The Disaster Mitigation Act of 2000 (DMA 2000)

In the past, federal legislation has provided funding for disaster relief, recovery, and some hazard mitigation planning. The Disaster Mitigation Act of 2000 became law on October 30, 2000, and amends the Robert T. Stafford Disaster Relief and Emergency Assistance Act (the “Stafford Act”) (Public Law 93-288, as amended). Regulations for these activities can be found in Title 44 of the Code of Federal Regulations Part 206, Subpart M.

This legislation reinforces the importance of mitigation planning and emphasizes planning for disasters before they occur. This act establishes a pre-disaster hazard mitigation program and new requirements for the national, post-disaster, Hazard Mitigation Grant Program.

Section 322 of the act specifically addresses mitigation planning at the state and local levels. It identifies new requirements that allow Hazard Mitigation Grant Program (HMGP) funds to be used for mitigation planning activities, and increases the amount of HMGP funds available to states that have developed a comprehensive, enhanced mitigation plan prior to a disaster. States and communities must have an approved mitigation plan in place prior to receiving post-disaster HMGP funds. Local and tribal mitigation plans must demonstrate that their proposed mitigation measures are based on a sound planning process that accounts for the risk to and the capabilities of the individual communities.

DMA 2000 is intended to facilitate cooperation between state and local authorities, prompting them to work together. It encourages and rewards local and state pre-disaster planning and promotes sustainability as a strategy for disaster resistance. This enhanced planning network will better enable local and state governments to articulate accurate needs for mitigation, resulting in faster allocation of funding and more effective risk reduction projects. To implement the new DMA 2000 requirements, FEMA prepared an interim final rule, published in the Federal Register on February 26, 2002, at 44 CFR Parts 201 and 206, which establishes planning and funding criteria for states and local communities.

On October 31, 2007, FEMA subsequently published an Interim Rule in the Federal Register, which ensures the Flood Mitigation Assistance (FMA) program planning requirements are consistent with the mitigation planning regulations as cited in the Code of Federal Regulations (CFR) at Title 44, Chapter 1, Part 201 (44 CFR Part 201).

This interim rule established that local communities must comply with mitigation planning requirements to be eligible to apply for FEMA mitigation project grant funding, including FMA and FEMA's Severe Repetitive Loss Program (SRL). Meeting the requirements of the regulations cited above ensures participating jurisdictions in the planning area will be eligible to receive disaster assistance, including hazard mitigation grants available through the Robert T. Stafford Disaster Relief and Emergency Assistance Act, P.L. 93-288, as amended.

Section 1 – Mitigation Program and Strategy

The Tennessee Hazard Mitigation Program is the collective effort of many different agencies, organizations, communities, and individuals working together to lessen the impact of disasters. The efforts of this program are documented in this *State of Tennessee Hazard Mitigation Plan*. The group has members from many different organizations and disciplines, but all share an interest in the common Vision, Mission, and Values of the Tennessee Hazard Mitigation Program.

The *Tennessee Hazard Mitigation Strategy* documented in this section of the plan articulates Vision, Mission, Values, Goals, Objectives, and Actions of the Tennessee Hazard Mitigation Program. This outlines the state's approach to addressing hazard risks in the short and long term, beginning with one broad ideal (Vision) and moving into specific intent (Actions).

Vision of the Tennessee Hazard Mitigation Program

"Disaster Resilience for All"

These four words capture the essence of the Tennessee Hazard Mitigation Program. The program focuses on disaster resilience. Resilience is a broad concept and there are many organizations primarily focused on other aspects of resilience. The Tennessee Hazard Mitigation Program champions disaster resilience.

The Tennessee Hazard Mitigation Program is inclusive. The focus is on the State of Tennessee. However, the program impacts the nation and the world. The desired outcome is that all people, organizations, businesses, governments, and communities achieve resilience to disasters.

Mission of the Tennessee Hazard Mitigation Program

"The Tennessee Mitigation Program supports and makes effective long-term investments to lessen the impact of disasters"

The idealistic vision of the Tennessee Hazard Mitigation Program is carried forward by this practical mission. The program supports effective long-term investments by providing tools, technical assistance, data, best practices, information sharing, and coordination to support planning and decision-making across the public and private sector. Better informed people and organizations can make better decisions.

The Tennessee Hazard Mitigation Program makes effective long-term investments both directly and indirectly. Some resources, such as funds affiliated with the *Hazard Mitigation Grant Program*, may only be used for hazard mitigation projects that directly lessen disaster impacts. Other resources, such as staff time or other grant programs, may be used for a variety of purposes.

The Tennessee Hazard Mitigation Program helps partners make wise and well-informed investments of resources to lessen the impact of disasters. For instance, a community with a vibrant business community is economically resilient to disaster. The Tennessee Hazard Mitigation Program recognizes all of the interdependencies of resilience and its members are subject-matter experts, advocates, and champions for disaster resilience.

Values of the Tennessee Hazard Mitigation Program

Organizational values provide a practical way to connect or articulate connection between individuals, departments, divisions, and other sub-functions of a large organization. Leadership is critical in plotting the direction of an organization, but the everyday decisions of each individual are the footsteps in the journey. Organizational values serve as a common scale to inform everyday decisions. Values determine culture and culture determines almost everything else in an organization.

In the case of the Tennessee Hazard Mitigation Program, the commonly shared values were captured rather than created. These four values were already part of the culture of each organization comprising the diverse membership of the Tennessee Hazard Mitigation Program. These values do not represent the entire value-set of each organization, only those that represent the culture of the Tennessee Hazard Mitigation Program.

Long-term Outlook: planning processes consider future generations

Data-informed: planning processes consider the best data available

Risk-aware: planning processes consider probability of and vulnerability to disaster events

Sustainable: planning processes consider long-term maintenance requirements and contingencies

What is a "value?"

A value is a standard of behavior or a principle that sets a standard of behavior. Values guide the perspective and actions of an individual or group.

Strategies

A strategy is how an organization will fulfill its mission and support its vision while adhering to its values. Strategies reflect current lines of effort. As progress is made or obstacles encountered, strategies may need to be adjusted, abandoned, or added.

The Tennessee Hazard Mitigation Program has three current lines of effort or strategies in support of its mission. Each strategy results in effective long-term investment to lessen the impact of disasters.

RED STRATEGY

Institutionalize considerations of disaster resilience in all planning processes

(PARTNERS & TEAMBUILDING)

Disasters can impact anything. Therefore, disaster resilience is applicable to any planning process, whether a 25-year strategic plan for government or industry, or a family's plans for the weekend. This strategy focuses on ensuring disaster resilience is incorporated as a matter of course at all levels.

WHITE STRATEGY

Measure and report disaster resilience in Tennessee

(DATA & STATEWIDE IMPACT)

In order to determine the effectiveness of the Tennessee Hazard Mitigation Program and make adjustments to improve it, progress must be measured. Disaster resilience can be measured by a lot of different methods. The information gathered in the process is useful for many different stakeholders. This strategy focuses on developing those methodologies, tracking progress, and reporting the information to make it useful.

BLUE STRATEGY
Conduct and empower others to conduct effective hazard mitigation activities
(PROCESS & LOCAL IMPACT)

Effective hazard mitigation is a synchronized effort. In government, federal supports state, state supports local, and local supports individuals. Each level of government must work together to ensure the right resources are available at the right time. It is no small effort to administer grant programs, deliver technical assistance, and provide accurate information. This strategy focuses on all levels of government working together as part of the whole community in order to be effective.

1.1 – Mitigation Goals, Objectives, and Actions

TEMA rigorously identified, evaluated, and prioritized cost effective, environmentally sound, and technically feasible mitigation goals, objectives, and actions for its next hazard mitigation plan cycle. Identification of mitigation gaps was completed in the assessment of state capabilities. This assessment drove the selection of 43 mitigation actions to address the identified gaps and improve existing state and local capabilities. The mitigation actions were then discussed and evaluated. The results of the evaluation of actions were captured in STAPLE+E format, in which concerns are weighted based on societal, technical, administrative, political, legal, economic, environmental concerns. The results of this analysis is recorded in the action description tables and the STAPLE+E process itself is described in more detail in the following section.

A Goal is a general statement of what needs to be accomplished to implement a strategy. Each Strategy will be supported by one or more Goals. Objectives are specific, measurable, achievable, realistic, and time-bound (SMART) milestones in the process of accomplishing Goals. Each Goal will be supported by multiple Objectives. Actions are specific steps to achieving Objectives, including the responsible party for implementing the action.

RED STRATEGY
Institutionalize considerations of disaster resilience in all planning processes
(PARTNERS & TEAMBUILDING)

Goal 1. Unite and empower all disaster resilience resource and technical assistance providers

A. Develop and implement a strategy for strengthening intergovernmental partnerships by October 2021 (3 years)

1. Ensure all federal, state, and local-level entities with an interest in flood-risk management are informed about the Tennessee Silver Jackets program by October 2020 (2 years)
2. Develop a strategy for supporting other state agencies with disaster resilience planning requirements by October 2020 (2 years)

B. Develop and implement a strategy for engaging non-governmental and quasi-governmental organizations by October 2023 (3 years)

3. Develop a strategy for empowering the Tennessee Development Districts to support local hazard mitigation planning by October 2020 (2 years)
4. Develop a strategy for empowering non-profit groups such as environment or watershed protection organizations to support local hazard mitigation planning by October 2021 (3 years)
5. Develop a strategy for empowering colleges and universities to support and conduct hazard mitigation planning by October 2021 (3 years)
6. Develop a strategy for empowering schools to conduct hazard mitigation planning and projects by October 2021 (3 years)

C. Develop and implement a strategy for engaging the private sector by October 2023 (5 years)

7. Develop a strategy for informing the private sector about how to incorporate hazard mitigation information by October 2020 (2 years)
8. Develop a strategy for empowering for profit private sector entities such as large employers to support local hazard mitigation planning and projects by October 2021 (3 years)

Goal 2. Improve understanding of disaster resilience among policy and decision-makers

D. Develop a best-practices outreach program by October 2021 (3 years)

9. Write and publish case studies of at least three (3) exemplary Tennessee hazard mitigation projects or programs by April 2019 (1.5 years)
10. Develop a list of every federal, state, or local planning process which requires a resiliency component by October 2021 (3 years)
11. Develop a strategy for linking hazard mitigation planning with Comprehensive Economic Develop Strategies (CEDS), which now require a resilience component, by October 2020 (2 years)
12. Develop fund-ready project to conduct a baseline assessment of codes, zoning, and other regulations in Tennessee by October 2019 (1 year)

WHITE STRATEGY
Measure and report disaster resilience in Tennessee
(DATA & STATEWIDE IMPACT)

Goal 3. Develop and improve disaster resilience data

E. Develop and prioritize data needs by October 2020 (2 years)

13. Complete flood study of Mansker Basin by April 2019 (0.5 years)
14. Develop target list and methodology for mitigation loss avoidance studies by October 2019 (1 year)

15. Develop a strategy for improving changing future conditions data by October 2019 (1 year)
16. Develop TEMA Hazard Mitigation intern program to by October 2019 (2 years)
17. Update State Hazard Mitigation Plan with 2020 Census data by October 2021 (3 years)

F. Develop a strategy for hazard-specific studies by October 2020 (2 years)

18. Develop a fund-ready project to complete Level 2 Hazus flood and earthquake studies of all 95 counties, similar to Missouri's project, by October 2020 (2 years)
19. Develop a fund-ready project for a statewide study of extreme temperature, drought impacts and wildfire risks by October 2021 (3 years)
20. Develop fund-ready projects for formal studies of LiDar datasets for high-hazard flood areas and state-owned property by October 2023 (5 years)
21. Develop a fund-ready project for study of Tennessee sinkhole data by October 2023 (5 years)
22. Develop a fund-ready project for dam breach modeling for all high-hazard dams by October 2023 (5 years)
23. Coordinate with other state agencies for infrastructure, hazardous materials, terrorism and communicable disease risk assessments by October 2023 (5 years)

Goal 4. Provide accessible disaster resilience data

G. Publish state mitigation website by October 2019 (1 year)

24. Develop web-based display dashboards for mitigation projects by October 2019 (1 year)
25. Develop web-based display dashboards for mitigation plans by October 2019 (1 year)

H. Develop web-based library of mitigation planning resources that is accessible to the public by October 2021 (3 years)

26. Develop a publically available library of local hazard mitigation plans by April 2020 (1.5 years)
27. Incorporate projects and initiatives from other agencies such as TNECD, TDEC, and CUSEC in web-based library by October 2020 (2 years)

BLUE STRATEGY
Conduct and empower others to conduct effective hazard mitigation activities
(PROCESS & LOCAL IMPACT)

Goal 5. Develop a comprehensive suite of tools for hazard mitigation planning

I. Improve local hazard mitigation plan template by October 2019 (1 year)

28. Integrate Community Rating System into the Local Hazard Mitigation Plan template by October 2019 (1 year)
29. Develop methodologies for local planners to use in determining hazard extent for flood, wildfire, and drought by October 2019 (1 year)

J. Develop toolkit for local hazard mitigation program development by October 2021 (3 years)

30. Develop a Tennessee-specific mitigation project ideas list by October 2020 (2 years)
31. Develop local mitigation program information for CTAS/MTAS to provide for elected officials by October 2020 (2 years)
32. Develop a local mitigation program development toolkit of public outreach materials, stakeholder engagement tools, and project development tools by October 2019 (1 year)

Goal 6. Develop a comprehensive hazard mitigation technical assistance program

K. Ensure 100% of Tennesseans are considered in an effective hazard mitigation plan by October 2021 (3 years)

33. Develop local mitigation projects database and review process by April 2019 (0.5 years)
34. Develop state approval and recognition program for local hazard mitigation plans by October 2019 (1 year)
35. Learn to deliver G318 – Local Mitigation Planning Training by October 2020 (2 years)

L. Address Repetitive Loss and Severe Repetitive Loss

36. Develop tools to support the Community Rating System Users Group by October 2019 (1 year)
37. Review and update Tennessee Model Floodplain Ordinances by October 2019 (1 year)
38. Develop a fund-ready project to host a joint Emergency Management and Floodplain Manager Conference in Tennessee by October 2020 (2 years)
39. Increase ranking of 25% of communities participating in the Community Rating System by October 2021 (3 years)
40. Encourage and prioritize funding for high flood risk Repetitive Loss and Severe Repetitive Loss projects through October 2023 (5 years)

Goal 7. Maximize investment in hazard mitigation activities

M. Demonstrate the capability to effectively manage increased funding to achieve hazard mitigation goals by October 2023 (5 years)

41. Document how the state has fully made use of all available FEMA funding in each year to October 2020 (2 years)
42. Document integration of other local, state, and federal hazard mitigation programs and initiatives by October 2020 (2 years)
43. Compete for nation-wide mitigation funding for state-level projects in each year to October 2023 (5 years)

Action Number and Title	**1.) TN Silver Jackets**
Number in Previous Plan	22
Action Description	**Ensure all federal, state, and local-level entities with an interest in flood-risk management are informed about the Tennessee Silver Jackets program by October 2020 (2 years)**
How Action Contributes to Risk Reduction	Robust representation in the state's flood-risk management coordination group will help identify and resolve flood-related issues
Years of Action Establishment	2014
Current Status of Action	Implemented & Ongoing
Hazard Addressed	All Hazards
STAPLE+E Priority	High
Goal	1
Objective Addressed	A
Funding Source(s)	Silver Jackets and EMPG (staff time)
Primary Federal Agency	U.S. Army Corps of Engineers
Primary State Agency	TEMA
Other Contributing Agencies	Many state, federal and local agencies and organizations
Completion Date	October 2020
Notes	The Tennessee Silver Jackets team includes a robust and impressive membership. This project pushes the team to self-evaluate and develop a strategy to ensure the team is as inclusive and effective as is possible.

Action Number and Title	**2.) State Disaster Resilience**
Number in Previous Plan	10
Action Description	**Develop a strategy for supporting other state agencies with disaster resilience planning requirements by October 2020 (2 years)**
How Action Contributes to Risk Reduction	Consistent and accessible disaster resilience information will improve state-level resilience planning, which is a requirement in many planning processes
Years of Action Establishment	2018
Current Status of Action	Implemented & Ongoing
Hazard Addressed	All Hazards
STAPLE+E Priority	Medium
Goal	1
Objective Addressed	A
Funding Source(s)	
Primary Federal Agency	FEMA
Primary State Agency	TEMA
Other Contributing Agencies	Many state, federal and local agencies and organizations
Completion Date	October 2020
Notes	

Action Number and Title **Number in Previous Plan**	**3.) Development Districts**
Action Description **How Action Contributes to Risk Reduction**	**Develop a strategy for empowering the Tennessee Development Districts to support local hazard mitigation planning by October 2020 (2 years)** Consistently involving the multi-discipline Development Districts in local mitigation planning will improve plans and implementation of mitigation actions
Years of Action Establishment **Current Status of Action**	2018 Proposed
Hazard Addressed **STAPLE+E Priority**	All Hazards Medium
Goal **Objective Addressed**	1 B
Funding Source(s)	EMPG, HMGP
Primary Federal Agency **Primary State Agency** **Other Contributing Agencies**	FEMA TEMA TNECD
Completion Date	October 2020
Notes	The Tennessee Development District Association or TDDA is an association of the nine state-wide development districts, which were established by the General Assembly under the Tennessee Development District Act of 1965. The Act established a statewide system of nine regional planning and economic development organizations to promote intergovernmental cooperation on growth and development issues, including regional and statewide concerns. The organizations also promote more effective utilization of available resources in dealing with these needs. The Board Membership for each Development District is made up of the chief elected officials from member counties and cities, a designated economic development professional from each county, and one Senator and one State Representative from within each region. The Tennessee Development District Association was established to serve as a statewide forum for the diverse problems the Districts must solve in their mission to serve 95 counties and some 350 municipalities. *See https://www.tennesseedevelopmentdistricts.org/*

Action Number and Title	**4.) Non-profit Groups**
Number in Previous Plan	56
Action Description	**Develop a strategy for empowering non-profit groups such as environment or watershed protection organizations to support local hazard mitigation planning by October 2021 (3 years)**
How Action Contributes to Risk Reduction	Involving non-profit groups, especially those with directly aligned interests, in local mitigation planning will improve plans and implementation of mitigation actions
Years of Action Establishment	2018
Current Status of Action	Proposed
Hazard Addressed	All Hazards
STAPLE+E Priority	Medium
Goal	1
Objective Addressed	B
Funding Source(s)	EMPG, HMGP, Silver Jackets
Primary Federal Agency	FEMA
Primary State Agency	TEMA
Other Contributing Agencies	Many state, federal and local agencies and organizations
Completion Date	October 2021
Notes	

Action Number and Title Number in Previous Plan	**5.) Colleges & Universities**
Action Description How Action Contributes to Risk Reduction	**Develop a strategy for empowering colleges and universities to support and conduct hazard mitigation planning by October 2021 (3 years)** Increasing the involvement of colleges and universities in hazard mitigation planning will increase participation, grant eligibility, and impactful projects
Years of Action Establishment Current Status of Action	2018 Proposed
Hazard Addressed STAPLE+E Priority	All Hazards High
Goal Objective Addressed	1 B
Funding Source(s)	EMPG, HMGP
Primary Federal Agency Primary State Agency Other Contributing Agencies	FEMA TEMA
Completion Date	October 2021
Notes	

Action Number and Title **Number in Previous Plan**	**6.) Schools**
Action Description **How Action Contributes to Risk Reduction**	**Develop a strategy for empowering schools to conduct hazard mitigation planning and projects by October 2021 (3 years)** Assisting school districts in becoming effective participants in hazard mitigation planning will increase participation, grant eligibility, and impactful projects
Years of Action Establishment **Current Status of Action**	2018 Proposed
Hazard Addressed **STAPLE+E Priority**	All Hazards High
Goal **Objective Addressed**	1 B
Funding Source(s)	EMPG, HMGP
Primary Federal Agency **Primary State Agency** **Other Contributing Agencies**	FEMA TEMA
Completion Date	October 2021
Notes	

Action Number and Title **Number in Previous Plan**	**7.) Inform Private Sector**
Action Description **How Action Contributes to Risk Reduction**	**Develop a strategy for informing the private sector about how to incorporate hazard mitigation information by October 2021 (3 years)** Informing private sector about the informational resources available to conduct hazard mitigation planning will help private sector partners drive down their risk
Years of Action Establishment **Current Status of Action**	2018 Implemented & Ongoing
Hazard Addressed **STAPLE+E Priority**	All Hazards High
Goal **Objective Addressed**	1 C
Funding Source(s)	EMPG
Primary Federal Agency **Primary State Agency** **Other Contributing Agencies**	FEMA TEMA
Completion Date	October 2021
Notes	

Action Number and Title **Number in Previous Plan**	**8.) Empower Private Sector**
Action Description **How Action Contributes to Risk Reduction**	**Develop a strategy for empowering for profit private sector entities such as large employers to support local hazard mitigation planning and projects by October 2021 (3 years)** Engaging private sector resources in hazard mitigation planning will improve the effectiveness of local and state planning processes
Years of Action Establishment **Current Status of Action**	2018 Implemented & Ongoing
Hazard Addressed **STAPLE+E Priority**	All Hazards Medium
Goal **Objective Addressed**	1 C
Funding Source(s)	EMPG
Primary Federal Agency **Primary State Agency** **Other Contributing Agencies**	FEMA TEMA
Completion Date	October 2021
Notes	

Action Number and Title	**9.) Case Studies**
Number in Previous Plan	14, 27, 28, 30, 31
Action Description	**Write and publish case studies of at least three (3) exemplary Tennessee hazard mitigation projects or programs by October 2019 (1 years)**
How Action Contributes to Risk Reduction	Local case studies will provide real-life examples of the benefits of hazard mitigation in Tennessee, encouraging more participation
Years of Action Establishment	2018
Current Status of Action	Implemented & Ongoing
Hazard Addressed	All Hazards
STAPLE+E Priority	Medium
Goal	2
Objective Addressed	D
Funding Source(s)	EMPG, HMGP
Primary Federal Agency	FEMA
Primary State Agency	TEMA
Other Contributing Agencies	
Completion Date	April 2020
Notes	These case studies will be supported by graphic information system (GIS), videos, and other features to allow effective outreach and sharing.

Action Number and Title **Number in Previous Plan**	**10.) Resiliency Requirements**
Action Description **How Action Contributes to Risk Reduction**	**Develop a list of every federal, state, or local planning process which requires a resiliency component by October 2021 (3 years)** Understanding both potential sources and consumers of hazard mitigation data allows targeted hazard mitigation planning research and outreach
Years of Action Establishment **Current Status of Action**	2016 Implemented & Ongoing
Hazard Addressed **STAPLE+E Priority**	All Hazards Medium
Goal **Objective Addressed**	2 D
Funding Source(s)	EMPG, HMGP
Primary Federal Agency **Primary State Agency** **Other Contributing Agencies**	FEMA TEMA
Completion Date	October 2021
Notes	

Action Number and Title **Number in Previous Plan**	**11.) CEDS Coordination**
Action Description	**Develop a strategy for linking hazard mitigation planning with Comprehensive Economic Develop Strategies (CEDS), which now require a resilience component, by October 2020 (2 years)**
How Action Contributes to Risk Reduction	Consistently linking economic development planning with hazard mitigation planning helps institutionalize hazard mitigation and risk reduction principles
Years of Action Establishment	2018
Current Status of Action	Proposed
Hazard Addressed	All Hazards
STAPLE+E Priority	High
Goal	2
Objective Addressed	D
Funding Source(s)	EMGP, HMGP, Silver Jackets, CEDS
Primary Federal Agency	Economic Development Administration
Primary State Agency	TEMA
Other Contributing Agencies	TNECD
Completion Date	
Notes	This would require extensive coordination with the Development Districts, which connects with Action 3 in this plan

Action Number and Title	**12.) Regulatory Assessment**
Number in Previous Plan	18, 32, 34, 35, 48
Action Description	**Develop fund-ready project to conduct a baseline assessment of codes, zoning, and other regulations in Tennessee by October 2019 (1 year)**
How Action Contributes to Risk Reduction	Understanding the status of regulations related to hazard mitigation help the state develop effective risk reduction strategies and actions
Years of Action Establishment	2018
Current Status of Action	Proposed
Hazard Addressed	All Hazards
STAPLE+E Priority	Medium
Goal	2
Objective Addressed	D
Funding Source(s)	HMGP, other
Primary Federal Agency	
Primary State Agency	TEMA
Other Contributing Agencies	TNECD
Completion Date	
Notes	This would require significant staff time

Action Number and Title **Number in Previous Plan**	**13.) Mansker Basin Study**
Action Description **How Action Contributes to Risk Reduction**	**Complete flood study of Mansker Basin by April 2019 (0.5 years)** Better data will empower better risk reduction decisions
Years of Action Establishment **Current Status of Action**	2016 Ongoing
Hazard Addressed **STAPLE+E Priority**	Flood High
Goal **Objective Addressed**	3 E
Funding Source(s)	Silver Jackets
Primary Federal Agency **Primary State Agency** **Other Contributing Agencies**	U.S. Army Corps of Engineers TEMA Many state, federal and local agencies and organizations
Completion Date	April 2019
Notes	This project is also a Tennessee Silver Jackets team project

Action Number and Title **Action Number in Previous Plan**	**14.) Loss Avoidance Studies**
Action Description **How Action Contributes to Risk Reduction**	**Develop target list and methodology for mitigation loss avoidance studies by October 2019 (1 year)** Loss avoidance studies provide hard data to make "business-case" arguments for hazard mitigation and risk reduction measures
Years of Action Establishment **Current Status of Action**	 Proposed
Hazard Addressed **STAPLE+E Priority**	Flood Medium
Goal **Objective Addressed**	3 E
Funding Source(s)	EMPG and HMGP
Primary Federal Agency **Primary State Agency** **Other Contributing Agencies**	FEMA TEMA Other state EMA
Completion Date	October 2019
Notes	These case studies will be supported by graphic information system (GIS), videos, and other features to allow effective outreach and sharing.

Action Number and Title **Action Number in Previous Plan**	**15.) Changing Future Conditions**
Action Description **How Action Contributes to Risk Reduction**	**Develop a strategy for improving changing future conditions data by October 2019 (1 year)** Better data will empower better risk reduction decisions
Years of Action Establishment **Current Status of Action**	2018 Ongoing
Hazard Addressed **STAPLE+E Priority**	All Hazards Medium
Goal **Objective Addressed**	3 E
Funding Source(s)	EMPG, HMGP
Primary Federal Agency **Primary State Agency** **Other Contributing Agencies**	FEMA TEMA TDOT
Completion Date	October 2019
Notes	TDOT's work in this area has been tremendous and there is opportunity to collaborate more and improve the data.

Action Number and Title **Action Number in Previous Plan**	**16.) Mitigation Intern Program**
Action Description **How Action Contributes to Risk Reduction**	**Develop TEMA Hazard Mitigation intern program to by October 2020 (2 years)** TEMA will be able to implement more risk reduction measures with additional support, as well as potentially train and recruit talent
Years of Action Establishment **Current Status of Action**	2018 Implemented & Ongoing
Hazard Addressed **STAPLE+E Priority**	All Hazards High
Goal **Objective Addressed**	3 E
Funding Source(s)	EMPG
Primary Federal Agency **Primary State Agency** **Other Contributing Agencies**	FEMA TEMA
Completion Date	October 2020
Notes	TEMA has had interns in the past, but not specifically for mitigation

Action Number and Title **Action Number in Previous Plan**	**17.) 2020 Census Data**
Action Description **How Action Contributes to Risk Reduction**	**Update State Hazard Mitigation Plan with 2020 Census data by October 2021 (3 years)** Better data will empower better risk reduction decisions
Years of Action Establishment **Current Status of Action**	2018 Implemented & Ongoing
Hazard Addressed **STAPLE+E Priority**	All Hazards High
Goal **Objective Addressed**	3 E
Funding Source(s)	EMPG
Primary Federal Agency **Primary State Agency** **Other Contributing Agencies**	FEMA TEMA Finance and Administration – Strategic Technology Solutions
Completion Date	October 2021
Notes	

Action Number and Title	**18.) Statewide Level 2 Hazus**
Action Number in Previous Plan	29, 34, 35
Action Description	**Develop a fund-ready project to complete Level 2 Hazus flood and earthquake studies of all 95 counties by October 2020 (2 years)**
How Action Contributes to Risk Reduction	Better data will empower better risk reduction decisions
Years of Action Establishment	2018
Current Status of Action	Proposed
Hazard Addressed	Flood and Earthquake
STAPLE+E Priority	Medium
Goal	3
Objective Addressed	F
Funding Source(s)	EMPG and HMGP
Primary Federal Agency	FEMA
Primary State Agency	TEMA
Other Contributing Agencies	Missouri EMA
Completion Date	October 2020
Notes	This project is intended to be similar to the State of Missouri's project

Action Number and Title	**19.) Temperature, Drought & Wildfire**
Action Number in Previous Plan	29, 32, 33,
Action Description	**Develop a fund-ready project for a statewide study of extreme temperature, drought impacts and wildfire risks by October 2021 (3 years)**
How Action Contributes to Risk Reduction	Better data will empower better risk reduction decisions
Years of Action Establishment	2018
Current Status of Action	Proposed
Hazard Addressed	Extreme Temperature, Drought and Wildfire
STAPLE+E Priority	Medium
Goal	3
Objective Addressed	F
Funding Source(s)	EMPG, HMGP
Primary Federal Agency	FEMA
Primary State Agency	TEMA
Other Contributing Agencies	
Completion Date	October 2021
Notes	

Action Number and Title	**20.) LiDar Studies**
Action Number in Previous Plan	26, 29, 51
Action Description	**Develop fund-ready projects for formal studies of LiDar datasets for high-hazard flood areas and state-owned property by October 2023 (5 years)**
How Action Contributes to Risk Reduction	Better data will empower better risk reduction decisions
Years of Action Establishment	2018
Current Status of Action	Proposed
Hazard Addressed	Flood
STAPLE+E Priority	Medium
Goal	3
Objective Addressed	F
Funding Source(s)	EMPG, HMGP
Primary Federal Agency	FEMA
Primary State Agency	TEMA and F&A - GIS
Other Contributing Agencies	
Completion Date	October 2023
Notes	

Action Number and Title **Action Number in Previous Plan**	**21.) Sinkhole**
Action Description **How Action Contributes to Risk Reduction**	**Develop a fund-ready project for study of Tennessee sinkhole data by October 2023 (5 years)** Better data will empower better risk reduction decisions
Years of Action Establishment **Current Status of Action**	2018 Proposed
Hazard Addressed **STAPLE+E Priority**	All Hazards Medium
Goal **Objective Addressed**	3 F
Funding Source(s)	EMPG, HMGP
Primary Federal Agency **Primary State Agency** **Other Contributing Agencies**	USGS TEMA TDEC – Geological Survey
Completion Date	October 2023
Notes	

Action Number and Title **Action Number in Previous Plan**	**22.) Dam Breach Modeling** 50
Action Description **How Action Contributes to Risk Reduction**	**Develop a fund-ready project for dam breach modeling for all high-hazard dams by October 2023 (5 years)** Better data will empower better risk reduction decisions
Years of Action Establishment **Current Status of Action**	2018 Proposed
Hazard Addressed **STAPLE+E Priority**	All Hazards Low
Goal **Objective Addressed**	3 F
Funding Source(s)	EMPG, HMGP
Primary Federal Agency **Primary State Agency** **Other Contributing Agencies**	U.S. Army Corps of Engineers TEMA Tennessee Valley Authority
Completion Date	October 2023
Notes	This project will be coordinated with TVA Flood Risk Program

Action Number and Title **Action Number in Previous Plan**	**23.) Risk Assessments**
Action Description **How Action Contributes to Risk Reduction**	**Coordinate with other state agencies for infrastructure, hazardous materials, terrorism, and communicable disease risk assessments by October 2023 (5 years)** This action ensures mitigation partners across the state are collaborating to increase risk reduction
Years of Action Establishment **Current Status of Action**	2018 Proposed
Hazard Addressed **STAPLE+E Priority**	Infrastructure, Hazardous Materials, Terrorism, and Communicable Disease Medium
Goal **Objective Addressed**	3 F
Funding Source(s)	EMPG, HMGP
Primary Federal Agency **Primary State Agency** **Other Contributing Agencies**	DHS TEMA TDOT, TDOSHS, and TDH
Completion Date	October 2023
Notes	

Action Number and Title	**24.) Project Dashboards**
Action Number in Previous Plan	13
Action Description	**Develop web-based display dashboards for mitigation projects by October 2019 (1 year)**
How Action Contributes to Risk Reduction	This action would help local planners develop effective hazard mitigation plans that ensure eligibility for federal funds by making other projects easily available
Years of Action Establishment	2017
Current Status of Action	Ongoing
Hazard Addressed	All Hazards
STAPLE+E Priority	Medium
Goal	4
Objective Addressed	G
Funding Source(s)	EMPG, CUSEC
Primary Federal Agency	DHS – S&T
Primary State Agency	TEMA
Other Contributing Agencies	CUSEC
Completion Date	October 2019
Notes	This project is already underway as a pilot of the Community Hazard Assessment and Mitigation Planning System (CHAMPS), supported by CUSEC

Action Number and Title	**25.) Plan Dashboards**
Action Number in Previous Plan	13
Action Description	**Develop web-based display dashboards for mitigation plans by October 2019 (1 year)**
How Action Contributes to Risk Reduction	This action would help local planners develop effective hazard mitigation plans that ensure eligibility for federal funds by making other plans easily available
Years of Action Establishment	2017
Current Status of Action	Ongoing
Hazard Addressed	All Hazards
STAPLE+E Priority	Medium
Goal	4
Objective Addressed	G
Funding Source(s)	EMPG, CUSEC
Primary Federal Agency	DHS – S&T
Primary State Agency	TEMA
Other Contributing Agencies	CUSEC
Completion Date	October 2019
Notes	This project is already underway as a pilot of the Community Hazard Assessment and Mitigation Planning System (CHAMPS), supported by CUSEC

Action Number and Title	**26.) Library of Plans**
Action Number in Previous Plan	13
Action Description	**Develop a publically available library of local hazard mitigation plans by April 2020 (1.5 years)**
How Action Contributes to Risk Reduction	This action would help local planners develop effective hazard mitigation plans that ensure eligibility for federal funds by making other plans easily available
Years of Action Establishment	2017
Current Status of Action	Proposed
Hazard Addressed	All Hazards
STAPLE+E Priority	Medium
Goal	4
Objective Addressed	H
Funding Source(s)	EMPG, CUSEC
Primary Federal Agency	DHS – S&T
Primary State Agency	TEMA
Other Contributing Agencies	CUSEC
Completion Date	April 2020
Notes	This project is already underway as a pilot of the Community Hazard Assessment and Mitigation Planning System (CHAMPS), supported by CUSEC

Action Number and Title	**27.) Other Initiatives**
Action Number in Previous Plan	13,17
Action Description	**Incorporate projects and initiatives from other agencies such as TNECD, TDEC, and CUSEC in web-based library by October 2020 (2 years)**
How Action Contributes to Risk Reduction	This action ensures mitigation partners across the state are collaborating to increase risk reduction
Years of Action Establishment	2018
Current Status of Action	Proposed
Hazard Addressed	All Hazards
STAPLE+E Priority	Low
Goal	4
Objective Addressed	H
Funding Source(s)	EMPG, CUSEC
Primary Federal Agency	DHS – S&T
Primary State Agency	TEMA
Other Contributing Agencies	CUSEC, TNECD, and TDEC
Completion Date	October 2020
Notes	

Action Number and Title	**28.) CRS & LHMP**
Number in Previous Plan	16
Action Description	**Integrate Community Rating System into the Local Hazard Mitigation Plan template by October 2019 (1 year)**
How Action Contributes to Risk Reduction	This action would help local planners develop effective hazard mitigation plans that ensure eligibility for federal funds
Years of Action Establishment	2018
Current Status of Action	Proposed
Hazard Addressed	Flood
STAPLE+E Priority	High
Goal	5
Objective Addressed	I
Funding Source(s)	HMGP, EMPG
Primary Federal Agency	FEMA
Primary State Agency	TEMA
Other Contributing Agencies	TDEC - NFIP
Completion Date	October 2019
Notes	The Community Rating System is already included in the plan template, but this could be substantially improved upon

Action Number and Title Action Number in Previous Plan	**29.) Extent Methodologies**
Action Description	**Develop methodologies for local planners to use in determining hazard extent for flood, wildfire, and drought by October 2019 (1 year)**
How Action Contributes to Risk Reduction	This action would help local planners develop effective hazard mitigation plans that ensure eligibility for federal funds
Years of Action Establishment	2018
Current Status of Action	Proposed
Hazard Addressed	Flood, Wildfire, and Drought
STAPLE+E Priority	Medium
Goal	5
Objective Addressed	I
Funding Source(s)	HMGP, EMPG
Primary Federal Agency	FEMA
Primary State Agency	TEMA
Other Contributing Agencies	TDA
Completion Date	October 2019
Notes	The extent requirement in 44 CFR 201.6 (c)(2)(i) is one of the most frequently missed hazard mitigation planning requirements that delays eligibility for federal funds

Action Number and Title	**30.) Mitigation Project Ideas**
Action Number in Previous Plan	27, 28, 30, 31, 33
Action Description	**Develop a Tennessee-specific mitigation project ideas list by October 2020 (2 years)**
How Action Contributes to Risk Reduction	This action seeks to support local governments in planning and implementing effective hazard mitigation and risk management programs
Years of Action Establishment	2018
Current Status of Action	Proposed
Hazard Addressed	All Hazards
STAPLE+E Priority	High
Goal	5
Objective Addressed	J
Funding Source(s)	EMPG, HMGP
Primary Federal Agency	FEMA
Primary State Agency	TEMA
Other Contributing Agencies	
Completion Date	October 2020
Notes	Simplifying the FEMA list of project ideas and adding some Tennessee specifics would be a great start for this action.

Action Number and Title Action Number in Previous Plan	**31.) CTAS/MTAS** 18, 19, 32
Action Description How Action Contributes to Risk Reduction	**Develop local mitigation program information for CTAS/MTAS to provide for elected officials by October 2020 (2 years)** This action seeks to support local governments in planning and implementing effective hazard mitigation and risk management programs
Years of Action Establishment Current Status of Action	2018 Implemented & Ongoing
Hazard Addressed STAPLE+E Priority	All Hazards Medium
Goal Objective Addressed	5 J
Funding Source(s)	EMPG, HMGP
Primary Federal Agency Primary State Agency Other Contributing Agencies	FEMA TEMA CTAS/MTAS
Completion Date	October 2020
Notes	Hazard mitigation is complex and local elected officials receive a lot of information. Simplifying hazard mitigation and highlighting the benefits is essential to helping them make the best decisions for the communities for which they are responsible.

Action Number and Title **Action Number in Previous Plan**	**32.) Mitigation Program Toolkit**
Action Description **How Action Contributes to Risk Reduction**	**Develop a local mitigation program development toolkit of public outreach materials, stakeholder engagement tools, and project development tools by October 2019 (1 years)** This action seeks to support local governments in planning and implementing effective hazard mitigation and risk management programs
Years of Action Establishment **Current Status of Action**	2018 Proposed
Hazard Addressed **STAPLE+E Priority**	All Hazards High
Goal **Objective Addressed**	5 J
Funding Source(s)	HMGP, EMPG
Primary Federal Agency **Primary State Agency** **Other Contributing Agencies**	FEMA TEMA
Completion Date	October 2021
Notes	This action is very important to state and local emergency managers to ensure that local planners have all of the tools they need to develop a successful program.

Action Number and Title **Action Number in Previous Plan**	**33.) Projects Database**
Action Description	**Develop local mitigation projects database and review process by April 2019 (0.5 years)**
How Action Contributes to Risk Reduction	This action seeks to support local governments in planning and implementing effective hazard mitigation and risk management programs
Years of Action Establishment	2017
Current Status of Action	Proposed
Hazard Addressed	All Hazards
STAPLE+E Priority	Medium
Goal	6
Objective Addressed	K
Funding Source(s)	Silver Jackets, HMGP, EMPG
Primary Federal Agency	FEMA
Primary State Agency	TEMA
Other Contributing Agencies	
Completion Date	
Notes	This action will allow potential partners and collaborators such as Silver Jackets team members to review local hazard mitigation projects for opportunities to help implement. This action is also related to a Tennessee Silver Jackets project.

Action Number and Title	**34.) State Approval of Local Plans**
Action Number in Previous Plan	
Action Description	**Develop state approval and recognition program for local hazard mitigation plans by October 2019 (1 year)**
How Action Contributes to Risk Reduction	This action seeks to support local governments in planning and implementing effective hazard mitigation and risk management programs
Years of Action Establishment	
Current Status of Action	Proposed
Hazard Addressed	All Hazards
STAPLE+E Priority	High
Goal	6
Objective Addressed	K
Funding Source(s)	HMGP, EMPG
Primary Federal Agency	
Primary State Agency	TEMA
Other Contributing Agencies	
Completion Date	October 2019
Notes	The intent of this action is to recognize and include local hazard mitigation actions and projects in the state database of projects (*see* Actions 24 and 34 in this plan) prior to FEMA approval of the local hazard mitigation plan. This will allow the local mitigation program to continue to make progress as it seeks FEMA approval for the plan.

Action Number and Title **Action Number in Previous Plan**	**35.) State Delivery of G-318**
Action Description **How Action Contributes to Risk Reduction**	**Learn to deliver G318 – Local Mitigation Planning Training by October 2020 (2 years)** This action seeks to support local governments in planning and implementing effective hazard mitigation and risk management programs
Years of Action Establishment **Current Status of Action**	 Proposed
Hazard Addressed **STAPLE+E Priority**	All Hazards Low
Goal **Objective Addressed**	6 K
Funding Source(s)	HMGP, EMPG
Primary Federal Agency **Primary State Agency** **Other Contributing Agencies**	FEMA TEMA
Completion Date	October 2019
Notes	

Action Number and Title	**36.) CRS Users Group**
Action Number in Previous Plan	16
Action Description	**Develop tools to support the Community Rating System Users Group by October 2019 (1 year)**
How Action Contributes to Risk Reduction	This action seeks to support local governments in implementing effective flood-risk management programs
Years of Action Establishment	2016
Current Status of Action	Proposed
Hazard Addressed	Flood
STAPLE+E Priority	Low
Goal	6
Objective Addressed	L
Funding Source(s)	NFIP, EMPG
Primary Federal Agency	FEMA
Primary State Agency	TDEC
Other Contributing Agencies	TEMA
Completion Date	October 2019
Notes	

Action Number and Title **Action Number in Previous Plan**	**37.) Model Floodplain Ordinance**
Action Description **How Action Contributes to Risk Reduction**	**Review and update Tennessee Model Floodplain Ordinances by October 2019 (1 year)** This action seeks to support local governments in implementing effective flood-risk management programs
Years of Action Establishment **Current Status of Action**	2009 Proposed
Hazard Addressed **STAPLE+E Priority**	Flood Medium
Goal **Objective Addressed**	6 L
Funding Source(s)	EMPG, NFIP
Primary Federal Agency **Primary State Agency** **Other Contributing Agencies**	FEMA TDEC TEMA
Completion Date	October 2019
Notes	

Action Number and Title **Action Number in Previous Plan**	**38.) EMAT & TNAFPM**
Action Description **How Action Contributes to Risk Reduction**	**Develop a fund-ready project to host a joint Emergency Management and Floodplain Manager Conference in Tennessee by October 2020 (2 years)** This action seeks to support local governments in implementing effective risk management programs, especially flood risk
Years of Action Establishment **Current Status of Action**	2018 Proposed
Hazard Addressed **STAPLE+E Priority**	Flood Low
Goal **Objective Addressed**	6 L
Funding Source(s)	EMPG
Primary Federal Agency **Primary State Agency** **Other Contributing Agencies**	 EMAT & TNAFPM TEMA & TDEC
Completion Date	October 2020
Notes	

Action Number and Title	**39.) CRS Participants**
Number in Previous Plan	16
Action Description	**Increase ranking of 25% of communities participating in the Community Rating System by October 2021 (3 years)**
How Action Contributes to Risk Reduction	This action seeks to support local governments in implementing effective flood-risk management programs
Years of Action Establishment	2018
Current Status of Action	Implemented & Ongoing
Hazard Addressed	Flood
STAPLE+E Priority	Low
Goal	6
Objective Addressed	L
Funding Source(s)	NFIP, EMPG
Primary Federal Agency	FEMA
Primary State Agency	TDEC
Other Contributing Agencies	TEMA
Completion Date	October 2021
Notes	

Action Number and Title	**40.) RL & SRL Properties**
Number in Previous Plan	25
Action Description	**Encourage and prioritize funding for high flood risk Repetitive Loss and Severe Repetitive Loss projects through October 2023 (5 years)**
How Action Contributes to Risk Reduction	This action ensures focus on reducing the highest risk first, as flood is the costliest and among the deadliest of hazards in Tennessee
Years of Action Establishment	2018
Current Status of Action	Proposed
Hazard Addressed	Flood
STAPLE+E Priority	High
Goal	6
Objective Addressed	L
Funding Source(s)	EMPG, HMGP, PDM, FMA
Primary Federal Agency	FEMA
Primary State Agency	TEMA
Other Contributing Agencies	TDEC
Completion Date	October 2023
Notes	

Action Number and Title	**41.) FEMA Funding**
Number in Previous Plan	3
Action Description	**Document how the state has fully made use of all available FEMA funding in each year to October 2020 (2 years)**
How Action Contributes to Risk Reduction	This action ensures Tennessee remains proactive in seeking to "buy down" risk using every available funding source
Years of Action Establishment	2018
Current Status of Action	Proposed
Hazard Addressed	All Hazards
STAPLE+E Priority	Low
Goal	7
Objective Addressed	M
Funding Source(s)	EMPG, HMGP, PDM, FMA, PA
Primary Federal Agency	FEMA
Primary State Agency	TEMA
Other Contributing Agencies	
Completion Date	October 2020
Notes	This action is directly connected to developing an Enhanced Hazard Mitigation Program (for more information see FEMA Hazard Mitigation FAQs)

Action Number and Title	**42.) Document Integration**
Number in Previous Plan	3, 17,54
Action Description	**Document integration of other local, state, and federal hazard mitigation programs and initiatives by October 2020 (2 years)**
How Action Contributes to Risk Reduction	This action ensures mitigation partners across the state are collaborating to increase risk reduction
Years of Action Establishment	2018
Current Status of Action	Proposed
Hazard Addressed	All Hazards
STAPLE+E Priority	Low
Goal	7
Objective Addressed	M
Funding Source(s)	EMPG
Primary Federal Agency Primary State Agency Other Contributing Agencies	TEMA
Completion Date	October 2020
Notes	This action is directly connected to developing an Enhanced Hazard Mitigation Program (for more information see FEMA Hazard Mitigation FAQs)

Action Number and Title **Number in Previous Plan**	**43.) Compete for Funding**
Action Description **How Action Contributes to Risk Reduction**	**Compete for nation-wide mitigation funding for state-level projects in each year to October 2023 (5 years)** This action ensures Tennessee remains proactive in seeking to "buy down" risk using every available funding source
Years of Action Establishment **Current Status of Action**	2018 Proposed
Hazard Addressed **STAPLE+E Priority**	All Hazards Low
Goal **Objective Addressed**	7 M
Funding Source(s)	HMGP, PDM, FMA
Primary Federal Agency **Primary State Agency** **Other Contributing Agencies**	TEMA
Completion Date	October 2023
Notes	This action is directly connected to developing an Enhanced Hazard Mitigation Program (for more information see FEMA Hazard Mitigation FAQs)

State Hazard Mitigation Grant Funding Priorities

One of the most effective funding mechanisms for accomplishing hazard mitigation actions are the specific hazard mitigation funding streams administered by the state through FEMA. These funding streams include the post-disaster Hazard Mitigation Grant Program (HMGP) and the pre-disaster Flood Mitigation Assistance (FMA) and Pre-Disaster Mitigation (PDM) programs. The Tennessee Emergency Management Agency administers these programs, providing funding to local governments and eligible public entities. These funds are awarded based on the State of Tennessee's hazard mitigation grant funding priorities.

The Tennessee Mitigation Council reviews and ranks project applications for funding based on the State of Tennessee's hazard mitigation grant funding priorities. These priorities are reflected in the Mitigation Application Ranking System (MARS) form. The MARS form is a hazard mitigation grant application with an accompanying ranking system based upon a point response ranging from zero to 111 across 17 different categories with accompanying sub-categories. A number of these award the applicant based upon a scaled answer and have scales ranging from zero to 5, 6, and 10. Other categories are binary in nature and will award the applicant points based upon yes or no answers resulting in a scale of 0 to 5, 10, and 25 points.

Hazard Mitigation Priorities Summary

The list below summarizes priorities based on the scoring criteria in the MARS form.

- Effective Mitigation Project (up to 26 points)
- Community Impacted by a Disaster in Past Year (25 points)
- Demonstrated Hazard Mitigation Planning and Capability (up to 20 points)
- Repetitive Loss, Severe Repetitive Loss, Floodplain or Floodway (up to 15 points)
- Critical Facility or Economic Benefit (up to 15 points)
- Disadvantaged Area (up to 10 points)

In the first three scored categories, the State of Tennessee prioritizes rural and low income counties that have demonstrated capability to successfully plan or implement hazard mitigation projects. The next three scored categories focus on an applicant's risk, vulnerability, and commitment to implementing hazard mitigation. If a community was part of a Presidentially-declared disaster within the last year, the community is given an additional 25 points. This is intended to prioritize communities currently recovering from a major disaster.

The next three scored categories give priority to high-risk hazards and high-priority hazards, as listed in the applicant's own mitigation plan, as well as the number of people benefited by the project. The next four categories focus on high-flood risk properties, giving a very significant amount of points for repetitive loss, severe repetitive loss, floodplain, and floodway properties. It is possible to get as many as 15 points from this section for a single project. The next two scored categories focus on critical facilities and economic benefit. The last two scored categories provide points for permanently solving the issue, saving the lives, or addressing more than one issue.

The following excerpt demonstrates the prioritization portion of the mitigation application. To request an application, please contact the State of Tennessee Hazard Mitigation Office.

Excerpt from Mitigation Application Rating System (MARS) Form

Category	Scoring Points	Range	
Capability of the applicant to achieve the desired activity, based on previous grants performance, regional recommendation, and/or local mitigation plan capability assessment.	0	1 to 5	Lowest to highest capability
Population of the applicant area.	0	1) 50,001 and Up 2) 25,001 – 50,000 3) 15,001 – 25,000	4) 3,001 – 15,000 5) Up to 3,000
Median Income	0	1) $40,001 and Up 2) $30,001 – $40,000 3) $20,001 – $30,000	4) $10,001 – $20,000 5) Up to $10,000
Does the community have any of the following: • Member of the Community Rating System • Adoption of IBC/Nationally recognized building code • History of mitigation/prevention measures • Intense Developmental Stress[1] • Involved in a declared disaster within the past year? [1]*Intense Developmental Stress (IDS), as defined by the State of Tennessee, is the lack of or inadequate infrastructure to support the rapidly changing socio-economic conditions in the jurisdiction submitting the application.*	0 0 0 0 0	0 to 5	1 point for each "yes" answer
If the community was involved in a declared disaster within the past year, does the proposed project mitigate the hazard generating the disaster?	0	25 points for "yes"	0 points for "no"
Number of Presidentially-declared disasters in their area in the last 10 years.	0	1) 1 – 2 2) 3 – 4 3) 5 – 6	4) 7 – 8 5) 9 and Above
Does the proposed activity mitigate a high-risk hazard for the project's geographic area?	0	5 points for "yes"	0 points for "no"
What priority is the project/strategy being mitigated in the applicants plan?	0	0 points for "Low" 5 points for "Medium" 10 points for "High"	
Number of people benefiting from the proposed activity.	0	1) Up to 50 2) 50 – 500 3) 501 – 1,000	4) 1,001 – 1,999 5) 2,000 and Up
Does this proposal include a Repetitive Flood Claims structure(s) in proposed activity[2]? [2]*Repetitive Flood Claims (RFC) is defined as a structure insured under the National Flood Insurance Program (NFIP) and has had one or more claim payment(s) for flood damage.*	0	5 points for "yes"	0 points for "no"
Does this proposal include a Severe Repetitive Loss structure(s) in the activity[3]? [3]*Severe Repetitive Loss (SRL) is defined as a residential property insured under the National Flood Insurance Program (NFIP). The property must have incurred flood losses that resulted in either (1) four or more flood insurance claims payments that each exceeded $5000.00 with at least two of the payments occurring within a ten-year period, or (2) two or more flood insurance claims payments that cumulatively exceeded the value of the property.*	0	5 points for "yes"	0 points for "no"
Does this proposal include a property(ies) located in the floodplain?	0	5 points for "yes"	0 points for "no"
Does this proposal include a property(ies) located in the floodway?	0	5 points for "yes"	0 points for "no"
Does this proposal consist of a critical facility or function?	0	10 points for "yes"	0 points for "no"
Provides economic benefit to the local community? • Private sector (residents) • Public sector (business) • Government (local) • Minority (NEPA) • Partnering (between public and government)	0 0 0 0 0	0 to 5	1 point for each "yes" answer
Will the proposed activity permanently eliminate the problem?	0	5 points for "yes"	0 points for "no"
Will the proposed activity: • Save lives? • Mitigate more than one hazard? • Accomplish multiple objectives?	0 0 0	0 to 6	2 points for each "yes" answer

1.2.1 – STAPLE+E

The Hazard Mitigation Council utilized the STAPLE+E method of action prioritization and assessment. The tables below provide the STAPLE+E evaluation criteria and the evaluation of the mitigation actions.

Table 1 – STAPLE+E Criteria

Evaluation Category	Sources of Information
Social	Mitigation actions are acceptable to the community if they do not adversely affect a particular segment of the population, do not cause relocation of lower income people, and if they are compatible with the community's social and cultural values.
Technical	Mitigation actions are technically most effective if they provide long term reduction of losses and have minimal secondary adverse impacts.
Administrative	Mitigation actions are easier to implement if the jurisdiction has the necessary staffing and funding.
Political	Mitigation actions can truly be successful if all stakeholders have been offered an opportunity to participate in the planning process and if there is public support for the action.
Legal	It is critical that the jurisdiction or implementing agency have the legal authority to implement and enforce a mitigation action.
Economic	Budget constraints can significantly deter the implementation of mitigation actions. Hence, it is important to evaluate whether an action is cost-effective, as determined by a cost benefit review, and possible to fund.
Environmental	Sustainable mitigation actions that do not have an adverse effect on the environment, that comply with federal, state, and local environmental regulations, and that are consistent with the community's environmental goals, have mitigation benefits while being environmentally sound.

Action No.	STAPLE+E Criteria Action Title	Social	Technical	Administrative	Political	Legal	Economic	Environmental	Total	STAPLE+E Priority
1	TN Silver Jackets	1	1	0	1	1	1	1	**6**	*High*
2	State Disaster Resilience	1	1	0	0	1	1	1	**5**	*Med*
3	Development Districts	1	1	0	0	1	1	1	**5**	*Med*
4	Non-profit Groups	1	1	0	0	1	1	1	**5**	*Med*
5	Colleges & Universities	1	1	0	1	1	1	1	**6**	*High*
6	Schools	1	1	0	1	1	1	1	**6**	*High*
7	Inform Private Sector	1	1	0	1	1	1	1	**6**	*High*
8	Empower Private Sector	1	1	0	0	1	1	1	**5**	*Med*
9	Case Studies	1	1	0	0	1	1	1	**5**	*Med*
10	Resiliency Requirements	1	1	0	0	1	1	1	**5**	*Med*
11	CEDS Coordination	1	1	0	1	1	1	1	**6**	*High*
12	Regulatory Assessment	1	0	0	0	1	1	1	**4**	*Med*
13	Mansker Basin Study	1	1	1	1	1	1	1	**7**	*High*
14	Loss Avoidance Studies	1	0	0	1	1	1	1	**5**	*Med*
15	Changing Future Conditions	1	0	0	0	1	1	1	**4**	*Med*
16	Mitigation Intern Program	1	1	0	1	1	1	1	**6**	*High*
17	2020 Census Data	1	1	0	1	1	1	1	**6**	*High*
18	Statewide Level 2 Hazus	1	0	0	1	1	1	1	**5**	*Med*
19	Temperature, Drought & Wildfire	1	0	0	1	1	1	1	**5**	*Med*
20	LiDar Studies	1	0	0	1	1	1	1	**5**	*Med*
21	Sinkhole	1	0	0	1	1	1	1	**5**	*Med*
22	Dam Breach Modeling	1	0	0	0	0	1	1	**3**	*Low*
23	Risk Assessments	1	0	0	1	0	1	1	**4**	*Med*
24	Project Dashboards	1	0	0	1	1	1	1	**5**	*Med*
25	Plan Dashboards	1	0	0	0	1	1	1	**4**	*Med*
26	Library of Plans	1	0	0	0	1	1	1	**4**	*Med*
27	Other Initiatives	1	0	0	0	0	1	1	**3**	*Low*
28	CRS & LHMP	1	1	0	1	1	1	1	**6**	*High*
29	Extent Methodologies	1	0	0	1	1	1	1	**5**	*Med*
30	Mitigation Project Ideas	1	1	0	1	1	1	1	**6**	*High*
31	CTAS/MTAS	1	0	0	1	0	1	1	**4**	*Med*
32	Mitigation Program Toolkit	1	1	0	1	1	1	1	**6**	*High*
33	Projects Database	1	1	0	1	1	1	1	**5**	*Med*
34	State Approval of Local Plans	1	1	0	1	1	1	1	**6**	*High*
35	State Delivery of G-318	1	0	0	0	0	1	1	**3**	*Low*

Action No.	STAPLE+E Criteria Action Title	Social	Technical	Administrative	Political	Legal	Economic	Environmental	Total	STAPLE+E Priority
36	CRS Users Group	1	0	0	0	0	1	1	**3**	*Low*
37	Model Floodplain Ordinance	1	0	0	1	0	1	1	**4**	*Med*
38	EMAT & TNAFPM	1	0	0	0	0	1	1	**3**	*Low*
39	CRS Participants	1	0	0	0	0	1	1	**3**	*Low*
40	RL & SRL Properties	1	1	0	1	1	1	1	**6**	*High*
41	FEMA Funding	1	0	0	0	0	1	1	**3**	*Low*
42	Document Integration	1	0	0	0	0	1	1	**3**	*Low*
43	Compete for Funding	1	0	0	0	0	0	1	**2**	*Low*

1.2.2 – Implemented State Mitigation Activities

The State of Tennessee's mitigation program has continued to grow since the 2013 planning process last captured its progress. The Tennessee Silver Jackets Team is a nationally recognized team with several completed projects under its belt and plans to maintain constant improvement. The state has supported locals in many, many hazard mitigation projects. Hundreds of jurisdictions have participated in local hazard mitigation planning processes.

As the program grew and changed, the strategies and actions needed to change. The 2018 strategy remains true to the intent of the 2013 plan while growing with the program. Many of the actions have from the previous plan have been institutionalized and now occur as part of the **regular course of business**. Additionally a few actions were fully completed to the degree possible.

Other actions listed in the 2013 plan were not implemented or completed. The lack of progress to those mitigation actions were due to the absence of clear, feasible, and actionable milestones tied to the specifics actions. To ensure the original 2013 plan actions can be implemented moving forward, the planning team restructured the milestones on the 2018 plan. Continuing actions are those that were identified as not being clearly written in the 2013 plan but are now clearly written in the 2018 plan. Modified actions are those that were identified as not being feasible as written in the 2013 plan but are now scoped correctly in the 2018 plan to be feasible moving forward. The planning team believes this restructuring of milestones will deliver actionable progress in the future where there wasn't in the past.

The following table lists the 2013 HMP's mitigation actions, their current status, whether or not they have been included in this plan, and if excluded, the reasoning behind their exclusion. Narrative updates are included where applicable.

Table 2 – Tracking 2013 Hazard Mitigation Strategies

#	2013 SHMP Strategies & Update Narrative (as needed)	Status	Number in new plan
1	Strategy 1.1: Continue to develop a FEMA approved state hazard mitigation plan to ensure state and local eligibility for federal grants	Regular course of business	n/a
2	Strategy 1.2: Continue to maintain and improve a FEMA approved THIRA	Regular course of business	n/a
3	Strategy 1.3: Develop a FEMA approved enhanced state hazard mitigation plan to increase total grant funding	Continuing	42, 43
4	Strategy 2.1: Continue to maintain a professional, trained, and effective, grant program staff at TEMA to ensure a continual grant cycle	Regular course of business	n/a
5	Strategy 2.2: Continue to maintain a professional, trained, and effective, State Hazard Mitigation Office to ensure a continual grant cycle	Regular course of business	n/a

6	Strategy 2.3: Expand TEMA's professional development program by training its grants staff in FEMA's Cost Benefit Analysis Methodology, the State of Tennessee Historic Site Review process, and the State of Tennessee's Environmental Review process to decrease the grant application process timeframe while improving its effectiveness	Regular course of business	n/a
7	Strategy 3.1: Support and encourage TEMA's professional development program among mitigation staff	Regular course of business	n/a
#	**2013 SHMP Strategies & Update Narrative (as needed)**	**Status**	**Number in new plan**
8	Strategy 3.2: Encourage participation in the training and testing in mitigation related courses such as the Certified Floodplain Managers program and FEMA's HAZUS loss estimation program	Regular course of business	n/a
9	Strategy 4.1: Continue to develop a grant information outreach program for local jurisdictions	Regular course of business	n/a
10	Strategy 5.1: Ensure Tennessee Mitigation Initiative's sustainability by expanding the size of TEMA's mitigation planning outreach program	Continuing	2
11	Strategy 6.1: Distribute the HMP's state risk assessment to local jurisdictions	Regular course of business	n/a
12	Strategy 6.2: Work with local jurisdictions to develop better prioritized mitigation goals, objectives, and strategies	Regular course of business	n/a
13	Strategy 6.3: Grant local jurisdictions access to TEMA-maintained databases to improve mitigation plans and mitigation project planning	Continuing	24-28
14	Strategy 7.1: Develop a best practices guide by collecting mitigation success stories from local jurisdictions	Continuing	9
15	Strategy 7.2: Develop a public awareness campaign designed to encourage the public's practice of individual mitigation activities through local emergency management agencies	Regular course of business	n/a
16	Strategy 8.1: Develop a cost benefit analysis for local communities encouraging their participation in the CRS and NFIP programs to increase the number of CRS and NFIP participating communities	Modified	29, 37, 40
17	Strategy 8.2: Develop a cost benefit analysis for local communities encouraging their participation in the FireWise program and the Community Wildfire Protection Plan to increase the number of participating communities	Modified	27, 43
18	Strategy 9.1: Develop a cost benefit analysis for local communities encouraging enforcement of current state established building codes and outline the benefits of enacting enhanced local codes	Modified	12, 32
19	Strategy 9.2: Engage in outreach to local planning commissioners and zoning officials to spread awareness of assistance options, available grant programs, current and future development in hazard prone areas, and mitigation approaches	Modified	32
20	Strategy 9.3: Encourage the establishment of pre-approved debris	Completed	n/a

#	2013 SHMP Strategies & Update Narrative (as needed)	Status	Number in new plan
	storage areas *Update Narrative*: The TN Department of Environment and Conservation partnered with TEMA to develop a debris management template, which has been distributed statewide, that encourages pre-approved debris storage areas.		
21	Strategy 10.1: Develop a quick assessment tool to be used by the planning & recovery to assess mitigation opportunities post disaster	Modified	24, 25, 26
22	Strategy 10.2: Develop a coordinated group to make decisions on mitigation opportunities post disaster	Modified	1
23	Strategy 10.3: Assist in the development of the State of Tennessee's Development and Housing Authority "Rebuild & Recover" program to ensure capitalization of post disaster long-term recovery operations *Update Narrative*: TDHA has implemented Rebuild & Recover (see https://thda.org/business-partners/rebuild-and-recover)	Completed	n/a
24	Strategy 11.1: Identify high property count jurisdictions and prioritize RL/SRL properties by cost	Modified	40
25	Strategy 11.2: Accelerate the RL/SRL buyout program by targeting the prioritized jurisdictions and properties	Modified	41
26	Strategy 12.1: Conduct a study of flash flooding damages, their causes, and assess measures that could have mitigated their impacts	Modified	20
27	Strategy 12.2: Distribute flash flooding information and mitigation best practices to the identified hazard-prone communities	Modified	9, 31
28	Strategy 12.3: Based on the flash flooding study, develop flash flooding mitigation projects for local jurisdictions	Modified	9, 31
29	Strategy 13.1: Conduct a study of severe storm damages, their causes, and assess measures that could have mitigated their impacts	Modified	18, 19, 20
30	Strategy 13.2: Distribute severe storm information and mitigation best practices to the identified hazard-prone communities	Modified	9, 31
31	Strategy 13.3: Based on the severe storm study, develop severe storm mitigation projects for local jurisdictions	Modified	9, 31
32	Strategy 14.1: Promote local and state legislation mitigating the impacts of droughts through water use restrictions and burning prohibitions during declared events	Modified	12, 19, 32
33	Strategy 14.2: Directly and/or indirectly establish secondary and reserve water supplies to mitigate the effects of a drought on identified hazard prone communities	Modified	19, 31
34	Strategy 15.1: Develop cost benefit analysis on increasing the use of seismic building codes and distribute it to local governments and private construction companies doing business in Tennessee	Modified	12, 18
35	Strategy 15.2: Support, assist, and encourage local governments to provide incentives for private construction companies to voluntarily build higher than the minimum seismic standards	Modified	12, 18

36	Strategy 15.3: Continue to seismically retrofit bridges and transportation infrastructure in West Tennessee	Regular course of business	n/a
37	Strategy 15.4: Continue to support, assist, and encourage local governments to perform seismic retrofit studies and seismic retrofit projects	Regular course of business	n/a
38	Strategy 16.1: Encourage state and local governments to perform increased site level soil testing in identified hazard prone areas	Regular course of business	n/a
#	**2013 SHMP Strategies & Update Narrative (as needed)**	**Status**	**Number in new plan**
39	Strategy 16.2: Implement slope stabilizing mitigation measures protecting infrastructure in identified landslide prone areas *Update Narrative*: None of these areas have been identified, outside of projects that already include slope stabilization measures as part of the project (i.e., roadway projects)	Not feasible	n/a
40	Strategy 17.1: Assist, support, and encourage the construction of FEMA 361 tornado safe rooms throughout Tennessee	Regular course of business	n/a
41	Strategy 17.2: Assist, support, and encourage communities to require or implement the installation of anchoring systems at mobile home parks	Regular course of business	n/a
42	Strategy 18.1: Coordinate with the Tennessee Department of Transportation to identify transportation infrastructure in hazard-prone areas	Regular course of business	n/a
43	Strategy 18.2: Coordinate with the Tennessee Department of Transportation to implement mitigation projects for transportation infrastructure in the identified hazard prone areas	Regular course of business	n/a
44	Strategy 18.3: Coordinate with state agencies and local governments to install backup generators for critical facilities in identified hazard prone areas	Regular course of business	n/a
45	Strategy 18.4: Coordinate with state agencies and local governments to backup software and database systems *Update Narrative*: Strategic Technology Solutions coordinate best practice information through trainings and groups such as the Multi-State Information Sharing and Analysis Center (MS-ISAC)	Completed	n/a
46	Strategy 19.1: Install firewall and other hardware system protective measures in critical network systems to prevent cyber-attacks *Update Narrative*: Strategic Technology Solutions have implemented appropriate measures across state infrastructure	Completed	n/a
47	Strategy 20.1: Develop and maintain a comprehensive statewide GIS database of state property, in collaboration with the State of Tennessee Office of Information Resources, to identify, GPS locate, geocode, and build polygon files of all state property	Completed	n/a

#	2013 SHMP Strategies & Update Narrative (as needed)	Status	Number in new plan
	Update Narrative: Strategic Technology Solutions (formerly Office of Information Resources) have completed this project and it is currently being utilized (see maps 18-21 in this plan).		
48	Strategy 20.2: Collect and maintain a database of local jurisdictions' building codes, zoning, and subdivision regulations by adopting the maintenance of the State of Tennessee's "Status of Planning and Land Use Control Report for Tennessee" from the now disbanded Local Planning Assistance Office (LPAO) under TNECD	Continuing	12
49	Strategy 20.3: Pursue and promote LiDAR mapping opportunities in at risk areas throughout Tennessee *Update Narrative*: Strategic Technology Solutions is implementing the plan to acquire LiDAR for the entire state. See https://www.tn.gov/finance/sts-gis/gis/gis-projects/gis-projects-elevation.html	Completed	n/a
50	Strategy 21.1: Identify and assess community risk from potential dam failures by studying the impact potential of non-profiled dams	Continuing	22
51	Strategy 21.2: In coordination with the USACE, improve and refine flood inundation mapping throughout the state based on river depth measurements	Continuing	20
52	Strategy 21.3: Conduct a statewide, multiple scenario assessment of chemical spills and plume models for chemical and radiological facilities	Continuing	23
53	Strategy 22.1: Maintain TEMA's ESC program and keep the ESCs informed on mitigation efforts, progress, and successes throughout the state	Regular course of business	n/a
54	Strategy 23.1: Work with state agencies, federal agencies, and non-profits to promote mitigation practices at historic and culturally significant locations and properties	Continuing	43
55	Strategy 23.2: Promote the development of the State of Tennessee's Development and Housing Authority "Rebuild & Recover" program *Update Narrative*: TDHA has implemented Rebuild & Recover (see https://thda.org/business-partners/rebuild-and-recover)	Completed	n/a
56	Strategy 23.3: Continue to support mitigation planning efforts with non-profits such as the Red Cross, Salvation Army, and Volunteer Organization Active in Disasters	Continuing	4

Section 2 – The State of Tennessee

2.1 – Topography

Tennessee is a long and narrow state bordered on the east by the Appalachian Mountains and on the west by the Mississippi River. It is divided into 3 distinct geographic regions known as the Grand Divisions: East Tennessee, Middle Tennessee, and West Tennessee. East Tennessee contains the mountains and valleys of the Appalachian Mountains. The Cumberland Plateau divides East and Middle Tennessee. The Tennessee River divides Middle and West Tennessee.

Tennessee borders 8 other states: Kentucky and Virginia to the north; North Carolina to the east; Georgia, Alabama and Mississippi to the South; Arkansas and Missouri on the Mississippi River to the west. The highest point in the state is Clingmans Dome at 6,643 feet; this peak, which lies on Tennessee's eastern border, is also the highest point on the Appalachian Trail and the state line between Tennessee and North Carolina crosses the summit. The lowest point in Tennessee is the Mississippi River at the Mississippi State line. The geographical center of the state is located in Murfreesboro. Tennessee also lays claim to the most caves in the United States, with over 8,350 caves registered to date.

The lowlands of West Tennessee are bordered by the Mississippi River on the west and a portion of the Tennessee River on the east. Aside from the city of Memphis, land in West Tennessee is primarily agricultural. Nashville, the state's capital, is located in Middle Tennessee, an area characterized by rolling hills and fertile river valleys extending eastward to the Cumberland Plateau. East Tennessee is dominated by the Appalachian Mountains and foothills, including the Cumberland Mountains, the Ridge-and-Valley area with its principal urban areas of Knoxville, Chattanooga and the Tri-Cities, and the Great Smoky Mountains that straddle the border with North Carolina.

West, Middle and East Tennessee can be further divided into 6 major physiographic regions: Blue Ridge, Appalachian Ridge and Valley Region, Appalachian Plateau, Highland Rim, Central Basin, and the Gulf Coastal Plain.

Blue Ridge Mountains

The Blue Ridge area lies on the eastern edge of Tennessee, on the border of North Carolina. This region of Tennessee is characterized by high mountains, including the Great Smoky Mountains, the Chilhowee Mountains, and the Snowbird Mountains. The average elevation of the Blue Ridge area is 5,000 feet above sea level. The Blue Ridge region, sometimes called the Unakas, constitutes the highest and most rugged surface in the state and covers an area of about 2,600 square miles. The face of the country is exceedingly rough, and the chains of mountain ridges are cut in numerous places by deep, rocky channels.

Appalachian Ridge and Valley Region

Stretching west from the Blue Ridge area for approximately 55 miles is the Appalachian Ridge and Valley Region. This area of Tennessee is covered by fertile valleys separated by wooded ridges. The western section of the Appalachian Ridge and Valley Region, where the valleys become broader and the ridges become lower, is called The Great Valley. Extending from southwestern Virginia into northern Georgia, the Great Valley is a segment of the ridge and valley province of the Appalachian Highlands, which reach from New York into Alabama. This region, consisting of long, narrow ridges with broad valleys trending from northeast to southwest between them, covers more than 9,000 square miles of Tennessee. Since the coming of the Tennessee Valley Authority in 1933, the area has been dotted with artificial lakes and dams, which supply electric power and aid in flood control.

This region has much arable land and constitutes one of the best developed and most populous agricultural districts of the state.

Cumberland Plateau

To the west of the Appalachian Ridge and Valley Region lies the Cumberland Plateau, an area covered with flat- topped mountains separated by sharp valleys. The elevation of the plateau rises from 1,500 to 1,800 feet above sea level. Lookout Mountain, southwest of Chattanooga and in the southern section of the plateau, provides views of 7 states. The Cumberland Plateau, which extends in its entirety from southern Kentucky into central Alabama, has an area of about 5,400 square miles in Middle Tennessee. The plateau is a region of contrasts, including both the Cumberland Mountains, which rise to a height of 3,500 feet, and the Sequatchie Valley, the floor of which lies about 1,000 feet below the surface of the adjoining plateau. This is the coal region of Tennessee.

Highland Rim

To the west of the Cumberland Plateau lies the Highland Rim, an elevated plain that surrounds the Nashville Basin. The Highland Rim is the state's largest natural region, consisting of more than 12,500 square miles. The eastern section is a gently rolling plain some 1,000 feet lower than the Cumberland Plateau. The western part has an even lower elevation and sinks gently toward the Tennessee River.

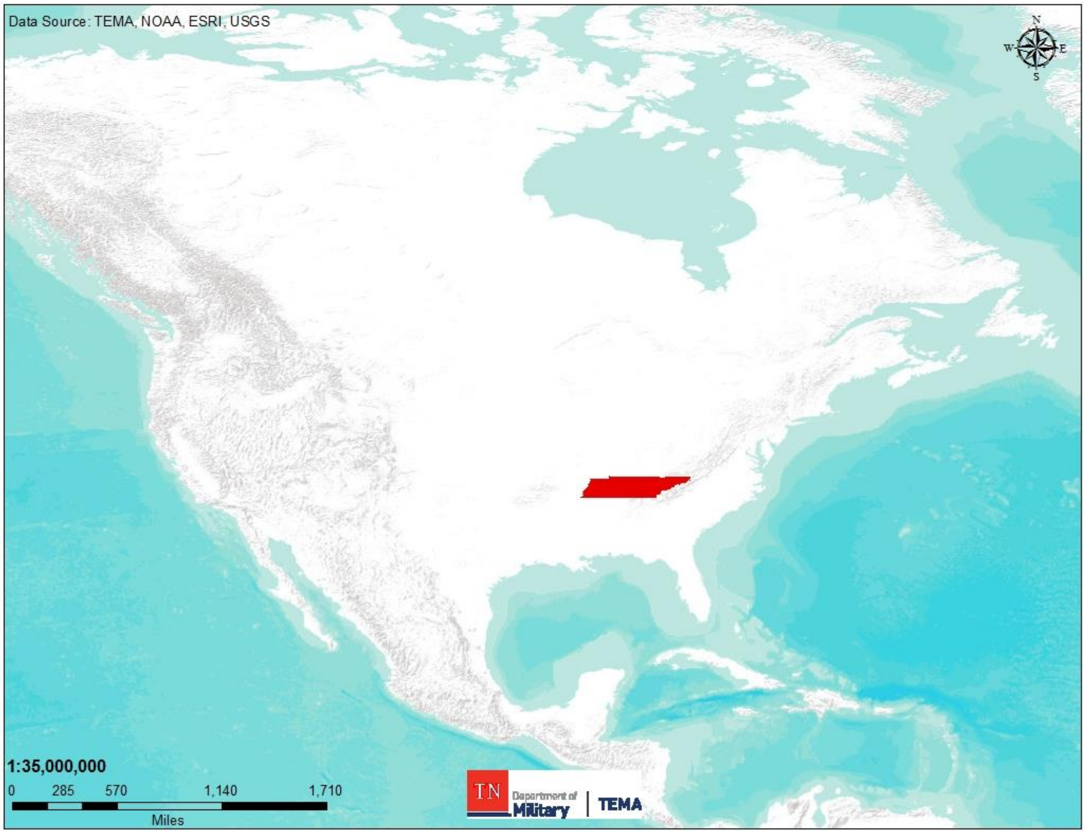
Central Basin

The Central, or Nashville, Basin is an oval depression with a gently rolling surface and has been compared to the bottom of an oval dish, of which the Highland Rim forms the broad, flat brim. With its rich soil, the region has attracted people from the earliest days of European settlement and is more densely populated than any other area in the state.

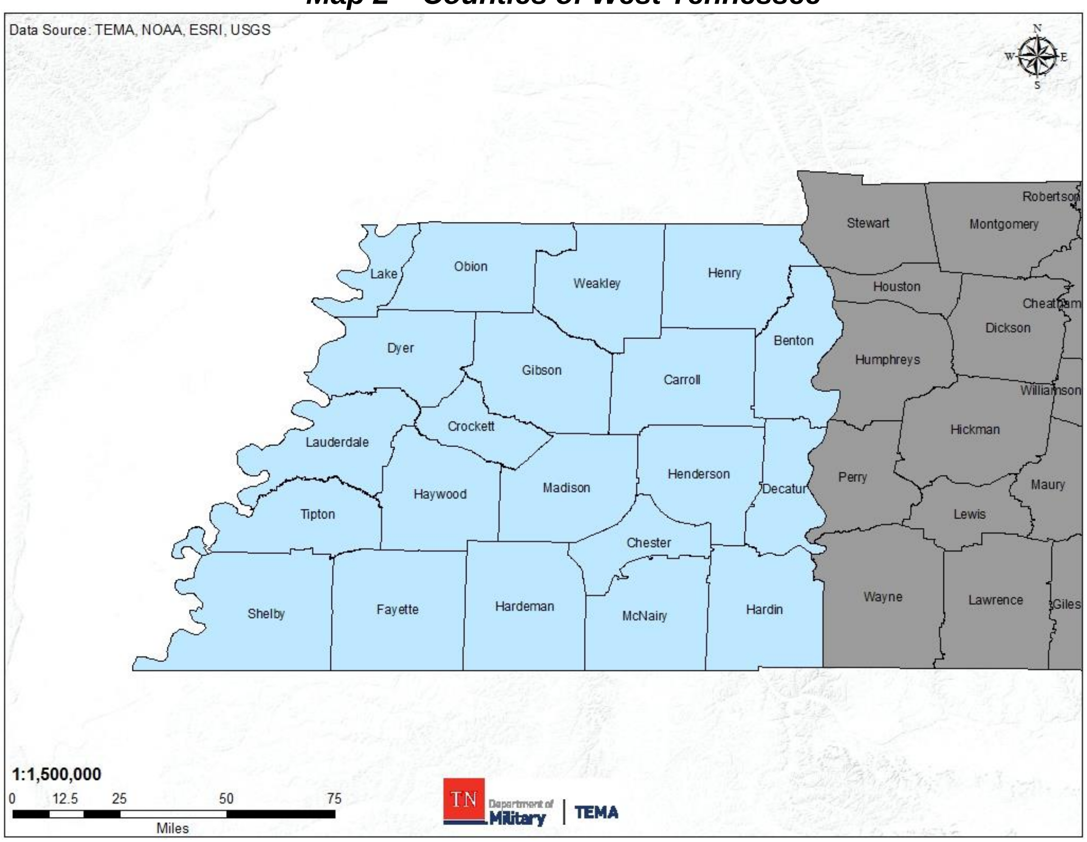
Gulf Coastal Plain

The westernmost part of the major regions is the Gulf Coastal Plain. The Gulf Coastal Plain covers an area of 9,000 square miles. It is a broad plain, sloping gradually westward until it ends abruptly at the bluffs overlooking the Mississippi flood plains and river. In the northwest corner is Reelfoot Lake, the only natural lake of significance in the state, formed by a series of earthquakes in 1811 and 1812. The plain is part of the large geographic land area that begins at the Gulf of Mexico and extends north into southern Illinois. In Tennessee, the Gulf Coastal Plain is divided into 3 sections, extending from the Tennessee River, in the east, to the Mississippi River in the west. The easternmost section or West Tennessee Uplands is approximately 10 miles wide and consists of hilly land running along the western bank of the Tennessee River. To the west of this narrow strip of land is a wide area of rolling hills and streams that stretches all the way to Memphis in western Tennessee. This is the Coastal Plain area or what is more commonly called the Tennessee Bottoms or Bottom Land.

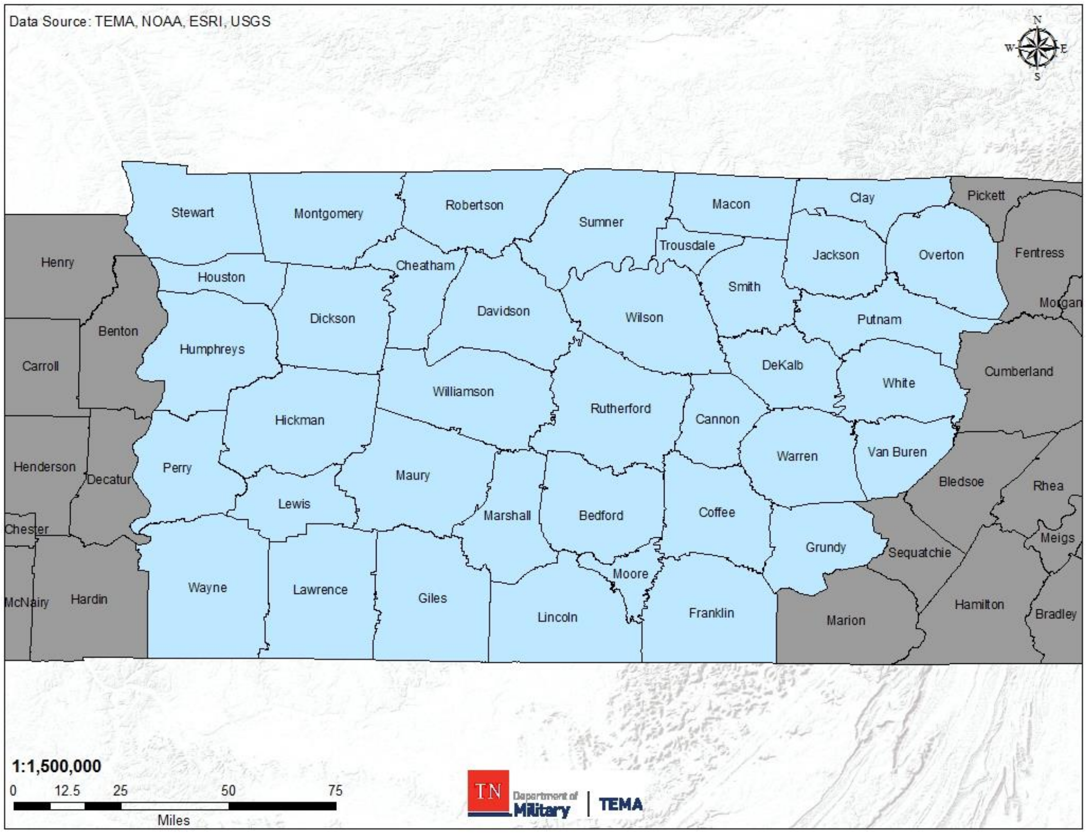
Map 1 – Tennessee within the United States of America



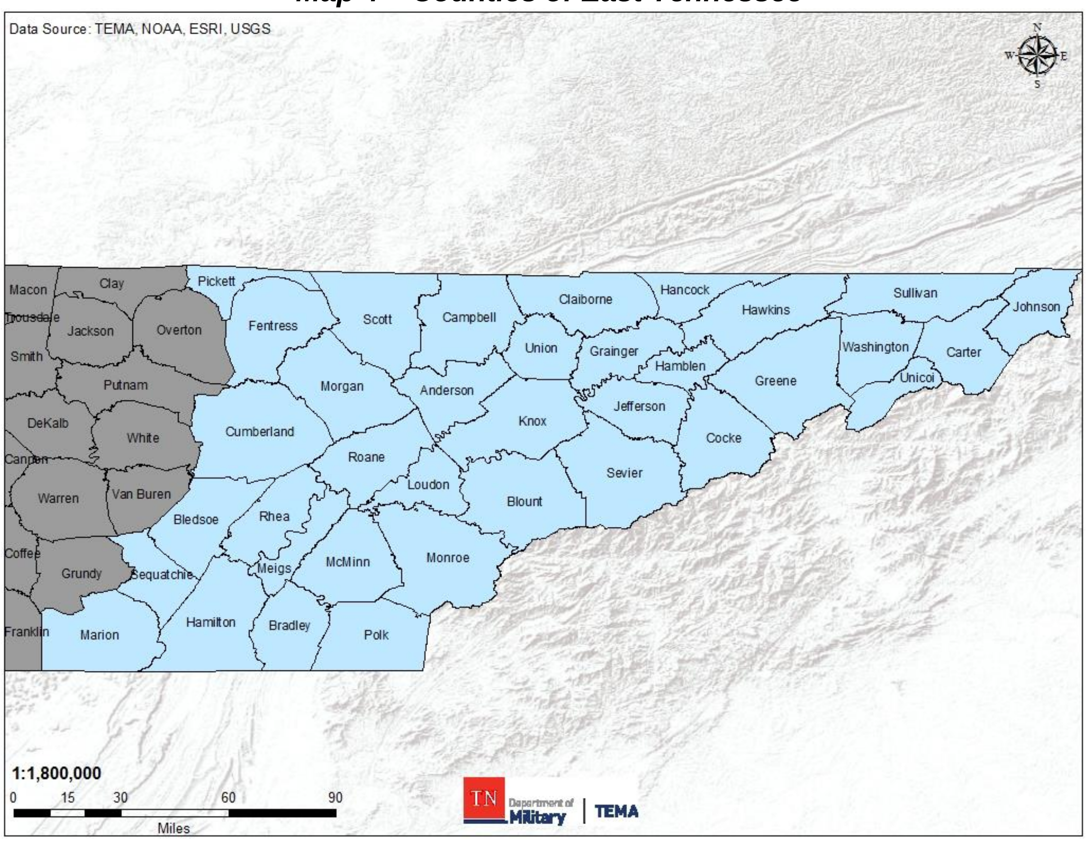
Map 2 – Counties of West Tennessee



Map 3 – Counties of Middle Tennessee



Map 4 – Counties of East Tennessee



2.2 – Climate

Most of Tennessee has a humid subtropical climate, with the higher elevations in the Appalachians classified as having a mountain temperate climate or a humid continental climate due to cooler temperatures. The Gulf of Mexico is the dominant factor in the climate of Tennessee, with moisture filled winds from the south being responsible for most of the state's annual precipitation. Generally, the state has hot summers and mild to cool winters with generous precipitation throughout the year. On average the state receives 50 inches of precipitation annually. Snowfall ranges from 5 inches in West Tennessee to over 16 inches in the higher mountains in East Tennessee, yet due to relatively mild winter temperatures, snow cover in most locations rarely persists for more than a few days.

Historically, Tennessee has an annual average temperature of 57.4 °F with an average high temperature of 68.8 °F and an average low temperature of 45.8 °F. The humidity in Tennessee varies from an average relative humidity in the morning of 83.8% to 59.2% in the afternoon/evening. The average yearly cloudiness breakdown for the state indicates 103 days of clear skies, 104 days of partly cloudy skies, and 157 annual cloudy days.

Summers in the state are mostly hot and humid, with much of the state averaging a high of around 90 °F during the season. Winters tend to be mild to cool, increasing in coolness at higher elevations. Generally, for areas outside the highest mountains, the average overnight lows in winter are near freezing for most of the state. The highest recorded temperature in the state is 113 °F at Perryville on August 9, 1930 while the lowest recorded temperature is −32 °F at Mountain City on December 30, 1917.

Tennessee's varied topography leads to a variation in weather conditions across the state. For example, the average annual temperature varies from over 62°F in the extreme southwest to near 45°F atop the highest peaks of the east. Since Tennessee's moist air comes primarily from the Gulf of Mexico to the south, there is a gradual decrease of average precipitation from south to north across the state.

Tennessee's usual flood season occurs during the winter and early spring when frequent storms bring general rains of high intensity that contribute to local or more widespread flooding. Such storms can also be accompanied by damaging winds and hail and may produce tornadoes. Heavy summer thunderstorms also result in local flash flooding. Flood-producing rains are generally rare in the fall, although occasional tropical storm systems may cause serious floods as they pass through the area. Tennessee winters can be accompanied by ice storms in some areas and occasionally there are heavy snowstorms.

While the state is far enough from the coast to avoid any direct impacts from a hurricane, the location of the state makes it likely to be impacted from the remnants of tropical cyclones which weaken over land and can cause significant rainfall.

2.3 – Rivers & Watersheds

Tennessee contains a variety of small rivers, streams, creeks, and several major rivers with over 1,062 miles of navigable waterways. The Tennessee, Cumberland, and Mississippi Rivers are the most significant rivers in the state, with the Clinch and Duck Rivers also being of importance. Most of the state is drained by the Mississippi River and its tributaries. Waters from the 2 longest rivers—the Tennessee, with a total length of 652 miles, and the Cumberland, which is 687 miles long—flow into the Ohio River in Kentucky and join the Mississippi at Cairo, Illinois.

Formed a few miles north of Knoxville by the confluence of the Holston and French Broad Rivers, the Tennessee flows southwestward through the Great Valley into northern Alabama, then curves back into the state and flows northward into Kentucky. Other tributaries of the Tennessee are the Clinch, Duck, Elk, Hiwassee, and Sequatchie Rivers. The Cumberland River rises in southeastern Kentucky, flows across central Tennessee, and then turns northward back into Kentucky; its principal tributaries are the Harpeth, Red, Obey, Caney Fork, and Stones Rivers and Yellow Creek. In the western part of the state, the Forked Deer and Wolf Rivers are among those flowing into the Mississippi, forming the western border with Missouri and Arkansas.

Many smaller rivers transverse the state. During the early settlement periods, these rivers and streams served as the major means of transportation that allowed access to various areas of Tennessee. Cities that became major urban centers such as Knoxville, Chattanooga, Nashville, and Memphis developed alongside larger rivers. Other communities of various sizes adjacent to streams also grew and flourished, only to die as overland transportation became more accessible and reliable. Early residents located nearly all the county seats, especially those in early settled areas, near relatively substantial streams.

Thirteen of Tennessee’s rivers have had sections designated as State Scenic Rivers pursuant to the state’s Scenic Rivers Program established by the legislature in 1968. The Scenic Rivers Program seeks to preserve valuable selected rivers, or sections thereof, in their free-flowing natural or scenic conditions and to protect their water quality and adjacent lands. The program seeks to preserve within the scenic rivers system itself several different types and examples of river areas, including mountain streams and deep gorges of east Tennessee, the pastoral rivers of middle Tennessee, and the swamp rivers of west Tennessee.

The Ocoee River in southeastern Tennessee is rated among the top white water recreational rivers in the nation and was the site for the Olympic white water canoe/kayak competition in the 1996 Olympics.

Tennessee has more than 1,000 lakes listed in the USGS comprising over 540,000 acres. There are several major lakes including Kentucky Lake, Norris Lake, Chickamauga Lake, Cherokee Lake, and Tim’s Ford Reservoir. Other lakes include Old Hickory, Percy Priest, Center Hill, Watauga, and Dale Hollow. Kentucky Lake is the largest man-made lake in the eastern United States. Reelfoot Lake in the northwest part of the state was formed after the series of New Madrid earthquakes in 1811-1812, and is the largest naturally formed lake in Tennessee. Many lakes have been formed in Tennessee by the building of dams, especially by the Tennessee Valley Authority and the Army Corps of Engineers.

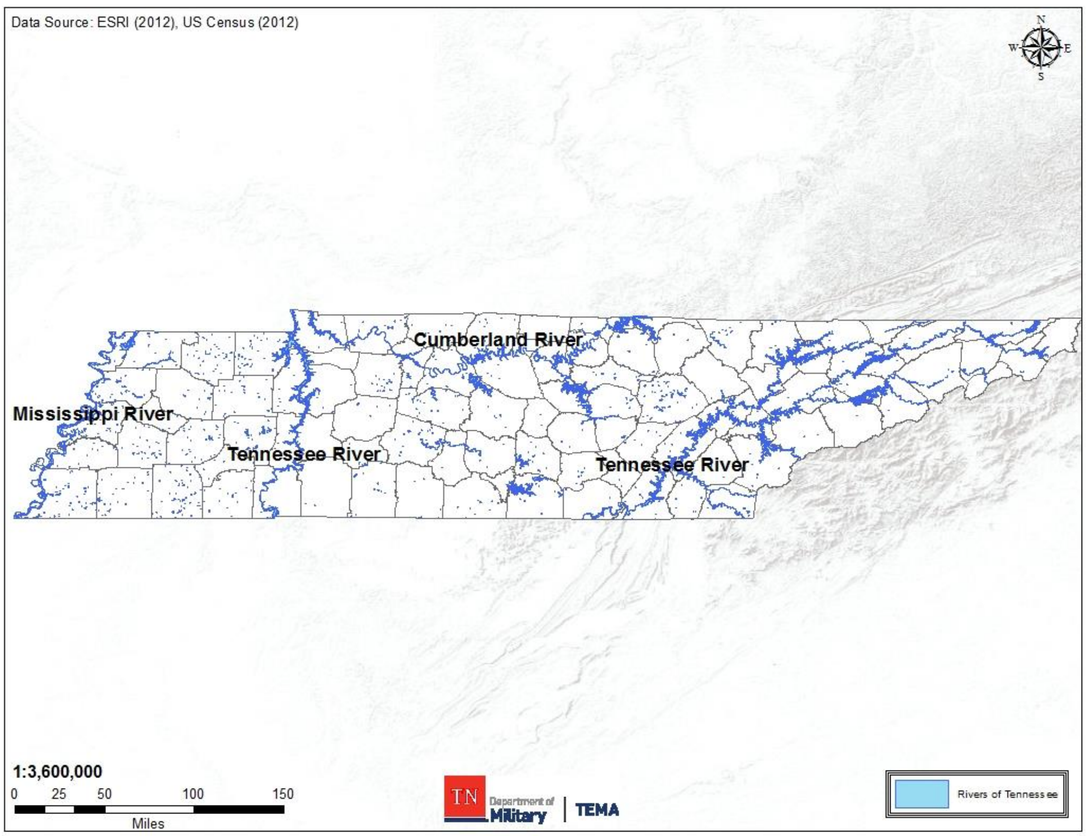
The Tennessee Valley Authority, a corporation owned by the U.S. government, provides electricity for 9 million people in parts of 7 southeastern states. The TVA, which receives no taxpayer money and makes no profits, also provides flood control, navigation, and land management for the Tennessee River system. The TVA serves virtually all of the 95 counties in Tennessee. The TVA service area in Tennessee covers about 42,038 square miles, about 49% of TVA's territory, and 99.7% of Tennessee.

This includes an electricity service area of 41,420 square miles and a watershed management area of 22,514 square miles.

A substantial portion of the power produced by the TVA comes from their 19 hydroelectric dams built across Tennessee rivers. The TVA also maintains 11 non-power dams and a total of 33 reservoirs across the state. The reservoirs have a combined surface area of about 300,000 acres and about 7,000 miles of shoreline. The TVA also owns and operates 7 locks in Tennessee (6 main locks and 1 auxiliary lock), serving about 110 Tennessee ports and terminals. About 17 million tons of cargo move through the facilities annually.

The ACOE also operates many dams and locks in Tennessee. The Corps ensures the navigability of the state's waterways and provides many recreational opportunities in and around their many reservoirs. There are 2 district offices in the state, 1 in Memphis that focuses on flood control and navigation of the Mississippi River and 1 in Nashville that is the headquarters of one of the Corps' largest districts for the miles of waterway and visitor use of facilities.

Map 5 – Rivers of Tennessee



2.4 – Transportation Systems

Tennessee has assumed a leadership position in the transportation and logistics industry with an excellent network of highways, waterways, rail lines and airports. The Volunteer State is centrally located within a day's drive of 75% of major U.S. markets. This combination of ideal location and excellent transportation resources has drawn a growing distribution and logistics industry to the state, as Tennessee is home to nearly 14,000 distribution centers, employing more than 146,000 workers.

The state has over 14,000 miles of roads in the state highway system, 80 public airports, 19,500 bridges, over 1,000 miles of navigable waterways, and over 3000 miles of rail track. The task of ensuring the safety and efficiency of the entire transit system falls on the TDOT, a multimodal agency with statewide responsibility for roads, airports, water transportation, and railroads. Memphis, Nashville, Knoxville, and Chattanooga are the focal points for all types of transportation in the state as all are located on important rivers and interstate highways, and all have airports served by the major airlines.

Airports

Tennessee has 74 general aviation airports, 6 commercial airports, over 100 private airports, and approximately 100 heliports. Tennessee's commercial airports (Memphis, Nashville, Knoxville, Tri-Cities, Chattanooga, and McKellar-Sipes at Jackson) are designed for passenger and freight movement, and are an essential part of the state's infrastructure. These commercial airports have an average runway length of 8,450 feet, and are designed to support frequent and convenient service to a variety of destinations, both domestic and international. The exception is Jackson's McKellar-Sipes airport, which has a strictly regional focus. The largest Tennessee airport, Memphis International Airport also handles the largest cargo volume of any airport in the world: 4,016,818 metric tons in 2012.

Tennessee receives the most scheduled air freight of any state in the U.S. as measured by short tons (2,000 lbs.) and the 10th most unscheduled freight in the nation. A remarkable 15.5% of all scheduled freight tonnage received nationwide arrived in the state, primarily at Memphis. Fed Ex which has its primary hub at Memphis International Airport is responsible for 200 of the airport's daily flights and 97% of the statewide air freight. With just over 10 million commercial service boarding passengers per year, Tennessee's passenger enplanements are also considerable, and 90% of commercial passenger traffic statewide is handled in Memphis and Nashville.

Highway Infrastructure

Tennessee has 1,104 miles of interstate highways including I-40 which spans the entire horizontal length of the state, going from Knoxville through Nashville to Memphis. I-24, I-65, I-75 and I-81 are all interstates that cut across different portions of the state running north and south. Tennessee has 19 interstate rest areas and 13 state border welcome areas. In addition to its 14,000 miles of state owned highways, there are about 70,000 miles of rural roads and over 17,000 miles of urban roads maintained in the state. Approximately 5,000,000 motor vehicles are registered in the state, and over 4,250,000 Tennesseans hold drivers' licenses.

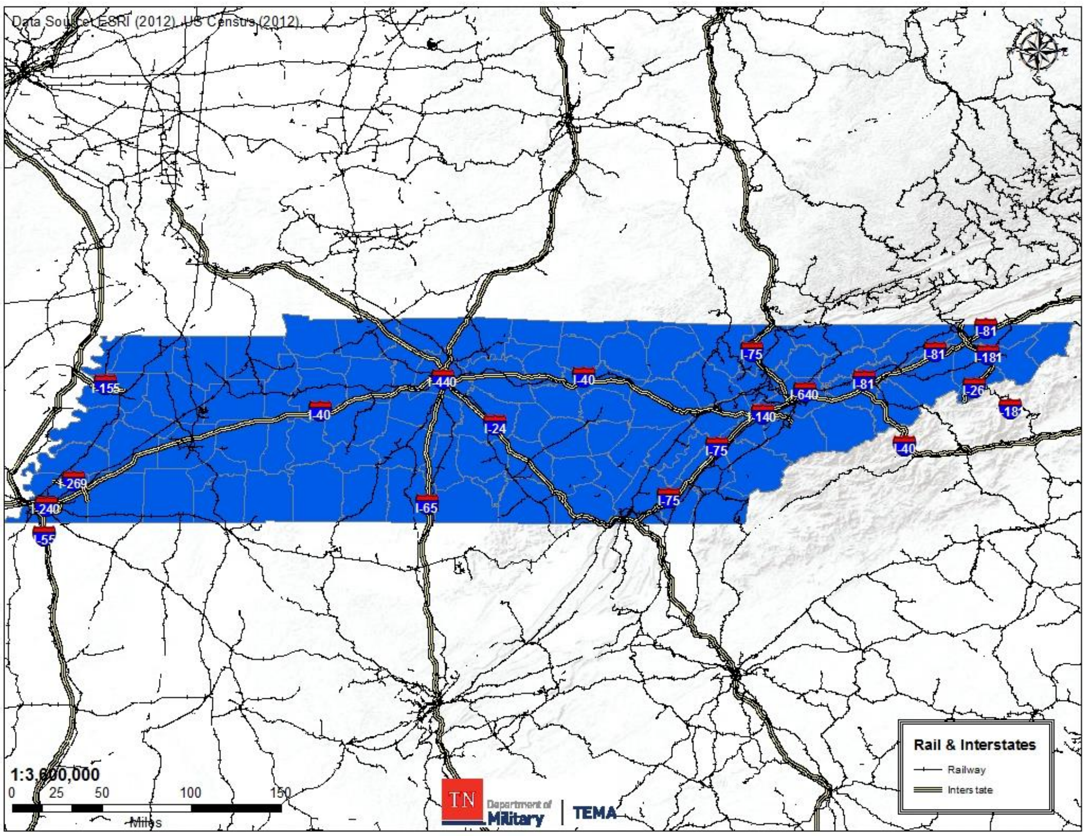
Rail

Railroad building began in Tennessee as early as the 1820s. During the 1850s, the basis for 19^{th} and 20^{th} century rail transportation was laid: the Louisville and Nashville Railroad linked Tennessee to the northern states, and the Memphis and Charleston line established ties with the East Coast. Tennessee has over 3,100 rail miles of track. Six major rail lines operate on the 2,340 miles of Class I track, and 20 different rail companies operate on the 810 miles of short-line track.

Water Based Transportation

The principal means of transportation during Tennessee's early history was water, and all the early settlements were built on or near streams. The introduction of steamboats on the Cumberland River in the early 19th century helped make Nashville the state's largest city and its foremost trading center. By mid-century, however, Memphis, on the Mississippi River, had surpassed Nashville in population and trade. The completion in 1985 of the 234 mile long Tennessee Tombigbee Waterway gave Tennessee shippers a direct north-south route for all vessels between the Tennessee River and the Gulf of Mexico via the Black Warrior River in Alabama. Although none of the waterway runs through Tennessee, the northern terminus is on the Tennessee River near the common borders of Tennessee, Alabama, and Mississippi. In 2010, the port of Memphis handled 12.1 million tons of freight, and the ports of Nashville and Chattanooga each handled about 2.0 million tons.

Map 6 – Rail & Interstates of Tennessee



2.5 – Demographics

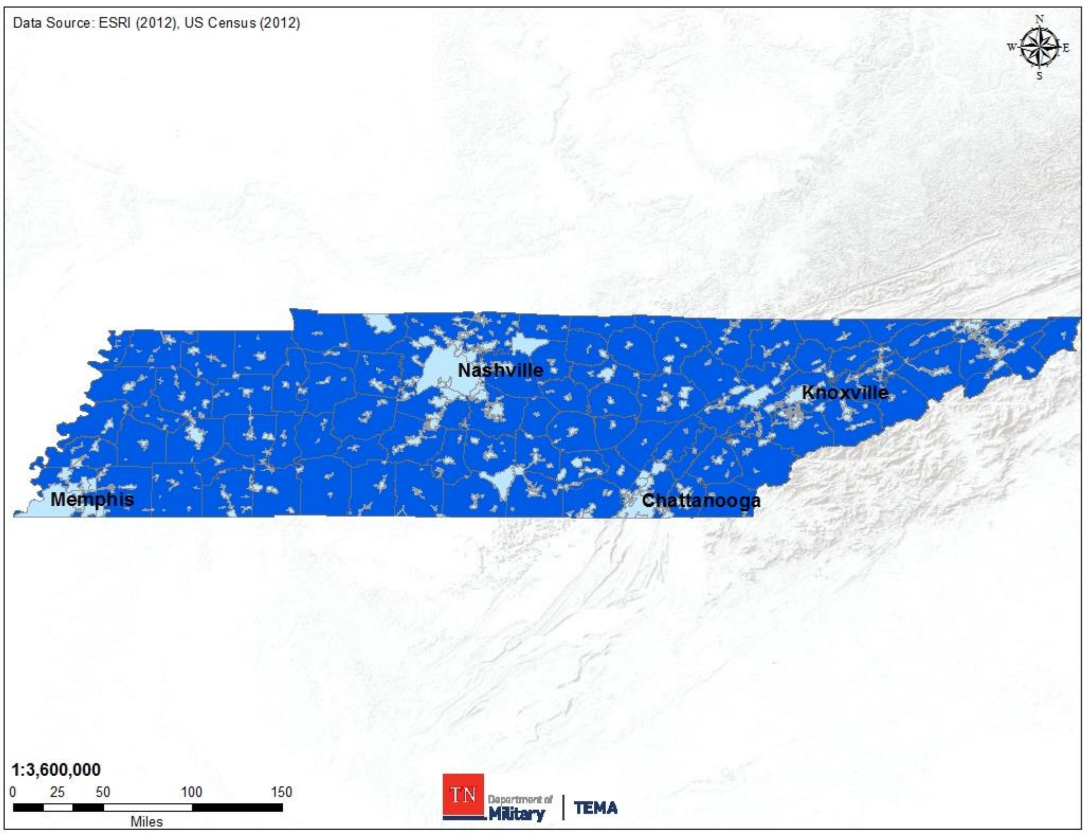
According to the US Census Bureau, the 2017 population estimate for Tennessee is 6,715,984. According to the same study the largest city is the Capitol, Nashville, with 660,388, followed closely by Memphis with 652,717. The next two largest cities are Knoxville (186,239) and Chattanooga (177,571). The state has grown since the last official census, and is expected to follow, if not exceed, a similar growth pattern over the next twenty years. Tennessee’s 3 largest race groups are White (78.7%) African American (17.1%), and Hispanic (5.2%). Compared to the United States average, Tennessee has 4% more African Americans, almost 12% fewer Hispanics, and less than 3% Asians as a percentage of its total population.

The median age of a Tennessee resident in 2017 was 38.6 years old, with 6.1% of the population under 5 years old, 22.6% under 18 years old, and 15.7% of the population over 65 years old. These percentages compare very closely to the overall age composition of the entire United States.

The median income of a Tennessee family in 2016 was $46,574, which is the 42nd lowest family income of any state. In addition, 15.8% of the Tennessee population lives below the federally established poverty level. This places Tennessee 40th within the United States for person's living below the poverty level.

Population data for the following tables and graphs has remained unchanged from the previous plan and uses information from the 2012 US Census.

Map 7 – Cities & Towns of Tennessee



Map 8 – Total Population by County, Tennessee

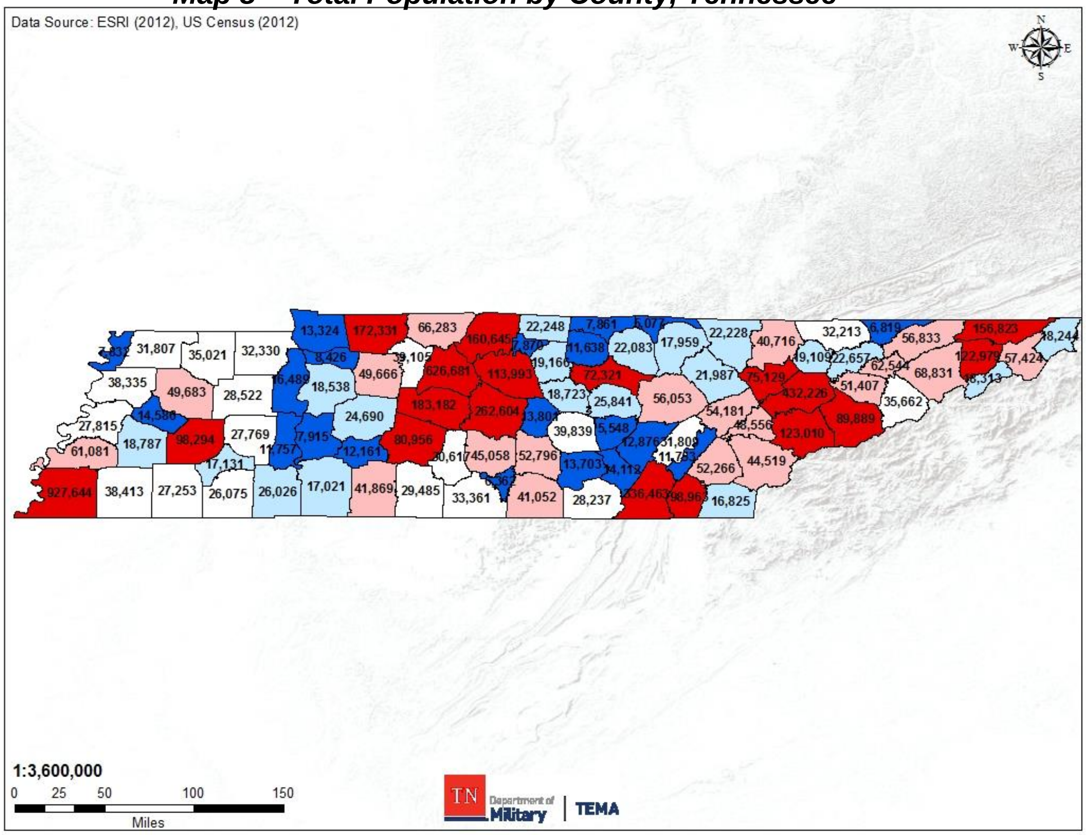


Table 3 – Tennessee Demographics		
Population	**Tennessee**	**USA**
Population, 2030 Projection	7,380,634	363,584,435
Population, % Change 2010 - 2030	16.30%	17.76%
Population, % Change 2020 - 2030	8.85%	8.27%
Population, 2020 Projection	6,780,670	335,804,546
Population, % Change 2010 - 2020	6.85%	8.76%
Total Population, 2010	6,346,105	308,745,538
Age		
Persons under 5 years old, 2010	407,813	20,201,362
Persons under 5 years old, 2010, %	6.43%	6.54%
Persons under 18 years old, 2010	1,496,001	74,181,467
Persons under 18 years old, 2010, %	23.57%	24.03%
Persons 65 years old and over, 2010	853,462	40,267,954
Persons 65 years old and over, 2010, %	13.45%	13.04%
Gender		
Female Persons, 2010	3,252,601	156,964,212
Female Persons, 2010, %	51.25%	50.84%
Male persons, 2010	3,093,504	151,781,326
Male persons, 2010, %	48.75%	49.16%
Race		
Black or African American persons, 2010	1,057,315	38,929,319
Black or African American persons, 2010, %	16.66%	12.61%
American Indian and Alaska Native Persons, 2010	19,994	2,932,248
American Indian and Alaska Native Persons, 2010, %	0.32%	0.95%
Asian Persons, 2010	91,242	14,674,252
Asian Persons, 2010, %	1.44%	4.75%
Native Hawaiian and Other Pacific Islander, 2010	3,642	540,013
Native Hawaiian and Other Pacific Islander, 2010, %	0.06%	0.17%
Persons Reporting Two or More Races, 2010	110,009	9,009,073
Persons Reporting Two or More Races, 2010, %	1.73%	2.92%
Persons of Hispanic or Latino Origin, 2010	290,059	50,477,594
Persons of Hispanic or Latino Origin, 2010, %	4.57%	16.35%
Income		
Median Household Income, 2011	$42,279	$50,054
Per Capita Income, 2011	$23,722	$27,554
Persons below poverty level, 2011	1,072,492	44,150,612
Persons below poverty level, 2011, %	16.90%	14.30%

**The data are from the U.S. Census Bureau*

Table 4 – East Tennessee County Demographics			
County	**Population (2000)**	**Population (2010)**	**Population Change**
Anderson	71,330	75,129	5.33%
Bledsoe	12,367	12,876	4.12%
Blount	105,823	123,010	16.24%
Bradley	87,965	98,963	12.50%
Campbell	39,854	40,716	2.16%
Carter	56,742	57,424	1.20%
Claiborne	29,862	32,213	7.87%
Cocke	33,565	35,662	6.25%
Cumberland	46,802	56,053	19.77%
Fentress	16,625	17,959	8.02%
Grainger	20,659	22,657	9.67%
Greene	62,909	68,831	9.41%
Hamblen	58,128	62,544	7.60%
Hamilton	307,896	336,463	9.28%
Hancock	6,786	6,819	0.49%
Hawkins	53,563	56,833	6.10%
Jefferson	44,294	51,407	16.06%
Johnson	17,499	18,244	4.26%
Knox	382,032	432,226	13.14%
Loudon	39,086	48,556	24.23%
Marion	27,776	28,237	1.66%
McMinn	49,015	52,266	6.63%
Meigs	11,086	11,753	6.02%
Monroe	38,961	44,519	14.27%
Morgan	19,757	21,987	11.29%
Pickett	4,945	5,077	2.67%
Polk	16,050	16,825	4.83%
Rhea	28,400	31,809	12.00%
Roane	51,910	54,181	4.37%
Scott	21,127	22,228	5.21%
Sequatchie	11,370	14,112	24.12%
Sevier	71,170	89,889	26.30%
Sullivan	153,048	156,823	2.47%
Unicoi	17,667	18,313	3.66%
Union	17,808	19,109	7.31%
Washington	107,198	122,979	14.72%

**The data are from the U.S. Census Bureau*

Table 5 – Middle Tennessee County Demographics			
County	**Population (2000)**	**Population (2010)**	**Population Change**
Bedford	37,586	45,058	19.88%
Cannon	12,826	13,801	7.60%
Cheatham	35,912	39,105	8.89%
Clay	7,976	7,861	-1.44%
Coffee	48,014	52,796	9.96%
Davidson	569,891	626,681	9.97%
DeKalb	17,423	18,723	7.46%
Dickson	43,156	49,666	15.08%
Franklin	39,270	41,052	4.54%
Giles	29,447	29,485	0.13%
Grundy	14,332	13,703	-4.39%
Hickman	22,295	24,690	10.74%
Houston	8,088	8,426	4.18%
Humphreys	17,929	18,538	3.40%
Jackson	10,984	11,638	5.95%
Lawrence	39,926	41,869	4.87%
Lewis	11,367	12,161	6.99%
Lincoln	31,340	33,361	6.45%
Macon	20,386	22,248	9.13%
Marshall	26,767	30,617	14.38%
Maury	69,498	80,956	16.49%
Montgomery	134,768	172,331	27.87%
Moore	5,740	6,362	10.84%
Overton	20,118	22,083	9.77%
Perry	7,631	7,915	3.72%
Putnam	62,315	72,321	16.06%
Robertson	54,433	66,283	21.77%
Rutherford	182,023	262,604	44.27%
Smith	17,712	19,166	8.21%
Stewart	12,370	13,324	7.71%
Sumner	130,449	160,645	23.15%
Trousdale	7,259	7,870	8.42%
Van Buren	5,508	5,548	0.73%
Warren	38,276	39,839	4.08%
Wayne	16,842	17,021	1.06%
White	23,102	25,841	11.86%
Williamson	126,638	183,182	44.65%
Wilson	88,809	113,993	28.36%

**The data are from the U.S. Census Bureau*

Table 6 – West Tennessee County Demographics			
County	**Population (2000)**	**Population (2010)**	**Population Change**
Benton	16,537	16,489	-0.29%
Carroll	29,475	28,522	-3.23%
Chester	15,540	17,131	10.24%
Crockett	14,532	14,586	0.37%
Decatur	11,731	11,757	0.22%
Dyer	37,279	38,335	2.83%
Fayette	28,806	38,413	33.35%
Gibson	48,152	49,683	3.18%
Hardeman	28,105	27,253	-3.03%
Hardin	25,578	26,026	1.75%
Haywood	19,797	18,787	-5.10%
Henderson	25,522	27,769	8.80%
Henry	31,115	32,330	3.90%
Lake	7,954	7,832	-1.53%
Lauderdale	27,101	27,815	2.63%
Madison	91,837	98,294	7.03%
McNairy	24,653	26,075	5.77%
Obion	32,450	31,807	-1.98%
Shelby	897,472	927,664	3.36%
Tipton	51,271	61,081	19.13%
Weakley	34,895	35,021	0.36%

**The data are from the U.S. Census Bureau*

2.6 – Facility & Infrastructure Inventory

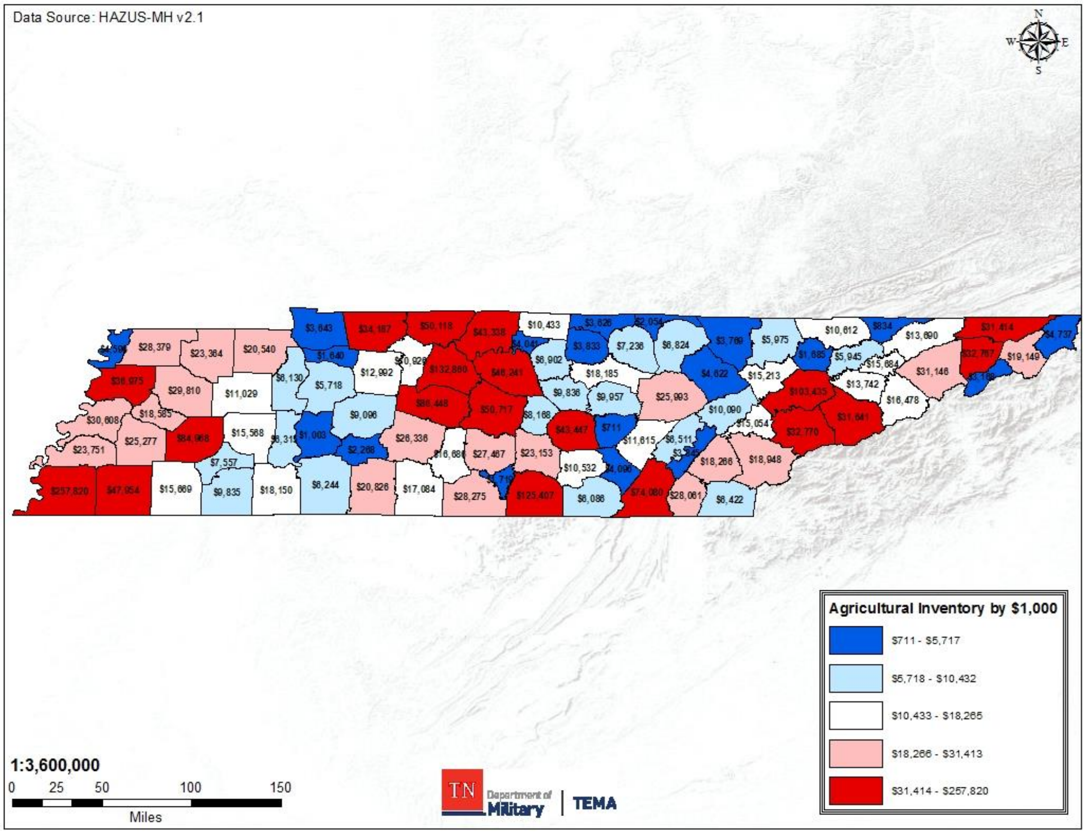
Table 7 – Structure Inventory by County, Tennessee								
County	Structure Classification							Total
	Agricultural	Commercial	Education	Government	Industrial	Religious	Residential	
Anderson	$15,213	$1,445,968	$98,780	$43,623	$478,249	$196,093	$6,354,405	$8,632,331
Bedford	$27,467	$599,114	$36,550	$29,135	$245,365	$91,287	$2,975,639	$4,004,557
Benton	$6,130	$193,756	$14,991	$9,182	$66,758	$45,490	$1,113,431	$1,449,738
Bledsoe	$11,615	$62,262	$15,320	$20,036	$26,128	$13,718	$662,886	$811,965
Blount	$32,770	$1,611,859	$95,517	$55,476	$405,548	$248,651	$10,027,006	$12,476,827
Bradley	$28,061	$1,313,047	$105,862	$26,959	$563,157	$290,014	$7,202,608	$9,529,708
Campbell	$5,975	$436,232	$29,510	$25,730	$154,915	$75,174	$2,673,469	$3,401,005
Cannon	$8,168	$148,919	$20,241	$10,664	$32,932	$23,769	$850,727	$1,095,420
Carroll	$11,029	$317,601	$46,287	$12,380	$132,192	$66,800	$1,914,561	$2,500,850
Carter	$19,149	$490,030	$76,087	$22,942	$151,738	$117,023	$3,671,297	$4,548,266
Cheatham	$10,926	$305,474	$48,569	$19,171	$241,494	$62,615	$3,232,201	$3,920,450
Chester	$7,557	$142,364	$14,056	$8,400	$47,673	$35,830	$1,083,657	$1,339,537
Claiborne	$10,612	$327,384	$33,206	$13,363	$193,315	$32,659	$1,948,583	$2,559,122
Clay	$3,626	$81,330	$8,274	$12,119	$16,272	$7,164	$582,273	$711,058
Cocke	$16,478	$407,616	$27,019	$19,940	$191,085	$71,006	$2,097,492	$2,830,636
Coffee	$23,153	$956,042	$67,630	$54,219	$381,093	$130,099	$3,878,059	$5,490,295
Crockett	$18,585	$155,380	$12,848	$8,360	$56,404	$39,146	$1,066,520	$1,357,243
Cumberland	$25,993	$702,902	$37,805	$25,621	$238,601	$94,902	$4,146,065	$5,271,889
Davidson	$132,860	$16,087,259	$1,420,113	$657,110	$3,085,880	$1,809,205	$57,318,395	$80,510,822
Decatur	$6,315	$145,393	$8,987	$6,542	$69,341	$24,799	$837,630	$1,099,007
DeKalb	$9,836	$249,936	$16,502	$8,912	$126,238	$36,359	$1,409,091	$1,856,874
Dickson	$12,992	$617,552	$41,486	$34,192	$249,596	$82,827	$3,752,116	$4,790,761
Dyer	$36,975	$808,989	$53,321	$32,375	$372,433	$106,527	$2,651,770	$4,062,390
Fayette	$47,954	$324,830	$70,674	$18,646	$311,010	$104,202	$3,411,816	$4,289,132
Fentress	$6,824	$176,509	$15,659	$4,790	$44,514	$24,653	$1,135,007	$1,407,956
Franklin	$125,407	$602,841	$61,626	$28,790	$221,475	$101,052	$3,149,826	$4,291,017
Gibson	$29,810	$755,111	$56,771	$44,457	$525,129	$162,104	$3,588,879	$5,162,261
Giles	$17,084	$425,684	$29,992	$17,226	$170,685	$68,944	$2,112,876	$2,842,491
Grainger	$5,945	$108,087	$18,850	$9,457	$117,609	$14,056	$1,279,936	$1,553,940
Greene	$31,146	$933,395	$65,272	$60,171	$575,310	$106,474	$4,448,943	$6,220,711
Grundy	$10,532	$63,306	$11,839	$7,834	$62,504	$13,800	$760,029	$929,844
Hamblen	$15,684	$975,462	$85,370	$30,518	$609,369	$115,858	$4,648,815	$6,481,076
Hamilton	$74,080	$7,902,528	$306,045	$289,273	$2,442,128	$914,246	$30,122,503	$42,050,803
Hancock	$834	$37,127	$7,324	$6,593	$8,876	$3,157	$432,349	$496,260
Hardeman	$15,669	$334,121	$28,468	$11,002	$74,702	$91,865	$1,542,042	$2,097,869
Hardin	$18,150	$375,750	$26,720	$12,436	$179,398	$55,877	$1,989,872	$2,658,203
Hawkins	$13,690	$415,551	$43,052	$33,714	$304,887	$105,659	$3,720,036	$4,636,589
Haywood	$25,277	$229,949	$20,635	$10,906	$181,932	$68,545	$1,204,179	$1,741,423
Henderson	$15,568	$348,300	$26,711	$16,838	$205,748	$70,799	$1,911,934	$2,595,898
Henry	$20,540	$493,192	$43,516	$18,182	$139,705	$92,971	$2,383,637	$3,191,743
Hickman	$9,096	$212,707	$19,683	$21,657	$78,949	$61,938	$1,696,935	$2,100,965

County	Structure Classification							Total
	Agricultural	Commercial	Education	Government	Industrial	Religious	Residential	
Houston	$1,640	$65,338	$7,882	$3,513	$24,685	$12,165	$570,162	$685,385
Humphreys	$5,718	$212,195	$22,233	$6,889	$84,062	$46,544	$1,402,890	$1,780,531
Jackson	$3,833	$72,630	$9,435	$11,242	$36,457	$14,909	$702,396	$850,902
Jefferson	$13,742	$568,945	$38,826	$28,085	$217,045	$78,092	$3,555,607	$4,500,342
Johnson	$4,737	$171,796	$11,633	$16,870	$32,303	$35,208	$1,104,295	$1,376,842
Knox	$103,435	$8,350,771	$527,178	$148,725	$1,870,943	$1,004,663	$40,580,689	$52,586,404
Lake	$4,596	$53,414	$6,472	$6,443	$9,399	$16,263	$430,166	$526,753
Lauderdale	$30,608	$269,805	$24,368	$26,001	$150,880	$70,495	$1,677,175	$2,249,332
Lawrence	$20,826	$518,589	$35,081	$35,137	$145,427	$85,275	$2,656,847	$3,497,182
Lewis	$2,268	$116,129	$11,011	$7,481	$80,901	$32,941	$781,246	$1,031,977
Lincoln	$28,275	$399,594	$25,699	$18,987	$172,359	$74,673	$2,519,577	$3,239,164
Loudon	$15,054	$627,505	$35,020	$22,179	$245,090	$181,817	$4,203,075	$5,329,740
Macon	$10,433	$222,414	$25,322	$6,010	$79,511	$23,241	$1,382,365	$1,749,296
Madison	$84,968	$1,832,090	$216,097	$56,249	$615,661	$256,540	$7,981,404	$11,043,009
Marion	$6,086	$344,345	$21,896	$14,734	$147,530	$66,742	$1,923,174	$2,524,507
Marshall	$16,686	$332,043	$20,583	$17,535	$292,994	$67,074	$2,180,162	$2,927,077
Maury	$26,336	$1,221,383	$80,788	$40,629	$281,110	$191,093	$6,568,494	$8,409,833
McMinn	$18,266	$690,433	$60,269	$19,795	$444,730	$148,391	$3,625,159	$5,007,043
McNairy	$9,835	$327,287	$20,452	$14,433	$209,962	$59,221	$1,649,334	$2,290,524
Meigs	$3,845	$68,064	$9,806	$3,414	$30,692	$11,699	$702,827	$830,347
Monroe	$18,948	$544,507	$48,590	$24,156	$215,950	$78,998	$2,781,698	$3,712,847
Montgomery	$34,187	$1,874,589	$216,884	$43,200	$419,401	$303,577	$13,803,434	$16,695,272
Moore	$1,719	$30,705	$8,129	$1,654	$16,156	$7,302	$522,778	$588,443
Morgan	$4,622	$111,817	$18,812	$22,029	$71,245	$33,584	$1,227,673	$1,489,782
Obion	$28,379	$601,532	$30,203	$26,523	$136,246	$102,342	$2,355,148	$3,280,373
Overton	$7,236	$202,055	$22,191	$14,131	$95,783	$45,847	$1,403,583	$1,790,826
Perry	$1,003	$88,335	$9,413	$2,770	$25,021	$11,219	$520,205	$657,966
Pickett	$2,054	$50,668	$6,585	$905	$26,892	$11,361	$436,273	$534,738
Polk	$6,422	$165,035	$11,274	$5,973	$41,640	$24,597	$1,145,420	$1,400,361
Putnam	$18,185	$1,157,364	$82,617	$29,774	$385,919	$147,348	$4,785,324	$6,606,531
Rhea	$6,511	$315,677	$32,887	$17,060	$143,144	$80,862	$1,933,508	$2,529,649
Roane	$10,090	$649,927	$115,992	$22,706	$124,706	$115,531	$4,405,894	$5,444,846
Robertson	$50,118	$844,425	$50,161	$21,931	$280,667	$127,195	$5,323,784	$6,698,281
Rutherford	$50,717	$3,270,944	$215,644	$84,376	$838,440	$357,525	$22,075,765	$26,893,411
Scott	$3,769	$239,703	$26,259	$12,712	$110,001	$33,426	$1,228,664	$1,654,534
Sequatchie	$4,096	$110,152	$8,055	$9,389	$34,442	$23,874	$922,961	$1,112,969
Sevier	$31,641	$1,574,531	$95,279	$47,906	$333,255	$201,848	$9,332,162	$11,616,622
Shelby	$257,820	$19,019,376	$1,531,766	$761,974	$4,166,076	$2,452,919	$83,370,294	$111,560,225
Smith	$6,902	$222,356	$14,590	$8,705	$80,138	$41,797	$1,276,598	$1,651,086
Stewart	$3,643	$118,083	$7,540	$10,555	$44,613	$25,608	$911,829	$1,121,871
Sullivan	$31,414	$2,301,741	$148,570	$66,369	$948,840	$423,857	$12,372,251	$16,293,042
Sumner	$43,338	$2,054,631	$129,999	$54,543	$881,048	$314,124	$14,788,964	$18,266,647
Tipton	$23,751	$445,953	$51,936	$29,309	$221,409	$116,649	$4,474,719	$5,363,726
Trousdale	$4,041	$92,237	$10,428	$3,714	$23,968	$13,266	$596,478	$744,132
Unicoi	$3,168	$128,821	$14,420	$4,718	$87,806	$41,487	$1,252,621	$1,533,041
Union	$1,685	$117,157	$16,118	$5,172	$65,306	$14,116	$1,049,446	$1,269,000

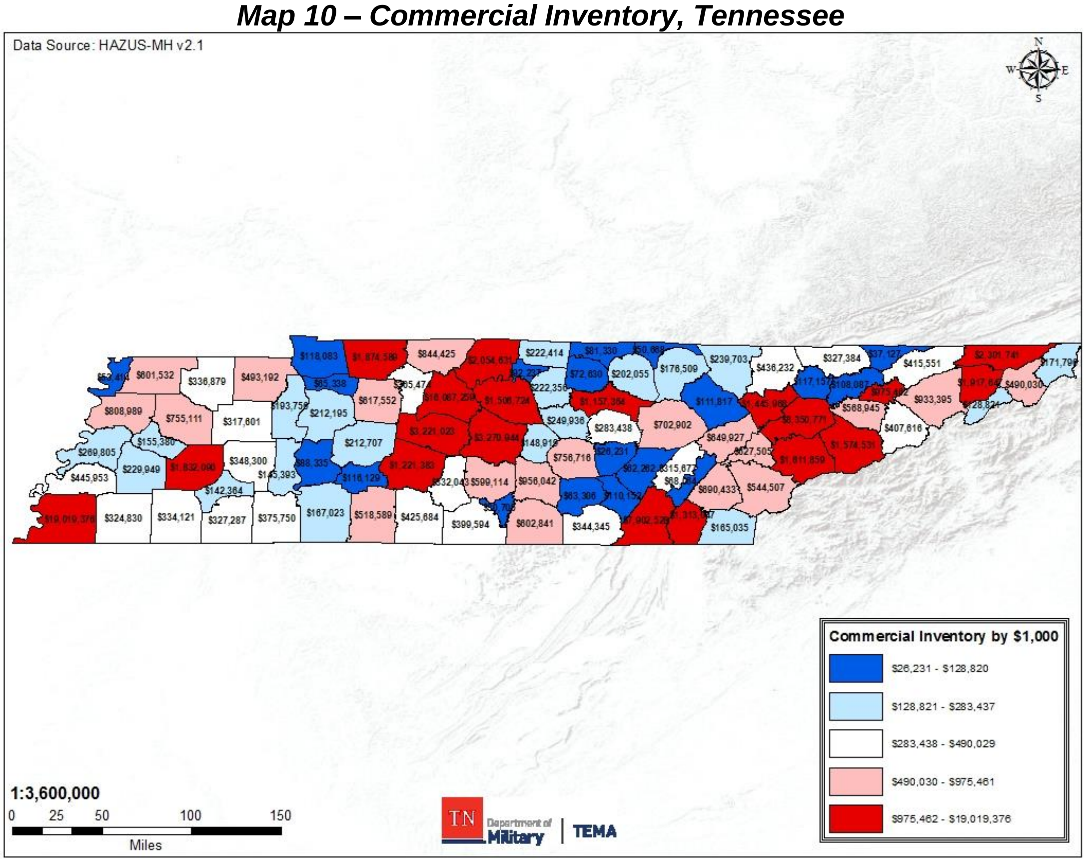
County	Structure Classification							Total
	Agricultural	Commercial	Education	Government	Industrial	Religious	Residential	
Van Buren	$711	$26,231	$6,925	$3,495	$20,895	$5,906	$330,644	$394,807
Warren	$43,447	$756,716	$34,828	$22,874	$285,609	$94,702	$2,710,052	$3,948,228
Washington	$32,767	$1,917,647	$591,381	$51,813	$561,708	$257,456	$9,751,171	$13,163,943
Wayne	$6,244	$167,023	$16,693	$14,203	$106,863	$26,712	$959,311	$1,297,049
Weakley	$23,364	$336,879	$44,716	$19,981	$179,916	$74,275	$2,307,729	$2,986,860
White	$9,957	$283,438	$27,043	$13,926	$128,583	$52,881	$1,438,804	$1,954,632
Williamson	$86,448	$3,221,023	$226,420	$79,158	$582,998	$336,036	$21,866,616	$26,398,699
Wilson	$46,241	$1,506,724	$334,373	$25,870	$519,944	$225,438	$10,638,602	$13,297,192
State of Tennessee	**$2,280,600**	**$103,333,631**	**$8,683,940**	**$3,866,866**	**$31,156,706**	**$14,578,068**	**$521,486,942**	**$685,386,753**

**The data are from FEMA's HAZUS-MH 4.0.*
***The dollar values are in thousands.*

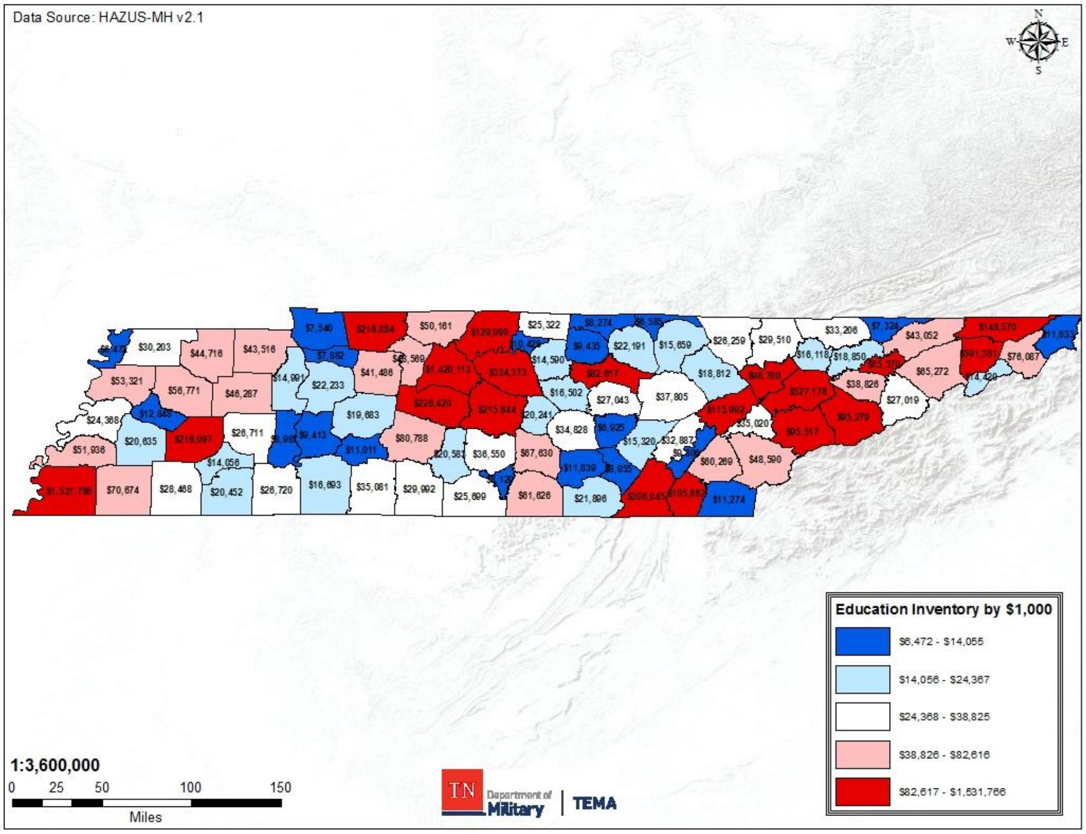
Map 9 – Agricultural Inventory, Tennessee



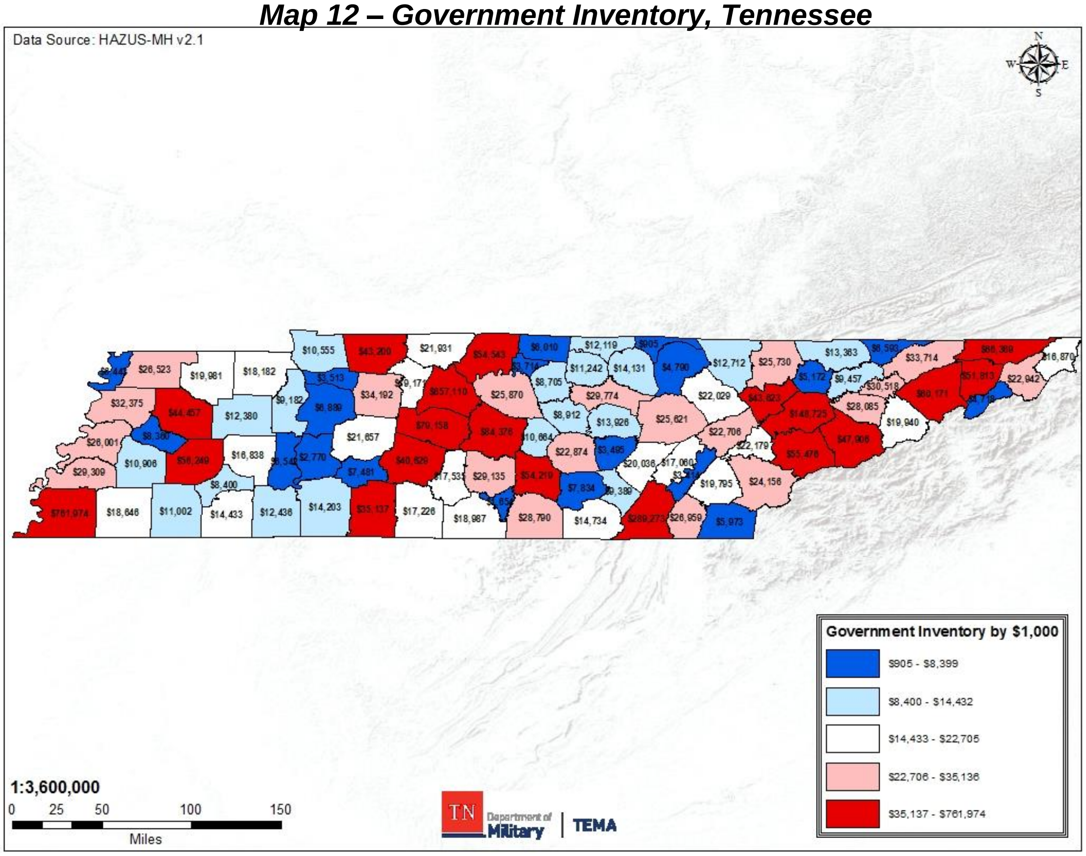
Map 10 – Commercial Inventory, Tennessee



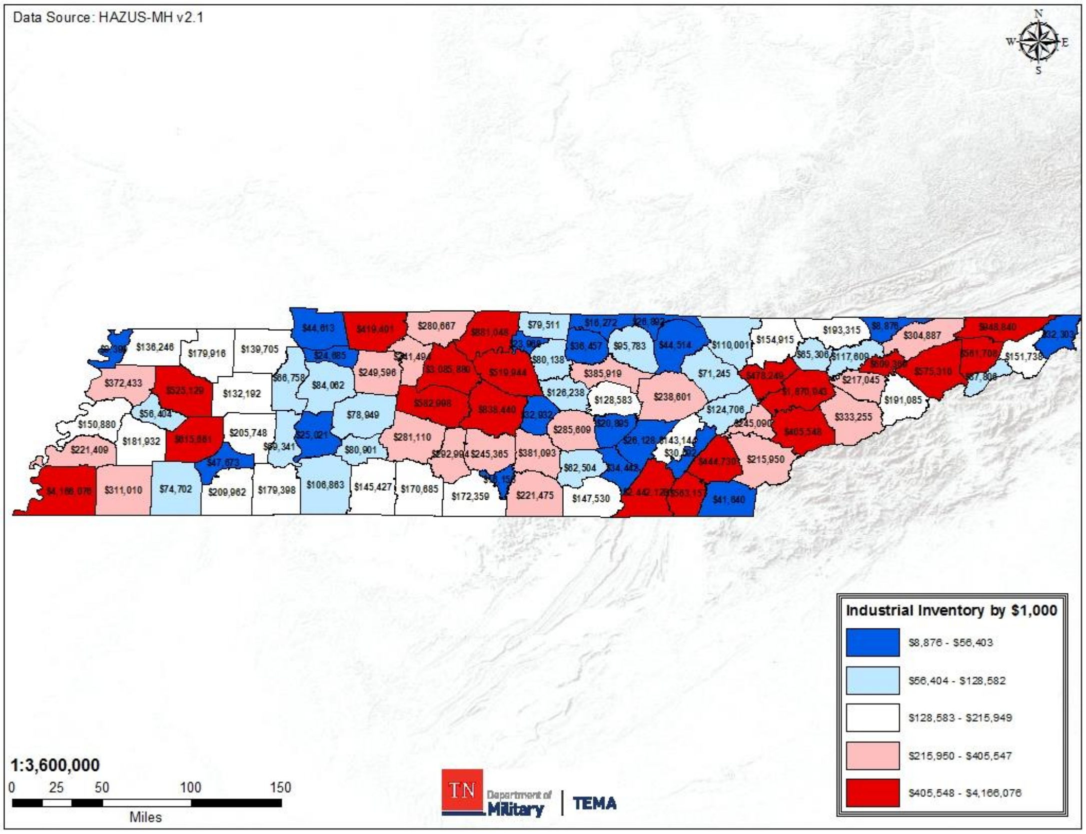
Map 11 – Education Inventory, Tennessee



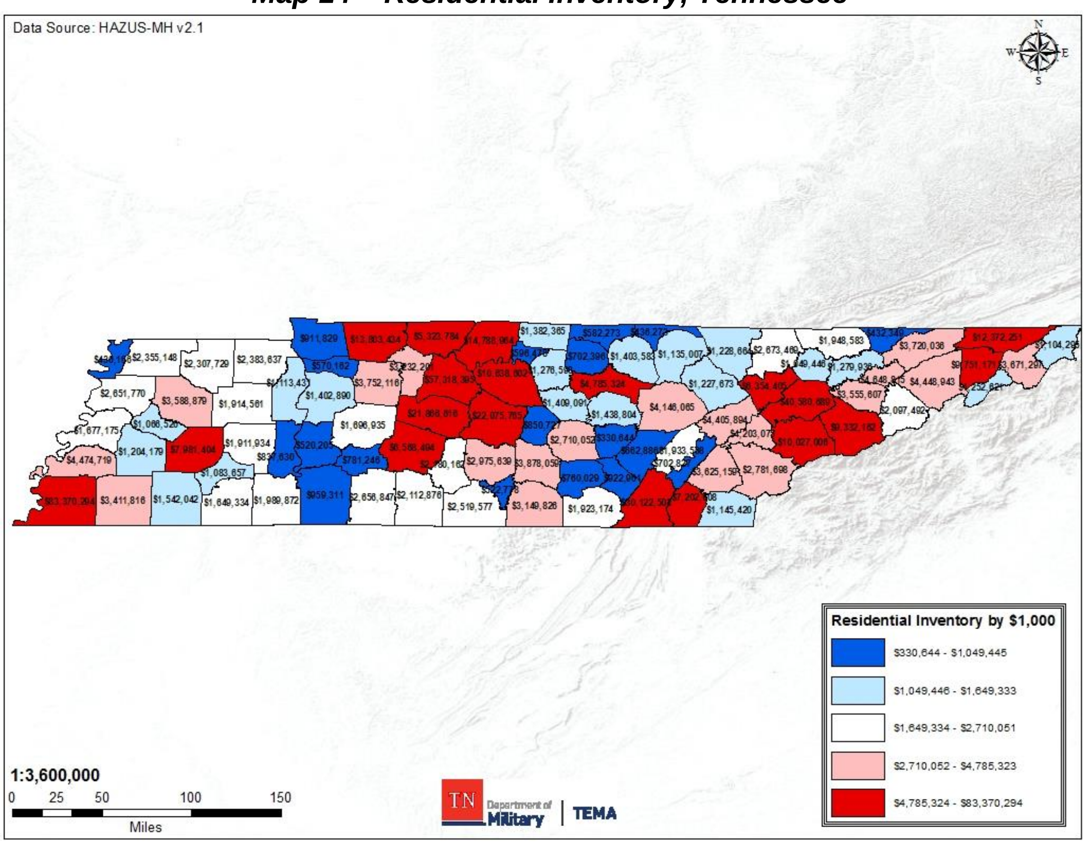
Map 12 – Government Inventory, Tennessee



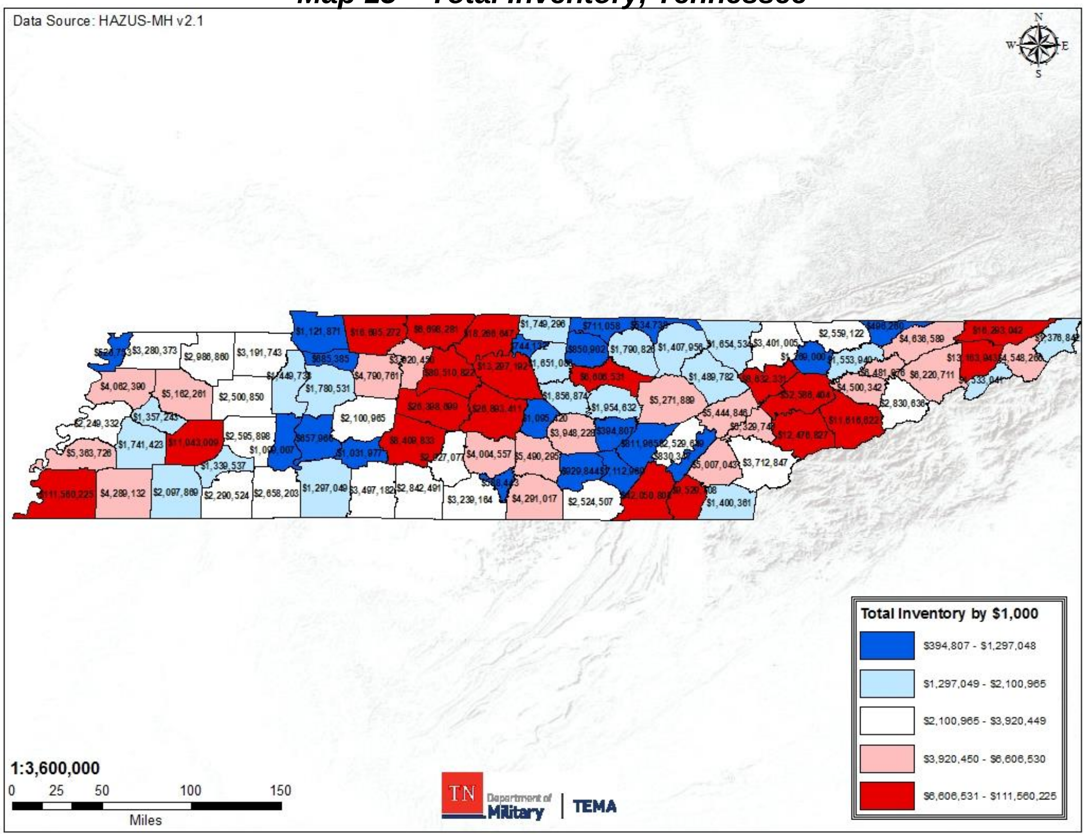
Map 13 – Industrial Inventory, Tennessee



Map 14 – Residential Inventory, Tennessee



Map 15 – Total Inventory, Tennessee



2.7 – State Capabilities

This assessment evaluates existing mitigation capabilities of state agencies and organizations. It covers pre and post disaster hazard management policies, programs, regulations, development in hazard prone areas, and funding sources. Specifically:

- Identification of agencies and statewide organizations that have mitigation programs.
- Identification of agencies and statewide organizations that have mitigation funding capabilities.
- Identification of state statutes, regulations, policies, and programs relating to mitigation.
- Identification of state restrictions on development in hazard prone areas.
- Assess strengths and gaps among the identified agencies and statewide organizations.

The HMPC determined a set number of interviews to be conducted with primary stakeholders. These primary interviews would be the focal point of assessing state capabilities and changes in state capabilities. Additional research and correspondence was conducted on more minor and less active programs and capabilities.

The following subsections list state agencies that engage in mitigation and mitigation-related activities, their points of contact, and a description of their involvement. Tables 8 and 9 at the end of this section categorically summarize each agency's capabilities.

2.7.1 – Tennessee Commission on Aging and Disability

Elderly and disabled people are often the most vulnerable in times of disaster or emergency. The Tennessee Commission on Aging and Disability offers workshops by appointment where a representative will come to a group, organization, or home and provide general and specific disaster preparedness and mitigation advice.

2.7.2 – Tennessee Department of Agriculture

Agricultural Enhancement Program (TAEP)

TAEP was established in 2005 to increase farm income by helping farmers invest in better farming practices and by encouraging diversification and innovation. Through TAEP farmers can qualify for a 35% to 50% cost share, ranging from a maximum of $1,200 to $15,000 depending on the project. The TAEP provides cost-share funds for long-term investments in livestock and farming operations.

Agricultural Resources Conservation Fund (ARCF)

The Agricultural Resources Conservation Fund was established in 1991 and is funded through a portion of the real estate transfer tax that also funds state land acquisition programs. The ARCF grants help landowners install conservation practices that prevent soil erosion and farm runoff and improve water quality. The grants also help support soil conservation districts with administrative costs, educational projects and technical assistance. Landowners can apply through county soil conservation district offices for up to 75% of the cost of implementing conservation practices. Conservation practices include projects such as streamside restoration and planting, alternative livestock watering systems, terracing and pasture management.

Animal Disease Risk Assessment, Prevention, & Control Act

The U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) provides leadership in ensuring the health and care of animals and plants. The agency improves agricultural productivity and competitiveness and contributes to the national economy and the public health. Tennessee is a full participant in the various programs from APHIS especially related to potential biological hazards that could impact its agricultural industries. Results are available for public review via hard copy and postings on the Internet.

Disaster Animal Response Team (DART)

The Tennessee Disaster Animal Response Team is a statewide program under the authority of the State Veterinarian, Tennessee Department of Agriculture. The DART program was created in the 1990's and has been expanded since both the 9/11 and Hurricane Katrina disasters, as these 2 events showed deficiencies in emergency response in regard to responding to the needs of animals. By coordinating the efforts of credentialed responders, as well as registered volunteers, DART is an integral part of animal disaster preparedness and response. Responders are volunteers from many backgrounds and include veterinarians, animal health technicians, County Extension Agents, Animal Control Officers, exotic animal specialists, livestock producers and the general public. Additionally, DART members also include local Emergency Management Agency personnel, health department, law enforcement, and fire/HAZMAT personnel. The ideal DART should include a wide variety of expertise that could provide a multi-layered response to any animal/agricultural disaster that might impact a local community.

National Animal Health Monitoring System (NAHMS)

The National Animal Health Monitoring System was initiated in 1983 for the purpose of collecting, analyzing, and disseminating data on animal health, management, and productivity across the United States. The NAHMS unit conducts national studies on the health and health management of America's domestic livestock populations. These studies are designed to meet the information needs of the industries associated with these commodities, as identified by people within those industries. Tennessee's Department of Agriculture participates in the NAHMS by supplying data on its animal health and production.

National Surveillance Unit (NSU)

The National Surveillance Unit, established by the Veterinarian Services (VS) branch of the USDA in 2003, is the first unit within VS to have personnel devoted solely to animal disease surveillance and surveillance enhancement. The NSU was established to coordinate activities related to U.S. animal health surveillance, to address the recommendations regarding surveillance in the Animal Health Safeguarding Review, and to facilitate the development of a National Animal Health Surveillance system. The NSU works under the direction of the Veterinary Services National Surveillance Coordinator and in collaboration with the National Center for Animal Health Programs, which continues to be responsible for managing and implementing program disease surveillance. The Tennessee's Department of Agriculture participates in the NSU by supplying information and data on its animal diseases, health, and production

USDA Rural Development Grant

The program is targeted toward serving rural communities, with populations less than 10,000 that have the greatest financial need. Facilities financed by Rural Utilities Services may be located in non-rural areas; however, loan and grant funds may only be used to finance that portion of the facility serving rural areas. Loan and grant funds may be used to construct, enlarge, extend, or otherwise improve rural water facilities. There appear to be few restrictions on how funds are used, with construction, land acquisition, legal fees, engineering fees, capitalized interest, equipment, initial operation and maintenance cost, and project contingencies all identified as eligible expenses.

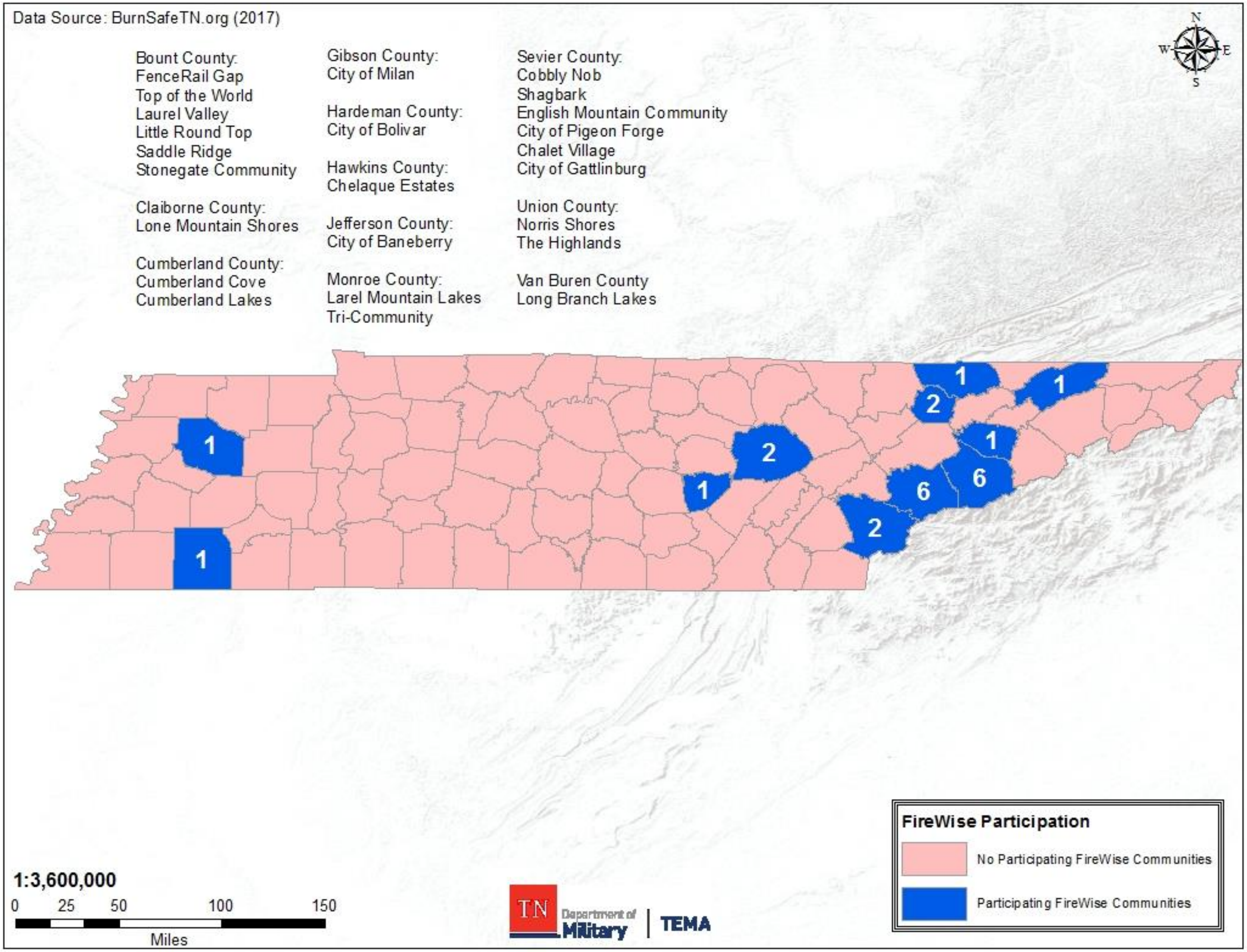
2.7.3 – Tennessee Department of Agriculture – Division of Forestry

The Tennessee Forestry Commission, established in 1985, serves in an advisory capacity on forestry policy to the Tennessee Department of Agriculture and the governor. The commission's role is to formulate and recommend programs relating to: fire protection; reforestation and seedling production; forestry assistance to private landowners; educational and informational functions that enhance understanding of the value and management of the forest resource; management of state forests; urban tree management; development of markets for Tennessee forest products; protection from insect and disease epidemics; and protection of the soil and water quality.

FireWise Communities Program

The FireWise Communities program is a multi-agency effort designed to reach beyond the fire service by involving homeowners, community leaders, planners, developers, and others in the effort to protect people, property, and natural resources from the risk of a wildland fire before a fire starts. The FireWise Communities approach emphasizes community responsibility for planning in the design of a safe community as well as effective emergency response, and individual responsibility for safer home construction and design, landscaping, and maintenance. The Tennessee Division of Forestry, in partnership with the USDA Forest Service, provides funding, training and technical assistance to rural communities and volunteer fire departments in conducting community wildfire hazard risk assessments, development of mitigation projects to reduce the risk from wildfires, and the development of Community Wildfire Protection Plans. Currently, Tennessee has 24 certified FireWise Communities. Please see Map 16 on the following page for a list of the locations of Tennessee's FireWise participants.

Map 16 – FireWise Communities, Tennessee



Forest Action Plan

The purpose of the Tennessee Forest Action Plan is to determine the status of the forest resource through an assessment— what's there, who owns it, what are its threats, and how can federal funds help to manage it. Strategies are developed to address issues raised from the assessment. The completion of the assessment and strategy enable the states eligibility to apply and compete for federal funds through an annual grant cycle.

Forest Legacy Program

The Tennessee Forest Legacy Program currently conserves 35,000 acres across Tennessee and is growing. Its mission is to protect environmentally important, working private forestlands threatened with conversion to non-forest uses. Delivered through Forest Service Cooperative Forestry, Tennessee and most other states qualify as a participant and compete nationally for 75% grant funding each year. Tennessee's State Forest Legacy Committee consists of experienced officials, professionals, and landowners, of diverse environmental and conservation interests who grade and rank proposals annually for consideration. Forest Legacy in Tennessee specifically targets and perpetuates traditional forestland values and benefits on environmentally valuable forest lands by requiring each tract to have a detailed forest management plan, known as a Forest Stewardship Plan, to address all resource elements and land management objectives.

Forest Stewardship Program

The Forest Stewardship program makes forestry assistance available to private forest landowners and increases public awareness about wise forest use and management. The program focuses on developing detailed plans for privately-owned forestland based on specific objectives of the owner. Free, on-the-ground planning assistance is provided by natural resource specialists under the leadership of the Tennessee Department of Agriculture, Forestry Division.

Depending upon landowners' objectives, stewardship plans may contain detailed recommendations for improvement of wildlife habitats and the development of recreational opportunities, as well as for timber establishment, stand improvement and harvesting. Guidelines for prevention of soil erosion, protection of water quality, and preservation of visual values are included in all stewardship plans. To qualify, landowners must: have 10 acres or more of forestland, obtain and implement a forest stewardship plan, have at least 1 secondary management objective in addition to their primary objective, protect the land from erosion and prevent pollution of streams and lakes, and carry out the plan according to standards that maintain the productivity of forest resources and protect the environment.

2.7.4 – Tennessee Department of Children's Services (DCS)

The Department of Children's Services central office and each division, regional, and field office have written emergency response preparedness plans to establish operations during emergency situations and to recover from damages/disruption in a reasonable time period. ERPPs are developed to include and provide preparation, response, and recovery efforts from emergencies and disasters. Key objectives of the emergency response preparedness plans include: provisions for safety and well-being, minimize immediate damage and losses, establish management succession, provisions for immediate response to critical tasks and functions and timely resumption of business, coordinate services and share information, and facilitate effective coordination of recovery tasks.

2.7.5 – Tennessee Department of Commerce & Insurance – Emergency Communications Board

The Emergency Communications Board is a self-funded, nine-member agency administratively attached to the Department of Commerce and Insurance, created to provide assistance to emergency communications district (ECDs) boards of directors in the areas of management, operations, and accountability, and to establish emergency communications for all citizens of Tennessee. The board is funded through a monthly emergency telephone service charge on users and subscribers of non-wire line communications services.

By statute, the board exercises financial and operational oversight over the state's 100 ECDs that administer or facilitate local E-911 call taking and/or dispatching services across the state. The Board establishes technical, operational and dispatcher training standards, and administers grants and reimbursement programs which distribute funds to ECDs. It also provides advisory technical assistance to ECDs upon request.

The board works on many fronts to facilitate the technical, financial, and operational advancement of the state's ECDs. A major focus has been to implement and maintain wireless Enhanced 911 for the state, as set forth by the Federal Communications Commission in orders and regulations it has issued on 911-related matters since 1994. Tennessee was the third state in the nation to fully deploy the equipment and technology needed to automatically locate 911 calls from properly equipped cellphones and has received national recognition for its leadership in 911 related matters.

Tennessee Department of Commerce & Insurance – Fire Prevention Division – Manufactured Housing Section

Under State of Tennessee Law, the Manufactured Housing Section is responsible for: licensing HUD labeled manufactured home manufacturers, retailers, and installers; monitoring used manufactured homes safety standards; performing manufactured home installation inspections in accordance with state law; and Investigating and taking appropriate action against violators of the Tennessee Acts referenced above.

Under its current agreement with HUD, the Manufactured Housing Section administers parts of the federal laws pertaining to manufactured housing, such as: monitoring manufacturers' home construction quality control program; investigating and monitoring consumer complaints under the Standards Act; searching for and when warranted, initiating class action cases through HUD; performing post-production monitoring of manufactured homes produced in and/or shipped to Tennessee; and investigating and taking appropriate action against violators of the federal act referenced above.

2.7.6 – Tennessee Department of Economic and Community Development

Community Development Block Grant Program (CDBG)

The primary purpose of the Community Development Block Grant program is the development of viable urban communities, by providing decent housing, suitable living environments, and expanding economic opportunities, principally for persons of low and moderate income. The CDBG program is sponsored by the U.S. Department of Housing & Urban Development. Grant dollars are available to communities with a population of fewer than 50,000 residents for the purpose of attracting new or expanding existing companies, as long as the projects align with 1 of 3 national objectives: 1. Principally benefit low and/or moderate income people, 2. Eliminate or prevent slums and/or blight, 3. Address imminent health and/or safety problems.

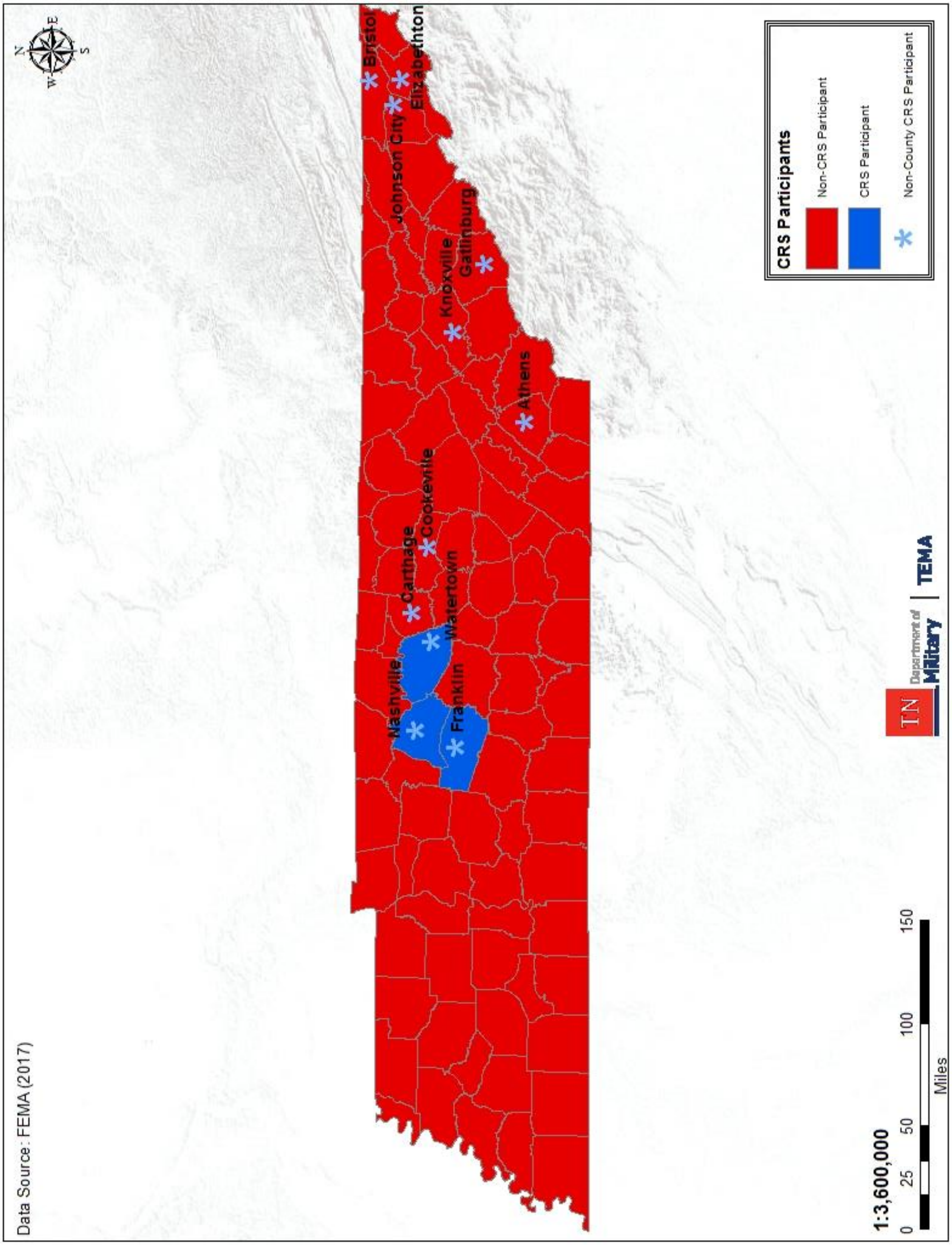
Community Rating System (CRS)

The Community Rating System, originally instituted by FEMA in 1990, allows states another tool in delineating between those communities that are making a notable effort at risk reduction and those that are not. It incentivizes those in the NFIP to meet 18 specific goals and objectives, which then qualify them for insurance rate reductions. These goals are in addition to the primary objectives of the NFIP which are insurance assessment, floodplain management, and hazard mapping. Those communities that are eligible for CRS reductions are listed below: Of those, 6 are classified as a Class 10 which qualifies them for no reduction in their insurance rates, and 5 as a Class 9 with the minimum reduction granted. These 11 counties at zero or minimal rate reduction represent 61% of eligible communities, and over 85% of square miles in designated NFIP zones.

For the 21,000 miles of waterways and CRS eligible communities that are currently identified as flood hazard zones, the Director of Special Projects is responsible for scheduling and completing Assistance Visits and meeting with local zoning regulators to assure timely assessment of structures and planning inside of hazard zones. These visits are to be scheduled on an annual basis, along with reports generated in the director's office in conjunction with the STS. Map 17 on the following page depicts Tennessee's CRS participants.

- Athens, City of
- Bristol, City of
- Carthage, City of
- Cookville, City of
- Elizabethton, City of
- Franklin, City of
- Gatlinburg, City of
- Johnson City, City of
- Knox County
- Knoxville, City of
- Nashville, City of
- Davidson County
- Watertown, City of
- Williamson County
- Wilson County

**Class 10 with no rate reduction*
*** Class 9 with the minimum rate reduction*



Map 17 – CRS Participants, Tennessee

National Flood Insurance Program (NFIP)
Created in 1968, the NFIP is a federal program that allows citizens in participating communities to purchase insurance coverage for potential property damage as a result of flooding. The NFIP in Tennessee works closely with private insurance companies to offer flood insurance to property owners and renters. In order to qualify for flood insurance, a community must join the NFIP and agree to enforce sound floodplain management standards. In return for a local community adopting and enforcing local floodplain management regulations, flood insurance is available in the community. Currently, nearly 400 Tennessee communities participate in the NFIP.

2.7.7 – Tennessee Department of Environment & Conservation

The Tennessee Department of Environment and Conservation is a diverse, dynamic department that: safeguards the health and safety of Tennessee citizens from environmental hazards; protects and improves the quality of Tennessee's land, air and water; and manages the Tennessee State Parks system.

TDEC has an extensive permitting program for air and water discharges and maintains Tennessee's compliance with all federal environmental laws, such as the Clean Air Act, the Clean Water Act, the Solid Waste Disposal Act, the Resource Conservation and Recovery Act and others. It also maintains the state's historical and archaeological resources, as well as its significant land holdings.

Archaeological Advisory Council
The Advisory Council works with the Tennessee Division of Archeology, which is responsible for the protection of archaeological sites and artifacts on all lands owned or controlled by the state, coordinates with all state agencies to ensure activities do not destroy significant sites, and reviews all federal projects to determine the impact on archaeological resources. It also provides expertise to the State Historic Preservation Office and prepares nominations to the National Register of Historic Places.

Clean Tennessee Energy Grants
Clean Tennessee Energy Program provides grants to municipal governments, county governments, utility districts and other entities created by statute in Tennessee to purchase, install, and construct energy projects that result in a reduction of emissions and pollutants and fit into one of the following eligible project categories below.

> ***Award Range:*** The funding maximum is $250,000 with a minimum project cost share of 50%.

Division of Geology
The Division of Geology promotes the prudent development and conservation of Tennessee's geological, energy and mineral resources by developing and maintaining data bases, maps, and technical services that provide accurate geologic hazard assessments and information through publications and outreach activities. The division advises other state agencies and federal and local organizations on matters relating to Tennessee geology.

Drinking Water State Revolving Fund (DWSRF)
U.S. Environmental Protection Agency awards annual capitalization grants to fund the program, and the State of Tennessee provides a twenty-percent funding match. The program provides grants at the local level for the planning, design, and construction of drinking water facilities, with priority given to projects associated with the greatest health risk, existing water problems, and community need. DWSRF provides funding to the following categories of projects: water quality problems, source or capacity, water storage, leakage problems, pressure problems, replacement or rehabilitation projects, and water

line extensions. Projects that are not eligible for DWSRF loan funding include dams, reservoirs, purchase of water rights, laboratory fees for monitoring, operation and maintenance expenses, and projects primarily intended for future growth, economic development, and fire protection.

Historical Commission
The mission of the Tennessee Historical Commission is to encourage the inclusive diverse study of Tennessee's history for the benefit of future generations; to protect, preserve, interpret, operate, maintain, and administer historic sites; to mark important locations, persons, and events in Tennessee history; to assist in worthy publication projects; to review, comment on and identify projects that will potentially impact state-owned and non-state-owned historic properties; to locate, identify, record and nominate to the National Register of Historic Places all properties that meet National Register criteria, and to implement other programs of the National Historic Preservation Act.

Multi-Purpose Pilot Grants
The EPA is piloting a new grant program that will provide a single grant to an eligible entity for both assessment and cleanup work at a specific brownfield site owned by the applicant.

> ***Award Range:*** An applicant may request up to $200,000 ($350,000 with a waiver) for assessment activities and $200,000 for direct clean-up activities at the same site.

Natural Heritage Inventory Program
The Natural Heritage Inventory Program operates under authority of the Rare Plant Protection and Conservation Act of 1985, and the Rare Plant Protection and Conservation Regulations. The program maintains a GIS database with information on the distribution and ecology of rare plants, animals, and ecological communities across Tennessee. The database currently contains over 14,000 rare species and plant community occurrence records as well as information on hundreds of conservation sites. Information gathered by program biologists, assists in directing conservation, restoration, and management activities of other programs in the division.

Office of Sustainable Practices
The Tennessee Department of Environment and Conservation operates a statewide indoor radon program as part of the Office of Sustainable Practices. The program offers a myriad of services and assistance such as: test kits for homeowners, technical information for universities, and specific materials for targeted audiences such as real estate professionals, home builders, building code officials, home inspectors, and school officials.

Safe Dams Program
The purpose of the Safe Dams Program is to provide for the comprehensive regulation and supervision of dams for the protection of the health, safety, and welfare of the citizens of Tennessee, and to assure proper planning, design, construction, maintenance, monitoring, and supervision of dams. The Safe Dams Program is responsible for conducting inspections, plan reviews, and permitting of dam and reservoir projects as required in the Safe Dams Act of 1973. The purpose of the program is to protect the public from dam failures. All non-federal dam owners are required to have a certificate of approval from the Commissioner to construct, alter, remove, or operate a dam.

State Revolving Fund Loan Program
The Tennessee Clean Water and Drinking Water Revolving Fund Loan Programs provide low-interest loans to cities, counties, utility districts, and water/wastewater authorities for the planning, design, and construction of wastewater and drinking water facilities. The U.S. Environmental Protection Agency

awards annual capitalization grants to fund the program, and the State of Tennessee provides a twenty-percent funding match.

Targeted Brownfield Assessment Grants (TBA)
The TBA program is designed to help states, tribes, and municipalities especially those without EPA Brownfields Assessment Pilots/Grants minimize the uncertainties of contamination often associated with brownfields. No projected grant cycles at this time.

Training, Research & Technical Assistance Grants
Training, Research, and Technical Assistance Grants provide funding to eligible organizations to provide training, research, and technical assistance to facilitate brownfield revitalization. No projected grant cycles at this time.

Waste Tire Cleanup Grants
The waste tire cleanup grant is designed to assist local governments in the cleanup of un-permitted waste tire sites. Eligibility for this grant is determined by priority as established by the 8 Environmental Field Offices. Each grant cycle, 2 sites from each field office are invited to compete for funds to assist in the cleanup of these un-permitted waste tire sites. Lien on property is required equal to cleanup costs.

Watershed and Protection Strategy (WRAPS)
WRAPS offers a framework that engages citizens and other stakeholders in a teamwork environment aimed at protecting and restoring Tennessee watersheds. The WRAPS framework consists of identifying watershed restoration and protection needs, establishing watershed goals, creating plans to achieve established goals, and implementing plans. Each watershed served by a WRAPS team completing the program framework is eligible for WRAPS grant funding. The WRAPS funds are administered by the Tennessee Department of Health and Environment in collaboration with an interagency work group that consists of representatives from a number of state and federal agencies.

2.7.8 – Tennessee Department of Finance & Administration – Office of Information Resources & Geographic Information Services

In conjunction with the Tennessee Emergency Communications Board, STS GIS Services helps to create, maintain, and sustain a statewide GIS dataset to support implementation of Next Generation 911 (NG911). Using the core GIS data developed through the initial production efforts of the Tennessee Base Mapping Program, local authoritative GIS data, and enhancements that were made through a contract with TeleAtlas, the Tennessee Information for Public Safety GIS dataset is being implemented throughout all 100 emergency communication districts. Having a statewide standardized GIS dataset for street centerlines, address points, and ESN boundaries is essential for NG911 implementation.

LiDAR Business Plan
As part of the National States Geographic Information Council's (NSGIC) "50 States Initiative," STS GIS Services has been awarded a grant by the Federal Geographic Data Committee (FGDC). The intent of this project is to develop a business plan in support of developing an enhanced elevation dataset for the State of Tennessee. The project will involve soliciting input through contractor led regional meetings throughout the state. The final product will be a written business plan that identifies the requirements, costs, and products necessary for building a statewide high resolution elevation dataset. STS GIS Services will use the information provided in the business plan to educate the Information Systems Council on the significance and benefits of this data with the intent to obtain funding to support the data acquisition efforts.

TNMap Portal

Through the TNMap portal, STS GIS Services is hosting a variety of geospatial content that can be consumed through ArcGIS, mobile devices, and custom web GIS applications by all Tennessee state agencies and groups.

2.7.9 – Tennessee Department of Health

Bioterrorism Preparedness and Response

The CDC has assumed responsibility for the national effort for preparedness related to biological hazards, and has funded the State of Tennessee's Bioterrorism Preparedness Program with federal grant funding. This preparedness effort is focused on potential terrorism agents such as anthrax and small pox, but these efforts are also mitigating the potential effects of naturally occurring diseases such as West Nile Virus, Influenza, and the Avian Flu. This program supports the development and funding of regional plans to purchase training, equipment, and supplies that enhance preparedness to respond to disease outbreaks involving 500 or more citizens.

Countermeasures Response Network (TNCRN)

The TNCRN is collaboration among the Emergency Preparedness Program, emergency managers, emergency responders, health care providers, pharmacies, and private entities. This web-based system assists the health community in making fast, well-informed decisions during public health emergencies. Before, during, and after an emergency, TNCRN allows emergency managers and planners to manage patient flow, medication allocation and dispensing, and other resources.

Disaster Support Network (TDSN)

The Tennessee Disaster Support Network is a web-based resource to assist Tennessee communities in meeting their needs before, during, and after a disaster. While the Tennessee Department of Health is working to ensure that all Tennessee citizens are prepared to respond to a wide range of emergencies, there is evidence that individuals with special needs may be disproportionately affected by a disaster. To close this gap, the TDSN was designed to specifically reach out to populations that have unique needs, as well as the agencies that serve them.

Division of Communicable and Environmental Diseases and Emergency Preparedness (CEDEP)

The Division of Communicable and Environmental Diseases and Emergency Preparedness works to discover and eliminate the threat of communicable diseases and to educate people how to protect themselves from illnesses. They also conduct surveillance activities in order to monitor new emerging infections or identify clusters of cases that could be related. Investigations are conducted to pinpoint the source of disease to prevent dangerous outbreaks.

The division is also responsible for developing plans for the Tennessee Department of Health to protect the health of residents and visitors from the effects of man-made and naturally occurring events. The EP program coordinates with federal, state, and regional partner agencies such as the CDC, the Tennessee Emergency Management Agency and local health departments to identify resource and planning needs.

Emergency Medical Awareness, Response and Resources (TEMARR)

These systems ensure secure electronic data exchange among public health partners' computer systems. These systems include the Tennessee Health Alert Network, the Healthcare Resource Tracking System, the Tennessee Volunteer Mobilizer, and the Tennessee Countermeasure Response Network. 8 Regional Medical Communication Centers serve as a statewide medical communication system.

Emergency Medical Services, Disaster Planning and Operations

The EMS Division has an important role in state government disaster planning and operations. The division's responsibilities are delineated in the Tennessee Emergency Management Plan, which is developed by the Tennessee Emergency Management Agency.

EMS Division responsibilities include:

- Developing casualty reports. When deaths or injuries occur in a disaster, TEMA tasks EMS with the responsibility of verifying deaths and injuries, determining where patients were transported and by what means. Official state casualty reports are produced by EMS Division staff.
- Health care facility damage assessment and assistance. EMS staff provides initial damage assessment and help to any health care facility damaged or disabled in a disaster. This includes reporting to TEMA and the Division of Health Care Facilities.
- Assistance to county EMS agencies. When a mass casualty incident occurs, regional EMS staff can assist local ambulance services manage the consequences. This includes contacting other services for help, identifying staging areas for responding ambulances and distributing patients to hospitals within the region. The emergency evacuation of health care facilities is part of this responsibility.
- Participation in disaster meetings, planning development workshops, training sessions and exercises. The division regularly participates in TEMA coordinated planning sessions and exercises, which include TVA nuclear plants, the Oak Ridge/Dept. of Energy facilities and earthquake exercises.
- To ensure that these emergency management responsibilities can be carried out rapidly, EMS Division management and all regional staff are on call 24 hours a day, 7 days a week.

Emerging Infections Program (EIP)

The Emerging Infections Program is a population-based network including the Centers for Disease Control and Prevention and state health departments, working with collaborators (academic centers, local health departments, infection control practitioners, and other federal agencies) to assess the public health impact of emerging infections and to evaluate methods for their prevention and control. Currently, the EIP Network consists of 10 sites: California, Colorado, Connecticut, Georgia, Maryland, Minnesota, New Mexico, New York, Oregon, and Tennessee.

The EIP is a collaborative effort of the Communicable and Environmental Disease Services section of the Tennessee Department of Health, the Vanderbilt University School of Medicine Department of Preventive Medicine, and the Centers for Disease Control and Prevention. The core activity of the EIP is active surveillance of laboratory-confirmed cases of reportable pathogens. Laboratory directors and staff, physicians, nurses, infection control practitioners, and medical records personnel are key participants in EIP. Components of the EIP in Tennessee investigate foodborne infections, invasive bacterial infections, and human papillomavirus.

Emergency Preparedness Program, Strategic National Stockpile

In 1999 Congress charged the Department of Health and Human Services and the Centers for Disease Control and Prevention (CDC) with the establishment of the National Pharmaceutical Stockpile. The mission was to provide a re-supply of large quantities of essential medical material to states and communities during an emergency within 12 hours of the federal decision to deploy. The Emergency Preparedness program distributes medicine and medical supplies in the event of a disaster. These items often come from the Strategic National Stockpile, a supply of emergency items. The SNS supplies antibiotics, vaccines, antitoxins, chemical antidotes and medical/surgical items. SNS materials are designed to supplement and re-supply state and local public health resources, as well as other health care agencies in the event of a national emergency. The Tennessee program continues to receive high ratings from the CDC for its level of preparedness to receive the stockpile during an act of bioterrorism or a mass casualty event.

Health Alert Network (TNHAN)

The TNHAN is a secure, web based site, consisting of 2 redundant systems, co-located at 2 different sites. The system is administrated and utilized both statewide and locally in the 13 public health regions. There are currently 3,000 professionals from police, fire, hospital, public health, and other emergency response agencies, that are maintained in specific roles, within the TNHAN system. These responders can be alerted through multiple media methods in the event of an emergency and their response can be tracked. The system is also used as a document repository for the purpose of storing information pertaining to specific events.

Healthcare Resource Tracking System (HRTS)

HRTS is a secure website used by Tennessee healthcare facilities and emergency managers to direct ill or injured patients to appropriate healthcare facilities in the event of an emergency or disaster. HRTS allows healthcare facilities to record and continually update their current availability of beds, specialty services, and resources providing statewide awareness for emergency managers.

Hospital Preparedness

The Tennessee Hospital Association serves as an advocate for hospitals, health systems, and other healthcare organizations and the patients they serve. It also provides education and information for its members, and informs the public about hospitals and healthcare issues at the state and national levels. This association is now involved in a variety of disaster preparedness initiatives especially relating to biological hazards but also related to delivering mass care during large scale natural events.

Medical Reserve Corps (MRC)

This MRC program is established in each of the state's 4 major metropolitan areas. The MRC is designed as a volunteer pool of active and retired health care professionals (physicians, pharmacists, veterinarians, and others) ready to support and augment workforce capabilities during large-scale local emergencies. The Medical Reserve Corps program also works to promote community public health. The MRC serves as the department's volunteer organization. Regional MRC units recruit and train medical and general volunteers to support the Tennessee Department of Health, hospitals, and medical care providers in a public health emergency.

Volunteer Mobilizer (TNVM)

The TNVM provides the Emergency Preparedness program the capability to alert volunteers and public health staff via automated e-mail, phone, pager, or text message notification. Registered users can edit profile information, upload and maintain training records, access shared calendars, and view posted messages. The system allows for simplified registration for health professionals through an automated process linked to state and national licensure agencies. By registering with the site, individuals can be part of an alert system and respond, when activated, to a significant disaster or public health emergency. The site generally serves to improve volunteer coordination during an emergency.

Tennessee Department of Human Services – Technology Access Program

The Tennessee Technology Access Program (TTAP) is a statewide program designed to increase access to, and acquisition of, assistive technology devices and services. Through its 4 core programs: Funding Assistance, Device Demonstration, Device Loan, and Device Reutilization, TTAP and a network of 5 assistive technology centers help people with disabilities and their families find and get the tools that they need to live independent, productive lives where and how they choose. Each of TTAP's core programs is designed to both maximize limited resources and improve the understanding of, and to gain better access to, assistive technology devices and services. TTAP provides funding to 5 regional assistive technology centers across Tennessee. The centers provide training, evaluation, minority outreach and advocacy services. The staff at each of the centers works closely with businesses, school systems, vocational rehabilitation and the medical community to increase the independence and productivity of persons with disabilities through the use of assistive technology devices and services.

2.7.10 – Tennessee Department of Transportation (TDOT)

Maintenance Division – Office of Emergency Operations

TDOT's Office of Emergency Operations is responsible for TDOT's emergency preparedness program (Including planning, training, and exercises) and for coordinating TDOT's statewide emergency response activities. TDOT's Office of Emergency Operations is equipped with a primary ESC and alternate ESC's. The departmental ESC's coordinate responses to incidents which may include earthquakes, floods, tornados, nuclear reactor emergencies, hazardous material spills, and any other situations that the Tennessee Emergency Management Association may request assistance from TDOT to provide traffic control, manpower, or equipment. TDOT's primary ESC is embedded at the TEMA complex. The ESC's primary duty is to coordinate field personnel during emergencies that require the department's resources.

Environmental Division, Natural Resources Office - Wetland Mitigation and Wetland Banking Program

The Tennessee Department of Transportation replaces unavoidable wetland impacts through a process referred to as compensatory mitigation, whereby wetlands that are impacted through permitted activities are replaced by restoration or enhancement of a wetland site. Compensatory mitigation typically occurs in advance of or concurrent with the impact and may be comprised of on-site mitigation, off-site mitigation or a combination of the two. On-site mitigation attempts to replace the wetlands functional capacity lost as a result of the highway project on the same site or in the immediate vicinity of the impacts; however, on-site mitigation is not always possible due to lack of suitable restoration sites. If mitigation cannot be accomplished on-site, the impact may be mitigated off-site at a mitigation site or a formal mitigation bank, pending approval by the regulatory agencies and/or Mitigation Banking Review Team. The mitigation sites and mitigation banks are typically larger former wetland sites that have been restored with the purpose of being used to offset wetland losses from multiple projects. Currently, TDOT uses 7 mitigation sites/banks, which are located throughout the state.

Federal Transportation Enhancement Program for Tennessee Roadways

These funds are used for a variety of safety, functional mitigation, hazard reduction and aesthetic enhancement to local, state and federal roadways. A 20% non-federal share of the proposed project must now be provided by the local agency as a hard cash match. The option of providing these funds as a soft (in-kind) match through the use of the value of preliminary engineering services, donated land, or materials and equipment is no longer available.

2.7.11 – Tennessee Emergency Management Agency (TEMA)

The Tennessee Code Annotated (TCA 58-2-104) established the Tennessee Emergency Management Agency and its authority to develop, plan, analyze, conduct, provide, implement, and maintain programs for disaster mitigation, preparedness, response, and recovery. Furthermore, the Tennessee Code Annotated restates the TEMA mandate to prepare the State of Tennessee to deal with disasters, preserve the lives and property of the people of the state, and protect the public peace, health, and safety in the event of a disaster.

The Tennessee Emergency Management Agency

Through state law, the Tennessee Code Annotated (TCA 58-2-104) established the Tennessee Emergency Management Agency and its authority to develop, plan, analyze, conduct, provide, implement, and maintain programs for disaster mitigation, preparedness, response, and recovery. Furthermore, the Tennessee Code Annotated restates the TEMA mandate to prepare the State of Tennessee to deal with disasters, preserve the lives and property of the people of the state, and protect the public peace, health, and safety in the event of a disaster.

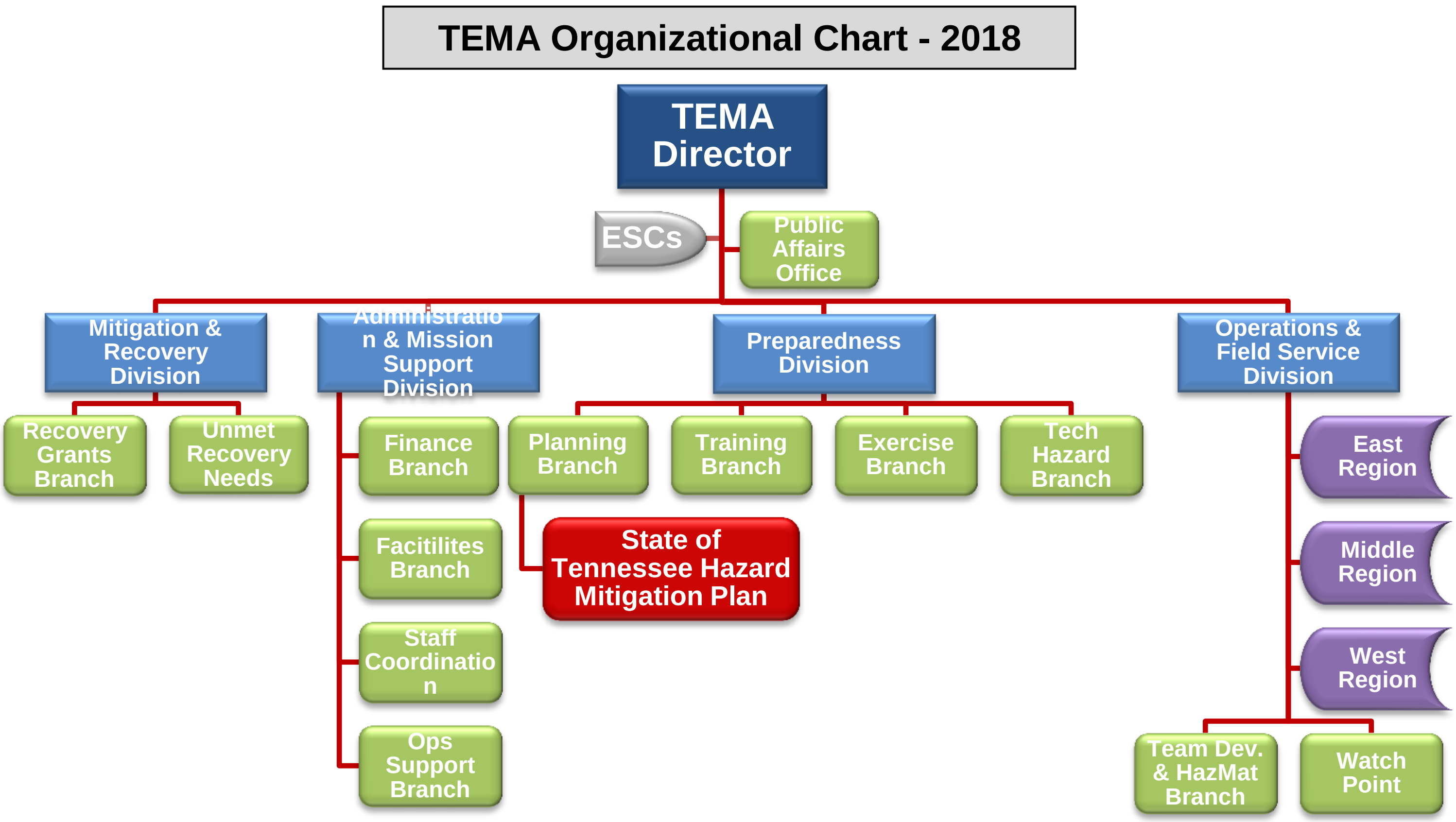
> ***Tennessee Code Annotated (TCA) Title 58, Chapter 2, Section 104 – Creation of Agency***
> *The governor is hereby authorized and directed to create a state agency to be known as the "Tennessee emergency management agency" (TEMA) under the adjutant general for day-to-day administrative purposes and, upon the recommendation of the adjutant general, to appoint a director of the TEMA, who shall be the administrator thereof. The director shall hold office at the pleasure of the governor, and shall receive such salary as is fixed by the adjutant general and approved by the governor. The agency shall authorize the creation of local organizations for emergency management in the political subdivisions of the state, and authorize cooperation with the federal government and the governments of other states.* [Acts 2000, ch. 946, § 1.]

Tennessee was 1 of 29 states accredited nationally in 2013 by the Emergency Management Accreditation Program (EMAP) of the National Emergency Managers Association. There are 63 standards for states to meet the accreditation and no single standard can be failed to achieve accreditation. An EMAP Assessor team will return to Tennessee in 2019 for an external reaccreditation assessment.

Objectives

Hazard mitigation objectives help guide the direction of future activities and projects toward reducing risk and preventing losses from disaster events. Additionally, the objectives facilitate cooperation between TEMA and its partner state agencies by creating a clear, succinct, and uniform mission. The State of Tennessee Hazard Mitigation Plan has been developed in alignment with TEMA's mitigation objectives listed below:

- I.) Protect life and prevent injury resulting from all hazards.
- II.) Prevent public and private property damage from all hazards.
- III.) Reduce the long term risk from all hazard events using whole community cooperation.
- IV.) Increase the disaster resiliency of local, state, and regional communities.
- V.) Reduce the disruption caused by disasters to critical infrastructure and essential services.
- VI.) Minimize the disruption caused by disasters to local and state economies.
- VII.) Continue to improve TEMA's mitigation program and its effectiveness.



TEMA Resources and Grant Programs

While the State of Tennessee does not have a separate stream of State funding dedicated solely to the advancement of hazard mitigation actions, the State of Tennessee has provided State funding to cover half of the non-federal matching requirement for every mitigation grant under the Hazard Mitigation Grant Program (HMGP), Flood Mitigation Assistance (FMA) program, and the Pre-Disaster Mitigation (PDM) program since 2010. This divides the cost of implementing a mitigation grant project in Tennessee to the following percentages: up to 75% of grant costs are covered by federal funds, up to 12.5% of grant costs are covered by state funds, and up to 12.5% of grant costs are covered by applicant funds, unless covered by a higher federal percentage. This initiative of covering half of the grant's non-federal matching requirement has allowed communities across Tennessee to implement successful mitigation projects that wouldn't be possible without the State's funding assistance.

Emergency Management Performance Grant (EMPG)

The EMPG is designed to sustain and improve state and local emergency management programs from all-hazard events through mitigation, preparedness, response, and recovery activities. In Tennessee, a large amount of this funding helps pay for state and local emergency management staff salaries.

Award Range: Varies; the amount awarded to each county is based on population and other factors. This grant requires a 50%, non-federal match.

Flood Mitigation Assistance Program (FMA)

FMA was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the NFIP. It provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. Annual program funding of $20 million, nationally, is provided through the National Flood Insurance Fund. Please see Appendix C for more information on the FMA program in Tennessee.

The State of Tennessee has invested approximately $3,000,000 in federal funds on FMA projects with approximately $2,930,000 invested on projects such as acquisitions and demolitions and approximately $60,000 on planning.

Award Range: NFIRA limits the amount of project funding under FMA any 1 state or community can receive in a 5 year period. The combined total of the grants for projects and technical assistance awarded to any state is $20 million. This grant has a match ratio of 75% federal share and 25% local share.

Hazard Mitigation Grant Program (HMGP)

HMPG was created in November 1988 by Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288 as amended by Public Law 100-707, Public Law 103-181, the Hazard Mitigation and Relocation Assistance Act (1993), and Public Law 106-390, and Disaster Mitigation Act of 2000. The purpose of the program is to reduce the (long-term) loss of life and property due to natural disasters and enable mitigation measures to be implemented during the immediate recovery from a disaster declaration. (See 44 CFR Part 206 Subpart N for guidance and implementation). Please see Appendix 8 for more information on the HMGP program in Tennessee.

The State of Tennessee has invested approximately $87,300,000 in federal funds on HMGP projects with approximately $85,800,000 in federal funds invested in regular projects such as acquisitions/demolitions, safe rooms, flood control, and bridge elevation/replacement. Initiative projects such as statewide warning systems and education and awareness initiatives came in at approximately $1,800,000 and planning investments of approximately $1,300,000.

Award Range: HMGP funding is allocated on a sliding scale with 15% of the first $2 billion of estimated aggregated amount of disaster assistance in a presidentially declared disaster. This grant has a match ratio of 75% federal share and 25% local share.

Hazardous Materials Emergency Preparedness Grant (HMEP)

The HMEP grant program provides financial and technical assistance to first responders in state and local governments as well as national direction and guidance toward hazardous materials emergency planning and training. TEMA uses this funding to train state & local government first responders for hazardous material incidents and to provide planning assistance to local emergency planning committees (LEPC). The requirements for the use of funds are contained in the federal guidance that is provided each year for that fiscal year's program. Also additional eligibility is determined by the regional director for TEMA for each participating county.

Award Range: Approximately $550,000 annually

National Earthquake Hazards Reduction Program (NEHRP)
The NEHRP was established by the U.S. Congress when it passed the Earthquake Hazards Reduction Act of 1977, Public Law (PL) 95–124. At the time of its creation, Congress' stated purpose for NEHRP was "to reduce the risks of life and property from future earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards reduction program." In establishing NEHRP, Congress recognized that earthquake-related losses could be reduced through improved design and construction methods and practices, land use controls and redevelopment, prediction techniques and early-warning systems, coordinated emergency preparedness plans, and public education and involvement programs.

Pre-Disaster Mitigation Grant Program (PDM)
PDM was established through the Disaster Mitigation Act of 2000, Public Law 106-390. It provides technical and financial assistance to states and local governments for cost-effective pre-disaster hazard mitigation activities that complement a comprehensive mitigation program, and reduce injuries, loss of life, and damage and destruction of property. The program focuses primarily on mitigation planning and projects and will follow many of the guidelines of the Hazard Mitigation Grant Program. Please see Appendix 8 for more information on the PDM program in Tennessee.

The State of Tennessee has invested approximately $6,000,000 in federal funds on PDM projects with approximately $3,800,00 invested on projects such as acquisitions, demolitions and seismic retrofits and approximately $2,000,000 on planning.

Award Range: PDM Grants are awarded on a competitive basis and are allocated year to year by Congress with any 1 project not to exceed $3,000,000 federal share. This grant has a match ratio of 75% federal share and 25% local share. This grant program is available to state and local governments, and Native American tribes.

Public Assistance Program
Public Assistance (PA) is FEMA’s largest grant program providing funds to assist communities responding to and recovering from major disasters or emergencies declared by the President. The program provides emergency assistance to save lives and protect property, and assists with permanently restoring community infrastructure affected by a federally declared incident.

Project Categories
TEMA processes PA grant funding according to the type of work the applicant undertakes. Eligible work must be required as a result of the declared incident, be located in the designated area, be the legal responsibility of the applicant, and be undertaken at a reasonable cost.

Eligible work is classified into the following categories:

Emergency Work
Category A: Debris removal
Category B: Emergency protective measures

Permanent Work
Category C: Roads and bridges
Category D: Water control facilities
Category E: Public buildings and contents

Category F: Public utilities
Category G: Parks, recreational, and other facilities

Federal funding guidelines for each of these categories are listed in the *Public Assistance Program and Policy Guide*, which is located online at https://www.fema.gov/media-library/assets/documents/111781.

Application Process

After a federal declaration, the recipient (i.e. state, tribe, or territory) conducts Applicant Briefings to inform potential applicants (i.e. state, local, tribal, territorial, and PNP officials) of the assistance available and how to apply. Applicants must then file a Request for Public Assistance within 30 days of the date their respective area is designated by the federal declaration.

Following the approved request, FEMA and the applicants will conduct additional meetings to discuss disaster damage and project formulation. Applicants must identify and report damages to FEMA within the 60-day regulatory timeframe. FEMA, the recipient, or the applicant will then prepare project worksheets for eligible work and eligible facilities based on actual or estimated project costs.

Grant Administration

The federal share of assistance will not be less than 75 percent of the eligible cost for emergency measures and permanent restoration. The recipient determines how the non-federal share of 25 percent will be dispersed to its applicants.

Recipients are responsible for managing the funds obligated to them by FEMA, including disbursement to applicants. FEMA will continue to monitor the recovery progress to ensure the timely delivery of eligible assistance, and compliance with federal laws and regulations.

Tennessee-specific Requirements for Public Assistance

The state uses every opportunity to promote and assist applicants to embrace available funding for mitigation actions. It is very thoroughly covered during the post-disaster applicant briefings with information regarding both 406 and 404 mitigation. Later in the project development and review phases, if any damages eligible for permanent work (categories C-G) have an element that would benefit from and qualify for 406 mitigation funds, it is discussed with the applicant during the grantee review process prior to project approval. This is in addition to the consideration of mitigation FEMA covers with applicants in the field. This ensures every applicant considers any applicable hazard mitigation opportunities related to their project(s) as part of the state's commitment to reduce risks in communities and encourage long-term resiliency in disaster repair, which can often be difficult post-disaster.

Southern States Energy Board

This contract centers around radiological transportation. Funding pays for staffing and equipment focused around radiological monitoring devices and material escorting. Planning and exercise services are also funded by this contract.

State Homeland Security Grant Program

This grant is specifically designed to address the homeland security and response capabilities in Tennessee by providing specific equipment and training to first responders and state agencies based on the needs, vulnerabilities and population of each county, along with other program priorities and authorizations. Eligibility includes all counties participating in the needs assessment. The deadlines are based on each grant timeframe. Counties receiving funding must participate within the strict guidelines of the grant program, including providing mutual aid to surrounding counties, completing a terrorism annex to their Emergency Operations Plan (EOP) and holding an annual terrorism exercise. Equipment purchased through the grant will be tracked by the local jurisdiction and reported to TEMA for 3 years after the close of the grant. The HSGP is a disaster preparedness grant program. The State of Tennessee is divided into 11 state homeland districts.

Award Range: Based upon assessment of needs, vulnerabilities and population of each county, along with other program priorities/ authorizations.

Tennessee Valley Authority Contract

The contract is used for offsite monitoring and planning for jurisdictions and personnel around TVA locations. This contract facilitates local and state personnel to facilitate training and exercise programs for stakeholders located around TVA facilities including Watts Bar, Watts Bar and Browns Ferry Nuclear Plants in accordance with federal statutory and regulatory requirements, and Nuclear Regulatory Commission and Federal Emergency Management Agency guidance.

2.7.12 – Tennessee Housing & Development Agency

Emergency Repair Program

The Tennessee Housing Development Agency has created a statewide Emergency Repair fund for the elderly. The program provides grants to low income, elderly homeowners who are 60 years or older to correct, repair, or replace an essential system and/or a critical structural problem. The purpose of the program is to stabilize the elderly homeowner's residence by making rapid, essential repairs to make the home livable. The Emergency Repair Program is administered through Tennessee's 9 development districts to help ensure that the program is available state-wide.

Housing Locator Assistance for Displaced Individuals

TNHousingSearch.org is a housing locator service, launched across the State of Tennessee in April 2008. Sponsored by the Tennessee Housing Development Agency, TNHousingSearch.org provides detailed information about rental properties and helps people find housing to best fit their needs. The service can be accessed at no cost online 24 hours a day or through a toll-free, bilingual call center. To help displaced residents find housing quickly, the Tennessee Housing Development Agency urges all property providers to list available rental housing on the free, statewide housing locater service www.TNHousingSearch.org.

Weatherization Assistance Program

The Weatherization Assistance Program is designed to assist low-income households in reducing their fuel costs while contributing to national energy conservation through increased energy efficiency and consumer education. Households that include young children, elderly, or disabled members are given priority for service. Weatherization measures provided will reduce heat loss and energy costs by improving the thermal efficiency of dwelling units occupied by low-income households. Examples of common weatherization measures that may be provided are weather stripping, caulking, and adding of insulation to attics, walls, and floors. The Weatherization Assistance Program is administered and funded at the federal level by the U.S. Department of Energy.

2.7.13 – Tennessee Regulatory Authority – Gas Pipeline Safety Division (TRA GPSD)

The mission of the Tennessee Regulatory Authority's (TRA) Gas Pipeline Safety Division (GPSD) is to contribute to the safety and reliability of intrastate natural gas distribution and transmission pipeline facilities by conducting pipeline safety inspections across the state. It is the goal of the staff to minimize the risk to public health and safety as a result of the unintended release of natural gas from a pipeline. Public health and safety also depends on maintaining the flow of natural gas as a source of energy necessary to sustain domestic, commercial and industrial activities. In support of this effort, pipeline safety inspections by the TRA's GPSD promote pipeline integrity and reliability. The GPSD inspections promote underground utility damage prevention and public awareness of gas pipeline safety issues.

2.7.14 – Tennessee Valley Authority

The Tennessee Valley Authority (TVA) is a federal corporation and the nation's largest public power company. Although not a state agency or program, it has had and continues to have such a vast impact on Tennessee, its water bodies and watersheds that it must be included in this list of Tennessee's available mitigation resources. Created in May 1933, TVA's jurisdiction covers most of Tennessee. It is a geopolitical entity with a territory the size of a major state, and with some state powers (such as eminent domain), but unlike a state it has no citizenry or elected officials. It was the first large regional planning agency of the federal government and remains the largest.

TVA's responsibility to provide flood control and thus reduce flood risk in the Tennessee Valley is outlined in the Tennessee Valley Authority Act. It provides the legal foundation for the policies that guide the operation of TVA's dams and reservoirs today, requiring that the reservoir systems be operated primarily to promote navigation and flood control. TVA works closely with FEMA and local governments responsible for administration of NFIP requirements to guide sound floodplain development below TVA projects, provide assistance with identification to areas within the Tennessee Valley that are prone to flooding, provide information on flood risks, and advise communities on appropriate steps needed to ensure consistency with the NFIP.

Tennessee Valley Authority activities include: emergency preparedness, mitigation, response, and recovery programs; development of agency plans, exercises, and training; support of state and local preparedness and evacuation planning efforts; and interagency planning and coordination. TVA also is involved in the evaluation, design, and construction of specific projects to mitigate flood threats. The TVA: updates hazard models; develops design standards and guides; evaluates risks due to natural hazards; modifies and strengthens existing dam structures and designs and; constructs new facilities to withstand threats from natural hazards. In conjunction with regional power distributors, TVA works to reduce losses from earthquakes, severe weather, and fire. The agency also manages a seismic safety program to implement seismic design standards and federal mandates, and it conducts research to assess seismic hazards at its facilities. TVA supports federal disaster response and recovery efforts with technical engineering and specialized support, as required, and supports major wildland firefighting with trained firefighters.

2.7.15 – Tennessee Wildlife Resources Agency

Farm Wildlife Habitat Program (FWHP)

TWRA's GIS Habitat Program is a modestly funded cost-share program intended to complement the major conservation programs available through the U.S. Department of Agriculture. The program is used for qualified projects on lands not eligible for USDA funding, practices that complement existing habitat conversions already under a USDA contract, or assist a landowner to begin implementing habitat projects in a timely manner when USDA funds are not available.

Under an approved plan written by a TWRA Private Lands Biologist, the program provides 75% cost share reimbursement at a maximum of $2,000 in any state fiscal year to implement prescribed habitat practices intended to restore and manage native habitats. Upon approval of a FWHP plan that includes at least 5 acres of habitat practices, the landowner signs the contract agreeing to protect the improved habitat for 5 years. After the practices are implemented, the landowner is reimbursed at the specified practice rates based on 75% of established state average practice costs. Applicants are considered on a first-come, first-served basis.

Stream Mitigation Program (TSMP)

The TSMP was created to serve as 1 alternative for providing compensatory mitigation to offset unavoidable stream impacts permitted through Sections 404 and 401 of the Clean Water Act. The TSMP uses the principles of natural channel design and process-based methodologies to identify and develop stream restoration projects statewide. The program uses a watershed approach to complete large-scale restoration projects. Working with private landowners, other non-profit organizations, municipalities as well as state and federal agencies, the TSMP funds projects on significantly degraded streams to arrest bank erosion, improve water quality and restore aquatic and riparian habitat. With permission and cooperation from participating landowners, the TSMP designs and implements mitigation projects that benefit both the stream and the landowner. All TSMP projects are constructed at no cost to the landowner. Mitigation projects are monitored for success over a period of 2 to 5 years and must be protected by a perpetual land preservation agreement held by the Tennessee Wildlife Resources Foundation.

2.7.16 – State Agencies’ & Departments’ Technical Capabilities

Table 8 – State Agencies' & Departments' Technical Capabilities, Part 1

State Agency or Department	Agriculture Data Gathering/ Analysis	Demographic Data Gathering/ Analysis	Economic Analyses	Energy Resource Regulation	Environmental Data Gathering/ Analysis	GIS Data Management	Historical/ Cultural Resource Analyses	Natural Resource Management	Risk Analysis	State Property Information and Management
Department of the Military		X	X		X	X			X	X
Tennessee Emergency Management Agency	X	X	X		X	X	X	X	X	
Department of Agriculture: APHIS	X	X	X		X	X		X	X	
Tennessee Corporation Commission			X			X			X	
Department of Education Facilities Management		X	X			X				X
TDEC: Division of Water Resources	X		X	X	X	X		X	X	
Department of Commerce		X	X			X				X
Department of Environment and Conservation	X	X	X	X	X	X		X	X	X
Tennessee Department of Health CEDEP	X	X	X		X	X			X	X
Department of Labor		X	X							X
Department of Transportation		X			X	X			X	
Tennessee Forestry Division	X			X	X	X		X	X	
Tennessee Geological Survey	X	X		X	X	X				X
Tennessee Highway Patrol		X				X			X	X
Tennessee State Fire Marshal ‘s Office					X				X	X
Tennessee State Historical Society						X	X			
Tennessee Cooperative University Extension Service		X	X		X	X		X	X	
State Conservation Commission			X				X	X		X

**This assessment is based on an interpretation of the each organization’s capabilities and does not necessarily reflect an organization’s legal responsibility, legal authority, or proven ability.*

Agency or Department	Audits/Code Enforcement	Information Management	Inspection	Project Engineering/ Design	Project Funding	Project Operations/ Maintenance	Project Permitting/ Licensing	State Water Planning	Grants and Loans	Regulatory Guidance/ Control	Technical Support	Training and Education
Table 9 – State Agencies' & Departments' Technical Capabilities, Part 2												
Department of the Military	X	X	X	X		X					X	X
Tennessee Emergency Management Agency		X			X	X	X		X		X	X
Department of Agriculture: APHIS		X	X		X	X	X				X	X
Tennessee Corporation Commission	X	X	X			X	X			X		X
Department of Education Facilities Management			X	X	X	X		X		X		X
TDEC: Division of Water Resources	X			X		X	X	X		X	X	
Department of Commerce	X								X		X	X
Department of Environment and Conservation			X	X			X			X	X	X
Tennessee Department of Health CEDEP		X			X				X	X	X	X
Department of Labor	X	X	X							X	X	
Department of Transportation		X										
Tennessee Forestry Division			X								X	
Tennessee Geological Survey		X	X	X	X	X	X				X	X
Tennessee Highway Patrol			X						X		X	X
Tennessee State Fire Marshal 's Office									X		X	X
Tennessee State Historical Society	X		X	X	X				X	X	X	X
Tennessee Cooperative University Extension Service	X		X		X				X		X	X
State Conservation Commission									X			X

**This assessment is based on an interpretation of the each organization's capabilities and does not necessarily reflect an organization's legal responsibility, legal authority, or proven ability.*

2.7.17 – Legal Statutes and Regulations

The State of Tennessee has enacted various laws, acts, and statutes establishing mitigation measures. The table below details the Tennessee's legal efforts to protect its people and property.

Table 10 – Legal Statutes & Regulations, Tennessee

Statute/Regulation	Hazard/s Addressed	Description
Safe Dams Act of 1973, T.C.A. §69-11-101	Dam Failure	The Tennessee Department of Environment and Conservation has been charged for over 40 years with the responsibility for regulating the construction, alteration, and operation of all dams in the state. A certificate of approval of safety issued by TDEC is a requirement of the operation of any dam and the certificates may be revoked if a dam fails an inspection by the TDEC. The act also preempts any local dam regulation.
T.C.A. §13-7-101	All-Hazards	Grants county governments the authority to adopt zoning and building regulations, as well as to establish special districts in areas subject to flooding.
T.C.A. §13-7-201	All-Hazards	Grants municipal governments the same broad authority given to counties to adopt zoning and building regulations, including creating special districts or zones in flood prone areas.
T.C.A. §13-3-101	All-Hazards	The state is authorized to establish regional planning commissions the main purpose of which is to foster communication and cooperation among the various local planning commissions and agencies.
T.C.A. §64-1-101, et seq.	Floods	Tennessee has authorized and created numerous river basin development authorities to regulate development and flood control on various rivers within the state and these authorities are to cooperate with the soil conservations commissions affected by the river basin.
T.C.A. §64-3-101	Floods	Provides for broad flood control authority as a public purpose and specifically creates the Mill Creek watershed flood control authority in Davidson, Williamson, and Rutherford Counties.
T.C.A. §6-58-117	Floods	Requires any county with a special flood hazard area to meet all the requirements of the National Flood Insurance Program.
T.C.A. §68-221-1103	Floods, Flash Floods	Provides municipalities with broad authority to construct, enlarge, or acquire storm water or flood control improvements within its boundaries.
Watershed District Act, T.C. A. §69-6-101	Floods	Passed in 1955, this act establishes watershed districts and outlines how they will be established and operate. One of the main purposes of the watershed districts is to conserve soil and water and to retard floods and develop the water resources of the district.
T.C.A.§69-5-101	Floods, Flash Floods	Provides any county court with the authority to establish a levee or drainage district within its boundaries that has the power and discretion to alter the course, direction, width, or depth of any natural watercourse in the county.
Tennessee Water Resources Information Act, T.C.A. §69-7-301	Droughts	Provides a regulatory system for the use of surface and ground water which requires a permit for withdrawals greater than 10,000 gallons. The Commissioner of the Tennessee Department of Environment and Conservation is assisted in setting water use policies by a Technical Advisory Committee.

Statute/Regulation	Hazard/s Addressed	Description
T.C.A. §68-102-112	Wildfires	Establishes the Office of the State Fire Marshal and outline its duties as well as the role the state will play in fire prevention, safety, and investigation.
T.C.A. §5-6-121 & §6-21-704	Wildfires	Provides the authority for the appointment of a fire marshal by a county and city government, respectively. Subject to the authority of the local fire chief, their main role is fire prevention and investigation.
T.C.A. §43-3-201	Communicable Diseases	The Department of Agriculture and its commissioner are given broad authority to promote agricultural endeavors and to protect the agricultural industry and Tennessee citizens from plant pests and livestock diseases. This includes the appointment of a state veterinarian who is responsible for inspecting and monitoring animal health.
State Apiary Act of 1995, T.C.A. §45-15-101	Communicable Diseases	Specifically provides for the appointment of a state apiarist and the development of regulations to protect the state's honeybee industry from diseases, pests, and other threats.
Tennessee Emergency Management Act, T.C.A. §58-2-101	All-Hazards	Creates Tennessee Emergency Management Agency under the direction of the Adjutant General who shall recommend the appointment of a Director and Deputy Directors. The act outlines the emergency management responsibilities and capabilities of TEMA and gives the governor the power to declare a state of disaster emergency and direct emergency operations. Directs TEMA to formulate a statewide emergency plan and outlines the duties of the agency. Requires counties to establish and maintain a disaster agency responsible for emergency management, prepare a county emergency response plan, and coordinate efforts with TEMA.
Tennessee Emergency Management Act, T.C.A. §58-2-116	All-Hazards	In addition to prevention measures included in the state and local comprehensive emergency management plans, the governor shall consider, on a continuing basis, steps that could be taken to mitigate the harmful consequences of emergencies. At the governor's direction, state agencies, including, but not limited to, those charged with responsibilities in connection with flood plain management, stream encroachment and flow regulation, weather modification, fire prevention and control, air quality, public works, land use and land use planning, and construction standards, shall make studies of emergency mitigation-related matters. The governor, from time to time, shall make such recommendations to the general assembly, local governments, and other appropriate public and private entities as may facilitate measures for mitigation of the harmful consequences of emergencies.
Emergency Planning and Community Right-to Know Act, T.C.A. §58-2-110 & Executive Order 15-98	Hazardous Materials Release	Establishes the state emergency response commission within TEMA and authorizes local emergency planning committees to collect fees. The Executive Order further provides the SERC with the authority to provide assistance in the coordination of state agency activities relating to chemical emergency training, preparedness, and response, as well as chemical release reporting and prevention. The SERC also has the authority to oversee the transportation, manufacture, storage, handling, and use of hazardous materials within Tennessee.
Interstate Earthquake Compact , T.C.A. §58-2-701	Earthquakes	Given its location along the eastern flank of the New Madrid fault, Tennessee has joined other states in pledging mutual aid in the event of an earthquake disaster.
T.C.A. §58-9-101	Earthquakes	Creates the West Tennessee Seismic Safety Commission which is charged with developing a state plan of preparation and response to a major earthquake.
Underground Utility Damage Prevention Act, T.C.A. §65-31-101	All-Hazards	Provides conditions and regulations for the prevention of damage to underground utilities. Includes notice provisions, establishes liability provisions, and, in some cases, provides for criminal penalties.

Statute/Regulation	Hazard/s Addressed	Description
T.C.A. §8-1-108	Wildfires	During periods of extreme drought, the governor may forbid by proclamation the starting of any open air fires in or near woodlands. Violation of such a proclamation is a misdemeanor.
T.C.A. §11-4-401	Wildfires	Creates the Tennessee Division of Forestry to promote public forestry programs that protect and conserve Tennessee's woodland resources.
Wastewater Facilities Act of 1987, T.C.A. §68-221-1001	Droughts	Provides requirements and standards for the construction and operation of wastewater facilities for the protection of surface and ground waters.
T.C.A. §4-3-501 & Title 68	All-Hazards	The Tennessee Department of Environment and Conservation is given broad authority to regulate the entire range of environmental hazards. The discharge of air pollutants, solid waste, hazardous waste, storm water, as well as the storage of fuels and other chemicals are all regulated by the TDEC, which regulations provide a range of mitigation effects for all possible hazards.
T.C.A. §69-1-101	Floods	Provides for the protection of navigable waters including penalties for the diversion or obstruction of their course.
T.C.A. §56-7-130	Land Subsidence/Sinkholes	Requires all insurers in the state that offer homeowners insurance to offer coverage for sinkhole losses, including coverage for the loss of personal property
T.C.A. §58-2-108	All-Hazards	Provides that the head of each executive agency and department shall appoint an emergency service coordinator who shall coordinate and communicate with the Tennessee Emergency Management Agency. The ESC shall also insure that each state facility has a TEMA-approved disaster preparedness plan.
T.C.A. §42-6-101	Infrastructure Incidents	Creates a system of zoning around airports to minimize the hazards faced by both aircraft and the persons living near airport facilities.
Tennessee Modular Building Act, T.C.A. §68-126-301	All-Hazards	Establishes building construction and installation standards for modular structures.
T.C.A. §12-4-109	Floods	Mandates the identification of special flood hazard areas and the establishment of the NFIP in Tennessee.

2.8 – Changes in State Capabilities

Since 2013, the State of Tennessee has seen multiple agency resource reallocations.

2.8.1 – Changes in Agency Capabilities

Tennessee Department of Health

One of the most notable additions to the capabilities of the Tennessee Department of Health's Emergency Response system is the development of designated strike teams with the following functions:

Epidemiology - used for outbreak investigations as well as to measure the impact a disaster has had on a community.

Nursing - provide medical care in shelters and other such venues.

Ambulance - 8 teams each comprised of 5 ambulances and 1 supervisor.

Teams in development are Medico and Legal Death Investigation Response Units for mass casualty events and Environmental Health Units for establishing hygienic food and shelter programs after an event. These CASPER joint teams all now have cross listed capabilities for KY, TN, FL, AL and MS.
TDH is also in the process of revising a request to DHS for the reclassification and typing of medical equipment and assets.

All H1N1 funding provided by CDC is allocated separately from other TDH monies. The external task force is in the process of revising H1N1 response standards and vaccination programs, including consolidation of all data in the CDC's BioSense program.

Tennessee Department of Agriculture

Changes to the TDA's capabilities include the loss of DART funding from DHS in 2008 due to congressional cutbacks: supplementary funding now maintains tagging and ID systems for beef, and health certification and surveillance of poultry and swine. Further, the Department of Agriculture receives state funds to oversee mosquito irradiation programs since the rise in West Nile Virus incidents in 2012. Direct surveillance and monies from USDA and Department of Agriculture are used for safe dairy (7 state alliance initiative) and safe egg supply.

TDEC

TDEC has experienced no significant funding changes and regulatory oversight responsibilities and capabilities remain largely unchanged. However, the Safe Dam Program purview has been extended with more frequent inspections and oversight. Additionally, a comprehensive water infrastructure survey was commissioned and completed for seismic risk analysis to water resources in West Tennessee.
TDEC oversees a loan program for drinking water projects under the Drinking Water State Revolving Fund.

Funds for this program come from federal capitalization grants and a state match. The program provides funding for the planning, design, and construction of drinking water facilities, with priority given to projects associated with the greatest health risk, existing water problems, and community need. DWSRF provides funding to the following categories of projects: water quality problems, source or capacity, water storage, leakage problems, pressure problems, replacement or rehabilitation projects, and water line extensions. Projects that are not eligible for DWSRF loan funding include dams, reservoirs, purchase of water rights, laboratory fees for monitoring, operation and maintenance expenses, and projects primarily intended for future growth, economic development, and fire protection. The loan program maintains a priority ranking list to determine funding eligibility and the subsequent allocation of DWSRF loans. DWSRF loans are awarded to those projects that have met the DWSRF technical, financial, and administrative requirements, possess the highest priority rank on the Priority Ranking List, and are ready to proceed. However, there is a relatively small amount of loan funding available in comparison to statewide needs.

Safe Dams Program Capabilities

The Division of Water Resources' Safe Dams Program is responsible for conducting inspections, plans reviews, and permitting of dams and reservoir projects as required in the Safe Dams Act of 1973. The purpose of the program is to protect the public from dam failures. All non-federal dam owners are required to have a certificate of approval from the commissioner to construct, alter, remove, or operate a dam. These responsibilities were extended in response to the Harriman Slurry Dam failure of 2007
A dam is defined as a structure at least 20 feet high or holds 30 acre-feet or more of water at maximum pool. Any dam that meets these size requirements and is used exclusively as a farm pond (not used by the public) is not regulated by the division.

Classifications of Dams

Dams are classified by size and Hazard Potential Category (HPC). The size classification is based on dam height or storage volume, whichever is greater, as shown in the following table.

Table 11 – Dam Hazard Potential Categories

Classification	Storage (Acre-Feet)	Height (Feet)
Small	30 - 999	20 - 49
Significant	1,000 - 49,999	50 - 99
Large	50,000 +	100 +

The HPC is determined by the downstream damage that could result if a dam failed, based on the following definitions.

High hazard (HPC-1) dams would probably cause loss of life in the event of failure.
Significant hazard (HPC-2) dams would cause property damage or temporary loss of roads or utilities with a remote chance of loss of life.
Low hazard (HPC-3) dams would have little or no effect downstream if they failed.

Inspections

Dams are inspected every 1, 2, or 3 years by TDEC engineers and staff depending on whether they are high hazard, significant hazard, or low hazard, respectively. Unregulated dams are reviewed every 5 years for changes in ownership and hazard category. When dams are found to be unsafe, engineering plans that detail repairs are required before alteration permits are issued. Dams regulated by the Safe Dams program maintain a compliance rate of over 95%.

NFIP and Office of Special Projects

There have been extensive changes to NFIP as it is administered in Tennessee. Internal changes include Stanley Harrison as the only official coordinator, with the elimination of 6 regional offices, plus the elimination of internal finance and administration offices. They now coordinate directly with the STS and Dennis Peterson for GIS services. While they no longer receive direct funds for administrative services, they are required to file annual business cases and meet with all mapping partners in July to discuss the pending year's work.

NFIP offices are entirely funded by a 75/25% share program (with federal cap funds). They have 9 program work activities, of which those with primary importance for mitigation planning are: technical assistance requests, community assistance visits, contact visits, and non-participant outreach. In 2010 legislature passed Public Chapter No.1091 amending T.C.A. 12-4-109, under which all communities with FEMA identified zones must join the program. Of those identified, 393 have joined the program, and 18 have refused to join. Those include:

- Town of Braden (Fayette County)
- Town of Burlison (Tipton County)
- Town of Coalmont (Grundy County)
- Town of Enville (McNairy/Chester County)
- Town of Finger (McNairy County)
- Town of Gibson (Gibson County)
- Town of Guys (McNairy County)
- City of Hollow Rock (Carroll County)
- Houston County Unincor.
- Humphreys County Unincor.
- City of Minor Hill (Giles County)
- City of Niota (McMinn County)
- Town of Normandy (Bedford County)
- Town of Orlinda (Robertson County)
- Town of Orme (Marion County)
- City of St. Joseph (Lawrence County)
- City of Yorkville (Gibson County)

Municipalities have historically participated and have good compliance histories, counties are historically more difficult to integrate. CDBG now also requires compliance under 1091. They receive some TDEC waste water development assistance. Mitigation activities under current development: the Community Rating System needs reevaluation: as 27% of those identified need updating. During the 2009 CRS push FEMA was hesitant regarding the risk map approach. The department is attempting to get more data, and has extended the deadline.

Tennessee Division of Forestry

Tennessee participates in Forest Fire Compacts with 13 states regionally. These regions share DHS typed assets, of which Tennessee owns 120 Type 6 engines with 100 or larger gallon capacities, and has access to 206 aircraft regionally.

The extension of the CWPP to fund more programs for Fire Adaptive communities includes $700 of which 50% is dedicated for mitigation efforts. Those communities also receive dedicated prescribe burn monies beginning in 2013, with 25 classes in prescribed burns offered across the state annually.

2.8.2 – Changes in Roles & Responsibilities

TEMA continues to manage the FEMA mitigation grant programs for HMGP, PDM, and FMA. In conjunction with the state NFIP coordinator, TEMA will continue to inform and educate jurisdictions about the NFIP and mitigation efforts to reduce property impacts within flood hazard areas. Additionally, as the new requirements for local multi-hazard mitigation plans are mandated to include FMA criteria, the state will pursue more FMA grants for interested communities as part of their flood mitigation strategy.

The Fire Prevention Division of the Department of Commerce and Insurance requires all building permits purchased on or after October 1, 2011, to have the plumbing and mechanical systems inspected at rough-in and final inspection. These inspections should reduce the fire hazard at participating jurisdictions.

2.8.3 – Changes in Funding Sources

The Pre-Disaster Mitigation (PDM) program makes available Federal funds to State, Local and Tribal Governments to implement and sustain cost-effective measures designed to reduce the risk to individuals and property from natural hazards, while also reducing reliance on Federal funding from future disasters.

FEMA will provide allocations of $575,000 as required by the Stafford Act to states and territories; and a tribal set aside of $15 million for allocations up to $575,000 for Native American Indian tribal governments to support overall mitigation planning and projects. The remaining PDM funds will be awarded on a competitive basis with a focus on multi-state/tribal mitigation initiatives.

FEMA announced the Fiscal Year (FY) 2018 application cycle will start on August 3, 2018. The application period is October 1, 2018 through January 31, 2019.

2.9 – Silver Jackets

Tennessee Silver Jackets Team

The Silver Jackets program supports the development of state-led teams focusing on reducing flood risk and other natural disasters. The U.S. Army Corps of Engineers (USACE) is a critical proponent and supporter of the program. Silver Jackets teams in states across the United States bring together multiple state, federal, and sometimes tribal and local agencies to learn from one another. By applying their shared knowledge, the teams enhance mitigation, response and recovery efforts related to such events. No single agency has all the answers, but leveraging multiple programs and perspectives can provide a cohesive solution.

Although each state Silver Jackets team is unique, common agency participants include state agencies with mission areas of hazard mitigation, emergency management, floodplain management, and natural resources management or conservation. Federal participation typically includes the USACE and the Federal Emergency Management Agency and often others such as the National Weather Service and the U.S. Geological Survey.

Why "*Silver Jackets*?"
Traditionally, different agencies wear different colored shirts or jackets when responding to emergencies. FEMA personnel wear blue and USACE personnel wear red. The name Silver Jackets is used to underscore the common mission of the diverse agencies involved. Figuratively wearing silver jackets indicates our commonality of purpose.

2.9.1 – Formation of Tennessee Silver Jackets

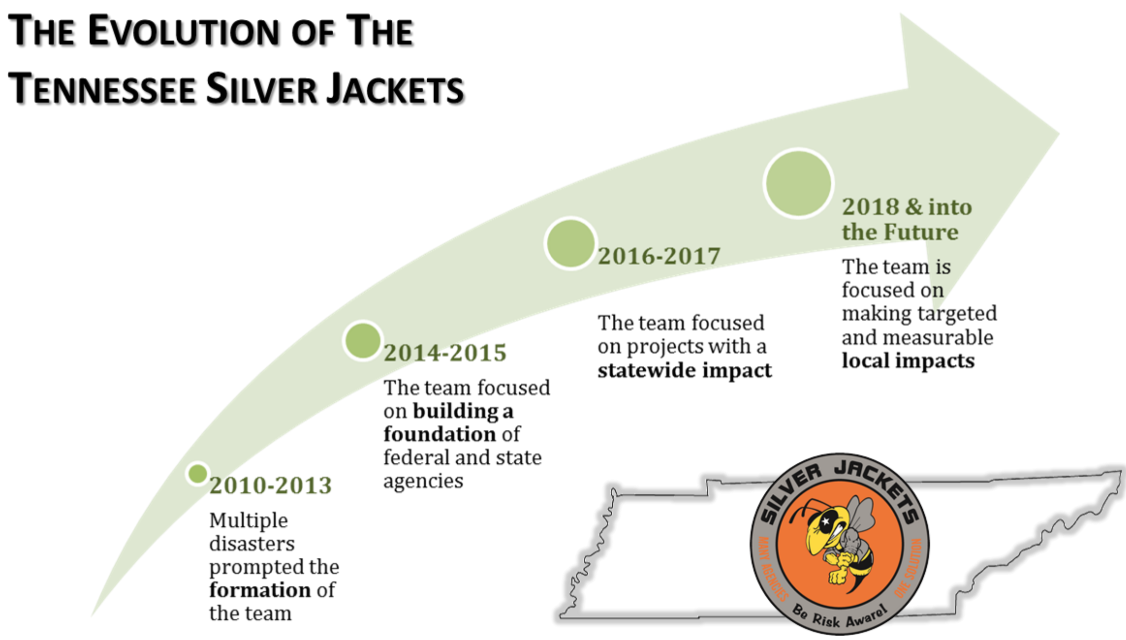
From 2010 to 2012, the State of Tennessee weathered eight major disasters resulting in presidential declarations, including record-breaking floods in several Tennessee watersheds. Stakeholders needed innovative solutions to help address disaster risk in the state. In September 2013, a small group of those stakeholders hosted the official kick-off of a collaboration designed to find and foster those innovative solutions: Tennessee Silver Jackets. A year later, eighteen federal, state and local agencies signed the official charter of the Tennessee Silver Jackets, including the mayors of the five most populous cities and metropolitan areas in the state.

A group of a few concerned stakeholders had grown into a recognized and productive team with a vision:

Establish and strengthen partnerships at the local, state, and federal level as a means for developing comprehensive and sustainable solutions to natural disasters.

2.9.2 – Team Goals

- Collaboratively address risk management issues, prioritize those issues, and implement solutions
- Increase and improve risk communication through a unified interagency effort
- Leverage information and resources in support of risk management
- Provide focused and coordinated hazard mitigation assistance
- Identify gaps among the various agency programs and provide appropriate recommendations



2.9.3 – Team Members

Federal

- U.S. Army Corps of Engineers
- Federal Emergency Management Agency
- Tennessee Valley Authority
- U.S. Fish and Wildlife Service
- National Weather Service
- U.S. Geological Survey
- Natural Resources Conservation Service
- Civil Air Patrol
- U.S. Department of Housing and Urban Development

State

- Tennessee Emergency Management Agency
- Tennessee Economic & Community Development
- Tennessee Department of Environment & Conservation
- Tennessee Department of Transportation
- State of Tennessee

Local

- City of Chattanooga
- City of Clarksville
- City of Cleveland
- City of Knoxville
- Hamilton County Emergency Management Agency
- Humphries County Emergency Management Agency
- Knoxville Emergency Management Agency
- Knox County
- Shelby County
- Metro Nashville Metro Water Services

2.9.4 – Tennessee Silver Jackets Training Topics

- Management of the Cumberland River System
- Tennessee Resilience Council
- USGS 3D Elevation Program
- Federal Flood Risk Management Standard
- Low Head Dam Removal
- New Madrid Seismic Zone
- Mississippi River and Tributaries System
- Sevier County Wildfire Recovery

The Tennessee Silver Jackets team coordinates site visits to important areas or infrastructure to help the team understand the many facets of risk management in the State of Tennessee.

2.9.5 – Tennessee Silver Jackets Site Visits

- Old Hickory Dam
- Tennessee State Emergency Operations Center
- Nashville Development Services Center
- Murfreesboro Waste Water Treatment Plant
- TVA Raccoon Mountain Pump Storage Plant (TVA's largest hydroelectric project)
- National Weather Service Nashville Forecast Center
- Nashville Metro Center Levee
- Clarksville Riverfront Stabilization Project
- Recovering fire-damaged areas in Sevier County

The team hosts information booths at risk management events like the Tennessee Association of Floodplain Managers Conference (AFPM) and sends representatives to the annual National Flood Risk Management Workshop. The Tennessee Silver Jackets team has made great progress since its inception, promulgating a formal charter, engaging a robust membership, reaching out to all 95 counties, and accomplishing several large projects. Overall, the Tennessee Silver Jackets team finds the greatest value in developing professional relationships.

2.9.6 – Tennessee Silver Jackets Team Projects

The Tennessee Silver Jackets Team endeavors to complete at least one large project each year, in addition to many smaller engagements. These large, non-structural projects may be awarded USACE staff support funding through the USACE Flood Risk Management Program, following a nation-wide competitive process. Tennessee has competed successfully several times, receiving USACE staff support funding for three major projects:

1. Tennessee Post-Disaster Guide (2016)
2. Understanding a Property's Flood Risk (2017)
3. Mansker Basin Flood Modeling Project (2018)

In addition, the team is submitting a project application to support the development of a county mitigation project database for 2019.

Tennessee Post Disaster Guide (FY16)

Over the course of their risk management careers, many Tennessee Silver Jackets team members had observed communities that were uncertain what to do after flooding and other disaster events. The team's first proposal was designed to address this issue and was selected for USACE staff support funding in 2015. The *Tennessee Post Disaster Guide* publication was designed to compile and provide easily digestible disaster recovery information to a large audience to speed recovery efforts and broaden awareness of key programs and resources.

The *Tennessee Post Disaster Guide* includes state and federal permitting requirements for debris removal and related activities, a list of programs that can provide assistance, and best practices for documenting a flood event. It serves as a resource to local, state, and federal officials on programs and the points of contacts for each program. The *Guide* includes customizable section that can be tailored to meet the needs of any community and includes all Tennessee Silver Jackets partners. The Tennessee Silver Jackets team presented the draft project at regional meetings of all emergency management directors to gather and incorporate feedback. The *Tennessee Post Disaster Guide* was distributed electronically as well as at the annual Emergency Management Association of Tennessee (EMAT) meeting in the fall of 2016. The Guide is also available on the Tennessee Silver Jackets team website at: https://silverjackets.nfrmp.us/State-Teams/Tennessee

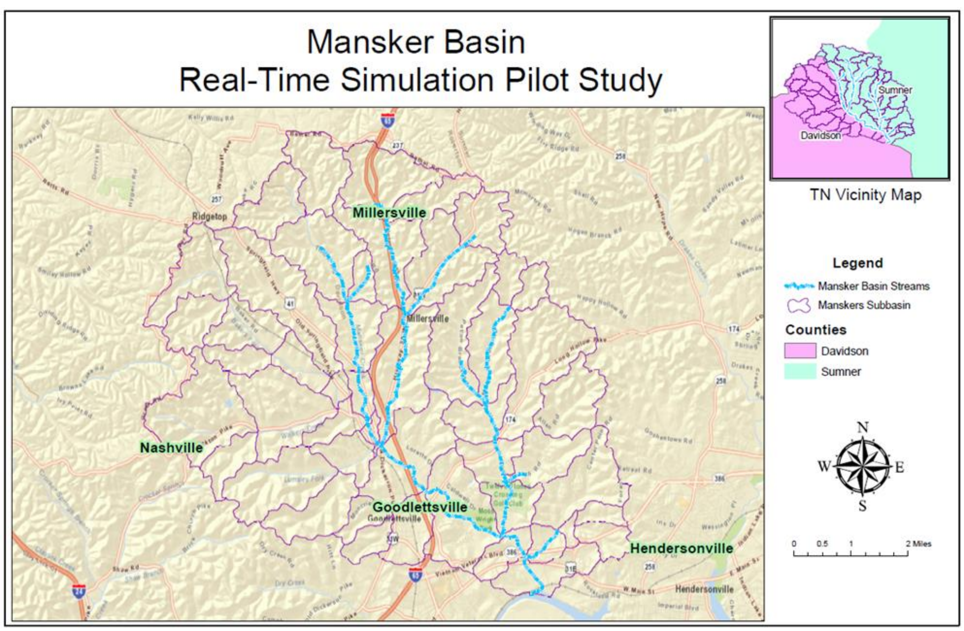
Understanding a Property's Flood Risk (FY17)

Upon successful completion of their first project, the Tennessee Silver Jackets team immediately began work on a second project designed to have a statewide impact. Several team members had become aware of a knowledge gap among real estate professionals regarding flood risk. The team was fortunate to be able to solicit input from the Tennessee Real Estate Commission and several realtors with flood risk management experience. The team designed a project to educate real estate professionals and others on the basics of understanding a Tennessee property's flood risk. The proposal was awarded USACE staff support funding in 2016.

Mansker Basin Flood Modeling Project (FY18)

The Mansker Basin is a watershed that covers 47 square miles in Middle Tennessee, extending from Millersville through Goodlettsville to the Cumberland River. It has experienced significant flooding in recent years, most notably in May 2010 when 293 structures were damaged costing $32 million. The watershed was the subject of hydrologic and hydraulic (H&H) modeling after the May 2010 flood. The Tennessee Silver Jackets *Mansker Basin Flood Modeling Project* was designed to advance the existing modeling into a Hydrologic Engineering Center Real-time Simulation (HEC-RTS) model for the Mansker Basin.

The information from the simulation was used to improve the stage-discharge rating curve at the Mansker's U.S. Geological Survey (USGS) flood gage to provide better continuous flow data. The National Weather Service (NWS) aided in the development of real-time flood forecasting within HEC-RTS. NWS is now able to run various high water scenarios and visually examine the impacts. These visuals and the underlying data can be used in Flood Warning products that are issued for the public. The products developed in this project aid Sumner and Davidson Counties and the cities of Nashville, Millersville, Goodlettsville, and Hendersonville in flood warning and preparedness in the Mansker Basin. This project is also an action in the strategy section of the *State of Tennessee Hazard Mitigation Plan*.



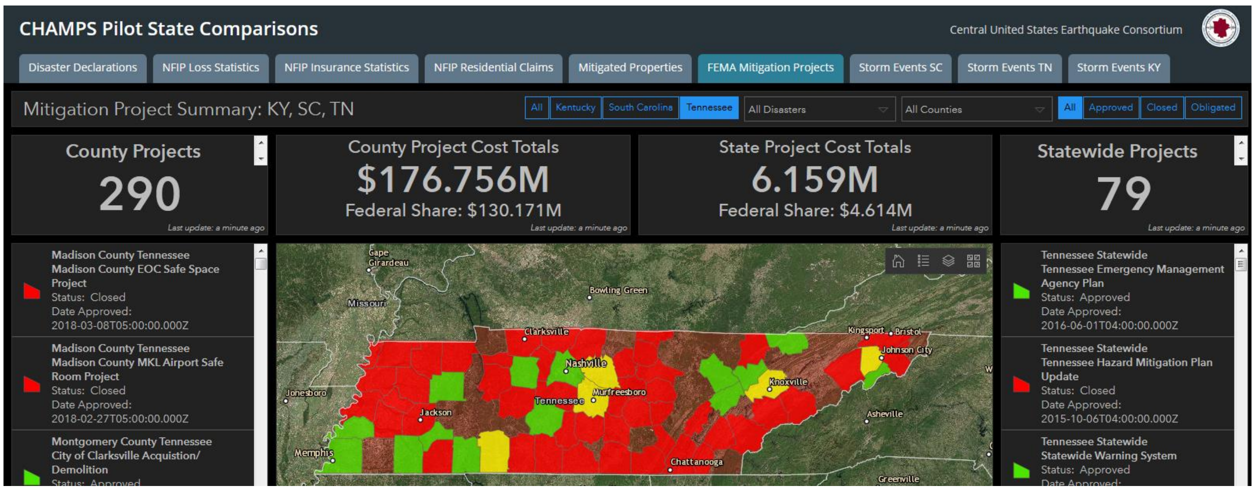
County Hazard Mitigation Project Database (FY19)

70 of 95 TN counties have hazard mitigation plans that include risk-reduction projects. Some of these plans are not currently approved by FEMA, but the plans are still valuable. Many local jurisdictions think of mitigation projects as only those projects funded by FEMA under the Hazard Mitigation Program. As

a consequence, local mitigation plans often sit on the shelf until there is a Presidentially-declared disaster that provides FEMA mitigation funding.

There are many resources and partners that can support mitigation projects. The first step is to get the plans off of the shelf and in front of potential partners. As local plans range from 100 to 1,000 pages and are typically too large to email, a database of project essentials presents a practical solution.

With this project, Silver Jackets will build a basic dataset of all of the proposed projects from all available Tennessee county hazard mitigation plans. The data can be utilized efficiency once it is in a spreadsheet format. Through a partnership with the Central United States Earthquake Consortium, the information will be included in an ArcGIS online-based dashboard system that is being developed as a pilot project with the Tennessee Emergency Management Agency.



The desired outcome is that all Silver Jackets partners and other potential partners can efficiently review all of the hazard mitigation projects statewide and look for opportunities to collaborate. In addition, the information will be valuable for analyzing and improving the state's hazard mitigation efforts. The project has been proposed for Silver Jackets annual nationwide competitive funding. If the project is not awarded funding this year, the state will continue to pursue the project.

2.10 – State Capabilities Gap Analysis

This section highlights policies and programs that have been effective in achieving mitigation objectives and actions in Tennessee and discusses opportunities for improving state mitigation capabilities. The Hazard Mitigation Planning Committee (HMPC) used a small group brainstorming process to identify the strengths and weaknesses in the state's mitigation capabilities, and the opportunities and obstacles to improving mitigation capabilities. Several themes emerged from this process and are summarized below.

Consolidation of the Economic and Community Development NFIP Program:
The elimination of the 6 regional offices for administration of the NFIP and Economic and Community Development has stressed resources and resulted in difficulty with technical assistance, community assistance visits, and non-participant outreach.

STS-GIS Budget Constriction with Incomplete LiDAR sets for the state as a whole:
The lack of direct set aside funding for LiDar has resulted in incomplete mapping and the inability for the STS to continue the development of detailed datasets. This directly inhibits the use of accurate elevations for a variety of business and government needs.

Interagency Coordination
The HMPC identified interagency coordination as an obstacle to improving state capabilities, specifically related to planning efforts and sharing information and technical data. The long-term effectiveness of the state's mitigation program is contingent on using existing mitigation-related programs in as coordinated and integrated a manner as possible to achieve the maximum benefits to statewide capabilities.

Based on Tennessee Code Annotated 58-2-108 requires the designation of Emergency Services Coordinators for each state agency. ESC responsibilities include:

- At the direction of the governor, the head of each executive department and independent agency shall select from within such department or agency a person to be designated as the emergency services coordinator for the department or agency together with an alternate ESC.
- The ESC is responsible for coordinating with TEMA and reporting to that agency on emergency preparedness issues, preparing and maintaining emergency preparedness and post disaster response and recovery plans for their agency, maintaining rosters of personnel to assist in disaster operations, and coordinating appropriate training for agency personnel.
- These individuals shall be responsible for ensuring that each state facility, such as a prison, office building, or university, has a disaster preparedness plan that is reviewed by the applicable local emergency management agency and approved by TEMA

Financial and Technical Assistance to Local Governments
Many agencies provide support to local governments through training and education, grants and loans, and technical support:

- TEMA provides technical assistance to counties for the development of local mitigation plans and for funding mitigation projects. TEMA also coordinates programs for local comprehensive emergency management planning and local mitigation planning to ensure that planning efforts are consistent and mutually supportive.

- The Tennessee Department of Commerce and Insurance administers community development programs, such as the NFIP. Other local jurisdictional resources include the administering of Appalachian Regional Commission Grants, Delta Regional Authority Grants, and Community Development Block Grants
- The Tennessee Forestry Commission, serves in an advisory capacity on forestry policy to the Tennessee Department of Agriculture and the governor. In brief, the commission is to formulate and recommend programs of fire protection,

reforestation and seedling production, forestry assistance to private landowners, educational and informational functions which enhance understanding of the value and management of the forest resource, management of state forests, urban tree management, development of markets for Tennessee forest products, protection from insect and disease epidemics, and protection of the soil and water quality.

- The Tennessee Department of Agriculture has several programs that are supportive of local government efforts, particularly in flood control and fire reduction. The Urban Forests Riparian Program and the Volunteer Fire Assistance (VFA) are 2 program examples.
- The Tennessee Department of Health has programs supporting local government efforts to respond to human disease outbreaks.
- The Tennessee Department of Transportation Local Program Development Office (LPDO) administers those federal and state funding programs that are available to local governments to improve their transportation systems. Current programs include Surface Transportation, Enhancement, Safe Routes to School, Congestion Mitigation and Air Quality Improvement, Spot Safety, Local Interstate Connector, State Industrial Access Road, Interchange Lighting and Bridge Replacement.

Opportunities exist for building state and local mitigation capabilities by expanding the state's capabilities for helping local governments meet nonfederal matching costs for mitigation-related projects and by improving the coordination and integration of state training programs for local officials with more emphasis on hazard mitigation. The greatest opportunities for improvement in hazard mitigation in Tennessee exist at the local level. Therefore, helping all communities develop and adopt local hazard mitigation plans is one of the state's top priorities.

Statewide Regulation and Enforcement

One important aspect of the state's mitigation policy framework is the requirement or encouragement of general actions by local governments to reduce vulnerability to disasters. two such general actions are adoption and enforcement of building codes and comprehensive land use planning to manage growth in known hazard areas.

The Tennessee state legislature has not implemented a statewide building code nor does it require comprehensive planning by local governments. The state does not have a land use plan or specific plans for critical areas or those of special concern. The HMPC identified the lack of requirements in these areas as a weakness in the state's mitigation capabilities and found that additional statewide guidance and requirements in these areas offer opportunities to enhance mitigation capabilities at the local level. In addition, inadequate enforcement of existing regulations by the state was found to be an obstacle.

New regulations are not popular in Tennessee, which is a Home Rule state. Home Rule is the granting of powers from the central government of a state to governments at regional or local levels. The HMPC identified that distrust of state and federal government is common among residents. The HMPC did not believe that Tennessee legislation in these areas will change in the near future but did identify opportunities to encourage local adoption of building codes and land use plans through promoting model codes and ordinances and providing guidance on integrating land use and mitigation.

GIS Data Integrity for the State

The Office for Information Resources is currently facilitating 2 major GIS data update projects for the State of Tennessee. These projects include the FEMA Flood Map Modernization Program as well as the Statewide LiDAR/Elevation Business Plan.

Flood map modernization is a program that will greatly improve the information used to establish the risk in flood plain development and will allow the insurance industry to make better policy determinations. Moving from paper maps to an integrated digital resource will expand access to flood risk data using both state and federal data access portals. Using the digital base map currently being created and implemented through the Tennessee Base Mapping Program only makes sense. The goal of the Tennessee Base Mapping Program is to create high accuracy base maps that allow a variety of information to be spatially related through geographic information systems technology. Not only will many pieces of information be available for analysis by establishing flood mapping on the state's digital base map, the value of the mapping will be leveraged to request the maximum amount of funds available for Tennessee Flood Map Modernization. The final product will be a flood risk map accessible via the internet that allows private property owners, local regulatory officials, lenders, insurers, and design professionals a more accurate Digital Flood Insurance Rate Map (DFIRM) in each county and municipality of Tennessee.

The STS is currently working to update State of Tennessee owned and operated facility data. This vital project is pushing toward the goal of adding each building's footprint to a visual database that can then be layered over flood zone maps as well as current LiDar datasets. STS GIS Services, with the help of AppGeo/AECOM, Tennessee Geographic Information Council (TNGIC), and the Tennessee GIS community, has completed its development of a LiDAR/elevation business plan. The eventual goal is to create a very accurate topographic GIS dataset through the use of LiDAR technology (scanning the earth with lasers from an aircraft) to obtain accurate elevations that will support a wide variety of business needs at all levels of government.

2.11 – Vulnerability Assessment of State Property

The State of Tennessee owns and operates 7,555 properties and structures covering 96,641,959 square feet. The Tennessee Department of the Treasury reports these properties and structures are worth $15,422,764,100 with a total content value of $3,793,355,000. Maps 18 through 21 depict the locations of all state owned and operated properties.

Of these properties and structures, the vast majority of their worth is located in hazard areas ranked 3 or lower. However, due to the high threat level in West Tennessee along the Mississippi River, there is a sizable worth of property and structures located in a high threat hazard area.

The State of Tennessee Department of the Treasury has broken down state owned and operated properties by the following classifications:

Administrative: This classification includes any non-chemical, communications, power, or healthcare facilities used for administrative and bureaucratic functions under any number of state agencies and departments.
Chemical: This classification includes facilities that handle significant amount of chemicals such water and sewage treatment facilities. The state does not own or operate any chemical production facilities.
Communications: This classification is for any radio or telecommunications purposed structure.
Corrections: This classification includes any non-chemical, communications, power, or healthcare facilities under the Tennessee correctional system.
Education: This classification includes any non-chemical, communications, power, or healthcare facilities under any number of Tennessee's college and/or university systems.
Healthcare: Any state owned or operated facilities associated with a healthcare practice. These are typically mental healthcare, rehabilitation, or therapy associated facilities. The state does not own or operate any hospitals.
Military: This classification includes any non-chemical, communications, power, or healthcare facilities under the Tennessee National Guard.
Power: Any steam, coal, natural gas, nuclear, or other power producing facility owned or operated by the state.

The table on the following pages breaks down the number, structure sizes, structure values, contents values, and total value of all state owned and operated property located in each hazard's threat zone, 1 through 6. Due to their nature, neither drought nor extreme temperatures pose a threat to structures. For dam failure, each of the dams of prime concern is listed along with the values that are within their failure inundation.

Table 12 – Loss Estimates, State of Tennessee Properties					
Hazard Threat Zone	**Structure Count**	**Size (Sq. Ft.)**	**Structure Value**	**Content Value**	**Total Value**
Dam Failures					
Center Hill Dam	128	3,444,400	$318,056,600	$175,051,400	$493,108,000
Administrative	54	2,374,700	$193,699,000	$58,747,300	$252,446,300
Chemical	0	0	$0	$0	$0
Communications	1	100	$8,000	$200,000	$208,000
Corrections	24	436,700	$79,570,500	$5,167,100	$84,737,600
Education	46	615,000	$43,341,200	$110,719,000	$154,060,200
Healthcare	0	0	$0	$0	$0
Military	3	17,900	$1,437,900	$218,000	$1,655,900
Power	0	0	$0	$0	$0
Tellico Dam	1	1,500	$187,500	$5,000	$192,500
Administrative	1	1,500	$187,500	$5,000	$192,500
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Education	0	0	$0	$0	$0
Healthcare	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Power	0	0	$0	$0	$0
Wolf Creek Dam	155	3,682,200	$360,277,400	$182,499,000	$542,776,400
Administrative	61	2,403,800	$195,025,700	$59,680,300	$254,706,000
Chemical	0	0	$0	$0	$0
Communications	2	100	$148,000	$200,000	$348,000
Corrections	48	590,100	$110,272,000	$7,449,800	$117,721,800
Education	40	593,300	$39,695,300	$109,841,400	$149,536,700
Healthcare	1	76,400	$13,752,200	$5,112,000	$18,864,200
Military	3	18,500	$1,384,200	$215,500	$1,599,700
Power	0	0	$0	$0	$0
Droughts	No Threat	No Threat	No Threat	No Threat	No Threat
Earthquakes					
Earthquake 1	3,706	42,103,384	$6,387,066,500	$1,731,029,000	$8,118,095,500
Administrative	1,925	17,447,627	$2,220,972,200	$509,461,200	$2,730,433,400
Chemical	20	34,700	$8,773,800	$341,500	$9,115,300
Communications	37	145,900	$20,536,000	$11,025,500	$31,561,500
Corrections	395	4,355,100	$736,660,100	$96,691,700	$833,351,800
Education	1,124	17,594,657	$2,994,458,300	$1,029,130,400	$4,023,588,700
Healthcare	77	1,093,800	$199,576,300	$26,637,800	$226,214,100
Military	126	1,429,500	$206,089,800	$57,115,900	$263,205,700
Power	2	2,100	$0	$625,000	$625,000

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Earthquake 2	1,837	29,222,700	$5,351,361,600	$1,169,940,300	$6,521,301,900
Administrative	958	7,493,658	$1,225,605,500	$362,632,900	$1,588,238,400
Chemical	13	14,300	$3,150,200	$111,000	$3,261,200
Communications	18	107,900	$19,399,100	$9,834,100	$29,233,200
Corrections	108	1,924,470	$389,253,400	$131,315,600	$520,569,000
Education	640	17,962,772	$3,373,030,700	$616,237,400	$3,989,268,100
Healthcare	32	621,300	$109,585,100	$36,379,700	$145,964,800
Military	64	1,067,400	$147,176,000	$11,030,200	$158,206,200
Power	4	30,900	$84,161,600	$2,399,400	$86,561,000
Earthquake 3	78	264,520	$19,254,800	$8,180,100	$27,434,900
Administrative	55	152,020	$10,974,100	$2,876,700	$13,850,800
Chemical	0	0	$0	$0	$0
Communications	4	3,500	$198,800	$703,300	$902,100
Corrections	2	2,600	$139,200	$302,500	$441,700
Education	8	47,900	$278,000	$3,887,600	$4,165,600
Healthcare	0	0	$0	$0	$0
Military	8	57,500	$7,664,700	$240,000	$7,904,700
Power	1	1,000	$0	$170,000	$170,000
Earthquake 4	1,223	18,504,297	$2,677,385,300	$745,013,700	$3,422,399,000
Administrative	609	4,971,372	$605,418,400	$269,492,700	$874,911,100
Chemical	4	5,900	$1,383,200	$52,000	$1,435,200
Communications	19	13,070	$4,075,000	$4,895,400	$8,970,400
Corrections	46	1,432,500	$177,931,200	$20,090,300	$198,021,500
Education	457	10,913,400	$1,669,475,800	$400,180,000	$2,069,655,800
Healthcare	46	568,700	$100,669,200	$15,828,100	$116,497,300
Military	41	598,155	$118,432,500	$34,385,200	$152,817,700
Power	1	1,200	$0	$90,000	$90,000
Earthquake 5	401	4,225,993	$594,712,800	$79,019,800	$673,732,600
Administrative	159	1,423,280	$175,718,500	$22,261,700	$197,980,200
Chemical	2	6,500	$3,115,600	$335,000	$3,450,600
Communications	1	1,800	$225,000	$71,000	$296,000
Corrections	90	683,813	$139,082,300	$26,414,500	$165,496,800
Education	127	1,943,000	$252,529,600	$28,002,600	$280,532,200
Healthcare	10	51,600	$4,113,700	$503,000	$4,616,700
Military	11	109,400	$16,879,500	$432,000	$17,311,500
Power	1	6,600	$3,048,600	$1,000,000	$4,048,600
Earthquake 6	181	1,193,065	$213,606,500	$21,699,200	$235,305,700
Administrative	77	356,500	$48,589,400	$7,635,000	$56,224,400
Chemical	1	4,500	$454,200	$0	$454,200
Communications	4	400	$141,200	$1,100,000	$1,241,200
Corrections	60	507,465	$107,965,000	$5,073,100	$113,038,100
Education	34	302,500	$53,153,500	$7,720,500	$60,874,000
Healthcare	2	0	$0	$105,600	$105,600
Military	3	21,700	$3,303,200	$65,000	$3,368,200
Power	0	0	$0	$0	$0

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Extreme Temperatures	No Threat	No Threat	No Threat	No Threat	No Threat
Floods - Flash Floods					
Flash Flood 1	0	0	$0	$0	$0
Administrative	0	0	$0	$0	$0
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Education	0	0	$0	$0	$0
Healthcare	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Power	0	0	$0	$0	$0
Flash Flood 2	2,516	15,905,836	$2,212,645,200	$327,934,600	$2,540,579,800
Administrative	1,461	5,919,418	$665,477,800	$114,341,400	$779,819,200
Chemical	25	49,100	$12,436,300	$722,600	$13,158,900
Communications	29	38,470	$8,651,400	$9,316,700	$17,968,100
Corrections	384	3,227,848	$609,406,400	$61,135,900	$670,542,300
Education	495	5,580,200	$788,626,600	$132,436,600	$921,063,200
Healthcare	55	565,000	$71,103,100	$6,606,500	$77,709,600
Military	64	517,200	$53,890,900	$1,849,900	$55,740,800
Power	3	8,600	$3,052,700	$1,525,000	$4,577,700
Flash Flood 3	3,387	44,747,661	$8,025,691,300	$1,955,229,000	$9,980,920,300
Administrative	1,734	12,617,177	$2,013,534,400	$498,379,600	$2,511,914,000
Chemical	11	14,100	$3,393,600	$86,900	$3,480,500
Communications	35	169,200	$28,901,000	$11,068,600	$39,969,600
Corrections	177	2,702,800	$483,456,600	$174,323,400	$657,780,000
Education	1,232	26,382,429	$4,900,187,800	$1,191,745,800	$6,091,933,600
Healthcare	57	1,052,100	$212,179,900	$47,620,300	$259,800,200
Military	135	1,776,655	$299,880,500	$29,245,000	$329,125,500
Power	6	33,200	$84,157,500	$2,759,400	$86,916,900
Flash Flood 4	492	10,942,372	$1,445,265,600	$404,431,300	$1,849,696,900
Administrative	225	2,549,372	$268,253,200	$199,085,700	$467,338,900
Chemical	4	2,700	$1,047,100	$30,000	$1,077,100
Communications	10	30,500	$6,432,300	$3,479,700	$9,912,000
Corrections	14	730,700	$68,750,600	$6,398,700	$75,149,300
Education	218	7,203,200	$1,016,939,900	$168,470,900	$1,185,410,800
Healthcare	10	294,700	$64,361,300	$12,617,000	$76,978,300
Military	11	131,200	$19,481,200	$14,349,300	$33,830,500
Power	0	0	$0	$0	$0

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Flash Flood 5	559	8,395,420	$1,173,443,300	$293,497,800	$1,466,941,100
Administrative	220	2,526,820	$262,285,100	$72,457,000	$334,742,100
Chemical	0	0	$0	$0	$0
Communications	6	200	$378,600	$1,450,000	$1,828,600
Corrections	85	1,398,200	$232,498,800	$19,950,200	$252,449,000
Education	185	3,676,200	$584,354,400	$175,348,300	$759,702,700
Healthcare	34	386,000	$61,699,800	$9,554,000	$71,253,800
Military	29	408,000	$32,226,600	$14,738,300	$46,964,900
Power	0	0	$0	$0	$0
Flash Flood 6	471	15,479,970	$2,373,842,100	$773,789,400	$3,147,631,500
Administrative	142	8,188,970	$1,065,227,600	$290,096,500	$1,355,324,100
Chemical	0	0	$0	$0	$0
Communications	3	34,200	$211,800	$2,314,300	$2,526,100
Corrections	41	846,400	$156,918,800	$18,079,500	$174,998,300
Education	260	5,922,200	$1,052,817,200	$417,156,900	$1,469,974,100
Healthcare	11	37,600	$4,600,200	$3,056,400	$7,656,600
Military	14	450,600	$94,066,500	$43,085,800	$137,152,300
Power	0	0	$0	$0	$0
Floods - Riverine Floods					
Riverine Floods (100 Year)	320	2,325,964	$344,848,900	$42,201,100	$387,050,000
Administrative	162	625,594	$65,250,700	$9,290,800	$74,541,500
Chemical	3	900	$726,100	$33,000	$759,100
Communications	1	100	$8,000	$200,000	$208,000
Corrections	63	929,070	$175,764,300	$11,635,300	$187,399,600
Education	75	649,200	$86,303,700	$19,101,900	$105,405,600
Healthcare	1	1,400	$89,000	$4,500	$93,500
Military	14	118,400	$16,707,100	$1,435,600	$18,142,700
Power	1	1,300	$0	$500,000	$500,000
Riverine Floods (500 Year)	89	2,167,600	$140,178,500	$43,066,500	$183,245,000
Administrative	63	1,679,100	$100,522,200	$37,505,100	$138,027,300
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	2	174,800	$23,800,000	$900,000	$24,700,000
Education	22	281,600	$12,393,200	$4,611,400	$17,004,600
Healthcare	0	0	$0	$0	$0
Military	1	31,400	$3,459,000	$25,000	$3,484,000
Power	1	700	$4,100	$25,000	$29,100

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Riverine Floods (100 & 500)	409	4,493,564	$485,027,400	$85,267,600	$570,295,000
Administrative	225	2,304,694	$165,772,900	$46,795,900	$212,568,800
Chemical	3	900	$726,100	$33,000	$759,100
Communications	1	100	$8,000	$200,000	$208,000
Corrections	65	1,103,870	$199,564,300	$12,535,300	$212,099,600
Education	97	930,800	$98,696,900	$23,713,300	$122,410,200
Healthcare	1	1,400	$89,000	$4,500	$93,500
Military	15	149,800	$20,166,100	$1,460,600	$21,626,700
Power	2	2,000	$4,100	$525,000	$529,100
Geologic - Expansive Soils					
Expansive Soils 1	776	19,809,016	$3,754,113,500	$882,967,500	$4,637,081,000
Administrative	315	4,964,544	$904,601,300	$297,238,200	$1,201,839,500
Chemical	1	300	$277,800	$0	$277,800
Communications	5	77,700	$14,549,300	$6,117,100	$20,666,400
Corrections	38	807,800	$175,575,700	$109,576,800	$285,152,500
Education	348	12,586,272	$2,353,033,100	$429,706,000	$2,782,739,100
Healthcare	31	791,200	$129,212,000	$34,917,500	$164,129,500
Military	36	551,500	$92,706,800	$3,192,500	$95,899,300
Power	2	29,700	$84,157,500	$2,219,400	$86,376,900
Expansive Soils 2	4,371	50,598,666	$7,247,118,600	$1,896,468,100	$9,143,586,700
Administrative	2,253	18,824,406	$2,241,092,500	$680,953,700	$2,922,046,200
Chemical	34	63,100	$15,050,300	$816,600	$15,866,900
Communications	51	142,870	$21,843,600	$13,776,000	$35,619,600
Corrections	555	6,587,648	$1,129,873,300	$119,727,000	$1,249,600,300
Education	1,247	22,381,887	$3,441,383,700	$981,229,900	$4,422,613,600
Healthcare	80	724,400	$129,431,100	$21,767,600	$151,198,700
Military	146	1,863,555	$265,391,400	$76,412,300	$341,803,700
Power	5	10,800	$3,052,700	$1,785,000	$4,837,700
Expansive Soils 3	2,144	24,261,227	$4,131,082,300	$945,754,200	$5,076,836,500
Administrative	1,140	7,706,607	$1,093,827,000	$192,337,600	$1,286,164,600
Chemical	5	2,500	$1,548,900	$22,900	$1,571,800
Communications	25	48,000	$7,312,200	$7,636,200	$14,948,400
Corrections	101	1,474,100	$244,557,000	$50,151,900	$294,708,900
Education	748	13,442,220	$2,504,543,900	$651,303,000	$3,155,846,900
Healthcare	53	767,800	$146,678,100	$22,159,100	$168,837,200
Military	70	818,700	$132,615,200	$21,863,500	$154,478,700
Power	2	1,300	$0	$280,000	$280,000

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Expansive Soils 4	126	812,650	$105,396,100	$29,573,300	$134,969,400
Administrative	69	322,400	$42,794,200	$3,755,700	$46,549,900
Chemical	0	0	$0	$0	$0
Communications	2	4,000	$870,000	$100,000	$970,000
Corrections	7	36,400	$1,025,200	$432,000	$1,457,200
Education	44	347,950	$43,251,300	$22,875,600	$66,126,900
Healthcare	3	52,000	$8,623,100	$610,000	$9,233,100
Military	1	49,900	$8,832,300	$1,800,000	$10,632,300
Power	0	0	$0	$0	$0
Expansive Soils 5	10	36,800	$6,090,500	$119,000	$6,209,500
Administrative	7	30,900	$5,376,600	$75,000	$5,451,600
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Education	3	5,900	$713,900	$44,000	$757,900
Healthcare	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Power	0	0	$0	$0	$0
Expansive Soils 6	0	0	$0	$0	$0
Administrative	0	0	$0	$0	$0
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Education	0	0	$0	$0	$0
Healthcare	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Power	0	0	$0	$0	$0
Geologic - Land Subsidence					
Land Subsidence 1	5,489	70,255,501	$10,642,302,300	$2,687,220,000	$13,329,522,300
Administrative	2,715	24,868,691	$3,151,604,600	$837,768,000	$3,989,372,600
Chemical	26	48,300	$10,343,600	$728,000	$11,071,600
Communications	67	159,270	$26,450,800	$24,446,900	$50,897,700
Corrections	561	7,622,948	$1,284,070,000	$151,559,900	$1,435,629,900
Education	1,781	33,396,137	$5,494,575,500	$1,532,974,700	$7,027,550,200
Healthcare	136	1,921,500	$328,269,400	$47,370,400	$375,639,800
Military	198	2,228,555	$343,939,800	$90,832,100	$434,771,900
Power	5	10,100	$3,048,600	$1,540,000	$4,588,600

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Land Subsidence 2	974	19,382,188	$3,643,412,300	$888,883,200	$4,532,295,500
Administrative	482	4,889,816	$853,915,400	$291,789,700	$1,145,705,100
Chemical	6	4,700	$1,661,500	$22,900	$1,684,400
Communications	7	84,500	$12,033,600	$1,905,600	$13,939,200
Corrections	50	804,000	$180,633,400	$117,436,300	$298,069,700
Education	367	12,412,772	$2,321,588,300	$437,050,900	$2,758,639,200
Healthcare	19	297,300	$65,971,000	$29,850,200	$95,821,200
Military	39	857,400	$123,447,500	$8,083,200	$131,530,700
Power	4	31,700	$84,161,600	$2,744,400	$86,906,000
Land Subsidence 3	440	1,388,450	$179,629,300	$29,422,500	$209,051,800
Administrative	264	569,650	$63,094,800	$14,770,800	$77,865,600
Chemical	5	7,600	$3,294,400	$38,600	$3,333,000
Communications	4	19,800	$4,233,100	$521,500	$4,754,600
Corrections	75	324,800	$57,724,900	$6,319,900	$64,044,800
Education	82	429,400	$47,016,000	$6,690,500	$53,706,500
Healthcare	7	18,100	$2,757,700	$1,051,200	$3,808,900
Military	3	19,100	$1,508,400	$30,000	$1,538,400
Power	0	0	$0	$0	$0
Land Subsidence 4	174	615,800	$90,236,100	$12,819,300	$103,055,400
Administrative	119	209,300	$22,274,700	$4,088,700	$26,363,400
Chemical	1	100	$650,000	$0	$650,000
Communications	2	0	$450,000	$130,400	$580,400
Corrections	6	11,400	$1,319,000	$599,900	$1,918,900
Education	41	351,200	$55,485,400	$4,940,300	$60,425,700
Healthcare	2	3,400	$275,000	$30,000	$305,000
Military	3	40,400	$9,782,000	$3,030,000	$12,812,000
Power	0	0	$0	$0	$0
Land Subsidence 5	207	3,432,120	$637,202,400	$130,613,500	$767,815,900
Administrative	93	997,600	$158,116,000	$21,611,300	$179,727,300
Chemical	1	1,000	$650,000	$0	$650,000
Communications	3	9,000	$1,407,600	$624,900	$2,032,500
Corrections	7	140,600	$27,183,100	$3,951,700	$31,134,800
Education	94	2,077,020	$416,131,000	$102,103,600	$518,234,600
Healthcare	2	92,100	$16,580,100	$1,074,000	$17,654,100
Military	7	114,800	$17,134,600	$1,248,000	$18,382,600
Power	0	0	$0	$0	$0
Land Subsidence 6	139	435,600	$49,955,100	$5,888,600	$55,843,700
Administrative	108	306,400	$37,772,600	$4,321,700	$42,094,300
Chemical	1	4,200	$277,500	$50,000	$327,500
Communications	0	0	$0	$0	$0
Corrections	2	2,200	$100,800	$20,000	$120,800
Education	24	96,400	$7,979,700	$1,373,500	$9,353,200
Healthcare	1	3,000	$91,100	$78,400	$169,500
Military	3	23,400	$3,733,400	$45,000	$3,778,400
Power	0	0	$0	$0	$0

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Geologic - Landslides					
Landslide 1	3,671	48,574,611	$6,963,377,200	$1,918,799,700	$8,882,176,900
Administrative	1,882	19,383,859	$2,332,563,700	$681,537,400	$3,014,101,100
Chemical	16	26,200	$5,961,900	$445,900	$6,407,800
Communications	48	85,570	$11,490,200	$15,652,000	$27,142,200
Corrections	299	4,641,370	$724,485,000	$78,809,100	$803,294,100
Education	1,197	21,839,957	$3,489,721,100	$1,038,565,900	$4,528,287,000
Healthcare	88	1,124,700	$192,263,600	$32,903,800	$225,167,400
Military	138	1,464,555	$203,843,100	$69,590,600	$273,433,700
Power	3	8,400	$3,048,600	$1,295,000	$4,343,600
Landslide 2	1,411	28,122,586	$5,023,839,700	$1,183,167,600	$6,207,007,300
Administrative	659	7,768,814	$1,266,565,100	$348,401,700	$1,614,966,800
Chemical	4	7,300	$1,120,400	$20,000	$1,140,400
Communications	12	33,700	$4,097,700	$3,652,300	$7,750,000
Corrections	48	1,139,300	$218,337,000	$132,945,300	$351,282,300
Education	582	17,236,372	$3,119,367,000	$643,072,100	$3,762,439,100
Healthcare	46	876,700	$181,431,900	$40,664,900	$222,096,800
Military	57	1,030,000	$148,759,000	$12,166,900	$160,925,900
Power	3	30,400	$84,161,600	$2,244,400	$86,406,000
Landslide 3	614	4,783,620	$780,155,000	$128,913,300	$909,068,300
Administrative	316	1,115,220	$161,986,700	$31,992,300	$193,979,000
Chemical	8	9,100	$4,960,800	$34,600	$4,995,400
Communications	6	58,200	$12,675,700	$5,015,500	$17,691,200
Corrections	89	498,900	$82,587,200	$9,008,100	$91,595,300
Education	167	2,747,400	$476,109,100	$77,140,500	$553,249,600
Healthcare	15	235,600	$26,374,700	$5,076,900	$31,451,600
Military	13	119,200	$15,460,800	$645,400	$16,106,200
Power	0	0	$0	$0	$0
Landslide 4	572	1,980,115	$310,630,200	$35,820,300	$346,450,500
Administrative	391	924,250	$123,910,100	$19,091,400	$143,001,500
Chemical	3	4,800	$723,100	$54,000	$777,100
Communications	8	22,800	$4,533,200	$897,900	$5,431,100
Corrections	63	503,565	$108,967,500	$4,811,200	$113,778,700
Education	93	481,900	$66,833,700	$10,562,700	$77,396,400
Healthcare	5	5,000	$378,100	$178,100	$556,200
Military	8	36,600	$5,284,500	$135,000	$5,419,500
Power	1	1,200	$0	$90,000	$90,000

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Landslide 5	832	10,559,593	$1,951,099,000	$459,218,900	$2,410,317,900
Administrative	330	2,124,980	$337,607,400	$81,441,600	$419,049,000
Chemical	3	6,700	$2,682,000	$65,000	$2,747,000
Communications	6	71,600	$11,540,700	$1,611,600	$13,152,300
Corrections	139	1,566,813	$320,325,000	$45,103,700	$365,428,700
Education	314	6,184,000	$1,157,356,700	$309,651,100	$1,467,007,800
Healthcare	11	68,200	$8,596,000	$380,500	$8,976,500
Military	27	535,500	$112,991,200	$20,310,400	$133,301,600
Power	2	1,800	$0	$655,000	$655,000
Landslide 6	326	1,493,434	$214,286,400	$28,962,300	$243,248,700
Administrative	205	527,334	$64,645,100	$11,895,800	$76,540,900
Chemical	6	11,800	$1,428,800	$220,000	$1,648,800
Communications	3	700	$237,600	$800,000	$1,037,600
Corrections	63	556,000	$96,329,500	$9,210,300	$105,539,800
Education	37	274,600	$33,538,300	$6,166,200	$39,704,500
Healthcare	2	25,200	$4,900,000	$250,000	$5,150,000
Military	10	97,800	$13,207,100	$420,000	$13,627,100
Power	0	0	$0	$0	$0
Severe Storms - Hail					
Hail 1	0	0	$0	$0	$0
Administrative	0	0	$0	$0	$0
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Education	0	0	$0	$0	$0
Healthcare	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Power	0	0	$0	$0	$0
Hail 2	1,720	8,817,380	$1,281,534,400	$190,628,200	$1,472,162,600
Administrative	1,126	3,552,545	$390,727,600	$68,224,600	$458,952,200
Chemical	17	33,000	$5,727,400	$223,000	$5,950,400
Communications	25	89,100	$17,368,400	$7,842,000	$25,210,400
Corrections	191	1,974,235	$393,705,900	$26,315,400	$420,021,300
Education	280	2,413,100	$367,810,500	$77,769,300	$445,579,800
Healthcare	36	401,300	$50,980,000	$5,814,900	$56,794,900
Military	44	353,100	$55,214,600	$4,269,000	$59,483,600
Power	1	1,000	$0	$170,000	$170,000

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Hail 3	2,899	22,431,549	$3,372,992,000	$646,252,000	$4,019,244,000
Administrative	1,596	7,647,621	$965,206,800	$158,614,000	$1,123,820,800
Chemical	19	30,000	$10,341,300	$586,500	$10,927,800
Communications	27	35,370	$6,484,200	$6,449,100	$12,933,300
Corrections	315	2,600,913	$439,499,000	$81,689,800	$521,188,800
Education	798	10,747,290	$1,698,846,200	$372,340,500	$2,071,186,700
Healthcare	43	597,900	$123,788,800	$13,319,000	$137,107,800
Military	96	762,555	$125,773,000	$11,448,100	$137,221,100
Power	5	9,900	$3,052,700	$1,805,000	$4,857,700
Hail 4	991	13,214,809	$2,293,679,300	$622,776,100	$2,916,455,400
Administrative	419	4,287,942	$641,799,100	$128,699,700	$770,498,800
Chemical	4	2,900	$808,300	$30,000	$838,300
Communications	18	35,000	$5,014,200	$4,285,100	$9,299,300
Corrections	26	443,100	$58,847,400	$9,518,300	$68,365,700
Education	471	7,813,767	$1,489,911,600	$455,079,100	$1,944,990,700
Healthcare	25	245,400	$37,831,500	$4,823,300	$42,654,800
Military	28	386,700	$59,467,200	$20,340,600	$79,807,800
Power	0	0	$0	$0	$0
Hail 5	929	24,491,576	$4,784,329,900	$1,134,393,300	$5,918,723,200
Administrative	324	5,493,904	$1,002,108,800	$335,175,800	$1,337,284,600
Chemical	0	0	$0	$0	$0
Communications	9	78,900	$15,456,500	$6,738,800	$22,195,300
Corrections	107	1,889,400	$399,783,800	$133,354,800	$533,138,600
Education	420	15,451,272	$3,028,720,200	$599,658,100	$3,628,378,300
Healthcare	32	634,200	$120,929,700	$40,408,000	$161,337,700
Military	34	913,000	$133,173,400	$16,748,400	$149,921,800
Power	3	30,900	$84,157,500	$2,309,400	$86,466,900
Hail 6	886	26,515,945	$3,498,351,900	$1,160,832,500	$4,659,184,400
Administrative	317	10,819,745	$1,274,935,800	$483,646,100	$1,758,581,900
Chemical	0	0	$0	$0	$0
Communications	4	34,200	$251,800	$2,314,300	$2,566,100
Corrections	62	1,998,300	$259,195,100	$29,009,400	$288,204,500
Education	421	12,338,800	$1,757,637,400	$580,311,500	$2,337,948,900
Healthcare	31	456,600	$80,414,300	$15,089,000	$95,503,300
Military	51	868,300	$125,917,500	$50,462,200	$176,379,700
Power	0	0	$0	$0	$0

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Severe Storms - High/Strong Winds					
High/Strong Winds 1	0	0	$0	$0	$0
Administrative	0	0	$0	$0	$0
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Education	0	0	$0	$0	$0
Healthcare	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Power	0	0	$0	$0	$0
High/Strong Winds 2	379	1,887,613	$300,244,600	$35,145,200	$335,389,800
Administrative	244	612,548	$71,249,300	$13,613,700	$84,863,000
Chemical	2	300	$949,400	$5,000	$954,400
Communications	5	3,800	$194,000	$1,203,300	$1,397,300
Corrections	63	635,465	$128,242,000	$7,161,200	$135,403,200
Education	48	469,200	$80,834,100	$11,243,200	$92,077,300
Healthcare	11	138,400	$14,399,500	$1,718,800	$16,118,300
Military	5	26,700	$4,376,300	$110,000	$4,486,300
Power	1	1,200	$0	$90,000	$90,000
High/Strong Winds 3	3,859	50,264,473	$7,684,457,400	$1,907,850,100	$9,592,307,500
Administrative	1,916	17,675,620	$2,252,698,900	$631,704,100	$2,884,403,000
Chemical	24	43,400	$12,114,800	$711,600	$12,826,400
Communications	41	215,700	$35,896,200	$17,296,500	$53,192,700
Corrections	470	5,534,783	$980,079,900	$101,054,600	$1,081,134,500
Education	1,240	24,561,470	$4,004,506,800	$1,061,184,900	$5,065,691,700
Healthcare	58	867,800	$159,511,400	$28,700,600	$188,212,000
Military	106	1,356,800	$236,600,800	$65,747,800	$302,348,600
Power	4	8,900	$3,048,600	$1,450,000	$4,498,600
High/Strong Winds 4	2,079	18,582,283	$2,657,347,900	$743,072,200	$3,400,420,100
Administrative	1,153	7,196,771	$872,582,500	$208,299,000	$1,080,881,500
Chemical	10	15,100	$2,242,400	$52,900	$2,295,300
Communications	28	35,770	$7,254,700	$7,175,500	$14,430,200
Corrections	118	1,603,700	$222,061,100	$38,460,100	$260,521,200
Education	609	8,210,887	$1,354,815,500	$451,820,600	$1,806,636,100
Healthcare	59	501,800	$66,720,000	$9,666,600	$76,386,600
Military	101	1,016,955	$131,671,700	$27,097,500	$158,769,200
Power	1	1,300	$0	$500,000	$500,000

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
High/Strong Winds 5	760	18,992,805	$3,587,536,100	$862,848,200	$4,450,384,300
Administrative	325	4,643,633	$819,287,700	$288,962,700	$1,108,250,400
Chemical	3	600	$570,400	$50,000	$620,400
Communications	6	14,300	$829,000	$894,000	$1,723,000
Corrections	32	769,500	$169,587,100	$114,873,000	$284,460,100
Education	342	12,222,772	$2,310,708,800	$415,898,900	$2,726,607,700
Healthcare	22	569,000	$98,143,000	$31,806,200	$129,949,200
Military	27	742,600	$104,248,500	$8,119,000	$112,367,500
Power	3	30,400	$84,161,600	$2,244,400	$86,406,000
High/Strong Winds 6	348	5,744,085	$1,001,301,500	$205,966,400	$1,207,267,900
Administrative	144	1,673,185	$258,959,700	$31,780,700	$290,740,400
Chemical	1	6,500	$1,000,000	$20,000	$1,020,000
Communications	3	3,000	$401,200	$1,060,000	$1,461,200
Corrections	18	362,500	$51,061,100	$18,338,800	$69,399,900
Education	151	3,299,900	$592,060,700	$145,010,900	$737,071,600
Healthcare	17	258,400	$75,170,400	$7,562,000	$82,732,400
Military	14	140,600	$22,648,400	$2,194,000	$24,842,400
Power	0	0	$0	$0	$0
Severe Storms - Lightning					
Lightning 1	1,634	24,262,262	$4,498,482,300	$987,252,700	$5,485,735,000
Administrative	848	6,438,820	$1,058,397,500	$322,807,600	$1,381,205,100
Chemical	8	14,500	$2,659,800	$276,000	$2,935,800
Communications	21	108,900	$19,904,400	$7,315,300	$27,219,700
Corrections	183	2,645,270	$553,126,800	$142,253,000	$695,379,800
Education	466	13,435,272	$2,525,008,800	$462,944,500	$2,987,953,300
Healthcare	31	458,600	$91,356,900	$33,616,900	$124,973,800
Military	74	1,130,700	$163,870,600	$15,665,000	$179,535,600
Power	3	30,200	$84,157,500	$2,374,400	$86,531,900
Lightning 2	2,735	22,727,633	$3,352,622,100	$619,584,900	$3,972,207,000
Administrative	1,534	7,824,835	$978,692,900	$160,913,100	$1,139,606,000
Chemical	20	40,700	$10,889,800	$506,600	$11,396,400
Communications	24	72,500	$13,717,800	$10,219,500	$23,937,300
Corrections	287	2,386,478	$414,277,800	$66,401,100	$480,678,900
Education	728	10,870,620	$1,691,149,100	$357,287,100	$2,048,436,200
Healthcare	65	911,300	$151,318,400	$17,630,500	$168,948,900
Military	72	610,400	$89,523,600	$4,842,000	$94,365,600
Power	5	10,800	$3,052,700	$1,785,000	$4,837,700

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Lightning 3	1,111	17,168,485	$2,489,216,200	$712,726,800	$3,201,943,000
Administrative	599	9,380,690	$1,155,959,700	$294,951,600	$1,450,911,300
Chemical	2	800	$312,600	$0	$312,600
Communications	15	53,970	$2,615,100	$2,563,500	$5,178,600
Corrections	132	1,720,600	$316,534,400	$29,660,000	$346,194,400
Education	291	5,063,070	$853,524,400	$361,762,700	$1,215,287,100
Healthcare	27	462,000	$86,415,500	$12,976,700	$99,392,200
Military	44	486,555	$73,854,500	$10,687,300	$84,541,800
Power	1	800	$0	$125,000	$125,000
Lightning 4	1,272	22,251,979	$3,317,407,300	$1,007,041,300	$4,324,448,600
Administrative	534	5,820,212	$741,459,200	$301,911,700	$1,043,370,900
Chemical	6	7,000	$1,971,700	$30,000	$2,001,700
Communications	19	34,300	$7,959,800	$6,759,500	$14,719,300
Corrections	50	1,312,200	$155,138,500	$24,871,800	$180,010,300
Education	586	13,967,067	$2,249,801,000	$606,300,000	$2,856,101,000
Healthcare	30	470,500	$80,847,400	$14,866,900	$95,714,300
Military	47	640,700	$80,229,700	$52,301,400	$132,531,100
Power	0	0	$0	$0	$0
Lightning 5	354	2,295,400	$234,691,000	$77,003,700	$311,694,700
Administrative	205	1,082,900	$86,916,700	$32,778,500	$119,695,200
Chemical	4	2,900	$1,043,100	$26,900	$1,070,000
Communications	3	2,900	$291,500	$471,500	$763,000
Corrections	30	474,300	$37,654,700	$7,698,800	$45,353,500
Education	93	661,000	$97,242,700	$33,660,800	$130,903,500
Healthcare	11	25,500	$3,428,100	$285,200	$3,713,300
Military	8	45,900	$8,114,200	$2,082,000	$10,196,200
Power	0	0	$0	$0	$0
Lightning 6	318	6,720,100	$1,331,658,600	$351,247,700	$1,682,906,300
Administrative	61	1,208,900	$246,542,100	$60,972,700	$307,514,800
Chemical	0	0	$0	$0	$0
Communications	1	0	$86,500	$300,000	$386,500
Corrections	19	367,100	$74,299,000	$9,003,000	$83,302,000
Education	226	4,767,200	$926,199,900	$263,203,400	$1,189,403,300
Healthcare	3	7,500	$578,000	$78,000	$656,000
Military	8	369,400	$83,953,100	$17,690,600	$101,643,700
Power	0	0	$0	$0	$0

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Severe Storms - Thunderstorm Winds					
Thunderstorm Winds 1	0	0	$0	$0	$0
Administrative	0	0	$0	$0	$0
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Education	0	0	$0	$0	$0
Healthcare	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Power	0	0	$0	$0	$0
Thunderstorm Winds 2	2,138	12,001,282	$1,755,660,800	$235,550,200	$1,991,211,000
Administrative	1,302	4,808,964	$568,410,100	$84,009,500	$652,419,600
Chemical	20	36,200	$8,729,800	$572,000	$9,301,800
Communications	26	21,870	$6,386,400	$6,418,900	$12,805,300
Corrections	273	2,644,748	$536,025,100	$51,626,200	$587,651,300
Education	430	3,954,700	$558,721,000	$84,127,000	$642,848,000
Healthcare	28	188,200	$24,233,800	$2,813,100	$27,046,900
Military	57	339,000	$50,106,000	$4,813,500	$54,919,500
Power	2	7,600	$3,048,600	$1,170,000	$4,218,600
Thunderstorm Winds 3	2,471	19,706,991	$3,125,369,700	$773,513,300	$3,898,883,000
Administrative	1,298	6,675,479	$883,147,600	$180,739,200	$1,063,886,800
Chemical	17	26,500	$7,287,200	$257,500	$7,544,700
Communications	30	29,100	$6,890,100	$7,106,100	$13,996,200
Corrections	229	1,924,500	$300,766,100	$42,821,800	$343,587,900
Education	745	9,384,057	$1,672,736,700	$505,523,900	$2,178,260,600
Healthcare	71	805,700	$112,027,300	$12,199,900	$124,227,200
Military	80	860,355	$142,514,700	$24,364,900	$166,879,600
Power	1	1,300	$0	$500,000	$500,000
Thunderstorm Winds 4	1,259	15,859,641	$2,656,801,800	$549,381,200	$3,206,183,000
Administrative	670	4,652,541	$615,507,300	$110,148,000	$725,655,300
Chemical	3	3,200	$860,000	$10,000	$870,000
Communications	15	98,800	$15,628,100	$5,732,200	$21,360,300
Corrections	61	1,049,000	$163,188,200	$34,856,600	$198,044,800
Education	430	9,137,900	$1,687,991,300	$377,996,300	$2,065,987,600
Healthcare	25	488,900	$103,854,000	$12,316,700	$116,170,700
Military	51	426,100	$69,768,800	$7,926,400	$77,695,200
Power	4	3,200	$4,100	$395,000	$399,100

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Thunderstorm Winds 5	815	20,051,635	$3,054,220,300	$879,482,300	$3,933,702,600
Administrative	223	4,167,735	$596,916,900	$276,066,000	$872,982,900
Chemical	0	0	$0	$0	$0
Communications	6	84,000	$14,760,900	$5,532,800	$20,293,700
Corrections	92	1,749,600	$253,490,100	$23,100,900	$276,591,000
Education	467	12,944,800	$1,993,821,800	$533,694,100	$2,527,515,900
Healthcare	11	500,500	$101,815,800	$20,943,200	$122,759,000
Military	16	605,000	$93,414,800	$20,145,300	$113,560,100
Power	0	0	$0	$0	$0
Thunderstorm Winds 6	743	27,894,410	$4,651,334,900	$1,316,955,100	$5,968,290,000
Administrative	290	11,539,738	$1,623,296,200	$523,397,500	$2,146,693,700
Chemical	0	0	$0	$0	$0
Communications	6	38,800	$909,600	$2,839,300	$3,748,900
Corrections	46	1,538,100	$297,561,700	$127,482,200	$425,043,900
Education	318	13,342,772	$2,429,655,100	$583,817,200	$3,013,472,300
Healthcare	32	352,100	$72,013,400	$31,181,300	$103,194,700
Military	49	1,053,200	$143,741,400	$46,018,200	$189,759,600
Power	2	29,700	$84,157,500	$2,219,400	$86,376,900
Severe Storms - Winter Storms					
Winter Storm 1	0	0	$0	$0	$0
Administrative	0	0	$0	$0	$0
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Education	0	0	$0	$0	$0
Healthcare	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Power	0	0	$0	$0	$0
Winter Storm 2	185	6,774,475	$719,625,500	$270,219,600	$989,845,100
Administrative	1,302	1,351,475	$118,174,800	$164,541,300	$282,716,100
Chemical	20	100	$450,000	$5,000	$455,000
Communications	26	0	$0	$0	$0
Corrections	273	788,300	$77,538,900	$7,876,000	$85,414,900
Education	430	4,363,500	$464,670,400	$87,427,400	$552,097,800
Healthcare	28	257,400	$57,282,500	$10,279,900	$67,562,400
Military	57	12,500	$1,508,900	$0	$1,508,900
Power	2	1,200	$0	$90,000	$90,000

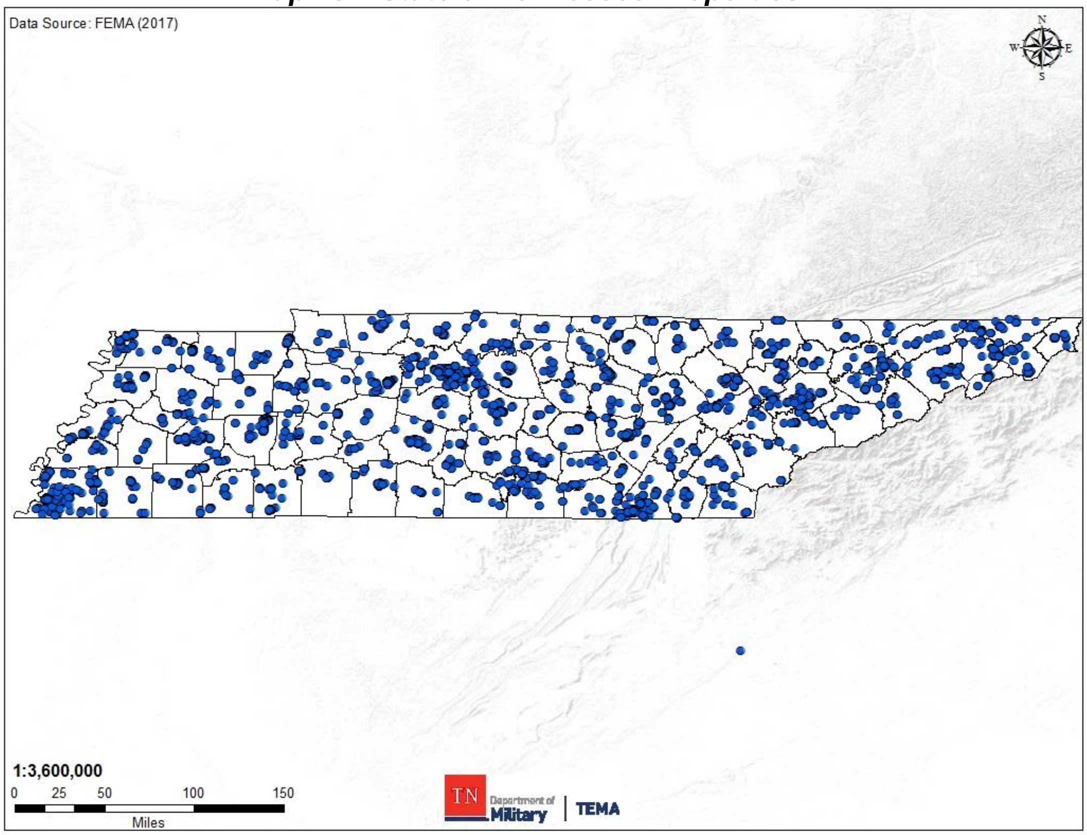
Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Winter Storm 3	993	10,885,651	$1,897,193,500	$427,811,200	$2,325,004,700
Administrative	1,298	2,489,316	$374,816,000	$85,791,700	$460,607,700
Chemical	17	14,900	$2,062,600	$51,000	$2,113,600
Communications	30	5,600	$1,042,700	$4,130,300	$5,173,000
Corrections	229	1,533,235	$292,878,000	$20,262,900	$313,140,900
Education	745	6,037,900	$1,085,873,800	$292,132,600	$1,378,006,400
Healthcare	71	227,200	$24,941,200	$5,199,700	$30,140,900
Military	80	577,500	$115,579,200	$20,243,000	$135,822,200
Power	1	0	$0	$0	$0
Winter Storm 4	3,433	52,660,907	$8,473,630,400	$2,085,666,500	$10,559,296,900
Administrative	670	19,965,347	$2,638,679,700	$717,449,600	$3,356,129,300
Chemical	3	13,100	$4,776,800	$432,000	$5,208,800
Communications	15	250,370	$39,333,500	$17,155,400	$56,488,900
Corrections	61	3,948,113	$740,030,300	$182,951,100	$922,981,400
Education	430	25,867,522	$4,583,339,100	$1,054,764,900	$5,638,104,000
Healthcare	25	809,500	$150,024,700	$47,340,500	$197,365,200
Military	51	1,770,155	$230,240,200	$62,198,600	$292,438,800
Power	4	36,800	$87,206,100	$3,374,400	$90,580,500
Winter Storm 5	2,203	15,811,606	$2,492,345,800	$634,169,700	$3,126,515,500
Administrative	223	5,098,119	$693,957,200	$146,142,500	$840,099,700
Chemical	0	25,000	$7,170,800	$331,500	$7,502,300
Communications	6	4,600	$2,390,100	$4,658,700	$7,048,800
Corrections	92	2,255,000	$375,908,800	$48,342,900	$424,251,700
Education	467	7,106,287	$1,221,819,600	$413,183,500	$1,635,003,100
Healthcare	11	716,400	$92,685,700	$6,671,900	$99,357,600
Military	16	602,400	$98,409,500	$14,018,700	$112,428,200
Power	0	3,800	$4,100	$820,000	$824,100
Winter Storm 6	611	9,338,620	$1,648,092,300	$337,015,100	$1,985,107,400
Administrative	290	2,897,500	$449,150,400	$60,435,100	$509,585,500
Chemical	0	12,800	$2,416,800	$20,000	$2,436,800
Communications	6	12,000	$1,808,800	$1,684,900	$3,493,700
Corrections	46	381,300	$64,675,200	$20,454,800	$85,130,000
Education	318	5,389,020	$987,223,000	$237,650,100	$1,224,873,100
Healthcare	32	324,900	$89,010,200	$9,962,200	$98,972,400
Military	49	321,100	$53,807,900	$6,808,000	$60,615,900
Power	2	0	$0	$0	$0

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Tornadoes					
Tornado 1	0	0	$0	$0	$0
Administrative	0	0	$0	$0	$0
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Education	0	0	$0	$0	$0
Healthcare	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Power	0	0	$0	$0	$0
Tornado 2	2,370	32,949,584	$5,888,980,400	$1,272,533,000	$7,161,513,400
Administrative	1,153	8,903,027	$1,428,542,000	$370,993,400	$1,799,535,400
Chemical	16	27,400	$5,607,500	$400,600	$6,008,100
Communications	21	111,200	$17,249,200	$4,865,600	$22,114,800
Corrections	337	3,782,935	$754,277,000	$168,407,900	$922,684,900
Education	707	17,988,322	$3,213,683,100	$666,332,600	$3,880,015,700
Healthcare	46	948,000	$194,513,900	$41,712,500	$236,226,400
Military	85	1,156,500	$190,946,100	$16,921,000	$207,867,100
Power	5	32,200	$84,161,600	$2,899,400	$87,061,000
Tornado 3	2,381	12,790,650	$1,850,951,600	$379,947,300	$2,230,898,900
Administrative	1,526	5,365,127	$618,939,400	$109,460,100	$728,399,500
Chemical	17	27,800	$8,421,400	$103,900	$8,525,300
Communications	31	29,670	$7,566,900	$8,767,100	$16,334,000
Corrections	161	1,277,213	$223,443,500	$51,554,200	$274,997,700
Education	534	5,037,840	$849,312,700	$194,173,400	$1,043,486,100
Healthcare	39	315,300	$44,997,800	$6,762,100	$51,759,900
Military	72	736,700	$98,269,900	$8,956,500	$107,226,400
Power	1	1,000	$0	$170,000	$170,000
Tornado 4	1,937	27,802,880	$4,330,681,400	$1,047,272,300	$5,377,953,700
Administrative	834	9,118,458	$1,083,723,900	$259,087,100	$1,342,811,000
Chemical	6	6,200	$2,393,900	$335,000	$2,728,900
Communications	26	97,500	$19,422,000	$10,782,300	$30,204,300
Corrections	147	2,079,500	$346,883,200	$32,778,000	$379,661,200
Education	803	15,047,867	$2,668,411,400	$696,950,900	$3,365,362,300
Healthcare	60	760,700	$110,138,900	$17,426,300	$127,565,200
Military	59	685,255	$96,659,500	$28,787,700	$125,447,200
Power	2	7,400	$3,048,600	$1,125,000	$4,173,600

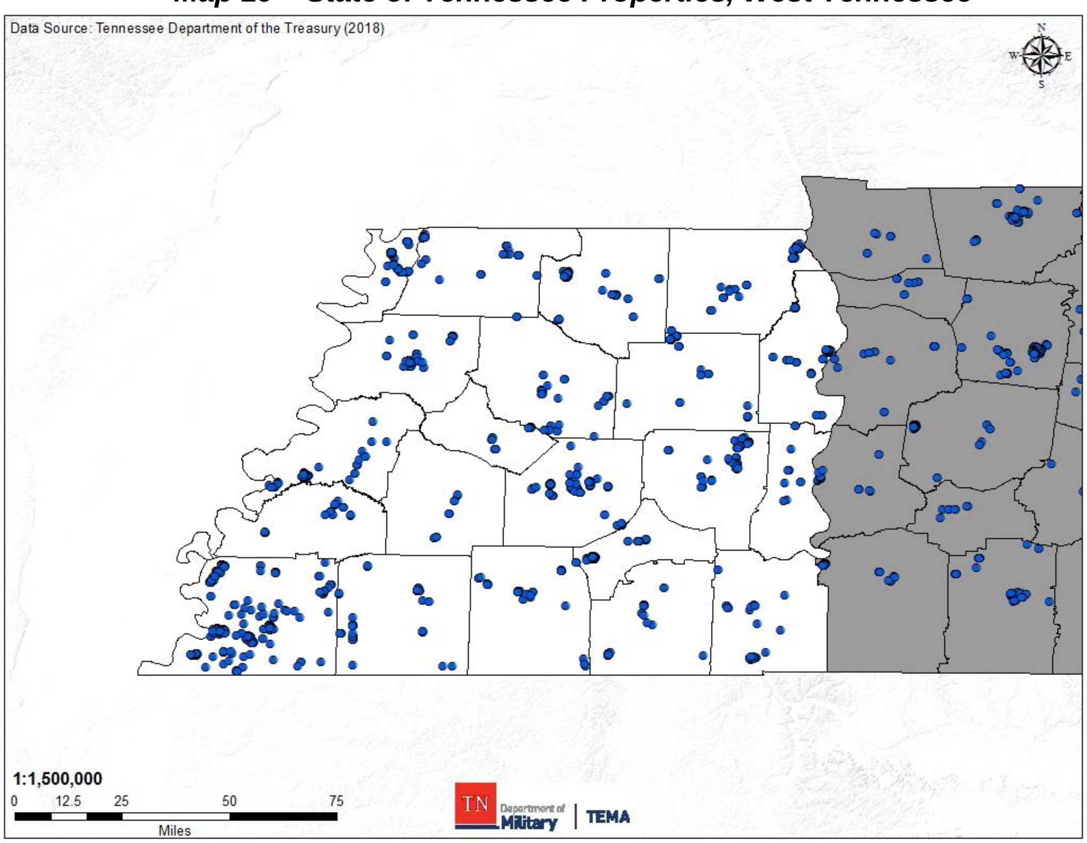
Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Tornado 5	335	9,316,770	$1,305,876,200	$450,449,000	$1,756,325,200
Administrative	165	6,120,370	$833,777,900	$217,456,300	$1,051,234,200
Chemical	1	4,500	$454,200	$0	$454,200
Communications	5	34,200	$337,000	$3,214,300	$3,551,300
Corrections	42	918,300	$150,688,100	$16,995,900	$167,684,000
Education	81	1,866,800	$285,399,600	$180,499,400	$465,899,000
Healthcare	15	51,500	$7,011,200	$3,215,900	$10,227,100
Military	26	321,100	$28,208,200	$29,067,200	$57,275,400
Power	0	0	$0	$0	$0
Tornado 6	403	12,654,075	$1,866,897,900	$604,680,500	$2,471,578,400
Administrative	105	2,337,475	$322,294,900	$217,363,300	$539,658,200
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	14	848,000	$75,739,400	$10,151,700	$85,891,100
Education	265	8,823,400	$1,326,119,100	$347,202,200	$1,673,321,300
Healthcare	7	259,900	$57,282,500	$10,337,400	$67,619,900
Military	11	384,100	$85,462,000	$19,535,900	$104,997,900
Power	1	1,200	$0	$90,000	$90,000
Wildfires					
Wildfire (WUI)	2,277	11,616,916	$1,565,228,400	$275,344,200	$1,840,572,600
Administrative	1,428	4,689,546	$492,066,300	$91,213,100	$583,279,400
Chemical	27	36,100	$9,097,900	$419,500	$9,517,400
Communications	25	93,400	$17,623,700	$4,625,100	$22,248,800
Corrections	255	2,214,870	$398,252,600	$40,168,700	$438,421,300
Education	436	3,732,600	$519,780,800	$119,751,900	$639,532,700
Healthcare	35	416,300	$58,958,000	$10,976,700	$69,934,700
Military	69	432,100	$69,445,000	$7,664,200	$77,109,200
Power	2	2,000	$4,100	$525,000	$529,100

**The compiled data are from the Tennessee Department of the Treasury.*

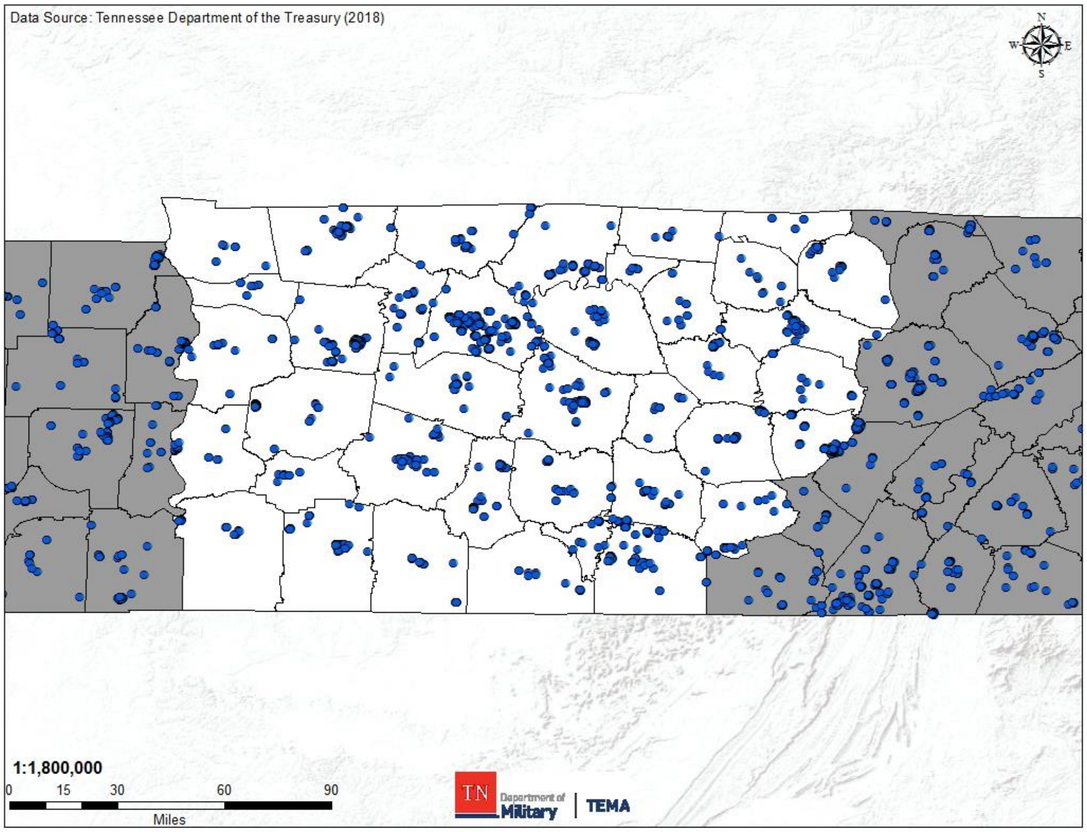
Map 18 – State of Tennessee Properties



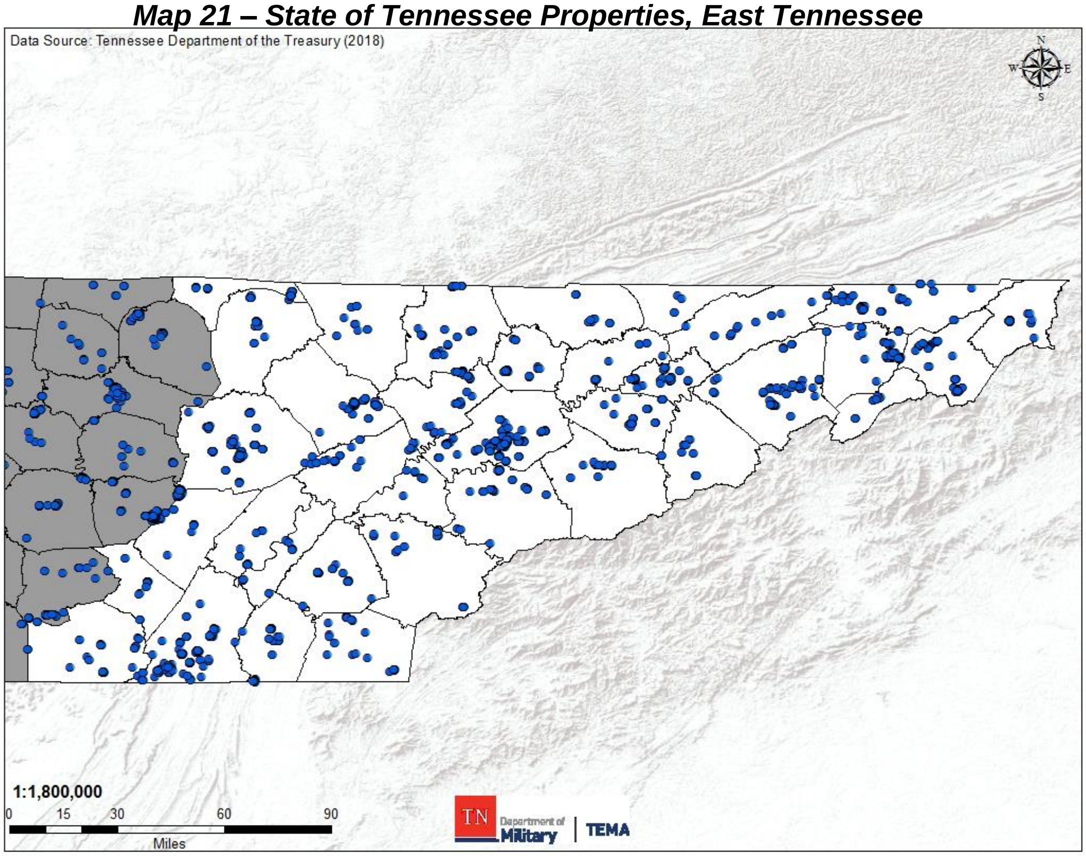
Map 19 – State of Tennessee Properties, West Tennessee



Map 20 – State of Tennessee Properties, Middle Tennessee



Map 21 – State of Tennessee Properties, East Tennessee



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Section 3 – Local Plan Integration

3.1 – Local Planning Integration

Upon approval and adoption of this state hazard mitigation plan, a new 5 year cycle will begin. It is the state's intention to update the plan at least annually. It will not be appropriate to update every section of the plan. Updates will be made to the plan's mitigation goals and objectives, mitigation actions, local plan statuses, grant information, state and local capabilities, and any procedure changes applicable to the processes detailed in this plan. Special attention will be given to these updates to reflect changes in development, priorities, and completed mitigation efforts. On a yearly basis these changes will be presented to Tennessee's ESC program as well as the Hazard Mitigation Council.

TEMA's highest priority is local plan development. This includes the state's review process for local mitigation plans. Once completed, jurisdictions submit plans to TEMA for preliminary review. TEMA reviews plans within a 30 to 45 day timeframe. The state's reviews the plans closely following FEMA's Local Mitigation Planning Handbook and FEMA's Local Mitigation Plan Review Guide. The plan is then returned to the local jurisdiction for revisions, or it is forwarded on to FEMA for their review.

3.2 – Local Planning Assistance

The Tennessee Emergency Management Agency (TEMA) is structured to primarily support county government. However, the agency strives to support all stakeholders of emergency management to the fullest extent possible. TEMA proactively offers a high level of technical assistance to Tennessee counties in the development of county hazard mitigation plans. TEMA also provides support to individual jurisdictions and other organizations in developing mitigation plans, as appropriate.

The Tennessee Emergency Management Agency (TEMA) is a relatively small organization, with about 110 staff positions. There is some variance, as temporary hires and other changes cause staffing levels to fluctuate slightly. TEMA has four offices: Headquarters (statewide), TEMA West Region, TEMA Middle Region, and TEMA East Region offices.

TEMA Headquarters mitigation staff supports the Region Offices with mitigation plan compliance review and mitigation grant management.

TEMA West Region has eight (8) staff positions and serves 21 counties. TEMA Middle Region has ten (10) staff positions and serves 38 counties. TEMA East Region has ten (10) staff positions and serves 36 counties. In addition, TEMA East Region houses several staff responsible for planning with the U.S. Department of Energy.

TEMA Support for County Mitigation Plans

The three TEMA Region Offices provide direct mitigation planning technical assistance to counties. Each Region Office has a full-time planner assigned to the Region who supports the development of county plans, including mitigation plans. These planners also assist counties in developing other plans such as special event plans and basic emergency operations plans (BEOP), which are required in section 58-2-101, Tennessee Code Annotated.

Mitigation Planning Challenges & Opportunities

Hazard mitigation planning is one of the most challenging processes in emergency management. Hazard mitigation combines many disciplines including community planning, infrastructure design, capital improvement, and floodplain management, along with emergency management. Emergency Management professionals must rely heavily on outside expertise in order to produce an effective plan.

In addition, local mitigation plans are subject to a substantial list of federal requirements enumerated in the Code of Federal Regulations (44 CFR §201.6) and supporting administrative policy documents. These requirements specify content, process, and participants for local hazard mitigation plan development. Once developed, local hazard mitigation plans must be submitted to the Federal Emergency Management Agency for compliance review. Noncompliant plans must be revised by the jurisdiction and re-submitted.

Tennessee Local Mitigation Planning Template

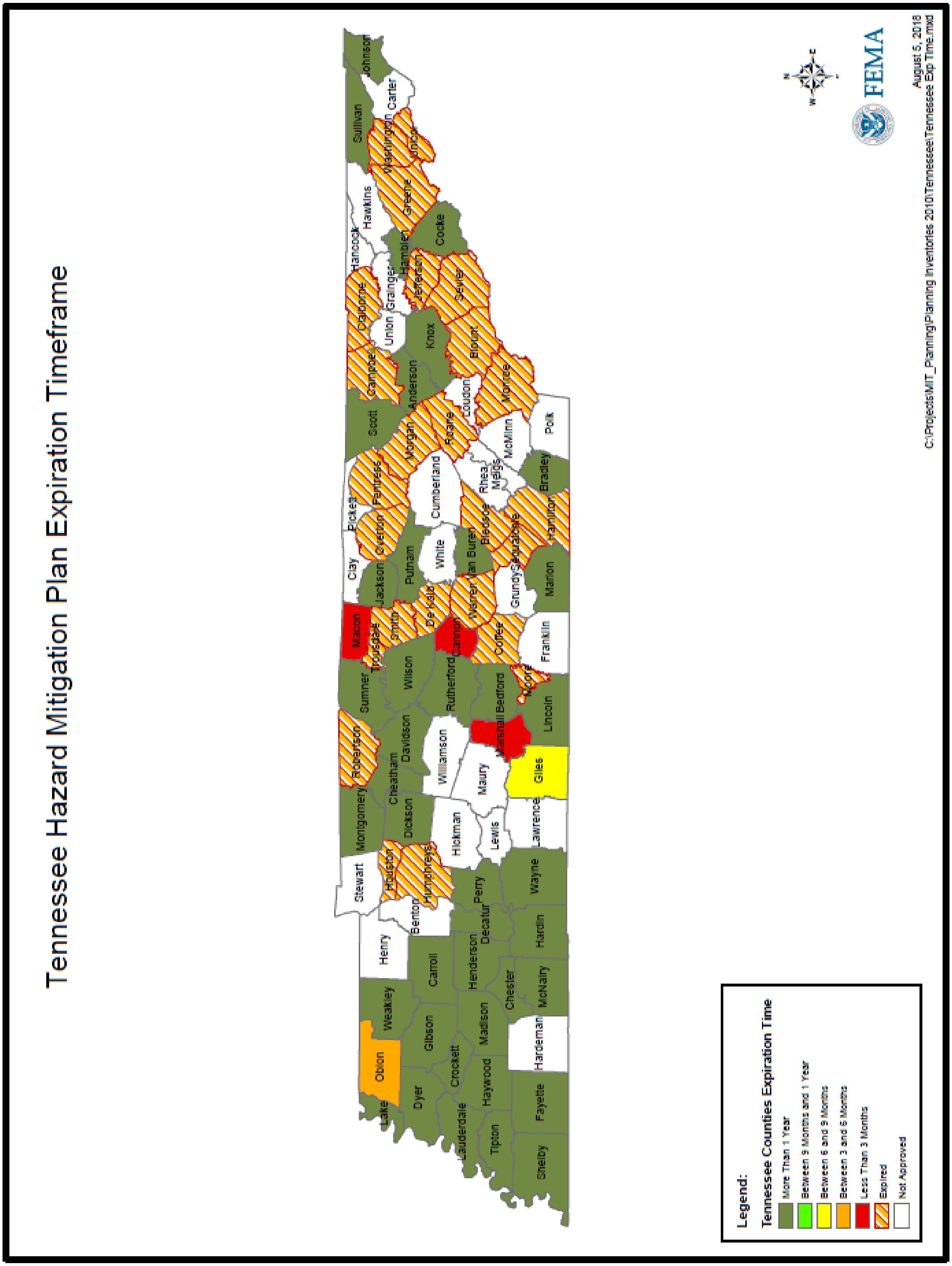
The Tennessee Local Mitigation Planning Template was first developed in 2010 and has evolved significantly since that time. Initially, it was developed out of necessity to allow the single TEMA planner assigned to supporting county mitigation plan updates to efficiently produce an approvable mitigation plan document during a county planning process. The resulting uniformity of plans developed using this template also began to foster the sense of connectedness to the larger hazard mitigation program in the state. Each county plan had similar elements that could be easily understood and digested once one was familiar with the basics of any plan.

The Tennessee Local Mitigation Planning Template has evolved as the planning technical assistance process in the state has evolved. Now, the three TEMA Regional Planners each support the counties in their Grand Region of the State, which are the basis for the TEMA Regions. The Grand Regions of the State are West, Middle and Eastern Tennessee, roughly bounded by the Tennessee River separating West from Middle, and the Cumberland Plateau separating Middle from East.

Currently, the State of Tennessee places no additional requirements or restrictions on local mitigation planning. County or local mitigation plans must simply satisfy the planning requirements set forth by FEMA in the Code of Federal Regulations (44 CFR 201.6) to be approved at the state level. The Tennessee Local Mitigation Planning Template lays out a table of contents to assist in meeting the required elements for a FEMA-approvable hazard mitigation plan. In addition, the template includes helpful overview language and applicable graphics related to common hazards that impact Tennessee. The template also includes blank charts that support simple hazard identification and risk assessment processes.

Hazard mitigation grant funds are often available to support the development of local plans. More information and contact information can be found on the state website at: https://www.tn.gov/tema/emergency-community/mitigation/mitigation-grant-programs.html.

Map 22 – Local Plan Statuses, Tennessee



3.3 – Prioritizing Local Assistance

Clearly defined processes and procedures are critical to the fair and reasonable allocation of funds for hazard mitigation. Competing interests at the state and local level must be subordinated to a prioritize ation paradigm, as outlined in FEMA's Hazard Mitigation Unified Guidance. To this end, the State of Tennessee has established an explicit application procedure for the procurement and prioritization of HMGPs according to a *Mitigation Application Ranking System* (MARS.) This system allows for a finitely scored, but reasonably adaptive assessment of 14 criteria to help facilitate Tennessee's authorities in assessing a request's qualifications for funding. The process has roughly 5 constituent parts.

An application is provided by the state to jurisdictions requesting funding. This application includes a project proposal, which must include project duration, scope of work and anticipated budget requirements. A Cost Benefit Analysis is a requisite component of the applicant's proposal. If one is not completed, TEMA will conduct one in cooperation with the local body. To this end, clear and demonstrable economic data should be provided in the application and adjuvant materials.

The state then delineates the grants by the specific activity for which the monies will be used. These include: *Acquisition/Elevation, Flood Control, Safe Room/Space, Seismic Retrofit, Planning, and Not Specifically Defined/or/Miscellaneous*. The more specific and targeted the action, the better the Tennessee Hazard Mitigation Council (TNHMC) and the State Hazard Mitigation Officer (SHMO) will be able to establish its eligibility for FEMA funding. The TNHMC is comprised of 10 members from departments with a broad spectrum of experience and interests in mitigation activities and vulnerable sectors. These departments include:

- Department of Agriculture
- Department of Commerce & Insurance
- Department of Economic & Community Development
- Department of Environment & Conservation
- Department of Finance & Administration
- Department of Health
- Department of Safety- Homeland Security
- Department of Safety- Highway Patrol
- Tennessee Wildlife Resources Agency
- Department of Transportation
- TEMA (1 member- State Hazard Mitigation Officer)

Additionally the SHMO will review every application to established NFIP compliance. The components to the MARS system are then scored: These components are broken down as follows:

- The capability of the applicant to complete the activity based on prior project performance and regional assessments of those activities.
- The population of the area in question.
- Median income of that population.
- The community's participation in CRS, adoption of IBC/building codes, history of mitigation efforts, IDS (Intense Developmental Stress) or its involvement in a declared disaster within the past year.
- If involved in a declared disaster, does the proposal directly address said disaster?

- What is the incidence of presidentially declared disasters in the area for the previous 10 years?
- Does the project address high risk hazards for the geographic region at large?
- What is the relative priority of the proposal to only the applicant's area?
- Does the proposal include Repetitive Flood Claim structures (e.g. insured by NFIP and with a history of 1 or more claims for damage or loss)?
- Is the project located in a floodplain or flood way?
- Does the proposal have a demonstrable and direct economic benefit to the local community through either:
  - Private sector?
  - Public sector?
  - Government?
  - The mitigation of disproportionate environmental effects to minorities and low-income individuals per executive order 12898 or partnerships between the government and private sector?
- Does the proposal include CIAO assets, or assets and infrastructure that perform a critical function for the state, region, or area included in the application?
- Will the proposal permanently eliminate or mitigate the hazard being addressed?
- Does the proposal save lives, address more than 1 hazard or consist of multiple objectives that can be accomplished through a single project?

After the completion of scoring the criteria, the proposal is re-evaluated by the HMC and SHMO. This evaluation includes the following criteria, which the members of TNHMC must verify:

- Is there personal knowledge of an activity in progress, completed, or upcoming that could negatively impact the proposal?
- Is there personal knowledge of any existing financial mechanisms?
- Is there potential for the duplication of benefits?
- Is there personal information capable of supporting the applicant, their proposal, or conversely generating concern for either?

Prior to submission to FEMA, applicants include any and all necessary documentation for a FEMA environmental compliance review. This also includes documentation to establish compliance with Executive Order 12898 to ensure that environmental justice is addressed for disproportionally high and adverse human health or environmental effects on minority populations. Additionally, the protection of wetlands and associated long-term environmental costs will be included in the CBA as part of the environmental compliance assurance. This further assists the SHMO in prioritizing applicants and their regions long term as well as short-term needs.

FEMA will conduct an independent and thorough environmental compliance review, though state standards will ensure a transition of application materials and adequate data for this process. Once the SHMO has completed a summary document outlining all proposals, this summary is presented to the MARS TNHMC for prioritization and final review. This disposition is not binding until a majority vote is reached, as well as any non-consenting objections have been discussed in council or individually to resolve particular areas of concern. The council's final recommendations are forwarded to the GAR/Director for a disposition determination.

As part of their targeted and critical mitigation actions, TEMA has identified as a priority in 2.1 and 2.2 the intent to "continue to maintain a professional, trained, and effective, grant programs staff at TEMA to ensure a continual grant cycle." This Mitigation Action allows for the prioritization of community and local grant funding on a rolling basis throughout the planning year, as well as to address it in contacts with community and local planners.

When RL/SRL, FMA, or RFC grants are applicable, the SHMO or TEMA administration may opt to exempt the applicant from the TNHMC requirement as adequate evaluations will substitute for this component of the process. It remains the responsibility of the SHMO however to ensure that all environmental and CBA information satisfies existing guidelines, as well as the MARS scoring system elements.

The SHMO remains responsible for compliance with application procedures during the course of the fiscal year notification cycle. The director and GAR then submits the completed and approved applications to FEMA via the eGrant module. Acting as adjuvants to the application itself are

- Sub-application summaries with rankings, agreement terms and SHMO notes
- Extensions if applicable from Region IV administrators

Additionally, for FEMA HMGP, PDM and FMA grants, the state shall submit all requisite materials via the director and GAR, but will not submit the proposal to the MARS scoring procedures. These materials will still be reviewed by the TNHMC along with all sub-application summaries and CBA and supporting budget documentation.

Final approval authority for all projects described in the preceding outline resides with FEMA, and given project rejection, the SHMO will advise denied applicants of their status, as well as their rights under appeals processes.

Local Plan Assistance Improvements

The new plan includes criteria that specifically address IDS (Intense Developmental Stress), as well as making requisite the adoption of IBC and nationally recognized building codes. According to US Census data and the BEA, Tennessee contains 2 of the 30 most rapidly growing counties in the United States, with both Rutherford and Davidson Counties expected to more than double in population over the next 25 years. This developmental stress meets Tennessee's criteria for intense development as housing adjustments are expected to produce a significant strain on local building codes and enforcement, as well as zoning regulations and comprehensive plans. Further, in high production agricultural regions, the reallocation of existing farm land that may or may not include floodways and flood zones requires dedicated efforts to account for potential loss and environmental consequences.

Additionally, the new plan addresses the executive order that requires planning officials and grant awards to account for the mitigation of environmental impact on minority and low income populations that are disproportionately affected by disasters and emergencies. Recent grants coordinated through TDEC, THDA, and TDOT to improve environmental conditions, access and improve response times during emergencies all point to compliance and awareness of this directive. The MARS scoring requirement incorporates this directive as well as a ranking based on developmental stress. Separate from these 2 categories are the scorings of high risk communities, Severe Repetitive Loss structures, presidential disasters, and assessment of declared disasters in the areas requesting grant funds. Specifically, the criteria differentiate between SRL, RFC, as well as declared disaster areas. The criteria further enumerate and account for properties that are in floodplains and floodways, as well as those with high population densities where disasters have historically occurred. The scoring for those areas with presidentially declared disasters over the preceding 10 year period rises at a proportion to the number of disasters (1-2 equals a score of 1, 3-4 equals a score of 2, until a score of 5 is assigned for 9 or more disasters in the past 10 years). Cumulatively, 54% of the ranking criteria identify and prioritize high risk, hazard-prone areas. Of these 54% high risk criteria, there are 8 separate methods of prioritizing a hazard-prone area as high risk.

Non-Federal Funds

Any non-federal funds are used as matching funds for federal grants and are prioritized using the same methodology. Other state agency grant programs are prioritized according to each agency's policies and procedures. A copy of the mitigation application ranking system form can be found on the following page. An excerpt of the form that is easier to read is available on p. 54 of this plan.

County: TID#:

Mitigation Application Ranking System
Hazard Mitigation Grant Application

Applicant: ____ Proposed Activity Title: ____

Total Cost: ____ Federal Share: ____ Non-Federal Share: ____

Description: Ranking Score – __

Category	Scoring Points	Range	
Capability of the applicant to achieve the desired activity, based on previous grants performance, regional recommendation, and/or local mitigation plan capability assessment.		1 to 5	Lowest to highest capability
Population of the applicant area.		1) 50,001 and Up 2) 25,001 – 50,000 3) 15,001 – 25,000	4) 3,001 – 15,000 5) Up to 3,000
Median Income		1) $40,001 and Up 2) $30,001 – $40,000 3) $20,001 – $30,000	4) $10,001 – $20,000 5) Up to $10,000
Does the community have any of the following: • Member of the Community Rating System • Adoption of IBC/Nationally recognized building code • History of mitigation/prevention measures • Intense Developmental Stress[1] • Involved in a declared disaster within the past year? [1]*Intense Developmental Stress (IDS), as defined by the State of Tennessee, is the lack of or inadequate infrastructure to support the rapidly changing socio-economic conditions in the jurisdiction submitting the application.*		0 to 5	1 point for each "yes" answer
If the community was involved in a declared disaster within the past year, does the proposed project mitigate the hazard generating the disaster?		25 points for "yes"	0 points for "no"
Number of Presidentially-declared disasters in their area in the last 10 years.		1) 1 – 2 2) 3 – 4 3) 5 – 6	4) 7 – 8 5) 9 and Above
Does the proposed activity mitigate a high-risk hazard for the project's geographic area?		5 points for "yes"	0 points for "no"
What priority is the project/strategy being mitigated in the applicants plan?		0 points for "Low" 5 points for "Medium" 10 points for "High"	
Number of people benefiting from the proposed activity.		1) Up to 50 2) 50 – 500 3) 501 – 1,000	4) 1,001 – 1,999 5) 2,000 and Up
Does this proposal include a Repetitive Flood Claims structure(s) in proposed activity[2]? [2]*Repetitive Flood Claims (RFC) is defined as a structure insured under the National Flood Insurance Program (NFIP) and has had one or more claim payment(s) for flood damage.*		5 points for "yes"	0 points for "no"
Does this proposal include a Severe Repetitive Loss structure(s) in the activity[3]? [3]*Severe Repetitive Loss (SRL) is defined as a residential property insured under the National Flood Insurance Program (NFIP). The property must have incurred flood losses that resulted in either (1) four or more flood insurance claims payments that each exceeded $5000.00 with at least two of the payments occurring within a ten-year period, or (2) two or more flood insurance claims payments that cumulatively exceeded the value of the property.*		5 points for "yes"	0 points for "no"
Does this proposal include a property(ies) located in the floodplain?		5 points for "yes"	0 points for "no"
Does this proposal include a property(ies) located in the floodway?		5 points for "yes"	0 points for "no"
Does this proposal consist of a critical facility or function?		10 points for "yes"	0 points for "no"
Provides economic benefit to the local community? • Private sector (residents) • Public sector (business) • Government (local) • Minority (NEPA) • Partnering (between public and government)		0 to 5	1 point for each "yes" answer
Will the proposed activity permanently eliminate the problem?		5 points for "yes"	0 points for "no"
Will the proposed activity: • Save lives? • Mitigate more than one hazard? • Accomplish multiple objectives?		0 to 6	2 points for each "yes" answer

☐ Concur ☐ Non-Concur* ____ Signature ____ Agency ____ Date

Council Questions	Yes* *If Yes, provide explanation*	No
Do you have personal knowledge of any activity in progress, complete, or upcoming that could negatively impact or conflict with the objective of the proposal (i.e., future highway construction, neighborhood expansion, etc.)?		
Do you have personal knowledge of any other financial mechanism(s) capable of providing assistance for the proposal?		
Do you have any reservation to the possibility of a Duplication of Benefits?		
Do you have personal knowledge of additional information capable of lending support to, or creating concern for, backing the proposal/applicant?		

* Any "Non-Concur" or "Yes" answer requires explanation.

3.4 – Risk Assessment by Local Plan Integration

A comprehensive review was conducted of all currently approved local hazard mitigation plans in order to integrate the local risk assessments into the state's analysis. Each and every local plan's hazard vulnerability assessment was carefully reviewed, analyzed, and equated to the state's 1 through 5 index to compile a local plan driven loss estimate. The analysis and index equation was performed for every locally profiled hazard for both vulnerability and total risk. Threat was not individually profiled as local planners factored it into their risk calculations. Additionally, they did not provide sufficient and separate enough details on local threat levels to be successfully profiled individually.

The review was conducted by qualified emergency management specialists and approved by TEMA. No modifications or skewing of the local plans' assessments occurred. Instead, the review specialists simply translated the local assessments into the unified model. It was necessary to translate the local plans into a unified model to the high variability in methodologies used across the state. The reviewers used a standard threat, vulnerability, risk matrix to translate the local plans' assessments.

The result of this assessment is more of a total picture of how local jurisdictions perceive threat than an actionable risk assessment. Planners at the local level are limited in scope by analyzing hazard risk to their sole jurisdiction without comparison. This limit creates an effect where, without comprehensive hazard data and unified methodologies, local planners may have a skewed perception of their hazard risks. What one emergency manager perceives as catastrophic could be a seasonal impact for another. With such varying analyses, county by county, we must view this aggregation of local plans as a supplement to the state's risk assessment and not a comprehensive assessment itself. Additionally, the number and types of hazards vary among the local plans. This creates an incomplete picture in terms of this assessment.

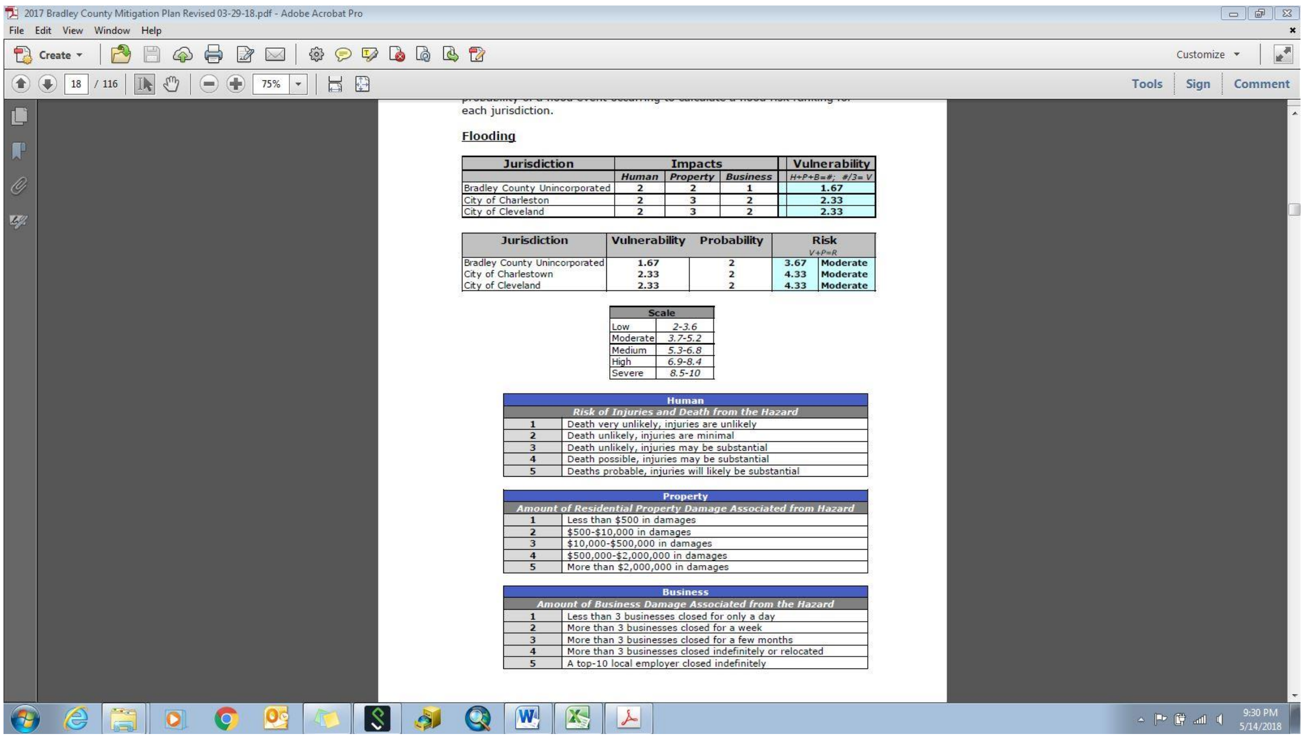
TEMA and the State of Tennessee have profiled the 13 hazards of prime concern in the risk assessment portion.

Generally, the risk assessments from local mitigation plans are linked with the state hazard mitigation plan as part of the regular five-year update cycle, rather than annually. Most local plans are updated on a five-year cycle, as well, ensuring that all of the data is up to date. If there are significant changes to risk assessment methodologies or some other significant or statewide change, an off-cycle update or a permanent change to the update cycle may be warranted.

Step 1: Reviewing of Local Hazard Mitigation Plans

The 1st step in completing a statewide risk assessment based on local risk assessment was to devise a method of unifying and integrating all FEMA approved local hazard mitigation plans. This was accomplished by conducting a comprehensive review of each individual plan and transforming their risk assessment into a unified vulnerability and risk index. The reviewers based their scores on an emergency management approved risk matrix and recorded only the 13 hazards of prime concern that were profiled, and the vulnerability and risk as written in each plan.

The image below depicts the local risk assessments used for unifying and transforming every FEMA approved plan in the State of Tennessee.



each jurisdiction.

Flooding

Jurisdiction	Impacts				Vulnerability
	Human	Property	Business		H+P+B=#; #/3= V
Bradley County Unincorporated	2	2	1		1.67
City of Charleston	2	3	2		2.33
City of Cleveland	2	3	2		2.33

Jurisdiction	Vulnerability	Probability	Risk V+P=R	
Bradley County Unincorporated	1.67	2	3.67	Moderate
City of Charlestown	2.33	2	4.33	Moderate
City of Cleveland	2.33	2	4.33	Moderate

Scale	
Low	2-3.6
Moderate	3.7-5.2
Medium	5.3-6.8
High	6.9-8.4
Severe	8.5-10

Human	
Risk of Injuries and Death from the Hazard	
1	Death very unlikely, injuries are unlikely
2	Death unlikely, injuries are minimal
3	Death unlikely, injuries may be substantial
4	Death possible, injuries may be substantial
5	Deaths probable, injuries will likely be substantial

Property	
Amount of Residential Property Damage Associated from Hazard	
1	Less than $500 in damages
2	$500-$10,000 in damages
3	$10,000-$500,000 in damages
4	$500,000-$2,000,000 in damages
5	More than $2,000,000 in damages

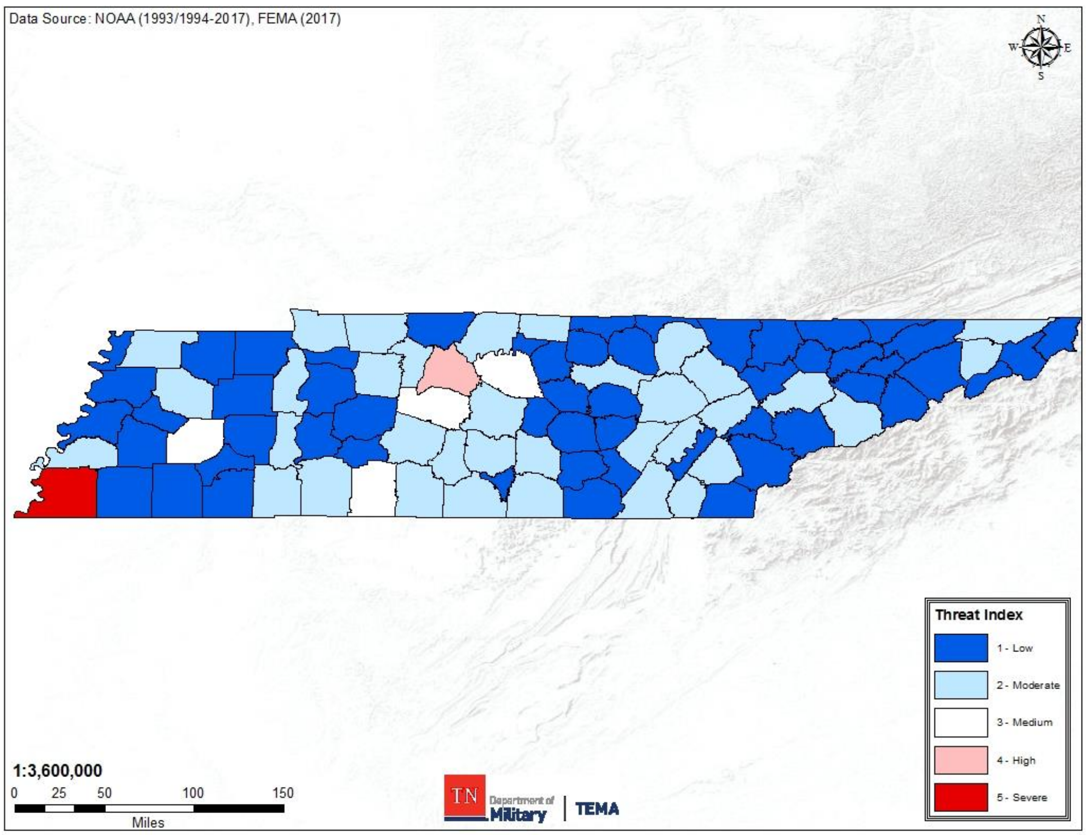
Business	
Amount of Business Damage Associated from the Hazard	
1	Less than 3 businesses closed for only a day
2	More than 3 businesses closed for a week
3	More than 3 businesses closed for a few months
4	More than 3 businesses closed indefinitely or relocated
5	A top-10 local employer closed indefinitely

Step 2: Illustrating Probability

The 2nd step was mapping and recording probability based on previous incidents that have occurred within each county. The values were entered into ArcGIS, by county per hazard, mapped, and exported into tables. The unified index developed in step 1 ranks each jurisdiction's hazard probability 1 through 5, from lowest number of incidents (ranking 1 – dark blue) to highest number of incidents (ranking 5 – dark red) for each of Tennessee's counties.

These illustrations can be seen in Section 4.3.3 for each of the 13 Hazards of Prime Concern.

The image below shows an example of hazard probability maps.

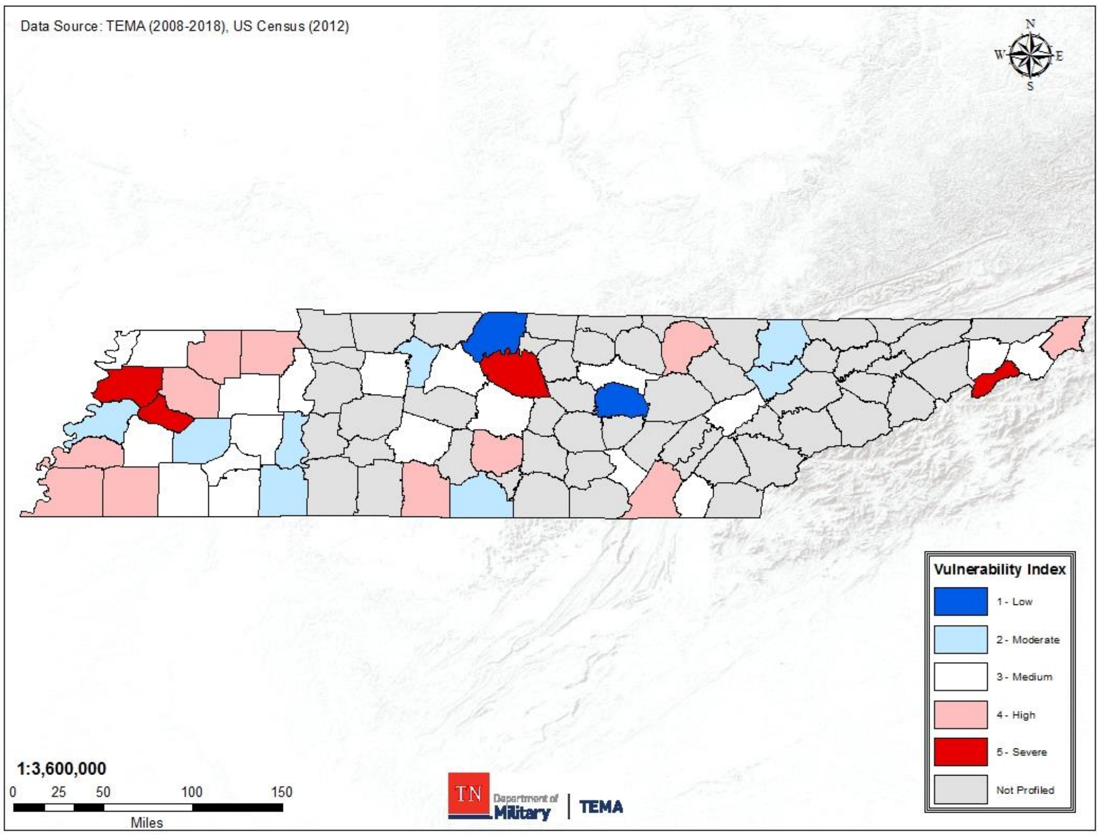


Step 3: Illustrating Vulnerability

The 3rd step was mapping and recording vulnerability from the local plan database. The values were entered into ArcGIS, by county per hazard, mapped, and exported into tables. This data table can be found in the next subsection 3.4.1 The unified index developed in step 1 ranks each jurisdiction's hazard vulnerability 1 through 5, from lowest threat (ranking 1 – dark blue) to highest threat (ranking 5 – dark red) for each of Tennessee's FEMA approved mitigation plans. Jurisdictions that do not have hazards profiled are colored grey.

These illustrations can be seen in Section 4.3.4 for each of the 13 Hazards of Prime Concern.

The image below shows an example of a local plan integrated completed vulnerability map.

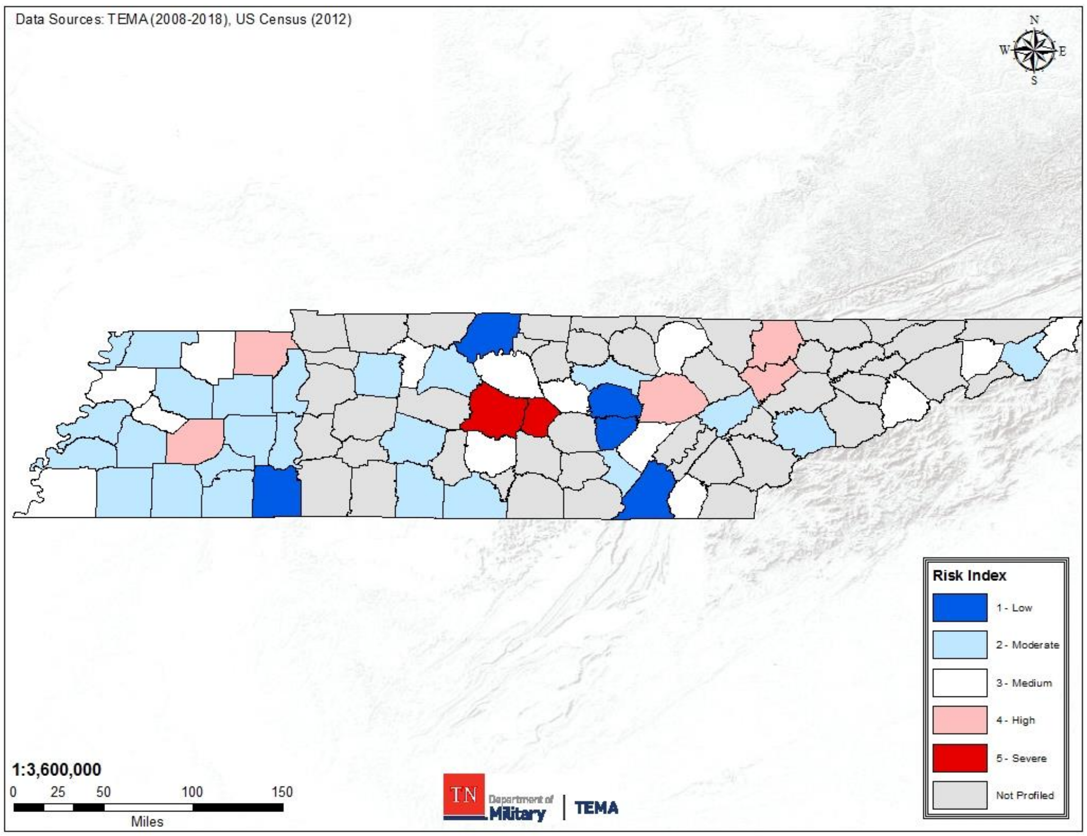


Step 4: Illustrating Risk

The 4th step was mapping and recording risk using the risk matrix: Probability+Vulnerability=Risk. The values were entered into ArcGIS, by county per hazard, mapped, and exported into tables. This data table can be found in the next subsection 3.4.2. The unified index developed in step 1 ranks each jurisdiction's hazard risk 1 through 5, from lowest threat (ranking 1 – dark blue) to highest threat (ranking 5 – dark red) for each of Tennessee's FEMA approved mitigation plans. Jurisdictions that do not have hazards profiled are colored grey.

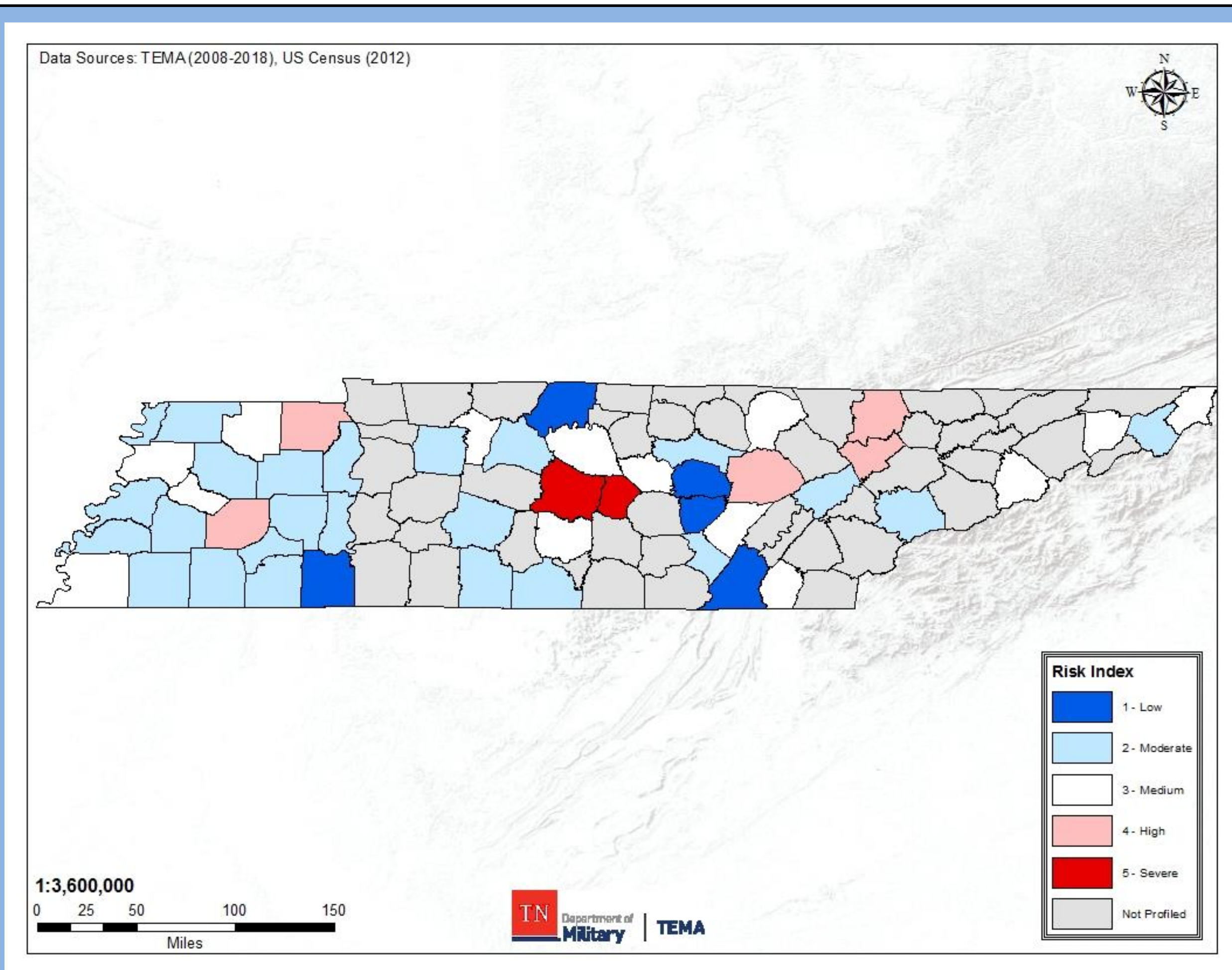
These illustrations can be seen in Section 4.3.5 for each of the 13 Hazards of Prime Concern.

The image below shows an example of a local plan integrated completed risk map.



Step 5: Potential Losses by Local Plan Integration

For the final step, mitigation planners took the composite risk assessment maps from step 4, and overlaid each of these maps with the structural inventory database from FEMA's HAZUS-MH 4.0 SP1 software. The final result of the GIS analysis is a table that describes the total structural loss estimation per county risk rankings for each hazard. The following diagram shows this process. The results can be seen in Table 17 through 25 in the following subsection 3.4.3.



HAZUS-MH Structural Inventory per County

GIS Analysis – Inventory & County Pairing

Table 52 – Loss Estimation by Local Plan Integration, Tennessee

Hazard	Risk Index by Local Plan Integration						Total Structure Value
	1	2	3	4	5	6	
Dam Failure	$0	$29,360,452,000	$44,439,481,000	$0	$0	$0	$73,799,933,000

3.4.1 – Vulnerability Assessment by Local Plan Integration

Table 13 – Vulnerability Index by Local Plan Integration Part 1, Tennessee

County	Droughts	Earthquakes	Extreme Temperatures	Floods	Geologic Hazards	Severe Storms	Tornadoes
Anderson	1.5	1.5	3	4.5	1	3	5
Bedford	4.5	4	3	5	3	4	4
Benton	NP	2.5	2.33	2.5	3	3	3
Bledsoe	NP	NP	2.67	2.15	NP	4	4
Blount	NP	NP	NP	NP	NP	NP	NP
Bradley	NP	3	2	2	1.5	2	4.15
Campbell	1.5	1.5	3	3	2	3	5
Cannon	NP	NP	NP	NP	NP	NP	NP
Carroll	3	2.7	1.52	2	NP	3	2.44
Carter	1.5	3.2	2.5	3.8	1.8	3	2.4
Cheatham	NP	1.5	3.9	3	NP	3	3
Chester	NP	2.88	2.11	2.2	NP	N	3.05
Claiborne	NP	NP	1.9	1.7	NP	3.06	3.06
Clay	NP	NP	NP	NP	NP	NP	NP
Cocke	NP	NP	2.22	2.33	1.5	3.45	1.5
Coffee	NP	NP	3	2	NP	4	4
Crockett	NP	4.6	1.5	2	NP	2.5	2.5
Cumberland	NP	NP	2	2.5	NP	2.5	2.5
Davidson	1.5	3	1.5	3	1.5	3	3
Decatur	NP	1.7	1.5	1.3	NP	2.5	2.5
DeKalb	NP	NP	2.3	1.6	NP	3.5	3.5
Dickson	NP	3	NP	3	NP	3	3
Dyer	NP	4.5	3.5	2	NP	4.67	4.67
Fayette	NP	3.8	2.2	2	NP	3.2	3.2
Fentress	NP	4	2.6	1.67	NP	3.2	3.2
Franklin	NP	NP	NP	NP	NP	NP	NP
Gibson	NP	4	1.4	1.8	NP	2.3	2.3
Giles	4	4	NP	3	NP	2.5	3.8
Grainger	NP	NP	NP	NP	NP	NP	NP
Greene	NP	NP	NP	NP	NP	NP	NP
Grundy	NP	NP	NP	NP	NP	NP	NP
Hamblen	NP	NP	2	2	NP	3	3
Hamilton	NP	4	3	3	NP	2	3
Hancock	NP	NP	NP	NP	NP	NP	NP
Hardeman	NP	3	2	2	NP	2	3
Hardin	1	2	2	2	1	2	3
Hawkins	NP	NP	2	3	NP	2	3
Haywood	NP	3	3	2	NP	3	3
Henderson	1	3	2	2	NP	3	3
Henry	1	4	1	1	1	5	1
Hickman	NP	NP	3	2	NP	3	3
Houston	NP	NP	2	3	NP	1	1

County	Droughts	Earthquakes	Extreme Temperatures	Floods	Geologic Hazards	Severe Storms	Tornadoes
Humphreys	NP	NP	2	2	NP	3	5
Jackson	NP	NP	NP	NP	NP	NP	4
Jefferson	NP	NP	2	2	NP	3	3
Johnson	NP	4	3	2	NP	4	4
Knox	NP	NP	NP	NP	NP	NP	NP
Lake	NP	3	4	2	NP	4	4.15
Lauderdale	NP	2	3	2	NP	3	5
Lawrence	NP	NP	NP	NP	NP	NP	NP
Lewis	NP	NP	2	2	NP	3	2.44
Lincoln	NP	2	3	3	NP	3	2.4
Loudon	NP	NP	2	2	NP	2	3
Macon	NP	NP	2	2	NP	3	3.05
Madison	NP	2	3	2	NP	3	3.06
Marion	NP	NP	NP	2	NP	2	NP
Marshall	NP	NP	NP	2	NP	2	1.5
Maury	1	3	1	3	1	2	4
McMinn	NP	NP	NP	3	NP	2	2.5
McNairy	NP	3	2	2	NP	4	2.5
Meigs	NP	NP	2	3	NP	3	3
Monroe	NP	NP	1	2	NP	3	2.5
Montgomery	NP	NP	NP	NP	NP	NP	3.5
Moore	NP	NP	3	2	NP	4	3
Morgan	NP	NP	2	3	NP	2	4.67
Obion	NP	3.3	1.93	2.06	NP	2.59	3.2
Overton	NP	NP	NP	NP	NP	NP	3.2
Perry	1.42	NP	2.33	3.42	NP	3.42	NP
Pickett	NP	NP	2.34	2.17	NP	3.67	2.3
Polk	NP	NP	NP	NP	NP	NP	3.8
Putnam	NP	2.93	1.93	2.26	1.06	2.4	NP
Rhea	NP	NP	NP	NP	NP	NP	NP
Roane	1.5	3	1.5	3	1.5	1.5	NP
Robertson	NP	NP	2.083	2.17	NP	3.58	3
Rutherford	1	2.67	1	1	1	1	3
Scott	2.67	NP	2.33	2.415	NP	1.5	NP
Sequatchie	1.5	3	1.5	3	NP	1.5	3
Sevier	NP	NP	2.17	2.99	NP	2.17	3
Shelby	NP	4.46	2.44	3.08	NP	3.88	3
Smith	NP	NP	2.5	2.75	NP	3.84	3
Stewart	NP	NP	1.92	2.83	NP	3.58	3
Sullivan	NP	NP	NP	NP	NP	NP	1
Sumner	NP	1.15	0.78	2.63	NP	2.36	3
Tipton	NP	3.74	1.88	2.41	NP	3.41	1
Trousdale	NP	NP	2	2.67	NP	3.5	5
Unicoi	NP	4.5	NP	3	NP	3	4
Union	NP	NP	NP	NP	NP	NP	3
Van Buren	NP	NP	NP	NP	NP	NP	4

County	Droughts	Earthquakes	Extreme Temperatures	Floods	Geologic Hazards	Severe Storms	Tornadoes
Warren	NP	NP	1.87	1.67	NP	2.87	3.5
Washington	3.33	3.33	2.22	3.33	1.67	3.33	3
Wayne	NP	NP	1.58	3	NP	3.085	NP
Weakley	NP	4.17	2.78	2.89	NP	3.89	NP
White	NP	1	2.33	1.44	NP	2.33	2.87
Williamson	2	NP	2.33	4	NP	2.33	3.33
Wilson	5	5	5	3.88	NP	5	3.085
Austin Peay	NP	4.5	1.5	1.5	1.5	1.5	3.89
MTSU	NP	4.5	NP	NP	NP	1.5	3.88
UT- Chattanooga	1.5	4.5	1.5	1.5	1.5	3	4.33
UT- HSC	1.5	4.5	1.5	1.5	1.5	3	5
UT- Knoxville	1.5	4.5	1.5	1.5	1.5	3	4.5
UT- Martin	1.5	4.5	1.5	1.5	1.5	3	3
Forest Hills	1.5	3	3	4.5	4.5	3	3
Pigeon Forge	3	3	1.5	3	3	3	3

Table 14 – Vulnerability Index by Local Plan Integration Part 2, Tennessee						
County	**Wildfires**	**Communicable Diseases**	**Dam/Levee Failure**	**Hazardous Materials**	**Infrastructure Incidences**	**Terrorism**
Anderson	3	NP	4	NP	NP	NP
Bedford	3	2	4	5	NP	2
Benton	3	NP	3	NP	NP	NP
Bledsoe	NP	NP	NP	NP	NP	NP
Blount	NP	NP	NP	NP	NP	NP
Bradley	3	NP	NP	NP	NP	NP
Campbell	1.5	NP	4.5	NP	NP	NP
Cannon	NP	NP	NP	NP	NP	NP
Carroll	NP	NP	NP	NP	NP	NP
Carter	3.6	NP	4	3	2.6	NP
Cheatham	NP	NP	4.5	NP	NP	NP
Chester	NP	NP	NP	NP	NP	NP
Claiborne	NP	NP	NP	NP	NP	NP
Clay	NP	NP	NP	NP	NP	NP
Cocke	3	NP	NP	NP	NP	NP
Coffee	NP	NP	NP	NP	NP	NP
Crockett	NP	NP	NP	NP	NP	NP
Cumberland	NP	NP	NP	NP	NP	NP
Davidson	NP	NP	NP	NP	NP	NP
Decatur	NP	NP	NP	NP	NP	NP
DeKalb	NP	NP	NP	NP	NP	NP
Dickson	NP	NP	NP	NP	NP	NP
Dyer	NP	NP	NP	NP	NP	NP
Fayette	NP	NP	NP	NP	NP	NP
Fentress	NP	NP	NP	NP	NP	NP
Franklin	NP	NP	NP	NP	NP	NP
Gibson	NP	NP	NP	NP	NP	NP
Giles	1.5	NP	NP	NP	NP	NP
Grainger	NP	NP	NP	NP	NP	NP
Greene	NP	NP	NP	NP	NP	NP
Grundy	NP	NP	NP	NP	NP	NP
Hamblen	NP	NP	NP	NP	NP	NP
Hamilton	NP	NP	NP	NP	NP	NP
Hancock	NP	NP	NP	NP	NP	NP
Hardeman	NP	NP	NP	NP	NP	NP
Hardin	1	NP	NP	NP	NP	NP
Hawkins	NP	NP	NP	NP	NP	NP
Haywood	NP	NP	NP	NP	NP	NP
Henderson	1	NP	NP	NP	NP	NP
Henry	1	NP	1	1	NP	2
Hickman	NP	NP	NP	NP	NP	NP
Houston	NP	NP	NP	NP	NP	NP
Humphreys	NP	NP	NP	NP	NP	NP

County	Wildfires	Communicable Diseases	Dam/Levee Failure	Hazardous Materials	Infrastructure Incidences	Terrorism
Jackson	NP	NP	NP	NP	NP	NP
Jefferson	NP	NP	NP	NP	NP	NP
Johnson	NP	NP	NP	NP	NP	NP
Knox	NP	NP	NP	NP	NN	NP
Lake	NP	NP	NP	NP	NP	NP
Lauderdale	1	NP	NP	NP	NP	NP
Lawrence	NP	NP	NP	NP	NP	NP
Lewis	NP	NP	NP	NP	NP	NP
Lincoln	NP	NP	NP	NP	NP	NP
Loudon	NP	NP	NP	NP	NP	NP
Macon	NP	NP	NP	NP	NP	NP
Madison	NP	NP	NP	NP	NP	NP
Marion	NP	NP	NP	NP	NP	NP
Marshall	NP	NP	NP	NP	NP	NP
Maury	2	NP	NP	NP	NP	NP
McMinn	NP	NP	NP	NP	NP	NP
McNairy	NP	NP	NP	NP	NP	NP
Meigs	NP	NP	NP	NP	NP	NP
Monroe	NP	NP	NP	NP	NP	NP
Montgomery	NP	NP	NP	NP	NP	NP
Moore	NP	NP	NP	NP	NP	NP
Morgan	NP	NP	NP	NP	NP	NP
Obion	NP	NP	NP	NP	NP	NP
Overton	NP	NP	NP	NP	NP	NP
Perry	NP	NP	NP	NP	NP	NP
Pickett	NP	NP	NP	NP	NP	NP
Polk	NP	NP	NP	NP	NP	NP
Putnam	NP	NP	3.07	NP	2.43	2.53
Rhea	NP	NP	NP	NP	NP	NP
Roane	1.5	NP	3	NP	NP	NP
Robertson	NP	NP	NP	NP	NP	NP
Rutherford	1	NP	1	1.33	1	1
Scott	NP	NP	NP	NP	NP	NP
Sequatchie	NP	NP	3	NP	NP	NP
Sevier	NP	NP	NP	NP	NP	NP
Shelby	NP	NP	NP	NP	NP	NP
Smith	NP	NP	NP	NP	NP	NP
Stewart	NP	NP	NP	NP	NP	NP
Sullivan	NP	NP	NP	NP	NP	NP
Sumner	NP	NP	NP	NP	NP	NP
Tipton	NP	NP	NP	NP	NP	NP
Trousdale	NP	NP	NP	NP	NP	NP
Unicoi	NP	NP	NP	NP	NP	NP
Union	NP	NP	NP	NP	NP	NP
Van Buren	NP	NP	NP	NP	NP	NP
Warren	NP	NP	NP	NP	NP	NP

County	Wildfires	Communicable Diseases	Dam/Levee Failure	Hazardous Materials	Infrastructure Incidences	Terrorism
Washington	3.33	NP	2.78	3.33	NP	NP
Wayne	NP	NP	NP	NP	NP	NP
Weakley	NP	NP	NP	NP	NP	NP
White	NP	NP	NP	NP	NP	NP
Williamson	NP	2	1.66	2	1.66	1.66
Wilson	2	NP	1.67	NP	NP	NP
Austin Peay	NP	NP	NP	NP	NP	NP
MTSU	NP	NP	NP	NP	NP	NP
UT- Chattanooga	1.5	NP	4.5	NP	NP	NP
UT- HSC	1.5	NP	4.5	NP	NP	NP
UT- Knoxville	1.5	NP	4.5	NP	NP	NP
UT- Martin	1.5	NP	4.5	NP	NP	NP
Forest Hills	3	NP	4.5	NP	NP	NP
Pigeon Forge	3	NP	NP	NP	NP	NP

3.4.2 – Composite Risk by Local Plan Integration

Table 15 – Risk Index by Local Plan Integration Part 1, Tennessee

County	Droughts	Earthquakes	Extreme Temperatures	Floods	Geologic Hazards	Severe Storms	Tornadoes
Anderson	3.9	4.4	2.6	1.88	1.66	3.5	2.2
Bedford	4.8	2.9	NP	3.1	4	3.5	NP
Benton	3.3	1.77	2.39	2.72	3.4	2.39	2.77
Bledsoe	4	2.9	3.08	3.33	NP	3.33	3.33
Blount	NP	1.5	NP	4	1.5	3.5	3.5
Bradley	3.3	2.61	2.9	2.05	2.8	2	2.11
Campbell	4.1	4.1	2.6	3.8	3	3.5	NP
Cannon	2.16	4.75	2.16	1.58	NP	1.6	1.6
Carroll	NP	1.85	2.53	2.24	NP	2.66	2.66
Carter	0.9	1.95	1.3	2.4	1.15	2.05	1.1
Cheatham	3	2.9	NP	NP	3.8	3.8	NP
Chester	NP	1.94	2.64	2.15	NP	NP	3.11
Claiborne	NP	NP	2.96	2.36	NP	2.53	2.53
Clay	NP	NP	NP	NP	NP	NP	NP
Cocke	3.3	2.9	2.61	3.17	3.2	2.22	2.22
Coffee	NP	NP	2.61	3	NP	2.77	2.77
Crockett	4.7	2.55	2.5	2.25	2.3	2.89	2.89
Cumberland	3.3	4.3	3.66	3	4.1	3.23	3.23
Davidson	3.33	2.42	1.66	2.08	2.25	2.67	2.67
Decatur	3.3	1.92	2.17	1.79	2.1	2.79	2.79
DeKalb	3.3	2.5	2.19	2	2.1	2.72	2.72
Dickson	NP	2.42	NP	NP	2.71	NP	NP
Dyer	NP	2.86	2.29	2	4	3.42	3.42
Fayette	4	2.21	2.53	2.68	2.7	2.97	2.97
Fentress	3.17	3	NP	NP	3.17	NP	NP
Franklin	NP	NP	NP	NP	NP	NP	NP
Gibson	3.5	2.47	2.36	2.43	4.1	2.71	2.71
Giles	3.33	2.08	NP	NP	2.92	NP	NP
Grainger	NP	NP	NP	NP	NP	NP	NP
Greene	NP	NP	NP	NP	NP	NP	NP
Grundy	NP	NP	NP	NP	NP	NP	NP
Hamblen	NP	NP	3	3	NP	3	3
Hamilton	NP	1	3	4	NP	3	3
Hancock	NP	NP	NP	N	NP	N	N
Hardeman	NP	2	2	3	NP	3	3
Hardin	1	1	2	3	1	3	3
Hawkins	NP	NP	2	4	NP	3	3
Haywood	NP	2	3	2	NP	3	3
Henderson	1	2	2	2	NP	3	3
Henry	4	4	2	3	2	4	3
Hickman	NP	NP	3	4	NP	3	4
Houston	NP	NP	3	3	NP	3	3

County	Droughts	Earthquakes	Extreme Temperatures	Floods	Geologic Hazards	Severe Storms	Tornadoes
Humphreys	NP	NP	3	4	NP	4	4
Jackson	NP	NP	NP	NP	NP	NP	NP
Jefferson	NP	NP	3	3	NP	2	2
Johnson	NP	3	3	3	NP	3	3
Knox	NP	NP	NP	NP	NP	NP	NP
Lake	NP	2	4	3	NP	4	4
Lauderdale	NP	2	3	3	NP	3	3
Lawrence	NP	NP	NP	NP	NP	NP	NP
Lewis	NP	NP	3	2	NP	3	3
Lincoln	NP	2	3	4	NP	3	4
Loudon	NP	NP	1	2	NP	2	2
Macon	NP	NP	2	3	NP	3	3
Madison	NP	4	3	2	NP	3	3
Marion	NP	NP	NP	2	NP	2	2
Marshall	NP	NP	NP	3	NP	2	3
Maury	1	2	1	2	1	3	4
McMinn	NP	NP	NP	4	NP	2	3
McNairy	NP	2	2	2	NP	3	3
Meigs	NP	NP	2	4	NP	3	3
Monroe	NP	NP	3	4	NP	3	3
Montgomery	NP	NP	NP	NP	NP	NP	NP
Moore	NP	NP	3	3	NP	4	4
Morgan	NP	NP	3	4	NP	2	2
Obion	NP	2.15	2.217	2.33	NP	2.7	2.7
Overton	NP	NP	NP	NP	NP	NP	NP
Perry	1.58	NP	3.67	3.58	3.5	3.58	3.58
Pickett	NP	NP	2.92	3.58	NP	3.34	3.34
Polk	NP	NP	NP	NP	NP	NP	NP
Putnam	2.2	2.3	3.27	2.63	1.13	3.7	3.07
Rhea	NP	NP	NP	NP	NP	NP	NP
Roane	2.6	2.3	2.2	2.5	3.5	NP	2.6
Robertson	NP	NP	2.54	2.13	3.5	3.1	3.1
Rutherford	2	4.5	2	2.25	1	3	4.83
Scott	2.21	NP	2.29	2.46	3.5	2.5	2.5
Sequatchie	2.83	1.67	3.17	5	3.5	4.67	4.67
Sevier	NP	NP	3.08	2.99	4	3.08	2.13
Shelby	NP	2.89	3.25	2.98	5.1	3.19	3.19
Smith	NP	NP	2.25	3.12	4	3.04	3.04
Stewart	NP	NP	3.47	3.17	4	3.29	3.29
Sullivan	NP	NP	NP	NP	NP	NP	NP
Sumner	NP	1	2.88	3.06	4.4	3.25	3.5
Tipton	NP	2.37	2.39	2.26	4.4	3.09	3.09
Trousdale	NP	NP	3	3.83	3.75	2.75	2.75
Unicoi	NP	NP	NP	NP	3.3	4.4	3.1
Union	NP	NP	NP	NP	NP	NP	NP
Van Buren	1	1	2	4	NP	3	3

County	Droughts	Earthquakes	Extreme Temperatures	Floods	Geologic Hazards	Severe Storms	Tornadoes
Warren	NP	NP	2.03	1.93	4.1	2.33	2.33
Washington	2.78	2.78	1.67	3.33	1.67	3.89	2.78
Wayne	NP	NP	2.29	3.63	4.1	3.04	3.04
Weakley	NP	2.58	3.39	2.69	3.4	3.44	3.44
White	NP	1	3.17	3.67	NP	3.67	3.94
Williamson	2.5	NP	2.67	3.5	3.75	2.67	3.67
Wilson	3.13	3	3.47	4.25	NP	4.06	4.06
Austin Peay	NP	NP	2.9	NP	NP	3.2	4.2
MTSU	NP	NP	NP	NP	NP	NP	3.1
UT- Chattanooga	2.2	2.9	2.2	2.3	2.2	2.9	3.8
UT- HSC	2.2	2.9	2.2	2.3	2.2	2.9	3.8
UT- Knoxville	2.2	2.9	2.2	2.3	2.2	2.9	3.8
UT- Martin	2.2	2.9	2.2	2.3	2.2	2.9	3.8
Forest Hills	4.3	2.7	3	2.6	NP	5.3	2.8
Pigeon Forge	2.9	NP	1.8	3.6	NP	4.7	3.6

Table 16 – Risk Index by Local Plan Integration Part 2, Tennessee						
County	Wildfires	Communicable Diseases	Dam/Levee Failure	Hazardous Materials	Infrastructure Incidences	Terrorism
Anderson	3.6	NP	2.33	NP	NP	NP
Bedford	4.8	NP	4	4	NP	NP
Benton	NP	NP	NP	NP	NP	NP
Bledsoe	NP	NP	4	NP	NP	NP
Blount	3.5	2	NP	2	NP	1.5
Bradley	3.08	NP	NP	NP	NP	NP
Campbell	NP	NP	4.2	NP	NP	NP
Cannon	3.33	NP	2.16	2.25	NP	2.58
Carroll	NP	NP	NP	NP	NP	NP
Carter	2.1	NP	1.4	2.25	1.3	NP
Cheatham	NP	NP	3.3	NP	NP	NP
Chester	NP	NP	NP	NP	NP	NP
Claiborne	NP	NP	NP	NP	NP	NP
Clay	NP	NP	NP	NP	NP	NP
Cocke	1.8	NP	2.9	NP	NP	NP
Coffee	NP	NP	NP	NP	NP	NP
Crockett	NP	NP	NP	NP	NP	NP
Cumberland	NP	3.3	NP	NP	NP	NP
Davidson	NP	NP	2.75	NP	NP	NP
Decatur	NP	NP	NP	NP	NP	NP
DeKalb	NP	NP	3.3	NP	NP	NP
Dickson	NP	NP	3.33	NP	NP	NP
Dyer	NP	NP	4.2	NP	NP	NP
Fayette	NP	NP	NP	NP	NP	NP
Fentress	NP	NP	3.5	NP	NP	NP
Franklin	NP	NP	NP	NP	NP	NP
Gibson	NP	NP	NP	NP	NP	NP
Giles	NP	NP	2.92	NP	NP	NP
Grainger	NP	NP	NP	NP	NP	NP
Greene	NP	NP	NP	NP	NP	NP
Grundy	NP	NP	NP	NP	NP	NP
Hamblen	NP	NP	NP	NP	NP	NP
Hamilton	NP	NP	NP	NP	NP	NP
Hancock	NP	NP	NP	NP	NP	NP
Hardeman	NP	NP	NP	NP	NP	NP
Hardin	1	NP	NP	NP	NP	NP
Hawkins	NP	NP	NP	NP	NP	NP
Haywood	NP	NP	NP	NP	NP	NP
Henderson	1	NP	NP	NP	NP	NP
Henry	3	NP	2	5	NP	4
Hickman	NP	NP	NP	NP	NP	NP
Houston	NP	NP	NP	NP	NP	NP
Humphreys	NP	NP	NP	NP	NP	NP

County	Wildfires	Communicable Diseases	Dam/Levee Failure	Hazardous Materials	Infrastructure Incidences	Terrorism
Jackson	NP	NP	NP	NP	NP	NP
Jefferson	NP	NP	NP	NP	NP	NP
Johnson	NP	NP	NP	NP	NP	NP
Knox	NP	NP	NP	NP	NP	NP
Lake	NP	NP	NP	NP	NP	NP
Lauderdale	1	NP	NP	NP	NP	NP
Lawrence	NP	NP	NP	NP	NP	NP
Lewis	NP	NP	NP	NP	NP	NP
Lincoln	NP	NP	NP	NP	NP	NP
Loudon	NP	NP	NP	NP	NP	NP
Macon	NP	NP	NP	NP	NP	NP
Madison	NP	NP	NP	NP	NP	NP
Marion	NP	NP	NP	NP	NP	NP
Marshall	NP	NP	NP	NP	NP	NP
Maury	3	NP	NP	NP	NP	NP
McMinn	NP	NP	NP	NP	NP	NP
McNairy	NP	NP	NP	NP	NP	NP
Meigs	NP	NP	NP	NP	NP	NP
Monroe	NP	NP	NP	NP	NP	NP
Montgomery	NP	NP	NP	NP	NP	NP
Moore	NP	NP	NP	NP	NP	NP
Morgan	NP	NP	NP	NP	NP	NP
Obion	NP	NP	NP	NP	NP	NP
Overton	NP	NP	NP	NP	NP	NP
Perry	3.3	NP	4.3	NP	NP	NP
Pickett	NP	NP	NP	NP	NP	NP
Polk	NP	NP	NP	NP	NP	NP
Putnam	NP	NP	2.03	NP	2.93	1.77
Rhea	NP	NP	NP	NP	NP	NP
Roane	3.3	NP	3.6	NP	NP	NP
Robertson	NP	NP	3.6	NP	NP	NP
Rutherford	2	NP	2	3	2	2
Scott	NP	NP	3.6	NP	NP	NP
Sequatchie	2.6	NP	4.4	NP	NP	NP
Sevier	NP	NP	4.3	NP	NP	NP
Shelby	NP	NP	4.3	NP	NP	NP
Smith	NP	NP	4.3	NP	NP	NP
Stewart	NP	NP	3.8	NP	NP	NP
Sullivan	NP	NP	NP	NP	NP	NP
Sumner	NP	NP	4.3	NP	NP	NP
Tipton	NP	NP	4.4	NP	NP	NP
Trousdale	NP	NP	3.8	NP	NP	NP
Unicoi	NP	NP	4.3	NP	NP	NP
Union	NP	NP	NP	NP	NP	NP
Van Buren	1	NP	NP	NP	NP	NP
Warren	NP	NP	3.8	NP	NP	NP

County	Wildfires	Communicable Diseases	Dam/Levee Failure	Hazardous Materials	Infrastructure Incidences	Terrorism
Washington	3.88	NP	2.78	3.33	NP	NP
Wayne	NP	NP	4.3	NP	NP	NP
Weakley	NP	NP	4.3	NP	NP	NP
White	NP	NP	NP	NP	NP	NP
Williamson	3.1	2	1.33	3.5	1.83	1.83
Wilson	2.88	NP	3.5	NP	NP	NP
Austin Peay	NP	NP	3.2	NP	NP	NP
MTSU	NP	NP	NP	NP	NP	NP
UT- Chattanooga	2.6	NP	1.8	NP	NP	NP
UT- HSC	2.6	NP	1.8	NP	NP	NP
UT- Knoxville	2.6	NP	1.8	NP	NP	NP
UT- Martin	2.6	NP	1.8	NP	NP	NP
Forest Hills	2.6	NP	5.3	NP	NP	NP
Pigeon Forge	2.4	NP	3.2	NP	NP	NP

3.4.3 – Potential Losses by Local Plan Integration

To estimate the state's potential losses based on the local hazard mitigation plan's risk assessments, their calculated risk indices were cross referenced with each jurisdiction's structural inventory value. The structural inventory value was exported from FEMA's HAZUS-MH 4.0 by Census tract and then spatially joined and aggregated by county. The tables below list the identified vulnerable structural inventory by county per hazard risk index. Drought and Extreme Heat are not listed here as they do not pose a threat to buildings and infrastructure.

Table 17 – Loss Estimation by Local Plan Integration, Tennessee

Hazard	Risk Index by Local Plan Integration					Total Structure Value
	1	2	3	4	5	
Drought	$18,607,007	$36,907,862	$23,002,421	$22,934,467	$5,361,800	$106,813,557
Earthquakes	$65,325,092	$165,968,933	$172,804,614	$31,539,977	$32,383,706	$468,022,322
Extreme Temperatures	$18,287,839	$178,378,984	$315,397,116	$20,875,671	$18,287,839	$551,227,449
Floods	$1,095,420	$205,963,875	$226,236,977	$126,005,118	$1,112,969	$560,414,359
Geologic Hazards	$49,116,244	$122,288,790	$35,061,328	$108,398,203	$111,560,225	$426,424,790
Severe Storms	$0	$45,180,487	$435,331,487	$75,735,945	$1,112,969	$557,360,888
Tornadoes	$4,548,266	$51,497,316	$373,579,350	$89,697,652	$28,006,380	$547,328,964
Wildfire	$7,898,240	$34,272,313	$69,138,376	$34,273,101	$4,004,557	$149,586,587

**The structure values are estimates extracted from FEMA's HAZUS-MH 4.0 inventory database.*

Table 18 – Loss Estimation by Local Plan Integration, Drought									
Risk Rank 1	**Loss Estimate**	**Risk Rank 2**	**Loss Estimate**	**Risk Rank 3**	**Loss Estimate**	**Risk Rank 4**	**Loss Estimate**	**Risk Rank 5**	**Loss Estimate**
Carter	$4,548,266	Cannon	$1,095,420	Benton	$1,449,738	Anderson	$8,632,331	Bedford	$4,004,557
Hardin	$2,658,203	Perry	$657,966	Bradley	$9,529,708	Bledsoe	$1,449,738	Crockett	$1,357,243
Henderson	$2,595,898	Putnam	$6,606,531	Cheatham	$3,920,450	Campbell	$3,401,005		
Maury	$8,409,833	Rutherford	$26,893,411	Cocke	$2,830,636	Fayette	$4,289,132		
Van Buren	$394,807	Scott	$1,654,534	Cumberland	$5,271,889	Gibson	$5,162,261		
				Davidson	$80,510,822	Henry	$3,191,743		
				Decatur	$1,099,007				
				Dekalb	$1,856,874				
				Fentress	$1,407,956				
				Giles	$2,842,491				
				Roane	$5,444,846				
				Sequatchie	$1,112,969				
				Washington	$13,163,943				
				Williamson	$26,398,699				
				Wilson	$13,297,192				

**The structure values are estimates extracted from FEMA's HAZUS-MH 4.0 inventory database.*

Table 19 – Loss Estimation by Local Plan Integration, Earthquakes									
Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate
Hamilton	$42,050,803.00	Benton	$1,449,738.00	Bedford	$4,004,557.00	Anderson	$8,632,331.00	Coffee	$5,490,295.00
Hardin	$2,658,203.00	Blount	$12,476,827.00	Bledsoe	$1,449,738.00	Campbell	$3,401,005.00	Rutherford	$26,893,411.00
Sumner	$18,266,647.00	Carroll	$2,500,850.00	Bradley	$9,529,708.00	Cumberland	$5,271,889.00		
Van Buren	$394,807.00	Carter	$4,548,266.00	Cheatham	$3,920,450.00	Henry	$3,191,743.00		
White	$1,954,632.00	Chester	$1,339,537.00	Cocke	$2,830,636.00	Madison	$11,043,009.00		
		Davidson	$80,510,822.00	Crockett	$1,357,243.00				
		Decatur	$1,099,007.00	Dekalb	$1,856,874.00				
		Dickson	$4,790,761.00	Dyer	$4,062,390.00				
		Fayette	$4,289,132.00	Fentress	$1,407,956.00				
		Gibson	$5,162,261.00	Johnson	$1,376,842.00				
		Giles	$2,842,491.00	Shelby	$111,560,225.00				
		Hardeman	$2,097,869.00	Washington	$13,163,943.00				
		Haywood	$1,741,423.00	Weakley	$2,986,860.00				
		Henderson	$2,595,898.00	Wilson	$13,297,192.00				
		Lake	$526,753.00						
		Lauderdale	$2,249,332.00						
		Lincoln	$3,239,164.00						
		Maury	$8,409,833.00						
		McNairy	$2,290,524.00						
		Obion	$3,280,373.00						
		Putnam	$6,606,531.00						
		Roane	$5,444,846.00						
		Sequatchie	$1,112,969.00						
		Tipton	$5,363,726.00						

**The structure values are estimates extracted from FEMA's HAZUS-MH 4.0 inventory database.*

Table 20 – Loss Estimation by Local Plan Integration, Extreme Temperatures									
Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate
Carter	$4,548,266	Benton	$1,449,738	Anderson	$8,632,331	Cumberland	$5,271,889	Carter	$4,548,266
Loudon	$5,329,740	Cannon	$1,095,420	Bledsoe	$1,449,738	Lake	$526,753	Loudon	$5,329,740
Maury	$8,409,833	Davidson	$80,510,822	Bradley	$9,529,708	Perry	$657,966	Maury	$8,409,833
		Decatur	$1,099,007	Campbell	$3,401,005	Stewart	$1,121,871		
		Dekalb	$1,856,874	Carroll	$2,500,850	Wilson	$13,297,192		
		Dyer	$4,062,390	Chester	$1,339,537				
		Gibson	$5,162,261	Claiborne	$2,559,122				
		Hardeman	$2,097,869	Cocke	$2,830,636				
		Hardin	$2,658,203	Coffee	$5,490,295				
		Hawkins	$4,636,589	Crockett	$1,357,243				
		Henderson	$2,595,898	Fayette	$4,289,132				
		Henry	$3,191,743	Hamblen	$6,481,076				
		Macon	$1,749,296	Hamilton	$42,050,803				
		McNairy	$2,290,524	Haywood	$1,741,423				
		Meigs	$830,347	Hickman	$2,100,965				
		Obion	$3,280,373	Houston	$685,385				
		Roane	$5,444,846	Humphreys	$1,780,531				
		Rutherford	$26,893,411	Jefferson	$4,500,342				
		Scott	$1,654,534	Johnson	$1,376,842				
		Smith	$1,651,086	Lauderdale	$2,249,332				
		Tipton	$5,363,726	Lewis	$1,031,977				
		Van Buren	$394,807	Lincoln	$3,239,164				
		Warren	$3,948,228	Madison	$11,043,009				

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate
		Washington	$13,163,943	Monroe	$3,712,847				
		Wayne	$1,297,049	Moore	$588,443				
				Morgan	$1,489,782				
				Putnam	$6,606,531				
				Robertson	$6,698,281				
				Sequatchie	$1,112,969				
				Sevier	$11,616,622				
				Shelby	$111,560,225				
				Sumner	$18,266,647				
				Trousdale	$744,132				
				Weakley	$2,986,860				
				White	$1,954,632				
				Williamson	$26,398,699				

**The structure values are estimates extracted from FEMA's HAZUS-MH 4.0 inventory database.*

Table 21 – Loss Estimation by Local Plan Integration, Floods

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate
Cannon	$1,095,420.00	Anderson	$8,632,331	Bedford	$4,004,557	Blount	$12,476,827.00	Sequatchie	$1,112,969.00
		Bradley	$9,529,708	Benton	$1,449,738	Campbell	$3,401,005.00		
		Carroll	$2,500,850	Bledsoe	$1,449,738	Hamilton	$42,050,803.00		
		Carter	$4,548,266	Cocke	$2,830,636	Hawkins	$4,636,589.00		
		Chester	$1,339,537	Coffee	$5,490,295	Hickman	$2,100,965.00		
		Claiborne	$2,559,122	Cumberland	$5,271,889	Humphreys	$1,780,531.00		
		Crockett	$1,357,243	Fayette	$4,289,132	Lincoln	$3,239,164.00		
		Davidson	$80,510,822	Hamblen	$6,481,076	McMinn	$5,007,043.00		
		Decatur	$1,099,007	Hardeman	$2,097,869	Meigs	$830,347.00		
		Dekalb	$1,856,874	Hardin	$2,658,203	Monroe	$3,712,847.00		
		Dyer	$4,062,390	Henry	$3,191,743	Morgan	$1,489,782.00		
		Gibson	$5,162,261	Houston	$685,385	Perry	$657,966.00		
		Haywood	$1,741,423	Jefferson	$4,500,342	Pickett	$534,738.00		
		Henderson	$2,595,898	Johnson	$1,376,842	Trousdale	$744,132.00		
		Lewis	$1,031,977	Lake	$526,753	Van Buren	$394,807.00		
		Loudon	$5,329,740	Lauderdale	$2,249,332	Wayne	$1,297,049.00		
		Madison	$11,043,009	Macon	$1,749,296	White	$1,954,632.00		
		Marion	$2,524,507	Marshall	$2,927,077	Williamson	$26,398,699.00		
		Maury	$8,409,833	Moore	$588,443	Wilson	$13,297,192.00		
		McNairy	$2,290,524	Putnam	$6,606,531				
		Obion	$3,280,373	Roane	$5,444,846				
		Robertson	$6,698,281	Sevier	$11,616,622				
		Rutherford	$26,893,411	Shelby	$111,560,225				
		Scott	$1,654,534	Smith	$1,651,086				
		Tipton	$5,363,726	Stewart	$1,121,871				
		Warren	$3,948,228	Sumner	$18,266,647				
				Washington	$13,163,943				
				Weakley	$2,986,860				

**The structure values are estimates extracted from FEMA's HAZUS-MH 4.0 inventory database.*

Table 22 – Loss Estimation by Local Plan Integration, Geologic Hazards									
Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate
Carter	$4,548,266.00	Anderson	$8,632,331	Benton	$1,449,738	Bedford	$4,004,557	Shelby	$111,560,225.00
Hardin	$2,658,203.00	Blount	$12,476,827	Bradley	$9,529,708	Cheatham	$3,920,450		
Maury	$8,409,833.00	Crockett	$1,357,243	Campbell	$3,401,005	Cumberland	$5,271,889		
Putnam	$6,606,531.00	Davidson	$80,510,822	Cocke	$2,830,636	Dyer	$4,062,390		
Rutherford	$26,893,411.00	Decatur	$1,099,007	Dickson	$4,790,761	Gibson	$5,162,261		
		Dekalb	$1,856,874	Fayette	$4,289,132	Perry	$657,966		
		Henry	$3,191,743	Fentress	$1,407,956	Roane	$5,444,846		
		Washington	$13,163,943	Giles	$2,842,491	Robertson	$6,698,281		
				Unicoi	$1,533,041	Scott	$1,654,534		
				Weakley	$2,986,860	Sequatchie	$1,112,969		
						Sevier	$11,616,622		
						Smith	$1,651,086		
						Stewart	$1,121,871		
						Sumner	$18,266,647		
						Tipton	$5,363,726		
						Trousdale	$744,132		
						Warren	$3,948,228		
						Wayne	$1,297,049		
						Williamson	$26,398,699		

**The structure values are estimates extracted from FEMA's HAZUS-MH 4.0 inventory database.*

Table 23 – Loss Estimation by Local Plan Integration, Severe Storms

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate
		Benton	$1,449,738	Bledsoe	$1,449,738	Anderson	$8,632,331	Sequatchie	$1,112,969.00
		Bradley	$9,529,708	Carroll	$2,500,850	Bedford	$4,004,557		
		Cannon	$1,095,420	Claiborne	$2,559,122	Blount	$12,476,827		
		Carter	$4,548,266	Coffee	$5,490,295	Campbell	$3,401,005		
		Cocke	$2,830,636	Crockett	$1,357,243	Cheatham	$3,920,450		
		Jefferson	$4,500,342	Cumberland	$5,271,889	Henry	$3,191,743		
		Loudon	$5,329,740	Davidson	$80,510,822	Humphreys	$1,780,531		
		Marion	$2,524,507	Decatur	$1,099,007	Lake	$526,753		
		Marshall	$2,927,077	Dekalb	$1,856,874	Moore	$588,443		
		McMinn	$5,007,043	Dyer	$4,062,390	Perry	$657,966		
		Morgan	$1,489,782	Fayette	$4,289,132	Putnam	$6,606,531		
		Warren	$3,948,228	Gibson	$5,162,261	Unicoi	$1,533,041		
				Hamblen	$6,481,076	Washington	$13,163,943		
				Hamilton	$42,050,803	White	$1,954,632		
				Hardeman	$2,097,869	Wilson	$13,297,192		
				Hardin	$2,658,203				
				Hawkins	$4,636,589				
				Haywood	$1,741,423				
				Henderson	$2,595,898				
				Hickman	$2,100,965				
				Houston	$685,385				
				Johnson	$1,376,842				
				Lauderdale	$526,753				
				Lewis	$1,031,977				
				Lincoln	$3,239,164				
				Macon	$1,749,296				
				Madison	$11,043,009				
				Maury	$8,409,833				
				McNairy	$2,290,524				
				Meigs	$830,347				
				Monroe	$3,712,847				
				Obion	$3,280,373				
				Pickett	$534,738				

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate
				Robertson	$6,698,281				
				Rutherford	$26,893,411				
				Scott	$1,654,534				
				Sevier	$11,616,622				
				Shelby	$111,560,225				
				Smith	$1,651,086				
				Stewart	$1,121,871				
				Sumner	$18,266,647				
				Tipton	$5,363,726				
				Trousdale	$744,132				
				Van Buren	$394,807				
				Wayne	$1,297,049				
				Weakley	$2,986,860				
				Williamson	$26,398,699				

**The structure values are estimates extracted from FEMA's HAZUS-MH 4.0 inventory database.*

Table 24 – Loss Estimation by Local Plan Integration, Tornadoes									
Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate
Carter	$4,548,266.00	Anderson	$8,632,331	Benton	$1,449,738	Blount	$12,476,827.00	Rutherford	$26,893,411.00
		Bradley	$9,529,708	Bledsoe	$1,449,738	Hickman	$2,100,965.00	Sequatchie	$1,112,969.00
		Cannon	$1,095,420	Carroll	$2,500,850	Humphreys	$1,780,531.00		
		Cocke	$2,830,636	Chester	$1,339,537	Lake	$526,753.00		
		Jefferson	$4,500,342	Claiborne	$2,559,122	Lincoln	$3,239,164.00		
		Loudon	$5,329,740	Crockett	$1,357,243	Maury	$8,409,833.00		
		Marion	$2,524,507	Cumberland	$5,271,889	Moore	$588,443.00		
		Morgan	$1,489,782	Davidson	$80,510,822	Perry	$657,966.00		
		Sevier	$11,616,622	Decatur	$1,099,007	Sumner	$18,266,647.00		
		Warren	$3,948,228	Dekalb	$1,856,874	White	$1,954,632.00		
				Dyer	$4,062,390	Williamson	$26,398,699.00		
				Fayette	$4,289,132	Wilson	$13,297,192.00		
				Gibson	$5,162,261				
				Hamblen	$6,481,076				
				Hamilton	$42,050,803				
				Hardeman	$2,097,869				
				Hardin	$2,658,203				
				Hawkins	$4,636,589				
				Haywood	$1,741,423				
				Henderson	$2,595,898				
				Henry	$3,191,743				
				Houston	$685,385				
				Johnson	$1,376,842				
				Lau7derdale	$526,753				
				Lewis	$1,031,977				
				Macon	$1,749,296				
				Madison	$11,043,009				
				Marshall	$2,927,077				
				McMinn	$5,007,043				
				McNairy	$2,290,524				
				Meigs	$830,347				
				Monroe	$3,712,847				
				Obion	$3,280,373				
				Pickett	$534,738				

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate
				Putnam	$6,606,531				
				Roane	$5,444,846				
				Robertson	$6,698,281				
				Scott	$1,654,534				
				Shelby	$111,560,225				
				Smith	$1,651,086				
				Stewart	$1,121,871				
				Tipton	$5,363,726				
				Trousdale	$744,132				
				Unicoi	$1,533,041				
				Van Buren	$394,807				
				Washington	$13,163,943				
				Wayne	$1,297,049				
				Weakley	$2,986,860				

**The structure values are estimates extracted from FEMA's HAZUS-MH 4.0 inventory database.*

Table 25 – Loss Estimation by Local Plan Integration, Wildfire									
Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate
Hardin	$2,658,203	Carter	$4,548,266	Bradley	$9,529,708	Anderson	$8,632,331	Bedford	$4,004,557
Henderson	$2,595,898	Cocke	$2,830,636	Cannon	$1,095,420	Blount	$12,476,827		
Lauderdale	$2,249,332	Rutherford	$26,893,411	Henry	$3,191,743	Washington	$13,163,943		
Van Buren	$394,807			Maury	$8,409,833				
				Perry	$657,966				
				Roane	$5,444,846				
				Sequatchie	$1,112,969				
				Williamson	$26,398,699				
				Wilson	$13,297,192				

**The structure values are estimates extracted from FEMA's HAZUS-MH 4.0 inventory database*

3.5 – Population Growth, Development Trends, & Land Use Changes

More often than not, mitigation projects address current or previous hazard vulnerabilities and are static in location. Additionally, it may take years for a mitigation project to mature from inception, grant application, construction, completion, and grant close out. In contrast, populations grow and shrink, private industry develops and constructs, and land use changes at a far quicker pace. It's imperative that this risk assessment addresses recent changes and attempts to predict the impact of future developments, since population growth, development trends, and land use changes can significantly alter a state's hazard vulnerability landscape. Specific examples of how vulnerabilities can quickly change are as follows:

- Unrestricted residential growth can increase a population's exposure to identified hazard prone areas.
- Increased population growth can outpace a local community's capability to protect itself from hazards such as providing reserve water resources during a drought.
- Rapid development can put a strain on a community's vulnerable resources such as its energy infrastructure.
- Residential development constructed quickly and inexpensively to meet consumer demand will often lack long term mitigation measures and resiliency.
- Rapid development under pressure to meet consumer demand can alter the landscape in ways affecting urban runoff, drainage, or other environmental considerations which have drastic effects on floodplains.
- An increase in businesses can increase the amount of hazardous materials being transported throughout the state to be used in the production of other goods of the maintenance of manufacturing equipment.
- An increase in businesses producing chemicals and other hazardous materials can increase a community's risk based on the new stockpiles as well as the materials being transported away from a site.

In this section, development changes and trends that effluence potential loss estimates are broken down into 3 categories: Land Use, Demographics, and Business & Industry.

Land Use
Land use changes have been broken down into zoning, floodplain management, wildfire mitigation, and building code changes.

Zoning Changes
Since the previous State Hazard Mitigation Plan was approved in 2013, Tennessee has experienced extensive changes to how the state administers land use and zoning assistance for local governments. In 2011, the Department of Economic and Community Development's Local Planning Assistance Office was eliminated. The Local Planning Assistance Office, which housed 6 regional offices and a staff of approximately 60 persons, was the state's center for providing land use, zoning, and community planning assistance to local governments. As part of the office's duties, local governments could receive state assistance in identifying areas in their communities that were more vulnerable to hazards impacts. This assistance would also include guidance on how to use land use and zoning procedures to reduce a community's vulnerability to flooding, wildfires, landslides, earthquakes, and other hazard events. With the elimination of the Local Planning Assistance Office, numerous communities no longer receive the technical expertise needed to help make land use discussions in hazard-prone areas. Many believe that this decision will affect Tennessee's hazard vulnerability in the future because there will be less pressure to not build in hazard-prone areas, especially for the state's more rural communities.

Floodplain Management Changes
Since the previous State Hazard Mitigation Plan was approved in 2013, state legislature passed Public Chapter No. 1091 which amends State Code T.C.A. 12-4-109. Public Chapter No. 1091 requires all communities with FEMA identified special flood hazard areas in Tennessee to adopt into FEMA's National Flood Insurance Program (NFIP). This Public Chapter has drastically

increased statewide participation in the NFIP. Currently, 401 communities have joined the NFIP in Tennessee. Additionally, in 2010 the Tennessee Association of Floodplain Managers (TN AFPM) was created to support local floodplain managers, in August 2013 the Tennessee Department of Economic & Community Development contracted with the Tennessee Development Districts to start providing statewide floodplain management trainings, and in September 2014 Tennessee was the 40th state to charter a Silver Jackets Team. These initiatives will help reduce the development in floodplains, thereby reducing future potential losses. Additionally the areas with the highest forecasted growth rates also now have some of the state's strongest floodplain management programs. (*see* https://www.tn.gov/environment/nfip-national-flood-insurance-program.html)

Wildfire Mitigation Changes

Since the 2013 plan, the Tennessee Division of Forestry has increased participation in the State's Firewise program and in Community Wildfire Protection Planning efforts. The Division of Forestry now has 2 "mitigation" specialists on staff to assist communities in determining approaches to reduce their vulnerabilities to wildfire threats. Because of the trend of retirees moving to the state's more forested areas, especially in the Upper Cumberland, Highland Rim, and Appalachian regions, these increased wildfire mitigation capabilities should help reduce some future wildfire vulnerabilities (*see* http://www.burnsafetn.org/firewise_nat_com.html).

Building Code Changes

Since the 2013 plan, the state continues to utilize the 2009 International Residential Code. Meetings have been had to identify when the State should update to a newer set of building codes, but that is still to be determined. One amendment that was made in 2011 is the requirement for additions over 30 square feet to existing homes will now require a building permit. Also Memphis/Shelby County, which is considered Tennessee's greatest vulnerability in terms of a large-scale New Madrid earthquake event, adopted stronger seismic provisions into their building codes on October 1, 2013.

Demographics

Although, the State of Tennessee has been experiencing drastic population changes since 2000, very little has changed demographically since the approval and adoption of its previous plan. What changes have occurred are addressed in this risk assessment through the incorporation of the best available data. Exposure and impacts of hazards on changing communities is addressed by using the most up to date NOAA NCDC data. In terms of Tennessee's growing population, the risk assessment addresses these changes by using the latest SoVI© data which was published in 2010, post approval of the previously approved HMP.

Tables on the following pages display the US Census Bureau's predictions for Tennessee's future population growth. The higher a county's population growth, the greater the chance their hazard vulnerability will increase as well. Counties highlighted in red or orange will require the greatest predicted attention. This information is highly speculative, but it's the best available indicator.

Business & Industry
A group of 500 CEOs convening annually for "Chief Executive" magazine rated Tennessee the 4th most business friendly state, a position it has held since 2010, when it was 3rd. In 2011, the latest complete business growth statistics, Tennessee ranked 6th in the nation for economic growth. It is of no surprise, that with this reputation, Tennessee has managed to attract business and remain prosperous throughout the past decade's economic fluctuations. Tennessee is a main transportation route for rail, truck, and air transit, and hosts one of the county's major oil and natural gas pipelines. It is home to a number of national corporations including FedEx, AutoZone, International Paper, Pilot, Regal Entertainment, Eastman Chemical, Caterpillar Financial, and the North American headquarters of Nissan.

Tennessee's continued economic growth has similar impacts on its vulnerability as does its population growth. Vulnerability can be increased in 2 ways, first, by location based growth in identified hazard prone areas as in the case of manufacturing requiring river or lake access, or by the industry type itself as is the case with chemical manufacturing or mining. Table 29 illustrates Tennessee's GDP growth per industry over the past 5 years.

Table 26 – East Tennessee Population Growth Projections (2010 – 2030)						
% Growth Categories						
(X < 0%)	(0% < 5%)	(5% < 10%)	(10% < 15%)	(15% < 20%)	(20% < 25%)	(25% < X)
County	**2010 Population**	**2020 Population**	**2030 Population**	**2010 - 2020 % Growth**	**2020 - 2030 % Growth**	**2010 - 2030 % Growth**
Anderson	75,129	77,949	80,367	3.75%	3.10%	6.97%
Bledsoe	12,876	12,674	13,150	-1.57%	3.76%	2.13%
Blount	123,010	137,001	155,543	11.37%	13.53%	26.45%
Bradley	98,963	108,423	117,834	9.56%	8.68%	19.07%
Campbell	40,716	43,036	44,846	5.70%	4.21%	10.14%
Carter	57,424	58,978	61,831	2.71%	4.84%	7.67%
Claiborne	32,213	34,843	38,784	8.16%	11.31%	20.40%
Cocke	35,662	40,302	47,868	13.01%	18.77%	34.23%
Cumberland	56,053	60,395	69,955	7.75%	15.83%	24.80%
Fentress	17,959	19,160	20,578	6.69%	7.40%	14.58%
Grainger	22,657	23,778	25,922	4.95%	9.02%	14.41%
Greene	68,831	71,574	75,163	3.99%	5.01%	9.20%
Hamblen	62,544	66,262	70,693	5.94%	6.69%	13.03%
Hamilton	336,463	352,163	355,597	4.67%	0.98%	5.69%
Hancock	6,819	6,606	6,360	-3.12%	-3.72%	-6.73%
Hawkins	56,833	58,149	56,744	2.32%	-2.42%	-0.16%
Jefferson	51,407	57,983	65,990	12.79%	13.81%	28.37%
Johnson	18,244	18,164	18,782	-0.44%	3.40%	2.95%
Knox	432,226	480,538	527,740	11.18%	9.82%	22.10%
Loudon	48,556	53,056	57,095	9.27%	7.61%	17.59%
Marion	28,237	28,014	27,406	-0.79%	-2.17%	-2.94%
McMinn	52,266	54,984	59,288	5.20%	7.83%	13.44%
Meigs	11,753	12,742	13,148	8.41%	3.19%	11.87%
Monroe	44,519	48,508	52,916	8.96%	9.09%	18.86%
Morgan	21,987	22,265	22,992	1.26%	3.27%	4.57%
Pickett	5,077	4,790	4,579	-5.65%	-4.41%	-9.81%
Polk	16,825	16,350	15,885	-2.82%	-2.84%	-5.59%
Rhea	31,809	35,062	37,252	10.23%	6.25%	17.11%
Roane	54,181	54,246	54,059	0.12%	-0.34%	-0.23%
Scott	22,228	22,244	23,215	0.07%	4.37%	4.44%
Sequatchie	14,112	16,230	18,669	15.01%	15.03%	32.29%
Sevier	89,889	101,102	116,428	12.47%	15.16%	29.52%
Sullivan	156,823	159,275	158,532	1.56%	-0.47%	1.09%
Unicoi	18,313	18,470	18,696	0.86%	1.22%	2.09%
Union	19,109	19,743	20,391	3.32%	3.28%	6.71%
Washington	122,979	139,679	154,511	13.58%	10.62%	25.64%
East Tennessee	**2,364,692**	**2,534,738**	**2,708,809**	**5.29%**	**5.85%**	**14.55%**
Tennessee	**6,346,105**	**6,894,708**	**7,451,677**	**8.64%**	**8.08%**	**17.42%**

**The data are from the U.S. Census Bureau.*

Table 27 – Middle Tennessee Population Growth Projections (2010 – 2030)						
% Growth Categories						
(X < 0%)	(0% < 5%)	(5% < 10%)	(10% < 15%)	(15% < 20%)	(20% < 25%)	(25% < X)
County	**2010 Population**	**2020 Population**	**2030 Population**	**2010 - 2020 % Growth**	**2020 - 2030 % Growth**	**2010 - 2030 % Growth**
Bedford	45,058	52,145	62,095	15.73%	19.08%	37.81%
Cannon	13,801	14,713	15,526	6.61%	5.53%	12.50%
Cheatham	39,105	41,002	42,004	4.85%	2.44%	7.41%
Clay	7,861	7,623	7,424	-3.03%	-2.61%	-5.56%
Coffee	52,796	58,054	67,137	9.96%	15.65%	27.16%
Davidson	626,681	691,339	736,581	10.32%	6.54%	17.54%
DeKalb	18,723	19,875	21,559	6.15%	8.47%	15.15%
Dickson	49,666	51,766	53,611	4.23%	3.56%	7.94%
Franklin	41,052	42,765	46,437	4.17%	8.59%	13.12%
Giles	29,485	29,097	28,328	-1.32%	-2.64%	-3.92%
Grundy	13,703	13,271	12,883	-3.15%	-2.92%	-5.98%
Hickman	24,690	25,171	25,633	1.95%	1.84%	3.82%
Houston	8,426	8,594	8,695	1.99%	1.18%	3.19%
Humphreys	18,538	18,650	18,855	0.60%	1.10%	1.71%
Jackson	11,638	11,544	11,258	-0.81%	-2.48%	-3.27%
Lawrence	41,869	42,169	42,030	0.72%	-0.33%	0.38%
Lewis	12,161	12,030	11,927	-1.08%	-0.86%	-1.92%
Lincoln	33,361	37,681	44,505	12.95%	18.11%	33.40%
Macon	22,248	23,813	25,707	7.03%	7.95%	15.55%
Marshall	30,617	33,622	36,912	9.81%	9.79%	20.56%
Maury	80,956	94,620	109,023	16.88%	15.22%	34.67%
Montgomery	172,331	202,325	227,710	17.40%	12.55%	32.14%
Moore	6,362	6,382	6,618	0.31%	3.70%	4.02%
Overton	22,083	23,043	24,376	4.35%	5.78%	10.38%
Perry	7,915	7,954	7,729	0.49%	-2.83%	-2.35%
Putnam	72,321	84,511	97,154	16.86%	14.96%	34.34%
Robertson	66,283	74,995	82,447	13.14%	9.94%	24.39%
Rutherford	262,604	339,867	434,009	29.42%	27.70%	65.27%
Smith	19,166	20,598	22,402	7.47%	8.76%	16.88%
Stewart	13,324	14,175	15,019	6.39%	5.95%	12.72%
Sumner	160,645	184,643	210,015	14.94%	13.74%	30.73%
Trousdale	7,870	8,772	9,640	11.46%	9.90%	22.49%
Van Buren	5,548	5,409	5,151	-2.51%	-4.77%	-7.16%
Warren	39,839	41,698	44,321	4.67%	6.29%	11.25%
Wayne	17,021	16,647	16,008	-2.20%	-3.84%	-5.95%
White	25,841	28,071	31,355	8.63%	11.70%	21.34%
Williamson	183,182	226,297	280,804	23.54%	24.09%	53.29%
Wilson	113,993	133,998	154,117	17.55%	15.01%	35.20%
Middle Tennessee	**2,418,763**	**2,748,929**	**3,097,005**	**7.28%**	**7.15%**	**28.04%**
Tennessee	**6,346,105**	**6,894,708**	**7,451,677**	**8.64%**	**8.08%**	**17.42%**

**The data are from the U.S. Census Bureau.*

Table 28 – West Tennessee Population Growth Projections (2010 – 2030)						
% Growth Categories						
(X < 0%)	(0% < 5%)	(5% < 10%)	(10% < 15%)	(15% < 20%)	(20% < 25%)	(25% < X)
County	2010 Population	2020 Population	2030 Population	2010 - 2020 % Growth	2020 - 2030 % Growth	2010 - 2030 % Growth
Benton	16,489	15,896	15,307	-3.60%	-3.71%	-7.17%
Carroll	28,522	27,692	26,933	-2.91%	-2.74%	-5.57%
Chester	17,131	18,305	19,523	6.85%	6.65%	13.96%
Crockett	14,586	14,815	15,186	1.57%	2.50%	4.11%
Decatur	11,757	11,502	11,397	-2.17%	-0.91%	-3.06%
Dyer	38,335	38,493	38,405	0.41%	-0.23%	0.18%
Fayette	38,413	46,260	56,903	20.43%	23.01%	48.13%
Gibson	49,683	52,072	53,740	4.81%	3.20%	8.17%
Hardeman	27,253	26,212	25,532	-3.82%	-2.59%	-6.31%
Hardin	26,026	26,440	27,040	1.59%	2.27%	3.90%
Haywood	18,787	18,437	18,707	-1.86%	1.46%	-0.43%
Henderson	27,769	28,611	29,611	3.03%	3.50%	6.63%
Henry	32,330	32,905	33,516	1.78%	1.86%	3.67%
Lake	7,832	7,399	6,952	-5.53%	-6.04%	-11.24%
Lauderdale	27,815	27,388	27,702	-1.54%	1.15%	-0.41%
Madison	98,294	102,228	106,390	4.00%	4.07%	8.24%
McNairy	26,075	26,917	27,454	3.23%	2.00%	5.29%
Obion	31,807	31,082	30,628	-2.28%	-1.46%	-3.71%
Shelby	927,644	953,346	960,700	2.77%	0.77%	3.56%
Tipton	61,081	68,999	77,508	12.96%	12.33%	26.89%
Weakley	35,021	36,042	36,729	2.92%	1.91%	4.88%
West Tennessee	**1,562,650**	**1,611,041**	**1,645,863**	**2.03%**	**2.33%**	**5.33%**
Tennessee	**6,346,105**	**6,894,708**	**7,451,677**	**8.64%**	**8.08%**	**17.42%**

**The data are from the U.S. Census Bureau.*

Table 29 – Industrial Growth, Tennessee (2010 – 2012)						
% Growth Categories						
(X < -15%)	(-10% < -5%)	(-5% < 0%)	(0% < 5%)	(5% < 15%)	(15 < 25%)	(25% < X)
Industrial Sector	**2010 GDP**	**2011 GDP**	**2012 GDP**	**2010 – 2011 GDP Growth**	**2011 – 2012 GDP Growth**	**2010 – 2012 GDP Growth**
All industry total	$227,360	$232,891	$240,523	2.43%	3.28%	5.79%
Private industries	$201,164	$206,964	$214,557	2.88%	3.67%	6.66%
Agriculture, forestry, fishing, and hunting	$1,276	$1,122	$1,140	-12.07%	1.60%	-10.66%
Crop and animal production (Farms)	$929	$771	N/A	-17.01%	N/A	N/A
Forestry, fishing, and related activities	$321	$334	N/A	4.05%	N/A	N/A
Mining	$195	$165	$188	-15.38%	13.94%	-3.59%
Oil and gas extraction	$20	$17	N/A	-15.00%	N/A	N/A
Mining (except oil and gas)	$128	$115	N/A	-10.16%	N/A	N/A
Support activities for mining	$43	$27	N/A	-37.21%	N/A	N/A
Utilities	$1,441	$1,495	$1,486	3.75%	-0.60%	3.12%
Construction	$7,443	$7,638	$7,794	2.62%	2.04%	4.72%
Manufacturing	$33,486	$35,357	$38,211	5.59%	8.07%	14.11%
Durable goods	$18,414	$21,056	$24,028	14.35%	14.11%	30.49%
Wood product manufacturing	$844	$942	N/A	11.61%	N/A	N/A
Nonmetallic mineral product manufacturing	$741	$850	N/A	14.71%	N/A	N/A
Primary metal manufacturing	$895	$947	N/A	5.81%	N/A	N/A
Fabricated metal product manufacturing	$2,894	$2,995	N/A	3.49%	N/A	N/A
Machinery manufacturing	$2,262	$2,419	N/A	6.94%	N/A	N/A
Computer and electronic product manufacturing	$2,330	$2,848	N/A	22.23%	N/A	N/A
Electrical equipment, appliance, and component manufacturing	$1,790	$2,252	N/A	25.81%	N/A	N/A
Motor vehicle, body, trailer, and parts manufacturing	$2,956	$4,142	N/A	40.12%	N/A	N/A
Other transportation equipment manufacturing	$328	$364	N/A	10.98%	N/A	N/A
Furniture and related product manufacturing	$393	$379	N/A	-3.56%	N/A	N/A
Miscellaneous manufacturing	$2,227	$2,228	N/A	0.04%	N/A	N/A
Nondurable goods	$14,753	$14,273	$14,429	-3.25%	1.09%	-2.20%
Food and beverage and tobacco product manufacturing	$5,990	$5,797	N/A	-3.22%	N/A	N/A

% Growth Categories						
(X < -15%)	(-10% < -5%)	(-5% < 0%)	(0% < 5%)	(5% < 15%)	(15 < 25%)	(25% < X)
Industrial Sector	**2010 GDP**	**2011 GDP**	**2012 GDP**	**2010 - 2011 GDP Growth**	**2011 - 2012 GDP Growth**	**2010 - 2012 GDP Growth**
Textile mills and textile product mills	$434	$361	N/A	-16.82%	N/A	N/A
Apparel and leather and allied product manufacturing	$264	$238	N/A	-9.85%	N/A	N/A
Paper manufacturing	$2,089	$1,940	N/A	-7.13%	N/A	N/A
Printing and related support activities	$837	$843	N/A	0.72%	N/A	N/A
Petroleum and coal products manufacturing	$418	$325	N/A	-22.25%	N/A	N/A
Chemical manufacturing	$3,103	$3,124	N/A	0.68%	N/A	N/A
Plastics and rubber products manufacturing	$1,659	$1,700	N/A	2.47%	N/A	N/A
Wholesale trade	$13,765	$14,082	$14,768	2.30%	4.87%	7.29%
Retail trade	$18,503	$18,497	$18,957	-0.03%	2.49%	2.45%
Transportation and warehousing	$11,112	$11,697	$11,941	5.26%	2.09%	7.46%
Air transportation	$523	$543	N/A	3.82%	N/A	N/A
Rail transportation	$513	$530	N/A	3.31%	N/A	N/A
Water transportation	$466	$609	N/A	30.69%	N/A	N/A
Truck transportation	$4,283	$4,370	N/A	2.03%	N/A	N/A
Transit and ground passenger transportation	$331	$316	N/A	-4.53%	N/A	N/A
Pipeline transportation	$42	$41	N/A	-2.38%	N/A	N/A
Other transportation and support activities	$4,177	$4,407	N/A	5.51%	N/A	N/A
Warehousing and storage	$811	$969	N/A	19.48%	N/A	N/A
Information	$7,551	$7,926	$8,316	4.97%	4.92%	10.13%
Publishing industries, except Internet	$1,163	$1,150	N/A	-1.12%	N/A	N/A
Motion picture and sound recording industries	$1,006	$923	N/A	-8.25%	N/A	N/A
Broadcasting and telecommunications	$4,520	$4,911	N/A	8.65%	N/A	N/A
Information and data processing services	$886	$993	N/A	12.08%	N/A	N/A
Finance and insurance	$15,322	$15,033	$15,829	-1.89%	5.30%	3.31%
Federal Reserve banks, credit intermediation and related services	$7,610	$7,415	N/A	-2.56%	N/A	N/A
Securities, commodity contracts, investments	$1,639	$1,496	N/A	-8.72%	N/A	N/A
Insurance carriers and related activities	$5,915	$5,903	N/A	-0.20%	N/A	N/A
Funds, trusts, and other financial vehicles	$173	$225	N/A	30.06%	N/A	N/A

% Growth Categories							
(X < -15%)	(-10% < -5%)	(-5% < 0%)	(0% < 5%)	(5% < 15%)	(15 < 25%)	(25% < X)	
Industrial Sector	**2010 GDP**	**2011 GDP**	**2012 GDP**	**2010 - 2011 GDP Growth**	**2011 - 2012 GDP Growth**	**2010 - 2012 GDP Growth**
Real estate and rental and leasing	$25,516	$25,652	$25,522	0.53%	-0.51%	0.02%
Real estate	$22,382	$22,502	N/A	0.54%	N/A	N/A
Rental and leasing services and lessors of intangible assets	$3,132	$3,148	N/A	0.51%	N/A	N/A
Professional, scientific, and technical services	$12,981	$13,542	$13,744	4.32%	1.49%	5.88%
Legal services	$1,678	$1,653	N/A	-1.49%	N/A	N/A
Computer systems design and related services	$1,467	$1,572	N/A	7.16%	N/A	N/A
Other professional, scientific and technical services	$9,907	$10,412	N/A	5.10%	N/A	N/A
Management of companies and enterprises	$2,516	$2,607	$3,298	3.62%	26.51%	31.08%
Administrative and waste management services	$9,459	$10,187	$10,677	7.70%	4.81%	12.88%
Administrative and support services	$8,514	$9,282	N/A	9.02%	N/A	N/A
Waste management and remediation services	$941	$908	N/A	-3.51%	N/A	N/A
Educational services	$1,927	$1,927	$1,948	0.00%	1.09%	1.09%
Health care and social assistance	$22,788	$23,570	$23,841	3.43%	1.15%	4.62%
Ambulatory health care services	$11,750	$11,877	N/A	1.08%	N/A	N/A
Hospitals and nursing and residential care facilities	$9,835	$10,453	N/A	6.28%	N/A	N/A
Social assistance	$1,191	$1,215	N/A	2.02%	N/A	N/A
Arts, entertainment, and recreation	$2,289	$2,438	$2,615	6.51%	7.26%	14.24%
Performing arts, spectator sports, museums, and related services	$1,596	$1,717	N/A	7.58%	N/A	N/A
Amusement, gambling, and recreation	$692	$719	N/A	3.90%	N/A	N/A
Accommodation and food services	$7,227	$7,612	$7,863	5.33%	3.30%	8.80%
Accommodation	$1,721	$1,919	N/A	11.50%	N/A	N/A
Food services and drinking places	$5,491	$5,691	N/A	3.64%	N/A	N/A
Other services, except government	$6,195	$6,303	$6,308	1.74%	0.08%	1.82%
Government	$26,175	$25,966	$26,066	-0.80%	0.39%	-0.42%
Federal civilian	$5,393	$5,249	N/A	-2.67%	N/A	N/A
Federal military	$1,278	$1,164	N/A	-8.92%	N/A	N/A
State and local	$19,492	$19,540	N/A	0.25%	N/A	N/A
Natural resources and mining	$1,459	$1,275	$1,321	-12.61%	3.61%	-9.46%

% Growth Categories						
(X < -15%)	(-10% < -5%)	(-5% < 0%)	(0% < 5%)	(5% < 15%)	(15 < 25%)	(25% < X)
Industrial Sector	**2010 GDP**	**2011 GDP**	**2012 GDP**	**2010 - 2011 GDP Growth**	**2011 - 2012 GDP Growth**	**2010 - 2012 GDP Growth**
Trade	$32,198	$32,527	$33,690	1.02%	3.58%	4.63%
Transportation and utilities	$12,584	$13,221	$13,451	5.06%	1.74%	6.89%
Financial activities	$40,842	$40,682	$41,372	-0.39%	1.70%	1.30%
Professional and business services	$24,991	$26,358	$27,834	5.47%	5.60%	11.38%
Education and health services	$24,682	$25,453	$25,744	3.12%	1.14%	4.30%
Leisure and hospitality	$9,515	$10,048	$10,473	5.60%	4.23%	10.07%
Information, Communication, and Technology (ICT)	$6,173	$6,829	N/A	10.63%	N/A	N/A
Private goods-producing industries	$42,385	$44,200	$47,195	4.28%	6.78%	11.35%
Private services-providing industries	$158,660	$162,659	$167,291	2.52%	2.85%	5.44%

**The data are from the U.S. Bureau of Economic Analysis.*

***The GDP data are displayed as millions of 2005 chained dollars.*

3.6 – Local Capabilities

Local capabilities are the existing programs and policies through which local governments implement mitigation actions to reduce potential disaster losses. The local capability assessment provides a general description of local mitigation capabilities in Tennessee and their effectiveness for mitigation. The HMPC assessed the challenges and opportunities to implementing and strengthening local mitigation capabilities in Tennessee through a small group brainstorming process. The key issues identified from this process and from reviewing capabilities identified in local plans are summarized below.

There is a wide range of policies that can serve as a foundation for implementing local mitigation plans, including building codes, floodplain ordinances, zoning codes, and comprehensive land use plans. The state continues to encourage and authorize through state statute local adoption of these types of capabilities, but they are not required. Other types of capabilities that may be used to implement local mitigation actions include economic development plans, capital improvement plans, stormwater management plans, erosion management plans, environmental regulations, growth management plans, and hazard specific ordinances.

In 2011, the *Status of Planning and Land Use Controls in Tennessee* manual was published to facilitate a more comprehensive understanding of the role land use controls and zoning play in mitigation efforts and local and state integration. This manual provides includes regional analysis of population to zoning ordinance relationships and the role that Local Planning Assistance Office potentially played in developing mitigation strategies. It also provides guidance for counties and regional planning authorities in regards to the integration of land use controls and the NFIP. This information has not been updated and remains the most current information available. Mitigation action 12 in this plan seeks to update this valuable information when funding is available.

The following table illustrates counties with zoning ordinances and their proportional population.

Table 30 – Zoning & Subdivision Regulations, Tennessee (2011)

	County Population Range						
Counties	Under 25,000	25,000 - 50,000	50,000 - 75,000	75,000 - 100,000	100,000 - 200,000	200,000 and more	Total
Total	38	32	11	3	7	4	95
% of Total	40.00%	33.68%	11.58%	3.16%	7.37%	4.21%	100.00%
Total with Zoning	10	15	9	3	7	4	48
% with Zoning	26.32%	46.88%	81.82%	100.00%	100.00%	100.00%	50.53%
Total with Subdivision Regulations	20	25	11	3	7	4	70
% with Subdivision Regulations	52.63%	78.13%	100.00%	100.00%	100.00%	100.00%	73.68%

Local Emergency Management Departments

The county emergency management agency is the first line of defense in responding to emergencies in their jurisdiction. TCA 58-2-110 requires counties to develop a county emergency management plan that is consistent with the TEMP and emergency management program to ensure an effective response and recovery. This plan, called a basic emergency operations plan, must be periodically reviewed and approved by TEMA. Conceptually, local emergency management responders deal with an emergency in their jurisdiction with their assets and with as much additional support that may be provided by intrastate mutual aid or assistance under TCA 58-8-101. When the emergency exceeds the local jurisdiction's capability, the county may request additional assistance from higher levels of government. The mayor or his authorized representative, typically the emergency management director, may request formal assistance from other jurisdictions, including state and federal help.

- Counties have responsibility for emergency preparedness and response within their jurisdictions. These officials may appoint an Emergency Management Coordinator/Director (EMC) to manage day-to-day program activities. Local emergency management programs include all hazard threat identification and prevention activities, emergency planning, providing or arranging training for local officials and emergency responders, planning and conducting drills and exercises, carrying out public education relating to known hazards, designing and implementing hazard mitigation programs, coordinating emergency response operations during incidents and disasters, and carrying out recovery activities in the aftermath of a disaster.
- Local emergency management organizations may be organized at the city level, at the county level or as an inter-jurisdictional program that includes 1 or more counties and multiple cities. Local emergency management organizations may be organized as part of the county's staff, as a separate office or agency, as part of the local fire department or law enforcement agency, or in other ways. Local emergency management agencies may also have some homeland security responsibilities.
- Many local jurisdictions have an Emergency Operations Center staffed by members of its various departments which is activated to manage the response to major threats and incidents and coordinate internal and external resource support. Some local governments have an alternate or mobile EOC as well. Most local governments use the Incident Command System (ICS) as their incident management scheme. Under ICS, an Incident Commander typically directs the on-scene response by local responders from a field command post set up at or near the incident site. Responders from other jurisdictions and state and federal responders that have been called on to assist when local resources are inadequate to deal with a major emergency are integrated into the local incident command system.

While counties are required to develop an emergency management plan, many smaller jurisdictions also adopt plans and even create agencies or departments to deal with the specific needs of their citizens. In Tennessee, these smaller jurisdictions include cities, local school districts and university campuses.

Local Hazard Mitigation Plans

Federal regulations require local jurisdictions to prepare and adopt a local hazard mitigation plan approved by FEMA **to be eligible for FEMA's Hazard Mitigation Grant Program and Pre-Disaster Mitigation program**. The mitigation section of TEMA supports local hazard mitigation planning, administers funding programs, and reviews plans before submission to FEMA. There are 67 FEMA approved local hazard mitigation plans in Tennessee. Therefore, out of 95 counties in Tennessee, about 70% have approved/approval pending adoption local hazard mitigation plans. Several other plans are at various stages of review and adoption. The majority of these local plans are multi-jurisdictional and also cover incorporated communities and special districts.

Building, Fire, and Life Safety Codes

The State Residential Building Code Enforcement Program applies to one- and two-family dwellings and townhouses in areas of the state that have not: 1) received an exemption from the State Fire Marshal's Office by having local building codes enforced by the local government, or 2) opted out of state residential building codes and enforcement by a 2/3 vote of the city or county's legislative body. The state has adopted the 2009 International Residential Code (IRC) and the 2006 International Energy Conservation Code (IECC). Fire sprinkler systems are not required in one- and two-family dwellings or 3 unit townhouses that are less than 5,000 square feet, 3 stories or less, and separated by 2 hour fire walls. Effective October 1, 2011, additions over 30 square feet to existing homes will require a permit. The existing home will not be required to be brought up to code; however, the addition must meet code.

State statutes do assign the fire marshal the responsibility of establishing reasonable and uniform regulations to ensure a minimum level of life safety. To meet the intent of the Tennessee Fire Prevention Code and other statutory requirements, new construction and changes in building use are required to be under the direct supervision of a licensed design professional. It is also required to be designed and constructed to a criteria established by 1 of the 3 model building codes adopted by Tennessee regulations, and either have plans reviewed for compliance to code intent or receive a building permit from a local building official with fire authority with building inspections during construction as well as receive a certificate of occupancy prior to formal use.

Land Use and Comprehensive Plans

The preparation of a comprehensive land use plan is optional for local governments in Tennessee. The state planning statutes are permissive, that is, local governments have the authority to engage in a variety of planning activities. There is no mandate from the state that they are required to have a plan for the future development of the area.

The power to engage in comprehensive planning and to adopt land use controls is authorized by the planning and zoning enabling statutes contained in TCA Title 13. Municipalities and counties are given the authority to establish planning commissions, prepare and adopt a general plan for future development, and adopt and enforce subdivision regulations and a zoning ordinance.

A general or comprehensive plan is not required for local governments to adopt and enforce subdivision regulations and zoning ordinances. Furthermore, there is no requirement for consistency between the zoning ordinance and a comprehensive plan, if it exists. The legislative body is also not required to adhere to the plan in the consideration of zoning amendments in the original statute. An amendment to Title 13 gave local governments the authority for a municipal or county planning commission to recommend the adoption of the plan by the legislative body. If that procedure is followed and the plan is adopted by the legislative body, the plan becomes a legal document of the legislative body, and the law then requires that all land use decisions must be consistent with the adopted plan.

Floodplain Management

The potential for future flood damage may be reduced significantly by preventing inappropriate development from occurring in flood-prone areas. Local governments may accomplish floodplain management through their land use planning and zoning authority to protect the public health, safety, and welfare. Multi-objective management of flood-prone areas can provide significant benefits for recreation, water quality, and wildlife habitat while reducing the risk of future flood damage.

State statute allows cities and municipalities to designate flood zones and restrict the use of land within these zones. It requires that any local ordinances relating to flood zones be in compliance with the Flood Insurance Act of 1968. Currently, out of 442 communities (including municipalities and counties), 394 participate (89%) in the National Flood Insurance Program. Of these NFIP participants, 17 (4%) are current in the associated Community Rating System. Of the top 50 Tennessee communities, in terms of total flood insurance policies held by residents, 6 participate in the CRS.

Currently, in Tennessee there are 18 local jurisdictions that are known to be vulnerable to flood hazards that are not yet participants in the NFIP. According to the Tennessee Water Plan, flood insurance is available to nearly 95% of Tennesseans living within identified flood hazard areas, but fewer than 15 % of flood hazard area residents are actually covered by flood insurance.

One concern of the state mitigation program is repetitive loss properties. There are 902 identified repetitive loss properties in Tennessee. Flood losses to these properties have resulted in total payments of over $59 million over the last 30 years. To date, Tennessee has used mitigation funding from various sources to mitigate 186 repetitive loss properties. Currently, there are 44 validated severe repetitive loss properties in Tennessee. Total payments to these 44 properties and their contents have equaled over $5 million.

Table 31 – Floodplain Management Summary, Tennessee	
NFIP Communities	394
Non NFIP Communities in Identified Hazard Areas	18
CRS Communities	17
Non Mitigated RL/SRL Properties	902

**The data are from FEMA.*

Regional and Local Water Resource Management Organizations

Tennessee state agencies are assisted in their efforts to effectively control water resources through regional and local water resource management organizations. From the state level, the Tennessee Department of Environment and Conservation, the Department of Agriculture and the Water Resources Technical Advisory Committee works with these regional and local organizations on a regular basis.

National Weather Service StormReady Program

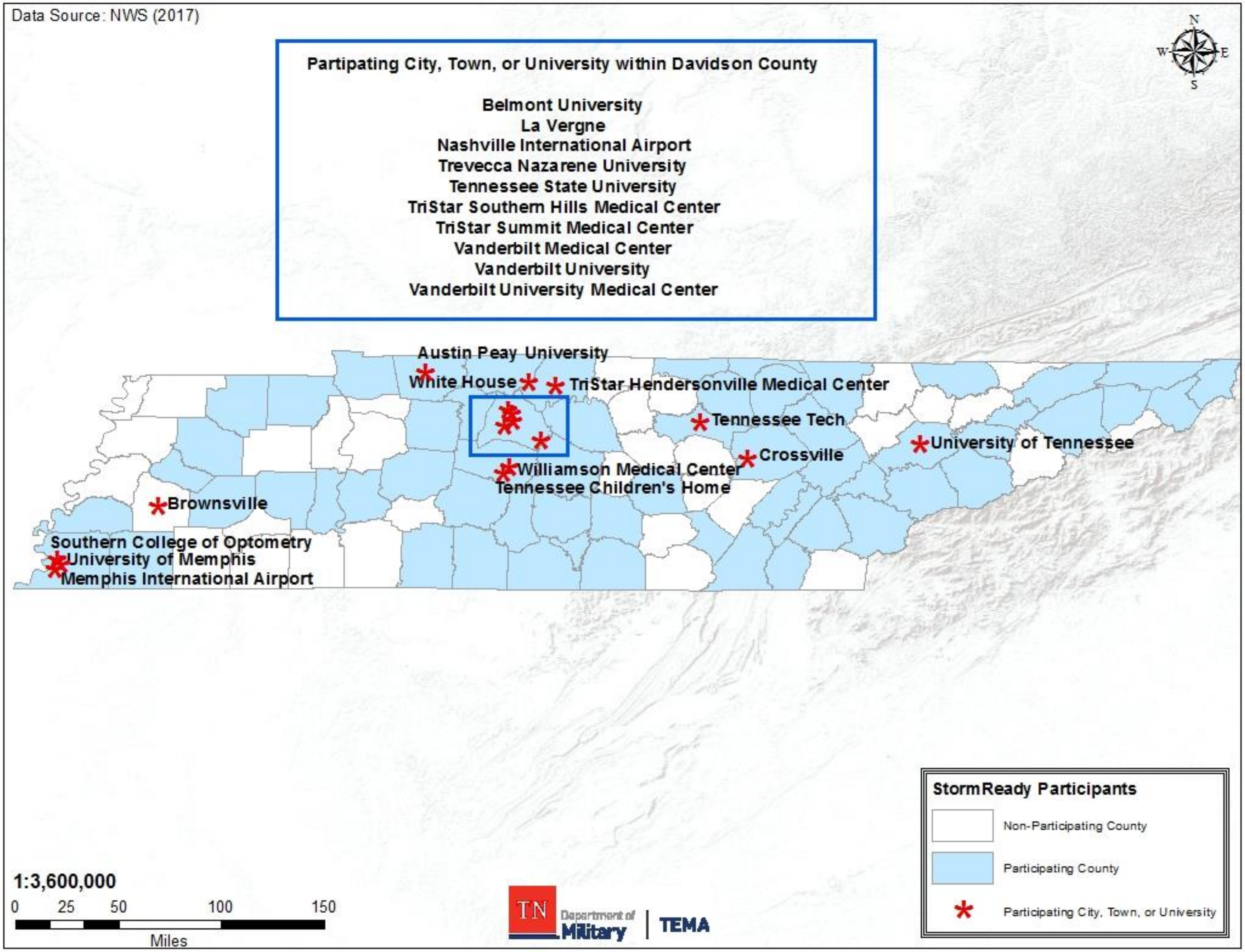
StormReady is a nationwide community preparedness program that uses a grassroots approach to help communities develop plans to handle all types of severe weather—from tornadoes to flooding. The program encourages communities to take a new, proactive approach to improving local hazardous weather operations by providing emergency managers with clear-cut guidelines on how to improve their hazardous weather operations. StormReady is designed to help community leaders and emergency managers strengthen local safety programs.

To be officially StormReady, a community must:

- Establish a 24-hour warning point and emergency operations center,
- Have more than 1 way to receive severe weather warnings and forecasts and to alert the public,
- Create a system that monitors weather conditions locally,
- Promote the importance of public readiness through community seminars
- Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.

In Tennessee, there are 61 counties, 2 communities, 8 universities, 9 commercial and 63 supporters with StormReady designations. Please see Map 23 on the following page.

Map 23 – StormReady Communities, Tennessee



3.6.1 – Implemented Local Mitigation Projects

Another measure of a local government's capabilities is its ability to complete mitigation actions and activities as proposed in their local hazard mitigation plans. TEMA's tracking of local mitigation activities is being refined in this HMP and is discussed further in the plan maintenance section. In its current state, TEMA's database is not complete. However, the following table lists the recorded and tracked completed mitigation actions from local government's most recently updated local hazard mitigation plans. Additionally, Map 24 displays all completed local mitigation projects within the State of Tennessee since 2010 and Map 25 displays all completed local mitigation project within the State of Tennessee since 2000.

Table 32 – Completed Local Mitigation Projects

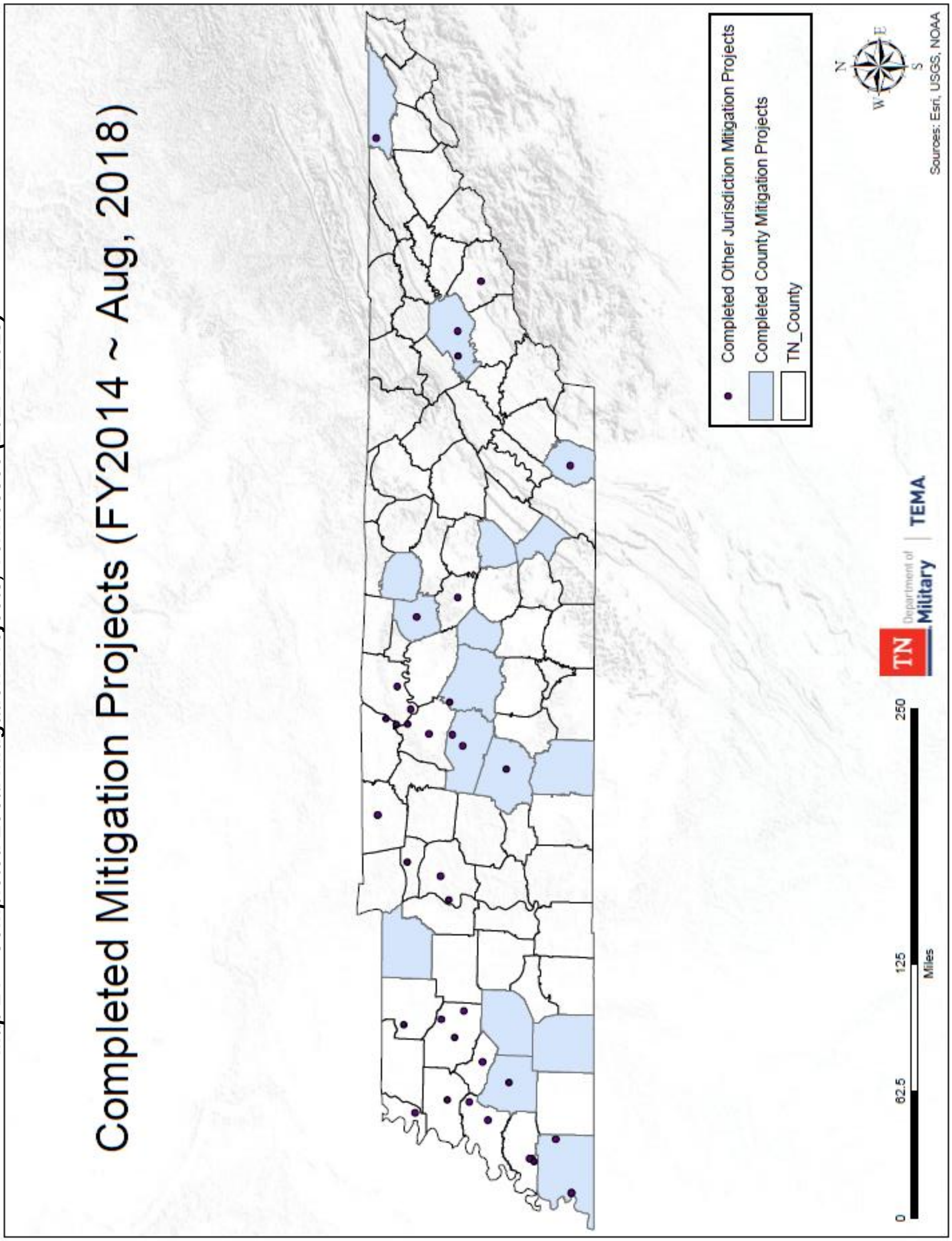
Jurisdiction	Project	Description
Anderson County	Channel Widening	In 1959, the U.S. Army Corps of Engineers made channel improvements through the town of Lake City and excavated an overflow gap through a ridge downstream of town. That work provided protection from a 100-year flood incident for most structures that existed in Lake City at that time.
Anderson County	Channel Improvements	A major flood occurred in the communities of Briceville, Fratersville, and Beech Grove on December 1969, resulting in a fatality on Beech Grove Fork, a tributary of Coal Creek, and prompting TVA to perform channel improvements along Coal Creek from a point approximately 2000 feet upstream of Briceville Elementary School to a point approximately 400 feet downstream of where Beech Grove Fork discharges into Coal Creek, providing protection from a 50-year flood incident for most structures existing at that time.
Anderson County	Acquisition of Private Property	In 1999, Oak Ridge received a FEMA grant to acquire and raze 25 homes affected by land subsidence. Total cost was $3,193,680.
Anderson County	Improved GIS Functionality	The purchase of GIS software and equipment and hiring of a full-time GIS director.
Anderson County	Parental Notification System	All 3 school systems have implemented direct parent contact phone systems.
Anderson County	Preparedness Exercises	Anderson County has expanded preparedness exercises to include severe winter weather and earthquake incidents.
Anderson County	Road Widening	Necessary due to out of bank flooding of the East Fork or Poplar Creek. The creek previously covered the road.
Anderson County	River Channel Clearing	In August 2010, Lake City received a PDM grant totaling $557, 335 for bank stabilization and selective removal of earth-rock sediment from the Coal Creek stream bottom to reduce out-of-bank flooding and erosion.
Carroll County	NOAA Repeater	Work with Henry County to put in a NOAA weather radio repeater to better reach Bruceton, Hollow Rock, and McKenzie.
Carroll County	Dam Construction	County built a dam/lake which will help reduce the amount of flooding of agriculture landing in the western part of the county.
Crockett County	NFIP Membership	Completed - since the first review both Bells and Gadsden have been added to the NFIP by FEMA
Davidson County	EOC Software/Hardware Upgrade	OEM has purchased and is actively utilizing WebEOC within the local Emergency Operations Center
Davidson County	Flood Warning Gauges	Installed hardware for the alarm system at the Dry Creek flood control structure. The alarm will alert MWS and OEM. This was conducted using 100% local funding. Manual staff gauges were installed in 2009 at Mill Creek and are in the process of being installed at Seven Mile Creek.

Jurisdiction	Project	Description
Davidson County	Flood Plain Mgt. - Property Acquisition	Since 2002, MWS has acquired and removed 52 homes from the 100 year floodplain.
Davidson County	Flood Plain Mgt. - Monitoring	The GIS database was completed in 2003 based upon the available data through 2002. A maintenance schedule using the GIS database was initiated in June of 2004. The MWS Stormwater Division Maintenance Staff estimate that they inspect 100 stormwater structures each month. The inspection program is performed in conjunction with system maintenance for documentation purposes.
Davidson County	Flood Plain Mgt. - Public Works Staffing	The MWS Stormwater Division currently employs 8 maintenance crews. The crews are assigned to large ditch maintenance, stormwater inlet construction, stormwater inlet cleanout, and masonry.
Davidson County	Flood Plain Mgt. - Deed Restrictions	Deed restrictions have been revised and/or placed on all flood prone lands purchased with public funds as a part of the CRS annual review and update.
Davidson County	Flood Plain Mgt. - Specific Citizen Info Plan	Developed for the repetitive loss homeowner mail outs, a database of parcels and structures located in the floodplain has been linked to existing elevation certificate information. This information is provided to all homeowners located in the floodplain on an annual basis. Approximately 10,000 homeowners currently receive a residence-specific mail out.
Decatur County	Communications Resources	Have available a list of ham radio operators to assist with communications.
Decatur County	Resource Mgt. - Generators	Have a list and location of available generators and provide these to emergency response people.
Decatur County	Incident Command	A secure room to be prepared at the water filter plant and waste water treatment system for use in the event of a major incident.
Decatur County	Incident Command	EMA, Rescue Squad, and Fire Department personnel to develop an evacuation and detour plan for use in disaster events.
Decatur County	Water Mgt.	Scotts Hill to complete the construction of a 400,000 gallon water storage tank and 2 new wells to enhance the water supply and pressure to their customers.
Dickson County	Flood Mgt.	Updated flood maps.
Dyer County	Flood Mgt.	As a result of the 1997 tornado and flood Dyer County applied for and was awarded a hazard mitigation grant. These funds were used to purchase 14 homes in the Bogota and Miston communities and relocated their occupants.
Dyer County	Severe Weather Notices	The cities of Dyersburg, Newbern, and Trimble and the communities of Finley, Fowlkes, and Tigrett installed outdoor tornado warning sirens. Dyer County purchased a NOAA weather radio transmitter to serve all the citizens of the county and Northwest Tennessee.
Fayette County	Acquire Emergency Generators	Acquire emergency generators
Fayette County	Weather Spotters	Develop weather spotter's program across the county and especially smaller jurisdictions such as Williston, Lagrange, Braden, and Gallaway.
Gibson County	Flooding Avoidance	Local codes enforcement has razed houses in Humboldt.
Gibson County	Building Codes - Earthquake	Building Codes - Trenton, Dyer, Milan, Humboldt, and Gibson County have adopted by resolution the international code in accordance with the State of Tennessee.
Gibson County	Participated in TNCat07	Participated in TNCat07
Hamilton County	Installation of early warning system (Reverse 911)	Completed: A reverse notification system to contact all landlines in the county was completed in 2005. County Emergency Services expanded the capabilities of the notification system in 2009 to contact cell phones, e-mail, and VOIP.

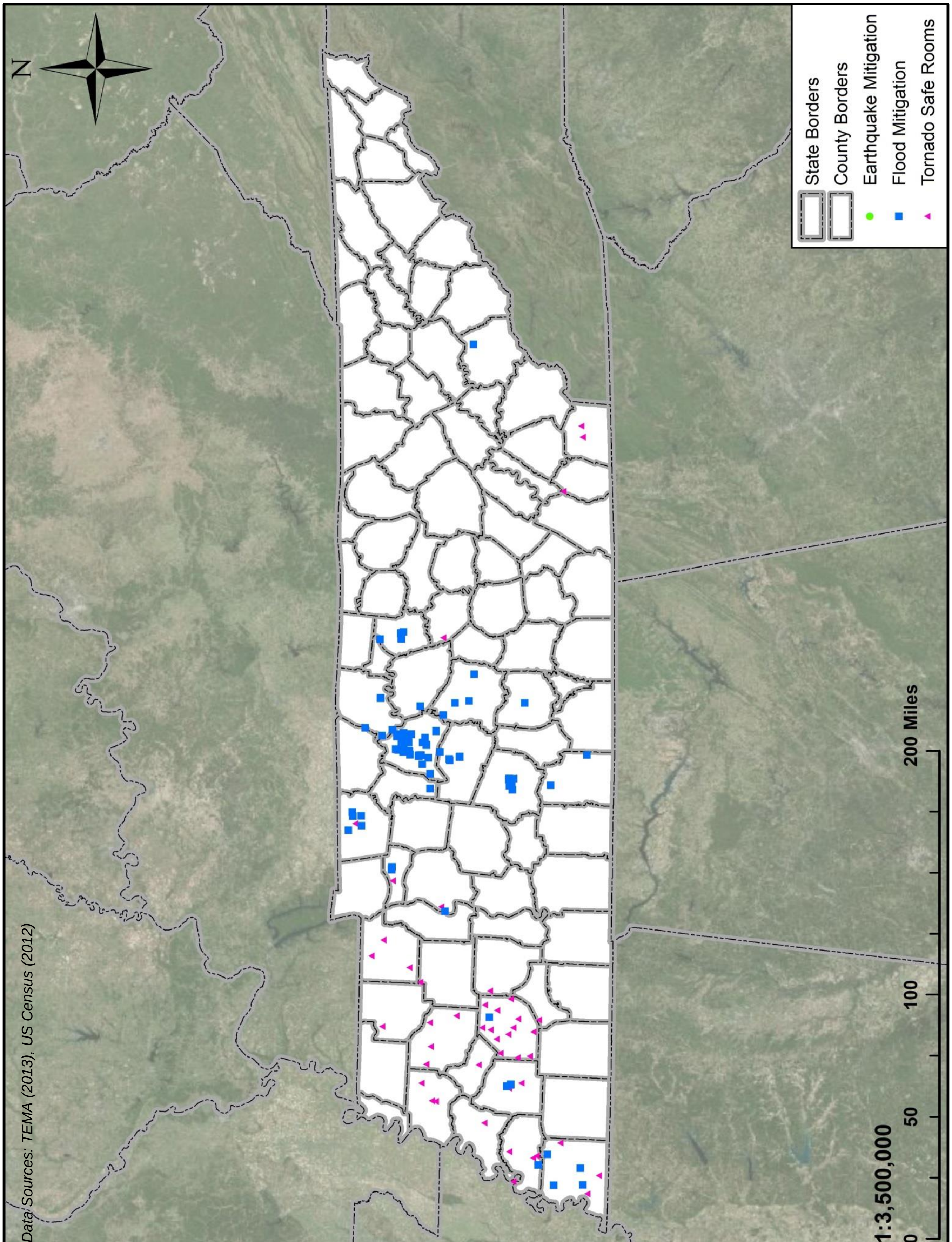
Jurisdiction	Project	Description
Hamilton County	Creek Bank Stabilization	The city received a grant from FEMA in the amount of $1,300,000 to stabilize the creek banks and re-channel over 2,000 feet of the creek. Gabion baskets were installed on the north west side of the creek (adjacent to the Willow Creek Subdivision) for 700 feet and on the northeast side of Dayton Pike bridge adjacent to the industrial park for 325 feet. Total cost of project to include in-kind services is estimated to be $1,600,000.
Henderson County	First Aid Presentations	Prepare and use a disaster and first aid kit to present programs on preparedness for senior citizens, volunteer fire fighters, rescue squad members, and other community groups.
Henderson County	Compile List of HAM Radio Operators	Have available a list of ham radio operators to assist with communications.
Henderson County	Right of Way Mgt.	Henderson County Highway Department to use heavy-duty, side mounted mowers with tractors of sufficient size to operate the mower for cutting down trees and brush that fall on roads and interfere with traffic flow. County funds were used to purchase 2 of these machines in 2005.
Henderson County	Asset Location	Have a list and location of available generators and provide to emergency response people.
Henderson County	NFIP Compliance	Sardis and Parkers Crossroads to complete the certification process for participation in the NFIP and for Henderson County, Lexington, and Scotts Hill to keep their certification current. ALL ARE CERTIFIED.
Henry County	Bridge Removal	City of Paris removed a bridge on Post Oak Drive that was causing flooding in the Valley Wood and Franklin Drive areas.
Henry County	Hardened School Hallways	Paris Special School District completed a new addition at Rhea Elementary School for use as classrooms for kindergarten students. This new addition included hardened hallways to be used as safe areas during severe weather events and earthquakes.
Henry County	Water Source	Henry County Medical Center installed on site water well and water storage tank for back-up potable water supply during disruption of main water supply.
Henry County	Safe Building Built	Tornado Safe Building at Inman School was dedicated and keys turned over to Paris City Manager, Carl Holder and Henry County Mayor, Brent Greer. The building will hold up to 800 persons. PSSD plans to add multi-media equipment and encourages local government to use facility for meetings and events.
Henry County	Bridge Replacement	City of Paris Public Works replaced bridge on Lane Oak Rd with larger box culvert.
Madison County	Anderson Creek flood Mitigation Project	HMGP grant. With 25% local matching funds
Tipton County	Relocation of Atoka wastewater pumping station	Relocate Atoka's wastewater pumping station on Meade Lake Road to a site above flood level to avoid recurring flood damage. Completed in 2008. Funded with an HMPG/CDBG grant
Tipton County	Cobb Parr Park Detention basin	To reduce flooding along Hazen Branch, which runs from the Cobb Parr Park Basin down along the west side of Highway 51, under Highway 59, continuing along the west side of Highway 51 until its confluence with Town Creek north of Peeler Street in Covington, a detention basin was constructed at the lower end of Cobb Parr Park to release the rainfall runoff at a more controlled rate thereby reducing the flood frequency. Completed in 2008 with an HMPG/CDBG/TDOT grant. City of Covington was responsible for the project

Jurisdiction	Project	Description
Tipton County	Increase the size of Munford Culverts	Eliminate flooding along an area between East Drive and West Drive in Munford, by replacing existing culverts with larger ones and installing either headwalls or riff-raff. Completed in 2009 with HMGP funding. Larger culverts also installed between Beaver Road and Bass Street in 2010.
Williamson County	Retention Ponds	22 new retention ponds completed as of 2005 to mitigate flooding in the City of Fairview
Williamson County	Hill Estates drainage improvements	General locally funded improvements to drainage in the City of Franklin.

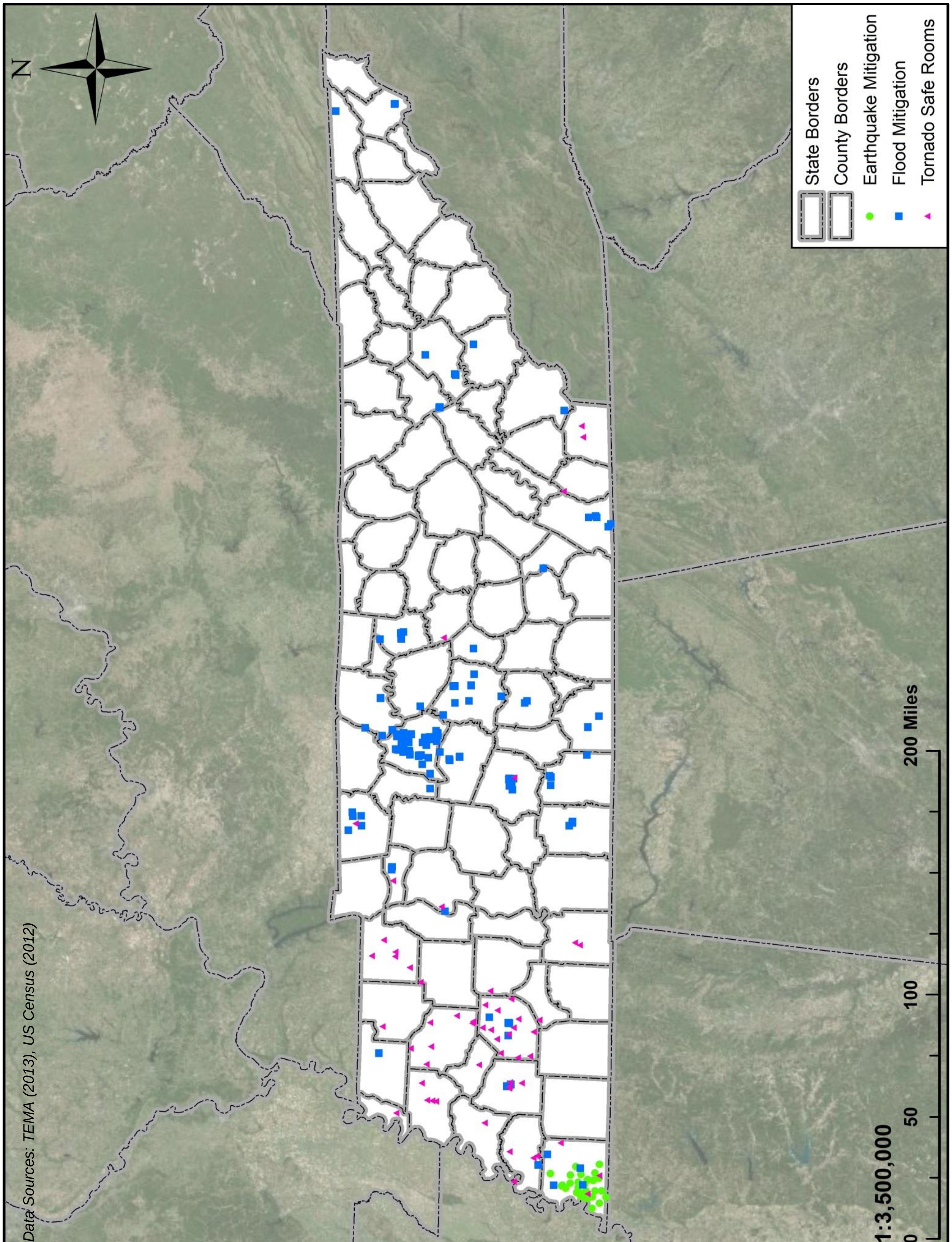
Map 24 – Completed Local Mitigation Projects, Tennessee (2014 – 2018)



Map 24.1 – Completed Local Mitigation Projects, Tennessee (2010 – 2013)



Map 25 – Completed Mitigation Projects, Tennessee (2000 – 2013)



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Section 4 – Hazard Profiles & Risk Assessment

4.1 – Methodology

Section 3 – Hazard Profiles was developed to drive the state's risk assessment, comply with EMAP guidelines, and meet FEMA crosswalk requirements under the "Risk Assessment" categories "Identifying Hazards," "Profiling Hazards," and the "Severe Repetitive Loss Strategy." This has been accomplished through the following subsections. Their descriptions, methods, and data sources are as follows.

4.1X – Hazard Name
This subsection provides a description of the hazard (natural, man-made, or technological) that has historically and potentially will continue to affect the State of Tennessee. If the hazard is measured on scale, the scale has been included and described.

4.1.1 – Location & Extent
This subsection provides the geographic area and potential extent of impacts affected by each natural hazard identified as a threat in the State of Tennessee. This section was developed with data from the following sources: FEMA, NOAA, Natural Resources Conservation Service (NRCS), NWS, the University of Wisconsin's SILVIS Labs, USDA, and the USGS.

4.1.2 – Previous Occurrences
This subsection details the hazards history in the State of Tennessee. If reliable data has been recorded on the previous occurrences, their summaries have been included. Depending on the hazard, the prediction may come from an in-house analysis or an already existing study performed by a government agency with expertise in the hazard. This section was developed with data from the following sources: FEMA, NOAA, NRCS, NWS, USDA, and the USGS.

Well recorded and accurate hazard event information is scarce. Although this plan uses reputable and expert federal agency data sources, often the information has been recorded by impact location and not by the number of events. These sections carefully note the descriptions and summaries of these data as "impacts" or "impact events" and are in no way to be interpreted as climate or meteorological predictions. Instead they are to be taken exactly as written, descriptive summaries and collections of the historical impacts of hazard events.

4.1.3 – Incidents & Probability
This subsection details data from previous occurrences and if geographic data exists to map the threat and/or exposure locations of the hazard, GIS maps have been included.

4.1.4 – Changing Future Conditions
This subsection details changing future conditions based on national data research and the possible climate future facing Tennessee. Also, based on current data from local plan integration GIS maps have been included to depict vulnerability of each county within Tennessee.

4.1.5 – Future Risk
This subsection, where possible, makes an attempt to predict the likelihood of a future hazard event occurring. These predictions were based on a risk assessment matrix:

Probability + Vulnerability = Risk

The outcomes of this risk assessment are portrayed in risk maps within this subsection.

4.2 – Hazard Identification

TEMA's Hazard Mitigation Committee met to discuss the list and deliberate on any alterations. The hazards list is derived from historical hazard events and events existing with a high hazard potential. No changes were made from the previous plan's list.

Table 33 – Tennessee 13 Hazards of Prime Concern
Natural Hazards
1- Droughts
2- Earthquakes
3- Extreme Temperatures
4- Floods
5- Geologic Hazards
6- Severe Storms
7- Tornadoes
8- Wildfires
Man-Made Hazards
9- Communicable Diseases
10- Dam/Levee Failure
11- Hazardous Materials Release
12- Infrastructure Incidences
13- Terrorism

Section 4NH – Natural Hazards

4.3D – Droughts

Drought is an abnormally dry period lasting months or years when an area has a deficiency of water and precipitation in its surface and/or underground water supply. The hydrological imbalance can be grouped into the following non-exclusive categories.

- ***Agricultural:*** When the amount of moisture in the soil no longer meets the needs of previously grown crops.
- ***Hydrological:*** When surface and subsurface water levels are significantly below their normal levels.
- ***Meteorological:*** When there is a significant departure from the normal levels of precipitation.
- ***Socio-Economic:*** When the water deficiency begins to significantly affect the population.

Droughts are regularly monitored by multiple federal agencies using a number of different indices. Typically, they are seasonal occurring in the late spring through early fall. Drought monitoring focuses on precipitation and temperature. When precipitation is less than normal, and natural water supplied begin to decease, a drought is occurring.

When below average, little or no rain falls soil can dry out and plants can die. If unusually dry weather persists and water supply problems develop. The time period is defined as a drought. Human activity such as over farming, excessive irrigation, deforestation, and poor erosion controls can exacerbate a drought's effects. It can take weeks or months before the effects of below average precipitation on bodies of water are observed. Depending on the region droughts can happen quicker, noticed sooner, or have their effects naturally mitigated. The more humid and wet an area is, the quicker the effects will be realized. A naturally dry region, which typically relies more on subsurface water will take more time to actualize its effects.

Periods of drought can have significant environmental, agricultural, health, economic, and social consequences. The effects vary depending on vulnerability and regional characteristics. Droughts can also reduce water quality through a decreased ability for natural rivers and streams to dilute pollutants and increase contamination. The most common consequences of droughts in the United States are: diminished crop yield; erosion; dust storms; ecosystem and environmental damage; wildfires; reduced electricity production from hydroelectric dams; livestock reduction.

When a drought begins and ends is difficult to determine. Rainfall data alone won't tell if an area is in a drought, how severe the drought may be, or how long the area has been in drought. However, one can identify various indicators of drought, such as rainfall, snowpack, stream flow, and more, and track these indicators to monitor drought. Researchers have developed a number of tools to help define the onset, severity, and end of droughts. Drought indices take thousands of bits of data on rainfall, snowpack, stream flow, etc., analyze the data over various time frames, and turn the data into a comprehensible big picture. A drought index value is typically a single number, which is interpreted on a scale of abnormally wet, average, and abnormally dry. There are 3 primary drought indices that are all used to determine the onset and the severity of a drought, the Standard Precipitation Index, the Palmer Drought Severity Index, and the Crop Moisture Index.

The Standard Precipitation Index (SPI)

The SPI shows the actual precipitation compared to the probability of precipitation for various time frames. The SPI is an index based on precipitation only. It can be used on a variety of time scales, which allows it to be useful for both short-term agricultural and long-term hydrological applications. A drought event occurs any time the SPI is continuously negative and reaches an intensity of -1.0 or less. The event ends when the SPI becomes positive. Each drought event, therefore, has a duration defined by its beginning and end, and intensity for each month the event continues. The positive sum of the SPI for all the months within a drought event can be termed the drought's "magnitude."

Table 34 – Standard Precipitation Index	
Extremely Wet	2.0+
Very Wet	1.5 to 1.99
Moderately Wet	1.0 to 1.49
Near Normal	-.99 to .99
Moderately Dry	-1.0 to -1.49
Severely Dry	-1.5 to -1.99
Extremely Dry	-2 and less

The Palmer Drought Severity Index (PDSI)

The PDSI has been used the longest for monitoring drought. The PDSI allows for a categorization of various levels of wetness and dryness that are prominent over an area. The PDSI is calculated based on precipitation and temperature data, as well as the local Available Water Content (AWC) of the soil. Palmer values may lag emerging droughts by several months, are less well suited for mountainous land or areas of frequent climatic extremes, and are complex—have an unspecified, built-in time scale that can be misleading.

Table 35 – Palmer Drought Severity Index	
Extremely Wet	4.0 or more
Very Wet	3.0 to 3.99
Moderately Wet	2.0 to 2.99
Slightly Wet	1.0 to 1.99
Incipient Wet Spell	0.5 to 0.99
Near Normal	0.49 to -0.49
Incipient Dry Spell	-0.5 to -0.99
Mild Drought	-1.0 to -1.99
Moderate Drought	-2.0 to -2.99
Severe Drought	-3.0 to -3.99
Extreme Drought	-4.0 or less

Crop Moisture Index (CMI)

A derivative of the PDSI is the CMI. It looks at moisture supply in the short term for crop producing regions. The CMI monitors week-to-week crop conditions, whereas the PDSI monitors long-term meteorological wet and dry spells. The CMI was designed to evaluate short-term moisture conditions across major crop-producing regions. Because it is designed to monitor short-term moisture conditions affecting a developing crop, the CMI is not a good long-term drought monitoring tool. The CMI's rapid response to changing short-term conditions may provide misleading information about long-term conditions. The CMI uses the same index as the PDSI, but in its own redefined context.

4.3.1 – Location & Extent

While extended periods without sufficient rainfall can and do occur across the state, causing damage to lawns, gardens, flora and fauna, it is most disastrous in the western half of the state where the vast majority of agricultural businesses are located. Severe drought can cause enormous economic consequences, not only in the state but in the region and nation as well. There is no set speed of onset or warning period. A drought may begin in as short of period as a week or it may take months to reach an official declared drought. Additionally, the drought can last for as little as a week to up to the entire season.

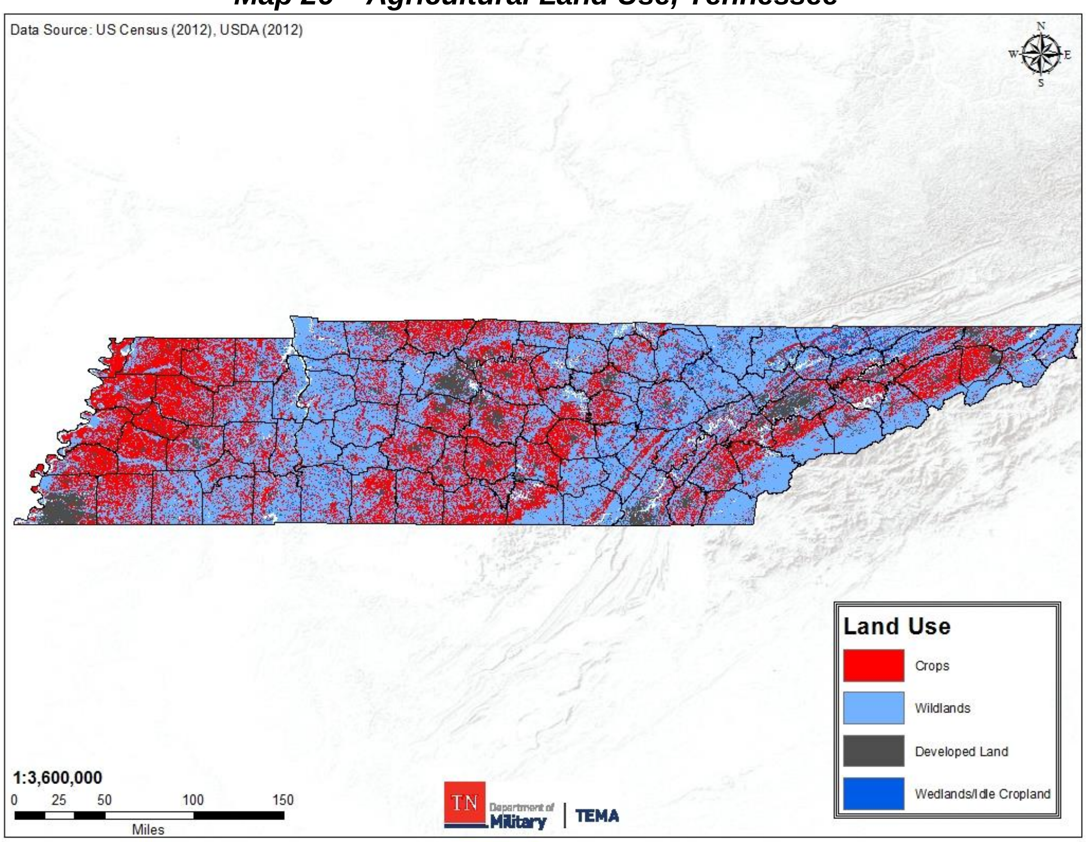
According to the Tennessee Department of Agriculture, agriculture and forestry have a profound impact on Tennessee's economy, the health of our citizens, the beauty of our landscape as well as the quality of our lives. In hundreds of rural communities across our state, agriculture and forestry are the primary drivers of local economic activity. Agriculture and forestry's impact is also felt throughout the manufacturing, processing, distribution and marketing sectors of our economy. The following economic impact study was developed by the University of Tennessee, Institute of Agriculture, Department of Agricultural and Resource Economics, and is presented by the Tennessee Department of Agriculture.

Major findings of note:

- In 2009, agriculture and forestry contributed $71.4 billion to Tennessee's economy.
- Agriculture and forestry accounted for 14.7% of the economic activity within the state.
- Agriculture and forestry employed more than 363,500 people, or 10.3% of the workforce.

Historically, the most severe and extreme drought conditions have occurred in the western quarter of the state and in 8 counties in southern middle Tennessee.

Map 26 – Agricultural Land Use, Tennessee



4.3.2 – Previous Occurrences

Historic Hazard Incident – Drought – 1986

The dry and hot weather in the southeast United States during the first 7 months of 1986 caused a record drought. The beginning and middle of the 1986 growing season was by far the worst on record. On a hydrological standpoint, the duration was not long enough to stand out as an extreme anomaly. This drought was a significant change from the wet weather of the 1960s and 70s. The hydrological drought resulted in the lowest observed stream flows in more than half a century.

The subsequent winter months resulted in the second driest winter of the twentieth century due to the lack of Gulf Coast and East Coast winter storms. This was followed by the third driest spring in the twentieth century. Precipitation continued to be well below the norm, and temperatures were well above normal throughout the summer of 1986.

Historic Hazard Incident – Drought – 2007/2008

The drought of 2007-2008 severely affected the water supplies of the North Central Tennessee area. This was one of the worst droughts in Middle Tennessee's history. Temperatures in the Nashville area climbed to 106 degrees. For twelve consecutive days temperatures were recorded above 99 degrees. By the end of the drought many critical water supply systems neared failure. This left Tennessee to rely on mandatory and voluntary conservation measures to reduce demand on neighboring water districts to help provide additional supply. Although there are no local estimates for Tennessee alone, the USDA estimates this drought cost the affected areas of the United States $35 billion.

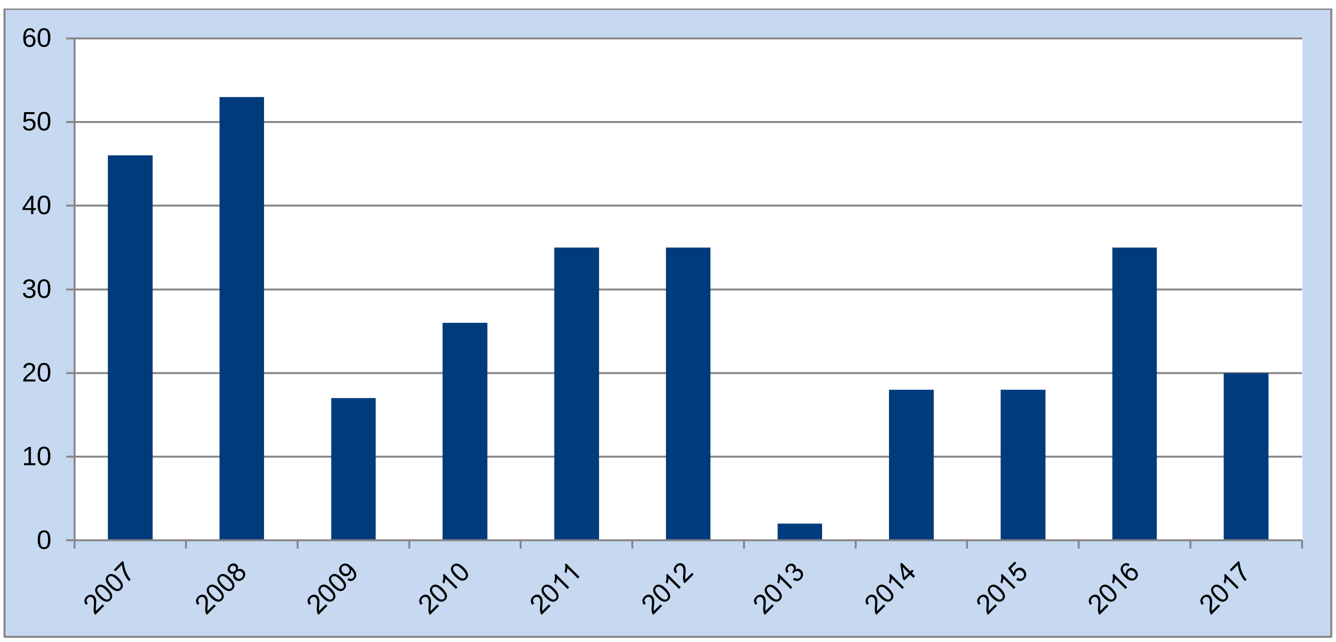
Historic Hazard Incident – Drought & Wildfire – 2016

A historic drought in the fall of 2016 preceded historic wildfires. By November 22, all 95 counties in Tennessee were classified in "Severe Drought" (D2) or higher. Tennessee experienced numerous wildfires across the state, including several that required federal assistance. On November 28, 2016, hurricane-force winds rapidly expanded a small wildfire in Sevier County into the largest interface fire to impact the state of Tennessee in 100 years, resulting in an estimated $595 million real property and contents loss. There were fourteen (14) fatalities and 221 people treated with fire-related injuries. The fire area was reported at 17,140 acres.

Table 36 – Drought Incidents in Tennessee (1964 – 2017)	
Count of Impacts	305
Impacts Per Year	30.5
Average Magnitude	D1
Magnitude Range	D1-D4
Average Cost	0
Magnitude of Cost	0
Total Recorded Cost	0
Average Crop Damage	0
Magnitude of Crop Damage	$0-$25,000
Total Crop Damage	$25,000
Average Fatalities	0
Total Fatalities	0
Average Injuries	0
Total Injuries	0

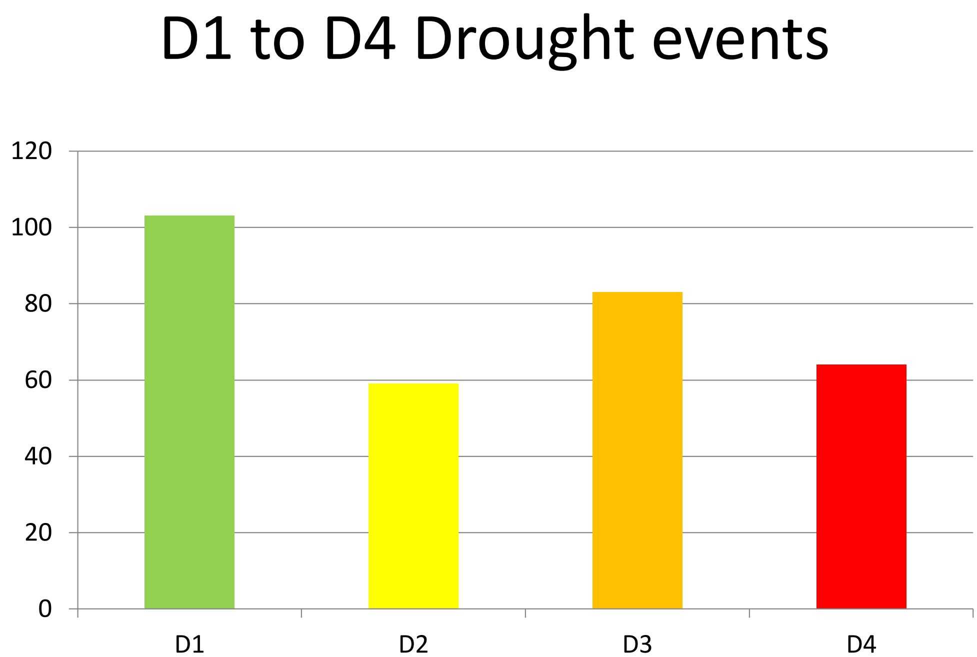
The data is from The National Drought Mitigation Center University of Nebraska-Lincoln

Chart 1 – Drought Incidents by Year (2007 – 2017)



The data are from the MDMCU Yearly drought Count.

Chart 2 – Drought Incidents by Class (2007 – 2018)



The data is from The National Drought Mitigation Center University of Nebraska-Lincoln

4.3.3 – Incidents & Probability

Comprehensive data on droughts, drought impacts, and drought forecasting is extremely limited and often inaccurate. Due to the complexity of drought monitoring, the complexity of agricultural and livestock market pricing, and the large areas droughts impact, the USDA and USGS have difficulty quantifying and standardizing drought data. Each of these contributing drought factors has confounding variables within them.

The USGS partners with the USDA for drought monitoring by means of ground water and aquifer measurement. Since ground water and aquifer levels are highly variable from year to year, this indicator is useful for reporting whether there is a current shortage or surplus, but is unhelpful in forecasting future events. Additionally, ground water and aquifer levels are correlates only in a lagged model to climactic conditions further compounding their usefulness in predicting future droughts.

Drought's primary impact is on agriculture and livestock. However, there are many factors it can affect: most notably livestock count, crop prices, crop losses, livestock size, and livestock by products such as milk. Absent a drought, these factors highly vary from season to season. Prices vary with international market factors influenced by conditions across the globe. Crop yields vary with other climate conditions such as too much rain during planting season or insect abundance, and even marketing campaigns developed to sell more meat from 1 type of livestock. Drought is only 1 factor in an equation of many variables.

The USDA monitors these conditions and aggregates the data to create its drought monitor. However, due to the reasons discussed, it is limited in its ability to quantify how severe a drought was over specified period of time and a specific jurisdiction.

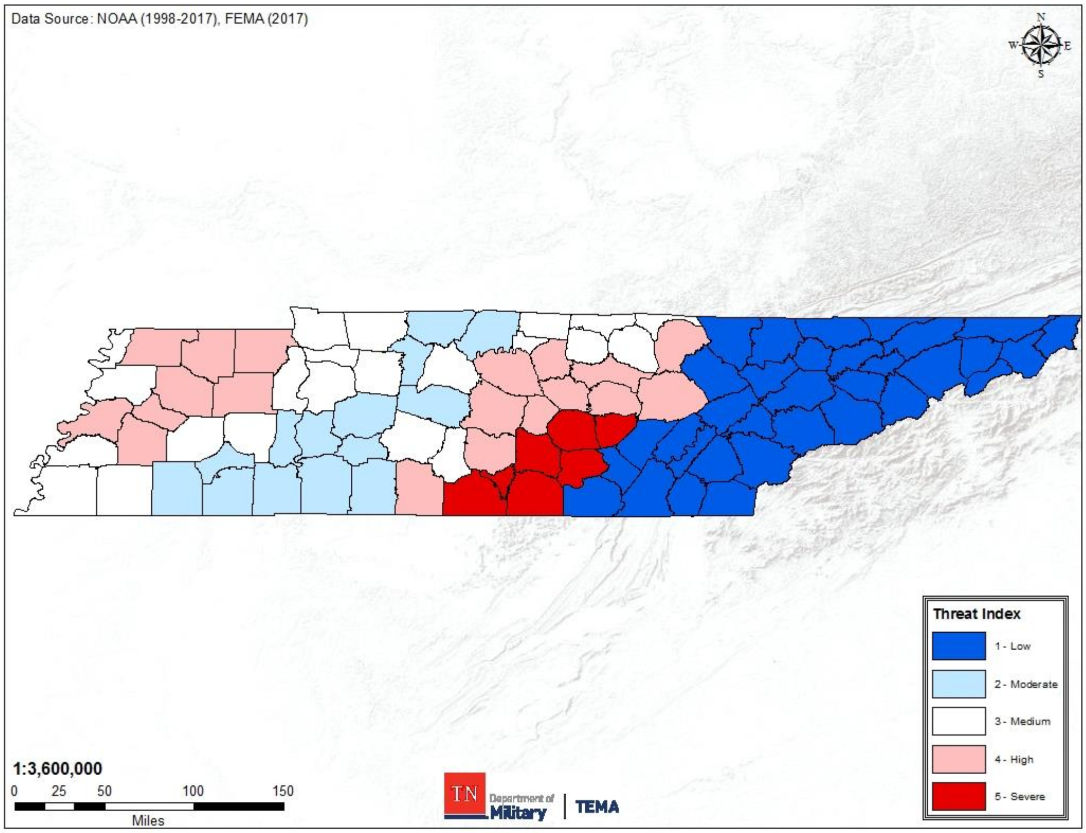
Given NOAA's records of declared drought impacts and US Drought Monitor data, the state can expect a drought impact of varying levels of effects (D1-D4) 30.5 incidents per year.

Table 37 – Drought Impact Probability in Tennessee (2007 – 2017)

Impact Probability of Drought events D1-D4						
	D1-Moderate	D2- Severe	D3-Extreme	D4-Exceptional	Total D1-D4 Events	Impact Probability D1-D4
2007	4	4	9	29	46	
2008	1	10	24	18	53	
2009	12	5	0	0	17	
2010	9	6	11	0	26	
2011	27	3	5	0	35	
2012	5	18	5	7	35	
2013	2	0	0	0	2	
2014	18	0	0	0	18	
2015	15	3	0	0	18	
2016	4	4	17	10	35	
2017	4	4	12	0	20	
	101	57	83	64	305	3050%

The following map depicts the concentrations of drought impacts throughout the State of Tennessee.

Map 27 – Drought Probability based on Impact Density, Tennessee

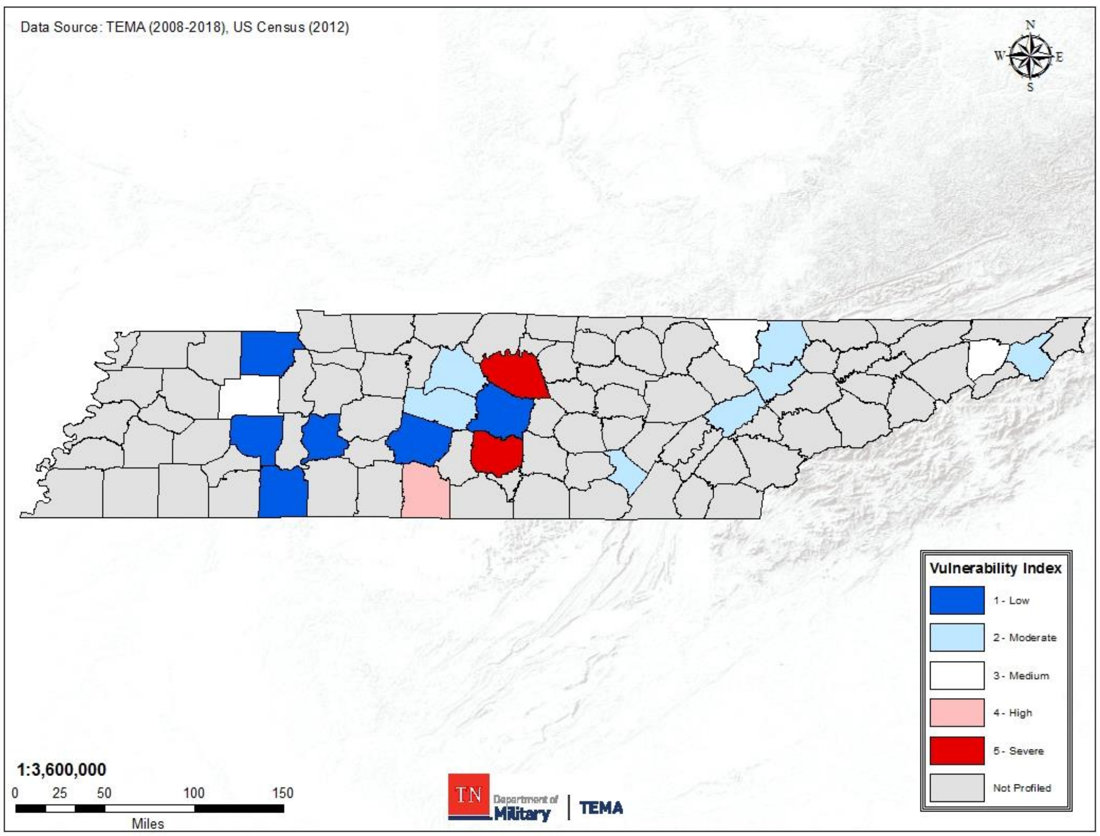


4.3.4 – Changing Future Conditions

The southern portions of Tennessee and much of the Cumberland Plateau are expected to see low precipitation periods that are even drier than today, suggesting a growing concern of future drought in these areas. Interestingly, many of these same locations are also expected to experience high precipitation periods that are wetter than today. This suggests that these areas may see more short duration, intense heavy precipitation events with long periods of dryness in between, which is consistent with the observed trends across the U.S. This combination can be particularly troublesome in terms of the ability of the ground to absorb water, especially when the soil is compacted as is common practice to prepare the soil foundations around constructed transportation infrastructure. Flooding and flash flooding can more readily ensue, and such weather can also exacerbate conditions at encourage rockslides.

The following map depicts the vulnerability to drought incidents for each county throughout the State of Tennessee. This data was compiled using local plan integration.

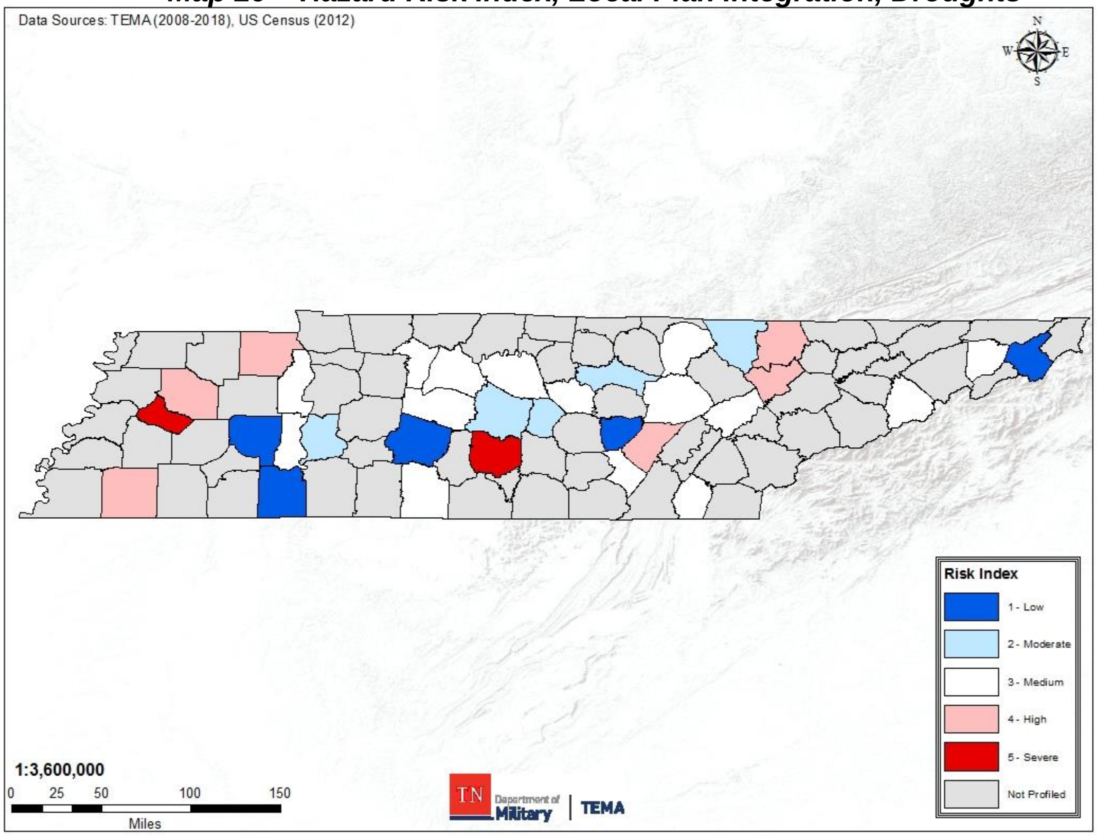
Map 28 – Hazard Vulnerability Index, Local Plan Integration, Droughts



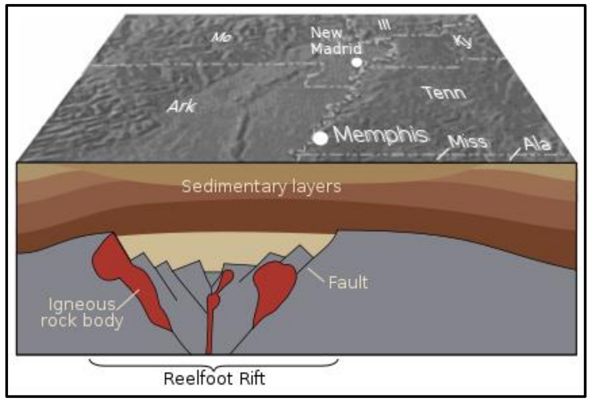
4.3.5 – Future Risk

Using a basic risk matrix: Vulnerability+Probability=Risk, TEMA was able to calculate hazard risk using data from the previous subsections. This process is further explained in Section 3.4. As shown in the following map of the risk index, Crockett and Bedford counties are highest risk for droughts.

Map 29 – Hazard Risk Index, Local Plan Integration, Droughts



4.3EQ – Earthquakes



An earthquake is the result of a sudden release of energy in the Earth's crust that creates seismic waves. The energy originates from a subsurface fault. A fault is a fracture or discontinuity in a volume of rock along tectonic plates. In the most general sense, the word earthquake is used to describe any event that generates seismic waves. Earthquakes are typically caused by the rupturing of geological faults. Occasionally, they are also caused by other events such as volcanic activity, landslides, mine blasts, and nuclear tests. An earthquake's point of initial rupture is called its focus or hypocenter. The epicenter is the point at ground level directly above the hypocenter.

At the Earth's surface, earthquakes manifest themselves by shaking and sometimes displacement of the ground. The direct force of the earthquake will shake the ground and cause structures to collapse or become unstable. The shaking can also cause phenomena known as liquefaction. Liquefaction occurs when water saturated sediments are transformed by the earthquake's force into a substance that behaves like a liquid. By undermining the foundations and base courses of infrastructure, liquefaction can destroy or significantly damage a structure.

In addition to direct damage caused by an earthquake, it can cause a number of secondary hazards. When the epicenter of a large earthquake is located offshore, the seabed may be displaced sufficiently to cause a tsunami. Earthquakes can also trigger landslides, and occasionally volcanic activity. The shallower an earthquake, the more damage to structures it causes, all else being equal.

Seismic experts have not suggested that earthquakes occur seasonally or during a particular time of year.

Two scales are used when referring to earthquake activity. Estimating the total force of an earthquake is the Richter scale, and the observed damage from an earthquake is, the Modified Mercalli Intensity Scale. Please see the figures on the following pages for both scales and their estimated matching equivalent index. Please see the tables on the following page for details on these scales.

Table 38 – Modified Mercalli Scale vs. Richter Scale

Category	Effects	Richter Scale (approximate)
I. Instrumental	Not felt	1-2
II. Just perceptible	Felt by only a few people, especially on upper floors of tall buildings	3
III. Slight	Felt by people lying down, seated on a hard surface, or in the upper stories of tall buildings	3.5
IV. Perceptible	Felt indoors by many, by few outside; dishes and windows rattle	4
V. Rather strong	Generally felt by everyone; sleeping people may be awakened	4.5
VI. Strong	Trees sway, chandeliers swing, bells ring, some damage from falling objects	5
VII. Very strong	General alarm; walls and plaster crack	5.5
VIII. Destructive	Felt in moving vehicles; chimneys collapse; poorly constructed buildings seriously damaged	6
IX. Ruinous	Some houses collapse; pipes break	6.5
X. Disastrous	Obvious ground cracks; railroad tracks bent; some landslides on steep hillsides	7
XI. Very disastrous	Few buildings survive; bridges damaged or destroyed; all services interrupted (electrical, water, sewage, railroad); severe landslides	7.5
XII. Catastrophic	Total destruction; objects thrown into the air; river courses and topography altered	8

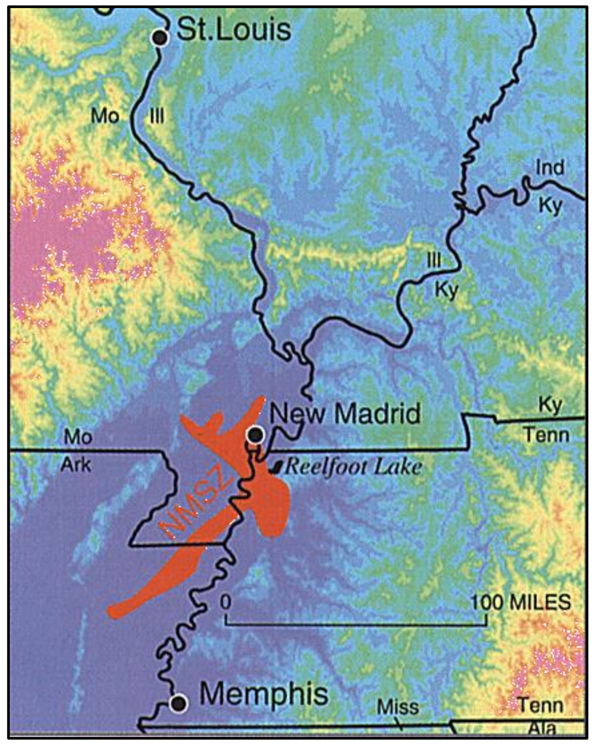
Table 39 – % Peak Ground Acceleration Vs. Mercalli & Richter Scales

Mercalli Scale Intensity	Richter Scale (Approximate)	Minimum %g	Maximum %g
I	1 - 2	0.00%	0.17%
II - III	3 - 3.5	0.17%	1.40%
IV	4	1.40%	3.90%
V	4.5	3.90%	9.20%
VI	5	9.20%	18.00%
VII	5.5	18.00%	34.00%
VIII	6	34.00%	65.00%
IX	6.5	65.00%	124.00%
X +	7 +	124.00%	-

4.3.1 – Location & Extent

Earthquakes strike suddenly and without warning, occur at any time of the year, and at any time of the day. A damaging earthquake occurs without definitive signals and massive earthquakes are accompanied by aftershocks. The duration of shaking can last anywhere from a second to a period of minutes. There are numerous characteristics measured when observing earthquake activity; however, its force, depth, peak ground acceleration, and the distance to the epicenter are the most influential in determining damage.

Earthquakes of magnitude 5.5 or greater are considered potentially threatening to Tennessee and its jurisdictions, as this is the point at which structures can become damaged. Any earthquake felt at this magnitude or greater would cause for cessation of operations until sight inspections can take place.
While earthquake events have been recorded all across the state, the locations of the most likely occurrences in the future lie along the New Madrid Seismic Zone near the western border and the Southern Appalachian Seismic Zone near the eastern border.

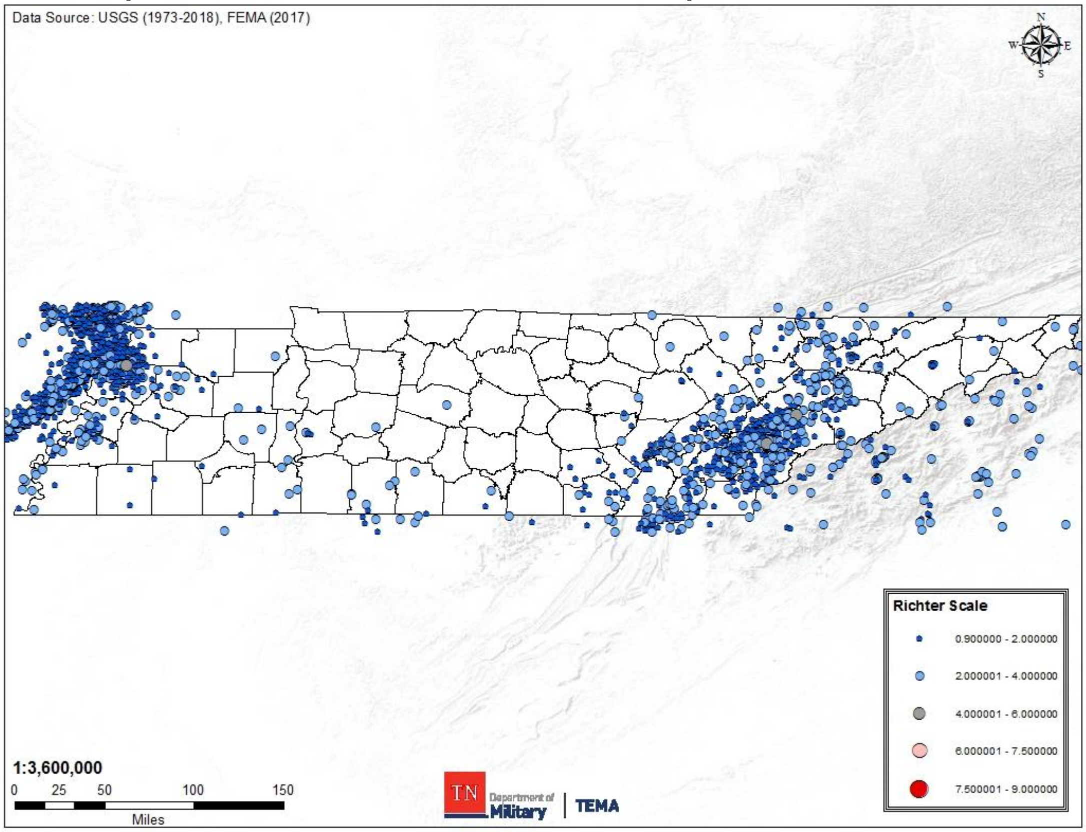


In a report filed in November 2008, FEMA warned that a serious earthquake in the New Madrid Seismic Zone could result in "the highest economic losses due to a natural disaster in the United States," further predicting "widespread and catastrophic" damage across Alabama, Arkansas, Illinois, Indiana, Kansas, Kentucky, Mississippi, Missouri, Oklahoma, Texas, and particularly Tennessee, where a 7.7 magnitude quake or greater would cause damage to tens of thousands of structures affecting water supply, transportation/communication and other vital infrastructure. A major earthquake is expected to also result in many thousands of fatalities, with several thousand of the fatalities expected in Memphis alone.

The Southern Appalachian Seismic Zone (East Tennessee Seismic Zone) is a geographic band stretching from northeastern Alabama through eastern Tennessee into southwestern Virginia which is subject to frequent small earthquakes. This seismic zone is one-of the most active earthquake zones in the eastern United States.

Most earthquakes in the Southern Appalachian Zone are small and are detected only with instruments. A few damaging earthquakes have occurred with the largest historic earthquakes measuring 4.6 magnitude on the Richter scale, occurring in 1973 near Knoxville and April 29, 2003 near Fort Payne, Alabama. Earthquakes large enough to be felt occur approximately once a year in this zone. The USGS estimates that earthquakes as large as magnitude 7.5 are possible in the Southern Appalachian Zone which would as devastating to the region as a major quake along the New Madrid fault. See Map 23 for a geographic depiction of Tennessee's seismic zones.

Map 30 – Seismic Zones & Historical Earthquakes, Tennessee



4.3.2 – Previous Occurrences

Historic Hazard Incident – Earthquakes – 1811/1812

Between 1811 and 1812 there was a series of 4 major earthquakes in the New Madrid Seismic Zone. On December 16, 1811, an earthquake occurred on the New Madrid with the epicenter located in northeast Arkansas. It resulted in only slight damages, mainly because of the sparse population in the epicenter area. Since the area was sparsely populated at the time, the exact locations of the earthquakes is unknown although it is predicted the future location of Memphis experienced seismic levels equal to IX on the Mercalli Intensity scale.

Historic Hazard Incident – Earthquake – August 1865

An earthquake with a magnitude of 5.0 and intensity of VII occurred on August 17, 1865 in Memphis affecting southwest Tennessee. Land appeared to roll and waves were created in nearby rivers. The force felled and cracked chimneys in Memphis and New Madrid.

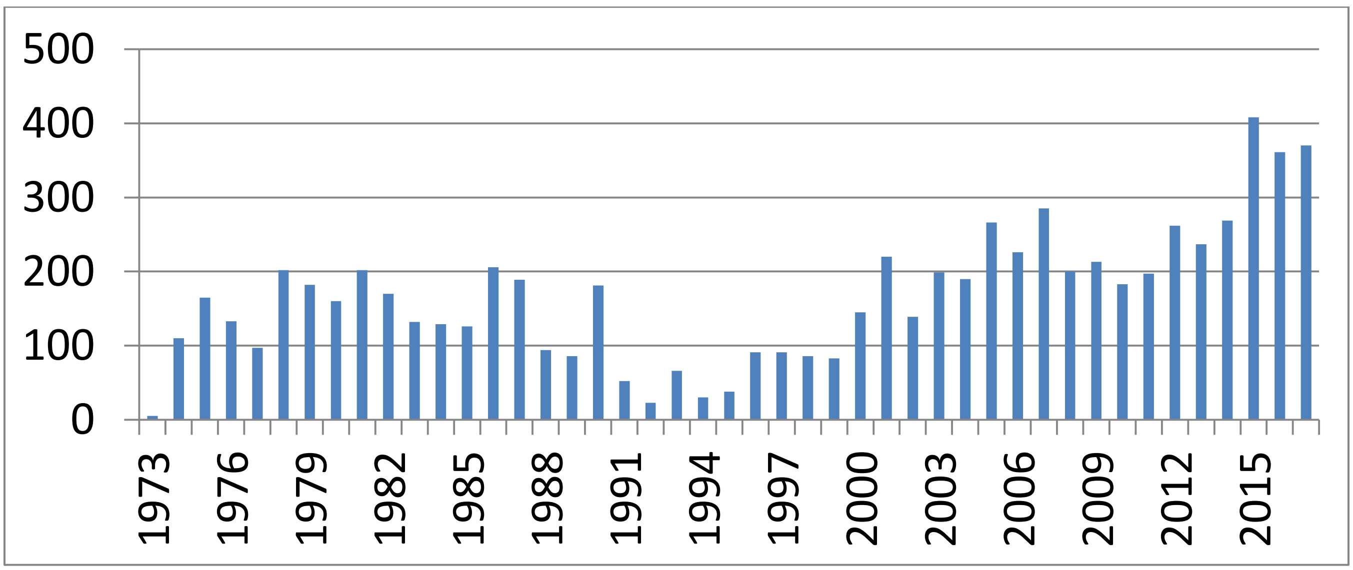
Since 1964, the USGS has recorded 609 earthquakes within 100 miles of Tennessee. Tennessee does not have on record any property damage, crop damage, deaths, or injuries as a result of earthquakes.

Based on the USGS's data, the average earthquake within 100 miles of Tennessee has a magnitude of 2.76 and has been as high as 5.6 on the Richter scale. The average depth of these earthquakes is 8.34 kilometers and has been just below the surface or as deep as 101.7 kilometers.

Table 40 – Earthquakes within 100 Miles of Tennessee (1973 – 2018)	
Count of Events	7612
Events Per Year	169.15
Average Magnitude	1.7
Magnitude Range	0.9 – 4.7
Average Depth (km)	8.04
Depth Range (km)	0 – 33
Total Recorded Cost	$0
Total Crop Damage	$0
Total Fatalities	0
Total Injuries	0

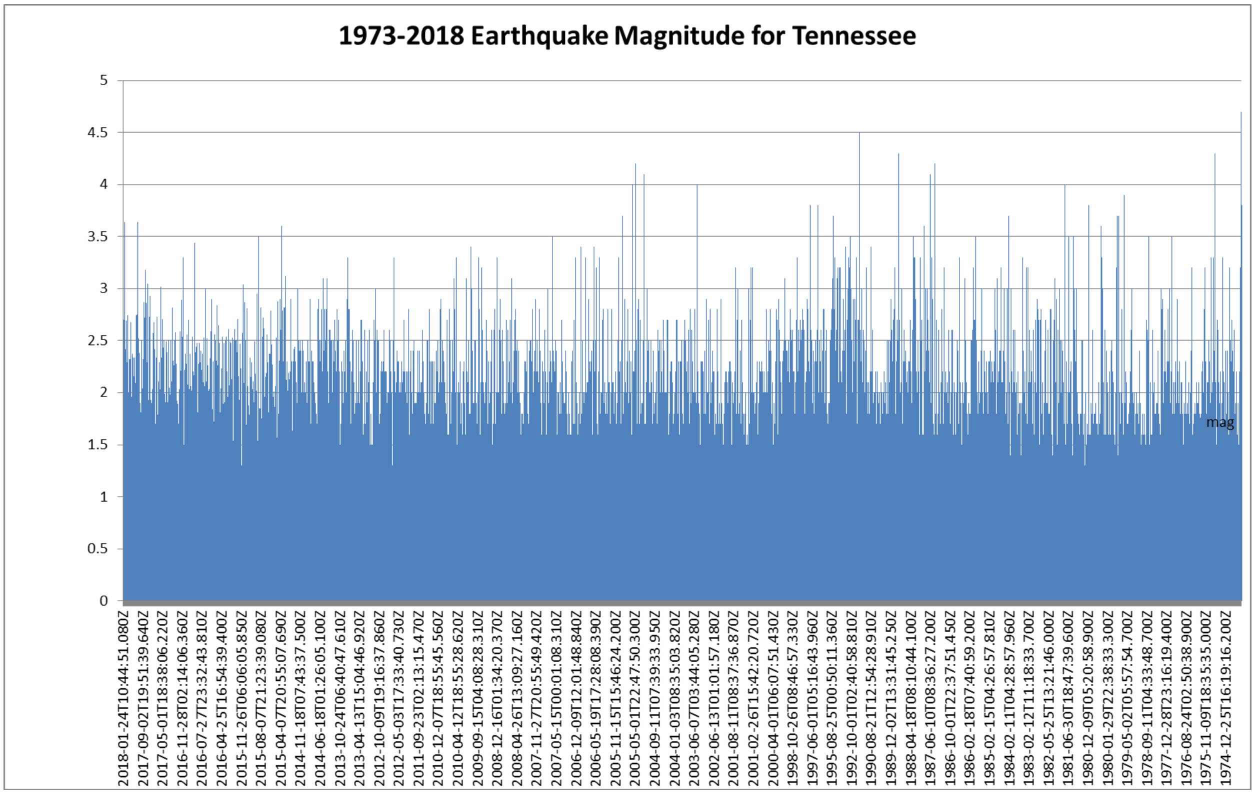
**The data are compiled from the USGS.*

Chart 3 – Earthquakes by Year, 100 Miles Buffer (1973 – 2017)



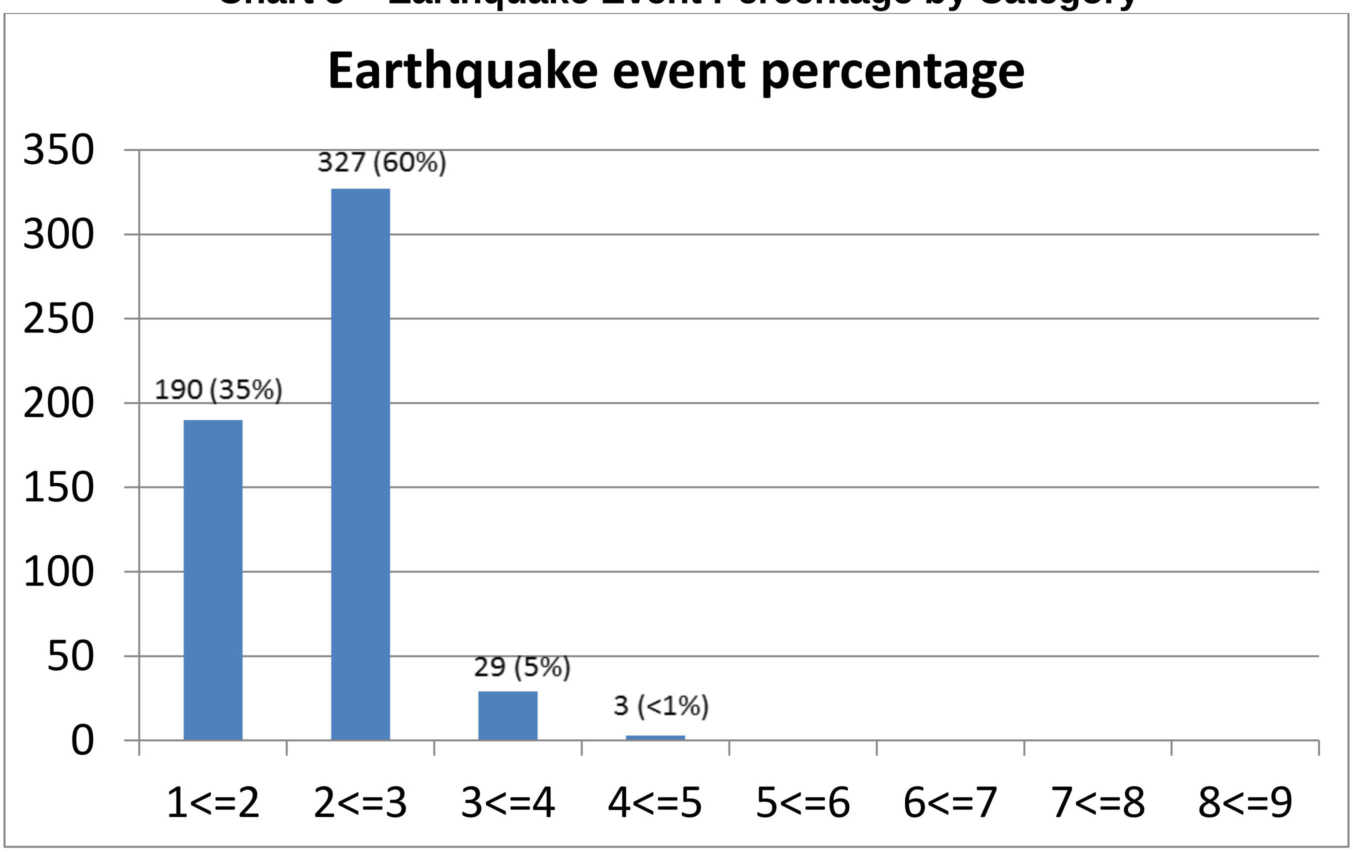
**The data are from the USGS.*

Chart 4 – Earthquakes by Magnitude, 100 Mile Buffer (1964 – 2018)



327 (60%) **The data are from the USGS.*

Chart 5 – Earthquake Event Percentage by Category



4.3.3 – Incidents & Probability

In 2006 the USGS published a study on the past, present, and future state of the NMSZ. Included in this study was a scientific prediction on the future probability of a NMSZ earthquake event.

In summary, the study predicts the NMSZ will produce the following:

- A Magnitude 6 earthquake at a probability of 25% - 50% in the next 50 years.
- An earthquake sequence similar to the 1811-12 earthquakes at a probability of 7% - 10% in the next 50 years.

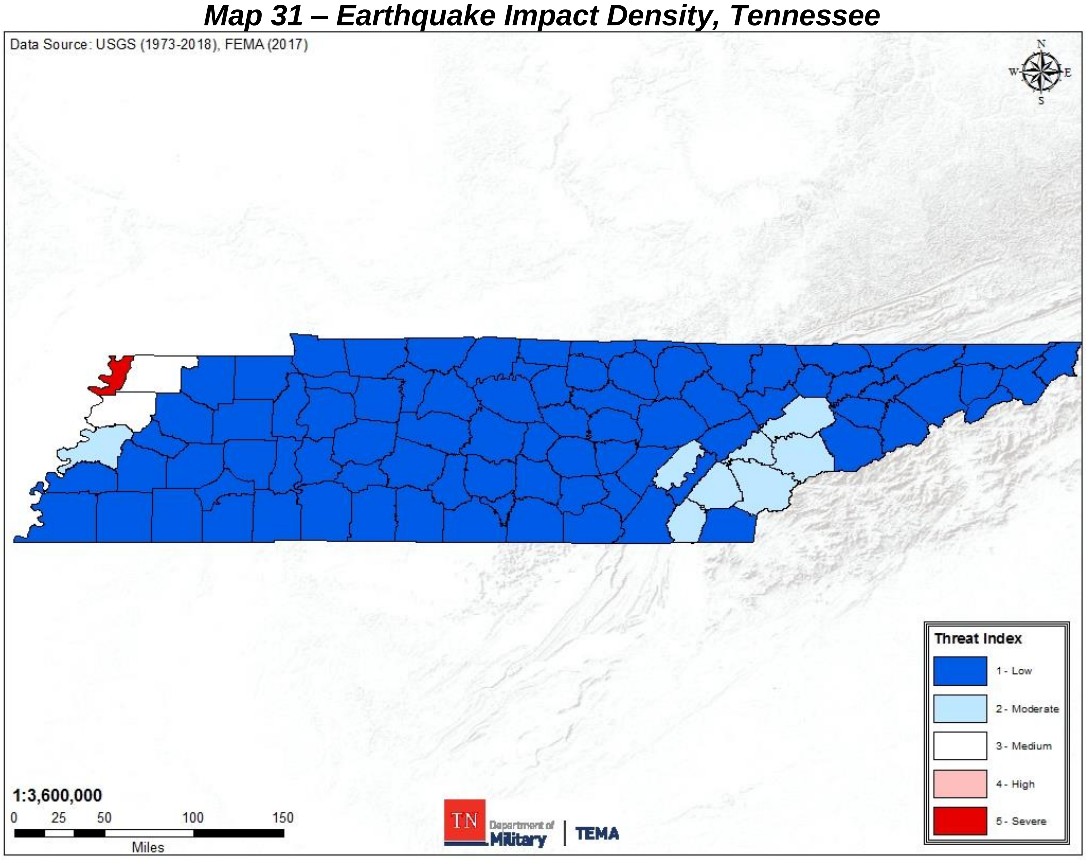
The USGS study on the NMSZ, found on the following pages, states:

> "It was the consensus of this broad group of scientists that (1) the evidence indicates that we can expect large earthquakes similar to the 1811–12 earthquakes to occur in the future with an average recurrence time of 500 years and that (2) magnitude 6 earthquakes, which can also cause serious damage, can be expected more frequently than the large 1811–12 shocks.

Based on this history of past earthquakes, the USGS estimates the chance of having an earthquake similar to one of the 1811–12 sequence in the next 50 years is about 7% to 10%, and the chance of having a magnitude 6 or larger earthquake in 50 years is 25% to 40%.

The following map depicts the concentrations of earthquake impacts throughout the State of Tennessee. Shelby county is marked severe because we have only had one recorded incident of an earthquake in the year 1865 which happened in Shelby county. This map does not account for possible occurrences that may happen along the New Madrid fault.

Map 31 – Earthquake Impact Density, Tennessee



The State of Tennessee Threat Hazard Identification Risk Assessment, completed and approved in 2012, summarizes a number of complex models and reports conducted on the New Madrid Seismic Zone. Tennessee's THIRA included the following reports on earthquakes:

- Mid-America Earthquake Center Level 2 Regional Impact Report: New Madrid Seismic Zone M7.7 Earthquake for the State of Tennessee
- FEMA's New Madrid Seismic Zone Catastrophic Event Planning: State of Tennessee-Direct Damaged, Economic Loss and Social Impacts Assessment
- TEMA generated HAZUS assessments

The following impacts are summarized results from the previous studies and assessments. The scenario yielding the below impacts is a 7.7 magnitude earthquake delivering catastrophic impacts across Western Tennessee during the dead of winter emanating from below Marked Tree, Arkansas.

Scope
- 20 Counties of Western Tennessee at 10,260 miles
- 1.5 million people in these 20 counties.
  - 284,000 people under the age of 5 and over the age of 65
  - 333,000 with disabilities
  - 16,000 don't speak English well
  - 289,000 currently in poverty
  - 10,300 currently in nursing homes
  - 13,100 currently in college housing
  - 18,100 currently in jail or prison

Population Impacts
- 33,000 injuries
- 1,300 deaths

Essential Facilities Impacts
- 600 schools damaged, can't provide for service
- 250 fire stations damaged, can't provide for service
- 125 police stations damaged, can't provide for service
- 55 hospitals damaged, can't provide for service

Utility Impacts
- 710,000 households without power
- 510,000 households without potable water
- 100 electric power facilities damaged
- 10 potable water facilities damaged
- 450 waste water facilities damaged
- 60 natural gas facilities damaged
- 4,000 communication facilities damaged
- Potable Water Pipeline (Local); 117,400 miles w/ 15,300 leaks & 24,000 breaks
- Waste Water Pipeline (Local); 70,500 miles w/ 12,000 leaks & 19,000 breaks
- Natural Gas Pipeline (Local); 47,000 miles w/ 12,900 leaks & 20,300 breaks
- Natural Gas Pipeline (Regional); 4,600 miles w/ 350 leaks & 1,200 breaks
- Oil Pipeline (Regional); 1,000 miles w/ 70 leaks & 230 breaks

Building Impacts
- 265,000 buildings damaged
- 107,000 buildings completely damaged (uninhabitable)
- 80% single family residences, 15% multi-family residences

Transportation Impacts
- 40 airports damaged; most not operational
- 1,000 bridges damaged; 250 completely damaged
- 80 ports damaged

- 60 railroad facilities damaged
- 2 railroad bridges damaged

Other Critical Infrastructure Impacts

- 50 dams damaged
- 7 levees damaged
- 8 registered National Historic Landmarks are within the 20 county impact zone
- 1,500 – 2,000 fixed hazardous materials facilities damaged

Debris Impacts

- 21 million tons of debris
- 850,000 truckloads (@ 25-tons per truck) to remove all debris

Direct Economic Losses

- $63 billion in total direct economic losses
- $47 billion in building losses
- $3 billion in transportation losses
- $13 billion in utility losses

Shelter/Commodity Requirements

- 400,000 people will seek shelter
- 400,000 cots; 5,000 sinks; 10,000 toilets; 800,000 blankets; 8,000 trash cans
- Over 1,000 truckloads of commodities
- 260 truckloads of water ; 150 truckloads of MREs; 315 truckloads of Ice (first 3 days)
- 23,600 people with diabetes & 42,800 with mental disorders will need to be sheltered

Search & Rescue Requirements

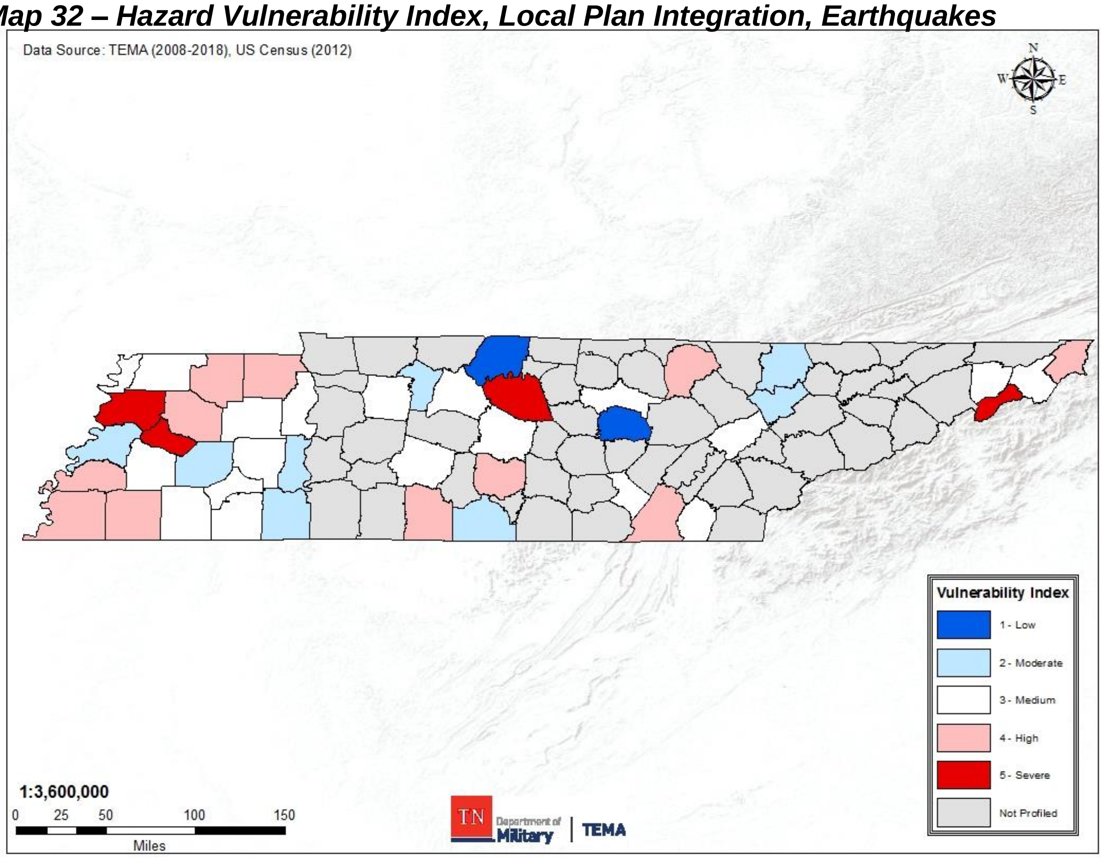
- 460 SAR teams of 12,700 personnel

4.3.4 – Changing Future Conditions

With current technology long term earthquake prediction is at best highly speculative. With many metropolitan areas growing within the state in both population size and density, along with the supporting infrastructures for those changes in population, this puts more of the population at risk, and in need of disaster response services should an event occur. The western portion of the state, particularly the Memphis/Shelby county area is the most vulnerable area due to close proximity to the New Madrid fault, large population, and economic situation of many of the residence of the metropolitan area. Response to such an event would be significantly delayed due to potential damage to infrastructure and roadways between the Memphis/Shelby area and the rest of the state.

The following map depicts the vulnerability to earthquake incidents for each county throughout the State of Tennessee. This data was compiled using local plan integration.

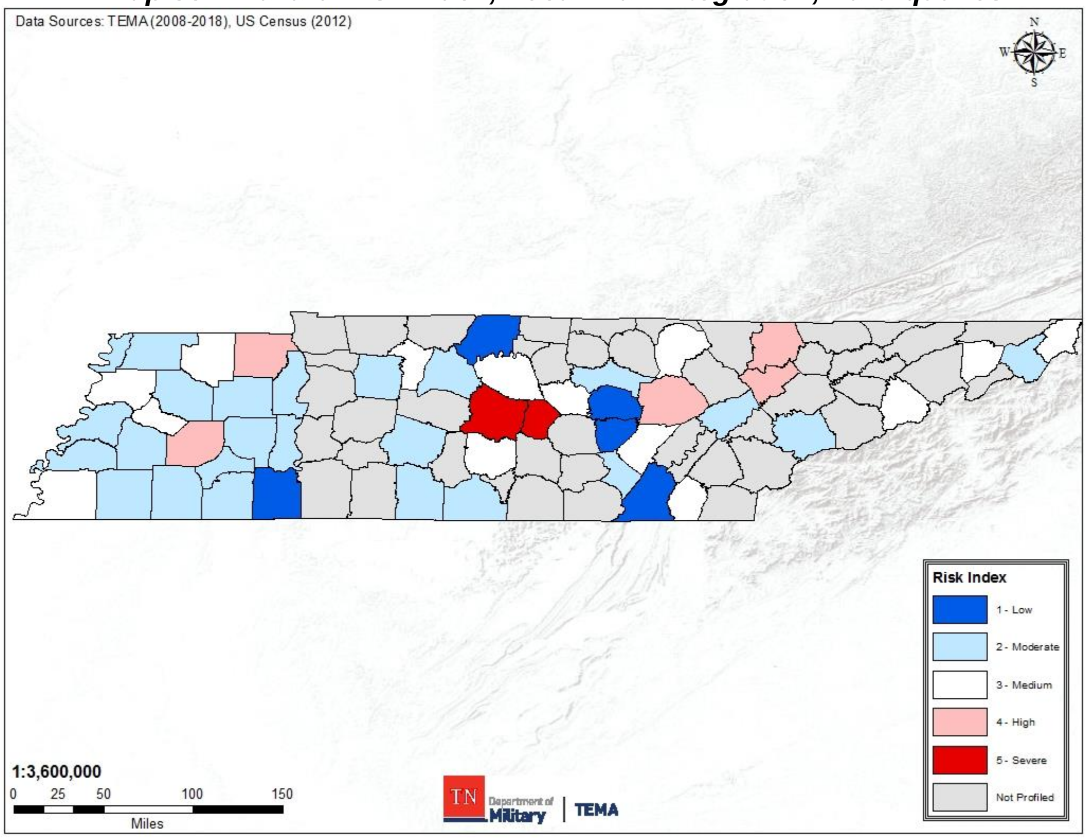
Map 32 – Hazard Vulnerability Index, Local Plan Integration, Earthquakes



4.3.5 – Future Risk

Using a basic risk matrix: Vulnerability+Probability=Risk, TEMA was able to calculate hazard risk using data from the previous subsections. This process is further explained in Section 3.4. As shown in the following map of the risk index, Rutherford and Cannon counties are highest risk for earthquakes.

Map 33 – Hazard Risk Index, Local Plan Integration, Earthquakes



4.3ET – Extreme Temperatures

An extreme temperature event occurs when the temperature is exceptionally hotter or colder than the geographic norm and persists long enough to affect the life of the community.

Extreme Heat
Extreme heat is defined as temperatures which hover 10 degrees or more above the average high temperature for a region and last for several weeks, and though the event may not be as notable as other hazards, its effects can have devastating consequences. While it is hard to quantify the exact total number of deaths that are advanced by heat wave weather, in a normal year, about 175 Americans succumb to the demands of summer heat.

The term "Heat Index" was created by the NWS to measure apparent temperature of the air as it increases with the relative humidity. This was done to help the public understand that a lower temperature with a high relative humidity can be just as dangerous as a hotter, dryer day. The Heat Index can be used to determine what effects the temperature and humidity can have on the population. It is important to know that the Heat Index (HI) values are devised for shady, light wind conditions. Exposure to full sunshine can increase HI values by up to 15 degrees. Also, strong winds, particularly with very hot, dry, air can be extremely hazardous to individuals.

Extreme Cold
While not as clearly defined as extreme heat, extreme cold can be just as problematic and deadly for a jurisdiction that encounters this hazard. Extreme cold conditions typically accompany winter storm events but may occur on beautiful, sunny days as well. Exposure to cold can cause frostbite or hypothermia and become life-threatening. Infants and elderly people are most susceptible.

The term wind chill, much like the term heat index is not the actual temperature but rather how wind and cold feel on exposed skin. As the wind increases, heat is carried away from the body at an accelerated rate, driving down the body temperature.

Extreme cold events are typically associated with the winter months while extreme heat is associated with the winter months. Please see the chart below depicting the seasonal differences in extreme heat and extreme cold.

4.3.1 – Location & Extent

Extreme heat and cold can occur in all 95 counties in Tennessee. Extreme heat is not a hazard that responds to the traditional mitigation measures of building codes or land use restrictions. Heat is the number 1 weather related killer in the United States, resulting in roughly 175 fatalities each year. In fact, on average, excessive heat claims more lives each year than floods, lightning, tornadoes and hurricanes combined.

What constitutes extreme cold varies in different parts of the country. In the southern United States, near freezing temperatures are considered extreme cold. Freezing temperatures can cause severe damage to citrus fruit crops and other vegetation. Pipes may freeze and burst in homes that are poorly insulated or without heat. Most people judge extreme cold by the problems it causes rather than just by a temperature or a wind chill factor. In the northern areas of the country, extreme cold means temperatures well below zero.

The speed of onset of extreme temperatures, both hot and cold, is fairly slow and predictable from short and long term weather forecasts. The scale of measurement for this hazard is temperature and departure from normal temperature.

NOAA's National Weather Service

Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

At the state level, the primary response is more careful monitoring of the statewide power grid, as extreme temperature days usually result in dramatic electric power demands. Public information campaigns are designed to remind citizens to hydrate and avoid direct exposure to the elements during the time of temperature extremes. Typical medical problems caused by extreme temperatures include the following:

- Heatstroke is a life threatening condition that requires immediate medical attention. It exists when the body's core temperature rises above 105 degrees F as a result of environmental temperatures. Patients may be delirious, stuporous, or comatose. The death-to-care ratio in reported cases in the U.S. averages about 15%.
- Heat exhaustion is much less severe than heatstroke. The body temperature may be normal or slightly elevated. A person suffering from heat exhaustion may complain of dizziness, weakness, or fatigue. The primary cause of heat exhaustion is fluid and electrolyte imbalance. The normalization of fluids will typically alleviate the situation.
- Heat syncope is typically associated with exercise by people who are not acclimated to exercise. The symptom is a sudden loss of consciousness. Consciousness returns promptly when the person lies down. The cause is primarily associated with circulatory instability because of heat. The condition typically causes little or no harm to the individual.
- Heat cramps are typically a problem for individuals who exercise outdoors but are unaccustomed to heat. Similar to heat exhaustion, it is thought to be a result of a mild imbalance of fluids and electrolytes.
- Frostbite is one of the many problems caused by exposure to extreme cold. It is damage to body tissue caused by extreme cold. A wind chill of -20 degrees Fahrenheit (F) will cause frostbite in just 30 minutes. Frostbite causes a loss of feeling and a white or pale appearance in extremities, such as fingers, toes, ear lobes or the tip of the nose.
- Hypothermia is a condition brought on when the body temperature drops to less than 95 degrees Fahrenheit (F). Hypothermia is deadly and for those who survive, there are likely to be lasting kidney, liver and pancreas problems. Warning signs include uncontrollable shivering, memory loss, disorientation, incoherence, slurred speech, drowsiness and apparent exhaustion. Immediate critical care is essential to save the victim's life.

Historically, the highest frequency and greatest impact of extreme summer temperatures has been in the western part of Tennessee and is generally in the months of June, July and August.

4.3.2 – Previous Occurrences

Historic Hazard Event – Extreme Heat – June 2012

On June 29, 2012 the highest recorded temperature in Nashville reached 109 degrees.

Historic Hazard Event – Extreme Heat – January 2014

On January 6, 2014 a record cold airmass overspread the region as a strong cold front moved through. 1 to 2 inches of snowfall was recorded on the Cumberland Plateau in Franklin County. Temperatures hovered in the single digits and wind chills of -1 to -9 degrees were observed.

Historic Hazard Event – Extreme Heat – July 2016

The combination of hot temperatures and high humidity created heat indexes greater than 110 degrees in Memphis. Two heat related deaths occurred as a result.

Since 1996, NOAA has recorded 103 extreme temperature impact events, 14 extreme cold, and 89 extreme heat in the State of Tennessee. Tennessee has recorded 34 deaths and 1 injury from extreme temperature events. These events have not cost Tennesseans any dollar amount in property damage.

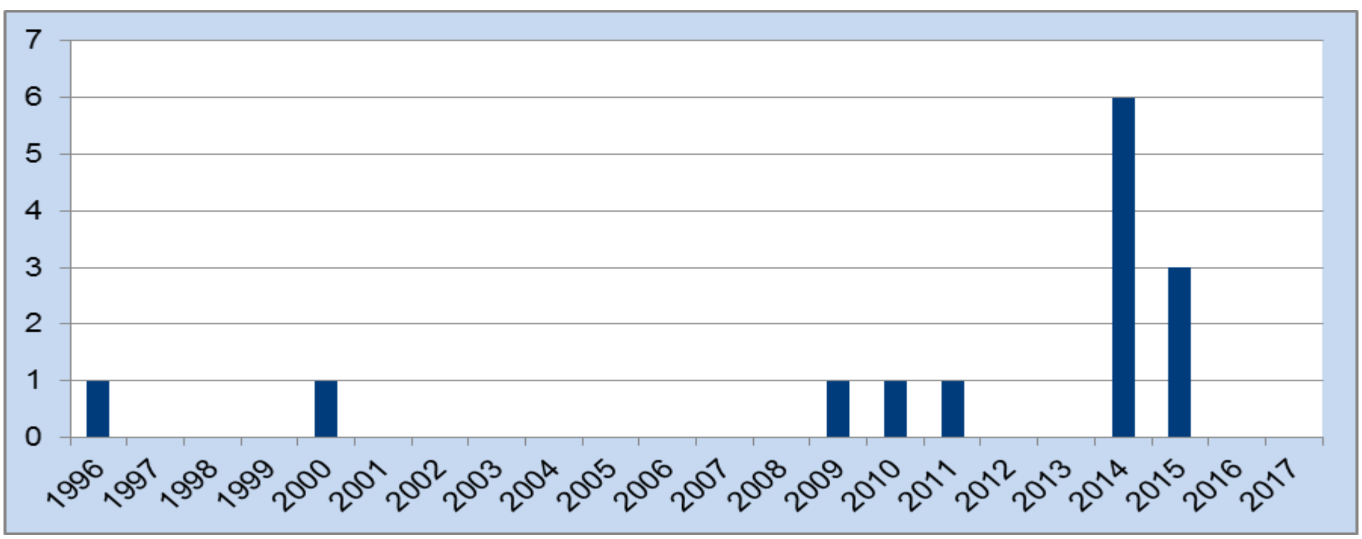
Based on NOAA's data, an extreme cold impact will cost $0 in property damage and $0 in crop damage while an extreme heat impact will cost $0 in property damage and $0 in crop damage. The average extreme cold impact will injure 0 people and kill 0.36 person while the average extreme heat event will injure 0.01 people and kill 0.33 people.

Table 41 – Historical Impacts, Extreme Cold & Heat (1996 – 2017)

	Extreme Cold	Extreme Heat
Count of Impacts	14	89
Impacts Per Year	0.64	4.05
Average Magnitude	-	-
Magnitude Range	-	-
Average Cost	0	0
Magnitude of Cost	0	0
Total Recorded Cost	0	0
Average Crop Damage	0	0
Magnitude of Crop Damage	0	0
Total Crop Damage	0	0
Average Fatalities	0.36	0.33
Total Fatalities	5	29
Average Injuries	0	0.01
Total Injuries	0	1

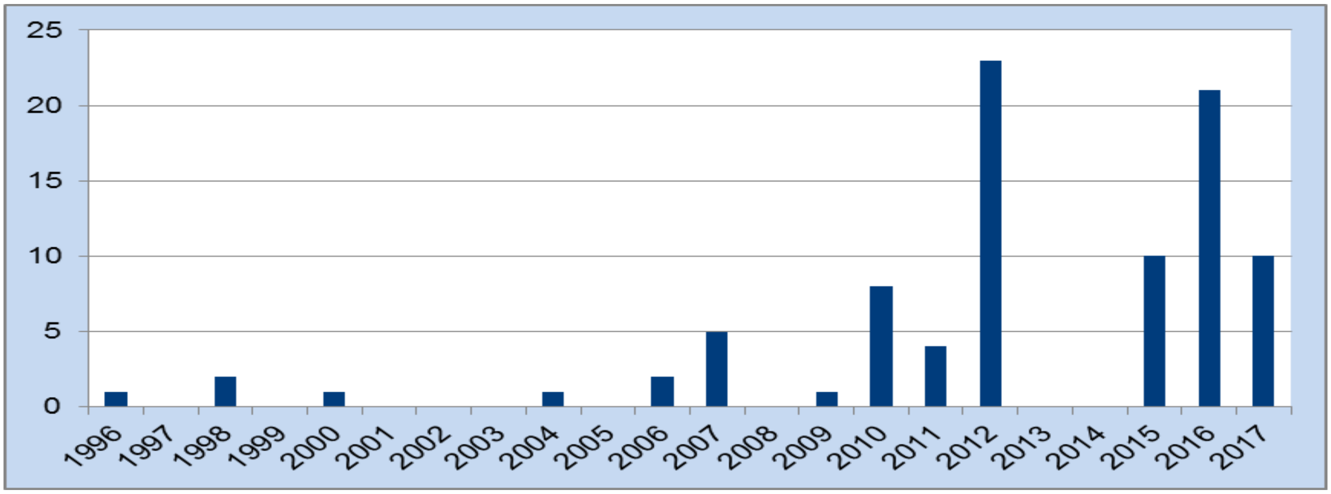
**The data are compiled from the NOAA NCDC Storm Event Database.*

Chart 6 – Extreme Cold Impacts by Year, Tennessee (1996 – 2017)



**The data are compiled from the NOAA NCDC Storm Event Database.*

Chart 7 – Extreme Heat Impacts by Year, Tennessee (1996 – 2017)



**The data are from the NOAA NCDC Storm Event Database.*

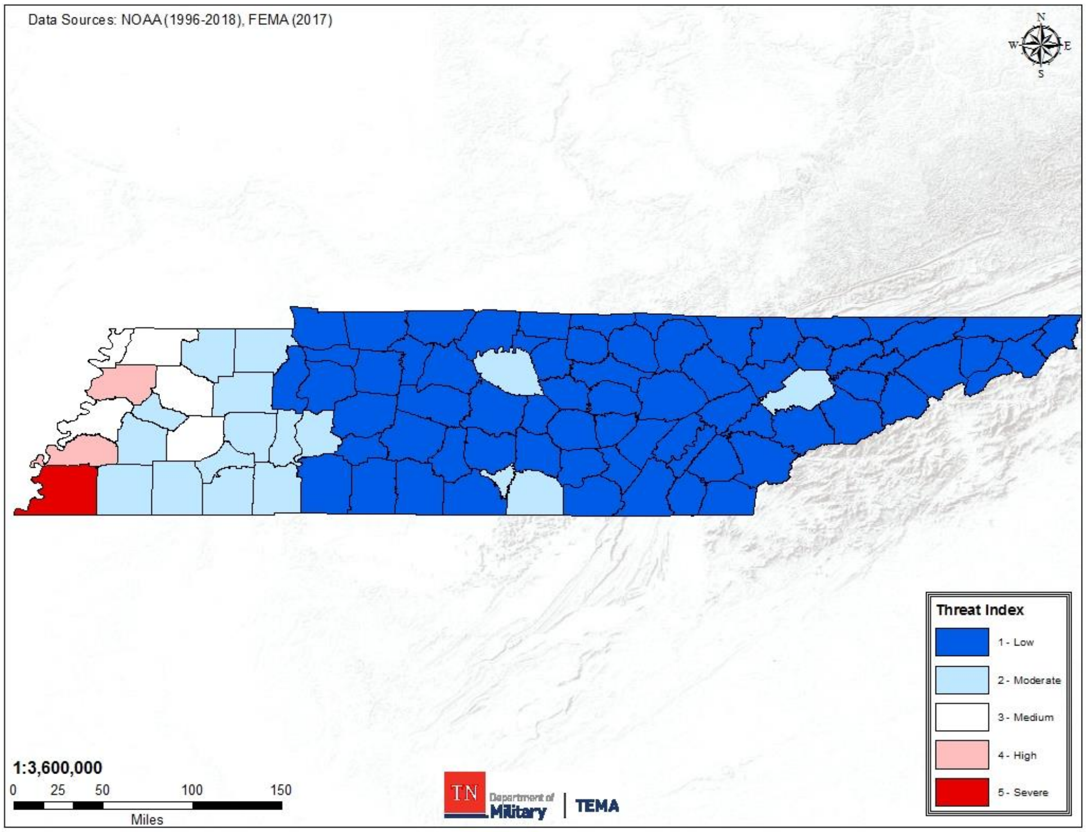
4.3.3 – Incidents & Probability

The state can expect 0.63 extreme cold impacts per year while is can expect an extreme heat impact 3.59 times per year.

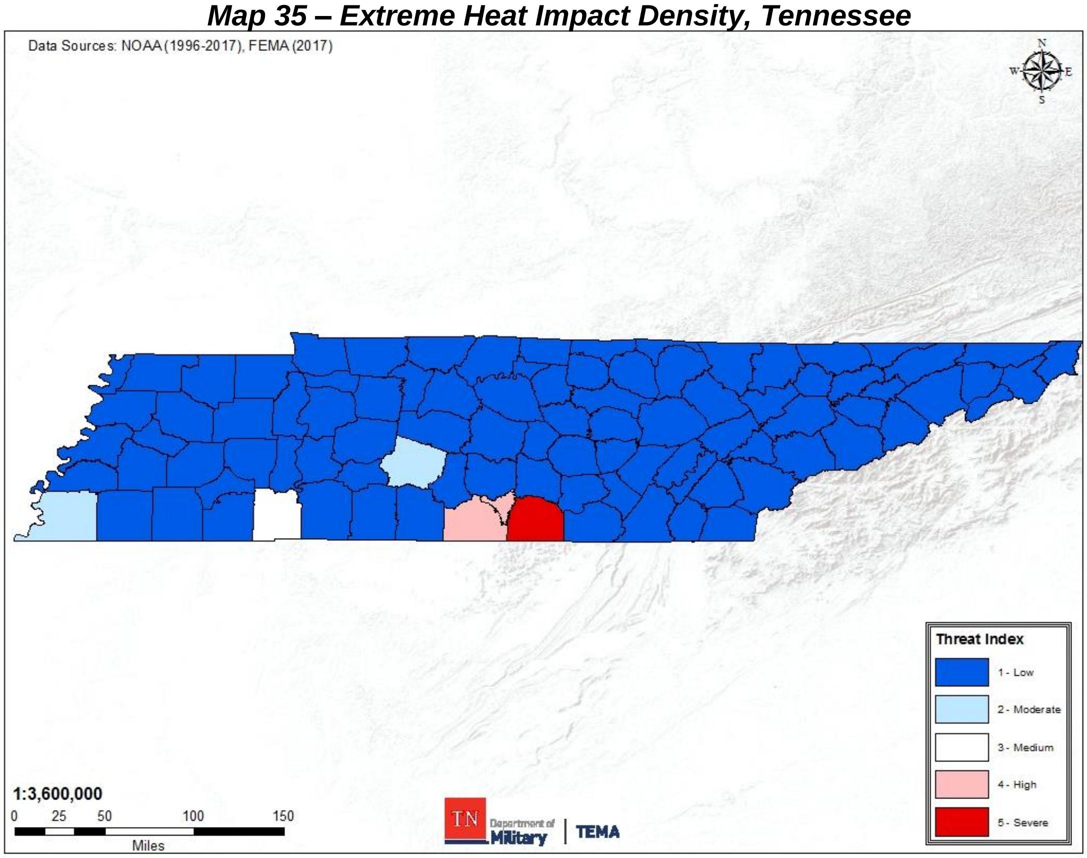
Table 42 – Impact Probability, Extreme Cold & Heat Events (1996-2017)		
Impact Year	**Count of Impacts**	
1996-2005	2	5
2006	0	2
2007	0	5
2008	0	0
2009	1	1
2010	1	8
2011	1	4
2012	0	23
2013	0	0
2014	6	0
2015	3	10
2016	0	21
2017	0	10
Total Recorded Impacts =	14	79
Total Years =	22	22
Yearly Probability = **Average Impacts per Year=**	**63.64%** **0.63**	**359.10%** **3.59**

**The data are compiled from the NOAA NCDC Storm Event Database*

Map 34 – Extreme Cold Impact Density, Tennessee

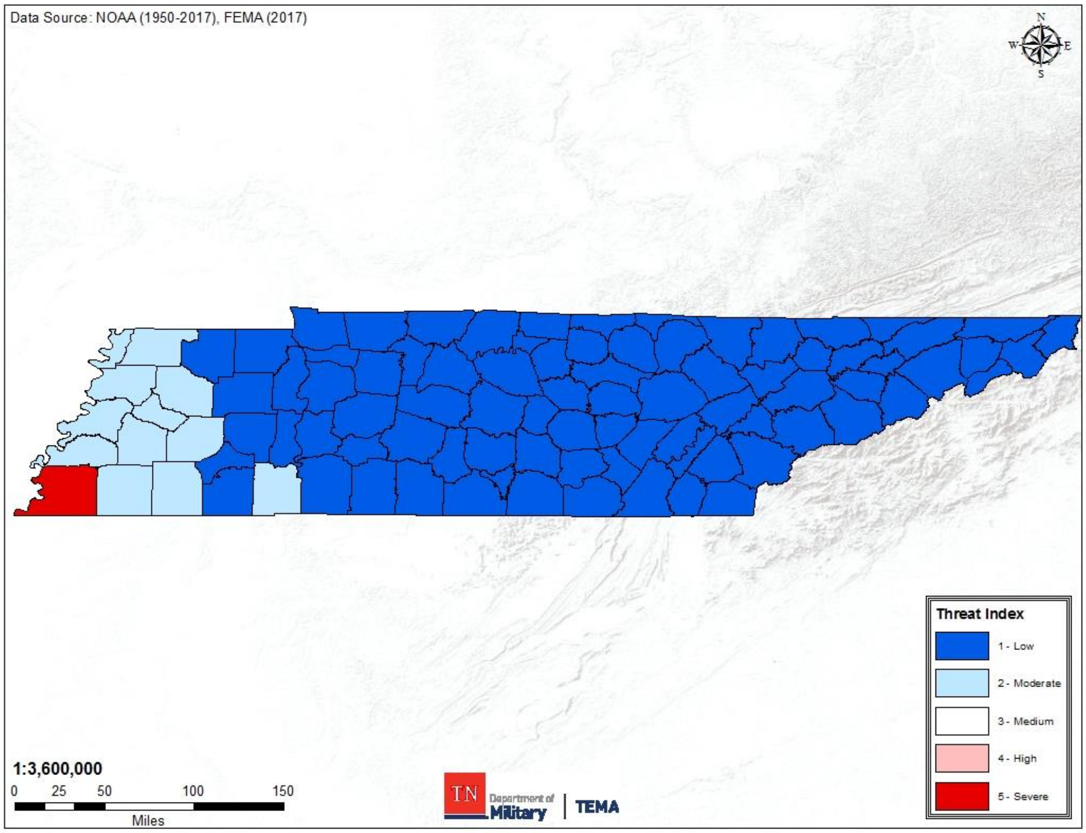


Map 35 – Extreme Heat Impact Density, Tennessee



The following map depicts the concentrations of extreme temperatures (a composite of extreme cold and extreme heat) impacts throughout the State of Tennessee.

Map 36 – Extreme Temperatures Impact Density, Tennessee

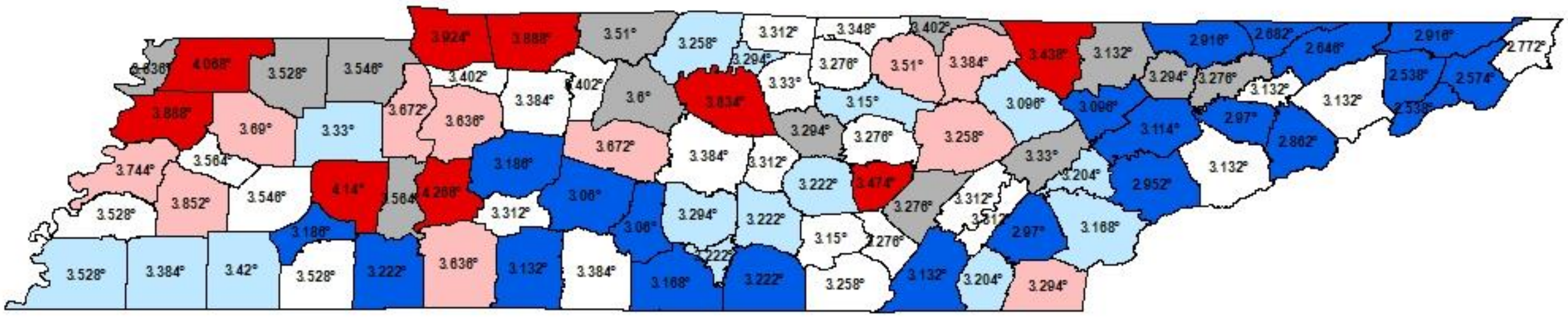


4.3.4 – Changing Future Conditions

For Tennessee, there is a projection of dramatic warming across the entire state, such that the coldest periods may be much warmer than they are now. The most significant warming is expected to occur in East Tennessee, which is also where historically there have been the most frequent winter weather events; thus, resulting in possibly less concern for winter weather vulnerability in that region. Some warming will also occur throughout the state for the hottest periods of the year

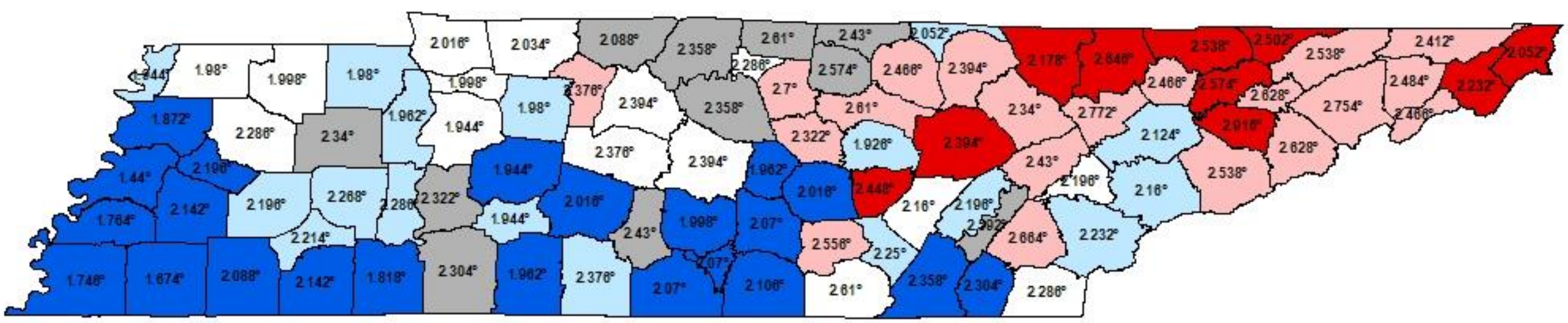
Map 37 – Changing Future Conditions, Tennessee

Projected High Temperature Difference from 2000-2010 data and 2050-2060 data



This represents the difference between the 95th percentile temperature threshold from the 2000-2010 data (high temperatures, 95% of temperatures fall below this number) subtracted from the projected 95% of temperatures in 2050-2060 data.
*All temperatures in Fahrenheit

Projected Low Temperature Difference from 2000-2010 data and 2050-2060 data

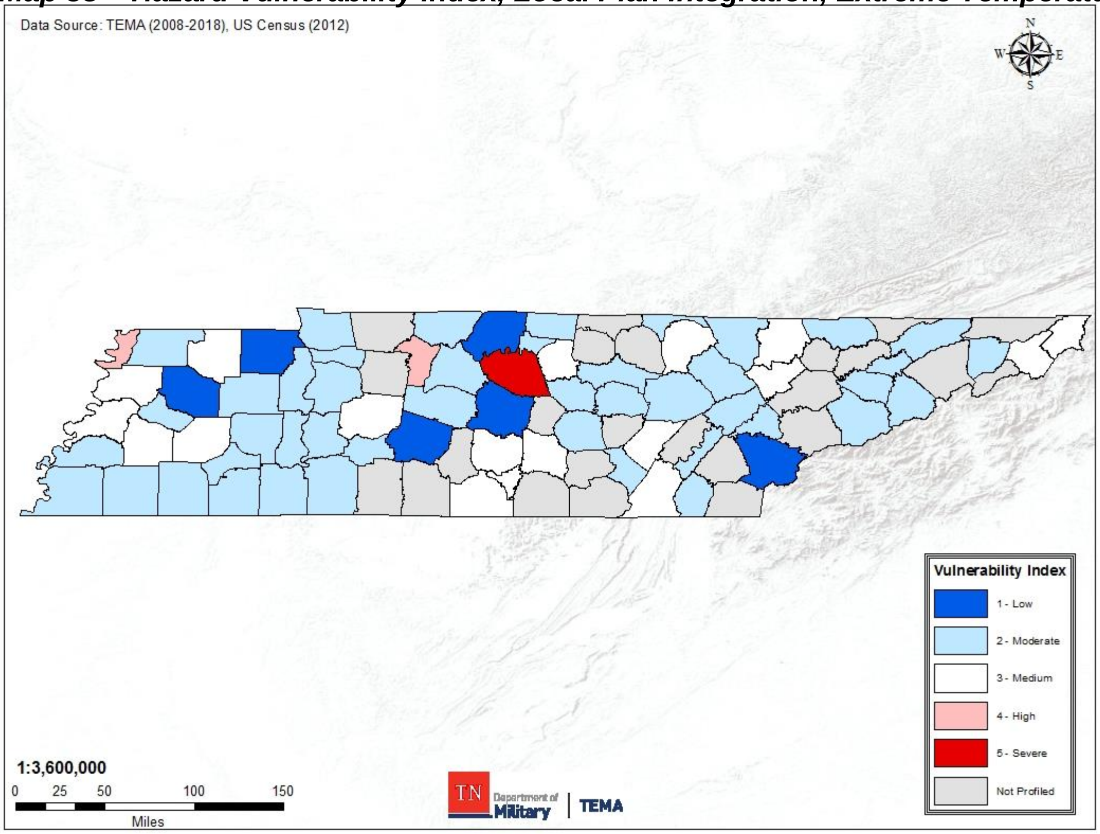


This represents the difference between the 5th percentile temperature threshold from the 2000-2010 data low temperatures, 5% of temperatures fall below this number) subtracted from the projected 5% of temperatures in 2050-2060 data.
*All temperatures in Fahrenheit

Data Source: Assessing the Vulnerability of Tennessee Transportation Assets to Extreme Weather, TDOT

The following map depicts the vulnerability to extreme temperatures incidents for each county throughout the State of Tennessee. This data was compiled using local plan integration.

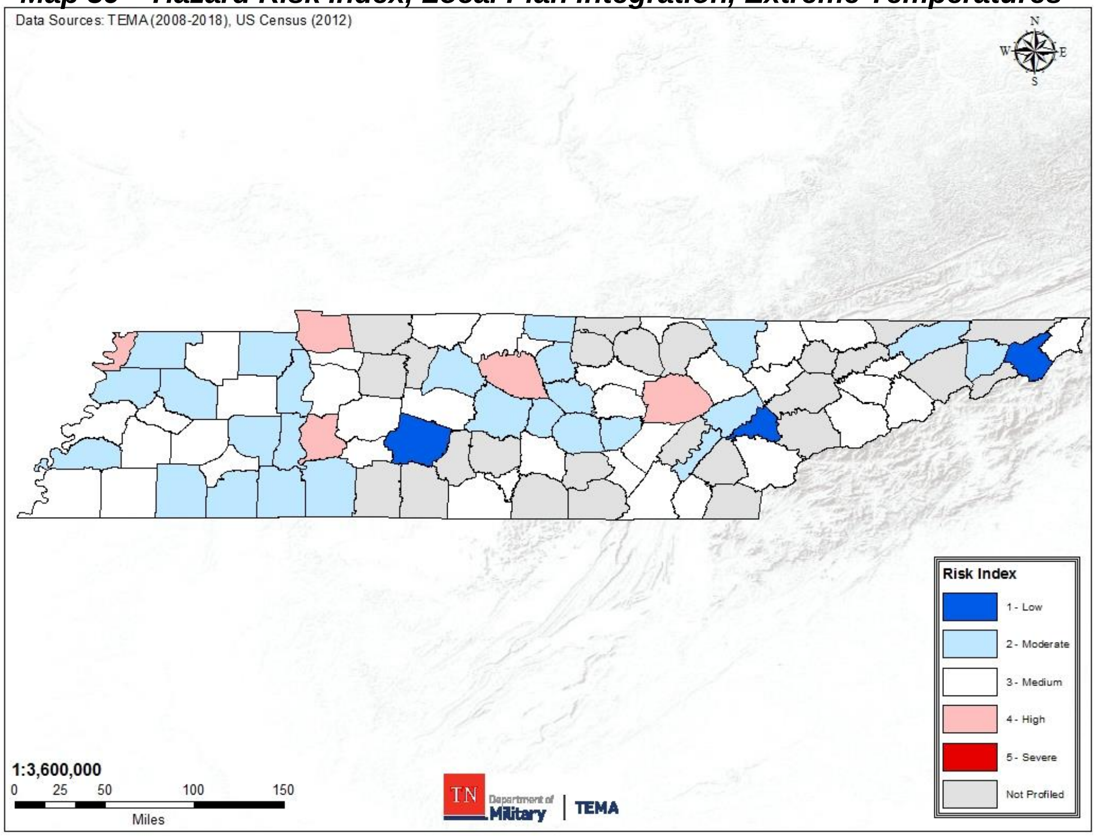
Map 38 – Hazard Vulnerability Index, Local Plan Integration, Extreme Temperatures



4.3.5 – Future Risk

Using a basic risk matrix: Vulnerability+Probability=Risk, TEMA was able to calculate hazard risk using data from the previous subsections. This process is further explained in Section 3.4. As shown in the following map of the risk index, there are no counties that are at the most severe risk index for extreme temperatures, with most of the risk being moderate to medium across the state.

Map 39 – Hazard Risk Index, Local Plan Integration, Extreme Temperatures



4.3F – Floods

Flooding is the most prevalent and costly disaster in the United States. Flooding occurs when water, due to dam failures, rain, or melting snows, exceeds the absorptive capacity of the soil and the flow capacity of rivers, streams or coastal areas. At this point, the water concentration hyper extends the capacity of the flood way and the water enters the floodplain. Floods are most common in seasons of rain and thunderstorms. Floods can be associated with other natural phenomena such as rainstorms, thunderstorms, hurricanes, coastal swells, earthquakes, tsunamis and rapidly melting snow.

Intense rainfall events, often accompanying the large thunderstorms that occur in Tennessee and its jurisdictions several times a year, may result in water flowing rapidly from higher elevations into valleys, collecting in, and sometimes overtopping the low lying streams. Various types of floods can happen quickly in the form of a flash flood, or accumulate seasonally over a period of weeks as is the case in a riverine flood. Flash floods often drain quickly, while riverine floods can remain for weeks. The magnitude of these floods is indeterminate and can vary, however, some areas have established a base flood elevation (BFE) to use as a determinate for construction and mitigation activities.

A variety of factors affects the type and severity of flooding within Tennessee and its jurisdictions including topography, urban development and infrastructure, and geology. Serious flooding in the mountainous or elevated areas is unusual because streams tend to be faster flowing and flood waters drain quickly. Flooding can occur anytime throughout the year, but is typically associated with the spring season. The chart below illustrates seasonal differences between riverine and flash flood impacts per month.

4.3.1 – Location & Extent

A variety of factors affects the type and severity of flooding in Tennessee including topography, urban development and infrastructure, and geology. Serious flooding in the mountainous or elevated areas is unusual because streams tend to be faster flowing and flood waters drain quickly.

Intense flooding will cause havoc on the jurisdictions affected. Floods can cause minimal damage in the form of just inches of water to complete submersion of houses and critical facilities. Any amount of damage can render a structure unusable for as long as recovery operations would take depending on the level of damage. Intense and widespread flooding can trap people and entire communities without basic goods or services.

Flash floods tend to affect developed areas as their development has altered the natural drainage of the land. Map 48 depicts the density of flash flood impacts and corroborates their impacts occurring around developed areas.

Maps 40 through 42 on the following pages use FEMA's National Flood Hazard Layer data to depict the location of 100 and 500 year floodplains in East, Middle, and West Tennessee. No single region is left without risk to riverine floods as is shown in these maps. Below is a description of FEMA designation flood plains.

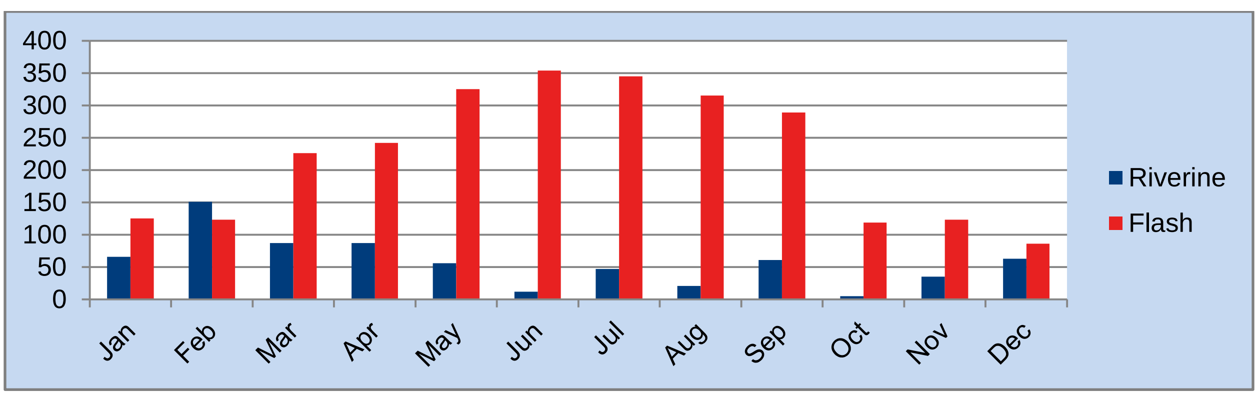
Table 43 – Primary Flood Zone Classifications in Tennessee

Zone Class	Description
A	An area inundated by 1% annual chance flooding, for which no BFEs have been determined. (100 Year Floodplain)
AE	An area inundated by 1% annual chance flooding, for which BFEs have been determined. (100 Year Floodplain)
B	Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood. An area inundated by 0.2% annual chance flooding.

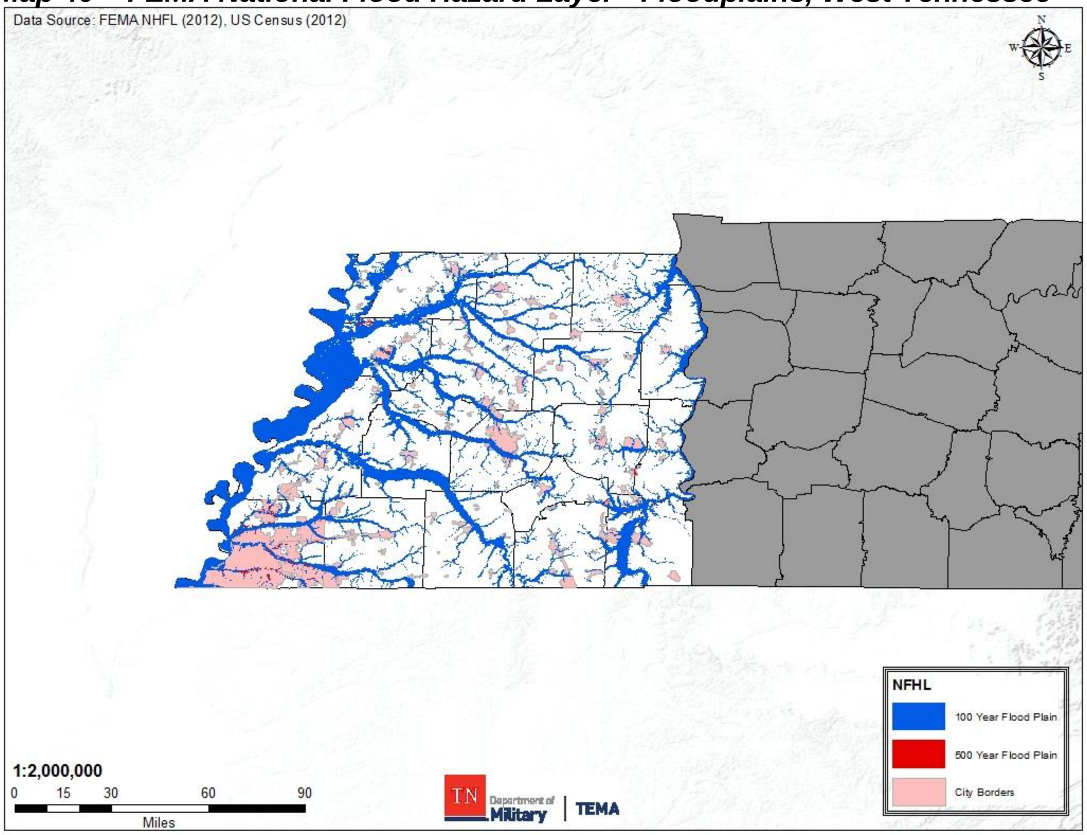
**Although FEMA designates many more floodplain classifications, these represent 99% of the flood zoning in TN. Related classifications, i.e. '100 Year protected by levee' were incorporated in classification A.*

An issue related to the hazard of flooding is Repetitive Loss and Severe Repetitive Loss properties. An RL property is a residential property which has received 2 or more flood loss claims over $1000 each. For a residential property to be classified as SRL, it must have experienced at least 4 claims over $5,000 (including building and contents payments) or at least 2 claims that cumulatively exceed the market value of the structure. For both instances, at least 2 of the referenced claims must have occurred within any 10 period and must have been more than 10 days apart. SRL properties are seen as a major burden to the National Flood Insurance Program and since they have been flooded frequently in the past, they are a high risk to be flooded again. Map 43 depicts Tennessee's RL/SRL properties and their corresponding county statistics.

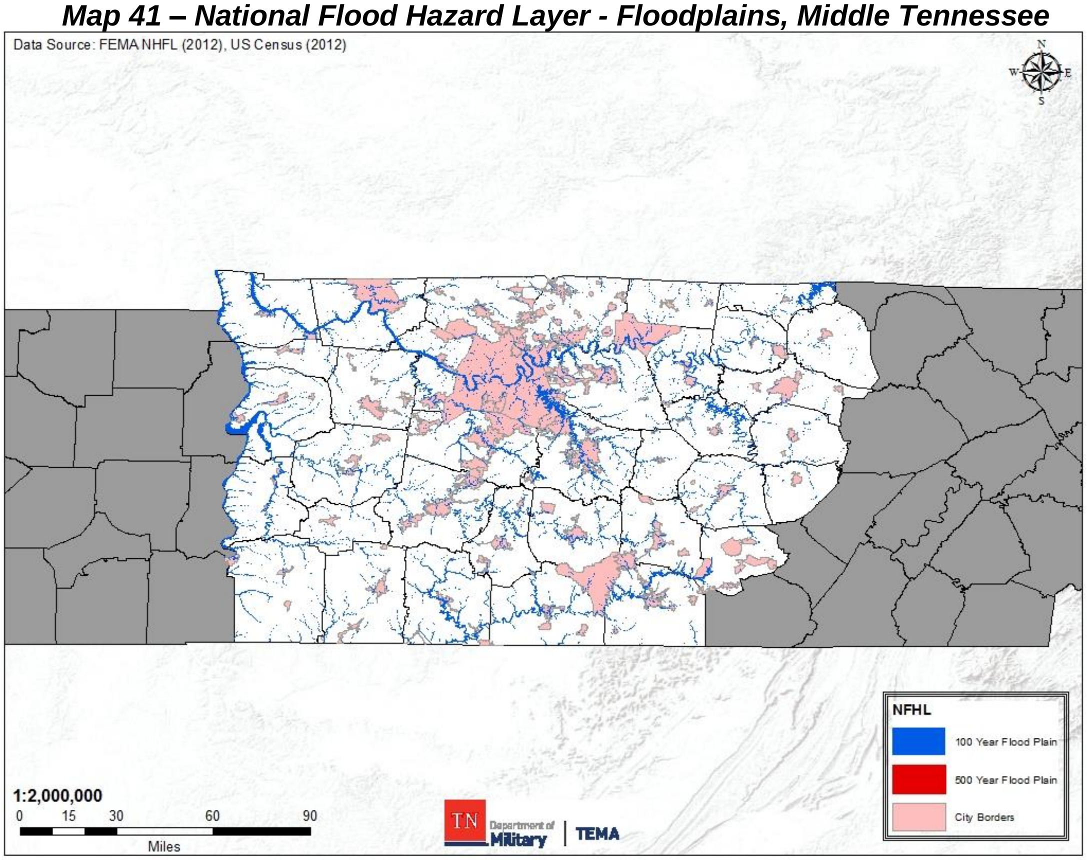
Chart 8 – Flood Incidents by Month, Tennessee (1993 – 2017)



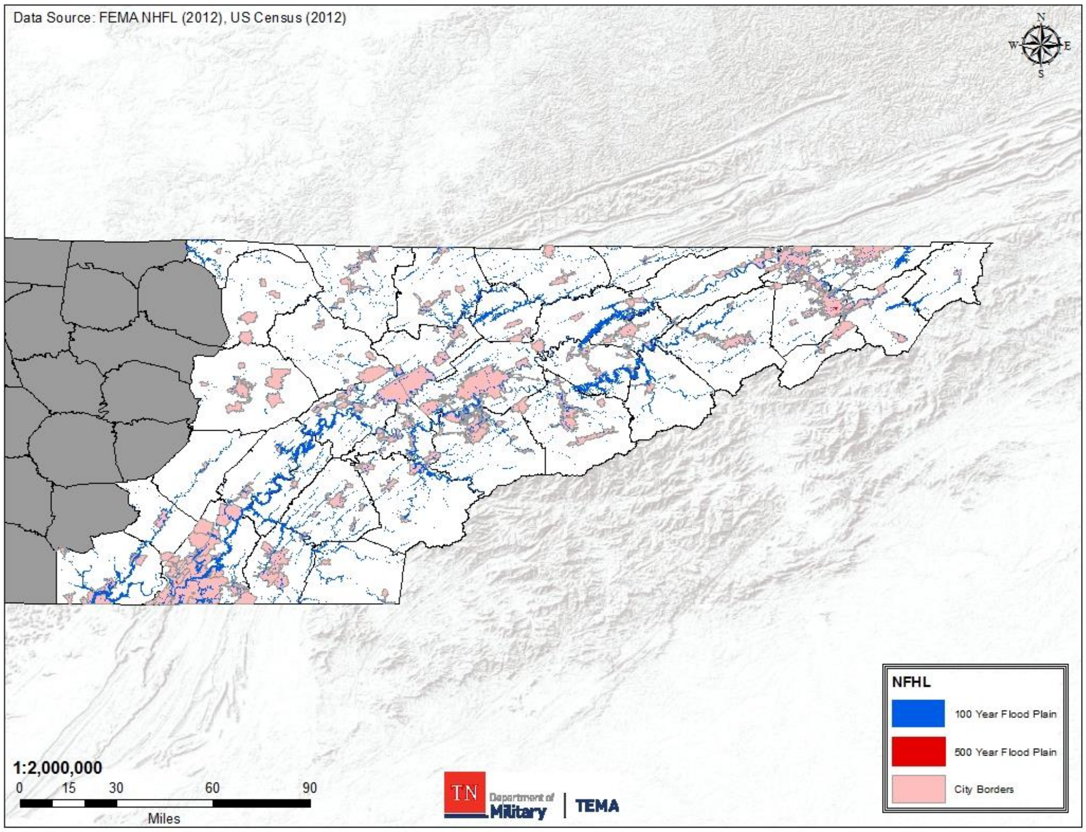
Map 40 – FEMA National Flood Hazard Layer - Floodplains, West Tennessee



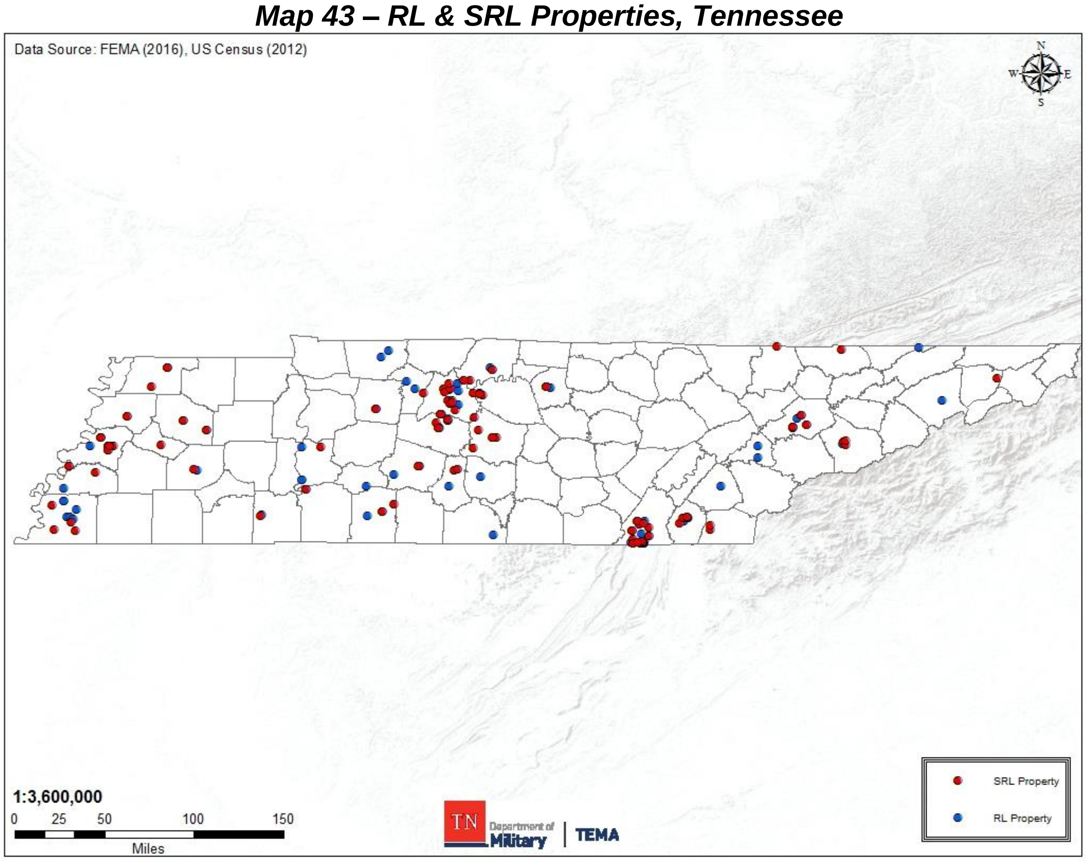
Map 41 – National Flood Hazard Layer - Floodplains, Middle Tennessee



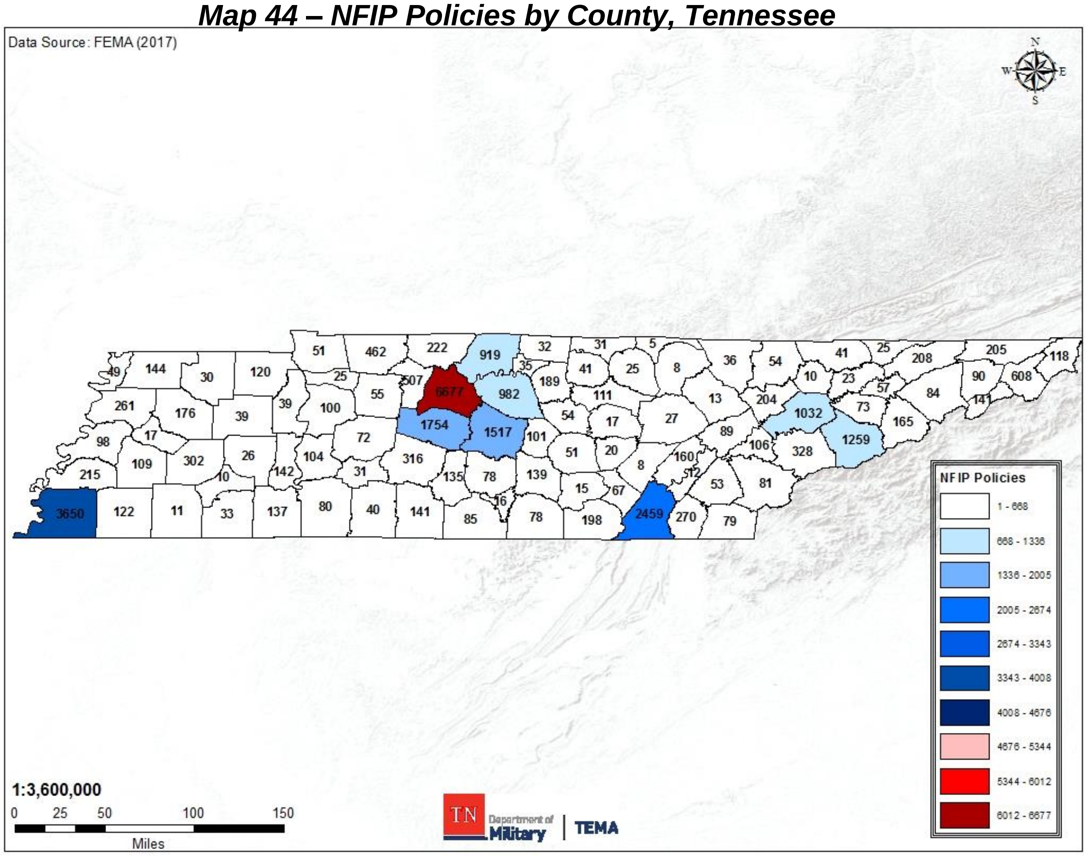
Map 42 – National Flood Hazard Layer - Floodplains, East Tennessee



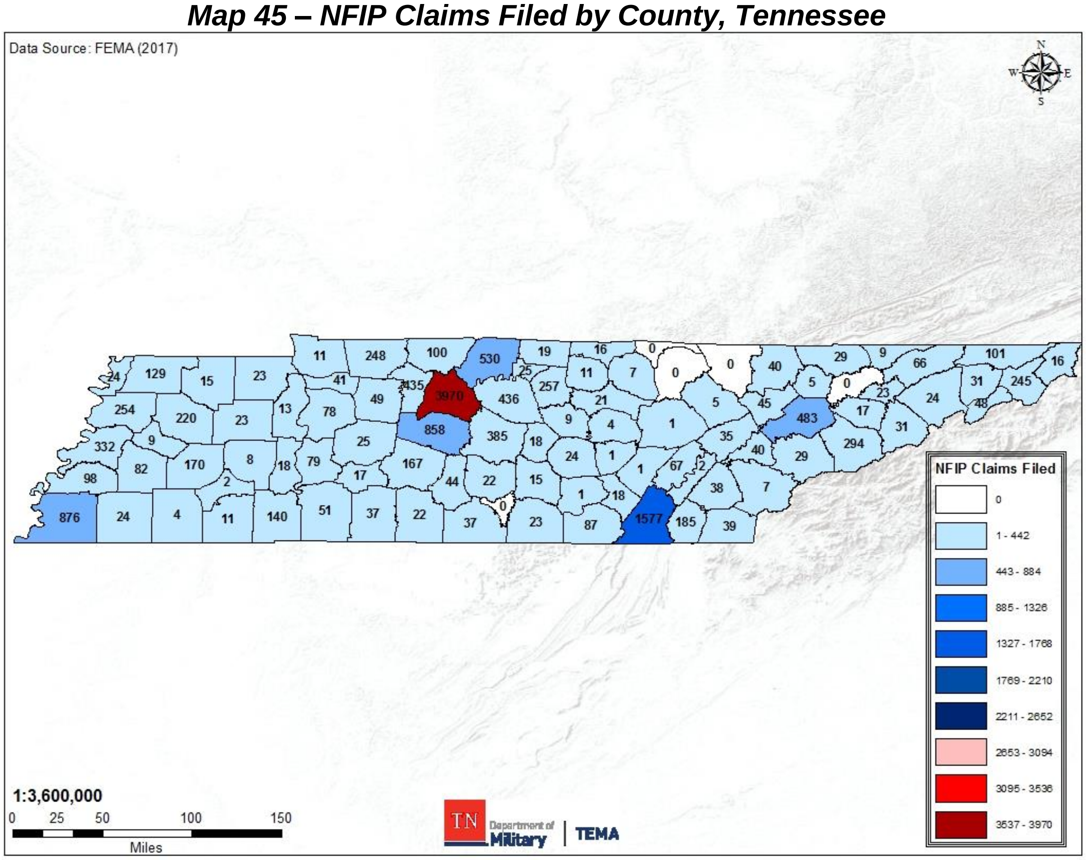
Map 43 – RL & SRL Properties, Tennessee



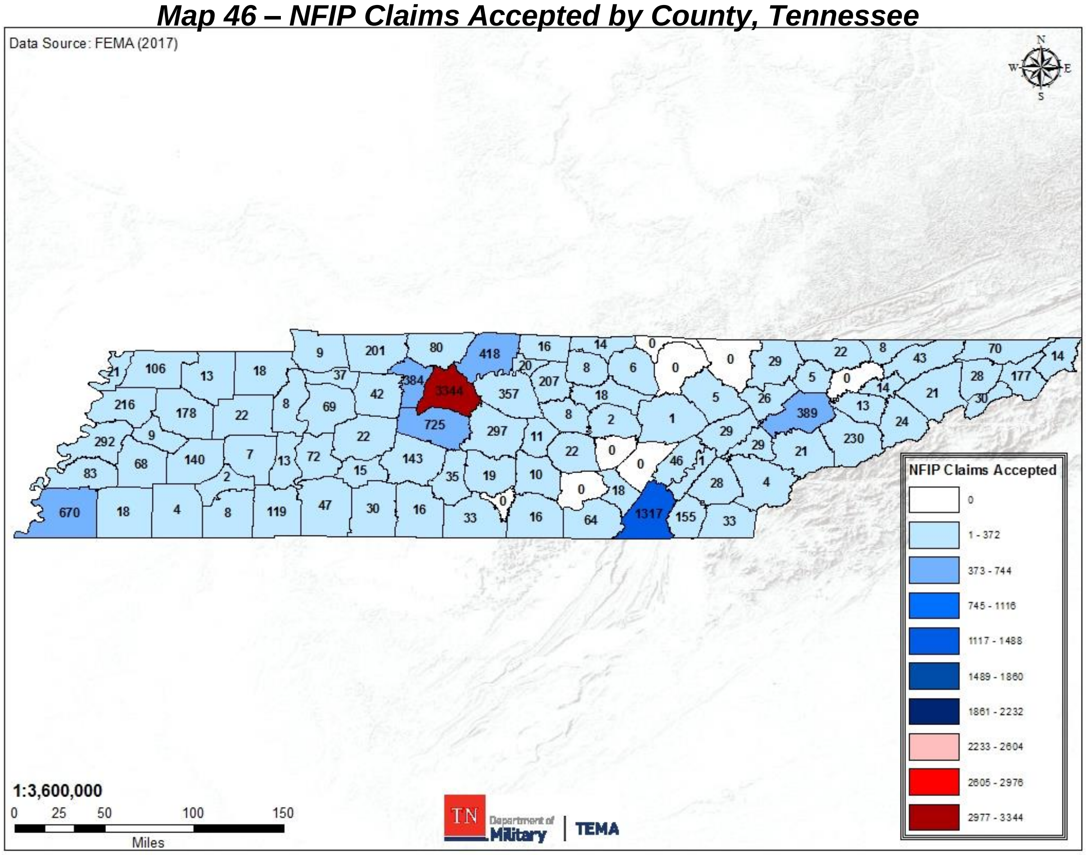
Map 44 – NFIP Policies by County, Tennessee



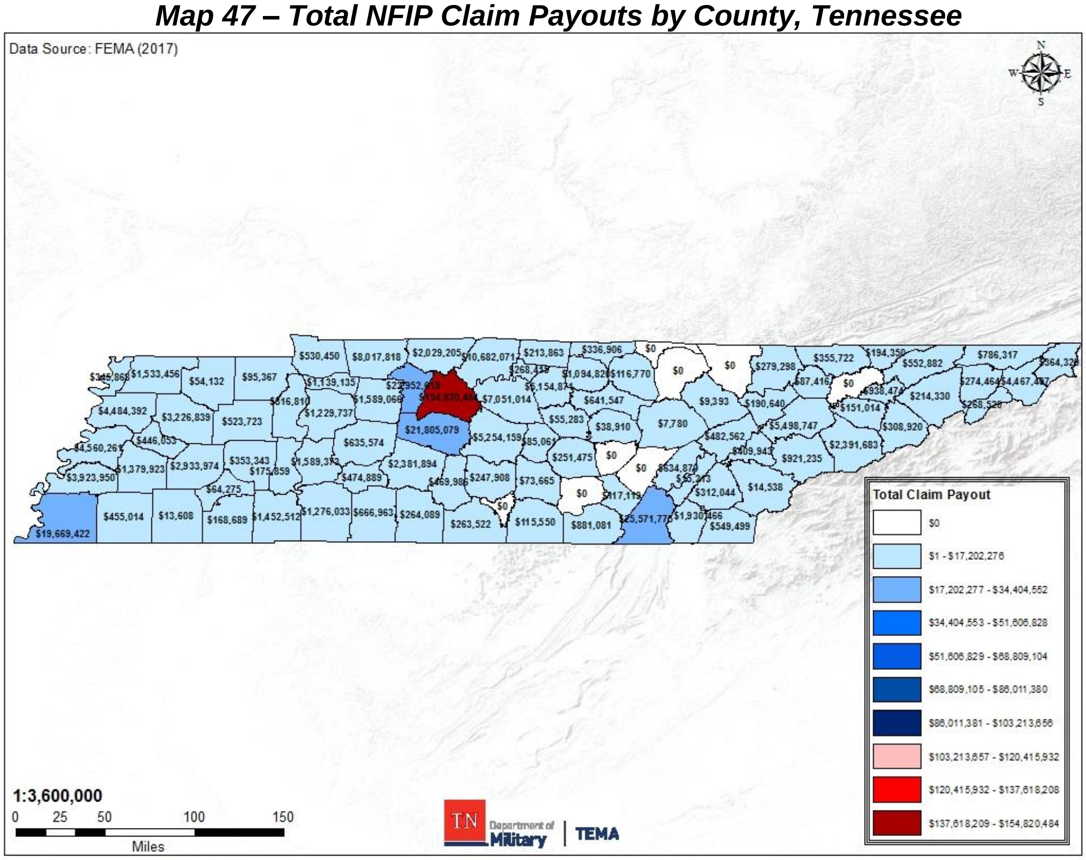
Map 45 – NFIP Claims Filed by County, Tennessee



Map 46 – NFIP Claims Accepted by County, Tennessee



Map 47 – Total NFIP Claim Payouts by County, Tennessee



4.3.2 – Previous Occurrences

Historic Hazard Incident – Riverine Flood – January 1927

Flooding began when the Mississippi Basin was hit with heavy rain in the summer of 1926. The Cumberland River considers 40 feet and above to be a flood stage, with 45 feet being considered a major flood. In January 1927, the river crested at a record of 56.2', which is still the record today, even exceeding the 2010 floods. By May, the Mississippi River below Memphis reached 60 miles in width.

Historic Hazard Incident – Riverine Flood – May 2010

The May 2010 floods were the devastating outcome of a 2 day rainfall over May 1st and 2nd totaling over 19 inches. Over 30 counties (31% of Tennessee) were declared major disaster areas by the FEMA. Nashville set a new all-time record for 1 day rainfall with 7.25 inches and for a 2 day total of 13.57 inches. Rainfall intensity records for 6 hours (5.57") and 12 hours (7.20") are also set.

The Cumberland River flooded for the first time in 26 years and crested at 51.86 feet (15.81 m) in Nashville. The Cumberland River is considered to have reached a flood stage at 40 feet, and reaching major flood stage at 45 feet. All-time record crests were observed on the Cumberland River at Clarksville, the Duck River at Centerville and Hurricane Mills, the Buffalo River at Lobelville, the Harpeth River at Kingston Springs and Bellevue, and the Red River at Port Royal.

Twenty-one deaths were recorded in Tennessee. Almost all schools in the Middle Tennessee area were closed; some for multiple weeks. Many roads had damage from erosion including I-40, which was under construction for months. Homes and other establishments were destroyed. Flooding from the Cumberland River damaged the Grand Ole Opry House, Gaylord Opryland Resort & Convention Center, Opry Mills Mall, Bridgestone Arena, and LP Field.

Historic Hazard Incident – Riverine Flood – April 2011

Tennessee was declared a Federal Disaster Area when the Mississippi River flooded affecting Illinois, Missouri, Kentucky, Tennessee, Arkansas, Mississippi, and Louisiana. Over 1,300 homes were evacuated in Memphis.

Historic Hazard Incident –Flash Flood – May 2016

The largest severe weather event of Spring 2016 across Middle Tennessee affected areas mainly north of I-40 from the late evening hours on May 10 into the morning hours on May 11. Heavy rainfall of 3 to 7 inches was reported across Robertson, Sumner, Macon, Trousdale, Wilson, Smith, and Putnam Counties. Major flash flooding across these counties resulted in dozens of homes and businesses flooded, numerous roads being flooded and closed or washed out, and several water rescues from flooded homes and vehicles. The flooding across these counties was reportedly the worst since the historic May 2010 floods. Since 1993, NOAA has recorded 2279 flash flood impacts in the State of Tennessee. Tennessee has recorded 25 deaths and 47 injuries relating to flash flooding. These events have cost Tennesseans $541,321,970 in property damage and $555,600 in crop damage.

Table 44 – Historical Impacts, Flash Floods (1993 – 2017)	
Count of Impacts	2279
Impacts Per Year	91.16
Average Magnitude	-
Magnitude Range	-
Average Cost	$237,526
Magnitude of Cost	$0 - $50,000,000
Total Recorded Cost	$541,321,970
Average Crop Damage	$244
Magnitude of Crop Damage	$0 - $250,000
Total Crop Damage	$555,600
Average Fatalities	0.0110
Total Fatalities	25
Average Injuries	0.0206
Total Injuries	47

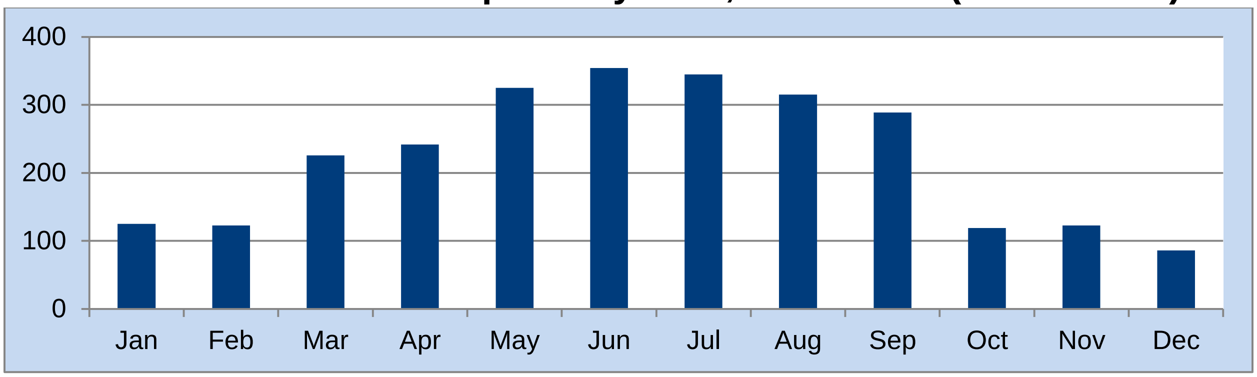
**The data are compiled from the NOAA NCDC Storm Event Database*

Table 45 – Historical Impacts, Riverine Floods (1994 – 2017)	
Count of Impacts	691
Impacts Per Year	28.79
Average Magnitude	-
Magnitude Range	-
Average Cost	$6,689,058.32
Magnitude of Cost	$0 - $2,000,000,000
Total Recorded Cost	$4,622,139,300
Average Crop Damage	$11,335
Magnitude of Crop Damage	$0 - $2,000,000
Total Crop Damage	$6,597,000
Average Fatalities	0.0507
Total Fatalities	35
Average Injuries	0.0014
Total Injuries	1

*The data are compiled from the NOAA NCDC Storm Event Database.

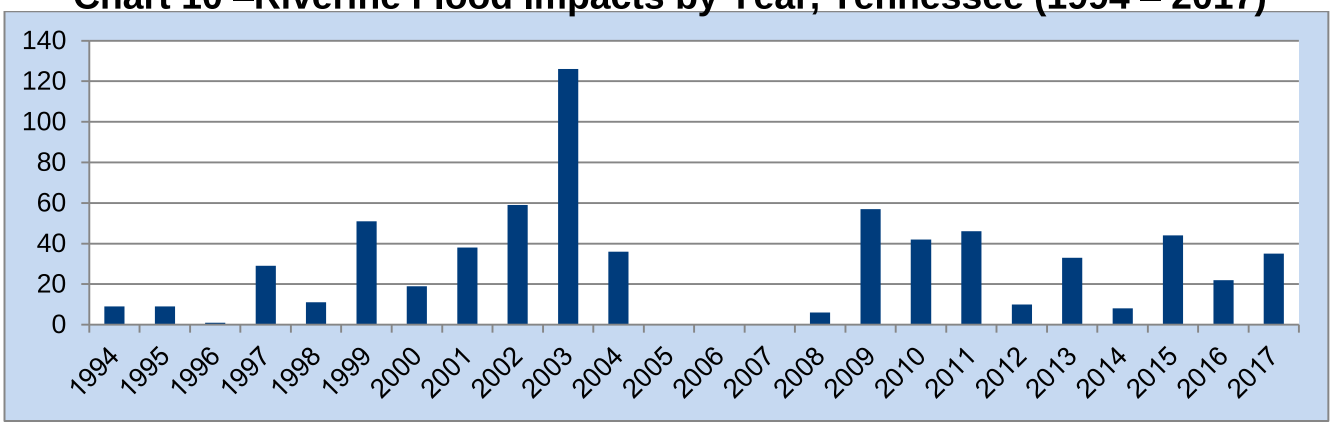
Since 1994, NOAA has recorded 5691 riverine flood impacts in the State of Tennessee. Tennessee has recorded 35 deaths and 1 injury relating to riverine flooding. These events have cost Tennesseans $4,622,139,300 in property damage and $6,597,000 in crop damage.

Chart 9 – Flash Flood Impacts by Year, Tennessee (1993 – 2017)



**The data are from the NOAA NCDC Storm Event Database.*

Chart 10 –Riverine Flood Impacts by Year, Tennessee (1994 – 2017)



**The data are from the NOAA NCDC Storm Event Database.*

4.3.3 – Incidents & Probability

Based on NOAA's data, a flash flood impact can cost up to $50,000,000 in property damage, and $250,000 in crop damage. The average riverine flood impact will cause $237,526 in property damage, $244 in crop damage, kill 0.0110 people, and injure 0.0206 people.

Based on NOAA's data, a riverine flood impact can cost up to $2,000,000 in property damage, and $6,597,000 in crop damage. The average riverine flood impact will cause $6,689,058.32 in property damage, $11,335 in crop damage, kill 0.0507 people, and injure 0.0014 people.

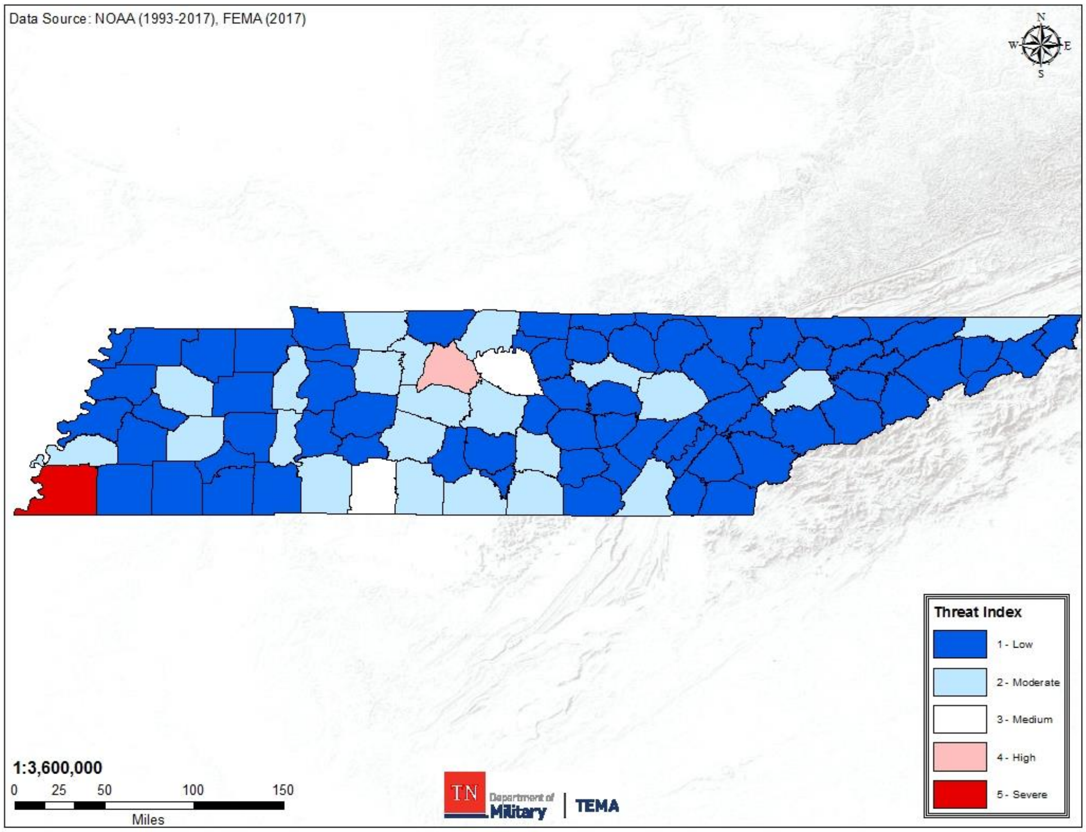
The state can expect 95.2 flash flood impacts per year while riverine flood impacts are expected to number 29.10 impacts per year.

**The data are compiled from the NOAA NCDC Storm Event Database*

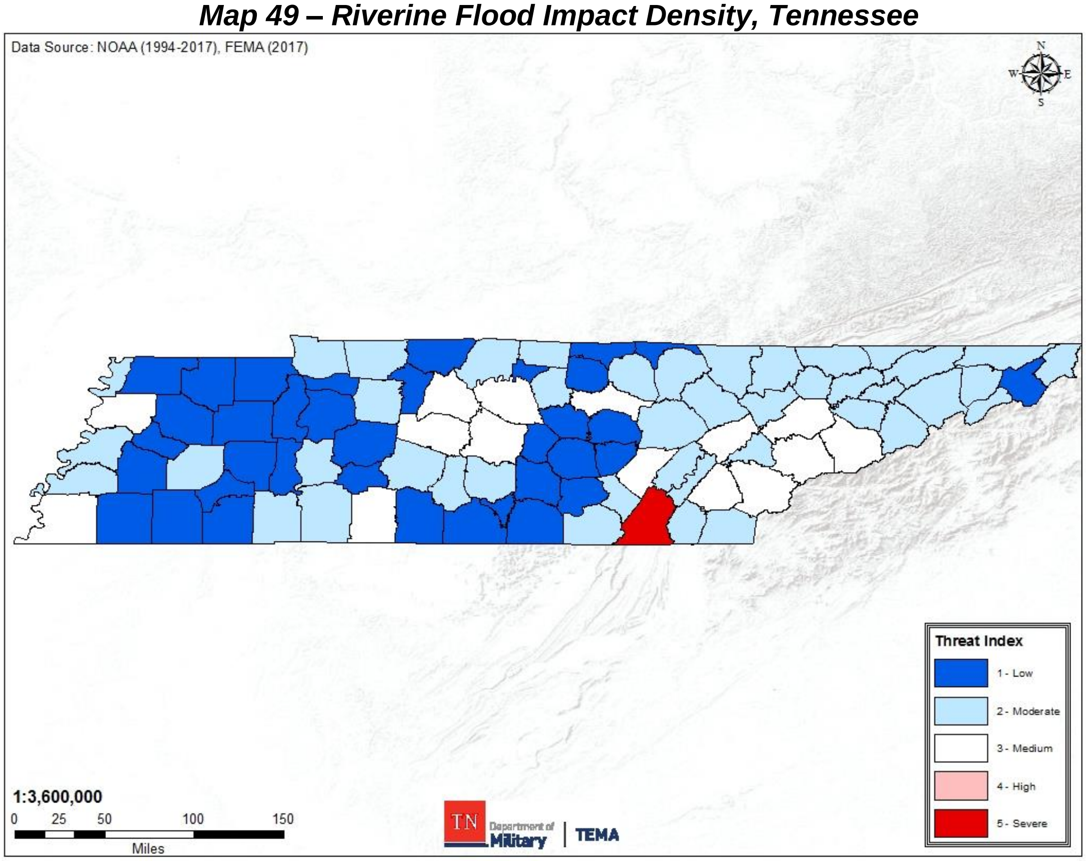
Table 46 – Impact Probability, Flash & Riverine Flood Events

Impact Year	Count of Impacts	
	Flash Floods	Riverine Floods
1993	23	-
1994	112	9
1995	52	9
1996	59	1
1997	205	29
1998	172	11
1999	59	51
2000	64	19
2001	69	38
2002	194	59
2003	188	126
2004	152	36
2005	47	0
2006	60	0
2007	14	0
2008	62	6
2009	179	57
2010	77	42
2011	70	46
2012	46	10
2013	95	33
2014	82	8
2015	50	43
2016	76	22
2017	81	35
Total Recorded Impacts =	2280	690
Total Years =	25	25
Yearly Probability = Average Impacts per year=	**9120.00%** 91.25	**2760.00%** 27.6

Map 48 – Flash Flood Impact Density, Tennessee

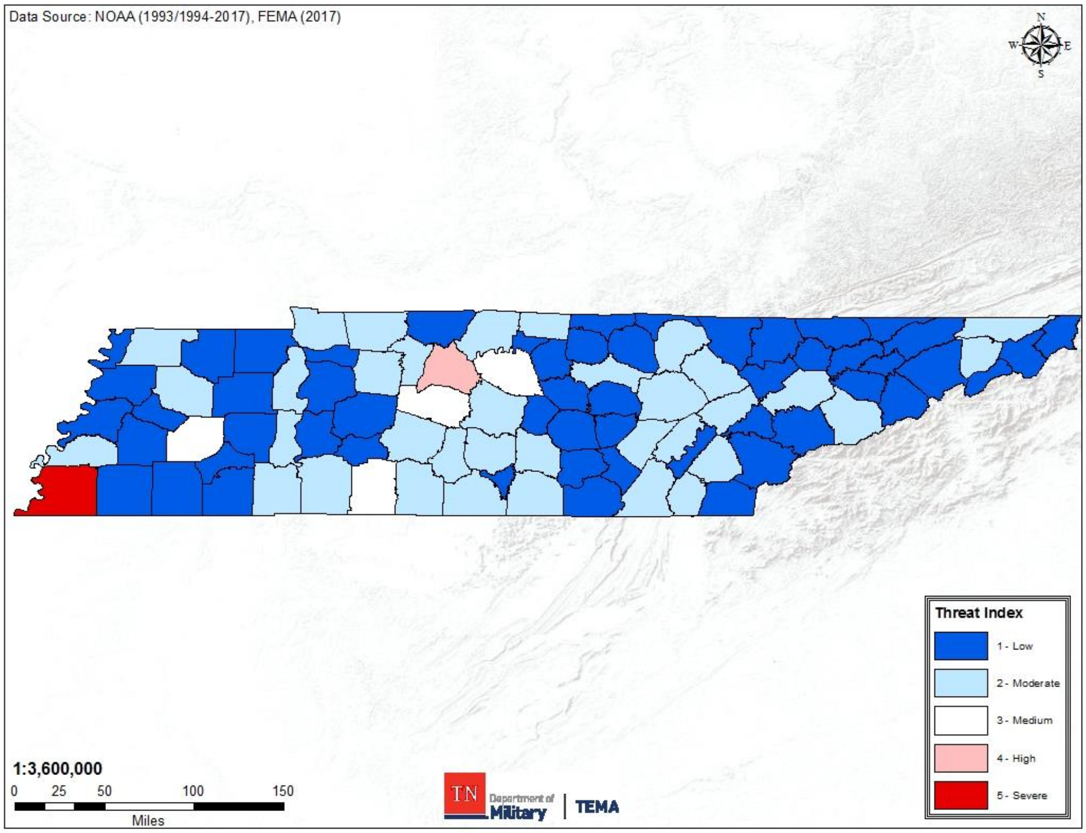


Map 49 – Riverine Flood Impact Density, Tennessee



The following map depicts the concentrations of flood impacts (a composite of flash flood and riverine flood) throughout the State of Tennessee.

Map 50 – Flood Impact Density, Tennessee



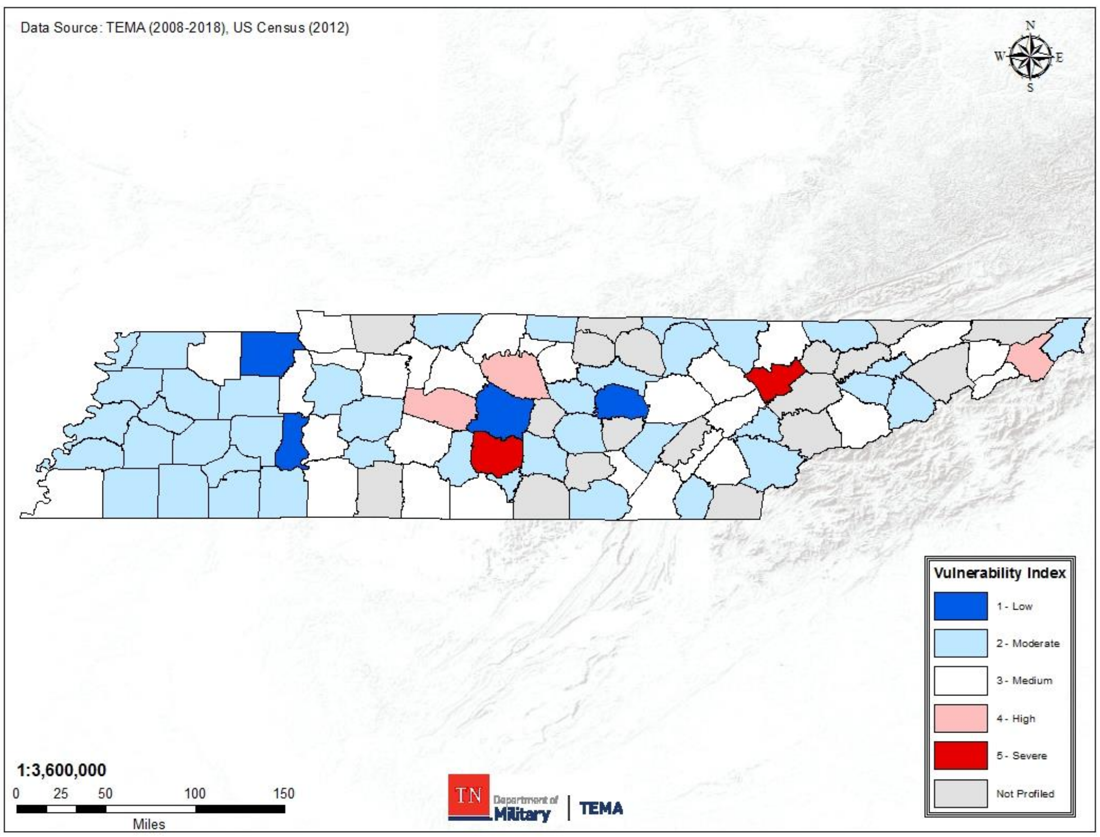
4.3.4 – Changing Future Conditions

Changing climate and weather patterns, environmental conditions, and urban and rural development may affect the frequency and intensity of flooding in Tennessee. Although flooding events have been recorded in many parts of the state, Tennessee's western to middle regions remain most effected by such events. A 2017 report by the US Government Accountability Office mentions that over the last decade, $90 billion in losses has been incurred by the US government in combined flood and crop insurance payments due to extreme weather. Intensified flooding and increased periods of extreme precipitation would have severe impacts on the Tennessee's economy, public health, and environment.

Additionally, according to the National Climate Assessment, the increased likelihood of extreme precipitation events due to climate change will result in greater risks of flash flooding and impacts from storm water runoff in the state. Indeed, even though there may be less precipitation overall in the long term (leading to more frequent drought events), the rainfall that does occur will be likely be during more intense, events that may lead to flash flooding. While overall precipitation may decline, flooding impacts may actually intensify as a result of changing future conditions such as increased urbanization and build-up of infrastructure, resulting in a build-up of impervious terrain which can lead to an increase in urban flooding.

The following map depicts the vulnerability to flood incidents for each county throughout the State of Tennessee. This data was compiled using local plan integration.

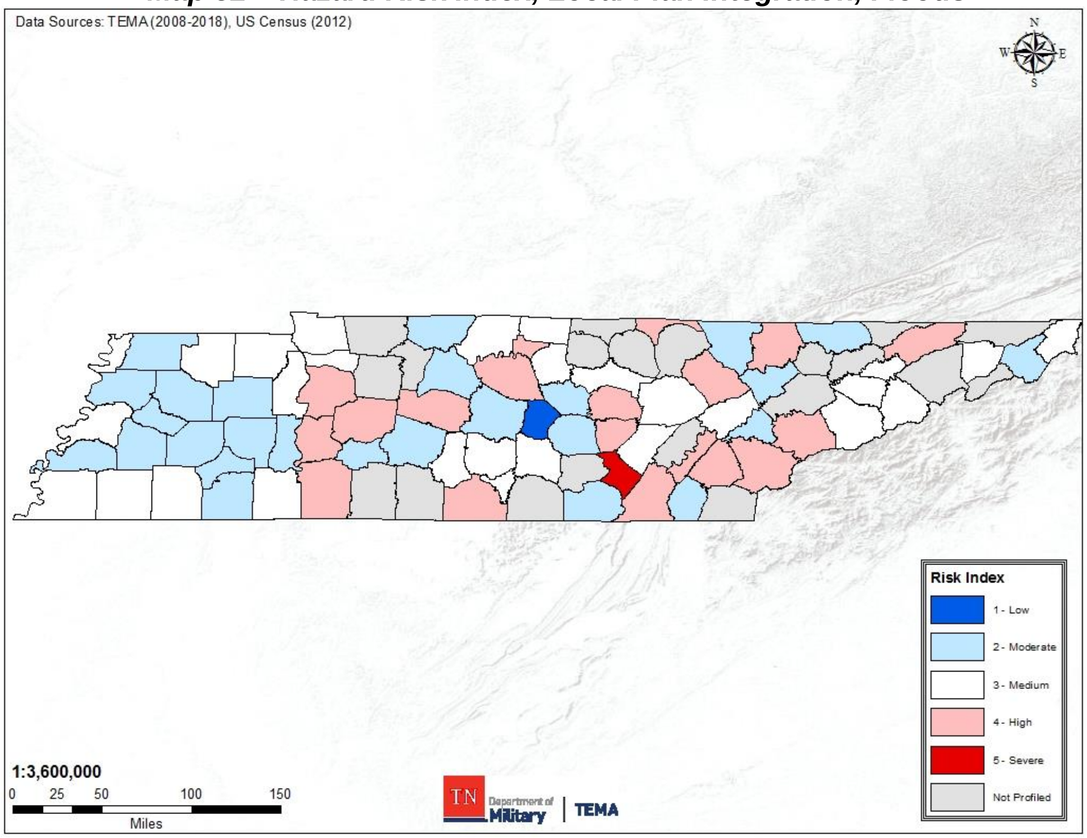
Map 51 – Hazard Vulnerability Index, Local Plan Integration, Floods



4.3.5 – Future Risk

Using a basic risk matrix: Vulnerability+Probability=Risk, TEMA was able to calculate hazard risk using data from the previous subsections. This process is further explained in Section 3.4. As shown in the following map of the risk index, Sequatchie County is the highest risk for flooding incidents.

Map 52 – Hazard Risk Index, Local Plan Integration, Floods



4.3G – Geologic Hazards

Geologic hazards relate to the danger involved in topography, rock formations, and soil. Included in this category are expansive soils, land subsidence/sinkholes, and landslides.

Expansive Soils
Soils and soft rock that tend to swell or shrink due to changes in moisture content are expansive soils. Changes in soil volume present a hazard primarily to structures built on top of expansive soils. The effects of expansive soils are most prevalent in regions of moderate to high precipitation, where prolonged periods of drought are followed by long periods of rainfall.

In the United States, 2 groups of rocks serve as parent materials of expansive soils. The first group is composed of aluminum silicate minerals from volcanic materials decompose to form expansive clay minerals of the smectite group. The second group consists of sedimentary rock containing high concentrations of clay minerals.

Structural damage due to expansive soils is not covered by most insurance. Recent estimates put the annual damage from expansive soils in the United States as low as $2.5 billion and as high as $7 billion.

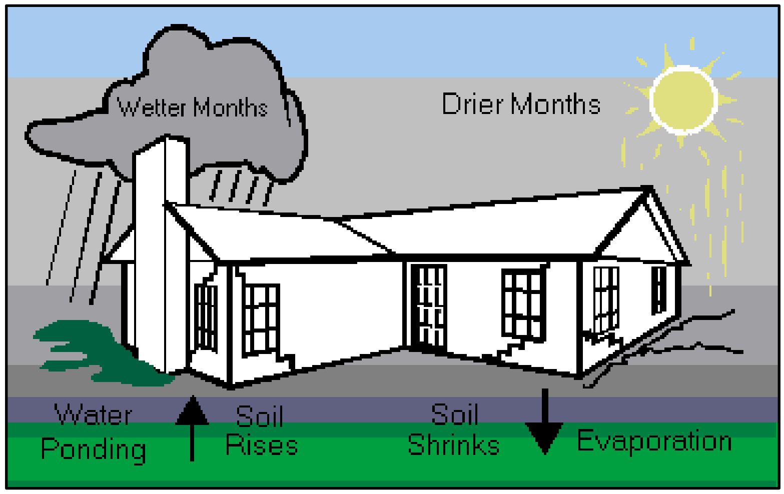
Land Subsidence/Sinkholes
Land subsidence is the loss of surface elevation and occurs when large amounts of groundwater have been withdrawn from certain types of rocks, such as fine-grained sediments. The rock compacts because the water is partly responsible for holding the ground up. When the water is withdrawn, the rock falls in on itself. Subsidence may occur abruptly or over many years. It can occur uniformly over large areas or as localized sinkholes.

Landslides
Landslides are the downward and outward movement of slopes. Landslides include a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on and over steepened slopes is the primary reason for a landslide, landslides are often prompted by the occurrence of other disasters. Other contributing factors include the following: erosion; steep slopes; rain and snow; and earthquakes.

Slope material often becomes saturated with water and may develop a debris or mudflow. If the ground is saturated, the water weakens the soil and rock by reducing cohesion and friction between particles. Cohesion, which is the tendency of soil particles to "stick" to each other, and friction affect the strength of the material in the slope and contribute to a slope's ability to resist down slope movement. Saturation also increases the weight of the slope materials and, like the addition of material on the upper portion of a slope, increases the gravitational force on the slope. Undercutting of a slope reduces the slope's resistance to the force of gravity by removing much-needed support at the base of the slope. Alternating cycles of freeze and thaw can result in a slow, virtually imperceptible loosening of rock, thereby weakening the rock and making it susceptible to slope failure. The resulting slurry of rock and mud can pick up trees, houses, and cars, and block bridges and tributaries, causing flooding along its path. Additionally, removal of vegetation can leave a slope much more susceptible to superficial landslides because of the loss of the stabilizing root systems.

4.3.1 – Location & Extent

Expansive Soils



Expansive soils are slow to develop and do not usually pose a risk to public safety. The slow expansion and contraction of the clays and soils places pressure on structural foundations and subsurface dwellings. This pressure can become so great it damages foundations, cracks walls, and deforms structures. Due to the slow nature of the process it can take years before damage is observed.

The diagram located in the upper right corner of this page details the process of expansive soils over time. Expansive soils' risk is measured by quantifying the soils ability to swell and shrink from water content. The quality used to quantify the swelling capacity is called "linear extensibility." It is an expression of the length of change between water content 1/3 to 1/10 bar tension (33kPascal to 10 kPascal) and oven dryness multiplied by the thickness of the soil layer.

The NRCS uses 4 risk categories, from low to very high, measuring the change in the soils' volume expressed as a percent value of linear extensibility. Since expansive soils' risk is extremely complex to measure, current soil science techniques do not offer a known or predicted level of occurrence or impact. Please see Table 29 below for a breakdown of expansive soil threat categories. For hazard mitigation purposes a "low" rank on the scale is not considered a reasonable risk as even the most basic of structural foundations can resist this level of swelling and expansion.

Table 47 – Linear Extensibility Zones

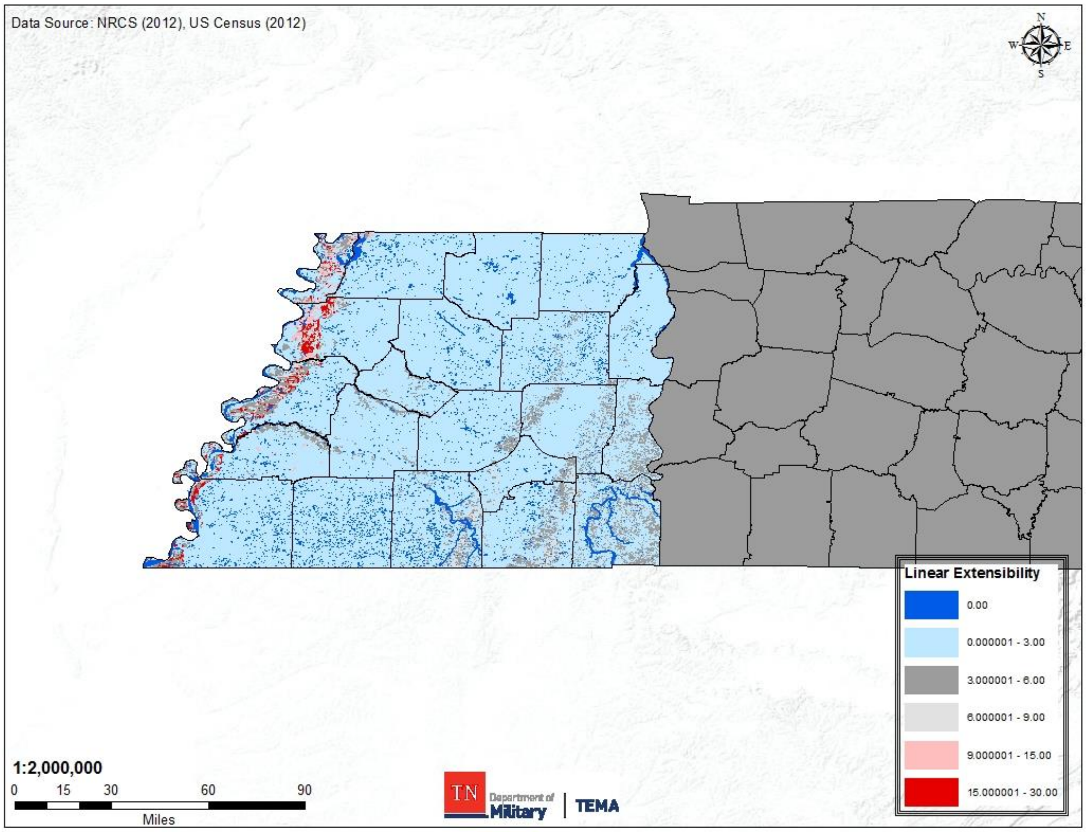
Ranking	Linear Extensibility %	Clay %
Low	0.0% - 3.0%	< 25
Moderate	3.0% - 6.0%	25 - 35
High	6.0% - 9.0%	35 - 45
Very High	> 9.0%	> 45

**The table data is from the NRCS*

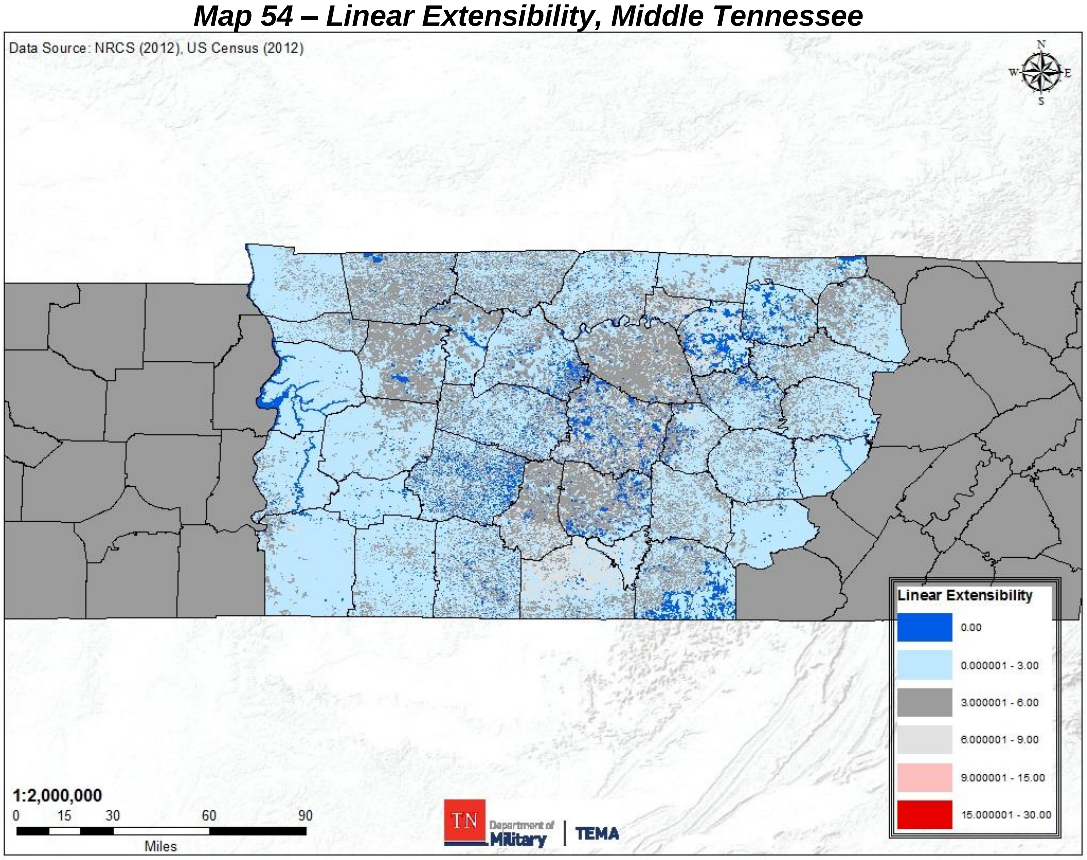
Each increase in linear extensibility increases the potential level of damage structures could incur. Ultimately, whether or not the soil swells or not is completely dependent on weather patterns. However, linear extensibility shows exactly how much swelling could occur and how bad it has the potential to be.

Maps 53 through 55 on the following pages depict the expansive soil risk throughout the State of Tennessee. The vast majority of the state is not threatened by expansive soil damage with small pockets existing throughout the state and some concentrations of high linear extensibility existing along the Mississippi River in the west.

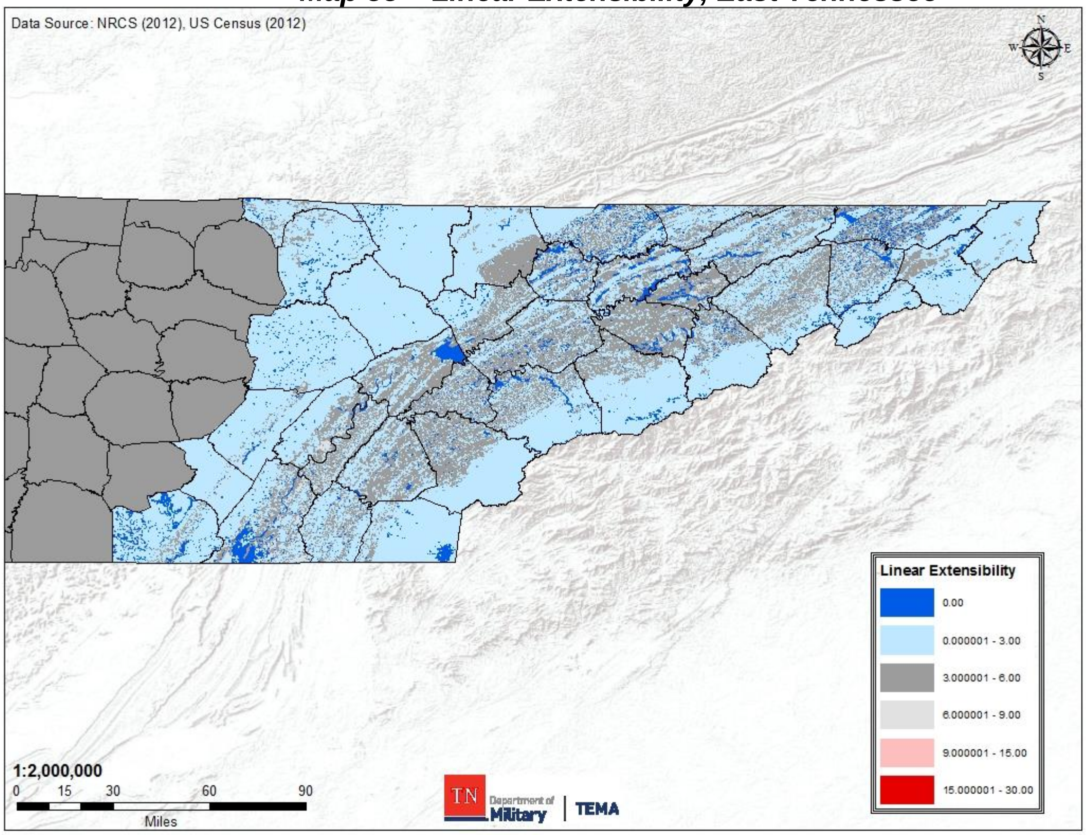
Map 53 – Linear Extensibility, West Tennessee



Map 54 – Linear Extensibility, Middle Tennessee



Map 55 – Linear Extensibility, East Tennessee



Land Subsidence/Sinkholes

Speed of onset of a landslide or sinkhole event is very rapid and unpredictable although broad areas susceptible to this type of hazard may be identified by soil samples and/or surrounding geological/riverine features. Measurement of this hazard is usually done in terms of yards of soil displaced and financial damage caused.

Land subsidence and sinkholes from human activity are results of pumping water, oil, and gas from underground reservoirs; dissolution of limestone aquifers (sinkholes); collapse of underground mines; drainage of organic soils; and initial wetting of dry soils (hydro compaction). Land subsidence occurs all over Tennessee and is usually not observable because it occurs over a large area.

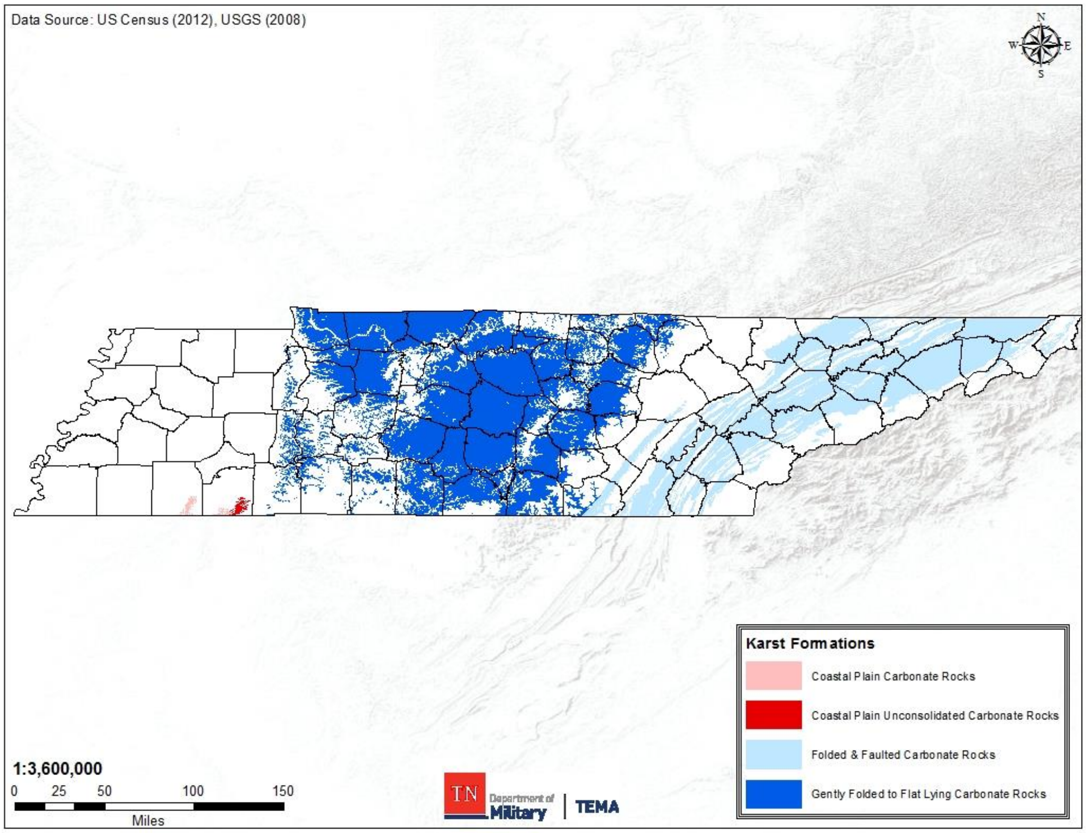
Land subsidence and sinkholes can occur naturally in parts of the country designated by rock formation as “Karst Formations.” It is difficult to accurately predict exactly where land subsidence and sinkholes will occur, but the USGS has managed to identify areas of Tennessee where there is potential, that being within the areas of Karst formations. It is extremely unlikely that a sinkhole will form in an area not considered a Karst formation.

Please see Map 57 on the following page for a depiction of Tennessee Karst Formations and the limited number of recorded land subsidence and sinkhole locations. There is no measurable difference in potential or probability among the different Karst formations. Their difference in color coding is simply to highlight other geological classifications.

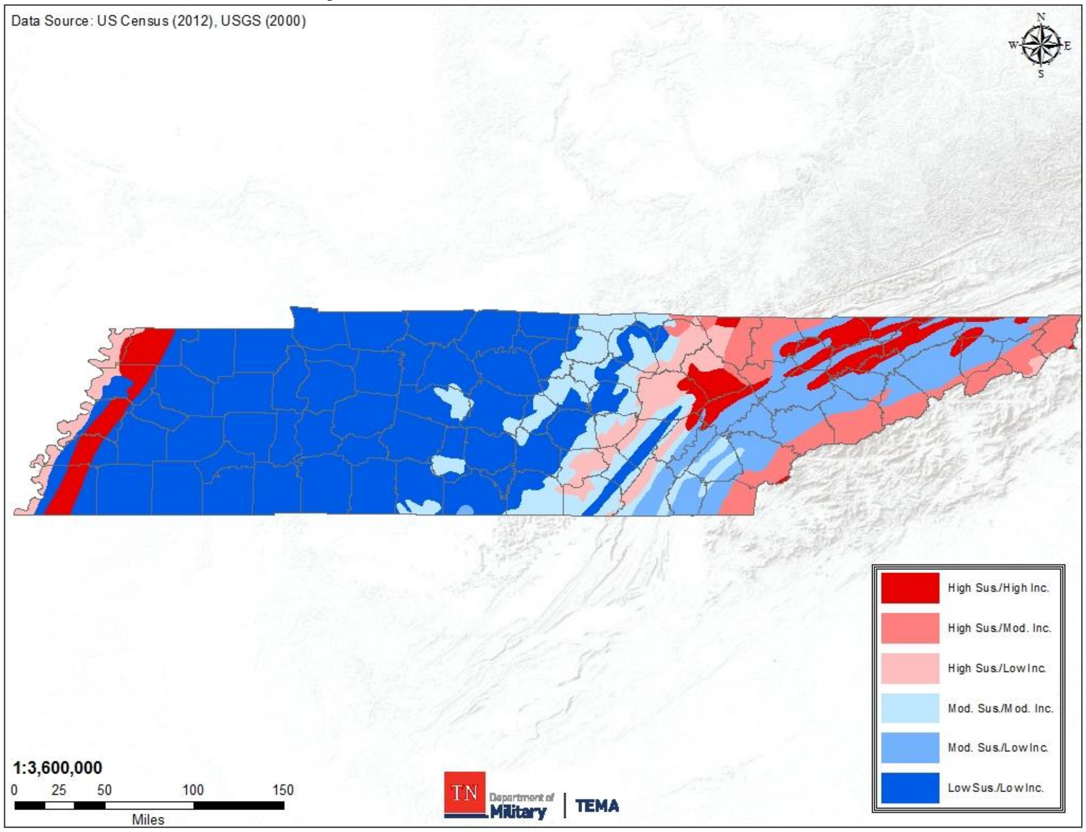
Landslides

Landslide potential varies throughout the state with Eastern Tennessee and some parts in the west along the Mississippi River having high threat areas. Landslides have the potential to destroy structures and infrastructure or block transportation in mountainous valleys. See the following map for a depiction of Tennessee's landslide potential.

Map 56 – Landslide Susceptibility, Tennessee



Map 57 – Karst Formations, Tennessee



4.3.2 – Previous Occurrences

Historic Hazard Incident – Land Subsidence/Sinkhole – February 1999

A sinkhole caused a Colonial owned pipeline to rupture on February 9, 1999 in Knoxville, Tennessee. Roughly 53,550 gallons of diesel fuel, high sulfur, 86 Grade was released into the environment causing $7 million in damage. The leading edge of the oil slick on the Tennessee River advanced 6 miles downstream from Goose Creek within the first 24 hours. There were 44,016 gallons recovered from the river. About 18,000 tons of contaminated soil was excavated at the leak site during March and April.

Historic Hazard Incident – Landslide – December 2011

In December of 2011 a major rockslide blocked I-40 westbound in Cocke County between mile markers 450 and 451 near the North Carolina border. Another occurred in January of 2012 in the same location. A 53-mile detour was created to make up for the I-40 stretch. Eastbound traffic was not affected. Along with anchors and large bolts that bolster the stability of the mountainside, blankets of metal mesh were put in place to prevent smaller debris. The 2 rockslide repairs along I-40 cost more than $2.6 million.

Historic Hazard Incident – Landslide – January 2013

On January 17, 2013, a landslide measured at about 150 feet wide and extending 800 to 900 feet down the mountainside took place in Graham County, North Carolina, about a half mile from the Tennessee border. After heavy rain the landslide occurred closing the Cherohala Skyway. The western end of the roadway extended into southeast Knoxville and closed down the border. There were nearly 50 more slope failures on state-maintained roads extending into western North Carolina.

The table below identifies sinkholes by county.

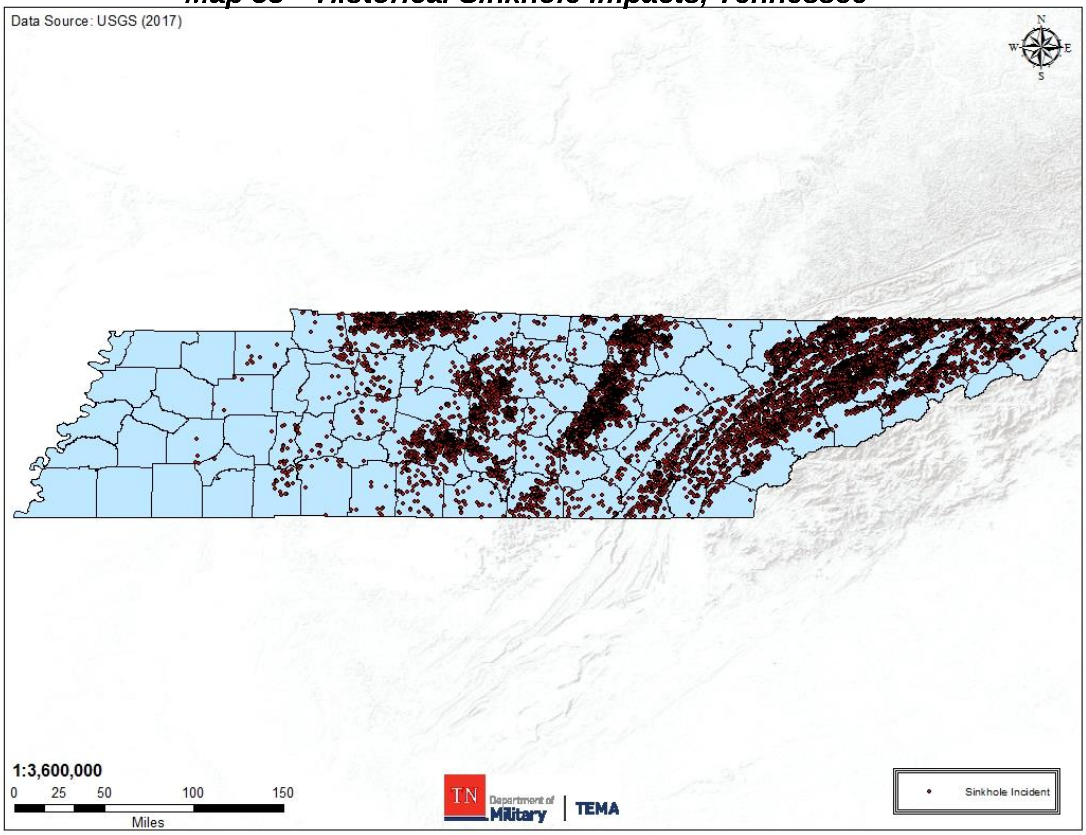
Table 48 – Sinkholes of Distinction by County, Tennessee (2017)

County	Sinkholes	Depth (ft)	Area (km^2)	Volume (m^3)
Anderson	625	67.6	0.1671	158921
Bedford	1382	70.2	3.2608	837298
Benton	12	0	0	0
Bledsoe	150	53.8	0.1061	59833
Blount	1080	199.1	0.6977	1526579
Bradley	129	31.2	0.0612	15757
Campbell	759	119.1	0.2779	214349
Cannon	42	30.2	0.0251	9628
Carroll	25	22.3	0.0582	19016
Carter	349	104.3	1.2049	1284326
Cheatham	165	26.9	0.2078	60897
Chester	3	23	0.0374	10870
Claiborne	1641	164.7	0.4712	1001104
Clay	286	50.5	0.5063	297250
Cocke	760	118.1	0.3596	280828
Coffee	447	52.5	1.1025	441673
Crockett	0	0	0	0
Cumberland	54	140.1	13.611	37736946
Davidson	609	62	0.509	149152
Decatur	47	48.9	0.1582	67901
DeKalb	131	48.2	0.2021	70461
Dickson	183	49.9	0.29	130843
Dyer	0	0	0	0
Fayette	0	0	0	0
Fentress	445	84.3	0.3529	166336
Franklin	782	242.1	4.5087	4303666
Gibson	0	0	0	0
Giles	193	52.2	0.2182	88226
Grainger	1418	74.5	0.2336	68002
Greene	1618	86.9	0.7001	553511
Grundy	78	155.8	0.4107	163505
Hamblen	1491	72.5	0.5234	193114
Hamilton	531	94.8	0.3334	146848
Hancock	817	108.9	0.2179	252806
Hardeman	1	0	0	0

Sinkholes of Distinction by County, Tennessee (2017) cont.				
County	Sinkholes	Depth (ft)	Area (km^2)	Volume (m^3)
Hardin	54	76.1	0.1994	151195
Hawkins	1919	97.4	0.3878	375411
Haywood	0	0	0	0
Henderson	29	15.1	0.0073	1953
Henry	52	24.6	0.0614	13007
Hickman	111	32.8	0.1961	48473
Houston	72	26.9	0.0597	17961
Humphreys	40	28.2	0.0502	18308
Jackson	40	43	0.0519	24332
Jefferson	2364	76.8	0.3856	326747
Johnson	20	47.9	0.0218	15469
Knox	1663	77.4	2.2135	1535832
Lake	0	0	0	0
Lauderdale	0	0	0	0
Lawrence	27	21.7	0.1862	47989
Lewis	9	42.7	0.0122	7840
Lincoln	92	66.6	0.1211	25922
Loudon	795	72.5	1.293	1065106
Macon	36	48.2	0.1237	49246
Madison	3	16.4	0.0118	3466
Marion	110	108.9	0.0249	16163
Marshall	2312	73.2	0.6609	121850
Maury	1347	42.3	0.2392	93298
McMinn	427	49.9	0.2396	105140
McNairy	1	0	0	0
Meigs	246	47.2	0.1058	65192
Monroe	696	94.2	0.6779	360181
Montgomery	3025	84.3	2.6746	1130081
Moore	76	62.3	0.093	62127
Morgan	8	28.9	0.0053	2046
Obion	0	0	0	0
Overton	2026	152.2	2.2532	2971017
Perry	36	39.7	0.0744	34181
Pickett	307	53.1	0.3581	131487
Polk	149	77.4	0.2692	148011
Putnam	535	206	4.2106	8530852
Rhea	203	47.2	0.1155	81848
Roane	446	76.8	0.2637	186734
Robertson	3602	67.9	1.1984	527084
Rutherford	2988	76.8	1.4227	343784

Sinkholes of Distinction by County, Tennessee (2017) cont.				
County	Sinkholes	Depth (ft)	Area (km^2)	Volume (m^3)
Scott	6	12.1	0.0096	1693
Sequatchie	36	43.3	0.0821	47539
Sevier	586	79.1	0.6025	486887
Shelby	0	0	0	0
Smith	150	45.9	0.0786	39636
Stewart	145	53.5	0.2044	85549
Sullivan	1876	89.2	0.4402	309614
Sumner	371	47.6	1.227	758651
Tipton	0	0	0	0
Trousdale	87	65.6	0.1368	49576
Unicoi	3	23	0.0263	10712
Union	706	82.3	0.2086	241526
Van_Buren	653	141.4	2.2759	1334351
Warren	1596	182.1	4.8722	3164142
Washington	944	68.6	0.5232	277137
Wayne	21	46.9	0.0734	20042
Weakley	3	0	0	0
White	2970	260.5	3.5128	3987376
Williamson	217	38.4	0.0602	17153
Wilson	1882	47.9	0.6967	207611

Map 58 – Historical Sinkhole Impacts, Tennessee



4.3.3 – Incidents/Probability

At present there is no centralized and complete database containing historical records for expansive soils, land subsidence, or landslides. Where available this plan highlights historic hazard events, but does not contain a comprehensive database of these hazard events or impacts.

All 3 geologic hazards with the potential to affect the State of Tennessee are incredibly difficult to quantify and forecast. Instead of predicting the likelihood of an event, the hazard experts at the USGS and NRCS describe the hazards by their potential threat. Please see 4.3.1 – Location & Extent for maps depicting the geographic areas threatened by expansive soils, land subsidence, and landslides. Please see below a hazard specific description of forecasting difficulties.

Expansive Soils

Property damage caused by expansive soils is dependent on the climactic conditions of precipitation and rapid changes in temperature. Structures within an area with high swelling potential are at risk, but may never see damage from expansive soils.

Land Subsidence

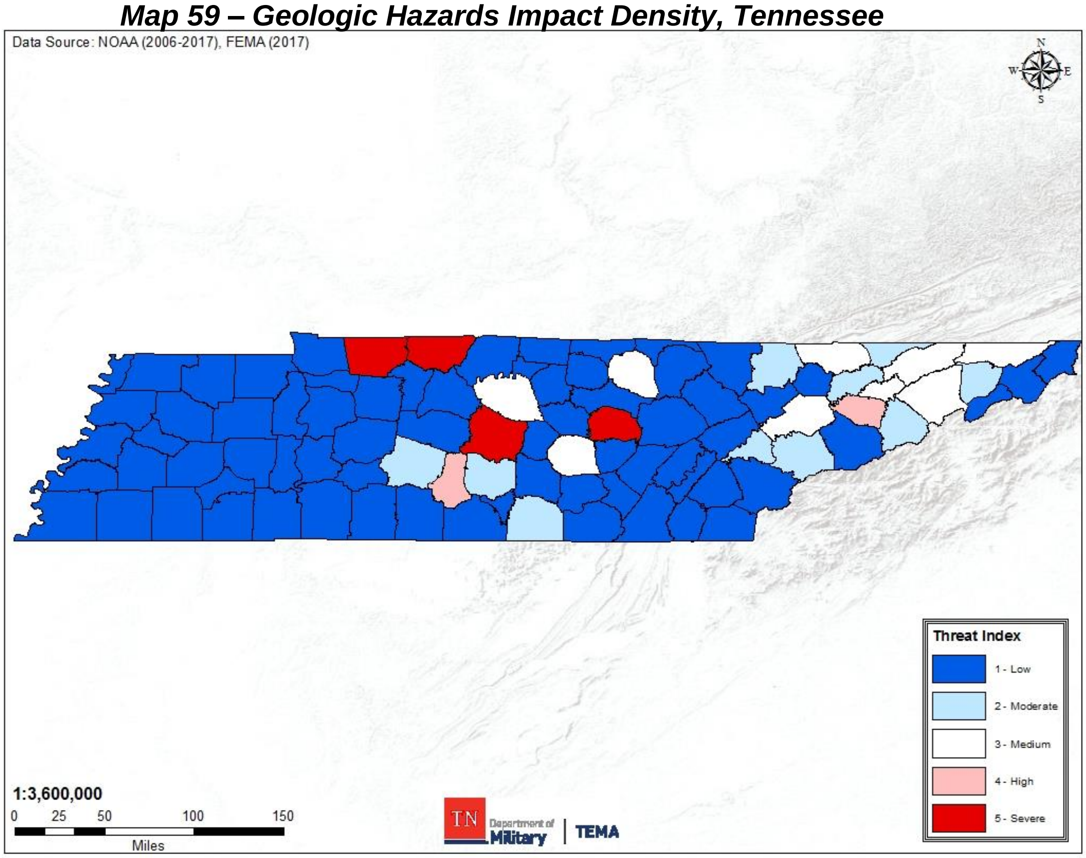
Land subsidence and sinkholes form deep underground without knowledge or geologists or environmental engineers. Over time, based on empirical evidence, experts have isolated the geologic formations most likely to form land subsidence and sinkholes, but are unable to accurately predict specific formations. Further compounding the problem of depth, their formation begins with erosion on a micro scale. Map 40 on the following page depicts a limited dataset of only some of the few known land subsidence and sinkhole locations in Tennessee.

Landslides

Landslides occur on their own, but often occur as a secondary hazard. Incidents of heavy rain, melting snow, earthquakes, and land subsidence are their primary cause. Hence, their future occurrences are highly dependent on the likelihood of the mentioned hazards. There are identified high risk areas, as shown in 3.3.1 – Location & Extent, which take into account rock type, rock formation, and slope.

The following map depicts the concentrations of geologic hazards (a composite of expansive soils, land subsidence, and landslides) impacts throughout the State of Tennessee.

Map 59 – Geologic Hazards Impact Density, Tennessee



4.3.4 – Changing Future Conditions

Landslides

An increase in the number and intensity of severe storms will result in more frequent heavy rains and flooding. Since heavy rains and flooding can trigger landslides, landslides may occur more often in the future. With increases in population and development in certain areas, this could lead to increases in infrastructure disruption alongside casualties. The risk of landslides dramatically increase in the eastern region due to the mountainous terrain which increases as one heads eastward.

Sinkholes

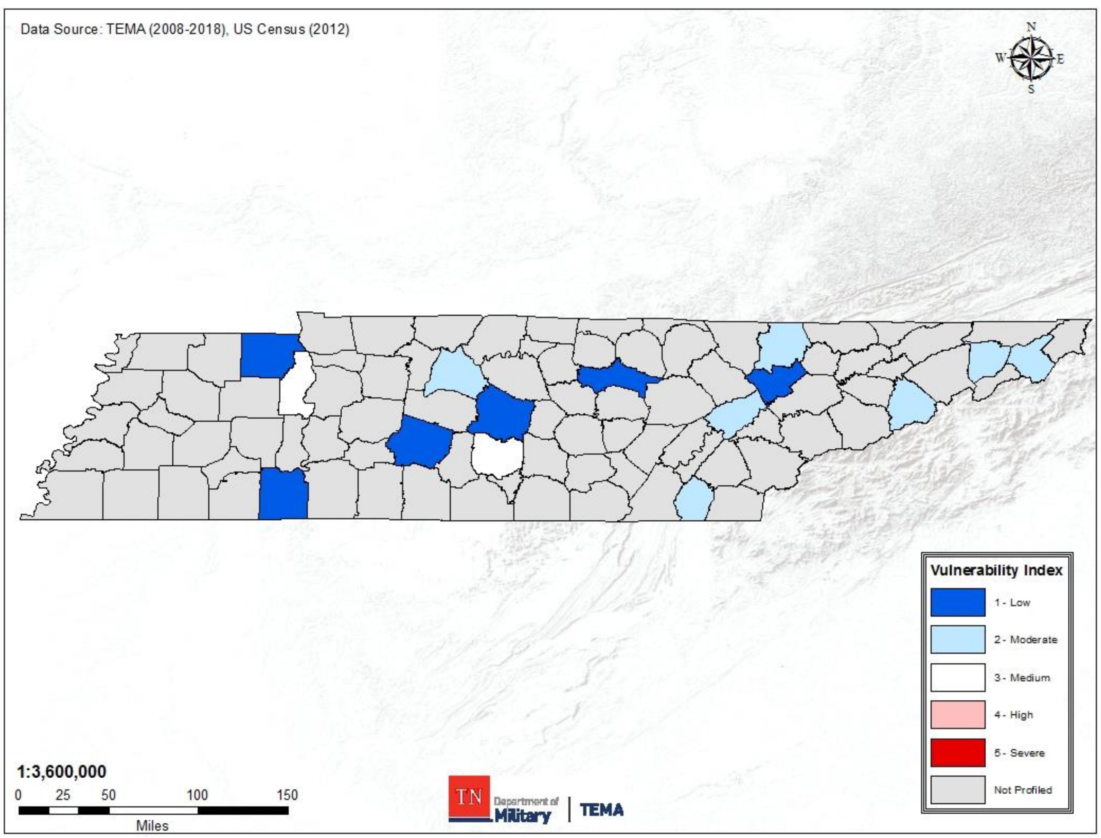
Similar to landslides, sinkholes can be triggered by heavy rains and flooding. An increase in the number and intensity of severe storms, and resulting heavy rains and flooding, may also result in sinkholes developing more frequently. With several areas within the state increasing in population and infrastructure (both public and private), this could lead to damage to infrastructure, property values, and commerce disruption. Historically most sinkhole impacts have occurred along the border between the central and east regions and along the waterways of the eastern region.

Expansive Soils

Expansive soils are the result of the expansion and contraction of soil due to temperature and moisture changes. Rapid subsidence over extended periods of time could cause structural damage to infrastructure such as roads and buildings eventually rendering them unusable for human habitation without extensive and expensive retrofitting. The rapidity of these changes in temperature are expected to increase dramatically which could lead to increased subsidence events and overtime, damage to infrastructures, leading to costly retrofitting projects or demolition and rebuilding.

The following map depicts the vulnerability to geologic hazards incidents for each county throughout the State of Tennessee. This data was compiled using local plan integration.

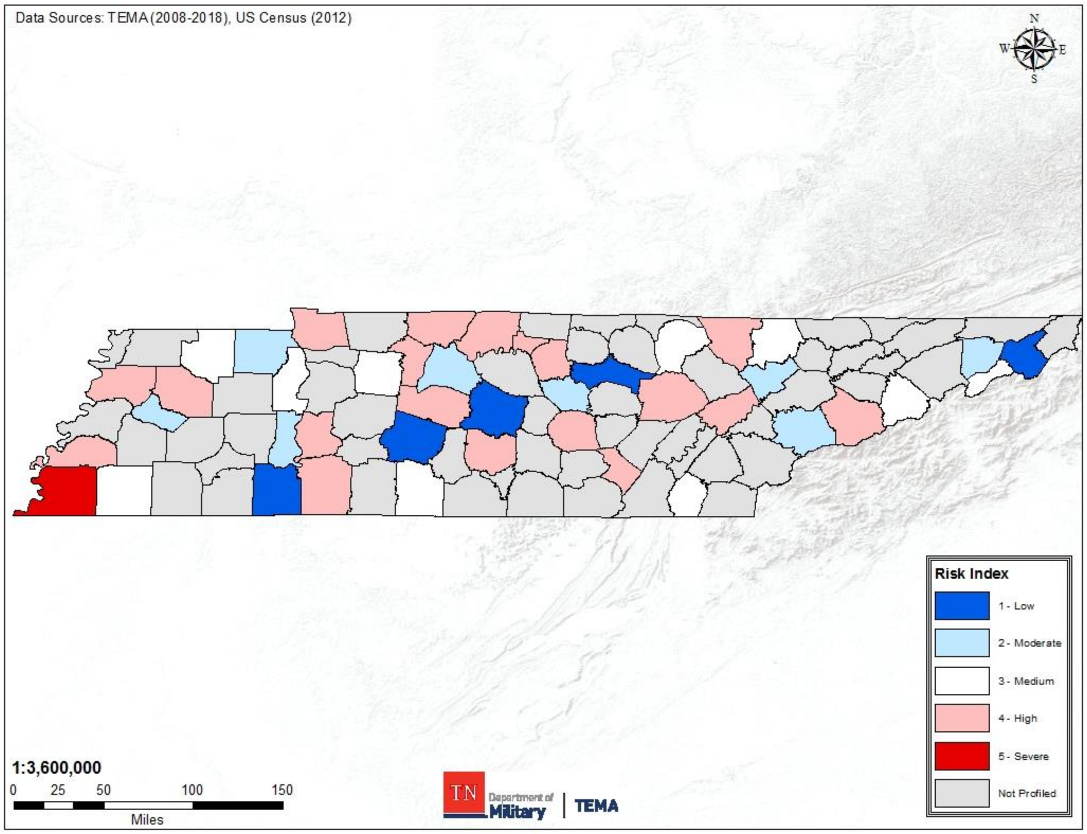
Map 60 – Hazard Vulnerability Index, Local Plan Integration, Geologic Hazards



4.3.5 – Future Risk

Using a basic risk matrix: Vulnerability+Probability=Risk, TEMA was able to calculate hazard risk using data from the previous subsections. This process is further explained in Section 3.4. As shown in the following map of the risk index, Shelby County is at the highest risk for geological hazards.

Map 61 – Hazard Risk Index, Local Plan Integration, Geologic Hazards



4.3SS – Severe Storms

Severe storms comprise the hazardous and damaging weather effects often found in violent storm fronts. They can occur together or separate; they are common and usually not hazardous, but on occasion they can pose a threat to life and property.

This plan defines Severe Storms as a combination of the following severe weather events as defined by NOAA and the NWS.

Hail: Showery precipitation in the form of irregular pellets or balls of ice more than 5 mm in diameter, falling from a cumulonimbus cloud.

High/Strong Wind: Sustained wind speeds of 40 miles per hour or greater lasting for 1 hour or longer, or winds of 58 miles per hour or greater for any duration. Often referred to as straight line winds to differentiate from rotating or tornado associated wind.

Lightning: A visible electrical discharge produced by a thunderstorm. The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground or between the ground and a cloud.

Thunderstorm Winds: The same classification as high or strong winds, but accompanies a thunderstorm. It is also referred to as a straight line wind to differentiate it from rotating or tornado associated wind.

Winter Storm: Hazardous winter weather in the form of heavy snow, ice storms, heavy freezing rain, or heavy sleet. May also include extremely low temperatures and increased wind.

> ***Ice Storm:*** An ice storm is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. Significant accumulations of ice pull down trees and utility lines resulting in loss of power and communication. These accumulations of ice make walking and driving extremely dangerous. Significant ice accumulations are usually accumulations of ¼" or greater.
>
> ***Heavy Snow:*** This generally means snowfall accumulating to 4" or more in depth in 12 hours or less; or snowfall accumulating to 6" or more in depth in 24 hours or less. In forecasts, snowfall amounts are expressed as a range of values, e.g., "8 to 12 inches." However, in heavy snow situations where there is considerable uncertainty concerning the range of values, more appropriate phrases are used, such as "...up to 12 inches..." or alternatively "...8 inches or more."

Severe storms have been so consistent throughout modern history that much of the vulnerability is mitigated. However this section is not concerned with everyday wind, lightning in the sky, or mild precipitation. This section is concerned with common storm elements when they behave such that they pose a threat to property and life. This is what is classified as “severe.”

To measure wind speed and its correlating potential for damage, experts use the Beaufort scale as shown on the following page. Neither lightning nor winter storms have a measurement unto their own. Snow accumulation from winter storms is measured in inches while NOAA has developed the hailstorm intensity index, shown in Table 50, to match hail size and their likely damage impacts.

Table 49 – Beaufort Scale

Beaufort Scale

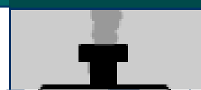
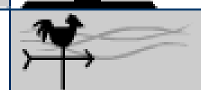
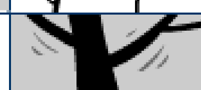
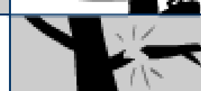
Beaufort number	Wind Speed (mph)	Seaman's term		Effects on Land
0	Under 1	Calm		Calm; smoke rises vertically.
1	1-3	Light Air		Smoke drift indicates wind direction; vanes do not move.
2	4-7	Light Breeze		Wind felt on face; leaves rustle; vanes begin to move.
3	8-12	Gentle Breeze		Leaves, small twigs in constant motion; light flags extended.
4	13-18	Moderate Breeze		Dust, leaves and loose paper raised up; small branches move.
5	19-24	Fresh Breeze		Small trees begin to sway.
6	25-31	Strong Breeze		Large branches of trees in motion; whistling heard in wires.
7	32-38	Moderate Gale		Whole trees in motion; resistance felt in walking against the wind.
8	39-46	Fresh Gale		Twigs and small branches broken off trees.
9	47-54	Strong Gale		Slight structural damage occurs; slate blown from roofs.
10	55-63	Whole Gale		Seldom experienced on land; trees broken; structural damage occurs.
11	64-72	Storm		Very rarely experienced on land; usually with widespread damage.
12	73 or higher	Hurricane Force		Violence and destruction.

Table 50 – Modified NOAA/TORRO Hailstorm Intensity Scale				
Code	**Intensity Category**	**Diameter (Inches)**	**Approximate Size**	**Typical Damage Impacts**
H0	Hard Hail	0 - 0.33	Pea	No damage
H1	Potentially Damaging	0.33 - 0.60	Marble/Mothball	Slight damage to crops
H2	Potentially Damaging	0.60 - 0.80	Dime/Grape	Significant damage to crops
H3	Severe	0.80 - 1.20	Nickel to Quarter	Severe damage to crops, damage to glass and plastic, paint and wood scored
H4	Severe	1.20 - 1.60	Half Dollar	Widespread glass damage, vehicle bodywork damage
H5	Destructive	1.60 - 2.00	Silver Dollar to Golf Ball	Damage to tiled roofs, significant risk of personal injury.
H6	Destructive	2.00 - 2.40	Egg	Aircraft bodywork dented, brick walls pitted
H7	Very Destructive	2.40 - 3.00	Tennis Ball	Severe roof damage, risk of serious injuries to persons not protected
H8	Very Destructive	3.00 - 3.50	Baseball to Orange	Severe damage to aircraft bodywork
H9	Super Hailstorms	3.50 - 4.00	Grapefruit	Extensive structural damage, risk of severe injury or fatal injuries to persons not protected
H10	Super Hailstorms	4.00 +	Softball and up	Extensive structural damage, risk of severe injury or fatal injuries to persons not protected

4.3.1 – Location & Extent

Severe storms can rapidly descend on an area but in many cases are predictable. Most weather forecasts focus on more than just temperature but on quickly changing conditions that may lead to the onset of severe storms.

The entire state is susceptible to severe weather as Tennessee is located in a temperate climate zone. Snow and ice can occur in Memphis and wind events can occur in the eastern, more mountainous sections. However, the greatest number of occurrences of winter storms occurs in the eastern half of the state as the elevation steadily increases from Nashville to the eastern border with North Carolina. Winter storms, while always dangerous, range from being a nuisance for transportation in the middle part of the state to being life threatening in the eastern part of the state.

Lightning strikes occur far more time than they are reported to NOAA and the NWS and as such their impact density centers on highly populated areas.

Severe storm wind events more commonly impact the eastern part of the state as the topography begins to affect the wind speed accompanying severe storms. These storms can quite frequently be threatening to life and property and are very dangerous as many occur at night after the area has been heated all day. Additionally, the state sits in a position where cold northern air and warm, moist air from the Gulf of Mexico collide frequently.

Typical patterns show hail incidents are more likely to occur between the months of March to July. With incidents of hail commonly occurring October to February and incidents of lightning between April to August. Thunderstorm incidents are common between March and August. Strong wind incidents can commonly occur all months of the year with significantly less reported incidents occurring June and July. Winter storms commonly occur December to March with little to no incidents happening any other months.

4.3.2 – Previous Occurrences

Historic Hazard Event – Winter Storm – January 1951
The worst ice storm in the history of Nashville, Tennessee occurred on January 29, 1951 and ended February 1, 1951. To this day it is known as the “Great Blizzard.” A strong cold front moved through Nashville on the 28th causing temperatures to drop below freezing. On February 2nd the temperature dropped to negative 10 degrees Fahrenheit. The storm caused a complete shutdown of transportation for 2 days. By the end of it Nashville was buried under 8 inches of ice and snow.

Power failures affected the entire area. Over 16,000 homes and 80,000 residents were without electricity, and over 2,000 telephones were out. Transportation and communication systems alone were more than $2 million in damages. There were 2 fatalities in weather-related car crashes and dozens of other injuries. Roofs collapsed from the weight of snow and ice, hundreds of automobiles were abandoned, and thousands of trees had to be cleared from the roads. Not 1 business was open for 3 days. Eastern Air Lines canceled flights for 3 days, and Louisville & Nashville Railroad trains were up to 2 days behind schedule.

When the storm cleared, thousands of residents took to the streets creating what is still considered the worst traffic jam in Nashville’s history. Some of these traffic jams were up to 5 miles long and clogged the main streets leading downtown. The ice and snow did not completely melt until February 12th.

Historic Hazard Incident – Winter Storm – January 1963
On New Year’s Eve of 1963 a winter storm swept through most of the southern United States. The storm formed when a surface low-pressure system moved northward through the eastern Gulf of Mexico, leading to a snowstorm from the central Gulf Coast northward into Tennessee. The storm resulted in 3 fatalities. Travel was severely restricted for multiple days following the storm. Central and eastern sections of the state recorded over 6 inches of snow, with up to 16 inches in south-central Tennessee at Lawrenceburg. Several boats and docks were sunk, power and telephone lines collapsed overloaded with snow.

Historic Hazard Incident – Winter Storm – March 1993

One of the largest and intense winter storms in a century hit the south on March 12-14, 1993. Severe cold following the storm preserved much of the snow, prolonging road closures. High wind and heavy, wet snow brought down thousands of miles of power lines leaving millions of people without power for up to a week for some. Wind gusts were measured as high as 99 mph. Along with heavy snow fall, Tennessee and Ohio Valleys were hit by a tornado outbreak. Florida received the worst of the outbreak with 27 tornadoes touching down resulting in 4 fatalities.

Historic Hazard Incident – Hail/Lightning – May 2016

The largest severe weather event of Spring 2016 across Middle Tennessee affected areas mainly north of I-40 from the late evening hours on May 10 into the morning hours on May 11. Widely scattered supercell thunderstorms moved southeast out of Kentucky, producing dozens of reports of wind damage and large hail up to tennis ball size. Storms formed along an outflow boundary situated northwest to southeast from Robertson County to Cumberland County during the early morning hours on May 11, with heavy rainfall of 3 to 7 inches occurring across Robertson, Sumner, Macon, Trousdale, Wilson, Smith, and Putnam Counties. Major flash flooding across these counties resulted in dozens of homes and businesses flooded, numerous roads being flooded and closed or washed out, and several water rescues from flooded homes and vehicles being conducted.

Several Facebook reports and photos showed hail up to tennis ball size fell along Andrew Jackson Parkway in Hermitage. Numerous cars were damaged and several homes suffered roof damage and broken windows in a small area from Andrew Jackson Parkway southeast to Tulip Grove Road. Lightning struck a strip mall along Lebanon Road in Mount Juliet. The resulting fire destroyed half of the building which included several businesses and a church.

Table 51 – Historical Impacts, Hail & Thunderstorm Winds (1955 – 2017)

	Hail	Thunderstorm Winds
Count of Impacts	6074	14,983
Average Impacts per Year	97.97	258.33
Average Magnitude (Inches/MpH)	1.11	52.39
Magnitude Range (Inches/MpH)	0.75 - 4.5	35 - 96
Average Cost	$2,578	$15,705
Magnitude of Cost	$0 - $5,000,000	$0 - $40,000,000
Total Recorded Cost	$15,661,600	$235,308,200
Average Crop Damage	$146	$668
Magnitude of Crop Damage	$0 - $400,000	$0 - $80,000
Total Crop Damage	$888,000	$10,009,510
Average Fatalities	0	0.002
Total Fatalities	0	25
Average Injuries	0.0035	0.019
Total Injuries	21	291

**The data are compiled from the NOAA NCDC Storm Event Database.*

Data Deficiency

NOAA's methodologies and recording practices have changed over the period of some of the following datasets. For instance, one may notice a sharp increase in the recorded impacts for hail and thunderstorm winds in the middle 1990s. This is not due to an increase in hail or thunderstorm wind impacts, but instead is a result of a change of policy for NOAA. During this time period they altered their recording process from county based to city and town based. This does not skew the number of fatalities, injuries, recorded magnitudes, or damage numbers as these would have simply been aggregated at the county level.

Table 52 – Historical Impacts, High & Strong Winds (1993/2003-2017)		
	High Winds	**Strong Winds**
Count of Impacts	376	341
Average Impacts per Year	15.67	13.64
Average Magnitude (MpH)	55.80	41.11
Magnitude Range (MpH)	34 - 87	22 - 65
Average Cost	$20,844	$11,177
Magnitude of Cost	$0 - $2,000,000	$0 - $1,000,000
Total Recorded Cost	$7,837,650	$3,981,900
Average Crop Damage	$4,843	$150
Magnitude of Crop Damage	$0 - $1,700,000	$0 - $20,000
Total Crop Damage	$1,821,000	$51,000
Average Fatalities	0	0.03
Total Fatalities	1	9
Average Injuries	0	0.02
Total Injuries	5	6

**The data are compiled from the NOAA NCDC Storm Event Database.*

Data Deficiency

NOAA's methodologies and recording practices have changed over the period of some of the following datasets. For instance, one may notice a sharp increase in the recorded impacts for hail and thunderstorm winds in the middle 1990s. This is not due to an increase in hail or thunderstorm wind impacts, but instead is a result of a change of policy for NOAA. During this time period they altered their recording process from county based to city and town based. This does not skew the number of fatalities, injuries, recorded magnitudes, or damage numbers as these would have simply been aggregated at the county level.

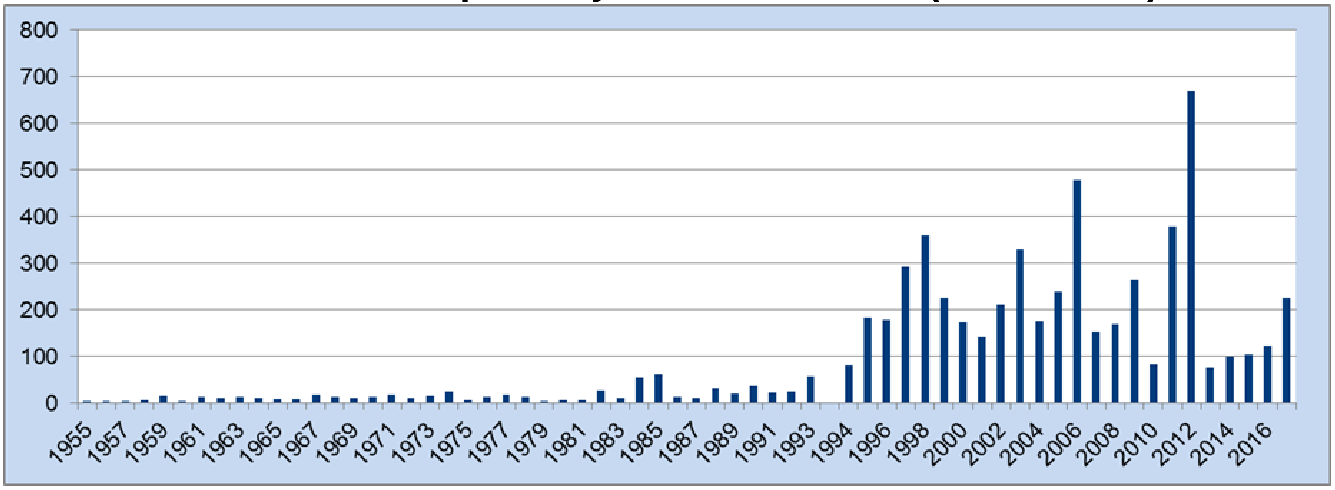
Table 53 – Historical Impacts, Lightning & Winter Storms (1993 – 2017)		
	Lightning	**Winter Storms**
Count of Events	795	2010
Events Per Year	39.75	83.75
Average Magnitude	-	-
Magnitude Range	-	-
Average Cost	$60,585	$38,335
Magnitude of Cost	$0 - $6,000,000	$0 - $20,000,000
Total Recorded Cost	$48,165,240	$76,977,350
Average Crop Damage	$116	$2,493
Magnitude of Crop Damage	$0 - $30,000	$0 - $5,000,000
Total Crop Damage	$92,000	$5,005,000
Average Fatalities	0.0478	0.003
Total Fatalities	38	6
Average Injuries	0.2692	0.01
Total Injuries	214	20

**The data are from the NOAA NCDC Storm Event Database*

Data Deficiency

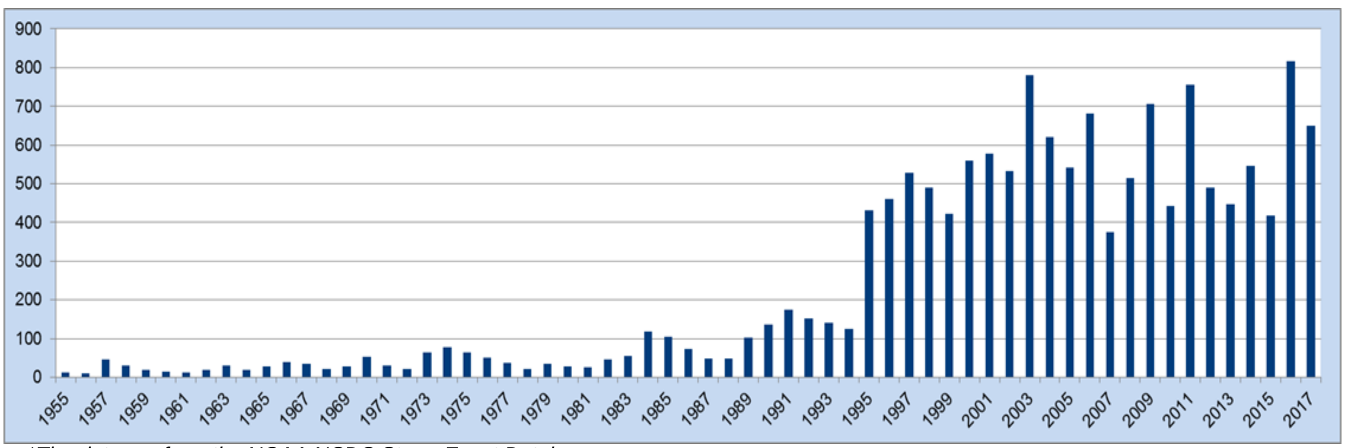
NOAA's methodologies and recording practices have changed over the period of some of the following datasets. For instance, one may notice a sharp increase in the recorded impacts for hail and thunderstorm winds in the middle 1990s. This is not due to an increase in hail or thunderstorm wind impacts, but instead is a result of a change of policy for NOAA. During this time period they altered their recording process from county based to city and town based. This does not skew the number of fatalities, injuries, recorded magnitudes, or damage numbers as these would have simply been aggregated at the county level.

Chart 11 – Hail Impacts by Year, Tennessee (1955 – 2017)



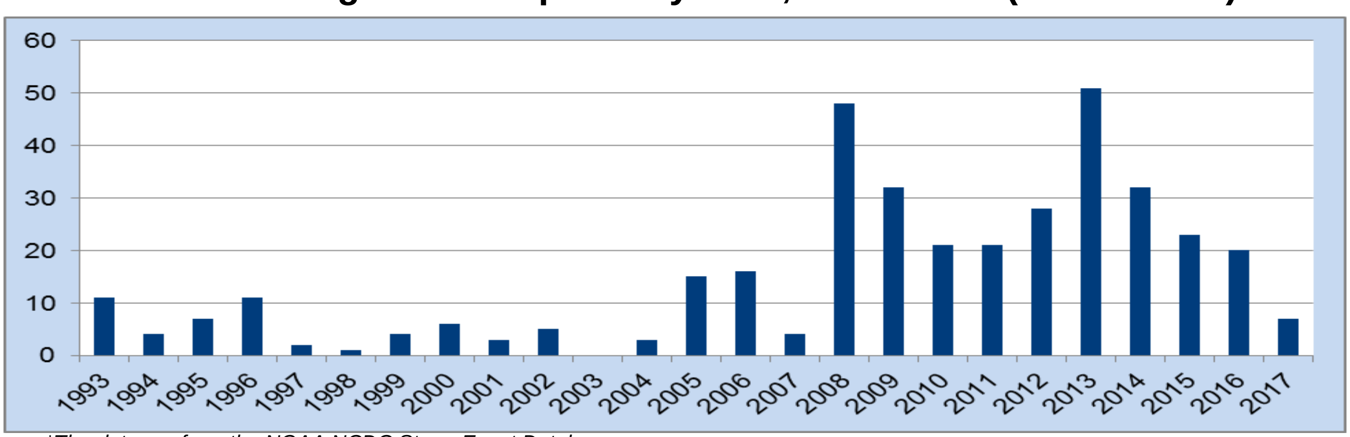
**The data are from the NOAA NCDC Storm Event Database.*

Chart 12 – Thunderstorm Wind Impacts by Year, Tennessee (1955 – 2017)



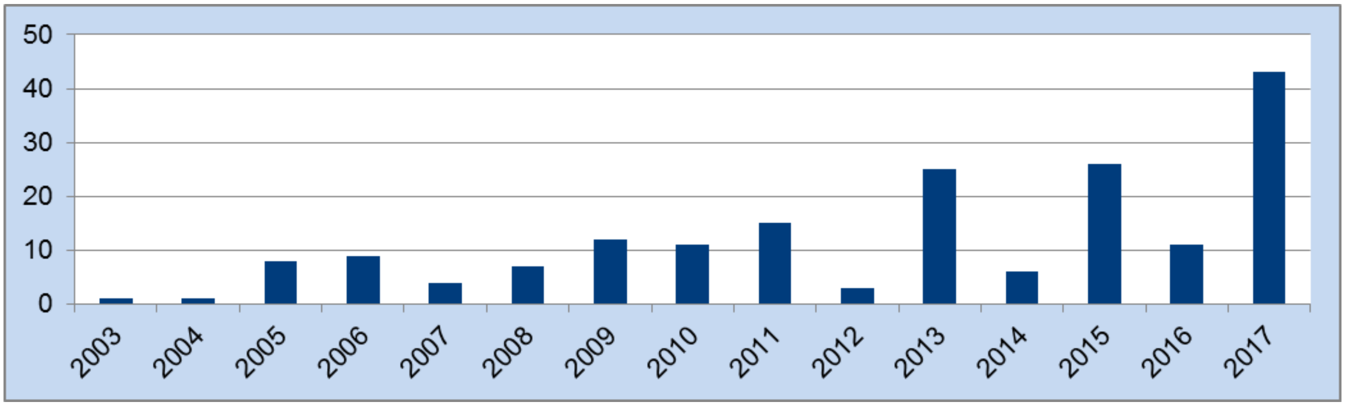
**The data are from the NOAA NCDC Storm Event Database.*

Chart 13 – High Wind Impacts by Year, Tennessee (1993 – 2017)



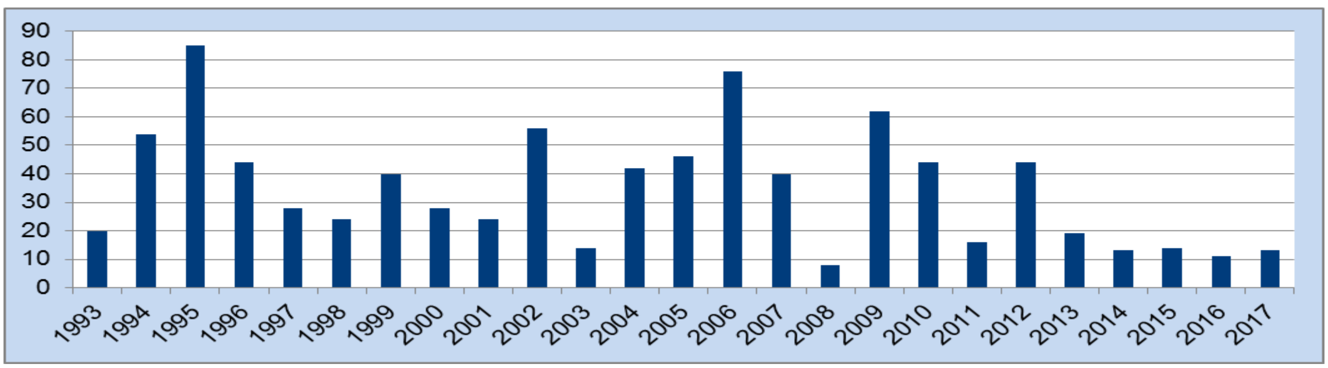
**The data are from the NOAA NCDC Storm Event Database.*

Chart 14 – Strong Wind Impacts by Year, Tennessee (2003 – 2017)



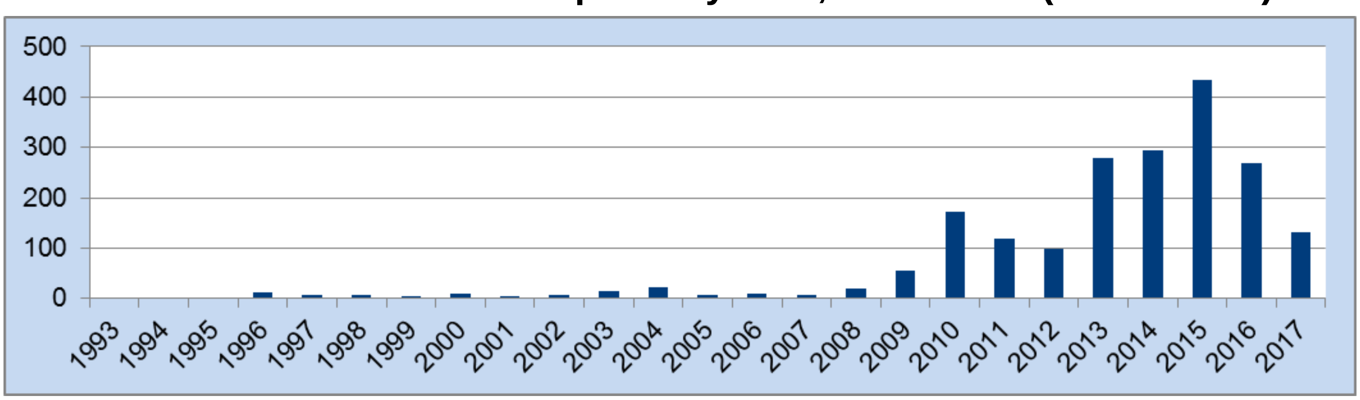
**The data are from the NOAA NCDC Storm Event Database.*

Chart 15 – Lightning Impacts by Year, Tennessee (1993 – 2017)



**The data are from the NOAA NCDC Storm Event Database.*

Chart 16 – Winter Storm Impacts by Year, Tennessee (1993 – 2017)



**The data are from the NOAA NCDC Storm Event Database.*

4.3.3 – Incidents & Probability

Since 1955, NOAA has recorded 6,074 hail impacts and 14,983 thunderstorm wind impacts in the State of Tennessee. Tennessee has experienced 0 deaths and 21 injuries relating to hail activity while it has experienced 25 deaths and 291 injuries relating to thunderstorm wind activity. Hail events have cost Tennesseans $15,661,600 in property damage and $888,000 in crop damage. Thunderstorm wind events have cost Tennesseans $235,308,200 in property damage and $10,009,510 in crop damage.

The state can expect hail impact events 96.4113 per year while it can expect a lightning impacts events 34.60 per year and it can expect winter storm impacts 80.40 per year.

Table 54 – Impact Probability, Hail, Lightning, & Winter Storms			
Impact Year	Count of Impacts		
	Hail	Lightning	Winter Storms
1955 - 1959	31	-	-
1960 - 1969	108	-	-
1970 - 1979	133	-	-
1980 - 1989	241	-	-
1990 - 1999	1,462	294	44
2000-2009	2325	387	156
2010	82	43	170
2011	378	15	119
2012	669	44	115
2013	77	19	279
2014	100	13	295
2015	105	14	435
2016	123	11	269
2017	225	13	132
Total Years =	63	25	25
Total Recorded Impacts =	6074	865	2010
Yearly Probability = **Average Impacts per Year =**	**9641.13%** **96.41**	**3460.00%** **34.60**	**8040.00%** **80.40**

**The data are compiled from the NOAA NCDC Storm Event Database*

Based on NOAA's data, hail in Tennessee can be anywhere from 0.75 to 4.5 inches in diameter, cost up to $5,000,000 in property damage and $400,000 in crop damage in 1 impact. The average hail impact will yield hail 1.11 inches in diameter, cause $2,578 in property damage, cause $146 in crop damage, kill 0 people, and injure 0.0035 people.

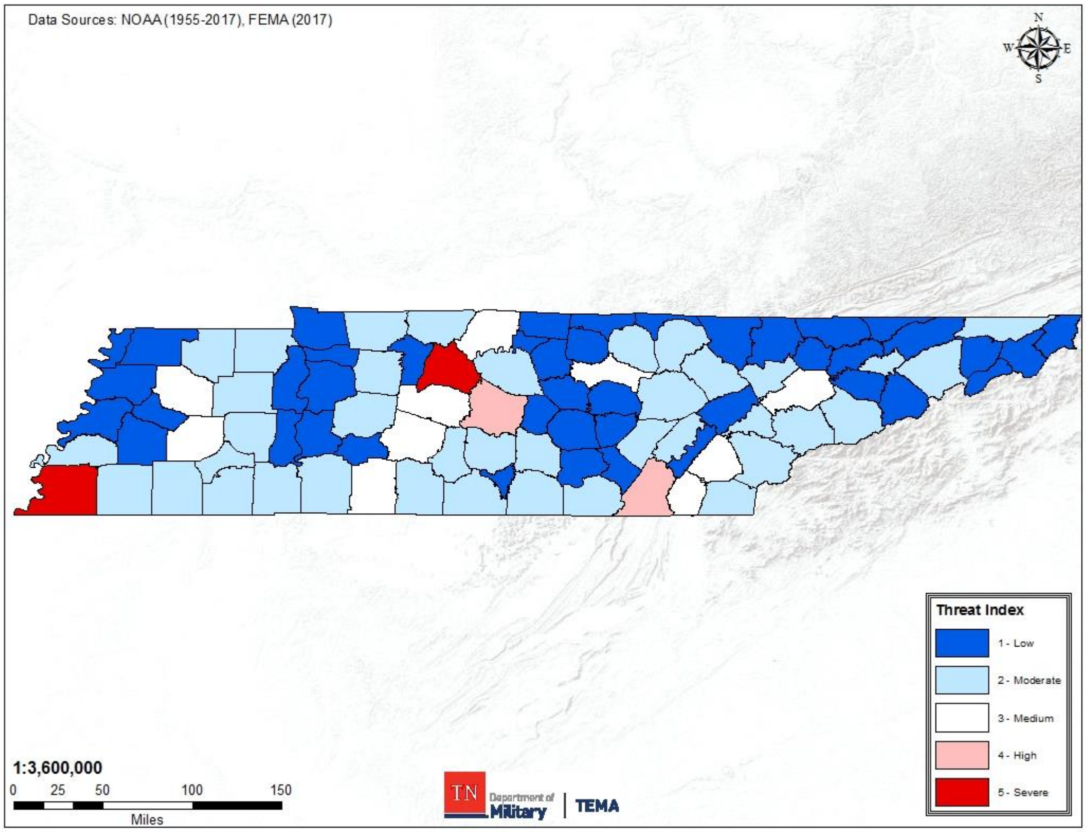
The state can expect a high wind impact with a probability of 1504.00% per year or 15.04 impacts per year while it can expect a strong wind impact with a probability of 1213.00% per year or 12.13 impacts per year and it can expect a thunderstorm wind impact with a probability of 23777.78% per year or 237.77 impacts per year.

Table 55 – Impact Probability, High, Strong & Thunderstorm Winds			
Impact Year	**Count of Impacts**		
	High Wind	**Strong Wind**	**Thunderstorm Wind**
1955 - 1959	-	-	117
1960 - 1969	-	-	248
1970 - 1979	-	-	453
1980 - 1989	-	-	650
1990 - 1999	40	-	3061
2000-2009	132	42	5889
2010	21	11	442
2011	21	15	755
2012	29	3	489
2013	51	25	447
2014	32	6	546
2015	23	26	417
2016	20	11	817
2017	7	43	649
Total Years =	25	15	63
Total Recorded Impacts =	376	182	14980
Yearly Probability = **Average Impacts per Year =**	**1504.00%** **15.04**	**1213.33%** **12.13**	**23777.78%** **237.77**

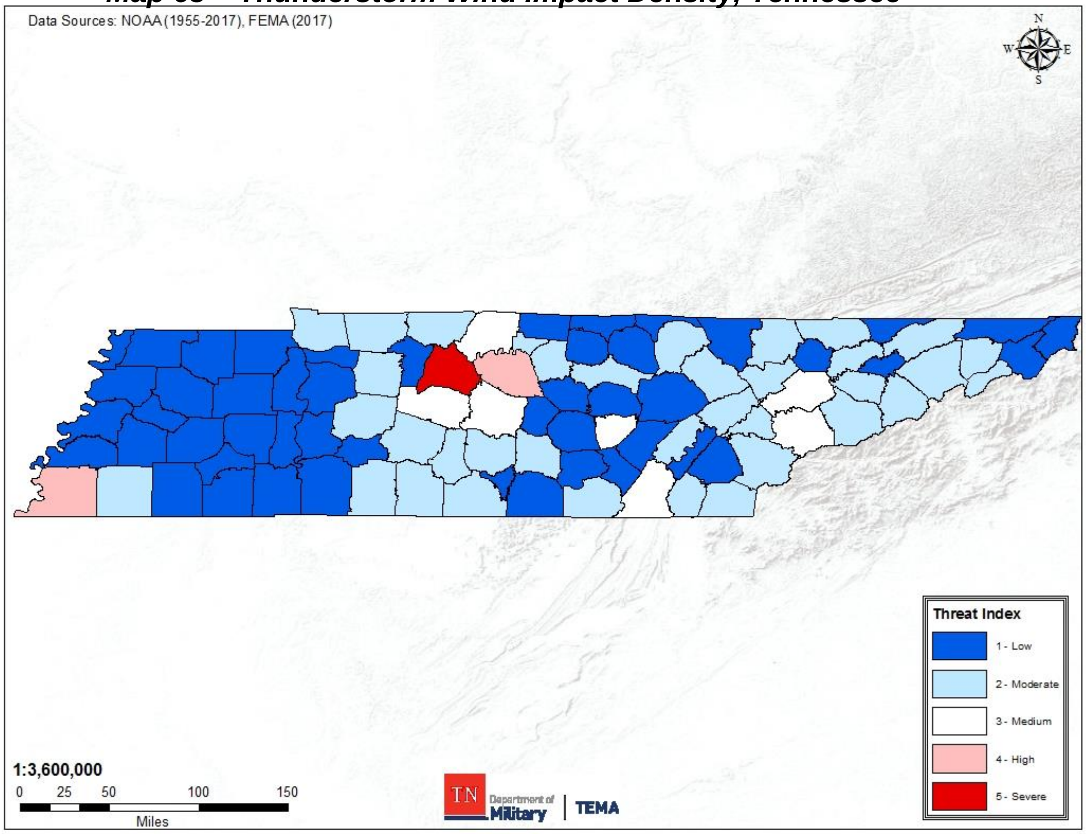
**The data are compiled from the NOAA NCDC Storm Event Database*

Based on NOAA's data, thunderstorm winds in Tennessee can blow anywhere from 35 to 96 miles per hour, cost up to $40,000,000 in property damage, $80,000 in crop damage in 1 impact. The average thunderstorm wind event will blow at 52.39 miles per hour, cause $15,705 in property damage, $668 in crop damage, kill 0.002 people, and injure 0.019 people.

Map 62 – Hail Impact Density, Tennessee



Map 63 – Thunderstorm Wind Impact Density, Tennessee

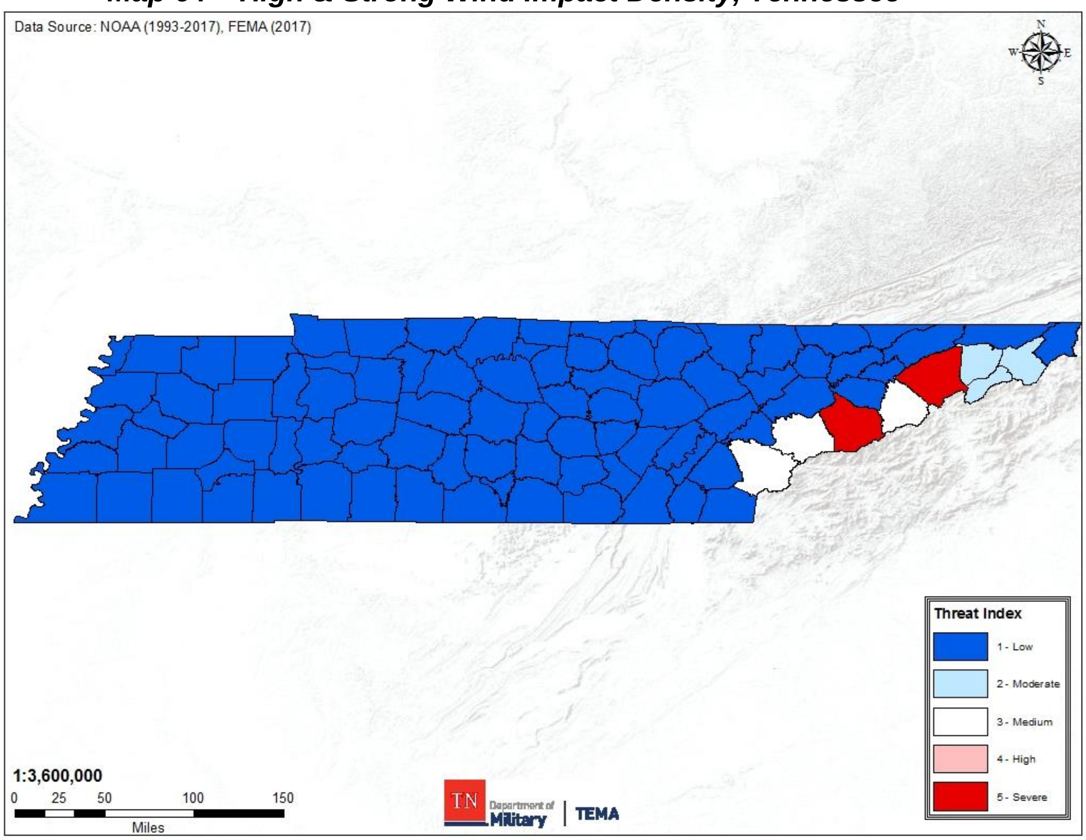


Since 1993 (for high winds) and 2003 (for strong winds), NOAA has recorded 376 high wind impacts and 341 strong wind impacts in the State of Tennessee. Tennessee has experienced 1 death and 5 injuries relating to high wind activity while it has experienced 9 deaths and 6 injuries relating to strong wind activity. High wind events have cost Tennesseans $7,837,650 in property damage and $4,843 in crop damage. Strong wind events have cost Tennesseans $3,981,900 in property damage and $51,000 in crop damage.

Based on NOAA's data, high winds in Tennessee can blow anywhere from 34 to 87 miles per hour, cost up to $2,000,000 in property damage, $1,700,000 in crop damage in 1 impact. The average high wind event will blow at 55.80 miles per hour, cause $20,844 in property damage, $4,843 in crop damage, kill 0 people, and injure 0 people.

Based on NOAA's data, strong winds in Tennessee can blow anywhere from 22 to 65 miles per hour, cost up to $1,000,000 in property damage, $20,000 in crop damage in 1 impact. The average strong wind event will blow at 41.11 miles per hour, cause $11,177 in property damage, $150 in crop damage, kill 0.03 people, and injure 0.02 people.

Map 64 – High & Strong Wind Impact Density, Tennessee

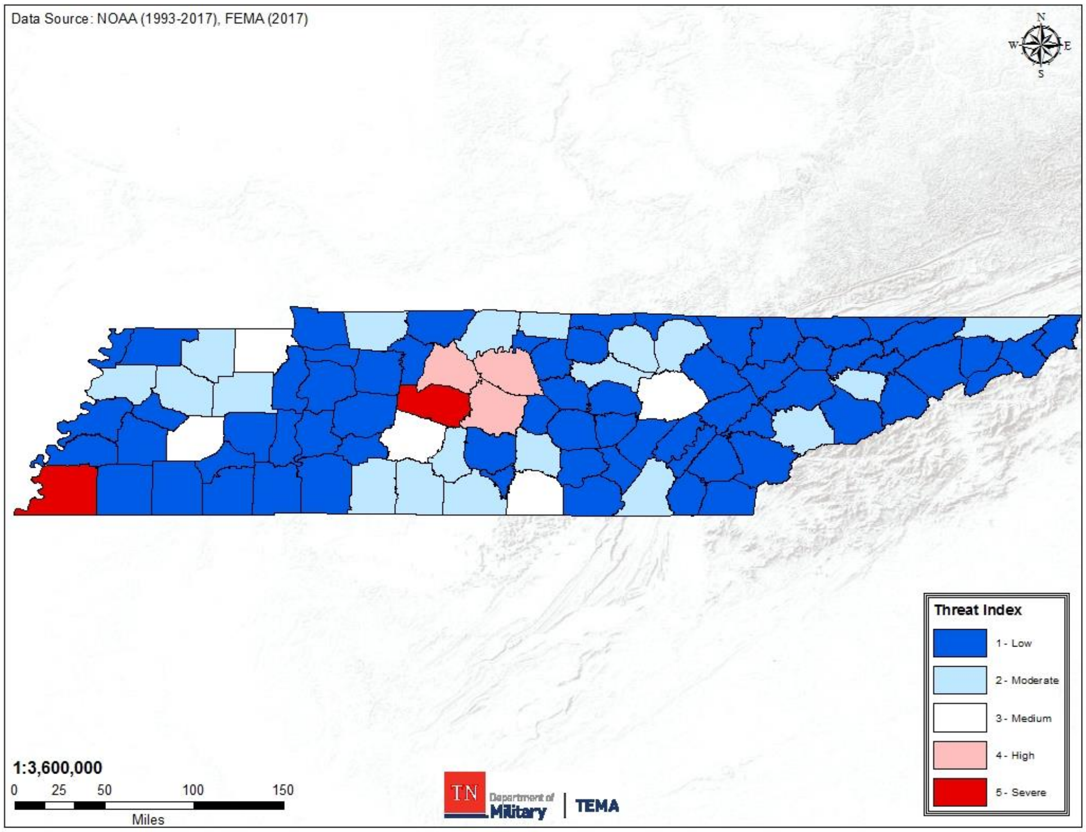


Since 1993, NOAA has recorded 795 lightning impacts and 499 winter storm impacts in the State of Tennessee. Tennessee has experienced 38 deaths and 214 injuries relating to lightning activity while it has experienced 5 deaths and 20 injuries relating to winter storm activity. Lightning events have cost Tennesseans $48,165,240 in property damage and $92,000 in crop damage. Winter storm events have cost Tennesseans $11,338,350 in property damage and $5,000,000 in crop damage.

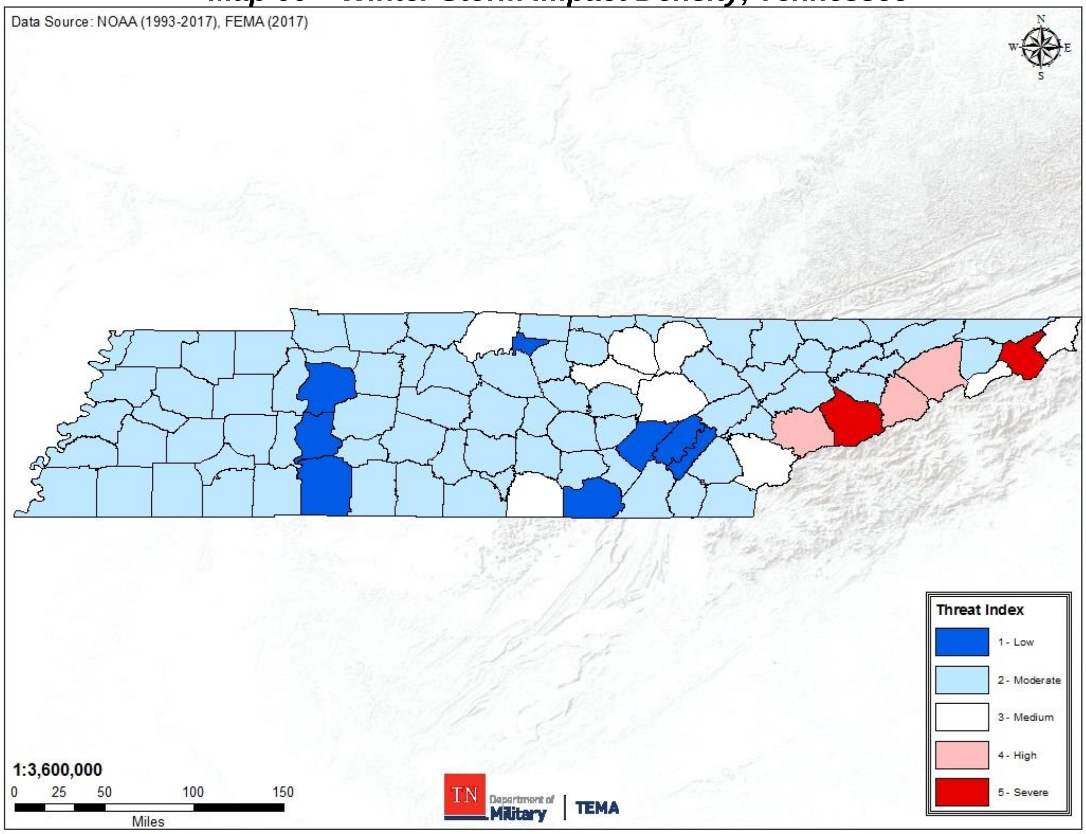
Based on NOAA's data, lightning in Tennessee can cost up to $6,000,000 in property damage and $30,000 in crop damage in 1 impact. The average lightning impact cause $60,585 in property damage, cause $116 in crop damage, kill 0.0478 people, and injure 0.2692 people.

Based on NOAA's data, winter storms in Tennessee can cost up to $5,000,000 in property damage, and $5,000,000 in crop damage in 1 impact. The average winter storm event will cause $22,722 in property damage, $10,020 in crop damage, kill 0.01 people, and injure 0.04 people.

Map 65 – Lightning Impact Density, Tennessee

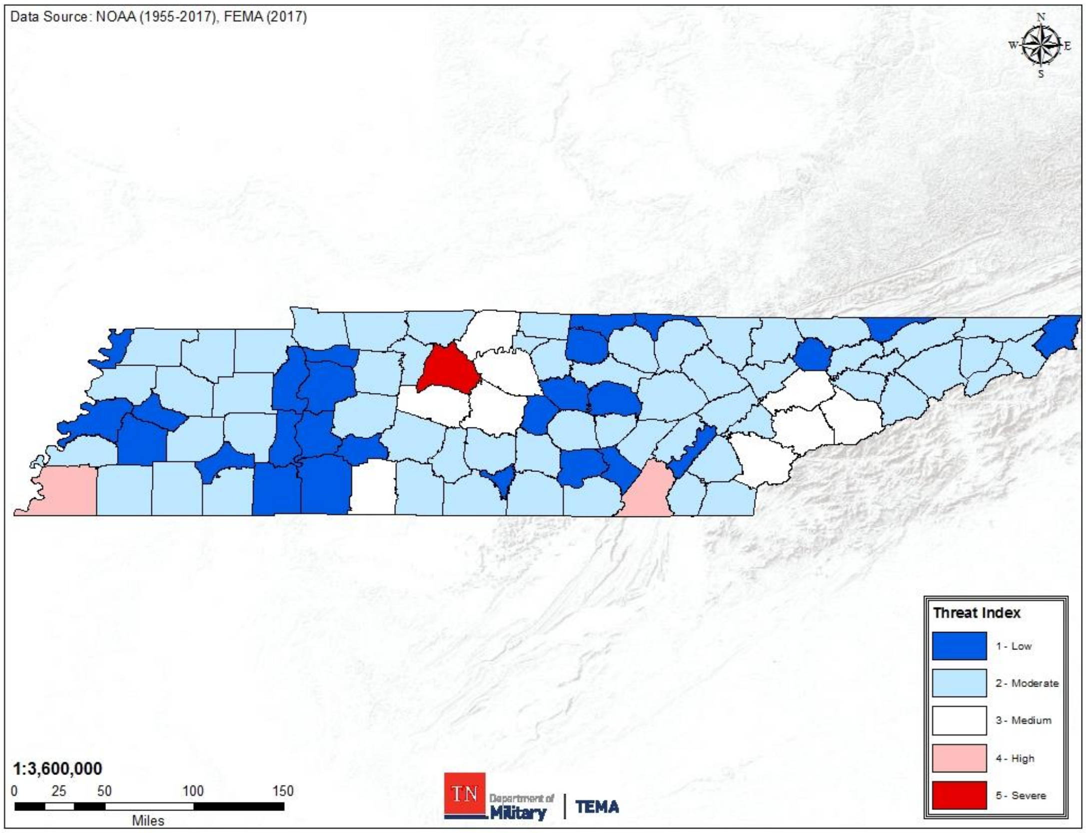


Map 66 – Winter Storm Impact Density, Tennessee



The following map depicts the concentrations of severe storms (a composite of hail, high/strong wind, lightning, thunderstorm wind and winter storm) impacts throughout the State of Tennessee.

Map 67 – Severe Storms Impact Density, Tennessee

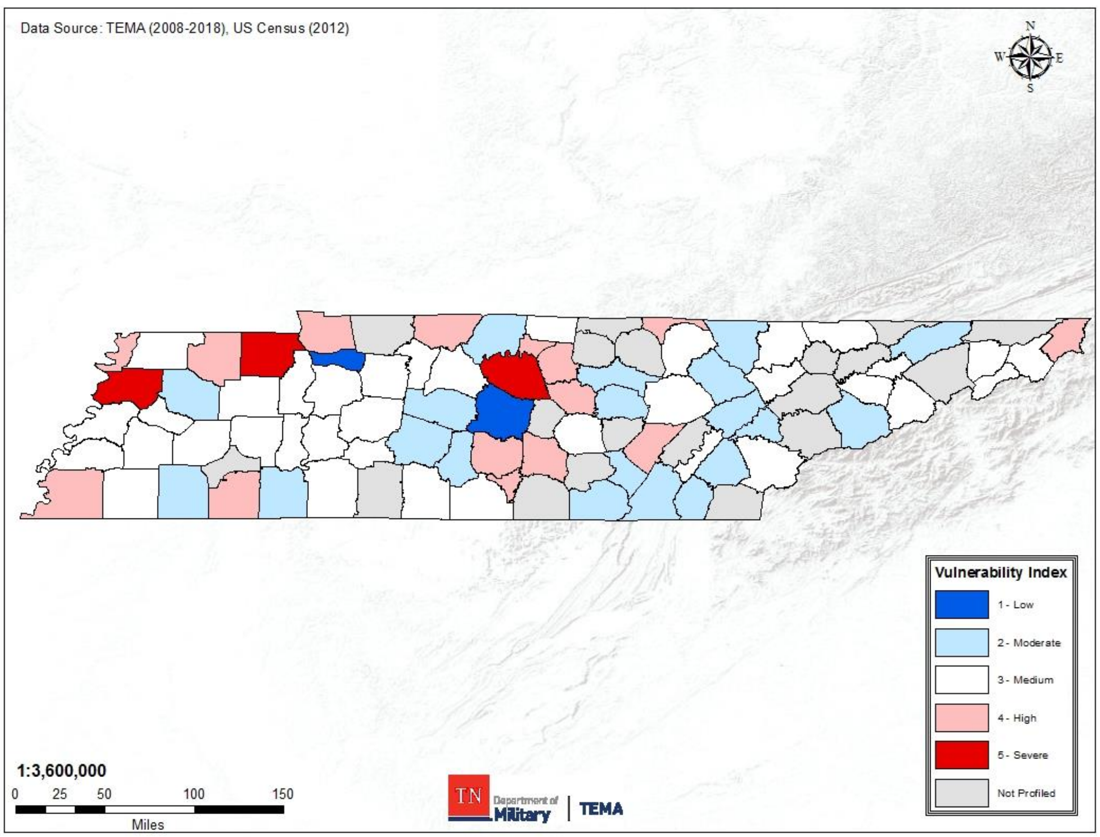


4.3.4 – Changing Future Conditions

The uncertainty associated with potentially changing climate conditions creates uncertainty for predicting future severe winter storms. If it is determined that global temperatures are indeed rising, this could cause shorter and warmer winters in many areas; however, the likelihood of dangerously low temperatures may increase due to continuing trends of temperature extremes. Warmer winters, however, mean that precipitation that would normally fall as snow may begin to fall as rain or freezing rain instead. This increases the likelihood of the accumulation of ice on powerlines and trees which could lead to increase power outages during winter weather.

The following map depicts the vulnerability to severe storm incidents for each county throughout the State of Tennessee. This data was compiled using local plan integration.

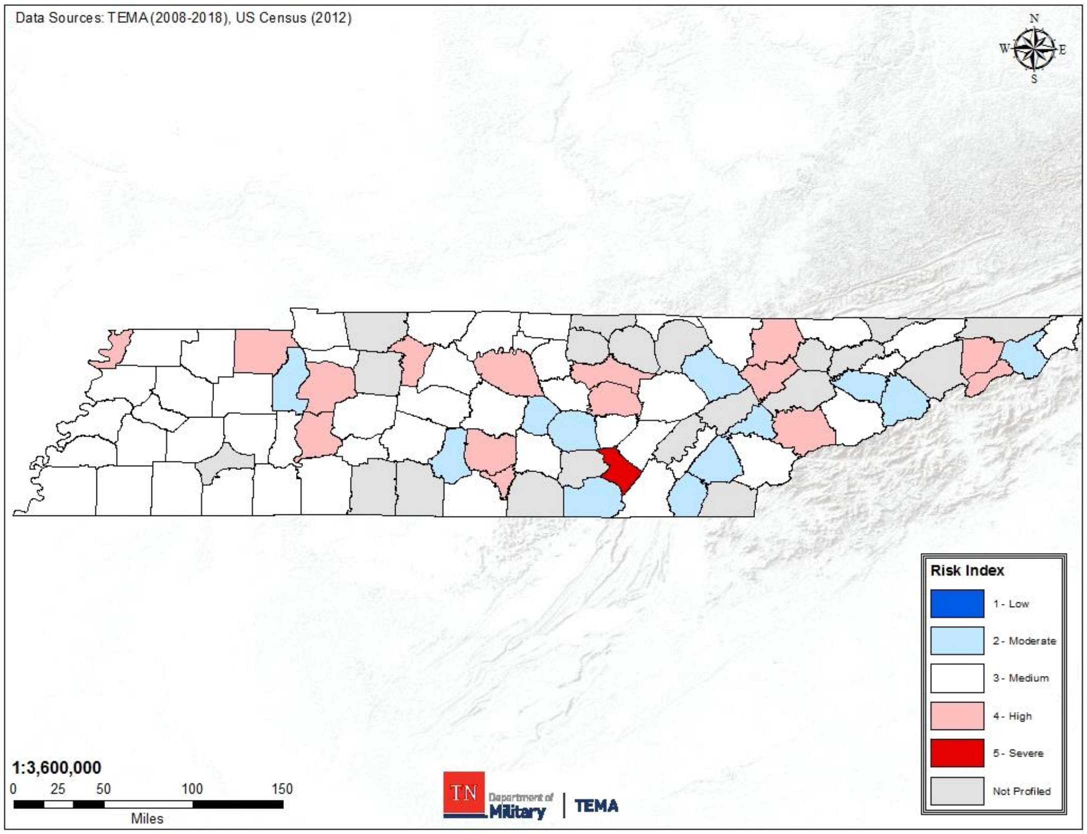
Map 68 – Hazard Vulnerability Index, Local Plan Integration, Severe Storms



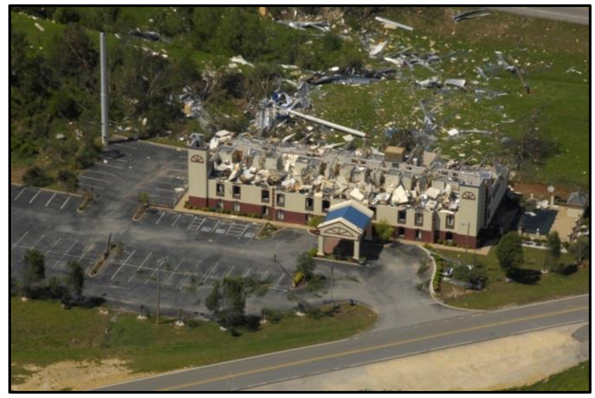
4.3.5 – Future Risk

Using a basic risk matrix: Vulnerability+Probability=Risk, TEMA was able to calculate hazard risk using data from the previous subsections. This process is further explained in Section 3.4. As shown in the following map of the risk index, Sequatchie County is the highest risk for severe storms.

Map 69 – Hazard Risk Index, Local Plan Integration, Severe Storms



4.3T – Tornadoes



A tornado is a violently rotating column of air in contact with the ground. Often referred to as a twister or a cyclone, they can strike anywhere and with little warning. Tornadoes come in many shapes and sizes, but are typically in the form of a visible condensation funnel, whose narrow end touches the earth and is often encircled by a cloud of debris and dust.

Statistically, tornadoes are seasonal, but the season varies from area to area throughout North America. Tennessee's tornado season lasts from February through May with a small spike of activity in November. Please see Chart 22 below for details.

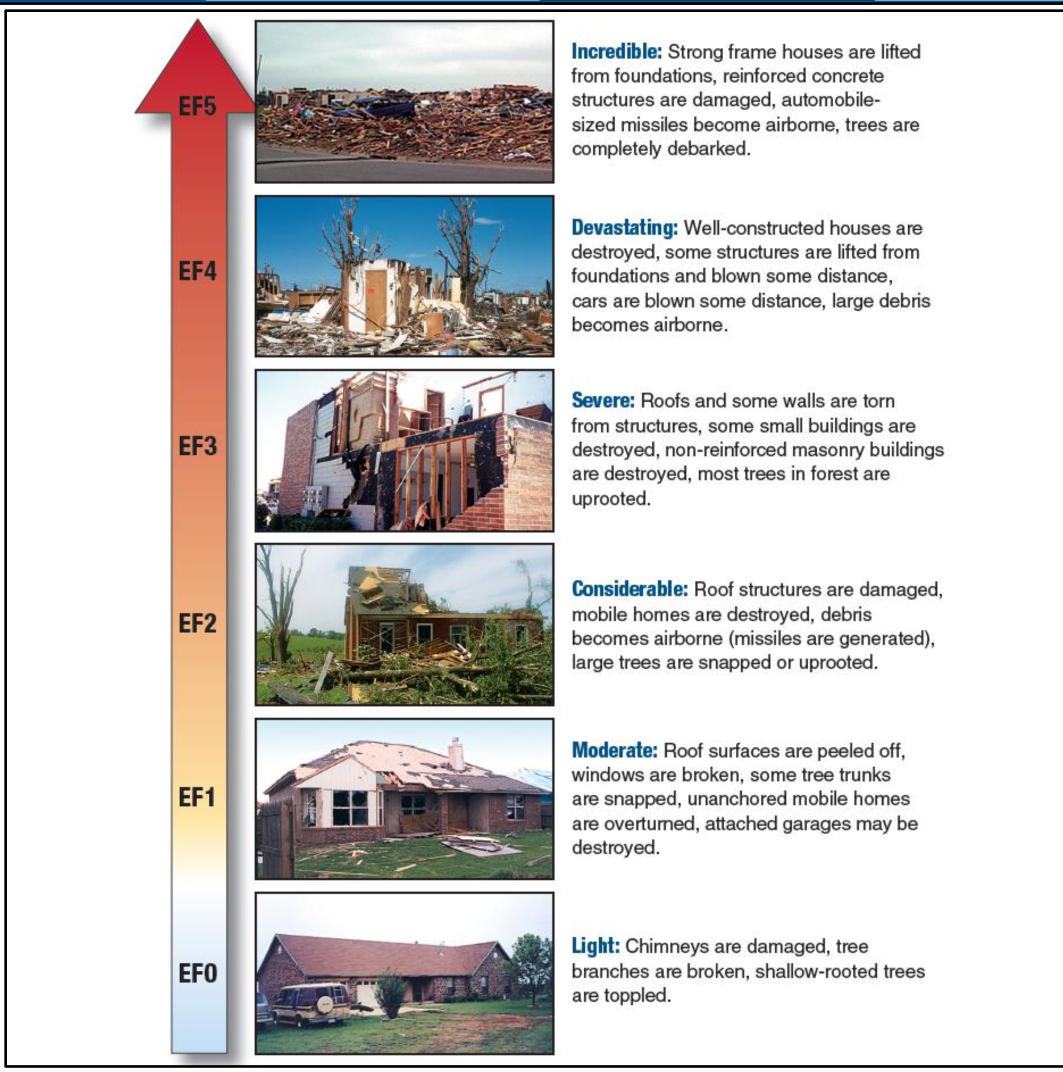
Tornadoes can cause several kinds of damage to buildings. Tornadoes have been known to lift and move objects weighing more than 3 tons, toss homes more than 300 feet from their foundations, and siphon millions of tons of water. However, less spectacular damage is much more common.

Tornadoes can also generate a tremendous amount of flying debris. If wind speeds are high enough, airborne debris can be thrown at buildings with enough force to penetrate windows, roofs, and walls.

Until 2007, the Fujita Tornado Scale ranked the severity of tornadoes. The Fujita Scale assigned a numerical F value, F0 through F5, based on the wind speeds and estimated damage. Since 2007 the U.S. switched over to the Enhanced Fujita Scale. The altered scale adjusted the wind speed values per F level and introduced a rubric for estimating damage. Please see the chart below for a comparison between the Fujita and Enhanced Fujita Scales.

An EF0 or EF1 tornado could lightly damage structures where they would be unsafe to use until repaired. An EF3 or larger tornado could destroy the entire neighborhood, town, or city, or damage any number of structures to the point where they would be unusable or unsafe. Please see the chart on the following page for a description of the typical amount of damage for each level on the Enhanced Fujita Scale.

Fujita Scale		EF Scale	
Fujita Scale	3-Second Gust Speed (mph)	EF Scale	3-Second Gust Speed (mph)
F0	45-78	EF0	65-85
F1	79-117	EF1	86-109
F2	118-161	EF2	110-137
F3	162-209	EF3	138-167
F4	210-261	EF4	168-199
F5	262-317	EF5	200-234



4.3.1 – Location & Extent

Tornadoes can strike anywhere in the State of Tennessee, placing the entire planning area at risk. Many tornadoes only exist for a few seconds in the form of a touchdown. The most extreme tornadoes can attain wind speeds of more than 200 miles per hour, stretch more than 2 miles across, and travel dozens of miles.

A tornado may arrive with a squall line or cold front and touch down quickly. Smaller tornadoes can strike without warning. Other times tornado watches and sirens will alert communities of high potential tornado producing weather or an already formed tornado and its likely path.

In data collected from 1950 to present tornadoes can occur in any given month in the state of Tennessee. However, tornadoes are most likely to occur between February and May, with an exponentially high possibility in the month of April.

4.3.2 – Previous Occurrences

Historic Hazard Incident – Tornadoes – April 1998

On April 15-16, 1998, a 2 day tornado outbreak occurred in the Midwestern United States, Mississippi and Tennessee Valleys. The worst of the outbreak occurred on the second day when 13 tornadoes swept through Middle Tennessee. 2 of these tornadoes touched down in Nashville, causing of damage to the downtown and East Nashville areas. This made Nashville the first major city in almost 20 years to have an EF2 or larger tornado make a direct hit in the downtown area. The outbreak also produced several other tornadoes. A total of 10 tornadoes were reported throughout the breakout. One was an EF5 tornado. There were 7 fatalities and 105 injuries throughout Middle Tennessee.

Historic Hazard Incident – Tornadoes – February 2008 (Super Tuesday Outbreak)

The 2008 Super Tuesday tornado outbreak affected the Southern United States and the lower Ohio Valley. The event began on Super Tuesday, while 24 U.S. states were holding primary elections and caucuses to select the presidential candidates for the upcoming presidential election.

87 tornadoes occurred over the 15 hour outbreak. Many of these destructive tornadoes hit heavily populated areas, including the Memphis metropolitan area, Jackson, Tennessee, and the Nashville metropolitan area. 57 people were killed across 4 states and 18 counties, with hundreds of others injured. Damage from the tornadoes was estimated at over $500 million. The weather system caused significant straight-line wind damage, hail as large as softballs – 4.5 inches in diameter, major flooding, significant freezing rain, and heavy snow. The total damage from the entire weather system exceeded $1 billion.

In Memphis, an EF-2 tornado swept through destroying the Hickory Ridge Mall, parts of Germantown, and the International Airport. 4 people in the metropolitan area were killed, 36 others were injured in Shelby County by tornadoes, and there was 1 additional death southeast of Hebron, Tennessee from an EF-3 tornado.

Northeast, near Jackson, TN, a tornado touchdown overturned several cars and at least 15 tractor trailers along Interstate 40. The Sharon Baptist Church in Savannah, TN lost its $7 million facilities to the tornado. 31 buildings on the Union University campus received damage. 12 students were trapped in the damaged buildings, but all were rescued. Over 60 people in the Jackson area were treated for

injuries. There were no fatalities caused by the Jackson tornado, however there were 2 fatalities in the Huntersville community, located west of Jackson, from another EF-3 tornado. The tornadoes caused about $47 million worth of damages in Madison County, with $40 million of that total occurring at Union University alone.

In the Nashville metropolitan area, a supercell moved through forming funnel clouds, but there was never a touch-down; after passing through an EF-3 tornado touched down in Castalian Springs and Westmoreland. The tornado path was 51 miles long and up to 0.75 miles wide. There were 22 fatalities. The tornado caused a major fire at a natural gas plant near Green Grove. The area was evacuated and no one was injured. In total, about 260 houses in the 3 counties were destroyed. Damages were around $78 million in Macon County alone. Debris from the Lafayette area was found as far as 70 miles to the northeast. Sixteen thousand TVA electricity customers in Macon and Trousdale Counties lost power.

Historic Hazard Incident – Tornadoes – April 2011

The largest tornado outbreak ever recorded in the United States occurred on April 25-28, 2011. Southern, Midwestern, and northeastern United States were all affected leaving catastrophic destruction in its path. The outbreak totaled 358 tornadoes in 21 states.

A series of intense storm cells produced multiple tornadoes, damaging hail, and lightning across East Tennessee. Two tornadoes struck near Cleveland, Tennessee, including an EF-2, which injured 1 person and destroyed 3 mobile homes and an EF-1, also landed about a mile west of Cleveland. A third touchdown was reported, but unconfirmed, near Etowah in McMinn County. Golf ball- and baseball-sized hail fell throughout the area. 6,900 Knoxville Utilities Board customers were left without power, and 22,000 customers were affected by the outages across Knox County.

Historic Hazard Incident – Tornadoes – January 2013

On January 29-30, 2013, a powerful upper level trough moved across the United States containing strong winds with speeds of 80 mph just 2,500 feet above the surface and 150 mph at 20,000 feet. A record warm air mass with temperatures in the 60s and 70s spread northward ahead of the system as a powerful cold front moved eastward across the state during the early morning. This created a line of showers and thunderstorms known as a Quasi-Linear Convective System producing numerous tornadoes and widespread wind damage. There was 1 fatality and at least 3 injuries across the state. 24 tornadoes were confirmed making this event the largest January tornado outbreak and the second largest outbreak of tornadoes for any month in Tennessee history.

Historic Hazard Incident – Tornadoes – December 2015

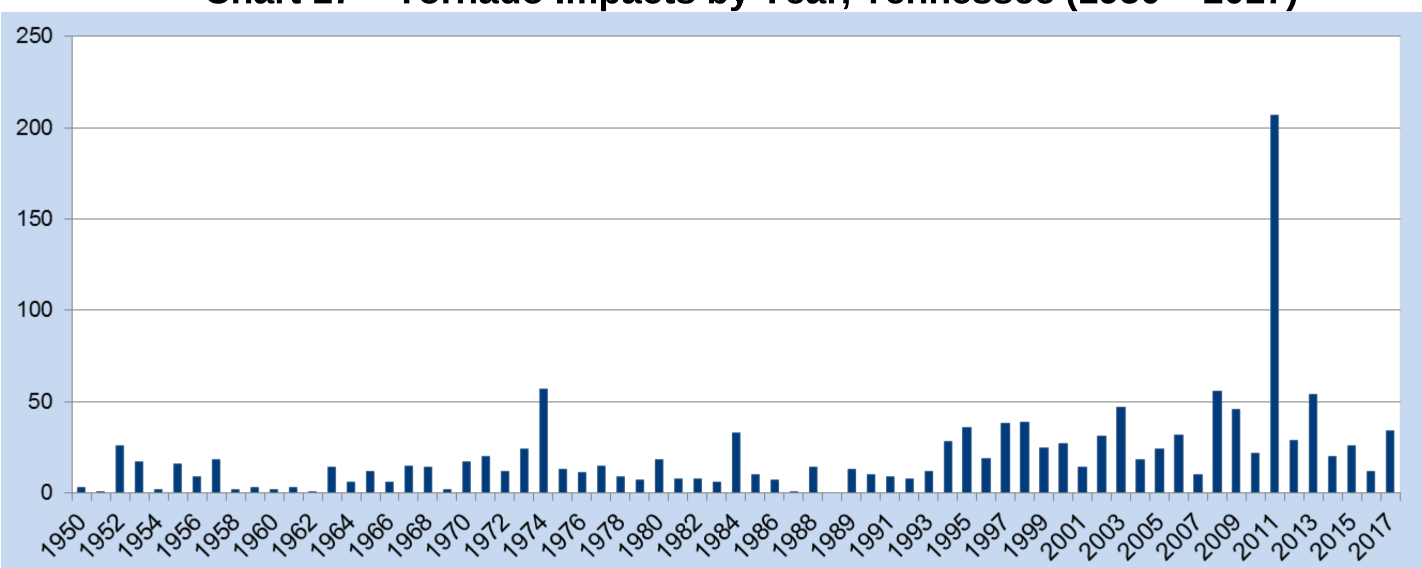
On December 23, 2015, a severe storm system crossed the eastern United States reaching areas from the Gulf Coast to the Great Lakes. Several tornadic supercell thunderstorms developed across northern Mississippi and western Tennessee, which then moved rapidly east-northeastward at up to 70 mph across Middle Tennessee during the evening hours on December 23. These storms produced 4 long-track tornadoes that caused 2 deaths and 7 reported injuries. Only 7 tornadoes had been previously recorded across Middle Tennessee in the month of December from the 1800s through 2014, easily making this the largest and worst December tornado outbreak in Middle Tennessee history.

In addition to the tornadoes, several reports of wind damage, large hail, and flash flooding were received. Some of the worst flash flooding occurred in Maury County, where 3 teenagers drowned in a submerged vehicle on Carters Creek Pike.

Table 56 – Historical Impacts, Tornadoes (1950 - 2017)	
Count of Impacts	1413
Impacts Per Year	21.08
Average Magnitude (EF)	1.22
Magnitude Range (EF)	0 - 5
Average Cost	$1,137,023
Magnitude of Cost	$0 - $100,000,000
Total Recorded Cost	$1,605,476,890
Average Crop Damage	$4,807
Magnitude of Crop Damage	$0 - $1,000,000
Total Crop Damage	$6,788,000
Average Fatalities	0.27
Total Fatalities	376
Average Injuries	3.44
Total Injuries	4,853

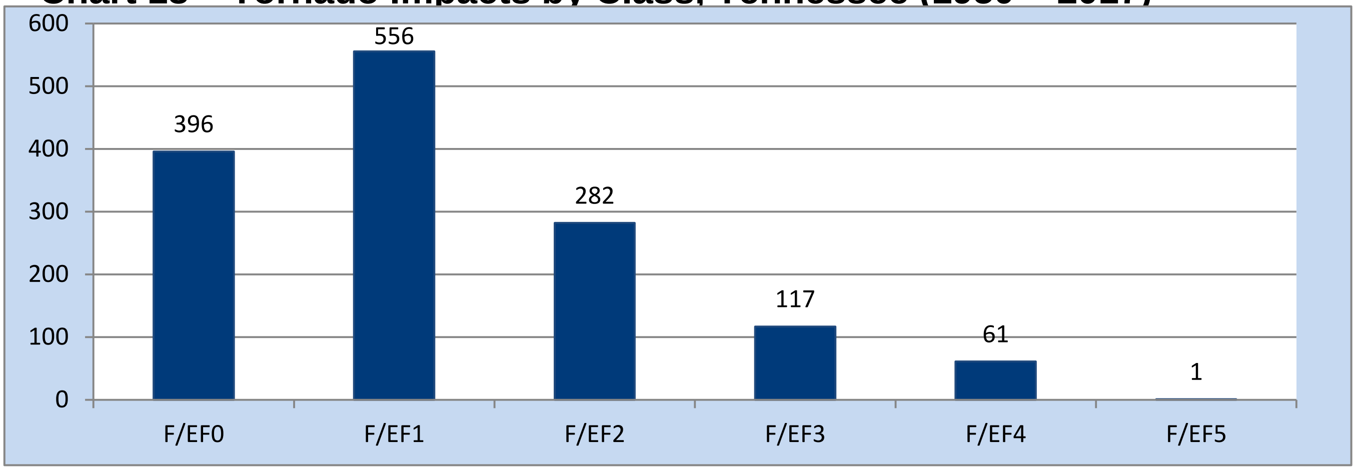
**The data are compiled from the NOAA NCDC Storm Event Database*

Chart 17 – Tornado Impacts by Year, Tennessee (1950 – 2017)



**The data are from the NOAA NCDC Storm Event Database.*

Chart 18 – Tornado Impacts by Class, Tennessee (1950 – 2017)

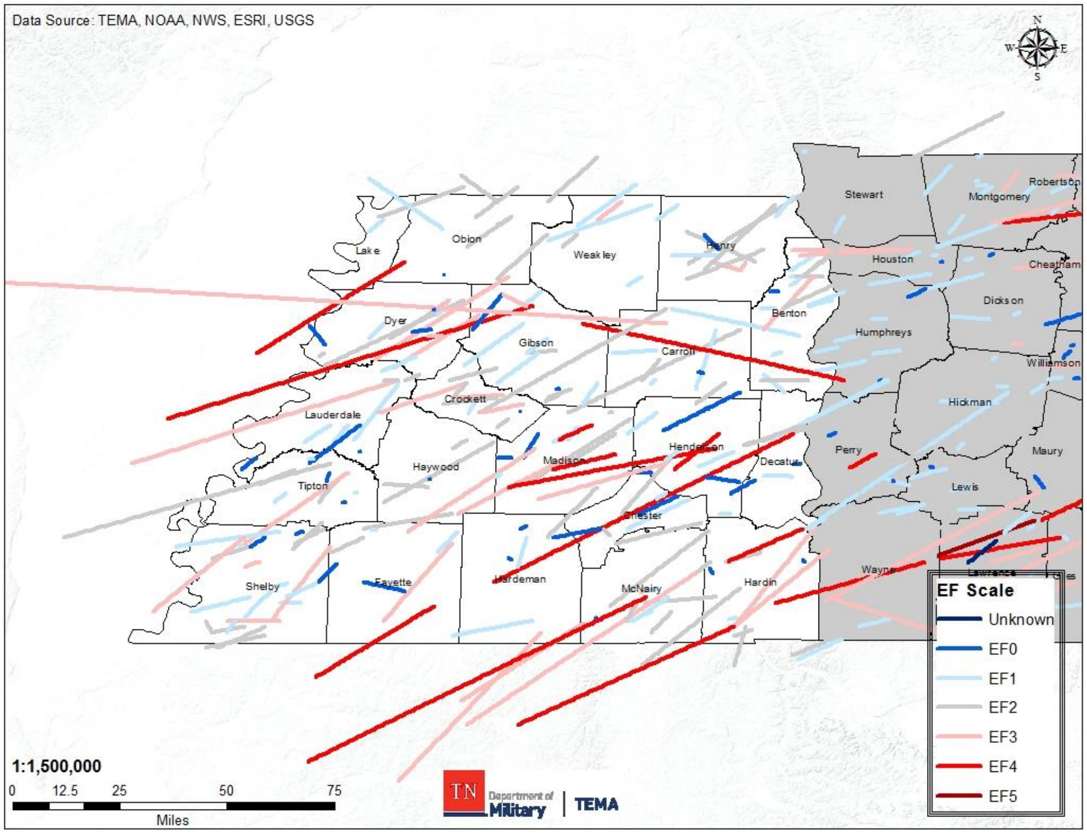


**The data are from the NOAA NCDC Storm Event Database.*

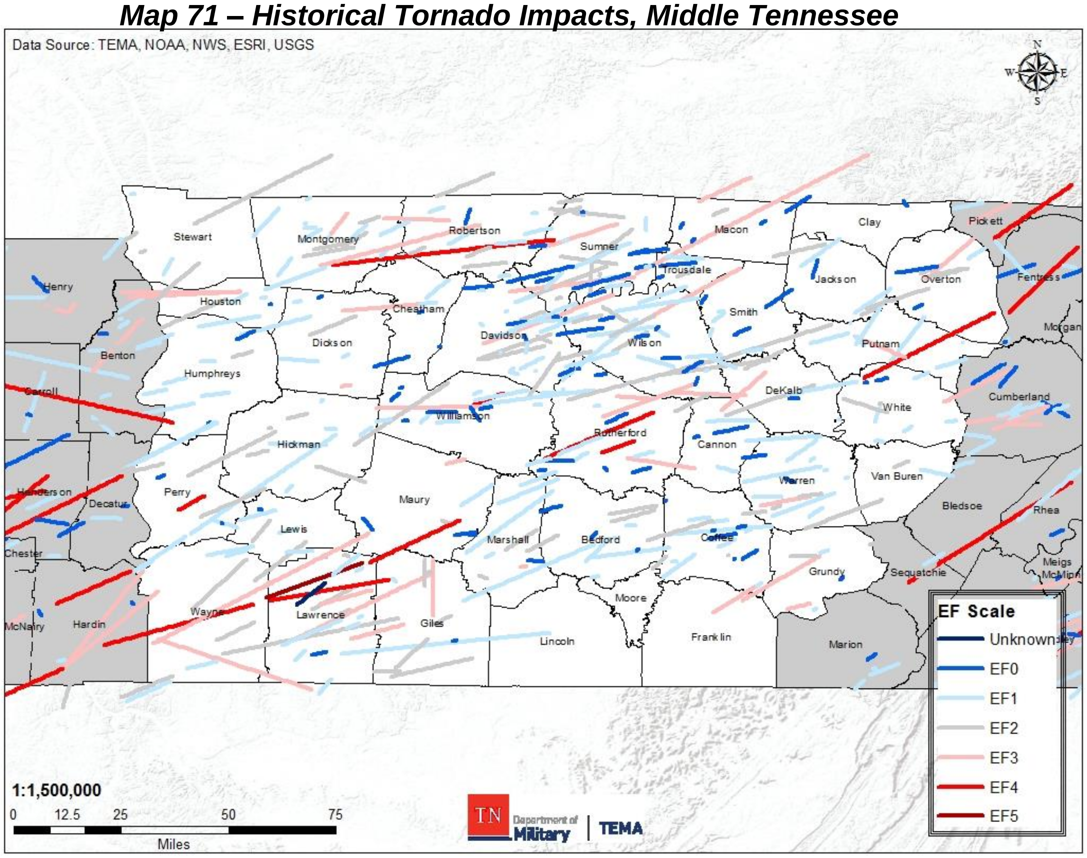
Since 1950, NOAA has recorded 1,413 tornado impacts in the State of Tennessee. Tennessee has experienced 376 deaths and 4,853 injuries relating to tornado activity. These events have cost Tennesseans $1,605,476,890 in property damage and $6,788,000 in crop damage.

Based on NOAA's data, a tornado in Tennessee can be anywhere from an EF0 to EF5 in magnitude, cost up to $100,000,000 in property damage, and $1,000,000 in crop damage. The average tornado impacts will be an EF1 or EF2 in magnitude, cause $1,137,023 in property damage, cause $4,807 in crop damage, kill 0.27 people, and injure 3.44 people.

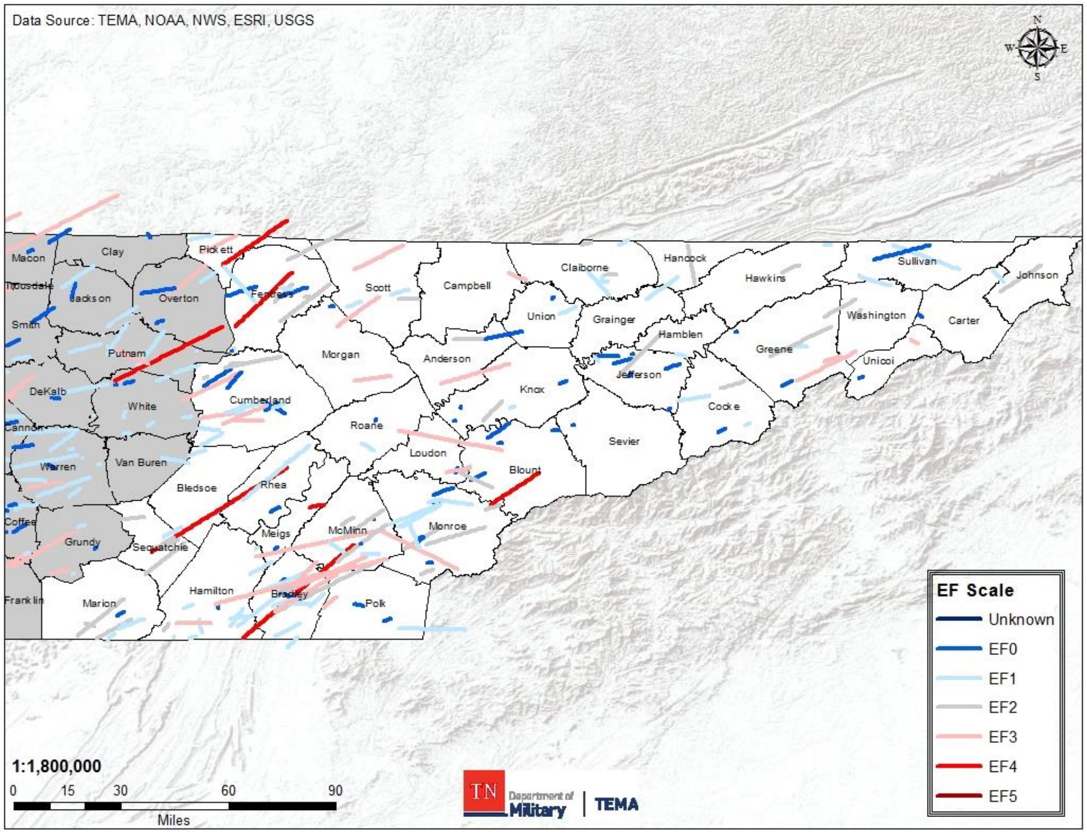
Map 70 – Historical Tornado Impacts, West Tennessee



Map 71 – Historical Tornado Impacts, Middle Tennessee



Map 72 – Historical Tornado Impacts, East Tennessee



4.3.3 – Incidents & Probability

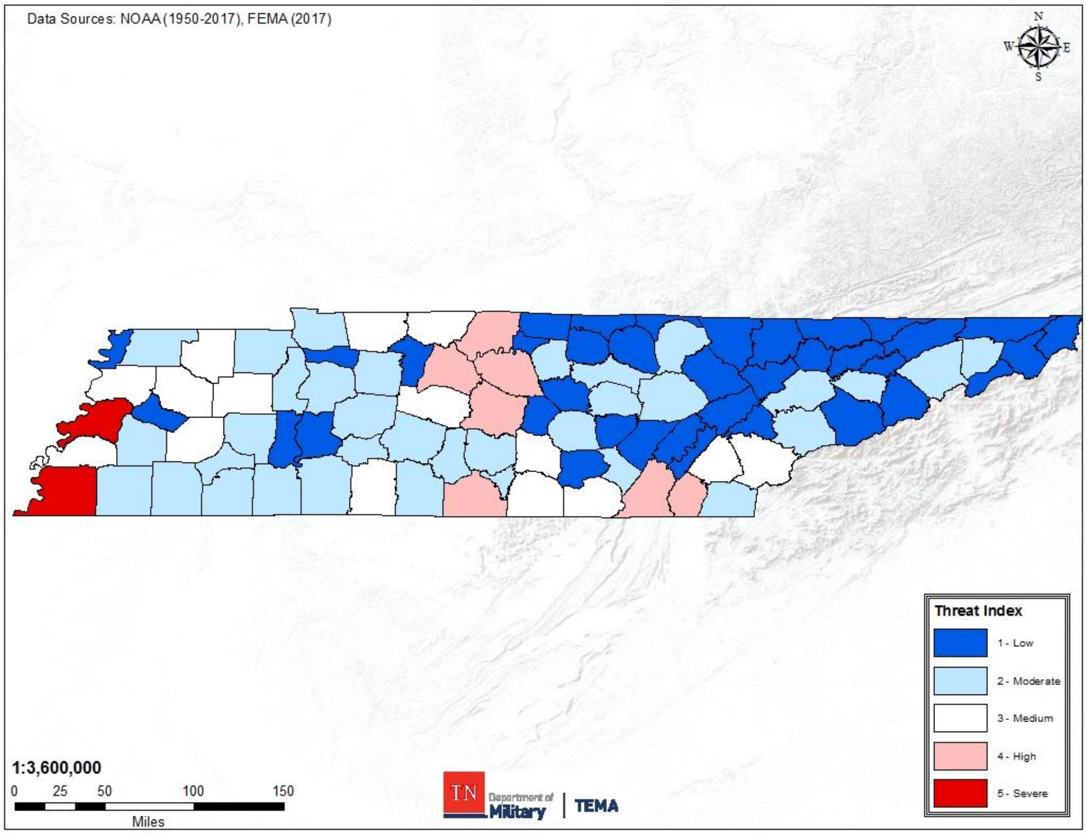
The state can expect tornado impacts 21.08 times per year. Of the total probability; there are 5.91 EF0 impacts; 8,29 EF1 impacts; 4.2 EF2 impacts; 1.74 EF3 impacts;.91 EF4 impacts; and .01 EF5 impacts per year.

Table 57 – Impact Probability, Tornadoes						
Impact Year	Count of Impacts by Fujita Scale					
	F/EF0	F/EF1	F/EF2	F/EF3	F/EF4	F/EF5
1950 - 1959	0	33	40	12	12	0
1960 - 1969	0	37	28	10	0	0
1970 - 1979	27	82	35	23	18	0
1980 - 1989	23	57	27	10	1	0
1990 - 1999	79	62	48	25	8	1
2000-2009	101	131	43	25	5	0
2010	11	9	2	0	0	0
2011	78	70	39	6	14	0
2012	11	10	8	1	0	0
2013	29	26	3	0	0	0
2014	3	12	2	3	0	0
2015	10	10	3	1	3	0
2016	3	5	3	1	0	0
2017	21	12	1	0	0	0
Total Years =	67					
Total Recorded Events =	396	556	282	117	61	1
Total Tornadoes =	1413					
Probability By Class = Average Impacts per Year =	591.04% 5.91	829.85% 8.29	420.89% 4.20	174.63% 1.74	91.04% 0.91	1.49% 0.01
Yearly Probability = **Average Impacts per Year =**	**2108.94%** **21.08**					

**The data are compiled from the NOAA NCDC Storm Event Database*

The following map depicts the concentrations of tornado impacts throughout the State of Tennessee.

Map 73 – Tornado Impact Density, Tennessee

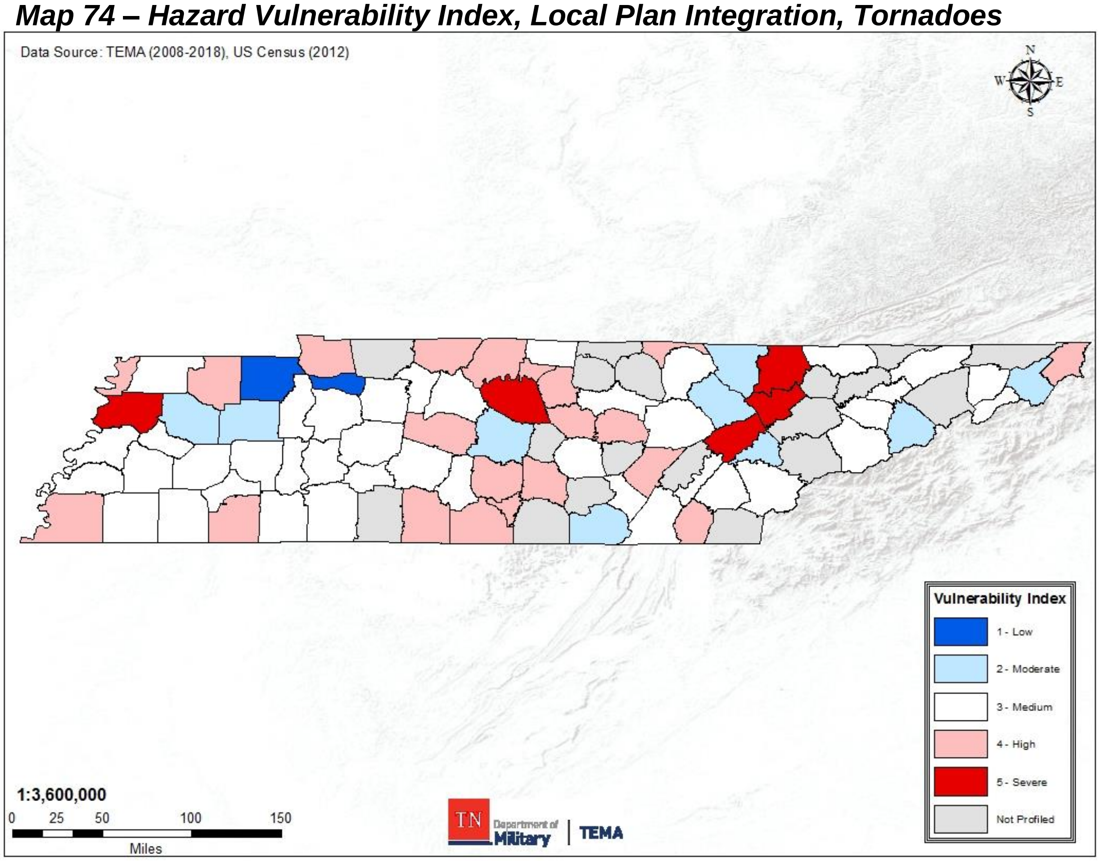


4.3.4 – Changing Future Conditions

Climate is more than a measure of average conditions; it also is the range of weather variability, which can include the frequency and severity of extreme events like tornadoes and storms. Changing weather patterns may result in more frequent and more severe tornadoes in North Carolina. A US Government Accountability Report in 2017 states that $350 billion has been incurred by the US Government from extreme weather and these costs are expected to increase as rare events become more common. Additionally, according to the National Aeronautics and Space Administration (NASA), tornado and thunderstorm events in the future are likely to become more frequent in the southeast as a result of weather extremes. Thunderstorm/tornado potential is measured by an index that NASA created that is called the Convective Available Potential Energy (CAPE) index which measures how warm and moist the air is, which is a major contributing factor in thunderstorm/tornado formation. NASA projects that by the period of 2072-2099, the CAPE in the southeastern United States will increase dramatically.

The following map depicts the vulnerability to tornado incidents for each county throughout the State of Tennessee. This data was compiled using local plan integration.

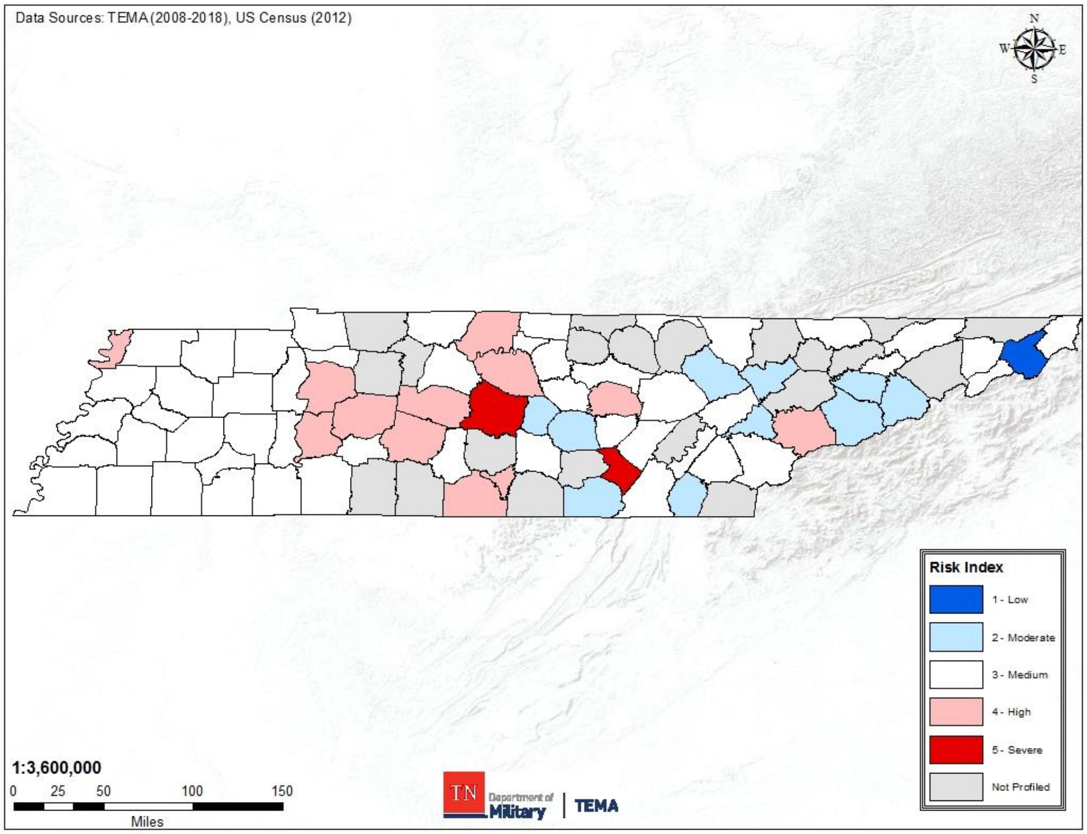
Map 74 – Hazard Vulnerability Index, Local Plan Integration, Tornadoes



4.3.5 – Future Risk

Using a basic risk matrix: Vulnerability+Probability=Risk, TEMA was able to calculate hazard risk using data from the previous subsections. This process is further explained in Section 3.4. As shown in the following map of the risk index, Rutherford and Sequatchie counties are highest risk for tornadoes.

Map 75 – Hazard Risk Index, Local Plan Integration, Tornadoes



4.3WF – Wildfires

The NWS defines a wildfire as: Any free burning uncontainable wildland fire not prescribed *for the area which consumes the natural fuels and spreads in response to its environment.* They can occur naturally, by human accident, and on rare occasions by human action. Typically their point of origin is far from human development with the exception of roads, power lines, and similar infrastructure. There is a constant threat to hikers, campers, and other people engaging in outdoor activities. Significant danger to life and property occurs when human development meets and becomes intertwined with the wildland's vegetation. The threat of wildfire increases in areas prone to intermittent drought, or are generally arid and or dry.

Rampant destruction can be mitigated by fire services regularly engaging in preventive burns and land use measures to minimize the spread of wildfire events. Both of these practices are used in Tennessee to minimize the threat of wildfires.

Population de-concentration in the U.S. has resulted in rapid development in the outlying fringe of metropolitan areas and in rural areas with attractive recreational and aesthetic amenities, especially forests. This demographic change is increasing the size of the wildland-urban interface (WUI), defined as the area where structures and other human development meet or intermingle with undeveloped wildland. Its expansion has increased the likelihood that wildfires will threaten life and property.

The expansion of the WUI in recent decades has significant implications for wildfire management and its impact. The WUI creates an environment in which fire can move readily between structural and vegetation fuels. Two types of WUI are mapped: intermixed and interface. Intermix WUI are areas where housing and vegetation intermingle; interface WUI are areas with housing in the vicinity of dense, contiguous wildland vegetation.

Table 58 shown below, details ranges of wildfire damages. The severity of the wildfire depends on a number of quickly changing environmental factors. It is impossible to strategically estimate the severity of a wildfire as the quickly changing factors, drought conditions and wind speed, have such a great influence on the wildfire conditions.

Table 58 – Burn Severity Index			
Rank	**Burn Severity**	**Description**	**Characteristics**
0	Unburned	Fire extinguished before reaching microsite	• Leaf litter from previous years intact and uncharred • No evidence of char around base of trees and shrubs • Pre-burn seedlings and herbaceous vegetation present.
1	Low Severity Burn	Surface fire which consumes litter yet has little effect on trees and understory vegetation.	• Burned with partially consumed litter present • Evidence of low flame heights around base of trees and shrubs (<0.5 m) • No significant decreases in overstory & understory basal area, diversity or species richness from pre-burn assessments • Usually burning below 80 ° C
2	Medium-Low Severity Burn	No significant differences in overstory density and basal area, & no significant differences in species richness. However, understory density, basal area, and species richness declined.	• No litter present and 100% of the area covered by duff • Flame lengths < 2 m • Understory mortality present, little or no overstory mortality
3	Medium-High Severity Burn	Flames that were slightly taller than those of Medium-low intensity fires, but these fires had occasional hot spots that killed large trees, With significant reduction in the understory	• Soil exposure on l-50% of the area • Flame lengths <6m • High understory mortality with some overstory trees affected
4	High Severity Burn	Crown fires, usually a stand replacing burn with relatively high overstory mortality	• Soil exposure >50% • Flame lengths >6m • Higher overstory mortality >20% • Usually burning above 800 ° C

4.3.1 – Location & Extent

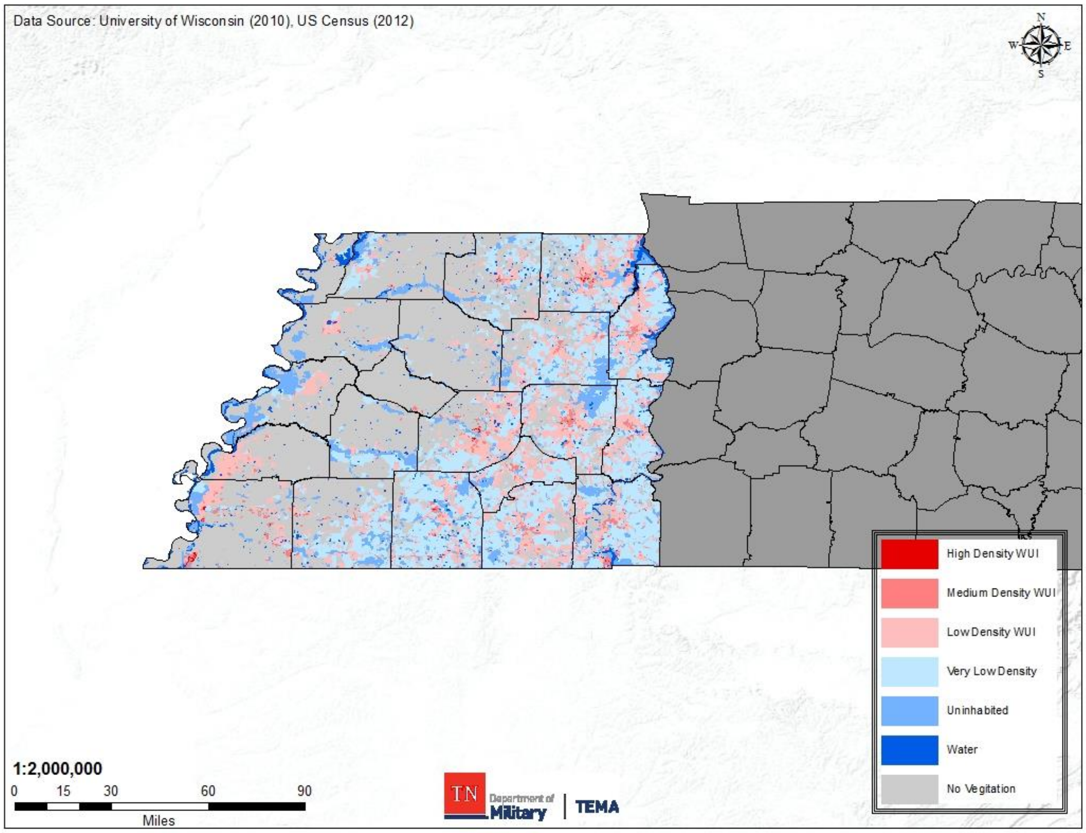
In Tennessee, as in most places, the WUI is at its most vulnerable the larger the population-bases are that interface or intermix. In western parts of the state, the largest interface/intermix is situated near Memphis. The other interface/intermix areas are scattered fairly evenly north to south in the eastern part of western Tennessee. In Middle Tennessee, the largest areas of WUI are concentrated in Cheatham, Dickson, Davidson, Montgomery and Williamson Counties with the remaining areas even distributed north to south in middle Tennessee.

Since there are more forest lands and a substantial population in the eastern third of the state, it is no surprise that the largest concentration of WU interface/intermix occurs there. The largest area is near Knoxville with the eastern half of East Tennessee having the most frequent occurrence of population with interface/intermix.

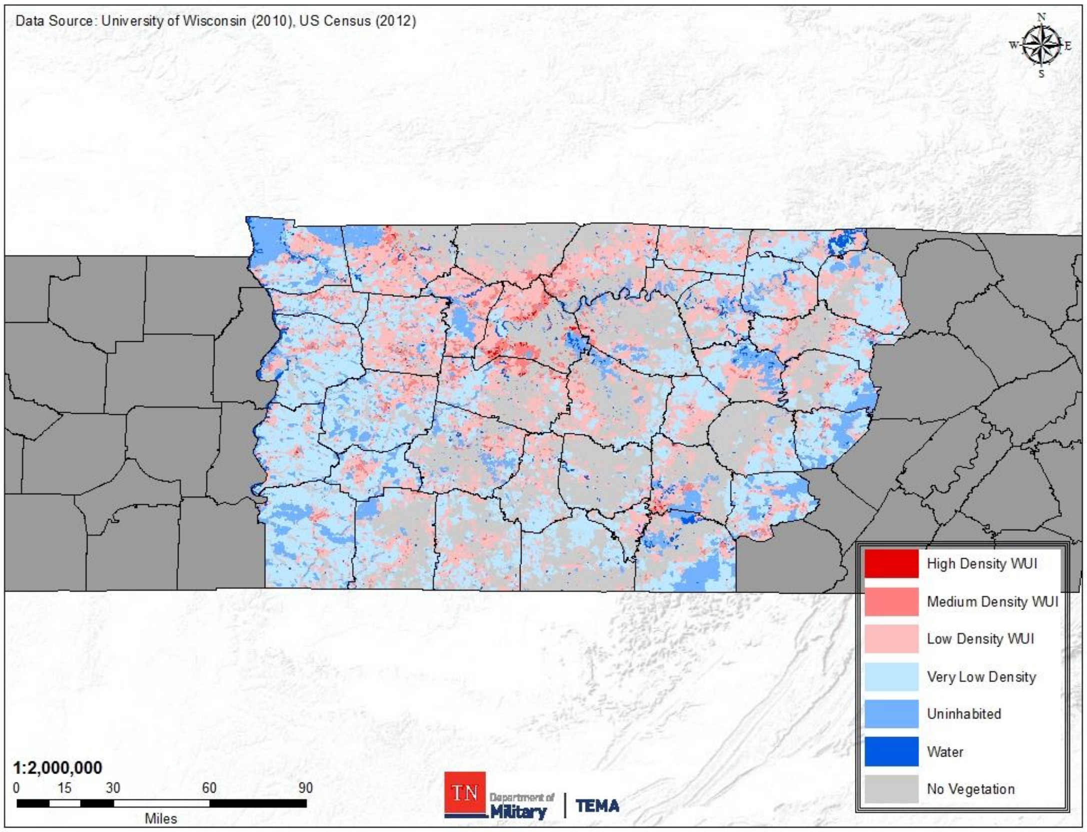
The duration of a wildfire depends on the weather conditions, how dry it is, the availability of fuel to spread, and the ability of responders to contain and extinguish the fire. Historically, some wildfires have lasted only hours while other fires have continued to spread and grow for an entire season. They spread quickly and often begin unnoticed until they have grown large enough to signal by dense smoke. If fuel is available, and the high wind speeds hit, a wildfire can spread over a large area in a very short amount of time. These factors make the difference between small upstart fires easily controlled by local fire services to fires destroying thousands of acres requiring multiple state and federal assets for containment and suppression.

The following map depicts the wildland-urban interface (WUI) for Tennessee. 2010 WUI data is the most recent wildfire data available for the state of Tennessee.

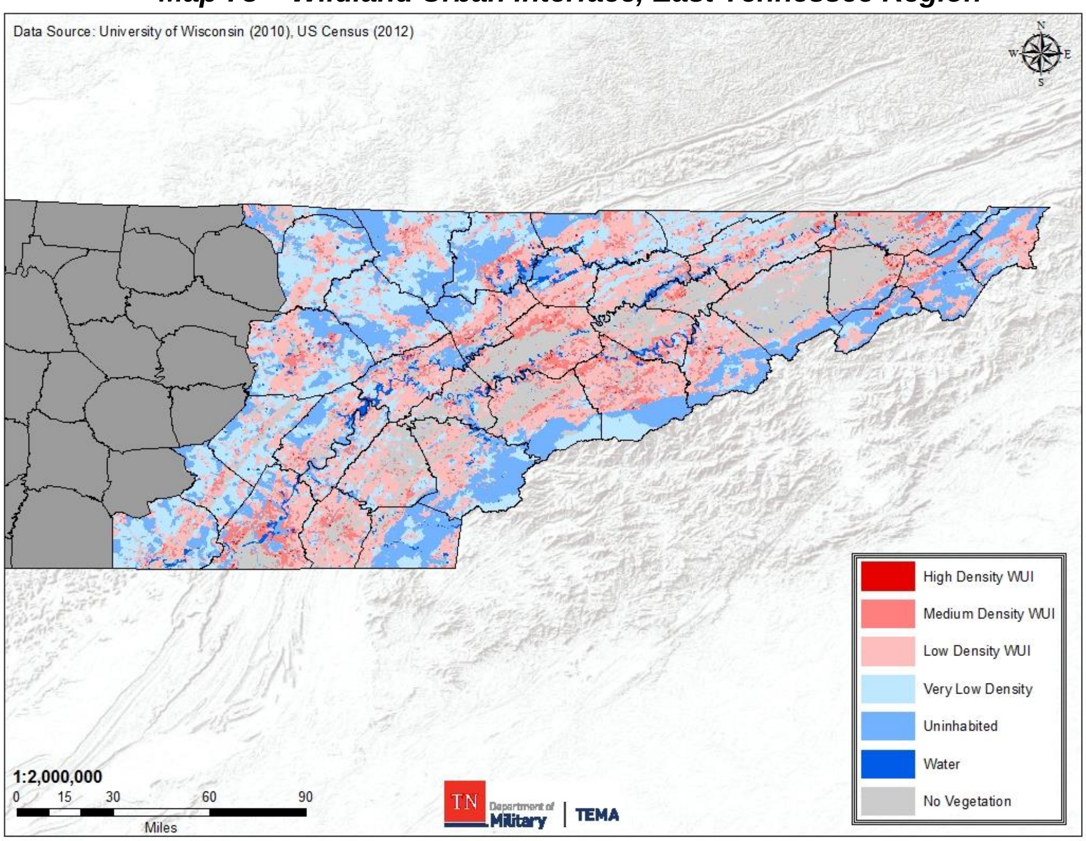
Map 76 – Wildland Urban Interface, West Tennessee Region



Map 77 – Wildland Urban Interface, Middle Tennessee Region



Map 78 – Wildland Urban Interface, East Tennessee Region



4.3.2 – Previous Occurrences

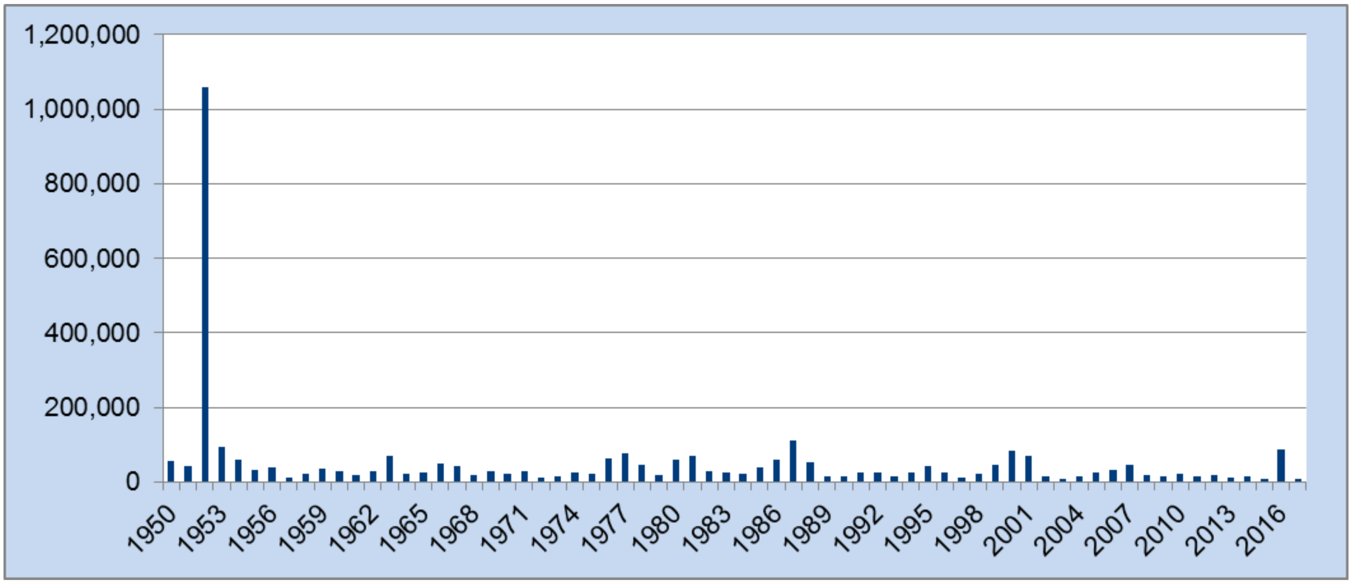
Historic Hazard Event – Wildfire – Summer 1953
Forest and brush fires were severe statewide. This is the worst recorded fire season in the state's history burning over 1,000,000 acres of land.

Historic Hazard Incident – Drought & Wildfire – 2016
A historic drought in the fall of 2016 preceded historic wildfires. By November 22, all 95 counties in Tennessee were classified in "Severe Drought" (D2) or higher. Tennessee experienced numerous wildfires across the state, including several that required federal assistance. On November 28, 2016, hurricane-force winds rapidly expanded a small wildfire in Sevier County into the largest interface fire to impact the state of Tennessee in 100 years, resulting in an estimated $595 million real property and contents loss. There were fourteen (14) fatalities and 221 people treated with fire-related injuries. The fire area was reported at 17,140 acres.

Table 59 – Historical Impacts, Wildfires (1950 - 2017)	
Total Fires	198,708
Average Impacts per Year	2,922
Fire Probability	2922%
Total Acres	3,339,615
Acres Per Year	49,112
Acres Per Wildfire	17

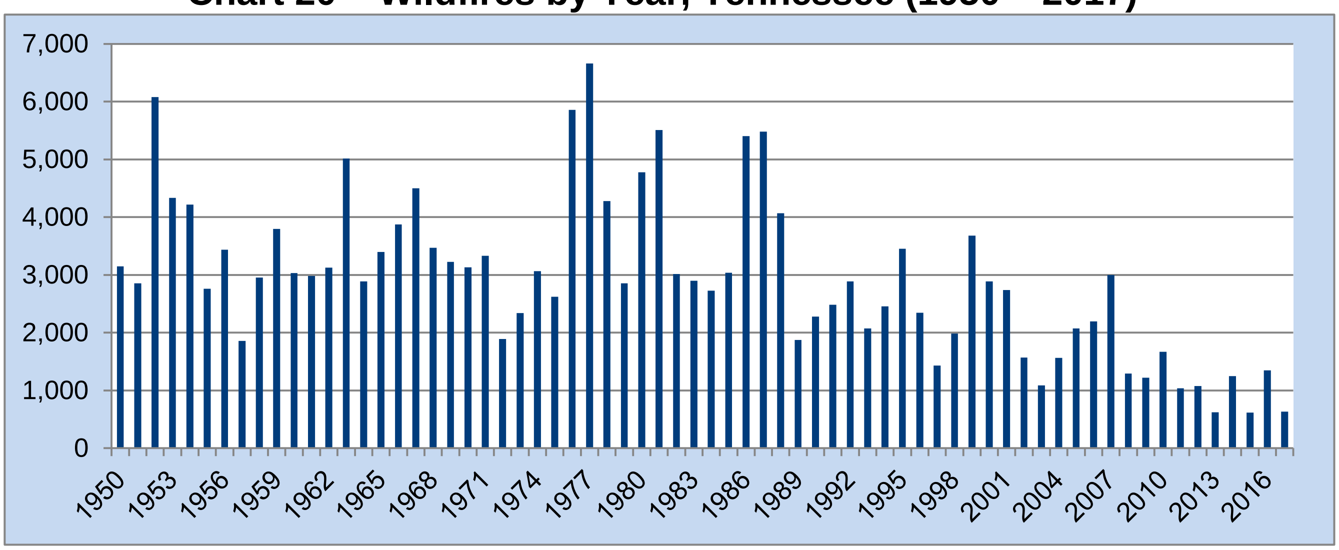
**The data are from the Tennessee Division of Forestry*

Chart 19 – Acres Burned by Year, Tennessee (1950 – 2017)



**The data are from the Tennessee Division of Forestry*

Chart 20 – Wildfires by Year, Tennessee (1950 – 2017)



**The data are from the Tennessee Division of Forestry*

4.3.3- Incidents/Probability

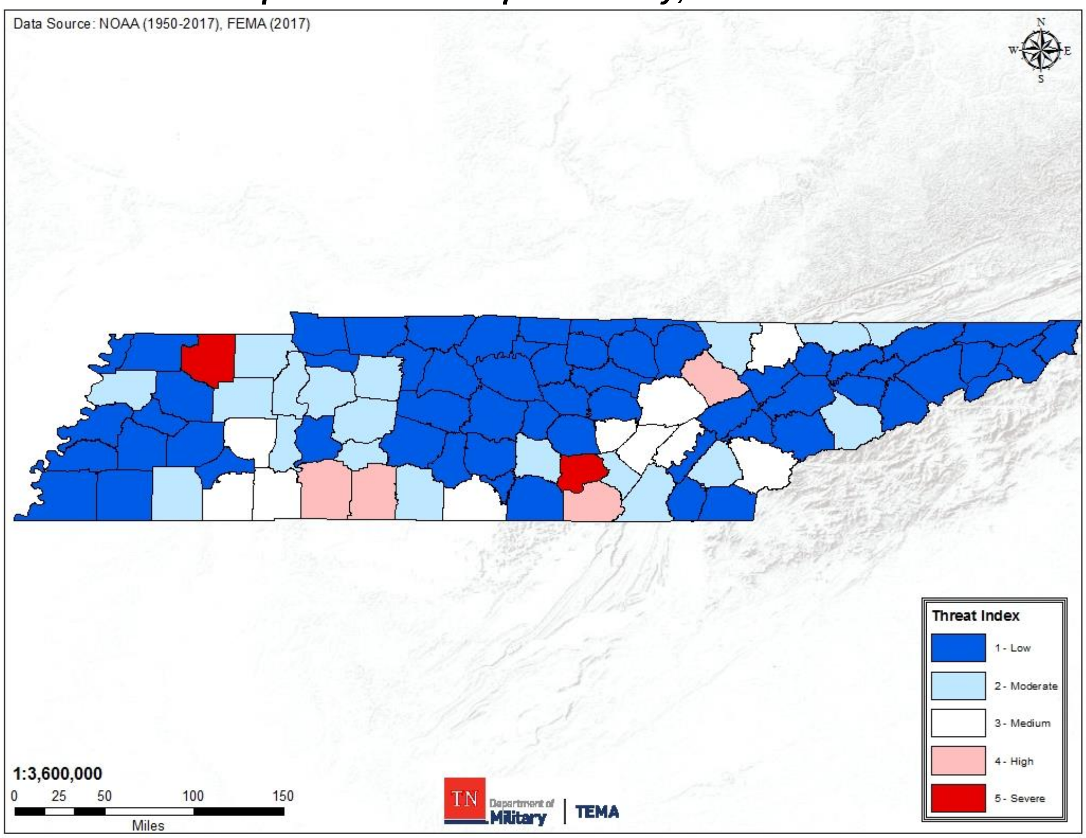
Since 1950, the Tennessee Division of Forestry has recorded 198,708 wildfires burning 3,339,615 acres in the State of Tennessee. They do not have a complete record of property damage or total environmental damage.

Based on the Division of Forestry's data, Tennessee wildfires burn 17 acres per wildfire and 49,112 acres per year.

The state can expect wildfires 2,922 per year.

The following map depicts the concentrations of wildfire impacts throughout the State of Tennessee.

Map 79 – Wildfire Impact Density, Tennessee



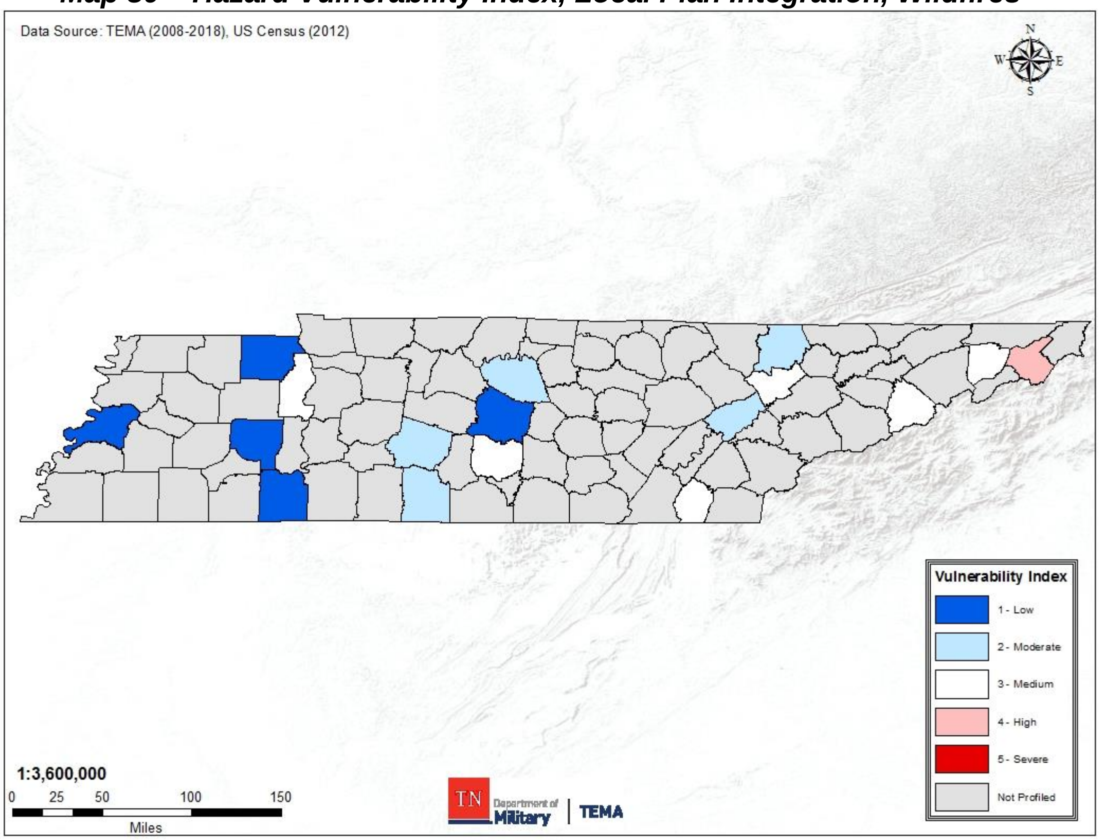
4.3.4 – Changing Future Conditions

A United States Government Accountability Office report dated September 2017 states that the Presidential budget proposal for 2017 references that the United States government has incurred direct costs of more than $350 billion because of extreme weather and fire events including:
- $205 billion for domestic disaster response and relief
- $90 billion for crop and flood insurance
- $34 billion for wildland fire management and
- $28 billion for maintenance/repairs to federal facilities, managed lands, infrastructure and waterways.

These costs are only expected to increase according to the U.S. Global Change Research Program that finds "impacts and costs of extreme events – such as floods, drought, and other events – will increase in significance as what are considered rare events become more common and intense because of weather extremes. Periods of heavy precipitation can result in an explosion of vegetative growth. This, followed by higher temperatures and drought events can lay the ground work for a wildfire rich environment. Growing populations, urbanization and encroachment upon wilderness areas also increase the probability of a wildfire event.

The following map depicts the vulnerability to wildfire incidents for each county throughout the State of Tennessee. This data was compiled using local plan integration.

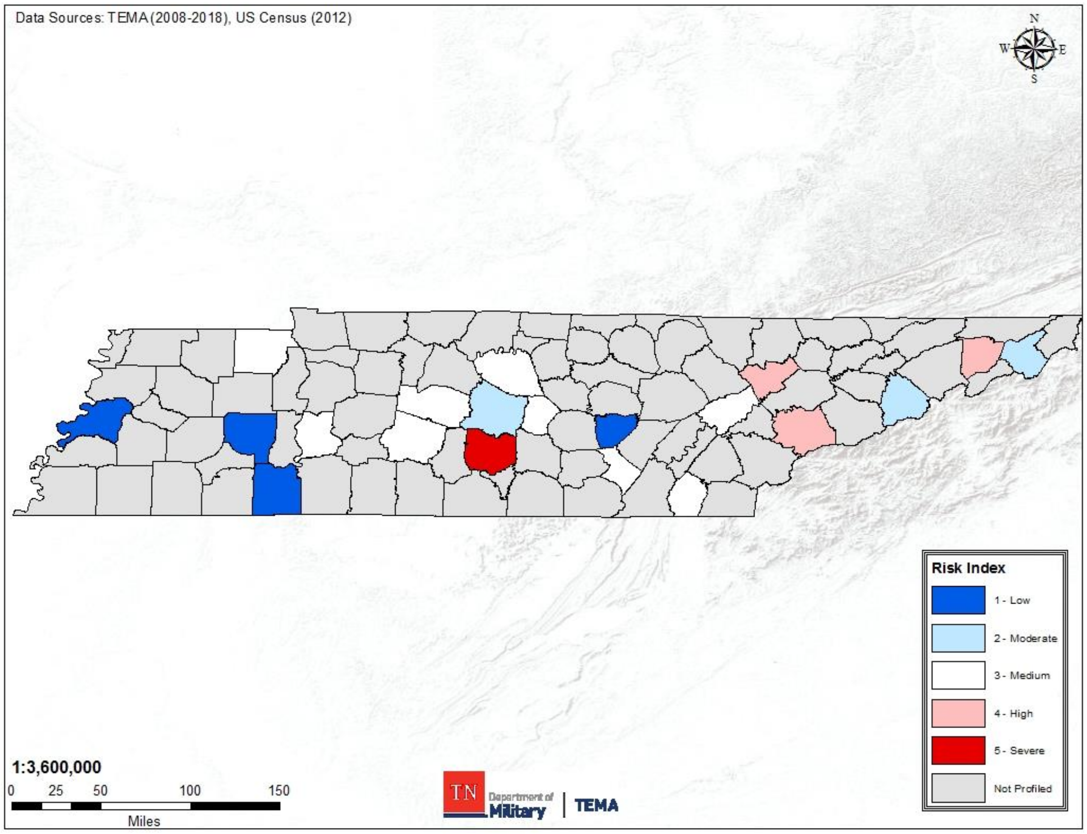
Map 80 – Hazard Vulnerability Index, Local Plan Integration, Wildfires



4.3.5 – Future Risk

Using a basic risk matrix: Vulnerability+Probability=Risk, TEMA was able to calculate hazard risk using data from the previous subsections. This process is further explained in Section 3.4. As shown in the following map of the risk index, Bedford County is the highest risk for wildfires.

Map 81 – Hazard Risk Index, Local Plan Integration, Wildfires



Section 4MM/T – Man Made & Technological Hazards

While natural disaster and hazard mitigation employs the methodology described in standard publications such as FEMA 386-2 "Understanding Your Risks – Identifying Hazards and Estimating Losses," man-made risk assessment requires the integration of more complex economic impact models, and other publications including, but not limited to FEMA publication 386-7 "Integrating Human-Caused Hazards Into Mitigation Planning" and the Emergency Management Accreditation Program Standards. Man-made risks, technological hazards, and biologic threat modeling often require greater extrapolation from related data, as their historic incidence may not be as frequent, or have yet occurred for newer technologies. Succinctly put, the mechanics of man-made disasters requires inferential, rather than empirical determination.

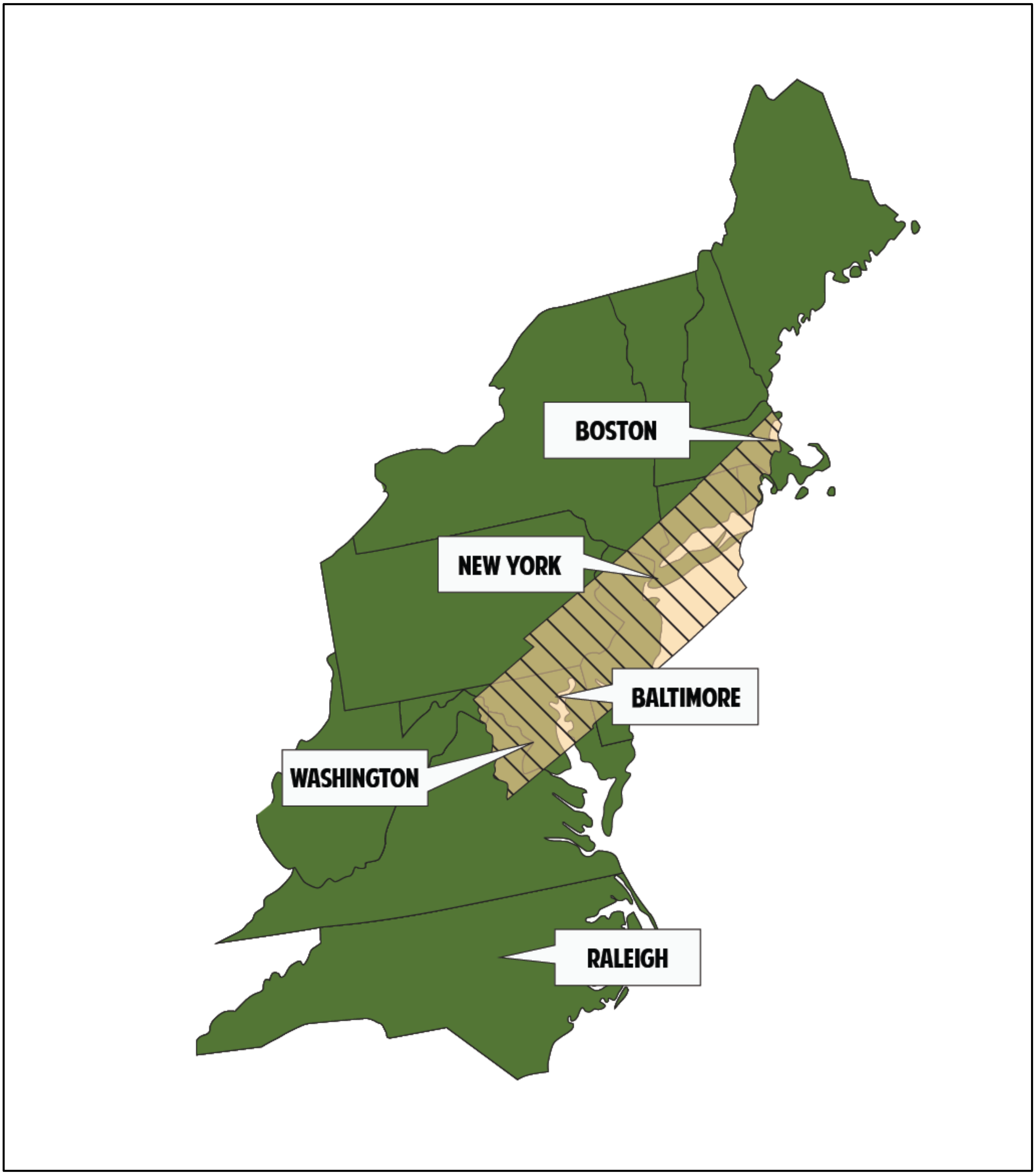
Methodology

There is no quantity more variable or subject to change than the human-factor: it increases the difficulty in prediction, and the necessity for flexibility in modeling. To this end, the following statistical sources have been consulted to provide economic impact scenarios and reference points, and then to correlate by region expressing that region's particular exposures and liabilities:

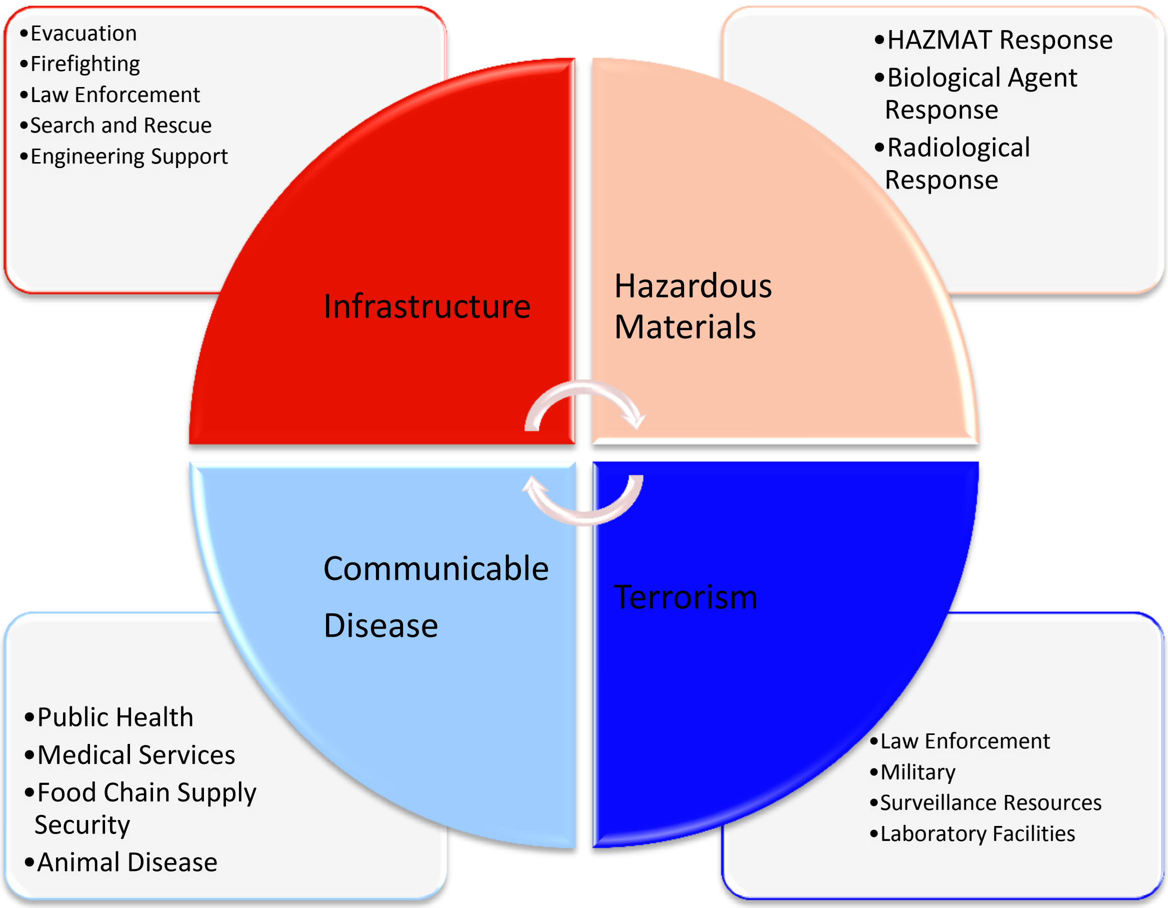
- US Census Bureau
- US Department of Commerce: Bureau Economic Analysis (BEA): RIM II
- The US Critical Infrastructure Assurance Office (CIAO) Site List
- Housing and Urban Development (HUD)
- NAIC (National Association of Insurance Commissioners) SAP (Statutory Accounting Principles)
- Tennessee Department of Transportation (TDOT)
- Tennessee Department of Commerce and Insurance (TDCI)
- RAMCAP Plus®

Tennessee, by its physical nature, creates a markedly wide exposure platform. Map 82 below demonstrates the proportional geographic and metropolitan risks when compared to the more localized and manageable areas on the Eastern seaboard.

Map 82 – Proportional Geographic Risk



Intra-agency dependency constitutes both an asset and a liability; understanding workflows determines how effectively these agencies can share or delegate their responsibilities. The constituent needs in 4 of the Man Made and Technical Hazards and the work flow they depend on can be best visualized in the graph below.



4.3CD – Communicable Diseases

Communicable diseases encompass a wide variety of pathogens along with multiple mediums for transmission, and pose one of the most flexible and rapidly evolving public health threats in Tennessee and FEMA Region IV at large. The scope of these threats, and the multiple agencies often required to respond to even singular incidents make protocols and timely dissemination of public health information of particular importance. Further, communicable diseases that are not generalized public health threats can spread quickly in close quarters or through contaminated public resources immediately following an emergency and relocation of large populations. Protocols must be in place for proper sanitation, timely triaging, and reporting of cases when overcrowding due to displacement is present in temporary housing, shelters, or residential facilities. The Emergency Provider Infection Control Manual must also be referenced during the course of emergencies to institute protocols that prevent patient to provider transmission of infectious diseases.

A Communicable Disease Emergency occurs when urgent or extensive public health or medical interventions are necessary because the risk of disease outbreak or biologic threat carries the potential for morbidity and mortality in Tennessee, a specific region, at county or municipal levels or nationally. The CEDEP participates in the Emerging Infections Program (EIP) in conjunction with Tennessee Department of Health, Vanderbilt University School of Medicine, Department of Preventive Medicine, and the CDC. This program allows for the combined resources of these entities to assess the public health impact of emerging infections and to evaluate methods for their prevention and control. The EIP operates in conjunction with 9 other states: California, Colorado, Connecticut, Georgia, Maryland, Minnesota, New Mexico, New York, and Oregon. 2015 commemorated the 20th anniversary of the Emerging Infections Program. The EIP was established by the CDC, but is operated at the state level to facilitate: surveillance, prevention, and control of emerging infectious diseases. EIP activities go beyond the routine functions of health departments by:

- Addressing the most important issues in infectious diseases and selecting projects that the EIP network is particularly suited to investigate
- Maintaining sufficient flexibility for emergency response and addressing new problems as they arise
- Developing and evaluating public health interventions and ultimately transferring what is learned to public health agencies
- Incorporating training as a key function of EIP activities
- Giving high priority to projects that lead directly to the prevention of disease

4.3.1 – Location & Extent

Tennessee maintains an extensive array of communicable disease personnel both inside and ancillary to the Communicable and Environmental Diseases and Emergency Preparedness (CEDEP) division. Communicable and Environmental Disease and Emergency Preparedness is a program area of the Tennessee Department of Health; it is assigned the responsibility of detecting, preventing, educating, and controlling infectious and environmentally-related illnesses of public health significance. Emergency management personnel are more frequently including pandemic and communicable disease drills in their exercise dockets at locations across the nation. The Centers for Disease Control and Prevention (CDC) has created a pandemic flu toolkit which is aligned with the pandemic phases outlined by the 2013 World Health Organization guidelines.

Communicable diseases fall into 2 broad categories: Human or Zoonotic. While the purview of the human to human pathogens remains fairly well delineated at both the state and federal level, zoonotic responses will often require the assistance of Tennessee Department of Agriculture, Tennessee Wildlife Management Agencies, CDC, FDA, USDA Wildlife Services, or local Fish and Game officials. Of those diseases that are classified by the state as 1A level incidents, requiring the immediate filing by the observing individual of a telephone incident report, 12 are communicable.

GOVERNING AND COORDINATING AGENCIES:

The following agencies are primarily responsible for any public health threat via communicable disease, though cooperating agencies may not be limited to those listed below.

State Coordinating Agency

- Tennessee Department of Health

State Cooperating Agency

- Communicable and Environmental Diseases Services

Federal Coordinating Agency:

- Department of Health and Human Services

Federal Cooperating Agencies

- Department of Agriculture
- Department of Commerce
- Department of Defense
- Department of Energy
- Department of Homeland Security
- Department of the Interior
- Department of Justice
- Department of Labor
- Department of State
- Department of Transportation
- Department of Veterans Affairs
- Environmental Protection Agency
- General Services Administration
- U.S. Agency for International Development
- U.S. Postal Service
- U.S. Customs and Border Patrol
- American Red Cross

LOCATIONS:

A biologic or communicable disease threat can occur anywhere, or anytime. Concentrated efforts must be made at surveillance in the following arenas:

Healthcare

Tennessee health care institutions serve as the front lines to communicable disease response and also as potential disease reservoir populations and points of cross contamination. Tennessee maintains excellent hospital and in-patient coverage in all 3 of its primary regions, with Level I trauma facilities. All Tennessee hospitals and healthcare facilities are required to report specific Healthcare Acquired Infections to the NHSN, the National Healthcare Safety Network. The NHSN is a web-based data reporting and submission program, which includes validation routines for many data elements, thus reducing common data entry errors. Hospitals can view, edit, and analyze their data at any time. TDH staff download, analyze, and validate NHSN data monthly.

Education Facilities and Dormitories

The State of Tennessee mandates a vaccination series for all incoming resident students at educational facilities, consisting of measles, mumps, rubella, meningococcal meningitis, and varicella vaccines. In spite of these vaccine series, dormitory housing at colleges and universities have historically been susceptible to outbreaks of viral meningitis. In September of 2012, 2 students died from bacterial meningitis at Middle Tennessee State University and Mt. Juliet High School. An outbreak at Oak View Elementary in October of 2012 necessitated the closure of the school and decontamination of the premises and school buses. Vaccination, along with immediate quarantine procedures should be adhered to with particular care in the academic setting where institutional controls are the primary mitigation technique with proven effectiveness

Rural and Isolated Population Reservoirs

Livestock facilities in rural areas post a consistent and demonstrable communicable disease risk addressed in FEMA's Biological Incident Annex publication 12 from 2008. A statistically significant rise in H3N2v in Tennessee has been reported since July 2012; this variant of "swine flu" is significant and poses a higher risk to children than to adults. Along with rises in swine flu, international observation by the WHO and others has pointed to the occurrence of H7N9 (avian influenza) in human populations as a reason for more careful monitoring of poultry facilities throughout the US, particularly those in proximity to international ports and gateways. With over $454 million of farm income generated in 2012, poultry is Tennessee's second largest agricultural product (beef is the first). With the unique combination of a high worth product, a susceptible population in concentrated areas (poultry farms and chicken houses) and Memphis International Airport handling the largest amount of cargo in the world (3.91 million tons in 2012 alone) surveillance and integration with U.S. Customs and Border protection is imperative.

In Germany, in 1993 and in the Netherlands in 1994, the cost of outbreaks of Classical Swine Fever cost each country more than $5 billion. In 2001, the outbreak of Foot and Mouth Disease in the United Kingdom cost more than $6 billion, nearly 0.5% of the UK's Gross Domestic Product. The outbreak affected nearly 25% of all farms in the UK. Because of the time of year at which Foot and Mouth Disease struck, British tourism suffered greater direct losses than the livestock industry. With these figures in mind, it is critical that state and local officials have mitigation plans for communicable disease outbreaks because of the direct threat to human food supplies from meat, milk, and animal by-products. FEMA and the USDA estimate the direct cost of a Foot and Mouth Disease outbreak in the U.S. is as high as $13.5 billion. Indirect costs could be far higher. Given Tennessee's reliance on beef and swine agriculture, the impact could be particularly acute at the state level.

The following map illustrates county livestock cash income, and as such, higher value counties that warrant more significant surveillance due to economic exposure.

Beef cattle are Tennessee's highest revenue agricultural product, accounting for over 16% of all agricultural cash and more than 2 million head of cattle in the state. As such, protection of the beef industry through the Tennessee Department of Agriculture is a paramount concern, in addition to the human risk that bovine communicable diseases pose. The identification in 2003 of a BSE case in Canada, and the subsequent identification later that year of a BSE case in the United States, which had been imported from Canada, led to the concern that indigenous transmission of BSE may be occurring in North America. From 2004 through August 2006, the evidence for such transmission in North America was strengthened by the confirmation of 9 additional indigenous North American BSE cases (seven in Canada and 2 in the United States).

Ports and International Gateways
Tennessee is home to 2 international airports, 1 in Nashville and the other in Memphis. This exposure, along with security breaches that have occurred in the state such as the Y12 breach in July of 2012, prompted the development and implementation of new tracking technology by TrakLok Corporation. This project was funded in part by Innova of Memphis, and through the Tennessee Investment Company Credit Act to better secure freight with flexible locking and container refusal times (e.g. while the cargo is still in transit before arriving at port). This significantly reduces not only the potential for terrorist activity, or invalidated cargo, but allows for real time refusal to prevent the entry of communicable disease or biologic contamination in port before arrival. With almost 4 million tons of cargo arriving in Memphis annually this investment has measureable benefits that include safety and increased business due to reassurances by the state and port authorities.

With borders on 7 states, importation or transport requirements for livestock include brucellosis and pseudo rabies for swine, National Poultry Improvement Plan certified flock certificate for poultry as well as a negative Pullorum-Typhoid test within 90 days, and Trichinosis tests for all bulls transported to or through the state.

4.3.2 – Previous Occurences

Avian Influenza Zoonotic
In March 2017, two commercial chicken flocks on premises approximately two miles apart were affected by Tennessee's first commercial occurrence of highly pathogenic avian influenza. The affected premises were quickly remediated and no affected animals entered the food chain. The virus poses no risk to food supply and the risk of a human becoming ill with avian influenza is very low. Rigorous monitoring and testing for avian influenza is a regular part of the poultry industry nationwide.

Influenza
In 2012, Tennessee was listed by the CDC as one of the highest influenza burdened states in the nation. On average, 20% of the nation's population will contract the seasonal influenza every year. Tennessee carries a higher than average mortality and morbidity rate for influenza and associated pneumonia, with 20.9 per 100,000 compared with the national average of 16.2 per 100,000. In light of this burden, the Tennessee Department of Health maintains a Pandemic Influenza Response Plan, last updated in July of 2008. This plan outlines the response to a pandemic level influenza outbreak, and addresses state and local responsibilities in monitoring potential outbreak scenarios, as well as the economic impact of a given epidemic. At the time of writing this report, H3N2 is of greatest significance, though the ability for any influenza Type A to mutate into highly pathogenic forms is the most difficult facet of the disease. Regional disparities continue to be problematic for influenza vaccine distribution and compliance, as well as lack of access issues in rural areas. Urban vaccination rates are significantly higher than rural or suburban population rates. Thus, lower per capita mortality and morbidity can be assumed though transmission liability is higher in denser population centers. However, the CDC MMWR only maintains data for major metropolitan areas, as such, assumptions for flu cost and containment are made based on their Nashville, Chattanooga, Knoxville, and Memphis P&I rates combined with TDH Resident Death Certificate data for metro versus non-metro regions. The chart below demonstrates regional discrepancies and provides a point of reference for these in the state at large. Rates are deaths per 100,000 across all ages, race, and gender, from 2008 to 2009.

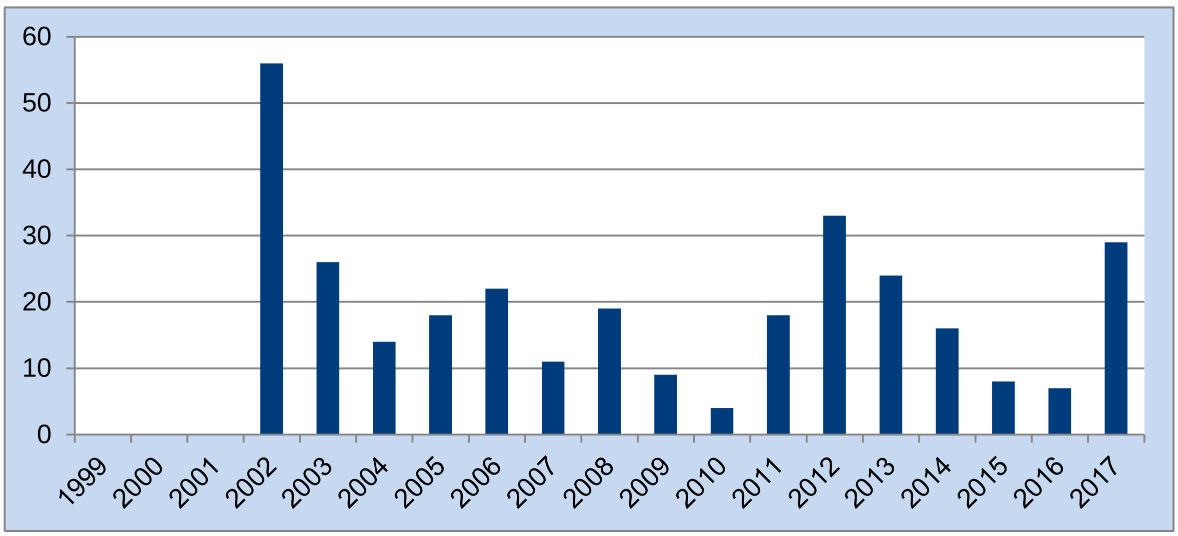
HIV/AIDS
The incidence of HIV/AIDS and their associated comorbidities (including tuberculosis) increased in Tennessee from 2006 to 2012 across almost all ages, sexes, and races, with the exception of diagnosed AIDS cases in 2011, which decreased markedly. The 2 are categorized separately by both state and federal agencies due to differing mortalities and comorbidities for each. HIV/AIDS mitigation

efforts focus on Diffused Effective Behavioral Intervention programs (DEBI), Health Education and Risk Reduction programs (HERR), and prevention programs for HIV infected persons (HIV-IP) to each of 5 health regions throughout the state. Allocations are based on priorities identified in the Comprehensive Community Plan. Lead agencies in each region contract with community-based organizations within their regions, which are responsible for implementing interventions. Currently in Tennessee, 18 community-based organizations are funded to implement a wide-range of science-based HIV prevention programs.

West Nile Virus (WNV)

West Nile Virus is a mosquito-borne illness that saw record levels of infection in humans as well as animals in 2012, with Tennessee being no exception. The CDC documented 32 cases in Tennessee alone in 2012, with peak levels the fourth week of August as shown in the following chart

Chart 21 – West Nile Virus – Human Cases, Tennessee (1999-2017)

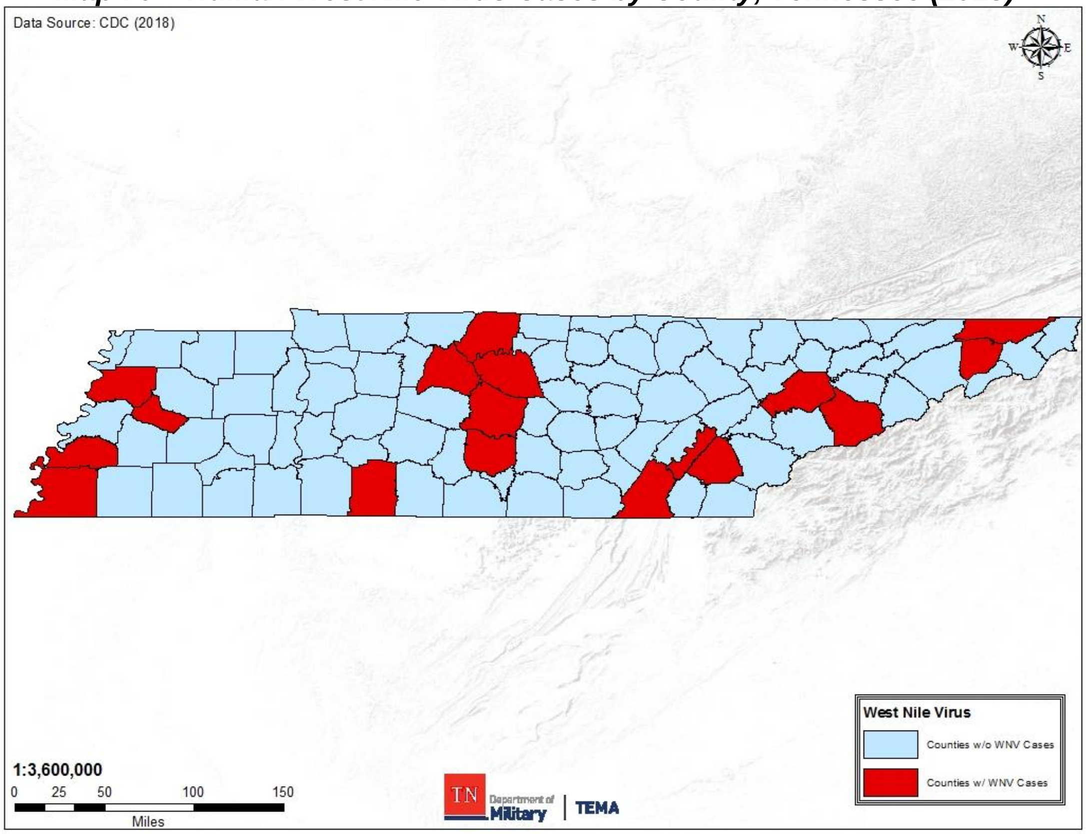


** The data are from the Centers for Disease Control and Prevention*

80% percent of individuals infected with WNV will not present with symptoms. The remaining 20% may experience a range of flu-like symptoms including but not limited to fever, headache, weakness, stiff neck, nausea, vomiting, muscle aches and pains, rash, and in some cases diarrhea, and sore throat. Less than 1 percent of individuals infected with WNV will develop acute illness. Persons over 50 years of age are at highest risk of developing the most severe form of the disease and persons over the age of 70 with other health problems are at greatest risk for death.

As is evident in the following map, WNV infections remain evenly distributed throughout the state. Eradication programs include vaccination of horses and veterinary tracking of vaccination records, as well as community programs to fog or disseminate pesticides over large bodies of stagnant water, and encouraging local residents to remove pools, tires, trash, and other breeding grounds for mosquitos, as well as maintaining good hygiene in standing supplies of water for bird baths, pet water bowls, and children’s pools.

Map 79 – Human West Nile Virus Cases by County, Tennessee (2018)



Rabies

As a viral infection that attacks the nervous system of any mammal and causes encephalitic inflammation, rabies constitutes one of the most persistent, yet preventable public health threats in Tennessee. The state mandates (TCA 68 – 8 – 1) the vaccination of all domestic dogs and cats age 6 months and older on an annual basis. Equine vaccinations are also key to control as horses are exposed in pasture to wild animal bites and feces, and are kept in close quarters in stable and boarding scenarios. These horses come into direct contact with humans through saliva and injury. In addition, the state deposits the ORV (oral rabies vaccination) Raboral VRG® into rural areas by crop dusting methods with aircraft and helicopters to passively vaccinate skunk, raccoon, and opossum populations. 2012 was the eleventh year these baitings occurred with widespread support for their successful reduction in rabid feral animal populations. Large scale kills and poisonings have also been used in Middle Tennessee for high carrier populations that are aggressive, such as coyotes and red tail fox. The "Rabies Control Manual" provided by the state details state level responses, local mitigation efforts, and ongoing monitoring techniques. Rutherford County continues to maintain the highest animal incidence of positive rabies tests, with the primary reservoir population being skunks. The Zoonosis Control Branch of the Texas Health Services Department is the only single repository in the nation for a comprehensive list of rabies-related human fatalities from 1947 through 2008, though TDH maintains state records. As an outbreak often involves bordering states, this data should always be compared to that in the Texas Health Services Database.

Influenza Zoonotic Strains
In 2012 and 2013, the WHO found human carriers of more virulent strains of avian influenza, including H7N9. Unlike H5N1 that raised concerns starting in 2003 and 2009, H7N9 does not manifest in a symptomatic way in poultry, making tracking the movement of the virus and containing it exceptionally difficult. These strains of influenza threaten poultry industry states, but also those states that border them. Multiple poultry producers operate large scale broiler plants in Chattanooga, Monterey, Obion County, Shelbyville, and Morrison, TN. The large footprint of Tyson, Perdue, Koch, and Pilgrims Pride and a growing number of independent mid-scale farms demonstrate the need for continued surveillance and intra-agency communication between the Department of Agriculture and TDH. Currently, these strains post a human health hazard. The economic impact of an outbreak could be difficult to mitigate once the virus is present. Large scale culls have so far been the only mitigation technique to prove successful against a virus that remains latent and asymptomatic for long periods of time. While reinsurance covers large-scale insurance claims by these producers, insurance does not encompass health care or tertiary expenses incurred by the state.

Tertiary Events

Hepatitis C
In 2012, the CDC revised its recommendations to include prophylactic screening for Hepatitis C for anyone born between the years 1945 and 1965. This screening is seen as paramount to reducing potential contamination in the blood supply as Hepatitis C is spread primarily through contaminated needles and drug use. Prior to 1992 blood supply screening techniques were not used resulting in Hep C being transmitted through blood transfusions and organ transplants.

Hepatitis A
The most common mode of transmission for Hep A is person-to-person, resulting from fecal contamination and oral ingestion, and contaminated shellfish. In 1995, a major outbreak of Hepatitis A occurred in Tennessee with Shelby County documenting over 80% of the diagnosed cases. In the fall of 2003, approximately 80 cases were attributed to a Hepatitis A outbreak resulting from ingestion of contaminated green onions at a restaurant in East Tennessee.

Hepatitis B
Hepatitis B is transmitted through blood or body fluids, semen, cervical secretions, and saliva. People with chronic HBV infection are the primary reservoirs for infection. With the exception of the year 2001, from 1995 to 2002, Hepatitis B acute cases steadily decreased. The prevalence of HBV infection among adolescents and adults is 3 to 4 times greater for black individuals than white individuals. Children born to Hepatitis B Surface Antigen positive women are at high risk of becoming chronic carriers of hepatitis B. If these children are administered Hepatitis B Immune Globulin and hepatitis B vaccine at birth, their chances of being protected from the illness are greatly increased. The result is the endorsement of this mitigation procedure by the TDH and the CDC.

4.3.3 – Incidents/Probability

Economic impact analyses from communicable disease events of any scale must take into account medical response, state and private resources, loss of production hours, and human resource drains. According to the Critical Infrastructure Assurance Office (CIAO), the Nation’s Healthcare and Public Health (HPH) sector is an industry critical to maintaining resiliency during any major event. The HPH Sector constitutes 17% of the Gross National Product and protects all sectors of the economy from hazards such as terrorism, infectious disease outbreaks, and natural disasters. Because the vast majority of the sector’s assets are privately owned and operated, collaboration and information sharing between the public and private sectors is essential to increasing resilience of the nation’s HPH critical infrastructure.

The communicable disease events categorized by the CDC and the US Department of Labor as the most likely to adversely affect human performance are any and all strains of influenza. In a typical flu season, between 5% and 20% of the public contract influenza resulting in an average of 36,000 deaths. Pandemic flu viruses may cause illness in 20% to 40% of the population and cause more severe illness and deaths than ordinary seasonal influenza. A pandemic virus vaccine could take 6 to 8 months to produce in conjunction with CDC labs in Atlanta, limiting mitigation success in initial months of an outbreak. Because of this potential, the TDH and CDC consider influenza monitoring and reporting of critical importance.

In addition to agriculturally significant communicable diseases, Tennessee’s unique horse industry makes it particularly susceptible along with bordering states like Virginia and Kentucky to the economic impact of WNV and EHV1 (Equine Herpes Virus), which are also human health threats. WNV and EHV1 were present in Shelby County at the time of this writing in 2013, and 32 cases had been confirmed as transmitted to humans in 2012 in all 3 regions of Tennessee.

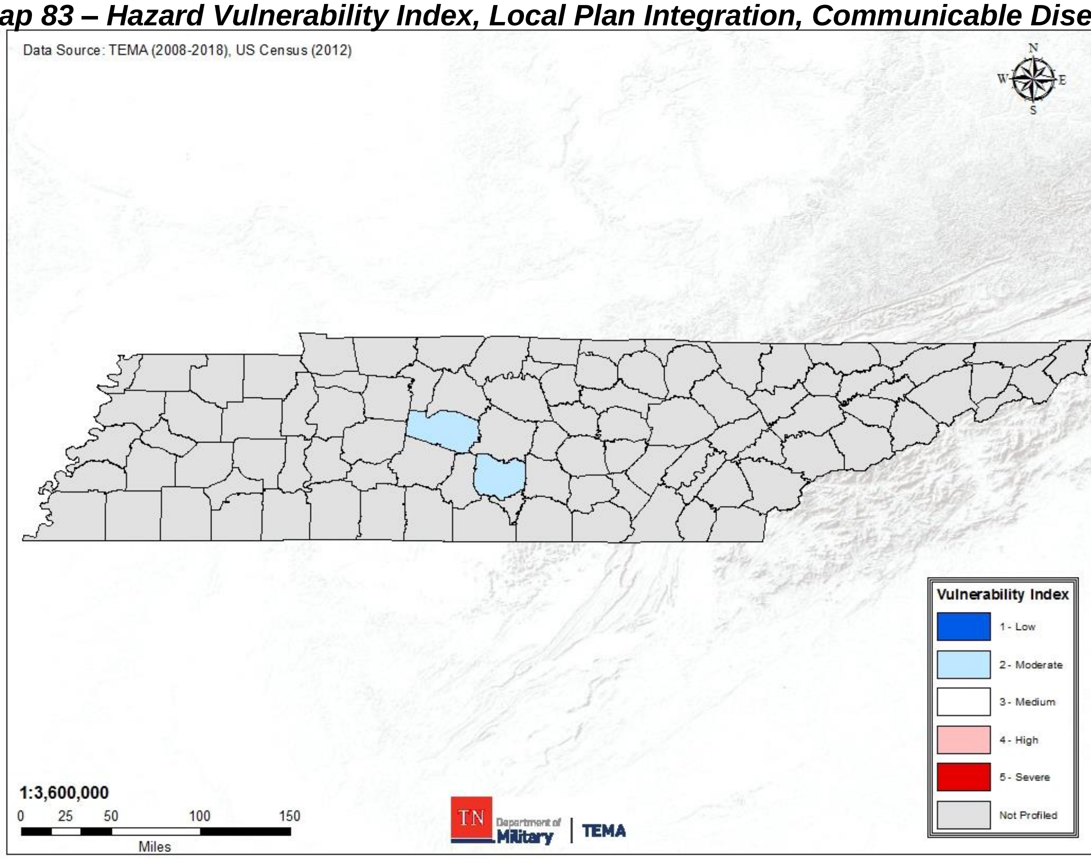
4.3.4 – Changing Future Conditions

There have been many studies conducted between climatic conditions and infectious diseases, and trends show there is a link. Many diseases, such as malaria, dengue fever, and yellow fever are spread through mosquitoes that reproduce and thrive in warm, wet conditions. According to the World Health Organization, Malaria epidemic risk has shown to increase after El Niño events; therefore, if warming surface temperatures and increased precipitation trends continue, Tennessee may be more susceptible to disease occurrence.

In addition to this, due to globalization, the increased migratory status of people, and closer living proximities, diseases and invasive foreign organisms previously not exposed to the Tennessee area may make an appearances resulting in exposure to the Tennessee population to diseases and organisms not normally encountered. This can have an effect on not just the human population but also the flora and fauna of the State, thus effecting not just wildlife but agriculture as well. As large portions of the state are dedicated to various forms of agriculture this could have significant and long term effects on production, quality of life, and the state's economy.

The following map depicts the vulnerability to communicable diseases incidents for each county throughout the State of Tennessee. This data was compiled using local plan integration.

Map 83 – Hazard Vulnerability Index, Local Plan Integration, Communicable Diseases



4.3.5 – Future Risk

Using a basic risk matrix: Vulnerability+Probability=Risk, TEMA was able to calculate hazard risk using data from the previous subsections. This process is further explained in Section 3.4. As shown in the following map of the risk index for communicable diseases most counties do not profile vulnerability and risk for this hazard and those that do it is a very mild threat

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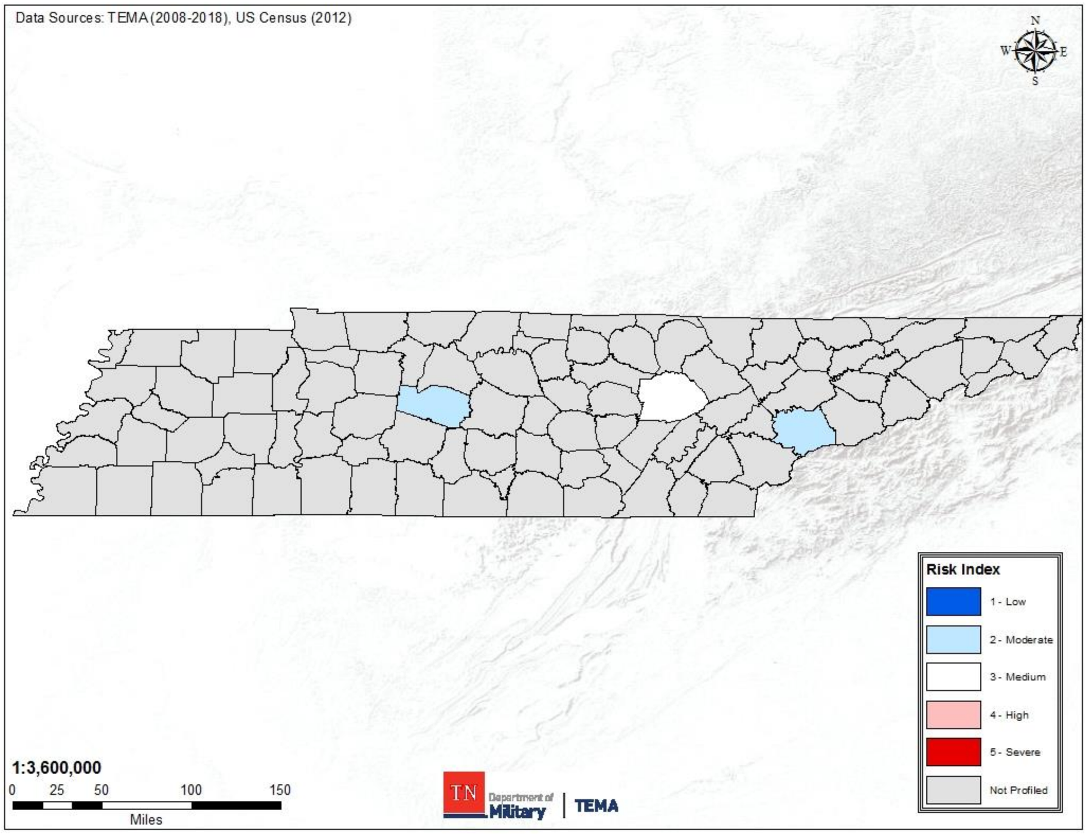
Map 84 – Hazard Risk Index, Local Plan Integration, Communicable Diseases



4.3DLF – Dam & Levee Failure

A dam is a barrier across flowing water that obstructs, directs or slows down the flow, often creating a reservoir, lake or impoundments. Most dams have a section called a spillway or weir, over or through, which water flows, either intermittently or continuously.

According to the Tennessee Safe Dams Program, a dam is any structure that is at least 20 feet high or can impound at least 30 acre-feet of water.

According to the Tennessee Safe Dams program, Dams are classified by size:

Size		
Size	Storage (Ac-ft)	Height (ft)
Small	30- 999	20- to 49
Intermediate	1,000 to 49,999	50 to 99
Large	>= 50,000	>=100

Dams fail in 2 ways, a controlled spillway release done to prevent full failure, or the partial or complete collapse of the dam itself. In each instance an overwhelming amount of water, and potentially debris, is released. Dam failures are rare, but when they occur can cause loss of life, and immense damage to infrastructure and the environment.

Common reasons for dam failure are the following:

- Sub-standard construction materials/techniques
- Spillway design error
- Geological instability caused by changes to water levels during filling or poor surveying
- Sliding of a mountain into the reservoir
- Poor maintenance, especially of outlet pipes (Extreme inflow
- Human, computer or design error
- Internal erosion, especially in earthen dams.
- Earthquakes

4.3.1 – Location & Extent

Dam failures can occur with little warning. Intense storms may produce a flood in a few hours or even minutes from upstream locations. A dam failure can occur within hours of the first signs of breaching. Although the floodwaters will drain, the area will be affected by flooding from the dam failure for days to weeks and the destruction will affect the area for years.

Tennessee has a total of 1200 dams and levees within its borders with 660 of them being state regulated. Roughly 93% are earth dams that are less than 50 feet in height, 40 of these dams are made of concrete, and 37 of the state's dams are over 100 feet tall. 64% of the state's dams are privately owned, 15% locally, 12% by the state, 8% federally, and 1% public utility. Of those, 148 are considered a high-hazard potential with 207 a significant hazard, and 305 a low hazard. The majority of the State's high hazard potential dams are privately owned.

Table 60 – Dam & Levee Inventory, Tennessee			
Dam/Levee Name	**Year Built**	**Maximum Storage (Acre-Feet)**	**Average Storage (Acre-Feet)**
Nickajack	1967	251600	220100
Gypsum Pond	1972	1270	750
N. Potato Creek Diversion	1979	4100	0
London Mills Tailings Pd	1944	2416	800
Raccoon Mountain	1978	37310	2200
Ocoee No. 3	1942	4180	551
Pickwick Landing	1938	1105000	687300
Campbell Cove	1963	2430	1394
Ocoee No. 1	1911	83300	52270
Weatherford-Bear Creek 1B	1970	4600	200
Chickamauga	1940	737300	392000
Jackson	1968	674	460
Lakeland	1950	8711	5617
Boston Branch	1968	478.2	333
Tn Consolidated Coal #1	1976	1342	20
Elk River Dam	1952	101844	77915
Poplar Tree	1952	2255	1535
Tellico	1910	942	402
Laurel Hill Lake	1970	9400	3800
Vfw Lake	1951	467	353
Chief Creek	1970	3130	1520
Normandy	1976	126100	65600
Glenn Springs	1993	9450	5399
Calderwood	1930	0	41100
Rhone Poulenc #21	1980	4600	550
Old Columbia	1925	0	1000
Sweetwater Creek #16	1978	213	46
Sweetwater Creek #15	1979	492	82
Watts Bar	1942	1175000	796000
Twin Lakes #2	1969	282	220
Twin Lakes #1	1969	124	76
Lake Graham	N/A	13841	6451
Lambert	1965	454	361
Beech	1963	15400	7350
Fall Creek Falls	1970	9393	6100
Solutia #2	1962	262.9	20
Solutia #11	1962	2012	500
Occidental Chem #10	1965	1838	1758
Pin Oak	1964	12700	7560
Solutia #15	1977	32945	23614
Lake Marian	1958	114.3	80
Shellcracker	N/A	2508	2205
Goldeneye Lake	N/A	1200	981

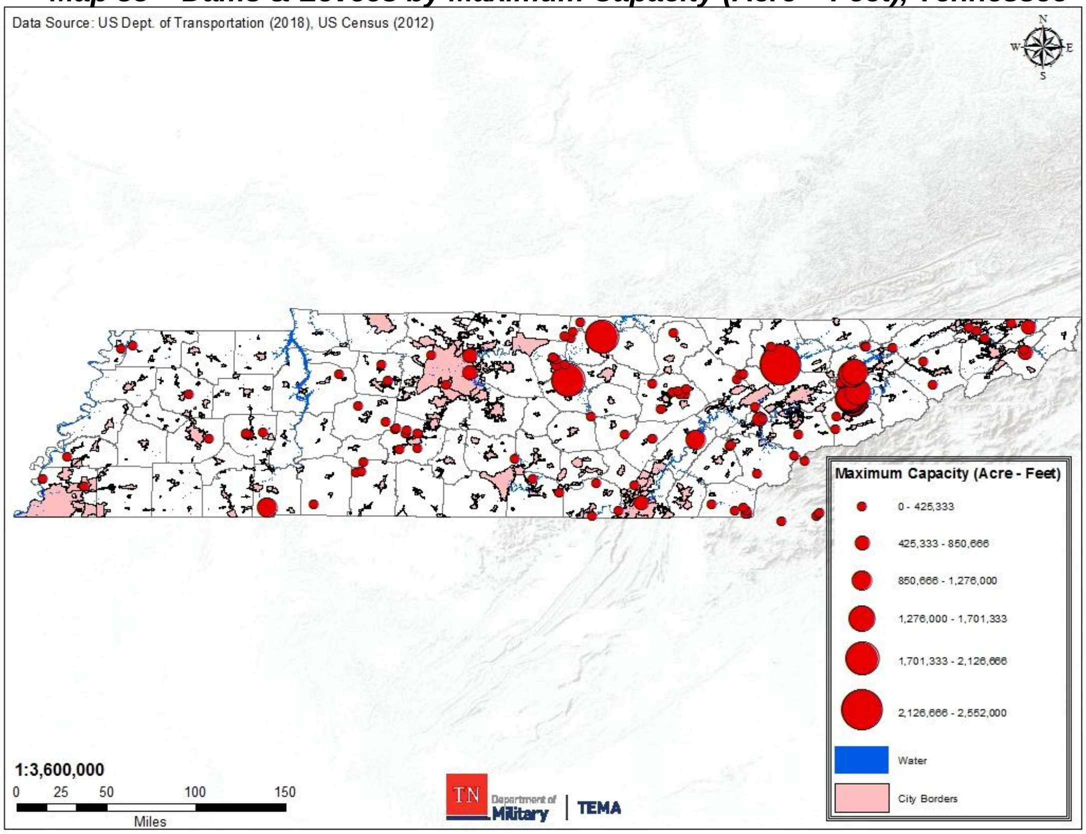
Dam/Levee Name	Year Built	Maximum Storage (Acre-Feet)	Average Storage (Acre-Feet)
Bluecat Lake	1979	5,760	4,200
Littlelot Washer Plt #1	1950	449	64
Tellico	1979	467,600	304,000
Fort Loudoun	1943	393,000	282,000
Hidden Mountain #2	N/A	66	62
Great Falls	1916	50,200	14,500
Tansi	1959	16,000	12,300
Melton Hill	1963	126,000	94,100
Crystal Lake	1989	1,756	1,382
Douglas	1943	1,461,000	210,000
Gibson County Lake	1999	12,701	7,338
Glastowbury	1979	2,880	2,400
St. George	1965	2,400	1,801
Fox Creek Lake	1966	2,590	2,340
Otter Creek	1995	5,227	3,808
Dartmoor	N/A	6,070	4,000
Radnor	1914	2,035	1,132
Nolichucky	1913	2,003	1,507
Caryonah Lake	1970	465	297
Young Mill Tailings Impoundment	N/A	15,450	0
Creech Hollow Dam	1973	2,098	1,490
Acorn	1939	715	370
Center Hill Dam	1951	2,092,000	1,330,000
Brushy Mountain	1949	139	68
Gum Branch Slurry Dam	N/A	250	0
Gum Branch	1982	2,025	1,134
Hooper	1999	0	0
J Percy Priest Dam	1967	652,000	202,000
Cherokee	1941	1,541,000	393,000
Elmwood Tailings	N/A	9,500	0
Norris	1936	2,552,000	630,000
Laurel	1975	1,895	1,489
Cheatham Dam	1954	104,000	8,4200
Big Ridge	1936	1,100	1,027
Savage Zinc Tailings Pond	1974	3,900	250
Cordell Hull Dam	1973	310,900	258,000
Old Hickory Dam	1954	545,000	420,000
Marrowbone	1939	1,670	510
Watauga	1948	677,000	324,000
Wilbur	1912	715	388
Reelfoot Lake	N/A	0	33,500
Pond No. 1A	N/A	493	0
Eblen-Powell #2	1964	808	385
Clinch Valley "A"	1992	1,704	1,363
Reelfoot-Indian Creek #18	1988	5,289	855
Jennings Creek #18	1963	1,260	125

Dam/Levee Name	Year Built	Maximum Storage (Acre-Feet)	Average Storage (Acre-Feet)
Boone	1952	193,400	45,000
Dale Hollow Dam	1943	1,706,000	857,000
Jennings Creek #17	1962	1,930	137
Whispering Winds	1976	1,492	1,492
Jennings Creek #13	1961	400	20
Fort Patrick Henry	1953	26,900	22,650
South Holston	1950	764,000	325,700
B Bend Hollow	1997	1,090	500
Steele Creek	1963	1,989	528
Line Creek #3B	1965	1,446	90

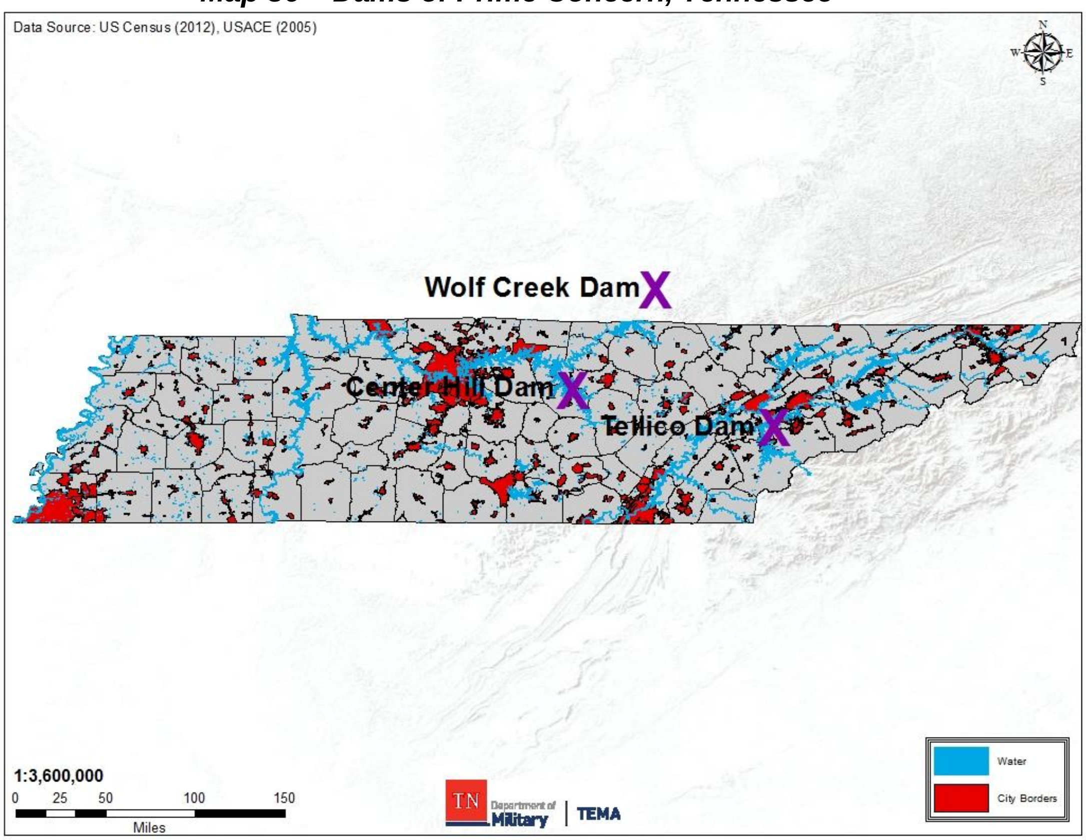
**The data are from the USACE's National Dam Inventory.*

The USACE and the TVA profile 3 potential inundation areas as dam failures of prime concern. These are the Center Hill Dam in middle Tennessee, the Wolf Creek Dam in southern Kentucky, and the Tellico Dam in east Tennessee. Maps 87 through 89 depict the inundation studies for these dams as developed by the USACE and the TVA.

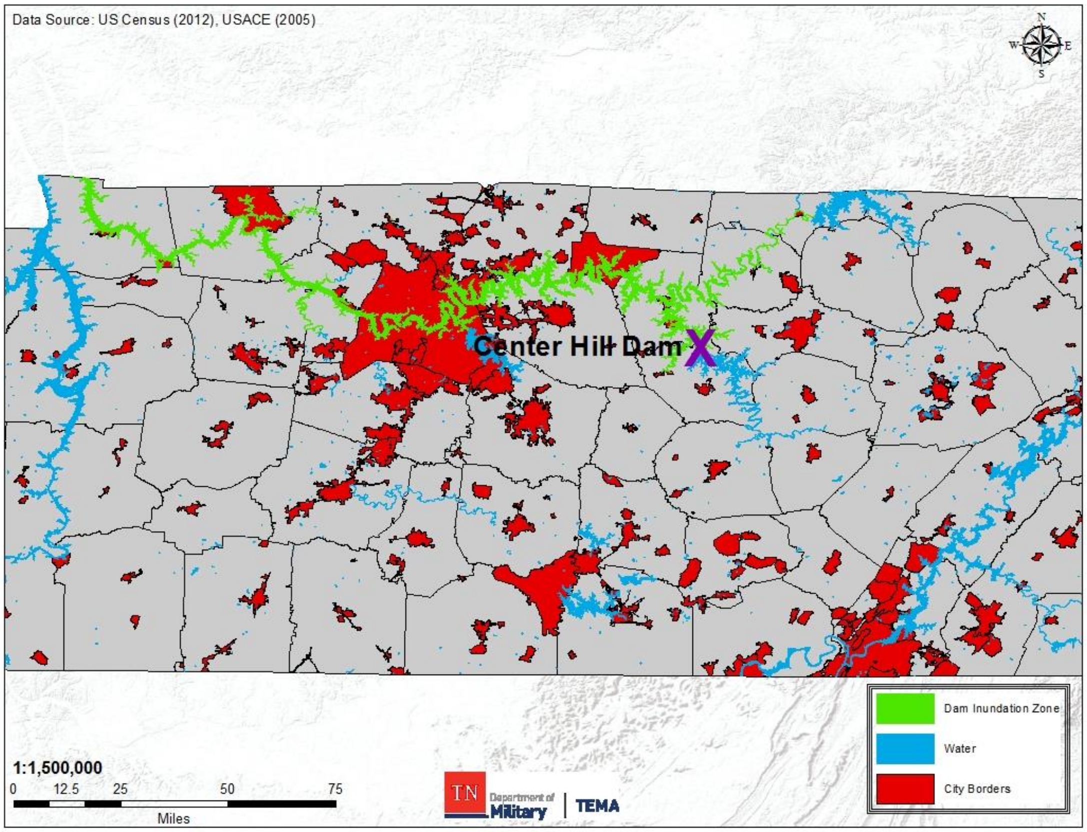
Map 85 – Dams & Levees by Maximum Capacity (Acre – Feet), Tennessee



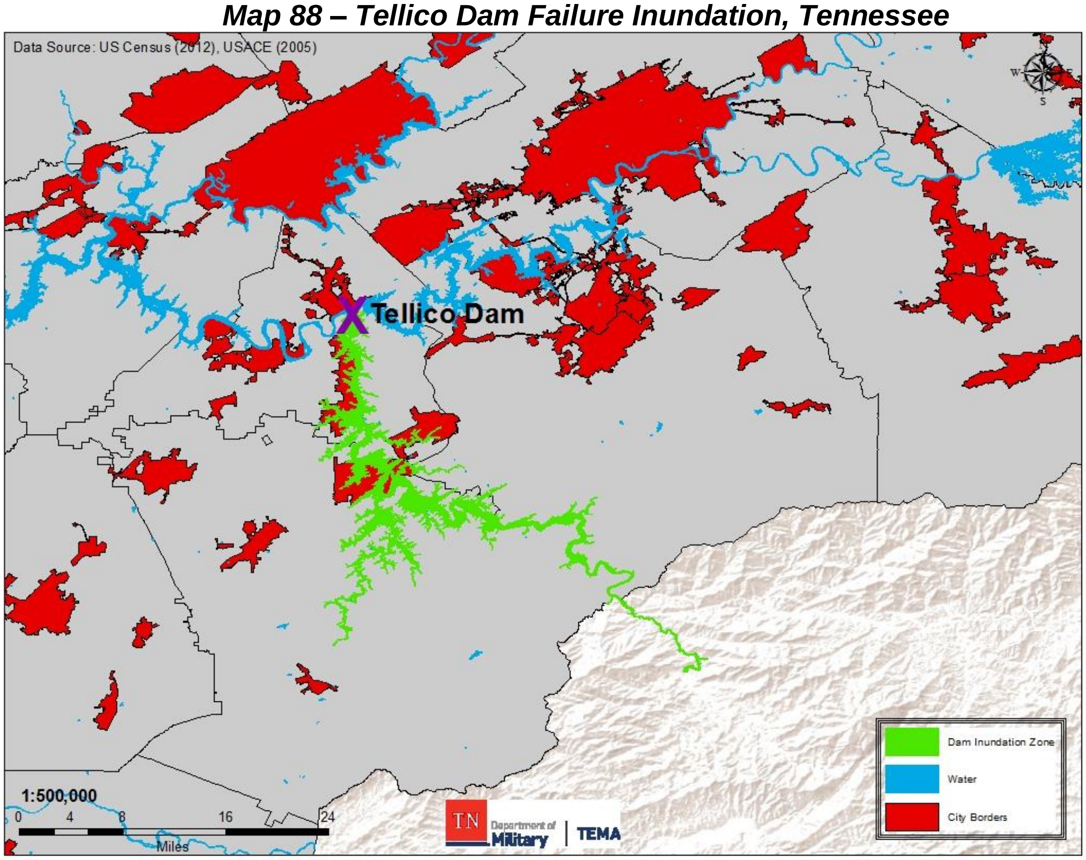
Map 86 – Dams of Prime Concern, Tennessee



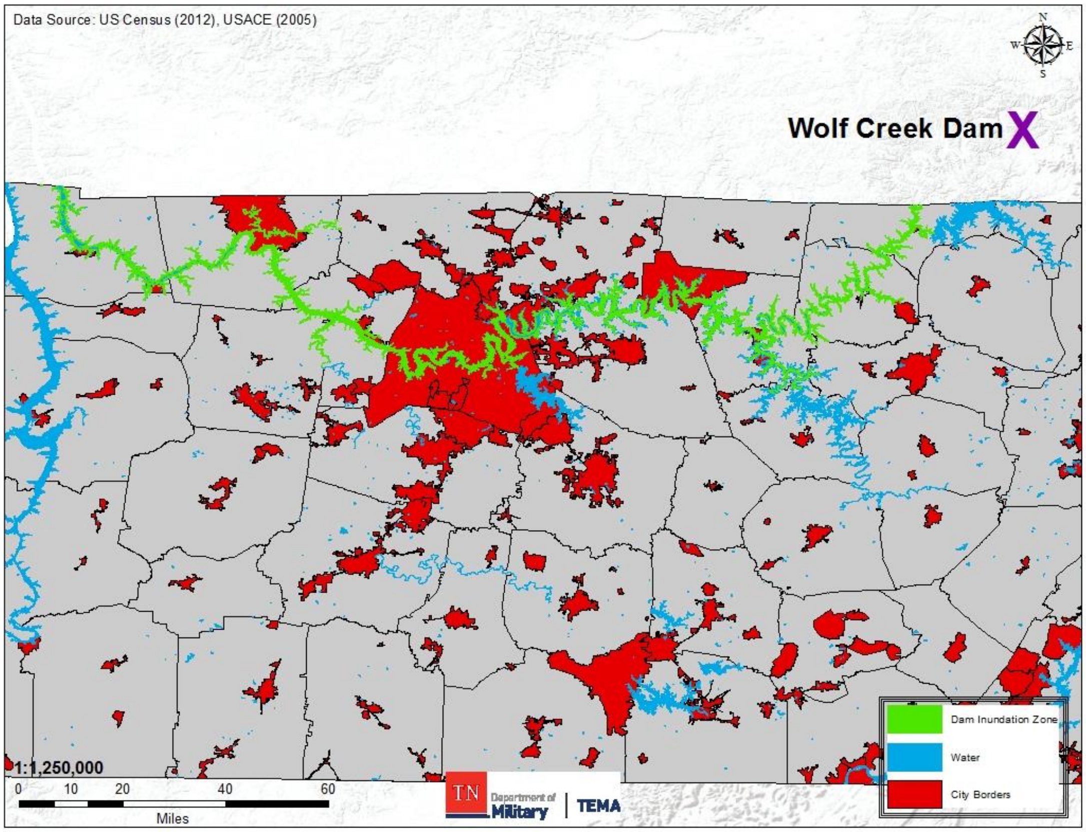
Map 87 – Center Hill Dam Failure Inundation, Tennessee



Map 88 – Tellico Dam Failure Inundation, Tennessee



Map 89 – Wolf Creek Dam Failure Inundation, Tennessee



4.3.2 – Previous Occurrences

Tennessee has suffered a number of dam failures throughout its history. Below are the recorded dam and levee failures in the state.

Historic Event – Dam/Levee Failure – November 1912

A Nashville city reservoir gave way to seepage dumping 25 million gallons of water into Nashville. No one was injured or killed. Property damage estimates are not available

Historic Event – Dam/Levee Failure – August 1916

An unnamed dam in Claiborne County gave way to heavy rainfall. No one was injured or killed, but an estimated $50,000 to $100,000 (in 1916 dollars) was incurred in property damage.

Historic Event – Dam/Levee Failure – May 2008

Within Lawrence County, multiple dam breaches due to overtopping in heavy rain resulting in several structures destroyed, and loss of cattle. Civilians were evacuated prior to dam failure

Historic Event – Dam/Levee Failure – December 2008

50 miles west of Knoxville, the TVA owned and operated levee gave way to 5.4 million cubic yards of sludge, a coal ash slurry. The levee was containing a 40 acre industrial waste pond for the Kingston Coal Plant. The industrial waste cleanup operations cost an estimated 1 million dollars.

Historic Event – Dam/Levee Failure – May 2010

Across multiple counties across the Middle and West regions of the state experienced heavy flooding and multiple dam failures resulting in numerous breaches. Most Breaches occurred due to overtopping during heavy rains.

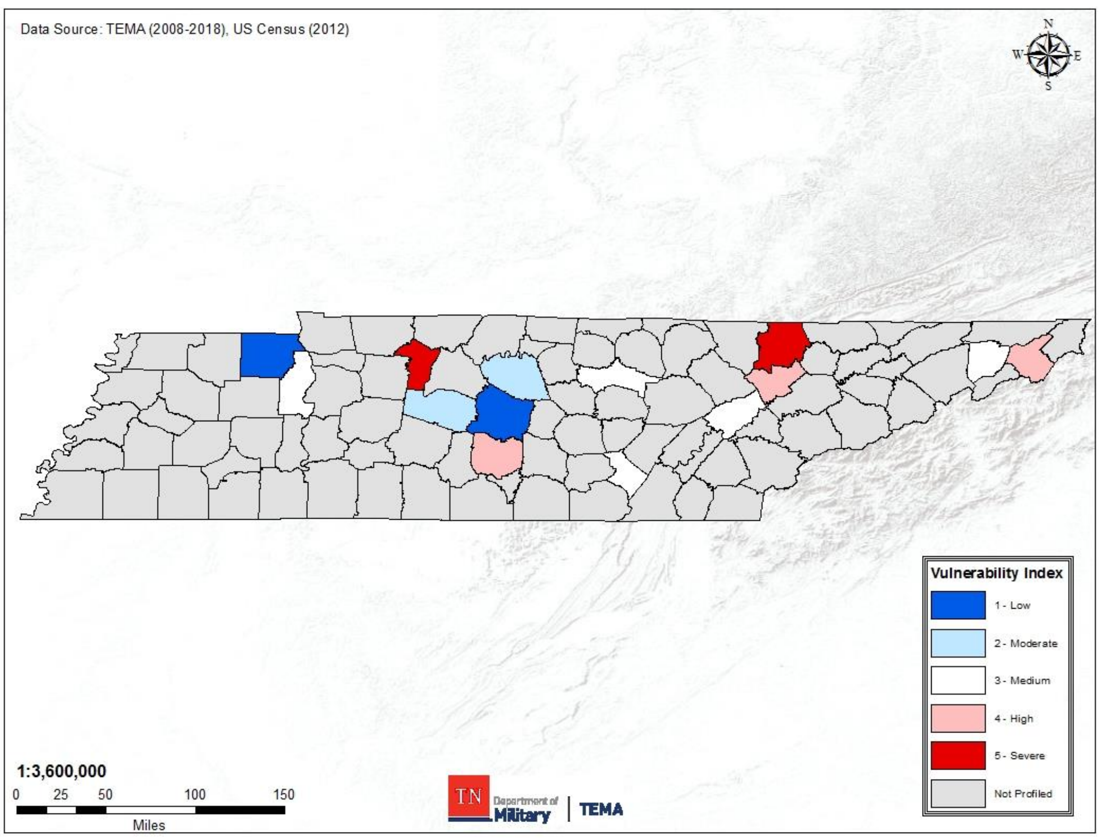
4.3.3 – Incidents/Probability

On average these dams contain a total of 8,301,075 acre-feet or water with a maximum total capacity of 1,7551,438.5 acre-feet. Table 60 lists a complete dam inventory for Tennessee. Map 85 depicts dam locations sized according to their maximum water holding capacity.

4.3.4 – Changing Future Conditions

Climate and weather pattern changes may not affect dams as much as other hazards. However, there are growing concerns on whether or not dams positively or negatively contribute to weather extremes. Supporters believe dams may keep stored water cooler than undammed rivers, while critics argue dams only add to increasing global temperatures. Dam failures, however, present dangers of flooding, which could be problematic in the flat, low lying areas of Tennessee. Threats to the population and infrastructure increase if those flat, low lying areas have been used to house infrastructure or members of the population.

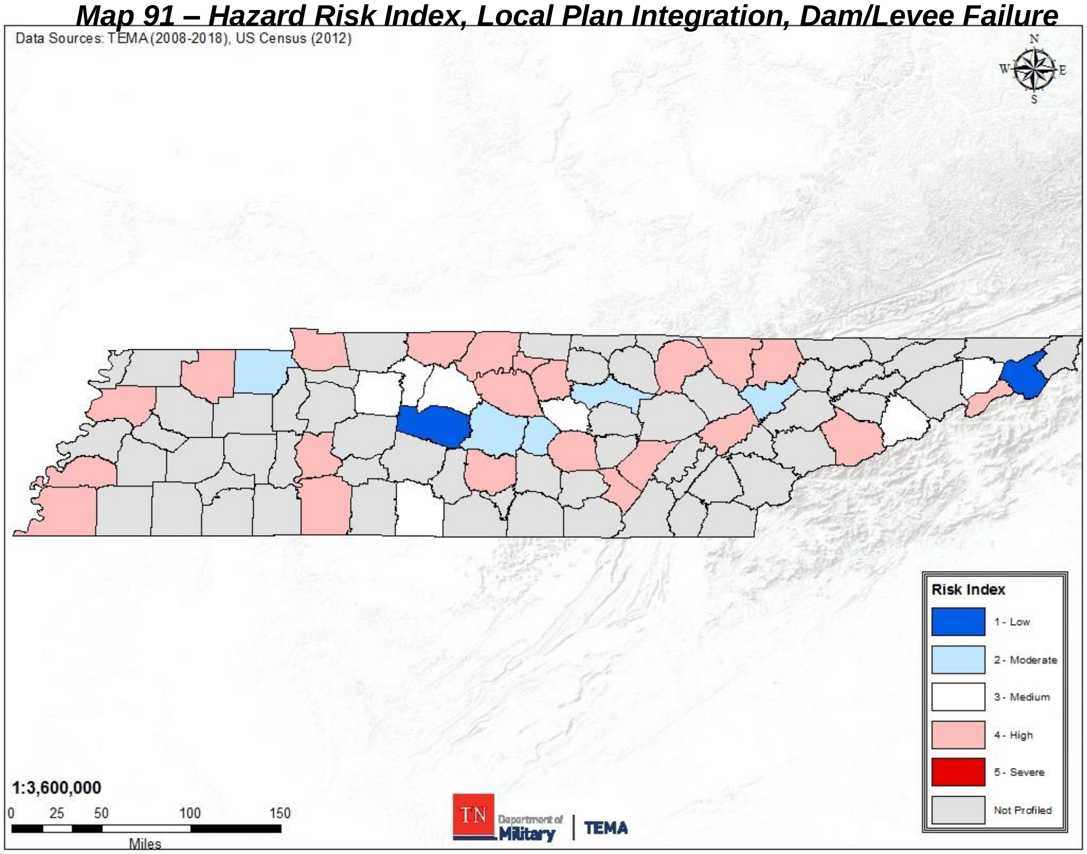
Map 90 – Hazard Vulnerability Index, Local Plan Integration, Dam/Levee Failure



4.3.5 – Future Risk

Using a basic risk matrix: Vulnerability+Probability=Risk, TEMA was able to calculate hazard risk using data from the previous subsections. This process is further explained in Section 3.4. As shown in the following map of the risk index, several have medium to high risk for dam/levee failure.

Map 91 – Hazard Risk Index, Local Plan Integration, Dam/Levee Failure



4.3HZMT – Hazardous Materials Release

Hazardous materials are any substances that pose a risk to health, life, or property when released or improperly handled. Generally, the term refers to materials with hazardous chemical or physical properties, though sometimes biological agents can fall under this category. The hazardous properties can be combustible, flammable, toxic, poisonous, corrosive/severely acidic, reactive, radioactive, or noxious. Though EPA, DOT, and OSHA categorize these in different ways, a basic distinction among hazardous substances is their persistence in the environment and respective levels of health risk that these pose. A release of a hazardous material can be caused by a spill, leak, explosion, pipeline break, transportation accident, or human action. If the material has escaped its container into the outside environment, a potentially hazardous situation exists.

Hazardous materials are so widely used, transported, and stored, often in large quantities, so a spill or other event could happen nearly anywhere in the state. Because of the ubiquity of hazardous materials, risk mitigation requires cooperation among state agencies, the EPA, OSHA, DOT, and many private and public corporations.

4.3.1 – Location & Extent

By EPA classification, hazardous substances are generally materials that “if released into the environment, tend to persist for long periods and pose long-term health hazards for living organisms. Hazardous materials present acute health hazards that, when released, are immediately dangerous to the lives of humans and animals and cause serious damage to the environment.” The major categories of chemical/material hazards are classified according to their predominant effects−corrosive, flammable, toxic, irritant, or explosive being the essential classes. These properties may overlap, and commonly do with chemicals used in industry, agriculture, and energy. While over 500,000 substances are considered HAZMATs, a few thousand products account for common hazards. Many of the costlier hazardous substance incidents in the United States are petrochemical in makeup, but event reports indicate that substantive numbers of accidents involving all major chemical classes occur regularly. Deadly explosions at chemical plants occur with some regularity in Tennessee. When facilities have hazardous materials in quantities at or above the threshold planning quantity, they must submit “Tier II” information to appropriate federal and state agencies to facilitate emergency planning.”

The basic types of hazardous materials may be categorized according to more than 6 different systems; but the categories of U.S. Emergency Planning and Community Right-to-Know Act (42 U.S.C. 11002) will be used here.

Extremely Hazardous Substances
These materials have acutely toxic chemical or physical properties and may cause irreversible damage or death to people, or harm the environment if released or used outside their intended use. Common examples include ammonia, chlorine gas, sulfuric acid, formaldehyde, hydrocyanic acid, nitrogen dioxide, phenol, phosphorus trichloride, and polyvinyl acetate. Radioactive materials are extremely hazardous.

Hazardous Substances

These are any materials posing a threat to human health and/or the environment, or any substance designated by the EPA to be reported if a designated quantity of the substance is spilled into waterways, aquifers, or water supplies or is otherwise released into the environment. Many common fuels and most petrochemicals fall under this list.

Additionally, some materials require registration if present in chemical facilities above the threshold quantity. These *hazardous chemicals* require a Material Safety Data Sheet under the Occupational Safety and Health Administration Hazard Communication Standard. These chemicals might cause fires and explosions or adverse health effects such as cancer, burns, or dermatitis, but they are not necessarily dangerous or volatile in all quantities. *Toxic chemicals* cause disease with long term exposure or chronic illness above a certain threshold exposure. This includes carcinogenicity.

Tennessee requires businesses to adhere to EPA Tier II reporting standards. Tier II is a federal obligation mandated by the EPA, with reporting done on the state and local level. The reports are forms that organizations and businesses in the United States with hazardous chemicals above certain quantities, are required to fill out by the EPA. Known officially as Emergency and Hazardous Chemical Inventory Forms, Tier II Reports are submitted annually to local fire departments, Local Emergency Planning Committees (LEPC) and State Emergency Response Commissions (SERCs) to help those agencies plan for and respond to chemical emergencies.

Mandated by Section 312 of the Emergency Planning and Community Right-To-Know Act (EPCRA) – also known as SARA Title III – the Tier II form captures information about the types, quantities and locations of hazardous chemicals at a given facility. The form also lists contact information for the facility's designated emergency point-of-contact.

The ATSDR and CDC both keep a list of hazardous materials ranked for hazard planning purposes. It is ranked according to a material's use, ubiquity, toxicity, and the likelihood of exposure. These are mapped along with known aquifers that supply large numbers of residential wells, municipal sources, known floodways and FEMA flood zones. General inferences as to the risk of cross contamination and transmission of the compound can be made from these maps, though for specific risk TDEC registry or coordinating agency of response and their information should be consulted.

Hazardous materials incidents can occur at the factories, laboratories, refineries, and storage facilities where such chemicals are present. But incidents can also happen during transportation, loading and unloading, and pipeline transport. Contributing and/or causal factors include human error; natural hazards such as earthquakes, tornadoes, floods, and lightning strikes; automobile and railroad accidents; power outages; electrical fires; computer malfunctions or server breakdowns. The scope of damage to persons, property, and economy is vast, though impact can often be contained with quick response by trained teams. The quantity, chemical, and physical properties of the material involved in an incident determine the scope of threat, but weather during and after the incident, location, proximity to human and wildlife populations, to rivers and lakes, and to major ecological vulnerabilities must be considered in assessing the scope of the threat posed.

Hazardous materials may also be released as a secondary result of a natural disaster like floods or (in lower probability event in TN) an earthquake. Buildings or vehicles can release their hazardous material contents when they are structurally compromised or involved in traffic accidents. Pipelines can be exposed or ruptured from collapsed embankments, road washouts, bridge collapses, and fractures in roadways.

Prevention and mitigation of a hazardous materials incident comprises analysis with different measures of the threats that exist in specific categories per region or locality. These sometimes overlap, but must be considered separately when possible to determine the best allocation of resources and response strategies should a HAZMAT event occur. The basic planning categories of hazard, vulnerability, and risk apply to hazardous materials preparation. In this context, the hazard category includes the nature of the chemicals present and the locations where an incident is likely; the vulnerability describes what damage might occur, the range of the impact, and what types of incidents are possible in a given community or region; The risk analysis assesses the probability of damage (or injury) that would occur in the community if a hazardous material were released and the actual damage (or injury) that might occur, in light of the vulnerability analysis

GOVERNING AND COORDINATING AGENCIES:

TDEC is the coordinating and primary agency responsible for mitigation strategies and surveillance programs. However, first responders, hospitals, the CDC, TDH and TDOT maintain supplies, strategic stockpiles and assets that are in many cases, deployed during a HAZMAT event. These agencies input in mitigation planning are not only germane but essential to effective strategies that utilize all available resources.
They coordinate responses to hazardous materials events, report directly to the EPA and inter-state agencies when necessary. With almost 3,000 employees and a budget of over $357 million, TDEC maintains one of the largest footprints of any state agency, with employees in every county, municipality, and region of the state.

Directly supporting private integration of mitigation strategies, TDEC maintains the Fleming Training Center in Murfreesboro. This center offers cutting-edge technology and advanced classes in a variety of water areas to assist certified operators with ongoing training and services as they complete their continuing education requirements. It educates and certifies thousands of treatment plant and water management staff every year throughout the state. The plans and certifications this program supports directly enable private contractors and companies to coordinate with the state to facilitate mitigation planning, surveillance, and response.

Pre-emergency / Notification
Once a HAZMAT incident is suspected, TDEC, municipal and regional authorities are notified, as well as any necessary supporting agencies. Pre-emergency, the state may allocate a first response responsibility to a dedicated team or set up several such teams. If a spill, accident, or fire occurs, the firefighters or other first responders will alert the HAZMAT Emergency Response Teams. If a suspected incident occurs (someone smells gas or reports strange substances in a street, a building, etc.), a preliminary HAZMAT emergency response team evacuates the site and conducts an inspection.

Notification via local responders, the 911 call operator, or other mediums should be directed to TEMA, which then can decide to activate the Emergency Response Team; then notification goes to the National Response Center, OSHA, TN State Police, and the DOT and/or CDC, if indicated. Typically, after the initial 911 call, local first responders, (fire or police), will arrive on the scene and evaluate the incident.

Environmental Response Teams
Environmental Response Teams are located at the local level and regulated through TDEC. Typically the commander is an official with experience of environmental and chemical dangers. The commander should activate an emergency response plan, gather the team, designate the initial perimeter for entrance, evacuation, and the like. If the team is of the first responders, they should also decide the evacuation range. If the fire department personnel are first responders, the environmental response teams must coordinate with them. The commander of the response team is responsible for the placement of the staging area for equipment, personnel, and medical resources, if needed. He or she should also assign the remaining staff and determine the relationship of the team to other responders.

When an ERT arrives on the scene, their job is to provide technical resources to the incident commander, whether this person is a local, federal, or the state-appointed HAZMAT team commander. The local first responder retains incident command in small, containable situations. If the incident is large enough to require a unified command, the team leader becomes a part of that structure. The regional teams are responsible for mitigating and containing the incident. Once the situation is stable, the Department of Environmental Quality is responsible for working with the responsible party to assure cleanup of the incident is completed appropriately. A full team may not respond in every instance. The system provides for a tiered response ranging from technical advice over the phone, to on-site reconnaissance, then to a full team response. Specialized considerations should include stress management, supplemental air purification systems and other respiratory support, and sufficient personnel for large incidents to allow for 3 daily shifts.

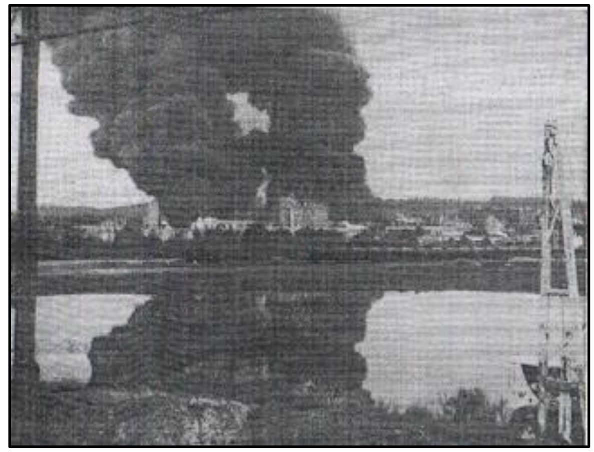
LOCATIONS:
The threat of a spill, leak, explosion, or hijacking affects the entire state of Tennessee. Many chemical plants, particularly in the eastern half of the state, store and process hazardous materials in bulk. But the major transportation routes passing through TN ensure that chemicals from across the United States pass within state borders not directly regulated by the state of Tennessee or its agencies. Interstates 65, 40, 24, 75, and 81 all pass through Tennessee, and transport of hazardous materials on these highways occurs continually. The Illinois Central Railroad passing through western Tennessee along the Mississippi river valley, along with rail lines operated by CSX and by the Norfolk Southern Railroad, carry carloads of hazardous materials in varying quantities throughout the state. Furthermore, the agricultural supply chain involves the transport of fertilizers and other explosive and incendiary chemicals. Natural gas and petrol transportation is ubiquitous on the highways and railroads. There is regular transport of chlorine gas and of ammonium nitrate and phosphorus across roads, rail lines, and occasionally barges along the Mississippi.

Communities where hazardous materials are fabricated, processed, and stored as well as those designated for hazardous waste storage or disposals have higher risk, as do localities near or on transportation corridors that carry these materials at elevated risk.

Highly developed areas or priority environmental resources located near a high risk facility, mitigation strategies must be regularly reviewed. These include facilities with permitted air releases, hazardous waste sites, radioactive materials storage or disposals, facilities permitted to release toxic materials, and facilities permitted to discharge chemicals into surface waters. For transportation corridors, both localities along highways and major systems are at elevated risk.

Areas with known methamphetamine labs or a disproportionately high (for the state) number of drug raids in the past should be considered at significant risk. Both TBI and the DEA and ATF maintain comprehensive records now accessible for public review of the homes and locations of known and closed methamphetamine labs, either flagged for mitigation, demolition or other remediation strategies. Contamination from methamphetamine production contributes to Tennessee's elevated hazardous materials concerns in otherwise rural communities, as well as in mobile housing, which is difficult to trace except by VIN number, in state parks, motels, apartment complexes, and places with large transient populations.

4.3.2 – Previous Occurences



Historic Event – Hazardous Materials Release– 2008
2008, the TVA coal power plant in Kingston spilled over a billion gallons of sludge (coal fly ash), endangering the Tennessee River the Clinch River tributary, and covering more than 300 acres of land. The largest ash release in U.S. history, the incident elevated toxic metal levels in a vast strip in TN due east of Knoxville, and killed fish and small wildlife. Local agencies have yet to report population recovery and the EPA continues to monitor the area.

Historic Event – Hazardous Materials Release– May 2011
May 2011, Hoeganaes Iron Power Plant in Gallatin experienced an explosion caused by a leaking hydrogen gas pipe, involving combustible iron dust and a subsequent fire. Two fatalities occurred.

Historic Event – Hazardous Materials Release– September 2012
A PennAKem plant explosion in Memphis critically injured several workers, killing one.

Historic Event – Hazardous Materials Release– December 2014
A tractor trailer carrying pool supplies, Chlorine, overturned on I-24 near mile marker 87 and caught fire. 150 homes evacuated.

Historic Event – Hazardous Materials Release– July 2015
Knoxville area, a CSX tank car carrying petroleum caught fire, Emergency services put out the fire, however, contamination of the land and local water may have occurred.

Historic Event – Hazardous Materials Release– January 2018
An unauthorized release of several thousand gallons of an oil based substance from an unknown source was released into the Chickamauga Creek near Chattanooga.

4.3.3 – Incidents/Probability

Hazardous materials incidents occur with relative frequency in Tennessee, and some major disasters related to chemical plants and accidental gas releases have led to nationally significant damage. Historically important events include the Eastman Chemical Plant explosion of 1960 that left 16 dead and 200 injured; significant damage to the town of Kingsport occurred. In 1978, in Waverly, a Louisville and Nashville freight train derailed, consequently causing the explosion of a tank car containing liquefied natural gas. The spill was continued post-12 hours after the event, allowing for wide spread dispersion of the LPG. The cost of this event was $1,800,000 (the equivalent of $5,693,810 in 2013).

4.3.4 – Changing Future Conditions

Some HAZMAT emergencies may be triggered by natural disasters and changing climatic conditions may cause more extreme weather events. Furthermore, as Tennessee's population continues to grow, more people become increasingly vulnerable to incidents involving hazardous substances. Therefore, it is important to critically monitor all hazardous fixed facilities and transportation routes and continue to attempt to prevent future incidents from occurring through continued preparedness, monitoring and training.

Historically, most relatively minor hazmat incidences within the state have occurred on a major roadway or rail line. With Tennessee, especially Nashville, continuing to grow, and the major interstates become more populated, the chances of a hazmat incident occurring increase along with the number of potentially affected persons as well as disruption to local traffic and services.

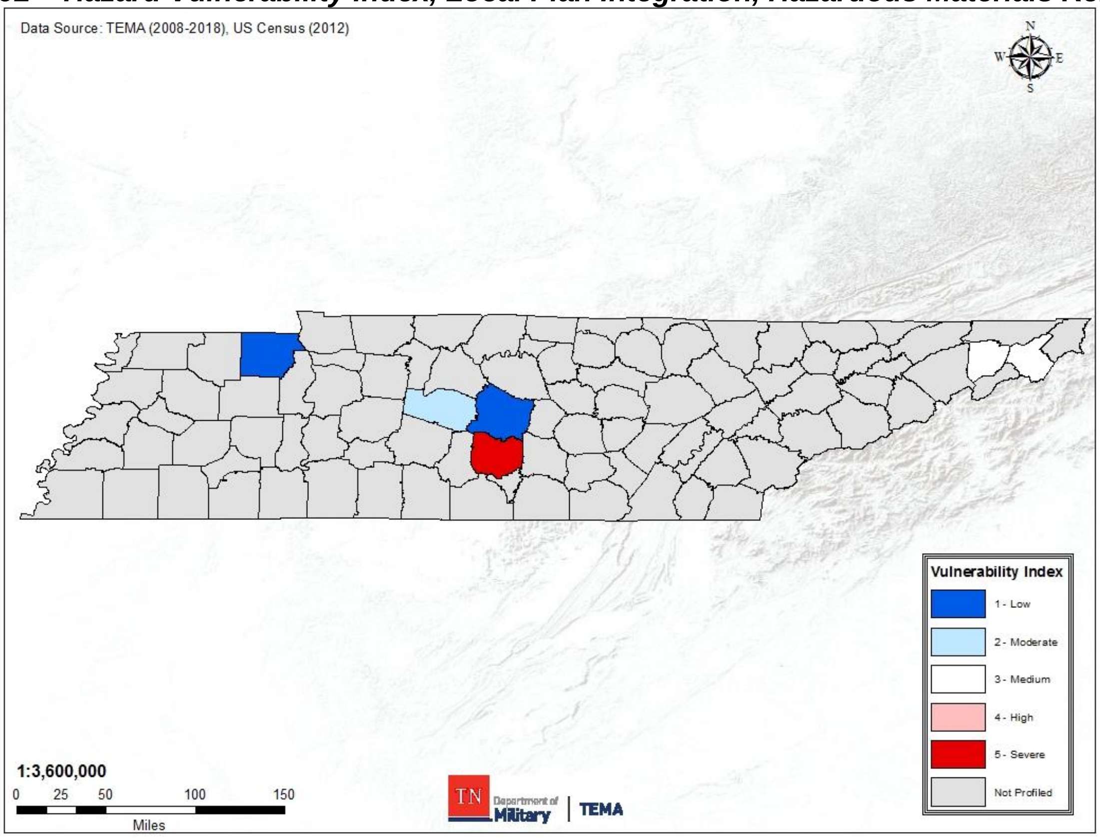
Radiological

Although Tennessee has not recently experienced nuclear catastrophes, earthquakes are one of the causes of potential harm to nuclear facilities. The possibility of earthquake events due to Tennessee's close proximity to the New Madrid fault increases the likelihood that effects would be felt by our various nuclear facilities, so it is critically important to continue to monitor radiological facilities in the state. Tennessee's population growth is also a concern for nuclear emergencies; as the population increases, more people become subject to radiological effects. In the event of a disaster, millions of people could be harmed or killed. This growth is especially apparent in the areas surrounding the population centers. As more people move to or commute to the area, they are also more susceptible to a hazardous event occurrence.

The NRC and local governments study and develop evacuation time estimates (ETEs), which are part of the planning basis for each nuclear power plant. They are required to be performed to estimate the time needed to evacuate the public in the event of a disaster, and they are updated based on population growth near nuclear facilities. In Tennessee, the most recent ETE update took place in 2017 because of population booms. The number of Rhea County residents in a 10-mile zone of a nuclear facility rose from 22,569 in 2010 to 22,820 in 2015. As the state's population continues to grow, it will be important to advance mitigation strategies as well.

The following map depicts the vulnerability to hazardous material incidents for each county throughout the State of Tennessee. This data was compiled using local plan integration.

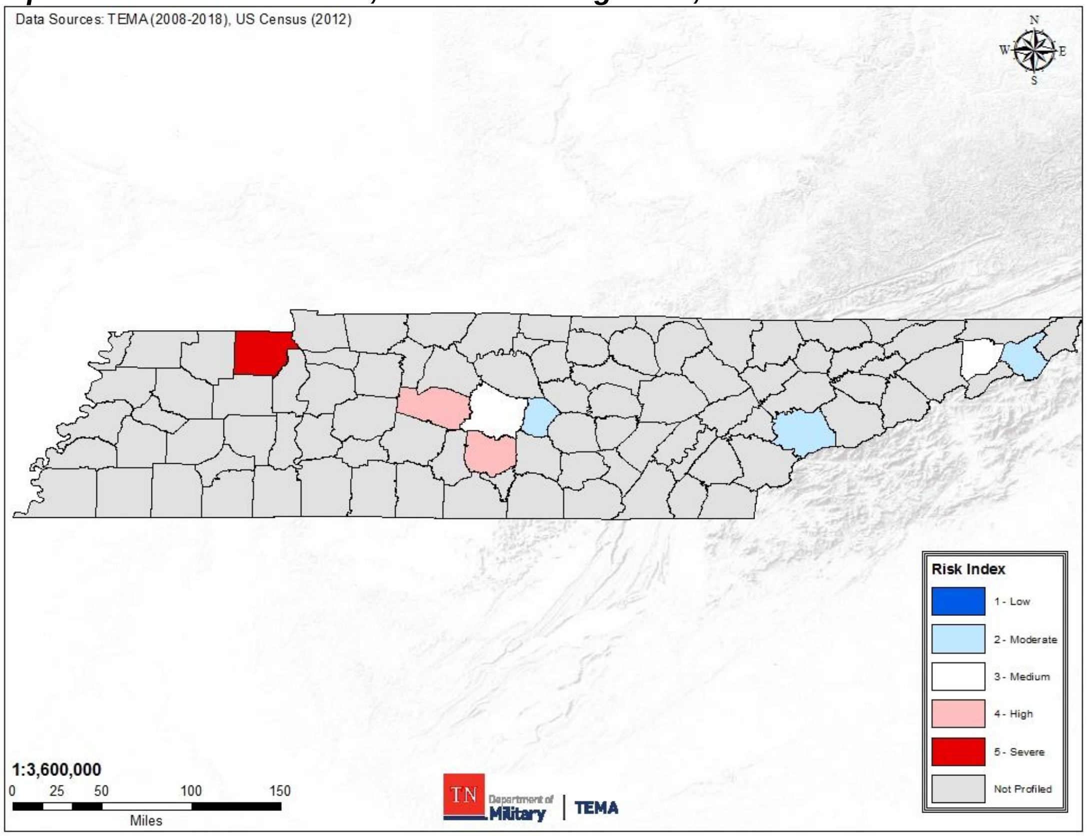
Map 92 – Hazard Vulnerability Index, Local Plan Integration, Hazardous Materials Release



4.3.5 – Future Risk

Using a basic risk matrix: Vulnerability+Probability=Risk, TEMA was able to calculate hazard risk using data from the previous subsections. This process is further explained in Section 3.4. As shown in the following map of the risk index, Henry County is the highest risk for hazardous materials release.

Map 93 – Hazard Risk Index, Local Plan Integration, Hazardous Materials Release



4.3II – Infrastructure Incidents

Infrastructure disasters are complex scenarios. They can be difficult to respond to, prepare for, and mitigate, as the infrastructure itself is often a mechanism in responding to, preparing for, and mitigating hazards. Further, infrastructure is often owned by a variety of public and private interests, and in some cases both, making the delegation of responsibilities and assessment of state liability difficult.

Infrastructure is defined as any permanent or semi-permanent asset that facilitates the transport of goods, services, human resources, or information. This can include but is not limited to roadways, rail, airports, telephone, cellular, and data communications mediums, hospitals, waste water treatment facilities, municipal water reservoirs and community support facilities (shelters, libraries, and historic registrar sites). Dams and Levees are treated separately in 3.3DLF.

4.3.1 Location & Extent

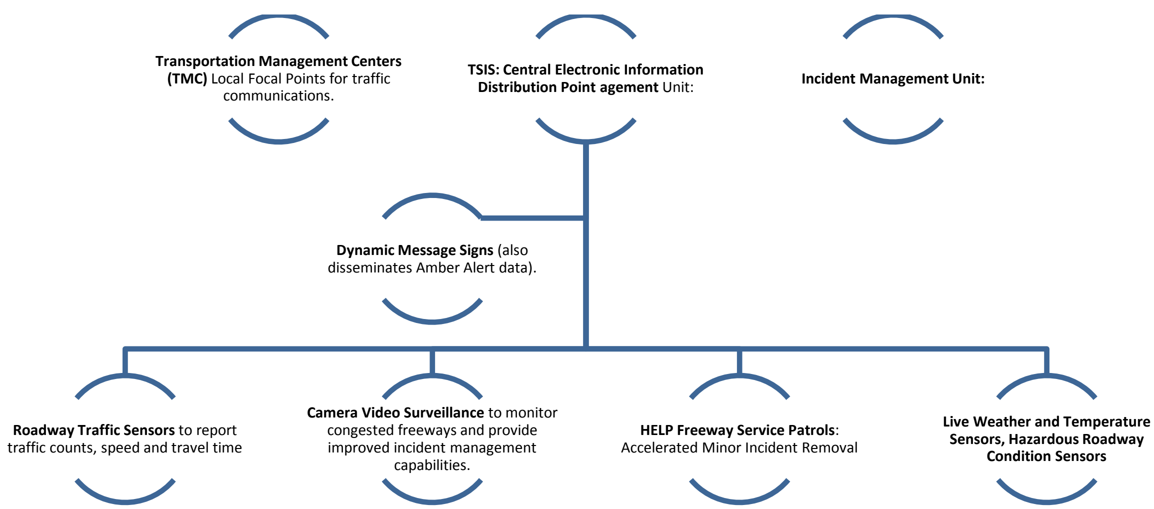
Most states, including Tennessee rely on a Perpetual Inventory Method (PIM) to value roadway infrastructure value and depreciation. The function is defined as

$$\textit{Infrastructure Assets}_{\textit{Year}} = \textit{Capital Investment}_{\textit{year}} + (1 - r)\ \textit{Infrastructure Assets}_{(\textit{year} - 1)}$$

This formula allows for estimation of depreciation on existing infrastructure, but does not take into account active costs for events. It can however, according to the Bureau of Economic Analysis (BEA), be used to accurately value, for actuarial purposes, existing structures at the time of an event.

Roadways

The primary mitigation component for active and passive management in the Tennessee roadway system is "SmartWay": a series of components owned and operated by TDOT in conjunction with other regional and national authorities. SmartWay is defined as an ITS (Intelligent Transportation System) that uses both wireless and wire technology to maintain a fluid response to ongoing events during normal and emergency operations.



Tennessee's well integrated intrastate infrastructure makes quarantine procedures and the localization of threats particularly challenging with over 14,000 miles of state, federal, and interstate roadways, 80 public airports, and 6 major rail lines with 2,098 miles of track.

TDOT developed a 25-Year Policy Plan to guide the department's direction. This plan consists of two main elements, a 25 Year Policy Plan and a 10-Year Strategic Investment Plan. The 10-Year Strategic Investment Plan includes a budget of $18.7 billion in infrastructure allocation.

The NHTSA considers fatal crash incidence a general indicator for predicting roadway liability in other arenas, particularly the likelihood for large scale events like those on the I-81 and I-77 corridor in Virginia involving 95 cars. The section of interstate had long been flagged by NHTSA and DOT as a high risk corridor warranting mitigation strategies. Further, large-scale accidents or repetitive risk areas are designated as warranting specific mitigation strategies as defined by EMAP standards. General fatality rates by county can be seen on the following page.

Federal Safety Grant Funding for Tennessee is based on legislative efforts in the state, as well as programs included that meet federal criteria. Tennessee received $20,200,145.09 dedicated for direct mitigation of fatal events in 2017.

The State of Tennessee's roadway incident exposure remains statistically high, with a large number of uninsured motorists proportional to its population. The large number of licensed drivers and a relatively high number of vehicle miles driven, are shown here, as well as crash statistics collected from 2014-2016.

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Table 61 – Vehicle Transportation Statistics, Tennessee

State Size: 42,146 Square Miles	2014	2015	2016
Population	6,544,663	6,595,056	6,651,194
Registered Vehicles	5,495,647	5,612,123	5,709,923
Licensed Drivers	4,697,047	4,692,253	4,716,375
Miles of State & Federal Roadways	13,884	13,877	13,883
Miles of Interstate	1,104	1,104	1,182
Total Crashes	176,321	197,195	206,399
Number of Non- Injury Crashes	130,367	147,506	154,229
Injury Crashes	45,061	48,805	51,208
Fatal Crashes	893	884	962
Injuries	63,093	70,430	74,066
Fatalities	963	962	1,037
Vehicle Miles Travelled (100 Millions)	725.04	753.53	768.86
Fatality Rate Per 100 Million VMT	1.33	1.25	1.35

**The data are from the Tennessee Department of Safety.*

Rail

Tennessee railways are not heavily dependent on other existing infrastructures to the extent that eastern seaboard or trans-continental railways through the northwest are. Slightly less than 20% of Tennessee rail lines traverse floodways or known seismic threats, though railways often transport large amounts of hazardous materials considered too dangerous or heavy for interstate transit, and their exposure should be accounted for through improved communications among private transit companies, TDOT, TDEC, and regional authorities.

Railways, carriages, and cargo remain vulnerable at the national level, due to the slow moving speeds of freight and unobserved stops through a variety of rural and urban terrain. Further, rail lines and depots are often unmonitored by CCTV, or equipped with motion activated lighting or alarms.

Airports

Home to the single largest air cargo and freight depot in the world, Memphis, along with other Tennessee airports are responsible for proportionally large volumes of both material and human transport. Boeing's Air cargo analysis reports that world air cargo traffic has struggled to maintain sustained growth since the end of the global economic downturn in 2008 and 2009. After bouncing back in 2010, then stagnating in 2011 and 2012, air cargo began growing again in mid-2013, even growing 4.8% in 2014. Growth accelerated in the first quarter of 2015, but, then traffic volumes remained flat for the rest of that year. Air cargo traffic gathered some strength after a weak first quarter of 2016, and is projected to return to trend growth by 2018. Despite the weak growth of the past decade, more than one-half of air cargo is still carried on freighters.

Communications

Communications infrastructure has expanded rapidly in the past decade, with nearly a 112% increase in cell towers and fiber optic lines. Increasingly, emergency responders and state and local governments rely on these often privately held infrastructures, with minimal oversight of their disaster mitigation strategies. Verizon Wireless, the state's largest cellular provider, has a dedicated disaster response team, and multiple continuity of operations and business continuity plans in place. Smaller providers however have not yet dedicated the staffing resources to these needs, and often serve more inaccessible and remote locations.

The loss of communication infrastructure concomitant with a disaster can exacerbate logistical difficulties. As such, enhanced communication and integration with the existing business continuity plans on file with cellular infrastructure owners and operators can facilitate faster recovery times and alternate communications. Verizon maintains COWs (Cells On Wheels) and COLTs (Cells On Light Trucks) for all of its major regions including Tennessee. These not only provide replacement coverage when towers are damaged, but can provide supplemental coverage for increased network burdens during an emergency (land lines and other means of communication are often impaired, and individual communication needs can overwhelm a given network) and reach inaccessible regions where coverage may not be adequate to the response needs.

Verizon as the largest regional provider also maintains an extensive fleet of mobile and permanent on-site generators to supply power when municipal grids are compromised or over-extended. Not all cellular network providers though maintain systemic continuity of operations models and supplies, and as such, larger providers are often asked to bridge the gap in operations during an emergency.

Electric Delivery

In 2011, EPB of Chattanooga, a TVA distributor received the largest DOE ARRA stimulus grant for a municipal utility of $111.5 million to accelerate a fiber optics project for integration of the grid into fiber optic lines and transmitters. This integrated "Smart Grid" qualified for federal mitigation grant funding as it promises to provide a 40% in outage reductions resulting from improved distribution system management and intelligent switch technology.

A 2014 study found that Smart Grid investments improve grid reliability, resilience, and storm response. These technologies accelerated service restoration and limited the number of affected customers during major storms. The utilities required fewer truck rolls during restoration and used repair crews more efficiently, which reduced utility restoration costs and total outage time and resulted in less impact to business and residential customers.

Energy Supply

Tennessee is home to a variety of natural gas (NG), liquid natural gas (LNG) and petroleum lines. Petrol depots and dispensing stations are located in Nashville, Chattanooga, Knoxville, and Memphis, with the majority of the state reliant on Colonial Pipeline for delivery of both diesel and gasoline to the Middle and Eastern Regions of the states. Complications with this dependence were highlighted in October 2016 when a break in the pipeline caused fuel shortages throughout the South.

In particular, karst aquifer and porous limestone substrates are at greatest risk of long term side effects resulting from a spill or compromised line. Areas with a high likelihood of seismic activity should be considered at increased risk for compromised lines. Even small scale events and geologic disturbances can disturb a line, and pressure changes or leaks may not be detected for weeks to months if the incremental leak is small enough.

Waste Water Treatment and Municipal Supplies

Water infrastructure falls broadly into 2 categories: disposal and treatment, and storage and supply. While the EPA provides specific guidelines for agencies such as TDEC to follow in the treatment and disposal of waste water both from municipal and private sources, the infrastructure that handles these requirements is often compromised or destroyed during flooding or seismic activity. Tornados and damaging winds can shut down power to waste water treatment plants and private septic systems for hours or days, and recovery windows can be complicated by increased burdens or flooding that occurs in the interim.

The EPA outlines 4 components necessary for the recuperation of municipal supplies that must continue to operate during and after an emergency:

- Chemical – for disinfection and other treatment processes
- Transportation – for delivery of chemicals for treatment and fuel to power equipment and to enable employees to commute to their jobs
- Energy and Electricity – to power pumps and motors
- Communications – to maintain Supervisory Control and Data Acquisition (SCADA) systems

Water represents 1 of Tennessee's greatest resources and 1 of its greatest liabilities. The droughts of 2006 and 2012 highlighted the state's dependence on underground aquifers, reservoirs, and secondary supplies. WHEAT (Water Health and Economic Analysis Tool), an EPA developed program, provides threat-neutral consequence analysis for events that jeopardize both waste water treatment and potable supplies. To generate effective cost scenarios, each module should be run for counties independently. Some districts share municipal providers (such as Nashville, which uses Suburban Madison supplies and Metro Davidson supplies within proximity to each other). As such, the inputs for the WHEAT model must take into account revenue and supply costs from all suppliers in a given district or county, as well as breakdown of shared versus independent miles of line. Nashville Metro alone maintains 2800 miles of independent line, while Suburban Madison supplies almost 4300. These 2 suppliers maintain all water access for a population density of 1204 people per square mile. Memphis and Shelby County Metro are supplied by MLGW, which is the sole supplier for a population density of nearly double that of Nashville (2307 per square mile) but maintains only 3600 total miles of line. The resulting dependence is greater for a higher number of households, on fewer total miles of lines. Further, MLGW and consolidated service providers who also manage gas and electric delivery may experience a greater burden on their staff and infrastructure during an emergency than those suppliers that provide 1 direct service or product, and can concentrate efforts on a single recovery tactic.

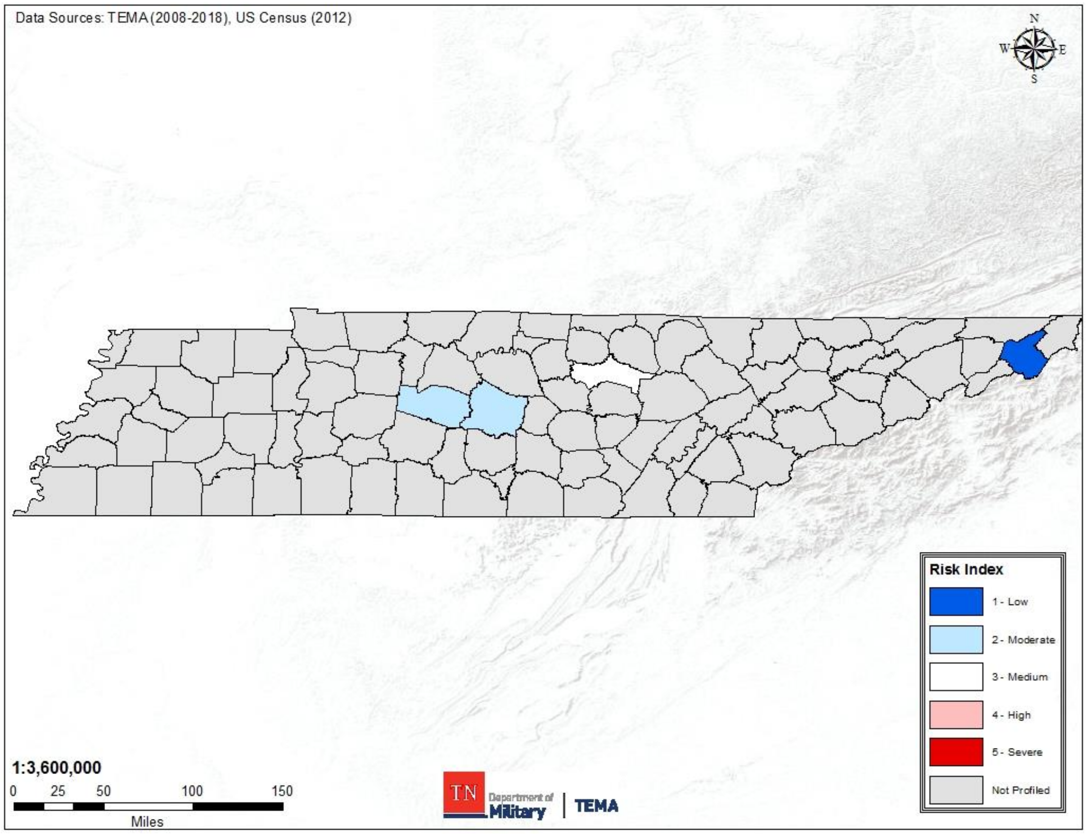
4.3.4 – Changing Future Conditions

A combination of population, climate change, and increased wear and tear on our nation’s infrastructure increases the vulnerability of many of the facilities and structures necessary for the citizens of Tennessee to go about their daily life. The State of Tennessee has experienced an increase in population over the past decade, especially in and around its larger population centers. This rapid amount of growth and increased use of infrastructure assets by both the residential and transient populations will result in increased fatigue and possible collapse of existing resources unless proper maintenance and upkeep is invested in and applied.

4.3.5 – Future Risk

Using a basic risk matrix: Vulnerability+Probability=Risk, TEMA was able to calculate hazard risk using data from the previous subsections. This process is further explained in Section 3.4. As shown in the following map of the risk index only 4 counties have profiled infrastructure threats and they all rank as relatively low to moderate risk.

Map 94 – Hazard Risk Index, Local Plan Integration, Infrastructure Incidences



4.3TE – Terrorism

Terrorism encompasses all man-made threats or actions intended and designed to harm the population at large or a subgroup therein, or to cause fear, damage to property, or disruption of social and economic functions. The FBI offers a stricter definition of terrorism as “the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives.” Terrorism can occur at any time without warning, affecting multiple geographical areas at once, and inflicting mass casualties and significant property damage. Most problematic, each area under attack can constitute an incident scene, quarantine or hazardous materials zone, and a crime scene simultaneously. This complicates first response considerably. Furthermore, terrorists use a wide variety of targets, tactics, and means, forcing hazard prediction and mitigation to rely on even more variables than most other man-made hazards.

4.3.1 – Location & Extent

The basic categories of attack can be sorted by types of weapons or methods used and by the extent of potential damage. Terrorists may act alone, in small groups, in organized cells and quasi-military hierarchies, and in actual militias. They may be state-sponsored, state-trained, untrained, self-taught organized by paramilitaries, religious organizations, cults, or home based (“home-grown”) entities. Terrorist incidents may occur in 1 location or in many, simultaneously or staggered, with thwarted attacks and copycat events following a major terrorist action. A defining feature of terrorism according to the DHS is the need to get public attention and “make a statement,” whether about an individual, a cause, or political organization. Small groups or individual terrorists may not succeed in communicating their grievances or causes, and occasionally, serial or pathologic terrorists without a known ideology do strike.

An act of terrorism using WMDs and chemicals, biologicals, radiological, and nuclear (CBRN) materials can be directed against a population center, disseminated in food or water supplies, fed to domestic animal populations or dispersed into mass transit. Any of these scenarios will produce mass effects, which can overwhelm the capacity of local or state emergency response agencies, requiring both surge personnel and extra facilities to mitigate the damage. Furthermore, conventional terrorism along with the increasingly present self-radicalized initiators, using manufactured or improvised explosive devices (IEDs/VBIEDS), firearms/weapons, and vehicles or executed through extensive attacks by gunman or saboteurs, can also overwhelm local and regional capabilities, particularly during the initial phase of an attack. The resolution and threat mitigation required after an act of terrorism demands rapidly response and smooth, well-rehearsed cooperation among agencies; successful responses also demand cooperation of law enforcement, emergency management agencies, and the first responders. Major airports, shipping hubs, ports, interstate highway intersections, rail stations, water purification facilities, armories, chemical processing plants, communications towers, and other critical infrastructure components need to be guarded against terrorism and incorporated into a special category of high-risk sites for planning purposes.

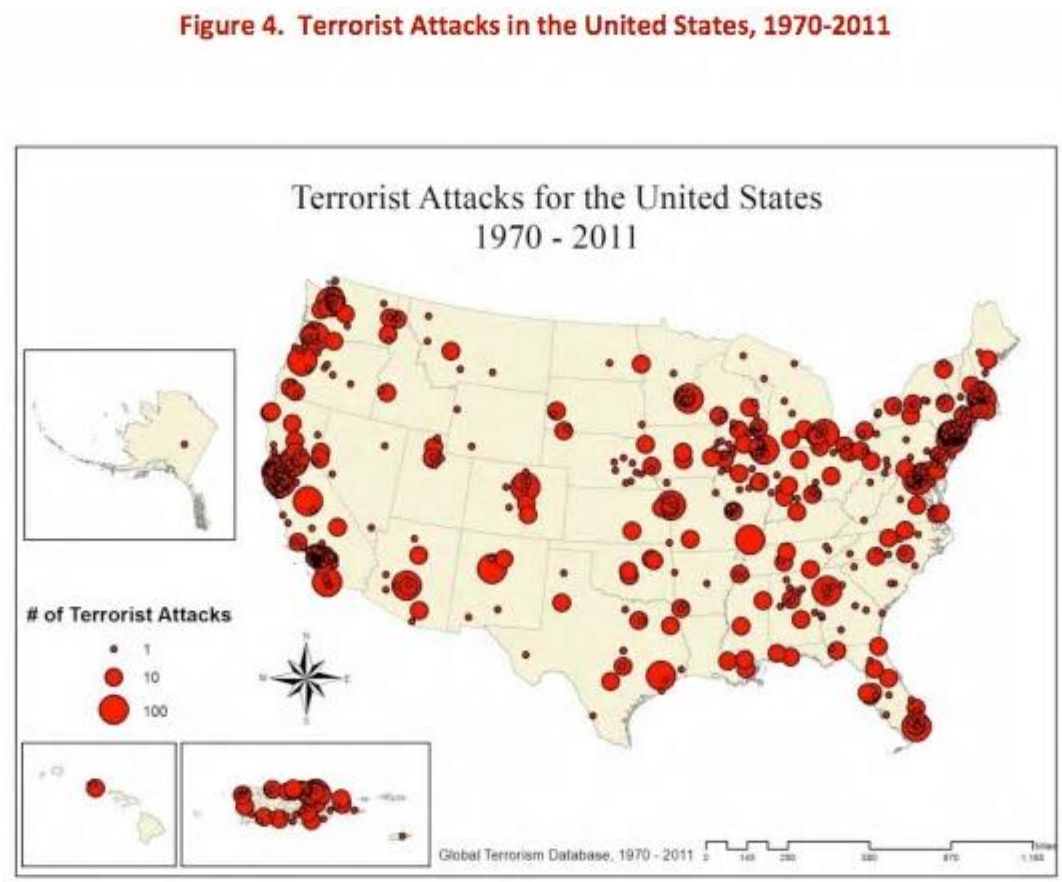
GOVERNING AND COORDINATING AGENCIES:

Because of the scope of any terror incident, the number of agencies and responders are difficult to define. Multiple law enforcement, military and National Guard resources may or may not be deployed during an event. Coordination of these resources is critical, and accreditation and proper vetting of personnel on the scene is typically managed by the FBI or DHS. Threat assessment and the mitigation approach must be modified sufficiently to prepare for efficient communication among agencies at local, metropolitan, state, and federal levels and to assure readiness for different types of terror threats without the aid of probability models that are used for natural hazards like floods or tornados. By legal definition, terrorist attacks will mandate state and federal cooperation at all agency levels, as well as for response and resolution. Terrorist events have markedly different event structures and profiles. This results in the scope of the threat changing with the scale of the event and the means of attack. Immediate events account for the majority of terrorist threats based on historical data. They require prompt and coordinated deployment of state and non-state personnel and equipment, and rapid response to a crisis. Cascading events present over time and may not be immediately perceived as terrorist attacks. This timeline, and sometimes the similarity of attacks dispersed across geographical regions present evidence of terrorism.

LOCATIONS:

Despite the historical data of past attacks worldwide, authorities have no reliable risk metrics for a terrorist attack probability. Though recent studies suggest that select metropolitan areas are repetitive risk or loss areas: The START Center (Study of Terrorism and Responses to Terrorism) at the University of Maryland found that some traditional predictors of ordinary crime also predict terrorist attacks, while many robust correlates of ordinary crime do not. As such, terror remains an unquantifiable rather than quantifiable risk. An attack's severity, economic impact, location, duration, and most other details will be uncertain. The START Center's datasets and conclusions can however point us to statistically more likely "hot spots" within Tennessee for mitigation planning needs. The following START map identifies national event clusters, and the location in Tennessee or proximity to it.

Map 95 – Terrorism Event Clusters



4.3.2 – Previous Occurences

Historic Event – Self Radicalized Terrorism– July 2015

Muhammad Youssef Abdulazeez opened fired on two military installations in Chattanooga, Tennessee. The attack took the lives of four US Marines and one US Sailor, and resulted in the wounding of two additional Service Members and a police officer.

Historic Event – Self Radicalized Terrorism– September 2017

Emanuel Kidega Samson opened fire at Burnette Chapel Church of Christ in Nashville, Tennessee. The attack took the life one woman and resulted in the wounding of 7 members of the congregation.

4.3.3 – Incidents/Probability

Tennessee's unique infrastructure, nuclear and hydroelectric energy facilities, large health care centers, and transportation hubs necessitate location-based threat management, as well as Sector Specific Guidance (SSG) from RAMCAP Plus when applicable to the infrastructure inventory, not all of which may be disclosed per classified information guidelines. The virulence and sophistication of an attack will determine its true impact, but critical infrastructure inventories will act as predictors overall.

4.3.4 – Changing Future Conditions

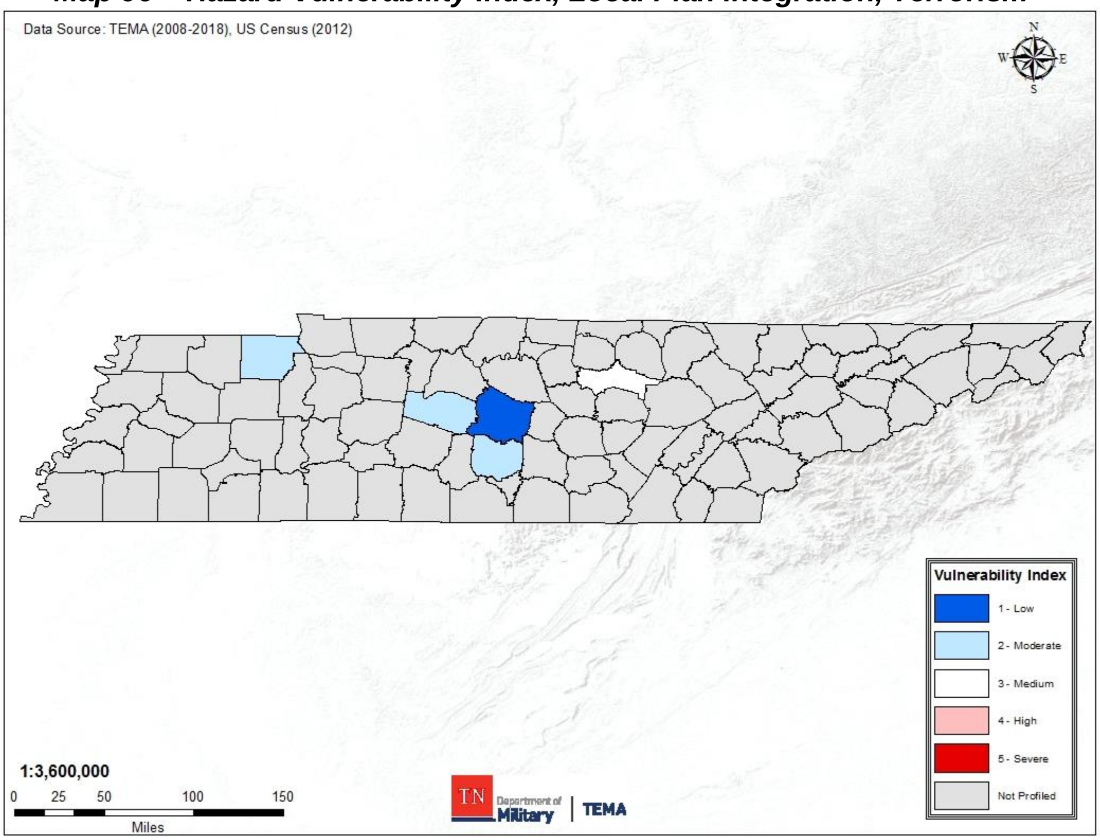
Population growth continues to change the face of Tennessee. The State is now the 16th most populated state in the Nation. Population growth necessarily raises the odds of incidents involving terror within the state as more diverse cultures interact with each other and the cultural landscape changes. In addition, the close proximity of Fort Campbell Army Post, along with various DOE assets could make Tennessee an attractive target area for domestic and foreign terrorists.

Recently Tennessee has been the site of numerous political protests and events organized by both far right and far left organizations. It is suspected that these groups have chosen this state for their events due to the high level of law enforcement mitigation and intervention. This level of diligence by state, county, and local assets ensures that protesting organizations can exercise their First Amendment rights while remaining relatively unharmed by counter protestor organizations. While this makes the State an attractive venue for these organizations, the lack of volatility tends to result in the media coverage being limited to local coverage.

Terrorism is also driven by trends, technology, and information exchange. Terrorist propaganda and literature continues to play a role in educating terrorists in attack trends, tactics, technology, and procedures. We can reasonably expect terrorists, both foreign and domestic, criminals, and foreign state actors to employ increasingly sophisticated methods of attack on both physical and virtual infrastructure, private companies, and government.

The following map depicts the vulnerability to terrorism incidents for each county throughout the State of Tennessee. This data was compiled using local plan integration.

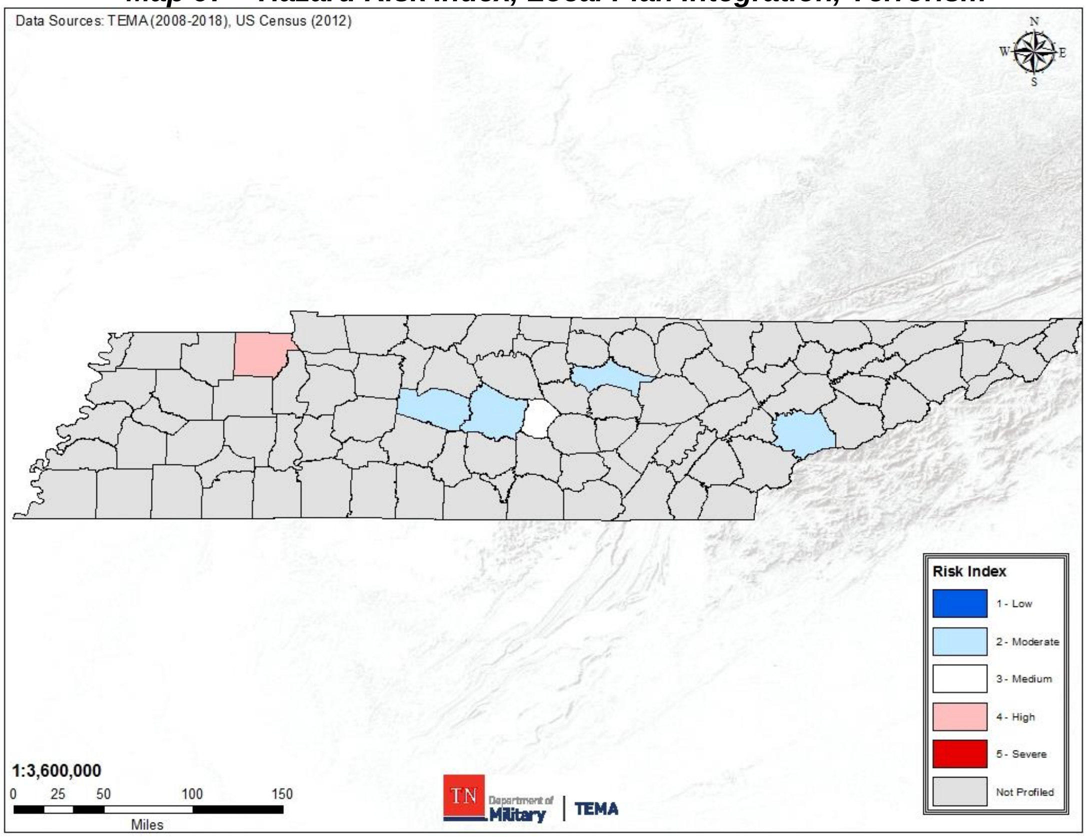
Map 96 – Hazard Vulnerability Index, Local Plan Integration, Terrorism



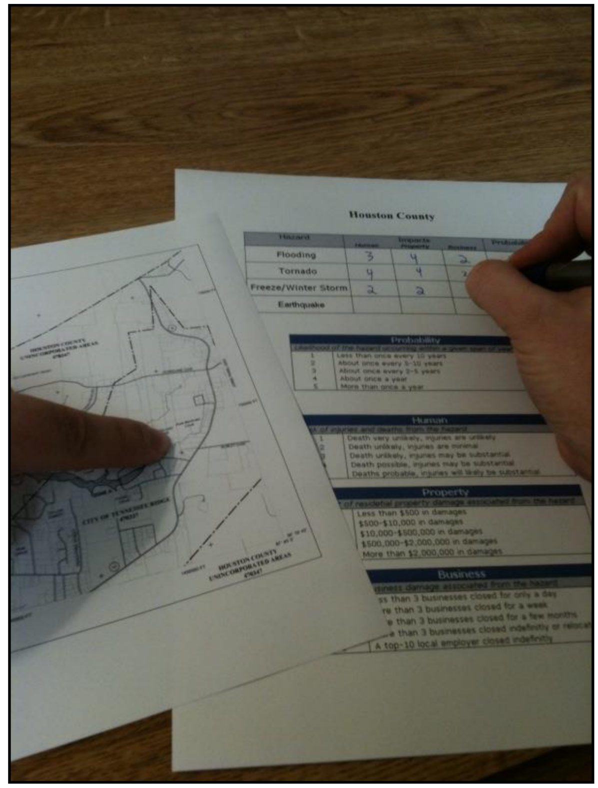
4.3.5 – Future Risk

Using a basic risk matrix: Vulnerability+Probability=Risk, TEMA was able to calculate hazard risk using data from the previous subsections. This process is further explained in Section 3.4. As shown in the following map of the risk index, 6 counties have profiled terrorism as a hazard and Henry County has the highest risk rating.

Map 97 – Hazard Risk Index, Local Plan Integration, Terrorism



Section 5 – Planning Process & Plan Maintenance



Federally approved state and local mitigation plans are a prerequisite for mitigation project grants. Development and FEMA approval of the State of Tennessee Hazard Mitigation Plan will ensure the state's future eligibility for federal disaster mitigation funds through the HMPG, Pre Disaster Mitigation Grant Program (PDM), Repetitive Flood Claims (RFC), SRL, and FMA grant programs.

The plan is maintained and updated in accordance with FEMA's required five year planning cycle. This update strives to improve on the planning methodology of Tennessee's previous hazard mitigation plans. Significant steps have been taken over the past 5 years to improve TEMA's mitigation program, specifically improvements to local plan integration and technical assistance programs. This plan's improved risk and vulnerability assessment drives a more effective and implementable mitigation strategy. After submitting the plan to FEMA for review and approval, TEMA's director will petition the Governor's Office of the State of Tennessee for a letter of formal plan adoption.

5.1 – Planning Process Methodology

The *Tennessee Hazard Mitigation Plan 2018 Update* was developed with the help of many agencies, organizations and individuals. The Tennessee Emergency Management Agency (TEMA) led the planning process including drafting and assembling the plan document itself. The planning process was designed to engage all stakeholders and integrate with other state planning efforts.

The planning process for the *Tennessee Hazard Mitigation Plan 2018 Update* was seamlessly integrated with the previous state planning process. The 2013 *Tennessee Hazard Mitigation Plan* was supported by BOLD Planning Solutions (http://www.boldplanning.com/). The BOLD Planning Solutions team helped the state design the 2013 plan so that it could be updated in-house in following plan cycles. BOLD Planning Solutions developed simplified Microsoft-office based analysis tools and templates that allowed TEMA to update the plan without consultant support for the 2018 update. For 2018, TEMA hired three full-time, interim Emergency Management Planning Specialists using Hazard Mitigation Grant Program planning funds from DR-4211. Although they were fully integrated into the TEMA team, these Planning Specialists focused solely on the update of the *Tennessee State Hazard Mitigation Plan* and program.

Upon completion of the previous plan update in 2013, TEMA maintained an annual review cycle. Stakeholders were engaged to provide updates on mitigation progress and to provide feedback on the mitigation program. Development of the plan document itself occurred over a one-year period from April 2017 to August 2018.

- 2014 Annual Mitigation Review – November 4, 2014
- 2015 Annual Mitigation Review – August 20, 2015

- 2016 Annual Mitigation Review – August 19, 2016
- 2017 Mitigation Planning Kickoff Meeting – April 07, 2017
- 2017 Hazard Review – November 2017
- 2018 Strategy Review – April 26, 2018

2016 SHMP Review

The review of hazards of prime concern occurred during the 2017 Emergency Services Coordinators (ESC) Workshop in Paris Landing State Park. The review included 120 participants representing state, federal, non-governmental, and private sector emergency management partners [see appendix 4].

Left: Participants from many emergency management partners review and provide feedback on plans and programs including the state hazard mitigation plan at the 2017 ESC Workshop in Paris Landing State Park.

In addition to group meetings, TEMA planning staff met with many state agencies, federal partners, and other partners individually as part of the state hazard mitigation planning process. Organization representatives provided feedback on hazards, vulnerability, risk, projects and concerns specific to each agency. The *State of Tennessee Hazard Mitigation Plan* is an annex to the *Tennessee Emergency Management Plan* (TEMP) and information gathered at these meetings was used in the update process for both documents.

During the individual meetings, emergency management partners were asked to identify hazards most likely to impact their facilities, operations, employees, and customers. The results are included in [Appendix 5]. The list below notes the dates of meetings.

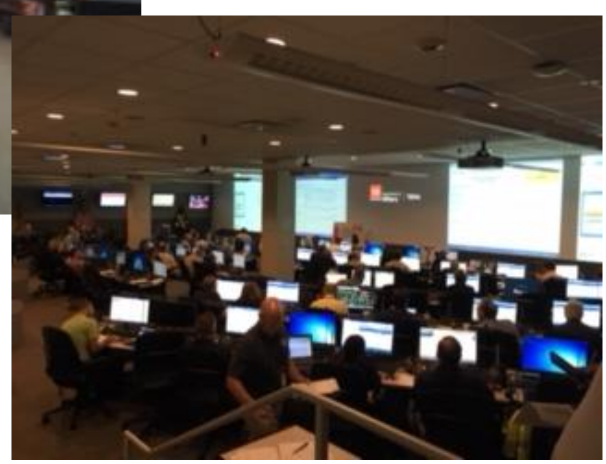
	Organization	Meeting Date
1	National Weather Services	12/11/2017
2	TN Dept. of Commerce & Insurance	12/19/2017
3	TN Emergency Communications Commission	12/19/2017
4	TN Regulatory Boards	12/19/2017
5	TN Fire Chiefs Association	12/19/2017
6	TN Dept. of Environment & Conservation	1/5/2018
7	TN Dept. of Transportation	1/11/2018
8	TN Dept. of Children Services	1/11/2018
9	TN Dept. of Health- Emergency Medical Services Division	1/18/2018
10	TN Dept. of Health- Communicable Disease Division	1/18/2018
11	TN Dept. of Finance & Administration	1/19/2018
12	TN Dept. of General Services	1/30/2018
13	TN Dept. of Safety- TN Highway Patrol	2/20/2018
14	TN Dept. of Mental Health & Substance Abuse	2/20/2018
15	TN Dept. of Safety- Office of Homeland Security	2/21/2018
16	TN Fusion Center	2/21/2018
17	TN Dept. of Labor & Workforce Development	2/22/2018
18	TN Dept. of Agriculture- Animal Health Division	2/22/2018
19	TN Dept. of Agriculture- Food & Diary Division	2/22/2018
20	TN Dept. of Human Services	2/23/2018
21	TN Dept. of Military- National Guard	2/23/2018
22	Volunteer Organizations Active in Disasters	2/26/2018
23	Civil Air Patrol	2/26/2018
24	Volunteer TN	2/27/2018
25	Strategic Technology Solutions	2/27/2018
26	TN Dept. of Financial Institutions	2/28/2018
27	TN Dept. of Correction	2/28/2018
28	TN Dept. of Education	3/1/2018
29	TN Dept. of Economic & Community Development	3/1/2018
30	TN Office of Energy Programs	3/2/2018
31	TN Office of Safe Dams	3/2/2018
32	TN Dept. of Human Resources	3/2/2018
33	TN Dept. of Tourist Development	3/6/2018
34	TN Wildlife Resources Agency	4/2/2018
35	TN Dept. of Revenue	4/3/2018
36	TN Division of Forestry	4/5/2018
37	TN Dept. of Veteran Services	4/6/2018
38	TN Dept. of Intellectual & Developmental Disabilities	4/11/2018
39	American Red Cross	4/11/2018
40	TN Emergency Management Agency	4/12/2018

Tennessee Emergency Services Coordinators Program

Emergency Services Coordinators (ESC) are designated persons that provide functionality to the State of Tennessee's emergency coordination structure. ESCs lead their respective department or agency's emergency support and planning roles. Per T.C.A. § 58-2-108(b) the "*ESC is responsible for coordinating with TEMA and reporting to that agency on emergency preparedness issues, preparing and maintaining emergency preparedness and post-disaster response and recovery plans for their agency, maintaining rosters of personnel to assist in disaster operations, and coordinating appropriate training for agency personnel*." Per T.C.A. § 58-2-108(a) the head of each state department and agency shall designate a Primary and an Alternate ESC to coordinate with TEMA.

In addition to the state law requirement for state government ESCs, the State of Tennessee also encourages the designation of ESCs among non-governmental organizations and private sector partners as well. While non-governmental and private sector ESCs do not have the same legal requirements, they do serve a critical role in ensuring a successful all-stakeholder approach to emergency operations. Coordination efforts between non-governmental organizations and private sector partners are described later in this plan.

Left and below: Emergency Services Coordinators hard at work in the James H. Bassham State Emergency Operations Center. ESCs are the backbone of the Tennessee Emergency Management program.



Threat & Hazard Identification and Risk Assessment (THIRA)

The State of Tennessee conducts an annual review of all hazards and hazard mitigation core capabilities as part of the Threat & Hazard Identification and Risk Assessment (THIRA) and State Preparedness Report (SPR). The documentation of the THIRA/SPR process is not included in this plan, as it is already available to FEMA and some of the information contained in the report is protected.

The following documents served as primary sources in the assistance of developing this plan. They were used to provide technical assistance, planning guidelines, and document production procedures. The specific details are as follows.

FEMA Multi-Hazard Mitigation Planning Guidance Under the Disaster Mitigation Act of 2000
This publication was developed to help states better understand the mitigation planning regulations cited in CFR 44. This document was a cornerstone in developing a state mitigation plan designed to meet and exceed FEMA's planning requirements.

FEMA 386 "How-to" Guides
These publications provided the plans overall format guidance, planning procedures, and risk assessment assistance. The publication is divided into the following guides:

FEMA 386 – 1 – Building Support for Mitigation Planning
FEMA 386 – 2 – Identifying Hazards and Estimating Losses
FEMA 386 – 3 – Identifying Mitigation Actions and Implementation Strategies
FEMA 386 – 4 – Implementing the Hazard Mitigation Plan
FEMA 386 – 5 – Using Benefit Cost Review in Mitigation Planning
FEMA 386 – 6 – Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning
FEMA 386 – 7 – Integrating Manmade Hazards Into Mitigation Planning
FEMA 386 – 8 – Multi-Jurisdictional Mitigation Planning
FEMA 386 – 9 – Using the Hazard Mitigation Plan to Prepare Successful Mitigation Projects

FEMA Multi-Hazard Identification and Risk Assessment
This publication is a reference to assist hazard identification, risk assessment, and mitigation specialists in refining the understanding of hazards and their impact on people and their environment.

FEMA Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards
This document provides communities a guide to identify and evaluate a range of potential mitigation actions for reducing risk to natural hazards and disasters.

FEMA Guidelines and Specifications for Flood Hazard Mapping Partners
This publication details the processes, guidelines, and specifications by which FEMA develops and updates flood insurance rate maps (FIRM) and collateral flood insurance study reports. The mapping assessment guidelines within this document were incorporated into all flood mapping and models produced for this HMP.

Emergency Management Standard, EMAP
This publication details the hazard mitigation planning guidelines and requirements for compliance with EMAP.

5.4 – Program Integration

The Hazard Mitigation Plan is an overarching document that is both comprised of, and contributes to, various other state plans. In creating this HMP, all the planning documents identified below were consulted and reviewed, often extensively. In turn, when each of these other plans is updated, they will be measured against the contents of the HMP.

Below is a general description of the state's various planning efforts and documents. While each plan can stand alone, the functional integration of the plans with the HMP will further strengthen and improve Tennessee's resilience to disasters. Following the descriptions is a matrix that identifies the most recent version of each plan and when it will be updated again. Also included is a brief narrative on how the plan was utilized and integrated into the HMP.

5.4.1 – Related State Planning

Community Wildfire Protection Plan
Led by the Division of Forestry and developed in conjunction with participating local communities, CWPPs are a prerequisite for becoming an active member of the FireWise program. The purpose of the plans is to actively reduce and implement wildfire mitigation measures and encourage local community participation and eventually become an active member of the FireWise program.

Drought Management Plan
The purpose of this plan is to provide a framework for action and cooperation in water resources management among the many local, state, and federal agencies with drought-related responsibilities. This plan outlines the resources that other state, federal and local entities can provide and the ways in which we can work together to lessen the impacts of a drought.

Emergency Management Accreditation Program Standard
The EMAP is a scalable yet rigorous national accreditation standard for state, territorial, local, and tribal government emergency management programs. TEMA accreditation was collaboratively developed in a series of working groups of emergency management stakeholders from government, business, and other sectors.

Expanding and Using Knowledge to Reduce Earthquake Losses-Strategic Plan
This serves as the strategic and operational plan for all the National Earthquake Hazards Reduction Program agencies and guides federal earthquake research, loss reduction, and mitigation efforts in the United States. It articulates the mission and goals of the National Earthquake Hazard Reduction Program (NEHRP), provides a framework for priority-setting and coordinating activities, and defines priority areas for the future. The NEHRP seeks to mitigate earthquake losses in the United States through both basic and directed research and implementation activities in the fields of earthquake science and engineering

Interim Air Quality Policy on Wildland and Prescribed Fires
The policy statement responds to plans by some federal, tribal, and state wildland owners/managers to significantly increase the use of wildland and prescribed fires to achieve resource benefits in the wildlands. The policy integrates 2 public goals; (1) to allow fire to function, as nearly as possible, in its natural role in maintaining healthy wildland ecosystems, and (2) to protect public health and welfare by mitigating the impacts of air pollutant emissions on air quality and visibility.

Mitigate Potential Terrorist Attacks Against Buildings Reference Manual
This document provides guidance to the building science community of architects and engineers, to reduce physical damage to buildings, related infrastructure, and people caused by terrorist assaults.

National Incident Management System (NIMS)
The NIMS integrates existing best practices into a consistent, nationwide approach to domestic incident management that is applicable at all jurisdictional levels and across functional disciplines in an all-hazards context.

National Fire Protection Association NFPA1600
Standard on Disaster, Emergency Management, and Business Continuity Programs – Documents codes, standards, recommended practices, and guides which were developed through a consensus standards development process approved by the American National Standards Institute.

National Response Framework (NRF)
The National Response Framework is a guide to how the nation conducts an all-hazards response. It is built upon scalable, flexible, and adaptable coordinating structures to align key roles and responsibilities across the nation, linking all levels of government, nongovernmental organizations, and the private sector. It is intended to capture specific authorities and best practices for managing incidents that range from the serious but purely local, to large-scale terrorist attacks or catastrophic natural disasters. (Incorporates Federal Response Plan, 2003/National Response Plan, 2006)

State of Tennessee Administrative Plan for Hazard Mitigation
This plan prescribes the manner in which the State of Tennessee will manage and administer the: Flood Mitigation Assistance, Repetitive Flood Claims, Severe Repetitive Loss, Hazard Mitigation Grant, Pre-Disaster Mitigation, and FEMA Unmet Needs Programs as well as the policies and procedures to be utilized.

State of Tennessee Administrative Plan for Public Assistance
This plan identifies the roles and responsibilities of the state in administering the Public Assistance Program, outlines staffing requirements as well as the policies and procedures to be utilized.

State of Tennessee Five-Year Floodplain Management Work Plan
This 5 year plan for the administration and implementation of the National Flood Insurance Program in the State of Tennessee is coordinated by the Tennessee Department of Economic and Community Development. The various state departments and agencies are directed through a Governor's Executive Order to operate in a manner that will minimize impacts on areas of identified flood hazard. Local communities in Tennessee are authorized to implement floodplain management under the general zoning enabling statutes.

State of Tennessee Hazard Assessment
This is now a supporting document and annex to the Tennessee Emergency Management Plan. The assessment highlights hazards most likely to adversely affect the physical and socio-economic environs of the state. In doing so, it promotes development of interagency, multi-hazard activities addressing all phases of the emergency management cycle. From the local and regional perspective, it assesses natural, technological, and man-made hazards likely to affect the State of Tennessee as well as discusses the process utilized to identify and evaluate the same.

State of Tennessee Recovery Plan

This plan assists in making decisions and organizing efforts relating to the methods utilized in disaster recovery. It incorporates the composite input from multiple sources of government, charitable organizations, and other private entities active in a disaster. The plan addresses the actions that should be taken starting immediately upon the occurrence of the disaster/emergency through the entire response phase and recovery phase.

State Plan for Public Health

This is the state plan to prepare for and mitigate against the impact of hazardous events in the changing environment in which Public Health may be required to function. This plan has now been transferred and merged into the Tennessee Emergency Management Plan (TEMP) under ESF-8/Disaster Operations Guide.

Strategic Plan of the Tennessee Emergency Management Program and Tennessee Emergency Management Agency

This is a strategic multi-year plan aimed at reducing the loss of life and property while protecting the state of Tennessee from all hazards, including natural disasters, acts of terrorism, and other man-made disasters. It directs and supports the state in a risk-based, comprehensive emergency management system of preparedness, protection, response, recovery, and mitigation.

Tennessee Code Annotated

The Tennessee Code Annotated is the official compilation of the statutes, codes, and session laws of the State of Tennessee.

Tennessee Emergency Management Agency Annual Report

TEMA is empowered by state law and by the governor's executive authority to protect the public from disasters and emergencies. TEMA and the State Emergency Operations Center (SEOC) perform as the staff of the governor during a state declaration of emergency. TEMA and the SEOC are charged by law to ensure that the orders of the governor are implemented and enforced. This annual report is a narrative of all actions taken by TEMA during the previous calendar year in furtherance of these missions.

Tennessee Catastrophic Event Plan

The plan defines a coordinated operational response to a catastrophic earthquake and also helps to clarify response outcomes over a planned period of time. It increases not only the state's readiness to a New Madrid Seismic Zone catastrophic earthquake event, but improves regional and national readiness. The plan defines the answer to the question, "What will the State of Tennessee do if an earthquake should impact western regions of the state tomorrow?" It focuses on the major issues the State of Tennessee expects to encounter for an unpredicted catastrophic earthquake.

Tennessee Emergency Management Plan (TEMP)

The Tennessee Emergency Management Plan is the document that provides the foundation for all disaster and emergency response operations conducted within the State of Tennessee. Tennessee state law requires TEMA to develop this plan and update it on a periodic basis. All local emergency management plans are required to emulate the TEMP in terms of structure and purpose. All of the other plans developed by the agency make reference to the TEMP in some form or fashion. Many of the plans are tabs or sub-elements of the TEMP. Many details of emergency management involving sensitive national security issues, events involving terrorism, locations of critical facilities and references to systemic weaknesses or problems which may develop under catastrophic scenarios, are classified as confidential by state law, closely held by the agency, and not made available to the general public.

Tennessee Health Access Plan

The Tennessee Health Access Plan is published annually by the Tennessee Department of Health, Bureau of Health Services, Community Services Section. The plan assists federal, state, and local health planning officials in identifying shortage areas for primary and dental health care in Tennessee. It is generated to provide guidelines for the Health Access Incentive Grant Program, Annual Health Professional Recruitment Fair, National Health Service Corps, Graduate Medical Education – Residency Stipend Program, and J-1 Visa Waiver Programs, and to disseminate data from the annual survey of physicians, physician extenders, and dentists.

The State of Tennessee Multi-Jurisdictional Emergency Response Plans for the Sequoyah Nuclear Plant, the Watts Bar Nuclear Plant, and the United States Department of Energy Oak Ridge Reservation (MJERP)

The MJERPs were developed and are maintained by TEMA as a requirement of the Tennessee Oversight Agreement, which tasks the agency to develop a plan that protects the citizens of Tennessee from emergencies occurring at the Sequoyah Nuclear Plant, the Watts Bar Nuclear Plant, and/or on the Oak Ridge Reservation. The MJERPs meet that requirement by specifying the coordinated response among federal, state, and local organizations during an emergency event at the Sequoyah or Watts Bar Nuclear Plants or on the Oak Ridge Reservation. It also describes TEMA's responsibility to coordinate the development of state and local emergency response programs including the review, revision, and maintenance of existing documents, coordination of local emergency planning activities, development and delivery of training, and conduct of drills and exercises to verify effective offsite response capabilities.

Tennessee Threat and Hazard Identification and Risk Assessment (THIRA)

By Presidential Directive (PPD-8) all states were required to complete a Threat and Hazard Identification and Risk Assessment by 2012, as a condition to the continued receipt of EMPG and other grant funds. The THIRA is developed by TEMA annually.

Assessing the Vulnerability of Tennessee Transportation Assets to Extreme Weather, Revised Final Report, May 28, 2015

This publication represents TDOT's first attempt to understand the impacts of extreme weather on transportation assets across the state. The study represents a starting point for integrating extreme weather risk into the agency's management, planning and operations. It also serves as a foundation that TDOT can build upon by performing follow-on activities based on the results of the extreme weather vulnerability assessment.

Table 62 – Planning Integration			
Plan Title	**Last Update**	**Next Update**	**Integration Description**
Community Wildfire Protection Plan	2017	2018	Tennessee's HMP has an extensive GIS driven risk assessment on wildfire risk and vulnerability. This assessment will be integrated into the Division of Forestry's future development and updates of CWPPs.
Drought Management Plan	2010	2019	Tennessee's HMP has a drought risk and vulnerability assessment section. This section will be used as the base risk and vulnerability assessment for the Drought Action Plan's update driving the state's drought response and preparedness activities.
Emergency Management Accreditation Program	2013	2019	Reviewing the standards for the conduct of emergency management professionals and their required substantive knowledge strengthened the focus of the HMP.
Interim Air Quality Policy on Wildland and Prescribed Fires	1998	---	The HMP utilized the information in this plan about mitigating against the effects of smoke and airborne pollutants.
Mitigate Potential Terrorist Attacks Against Buildings	2008	---	Mitigating damages caused to structures by terrorist attacks can also be effective against natural disasters.
National Incident Management System (NIMS)	2008	---	Any HMP must consider the precepts and organizational directives of NIMS to be an effective disaster mitigation and management tool.
National Fire Protection Association (NFPA) 1600	2016	2019	Determining the resistance of a community to a disaster is a critical step in developing a mitigation plan. Information ascertained through evaluating Tennessee's fire protection paradigm assisted in determining mitigation priorities.
National Response Framework (NRF)	2008	---	As with NIMS, no HMP could be constructed without a thorough understanding and incorporation of the standards and methods included within the NRF.
State of Tennessee Administrative Plan for Hazard Mitigation	2017	2018	This annually updated plan provided substantive information for several important mitigation programs, such as Flood Mitigation Assistance, Repetitive Flood Claims, Severe Repetitive Loss, Hazard Mitigation Grant, Pre-Disaster Mitigation and the FEMA Unmet Needs Programs.
State of Tennessee Administrative Plan for Public Assistance	2017	2018	Information from and about the Public Assistance program is crucial to an overall mitigation plan as it helps identify those areas that most often require relief from a disaster and thus should be the focus of mitigation projects.
State of Tennessee Five-Year Floodplain Management Work Plan	2015	2020	Flooding is a critical concern for Tennessee and thus the state's 5 year plan for lessening the impacts of floods was fully vetted and incorporated into the HMP.
State of Tennessee Hazard Assessment Guide and Hazard Identification and Risk Assessment (HIRA)	2013	2018	Tennessee hazard assessment and the HIRA are now subsumed within the state's HMP.

Plan Title	Last Update	Next Update	Integration Description
State of Tennessee Recovery Plan	2017	2022	This plan identifies how Tennessee will recover from a disaster and thus included important information on the types and amount of damage likely to be faced in the state after a disaster.
Strategic Plan of the Emergency Management Agency	2017	2018	Given that this document is a guidepost for Tennessee's Emergency Management Agency, it was critical in evaluating the hazards that the state will likely face and how the state intends to respond to them.
Tennessee Code Annotated	2018	2019	These are Tennessee's laws and as such determine the state's response to hazards and disasters. Since any state action must be lawful, the Tennessee Code Annotated was reviewed to ensure that the HMP was fully compliant with its requirements.
Tennessee Emergency Management Agency Annual Report	2017	2018	The annual reports provided critical information on what hazards and disasters actually have impacted Tennessee. By focusing on the actual state responses, the annual reports helped to hone the expected effectiveness of the HMP.
Tennessee Catastrophic Event Plan	2017	2022	This is an earthquake response plan that is updated every 5 years and is currently included as an annex to the TEMP.
Tennessee Emergency Management Plan (TEMP)	2018	2023	A critical document for guiding the contents of the HMP. Its body and annexes include much of the information necessary to determine the hazards that face the State of Tennessee and its citizens and how the state government intends to prepare for, respond to, recover from, and mitigate against disasters.
Tennessee Multi-Jurisdictional Radiological Emergency Response Plan for the Sequoyah Nuclear Plan	2018	2019	This is now an annex of the TEMP.
Tennessee Multi-Jurisdictional Radiological Emergency Response Plan for the Watts Bar Nuclear Plant	2018	2019	This is now an annex of the TEMP.
The State of Tennessee Multi-Jurisdictional Emergency Response Plan for The United States Department of Energy Oak Ridge Reservation	2018	2019	This is now an annex of the TEMP.
Tennessee Threat and Hazard Identification and Risk Assessment (THIRA)	2017	2018	The threats and hazards identified by the THIRA assisted in the process of determining those risks that may be able to be mitigated to lessen their severity.

5.4.2 – Related Federal Planning

A primary task in fulfilling TEMA's mission is the development and maintenance of the Tennessee Emergency Management Plan. The TEMP is an all-inclusive, strategic document, which governs the development and use of all subsequent planning documents in the State of Tennessee. The TEMP integrates all federal emergency management plans, programs, initiatives, and policies to keep the state and all state planning activities aligned with federal goals and objectives. Per these design guidelines, TEMA works with FEMA to administer federal hazard mitigation assistance programs to the State of Tennessee.

State-level mitigation is inherently integrated into a host of federal programs and initiatives. Utilizing federal grant programs the state and its local jurisdictions have accomplished numerous quality mitigation activities, negating much if not all of the adverse effects associated with hazards. Additionally, participation in some of the lesser utilized federal initiatives (CRS and FireWise) is growing in the State of Tennessee. The following information illustrates the financial impact of federal programs and the planning impact of federal initiatives on the State of Tennessee's mitigation efforts.

Hazard Mitigation Grant Program (HMGP)
Authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act 42 USC, the HMGP provides grants to states, local, and tribal governments to implement long-term hazard mitigation measures. The funds become available only after a major disaster declaration in order to reduce the loss of life and property due to hazard events and to enable the implementation of mitigation measures during the recovery period. The recipient of an HMGP grant must have a current, FEMA approved hazard mitigation plan, unless the recipient is using the grant for the development of a FEMA approved hazard mitigation plan.

Pre-Disaster Mitigation Program (PDM)
Authorized by Section 203 of the Robert T. Stafford Disaster Assistance and Emergency Relief Act 42 USC, the PDM program assists states, local, and tribal governments in implementing cost-effective hazard mitigation activities and projects. These activities and projects must complement a comprehensive mitigation program prior to a hazard event and disaster declaration. PDM grants are typically awarded on a competitive basis, but sometimes through legislative action. The recipient of a PDM grant must have a current, FEMA approved hazard mitigation plan, unless the recipient is using the grant for the development of a FEMA approved hazard mitigation plan.

Flood Mitigation Assistance Program (FMA)
Created under the National Flood Insurance Reform Act of 1994, 42 U.S.C. 4101, the FMA aims to reduce or eliminate claims under the National Flood Insurance Program. FEMA provides FMA grant funds to assist states and communities in implementing measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. FMA funds are awarded on a competitive basis and can be used for flood related projects or planning.

National Flood Insurance Program (NFIP)

The NFIP is a federal program created in 1968 that allows citizens in participating communities to purchase insurance coverage for potential property damage as a result of flooding. This voluntary program for local communities is administered by the Mitigation Division of FEMA. The National Flood Insurance Program in Tennessee is administered by the Department of Economic & Community Development. The program works closely with private insurance companies to offer flood insurance to property owners and renters. In order to qualify for flood insurance, a community must join the NFIP and agree to enforce sound floodplain management standards. The 3 components of the NFIP are flood insurance, floodplain management and flood hazard mapping.

In return for a local community adopting and enforcing local floodplain management regulations, flood insurance is available in the community. Currently, nearly 400 Tennessee communities participate in the NFIP. Of all natural disasters, flooding is historically responsible for the most loss of life and the greatest damage to property in the state.

Community Rating System (CRS)

FEMA's Community Rating System program is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. The program incentivizes communities by offering CRS participants NFIP discounts. The goals of the CRS are to reduce flood losses, to facilitate accurate insurance rating, and to promote awareness of flood insurance.

Repetitive Flood Claims Program (RFC)

Authorized by the Bunning – Bereuter – Blumenauer Flood Insurance Reform Act of 2004, the Repetitive Flood Claims program provides funds to assist states and communities in reducing flood damages to insured properties that have had 1 or more claims to the NFIP. RFC grants are to be awarded on a competitive basis and without reference to state allocations, quotas, or other formula based methodologies.

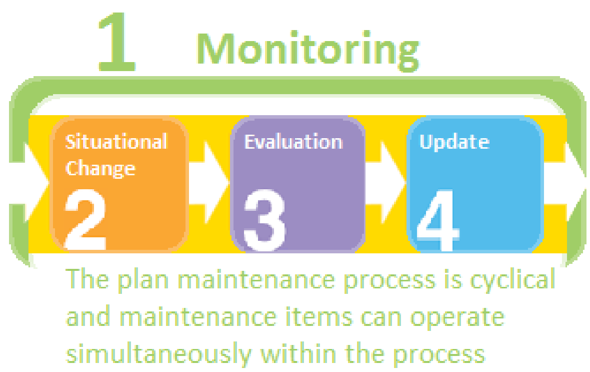
Repetitive Loss & Severe Repetitive Loss Program (RL/SRL)

Authorized by the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004, the Repetitive Loss and Severe Repetitive Loss program provides funding to reduce or eliminate the long-term risk of flood damage to repetitive loss and severe repetitive loss properties insured under the NFIP. Repetitive loss and severe repetitive loss properties include residential properties covered under the NFIP flood insurance policy that have had at least 4 NFIP claim payments each over $5,000 and the cumulative amount exceeding $20,000, or 2 separate claims with the cumulative amount exceeding the market value of the structure. The typical RL/SRL project uses federal funds to acquire and demolish these properties and replace them with open space areas that have little to no liability in the event of a flood. The State of Tennessee has used this program to acquire and demolish many RL/SRL properties.

FireWise Communities Program

Established in 2010 by the USDA Forest Service, the US Department of the Interior, and the National Association of State Foresters, the FireWise Communities Program teaches communities how to mitigate against the risk of wildfire. Its aim is to facilitate the acceptance of national standards for evacuation procedures, develop local wildfire plans, instigate local mitigation activities, and educate communities. The program stresses local solutions by involving community homeowners, community leaders, planners, developers, and firefighters.

5.5 – Plan Maintenance Process

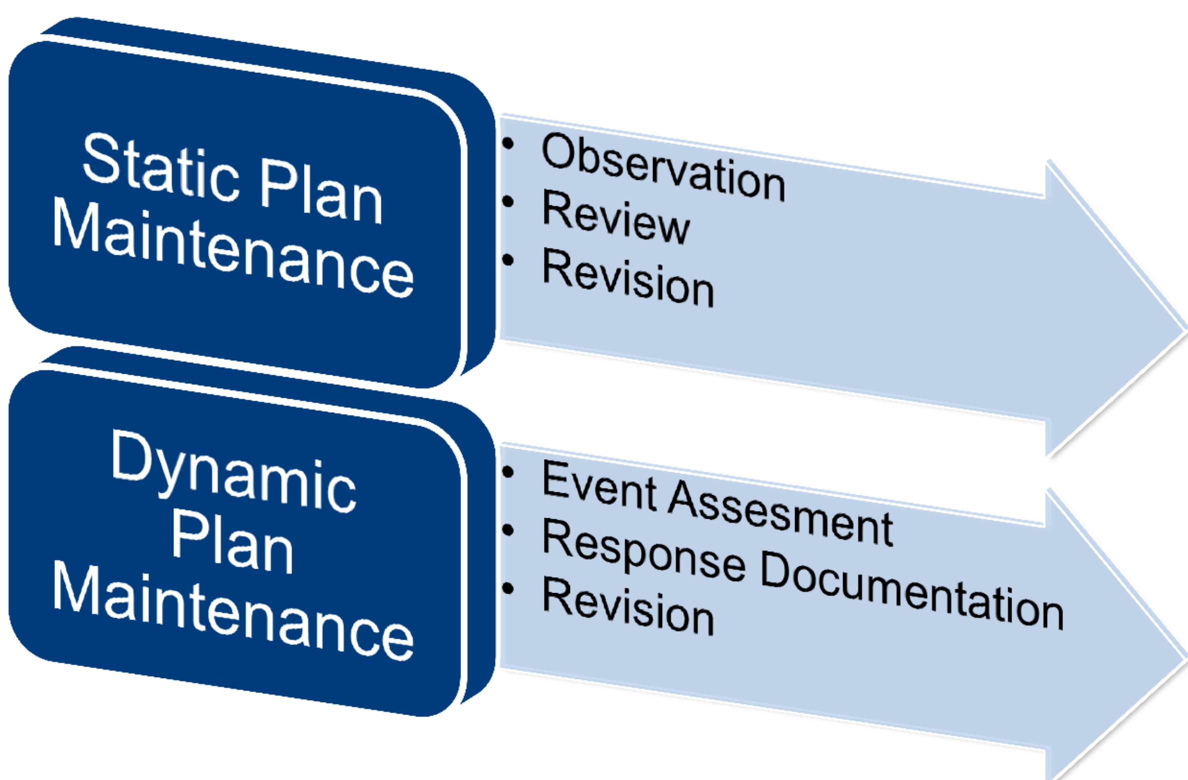


The rebuilding of TEMA's mitigation program, as discussed later in this section, demanded a complete re-write of the HMP's maintenance process. Plan maintenance was conducted as scheduled over the past 5 years, maintaining interest and participation in the Tennessee mitigation program.

While plans are relatively static, the conditions, governments and populations that inform them are not. The maintenance process for the plan in a dynamic setting, as well as with a static timeline is critical to ensure current and up to date information, contact points and accurate legislative guidance. These 2 workflows (an established and fixed one, as well as the dynamic allowances) can operate simultaneously, concurrently or symbiotically under the guidance of the State Hazard Mitigation Planner. Examples of static evaluation for plan maintenance include scheduled annual meetings, LiDAR and GIS plus attendant dataset updates. Both approaches, static and dynamic, work simultaneously throughout the plan maintenance process.

The static workflow maintenance has 3 primary facets: observation, review and revision. These 3 are inherently dependent on integrated scheduling and all invested parties prioritizing the HMP's goals and objectives in their own reports. These reports should reflect the agency or department's specific efforts to achieve goals and objectives outlined in the HMP.

The dynamic aspects of plan maintenance include similar techniques but progress in a different order and usually on an accelerated timeline. They include, but are not limited to: event evaluation, response documentation and revision.



5.6 – Plan Monitoring

1 Monitoring

Regularly report on mitigation action's/project's progress from start to finish.

Plan monitoring can be defined as the ongoing process by which stakeholders obtain regular feedback on the progress being made toward achieving their goals and objectives. In the more limited approach, monitoring may focus on tracking projects and the use of the agency's resources. In the broader approach, monitoring also involves tracking strategies and actions being taken by partners and non-partners, and figuring out what new strategies and actions need to be taken to ensure progress toward the most important results.

The HMPC will set and adhere to an annual meeting schedule. These meetings will include state employees of HMPC, the State Hazard Mitigation Planner, members of TEMA's planning branch, and ESC's from relevant agencies. The meeting content must address but is not limited to the following:

- Changes in state and/or federal legislation
- Changes in funding sources
- Changes in staffing and TEMA organizational structure
- Recent hazard events
- Changes in demographics and development
- Improvements in and availability of hazard data

These meetings and their agendas will be scheduled well in advance, usually in the 3rd or 4th quarter of each year. This will include secure electronic reminders and confirmation of attendance. A log of attendees and documentation including minutes and any and all changes to the plan will be kept and disseminated to the HMPC and TNHMC.

It will be the responsibility of TEMA to disseminate significant changes in federal fiduciary resources and instruments such as HMPG, PDM or other federal sources of importance to mitigation activities. It falls within the purview of the staff members who manage these grant programs to review, respond or incorporate common changes or regular appropriations information. Significant changes or updated information should be sent to the HMPC within 30 days of receipt. Those projects that are funded solely with state funds for state mitigation efforts will be handled by the agency that provides the state funded grant or loan including those with matching rates to federal funding.

Quarterly	Annual	Five Year
• Conduct site visits or obtain reports of completed or initiated mitigation actions to incorporate in the plan revision as needed. • Coordinate, compile, and disseminate hazard mitigation funding information and applications. • Collect and review NFIP HMG/PDM and grant receipient reports	• Collect annual reports from the agencies involved in implementing mitigation projects • Research and document new natural disaster information and incorporate into the Risk Assessment section as needed. • Organize annual meetings with the Hazard Mitigation Committee • Coordinate, compile and disseminate STS updates and GIS data.	• Document and collate all major disasters and events during the previous three calendar years. • Revise and Ammend the HMP in accordance with collected data, cost benefit analyses and relevant legislation. • Consolidate close out statistics and cost benefit analyses of mitigation actions and grants given during the previous three years.

5.6.1 – Monitoring Plan Implementation

An organized, effective, efficient, monitoring system is integral to the successful deployment of the HMP's mitigation strategy. Since the approval of the 2013 plan, TEMA has maintained its tracking and monitoring systems.

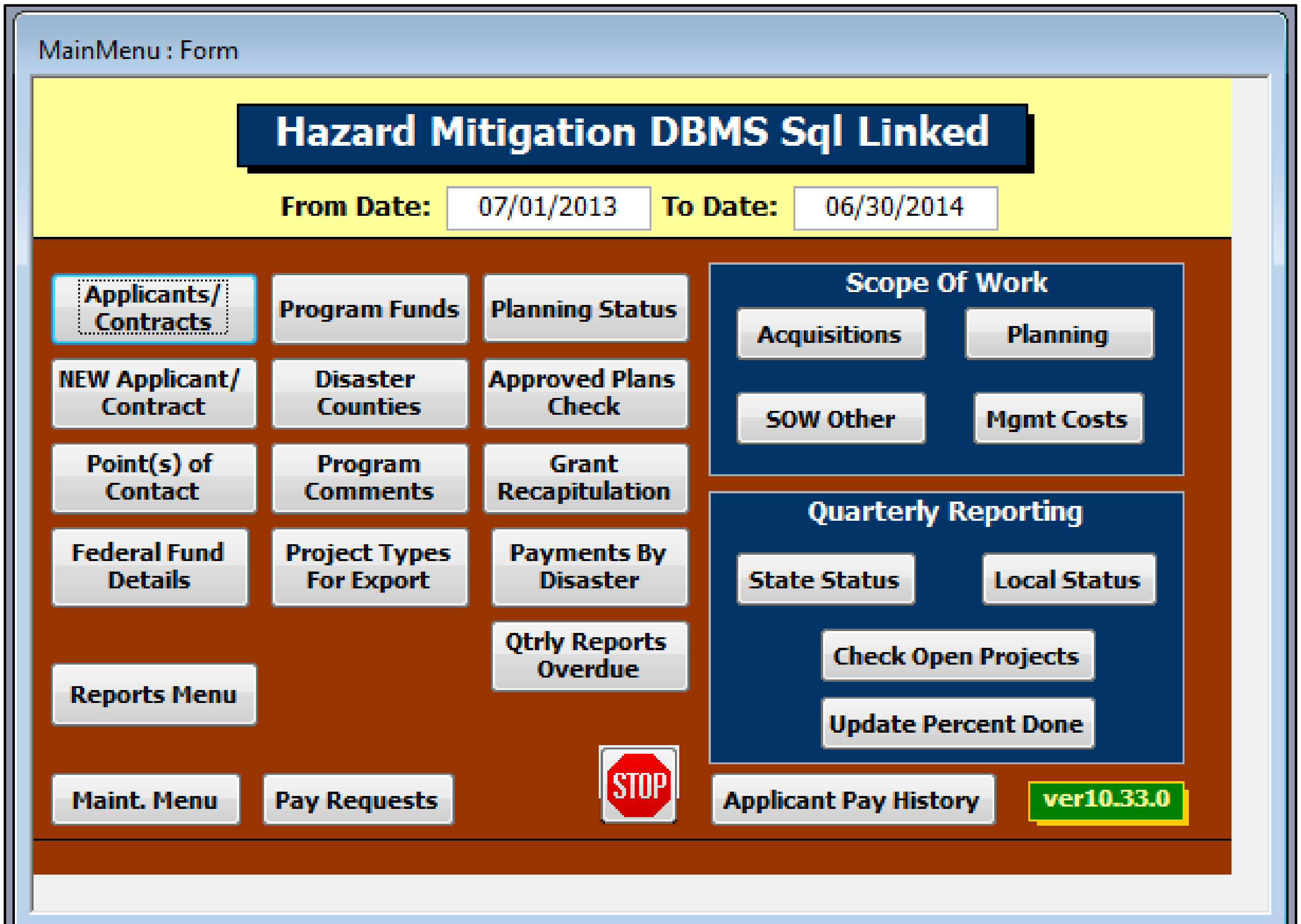
In 2006, TEMA brought online its state of the art Hazard Mitigation Database Management System. The Hazard Mitigation Database Management System runs off of a TEMA hosted Microsoft SQL 2005 database server. In prior years the system was designed and used solely for tracking and monitoring grants, however, over the past year TEMA has begun to integrate the monitoring and tracking of all state mitigation programs, including this HMP. The system integrates all mitigation tracking and monitoring necessary to maintain a common operating picture throughout Tennessee. A centralized SQL system offers significant advantages over the previous system.

Instead of users updating tracking and monitoring data as a separate task, the new SQL system was designed as a work-user interface. This means users perform their essential job tasks from within the program itself therefore eliminating the need for additional and sometimes unreliable manual user entry. The system's interface is designed with selectable options as the primary interface, not manual entries, decreasing the chance of user entered errors. Additionally, since the system is hosted on a centralized server, a user cannot create divergent systems.

In addition to mitigating many of the old systems deficiencies, the Hazard Mitigation Database Management System offers significant advantages, including:

- Full mitigation program integration
- Tracks grants from NOI to closeout
- Tracks local plan status from NOI to adoption
- Tracks the progress of local mitigation projects
- Exportable mitigation project designs
- Tracks grant funding availability
- Tracks the progress of state mitigation projects and activities
- Tracks the progress of state mitigation goals, objectives, and strategies
- Tracks and displays statewide statuses for grants, plans, project, activities, and disasters
- Tracks overdue activities and notifies of overdue reports
- All tracking and monitoring data can be outputted to printable reports

The screenshot on the following page is of the Hazard Mitigation Database Management System's home screens.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Hazard Mitigation DBMS Sql Linked
From Date: 07/01/2013
To Date: 06/30/2014
Applicants/ Contracts
Program Funds
Planning Status
NEW Applicant/ Contract
Disaster Counties
Approved Plans Check
Point(s) of Contact
Program Comments
Grant Recapitulation
Federal Fund Details
Project Types For Export
Payments By Disaster
Qtrly Reports Overdue
Reports Menu
Scope Of Work
Acquisitions
Planning
SOW Other
Mgmt Costs
Quarterly Reporting
State Status
Local Status
Check Open Projects
Update Percent Done
Maint. Menu
Pay Requests
STOP
Applicant Pay History
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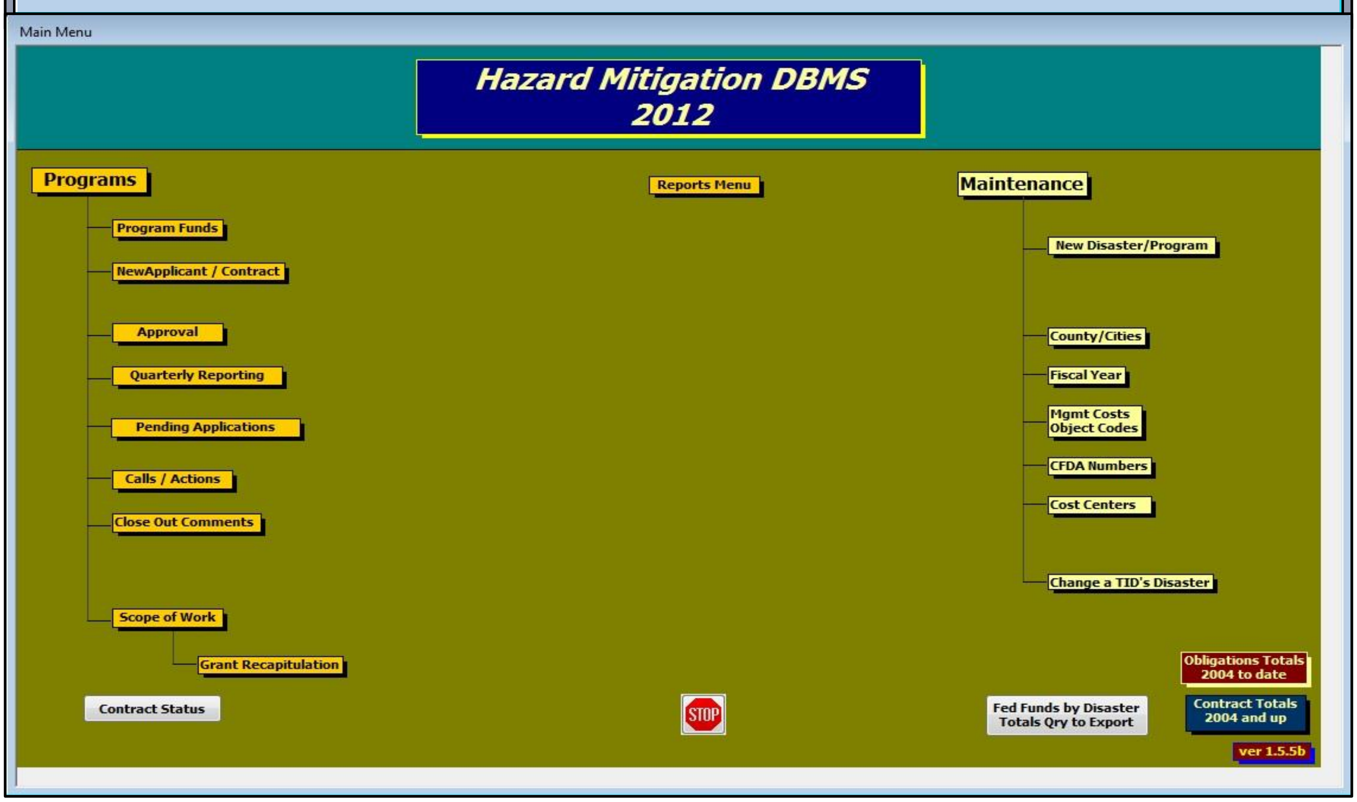
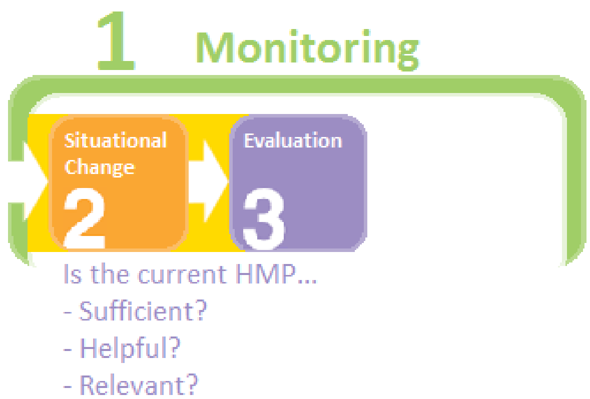

Main Menu
Hazard Mitigation DBMS 2012
Programs
Program Funds
NewApplicant / Contract
Approval
Quarterly Reporting
Pending Applications
Calls / Actions
Close Out Comments
Scope of Work
Grant Recapitulation
Reports Menu
Maintenance
New Disaster/Program
County/Cities
Fiscal Year
Mgmt Costs Object Codes
CFDA Numbers
Cost Centers
Change a TID's Disaster
Contract Status
STOP
Fed Funds by Disaster Totals Qry to Export
Obligations Totals 2004 to date
Contract Totals 2004 and up
ver 1.5.5b

5.7 – Plan Evaluating

An evaluation report will be written and submitted to the HMPC when the situation dictates. The following situations are typical examples of when an evaluation will be necessary.

- Post hazard event
- Post training exercise
- Post tabletop or drill exercise
- Significant change or completion of a mitigation project
- Significant change or completion of a mitigation action



A plan evaluation is a rigorous assessment of the plan to determine the extent to which stated objectives are being achieved and whether they are contributing to decision making. Evaluating the HMP is the process by which those invested in or responsible for the plan (TEMA, local and state agencies) review existing data or projections and contribute meaningful data driven feedback from real world scenarios, along with economic and demographic projections provided by the STS or other state agencies.

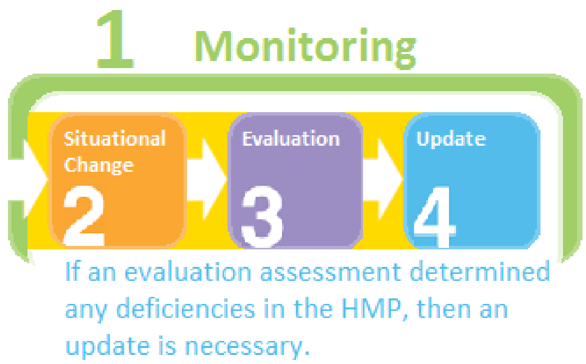
Quarterly or bi-annual reviews of the strategy should occur after winter and spring flooding and severe storm months to properly assess major events and, storm damage and to review reports from the Department of Economic and Community Development, TDEC and other regulatory bodies. Considerations should include site and assistance visit assessments and follow up documentation from these agencies and departments; they should specifically include assessments of whether the goals and objectives in the plan were adequately met after major natural cycles and/or events.

After a response to a declared disaster has been documented, a comprehensive economic, social and environmental analysis will be completed by the State Hazard Mitigation Planner and incorporated into the HMP.

An evaluation report will ask the following questions in response to the previously listed events.

- Do the mitigation objectives and goals continue to address the current hazards?
- Are there new or previously unforeseen hazards?
- Are current resources appropriate for implementing a mitigation project?
- Was the outcome of a mitigation action/project expected?
- Are there implementation problems?
- Are there coordination problems?

5.8 – Plan Updating



The HMP update is initiated upon the completion of a plan evaluation and even then, only when the evaluation determines an update is appropriate. Additionally, when new hazard data becomes available it will be reviewed at the annual TNHMC meeting.

The mitigation strategies set forth in local mitigation plans will be evaluated as part of the SHMP annual review process. This ensures that the state mitigation strategy accurately reflects the needs across the state. Practically speaking, this will occur through trend analysis throughout the year. Trends in local mitigation strategies will be examined during the annual state hazard mitigation plan review, since examining individual projects would not be feasible. The State Hazard Mitigation Planning Committee can then determine the need for adjustments in the state strategy.

The plan will be revised and updated at a comprehensive level every 5 years or sooner if significant changes to state resources, community structures, or incidents have occurred. When the plan review meeting falls within a 3 or 5 year US Census American Community Survey estimate revision, the plan will be updated to include new and accurate community demographics data and components directly affected by this data will be assessed for their continued applicability.

Updates determined to be necessary from recent hazard events will require adjustments to the plan's hazard profiles and risk assessments. Examples of this may include, but are not limited to: dam failure and new inundation studies, serious geologic or seismic events, completion of 3rd party hazard studies, or significant land use and development changes. Additionally, completion of local hazard mitigation plans and their new risk assessments must be incorporated into the HMP's current risk assessment by local integration.

Once significant revisions are instituted, the FEMA regional office will be notified of any changes to the HMP and will be sent a copy of the updated plan, along with documentation of the rationale for said changes. If no changes are deemed necessary, written documentation and an explanatory report will be generated as to why no changes are to be made. As deemed appropriate by the HMPC, public notices will be provided in multiple mediums, including TEMA's website, and other sources as deemed appropriate, during the 5 year review and revision process.

Glossary of Terms

AEPHIS – Animal and Plant Health Inspection Service
ARCF – Agricultural Resources Conservation Fund
BEA – United States Bureau of Economic Analysis
BFE – Base Flood Elevation
CBA – Cost Benefit Analysis
CDBG – Community Development Block Grant Program
CDC – United States Centers for Disease Control and Prevention
CEDEP – Communicable and Environmental Diseases and Emergency Preparedness
CRS – Community Rating System
CUSEC – Central United States Earthquake Consortium
CWPP – Community Wildfire Protection Plan
DART – Disaster Animal Response Team
DCS – Tennessee Department of Children's Services
DFIRM – Digital Flood Insurance Rate Map
DHS – Department of Homeland Security
DMA 2000 – Disaster Mitigation Act of 2000
DWSRF – Drinking Water State Recovery Fund
ECD – Emergency Communication District
EIP – Emerging Infections Program
EMAP – Emergency Management Accreditation Program
EMPG – Emergency Management Performance Grant
EMS – Emergency Medical Services
EOC – Emergency Operations Center
EOP – Emergency Operations Plan
ESC – Emergency Services Coordinator
FMA – Flood Mitigation Assistance Grant Program
FEMA – Federal Emergency Management Agency
FIRM – Flood Insurance Rate Map
FWHP – Farm Wildlife Habitat Program
GIS – Geographic Information Systems
HAZMAT – Hazardous Materials
HHS – United State Department of Health and Human Services
HMEP – Hazardous Materials Emergency Preparedness Grant
HMGP – Hazard Mitigation Grant Program
HMP – Hazard Mitigation Plan
HMPC – Hazard Mitigation Planning Committee
HPC – Hazard Potential Category
HRTS – Healthcare Resource Tracking System
HUD – United States Department of Housing and Urban Development
HVRI – Hazard Vulnerability Research Institute
ICS – Incident Command System
IECC – International Energy Conservation Code
IRC – International Residential Code
LEPC – Local Emergency Planning Committee
LiDAR – Light Detection and Ranging
LPAO – Local Planning Assistance Office
MARS – Mitigation Application Ranking System
MRC – Medical Reserve Corps.
NAHMS – National Animal Health Monitoring System
NEHRP – National Earthquake Hazards Reduction Program
NFHL – National Flood Hazard Layer
NFIP – National Flood Insurance Program
NIMS – National Incident Management System
NMSZ – New Madrid Seismic Zone
NOAA – National Oceanic and Atmospheric Administration
NRCS – Natural Resources Conservation Service
NRF – National Response Framework
NSGIC – National State Geographic Information Council
NSU – National Surveillance Unit
OEM – Office of Emergency Management
OSHA – Occupational Safety and Health Administration
PDM – Pre Disaster Mitigation Grant Program
PPD – Presidential Policy Directive
RFC – Repetitive Flood Claims
RFP – Request for Proposal
RL – Repetitive Loss
SEOC – State Emergency Operations Center
SHMO – State Hazard Mitigation Officer
SOP – Standard Operating Procedure
SoVI© – Social Vulnerability Index
SRL – Severe Repetitive Loss
STS – Strategic Technology Solutions
SSURGO – Soil Survey Geographic Database
TAEP – Tennessee Agricultural Enhancement Program
TBA – Targeted Brownfield Assessment Grant Program
TBI – Tennessee Bureau of Investigation
TCA – Tennessee Code Annotated
TDA – Tennessee Department of Agriculture
TDH – Tennessee Department of Health
TDEC – Tennessee Department of Environment and Conservation
TDOT – Tennessee Department of Transportation
TDSN – Tennessee Disaster Support Network
TEMA – Tennessee Emergency Management Agency
TEMARR – Tennessee Emerging Medical Awareness, Response, and Resources Program
TEMP – Tennessee Emergency Management Plan
THDA – Tennessee Housing and Development Authority
THIRA – Threat Hazard Identification and Risk Assessment
THP – Tennessee Highway Patrol
TMI – Tennessee Mitigation Initiative
TN – Tennessee
TN ECD – Tennessee Department of Economic and Community Development
TNCAT – Tennessee Catastrophic Training
TNCRN – Tennessee Countermeasures Response Network
TNGIC – Tennessee Geographic Information Council
TNHAN – Tennessee Health Alert Network
TNHMC – Tennessee Hazard Mitigation Council
TNVM – Tennessee Volunteer Mobilizer
TRA GPSD – Tennessee Regulatory Authority Gas Pipeline Safety Division
TSMP – Tennessee Stream Mitigation Program
TTAP – Tennessee Technology Access Program
TVA – Tennessee Valley Authority
USACE – United States Army Corps. of Engineers
USDA – United States Department of Agriculture
USGS – United States Geological Survey
VS – Veterinary Services
WRAPS – Watershed and Protection Strategy
WUI – Wildland Urban Interface

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