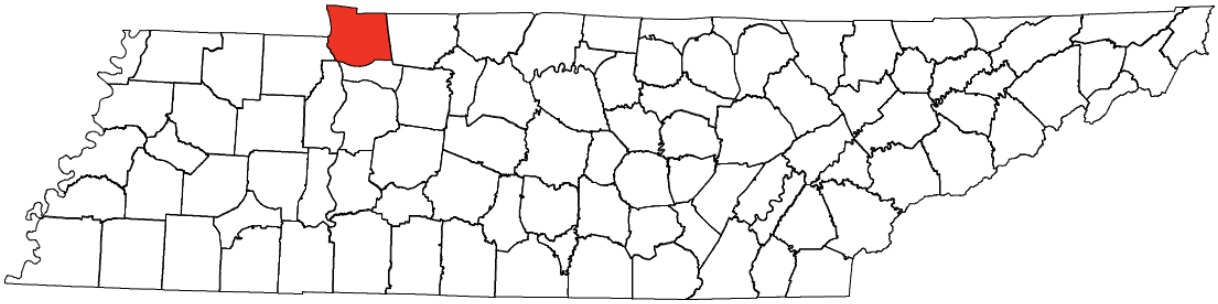
Stewart County
Hazard Mitigation Plan

2023 Update



Prepared BY:

Stewart County Hazard Mitigation Planning Committee

Stewart County Emergency Management Agency/Office of Emergency Management

Assistance Provided By:

Tennessee Emergency Management Agency
as part of the Tennessee Mitigation Initiative

Executive Summary

Over the past two decades, hazard mitigation has gained increased national attention due to the large number of natural disasters that have occurred throughout the U.S. and the rapid rise in costs associated with those disaster recoveries. It has become apparent that money spent mitigating potential impacts of a disaster event can result in substantial savings of life and property. With these benefit-cost ratios extremely advantageous, the Disaster Mitigation Act of 2000 was developed as U.S. Federal legislation reinforcing the importance of pre-disaster mitigation planning by calling for local governments to develop mitigation plans *(44 CFR 201)*.

A local hazard mitigation plan aims to identify the community's notable risks and specific vulnerabilities and then to create/implement corresponding mitigation projects to address those areas of concern. This methodology helps reduce human, environmental, and economic costs from natural and man-made hazards through the creation of long-term mitigation initiatives.

The advantages of developing a local hazard mitigation plan are numerous and include improved post-disaster decision-making, education on mitigation approaches, and an organizational method for prioritizing mitigation projects. Communities with a mitigation plan receive larger amounts of Federal and State funding opportunities to be used on mitigation projects and can receive these funds faster than communities without a plan.

This 2023 update of the Stewart County Hazard Mitigation Plan addresses Building Resilient Communities and Infrastructure (BRIC), Flood Mitigation Assistance (FMA), and Hazard Mitigation Grant Program (HMGP) requirements. Each jurisdiction within the county participated in the preparation of the update, including:

- Stewart County
- Town of Dover
- Town of Cumberland City
- Stewart County Board of Education

In reference to federal code title *44 CFR 201*, the plan is required to be submitted to both TEMA (State) and FEMA (Federal) for review to be approved. When the plan is deemed "approval pending adoption" by FEMA *(44 CFR 201.6(c)5)*, each of the participating jurisdictions will adopt the plan through a local resolution.

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Chapter 1. The Planning Process

1.1 Purpose and Need, Authority and Statement of Problem

1.1.1 Purpose and Need

FEMA defines "hazard mitigation" as any sustained action taken to reduce or eliminate the long-term risk to life and property from a hazard event. Hazard mitigation planning is the process through which hazards are identified, likely impacts determined, mitigation goals set, and appropriate mitigation strategies defined, prioritized, and implemented. The Hazard Mitigation Plan aims to identify, assess, and mitigate risk to better protect the people and property of Stewart County from the effects of natural and man-made hazards. This Plan documents the hazard mitigation planning process and identifies relevant hazards, vulnerabilities, and strategies the County and incorporated jurisdictions will use to decrease vulnerability and increase resiliency and sustainability. This Plan demonstrates the participating communities' commitment to reducing risks from identified hazards and serves as a tool to help decision-makers direct mitigation activities and resources.

1.1.2 Authority

This Hazard Mitigation Plan has been adopted by Stewart County and all participating jurisdictions in accordance with the authority granted to local communities by the State of Tennessee. This Plan was updated per state and federal rules and regulations governing local hazard mitigation plans. The Plan shall be reviewed annually and go through a complete update process every five years to remain eligible for hazard mitigation grants. The following legislation was used for guidance:

- Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act or the Act), 42 U.S.C. 5165, enacted under Section 104 of the Disaster Mitigation Act of 2000 (DMA 2000) Public Law 106-390 of October 30, 2000, as implemented at 44 CFR 201.6 and 201.7 dated October 2011.
- Tennessee Code Annotated
  - **T.C.A. 58-2-106(b)(16)**
  - **T.C.A. 58-2-106(b)(1)**
  - **T.C.A. 58-2-103(a)(5)**

1.1.3 Statement of Problem

Each year in the United States, natural disasters take the lives of hundreds of people and injure thousands more. Taxpayers pay billions of dollars annually to help communities, organizations, businesses, and individuals recover from disasters. Unfortunately, this only partially reflects the cost of disasters because additional expenses incurred by insurance companies and non-governmental organizations are not reimbursed by tax dollars. Many natural disasters are predictable, and much of the damage caused by these events can be reduced or even eliminated.

The original Stewart County Hazard Mitigation Plan was created and approved by FEMA in 2013. Per federal requirements stated in *44 CFR 201*, all local hazard mitigation plans are required to go through a FEMA approval process every five years to remain eligible for hazard mitigation grants. This plan will be re-evaluated and updated every five years to ensure local governments are continuing to assess the hazards and risks within their communities. This plan update has been prepared to meet requirements set forth by FEMA and the Tennessee Emergency Management Agency (TEMA) to ensure Stewart County is eligible for funding and technical assistance from state and federal hazard mitigation programs. All communities are welcome to address man-made hazards and risks in their hazard mitigation plan. However, it's important to note that the State and Federal governments only evaluate and approve based on natural hazards only as per federal code title 44 CFR 201.

1.2 Methodology, Update Process, and Participation Summary

This Hazard Mitigation Plan was developed under the guidance of a Hazard Mitigation Planning Committee (HMPC). The Committee included representatives of Stewart County, Town of Dover, Town of Cumberland City, and the Stewart County Board of Education.

Information in this plan will be used to help guide and coordinate mitigation activities and decisions for local land use policy in the future. Proactive mitigation planning will help reduce the cost of disaster response and recovery to communities and their residents by protecting critical community facilities, reducing liability exposure, and minimizing overall community impacts and disruptions. This plan identifies activities that can be undertaken by both the public and the private sectors to reduce risk to safety, health, and property caused by natural and man-made hazards.

1.2.1 Local Government Participation

The planning regulations and guidance stress that each local government seeking FEMA approval of their mitigation plan must participate in the planning effort in the following ways:

- Participate in the process as part of the HMPC;
- Detail where within the planning area the risk differs from that facing the entire area;
- Identify potential mitigation actions; and
- Formally adopt the plan.

For the HMPC, “participation” meant the following:

- Providing facilities for meetings;
- Attending and participating in the HMPC meetings;
- Collecting and providing other requested data (as available);
- Identifying mitigation actions for the plan;
- Reviewing and providing comments on plan drafts;
- Informing the public, local officials, and other interested parties about the planning process and providing opportunity for them to comment on the plan;

- Coordinating, and participating in the public input process; and
- Coordinating the formal adoption of the plan by the appropriate governing body.

The HMPC met all the above-stated participation requirements. Stewart County and all its incorporated jurisdictions (Dover, Cumberland City, Board of Education) participated in the 2023 Plan update, as well as reviewed and provided timely comments on all draft components of the Plan. A summary of past and current community participation is shown below in *Table 1*. All participants were invited to this committee via email by the County EMA Director. Those who did not originally respond were reached out to via phone or email by the County EMA Director.

Table 1 Multi-Jurisdictional HMPC Participation

Jurisdiction	2017 Participation	2023 Participation
Stewart County	X	X
Town of Dover	X	X
Town of Cumberland City	X	X
Stewart County Board of Education	X	X

The HMPC for the 2023 plan update included key community representatives. *Table 2* details the HMPC members, meeting dates, associated FEMA Lifeline, and committee member attendance. FEMA Lifelines are fundamental way for a community to recover, however, all participants might not be associated with a FEMA Lifeline. If they are not associated with a FEMA Lifeline, then they will be indicated as not applicable (NA).

The EMA director invited individuals who represented regional and local agencies that have authority in regulating county/city development, individuals that represent vulnerable populations, as well as those that are responsible for responding to the identified hazards of prime concern. These partners include jurisdictional police, fire, public works, and health departments, community representatives, nonprofit organizations, local floodplain administration, the county/city school board, elected officials, and electric utility companies. All committee members provided key information to recognize and mitigate hazards of prime community concern. A more detailed summary of HMPC meeting dates, members seeking approval and FEMA lifeline association follows in *Table 2*. Meeting sign-in sheets are included in Appendix A.

Table 2 HMPC Members

Name	Title	Organization/ Jurisdiction	Meeting Dates	
			6/21/2023	8/9/2023
Clint Mathis	Director	Stewart County EMA	X	X
Joe Campbell	Deputy Dir.	Stewart County EMA	X	X
Autumn Joanow	Planner	TEMA	X	X
Ronnie Sumner	Dir.	Stewart County Highway Dept		X
Rodney Grimsley	Deputy Dir	Montgomery County EMA		X
Jeff Brigham	Codes	Town of Dover		X
Charles Parks	City Admin.	Town of Dover		X
James Hunter	District Coord.	TEMA		X
Jeff Welker	Deputy Chief	SCFR		X
Eric Watkins	Transportation Dir.	Stewart County Board of Education		X
Robert Beecham	Mayor	Stewart County		X
Greg Barrow	Director	Stewart County EMS		X
Jon Bumpus	Deputy Director	Stewart County EMA		X
Rick Smith	Chief	Cumberland City Police Dept.		X

Melissa Fields	County Commissioner/Coalition Dir.	Stewart County		X
Dale Ward	Chief Deputy	Stewart County Sheriff		X
Jeff Hancock	NRPS	USACE		X

1.2.2 Hazard Mitigation Planning Process

The 2023 Stewart County Hazard Mitigation Plan was updated following guidance put forth by FEMA in the *Local Mitigation Planning Policy Guide* which became effective on April 19, 2023. This guidance emphasized the need for a whole community planning approach to include representatives from all sectors of the community with an emphasis on the increased need for vulnerable and underserved population representation. The guidance also highlighted increased emphasis on risk, vulnerability, and resilience assessments, the inclusion of high hazard dams, and future weather trends/patterns.

FEMA guidance proposes a structured four-phase approach to completing a Hazard Mitigation Plan as follows:

1) Planning Process
2) Risk Assessment
3) Mitigation Strategy
4) Plan Maintenance

Phase I - Planning Process

Organize to Prepare the Plan

The planning process officially began with a meeting held on June 21, 2023 at the Stewart County Emergency Management Agency to discuss stakeholder invites and to strategize the planning process. A HMPC meeting was held on August 9, 2023 at the Stewart County Emergency Management Agency. The meeting covered the scope of hazard mitigation, the purpose of planning, eligible grants, risk assessments and vulnerabilities impacting the community. During the planning process, the committee communicated through face-to-face meetings, email, and telephone conversations. The neighboring communities were given an opportunity to be involved in the planning process with email invitations by the County EMA Director for the planning committee meetings. Some of those neighboring communities that were outreached to include: Houston County and Montgomery County.

Involve the Public

Early discussions established the significance of involving the public. The HMPC agreed to an approach using established public information mechanisms and resources within the community. Public involvement activities for this plan update included public notices, stakeholder and public meetings, and the collection of public and stakeholder comments on the draft plan. In order to ensure socially vulnerable and underserved populations were included in organizing efforts the Stewart County EMA director contacted organizations that had roots within the community such as the local Good Samaritans organization, Stewart County Drug Coalition, and the Stewart County Senior Citizens Center. Due to the nature of the public meetings, neighboring communities, agencies, utilities, academia, civic organizations, and other interested parties were given the opportunity to participate.

A public notice was posted at strategic places across the county on July 21, 2023 and July 24, 2023 inviting members of the public to attend the August 9, 2023 Hazard Mitigation Planning Committee Public meeting. Documentation to support outreach efforts such as emails, community flyers, flyer locations, and social media postings can be found in Appendix A.

Sign-in sheets from all three meetings are included in Appendix A. The meeting date and topics discussed are summarized below in *Table 3*. The second meeting on August 9, 2023 (meeting #3) was open to the public and announced via newspaper and flyer postings, however, no members of the general public chose to attend.

Table 3 Summary of Hazard Mitigation Planning Meetings

Meeting Number	Meeting Topic	Meeting Date	Meeting Location
Meeting #1	Planning Process Vital Stakeholders Strategy/Timeline	June 21, 2023	Stewart County Emergency Management Agency
Meeting #2	Overview of hazard mitigation Hazard Mitigation Planning Process Purpose of the HMP Area growth and changes Identification of Hazards Future weather predictions Assessment of risk, vulnerabilities, resilience Review of NFIP Previous HMP goals/projects New goals/projects	August 9, 2023	Stewart County Emergency Management Agency
Meeting #3 (Public Meeting)	Hazard Mitigation Planning Process Purpose of the HMP Area growth and changes Identification of Hazards Future weather predictions Assessment of risk, vulnerabilities, resilience Review of NFIP Previous HMP goals/projects New goals/projects	August 9, 2023	Stewart County Visitor Center

Coordination

Early in the planning process, the committee determined that the risk assessment, mitigation strategy development, and plan approval would be greatly enhanced by inviting other local and state partners to participate in the process. The coordination involved contacting these agencies through email, flyers, in-person, and phone conversations. All groups and agencies were advised on how to become involved in the plan development process and were solicited asking for their assistance and input. A summary of agencies and organizations actively involved in the HMPC is as follows:

- Tennessee Emergency Management Agency
- Stewart County Emergency Management Agency
- Town of Dover

- Town of Cumberland City
- Stewart County Drug Coalition
- USACE (NRPS)
- Cumberland City Police Department
- Stewart County Sheriff
- Stewart County Board of Education
- Stewart County Emergency Medical Service
- Stewart County Fire Rescue

Coordination with other community planning efforts was also paramount to the success of this plan. Mitigation planning involves identifying existing policies, tools, and actions that will reduce a community's risk and vulnerability to hazards. Stewart County uses a variety of planning mechanisms such as land development regulations and ordinances to guide growth and development. Integrating existing planning efforts and mitigation policies and action strategies into this plan establishes a credible and comprehensive plan that ties into and supports other community programs.

Table 4 identifies the existing planning mechanisms that were reviewed and how they were incorporated into the 2023 Hazard Mitigation Plan Update.

Table 4 Planning Mechanism Review

Existing Planning Mechanisms	Reviewed? (Yes/No)	Method of Use in Hazard Mitigation Plan
State Hazard Mitigation Plan	Yes	Identifying hazards, assessing vulnerabilities, and mitigation strategies
Local Emergency Operations Plan	Yes	Identify major capabilities
Community Data Profile	Yes	Development trends, capability assessment
Stormwater Ordinance	Yes	Capability assessment, mitigation strategies
Building and Zoning Codes and Ordinances	Yes	Different years of code regulations utilized in different jurisdictions
CDC Social Vulnerability Index	Yes	Analyze vulnerable population in jurisdictions
FEMA's National Risk Index	Yes	Analyze natural hazard risk within each jurisdiction
Land Use Maps	Yes	Assessing vulnerabilities, development trends, and mitigation strategies
Critical2TN Infrastructure Database	Yes	Assessing vulnerabilities, mitigation strategies
NOAA Archives	Yes	Analyze weather data and trends
ETSU Geoinformatics & Disaster Science Lab	Yes	Analyze future weather trends and patterns
U.S Census Bureau	Yes	Analyze community demographic data and trends
Local County Hazard Mitigation Plan	Yes	Analyze previous plan for updates
Flood Insurance Rate Maps	Yes	Analyze flood prone areas within the community

These and other documents were reviewed and considered, as appropriate, during the collection of hazard identification, vulnerability assessment, and capability assessment. Data from these plans and ordinances were incorporated into the risk assessment and hazard vulnerability sections of the plan as appropriate. The data was also used in determining the capability of the community in being able to implement certain mitigation strategies.

Phase II – Risk Assessment

Identify the Hazard, Assess the Risk and Vulnerabilities

The committee completed a comprehensive effort to identify/update, document, and profile all hazards that have, or could have, an impact on the community. The committee also conducted a capability assessment to review and document the planning area's current capabilities and gaps. By collecting information about existing government programs, policies, regulations, ordinances, and emergency plans, the committee could assess the activities and measures already in place that contribute to mitigating some of the risks and vulnerabilities identified. A more detailed description of the risk assessment process and the results are included in Chapter 2 Risk and Vulnerability Assessment.

Phase III – Mitigation Strategy

Set Goals and Review Actions

This meeting facilitated brainstorming and discussion sessions that described the purpose and process of developing planning goals and objectives, a comprehensive range of mitigation alternatives, and a method of selecting and defending recommended mitigation actions using a series of selection criteria. This information is included in Chapter 3 Mitigation Strategy.

Draft an Action Plan

A complete first draft of the plan was prepared based on information and input collected during the HMPC meetings, and various agencies and individuals were invited to comment on this draft. Public and agency comments were integrated into the final draft for TEMA and FEMA Region IV to review and approve, contingent upon final adoption by Stewart County.

Phase IV – Plan Maintenance

Adopt the Plan

To secure buy-in and officially implement the plan, the plan was reviewed and adopted by the appropriate governing bodies.

Implement, Evaluate, and Revise the Plan

Implementation and maintenance of the plan is critical to the overall success of hazard mitigation planning and actions. Chapter 4 Plan Integration and Maintenance discusses incorporating the plan into existing planning mechanisms and how to address continued public involvement.

1.3 Plan Update

The 2023 Stewart County Hazard Mitigation Plan contained a hazard identification and risk assessment for each jurisdiction and a corresponding action list aimed at mitigation risk. Since that time, progress has been made by both the County and incorporated jurisdictions on the implementation of the mitigation strategy with 0 completed actions and 2 in progress. The HMPC has met annually over the past five years to monitor, implement, and

update the plan. This chapter includes an overview of the approach to updating the plan and identifies new analyses and information included in this plan update.

1.3.1 The New Plan

The updated plan involved a comprehensive review and revision of each section of the 2017 plan and included an assessment of the success of the County and the incorporated jurisdictions in evaluating, monitoring, and implementing the mitigation strategy outlined in the 2017 plan. Only the information and data still valid from the 2017 plan was carried forward as applicable in this update. The following requirements were addressed during this plan update process with consideration of the priorities and goals of the Stewart County Hazard Mitigation Planning Committee:

- Consider changes in vulnerability due to action implementation;
- Document success stories where mitigation efforts have proven effective;
- Document areas where mitigation actions were not effective;
- Document any new hazards that may arise or were previously overlooked;
- Document NFIP as related to the county and jurisdictions;
- Incorporate new data or studies on hazards and risks;
- Incorporate new data related to future climate patterns and trend;
- Incorporate new capabilities or changes in capabilities;
- Incorporate social vulnerability data and vulnerable population information;
- Incorporate growth and development-related changes to inventories; and
- Incorporate new action recommendations or changes in action prioritization;
- Enhanced public outreach and multi-agency coordination efforts.

1.3.2 2017 HMP Strategy Review

During the 2017 update of the Stewart County Hazard Mitigation Plan, the HMPC identified 15 actions as relevant to the county. Of these 15 actions, 0 have been completed, 2 are in progress, and 13 have not been started. Actions that had not been pursued were discussed for relevance to the new plan and were either carried over to the 2023 plan or deleted from the strategy. 13 of these projects were determined to still be viable and will be carried over or revised in this plan update. Details and the status of all previous actions are in *Table 5.*

Table 5 Mitigation Action Progress Summary (2018 Plan)

Project Name	Action Description	Responsible Dept.	Jurisdiction	Current Status			2023 Plan Update		Funding Source				Priority Score	Est. Cost	New or Existing Infrastructure
				Complete	In-Progress	Not yet Started	Delete Action	Carry Forward or Revise	HMGP	BRIC[1]	FMA	Local			
Flooding															
Drainage Improvements	Increase elevation on Lakeland Dr	Town of Dover	Dover			X		X	X	X		X	2.8	400K	Existing
Drainage Improvements	Increase elevation on HWY 233 and 434	TDOT	Cumberland City			X		X				X	2.8	500K+	Existing
Drainage Improvements	Increase elevation on Bellwood Hollow Rd	County	County		X			X	X	X		X	2.8	250K	Existing
Drainage Improvements	Increase water flow under the bridge on Riversbend Rd	County	County			X	X		X	X		X	2.8	400K	Existing
Drainage Improvements	Increase water flow under the bridge on Hurricane Creek Rd	County	County			X		X	X	X		X	2.8	250k	Existing
Drainage Improvements	Increase elevation on Indian Mound Rd near Hwy 46	County	County			X		X	X	X		X	2.8	400K	Existing
Drainage Improvements	Increase the elevation of the sewer lift station	Town of Dover	Dover			X		X	X	X		X	2.6	1M	Existing
Drainage Improvements	Increase elevation on Beech St	Town of Dover	Dover			X		X	X	X		X	2.6	300K	Existing

[1] BRIC previously referred to as PDM in the 2018 Hazard Mitigation Plan

Drainage Improvements	Elevate and floodproof sewer facilities	Cumberland City	Cumberland City			X		X	X	X		X	2.6	>500K	Existing
Drainage Improvements	Increase elevation on Mary Trailor Rd Right of Ways	County	County			X		X	X	X		X	2.6	400K	Existing
Drainage Improvements	Increase elevation on Lower Cross Creek and Grassy Hollow Rd	County	County			X		X	X	X		X	2.6	400K	Existing
Severe Storm/ Tornado															
Tornado Safety	Retrofit existing spaces and/or build tornado-safe rooms	Board of Education	County			X		X	X	X		X	2.6	1M	Both
All															
Property Buyout	Purchase properties with repetitive flooding	County	All			X		X	X	X	X	X	2.8	N/A	Existing
Public Education	Provide pamphlets to citizens that have information about how they can protect themselves from natural hazards	EMA	All		X			X	X	X		X	2.8	<1k	Both
Public Education	Provide mitigation informational materials to public agencies and offices	EMA	All			X	X		X	X		X	2.0	<1K	Both

1.4 Multi-Jurisdictional Special Considerations

Hazards Assessment

Most of the natural hazards identified within this plan have an impact on both Stewart County and the incorporated jurisdictions. Some hazards have a larger impact on the County rather than the incorporated jurisdictions and vice versa. Impacts of identified hazards differ the most at the rural and urban interface where flooding can have different severity levels. Therefore, the flooding section emphasizes the depth, duration, and timing of severe flooding events. Below is a table that shows whether a hazard will have multi-jurisdictional impacts.

Table 6 Multijurisdictional impacts

Hazards	Will the hazard have multi-jurisdictional differences?
Earthquake	No
Extreme Temperature	Yes
Flooding	Yes
Severe Weather	Yes
Tornado	Yes

1.5 Public Participation

Public involvement included press releases, public meetings, and a public comment period on the draft plan. Organizations representing vulnerable and underserved populations were contacted in an effort to gain further input from populations most at risk during hazardous events. The formal public meetings for this plan are summarized in *Table 3* (Section 1.2.2) discussed early in this chapter. The August 9, 2023 HMPC meeting was open to the public; however, no members of the public chose to attend the meeting.

A public notice was posted in in six locations across the county as shown in *Table 7*. Documentation to support the public outreach efforts can be found in Appendix A. Over the past five years, the community was kept involved in the planning process through the implementation of projects in the plan.

Table 7 Public Notice Flyer Locations

Location/Building	Address	Date Flyer Posted
Bev Market	3035 TN-120, Bumpus Mills, TN 37028	7/24/2023
JT Bait Shop	3162 US-79, Indian Mound, TN 37079	7/24/2023
Piggly Wiggly	1536 Donelson Pkwy, Dover, TN 37058	7/21/2023
Stewart County Court House	225 Donelson Pkwy, Dover, TN 37058	7/24/2023
Stewart County Mayors Office	226 Lakeview Dr, Dover, TN 37058	7/21/2023
Stewart County Visitors Center	117 Visitor Center Lane, Dover, TN 37058	7/24/2023

1.6 County Data Profile

1.6.2 Resources and Assets

The county has approximately 75 volunteer firefighters with 9 stations, and 25 full time Law Enforcement officers including the county sheriff. Stewart County School District facilities the learning of approximately 1922 students via their system of 6schools within the region. According to the RWJ Foundation County Health Rankings profile Stewart County Schools are underfunded by $1,034 per pupil as related to dollars to test score achievement.

Stewart County houses two radio stations (WTPR 101.7 and WCVQ 107.9) and 10 tv networks. The main phone companies in the area are AT&T and Cumberland Connect. Residents in the county can obtain internet via AT&T, Cumberland Connect, Peoples Telephone DSL, Mediacom, HughsNet, or Exede. Communication resources, a vital component of emergency response and preparedness, is notably lacking in the more rural portions of Stewart County. Between 2017 and 2021 only 84.3% of households had a computer and only 78.9% had broadband internet access according to the United States Census Bureau.

The main roadways that travel through the county are US Highway 79 and State Highways 46, 149, 233, 434, and 232. The nearest interstates are I-24 (30 miles away) and I-40 (27 miles away). The Tennessee River borders the western side of the county, and the Cumberland River winds through the center of the county traveling from northern end to the southeastern end. Other small waterways like creeks and streams travel throughout the county and a further analysis of these water systems will be explored in the hazard flood section as related to their propensity for flood events.

The nearest international airport is BNA (approx. 72 miles) and the closest general aviation location is Outlaw Field in Clarksville approximately 27 miles from the county seat. Given the limited public transportation options and the rural environment of Stewart County, 59% of working individuals endure a commute of more than 30 minutes and 79% of all working individuals drive alone to work.

Stewart County is governed by an elected County Mayor and Board of Commissioners (fourteen members). The jurisdictions within Stewart County are governed by an elected Mayor and Council. There are multiple regulatory committees that are appointed by both the County Mayor and the Board of Commissioners.

1.6.3 Development and Growth

Stewart County has been experiencing slight growth over the past few years. The population of the county increased between the 2010 and 2020 censuses from 13,325 to 13,657. 10% of the 5,091 Stewart County households deal with at least 1 severe housing problem (overcrowding, high housing costs, lack of kitchen facilities, or lack of plumbing facilities). Most of Stewart County's employed population work within the service industry (34.8%) and the retail trade industry (17.6%). Stewart County is a member of Joint Economic and Community Development Boards to ensure and promote economic growth within the

county and for its constituents. As stated, Stewart County has experienced minimal growth since the last planning period. However, it is noteworthy that the county has seen residential development in the Indian Mound area, and the Town of Dover has seen growth within its jurisdiction with families relocating and building homes. Growth in the industrial sector has occurred with the development of the Cumberland City Industrial Park. HMPC members also identified new logging locations across the county as potentially increasing flood hazards.

1.6.4 Demographics

Throughout the planning process, Stewart County HMPC remained committed to recognizing socially vulnerable and underserved populations. In order to maintain this commitment, the HMPC reached out to key stakeholders as discussed in Section 1.2 and reviewed the CDC/ATSDR Social Vulnerability Index (SVI). SVI information is located in Appendix B.

Table 8 below illustrates the population data of the county according to the 2020 U.S Census. Other important demographics obtained via the U.S Census Bureau and County Health Rankings (RWJ Foundation) are presented in list form. Of the 13,657 residents living within Stewart County:

- The median household income is $51,460.
- 13.2% live below the national poverty line.
- 100.0% live in rural areas.
- 13% live with at least 1 of 4 severe housing problems (overcrowding, high housing costs, lack of kitchen facilities, lack of plumbing facilities)
- 15% are confronted with food insecurity.
- 13.2% of the under 65 years of age population live with a disability.
- 13.3% of the under-65 population do not have health insurance.
- Population as of 2020 was 29.7 people per square mile.

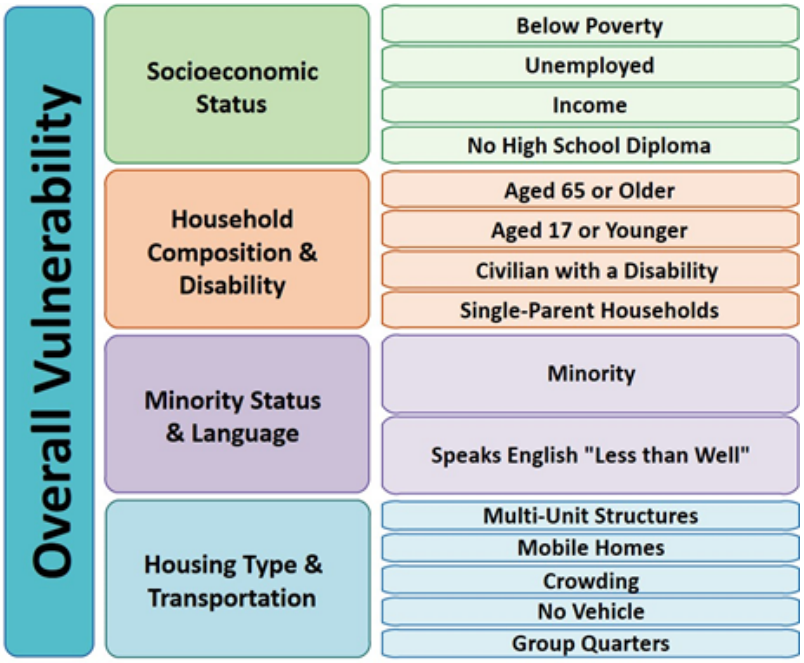
Table 8 Population Data

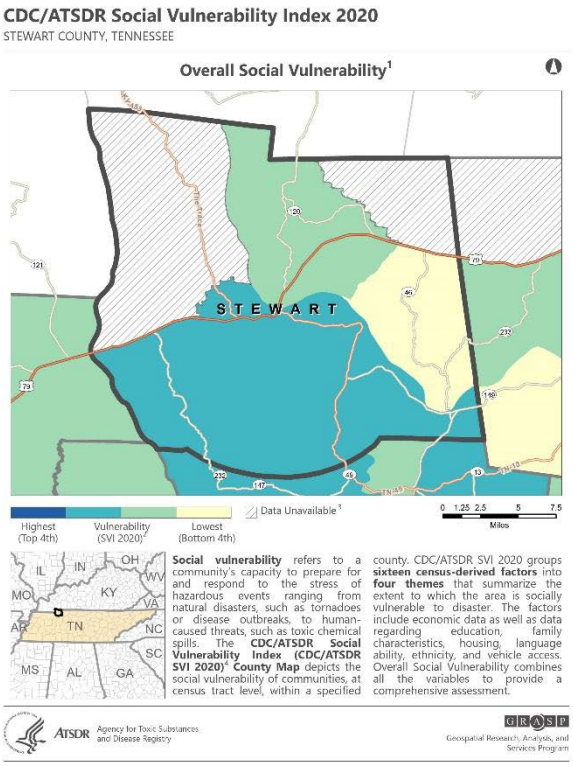
Demographic	Percentage
Identified gender	
Male	50.1
Female	49.9
Age Group	
Under 5	5.4
Under 18	21.1
Over 65	20.7
Race/Ethnicity (one)	
White (not Hispanic/Latin)	90.6
Asian	1.0
Black or African American	2.0
American Indian or Alaskan Native	0.8
Native Hawaiian or Pacific Islander	0.1
Hispanic/Latino	3.8
Education	
High School Graduate or Higher	86.8
Bachelor's Degree or Higher	20.2

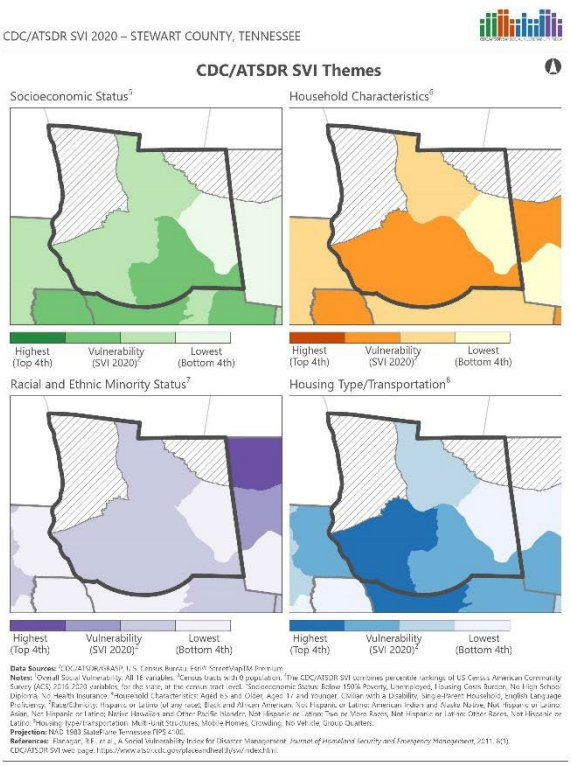
1.6.5 Social Vulnerability

Social vulnerability refers to a community's capacity to prepare for and respond to the stress of hazardous events ranging from natural disasters, such as tornadoes or disease outbreaks, to human-caused threats, such as toxic chemical spills. Social vulnerability considerations were included in this plan update to identify areas across the planning area that might be more vulnerable to hazard impacts based on several factors. The County BEOP will also incorporate this information to improve response efforts in socially vulnerable neighborhoods.

The Center for Disease Control and Prevention (CDC) has developed a social vulnerability index (SVI) to measure the resilience of communities when confronted by external stresses such as natural or human-caused disasters or disease outbreaks. The SVI is broken down to the census tract level and provides insight into vulnerable populations to assist emergency planners and public health officials in identifying communities more likely to require additional support before, during, and after a hazardous event. The SVI index combines four main themes of vulnerability, which are, in turn, broken down into subcategories for 16 vulnerability factors. The themes are outlined in the below table.







1.6.6 Critical Infrastructure

Critical Infrastructure are assets in a community that are considered vital to the public's health and safety. Due to the sensitivity of these assets in Stewart County and the incorporated jurisdictions, these assets are restricted for public viewing. However, the data is viewable to restricted personnel on the State of Tennessee's Critical2TN Database. The county and incorporated jurisdictions currently have 22 assets identified.

1.7 Resource Capabilities

The committee gathered the following resource capabilities to determine what existing staff and resources are being used to support mitigation programs.

Table 9 Jurisdictional Mitigation Capabilities

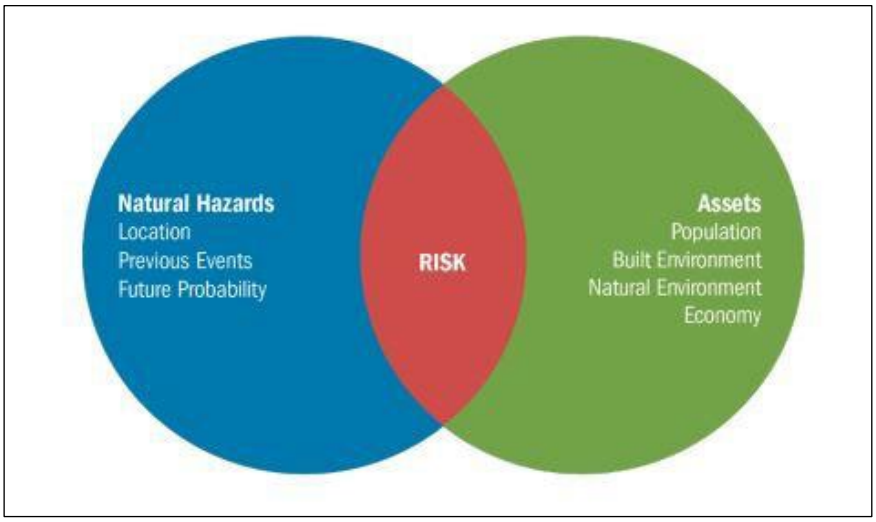
Mitigation Capabilities	Stewart County	Dover	Cumberland City	Stewart County Board of Education
Regulatory Capabilities				
Building Codes	No	Yes	Yes	No
Zoning Codes	No	Yes	Yes	No
Subdivision Ordinance	No	Yes	No	No
Stormwater Ordinance	No	Yes	No	No
Floodplain Ordinance	Yes	Yes	Yes	No
Erosion, Sedimentation and Pollution Control Ordinance	No	No	No	No
Stormwater Management Program	No	Yes	No	No
Site Plan Review Requirements	No	Yes	Yes	No
Capital Improvements Plan	Yes	Yes	Yes	No
Economic Development Plan	Yes	Yes	Yes	No
Local Emergency Operations Plan	Yes	Yes	Yes	Yes
Flood Insurance Study or Other Engineering Study for Streams	Yes	Yes	Yes	No
Repetitive Loss Plan	No	No	No	No
Elevation Certificates	No	Yes	Yes	No
Administrative Capabilities				
Grant writer	No	No	No	No
Public Information Officer	No	Yes	No	Yes
Floodplain Manager	Yes	Yes	Yes	Yes
Full Time Fire Service	No	Yes	No	No
Law Enforcement	Yes	Yes	Yes	Yes
Emergency Manager	Yes	Yes	Yes (via the county)	Yes
GIS Personnel	Yes	Yes	No	No
Fiscal Capabilities				
Capital improvements project funding	Yes	Yes	Yes	No
Fees for water, sewer, gas, or electric services	Yes	Yes	Yes	No
Impact fees for new development	No	No	No	No
General obligation bonds	Yes	Yes	Yes	No
Withhold spending in hazard-prone areas	No	No	No	No

Chapter 2: Hazard and Risk Assessment

Risk Assessment Overview

Hazard Mitigation Planning is about developing a strategy to reduce risk in the long term. An essential part of the process is identifying hazards, risks, impacts and vulnerabilities. In mitigation planning, "risk" is the potential for damage or loss when a hazard interacts with an asset. Assets can be people, buildings, infrastructure, the economy, or natural and cultural resources.

The risk assessment helps communicate vulnerabilities, develop priorities, and inform decision making. It is the factual basis for the mitigation strategy. The hazards and associated impacts in the risk assessment should be the hazards and impacts the mitigation strategy seeks to address. If, for example, the risk assessment shows that the state will have hurricane damage in a specific area, the mitigation strategy should include actions to protect state assets and jurisdictions, especially underserved communities, and socially vulnerable populations, in those areas.



The Stewart County HMPC conducted a hazard identification analysis to determine the natural and man-made hazards that threaten the County. Existing hazard data from TEMA, FEMA, the National Oceanic and Atmospheric Administration (NOAA), and other sources were examined to assess the significance of these hazards to the planning area. Hazard data from the ETSU Geoinformatics & Disaster Science Lab was also analyzed as related to the changing weather trends and their significance. Significance was measured in general terms and focused on key criteria such as frequency and resulting damage, which includes deaths and injuries, as well as property and economic damage. Any hazard that had two or more green lifeline categories is considered low risk for damages and therefore, will not be providing mitigation actions for those specific hazards.

To further focus on the list of identified hazards for this plan update, the HMPC researched past events that resulted in a federal and/or state emergency or disaster declaration in Stewart County to identify known hazards. *Table 10* presents a list of all major disaster and emergency declarations that have occurred in Stewart County since 1953, illustrating which hazards pose the greatest risk to the County.

Table 10 Presidential Disaster Declarations in Stewart County (1953-2023)

Declaration #	Date	Event Details	Individual Assistance	Public Assistance
4637	1/14/2022	Severe Storms, Straight-line Winds, Tornadoes	X	X
3576	12/13/2021	Severe Storms, Straight-line Winds, Tornadoes		X
4514	4/2/2020	COVID-19	X	X
3473	3/13/2020	COVID-19		X
1979	5/9/2011	Severe Storms, Straight-line Winds, Flooding, Tornadoes	X	X
3321	5/4/2011	Flooding		
1909	5/4/2010	Severe Storms, Straight-line Winds, Flooding, Tornadoes	X	X
1821	2/17/20009	Severe Winter Storms, Flooding		X
3217	9/5/2005	Hurricane Katrina Evacuation		X
1464	5/8/2003	Severe Storms, Tornadoes, Flooding	X	X
1456	3/20/2003	Severe Storms, Flooding		X
1331	6/12/2000	Severe Storms, Tornadoes, Flooding		X
1275	5/12/1999	Severe Storms, Tornadoes, Flooding		X
1262	1/19/1999	Severe Storms, Tornadoes, High Winds		X
1167	3/7/1997	Severe Storms, Flooding	X	X
1010	2/28/1994	Ice Storm, Severe Winter Storm, Flash Flooding		X
459	3/22/1975	Severe Storms, Flooding	X	X

Table 11 documents the hazards of interest to Stewart County and the decision to re-evaluate or delete them from this plan update. The hazards of concern were altered as necessary to ensure the Stewart County Hazard Mitigation Plan is in accordance with the Tennessee Mitigation Strategy.

Table 11 Overview of Updates to Chapter 2: Risk and Vulnerability Assessment

Tennessee 2018 Mitigation Strategy	Stewart County 2017 HMP	Status	Stewart County 2023 HMP Update
Communicable Disease	Not Included	N/A	Not Included
Dam Failure	Dam Failure	Removed	Not Included
Drought	Drought	Removed	Not Included
Earthquakes	Earthquake	Continued	Earthquake
Extreme Temperatures	Freezes/Winter Storms	Freezes categorized with extreme heat as Extreme Temperatures, Winter Storms categorized under Severe Weather	Extreme Temperatures
Flooding	Flooding	Continued	Flooding
Geological Hazard	Not Included	N/A	Not Included
Hazardous Materials Release	Not Included	N/A	Not Included
Infrastructure Incident	Not Included	N/A	Not Included
Terrorism	Not Included	N/A	Not Included
Tornadoes	Tornadoes/Severe Storms	Split between Tornadoes and Severe Weather	Tornadoes
Severe Weather (thunderstorms, lighting, hail)	Tornadoes/Severe Storms	Split between Tornadoes and Severe Weather	Severe Weather
Wildfire	Not Included	N/A	Not Included

Summary of changes in the 2023 plan update:

- Freezes are to be categorized as extreme heat and labeled as an Extreme Temperatures hazard.
- Winter Storms will be categorized with the Severe Weather hazard.
- Tornadoes and Severe Storms are to be split and categorized as Tornadoes and Severe Weather.

The complete list of hazards to be addressed in this 2023 Plan Update include:

- Earthquake
- Extreme Temperature
- Flooding
- Severe Weather (hail, lightning, wind, winter weather)
- Tornadoes

2.1 Earthquakes

A. Hazard Overview

An earthquake results from 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 describes 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.

B. County Profile

Stewart County is near the major intraplate (within a tectonic plate) seismic zone known as the New Madrid Seismic Zone. The New Madrid Seismic Zone (NMSZ) is an approximately 120-mile-long fault system that stretches across five states, including Western Tennessee. The figure below illustrates the risk level of the NMSZ within the state.

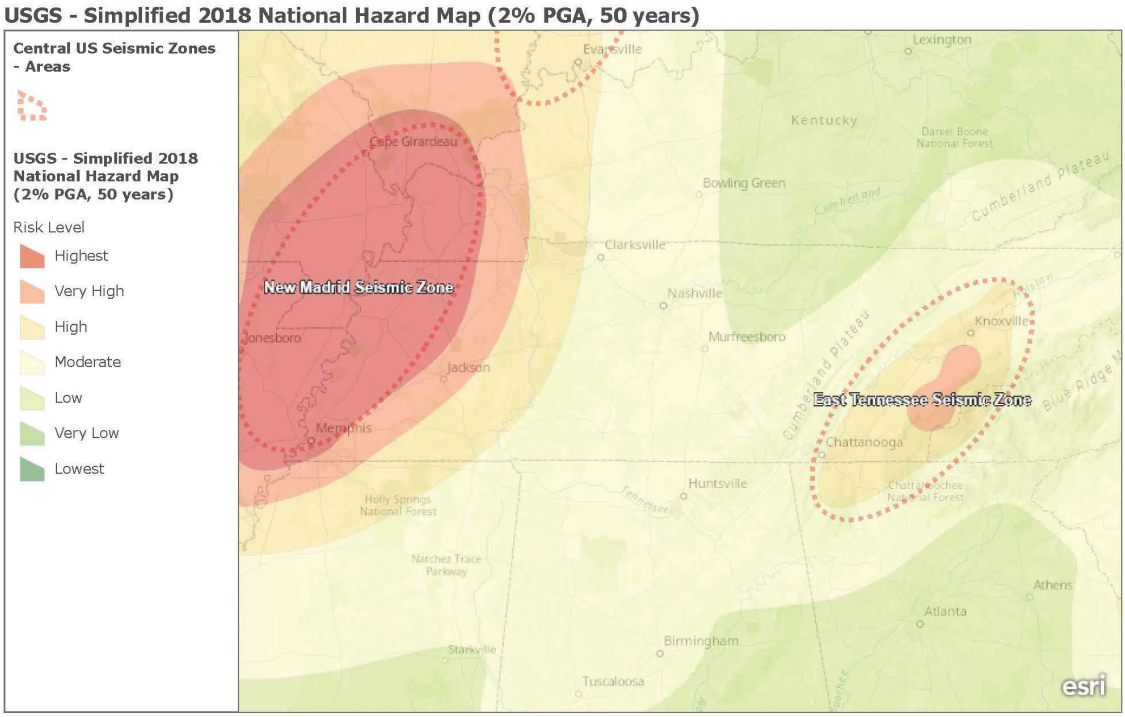


Figure 1 New Madrid Seismic Zone (Source: CUSEC)

The NMSZ is known for producing four of the largest North American earthquakes in recorded history, all of which would have been felt in Stewart County. This includes the noted three-month period between December 1811 and February 1812 that had at least four earthquakes which are understood by scientists to be greater than a M7.0. During this period, there were dozens of strong earthquakes ranging between M6.0 and M7.5. Thousands of smaller shocks were documented. Similar to the 1811-12 New Madrid earthquake sequence which created Reelfoot Lake in Lake County, Tennessee, very large magnitude earthquake sequences are believed to have occurred in pre-historic times as well. Paleo-liquefaction and geologic evidence suggests large earthquake sequences occurred in the New Madrid Seismic Zone in 1450 AD and 900AD.

Based on geologic research on the paleo seismic record of past earthquakes, the USGS estimates that there is a 7 to 10 percent chance of a New Madrid earthquake the size of those in 1811-12 occurring in the next 50 years. However, the occurrence of even a moderate-sized earthquake located in close proximity to urban centers such as Memphis or St. Louis could be locally devastating. The last magnitude-6 earthquake struck near

Charleston, Missouri, in 1895. The chance of such an earthquake occurring in the New Madrid region in the next 50 years is 25 to 40 percent.

These probabilities are derived from the USGS National Seismic Hazard Maps, which are developed from geologic information about faults, evidence of prehistoric earthquakes, instrumental and historical earthquake catalogs generated by seismic monitoring, and ground deformation measurements. The National Seismic Hazard Maps are used to estimate probabilities of large earthquakes and the ground shaking to be expected if those earthquakes occur.

The Eastern Tennessee Seismic Zone (ETSZ), a zone of small earthquakes stretching from northeastern Alabama to southwestern Virginia. The ETSZ is the second-most active natural seismic zone in the central and eastern United States, behind the New Madrid Seismic Zone in the Mississippi River region that produced the 1811-1812 magnitude 7+ earthquakes. In historic times, the ETSZ has not produced earthquakes larger than magnitude 4.8, however scientists believe the ETSZ is capable of generating magnitude 6 or greater. The ETSZ region is home to several nuclear power plants and hydroelectric dams related to the Tennessee Valley Authority, along with major population centers such as Knoxville and Chattanooga.

Table 12 Richter Scale Classification (Source: USGS)

Richter Scale for Earthquakes		
Magnitudes	**Description**	**Typical Impacts**
< 2.0	Micro	Not felt.
2.0-2.9	Slight	Generally, not felt but recorded.
3.0-3.9	Minor	Often felt, but rarely causes damage.
4.0-4.9	Light	Noticeable shaking of indoor items and rattling noises. Significant damage is likely.
5.0-5.9	Moderate	It can cause major damage to poorly constructed buildings in small regions. At most slight damage to well-designed buildings.
6.0-6.9	Strong	It can be destructive in areas up to about 100 miles across populated areas.
7.0-7.9	Major	It can cause serious damage over larger areas.
8.0-8.9	Great	It can cause severe damage in areas several hundred miles across.
9.0-9.9	Epic	They are devastating in areas several thousand miles across.

Since 1812, the most significant recorded earthquakes from the New Madrid Zone were in 1895 and 1968. Since seismic measurement instruments were installed in and around the zone in the 1970s, more than 4,000 small earthquakes have been recorded, with the vast majority being too small to be felt.

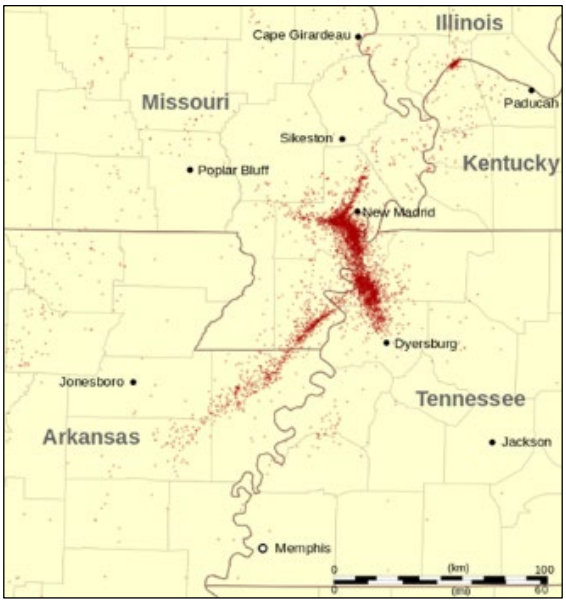


Figure 2 NMSZ Earthquakes Recorded Since 1974 (Source: USGS)

According to a 2008 FEMA report, a severe earthquake in the NMSZ could result in the highest economic loss due to a natural disaster in U.S. history. Based on this report, a 7.7 magnitude quake in the NMSZ would result in thousands of fatalities, hundreds of billions of dollars in damage to structures, and total disruption of vital infrastructure in Western Tennessee, including Stewart County.

A catastrophic earthquake at the NMSZ would result in $100-200 million in building damages. Furthermore, according to the HAZUS, Stewart County will experience the following in a catastrophic earthquake scenario:

Table 13 Earthquake HAZUS

Impact Overview		Numerical Value	
Fatalities		0	
Injuries		1	
Displaced Residents		5 households	
Residents Requiring Shelter		2 persons	
Debris (tons)		2,000	
Residencies experiencing >moderate damage		102	
Day 1			
Households without power		N/A	
Households without potable water		N/A	
Resources Functioning on Day 1		**Infrastructure Functioning after Day 1**	
Resource	**Percentage Functioning**	**Resource**	**Percentage Functioning**
Hospitals 1	>50%	Highway Segments 5	>50%
Police Stations 3	>50%	Railway Segments 1	>50%
Fire Stations 14	>50%	Airport Segments 0	
Schools 6	>50%	Ferry 2	>50%
Communications 1	>50%	Ports 2	>50%

Many buildings and the majority of infrastructure networks throughout the county could be vulnerable to earthquake impacts. Stewart County's building stock can be broken down into the following percentage categories: 63.2% residential, 20.8% commercial, 9.9% industrial, 1% agricultural, 2.8% religious, 0.9% governmental, and 1.5% educational.

Throughout the county, all buildings and infrastructure are vulnerable to earthquake impacts.

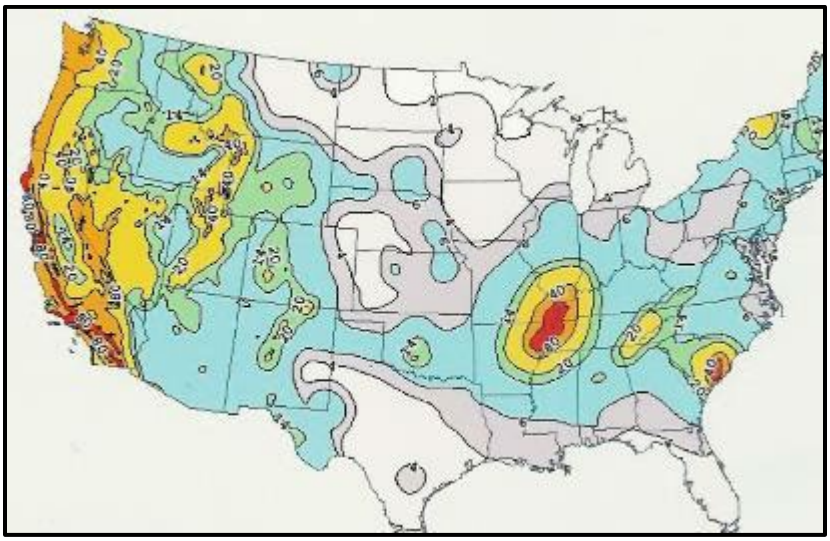


Figure 3 National Seismic Hazard Map (Source: USGS)
Ground Motions with a 2% Chance of Occurring in 50 Years

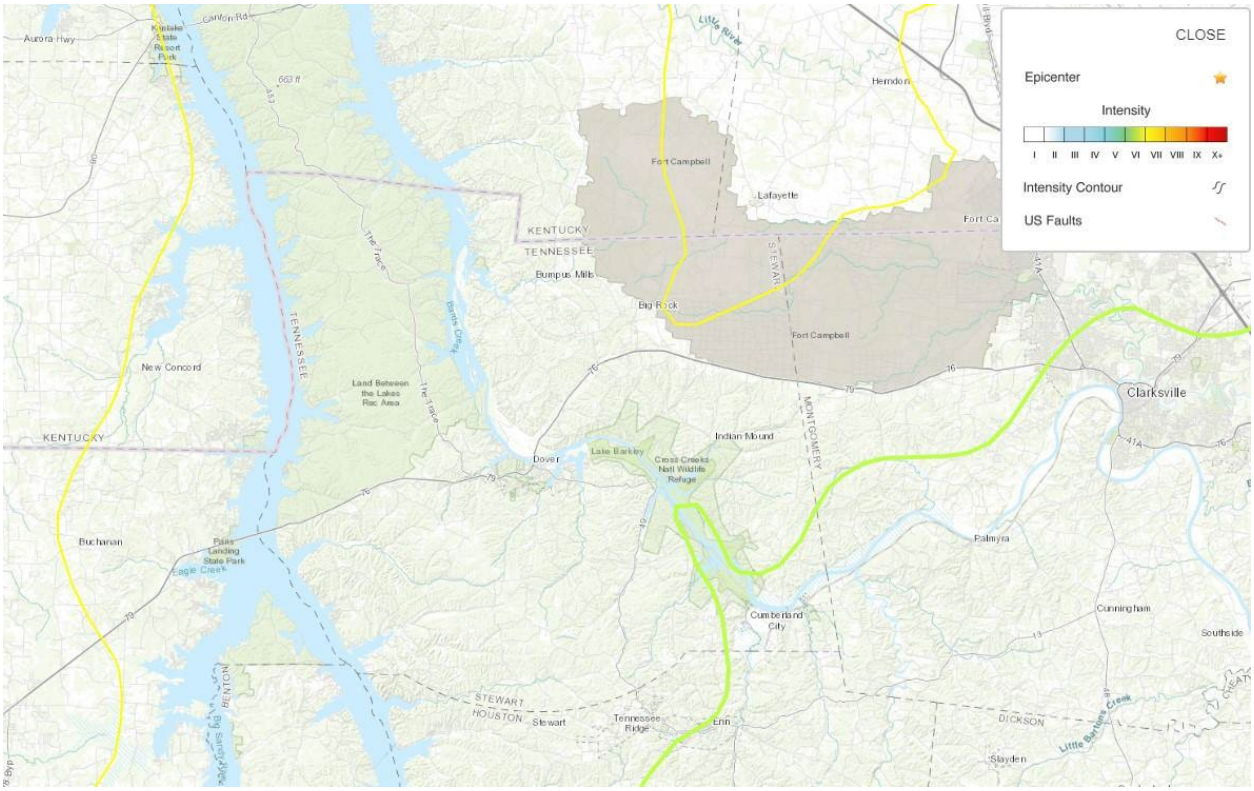


Figure 4 Mercalli Intensity Zones in Stewart County (Source: USGS)

As indicated in the above maps, all of Stewart County's jurisdictions and districts sit within intensity zone VII of the Modified Mercalli Intensity Scale due to its proximity to the NMSZ.

According to the Central United States Earthquake Consortium (CUSEC), Stewart County is at low level of risk for liquefaction following an earthquake.

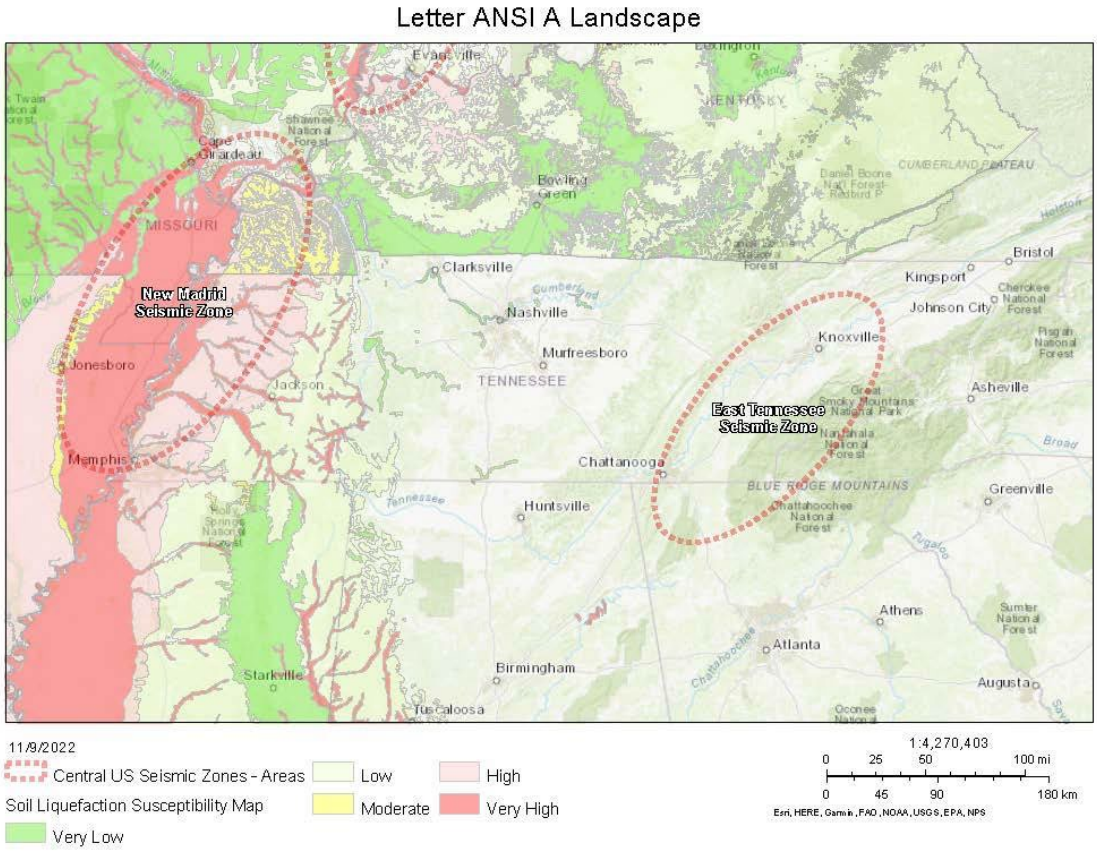


Figure 5 Earthquake Induced Liquification (Source: CUSEC)

C. Risk Assessment

The National Risk Index is a dataset and online tool to help illustrate the United States communities most at risk for natural hazards. It was built and designed by FEMA in close collaboration with various stakeholders and partners in academia; local, state and federal government. The Risk Index leverages available source data for natural hazards and community risk factors to develop a baseline relative risk assessment for each county and census trace. Some of these community risk factors include social vulnerability which is determined by the data pulled from the Census performed every ten years. A higher social vulnerability score is proportional to a higher risk score.

National Risk Index Score for Earthquake = relatively low

Although the National Risk Index is a well-valued tool it fails to properly show the feedback from the participating jurisdictions. Therefore, all identified hazards were evaluated in regard to risk in FEMA lifelines per jurisdiction. The scenario that local jurisdictions would evaluate the conditions of was a mid-level impact of the identified hazard. The results are below:

Table 14 Earthquake Risk based on selected FEMA Lifelines

Earthquake	FEMA Lifelines						
Jurisdiction	Safety & Security	Food, Water & Shelter	Health & Medical	Energy	Communications	Transportation	Hazardous Materials
County							
Cumberland City							
Dover							
Stewart County Schools							

Colors indicate lifeline or component conditions:	
Red	Significant Impact, Multiple Required Resources
Yellow	Some Impact, Some Outside Resources Required
Green	Little to No Impact, No Outside Resources Required

Given the information above it becomes vital that all participating jurisdictions are able to prioritize the necessity of mitigation actions in the following lifeline categories so that they can become more resilient in the whole community that they serve.

D. Land Use and Development Trends

Heavily populated or industrialized centers are at a higher risk for catastrophic earthquake damage. Stewart County, like much of Tennessee, is experiencing rapid growth increasing the likelihood of significant impacts to life and property from a significant earthquake.

E. Multi-Jurisdictional Differences

Counties predominantly in the West Portion of Tennessee will be more likely impacted by the New Madrid Zone. However, a significant magnitude earthquake can cause primary and secondary effects across the state.

F. Summary

Due to its proximity to the New Madrid Fault, the entirety of Stewart County could be subject to an earthquake. This includes the entire County population and all infrastructure. A significant earthquake event would result in a substantial loss of life and billions of dollars in damages.

2.2 Extreme Temperatures

A. Hazard Overview

Heat Waves

Excessive Heat is when the heat index reaches at least 105ºF for at least three hours on two consecutive days, and the nighttime air temperature does not drop below 75ºF. The definition of Excessive Heat is a "rule of thumb" because the detrimental effects of high temperatures and humidity vary among segments of the population (old, young, etc.) and whether the population, in general, has built up a heat tolerance (residents in desert communities fare better than visitors). While some may be better able to cope with Excessive Heat as defined, others may still be adversely affected by a lower heat index. A "rule of thumb" works for mitigation planning because the benefits of specific mitigation actions start accruing before conditions reach Excessive Heat levels. Exposure to extreme heat can pose health risks, including sunburn, dehydration, heat cramps, and heat stroke.

The National Weather Service Heat Index calculates how hot it feels when relative humidity is factored in with the actual air temperature using a 4-factor scale: caution, extreme caution, danger, extreme danger. The National Weather Service (NWS) also issues Heat Alerts.

- A Heat Advisory is issued 12-24 hours before the onset, at least 100ºF but less than 105ºF for at least 2 hours.
- An Excessive Heat Watch is issued when temperatures of 105ºF or greater are forecasted for the next 24 to 72 hours.
- An Excessive Heat Warning is issued when temperatures of 105°F last for more than 3 hours per day for two consecutive days or temperatures exceed 115°F for any period.

Cold Wave

Extreme cold temperatures occur during the winter months and typically accompany winter storm events. Extended periods of extremely cold temperatures result from the movement of high-pressure systems into the United States. When Arctic air masses are present, extreme winter temperatures hover over Tennessee.

The National Weather Service (NWS) issues the nation's Wind Chill Warning, Watch, and Advisory:

- Wind Chill Warning: NWS issues a wind chill warning when dangerously cold wind chill values are expected or occurring.
- Wind Chill Watch: NWS issues a wind chill watch when dangerously cold wind chill values are possible.
- Wind Chill Advisory: NWS issues a wind chill advisory when seasonably cold wind chill values, but not extremely cold values, are expected or occurring.

The National Weather Service Wind Chill Chart calculates the danger from winter winds and freezing temperatures using a 3-factor time-based scale (30 min, 10 min, 5 min).

B. County Profile

The following figure provides extreme temperature event information for Stewart County. The threat index for Stewart County is 1 (low).

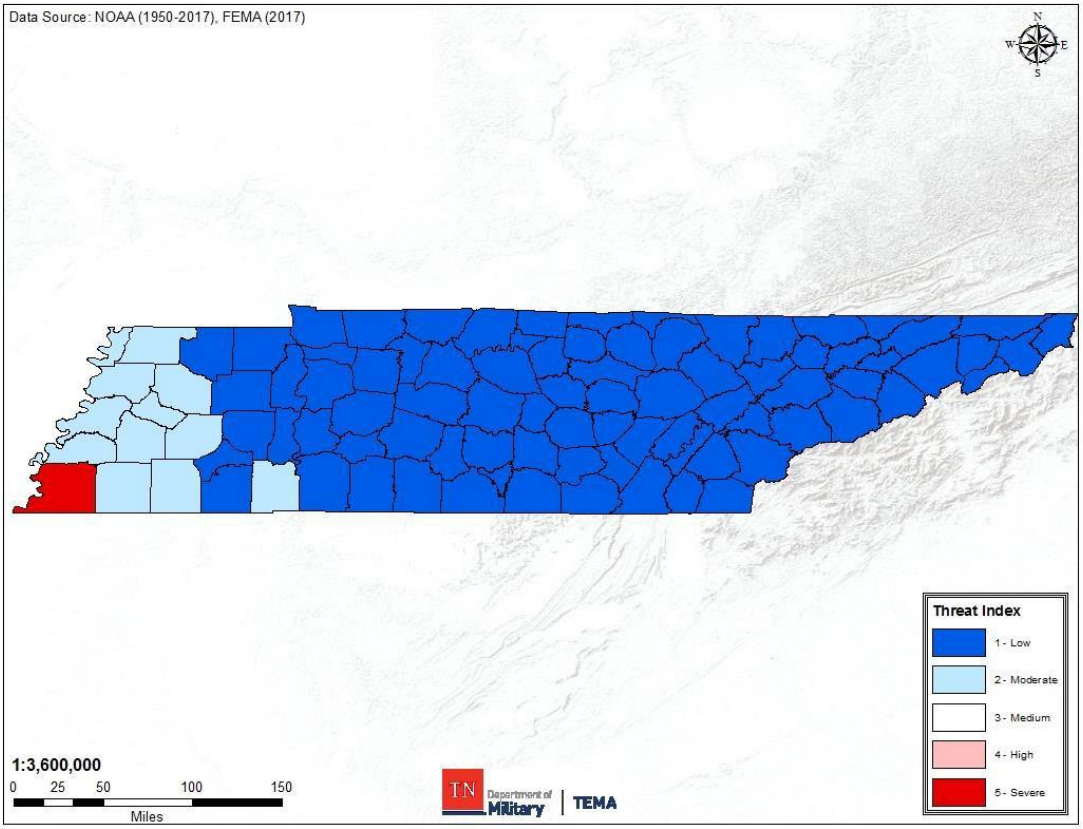


Figure 6 Extreme Temperatures Impact Density (Source: 2018 Tennessee Hazard Mitigation Plan)

The following narratives were obtained via the NOAA Storm Event Database for Cold/Wind Chill, Excessive Heat, and Extreme Cold/Wind Chill. A table containing all NOAA-recorded events between 2000-2023 for Stewart County is included in Appendix C.

August 4, 2010 – Afternoon temperatures were approximately 100 degrees. The humidity on this day cause heat indexes ranging from 110 to 115 degrees.

December 23, 2022 – The abnormally strong and cold upper-level low pressure system that traveled through Middle Tennessee caused below freezing temperatures in the area over three days (Dec 22nd – Dec 24th). Traffic accidents occurred across the state due to the incident. A weather station in Dover measured a minimum wind chill of -22 degrees.

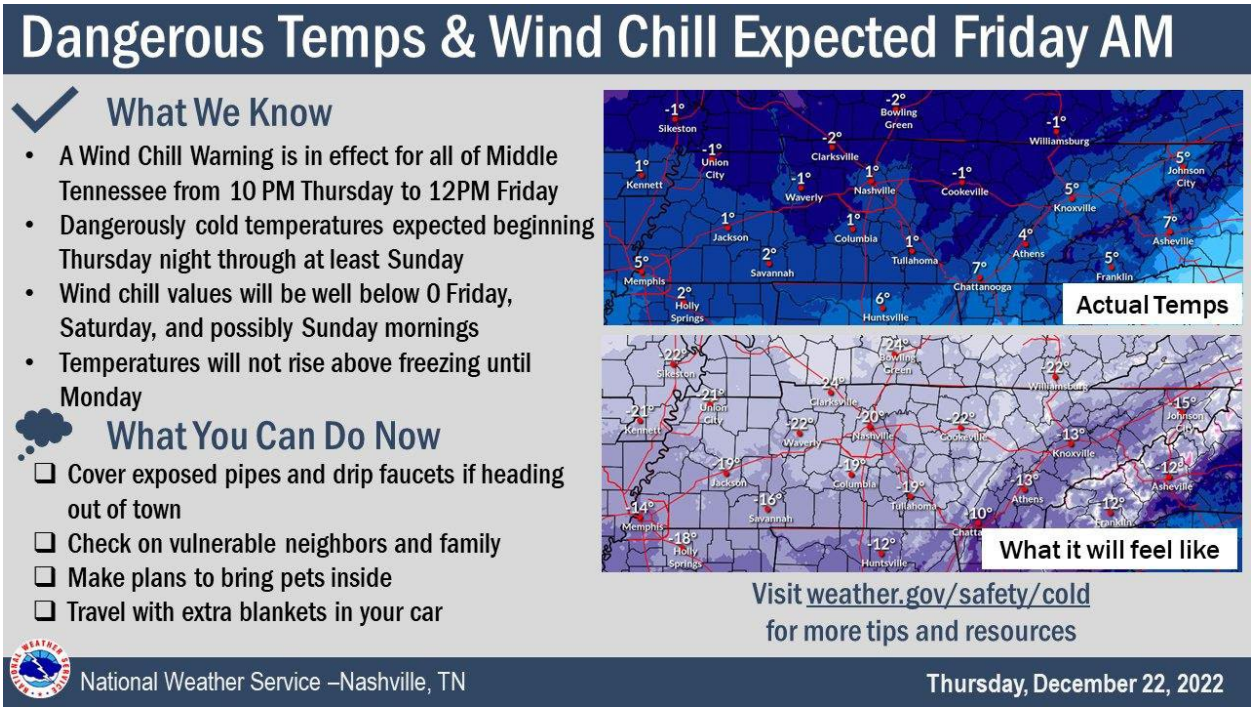


Figure 7 Extreme Cold December 2023 (Source: NWS - Nashville)

June 30, 2023 – Dangerous hot and humid conditions aware affecting most of Middle Tennessee. The CWOP station in Dover measured a maximum heat index of 126 degrees.

The probability of Stewart County and its participating jurisdictions experiencing extreme temperature variations is difficult to predict but based on the historical record of events since 2000; it can reasonably be assumed that this type of event occurs infrequently; 3 events over an 20-year period. In conjunction with the future weather projections developed by the US Climate Resilience Toolkit, it can be assumed that by mid century, temperatures exceeding 100 ºF will occur in Stewart County 10-15 days a year compared to the historical average of one day.

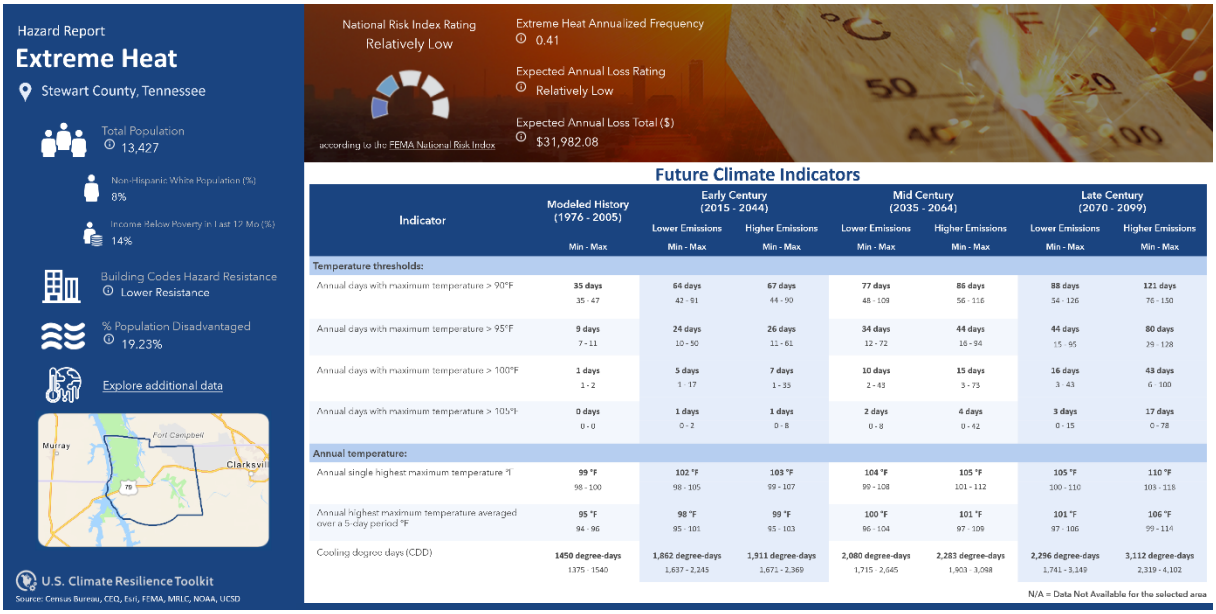


Figure 8 illustrates the projections developed by the US Climate Resilience Toolkit.

C. Risk Assessment

In the county, road traveling conditions, electrical lines, human health, and agricultural functions are some of the most vulnerable features.

The National Risk Index is a dataset and online tool to help illustrate the United States communities most at risk for natural hazards. It was built and designed by FEMA in close collaboration with various stakeholders and partners in academia; local, state, and federal government. The Risk Index leverages available source data for natural hazards and community risk factors to develop a baseline relative risk assessment for each county and census trace. Some of these community risk factors include social vulnerability which is determined by the data pulled from the Census performed every ten years. A higher social vulnerability score is proportional to a higher risk score.

National Risk Index Score for Cold Waves = relatively low

National Risk Index Score for Hot Waves = relatively low

Although the National Risk Index is a well-valued tool it fails to properly show the feedback from the participating jurisdictions. Therefore, all identified hazards were evaluated in regard to risk in FEMA lifelines per jurisdiction. The scenario that local jurisdictions would evaluate the conditions off of was mid-level impact of the identified hazard. The results are below:

Table 15 Extreme Temperature Risk based on selected FEMA Lifelines

Extreme Temperature	FEMA Lifelines						
Jurisdiction	**Safety & Security**	**Food, Water & Shelter**	**Health & Medical**	**Energy**	**Communications**	**Transportation**	**Hazardous Materials**
County							
Cumberland City							
Dover							
Stewart County Schools							

Colors indicate lifeline or component conditions:	
Red	Significant Impact, Multiple Required Resources
Yellow	Some Impact, Some Outside Resources Required
Green	Little to No Impact, No Outside Resources Required

Given the information above it becomes vital that all participating jurisdictions are able to prioritize the necessity of mitigation actions in the following lifeline categories so that they can become more resilient in the whole community that they serve.

Future Heat Events and Social Vulnerability

Multiple determinates such as socioeconomic status, household composition, disability, minority status, language, housing, and transportation heavily indicate how an individual will be affected by extreme temperatures. Individuals within vulnerable or underserved populations are not only more likely to experience the effects of extreme temperatures but they will likely be impacted to a higher degree than their counterparts.

D. Land Use and Development

Extreme temperature events have significant or even catastrophic impacts on property and critical infrastructure. Stewart County is interested in protecting facilities, property, and infrastructure owned and managed by the jurisdictions. Disasters can damage not only private property but government property as well, placing a financial and operational burden on the County. Losses can extend from structures and contents to the interruption of services and the general economy. Many of these structures could receive indirect impacts, such as downed electrical lines that cut off electricity to the facilities, frozen

pipelines that crack, destroyed crops, and customers not being able to access travel to the structures due to ice-covered roads.

E. Multi-Jurisdictional Differences

Due to the nature of extreme temperatures, Stewart County and the incorporated jurisdictions are equally susceptible. The entire State is vulnerable to extreme temperatures. Varying land elevations, the landscape's character, and proximity to large bodies of water play a significant role in the State's temperatures.

F. Summary

Stewart County and the incorporated jurisdictions are equally vulnerable to extreme temperatures, affecting people's health and safety. Therefore, it is essential to have proper measurements in place to prevent critical structures from being vulnerable to utility failure during extreme temperatures.

2.3 Flood

A. Hazard Overview

Flooding events occur when excess water from rivers and other bodies of water overflow onto riverbanks and adjacent floodplains. In addition, lower-lying regions can collect water from rainfall, and poorly drained land can accumulate rain through ponding on the surface. Floods in Stewart County are usually caused by rain and may also be caused by snowmelt and man-made incidents.

The area adjacent to a channel is the floodplain, as shown in *Figure 9.* A floodplain is flat or nearly flat land adjacent to a stream or river that experiences occasional or periodic flooding. It includes the floodway, which consists of the stream channel and adjacent areas that carry flood flows, and the flood fringe, which are areas covered by the flood but do not experience a strong current. Floodplains are made when floodwaters exceed the capacity of the main channel or escape the channel by eroding its banks. When this occurs, sediments (including rocks and debris) are deposited that gradually build up over time to create the floor of the floodplain. Floodplains generally contain unconsolidated sediments, often extending below the stream's bed.

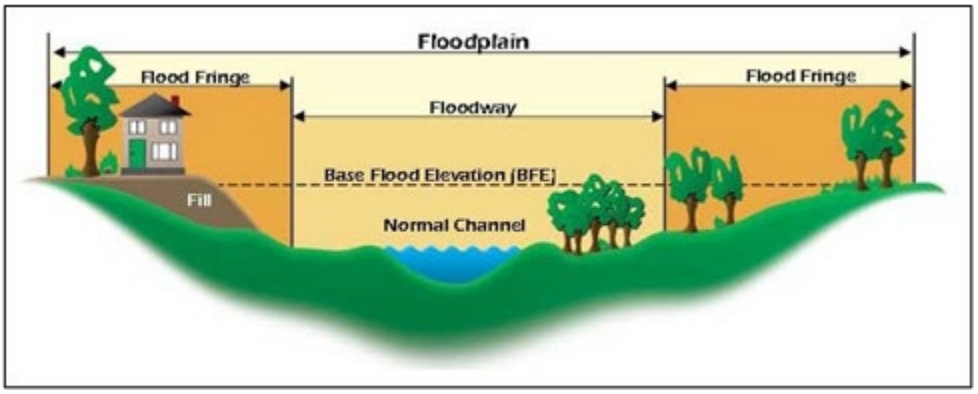


Figure 9 Characteristics of a Floodplain (Source: FEMA)

Three general health hazards common to flood events:

1. Floodwaters carry anything on the ground that the upstream runoff picked up, including dirt, oil, bacteria, animal waste, lawn, farm, and industrial chemicals. Pastures and areas where farm animals are kept or their wastes are stored can contribute to polluted waters in the receiving streams. Floodwaters also saturate the ground, which leads to infiltration into sanitary sewer lines. When wastewater treatment plants are flooded, there is nowhere for the sewage to flow. Infiltration and lack of treatment can lead to overloaded sewer lines that can back up into low-lying areas and homes. Even when flood waters dilute it, raw sewage can be a breeding ground for bacteria such as *E. coli* and other disease-causing agents.
2. The second health problem arises after most water has gone. Stagnant pools can become breeding grounds for mosquitoes, and wet building areas that have not been adequately cleaned breed mold and mildew. A building that is not thoroughly cleaned becomes a health hazard, especially for small children and the elderly.

Another health hazard occurs when ducts in a forced air system are not adequately cleaned after inundation. When the furnace or air conditioner is turned on, the sediments left in the ducts are circulated throughout the building and breathed in by the occupants. If the county water system loses pressure, a boil order may be issued to protect people and animals from contaminated water.

3. The third problem is the long-term psychological impact of having been through a flood and seeing one's home damaged and personal belongings destroyed. The cost and labor needed to repair a flood-damaged home severely strain people, especially the unprepared and uninsured. There is also a long-term problem for those who know their homes can be flooded again. The resulting stress on floodplain residents takes its toll in the form of aggravated physical and mental health problems.

B. County Profile

Riverine flooding occurs from inland water bodies such as streams and rivers. In Tennessee, flooding is highly dependent on precipitation amounts and is highly variable within the State.

HAZUS is a regional multi-hazard loss estimation model developed by FEMA and the National Institute of Building Sciences (NIBS). The primary purpose of HAZUS is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state, and regional officials to plan and stimulate efforts to reduce multi-hazard risks to prepare for emergency response and recovery.

Table 16 Mapped Flood Insurance Zones

Flood Hazard Area	Description
HAZUS (100-yr)	Areas subject to inundation by the 1-percent-annual-chance flood event are generally determined using approximate methodologies. Mandatory flood insurance purchase requirements and floodplain management standards apply.
HAZUS (500-yr)	A 500-year flood zone is a moderate flood hazard area and is an area between the limits of the base flood and the 0.2- percent-annual-chance (or 500-year) flood. Mandatory flood insurance is not required.
Non-highlighted Areas	Minimal risk areas outside the 1-percent and .2 percent-annual-chance floodplains.

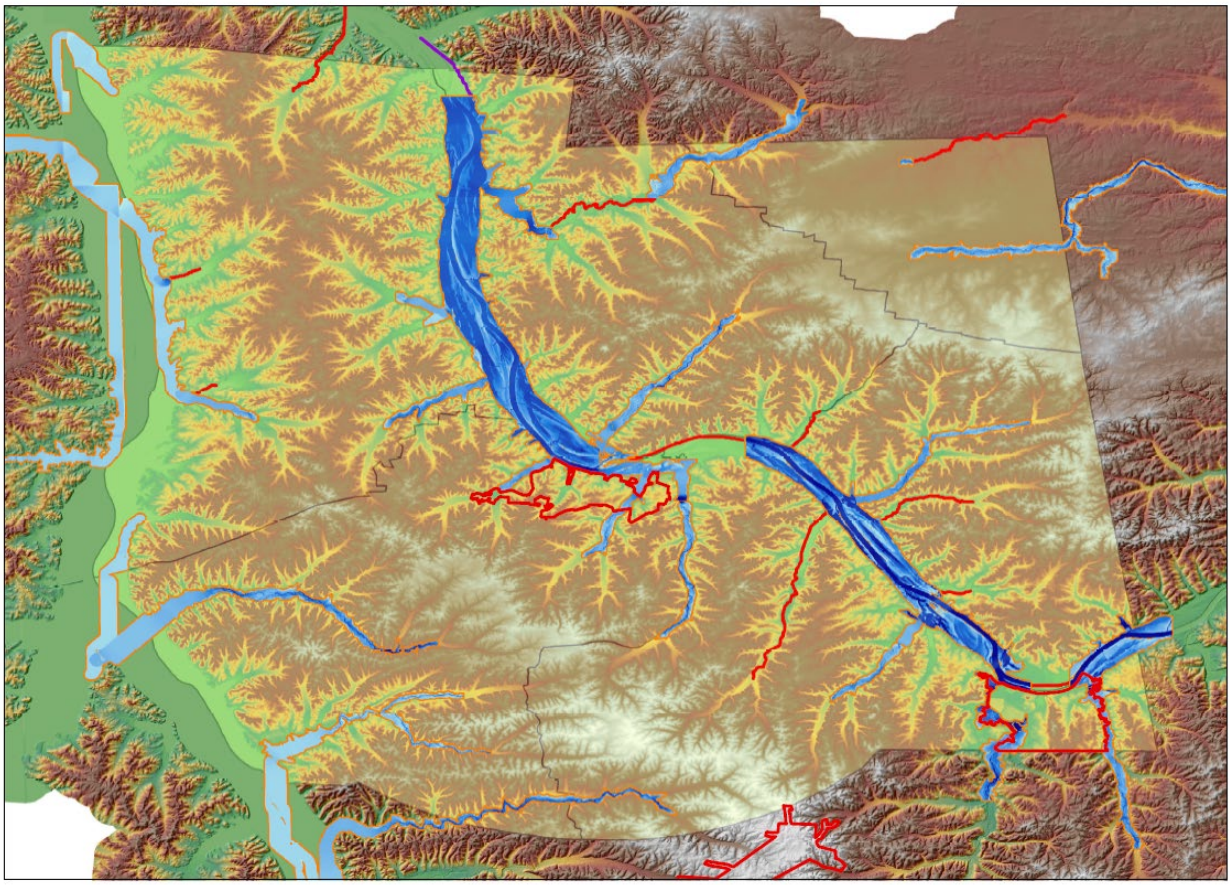


Figure 10: HAZUS 100-year Flood Map

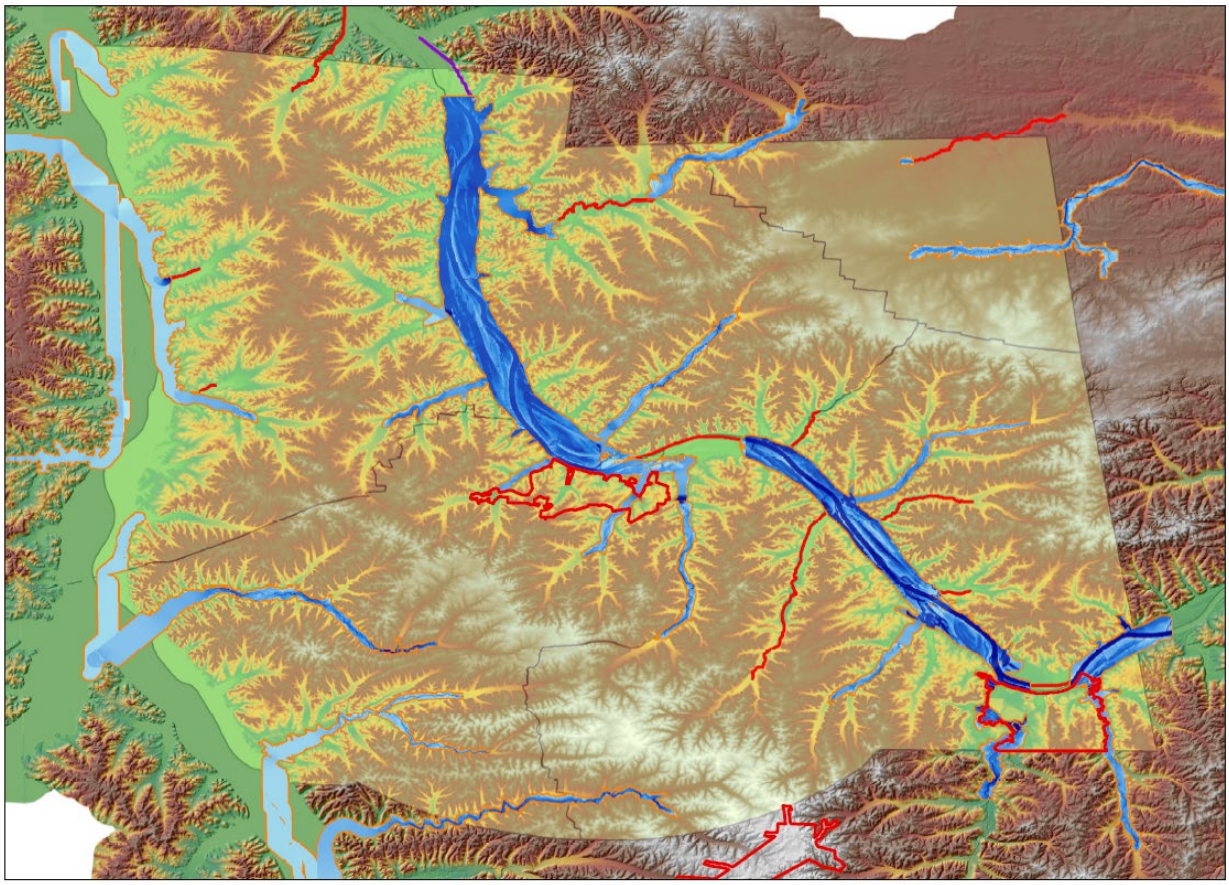


Figure 11: HAZUS 500-year Flood Map

Table 17: NFIP Policy Data

NFIP Policy Data for Stewart County			
Jurisdiction	**CID Number**	**Policies In-Force**	**Written Premium In-Force**
Stewart County	470180B	13	$22896
Town of Dover	470237B	0	0
Town of Cumberland City	470375B	0	0

Policies In-force: number of NFIP flood insurance policies
Written Premium In-force: total premiums paid for NFIP insurance policies

According to the National Flood Insurance Program, repetitive flood loss is a facility or structure that has experienced two or more insurance claims of at least $1,000 in any given 10-year period since 1978. Severe repetitive loss is defined as a facility or structure that has experienced four or more insurance claims exceeding $5,000 or two claims exceeding the value of the building. Within the NFIP, flood loss properties are usually considered the most vital structures to mitigate. The chart below provides a summary of repetitive and severe repetitive losses for Stewart County.

Table 18 NFIP Loss Data

NFIP Loss Data for Stewart County					
Jurisdiction	**Total Losses**	**Closed Loses**	**Open Loses**	**CWOP Loses**	**Total Payments**
Stewart County	RL: 1 (residential) SRL: 0	9	0	3	$431503
Town of Dover	RL: 0 SRL: 0	0	0	0	0
Town of Cumberland City	RL: 0 SRL: 0	0	0	0	0

RL: Repetitive Loss
SRL: Severe Repetitive Loss
Total Losses: number of flood insurance claims filed by policyholders
Closed Losses: number of flood insurance claims paid to policyholders
Open Losses: claims that are still being processed
CWOP Losses: claims that were "closed without payment"
Total Payments: total dollars paid to policyholders

Over the past 30 years, there have been approximately 40 flooding events in Stewart County. A table of NOAA-reported flooding events is located in Appendix C. The following narratives were obtained via the NOAA Storm Event Database. Only events resulting in injury, death, or extensive damage (greater than $200.0K property/crop damage) were included as expanded narratives.

4/29/2010 - 5/1/2010 – Two individuals became trapped in their vehicle when crossing a low-lying bridge on their property, between Tennessee Ridge and Dover. A neighbor attempted to assist and was also caught up in the flood waters. One individual in the vehicle and the neighbor both passed away due to the flood. 25 roads were closed in the county and approximately 20 homes were inaccessible. This event was a part of the larger 2010 flood event that affected much of Middle Tennessee, taking 26 lives, and causing 242.2 billion in property damage/destruction.

Figure 12: Stewart County Flood Response 2010 (Source: Stewart County EMA)

04/27/2013- 04/28/2013

Over 6 inches of rain caused flash flooding in the Carlise and Indian Mound area of Stewart County resulting in multiple calls for rescue. Two people were rescued by swift water teams off North Cross Creek Road in the Carlise community when their truck was swept away and 4 people were evacuated from a home in the area. The flooding caused minor damage to 20 homes, major damage to 25 homes and destroyed 25 homes. No injuries or deaths were reported.

Figure 13: Stewart County Road Flooding 2013 (Source: Stewart County EMA)

Table 19 Flooding Extent History

Location	Extent & Impact	Event Date
Stewart County	Around 2 feet of water covered several sections of Hwy 49 in the Carlise community and on North Cross Creek Road resulting in 6 people being evacuated by rescue teams.	4/28/2013
Dover	4 feet of water covered Lakeland Drive in Dover due to Cumberland River flooding.	5/5/2010
Cumberland City	1 foot of water covered Hwy 434 in Cumberland City due to Cumberland River flooding.	5/5/2010

Probability of Future Events - Likely

The impact of extreme weather events may increase the frequency and intensity of flash flooding within Tennessee, particularly in highly urbanized regions such as Memphis, Nashville, Knoxville, and Chattanooga. Any area with extreme changes in deep terrain, predominately in East Tennessee, will experience significant flooding impacts.

Based on a historical record of 40 flood events over 30 years (1994 - 2023), there is a likelihood for a flood event to occur annually or semiannually. In conjunction with the future weather projections developed by ETSU Geoinformatics & Disaster Science Lab, it can be assumed that an annualized frequency of 1.13 flooding events in Stewart County. Figure 14 illustrates the projections developed by the ETSU Geoinformatics & Disaster Science Lab.

Figure 14 illustrates the projections developed by the US Climate Resilience Toolkit.

C. Risk Assessment

The HMPC meeting cited flooding as a repetitive hazard in the county and jurisdictions. Discussion of commonly flood-prone areas took place, as did mention of improvements that are in progress to mitigate risks including elevating Bellwood Landing Road. Future projects were also discussed at this time and can be found in the Mitigation Action Plan.

The National Risk Index is a dataset and online tool to help illustrate the United States communities most at risk for natural hazards. It was built and designed by FEMA in close collaboration with various stakeholders and partners in academia; local, state and federal government. The Risk Index leverages available source data for natural hazards and community risk factors to develop a baseline relative risk assessment for each county and census trace. Some of these community risk factors include social vulnerability which is

determined by the data pulled from the Census performed every ten years. A higher social vulnerability score is proportional to a higher risk score.

National Risk Index Score for Flooding = Relatively low.

Although the National Risk Index is a well-valued tool, it fails to properly show the feedback from the participating jurisdictions. Therefore, all identified hazards were evaluated in regard to risk in FEMA lifelines per jurisdiction. The scenario that local jurisdictions would evaluate the conditions off of was a mid-level impact of the identified hazard. The results are below:

Table 20: Flooding Risk based on selected FEMA Lifelines

Flooding	FEMA Lifelines						
Jurisdiction	Safety & Security	Food, Water & Shelter	Health & Medical	Energy	Communications	Transportation	Hazardous Materials
County							
Cumberland City							
Dover							
Stewart County Schools							

Colors indicate lifeline or component conditions:	
Red	Significant Impact, Multiple Required Resources
Yellow	Some Impact, Some Outside Resources Required
Green	Little to No Impact, No Outside Resources Required

Given the information above it becomes vital that all participating jurisdictions are able to prioritize the necessity of mitigation actions in the following lifeline categories so that they can become more resilient in the whole community that they serve.

HAZUS Methodology

A Level I HAZUS analysis was completed using a probabilistic risk assessment for the 100-yr and 500-year return periods. The Level I vulnerability assessment is presented below by return period.

Building Inventory (General Building Stock)

HAZUS estimates that 7,567 buildings in the region have an aggregate total replacement value of $2,187 million. The tables below present the relative distribution of the value concerning the general occupancies by Study Region and Scenario, respectively.

Table 21 Building Exposure by Occupancy Type

Stewart County (Study Region)		
Occupancy Type	**Exposure ($1000)**	**Percent Total**
Agricultural	8,629	0.4%
Commercial	287,168	13.1%
Education	93,109	4.3%
Government	10,554	0.5%
Industrial	140,362	6.4%
Religion	127,684	5.8%
Residential	1,519,445	69.5%
Total	2,186,951	100%

Table 22 Building Exposure by Occupancy Type for 100-yr Flood Scenario

100-year River Flood Scenario		
Occupancy Type	**Exposure ($1000)**	**Percent Total**
Agricultural	668	0.1%
Commercial	64,856	13.1%
Education	26,371	5.3%
Government	2,774	0.6%
Industrial	43,523	8.8%
Religion	17,483	3.5%
Residential	339,371	68.6%
Total	495,046	100%

Table 23 Building Exposure by Occupancy Type for 500-yr Flood Scenario

500-yr River Flood Scenario		
Occupancy Type	**Exposure ($1000)**	**Percent Total**
Agricultural	443	0.1%
Commercial	76,678	14.3%
Education	26,371	4.9%
Government	2,774	0.5%
Industrial	43,942	8.2%
Religion	30,553	5.7%
Residential	354,566	66.2%
Total	535,327	100%

Essential Facility Inventory

HAZUS indicates that there is 1 hospital in the region with a total capacity of 0 beds. The hospital is a county health department providing only primary care services. There are 6 schools, 14 fire stations, 3 police stations, and 1 emergency operation center.

General Building Stock Damage

For the 100-year flood scenario, HAZUS estimates that about 2 buildings will be at least moderately damaged. This is over 50% of the total number of buildings in the scenario. There is estimated 1 building that will be destroyed completely. *Table 24* below summarizes

the expected damage by general occupancy type for the buildings in the County during a 100-yr flood scenario.

Table 24 Expected Building Damage by Occupancy for 100-yr Flood Scenario

% Damaged	1-10		11-20		21-30		31-40		41-50		>50%	
Occupancy	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Agricultural	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	0	0	1	100	0	0	0	0	0	0	0	0
Education	0	0	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	0	0	0	0	0	0	0	0	0	0	1	100
Total	**0**		**1**		**0**		**0**		**0**		**1**	

For the 500-year flood scenario, HAZUS estimates that about 2 buildings will be at least moderately damaged. This is over 50% of the total number of buildings in the scenario. There is estimated 1 building that will be destroyed completely. *Table 25* below summarizes the expected damage by general occupancy type for the buildings in the County during a 500-yr flood scenario.

Table 25 Expected Building Damage by Occupancy for 500-yr Flood Scenario

% Damaged	1-10		11-20		21-30		31-40		41-50		>50%	
Occupancy	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Agricultural	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	0	0	0	0	0	0	0	0	0	0	0	0
Education	0	0	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	0	0	1	50	0	0	0	0	0	0	1	50
Total	**0**		**0**		**0**		**0**		**0**		**0**	

Essential Facility Damage

Table 26 and *Table 27* summarize the expected damage to essential facilities following a 100-yr and 500-yr flood, respectively.

Table 26: Expected Damage to Essential Facilities 100-yr Flood Scenario

Classification	Total	Number of Facilities		
		At Least Moderate	At Least Substantial	Loss of Use
EOC	1	0	0	0
Fire Stations	14	0	0	0
Hospitals	1	0	0	0
Police Stations	3	0	0	0
Schools	6	0	0	0

Table 27: Expected Damage to Essential Facilities 500-yr Flood Scenario

Classification	Total	Number of Facilities		
		At Least Moderate	At Least Substantial	Loss of Use
EOC	1	0	0	0
Fire Stations	14	0	0	0
Hospitals	1	0	0	0
Police Stations	3	0	0	0
Schools	6	0	0	0

Debris Generation

100-year Scenario

The model estimates that a total of 116 tons of debris will be generated. Of the total amount, Finishes comprises 53% of the total, Structure comprises 21% of the total, and Foundation comprises 26%. If the debris tonnage is converted into an estimated number of truckloads, it will require 5 truckloads (@25 tons/truck) to remove the debris generated by the flood.

500-year Scenario

The model estimates that a total of 169 tons of debris will be generated. Of the total amount, Finishes comprises 48% of the total, Structure comprises 24% of the total, and Foundation comprises 28%. If the debris tonnage is converted into an estimated number of truckloads, it will require 7 truckloads (@25tons/truck) to remove the debris generated by the flood.

Shelter Requirements

HAZUS estimates the number of households expected to be displaced due to the flood and the associated potential evacuation. HAZUS also estimates those displaced people that will require accommodations in temporary public shelters.

100-year Scenario

The model estimates 57 households (or 170 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 32 people (out of a total population of 13,649) will seek temporary shelter in public shelters.

500-year Scenario

The model estimates 63 households (or 189 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 36 people (out of a total population of 13,649) will seek temporary shelter in public shelters.

Building Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. Business interruption losses are the losses associated with the inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those displaced from their homes because of the flood. Total building-related losses were $25.13 million in the 100-year flood scenario and $25.4 million in the 500-yr flood scenario. *Table 28* and *Table 29* summarize the losses associated with the building damage in each scenario.

Table 28 Building Related Economic Loss Estimates for the 100-yr Flood Scenario ($ Millions)

Category	Area	Residential	Commercial	Industrial	Other	Total
Building Loss	Building	3.91	1.03	0.03	0.14	5.10
	Content	1.91	5.09	0.07	1.01	8.08
	Inventory	0.00	0.65	0.01	0.00	0.66
	Subtotal	5.82	6.77	0.10	1.15	13.84
Business Interruption	Income	0.00	2.79	0.00	0.32	3.11
	Relocation	0.90	0.73	0.00	0.11	1.74
	Rental Income	0.26	0.44	0.00	0.01	0.71
	Wage	0.00	4.81	0.00	0.92	5.74
	Subtotal	1.17	8.76	0.00	1.36	11.29
Total		**6.99**	**15.53**	**0.10**	**2.51**	**25.13**

Table 29 Building Related Economic Loss Estimates for the 100-yr Flood Scenario ($ Millions)

Category	Area	Residential	Commercial	Industrial	Other	Total
Building Loss	Building	5.10	0.99	0.05	0.19	6.33
	Content	2.51	4.15	0.15	1.39	8.20
	Inventory	0.00	0.80	0.02	0.01	0.83
	Subtotal	7.61	5.95	0.22	1.58	15.36
Business Interruption	Income	0.00	2.32	0.00	0.42	2.74
	Relocation	1.02	0.53	0.00	0.14	1.70
	Rental Income	0.30	0.34	0.00	0.01	0.65
	Wage	0.01	3.66	0.00	1.28	4.94
	Subtotal	1.34	6.85	0.01	1.85	10.04
Total		**8.94**	**12.79**	**0.23**	**3.44**	**25.40**

D. Land Use and Development

All future development within the floodplain may be considered at risk. An increase in population will likely increase the number of buildings and infrastructure. New development in unincorporated areas could potentially occur in areas prone to flooding and increase vulnerabilities and potential losses; however, most land use regulations require the consideration of flooding during the development process.

E. Multi-Jurisdictional Differences

Flooding affects all jurisdictions differently; that is why it is essential to document the depth, duration, and time that flooding occurred. These differences are noted in past occurrences to demonstrate the toll that flooding can take on the county's rural and urban areas. Due to the topography of Stewart County with its rolling hills and deep valleys, flood events are prone to occur near the streams and rivers within the county. Two large rivers, the Tennessee River and the Cumberland River, also flow through the county, chances are increased in these areas for a flood event. FIRM Panels are located within Appendix D to help illustrate the areas at risk and depth of flooding within the county and its incorporated jurisdictions.

Intersections & Roads that consistently flood in Stewart County:

- **Rorie Hollow Road**
- **Red Top Road**
- **Sandy Road**
- **Patrick Drive (behind the old VA Clinic)**
- **Bell Road**
- **River Road**
- **Cub Creek Road (Indian Mound)**
- **Bumpus Mills Road**
- **Highway 49**
- **Lakeland Drive**
- **North Cross Creek Road**
- **Bellwood Landing**
- **Patricia Circle**
- **Highway 120 Mile 1-3 (Big Rock area)**
- **Cox Hollow Road**

F. Summary

Severe flooding has the potential to inflict significant damage in Stewart County. The total economic loss estimated for the 100-year riverine flood is $25.13 million. The total economic loss estimated for the 500-year riverine flood is $25.40 million. Residential, commercial, and public buildings and critical infrastructures such as transportation, water, energy, and communication systems may be damaged or destroyed by flood waters. During a flood event, chemicals and other hazardous substances may contaminate local water bodies. Flooding kills animals and, in general, disrupts the ecosystem. Snakes and insects may also make their way to the flooded areas.

2.4 Severe Weather

A. Hazard Overview

Thunderstorms

Thunderstorms result from the rapid upward movement of warm, moist air. They can occur inside warm, moist air masses and at fronts. As the warm, moist air moves upward, it cools, condenses, and forms cumulonimbus clouds that can reach heights greater than 35,000 ft. Thunderstorms are responsible for developing and forming many severe weather phenomena, posing significant hazards to the population and landscape. Damage from thunderstorms is mainly inflicted by downburst winds, large hailstones, and flash flooding caused by heavy precipitation. Stronger thunderstorms can produce tornadoes and waterspouts.

Wind

All jurisdictions are vulnerable to receiving damage from severe winds. The NOAA Storm Data Preparation document categorizes wind into three different types, as defined below.

- High Wind: Sustained non-convective winds of 40mph or greater lasting for one hour or longer or winds (sustained or gusts) of 58 mph for any duration on a widespread or localized basis.
- Strong Wind: Non-convective winds gusting less than 58 mph or sustained winds less than 40 mph, resulting in a fatality, injury, or damage.
- Thunderstorm Wind: Winds arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 58 mph, or winds of any speed (non-severe thunderstorm winds below 58 mph) producing a fatality, injury, or damage.

Historically, severe wind events occur multiple times yearly in Stewart County. It is not unusual for Stewart County to experience winds speeds up to 70 knots (80.55 mph), causing structural damage, power outages, and downed trees. Based on a historical record of 159 wind events over 73 years (1950- 2023), the historic frequency calculates approximately 2 events a year.

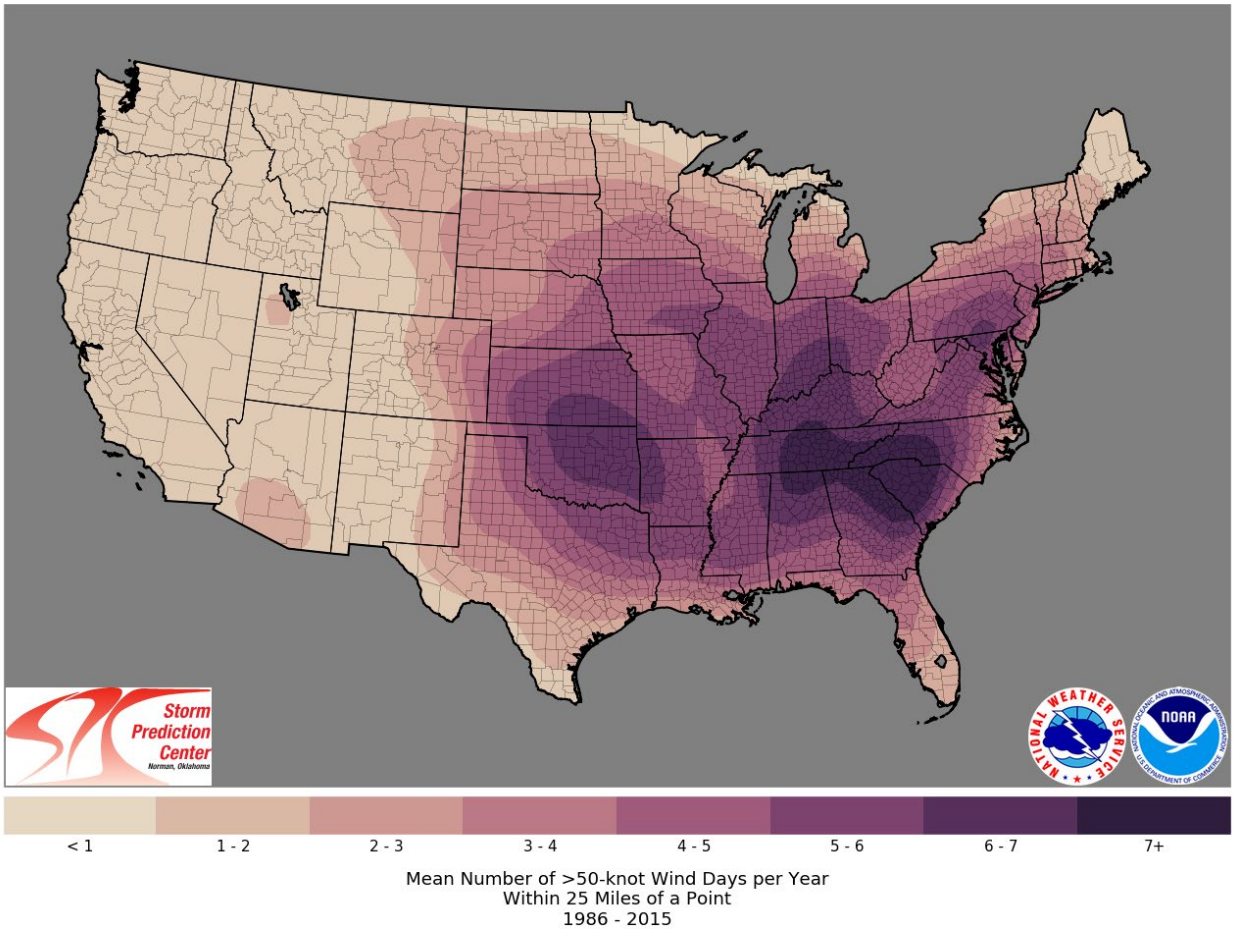


Figure 15: Mean Number of >50-knot Wind Days per Year (1986-2015) (source: NOAA)

Hail

Hail forms when updrafts carry raindrops into icy areas of the atmosphere, where they freeze into ice. Hailstorms occur throughout the spring, summer, and fall but are more frequent in late spring and early summer. Hailstones are usually less than two inches in diameter and can fall at speeds of 120 mph. Hail causes nearly $1 billion in damage to crops and property yearly in the United States. *Table 30* provides an overview of the typical impacts on a community related to hailstone size.

Table 30 TORRO Hail Index (Source: The Tornado and Storm Research Organization)

Scale	Description	Max Diameter (mm)	Typical Damage
H0	Pea	5-9	No damage
H1	Mothball	10-15	Slight general damage to crops and plants
H2	Marble	16-20	Significant damage to crops and vegetation
H3	Walnut	21-30	Severe damage to fruits and crops, damage to glass and plastic structures, wood and paint scored
H4	Pigeons Egg	31-40	Widespread glass damage, auto-body damage
H5	Golf Ball	41-50	Destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Hens Egg	51-60	Grounded aircrafts dented; brick walls pitted
H7	Tennis Ball	61-75	Severe roof damage and risk of serious injury

H8	Softball	76-90	Severe damage to aircrafts
H9	Grapefruit	91-100	Extensive structural damage, risk of severe or fatal injuries to people caught in storm
H10	Melon	>100	Extensive structural damage, risk of severe or fatal injuries to people caught in storm

Lightning

Lightning is an electrical discharge between positive and negative regions of a thunderstorm. Lightning is one of the more dangerous weather hazards in the United States. Annually, lightning is responsible for deaths, injuries, and millions of dollars in property damage, including damage to buildings, communications systems, power lines, and electrical systems. Lightning also causes forest and brush fires and deaths, and injuries to livestock and other animals. According to the National Lightning Safety Institute, lightning causes more than 26,000 fires in the United States annually. The institute estimates property damage, increased operating costs, production delays, and lost revenue from lightning and secondary effects to be more than $6 billion annually. Impacts can be direct or indirect. People or objects can be struck or damaged when the current passes through or nearby.

Winter Weather

A freeze occurs when temperatures are below 32 degrees Fahrenheit for a period. These temperatures can damage crops, burst water pipes, and create layers of “black ice.” Winter storms are events that can range from a few hours of moderate snow to blizzard-like circumstances that can affect driving conditions and impact communications, electricity, and other services. In Stewart County, all jurisdictions are vulnerable to freezes and moderate winter storms, but not to the severity level seen in much of the northern U.S. Based on previous occurrences, Stewart County can experience multiple winter weather events in one year affecting all jurisdictions equally. The severity of winter storms is commonly measured by inches of snowfall. It is possible for snowfall to accumulate up to 1 foot in Stewart County and/or ice accumulations to cause hazardous conditions due to its proximity to and around the mountains. U.S. Mean snowfall per year is from 6-12” annually average mean snowfall per year is below in *Figure 16.*

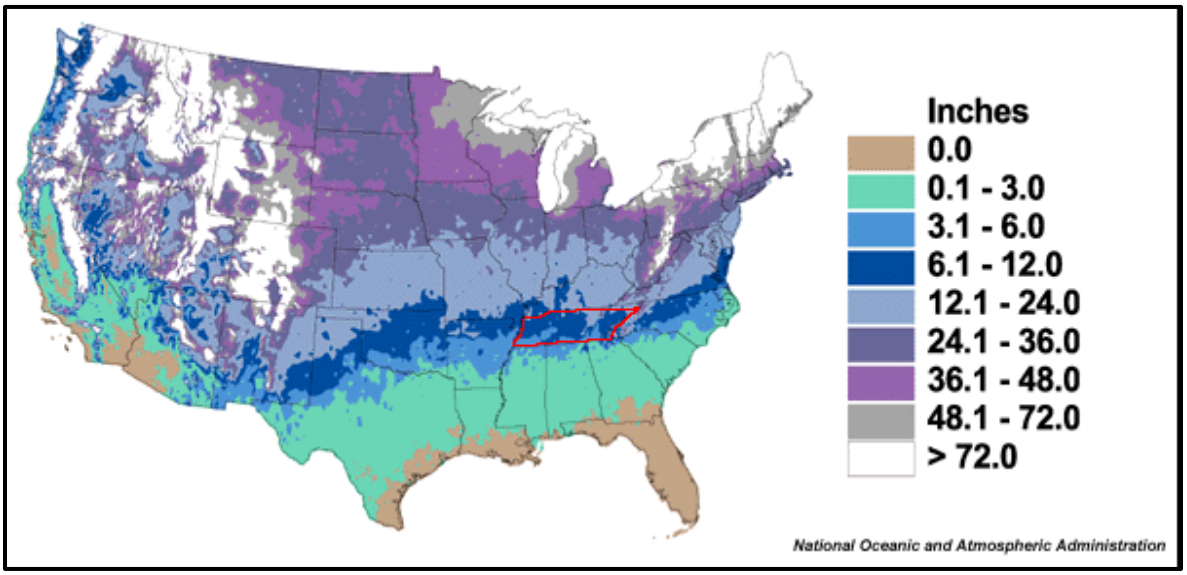


Figure 16 Average Snowfall per Year (Source: NOAA)

B. County Profile

The entirety of Stewart County is at risk of severe weather. Severe weather events are most likely in the spring and summer months and during the afternoon and evening hours, but they can occur year-round and at all hours. In terms of magnitude, the NWS defines thunderstorms in terms of severity. A severe thunderstorm produces winds greater than 57 miles per hour and/or hail greater than 1 inch in diameter and/or a tornado. The NWS chose these severity measures as parameters more capable of producing considerable damage. Hail stones can vary in diameter, and in Tennessee, there have been records of hail up to 2.75 inches.

Event narratives were obtained via the NOAA Storm Event Database and are included below for each severe weather category. Tables containing all NOAA-recorded severe weather events between 1950- 2023 for Stewart County are contained in Appendix C.

Thunderstorms

01/11/2020 – Thunderstorm resulted in numerous trees and powerlines down on Leatherwood Road. 730 homes were without power.

05/03/2020 – Thunderstorm blew tree on house on Twin Oaks Rd. Numerous trees and powerlines down resulting in over 1000 homes without power.

Figure 17 Thunderstorm damage on Leatherwood Road in 2020 (Source Stewart County EMA)

Wind

03/14/2019 – Strong winds with gust over 40 mph resulted in downed trees blocking roads

05/29/2018 – Strong winds associated with TD Alberto blew down trees across county.

Hail

04/08/2020 – Quarter size hail and strong winds reported in Dover

05/10/2016 – Quarter size hail reported in Cumberland City

Lightning

07/14/2016 – Lightning struck and killed woman at Piney Campground at LBL.

05/29/2012 – Lightning struck and set fire to shed on Leatherwood Rd.

Winter Weather

02/10/2021 – Freezing rain resulted in hazardous road conditions and power outages in the Bumpus Mills area.

01/06/2022 – 5 inches of snow fell in Stewart County resulting hazardous road conditions.

Figure 18 Freezing rain and sleet accumulating on roads (Source: Stewart County EMA)

Probability of Future Events - Likely

To determine the likelihood of future severe weather occurrences in Stewart County, historic data and weather patterns were analyzed by the ETSU Geoinformatics & Disaster Science Lab and evaluated by severe weather sub-hazards. There was an increasing trend in non-convective wind events and winter weather related storms. No significant trend was observed for thunderstorm wind and severe hail. There was a slight decreasing trend in lightning strikes. It was recognized that climate trends can contribute to compound

events where multiple extreme weather events occur simultaneously or in succession which can amplify the overall impacts on the community.

C. Risk Assessment

Severe weather is not as spatially defined in any location in Stewart County; therefore, the entire County is equally at risk of severe weather. This includes the entire County population, all critical facilities, buildings (commercial and residential), and infrastructure.

The National Risk Index is a dataset and online tool to help illustrate the United States communities most at risk for natural hazards. It was built and designed by FEMA in close collaboration with various stakeholders and partners in academia; local, state and federal government. The Risk Index leverages available source data for natural hazards and community risk factors to develop a baseline relative risk assessment for each county and census trace. Some of these community risk factors include social vulnerability which is determined by the data pulled from the Census performed every ten years. A higher social vulnerability score is proportional to a higher risk score.

National Risk Index Score for Hail = relatively low

National Risk Index Score for Strong Wind = relatively low

National Risk Index Score for Ice Storm = very low

National Risk Index Score for Winter Weather relatively low

Although the National Risk Index is a well-valued tool it fails to properly show the feedback from the participating jurisdictions. Therefore, all identified hazards were evaluated in regard to risk in FEMA lifelines per jurisdiction. The scenario that local jurisdictions would evaluate the conditions off of was a mid-level impact of the identified hazard. The results are below:

Table 31: Severe Weather Risk based on selected FEMA Lifelines

Severe Weather	FEMA Lifelines						
Jurisdiction	Safety & Security	Food, Water & Shelter	Health & Medical	Energy	Communications	Transportation	Hazardous Materials
County							
Cumberland City							
Dover							
Stewart County Schools							

Colors indicate lifeline or component conditions:	
Red	Significant Impact, Multiple Required Resources
Yellow	Some Impact, Some Outside Resources Required
Green	Little to No Impact, No Outside Resources Required

Given the information above it becomes vital that all participating jurisdictions are able to prioritize the necessity of mitigation actions in the following lifeline categories so that they can become more resilient in the whole community that they serve.

D. Land Use & Development

Increased development and population growth can reasonably translate to increased damage resulting from severe weather events. The population in Stewart County is expected to rise similarly to its surrounding counties and Tennessee. An increase in population will lead to an increase in the number of residential and commercial structures as well as new and improved infrastructure, which in turn means an increase in the number and value of assets at risk of wind damage.

E. Multi-Jurisdictional Differences

The entirety of Stewart County and the incorporated jurisdictions, including all assets, can be considered equally at risk of severe weather events. This includes the entire population, all critical facilities, buildings (commercial and residential), and infrastructure.

F. Summary

Stewart County is subject to severe weather hazards, including thunderstorms, wind, lightning, and hail. Associated damages include impacts to utilities, residential and

commercial buildings/property, and agricultural losses. High wind can cause trees to fall and potentially result in injuries or death; lightning can lead to house fires and serious injury. Hail can cause injury and severe property damage to homes and automobiles.

2.5 Tornadoes

A. Hazard Overview

Tornadoes have the potential to produce winds over 200 mph (EF5 on the Enhanced Fujita Scale) and can be very expansive. Before February 1, 2007, tornado intensity was measured by the Fujita (F) scale. This scale was revised and is now the Enhanced Fujita scale. Both scales are wind estimates (not measurements) based on damage. The new scale provides more damage indicators (28) and associated degrees of damage. *Table 32*shows the wind speeds associated with the enhanced Fujita scale ratings and the damage that could result at different intensity levels.

Table 32 Enhanced Fujita Scale

EF Rating	3 Second Wind Gust (mph)	Estimated Damage
0	65-85	**Light Damage.** Slight damage to roofs, gutters, siding, tree branches broken, shallow-rooted trees overturned
1	86-110	**Moderate Damage**. Mobile homes damaged, exterior portions of homes damaged or lost (i.e., roofs, doors, windows)
2	111-135	**Considerable Damage**. Mobile homes destroyed, cars lifted, well-constructed home frames shifted, roofs torn off, light-object missiles generated, large trees uprooted or snapped.
3	136-165	**Severe Damage**. Severe damage to large buildings, entire home stories destroyed, trees debarked, trains overturned, heavy vehicles lifted and thrown, structures with weaker foundations thrown
4	166-200	**Devastating Damage.** Well-constructed houses and whole frame houses leveled, cars thrown, small missiles generated
5	200+	**Incredible Damage**. Substantial frame houses leveled off foundations and the automobile-sized missiles generated, and high rises experience considerable damage and deformation

According to the Glossary of Meteorology (AMS 2000), a tornado is "a violently rotating column of air, pendant from a cumuliform cloud or underneath a cumuliform cloud, and often (but not always) visible as a funnel cloud." Most tornadoes move from southwest to northeast or west to east.

Although tornadoes can occur in any location, most of the tornado activity in the United States exists in the Mid-West and Southeast. An exact season does not exist for tornadoes; however, most occur between early spring and mid-summer (February – June). The onset of tornado events is rapid, giving those in danger minimal time to seek shelter. The current average lead time, according to NOAA, is 13 minutes. A tornado can reach wind speeds of 40 mph to 250 mph and higher. The following map illustrates the frequency of tornadoes in Tennessee.

B. County Profile

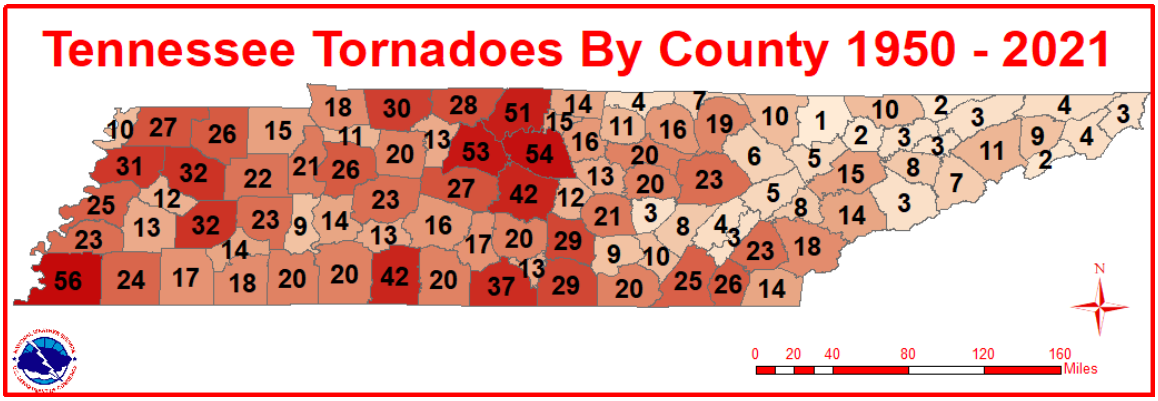


Figure 19 Tornadoes by County (NWS/NOAA)

Figure 20 illustrates the track of tornadoes through Stewart County as recorded by the National Weather Service Nashville and the National Climatic Data Center and compiled into a visual database by Mississippi State University. *Figure 21* provides a breakdown of tornado frequency by the hour in Stewart County; tornadoes commonly occur between 4pm and 7pm.

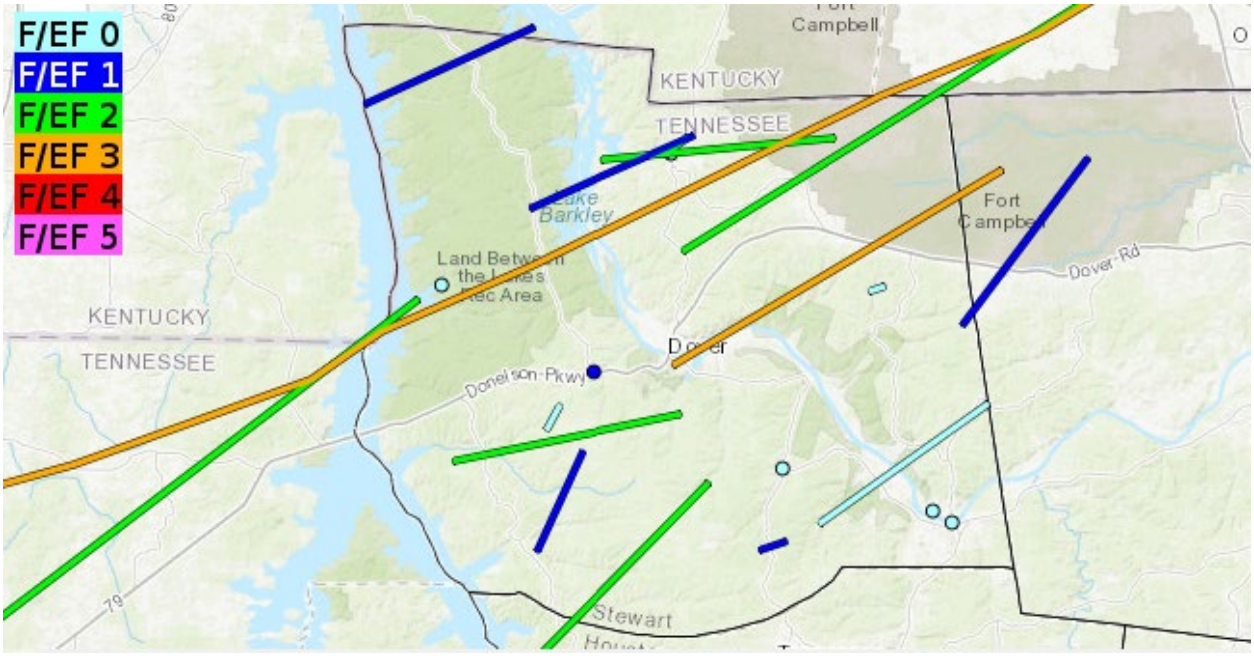


Figure 20 Tornadoes Tracks in Stewart County (Source: msstate.edu)

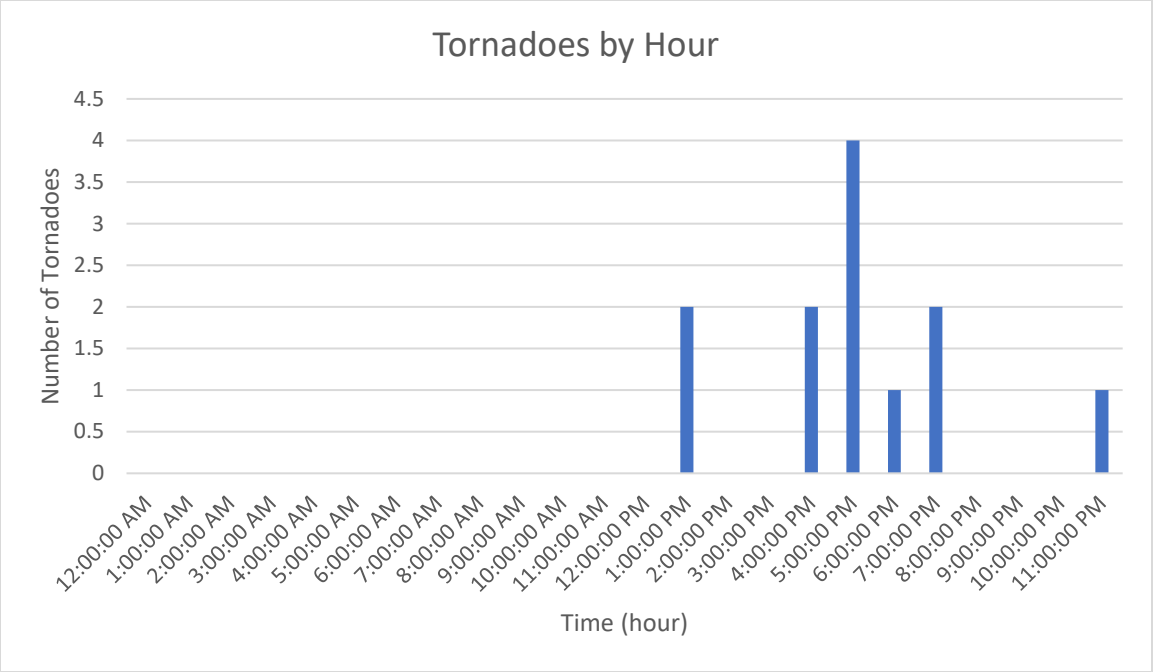


Figure 21 Tornadoes by Hour in Stewart County

The following narratives were obtained via the NOAA Storm Event Database. Only events resulting in injury, death, or extensive damage (greater than $200K property/crop damage) were included as expanded narratives. A table containing all NOAA-recorded tornadoes between 1950- 2023 for Stewart County is contained in Appendix C.

12/10/2021 – An EF2 tornado crossed Stewart County in the overnight hours starting at Land Between the Lakes and moved east northeast though the northern portion of county before entering Ft Campbell Army Base. Damages were reported on Link Road, Stimson Road, Hayes Fork Creek Road, Bumpus Mills Road, Hwy 120 and Walker Ridge. Four minor injuries were reported. Estimated damage was $2,000,000.

05/23/2011 – A EF2 tornado touched down near Bumpus Mills Rd and Bazzie Dock Road and continued northeast for 13 miles into Ft Campbell Army Base. Significant damage was along Cherry Hollow Road in the Big Rock Community. Several structures were damaged or destroyed. Estimated damage was $250,000.

Figure 22: Stewart County tornado damage (Source: Stewart County EMA)

Probability of Future Events - Likely

Historical data and weather patterns were analyzed to determine the likelihood of future tornado occurrence in Stewart County. Since 1950, 13 tornadoes have occurred within the county. In conjunction with the future weather projections developed by ETSU Geoinformatics & Disaster Science Lab, no significant up or down trends were identified, and it can be assumed that a tornado could occur in Stewart County on a 5 year basis.

C. Risk Assessment

The entirety of Stewart County can be considered at risk for a tornado. This includes the entire County population, all critical facilities, buildings (commercial and residential), and infrastructure. Tornadoes tracked in Tennessee predominantly travel in a northeasterly direction in the state. While all assets are considered at risk from this hazard, a particular tornado would only cause damage along its specific track.

The National Risk Index is a dataset and online tool to help illustrate the United States communities most at risk for natural hazards. It was built and designed by FEMA in close collaboration with various stakeholders and partners in academia; local, state and federal government. The Risk Index leverages available source data for natural hazards and

community risk factors to develop a baseline relative risk assessment for each county and census trace. Some of these community risk factors include social vulnerability which is determined by the data pulled from the Census performed every ten years. A higher social vulnerability score is proportional to a higher risk score.

National Risk Index Score for Tornado = relatively low

Although the National Risk Index is a well-valued tool it fails to properly show the feedback from the participating jurisdictions. Therefore, all identified hazards were evaluated in regard to risk in FEMA lifelines per jurisdiction. The scenario that local jurisdictions would evaluate the conditions off of was a mid-level impact of the identified hazard. The results are below:

Table 33: Tornado Risk based on selected FEMA Lifelines

Tornado	FEMA Lifelines						
Jurisdiction	Safety & Security	Food, Water & Shelter	Health & Medical	Energy	Communications	Transportation	Hazardous Materials
County							
Cumberland City							
Dover							
Stewart County Schools							

Colors indicate lifeline or component conditions:	
Red	Significant Impact, Multiple Required Resources
Yellow	Some Impact, Some Outside Resources Required
Green	Little to No Impact, No Outside Resources Required

Given the information above it becomes vital that all participating jurisdictions are able to prioritize the necessity of mitigation actions in the following lifeline categories so that they can become more resilient in the whole community that they serve.

D. Land Use and Development Trends

Stewart County codes include proper wind strength and safety regulations consistent with state and federal regulations. While the adopted code provides adequate protection, older and mobile homes are highly susceptible to tornado events. There are multiple mobile

home areas in the county ranging from small trailer plots to larger multi-trailer parks. These areas have not been officially analyzed for susceptibility to tornadoes. However, during the HMPC meeting discussion regarding possible mitigation activities was had.

E. Multi-Jurisdictional Differences

The entirety of Stewart County and its incorporated jurisdictions are at risk for a tornado event; however, historically, a higher impact tornadoes have occurred in the middle and northern portion of the county. It is also worth noting that given the county's sizeable rural component, some tornadic events may have gone unreported.

F. Summary

This includes the entire County population, all critical facilities, buildings (commercial and residential), and infrastructure. While all assets are considered at risk from this hazard, a tornado would only cause damage along its specific track. The weakest tornadoes, EF0, can cause minor roof damage, and stronger tornadoes can destroy frame buildings and badly damage steel reinforced concrete structures. Given the strength of the wind impact and construction techniques, buildings are vulnerable to direct impact, including potential destruction, from tornadoes and wind debris that tornadoes turn into missiles. Structures constructed of light materials such as mobile homes are most susceptible to damage.

Chapter 3. Mitigation Strategy

3.1 Mitigation Goals

Goals are general guidelines that explain what is to be achieved. They are usually broad-based policy-type statements, long-term, and represent global visions. Goals help define the benefits that the plan is trying to achieve.

Goal Setting Exercise

In 2017, the HMPC agreed upon the goals for their hazard mitigation plan. It was decided that the goals from the 2017 plan should be carried over into the 2023 plan. They still reflect the current hazards and current conditions in the community.

Resulting 2023 Plan Update Goals

At the end of the meeting, the HMPC agreed upon three general goals for planning efforts. Those goals are as follows:

Goal 1: Protect the Lives and health of citizens from the effects of natural hazards.

Goal 2: Emphasize mitigation planning to decrease vulnerability to new and existing structures.

Goal 3: Encourage public support and commitment to hazard mitigation by communicating mitigation benefits.

Expanding & Improving Mitigation Programs

The participating jurisdictions determined which areas they could improve or expand based on the table below. Gaps and limitations for each jurisdiction may be addressed in the mitigation strategy.

Table 34 Expansion Narrative

Jurisdiction/Applicant	How are you able to expand?
Stewart County	Hire grant administrator
Town of Dover	Reevaluate stormwater ordinance
Town of Cumberland City	Hire grant writer
School District	Grant writing training

3.2 Compliance with NFIP

Stewart County, Dover, and Cumberland City participate in FEMA's National Flood Insurance Program (NFIP). Each participating community enforces a flood damage prevention ordinance that regulates development within the Special Flood Hazard Area (SFHA). Additionally, as members of FEMA's NFIP, each community requires Elevation Certificates on all new buildings and substantial improvements within the SFHA.

Given the flood hazards in the planning area, an emphasis will be placed on continued compliance with the NFIP. Stewart County and it incorporated jurisdictions adopted minimum Floodplain Management Criteria via NFIP on the dates listed in *Table 35*.

Each jurisdiction is given the opportunity to participate in NFIP Webinars hosted by the State National Flood Insurance program Office. Each participating community will take the following steps to meet or exceed the following minimum requirements as set by the NFIP:

- Issuing or denying floodplain development/building permits;
- Inspecting all development to ensure compliance with the local ordinance;
- Maintaining records of floodplain development;
- Assisting in the preparation and revision of floodplain maps;
- Helping residents obtain information on flood hazards, floodplain map data, flood insurance, and proper construction measures.

The jurisdictions have the following processes for administering substantial damage regulation after a disaster.

- Town of Dover
    - Preliminary damage assessment
    - Safety evaluations by city codes officer
    - Distribute informational handouts on NFIP requirements
    - Building/Renovations permit process to meet NFIP requirements

- Town of Cumberland City
    - Preliminary damage assessment
    - Safety evaluations by city codes officer

  - Distribute informational handouts on NFIP requirements
  - Building/Renovations permit process to meet NFIP requirements

- Stewart County
  - Preliminary damage assessment
  - Seek assistance from Town of Dover Codes Officer in evaluating damage to structures.
  - Distribute informational handouts on NFIP requirements
  - Collaboration between County Tax Assessors, Codes Officer, Mayors Office and EMA to determine guidance for property owner

Table 35 NFIP Designees and Webinar Attendance

Jurisdiction	Title of NFIP Designee	NFIP Regulations Adopted	Regulations Citation	NFIP Joining Date
Stewart County	EMA Director	1/13/2021	Standalone regulations (County doesn't use ordinance numbers0	11/17/2010
Town of Dover	Code Enforcement Director	1/27/2021	446-20	02/01/1990
Town of Cumberland City	Building Official	12/18/2020	2020-05	10/19/2010

3.3 Prioritization Process

The prioritization process was necessary as most mitigation projects represent a significant investment of financial and personal resources. By evaluating each project's degree of feasibility and the level of costs versus benefits, Stewart County could determine which projects should include based on the available funding and time. The HMPC used the SAFE-T method to prioritize these projects. This approach was adopted from the successful methodology used by other counties in FEMA Region 4. This rating system uses five variables to evaluate each project's overall feasibility and appropriateness. *Figure 36* further explains this method

Figure 36 SAFE-T Project Prioritization

Project Prioritization Method: SAFE-T			
Variable		Value	Description
S	**Societal:** The public must support the overall implementation strategy and specified mitigation actions. The projects will be evaluated in terms of community acceptance, social vulnerability and societal benefits	1	Low community acceptance/priority
		2	Moderate community acceptance/priority
		3	High community acceptance/priority
A	**Administrative:** The projects will be evaluated for anticipated staffing and maintenance requirements to determine if the jurisdiction has the personnel and administrative capabilities necessary to implement the project or whether outside help will be needed.	1	High staffing, outside help needed
		2	Some staffing, no outside help needed
		3	Low staffing, no outside help needed
F	**Financial:** The projects will be evaluated on their general cost-effectiveness and whether additional outside funding will be required.	1	Somewhat cost-effective
		2	Moderately cost effective
		3	Very cost-effective
E	**Environmental:** The projects will be evaluated for any immediate or long-term environmental impacts caused by their construction or operation.	1	Many environmental impacts
		2	Some environmental impacts
		3	Few environmental impacts
T	**Technical:** the projects will be evaluated on their ability to reduce losses in the short term or long term.	1	Short-term fix
		2	Medium-term fix
		3	Long-term fix

The identification and analysis process of mitigation alternatives allowed the HMPC to come to a consensus and prioritize recommended mitigation actions. The HMPC discussed the contribution of the effort to save lives or property first and foremost, with additional consideration given to the benefit-cost aspect of a project; however, this was not a quantitative analysis. The team agreed that prioritizing the actions collectively enabled the actions to be ranked in order of relative importance and helped steer the development of additional actions that meet the more essential objectives while eliminating some of the actions which did not garner much support. The cost-effectiveness of any mitigation alternative will be considered in greater detail by performing benefit-cost project analyses when seeking FEMA mitigation grant funding for eligible actions associated with this plan.

3.4 Mitigation Action Plan

The Mitigation Action Plan was developed to present the recommendations developed by the HMPC for how the communities can reduce the risk and vulnerability of people, property, infrastructure, and natural and cultural resources to future disaster losses. Emphasis was placed on both future and existing development. The action plan summarizes who is responsible for implementing each of the prioritized actions and when and how the actions will be implemented. Due to funding availability and other criteria, it should be clarified that the actions included in this mitigation strategy are subject to further review and refinement, alternatives analyses, and reprioritization. This document does not obligate Stewart County and the incorporated jurisdictions to implement any or all of these projects. Rather this mitigation strategy represents the desires of the community to mitigate the risks and vulnerabilities from identified hazards.

Table 37 Stewart County Mitigation Actions and Projects

Stewart County Hazard Mitigation Actions

Action Description *Hazard Mitigated*	Responsible Department	Jurisdiction	Time Frame	Priority Score						Est Cost	Funding Sources	Infrastructure
				Societal	Administrative	Financial	Environmental	Technical	Total			
Generators for County EMS Stations *Earthquake, Extreme Temperature, Flood, Severe Weather, Tornadoes*	EMS/EMA	County	Medium-Term (3-5 years)	3	3	2	2	1	**11**	$15K	HMGP, Local	Existing
Generator for the County Highway Department *Earthquake, Extreme Temperature, Flood, Severe Weather, Tornadoes*	Stewart County Highway Department	County	Medium-Term (3-5 years)	2	3	2	2	1	**10**	$15K	HMGP, Local	Existing
Generators for sewage and water pumping stations *Earthquake, Extreme Temperature, Flood, Severe Weather, Tornadoes*	Mayor's Office	County	Medium-Term (3-5 years)	3	3	2	2	1	**11**	$15K	HMGP, Local	Existing
Generators for schools (x4) *Earthquake, Extreme Temperature, Flood, Severe Weather, Tornadoes*	Stewart County Board of Education	Stewart County Schools	Medium-Term (3-5 years)	3	3	2	2	1	**11**	$15K	HMGP, Local	Existing
Generators for county/city fire stations *Earthquake, Extreme Temperature, Flood, Severe Weather, Tornadoes*	Jurisdictional Fire Departments/County EMA	All	Medium-Term (3-5 years)	3	3	2	2	1	**11**	$15K	HMGP, Local	Existing
Battery back-up systems for critical traffic lights	County Mayor's Office	County	Medium-Term (3-5	2	3	2	2	1	**10**	$15K	HMGP, Local	Existing

Earthquake, Extreme Temperature, Flood, Severe Weather, Tornadoes			years)									
Generator for city sewage building *Earthquake, Extreme Temperature, Flood, Severe Weather, Tornadoes*	Cumberland City Public Works/Mayor's Office	Cumberland City	Medium-Term (3-5 years)	3	3	2	2	1	**11**	$15K	HMGP, Local	Existing
Retrofit schools for high winds and debris (window film, harden walls, etc.) *Severe Weather, Tornadoes*	Stewart County Board of Education	Stewart County Schools	Long-Term (5-10 years)	3	1	2	2	3	**11**	$200K	HMGP, Local	Existing
Retrofit the senior citizen center to function as a safe shelter *Severe Weather, Tornadoes*	Dover Mayor's Office	Dover	Long-Term (5-10 years)	3	1	2	2	3	**11**	$200K	HMGP, Local	Existing
Create a safe shelter in higher population/higher risk area of Indian Mound *Severe Weather, Tornadoes*	County Mayor's Office/ County EMA	County	Long-Term (5-10 years)	3	1	2	2	3	**11**	$200K	HMGP, Local	New
Retrofit local fire hall to function as a safe shelter *Severe Weather, Tornadoes*	Cumberland City Mayor's Office/Local Fire Department	Cumberland City	Long-Term (5-10 years)	3	1	2	2	3	**11**	$200K	HMGP, Local	Existing
Create a safe shelter in higher population/higher risk area of the city *Severe Weather, Tornadoes*	Dover Mayor's Office	Dover	Long-Term (5-10 years)	3	1	2	2	3	**11**	$200K	HMGP, Local	New
Weather Radio Giveaway for households *Flood, Severe Weather, Tornadoes*	County Mayor's Office, Jurisdictional Mayor's Offices	All	Medium-Term (3-5 years)	3	3	2	3	2	**13**	$10K	HMGP, BRIC, Local	Both New and Existing
Outdoor warning siren system in the Piney area and near county schools *Earthquake, Flood, Severe Weather,*	County Mayor's Office, County EMA, Stewart County Board of	Stewart County Schools, County	Short-Term (0-3years)	2	2	2	2	2	**10**	$50K	HMGP, Local	New

Tornadoes	Education											
Increase elevation on Lakeland Drive and Beech Street *Flood*	Dover Public Works/Mayor's Office	Dover	Long-Term (5-10 years)	2	1	2	1	3	**9**	$400K	HMGP, Local	Existing
Increase elevation on Highway 233 and Highway 434 *Flood*	Cumberland City Public Works/Mayor's Office	Cumberland City	Long-Term (5-10 years)	2	1	2	1	3	**9**	$700K	HMGP, Local	Existing
Increase elevation on Bellwood Hollow Road *Flood*	County Highway Department	County	Long-Term (5-10 years)	2	1	2	1	3	**9**	$500K	HMGP, Local	Existing
Increase elevation of sewer lift stations *Flood*	Dover Public Works/Mayor's Office	Dover	Medium-Term (3-5 years)	1	2	1	2	3	**9**	$1,000K	HMGP, Local	Existing
Property Acquisition for RL/SRL properties *Flood*	Jurisdictional Mayors Offices	All	Medium-Term (3-5 years)	2	2	2	2	3	**11**	$1,000K	HMGP, Local	Existing
Provide emergency preparedness instructional materials to citizens *Earthquake, Extreme Temperature, Flood, Severe Weather, Tornadoes*	Jurisdictional Mayor's Offices/ County EMA	All	Ongoing This is an ongoing project that the county and its incorporated jurisdictions pursue continually.	2	2	3	3	2	**12**	$1K	HMGP, Local	Both New and Existing
Increase elevation on Indian Mound Road (near HWY 46) *Flood*	County Highway Department	County	Long-Term (5-10 years)	2	1	2	1	3	**9**	$500K	HMGP, Local	Existing
Increase elevation on Mary Trailor Road	County Highway Department	County	Long-Term (5-10 years)	2	1	2	1	3	**9**	$500K	HMGP, Local	Existing

Flood												
Increase elevation on Lower Cross Road/Grassy Hollow Road *Flood*	County Highway Department	County	Long-Term (5-10 years)	2	1	2	1	3	**9**	$500K	HMGP, Local	Existing

Chapter 4. Implementation, Integration, and Maintenance

This section provides an overview of the overall plan implementation, integration and maintenance strategy and outlines the method and schedule for monitoring, evaluating, and updating the plan. This section also discusses incorporating the plan into existing planning mechanisms and how to address continued public involvement.

4.1 Plan Adoption, Implementation, Monitoring, and Evaluation

4.1.1 Plan Adoption

The purpose of formally adopting this plan is to secure buy-in, raise awareness of the plan, and formalize the plan's implementation. This plan will be adopted by the appropriate governing body for each participating community. Copies of the executed resolutions are shown below.

Note to Reviewer: Executed resolutions will be inserted when they become available.

4.1.2 Implementation

Implementation and maintenance of the plan is critical to the overall success of hazard mitigation planning. This section provides an overview of the overall strategy for plan implementation and maintenance.

Mitigation is most successful when it is incorporated into the day-to-day functions and priorities of the government. Implementation will be accomplished by adhering to the schedules identified for each action and through constant, pervasive, and energetic efforts to network and highlight the multi-objective benefits to each program and the community. This effort is achieved through the routine actions of monitoring agendas, attending meetings, and promoting a safe, sustainable community. Additional mitigation strategies could include consistent and ongoing enforcement of existing policies and vigilant review of programs for coordination and multi-objective opportunities.

Simultaneous to these efforts, it is important to maintain constant monitoring of funding opportunities that can be leveraged to implement some of the more costly actions. This will include creating and maintaining a list of ideas on how to meet local match or participation requirements. When funding does become available, the communities will be able to capitalize on the opportunity due to the diligence of the HMPC. Funding opportunities to be monitored include special pre- and post-disaster funds, state and federal funds, benefit assessments, and other grant programs, including those that can serve or support multi-objective applications.

Elected officials, officials appointed to head community departments and community staff are charged with the implementation of various activities in the plan. Recommendations will be made to modify timeframes for the completion of activities, funding resources, and responsible entities. On an annual basis, the priority standing of various activities may also be changed. Some activities that are found unachievable may be removed from the plan

entirely and activities addressing problems unforeseen during plan development may be added.

4.2 Integration into Local Planning Mechanism

A vital implementation mechanism that is highly effective and low-cost is the incorporation of the Hazard Mitigation Plan recommendations and their underlying principles into other plans and tools. All plan participants will use existing methods and programs to implement hazard mitigation actions where possible. As previously stated, mitigation is most successful when it is incorporated into government and public service's day-to-day functions and priorities. This plan builds upon the momentum developed through previous and related planning efforts and mitigation programs and recommends implementing actions, where possible, through these other program mechanisms. These existing mechanisms include:

- Regularity Capabilities
- Administrative Capabilities
- Fiscal Capabilities

For further information regarding the different capabilities refer to Chapter 3 – Mitigation Strategy.

No planning mechanisms were developed or updated after development of the previous plan. Opportunities to implementation and incorporation into future planning mechanisms will be conducted by respective planning authorities and will be done through the routine actions of:

- Monitoring other planning/program agendas;
- Attending other planning/program meetings;
- Participating in other planning processes; and
- Monitoring community budget meetings for other community program opportunities.

The successful implementation of this mitigation strategy will require constant and vigilant review of existing plans and programs for coordination and multi-objective opportunities that promote a safe, sustainable community. Efforts should continuously be made to monitor the progress of mitigation actions implemented through other planning mechanisms. Where appropriate, priority actions should be incorporated into Hazard Mitigation Plan updates.

4.3 Monitoring, Evaluating, Updating

For the Hazard Mitigation Plan update review process, the Stewart County Emergency Management Agency Director will be responsible for facilitating, coordinating, and scheduling reviews and maintenance of the plan. The review of the Hazard Mitigation Plan will be conducted as follows:

- The Stewart County Emergency Management Agency will be responsible for leading the meeting to review the plan.
- Notices will be emailed to the members of the HMPC, federal, state, and local agencies, non-profit groups, local planning agencies, and representatives of business interests, neighboring communities, and others advising them of the date, time, and place for the review.
- Local City officials will be notified by email or phone call.
- Before the review, department heads and others tasked with implementing various projects/actions will be queried concerning progress in their area of responsibility and asked to present a report at the review meeting.
- A copy of the current plan will be available for public comment.
- After the review meeting, a status report will be developed outlining the implementation of projects over the past year.

Criteria for Annual Reviews

The criteria recommended for annual reviews will include the following:

- Community growth or change in the past year to include residential, commercial, and industrial growth trends.
- The number of substantially damaged or improved structures by flood zone and review of jurisdictional NFIP membership.
- Renovations to public infrastructure, including water, sewer, drainage, roads, bridges, gas lines, and buildings.
- Natural hazard occurrences that required activation of the Emergency Operations Center (EOC) and whether the event resulted in a presidential disaster declaration.
- Natural hazard occurrences that were not of a magnitude to warrant activation of the EOC or a federal disaster declaration but were severe enough to cause damage in the community or closure of businesses, schools, or public services.
- The dates of hazardous events, narratives, and documented damages.
- Closures of places of employment or schools and the number of days closed.
- Road or bridge closures due to the hazard and the length of time closed.
- Assessment of the number of private and public buildings damaged and whether the damage was minor, substantial, major, or if buildings were destroyed. The assessment will include residences, mobile homes, commercial structures, industrial structures, and public buildings, such as schools and public safety buildings.
- Review of any changes in federal, state, and local policies to determine the impact of these policies on the community and how and if the policy changes can or should be incorporated into the Hazard Mitigation Plan.
- Review of the implementation status of projects/actions (mitigation strategies). The reason for delay will be discussed for any projects that are behind schedule or not yet started.

4.3.1 Continued Public Involvement

Continued public involvement is imperative to the overall success of the plan's implementation. The update process provides an opportunity to solicit participation from new and existing stakeholders, publicize mitigation success stories, and seek additional public comment. The plan maintenance and update process will include continued public and stakeholder involvement and input through attendance at designated committee meetings, web postings, press releases to local media, and public hearings.

Public Involvement Process for Annual Reviews

The public will be notified via the Stewart County website or any other form of a publicized social platform (i.e., local newspaper, Facebook, Twitter) well in advance of any public meetings or comment periods.

Public Involvement for Five-year Update

When the HMPC reconvenes for the five-year update, they will coordinate with all stakeholders participating in the planning process—including those that joined the committee since the planning process began—to update and revise the plan. In reconvening, the HMPC will develop a plan for public involvement and will be responsible for disseminating information through various media channels detailing the plan update process. As part of this effort, public meetings will be held, and public comments will be solicited on the plan update draft.

APPENDIX A

Planning Documentation

Sign In Sheet
Stewart **County Hazard Mitigation Planning Meeting**
Date: 10-21-2023

Name	Title	Department	Email Address	Phone Number
Autumn Jarrow	Planner	TEMA	autumn.jarrow@tn.gov	
Clint Mathis	EMA Director	SCEMA	cmathis@stewartcogov.com	931 627 6919
Joe Campbell	EMA Deputy Dir	SCEMA	jcampbell@stewartcogov.com	931 305 8836

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Stewart
Sign In Sheet
County Hazard Mitigation Planning Meeting
Date: 8/9/2023

Name	Title	Agency/Org	Email Address	Phone Number
Ronnie Sumner	Hwy Dept			931-232-5477
Rodney Grimsley	Deputy Director	Montgomery Co EMA	RGrimsley@mcgtn.net	931 648-5702
Clint Mathis	EMA Director	Stewart Co EMA	cmathis@stewartcogov.com	931 232-8332
JEFF BINGHAM	CODES / Dover	Town of Dover	JBINGHAM@DoverTN.com	931-232-5907
Charles Parks	City Admin.	Town of Dover	CParks@doverTN.com	931-232-5907
James Hunter	DC	TEMA	James.r.hunter@tn.gov	629-867-4787
Jeff Walker	Deputy Chief	SCFR	jbwalker9972@yahoo.com	9310627-0285
Eric Watkins	SCBOE	SCBOE	ericwatkins@stewartcountyschools	931-249-4921
Robert Beecham	Stewart Co Mayor	Stewart County	rsbeecham22@gmail	931-627-2800
Greg Barrow	StewartCo EMS	Stewart County	stewartcoems@yahoo.com	931-320-5785
Jont Bumpus	Stewart Co EMS	Stewart Co.	jbumpusscems@Yahoo.com	931-627-2419
Lee Smith	Chief COPD	Cumberland COPD	cumberlandcitypd@gmail.com	931-534-8799
Melissa Fields	County Commissioner Coalition Director	Stewart County Rev Coal	Stewartcountytasa@gmail.com	931-249-3811
Dale Ward	Chief Dep.	Stewart Co. Sheriff	dward@stewartcogov.com	931-232-6863
Jeff Hancock	NRPS	USACE	Jeffrey.C.Hancock@usace.army.mil	931-232-7724

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Sign In Sheet
Stewart County Hazard Mitigation Planning Meeting
Date: 8/9/2023

Name	Title	Agency/Org	Email Address	Phone Number
Joe Campbell	Deputy Director	Stewart Co. EMA	jcampbell@stewartcountytn.com	9312328332
Autumn Joarow	Planner	TEMA	autumn.joarow@tn.gov	

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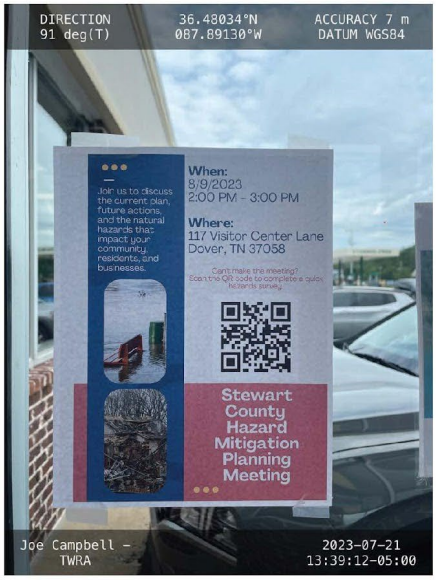
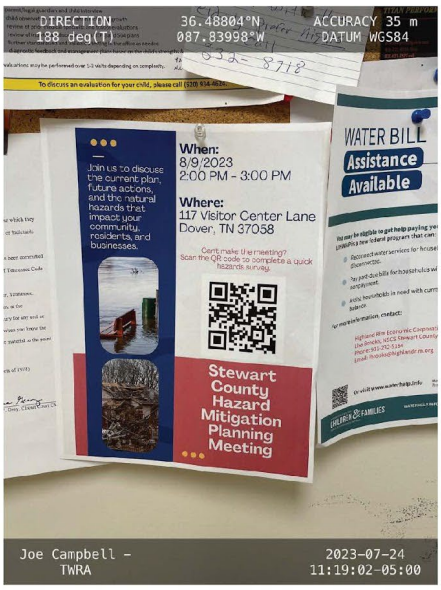
Sign In Sheet
Stewart County Hazard Mitigation Planning Meeting (Public)
Date: 8/9/23

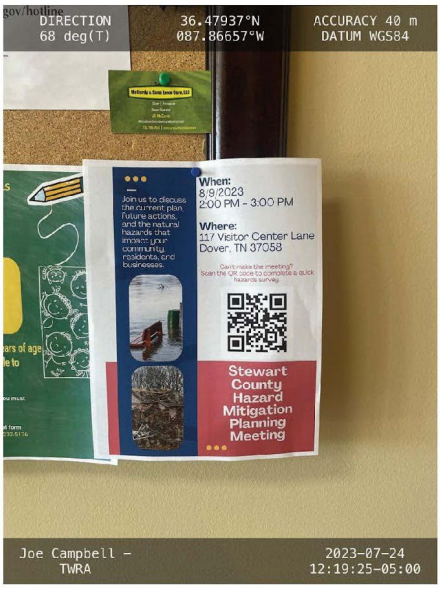
Name	Title	Agency/Org	Email Address	Phone Number
Clint Mathis	EMA Director	Stewart Co EMA	cmathis@stewartcountytn.com	931 232 8332
Joe Campbell	Deputy Director	Stewart Co EMA	jcampbell@stewartcountytn.com	931 232 8332
Robert Blechman	SC Mayor	Stewart County	rsblechman22@gmail	954-627-2801
Levi Page	Reporter	Stewart Co. Standard	news@stewartcountystandard.com	931-232-3801
Autumn Joarow	Planner	TEMA		

Page ___ of ___

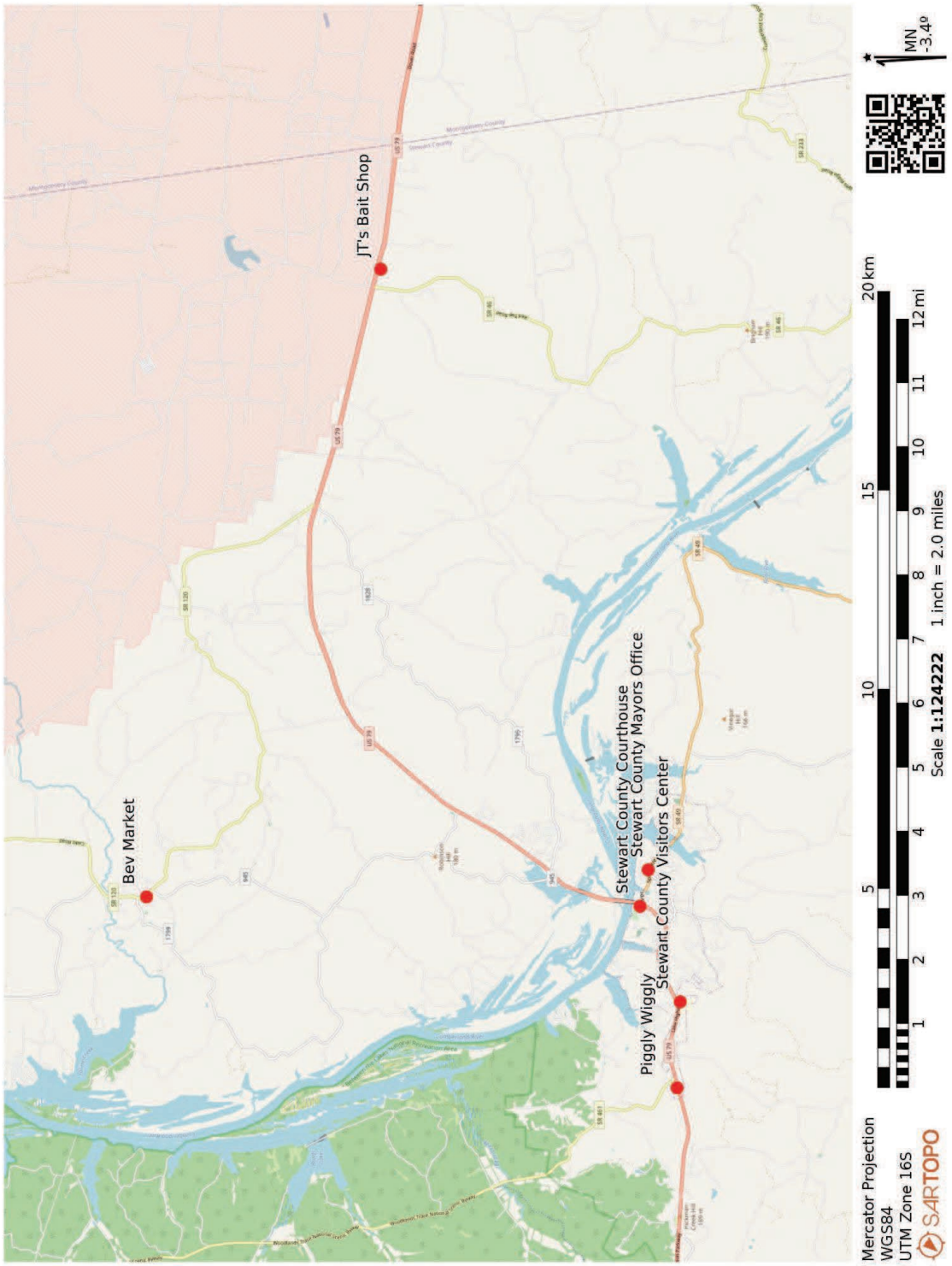
Stewart County HMP Meeting notices







Location	Address	Coordinates	Date flyer placed
Bev Market	3035 TN-120, Bumpus Mills, TN 37028	36.59950, -87.83729	7/24/2023
JT Bait Shop	3162 US-79, Indian Mound, TN 37079	36.54671, -87.66109	7/24/2023
Piggly Wiggly	1536 Donelson Pkwy, Dover, TN 37058	36.47977, -87.89101	7/21/2023
Stewart County Court House	225 Donelson Pkwy, Dover, TN 37058	36.48808, -87.84003	7/24/2023
Stewart County Mayors Office	226 Lakeview Dr, Dover, TN 37058	36.48622, -87.82969	7/21/2023
Stewart County Visitors Center	117 Visitor Cener Ln, Dover, TN 37058	36.47905, -87.86675	7/24/2023


JT's Bait Shop
Bev Market
Stewart County Courthouse
Stewart County Mayors Office
Stewart County Visitors Center
Piggly Wiggly
MN
-3.4°
20 km
12 mi
Scale 1:124222
1 inch = 2.0 miles
Mercator Projection
WGS84
UTM Zone 16S
SARTOPO

PUBLIC NOTICE

The Stewart County Hazard Mitigation Planning Committee will meet on **August 9, 2023 at 2:00pm** at the Stewart County Visitors Center, 117 Visitors Center Lane in Dover. The purpose of the meeting is to gather public input during the update of the Stewart County Hazard Mitigation Plan. The meeting is open to the public. The plan includes Stewart County, Town of Dover and Cumberland City.

Insertion Date: August 1, 2023

CLASSIFIEDS

PUBLIC NOTICE

NOTICE OF MEETING

Public Notice

NOTICE

SELL IT IN THE STANDARD!!

SERVICES

FOR SALE

Cub Cadet of Dover

931-232-7207

JACKSON HAULING

CALL TODAY 931-232-8422

PUBLIC FORUM:

Commentary From Our Readers

Roadwork Projects in Stewart County

FREE Yard Sale Kit

Joe Campbell

From: joecampbell@stewartcogov.com
Sent: Monday, August 07, 2023 1:23 PM
To: cparks@dovertn.com; cumberlandcitypd@gmail.com; rsbeecham22@gmail.com; ericwatkins@stewartcountyschools.org
Cc: Clint Mathis; Joe Campbell
Subject: Hazard Mitigation Plan - Jurisdiction representative meeting August 9 2023 at 10am

Eric, Charles, Ricky and Boo

Reminder of the Hazard Mitigation Plan - Jurisdiction representative meeting Wednesday, August 9 at 10am in the basement at 911.

A representative from Stewart County Government, School System, Town of Cumberland City and Town of Dover is required.

Please let Clint or me know if you have any questions.

Look forward to seeing you then.

Joe

Mike, Charles, Rick and Boo

Every five years, Stewart County is required to update our Hazard Mitigation Plan which identifies our community's notable risk and specific vulnerabilities and then creates/implements corresponding mitigation projects to address those areas of concerns.

The review process requires a representative from each of the following jurisdictions: Stewart County, Town of Dover, Town of Cumberland City and Stewart County Board of Education.

We have scheduled a meeting on **August 9, 2023 at 10am in the basement EOC at the Stewart County Emergency Communications Center, 117 Donelson Parkway in Dover**.

Please make plans for you or your designee to attend the meeting as we work to make Stewart County a more resilient community.

Please reach out to Clint or myself if you have any additional questions.

Joe

1

Joe Campbell

From: joecampbell@stewartcogov.com
Sent: Monday, August 07, 2023 1:16 PM
To: stewartsrcitizen@bellsouth.net; stewartcountychamber@gmail.com; dale.popp@houstonco911.com; eebaggett@montgomerycountytn.org; stewartcountyasap@gmail.com; fgray@stewartcogov.com; dward@stewartcogov.com; stewartcoems@yahoo.com; ethan.luffman@gmail.com; rsumner@stewartcogov.com; Jeffrey.C.Hancock@usace.army.mil; wmgraydom@gmail.com
Cc: Clint Mathis; Joe Campbell
Subject: Hazardous Mitigation Planning- Stakeholder meeting August 9 2023 at 10am.

Good afternoon all

Reminder of the Stewart County Hazard Mitigation Planning - Stakeholder meeting August 9, 2023 at 10am in the basement EOC of the Stewart County Emergency Communications Center.

Hope to see you then.

Joe

From: Joe Campbell <joecampbell@stewartcogov.com>
Sent: Monday, July 24, 2023 3:56 PM
To: 'Sandra Foust' <stewartsrcitizen@bellsouth.net>; william@jstba.com; stewartcountychamber@gmail.com; dale.popp@houstonco911.com; eebaggett@montgomerycountytn.org; stewartcountyasap@gmail.com; fgray@stewartcogov.com; dward@stewartcogov.com; 'Greg Barrow' <stewartcoems@yahoo.com>; 'Ethan Luffman' <ethan.luffman@gmail.com>; rsumner@stewartcogov.com; 'Hancock, Jeffrey C CIV USARMY CELRN (US)' <Jeffrey.C.Hancock@usace.army.mil>
Cc: 'Clint Mathis' <cmathis@stewartcogov.com>; jcampbell@stewartcogov.com; 'Autumn Joanow' <Autumn.Joanow@tn.gov>
Subject: Stewart County Hazard Mitigation Planning - Stakeholder meeting August 9, 2023 10am

Good afternoon

Every five years, Stewart County is required to update our Hazard Mitigation Plan which identifies our community's notable risk and specific vulnerabilities and then creates/implements corresponding mitigation projects to address those areas of concerns.

As a stakeholder in our community, we would like to invite your participation in the review and update of our Hazard Mitigation Plan.

We have scheduled a meeting on **August 9, 2023 at 10am in the basement EOC at the Stewart County Emergency Communications Center, 117 Donelson Parkway in Dover**.

We hope that you are able to attend this meeting as we make Stewart County a more resilient community.

Please reach out to Clint or myself if you have any additional questions.

Joe

1

HMP stakeholder and jurisdictional representative invitees		
Sandra Foust	Stewart County Senior Citizens Center	stewartsrcitizen@bellsouth.net
Angie Smith	Stewart County Chamber of Commerce	stewartcountychamber@gmail.com
William Gray	Good Samaritins	wmgraydom@gmail.com
Frankie Gray	Stewart County Sheriff Office	fgray@stewartcogov.com
Dale Ward	Stewart County Sheriff Office	dward@stewartcogov.com
Greg Barrow	Stewart County EMS	stewartcoems@yahoo.com
Ethan Luffman	Stewart County Fire Rescue	ethan.luffman@gmail.com
Ronnie Summer	Stewart County Road Department	rsumner@stewartcogov.com
Jeff Hancock	US Army Corp of Engineers	Jeffrey.C.Hancock@usace.army.mil
Dale Popp	Houston County EMA	dale.popp@houstonco911.com
Ed Baggett	Montgomery County EMA	eebaggett@montgomerycountytn.org
Melissa Fields	Stewart County Drug Coalition	stewartcountyasap@gmail.com
Robert Beecham	Stewart County Mayor	rsbeecham22@gmail.com
Charles Parks	City of Dover	cparks@dovertn.com
Ricky Smith	Town of Cumberland City	cumberlandcitypd@gmail.com
Eric Watkins	Stewart County School System	ericwatkins@stewartcountyschools.org

2

APPENDIX B

County Overview

STEWART COUNTY

2023 COMMUNITY DATA PROFILE

QUICK FACTS

County Seat	Dover
Year Incorporated	1903
Land Area in Square Miles (County)	459
Water Area in Square Miles (County)	34
Latitude	N36° 23.61'
Longitude	W87° 38.19'
Elevation	390'
Market Region	Nashville
Distance From Nashville	77 miles
Distance From Clarksville	18 miles
Time Zone	Central
County Website	www.stewartcogov.com
Additional Incorporated Cities within the County	Cumberland City
Unincorporated Cities	Big Rock, Bumpus Mills, Indian Mound

POPULATION

	County
2020 (Census)	13,657
2022 Population	13,628
2022 Median Age	45.6
2027 Population Projection	13,637
Annual Growth Rate (2022-2027 Projected)	0.01%

Source: ESRI

CLIMATE

Annual Average Temperature	58.0° F
Average High Temperature	68.3° F
Average Low Temperature	47.7° F
Annual Average Precipitation	52.63"
Annual Average Snowfall	6.0"
Prevailing Winds	Southerly
Mean Length of Freeze-Free Period (days)	180-220

TAX STRUCTURE

LOCAL — County

Property Taxes (2022)
- Rate per $100 value: $2.3607

Ratio of Assessment
- Residential and Farm: 25%
- Commercial/Industrial: 40%
- Personal (Equipment): 30%

Total Local Assessment (2021)	$289,911,647
Hotel-Motel Tax	5%
Motor Vehicle Wheel Tax Rate	$35.00

Source: Tennessee Comptroller of the Treasury, Division of Property Assessments
Source: County Technical Assistance Service, UTIP

STATE

Sales Tax
- 4% tax on food and food ingredients
- 7% on all other tangible personal property unless specifically exempted

Local Sales Tax Rate
- 2.25%

Local and State Sales Tax Collected (FY2022)
- $12,946,069

Income Tax
- **Personal:** Repealed beginning January 1, 2021
- **Corporate Excise Tax:** 6.5% of Tennessee taxable income
- **Franchise Tax:** .25% of the greater of the Tennessee portion of net worth or the book value of real and tangible property in Tennessee. The minimum tax is $100
- **Unemployment Tax:** New employers is typically 2.7% (based on occupation) of first $7,000

Source: Tennessee Department of Revenue

2023 COMMUNITY DATA PROFILE

EDUCATION

District Name	Stewart County
Type of Public School System	County
District Grades Served	Pre-K-12
Number of Schools	6
Number of Classroom Teachers	127
Student to Teacher Ratio	15:1
Additional Staff	19
Total Number of Students	1,922
Number of Private Schools	0
Total Number of Students	0
Number of Teachers	0
Number of High School Graduates (2022)	174
Graduation Rate	98.9%
Educational Attainment with a Degree (Adults Age 25+)	25.4%

Source: Tennessee Department of Education

REGIONAL HIGHER EDUCATIONAL INSTITUTIONS (within 30 miles)

• Austin Peay State University	Clarksville
• Hussain College-Daymar College	Clarksville
• TN College of Applied Technology	Dickson

Source: National Center for Education Statistics

FastTrack Job Training Assistance Program Available	Yes

Source: Tennessee Department of Economic and Community Development

GOVERNMENT

GOVERNING BODY

County	Mayor and County Commissioners Meets 2nd Monday, Jan/Apr/Jul/Oct at 7:00 p.m. Stewart County Visitor Center

Fire Department	County
• Full-time fire fighters in county	0
• County volunteers	75
• Fire stations in county	9
• County fire trucks	20
• Fire rescue boats	3
• Fire rescue ATV's	2

Law Enforcement	
• Full-time police officers in county & sheriff	25
• County patrol cars	32
•School resource officers	5

	County
Insurance Rating	6
Zoning Regulations	No
Planning Commission	No
Industrial Development Corp.	Yes

TRANSPORTATION

AIR SERVICE

Nearest General Aviation	Outlaw Field (Clarksville)
Location Identifier	CKV
Distance from Cumberland City	27 miles
Runway Length	6,000 feet and 4,004 feet
Surface	Asphalt
Lighting	MIRL/N/VASI
Fuel	100LL/Jet A
Repairs	Major
Storage	Hangar, Tie Down
Transportation	Taxi, Rental and Courtesy Car
Nearest Commercial Service	Nashville International Airport
Location Identifier	BNA
Distance from Cumberland City	72 miles

Nashville International Airport (BNA) serves approximately 17 million total passengers annually. BNA is currently served by 22 major carriers, including international carriers. BNA offers 585+ daily flights and provides nonstop air service to more than 101 destinations.

HIGHWAYS

U.S. Highways	79
State Highways	46, 149, 233, 434
Nearest Interstate	28 miles to I-24 and I-40

COMMON CARRIERS

Air Freight Companies	None
Motor Freight Companies	None
Terminal Facilities	None
Bus Services	
Inter-City	No
Local	No
Carrier Service	No
Cumberland City Ferry	Yes

RAILROADS SERVED BY

RJ Corman Railroad

NAVIGABLE WATERWAYS

River	Tennessee & Cumberland Rivers
Channel Depth	50 feet; 20 feet
Nearest Port Facility	South Pittsburgh, TN; Paducah, KY
Miles from Port	50

COMMUNICATIONS

Newspapers	The Tennessean The Stewart-Houston Times The Leaf Chronicle Stewart County Standard
Telephone Companies	AT&T
Radio Stations	WTPR-101.7; WCVQ-107.9
Television Networks	10
Cable Service Available	Yes
Channels	25+
Provider	Mediacom
Internet Service Available	Yes
Provider	Cumberland Connect, AT&T, Mediacom, HughesNet, Exede and Peoples Telephone DSL

STEWART COUNTY, TENNESSEE

2023 COMMUNITY DATA PROFILE

COMMUNITY FACILITIES *(countywide)*

Health Care	
Doctors	4
Dentists	3
Hospitals	0
Beds	0
Clinics	4
Nursing Homes	1
Beds	70
Retirement Homes	0
Beds	0
Residential Care/ Assisted Living	1
Beds	12

Religious Organizations	
Protestant	45
Catholic	1
Jehovah's Witness	1
Seventh Day Adventist	1
Latter Day Saints	1
Korean (Doalnara)	1
Islamic	1

Day Care Centers	1
Day Care Homes	4

Recreation	
Libraries	1
Parks	5
Golf Courses (Public & Private)	0
Swimming Pools (Public & Private)	0
Country Clubs	0
Theaters	0
Bowling Alleys	0

Hotels & Motels	2
Beds	33
Cabin Rentals	3
Beds	15
Airbnb	8
Beds	40
Bed & Breakfasts	1

Largest Meeting Room	
Capacity	275

Restaurants	25

FINANCIAL INSTITUTIONS

Banks:	Total Number of Institutions	3
	Total Number of Offices	4
	Deposits	250,000,000
Credit Unions:	Total Number of Branches	1
	Total Number of Offices	1
	Deposits	28,801,411
Countywide Combined Deposits		$278,801,411
(Deposits for June 30, 2022)		

Source: Federal Deposit Insurance Corporation and National Credit Union Administration

INDUSTRIAL SUPPORT SERVICES

Service	Location	Distance (Miles)
Tool & Die	Clarksville	28
Heat Treating	Clarksville	28
Foundry	Clarksville	28
Heavy Hardware	Clarksville	28
Sheet Metal	Clarksville	28
Lubricants	Clarksville	28
Welding Supplies	Nashville	77
Abrasives		

SELECTED ECONOMIC INDICATORS

2022 ANNUAL AVERAGES (AGE 16+)

Labor Force	County	Labor Market Area*
Population	11,418	191,901
Employed	5,908	96,990
Unemployed	231	5,016
Unemployment Rate	3.8%	4.9%

* Drive Time: 45 minute radius from Dover (County seat)

Source: ESRI

2022 EMPLOYED POPULATION 16+ BY INDUSTRY

Agriculture/Mining	1.3%
Construction	11.9%
Manufacturing	11.7%
Wholesale Trade	1.5%
Retail Trade	17.6%
Transportation/Utilities	9.1%
Information	0.5%
Finance/Insurance/Real Estate	2.5%
Services	34.8%
Public Administration	9.2%

Source: ESRI

MANUFACTURING IN AREA (Annual Averages 2021)

Number of Units	21
Ann. Avg. Employment	630
Ann. Avg. Weekly Wage	$888

Source: Tennessee Department of Labor and Workforce Development

PER CAPITA PERSONAL INCOME

Year	2022
Amount	$28,126

Source: ESRI

MEDIAN HOUSEHOLD INCOME

Year	2022
Amount	$51,035

Source: ESRI

AVERAGE HOME SALES

Year	2021
Number of Homes Sold	209
Average Cost	$176,279
2022 Median Home Value	$163,083

Source: Tennessee Housing Development Agency

RETAIL SALES

Year	2021
Amount	$109,940,981

Source: Tennessee Department of Revenue

NATURAL RESOURCES

Minerals: Limestone
Timber: Oak, hickory and poplar

AGRICULTURAL

Crops: Corn, tobacco, hay and soybeans
Livestock: Cattle

STEWART COUNTY, TENNESSEE

2023 COMMUNITY DATA PROFILE

UTILITIES

GAS

Local Distributor	Greater Dickson Gas Company
Phone	615.441.2830
Website	www.gdga.com/
Source Company	
Fuel Oil Suppliers	0
Suppliers of LP Gas	2

WATER

Water Supplier	City of Erin
Phone	931.289.4108
Website	www.erintn.org/
Source	Cumberland River
Capacity	910,520 GPD
Current Consumption	65,000 GPD
Storage Capacity	500,000 Gallons

WATER

Water Supplier	City of Dover
Phone	931.232.6592
Website	www.dovertn.com
Source	Cumberland River
Capacity	1,000,000 GPD
Current Consumption	325,000 GPD
Storage Capacity	900,000 Gallons

SEWER

Sewer Provider	Town of Cumberland City
Phone	931.827.2000
Website	None at this time
Type of Treatment	Activated sludge-lagoon
Capacity	0.85 million GPD
Current Usage	34,000 GPD
City Sewer Coverage	85%
Storm Sewer Coverage	0%
Solid Waste Disposal Type	BFI

SEWER

Sewer Provider	City of Dover
Phone	931.232.5817
Website	www.dovertn.com
Type of Treatment	Sequential batch reactor
Capacity	1,000,000 GPD
Current Usage	200,000 GPD
City Sewer Coverage	100%
Storm Sewer Coverage	25%
Solid Waste Disposal Type	Dumpster/Bi-County (City-household pickup)

ELECTRICITY

Source Company	Tennessee Valley Authority

LOCAL POWER COMPANY (City and County)

Cumberland Electric Membership Corporation/
Cumberland Connect

General Manager	Chris Davis
Local Address	420 Spring Street Dover, Tennessee 37058
Phone	931.232.5153 (800) 987-CEMC (2362)
Fax	931.221.4027
Website	www.cemc.org

MAJOR INDUSTRIAL MANUFACTURERS/DISTRIBUTION

Firm	Product or Service	Total Employees	Union	Phone Number
Tennessee Valley Authority	Power plant	325	Yes	931.827.6000
Commercial Insulated Glass	Insulated glass	120	None	931.827.2011
Georgia Pacific	Gypsum wallboard	120	None	931.827.4600
Kauffman Engineering	Wire harness assembly services	80	None	931.827.4000
Nashville Wire Products Corp.	Wire display racks	125	None	888.743.2680
GH Armor Systems	Tactical body armor	45	None	931.232.5341
Williams Cabinet & Woodworking	Cabinetry	19	None	931.232.5863
Milton Lumber Co.	Sawmill	15	None	931.232.6646
Synthetic Materials	De-Water synthetic gypsum	14	None	931.827.4075
Tractor Supply Company	Home and garden store	14	None	931.348.0004
DDT Concrete	Ready-mixed concrete	12	None	
Cumberland City Plastics	Recycled plastics	12	None	931.827.2777
Houston County Mfg.	Machining	9	None	931.827.2100
Swift Sawmill	Sawmill	9	None	931.232.8871
SEFA	Markets flay ash	8	None	931.827.3088
Sinbon Technologies	Wire Harness	3	None	931.827.4006
IMI South LLC	Septic tanks & ready-mixed concrete	3	None	931.232.7001

For information on industrial sites and available industrial buildings contact:

Robert T. Bibb, Executive Director
Middle Tennessee Industrial
Development Association
2108 Westwood Avenue
Nashville, Tennessee 37212
Phone: 615.269.5233
mtida@mtida.org
www.mtida.org

Robert S. Beecham, County Mayor
Stewart County Mayor's Office
Post Office Box 487
Dover, Tennessee 37058
Phone: 931.232.3100
Fax: 931.232.3111

www.stewartcogov.com

Angie Smith, Director
Stewart County Chamber of Commerce
117 Visitor Center Drive
Dover, Tennessee 37058
Phone: 931.232.8290
Fax: 931.232.4973
stewartcountychamber@gmail.com
www.stewartcountychamber.com

MTIDA
MIDDLE TENNESSEE INDUSTRIAL DEVELOPMENT ASSOCIATION

MTIDA represents the Local Electric Power and Natural Gas Distributors located in the 40 county region of Middle Tennessee.

The information contained herein was obtained from sources we consider reliable. We can not be responsible, however, for errors or change in information.

STEWART COUNTY, TENNESSEE

Updated January 2023

APPENDIX C

Historical Hazard Data

Extreme Temperatures

Location	Date	Event Type	Deaths	Injuries	Property Damage	Crop Damages
STEWART (ZONE)	8/4/2010	Excessive Heat	0	0	0	0
STEWART (ZONE)	12/23/2022	Extreme Cold/Wind Chill	0	0	0	0
STEWART (ZONE)	6/30/2023	Excessive Heat	0	0	0	0

Flood Events

Location	Date	Event Type	Deaths	Injuries	Property Damage	Crop Damage
NORTHEAST SECTIONS	7/21/1996	Flash Flood	0	0	0	0
SOUTHERN SECTIONS	2/4/1997	Flash Flood	0	0	0	0
COUNTYWIDE	3/1/1997	Flash Flood	0	0	0	0
COUNTYWIDE	3/1/1997	Flash Flood	0	0	0	0
BUMPUS MILLS	3/1/1997	Flash Flood	0	0	0	0
COUNTYWIDE	3/2/1997	Flash Flood	0	0	0	0
COUNTYWIDE	3/2/1997	Flash Flood	0	0	0	0
DOVER	6/5/1998	Flash Flood	0	0	0	0
CUMBERLAND CITY	6/5/1998	Flash Flood	0	0	0	0
COUNTYWIDE	1/22/1999	Flash Flood	0	0	0	0
COUNTYWIDE	4/17/2000	Flash Flood	0	0	0	0
COUNTYWIDE	2/16/2001	Flash Flood	0	0	0	0
	11/27/2001	Flood	0	0	0	0
COUNTYWIDE	11/29/2001	Flash Flood	0	0	0	0
SOUTHWEST PORTION	11/29/2001	Flash Flood	0	0	0	0
	12/12/2001	Flood	0	0	0	0
COUNTYWIDE	1/24/2002	Flash Flood	0	0	0	0
COUNTYWIDE	3/20/2002	Flash Flood	0	0	0	0
DOVER	5/17/2002	Flash Flood	0	0	0	0
COUNTYWIDE	9/26/2002	Flash Flood	0	0	0	0
INDIAN MOUND	12/19/2002	Flash Flood	0	0	0	0
	12/19/2002	Flood	0	0	0	0
DOVER	5/10/2004	Flash Flood	0	0	1000	0
DOVER	5/10/2004	Flash Flood	0	0	1000	0
INDIAN MOUND	5/9/2009	Flash Flood	0	0	150000	0
CARLISLE	5/1/2010	Flood	2	0	100000	0
BEAR SPG	4/27/2011	Flash Flood	0	0	1000	0
NEW HAVEN	5/2/2011	Flash Flood	0	0	5000	1000
BUMPUS MILLS	12/4/2011	Flood	0	0	0	0

TOBACCOPORT	4/27/2013	Flash Flood	0	1	10000000	0
FT HENRY	2/21/2015	Flood	0	0	0	0
BIG ROCK	2/2/2016	Flood	0	0	10000	0
BIG ROCK	7/7/2016	Flash Flood	0	0	3000000	500000
MODEL	12/23/2017	Flash Flood	0	0	0	0
DOVER	2/28/2021	Flash Flood	0	0	0	0
DOVER	6/2/2021	Flash Flood	0	0	10000	0
DOVER	8/21/2021	Flash Flood	0	0	20000	0
DOVER	2/22/2022	Flood	0	0	0	0
NEW HAVEN	2/16/2023	Flash Flood	0	0	0	0
FT HENRY	2/16/2023	Flash Flood	0	0	0	0

Severe Weather

Thunderstorm

Location	Date	Event Type	Deaths	Injuries	Property Damage	Crop Damage
BUMPUS MILLS	3/10/2013	Heavy Rain	0	0	0	0
CUMBERLAND CITY	2/4/2014	Heavy Rain	0	0	0	0
BUMPUS MILLS	7/6/2016	Heavy Rain	0	0	0	0

Wind

Location	Date	Event Type	Deaths	Injuries	Property Damage	Crop Damage
	7/7/1966	Thunderstorm Wind	0	0	0	0
	12/10/1971	Thunderstorm Wind	0	0	0	0
	7/5/1985	Thunderstorm Wind	0	0	0	0
	5/12/1992	Thunderstorm Wind	0	0	0	0
	6/25/1992	Thunderstorm Wind	0	0	0	0
	5/18/1995	Thunderstorm Wind	0	0	1000	0
DOVER	6/6/1995	Thunderstorm Wind	0	0	5000	0
DOVER	7/22/1995	Thunderstorm Wind	0	0	10000	0
ASHBURY	8/8/1995	Thunderstorm Wind	0	0	1000	0
DOVER	1/18/1996	Thunderstorm Wind	0	0	100	0
DOVER	4/20/1996	Thunderstorm Wind	0	0	1000	0
INDIAN MOUND	5/27/1996	Thunderstorm Wind	0	0	0	0
INDIAN MOUND	6/3/1996	Thunderstorm Wind	0	0	0	0
DOVER	6/11/1996	Thunderstorm Wind	0	0	1000	0
COUNTYWIDE	2/21/1997	Thunderstorm Wind	0	0	0	0
COUNTYWIDE	2/21/1997	Thunderstorm Wind	0	0	0	0
BIG ROCK	5/19/1997	Thunderstorm Wind	0	0	0	0
DOVER	5/26/1997	Thunderstorm Wind	0	0	1000	0
DOVER	6/13/1997	Thunderstorm Wind	0	0	0	0
DOVER	6/21/1997	Thunderstorm Wind	0	0	0	0
BUMPUS MILLS	6/21/1997	Thunderstorm Wind	0	0	0	0
INDIAN MOUND	6/30/1997	Thunderstorm Wind	0	0	1000	0
INDIAN MOUND	7/4/1997	Thunderstorm Wind	0	0	1000	0
BUMPUS MILLS	7/14/1997	Thunderstorm Wind	0	0	0	0

DOVER	7/14/1997	Thunderstorm Wind	0	0	0	0
DOVER	4/16/1998	Thunderstorm Wind	0	0	0	0
DOVER	5/21/1998	Thunderstorm Wind	0	0	0	0
DOVER	5/31/1998	Thunderstorm Wind	0	0	0	0
CARLISLE	6/5/1998	Thunderstorm Wind	0	0	0	0
DOVER	6/12/1998	Thunderstorm Wind	0	0	0	0
COUNTYWIDE	1/17/1999	Thunderstorm Wind	0	0	0	0
DOVER	1/22/1999	Thunderstorm Wind	0	0	15000	0
DOVER	2/11/1999	Thunderstorm Wind	0	0	0	0
SOUTHEAST PORTION	2/11/1999	Thunderstorm Wind	0	0	0	0
COUNTYWIDE	7/1/1999	Thunderstorm Wind	0	0	0	0
COUNTYWIDE	5/23/2000	Thunderstorm Wind	0	0	0	0
CUMBERLAND CITY	5/27/2000	Thunderstorm Wind	0	0	0	0
BUMPUS MILLS	2/24/2001	Thunderstorm Wind	0	0	0	0
COUNTYWIDE	5/20/2001	Thunderstorm Wind	0	0	0	0
DOVER	7/5/2001	Thunderstorm Wind	0	0	0	0
DOVER	7/18/2001	Thunderstorm Wind	0	0	0	0
DOVER	8/26/2001	Thunderstorm Wind	0	0	0	0
CUMBERLAND CITY	10/24/2001	Thunderstorm Wind	0	0	0	0
DOVER	11/27/2001	Thunderstorm Wind	0	0	20000	0
BIG ROCK	11/27/2001	Thunderstorm Wind	0	0	0	0
COUNTYWIDE	1/24/2002	Thunderstorm Wind	0	0	0	0
CARLISLE	4/28/2002	Thunderstorm Wind	0	0	0	0
INDIAN MOUND	11/10/2002	Thunderstorm Wind	0	0	0	0
WEST PORTION	5/1/2003	Thunderstorm Wind	0	0	0	0
DOVER	5/4/2003	Thunderstorm Wind	0	0	10000	0
DOVER	5/6/2003	Thunderstorm Wind	0	0	0	0
DOVER	5/11/2003	Thunderstorm Wind	0	0	0	0
DOVER	6/11/2003	Thunderstorm Wind	0	0	0	0
COUNTYWIDE	7/28/2003	Thunderstorm Wind	0	0	0	0
DOVER	7/4/2004	Thunderstorm Wind	0	0	0	0
DOVER	7/4/2004	Thunderstorm Wind	0	0	0	0
COUNTYWIDE	7/6/2004	Thunderstorm Wind	0	0	0	0
DOVER	8/26/2005	Thunderstorm Wind	0	0	0	0
DOVER	8/26/2005	Thunderstorm Wind	0	0	0	0
	8/30/2005	Strong Wind	0	0	1000	0
DOVER	11/6/2005	Thunderstorm Wind	0	0	0	0
NORTH PORTION	3/9/2006	Thunderstorm Wind	0	0	0	0
DOVER	4/2/2006	Thunderstorm Wind	0	0	20000	0
CUMBERLAND CITY	4/2/2006	Thunderstorm Wind	0	0	10000	0
DOVER	5/3/2006	Thunderstorm Wind	0	0	0	0
NORTHEAST PORTION	5/3/2006	Thunderstorm Wind	0	0	0	0
DOVER	5/30/2006	Thunderstorm Wind	0	0	0	0
DOVER	9/27/2006	Thunderstorm Wind	0	0	0	0
INDIAN MOUND	9/27/2006	Thunderstorm Wind	0	0	0	0
DOVER	6/2/2007	Thunderstorm Wind	0	0	500	0
SNIDER	10/18/2007	Thunderstorm Wind	0	0	0	20000
	1/29/2008	High Wind	0	0	5000	0

DOVER	2/5/2008	Thunderstorm Wind	0	0	1000	0
INDIAN MOUND	2/5/2008	Thunderstorm Wind	0	1	10000	0
CARLISLE	6/16/2009	Thunderstorm Wind	0	0	125000	0
DOVER	6/17/2009	Thunderstorm Wind	0	0	50000	0
INDIAN MOUND	7/4/2009	Thunderstorm Wind	0	0	10000	0
DOVER	8/4/2009	Thunderstorm Wind	0	0	20000	0
DOVER	9/6/2009	Thunderstorm Wind	0	0	2000	0
DOVER	9/6/2009	Thunderstorm Wind	0	0	30000	0
DOVER	9/6/2009	Thunderstorm Wind	0	0	0	0
CUMBERLAND CITY	9/6/2009	Thunderstorm Wind	0	0	10000	0
FT HENRY	4/24/2010	Thunderstorm Wind	0	0	9000	0
DOVER	4/24/2010	Thunderstorm Wind	0	0	3000	0
MODEL	5/1/2010	Thunderstorm Wind	0	0	250000	0
DOVER	6/17/2010	Thunderstorm Wind	0	0	25000	0
MODEL	10/26/2010	Thunderstorm Wind	0	0	5000	0
CARLISLE	2/24/2011	Thunderstorm Wind	0	0	50000	0
DOVER	2/28/2011	Thunderstorm Wind	0	0	5000	0
DOVER	4/19/2011	Thunderstorm Wind	0	0	12000	2000
WYATTS CHAPEL	4/25/2011	Thunderstorm Wind	0	0	2000	0
DOVER	4/25/2011	Thunderstorm Wind	0	0	25000	0
DOVER	5/13/2011	Thunderstorm Wind	0	0	1000	0
MODEL	5/25/2011	Thunderstorm Wind	0	0	10000	0
CUMBERLAND CITY	5/25/2011	Thunderstorm Wind	0	0	10000	0
FT HENRY	9/14/2011	Thunderstorm Wind	0	0	5000	0
DOVER	9/14/2011	Thunderstorm Wind	0	0	5000	0
CUMBERLAND CITY	1/22/2012	Thunderstorm Wind	0	0	5000	0
CUMBERLAND CITY	5/29/2012	Thunderstorm Wind	0	0	2000	0
THARPE	6/11/2012	Thunderstorm Wind	0	0	2000	0
WYATTS CHAPEL	8/1/2012	Thunderstorm Wind	0	0	0	0
INDIAN MOUND	8/1/2012	Thunderstorm Wind	0	0	10000	0
DOVER	9/6/2012	Thunderstorm Wind	0	0	1000	0
DOVER	1/30/2013	Thunderstorm Wind	0	0	5000	0
DOVER	6/26/2013	Thunderstorm Wind	0	0	1000	0
	10/31/2013	Strong Wind	0	0	5000	0
DOVER	10/31/2013	Thunderstorm Wind	0	0	2000	0
THARPE	12/21/2013	Thunderstorm Wind	0	0	10000	0
CARLISLE	12/21/2013	Thunderstorm Wind	0	0	2000	0
DOVER	6/23/2014	Thunderstorm Wind	0	0	5000	0
DOVER	5/26/2016	Thunderstorm Wind	0	0	1000	0
DOVER	6/15/2016	Thunderstorm Wind	0	0	2000	0
DOVER	7/6/2016	Thunderstorm Wind	0	0	2000	0
DOVER	7/6/2016	Thunderstorm Wind	0	0	3000	0
FT HENRY	7/8/2016	Thunderstorm Wind	0	0	3000	0
THARPE	7/8/2016	Thunderstorm Wind	0	0	2000	0
NEW HAVEN	7/8/2016	Thunderstorm Wind	0	0	1000	0
THROCKMORTON	7/8/2016	Thunderstorm Wind	0	0	1000	0
CARLISLE	7/14/2016	Thunderstorm Wind	0	0	1000	0
DOVER	12/17/2016	Thunderstorm Wind	0	0	1000	0
CUMBERLAND CITY	12/17/2016	Thunderstorm Wind	0	0	1000	0
BIG ROCK	3/1/2017	Thunderstorm Wind	0	0	3000	0

DOVER	3/9/2017	Thunderstorm Wind	0	0	2000	0
CARLISLE	3/20/2017	Thunderstorm Wind	0	0	15000	0
LEGATE	4/26/2017	Thunderstorm Wind	0	0	3000	0
FT HENRY	5/27/2017	Thunderstorm Wind	0	0	1000	0
NEW HAVEN	5/27/2017	Thunderstorm Wind	0	0	1000	0
	9/1/2017	Strong Wind	0	0	10000	0
CARLISLE	2/24/2018	Thunderstorm Wind	0	0	1000	0
BEAR SPG	4/3/2018	Thunderstorm Wind	0	0	2000	0
LEGATE	4/3/2018	Thunderstorm Wind	0	0	2000	0
	5/29/2018	Strong Wind	0	0	10000	0
DOVER	6/28/2018	Thunderstorm Wind	0	0	10000	0
WYATTS CHAPEL	6/28/2018	Thunderstorm Wind	0	0	3000	0
INDIAN MOUND	7/5/2018	Thunderstorm Wind	0	0	3000	0
CUMBERLAND CITY	7/5/2018	Thunderstorm Wind	0	0	5000	0
CUMBERLAND CITY	7/5/2018	Thunderstorm Wind	0	0	3000	0
SNIDER	12/31/2018	Thunderstorm Wind	0	0	5000	0
	3/14/2019	Strong Wind	0	0	1000	0
TOBACCOPORT	6/21/2019	Thunderstorm Wind	0	0	2000	0
FT HENRY	6/21/2019	Thunderstorm Wind	0	0	2000	0
DOVER	6/21/2019	Thunderstorm Wind	0	0	10000	0
DOVER	6/23/2019	Thunderstorm Wind	0	0	1000	0
CUMBERLAND CITY	10/26/2019	Thunderstorm Wind	0	0	20000	0
DOVER	1/11/2020	Thunderstorm Wind	0	0	6000	0
FT HENRY	3/28/2020	Thunderstorm Wind	0	0	3000	0
FT HENRY	5/3/2020	Thunderstorm Wind	0	0	0	0
DOVER	5/3/2020	Thunderstorm Wind	0	0	51160	0
DOVER	5/3/2020	Thunderstorm Wind	0	0	0	0
DOVER	5/4/2021	Thunderstorm Wind	0	0	10000	0
DOVER	6/12/2021	Thunderstorm Wind	0	0	2000	0
DOVER	7/31/2021	Thunderstorm Wind	0	0	3000	0
BUMPUS MILLS	12/6/2021	Thunderstorm Wind	0	0	5000	0
BIG ROCK	12/6/2021	Thunderstorm Wind	0	0	3000	0
DOVER	12/6/2021	Thunderstorm Wind	0	0	0	0
NEW HAVEN	12/6/2021	Thunderstorm Wind	0	0	3000	0
FT HENRY	3/30/2022	Thunderstorm Wind	0	0	5000	0
INDIAN MOUND	7/26/2022	Thunderstorm Wind	0	0	3000	0
STEWART (ZONE)	3/3/2023	High Wind	0	0	4000000	0

Hail

Location	Date	Magnitude (inches)	Deaths	Injuries	Property Damage	Crop Damages
	3/29/1974	1.5	0	0	0	0
	5/12/1992	1	0	0	0	0
DOVER	3/31/1993	0.75	0	0	0	0
DOVER	4/10/1994	0.88	0	0	50	0
DOVER	6/25/1994	0.75	0	0	0	0
BUMPUS MILLS	6/18/1995	0.75	0	0	100	0
BUMPUS MILLS	3/16/1996	0.75	0	0	0	0

DOVER	1/24/1997	0.75	0	0	0	0
DOVER	3/1/1997	0.88	0	0	0	0
DOVER	3/5/1997	0.75	0	0	0	0
BUMPUS MILLS	4/30/1997	0.75	0	0	0	0
CARLISLE	4/3/1998	0.75	0	0	0	0
DOVER	4/8/1998	0.75	0	0	0	0
DOVER	4/8/1998	1.5	0	0	0	0
CARLISLE	4/17/2000	0.75	0	0	0	0
BUMPUS MILLS	4/27/2000	1	0	0	0	0
CUMBERLAND CITY	5/4/2000	0.88	0	0	0	0
DOVER	5/13/2000	0.75	0	0	0	0
BUMPUS MILLS	7/10/2002	0.75	0	0	0	0
DOVER	5/5/2003	1	0	0	0	0
DOVER	5/5/2003	1.75	0	0	0	0
DOVER	3/27/2005	1.75	0	0	0	0
DOVER	4/7/2006	0.88	0	0	0	0
DOVER	4/7/2006	0.88	0	0	0	0
DOVER	5/3/2006	0.88	0	0	0	0
DOVER	5/30/2006	0.88	0	0	0	0
DOVER	2/20/2007	0.75	0	0	0	0
BUMPUS MILLS	2/20/2007	1	0	0	0	0
BUMPUS MILLS	4/3/2007	1.75	0	0	0	0
DOVER	2/27/2009	1	0	0	0	0
DOVER	3/28/2009	0.75	0	0	0	0
DOVER	4/5/2009	0.75	0	0	0	0
BUMPUS MILLS	5/8/2009	0.75	0	0	0	0
DOVER	6/17/2009	1	0	0	0	0
DOVER	6/26/2009	0.88	0	0	0	0
DOVER	9/6/2009	0.75	0	0	0	0
DOVER	1/21/2010	1	0	0	0	0
BUMPUS MILLS	5/25/2011	1	0	0	0	0
DOVER	6/15/2011	1	0	0	0	0
DOVER	9/25/2011	1	0	0	0	0
WYATTS CHAPEL	8/1/2012	1	0	0	0	0
CUMBERLAND CITY	5/10/2016	1	0	0	0	0
INDIAN MOUND	2/7/2017	0.88	0	0	0	0
DOVER	3/28/2020	1.75	0	0	0	0
DOVER	4/8/2020	1	0	0	0	0
INDIAN MOUND	7/12/2020	0.75	0	0	0	0
DOVER	5/21/2022	0.88	0	0	0	0

Lighting

Location	Date	Event Type	Deaths	Injuries	Property Damage	Crop Damages
DOVER	5/29/2012	Lighting	0	0	10K	0
CARLISLE	4/27/2013	Lighting	0	1	0	0
FT HENRY	7/14/2016	Lighting	1	0	0	0

Winter Weather

Location	Date	Event Type	Deaths	Injuries	Property Damage	Crop Damages
STEWART (ZONE)	1/6/1996	Winter Storm	0	0	0	0
STEWART (ZONE)	1/6/1996	Winter Storm	0	0	0	0
STEWART (ZONE)	12/13/2000	Winter Storm	0	0	0	0
STEWART (ZONE)	12/4/2002	Winter Storm	0	0	0	0
STEWART (ZONE)	12/22/2004	Winter Storm	0	0	0	0
STEWART (ZONE)	3/7/2008	Winter Storm	0	0	0	0
STEWART (ZONE)	12/15/2008	Winter Weather	0	0	0	0
STEWART (ZONE)	12/23/2008	Winter Weather	0	0	0	0
STEWART (ZONE)	2/14/2010	Winter Weather	0	0	0	0
STEWART (ZONE)	12/15/2010	Winter Weather	0	0	0	0
STEWART (ZONE)	12/24/2010	Winter Weather	0	0	0	0
STEWART (ZONE)	1/10/2011	Winter Weather	0	0	0	0
STEWART (ZONE)	1/20/2011	Winter Weather	0	0	0	0
STEWART (ZONE)	11/29/2011	Winter Weather	0	0	0	0
STEWART (ZONE)	1/12/2012	Winter Weather	0	0	0	0
STEWART (ZONE)	1/25/2013	Winter Weather	0	0	10000	0
STEWART (ZONE)	2/2/2014	Winter Weather	0	0	0	0
STEWART (ZONE)	2/7/2014	Winter Weather	0	0	0	0
STEWART (ZONE)	3/2/2014	Winter Storm	0	0	0	0
STEWART (ZONE)	1/23/2015	Winter Weather	0	0	0	0
STEWART (ZONE)	2/16/2015	Winter Storm	0	0	0	0
STEWART (ZONE)	2/18/2015	Winter Weather	0	0	0	0
STEWART (ZONE)	2/20/2015	Winter Storm	0	0	50000	0
STEWART (ZONE)	3/4/2015	Winter Storm	0	0	0	0
STEWART (ZONE)	1/9/2016	Winter Weather	0	0	0	0
STEWART (ZONE)	1/20/2016	Winter Weather	0	0	0	0
STEWART (ZONE)	1/21/2016	Winter Storm	0	0	10000	0
STEWART (ZONE)	2/8/2016	Winter Weather	0	0	0	0
STEWART (ZONE)	3/11/2017	Winter Weather	0	0	0	0
STEWART (ZONE)	1/12/2018	Winter Storm	0	0	0	0
STEWART (ZONE)	1/15/2018	Winter Storm	0	0	0	0
STEWART (ZONE)	11/14/2018	Winter Weather	0	0	0	0

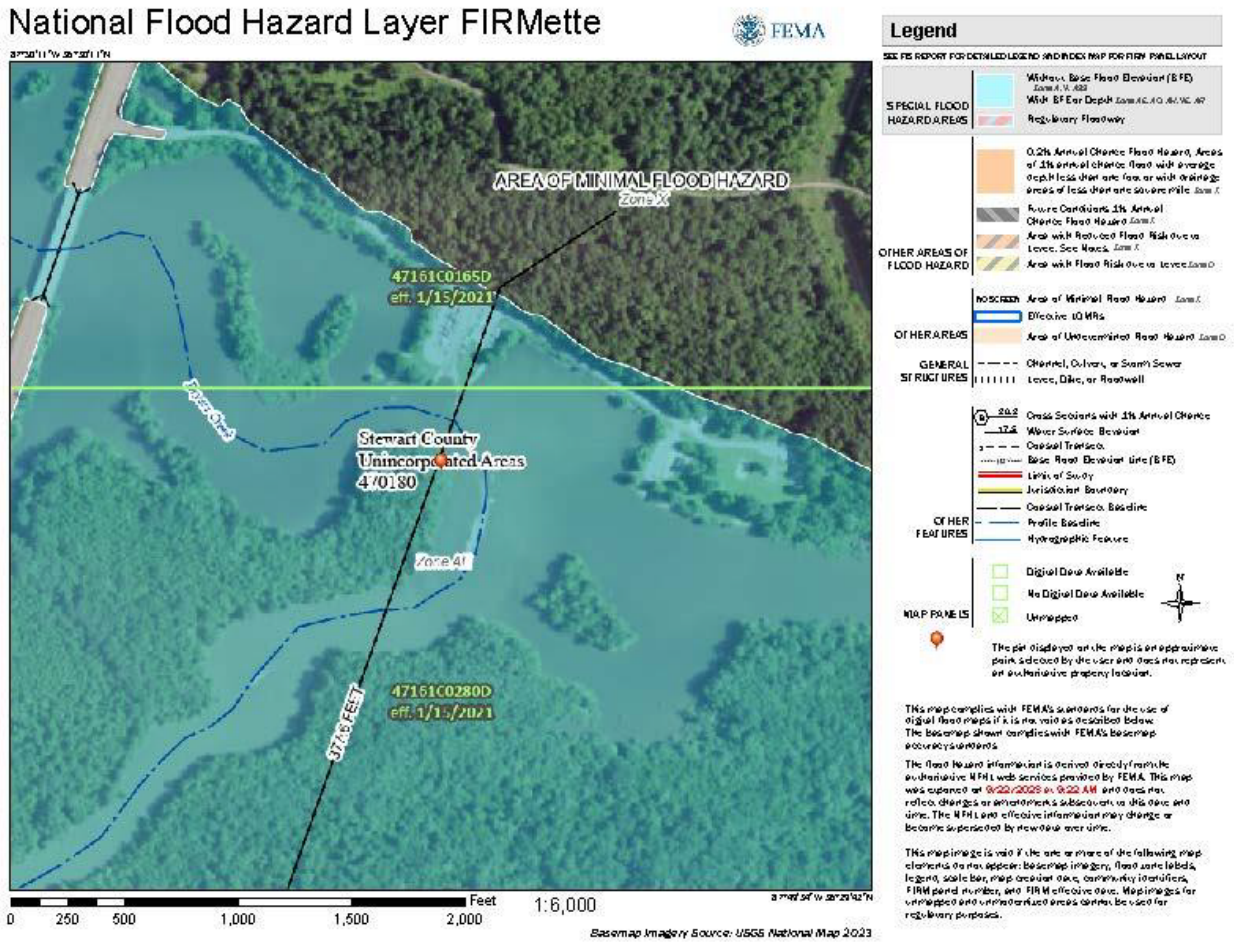
STEWART (ZONE)	1/19/2019	Winter Weather	0	0	0	0
STEWART (ZONE)	1/30/2019	Winter Weather	0	0	0	0
STEWART (ZONE)	11/11/2019	Winter Weather	0	0	0	0
STEWART (ZONE)	2/6/2020	Winter Weather	0	0	0	0
STEWART (ZONE)	2/11/2021	Winter Weather	0	0	0	0
STEWART (ZONE)	2/14/2021	Winter Storm	0	0	0	0
STEWART (ZONE)	2/17/2021	Winter Storm	0	0	0	0
STEWART (ZONE)	1/6/2022	Winter Storm	0	0	0	0
STEWART (ZONE)	2/24/2022	Winter Weather	0	0	5000	0
STEWART (ZONE)	3/11/2022	Winter Weather	0	0	0	0

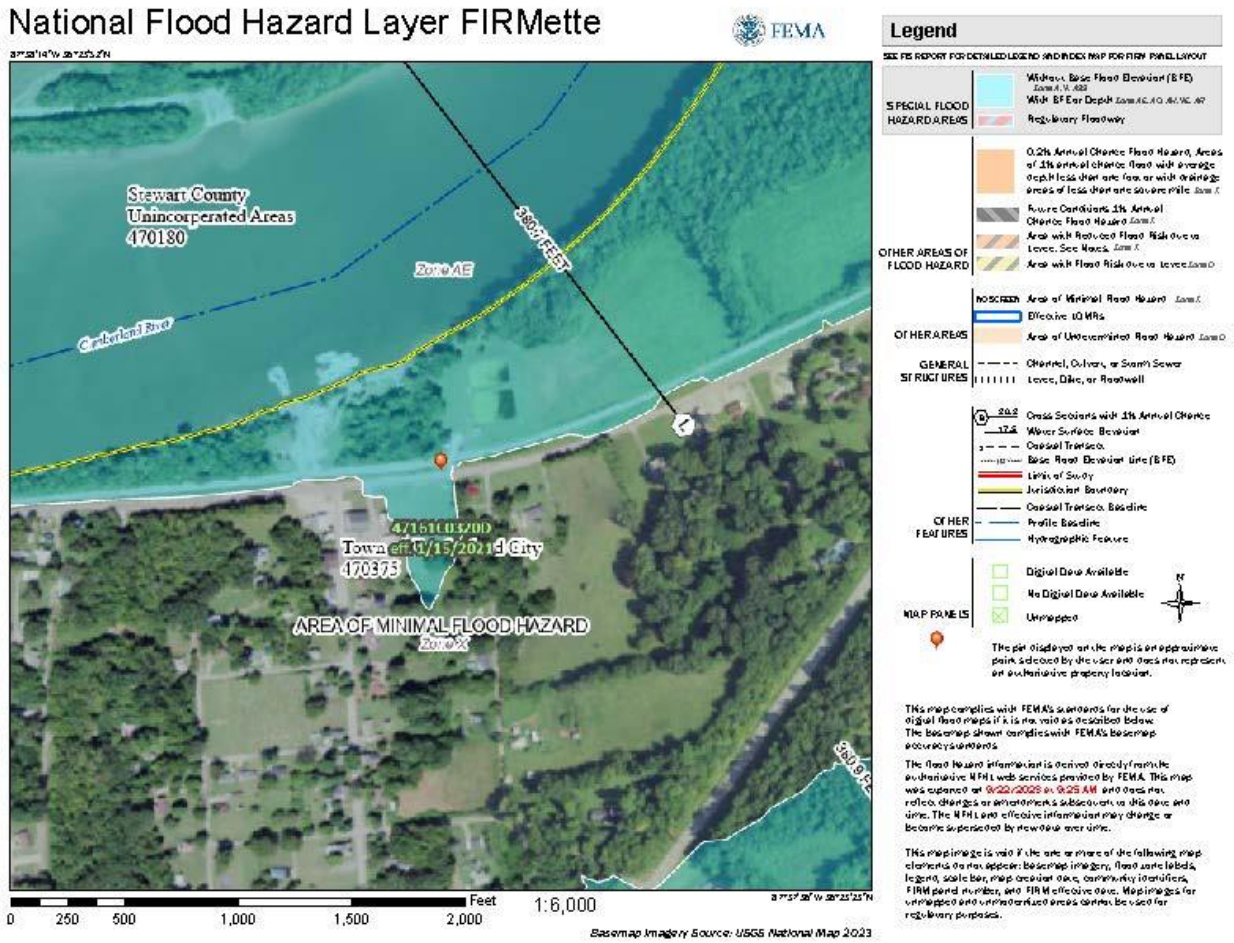
Tornadic Events

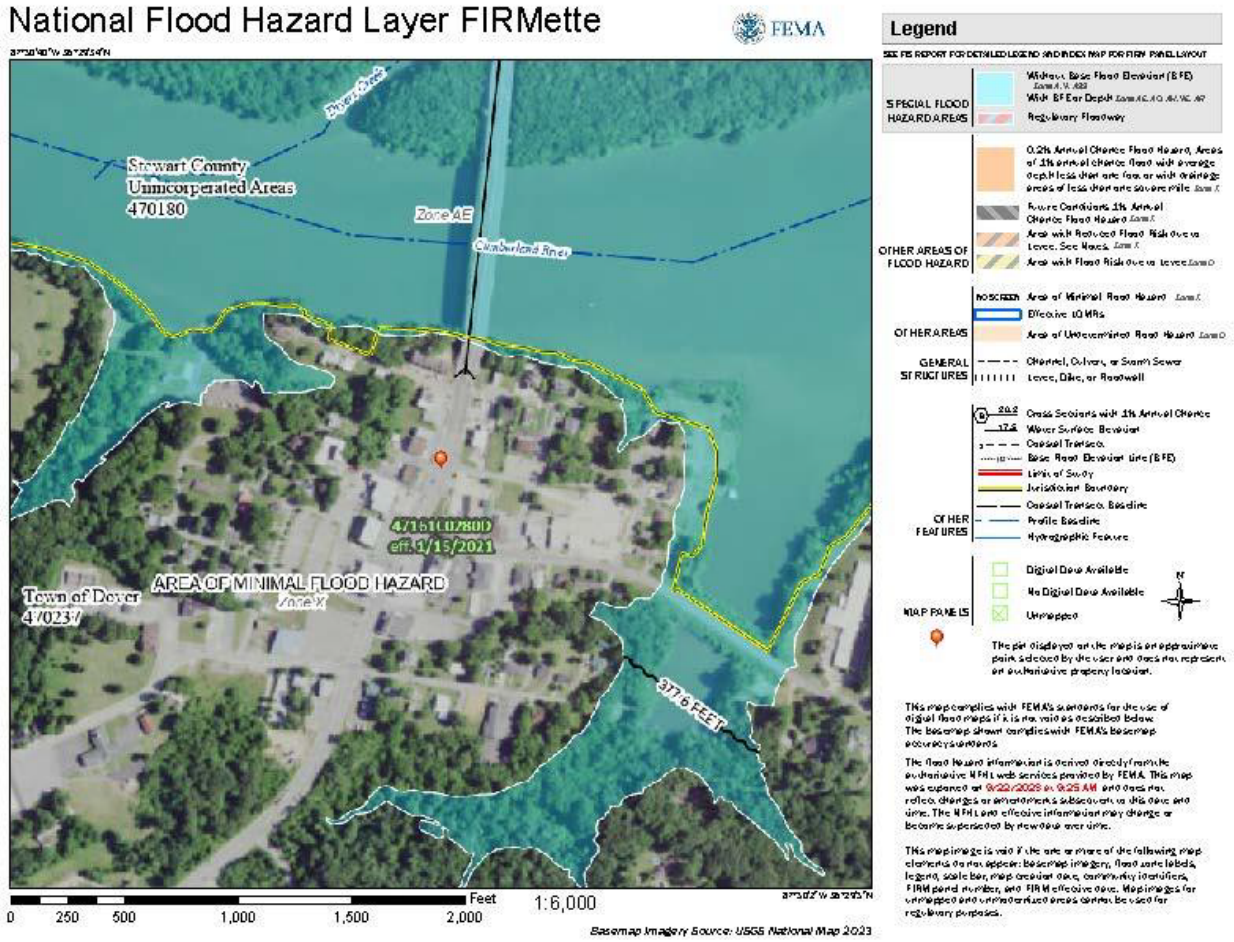
Location	Date	Magnitude (EF Scale)	Deaths	Injuries	Property Damages	Crop Damages
	1/23/1969	F2	0	0	250000	0
	5/7/1984	F0	0	0	0	0
	5/7/1984	F0	0	0	0	0
BUMPUS MILLS	11/27/1994	F0	0	0	50000	0
DOVER	1/17/1999	F1	0	0	30000	0
CUMBERLAND CITY	5/5/1999	F0	0	0	0	0
DOVER	5/23/2000	F1	0	0	0	0
DOVER	5/26/2000	F1	0	0	0	0
DOVER	5/26/2000	F1	0	0	0	0
INDIAN MOUND	5/4/2003	F0	0	0	20000	0
MODEL	10/18/2007	EF1	0	0	50000	0
BUMPUS MILLS	5/23/2011	EF2	0	2	250000	12000
HENRY	12/10/2021	EF2	0	4	2000000	0

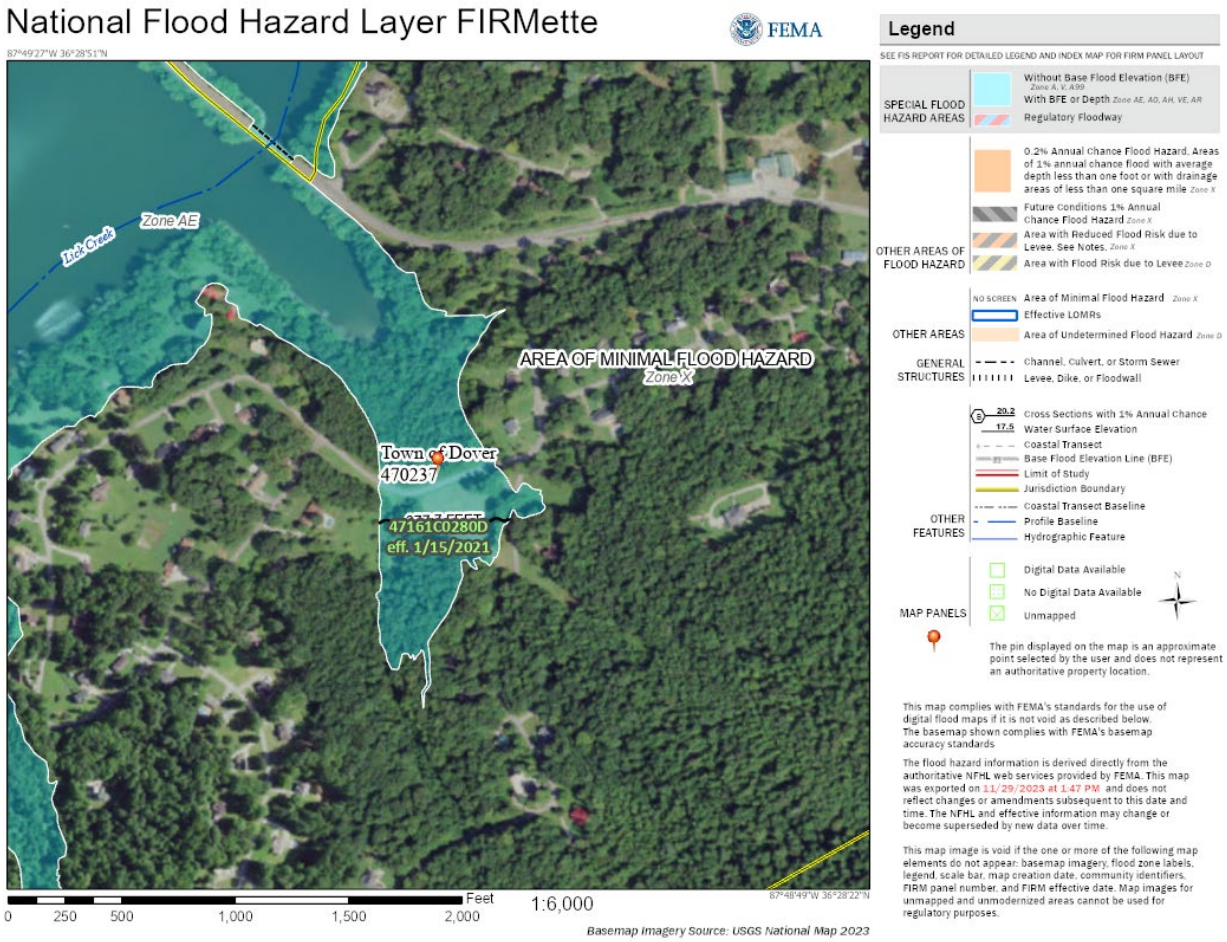
APPENDIX D

HAZUS/FIRM Panels


National Flood Hazard Layer FIRMette
FEMA
AREA OF MINIMAL FLOOD HAZARD
Zone X
47161C0165D
eff. 1/15/2021
Stewart County
Unincorporated Areas
470180
Zone AE
47161C0280D
eff. 1/15/2021
3716 FEET
0
250
500
1,000
1,500
2,000
Feet
1:6,000
Basemap Imagery Source: USGS National Map 2023
Legend
SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
SPECIAL FLOOD HAZARD AREAS
Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD
0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
Future Conditions 1% Annual Chance Flood Hazard Zone X
Area with Reduced Flood Risk due to Levee. See Notes. Zone X
Area with Flood Risk due to Levee Zone D
OTHER AREAS
NO SCREEN Area of Minimal Flood Hazard Zone X
Effective LOMRs
Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES
Channel, Culvert, or Storm Sewer
Levee, Dike, or Floodwall
OTHER FEATURES
20.2
17.5
Cross Sections with 1% Annual Chance
Water Surface Elevation
Coastal Transect
Base Flood Elevation Line (BFE)
Limit of Study
Jurisdiction Boundary
Coastal Transect Baseline
Profile Baseline
Hydrographic Feature
MAP PANELS
Digital Data Available
No Digital Data Available
Unmapped
N
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/22/2023 at 9:22 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.


National Flood Hazard Layer FIRMette
FEMA
Stewart County
Unincorperated Areas
470180
Zone AE
Cumberland River
3800 FEET
47161C0320D
Town eff. 1/15/2021
470375
AREA OF MINIMAL FLOOD HAZARD
Zone X
Feet
0
250
500
1,000
1,500
2,000
1:6,000
Basemap Imagery Source: USGS National Map 2023
Legend
SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
SPECIAL FLOOD HAZARD AREAS
OTHER AREAS OF FLOOD HAZARD
OTHER AREAS
GENERAL STRUCTURES
OTHER FEATURES
MAP PANELS
Digital Data Available
No Digital Data Available
Unmapped
N


National Flood Hazard Layer FIRMette
FEMA
Stewart County
Unincorporated Areas
470180
Zone AE
Cumberland River
4715107800D
eff. 1/15/2021
AREA OF MINIMAL FLOOD HAZARD
Zone X
Town of Dover
470237
377.8 FEET
Feet
0
250
500
1,000
1,500
2,000
1:6,000
Basemap Imagery Source: USGS National Map 2023
Legend
SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
SPECIAL FLOOD HAZARD AREAS
OTHER AREAS OF FLOOD HAZARD
OTHER AREAS
GENERAL STRUCTURES
OTHER FEATURES
MAP PANELS
Digital Data Available
No Digital Data Available
Unmapped
N


National Flood Hazard Layer FIRMette
FEMA
87°49'27"W 36°28'51"N
Zone AE
Jack Creek
AREA OF MINIMAL FLOOD HAZARD
Zone X
Town of Dover
470237
47161C0280D
eff. 1/15/2021
87°48'49"W 36°28'22"N
0 250 500 1,000 1,500 2,000 Feet
1:6,000
Basemap Imagery Source: USGS National Map 2023
Legend
SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
SPECIAL FLOOD HAZARD AREAS
Without Base Flood Elevation (BFE) Zone A, V, A99
With BFE or Depth Zone AE, AO, AH, VE, AR
Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD
0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
Future Conditions 1% Annual Chance Flood Hazard Zone X
Area with Reduced Flood Risk due to Levee. See Notes. Zone X
Area with Flood Risk due to Levee Zone D
OTHER AREAS
NO SCREEN Area of Minimal Flood Hazard Zone X
Effective LOMRs
Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES
Channel, Culvert, or Storm Sewer
Levee, Dike, or Floodwall
OTHER FEATURES
20.2 Cross Sections with 1% Annual Chance
17.5 Water Surface Elevation
Coastal Transect
Base Flood Elevation Line (BFE)
Limit of Study
Jurisdiction Boundary
Coastal Transect Baseline
Profile Baseline
Hydrographic Feature
MAP PANELS
Digital Data Available
No Digital Data Available
Unmapped
N
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/29/2023 at 1:47 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX E

ETSU Climate Data

Stewart County Climate Trends and Variations

Earthquake

There is little to no direct impact of climate trends and variations on the earthquake risk in Stewart County. However, there are some USGS and NASA scientists who believe melting glaciers in mountainous regions and at the poles could induce tectonic activity due to the tremendous amount of weight that is shifted on the earth's crust as water melts and runs off. This newly freed crust can experience post-glacial isostatic uplift, which could cause seismic plates to slip and stimulate seismic activity as it returns to its original, pre-glacial shape. These shifts in tectonic plates would not directly impact Tennessee, but changes to stress/strain in other parts of the North American tectonic plate could impact existing faults/seismic zones in Tennessee indirectly. Additionally, secondary impacts of earthquakes such as liquefaction or mass wasting may increase due to soils that have been saturated from repetitive or extreme precipitation.

Extreme Temperatures

The Fourth National Climate Assessment (2018, NCA4) states climate variability is expected to increase the average temperature and the number of high-heat days in the southeastern United States and intensify the hydrologic cycle, leading to an increase in both extreme temperature and precipitation events in the southeastern United States. The increasing trend in average temperature in Stewart County is also supported by observed historical data available from the NOAA National Centers for Environmental Information Climate at a Glance tool (refer to subsequent figures). The trend of increasing temperature has been more pronounced over the past several decades compared to the longer-term (1895-2022) trend. The long-term trend in temperature is negligible (+0.0°F increase per decade), while the medium-term (1961-2022) shows a substantially increased warming trend of +0.4°F per decade and the short-term (1991-2022) shows a slightly higher trend of +0.5°F per decade. This indicates that warming has substantially increased in Stewart County and based on the NCA4, this trend is expected to continue in the future.

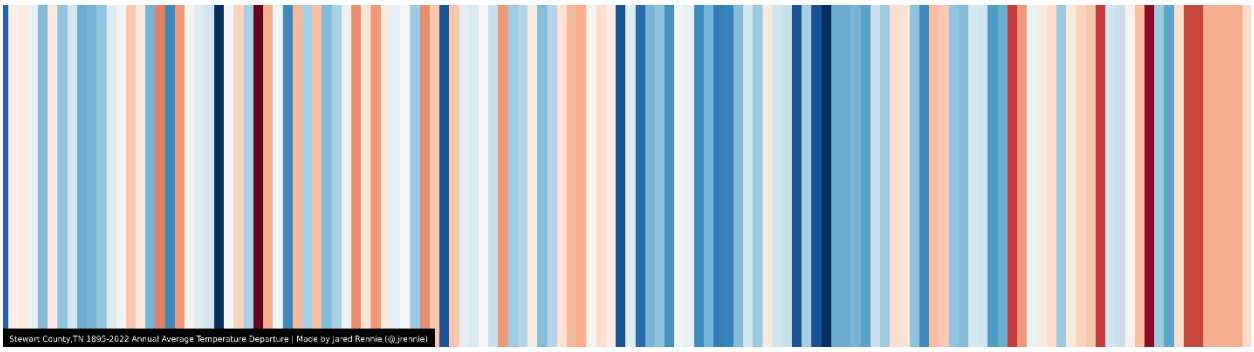


Figure 1: Observed (1895-2022) Annual Temperature for Stewart County Tennessee, Compared to the 20th Century Average with Darkening Shades of Blue for Below Average Temperature and Darkening Shades of Red for Above Average Temperature.
(Source: NOAA NCEI)

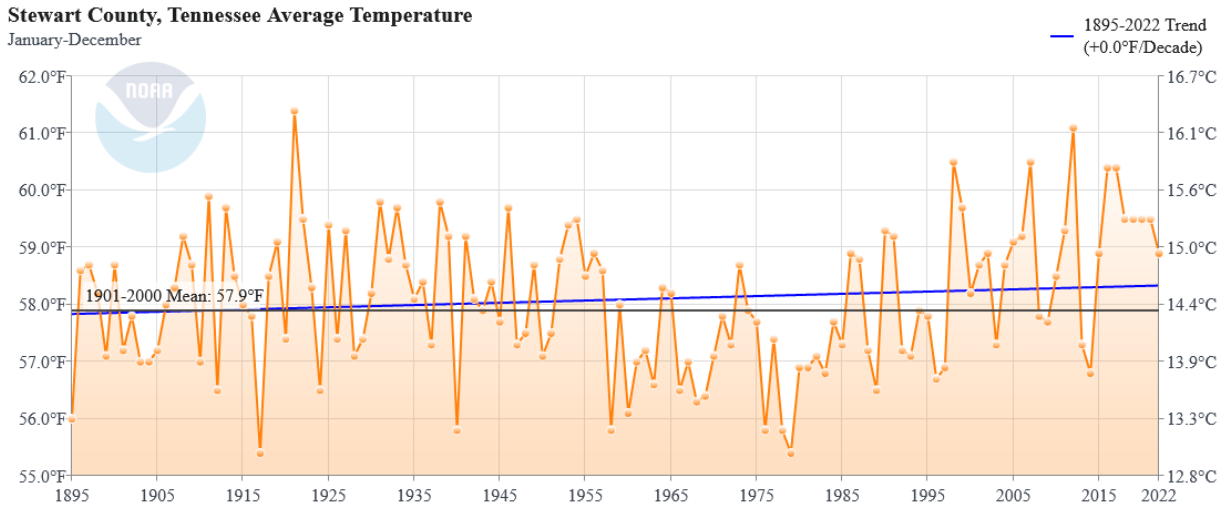


Figure 2: Annual Average Temperature for Stewart County Tennessee, Showing a Negligible +0.0˚F Increase per Decade Since 1895.
(Source: NOAA NCEI, Climate at a Glance: County Time Series)

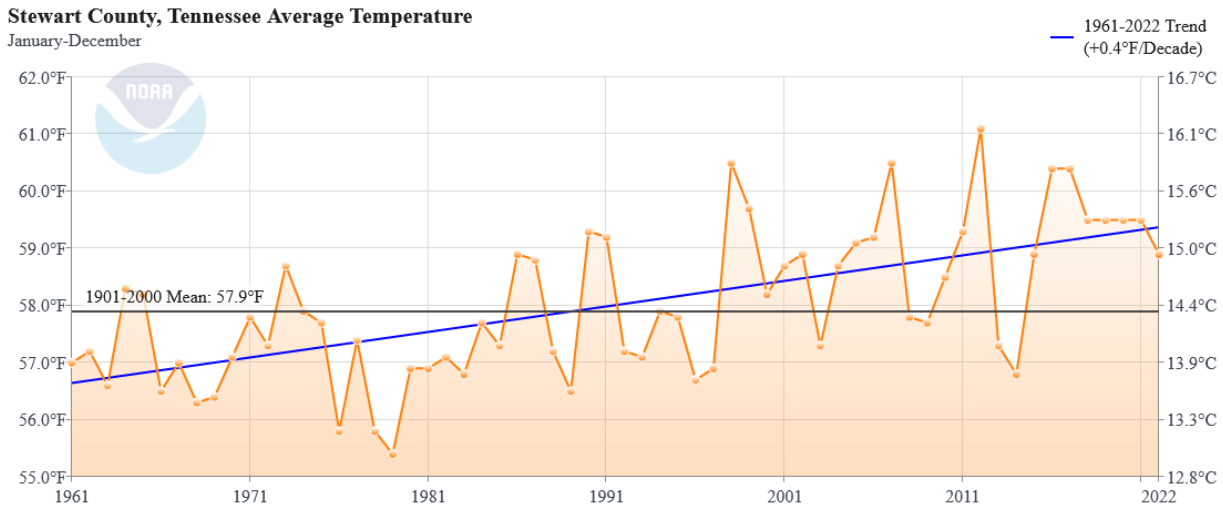


Figure 3. Annual Average Temperature for Stewart County, Tennessee, Showing a +0.4˚F Increase per Decade Since 1961.
(Source: NOAA NCEI, Climate at a Glance: County Time Series)

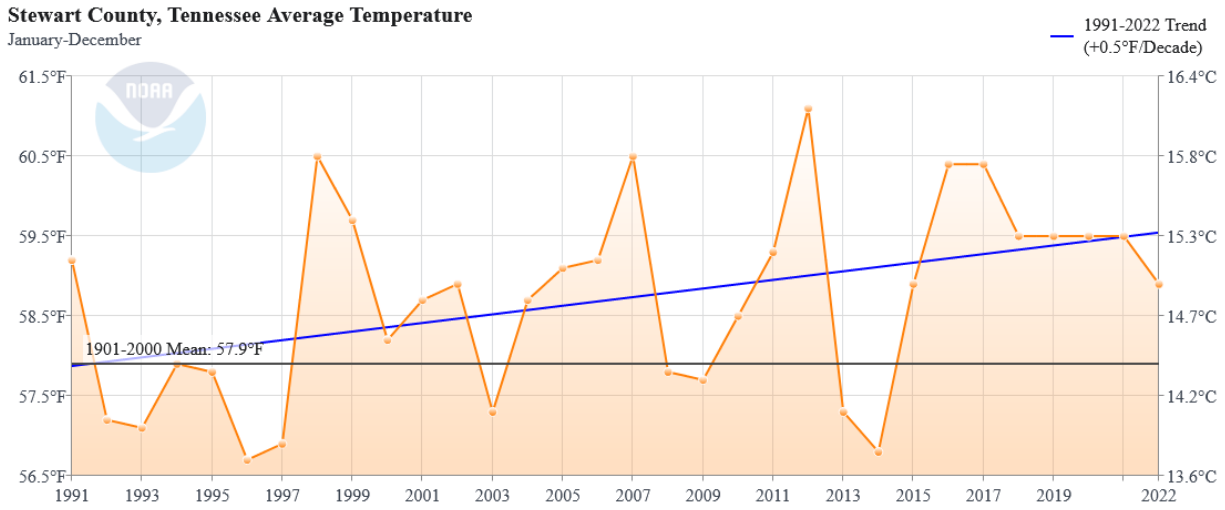


Figure 4. Annual Average Temperature for Stewart County, Tennessee, Showing a +0.5˚F Increase per Decade Since 1991.
(Source: NOAA NCEI, Climate at a Glance: County Time Series)

Heat

The Climate Mapping Risk Assessment (CMRA) Report for Stewart County shows the potential for an increase in high heat days, when examining temperature thresholds and annual temperatures. By mid-century, Stewart County could experience between 77 and 86 days of maximum temperatures exceeding 90˚F, compared to an historical (1976-2005) average of 35 days. There could be 10-15 days of maximum temperatures exceeding 100˚F by mid-century, compared to an historical average of just 1 day. Additionally, the annual single highest maximum temperature could be between 104˚F and 105˚F by mid-century, compared to an historical average of 99˚F.

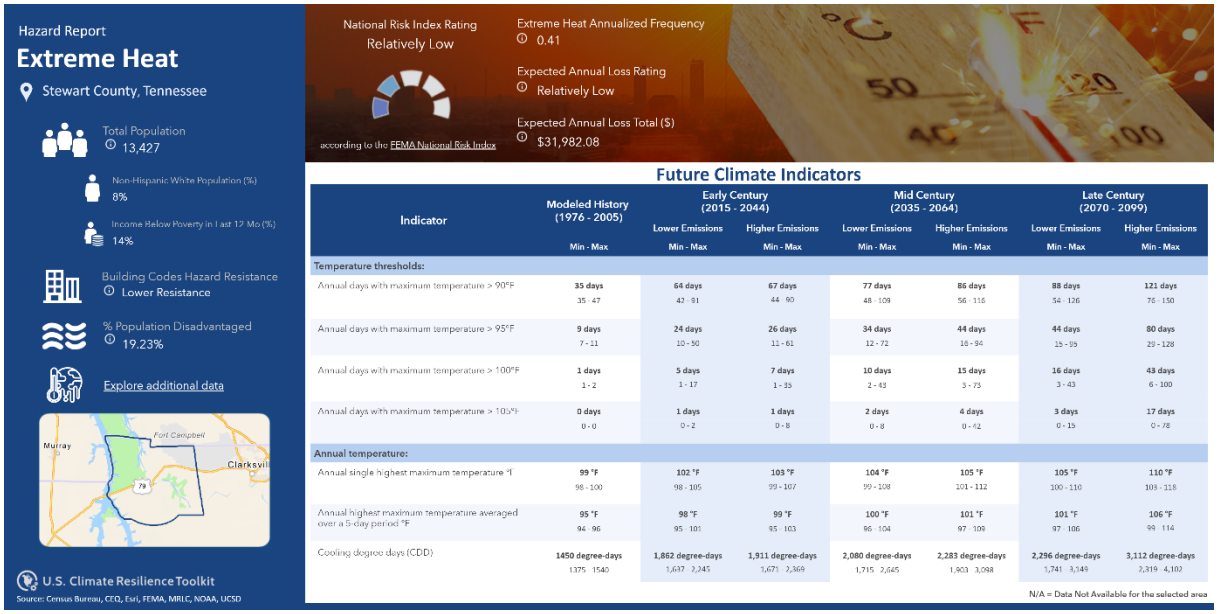


Figure 5: Climate Mapping Risk Assessment Report for Extreme Heat in Stewart County. (Source: US Climate Resilience Toolkit)

Trend analysis of heat advisories/excessive heat warnings showed no significant increasing or decreasing trend Stewart County, meaning that these types of advisories and warnings (issued by the National Weather Service) have remained relatively stable from 2005 to 2021. However, neighboring Benton County has experienced a modest increasing trend, indicating that there may be an increase in such warnings for Stewart County but that increase is not significant. While areas west of Stewart County have been identified as sporadic hot spots for heat advisories/warnings (meaning there have been periods of time between 2005 and 2021 when more advisories/warnings have been issued), Stewart County has experienced no significant hot/cold spot patterns.

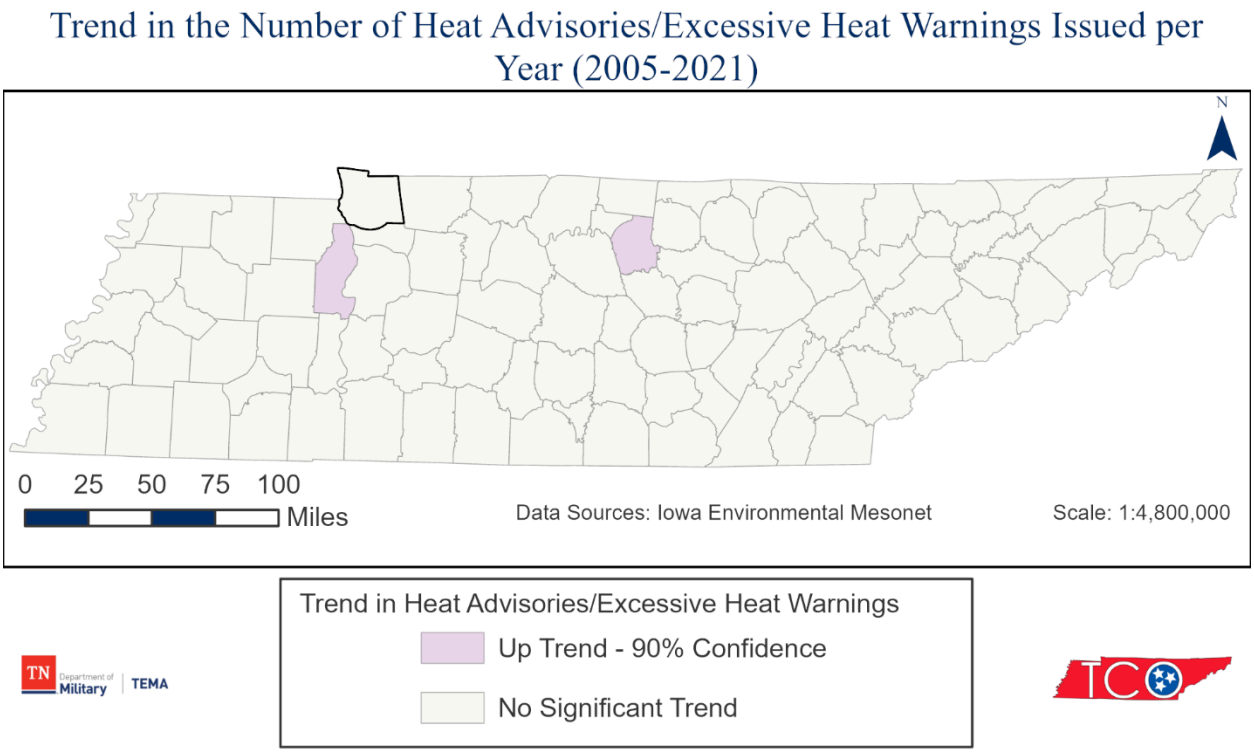


Figure 6: Trend in the Number of Heat Advisories/Excessive Heat Warnings Issued per Year, Stewart County Outlined in Bold.

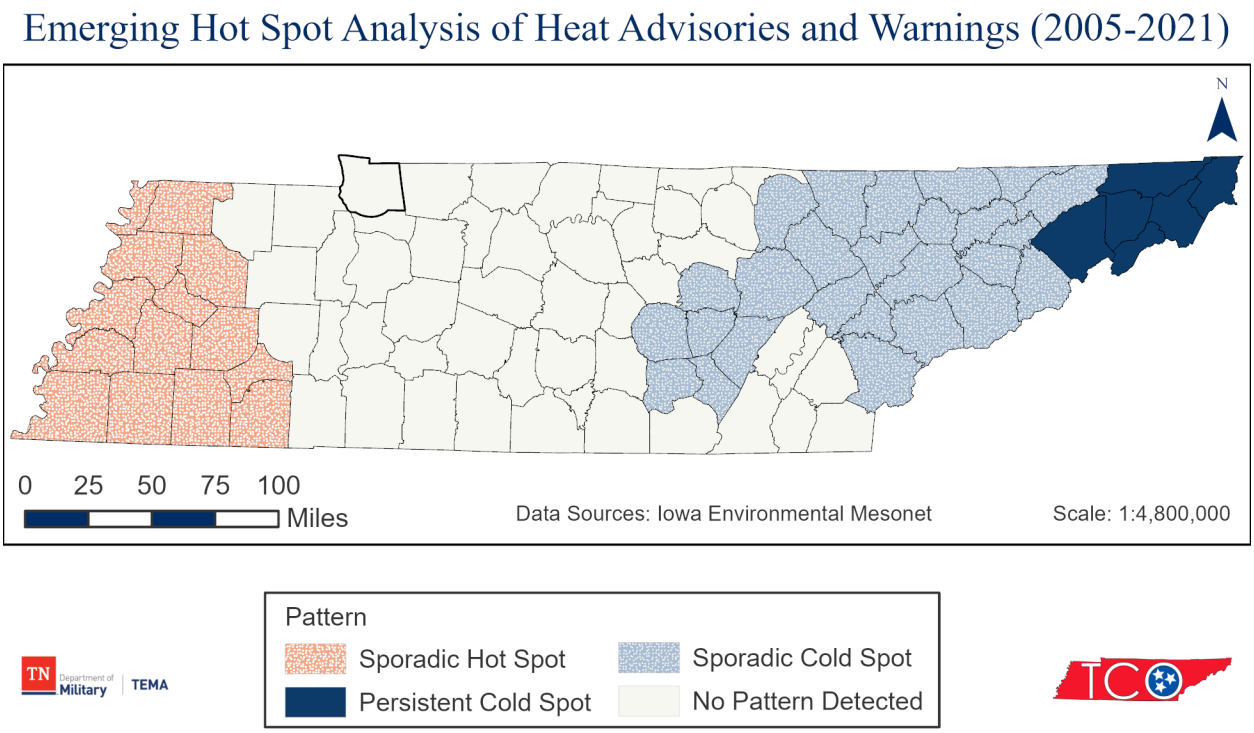


Figure 7: Emerging Hot Spot Analysis of Heat Advisories/Warnings Showing that No Pattern was Detected for Stewart County.

Cold

Trend analysis of cold/windchill advisories and extreme cold/extreme windchill warnings showed no significant increasing or decreasing trend for all of Tennessee, including Stewart County, meaning that these types of advisories and warnings (issued by the National Weather Service) have remained relatively stable from 2005 to 2021. While areas east of Stewart County have been identified as oscillating cold spots for cold/windchill advisories and warnings (meaning there have been periods of time between 2005 and 2021 when fewer advisories/warnings have been issued), Stewart County has experienced no significant hot/cold spot patterns.

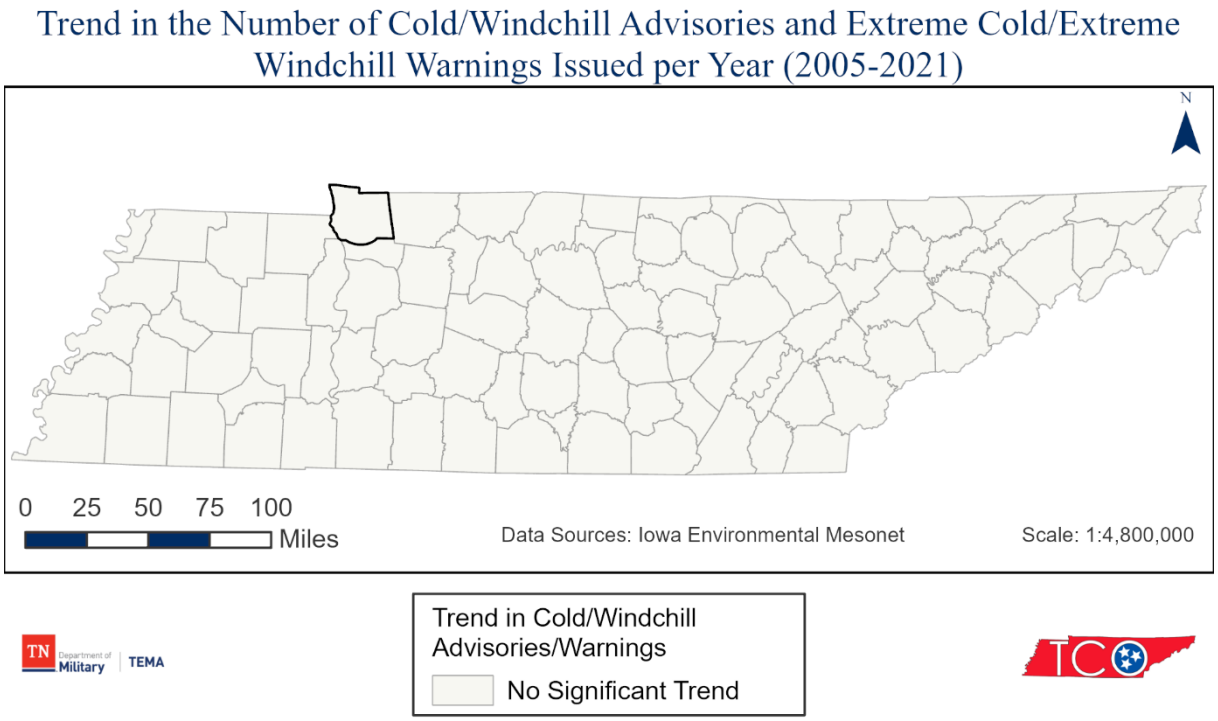


Figure 8: Trend Analysis Revealed that there was No Significant Trend in Cold/Windchill Advisories/Warnings for Stewart County.

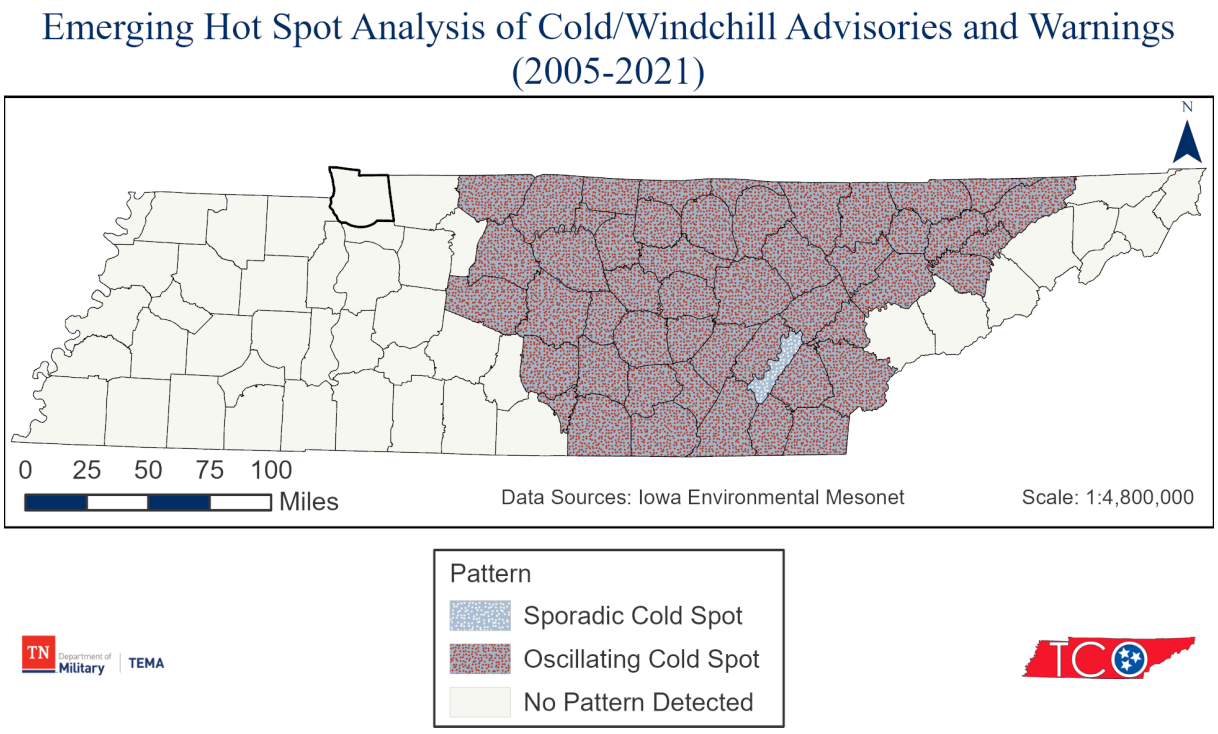


Figure 9: Emerging Hot Spot Analysis of Cold/Windchill Advisories/Warnings Showing that No Pattern was Detected for Stewart County.

Flooding

The future risk of flooding in Stewart County is tied to predicted changes in the precipitation patterns. Tennessee and Stewart County have increasing trends in observed precipitation, and the Fourth National Climate Assessment (2018) reports that the broader Southeast region has seen an increase in the frequency and intensity of extreme rainfall events, there is high confidence that this trend will continue in the future. According to the Climate Mapping Risk Assessment (CMRA) Report, Stewart County is expected to experience a modest increase in various flood indicators by mid- and late-century. Both the increase in total precipitation and extreme rainfall events will increase the risk of flooding in Stewart County. The long-term (1895-2022) and medium-term (1961-2022) trends in precipitation show an increase of +0.59" per decade, while the short-term (1991-2022) trend shows a more substantial trend of +1.53" per decade (almost triple the long and medium-term trends). This indicates that precipitation has noticeably increased in Stewart County over the past several decades.

Figure 10: Climate Mapping Risk Assessment Report for Flooding in Stewart County. (Source: US Climate Resilience Toolkit)

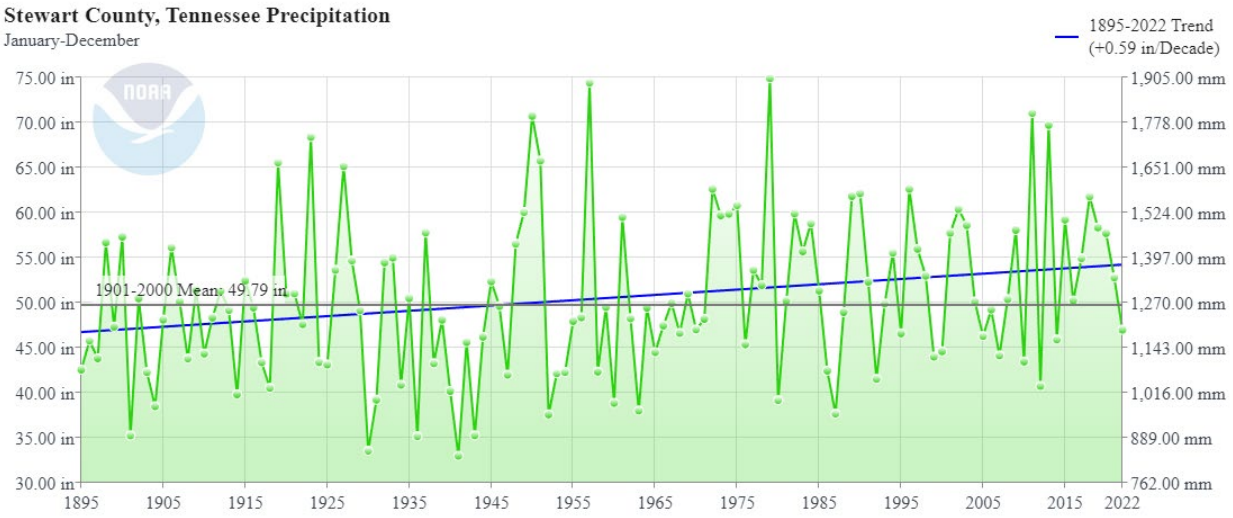


Figure 11: Total Annual Precipitation for Stewart County Tennessee, Showing a +0.59-inch Increase per Decade Since 1895. (Source: NOAA NCEI, Climate at a Glance: County Time Series)

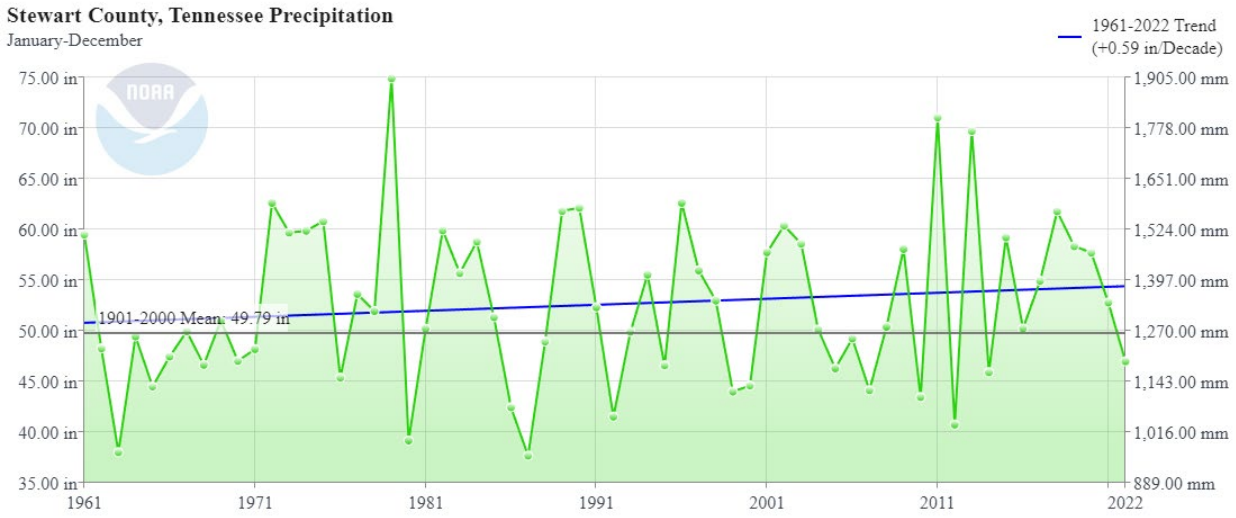


Figure 12: Total Annual Precipitation for Stewart County Tennessee, Showing a +0.59-inch Increase per Decade Since 1961.
(Source: NOAA NCEI, Climate at a Glance: County Time Series)

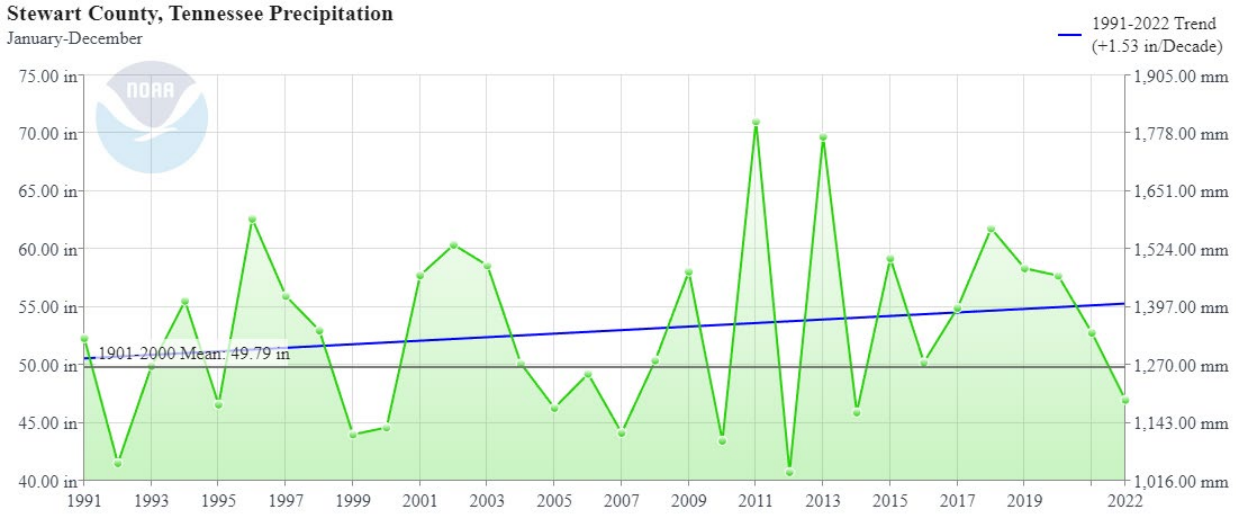


Figure 13: Total Annual Precipitation for Stewart County Tennessee, Showing a +1.53-inch Increase per Decade Since 1991.
(Source: NOAA NCEI, Climate at a Glance: County Time Series)

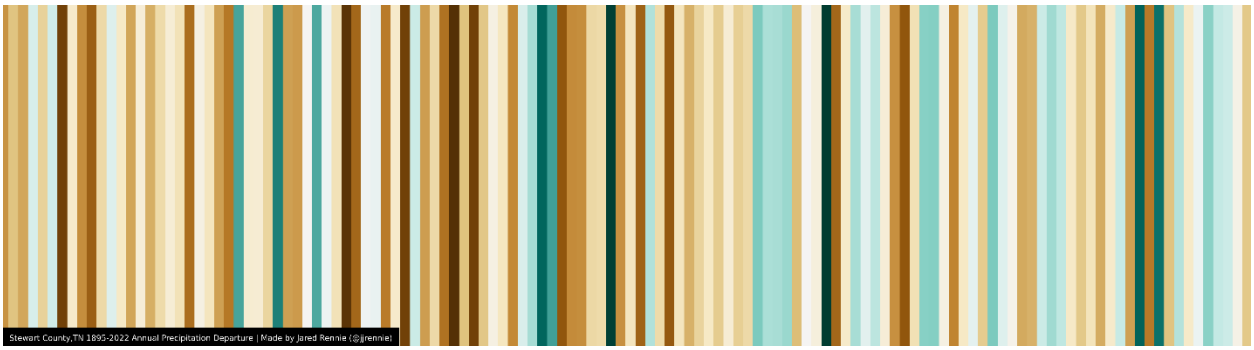


Figure 14: Observed (1895-2022) Annual Precipitation for Stewart County Tennessee, Compared to the 20th Century Average with Darkening Shades of Brown for Below Average Precipitation and Darkening Shades of Green for Above Average.
(Source: NOAA NCEI)

Using the NOAA Storm Events Database, flood events/damages and flash flood events/damages were examined for trends between 1996 and 2021. The only significant trend identified for Stewart County was a slight decreasing trend in flash flood events. Flood events/damages and flash flood damages revealed no significant changes over that time period.

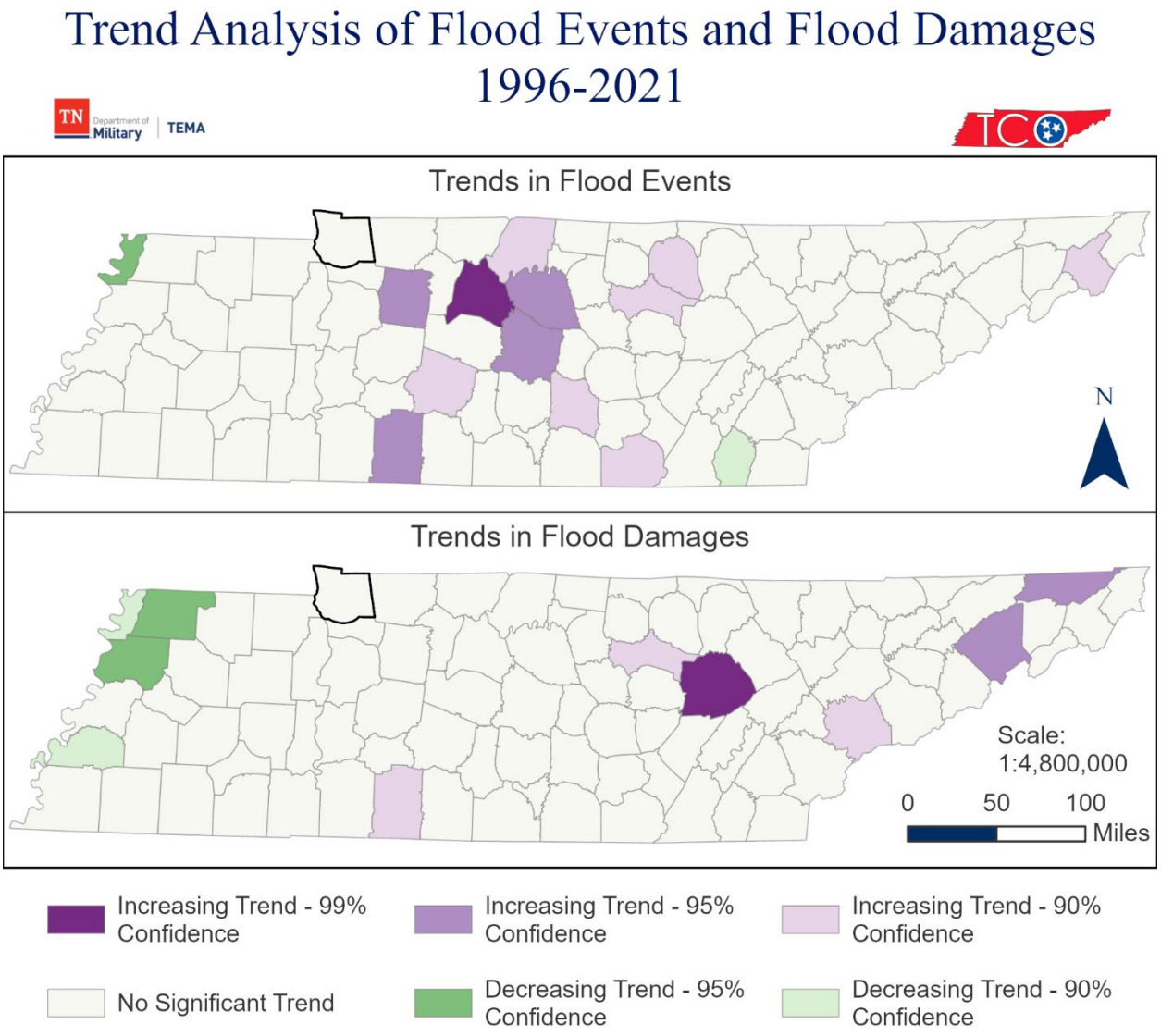


Figure 15: Trend in Flood Events and Flood Damages Reported in the NCEI Storm Events Database from 1996 to 2021, Stewart County Outlined in Bold.

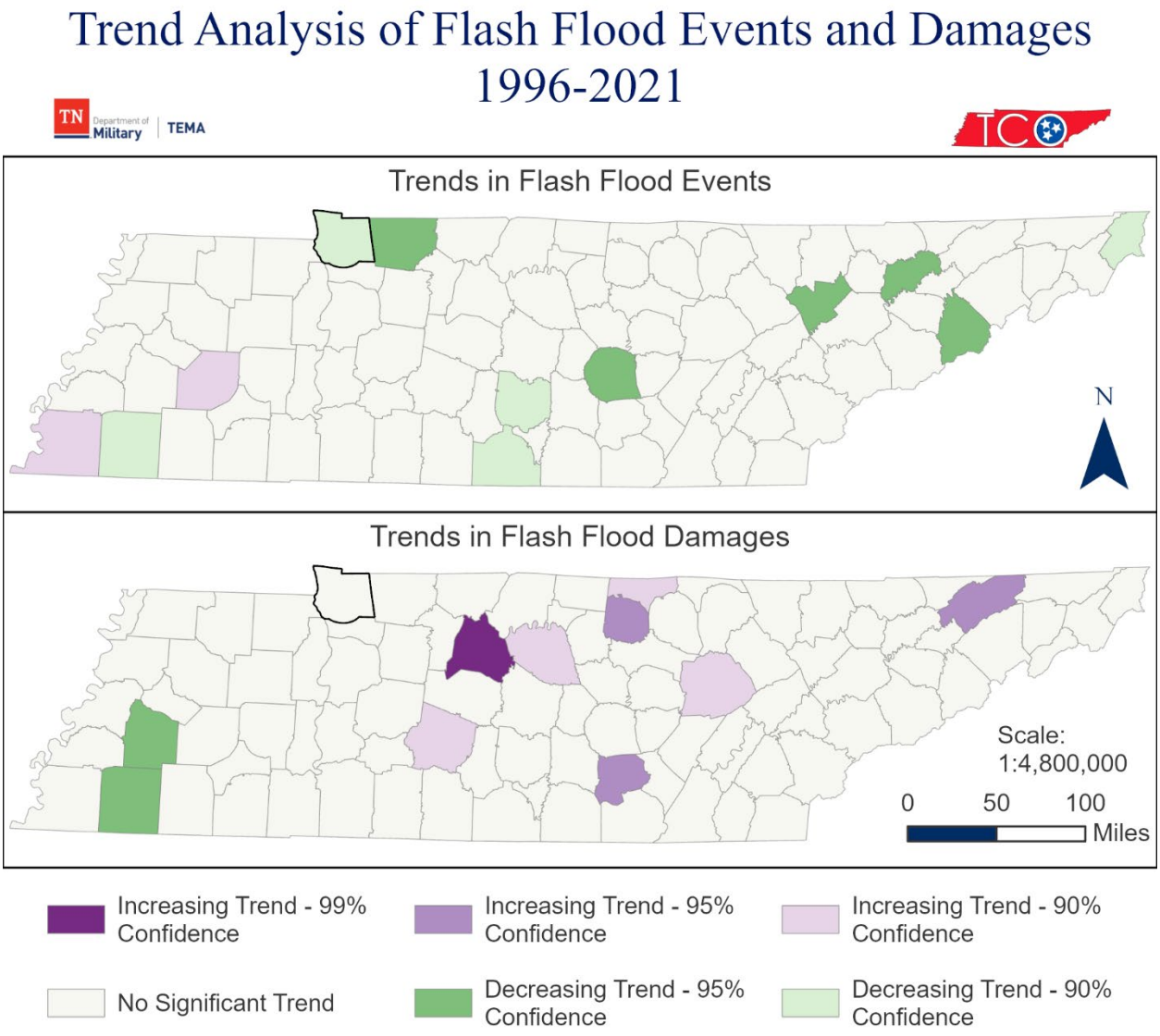


Figure 16: Trend in Flash Flood Events and Flash Flood Damages Reported in the NCEI Storm Events Database from 1996 to 2021, Stewart County Outlined in Bold.

Based on historical trends from the 3-month standardized precipitation index (SPI) between 1895 and 2022, there is a modest increasing trend for Stewart County. The increasing trend indicates an overall increase in total precipitation. Projected changes for the late 21st Century predict that the overall trend of increasing precipitation will continue (an expected 2-6% increase) with the largest potential increases occurring in northeastern Stewart County. Spring is projected to experience the largest increase across northern Tennessee, including Stewart County – 10+% higher precipitation amounts are projected in this region compared to the historical average. Summer in Stewart County is expected to be drier, with a potential 2-4% decrease in precipitation, while fall and winter are expected to be slightly wetter.

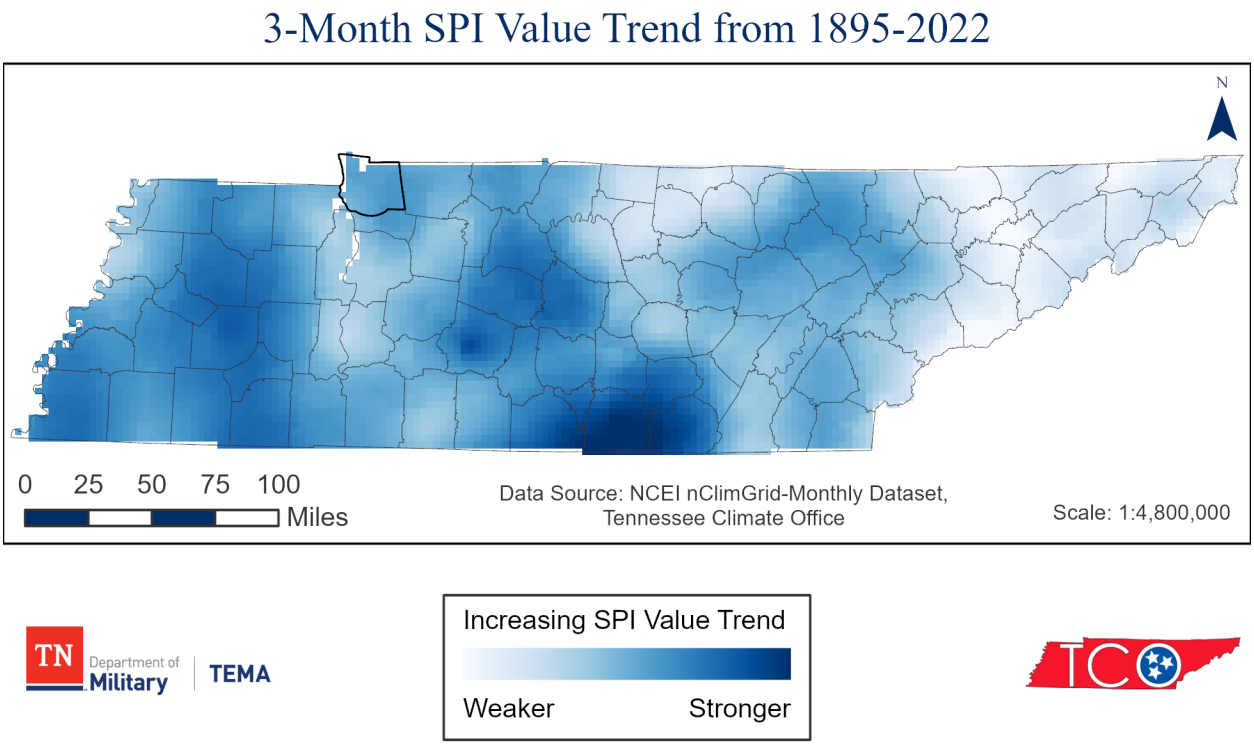


Figure 17: SPI Value Trend for 3-Months from 1895 to 2022, Stewart County Outlined in Bold.

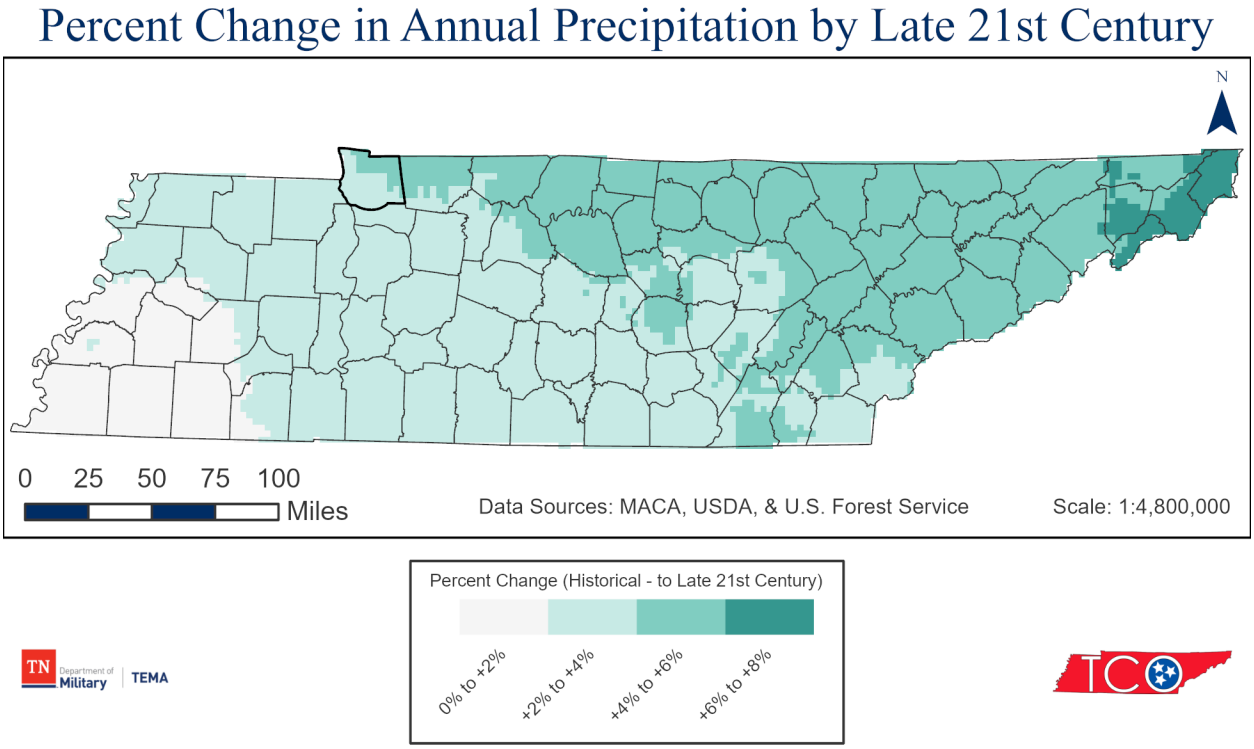


Figure 18: Projected Change in Annual Precipitation for Tennessee, Stewart County Outlined in Bold.

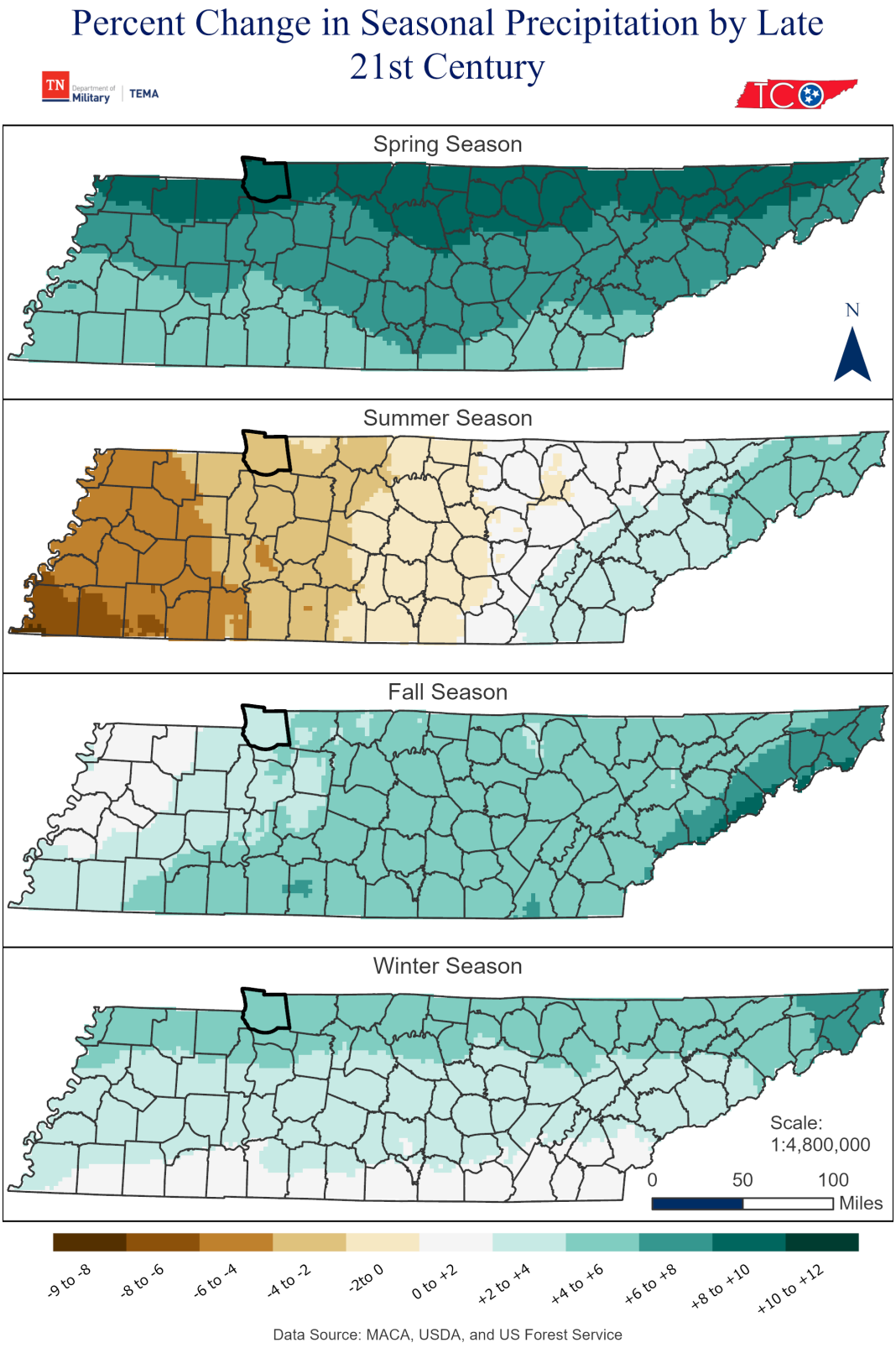


Figure 19: Projected Change in Seasonal Precipitation for Tennessee, Stewart County Outlined in Bold.

While overall precipitation is expected to increase, the number of wet days is expected to decrease in Stewart County, based on most models (driest, mean, wettest) and time periods (early-, mid-, and late-century). This indicates that more rain will fall on fewer days, likely resulting in an increase in extreme precipitation events interspersed with more periods of short-term drought. Additional models predict an increase in the number of days per year with extreme precipitation for Stewart County. A trend analysis of heavy precipitation events from 1991 to 2021 revealed that 1-year, 2-year, and 5-year heavy rainfall events have not yet increased significantly.

Table 1: Possible Change in the Number of Wet Days per Year for Stewart County, Tennessee

High Emissions Scenario	**Modeled History (1976-2005)**	**Early Century (2015-2044)**	**Mid Century (2035-2064)**	**Late Century (2070-2099)**
Wettest Projection	179.7	-0.5	3.3	9.4
Mean Projection	185.6	-3.3	-4.8	-8.1
Driest Projection	191.5	-20.3	-24.4	-45.1
Low Emissions Scenario	**Modeled History (1976-2005)**	**Early Century (2015-2044)**	**Mid Century (2035-2064)**	**Late Century (2070-2099)**
Wettest Projection	179.7	2.1	3.9	3.5
Mean Projection	185.6	-2.8	-3.7	-4.4
Driest Projection	191.5	-13.3	-16.2	-14.7

Table 2: Possible Change in the Number of Days per Year with Precipitation Exceeding 99th Percentile (Extreme Precipitation Days) for Stewart County, Tennessee

High Emissions Scenario	**Modeled History (1976-2005)**	**Early Century (2015-2044)**	**Mid Century (2035-2064)**	**Late Century (2070-2099)**
Driest Projection	6.5	1.0	2.0	3.3
Mean Projection	6.9	1.1	2.1	3.4
Wettest Projection	7.4	1.1	2.0	3.4
Low Emissions Scenario	**Modeled History (1976-2005)**	**Early Century (2015-2044)**	**Mid Century (2035-2064)**	**Late Century (2070-2099)**
Driest Projection	6.5	0.7	1.3	1.7
Mean Projection	6.9	0.8	1.5	1.8
Wettest Projection	7.4	0.9	1.5	1.8

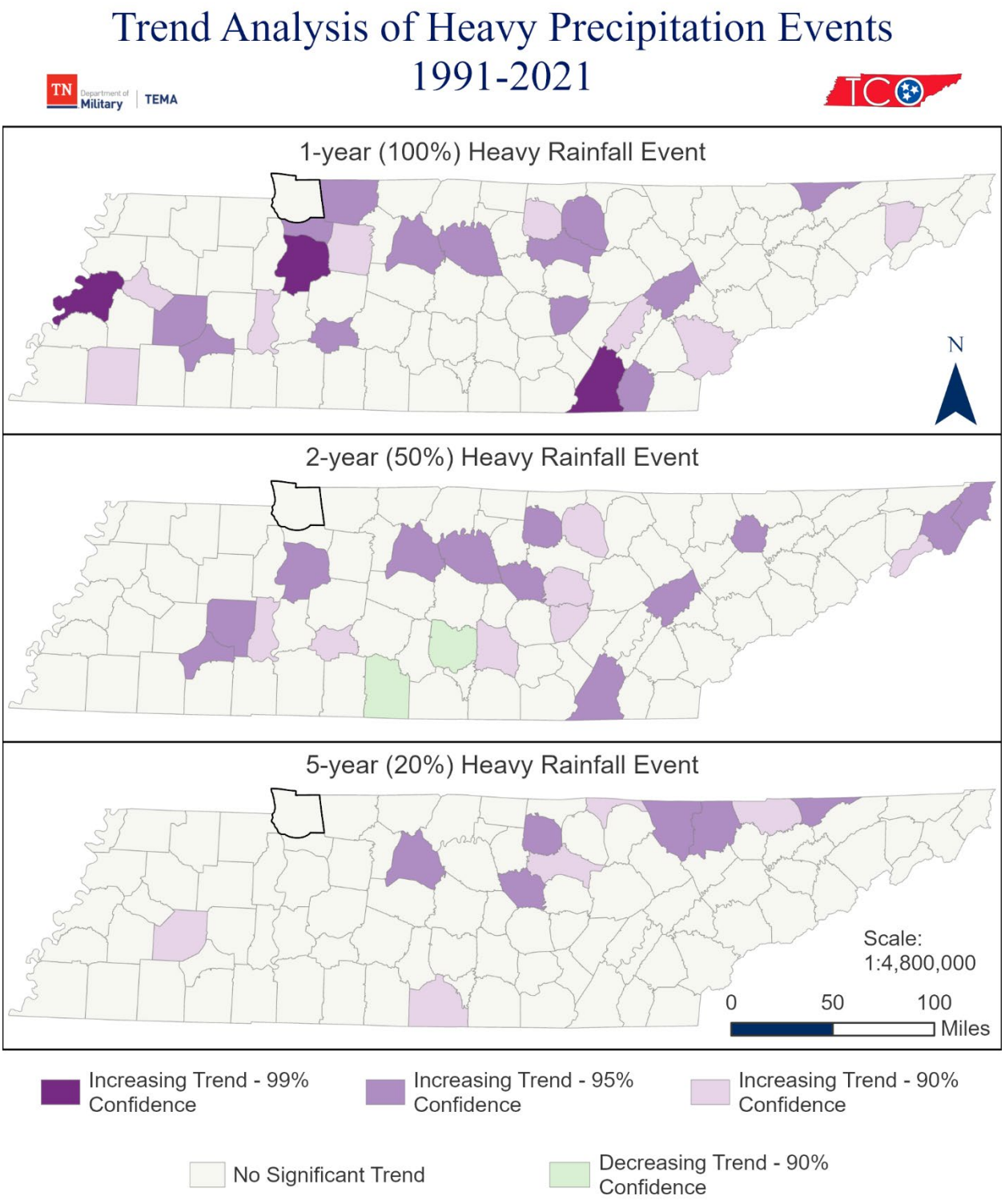


Figure 20: Trend in Heavy Precipitation Events (1-year, 2-year, and 5-year Return Period Exceedance Events), Stewart County Outlined in Bold.

Extreme rainfall events are often categorized based on how much above or below their amounts were compared to the 100-year, or 1% probability, rainfall amounts. For Stewart County, a 100-year 1-hour extreme rainfall would be ~3.01-3.25". For a 100-year 24-hour extreme rainfall event, most of Stewart County would experience ~7.01-8.00", with extreme western parts of the county possibly experiencing ~8.01-9.00". Based on analysis by the NCICS and NOAA, Dover (the county seat of Stewart County) currently has a 100-year 24-hour extreme rainfall amount of 7.85" and that amount is predicted to rise by as much as 1.3" (to 9.15") by 2055.

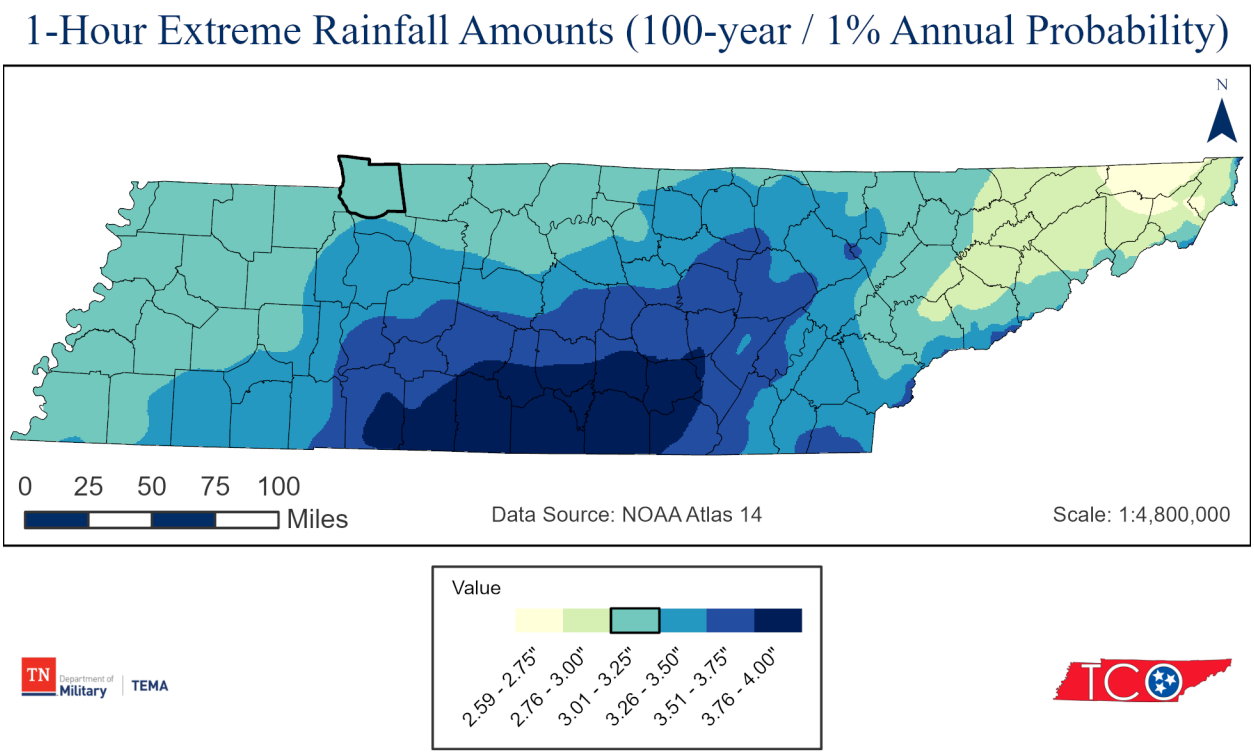


Figure 21: 1-hour Extreme Rainfall Estimates for 100-year Return Period (1% Annual Probability of Exceedance) using NOAA Atlas 14, Stewart County, Outlined in Bold.

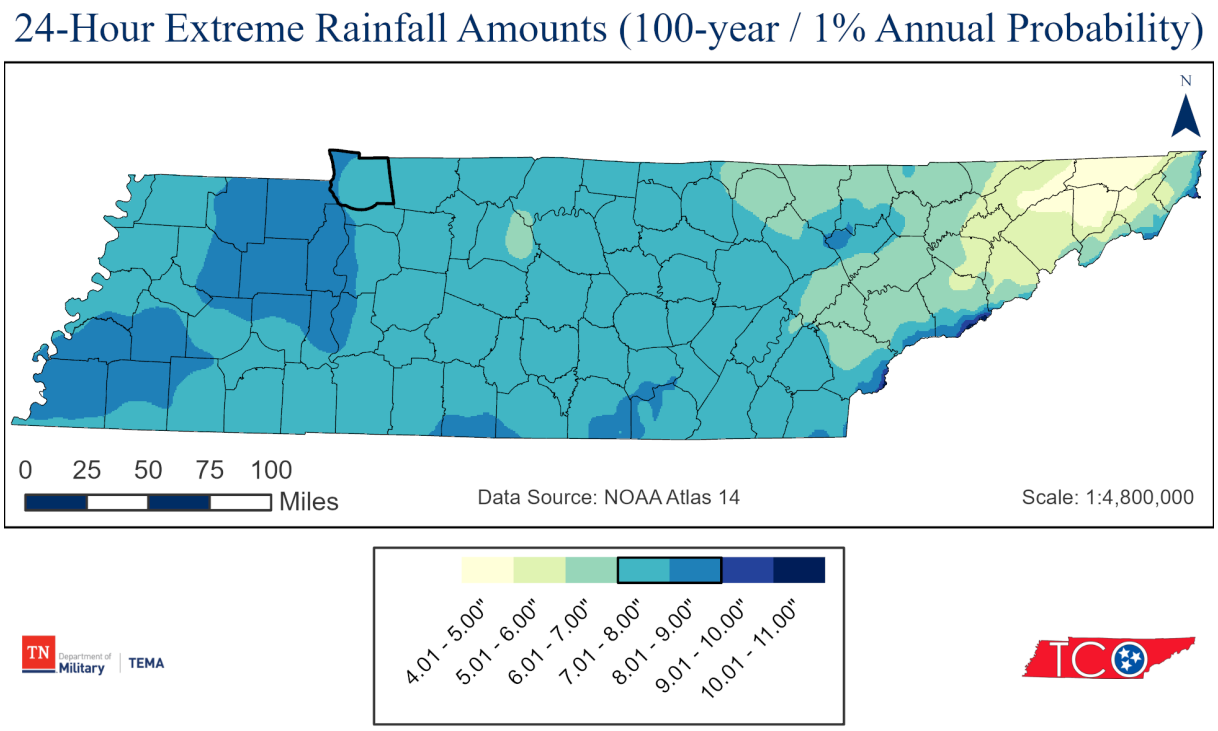


Figure 22: 24-hour Extreme Rainfall Estimates for 100-year Return Period (1% Annual Probability of Exceedance) using NOAA Atlas 14, Stewart County, Outlined in Bold.

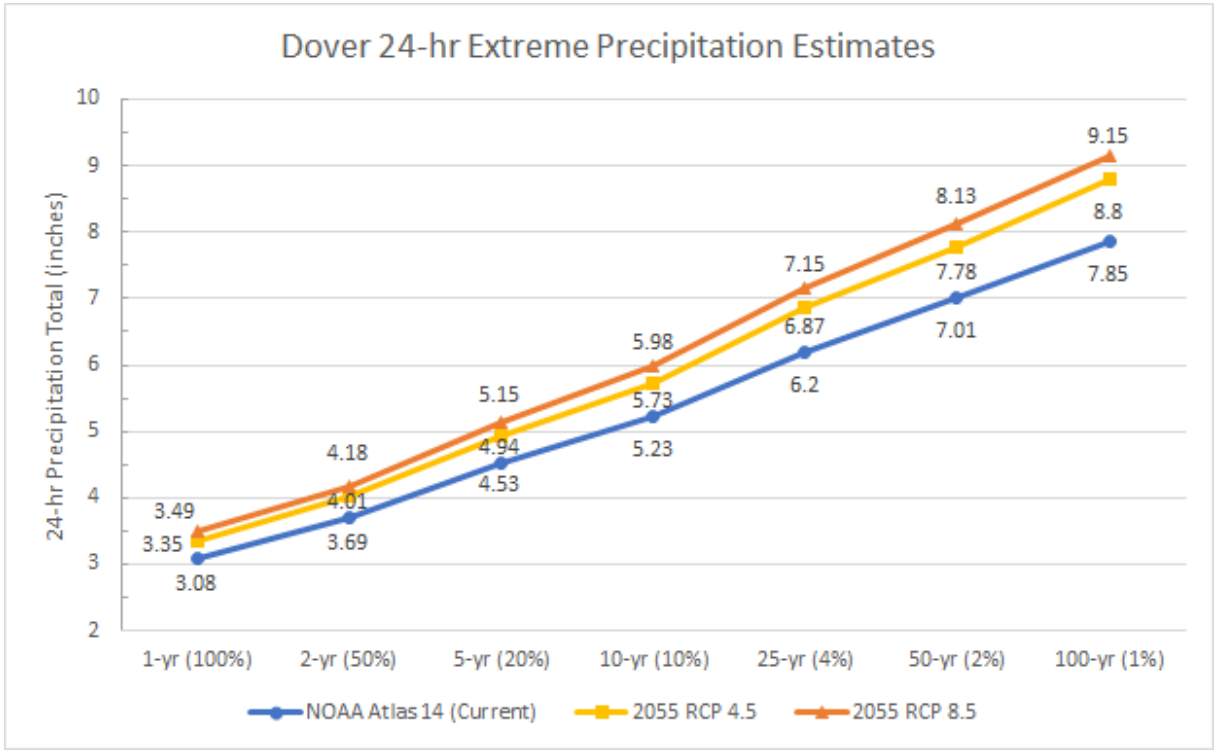


Figure 23: 24-hour Extreme Rainfall Estimates for 1-year, 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year Return Periods using NOAA Atlas 14 (historical data) and Mid-Century Values for 2055 using RCP4.5 and RCP8.5 Emission Scenarios.

Severe Weather

In the Stewart County, Tennessee Hazard Mitigation Plan Update of 2023, the Severe Weather hazard includes Thunderstorms (Wind, Hail, Lightning), Wind (Non-Convective), and Winter Weather. The effects of climate trends and variations on the future risk for each of these sub-hazards will be profiled individually.

Severe Thunderstorms

Climate trends and variations may lead to an increase in frequency and intensity of certain types of severe storms. Warmer air temperatures can contribute to more moisture in the atmosphere, providing fuel for stronger rainfall events and potentially more intense thunderstorms. The increased energy in the atmosphere can also contribute to the development of more powerful storms. Climate trends can also result in altered precipitation patterns influencing the distribution, timing, and intensity of rainfall during storms. Climate trends can influence the paths and tracks of severe storms too. Changes in atmospheric circulation patterns may lead to shifts in the regions where storms typically form or move, potentially affecting the areas that are historically vulnerable to specific types of storms. This can result in new areas being exposed to severe storms while other areas experience a decrease. Research by Ashley et al. (2023) into supercell thunderstorm formation compared historical data (1990-2005) and future climate models for the late 21st century (2085 – 2100), which indicate that the mid-South region of the US (including West and Middle Tennessee) could see an increase in the number of supercell thunderstorms capable of producing severe thunderstorm hazards and tornadoes. These increases were mostly found in the late winter to early spring months of February, March, and April. Additionally, they found that an increasing number of supercell thunderstorms in this region could form in the late afternoon to overnight hours. Climate trends can contribute to compound events where multiple extreme weather events can occur simultaneously or in succession. These compound events can amplify the overall impacts on communities and ecosystems, making them more challenging to manage and recover from.

The Tennessee Climate Office analyzed trends for thunderstorm winds (convective wind) and severe hail reports in counties across Tennessee using the NOAA Storm Events Database with data from 1996 to 2021, and lightning strikes per county from 1996 to 2021 from the NOAA Severe Weather Data Inventory (SWDI). The trend analysis for these three hazards did not show a significant trend in thunderstorm winds or severe hail over that time period for Stewart County. However, a slight significant decrease in lightning strikes was identified. This is a welcome trend as Stewart County is part of a western cluster of counties in Tennessee that experience the highest density of lightning strikes in the state.

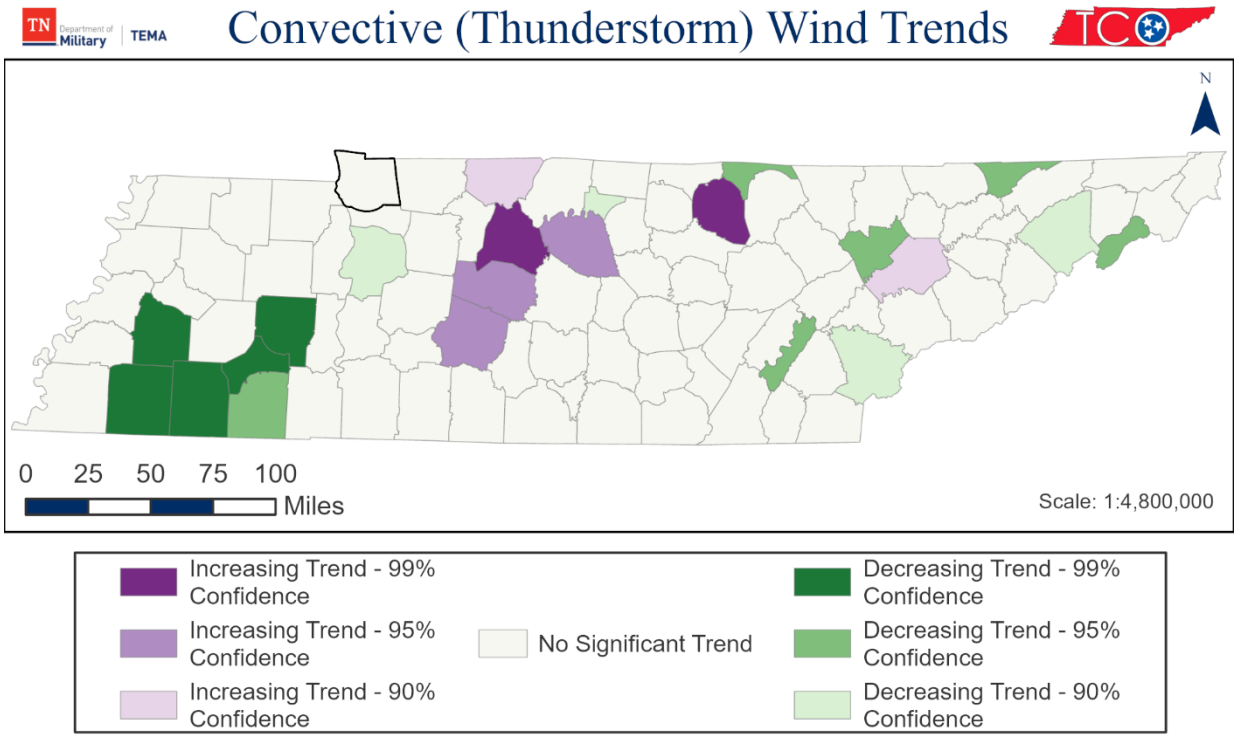


Figure 24: Trends in the Number of Thunderstorm Wind Events Recorded in the NCEI Storm Events Database from 1996 to 2021, Stewart County Outlined in Bold.

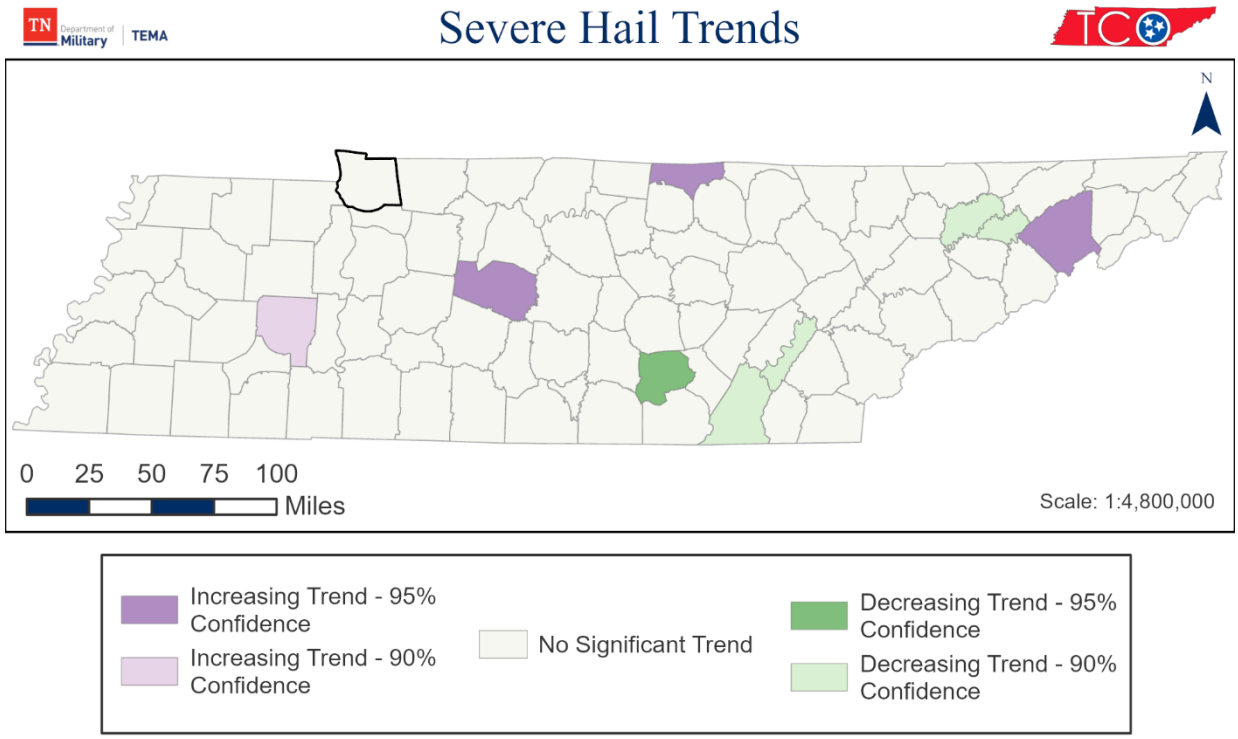


Figure 25: Trends in the Number of Severe Events Recorded in the NCEI Storm Events Database from 1996 to 2021, Stewart County Outlined in Bold.

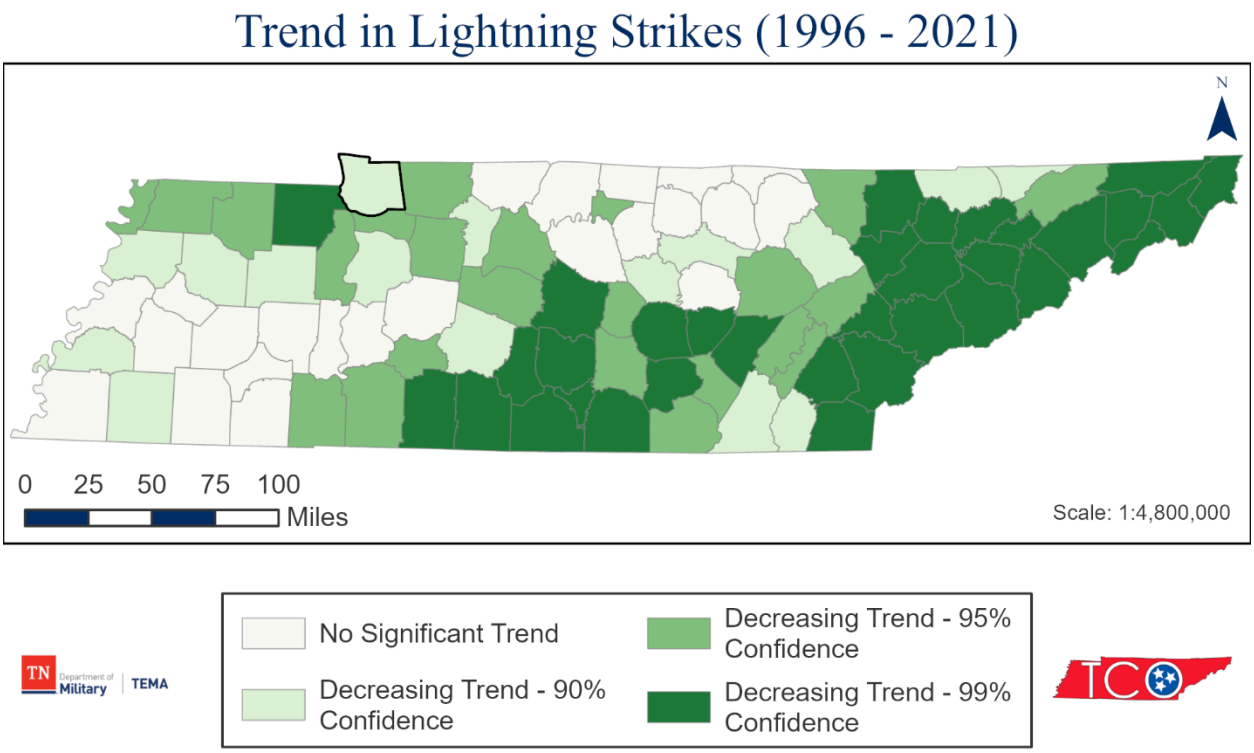


Figure 26: Trends in the Number of Lightning Strikes per County Recorded in the NOAA Severe Weather Data Inventory from 1996 to 2021, Stewart County Outlined in Bold.

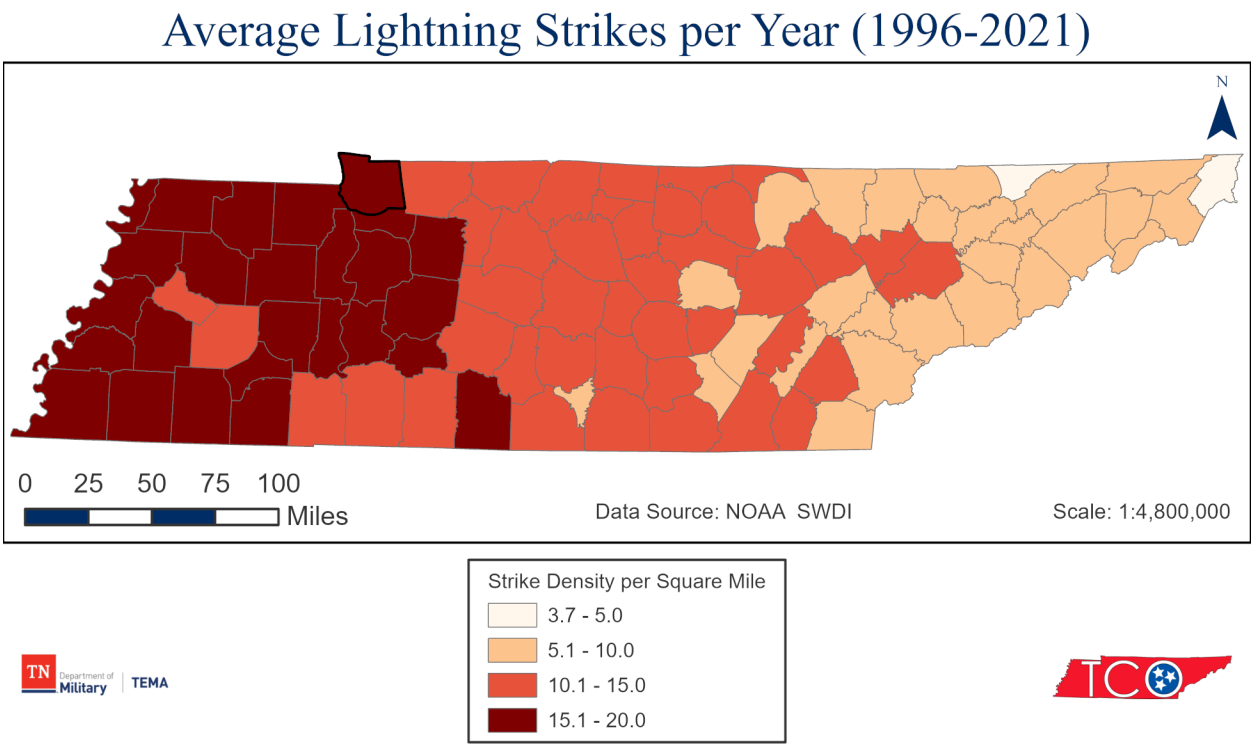


Figure 27: Average Annual Number of Lightning Strikes per Square Mile from 1996 to 2021, Stewart County Outlined in Bold.

Non-Convective High Winds

The Tennessee Climate Office also analyzed trends for non-convective (non-thunderstorm) wind reports in counties across Tennessee using the NOAA Storm Events Database with data from 1996 to 2021, and Stewart County showed a slight significant increasing trend in non-convective wind events during this time.

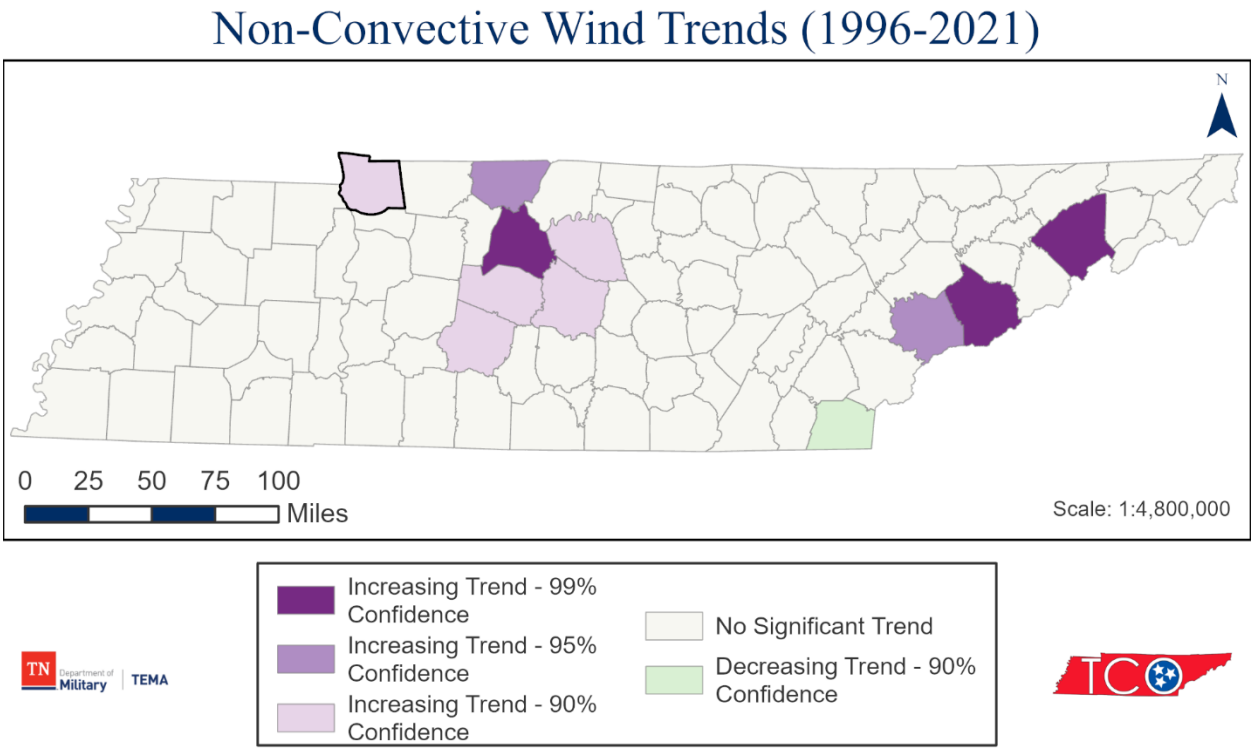


Figure 28: Trends in the Number of Non-Convective Wind Events Recorded in the NCEI Storm Events Database from 1996 to 2021, Stewart County Outlined in Bold.

Winter Weather

Data from the National Weather Service NOHRSC National Gridded Snowfall Analysis webpage covering the winters of 2008-2009 to 2022-2023 (the last 15-years) indicates that the average annual snowfall for Stewart County ranges from 4-inches per year in the southernmost parts of the county to 10-inches per year across the northern half of the county.

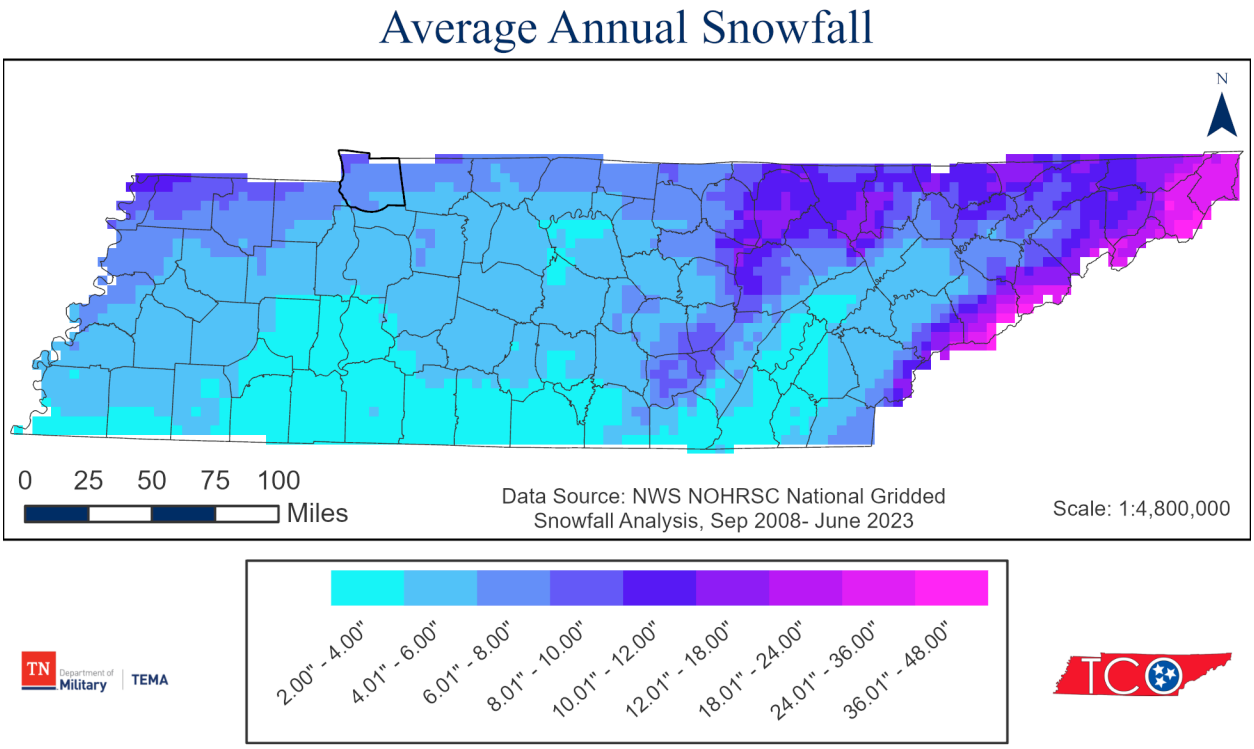


Figure 29: Average Annual Snowfall from the Winter of 2008/2009 to the Winter of 2022/2023, Stewart County Outlined in Bold.

Using data from the NOAA Storm Events Database, trend analysis was performed on winter weather-related storms from 1996 to 2021 across the state of Tennessee. In this time period there was an increasing trend in the number of winter storms impacting Stewart County, this trend was significant to the 99% confidence level threshold.

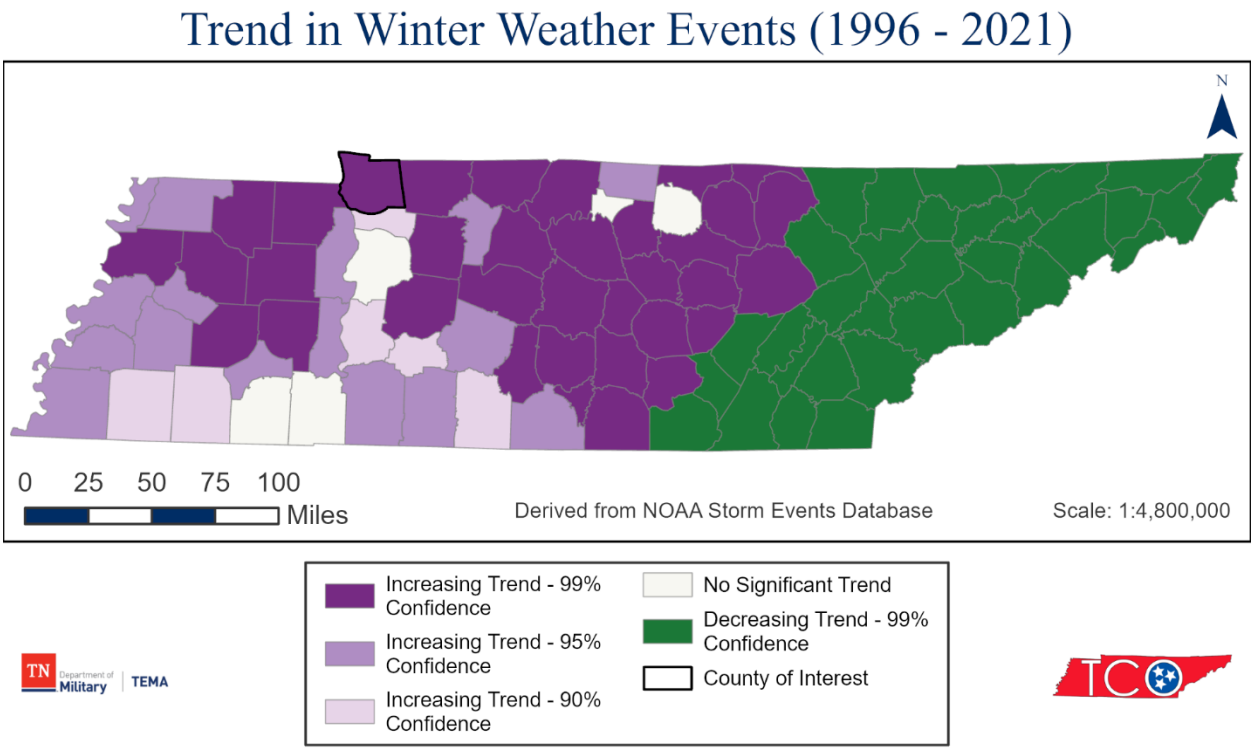


Figure 30: Trends in the Number of Winter Weather-Related Events Recorded in the NCEI Storm Events Database from 1996 to 2021, Stewart County Outlined in Bold.

Climate trends and variability will impact the future likelihood of winter weather events or severe winter storms in Tennessee, likely decreasing but not eliminating the overall risk. Average annual temperatures are expected to increase across the Southeast US, including temperatures during the winter season. Stewart County has an observed warming trend of +0.1°F per decade from 1896 to 2022 throughout the meteorological/climatological winter season (December – February). In the medium-term (1961 - 2022) the winter temperature trend shows greater warming at +0.7°F per decade, however the short-term (1991 - 2022) trend shows slightly moderated warming of +0.3°F per decade during the winter season. The moderation was caused by the exclusion of the very cold winters of 1963 and 1977-1979.

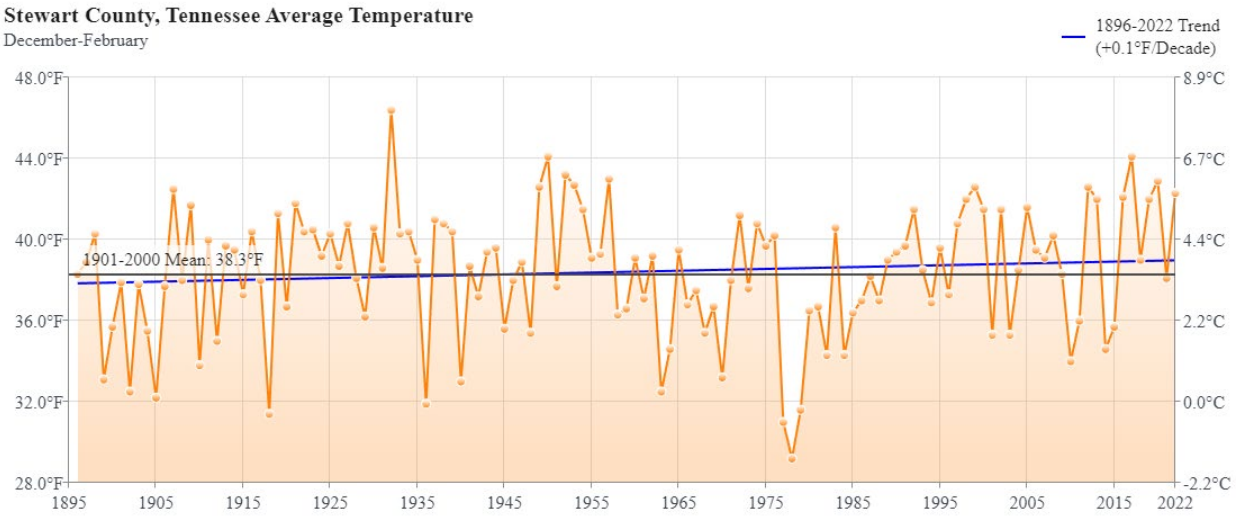


Figure 31: Winter (December to February) Mean Temperature for Stewart County Tennessee, Showing a +0.1°F Increase per Decade Since 1895.
(Source: NOAA NCEI, Climate at a Glance: County Time Series)

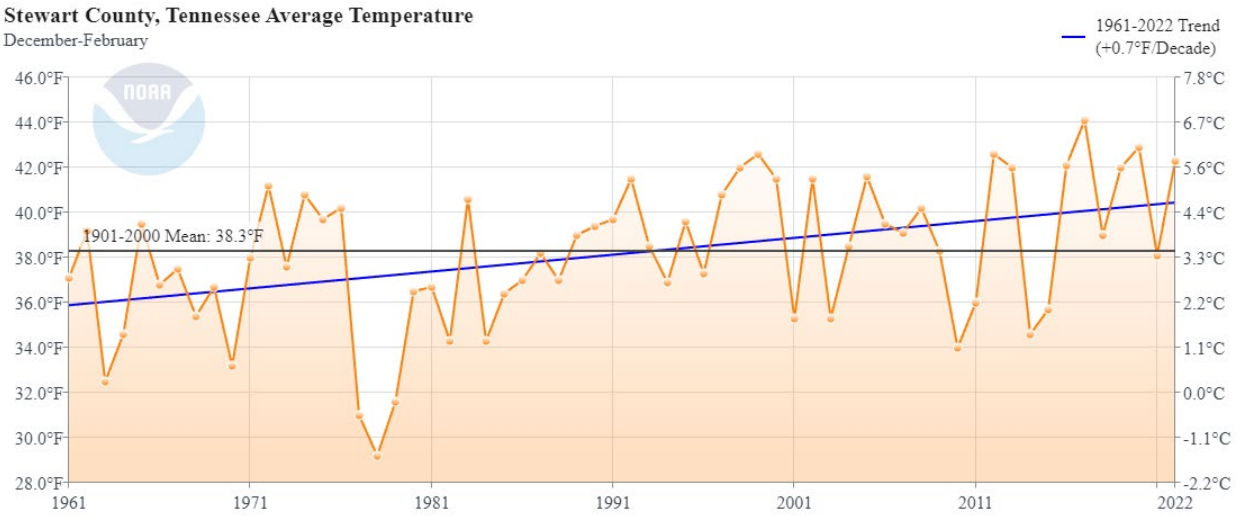


Figure 32: Winter (December to February) Mean Temperature for Stewart County Tennessee, Showing a +0.7°F Increase per Decade Since 1961.
(Source: NOAA NCEI, Climate at a Glance: County Time Series)

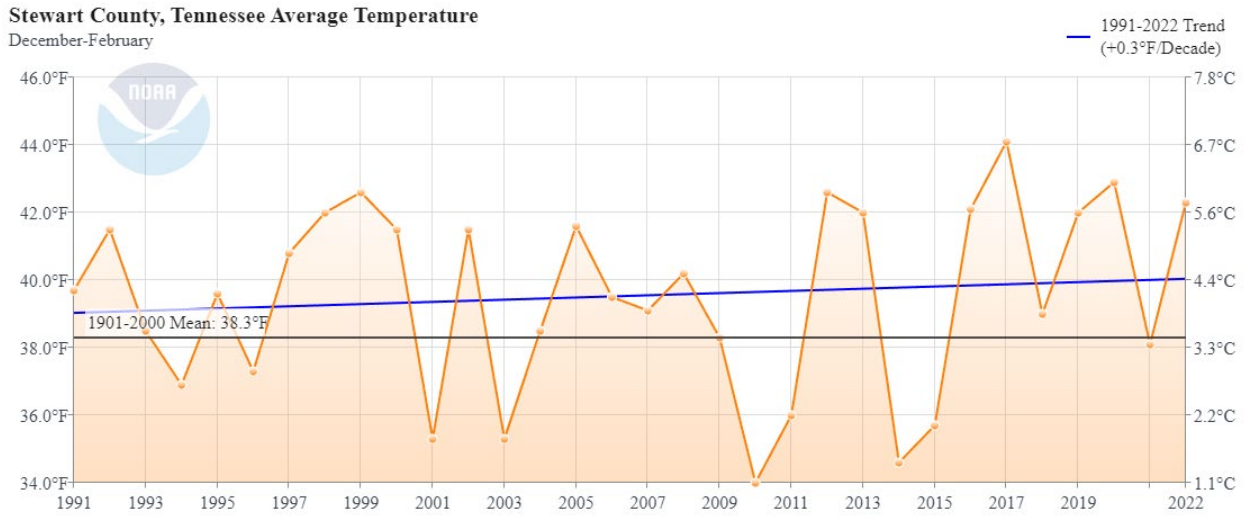


Figure 33: Winter (December to February) Mean Temperature for Stewart County Tennessee, Showing a +0.3°F Increase per Decade Since 1991.
(Source: NOAA NCEI, Climate at a Glance: County Time Series)

In addition to the increasing average annual and winter temperatures, the USDA and US Forest Service Office of Sustainability and Climate projects that the length of the frost-free season will increase by 40-50 days across Stewart County by the late 21st century. This means that the amount of time during the year where winter weather is possible will decrease. Currently, frost is possible in Stewart County for about two thirds of the year (from October until early May), but by the late 21st century that is projected to decrease to just a quarter of the year. In the following two figures the historical and projected number of Frost Days (days with a minimum temperature below freezing) and Icing Days (days with a maximum temperature below freezing) are shown for Stewart County from the U.S. Climate Resilience Toolkit Climate Explorer. The mean projection for the low emissions scenario indicates that Stewart County could have approximately 31 fewer Frost Days per year by the end of the century, while the mean projection for the high emissions scenario indicates Stewart County could have 49 fewer Frost Days per year than the 1961-1990 observed average number of frost days. The mean projection for the low emissions scenario shows that Stewart County could observe approximately eight fewer Icing Days per year, while the high emissions scenario shows that Stewart County could observe approximately 11 fewer Icing Days per year by the end of the century compared to the 1961-1990 observed average.

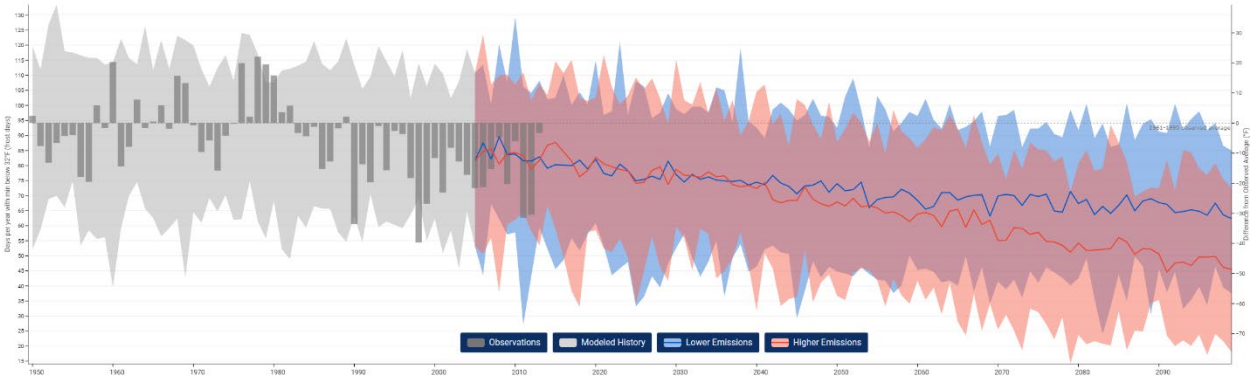


Figure 34: Days Per Year with Minimum Temperature Below 32°F (Frost Days) with Historical

Observations from 1950 to 2013 and High (red) and Low (blue) Emission Scenarios Going to 2100 for Stewart County, Tennessee.
(Source: U.S. Climate Resilience Toolkit Climate Explorer)

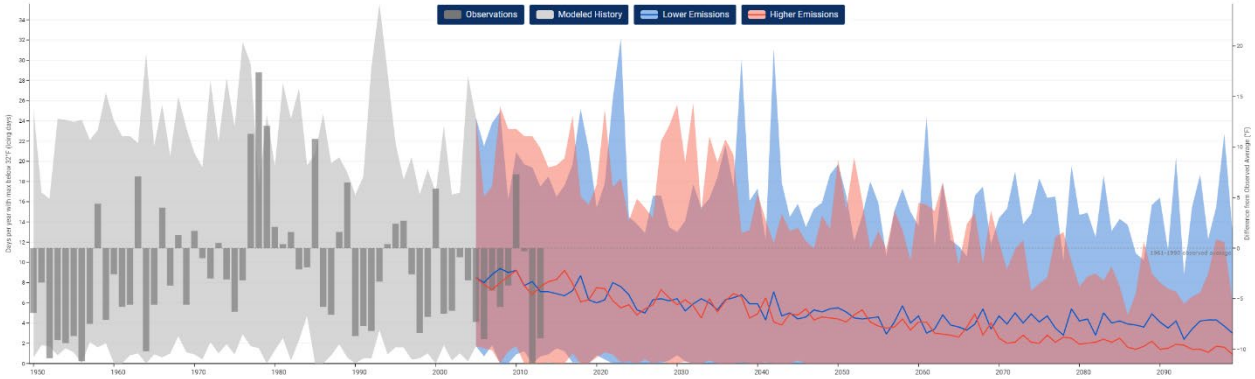


Figure 35: Days per Year with a Maximum Temperature Below 32°F (Icing Days) With Historical Observations from 1950 to 2013 and High (red) and Low (blue) Emission Scenarios Going to 2100 for Stewart County, Tennessee.
(Source: U.S. Climate Resilience Toolkit Climate Explorer)

Additionally, the USDA forecasted changes in plant hardiness zones for the Southeast U.S. The following figure, from the Fourth National Climate Assessment (2018) indicates that Stewart County may transition from Plant Hardiness Zones 6b (historical data, 1976-2005) to Plant Hardiness Zones 7b/8a by 2070-2099, based on climate models using the RCP8.5 (higher emissions) greenhouse gas emissions scenario. That would correlate to a warming of ~15 degrees in the average coldest temperature expected in parts of the county, from historical values of -5°F to +5°F to future values of +10°F to +15°F.

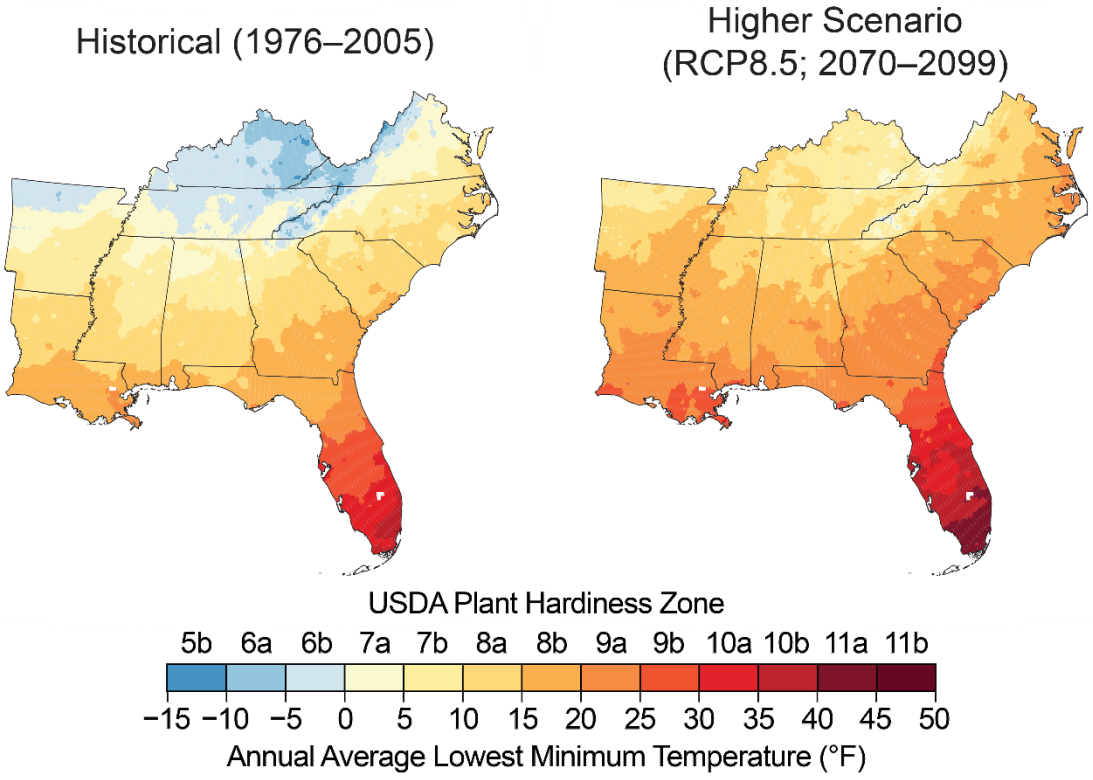


Figure 36: Comparison of Plant Hardiness Zones Across the Southeast U.S. from Historical Averages and Projected Values for Late Century using RCP8.5 (high emissions) Scenario Models. (Source: Fourth National Climate Assessment (Southeast Chapter))

Tornado

Using historical data from 1980 to 2021, Stewart County has a relatively high density for tornadoes in Tennessee, with an average of 0.11 to 0.2 tornado tracks per square mile in most of the county with a slightly lower density in the southeastern corner of Stewart County. A powerful EF3 tornado impacted parts of northwest Stewart County since the last hazard mitigation plan update.

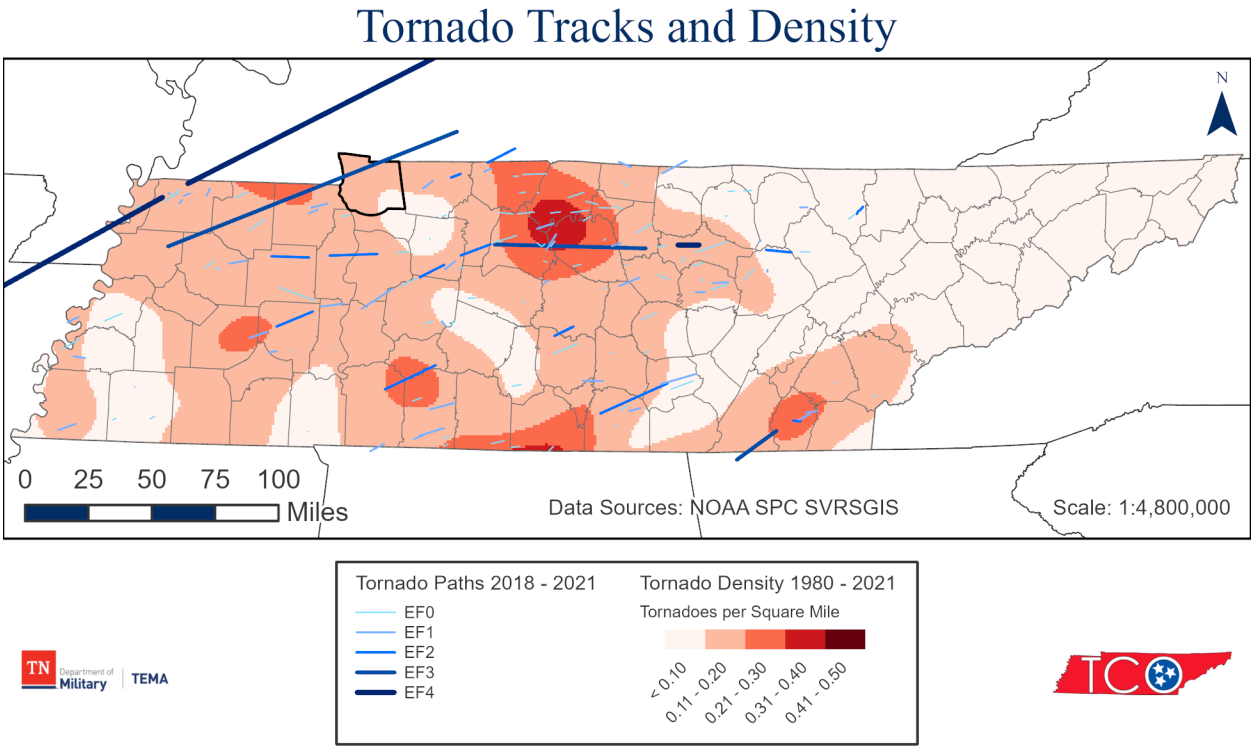


Figure 37: Tornado Tracks from 2018-2021 and the Density of Tornado Tracks across Tennessee from 1980 to 2021, Stewart County Outlined in Bold.

Using data from the NOAA Storm Events Database, trend analysis and emerging hotspot analysis were performed on the number of tornadoes reported in each county of Tennessee from 1996 to 2021. There was no significant up or down trend in the number of tornadoes observed in Stewart County and it was not identified as an emerging hot spot. These results indicate that while there are a high number of tornadoes occurring in Stewart County, there is not a significant increasing or decreasing trend in the number of tornadoes observed per year over the past 26 years.

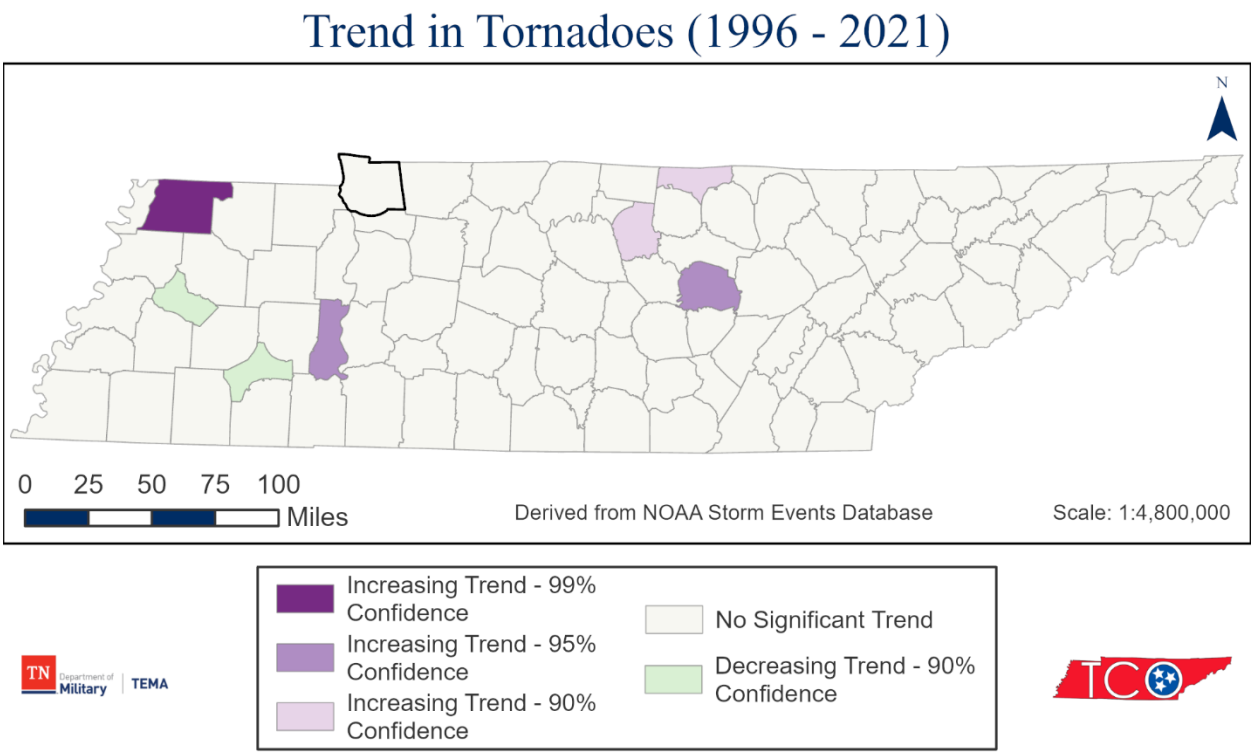


Figure 38: Trends in the Number of Tornadoes Recorded in the NCEI Storm Events Database from 1996 to 2021, Stewart County Outlined in Bold.

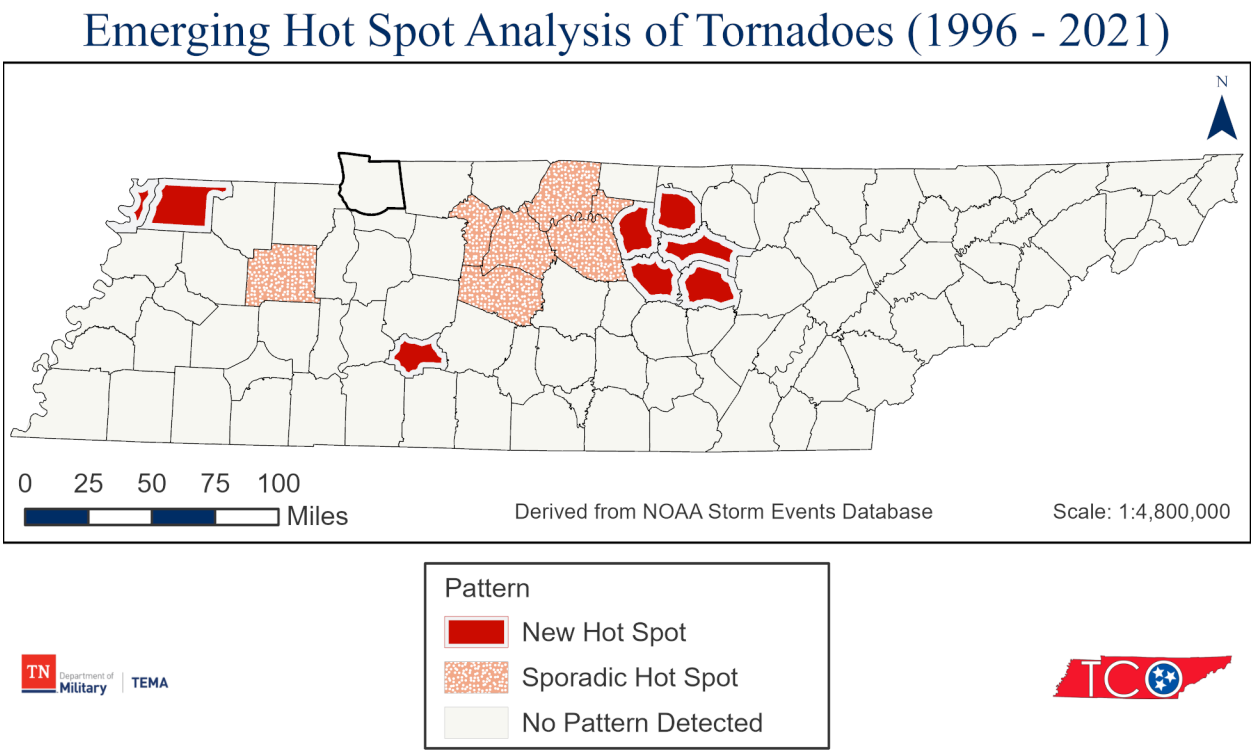


Figure 39: Emerging Hot Spot Analysis based on the Number of Tornadoes per Year Recorded in the NCEI Storm Events Database from 1996 to 2021, Stewart County Outlined in Bold.

Going forward, it is uncertain how climate trends will impact the overall frequency of tornadoes, with convective storms (from which tornadoes form) being the least well understood extreme events when it comes to attributing future changes to climate trends and variations. However, some studies suggest that the number of days conducive to severe thunderstorms, which can spawn tornadoes, may increase in some areas of the country including Middle Tennessee. Additionally, warmer temperatures can provide more energy to storms, potentially leading to more intense tornadoes.

Tornado formation depends on the interaction of multiple atmospheric factors, including temperature, humidity, wind shear, and instability. While climate trends may alter some of these factors, the precise impact on tornado formation remains uncertain. Warmer temperatures and increased moisture content in the atmosphere can contribute to more favorable conditions for tornado formation, but other factors like wind shear patterns may also change and reduce the chances for tornado formation.

Climate trends could also affect the geographical distribution and tracks of tornadoes. Changes in large-scale weather patterns, such as shifts in the jet stream or alterations in atmospheric circulation patterns, may influence where tornadoes form and how they move. This could lead to changes in the regions that are most susceptible to tornado activity.