2023 Madison County
Multi-Jurisdictional
Hazard Mitigation Plan

5 Year Update

Southeast Missouri
Regional Planning Commission

SEMORPC
SOUTHEAST MISSOURI REGIONAL
PLANNING COMMISSION

Madison County Hazard Mitigation Planning Committee

Jurisdictional Representatives

Name	Title	Department	Jurisdiction/Agency/Organization
Larry Kemp	Commissioner	Commission	Madison County
Donal Firebaugh	County Clerk	Admin	Madison County
Dean Stevens	Director	Emergency Management	Madison County
Gregg Pruett	Superintendent	Road and Bridge	Madison County
James Settle	City Administrator	Admin	Fredericktown
Theresa Harbison	City Clerk	Admin	Fredericktown
Chadd Starkey	Superintendent	Admin	Fredericktown R-I School Dist.
Shannon Henson	Assistant Superintendent	Admin	Fredericktown R-I School Dist.
Scott Blake	Superintendent	Admin	Marquand-Zion R-VI School Dist.

Stakeholder Representatives

Name	Title	Department	Agency/Organization
Becky Hunt	Administrator		Madison County Health Dept.
Jeff Stackle	Emergency Preparedness Coordinator		Madison County Memorial Hospital
John Clark	Chief	Fire Department	Fredericktown
Eric Hovis	Chief	Police Department	Fredericktown
Lt. Michele Coon	Lieutenant	Troop Staff	MSHP Region E

John Singleton	CEO	Admin	Black River Electric Cooperative
Jeremy Gray	Regional Coordinator	Mitigation	SEMA
Steve Besemer	Regional Coordinator	Mitigation	SEMA
Hank Voelker	Regional Coordinator	Mitigation	SEMA
Art Goodin	Director	Southeast Regional Office	Missouri Department of Natural Resources
Leslie Seabaugh	Coordinator	Regional Homeland Security Oversight Committee	SEMO Regional Planning Commission
Ben Nickols	Regional Disaster and Program Officer		American Red Cross - Eastern Missouri Chapter
Brian Okenfuss	Area Engineer	Engineering & Design	Missouri Department of Transportation
Brian Courtney	Director	Missouri Interoperability Center	Dept of Public Safety
Mary Smith	Hazard Mitigation Specialist	Mitigation	SEMA
Josh Thompson	Coordinator		Solid Waste Management District
Nick Jones	EMD	Emergency Management	St. Francois County
Kevin Cooper	EMD	Emergency Management	Bollinger County

Stakeholders are individuals or groups that are affected by a mitigation action or policy and include businesses, private organizations, and citizens. Unlike planning team members, stakeholders may not be involved in all stages of the planning process, but they inform the planning team on a specific topic or provide input from different points of view in the community.

TABLE OF CONTENTS

CONTRIBUTORS ..... *i*
County A Hazard Mitigation Planning Committee i
Stakeholder Representatives i

TABLE OF CONTENTS ..... *iii*

EXECUTIVE SUMMARY ..... *iv*

PREREQUISITES ..... *vii*
Model Resolution viii

1 Introduction And Planning Process 1.1

2 Planning Area Profile And Capabilities 2.1

3 Risk Assessment 3.1

4 Mitigation Strategy 4.1

5 Plan Maintenance Process 5.1

Appendix A: Adoption Resolutions
Appendix B: Planning Process

EXECUTIVE SUMMARY

The purpose of hazard mitigation is to reduce or eliminate long-term risk to people and property from hazards. Madison County and participating jurisdictions and school/special districts developed this multi-jurisdictional local hazard mitigation plan update to reduce future losses from hazard events to the County and its communities and school/special districts. The plan is an update of a plan that was approved on August 9, 2012. The plan and the update were prepared pursuant to the requirements of the Disaster Mitigation Act of 2000 to result in eligibility for the Federal Emergency Management Agency (FEMA) Hazard Mitigation Assistance Grant Programs.

The County Multi-Hazard Mitigation Plan is a multi-jurisdictional plan that covers the following four (4) jurisdictions that participated in the planning process:

- Unincorporated Madison County
- City of Fredericktown
- Fredericktown R-I School District
- Marquand-Zion R-VI School District

The villages of Cobalt Village and Junction City were invited to participate in the planning process, but did not meet all of the established requirements for official participation. When the future five-year update is developed for this plan, these jurisdictions will be invited again to participate.

Madison County and the entities listed above developed a Multi-Jurisdictional Hazard Mitigation Plan that was approved by FEMA on June 18, 2018 (hereafter referred to as the *2018 Hazard Mitigation Plan*). This current planning effort serves to update that previously approved plan.

The plan update process followed a methodology prescribed by FEMA, which began with the formation of a Hazard Mitigation Planning Committee (HMPC) comprised of representatives from Madison County and participating jurisdictions. The HMPC updated the risk assessment that identified and profiled hazards that pose a risk to Madison County and analyzed jurisdictional vulnerability to these hazards. The HMPC also examined the capabilities in place to mitigate the hazard damages, with emphasis on changes that have occurred since the previously approved plan was adopted. The HMPC determined that the planning area is vulnerable to several hazards that are identified, profiled, and analyzed in this plan. Riverine and flash flooding, winter storms, severe thunderstorms/hail/lightning/high winds, and tornadoes are among the hazards that historically have had a significant impact.

Based upon the risk assessment, the HMPC updated goals for reducing risk from hazards. The goals are listed below:

1. Protect the health, safety, and welfare of residents and students.
2. Ensure the operation of critical facilities and services.
3. Protect public and private property.
4. Enhance informed decision making of mitigation actions.

To advance the identified goals, the HMPC developed recommended mitigation actions, which are detailed in Chapter 4 of this plan. The HMPC developed an implementation plan for each action, which identifies priority level, background information, ideas for implementation, responsible agency, timeline, cost estimate, potential funding sources, and more.

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
	Prevention							
1.1	NFIP Participation	Madison	H	3	F	Y	Y	Y
1.1	NFIP Participation	Fredericktown	H	3	F	Y	Y	Y
	Structure and Infrastructure Projects							
2.1	Justice Center	Madison	H	2	E	Y	Y	
4.1	Safe Room	Madison	H	1	T, ST, EH, EC	Y	Y	
6.1	Bridge or Low Water Crossing Replacement	Madison	H	2	F, E	Y	Y	
2.1	Bridge or Low Water Crossing Replacement	Fredericktown	L	2	F, E	Y	Y	
3.1	Safe Room	Fredericktown	M	1	T, ST, EH, EC	Y	Y	
1.1	Seismically Retrofit Priority Building	F R-I	L	3	E	Y	N	
4.1	Safe Room	F R-I	M	1	T, ST, EH, EC	Y	Y	
1.1	Bury Powerlines	M-Z R-VI	H	2	ST, SWW, T	Y	N	
4.1	Safe Room	M-Z R-VI	M	1	T, ST, EH, EC	Y	Y	
	Natural Systems Protection							
3.1	Stream Maintenance	F R-I	M	1	F	Y	Y	
	Emergency Services							
3.1	Purchase Emergency Generators	Madison	M	2	E, ST, SWW, T	Y	Y	
5.1	Early Warning Sirens	Madison	H	1	T	Y	Y	
4.1	Early Warning Sirens	Fredericktown	H	1	T	Y	Y	
5.1	Purchase Emergency Generators	Fredericktown	M	2	E, ST, SWW, T	Y	Y	
2.1	Purchase Emergency Generators	F R-I	H	2	E, ST, SWW, T	Y	Y	
2.1	Purchase Emergency Generators	M-Z R-VI	H	2	E, ST, SWW, T	Y	Y	
3.1	Early Warning Sirens	M-Z R-VI	H	1	T	Y	Y	
	Education and Outreach							

PREREQUISITES

This plan has been reviewed by and adopted with resolutions or other documentation of adoption by all participating jurisdictions and schools/special districts. The documentation of each adoption is included in Appendix D, and a model resolution is included on the following page.

The following jurisdictions participated in the development of this plan and have adopted the multi-jurisdictional plan.

- Unincorporated Madison County
- City of Fredericktown
- Fredericktown R-I School District
- Marquand-Zion R-VI School District

Model Resolution

Resolution # ____

Adopting the Madison County Multi-Jurisdictional Local Hazard Mitigation Plan

Whereas, the (Name of Government/District/Organization seeking FEMA approval of hazard mitigation plan) recognizes the threat that natural hazards pose to people and property within our community; and

Whereas, undertaking hazard mitigation actions will reduce the potential for harm to people and property from future hazard occurrences; and

Whereas, the U.S. Congress passed the Disaster Mitigation Act of 2000 ("Disaster Mitigation Act") emphasizing the need for pre-disaster mitigation of potential hazards;

Whereas, the Disaster Mitigation Act made available hazard mitigation grants to state and local governments; and

Whereas, an adopted Local Hazard Mitigation Plan is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

Whereas, the (Name of Government/District/Organization) fully participated in the hazard mitigation planning process to prepare this Multi-Jurisdictional Local Hazard Mitigation Plan; and

Whereas, the Missouri State Emergency Management Agency and the Federal Emergency Management Agency Region VII officials will review the "County A Multi-Jurisdictional Local Hazard Mitigation Plan," and approved it as to form and content; and

Whereas, the (Name of Government/District/Organization) desires to comply with the requirements of the Disaster Mitigation Act and to augment its emergency planning efforts by formally adopting the Madison County Multi-Jurisdictional Local Hazard Mitigation Plan; and

Whereas, adoption by the governing body for the (Name of Government/District/Organization) demonstrates the jurisdictions' commitment to fulfilling the mitigation goals outlined in this Multi-Jurisdictional Local Hazard Mitigation Plan; and

Whereas, adoption of this legitimizes the plan and authorizes responsible agencies to carry out responsibilities under the plan;

Now, therefore, be it resolved, that the (Name of Government/District/Organization) has adopted the "Madison County Multi-Jurisdictional Local Hazard Mitigation Plan" as an official plan.

Date: _____

Certifying Official: _____

1 INTRODUCTION AND PLANNING PROCESS

1 INTRODUCTION AND PLANNING PROCESS 1

1.1 Purpose *1*

1.2 Background and Scope *1*

1.3 Plan Organization 2

1.4 Planning Process 3

1.4.1 Multi-JurisdictionalParticipation 4

1.4.2 The Planning Steps 6

1.1 Purpose

The purpose of hazard mitigation is to reduce or eliminate long-term risk to people and property from hazards. Hazard mitigation is generally considered to be the actions taken well in advance of a disaster event. Actions taken immediately prior to or during an event or immediately following an event are typically considered response and recovery actions, respectively. This plan has been developed to assist participating jurisdictions in identifying potential hazard exposures and defining actions that can limit such.

For jurisdictions to be eligible for federal Hazard Mitigation Grants, they must participate in this planning process and adopt the plan by resolution. Any jurisdictions that do not participate will be ineligible for such grants until the next plan update is undertaken. This plan is viable for five (5) years from the date of FEMA approval.

For additional information about the Hazard Mitigation Planning Process, please refer to: the Disaster Mitigation Act of 2000 (Public Law 106-390) and the implementing regulations set forth by the Interim Final Rule published in the Federal Register on February 26, 2002, (44 CFR §201.6) and finalized on October 31, 2007 (hereafter referred to collectively as the Disaster Mitigation Act or DMA) and the Robert T. Stafford Disaster Relief and Emergency Act (Public Law 93-288).

1.2 Background and Scope

This hazard mitigation plan (HMP) is an update to the 2018 Madison County HMP which was approved by FEMA on June 18, 2018. This plan is valid for a period of five years and will undergo a full update cycle in 2028.

The following table provides a list of participants during this plan update process as well as the previous one.

Table 1.1. Plan Participants

Jurisdiction	NFIP Participant	Participating Jurisdiction (2018)	Participating Jurisdiction Criteria (2017)				Participating Jurisdiction (2016)
			Meetings Attended	Actions Developed	Draft Reviewed	Formal Adoption	
Madison County	Y	Y	X	X	X	X	X
Cobalt Village	Y	N	X				
Fredericktown	Y	Y	X	X	X	X	X
Junction City	N	N					
Marquand	Y	N					
Fredericktown R-I School Dist.	N/A	Y	X	X	X	X	X
Marquand-Zion R-VI School Dist.	N/A	Y	X	X	X	X	X

Information in this plan will be used to help guide and coordinate mitigation activities and decisions for local land use and development policy in the future. Actions from this plan will also be incorporated into local jurisdiction's other planning efforts as appropriate.

1.3 Plan Organization

This HMP is organized into 5 main chapters, along with an executive summary and appendices, as follows:

- Executive Summary
- Chapter 1: Introduction and Planning Process
- Chapter 2: Planning Area Profile and Capabilities
- Chapter 3: Risk Assessment
- Chapter 4: Mitigation Strategy
- Chapter 5: Plan Implementation and Maintenance
- Appendices

Table 1.2 shows a comparison between this plan's structure and that of the previous plan, along with a summary of changes in each section from the previous plan.

Table 1.2. Changes Made in Plan Update

Changes and Revisions	Current Plan Sections	Previous Plan Sections
Participants, stakeholders, resolution of adoption	Executive Summary & Prerequisites	Introduction
		Prerequisites
Information on the current planning process, including dates, locations, participants, and meetings	Introduction and Planning Process	The Planning Process
Information on the planning area including demographics, economics, and assets as well as the capabilities of each jurisdiction	Planning Area Profile and Capabilities	Risk Assessment
Information on jurisdictions' exposure to hazards	Risk Assessment	
Jurisdictions' previous, continuing, and new actions as well as the goals and objectives for the plan	Mitigation Strategy	Hazard Mitigation Program
Information on implementation with other plans and the maintenance schedule and responsibilities	Plan Implementation and Maintenance	Plan Maintenance Process
Additional relevant data	Appendices	Appendices

1.4 Planning Process

The Southeast Missouri Regional Planning Commission (SEMO RPC) was contracted by SEMA to facilitate the update of the HMP. RPC staff assisted local jurisdictions in the establishment of an HMPC as defined by the DMA and updated the committee on current requirements for the HMP process. Planning staff determined the plan had been maintained in accordance with the methodology set forth in the previous plan through communications with all participating jurisdictions on a yearly basis to assess the need for revisions to the plan, of which there were none. SEMO RPC staff also ensured the updated plan met the DMA requirements as established by federal regulations and that it followed the most current planning guidance of FEMA.

The RPC also facilitated the entire plan development process by identifying the data which HMPC participants should provide and conducting research and documentation necessary to augment such data and by soliciting public input in the planning process. Commission staff also produced the draft and final plan update in a FEMA-approvable document and coordinated plan reviews with both SEMA and FEMA.

Table 1.3. Jurisdictional Representatives Madison County Mitigation Planning Committee

Name	Title	Department	Jurisdiction/Agency/Organization
Larry Kemp	Commissioner	Commission	Madison County
Donal Firebaugh	County Clerk	Admin	Madison County
Dean Stevens	Director	Emergency Management	Madison County
Gregg Pruett	Superintendent	Road and Bridge	Madison County
James Settle	City Administrator	Admin	Fredericktown
Theresa Harbison	City Clerk	Admin	Fredericktown
Chadd Starkey	Superintendent	Admin	Fredericktown R-I School Dist.
Shannon Henson	Assistant Superintendent	Admin	Fredericktown R-I School Dist.
Scott Blake	Superintendent	Admin	Marquand-Zion R-VI School Dist.

Table 1.4. MPC Capability with Six Mitigation Categories

Community Department/Office	Preventive Measures	Structure and Infrastructure Projects		Natural Resource Protection	Public Information	Emergency Services
		Property Protection	Structural Flood Control Projects			
County Commission	X	X	X		X	
County Emergency Management	X	X	X	X	X	X
County Road & Bridge	X		X			
Fredericktown Admin	X	X			X	X
Fredericktown R-I Admin	X	X			X	
Marquand-Zion R-Vi Admin	X	X			X	

1.4.1 Multi-Jurisdictional Participation

Active participation in the hazard mitigation planning process is important to ensure each jurisdiction is adequately represented, that their needs and exposures are properly evaluated, and that their actions are appropriate and effective at addressing those needs and exposures. Representatives from the County, incorporated communities, public schools, and stakeholders were invited to participate in the planning process through certified mail and electronic communications. The DMA requires each jurisdiction to participate in the planning process and officially adopt the plan to be considered an eligible participant.

During its first meeting, the HMPC determined the criteria for being considered an eligible participant in this planning process, as follows:

- Representation (direct or through appointee) at a majority of the public HMPC meetings,
- Actively solicit public input and participation in planning process,
- Review prior plan,
- Complete HMP questionnaire,
- Update jurisdiction's hazard mitigation actions from previous plan,
- Review and comment on new draft, and
- Adoption of new plan.

Four jurisdictions met all of the participation requirements: Madison County, Fredericktown, Fredericktown R-I School Dist., and Marquand-Zion R-VI School Dist. The three (3) remaining jurisdictions, Cobalt Village, Junction City, and Marquand, met some of the requirements, but not all. These three jurisdictions will be invited to participate again in the next plan update process in five (5) years.

For small, rural jurisdictions, participation in planning processes such as these can be difficult. Many rural communities have no full-time staff, and in some cases have only a volunteer clerk. Making committee meetings, completing questionnaires, review previous plans, validating actions, and commenting on drafts are entirely different undertakings for officials who have a full-time day job and a full-time elected position. Additionally, acquiring public input in rural areas can be challenging as well. Many residents lack adequate access to the internet, do not visit their local library or courthouse on a regular basis, and do not subscribe to other media. Limited resources, less population density, and longer commute times mean word of mouth spreads much more slowly in these areas. These issues make it more difficult for small communities and the rural public to participate in planning processes. RPC staff continues to work with jurisdictions to improve public outreach and engagement practices.

Table 1.4 shows the manner of participation for each participating jurisdiction. Meeting sign-in sheets can be found in the appendix.

Table 1.5. Jurisdictional Participation in Planning Process

Jurisdiction	Kick-off Meeting	Meeting #2	Meeting #3	Data Collection Questionnaire Response	Update/Develop Mitigation Actions
Madison County	X	X	X	X	X
Fredericktown	X	X	X	X	X
Fredericktown R-I School Dist.	X	X	X	X	X
Marquand-Zion R-VI School Dist.	X	X	X	X	X

1.4.2 The Planning Steps

SEMO RPC and Madison County worked together to establish the framework and process for this planning effort using FEMA's *Local Mitigation Planning Handbook* (March 2013). The plan update was completed utilizing the 9-task approach within a more broad four-phase process:

1. Organize resources,
2. Assess risks,
3. Develop the mitigation plan, and
4. Implement the plan and monitor progress.

Into this process, SEMO RPC integrated a detailed 10-step planning process adapted from FEMA's Community Rating System (CRS) and Flood Mitigation Assistance programs. Thus, the process used for this plan meets the funding eligibility requirements of the Hazard Mitigation Grant Program, Pre-Disaster Mitigation Program, Community Rating System, and Flood Mitigation Assistance Program. Table 1.5 shows how this process fits into FEMA's original four-phase DMA process as well as the revised Nine Task Process outlined in the 2013 *Local Mitigation Planning Handbook* and the 10-step CRS process.

Table 1.6. County Mitigation Plan Update Process

Community Rating System (CRS) Planning Steps (Activity 510)	Local Mitigation Planning Handbook Tasks (44 CFR Part 201)
Step 1. Organize	Task 1: Determine the Planning Area and Resources
	Task 2: Build the Planning Team 44 CFR 201.6(c)(1)
Step 2. Involve the public	Task 3: Create an Outreach Strategy 44 CFR 201.6(b)(1)
Step 3. Coordinate	Task 4: Review Community Capabilities 44 CFR 201.6(b)(2) & (3)
Step 4. Assess the hazard	Task 5: Conduct a Risk Assessment 44 CFR 201.6(c)(2)(i) 44 CFR 201.6(c)(2)(ii) & (iii)
Step 5. Assess the problem	
Step 6. Set goals	Task 6: Develop a Mitigation Strategy 44 CFR 201.6(c)(3)(i); 44 CFR 201.6(c)(3)(ii); and 44 CFR 201.6(c)(3)(iii)
Step 7. Review possible activities	
Step 8. Draft an action plan	
Step 9. Adopt the plan	Task 8: Review and Adopt the Plan
Step 10. Implement, evaluate, revise	Task 7: Keep the Plan Current
	Task 9: Create a Safe and Resilient Community 44 CFR 201.6(c)(4)

Step 1: Organize the Planning Team (Handbook Tasks 1, 2, and 4)

The planning process resulting in the preparation of this plan document officially began with the Kick-off Meeting in Fredericktown, MO on March 16, 2021. Participants of the meeting included representatives from all four participating jurisdictions and RPC staff. The purpose of this meeting was to set planning meeting dates, determine hazards to be included in the plan update, discuss options for the flood risk assessment methodology, develop an initial public participation strategy, and discuss the plan update format. Meeting materials are included in the appendix. An HMPC was created that includes representatives from each participating jurisdiction.

After the initial meeting, two additional planning meeting were held on March 30, 2021, and April 20th, 2021. A complete list of all representatives of the agencies and organizations that participated on the Madison County HMPC is provided in the appendix.

The HMPC communicated during the planning process with a combination of face-to-face meetings, phone interviews, and email correspondence. The meeting schedule and topics are listed in Table 1.6.

Table 1.7. Schedule of HMPC Meetings

Meeting	Topic	Date
Kick-off Meeting	General overview of planning process, requirements, and schedule. Introduction to DMA, hazard identification, and public input strategy. Distribution of data collection guide to jurisdictions. Preliminary hazard rankings. Determine process to monitor, evaluate, and update plan.	March 16, 2021
Planning Meeting #2	Review of draft Risk Assessment, distribution of critical facility inventories for jurisdictions to validate/correct, development of plan goals. Mitigation action update, development, and prioritization.	March 30, 2021
Planning Meeting #3	Review of draft Risk Assessment, review of critical facility inventories. Mitigation action update, development, and prioritization.	April 20th, 2021

During the meetings, SEMO RPC presented information on the scope and purpose of the plan, participation requirements of HMPC members, and the proposed project work plan and schedule. Plans for public involvement (Step 2) and coordination with other agencies and departments (Step 3) were discussed. SEMO RPC also introduced hazard identification requirements and data needs. The HMPC discussed potential hazards as well as past events and impacts and refined the identified hazards relevant to the County. The HMPC made preliminary determinations of probability and magnitude for each hazard identified.

Participants were given the Data Collection Guide to facilitate the collection of information needed to support the plan, such as data on historic hazard events, values at risk, and current capabilities. Each participating jurisdiction completed and returned the worksheets in the Data Collection Guide to the RPC. SEMO RPC integrated this information into the plan, supporting the development of Chapters 2 and 3.

Step 2: Plan for Public Involvement (Handbook Task 3)

At the kickoff meeting, the HMPC discussed options for soliciting public input on the mitigation plan. To provide an opportunity for the public to comment during the drafting stage, the committee determined the most effective method would be to invite the public to the HMPC meetings to gather direct input.

The public was also given an opportunity to provide input on a draft of the complete plan prior to its submittal to the State and FEMA. The entire plan draft was made available on the RPC's website as a PDF document. In addition, two hard copies were made available; one at the Emergency Management Office and the other at the County Courthouse. The participants announced the availability of the entire final draft plan and the two-week final public comment period on their websites. A copy of the announcement is provided in the appendix. The final public comment period was from December 1-16, 2022.

The HMPC invited other targeted stakeholders to comment on the draft plan via e-mail, and phone conversations, which are described in greater detail in Step 3: Coordinate with Other Departments and Agencies. Minor comments were received and incorporated.

Step 3: Coordinate with Other Departments and Agencies and Incorporate Existing Information (Handbook Task 3)

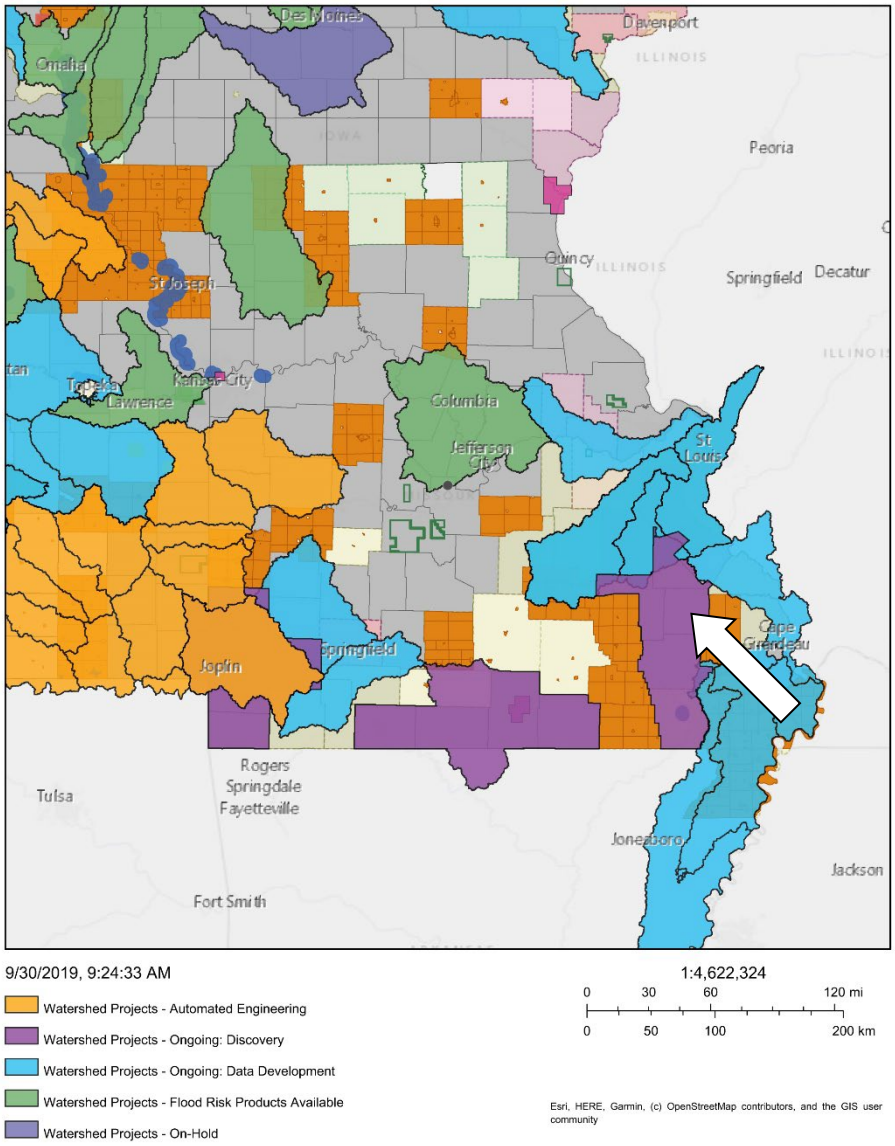
There are numerous organizations whose goals and interests interface with hazard mitigation in Madison County. Coordination with these organizations and other community planning efforts is vital to the success of this plan. The County invited neighboring counties, other local, state, and federal departments and agencies to the planning meetings to learn about the hazard mitigation planning initiative. In addition, the HMPC developed a list of additional stakeholders involved in hazard mitigation activities, to invite to review and comment on the draft of the Madison County Multi-jurisdictional Hazard Mitigation Plan prior to submittal to the State and FEMA. Those agencies invited to meetings and/or comment on the plan draft included emergency management officials of adjacent counties, the Fredericktown IDA, various state agencies such as the Department of Natural Resources and MoDOT.

Coordination with FEMA Risk MAP Project

Madison County is designated as “Effective FIS/FIRM” for the Risk MAP project. Risk Mapping, Assessment, and Planning (Risk MAP) is the Federal Emergency Management Agency (FEMA) Program that provides communities with flood information and tools they can use to enhance their mitigation plans and take action to better protect their citizens.

Through collaboration with State, Tribal, and local entities, Risk MAP delivers quality data that increases public awareness and leads to action that reduces risk to life and property. This data is not yet available for the County, though work is underway as the county falls in the Ongoing: Discovery category. Figure 1.1 Risk MAP Status Map shows the status of regional counties.

Figure 1.1. RiskMAP Status Map (Sept 30, 2019)



Integration of Other Data, Reports, Studies, and Plans

In addition, input was solicited from many other agencies and organizations that provided information but were not able to attend planning meetings. As part of the coordination with other agencies, the HMPC collected and reviewed existing technical data, reports, and plans. These included:

- Missouri Hazard Mitigation Plan,
- Madison County Hazard Mitigation Plan (2018),
- National Flood Insurance Program's Community Information System Reports,
- Digital Flood Insurance Rate Maps,
- DNR Dam and Reservoir Safety Program,

- DNR Sinkhole Location Data,
- MO Land Use Land Cover Data,
- National Fire Incident Reporting System Fire Incident Data,
- Various local plans such as Comprehensive Plans, Economic Development Plans, Emergency Operations Plans, Capital Improvement Plans, etc.

This information was used in the development of the hazard identification, vulnerability assessment, and capability assessment and in the formation of goals, objectives, and mitigation actions. These sources, as well as additional sources of information are documented throughout the plan and in the appendix.

Step 4: Assess the Hazard: Identify and Profile Hazards (Handbook Task 5)

SEMO RPC assisted the HMPC in a process to identify the hazards that have impacted or could impact communities in the County. At the first meeting, the HMPC examined the history of disaster declarations in Madison County, the list of hazards considered in the 2018 Missouri State Hazard Mitigation Plan, and the hazards identified in the previous hazard mitigation plan. The committee then worked through this list of all potential hazards that could affect the planning area. They discussed past hazard events, types of damage, and where additional information might be found. The committee identified 11 natural hazards that have the potential to impact the planning area. Additional information on the hazard identification process and which hazards were identified for each jurisdiction is provided in Chapter 3.

During the kick-off meeting, the HMPC refined the list of hazards to make the analysis relevant to Madison County, discussed past events and impacts and came to consensus on the preliminary probability and magnitude on a county-wide basis. In addition, each jurisdiction completed a Data Collection Guide, including information on previous hazard events in their community. Utilizing the information from the Data Collection Guides as well as existing plans, studies, reports, and technical information as well as information available through internet research and GIS analysis, a profile was developed for each hazard identified. More information on the methodology and resources used to identify and profile the hazards can be found in Chapter 3.

Step 5: Assess the Problem: Identify Assets and Estimate Losses (Handbook Task 5)

Assets for each jurisdiction were identified through a combination of several resources. A listing of critical facilities in each jurisdiction from the previous HMP was presented at Meeting #2 for correction and validation. Once the critical/essential facility lists were validated, they were geo-located to create a consolidated GIS layer of these facilities to be used in additional risk analysis. Methodologies and results of the analyses are provided in Chapter 3.

Additional assets such as historic, cultural, and economic assets as well as specific vulnerable populations and structures were obtained from a variety of sources as described in Chapter 3.

The HMPC also analyzed development trends from data available from the U.S. Census Bureau as well as information obtained from each jurisdiction such as Comprehensive Plans and Future Development Plans. For each hazard, there is a discussion regarding future development and how it may impact vulnerability to that specific hazard.

After profiling the hazards that could affect the County and identifying assets, the HMPC collected information to describe the likely impacts of future hazard events on the participating jurisdictions.

Existing mitigation capabilities were also considered in developing loss estimates. This assessment consisted of identifying the existing mitigation capabilities of participating jurisdictions. This involved collecting information about existing government programs, policies, regulations, ordinances, and plans that mitigate or could be used to mitigate risk from hazards. Participating jurisdictions collected information on their regulatory, personnel, fiscal, and technical capabilities, as well as previous and ongoing mitigation initiatives. This information is included in Chapter 2 Planning Area Profile and Capabilities.

Specific capabilities such as participation in the National Flood Insurance Program as well as designation as Fire Wise Communities or Storm Ready Communities and placement of storm sirens are incorporated in the vulnerability analysis discussions, where applicable.

Taking into consideration the vulnerability and capability assessments, and where sufficient information was available, a variety of methods were used to estimate losses for each profiled hazard. For geographic hazards such as river flooding and wild fire, specific assets at risk and loss estimates were determined through GIS analysis. For other hazards such as weather-related hazards, loss estimates were developed based on statistical analysis of historic events and HMPC input. For dam and levee failure, GIS data was not available to identify specific geographic boundaries at risk. Therefore, the risk assessment is based on aerial photography analysis of development within an estimated hazard area. The methodologies for each loss estimate are described in detail in Chapter 3. Within each hazard section, the text provides details on how the hazard varies by jurisdiction, where applicable. In addition, at the conclusion of each hazard section, a summary table indicates the specific probability and magnitude of the hazard for each jurisdiction to show how the hazard varies. Where applicable, introductory text preceding the table highlights noted variables.

Results of the preliminary risk assessment were presented at Meeting #2 and the Draft Risk Assessment (Chapter 3) was provided to the HMPC for review and comment. Several comments, corrections, and suggestions were provided to SEMO RPC and incorporated into the risk assessment as appropriate.

Step 6: Set Goals (Handbook Task 6)

SEMO RPC facilitated a discussion session with the HMPC during Meeting #2 to review and update goals. Common categories of mitigation goals were presented as well as the 2018 State Hazard Mitigation Plan goals.

This planning effort is an update to an existing hazard mitigation plan. As a result, the goals from the previous plan were reviewed. The planning committee decided to that the 2018 goals are still valid. The goals for the plan update are provided below.

1. Protect the health, safety, and welfare of residents and students.
2. Ensure the operation of critical facilities and services.
3. Protect public and private property.
4. Enhance informed decision making of mitigation actions.

Step 7: Review Possible Mitigation Actions and Activities (Handbook Task 6)

One of the focuses of Meeting #2 and #3 was to update the mitigation strategy by reviewing existing actions submitted in the previous mitigation plans as well as discuss relevant new actions considered necessary as a result of the updated risk assessment. The development of mitigation actions was facilitated through group discussion of the capabilities and risks of each jurisdiction. Consideration was given to the analysis results provided in the risk assessment and the anticipated success for each project type. Committee members discussed issues such as: availability of funds, prioritization of actions, and feasibility of implementation utilizing the STAPLEE methodology as a guide. Projects relating to emergency response were discussed, but participants were encouraged to focus on long-term mitigation solutions since response-related mitigation actions occur on a routine basis as requirements of other plans. Complex projects that would necessitate use of large numbers of county resources were also discussed. This opportunity to discuss a broad range of mitigation alternatives allowed the jurisdictions to understand the overall priorities of the committee and to allow for discussion of the types of project most beneficial to each jurisdiction. As part of this discussion, consideration was given to the potential cost of each project in relation to the anticipated future cost savings.

Since this plan is an update to the *2018 Madison County Hazard Mitigation Plan*, the update of the mitigation strategy included review and update of the status of all actions included in the previous hazard mitigation plan. Jurisdictions were encouraged to maintain a focused approach and continue forward only those actions that are aimed at implementing long-term solutions to prevent losses from hazards. To facilitate the update of previous actions, a spreadsheet was provided to each jurisdiction prior to Meeting #2 with the actions they submitted in the previous mitigation plan. The jurisdictions were also provided instructions for completing the status of each of the previous actions as well as the details to provide for continuing and newly developed actions. A modified form of the STAPLEE prioritization tool was provided to assist jurisdictions in determining the prioritization that should be assigned to each action. Each participating jurisdiction prioritized the projects they submitted by indicating high, moderate, or low local priority. The completed spreadsheets with action details were returned to SEMO RPC. Chapter 4 provides additional details regarding the process undertaken to refine the mitigation strategy to make the County and its jurisdictions more disaster resistant.

Step 8: Draft an Action Plan (Handbook Task 6)

A complete draft of the plan was made available online and in hard copy for review and comment by the public, other agencies and interested stakeholders. This review period was from December 1-16, 2022. Methods for inviting interested parties and the public to review and comment on the plan were discussed in Steps 2 and 3, and materials are provided in the appendix. Comments were integrated into a final draft for submittal to SEMA and FEMA.

Step 9: Adopt the Plan (Handbook Task 8)

To secure buy-in and officially implement the plan, the governing bodies of each participating jurisdiction adopted the plan. Scanned copies of resolutions of adoption are included in the appendix of this plan.

Step 10: Implement, Evaluate, and Revise the Plan (Handbook Tasks 7 & 9)

The HMPC developed and agreed upon an overall strategy for plan implementation and for monitoring and maintaining the plan over time during Meeting #1. This strategy is described in Chapter 5, Plan Maintenance Process.

2 PLANNING AREA PROFILE AND CAPABILITIES

2 PLANNING AREA PROFILE AND CAPABILITIES..... 1

2.1 *Madison County Planning Area Profile..... 1*
2.1.2 Geography, Geology and Topography..... 3
2.1.3 Climate..... 4
2.1.4 Population/Demographics..... 4
2.1.5 History..... 6
2.1.6 Occupations..... 6
2.1.7 Agriculture..... 6
2.1.8 FEMA Hazard Mitigation Assistance Grants in Planning Area..... 6

2.2 *Jurisdictional Profiles and Mitigation Capabilities..... 12*
2.2.1 Unincorporated Madison County..... 12
2.2.2 City of Fredericktown..... 16
2.2.3 Public School District Profiles and Mitigation Capabilities..... 20

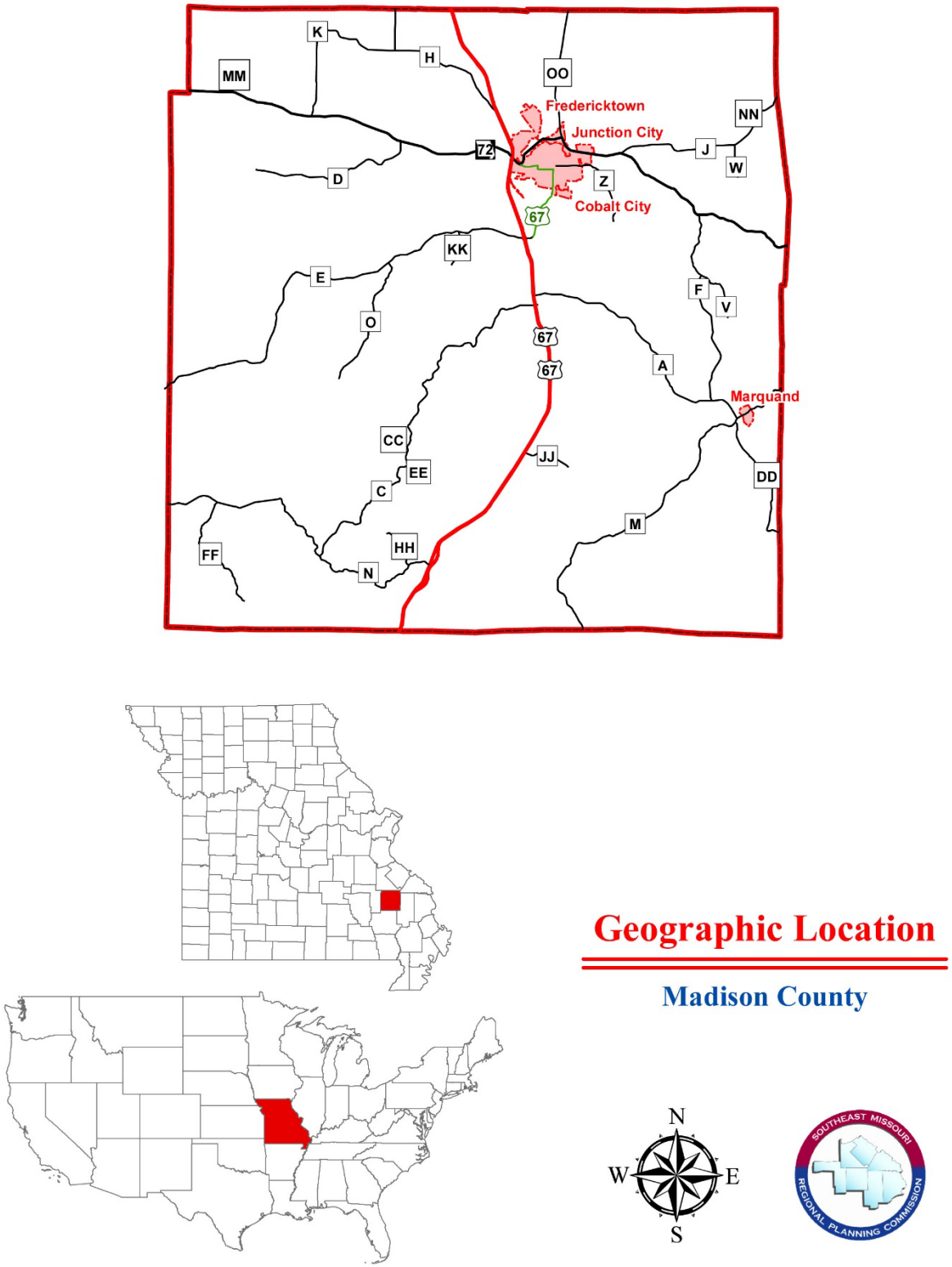
This chapter provides a general profile of Madison County followed by individual sections for each participating jurisdiction. The section for each jurisdiction provides an overview profile as well as details on existing capabilities, plans, and programs that enhance their ability to implement mitigation strategies.

2.1 Madison County Planning Area Profile

Figure 2.1 provides a map of the Madison County planning area. The planning area boundaries include all portions of the city limits of the following incorporated cities: Fredericktown.

As of 2010, the total Madison County population was 12,226, a growth of 4% since 2000. The population growth rate was below both the nation's (10%) and the State's (7%). Madison County median household income was $33,456 in 2010 an increase of 31% over 2000, which is higher than the national rate of 24% and state rate of 22%. However, the county's 2010 MHI is below that of both the nation and state, $51,914 and $46,262 respectively. Madison County median home value in 2015 was $89,200, up 7% from 2010 census estimates. While median home value is well below state and national amounts ($138,400 and $178,600) the rate of growth outpaced both the state's rate of 1% and the nation's of -5%.

Figure 2.1. **Map of Madison County**



2.1.1 Geography, Geology and Topography

Madison County lies in the southeast part of the state. The St. Francois Mountains are the dominant topographic feature in the County. Terrain varies from the steep slopes of the mountains to alluvial plains along the creeks and rivers. The land is either timbered or used for agricultural or urban purposes.

The County can be broadly divided into four physiographic subregions. The St. Francois Mountains, which are dominated by rounded "knobs" and ridges of granite and felsite, and generally have a thin soil cover with many exposures of bedrock. The Fredericktown Basin, which lies within the watershed of the Little St. Francis River, is an area in which steep slopes are common. The Caster River Hills drain in a southward direction through the Castor and Whitewater Rivers and their tributaries. Moderate to steep slopes predominate, although relatively large areas of gentle to moderate slopes occur on broad divides between some of the stream valleys.

Madison County soils can be classified into four broad general types. The Union-Goss-Gasconade-Crider Association is the first of these and is found in the southeastern part of the County. The soils in this association have formed in cherty limestone residual material. Union soils have a silt-loam topsoil grading downward into a moderately permeable subsoil overlying a massive fragipan. Goss soils have a cherty, silt-loam topsoil overlying a moderately permeable, very cherty, silty-clay subsoil. These soils are found on steep upland slopes of from 2% to 45%. Gasconade soils are found on slopes ranging from 2% to 50%. They have a flaggy (blocky limestone fragments), clay-loam topsoil overlying a flaggy, clay subsoil. Crider soils occur on slopes ranging from nearly flat to 20%. Crider soils have a silt loam topsoil overlying a moderately permeable, silty-clay-loam subsoil.

The second association, the Knobtop-Irondale-Delassus-Syenite, occurs in the St. Francois Mountains in Madison County. Knobtop soils have a silt-loam topsoil overlying a silty-clay-loam subsoil. They are found on the ridgetops of mountainous areas where slopes range from 2% to 12%. Irondale soils are found on steep, mountainous slopes, and are characterized by a cobbly, silt-loam topsoil overlying a moderately permeable cobbly, silt-loam subsoil. Slopes where these soils are found range from 15% to 40%. Delassus soils occur on slopes ranging from 2% to 9%. They have a silt-loam topsoil overlying a moderately permeable, silty-clay-loam subsoil. They also have a massive, compact, brittle, loamy fragipan underlying the subsoil. Syenite soils occur on the side slopes of mountainous areas. These soils have a silt-loam topsoil that contains boulders and overlies a silt-loam and light clay-loam subsoil with rock fragments. The slopes on which these soils occur range from 10% to 25%.

A third association, Jonca-Lamotte-Lily-Ramsey, is found on broad, gently to moderately sloping pastures and broad, moderate to very seep divides in forested areas. Jonca soils have a silt-loam topsoil and a slowly permeable, silty-clay-loam subsoil. The subsoil overlies a compact, massive, brittle, loam fragipan. The Lamotte soils occur in uplands with slopes of 5% to 14%. These soils have a silt-loam topsoil overlying a silty-clay-loam subsoil. Lily soils are found on upland side slopes and ridges with 2% to 50% slopes. The soil has a loam topsoil overlying a clay-loam subsoil. Ramsey soils have a loam topsoil overlying a rapidly permeable loam subsoil. They are found on hills with slopes of 10% to 70%.

The fourth soil association present in the County is the Crider-Cantwell-Gasconade. This association typically consists of forested, long, moderately sloping to very steep side slopes. It also occurs in small pastures and cultivated land on gently to moderately sloping ridgetops. Crider soils occur on uplands with slopes ranging up to 20%. They consist of a silt-loam topsoil overlying a silty-clay-loam subsoil. Cantwell soils occur on slopes ranging from 2% to 20%. These soils consist of a silt-loam topsoil overlying a silty-clay-loam subsoil. The Gasconade soils are on steep upland slopes of from 2% to 50%. The soils have a flaggy (limestone), clay-loam

topsoil over a flaggy, clay subsoil.

Several types of bedrock occur in Madison County. Dolomite, limestone, sandstone, and shale are the primary bedrock types in approximately three-quarters of the County. The northwest quarter of the County is primarily made up of granite and felsite, with small areas of sandstone scattered through the northwest quarter.

2.1.2 Climate

Because the County is located in the middle section of the United States, it is prone to several kinds of natural hazards. The county has a continental climate, meaning that the weather is changeable and has large variations in temperature and precipitation.

Madison County's climate parallels that of southeast Missouri. In general, the County has hot humid summers and mild to cold winters. Average temperatures fall in the 56° to 58° range. The warmest month is normally July, when average maximum temperatures are around 90° to 92°, and minimum temperatures range in the neighborhood of 62° to 68°. The coldest month is usually January, when maximum temperatures reach an average of only 45° to 46°, and minimum average temperatures run 25° to 28°. Below freezing temperatures usually occur on 80 to 100 days during the year.

Rainfall averages approximately 43 to 45 inches per year, while snowfall averages approximately 13 to 14 inches per year. Springtime and early summer are normally the seasons when much of the rainfall occurs during frequent thunderstorms. This is also the time when flooding normally occurs along the creeks and rivers in the County. On average, 70% to 80% of the annual rainfall occurs during the months from April through September.

2.1.3 Population/Demographics

According to the 2020 U.S. Census, the population of Madison County was 12,176, down 0.4 percent from the 2010 population of 12,226. Table 2.1 provides the populations for each city and the unincorporated county for 2010 and 2020 with the number and percent change. The unincorporated area's population was determined by subtracting the populations of the incorporated areas from the overall county population.

Table 2.1. Madison County Population 2010-2020 by Community

Population				
	2010	2020	Change	% Change
Madison County	12,226	12,176	-50	-0.41%
Cobalt Village	226	210	-16	-7.08%
Fredericktown	3,985	4,006	21	0.53%
Junction City	327	270	-57	-17.43%
Marquand	203	193	-10	-4.93%
Unincorporated County	7,485	7,497	12	0.16%
Missouri	5,988,927	6,124,160	135,233	2.26%
United States	308,745,538	326,569,308	17,823,770	5.77%

Source: American FactFinder

According to the 2020 census, 5.5% of the county population is under the age of 5 and 19% is 65 and older. In 2020 there were 4,851 households with an average household size of 2.47 people.

The University of South Carolina developed an index to evaluate and rank the ability to respond to, cope with, recover from, and adapt to disasters. The index synthesizes 30 socioeconomic variables which research literature suggests contribute to reduction in a community's ability to prepare for, respond to, and recover from hazards. SoVI ® data sources include primarily those from the United States Census Bureau.

Figure 2.2 shows that Madison County, with an index of 2.47, has a Medium-High Social Vulnerability Index when compared to counties nation-wide and to counties state-wide.

Figure 2.2. Madison County Social Vulnerability Index (SoVI)

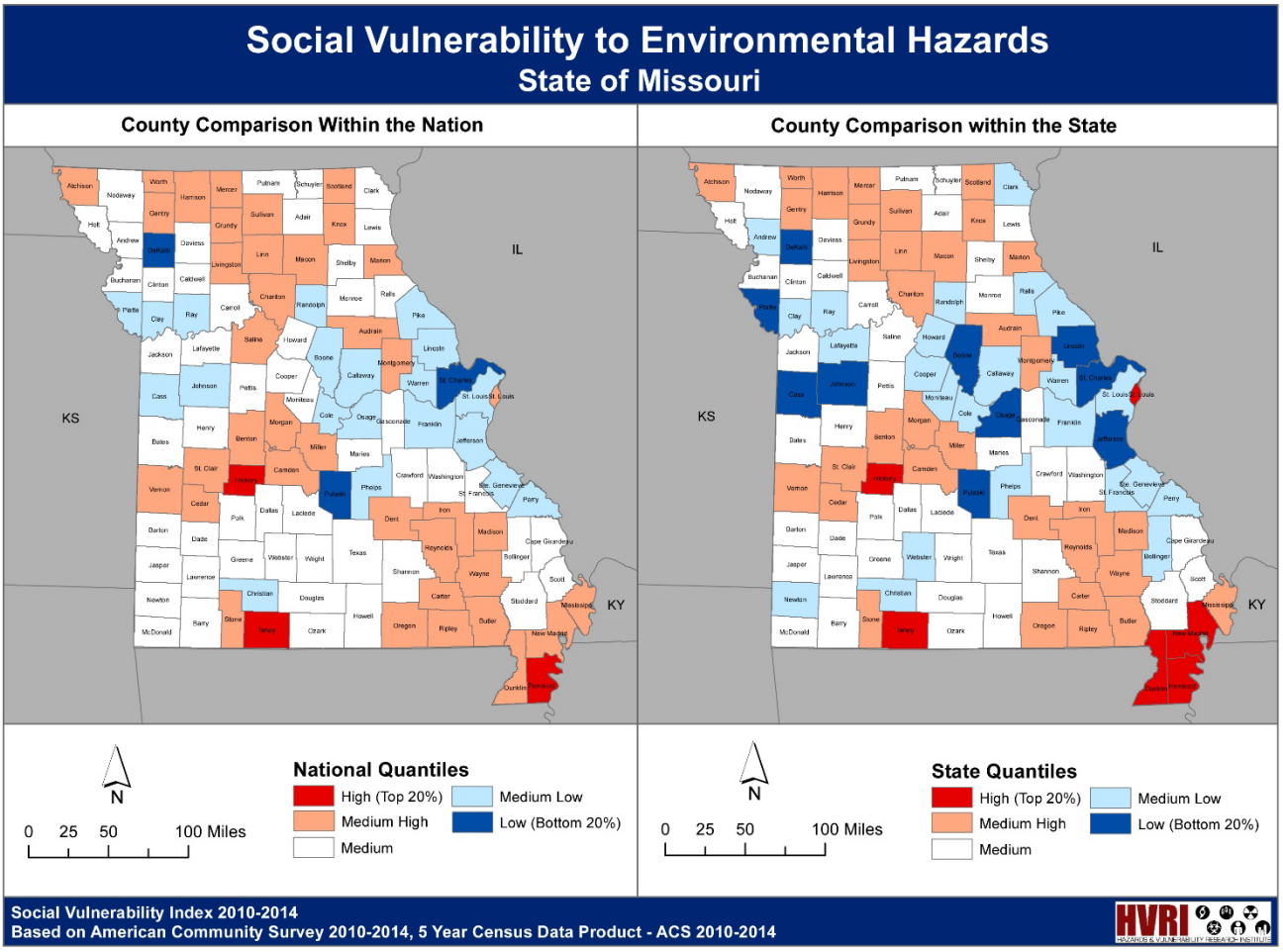


Table 2.2 provides additional demographic and economic indicators for Madison County. The Madison County values are for all of Madison County, including the incorporated cities.

Table 2.2. Unemployment, Poverty, Education, and Language Percentage Demographics, Madison County, Missouri

Jurisdiction	% Labor Force Participation	% of Population Unemployed	% of Families Below the Poverty Level	% of Population (High School graduate)	% of Population (Bachelor's degree or higher	% of Households (Limited English Proficiency)
Madison County	54.0	4.4	14.0	86.0	14.1	1.0
Fredericktown	55.4	5.0	18.1	88.2	28.4	2.0

Source: American FactFinder.

2.1.4 History

Madison County is a county located in the Lead Belt region of Missouri. Its county seat and largest city is Fredericktown. The county was officially organized on December 14, 1818, and was named after President James Madison. Mining has been a key industry in this area of the state and nation, with Madison County recorded as having the oldest lead mine west of the Mississippi River.

2.1.5 Occupations

Table 2.3 provides occupation statistics for the participating cities and the county as a whole.

Table 2.3. Occupation Statistics, Madison County, Missouri

Jurisdiction	Management, business, science, and arts	Service	Sales and office	Natural resources, construction, and maintenance	Production, transportation, and material moving
Madison County	24%	22%	21%	14%	19%
Fredericktown	23%	25%	22%	6%	24%

Source: American FactFinder.

2.1.6 Agriculture

According to the USDA's 2017 Census of Agriculture, Madison County had 361 farms comprised of 94,142 acres, with an average size of 261 acres. Just over 230 of the farms in the county fall into the range of 50-499 acres. The average market value of land and buildings per farm was $547,402. Crops account for approximately $794,000 of agriculture sales in the county, while livestock and poultry account for $15.5 million in sales.

2.1.7 FEMA Hazard Mitigation Assistance Grants in Planning Area

Since 1994, nearly $8 million in Federal Hazard Mitigation Assistance grants have been awarded to subgrantees in Madison County. Table 2.4 provides details on the previous FEMA HMAG in the planning area.

Table 2.4. FEMA HMA Grants in County from 1993-2009

Disaster Dec.	Project Type	Subrecipient	Date Approved	Project Total
1403	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	Madison (County)	1/12/2007	$ 366,646
1403	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	Fredericktown	1/12/2007	$ 753,724
1736	206.2: Safe Room (Tornado and Severe Wind Shelter) - Public Structures	MARQUAND-ZION R-VI SCHOOL DIST	8/1/2012	$ 1,331,391
1270	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	Marquand	9/17/2013	$ 240,637
1253	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	CITY OF MARQUAND	8/11/1999	$ 97,977
1270	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	Madison (County)	8/11/1999	$ 162,650
1256	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	FREDERICKTOWN	8/11/1999	$ 512,080
1253	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	FREDERICKTOWN	8/11/1999	$ 489,820
1253	103.1: Feasibility, Engineering and Design Studies	STATE OF MISSOURI	7/12/1999	$ 25,000
1822	206.2: Safe Room (Tornado and Severe Wind Shelter) - Public Structures	FREDERICKTOWN DISTRICT SCHOOLS	9/7/2012	$ 1,743,047
1006	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	FREDERICKTOWN	6/29/1994	$ 311,396
1822	206.2: Safe Room (Tornado and Severe Wind Shelter) - Public Structures	FREDERICKTOWN DISTRICT SCHOOLS	6/10/2013	$ 1,874,459
Total				$ 7,908,827

Source: FEMA

2.1.8 FEMA Public Assistance (PA) Grants in Planning Area

Since 2002, nearly $18 million in Federal PA grants have been awarded to subgrantees in Madison County. Table 2.5 provides details on the previous FEMA PA Grants in the planning area.

Table 2.5. FEMA PA Grants in County from 1993-2020

Disaster Dec	Incident Type	Applicant	Project Type	Project Size	Project Total
1673	Severe Storm	Black River Electric Cooperative	A - Debris Removal	Small	$ 2,291.69
1673	Severe Storm	Black River Electric Cooperative	A - Debris Removal	Small	$ 3,564.15
1847	Severe Storm	Black River Electric Cooperative	A - Debris Removal	Large	$ 194,752.00
1847	Severe Storm	Black River Electric Cooperative	A - Debris Removal	Large	$ 667,702.60
1961	Severe Storm	Black River Electric Co-op	A - Debris Removal	Small	$ 3,408.00
1847	Severe Storm	Cobalt Village	A - Debris Removal	Small	$ 5,016.00
1809	Severe Storm	Fredericktown	A - Debris Removal	Small	$ 22,130.61

1847	Severe Storm	Fredericktown	A - Debris Removal	Large	$ 146,802.90
1847	Severe Storm	Fredericktown	A - Debris Removal	Large	$ 176,262.60
1980	Severe Storm	Fredericktown	A - Debris Removal	Small	$ 4,992.00
1412	Severe Storm	Marquand	A - Debris Removal	Small	$ 5,129.90
1749	Severe Storm	Marquand	A - Debris Removal	Small	$ 5,311.27
1748	Severe Ice Storm	Madison County	A - Debris Removal	Small	$ 10,352.88
1748	Severe Ice Storm	Madison County	A - Debris Removal	Small	$ 28,719.56
1412	Severe Storm	Madison County	A - Debris Removal	Small	$ 5,435.10
1809	Severe Storm	Madison County	A - Debris Removal	Small	$ 13,422.63
1847	Severe Storm	Madison County	A - Debris Removal	Large	$ 520,677.78
1847	Severe Storm	Madison County	A - Debris Removal	Small	$ 54,611.95
1980	Severe Storm	Madison County	A - Debris Removal	Small	$ 11,620.48
1748	Severe Ice Storm	Black River Electric Cooperative	B - Protective Measures	Small	$ 25,562.11
1748	Severe Ice Storm	Black River Electric Cooperative	B - Protective Measures	Small	$ 19,155.81
1412	Severe Storm	Black River Electric Cooperative	B - Protective Measures	Small	$ 2,148.51
1412	Severe Storm	Black River Electric Cooperative	B - Protective Measures	Small	$ 6,046.31
1673	Severe Storm	Black River Electric Cooperative	B - Protective Measures	Small	$ 2,278.66
1673	Severe Storm	Black River Electric Cooperative	B - Protective Measures	Small	$ 1,025.40
1847	Severe Storm	Black River Electric Cooperative	B - Protective Measures	Small	$ 28,821.63
1961	Severe Storm	Black River Electric Co-op	B - Protective Measures	Small	$ 1,492.33
1847	Severe Storm	Fredericktown Dist. Schools	B - Protective Measures	Small	$ 6,392.50
4490	Biological	Madison Co Health Dept	B - Protective Measures	Large	$ -
1412	Severe Storm	Madison Co Health Dept	B - Protective Measures	Small	$ 3,536.53
1847	Severe Storm	Madison Co Health Dept	B - Protective Measures	Small	$ 3,135.17
1847	Severe Storm	Cobalt Village	B - Protective Measures	Small	$ 5,855.50
1748	Severe Ice Storm	Fredericktown	B - Protective Measures	Small	$ 18,272.41
1809	Severe Storm	Fredericktown	B - Protective Measures	Small	$ 2,066.67
1809	Severe Storm	Fredericktown	B - Protective Measures	Small	$ 7,824.32
1822	Severe Storm	Fredericktown	B - Protective Measures	Small	$ 25,218.86
1847	Severe Storm	Fredericktown	B - Protective Measures	Small	$ 12,055.14
1847	Severe Storm	Fredericktown	B - Protective Measures	Small	$ 9,757.05
1847	Severe Storm	Fredericktown	B - Protective Measures	Small	$ 6,141.00
1412	Severe Storm	Marquand	B - Protective Measures	Small	$ 1,709.96
1748	Severe Ice Storm	Madison County	B - Protective Measures	Small	$ 21,180.08
1412	Severe Storm	Madison County	B - Protective Measures	Small	$ 7,495.31
1809	Severe Storm	Madison County	B - Protective Measures	Small	$ 1,201.13
1822	Severe Storm	Madison County	B - Protective Measures	Small	$ 45,972.10
1847	Severe Storm	Madison County	B - Protective Measures	Small	$ 21,200.00
1847	Severe Storm	Madison County	B - Protective Measures	Small	$ 10,162.49
1847	Severe Storm	Madison County	B - Protective Measures	Small	$ 6,218.93
1961	Severe Storm	Madison County	B - Protective Measures	Small	$ 2,581.85
1749	Severe Storm	Fredericktown	C - Roads and Bridges	Small	$ 2,965.75

1847	Severe Storm	Fredericktown	C - Roads and Bridges	Small	$ 4,422.71
1980	Severe Storm	Fredericktown	C - Roads and Bridges	Small	$ 22,996.24
1412	Severe Storm	Marquand	C - Roads and Bridges	Small	$ 7,791.75
1749	Severe Storm	Marquand	C - Roads and Bridges	Small	$ 38,170.98
4317	Flood	Madison County	C - Roads and Bridges	Large	$ 158,980.82
4317	Flood	Madison County	C - Roads and Bridges	Large	$ 208,457.83
4317	Flood	Madison County	C - Roads and Bridges	Small	$ 106,746.08
4317	Flood	Madison County	C - Roads and Bridges	Small	$ 11,740.60
1412	Severe Storm	Madison County	C - Roads and Bridges	Large	$ 868,262.43
1412	Severe Storm	Madison County	C - Roads and Bridges	Large	$ 17,480.45
1412	Severe Storm	Madison County	C - Roads and Bridges	Large	$ 140,969.28
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 3,315.26
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 6,088.81
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 7,690.44
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 7,130.77
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 9,068.84
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 8,782.25
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 24,021.76
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 14,635.92
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 11,308.92
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 3,887.93
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 13,944.47
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 9,505.34
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 5,154.83
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 5,162.91
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 4,843.88
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 15,840.78
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 9,059.44
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 7,340.31
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 3,059.94
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 7,055.15
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 5,865.86
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 6,476.57
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 18,960.44
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 1,704.65
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 19,795.72
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 11,059.97
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 2,129.93
1749	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 1,394.53
1847	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 3,642.75
1847	Severe Storm	Madison County	C - Roads and Bridges	Large	$ 80,585.98
1847	Severe Storm	Madison County	C - Roads and Bridges	Large	$ 83,135.68

1847	Severe Storm	Madison County	C - Roads and Bridges	Large	$ 61,103.97
1847	Severe Storm	Madison County	C - Roads and Bridges	Large	$ 58,909.71
1980	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 31,231.03
1980	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 1,234.70
1980	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 3,728.01
1980	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 21,000.69
1980	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 12,138.89
1980	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 11,904.70
1980	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 25,610.10
1980	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 22,717.74
1980	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 12,672.32
1980	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 3,093.12
1980	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 35,102.06
1980	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 20,370.70
1980	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 10,729.82
1980	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 3,236.24
1980	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 13,469.38
1980	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 25,502.98
1980	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 23,771.66
1980	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 26,284.04
1980	Severe Storm	Madison County	C - Roads and Bridges	Small	$ 2,374.03
1749	Severe Storm	Fredericktown	D - Water Control Facilities	Small	$ 2,921.23
1847	Severe Storm	Fredericktown Dist. Schools	E - Public Buildings	Small	$ 1,000.00
1847	Severe Storm	Madison Co Health Dept	E - Public Buildings	Small	$ 1,000.00
1847	Severe Storm	Cobalt Village	E - Public Buildings	Small	$ 1,000.00
1412	Severe Storm	Marquand	E - Public Buildings	Small	$ 3,590.50
1847	Severe Storm	Madison County	E - Public Buildings	Small	$ 2,000.00
1748	Severe Ice Storm	Black River Electric Cooperative	F - Public Utilities	Large	$ 748,910.21
4250	Flood	Black River Electric Cooperative	F - Public Utilities	Small	$ 57,799.31
4317	Flood	Black River Electric Cooperative	F - Public Utilities	Small	$ 68,346.79
4317	Flood	Black River Electric Cooperative	F - Public Utilities	Large	$ 160,101.35
1631	Severe Storm	Black River Electric Cooperative	F - Public Utilities	Large	$ 114,034.74
1412	Severe Storm	Black River Electric Cooperative	F - Public Utilities	Large	$ 89,137.42
1412	Severe Storm	Black River Electric Cooperative	F - Public Utilities	Large	$ 72,822.78
1412	Severe Storm	Black River Electric Cooperative	F - Public Utilities	Small	$ 37,320.79
1412	Severe Storm	Black River Electric Cooperative	F - Public Utilities	Small	$ 51,328.34
1412	Severe Storm	Black River Electric Cooperative	F - Public Utilities	Small	$ 7,033.83
1412	Severe Storm	Black River Electric Cooperative	F - Public Utilities	Small	$ 1,946.53
1412	Severe Storm	Black River Electric Cooperative	F - Public Utilities	Small	$ 26,985.11
1412	Severe Storm	Black River Electric Cooperative	F - Public Utilities	Small	$ 8,697.66
1412	Severe Storm	Black River Electric Cooperative	F - Public Utilities	Small	$ 19,113.26
1412	Severe Storm	Black River Electric Cooperative	F - Public Utilities	Small	$ 37,402.69

1463	Severe Storm	Black River Electric Cooperative	F - Public Utilities	Small	$ 12,222.00
1673	Severe Storm	Black River Electric Cooperative	F - Public Utilities	Large	$ 93,000.63
1673	Severe Storm	Black River Electric Cooperative	F - Public Utilities	Large	$ 83,778.75
1749	Severe Storm	Black River Electric Cooperative	F - Public Utilities	Large	$ 127,790.98
1809	Severe Storm	Black River Electric Cooperative	F - Public Utilities	Large	$ 388,187.10
1847	Severe Storm	Black River Electric Cooperative	F - Public Utilities	Large	$ 1,000,253.62
1847	Severe Storm	Black River Electric Cooperative	F - Public Utilities	Large	$ 7,860,064.57
1980	Severe Storm	Black River Electric Cooperative	F - Public Utilities	Large	$ 1,286,863.66
4451	Severe Storm	Black River Electric Cooperative	F - Public Utilities	Large	$ 173,369.42
4636	Severe Storm	Black River Electric Cooperative	F - Public Utilities	Small	$ 53,307.31
1961	Severe Storm	Black River Electric Co-op	F - Public Utilities	Small	$ 61,108.47
1749	Severe Storm	Fredericktown	F - Public Utilities	Small	$ 11,707.08
1749	Severe Storm	Fredericktown	F - Public Utilities	Small	$ 24,156.52
1809	Severe Storm	Fredericktown	F - Public Utilities	Small	$ 36,324.23
1847	Severe Storm	Fredericktown	F - Public Utilities	Small	$ 5,297.90
1847	Severe Storm	Fredericktown	F - Public Utilities	Small	$ 3,438.18
1847	Severe Storm	Fredericktown	F - Public Utilities	Large	$ 539,131.79
1980	Severe Storm	Fredericktown	F - Public Utilities	Small	$ 5,239.03
1749	Severe Storm	Marquand	F - Public Utilities	Small	$ 1,728.20
1749	Severe Storm	Black River Electric Cooperative	G - Recreational or Other	Small	$ 5,250.00
1749	Severe Storm	Fredericktown	G - Recreational or Other	Small	$ 1,680.90
1980	Severe Storm	Fredericktown	G - Recreational or Other	Small	$ 3,802.66
Total					$ 17,903,728.24

2.2 Jurisdictional Profiles and Mitigation Capabilities

This section includes individual profiles for each participating jurisdiction as well as a discussion of previous mitigation initiatives and a summary table indicating specific capabilities of each jurisdiction that relate to their ability to implement mitigation opportunities. The unincorporated county is profiled first, followed by the incorporated cities, and the public school districts.

2.2.1 Unincorporated Madison County

The jurisdiction of Madison County includes all unincorporated areas within the county boundaries. The Madison County government is a County Commission comprised of a Presiding Commissioner voted on by the entire county and two Associate Commissioners voted on by their respective districts. The County government includes the following departments and offices:

- County Commissioners
- County Assessor
- County Auditor
- County Recorder
- County Sheriff
- County Treasurer
- Emergency Management
- Health Department

Mitigation Initiatives/Capabilities

Table 2.5 shows the County's planning and hazard mitigation capabilities.

Table 2.6. Unincorporated Madison County Mitigation Capabilities

Element	Yes, No, N/A	Comments and/or Weblink
Planning Capabilities		
Comprehensive or Land-Use Plan	N/A	Date:
Capital Improvement Plan	N/A	Date:
Transportation Plan / Highway Department	N/A	Date:
Emergency Operations Plan	YES	Date:
Local Recovery Plan	NO	Date:
Debris Management Plan	NO	Date:
Firewise or other fire mitigation plan	YES	Date:
Economic Development Plan	YES	Date:
Policies/Ordinance		
Zoning Ordinance	N/A	
Building Code	N/A	Version:
Floodplain Ordinance	NO	Date:
Drainage/Stormwater Ordinance	N/A	
Site Plan Review Requirements	N/A	
Historic Preservation Ordinance	N/A	

Element	Yes, No, N/A	Comments and/or Weblink
Program		
National Flood Insurance Program (NFIP)	YES	
NFIP Community Rating System (CRS) program	NO	If so, what is your current level rating?
National Weather Service (NWS) Storm Ready Certification	NO	
Firewise Community Certification	NO	
Building Code Effectiveness Grading (BCEGs)	NO	
ISO Fire Rating	Rating:	
Public Education or information programs (i.e., responsible water use, fire safety, household preparedness, or environmental education	NO	
Mutual Aid Agreements	YES	
Studies/Reports/Maps		
Critical Facilities Inventory	NO	
Vulnerable Population Inventory	NO	
Staff/Department		**Full Time or Part Time?**
Building Code Official / Building Inspector	NO	
Engineer	NO	
Development Planner	SEMO RPC	
NFIP Floodplain Administrator	YES	PART
Mapping Specialist (GIS)	YES	RESOURCED OUTSIDE
Public Works Official	YES	
Emergency Management Coordinator	YES	PART
Local Emergency Planning Committee	YES	
Sanitation Department	YES	
Highway/Transportation Department	YES	
Economic Development Department	YES	
Housing Department	NO	
Historic Preservation	YES	

Element	Yes, No, N/A	Comments and/or Weblink
Non-Governmental Organizations (NGOs)	**Is there a local chapter? Yes or No**	
American Red Cross	NO	
Salvation Army	YES	
Veterans Groups	YES	
Local Environmental Organization	YES	
Homeowner Associations	YES	
Neighborhood Associations	NO	
Chamber of Commerce	YES	
Community Organizations (Lions, Kiwanis, etc.	YES	

Financial Resources	Is your jurisdiction able to? Yes or No
Apply for Community Development Block Grants	NO
Fund projects thru Capital Improvements funding	NO
Authority to levy taxes for specific purposes	YES
Fees for water, sewer, gas, or electric services	NO
Impact fees for new development	YES
Incur debt through general obligation bonds	YES
Incur debt through special tax bonds	YES
Incur debt through private activities	YES
Withhold spending in hazard prone areas	NO

2.2.2 City of Fredericktown

The City of Fredericktown is located in north-central Madison County. It is governed by a Mayor and 6-member board of aldermen.

Table 2.7. Fredericktown Mitigation Capabilities

Element	Yes, No, N/A	Comments and/or Weblink
Planning Capabilities		
Comprehensive or Land-Use Plan	Yes	Date:
Capital Improvement Plan	Yes	Date:
Transportation Plan / Highway Department	Yes	Date:
Emergency Operations Plan	Yes	Date:
Local Recovery Plan	Yes	Date:
Debris Management Plan	Yes	Date:
Firewise or other fire mitigation plan	Yes	Date:
Economic Development Plan	Yes	Date:
Policies/Ordinance		
Zoning Ordinance	Yes	
Building Code	Yes	Version: 2015
Floodplain Ordinance	Yes	Date: 2012
Drainage/Stormwater Ordinance	Yes	
Site Plan Review Requirements	Yes	
Historic Preservation Ordinance	No	
Program		
National Flood Insurance Program (NFIP)	Yes	
NFIP Community Rating System (CRS) program	NA	If so, what is your current level rating?
National Weather Service (NWS) Storm Ready Certification	Yes	
Firewise Community Certification	NO	
Building Code Effectiveness Grading (BCEGs)		
ISO Fire Rating	Rating: 4	
Public Education or information programs (i.e., responsible water use, fire safety, household preparedness, or environmental education	Yes	
Mutual Aid Agreements	Yes	

Element	Yes, No, N/A	Comments and/or Weblink
Studies/Reports/Maps		
Critical Facilities Inventory		
Vulnerable Population Inventory		
Staff/Department		**Full Time or Part Time?**
Building Code Official / Building Inspector	Yes	Full Time
Engineer	Yes	
Development Planner	No	
NFIP Floodplain Administrator	Yes	
Mapping Specialist (GIS)	SEMO RPC	
Public Works Official	Yes	
Emergency Management Coordinator	Yes	Part-Time
Local Emergency Planning Committee	Yes	
Sanitation Department	Yes	Full Time
Highway/Transportation Department	Yes	Full Time
Economic Development Department	Yes	
Housing Department	No	
Historic Preservation	No	
Non-Governmental Organizations (NGOs)	**Is there a local chapter? Yes or No**	
American Red Cross	Yes	
Salvation Army	Yes	
Veterans Groups	Yes	
Local Environmental Organization	Yes	
Homeowner Associations	Yes	
Neighborhood Associations	Yes	
Chamber of Commerce	Yes	
Community Organizations (Lions, Kiwanis, etc.	Yes	

Element	Yes, No, N/A	Comments and/or Weblink
Financial Resources		**Is your jurisdiction able to? Yes or No**
Apply for Community Development Block Grants		Yes
Fund projects thru Capital Improvements funding		Yes
Authority to levy taxes for specific purposes		Yes
Fees for water, sewer, gas, or electric services		Yes
Impact fees for new development		Yes
Incur debt through general obligation bonds		Yes
Incur debt through special tax bonds		Yes
Incur debt through private activities		Yes
Withhold spending in hazard prone areas		No
Planning Capabilities		Method of Incorporation Since Previous Plan or Challenges Preventing Incorporation
Comprehensive or Land-Use Plan		Yes, 1980
Capital Improvement Plan		Yes, updated yearly with budget
Transportation Plan / Highway Department		Yes,
Emergency Operations Plan		Yes
Local Recovery Plan		Yes
Debris Management Plan		Yes
Firewise or other fire mitigation plan		Yes
Economic Development Plan		Yes

2.2.3 Summary of Jurisdictional Capabilities

Table 2.8. Mitigation Capabilities Summary Table

CAPABILITIES	Madison Co	Fredericktown
Planning Capabilities		
Comprehensive Plan	N	Y
Builder's Plan	N	N
Capital Improvement Plan	N	Y
Local Emergency Plan	N/A	Y
County Emergency Plan	Y	N/A
Local Recovery Plan	N/A	Y
County Recovery Plan	N	N/A
Local Mitigation Plan	N/A	Y
County Mitigation Plan	Y	N/A
Local Mitigation Plan (PDM)	N/A	Y
County Mitigation Plan (PDM)	Y	N/A
Debris Management Plan	N	Y
Economic Development Plan	Y	Y
Transportation Plan	N	Y
Land-use Plan	N	Y
Flood Mitigation Assistance (FMA) Plan	N	Y
Watershed Plan	N	N
Firewise or other fire mitigation plan	Y	Y
School Mitigation Plan	N/A	N/A
Critical Facilities Plan (Mitigation/Response/Recovery)	N	N
Policies/Ordinance		
Zoning Ordinance	N	Y
Building Code	N	Y
Floodplain Ordinance	N	Y
Subdivision Ordinance	N	Y
Tree Trimming Ordinance	N	Y
Nuisance Ordinance	N	Y
Storm Water Ordinance	N	Y
Drainage Ordinance	N	Y
Site Plan Review Requirements	N	Y
Historic Preservation Ordinance	N	N
Landscape Ordinance	N	N
Seismic Construction Ordinance	N	N
Program		
Zoning/Land Use Restrictions	N	Y
Codes Building Site/Design	N	Y
National Flood Insurance Program (NFIP) Participant	Y	Y
NFIP Community Rating System (CRS) Participating Community	N	N
Hazard Awareness Program	N	N
National Weather Service (NWS) Storm Ready	N	Y

Building Code Effectiveness Grading (BCEGs)	N	N
ISO Fire Rating	N	4
Economic Development Program	Y	Y
Land Use Program	N	Y
Public Education/Awareness	N	Y
Property Acquisition	Y	Y
Planning/Zoning Boards	N	Y
Stream Maintenance Program	N	N
Tree Trimming Program	N	N
Engineering Studies for Streams (Local/County/Regional)	N	N
Mutual Aid Agreements	Y	Y
Studies/Reports/Maps		
Hazard Analysis/Risk Assessment (Local)	N/A	Y
Hazard Analysis/Risk Assessment (County)	Y	N/A
Flood Insurance Maps	Y	Y
FEMA Flood Insurance Study (Detailed)	N	N
Evacuation Route Map	N	N
Critical Facilities Inventory	N	N
Vulnerable Population Inventory	N	N
Land Use Map	N	Y
Staff/Department		
Building Code Official	N	Y
Building Inspector	N	Y
Mapping Specialist (GIS)	Y	Y
Engineer	N	Y
Development Planner	N	N
Public Works Official	Y	Y
Emergency Management Coordinator	Y	Y
NFIP Floodplain Administrator	Y	Y
Emergency Response Team	Y	Y
Hazardous Materials Expert	N	N
Local Emergency Planning Committee	N/A	Y
County Emergency Management Commission	Y	N/A
Sanitation Department	N	Y
Transportation Department	Y	Y
Economic Development Department	Y	Y
Housing Department	N	N
Historic Preservation	Y	N
Non-Governmental Organizations (NGOs)		
American Red Cross	N	Y
Salvation Army	Y	Y
Veterans Groups	Y	Y
Environmental Organization	Y	Y
Homeowner Associations	Y	Y
Neighborhood Associations	N	Y
Chamber of Commerce	Y	Y
Community Organizations (Lions, Kiwanis, etc.	Y	Y

Financial Resources		
Apply for Community Development Block Grants	N	Y
Fund projects through Capital Improvements funding	N	Y
Authority to levy taxes for specific purposes	Y	Y
Fees for water, sewer, gas, or electric services	N	Y
Impact fees for new development	Y	Y
Incur debt through general obligation bonds	Y	Y
Incur debt through special tax bonds	Y	Y
Incur debt through private activities	Y	Y
Withhold spending in hazard prone areas	N	N

2.2.4 Public School District Profiles and Mitigation Capabilities

This section includes general profile information for both Fredericktown R-I School District and Marquand-Zion R-VI School District. Both school districts fully participated in the development process of this plan. Two additional school districts, Arcadia Valley R-II (Iron County) and Clearwater R-I (Wayne County) cover small portions of Madison County. However, neither of these districts have any structures or assets located in Madison County, and are therefore not included in this mitigation plan. For information on these school districts, see their respective county HMPs.

It should also be noted that Fredericktown R-I School District extends beyond the county boundaries in areas to the north and east of the County. Students in these areas are included in any enrollment or other statistics as data is by district.

Figure 2.3. Madison County School Districts

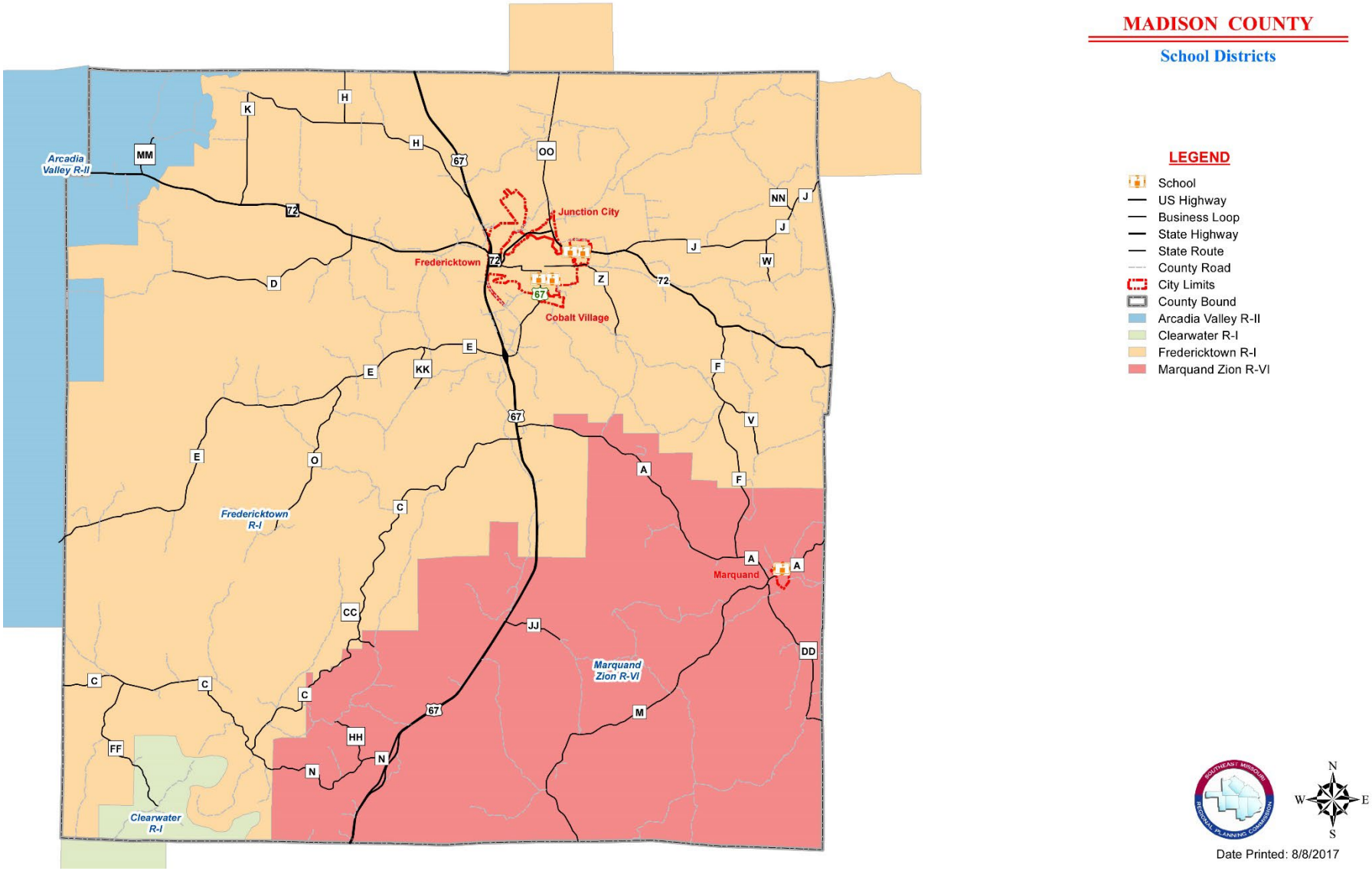


Table 2.9. School District A Buildings and Enrollment Data, [Insert Date]

District Name	Building Name	Building Enrolment
Fredericktown R-I	Fredericktown High	594
Fredericktown R-I	Kelly A Burlison Middle School	494
Fredericktown R-I	Fredericktown Elementary	445
Fredericktown R-I	Fredericktown Intermediate	430
Marquand-Zion R-VI	Marquand-Zion High	68
Marquand-Zion R-VI	Marquand Elementary	54

Source: MO DESE

Table 2.10. Summary of Mitigation Capabilities-Fredericktown R-I School District

Planning Elements	Yes/No	Date of Latest Version	Comments
Master Plan	Yes	6/13/2017	
Capital Improvement Plan	Yes	6/13/2017	
School Emergency Plan Shelter in place protocols Evacuation protocols	Yes	6/13/2017	
Weapons Policy	Yes	6/13/2017	

Administrative/Technical

Identify the technical and personnel resources responsible for activities related to hazard mitigation/loss prevention within your school district / institution.

Personnel Resources	Yes/No	Department/Position	Comments
Full-time building official (i.e. Principal)	Yes	Principal	
Emergency Manager	Yes	District Safety Coordinator	
Grant Writer	No		
Public Information Officer	No		

Financial Resources

Identify whether your school district /institution has access to or is eligible to use the following financial resources for hazard mitigation.

Financial Resources	Accessible/Eligible to Use (Y/N)	Comments
Capital improvements project funding	Yes	
Local funds	Yes	
General obligation bonds	No	
Special tax bonds	No	
Private activities/donations	Yes	
State and federal funds	Yes	

Table 2.11. Summary of Mitigation Capabilities-Marquand-Zion R-VI School District

Planning Elements	Yes/No	Date of Latest Version	Comments
Master Plan	No		
Capital Improvement Plan	No		
School Emergency Plan Shelter in place protocols Evacuation protocols	Yes	3/19/19	
Weapons Policy	Yes	11/17/2015	

Administrative/Technical

Identify the technical and personnel resources responsible for activities related to hazard mitigation/loss prevention within your school district / institution.

Personnel Resources	Yes/No	Department/Position	Comments
Full-time building official (i.e. Principal)	Yes	Principal	
Emergency Manager	Yes	Principal	
Grant Writer	No		
Public Information Officer	Yes	Superintendent	

Financial Resources

Identify whether your school district /institution has access to or is eligible to use the following financial resources for hazard mitigation.

Financial Resources	Accessible/Eligible to Use (Y/N)	Comments
Capital improvements project funding	No	
Local funds	Yes	
General obligation bonds	No	
Special tax bonds	No	
Private activities/donations	Yes	
State and federal funds	Yes	

Table 2.12. Summary of Mitigation Capabilities

Capability	Fredericktown R-I	Marquand-Zion R-VI
Planning Elements		
Master Plan/ Date	Y	N
Capital Improvement Plan/Date	Y	N
School Emergency Plan / Date	Y	Y
Weapons Policy/Date	Y	Y
Personnel Resources		
Full-Time Building Official (Principal)	Y	Y
Emergency Manager	Y	Y
Grant Writer	N	N
Public Information Officer	N	Y
Financial Resources		
Capital Improvements Project Funding	Y	N
Local Funds	Y	Y
General Obligation Bonds	N	N
Special Tax Bonds	N	N
Private Activities/Donations	Y	Y
State and Federal Funds/Grants	Y	Y
Other		
Public Education Programs	Y	Y
Privately or Self- Insured?	P	P
Fire Evacuation Training	Y	Y
Tornado Sheltering Exercises	Y	Y
Public Address/Emergency Alert System	Y	Y
NOAA Weather Radios	Y	Y
Lock-Down Security Training	Y	Y
Mitigation Programs	N	N
Tornado Shelter/Saferoom	Y	Y
Campus Police	N	N

3 RISK ASSESSMENT

3.1 Hazard Identification 4

3.1.1 Review of Existing Mitigation Plans 4

3.1.2 Review Disaster Declaration History 4

3.1.3 Research Additional Sources 5

3.1.4 Hazards Identified 6

3.1.5 Multi-Jurisdictional Risk Assessment 7

3.2 Assets at Risk 8

3.2.1 Total Exposure of Population and Structures 8

Unincorporated County and Incorporated Cities 8

3.2.2 Critical and Essential Facilities and Infrastructure 9

3.2.3 Other Assets 12

3.3 Land Use and Development 15

3.3.1 Development Since Previous Plan Update 15

3.3.2 Future Land Use Development 16

3.4 Hazard Profiles, Vulnerability, and Problem Statements 17

Hazard Profiles 17

Vulnerability Assessments 17

Problem Statements 18

3.4.1 Dam Failure 19

Hazard Profile 19

Vulnerability 22

Problem Statement 23

3.4.2 Drought 24

Hazard Profile 24

Vulnerability 26

Problem Statement 27

3.4.3 Earthquakes 28

Hazard Profile 28

Vulnerability 33

Problem Statement 34

3.4.4 Extreme Temperatures 35

Hazard Profile 35

Vulnerability 39

Problem Statement 40

3.4.5 Wildfires 41

Hazard Profile 41

Vulnerability 43
Problem Statement 44
3.4.6 Flooding (Flash and River) *45*
Hazard Profile 45
Vulnerability 53
Problem Statement 54
3.4.7 Sinkholes *56*
Hazard Profile 56
Vulnerability 58
Problem Statement 58
3.4.8 Levee Failure *59*
Hazard Profile 59
Vulnerability 60
Problem Statement 61
3.4.9 Severe Thunderstorms, Including High Winds, Hail, and Lightning *62*
Hazard Profile 62
Vulnerability 67
Problem Statement 68
3.4.10 Tornado *69*
HazardProfile 69
Vulnerability 73
Problem Statement 75
3.4.11 Winter Weather/Snow/Ice *76*
Hazard Profile 76
Vulnerability 78
Problem Statement 79

The goal of the risk assessment is to estimate the potential loss in the planning area, including loss of life, personal injury, property damage, and economic loss, from a hazard event. The risk assessment process allows communities and school/special districts in the planning area to better understand their potential risk to the identified hazards. It will provide a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events.

There have been little changes in the County over the past 5 years. Since 2018, there have only been two dozen residential permits issued in the entire county. Likewise, there has been little commercial, office, and industrial development in the County as well. Additionally, no jurisdiction has seen an increase in population over the past 5 years, with some of the jurisdictions having experienced population declines. This means most of the exposure and risk in the planning area has remained relatively unchanged since the 2018 plan.

This chapter is divided into four main parts:

- **Section 3.1 Hazard Identification** identifies the hazards that threaten the planning area and provides a factual basis for elimination of hazards from further consideration;
- **Section 3.2 Assets at Risk** provides the planning area's total exposure to natural hazards, considering critical facilities and other community assets at risk;
- **Section 3.3 Future Land Use and Development** discusses areas of planned future development
- **Section 3.4 Hazard Profiles and Vulnerability Analysis** provides more detailed information about the hazards impacting the planning area. For each hazard, there are three sections: 1) Hazard Profile provides a general description and discusses the threat to the planning area, the geographic location at risk, potential severity/magnitude/extent, previous occurrences of hazard events, probability of future occurrence, risk summary by jurisdiction, impact of future development on the risk; 2) Vulnerability Assessment further defines and quantifies populations, buildings, critical facilities, and other community/school or special district assets at risk to natural hazards; and 3) Problem Statement briefly summarizes the problem and develops possible solutions.

3.1 Hazard Identification

The 10 hazards identified for this plan update are listed below in alphabetical order:

- Dam & Levee Failure
- Drought
- Earthquake
- Extreme Temperatures
- Flash & Riverine Flooding
- Severe Thunderstorms
- Severe Winter Weather
- Sinkholes
- Tornadoes
- Wild Fire

It should be noted that this mitigation plan, like most local HMP in the state, only includes natural hazards and does not address "man-made" hazards such as terrorism, structural fires, chemical spills, etc.

Sections 3.1.1 through 3.1.3 describe how these hazards were identified for this plan update.

3.1.1 Review of Existing Mitigation Plans

To determine which hazards to include in this plan update cycle, the HMPC considered all hazards from the previous Madison County HMP, hazards from surrounding counties' HMPs, and the State's current HMP. The HMPC decided to carry forward the hazards from the 2018 plan into this plan unchanged, as they felt there had been no significant changes in the county to warrant revision.

3.1.2 Review Disaster Declaration History

Federal disaster declarations may be granted when the severity and magnitude of an event surpasses the ability of the local government to respond and recover. Disaster assistance is supplemental and sequential. When the local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. If the disaster is so severe that both the local and state governments' capacities are exceeded; a federal emergency or disaster declaration may be issued allowing for the provision of federal assistance.

FEMA also issues emergency declarations, which are more limited in scope and do not include the long-term federal recovery programs of major disaster declarations. Determinations for declaration type are based on scale and type of damages and institutions or industrial sectors affected.

Table 3.1. FEMA Disaster Declarations That Included Madison County, 2007-Present

Disaster Number	Description	Incident Period	Individual Assistance (IA) Public Assistance (PA)
DR-4636	Severe Storms, Straight-line Winds, Tornadoes	12/10/2021	PA
DR-4490	Covid-19 Pandemic	1/20/2020	IA, PA
DR-4317	Severe Storms, Tornadoes, Straight-line Winds, and Flooding	4/29/2017 - 5/11/2017	IA, PA
DR-3374	Severe Storms, Tornadoes, Straight-line Winds, and Flooding	12/22/2015 - 1/9/2016	NA
DR-1980	Severe Storms, Tornadoes, and Flooding	4/10/2011 - 6/6/2011	PA
DR-1961	Severe Winter Storm and Snowstorm	1/31/2011 - 2/5/2011	PA
DR-1847	Severe Storms, Tornadoes, and Flooding	5/8/2009 - 5/16/2009	PA
DR-1822	Severe Winter Storm	1/26/2009 - 1/28/2009	PA
DR-1809	Severe Storms, Flooding, and Tornado	9/11/2008 - 9/24/2008	PA
DR-1749	Severe Storms and Flooding	3/17/2008 - 5/9/2008	IA, PA
DR-1748	Severe Winter Storms and Flooding	2/10/2008 - 2/14/2008	PA

Source: Federal Emergency Management Agency http://www.fema.gov/disastershttp://www.fema.gov/disasters

3.1.3 Research Additional Sources

Additional data on locations and past impacts of hazards in the planning area was collected from the following sources:

- Missouri Hazard Mitigation Plan (2018)
- 2018 Madison County Hazard Mitigation Plan
- Federal Emergency Management Agency (FEMA)
- Missouri Department of Natural Resources (MDNR)
- National Drought Mitigation Center Drought Reporter
- US Department of Agriculture's (USDA) Risk Management Agency Crop Insurance Statistics
- National Agricultural Statistics Service (Agriculture production/losses)
- Data Collection Questionnaires completed by each jurisdiction
- State of Missouri GIS data
- Environmental Protection Agency (EPA)
- Flood Insurance Administration
- Missouri Department of Transportation (MoDOT)
- Missouri Division of Fire Marshal Safety
- National Fire Incident Reporting System (NFIRS)
- National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC);
- County and local Comprehensive Plans when available
- County Emergency Management
- County Flood Insurance Rate Map, FEMA

- SILVIS Lab, Department of Forest Ecology and Management, University of Wisconsin
- U.S. Army Corps of Engineers
- U.S. Department of Transportation
- United States Geological Survey (USGS)

Note that the only centralized source of data for many of the weather-related hazards is the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC). Although it is usually the best and most current source, there are limitations to the data which should be noted. The NCDC documents the occurrence of storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce. In addition, it is a partial record of other significant meteorological events, such as record maximum or minimum temperatures or precipitation that occurs in connection with another event. Some information appearing in the NCDC may be provided by or gathered from sources outside the National Weather Service (NWS), such as the media, law enforcement and/or other government agencies, private companies, individuals, etc. An effort is made to use the best available information but because of time and resource constraints, information from these sources may be unverified by the NWS. Those using information from NCDC should be cautious as the NWS does not guarantee the accuracy or validity of the information.

The NCDC damage amounts are estimates received from a variety of sources, including those listed above in the Data Sources section. For damage amounts, the NWS makes a best guess using all available data at the time of the publication. Property and crop damage figures should be considered as a broad estimate. Damages reported are in dollar values as they existed at the time of the storm event. They do not represent current dollar values.

The database currently contains data from January 1950 to date, as entered by the NWS. Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type. The following timelines show the different time spans for each period of unique data collection and processing procedures.

1. Tornado: From 1950 through 1954, only tornado events were recorded.
2. Tornado, Thunderstorm Wind and Hail: From 1955 through 1992, only tornado, thunderstorm wind and hail events were keyed from the paper publications into digital data. From 1993 to 1995, only tornado, thunderstorm wind and hail events have been extracted from the Unformatted Text Files.
3. All Event Types (48 from Directive 10-1605): From 1996 to present, 48 event types are recorded as defined in NWS Directive 10-1605.

Note that injuries and deaths caused by a storm event are reported on an area-wide basis. When reviewing a table resulting from an NCDC search by county, the death or injury listed in connection with that county search did not necessarily occur in that county.

3.1.4 Hazards Identified

Through the hazard identification review process, 11 natural hazards that have the potential to significantly affect the planning area were chosen for further analysis in the risk assessment. The hazards identified for this plan update are shown in Table 3.2. Although 11 hazards were identified, not all hazards impact every jurisdiction. In addition to listing the hazards selected for this plan, Table 3.2 also provides a summary of the jurisdictions impacted by each hazard. An "X" indicates the jurisdiction is impacted by the hazard, while a "-"

indicates the hazard is not applicable to that jurisdiction.

Table 3.2. Hazards Identified for Each Jurisdiction

Hazard	Madison County	Fredericktown	Fredericktown R-I	Marquand-Zion R-VI
Dam/Levee Failure	X	X	-	-
Drought	X	X	X	X
Earthquake	X	X	X	X
Extreme Cold	X	X	X	X
Extreme Heat	X	X	X	X
Flash & Riverine Flooding	X	X	-	-
Severe Thunderstorm	X	X	X	X
Severe Winter Weather	X	X	X	X
Sinkhole	X	-	-	-
Tornado	X	X	X	X
Wild Fire	X	X	X	X

3.1.5 Multi-Jurisdictional Risk Assessment

For this multi-jurisdictional plan, the risks are assessed for each jurisdiction where they deviate from the risks facing the entire planning area. The planning area is generally uniform in terms of climate and topography as well as building construction characteristics. Accordingly, the geographic areas of occurrence for weather-related hazards do not vary greatly across the planning area for most hazards. The more urbanized areas within the planning area have more assets that are vulnerable to the weather-related hazards and varied development trends impact the future vulnerability. These differences are discussed in greater detail in the vulnerability sections of each hazard.

The hazards that have the potential to vary across the planning area in terms of geographic areas at risk include dam/levee failure, flash & riverine flooding, sinkhole, and wild fire.

3.2 Assets at Risk

This section assesses the population, structures, critical facilities, and other important assets in the planning area that may be at risk to hazards.

3.2.1 Total Exposure of Population and Structures

Unincorporated County and Incorporated Cities

In the following three tables, population data is based on 2020 Census Bureau data. Building counts are based on the University of Missouri Structures Count, and building exposure values are HMPC and SEMO RPC estimates based on median home values in each jurisdiction. Contents exposure values were calculated by factoring a multiplier to the building exposure values based on usage type. The multipliers were derived from the HAZUS MH 2.1 and are defined below in Table 3.3. Land values have been purposely excluded from consideration because land remains following disasters, and subsequent market devaluations are frequently short term and difficult to quantify. Another reason for excluding land values is that state and federal disaster assistance programs generally do not address loss of land (other than crop insurance). It should be noted that this valuation methodology is an estimate only and will not equal other estimates or calculations (e.g. Assessor data) due to variations in the methodologies.

Table 3.3 shows the total population, building count, estimated value of buildings, estimated value of contents and estimated total exposure for the unincorporated county and each participating incorporated city. Table 3.4 that follows provides the building value exposures for the county and each participating city in the planning area broken down by usage type. Finally, Table 3.5 provides the building count total for the county and each participating city in the planning area broken out by building usage types (residential, commercial, industrial, and agricultural).

Table 3.3. Maximum Population and Building Exposure by Jurisdiction - Communities

Jurisdiction	2020 Population	Building Count	Building Exposure	Contents Exposure	Total Exposure
Madison County-Unincorporated	7,497	6,586	$ 1,456,004,400	$ 1,254,597,400	$ 2,710,601,800
Fredericktown	4,006	2,042	$ 217,496,617	$ 159,292,408	$ 376,789,025
Total	11,503	8,628	$ 1,673,501,017	$ 1,413,889,808	$ 3,087,390,825

Sources: Population, 2010 Census; Building Count, SEMO RPC data; Building Exposure, HMPC and SEMO RPC data; Contents Exposure derived by applying multiplier to Building Exposure based on HAZUS MH 2.1 standard contents multipliers per usage type as follows: Residential (50%), Commercial (100%), Industrial (150%), Agricultural (100%).

Table 3.4. Building Values/Exposure by Usage Type

Jurisdiction	Residential	Commercial	Industrial	Agricultural	Total
Madison County-Unincorporated	$ 444,822,000	$ 35,884,800	$ 42,008,000	$ 933,289,600	$ 1,456,004,400
Fredericktown	$ 140,376,917	$ 50,291,800	$ 23,968,500	$ 2,859,400	$ 217,496,617
Total	$ 585,198,917	$ 86,176,600	$ 65,976,500	$ 936,149,000	$ 1,673,501,017

Table 3.5. Building Counts by Usage Type

Jurisdiction	Residential	Commercial	Industrial	Agricultural	Total
Madison County-Unincorporated	3,124	126	59	3,277	6,586
Fredericktown	1,669	299	57	17	2,042
Total	4,793	425	116	3,294	8,628

Based on the data that is available from the districts' completion of the Data Collection Questionnaire and district maintained websites, the number of enrolled students at the participating public school districts is provided in Table 3.6 below. Additional information includes the number of buildings, building values (building exposure) and contents value (contents exposure).

Table 3.6. Population and Building Exposure by Jurisdiction-Public School Districts

Public School District	Enrolment	Building Count	Building Exposure ($)	Contents Exposure ($)	Total Exposure ($)
Fredericktown R-I	1963	34	50,000,000	9,500,000	59,500,000
Marquand-Zion R-VI	122	6	20,000,000	3,750,000	23,750,000

Source: Enrollment - http://mcds.dese.mo.gov/quickfacts/Pages/District-and-School-Information.aspx. Building Count, Building Exposure, Contents Exposure, and Total Exposure amounts - Public School Districts.

3.2.2 Critical and Essential Facilities and Infrastructure

This section will include information from the Data Collection Questionnaire and other sources concerning the vulnerability of participating jurisdictions' critical, essential, high potential loss, and transportation/lifeline facilities to identified hazards. Definitions of each of these types of facilities are provided below.

- Critical Facility: Those facilities essential in providing utility or direction either during the response to an emergency or during the recovery operation.
- Essential Facility: Those facilities that if damaged, would have devastating impacts on disaster response and/or recovery.
- High Potential Loss Facilities: Those facilities that would have a high loss or impact on the community.
- Transportation and lifeline facilities: Those facilities and infrastructure critical to transportation, communications, and necessary utilities.

Table 3.7 includes a summary of the inventory of critical and essential facilities and infrastructure in the planning

area. The list was compiled from the Data Collection Questionnaire as well as the 2018 Missouri State Hazard Mitigation Plan.

Jurisdiction	Airport Facility	Bus Facility	Childcare Facility	Communications Tower	Electric Power Facility	Emergency Operations	Fire Service	Government	Housing	Shelters	Highway Bridge	Hospital/Health Care	Military	Natural Gas Facility	Nursing Homes	Police Station	Potable Water Facility	Rail	Sanitary Pump Stations	School Facilities	Stormwater Pump Stations	Tier II Chemical Facility	Wastewater Facility	TOTAL
Madison County			3	9	6	4	6	7			263				1		4							303
Fredericktown			4	4	4	3	1	7		1	8	6	1		3	1	1		5	5			1	55
Totals			7	13	10	7	7	14		1	271	6	1		4	1	5		5	5			1	358

3.2.3 Other Assets

Assessing the vulnerability of the planning area to disaster also requires data on the natural, historic, cultural, and economic assets of the area. This information is important for many reasons.

- These types of resources warrant more protection due to their unique and irreplaceable nature and contribution to the overall economy.
- Knowing about these resources in advance allows for consideration immediately following a hazard event, which is when the potential for damages is higher.
- The rules for reconstruction, restoration, rehabilitation, and/or replacement are often different for these types of designated resources.
- The presence of natural resources can reduce the impacts of future natural hazards, such as wetlands and riparian habitats which help absorb floodwaters.
- Losses to economic assets like these (e.g., major employers or primary economic sectors) could have severe impacts on a community and its ability to recover from disaster.

Table 3.7. Threatened and Endangered Species in Madison County

Species	Status
Mussels	
Cyprogenia aberti (Western Fan-Shell)	Endangered
Potamilus purpuratus (Western Heel Splitter)	Endangered
Fishes	
Percina Nasuta (Longnose Darter)	Rare
Amphibians and Reptiles	
Hemidactylium scutatum	Rare
Birds	
Haliaeetus leucocephalus (Bald Eagle)	Rare*
Accipiter striatus (Sharp-shinned Hawk)	Endangered
Mammals	
Mustela frenata (Long Tailed Weasel)	Rare
Plant Kingdom	
Marsupella sullivantii	Endangered
Metzgeria furcata	Endangered
Grimmia olneyi	Rare
Isopterygium distichaceum	Endangered
Seligeria donniana	Endangered
Lycopodium selago var. patens	Rare
Dennstaedtia punctilobula (Hay Scented Fern)	Rare
Dryopteris goldiana (Goldie's Fern)	Endangered
Habenaria leucophaea	Endangered*
Heuchera missouriensis (Alum Root)	Endangered*
Ilex verticillata var. padifolia (Winterberry)	Rare

Vitis rotundifolia (Muscadine, Scuppernong)	Endangered
Matelea obliqua (Climbing Milkweed)	Rare

Source: U.S. Fish and Wildlife Service

Table 3.8. Parks in Madison County

Park / Conservation Area	Address	City
Roselle Access	Hwy 72	County
Millstream Gardens	Hwy 72, Rt D	County
Thompson Ford Access	CR 503	County
Fredericktown City Lake	CR 209	Fredericktown
Amidon Memorial Conservation Area	CR 208	County
Marquand Access	Rt DD	County
Azalea Park	N. Main St	Fredericktown
Rotary Park	Buford Blvd	Fredericktown
Fredericktown Sports Complex	Sports Complex Dr.	Fredericktown

Source: MDC, Data Questionnaires, Juridictions

Historic Properties

Although there are many structures in Madison County of significant historic importance, there are currently only five properties/sites in Madison County which are listed on the National Register of Historic Places. The County has one designated historic district.

- The Fredericktown Missouri Pacific Railroad Depot (listed February 10, 2000).
- The Madison County Courthouse (listed December 28, 2000).
- Fredericktown United States Post Office (listed October 8, 2009).
- St. Louis, Iron Mountain and Southern Railroad Depot (October 19, 2005).
- Fredericktown Courthouse Square Historic District (July 8, 2009).

These National Register properties, and other historic structures found in Madison County, are probably most vulnerable to damage which could be caused by earthquakes, tornadoes or severe thunderstorms.

Table 3.9. Major Employers in Madison County

COMPANY	TYPE OF BUSINESS	EMPLOYEES
Cap America	Caps and hats	290
Fredericktown R-I School District	Public education	230
Madison Medical Center	Health care	240
Madison County Wood Products, Inc.	Wooden pallets	130
Black River Electric Co-op	Electric utility	90

COMPANY	TYPE OF BUSINESS	EMPLOYEES
Wal-Mart	General sales	85
Claru De Ville Nursing Care	Long term care	80
Country Mart	Grocery sales	70
City of Fredericktown	City government	55
Madison County	County government	50
Main Street Productions	Aviation fluids and filtration products	45
Marquand-Zion R-VI School District	Public education	40
Ozark Manor	Long term care	15

Source: HMPC

Agriculture

Agriculture plays an important role in the economy of the county. According to the 2017 Census of Agriculture, farms in the county sold over $794,000 in crops and $15.5 million in livestock and poultry. This equals nearly $16.3 million dollars in sales for all farms in the county. Additionally, in 2017, there were 142 hired workers in agriculture in the county, with wages paid in excess of $1.7 million. Many of these workers are seasonal, but the additional wages are nevertheless important to the county's economy.

3.3 Land Use and Development

3.3.1 Development Since Previous Plan Update

Both participating jurisdictions saw almost no change in population over the past decade. The following table shows the population changes in all jurisdictions between 2010 and 2020. Participating jurisdictions are highlighted in blue. The data shows there has been a growth of only 33 people across both participating jurisdictions. Fredericktown did not annex any areas, and new construction growth was very limited in parallel with the minor population growth.

Table 3.10. County Population Growth, 2010-2020

Population				
	2010	2020	Change	% Change
Madison County	12,226	12,176	-50	-0.41%
Cobalt Village	226	210	-16	-7.08%
Fredericktown	3,985	4,006	21	0.53%
Junction City	327	270	-57	-17.43%
Marquand	203	193	-10	-4.93%
Unincorporated County	7,485	7,497	12	0.16%
Missouri	5,988,927	6,124,160	135,233	2.26%
United States	308,745,538	326,569,308	17,823,770	5.77%

Source: American FactFinder

Population growth or decline is generally accompanied by increases or decreases in the number of housing units. Table 3.11 shows the change in numbers of housing units in the planning area from 2010 to 2020. This data is similar to the population trends over the same time period, with neither jurisdiction seeing any significant growth in housing units; with the unincorporated county experiencing a decline in housing units. This data, like the population data, indicates almost no change in the jurisdiction since the previous plan update.

Table 3.11. Change in Housing Units, 2010-2020

Housing Units				
	2010	2020	Change	% Change
Madison County	5970	5832	-138	-2.3%
Cobalt Village	104	116	12	11.5%
Fredericktown	1902	1907	5	0.3%
Junction City	179	169	-10	-5.6%
Marquand	108	107	-1	-0.9%
Unincorporated County	3677	3533	-144	-3.9%

Source: American FactFinder

Unincorporated County

There have been little to no changes in development of the county since the previous update. The unincorporated county experienced practically no change in population, while experiencing a drop in the number of housing units.

Fredericktown

The city experienced no significant changes in either population or housing units, and as a result saw little development within the planning area. What development did was scattered across the city as in-fill development, or was spread around the edges of the city, with no concentrations of growth.

3.3.2 Future Land Use Development

Unincorporated County

Based on recent trends, the county expects to see little to no change in population over the next 5 years, and by extension little development occurring in unincorporated areas. Any development that does occur will likely be residential or agricultural in nature. There are no increases in risk or exposure to hazards anticipated in the next few years.

Fredericktown

As with the county, Fredericktown expects little to no changes in population or development over the next 5 years. What development does occur is expected to be mainly residential and commercial in nature and spread across the city, rather than concentrated in any one particular area. There are no increases in risk or exposure to hazards anticipated in the next few years.

School District's Future Development

Both school districts anticipate only minor changes in student population over the next 5 years and do not expect any building development in the foreseeable future, other than potentially building safe rooms for their students and surrounding communities.

3.4 Hazard Profiles, Vulnerability, and Problem Statements

Each hazard will be analyzed individually in a hazard profile. The profile will consist of a general hazard description, location, severity/magnitude/extent, previous events, future probability, a discussion of risk variations between jurisdictions, and how anticipated development could impact risk. At the end of each hazard profile will be a vulnerability assessment, followed by a summary problem statement.

Hazard Profiles

The level of information presented in the profiles will vary by hazard based on the information available. With each update of this plan, new information will be incorporated to provide better evaluation and prioritization of the hazards that affect the planning area. Detailed profiles for each of the identified hazards include information categorized as follows:

Hazard Description: This section consists of a general description of the hazard and the types of impacts it may have on a community or school/special district.

Geographic Location: This section describes the geographic location of the hazard in the planning area. Where available, use maps to indicate the specific locations of the planning area that are vulnerable to the subject hazard. For some hazards, the entire planning area is at risk.

Severity/Magnitude/Extent: This includes information about the severity, magnitude, and extent of a hazard. For some hazards, this is accomplished with description of a value on an established scientific scale or measurement system, such as an EF2 tornado on the Enhanced Fujita Scale. Severity, magnitude, and extent can also include the speed of onset and the duration of hazard events. Describing the severity/magnitude/extent of a hazard is not the same as describing its potential impacts on a community. Severity/magnitude/extent defines the characteristics of the hazard regardless of the people and property it affects.

Previous Occurrences: This section includes available information on historic incidents and their impacts. Historic event records form a solid basis for probability calculations.

Probability of Future Occurrence: The frequency of recorded past events is used to estimate the likelihood of future occurrences. Probability was determined by dividing the number of recorded events by the number of years and multiplying by 100. This gives the percent chance of the event happening in any given year. For events occurring more than once annually, the probability will be reported 100% in any given year, with a statement of the average number of events annually.

Vulnerability Assessments

Following the hazard profile for each hazard will be the vulnerability assessment. The vulnerability assessment further defines and quantifies populations, buildings, critical facilities, and other community assets at risk to damages from natural hazards. The vulnerability assessments will be based on the best available county-level data, which is in the Missouri Hazard Mitigation Plan (2018). The county-level assessments in the State Plan were based on the following sources:

- Statewide GIS data sets compiled by state and federal agencies; and
- FEMA's HAZUS-MH loss estimation software.

The vulnerability assessments in the plan will also be based on:

- Written descriptions of assets and risks provided by participating jurisdictions;
- Existing plans and reports;
- Personal interviews with planning committee members and other stakeholders; and
- Other sources as cited.

Detailed profiles for each of the identified hazards include information categorized as follows:

Vulnerability Overview
An overall summary of each jurisdiction's vulnerability to the identified hazards.

Potential Losses to Existing Development
Describes the potential impacts of the hazard.

Previous and Future Development
This section provides information on how changes in development have impacted the community's vulnerability to this hazard.

Hazard Summary by Jurisdiction
For hazards that vary by jurisdiction, this section will provide an overview of the variation.

Problem Statements

A brief summary of the problems created by the hazard in the planning area, and possible ways to resolve those problems.

3.4.1 Dam Failure

Hazard Profile

Hazard Description

A dam is defined as a barrier constructed across a watercourse for storage, control, or diversion of water. Dams are typically constructed of earth, rock, concrete, or mine tailings. Dam failure is the uncontrolled release of impounded water resulting in downstream flooding, affecting both life and property. Dam failure can be caused by any of the following:

1. Overtopping - inadequate spillway design, debris blockage of spillways or settlement of the dam crest.
2. Piping: internal erosion caused by embankment leakage, foundation leakage and deterioration of pertinent structures appended to the dam.
3. Erosion: inadequate spillway capacity causing overtopping of the dam, flow erosion, and inadequate slope protection.
4. Structural Failure: caused by an earthquake, slope instability or faulty construction.

Dams in the NID are classified according to hazard potential, an indicator of the consequences of dam failure. A dam's hazard potential classification, presented in Table 3.10 does not indicate its condition. Dams assigned the high hazards potential classification are those where failure will potentially result in loss of human life. Significant hazard potential are those dams where failure results in no probable loss of human life but can cause economic loss. Dams assigned the low hazard potential classification are those where failure will result in no probable loss of human life and low economic or environmental losses. Losses are principally limited to the owner's property.

Table 3.12. MDNR Dam Hazard Classification Definitions

Hazard Class	Definition
Class I	The area downstream from the dam that would be affected by inundation contains ten (10) or more permanent dwellings or any public building. Inspections of these dams must occur every two years.
Class II	The area downstream from the dam that would be affected by inundation contains one to nine permanent dwellings, or one (1) or more campgrounds with permanent water, sewer and electrical services or one (1) or more industrial buildings. Inspections of these dams must occur once every three years.
Class III	The area downstream from the dam that would be affected by inundation does not contain any of the structures identified for Class I or Class II dams. Inspections of these dams must occur once every five years.

Source: Missouri Department of Natural Resources, http://dnr.mo.gov/env/wrc/docs/rules_reg_94.pdf

Table 3.13. NID Dam Hazard Classification Definitions

Hazard Class	Definition
Low Hazard	Failure results in only minimal property damage
Significant Hazard	Failure could possibly result in the loss of life and appreciable property damage
High Hazard	If the dam were to fail, lives would likely be lost and extensive property damage would result

Source: National Inventory of Dams

There is not a direct correlation between the State Hazard classification and the NID classifications. However, most dams that are in the DNR's Class I and Class II are considered NID High Hazard Dams.

Geographic Location

Dams Located Within the Planning Area

The following table shows the National Inventory of Dams listing for Madison County. There are 28 dams listed in the Inventory, with 21 of them being classified as High Hazard Potential.

Table 3.14. Madison County National Inventory of Dams Listing

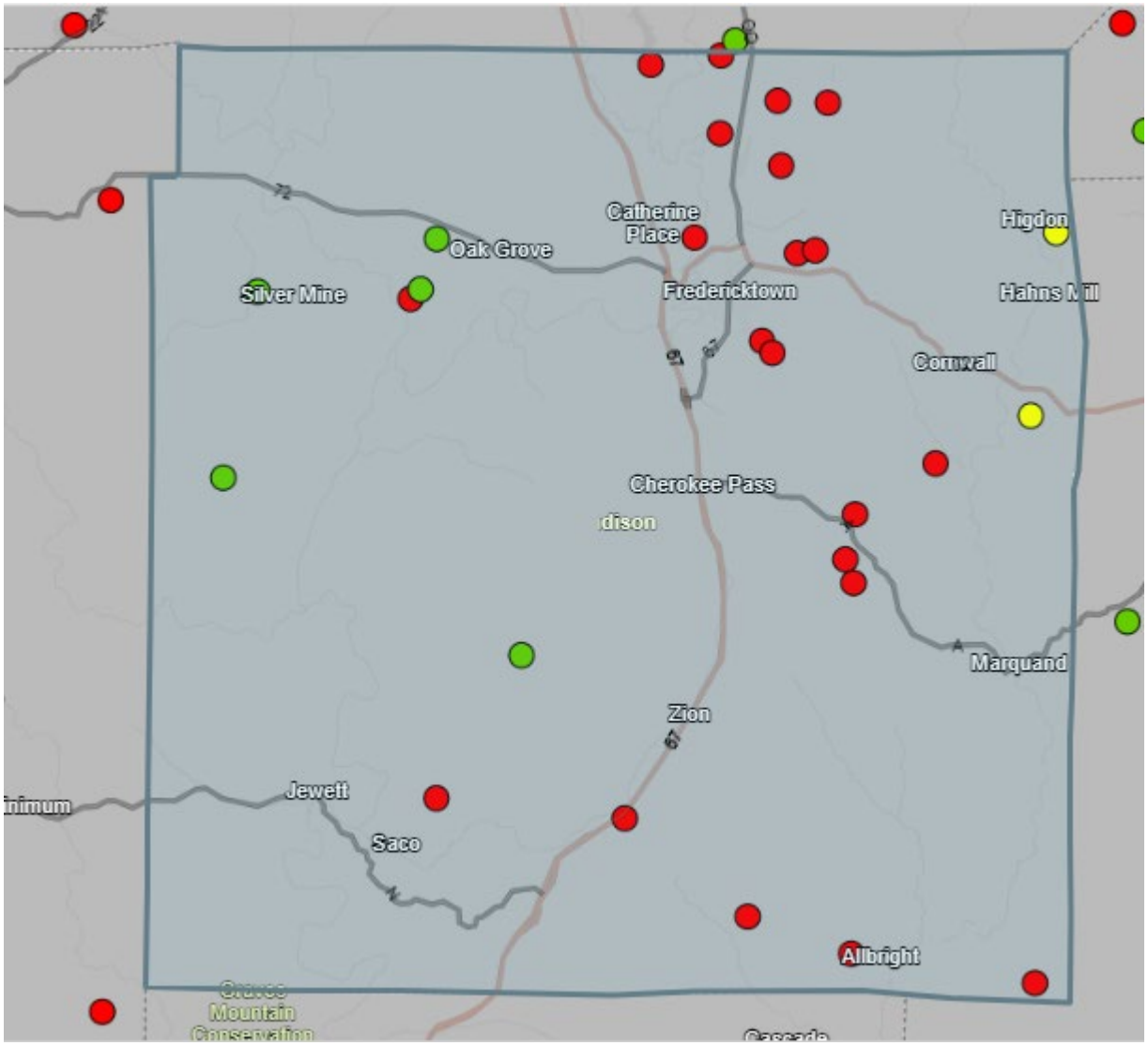
Dam Name	NIDID	Hazard Potential *	NID Height (Ft.)	River	Nearest City	Distance To City (Mi.)	Enforce-ment Authority
SKAGGS LAKE DAM	MO31386	High	40	TR TO TRACE CREEK	SAKO	0	Y
LOST VALLEY LAKE DAM	MO31079	High	38	TR TO VILLAGE CREEK	JUNCTION CITY	0	Y
SMITTY'S CATFISH POND DAM	MO30613	High	27	TR TO GREASY CREEK	MARQUAND	6	N
NEVILLE DAM	MO31212	High	30	TR TO CASTOR RIVER	MARQUAND	0	N
NIMS LAKE DAM	MO30064	High	57	WILLS BRANCH	FREDERICKTOWN	7	Y
SILVER MINES LAKE RESORT DAM	MO30617	High	28	TR TO ST FRANCIS RIVER	FREDERICKTOWN	8	N
DEER RUN LAKE DAM	MO30486	High	43	TR TO LITTLE ST FRANCIS RIVER	JUNCTION CITY	0	Y
NEWMAN LAKE DAM	MO30488	High	25	TRIB-SNOWDEN BRANCH	MARQUAND	9	N
ANSCHUTZ UPSTREAM DAM	MO31080	High	20	TOLER CREEK TR SALINE CREEK	FREDERICKTOWN	0	N
BRITTON LAKE DAM	MO30614	High	32	TR TO GIMLET CREEK	ZALMA	22	N
DOLL LAKE DAM	MO30615	High	25	TR TO EAST FORK BIG CREEK	ZALMA	26	N
JOHN BOLLINGER NO. 1 DAM	MO31417	High	18	TR TO SALINE CREEK	FREDERICKTOWN	2	N
JOHN BOLLINGER NO. 2 DAM	MO31433	High	29	TR TO SALINE CREEK	FREDERICKTOWN	1	N
MADISON MINE MAIN DAM	MO31082	High	40	TOLER CREEK - SALINE CREEK	FREDERICKTOWN	1	Y
SLIME POND DAM	MO30611	High	33	TR TO SHAYS CREEK	FREDERICKTOWN	2	N
WHITEHURST LAKE DAM	MO30126	High	31	TR TO TWELVEMILE CREEK	SACO	7	N
LAKE HARMONY DAM	MO30612	High	21	TR-LITTLE ST FRANCOIS RIVER	FREDERICKTOWN	0	N
MINE LAMOTTE DAM	MO30289	High	27	TR-LITTLE ST FRANCOIS RIVER	FREDERICKTOWN	0	N
FREDERICKTOWN CITY DAM	MO30489	High	24	LITTLE ST FRANCIS RIVER	FREDERICKTOWN	1	N
POGUE LAKE DAM	MO30127	High	18	TR TO GREASY CREEK	MARQUAND	5	N
TRACE CREEK DAM	MO40114	High	40	TRACE CRK. (TRIB. CASTOR RIV	-	0	N

GAINES,HENRY LAKE DAM	MO30618	Low	31	TR TO TRACE CREEK	SAKO	6	N
ALLGIER LAKE DAM	MO30610	Low	30	TR-PINEY CREEK	WAPPAPELLO	-	N
BLUE MOUNTAIN METHODIST CAMP LAKE DAM	MO30084	Low	33	TR TO ROCK CREEK	MACON	5	N
DOUG GAINES	MO51008	Low	36	TR-LOWER ROCK CREEK	FREDERICKTOWN	-	N
BETTY FRANCIS	MO51009	Low	29	TR-PINEY CREEK	FREDRICKTOWN	-	N
MOORE LAKE DAM	MO32092	Significant	28	UNNAME TRIB CASTOR RIVER	MARQUAND	12.6	N
VANCE LAKE DAM	MO32093	Significant	34	CASTOR RIVEW	MARQUAND	7.7	N

Source: National Inventory of Dams

The following map shows the locations of all NID dams in the county, with the High hazard dams in red.

Figure 3.1. NID Dams In County



Source: National Inventory of Dams

Inundation areas for the failure of High hazard dams in the county are estimated to impact only limited numbers of residents and structures. The majority of the dams in the county are either agricultural or recreational in nature and most are privately owned. Failure of a dam in the county would result in only minimal damage to structures as most of the development near the dams occurs upstream around the lakes or ponds created by the dam. There are no critical facilities in the inundation zones.

Fredericktown does have 5 dams nearby, with the most significant dam being Fredericktown City Dam. Failure of any of these dams would potentially impact only a few structures downstream, though there are no critical facilities in the estimated inundation zones of any of them.

Upstream Dams Outside the Planning Area
There are no dams outside the county that would significantly impact the planning area in the event of a failure.

Strength/Magnitude/Extent

The strength/magnitude of dam failure would be similar in some cases to the impacts associated with flood events (see the flood hazard vulnerability analysis and discussion). Based on the hazard class definitions, failure of any of the High Hazard/Class I dams could result in a serious threat of loss of human life, serious damage to residential, industrial or commercial areas, public utilities, public buildings, or major transportation facilities. Catastrophic failure of any high hazard dams has the potential to result in greater destruction due to the potential speed of onset and greater depth, extent, and velocity of flooding. Note that for this reason, dam failures could flood areas outside of mapped flood hazards. Also note that inundation areas have not been mapped for these dams; however, the expected inundation area is generally considered to be greater than the SFHA near the dam, then decreasing down to equal to the SFHA further from the dam, and then eventually falling within the SFHA.

Previous Occurrences

There have been no previous occurrences of dam or levee failures in the past 20 years.

Probability of Future Occurrence

There are no documented dam failures in the county in the past 20 years. This makes a calculation of probability difficult. However, regulated dams are inspected regularly, which greatly reduces the chances of a failure.

Changing Future Conditions

Most dam failures are a result of structural failures, though increased rainfall and runoff can exacerbate deteriorating conditions of dams.

Vulnerability

Vulnerability Overview

According to the 2018 State Hazard Mitigation Plan, there are approximately 23 buildings in the county vulnerable to a failure of a state-regulated dam. There are, of course, other non-regulated dams in the county, but estimates are difficult due to data limitations.

Potential Losses to Existing Development: (including types and numbers, of buildings, critical facilities, etc.)

The 2018 State Hazard Mitigation Plan estimates potential losses due to the failure of state-regulated dams at $5.6 million. As with the number of buildings exposed, it is difficult to make any estimates for non-regulated dams due to data limitations.

Impact of Future Development

Future development will be most prominent around the Fredericktown area and the City Lake Dam. However, over the next five years, little development is anticipated in the estimated inundation area of City Lake Dam.

Hazard Summary by Jurisdiction

Unincorporated County
While there are multiple dams in the unincorporated areas of the county, the sparse development patterns limit the impact of any dam failure. There are no critical structures in estimated inundation zones. There are only 23 buildings and 45 people likely to be impacted by a dam failure in the county.

Fredericktown
The city has limited exposure and vulnerability to a dam failure, as there are few if any structures in the estimated inundation zones of the 5 surrounding dams. However, a failure of City Lake Dam would cause issues for the city's water supply.

Fredericktown R-I School Dist.
The district has no structures in estimated inundation zones.

Marquand-Zion R-VI School Dist.
The district has no structures in estimated inundation zones.

Problem Statement

The impacts of a dam failure in the unincorporated areas of the county are limited by the low development density of the area. For Fredericktown, there are only a small number of structures in the estimated inundation zones.

Data limitations currently prevent detailed analysis of inundation zones.

3.4.2 Drought

Hazard Profile

Hazard Description

Drought is generally defined as a condition of moisture levels significantly below normal for an extended period over a large area that adversely affects plants, animal life, and humans. A drought period can last for months, years, or even decades. There are four types of drought conditions relevant to Missouri, according to the State Plan, which are as follows.

- Meteorological drought is defined in terms of the basis of the degree of dryness (in comparison to some "normal" or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts also are out of phase with impacts in other economic sectors.

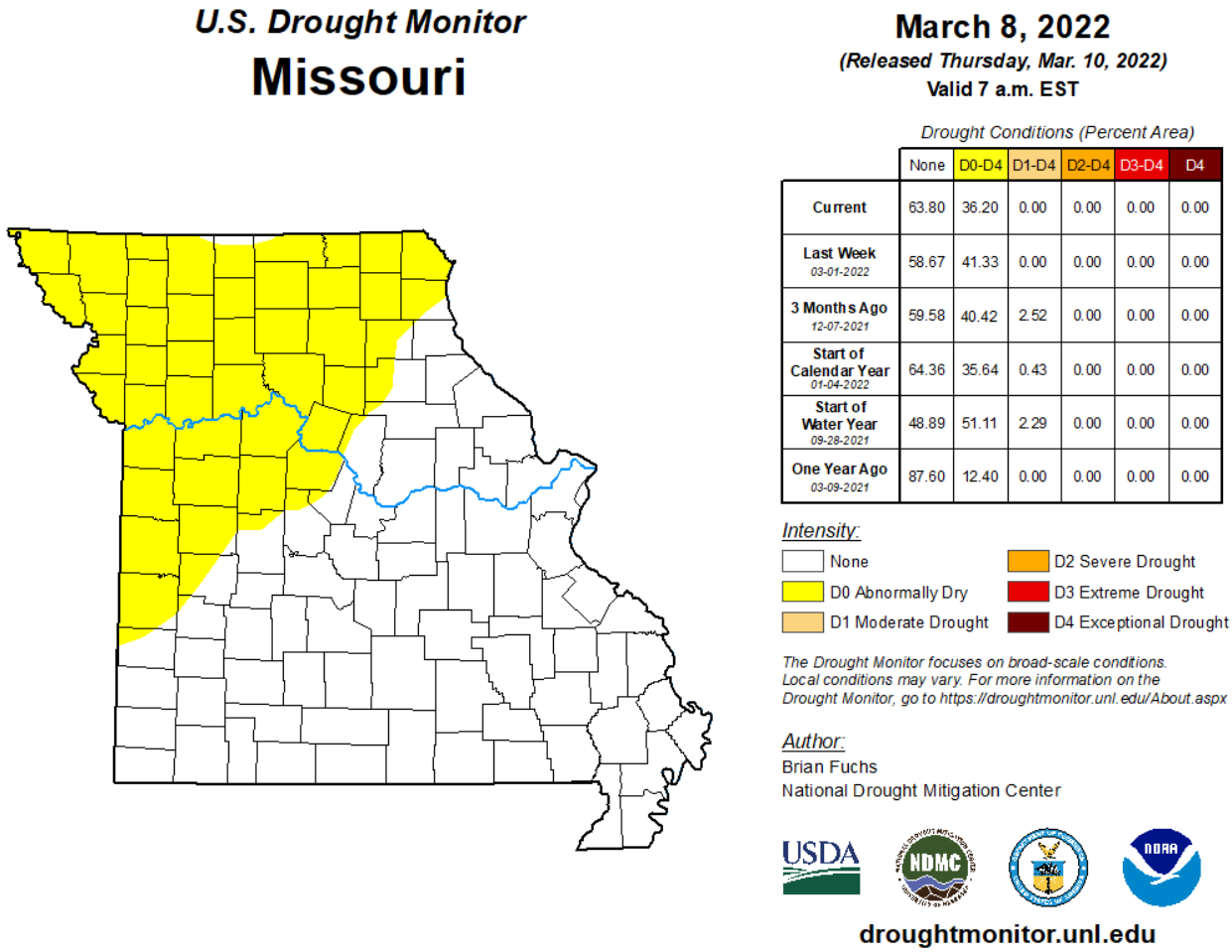
- Agricultural drought focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, etc. Plant demand for water depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.

- Socioeconomic drought refers to when physical water shortage begins to affect people.

Geographic Location

Given the nature of droughts, the entire county is equally exposed to this hazard. Droughts do tend to have greater impact on agricultural activities and would therefore have more impact in the unincorporated county than the more urbanized areas.

Figure 3.2. U.S. Drought Monitor Map of Missouri on 8/1/2017



Source: U.S. Drought Monitor, http://droughtmonitor.unl.edu/Home/StateDroughtMonitor.aspx?MO

Severity/Magnitude/Extent

The Palmer Drought Indices measure dryness based on recent precipitation and temperature. The indices are based on a "supply-and-demand model" of soil moisture. Calculation of supply is relatively straightforward, using temperature and the amount of moisture in the soil. However demand is more complicated as it depends on a variety of factors, such as evapotranspiration and recharge rates. These rates are harder to calculate. Palmer tried to overcome these difficulties by developing an algorithm that approximated these rates, and based the algorithm on the most readily available data — precipitation and temperature.

The Palmer Index has proven most effective in identifying long-term drought of more than several months. However, the Palmer Index has been less effective in determining conditions over a matter of weeks. It uses a "0" as normal, and drought is shown in terms of negative numbers; for example, negative 2 is moderate drought, negative 3 is severe drought, and negative 4 is extreme drought. Palmer's algorithm also is used to describe wet spells, using corresponding positive numbers.

Palmer also developed a formula for standardizing drought calculations for each individual location based on

the variability of precipitation and temperature at that location. The Palmer index can therefore be applied to any site for which sufficient precipitation and temperature data is available.

Previous Occurrences

According to the NCEI, since 2002, there have been 3 significant drought events to affect the county, totaling 5 months of drought conditions. Droughts occurred in the summers of 2005, 2007, and 2012. The most severe was the months-long event in the summer of 2012.

Probability of Future Occurrence

Over the last 240 months drought conditions have occurred in 5 months. This equals a 2% monthly chance of a drought.

Changing Future Conditions Considerations

An analysis performed by the Natural Resources Defense Council examined the effects of climate change on water supply and demand in the contiguous United States and found that more than 1,100 counties will face higher risks of water shortages by mid-century as a result of climate change. Two of the principal reasons for the projected water constraints are shifts in precipitation and potential evapotranspiration (PET). Climate models project decreases in precipitation in many regions of the U.S., including areas that may currently be described as experiencing water shortages of some degree.

Vulnerability

Vulnerability Overview

According to the 2018 State HMP, the county has a "low-medium" vulnerability to drought events.

Potential Losses to Existing Development

The National Drought Monitor Center at the University of Nebraska at Lincoln summarized the potential severity of drought as follows. Drought can create economic impacts on agriculture and related sectors, including forestry and fisheries, because of the reliance of these sectors on surface and subsurface water supplies. In addition to losses in yields in crop and livestock production, drought is associated with increases in insect infestations, plant disease, and wind erosion. Droughts also bring increased problems with insects and disease to forests and reduce growth. The incidence of forest and range fires increases substantially during extended droughts, which in turn place both human and wildlife populations at higher levels of risk. Income loss is another indicator used in assessing the impacts of drought because so many sectors are affected. Finally, while drought is rarely a direct cause of death, the associated heat, dust and stress can all contribute to increased mortality.

Much of the impact would be felt by agricultural activities, especially for crop related uses. Most of Madison County's agricultural land use is in livestock, however, which has less vulnerability to drought of the two. The 2018 Missouri State Hazard Mitigation Plan indicates the county has only had $14,719 in annualized crop insurance claims due to drought. Given that many counties have claims over $1 million dollars, this indicates only slight vulnerability. Impacts on the city of Fredericktown and the school districts will be lesser still.

Impact of Previous and Future Development

Given the small amount of growth the County has experienced since the previous plan, recent development has

had little to no impact on the exposure or severity of drought in the county. Similarly, with little to no growth projected in the next 5 years, future development will have minimal impact on drought events.

Hazard Summary by Jurisdiction

Unincorporated County
The unincorporated areas of the county are the most vulnerable to a drought given the large amount of agricultural activity in the county. Additionally, many residents are on private wells for water, and drops in the water table could lead to problems for some residents.

Fredericktown
While the city's exposure to drought is the same as the county, the impact is less. However, a severe enough drought could impact water levels in the city lake, the source of the city's water supply.

Fredericktown R-I School Dist.
The district has little vulnerability to drought other than to building foundations, which could be damaged by contracting and expanding soils.

Marquand-Zion R-VI School Dist.
The district has little vulnerability to drought other than to building foundations, which could be damaged by contracting and expanding soils.

Problem Statement

While droughts have regional impacts, within the county the most vulnerable areas are the agricultural assets in the unincorporated county. Droughts have little to no impact on the school districts, and the municipalities have had no issues with water source depletion in recent history.

3.4.3 Earthquakes

Hazard Profile

Hazard Description

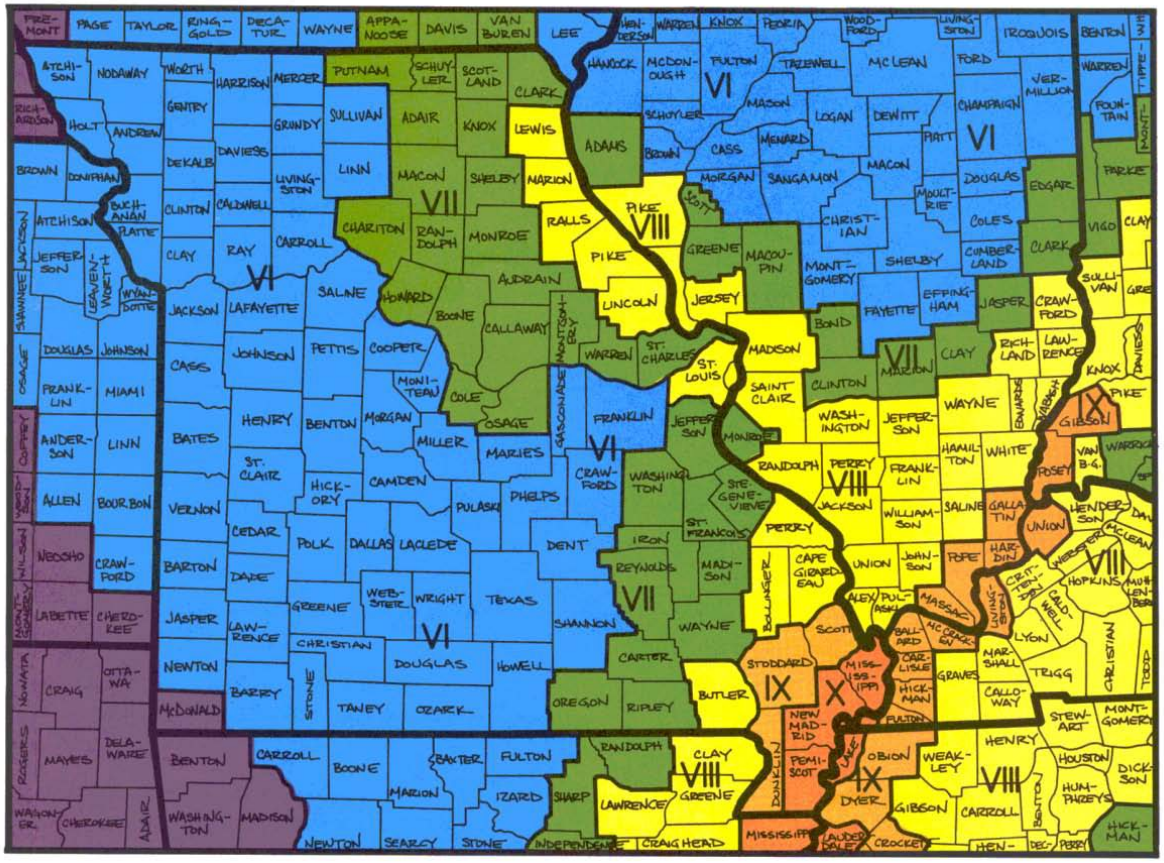
An earthquake is a sudden motion or trembling that is caused by a release of energy accumulated within or along the edge of the earth's tectonic plates. Earthquakes occur primarily along fault zones and tears in the earth's crust. Along these faults and tears in the crust, stresses can build until one side of the fault slips, generating compressive and shear energy that produces the shaking and damage to the built environment. Heaviest damage generally occurs nearest the earthquake epicenter, which is that point on the earth's surface directly above the point of fault movement. The composition of geologic materials between these points is a major factor in transmitting the energy to buildings and other structures on the earth's surface.

Geographic Location

Madison County is located approximately 80 miles northwest of the New Madrid Fault. This fault was responsible for the famous 1811 earthquakes that registered up to 7.9 on the Richter Scale and rang church bells in Boston, MA.

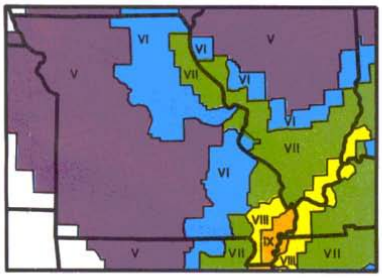
The following Figures illustrate the potential impact the New Madrid Fault could have on Madison County.

Figure 3.3. Impact Zones for Earthquake Along the New Madrid Fault



This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude – 7.6 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone.

6.7

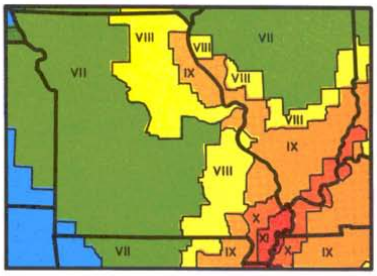


This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude – 6.7 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone.

7.6

This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude – 8.6 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone.

8.6



Source:
http://sema.dps.mo.gov/docs/programs/Planning,%20Disaster%20&%20Recovery/State%20of%20Missouri%20Hazard%20Analysis/2012-State-Hazard-Analysis/Annex_F_Earthquakes.pdf

MODIFIED MERCALLI INTENSITY SCALE

I People do not feel any Earth movement.

II A few people might notice movement.

III Many people indoors feel movement. Hanging objects swing.

IV Most people indoors feel movement. Dishes, windows, and doors rattle. Walls and frames of structures creak. Liquids in open vessels are slightly disturbed. Parked cars rock.

V Almost everyone feels movement. Most people are awakened. Doors swing open or closed. Dishes are broken. Pictures on the wall move. Windows crack in some cases. Small objects move or are turned over. Liquids might spill out of open containers.

VI Everyone feels movement. Poorly built buildings are damaged slightly. Considerable quantities of dishes and glassware, and some windows are broken. People have trouble walking. Pictures fall off walls. Objects fall from shelves. Plaster in walls might crack. Some furniture is overturned. Small bells in churches, chapels and schools ring.

VII People have difficulty standing. Considerable damage in poorly built or badly designed buildings, adobe houses, old walls, spires and others. Damage is slight to moderate in well-built buildings. Numerous windows are broken. Weak chimneys break at roof lines. Cornices from towers and high buildings fall. Loose bricks fall from buildings. Heavy furniture is overturned and damaged. Some sand and gravel stream banks cave in.

VIII Drivers have trouble steering. Poorly built structures suffer severe damage. Ordinary substantial buildings partially collapse. Damage slight in structures especially built to withstand earthquakes. Tree branches break. Houses not bolted down might shift on their foundations. Tall structures such as towers and chimneys might twist and fall. Temporary or permanent changes in springs and wells. Sand and mud is ejected in small amounts.

IX Most buildings suffer damage. Houses that are not bolted down move off their foundations. Some underground pipes are broken. The ground cracks conspicuously. Reservoirs suffer severe damage.

X Well-built wooden structures are severely damaged and some destroyed. Most masonry and frame structures are destroyed, including their foundations. Some bridges are destroyed. Dams are seriously damaged. Large landslides occur. Water is thrown on the banks of canals, rivers, and lakes. Railroad tracks are bent slightly. Cracks are opened in cement pavements and asphalt road surfaces.

XI Few if any masonry structures remain standing. Large, well-built bridges are destroyed. Wood frame structures are severely damaged, especially near epicenters. Buried pipelines are rendered completely useless. Railroad tracks are badly bent. Water mixed with sand, and mud is ejected in large amounts.

XII Damage is total, and nearly all works of construction are damaged greatly or destroyed. Objects are thrown into the air. The ground moves in waves or ripples. Large amounts of rock may move. Lakes are dammed, waterfalls formed and rivers are deflected.

Intensity is a numerical index describing the effects of an earthquake on the surface of the Earth, on man, and on structures built by man. The intensities shown in these maps are the highest likely under the most adverse geologic conditions. There will actually be a range in intensities within any small area such as a town or county, with the highest intensity generally occurring at only a few sites. Earthquakes of all three magnitudes represented in these maps occurred during the 1811 - 1812 "New Madrid earthquakes." The isoseismal patterns shown here, however, were simulated based on actual patterns of somewhat smaller but damaging earthquakes that occurred in the New Madrid seismic zone in 1843 and 1895.

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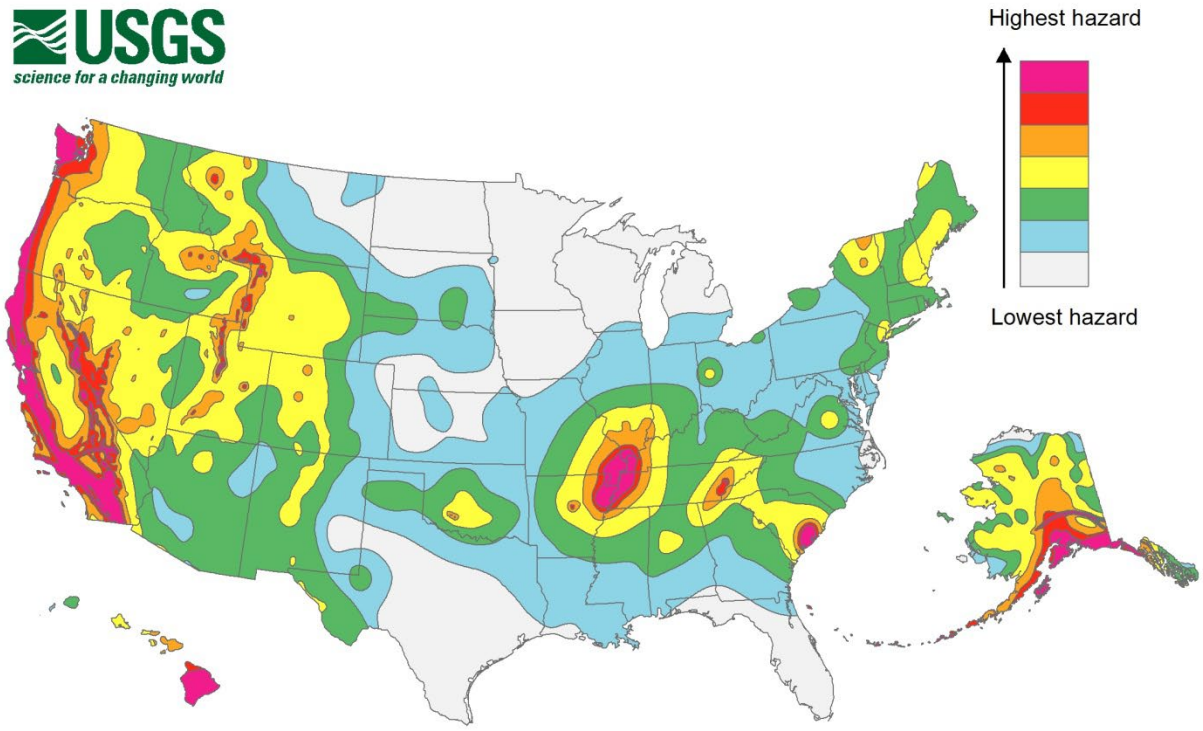
THE MISSOURI STATE
EMERGENCY MANAGEMENT AGENCY
P.O. BOX 116
JEFFERSON CITY, MO 65102
Telephone: 573-526-9100

Figure 3.4. United States Seismic Hazard Map



Source: United States Geological Survey at http://earthquake.usgs.gov/hazards/products/conterminous/2014/HazardMap2014_lg.jpg

Strength/Magnitude/Extent

The extent or severity of earthquakes is generally measured in two ways: 1) the Richter Magnitude Scale is a measure of earthquake magnitude; and 2) the Modified Mercalli Intensity Scale is a measure of earthquake severity. The two scales are defined a follows.

Richter Magnitude Scale

The Richter Magnitude Scale was developed in 1935 as a device to compare the size of earthquakes. The magnitude of an earthquake is measured using a logarithm of the maximum extent of waves recorded by seismographs. Adjustments are made to reflect the variation in the distance between the various seismographs and the epicenter of the earthquakes. On the Richter Scale, magnitude is expressed in whole numbers and decimal fractions. For example, comparing a 5.3 and a 6.3 earthquake shows that the 6.3 quake is ten times bigger in magnitude. Each whole number increase in magnitude represents a tenfold increase in measured amplitude because of the logarithm. Each whole number step in the magnitude scale represents a release of approximately 31 times more energy.

Modified Mercalli Intensity Scale

The intensity of an earthquake is measured by the effect of the earthquake on the earth's surface. The intensity scale is based on the responses to the quake, such as people awakening, movement of furniture, damage to

chimneys, etc. The intensity scale currently used in the United States is the Modified Mercalli (MM) Intensity Scale. It was developed in 1931 and is composed of 12 increasing levels of intensity. They range from imperceptible shaking to catastrophic destruction, and each of the twelve levels is denoted by a Roman numeral. The scale does not have a mathematical basis, but is based on observed effects. Its use gives the laymen a more meaningful idea of the severity.

Previous Occurrences

Earthquakes in the county from 1973 through 2022 are presented below. In recent years there have been earthquakes recorded in the county ranging in magnitude from 1.4 to 2.5, but no known serious damage has resulted.

The New Madrid Seismic Zone experiences more than 200 measurable earthquakes a year. Earthquakes of magnitude 2.5 to 3 on the Richter scale are felt annually, with a quake of 4 or more being released every 18 months. An earthquake of 5.0 or greater on the Richter scale occurs about once per decade.

Table 3.15. Historic Earthquake Events In The County

Date	Magnitude	Depth (mi)
8/9/2019	2	10.7
6/6/2017	2.5	15.2
1/23/2017	2.4	0.8
11/6/2015	2.1	11.9
11/6/2015	1.4	4.4
12/4/2013	2.1	19.8
2/7/2012	2.5	0.1
1/30/2011	2	5.2
10/25/2009	2.3	1.7
1/9/2009	2.5	8.3
4/21/2004	2.7	9.6
8/30/2000	2.5	2.4
7/22/1998	2.7	17.5
7/31/1995	2.8	5
1/3/1977	5	5
12/13/1976	3.5	5
1/12/1973	3.2	20

Source: homefacts.com

Probability of Future Occurrence

Based on the past 20 years of events, the probability of an earthquake occurring within 30 miles of the planning area is calculated as 55% (11events / 20 years). However, more than one 3.0 magnitude or less earthquake occurs each year in the New Madrid Seismic Zone.

The USGS estimates the probability of a magnitude 7.5 or greater earthquake in the New Madrid Seismic Zone over the next 50 years is 7-10%. The probability of an earthquake exceeding magnitude 6 over the same period is 25-40%.

Changing Future Conditions Considerations

None for this hazard.

Vulnerability

Vulnerability Overview

Madison County has a 16% economic loss ratio for an event of 2% probability of exceedance in 50 years. This number is higher than most counties across the state due to its close proximity to the New Madrid Seismic Zone, though it is not as high as other counties even closer to the fault zone.

Also of note, according to the Missouri Dept. of Insurance, in 2014, only 61% of residents in the county had earthquake insurance in their coverage. This is down from 81% in 2000. The DOI 2015 report on earthquake insurance and coverage states that, “coverage has become less available and less affordable over the last 15 years.”

Potential Losses to Existing Development

Given a scenario of 2% probability of exceedance in 50 years, Madison County would be projected to suffer over $288,900,000 in total economic losses. Such an economic loss in a rural county could be catastrophic and devastate the population for decades.

Impact of Future Development

Future development is not expected to increase the risk of an earthquake other than by contributing to the overall exposure of what could become damaged as a result of an event. Given the small growth anticipated in the County, even this increase in exposure is small.

Hazard Summary by Jurisdiction

Unincorporated County

The unincorporated areas of the county will experience significant damage from an earthquake similar to that projected in the 2018 State HMP. This damage will impact numerous structures, including critical facilities in the county, such as transportation, utilities, emergency response facilities, etc.

Fredericktown

The city will experience damages similar to the county, with potentially increased damage due to denser development and buildings with more stories, especially in the downtown area. All critical facilities are equally exposed to impacts from an earthquake, including multiple child and adult care facilities.

Fredericktown R-I School Dist.
All of the school district's buildings are equally exposed to damage from an earthquake.

Marquand-Zion R-VI School Dist.
All of the school district's buildings are equally exposed to damage from an earthquake.

Problem Statement

All jurisdictions are equally exposed to the impacts of an earthquake, though Fredericktown will experience greater damages due to development density and building types. Older buildings are more susceptible to damage, but retrofitting entire buildings or constructing new ones solely for seismic stability is cost prohibitive for all jurisdictions. Additionally, decreasing insurance coverage in the county will be problematic if serious damages are realized, as owners will not be as able to rebuild and recover from an event.

3.4.4 Extreme Temperatures

Hazard Profile

Hazard Description

Extreme temperature events, both hot and cold, can impact human health and mortality, natural ecosystems, agriculture and other economic sectors. The remainder of this section profiles extreme heat. Extreme cold events are profiled in combination with Winter Storm. According to information provided by FEMA, extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks. Ambient air temperature is one component of heat conditions, with relative humidity being the other. The relationship of these factors creates what is known as the apparent temperature. The Heat Index chart shown in **Figure 3.4** uses both of these factors to produce a guide for the apparent temperature or relative intensity of heat conditions.

Extreme cold often accompanies severe winter storms and can lead to hypothermia and frostbite in people without adequate clothing protection. Cold can cause fuel to congeal in storage tanks and supply lines, stopping electric generators. Cold temperatures can also overpower a building's heating system and cause water and sewer pipes to freeze and rupture. Extreme cold also increases the likelihood for ice jams on flat rivers or streams. When combined with high winds from winter storms, extreme cold becomes extreme wind chill, which is hazardous to health and safety.

The National Institute on Aging estimates that more than 2.5 million Americans are elderly and especially vulnerable to hypothermia, with the isolated elders being most at risk. About 10 percent of people over the age of 65 have some kind of bodily temperature-regulating defect, and 3-4 percent of all hospital patients over 65 are hypothermic.

Also at risk, are those without shelter, those who are stranded, or who live in a home that is poorly insulated or without heat. Other impacts of extreme cold include asphyxiation (unconsciousness or death from a lack of oxygen) from toxic fumes from emergency heaters; household fires, which can be caused by fireplaces and emergency heaters; and frozen/burst pipes.

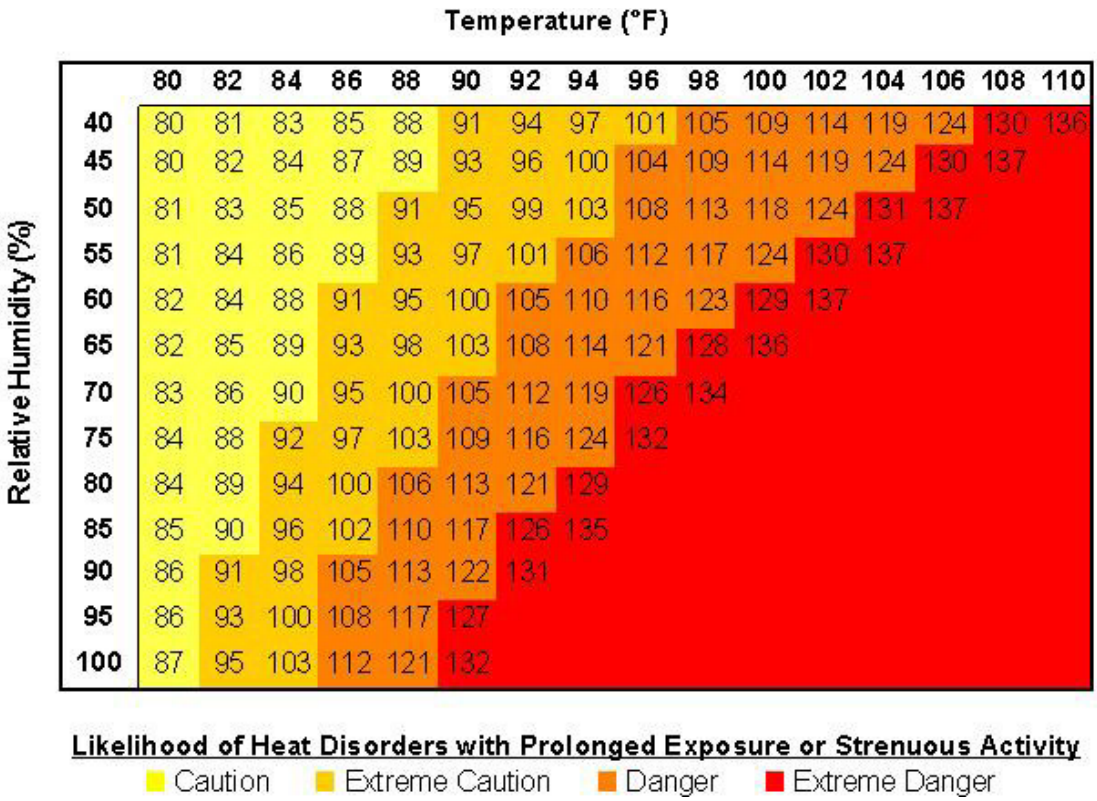
Geographic Location

Extreme temperature is an area-wide hazard event, the risk of extreme temperatures does not vary across the planning area.

Strength/Magnitude/Extent

The National Weather Service has an alert system in place (advisories or warnings) when the Heat Index is expected to have a significant impact on public safety. The expected severity of the heat determines whether advisories or warnings are issued. A common guideline for issuing excessive heat alerts is when for two or more consecutive days : (1) when the maximum daytime Heat Index is expected to equal or exceed 105 degrees Fahrenheit (°F); and the night time minimum Heat Index is 80°F or above. A heat advisory is issued when temperatures reach 105 degrees and a warning is issued at 115 degrees.

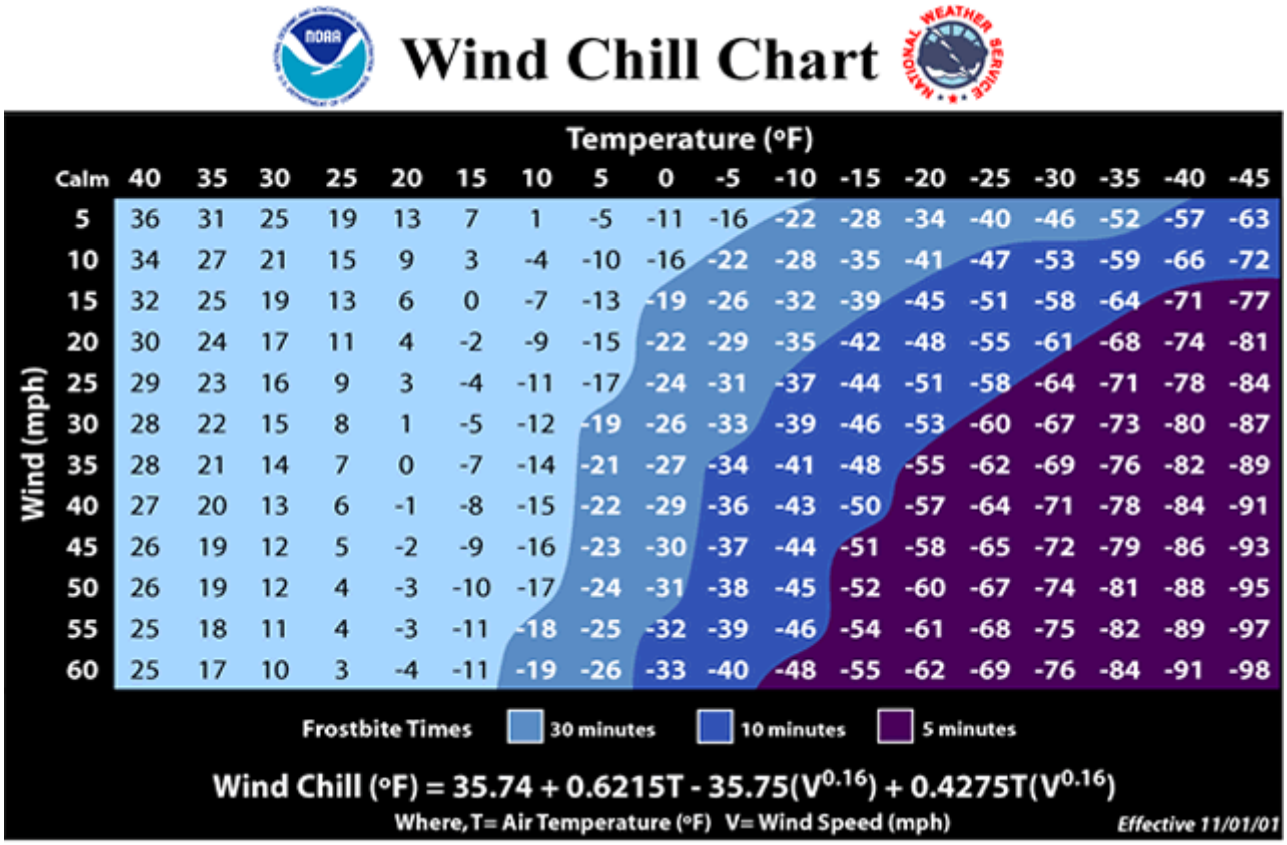
Figure 3.5. Heat Index (HI) Chart



Source: National Weather Service (NWS)
Note: Exposure to direct sun can increase Heat Index values by as much as 15°F. The shaded zone above 105°F corresponds to a HI that may cause increasingly severe heat disorders with continued exposure and/or physical activity.

The NWS Wind Chill Temperature (WCT) index uses advances in science, technology, and computer modeling to provide an accurate, understandable, and useful formula for calculating the dangers from winter winds and freezing temperatures. The figure below presents wind chill temperatures which are based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature.

Figure 3.6. Wind Chill Chart



Source: https://www.weather.gov/safety/cold-wind-chill-chart

Previous Occurrences

The NCDC lists 21 recorded events in the past 20 years, with no deaths reported. Additionally, Figure 3.5 shows there have been no heat-related deaths in Madison County between 2000 and 2013.

Table 3.16. Extreme Temperature Events, 2002-2022

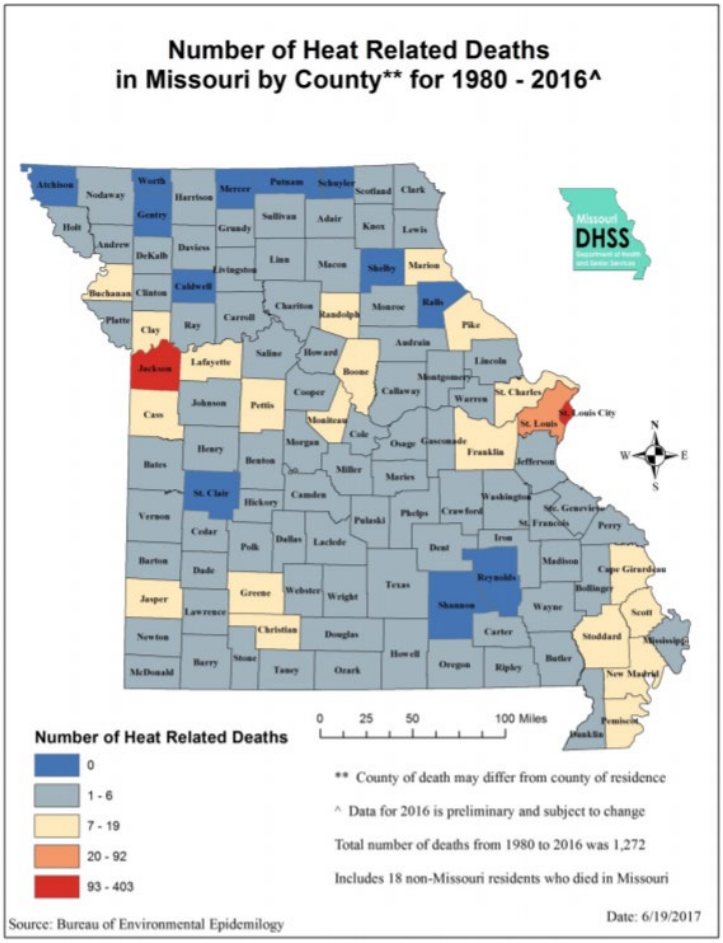
DATE	EVENT TYPE	DEATHS	INJURIES	PROPERTIES DAMAGED	CROP DAMAGE
8/5/2007	Excessive Heat	0	0	0	0
6/21/2009	Excessive Heat	0	0	0	0
6/18/2010	Excessive Heat	0	0	0	0
7/14/2010	Excessive Heat	0	0	0	0
7/17/2010	Excessive Heat	0	0	0	0
7/22/2010	Excessive Heat	0	0	0	0
8/2/2010	Excessive Heat	0	0	0	0
8/8/2010	Excessive Heat	0	0	0	0
7/17/2011	Excessive Heat	0	0	0	0
8/1/2011	Excessive Heat	0	0	0	0
6/27/2012	Excessive Heat	0	0	0	0
7/1/2012	Excessive Heat	0	0	0	0
7/22/2012	Excessive Heat	0	0	0	0
7/31/2012	Excessive Heat	0	0	0	0
8/1/2012	Excessive Heat	0	0	0	0

8/20/2014	Excessive Heat	0	0	0	0
7/12/2015	Excessive Heat	0	0	0	0
7/18/2015	Excessive Heat	0	0	0	0
7/27/2015	Excessive Heat	0	0	0	0
7/18/2016	Excessive Heat	0	0	0	0
7/21/2017	Excessive Heat	0	0	0	0

Source: NOAA NCEI

While the NCEI reports no deaths related to extreme temperatures in the county in the time period between 2002-2022, the DHSS indicates that from 1980-2016 the county experienced at least one temperature-related death.

Figure 3.7. Heat Related Deaths in Missouri 1980-2016



Source: https://health.mo.gov/living/healthcondiseases/hyperthermia/pdf/stat-report.pdf

Extreme heat can strain crops, livestock, and human health, as well as electricity delivery infrastructure overloaded during peak use of air conditioning during extreme heat events. Another type of infrastructure damage from extreme heat is road damage. When asphalt is exposed to prolonged extreme heat, it can cause buckling of asphalt-paved roads, driveways, and parking lots.

From 1988-2011, there were 3,496 fatalities in the U.S. attributed to summer heat. This translates to an annual national average of 146 deaths. Thankfully, during the same period, no deaths were recorded in the planning area, according to NCDC data. The National Weather Service stated that among natural hazards, no other natural

disaster—not lightning, hurricanes, tornadoes, floods, or earthquakes—causes more deaths.

Probability of Future Occurrence

While Extreme Temperature events can potentially be under-reported in the NCDC, a total of 21 reported events in 20 years calculates to an annual probability of an event of 100%.

Changing Future Conditions Considerations

During the period from 2002-2006, there were only 0 recorded extreme temperature events, while the remining 21 occurred from 2007-2022. This could indicate either better record keeping of events over time, or a general increase in extreme temperature events.

Vulnerability

Vulnerability Overview

Those at greatest risk for heat-related illness include infants and children up to five years of age, people 65 years of age and older, people who are overweight, and people who are ill or on certain medications. However, even young and healthy individuals are susceptible if they participate in strenuous physical activities during hot weather. In agricultural areas, the exposure of farm workers, as well as livestock, to extreme temperatures is a major concern.

Table 3.17 lists typical symptoms and health impacts due to exposure to extreme heat.

Table 3.17. Typical Health Impacts of Extreme Heat

Heat Index (HI)	Disorder
80-90° F (HI)	Fatigue possible with prolonged exposure and/or physical activity
90-105° F (HI)	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and/or physical activity
105-130° F (HI)	Heatstroke/sunstroke highly likely with continued exposure

Source: National Weather Service Heat Index Program, www.weather.gov/os/heat/index.shtml

According to the 2018 State HMP, the county has a medium vulnerability to extreme heat, and a low medium vulnerability to extreme cold.

Potential Losses to Existing Development

Given the absence of heat related deaths in the past 20 years and the median concentration of elderly in the County, the potential losses to existing development are marginal. Additionally, NECI data indicates no crop losses in past 20 years.

Impact of Previous and Future Development

Population growth can result in increases in the age-groups that are most vulnerable to extreme temperatures. Population growth also increases the strain on electricity infrastructure, as more electricity is needed to accommodate the growing population. While no jurisdictions are experiencing growth, the aging of the Baby Boomers is likely to lead to a growth in the percentage of elderly in the County.

Hazard Summary by Jurisdiction

Those at greatest risk for heat-related illness and deaths include children up to five years of age, people 65 years

of age and older, people who are overweight, and people who are ill or on certain medications. To determine jurisdictions within the planning area with populations more vulnerable to extreme heat, demographic data was obtained from the 2020 census on population percentages in each jurisdiction comprised of those under age 5 and over age 65. Data was not available for overweight individuals and those on medications vulnerable to extreme heat. Table 3.18 below summarizes vulnerable populations in the participating jurisdictions. Note that school and special districts are not included in the table because students and those working for the special districts are not customarily in these age groups.

Table 3.18. County Population Under Age 5 and Over Age 65, 2020 Census Data

Jurisdiction	Population Under 5 yrs	Population 65 yrs and over
Madison County	6%	19%
Fredericktown	5%	17%

Source: U.S. Census Bureau

Unincorporated County
Given the county's similar demographics to the state and its municipalities, the county has a similar exposure and vulnerability to extreme temperatures as the other jurisdictions in the planning area.

Fredericktown
Given the city's similar demographics to the county and other municipalities, the city has a similar exposure and vulnerability to extreme temperatures as the other jurisdictions in the planning area.

Fredericktown R-I School Dist.
The district has little vulnerability to extreme temperatures, as all buildings are climate controlled.

Marquand-Zion R-VI School Dist.
The district has little vulnerability to extreme temperatures, as all buildings are climate controlled.

Problem Statement

Extreme temperatures are the most impactful on the elderly and the young. All of the participating jurisdictions have similar demographics in this regard, and all are similarly impacted by extreme temperatures. While schools host much of the youth population for a period of time each day, the buildings are temperature controlled and offer a reprieve to students from the heat if they lack air conditioning at home.

3.4.5 Wildfires

Hazard Profile

Hazard Description

The incident types considered for wildfires include: 1) natural vegetation fire, 2) outside rubbish fire, 3) special outside fire, and 4) cultivated vegetation, crop fire.

The Missouri Division of Fire Safety (MDFS) indicates that approximately 80 percent of the fire departments in Missouri are staffed with volunteers. Whether paid or volunteer, these departments are often limited by lack of resources and financial assistance. The impact of a fire to a single-story building in a small community may be as great as that of a larger fire to a multi-story building in a large city.

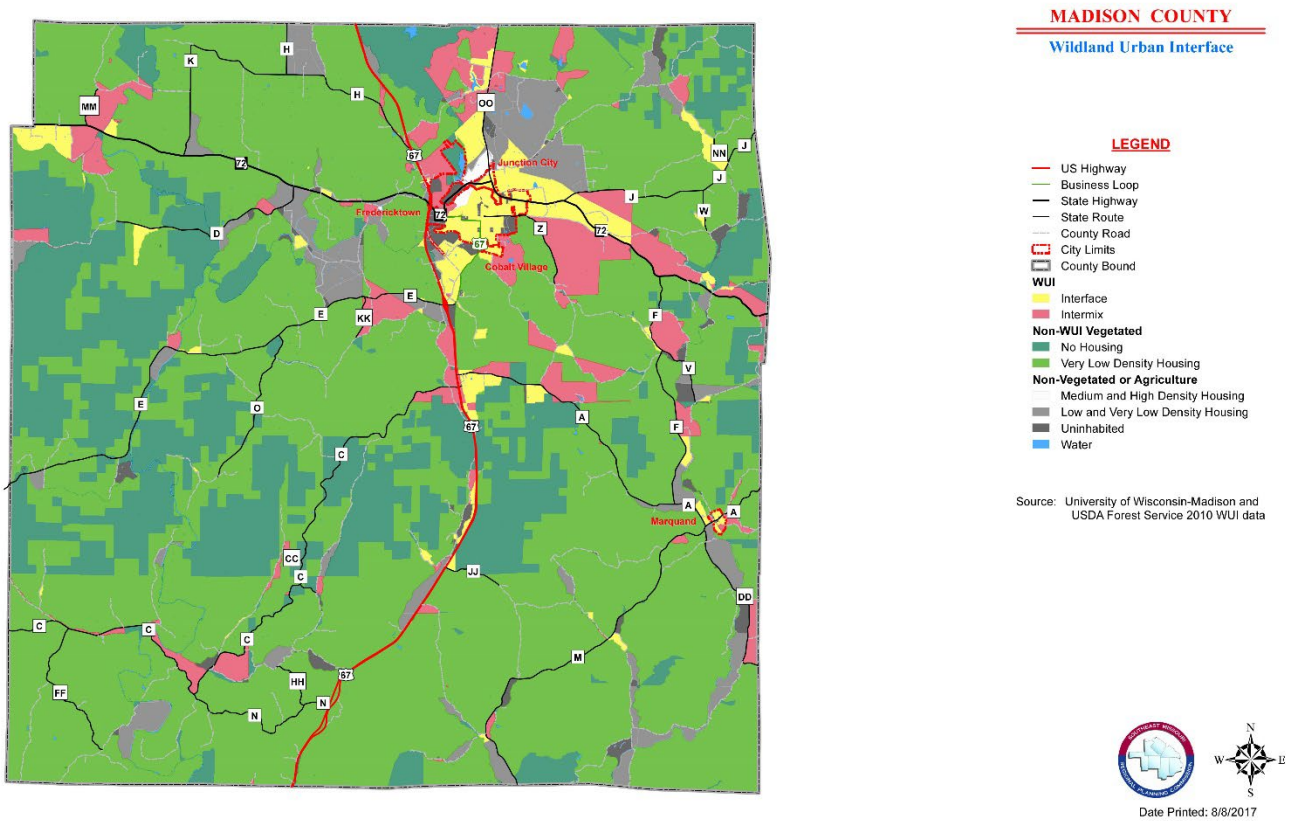
The Forestry Division of the Missouri Department of Conservation (MDC) is responsible for protecting privately owned and state-owned forests and grasslands from wildfires. To accomplish this task, eight forestry regions have been established in Missouri for fire suppression. The Forestry Division works closely with volunteer fire departments and federal partners to assist with fire suppression activities. Currently, more than 900 rural fire departments in Missouri have mutual aid agreements with the Forestry Division to obtain assistance in wildfire protection if needed.

Most of Missouri fires occur during the spring season between February and May. The length and severity of both structural and wildland fires depend largely on weather conditions. Spring in Missouri is usually characterized by low humidity and high winds. These conditions result in higher fire danger. In addition, due to the recent lack of moisture throughout many areas of the state, conditions are likely to increase the risk of wildfires. Drought conditions can also hamper firefighting efforts, as decreasing water supplies may not prove adequate for firefighting. It is common for rural residents burn their garden spots, brush piles, and other areas in the spring. Some landowners also believe it is necessary to burn their forests in the spring to promote grass growth, kill ticks, and reduce brush. Therefore, spring months are the most dangerous for wildfires. The second most critical period of the year is fall. Depending on the weather conditions, a sizeable number of fires may occur between mid-October and late November.

Geographic Location

The risk of structural fire does not vary widely across the planning area. However, damages due to wildfires are likely to be higher in communities with more wildland–urban interface (WUI) areas. WUI refers to the zone of transition between unoccupied land and human development. Within the WUI, there are two specific areas identified: 1) Interface and 2) Intermix. The Interface areas are those areas that abut wildland vegetation and the Intermix areas are those areas that intermingle with wildland areas. Figure 3.6 illustrates the most vulnerable areas of the county based on Interface and Intermix, primarily Fredericktown and areas along major transportation corridors.

Figure 3.8. Madison County Woodland-Urban Interface Map



Severity/Magnitude/Extent

Wildfires damage the environment, killing some plants and occasionally animals. Firefighters have been injured or killed, and structures can be damaged or destroyed. The loss of plants can heighten the risk of soil erosion and landslides. Although Missouri wildfires are not the size and intensity of those in the Western United States, they could impact recreation and tourism in and near the fires.

Wildland fires in Missouri have been mostly a result of human activity rather than lightning or some other natural event. Wildfires in Missouri are usually surface fires, burning the dead leaves on the ground or dried grasses. They do sometimes "torch" or "crown" out in certain dense evergreen stands like eastern red cedar and shortleaf pine. However, Missouri does not have the extensive stands of evergreens found in the western US that fuel the large fire storms seen on television news stories.

While very unusual, crown fires can and do occur in Missouri native hardwood forests during prolonged periods of drought combined with extreme heat, low relative humidity, and high wind. Tornadoes, high winds, wet snow and ice storms in recent years have placed a large amount of woody material on the forest floor that causes wildfires to burn hotter and longer. These conditions also make it more difficult for fire fighters suppress fires safely. See ***http://www.firewisemissouri.org/wildfire-in-missouri.html***

Often wildfires in Missouri go unnoticed by the general public because the sensational fire behavior that captures the attention of television viewers is rare in the state. Yet, from the standpoint of destroying homes and other property, Missouri wildfires can be quite destructive.

Information on severity of damages from wildfires is not currently available.

Previous Occurrences

The Missouri Department of Conversation Wildfire Data Search lists 365 wildfire incidents between 2005-2022. No damage estimates are available.

Probability of Future Occurrence

With 365 incidents reported in a 17 year timeframe, the county experiences approximately 21 wildfires per year.

Changing Future Conditions Considerations

If drought conditions were to set in, the number of wildfires would likely increase. However, if annual rainfall increases, the number of wildfires would likely decrease.

Vulnerability

Vulnerability Overview

Based on the previously discussed WUI, it can be concluded that the unincorporated portions of the county are the most vulnerable to wildfires given the amount of vegetation in the area; however, Fredericktown has a high amount of Interface and Intermix, which can lead to increased opportunities for fires to start, though less fuel available to burn.

Potential Losses to Existing Development

The 2018 State HMP lists a total of 3,648 structures and 8,129 residents as being exposed to wildfires in the county. While specific locations of these structures and people are not available, based on the WUI, it can be assumed that they are spread throughout the county, including Fredericktown.

Impact of Previous and Future Development

Future development is most likely to occur in areas of Intermix on the WUI map. This will increase the number of structures in the area while also reducing the amount of vegetation to serve as fuel. These two factors are expected to balance one another, leading to no significant impact from future development.

Hazard Summary by Jurisdiction

Unincorporated County
The county is by far the most vulnerable to wildfires, based on the WUI and development patterns. The lower population density means that loss of life and property damage are less severe, but crop damage could be significant if a severe fire were to burn for a prolonged time.

Fredericktown
The city is almost entirely Interface WUI, with Intermix around the periphery of the city. This leads to an increased chance of human activity igniting a fire.

Fredericktown R-I School Dist.

There are no WUI areas near any district structures, making it likely there is little vulnerability to wildfires for the district.

Marquand-Zion R-VI School Dist.
There are no WUI areas near any district structures, making it likely there is little vulnerability to wildfires for the district.

Problem Statement

Wildfires are a common occurrence in the county, though the vast majority of these events are small, impacting 5 acres or less. Approximately 1/3 of the historical events referenced above impacted less than 1 acre. However, any wildfire does pose the threat to grow quickly and impact a much larger area if not addressed quickly. Local fire departments are equipped and trained to handle these common events.

3.4.6 Flooding (Flash and River)

Hazard Profile

Hazard Description

A flood is partial or complete inundation of normally dry land areas. Riverine flooding is defined as the overflow of rivers, streams, drains, and lakes due to excessive rainfall, rapid snowmelt, or ice. There are several types of riverine floods, including headwater, backwater, interior drainage, and flash flooding. Riverine flooding is defined as the overflow of rivers, streams, drains, and lakes due to excessive rainfall, rapid snowmelt or ice melt. The areas adjacent to rivers and stream banks that carry excess floodwater during rapid runoff are called floodplains. A floodplain is defined as the lowland and relatively flat area adjoining a river or stream. The terms "base flood" and "100- year flood" refer to the area in the floodplain that is subject to a one percent or greater chance of flooding in any given year. Floodplains are part of a larger entity called a basin, which is defined as all the land drained by a river and its branches.

Flooding caused by dam and levee failure is discussed in the Dam and Levee Failure section. It will not be addressed in this section.

A flash flood occurs when water levels rise at an extremely fast rate because of intense rainfall over a brief period, sometimes combined with rapid snowmelt, ice jam release, frozen ground, saturated soil, or impermeable surfaces. Flash flooding can happen in Special Flood Hazard Areas (SFHAs) as delineated by the National Flood Insurance Program (NFIP), and can also happen in areas not associated with floodplains.

Ice jam flooding is a form of flash flooding that occurs when ice breaks up in moving waterways, and then stacks on itself where channels narrow. This creates a natural dam, often causing flooding within minutes of the dam formation.

In some cases, flooding may not be directly attributable to a river, stream, or lake overflowing its banks. Rather, it may simply be the combination of excessive rainfall or snowmelt, saturated ground, and inadequate drainage. With no place to go, the water will find the lowest elevations – areas that are often not in a floodplain. This type of flooding, often referred to as sheet flooding, is becoming increasingly prevalent as development outstrips the ability of the drainage infrastructure to properly carry and disburse the water flow.

Most flash flooding is caused by slow-moving thunderstorms or thunderstorms repeatedly moving over the same area. Flash flooding is a dangerous form of flooding which can reach full peak in only a few minutes. Rapid onset allows little or no time for protective measures. Flash flood waters move at very fast speeds and can move boulders, tear out trees, scour channels, destroy buildings, and obliterate bridges. Flash flooding can result in higher loss of life, both human and animal, than slower developing river and stream flooding.

In certain areas, aging storm sewer systems are not designed to carry the capacity currently needed to handle the increased storm runoff. Typically, the result is water backing into basements, which damages mechanical systems and can create serious public health and safety concerns. This combined with rainfall trends and rainfall extremes all demonstrate the high probability, yet generally unpredictable nature of flash flooding in the planning area.

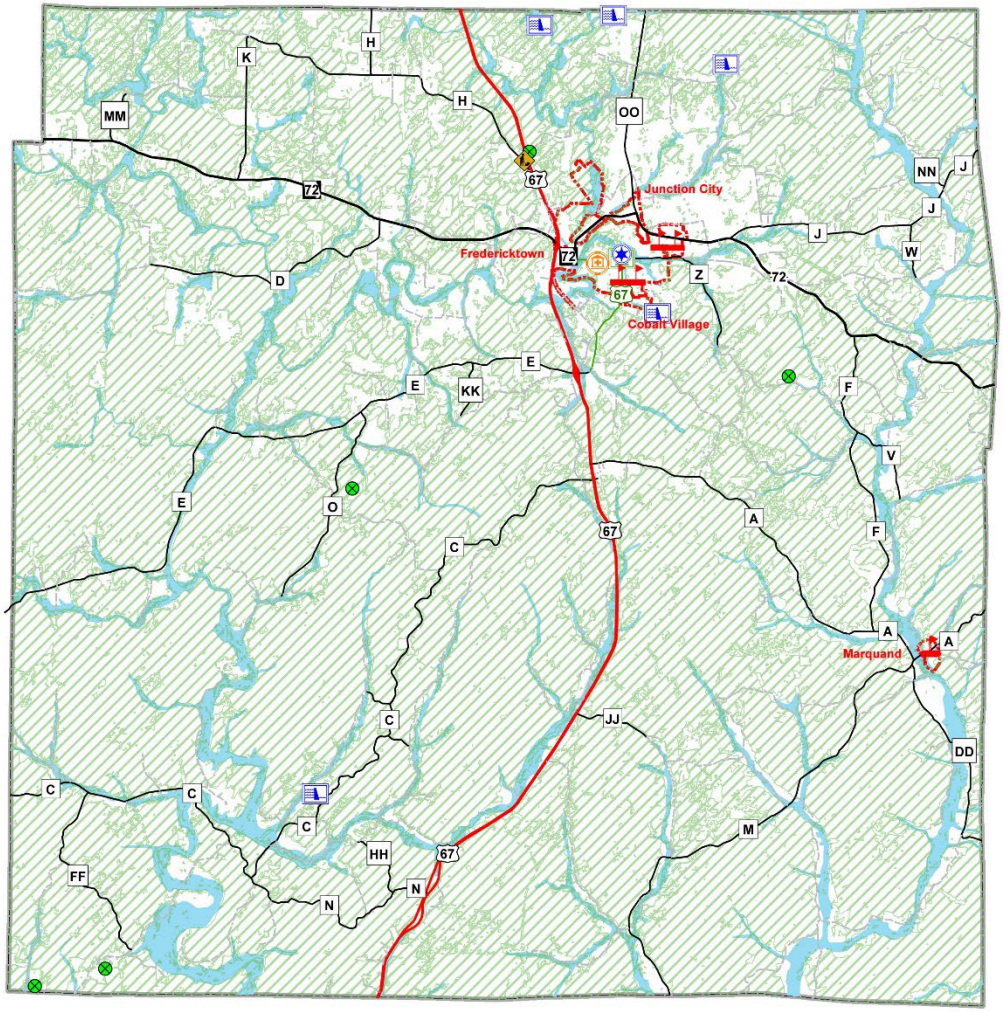
Although flash floods are somewhat unpredictable, there are factors that can point to the likelihood of flash floods occurring. Weather surveillance radar is being used to improve monitoring capabilities of intense rainfall. This, along with knowledge of the watershed characteristics, modeling techniques, monitoring, and advanced

warning systems has increased the warning time for flash floods.

Geographic Location

River flooding is most likely to occur in SFHAs. The following maps illustrate the SFHAs for all participating jurisdictions.

Figure 3.9. Madison County SFHAs



MADISON COUNTY

LOCATION SPECIFIC HAZARDS

LEGEND

- School
- Sheriff/EOC
- County Facility
- County Road Maintenance
- Health Department
- Sinkhole
- Dam 35 ft +
- US Highway
- Business Loop
- State Highway
- State Route
- County Road
- Forest Cover
- City Limits
- Flood Prone Area
- County Bound

Source: FEMA National Flood Hazard Layer
2011 Flood Hazard Boundaries
Forest Cover derived from MO 2005
Land Use Land Cover data
MODNR 2014 Sinkhole data
MODNR 2014 Regulated Dam data

N
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S

Date Printed: 8/8/2017

Figure 3.10. Fredericktown SFHAs

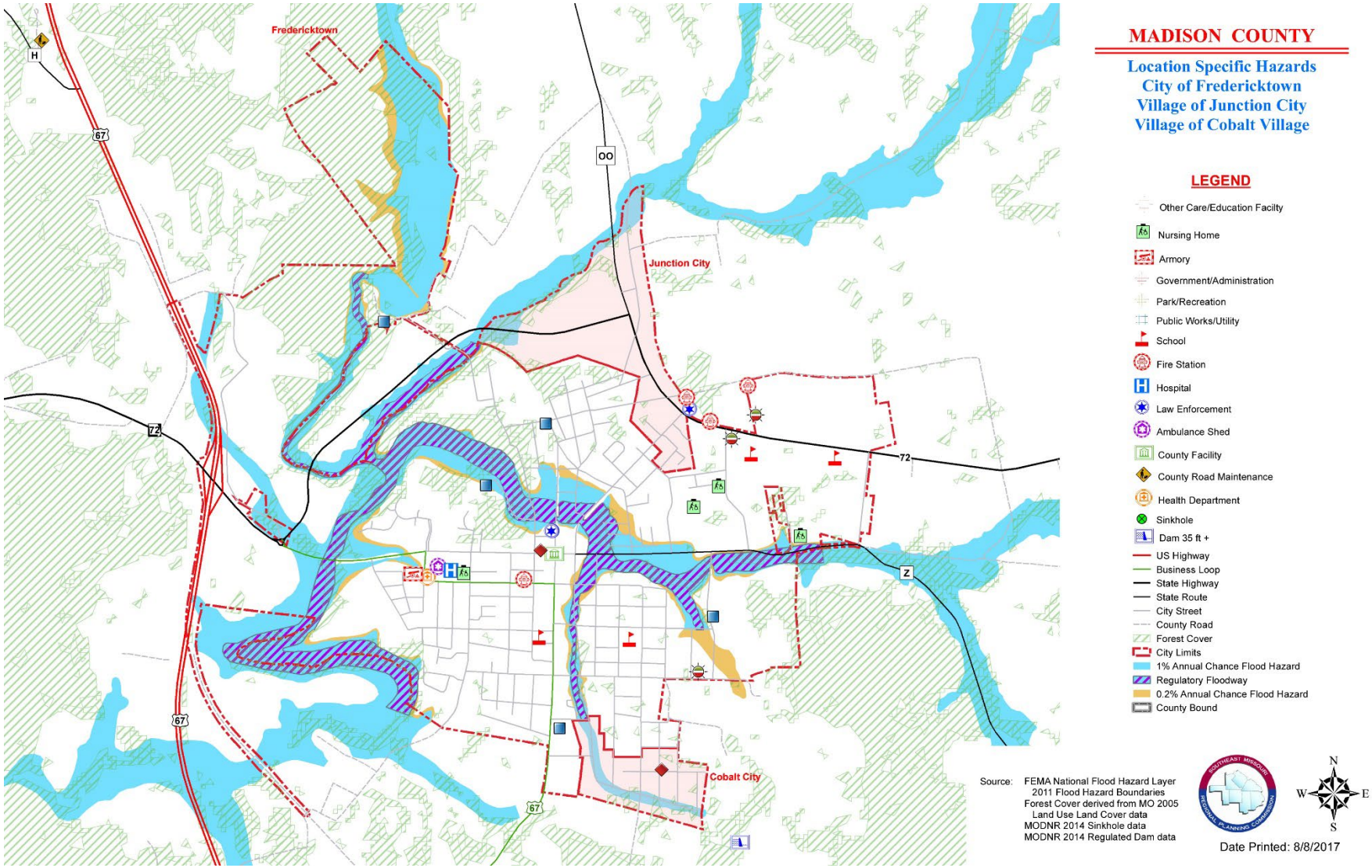


Figure 3.11. Fredericktown R-I School District SFHAs

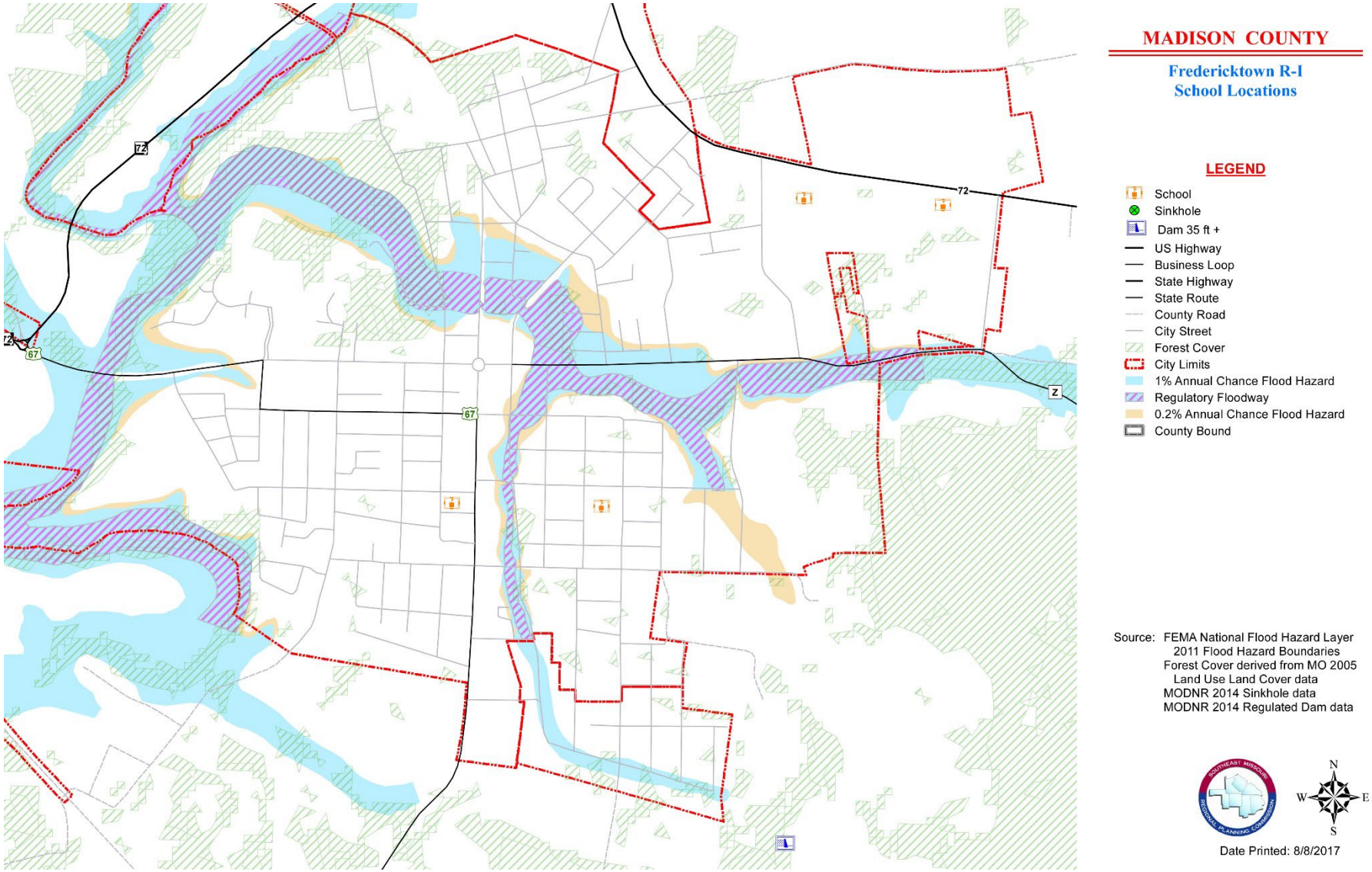
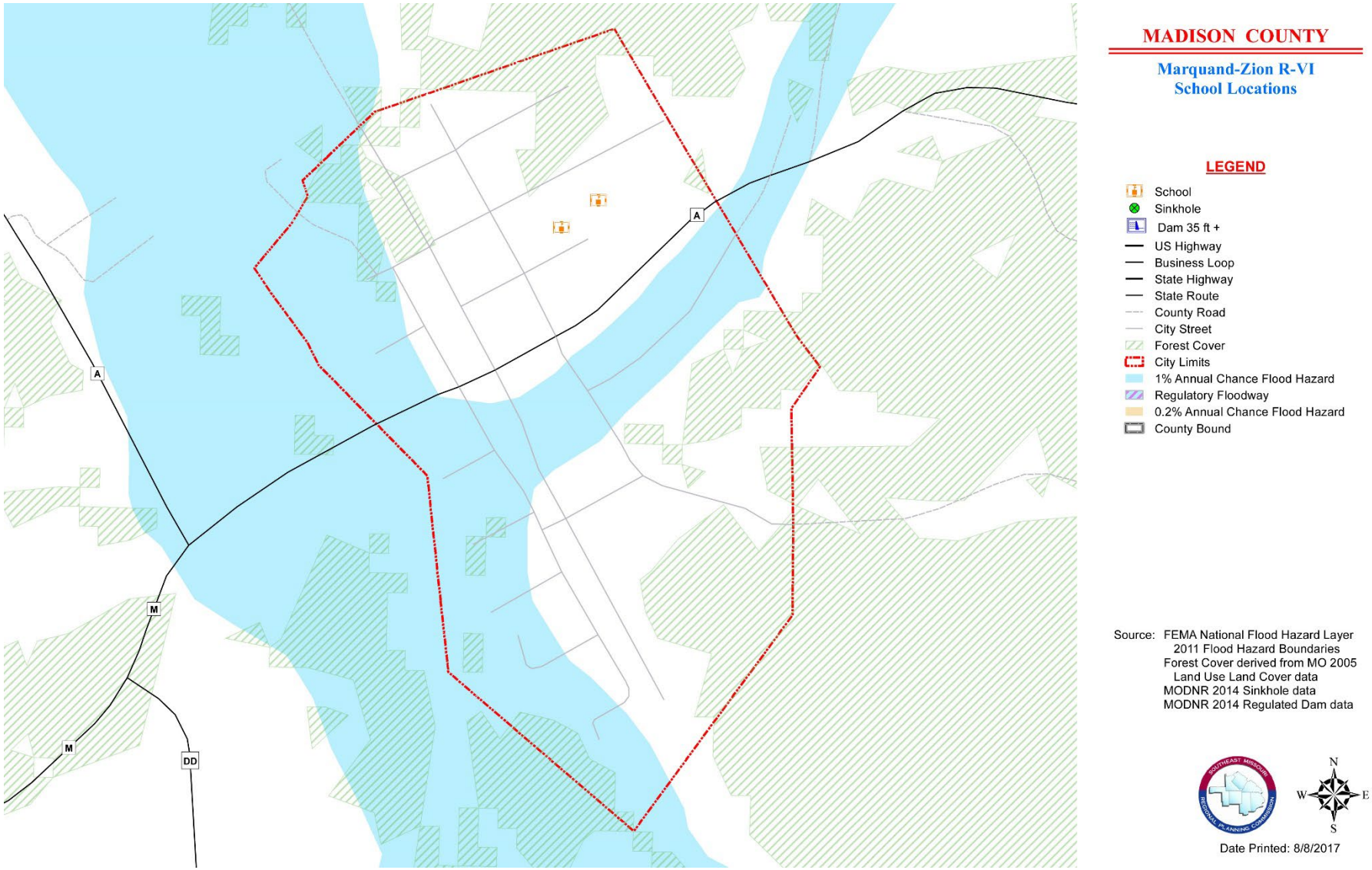


Figure 3.12. Marquand-Zion R-VI School District SFHAs



Flash flooding occurs in SFHAs and those locations in the planning area that are low-lying. They also occur in areas without adequate drainage to carry away the amount of water that falls during intense rainfall events.

Strength/Magnitude/Extent

Missouri has a long and active history of flooding over the past century, according to the 2013 State Hazard Mitigation Plan. Flooding along Missouri's major rivers generally results in slow-moving disasters. River crest levels are forecast several days in advance, allowing communities downstream sufficient time to take protective measures, such as sandbagging and evacuations. Nevertheless, floods exact a heavy toll in terms of human suffering and losses to public and private property. By contrast, flash flood events in recent years have caused a higher number of deaths and major property damage in many areas of Missouri.

According to the U.S. Geological Survey, two critical factors affect flooding due to rainfall: rainfall duration and rainfall intensity – the rate at which it rains. These factors contribute to a flood's height, water velocity and other properties that reveal its magnitude.

Table 3.19. NFIP Participation in Madison County

Community ID #	Community Name	NFIP Participant (Y/N)	Current Effective Map Date	Regular-Emergency Program Entry Date
290815	Madison County	Y	8/2/2012	12/6/2012
290601	Cobalt Village	Y	8/2/2012	7/2/1987
290221	Fredericktown	Y	8/2/2012	1/3/1979
290931	Junction City	N	8/2/2012	12/6/2003
290565	Marquand	Y	8/2/2012	7/1/1987

Source: NFIP Community Status Book, 8/17/2017; BureauNet, http://www.fema.gov/national-flood-insurance-program/national-flood-insurance-program-community-status-book; M= No elevation determined – all Zone A, C, and X: NSFHA = No Special Flood Hazard Area; E=Emergency Program

Table 3.20. NFIP Policy and Claim Statistics as of 8/17/2017

Community Name	Total Losses	Closed Losses	Total Payments
Madison County	1	1	$21,137
Fredericktown	124	112	$2,525,348

Source: NFIP Community Status Book, 8/17/2017; BureauNet, http://bsa.nfipstat.fema.gov/reports/reports.html; *Closed Losses are those flood insurance claims that resulted in payment.

Repetitive Loss/Severe Repetitive Loss Properties

Repetitive Loss Properties are those properties with at least two flood insurance payments of $1,000 or more in a 10-year period. According to the Flood Insurance Administration, jurisdictions included in the planning area have a combined total of 23 repetitive loss/severe repetitive loss properties. As of November 2022, 6 properties have been mitigated, leaving 17 un-mitigated repetitive loss properties.

Severe Repetitive Loss (SRL): A SRL property is defined it as a single family property (consisting of one-to-four residences) that is covered under flood insurance by the NFIP; and has (1) incurred flood-related damage for which four or more separate claims payments have been paid under flood insurance coverage with the amount of each claim payment exceeding $5,000 and with cumulative amounts of such claims payments exceeding $20,000; or (2) for which at least two separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property.

There are no severe repetitive loss properties in the county.

Table 3.21. Repetitive Loss Properties

As of Date	Community Name	Community Number	Repetitive Loss Properties	Non-Mitigated	Mitigated	Total Losses	Total Paid
11/15/2022	Fredericktown	290221	20	14	6	46	$ 438,375.02
11/15/2022	Marquand	290565	2	2	0	4	$ 401,256.40
11/15/2022	Madison County	290815	1	1	0	2	$ 55,830.80

Source: SEMA

Previous occurrences

In the past 20 years there have been 2 Flood events in the county (one in Fredericktown, on in the county) and 12 Flash Flood events (one in Fredericktown, eleven in the county).

Table 3.22. Flood Events, 2002-2022

Location	Date	Deaths	Injuries	Properties Damaged	Crop Damage
FREDERICKTOWN	1/13/2007	0	0	0	0
HIGDON	1/12/2013	1	0	0	0

Source: NCEI

Table 3.23. Flash Flood Events, 2002-2022

Location	Date	Deaths	Injuries	Property Damage	Crop Damage
COUNTYWIDE	5/12/2002	0	0	0	0
COUNTYWIDE	11/15/2005	0	0	0	0
FREDERICKTOWN	9/8/2007	0	0	1000	0
OAK GROVE	2/5/2008	0	0	0	0
HIGDON	3/18/2008	0	0	0	0
ALLBRIGHT	4/10/2008	0	0	1000	0
HIGDON	12/24/2009	0	0	0	0
SLABTOWN	3/21/2010	0	0	0	0
ROSELLE	4/23/2011	0	0	0	0
HIGDON	12/28/2015	0	0	0	0
ROSELLE	8/13/2016	0	0	0	0
FARO	4/29/2017	0	0	0	0

Source: NCEI

Probability of Future Occurrence

For flood events, the unincorporated county and Fredericktown each had 1 event in 20 years, equaling a 5% annualized probability.

For flash flood events, the unincorporated county had 11 event in 20 years, equaling a 55% annualized probability. Fredericktown had 1 event in 20 years, equaling a 5% annualized probability.

Changing Future Conditions Considerations

Historical data does not suggest any significant changes in the frequency of flooding in the planning area. However, changes in rainfall over time would likely impact the frequency of either type of flood event.

Vulnerability

Vulnerability Overview

Flooding presents a danger to life and property, often resulting in injuries, and in some cases, fatalities. Floodwaters themselves can interact with hazardous materials. Hazardous materials stored in large containers could break loose or puncture because of flood activity. Examples are bulk propane tanks. When this happens, evacuation of citizens is necessary.

Public health concerns may result from flooding, requiring disease and injury surveillance. Community sanitation to evaluate flood-affected food supplies may also be necessary. Private water and sewage sanitation could be impacted, and vector control (for mosquitoes and other entomology concerns) may be necessary.

When roads and bridges are inundated by water, damage can occur as the water scours materials around bridge abutments and gravel roads. Floodwaters can also cause erosion undermining road beds. In some instances, steep slopes that are saturated with water may cause mud or rock slides onto roadways. These damages can cause costly repairs for state, county, and city road and bridge maintenance departments. When sewer back-up occurs, this can result in costly clean-up for home and business owners as well as present a health hazard.

Potential Losses to Existing Development

Table 3.24 shows the number of buildings in the floodplain in the County and Fredericktown. The table also shows the value of those buildings and their contents. Both jurisdictions have approximately 10% of their total estimated value in the floodplain.

Neither school district has any structures in floodplains.

Table 3.24. Maximum Potential Flood Losses

Jurisdiction	Building Count	Building Exposure	Contents Exposure	Total Exposure
Madison County-Unincorporated	650	$ 150,821,536	$ 133,937,168	$ 284,758,704
Fredericktown	166	$ 21,201,610	$ 18,674,405	$ 39,876,015
Total	816	$ 172,023,146	$ 152,611,573	$ 324,634,719

Sources: Population, 2020 Census; Building Count, SEMO RPC data; Building Exposure, HMPC and SEMO RPC data; Contents Exposure derived by applying multiplier to Building Exposure based on HAZUS MH 2.1 standard contents multipliers per usage type as follows: Residential (50%), Commercial (100%), Industrial (150%), Agricultural (100%).

Impact of Future Development

Future development which occurs in floodplains, low-lying areas near rivers or streams or where drainage systems are not adequate to provide drainage during heavy rainfall events will face a much higher risk of flooding. Additionally, future development will also increase impervious surfaces, leading to additional run off, putting more strain on existing drainage systems.

Hazard Summary by Jurisdiction

Unincorporated County
The unincorporated county has the greatest number of structures exposed to river flooding, though the vast majority of these are agricultural or residential outbuildings such as sheds. The county also, not surprisingly, has the greatest area of SFHAs in the county, due to its size. Most of the SFHAs in the county cover agricultural land. Flash flooding in the county can have a negative impact on the transportation network when low water crossings are flooded, leaving the stream impassable until waters recede. Other than bridges, the county has no critical facilities in the SFHAs.

Fredericktown
Most of the city's SFHAs are along the St. Francis River and Saline Creek. Few structures lie in either water features SFHAs, though most that do are near Saline Creek as it cuts through town while the St. Francis River is mainly on the edge of town. However, historic data shows that flooding is not a common occurrence in the city.

Fredericktown R-I School Dist.
The district has no structures in SFHAs.

Marquand-Zion R-VI School Dist.
The district has no structures in SFHAs.

Problem Statement

None of the jurisdictions suffer from significant impacts from riverine flooding in the county. The unincorporated county is the most exposed to flash flooding, though the impacts from such evens are minor other than impacts to the transportation network. Projects raising low water crossings out of the flood plain would be beneficial.

3.4.7 Sinkholes

Hazard Profile

Hazard Description

Sinkholes are common where the rock below the land surface is limestone, carbonate rock, salt beds, or rocks that naturally can be dissolved by ground water circulating through them. As the rock dissolves, spaces and caverns develop underground. The sudden collapse of the land surface above them can be dramatic and range in size from broad, regional lowering of the land surface to localized collapse. However, the primary causes of most subsidence are human activities: underground mining of coal, groundwater or petroleum withdrawal, and drainage of organic soils. In addition, sinkholes can develop as a result of subsurface void spaces created over time due to the erosion of subsurface limestone (karst).

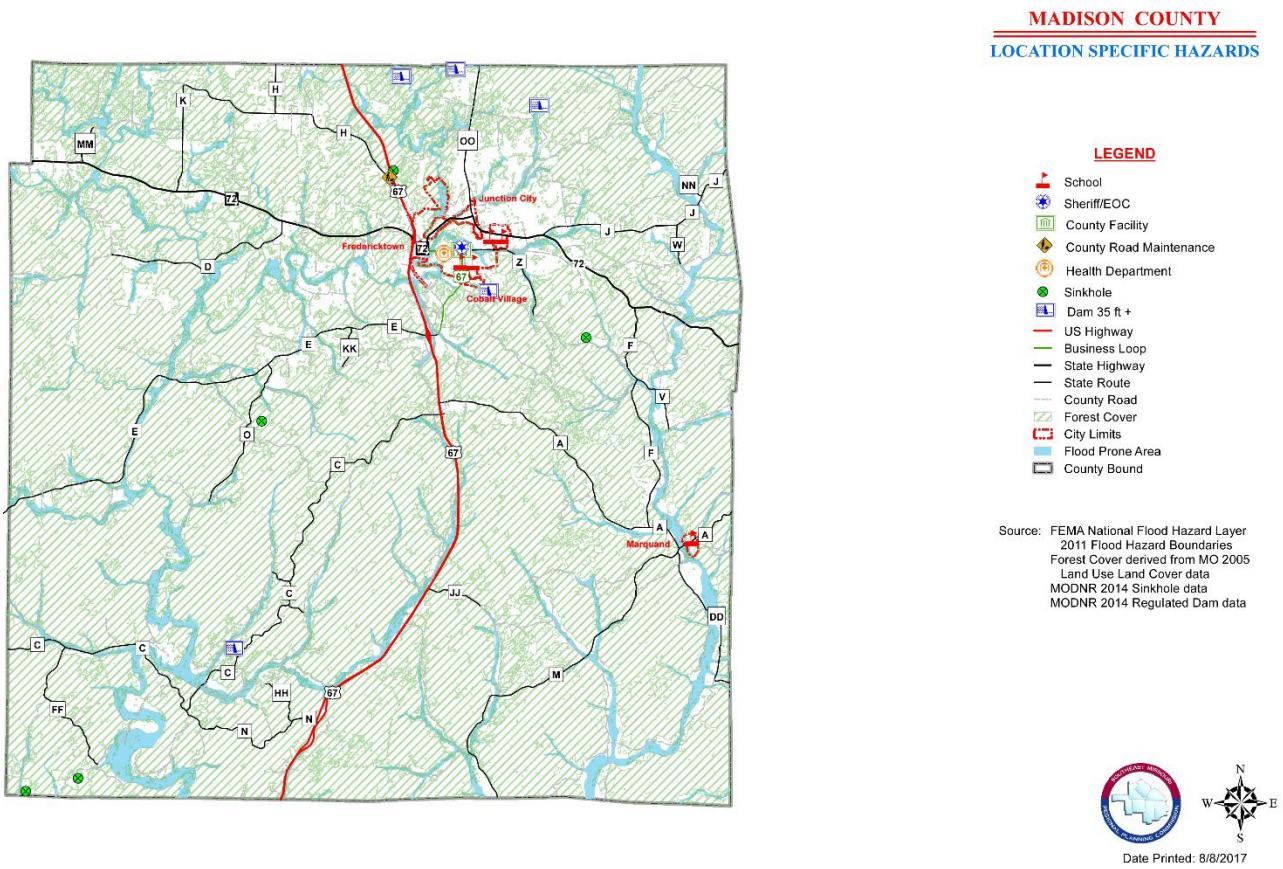
In the case of sinkholes, the rock below the surface is rock that has been dissolving by circulating groundwater. As the rock dissolves, spaces and caverns form, and ultimately the land above the spaces collapse. In Missouri, sinkhole problems are usually a result of surface materials above openings into bedrock caves eroding and collapsing into the cave opening. These collapses are called "cover collapses" and geologic information can be applied to predict the general regions where collapse will occur. Sinkholes range in size from several square yards to hundreds of acres and may be quite shallow or hundreds of feet deep.

According to the U.S. Geological Survey (USGS), the most damage from sinkholes tends to occur in Florida, Texas, Alabama, Missouri, Kentucky, Tennessee, and Pennsylvania. Fifty-nine percent of Missouri is underlain by thick, carbonate rock that makes Missouri vulnerable to sinkholes. Sinkholes occur in Missouri on a fairly frequent basis. Most of Missouri's sinkholes occur naturally in the State's karst regions (areas with soluble bedrock). They are a common geologic hazard in southern Missouri, but also occur in the central and northeastern parts of the State. Missouri sinkholes have varied from a few feet to hundreds of acres and from less than one to more than 100 feet deep. The largest known sinkhole in Missouri encompasses about 700 acres in western Boone County southeast of where Interstate 70 crosses the Missouri River. Sinkholes can also vary is shape like shallow bowls or saucers whereas other have vertical walls. Some hold water and form natural ponds.

Geographic Location

There are only a handful of known sinkholes located in Madison County, shown in Figure 3.11.

Figure 3.13. Sinkhole Locations In Madison County



Severity/Magnitude/Extent

Sinkholes vary in size and location, and these variances will determine the impact of the hazard. A sinkhole could result in the loss of a personal vehicle, a building collapse, or damage to infrastructure such as roads, water, or sewer lines. Groundwater contamination is also possible from a sinkhole. Because of the relationship of sinkholes to groundwater, pollutants captured or dumped in sinkholes could affect a community's groundwater system. Sinkhole collapse could be triggered by large earthquakes. Sinkholes located in floodplains can absorb floodwaters but make detailed flood hazard studies difficult to model.

The 2018 State Plan included only seven documented sinkhole "notable events". The plan stated that sinkholes are common to Missouri and the probability is high that they will occur in the future. To date, Missouri sinkholes have historically not had major impacts on development nor have they caused serious damage. Thus, the severity of future events is likely to be low.

Previous Occurrences

While there are 5 known sinkholes in the County, there have been no significant events related to them.

Probability of Future Occurrence

It is difficult to predict the probability of future occurrence of sinkholes given the complexities involved with bedrock conditions and the unknown "start" dates of the existing sinkholes. Given the karst topography of the

county additional sinkholes are likely to occur eventually.

Changing Future Conditions Considerations

None for this hazard.

Vulnerability

Vulnerability Overview

With only 5 known sinkholes and no significant events associated with them, the County's vulnerability to such events is low.

Potential Losses to Existing Development

The occurrence of new sinkholes is possible, but it is virtually impossible to predict the exact location at this time, making potential losses impractical to estimate.

Impact of Future Development

Additional future development will statistically increase the risk of damage to development, though not in any significant amount.

Hazard Summary by Jurisdiction

Unincorporated County
There are only 5 known sinkholes in the county, with no related significant impacts or damages reported.

Fredericktown
There are no known sinkholes in the city.

Fredericktown R-I School Dist.
There are no known sinkholes near any school property.

Marquand-Zion R-VI School Dist.
There are no known sinkholes near any school property.

Problem Statement

There are only 5 known sinkholes in the entire county. While the development of new sinkholes is possible, there is no way to predict precisely where they could occur, or to what magnitude. Additional studies could help determine prone areas.

3.4.8 Levee Failure

Hazard Profile

Hazard Description

Levees are earth embankments constructed along rivers and coastlines to protect adjacent lands from flooding. Floodwalls are concrete structures, often components of levee systems, designed for urban areas where there is insufficient room for earthen levees. When levees and floodwalls and their appurtenant structures are stressed beyond their capabilities to withstand floods, levee failure can result in injuries and loss of life, as well as damages to property, the environment, and the economy.

Levees can be small agricultural levees that protect farmland from high-frequency flooding. Levees can also be larger, designed to protect people and property in larger urban areas from less frequent flooding events such as the 100-year and 500-year flood levels. For purposes of this discussion, levee failure will refer to both overtopping and breach as defined in FEMA's Publication "So You Live Behind a Levee" (http://content.asce.org/ASCELeveeGuide.html). Following are the FEMA publication descriptions of different kinds of levee failure:

> **Overtopping: When a Flood Is Too Big**
> Overtopping occurs when floodwaters exceed the height of a levee and flow over its crown. As the water passes over the top, it may erode the levee, worsening the flooding and potentially causing an opening, or breach, in the levee.
>
> **Breaching: When a Levee Gives Way**
> A levee breach occurs when part of a levee gives way, creating an opening through which floodwaters may pass. A breach may occur gradually or suddenly. The most dangerous breaches happen quickly during periods of high water. The resulting torrent can quickly swamp a large area behind the failed levee with little or no warning.

Earthen levees can be damaged in several ways. For instance, strong river currents and waves can erode the surface. Debris and ice carried by floodwaters—and even large objects such as boats or barges—can collide with and gouge the levee. Trees growing on a levee can blow over, leaving a hole where the root wad and soil used to be. Burrowing animals can create holes that enable water to pass through a levee. If severe enough, any of these situations can lead to a zone of weakness that could cause a levee breach. In seismically active areas, earthquakes and ground shaking can cause a loss of soil strength, weakening a levee and possibly resulting in failure. Seismic activity can also cause levees to slide or slump, both of which can lead to failure.

Geographic Location

Missouri is a state with many levees. Currently, there is no single comprehensive inventory of levee systems in the state. Levees have been constructed across the state by public entities and private entities with varying levels of protection, inspection oversight, and maintenance. The lack of a comprehensive levee inventory is not unique to Missouri.

There are two concurrent nation-wide levee inventory development efforts, one led by the United State Army Corps of Engineers (USACE) and one led by Federal Emergency Management Agency (FEMA). The National Levee Database (NLD), developed by USACE, captures all USACE related levee projects, regardless of design levels of protection. The Midterm Levee Inventory (MLI), developed by FEMA, captures all levee data (USACE

and non-USACE) but primarily focuses on levees that provide 1% annual-chance flood protection on FEMA Flood Insurance Rate Maps (FIRMs).

It is likely that agricultural levees and other non-regulated levees within the planning area exist that are not inventoried or inspected. These levees that are not designed to provide protection from the 1-percent annual chance flood would overtop or fail in the 1-percent annual chance flood scenario. Therefore, any associated losses would be taken into account in the loss estimates provided in the Flood Hazard Section.

There are no levees listed in the USACE NLD in the County.

Strength/Magnitude/Extent

Levee failure is typically an additional or secondary impact of another disaster such as flooding or earthquake. The main difference between levee failure and losses associated with riverine flooding is magnitude. Levee failure often occurs during a flood event, causing destruction in addition to what would have been caused by flooding alone. In addition, there would be an increased potential for loss of life due to the speed of onset and greater depth, extent, and velocity of flooding due to levee breach.

As previously mentioned, agricultural levees and levees that are not designed to provide flood protection from at least the 1-percent annual chance flood likely do exist in the planning area. However, none of these levees are shown on the Preliminary DFIRM, nor are they enrolled in the USACE Levee Safety Program. As a result, an inventory of these types of levees is not available for analysis. Additionally, since these types of levees do not provide protection from the 1-percent annual chance flood, losses associated with overtopping or failure are captured in the Flood Section of this plan.

Previous Occurrences

There are no documented occurrences of a levee failure in Madison County.

Probability of Future Occurrence

The only levees in the County are low-level, non-regulated agricultural levees, the failure of which would have only very localized impact. As such, the probability of a significant levee failure in the County is 0%.

Changing Future Conditions Considerations

As there are no significant levees in the county, there are no considerations for this hazard.

Vulnerability

Vulnerability Overview

The USACE regularly inspects levees within its Levee Safety Program to monitor their overall condition, identify deficiencies, verify that maintenance is taking place, determine eligibility for federal rehabilitation assistance (in accordance with P.L. 84-99), and provide information about the levees on which the public relies. Inspection information also contributes to effective risk assessments and supports levee accreditation decisions for the National Flood Insurance Program administered by the Federal Emergency Management Agency (FEMA).

The USACE now conducts two types of levee inspections. Routine Inspection is a visual inspection to verify and rate levee system operation and maintenance. It is typically conducted each year for all levees in the USACE

Levee Safety Program. Periodic Inspection is a comprehensive inspection led by a professional engineer and conducted by a USACE multidisciplinary team that includes the levee sponsor. The USACE typically conducts this inspection every five years on the federally authorized levees in the USACE Levee Safety Program.

Both Routine and Periodic Inspections result in a rating for operation and maintenance. Each levee segment receives an overall segment inspection rating of Acceptable, Minimally Acceptable, or Unacceptable. Figure 3.14 below defines the three ratings.

Figure 3.14. Definitions of the Three Levee System Ratings

Levee System Inspection Ratings	
Acceptable	All inspection items are rated as Acceptable.
Minimally Acceptable	One or more levee segment inspection items are rated as Minimally Acceptable or one or more items are rated as Unacceptable and an engineering determination concludes that the Unacceptable inspection items would not prevent the segment/system from performing as intended during the next flood event.
Unacceptable	One or more levee segment inspection items are rated as Unacceptable and would prevent the segment/system from performing as intended, or a serious deficiency noted in past inspections (previous Unacceptable items in a Minimally Acceptable overall rating) has not been corrected within the established timeframe, not to exceed two years.

Potential Losses to Existing Development

No levees are present in the county. No losses are anticipated.

Impact of Future Development

No impacts are anticipated, as there are no regulated, significant levees in the County.

Hazard Summary by Jurisdiction

Unincorporated County
There are no regulated levees in the jurisdiction.

Fredericktown
There are no regulated levees in the jurisdiction.

Fredericktown R-I School Dist.
There are no regulated levees in the jurisdiction.

Marquand-Zion R-VI School Dist.
There are no regulated levees in the jurisdiction.

Problem Statement

There are no regulated levees in the planning area.

3.4.9 Severe Thunderstorms, Including High Winds, Hail, and Lightning

Hazard Profile

Hazard Description

Thunderstorms

A thunderstorm is defined as a storm that contains lightning and thunder which is caused by unstable atmospheric conditions. When cold upper air sinks and warm moist air rises, storm clouds or 'thunderheads' develop resulting in thunderstorms. This can occur singularly, as well as in clusters or lines. The National Weather Service defines a thunderstorm as "severe" if it includes hail that is one inch or more, or wind gusts that are at 58 miles per hour or higher. At any given moment across the world, there are about 1,800 thunderstorms occurring. Severe thunderstorms most often occur in Missouri in the spring and summer, during the afternoon and evenings, but can occur at any time. Other hazards associated with thunderstorms are heavy rains resulting in flooding and tornadoes (discussed separately).

High Winds

A severe thunderstorm can produce winds causing as much damage as a weak tornado. The damaging winds of thunderstorms include downbursts, microbursts, and straight-line winds. Downbursts are localized currents of air blasting down from a thunderstorm, which induce an outward burst of damaging wind on or near the ground. Microbursts are minimized downbursts covering an area of less than 2.5 miles across. They include a strong wind shear (a rapid change in the direction of wind over a short distance) near the surface. Microbursts may or may not include precipitation and can produce winds at speeds of more than 150 miles per hour. Damaging straight-line winds are high winds across a wide area that can reach speeds of 140 miles per hour.

Lightning

All thunderstorms produce lightning which can strike outside of the area where it is raining and has been known to strike more than 10 miles away from the rainfall area. Thunder is simply the sound that lightning makes. Lightning is a huge discharge of electricity that shoots through the air causing vibrations and creating the sound of thunder.

Hail

According to the National Oceanic and Atmospheric Administration (NOAA), hail is precipitation that is formed when thunderstorm updrafts carry raindrops upward into extremely cold atmosphere causing them to freeze. The raindrops form into small frozen droplets. They continue to grow as they come into contact with super-cooled water which will freeze on contact with the frozen rain droplet. This frozen droplet can continue to grow and form hail. As long as the updraft forces can support or suspend the weight of the hailstone, hail can continue to grow before it hits the earth.

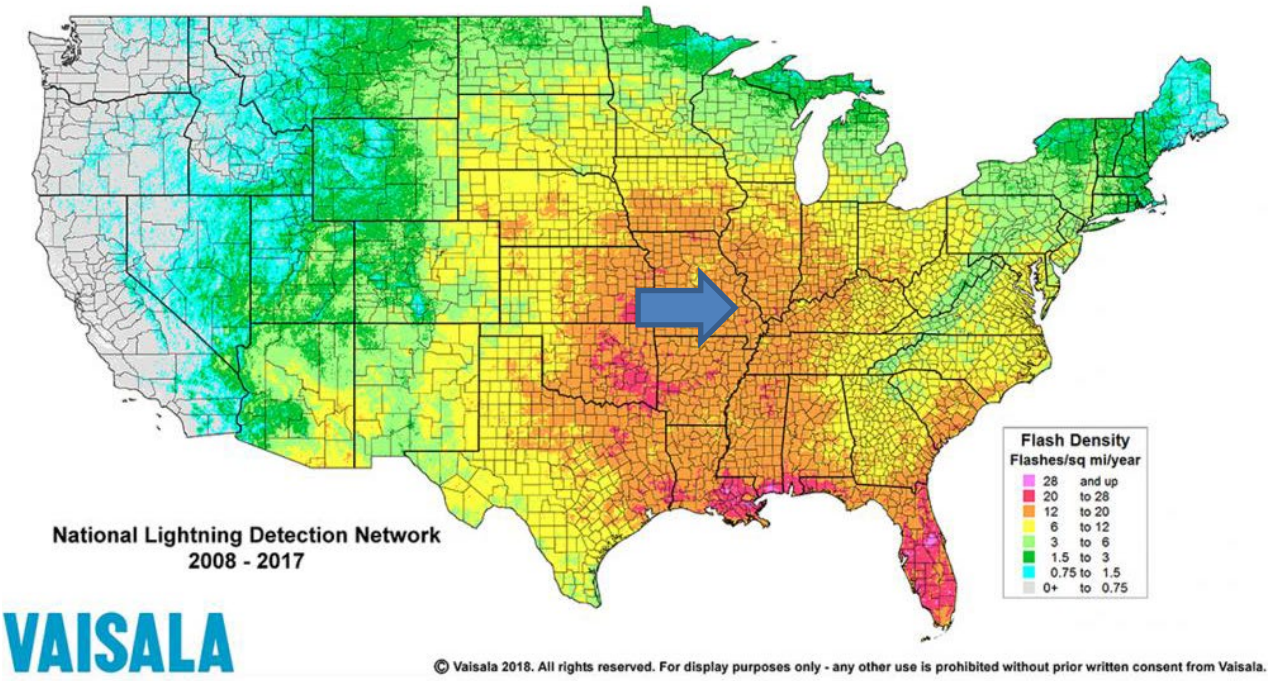
At the time when the updraft can no longer support the hailstone, it will fall down to the earth. For example, a ¼" diameter or pea sized hail requires updrafts of 24 miles per hour, while a 2 ¾" diameter or baseball sized hail requires an updraft of 81 miles per hour. According to the NOAA, the largest hailstone in diameter recorded in the United States was found in Vivian, South Dakota on July 23, 2010. It was eight inches in diameter, almost the size of a soccer ball. Soccer-ball-sized hail is the exception, but even small pea-sized hail can do damage.

Geographic Location

Thunderstorms/high winds/hail/lighting events are an area-wide hazard that can happen anywhere in the county. Although these events occur similarly throughout the planning area, they are more frequently reported in more urbanized areas. In addition, damages are more likely to occur in more densely developed urban areas.

Figure 3.15 shows lightning frequency in the country and in the county.

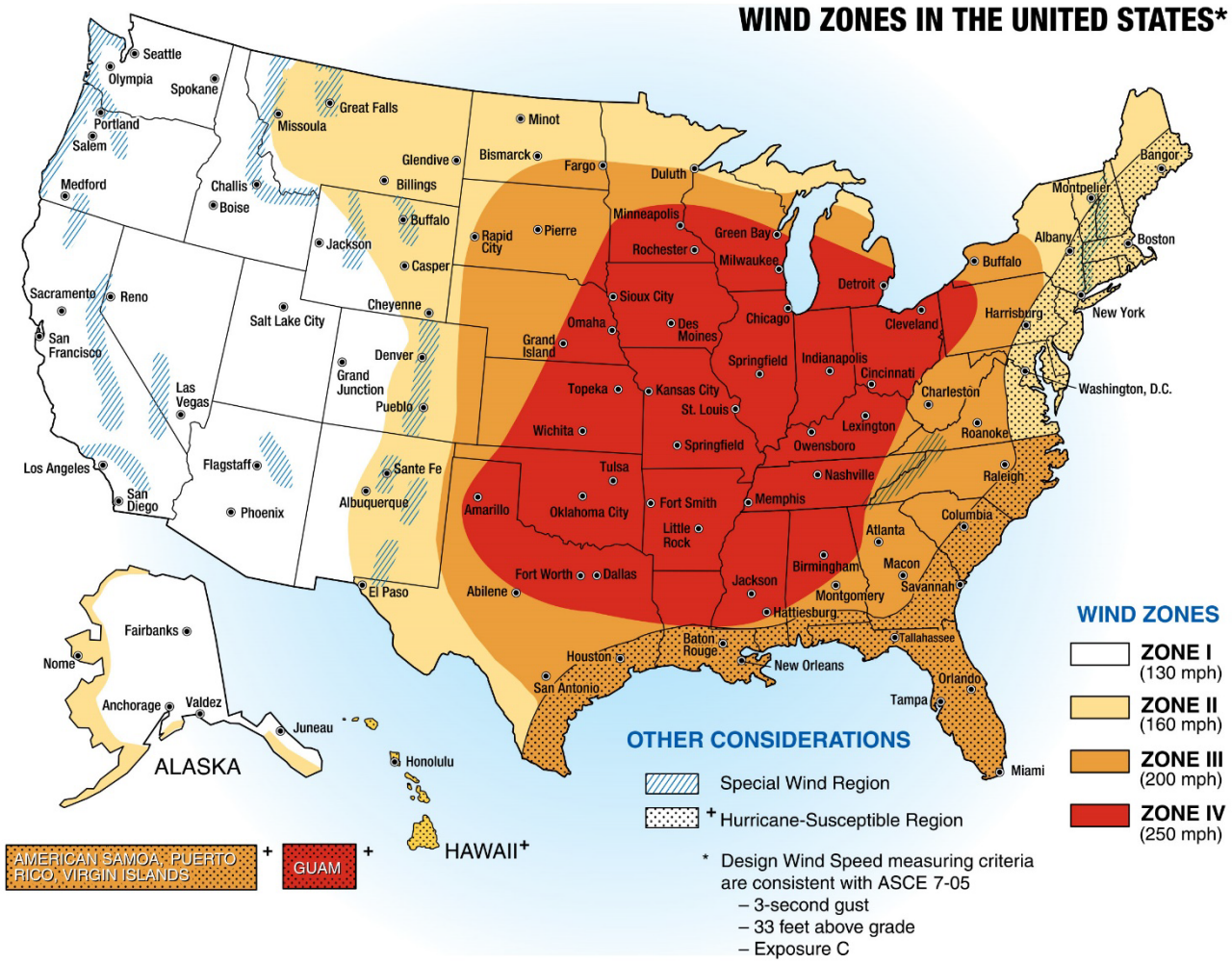
Figure 3.15. Location and Frequency of Lightning in Missouri



Source: National Weather Service, http://www.vaisala.com/en/products/thunderstormandlightningdetectionsystems/Pages/NLDN.aspx

Figure 3.16 shows the wind zones in the nation, with Madison county located in Zone 4.

Figure 3.16. Wind Zones in the United States



Source: FEMA 320, Taking Shelter from the Storm, 3rd edition, http://www.weather.gov/media/bis/FEMA_SafeRoom.pdf

Strength/Magnitude/Extent

Based on information provided by the Tornado and Storm Research Organization (TORRO), **Table 3.25** below describes typical damage impacts of the various sizes of hail.

Table 3.25. Tornado and Storm Research Organization Hailstorm Intensity Scale

Intensity Category	Diameter (mm)	Diameter (inches)	Size Description	Typical Damage Impacts
Hard Hail	5-9	0.2-0.4	Pea	No damage
Potentially Damaging	10-15	0.4-0.6	Mothball	Slight general damage to plants, crops
Significant	16-20	0.6-0.8	Marble, grape	Significant damage to fruit, crops, vegetation
Severe	21-30	0.8-1.2	Walnut	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
Severe	31-40	1.2-1.6	Pigeon's egg > squash ball	Widespread glass damage, vehicle bodywork damage
Destructive	41-50	1.6-2.0	Golf ball > Pullet's egg	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries

Destructive	51-60	2.0-2.4	Hen's egg	Bodywork of grounded aircraft dented, brick walls pitted
Destructive	61-75	2.4-3.0	Tennis ball > cricket ball	Severe roof damage, risk of serious injuries
Destructive	76-90	3.0-3.5	Large orange > Soft ball	Severe damage to aircraft bodywork
Super Hailstorms	91-100	3.6-3.9	Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
Super Hailstorms	>100	4.0+	Melon	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Source: Tornado and Storm Research Organization (TORRO), Department of Geography, Oxford Brookes University
Notes: In addition to hail diameter, factors including number and density of hailstones, hail fall speed and surface wind speeds affect severity. http://www.torro.org.uk/site/hscale.php

Straight-line winds are defined as any thunderstorm wind that is not associated with rotation (i.e., is not a tornado). It is these winds, which can exceed 100 miles per hour, which represent the most common type of severe weather. They are responsible for most wind damage related to thunderstorms. Since thunderstorms do not have narrow tracks like tornadoes, the associated wind damage can be extensive and affect entire (and multiple) counties. Objects like trees, barns, outbuildings, high-profile vehicles, and power lines/poles can be toppled or destroyed, and roofs, windows, and homes can be damaged as wind speeds increase.

The onset of thunderstorms with lightning, high wind, and hail is generally rapid. Duration is less than six hours and warning time is generally six to twelve hours. Nationwide, lightning kills 75 to 100 people each year. Lightning strikes can also start structural and wildland fires, as well as damage electrical systems and equipment.

Previous Occurrences

Table 3.21, Table 3.22, and Table 3.23 show the previous occurrences of high wind events, lightning events, and hail events in the County. All data is from the NCDC.

Limitations to the use of NCDC reported lightning events include the fact that only lightning events that result in fatality, injury and/or property and crop damage are in the NCDC.

Table 3.26. Hail Events 1" Or Larger In County, 2002-2022

Location	Date	Size of Hail (in.)	Deaths	Injuries	Property Damage	Crop Damage
FREDERICKTOWN	3/11/2006	1	0	0	0	0
FREDERICKTOWN	3/11/2006	1.75	0	0	0	0
MINE LA MOTTE	3/11/2006	1	0	0	0	0
FREDERICKTOWN	5/13/2009	1	0	0	0	0
CHOBB STORE	6/15/2009	1	0	0	0	0
FREDERICKTOWN	4/15/2011	1	0	0	0	0
ALLBRIGHT	3/15/2012	1	0	0	0	0
SLABTOWN	5/9/2014	1	0	0	0	0
STRINGTOWN	8/19/2014	1.75	0	0	0	0
OAK GROVE	10/19/2016	1.75	0	0	0	0
SACO	5/27/2017	1.75	0	0	0	0
FREDERICKTOWN	3/2/2020	1	0	0	0	0

Source: NCEI

Table 3.27. Lightning Events, 2002-2022

None. Note NCEI data limitations.
Source: NCEI

Table 3.28. Strong Wind Events 60+ Knots, 2002-2022

Location	Date	Wind Speed (knts)	Deaths	Injuries	Property Damage	Crop Damage
FREDERICKTOWN	9/22/2006	60	0	0	0	0
ROSELLE	5/8/2009	78	0	0	0	0
MILLCREEK	2/28/2011	61	0	0	0	0
FREDERICKTOWN	4/19/2011	61	0	0	0	0
SACO	5/27/2017	61	0	0	0	0
STRINGTOWN	8/20/2019	61	0	0	0	0
FREDERICKTOWN	8/26/2019	61	0	0	0	0
FREDERICKTOWN	3/11/2021	61	0	0	0	0
FREDERICKTOWN	7/10/2021	61	0	0	5000	0
CHOBB STORE	12/10/2021	61	0	0	1000	0

Probability of Future Occurrence

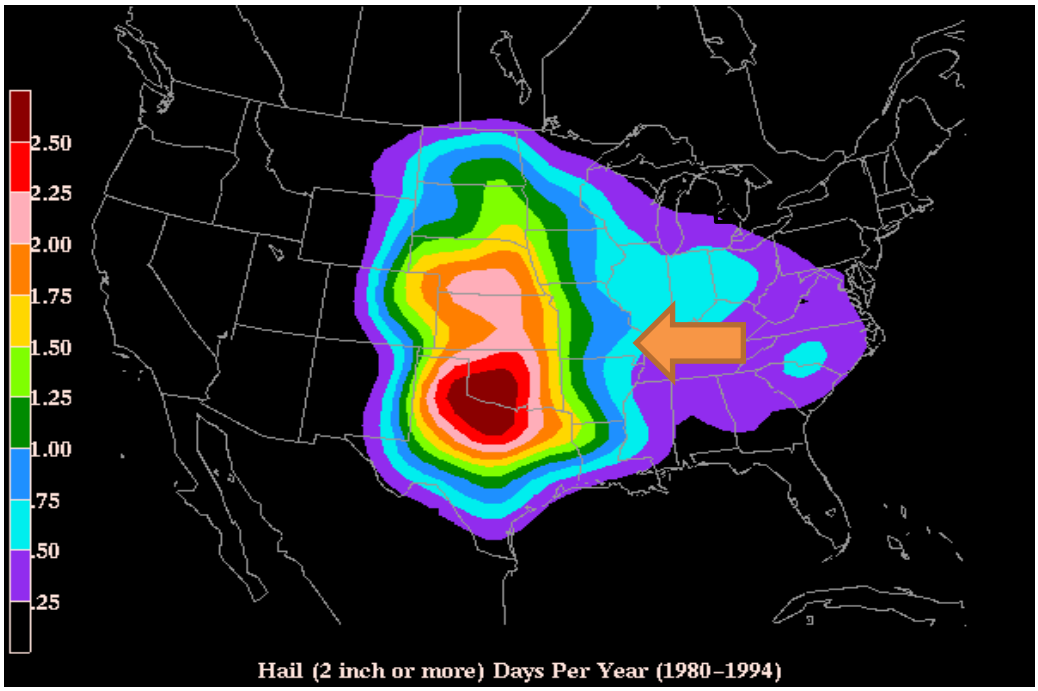
The NCEI lists 12 recorded events of hail 1" or larger in the county in past 20 years, an annualized probability of 60%.

The NCEI lists 0 recorded events of lightning strikes in the county in past 20 years; however, data limitations are the leading factor in this phenomenon, not the lack of any actual events. The HMPC believes it is safe to assume that at least one lightning strike will occur each year in the county, an annualized probability of 100%.

The NCEI lists 10 recorded events of winds over 60 knots in the county in past 20 years, an annualized probability of 50%.

NOAA's NSSL indicates hail of 2" or more is likely to occur 1 day every two years in the County (see Figure 3.15)

Figure 3.17. Annual Hailstorm Probability (2'' diameter or larger), U 1980-1994



Source: NSSL, http://www.nssl.noaa.gov/users/brooks/public_html/bighail.gif Note:

Vulnerability

Vulnerability Overview

Based on the state's 2018 HMP, Madison County has a summarized thunderstorm vulnerability rating of "Low."

Severe thunderstorm losses are usually attributed to the associated hazards of hail, downburst winds, lightning and heavy rains. Losses due to hail and high wind are typically insured losses that are localized and do not result in presidential disaster declarations. However, in some cases, impacts are severe and widespread and assistance outside state capabilities is necessary. Hail and wind also can have devastating impacts on crops. Severe thunderstorms/heavy rains that lead to flooding are discussed in the flooding hazard profile. Hailstorms cause damage to property, crops, and the environment, and can injure and even kill livestock. In the United States, hail causes more than $1 billion in damage to property and crops each year. Even relatively small hail can shred plants to ribbons in a matter of minutes. Vehicles, roofs of buildings and homes, and landscaping are also commonly damaged by hail. Hail has been known to cause injury to humans, occasionally fatal injury.

In general, assets in the County vulnerable to thunderstorms with lightning, high winds, and hail include people,

crops, vehicles, and built structures. Although this hazard results in high annual losses, private property insurance and crop insurance usually cover the majority of losses. Considering insurance coverage as a recovery capability, the overall impact on jurisdictions is reduced.

Most lightning damages occur to electronic equipment located inside buildings. But structural damage can also occur when a lightning strike causes a building fire. In addition, lightning strikes can cause damages to crops if fields or forested lands are set on fire. Communications equipment and warning transmitters and receivers can also be knocked out by lightning strikes.
http://www.lightningsafety.noaa.gov/stats/08_Vaisala_NLDN_Poster.pdf and
http://www.lightningsafety.noaa.gov/

Potential Losses to Existing Development

The 2018 State HMP lists annualized property losses in the county due to wind evens as $11,905, and annualized losses due to hail and lightning as $0. These figures are reasonable for future loss estimates.

Previous and Future Development

Additional development will result in the exposure of more structures to damages from severe thunderstorms.

Hazard Summary by Jurisdiction

Unincorporated County
With the county's agricultural land uses and less-dense development, the county's greatest vulnerability during thunderstorms is crop damage. However, recent data indicates these events have had only a small impact on crops.

Fredericktown
Because of higher density development, the city has a greater vulnerability to the effects of thunderstorms on its residents. Property damage is higher when a thunderstorm strikes a more densely developed area, and more residents are impacted by interruptions to services such as electricity.

Fredericktown R-I School Dist.
The district's greatest vulnerability to thunderstorms is to its buildings and facilities.

Marquand-Zion R-VI School Dist.
The district's greatest vulnerability to thunderstorms is to its buildings and facilities.

Problem Statement

Impacts from these events are typically property related, with debris, falling trees, and hail damage. Advanced warnings typically keep residents inside during such events which limits potential injuries and loss of life. While all jurisdictions can be impacted by these events, the cities and county are most affected due to their size compared to the relatively small campuses of the school districts. Of the cities and the county, the cities are the most affected due to the density of development and concentration of higher property values.

3.4.10 Tornado

HazardProfile

Hazard Description

Essentially, tornadoes are a vortex storm with two components of winds. The first is the rotational winds that can measure up to 500 miles per hour, and the second is an uplifting current of great strength. The dynamic strength of both these currents can cause vacuums that can overpressure structures from the inside.

Although tornadoes have been documented in all 50 states, most of them occur in the central United States. The unique geography of the central United States allows for the development of thunderstorms that spawn tornadoes. The jet stream, which is a high-velocity stream of air, determines which area of the central United States will be prone to tornado development. The jet stream normally separates the cold air of the north from the warm air of the south. During the winter, the jet stream flows west to east from Texas to the Carolina coast. As the sun "moves" north, so does the jet stream, which at summer solstice flows from Canada across Lake Superior to Maine. During its move northward in the spring and its recession south during the fall, the jet stream crosses Missouri, causing the large thunderstorms that breed tornadoes.

Tornadoes spawn from the largest thunderstorms. The associated cumulonimbus clouds can reach heights of up to 55,000 feet above ground level and are commonly formed when Gulf air is warmed by solar heating. The moist, warm air is overridden by the dry cool air provided by the jet stream. This cold air presses down on the warm air, preventing it from rising, but only temporarily. Soon, the warm air forces its way through the cool air and the cool air moves downward past the rising warm air. This air movement, along with the deflection of the earth's surface, can cause the air masses to start rotating. This rotational movement around the location of the breakthrough forms a vortex, or funnel. If the newly created funnel stays in the sky, it is referred to as a funnel cloud. However, if it touches the ground, the funnel officially becomes a tornado.

A typical tornado can be described as a funnel-shaped cloud that is "anchored" to a cloud, usually a cumulonimbus that is also in contact with the earth's surface. This contact on average lasts 30 minutes and covers an average distance of 15 miles. The width of the tornado (and its path of destruction) is usually about 300 yards. However, tornadoes can stay on the ground for upward of 300 miles and can be up to a mile wide. The National Weather Service, in reviewing tornadoes occurring in Missouri between 1950 and 1996, calculated the mean path length at 2.27 miles and the mean path area at 0.14 square mile.

The average forward speed of a tornado is 30 miles per hour but may vary from nearly stationary to 70 miles per hour. The average tornado moves from southwest to northeast, but tornadoes have been known to move in any direction. Tornadoes are most likely to occur in the afternoon and evening, but have been known to occur at all hours of the day and night.

Geographic Location

Tornadoes can occur at any location in the planning area with equal probability.

Strength/Magnitude/Extent

Tornadoes are the most violent of all atmospheric storms and are capable of tremendous destruction. Wind speeds can exceed 250 miles per hour and damage paths can be more than one mile wide and 50 miles long. Tornadoes have been known to lift and move objects weighing more than 300 tons a distance of 30 feet, toss

homes more than 300 feet from their foundations, and siphon millions of tons of water from water bodies. Tornadoes also can generate a tremendous amount of flying debris or "missiles," which often become airborne shrapnel that causes additional damage. If wind speeds are high enough, missiles can be thrown at a building with enough force to penetrate windows, roofs, and walls. However, the less spectacular damage is much more common.

Tornado magnitude is classified according to the EF- Scale (or the Enhance Fujita Scale, based on the original Fujita Scale developed by Dr. Theodore Fujita, a renowned severe storm researcher). The EF- Scale (see **Table 3.24**) attempts to rank tornadoes according to wind speed based on the damage caused. This update to the original F Scale was implemented in the U.S. on February 1, 2007.

Table 3.29. Enhanced F Scale for Tornado Damage

FUJITA SCALE			DERIVED EF SCALE		OPERATIONAL EF SCALE	
F Number	Fastest ¼-mile (mph)	3 Second Gust (mph)	EF Num	3 Second Gust (mph)	EF Number	3 Second Gust (mph)
0	40-72	45-78	0	65-85	0	65-85
1	73-112	79-117	1	86-109	1	86-110
2	113-157	118-161	2	110-137	2	111-135
3	158-207	162-209	3	138-167	3	136-165
4	208-260	210-261	4	168-199	4	166-200
5	261-318	262-317	5	200-234	5	Over 200

Source: The National Weather Service, www.spc.noaa.gov/faq/tornado/ef-scale.html

The wind speeds for the EF scale and damage descriptions are based on information on the NOAA Storm Prediction Center as listed in **Table 3.25**. The damage descriptions are summaries. For the actual EF scale it is necessary to look up the damage indicator (type of structure damaged) and refer to the degrees of damage associated with that indicator. Information on the Enhanced Fujita Scale's damage indicators and degrees or damage is located online at www.spc.noaa.gov/efscale/ef-scale.html.

Table 3.30. Enhanced Fujita Scale with Potential Damage

Enhanced Fujita Scale			
Scale	Wind Speed (mph)	Relative Frequency	Potential Damage
EF0	65-85	53.5%	Light. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e. those that remain in open fields) are always rated EF0).
EF1	86-110	31.6%	Moderate. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111-135	10.7%	Considerable. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes complete destroyed; large trees snapped or uprooted; light object missiles generated; cars lifted off ground.
EF3	136-165	3.4%	Severe. Entire stores of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	166-200	0.7%	Devastating. Well-constructed houses and whole frame houses completely levelled; cars thrown and small missiles generated.
EF5	>200	<0.1%	Explosive. Strong frame houses levelled off foundations and swept away; automobile-sized missiles fly through the air in excess of 300 ft.; steel reinforced concrete structure badly damaged; high rise buildings have significant structural deformation; incredible phenomena will occur.

Source: NOAA Storm Prediction Center, http://www.spc.noaa.gov/efscale/ef-scale.html

Enhanced weather forecasting has provided the ability to predict severe weather likely to produce tornadoes days in advance. Tornado watches can be delivered to those in the path of these storms several hours in advance. Lead time for actual tornado warnings is about 30 minutes. Tornadoes have been known to change paths very rapidly, thus limiting the time in which to take shelter. Tornadoes may not be visible on the ground if they occur after sundown or due to blowing dust or driving rain and hail.

Previous Occurrences

Table 3.26 lists all tornado events from 1993 to 2016. Prior to 1993, only very destructive tornadoes were recorded. It is necessary to go back as far as possible due to the random and intermittent nature of tornado events, but data limitations hinder this.

There are additional limitations to the use of NCDC tornado data that must be noted. For example, one tornado may contain multiple segments as it moves geographically. A tornado that crosses a county line or state line is considered a separate segment for the purposes of reporting to the NCDC. Also, a tornado that lifts off the ground for less than 5 minutes or 2.5 miles is considered a separate segment. If the tornado lifts off the ground for greater than 5 minutes or 2.5 miles, it is considered a separate tornado. Tornadoes reported in Storm Data and the Storm Events Database are in segments.

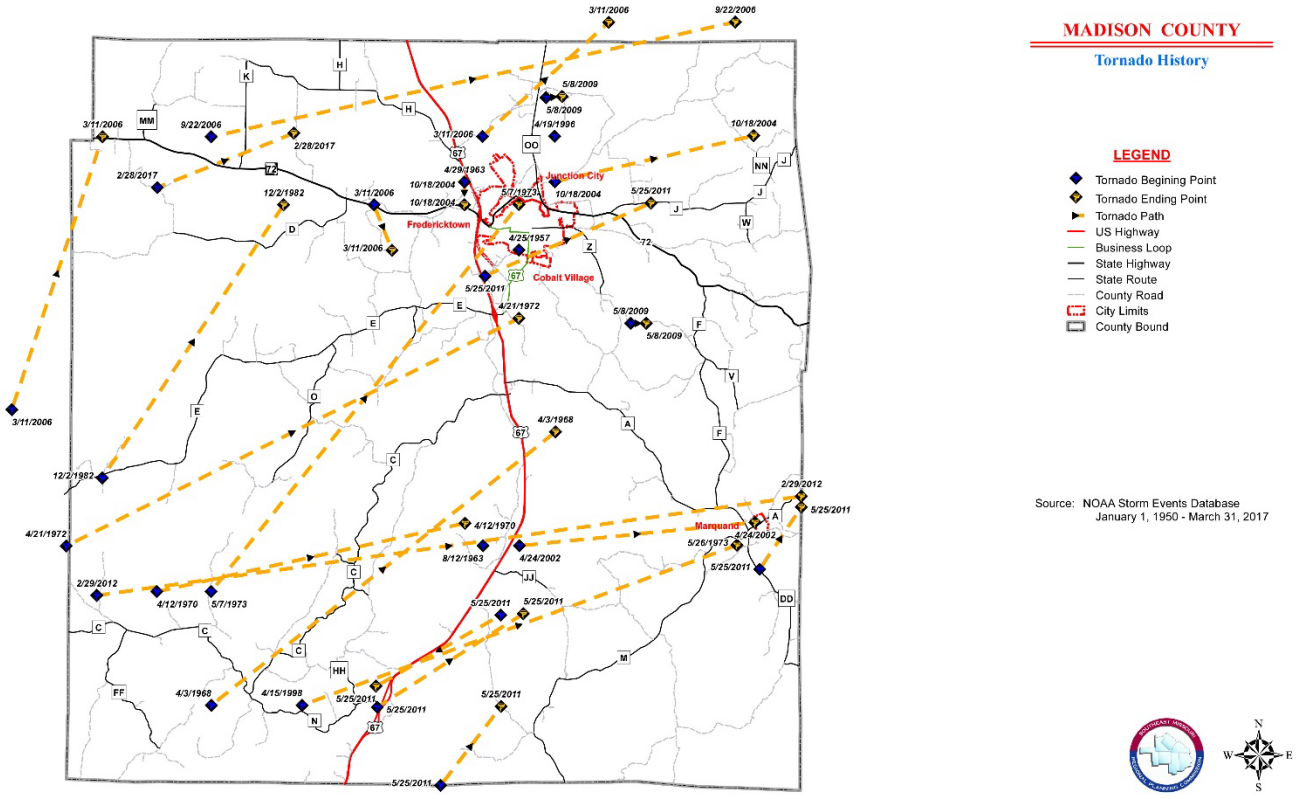
Figure 3.16 shows the approximate paths of all NCDC listed tornadoes in the County from 1950 to present.

Table 3.31. Recorded Tornadoes in Madison County, 1993-2016

Location	Date	F Scale	Deaths	Injuries	Property Damage	Crop Damage
FREDRICKTOWN MUNI AR	4/19/1996	F0	0	0	0	0
SACO	4/15/1998	F1	0	0	0	0
FREDERICKTOWN	4/24/2002	F2	0	3	0	0
FREDERICKTOWN	10/18/2004	F0	0	0	0	0
FREDERICKTOWN	10/18/2004	F1	0	0	0	0
SILVER MINE	3/11/2006	F1	0	0	0	0
OAK GROVE	3/11/2006	F1	0	0	0	0
MINE LA MOTTE	3/11/2006	F1	0	0	0	0
ROSELLE	9/22/2006	F2	0	1	0	0
MINE LA MOTTE	5/8/2009	EF0	0	0	0	0
CORNWALL	5/8/2009	EF1	0	0	0	0
MILLCREEK	5/25/2011	EF1	0	0	0	0
BUCKHORN	5/25/2011	EF1	0	0	0	0
CHOBB STORE	5/25/2011	EF1	0	0	0	0
ZION	5/25/2011	EF1	0	0	0	0
MARQUAND	5/25/2011	EF1	0	0	0	0
JEWETT	2/29/2012	EF2	0	1	0	0
SILVER MINE	2/28/2017	EF0	0	0	0	0
MARQUAND	3/24/2019	EF1	0	0	0	0
	10/24/2021	EFU	0	0	0	0
	10/24/2021	EF3	0	1	0	0

Source: NCEI

Figure 3.18. Madison County: Map of Historic Tornado Events



Source: NCEI

Probability of Future Occurrence

There have been 19 NCEI listed tornadoes in the County over the past 29 years. This equals an annual probability of 66% of a tornado event.

Changing Future Conditions Considerations

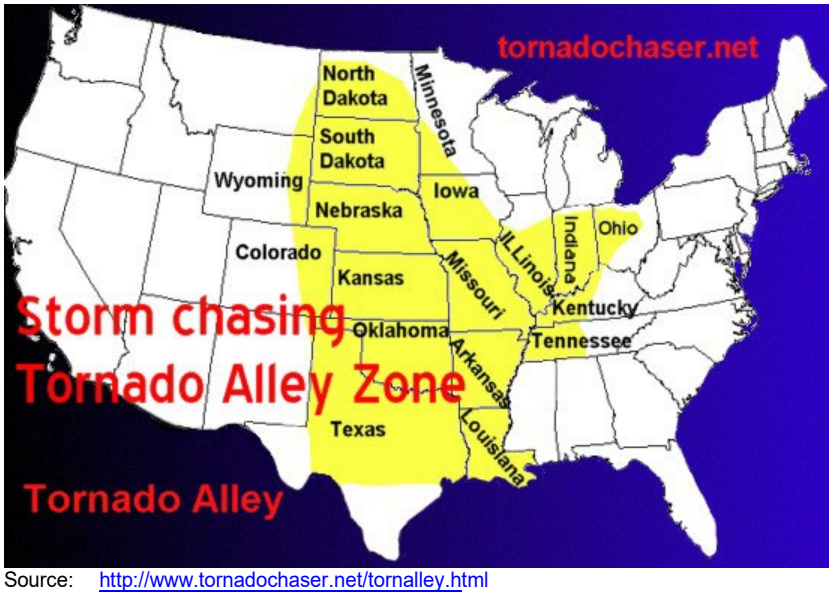
Data from the past 29 years show little variation is the occurrence of tornadoes.

Vulnerability

Vulnerability Overview

Madison County is located in the region of the country known as "Tornado Alley," a region of the nation with a high frequency of dangerous and destructive tornadoes (Figure 3.17). This high frequency leads to an elevated vulnerability to tornadoes for the County, but the rural nature of the County limits the amount of damage done by any single event. Because of this, the 2013 State HMP rates Madison County with a "Moderate" tornado vulnerability.

Figure 3.19. Tornado Alley in the U.S.



Source: http://www.tornadochaser.net/tornalley.html

Potential Losses to Existing Development

According to the 2018 State HMP, Madison County has annualized tornado damages of only $16,455. Compared to some surrounding counties with amounts 3-10 times higher, and given the rural nature of the county, potential losses are relatively low. This is not to say though that impacts on individuals may not be catastrophic.

Previous and Future Development

Additional development in any jurisdiction will lead to greater exposure of structures to a tornado event. Given the low growth history of the County recently though, increases are expected to be minimal.

Hazard Summary by Jurisdiction

Unincorporated County
With the county's agricultural land uses and less-dense development, the county's greatest vulnerability during tornadic events is crop damage. However, recent data indicates these events have had only a small impact on crops.

Fredericktown
Because of higher density development, the city has a greater number of people and businesses exposed to tornadoes. Property damage is higher when a tornado strikes a more densely developed area, and more residents are impacted by interruptions to services such as electricity and transportation. The city's building code does provide some reduction in vulnerability, though the mobile home developments in the city are more vulnerable than most other developments.

Fredericktown R-I School Dist.
The district is vulnerable in two respects to tornadoes. First, all of the districts buildings and facilities are vulnerable to damage from a tornado. Secondly, during school hours, there is a high density of children in each district building, leading to much greater vulnerability during these times.

Marquand-Zion R-VI School Dist.
The district is vulnerable in two respects to tornadoes. First, all of the districts buildings and facilities are vulnerable to damage from a tornado. Secondly, during school hours, there is a high density of children in each district building, leading to much greater vulnerability during these times.

Problem Statement

Any participant can be affected by a tornado. While the cities are the most exposed due to population and development density, the school district is also densely populated during session. The cities and county have early warning sirens to alert residents to approaching tornadoes. Given the low population density in the county, saferooms are not typically cost effective, unless developed on a county property in one of the communities. All jurisdictions are considering construction of saferooms as a potential solution to tornado mitigation.

3.4.11 Winter Weather/Snow/Ice

Hazard Profile

Hazard Description

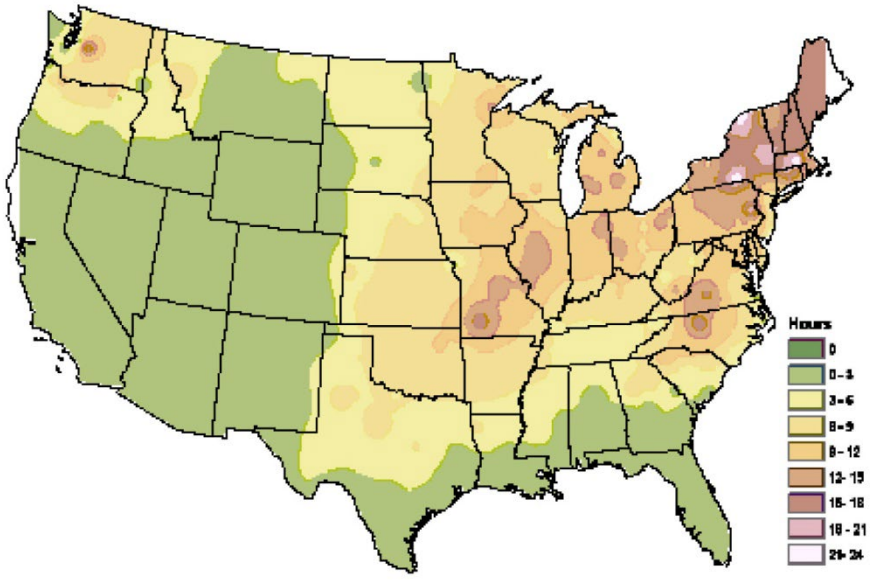
A major winter storm can last for several days and be accompanied by high winds, freezing rain or sleet, heavy snowfall, and cold temperatures. The National Weather Service describes different types of winter storm events as follows.

Blizzard—Winds of 35 miles per hour or more with snow and blowing snow reducing visibility to less than ¼ mile for at least three hours.
Blowing Snow—Wind-driven snow that reduces visibility. Blowing snow may be falling snow and/or snow on the ground picked up by the wind.
Snow Squalls—Brief, intense snow showers accompanied by strong, gusty winds. Accumulation may be significant.
Snow Showers—Snow falling at varying intensities for brief periods of time. Some accumulation is possible.
Freezing Rain—Measurable rain that falls onto a surface with a temperature below freezing. This causes it to freeze to surfaces, such as trees, cars, and roads, forming a coating or glaze of ice. Most freezing-rain events are short lived and occur near sunrise between the months of December and March.
Sleet—Rain drops that freeze into ice pellets before reaching the ground. Sleet usually bounces when hitting a surface and does not stick to objects.

Geographic Location

The entire county is vulnerable to heavy snow, ice, freezing rain, and extreme cold temperatures. Figure 3.18 shows the average number of hours per year with freezing rain, with Madison County sitting on the line between 9-12 hours and 12-15 hours.

Figure 3.20. NWS Statewide Average Number of Hours per Year with Freezing Rain



Source: American Meteorological Society. "Freezing Rain Events in the United States." http://ams.confex.com/ams/pdfpapers/71872.pdf

Strength/Magnitude/Extent

Severe winter storms include heavy snowfall, ice, and strong winds which can push the wind chill well below zero degrees in the planning area.

For severe weather conditions, the National Weather Service issues some or all of the following products as conditions warrant across the State of Missouri. NWS local offices in Missouri may collaborate with local partners to determine when an alert should be issued for a local area.

- Winter Weather Advisory — Winter weather conditions are expected to cause significant inconveniences and may be hazardous. If caution is exercised, these situations should not become life threatening. Often the greatest hazard is to motorists.
- Winter Storm Watch — Severe winter conditions, such as heavy snow and/or ice are possible within the next day or two.
- Winter Storm Warning — Severe winter conditions have begun or are about to begin.
- Blizzard Warning — Snow and strong winds will combine to produce a blinding snow (near zero visibility), deep drifts, and life-threatening wind chill.
- Ice Storm Warning -- Dangerous accumulations of ice are expected with generally over one quarter inch of ice on exposed surfaces. Travel is impacted, and widespread downed trees and power lines often result.
- Wind Chill Advisory -- Combination of low temperatures and strong winds will result in wind chill readings of -20 degrees F or lower.
- Wind Chill Warning -- Wind chill temperatures of -35 degrees F or lower are expected. This is a life-threatening situation.

Previous Occurrences

The NCEI lists 26 winter weather events in the past 20 years. Table 3.32 provides a list of the events.

Table 3.32. NCDC Madison County Winter Weather Events Summary, 1992-2016

Date	Event Type	Deaths	Injuries	Property Damage	Crop Damage
12/4/2002	Winter Storm	0	0	0	0
12/24/2002	Winter Storm	0	0	0	0
2/15/2003	Winter Storm	0	0	0	0
2/23/2003	Winter Storm	0	0	0	0
1/25/2004	Winter Storm	0	0	0	0
12/22/2004	Winter Storm	0	0	0	0
12/8/2005	Winter Storm	0	0	0	0
11/30/2006	Winter Storm	0	0	0	0
12/1/2006	Winter Storm	0	0	0	0
2/11/2008	Sleet	0	0	0	0
2/21/2008	Sleet	0	0	0	0
3/3/2008	Winter Storm	0	0	0	0
3/3/2008	Winter Storm	0	0	0	0

1/26/2009	Winter Storm	0	0	0	0
1/28/2010	Heavy Snow	0	0	0	0
1/31/2011	Winter Storm	0	0	0	0
2/1/2011	Winter Storm	0	0	0	0
2/21/2013	Winter Storm	0	0	0	0
12/5/2013	Winter Storm	0	0	0	0
1/5/2014	Winter Storm	0	0	0	0
3/1/2014	Winter Storm	0	0	0	0
2/15/2015	Heavy Snow	0	0	0	0
2/20/2015	Heavy Snow	0	0	0	0
2/14/2021	Heavy Snow	0	0	0	0
2/2/2022	Heavy Snow	0	0	0	0
2/24/2022	Sleet	0	0	0	0

Source: NCEI

Probability of Future Occurrence

With 26 events in 20 years, the County is projected to experience 1.3 winter storm events every year.

Changing Future Conditions Considerations

Data from the past decade shows little variation in event occurrences.

Vulnerability

Vulnerability Overview

The 2018 State HMP lists Madison County with a "Low Medium" vulnerability to winter storm events. This determination is made based on multiple factors, including housing density, likelihood of the event, property and crop losses, and social vulnerability. The State Plan shows $0 for annualized property losses in the county due to severe winter weather.

Heavy snow can bring a community to a standstill by inhibiting transportation (in whiteout conditions), weighing down utility lines, and by causing structural collapse in buildings not designed to withstand the weight of the snow. Repair and snow removal costs can be significant. Ice buildup can collapse utility lines and communication towers, as well as make transportation difficult and hazardous. Ice can also become a problem on roadways if the air temperature is high enough that precipitation falls as freezing rain rather than snow.

Buildings with overhanging tree limbs are more vulnerable to damage during winter storms when limbs fall. Businesses experience loss of income as a result of closure during power outages. In general heavy winter storms increase wear and tear on roadways though the cost of such damages is difficult to determine. Businesses can experience loss of income as a result of closure during winter storms.

Overhead power lines and infrastructure are also vulnerable to damages from winter storms. In particular ice accumulation during winter storm events damage to power lines due to the ice weight on the lines and equipment. Damages also occur to lines and equipment from falling trees and tree limbs weighted down by ice. Potential losses could include cost of repair or replacement of damaged facilities and lost economic opportunities for businesses.

Secondary effects from loss of power could include burst water pipes in homes without electricity during winter storms. Public safety hazards include risk of electrocution from downed power lines. Specific amounts of estimated losses are not available due to the complexity and multiple variables associated with this hazard. Standard values for loss of service for utilities reported in FEMA's 2009 BCA Reference Guide, the economic impact as a result of loss of power is $126 per person per day of lost service.

Potential Losses to Existing Development

According to the 2018 State HMP, Madison County has had property losses of $0 over a 20 year period, equaling an annualized loss of $0 per year. While this is likely due to data limitations, no better estimate is available at this time.

Previous and Future Development

Additional development will increase a jurisdictions exposure to the hazard by adding structure and people to the study area. The minor growth rate of the county and communities indicates little future impact due to development trends.

Hazard Summary by Jurisdiction

Unincorporated County
With the county's agricultural land uses and less-dense development, one of the county's greatest vulnerabilities during winter storm events is crop damage. However, recent data indicates these events have had only a small impact on crops. Additionally, winter storms make travel dangerous for residents. Given how far some residents in the county live from needed goods and services, winter storms can effectively close off access to these goods and services.

Fredericktown
Because of higher density development, the city has a greater number of people and businesses exposed to winter storms. Property damage is higher when a storm strikes a more densely developed area, and more residents are impacted by interruptions to services such as electricity and transportation; however, these services are more quickly restored in the cities.

Fredericktown R-I School Dist.
The district's greatest vulnerability to winter storms is to its buildings and facilities, especially the loss of power.

Marquand-Zion R-VI School Dist.
The district's greatest vulnerability to winter storms is to its buildings and facilities, especially the loss of power.

Problem Statement

All jurisdictions are equally exposed to severe winter weather, though the event will have different impacts on different jurisdictions. Schools are typically closed during these events, making property damage their primary concern. While Madison County has far less population density compared to Fredericktown, county residents can far more easily have transportation and communications severed by winter storms, leaving them isolated for days or even weeks in extreme cases. For Fredericktown, the inverse is true; residents continue to have services and contacts in close proximity, but there are far more people affected by the event.

4 MITIGATION STRATEGY 4.1

4.1 Goals 4.1

4.2 Identification and Analysis of Mitigation Actions 4.1

4.3 Implementation of Mitigation Actions 4.3

This section presents the mitigation strategy updated by the HMPC based on the updated risk assessment. The mitigation strategy was developed through a collaborative group process. The process included review of updated general goal statements to guide the jurisdictions in lessening disaster impacts as well as specific mitigation actions to directly reduce vulnerability to hazards and losses. The following definitions are taken from FEMA's *Local Hazard Mitigation Review Guide (October 1, 2012)*.

- **Mitigation Goals** are general guidelines that explain what you want to achieve. Goals are long-term policy statements and global visions that support the mitigation strategy. The goals address the risk of hazards identified in the plan.

- **Mitigation Actions** are specific actions, projects, activities, or processes taken to reduce or eliminate long-term risk to people and property from hazards and their impacts. Implementing mitigation actions helps achieve the plan's mission and goals.

4.1 Goals

This planning effort is an update to Madison County's existing hazard mitigation plan approved by FEMA in 2012. Therefore, the goals from the previous HMP were reviewed to see if they were still valid, feasible, practical, and applicable to the defined hazard impacts. The HMPC conducted a discussion session during their second meeting to review and update the plan goals. To ensure that the goals developed for this update were comprehensive and supported State goals, the 2018 State Hazard Mitigation Plan goals were also reviewed. SEMO RPC also presented common goals from other county HMPs.

After discussion, the HMPC decided the 2018 goals were still valid. The goals for this plan update are:

1. Protect the health, safety, and welfare of residents and students.
2. Ensure the operation of critical facilities and services.
3. Protect public and private property.
4. Enhance informed decision making of mitigation actions.

4.2 Identification and Analysis of Mitigation Actions

During the second MPC meeting, the results of the risk assessment update were provided to the HMPC members for review and the key issues were identified for specific hazards. Changes in risk since adoption of the previously approved plan were discussed. The second meeting concluded with the distribution of a list of possible mitigation actions to prompt discussions within and among the jurisdictions. The discussions occurred during jurisdictional break-out meetings. The list included possible new mitigation actions, as well as actions from the previously approved plan. Actions from the previous plan included completed actions, on-going actions, and

actions upon which progress had not been made. The HMPC discussed SEMA's identified funding priorities and the types of mitigation actions generally recognized by FEMA.

The HMPC then updated the mitigation strategy of each jurisdiction during Meeting 2 and through electronic correspondence afterward. For a comprehensive range of mitigation actions to consider, the HMPC reviewed the following information:

- A list of actions proposed in the previous mitigation plan, the current State Plan, and approved plans in surrounding counties,
- Key issues from the risk assessments,
- State priorities established for Hazard Mitigation Assistance grants, and
- Public input during meetings, responses to Data Collection Questionnaires, and other efforts to involve the public in the plan development process.

Individual jurisdictions, including school and special districts, then developed final mitigation strategies for inclusion in the plan. They were encouraged to review the details of the risk assessment vulnerability analysis specific to their jurisdiction. They were also provided a link to the FEMA's publication, *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards (January 2013).* This document was developed by FEMA as a resource for identification of a range of potential mitigation actions for reducing risk to natural hazards and disasters.

The MPC reviewed the actions from the previously approved plan for progress made since the plan had been adopted, using worksheets included in the appendix of this plan. Each jurisdiction was instructed to provide information regarding the "Action Status" with one of the following status choices:

- Completed, with a description of the progress,
- Not Started/Continue in Plan Update, with a discussion of the reasons for lack of progress,
- In Progress/Continue in Plan Update, with a description of the progress made to date or
- Deleted, with a discussion of the reasons for deletion.

Additionally, the future inclusion of each mitigation action in the plan update was identified as either keep, delete, or modify. Based on the status updates, there were 0 completed actions, 19 continuing actions (either ongoing or modified), and 2 deleted actions.

Table 4.1 provides a summary of the action statuses for each jurisdiction:

Table 4.1. Action Status Summary

Jurisdiction	Completed Actions	Continuing Actions (ongoing or modify)	Deleted Actions
Madison County	0	6	1
Fredericktown	0	5	0
Fredericktown R-I	0	4	0
Marquand-Zion R-VI	0	4	1

Table 4.2 provides a summary of the completed and deleted actions from the previous plan.

Table 4.2. Summary of Completed and Deleted Actions from the Previous Plan

Completed Actions	Completion Details (date, amount, funding source)
Deleted Actions	**Reason for Deletion**
Madison Co: Seismically Retrofit Sheriff's Office	Cost ineffective
Marquand-Zion R-VI: Purchase comms equipment	Cost ineffective

Source: 2023 Madison County HMP; Data Collection Questionnaires

4.3 Implementation of Mitigation Actions

Jurisdictions were encouraged to meet with others in their community to finalize the actions to be submitted for the updated mitigation strategy. Throughout the HMPC consideration and discussion, emphasis was placed on the importance of a benefit-cost analysis in determining project priority. The Disaster Mitigation Act requires benefit-cost review as the primary method by which mitigation projects should be prioritized. The HMPC decided to pursue implementation according to when and where damage occurs, available funding, political will, and jurisdictional priority. The benefit/cost review at the planning stage primarily consisted of a qualitative analysis, and was not the detailed process required for grant funding applications. For each action, the plan sets forth a narrative describing the types of benefits that could be realized from action implementation. The cost was estimated as closely as possible, with further refinement to be supplied as project development occurs.

FEMA's STAPLEE methodology was used to assess the costs and benefits, overall feasibility of mitigation actions, and other issues impacting project. During the prioritization process, the HMPC used worksheets to assign scores. The worksheets posed questions based on the STAPLEE elements as well as the potential mitigation effectiveness of each action. Scores were based on the responses to the questions as follows:

Definitely yes = 3 points
Maybe yes = 2 points
Probably no = 1
Definitely no = 0

The following questions were asked for each proposed action.

S: Is the action socially acceptable?
T: Is the action technically feasible and potentially successful?
A: Does the jurisdiction have the administrative capability to successfully implement this action?
P: Is the action politically acceptable?
L: Does the jurisdiction have the legal authority to implement the action?
E: Is the action economically beneficial?
E: Will the project have an environmental impact that is either beneficial or neutral? (score "3" if positive and "2" if neutral)

Will the implemented action result in lives saved?
Will the implanted action result in a reduction of disaster damage?

A blank STAPLEE worksheet is shown in Figure 4.1

Figure 4.1. Blank Action Worksheet

STAPLEE Worksheet		
Name of Jurisdiction:		
Action or Project		
Action/Project Number:	Insert a unique action number for this action for future tracking purposes. This can be a combination of the jurisdiction name, followed by the goal number and action number (i.e. Joplin1.1)	
Name of Action or Project:		
Mitigation Category:	Prevention; Structure and Infrastructure Projects; Natural Systems Protection; Education and Outreach; Emergency Services	
STAPLEE Criteria **Evaluation Rating** Definitely YES = 3 Maybe YES = 2 Probably NO = 1 Definitely NO = 0		**Score**
S: Is it **Socially** Acceptable		
T: Is it **Technically** feasible and potentially successful?		
A: Does the jurisdiction have the **Administrative** capacity to execute this action?		
P: Is it **Politically** acceptable?		
L: Is there **Legal** authority to implement?		
E: Is it **Economically** beneficial?		
E: Will the project have either a neutral or positive impact on the natural **Environment**?		
Will historic structures be saved or protected?		
Could it be implemented quickly?		
STAPLEE SCORE		
Mitigation Effectiveness Criteria	**Evaluation Rating**	**Score**
Will the implemented action result in lives saved?	Assign from 5-10 points based on the likelihood that lives will be saved.	
Will the implemented action result in a reduction of disaster damages?	Assign from 5-10 points based on the relative reduction of disaster damages.	
MITIGATION EFFECTIVENESS SCORE		
TOTAL SCORE (STAPLEE + Mitigation Effectiveness)		

☐ **High Priority (30+ points)**	☐ **Medium Priority (25 - 29 points)**	☐ **Low Priority (<25 points)**

Completed by
(Name, Title, Phone Number) _____

Template Action Worksheet

Action Worksheet	
Name of Jurisdiction:	
Risk / Vulnerability	
Problem being Mitigated:	Provide a brief description of the problem that the action will address
Hazard(s) Addressed:	List the hazard or hazards that will be addressed by this action
Action or Project	
Action/Project Number:	Insert a unique action number for this action for future tracking purposes. This can be a combination of the jurisdiction name, followed by the goal number and action number (i.e. Joplin1.1)
Name of Action or Project:	
Action or Project Description:	Describe the action or project.
Applicable Goal Statement:	Choose the goal statement that applies to this action
Estimated Cost:	Provide an estimate of the cost to implement this action. This can be accomplished with a range of estimated costs.
Benefits:	Provide a narrative describing the losses that will be avoided by implementing this action. If dollar amounts of avoided losses are known, include them as well.
Plan for Implementation	
Responsible Organization/Department:	Which organization will be responsible for tracking this action? Be specific to include the specific department or position within a department.
Action/Project Priority:	Include the STAPLEE score and Priority (H, M, L)
Timeline for Completion:	How many months/years to complete.
Potential Fund Sources:	List specific funding sources that may be used to pay for the implementation of the action.
Local Planning Mechanisms to be Used in Implementation, if any:	
Progress Report	
Action Status	Indicate status as New, Continuing Not Started, or Continuing in Progress)
Report of Progress	For Continuing actions only, indicate the report on progress. If the action is not started, indicate any barriers encountered to initiate the action. If the action is in progress, indicate the activity that has occurred to date.

Figure 4.2. Madison County Actions

Action Worksheet	
Name of Jurisdiction:	Madison County
Risk / Vulnerability	
Problem being Mitigated:	Flood impacts to residents and businesses
Hazard(s) Addressed:	Flood
Action or Project	
Action/Project Number:	Madison 1.1
Name of Action or Project:	NFIP Participation
Mitigation Category:	Prevention
Action or Project Description:	Enforcement of floodplain management requirements, including regulating new construction in SFHAs; addressing requests for floodplain map updates.
Applicable Goal Statement:	Protect public and private property
Estimated Cost:	$60,000 per year
Benefits:	Eligibility for flood insurance for residents and businesses, technical assistance with flood mitigation planning
Plan for Implementation	
Responsible Organization/Department:	Emergency Management
Action/Project Priority:	30, H
Timeline for Completion:	Ongoing
Potential Fund Sources:	Local funds
Local Planning Mechanisms to be Used in Implementation, if any:	None
Progress Report	
Action Status	Continuing (ongoing)
Report of Progress	County is a participant in NFIP

Action Worksheet	
Name of Jurisdiction:	Madison County
Risk / Vulnerability	
Problem being Mitigated:	Earthquake Impacts
Hazard(s) Addressed:	Earthquake
Action or Project	
Action/Project Number:	Madison 2.1
Name of Action or Project:	Justice Center
Mitigation Category:	Structure and Infrastructure Projects
Action or Project Description:	Construct new Justice Center to current seismic standards
Applicable Goal Statement:	Ensure operation of critical facilities and services
Estimated Cost:	$2-$3 million
Benefits:	Maintain operability of critical facility after an earthquake
Plan for Implementation	
Responsible Organization/Department:	Sheriffs Department
Action/Project Priority:	31, H
Timeline for Completion:	5 years
Potential Fund Sources:	Local funds, Federal grants (USDA, CDBG, etc.)
Local Planning Mechanisms to be Used in Implementation, if any:	None
Progress Report	
Action Status	New
Report of Progress	N/A

Action Worksheet	
Name of Jurisdiction:	Madison County
Risk / Vulnerability	
Problem being Mitigated:	Power outages
Hazard(s) Addressed:	Earthquake, Severe Thunderstorm, Severe Winter Weather, Tornado
Action or Project	
Action/Project Number:	Madison 3.1
Name of Action or Project:	Purchase emergency generators
Mitigation Category:	Emergency Services
Action or Project Description:	Purchase emergency generators for critical facilities, including courthouse and sheriff's office
Applicable Goal Statement:	Ensure operation of critical facilities and services
Estimated Cost:	$100,000-$200,000
Benefits:	Continued operation of critical facilities and services during and after hazard event
Plan for Implementation	
Responsible Organization/Department:	Emergency Management
Action/Project Priority:	26, M
Timeline for Completion:	5 years
Potential Fund Sources:	Local funds, Federal grants
Local Planning Mechanisms to be Used in Implementation, if any:	None
Progress Report	
Action Status	Continuing (not started)
Report of Progress	

Action Worksheet	
Name of Jurisdiction:	Madison County
Risk / Vulnerability	
Problem being Mitigated:	Loss of life due to hazard events
Hazard(s) Addressed:	Tornado, Severe Thunderstorms, Extreme Heat, Extreme Cold
Action or Project	
Action/Project Number:	Madison 4.1
Name of Action or Project:	Safe room
Mitigation Category:	Structure and Infrastructure Projects
Action or Project Description:	Construct safe room
Applicable Goal Statement:	Protect health, safety, and welfare of residents and students
Estimated Cost:	$2,000,000-$4,000,000
Benefits:	Reduce or eliminate loss of life and injuries resulting from hazard events
Plan for Implementation	
Responsible Organization/Department:	County Commission
Action/Project Priority:	33, H
Timeline for Completion:	5 years
Potential Fund Sources:	Local funds, Federal Grants
Local Planning Mechanisms to be Used in Implementation, if any:	None
Progress Report	
Action Status	Continuing (not started)
Report of Progress	

Action Worksheet	
Name of Jurisdiction:	Madison County
Risk / Vulnerability	
Problem being Mitigated:	Loss of life due to hazard events
Hazard(s) Addressed:	Tornado
Action or Project	
Action/Project Number:	Madison 5.1
Name of Action or Project:	Early Warning Sirens
Mitigation Category:	Emergency Services
Action or Project Description:	Install early warning sirens at key locations to alert residents about active tornado threats
Applicable Goal Statement:	Protect health, safety, and welfare of residents and students
Estimated Cost:	$500,000-$1,000,000
Benefits:	Reduce or eliminate loss of life and injuries resulting from hazard events
Plan for Implementation	
Responsible Organization/Department:	County Commission, EMD
Action/Project Priority:	32, H
Timeline for Completion:	3 years
Potential Fund Sources:	Local funds, Federal Grants
Local Planning Mechanisms to be Used in Implementation, if any:	None
Progress Report	
Action Status	Continuing (not started)
Report of Progress	

Action Worksheet	
Name of Jurisdiction:	Madison County
Risk / Vulnerability	
Problem being Mitigated:	Transportation network failure
Hazard(s) Addressed:	Flooding, earthquake
Action or Project	
Action/Project Number:	Madison 6.1
Name of Action or Project:	Bridge or Low Water Crossing Replacement
Mitigation Category:	Structure and Infrastructure Projects
Action or Project Description:	Replace flood prone or seismically unfit bridge/low water crossing
Applicable Goal Statement:	Ensure the operation of critical facilities and services
Estimated Cost:	$500,000-$1,000,000
Benefits:	Maintain emergency services access to areas of county
Plan for Implementation	
Responsible Organization/Department:	Road & Bridge
Action/Project Priority:	30, H
Timeline for Completion:	4 years
Potential Fund Sources:	Local funds, State Grants, Federal Grants
Local Planning Mechanisms to be Used in Implementation, if any:	None
Progress Report	
Action Status	New
Report of Progress	

Figure 4.3. Fredericktown Actions

Action Worksheet	
Name of Jurisdiction:	Fredericktown
Risk / Vulnerability	
Problem being Mitigated:	Flood impacts to residents and businesses
Hazard(s) Addressed:	Flood
Action or Project	
Action/Project Number:	Fredericktown 1.1
Name of Action or Project:	NFIP Participation
Mitigation Category:	Prevention
Action or Project Description:	Enforcement of floodplain management requirements, including regulating new construction in SFHAs; addressing requests for floodplain map updates.
Applicable Goal Statement:	Protect public and private property
Estimated Cost:	$60,000 per year
Benefits:	Eligibility for flood insurance for residents and businesses, technical assistance with flood mitigation planning
Plan for Implementation	
Responsible Organization/Department:	City administrator
Action/Project Priority:	32, H
Timeline for Completion:	Ongoing
Potential Fund Sources:	Local funds
Local Planning Mechanisms to be Used in Implementation, if any:	None
Progress Report	
Action Status	Continuing (ongoing)
Report of Progress	City is a participant in NFIP

Action Worksheet	
Name of Jurisdiction:	Fredericktown
Risk / Vulnerability	
Problem being Mitigated:	Transportation network failure
Hazard(s) Addressed:	Flood, Earthquake
Action or Project	
Action/Project Number:	Fredericktown 2.1
Name of Action or Project:	Bridge or Low Water Crossing Replacement
Mitigation Category:	Structure and Infrastructure Projects
Action or Project Description:	Replace flood prone or seismically unfit bridge/low water crossing
Applicable Goal Statement:	Protect health, safety, and welfare of residents and students
Estimated Cost:	$250,000-$1,000,000
Benefits:	Maintain emergency services access to areas of city
Plan for Implementation	
Responsible Organization/Department:	Public Works
Action/Project Priority:	20, L
Timeline for Completion:	5 years
Potential Fund Sources:	Local funds, State Grants, Federal Grants
Local Planning Mechanisms to be Used in Implementation, if any:	Comprehensive plan
Progress Report	
Action Status	Continuing (modified)
Report of Progress	

Action Worksheet	
Name of Jurisdiction:	Fredericktown
Risk / Vulnerability	
Problem being Mitigated:	Loss of life due to hazard events
Hazard(s) Addressed:	Tornado, Severe Thunderstorms, Extreme Heat, Extreme Cold
Action or Project	
Action/Project Number:	Fredericktown 3.1
Name of Action or Project:	Safe room
Mitigation Category:	Structure and Infrastructure Projects
Action or Project Description:	Construct safe room
Applicable Goal Statement:	Protect health, safety, and welfare of residents and students
Estimated Cost:	$2,000,000-$4,000,000
Benefits:	Reduce or eliminate loss of life and injuries resulting from hazard events
Plan for Implementation	
Responsible Organization/Department:	City administrator
Action/Project Priority:	25, M
Timeline for Completion:	5 years
Potential Fund Sources:	Local funds, Federal Grants
Local Planning Mechanisms to be Used in Implementation, if any:	None
Progress Report	
Action Status	Continuing (not started)
Report of Progress	

Action Worksheet	
Name of Jurisdiction:	Fredericktown
Risk / Vulnerability	
Problem being Mitigated:	Loss of life due to hazard events
Hazard(s) Addressed:	Tornado
Action or Project	
Action/Project Number:	Fredericktown 4.1
Name of Action or Project:	Early Warning Sirens
Mitigation Category:	Emergency Services
Action or Project Description:	Install early warning sirens at key locations to alert residents about active tornado threats
Applicable Goal Statement:	Protect health, safety, and welfare of residents and students
Estimated Cost:	$500,000-$1,000,000
Benefits:	Reduce or eliminate loss of life and injuries resulting from hazard events
Plan for Implementation	
Responsible Organization/Department:	City Administrator
Action/Project Priority:	30, H
Timeline for Completion:	5 years
Potential Fund Sources:	Local funds, Federal Grants
Local Planning Mechanisms to be Used in Implementation, if any:	None
Progress Report	
Action Status	Continuing (not started)
Report of Progress	

Action Worksheet	
Name of Jurisdiction:	Fredericktown
Risk / Vulnerability	
Problem being Mitigated:	Power outages
Hazard(s) Addressed:	Earthquake, Severe Thunderstorm, Severe Winter Weather, Tornado
Action or Project	
Action/Project Number:	Fredericktown 5.1
Name of Action or Project:	Purchase emergency generators
Mitigation Category:	Emergency Services
Action or Project Description:	Purchase emergency generators for critical facilities, including City Hall and police station
Applicable Goal Statement:	Ensure operation of critical facilities and services
Estimated Cost:	$50,000-$250,000
Benefits:	Continued operation of critical facilities and services during and after hazard event
Plan for Implementation	
Responsible Organization/Department:	Emergency Management
Action/Project Priority:	27, M
Timeline for Completion:	5 years
Potential Fund Sources:	Local funds, Federal grants
Local Planning Mechanisms to be Used in Implementation, if any:	None
Progress Report	
Action Status	New
Report of Progress	

Figure 4.4. Fredericktown R-I School District Actions

Action Worksheet	
Name of Jurisdiction:	Fredericktown R-I School District
Risk / Vulnerability	
Problem being Mitigated:	Damage to buildings
Hazard(s) Addressed:	Earthquake
Action or Project	
Action/Project Number:	Fredericktown R-I 1.1
Name of Action or Project:	Seismically retrofit priority building
Mitigation Category:	Structure and Infrastructure Projects
Action or Project Description:	Seismically retrofit building ranking highest in priority based on impacts, cost, and timeline
Applicable Goal Statement:	Protect health, safety, and welfare of residents and students
Estimated Cost:	$2,000,000-$10,000,000
Benefits:	Reduce damage to, or failure of, school facilities
Plan for Implementation	
Responsible Organization/Department:	Facilities manager
Action/Project Priority:	21, L
Timeline for Completion:	5 years
Potential Fund Sources:	Local funds, Federal Grants
Local Planning Mechanisms to be Used in Implementation, if any:	None
Progress Report	
Action Status	Continuing (not started)
Report of Progress	

Action Worksheet	
Name of Jurisdiction:	Fredericktown R-I School District
Risk / Vulnerability	
Problem being Mitigated:	Power outages
Hazard(s) Addressed:	Earthquake, Severe Thunderstorms, Severe Winter Weather, Tornado
Action or Project	
Action/Project Number:	Fredericktown R-I 2.1
Name of Action or Project:	Purchase Emergency Generators
Mitigation Category:	Emergency Services
Action or Project Description:	Purchase emergency generators to keep critical facilities functional during and after event
Applicable Goal Statement:	Ensure operation of critical facilities and services
Estimated Cost:	$50,000-$100,000
Benefits:	Keep facilities and services operational
Plan for Implementation	
Responsible Organization/Department:	Facilities manager
Action/Project Priority:	30, H
Timeline for Completion:	5 years
Potential Fund Sources:	Local funds, Federal Grants
Local Planning Mechanisms to be Used in Implementation, if any:	None
Progress Report	
Action Status	Continuing (not started)
Report of Progress	

Action Worksheet	
Name of Jurisdiction:	Fredericktown R-I School District
Risk / Vulnerability	
Problem being Mitigated:	Flooding due to stream obstruction
Hazard(s) Addressed:	Flood
Action or Project	
Action/Project Number:	Fredericktown R-I 3.1
Name of Action or Project:	Stream maintenance
Mitigation Category:	Natural System Protection
Action or Project Description:	Keep stream clear of obstructions
Applicable Goal Statement:	Protect public and private property
Estimated Cost:	$5,000-$25,000
Benefits:	Reduce risk of flooding
Plan for Implementation	
Responsible Organization/Department:	Facilities manager
Action/Project Priority:	25, M
Timeline for Completion:	Ongoing
Potential Fund Sources:	Local funds
Local Planning Mechanisms to be Used in Implementation, if any:	None
Progress Report	
Action Status	Continuing (ongoing)
Report of Progress	Stream serviced annually

Action Worksheet	
Name of Jurisdiction:	Fredericktown R-I School District
Risk / Vulnerability	
Problem being Mitigated:	Loss of life due to hazard events
Hazard(s) Addressed:	Tornado, Severe Thunderstorms, Extreme Heat, Extreme Cold
Action or Project	
Action/Project Number:	Fredericktown R-I 4.1
Name of Action or Project:	Safe room
Mitigation Category:	Structure and Infrastructure Projects
Action or Project Description:	Construct safe room
Applicable Goal Statement:	Protect health, safety, and welfare of residents and students
Estimated Cost:	$3,000,000-$5,000,000
Benefits:	Reduce or eliminate loss of life and injuries resulting from hazard events
Plan for Implementation	
Responsible Organization/Department:	Facilities manager
Action/Project Priority:	29, M
Timeline for Completion:	5 years
Potential Fund Sources:	Local funds, Federal Grants
Local Planning Mechanisms to be Used in Implementation, if any:	None
Progress Report	
Action Status	New
Report of Progress	

Figure 4.5. Marquand-Zion R-VI School District Actions

Action Worksheet	
Name of Jurisdiction:	Marquand-Zion R-VI School District
Risk / Vulnerability	
Problem being Mitigated:	Power outages
Hazard(s) Addressed:	Severe Thunderstorms, Severe Winter Weather, Tornado
Action or Project	
Action/Project Number:	Marquand-Zion R-VI 1.1
Name of Action or Project:	Bury Powerlines
Mitigation Category:	Structure and Infrastructure Projects
Action or Project Description:	Bury powerlines and other cables which currently run over building and walkways
Applicable Goal Statement:	Protect public and private property
Estimated Cost:	$50,000-$250,000
Benefits:	Reduce risk of line failures and maintenance needs
Plan for Implementation	
Responsible Organization/Department:	Facilities manager
Action/Project Priority:	38, H
Timeline for Completion:	2 years
Potential Fund Sources:	Local funds
Local Planning Mechanisms to be Used in Implementation, if any:	None
Progress Report	
Action Status	Continuing (not started)
Report of Progress	

Action Worksheet	
Name of Jurisdiction:	Marquand-Zion R-VI School District
Risk / Vulnerability	
Hazard(s) Addressed:	Earthquake, Tornado, Severe Thunderstorms, Severe Winter Weather, Extreme Heat
Problem being Mitigated:	Power outages
Action or Project	
Applicable Goal Statement:	Ensure operation of critical facilities and services
Action/Project Number:	Marquand-Zion R-VI 2.1
Name of Action or Project:	Emergency Generators
Mitigation Category:	Emergency services
Action or Project Description:	Purchase emergency.
Estimated Cost:	$50,000-$200,000
Benefits:	Keep facilities and services operational. Provide needed lights, AC, and Heat
Plan for Implementation	
Responsible Organization/Department:	Facilities manager
Supporting Organization/Department:	Maintenance department
Action/Project Priority:	40, H
Timeline for Completion:	12 months
Potential Fund Sources:	Local funds, Federal grants, State grants
Local Planning Mechanisms to be Used in Implementation, if any:	None
Progress Report	
Action Status:	New
Report of Progress:	

Action Worksheet	
Name of Jurisdiction:	Marquand-Zion R-VI School District
Risk / Vulnerability	
Hazard(s) Addressed:	Severe Thunderstorms, Tornado
Problem being Mitigated:	Alert community and school to an approaching hazard
Action or Project	
Applicable Goal Statement:	Protect health, safety, and welfare of residents and students
Action/Project Number:	Marquand-Zion R-VI 3.1
Name of Action or Project:	Early Warning Sirens
Mitigation Category:	Emergency Services
Action or Project Description:	Purchase & install early warning sirens
Estimated Cost:	$50,000-$175,000
Benefits:	Alert community and school to an approaching hazard
Plan for Implementation	
Responsible Organization/Department:	Facilities manager
Supporting Organization/Department:	Maintenance department
Action/Project Priority:	42, H
Timeline for Completion:	6 months
Potential Fund Sources:	Local funds, Federal grants, State grants
Local Planning Mechanisms to be Used in Implementation, if any:	None
Progress Report	
Action Status:	New
Report of Progress:	

Action Worksheet	
Name of Jurisdiction:	Marquand-Zion R-VI School District
Risk / Vulnerability	
Problem being Mitigated:	Loss of life due to hazard events
Hazard(s) Addressed:	Tornado, Severe Thunderstorms, Extreme Heat, Extreme Cold
Action or Project	
Action/Project Number:	Marquand-Zion R-VI 4.1
Name of Action or Project:	Safe room
Mitigation Category:	Structure and Infrastructure Projects
Action or Project Description:	Construct safe room
Applicable Goal Statement:	Protect health, safety, and welfare of residents and students
Estimated Cost:	$2,500,000-$5,000,000
Benefits:	Reduce or eliminate loss of life and injuries resulting from hazard events
Plan for Implementation	
Responsible Organization/Department:	Facilities manager
Action/Project Priority:	27, M
Timeline for Completion:	5 years
Potential Fund Sources:	Local funds, Federal Grants
Local Planning Mechanisms to be Used in Implementation, if any:	None
Progress Report	
Action Status	New
Report of Progress	

Table 4.3. Mitigation Action Matrix

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
	Prevention							
1.1	NFIP Participation	Madison	H	3	F	Y	Y	Y
1.1	NFIP Participation	Fredericktown	H	3	F	Y	Y	Y
	Structure and Infrastructure Projects							
2.1	Justice Center	Madison	H	2	E	Y	Y	
4.1	Safe Room	Madison	H	1	T, ST, EH, EC	Y	Y	
6.1	Bridge or Low Water Crossing Replacement	Madison	H	2	F, E	Y	Y	
2.1	Bridge or Low Water Crossing Replacement	Fredericktown	L	2	F, E	Y	Y	
3.1	Safe Room	Fredericktown	M	1	T, ST, EH, EC	Y	Y	
1.1	Seismically Retrofit Priority Building	F R-I	L	3	E	Y	N	
4.1	Safe Room	F R-I	M	1	T, ST, EH, EC	Y	Y	
1.1	Bury Powerlines	M-Z R-VI	H	2	ST, SWW, T	Y	N	
4.1	Safe Room	M-Z R-VI	M	1	T, ST, EH, EC	Y	Y	
	Natural Systems Protection							
3.1	Stream Maintenance	F R-I	M	1	F	Y	Y	
	Emergency Services							
3.1	Purchase Emergency Generators	Madison	M	2	E, ST, SWW, T	Y	Y	
5.1	Early Warning Sirens	Madison	H	1	T	Y	Y	
4.1	Early Warning Sirens	Fredericktown	H	1	T	Y	Y	
5.1	Purchase Emergency Generators	Fredericktown	M	2	E, ST, SWW, T	Y	Y	
2.1	Purchase Emergency Generators	F R-I	H	2	E, ST, SWW, T	Y	Y	
2.1	Purchase Emergency Generators	M-Z R-VI	H	2	E, ST, SWW, T	Y	Y	
3.1	Early Warning Sirens	M-Z R-VI	H	1	T	Y	Y	
	Education and Outreach							

5 PLAN MAINTENANCE PROCESS

5 PLAN MAINTENANCE PROCESS 1

5.1 Monitoring, Evaluating, and Updating the Plan 1

5.1.1 Responsibility for Plan Maintenance 1

5.1.2 Plan Maintenance Schedule 1

5.1.3 Plan Maintenance Process 1

5.2 Incorporation into Existing Planning Mechanisms 2

5.3 Continued Public Involvement 5

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

5.1 Monitoring, Evaluating, and Updating the Plan

5.1.1 Responsibility for Plan Maintenance

The MPC is an advisory body and can only make recommendations to county, city, town, or district elected officials. Its primary duty is to see the plan successfully carried out and to report to the community governing boards and the public on the status of plan implementation and mitigation opportunities. Other duties include reviewing and promoting mitigation proposals, hearing stakeholder concerns about hazard mitigation, passing concerns on to appropriate entities, and posting relevant information in areas accessible to the public.

5.1.2 Plan Maintenance Schedule

The MPC agrees to meet annually and after a state or federally declared hazard event as appropriate to monitor progress and update the mitigation strategy. The Madison County Emergency Management Director will be responsible for initiating the plan reviews and will invite members of the MPC (or other designated responsible entity) to the meeting.

In coordination with all participating jurisdictions, a five-year written update of the plan will be submitted to the Missouri State Emergency Management Agency (SEMA) and FEMA Region VII per Requirement §201.6(c)(4)(i) of the Disaster Mitigation Act of 2000, unless disaster or other circumstances (e.g., changing regulations) require a change to this schedule.

5.1.3 Plan Maintenance Process

Progress on the proposed actions can be monitored by evaluating changes in vulnerabilities identified in the plan. The MPC, during the annual meeting, should review changes in vulnerability identified as follows:

- Decreased vulnerability as a result of implementing recommended actions,
- Increased vulnerability as a result of failed or ineffective mitigation actions,
- Increased vulnerability due to hazard events, and/or

- Increased vulnerability as a result of new development (and/or annexation).

Future 5-year updates to this plan will include the following activities:

- Consideration of changes in vulnerability due to action implementation,
- Documentation of success stories where mitigation efforts have proven effective,
- Documentation of unsuccessful mitigation actions and why the actions were not effective,
- Documentation of previously overlooked hazard events that may have occurred since the previous plan approval,
- Incorporation of new data or studies with information on hazard risks,
- Incorporation of new capabilities or changes in capabilities,
- Incorporation of growth data and changes to inventories, and
- Incorporation of ideas for new actions and changes in action prioritization.

In order to best evaluate any changes in vulnerability as a result of plan implementation, the participating jurisdictions will adopt the following process:

- Each proposed action in the plan identified an individual, office, or agency responsible for action implementation. This entity will track and report on an annual basis to the jurisdictional MPC member on action status. The entity will provide input on whether the action as implemented meets the defined objectives and is likely to be successful in reducing risk.
- If the action does not meet identified objectives, the jurisdictional MPC member will determine necessary remedial action, making any required modifications to the plan.

Changes will be made to the plan to remedy actions that have failed or are not considered feasible. Feasibility will be determined after a review of action consistency with established criteria, time frame, community priorities, and/or funding resources. Actions that were not ranked high but were identified as potential mitigation activities will be reviewed as well during the monitoring of this plan. Updating of the plan will be accomplished by written changes and submissions, as the MPC deems appropriate and necessary. Changes will be approved by the Madison County Commission and the governing boards of the other participating jurisdictions.

5.2 Incorporation into Existing Planning Mechanisms

Where possible, plan participants, including school and special districts, will use existing plans and/or programs to implement hazard mitigation actions. Those existing plans and programs were described in Section 2 of this plan. Based on the capability assessments of the participating jurisdictions, communities in Madison County will continue to plan and implement programs to reduce losses to life and property from hazards. This plan builds upon the momentum developed through previous and related planning efforts and mitigation programs and recommends implementing actions, where possible, through the following plans:

- General or master plans of participating jurisdictions;
- Ordinances of participating jurisdictions;
- Madison County Emergency Operations Plan;
- Capital improvement plans and budgets;
- Other community plans within the County, such as water conservation plans, storm water management plans, and parks and recreation plans;
- School and Special District Plans and budgets; and

- Other plans and policies outlined in the capability assessment sections for each jurisdiction in Chapter 2 of this plan.

The MPC members involved in updating these existing planning mechanisms will be responsible for integrating the findings and actions of the mitigation plan, as appropriate. The MPC is also responsible for monitoring this integration and incorporation of the appropriate information into the five-year update of the multi-jurisdictional hazard mitigation plan.

Additionally, after the annual review of the Hazard Mitigation Plan, the Madison County Emergency Management Director will provide the updated Mitigation Strategy with current status of each mitigation action to the County Commission as well as all Mayors, City Clerks, and School District Superintendents. The Emergency Manager Director will request that the mitigation strategy be incorporated, where appropriate, in other planning mechanisms.

Table 5.1 below lists the planning mechanisms by jurisdiction into which the Hazard Mitigation Plan will be integrated.

Table 5.1. Planning Mechanisms Identified for Integration of Hazard Mitigation Plan

Jurisdiction	Planning Mechanisms	Integration Process for Previous Plan	Integration Process for Current Plan
Madison County	County Emergency Operations Plan	County officials identified actions relating to emergency operations that were included in the update to the EOP	County officials identified new or ongoing actions relating to emergency operations that will be included in the next update to the EOP
Madison County	Capital Improvement Plan	County officials identified actions relating to capital and infrastructure projects that were included in the update to the CIP	County officials identified new or ongoing actions relating to future development that will be included in the next CIP update
Fredericktown	Comprehensive Plan	City officials identified actions relating to various projects and policies that were included in the update to the Comprehensive Plan	City officials identified new or ongoing actions relating to future development that will be included in the next Comprehensive Plan update
Fredericktown	Capital Improvement Plan	City officials identified actions relating to capital and infrastructure projects that were included in the update to the CIP	City officials identified new or ongoing actions relating to future development that will be included in the next CIP update

Fredericktown	Land Use Plan	City officials identified actions relating development that were included in the update to the Land Use Plan	City officials identified new or ongoing actions relating to future development that will be included in the next Land Use Plan update
Fredericktown	Transportation Plan	City officials identified actions relating transportation projects that were included in the update to the Transportation Plan	City officials identified new or ongoing actions relating to future development that will be included in the next Transportation Plan update
Fredericktown R-I School Dist.	Master Plan	School representatives identified actions relating to future development that were included in the Master Plan update	School representatives identified new or ongoing actions relating to future development that will be included in the next Master Plan update
Fredericktown R-I School Dist.	Capital Improvement Program	School representatives identified actions relating to infrastructure that were included in annual update to CIP	School representatives identified new actions or ongoing actions relating to infrastructure that will be included in annual update to CIP
Fredericktown R-I School Dist.	School Emergency Plan	School representatives identified actions relating to emergency procedures that were included in previous update to Emergency Plan	School representatives identified new actions or ongoing actions relating to emergency procedures that will be included in the next update to the Emergency Plan
Marquand-Zion R-VI School Dist.	Master Plan	School representatives identified actions relating to future development that were included in the Master Plan update	School representatives identified new or ongoing actions relating to future development that will be included in the next Master Plan update
Marquand-Zion R-VI School Dist.	Capital Improvement Program	School representatives identified actions relating to infrastructure that were included in annual update to CIP	School representatives identified new actions or ongoing actions relating to infrastructure that will be included in annual update to CIP
Marquand-Zion R-VI School Dist.	School Emergency Plan	School representatives identified actions	School representatives identified new actions or

		relating to emergency procedures that were included in previous update to Emergency Plan	ongoing actions relating to emergency procedures that will be included in the next update to the Emergency Plan

5.3 Continued Public Involvement

The hazard mitigation plan update process provides an opportunity to publicize success stories resulting from the plan's implementation and seek additional public comment. Information about the annual reviews will be posted in the local newspaper as well as on the Madison County website following each annual review of the mitigation plan. When the MPC reconvenes for the five-year update, it will coordinate with all stakeholders participating in the planning process. Included in this group will be those who joined the MPC after the initial effort, to update and revise the plan. Public notice will be posted and public participation will be actively solicited, at a minimum, through available website postings and press releases to local media outlets, primarily newspapers.

APPENDIX A: ADOPTION RESOLUTIONS

APPENDIX A: ADOPTION RESOLUTIONS.....1

1.1 Adoption Resolutions 1

1.1 Adoption Resolutions

COUNTY COMMISSION
MADISON COUNTY, MISSOURI

RESOLUTION (01-2022)

MADISON COUNTY, MISSOURI RESOLUTION 2022-01_____

A RESOLUTION OF THE MADISON COUNTY MISSOURI COMMISSION ADOPTING THE MADISON COUNTY HAZARD MITIGATION PLAN

WHEREAS the Madison County, Missouri Commission recognizes the threat that natural hazards pose to people and property within the (local governing body/school district); and

WHEREAS the Madison Countyi Commission has participated in the preparation of a multi-jurisdictional local hazard mitigation plan, hereby known as the Madison County All-Hazard Mitigation Plan hereafter referred to as the *Plan*, in accordance with the Disaster Mitigation Act of 2000; and

WHEREAS the *Plan* identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in the Madison County, Missouri from the impacts of future hazards and disasters; and

WHEREAS the Madison County, Missouri Commission recognizes that land use policies have a major impact on whether people and property are exposed to natural hazards, the Madison County Commission will endeavor to integrate the *Plan* into the comprehensive planning process; and

WHEREAS adoption by the Madison County Commission demonstrates their commitment to hazard mitigation and achieving the goals outlined in the *Plan*.

NOW THEREFORE, BE IT RESOLVED BY THE MADISON COUNTY COMMISSION, in the State of Missouri, THAT:

In accordance with the Madison County Commission adopts the final *FEMA-approved Madison County Multi-Jurisdictional Hazard Mitigation Plan*.

ADOPTED by a vote of 3 in favor and 0 against, and 0 abstaining, this 5th day of DECEMBER, 2022.

By _____
Print name: JASON GREEN

ATTEST:
By: _____

Print name: DONAL E. FIREBAUGH

APPROVED AS TO FORM:

By _____
Print name: M. DWIGHT ROBBINS

MADISON COUNTY, MO CLERK OF THE COUNTY COMMISSION SEAL

Resolution

City of Fredericktown, Missouri RESOLUTION NO. 22-14

A RESOLUTION OF THE CITY OF FREDERICKTOWN ADOPTING THE *MADISON COUNTY HAZARD MITIGATION PLAN (HMP)*

WHEREAS the City of Fredericktown recognizes the threat that natural hazards pose to people and property within the City of Fredericktown; and

WHEREAS the City of Fredericktown has participated in the preparation of a multi-jurisdictional local hazard mitigation plan, hereby known as the Madison County Hazard Mitigation Plan (HMP), hereafter referred to as the *Plan*, in accordance with the Disaster Mitigation Act of 2000; and

WHEREAS the *Plan* identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in the *City of Fredericktown* from the impacts of future hazards and disasters; and

WHEREAS the City of Fredericktown recognizes that land use policies have a major impact on whether people and property are exposed to natural hazards, the City of Fredericktown will endeavor to integrate the *Plan* into the comprehensive planning process; and

WHEREAS adoption by the City of Fredericktown demonstrates their commitment to hazard mitigation and achieving the goals outlined in the *Plan*.

NOW THEREFORE, BE IT RESOLVED BY THE CITY OF FREDERICKTOWN, in the State of Missouri, THAT:

The City of Fredericktown adopts the final *FEMA-approved Madison County Multi-Jurisdictional Hazard Mitigation Plan*.

1 absent

ADOPTED by a vote of 5 in favor and __against, and __abstaining, this 28 day of November, 2022.

By (Sig): _____

Print name: Travis Parker

ATTEST:

By (Sig.): Theresa Harbison

Print name: Theresa Harbison

APPROVED AS TO FORM:

By (Sig.): _____

Print name: _____

Board Resolution

(*Fredericktown School District R-I*), Missouri RESOLUTION NO.1

A RESOLUTION OF THE (*Fredericktown School District R-I*) ADOPTING THE (*Madison County Multi-Jurisdictional Hazard Mitigation Plan*)

WHEREAS the (*Fredericktown School District R-I*) recognizes the threat that natural hazards pose to people and property within the (Fredericktown School District R-I); and

WHEREAS the (*Fredericktown School District R-I*) has participated in the preparation of a multi-jurisdictional local hazard mitigation plan, hereby known as the (*Madison County Multi-Jurisdictional Hazard Mitigation Plan*), hereafter referred to as the *Plan*, in accordance with the Disaster Mitigation Act of 2000; and

WHEREAS the *Plan* identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in the *(Fredericktown School District R-I)* from the impacts of future hazards and disasters; and

WHEREAS the (*Fredericktown School District R-I*) recognizes that land use policies have a major impact on whether people and property are exposed to natural hazards, the (Fredericktown School District R-I) will endeavor to integrate the *Plan* into the comprehensive planning process; and

WHEREAS adoption by the (*Fredericktown School District R-I*) demonstrates their commitment to hazard mitigation and achieving the goals outlined in the *Plan*.

NOW THEREFORE, BE IT RESOLVED BY THE (*FREDERICKTOWN SCHOOL DISTRICT R-I*), in the State of Missouri, THAT:

In accordance with (*local rule for adopting resolutions*), the (*Fredericktown School District R-I*) adopts the final *FEMA-approved Madison County Multi-Jurisdictional Hazard Mitigation Plan.*

ADOPTED by a vote of 7 in favor and 0 against, and 0 abstaining, this 15th day November, 2022.

By (Sig): Richard Allgier
Print name: Richard Allgier

ATTEST:
By (Sig.): Judith Graham
Print name: Judith Graham

APPROVED AS TO FORM:
By (Sig.): Chadd Starkey
Print name: Chadd Starkey

MARQUAND-ZION SCHOOL DISTRICT, Missouri RESOLUTION NO. 12

A RESOLUTION OF THE MARQUAND-ZION S*CHOOL DISTRICT* ADOPTING THE Madison County Mitigation Plan.

WHEREAS the *Marquand-Zion school district* recognizes the threat that natural hazards pose to people and property within the (Marquand-Zion school district); and

WHEREAS the *Marquand-Zion school district* has participated in the preparation of a multi-jurisdictional local hazard mitigation plan, hereby known as the Madison County Mitigation Plan, hereafter referred to as the *Plan*, in accordance with the Disaster Mitigation Act of 2000; and

WHEREAS the *Plan* identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in the *Marquand-Zion school district* from the impacts of future hazards and disasters; and

WHEREAS the Marquand-Zion Board of Education recognizes that land use policies have a major impact on whether people and property are exposed to natural hazards, the Marquand-Zion *school district* will endeavor to integrate the *Plan* into the comprehensive planning process; and

WHEREAS adoption by the Marquand-Zion *school district* demonstrates their commitment to hazard mitigation and achieving the goals outlined in the *Plan*.

NOW THEREFORE, BE IT RESOLVED BY THE MARQUAND-ZION *SCHOOL DISTRICT*), in the State of Missouri, THAT:

In accordance with Marquand-Zion Board of Education Policies, the Marquand-Zion *school district* adopts the final *FEMA-approved Madison County Multi-Jurisdictional Hazard Mitigation Plan*.

ADOPTED by a vote of 5 in favor and 0 against, and 0 abstaining, this 17th day of November, 2022

By (Sig): Steven D Stroup
Print name: STEVEN D. STROUP

ATTEST:
By (Sig.): Leslie Stafford
Print name: LESLIE Stafford

APPROVED AS TO FORM: Scott Blake
By (Sig.):
Print name: Scott Blake

APPENDIX B: MEETING AND NOTICE MATERIALS

APPENDIX B: MEETING AND NOTICE MATERIALS 1
1.1 Meeting and Notice Materials 1

1.1 Meeting and Notice Materials

PUBLIC NOTICE

Madison County and Participating Jurisdictions, along with the Southeast Missouri Regional Planning Commission (SEMO RPC), are **seeking public input** for the **2023 Madison County Hazard Mitigation Plan**.

To provide input, complete a short survey to help the jurisdictions plan their mitigation strategies.

https://www.surveymonkey.com/r/RCTTNJ8

Public participation is encouraged to help develop the best plan possible. The draft plan can be found at: http://www.semorpc.org/hazard_mitigation_planning.html
For more information or to provide comments or feedback on the draft, please contact:

Drew Christian
Deputy Director
Southeast Missouri Regional Planning Commission
1 W. St. Joseph Street
P.O. Box 366 Perryville, MO 63775
Phone: 573-547-8357 ext 315
Fax: 573-547-7283
dchristian@semorpc.org
www.semorpc.org

PUBLIC NOTICE

Madison County and Participating Jurisdictions, along with the Southeast Missouri Regional Planning Commission (SEMO RPC), are holding a **Hazard Mitigation Planning Committee meeting** for the **2023 Madison County Hazard Mitigation Plan** on

Tuesday, March 16th, 2021 at 1:30 p.m. at the Black River Electric Office 2600 US-67, Fredericktown, MO 63645.

This meeting is open to the public.

Public participation is encouraged to help develop the best plan possible. The draft plan can be found at: http://www.semorpc.org/hazard_mitigation_planning.html
For more information or to provide comments or feedback on the draft, please contact:

Drew Christian
Director of Planning
Southeast Missouri Regional Planning Commission
1 W. St. Joseph Street
P.O. Box 366 Perryville, MO 63775
Phone: 573-547-8357 ext 315
Fax: 573-547-7283
dchristian@semorpc.org
www.semorpc.org

PUBLIC NOTICE

Madison County and Participating Jurisdictions, along with the Southeast Missouri Regional Planning Commission (SEMO RPC), are holding a **Hazard Mitigation Planning Committee meeting** for the **2023 Madison County Hazard Mitigation Plan** on

Tuesday, March 30th, 2021 at 1:30 p.m. at the Black River Electric Office 2600 US-67, Fredericktown, MO 63645.

This meeting is open to the public.

Public participation is encouraged to help develop the best plan possible. The draft plan can be found at: http://www.semorpc.org/hazard_mitigation_planning.html
For more information or to provide comments or feedback on the draft, please contact:

Drew Christian
Director of Planning
Southeast Missouri Regional Planning Commission
1 W. St. Joseph Street
P.O. Box 366 Perryville, MO 63775
Phone: 573-547-8357 ext 315
Fax: 573-547-7283
dchristian@semorpc.org
www.semorpc.org

PUBLIC NOTICE

Madison County and Participating Jurisdictions, along with the Southeast Missouri Regional Planning Commission (SEMO RPC), are holding a **Hazard Mitigation Planning Committee meeting** for the **2023 Madison County Hazard Mitigation Plan** on

Tuesday, April 20th, 2021 at 1:30 p.m. at the Black River Electric Office 2600 US-67, Fredericktown, MO 63645.

This meeting is open to the public.

Public participation is encouraged to help develop the best plan possible. The draft plan can be found at: http://www.semorpc.org/hazard_mitigation_planning.html
For more information or to provide comments or feedback on the draft, please contact:

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Fax: 573-547-7283
dchristian@semorpc.org
www.semorpc.org

PUBLIC NOTICE

Madison County and Participating Jurisdictions, along with the Southeast Missouri Regional Planning Commission (SEMO RPC), are **seeking public input** for the **2023 Madison County Hazard Mitigation Plan**.

The draft 2023 HMP is available for a 14 public comment period from December 1st to December 16th 2022.

Public participation is encouraged to help develop the best plan possible. The draft plan can be found at: https://semorpc.org/planning/hazard-mitigation-planning-in-southeast-missouri/ For more information or to provide comments or feedback on the draft, please contact:

Drew Christian
Deputy Director
Southeast Missouri Regional Planning Commission
1 W. St. Joseph Street
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Phone: 573-547-8357 ext 315
Fax: 573-547-7283
dchristian@semorpc.org
www.semorpc.org

2023 Madison County HMP			
Meeting Attendance			
	3/16/2021	**3/30/2021**	**4/20/2021**
Larry Kemp	X	X	
Donal Firebaugh	X		X
Dean Stevens	X	X	X
Gregg Pruett	X	X	
James Settle	X	X	X
Theresa Harbison	X	X	X
Chadd Starkey	X	X	X
Shannon Henson	X	X	X
Scott Blake	X	X	X