

CONTRIBUTORS

Sullivan County Hazard Mitigation Planning Committee

Jurisdictional Representatives

Name	Title	Department	Jurisdiction/Agency/Organi
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Chris May	Presiding Commissioner	Administration	Sullivan County
Mike Hepler	Associate Commissioner	Administration	Sullivan County
Randy Huffman	Associate Commissioner	Administration	Sullivan County
Greg Dobrinske	Mayor	Administration	City of Green Castle
Charity Taylor	Mayor	Administration	City of Green City
Ronald Putnam	Chairman	Administration	Village of Harris
Andy Herrington	Mayor	Administration	City of Milan
Ivan Otto	Mayor	Administration	City of Newtown
Tenille Banner	Superintendent	Administration	Green City R-I School District
Lucas McKinnis	Superintendent	Administration	Newtown-Harris R-III School District
Ben Yocum	Superintendent	Administration	Milan C-2 School District

Stakeholder Representatives

Name	Title	Department	Agency/Organization
Jackie Morris	County Clerk	Administration	Sullivan County
April Lee	City Clerk	Administration	City of Green Castle
Rachael Hall	City Clerk	Administration	City of Green City
Lisa Sharp	City Clerk	Administration	City of Milan
Tanda Abernathy	City Clerk	Administration	City of Newtown
Lindsay Moore	Secretary	Administration	Green City R-I School District
Lori Tucker	Secretary	Administration	Newtown-Harris R-III School District
Danah Fowler	Secretary	Administration	Milan C-2 School District

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EXECUTIVE SUMMARY

The purpose of hazard mitigation is to reduce or eliminate long-term risk to people and property from hazards. Sullivan 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 [insert date]. 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 Sullivan County Multi-Hazard Mitigation Plan is a multi-jurisdictional plan that covers the following jurisdictions that participated in the planning process:

- Unincorporated Sullivan County
- City of Green Castle
- City of Green City
- City of Milan
- Green City R-I School District
- Newtown-Harris R-III School District
- Milan C-2 School District

Sullivan County and the entities listed above developed a Multi-Jurisdictional Hazard Mitigation Plan that was approved by FEMA on March 24, 2016 (hereafter referred to as the *2016 Hazard Mitigation Plan*). This current planning effort serves to update that previously approved plan.

The plan update process followed a methodology in accordance with FEMA guidance, which began with the formation of a Mitigation Planning Committee (MPC) comprised of representatives from Sullivan County and participating jurisdictions. The MPC updated the risk assessment that identified and profiled hazards that pose a risk to Sullivan County and analyzed jurisdictional vulnerability to these hazards. The MPC 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 MPC 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 MPC updated goals for reducing risk from hazards. The goals are listed below:

- Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the plan.
- Goal 2: To recognize and increase disaster mitigation management capabilities for each jurisdiction, school district and special district.
- Goal 3: Protect the lives, property and livelihoods of all citizens by evaluating and implementing optimal mitigation alternatives.
- Goal 4: To ensure continued operation of government and emergency functions in a disaster.
- Goal 5: To implement Action Items according to a 5-year action plan.

To advance the identified goals, the MPC developed recommended mitigation actions, as summarized in the table on the following pages. The MPC 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. These additional details are provided in Chapter 4.

Table I. Mitigation Action Matrix

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
Sullivan County 2020.1	Maintain Transportation Infrastructure	Sullivan County	Medium	1,2,5	Flooding, Severe Thunderstorms, Winter Weather	✓	✓	
Sullivan County 2020.2	Generator for Shelters/Critical Facilities	Sullivan County	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
Sullivan County 2020.3	Debris Removal	Sullivan County	High	1, 3,4	Tornado, Severe Thunderstorms	✓	✓	
Sullivan County 2020.4	Installation/Upgrade Siren	Sullivan County	High	1,3,4	All Hazards	✓	✓	
Sullivan County 2020.5	Response to Pandemic	Sullivan County	High	1,2,3,4	Pandemic	✓	✓	

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
Sullivan County 2020.6	NOAA Weather Radios	Sullivan County	High	1,3,4	All Hazards	✓	✓	
City of Milan 2020.1	Generator for Shelters/Critical Facilities	City of Milan	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
City of Milan 2020.2	Maintain Transportation Infrastructure	City of Milan	Medium	1,2,5	Flooding, Severe Thunderstorms, Winter Weather	✓	✓	
City of Milan 2020.3	Safe Room and Storm Shelters	City of Milan	High	1,3,4	Severe Thunderstorms, Tornadoes, Wind Storms	✓		
City of Milan 2020.4	Installation/Upgrade Siren	City of Milan	High	1,3,4	All Hazards	✓	✓	
City of Milan 2020.5	NFIP Participation	City of Milan	High	3	Flooding			✓
City of Green City 2020.1	Maintain Transportation Infrastructure	City of Green City	Medium	1,2,5	Flooding, Severe Thunderstorms, Winter Weather	✓	✓	

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
City of Green City 2020.2	Generator for Shelters/Critical Facilities	City of Green City	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
City of Green City 2020.3	Installation/Upgrade Siren	City of Green City	High	1,3,4	All Hazards	✓	✓	
City of Green City 2020.4	Safe Room and Storm Shelters	City of Green City	High	1,3,4	Severe Thunderstorms, Tornadoes, Wind Storms	✓		
City of Green Castle 2020.1	Maintain Transportation Infrastructure	City of Green Castle	Medium	1,2,5	Flooding, Severe Thunderstorms, Winter Weather	✓	✓	
City of Green Castle 2020.2	Generator for Shelters/Critical Facilities	City of Green Castle	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
City of Green Castle 2020.3	Installation/Upgrade Siren	City of Green Castle	High	1,3,4	All Hazards	✓	✓	

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
City of Green Castle 2020.4	Safe Room and Storm Shelters	City of Green Castle	High	1,3,4	Severe Thunderstorms, Tornadoes, Wind Storms	✓		
Milan C-2 2020.1	Safe Room and Storm Shelters	Milan C-2	High	1,3,4	Severe Thunderstorms, Tornadoes, Wind Storms	✓		
Milan C-2 2020.2	Response to Pandemic	Milan C-2	High	1,2,3,4	Pandemic	✓		
Milan C-2 2020.3	Generator for School Buildings	Milan C-2	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
Newtown-Harris R-III 2020.1	Safe Room and Storm Shelters	Newtown-Harris R-III	High	1,3,4	Severe Thunderstorms, Tornadoes, Wind Storms	✓		
Newtown-Harris R-III 2020.2	Response to Pandemic	Newtown-Harris R-III	High	1,2,3,4	Pandemic	✓		
Newtown-Harris R-III 2020.3	Generator for School Buildings	Newtown-Harris R-III	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
Green City R-I 2020.1	Safe Room and Storm Shelters	Green City R-1	High	1,3,4	Severe Thunderstorms, Tornadoes, Wind Storms	✓		
Green City R-I 2020.2	Response to Pandemic	Green City R-I	High	1,2,3,4	Pandemic	✓		
Green City R-I 2020.3	Generator for School Buildings	Green City R-I	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		

PREREQUISITES

44 CFR requirement 201.6(c)(5): The local hazard mitigation plan shall include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan. For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.

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 C, and a model resolution is included on the following page.

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

Model Resolution

(LOCAL GOVERNING BODY/SCHOOL DISTRICT), Missouri RESOLUTION NO. _____

A RESOLUTION OF THE (LOCAL GOVERNING BODY/SCHOOL DISTRICT) ADOPTING
THE (PLAN NAME)

WHEREAS the (*local governing body/school district*) recognizes the threat that natural hazards pose to people and property within the (*local governing body/school district*); and

WHEREAS the (*local governing body/school district*) has participated in the preparation of a multi-jurisdictional local hazard mitigation plan, hereby known as the (*plan name*), 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 (*local governing body/school district*) from the impacts of future hazards and disasters; and

WHEREAS the (*local governing body*) recognizes that land use policies have a major impact on whether people and property are exposed to natural hazards, the (*local governing body/school district*) will endeavor to integrate the *Plan* into the comprehensive planning process; and

WHEREAS adoption by the (*local governing body/school district*) demonstrates their commitment to hazard mitigation and achieving the goals outlined in the *Plan*.

NOW THEREFORE, BE IT RESOLVED BY THE (LOCAL GOVERNMENT/SCHOOL DISTRICT), in the State of Missouri, THAT:

In accordance with (*local rule for adopting resolutions*), the (*local governing body/school district*) adopts the final *FEMA-approved Plan*.

ADOPTED by a vote of____in favor and__against, and__abstaining, this____day of
_____,_____.

By (Sig.): _____

Print name:

ATTEST:

By (Sig.): _____

Print name:

APPROVED AS TO FORM:

By (Sig.): _____

Print name:_____

INTRODUCTION AND PLANNING PROCESS

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1.1 Purpose

Hazard mitigation is “any actions taken to reduce or eliminate the long-term risk to human life and property from natural hazards”. We understand that hazard events will continue to occur, and at their worst can result in death and destruction of property and infrastructure. The work done to minimize the impact of hazard events to life and property is called hazard mitigation. Sullivan County and the participating jurisdictions, and school districts developed this multi-jurisdictional local hazard mitigation plan update to reduce future losses from hazards.

- The County of Sullivan, City of Green Castle, City of Green City, City of Milan, Green City R-I School District, Newtown-Harris R-III School District and Milan C-2 School District, adopted the plan as a Prerequisite for mitigation grant eligibility and cite the current legislation authorizing plan development.
- The Village of Humphreys, Village of Osgood, Village of Harris and the Village of Pollock will not be eligible for grant funding due to their lack of participation and plan adoption.

1.2 Background and Scope

This plan is a 5-year update of a plan that was approved on March 24, 2016. The plan and update were prepared pursuant to the requirements of the Disaster Mitigation Act of 2000 to result in the eligibility for the Federal Emergency Management Agency (FEMA) Hazard Mitigation Assistance Grant programs.

- Following is a list of participants in both the previous plan as well as the current plan: County of Sullivan, City of Green Castle, City of Green City, City of Milan, Green City R-1 School District, Newtown-Harris R-III School District and Milan C-2 School District.
- Village of Humphreys, Village of Osgood, Village of Pollock, Village of Harris and Grundy R-V School District chose not to participate in the plan update.

In addition to securing Hazard Mitigation Grant Funding eligibility, the plan is useful for incorporating hazard mitigation planning and principals into other documents, such as zoning regulations and land use plans.

1.3 Plan Organization

Below is the outline of the plan:

- 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 1.1 provides details on the changes made in the plan update.

Table 1.1. Changes Made in Plan Update

Plan Section	Summary of Updates
Chapter 1 - Introduction and Planning Process	Updated members of the Mitigation Planning Committee (MPC) and participating jurisdictions formally adopted the MPC.
Chapter 2 - Planning Area Profile and Capabilities	Noted new GIS capabilities for participating jurisdictions.
Chapter 3 - Risk Assessment	Combined extreme heat and extreme cold into one hazard: extreme temperatures.
Chapter 4 - Mitigation Strategy	The mitigation category of each action was added to the action worksheets.
Chapter 5 - Plan Implementation and Maintenance	Updated MPC meetings for evaluating and updating the plan to quarterly.

1.4 Planning Process

44 CFR Requirement 201.6(c)(1): [The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

Sullivan County Commissioners contracted with the Green Hills Regional Planning Commission (GHRPC) to facilitate the update of the multi-jurisdictional, local hazard mitigation plan. In fulfillment of this role, the GHRPC:

- Assisted in establishing a Mitigation Planning Committee (MPC) as defined by the Disaster Mitigation Act (DMA)
- Ensured the updated plan met the Disaster Mitigation Assistance requirements as established by federal regulations and followed the most current planning guidance of the Federal Emergency Management Agency (FEMA)

- Facilitated the entire plan development process,
 - Identified the data the MPC participants could provide and conducted the research and documentation necessary to augment the data,
 - Assisted in the soliciting public input,
 - Produced the draft and final plan update in a FEMA-approvable document,
- Coordinate
- the Missouri State of Emergency Management Agency (SEMA) and (FEMA) plan reviews.

Table 1.2. Jurisdictional Representatives of Sullivan County Mitigation Planning Committee

Name	Title	Department	Jurisdiction/Agency
Dennis Goldsmith	Emergency Management Director	Administration	Sullivan County
Chris May	Presiding Commissioner	Administration	Sullivan County
Mike Hepler	Associate Commissioner	Administration	Sullivan County
Randy Huffman	Associate Commissioner	Administration	Sullivan County
Greg Dobrinske	Mayor	Administration	City of Green Castle
Charity Taylor	Mayor	Administration	City of Green City
Ronald Putnam	Chairman	Administration	Village of Harris
Andy Herrington	Mayor	Administration	City of Milan
Ivan Otto	Mayor	Administration	City of Newtown
Tenille Banner	Superintendent	Administration	Green City R-I School District
Lucas McKinnis	Superintendent	Administration	Newtown-Harris R-III School
Ben Yocum	Superintendent	Administration	Milan C-2 School District

Table 1.3 demonstrates each member’s expertise in the six mitigation categories (Prevention, Property Protection, Natural Resource Protection, Emergency Services, Structural Flood Control Projects and Public Information).

Table 1.3. MPC Capability with Six Mitigation Categories

Community Department/Office	Prevention	Structure and Infrastructure Projects		Natural Systems Protection	Education and Awareness Programs	Emergency Services
		Property Protection	Structural Flood Control Projects			
County Commission	✓	✓	✓	✓	✓	✓
EMD	✓	✓	✓	✓	✓	✓
City Clerk	✓	✓	✓	✓	✓	✓
Mayor	✓	✓	✓	✓	✓	✓
School Administration	✓	✓		✓	✓	✓

Multi-Jurisdictional Participation

44 CFR Requirement §201.6(a)(3): Multi-jurisdictional plans may be accepted, as appropriate, as long as each jurisdiction has participated in the process and has officially adopted the plan.

Hazard mitigation is defined as “sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards” and its purpose is to lessen the negative impact of a disaster on community’s economic, social and environmental well-being.

Outreach programs that increase the public’s awareness of hazard risks, projects to protect critical facilities and the removal of structures from flood hazard areas are all examples of mitigation actions. Local mitigation actions and concepts can also be incorporated into land use plans and building codes.

Local governments have the responsibility to protect the health, safety, and welfare of their

citizens. Proactive mitigation policies and actions help to reduce risk and create safer, more disaster-resilient communities. Mitigation is an investment in a community's future safety and sustainability by facilitating:

- The protection of public safety and prevention of loss of life and injury.
- The reduction of harm to existing and future development
- The prevention of damage to a community's unique assets

The importance of active public participation in such an endeavor is obvious but can be difficult to obtain reality. Nowhere is difficulty more apparent than in small rural communities like those in North Missouri. The County of Sullivan, City of Green Castle, City of Green City, City of Milan, Green City R-1 School District, Newton-Harris R-III School District and Milan C-2 School District participated in all elements of the planning process. Village of Humphreys, Village of Osgood and Village of Osgood did not meet the requirements of the MPC.

Local government jurisdictions were invited to participate in the planning process via email and in many cases follow up phone calls and personal visits. (Appendix B – public documentation). Committee members were placed on a contact list featuring email and contact information. They were also directed to the Green Hills Regional Planning Commission webpage.

Jurisdictions that were presented with a multi-jurisdictional plan are required to participate in the planning process and formally adopt the plan. The County of Sullivan, City of Green City, City of Green Castle, City of Milan, Green City R-1 School District, Newtown-Harris R-III School District and Milan C-2 School District participated in the plan update by meeting minimal requirements as described in the next paragraph. Each participating jurisdiction has formally adopted the mitigation plan.

Minimum participation requirements included:

- Designation of a representative to serve on the MPC

- Provision of sufficient information to support plan development by completion and return of Data Collection Questionnaires and validating/correcting critical facility inventories
- When applicable provide progress reports on mitigation actions from previously approved plan and identify additional mitigation actions plan
- Eliminate from further consideration those actions from the previously approved plan that were not implemented because they were impractical, inappropriate, not cost-effective, or were otherwise not feasible
- Review and comment on plan drafts
- Provide documentation to show time donated to the planning effort (if a FEMA planning grant was awarded to the county); and
- Formally adopt the mitigation plan prior to submittal to SEMA and FEMA for final approval.

The County of Sullivan, City of Green Green City, City of Green Castle, City of Milan, Green City R-1 School District, Newtown-Harris R-III School District and Milan C-2 School District, met the participation requirements.

Table 1.4. Jurisdictional Participation in Planning Process

Jurisdiction	Data Collection Questionnaire Response	Update/Develop Mitigation Actions	Adopt Resolution
Unincorporated Sullivan County	X	X	X
City of Green Castle	X	X	X
City of Green City	X	X	X
City of Milan	X	X	X
Green City R-1 School District	X	X	X
Newtown-Harris R-III School District	X	X	X
Milan C-2 School District	X	X	X

The Planning Steps

Table 1.5. Sullivan 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)

Table 1.6. Schedule of MPC Requirements

Meeting	Date
Completion of Data Questionnaire	2020/2021
Update Action Items	2020/2021
Adopt Resolution	2020/2021

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

44 CFR Requirement 201.6(b): An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: (1) An opportunity for the public to comment on the plan during the drafting stage and prior

The MPC developed a survey for public comment and released the survey to the public. No comments were received from the survey. Public notice was also posted on the Northeast Missouri Regional Planning Commission website and Facebook pages, a notice was posted at the County Courthouse.

No public comments were received which is characteristic for the area. The public in Sullivan County typically does not become active in planning activities such as plan development or updates.

Step 3: Coordinate with Other Departments and Agencies and Incorporate Existing Information⁷

(Handbook Task 3)

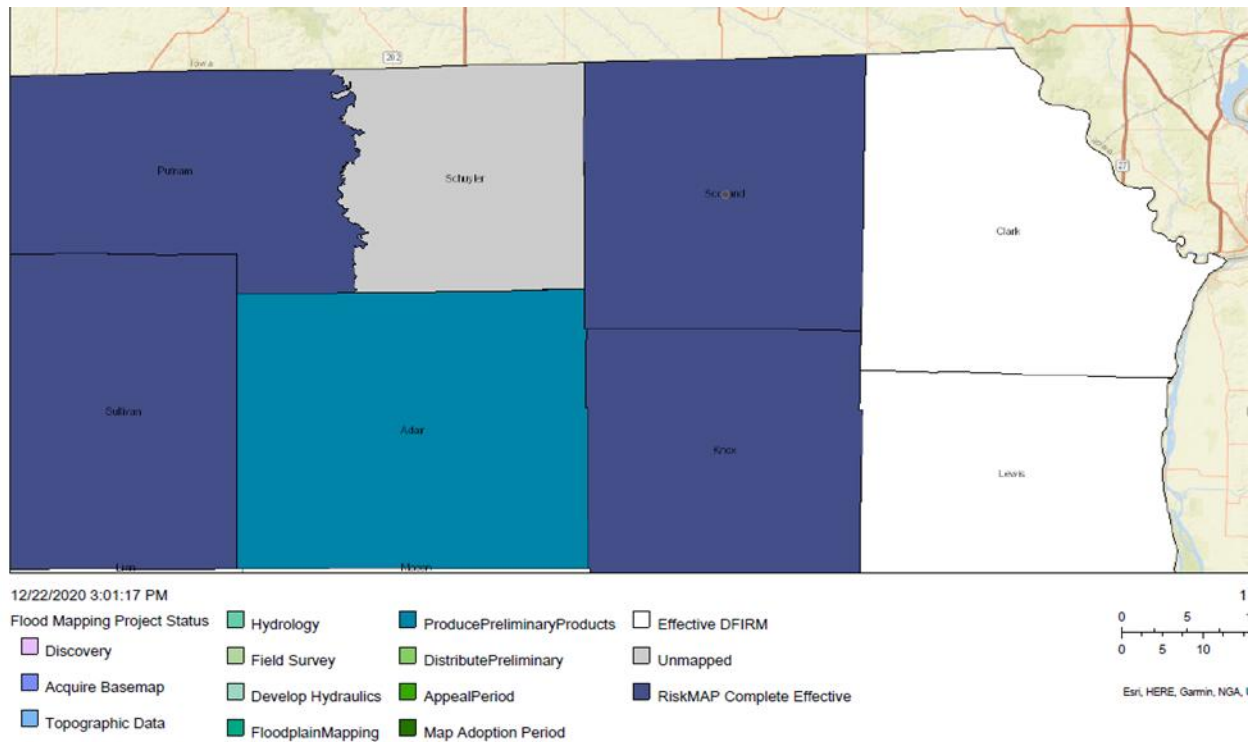
44 CFR Requirement 201.6(b): An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: (2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process. (3) Review and incorporation, if

The Sullivan County stakeholders were sent an invitation to review the updated plan and provide their input. Stakeholders invited to participate include police departments, fire departments, nursing homes, economic developer, Missouri Department of Natural Resources, Missouri Department of Transportation, water districts and ambulance districts. Neighboring communities were informed of the Sullivan County plan update and was invited to offer input to the plan as they see fit. No comments were received from the stakeholders during the planning process.

Table 1.7. Stakeholder Representatives

Name	Title	Department	Agency/Organization
Jackie Morris	County Clerk	Administration	Sullivan County
April Lee	City Clerk	Administration	City of Green Castle
Rachael Hall	City Clerk	Administration	City of Green City
Lisa Sharp	City Clerk	Administration	City of Milan
Tanda Abernathy	City Clerk	Administration	City of Newtown
Lindsay Moore	Secretary	Administration	Green City R-I School District
Lori Tucker	Secretary	Administration	Newtown-Harris R-III School District
Danah Fowler	Secretary	Administration	Milan C-2 School District

Figure 1.1. RiskMAP Study Status Map



Integration of Other Data, Reports, Studies, and Plans

Other documents critical to the formation of the plan include, mitigation plan of the state and adjacent counties, reports from university extensions, Flood Insurance Studies (FIS), Flood Insurance Rate Maps (FIRMs), State Department of Natural Resources (DNR) dam information, the National Inventory of Dams (NID), dam inspection reports, state fire reports, Wildland /Urban Interface and Intermix areas from the SILVIS Lab-Department of Forest Ecology and Management – University of Wisconsin, local comprehensive plans, economic development plans, capital improvement plans, US Department of Agriculture's (USDA) Risk Management Agency Crop Insurance Statistics, and local budgets.

Examples of information that was incorporated into the plan include: - FEMA FIRM maps – DNR dam inspection reports – County Master Plan: future growth trends
SEMA's Arc GIS helped with mapping for hazards – State Hazard Mitigation Plan –

building counts and content exposure – American Factfinder and 2019 American Community survey, demography.

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

Participating jurisdictions was asked to review the following and provide comment on them:

- previous disaster declarations in the county
- hazards in the most recent State Hazard Mitigation Plan
- hazards identified in the previously approved hazard mitigation plan.

The information obtained from the jurisdictions can be reviewed in Section 4 of this document. Data Collection Questionnaires from the previous plan update were disseminated to jurisdictions in attendance. Participants were requested to review and update the Questionnaires.

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

Assets were identified with demographic data from the US Census, Census of Agriculture, GIS Structure data, Data Collection Questionnaires and information from the NMRPC.

All loss estimates could not be provided due to lack of information provided by participating Jurisdictions. MPC members could not ascertain the value of building in the community, thus the information was not provided.

Step 6: Set Goals (Handbook Task 6)

The MPC reviewed the goals from the previously approved plan at the Sullivan County Multi-Jurisdictional Plan update meeting and accepted the goals:

- Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the plan.
- Goal 2: To recognize and increase disaster mitigation management capabilities for each jurisdiction, school district and special district.
- Goal 3: Protect the lives, property and livelihoods of all citizens by evaluating and implementing optimal mitigation alternatives.
- Goal 4: To ensure continued operation of government and emergency functions in a disaster.
- Goal 5: To implement Action Items according to a 5-year action plan.

Step 7: Review Possible Mitigation Actions and Activities

(Handbook Task 6)

Participating jurisdictions were asked to review the mitigation strategy from the previously approved plan and note changes and update as it pertains to their individual jurisdictions. Committee members were requested to address progress (or lack thereof) on previously identified actions in the previously approved plan. MPC members were encouraged to continue forward only those actions that substantively address long-term mitigation solutions to the risk identified in the risk assessment.

There were virtually no changes to any of the risk assessment in the plan. The MPC used the STAPLEE method to analyze and prioritize proposed actions. Members were provided a copy of the FEMA publication Mitigation Ideas – A Resource for Reducing Risk to Natural Hazard at the Planning meeting.

Step 8: Draft an Action Plan

(Handbook Task 6)

The action worksheets, including the plan for implementation, submitted by each jurisdiction for the updated Mitigation Strategy are included in Chapter 4.

Step 9: Adopt the Plan

(Handbook Task 8)

After the majority of the draft plan was composed, adoption resolution examples were given to the jurisdictional representatives and requested for adoption by whatever tools their jurisdictions utilize for such activities.

Step 10: Implement, Evaluate, and Revise the Plan

(Handbook Tasks 7 & 9)

Part of the plan draft development included an outline of plan maintenance (Chapter 5) and was discussed and accepted by the MPC. This process includes reviews annually and in the wake of

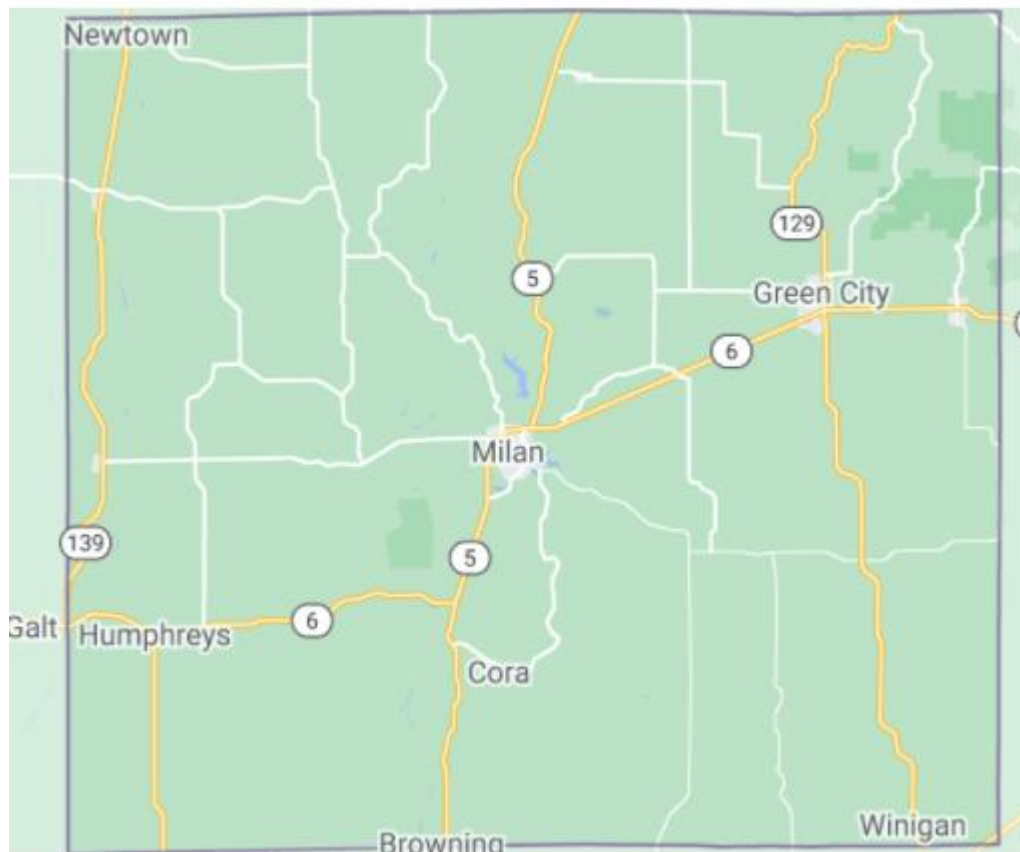
any significant hazard event, as well as provisions for the five-year update process.

PLANNING AREA PROFILE AND CAPABILITIES

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2.2.7	Special District	Error! Bookmark not defined.
2.2.8	Public School District Profiles and Mitigation Capabilities	75

2.1 Sullivan County Planning Area Profile

Figure 2.1. Map of Sullivan County



According to the 5-year Community Survey 2019, the population estimate for Sullivan County is 6,089 persons compared to the 2010 Census population of 6,714; a 9% decline estimate in the nine year period. This percent of decline falls far behind the growth estimate for the State of Missouri for the same time period (2.41%) and of the Nation at 5.94%.

Sullivan County has a median household income of \$35,789 which falls below the Missouri State median of \$45,427 and the United States median household income of \$49,898.

Geography, Geology and Topography

Sullivan County has a total of 652 square miles, of which 648 square miles is land and 3.5 square miles is water. The County is an area of hills and valleys- the most gently sloping areas of Sullivan County are in the southwestern part. The primary drainage divide is occupied by Green City in the north-central part of the county.

The northeastern part of the county is the most dissected and has the steepest back slopes and the greatest differences in elevation between the tops of the ridges and the valley floors. The highest point in the county, about 1,060 feet above sea level, is on the primary divide between the Chariton River and Grand River drainage basins along the Putnam County line northwest of Green City. The lowest point in the county, about 740 feet above sea level, is where Locust creek flows out of the county, near the town of Browning. Figure 2.2 depicts a generalized geologic map of Missouri and its counties.

Figure 1.2. Figure 2.2 Generalized Geologic Map of Missouri
 Figure 1.3.

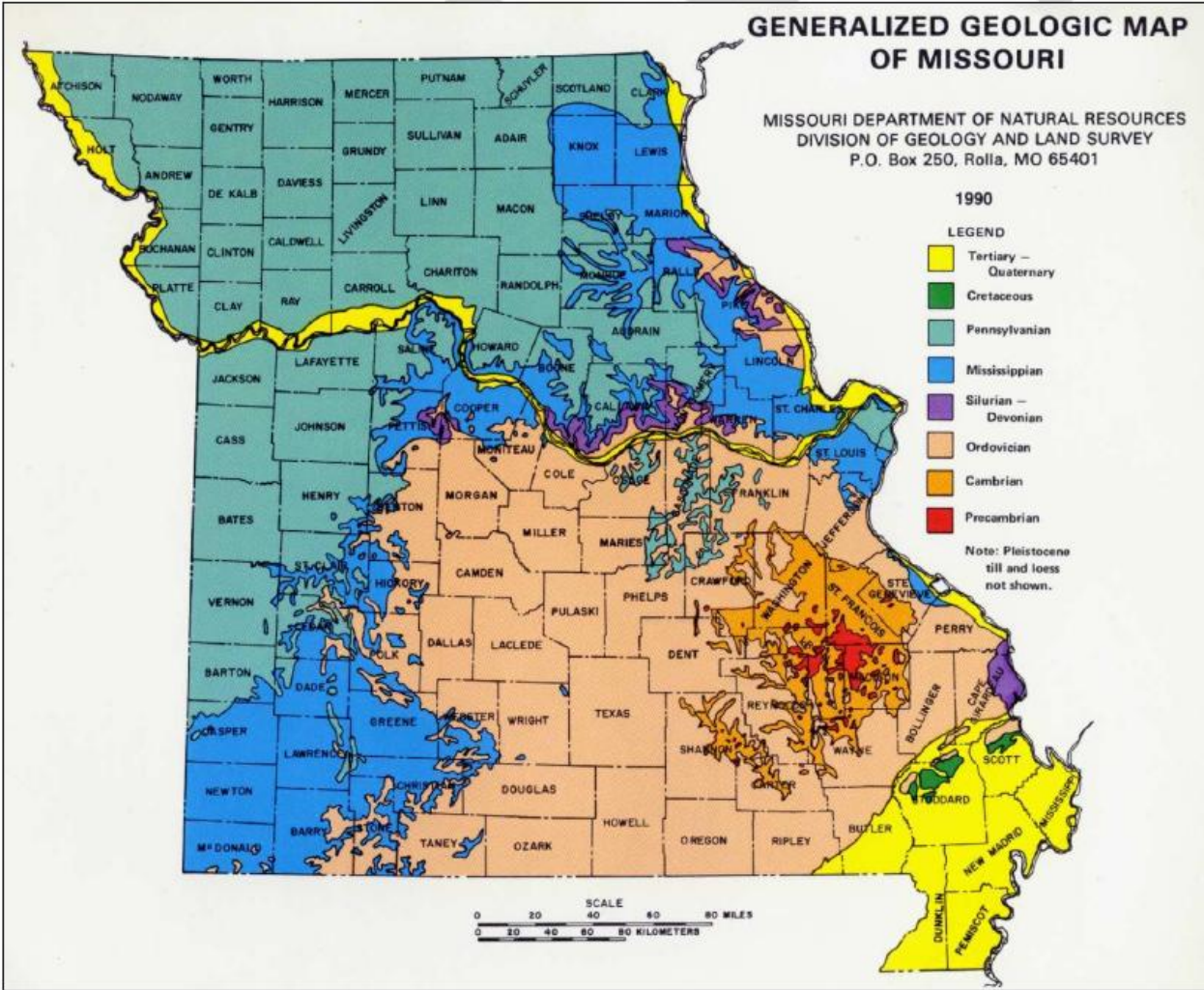


Figure 1.4.
 Figure 1.5. <http://geology.about.com/library/bl/maps/blmissourimap.htm>
 Figure 1.6. <http://members.socket.net/~joschaper/ordo.html>

Climate

Sullivan County gets an average of 45 inches of rain per year. The average snowfall is 13 inches

per year. On average there are 200 sunny days per year. The average high temperature is 64 degrees, and the average low is 45 degrees. The average low in January is 19 degrees and in July the average temperature is 89 degrees.

Population/Demographics

Table 2.1 provides the populations for each city, village, and the unincorporated county for 2000, 2010 and the latest population estimates for American Community Survey with the number and percentage change. The unincorporated area population can be estimated by subtracting the populations of the incorporated areas from the overall county population.

Table 1.8. Sullivan County Population 2000-2010 by Jurisdiction

Jurisdiction	2000 Population	2010 Population	2019 Annual Population Estimate or ACS Population	# Change (2010-2019)	% Change (2010-2019)
Unincorporated Sullivan County	4,265	3,822	2,477	-1,345	-35%
City of Green Castle	308	275	2,838	-70	-25%
City of Green City	688	657	275	-163	-24.8%
City of Milan	1,958	1,960	657	503	-25%
Total	7,219	6,714	6,247	-467	-6.9%

Source: U.S. Bureau of the Census, Decennial Census, annual population estimates/ 5-Year American Community Survey 2019;
*population includes the portions of these cities in adjacent counties

Table 2.2 provides information in regard to the percent of individuals under the age of 5 , and over

for the county, State, and Nation. In addition, average household size is illustrated in Table 2.3 including figures of Sullivan County, Missouri and U.S. In 2019 there were an estimated 3,337 households within the county.

Table 1.9. Percent of Individuals Under the Age of 5, and Over 65 for Sullivan County, Missouri, and the U.S. (2019)

Location	% Under Age of 5	% Over Age of 65
Sullivan County	6.5%	20.8%
Missouri	6.1	16.5
United States	6.1	15.6

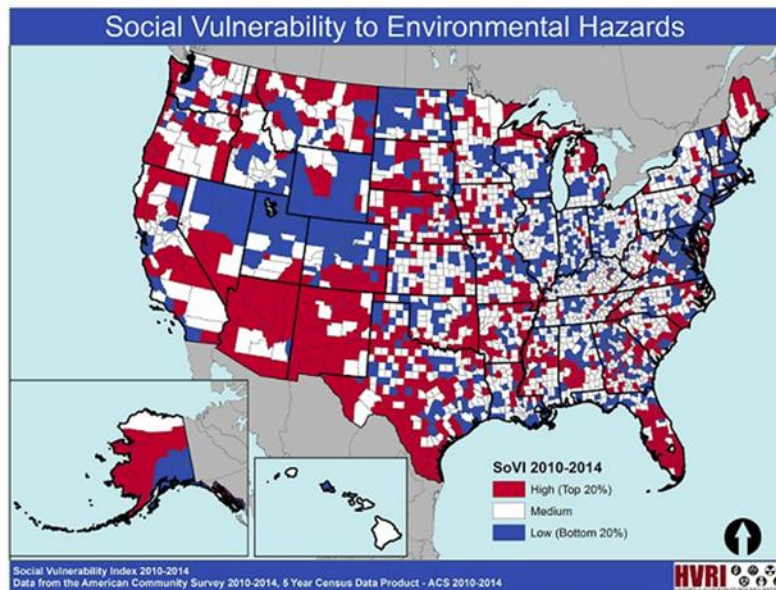
Table 1.10.

cation	Average Household Size
llivan County	2.83
ssouri	2.41
ited States	2.6

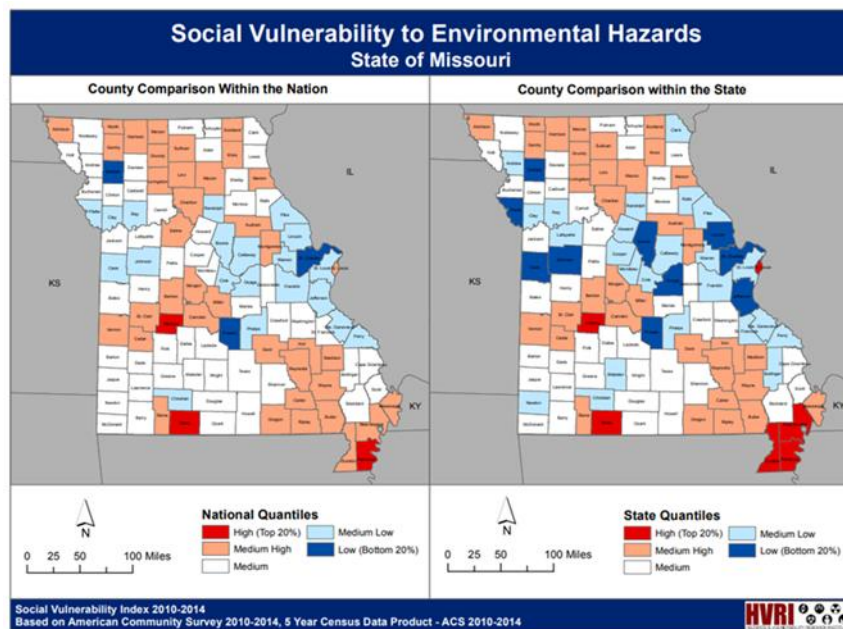
Social Vulnerability Index (SoVI)

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 29 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 1.7. Figure 2.3 SoVI for Sullivan County
Figure 1.8.
Figure 1.9.



Source: <http://artsandsciences.sc.edu/geog/hvri/sovi%C2%AE-0>



Source: http://artsandsciences.sc.edu/geog/hvri/sites/sc.edu.geog.hvri/files/attachments/MO_1014.pdf

A low number means the county is more resilient to hazard events, and a high number means the county is less resilient. Sullivan County has a medium high rating.

Table 2.4 provides additional demographic and economic indicators for Sullivan County.

Table 1.11. Poverty, Education, and Language Percentage Demographics, Sullivan County, Missouri

Jurisdiction	Total in Labor Force	Percent of Families Below the Poverty Level	Percentage of Population (High School graduate)	Percentage of Population (Bachelor's degree or higher)	Percentage of population with spoken language other than English
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Sullivan County	2,073	15.6%	84.3%	11.7%	21.6%
City of Green City	392	13.6%	40.7%	0%	11%
City of Green Castle	Not Available	Not Available	Not Available	Not Available	Not Available
City of Milan	956	28.4%	77.8%	6.1%	21.6%

Source: U.S. Census, 2018 American Community Survey, 5-year Estimates.

History

Present-day Sullivan County was acquired by the United States under terms of the Louisiana

Purchase on July 4, 1803. Twenty-one years later, the Sac (Sauk), Meskwaki (Fox), and Iowa Native

American nations ceded their tribal land to the U.S. government under two treaties in August 1824.

A little more than a decade later the permanent European settlers would arrive, soon followed by

others from Ohio, Illinois, Kentucky, Tennessee, and Virginia. Many of these established farms and

small businesses at a settlement known then as Pharsalia, which would eventually become Milan.

The Missouri state legislature defined the boundaries of what they called “Highland County” during

the 1842–1843 legislative sessions, but the population was such that it was attached to Linn County

until the rising population enabled it’s formal organization by the legislature on February 14, 1845, at

which time it was renamed Sullivan County in honor of the Revolutionary War hero John Sullivan.

Settlers established the town of Milan in 1845, located at the center of the county, but it wouldn’t be

officially incorporated for another fourteen years. The first courthouse (a wood structure) was

occupied in October 1847. Ten years later, residents leveled an Indian mound in the middle of town

to make the public square, where the last federal land office established in Missouri operated from

1849 to 1859. The second courthouse (and the first brick structure in Milan) was erected in 1857.

That courthouse was destroyed by fire in 1908 and for 30 years there was no courthouse in Sullivan

County, until the construction of the third courthouse, a three-story limestone building still in use

today.

Other towns platted in the county's early years included Green Castle (1857), Newtown (1858),

Pollock (1873), Boynton and Cora (1877), Green City and Winigan (1880), Humphreys and Reger

(1881), Osgood (1886), and Harris (1887). Green City College opened in 1885, and a business

institute opened in Humphreys in 1884.

During the U.S. Civil War (1861–1865), a Union Army post stood in Milan. The locals were well

represented on both sides of the conflict, and though military skirmishes within the county itself were

mostly confined to partisan activity, soldiers from Sullivan County were known to have fought at the

Battle of Shiloh, Battle of Atlanta, Battle of Jonesborough, and other major engagements throughout

the war.

Expansion of the railroads brought growth to Sullivan County beginning in the 1870s. The C., B. &

K.C. (Chicago, Burlington and Kansas City Railway) built a line running north to south through the

county in 1876, which was followed by construction of the Quincy, Missouri & Pacific Railway line

east to west through the county from 1878 to 1881. The two lines crossed in Milan, which became a

major shipping point. The Chicago, Milwaukee & St. Paul Railway soon built a north–south line along

Medicine Creek the length of the western edge of the county that served the towns of Newtown and

Harris, which continues to be active today. (All three railroads eventually merged into the Chicago,

Burlington and Quincy Railroad.)

By 1900, following the railroad construction boom, the county's population exceeded 20,000.

However, business activity and the number of residents declined steadily during the subsequent

decades. The number of farms decreased from about 3,100 in 1900 to fewer than 900 by 1982, but

over the same time period, the size of farms increased from about 130 acres to 385 acres. The

county primarily remains rural agricultural land today.

Occupations

Table 2.5 provides occupation statistics for the incorporated jurisdictions and incorporated county.

Table 1.12. Occupation Statistics, Sullivan County, Missouri

Place	Management, Business, Science, and Arts Occupations	Service Occupations	Sales and Office Occupations	Natural Resources, Construction, and Maintenance Occupations	Production, Transportation, and Material Moving Occupations
Sullivan County	726	357	420	376	812
City of Green Castle	60	27	28	32	38
City of Green City	60	27	28	32	38
City of Milan	Not Available	Not Available	Not Available	Not Available	Not Available

Source: U.S. Census, 2019 American Community Survey, 5-year Estimates.

Agriculture

Sullivan County has a total of 671 farms with the total acreage of 309,995 acres. The average farm size is 461 acres and there are 46 farms comprised of more than 1,000 acres. The top crops for Sullivan County are soybeans with 36,076 acres planted, corn is second with 50,170 acres planted and wheat is third with 1,079 acres planted. The average sales per farm is \$265,928. Sullivan County has 140 hired workers which is 21% of the total workforce.

FEMA Hazard Mitigation Assistance (HMA) Grants in Planning Area

FEMA's Hazard Mitigation Assistance (HMA) grant program provides funding for mitigation activities which have the potential to reduce disaster losses and protect life and property from future disaster damages. Previous FEMA HMA Grants issued in the planning area can be found in

Table 2.6

Table 1.13. FEMA HMA Grants in County from 1993-2019

Project Type	Sub-Grantee	Date Approved	Project Total
402.1 Infrastructure Protective Measures	Sullivan County	9/8/2005	\$336,941
Total			\$336,941

Source: Federal Emergency Management Agency, 3/14/2021

FEMA Public Assistance (PA) Grants in Planning Area

The purpose of the Public Assistance (PA) Grant Program is to support communities' recovery from major disasters by providing them with grant assistance for debris removal, live-saving emergency protective measures, and restoring public infrastructure. Local governments, states, tribes, territories and certain private nonprofit organizations are eligible to apply. Public Assistance is FEMA's largest grant program. Table 2.7 below gives information about all Public Assistance Grants for the Planning Area. It gives the declaration number, project type, and size, the applicant, and the project total. Total PA grants is \$7,158,126.

Table 1.14. FEMA PA Grants in County from 1993- 2019

Disaster Declaration	Project Type	Project Size	Applicant	Project Total
1412	Severe Storm(s)	Small	Sullivan County	\$11,174
1412	Severe Storm(s)	Small	Sullivan County	\$33,746
1412	Severe Storm(s)	Small	Sullivan County	\$29,445
1412	Severe Storm(s)	Small	Sullivan County	\$43,898
1412	Severe Storm(s)	Small	Sullivan County	\$4,125
1412	Severe Storm(s)	Small	Sullivan County	\$15,228
1412	Severe Storm(s)	Small	Sullivan County	\$17,041
1412	Severe Storm(s)	Small	Sullivan County	\$9,245
1412	Severe Storm(s)	Large	Sullivan County	\$75,830
1412	Severe Storm(s)	Small	Sullivan County	\$34,012
1412	Severe Storm(s)	Small	Sullivan County	\$25,200
1708	Severe Storm(s)	Small	Sullivan County	\$10,221
1708	Severe Storm(s)	Small	Sullivan County	\$10,051
1708	Severe Storm(s)	Small	Sullivan County	\$10,931

1708	Severe Storm(s)	Small	Sullivan County	\$6,231
1708	Severe Storm(s)	Small	Sullivan County	\$7,346
1708	Severe Storm(s)	Small	Sullivan County	\$8,837
1708	Severe Storm(s)	Small	Sullivan County	\$17,934
1708	Severe Storm(s)	Small	Sullivan County	\$21,796
1708	Severe Storm(s)	Small	Sullivan County	\$23,036
1708	Severe Storm(s)	Small	Sullivan County	\$14,205
1708	Severe Storm(s)	Small	Sullivan County	\$16,570
1708	Severe Storm(s)	Small	Sullivan County	\$54,572
1708	Severe Storm(s)	Small	Sullivan County	\$4,454
1708	Severe Storm(s)	Small	Sullivan County	\$8,890
1708	Severe Storm(s)	Small	Sullivan County	\$10,207
1708	Severe Storm(s)	Small	Sullivan County	\$14,522
1708	Severe Storm(s)	Small	Sullivan County	\$16,334
1708	Severe Storm(s)	Small	Sullivan County	\$11,300
1708	Severe Storm(s)	Small	Sullivan County	\$10,669
1708	Severe Storm(s)	Small	Sullivan County	\$6,963
1708	Severe Storm(s)	Small	Sullivan County	\$5,048
1708	Severe Storm(s)	Small	Sullivan County	\$25,467
1708	Severe Storm(s)	Small	Sullivan County	\$4,600
1708	Severe Storm(s)	Small	Sullivan County	\$4,614
1708	Severe Storm(s)	Small	Sullivan County	\$7,454
1708	Severe Storm(s)	Small	Sullivan County	\$7,998
1708	Severe Storm(s)	Small	Sullivan County	\$26,906
1708	Severe Storm(s)	Small	Sullivan County	\$7,086
1708	Severe Storm(s)	Small	Sullivan County	\$23,962

1708	Severe Storm(s)	Small	Sullivan County	\$16,316
1708	Severe Storm(s)	Small	Sullivan County	\$19,557
1708	Severe Storm(s)	Small	Sullivan County	\$11,855
1708	Severe Storm(s)	Small	Sullivan County	\$18,744
1708	Severe Storm(s)	Small	Sullivan County	\$9,501
1736	Severe Ice Storm	Small	Sullivan County	\$2,313
1736	Severe Ice Storm	Small	Sullivan County	\$5,478
1736	Severe Ice Storm	Small	Sullivan County	\$5,624
1736	Severe Ice Storm	Small	Sullivan County	\$3,000
1736	Severe Ice Storm	Small	Sullivan County	\$4,213
1736	Severe Ice Storm	Small	Sullivan County	\$8,108
1736	Severe Ice Storm	Small	Sullivan County	\$5,563
1736	Severe Ice Storm	Small	Sullivan County	\$3,404
1736	Severe Ice Storm	Small	Sullivan County	\$1,764
1736	Severe Ice Storm	Small	Sullivan County	\$2,371
1736	Severe Ice Storm	Small	Sullivan County	\$3,015
1736	Severe Ice Storm	Small	Sullivan County	\$12,717

1736	Severe Ice Storm	Small	Sullivan County	\$10,202
1736	Severe Ice Storm	Small	Sullivan County	\$7,963
1736	Severe Ice Storm	Small	Sullivan County	\$1,261
1736	Severe Ice Storm	Small	Sullivan County	\$3,193
1736	Severe Ice Storm	Small	Sullivan County	\$17,588
1736	Severe Ice Storm	Small	Sullivan County	\$7,592
1736	Severe Ice Storm	Small	Sullivan County	\$3,291
1736	Severe Ice Storm	Small	Sullivan County	\$3,966
1736	Severe Ice Storm	Small	Sullivan County	\$5,237
1736	Severe Ice Storm	Small	Sullivan County	\$4,633
1773	Severe Storm(s)	Large	Sullivan County	\$0
1773	Severe Storm(s)	Small	Sullivan County	\$8,705
1773	Severe Storm(s)	Small	Sullivan County	\$5,683
1773	Severe Storm(s)	Small	Sullivan County	\$4,634
1773	Severe Storm(s)	Small	Sullivan County	\$4,075
1773	Severe Storm(s)	Small	Sullivan County	\$4,957
1773	Severe Storm(s)	Small	Sullivan County	\$1,004
1773	Severe Storm(s)	Small	Sullivan County	\$7,326
1773	Severe Storm(s)	Small	Sullivan County	\$7,790

1773	Severe Storm(s)	Small	Sullivan County	\$8,893
1773	Severe Storm(s)	Small	Sullivan County	\$24,484
1773	Severe Storm(s)	Small	Sullivan County	\$5,690
1773	Severe Storm(s)	Small	Sullivan County	\$9,851
1773	Severe Storm(s)	Small	Sullivan County	\$5,873
1773	Severe Storm(s)	Small	Sullivan County	\$2,002
1773	Severe Storm(s)	Small	Sullivan County	\$3,384
1773	Severe Storm(s)	Small	Sullivan County	\$7,104
1773	Severe Storm(s)	Small	Sullivan County	\$8,845
1773	Severe Storm(s)	Small	Sullivan County	\$11,447
1773	Severe Storm(s)	Small	Sullivan County	\$5,034
1773	Severe Storm(s)	Small	Sullivan County	\$2,110
1773	Severe Storm(s)	Small	Sullivan County	\$3,142
1773	Severe Storm(s)	Small	Sullivan County	\$17,230
1773	Severe Storm(s)	Small	Sullivan County	\$21,283
1773	Severe Storm(s)	Small	Sullivan County	\$11,718
1773	Severe Storm(s)	Small	Sullivan County	\$3,196
1773	Severe Storm(s)	Small	Sullivan County	\$6,522
1773	Severe Storm(s)	Small	Sullivan County	\$1,736
1773	Severe Storm(s)	Small	Sullivan County	\$2,573
1773	Severe Storm(s)	Small	Sullivan County	\$15,047
1773	Severe Storm(s)	Small	Sullivan County	\$9,673
1773	Severe Storm(s)	Small	Sullivan County	\$28,646
1773	Severe Storm(s)	Small	Sullivan County	\$10,049
1773	Severe Storm(s)	Small	Sullivan County	\$23,858
1773	Severe Storm(s)	Small	Sullivan County	\$4,220

1773	Severe Storm(s)	Small	Sullivan County	\$12,139
1773	Severe Storm(s)	Small	Sullivan County	\$4,978
1773	Severe Storm(s)	Small	Sullivan County	\$10,261
1773	Severe Storm(s)	Small	Sullivan County	\$2,492
1773	Severe Storm(s)	Small	Sullivan County	\$5,724
1773	Severe Storm(s)	Small	Sullivan County	\$8,554
1773	Severe Storm(s)	Small	Sullivan County	\$2,974
1773	Severe Storm(s)	Small	Sullivan County	\$18,840
1773	Severe Storm(s)	Small	Sullivan County	\$17,510
1773	Severe Storm(s)	Small	Sullivan County	\$20,463
1773	Severe Storm(s)	Small	Sullivan County	\$13,824
1773	Severe Storm(s)	Small	Sullivan County	\$11,456
1773	Severe Storm(s)	Small	Sullivan County	\$50,798
1773	Severe Storm(s)	Small	Sullivan County	\$8,595
1773	Severe Storm(s)	Small	Sullivan County	\$53,949
1773	Severe Storm(s)	Small	Sullivan County	\$15,889
1773	Severe Storm(s)	Small	Sullivan County	\$21,499
1773	Severe Storm(s)	Small	Sullivan County	\$1,794
1773	Severe Storm(s)	Small	Sullivan County	\$37,204
1773	Severe Storm(s)	Small	Sullivan County	\$15,243
1773	Severe Storm(s)	Small	Sullivan County	\$32,768
1773	Severe Storm(s)	Small	Sullivan County	\$19,922
1773	Severe Storm(s)	Small	Sullivan County	\$15,099
1773	Severe Storm(s)	Small	Sullivan County	\$27,345
1773	Severe Storm(s)	Small	Sullivan County	\$27,725
1773	Severe Storm(s)	Small	Sullivan County	\$23,053

1773	Severe Storm(s)	Small	Sullivan County	\$8,472
1773	Severe Storm(s)	Small	Sullivan County	\$5,854
1773	Severe Storm(s)	Small	Sullivan County	\$10,499
1773	Severe Storm(s)	Small	Sullivan County	\$9,518
1773	Severe Storm(s)	Small	Sullivan County	\$22,764
1773	Severe Storm(s)	Small	Sullivan County	\$1,680
1773	Severe Storm(s)	Small	Sullivan County	\$4,040
1773	Severe Storm(s)	Small	Sullivan County	\$21,856
1773	Severe Storm(s)	Small	Sullivan County	\$26,372
1773	Severe Storm(s)	Small	Sullivan County	\$29,177
1773	Severe Storm(s)	Small	Sullivan County	\$16,718
1773	Severe Storm(s)	Small	Sullivan County	\$23,241
1773	Severe Storm(s)	Small	Sullivan County	\$13,437
1773	Severe Storm(s)	Small	Sullivan County	\$6,608
1773	Severe Storm(s)	Small	Sullivan County	\$1,761
1773	Severe Storm(s)	Small	Sullivan County	\$14,725
1773	Severe Storm(s)	Small	Sullivan County	\$30,528
1773	Severe Storm(s)	Small	Sullivan County	\$39,491
1773	Severe Storm(s)	Small	Sullivan County	\$3,812
1773	Severe Storm(s)	Small	Sullivan County	\$4,140
1773	Severe Storm(s)	Small	Sullivan County	\$15,040
1773	Severe Storm(s)	Small	Sullivan County	\$7,148
1773	Severe Storm(s)	Small	Sullivan County	\$24,753
1773	Severe Storm(s)	Small	Sullivan County	\$19,756
1773	Severe Storm(s)	Small	Sullivan County	\$22,943
1773	Severe Storm(s)	Small	Sullivan County	\$7,732

1773	Severe Storm(s)	Small	Sullivan County	\$11,166
1773	Severe Storm(s)	Small	Sullivan County	\$9,391
1773	Severe Storm(s)	Small	Sullivan County	\$12,242
1773	Severe Storm(s)	Small	Sullivan County	\$9,862
1773	Severe Storm(s)	Small	Sullivan County	\$15,143
1773	Severe Storm(s)	Small	Sullivan County	\$41,720
1773	Severe Storm(s)	Small	Sullivan County	\$40,201
1773	Severe Storm(s)	Small	Sullivan County	\$33,392
1773	Severe Storm(s)	Small	Sullivan County	\$2,540
1773	Severe Storm(s)	Small	Sullivan County	\$33,505
1773	Severe Storm(s)	Small	Sullivan County	\$13,011
1773	Severe Storm(s)	Large	Sullivan County	\$60,693
1773	Severe Storm(s)	Small	Sullivan County	\$25,457
1809	Severe Storm(s)	Small	Sullivan County	\$2,375
1809	Severe Storm(s)	Large	Sullivan County	\$82,240
1809	Severe Storm(s)	Small	Sullivan County	\$5,836
1809	Severe Storm(s)	Small	Sullivan County	\$24,764
1809	Severe Storm(s)	Small	Sullivan County	\$19,494
1809	Severe Storm(s)	Small	Sullivan County	\$2,326
1809	Severe Storm(s)	Small	Sullivan County	\$2,402
1809	Severe Storm(s)	Small	Sullivan County	\$14,230
1809	Severe Storm(s)	Small	Sullivan County	\$4,368
1809	Severe Storm(s)	Small	Sullivan County	\$7,643
1809	Severe Storm(s)	Small	Sullivan County	\$4,065
1809	Severe Storm(s)	Small	Sullivan County	\$4,796
1809	Severe Storm(s)	Small	Sullivan County	\$15,181

1809	Severe Storm(s)	Small	Sullivan County	\$5,087
1809	Severe Storm(s)	Small	Sullivan County	\$5,813
1809	Severe Storm(s)	Small	Sullivan County	\$12,002
1809	Severe Storm(s)	Small	Sullivan County	\$5,301
1809	Severe Storm(s)	Small	Sullivan County	\$14,414
1847	Severe Storm(s)	Small	Sullivan County	\$7,830
1847	Severe Storm(s)	Small	Sullivan County	\$5,974
1847	Severe Storm(s)	Small	Sullivan County	\$5,124
1847	Severe Storm(s)	Small	Sullivan County	\$7,078
1847	Severe Storm(s)	Small	Sullivan County	\$19,360
1847	Severe Storm(s)	Small	Sullivan County	\$5,128
1847	Severe Storm(s)	Small	Sullivan County	\$6,853
1847	Severe Storm(s)	Small	Sullivan County	\$10,133
1847	Severe Storm(s)	Small	Sullivan County	\$10,010
1847	Severe Storm(s)	Small	Sullivan County	\$3,338
1847	Severe Storm(s)	Small	Sullivan County	\$5,356
1847	Severe Storm(s)	Small	Sullivan County	\$36,532
1847	Severe Storm(s)	Small	Sullivan County	\$38,157
1847	Severe Storm(s)	Small	Sullivan County	\$9,486
1847	Severe Storm(s)	Small	Sullivan County	\$13,621
1847	Severe Storm(s)	Small	Sullivan County	\$37,583
1847	Severe Storm(s)	Small	Sullivan County	\$47,697
1847	Severe Storm(s)	Small	Sullivan County	\$15,548
1847	Severe Storm(s)	Large	Sullivan County	\$79,305
1847	Severe Storm(s)	Small	Sullivan County	\$50,358
1847	Severe Storm(s)	Small	Sullivan County	\$10,651

1934	Severe Storm(s)	Small	Sullivan County	\$2,304
1934	Severe Storm(s)	Small	Sullivan County	\$9,012
1934	Severe Storm(s)	Small	Sullivan County	\$4,660
1934	Severe Storm(s)	Small	Sullivan County	\$5,500
1934	Severe Storm(s)	Small	Sullivan County	\$1,630
1934	Severe Storm(s)	Small	Sullivan County	\$2,310
1934	Severe Storm(s)	Small	Sullivan County	\$3,477
1934	Severe Storm(s)	Small	Sullivan County	\$5,868
1934	Severe Storm(s)	Small	Sullivan County	\$12,191
1934	Severe Storm(s)	Small	Sullivan County	\$1,096
1934	Severe Storm(s)	Small	Sullivan County	\$30,925
1934	Severe Storm(s)	Small	Sullivan County	\$7,563
1934	Severe Storm(s)	Small	Sullivan County	\$12,145
1934	Severe Storm(s)	Small	Sullivan County	\$5,103
1934	Severe Storm(s)	Small	Sullivan County	\$5,354
1934	Severe Storm(s)	Small	Sullivan County	\$2,704
1934	Severe Storm(s)	Small	Sullivan County	\$41,514
1934	Severe Storm(s)	Small	Sullivan County	\$7,947
1934	Severe Storm(s)	Small	Sullivan County	\$12,308
1934	Severe Storm(s)	Small	Sullivan County	\$2,382
1934	Severe Storm(s)	Small	Sullivan County	\$7,358
1934	Severe Storm(s)	Small	Sullivan County	\$3,538
1934	Severe Storm(s)	Small	Sullivan County	\$5,693
1934	Severe Storm(s)	Small	Sullivan County	\$3,859
1934	Severe Storm(s)	Small	Sullivan County	\$4,285
1934	Severe Storm(s)	Small	Sullivan County	\$3,910

1934	Severe Storm(s)	Small	Sullivan County	\$7,733
1934	Severe Storm(s)	Small	Sullivan County	\$6,440
1934	Severe Storm(s)	Small	Sullivan County	\$6,167
1934	Severe Storm(s)	Small	Sullivan County	\$2,595
1934	Severe Storm(s)	Small	Sullivan County	\$8,603
1934	Severe Storm(s)	Small	Sullivan County	\$12,183
1934	Severe Storm(s)	Small	Sullivan County	\$5,553
1934	Severe Storm(s)	Small	Sullivan County	\$11,925
1934	Severe Storm(s)	Small	Sullivan County	\$11,293
1934	Severe Storm(s)	Small	Sullivan County	\$11,732
1934	Severe Storm(s)	Small	Sullivan County	\$6,213
1934	Severe Storm(s)	Small	Sullivan County	\$15,455
1934	Severe Storm(s)	Large	Sullivan County	\$287,420
1934	Severe Storm(s)	Small	Sullivan County	\$2,100
1934	Severe Storm(s)	Small	Sullivan County	\$21,807
1934	Severe Storm(s)	Small	Sullivan County	\$40,378
1934	Severe Storm(s)	Small	Sullivan County	\$13,117
1934	Severe Storm(s)	Small	Sullivan County	\$36,976
1934	Severe Storm(s)	Small	Sullivan County	\$2,734
1934	Severe Storm(s)	Small	Sullivan County	\$12,861
1934	Severe Storm(s)	Small	Sullivan County	\$2,680
1934	Severe Storm(s)	Small	Sullivan County	\$2,097
1934	Severe Storm(s)	Small	Sullivan County	\$2,411
1934	Severe Storm(s)	Small	Sullivan County	\$2,053
1934	Severe Storm(s)	Small	Sullivan County	\$1,784
1934	Severe Storm(s)	Small	Sullivan County	\$46,606

1934	Severe Storm(s)	Small	Sullivan County	\$23,550
1934	Severe Storm(s)	Small	Sullivan County	\$9,594
1934	Severe Storm(s)	Small	Sullivan County	\$4,991
1934	Severe Storm(s)	Small	Sullivan County	\$4,266
1934	Severe Storm(s)	Small	Sullivan County	\$3,047
1934	Severe Storm(s)	Small	Sullivan County	\$18,361
1934	Severe Storm(s)	Small	Sullivan County	\$12,385
1934	Severe Storm(s)	Small	Sullivan County	\$2,451
1934	Severe Storm(s)	Small	Sullivan County	\$2,243
1934	Severe Storm(s)	Small	Sullivan County	\$56,575
1934	Severe Storm(s)	Small	Sullivan County	\$5,322
1934	Severe Storm(s)	Small	Sullivan County	\$23,930
1934	Severe Storm(s)	Small	Sullivan County	\$19,901
1934	Severe Storm(s)	Small	Sullivan County	\$33,357
1934	Severe Storm(s)	Small	Sullivan County	\$3,556
1934	Severe Storm(s)	Small	Sullivan County	\$11,890
1934	Severe Storm(s)	Small	Sullivan County	\$13,775
1934	Severe Storm(s)	Small	Sullivan County	\$6,822
1934	Severe Storm(s)	Small	Sullivan County	\$16,506
1934	Severe Storm(s)	Small	Sullivan County	\$17,243
1934	Severe Storm(s)	Large	Sullivan County	\$69,540
1934	Severe Storm(s)	Small	Sullivan County	\$4,436
1934	Severe Storm(s)	Small	Sullivan County	\$2,892
1934	Severe Storm(s)	Small	Sullivan County	\$4,127
1934	Severe Storm(s)	Small	Sullivan County	\$3,709
1934	Severe Storm(s)	Small	Sullivan County	\$6,684

1934	Severe Storm(s)	Small	Sullivan County	\$3,323
1934	Severe Storm(s)	Small	Sullivan County	\$14,424
1934	Severe Storm(s)	Small	Sullivan County	\$4,151
1934	Severe Storm(s)	Small	Sullivan County	\$3,400
1934	Severe Storm(s)	Small	Sullivan County	\$26,736
1934	Severe Storm(s)	Small	Sullivan County	\$2,958
1934	Severe Storm(s)	Small	Sullivan County	\$36,862
1961	Severe Storm(s)	Small	Sullivan County	\$2,901
1961	Severe Storm(s)	Small	Sullivan County	\$3,070
1961	Severe Storm(s)	Small	Sullivan County	\$3,863
1961	Severe Storm(s)	Small	Sullivan County	\$2,339
1961	Severe Storm(s)	Small	Sullivan County	\$2,387
1961	Severe Storm(s)	Small	Sullivan County	\$260
1961	Severe Storm(s)	Small	Sullivan County	\$5,656
1961	Severe Storm(s)	Small	Sullivan County	\$2,097
1961	Severe Storm(s)	Small	Sullivan County	\$9,788
1961	Severe Storm(s)	Small	Sullivan County	\$7,575
1961	Severe Storm(s)	Small	Sullivan County	\$9,127
1961	Severe Storm(s)	Small	Sullivan County	\$5,649
1961	Severe Storm(s)	Small	Sullivan County	\$20,502
1961	Severe Storm(s)	Small	Sullivan County	\$731
1961	Severe Storm(s)	Small	Sullivan County	\$52,392
1961	Severe Storm(s)	Small	Sullivan County	\$4,021
1961	Severe Storm(s)	Small	Sullivan County	\$3,212
1961	Severe Storm(s)	Small	Sullivan County	\$9,986
1961	Severe Storm(s)	Small	Sullivan County	\$5,784

1961	Severe Storm(s)	Small	Sullivan County	\$5,536
1961	Severe Storm(s)	Small	Sullivan County	\$8,178
1961	Severe Storm(s)	Small	Sullivan County	\$6,613
4130	Severe Storm(s)	Large	Sullivan County	\$107,921
4130	Severe Storm(s)	Small	Sullivan County	\$1,723
4130	Severe Storm(s)	Small	Sullivan County	\$5,969
4130	Severe Storm(s)	Small	Sullivan County	\$20,256
4130	Severe Storm(s)	Small	Sullivan County	\$34,232
4130	Severe Storm(s)	Small	Sullivan County	\$1,083
4130	Severe Storm(s)	Small	Sullivan County	\$7,207
4130	Severe Storm(s)	Small	Sullivan County	\$14,786
4130	Severe Storm(s)	Small	Sullivan County	\$2,393
4130	Severe Storm(s)	Small	Sullivan County	\$1,560
4130	Severe Storm(s)	Large	Sullivan County	\$92,140
4130	Severe Storm(s)	Small	Sullivan County	\$54,765
4130	Severe Storm(s)	Small	Sullivan County	\$5,075
4130	Severe Storm(s)	Small	Sullivan County	\$9,711
4200	Severe Storm(s)	Small	Sullivan County	\$24,896
4200	Severe Storm(s)	Small	Sullivan County	\$106,647
4200	Severe Storm(s)	Small	Sullivan County	\$4,777
4200	Severe Storm(s)	Small	Sullivan County	\$56,800
4200	Severe Storm(s)	Small	Sullivan County	\$114,413
4200	Severe Storm(s)	Small	Sullivan County	\$31,598
4200	Severe Storm(s)	Small	Sullivan County	\$64,698
4200	Severe Storm(s)	Small	Sullivan County	\$33,423
4200	Severe Storm(s)	Small	Sullivan County	\$40,708

4200	Severe Storm(s)	Small	Sullivan County	\$3,824
4200	Severe Storm(s)	Small	Sullivan County	\$6,299
4200	Severe Storm(s)	Small	Sullivan County	\$32,291
4200	Severe Storm(s)	Small	Sullivan County	\$15,744
4200	Severe Storm(s)	Small	Sullivan County	\$45,060
4238	Severe Storm(s)	Small	Sullivan County	\$108,104
4238	Severe Storm(s)	Small	Sullivan County	\$45,415
4238	Severe Storm(s)	Large	Sullivan County	\$47,169
4238	Severe Storm(s)	Small	Sullivan County	\$94,526
4238	Severe Storm(s)	Small	Sullivan County	\$90,141
4238	Severe Storm(s)	Small	Sullivan County	\$106,426
4238	Severe Storm(s)	Small	Sullivan County	\$100,763
4238	Severe Storm(s)	Small	Sullivan County	\$107,253
4238	Severe Storm(s)	Small	Sullivan County	\$99,381
4238	Severe Storm(s)	Large	Sullivan County	\$80,877
4238	Severe Storm(s)	Small	Sullivan County	\$99,462
4238	Severe Storm(s)	Small	Sullivan County	\$86,930
4238	Severe Storm(s)	Small	Sullivan County	\$1,000
4451	Severe Storm(s)	Small	Sullivan County	\$22,642
4451	Severe Storm(s)	Small	Sullivan County	\$28,656
4451	Severe Storm(s)	Small	Sullivan County	\$5,738
4451	Severe Storm(s)	Small	Sullivan County	\$10,053
4451	Severe Storm(s)	Small	Sullivan County	\$22,149
4451	Severe Storm(s)	Small	Sullivan County	\$23,545
4451	Severe Storm(s)	Small	Sullivan County	\$32,900
4451	Severe Storm(s)	Small	Sullivan County	\$122,170

4451	Severe Storm(s)	Small	Sullivan County	\$5,649
4451	Severe Storm(s)	Small	Sullivan County	\$4,369
4451	Severe Storm(s)	Small	Sullivan County	\$15,105
4451	Severe Storm(s)	Small	Sullivan County	\$60,052
4451	Severe Storm(s)	Small	Sullivan County	\$27,567
4451	Severe Storm(s)	Small	Sullivan County	\$55,114
4451	Severe Storm(s)	Small	Sullivan County	\$8,606
4451	Severe Storm(s)	Small	Sullivan County	\$112,701
4451	Severe Storm(s)	Small	Sullivan County	\$6,138
4451	Severe Storm(s)	Small	Sullivan County	\$11,867
4451	Severe Storm(s)	Small	Sullivan County	\$33,976
4451	Severe Storm(s)	Small	Sullivan County	\$4,336
4451	Severe Storm(s)	Small	Sullivan County	\$1,349
4451	Severe Storm(s)	Small	Sullivan County	\$18,150
4451	Severe Storm(s)	Small	Sullivan County	\$15,485
4451	Severe Storm(s)	Small	Sullivan County	\$430
4451	Severe Storm(s)	Small	Sullivan County	\$26,761
4451	Severe Storm(s)	Small	Sullivan County	\$6,234
4451	Severe Storm(s)	Small	Sullivan County	\$7,382
Total				\$7,158,126

2.2 Jurisdictional Profiles and Mitigation Capabilities

This section will include profiles for each participating jurisdiction. It will also include a discussion of previous mitigation initiatives in the planning area. There will be 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 communities, the special districts, and the public school districts.

2.2.1 Unincorporated Sullivan County

By Missouri Statue (Section 483.020.1) Sullivan County is defined as a 3rd Class County, meaning it's assessed valuation is less than six hundred million dollars. The County seat is located in Milan.

Sullivan Counth has 5 townships (City of Green Castle, City of Green City, City of Milan, City of Newtown, City of Harris) , 3 Villages (Village of Osgood, Village of Humpreys, Village of Pollock) and 3 Unincorporated Communities (Winigan, Owasco, Reger). The county government provides services such as law enforcement, judicial services, land records, tax collection, property assessment, administration of elections and many additional services.

The County is governed by an elected board of Commissioners composed of Presiding Commissioner and two Associate Commissioners. Other positions within Sullivan County's government include:

- Assessor
- Associate Circuit Judge
- Circuit Clerk

- Collector
- Coroner
- County Clerk
- Emergency Management Director
- Presiding Circuit Judge
- Prosecuting Attorney
- Public Administrator
- Recorder
- Sheriff
- Treasurer
- General Services
- Health Department
- Health Services

Mitigation Initiatives/Capabilities

The County of Sullivan have implemented zoning and building requirements which govern development within the County. The County also has an Emergency Management Director (EMD). The EMD plans and directs disaster responses or crisis management activities, provides disaster preparedness training and prepares emergency plans and procedures for natural disasters.

The County has a Comprehensive Plan, County Emergency Plan, County Mitigation Plan, Transportation Plan, and Mutual Aid Agreements.

Sullivan County's Mitigation initiatives includes:

- Maintain Transportation Infrastructure
- Response to Pandemic
- NOAA Weather Radios
- Generator for Shelter (s)

- Debris Removal

Table 1.15. Unincorporated Sullivan County Mitigation Capabilities

Capabilities	Status Including Date of Document or Policy
Planning Capabilities	
Comprehensive Plan	No
Builder's Plan	No
Capital Improvement Plan	No
City Emergency Operations Plan	NA
County Emergency Operations Plan	Yes, 2019
Local Recovery Plan	NA
County Recovery Plan	Yes, section in EOP
City Mitigation Plan	NA
County Mitigation Plan	Yes, 2016
Debris Management Plan	No
Economic Development Plan	No, in process
Transportation Plan	No, MoDOT TAC members
Land-use Plan	No
Flood Mitigation Assistance (FMA) Plan	No
Watershed Plan	No
Firewise or other fire mitigation plan	No
School Mitigation Plan	NA
Critical Facilities Plan (Mitigation/Response/Recovery)	Yes, section in EOP
Policies/Ordinance	
Zoning Ordinance	No
Building Code	No
Floodplain Ordinance	No
Subdivision Ordinance	No
Tree Trimming Ordinance	No
Nuisance Ordinance	No
Stormwater Ordinance	No
Drainage Ordinance	No
Site Plan Review Requirements	No
Historic Preservation Ordinance	No
Landscape Ordinance	No
Seismic Construction Ordinance	NA
Program	
Zoning/Land Use Restrictions	No
Codes Building Site/Design	No
Hazard Awareness Program	LEPC Programs
National Flood Insurance Program (NFIP)	No
NFIP Community Rating System (CRS) program	No
National Weather Service (NWS) Storm Ready	No
Firewise Community Certification	No
Building Code Effectiveness Grading (BCEGs)	NA
ISO Fire Rating	NA

Capabilities	Status Including Date of Document or Policy
Economic Development Program	No, in process
Land Use Program	No
Public Education/Awareness	Yes, LEPC
Property Acquisition	No
Planning/Zoning Boards	No
Stream Maintenance Program	No
Tree Trimming Program	No
Engineering Studies for Streams (Local/County/Regional)	Yes, Sullivan County Lake Project
Mutual Aid Agreements	No
Studies/Reports/Maps	
Hazard Analysis/Risk Assessment (Local)	NA
Hazard Analysis/Risk Assessment (County)	Yes
Flood Insurance Maps	No
FEMA Flood Insurance Study (Detailed)	No
Evacuation Route Map	Yes, EOP
Critical Facilities Inventory	Yes, EOP
Vulnerable Population Inventory	Yes, EOP
Land Use Map	No
Staff/Department	
Building Code Official	No
Building Inspector	No
Mapping Specialist (GIS)	Yes, contracted
Engineer	No
Development Planner	No
Public Works Official	No
Emergency Management Director	Yes
NFIP Floodplain Administrator	No
Emergency Response Team	No
Hazardous Materials Expert	Yes
Local Emergency Planning Committee	Yes
County Emergency Management Commission	No
Sanitation Department	No
Transportation Department	Yes
Economic Development Department	Yes
Housing Department	No
Historic Preservation	No
Non-Governmental Organizations (NGOs)	
American Red Cross	No
Salvation Army	No
Veterans Groups	Yes
Local Environmental Organization	No
Homeowner Associations	No
Neighborhood Associations	No
Chamber of Commerce	No
Community Organizations (Lions, Kiwanis, etc.)	Yes

Capabilities	Status Including Date of Document or Policy
Local Funding Availability	
Apply for Community Development Block	Yes
Fund projects through Capital	Yes
Authority to levy taxes for a specific purpose	Yes

Fees for water, sewer, gas, or electric services	No
Impact fees for new development	No
Ability to incur debt through general obligation bonds	No
Ability to incur debt through special tax bonds	No
Ability to incur debt through private activities	No
Withhold spending in hazard prone areas	No

Source: Data Collection Questionnaire, 12/08/2020

2.2.2 City of Green Castle

Green Castle is a city in Sullivan County, Missouri, United States. The plat for Green Castle was surveyed on March 12, 1857 at the behest of Victor Doze, Marion Overstreet, E.E. Prindle, I.E. Wood, and M.P. Wood. It consisted of six full blocks and eight half blocks with each block containing eight lots. The area had been inhabited for some time prior to 1857 however, with the first permanent home built on the present site of Green Castle by Marion Sanders circa 1853. Moreover, the Green Castle Methodist Episcopal Church was organized in 1845 and held services just south of the town's later platted location.

The Green Castle post office was established in 1857 with I.E. Wood as first postmaster, followed a short time later by the opening of the new towns' first general store. Green Castle's first grist mill was built in 1879 and a newspaper, the Green Castle Independence began publication in 1881. It was also in 1881 that Green Castle was finally incorporated on August 8, 1881. A depot for the Quincy, Missouri, and Pacific Railroad was built in 1883. A creamery was established in 1885 and produced an average of 1,500 pounds of butter per week.

As of the census of 2010, there were 275 people, 123 households, and 71 families residing in the city. The population density was 611.1 inhabitants per square mile. There were 147 housing units at an average density of 326.7 per square mile. The racial makeup of the city was 99.6% White and 0.4% from two or more races. Hispanic or Latino of any race were 1.5% of the population.

There were 123 households, of which 27.6% had children under the age of 18 living with them, 42.3% were married couples living together, 11.4% had a female householder with no husband present, 4.1% had a male householder with no wife present, and 42.3% were non-families. 39.0% of all households were made up of individuals, and 24.4% had someone living alone who was 65 years of age or older. The average household size was 2.24 and the average family size was 3.03.

The median age in the city was 44.1 years. 23.3% of residents were under the age of 18; 8.8% were between the ages of 18 and 24; 19.6% were from 25 to 44; 25.9% were from 45 to 64; and 22.5% were 65 years of age or older. The gender makeup of the city was 48.0% male and 52.0% female.

The City of Green Castle's mitigation initiatives include:

- Maintain Transportation Infrastructure
- Generator for Shelter/Critical Facilities
- Installation/Upgrade Siren
- Safe Room and Storm Shelters

Table 1.16. City of Green Castle Mitigation Capabilities

Capability	Status Including Date of Document or Policy
Planning Capabilities	
Comprehensive Plan	No
Builder's Plan	NA
Capital Improvement Plan	No
Local Emergency Plan	Yes
County Emergency Plan	NA
Local Recovery Plan	No
County Recovery Plan	NA
Local Mitigation Plan	Yes
County Mitigation Plan	Yes
Local Mitigation Plan (PDM)	NA
County Mitigation Plan (PDM)	NA
Economic Development Plan	No
Transportation Plan	No
Land-use Plan	NA
Flood Mitigation Assistance (FMA) Plan	NA
Watershed Plan	NA
Firewise or other fire mitigation plan	Yes
School Mitigation Plan	NA
Critical Facilities Plan (Mitigation/Response/Recovery)	NA
Policies/Ordinance	

Capability	Status Including Date of Document or Policy
Zoning Ordinance	No
Building Code	No
Floodplain Ordinance	No
Subdivision Ordinance	NA
Tree Trimming Ordinance	NA
Nuisance Ordinance	NA
Storm Water Ordinance	No
Drainage Ordinance	No
Seismic Construction Ordinance	NA
Capability	
Site Plan Review Requirements	No
Historic Preservation Ordinance	No
Landscape Ordinance	NA
Iowa Wetlands and Riparian Areas Conservation Plan	NA
Debris Management Plan	No
Program	
Zoning/Land Use Restrictions	No
Codes Building Site/Design	No
National Flood Insurance Program (NFIP) Participant	No
NFIP Community Rating System (CRS) Participating Community	No
Hazard Awareness Program	NA
National Weather Service (NWS) Storm Ready	Yes
Building Code Effectiveness Grading (BCEGs)	No
ISO Fire Rating	Yes, 6
Economic Development Program	No
Land Use Program	NA
Public Education/Awareness	No
Property Acquisition	NA
Planning/Zoning Boards	NA
Stream Maintenance Program	NA
Tree Trimming Program	NA
Engineering Studies for Streams (Local/County/Regional)	NA
Mutual Aid Agreements	Yes
Studies/Reports/Maps	
Hazard Analysis/Risk Assessment (Local)	NA
Hazard Analysis/Risk Assessment (County)	NA
Flood Insurance Maps	No
FEMA Flood Insurance Study (Detailed)	No
Evacuation Route Map	NA
Critical Facilities Inventory	No
Vulnerable Population Inventory	No
Land Use Map	NA
Staff/Department	
Building Code Official	No
Building Inspector	No
Mapping Specialist (GIS)	No
Engineer	No
Development Planner	No
Public Works Official	Yes
Emergency Management Coordinator	Yes
NFIP Floodplain Administrator	No
Emergency Response Team	NA
Hazardous Materials Expert	NA
Local Emergency Planning Committee	No
County Emergency Management Commission	No

Capability	Status Including Date of Document or Policy
Sanitation Department	No
Transportation Department	No
Economic Development Department	No
Housing Department	No
Historic Preservation	No
Non-Governmental Organizations (NGOs)	
American Red Cross	No
Salvation Army	No
Veterans Groups	No
Environmental Organization	No
Homeowner Associations	No
Neighborhood Associations	No
Chamber of Commerce	No
Community Organizations (Lions, Kiwanis, etc.)	Yes
Local Funding Availability	
Ability to apply for Community Development Block Grants	Yes
Ability to fund projects through Capital Improvements funding	No
Authority to levy taxes for a specific purpose	Yes
Fees for water, sewer, gas, or electric services	Yes
Impact fees for new development	No
Ability to incur debt through general obligation bonds	Yes
Ability to incur debt through special tax bonds	Yes
Ability to incur debt through private activities	No
Ability to withhold spending in hazard prone areas	No

Source: Data Collection Questionnaire, 02/15/2021

2.2.3 City of Green City

Green City is a city in Sullivan County, Missouri, United States. According to the United States Census Bureau, the city has a total area of 1.46 square miles, of which 1.43 square miles is land and 0.03 square miles is water. Green City traces its beginnings to April, 1880 when Sullivan County farmer Henry Pfeiffer commissioned surveyor Thomas J. Dockery to lay out the town in what had previously been a cornfield. The town plat consisted of fifty lots, each 60-by-130 feet. The impetus for the town was the Quincy, Missouri & Pacific railway, which laid tracks close by in the early 1880s. A rail depot was built with donations from area farmers, and in 1881 C. B. Comstock built a store and warehouse. Around the same time a small frame building was moved from the nearby village of Kiddville by S.H. Davis who used it as a post office when he became Green City's first postmaster. Green City was officially incorporated on February 10, 1882.

Green City, Missouri, is the site of Widmark Airport (FAA LID: MO83). Towns the size of Green City, whose population numbered only 688 inhabitants in 2000, usually do not have airports, but Richard Widmark owned a cattle ranch in the area during the 1950s and 1960s.

Widmark contributed funds to the construction of an airport which led to its being named in his honor.

As of the census of 2010, there were 657 people, 316 households, and 181 families residing in the city. The population density was 459.4 inhabitants per square mile (177.4/km²). There were 357 housing units at an average density of 249.7 per square mile (96.4/km²). The racial makeup of the city was 93.3% White, 0.3% African American, 0.8% Native American, 0.3% Asian, 3.5% from other races, and 1.8% from two or more races. Hispanic or Latino of any race were 6.8% of the population.

There were 316 households, of which 25.0% had children under the age of 18 living with them, 40.8% were married couples living together, 12.7% had a female householder with no husband present, 3.8% had a male householder with no wife present, and 42.7% were non-families. 39.6% of all households were made up of individuals, and 17.8% had someone living alone who was 65 years of age or older. The average household size was 2.08 and the average family size was 2.71.

The median age in the city was 45.8 years. 20.5% of residents were under the age of 18; 6.5% were between the ages of 18 and 24; 21.1% were from 25 to 44; 30.6% were from 45 to 64; and 21.3% were 65 years of age or older. The gender makeup of the city was 48.1% male and 51.9% female.

The City of Green City's mitigation initiatives include:

- Generator for Shelters/Critical Facilities
- Maintain Transportation Infrastructure
- Safe Room and Storm Shelters
- Installation /Upgrade Siren
- NFIP Participation

Table 1.17. City of Green City Mitigation Capabilities

Capability	Status Including Date of Document or Policy
Planning Capabilities	
Comprehensive Plan	No
Builder's Plan	NA
Capital Improvement Plan	No
Local Emergency Plan	No
County Emergency Plan	NA
Local Recovery Plan	No

Capability	Status Including Date of Document or Policy
County Recovery Plan	NA
Local Mitigation Plan	Yes
County Mitigation Plan	Yes
Local Mitigation Plan (PDM)	NA
County Mitigation Plan (PDM)	NA
Economic Development Plan	Yes
Transportation Plan	No
Land-use Plan	NA
Flood Mitigation Assistance (FMA) Plan	NA
Watershed Plan	NA
Firewise or other fire mitigation plan	Yes
School Mitigation Plan	NA
Critical Facilities Plan (Mitigation/Response/Recovery)	NA
Policies/Ordinance	
Zoning Ordinance	Yes
Building Code	Yes
Floodplain Ordinance	No
Subdivision Ordinance	NA
Tree Trimming Ordinance	NA
Nuisance Ordinance	NA
Storm Water Ordinance	No
Drainage Ordinance	No
Seismic Construction Ordinance	NA
Capability	
Site Plan Review Requirements	No
Historic Preservation Ordinance	No
Landscape Ordinance	NA
Iowa Wetlands and Riparian Areas Conservation Plan	NA
Debris Management Plan	No
Program	
Zoning/Land Use Restrictions	No
Codes Building Site/Design	No
National Flood Insurance Program (NFIP) Participant	No
NFIP Community Rating System (CRS) Participating Community	No
Hazard Awareness Program	NA
National Weather Service (NWS) Storm Ready	No
Building Code Effectiveness Grading (BCEGs)	No
ISO Fire Rating	Yes, 7
Economic Development Program	No
Land Use Program	NA
Public Education/Awareness	No
Property Acquisition	NA
Planning/Zoning Boards	NA
Stream Maintenance Program	NA
Tree Trimming Program	NA
Engineering Studies for Streams (Local/County/Regional)	NA
Mutual Aid Agreements	Yes
Studies/Reports/Maps	
Hazard Analysis/Risk Assessment (Local)	NA
Hazard Analysis/Risk Assessment (County)	NA
Flood Insurance Maps	No
FEMA Flood Insurance Study (Detailed)	No
Evacuation Route Map	NA

Capability	Status Including Date of Document or Policy
Critical Facilities Inventory	No
Vulnerable Population Inventory	No
Land Use Map	NA
Staff/Department	
Building Code Official	No
Building Inspector	No
Mapping Specialist (GIS)	No
Engineer	No
Development Planner	No
Public Works Official	Yes
Emergency Management Coordinator	No
NFIP Floodplain Administrator	No
Emergency Response Team	NA
Hazardous Materials Expert	NA
Local Emergency Planning Committee	No
County Emergency Management Commission	No
Sanitation Department	Yes
Transportation Department	No
Economic Development Department	No
Housing Department	No
Historic Preservation	No
Non-Governmental Organizations (NGOs)	
American Red Cross	No
Salvation Army	No
Veterans Groups	Yes
Environmental Organization	No
Homeowner Associations	No
Neighborhood Associations	No
Chamber of Commerce	Yes
Community Organizations (Lions, Kiwanis, etc.)	Yes
Local Funding Availability	
Ability to apply for Community Development Block Grants	Yes
Ability to fund projects through Capital Improvements funding	No
Authority to levy taxes for a specific purpose	No
Fees for water, sewer, gas, or electric services	Yes
Impact fees for new development	No
Ability to incur debt through general obligation bonds	No
Ability to incur debt through special tax bonds	Yes
Ability to incur debt through private activities	No
Ability to withhold spending in hazard prone areas	No

Source: Data Collection Questionnaire, 01/20/2021

2.2.4 City of Milan

Milan is a city in Sullivan County, Missouri, United States. Milan is the County Seat of Sullivan.

Milan is located at the intersection of Missouri routes 5 and 6. Locust Creek flows past the west side of the city and the Locust Creek Conservation Area is three miles to the southwest. According to the United States Census Bureau, the city has a total area of 1.78 square miles, of which 1.77 square miles is land and 0.01 square miles is water. Milan was

laid out in 1845, and most likely named after Milan, in Italy. A post office called Milan has been in operation since 1847

As of the census of 2010, there were 1,960 people, 746 households, and 462 families living in the city. The population density was 1,107.3 inhabitants per square mile. There were 845 housing units at an average density of 477.4 per square mile. The racial makeup of the city was 74.7% White, 0.6% African American, 0.4% Native American, 0.3% Asian, 0.4% Pacific Islander, 22.4% from other races, and 1.2% from two or more races. Hispanic or Latino of any race were 45.3% of the population.

There were 746 households, of which 36.6% had children under the age of 18 living with them, 41.6% were married couples living together, 12.3% had a female householder with no husband present, 8.0% had a male householder with no wife present, and 38.1% were non-families. 31.5% of all households were made up of individuals, and 15.6% had someone living alone who was 65 years of age or older. The average household size was 2.56 and the average family size was 3.24.

The median age in the city was 32.9 years. 28.1% of residents were under the age of 18; 9.6% were between the ages of 18 and 24; 28.4% were from 25 to 44; 21.7% were from 45 to 64; and 12.4% were 65 years of age or older. The gender makeup of the city was 50.0% male and 50.0% female.

The City of Milan's mitigation initiatives include:

- Generator for Shelters/Critical Facilities
- Maintain Transportation Infrastructure
- Safe Room and Storm Shelters
- Installation /Upgrade Siren
- NFIP Participation

Table 1.18. City of Milan Mitigation Capabilities

Capability	Status Including Date of Document or Policy
Planning Capabilities	
Comprehensive Plan	Yes, 2001
Builder's Plan	NA
Capital Improvement Plan	No
Local Emergency Plan	Uncertain
County Emergency Plan	NA

Capability	Status Including Date of Document or Policy
Local Recovery Plan	No
County Recovery Plan	NA
Local Mitigation Plan	Yes
County Mitigation Plan	Yes
Local Mitigation Plan (PDM)	NA
County Mitigation Plan (PDM)	NA
Economic Development Plan	No
Transportation Plan	No
Land-use Plan	NA
Flood Mitigation Assistance (FMA) Plan	NA
Watershed Plan	NA
Firewise or other fire mitigation plan	Yes
School Mitigation Plan	NA
Critical Facilities Plan (Mitigation/Response/Recovery)	NA
Policies/Ordinance	
Zoning Ordinance	Yes
Building Code	Yes
Floodplain Ordinance	Yes
Subdivision Ordinance	NA
Tree Trimming Ordinance	NA
Nuisance Ordinance	NA
Storm Water Ordinance	No
Drainage Ordinance	No
Seismic Construction Ordinance	NA
Capability	
Site Plan Review Requirements	Yes
Historic Preservation Ordinance	No
Landscape Ordinance	NA
Iowa Wetlands and Riparian Areas Conservation Plan	NA
Debris Management Plan	No
Program	
Zoning/Land Use Restrictions	No
Codes Building Site/Design	No
National Flood Insurance Program (NFIP) Participant	Yes
NFIP Community Rating System (CRS) Participating Community	No
Hazard Awareness Program	NA
National Weather Service (NWS) Storm Ready	No
Building Code Effectiveness Grading (BCEGs)	No
ISO Fire Rating	Yes, 5
Economic Development Program	No
Land Use Program	NA
Public Education/Awareness	No
Property Acquisition	NA
Planning/Zoning Boards	NA
Stream Maintenance Program	NA
Tree Trimming Program	NA
Engineering Studies for Streams (Local/County/Regional)	NA
Mutual Aid Agreements	Yes
Studies/Reports/Maps	
Hazard Analysis/Risk Assessment (Local)	NA
Hazard Analysis/Risk Assessment (County)	NA
Flood Insurance Maps	No
FEMA Flood Insurance Study (Detailed)	No

Capability	Status Including Date of Document or Policy
Evacuation Route Map	NA
Critical Facilities Inventory	No
Vulnerable Population Inventory	No
Land Use Map	NA
Staff/Department	
Building Code Official	No
Building Inspector	No
Mapping Specialist (GIS)	No
Engineer	No
Development Planner	No
Public Works Official	Yes
Emergency Management Coordinator	Yes
NFIP Floodplain Administrator	No
Emergency Response Team	NA
Hazardous Materials Expert	NA
Local Emergency Planning Committee	No
County Emergency Management Commission	No
Sanitation Department	No
Transportation Department	Yes
Economic Development Department	No
Housing Department	No
Historic Preservation	No
Non-Governmental Organizations (NGOs)	
American Red Cross	No
Salvation Army	No
Veterans Groups	Yes
Environmental Organization	No
Homeowner Associations	No
Neighborhood Associations	No
Chamber of Commerce	No
Community Organizations (Lions, Kiwanis, etc.)	Yes
Local Funding Availability	
Ability to apply for Community Development Block Grants	Yes
Ability to fund projects through Capital Improvements funding	Yes
Authority to levy taxes for a specific purpose	Yes
Fees for water, sewer, gas, or electric services	Yes
Impact fees for new development	Yes
Ability to incur debt through general obligation bonds	Yes
Ability to incur debt through special tax bonds	Yes
Ability to incur debt through private activities	No
Ability to withhold spending in hazard prone areas	No

Source : Data Collection Questionnaire, December 2020

2.2.5 Summary of Jurisdictional Capabilities

Table 2.12 summarizes the mitigation capabilities of Phelps County and its jurisdictions.

Table 1.19. Mitigation Capabilities Summary Table

CAPABILITIES	Unincorporated Sullivan County	City of Green Castle	City of Green City	Milan
Planning Capabilities				
Comprehensive Plan	No	No	No	Yes
Builder's Plan	No	No	No	No
Capital Improvement Plan	No	No	No	No
Local Emergency Plan	NA	Yes	Yes	No
County Emergency Plan	Yes	NA	NA	NA
Local Recovery Plan	NA	No	No	No
County Recovery Plan	Yes	NA	NA	NA
Local Mitigation Plan	NA	Yes	Yes	No
County Mitigation Plan	Yes	Yes	Yes	NA
Local Mitigation Plan (PDM)	No	NA	NA	NA
County Mitigation Plan (PDM)	No	NA	NA	NA
Debris Management Plan	No	No	No	No
Economic Development Plan	No	No	Yes	No
Transportation Plan	No	No	No	No
Land-use Plan	No	No	No	No
Flood Mitigation Assistance (FMA) Plan	No	No	No	No
Watershed Plan	NA	No	No	No
Firewise or other fire mitigation plan	Yes	Yes	No	No
School Mitigation Plan	NA	NA	NA	NA
Critical Facilities Plan (Mitigation/Response/Recovery)	Yes	NA	NA	NA
Policies/Ordinance				

CAPABILITIES	Unincorporated Sullivan County	City of Green Castle	City of Green City	Milan
Zoning Ordinance	No	No	Yes	Yes
Building Code	No	No	Yes	Yes
Floodplain Ordinance	No	No	No	Yes
Subdivision Ordinance	No	NA	NA	NA
Tree Trimming Ordinance	No	NA	NA	NA
Nuisance Ordinance	No	NA	NA	NA
Storm Water Ordinance	No	No	No	No
Drainage Ordinance	No	No	No	No
Site Plan Review Requirements	No	No	No	Yes
Historic Preservation Ordinance	No	No	No	No
Landscape Ordinance	No	NA	NA	NA
Seismic Construction Ordinance	NA	NA	NA	NA
Program				
Zoning/Land Use Restrictions	No	NA	NA	NA
Codes Building Site/Design	No	NA	NA	NA
National Flood Insurance Program (NFIP) Participant	No	No	No	es
NFIP Community Rating System (CRS) Participating Community	No	No	No	No
Hazard Awareness Program	Yes	NA	NA	NA
National Weather Service (NWS) Storm Ready	No	Yes	Yes	Yes
Building Code Effectiveness Grading (BCEGs)	No	No	No	No
ISO Fire Rating	No	Yes, 6	Yes, 7	Yes, 5
Economic Development Program	No	NA	NA	NA
Land Use Program	No	NA	NA	NA
Public Education/Awareness	Yes	No	No	No
Property Acquisition	No	NA	NA	NA

CAPABILITIES	Unincorporated Sullivan County	City of Green Castle	City of Green City	Milan
Planning/Zoning Boards	No	NA	NA	NA
Stream Maintenance Program	No	NA	NA	NA
Tree Trimming Program	No	NA	NA	NA
Engineering Studies for Streams (Local/County/Regional)	Yes	NA	NA	NA
Mutual Aid Agreements	Yes	Yes	Yes	Yes
Studies/Reports/Maps				
Hazard Analysis/Risk Assessment (Local)	NA	NA	NA	NA
Hazard Analysis/Risk Assessment (County)	Yes	NA	NA	NA
Flood Insurance Maps	No	No	No	No
FEMA Flood Insurance Study (Detailed)	No	No	No	No
Evacuation Route Map	Yes	NA	NA	NA
Critical Facilities Inventory	Yes	No	No	No
Vulnerable Population Inventory	Yes	No	No	No
Land Use Map	No	NA	NA	NA
Staff/Department				
Building Code Official	No	No	No	No
Building Inspector	No	No	No	No
Mapping Specialist (GIS)	Yes	No	No	No
Engineer	No	No	No	No
Development Planner	No	No	No	No
Public Works Official	No	Yes	Yes	Yes
Emergency Management Coordinator	Yes	No	No	No
NFIP Floodplain Administrator	No	No	No	No
Emergency Response Team	No	No	No	No
Hazardous Materials Expert	Yes	No	No	No

CAPABILITIES	Unincorporated Sullivan County	City of Green Castle	City of Green City	Milan
Local Emergency Planning Committee	Yes	Yes	No	Yes
County Emergency Management Commission	No	No	No	No
Sanitation Department	No	No	Yes	No
Transportation Department	Yes	No	No	Yes
Economic Development Department	No	No	No	No
Housing Department	No	No	No	No
Historic Preservation	No	No	No	No
Non-Governmental Organizations (NGOs)				
American Red Cross	No	No	No	No
Salvation Army	No	No	No	No
Veterans Groups	Yes	No	Yes	Yes
Environmental Organization	No	No	No	No
Homeowner Associations	No	No	No	No
Neighborhood Associations	No	No	No	No
Chamber of Commerce	No	No	Yes	No
Community Organizations (Lions, Kiwanis, etc.	Yes	No	Yes	Yes
Financial Resources				
Apply for Community Development Block Grants	Yes	Yes	Yes	Yes
Fund projects through Capital Improvements funding	Yes	No	No	Yes
Authority to levy taxes for specific purposes	Yes	Yes	No	Yes
Fees for water, sewer, gas, or electric services	No	Yes	Yes	Yes
Impact fees for new development	No	No	No	Yes

CAPABILITIES	Unincorporated Sullivan County	City of Green Castle	City of Green City	Milan
Incur debt through general obligation bonds	No	Yes	No	Yes
Incur debt through special tax bonds	No	Yes	Yes	Yes
Incur debt through private activities	No	No	No	No
Withhold spending in hazard prone areas	No	No	No	No

Source: Data Collection Questionnaires

2.2.6 Public School District Profiles and Mitigation Capabilities

Sullivan County is served by five school districts. Three of these districts (Newtown Harris R-III,

Milan C-2 and Green City R-I) are located wholly within Sullivan County and have all their school

campuses and infrastructure inside the County. Grundy County R-V is based in the City of Galt,

in neighboring Grundy County and maintains a school campus in the Village of Humphreys, which is in Sullivan County. The last of the five districts has all of its school campuses and infrastructure in neighboring Linn Sullivan County and merely has a portion of its district area overlapping the County line into Sullivan.

Figure 1.10. Figure 2.4 Sullivan County School Districts

Figure 1.11.

Figure 1.12.

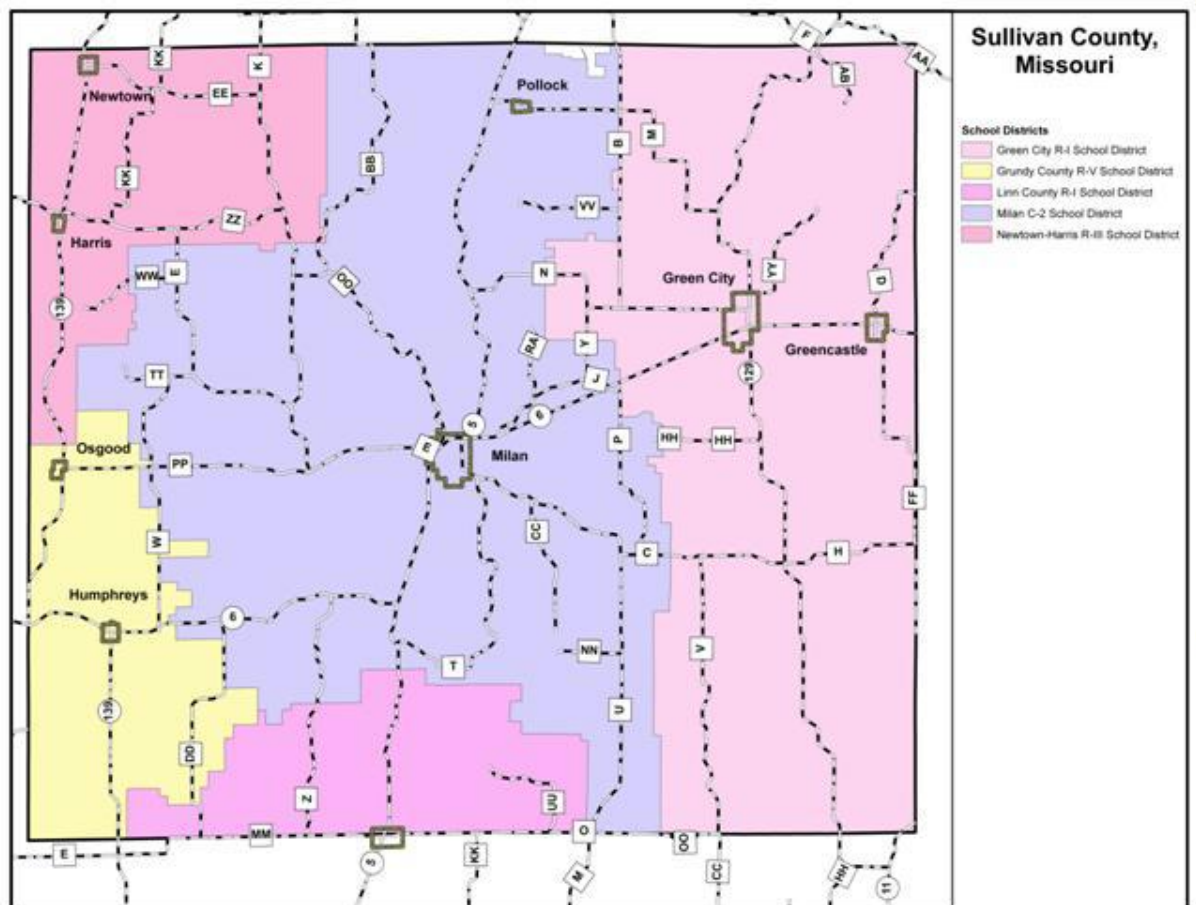


Figure 1.13.

The Public Schools within the planning area include the following:

Green City R-1 School District- Green City
 Green City Elementary School (K-06)
 Green City High School (07-12)

Newtown-Harris R-III School District- Newtown
 Newtown-Harris Elementary School (K-06)
 Newtown-Harris High School (07-12)

Milan C-2 School District- Milan
 Milan Elementary (PK-06)
 Milan High (07-12)

Table 1.20. Sullivan County School District Buildings and Enrollment Data, March 2021

District Name	Building Name	Building Enrolment
Green City R-1 School District	Elementary	163
	Middle School	-
	Junior High	-
	High School	123
Newtown-Harris R-III School District	Elementary	36
	Middle School	-
	Junior High	-
	High School	37
Milan C-2 School District	Elementary	347
	Middle School	-
	Junior High	-
	High School	302
Total		

Source: <http://mcids.dese.mo.gov/quickfacts/Pages/District-and-School-Information.aspx>, March 2021

Table 1.21. Summary of Mitigation Capabilities-Sullivan County Schools

Capability	Green City R-I	Milan C-2	Newtown-Harris R-III
Planning Elements			
Master Plan/ Date	Yes	Yes	Yes
Capital Improvement Plan/Date	No	Yes	No
School Emergency Plan / Date	Yes, 2020	Yes, January 2003	Yes, 8/10/2016
Weapons Policy/Date	Yes, 2020	Yes, July 2014	Yes, April 2018
Personnel Resources			
Full-Time Building Official (Principal)	Yes, Superintendent/Principal	Yes Superintendent/Principal	Yes, Superintendent/Principals
Emergency Manager	Yes, Superintendent	Yes, Principal	Yes, Superintendent/SRO
Grant Writer	No	No	No
Public Information Officer	Yes, Superintendent	Yes, Superintendent	Yes, Superintendent
Financial Resources			
Capital Improvements Project Funding	Yes	Yes	Yes
Local Funds	Yes	No	Yes
General Obligation Bonds	Yes – voter approval	No	No
Special Tax Bonds	Yes – voter approval	No	No
Private Activities/Donations	Yes	No	No
State and Federal Funds/Grants	Yes	Yes	Yes
Other			
Public Education Programs	Yes	Yes	No
Privately or Self- Insured?	Private	Private	Private
Fire Evacuation Training	Yes	Yes	Yes
Tornado Sheltering Exercises	Yes	Yes	Yes
Public Address/Emergency Alert System	Yes	Yes	Yes
NOAA Weather Radios	Yes	Yes	Yes
Lock-Down Security Training	Yes	Yes	Yes
Mitigation Programs	No	No	No
Tornado Shelter/Saferoom	Yes, not FEMA cert.	No	No
Campus Police	No	No	Yes/SRO POST certified

Source : Data Collection Questionnaire, December 2020

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	Hazard Profile				<i>cxxxii</i>
	Vulnerability				<i>cxxxviii</i>
	Problem Statement				<i>cxxxix</i>
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	Hazard Profile				<i>cxl</i>
	Vulnerability				<i>cxlvi</i>
	Problem Statement				<i>cxlviii</i>
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44 CFR Requirement §201.6(c)(2): [The plan shall include] A risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards

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.

The risk assessment for Sullivan County and its jurisdictions followed the methodology described in the Local Mitigation Planning Handbook (March 2013).

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 Land Use and Development** discusses development that has occurred since the last plan update and any increased or decreased risk that resulted. This section also discusses areas of planned future development and any implications on risk/vulnerability;
- **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 Strength/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

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...of all natural hazards that can affect the jurisdiction.

The Sullivan County Emergency Management Director, along with members of the MPC and the Green Hills Regional Planning Commission, reviewed existing mitigation plans, researched historical disaster declaration records, and surveyed various other sources, including anecdotal information, to fairly identify hazards to be included in this plan.

3.1.1 Review of Existing Mitigation Plans

The MPC previously developed a multi-jurisdiction Hazard Mitigation Plan dated March 24, 2016 and Sullivan County, Green Castle, Green City, Harris, Humphreys, Milan, Newtown, Green City R-I School District, Newtown-Harris R-III School District, and Milan C-2 School District participated in the multi-jurisdictional county wide-plan. The 2015 Hazard Mitigation Plan was consulted in development of the risk assessment and information included and updated where appropriate.

The MPC decided to include only natural hazards, as only natural hazards are required by federal regulation to be included. The human-caused and technological hazards were eliminated from further analysis due to these hazards are not necessary for plans to meet the requirements of the Disaster Mitigation Act of 2000.

Levee failure was excluded from the mitigation planning process as there are no mapped levees nor associated levee protected areas within or immediately upstream of Sullivan County per the 2018 Missouri State Hazard Mitigation Plan.

3.1.2 Review Disaster Declaration History

Federal and state 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 list the federal FEMA disaster declarations in Sullivan County from 1965 to present.

Table 1.22. FEMA Disaster Declarations that included Sullivan County, Missouri, 2007 - Present

Disaster Number	Description	Declaration Date Incident Period	Individual Assistance (IA) Public Assistance (PA)
1708-DR	Severe Storms, Flooding	June 11, 2007 05/05/2007 – 05/18/2007	PA
1736-DR	Severe Winter Storm	December 07, 2007 1/06/2007 – 12/17/2007	PA
1773-DR	Severe Storms, Flooding	June 25, 2008 06/01/2008 – 07/13/2008	PA
1809-DR	Severe Storms, Flooding, Tornado	November 13, 2008 09/11/2008 – 09/24/2008	PA
1847-DR	Severe Storms, Flooding, Tornados	June 19, 2009 05/08/2009 – 05/16/2009	PA
1934-DR	Severe Storms, Flooding, Tornados	August 17, 2010 06/12/2010 – 07/31/2010	PA
1961-DR	Severe Winter Storm, Snow	March 23, 2011 01/31/2011 – 02/05/2011	PA Snow Removal
4130-DR	Severe Storms, Tornado, Straight Line Winds	August 7, 2013 05/15/2013 – 07/27/2013	PA
4200-DR	Severe Storms, Tornados, Straight Line Winds, Flooding	October 31, 2014 09/09/2014 – 09/11/2014	PA
4238-DR	Severe Storms, Tornados, Straight Line Winds,	August 7, 2015 05/15/2015 – 07/27/2015	PA
4451-DR	Severe Storm	July 9, 2019 04/29/2019 – 07/05/2019	PA

Source: Federal Emergency Management Agency,
<https://www.fema.gov/data-visualization-summary-disaster-declarations-and-grants>

3.1.3 Research Additional Sources

List of the additional sources of data on locations and past impacts of hazards in the planning area:

- Missouri Hazard Mitigation Plans (2013, 2018)
- 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
 - Flood Insurance Administration
 - Hazards US (HAZUS)
 - Missouri Department of Transportation
 - Missouri Division of Fire Marshal Safety
 - Missouri Public Service Commission
 - National Fire Incident Reporting System (NFIRS)
 - National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information (NCEI);
 - Pipeline and Hazardous Materials Safety Administration
 - County and local Comprehensive Plans to the extent available
 - County Emergency Management
 - County Flood Insurance Rate Map, FEMA
 - Flood Insurance Study, 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)
 - Various articles and publications available on the internet (sources are cited in the body of the Plan)

The only centralized source of data for many of the weather-related hazards is the National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information (NCEI). Although it is usually the best and most current source, there are limitations to the data which should be noted. The NCEI 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 NCEI 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 NCEI should be cautious as the NWS does not guarantee the accuracy or validity of the information.

The NCEI 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 March 2014, 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 NCEI 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

The table below lists in alphabetical order the hazards that significantly impact Sullivan County that were chosen by the MPC for further analysis. Not all hazards impact every jurisdiction. An “X” in the table column indicates the jurisdiction is impacted by the hazards, and an empty cell indicates the hazard is not applicable to the jurisdiction. Each of the hazards listed have an equal likelihood of occurrence throughout the county and its communities, with the exception of dam failure, and flooding failure which by natural are located in low-lying areas downstream from dams, and rivers.

Table 1.23. Hazards Identified for Each Jurisdiction

Jurisdiction	Dam Failure	Drought	Earthquake	Extreme Temperatures	Flooding (River and Flash)	Land Subsidence/Sinkholes	Severe Winter Weather	Thunderstorm/Lightning/Hail/ High Wind	Tornado	Wildfire	Pandemic
Sullivan County	x	x	x	x	x	x	x	x	x	x	x
City of Green Castle	-	X	X	X	X	-	X	X	X	X	X
City of Green City	-	X	X	X	X	-	X	X	X	X	X
City of Milan	-	X	X	X	X	-	X	X	X	X	X
City of Newtown	-	X	X	X	X	-	X	X	X	X	X
Schools and Special Districts											
Green City R-I School District	-	-	X	-	-	-	X	X	X	X	X
Newtown-Harris R-III School District	-	-	X	-	-	-	X	X	X	X	X
Milan C-2 School District	-	-	X	-	-	-	X	X	X	X	X

3.1.5 Multi-Jurisdictional Risk Assessment

For this multi-jurisdictional plan, the risk assessment assesses each jurisdiction's risk where they deviate from risk's facing the entire county. Sullivan County is not geographically large at 652 square miles, and is fairly uniform in terms of climate and topography, as well as construction characteristics and development trends. Accordingly, overall hazards and vulnerability do not vary greatly across the planning area.

This is an update to the March 2016 plan. For this update, all hazards were assessed on a county-wide basis. Some hazards, like flooding, vary in risk across the planning area. Those variations were discussed by the MPC and included in the profile where appropriate. The hazards that vary across the planning area, in terms of risk, are dam failure, flash flood, levee failure, Land Subsidence/Sinkholes and floods.

The county is essentially rural with more densely populated areas in and around Milan. There are 3 schools throughout the County. Milan is situated along Highway 5. Row crops and silage across the county are susceptible to drought, floods, hail, and high winds. Livestock is not as big a concern but ranching is adversely affected by flooding, drought, and extremes of heat and cold. Where appropriate, these extremes will be explained in greater detail in the vulnerability sections of each hazard.

Each hazard identified in Section 3.1, Hazard Identification, is profiled individually in this section in alphabetical order for easier reference. The level of information presented in the profiles varies by hazard based on the information available. With each update of this plan, new information will be incorporated to provide for better evaluation and prioritization of the hazards that affect Sullivan County.

The sources used to collect information for these profiles include those mentioned in Section 3.1.3. and those cited individually in each hazard section. Detailed profiles for each of the identified hazards include information on the following characteristics of the hazard.

Hazard Description

This section consists of a general description of the hazard and the types of impacts it may have on a community. It also includes a ranking to indicate typical warning times and duration of hazard events.

Historical Statistics

This section describes the geographic extent or location of the hazard in the planning area and includes the information on historic incidents and their impacts based upon the sources described in Section 3.1.4, Hazard Identification and the information provided by the MPC. Where available, maps are utilized to indicate the areas of the planning region that are vulnerable to the subject hazard.

Probability of Future Occurrence

The frequency of past events is used to gauge the likelihood of future occurrences. Where possible, the probability and severity of occurrence was calculated based on historical data.

Probability was determined by dividing the number of events observed by the number of years and multiplying by 100. This gives the percent chance of the event happening in any given year. An example would be three droughts occurring over a 30-year period, which suggests 10 percent chance of drought in any given year.

Magnitude of Severity

The magnitude of the impact of a hazard event (past and perceived) is related directly to the vulnerability of the people, property, and the environment it affects. This is a function of when the event occurs, the location affected, the resilience of the community, and the effectiveness of the emergency response and disaster recovery efforts.

3.2 ASSETS AT RISK

In this section of the plan, the Sullivan County population, structures, critical facilities and infrastructure, and other important assets in the planning area that may be at risk to natural hazards. Table 3.3 shows the total population, building count, estimated value of buildings, estimated value of contents and estimated total exposure to parcels by jurisdiction. There were no changes to the planning area since the previously approved plan was adopted.

3.2.1 Total Exposure of Population and Structures

Unincorporated County and Incorporated Cities

In the following three tables, population data is based on 2019 Census Bureau data. Building counts values are based on parcel data provided by the 2018 Missouri State Hazard Mitigation Plan, which can be found at the following website, https://sema.dps.mo.gov/docs/programs/LRMF/mitigation/MO_Hazard_Mitigation_Plan2018.pdf

Table 1.24. Maximum Population and Building Exposure by Jurisdiction

Jurisdiction	2019 Annual Population Estimate	Building Count	Building Exposure (\$)	Contents Exposure (\$)	Total Exposure (\$)
Unincorporated Sullivan County	2,282	6,545	\$190,724.78	\$109,753	\$300,477.78
City of Green Castle	2,838	102	\$13,529.31	\$7,961	\$21,490.31
City of Green City	275	324	\$40,952.19	\$22,001	\$62,953.19
City of Milan	657	747	\$108,135.30	\$63,497	\$171,632.30
City of Newtown	195	99	\$10,298.19	\$5,023	\$15,321.19
Totals	6,247	7,817	\$363,639.77	\$208,235	\$571,7874.77

Source: U.S. Bureau of the Census, Annual population estimates/ 5-Year American Community Survey 2019; Building Count and Building Exposure, Missouri GIS Database from SEMA Mitigation Management; 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%). For purposes of these calculations, government, school, and utility were calculated at the commercial contents rate.

Table 1.25. Building Values/Exposure by Usage Type

Jurisdiction	Residential	Commercial	Industrial	Agricultural	Total
Unincorporated Sullivan	\$155,195.71	\$9,612.88	\$14,598.50	\$10,672.92	\$190,724.78
City of Green Castle	\$11,136.73	\$1,747.80	-	-	\$13,529.31
City of Green City	\$34,847.18	\$3,932.54	-	\$26.90	\$40,952.19
City of Milan	\$78,076.85	\$16,167.11	\$3,808.30	-	\$108,135.30
City of Newtown	\$7,424.49	\$1,310.85	-	\$62.08	\$10,298.19
Totals	\$286,730.96	\$32,771.18	\$18,406.80	\$10,761.90	\$363,639.77

Source : Missouri GIS Database, SEMA Mitigation Management Section

Table 1.26. Building Counts by Usage Type

Jurisdiction	Residential Counts	Commercial Counts	Industrial Counts	Agricultural Counts	Total
Unincorporated Sullivan	1,296	44	46	5,158	6,545
City of Green Castle	93	8	-	-	102
City of Green City	291	18	-	13	324
City of Milan	652	74	12	-	747
City of Newtown	62	6	-	30	99
Totals	2,394	150	58	5,201	7,817

Source: Missouri GIS Database, SEMA Mitigation Management Section; Public School Districts and Special Districts

Even though schools and special districts' total assets are included in the tables above, additional discussion is needed, 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 1.27 below. Additional information includes the number of buildings, building values (building exposure) and contents value (contents exposure). These numbers will represent the total enrollment and building count for the public school districts regardless of the county in which they are located.

Table 1.27. Population and Building Exposure by Jurisdiction-Public School Districts

Public School District	Enrolment	Building Count	Building Exposure (\$)	Contents Exposure (\$)	Total Exposure (\$)
Green City R-I School District	286	3	\$10,989,676.00	\$2,647,107	\$13,636,783
Newtown-Harris R-III School District	73	3	Not Available	Not Available	Not Available
Milan C-2 School District	649	18	\$177,947,507	\$3,899,140.26	\$181,846,647

Source : <http://mcids.dese.mo.gov/quickfacts/Pages/District-and-School-Information.aspx>, Data Collection Questionnaires

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 1.28 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 following sources:

- Interviews with County Emergency Management Director
- Interviews with City Government Employees
- Hazus
- 2018 Missouri State Hazard Mitigation Plan and Hazard Mitigation Viewer

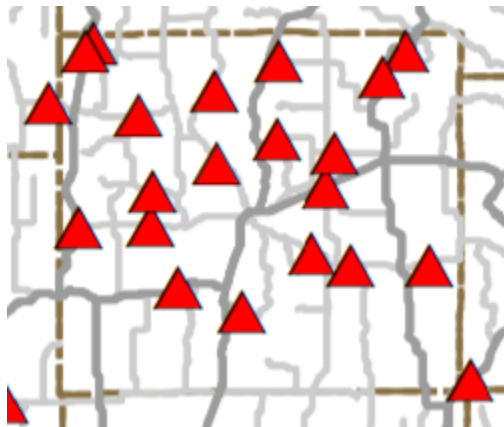
Table 1.28. Inventory of Critical/Essential Facilities and Infrastructure by Jurisdiction

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
Unincorporated Sullivan				X	X		X	X	X		X						X	X	X				X	10
City of Green Castle									X	X	X													3
City of Green City		X	X			X	X	X	X	X					X		X		X	X			X	12
City of Milan		X	X			X	X	X	X	X	X	X			X	X	X		X	X			X	15
City of Newtown		X					X		X	X	X							X		X				7
Totals		3	2	1	1	2	4	3	5	4	4	1	-	-	2	1	3	2	3	3	-	-	3	47

Source: Missouri 2018 State Hazard Mitigation Plan and Hazard Mitigation Viewer; Data Collection Questionnaires; Hazus, etc.

According to the National Bridge Inventory there are a total of 21 bridges in Sullivan County. Figure 3.1 shows the locations of State regulated bridges and non-State bridges in the planning area. Scour critical bridges were also examined. Scour critical refers to one of the database elements in the National Bridge Inventory. This element is quantified using a “scour index”, which is a number indicating the vulnerability of a bridge to scour during a flood. Bridges with a scour index between 1 and 3 are considered “scour critical”, or a bridge with a foundation determined to be unstable for the observed or evaluated scour condition. There is one scour critical bridge within Sullivan County.

Figure 1.14. Sullivan County Bridges



Source : https://www.modot.org/sites/default/files/documents/Statewide_Poor_Bridges_2019_with_insets.pdf

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 a greater degree of 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.

Sullivan County is home to threatened and endangered species including the bats, flowers and skunks list in Table 3.8 below.

Table 1.29. Threatened and Endangered Species in Sullivan County

Common Name	Scientific Name	Status
Indiana Bat	<i>Myotis sodalist</i>	Endangered
Northern Long Eared Bat	<i>Myotis septentrionalis</i>	Threatened
Mead's Milkweed	<i>Asclepias meadii</i>	Threatened
Plains Spotted Skunk	<i>Spilogale putorius</i>	Critically Imperiled
Gray Bat	<i>Myotis grisescens</i>	Endangered
Eastern Prairie Fringed Orchid	<i>Platanthera leucophaea</i>	Threatened

Source: U.S. Fish and Wildlife Service, <http://www.fws.gov/midwest/Endangered/lists/missouri-cty.html>; and <https://ecos.fws.gov/ipac/>

Natural Resources: The Missouri Department of Conservation (MDC) provides a database of lands the MDC owns, leases, or manages for public use. Table 1.30 provides the names and locations of parks and conservation areas in the planning area.

Table 1.30. Parks in Sullivan County

Park / Conservation Area	Address	City
Dark Hollow	From Green City, take Highway 129 north 1.25 miles, then take Hedge Drive north 2.10 miles.	Green City
Locust Creek	From Milan, take Highway 5/6 south .10 mile, then take River Road west 2.50 miles	Milan
Milan Lake	Elwood Reservoir, North of Milan	Milan
Morris Prairie	From Milan, take Highway 5 north 1.20 miles, then Oriole Road west, and Echo Drive south at the T intersection	Milan
Rocky Ford	From Browning, take Highway 5 north 3 miles, then Vernon Road west .50 mile.	Browning
Sears	From Milan, take Highway 6 east, then Route Y north, then Route RA north 2.50 miles to area.	Milan
Union Ridge	From Green Castle, take Route D north 2.50 miles	Green Castle

Source : <http://mdc7.mdc.mo.gov/applications/moatlas/AreaList.aspx?txtUserID=quest&txtAreaNm=s>

Historic Resources: The National Register of Historic Places is the official list of registered cultural resources worthy of preservation. It was authorized under the National Historic Preservation Act of 1966 as part of a national program. The purpose of the program is to coordinate and support public and private efforts to identify, evaluate, and protect our historic and archeological resources. The National Register is administered by the National Park Service under the Secretary of the Interior. Properties listed in the National Register include districts, sites, buildings, structures and objects that are significant in American history, architecture, archeology, engineering, and culture. Table 3.10 provides information in regards to properties on the National Register of Historic Places in Sullivan County.

Table 1.31. Sullivan County Properties on the National Register of Historic Places

Property	Address	City	Date Listed
Camp Ground Church and Cemetery	West of Milan	Milan	09/23/1985
Green City Presbyterian Church	One East Street	Green City	2/10/2000
Green City Railroad Depot	202 Lincoln Street	Green City	1/15/1999
Henry Cemetery	Eastern side of Route Z, approximately 1 mile south of Reger	Reger	12/28/2005
Milan Railroad Depot	Junction of E. 3 rd Street and Short Street	Milan	1/4/1996
Quincy, Omaha and Kansas City Railroad Office Building	117 N. Water Street	Milan	1/7/1992

Source: Missouri Department of Natural Resources – Missouri National Register Listings by County
<http://dnr.mo.gov/shpo/mnrlist.htm>

Economic Resources: Table 3.11 below shows major non-government employers in the planning area.

Table 1.32. Major Non-Government Employers in Sullivan County

Employer Name	Main Locations	Product or Service	Employees
Smithfield	Milan	Pork processing	1,500

Source: Data Collection Questionnaires; local Economic Development Commissions

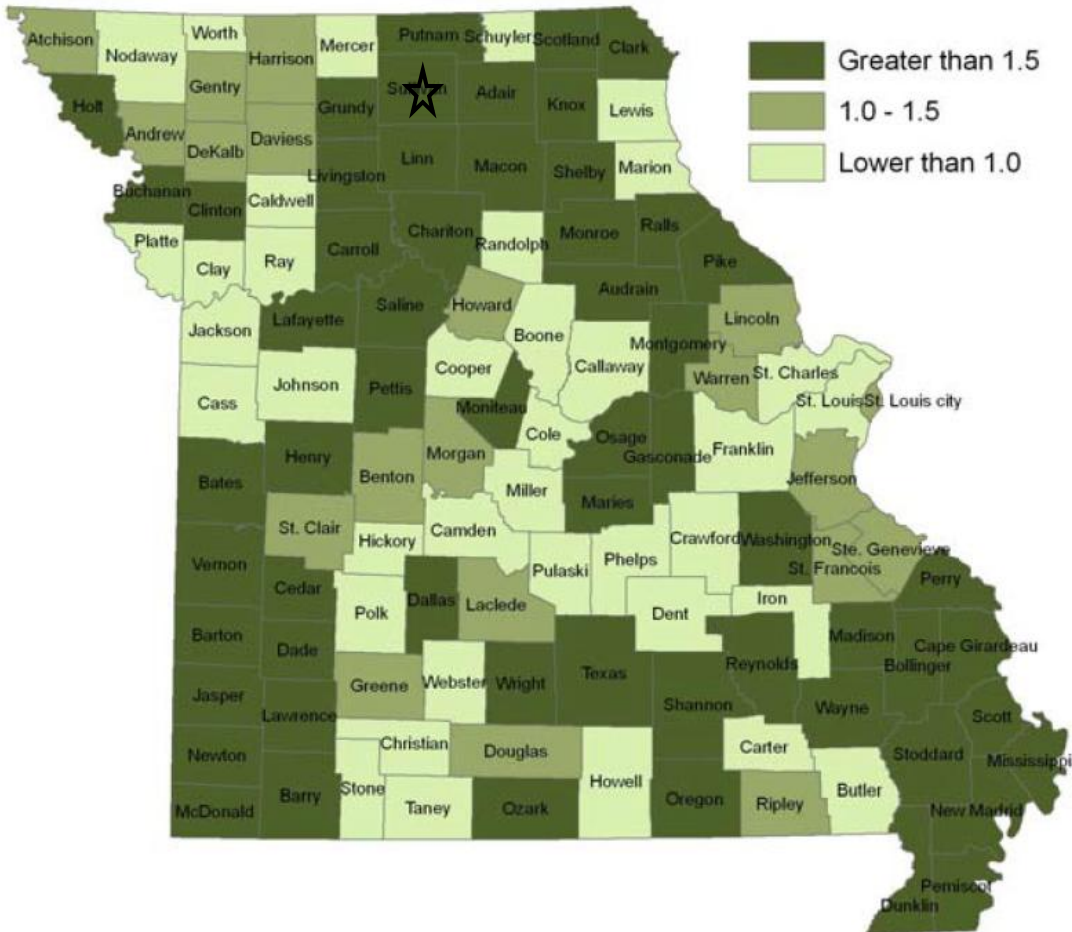
According to the USDA's 2017 Census of Agriculture, there are 671 farms in Sullivan County for a total of 309,995 acres. This compares to 95,320 farms in Missouri and 27,781,883 acres. The average size farm in Sullivan County is 461 acres while the state average is at 291 acres. The number of farms in Sullivan County in 2017 is a 4% decrease in the number from 2012.

Table 1.33. Hired Farm Labor-Workers and Payroll in 2017 for Sullivan County

Item		Sullivan
Hired farm labor	farms	140
	workers	567
	\$1,000 payroll	(D)
Farms with-		
1 worker	farms	78
	workers	78
2 workers	farms	41
	workers	82
3 or 4 workers	farms	14
	workers	47
5 to 9 workers	farms	6
	workers	(D)
10 workers or more	farms	1
	workers	(D)
Workers by days worked:		
150 days or more	farms	58
	workers	364
Farms with-		
1 worker	farms	41
	workers	41
2 workers	farms	11
	workers	22
3 or 4 workers	farms	4
	workers	(D)
5 to 9 workers	farms	1
	workers	(D)
10 workers or more	farms	1
	workers	(D)
Less than 150 days	farms	99
	workers	203
Farms with-		
1 worker	farms	56
	workers	56
2 workers	farms	32
	workers	64
3 or 4 workers	farms	6
	workers	(D)
5 to 9 workers	farms	4
	workers	22
10 workers or more	farms	1
	workers	(D)
Reported only workers working		
150 days or more	farms	41
	workers	(D)
	\$1,000 payroll	706
Reported only workers working		
less than 150 days	farms	82
	workers	139
	\$1,000 payroll	(D)
Reported both - workers working		
150 days or more and workers		
working less than 150 days	farms	17
	150 days or more, workers	(D)
	less than 150 days, workers	64
	\$1,000 payroll	(D)
Total migrant workers	farms	1
	workers	(D)
Migrant farm labor on farms with hired labor	farms	1
	workers	(D)
Migrant farm labor on farms reporting only		
contract labor	farms	-
	workers	-
Unpaid workers	farms	293
	workers	573

Figure 1.15. Agriculture Employment Location Quotient

Agribusiness Employment Location Quotient



Source: https://meric.mo.gov/sites/meric/files/library/missouri_farms_and_agribusiness.pdf *Black star indicates Sullivan County*

3.3 LAND USE AND DEVELOPMENT

3.3.1 Development Since Previous Plan Update

Population growth in Sullivan County has been on the decrease since 2010. The Unincorporated Sullivan County and each participating jurisdiction saw only a decrease except for Newtown which saw a slight increase due to natural population increase and there is not a particular event causing the increase in population.

The population table below shows a significant and steady decrease in population across all communities except Newtown during the period between 2010 and ACS 2019 Five-Year Estimate. This coincides to the change in housing unit table, also below, that shows a significant decrease in housing across all cities and the county except for Milan which shows a slight increase. This can be explained due to errors in the ACS estimates.

Table 1.34. Sullivan County Population Growth, 2010-2019

Jurisdiction	Total Population 2010	Total Population 2019	2010-2019 # Change	2010-2019 % Change
Sullivan County Total	6,714	6,247	-467	-6.9%
Unincorporated Sullivan County	3,550	2,838	-712	-20%
City of Green Castle	275	205	-70	-25%
City of Green City	657	494	-163	-24.8%
City of Milan	1,960	2,463	503	-25%
City of Newtown	183	195	12	6.5%
Village of Pollock	89	52	-37	-41%

Source: U.S. Bureau of the Census, Decennial Census, Annual Population Estimates, American Community Survey 5-year Estimates; Population Statistics are for entire incorporated areas as reported by the Census bureau

Population growth or decline is generally accompanied by increases or decreases in the number of housing units. All jurisdictions in Sullivan County have shown a decrease in population except for Milan which showed an increase. Overall, there has been a 1.5% decrease in housing in the Sullivan County area as reflected in Table 3.14.

Table 1.35. Change in Housing Units, 2010-2018

Jurisdiction	Housing Units 2010	Housing Units 2019	2010-2019 # Change	2010-2019 % Change
Sullivan County Total	3,388	3,337	-51	-1.5%
Unincorporated Sullivan County	1,864	1,779	-85	-4.5%
City of Green Castle	157	126	-31	-19.7%
City of Green City	360	340	-20	-5.5%
City of Milan	811	972	161	19.8%
City of Newtown	133	90	-43	-32.3%
Village of Pollock	63	30	-33	-52.3%

Source: U.S. Bureau of the Census, Decennial Census, American Community Survey 5-year Estimates; Population Statistics are for entire incorporated areas as reported by the U.S. Census Bureau

U.S. Census information is compiled every 10 years, with the last Census completed in 2010, estimates were used for the above data. According to the American Fact Finder, estimates show that in 2018 the number of housing units was expected to increase in four of the jurisdictions and decrease in the other jurisdiction within Sullivan County. Vulnerability to hazards will be affected based on population and where new housing units

have been built. Vulnerability overall is expected to increase, keeping in mind that city ordinances for new builds have been set to protect citizens.

3.3.2 Future Land Use and Development

Sullivan County and participating jurisdictions

Sullivan County and the participating jurisdictions are in a very rural area of North Central Missouri and it is very difficult to attract new development due to the inability to attract employers in the area. The County or participating jurisdictions did not indicate any future growth on the data questionnaires.

School District's Future Development

Total enrollment for all of the schools in Sullivan County's School District is 1,008 students. Each of the three schools has an elementary and high school to serve the students with the schools located in Milan, Newtown and Green City. There are no plans in the next five years for any additions or renovations for the school three schools.

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, strength/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

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Each hazard identified in this section will be profiled individually for easier reference. 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 areas in the planning area that are affected by the hazard. 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.*
- *Strength/Magnitude/Extent: This includes information about the strength, 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. This section should also include information on the typical or expected strength/magnitude/extent of the hazard in the planning area. Strength, magnitude, and extent can also include the speed of onset and the duration of hazard events. Describing the strength/magnitude/extent of a hazard is not the same as describing its potential impacts on a community. Strength/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. Tables are a good way to convey this data and when available, tables showing random events for the past 20 years are included.*
- *Probability of Future Occurrence: The frequency of recorded past events is used to estimate the likelihood of future occurrences. Probability can be determined by dividing the number of recorded events by the number of years of available data 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 should be reported as 100% in any given year, with a statement of the average number of events annually. For hazards such as drought that may have gradual onset and extended duration, probability can be based on the number of months in drought in a given time-period and expressed as the probability for any given month to be in drought.

- *Changing Future Conditions Considerations: In addition to the probability of future occurrence changing future conditions were considered, including the effects of long-term changes in weather patterns and climate on the identified hazards.*

Vulnerability Assessments

Requirement §201.6(c)(2)(ii) :[The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii)(A) :The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas.

Requirement §201.6(c)(2)(ii)(B) :[The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate.

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends

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 should be based on the best available data. The vulnerability assessments can also be based on data that was collected for the 2018 State Hazard Mitigation Plan Update. With the 2018 Hazard Mitigation Plan Update, SEMA is pleased to provide online access to the risk assessment data and associated mapping for the 114 counties in the State, including the independent City of St. Louis. Through the web-based Missouri Hazard Mitigation Viewer, local planners or other interested parties can obtain all State Plan datasets. This effort removes from local mitigation planners a barrier to performing all the needed local risk assessments by providing the data developed during the 2018 State Plan Update.

The Missouri Hazard Mitigation Viewer includes a Map Viewer with a legend of clearly labeled features, a north arrow, a base map that is either aerial imagery or a street map, risk assessment data symbolized the same as in the 2018 State Plan for easy reference, search and query capabilities, ability to zoom to county level data and capability to

download PDF format maps. The Missouri Hazard Mitigation Viewer can be found at this link: <http://bit.ly/MoHazardMitigationPlanViewer2018>.

The vulnerability assessments in the Sullivan County 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.

Within the Vulnerability Assessment, the following sub-headings will be addressed:

Vulnerability Overview:

The plan will provide an overall summary of each jurisdiction's vulnerability to the identified hazards. The overall summary of vulnerability identifies structures, systems, populations or other community assets as defined by the community that are susceptible to damage and loss for hazard events.

Potential Losses to Existing Development:

For each participating jurisdiction, the plan must describe the potential impacts of the hazard. Impact means the consequences of effect of the hazard on the jurisdiction and its assets. Assets are determined by the community and include, for example, people, structures, facilities, systems, capabilities, and/or activities that have value to the community. For example, impacts could be described by referencing historical disaster impacts and/or an estimate of potential future losses.

Previous and Future Development:

This section will include information on how changes in development have impacted the community's vulnerability to this hazard and describes how any changes in development that occurred in known hazard prone areas since the previous plan have increased or decreased the community's vulnerability. This section will also describe any anticipated future development in the county, and how that would impact hazard risk in the planning area.

Hazard Summary by Jurisdiction:

This section includes information on how changes in development have impacted the community's vulnerability to this hazard and describes how changes in development in known hazard prone areas since the previous plan have increased or decreased the community's vulnerability.

Problem Statements:

Each hazard analysis will conclude with a brief summary of the problems created by the hazard in the planning area, and possible ways to resolve those problems including jurisdiction-specific information in those cases where the risk varies across the planning area.

3.4.1 Flooding (Riverine and Flash)

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 is discussed in Section 3.4.2. It will not be addressed in this section.

A flash flood occurs when water levels rise at an extremely fast rate as a result 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

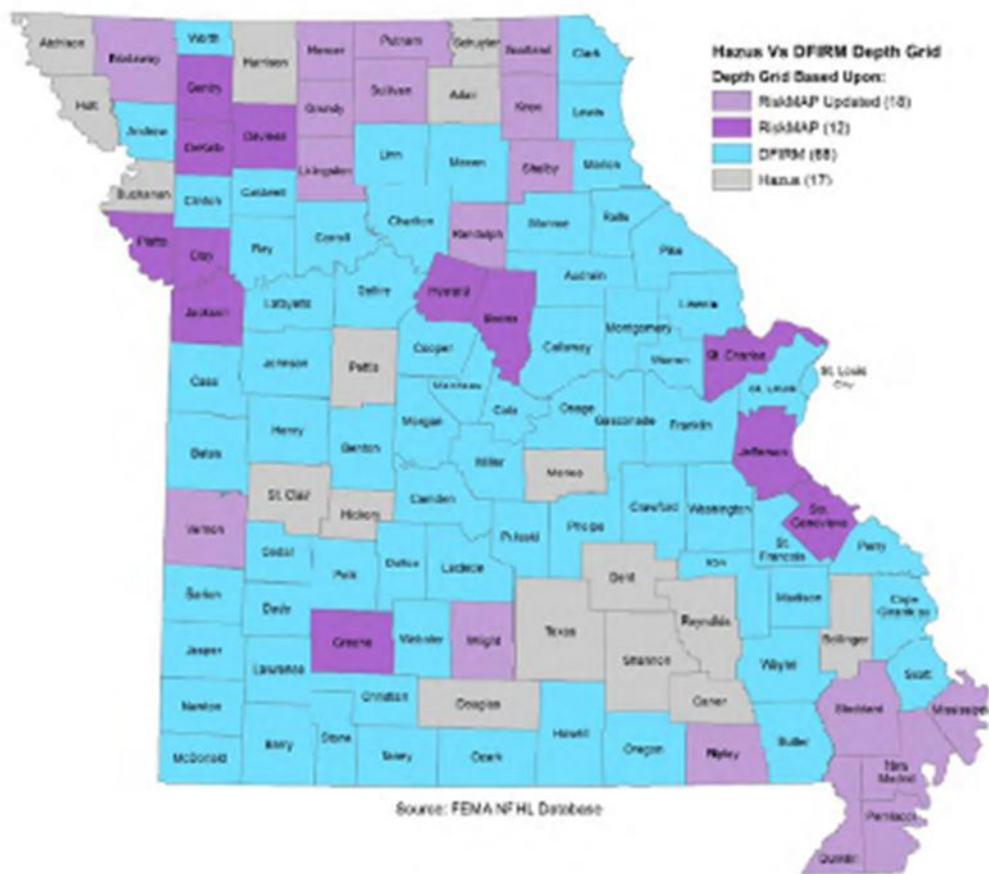
for flash floods.

Geographic Location

Riverine flooding can occur in any low-lying areas of Sullivan County which is adjacent to rivers and creeks during periods of heavy rain when ground is saturated. Many rural roads within the County are dependent upon low water crossings which are not navigable during periods of high water. During times of flooding these low water crossings can present a risk to life and property if an attempt to cross is made.

According to the National Mapping System, major rivers and creeks in Sullivan County include Bear Branch Creek, Locust Creek, Medicine Creek, Mussel Fork River and Parson Creek. The following figures show 100-year Flood Zone maps for Sullivan County and its communities.

Figure 1.16. RiskMap, DFIRM and Hazus based Depth Grids used in Hazus Analysis



Source: 2018 Missouri State Hazard Mitigation Plan

Figure 1.17. Risk MAP Study Status Map

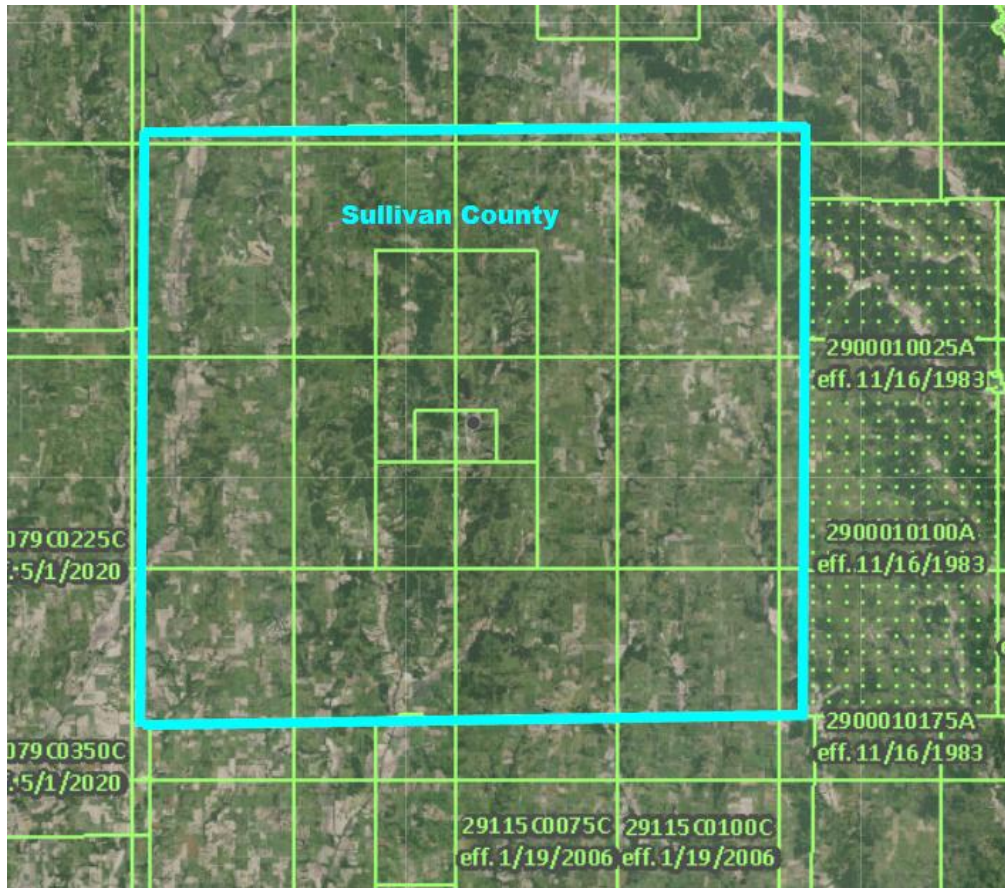


Figure 1.18. Legend



Source: FEMA Map Service Center; <https://msc.fema.gov/portal/home>

Figure 1.19. City of Green Castle



Figure 1.20. City of Green City

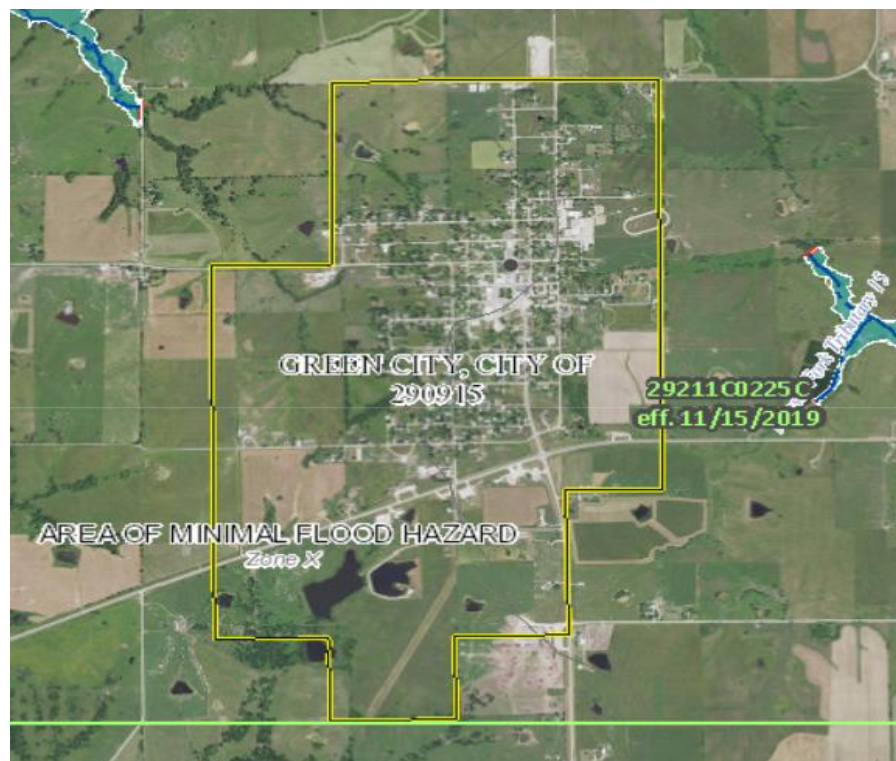


Figure 1.21. Village of Harris

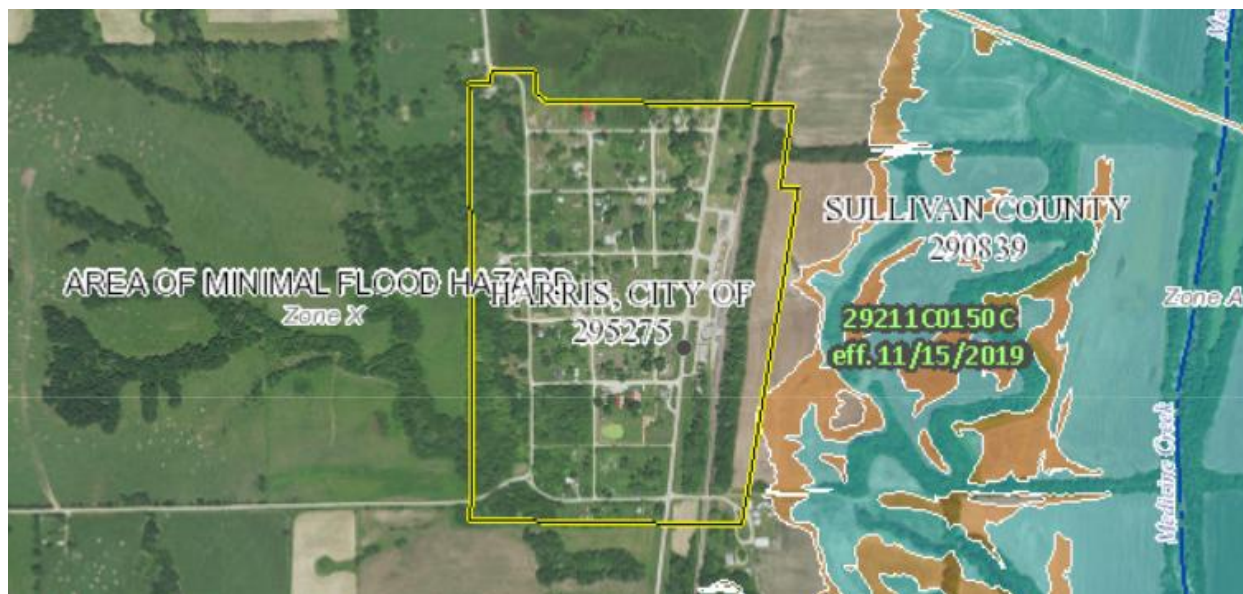


Figure 1.22. Village of Humphreys

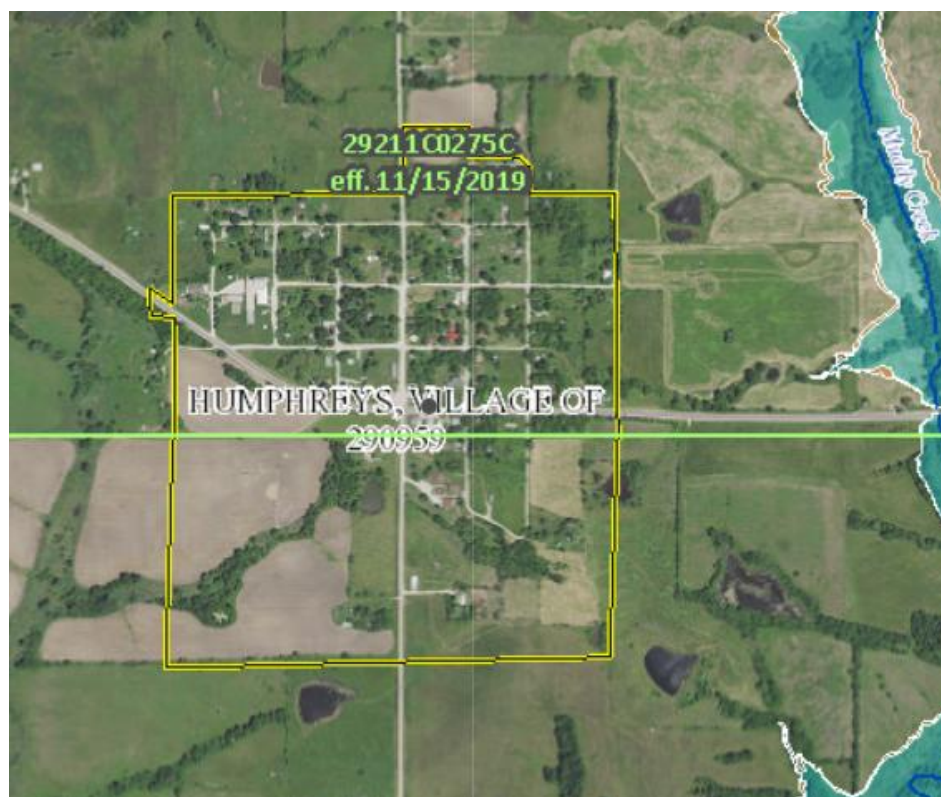


Figure 1.23. City of Milan

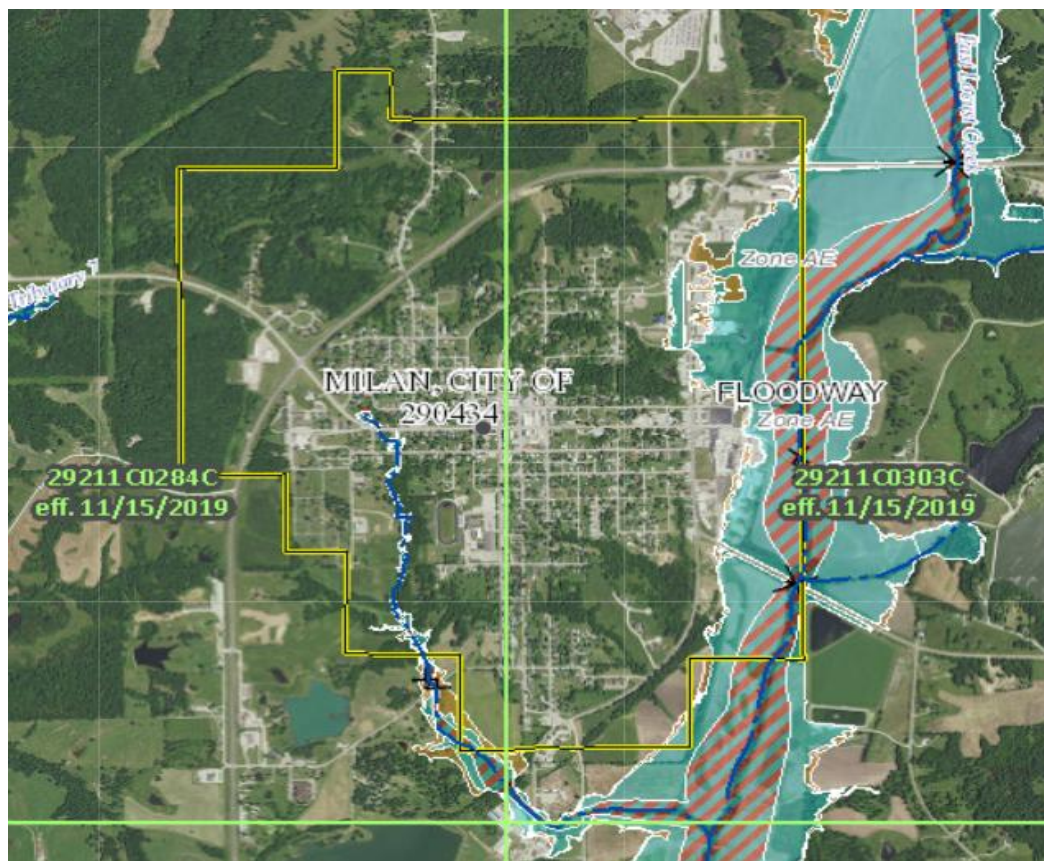


Figure 1.24. City of Newtown

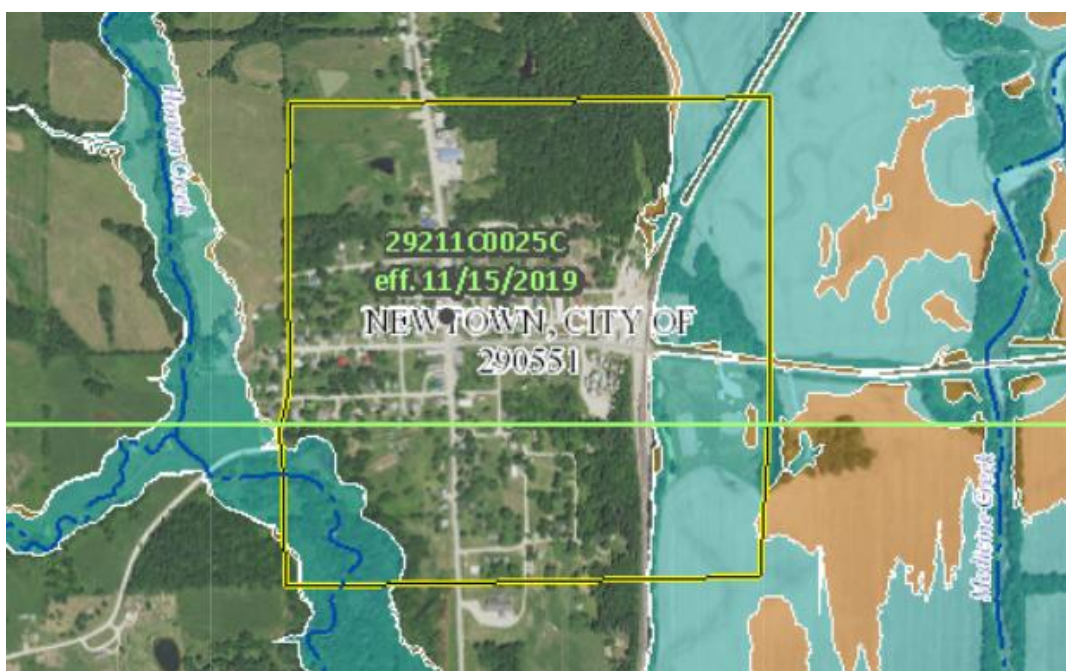


Figure 1.25. Village of Pollock



Figure 1.26. Green City R-I School District



Figure 1.27. Newtown-Harris R-III School District



Figure 1.28. Milan C-2 School District



The following National Centers for Environmental Information table shows 3 flood events from the last 21 years. The data includes events for flooding and flash flooding. Twenty years of history is generally adequate for a trend analysis. Although only 3 events are recorded for Sullivan County during the past 21 years, this is considered adequate to establish risk in Sullivan County.

Table 1.36. Sullivan County NCEI Flood Events by Location, 1999 - 2019

Location	# of Events
ger	2
good	1

Source: National Centers for Environmental Information, March 14, 2021

Special Flood Hazard Areas (SFHA's) are areas where flash flooding occurs 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. Flash flood events that occurred in those areas are listed in the table below. Sullivan County does not have any SFHA's. Table 3.16 shows the number of flash flood events by location recorded in NCDI for the 21-year period.

Table 1.37. Sullivan County NCEI Flash Flood Events by Location, 1999 - 2019

Location	# of Events
een City	1
cklerville	1
mphreys	2
an	2
ger	2
ntersville	1

Source: National Centers for Environmental Information, March 14, 2021

Strength/Magnitude/Extent

Missouri has a long and active history of flooding over the past century, according to the 2018 State Hazard Mitigation Plan. Flooding along Missouri 's major rivers generally result 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.

National Flood Insurance Program (NFIP) Participation

Only one community in Sullivan County currently participates in the National Flood Insurance Program. Table 3.17 provides details on NFIP participation for the communities in the planning area. Table 3.18 provides information on the number of policies in force, amount of insurance in force, number of closed losses, and total payments for each jurisdiction in Sullivan County.

Sullivan County and the smaller jurisdictions within its borders historically have not participated in the Flood Insurance Protection Program. However, recent and more accurate flood mapping products produced by FEMA and the increasingly standard requirement of flood plain information for real estate transactions have caused renewed discussion within the county about NFIP participation.

Sullivan County has been part of 11 Major (Presidential) Disaster declarations, since 2007, 6 of which have involved flooding.

Table 3.17 provides details on NFIP participation for the communities in the planning area.

Table 1.38. NFIP Participation in Sullivan County

Community ID #	Community Name	NFIP Participant (Y/N/Sanctioned)	Current Effective Map Date	Regular-Emergency Program Entry Date
290839	Sullivan County	Not Participating	11/15/2019	3/25/1999
290915	City of Green Castle	Not Participating	11/15/2019	3/25/1999
290595	City of Green City	Not Participating	11/15/2019	10/2/2006
295275	Village of Harris	Not Participating	11/15/2019	5/31/2017
290959	Village of Humphreys	Not Participating	11/15/2019	10/2/2006
290434	City of Milan	Participating	11/15/2019	7/4/1988
290551	City of Newtown	Sanctioned	11/15/2019	7/30/1976
290961	Village of Pollock	Not Participating	11/15/2019	10/2/2006

Source: NFIP Community Status Book, 6/23/2020; 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

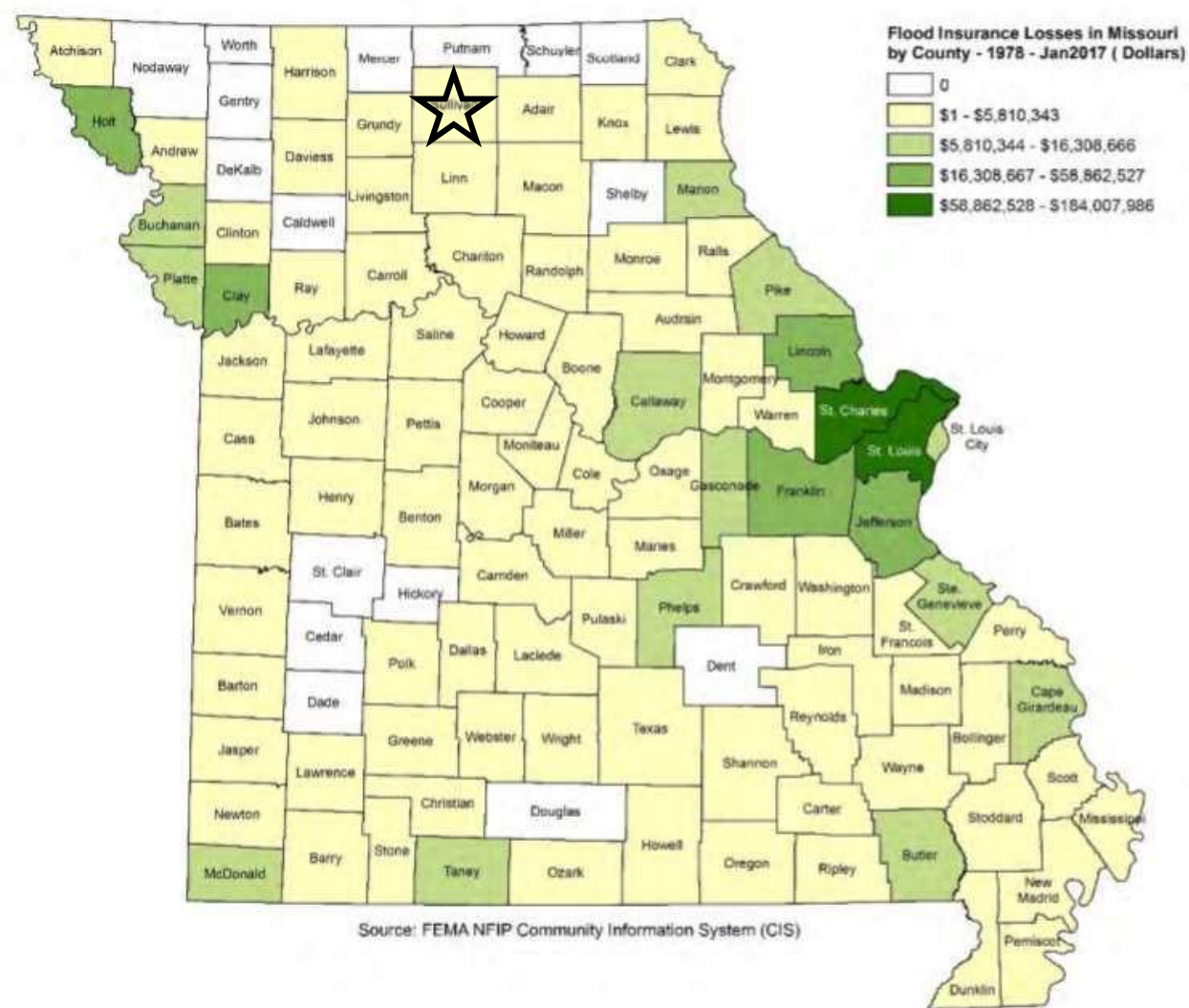
Table 1.39. NFIP Policy and Claim Statistics as of Date

Community Name	Policies in Force	Insurance in Force	Closed Losses	Total Payments
City of Milan	-	-	2	\$329

Source: NFIP Community Status Book, 6/23/20; BureauNet, <http://bsa.nfipstat.fema.gov/reports/reports.html>; *Closed Losses are those flood insurance claims that resulted in payment. Loss statistics are for the period from 1978 to 3/20/2020.

Figure 3.16 shows a dollars paid historically for flood insurance losses from 1978 – 2017. In this map which is located in the 2018 Missouri State Hazard Mitigation Plan, Sullivan County, indicated with a black star, has between \$1 and \$5,810,343 dollars paid for flood insurance losses.

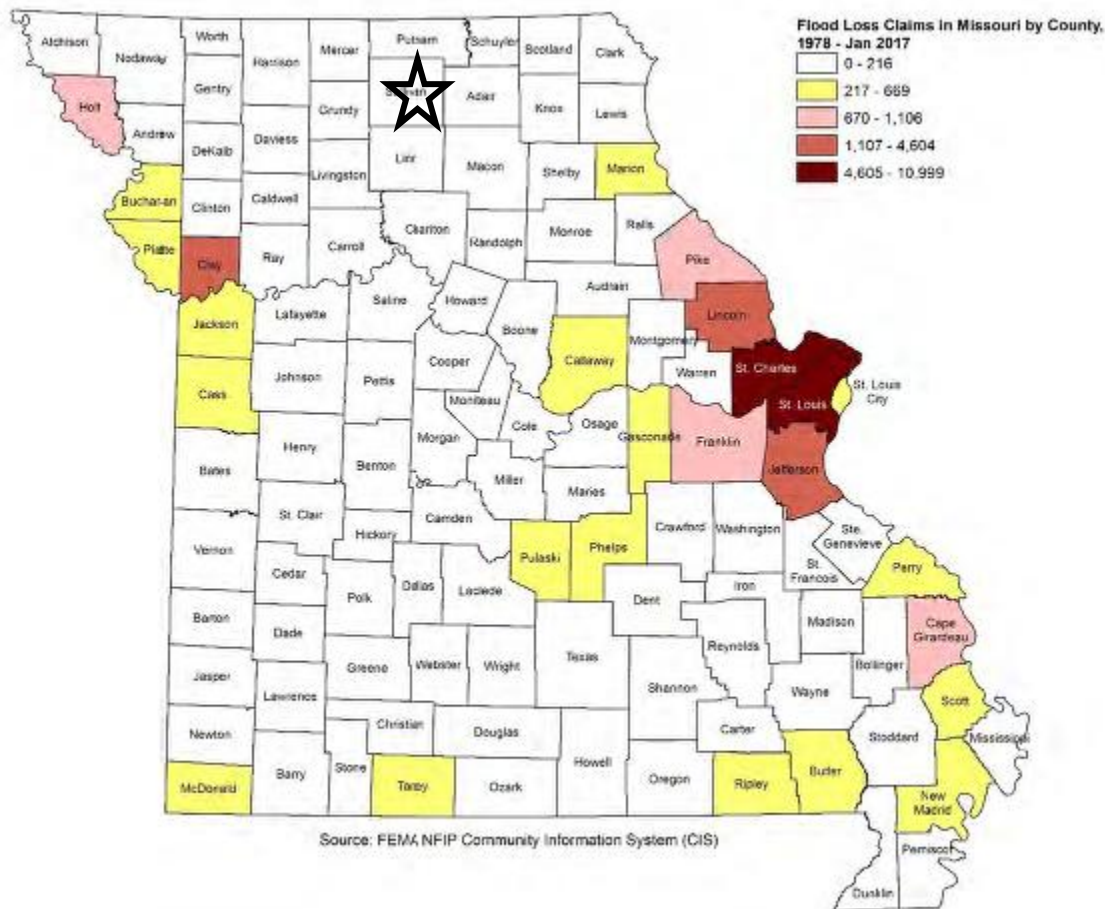
Figure 1.29. Map of Dollars Paid Historically for Flood Insurance Losses 1978 – 2017



Source: 2018 Missouri State Hazard Mitigation Plan

Figure 3.17 demonstrates between the period of 1978 and January 2017, Sullivan County had between 0 – 216 flood loss claims, per the 2018 Missouri State Hazard Mitigation Plan.

Figure 1.30. Flood Loss Claims in Missouri by County 1978 – 2017



Source: 2018 Missouri State Hazard Mitigation Plan

Repetitive Loss/Severe Repetitive Loss Properties

Repetitive Loss (RL): RL Properties are those properties with at least two flood insurance payments of \$1,000 each have been paid under the National Flood Insurance Program within any 10-year period since 1978. According to the Flood Insurance Administration, jurisdictions included in the planning area have no repetitive loss properties as of 9/30/2019.

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. According to the Flood Insurance Administration, jurisdictions included in the planning area have no severe repetitive loss properties as of 9/30/2019.

Previous Occurrences

Table 1.40. Sullivan County Presidential Declared Flood Events 2007 – 2019

Declaration Number	Declaration Date	Disaster Description
08-DR	Severe Storms, Flooding	June 11, 2007 05/2007 – 05/18/2007
03-DR	Severe Storms, Flooding	June 25, 2008 01/2008 – 07/13/2008
09-DR	Severe Storms, Flooding, Tornado	November 13, 2008 11/2008 – 09/24/2008
07-DR	Severe Storms, Flooding, Tornadoes	June 19, 2009 08/2009 – 05/16/2009
04-DR	Severe Storms, Flooding, Tornadoes	August 17, 2010 12/2010 – 07/31/2010
00-DR	Severe Storms, Tornadoes, Straight Line Winds, Flooding	October 31, 2014 09/2014 – 09/11/2014

Source: FEMA.gov, March 2021

Table 3.20 lists NCEI Flash Flood Events in Sullivan County from 2000 to 2019. Table 3.21 lists NCEI Riverine Flooding Events in Sullivan County from 2000 to 2019.

Table 1.41. NCEI Sullivan County Flash Flood Events Summary, 2000 to 2019

Year	# of Events	# of Deaths	# of Injuries	Property Damages	Crop Damages
2001	1	0	0	\$0	\$0
2002	2	0	0	\$0	\$0
2004	2	0	0	\$100,000	\$0
2008	2	0	0	\$1,000	\$0
2009	2	0	0	\$0	\$0

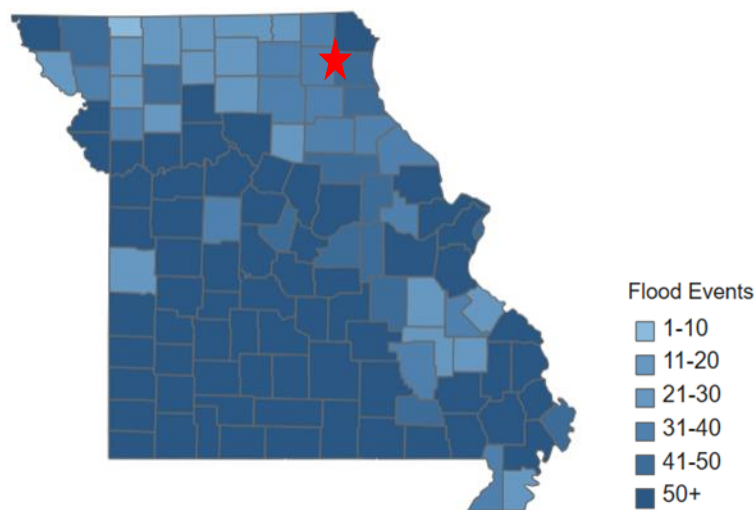
Source: NCEI, data accessed 1/5/2020

Table 1.42. NCEI Sullivan County Riverine Flood Events Summary, 2000 to 2019

Year	# of Events	# of Deaths	# of Injuries	Property Damages	Crop Damages
2017	1	0	0	\$0	\$0
2019	1	0	0	\$0	\$0

Figure 3.18 shows Sullivan County has had low impact from flooding in the past.

Figure 1.31. Historical Flood Impact for Sullivan County



Source: <https://www.fema.gov/data-visualization-floods-data-visualization> *Red star shows Sullivan County

Probability of Future Occurrence

Flash Flooding in the planning area is likely to occur as it has 9 times in the last 21 years. Expressed mathematically, this is 9 floods divided into 20 years for one flood per year, or a 42% probability of a flash flood occurring somewhere in Sullivan County during any given year.

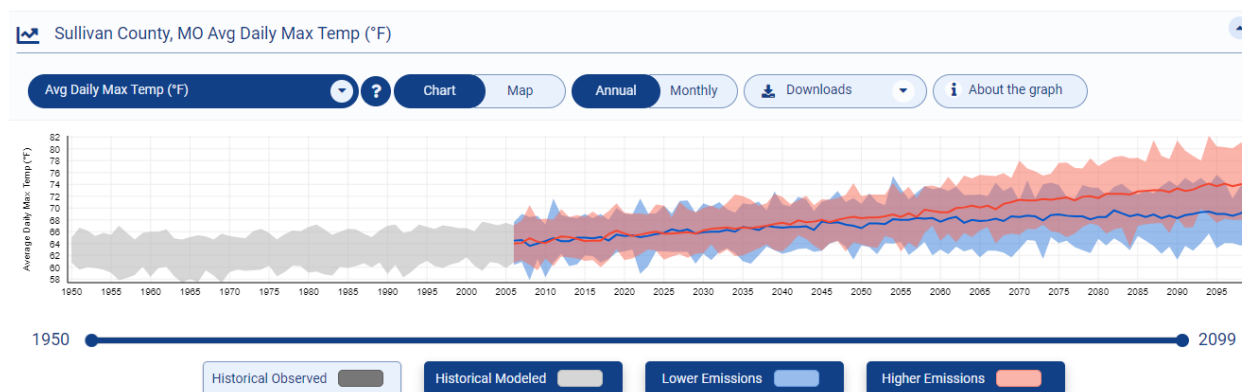
Riverine Flooding is more likely to occur in planning area with 2 events in the last 21 years. Applying the same formula used above, this would be a 9% probability of a riverine flood occurring somewhere in Sullivan County during a 12-month period. This probability is just a measurement tool, as you can see in the chart, some years had several riverine floods while other years had none.

Changing Future Conditions Considerations

Sullivan County should begin to consider the possibility traditional climate patterns are changing. According to the 2018 State Plan, if departure from normal with respect to increased precipitation intensity continues, frequency of floods in Missouri is likely to increase as well. Over the last half century, average annual precipitation in most of the Midwest has increased by 5 to 10 percent. But rainfall during the four wettest days of the year has increased about 35 percent, and the amount of water flowing in most streams during the worst flood of the year has increased by more than 20 percent. According to the National Climate Assessment, extreme rainfall events and flooding have increased during the last century and these trends are expected to continue.

Figure 3.19 shows the annual total precipitation for Sullivan County from 1950 to date, acquired from US Climate and Resilience Organization.

Figure 1.32. Annual Total Precipitation for Sullivan County



Source: US Climate Resilience <https://crt-climate-explorer.nemac.org/local-climate-charts/>

It is likely (66-100% probability) that the frequency of heavy precipitation or the proportion of total rainfall from heavy storms will increase in the 21st century across the globe. More specifically, it is “very likely” (90-100% probability) that most areas of the United States will exhibit an increase of at least 5% in the maximum 5-day precipitation by late 21st century. As the number of heavy rain events increase, more flooding and pooling water can be expected.

The expected increases in rainfall frequency and intensity are likely to put additional stress on natural hydrological systems and community storm water systems. Heavier snowfalls in the winter will lead to intensified spring flooding, and groundwater levels will remain high even in non-floodplain areas. Such changes in climate patterns can lead to the development of compounding events that interact to create extreme conditions. Flooding caused by high groundwater levels typically recedes more slowly than riverine flooding, slowing the response and recovery process. Groundwater-fed rivers and streams are also likely to experience heightened flooding when groundwater levels are high. Jurisdictions updating or installing storm water management systems should consider potentially larger future discharge amounts when sizing culverts and drainage ways; storage capacity can also be increased by building retention basins to hold excess storm water. Communities already prone to flooding should be prepared for a potential increase in facility closures and/or damages, as well as an increase in public demand for flood response and assistance. Natural features that experience repeated flooding may manifest changes in the form of stream bank instability and changing shoreline, floodplain, and wetland boundaries. Communities may also wish to plan for the potential loss of cropland and damage to both private property and public infrastructure such as bridges.

The environmental impacts of flooding include erosion, surface and groundwater contamination, and poor-quality water. The threat of more frequent flood events may thus

be a concern particularly for communities who depend on lakes, rivers, or trout streams for tourism. Rural communities may experience increases in well contamination and road washouts, while urban areas may be particularly vulnerable to flash flooding as heavy rain events quickly overwhelm the ability of a more impermeable environment to absorb excess storm water.

More climate information is available from the following sources:

▪ 2018 State Plan, see Chapter 3, Section 3.3.1, Changing Future Conditions Considerations,

page 3.100

▪ US Climate Resilience Toolkit; <https://toolkit.climate.gov/tools/climate-explorer>

▪ National Climate Assessment; <https://nca2014.globalchange.gov/>

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 as a result 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.

For Sullivan County, according to the 2018 State Plan, this can mean building exposure for a 100-year flood to range between \$556,304 and \$305,094,849 and impact as many as 588 buildings and up to 208 residents.

Potential Losses to Existing Development

Using the data obtained from Flood Insurance Administration, none of the jurisdictions in Sullivan County have a history of repetitive losses.

Impact of Previous and Future Development

Any future development in floodplains would increase risk in those areas. For the one community participating in the National Flood Insurance Program, enforcement of the floodplain management regulations will ensure mitigation of future construction in those areas. However, even if structures are mitigated, evacuation may be necessary due to rising waters. In addition, floods that exceed mitigated levels may still cause damages.

Hazard Summary by Jurisdiction

Vulnerability to flooding varies by jurisdiction as each community has a different layout, as described above overall Sullivan County experiences very little flooding. The floodplain maps in the Geographic Location section depict the flood area in each jurisdiction. Table 3.16 reflects the NCEI Flash Flood Events in Unincorporated Sullivan County at 9 events, Green City at 1, Sticklerville at 1, Humphreys at 2, Mila at 2, Reger at 2 and Wintersville at 1. Table 3.15 reflects the NCEI Flood Events in Unincorporated Sullivan County at only 2 events, Reger at 1 event and Osgood at 1 event. Overall the jurisdictions are minimally affected by flooding.

Problem Statement

Local governments should make a strong effort to improve emergency warning systems to ensure future deaths and injuries do not occur. Local governments should consider making improvements to roads and low water crossings that consistently flood by placing them on a hazard mitigation projects list, and actively seek funding to successfully complete the projects. Local governments that do not currently participate in NFIP should reconsider Participation based on trends and past flooding events.

3.4.2 Dam Failure

Hazard Profile

Hazard Description

A dam is defined as a barrier constructed across a watercourse for the purpose of 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.

Information can be obtained from:

- National Resources Conservation Service: <http://www.nrcs.usda.gov>
- DamSafetyAction.org: <https://damsafety.org/missouri>

Data on Dams in Sullivan County has been drawn from two sources: a listing maintained by the Missouri Department of Natural Resources (MoDNR) and the Army Corps of Engineers' National Dam Inventory (NID). Each has its own system of classifying dams. Neither the MDNR nor the NID hazard potential classification references the condition of the dam.

The 2018 State Mitigation Plan Update states that Sullivan County has one Class 1 state regulated dam, one Class 2 state regulated dam, and three Class 3 state regulated dams. Table 3.22 gives the definition of each dam hazard classification level.

Table 1.43. MoDNR Dam Hazard Classification Definitions

Hazard Class	Definition
Class I	Contains 10 or more permanent dwellings or any public buildings
Class II	Contains 1 to 9 permanent dwellings or 1 or more campgrounds with permanent water, sewer, and electrical services or 1 or more industrial buildings
Class III	Everything else

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

The 2018 State Mitigation Plan Update states that per the NID, Sullivan County has a total of five high hazard class dams, three significant hazard class dams, and 129 low hazard class dams. Table 3.23 defines each of the NID dam hazard classifications.

Table 1.44. NID Dam Hazard Classification Definitions

Hazard Class	Definition
Low Hazard	A dam located in an area where failure could damage only farm or other uninhabited buildings, agricultural or undeveloped land including hiking trails, or traffic on low volume roads that meet the requirements for low hazard dams.
Significant Hazard	A dam located in an area where failure could endanger a few lives, damage an isolated home, damage traffic on moderate volume roads that meet certain requirements, damage low-volume railroad tracks, interrupt the use or service of a utility serving a small number of customers, or inundate recreation facilities, including campground areas intermittently used for sleeping and serving a relatively small number of persons.
High Hazard	A dam located in an area where failure could result in any of the following: extensive loss of life damage to more than one home, damage to industrial or commercial facilities, interruption of a public utility serving a large number of customers, damage to traffic on high-volume roads that meet the requirements for hazard class C dams or a high-volume railroad line, inundation of a frequently used recreation facility serving a relatively large number of persons, or two or more individual hazards described for significant hazard dams.

Source: National Inventory of Dams

The NID indicates the total number of dams in Sullivan County to be 181 on January 20, 2021. The 2018 State Hazard Mitigation Plan Update indicates the number of dams in Sullivan County to be 137. Table 3.24 provides a list of dams in Sullivan County giving the name, NID ID #, owner type, height, storage, and hazard potential for each dam in Sullivan County. Figure 3.20 shows a map of Sullivan County that shows the location of each dam per information from the National Inventory of Dams. Figure 3.21 shows a map of the dams in Sullivan County, denoting each dam with a color specifying the owner type. This information was obtained by the National Inventory of Dams.

Table 1.45. Dams in Sullivan County – Missouri DNR Data

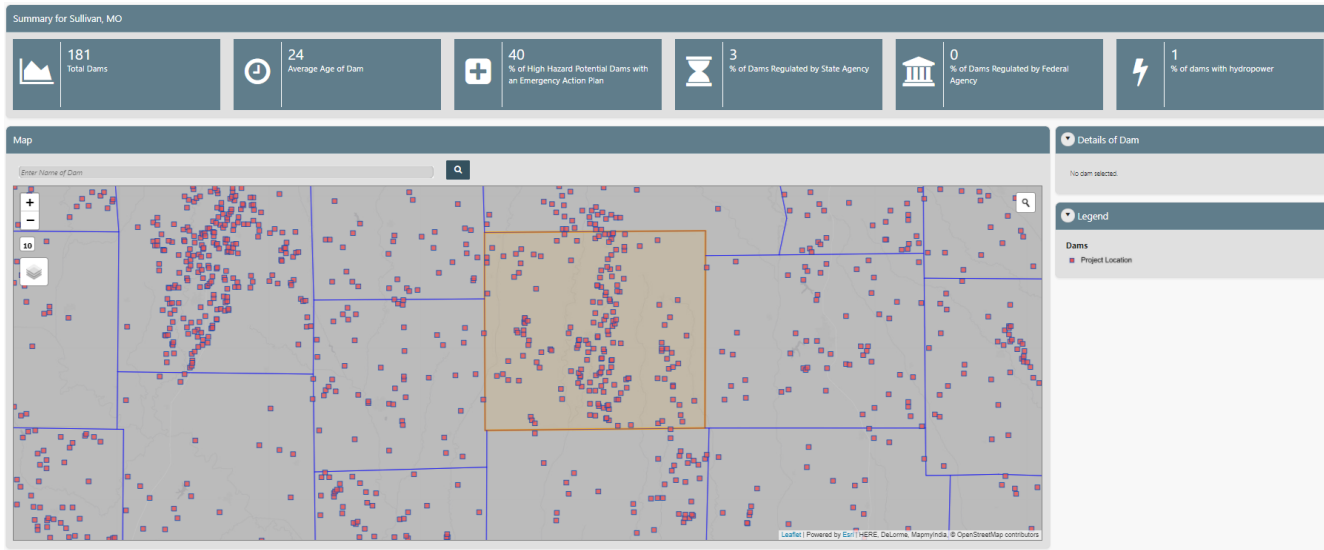
Name	ID #	Owner Type	Height (ft)	Storage (acre-ft)	Hazard Potential
LAKE LU JUAN DAM	MO10068	Private	49	765	High
GREEN CITY DAM-SECT 18	MO10155	Local	28	150	Low
ELMWOOD CITY LAKE DAM	MO10240	Local	47	7000	High
BOOTH LAKE DAM	MO10396	Private	29	47	Low
MILAN LAKE DAM SOUTH	MO10398	Local	36	562	Low
MILAN LAKE DAM-NORTH	MO10399	Local	30	241	Low
BRANTNER LAKE DAM	MO10400	Private	25	54	Low
MESERVEY LAKE DAM	MO10401	Private	30	64	Low

Name	ID #	Owner Type	Height (ft)	Storage (acre-ft)	Hazard Potential
JONES DAM	MO10402	Private	28	75	Low
DETWILDER LAKE DAM	MO10406	Private	34	127	Low
DICKSON LAKE DAM	MO10407	Private	25	80	Low
SEARS COMMUNITY LAKE DAM	MO10503	State	33	318	High
STRONG & STEWART LAKE DAM	MO10599	Private	25	160	Low
BAKER LAKE DAM	MO10807	Private	25	67	Low
HUMPHREY'S LAKE DAM	MO10808	Private	32	154	Low
CARTER LAKE DAM	MO10809	Private	25	54	Low
RUSK LAKE DAM	MO11076	Private	25	120	High
GARY GRAY LAKE DAM	MO11087	Private	30	60	Low
FIELDS LAKE DAM	MO11088	Private	30	193	Low
ISCHAN LAKE DAM	MO11090	Private	30	80	Low
EDDY'S LAKE DAM	MO11093	Private	30	128	High
GREEN CITY DAM-SECT 16	MO11097	Local	20	974	Low
K+W FARMS LAKE DAM	MO11551	Private	20	96	Low
TAYLOR LAKE DAM-SECT 24	MO11610	Private	30	48	Low
MAHER LAKE DAM	MO11611	Private	30	48	Low
TAYLOR LAKE DAM-SECT 19	MO11612	Private	25	27	Low
PICKERING LAKE DAM	MO11623	Private	25	30	Low
ELMWOOD NO 77A	MO12365	Local	31	43	Low
EAST LOCUST CREEK WATERSHED DAM E- 69	MO12366	Local	33	47	Low
EAST LOCUST CREEK WATERSHED DAM E- 67	MO12367	Private	28	72	Low
EAST LOCUST CREEK WATERSHED DAM E- 63	MO12368	Local	25	74	Low
EAST LOCUST CREEK WATERSHED DAM E- 70	MO12369	Local	27	73	Low
GREEN HILLS EAST DAM	MO12372	Private	35	528	Low
SOUTH MEADOWS EAST DAM	MO12388	Private	29	128	Low
SOUTH MEADOWS DAM	MO12389	Private	30	360	Low
VALLEY VIEW DAM	MO12390	Private	37	832	Low
LOCUST RIDGE WEST DAM	MO12391	Private	30	401	Significant
LOCUST RIDGE MIDDLE DAM	MO12392	Private	30	626	Significant
LOCUST RIDGE NORTH LAKE	MO12393	Private	30	289	Low
OVERLOOK	MO12394	Private	29	512	Low
BEMEAR	MO50194	Private	28	62	Low
COOK DAM	MO50195	Private	27	63	Low
POLOWNIAK DAM	MO50196	Private	29	34	Low
EAST LOCUST CREEK WATERSHED DAM E-27	MO50200	Local	26.5	52	Low
EAST LOCUST CREEK WATERSHED DAM E-22	MO50325	Local	27.2	155	Low
CLAY TOWNSHIP SITE 002-1	MO50475	Local	27	101	Low
GREEN HILLS RANCH LAKE DAM	MO50495	Private	30	173	Low
EAST LOCUST CREEK WATERSHED DAM E- 83	MO50497	Local	27	89	Low
EAST LOCUST CREEK WATERSHED DAM E-112	MO50498	Local	26	99	Low
EAST LOCUST CREEK WATERSHED DAM E-115	MO50499	Local	22	125	Low
EAST LOCUST CREEK WATERSHED DAM E-116	MO50500	Local	26	115	Low
EAST LOCUST CREEK WATERSHED DAM E-117	MO50501	Local	28	81	Low
EAST LOCUST CREEK WATERSHED DAM E- 76	MO50507	Local	32	78	Low
EAST LOCUST CREEK WATERSHED DAM E- 77	MO50508	Local	34	115	Low
EAST LOCUST CREEK WATERSHED DAM E- 81	MO50509	Local	29	134	Low
EAST LOCUST CREEK WATERSHED DAM E- 84	MO50510	Local	28	130	Low
EAST LOCUST CREEK WATERSHED DAM E- 85	MO50511	Local	28	124	Low
EAST LOCUST CREEK WATERSHED DAM E- 36	MO50512	Local	31	106	Low
EAST LOCUST CREEK WATERSHED DAM E- 43	MO50513	Local	35	150	Low
EAST LOCUST CREEK WATERSHED DAM E- 47	MO50514	Local	20	86	Low
EAST LOCUST CREEK WATERSHED DAM E- 51	MO50515	Local	32	103	Low
EAST LOCUST CREEK WATERSHED DAM E- 64	MO50516	Local	28	103	Low
EAST LOCUST CREEK WATERSHED DAM E- 16	MO50517	Local	26	146	Low
EAST LOCUST CREEK WATERSHED DAM E- 17	MO50518	Local	21.5	54	Low
EAST LOCUST CREEK WATERSHED DAM E- 20	MO50519	Local	23	133	Low
EAST LOCUST CREEK WATERSHED DAM E- 21	MO50520	Local	29	161	Low
EAST LOCUST CREEK WATERSHED DAM E- 23	MO50521	Local	29	153	Low
EAST LOCUST CREEK WATERSHED DAM E- 4	MO50522	Local	24	167	Low

Name	ID #	Owner Type	Height (ft)	Storage (acre-ft)	Hazard Potential
EAST LOCUST CREEK WATERSHED DAM E- 59	MO50524	Local	29	143	Low
EAST LOCUST CREEK WATERSHED DAM E- 39	MO50525	Local	24	85	Low
EAST LOCUST CREEK WATERSHED DAM E-114	MO50526	Local	25	115	Low
CHARLES EMBERTON DAM	MO50609	Private	34.1	36	Low
RONDA CONNOR DAM	MO50611	Private	33	18	Low
A DAM	MO50675	Private	27.7	32	Low
B DAM	MO50676	Private	26.5	37	Low
HAGGARD DAM	MO50677	Private	26.6	30	Low
ROMINE DAM	MO50678	Private	26.5	32	Low
EAST LOCUST CREEK WATERSHED DAM E-29	MO50718	Local	33.1	125	Low
EAST LOCUST CREEK WATERSHED DAM E-72	MO50719	Local	27.3	103	Low
EAST LOCUST CREEK WATERSHED DAM E-74	MO50720	Local	27.8	84	Low
EAST LOCUST CREEK WATERSHED DAM E-75	MO50721	Local	31.3	130	Low
EAST LOCUST CREEK WATERSHED DAM E-82	MO50722	Local	26	135	Low
EAST LOCUST CREEK WATERSHED DAM E-86	MO50723	Local	25.2	95	Low
EAST LOCUST CREEK WATERSHED DAM E-87	MO50724	Local	30	148	Low
EAST LOCUST CREEK WATERSHED DAM E-90	MO50725	Local	26	130	Low
EAST LOCUST CREEK WATERSHED DAM E-94	MO50726	Local	27.1	152	Low
EAST LOCUST CREEK WATERSHED DAM E-125	MO50727	Local	29	77	Low
EAST LOCUST CREEK WATERSHED DAM E-126	MO50728	Local	31	120	Low
EAST LOCUST CREEK WATERSHED DAM E-127	MO50729	Local	34.5	122	Low
EAST LOCUST CREEK WATERSHED DAM E-128	MO50730	Local	29	89	Low
UPPER LOCUST CREEK W-216	MO50755	Local	26.5	155	Low
UPPER LOCUST CREEK W-218	MO50756	Local	27.5	113	Low
UPPER LOCUST CREEK W-219	MO50757	Local	26.2	146	Low
EAST LOCUST CREEK WATERSHED DAM E-28	MO50761	Local	22.2	97	Low
EAST LOCUST CREEK WATERSHED DAM E- 5	MO50816	Local	26	71	Low
EAST LOCUST CREEK WATERSHED DAM E- 7	MO50817	Local	24.9	65	Low
EAST LOCUST CREEK WATERSHED DAM E- 8	MO50818	Local	19	50	Low
EAST LOCUST CREEK WATERSHED DAM E- 9	MO50819	Local	26	77	Low
EAST LOCUST CREEK WATERSHED DAM E- 11	MO50820	Local	26	111	Low
EAST LOCUST CREEK WATERSHED DAM E- 12	MO50821	Local	23	98	Low
EAST LOCUST CREEK WATERSHED DAM E- 18	MO50822	Local	27	112	Low
EAST LOCUST CREEK WATERSHED DAM E- 38A	MO50823	Local	32	136	Low
EAST LOCUST CREEK WATERSHED DAM E- 38B	MO50824	Local	26	55	Low
CRIST DAM	MO50990	Private	21	120	Low
EAST LOCUST CREEK WATERSHED DAM E-40	MO51017	Local	23.8	74	Low
EAST LOCUST CREEK E-41	MO51018	Local	25	45	Low
EAST LOCUST CREEK WATERSHED DAM E-35A	MO51019	Local	32	130	Low
EAST LOCUST CREEK WATERSHED DAM E-60	MO51020	Local	23	65	Low
EAST LOCUST CREEK WATERSHED DAM E-136	MO51041	Local	34	83	Low
EAST LOCUST CREEK WATERSHED DAM E-132	MO51042	Local	33.9	74	Low
EAST LOCUST CREEK WATERSHED DAM E-120	MO51043	Local	32	143	Low
LARRY COOK DAM	MO51121	Private	28	51	Low
DANEY DAM	MO51122	Private	24	71	Low
VASEY DAM	MO51123	Private	28	79	Low
EAST YELLOW CREEK W- 28	MO51312	Local	24.1	117.8	Low
EAST YELLOW CREEK A- 37	MO51313	Local	21	74.1	Low
EAST YELLOW CREEK A- 44	MO51314	Local	20	78.9	Low
EAST YELLOW CREEK A- 50	MO51315	Local	27	102.7	Low
EAST YELLOW CREEK A- 52	MO51316	Local	22	189.1	Low
EAST YELLOW CREEK A- 55A	MO51317	Local	22	114.5	Low
EAST YELLOW CREEK A- 56A	MO51318	Local	24	73.8	Low
EAST YELLOW CREEK A- 80	MO51319	Local	25	81	Low
EAST YELLOW CREEK A- 89A	MO51320	Local	30	85.3	Low
EAST YELLOW CREEK A- 92	MO51321	Local	27	167.2	Low
UPPER LOCUST CREEK L-210	MO51332	Local	28	104	Low
UPPER LOCUST CREEK L-217A	MO51333	Local	31	94	Low
UPPER LOCUST CREEK W-179	MO51335	Local	26	114.9	Low
UPPER LOCUST CREEK W-180A	MO51336	Local	26	174.5	Low

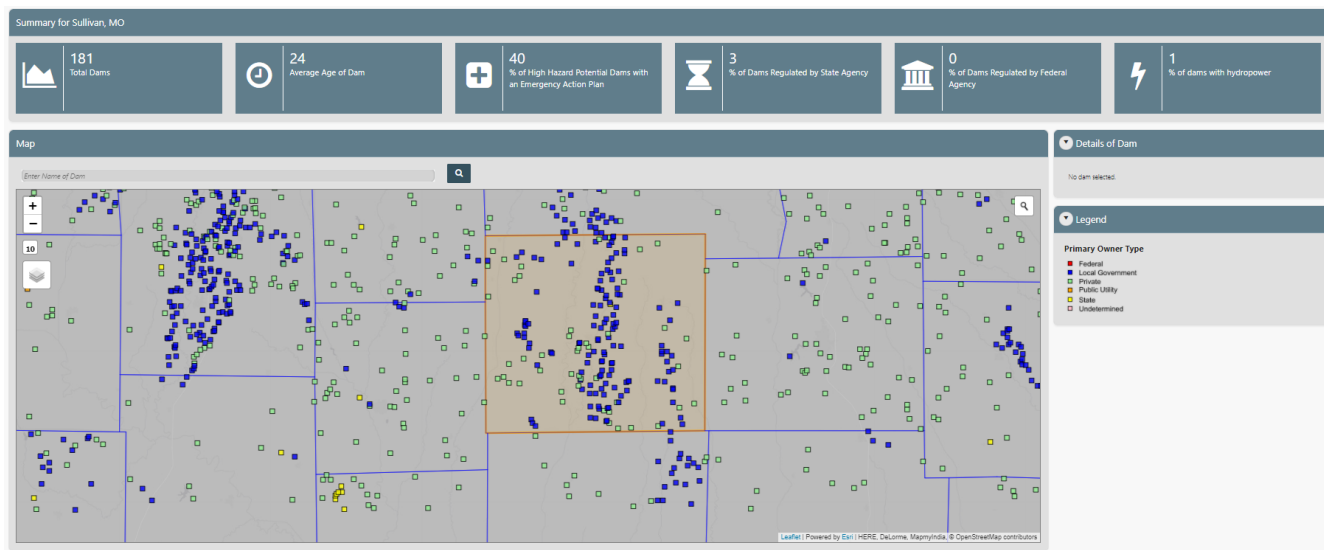
Name	ID #	Owner Type	Height (ft)	Storage (acre-ft)	Hazard Potential
UPPER LOCUST CREEK W-182	MO51337	Local	25	80.4	Low
UPPER LOCUST CREEK W-183A	MO51338	Local	22	66	Low
UPPER LOCUST CREEK W-183B	MO51339	Local	22	76.7	Low
UPPER LOCUST CREEK W-185	MO51340	Local	23	78	Low
EAST LOCUST CREEK WATERSHED DAM E- 52	MO51341	Local	33	114.4	Low
EAST LOCUST CREEK WATERSHED DAM E- 57	MO51342	Local	27	118.2	Low
EAST LOCUST CREEK WATERSHED DAM E- 65	MO51343	Local	30	130.4	Low
EAST LOCUST CREEK WATERSHED DAM E- 66	MO51344	Local	22	78.9	Low
EAST LOCUST CREEK WATERSHED DAM E- 68	MO51345	Local	33	130.7	Low
SMITH DAM	MO51392	Private	30	18.4	Low
UPPER LOCUST CREEK W-107	MO51471	Local	27	89.1	Low
UPPER LOCUST CREEK W-116	MO51472	Local	23.6	78.6	Low
UPPER LOCUST CREEK W-120	MO51473	Local	27	163.5	Low
UPPER LOCUST CREEK W-121	MO51474	Local	24.4	106.6	Low
UPPER LOCUST CREEK W-140	MO51475	Local	27	86.5	Low
EAST YELLOW CREEK W- 30A	MO51480	Local	27	75.7	Low
EAST LOCUST CREEK WATERSHED DAM E-137	MO51481	Local	30	135.3	Low
EAST LOCUST CREEK WATERSHED DAM E-119	MO51482	Local	34.2	180.7	Low
EAST LOCUST CREEK WATERSHED DAM E-142B	MO51483	Local	32	124.2	Low
EAST LOCUST CREEK WATERSHED DAM E-141	MO51484	Local	24.7	118.9	Low
EAST LOCUST CREEK WATERSHED DAM E-111A	MO51485	Local	30	115	Low
EAST LOCUST CREEK WATERSHED DAM E-109	MO51486	Local	27	89.3	Low
EAST LOCUST CREEK WATERSHED DAM E-107	MO51487	Local	29	113.7	Low
EAST LOCUST CREEK WATERSHED DAM E-134	MO51488	Local	27	255.4	Low
EAST LOCUST CREEK WATERSHED DAM E-122	MO51489	Local	28	218.2	Low
EAST LOCUST CREEK WATERSHED DAM E-108	MO51490	Local	33	180.9	Low
EAST LOCUST CREEK WATERSHED DAM E-149	MO51491	Local	28	132	Low
EAST LOCUST CREEK WATERSHED DAM E-147	MO51492	Local	31	111	Low
EAST LOCUST CREEK WATERSHED DAM E-144	MO51493	Local	33.6	115.6	Low
EAST LOCUST CREEK WATERSHED DAM E-130	MO51494	Local	29	91.1	Low
WISE DAM	MO51495	Private	31	32.8	Low
UPPER LOCUST CREEK L-152	MO51508	Local	28	244.3	Low
UPPER LOCUST CREEK L-157	MO51509	Local	33.9	205.4	Low
UPPER LOCUST CREEK R- 24	MO51510	Local	27	182.3	Low
EAST YELLOW CREEK A- 25	MO51511	Local	20	146.3	Low
EAST YELLOW CREEK A- 32	MO51512	Local	23.8	79.9	Low
EAST YELLOW CREEK A- 35	MO51513	Local	20	89.4	Low
EAST YELLOW CREEK A- 36	MO51514	Local	22	100	Low
EAST YELLOW CREEK A- 42	MO51515	Local	24.8	111.6	Low
EAST YELLOW CREEK A- 57	MO51520	Local	27	125.6	Low
EAST YELLOW CREEK A- 58	MO51521	Local	29	97.8	Low
EAST YELLOW CREEK A- 61	MO51522	Local	28	100.5	Low
EAST LOCUST CREEK WATERSHED DAM E-118	MO51558	Local	31	88.8	Low
UPPER LOCUST CREEK R- 9	MO51591	Local	29.3	121.9	Low
UPPER LOCUST CREEK R- 14	MO51592	Local	27.7	153.6	Low
UPPER LOCUST CREEK W-164A	MO51594	Local	32.3	140.9	Low
UPPER LOCUST CREEK W-165	MO51595	Local	32.2	78.4	Low
UPPER LOCUST CREEK W-170A	MO51596	Local	25.2	113	Low
UPPER LOCUST CREEK W-188	MO51597	Local	27	61.2	Low
UPPER LOCUST CREEK W-189	MO51598	Local	30.9	147	Low
UPPER LOCUST CREEK W-190	MO51599	Local	28.6	67.9	Low
UPPER LOCUST CREEK W-192	MO51600	Local	27.9	110.9	Low
UPPER LOCUST CREEK W-193	MO51601	Local	31.1	143.3	Low

Figure 1.33. Dams in Sullivan County – NID Data



Source: <https://nid.sec.usace.army.mil/ords/f?p=105:113:6533036260733::NO::>

Figure 1.34. Sullivan County Dams by Owner Type – NID Data



Source: <https://nid.sec.usace.army.mil/ords/f?p=105:113:6533036260733::NO::>

Geographic Location

Dams Located Within the Planning Area

There are 181 dams located inside the Sullivan County boundaries per the National Inventory of Dams. Five of those dams are high hazard dams per recorded data from the NID and MoDNR. Of the 181 dams in the County, 134 dams are local government owned and operated, 46 dams are privately owned and operated, and the remaining 1 dam in the County is State owned and

operated.

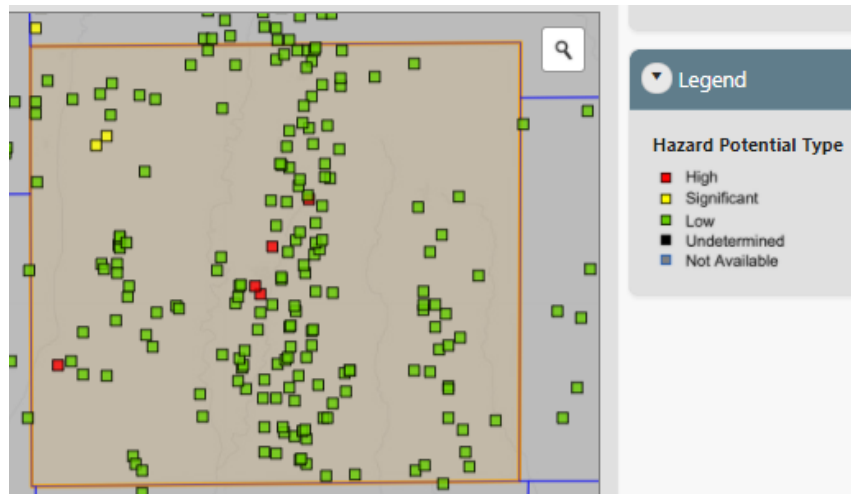
Table 3.25 below includes a list of the names, locations, and other pertinent information for all four high hazard dams in the planning area. Figure 3.22 provides a map of Sullivan County showing where the high hazard dams are located. Figure 3.23 provides a map of each dam location.

Table 1.46. High Hazard Dams in the Sullivan County Planning Area

Dam Name	Emergency Action Plan (EAP/AP)	Dam Height (Ft)	Normal Storage (Acre-Ft)	Last Inspection Date	River	Nearest Downstream City	Distance to Nearest City (Miles)	Dam Owner
LAKE LU JUAN DAM	YES	49	765	3/25/2010	TR-EAST LOCUST CREEK	MILAN	0.1	PRIVATE
ELMWOOD CITY LAKE DAM	YES	47	7000	3/7/2018	ELMWOOD BRANCH	MILAN	2	LOCAL GOVERNMENT
SEARS COMMUNITY LAKE DAM	NOT REQ'D	33	318	-	TR-EAST LOCUST CREEK	MILAN	3	STATE GOVERNMENT
RUSK LAKE DAM	NOT REQ'D	25	120	-	TR-MEDICINE CREEK	LAREDO	0	PRIVATE
EDDY'S LAKE DAM	NOT REQ'D	30	128	1/21/1981	TR-LOCUST CREEK	MILAN	0	PRIVATE

Sources: Missouri Department of Natural Resources, <https://dnr.mo.gov/geology/wrc/dam-safety/damsinmissouri.htm> and National Inventory of Dams, http://nid.usace.army.mil/cm_apex/f?p=838:12. Contact the MoDNR Dam and Reservoir Safety Program at 800-361-4827 to request the inundation maps for your county to show geographic locations at risk, extent of failure and to perform GIS analysis of those assets at risk to dam failure.

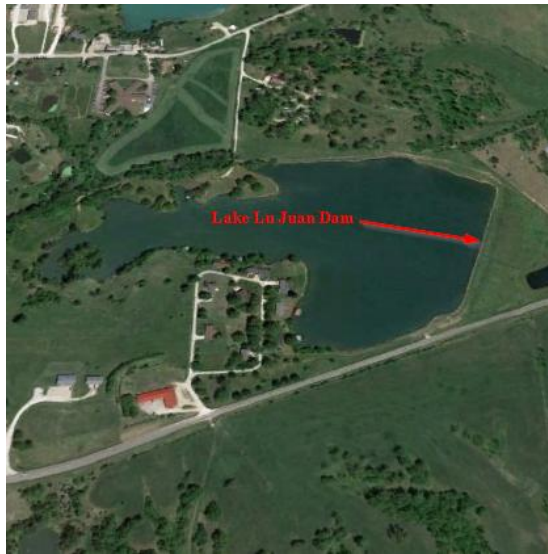
Figure 1.35. High Hazard Dams in Sullivan County



Source: <https://nid.sec.usace.army.mil/ords/f?p=105:113:17101960582123::NO::>

Figure 1.36. High Hazard Dam Locations in Sullivan County and Inundation Areas

Lake Lu Juan Dam



Elmwood City Lake Dam



Sears Community Lake Dam



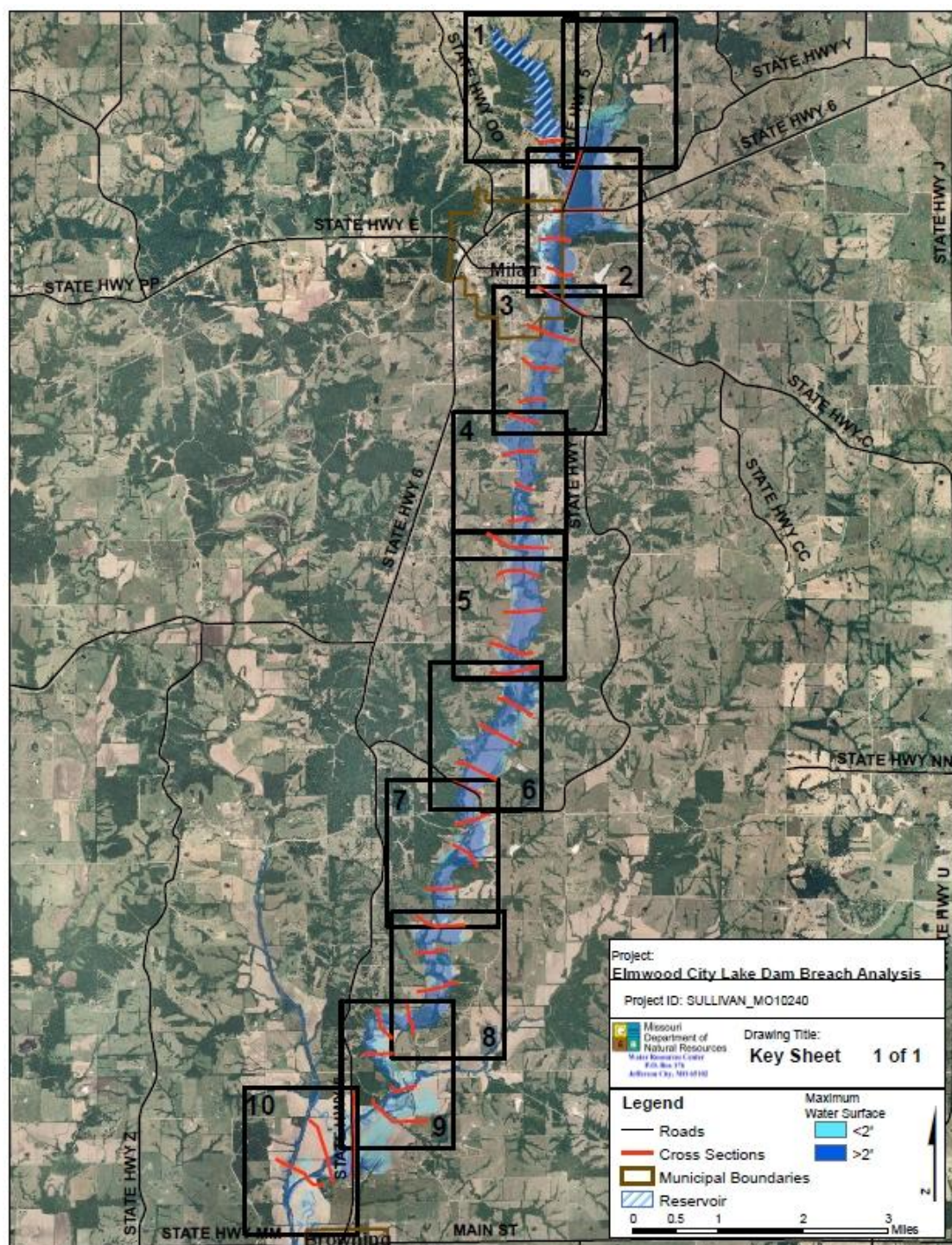
Rusk Lake Dam



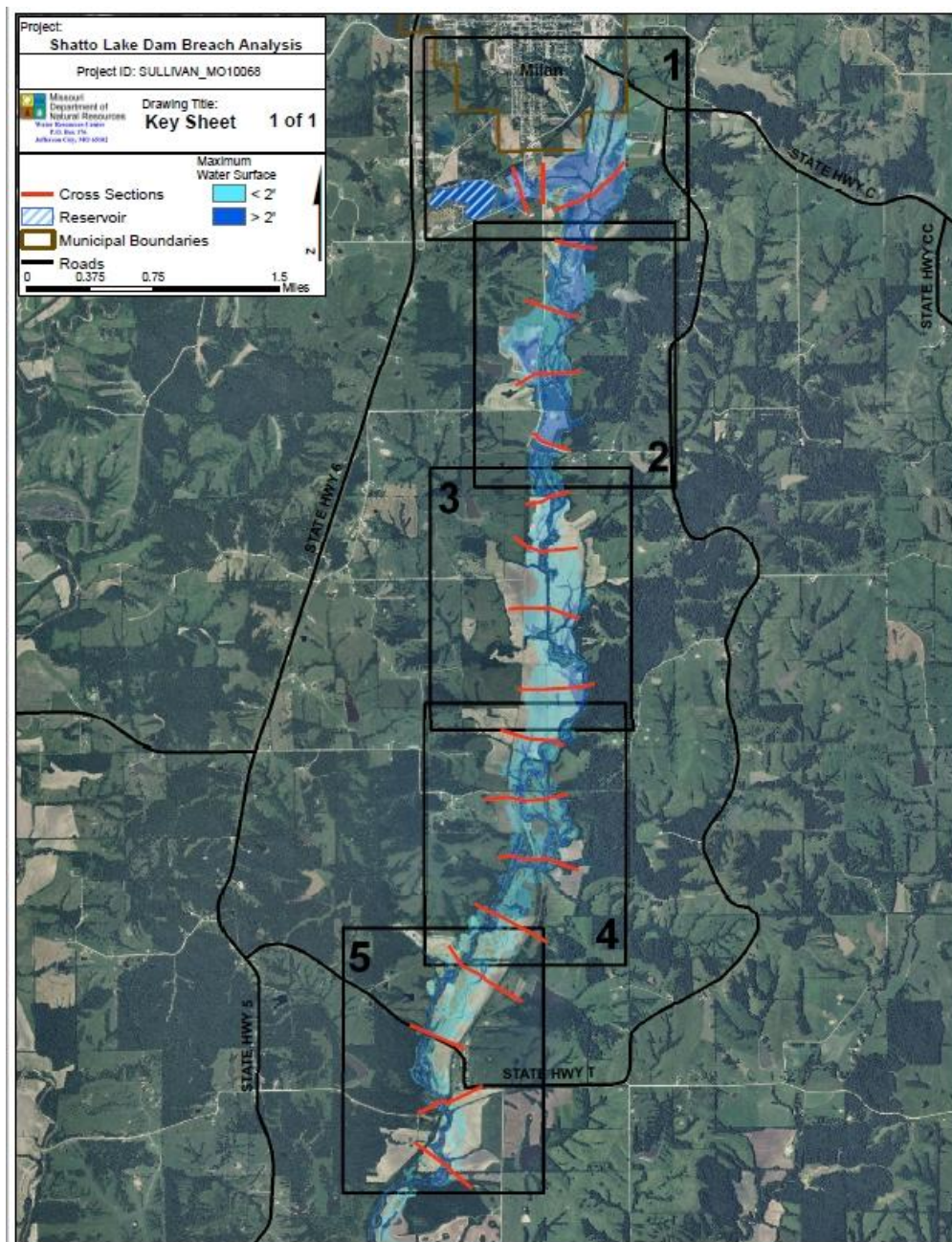
Eddy's Lake Dam



Elmwood City Lake Dam Inundation Map



Lake Lu Juan Dam (Shatto Dam) Inundation Map

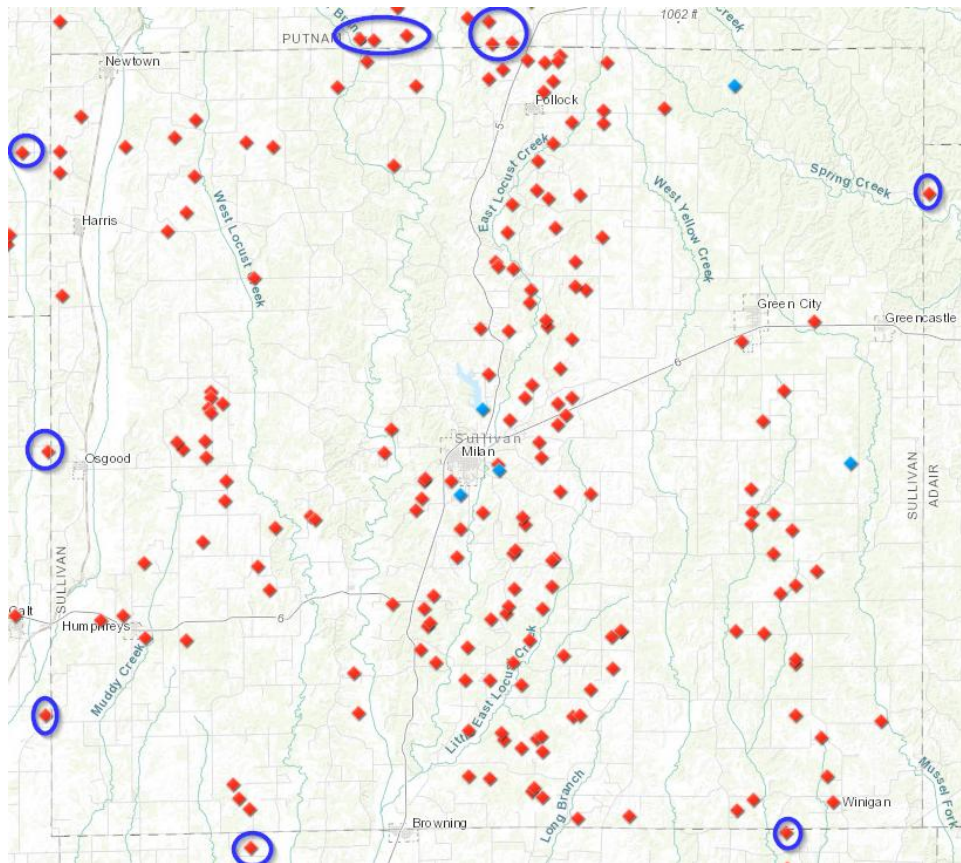


Source: U.S. Army Corps of Engineers, Missouri Department of Natural Resources

Upstream Dams Outside the Planning Area

The Missouri Department of Natural Resources was contacted to see if dams located outside of the Sullivan County would impact the planning area in the event of failure. It was determined there are no dams in neighboring counties that could overflow and potentially enter Sullivan County. The only upstream dams (circled in blue) that could potentially cause flooding in Sullivan County shown in Figure 3.24 are in neighboring counties and those dams are unregulated dams that are under 35'. Per the Missouri Department of Natural Resources, all of the dams circled in blue are not a flooding hazard.

Figure 1.37. Upstream Dams Outside Sullivan County



Source: U.S. Army Corps of Engineers, Missouri Department of Natural Resources

Strength/Magnitude/Extent

The strength/magnitude of dam failure would be similar in some cases to flood events (see the flood hazard vulnerability analysis and discussion). The strength/magnitude/extent of dam failure is related to the volume of water behind the dam as well as the potential speed of onset, depth, and velocity. Note that for this reason, dam failures could flood areas outside of mapped flood hazards.

There are five high hazard dams in Sullivan County. Two of the five high hazard dams in the County are state regulated dams, Elmwood City Lake Dam and Lake Lu Juan Dam (Shatto Dam). The Elmwood City Lake Dam is assigned a hazard class of 1, which is defined as containing 10 or more permanent dwelling or any public buildings. The Lake Lu Juan Dam has been assigned a hazard class of 2, which is defined as a dam that has one to nine permanent dwellings, or one or more campgrounds with permanent water, sewer and electrical services or one or more industrial buildings in the environmental zone downstream of the dam.

Previous Occurrences

To determine previous occurrences of dam failure within the planning area, the 2016 Sullivan County Hazard Mitigation Plan was consulted, the 2018 Missouri State Hazard Mitigation Plan, and the Stanford University's National Performance of Dams Program. There was no report of dam failures in Sullivan County.

Probability of Future Occurrence

There are no recorded dam failures for Sullivan County dams which make forecasting probability of failure difficult. However, there are two factors to impact dam failure; regulation and inspection. Regulations requires regular inspections which can determine issues that contribute to failure. Of the five MoDNR Class I dams in Sullivan County they are state-regulated. Of those five dams, three are privately owned dams, one dam is local government owned and one dam is state owned. Two of the five high hazard dams are state regulated and both have regular inspection schedules. Of the two state regulated dams, one is local government owned and the other is privately owned. One of the five high hazard dams is privately owned and has one inspection on record. Two of the three high hazard dams that are privately owned do not have inspection dates on record.

The impact of regular inspection and maintenance significantly reduces the probability of dam failure.

Changing Future Conditions Considerations

If we accept the climate change scenario that forecasts more dramatic periods of precipitation, we can then infer that more stress will be placed upon dams which will be more prone to failure. Couple that with an infrastructure of aging, uninspected, perhaps poorly maintained dams, and there are the makings of a serious problem for those living downstream.

Vulnerability

Vulnerability Overview

Vulnerability to dam failure is a factor due to the number of dams in the planning area, including five high hazard dams. Dam failure would affect mostly commercial and industrial structures in the planning area. Only a few residential structures could possibly be affected in the event of a dam failure.

The Elmwood City Lake Dam is located in an unincorporated area of Sullivan County. This local government owned, high hazard, class 1 state regulated dam has an emergency action plan, but has never reported a dam failure. The impact of a dam failure of the Elmwood City Lake Dam would potentially affect an industrial area close to the City of Milan, in addition to some structures and residential areas just inside the city limits of the City of Milan.

The Lake Lu Juan Dam is located just outside of the city limits of the City of Milan. This dam was referred to as the Shatto Lake Dam in previous plan updates. This high hazard dam is privately owned, was last inspected in 2010 and it has an emergency action plan. Failure of the Lake Lu Juan Dam would potentially affect commercial and agricultural areas, with the exception of what appears to be one residential structure and its outbuilding.

The Eddy's Lake Dam is a high hazard dam located in an unincorporated area of Sullivan County, just outside the city limits of the City of Milan. This dam is not state regulated and an emergency action plan is not required for this dam. The last inspection reported by the NID was from 1981. Failure of this dam could affect what appears to be an agricultural area. No residential or commercial structures appear to be present near the dam.

The Sears Community Lake Dam is owned by the Missouri Department of Conservation. While this high hazard dam is state owned, it is not state regulated. There have been no reported inspections and an emergency action plan is not required for this dam. It is located in an unincorporated area of the county and dam failure could affect what appears to be only one residential structure.

As there are no recorded dam failures within the jurisdictions or the unincorporated area of Sullivan County. The planning committee chose only to address high hazard dams when funding becomes available.

Potential Losses to Existing Development:

(including types and numbers, of buildings, critical facilities, etc.)

According to the 2018 Missouri State Hazard Mitigation Plan, there are no structures or populations that are vulnerable to failure of regulated dams with inundation maps. While dam failure is possible in the planning area, it is likely to not produce any losses.

Impact of Previous and Future Development

Sullivan County is largely rural within the inundation areas of high hazard dams. At this time, there are no known plans of expansion for the inundation areas.

Hazard Summary by Jurisdiction

The vast majority of Sullivan County is not in danger of being inundated due to dam breach or failure.

It is unknown if the private owners of the Lake Lu Juan Dam participate in dam emergency exercises. It is also encouraged that the City of Milan conduct regular dam emergency exercises for the city owned Elmwood City Lake Dam.

No further analysis of dam failure will be conducted for this plan update. It will be helpful for all residents and businesses near the five high hazard dams to get familiarized with the dam's Emergency Action Plan (EAP) and work closely with County EOP & participate in dam emergency exercises.

Problem Statement

A lack of regular inspection/maintenance of un-regulated high hazard dams was noted by the Mitigation Planning Committee. Possible solutions include the development of a regular maintenance schedule, identification of qualified staff and/or consultant to assist, and maintenance report submittal requirements.

Some private entities in Sullivan County that own and control dams do not properly inspect and maintain them to ensure the safety of people and property that lie within the inundation area of a dam breach. Jurisdictions and residents must be informed of the proper way to inspect a dam and look for initial problems.

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.

Eight earthquake seismic zones are located in the central United States, two of which are located in Missouri. The most active zone is the New Madrid Seismic Zone, which is also the most active seismic area in the United States east of the Rocky Mountains according to the U.S. Geological Survey. The New Madrid Zone is by some measures as high a risk for tremors as seismic zones in California. It runs from northern Arkansas through southeast Missouri and western Tennessee and Kentucky to the Illinois side of the Ohio River Valley. During the winter of 1811-1812 three earthquakes estimated to have been magnitude 7.5 or greater were centered in the New Madrid fault in the Bootheel region of southeast Missouri. Thousands of aftershocks continued for years.

Significant earthquakes, each about magnitude 6, occurred in 1843 near Marked Tree, Arkansas, and on October 31, 1895 near Charleston, Missouri. In November 1968 a magnitude 5.5 earthquake centered in southeastern Illinois caused moderate damage to chimneys and walls at Hermann, St. Charles, St. Louis, and Sikeston, Missouri. The quake was felt in areas that include all or portions of 23 states. Other earthquakes have occurred throughout southeastern parts of Missouri. Smaller, but still destructive earthquakes are even more likely, according to the Missouri Seismic Safety Commission.

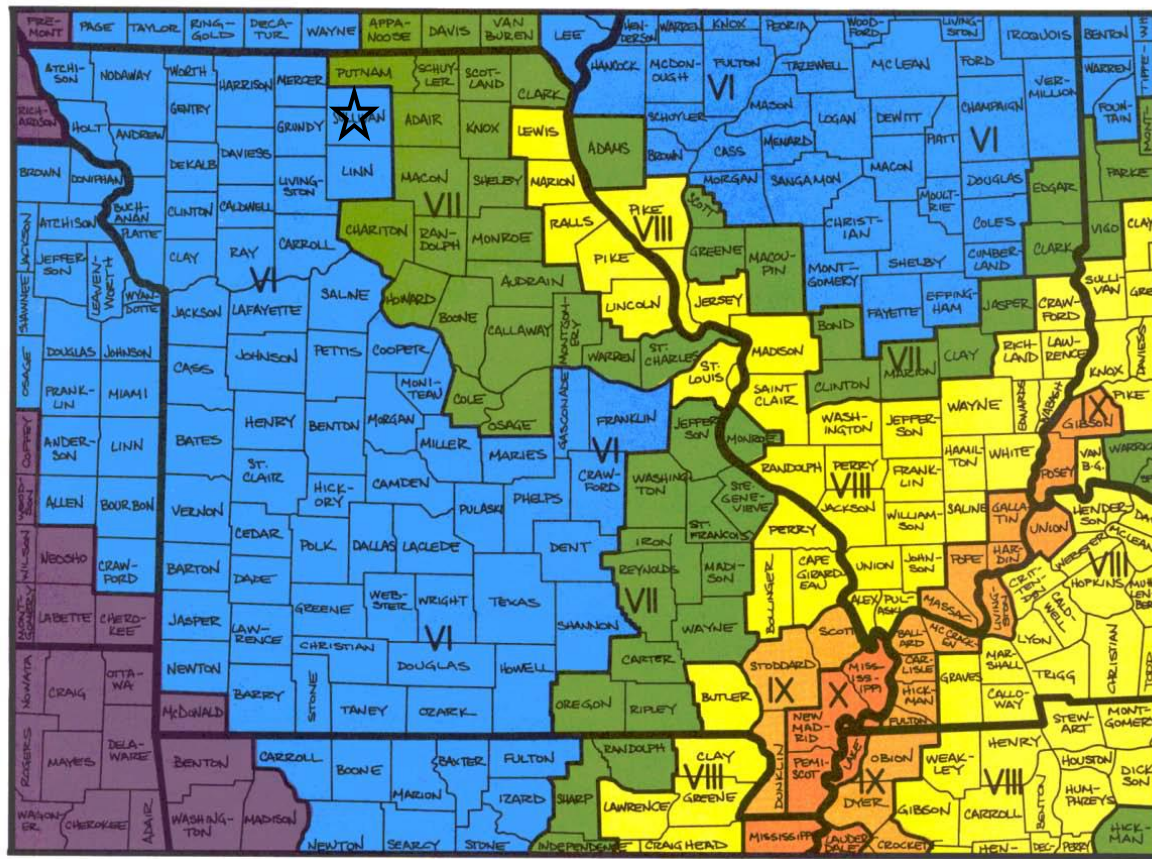
Geographic Location

Seismic activity on the New Madrid Seismic Zone of Southeastern Missouri is very significant both historically and at present. On December 16, 1811 and January 23 and February 7 of 1812, three earthquakes struck the central U.S. with magnitudes estimated to be 7.5-8.0. These earthquakes caused violent ground cracking and volcano-like eruptions of sediment (sand blows) over an area of >10,500 km², and uplift of a 50 km by 23 km zone (the Lake County uplift). The shaking was felt over a total area of over 10 million km² (the largest felt area of any historical earthquake). Of all the historical earthquakes that have the U.S., an 1811-style event would do the most damage if it recurred today. If an 1811 earthquake occurred in Sullivan County the earthquake intensity would not vary within the county. Damage would be to buildings of poor design and construction, slight to none in well-built ordinary structures; considerable damage in poorly built or badly designed structures and some chimneys broken.

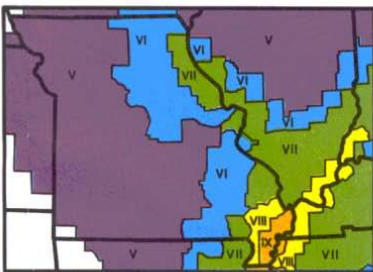
The following SEMA map (Figure 3.25) shows the highest projected Modified Mercalli intensities by county from a potential magnitude 7.6 earthquake whose epicenter could be anywhere along the length of the New Madrid Seismic Zone. The black star in the below figure indicates Sullivan

County and the affects that could be felt from the earthquake.

Figure 1.38. Impact Zones for Earthquake Along the New Madrid Fault

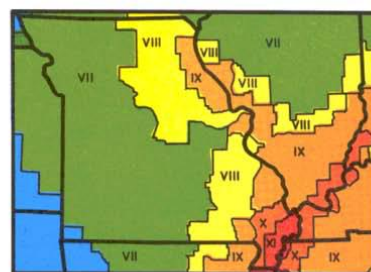


This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude - 7.6 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone.



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.

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.



Source : https://sema.dps.mo.gov/docs/EQ_Map.pdf

Figure 1.39. Projected Earthquake Intensities

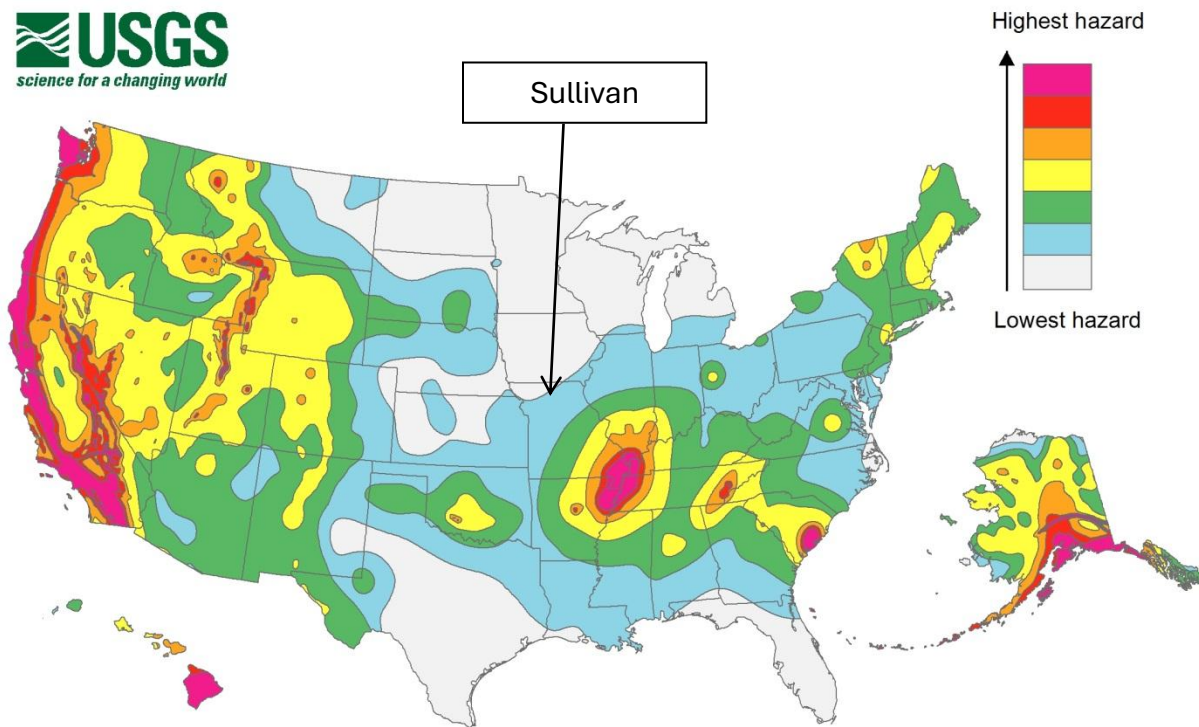
MODIFIED MERCALLI INTENSITY SCALE	
I	People do not feel any Earth movement.
II	A few people might notice movement.
III	Many people indoors feel movement. Hanging objects swing.
IV	Most people indoors feel movement. Dishes, windows, and doors rattle. Walls and frames of structures creak. Liquids in open 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.

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

The map in Figure 3.27 illustrates seismicity in the United States. Sullivan County is shown by an arrow pointing to the location of the planning area within the United States.

Figure 1.40. United States Seismic Hazard Map



Source: United States Geological Survey at
https://earthquake.usgs.gov/hazards/hazmaps/conterminous/2014/images/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 as 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.

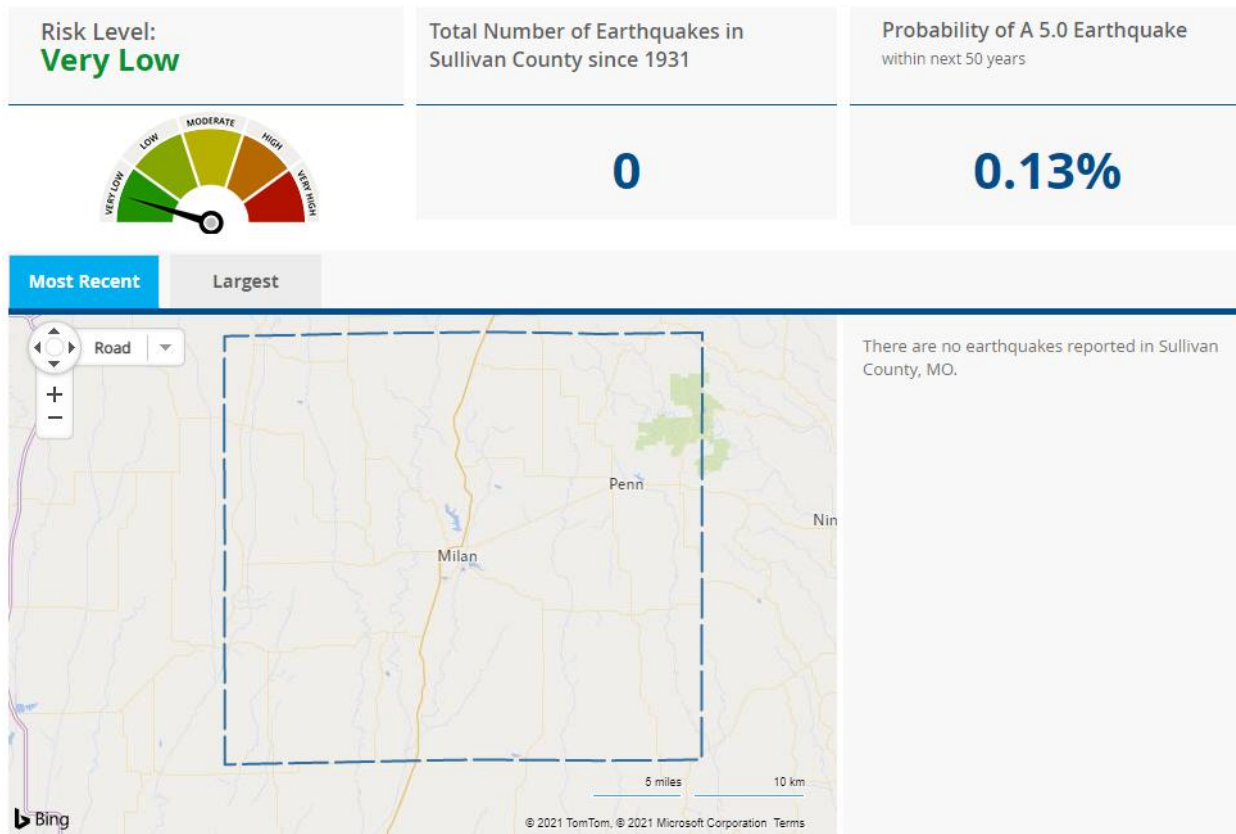
Previous Occurrences

There have been no earthquakes within 30 miles of Sullivan County since 1931 according to the information obtained from homefacts.com as shown in Figure 3.28.

Probability of Future Occurrence

Sullivan County has a very low earthquake risk, with a total of 0 earthquakes since 1931, as shown in Figure 3.28 below. The USGS database shows that there is a 0.13% chance of a major earthquake within 50 miles of Sullivan County within the next 50 years.

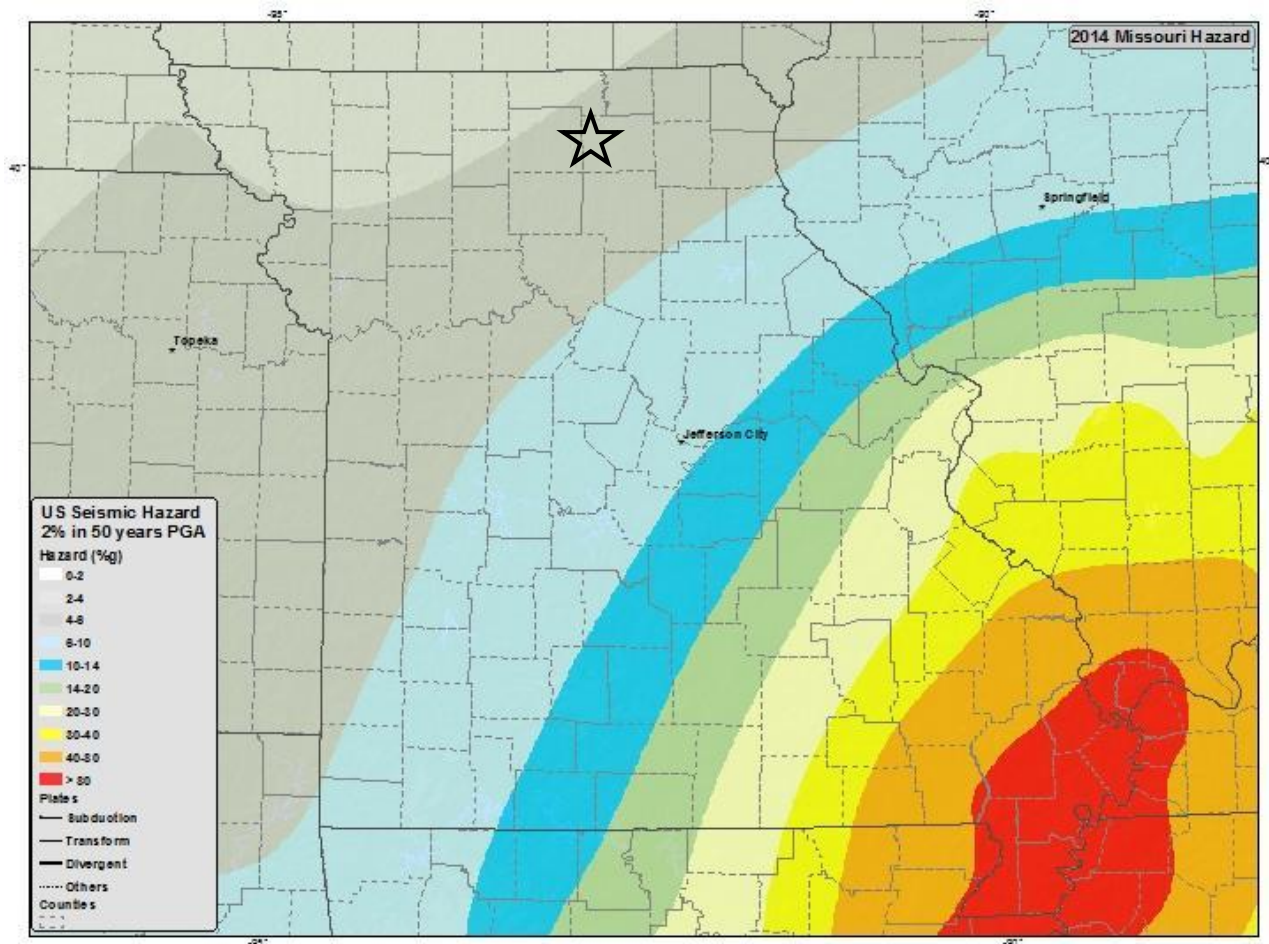
Figure 1.41. Earthquake Risk Level and Probability Percentage



Source : <https://www.homefacts.com/earthquakes/Missouri/Sullivan-County.html>

Figure 3.29 shows that Sullivan County has a four percent probability of exceedance of peak ground acceleration in 50 years, lending value to the assigned low earthquake risk probability.

Figure 1.42. Probability of Exceedance in 50 Years Map of Peak Ground Acceleration



Source : <https://www.usgs.gov/natural-hazards/earthquake-hazards/science/information-region-missouri>

Changing Future Conditions Considerations

Chapter 3, Section 3.3.1., page 3 – 202 of the 2018 Missouri State Hazard Mitigation Plan states “Scientists are beginning to believe there may be a connection between changing climate conditions and earthquakes. Changing ice caps and sea-level redistribute weight over fault lines, which could potentially have an influence on earthquake occurrences”., however, currently no studies quantify the relationship to a high level of detail, so recent earthquakes should not be linked with climate change. While not conclusive, early research suggests that more intense earthquakes and tsunamis may eventually be added to the adverse consequences which are caused by changing future conditions.

Vulnerability

Vulnerability Overview

According to the HAZUS-MH Earthquake Loss Estimation data obtained from the 2018 State Plan, Sullivan County is listed as having a 2% Probability of Exceedance in 50 years. The total loss is estimated at \$2,886.

The State of Earthquake Coverage Report states that the average premium for earthquake coverage in Sullivan County during 2018 was \$66.

Potential Losses to Existing Development

The Hazus building inventory counts are based on the 2010 census data adjusted to 2014 numbers using the Dun & Bradstreet Business Population Report. Inventory values reflect 2014 valuations, based on RSMeans (a supplier of construction cost information) replacement costs. Population counts are 2010 estimates from the U.S. Census Bureau.

Impact of Previous and Future Development

Future development is not expected to increase the risk other than contributing to the overall exposure of what could become damaged as a result of an event.

Hazard Summary by Jurisdiction

Since earthquake intensity is not likely to vary greatly throughout the planning area, the risk will be the same throughout. Sullivan County is not near the New Madrid Shock Zone, but it will likely endure mild effects from the earthquake such as structure damage environmental impacts and economic disruption/losses. However, damages could vary due to structural variations in the planning area's built environment. Sullivan County would likely be impacted by the number of refugees traveling through the area seeking safety and assistance.

Problem Statement

Although Sullivan County is not located in an area that will likely see catastrophic damage from an earthquake, the County will be impacted by the loss of communications, transportation, the disruption of roads, rail and pipelines, water transportation, and the area will see a significant amount of refugees fleeing from Southern Missouri if a quake hits that area. Education is minimal for earthquakes do to the low likely hood of impact. There is one Emergency Management Director for the County that knows where all the generators and emergency buildings are. Not all citizens utilize social media and texting. An emergency plan for earthquakes needs to be made available to all residents and stated what would happen in the event of an earthquake with details for communications and transportation. Downtown building owners need to know plan in case damage is done to their building. Residents need to be made aware of where the generators and emergency buildings are located. Utilization of social media and texting needs to be encouraged.

3.4.4 Land Subsidence/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).

Land subsidence occurs slowly and continuously over time, as a general rule. On occasion, it can occur abruptly, as in the sudden formation of sinkholes. Sinkhole formation can be aggravated by flooding.

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 in shape like shallow bowls or saucers whereas others have vertical walls. Some hold water and form natural ponds.

According to the 2018 Missouri State Hazard Mitigation Plan, there are 53 mines in Sullivan County and 0 sinkholes.

Geographic Location

The 2018 Missouri State Hazard Mitigation Plan states that there are no sinkholes in Sullivan County and 53 mines exist in the County, as shown by Figure 30.

Figure 1.43. Sinkhole and Mine Counts in Sullivan County

County	Number of Sinkholes Per County	Number of Mines Per County
Sullivan	0	53

Source: 2018 Missouri State Hazard Mitigation Plan

Figure 3.31 and 3.32 show sinkhole and mine counts by County. Sullivan County is indicated with a black star.

Figure 1.44. Sinkhole Counts by County

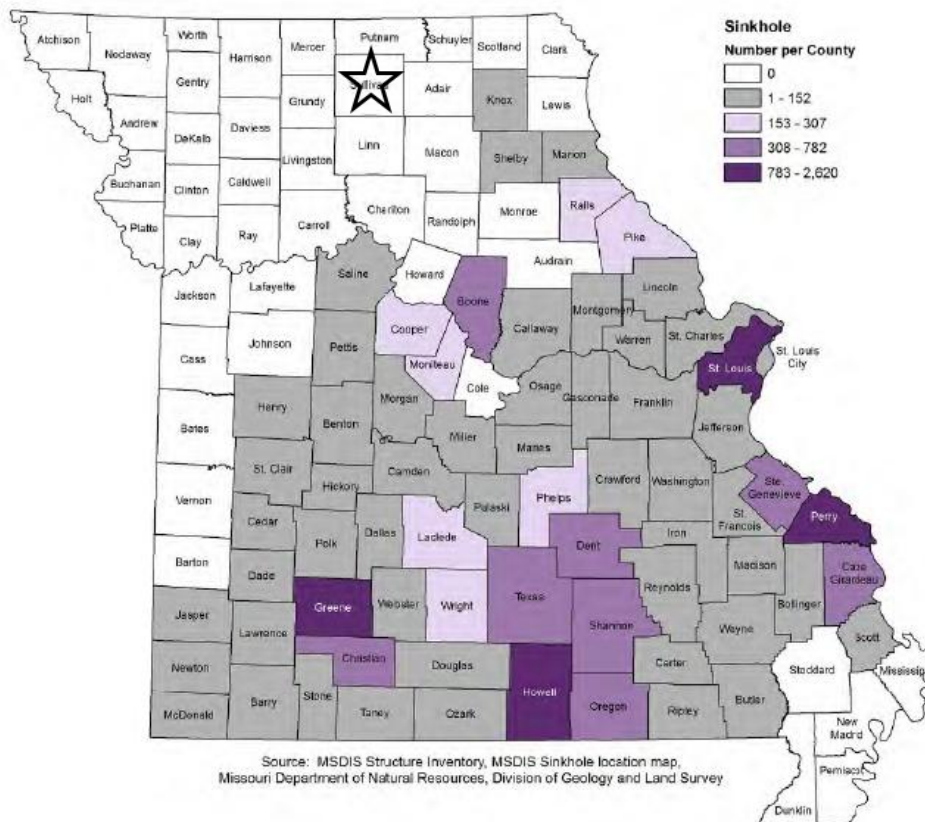
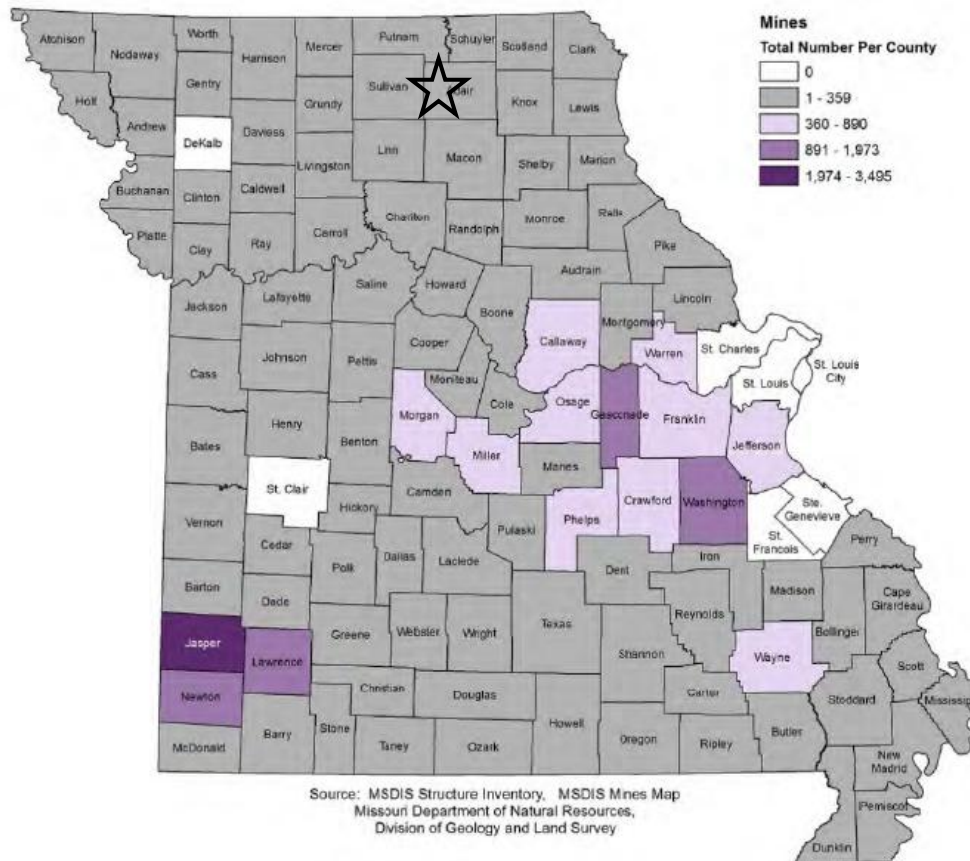


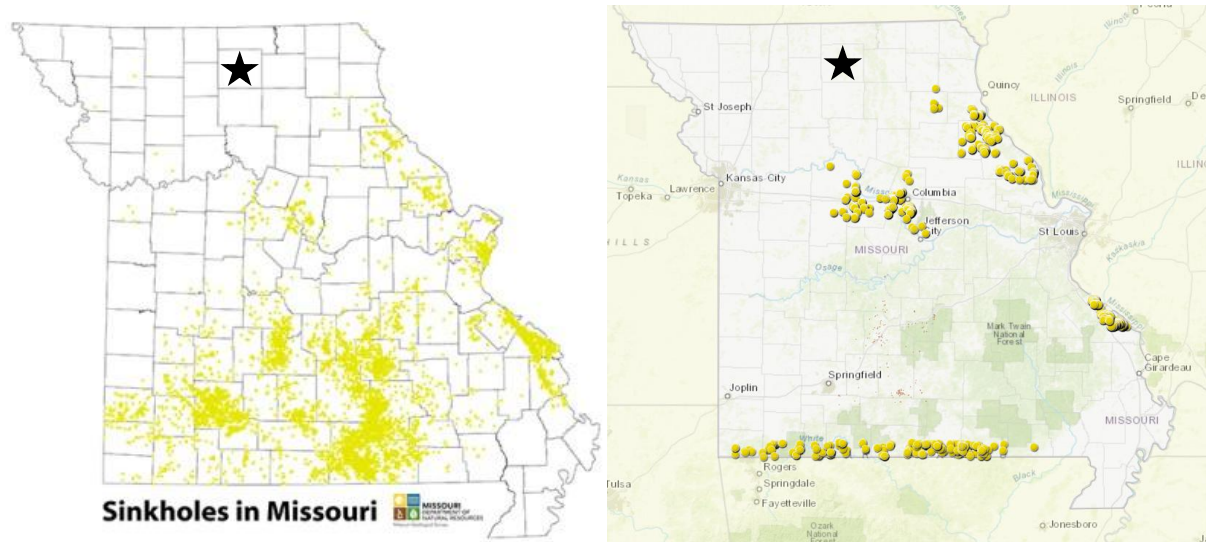
Figure 1.45. Mine Counts by County



Source: 2018 Missouri State Hazard Mitigation Plan

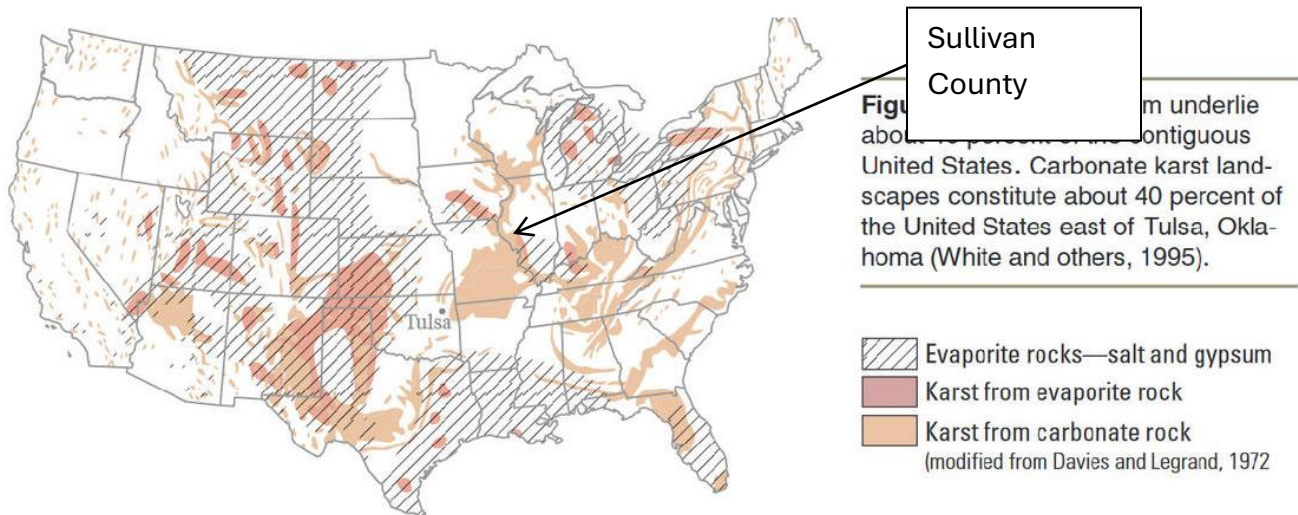
The following Figure 3.33 shows sinkhole locations and Figure 3.34 shows Karst in the State of Missouri. Sullivan County is denoted with a black star.

Figure 1.46. Sinkhole Locations in Missouri



Sources: <https://dnr.mo.gov/geology/geosrv/envgeo/sinkholes.htm> and https://www.arcgis.com/apps/webappviewer/index.html?id=3ac3a61da4af4834811503a24a3cb935&extent=-10935425.9421%2C4194110.701%2C-9418915.3009%2C5070996.2895%2C102100&showLayers=karst_1997%3Bkarst_399%3Bstate_mask_8886

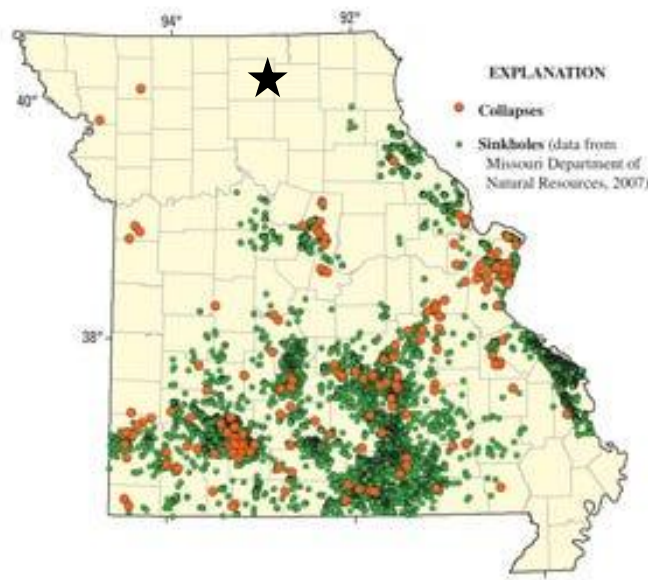
Figure 1.47. Karst Landscape in Missouri



Source : <https://www.usgs.gov/media/images/karst-landscapes-are-more-prone-have-land-subsidence-and-sinkholes>

Figure 3.35 shows a map of collapses and sinkholes in the State of Missouri, with a black star indicating the location of Sullivan County.

Figure 1.48. Collapses and Sinkholes in Missouri



Source : <https://www.businessinsider.com/where-youll-be-swallowed-by-a-sinkhole-2013-3>

Strength/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.

Previous Occurrences

As noted in the 2018 State Plan, sinkholes are a regular occurrence in Missouri, but rarely are the events of any significance. There is no record of previous occurrences in Sullivan County

Probability of Future Occurrence

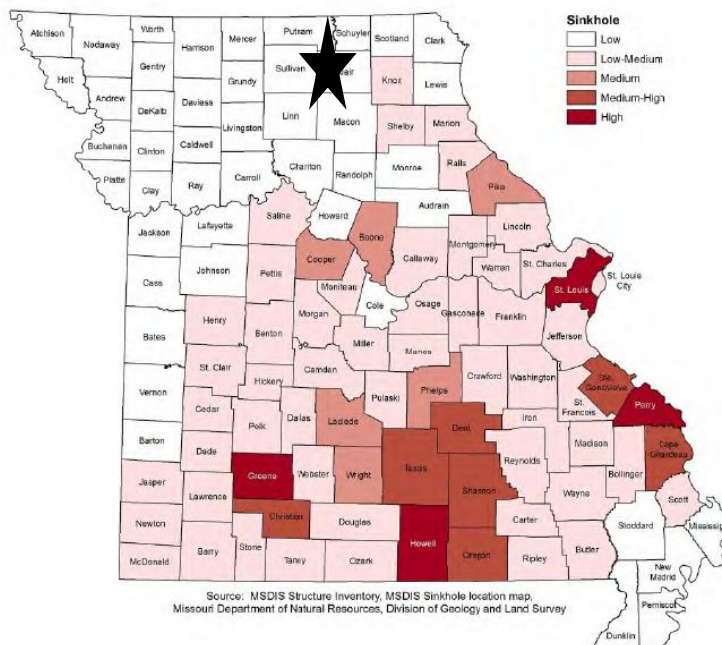
Figure 3.36 shows the hazard rating value and definition for both sinkholes and mines per county in Missouri. Figure 3.37 and 3.38 indicate that Sullivan County has a low hazard rating value for both sinkholes and mines. Sullivan County is indicated with a black star in both figures.

Figure 1.49. Hazard Rating Values

Factor	1 (Low)	2 (Low-medium)	3 (Medium)	4 (Medium-high)	5 (High)
Sinkholes per county	0	1 – 200	201 – 400	401 – 800	801+
Mines per county	0 - 100	101 - 250	251 – 500	501 – 750	751 +

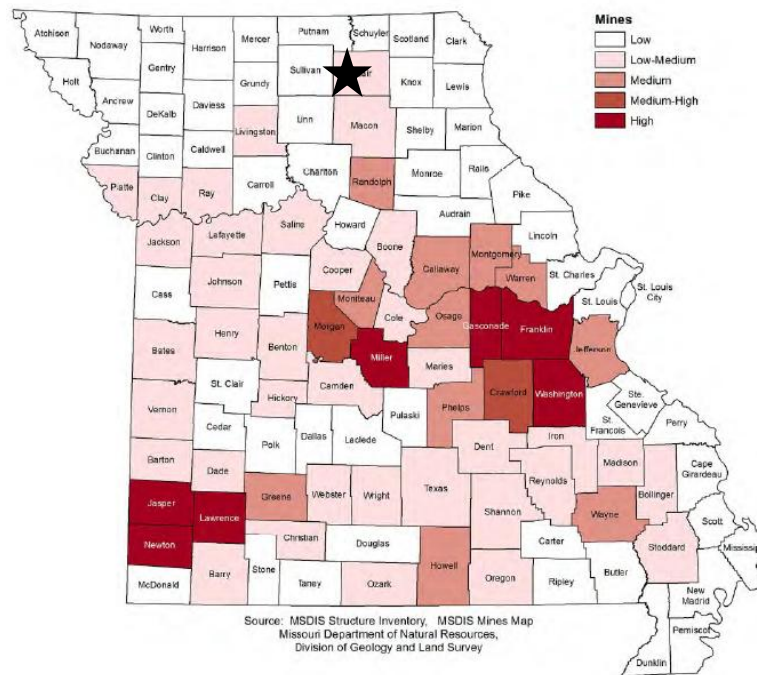
Source: 2018 Missouri State Hazard Mitigation Plan

Figure 1.50. Sinkhole Rating Value by County



Source: 2018 Missouri State Hazard Mitigation Plan

Figure 1.51. Mine Rating Value by County



Source: 2018 Missouri State Hazard Mitigation Plan

Changing Future Conditions Considerations

There are no records of previous event dates in the planning area and the probabilities cannot be calculated due to limited information. As represented in the figures below, the sinkholes and mine located in Sullivan County have been rated low risk.

Vulnerability

Vulnerability Overview

Sinkholes in the planning area are not common occurrence due to composition of the land. While some sinkholes may be considered a slow changing nuisance; other more sudden, catastrophic collapses can destroy property, delay construction projects and contaminate ground water resources.

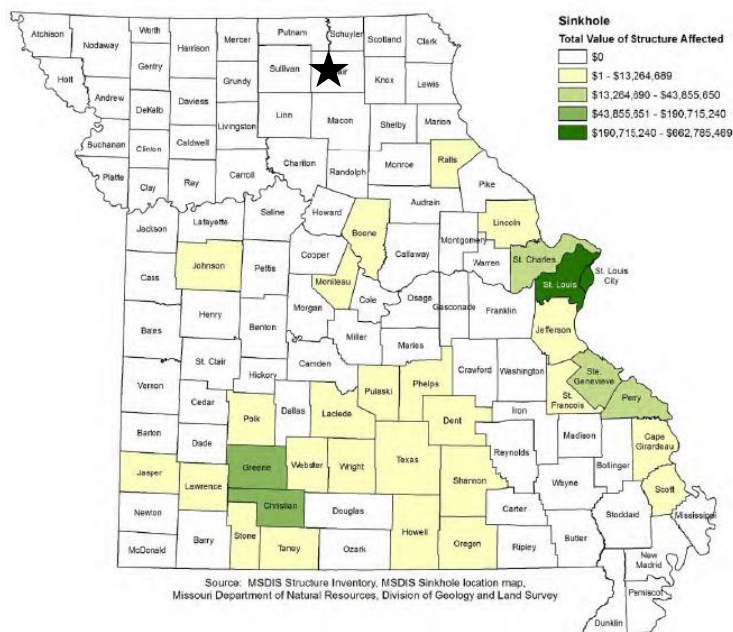
The Missouri Department of Natural Resources shows 0 sinkholes for the planning area.

Potential Losses to Existing Development

The potential impact of sinkholes on existing structures is difficult to determine due to the lack of data on historic damages caused by sinkholes. The mapping of potential sinkholes is difficult, if not impossible, to predict where a sinkhole will collapse and how significant the collapse will be. Because sinkhole collapse is not predictable and previous events have not occurred in the rural area, there is not significant data to estimate the future losses due to a sinkhole.

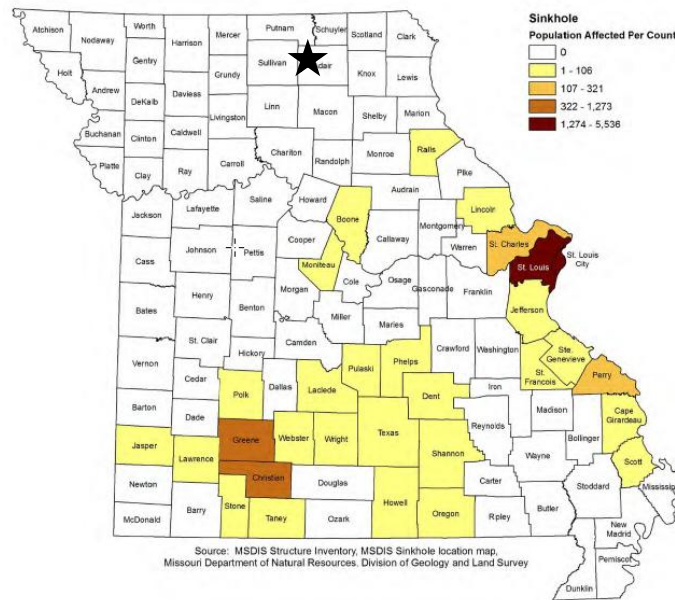
From the GIS data collected and analysis performed, Figure 3.39 indicates the potential for losses due to sinkholes. Figure 3.40 indicates the potential population impacted by sinkholes. In both figures, Sullivan County is indicated with a black star.

Figure 1.52. Ranking of Structures Potentially Impacted by Sinkholes



Source: 2018 Missouri State Hazard Mitigation Plan

Figure 1.53. Ranking of Population Potentially Impacted by Sinkholes by County



Source: 2018 Missouri State Hazard Mitigation Plan

Impact of Previous and Future Development

As more development occurs on unmapped rural areas, the vulnerability to the hazard will increase. However, sinkholes are unpredictable and the development in rural areas is difficult to limit due to the lack of occurrence. Sullivan County and participating jurisdictions have no plans to limit construction due to sinkholes.

Hazard Summary by Jurisdiction

The risk for development is uniform throughout the planning area and has not affected one jurisdiction specifically.

Problem Statement

Sinkholes can occur at any time and without warning and vary by size. There can be a disruption of transportation services and residents in any potentially dangerous area are not educated on what to do if a sinkhole occurs. Education needs to occur within the danger areas of a sinkhole occurring and what to do if a sinkhole does occur.

Karst topography and sinkholes were not noted in Sullivan County. Development within this area stabilized. Possible solutions to sinkholes noted in the future include updating the local ordinances/regulations to address the use of sinkholes for stormwater management.

3.4.5 Drought

Hazard Profile

Hazard Description

Drought is generally defined as a condition of moisture levels significantly below normal for an extended period of time 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

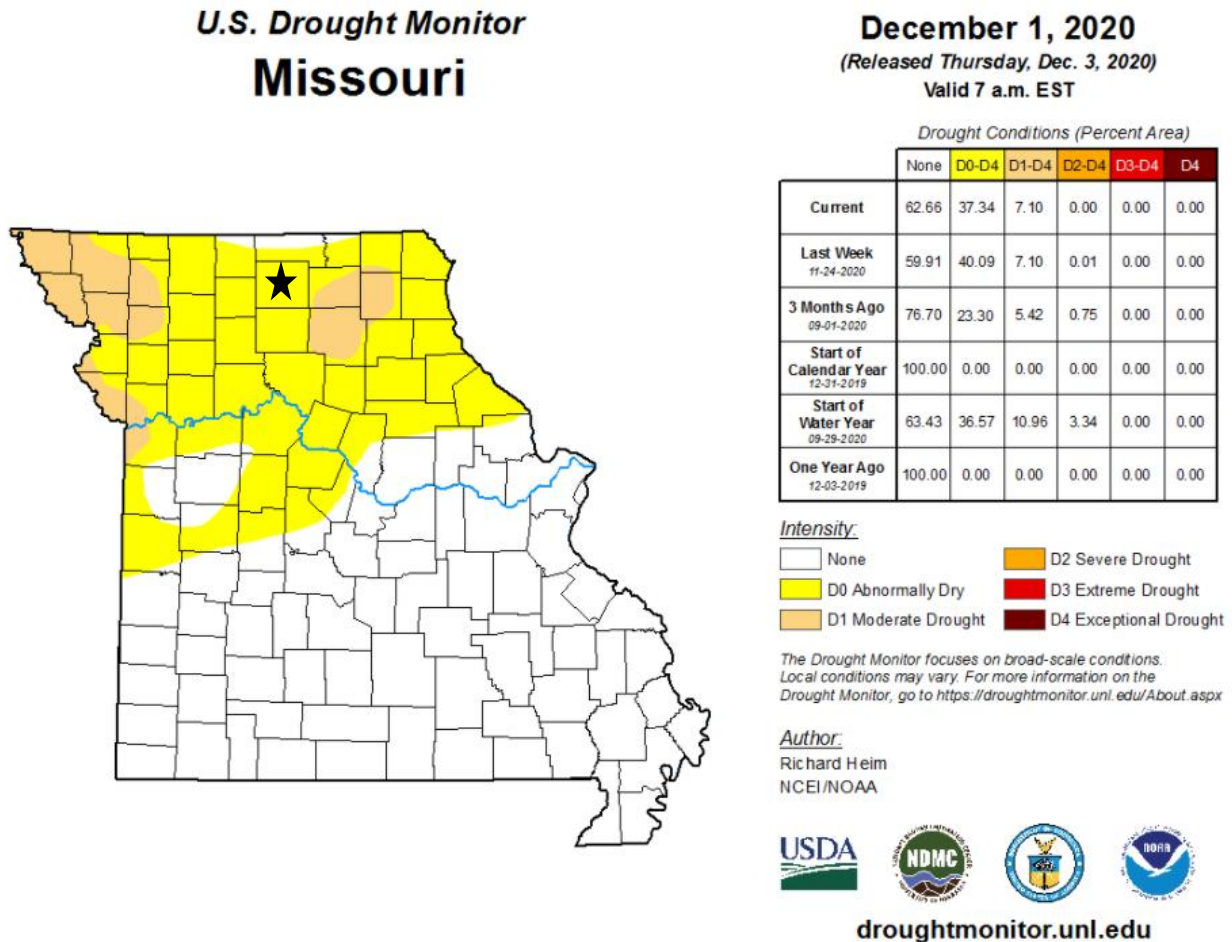
Droughts are regional in nature. All areas of the United States are vulnerable to the risk of drought and extreme heat. Droughts can be widespread or localized events. The extent of the droughts varies both in terms of the extent of the heat and range of precipitation. The severity of a drought depends on locations, duration, and geographical extent. Additionally, drought severity depends on the water supply, usage demands made by human activities, vegetation and agricultural operations. Drought brings several different problems that must be addressed. The quality and quantity of crops, livestock and other agricultural assets will be affected during a drought. Drought can adversely impact forested areas leading to an increased potential for extremely destructive forest and woodland fires that could threaten residential, commercial, and recreational structures.

Sullivan County is seated in the northwestern portion of Missouri. Most of the northern and west-central portions of Missouri are underlain by rocks that are not conducive to water-bearing formations. They yield only small amounts of water, even during periods of normal and above-normal rainfall. Under drought conditions, adequate amounts of water cannot be pumped from the rock formations of northern Missouri to supply even domestic needs. Most streams in northern Missouri do not receive appreciable groundwater recharge. During periods of drought, these streams are generally reduced to a series of pools, or may become completely dry. Streams and water impoundments are the only localized sources of water during droughts, and even these limited resources are at risk when the drought is prolonged. Agriculture in west-central and northern Missouri is usually the first to feel the effects of drought. Although row-cropping is more extensive in this part of the State, irrigation is generally not feasible except on the floodplains of major rivers.

According to the 2017 Census of Agriculture, Sullivan County consists of 309,995 acres land in farms, crop sales generate \$28,441,000 and livestock sales generate \$149,996,000. A drought would directly impact livestock production and the agriculture economy in Sullivan County.

Figure 3.41 indicates the U.S. Drought Monitor Map of Missouri on December 1, 2020. This map shows that Sullivan County was reported to be abnormally dry as of December 1, 2020. Sullivan County is denoted with a star.

Figure 1.54. U.S. Drought Monitor Map of Missouri on Date



Source: U.S. Drought Monitor, <https://droughtmonitor.unl.edu/Maps/MapArchive.aspx>

Strength/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 National Drought Mitigation Center's Drought Impact Reporter, during the 20-year period from January 2000 to December 2019, Sullivan County had 18 drought impacts and 16 reports, as noted in Figure 3.42 and 3.43 below. Table 3.26 below shows the last 10 years of drought payments in Sullivan County.

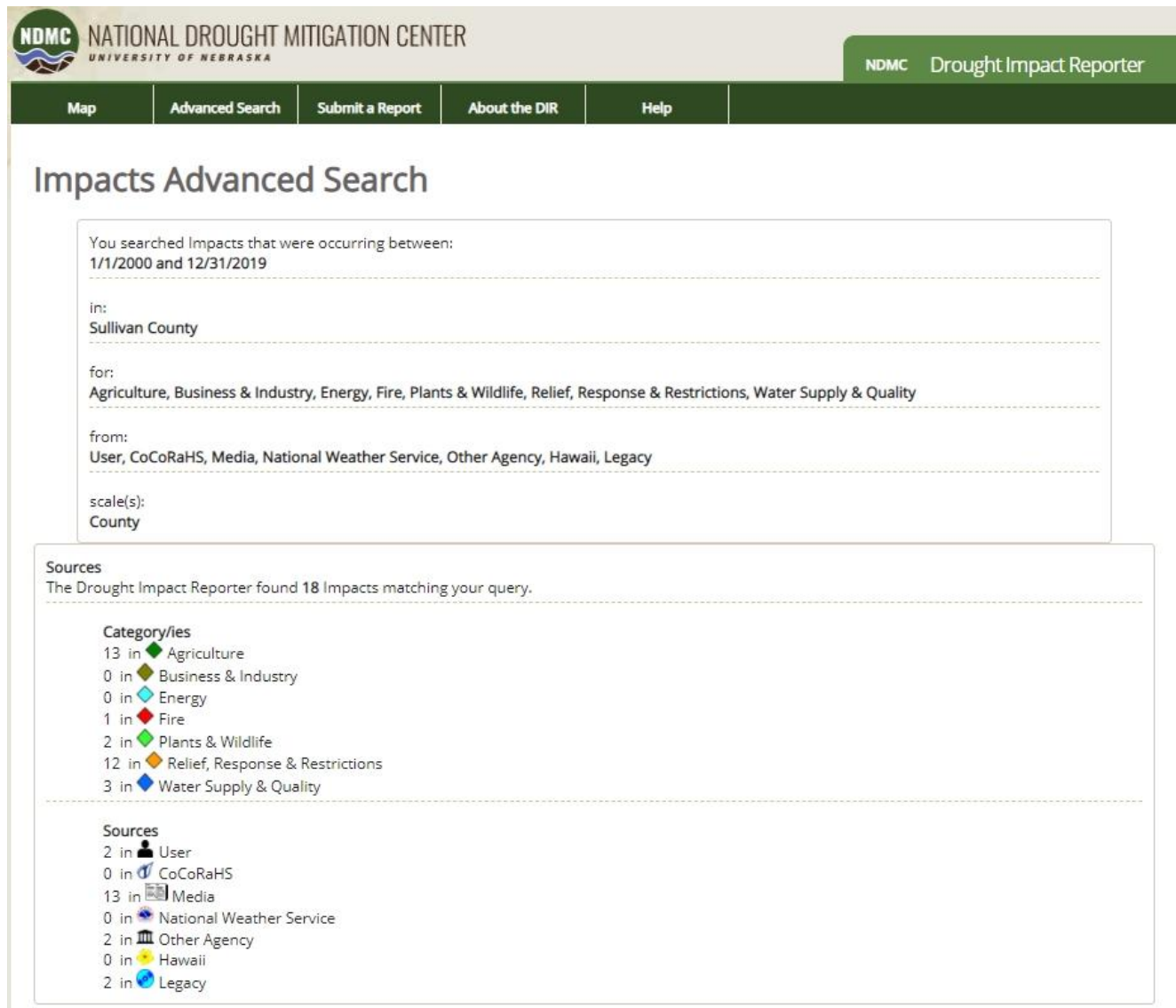
Table 1.47. Drought Payments in Sullivan County 2010 - 2019

Drought Year	Insurance Payment
2010	\$1,024.50
2011	\$1,390,237.00
2012	\$13,344,474.95
2013	\$11,822,045.83
2014	\$128,208.50
2015	\$1,554.00
2016	\$280,130.04
2017	\$1,523,312.75
2018	\$8,494,069.78
2019	\$0.00
Total	\$36,985,057.35

Source : <http://www.rma.usda.gov/data/cause.html>

Figure 3.42 below indicates 18 drought impacts for Sullivan County from January 1, 2000, through December 31, 2019.

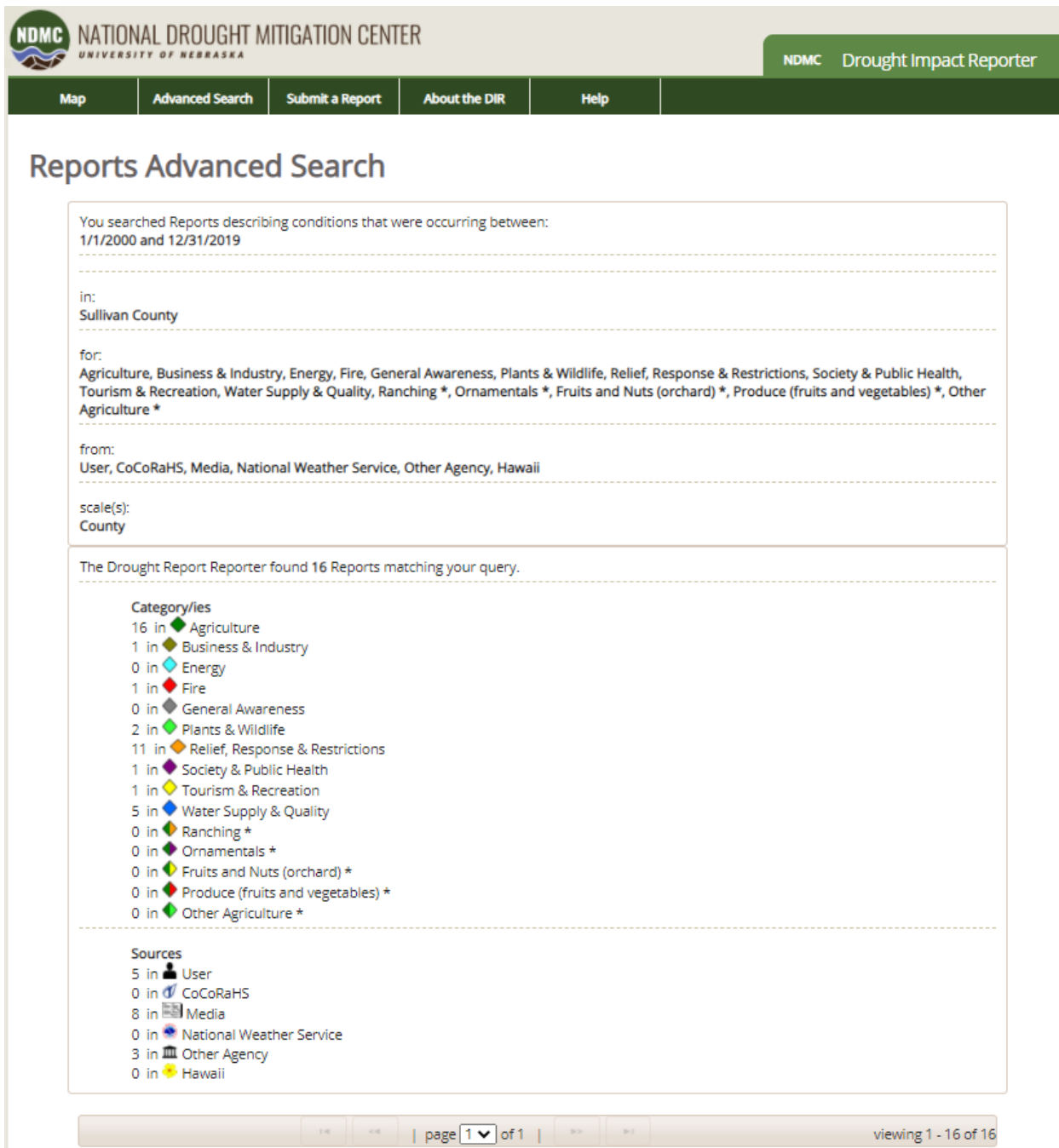
Figure 1.55. Drought Impacts in Sullivan County from 1/1/2000 – 12/31/2019



Source : <https://droughtreporter.unl.edu/advancedsearch/impacts.aspx>

Figure 3.43 below indicates 15 drought reports for Sullivan County from January 1, 2000, through December 31, 2019.

Figure 1.56. Drought Reports in Sullivan County from 1/1/2000 – 12/31/2019



Source : <https://droughtreporter.unl.edu/advancedsearch/reports.aspx>

Probability of Future Occurrence

According to the 2018 Missouri State Hazard Mitigation Plan, Sullivan County has a High total rating for droughts and is very likely to experience droughts in the future. Sullivan County has a 9.70% chance of a severe drought. Table 3.27 below indicates drought vulnerability information for Sullivan County.

Table 1.48. Drought Vulnerability of Sullivan County

County	SOM Index Rating	USDA RMA Total Drought Crop Claims	Average Annualized Crop Claims	USDA Claims Rating	2012 Crop Exposure	Crop Exposure Rating	Likelihood of Severe Drought (%)	Drought Occurrence Rating	Total Rating	Total Rating (Text) Drought
Sullivan	4	\$13,963,040	\$1,551,449	3	\$18,229,000	2	9.70	5	14	Medium-High

Source: 2018 Missouri State Hazard Mitigation Plan

Table 3.28 below provides the factors considered and the ranges for the rating values assigned. Once the ranges were determined and applied to all factors considered in the analysis, the ratings were combed to determine an overall vulnerability rating for drought.

Table 1.49. Ranges for Drought Vulnerability Factor Ratings

Factors Considered	Low (1)	Low-medium (2)	Medium (3)	Medium-high-4	High (5)
Social Vulnerability Index	1	2	3	4	5
Crop Exposure Ratio Rating	\$886,000 - \$10,669,000	\$10,669,001 - \$33,252,000	\$33,252,001 - \$73,277,000	\$73,277,001 - \$155,369,000	\$155,369,001 - \$256,080,000
Annualized USDA Crop Claims Paid	< \$340,000	\$670,000-\$669,999	\$670,000-\$999,999	\$1M-\$1,299,999	> \$1,300,000
Likelihood of Occurrence of severe or extreme drought	1-1.9%	2-3.9%	4-5.9%	6-8.9%	9-10.72%
Total Drought Vulnerability Rating	7-8	9-10	11-12	13-14	15-17

Source: 2018 Missouri State Hazard Mitigation Plan

Changing Future Conditions Considerations

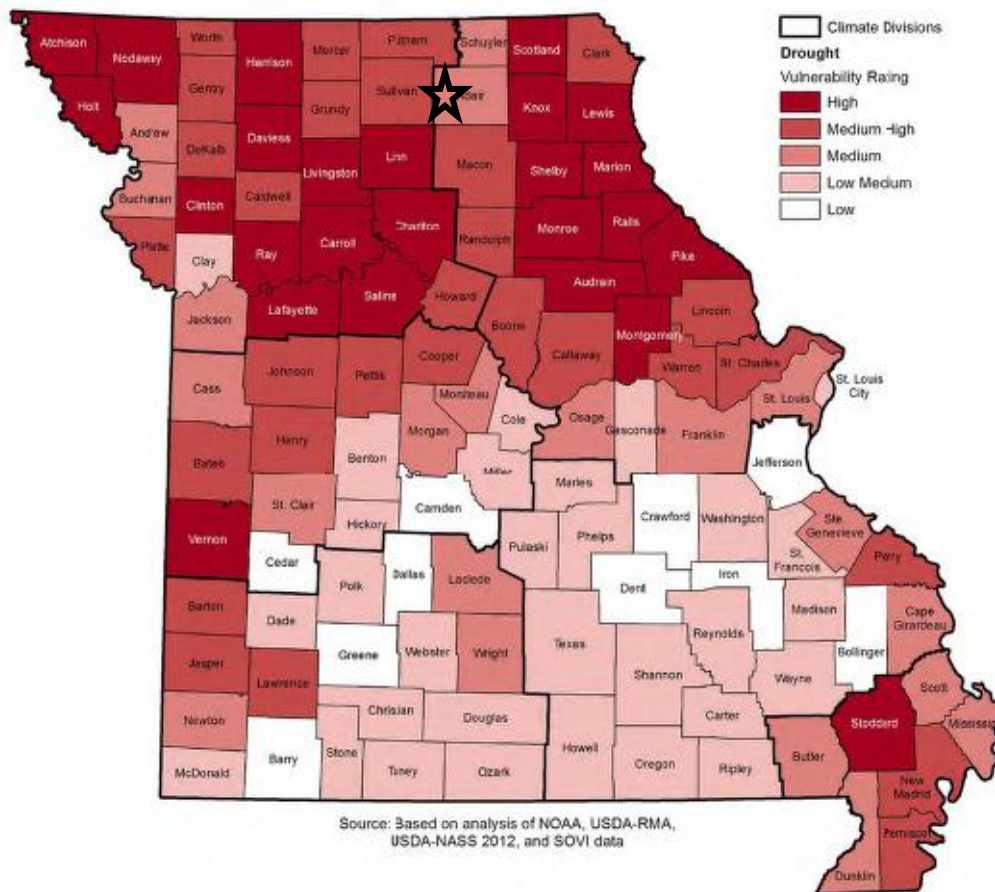
Although drought is not predictable, long-range outlooks and predicted impacts of climate change could indicate an increased chance of drought. In the 2018 Missouri State Plan, Severe drought, a natural part of Missouri's climate, is a risk to this agriculture-dependent state. Future increases in evaporation rates due to higher temperatures may increase the intensity of naturally-occurring droughts. The number of heavy rainfall events is predicted to increase, yet researchers currently expect little change in total rainfall amounts, indicating that the periods between heavy rainfalls will be marked by an increasing number of dry days. Higher temperatures and increased evapotranspiration increase the likelihood of a drought. This could lead to agricultural drought and suppressed crop yields.

Vulnerability

Vulnerability Overview

The impacts and severity of drought on Missouri can be significant. The 2018 Missouri State Hazard Mitigation Plan indicates that Sullivan County has a high vulnerability to drought, as shown in Figure 3.44 below. Sullivan County is indicated by a black star.

Figure 1.57. Drought Vulnerability by County



Source: 2018 Missouri State Hazard Mitigation Plan

Potential Losses to Existing Development

The National Drought Monitor Center at the University of Nebraska at Lincoln summarized the potential impacts 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,

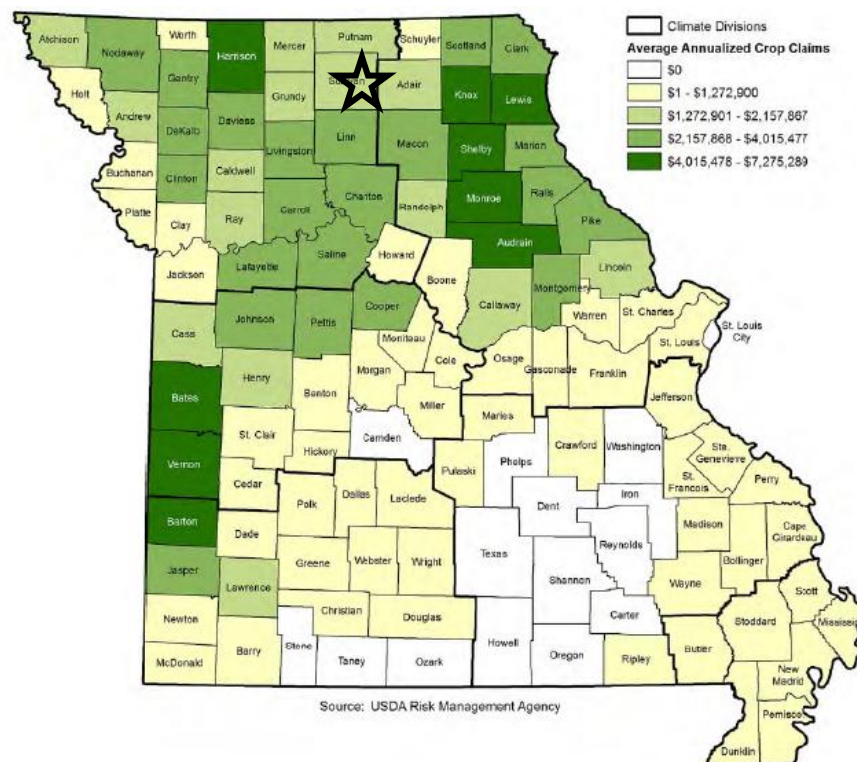
while drought is rarely a direct cause of death, the associated heat, dust and stress can all contribute to increased mortality.

Impact of Previous and Future Development

Determining the direct and indirect costs associated with drought is difficult because of the broad impacts of drought and the difficulty in establishing when droughts begin and end. The impacts of drought have been assessed through the vantage point of agricultural losses, primarily due to the excellent agricultural statistical and insurance data that is available and the fact that agricultural impacts are noted as the most prevalent impact from the Drought Impact Reporter Analysis.

The drought loss estimation methodology uses USDA Risk Management Agency's crop insurance claims paid in Missouri from 2007-2016 and the USDA's crop exposure value by county to determine the Annualized Drought Crop Insurance Claims Paid as mapped in Figure 3.45 below. Sullivan County is indicated with a black star.

Figure 1.58. Annualized Drought Crop Insurance Claims Paid from 2007 – 2016



Source: 2018 Missouri State Hazard Mitigation Plan

Future development will remain vulnerable to drought. Typically, some urban and rural areas are more susceptible than others. For example, urban areas are subject to water shortages during periods of drought. Excessive demands of the populated area place a limit on water resources.

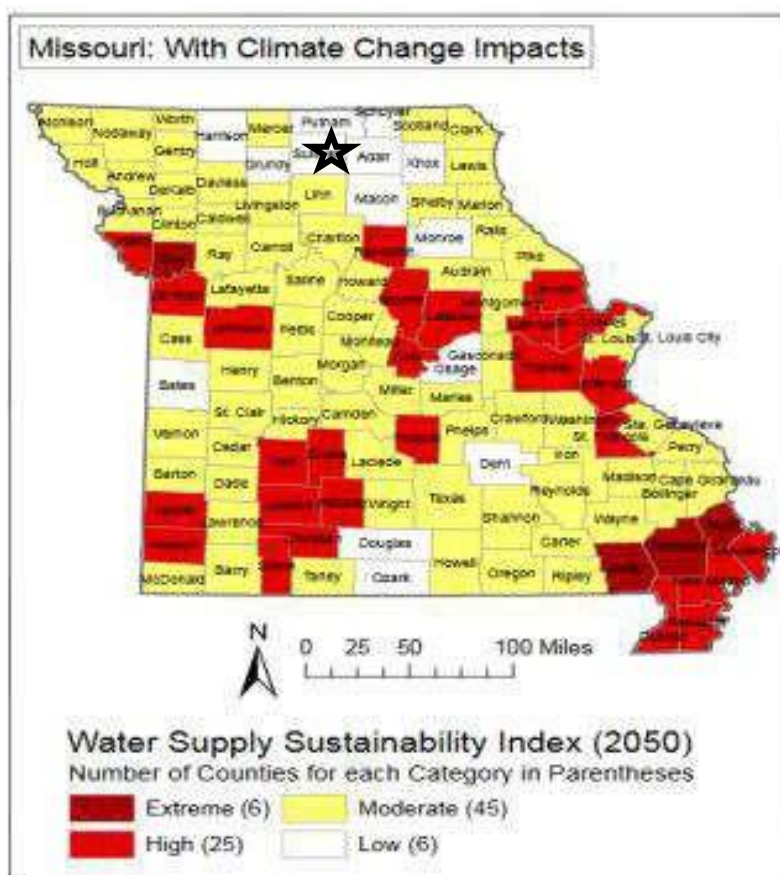
In rural areas, crops and livestock may suffer from extended periods of heat and drought. As the size of farms increase more crops will be exposed to drought-related agricultural losses. Dry conditions can lead to the ignition of wildfires that could threaten residential, commercial and recreational areas.

Changing Future Conditions Considerations

A new analysis, performed for the Natural Resources Defense Council, examined the effects of climate change on water supply and demand in the contiguous United States. The study 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.

Figure 3.46 below shows climate change impacts in Missouri and indicates that Sullivan County (indicated with a black star) is projected for low impact to water shortage due to climate change.

Figure 1.59. Climate Change Impacts



Hazard Summary by Jurisdiction

The entire planning area will be affected by drought of some degree. The unincorporated agricultural areas of Sullivan County are the most vulnerable to drought, while drought conditions will also affect the cities, except the magnitude would be different with only lawns and local gardens being impacted. In addition, damage to crops, produce, livestock, soils and building foundations could be weakened due to shrinking and expanding soil.

Problem Statement

Sullivan County is at a high risk for a severe drought, which is an extra strain placed on the water supply system. Possible solutions include the development of agreements with neighboring communities for a secondary water source and review of local ordinance/regulation for inclusion of water-use restrictions during periods of drought.

3.4.6 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. 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 3.47 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. Figure 3.48 below shows the relationship between the wind speed and cold temperatures in relationship to frostbite times.

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

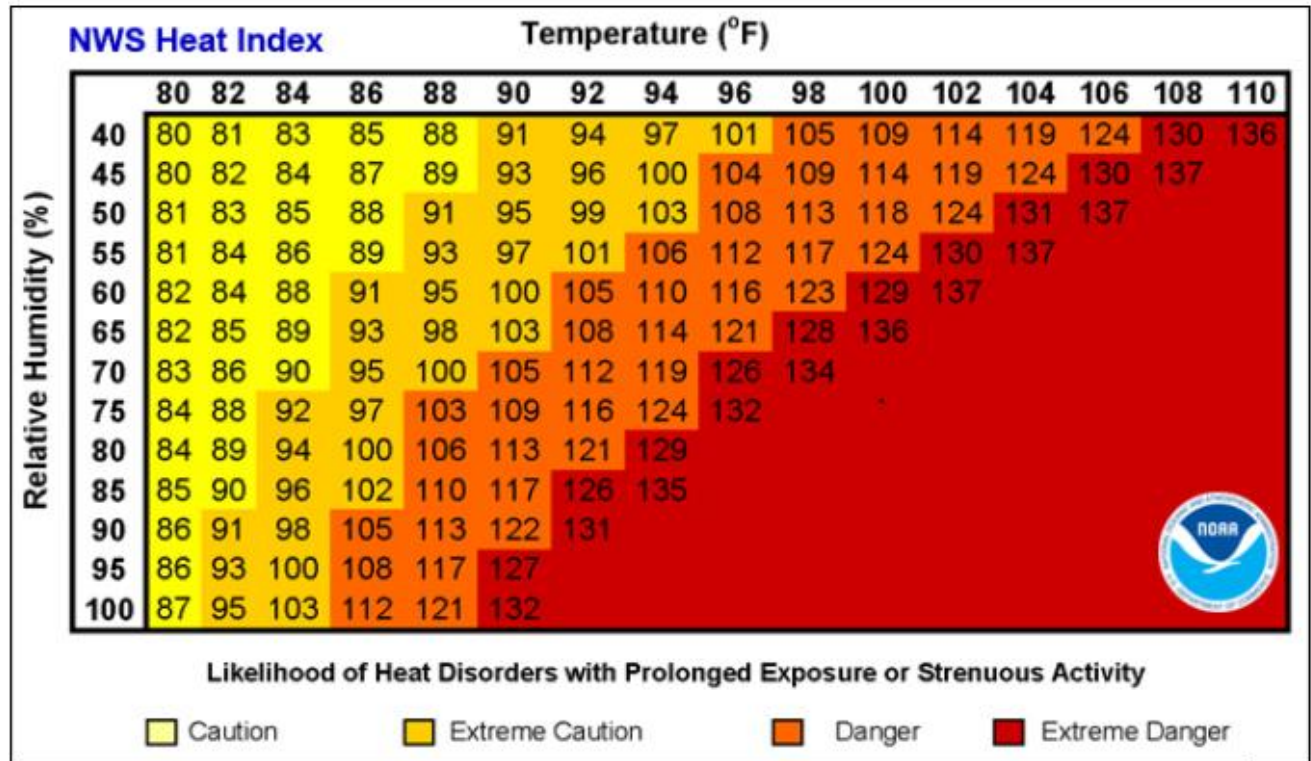
The entire planning area of Sullivan County is subject to extreme heat and all participating jurisdictions within the county are affected.

Strength/Magnitude/Extent

The National Weather Service (NWS) 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 3.47 below shows the Heat Index Chart from the National Weather Service that indicates the Heat Index calculation of temperature and relative humidity. A Heat Index is used to determine heat exposure, dangerous conditions and possible loss as a result of a high heat index rating.

Figure 1.60. Heat Index (HI) Chart

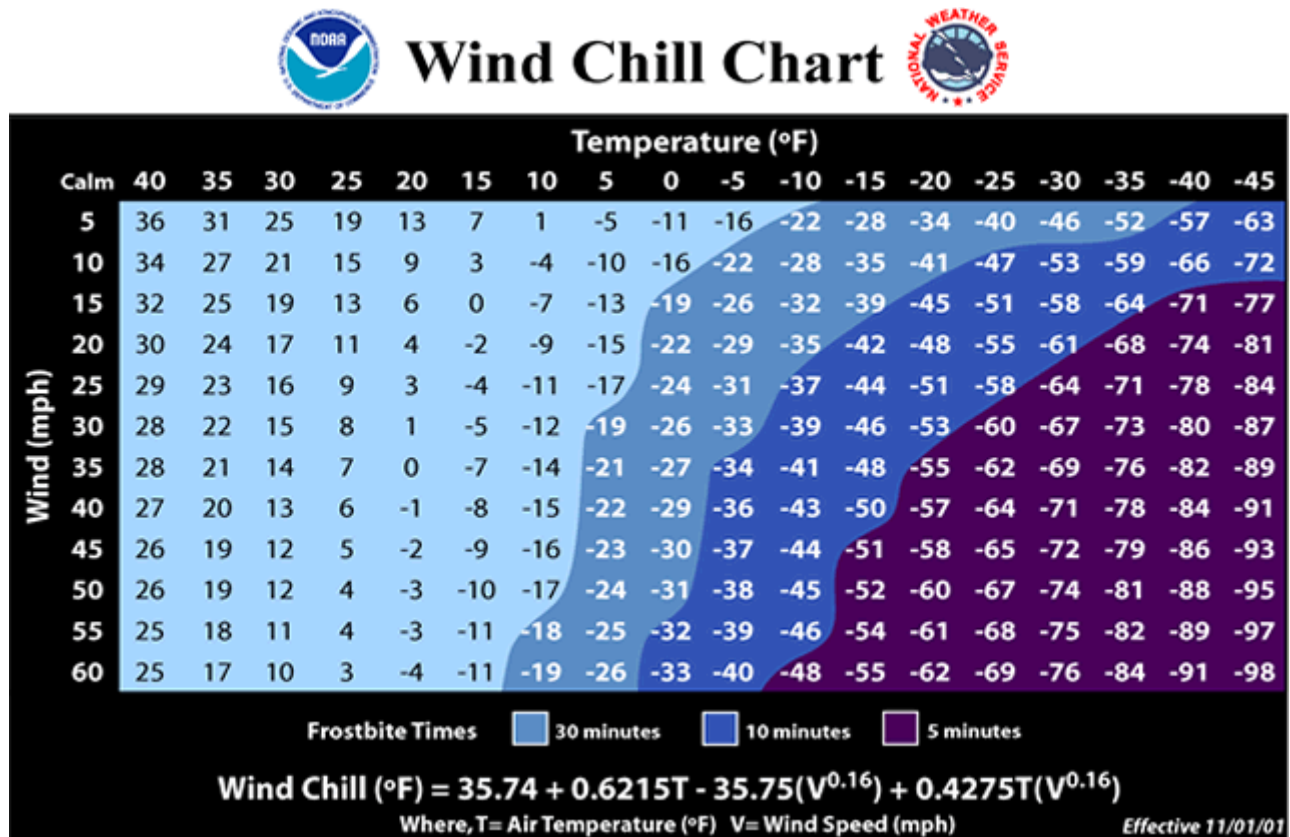


Source: National Weather Service (NWS); <https://www.weather.gov/safety/heat-index>

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. Figure 3.48 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 1.61. Wind Chill Chart

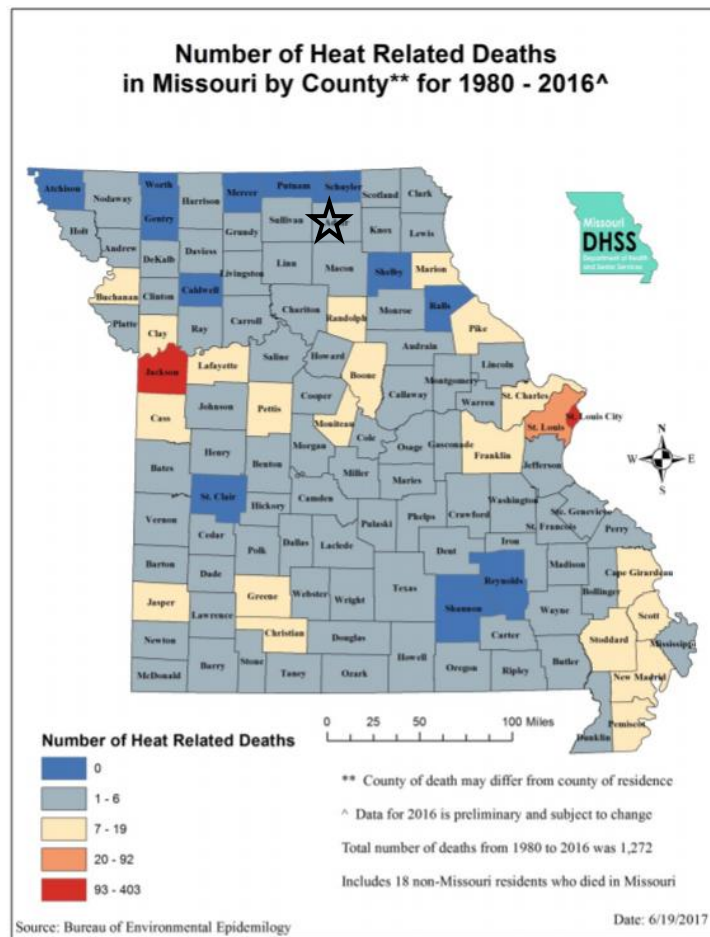


Source : <https://www.weather.gov/safety/cold-wind-chill-chart>

Previous Occurrences

The recorded events in the National Centers for Environmental Information (NCEI) database indicates there have been two recorded events of excessive heat in Sullivan County for the 20-year period of 2000 – 2019. There were no deaths or injuries associated with these events. The NCEI database indicates two recorded events of extreme cold/wind chill in the same 20-year period, with no deaths or injuries associated with these events. Figure 3.49 below shows between one and six heat related deaths in Sullivan County from 1980 – 2016, per DHSS records.

Figure 1.62. Heat Related Deaths in Missouri 1980 - 2016



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

Extreme heat can cause stress to crops and animals. According to USDA Risk Management Agency, losses to insurable crops during the 10-year time period from 2010 to 2019 were \$1,295,305.25. Extreme heat can also strain 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.

Table 3.29 below shows insurance payments for agriculture due to extreme heat and cold temperatures from the year 2010 through 2019.

Table 1.50. Agricultural Insurance Payments Due to Extreme Temperatures – Heat and Cold

Year	Heat	Cold	Total Insurance Payment
2010	\$0.00	\$0.00	\$0.00

2011	\$1,250,828.50	\$134,499.00	\$1,385,327.50
2012	\$31,267.25	\$162,929.17	\$194,196.42
2013	\$6,250.50	\$209,140.00	\$215,390.50
2014	\$0.00	\$226,686.00	\$226,686.00
2015	\$0.00	\$127,767.00	\$127,767.00
2016	\$6,959.00	\$269,440.00	\$276,399.00
2017	\$0.00	\$237,549.00	\$237,549.00
2018	\$0.00	\$33,174.00	\$33,174.00
2019	\$0.00	\$328,103.00	\$328,103
TOTAL	\$1,295,305.25	\$1,729,287.17	\$3,024,592.42

Source : <http://www.rma.usda.gov/data/cause.html>

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. During the same period, no deaths were recorded in the planning area, according to NCEI 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

NCEI, dating back to 2000, indicates 12 extreme heat events in the years 2000, 2001, 2005, 2006, 2007 and 2012. In ten years, there was one extreme heat event in 2012. Based on this historical data, the calculated probability of an extreme heat even in any given year is 60%. The probability was determined by taking the number of years with an extreme heat event (12) divided by the number of years (20) data was obtained for.

NCEI, dating back to 2000 indicates 2 years (2000, 2014) with four extreme cold events. In ten years, there were two extreme cold events, both in 2014. Based on the historical data, the calculated probability of an extreme cold event in any given year is 20%. The probability was determined by taking the number of years with an extreme cold event (4) divided by the number of years (20) data was obtained for.

Changing Future Conditions Considerations

According to the 2018 Missouri State Plan, average annual temperatures are projected to most likely exceed historical record levels by the middle of the 21st century. The impacts of extreme heat events are experienced most acutely by the elderly and other vulnerable populations. High temperatures are exacerbated in urban environments, a phenomenon known as the urban heat

island effect, which in turn tend to have higher concentrations of vulnerable populations. Higher demand for electricity as people tries to keep cool amplifies stress on power systems and may lead to an increase in the number of power outages. Atmospheric concentrations of ozone occur at higher air temperatures, resulting in poorer air quality, while harmful algal blooms flourish in warmer water temperatures, resulting in poorer water quality.

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 3.30 below lists typical symptoms and health impacts due to exposure to extreme heat.

Table 1.51. Typical Health Impacts of Extreme Heat

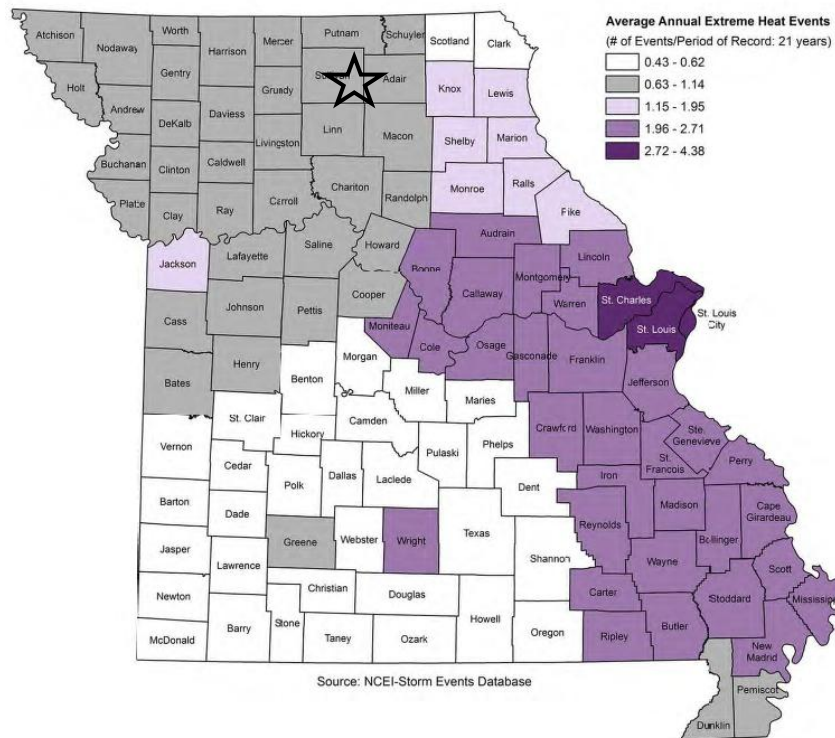
Heat Index (HI)	Disorder
80-90° F (HI)	Fatigue possible with prolonged exposure and/or physical activity
90-105° F (HI)	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and/or physical activity
105-130° F (HI)	Heatstroke/sunstroke highly likely with continued exposure

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

Potential Losses to Existing Development

Figure 3.50 below shows the average annual occurrence for extreme heat for the State of Missouri per the 2018 State Hazard Mitigation Plan. Sullivan County, indicated with a black star, has an average annual extreme heat event number of 0.63 – 1.14.

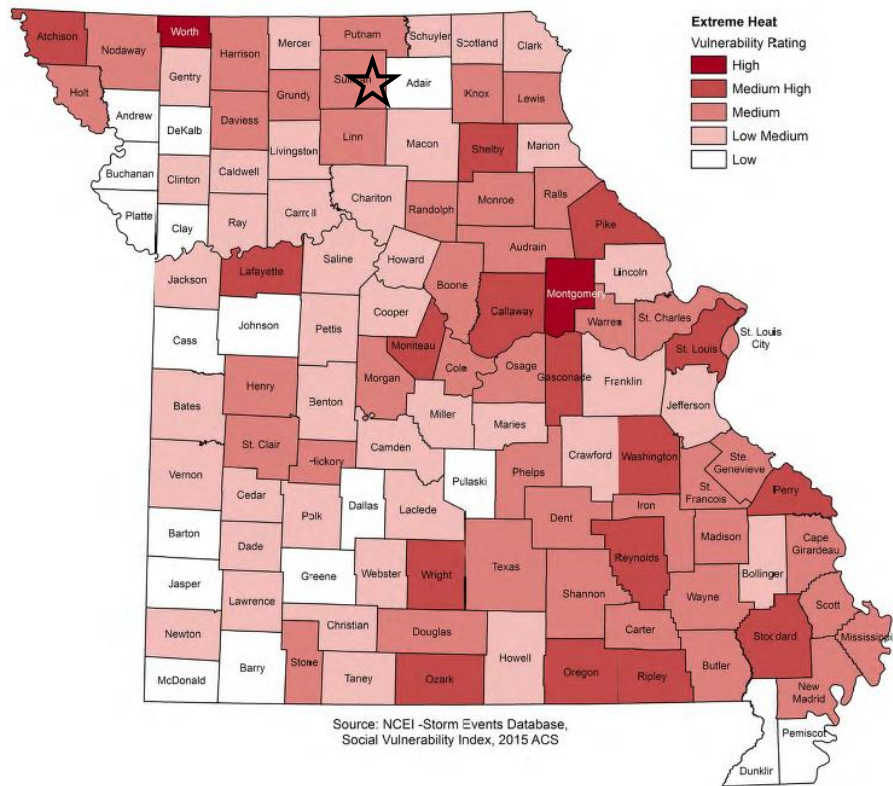
Figure 1.63. Average Annual Occurrence for Extreme Heat



Source: 2018 Missouri State Hazard Mitigation Plan

Figure 3.51 pictured below from the 2018 Missouri State Hazard Mitigation Plan shows vulnerability ratings for extreme heat. Sullivan County, denoted with a black star, has a medium rating.

Figure 1.64. Vulnerability Rating for Extreme Heat



Source: 2018 Missouri State Hazard Mitigation Plan

Potential Losses to Existing Development

During extreme heat events structural, road, and electrical infrastructure are vulnerable to damages. Depending upon temperatures and duration of extreme heat, losses will vary.

Impact of Previous and Future Development

Population growth can result in increases in the age-groups that are most vulnerable to extreme heat. Population growth also increases the strain on electricity infrastructure, as more electricity is needed to accommodate the growing population.

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 2019 ACS 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 3.31 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 1.52. Sullivan County Population Under Age 5 and Over Age 65, 2019 ACS Census

Data

Jurisdiction	Total Population	Population Under 5 yrs.	Population 65 yrs. and over
Sullivan County*	6,247	391	1,252
Unincorporated Sullivan County	2,731	62	665
City of Green Castle	205	24	42
City of Green City	494	64	116
Village of Harris	38	13	3
Village of Humphreys	69	0	13
City of Milan	2,463	228	368
City of Newtown	195	0	34
Village of Pollock	52	0	11

Source: U.S. Census Bureau, (*) includes entire population of each city or county

Problem Statement

Sullivan County has a growing population of residents over 65 years, who are at a greater risk for extreme-temperature related illnesses, injuries, and death. Possible solutions include organizing outreach to the vulnerable elderly populations, including establishing and promoting accessible heating or cooling centers in the community and creating a database in coordination with the Health Department to track those individuals at high risk.

3.4.7 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 (discussed separately in Section 3.4.1 and tornadoes (discussed separately in 3.4.9).

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 is has been known to fall 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

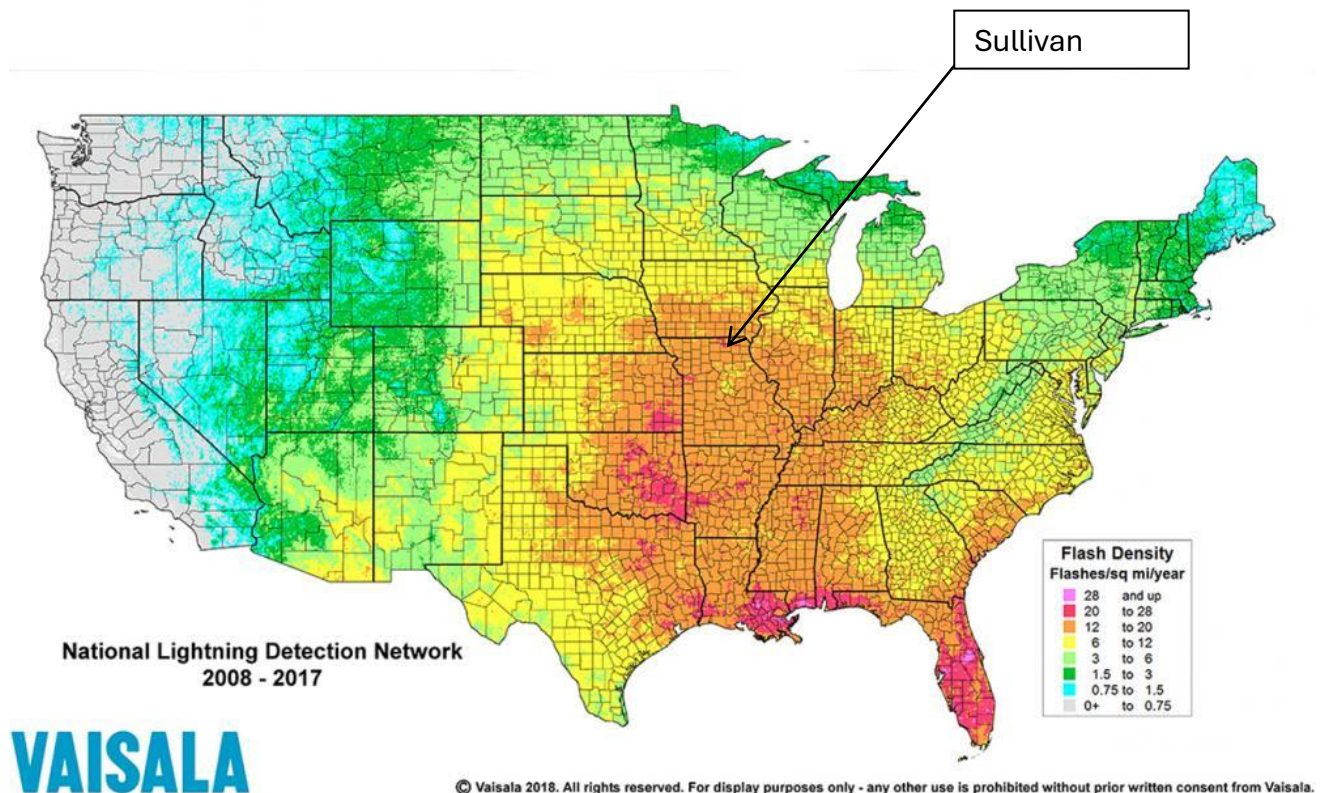
example, a ¼" diameter or pea sized hail requires updrafts of 24 miles per hour, while a 2 ¾" diameter or baseball sized hail requires an updraft of 81 miles per hour. According to the NOAA, the largest hailstone in diameter recorded in the United States was found in Vivian, South Dakota on July 23, 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/lightning 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 3.52 below shows the location and frequency of lightning occurrences in Missouri. Sullivan County has an average of 12-20 flashes per square miles per year.

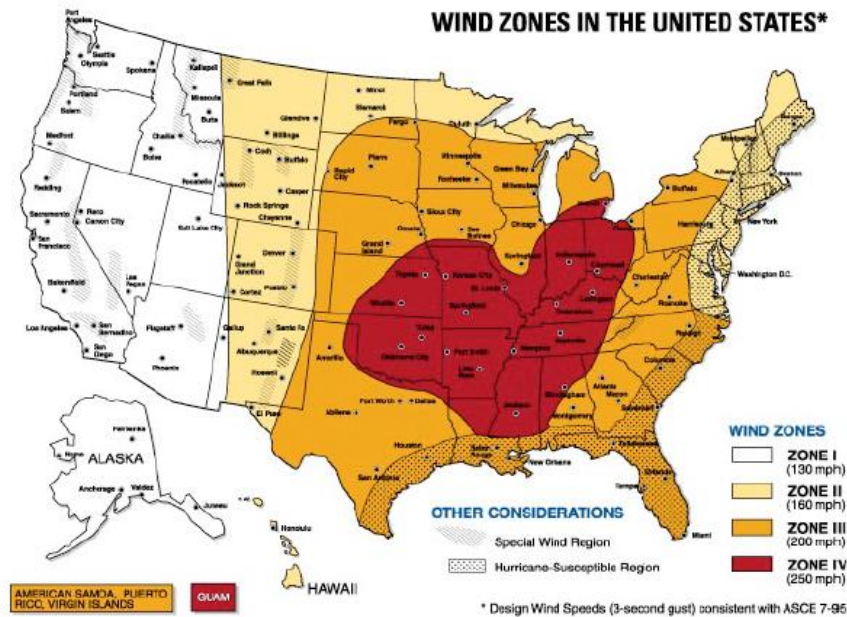
Figure 1.65. Location and Frequency of Lightning in Missouri



Source: National Weather Service,
<http://www.vaisala.com/en/products/thunderstormandlightningdetectionsystems/Pages/NL-DN.aspx>. Note: indicate location of planning area with a colored square or arrow.

Figure 3.53 below indicates wind zones in the United States, of which all counties in the State of Missouri are in Zone 4, experiencing winds up to 250 mph.

Figure 1.66. Wind Zones in the United States



Source: FEMA 320, Taking Shelter from the Storm, 3rd edition, https://www.fema.gov/pdf/library/ism2_s1.pdf

Strength/Magnitude/Extent

Based on information provided by the Tornado and Storm Research Organization (TORRO), Table 3.32 below describes typical damage impacts of the various sizes of hail.

Table 1.53. 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

Intensity Category	Diameter (mm)	Diameter (inches)	Size Description	Typical Damage Impacts
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

The following three tables (Table 3.33, 3.34, and 3.35) include NCEI reported events and damages for at least the past 10 years for three of the four included hazards. Limitations to the use of NCEI reported lightning events include the fact that only lightning events that result in fatality, injury and/or property and crop damage are in the NCEI. There were no crop insurance claims paid from thunderstorms in the past 10 years.

The tables below (Table 3.33, 3.34 and 3.35) summarize past crop damages as indicated by crop insurance claims and illustrate the magnitude of the impact on the planning area's agricultural economy.

Table 1.54. Crop Insurance Claims Paid in Sullivan County from High Winds, 2010 – 2019.

Crop Year	Crop Name	Cause of Loss Description	Insurance Paid
2011	Soybeans	Wind/Excess Wind	\$39,056.00
2016	Corn (3 claims)	Wind/Excess Wind	\$366,819.00
2017	Corn	Wind/Excess Wind	\$31,873.00
2018	Corn	Wind/Excess Wind	\$6,534.00
Total			\$444,282.00

Source: USDA Risk Management Agency, Insurance Claims, <https://www.rma.usda.gov/data/cause>

Table 1.55. Crop Insurance Claims Paid in Sullivan County from Lightning,

2010 - 2019.

Crop Year	Crop Name	Cause of Loss Description	Insurance Paid
2010	Corn (2 claims)	Other - Lightning	\$10,755.33
2013	Corn	Other - Lightning	\$80,966.00
2018	Soybeans	Other - Lightning	\$1,346.00
Total			\$93,067.33

Source: USDA Risk Management Agency, Insurance Claims, <https://www.rma.usda.gov/data/cause>

Table 1.56. Crop Insurance Claims Paid in Sullivan County from Hail, 2010 - 2019.

Crop Year	Crop Name	Cause of Loss Description	Insurance Paid
2011	Wheat	Hail	\$16,989.00
2011	Corn	Hail	\$3,032.00
2014	Wheat	Hail	\$18,584.00
2014	Corn	Hail	\$47,567.50
2018	Corn	Hail	\$150,222.50
2018	Soybeans (2 claims)	Hail	\$808,354.50
Total			\$1,044,749.50

Source: USDA Risk Management Agency, Insurance Claims, <https://www.rma.usda.gov/data/cause>

Probability of Future Occurrence

Thunderstorms

Based on the NCEI Storm Events Database, there were 25 thunderstorm events in Sullivan County from 2010 through 2019. There were no insurance claims on file in the same time period of 10 years of losses paid by insurance. There is a probability of future occurrence of 2.5 thunderstorm events per year, with an average insurance claim/loss of \$0.00 per year or an average loss of \$0 per each thunderstorm event.

High/Excessive Winds

Based on the data the NCEI Storm Events Database, there were 33 high/excessive wind events in Sullivan County from 2010 through 2019. There were six insurance claims on file for the same time period of 10 years, averaging 1 insurance claim every 1 to 2 years. Total claims amount in the same 10-year time period was \$444,282 for high/excessive winds. The probability of future occurrence is a 60% chance of a high/excessive winds event per year with an average insurance claim/loss per year of \$44,428.20. The average insurance claim/loss is \$13,463.09 per each high/excessive wind event.

Lightning

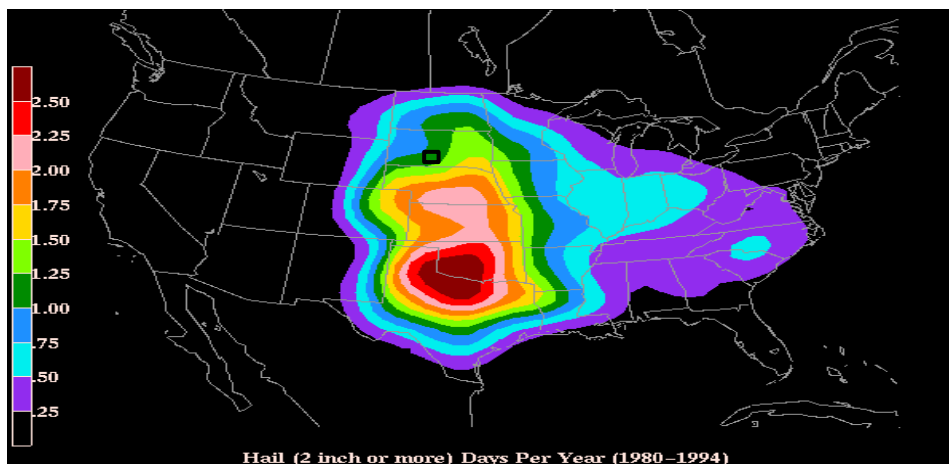
Based on the data in the NCEI Storm Events Database, there were no lightning events reported for the 10-year time period of 2010 to 2019. However, there were three insurance claims for lightning events in the same time period, with a total insurance claim/loss of \$93,067.33. The average loss per claim for a lightning event is \$31,022.44. The average insurance claims/loss per year in 10 years is \$9,306.73. The NCEI Storm Events Database does not give information on lightning events so calculating the probability of future occurrence cannot be calculated.

Hail

Based on this data in the NCEI Storm Events Database, there have been 31 hail events reported in a 10-year period from 2010 to 2019, producing an average probability of occurrence of 3.1 hail events projected per year in Sullivan County. There were 7 insurance claims for crop loss due to hail in the same time period, for a total of \$1,044,749.50, with an average of insurance claim losses per year totaling of \$104,474.95. The average total of an insurance claim/loss per hail event is \$149,249.93.

Figure 3.54 below shows hailstorm probability based on hailstorm data from 1980-1994. It shows the probability of hailstorm occurrence (2" diameter or larger) based on number of days per year. Sullivan County is approximately located in the region to receive 1.25 (dark green) hailstorms annually.

Figure 1.67. Annual Hailstorm Probability (2" diameter or larger), U 1980- 1994



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

Changing Future Conditions Considerations

According to the 2018 Missouri State Plan, predicted increases in temperature could help create atmospheric conditions that are fertile breeding grounds for severe thunderstorms and tornadoes in Missouri. Possible impacts include an increased risk to life and property in both the public and private sectors. Public utilities and manufactured housing developments will be especially prone to damages. Jurisdictions already affected should be prepared for more of these events, and should thus prioritize mitigation actions such as construction of safe rooms for vulnerable populations,

retrofitting and/or hardening existing structures, improving warning systems and public education, and reinforcing utilities and additional critical infrastructure.

Vulnerability

Vulnerability Overview

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.vaisala.com/en/products/thunderstormandlightningdetectionsystems/Pages/NLDN.aspx> and <http://www.lightningsafety.noaa.gov/>

Potential Losses to Existing Development

Most damages occur to electronic equipment located inside buildings, but structural damage can also occur when a lightning strike causes a building fire. Communications equipment, warning transmitters, and receivers can also be knocked out by lightning strikes. There have been no fatalities or injuries due to lightning in Sullivan County during the 10-year period reviewed of 2010 – 2019. When the review period was extended to 20 years (2000 – 2019), there were no reported lightning events and there were no individuals reporting injuries. The NCEI database reports no injuries attributed to thunderstorm winds.

Hail

There were seven reported crop insurance claims in a 10-year period resulting in \$1,044,749.50 in insurance payments. Crops affected by hail included corn, wheat and soybeans.

High/Excessive Winds

There were six reported crop insurance claims in a 10-year period resulting in \$444,282.00 in insurance payments. Crops affected by high/excessive winds included corn and soybeans.

Lightning

There were four reported crop insurance claims in a 10-year period resulting in \$93,067.33 in insurance payments. Crops affected by lightning included corn and soybeans.

Thunderstorm

There were no reported crop insurance claims in a 10-year period. There were no injuries reported due to thunderstorm winds.

Previous and Future Development

Sullivan County's future development plans will likely increase vulnerability to thunderstorms, high and/or excessive winds, hail and lightning. If the development of housing neighborhoods and businesses occur in the future, the increased population will be vulnerable to all hazards.

Hazard Summary by Jurisdiction

Thunderstorms, high/excessive winds, lightning, and hail events are area-wide. NCEI data did not indicate that any particular community had higher probability of occurring events as compared to another. All cities, village, communities, and unincorporated areas of Sullivan County are equally as vulnerable to thunderstorms, high/excessive winds, lightning, and hail events. Heavily populated areas of the counties are more likely to experience higher losses due to these events because of these areas being more densely populated. The unincorporated areas and communities are more likely to experience crop losses due to the fact that the population and structure numbers are less than incorporated areas. There were no injuries were reported in the 10-year period as a result of thunderstorm winds.

Sullivan County - The unincorporated areas of Sullivan County reported 5 funnel cloud events, 25 thunderstorm events and 31 hail events reported in a 10-year period of 2010 - 2019. There was a total of 16 cities/villages/communities (listed below) with reports of thunderstorm events and funnel cloud and hail events in the same 10-year period. Funnel cloud and high/excessive wind events were considered as thunderstorm wind events in the aforementioned 10-year time period.

City of Milan – The City of Milan has on record a total of 24 events, including 12 thunderstorm/wind events, 1 funnel cloud event and 11 hail events during the 10-year period of 2010 – 2019.

City of Green Castle – The City of Green Castle has on record a total of 6 events, including 4

thunderstorm/wind events and 2 hail events during the 10-year period of 2010 – 2019.

City of Green City – The City of Green City has on record a total of 5 events, including 3 thunderstorm/wind events and 2 hail events during the 10-year period of 2010 – 2019.

Village of Humphreys – The Village of Humphreys has on record a total of 4 events, 2 of which are reported to be thunderstorm events, 1 reported funnel cloud event and 1 reported hail event during the 10-year period of 2010 – 2019.

City of Newtown – The City of Newtown has on record 4 events, 1 of which was reported to be a thunderstorm/wind event and 3 reported hail events during the 10-year period of 2010 – 2019.

Village of Pollock – The Village of Pollock has on record 2 events, 1 of which was reported to be a thunderstorm/wind event and 1 reported funnel cloud event during the 10-year period of 2010 – 2019.

Village of Harris – The Village of Harris has on record 1 event, which was reported as a hail event, during the 10-year period of 2010 – 2019.

Unincorporated areas: Osgood, Browning, Reger, Wintersville, Winigan, Cora, Bairdstown, Judson, Pennville – These communities are all unincorporated communities in Sullivan County and events from these communities were included in the Sullivan County events listed above. In these areas, there are a total 16 events on record, including 11 hail events, 3 thunderstorm/wind events and 2 funnel cloud events during the 10-year period of 2010 – 2019.

Problem Statement

The NCEI Storm Events Database notes that Sullivan County had 25 thunderstorm wind events, 31 hail events, and 5 funnel cloud events in the 10-year period of 2010 – 2019. These events produced 16 crop loss claims with insurance paying \$1,582,098.83 in crop damage, and \$57,500 in property damage in the same 10-year period.

Severe thunderstorms can damage power lines with the high winds or fallen debris such as tree limbs. Not everyone in the county utilizes social media, texting or have access to a weather radio, communities would benefit from updated sirens. Possible solutions include review of local ordinance and building codes to address high winds and/or construction techniques to include structural bracing, straps and clips, or anchor bolts.

3.4.8 Severe Winter Weather

Hazard Profile

Hazard Description

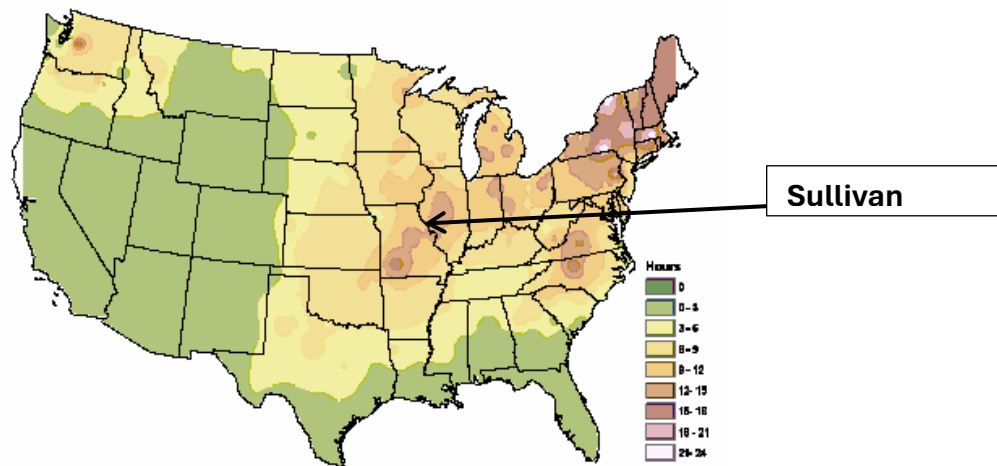
A major winter storm can last for several days and be accompanied by high winds, freezing rain or sleet, heavy snowfall, and cold temperatures. The National Weather Service describes different types of winter storm events as follows.

- **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

Sullivan County is vulnerable to heavy snow, ice, extreme cold temperatures, and freezing rain. Sullivan County (approximate location) is indicated by an arrow below in Figure 3.55. The county is located in a region that experiences an average of 6-9 hours per year of freezing rain.

Figure 1.68. 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

Table 3.36 below includes NCEI reported events and damages for at least the past 10 years. Events include blizzard, cold/wind chill, cold wet weather, extreme cold/wind chill, frost, freeze, freezing fog, heavy snow, ice storm, sleet, winter storm, and winter weather.

Table 1.57. NCEI Sullivan County Winter Weather Events Summary, 2010 - 2019

Type of Event	Inclusive Dates	# of Injuries	Property Damages	Crop Damages
Winter Storm	2/21/2010	0	\$0	\$0
Winter Weather	1/10/2011	0	\$0	\$0
Blizzard	2/1/2011	0	\$0	\$0
Winter Storm	2/24/2011	0	\$0	\$0
Winter Weather	12/19/2011	0	\$0	\$0
Winter Weather	1/27/2012	0	\$0	\$0
Winter Weather	2/13/2012	0	\$0	\$0
Winter Weather	2/24/2012	0	\$0	\$0
Winter Storm	12/20/2012	0	\$0	\$0
Winter Storm	2/21/2013	0	\$0	\$0
Winter Storm	2/25/2013	0	\$0	\$0
Winter Weather	5/2/2013	0	\$0	\$0
Heavy Snow	12/21/2013	0	\$0	\$0
Cold/Wind Chill	1/5/2014	0	\$0	\$0
Heavy Snow	2/4/2014	0	\$0	\$0
Extreme Cold/Wind Chill	2/6/2014	0	\$0	\$0
Heavy Snow	1/31/2015	0	\$0	\$0
Heavy Snow	2/1/2015	0	\$0	\$0
Winter Storm	12/27/2015	0	\$0	\$0
Ice Storm	1/15/2017	0	\$0	\$0
Ice Storm	2/20/2018	0	\$0	\$0
Blizzard	11/25/2018	0	\$0	\$0
Winter Storm	1/11/2019	0	\$0	\$0
Ice Storm	2/7/2019	0	\$0	\$0

Source: NCEI, data accessed 7/28/2020

Table 1.58. Presidential Declarations for Winter Storms in Sullivan County

Declaration Date	Disaster NO.	Incident Type	Counties Declared	Type of Assistance
12/07/2007	1736-DR	Severe Winter Storm	Sullivan	PA
12/12/2007	3281-DR	Severe Winter Storm	All Counties	PA
01/30/2009	3803-DR	Severe Winter Storm	All Counties	PA
03/23/2011	1961-DR	Severe Winter Storm	Sullivan	PA

Source: Federal Emergency Management Agency

Winter storms, cold, frost and freeze take a toll on crop production in the planning area. Table 3.38 below shows the USDA's Risk Management Agency payments for insured crop losses in the planning area as a result of cold conditions and snow for the past 10 years.

Table 1.59. Crop Insurance Claims Paid in Sullivan County as a Result of Cold Conditions and Snow, 2010 - 2019

Crop Year	Crop Name	Cause of Loss Description	Insurance Paid (\$)
2011	WHEAT	Cold Winter	39,849.00
2011	WHEAT	Cold Winter	7,594.00
2011	CORN	Cold Wet Weather	73,401.00
2011	SOYBEANS	Cold Wet Weather	13,655.00
2011	SOYBEANS	Other (Snow)	15,109.00
2012	WHEAT	Cold Wet Weather	29,514.00
2012	CORN	Frost	5,148.67
2012	CORN	Frost	19,352.17
2012	CORN	Cold Wet Weather	59,930.00
2012	CORN	Cold Wet Weather	48,984.33
2013	CORN	Cold Wet Weather	209,140.00
2013	SOYBEANS	Other (Snow)	83,851.00
2014	WHEAT	Freeze	4,541.00
2014	WHEAT	Cold Winter	4,150.00
2014	WHEAT	Cold Winter	2,799.50
2014	WHEAT	Cold Winter	25,267.00
2014	WHEAT	Cold Winter	3,892.50
2014	WHEAT	Cold Winter	11,031.00
2014	WHEAT	Cold Winter	106,787.00
2014	WHEAT	Cold Winter	17,205.00
2014	WHEAT	Cold Wet Weather	23,645.00
2014	CORN	Cold Wet Weather	23,784.00
2014	SOYBEANS	Freeze	3,584.00
2015	WHEAT	Cold Winter	76,982.00
2015	WHEAT	Cold Winter	27,867.00
2015	WHEAT	Cold Wet Weather	17,471.00
2015	CORN	Frost	5,447.00
2016	WHEAT	Cold Wet Weather	63,268.00
2016	WHEAT	Cold Wet Weather	19,597.00
2016	WHEAT	Cold Wet Weather	11,631.00
2016	WHEAT	Cold Wet Weather	10,860.00
2016	WHEAT	Other (Snow)	2,146.00
2016	WHEAT	Other (Snow)	2,146.00
2016	CORN	Cold Wet Weather	24,202.00
2016	CORN	Cold Wet Weather	115,952.00
2016	SOYBEANS	Cold Wet Weather	23,930.00
2017	SOYBEANS	Cold Wet Weather	237,549.00
2018	WHEAT	Cold Winter	22,382.00
2018	SOYBEANS	Cold Wet Weather	10,792.00
2019	WHEAT	Cold Wet Weather	22,887.00
2019	SOYBEANS	Frost	170,771.00
2019	SOYBEANS	Cold Wet Weather	134,445.00
Total	42 Claims		\$1,832,539.17

Source: USDA Risk Management Agency, <https://www.rma.usda.gov/data/cause>

Probability of Future Occurrence

The entire planning area is vulnerable to the effects of winter storm/blizzard, ice storms, winter weather, cold/wind chill and heavy snow. All effects of winters tend to make driving more treacherous and can impact the response of emergency vehicles. The probability of utility and infrastructure failure increases during winter weather due to the freezing rain accumulation on utility poles and power lines. Elderly populations are considered particularly vulnerable to the impact of winter weather.

In a 10-year period from 2010 – 2019, 42 insurance claims paid a total of \$1,832,539.17 in crop loss due to winter weather. This is an average of 4.2 insurance claims paying \$183,253.92 annually due to the effects of winter storms/blizzards, ice storms, winter weather, cold weather, wind chill, frost and snow. An average of \$43,631.89 was paid per each insurance claim for crop loss. The probability of future occurrence of winter weather based on the previous 10-year period is projected to be 4.2 insurance claims of crop loss with an annual cost of \$189,253.92 annually.

Changing Future Conditions Considerations

According to the 2018 Missouri State Plan, a shorter overall winter season and fewer days of extreme cold may have both positive and negative indirect impacts. Warmer winter temperatures may result in changing distributions of native plant and animal species and/or an increase in pests and non-native species. Warmer winter temperatures will result in a reduction of lake ice cover. Reduced lake ice cover impacts aquatic ecosystems by raising water temperatures. Water temperature is linked to dissolved oxygen levels and many other environmental parameters that affect fish, plant, and other animal populations. A lack of ice cover also leaves lakes exposed to wind and evaporation during a time of year when they are normally protected. As both temperature and precipitation increase during the winter months, freezing rain will be more likely. Additional wintertime precipitation in any form will contribute to saturation and increase the risk and/or severity of spring flooding. A greater proportion of wintertime precipitation may fall as rain rather than snow.

Vulnerability

Vulnerability Overview

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.

The method used to determine vulnerability to severe winter weather across Missouri was statistical analysis of data from several sources: National Centers for Environmental Information (NCEI) storm events data (1996 to December 31, 2016), HAZUS Building Exposure Value data, housing density data from the U.S. Census (2015 ACS), and the calculated Social Vulnerability Index for Missouri Counties from the Hazards and Vulnerability Research Institute in the Department of Geography at the University of South Carolina. From the statistical data collected, five factors were considered in determining overall vulnerability to severe winter weather as follows: housing density, building exposure, social vulnerability, likelihood of occurrence, and average annual property loss. Based on natural breaks in the statistical data, a rating value of 1 through 5 was assigned to each factor. These rating values correspond to the following descriptive terms: 1) Low 2) Low-medium 3) Medium 4) Medium-high 5) High. Table 3.39 below shows the ranges for severe winter weather vulnerability factor ratings.

Table 1.60. Ranges for Severe Winter Weather Vulnerability Factor Rating

Factors Considered	Low (1)	Low Medium (2)	Medium (3)	Medium High (4)	High (5)
Common Factors					
Housing Density (# per sq. mile)	4.11-44.23	44.24-134.91	134.92-259.98	259.99-862.69	862.70-2836.23
Building Exposure (\$)	\$269,532-\$3,224,641	\$3,224,642-\$8,792,829	\$8,792,830-\$22,249,768	\$22,249,769-\$46,880,213	\$46,880,214-\$138,887,850
Social Vulnerability	1	2	3	4	5
Likelihood of Occurrence (# of events/ yrs. of data)	1.05-1.43	1.44-1.76	1.77-2.10	2.11-2.67	2.68-4.57
Average Annual Property Loss (annual property loss/ yrs. Of data)	\$0-\$143,095.24	\$143,095.25-\$406,666.67	\$406,666.68-\$1,191,000.95	\$1,191,000.96-\$3,184,761.90	\$3,184,761.91-\$5,861,666.67

Once the individual ratings were determined for the above factors, a combined vulnerability rating was computed for severe winter weather events. Table 3.40 below provides the calculated ranges applied to determine overall vulnerability of Missouri Counties to severe winter weather.

Table 1.61. Ranges for Severe Winter Weather Combined Vulnerability Rating

	Low (1)	Low-medium (2)	Medium (3)	Medium-high-4	High (5)
Severe Winter Weather Combined Vulnerability	7-8	8-10	10-12	12-15	15-22

Source: 2018 Missouri State Hazard Mitigation Plan

Table 3.41 below provides the housing density, building exposure and SOVI Data for Sullivan County.

Table 1.62. Housing Density, Building Exposure and SOVI Data by County

County	Total Building Exposure (Hazes)	Building Exposure Rating	Housing Density	Housing Density Rating	SOVI Ranking	SOVI Rating
Sullivan	\$624,603,000	1	5.16	1	Medium High	4

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.

Previous and Future Development

The next severe winter storm will most likely close schools and businesses for multiple days, and make roadways hazardous for travel. Heavy ice accumulation may damage electrical infrastructures causing prolonged power outages for large portions of the region. In addition, freezing temperatures make water lines vulnerable to freeze/thaw. Fallen tree limbs also pose a threat to various structures/infrastructures across the county

Hazard Summary by Jurisdiction

Although crop loss as a result of severe winter storm occurs more in the unincorporated portions of the planning area, the density of vulnerable populations is higher in the urban areas of the planning areas. It is considered that the magnitude of this hazard is relatively equal. The factors of probability, warning time, and duration are also equal across the planning area. Therefore, the conclusion is the hazard does not substantially vary by jurisdiction.

Problem Statement

Sullivan County is expected to experience one to five severe winter weather events annually. The county has a medium vulnerability rating. Individual jurisdictions should enhance their weather monitoring to be better prepared for severe weather hazards. If the individual jurisdictions monitor winter weather, they can dispatch road crews to prepare for the hazard. County and city crews can also trim trees along power lines to minimize the potential for outages due to snow and ice. Citizens should also be educated about the benefits of being proactive and planning for winter weather to alleviate property damage, as well as preparing for power outages. Education needs to occur in all jurisdictions to ensure all residents are aware of available shelters in the County, ensure all residents are educated on emergency supplies to have available, and to ensure residents are aware of

the utilization of social media, news outlets, informational websites and texting of information increases

3.4.9 Tornado

Hazard Profile

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

Tornados can occur throughout the entire planning area. All jurisdictions in the planning area are susceptible to tornado suffering.

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 3.42 below) 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 1.63. 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 Nu	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 3.43 below. 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 of damage is located online at www.spc.noaa.gov/efscale/ef-scale.html.

Table 1.64. Enhanced Fujita Scale with Potential Damage

Enhanced Fujita Scale			
	Wind Speed (mph)	Relative Frequency	
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.
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

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

There are limitations to the use of NCEI 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 NCEI. 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. Prior to 1993, only really destructive tornadoes were recorded. Table 3.44 below lists tornadoes reported from 1993 until January 1, 2020.

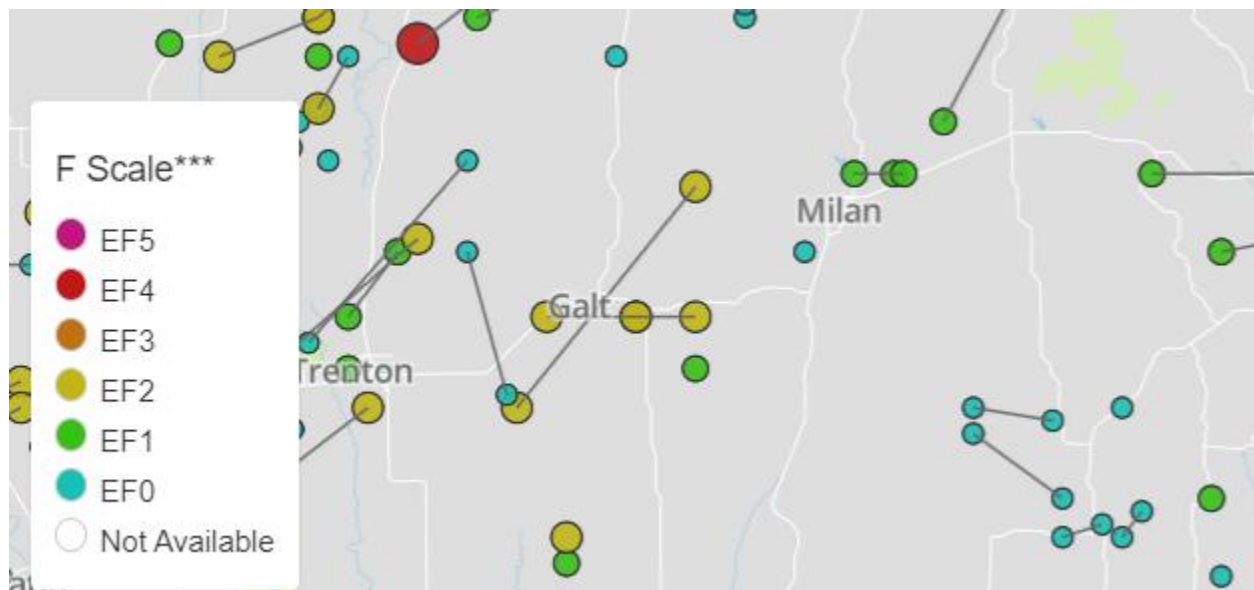
Table 1.65. Recorded Tornadoes in Sullivan County, 1993 – 2019

Date	Beginning Location	Ending Location	Length (miles)	Width (yards)	F/EF Rating	Death	Injury	Property Damage	Crop Damage
6/12/2008	1NW Pennville	1NNW Pennville	0.21	25	EF0	0	0	0	0
7/21/2008	5NW Winigan	1SSW Winigan	4.44	25	EF0	0	0	0	0
5/13/2009	2NNE Milan	3SSE Boynton	4.35	100	EF1	1	0	25,000	0
7/19/2010	0N Harris	0N Harris	0.01	25	EF0	0	0	10,000	0

7/19/2010	3SW Milan	3SW Milan	0.1	25	EF0	0	0	400	0
10/8/2018	2N Judson	3N Judson	0.82	25	EF0	0	0	0	0
	Total	6 Tornadoes				0	0	\$35,400	\$0

Source: National Centers for Environmental Information, <http://www.NCEI.noaa.gov/stormevents/>

Figure 1.70. Sullivan County Map of Historic Tornado Events



Source : <https://data.news-leader.com/tornado-archive/missouri/>

Probability of Future Occurrence

The National Center for Environmental Information reported 6 tornadoes in Sullivan County in a 17-year time period, which calculates to a 35% chance of a tornado occurring in any given year. Therefore, it is a higher probability that some portion of Sullivan County will experience tornado activity in any given year.

Changing Future Conditions Considerations

According to the 2018 Missouri State Hazard Mitigation Plan, scientists do not know how the frequency and severity of tornadoes will change. Research published in 2015 suggests that changes in heat and moisture content in the atmosphere, brought on by a warming world, could be playing a role in making tornado outbreaks more common and severe in the U.S. The research concluded that the number of days with large outbreaks have been increasing since the 1950s and that densely concentrated tornado outbreaks are on the rise. It is notable that the research shows that the area of tornado activity is not expanding, but rather the areas already subject to tornado activity are seeing the more densely packed

tornadoes. Because Missouri experiences on average around 39.6 tornadoes a year, such research is closely followed by meteorologists in the state.

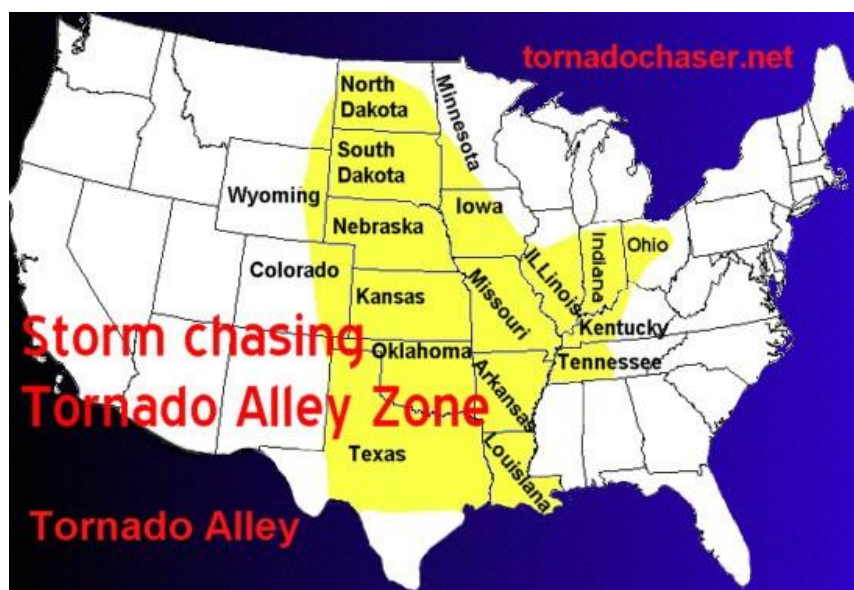
Vulnerability

Vulnerability Overview

Sullivan County is located in a region of the U.S. with high frequency of dangerous and destructive tornadoes referred to as “Tornado Alley”. Figure 3.58 below illustrates areas where dangerous tornadoes historically have occurred.

From the statistical data collected, six factors were considered in determining overall vulnerability to tornadoes as follows: building exposure, population density, social vulnerability, percentage of mobile homes, likelihood of occurrence, and annual property loss. Based on natural breaks in the statistical data, a rating value of 1 through 5 was assigned to each factor. These rating values correspond to the following descriptive terms: 1) Low 2) Low-medium 3) Medium 4) Medium-high 5) High.

Figure 1.71. Tornado Alley in the U.S.



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

Table 3.45 provides the factors considered and the ranges for the rating values assigned, according to the 2018 Missouri State Hazard Mitigation Plan.

Table 1.66. Ranges for Tornado Vulnerability Factor Ratings

Factors Considered	Low (1)	Low-medium (2)	Medium (3)	Medium-High (4)	High (5)
Common Factors					
Building Exposure (\$)	\$269,532- \$3,224,641	\$3,224,642- \$8,792,829	\$8,792,830- \$22,249,768	\$22,249,769- \$46,880,213	\$46,880,214- \$138,887,850
Population Density (#per sq. mile)	4.11-44.23	44.24-134.91	134.92-259.98	259.99-862.69	862.70-2,836.23
Social Vulnerability	1	2	3	4	5
Percent Mobile Homes	0.2-4.5%	4.51-8.8%	8.81-14%	14.01-21.2%	21.21-33.2%
Likelihood of Occurrence (# of events/ yrs. of data)	0.119 - 0.208	0.209 - 0.313	0.314 - 0.417	0.418 - 0.552	0.553 - 0.791
Total Annualized Property Loss (\$ / yrs. of data)	\$974 - \$281,874	\$281,875 - \$991,825	\$991,826 - \$2,099,000	\$2,099,001 - \$5,047,474	\$5,047,475 - \$42,467,109

Source: 2018 Missouri State Hazard Mitigation Plan

Once the ranges were determined and applied to all factors considered in the analysis, the ratings were combed to determine an overall vulnerability rating for tornadoes. Table 3.46 provides the calculated ranges applied to determine overall vulnerability of Missouri counties to tornadoes. Table 3.46 that follows provides the mapped results of this analysis for Sullivan County.

Table 1.67. Ranges for Tornado Combined Vulnerability Rating

	Low (1)	Low-medium (2)	Medium (3)	Medium-High (4)	High (5)
Tornado Combined Vulnerability	7-10	11-12	13-14	15-16	17-21

Source: 2018 Missouri State Hazard Mitigation Plan

Table 3.47 below provides the building exposure, population density, SOVI index ranking and percentage of mobile homes for Sullivan County and associated vulnerability rating, according to the 2018 Missouri State Hazard Mitigation Plan.

Table 1.68. Building Exposure, Population Density, SOVI, and Mobile Home Data

County	Total Building Exposure (Hazus)	Exposure Rating	Population Density	Population Rating	SOVI Index Ranking	SOVI Rating	Percent Mobile Homes	Mobile Home Rating
Sullivan	\$624,603,000	1	9.80	1	Medium High	4	10	3

Source: 2018 Missouri State Hazard Mitigation Plan

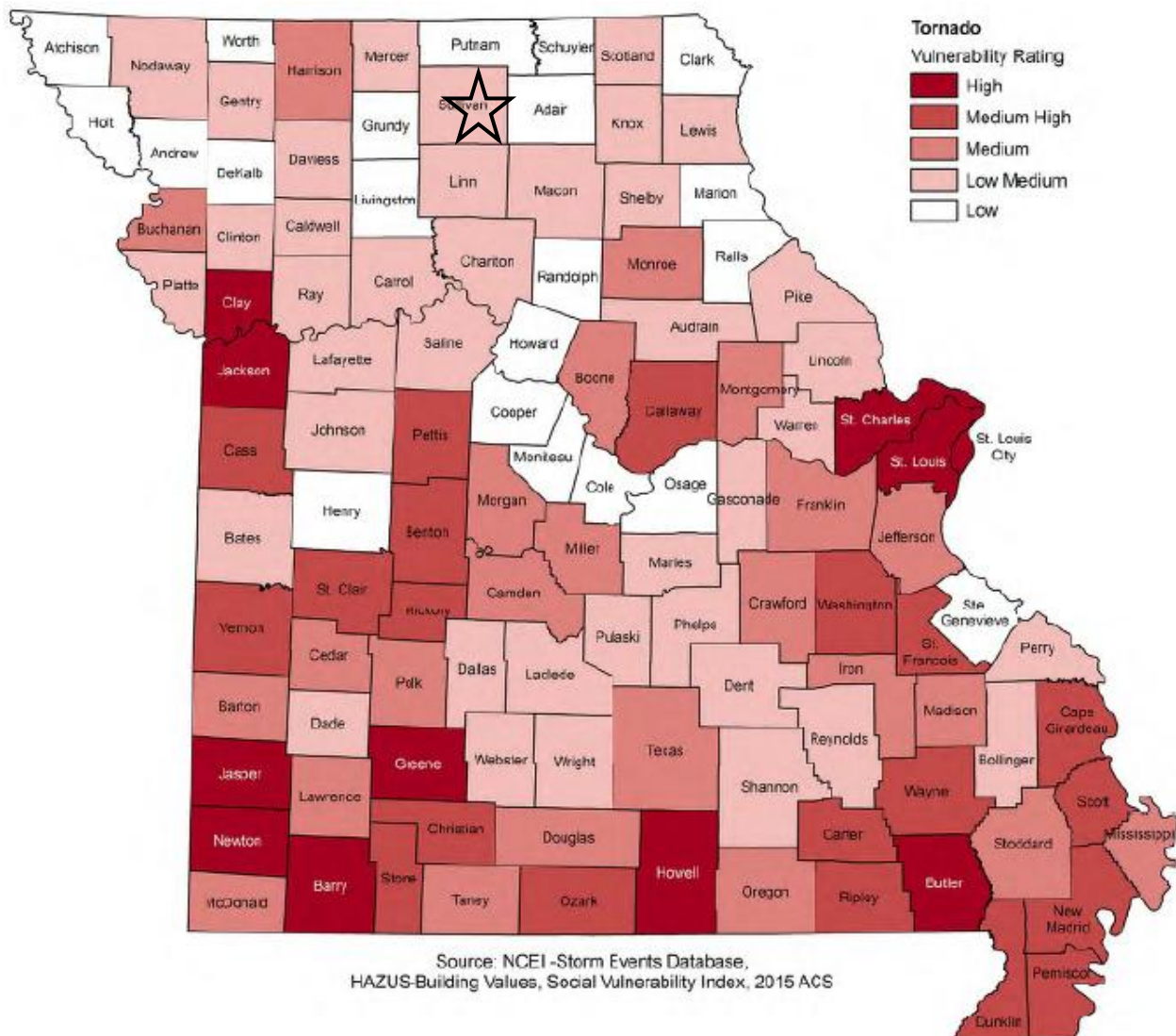
Table 3.48 below provides additional data obtained from the National Centers for Environmental Information to complete the overall vulnerability analysis and the total overall vulnerability for tornadoes in Figure 3.59 that follows the table below. Sullivan County is indicated with a black star.

Table 1.69. Likelihood of Occurrence, Annual Property Loss, and Overall Vulnerability Rating for Tornadoes

County	Total Number of Tornadoes	Likelihood of Occurrence	Likelihood of Occurrence Rating	Total Annualized Property Loss	Total Annualized Property Loss Rating	Overall Vulnerability Rating	Overall Vulnerability Rating Description
Sullivan	8	0.119	1	\$1,312	1	11	Low Medium

Source: 2018 Missouri State Hazard Mitigation Plan

Figure 1.72. Overall Vulnerability to Tornadoes



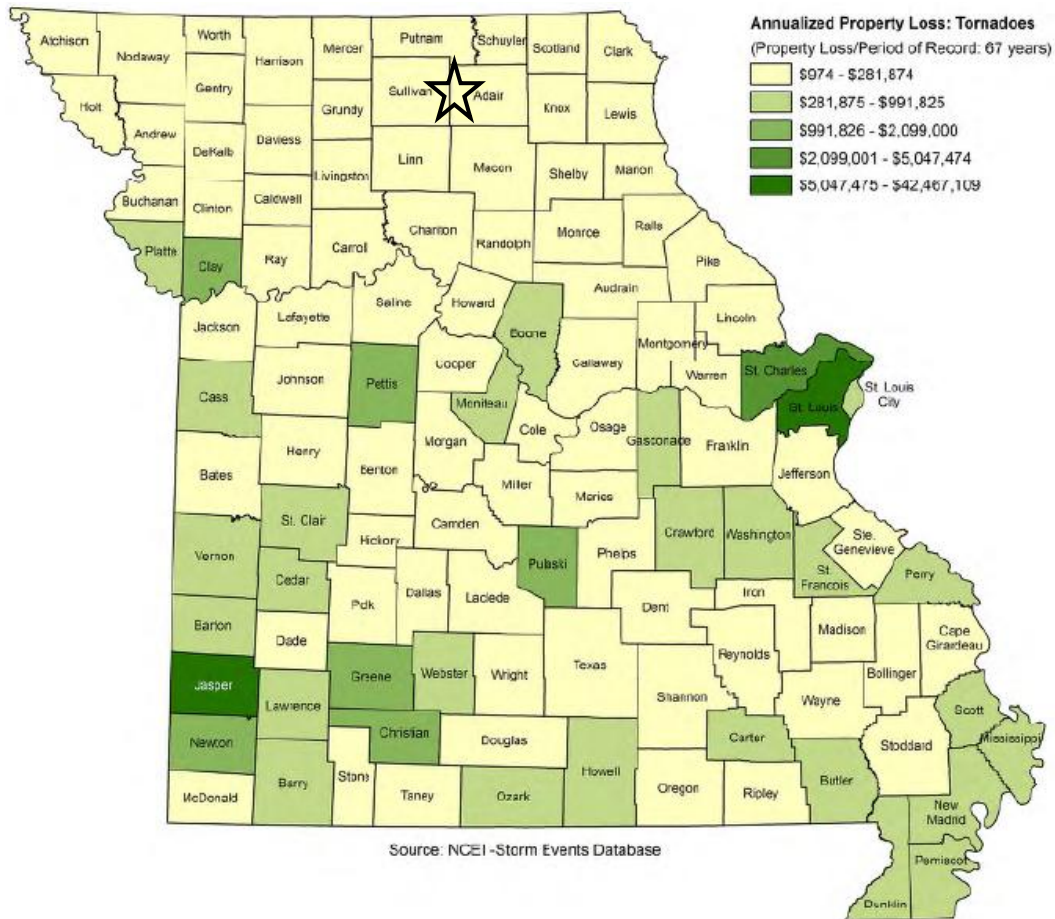
Source: 2018 Missouri State Hazard Mitigation Plan

Potential Losses to Existing Development

From the statistical data collected, annualized historical losses from 1950 to December 31, 2016 were considered in determining annualized tornado damages.

Figure 3.60 below shows a list of historical losses and Sullivan County is indicated with a black star. This figure shows that in the past 67 years, Sullivan County has had minimal property loss (\$974 - \$281,874) from tornadoes.

Figure 1.73. Annualized Property Loss for Tornadoes



Source: 2018 Missouri State Hazard Mitigation Plan

Previous and Future Development

Vulnerability to tornadoes is anticipated to remain the same. Future development for public buildings such as schools, government offices, as well as buildings with high occupancy and campgrounds should consider including a tornado safe room to protect occupants in the event of a tornado.

Hazard Summary by Jurisdiction

Tornado events could occur anywhere in the planning area, but some jurisdictions would suffer heavier damages because of the age of the housing or the high concentration of mobile homes.

Communities that have adopted building codes may also be less vulnerable to damages.

Problem Statement

Sullivan County has inadequate tornado shelters throughout the county, not everyone utilizes social media and/or texting, the rural areas do not have warning sirens, lack of awareness for available shelters and more education needs to occur. Possible solutions include promoting the use of NOAA weather radios and conducting public education and outreach activities to increase awareness of tornado risk.

3.4.10 Wildfire

Hazard Profile

Hazard Description

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

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 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

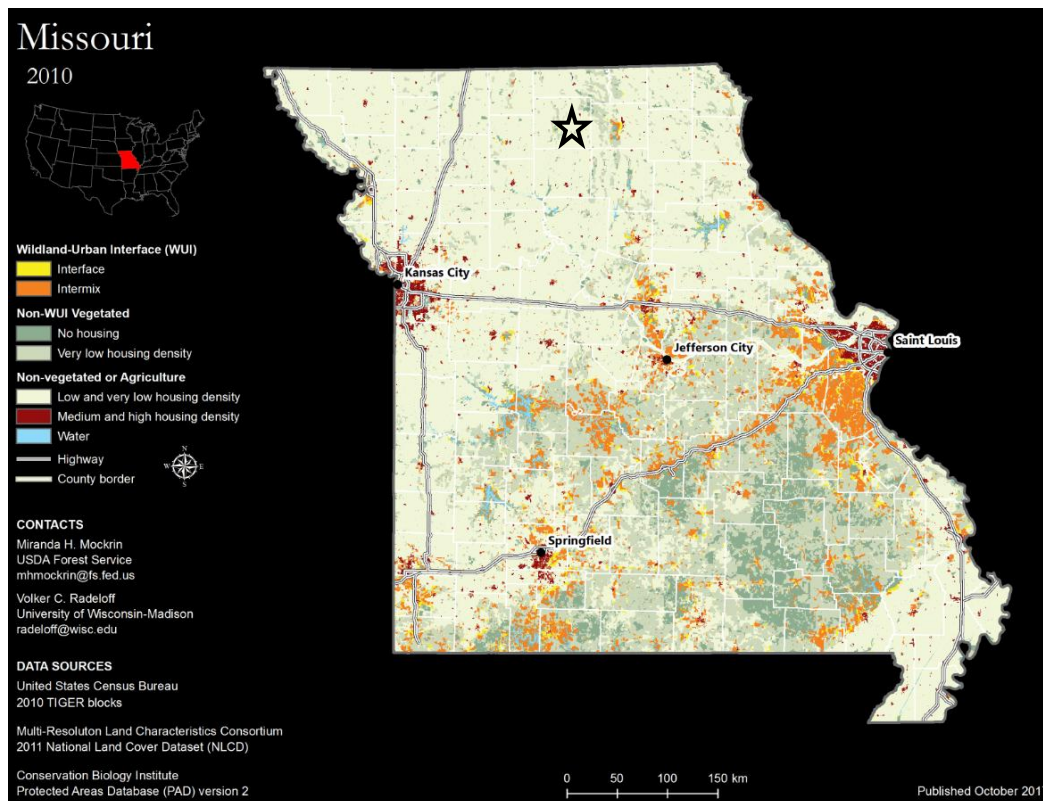
The term refers to the zone of transition between unoccupied land and human development and needs to be defined in the plan. Within the WUI, there are two specific areas identified: 1)

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.

According to the 2018 Missouri State Plan the Wildland-Urban Interface estimated the numbers and values of structures and population vulnerable to wildfire as the following: Total number of structures 143 valued at \$22,637,023 and a population of 339. The breakdown of the structures consists of 2 Agriculture valued at \$553,590; 2 Commercial valued at \$994,217; 1 Government valued at \$531,000 and 138 Residential valued at \$20,558,216.

Figure 3.61 below shows the Wildland-Urban Interface. Sullivan County is indicated with a black star. Sullivan County has a low risk of damage to wildfires, as the housing density is low.

Figure 1.74. 2010 Missouri Wildland Urban Interface



Source : http://silvis.forest.wisc.edu/GeoData/WUI_cp12/maps/gifs/black/Missouri_WUI_cp12_black_2010.gif

Strength/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.

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.

Previous Occurrences

According to the Missouri Division of Fire Safety (MDFS) Website as well as the Missouri Department of Conservation Wildfire Data Search, there were 127 reported wildland or grass fires in Sullivan County from 2010 – 2019. In total, these 127 fires burned 7,416.47 acres and no injuries were reported. During the 10-year reporting period, 39 of the fires had an unknown cause for starting and burned 2,137.60 acres, 25 of the fires were started by debris and burned 1,629.91 acres, 15 of the fires had a miscellaneous cause for starting and burned 862.70 acres, 13 of the fires were started by equipment and burned 1092.09 acres, 13 of the fires were started by smoking and burned 311.89 acres, 3 of the fires were started by lightning and burned 8 acres, 3 of the fires were started by a campfire and burned 461.11 acres, 3 of the fires were started by children and burned 22 acres and 13 of the fires had no reported cause and burned 891.17 acres.

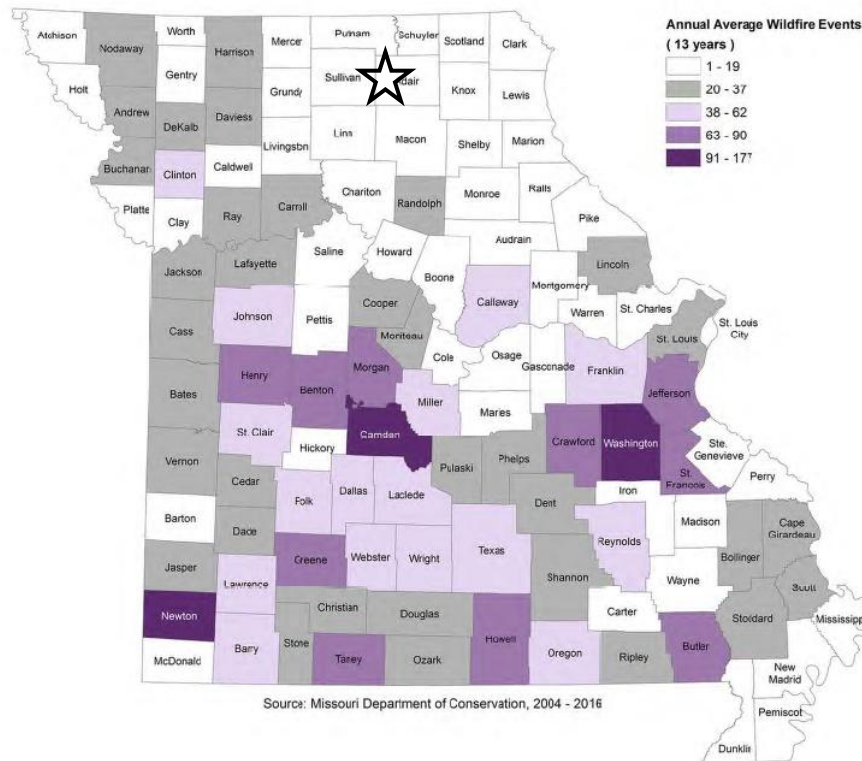
At this time, no information is available from school districts and special districts regarding previous fire events and the damages resulting from them.

Probability of Future Occurrence

Wildfires in the planning area are most likely to occur every year resulting in very little damage. The wildfires occur in the unincorporated areas and are limited to undeveloped land. The jurisdictions and school districts are largely surrounded by undeveloped land but have not been affected by wildfires. In years of significant drought or excessive heat, the potential for a wildfire in the planning area increases.

Figure 3.62 below shows the annual average of wildfire events from 2004 – 2016. Sullivan County had an annual average of 1 –19 wildfire events each year in the 13-year period. Sullivan County is indicated with a black star.

Figure 1.75. Likelihood of Wildfire Events 2004 – 2016



Source: 2018 Missouri State Hazard Mitigation Plan

When analyzing the wildland fires reported in the 2018 Missouri State Hazard Mitigation Plan, there were 84 wildfires that burned 1,411.75 acres from 2004 – 2016. This calculates to be an average of 9.54 wildfires per year burning an average of 6.46 acres per year. Each wildland fire burns approximately 190.85 acres. However, it was reported these fires did not result in major damages. The probability is more likely in any given year that a wildfire will occur in the planning area but not result in major damages.

Changing Future Conditions Considerations

Higher temperatures and changes in rainfall are unlikely to substantially reduce forest cover in Missouri, although the composition of trees in the forests may change. More droughts would reduce forest productivity and changing future conditions are also likely to increase the damage from insects and diseases. But longer growing seasons and increased carbon dioxide concentrations could offset the losses from those factors. Forests cover about one-third of the state, dominated by oak and hickory trees. As the climate changes, the abundance of pines in Missouri's forest are likely to increase, while the population of hickory trees is likely to decrease.

Additionally, stated in the 2018 State Plan, higher temperatures will also reduce the number of days prescribed burning can be performed. Reduction of prescribed burning will allow for growth of understory vegetation-providing fuel for destructive wildfires. Drought is also anticipated to increase in frequency and intensity during summer months under projected future scenarios. Drought can lead to dead or dying vegetation and landscaping material close to structures which creates fodder for wildfires within both the urban and rural settings.

Vulnerability

Vulnerability Overview

According to the 2018 Missouri State Hazard Mitigation Plan, Higher temperatures and changes in rainfall are unlikely to substantially reduce forest cover in Missouri, although the composition of trees in the forests may change. More droughts would reduce forest productivity, and changing future conditions are also likely to increase the damage from insects and diseases. But longer growing seasons and increased carbon dioxide concentrations could more than offset the losses from those factors. Forests cover about one-third of the state, dominated by oak and hickory trees. As the climate changes, the abundance of pines in Missouri's forests is likely to increase, while the population of hickory trees is likely to decrease. Higher temperatures will also reduce the number of days prescribed burning can be performed. Reduction of prescribed burning will allow for growth of understory vegetation – providing fuel for destructive wildfires. Drought is also anticipated to increase in frequency and intensity during summer months under projected future scenarios. Drought can lead to dead or dying vegetation and landscaping material close to structures which creates fodder for wildfires within both the urban and rural settings.

Potential Losses to Existing Development

The method used to determine vulnerability to wildfires across Missouri was a GIS comparative analysis of wildland urban interface and intermix (WUI) areas against building exposure data to determine the types, numbers, and estimated values of buildings at risk to wildfire. This GIS-based analysis utilized data from several sources: the Missouri Spatial Data Inventory Service (MSDIS), HAZUS building exposure value data, and wildland urban interface and intermix area data from the University of Wisconsin-Madison SILVIS Lab.

To calculate estimated values of buildings at risk, buildings values available in the HAZUS census block data were used to determine an average value for each property type. This average value per property type was then applied to the number of structures in the WUI areas, by type, to calculate an overall estimated value of buildings at risk by type. In addition to counts and values of structures at risk, an estimated population impacted for each county was calculated based on the number of residential properties in the WUI areas multiplied by the average household size.

Figure 3.63 below provides the results of the wildfire analysis with the numbers and values of various types of structures and population within Sullivan County as stated in the 2018 Missouri State Hazard Mitigation Plan.

Figure 1.76. Estimated Numbers and Value of Structures and Population Vulnerable to Wildfire in Sullivan County

County	Number of Structures	Value of Structures	Population
Sullivan	143	\$22,637,023	339
Agriculture	2	\$553,590	
Commercial	2	\$994,217	
Government	1	\$531,000	
Residential	138	\$20,558,216	

Source: 2018 Missouri State Hazard Mitigation Plan

For the wildfire hazard, the factors considered in determining future potential loss estimates were the average acreage burned each year in the county as a result of wildfire and the average value of structures per acre in WU-Interface/Intermix areas. Figure 3.64 below provides potential loss estimate from wildfires based on this methodology.

Figure 1.77. Wildfire Potential Loss Estimate

County	Total WUI Acreage	Total Structure Value Within WUI	Average Value/Acre within WUI	Average Annual Acreage Burned	Potential Loss
Sullivan	831.1	\$22,637,023	\$27,237	109	\$2,968,866

Source: 2018 Missouri State Hazard Mitigation Plan

Impact of Previous and Future Development

Future and previous development in the wildland-urban interface would increase vulnerability to the hazard.

Hazard Summary by Jurisdiction

The rural jurisdictions in the planning area are all surrounded by undeveloped agricultural land and face the possibility of a wildfire event. The school districts are located in a rural area and do not face danger of wildfire due to barriers in place around the schools. As long as drought conditions are not seriously inflamed, future wildfires in Sullivan County should have a negligible adverse impact on the community, as it would affect a small percentage of the population. Nonetheless, homes and businesses located in unincorporated areas are at higher risk from wildfires due to proximity to wood and distance from fire services. Variations in both structural/urban and wildfires are not able to be determined at this time due to lack of data. However, both fire types are expected to occur on an annual basis across the county.

Problem Statement

Residents do not comply with burn bans, education is not available for the levels of burn bans, many residents lack education in fire safety and not all residents utilize social media and texting. Education needs to occur on the dangers associated with not complying with the burn bans, more education for fire safety and encourage utilization of social media and texting. Due to Sullivan County's high drought rating, they may be more susceptible to fires. The County needs to review the response times and resources of the fire protection

districts that service the county, as well as emergency access, landscaping and water supply as rural areas are less populated and additional assistance in wildfire mitigation may be required.

3.4.11 Pandemic

Hazard Description

According to the Center for Disease Control, a pandemic is a global outbreak of disease. Pandemics happen when a new virus emerges to infect people and can spread between people sustainably. Because there is little to no pre-existing immunity against the new virus, it spreads worldwide. The pace at which a new virus spreads is dependent upon how quickly a virus or sickness is identified, how quickly a treatment can be established, and how quickly the local government responds to the pandemic itself. Pandemics not only affect the world's health, but can also take a huge toll on an effected country's economy.

Pandemics that have affected the United States since 1900 are the Spanish Flu of 1918 – 1919, the Asian flu of 1957, the Hong Kong flu of 1968, SARS in 2002, Bird flu and Swine flu in 2009, Ebola which peaked in 2013 – 2014, and COVID-19 of 2019-2020.

Source : <https://www.tandfonline.com/doi/full/10.1080/09669582.2020.1758708>

Geographic Location

All of Sullivan County is susceptible to a pandemic outbreak due to the main characteristic of a pandemic being on a global level. Sullivan County is a mostly rural county in the middle of the United States and located in the northwest region of Missouri. It rests approximately 125 miles northeast of Kansas City, which has an airport that has both international and domestic flight destinations and arrivals.

Strength/Magnitude/Extent

Risk depends on characteristics of the virus or sickness, including how quickly it spreads between people; the severity of resulting illness; and the medical or other measures available to control the impact of the virus (for example, success of contact tracing, diagnostic testing, vaccines or medications, medical equipment required and medical staffing required to treat the illness) and the relative success of these factors. In the absence of vaccine or treatment medications, non-pharmaceutical interventions become the most important response strategy. These are medical and community interventions that can reduce the impact of disease.

Previous Occurrences

COVID-19

The planning area, in addition to others across the globe, is currently in the midst of a pandemic. The coronavirus that causes COVID-19 is infecting people quickly and spreading easily from person-to-person. On March 11, 2020, the COVID-19 outbreak was characterized as a pandemic by the World Health Organization.

The first case of COVID-19 was reported by officials in Wuhan City, China, in December 2019. The first case reported in the United States was a patient on board a commercial airplane flight

returning from Wuhan to the State of Washington on January 25, 2019. The patient was assigned the COVID-19 diagnosis based on their travel history and symptoms.

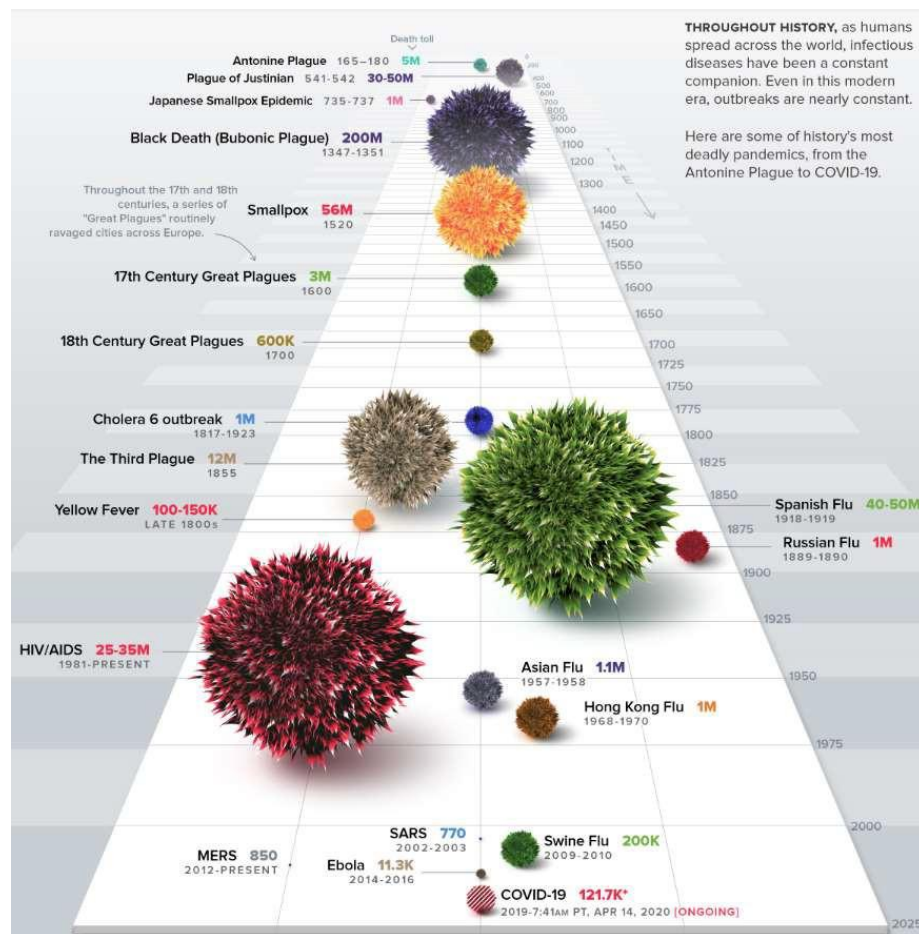
According to the Center for Disease Control, this is the first pandemic known to be caused by a new coronavirus. In the past century, there have been four pandemics caused by the emergence of new influenza viruses. As a result, most research and guidance around pandemics is specific to influenza, but the same premises can be applied to the current COVID-19 pandemic.

Spanish Flu, Asian Flu, Hong Kong Flu, SARS, Bird Flu, MERS, Ebola

Pandemics of respiratory disease follow a certain progression outlined in a “Pandemic Intervals Framework.” Pandemics begin with an investigation phase, followed by recognition, initiation, and acceleration phases. The peak of illnesses occurs at the end of the acceleration phase, which is followed by a deceleration phase, during which there is a decrease in illnesses. Different countries can be in different phases of the pandemic at any point in time and different parts of the same country can also be in different phases of a pandemic.

As humans have spread across the world, infectious diseases have continued to spread. Even in this modern era, outbreaks are nearly constant, though not every outbreak reaches pandemic level. Figure 3.65 below outlines some of the deadliest pandemics dating back to 165.

Figure 1.78. History of Pandemics



Source : <https://www.visualcapitalist.com/history-of-pandemics-deadliest/>

Probability of Future Occurrence

The threat of pandemics in the planning area and across the globe remains a concern. The probability of future occurrence of a pandemic is not possible to predict due to the increase in travel and business, which drives the evolution of a global economy.

Changing Future Conditions Considerations

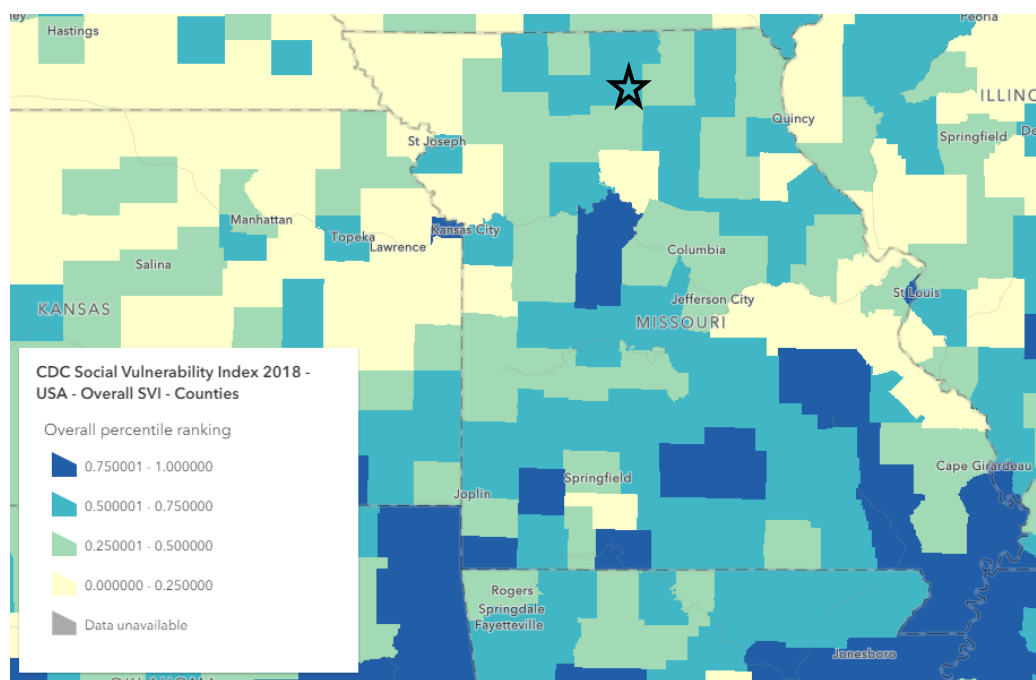
Climate change and weather patterns are widely thought to have direct impacts on the probability and severity of future pandemic outbreaks. Habitat loss due to climate is bringing animals that can transmit disease in contact with humans more often. Floods can enhance the spread of infectious agents like insects, bacteria, and viruses. Increasing temperatures and humidity affect the development, survival and spread of not only pathogens, but also their hosts (often animals).

Vulnerability

Vulnerability Overview

Each jurisdiction and its population, businesses, and school districts are vulnerable to a pandemic outbreak. Due to an increasing elderly population throughout the planning area, an outbreak of an infectious or viral disease could have major impacts on the communities and the assets each possess. Figure 3.66 shows the social vulnerability rating of the planning area, State of Missouri and the United States. Sullivan County is indicated with a black star.

Figure 1.79. Social Vulnerability Index Rating in Missouri



Source: <https://livingatlas.arcgis.com/policy/browse/?loc=-93.558,40.016,8&col=88f17b4580e846609f92c9f75a9d9eee,2c8fdc6267e4439e968837020e7618f3,48638a1be455429287d6756985013910,02a82293e2dd475391cb3699b5e82d61,d89c527f2e6b4d658db0948ea9d49cd9,48a70b524601428ba297e3106b751401,be559110b5c34591b1a767fbb807bcbf,e0427fbc472f4a45b7d94d182a5e9591,142e65436bed4063973380feae6ed248&viz=2c8fdc6267e4439e968837020e7618f3&hs=0>

Potential Losses to Existing Development

Travel restrictions, community lockdowns, and education that helps with mitigating the spread of the pandemic are all key items in preventing loss. During a pandemic like COVID-19, people have been ordered to stay home, wearing facial coverings in public, socially distance from other humans, schools adjourned the remainder of the year, restaurants and bars are forced to close their doors, employers of essential workers required specific practices in the workplace that would prevent the spread of COVID-19. It is very likely that the livelihood of the population and some of the planning area's most beloved assets and businesses will not be able to recover the pandemic due to extreme economic loss and health threats.

Impact of Previous and Future Development

Pandemics create unprecedented disruption for global health and the development of communities. Urbanization in the developing world is bringing more and more rural residents into denser neighborhoods, while population increases are putting greater pressure on the environment. In conjunction, air traffic nearly doubled in the past decade. These macro trends are having major impacts on the spread of infectious disease.

Hazard Summary by Jurisdiction

The planning area is largely rural and many have a sense of "safeness" when it comes to an infectious or viral pandemic, in the sense that most of the population can securely distance themselves from one another, whereas larger cities do not have that luxury. Unfortunately, pandemics happen on a global level and no community is immune. High risk areas for the emergence and spread of infectious disease are where an intersection happens between wild disease reservoirs, agricultural practices that increase contact between wildlife and livestock, and cultural practices that increase contact between humans, wildlife, and livestock. Sullivan County does not have a prominence of wild disease reservoirs, agricultural practices or a huge number of resident citizens who have cultural practices mentioned in this section.

Problem Statement

In order to keep transmission rates low during a pandemic outbreak, residents need to safely distance themselves as best as possible and follow the numerous Center for Disease Control guidelines. Residents should also consider personal protective equipment and social distancing guidelines and suggestions from the World Health Organization, CDC, Primary and Specialist Care Providers, and local government officials. Due to the lack of accessibility to ongoing public health information and broadband connectivity, it is especially challenging to inform residents about current and upcoming pandemic updates. It is an issue in rural America to convey the severity of pandemic outbreaks and provide preparedness instruction because social media, website posts, podcasts, etc. are not an option for every resident in the planning area. Education, travel restrictions and community lockdowns are key aspects in slowing the spread of a pandemic, but all three of those rest on the local government officials and agencies, as well as funds available.

MITIGATION STRATEGY

4	MITIGATION STRATEGY.....	ccviii
4.1	Goals.....	ccix
4.2	Identification and Analysis of Mitigation Actions	ccix
4.3	Implementation of Mitigation Actions.....	ccxii

44 CFR Requirement §201.6(c)(3): The plan shall include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.

This section presents the mitigation strategy updated by the Mitigation Planning Committee (MPC) 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.

Goals

44 CFR Requirement §201.6(c)(3)(i): [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

This planning effort is an update to Sullivan County's existing hazard mitigation plan approved by FEMA in March 2016. Therefore, the goals from the 2016 Sullivan County Hazard Mitigation Plan were reviewed to see if they were still valid, feasible, practical, and applicable to the defined hazard impacts. The MPC 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 reviewed. The MPC also reviewed the goals from current surrounding county plans.

Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the plan.

Goal 2: To recognize and increase disaster mitigation management capabilities for each jurisdiction, school district and special district.

Goal 3: Protect the lives, property and livelihoods of all citizens by evaluating and implementing optimal mitigation alternatives.

Goal 4: To ensure continued operation of government and emergency functions in a disaster.

Goal 5: To implement Action Items according to a 5-year action plan.

Identification and Analysis of Mitigation Actions

44 CFR Requirement §201.6(c)(3)(ii): The mitigation strategy shall include a section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

During the MPC Planning meeting, the results of the risk assessment update were provided to the MPC members for review and the key issues were identified for specific hazards. Changes in risk since adoption of the previously approved plan were discussed. Actions from the previous plan included completed actions, on-going actions, and actions upon which progress had not been made. The MPC discussed SEMA's identified funding priorities and the types of mitigation

actions generally recognized by FEMA.

The MPC included problem statements in the plan update at the end of each hazard profile. The problem statements summarize the risk to the planning area presented by each hazard and include possible methods to reduce that risk. Use of the problem statements allowed the MPC to recognize new and innovative strategies for mitigate risks in the planning area.

During the Planning Meeting the mitigation strategy was reviewed. For a comprehensive range of mitigation actions to consider, the MPC reviewed the following information during the Planning Meeting:

- 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, including the problem statements concluding each hazard profile and vulnerability analysis,
- State priorities established for HMA grants, and
- Public input during meetings, responses to data collection questionnaires, and other efforts to involve the public in the plan development process.

For the Planning Meeting, individual jurisdictions, including school and special districts, developed final mitigation strategy for submission to the MPC. 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 Appendix B of this plan. During the Planning Meeting a list of actions for each jurisdiction was provided to that jurisdiction's MPC representative along with the worksheets. 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;
- Ongoing, with a description of the progress made to date; or
- Not Yet Started, with a discussion of the reasons for lack of progress.

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 zero completed actions, two continuing actions (either ongoing or modified), and forty-one deleted actions.

0 provides a summary of the action statuses for each jurisdiction:

Table 1.70. Action Status Summary

Jurisdiction	Completed Actions	Continuing Actions (ongoing or modify)	Deleted Actions
Sullivan County	0	1	11

City of Milan	0	1	8
City of Green City	0	0	3
City of Green Castle	0	0	3
City of Newtown	0	0	3
Village of Harris	0	0	3
Village of Pollock	0	0	3
Village of Humphreys	0	0	3
Milan C-2	0	0	1
Green City R-1	0	0	1
Grundy R-V	0	0	1
Newtown-Harris R-III	0	0	1

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

Table 1.71. Summary of Deleted Actions from the Previous Plan

Deleted Actions	Reason for Deletion
Sullivan County	
Review and amend existing local planning documents to be certain vulnerability and environmental suitability of lands for future development is addressed.	Action was determined to be an everyday item
Encourage local plans to address the vulnerability of designated hazard areas.	Action was determined to be an everyday item
Assure that should the proposed manmade recreation lake be built, that the dam is built with every hazard precaution in mind, and that an accurate and reliable dam failure study, inundation map or computer model and safety plan are produced immediately.	Action was determined to be an everyday item
Obtain free publications from FEMA, NWQ, USFS and other Federal and State agencies and place them in places of public access, such as libraries, post offices, and government buildings.	Action was determined to be an everyday item
Maintain a local repository with the latest available publications.	Action was determined to be an everyday item
Review existing dumping regulations	Action was determined to be an everyday item
Ensure the use of best management practices for channel drainage and systems maintenance.	Action was determined to be an everyday item
Promote Storm Spotter training classes to local emergency response personnel and interested members of the public	Action was determined to be an everyday item
Inventory the state of drainage systems in the and determine the need and mechanism for improvement.	Action was determined to be an everyday item
Seek funding from CDBG, USDA, MoDOT and or other State and Federal agencies to address issues of inundation in low lying areas of State Highways PP and EE	Action was determined to be an everyday item
Make local governments experts available to property owners to offer hazard audits of	Action was determined to be an everyday item

vulnerable structures	
City of Milan	Action was determined to be an everyday item
Review and amend existing local planning documents to be certain vulnerability and environmental suitability of lands for future development is addressed.	Action was determined to be an everyday item
Encourage local plans to address the vulnerability of designated hazard areas.	Action was determined to be an everyday item
Assure that should the proposed manmade recreation lake be built, that the dam is built with every hazard precaution in mind, and that an accurate and reliable dam failure study, inundation map or computer model and safety plan are produced immediately.	Action was determined to be an everyday item
Obtain free publications from FEMA, NWQ, USFS and other Federal and State agencies and place them in places of public access, such as libraries, post offices, and government buildings.	Action was determined to be an everyday item
Maintain a local repository with the latest available publications	Action was determined to be an everyday item
Ensure the use of best management practices for channel drainage and systems maintenance.	Action was determined to be an everyday item
Promote Storm Spotter training classes to local emergency response personnel and interested members of the public	Action was determined to be an everyday item
Make local governments experts available to property owners to offer hazard audits vulnerable structures	Action was determined to be an everyday item
Green City, Green Castle, Newtown, Village of Harris, Village of Pollock, Village of Humphreys,	Action was determined to be an everyday item
Assure that should the proposed manmade recreation lake be built, that the dam is built with every hazard precaution in mind, and that an accurate and reliable dam failure study, inundation map or computer model and safety plan are produced immediately.	Action was determined to be an everyday item
Maintain a local repository with the latest available publications	Action was determined to be an everyday item
Obtain free publications from FEMA, NWQ, USFS and other Federal and State agencies and place them in places of public access, such as libraries, post offices, and government buildings.	Action was determined to be an everyday item
Milan C-2, Green City R-1, Grundy R-V, Newtown-Harris R-III,	Action was determined to be an everyday item
Expand the existing annual Earthquake Awareness program to encompass hazard and emergency preparedness awareness via such activities as presentations, poster contests, and the distribution of SEMA/FEMA materials to students.	Action was determined to be an everyday item

Source: Previously approved County Hazard Mitigation Plan; Data Collection Questionnaires.

Implementation of Mitigation Actions

44 CFR Requirement §201.6(c)(3)(ii): The mitigation strategy shall include an action strategy describing how the actions identified in paragraph (c)(2)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefits review of the proposed projects and their associated costs.

Jurisdictional MPC members were encouraged to meet with others in their community to finalize the actions to be submitted for the updated mitigation strategy. Throughout the MPC 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 MPC decided to pursue implementation according to when and where damage occurs, available funding, political will, jurisdictional priority, and priorities identified in the 2018 Missouri State Hazard Mitigation Plan. The benefit/cost review at the planning stage primarily consisted of a qualitative analysis and was not the detailed process required grant funding application. 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^{7(a)}. During the prioritization process, the jurisdictions 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 points
Definitely NO = 0 points

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?

The final scores are listed below in the analysis of each action. The STAPLEE final score for each action, absent other considerations, such as a localized need for a project, determined the priority. Low priority action items were those that had a total score of between 0 and 24. Moderate priority actions were those scoring between 25 and 29. High priority actions scored 30 or above. A blank STAPLEE worksheet is shown in Figure 1.80.

Figure 1.80. Blank STAPLEE 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)

ACTION WORKSHEET

Action Worksheet	
Name of Jurisdiction:	
Risk / Vulnerability	
Hazard(s) Addressed:	List the hazard or hazards that will be addressed by this action
Problem being Mitigated:	Provide a brief description of the problem that the action will address. Utilize the problem statement developed in the risk assessment.
Action or Project	
Applicable Goal Statement:	Choose the goal statement that applies to this action
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
Action or Project Description:	Describe the action or project.
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.
Supporting Organization/Department:	Which organization/department will assist in implementation of this action?
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.

Action Worksheet	
Name of Jurisdiction:	Sullivan County
Risk / Vulnerability	
Hazard(s) Addressed:	Flooding, Severe Thunderstorms, Winter Weather
Problem being Mitigated:	Accessibility for emergency services/evacuation routes.
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the Plan. Goal 2: To recognize and increase disaster mitigation management capabilities for each jurisdiction, school district and special district. Goal 5: To implement Action Items according to a 5-year Action Plan.
Action/Project Number:	County - 2020.1
Name of Action or Project:	Maintain Transportation Infrastructure
Mitigation Category:	Prevention, Structure and Infrastructure Projects, Emergency Services
Action or Project Description:	Project will make necessary improvements to roads, culverts, low water crossings, road elevations, bank stabilizations, bridges and the general transportation infrastructure throughout the city.
Estimated Cost:	\$750,000
Benefits:	The project protects citizens from harm due to damaged transportation infrastructure.
Plan for Implementation	
Responsible Organization/Department:	County Commission
Supporting Organization/Department:	Emergency Management Direct
Action/Project Priority:	Medium
Timeline for Completion:	1-5 years
Potential Fund Sources:	MoDOT; CDBG, Hazard Mitigation Grant Funds
Local Planning Mechanisms to be Used in Implementation, if any:	N/A
Progress Report	
Action Status:	New

Report of Progress:	New Project
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Action Worksheet	
Name of Jurisdiction:	Sullivan County
Risk / Vulnerability	
Hazard(s) Addressed:	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado
Problem being Mitigated:	Loss of electrical power to emergency shelters/critical facilities
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the Plan. Goal 2: To recognize and increase disaster mitigation management capabilities for each jurisdiction, school district and special district. Goal 3: To protect the lives, livelihoods and property of all citizens by evaluating and implementing optimal mitigation alternatives Goal 4: To ensure continued operation of government and emergency functions in a disaster.
Action/Project Number:	County – 2020.2
Name of Action or Project:	Generator for Shelters/critical facilities
Mitigation Category:	Prevention, Structure and Infrastructure Projects, Emergency Services
Action or Project Description:	Assist critical facilities with emergency communication plans and emergency power back-up plans as needed, including shelters, for those displaced from their homes by power outages.
Estimated Cost:	\$65,000
Benefits:	Generator will allow for continues use of shelters/critical facilities for service to citizens in the event of an outage, this would be beneficial during any hazard.
Plan for Implementation	
Responsible Organization/Department:	County Commission

Supporting Organization/Department:	Emergency Management Director
Action/Project Priority:	High
Timeline for Completion:	1 year
Potential Fund Sources:	Hazard Mitigation Grant Funds/RHSOC
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	Sullivan County
Risk / Vulnerability	
Hazard(s) Addressed:	Tornado, Severe Thunderstorms,
Problem being Mitigated:	Transportation routes can be disrupted by debris caused by natural disasters.
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the Plan. Goal 3: To protect the lives, livelihoods and property of all citizens by evaluating and implementing optimal mitigation alternatives Goal 4: To ensure continued operation of government and emergency functions in a disaster.
Action/Project Number:	Sullivan County 2020.3
Name of Action or Project:	Debris Removal
Mitigation Category:	Structure and Infrastructure
Action or Project Description:	Mitigate the risk to life and property and promote continued operation of government and emergency functions by regularly removing debris as needed along transportation routes and drainage systems.
Estimated Cost:	\$500,000
Benefits:	The project protects citizens from debris comprising the transportation system.
Plan for Implementation	
Responsible Organization/Department:	Road and Bridge Department

Supporting Organization/Department:	Emergency Management Direct
Action/Project Priority:	High
Timeline for Completion:	1-5 years
Potential Fund Sources:	Hazard Mitigation Grant Funds
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	Sullivan County
Risk / Vulnerability	
Hazard(s) Addressed:	All Hazards
Problem being Mitigated:	Provide early warning to residents
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the Plan. Goal 3: To protect the lives, livelihoods and property of all citizens by evaluating and implementing optimal mitigation alternatives Goal 4: To ensure continued operation of government and emergency functions in a disaster.
Action/Project Number:	County 2020.4
Name of Action or Project:	Installation/Upgrade Siren
Mitigation Category:	Emergency Services, Prevention, Structure and Infrastructure Projects
Action or Project Description:	Installation or the upgrade of warning sirens in areas of the County needing a siren or the siren upgraded.
Estimated Cost:	\$50,000
Benefits:	With adequate time for warning of storms, residents are able to seek cover to help minimize the loss of life.

Plan for Implementation	
Responsible Organization/Department:	County Commission
Supporting Organization/Department:	Emergency Management Director
Action/Project Priority:	High
Timeline for Completion:	1 – 5 years
Potential Fund Sources:	Hazard Mitigation Grant Funds
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	Sullivan County
Risk / Vulnerability	
Hazard(s) Addressed:	Pandemic
Problem being Mitigated:	Protecting outbreaks from affecting residents.
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the Plan. Goal 2: To recognize and increase disaster mitigation management capabilities for each jurisdiction, school district and special district. Goal 3: To protect the lives, livelihoods and property of all citizens by evaluating and implementing optimal mitigation alternatives Goal 4: To ensure continued operation of government and emergency functions in a disaster.
Action/Project Number:	County 2020.5
Name of Action or Project:	Response to Pandemic
Mitigation Category:	Emergency Services, Prevention, Public Education
Action or Project Description:	Project will provide necessary resources for the response to pandemic outbreaks.

Estimated Cost:	\$300,000
Benefits:	The project protects citizens from harm due to pandemic outbreaks
Plan for Implementation	
Responsible Organization/Department:	County Commission
Supporting Organization/Department:	Emergency Management Direct
Action/Project Priority:	High
Timeline for Completion:	1-5 years
Potential Fund Sources:	Hazard Mitigation Grant Funds
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	Sullivan County
Risk / Vulnerability	
Hazard(s) Addressed:	All Hazards
Problem being Mitigated:	Provide early warning to residents
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the Plan. Goal 3: To protect the lives, livelihoods and property of all citizens by evaluating and implementing optimal mitigation alternatives Goal 4: To ensure continued operation of government and emergency functions in a disaster.
Action/Project Number:	County 2020.6

Name of Action or Project:	NOAA Weather Radios
Mitigation Category:	Emergency Services, Prevention
Action or Project Description:	Purchase NOAA Weather Radios and promote the use of NOAA Weather Radios
Estimated Cost:	\$50,000
Benefits:	Mitigation actions will limit the future harm to lives in the County
Plan for Implementation	
Responsible Organization/Department:	County Commission
Supporting Organization/Department:	Emergency Management Director
Action/Project Priority:	High
Timeline for Completion:	1 – 2 years
Potential Fund Sources:	Hazard Mitigation Grant Funds
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	Continued
Report of Progress:	Modified

Action Worksheet	
Name of Jurisdiction:	City of Milan
Risk / Vulnerability	
Hazard(s) Addressed:	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado
Problem being Mitigated:	Loss of electrical power to emergency shelters/critical facilities
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the Plan. Goal 2: To recognize and increase disaster mitigation management capabilities for each jurisdiction, school district and special district. Goal 3: To protect the lives, livelihoods and property of all citizens by evaluating

	and implementing optimal mitigation alternatives Goal 4: To ensure continued operation of government and emergency functions in a disaster.
Action/Project Number:	Milan 2020.1
Name of Action or Project:	Generator for Shelters/critical facilities
Mitigation Category:	Prevention, Structure and Infrastructure Projects, Emergency Services
Action or Project Description:	Assist critical facilities with emergency communication plans and emergency power back-up plans as needed, including shelters, for those displaced from their homes by power outages.
Estimated Cost:	\$65,000
Benefits:	Generator will allow for continues use of shelters/critical facilities for service to citizens in the event of an outage, this would be beneficial during any hazard.
Plan for Implementation	
Responsible Organization/Department:	Mayor
Supporting Organization/Department:	City Council
Action/Project Priority:	High
Timeline for Completion:	1 year
Potential Fund Sources:	Hazard Mitigation Grant Funds/RHSOC
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	City of Milan
Risk / Vulnerability	
Hazard(s) Addressed:	Flooding, Severe Thunderstorms, Winter Weather
Problem being Mitigated:	Accessibility for emergency services/evacuation routes.
Action or Project	

Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the Plan. Goal 2: To recognize and increase disaster mitigation management capabilities for each jurisdiction, school district and special district. Goal 5: To implement Action Items according to a 5-year Action Plan.
Action/Project Number:	Milan 2020.2
Name of Action or Project:	Maintain Transportation Infrastructure
Mitigation Category:	Prevention, Structure and Infrastructure Projects, Emergency Services
Action or Project Description:	Project will make necessary improvements to roads, culverts, low water crossings, road elevations, bank stabilizations, bridges and the general transportation infrastructure throughout the city.
Estimated Cost:	\$750,000
Benefits:	The project protects citizens from harm due to damaged transportation infrastructure.
Plan for Implementation	
Responsible Organization/Department:	Mayor
Supporting Organization/Department:	City Council
Action/Project Priority:	Medium
Timeline for Completion:	1-5 years
Potential Fund Sources:	MoDOT; CDBG, Hazard Mitigation Grant Funds
Local Planning Mechanisms to be Used in Implementation, if any:	N/A
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	City of Milan
Risk / Vulnerability	
Hazard(s) Addressed:	Severe Thunderstorms, Tornadoes or Wind Storms

Problem being Mitigated:	Lack of shelter for residents
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the plan. Goal 3: Protect the lives, property and livelihoods of all citizens by evaluating and implementing optimal mitigation alternatives. Goal 4: To ensure continued operation of government and emergency functions in a disaster.
Action/Project Number:	Milan 2020.3
Name of Action or Project:	Safe Room and Storm Shelters
Mitigation Category:	Emergency Services, Prevention, Structure and Infrastructure Projects
Action or Project Description:	Build safe rooms and establish local ordinances requiring community storm shelters throughout the City.
Estimated Cost:	\$2M
Benefits:	The project protects citizens from harm due to tornados or severe thunderstorms.
Plan for Implementation	
Responsible Organization/Department:	Mayor
Supporting Organization/Department:	City Council
Action/Project Priority:	High
Timeline for Completion:	5 years
Potential Fund Sources:	Hazard Mitigation Grant Funds
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet

Name of Jurisdiction:	City of Milan
Risk / Vulnerability	
Hazard(s) Addressed:	All Hazards
Problem being Mitigated:	Provide early warning to residents
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the Plan. Goal 3: To protect the lives, livelihoods and property of all citizens by evaluating and implementing optimal mitigation alternatives Goal 4: To ensure continued operation of government and emergency functions in a disaster.
Action/Project Number:	Milan 2020.4
Name of Action or Project:	Installation/Upgrade Siren
Mitigation Category:	Emergency Services, Prevention, Structure and Infrastructure Projects
Action or Project Description:	Installation or the upgrade of warning sirens in areas of the City needing a siren or the siren upgraded.
Estimated Cost:	\$50,000
Benefits:	With adequate time for warning of storms, residents are able to seek cover to help minimize the loss of life.
Plan for Implementation	
Responsible Organization/Department:	Mayor
Supporting Organization/Department:	City Council
Action/Project Priority:	High
Timeline for Completion:	1 – 5 years
Potential Fund Sources:	Hazard Mitigation Grant Funds
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	City of Milan
Risk / Vulnerability	
Hazard(s) Addressed:	Flooding
Problem being Mitigated:	NFIP participation continuation
Action or Project	
Applicable Goal Statement:	Goal 3: To protect the lives, livelihoods and property of all citizens by evaluating and implementing optimal mitigation alternatives
Action/Project Number:	Milan 2020.5
Name of Action or Project:	NFIP Participation
Mitigation Category:	Natural Systems Protection, Emergency Services, Prevention, Structure and Infrastructure Projects, Education and Outreach
Action or Project Description:	Continue City of Milan participation and good standing in the National Flood Insurance Program
Estimated Cost:	\$50,000
Benefits:	Protection of life and reduction of damages due to accessibility to citizens in times of need.
Plan for Implementation	
Responsible Organization/Department:	Mayor
Supporting Organization/Department:	City Council
Action/Project Priority:	High
Timeline for Completion:	1 year
Potential Fund Sources:	City Funds
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	Continue
Report of Progress:	Continue

Action Worksheet	
Name of Jurisdiction:	City of Green City
Risk / Vulnerability	
Hazard(s) Addressed:	Flooding, Severe Thunderstorms, Winter Weather
Problem being Mitigated:	Accessibility for emergency services/evacuation routes.
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the Plan. Goal 2: To recognize and increase disaster mitigation management capabilities for each jurisdiction, school district and special district. Goal 5: To implement Action Items according to a 5-year Action Plan.
Action/Project Number:	Green City 2020.1
Name of Action or Project:	Maintain Transportation Infrastructure
Mitigation Category:	Prevention, Structure and Infrastructure Projects, Emergency Services
Action or Project Description:	Project will make necessary improvements to roads, culverts, low water crossings, road elevations, bank stabilizations, bridges and the general transportation infrastructure throughout the city.
Estimated Cost:	\$750,000
Benefits:	The project protects citizens from harm due to damaged transportation infrastructure.
Plan for Implementation	
Responsible Organization/Department:	Mayor
Supporting Organization/Department:	City Council
Action/Project Priority:	Medium
Timeline for Completion:	1-5 years
Potential Fund Sources:	MoDOT; CDBG, Hazard Mitigation Grant Funds
Local Planning Mechanisms to be Used in Implementation, if any:	N/A
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	City of Green City
Risk / Vulnerability	
Hazard(s) Addressed:	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado
Problem being Mitigated:	Loss of electrical power to emergency shelters/critical facilities
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the Plan. Goal 2: To recognize and increase disaster mitigation management capabilities for each jurisdiction, school district and special district. Goal 3: To protect the lives, livelihoods and property of all citizens by evaluating and implementing optimal mitigation alternatives Goal 4: To ensure continued operation of government and emergency functions in a disaster.
Action/Project Number:	Green City 2020.2
Name of Action or Project:	Generator for Shelters/critical facilities
Mitigation Category:	Prevention, Structure and Infrastructure Projects, Emergency Services
Action or Project Description:	Assist critical facilities with emergency communication plans and emergency power back-up plans as needed, including shelters, for those displaced from their homes by power outages.
Estimated Cost:	\$65,000
Benefits:	Generator will allow for continues use of shelters/critical facilities for service to citizens in the event of an outage, this would be beneficial during any hazard.
Plan for Implementation	
Responsible Organization/Department:	Mayor
Supporting Organization/Department:	City Council
Action/Project Priority:	High
Timeline for Completion:	1 year
Potential Fund Sources:	Hazard Mitigation Grant Funds/RHSOC
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	City of Green City
Risk / Vulnerability	
Hazard(s) Addressed:	All Hazards
Problem being Mitigated:	Provide early warning to residents
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the Plan. Goal 3: To protect the lives, livelihoods and property of all citizens by evaluating and implementing optimal mitigation alternatives Goal 4: To ensure continued operation of government and emergency functions in a disaster.
Action/Project Number:	Green City 2020.3
Name of Action or Project:	Installation/Upgrade Siren
Mitigation Category:	Emergency Services, Prevention, Structure and Infrastructure Projects
Action or Project Description:	Installation or the upgrade of warning sirens in areas of the City needing a siren or the siren upgraded.
Estimated Cost:	\$50,000
Benefits:	With adequate time for warning of storms, residents are able to seek cover to help minimize the loss of life.
Plan for Implementation	
Responsible Organization/Department:	Mayor
Supporting Organization/Department:	City Council
Action/Project Priority:	High
Timeline for Completion:	1 – 5 years
Potential Fund Sources:	Hazard Mitigation Grant Funds
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	City of Green City
Risk / Vulnerability	
Hazard(s) Addressed:	Severe Thunderstorms, Tornadoes or Wind Storms
Problem being Mitigated:	Lack of shelter for residents
Action or Project	
Applicable Goal Statement:	al 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the plan. al 3: Protect the lives, property and livelihoods of all citizens by evaluating and implementing optimal mitigation alternatives. al 4: To ensure continued operation of government and emergency functions in a disaster.
Action/Project Number:	Green City 2020.4
Name of Action or Project:	Safe Room and Storm Shelters
Mitigation Category:	Emergency Services, Prevention, Structure and Infrastructure Projects
Action or Project Description:	Build safe rooms and establish local ordinances requiring community storm shelters throughout the City.
Estimated Cost:	\$2M
Benefits:	The project protects citizens from harm due to tornados or severe thunderstorms.
Plan for Implementation	
Responsible Organization/Department:	Mayor
Supporting Organization/Department:	City Council
Action/Project Priority:	High
Timeline for Completion:	5 years
Potential Fund Sources:	Hazard Mitigation Grant Funds
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	City of Green Castle
Risk / Vulnerability	
Hazard(s) Addressed:	Flooding, Severe Thunderstorms, Winter Weather
Problem being Mitigated:	Accessibility for emergency services/evacuation routes.
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the Plan. Goal 2: To recognize and increase disaster mitigation management capabilities for each jurisdiction, school district and special district. Goal 5: To implement Action Items according to a 5-year Action Plan.
Action/Project Number:	Green Castle 2020.1
Name of Action or Project:	Maintain Transportation Infrastructure
Mitigation Category:	Prevention, Structure and Infrastructure Projects, Emergency Services
Action or Project Description:	Project will make necessary improvements to roads, culverts, low water crossings, road elevations, bank stabilizations, bridges and the general transportation infrastructure throughout the city.
Estimated Cost:	\$750,000
Benefits:	The project protects citizens from harm due to damaged transportation infrastructure.
Plan for Implementation	
Responsible Organization/Department:	Mayor
Supporting Organization/Department:	City Council
Action/Project Priority:	Medium
Timeline for Completion:	1-5 years
Potential Fund Sources:	MoDOT; CDBG, Hazard Mitigation Grant Funds
Local Planning Mechanisms to be Used in Implementation, if any:	N/A
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	City of Green Castle
Risk / Vulnerability	
Hazard(s) Addressed:	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado
Problem being Mitigated:	Loss of electrical power to emergency shelters/critical facilities
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the Plan. Goal 2: To recognize and increase disaster mitigation management capabilities for each jurisdiction, school district and special district. Goal 3: To protect the lives, livelihoods and property of all citizens by evaluating and implementing optimal mitigation alternatives Goal 4: To ensure continued operation of government and emergency functions in a disaster.
Action/Project Number:	Green Castle 2020.2
Name of Action or Project:	Generator for Shelters/critical facilities
Mitigation Category:	Prevention, Structure and Infrastructure Projects, Emergency Services
Action or Project Description:	Assist critical facilities with emergency communication plans and emergency power back-up plans as needed, including shelters, for those displaced from their homes by power outages.
Estimated Cost:	\$65,000
Benefits:	Generator will allow for continues use of shelters/critical facilities for service to citizens in the event of an outage, this would be beneficial during any hazard.
Plan for Implementation	
Responsible Organization/Department:	Mayor
Supporting Organization/Department:	City Council
Action/Project Priority:	High
Timeline for Completion:	1 year

Potential Fund Sources:	Hazard Mitigation Grant Funds/RHSOC
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	City of Green Castle
Risk / Vulnerability	
Hazard(s) Addressed:	All Hazards
Problem being Mitigated:	Provide early warning to residents
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the Plan. Goal 3: To protect the lives, livelihoods and property of all citizens by evaluating and implementing optimal mitigation alternatives Goal 4: To ensure continued operation of government and emergency functions in a disaster.
Action/Project Number:	Green Castle 2020.3
Name of Action or Project:	Installation/Upgrade Siren
Mitigation Category:	Emergency Services, Prevention, Structure and Infrastructure Projects
Action or Project Description:	Installation or the upgrade of warning sirens in areas of the City needing a siren or the siren upgraded.
Estimated Cost:	\$50,000
Benefits:	With adequate time for warning of storms, residents are able to seek cover to help minimize the loss of life.
Plan for Implementation	
Responsible Organization/Department:	Mayor
Supporting Organization/Department:	City Council
Action/Project Priority:	High
Timeline for Completion:	1 – 5 years

Potential Fund Sources:	Hazard Mitigation Grant Funds
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	City of Green Castle
Risk / Vulnerability	
Hazard(s) Addressed:	Severe Thunderstorms, Tornadoes or Wind Storms
Problem being Mitigated:	Lack of shelter for residents
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the plan. Goal 3: Protect the lives, property and livelihoods of all citizens by evaluating and implementing optimal mitigation alternatives. Goal 4: To ensure continued operation of government and emergency functions in a disaster.
Action/Project Number:	Green Castle 2020.4
Name of Action or Project:	Safe Room and Storm Shelters
Mitigation Category:	Emergency Services, Prevention, Structure and Infrastructure Projects
Action or Project Description:	Build safe rooms and establish local ordinances requiring community storm shelters throughout the City.
Estimated Cost:	\$2M
Benefits:	The project protects citizens from harm due to tornados or severe thunderstorms.
Plan for Implementation	
Responsible Organization/Department:	Mayor
Supporting Organization/Department:	City Council
Action/Project Priority:	High

Timeline for Completion:	5 years
Potential Fund Sources:	Hazard Mitigation Grant Funds
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	Milan C-2 School District
Risk / Vulnerability	
Hazard(s) Addressed:	Severe Thunderstorms, Tornadoes or Wind Storms
Problem being Mitigated:	Lack of shelter for residents
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the plan. Goal 3: Protect the lives, property and livelihoods of all citizens by evaluating and implementing optimal mitigation alternatives. Goal 4: To ensure continued operation of government and emergency functions in a disaster.
Action/Project Number:	Milan C-2 2020.1
Name of Action or Project:	Safe Room and Storm Shelters
Mitigation Category:	Emergency Services, Prevention, Structure and Infrastructure Projects
Action or Project Description:	Build safe rooms and establish local ordinances requiring community storm shelters throughout the City.
Estimated Cost:	\$2M
Benefits:	The project protects citizens from harm due to tornados or severe thunderstorms.

Plan for Implementation	
Responsible Organization/Department:	Milan C-2 Superintendent
Supporting Organization/Department:	School Board
Action/Project Priority:	High
Timeline for Completion:	5 years
Potential Fund Sources:	Hazard Mitigation Grant Funds
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	Milan C-2 School District
Risk / Vulnerability	
Hazard(s) Addressed:	Pandemic
Problem being Mitigated:	Protecting outbreaks from affecting students and staff.
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the Plan. Goal 2: To recognize and increase disaster mitigation management capabilities for each jurisdiction, school district and special district. Goal 3: To protect the lives, livelihoods and property of all citizens by evaluating and implementing optimal mitigation alternatives Goal 4: To ensure continued operation of government and emergency functions in a disaster.
Action/Project Number:	Milan C-2 2020.2

Name of Action or Project:	Response to Pandemic
Mitigation Category:	Emergency Services, Prevention, Public Education
Action or Project Description:	Project will provide necessary resources for the response to pandemic outbreaks.
Estimated Cost:	\$300,000
Benefits:	The project protects students and staff from harm due to pandemic outbreaks
Plan for Implementation	
Responsible Organization/Department:	Milan C-2 Superintendent
Supporting Organization/Department:	School Board
Action/Project Priority:	High
Timeline for Completion:	1-5 years
Potential Fund Sources:	Hazard Mitigation Grant Funds
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	Milan C-2 School District
Risk / Vulnerability	
Hazard(s) Addressed:	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado
Problem being Mitigated:	Loss of electrical power to school
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the Plan. Goal 2: To recognize and increase disaster mitigation management capabilities for each jurisdiction, school district and special district. Goal 3: To protect the lives, livelihoods and property of all citizens by evaluating and implementing optimal mitigation alternatives Goal 4: To ensure continued operation of government and emergency functions in a disaster.

Action/Project Number:	Milan C-2 2020.3
Name of Action or Project:	Generator for school buildings
Mitigation Category:	Prevention, Structure and Infrastructure Projects, Emergency Services
Action or Project Description:	Assist critical facilities with emergency communication plans and emergency power back-up plans as needed, including shelters, for those displaced from their homes by power outages.
Estimated Cost:	\$65,000
Benefits:	Generator will allow for continue use of school facilities in the event of an outage, this would be beneficial during any hazard.
Plan for Implementation	
Responsible Organization/Department:	Milan C-2 Superintendent
Supporting Organization/Department:	School Board
Action/Project Priority:	High
Timeline for Completion:	1 year
Potential Fund Sources:	Hazard Mitigation Grant Funds/RHSOC
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	Newtown-Harris R-III School District
Risk / Vulnerability	
Hazard(s) Addressed:	Severe Thunderstorms, Tornadoes or Wind Storms
Problem being Mitigated:	Lack of shelter for residents
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the plan. Goal 3: Protect the lives, property and livelihoods of all citizens by evaluating and implementing optimal mitigation alternatives. Goal 4: To ensure continued operation of government and emergency functions in a disaster.

Action/Project Number:	Newtown-Harris R-III 2020.1
Name of Action or Project:	Safe Room and Storm Shelters
Mitigation Category:	Emergency Services, Prevention, Structure and Infrastructure Projects
Action or Project Description:	Build safe rooms and establish local ordinances requiring community storm shelters throughout the City.
Estimated Cost:	\$2M
Benefits:	The project protects citizens from harm due to tornados or severe thunderstorms.
Plan for Implementation	
Responsible Organization/Department:	Newtown-Harris R-III Superintendent
Supporting Organization/Department:	School Board
Action/Project Priority:	High
Timeline for Completion:	5 years
Potential Fund Sources:	Hazard Mitigation Grant Funds
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	Newtown-Harris R-III School District
Risk / Vulnerability	
Hazard(s) Addressed:	Pandemic
Problem being Mitigated:	Protecting outbreaks from affecting students and staff.

Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the Plan. Goal 2: To recognize and increase disaster mitigation management capabilities for each jurisdiction, school district and special district. Goal 3: To protect the lives, livelihoods and property of all citizens by evaluating and implementing optimal mitigation alternatives Goal 4: To ensure continued operation of government and emergency functions in a disaster.
Action/Project Number:	Newtown-Harris R-III 2020.2
Name of Action or Project:	Response to Pandemic
Mitigation Category:	Emergency Services, Prevention, Public Education
Action or Project Description:	Project will provide necessary resources for the response to pandemic outbreaks.
Estimated Cost:	\$300,000
Benefits:	The project protects students and staff from harm due to pandemic outbreaks
Plan for Implementation	
Responsible Organization/Department:	Newtown-Harris R-III Superintendent
Supporting Organization/Department:	School Board
Action/Project Priority:	High
Timeline for Completion:	1-5 years
Potential Fund Sources:	Hazard Mitigation Grant Funds
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	Newtown-Harris R-III School District
Risk / Vulnerability	
Hazard(s) Addressed:	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado

Problem being Mitigated:	Loss of electrical power to school
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the Plan. Goal 2: To recognize and increase disaster mitigation management capabilities for each jurisdiction, school district and special district. Goal 3: To protect the lives, livelihoods and property of all citizens by evaluating and implementing optimal mitigation alternatives Goal 4: To ensure continued operation of government and emergency functions in a disaster.
Action/Project Number:	Newtown-Harris R-III 2020.3
Name of Action or Project:	Generator for school buildings
Mitigation Category:	Prevention, Structure and Infrastructure Projects, Emergency Services
Action or Project Description:	Assist critical facilities with emergency communication plans and emergency power back-up plans as needed, including shelters, for those displaced from their homes by power outages.
Estimated Cost:	\$65,000
Benefits:	Generator will allow for continue use of school facilities in the event of an outage, this would be beneficial during any hazard.
Plan for Implementation	
Responsible Organization/Department:	Newtown-Harris R-III Superintendent
Supporting Organization/Department:	School Board
Action/Project Priority:	High
Timeline for Completion:	1 year
Potential Fund Sources:	Hazard Mitigation Grant Funds/RHSOC
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet

Name of Jurisdiction:	Green City R-I School District
Risk / Vulnerability	
Hazard(s) Addressed:	Severe Thunderstorms, Tornadoes or Wind Storms
Problem being Mitigated:	Lack of shelter for residents
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the plan. Goal 3: Protect the lives, property and livelihoods of all citizens by evaluating and implementing optimal mitigation alternatives. Goal 4: To ensure continued operation of government and emergency functions in a disaster.
Action/Project Number:	Green City R-I 2020.1
Name of Action or Project:	Safe Room and Storm Shelters
Mitigation Category:	Emergency Services, Prevention, Structure and Infrastructure Projects
Action or Project Description:	Build safe rooms and establish local ordinances requiring community storm shelters throughout the City.
Estimated Cost:	\$2M
Benefits:	The project protects citizens from harm due to tornados or severe thunderstorms.
Plan for Implementation	
Responsible Organization/Department:	Green City R-I Superintendent
Supporting Organization/Department:	School Board
Action/Project Priority:	High
Timeline for Completion:	5 years
Potential Fund Sources:	Hazard Mitigation Grant Funds
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	Green City R-I School District
Risk / Vulnerability	
Hazard(s) Addressed:	Pandemic
Problem being Mitigated:	Protecting outbreaks from affecting students and staff.
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the Plan. Goal 2: To recognize and increase disaster mitigation management capabilities for each jurisdiction, school district and special district. Goal 3: To protect the lives, livelihoods and property of all citizens by evaluating and implementing optimal mitigation alternatives Goal 4: To ensure continued operation of government and emergency functions in a disaster.
Action/Project Number:	Green City R-I 2020.2
Name of Action or Project:	Response to Pandemic
Mitigation Category:	Emergency Services, Prevention, Public Education
Action or Project Description:	Project will provide necessary resources for the response to pandemic outbreaks.
Estimated Cost:	\$300,000
Benefits:	The project protects students and staff from harm due to pandemic outbreaks
Plan for Implementation	
Responsible Organization/Department:	Green City R-I Superintendent
Supporting Organization/Department:	School Board
Action/Project Priority:	High
Timeline for Completion:	1-5 years
Potential Fund Sources:	Hazard Mitigation Grant Funds
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Action Worksheet	
Name of Jurisdiction:	Green City R-I School District
Risk / Vulnerability	
Hazard(s) Addressed:	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado
Problem being Mitigated:	Loss of electrical power to school
Action or Project	
Applicable Goal Statement:	Goal 1: To respond to the issues highlighted in the hazard risk and vulnerability sections of the Plan. Goal 2: To recognize and increase disaster mitigation management capabilities for each jurisdiction, school district and special district. Goal 3: To protect the lives, livelihoods and property of all citizens by evaluating and implementing optimal mitigation alternatives Goal 4: To ensure continued operation of government and emergency functions in a disaster.
Action/Project Number:	Green City R-I 2020.3
Name of Action or Project:	Generator for school buildings
Mitigation Category:	Prevention, Structure and Infrastructure Projects, Emergency Services
Action or Project Description:	Assist critical facilities with emergency communication plans and emergency power back-up plans as needed, including shelters, for those displaced from their homes by power outages.
Estimated Cost:	\$65,000
Benefits:	Generator will allow for continue use of school facilities in the event of an outage, this would be beneficial during any hazard.
Plan for Implementation	
Responsible Organization/Department:	Green City R-I Superintendent
Supporting Organization/Department:	School Board
Action/Project Priority:	High
Timeline for Completion:	1 year
Potential Fund Sources:	Hazard Mitigation Grant Funds/RHSOC
Local Planning Mechanisms to be Used in Implementation, if any:	NA
Progress Report	
Action Status:	New
Report of Progress:	New Project

Table 1.72. Mitigation Action Matrix

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
	Prevention Public Education							
Sullivan County 2020.1	Maintain Transportation Infrastructure	Sullivan County	Medium	1,2,5	Flooding, Severe Thunderstorms, Winter Weather	✓	✓	
Sullivan County 2020.2	Generator for Shelter/Critical Facilities	Sullivan County	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
Sullivan County 2020.4	Installation/Upgrade Sirens	Sullivan County	High	1,3,4	All Hazards	✓	✓	
Sullivan County 2020.5	Pandemic	Sullivan County	High	1,2,3,4	Pandemic	✓	✓	
Sullivan County 2020.6	NOAA Weather Radios	Sullivan County	High	1,3,4	All Hazards	✓	✓	

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
City of Milan 2020.1	Generator for Shelter/Critical Facilities	City of Milan	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
City of Milan 2020.2	Maintain Transportation Infrastructure	City of Milan	Medium	1,2,5	Flooding, Severe Thunderstorms, Winter Weather	✓	✓	
City of Milan 2020.3	Safe Room and Storm Shelters	City of Milan	High	1,3,4	Severe Thunderstorms, Tornadoes, Wind Storms	✓		
City of Milan 2020.4	Installation/upgrade Siren	City of Milan	High	1,3,4	All Hazards	✓	✓	
City of Milan 2020.5	NFIP Participation	City of Milan	High	3	Flooding			✓
City of Green City 2020.1	Maintain Transportation Infrastructure	City of Green City	Medium	1,2,5	Flooding, Severe Thunderstorms, Winter Weather	✓	✓	
City of Green City 2020.2	Generator for Shelters/Critical Facilities	City of Green City	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
City of Green City 2020.3	Installation/Upgrade Siren	City of Green City	High	1,3,4	All Hazards	✓	✓	
City of Green City 2020.4	Safe Room and Storm Shelters	City of Green City	High	1,3,4	Severe Thunderstorms, Tornadoes, Wind Storms	✓		
City of Green Castle 2020.1	Maintain Transportation Infrastructure	City of Green Castle	Medium	1,2,5	Flooding, Severe Thunderstorms, Winter Weather	✓	✓	
City of Green Castle 2020.2	Generator for Shelters/Critical Facilities	City of Green Castle	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
City of Green Castle 2020.3	Installation/Upgrade Siren	City of Green Castle	High	1,3,4	All Hazards	✓	✓	
City of Green Castle 2020.4	Safe Room and Storm Shelters	City of Green Castle	High	1,3,4	Severe Thunderstorms, Tornadoes, Wind Storms	✓		
Milan C-2 2020.1	Safe Room and Storm Shelters	Milan C-2	High	1,3,4	Severe Thunderstorms, Tornadoes, Wind Storms	✓		

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
Milan C-2 2020.2	Response to Pandemic	Milan C-2	High	1,2,3,4	Pandemic	✓		
Milan C-2 2020.3	Generator for school buildings	Milan C-2	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
Newtown-Harris R-III 2020.1	Safe Room and Storm Shelters	Newtown-Harris R-III	High	1,3,4	Severe Thunderstorms, Tornados, Wind Storms	✓		
Newtown-Harris R-III 2020.2	Response to Pandemic	Newtown-Harris R-III	High	1,2,3,4	Pandemic	✓		
Newtown - Harris R-III 2020.3	Generator for school buildings	Newtown-Harris R-III	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
Green City R-I 2020.1	Safe Room and Storm Shelters	Green City R-I	High	1,3,4	Severe Thunderstorms, Tornados, Wind Storms	✓		
Green City R-I 2020.2	Response to Pandemic	Green City R-I	High	1,2,3,4	Pandemic	✓		

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
Green City R-I 2020.3	Generator for school buildings	Green City R-I	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
Structure and Infrastructure Projects								
Sullivan County 2020.1	Maintain Transportation Infrastructure	Sullivan County	Medium	1,2,5	Flooding, Severe Thunderstorms, Winter Weather	✓	✓	
Sullivan County 2020.2	Generator for Shelter/Critical Facilities	Sullivan County	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
Sullivan County 2020.3	Debris Removal	Sullivan County	High	1, 3,4	Tornado, Severe Thunderstorms	✓	✓	
Sullivan County 2020.4	Installation/Upgrade Sirens	Sullivan County	High	1,3,4	All Hazards	✓	✓	
City of Milan 2020.1	Generator for Shelter/Critical Facilities	Sullivan County	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
City of Milan 2020.2	Maintain Transportation Infrastructure	City of Milan	Medium	1,2,5	Flooding, Severe Thunderstorms, Winter Weather	✓	✓	
City of Milan 2020.3	Safe Room and Storm Shelters	City of Milan	High	1,3,4	Severe Thunderstorms, Tornadoes, Wind Storms	✓		
City of Milan 2020.4	Installation/Upgrade Siren	City of Milan	High	1,3,4	All Hazards	✓	✓	
City of Milan 2020.5	NFIP Participation	City of Milan	High	3	Flooding			✓
City of Green City 2020.1	Maintain Transportation Infrastructure	City of Green City	Medium	1,2,5	Flooding, Severe Thunderstorms, Winter Weather	✓	✓	
City of Green City 2020.2	Generator for Shelters/Critical Facilities	City of Green City	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
City of Green City 2020.3	Installation/Upgrade Siren	City of Green City	High	1,3,4	All Hazards	✓	✓	
City of Green City 2020.4	Safe Room and Storm Shelters	City of Green City	High	1,3,4	Severe Thunderstorms, Tornadoes, Wind Storms	✓		

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
City of Green Castle 2020.1	Maintain Transportation Infrastructure	City of Green Castle	Medium	1,2,5	Flooding, Severe Thunderstorms, Winter Weather	✓	✓	
City of Green Castle 2020.2	Generator for Shelters/Critical Facilities	City of Green Castle	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
City of Green Castle 2020.3	Installation/Upgrade Siren	City of Green Castle	High	1,3,4	All Hazards	✓	✓	
City of Green Castle 2020.4	Safe Room and Storm Shelters	City of Green Castle	High	1,3,4	Severe Thunderstorms, Tornados, Wind Storms	✓		
Milan C-2 2020.1	Safe Room and Storm Shelters	Milan C-2	High	1,3,4	Severe Thunderstorms, Tornados, Wind Storms	✓		
Milan C-2 2020.3	Generator for school buildings	Milan C-2	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
Newtown-Harris R-III 2020.1	Safe Room and Storm Shelters	Newtown-Harris R-III	High	1,3,4	Severe Thunderstorms, Tornadoes, Wind Storms	✓		
Newtown - Harris R-III 2020.3	Generator for school buildings	Newtown-Harris R-III	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
Green City R-I 2020.1	Safe Room and Storm Shelters	Green City R-I	High	1,3,4	Severe Thunderstorms, Tornadoes, Wind Storms	✓		
Green City R-I 2020.3	Generator for school buildings	Green City R-I	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
	Natural Systems Protection							
City of Milan 2020.5	NFIP Participation	City of Milan	High	3	Flooding			✓
	Emergency Services							

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
Sullivan County 2020.1	Maintain Transportation Infrastructure	Sullivan County	Medium	1,2,5	Flooding, Severe Thunderstorms, Winter Weather	✓	✓	
Sullivan County 2020.2	Generator for Shelter/Critical Facilities	Sullivan County	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
Sullivan County 2020.4	Installation/Upgrade Sirens	Sullivan County	High	1,3,4	All Hazards	✓	✓	
Sullivan County 2020.5	Response to Pandemic	Sullivan County	High	1,2,3,4	Pandemic	✓	✓	
Sullivan County 2020.6	NOAA Weather Radios	Sullivan County	High	1,3,4	All Hazards	✓	✓	
City of Milan 2020.1	Generator for Shelters/Critical Facilities	Sullivan County	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
City of Milan 2020.2	Maintain Transportation Infrastructure	City of Milan	Medium	1,2,5	Flooding, Severe Thunderstorms, Winter Weather	✓	✓	

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
City of Milan 2020.3	Safe Room and Storm Shelters	City of Milan	High	1,3,4	Severe Thunderstorms, Tornadoes, Wind Storms	✓		
City of Milan 2020.4	Installation/Upgrade Sirens	City of Milan	High	1,3,4	All Hazards	✓	✓	
City of Milan 2020.5	NFIP Participation	City of Milan	High	3	Flooding			✓
City of Green City 2020.1	Maintain Transportation Infrastructure	City of Green City	Medium	1,2,5	Flooding, Severe Thunderstorms, Winter Weather	✓	✓	
City of Green City 2020.2	Generator for Shelters/Critical Facilities	City of Green City	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
City of Green City 2020.3	Installation/Upgrade Siren	City of Green City	High	1,3,4	All Hazards	✓	✓	
City of Green City 2020.4	Safe Room and Storm Shelters	City of Green City	High	1,3,4	Severe Thunderstorms, Tornadoes, Wind Storms	✓		
City of Green Castle 2020.1	Maintain Transportation Infrastructure	City of Green Castle	Medium	1,2,5	Flooding, Severe Thunderstorms, Winter Weather	✓	✓	

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
City of Green Castle 2020.2	Generator for Shelters/Critical Facilities	City of Green Castle	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
City of Green Castle 2020.3	Installation/Upgrade Siren	City of Green Castle	High	1,3,4	All Hazards	✓	✓	
City of Green Castle 2020.4	Safe Room and Storm Shelters	City of Green Castle	High	1,3,4	Severe Thunderstorms, Tornadoes, Wind Storms	✓		
Milan C-2 2020.1	Safe Room and Storm Shelters	Milan C-2	High	1,3,4	Severe Thunderstorms, Tornadoes, Wind Storms	✓		
Milan C-2 2020.2	Response to Pandemic	Milan C-2	High	1,2,3,4	Pandemic	✓		
Milan C-2 2020.3	Generator for school buildings	Milan C-2	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
Newtown-Harris R-III 2020.1	Safe Room and Storm Shelters	Newtown-Harris R-III	High	1,3,4	Severe Thunderstorms, Tornadoes, Wind Storms	✓		
Newtown-Harris R-III 2020.2	Response to Pandemic	Newtown-Harris R-III	High	1,2,3,4	Pandemic	✓		
Newtown - Harris R-III 2020.3	Generator for school buildings	Newtown-Harris R-III	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
Green City R-I 2020.1	Safe Room and Storm Shelters	Green City R-I	High	1,3,4	Severe Thunderstorms, Tornadoes, Wind Storms	✓		
Green City R-I 2020.2	Response to Pandemic	Green City R-I	High	1,2,3,4	Pandemic	✓		
Green City R-I 2020.3	Generator for school buildings	Green City R-I	High	1,2,3,4	Extreme Temperature, Severe Thunderstorm, Severe Winter Weather, Tornado	✓		
	Education and Outreach							

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
Sullivan County 2020.5	Response to Pandemic	Sullivan County	High	1,2,3,4	Pandemic	✓	✓	
City of Milan 2020.5	NFIP Participation	City of Milan	High	3	Flooding			✓
Milan C-2 2020.2	Response to Pandemic	Milan C-2	High	1,2,3,4	Pandemic	✓		
Newtown-Harris R-III 2020.2	Response to Pandemic	Newtown-Harris R-III	High	1,2,3,4	Pandemic	✓		
Green City R-I 2020.3	Generator for school buildings	Green City R-I	High	1,2,3,4	Pandemic	✓		

PLAN MAINTENANCE PROCESS

5	PLAN MAINTENANCE PROCESS.....	cclx
5.1	<i>Monitoring, Evaluating, and Updating the Plan</i>	<i>cclx</i>
5.1.1	Responsibility for Plan Maintenance	cclx
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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.

Monitoring, Evaluating, and Updating the Plan

44 CFR Requirement 201.6(c)(4): The plan maintenance process shall include a section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.

Responsibility for Plan Maintenance

The Sullivan County 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.

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 Sullivan County Emergency Management Director will be responsible for initiating the plan reviews and will invite members of the MPC to the meeting.

In coordination with all participating jurisdictions, the Emergency Management Director will be responsible for initiating a five-year written update of the plan to 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.

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 (or designated responsible entity) 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 Sullivan County Commission and the governing boards of the other participating jurisdictions.

Incorporation into Existing Planning Mechanisms

44 CFR Requirement §201.6(c)(4)(ii): [The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital

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 Chapter 2 of this plan. Based on the capability assessments of the participating jurisdictions, communities in Sullivan 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;
- Sullivan 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 Sullivan County Emergency Management Director will provide the updated Mitigation Strategy with current status of each mitigation action to the Sullivan County Commission as well as all Mayors, City and/or Village 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
Unincorporated Sullivan County	Road and Bridge Department Emergency	Road and Bridge Department attended all planning meetings and identified actions relating	Road and Bridge Department attended all planning meetings. Identified new actions

	Management	to transportation infrastructure were included in annual update to Comprehensive Plan	or ongoing actions relating to transportation infrastructure will be included in annual update to Comprehensive Plan
City of Green Castle	Local Budget	The previous plan was not integrated into previous budgets due to the items not applicable to being added in previous plans.	The Hazard Mitigation Plan will be integrated into future budgets by consulting the plan during the process.
City of Green City	Local Budget	The previous plan was not integrated into previous budgets due to the items not applicable to being added in previous plans.	The Hazard Mitigation Plan will be integrated into future budgets by consulting the plan during the process.
City of Milan	Local Budget	The previous plan was not integrated into previous budgets due to the items not applicable to being added in previous plans.	The Hazard Mitigation Plan will be integrated into future budgets by consulting the plan during the process.
Green City R-I School District	Master Plan	The previous plan was not integrated into previous budgets due to the items not applicable to being added in previous plans.	The Hazard Mitigation Plan will be integrated into future budgets by consulting the plan during the process.
Milan C-2 School District	Master Plan	The previous plan was not integrated into previous budgets due to the items not applicable to being added in previous plans.	The Hazard Mitigation Plan will be integrated into future budgets by consulting the plan during the process.
Newtown-Harris R-III School District	Master Plan	The previous plan was not integrated into previous budgets due to the items not applicable to being added in previous plans.	The Hazard Mitigation Plan will be integrated into future budgets by consulting the plan during the process.

Continued Public Involvement

44 CFR Requirement §201.6(c)(4)(iii): [The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.

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 Sullivan County website following each annual review of the mitigation plan and will solicit comments from the public based on the annual review. 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.