3 RISK ASSESSMENT

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.

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.

This update of the Gentry County Multi-Jurisdictional Natural Hazard Mitigation Plan only addresses natural hazards. Human-caused and technological hazards are out of the scope of the plan. The risk assessment for Gentry County addresses individual jurisdictions' risk only when there is a notable difference in the impact relative to the entire county.

3.1.1 Review of Existing Mitigation Plans

In Missouri, local hazard mitigation plans typically contain only natural hazards as required by federal regulations. TABLE 3.1 below compares the hazards covered by this updated plan with the latest update to the state plan as well as Gentry County's previous plan.

Table 3.1. Comparison of Hazards Addressed by Existing Mitigation Plans

2025 State Plan	2021 Gentry County Plan	2025 Gentry Count Plan Update
Natural Hazards	Natural Hazards	Natural Hazards
Flooding	Flooding (Major and Flash)	Flooding
Levee Failure	Levee Failure	Levee Failure
Dam Failure	Dam Failure	Dam Failure
Earthquake	Earthquake	Earthquake
Land Subsidence/Sinkholes	Land Subsidence/Sinkholes	Land Subsidence/Sinkholes
Drought	Drought	Drought
Extreme Temperature	Extreme Temperature	Extreme Temperature
Severe Thunderstorms	Severe Thunderstorms	Severe Thunderstorms
Severe Winter Weather	Severe Winter Weather	Severe Winter Weather
Tornadoes	Tornadoes	Tornadoes
Wildfire	Wildfire	Wildfire
Human-Caused/Technological Hazards	Manmade & Other Hazards	Human-Caused/Technological Hazards
Civil Disorder Cyber Disruption Hazardous Materials Mass Transportation Accidents Nuclear Power Plants Public Health Emergencies Environmental Health Emergencies Special Events Terrorism Fires (Urban/Structural) Utilities (Interruptions and System Failures)	*Not included*	Civil Disorder Cyber Disruption Hazardous Materials Mass Transportation Accidents Nuclear Power Plants Public Health Emergencies Environmental Health Emergencies Special Events Terrorism Fires (Urban/Structural) Utilities (Interruptions and System Failures)

Because they do not threaten Missouri, the following natural hazards are not included in this analysis: avalanches, coastal erosion, coastal storms, hurricanes, tsunamis, and volcanoes.

3.1.2 Review Disaster Declaration History

Twenty federal disaster declarations have included Gentry County since 1965. Federal Disaster Declarations may be granted when the severity and magnitude of an event surpasses the ability of the local government to respond and recover. Disaster assistance is supplemental and sequential. When the local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. If the disaster is so severe that both the local and state governments' capacities are exceeded; a federal emergency or disaster declaration may be issued allowing for the provision of federal assistance.

TABLE 3.2 lists the federal FEMA disaster declarations that included the planning area from 1965 to present.

Table 3.2. FEMA Disaster Declarations that included Gentry County, Missouri, 1965-2025

Disaster Number	Description	Declaration Date	Individual Assistance (IA) Public Assistance (PA)
372	Heavy Rains, Tornadoes, Flooding	April 19, 1973	IA & PA
407	Severe Storms, Flooding	November 1, 1973	IA & PA
3017	Drought	September 24, 1976	IA & PA
713	Severe Storms, Flooding	June 31, 1984	IA & PA
995	Flooding, Severe Storms	July 9, 1993	IA & PA
1054	Severe Storm, Tornadoes, Hail, Flooding	June 2, 1995	IA & PA
1524	Severe Storms, Tornadoes, and Flooding	June 11, 2004	IA
3232	Hurricane Katrina Evacuation	September 10, 2005	PA
1708	Severe Storms and Flooding	June 11, 2007	IA & PA
1736	Severe Winter Storms	December 27, 2007	PA
3281	Severe Winter Storms	December 12, 2007	IA & PA
1773	Severe Storms and Flooding	June 25, 2008	IA & PA
3303	Severe Winter Storm	January 30, 2009	IA & PA
1934	Severe Storms, Flooding, and Tornadoes	August 17, 2010	PA
3317	Severe Winter Storm	February 3, 2011	IA & PA
4200	Severe Storms, Tornadoes, Straight-line Winds, and Flooding	October 31, 2014	PA
4238	Severe Storms, Tornadoes, Straight-line Winds, and Flooding	August 7, 2015	PA
4451	Severe Storms, Tornadoes, and Flooding	July 9, 2019	IA & PA
3482	COVID-19	March 13, 2020	IA
4490	COVID-19 Pandemic	March 26, 2020	PA

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

3.1.3 Research Additional Sources

This update to the Gentry County Multi-jurisdictional Hazard Mitigation Plan will use all readily available sources to obtain the most complete and most recent data available in determining the risks of natural hazards on the lives and property of the residents of Gentry County. The following is a list of the sources used:

- Missouri Hazard Mitigation Plan (2013, 2018, 2023)
- Previously approved planning area Hazard Mitigation Plan (2021)
- Federal Emergency Management Agency (FEMA)
- Missouri Department of Natural Resources
- 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 Public Safety, State Emergency Management Agency (SEMA)
- 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);
- Gentry County Emergency Management
- Gentry 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 (citations to the sources will be given 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 events. 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. 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 previous paragraph. 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. Zeroes entered do not mean that no damage occurred with the event, but there was no damage reported to the NWS.

The database currently contains data from January 1950 to the present as entered by the NWS. Due to changes in the data collection and processing procedures over time, there are unique periods of records available depending on the event type. From 1950 through 1954, only tornado events were recorded. 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. 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

Natural hazards in northwestern Missouri vary dramatically in regard to intensity, frequency, and the scope of impact. Some hazards, like earthquakes, happen without warning and do not provide any opportunity to warn the public. Other hazards, such as tornadoes, flooding, or severe winter storms, provide a period of warning which allows for public preparation prior to their occurrence. The following natural hazards have been identified as potential threats for Gentry County:

• Dam Failure	• Drought	• Earthquake
• Extreme Temperature	• Flooding (Major and Flash)	• Land Subsidence/Sinkholes
• Levee Failure	• Severe Thunderstorms	• Severe Winter Weather
• Tornadoes	• Wildfires	

The above ten hazards were chosen for further analysis. They significantly impact the planning area. Not all hazards impact every jurisdiction. The following table shows the hazards by jurisdiction. The symbols used in TABLE 3.3 are "X" to indicate the jurisdiction is impacted by the hazard, and a "-" indicates the hazard is not applicable to that jurisdiction. Since Gentry County is a very rural county there are not many variations. Most of the jurisdictions are taking mitigation actions to address all the hazards addressed in the plan. Many of the actions are focused on planning and education, therefore, address all the hazards regardless of the impact.

Table 3.3. Hazards Identified for Each Jurisdiction

Jurisdiction \ Hazard	Dam Failure	Drought	Earthquake	Extreme	Flooding	Sinkholes	Levee Failure	Severe Winter	Thunderstorm/ Lightning/Hail/	Tornado	Wildfire	
Gentry County	x	x	x	x	x	x	x	x	x	x	x	
City of Albany	x	x	x	x	x		x	x	x	x	x	
Village of Darlington												Non-participant
Village of Gentry												Non-participant
City of King City	x	x	x	x	x		x	x	x	x	x	
City of McFall												Non-participant
City of Stanberry	x	x	x	x	x		x	x	x	x	x	
Schools and Special Districts												
Albany R-III School District		x	x	x	x			x	x	x	x	
King City R-I School District		x	x	x	x			x	x	x	x	
Stanberry R-II School District		x	x	x	x			x	x	x	x	

3.1.5 Multi-Jurisdictional Risk Assessment

This Hazard Mitigation Plan for Gentry County is an update of the 2021 Plan. This is a multi-jurisdictional plan that addresses the unincorporated area of Gentry County, the seven communities within its boundaries and the three public school districts.

The plan is set up to address each hazard with an individual profile to detail risks associated with the hazard across the region and specifically for each jurisdiction participating. Each hazard profile will address hazard risk variations and describe variances.

Gentry County is uniform in terms of climate, topography and building construction characteristics. Most of the town centers date back to the middle years of the last century with little new construction. The communities are all small jurisdictions.

The development trends for Gentry County are flat. Since so much of the county is farmland, the rural areas have agricultural assets (crops/livestock) that are vulnerable to losses from weather-related hazards. These differences in vulnerability to damages will be discussed in greater detail in the vulnerability section of each hazard profile.

All municipalities and government subunits within Gentry County participated in the creation of this hazard mitigation plan, and unless otherwise noted, the actions prescribed within pertain to all jurisdictions without bias. Gentry County hazards tend to be either geographically random or regional in scope. Using historical events and data compiled from the National Weather Service and other sources including information from each jurisdiction, an analysis for each identified natural hazard affecting Gentry County is included in the following pages. The most recent declared disasters for the County were for the COVID-19 Pandemic in 2020.

The hazards that may vary across the planning area in terms of risk include dam failure, wildfires, levee failure, riverine flood, and flash flood. The details of these differences are detailed in each hazard profile under a separate heading.

3.2 ASSETS AT RISK

This section assesses the planning area population, structures, critical facilities and infrastructure, and other important assets that may be at risk to hazards. If there have been any changes in the planning area since the previously approved plan was adopted, these changes are summarized, and any new risks assessed.

The best data available for Gentry County regarding assets is from HAZUS 4.2 data and the 2023 Missouri State Hazard Mitigation Plan. With the 2023 Hazard Mitigation Plan Update, SEMA now provides online access to risk assessment data and associated mapping for the counties in the State (http://bit.ly/MoHazardMitigationPlanViewer2023). The tables, maps, and charts within this update to the Gentry County Plan are based on this data unless otherwise cited. There are FIRM maps included for each jurisdiction participating in the plan further in this section.

3.2.1 Total Exposure of Population and Structures

Unincorporated County and Incorporated Cities

In the following three tables, population data is based on 2023 Census Bureau estimates. Building counts and building exposure values are based on census tract data provided using the FEMA HAZUS 4.2 database. Contents exposure values were calculated by factoring a multiplier to the building exposure values based on usage type. The multipliers were derived from the HAZUS MH 2.1 and are defined below TABLE 3.7. Land values have been purposely excluded from consideration because land remains following disasters, and subsequent market devaluations are frequently short term and difficult to quantify. Another reason for excluding land values is that state and federal disaster assistance programs generally do not address loss of land (other than crop insurance). It should be noted that the total valuation of buildings is based on county assessors' data which may not be current. In addition, government-owned properties are usually taxed differently or not at all, and so may not be an accurate representation of true value. Note that public school district assets and special districts assets are included in the total exposure tables assets by community and county in TABLE 3.4 only.

On the following pages, TABLE 3.4 shows the total population, building count, estimated value of buildings, estimated value of contents and estimated total exposure to parcels for the unincorporated portions of Gentry County and each incorporated city. TABLE 3.5 provides the building value exposures for the county and each city in the planning area broken down by usage type. Finally, TABLE 3.6 provides the building count total for the county and each city in the planning area broken out by building usage types (residential, commercial, industrial, and agricultural). Different sources were used to compile the data in these tables. TABLE 3.4 uses data from SEMA Mitigation Management GIS Database to arrive at the number of buildings in each jurisdiction. TABLE 3.5 and TABLE 3.6 use information from HAZUS 4.2 to populate the cells and does not include educational, religious or some other types of structures in its calculations.

Table 3.4. Maximum Population and Building Exposure by Jurisdiction

Jurisdiction	2023 Annual Population Estimate	Building Count	Building Exposure ($)	Contents Exposure ($)	Total Exposure ($)
City of Albany	1,855	1,010	$114,162	$61,857	$176,019
Village of Darlington	35	80	$6,414	$3,296	$9,710
Village of Gentry	71	NA	NA	NA	NA
City of King City	745	575	$61,559	$35,904	$97,463
City of McFall	135	73	$6,902	$3,496	$10,399
City of Stanberry	1,190	710	$75,064	$43,673	$118,737
Gentry County(unincorp.)	6,224	6,165	$169,799	$90,231	$260,031
Totals	**10,225**	**8,613**	**$433,900**	**$238,457**	**$672,359**

Source: U.S. Bureau of the Census, Annual population estimates/ 5-Year American Community Survey 2019-2023; 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 3.5. Building Values/Exposure by Usage Type

Jurisdiction	Agricultural	Commercial	Government	Industrial	Residential
City of Albany	$306	$14,467	$1,832	$1,384	$86,963
Village of Darlington	$84	$261	$0	$0	$6,070
Village of Gentry	NA	NA	NA	NA	NA
City of King City	$237	$13,033	$523	$0	$44,695
City of McFall	$40	$130	$0	$0	$6,732
City of Stanberry	$291	$12,251	$1,178	$1,107	$57,166
Gentry County incorp.	$17,541	$16,683	$1,832	$4,845	$128,899
Total	**$18,499**	**$56,825**	**$5,365**	**$7,336**	**$330,525**

Source: Missouri GIS Database, SEMA Mitigation Management Section

Table 3.6. Building Counts by Usage Type

Jurisdiction	Agricultural Counts	Commercial Counts	Government Counts	Industrial Counts	Residential Counts
City of Albany	84	111	14	10	788
Village of Darlington	23	2	NA	NA	55
Village of Gentry	NA	NA	NA	NA	NA
City of King City	65	100	4	NA	405
City of McFall	11	1	NA	NA	61
City of Stanberry	80	94	9	8	518
Gentry County	4820	128	14	35	1168
Totals	4976	323	27	43	2152

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

The number of enrolled students at the participating public-school districts is provided in TABLE 3.7 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 3.7. Population and Building Exposure by Jurisdiction-Public School Districts

Public School District	Enrollment	Building Count	Building Exposure ($)	Contents Exposure ($)	Total Exposure ($)	Assessed Evaluation
Albany R-III School District	450	3				$44,327,002
King City R-I School District	336	1	$15,250,000	$2,136,000	$17,386,000	$30,449,959
Stanberry R-I School District	404	9	$ 14,720,290	$ 2,465,935	$17,186,225	$32,770,634

Source: https://dese.mo.gov/mcds, Data Collection Questionnaires from Public School Districts.

3.2.2 Critical and Essential Facilities and Infrastructure

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

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

TABLE 3.8, on the following page, includes a summary of the inventory of critical and essential facilities and infrastructure in the planning area.

Table 3.8. 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	Federal 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
City of Albany						1	1	1				1					1			1			1	7
Village of Darlington																								
Village of Gentry																								
City of King City			2				1	1				2			1	1	1			1				10
City of McFall							1	1																2
City of Stanberry							1	1	2						2					1			1	8
Gentry County				7	3			1			16					1	2							30
Totals			2	7	3	1	4	5	2		16	3			3	2	4			3			2	57

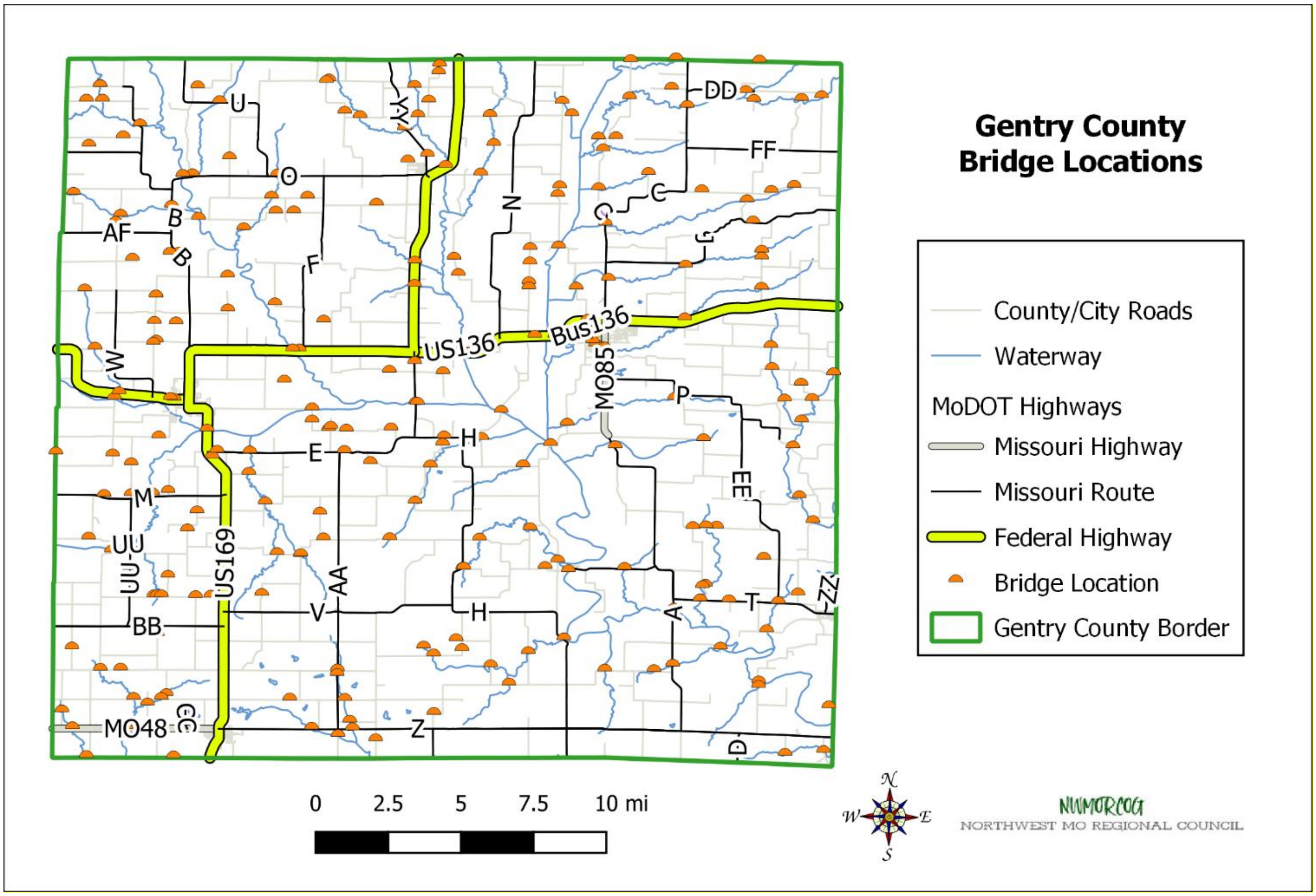
Source: Missouri 2023 State Hazard Mitigation Plan and Hazard Mitigation Viewer; Data Collection Questionnaires; HAZUS

The list was compiled from the Data Collection Questionnaires submitted by each participating jurisdiction, as well as the following sources: FEMA HAZUS 4.2, Missouri Spatial Data information Service (MSDIS), Missouri State Emergency Management Agency (SEMA), 2023 Missouri State Hazard Mitigation Plan using the Hazard Mitigation Viewer and input from the Gentry County Emergency Management Director (EMD).

Bridges:

Gentry County is a land of rolling hills and numerous streams and rivers. The transportation network of federal, state, county and local roads is necessary for the survival of the economic and social life of the residents of the County. These highways, roads, and streets are served by 247 bridges across Gentry County. Of these, 130 are in Good condition, 84 in Fair condition, and 33 in Poor condition. The bridges are shown in FIGURE 3.1.

Figure 3.1. Location of Gentry County Bridges

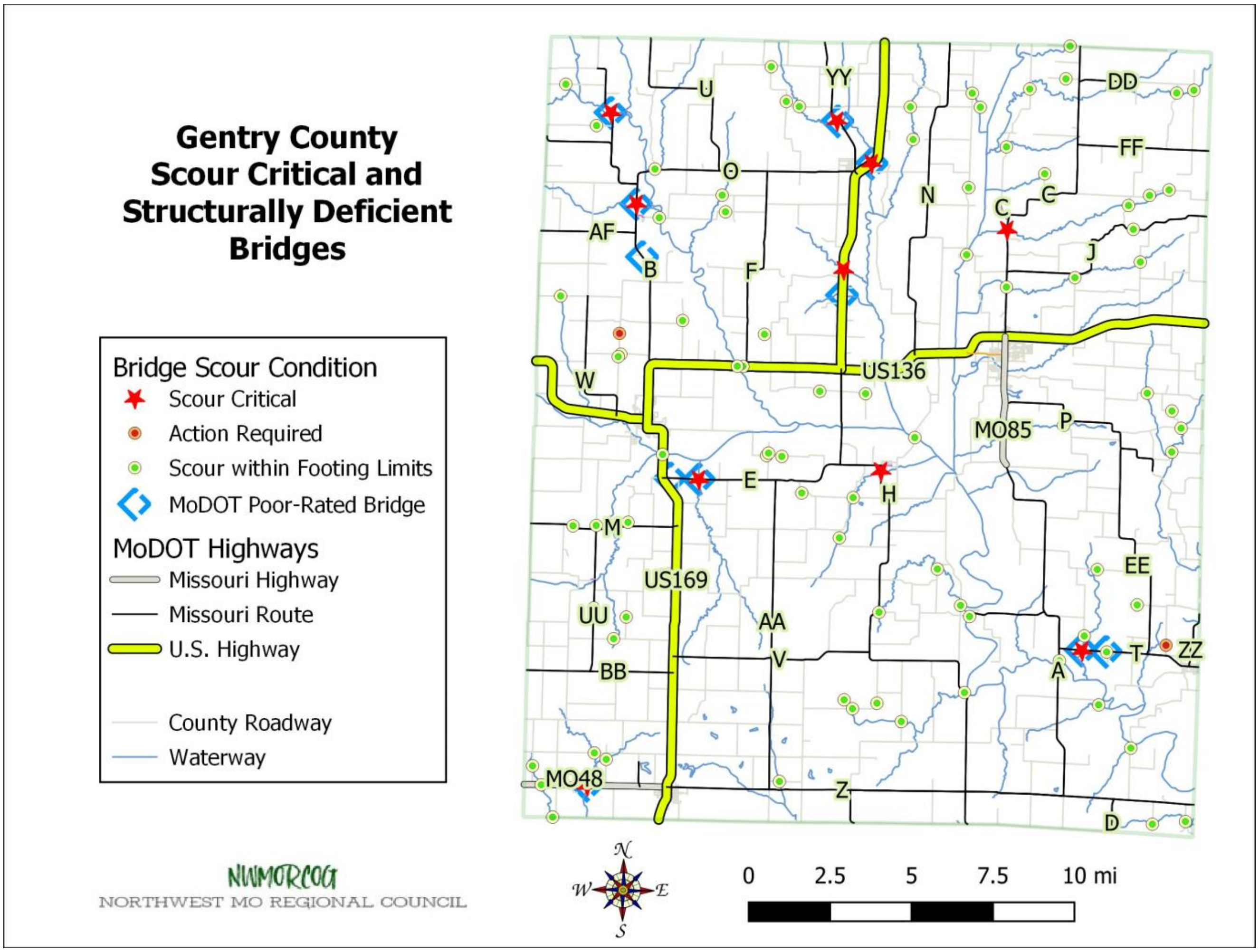


"Scour critical" refers to one of the database elements in the National Bridge Inventory. This element is quantified using a "scour index", which is a number indicating the vulnerability of a bridge to scour during a flood. Bridges with a scour index between 1 and 3 are considered "scour critical", or a bridge with a foundation determined to be unstable for the observed or evaluated scour condition. A scour critical bridge is one with abutment or pier foundations which are rated as unstable due to either observed scour at the bridge site or a scour potential as determined from a scour evaluation study. There are 10 bridges in the county with a scour index of 3. These bridges are scour critical and are all located in unincorporated areas of the county. In addition, there are 2 bridges within the county that have a scour index rating of 4. These bridges are at a moderate risk of damage due to scour. There are numerous bridges with a scour index of 5. These structures are considered stable, but scouring is noted. FIGURE 3.2 shows the location of the those with scour issues.

The Missouri Department of Transportation (MoDOT) is responsible for maintaining nearly 10,400 bridges on the state system. The average age of our bridges is 48 years and most of them were designed to last 50 years. Sixty percent of Missouri's bridges are beyond their original intended life. Bridges are rated on a nine-point scale, with 9 being a new bridge and 2 being a closed bridge.

Missouri's poor bridges carry a rating of 4 or less. The location of bridges earning a poor rating are shown in FIGURE 3.2.

Figure 3.2. Gentry County Scour Critical/Structurally Deficient Bridges



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.

Threatened and Endangered Species: TABLE 3.9 displays the Federally Threatened, Endangered, Proposed and Candidate Species in Gentry county.

Table 3.9. Threatened and Endangered Species in Gentry County

Common Name	Scientific Name	Status
Eastern Hellbender	Cryptobranchus alleganiensis alleganiensis	Endangered
Ozark Hellbender	Cryptobranchus alleganiensis bishopi	Endangered
Curtis Pearlymussel	Epioblasma curtisii	Endangered
Higgens Eye Pearlymussel	Lampsilis higginsii	Endangered
Pink mucket Pearlymussel	Lampsilis abrupta	Endangered
Scaleshell mussel	Leptodea leptodon	Endangered
Sheepnose mussel	Plethobasus cyphyus	Endangered
Snuffbox mussel	Epioblasma triquetra	Endangered
Spectaclecase mussel	Cumberlandia monodonta	Endangered
Western fanshell	Cyprogenia aberti	Threatened
Winged mapleleaf	Quadrula fragosa	Endangered
Big Creek Crayfish	Faxonius peruncus	Threatened
St. Francis River Crayfish	Faxonius quadruncus	Threatened
Grotto Sculpin	Cottus specus	Endangered
Niangua Darter	Etheostoma nianguae	Threatened
Topeka Shiner	Notropis topeka (=tristis)	Experimental Population, Non-Essential
Decurrent false aster	Boltonia decurrens	Threatened
Eastern prairie fringed orchid	Platanthera leucophaea	Threatened
Mead's Milkweed	Asclepias meadii	Threatened
Missouri Bladderpod	Physaria filiformis	Threatened
Western Prairie Fringed Orchid	Platanthera praeclara	Threatened
American Burying Beetle	Nicrophorus americanus	Experimental Population, Non-Essential
Hine's emerald dragonfly	Somatochlora hineana	Endangered
Gray Bat	Myotis grisescens	Endangered
Indiana Bat	Myotis sodalist	Endangered
Northern Long-eared Bat	Myotis septentrionalis	Threatened
Tumbling Creek cavesnail	Antrobia culveri	Endangered

Source: U.S. Fish and Wildlife Service

Natural Resources: The Missouri Department of Conservation provides an online atlas which contains information about land the MDC owns, leases, or manages for public use. TABLE 3.10 provides information about the sites that the MDC manages or owns in Gentry County.

Table 3.10. Parks in Gentry County

Park / Conservation Area	Address	City
Denton (Andy) Access	From King City, take Route Z east to Berlin, then Route H north 3 miles to area entrance.	Miller Township
Elam Bend CA	From Albany: take Route A south 10.50 miles, then 430th Street east 1.50 miles to the area entrance. From I-35: take Exit 68, then Highway 69 north 7 miles, then Route Z west 7.80 miles, then Route A north 3.10 miles, then 430th Street to the area entrance.	McFall

King Lake CA	From King City, take Route Z east 5 miles, then CR 500 south 1 mile to the area.	King City
Limpp CL	From King City, take Highway 48 west 1 mile, then Route CC north 0.50 mile.	King City
Emmett and Leah seat Mem. CA	From Albany, take Route C north 11 miles, then Route M east 1 mile.	McFall
Stanberry City Park	E Main St and N Locust St	Stanberry
Albany Community Park	Bethany St off Highway 85 South	Albany
Ada Yarrington Park	East Daniel Street	Albany

Source: Missouri Department of Conservation, County & Community Websites

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.

Properties in Gentry County that are on the National Register of Historic Places are listed in TABLE 3.11.

Table 3.11. Gentry Properties on the National Register of Historic Places

Property	Address	City	Date Listed
Albany Carnegie Public Library	101 W. Clay St.	Albany	2/23/90
Gentry County Courthouse	Public Square	Albany	9/18/80
Opera Hall Block	101-103 West Vermont/1010-103 South Connecticut	King City	5/9/02
Peery, Samuel and Pauline, House	1105 N. Hundley St.	Albany	8/11/05

Source: Missouri Department of Natural Resources – Missouri National Register Listings by County

Economic Resources: The following table (TABLE 3.12) summarizes the largest employers for Gentry County.

Table 3.12. Major Non-Government Employers in Gentry County

Employer Name	Main Locations	Product or Service	Employees
King City R-I School District	King City	Education	30 (20-49)
Caseys	King City, Stanberry	Retail	23 (20-49)
Novis Ag	Stanberry	Agricultural	18
Pineview Manor	Stanberry	Assisted Living	50-99
Opportunity Workshop	Stanberry	Employment Assistance	50-99
Stanberry R-III School District	Stanberry	Education	50-99
Grand River Ambulance	Stanberry	Health Services	20 (20-49)
Stanberry Grocery & Spirits	Stanberry	Retail	15
Ag Power	Stanberry	Agricultural	15
G&M Services	Stanberry	Concrete Construction	15
JCI, Inc	Albany	HVAC	150-199

Mosaic Medical Center	Albany	Medical	150-199
GHS Paper Tube & Core	Albany	Manufacturing	50-99
Albany School District	Albany	Education	50-99

Source: Data Collection Questionnaires; **Missouri Economic Research & Information Center, 2020**

Agriculture: According to the 2022 Census of Agriculture, Gentry County consists of 629 farms that cover 268,094 acres of land. The average farm size in Gentry County is 426 acres. The top crops in the county are wheat and corn. Most livestock in the county are cattle and hogs. In Gentry County, there are 336 farm jobs. This makes up 12 percent of the workforce in Gentry County.

The following TABLE 3.13 shows information about agriculture-related jobs in Gentry County.

Table 3.13. Agriculture-Related Jobs in Gentry County

	Hired Farm Labor	Unpaid Workers
Farms	117	202
Workers	415	508
Payroll	$11,441,000	

Source: USDA 2022 Census of Agriculture

3.3 LAND USE AND DEVELOPMENT

This section provides information on land use and development in Gentry County and the incorporated communities within its boundaries.

3.3.1 Development Since Previous Plan Update

Development in Gentry County has been flat since the adoption of the 2021 Hazard Mitigation Plan. TABLE 3.14 summarizes the trends in population and TABLE 3.15 housing changes for the different jurisdictions.

Table 3.14. Gentry County Population Growth, 2018-2023

Jurisdiction	Total Population 2023	2018-2023 # Change	2018-2023 % Change
City of Albany	1,855	-251	-11.9%
Village of Darlington	35	-29	-45.3%
Village of Gentry	71	+8	+12.7%
City of King City	745	-217	-22.6%
City of McFall	135	+40	+42.1%
City of Stanberry	1,190	-30	-2.7%
Gentry County	6,224	-441	-6.6%

Source: U.S. Bureau of the Census, Annual Population Estimates, American Community Survey 5-year Estimates 2014-2018, 2019-2023; Population Statistics are for entire incorporated areas as reported by the Census bureau

Table 3.15. Change in Housing Units, 2018-2023

Jurisdiction	Housing Units 2023	2018-2023 # Change	2018-2023 % Change

City of Albany	889	-79	-8.2%
Village of Darlington	22	-35	-61.4%
Village of Gentry	38	+8	+26.7%
City of King City	331	-124	-27.3%
City of McFall	85	+32	+60.4%
City of Stanberry	575	+0	+0.0%
Gentry County	2,928	-280	-8.7%

Source: U.S. Bureau of the Census, American Community Survey 5-year Estimates 2014-2018, 2019-2023; Population Statistics are for entire incorporated areas as reported by the U.S. Census Bureau

3.3.2 Future Land Use and Development

Gentry County is part of the trend in northwest Missouri of declining populations and limited if any growth and development. As seen above in TABLE 3.14 the County has had a loss of 6% of its population. The number of small communities has decreased and those that have survived have lost residents, especially those age groups of active employment age. It is estimated that the County's current population of 6,224 will shrink to 4,356 by the year 2035, a decrease of 30%.

City of Albany

In the last ten years, Albany has experienced a decrease of 12% in its population. There has also been a decrease of 8% in housing units during this period. There is no significant development planned in the next 5 years.

City of King City

King City has had a major decrease of 22% of its population and a decrease of 27% in housing units since 2019. There is no significant development planned in the next 5 years.

City of Stanberry

Stanberry has had a slight decrease of 3% population growth over the last 5 years. No change in the number of housing units was recorded. There is no significant development planned in the next 5 years.

School District's Future Development

Albany R III School District

Enrollment of pre-kindergarten through 12th grade classes has remained steady from 446 in 2019 to 450 in 2025. Renovation of the Elementary School, Middle School and High Schools are planned in the next 5 years.

King City R I

Total student numbers at King City R I Schools have remained the same, with a change from 338 to 336 since 2019. There is no significant development planned in the next 5 years.

Stanberry R II

Student enrollment has increased from 354 to 404, an increase of 14%, at Stanberry R II. There is no significant development planned in the next 5 years.

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 Section **3.1** will be profiled individually in this section in alphabetical order. 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, maps will be used to indicate the specific locations of the planning area that are vulnerable to the subject hazard. For some hazards, the entire planning area is at risk.

Severity/Magnitude/Extent:

This includes information about the severity, magnitude, and extent of a hazard. For some hazards, this is accomplished with description of a value on an established scientific scale or measurement system, such as an EF2 tornado on the Enhanced Fujita Scale. 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. Include tables if not already existing

Probability of Future Occurrence:

The frequency of recorded past events is used to estimate the likelihood of future occurrences. Probability was determined by dividing the number of recorded events by the number of years and multiplying by 100. This gives the percent chance of the event happening in any given year. For events occurring more than once annually, the probability will be reported as 100% in a 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 will 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 will also be considered, including the effects of long-term changes in weather patterns and climate on the identified hazards. NOAA has a new tool, NOAA Climate Explorer, https://toolkit.climate.gov/tools/climate-explorer, that will be used to discuss this issue.

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 within the community so that mitigation options can be considered in future land use decisions.

Requirement §201.6(c)(2)(ii): (As of October 1, 2008) [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged in floods.

Following the hazard profile for each hazard will be the vulnerability assessment. The vulnerability assessment further defines and quantifies populations, buildings, critical facilities, and other community assets at risk to damages from natural hazards. The vulnerability assessments will be based on the best available data. The vulnerability assessments will be partially based on data that was collected for the 2023 State Hazard Mitigation Plan Update. With the 2023 Hazard Mitigation Plan Update, SEMA provided 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.

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 to the same as in the 2023 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 Gentry 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

Each hazard included in the plan has a general statement of vulnerability. 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. This statement also describes whether the hazard affects the entire region or if specific jurisdictions have greater vulnerabilities.

Potential Losses to Existing Development

When data is available, the potential losses to existing development is stated for each hazard. The rural nature of the region makes the available data an estimated value that may not reflect the true vulnerability. The impact will describe the consequences of hazards effects on the jurisdiction and its assets. The assets, determined by the community, include people, structures, facilities, systems, capabilities, and/or activities that have value to the community.

Previous and Future Development

This section will include information about how changes in development have impacted the community's vulnerability to this hazard. Any changes in development that occurred in known hazard prone areas since the previous plan that have increased or decreased the community's vulnerability will be described. Since Gentry County and most of the jurisdictions within the county are losing or maintaining population, there is not much future development anticipated in the county.

Hazard Summary by Jurisdiction

For hazard risks that vary by jurisdiction, this section will provide an overview of the variation and the factual basis for that variation.

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. The focus of the problem statements sub-section will be to synthesize the "problems" revealed through the risk assessment and then through the process of updating the mitigation strategy, develop mitigation actions that are aimed at "solving" the identified problems. Problem statements will be as specific as possible; relating to specific jurisdictions as well as specific assets or areas of the planning area that are problematic. These problem statements will be used in the development of specific mitigation actions.

3.4.1 Flooding (Riverine and Flash)

Hazard Profile

Hazard Description

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

Flooding caused by dam and levee failure is discussed in the chapters for each of those hazards respectively. It will not be addressed in this section.

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

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

The jurisdictions that lie in the Special Flood Hazard Area are more susceptible to the potential damage from a flooding event. The jurisdictions include Albany, Stanberry and Darlington.
In the event of a flood event, up to 15% of any given jurisdiction may be at risk for flood-related damage in a 100-year event. Flash flooding occurs in SFHA and those other 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. Detailed maps for each incorporated community are included in the Vulnerability section for this hazard. Over the last 25 years there have been 19 flood incidents impacting Gentry County. **TABLE 3.16** shows the locations of recorded flood events.

Table 3.16. Gentry County NCEI Flood Events by Location, 2000-2025

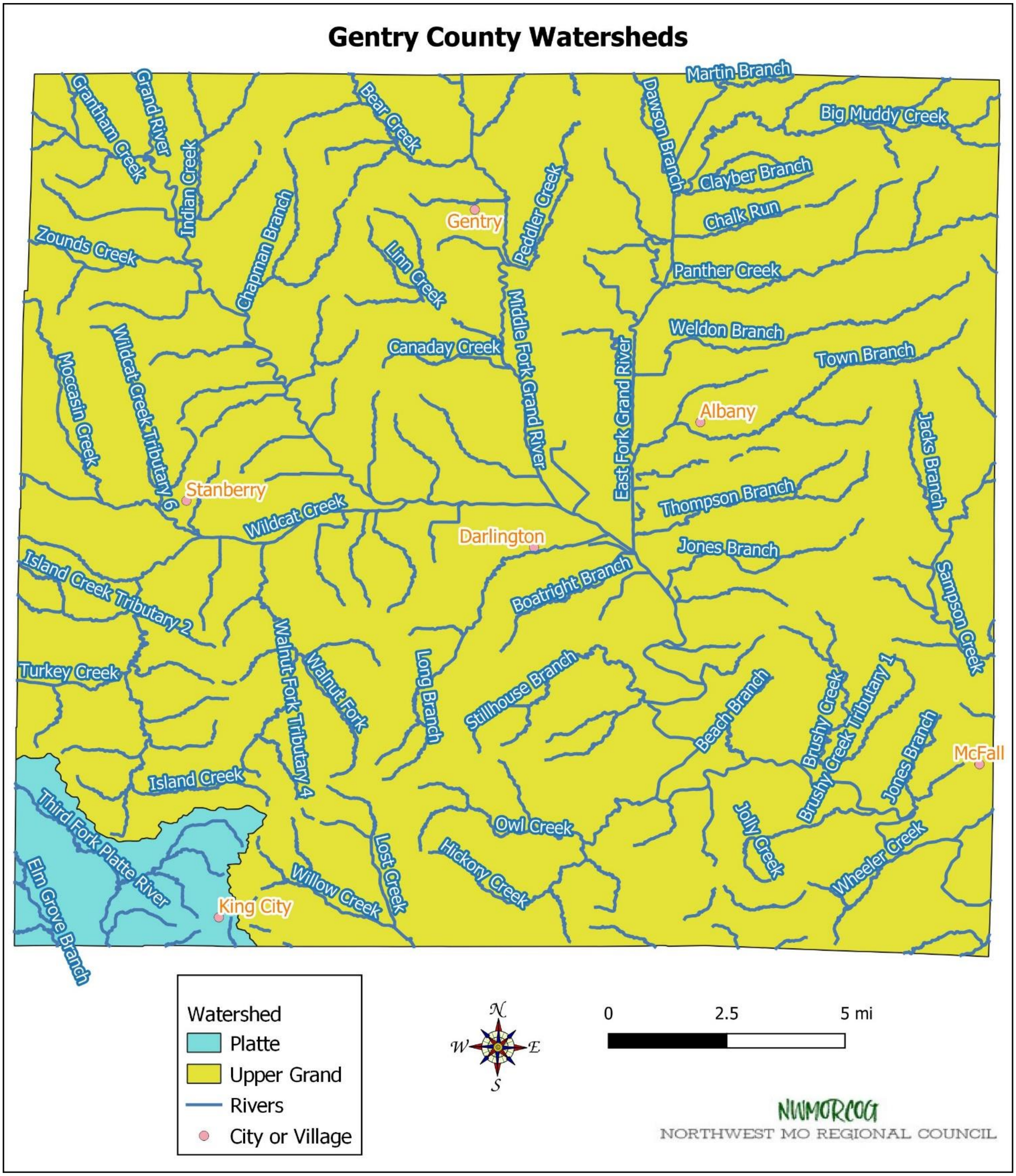
Location	Flash Flood Events	Riverine Flood Events
Unincorporated Gentry County	7	1
City of Albany	4	None reported
Village of Darlington	2	None reported
Village of Gentry	1	None reported
City of King City	1	None reported
City of McFall	0	None reported
City of Stanberry	4	None reported

Location	Flash Flood Events	Riverine Flood Events
Totals	19	1

Source: National Centers for Environmental Information, 9/23/2025

The following map in **FIGURE 3.3** shows that most of Gentry County lies in the Upper Grand watershed. The exception is the southeast corner of the County which includes King City. This area is in the Platte watershed.

Figure 3.3. Rivers and Watersheds of Gentry County



Strength/Magnitude/Extent

Missouri has a long and active history of flooding over the past century, according to the 2023 State Hazard Mitigation Plan. Flooding along Missouri's major rivers generally results in slow-moving disasters. River crest levels are forecast several days in advance, allowing communities downstream sufficient time to take protective measures, such as sandbagging and evacuations. Nevertheless, floods exact a heavy toll in terms of human suffering and losses to public and private property. By contrast, flash flood events in recent years have caused a higher number of deaths and major property damage in many areas of Missouri. According to the U.S. Geological Survey, two critical factors affect flooding due to rainfall: rainfall duration and rainfall intensity – the rate at which it rains. These factors contribute to a flood's height, water velocity and other properties that reveal its magnitude.

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

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

When roads and bridges are inundated by water, damage can occur as the water scours materials around bridge abutments and gravel roads. Floodwaters can also cause erosion, undermining roadbeds. In some instances, steep slopes that are saturated with water may cause mud or rockslides 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. Please refer to Figure 3.2 where scour critical bridges were identified, to see a discussion of high waters effects on transportation infrastructure.

National Flood Insurance Program (NFIP) Participation

Two of the County's communities currently participate in the National Flood Insurance Program. The NFIP aims to reduce the impact of flooding on private and public structures. It does so by providing affordable insurance to property owners and by encouraging communities to adopt and enforce floodplain management regulations. These efforts help mitigate the effects of flooding on new and improved structures. The following tables, TABLE 3.17 and TABLE 3.18, show information about NFIP in Gentry County.

Table 3.17. NFIP Participation in Gentry County

Community ID #	Community Name	NFIP Participant (Y/N/Sanctioned)	Current Effective Map Date	Regular-Emergency Program Entry Date
290145A	City of Albany	Y	06/16/15	08/19/85
290147A	City of Stanberry	Y	06/16/15	09/04/85
290146A	City of Darlington	N Sanctioned 08/19/85	06/16/15	08/19/85 (S)
290802A	Gentry County	N Sanctioned 06/16/16	06/16/15	06/16/16
291001A	Village of Gentry	N Sanctioned 06/16/16	06/16/15	06/16/16

Source: NFIP Community Status Book

Table 3.18. NFIP Policy and Claim Statistics

Community Name	Policies in Force	Insurance in Force	Closed Losses	Total Payments
City of Albany	2	$245,000	2	$35,554.40
City of Stanberry	1	$200,000	0	0

Source: NFIP Community Status Book, [03/24/2020]; 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 2025.

Repetitive Loss/Severe Repetitive Loss Properties

Repetitive Loss Properties are those properties with at least two flood insurance payments of $5,000 or more in a 10-year period. According to the Flood Insurance Administration, jurisdictions included in the planning area have one repetitive loss property as seen in TABLE 3.19.

Table 3.19. Gentry County Repetitive Loss Properties

Jurisdiction	Number of Properties	Number Mitigated	Building Payments	Content Payments	Total Payments	Average Payment
City of Albany	1	1	$17,416	$18,138	$35,554	$17,777
Source: Flood Insurance Administration as of September 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.

There were no SRL properties reported for Gentry County.

Previous Occurrences

Since 1965, there have been 12 declared disasters that have made funds available to Gentry County residents to aid in the recovery from storms that produced flooding. Information about these declared disasters was previously summarized in section 3.1.2. The reports of flash flooding within the county for the past 20 years are summarized in the table below. The NCEI database enters a zero for property damage when the amount is unknown.

As seen in TABLE 3.20, there have been 19 flash flood events reported in Gentry County during the last twenty-five years.

Table 3.20. NCEI Gentry County Flash Flood Events Summary, 2000 to 2025

Year	# of Events	# of Deaths	# of Injuries	Property Damages	Crop Damages
2000-2003	None reported				NA
2004	5	0	0	$100,000	$106,602
2005-2007	None reported				$552,635
2008	3	0	0	0	$477,184
2009	1	0	0	0	$6,925
2010	None reported				$190,276
2011	1	0	0	0	$0
2012-2013	None reported				$0
2014	1	0	0	0	$0
2015	5	0	0	0	$33,902
2016	None reported				$0
2017	1	0	0	0	$0
2018	None Reported				$975
2019	1	0	0	0	$686,142
2020	1	0	0	0	
Totals	19	0	0	$100,000	$2,054,641.00
Source: NCEI, data accessed 09/23/2025					

There are limitations to the property damage amounts listed by NCEI. Damage estimates are not available when the event is reported and follow up does not always occur. Riverine events are recorded in the following table, Table 3.21. Most of these events have affected agricultural assets. The Stanberry Schools reported $120,000 loss from flash flooding in 2019.

Table 3.21. NCEI Gentry County Riverine Flood Events Summary, 2000 to 2019

Year	# of Events	# of Deaths	# of Injuries	Property Damages	Crop Damages
2000-2018	None reported				Damages from all flooding types are listed in Flash Flood Table
2019	1	0	0	0	
Totals	1	0	0	0	
Source: NCEI 09/23/2025					

Probability of Future Occurrence

Based on twenty-five years of data, there is a 76% probability of a flash flooding event in any given year with 19 events reported. With 1 recorded riverine flood events there is a 4% probability of a riverine flooding event in any given year

Changing Future Conditions Considerations

From 2023 State Hazard Mitigation 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. For Missouri specifically, annual precipitation has been generally above average since 1990, while summer precipitation has been variable, with no extended periods of above or below average levels. 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.*

The U.S. Climate Resilience Toolkit indicates that Gentry County's annual precipitation levels may not vary much from historical levels but predicts that more of that amount will occur in the spring and less during the summer months. This could put further stress on infrastructure designed to handle snow melt and rainfall during the first half of the year.

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 roadbeds. In some instances, steep slopes that are saturated with water may cause mud or rockslides 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 presenting a health hazard.

Potential Losses to Existing Development

The 2023 Missouri State Hazard Plan used HAZUS data to analyze the county's vulnerability to flooding. A summary of the findings is shown in TABLE 3.22.

Table 3.22. HAZUS Estimation of Gentry County Vulnerability to Flood

Building Exposure	Structural Damage	Contents Loss	Inventory Loss	Total Direct Loss	Total Income loss	Total Direct and Income Loss
$838,279,112	$4,148,214	$3,862,533	$217,625	$8,228,399	$8,510	$8,236,910

Source: 2023 Missouri State HMP, Table 3.26

Impact of Previous and Future Development

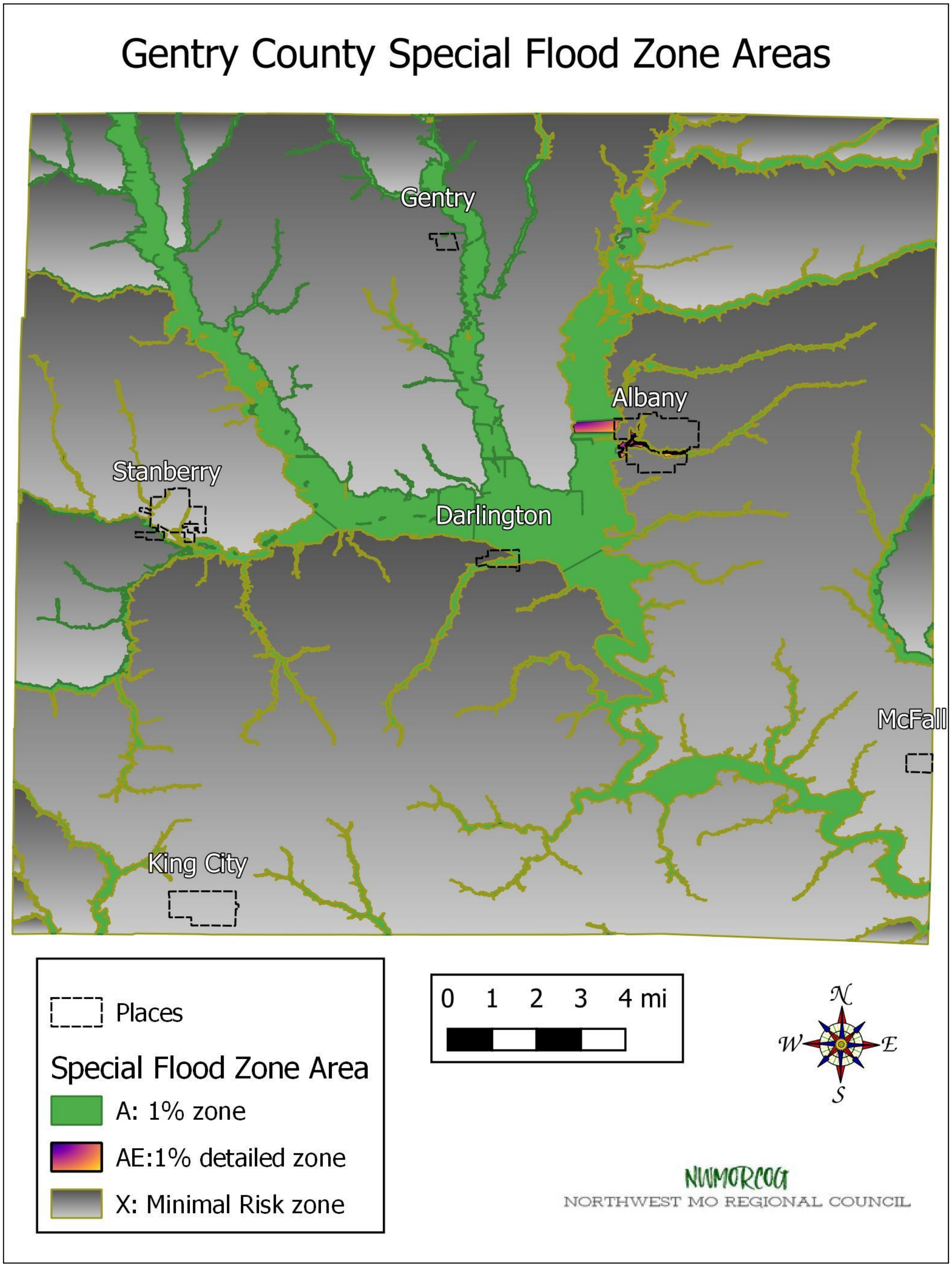
Since the largest communities of Albany and Stanberry participate in the NFIP and regulate development in Special Flood Hazard Areas (SFHA) there is no significant increase in vulnerable structures anticipated in those jurisdictions.

Since the County and the remaining jurisdictions have chosen not to participate in NFIP, there is the possibility of development in vulnerable locations where interior drainage systems are not adequate to provide drainage during heavy rainfall events. Future development would also increase impervious surfaces causing additional water run-off and drainage problems during heavy rainfall events.

Hazard Summary by Jurisdiction

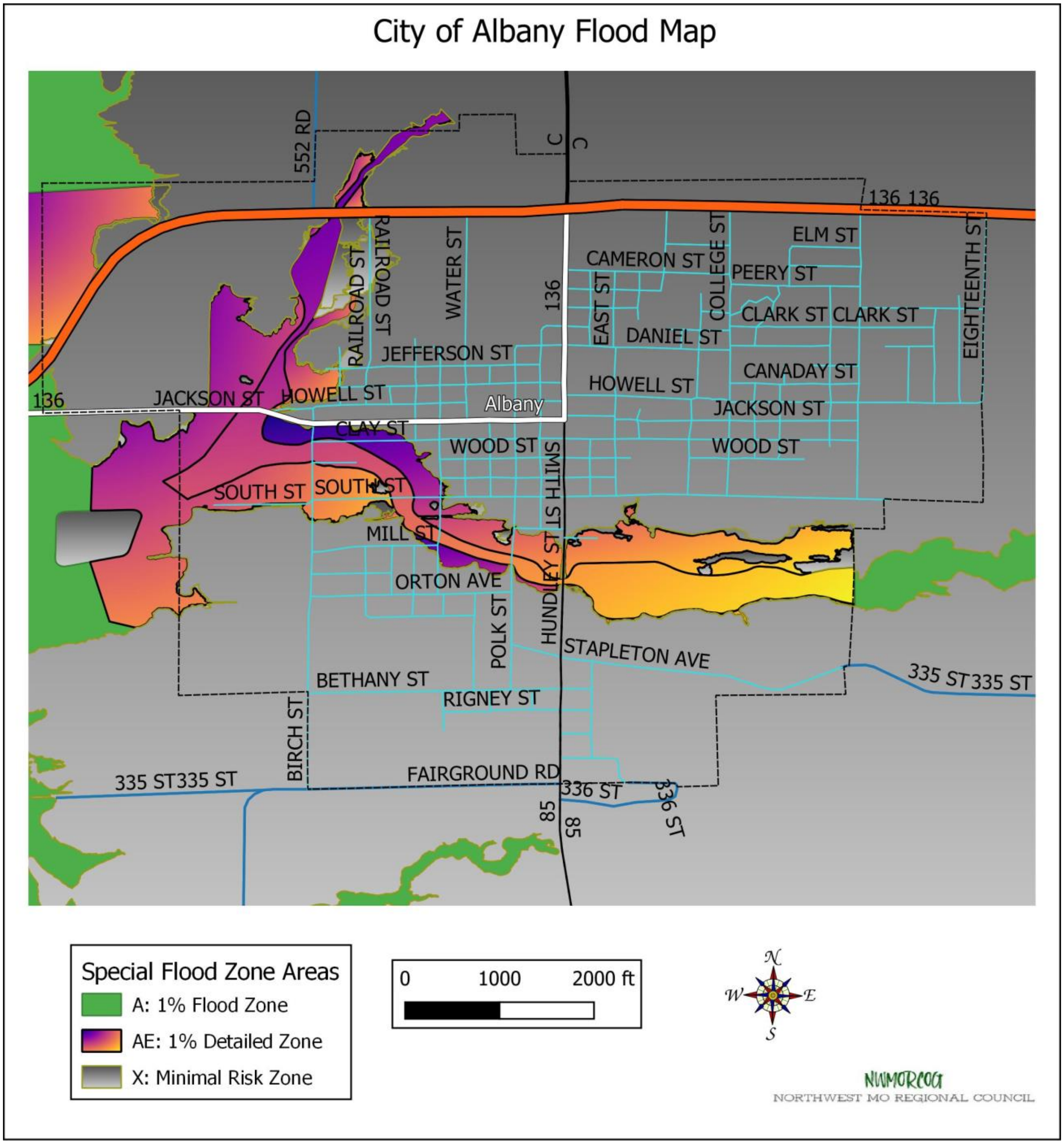
The following maps, starting with FIGURE 3.4 show the floodplains of the County as a whole and then the flood map for each of the communities in Gentry County.

Figure 3.4. Flood Zone Map of Gentry County



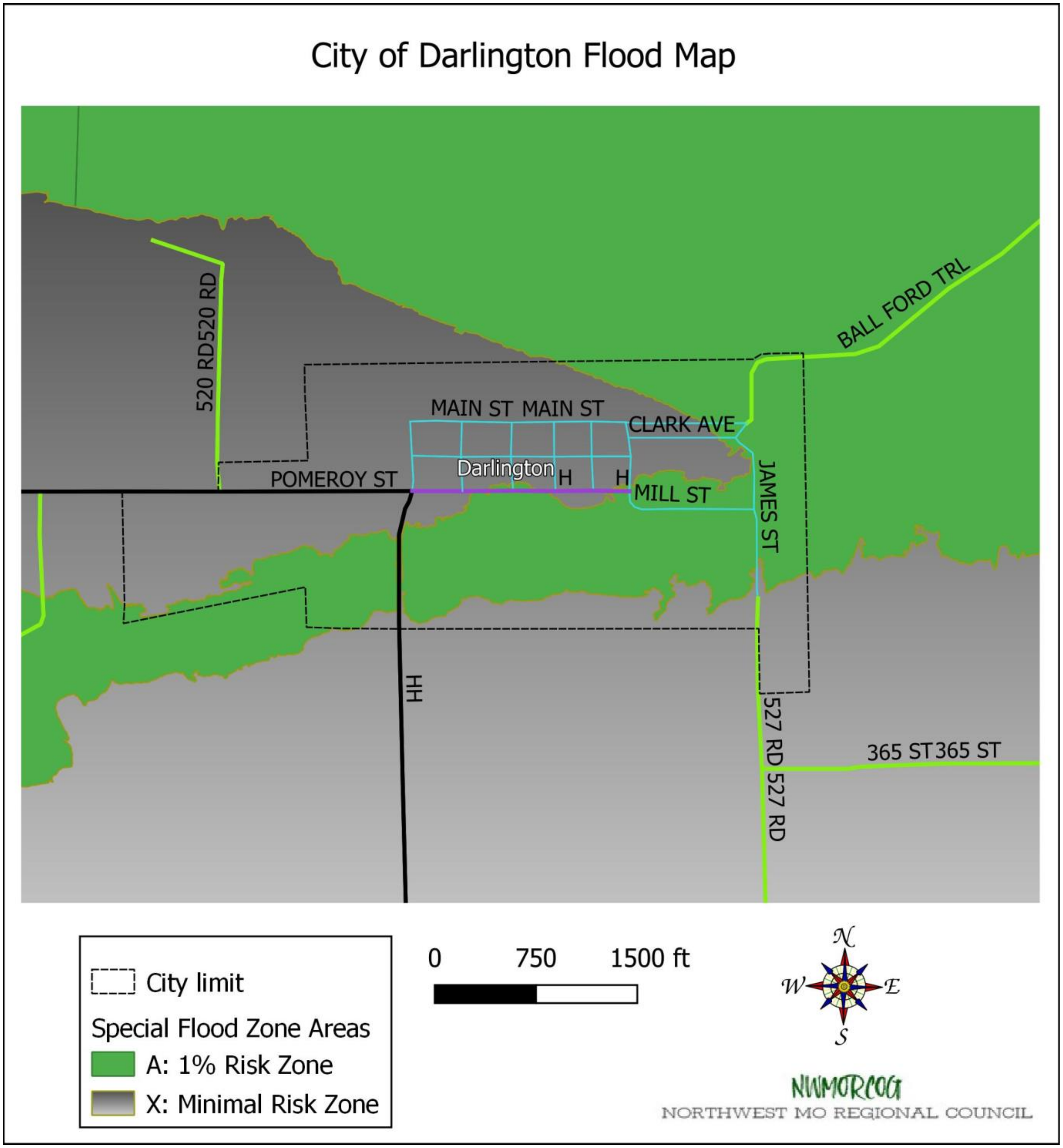
The following map for the City of Albany shows an area along the eastern portion of the city and another running through the south part that lie in the 100-year flood zone of two tributaries of the East Fork of the Grand River. A detailed study has been completed to assist the City in mitigating this area.

Figure 3.5. Flood Zone Map for the City of Albany



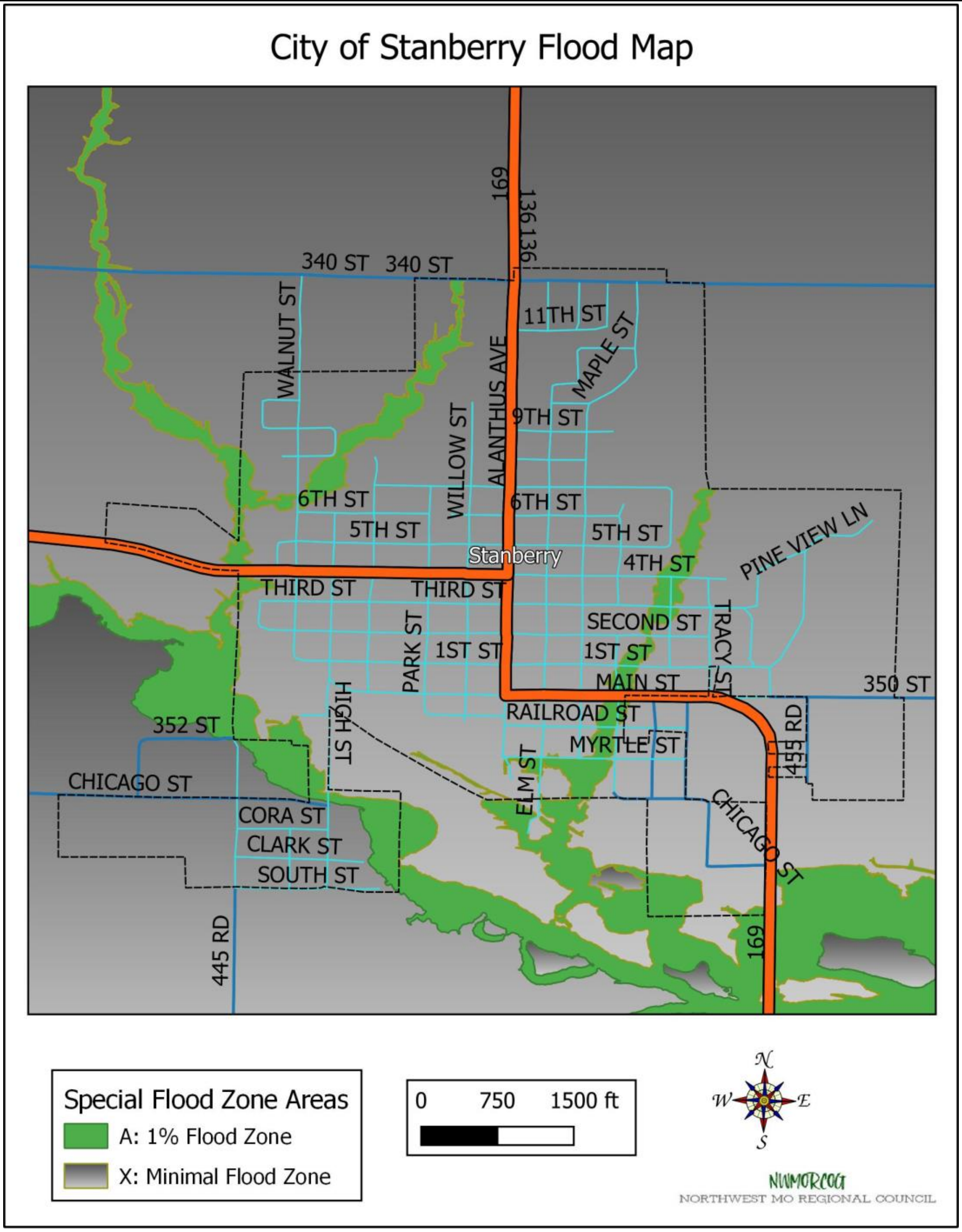
Access to the City of Darlington may be compromised in a significant flooding event. As seen in the following map FIGURE 3.6 the eastern and southern portions of the City lie in the 1% Flood zone.

Figure 3.6. Flood Zone Map for the City of Darlington



Stanberry lies north of Wildcat Creek whose tributaries pose a flooding risk to portions of the community as seen in the following map **Figure 3.7.**

Figure 3.7. Flood Zone Map for the City of Stanberry



The remaining communities of Gentry, King City and McFall do not have any SFHA within their limits. There are many unincorporated areas of flood risk where only agricultural assets are vulnerable.

Problem Statement

While the HAZUS estimate is over $8 million in potential loss to flood in the county, the losses have historically been agricultural crop loss. The City of Albany has suffered the most of any incorporated place and is prone to flash flood events. Possible solutions would be to consider the relocation of repetitive flood structures and NFIP regulations should prohibit the building of any new assets within SFHA.

3.4.2 Levee Failure

Hazard Profile

Hazard Description

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

Levees can be small agricultural levees that protect farmland from high-frequency flooding. Levees can also be larger, designed to protect people and property in larger urban areas from less frequent flooding events such as the 100-year and 500-year flood levels. For purposes of this discussion, levee failure will refer to both overtopping and breach as defined in FEMA's Publication "So You Live Behind a Levee" (http://mrcc.isws.illinois.edu/1913Flood/awareness/materials/SoYouLiveBehindLevee.pdf).

Following are the FEMA publication descriptions of different kinds of levee failure.

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

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

Geographic Location

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

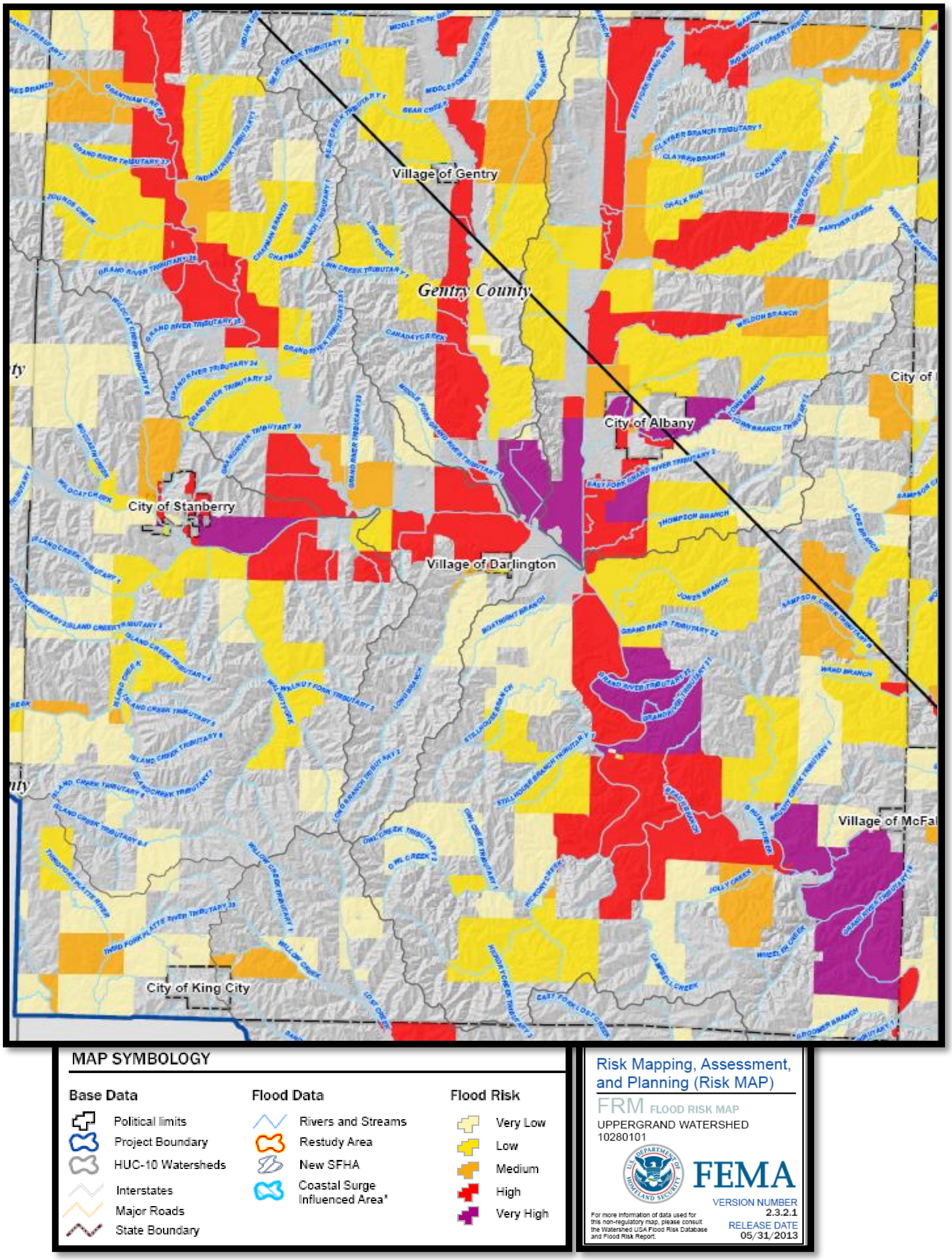
There are two concurrent nation-wide levee inventory development efforts, one led by the United State Army Corps of Engineers (USACE) and one led by Federal Emergency Management Agency (FEMA). The National Levee Database (NLD), developed by USACE, captures all USACE related levee projects, regardless of design levels of protection. The Midterm Levee Inventory (MLI), developed by FEMA, captures all levee data (USACE and non-USACE) but primarily focuses on levees that provide 1% annual-chance flood protection on FEMA Flood Insurance Rate Maps (FIRMs).

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

For purposes of the levee failure profile and risk assessment, those levees indicated on the Preliminary DFIRM as providing protection from at least the 1-percent annual chance flood would be discussed and further analyzed. Many levees in the county are low-head agricultural levees, the breach of which would not cause widespread damages. There are some levees along the Grand River and its tributaries that have caused damage to homes and roads. It is noted that increased discharges are being considered in revision of the flood maps as part of RiskMap efforts. This may result in changes to the flood protection level that existing levees are certified as providing.

A FEMA Risk MAP assessment has been completed on the Upper Grand Watershed. A detail from a map from this assessment is shown in FIGURE 3.8. This project's area includes the entire county. No levees are identified on this map, nor are levees identified by USACE. It is likely those agricultural levees and other non-regulated levees within the planning area exist that are not inventoried or inspected. These levees are not designed to provide protection from the 1-percent annual chance flood would overtop or fail in the 1-percent annual chance flood scenario. Therefore, any associated losses would be considered in the loss estimates provided in the Flood Hazard Section 3.4.

Figure 3.8. Detail of FEMA RiskMAP of the Upper Grand Watershed



Strength/Magnitude/Extent

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

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

Previous Occurrences

There were no documented cases of levee failure found in any recent state hazard plan for the County of Gentry. No community-returned survey questionnaires mentioned levee failure as a previous hazard or potential one.

Probability of Future Occurrence

With zero previous occurrences, the probability of future levee failure is estimated to be less than 1%.

Changing Future Conditions Considerations

From 2023 State Hazard Mitigation Plan: *The impact of changing future conditions on levee failure will most likely be related to changes in precipitation and flood likelihood. Climate change projections suggest that precipitation may increase and occur in more extreme events, which may increase risk of flooding, putting stress on levees and increasing likelihood of levee failure. Furthermore, aging levee infrastructure and a lack of regular maintenance (including checking for seepage and removing trees, roots and other vegetation that can weaken a levee) coupled with more extreme weather events may increase risk of future levee failure.*

Vulnerability

Vulnerability Overview

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

USACE now conducts two types of levee inspections. Routine Inspection is a visual inspection to verify and rate levee system operation and maintenance. It is typically conducted each year for all levees in the USACE Levee Safety Program. Periodic Inspection is a comprehensive inspection led by a professional engineer and conducted by a USACE multidisciplinary team that includes the levee sponsor. The USACE typically conducts this inspection every five years on the federally authorized levees in the USACE Levee Safety Program.

Both Routine and Periodic Inspections result in a rating for operation and maintenance. Each levee segment receives an overall segment inspection rating of Acceptable, Minimally Acceptable, or Unacceptable. FIGURE 3.9 below defines the three ratings.

Figure 3.9. Definitions of the Three Levee System Ratings

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

There are no USACE regulated levees in Gentry County.

Potential Losses to Existing Development

With only low-head agricultural levees in the county, the main vulnerability of levee failure will be to agricultural assets. Other at-risk properties will be discussed in the Flood Hazard section of this update.

Impact of Previous and Future Development

Development in areas protected by levees is at greater risk for flooding due to possible flooding. Local officials will need to monitor any future development in those areas.

Hazard Summary by Jurisdiction

The areas that are at risk from possible levee failure have been addressed in the Flood Hazard 3.4.1.

Problem Statement

Although there are no regulated levees in Gentry County and a listing of existing low-head levees is not available, the potential for damage from a levee failure does exist. Mitigation planning would be aided by the creation of a directory of existing levees in the County. Until more information is available, officials at the most local level will need to be aware of the levees under their jurisdiction and discourage development in vulnerable areas.

3.4.3 Dam Failure

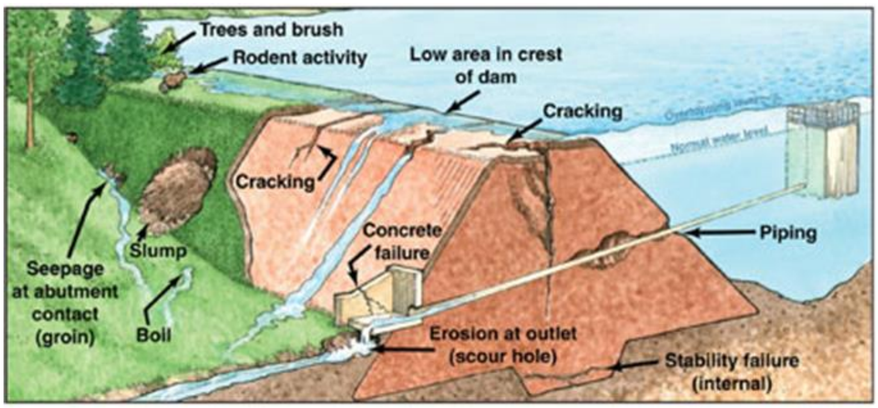
Hazard Profile

Hazard Description

A dam is defined as a barrier constructed across a watercourse for storage, control, or diversion of water. Dams are designed to help with flood control, stabilize a grade, provide water for livestock or fire protection, and/or for recreational activities. Dams are typically constructed of earth, rock, concrete, or mine tailings. Dam owners have primary responsibility for the safe design, operation, and maintenance of their dams. Dam owners also have the responsibility for inspections and providing early warning of problems at the dam which could result in dam failure.

A dam failure is characterized by an uncontrolled release of water from behind a dam. Flooding, earthquakes, blockages, landslides, lack of maintenance, improper operation, poor construction, damage caused by wildlife, vandalism, and terrorism can all cause a dam to fail. FIGURE 3.10 illustrates some of these common causes of dam failure. When a dam failure occurs, an enormous amount of water is suddenly released, destroying infrastructure, and flooding the area downstream of the dam.

Figure 3.10. Causes of Dam Failure



Dam failure can be caused by any of the following:

1. Overtopping - inadequate spillway design, debris blockage of spillways or settlement of the dam crest.

2. Piping: internal erosion caused by embankment leakage, foundation leakage and deterioration of pertinent structures appended to the dam.

3. Erosion: inadequate spillway capacity causing overtopping of the dam, flow erosion, and inadequate slope protection.

4. Structural Failure: caused by an earthquake, slope instability or faulty construction.

Dams in Gentry County are subject to classification by the State of Missouri and by the federal government. TABLE 3.23 shows the system of classification used by the Missouri Department of Natural Resources (MoDNR). A hazard classification is assigned to each dam during the initial permit process.

Table 3.23. MoDNR Dam Hazard Classification Definitions

Hazard Class	Definition
Class I	Represents the most severe threat to public safety based on the downstream environment
Class II	Represents a serious threat to public safety

Class III	Represents the least threat to public safety

Source: Missouri Department of Natural Resources

The U.S. Army Corps of Engineers has compiled a National Inventory of Dams (NID) for the United States. The NID consists of dams meeting at least one of the following criteria:

1) High hazard classification - loss of human life is likely if the dam fails,
2) Significant hazard classification - possible loss of human life and likely significant property or environmental destruction,
3) Equal or exceed 25 feet in height and exceed 15 acre-feet in storage,
4) Equal or exceed 50 acre-feet storage and exceed 6 feet in height.

TABLE 3.24 gives information about the hazard classification system used in the National Inventory of Dams. There is not a direct correlation between the State Hazard classification and the NID classifications. However, most dams that are in the State's Classes 1 and 2 are considered NID High Hazard Dams.

Table 3.24. NID Dam Hazard Classification Definitions

Hazard Class	Definition
Low Hazard	Where dam failure or operational errors result in no probable loss of human life and low economic and/or environmental losses
Significant Hazard	Where dam failure or operational errors result in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns
High Hazard	Where dam failure or operational errors will likely result in the loss of at least one human life

Source: National Inventory of Dams

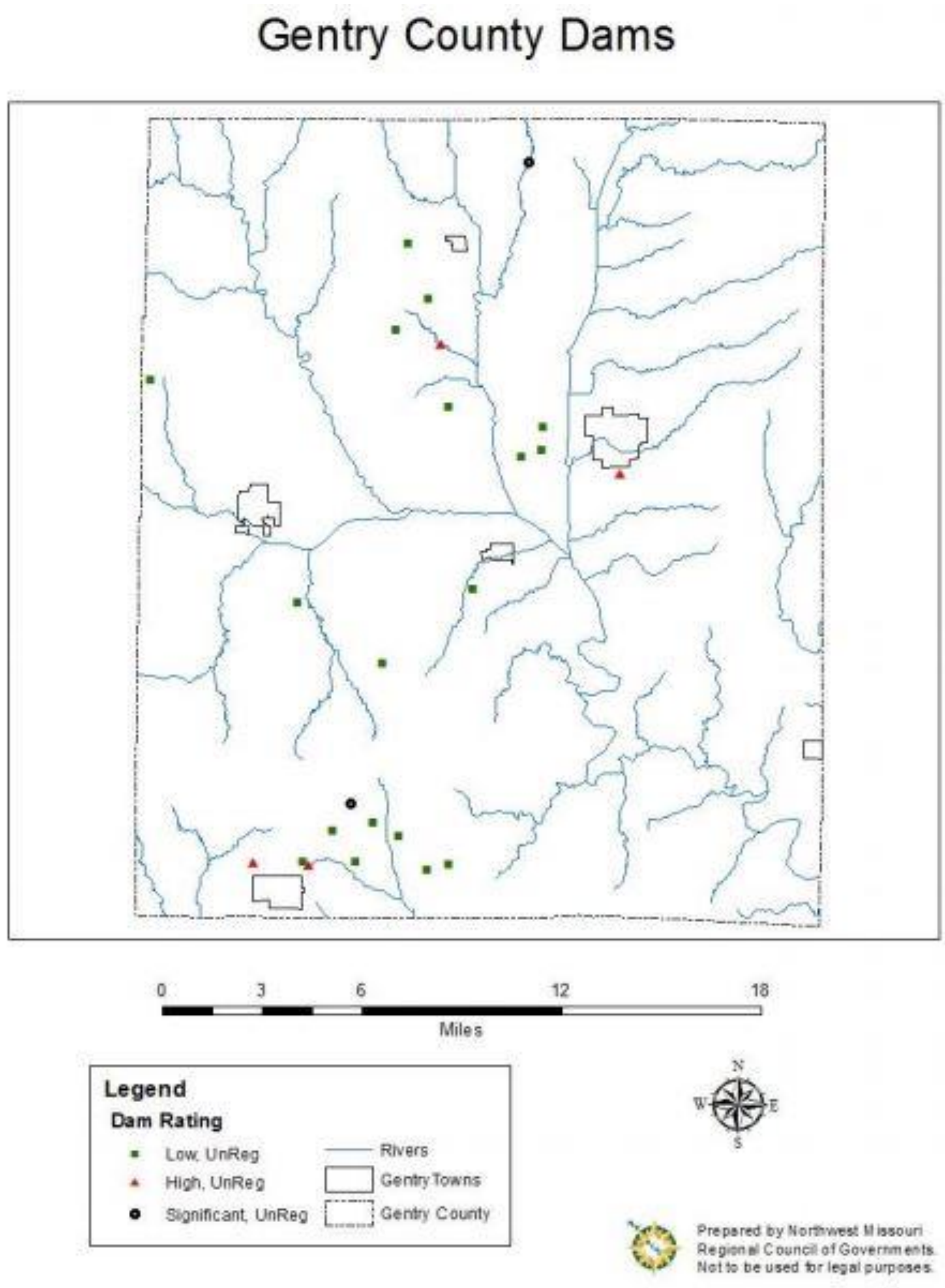
Geographic Location

Dams Located Within the Planning Area

The Missouri Dam and Reservoir Safety Program is leading an effort to help develop Emergency Action Plans, or EAPs, for regulated dams in the state. Completion of EAPs can help save lives and reduce property damage during a dam safety emergency. Plans increase preparedness by organizing emergency contact information and evacuation procedures into an official document and by providing enhanced communications between dam owners and local emergency management officials.

The Missouri Department of Natural Resources (MoDNR) has identified 22 dams in Gentry County. Four are high hazard dams (see TABLE 3.25), two are significant hazard dams, and sixteen are low hazard dams. One dam is owned by the Missouri Department of Conservation. The location of all dams is shown in FIGURE 3.11.

Figure 3.11. Dam Locations in Gentry County



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

Table 3.25. High Hazard Dams in the Gentry County Planning Area

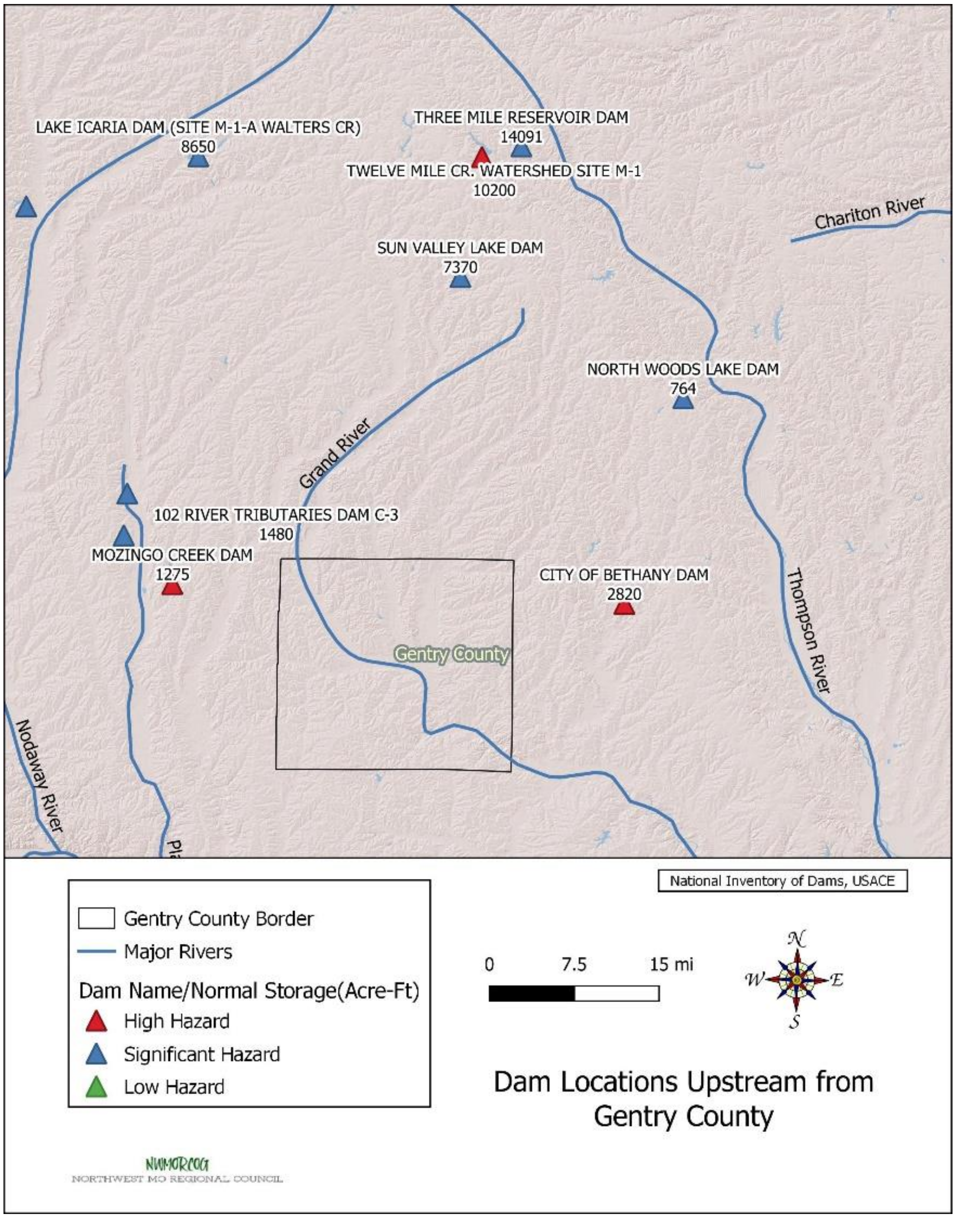
Dam Name	Emergency Action Plan (EAP)AP	Dam Height (Ft)	Normal Storage (Acre-Ft)	Last Inspection Date	River	Nearest Downstream City	Distance To Nearest City (Miles)	Dam Owner
Middle Fork Water Company Dam	Not required	37.8	1,052	--	Linn Creek	Darlington	8	Public Utility
Curt Lee Dam	Not required	34	1,000	5/15/1979	East Fork Grand River	Albany	2	Curt Lee
Limpp Lake Dam	Not required	25	374	--	3rd Fork Platte River	Union Star	0	MO Dept of Conservation
King City New Reservoir Dam	Not required	34	673	--	Tri-Willow Creek	Santa Rosa	29	City of King City

Sources: Missouri Department of Natural Resources and National Inventory of Dams

Upstream Dams Outside the Planning Area

There are a few dams on the branches of the Grand River within the Upper Grand Watershed. County in Ringold and Union Counties in Iowa. In FIGURE 3.12, the location of these dams is indicated. A dam failure in any of the upstream dams does carry the risk of flooding for assets near these rivers. The distance and the size of these reservoirs limit the potential for consequences for assets within Gentry County. The High Hazard rated dam of Twelve Mile Creek, and the large capacity of Three Mile Reservoir are in the Thompson Watershed. The only dam of concern is the Low Hazard rated Sun Valley Lake Dam, whose distance from Gentry County should minimize its effects to agricultural assets along the Grand River. The failure of Mozingo Lake Dam or the City of Bethany Dam will not directly affect Gentry County.

Figure 3.12. Upstream Dams Outside Gentry County



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

Strength/Magnitude/Extent

It can be stated that the severity/magnitude of dam failure would be similar in some cases to the impacts associated with flood events (see the flood hazard vulnerability analysis and discussion). Based on the hazard class definitions, failure of any of the High Hazard/Class I dams could result in a serious threat of loss of human life, serious damage to residential, industrial or commercial areas, public utilities, public buildings, or major transportation facilities. Catastrophic failure of any high hazard dam has the potential to result in greater destruction due to the potential speed of onset and greater depth, extent, and velocity of flooding. Note that for this reason, dam failures could flood areas outside of mapped flood hazards.

Previous Occurrences

No records were found to indicate any dam failures in Gentry County which caused injury, loss of life, or imposed a considerable cost due solely to dam failure.

Probability of Future Occurrence

Without no reported dam failures or incidents reported in the County over the last 20 years, the probability of occurrence is estimated to be at less than 5%. However, the probability for dam failure in any given year for the state of Missouri is 45% and the likelihood of a dam incident is 100%.

Increasing the number of inspections of regulated dams and periodic inspections of the remainder of the dams would increase the likelihood of early detection of potential problems. This would reduce the probability of dam failure.

Changing Future Conditions Considerations

With the prediction of more frequent and more intense rain events, the likelihood of increased stress on dams in the future seems possible. The majority of the dams in the county are decades or more of an age which leads to the susceptibility of failure.

Vulnerability

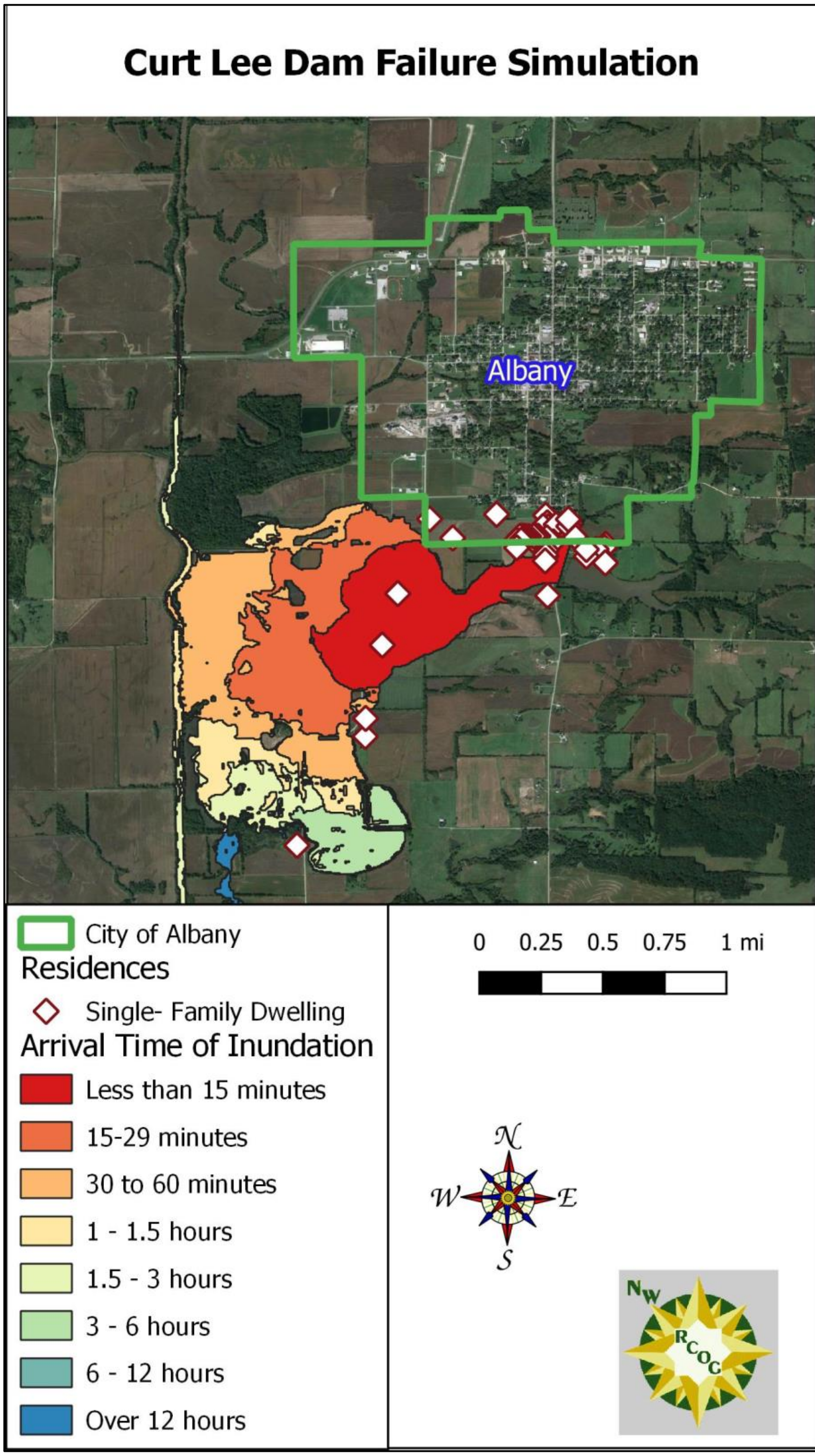
Vulnerability Overview

Most of Gentry County's vulnerability in the event of dam failure is loss of agriculture assets. Some of the dams are located close enough to major highways, a compromise in the integrity of a dam could threaten to close or damage roadways.

Potential Losses to Existing Development:

A Decision Support System for Water Infrastructure Security (DSS-WISE) simulation was run to estimate the consequences of a complete failure of the High-Risk Curt Lee Dam near Albany. As can be seen in FIGURE 3.13, there are several residences that would be subject to almost immediate consequence from a complete dam failure. North-south oriented highway MO85 would receive an inundating surge of water in minutes after a failure.

Figure 3.13. Simulation of Curt Lee Dam Failure



Best available information from FEMA, the NID, Google Earth Pro, states, locals, or other federal agencies (OFA's) is used for these runs. The accuracy, or inaccuracy of this information is outside of the responsibility and authority of FEMA and NWMORCOG. FEMA is not able to verify any of the information provided by such resources as the NID, Google Earth Pro, GIS, etc. Runs will only be as accurate as the information available.

Another High-Hazard dam, Middle Fork Water Company Dam, is in a low-density population area, but a failure would immediately flood highway US 169 as well as a few scattered farm residences. The released water would quickly spill down Linn Creek and spread out across the floodplain of the West Fork of the Grand River, eventually impacting highway US 136, north of Darlington.

The Limpp Lake Dam has a smaller reservoir than the previous dams discussed but a failure would have sudden effects on MO Route CC and a farm residence directly below the dam. The final high-hazard dam, King City New Reservoir Dam, does not appear to immediately imperil any residences in the case of a failure. The released waters would move away from King City down Willow Creek floodplain impacting agricultural assets.

Impact of Previous and Future Development

Gentry County has been proactive in the placement of dams to ensure population areas would not be in the path of released water in the event of a dam failure. Most of the assets in the zones are agricultural in nature. The county has monitored and discouraged any development in areas that would be affected by a dam failure.

Hazard Summary by Jurisdiction

As discussed previously the areas affected by dam failure would primarily be in the unincorporated areas of the County. A small area at the south edge of Albany was shown to be a potential zone of damage in the event of an incident at the Curt Lee Dam. It is estimated that dam failure would not affect the assets any of the school districts of the County and it appears that there are no critical facilities at risk although some major highways could be affected.

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.

3.4.4 Earthquakes

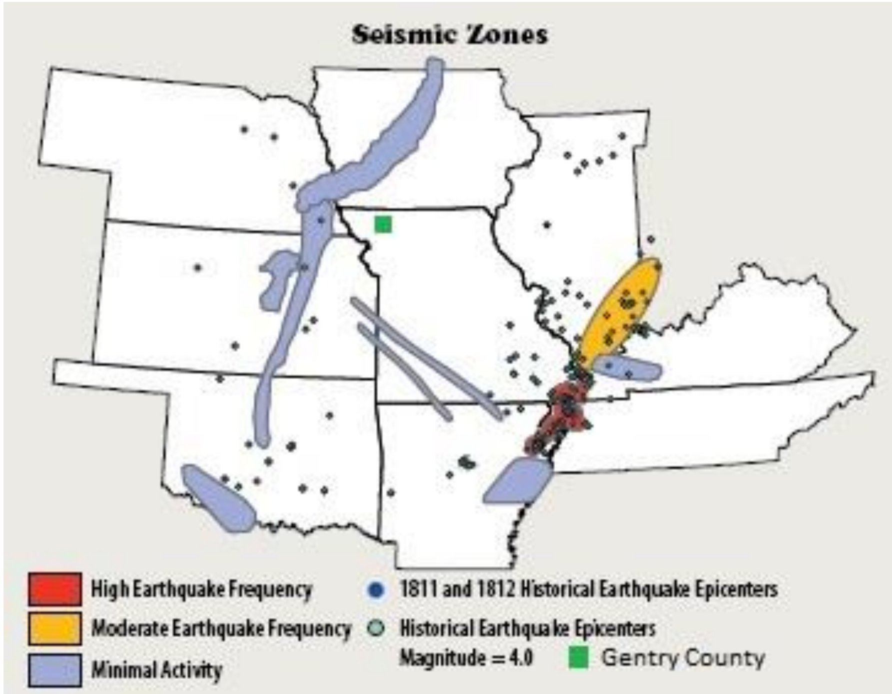
Hazard Profile

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. The heaviest damage generally occurs near 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 energy to buildings and other structures on the earth's surface.

There are two primary fault areas as shown in FIGURE 3.14 that can impact Gentry County: the Nemaha Fault in eastern Kansas and the New Madrid fault in southeast Missouri.

Figure 3.14. Primary Faults Impacting Gentry County



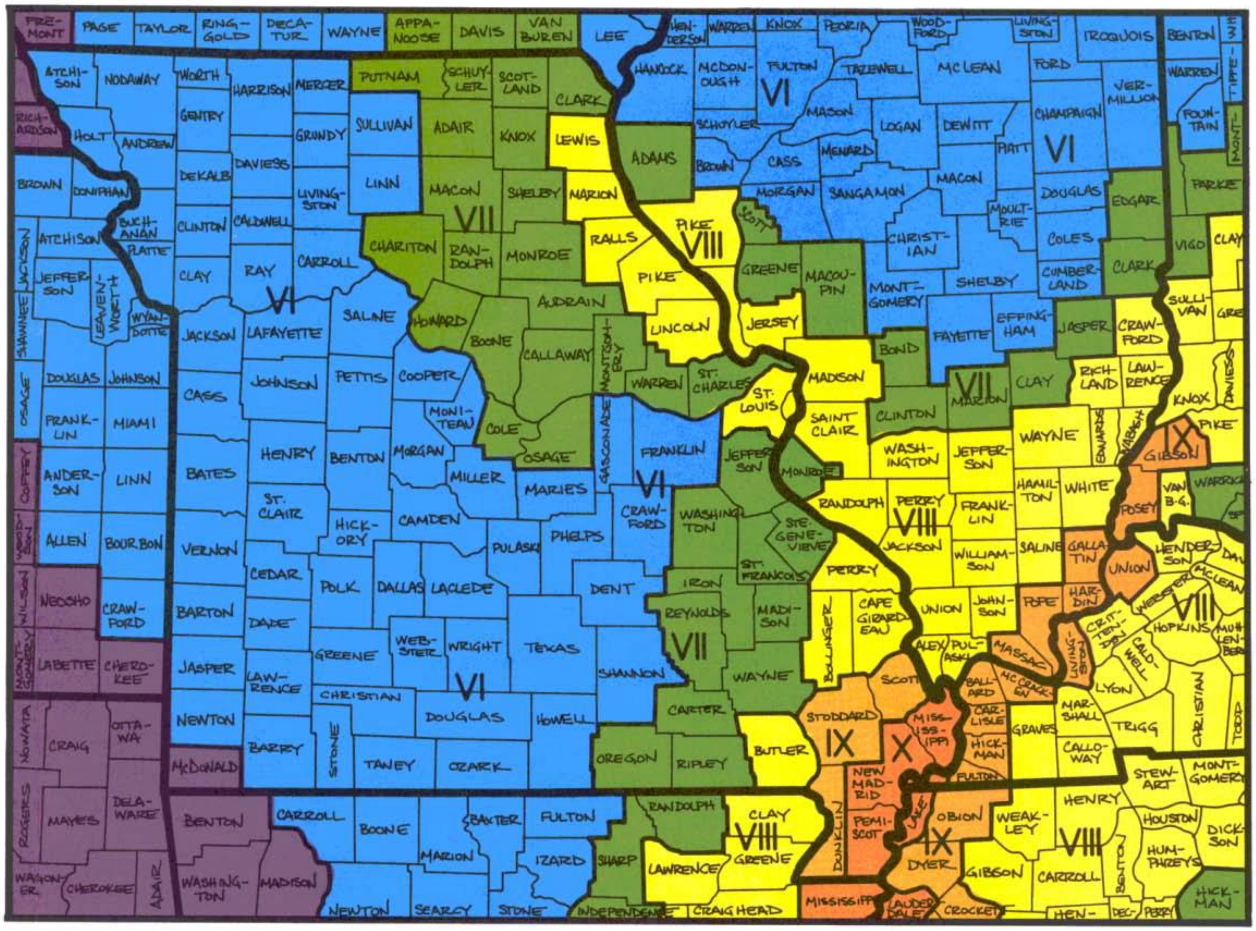
Source: MDNR Publication Geologic Hazards-https://dnr.mo.gov/pubs/pub2467.pdf

Geographic Location

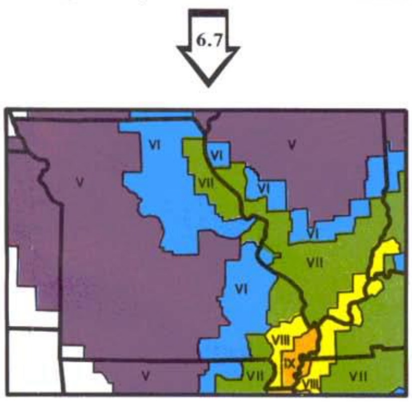
As Gentry County is located near the middle of the North American Continent, far away from mountains, volcanoes, and historic earthquake zones, many incorrectly assume that the community is not subject to the risk of an earthquake. While very infrequent and often only barely detectable, earthquakes can and will occur in the Gentry County area. The potential for damage from earthquakes in the entire state of Missouri comes from the New Madrid fault zone. Data indicates that earthquake intensity will not vary across the planning area, which will be the case in most Missouri counties.

In FIGURE 3.15, the larger map at the top shows that Gentry County would be in Zone VI in the event of an earthquake with a magnitude of 7.6. The smaller maps show that for an earthquake of 6.7, the County lies in Zone V, and for the more severe 8.6 earthquake, the zone would be VII. The projected consequences of an earthquake on locations in each zone are shown in the following explanation of the Modified Mercalli Intensity Scale in FIGURE 3.16.

Figure 3.15. Impact Zones for Earthquake Along the New Madrid Fault

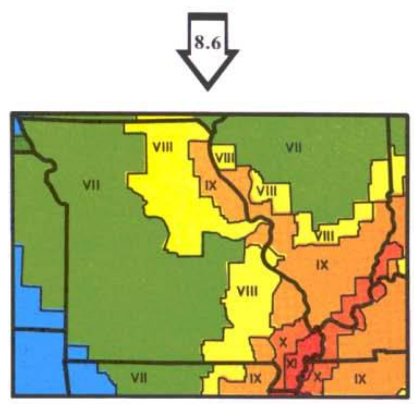


This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude – 7.6 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone.



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 3.16. 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.

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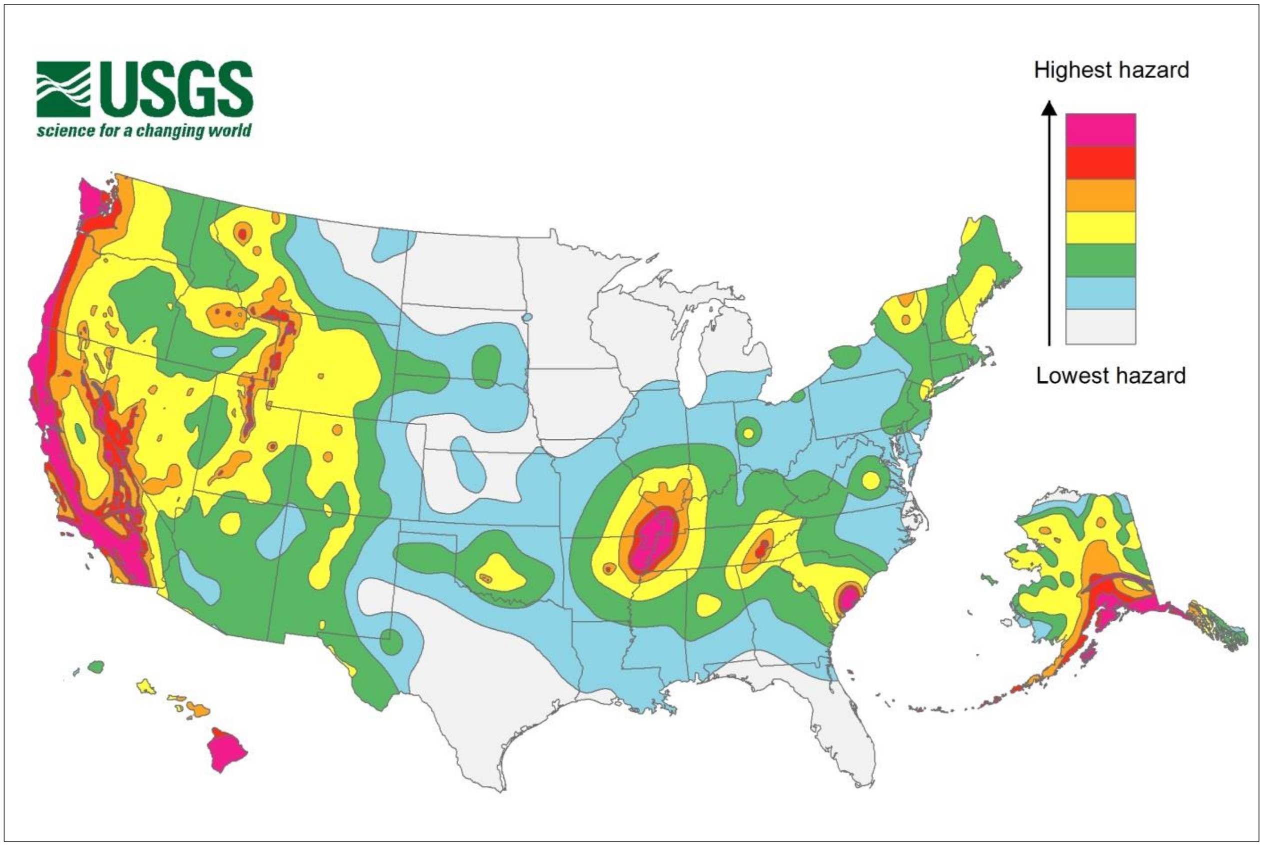
P.O. BOX 116
JEFFERSON CITY, MO 65102
Telephone: 573-526-9100

Gentry County is split between the lowest two risk categories on the following map of seismic hazards, FIGURE 3.17.

Figure 3.17. 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

All jurisdictions have very low earthquake risk, with no recorded earthquakes. No damages have been reported. Three documented M>4 events associated with the Nemaha Uplift were in Lawrence, Kansas in 1867 (magnitude 5.1), Eastern Nebraska in 1877 (magnitude 5.0) and in Enid, Oklahoma in 1952 (magnitude 5.1).

Probability of Future Occurrence

Gentry County is at low risk for earthquake damage. The probability of having an earthquake over 6.8 is near zero. The New Madrid fault is the source of the most intense earthquake activity in Missouri and it is located nearly 500 miles to the south and east of Gentry County. This fault has been under study for some time and seismologists expect that it is only a matter of time before the New Madrid fault moves, creating a substantial earthquake that would affect the entire Midwest region.

TABLE 3.26 below, shows the probability that there will be an earthquake with a magnitude greater than 5.0 in any given year. The risk for all jurisdictions is less than one percent within 50 years.

Table 3.26. Probability of Magnitude 5.0 or Greater Earthquake within 50 Years

Jurisdiction	Probability >5.0 in 50 Years
Albany	0.21%
Darlington	0.23%
Gentry	0.23%
King City	0.26%
McFall	0.20%
Stanberry	0.27%
Gentry County	0.23%

Source: https://www.homefacts.com/earthquakes/Missouri/Gentry-County.html (09/18/2025)

Changing Future Conditions Considerations

From the 2023 State HMP: *Direct effects from changing climate conditions such as an increase in droughts and could contribute to an increase in sinkholes. These changes raise the likelihood of torrential rain and flooding conditions which often lead to the exposure of sinkholes. Certain events such as a heavy precipitation following a period of drought can trigger a sinkhole due to low levels of groundwater combined with a heavy influx of rain.*

Vulnerability

Vulnerability Overview

Besides the risk to human life, earthquakes pose a risk to the buildings and infrastructures of the area. Most homeowner's insurance policies do not cover damage from earthquakes. Those who do have this additional coverage have experienced doubling of premium rates from 2000–2014. This led to a decrease in covered residences from 10.2% in 2000 to 6.9% in 2014. (2015 Missouri Insurance

Report). To assess Gentry County's exposure to this risk, the 2018 Missouri State Hazard Mitigation Plan was used.

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. Additionally, site-specific essential facility data was updated based on 2011 HSIP inventory data.

The estimates for Gentry County show an annualized building loss of $3,000.

A second scenario, based on an event with a 2% probability of exceedance in 50 years, was done to model a worst-case scenario. The methodology is based on probabilistic seismic hazard shaking grids developed by the U.S. Geological Survey (USGS) for the National Seismic Hazard Maps that are included with Hazus. The USGS maps provide estimates of peak ground acceleration and spectral acceleration at periods of 0.3 second and 1.0 second, respectively, which have a 2% probability of exceedance in the next 50 years. The International Building Code uses this level of ground shaking for building design in seismic areas. This scenario used a 7.7 driving magnitude in HAZUS-MH, which is the magnitude used for typical New Madrid fault planning scenarios in Missouri. While the 2% probability of exceedance in the next 50 years ground motion maps incorporate the shaking potential from all faults with earthquake potential in and around Missouri, the most severe shaking is predominately generated by the New Madrid Fault. TABLE 3.27 shows the results of this scenario for Gentry County.

Table 3.27. HAZUS-MH Earthquake Loss Estimation: 2% Probability of Exceedance in 50 Years Scenario for Gentry County

Structural Damage	Non-Structural Damage	Contents Damage and Inventory Loss	Relocation Loss	Total Economic Loss*
$519,000	$875,000	$237,000	$324,000	$2,273,000

*Total economic loss includes the four listed categories plus capital-related loss, wages loss, and rental income loss
Source: 2023 Missouri State Hazard Mitigation Plan

Impact of Previous and Future Development

Liquefaction takes place when loosely packed, water-logged sediments at or near the ground surface lose their strength in response to strong ground shaking. Liquefaction causes the normally solid ground to act like a viscous liquid, unable to support the structures built upon it. Most of the recent development has been in areas of low liquefaction potential. Future development would add to the county's exposure in the event of an earthquake, especially that which occurs in the high potential areas.

Hazard Summary by Jurisdiction

Referring to FIGURE 3.19, it is clear that the number of assets in the high liquefaction potential areas poses a risk if a higher magnitude event were to occur in the County. The City of Stanberry has several residences and critical infrastructure in the higher risk of damage zone. The major highways of US136 and US169 both repeatedly pass through the high potential areas impacting the ability of emergency services to respond. According to 2010 US Census data 35% of the structures in the County were built before 1940. Typically, older homes will sustain more damage than those of more recent construction. The following graph FIGURE 3.18 shows that largest percentage of older homes are located in the lower populated jurisdictions of the County.

Figure 3.18. Location of Older Structures in Gentry County

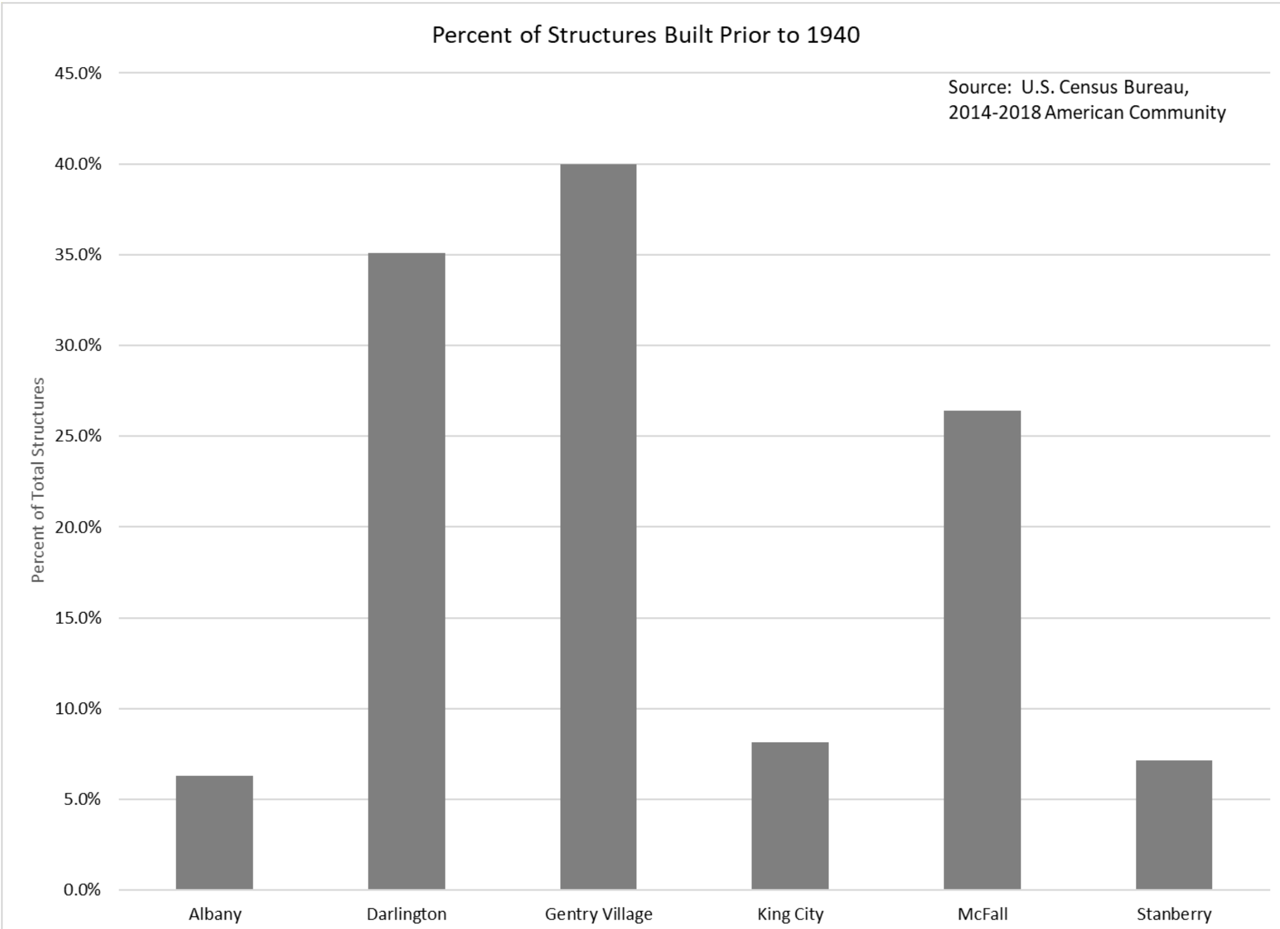
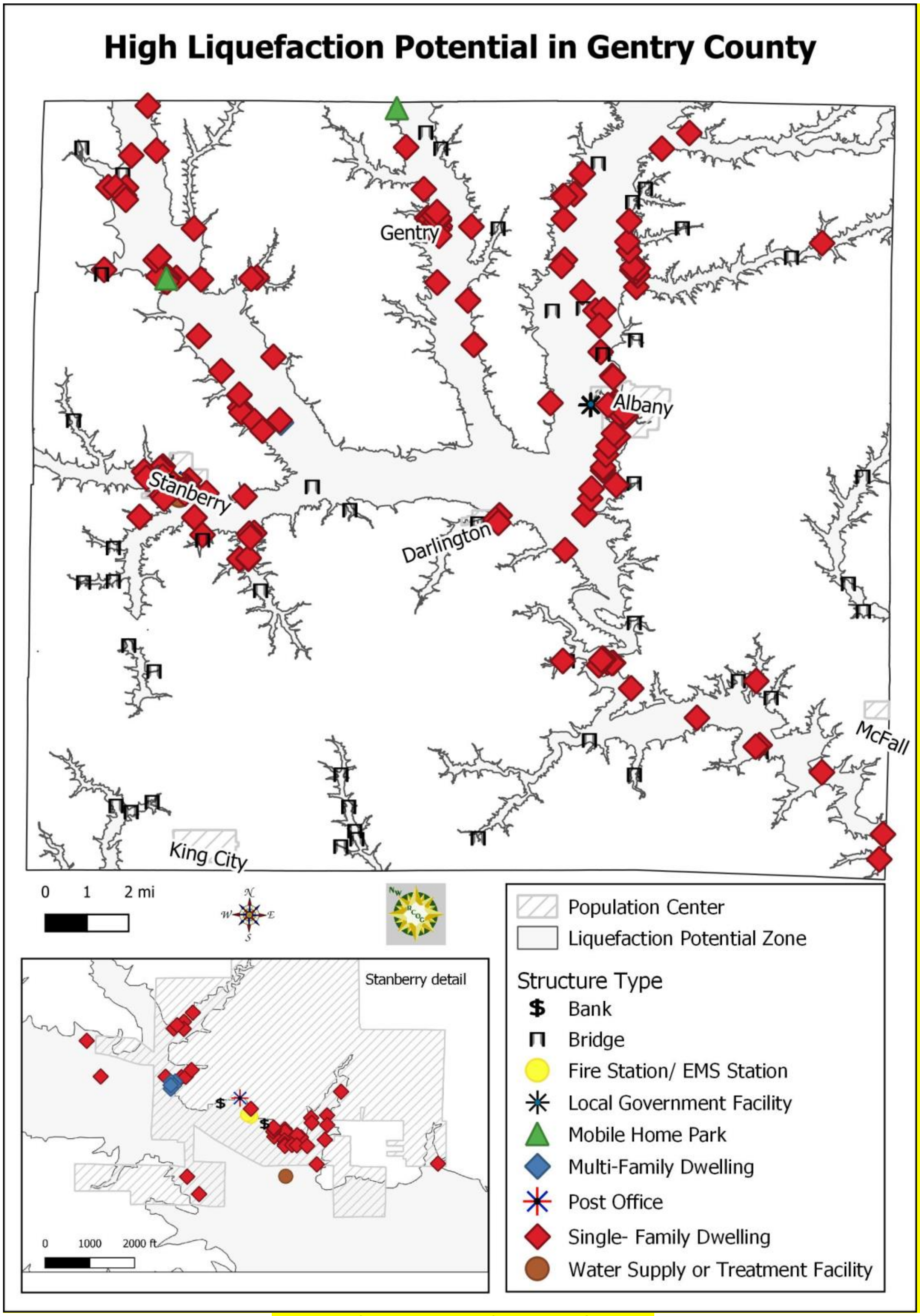


Figure 3.19. Areas of High Liquefaction Potential in Gentry County



Missouri Spatial Data Information Service

Problem Statement

The risk for damages from earthquakes is possible, but unlikely. The history shows that any earthquakes perceived by the population were only minor shaking causing no damages. Residents should be aware that earthquakes can happen on any active fault, large or small. The largest faults are the Nemaha Fault or the New Madrid fault. Earthquakes of higher magnitude might be felt in this area from movement on those two faults.

3.4.5 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.

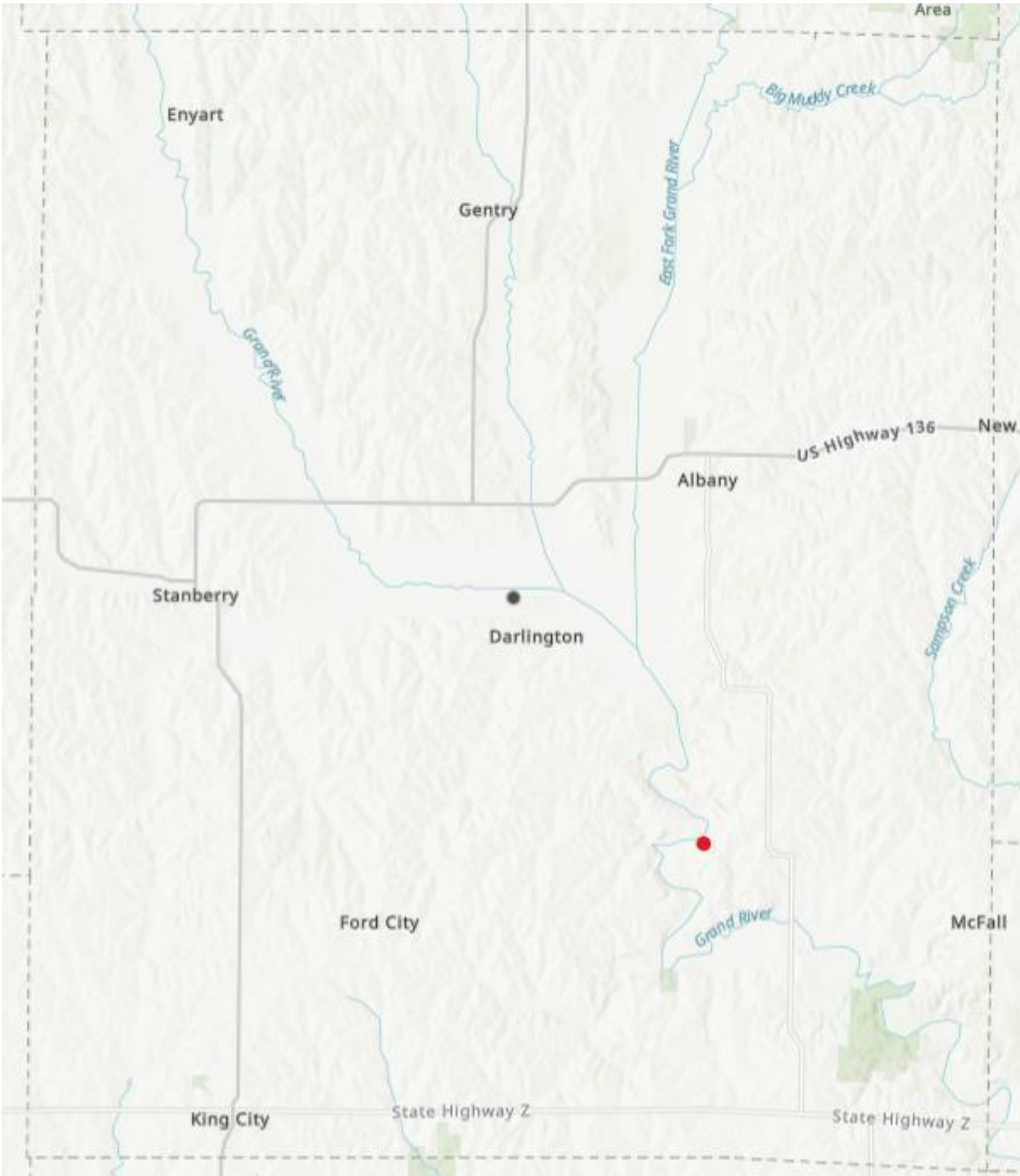
According to the U.S. Geological Survey (USGS), the most damage from sinkholes tends to occur in Florida, Texas, Alabama, Missouri, Kentucky, Tennessee, and Pennsylvania. Fifty-nine percent of Missouri is underlain by thick, carbonate rock that makes Missouri vulnerable to sinkholes. Sinkholes occur 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 is shape like shallow bowls or saucers whereas others have vertical walls. Some hold water and form natural ponds.

According to the 2023 Missouri State Hazard Mitigation Plan, there are 86 mining locations in Gentry County.

Geographic Location

There were two documented sinkhole locations identified on the most recent map available from MSDIS. Located in an agricultural area distant from any structures, the two locations are within feet of each other. The area is about equal distance from Darlington, Albany and McFall, just east of the Grand River. FIGURE 3.20 shows the location of the known sinkholes in Gentry County.

Figure 3.20. Documented Sinkhole Locations in Gentry County



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. Unlike earthquakes or other geologic hazards, there currently is no scale for measuring or determining the severity of sinkholes.

Previous Occurrences

As noted in the 2023 State Plan, sinkholes are a regular occurrence in Missouri, but rarely are events of any significance. There have been two reported events associated with sinkholes in the Gentry County since the last plan update.

Probability of Future Occurrence

With 2 sinkholes being reported over the past 20 years, the probability of future occurrence is 10%.

Changing Future Conditions Considerations

Direct effects from changing climate conditions such as an increase in droughts could contribute to an increase in sinkholes. These changes raise the likelihood of extreme weather, meaning the torrential rain and flooding conditions which often lead to the exposure of sinkholes are likely to become increasingly common. Certain events such as heavy precipitation following a period of drought can trigger a sinkhole due to low levels of groundwater combined with a heavy influx of rain (2023 State Hazard Mitigation Plan).

Vulnerability

Vulnerability Overview

Gentry County is considered to be at low risk for sinkholes. Gentry County has had 2 previous occurrences regarding sinkholes, and there are 84 mines located within the County.

Potential Losses to Existing Development

No hazard areas are known at this time.

Impact of Previous and Future Development

Future development over abandoned mines will increase vulnerability to this hazard.

Hazard Summary by Jurisdiction

Historically, there have only been 2 sinkholes reported in Gentry County- however, due to these being recent occurrences, the likelihood for future sinkholes developing has increased. Although the sinkholes appeared in a primarily agricultural area, the section of the Grand River should be monitored closely for future occurrences, and development of the area should be avoided.

Problem Statement

The absence of karst topography in the County makes the likelihood of this hazard becoming a widespread concern very low. Any development in the area of the documented sinkholes should be avoided.

3.4.6 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.

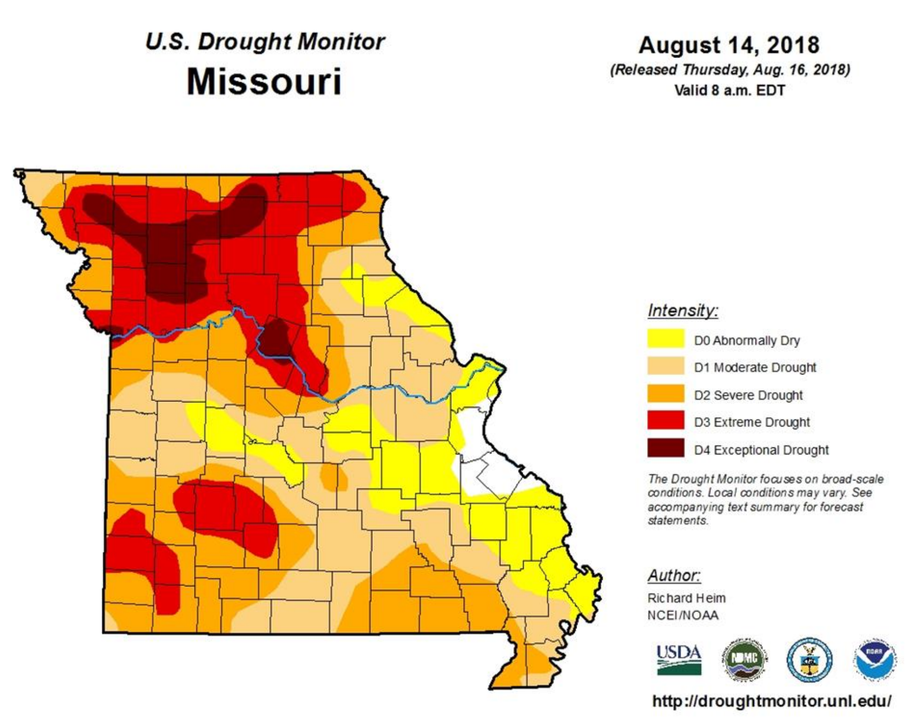
Geographic Location

Northwest Missouri is a region that is subject to drought. The impacts are predominately concentrated in the agricultural sector, but when the drought period extends into the extreme, water supplies for communities are also affected. In 2018, Gentry County experienced a historic drought that affected a large area of the central United States.

Gentry County has 238,570 acres in agriculture. The importance of agriculture in the region's economy is high. The annual market value of Gentry County's agriculture products was $120,233,000 according to the 2017 U.S. Census of Agriculture. Even though the most productive land in the county is found along the rivers and creeks, these areas are located throughout the county so that a drought in any part of the county affects agricultural assets.

FIGURE 3.21 below shows the widespread impact of the 2018 drought. Gentry County was facing extreme and exceptional drought conditions.

Figure 3.21. U.S. Drought Monitor Map of Missouri on August 14, 2018



Source: U.S. Drought Monitor

Strength/Magnitude/Extent

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

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.

The National Drought Mitigation Center uses a scale to show the intensity of drought that goes from D0 to D4. FIGURE 3.22 shows the correlation of this scale to the Palmer Index. Reports from NCEI Storm Database use the D0-D4 scale in their narratives.

Figure 3.22. Drought Intensity Scale Comparison

Category	Description	Possible Impacts	Palmer Drought Severity Index (PDSI)
D0	Abnormally Dry	Going into drought: ▪ short-term dryness slowing planting, growth of crops or pastures Coming out of drought: ▪ some lingering water deficits ▪ pastures or crops not fully recovered	-1.0 to -1.9
D1	Moderate Drought	▪ Some damage to crops, pastures ▪ Streams, reservoirs, or wells low, some water shortages developing or imminent ▪ Voluntary water-use restrictions requested	-2.0 to -2.9
D2	Severe Drought	▪ Crop or pasture losses likely ▪ Water shortages common ▪ Water restrictions imposed	-3.0 to -3.9
D3	Extreme Drought	▪ Major crop/pasture losses ▪ Widespread water shortages or restrictions	-4.0 to -4.9
D4	Exceptional Drought	▪ Exceptional and widespread crop/pasture losses ▪ Shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less

Source: National Drought Mitigation Center

Previous Occurrences

In the past 10 years, Gentry County was subject to periods of drought that resulted in crop indemnities. The year of the highest losses was 2012, when a prolonged drought caused $15,382,739 worth of damage throughout the county with the continuing effects lasting into 2013. The consequences of the 2018 drought shown in FIGURE 3.21 resulted in claims paid out for $4,559,694 in crop losses. The crops affected by drought in Gentry County over the past 10 years were corn, grain sorghum, soybeans, and wheat. TABLE 3.28 shows the amount of the drought losses for each of the past 10 years.

The following FIGURE 3.23 shows the change in drought conditions from the earlier 2018 illustration.

Figure 3.23. U.S. Drought Monitor Map on August 18, 2020

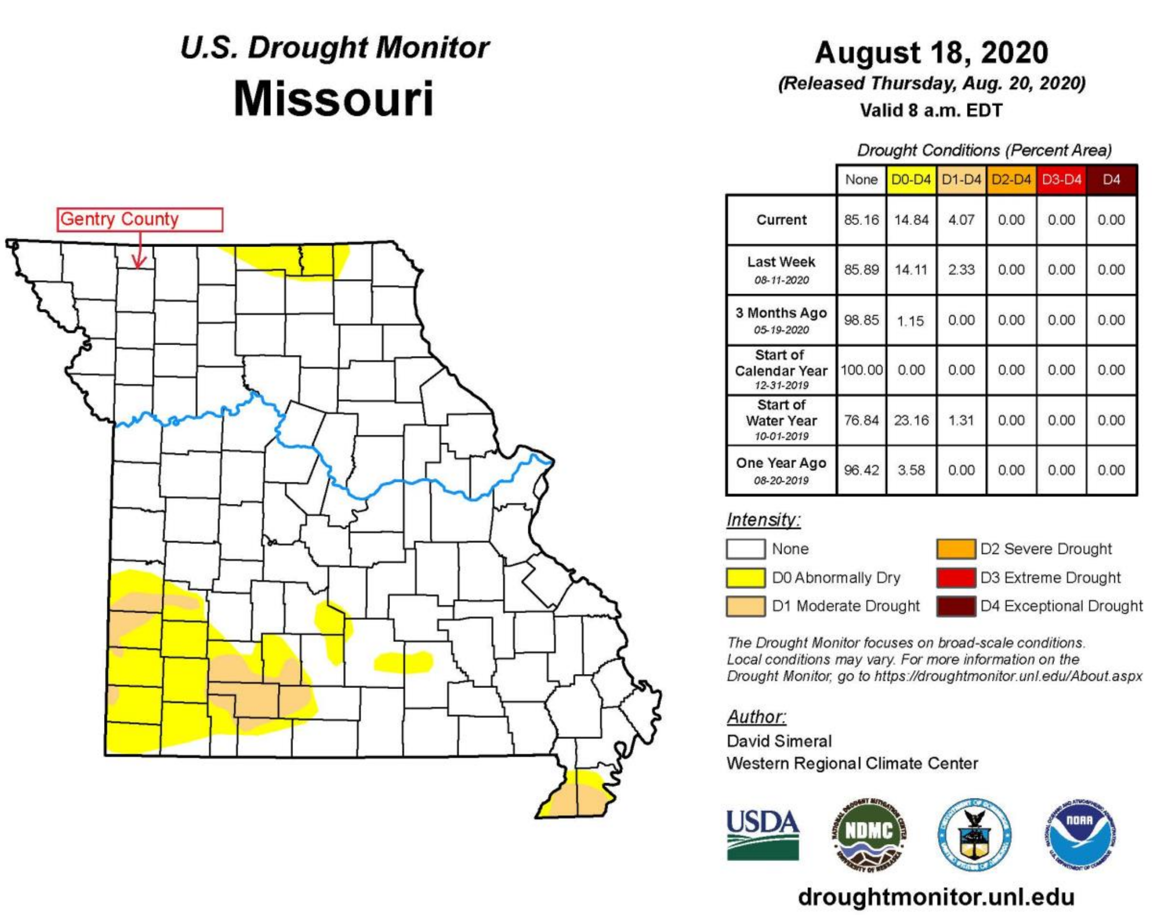


Table 3.28. USDA Indemnity Payments for Losses due to Drought 2010-2019

Year	Crop	Losses
2010	Soybeans	$2,278
2011	Corn	$250,810
	Soybeans	$398,266
	Wheat	$11,857
2012	Grain Sorghum	$12,552
	Corn	$10,822,619
	Soybeans	$4,547,568
	Wheat	$1,337
2013	Corn	$4,207,831
	Grain Sorghum	$4,764
	Soybeans	$3,989,791
2014	Wheat	$6,555
2015	Corn	$10,641
	Soybeans	$3,464
2016	Soybeans	$20,046
2017	Corn	$73,319
	Soybeans	$105,247
2018	Corn	$2,132,893
	Soybeans	$2,422,375
	Wheat	$4,426
2019	Corn	$2,449
Total		$29,031,088.00

Source: USDA Risk Management Agency
http://www.rma.usda.gov/data/cause.html

According to the Storm Database of the NCEI, there have been five periods of drought in the past 20 years. The information from the Storm Events Database is summarized in TABLE 3.29. A short period in 2000, then an extended period from 2012 through mid-2013. The drought resumed in 2013-2014. Drought returned in mid to late 2018. The last drought during this period was during the last months of 2023. The period in 2012-2013 and in 2018 brought hardships to crop and livestock farmers in the County. Pastures and water supplies dried up resulting in the liquidation of numerous livestock operations.

Table 3.29. Drought Report Events for Gentry County 2000-2025

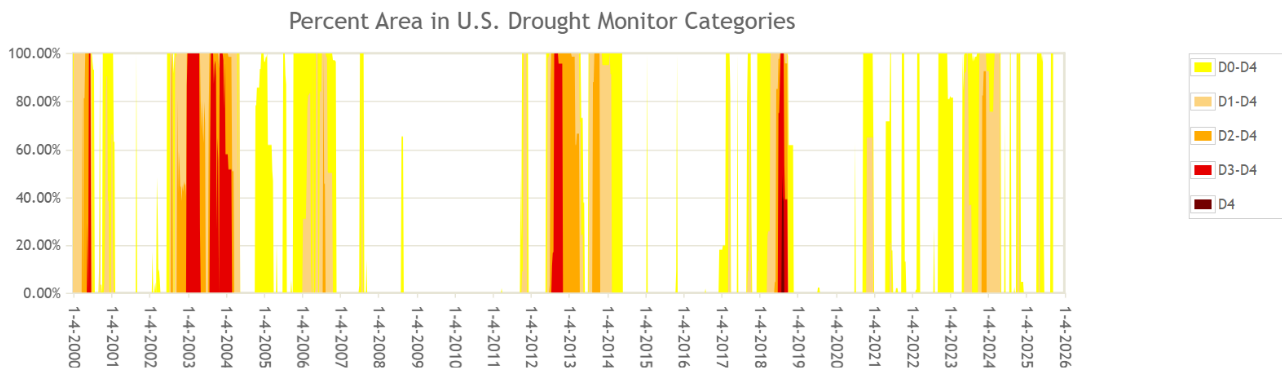
Duration	Report Date	Event Report
July 1999 to February 2001	April, 2000	April 2000 was the driest on record in the state of Missouri, according to the Midwestern Climate Center. The areas hardest hit by the long-term drought were along Missouri's northern border, where rainfall deficits had reached 15 to 20 inches.
June 2012 to April 2013	July, 2012	Below normal precipitation continued through July, with D2 severe drought conditions across the county. Albany reported 2.09 inches of rain for the month. Stanberry reported 1.44 inches of rain for the month.
	August, 2012	Below normal precipitation continued through August, with D3 extreme drought conditions across the county. Albany reported 2.39 inches of rain for the month.
	September, 2012	The remnants of Hurricane Isaac brought some much-needed relief to drought conditions across the area, on the 1st of September. This helped improve drought conditions from D4 and D3 to D3 and D2. Rainfall totals with the remnants of Isaac, ranged from around one inch near the Iowa border
	November, 2012	The drought continued across the area during the month of November. Slight improvement was noted, with D1 to D2 conditions prevailing. Rainfall deficits were generally in the 10 to 16-inch range for the year.
	February, 2013	Short-term drought conditions continue to improve over northern Missouri, through the month of February 2013. Recent rains and snowstorms have led to this improvement in the short-term, with retention ponds, streams, and rivers, beginning to return to normal or near normal levels. Long-term impacts continue to be the prevailing source for our drought conditions, but with the magnitude of the recent snow melt and rains, even the long-term impacts have diminished. As a result, a one category improvement to moderate drought (D1) was made, across mostly north central and central Missouri. The rest of the area also improved but remained in severe drought (D2) conditions.
August through November 2013	September 2013	A persistent upper-level ridge of high pressure centered over the lower Missouri Valley, in late August, caused D2 drought conditions to redevelop across portions of north central Missouri.
May 2018 through October 2018	June 2018	Starting at the very end of May and going into June, the US Drought Monitor at the University of Nebraska declared portions of Gentry County in a D2 or worse drought.
	August 2018	Gentry County reached or maintained D4 drought status for the entire month. While rain did move into the area through the month, the ground was dry enough from the below normal precipitation and above normal temperatures throughout the month to warrant D4 status maintenance. The direct impact to Gentry County is unclear, but statewide drought impacts are estimated around 2 billion dollars, per The University of Missouri Extension Center. The drought has also hurt pastures, with about three-quarters in poor or very poor conditions, according to the USDA report. Many pastures haven't been able to support grazing cattle, prompting farmers to feed cattle with hay that might normally be saved for winter. It's also hurt the hay crop, which is down about one-third from normal. The 2018 drought is turning out small corn ears. Some farmers are not waiting until harvest, instead trying to get the most out of the crop by baling it or cutting it for silage for cattle. Farmers can now clean out sediment in ponds to increase water-holding capacity. Ponds in the conservation program are built for erosion control.
November 2023 to December 2023	November 2023	Drought conditions worsened to severe drought (D2) for Gentry, Nodaway, and Andrew Counties in NW Missouri beginning with the Nov 14th installment of the US Drought Monitor. This continued through the end of the month.
	December 2023	Severe drought continued through much of December for portions of western Missouri before improving by late December.

Source: NCEI Storm Event Database Accessed 09/232025

Probability of Future Occurrence

Data from the year 2010–2025 period was available for analysis from the National Drought Mitigation Center. There is a 70% probability that the entire county will experience drought conditions of at least D1 drought. Based on this data, there is a 40% probability of the county being subjected to D2 conditions and a 20% chance of a D3 drought covering 100% of Gentry County. This data is shown in FIGURE 3.24. Although drought is not predictable, long-range outlooks and predicted impacts of climate change could indicate an increased chance of drought.

Figure 3.24. Percent of Area Affected by Drought 2000-2025



Changing Future Conditions Considerations

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. Although springtime in Missouri is likely to be wetter, summer droughts are likely to be more severe. Higher evaporation and lower summer rainfall are likely to reduce river flows. 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 drought. This could lead to agricultural drought and suppressed crop yields.

Vulnerability

Vulnerability Overview

The Missouri Drought Plan divided the state into four regions of susceptibility based on water resources and climate data. Most of northern Missouri, including Gentry County fell into Region C. This is how the Missouri Drought Plan described Region C: "Region C has severe surface and groundwater supply drought vulnerability. Surface water sources usually become inadequate during extended drought. Groundwater resources are naturally of poor quality and typically only supply enough water for domestic needs. Irrigation is generally not feasible." See FIGURE 3.25.

Figure 3.25. Drought Susceptibility Map

Water Resources Report Number 44 https://dnr.mo.gov/pubs/WR44.pdf

Agricultural assets are the most readily susceptible to drought. The agricultural assets are in the unincorporated areas of Gentry County. However, many of the other businesses in the incorporated parts of the county rely on a strong agricultural economy to ensure their success. Therefore, the most of county is vulnerable to the effects of a prolonged drought.

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.

From 1995 to 2024, $78,135,000 was paid to Gentry County farmers for losses. This is an annualized amount of $2,604,500. This figure is the baseline for estimating potential loss due to drought on an annual basis with the realization that losses related to livestock and other businesses is not included in this amount.

Impact of Previous and Future Development

Although the reported number of acres in cropland in Gentry County has decreased between the 2012 and 2017 Ag Census, the net cash farm income produced on the remaining acres has increased 84%. Gentry County is the 16th largest livestock producer in the state. Due to declining population growth in most communities and a trend of fewer acres of cropland planted, the potential losses due to drought should remain steady or decrease slightly, depending on current market value of the crops.

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 because 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. This study shows a moderate risk of water shortage in 2050 for Gentry County.

Hazard Summary by Jurisdiction

As discussed previously, the risk to agricultural assets is spread throughout the unincorporated portions of the county. Gains have been made in the county to provide a reliable source of water to all areas with the expansion of the rural water systems in both capacity and in coverage.

Problem Statement

Drought is a moderate risk to farming in any year in all jurisdictions in Gentry County. It is not a predictable hazard, but it is a hazard that can have lasting impact. Livestock is particularly susceptible to severe drought and farmers are often obligated to sell off their herds because they do not have access to adequate water supply. Crop insurance is the best way to provide protection from crop losses in times of drought. Conservation of the water supply, planting drought-resistant hybrid crops, and utilizing moisture-conserving farming methods will help farmers to endure drought conditions as is shown in the historical data presented. Communities should continue their efforts to cooperatively interconnect their water distribution systems with neighboring districts to help ensure water supply to drought-stricken areas when needed.

3.4.7 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 3.26 uses both of these factors to produce a guide for the apparent temperature or relative intensity of heat conditions.

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

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

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

Geographic Location

Location within the county is not a factor when facing an extreme temperature event. Specific climatic factors, such as the two previously discussed, temperature and humidity, along with wind and sun/shade determine the effects of this hazard. An individual's physical condition has a profound effect on his/her ability to deal with excessive temperatures. Illness or heavy exercise adds to the metabolic heat that the body must dissipate. Age is also a contributing factor. The accessibility of air-conditioned and heated shelters is important to those falling into at-risk groups.

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 nighttime 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. 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 3.26 uses both factors to produce a guide for the apparent temperature or relative intensity of heat conditions.

Figure 3.26. Heat Index (HI) Chart

NWS Heat Index

Temperature (°F)

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

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution / Extreme Caution / Danger / Extreme Danger

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. The figure below presents wind chill temperatures which are based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature. FIGURE 3.27 provides the NOAA Wind Chill Chart.

Figure 3.27. Wind Chill Chart

Wind Chill Chart

Temperature (°F)

Wind (mph) / Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes / 10 minutes / 5 minutes

$$\text{Wind Chill } (°F) = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

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

Previous Occurrences

For the 25-year period, 2000-2025, the National Weather Service has issued warnings for heat events 12 times. Information regarding those events is shown in TABLE 3.30.

Table 3.30. NCEI Recorded Heat Events from 2000–2025 for Gentry County

Start of the event	Duration in days	Details
August 28, 2000	7	Heat indices as high as 110 degrees
July 6, 2001	3	Dew points as high as 80 degrees, 2 deaths in KC area
July 17, 2001	8	Oppressive heat and humidity, 2 elderly deaths in KC
August 1, 2001	5	4 fatalities in the KC metro area due to heat
August 9, 2001	1	Afternoon heat indices ranged from 105 to 110 degrees. One death
July 14, 2003	5	Oppressive heat and humidity with heat indices to 110 degrees
July 21, 2005	5	Heat indices reached from 105 to 110 degrees
July 16, 2006	5	Heat indices from 105 to 115 degrees, highest heat index 121
July 29, 2006	6	Heat indices from 105 to 115 degrees
August 6, 2007	11	The combination of heat and humidity produced heat index readings in the 105 to 115 degree range.
July 18, 2012	7	Temperatures topped out from 100 to 110 degrees.
August 19, 2023	7	Heat indices ranged from 110-120 degrees

Source: NCEI Storm Event Database (09/23/2025)

The following, TABLE 3.31, shows the cold extreme temperature events recorded for the County.

Table 3.31. NCEI Recorded Cold Events from 2000–2015 for Gentry County

Start of the event	**Duration in days**	**Details**
October 6, 2000	4	An unusually strong early season Arctic high pressure system built into the central Plains with below freezing for 5 consecutive days and record low temperatures
December 10, 2000	21	Temperatures remained below freezing throughout the entire period. Snow cover persisted from the 13th through the end of the month.
February 6, 2014	1	Cold temperatures and north winds combined to bring wind chill values down to around 30 below zero.
February 14, 2021	3	In the first night of bitter cold across the area, temperatures dropped well below zero and with winds around 10-20 mph wind chills overnight going into Sunday morning dropped to around 20 to 30 below.
December 12, 2022	2	An arctic air mass sent temperatures below zero along with strong winds. Minimum wind chills across the region generally ranged from -30 to -40 degrees between roughly 10 am on 12/22 to noon on 12/23.
January 12, 2024	5	The coldest wind chill recorded during this cold air outbreak at Lamoni was -44 degrees at 6 AM on Jan 14th. This was the coldest wind chill at Lamoni since Jan 20, 1985 (-45). The 4-day period of Jan 13-16 was the 7th coldest 4-day period on record in Lamoni, with an average temperature of -7.3 degrees. (Period of record begins Aug 13, 1897).
February 18, 2025	4	The ASOS at St. Joseph airport reported a minimum wind chill of 23 degrees below zero at 8z on Feb 20th (temp of minus 7). Wind chills of -17 or colder were reported for multiple time frames between Feb 18 and Feb 20.

7 events	40 days	

Source: NCEI Storm Event Database (09/29/2025)

Probability of Future Occurrence

The likelihood of an excessive heat event in Gentry County over any given summer is likely. Limited data identifying such events makes it difficult to calculate reliable probability results. Based on data available, there were twelve events in a 25-year period. The probability of an event in any given year is 48% with past events averaging a length of 6.6 days. Data analysis was based on NCEI events occurring between 2000 and 2025. The same period of time and data source was used to analyze cold events. Although wind chill watches and warnings are issued for the area a few times during most winters, these do not show up in the NCEI Storm Database. Based on available data, 6 events occurring over 25 years, there is 24% chance of a cold event of three consecutive days or longer.

Changing Future Conditions Considerations

Under a higher emissions pathway, historically unprecedented warming is projected by the end of the century. Even under a pathway of lower greenhouse gas emissions, average annual temperatures are projected to most likely exceed historical record levels by the middle of the 21st century. Temperature increases will cause future heat waves to be more intense, a concern for this region which already experiences hot and humid conditions.

Vulnerability

Vulnerability Overview

All jurisdictions (municipalities and educational institutions) within the county are equally susceptible to damage stemming from a heat wave as these types of events tend to be regional in nature. With the main agriculture crops of corn and soybeans, farmers are at the mercy of the weather patterns to provide sufficient growing degree days without excessive heat or hot winds, to produce sufficient yields to make a profit.

Extreme temperatures can cause stress for crops and animals. Extreme temperatures can also strain electricity delivery infrastructure overloaded during peak use of air conditioning and furnaces during extreme 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. Extreme cold temperatures can also lead to infrastructure damage.

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

Table 3.32. 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 is highly likely with continued exposure

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

Potential Losses to Existing Development

According to the USDA Risk Management Agency, insured crop losses throughout the State of Missouri because of excessive heat for the eleven-year period of 1998–2008 totaled $13,751,457. Excessive heat ranked 6th in the State for insured crop losses. From 2000 to 2010, drought and heat were the source of about 31% of the crop losses in Missouri by indemnity payments. In addition, hot winds in Missouri caused $885,893 in insured crop losses from the same timeframe (2013 State of Missouri HMP).

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. Many of the smaller communities have experienced declining populations according to the 2020 census with an increasing average age of residents.

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 2019–2023 ACS 5-Year Estimates 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 3.33, below, summarizes vulnerable populations in the different jurisdictions Note that the school districts are not included in the table because students and those working for districts are not customarily in these age groups. Most of those persons at risk are closely split percentage wise between the incorporated and the unincorporated areas of the county.

Table 3.33. Gentry County Population Under Age 5 and Over Age 65, 2023 Estimates

Jurisdiction	Population Under 5 yrs.	Percent Under 5 yrs.	Population 65 yrs. and over	Percent Over 65 yrs.
Albany	140	7.5	412	22.2
Darlington	0	0	7	20.0
Gentry	5	7.0	0	0
King City	32	4.3	128	17.2
McFall	15	11.1	11	8.1
Stanberry	82	6.9	194	16.4
Unincorporated areas	154	7.0	414	18.9
Totals	428	6.9	1,166	18.7

Source: U.S. Census Bureau, 2019–2023 ACS 5-Year Estimates

While Gentry County mirrors the state and national averages on population percentage under 5 years of age, the percentage of residents over 65 years of age is higher. Two jurisdictions and the unincorporated areas top the State of Missouri statistic of 18.7% and the United States number of 18.0% of the population aged 65 years or greater. The jurisdictions of Gentry and McFall also have drastically lower population percentages below the state and national average.

Schools have improved their facilities by adding air conditioning and other upgrades to maintain an environment that is safe for the county's youth. The same is true for the nursing home facilities in the county. Some of the smaller communities in the county have informal systems of monitoring their older residents during prolonged periods of extreme temperatures.

Problem Statement

All jurisdictions within the county are equally susceptible to damage stemming from a heat wave as these types of events tend to be regional in nature. The large percentage of residents that are over 65 years of age means that many are at risk during extreme heat events. The rural nature of the county does work in its favor, as statistically more deaths occur in urban areas during a heat wave. Jurisdictions should include mitigation strategies which include the opening of cooling centers in case of a severe heat event. As with extreme cold temperatures, special consideration must be given to the potential impact upon the young, disabled, and elderly populations. Overutilization of the electrical power grid during heat waves can lead to brownouts or power failures. Gentry County should continue to provide cooling centers or portable fans for the elderly and those populations without air conditioning during sustained high temperatures. Availability of cooling stations will reduce the threat of heat stroke due to hyperthermia in vulnerable groups of the population.

3.4.8 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 3.4.1) and tornadoes (discussed separately in 3.4.10).

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

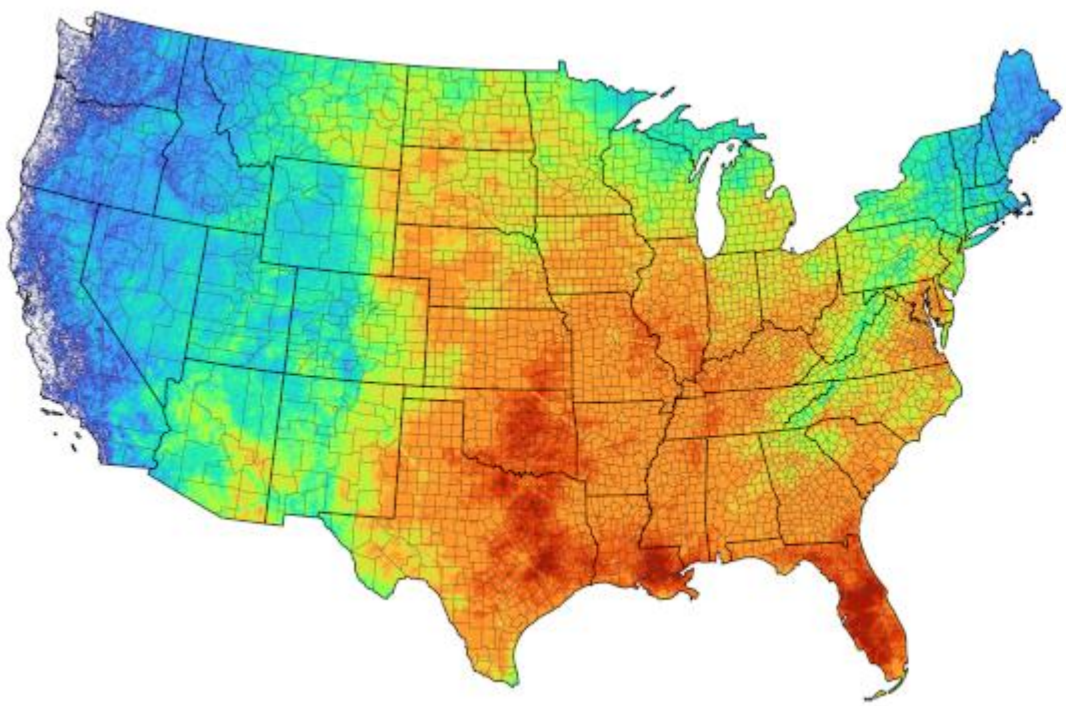
According to the National Oceanic and Atmospheric Administration (NOAA), hail is precipitation that is formed when thunderstorm updrafts carry raindrops upward into extremely cold atmosphere causing them to freeze. The raindrops form into small frozen droplets. They continue to grow as they come into 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.

Gentry County's location in the Midwest puts it in an area where lightning storms are common. The county can expect about 19 flashes per square mile on average each year as shown in the map below in FIGURE 3.28.

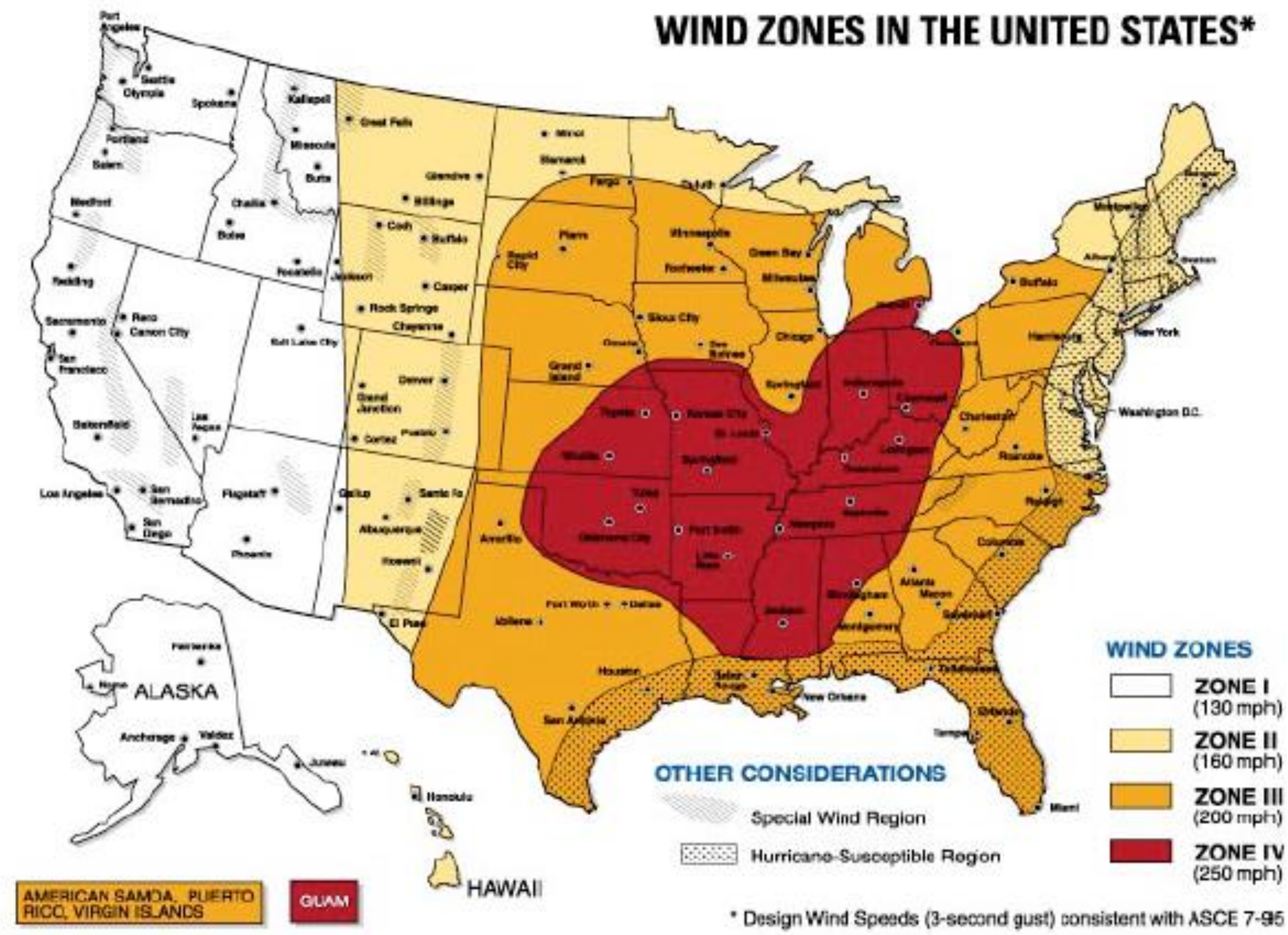
Figure 3.28. Location and Frequency of Lightning in Missouri



Source: National Weather Service

The wind zone map (FIGURE 3.29) shows that the entire state of Missouri is in Zone IV with winds up to 250 miles per hour. Gentry County, located in the northwest part of the state, is well within this highest velocity zone.

Figure 3.29. 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

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 most 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.

Based on information provided by the Tornado and Storm Research Organization (TORRO), TABLE 3.34 below describes typical damage impacts of the various sizes of hail.

Table 3.34. Tornado and Storm Research Organization Hailstorm Intensity Scale

Intensity Category	Diameter (mm)	Diameter (inches)	Size Description	Typical Damage Impacts
Hard Hail	5-9	0.2-0.4	Pea	No damage
Potentially Damaging	10-15	0.4-0.6	Mothball	Slight general damage to plants, crops
Significant	16-20	0.6-0.8	Marble, grape	Significant damage to fruit, crops, vegetation
Severe	21-30	0.8-1.2	Walnut	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
Severe	31-40	1.2-1.6	Pigeon's egg > squash ball	Widespread glass damage, vehicle bodywork damage
Destructive	41-50	1.6-2.0	Golf ball > Pullet's egg	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
Destructive	51-60	2.0-2.4	Hen's egg	Bodywork of grounded aircraft dented, brick walls pitted
Destructive	61-75	2.4-3.0	Tennis ball > cricket ball	Severe roof damage, risk of serious injuries
Destructive	76-90	3.0-3.5	Large orange > Soft ball	Severe damage to aircraft bodywork
Super Hailstorms	91-100	3.6-3.9	Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
Super Hailstorms	>100	4.0+	Melon	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

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

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

The tables below (TABLE 3.35 through TABLE 3.36) summarize past crop damages as indicated by crop insurance claims. The tables illustrate the magnitude of the impact on the planning area's agricultural economy.

Table 3.35. Crop Insurance Claims Paid from Thunderstorms, 2010—2019

Crop Year	Cause of Loss Description	Insurance Paid
2010	Excess Moisture/Precip/Rain	$1,083,055
2011		$99,159
2012		$145,107
2013		$831,206
2014		$1,083,859
2015		$10,937,656
2016		$1,731,492
2017		$2,206,750
2018		$228,586
2019		$4,630,111
	Total	$22,976,981

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

Table 3.36. Crop Insurance Claims Paid from High Winds, 2009—2018

Crop Year	Cause of Loss Description	Insurance Paid
2010	Wind/Excess Wind	$0
2011		$104,687
2012-2013		$0
2014		$775
2015		$0
2016		$5,777
2017		$520
2018-2019		$0
Total		$111,759

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

Table 3.37. Crop Insurance Claims Paid from Lightning, 2010—2019

Crop Year	Cause of Loss Description	Insurance Paid
2010–2019	Other (Lightning, etc.)	$0
Total		$0

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

Table 3.38. Crop Insurance Claims Paid from Hail, 2010—2019

Crop Year	Cause of Loss Description	Insurance Paid
2010	Hail	$0
2011		$478,401
2012-2013		$0
2014		$2,305
2015		$5,247
2016		$130,533
2017		$17,159
2018		$19,289
2019		$0
Total		$652,934

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

The total amount collected from federal crop insurance from 2010–2019 for damages from all thunderstorm perils was $23,741,674. The only precaution available to farmers is to insure their crops against damage. 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 two tables, TABLE 3.39 and TABLE 3.40 show the reported thunderstorm hail and wind episodes that occurred during the ten-year period 2008-2017. There were no reports for lightning or heavy rain. Limitations to using NCEI data for these events are reported lightning events include the only lightning events that result in fatality, injury and/or property and crop damage. Stanberry Schools reported lightning damage of $20,000 to electronic equipment in 2019. Heavy rain events usually coincide with flooding events and those events are discussed the hazard section on floods. NCEI relies not only on law enforcement and trained spotters to report storms, but also on input from the public. The information is often estimations and when a zero is recorded in the property damage column that means that the amount is unknown.

Table 3.39. Gentry County Hail Events (diameter 1 inch or greater), 2015-2025

Date	Size (inches)	Locations	Deaths/ Injuries	Property Damage ($)
6/21/2015	1	McFall	0/0	0
7/10/2017	1.75	Albany	0/0	0
6/7/2022	2	Unincorporated areas, Stanberry, Darlington	0/0	0
5/6/2023	1.5	Albany	0/0	0
8/11/2023	1.75	Gentry	0/0	0
5 days with events				

Source: NCEI, data accessed 9/29/2025

Table 3.40. Gentry County Thunderstorm Wind Events, 2015-2025

Date	Estimated Wind (mph)	Locations	Deaths/ Injuries	Property Damage ($)
6/11/2015	60	Unincorporated areas	0/0	$0
8/8/2015	60	Stanberry	0/0	$0
3/23/2016	60	Unincorporated areas	0/0	$0
3/6/2017	75	McFall, rural areas	0/0	$0
6/16/2017	65	Albany	0/0	$0
6/28/2017	70	Unincorporated areas	0/0	$0
6/11/2018	60	Unincorporated areas	0/0	$0
8/6/2018	65	Unincorporated areas	0/0	$0
5/27/2019	65	Stanberry	0/0	$0
7/30/2021	60	McFall	0/0	$0
6/29/2023	81	Stanberry, Albany	0/0	$0
7/29/2023	64	Stanberry, McFall	0/0	$0
6/25/2024	64	Albany	0/0	$0
13 events, Average wind speed of 65 mph				

Source: NCEI, data accessed 9/29/2025

Probability of Future Occurrence

Based on information from the National Centers for Environmental Information (NCEI) there has been an annual average of 1.3 days of thunderstorm wind activity in Gentry County during the previous ten-year period. During this period there was a 90% probability of a hail-storm event with one-inch or larger hailstones. The database provided by NCEI did not contain reports of lightning for the ten-year period. However, as has been discussed earlier, this database does not report these events unless there is a confirmed fatality or property damage because of the event. The data from the 2023 Missouri HMP put the annual likelihood of high winds at 3.3% and for hail at 3.1%, and FEMA's National Risk Index lists Gentry County's Hail Risk as Relatively Moderate.

Changing Future Conditions Considerations

Predicted increases in temperature could help create atmospheric conditions that are fertile breeding grounds for severe thunderstorms and tornadoes in Missouri. NASA's Earth Observatory provides an analysis on how climate change could, theoretically, increase potential storm energy by warming the surface and putting more moisture in the air through evaporation. Possible impacts include an increased risk to life and property in both the public and private sectors.

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 (2023 State Hazard Mitigation Plan).

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.

Potential Losses to Existing Development

The factors used to arrive at the vulnerability rating are summarized in TABLE 3.41. The overall vulnerability rating given to Gentry County was 2, Low Medium.

Table 3.41. Gentry County Exposure to Severe Thunderstorms

Housing Units/sq. mi.	Total Building Exposure	Mobile Homes	Social Vulnerability Index (1-5)
6.53	$734,656,000	4%	4 (medium-high)

Source: 2023 Missouri State Hazard Mitigation Plan

The main potential loss to the County due to thunderstorms is damage to crops with an annualized loss of $2,374,167. Using the 2018 MO HMP data summarized in TABLE 3.41, above, the average annual property due to thunderstorm hail is $266,667 and for wind is $6,164.

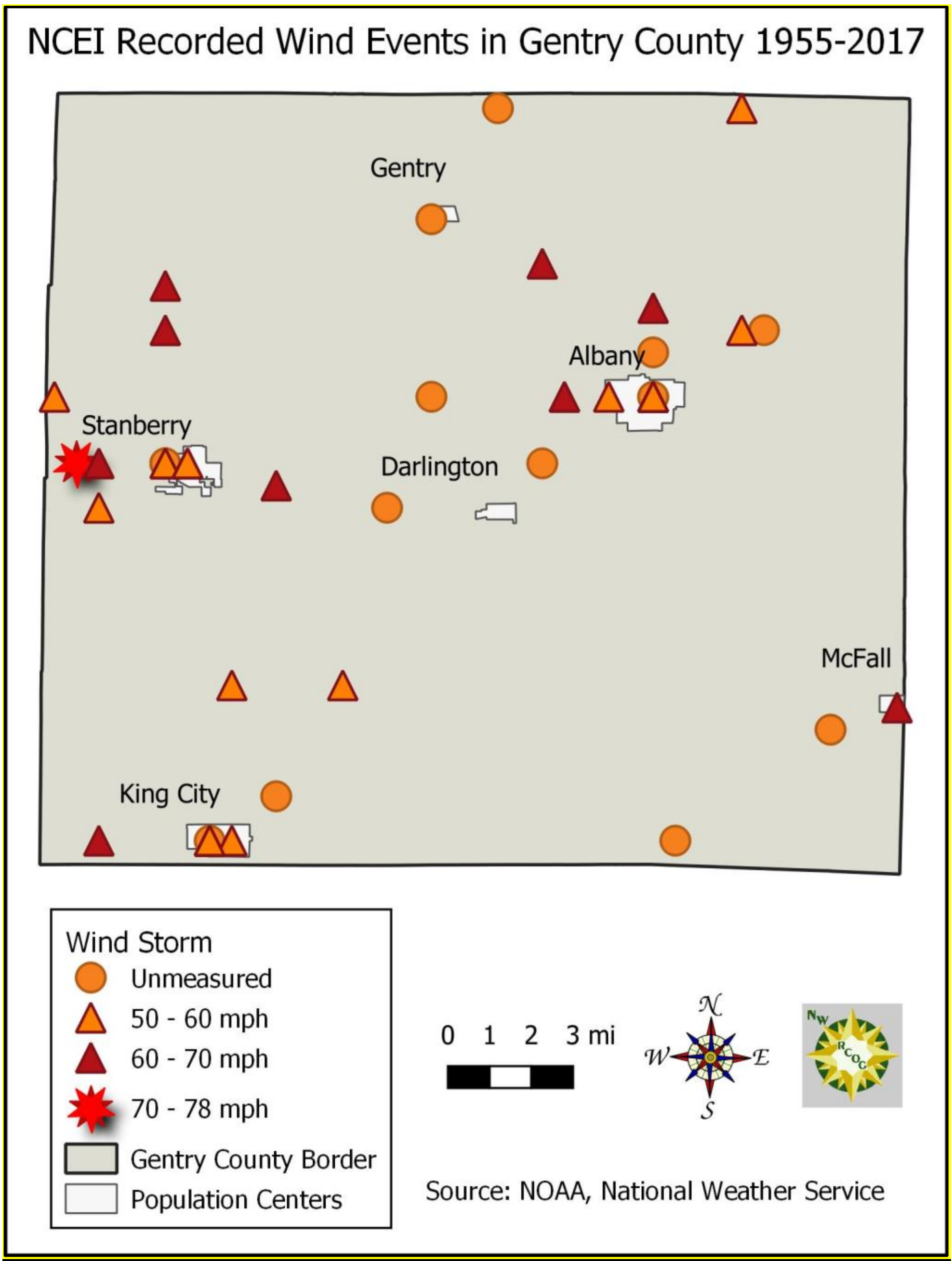
Previous and Future Development

Additional development results in the exposure of more homes and businesses to the threat of damage from thunderstorms. With the declining population trend for most of the County, no significant development is anticipated. The amount of crop acreage vulnerable to damage is expected to remain steady.

Hazard Summary by Jurisdiction

The hazards from thunderstorms are county-wide. The narratives from the NCEI database included storms affecting all parts of the county with equal likelihood. The following map, FIGURE 3.30, shows the location and magnitude of windstorms affecting Gentry County.

Figure 3.30. Location and Magnitude of Gentry County Windstorms



Problem Statement

Early warnings are possibly the best hope for residents when severe weather strikes. Cities that do not already possess warning systems should plan to purchase a system. Additional public awareness also includes coverage by local media sources. Local governments should encourage residents to purchase weather radios to ensure that everyone has sufficient access to information in times of severe weather. Storm shelters are another important means of mitigating the effects of severe thunderstorms. A community-wide shelter program should be adopted for residents who may not have adequate shelter in their homes. Residents should also be encouraged to build their own storm shelters to prepare for emergencies. Early warnings and available safe rooms will reduce the number of residents at-risk of injury or death from this type of hazard.

3.4.9 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.

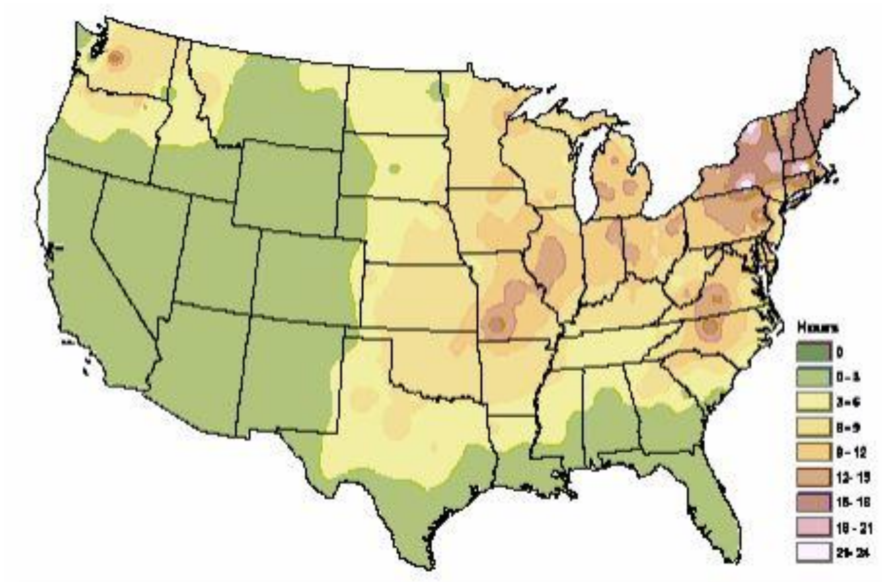
- **Blizzard**—Winds of 35 miles per hour or more with snow and blowing snow reducing visibility to less than ¼ mile for at least three hours.
- **Blowing Snow**—Wind-driven snow that reduces visibility. Blowing snow may be falling snow and/or snow on the ground picked up by the wind.
- **Snow Squalls**—Brief, 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 surfaces and does not typically stick to objects.

Geographic Location

Like thunderstorms, severe winter weather events tend to occur over wide geographic areas, encompassing an entire county or a large group of counties. According to SEMA, severe winter weather events such as snow, ice storms and extreme cold can cause injuries, deaths and property damage in a variety of ways. Winter storms are considered deceptive killers because most deaths are not directly related to the storm. Causes of death range from traffic accidents during adverse driving conditions to heart attacks caused by overexertion while shoveling snow. Hypothermia or frostbite may be considered the most direct cause of death and injuries attributed to winter storms and/or severe cold. Economic costs are difficult to measure. Heavy accumulations of ice can bring down trees, electric power lines and poles, telephone lines and communications towers. Crops, trees and livestock can be killed or injured due to deep snow, ice or severe cold. Buildings and automobiles may be damaged from falling tree limbs, power lines and poles. Local governments, homeowners, business owners, and power companies can be faced with spending millions of dollars for restoration of services, debris removal and landfill hauling.

Gentry County, located in northwest Missouri, is shown on the map below (FIGURE 3.31) to have 3–6 hours of freezing rain per year. Freezing rain events typically last less than six hours but can last more than 24 hours, increasing the risk for catastrophic damages. High winds also contribute to the amount of damage sustained during freezing rain events.

Figure 3.31. 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 extreme cold, heavy snowfall, ice, and strong winds which can push the windchill well below zero degrees in the planning area. 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 because 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 also 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.

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

During the period from 1965-2019, there has been one Presidential Major Disaster Declaration for this hazard that has included Gentry County. In December 2007, a series of ice storms lead to widespread damage that left thousands without power across the state. Three FEMA emergency declarations were made during this same period; an earlier ice storm in 2007 plus a January 2008 ice and heavy snow event. Then a blizzard hit the region at the end of January 2011 that carried on into February of 2011, leaving many roads impassable. All the winter weather events recorded by the National Centers for Environmental Information for past 20 years are summarized in TABLE 3.42.

Table 3.42. NCEI Gentry County Winter Weather Events Summary, [2005-2025]

Type of Event	Date(s)	Magnitude	# of Injuries	Property Damages	Crop Damages
Winter Storm	1/3/2005		0	0	0
Winter Storm	1/4/2005		0	0	0
Winter Weather	1/20/2006		0	0	0
Ice Storm	12/1/2007	One quarter of an inch of ice across the county was reported.	0	0	0
Ice Storm	12/10/2007	Ice accumulations of 3/4 inch were reported across the county. Many tree branches and power lines were down.	0	$25,000	0
Winter Storm	12/22/2007	Six to nine inches of snow was reported across southern portions of the county.	0	0	0
Heavy Snow	2/5/2008	Six to nine inches of snow was reported across the county. Stanberry measured 9.4 inches of snow.	0	0	0
Winter Storm	2/16/2008	Two to four inches of snow fell across the county. There was blowing and drifting snow.	0	0	0
Ice Storm	12/18/2008	One half inch of ice was reported.	0	0	0
Blizzard	12/7/2009	Blizzard conditions were observed across the area. Snowfall amounts ranged from 7 to 10 inches.	0	0	0

Type of Event	Date(s)	Magnitude	# of Injuries	Property Damages	Crop Damages
Winter Storm	12/24/2009	Up to 13 inches of snow fell across the county. Gusty northwest winds caused blowing and drifting of the snow.	0	0	0
Winter Storm	2/21/2010	The southern portion of the county had up to 6 inches of snow. Blowing and drifting snow caused hazardous driving conditions.	0	0	0
Winter Storm	3/19/2010	Up to six inches of snow was reported across the county.	0	0	0
Winter Weather	1/10/2011	Five to seven inches of snow was reported across the county.	0	0	0
Winter Storm	1/22/2011	Six inches of snow was estimated in Albany.	0	0	0
Winter Storm	2/1/2011	Up to 7.5 inches of snow was measured in Albany. Visibilities were as low as 1/4 mile at times, in the blowing and drifting snow. Winds occasionally gusted as high as 45 mph.	0	0	0
Winter Storm	2/24/2011	The combination of up to 5 inches of snow, and blowing and drifting snow, led to hazardous driving conditions across the county.	0	0	0
Winter Weather	11/9/2011	Up to one inch of snow was reported in Stanberry.	0	0	0
Winter Weather	2/13/2012	One to two inches of snow was measured across the county.	0	0	0
Winter Weather	2/23/2012	One half inch of snow was measured in Albany.	0	0	0
Blizzard	12/20/2012	The combination of high winds and snowfall of one to three inches caused blizzard conditions across the county.	0	0	0
Winter Storm	2/21/2013	Four to six inches of snow fell across the county.	0	0	0
Heavy Snow	12/21/2013	Light to moderate snow picked up during the afternoon hours on December 21. Preceding the snow freezing rain produced some minor icing in and around the area. Once the snow began it quickly accumulated between 6 and 9 inches across the area. The highest reported amount in the county came from Albany, Missouri where 7 to 8 inches of snow fell. While there were several vehicle spinouts across the area, and despite the ice accumulation the widespread effects were rather minimal.	0	0	0
Heavy Snow	2/4/2014	A major winter storm trekked through Kansas and Missouri on February 4 and 5. By the time the storm finished it dropped around a foot of snow across the entire area.	0	0	0
Heavy Snow	1/31/2015	Light snow fell for a long duration across northern Missouri through the evening and overnight hours on January 1 through the early morning hours on February 2. Strong winds moved into the area while the snow was falling and caused visibility problems and drifting on the roads. Generally, 6 to 8 inches fell across the county with the highest reported total from the county coming from Albany, where 7 inches fell. Numerous vehicle accidents occurred due to the poor driving conditions, but no serious injuries were reported.	0	0	0
Heavy Snow	2/1/2015	Light snow fell for a long duration across northern Missouri through the evening and overnight hours on January 1 through the early morning hours on February 2. Strong winds moved into the area while the snow was falling and caused visibility problems and drifting on the roads. Generally, 6 to 8 inches fell across the county with the	0	0	0

Type of Event	Date(s)	Magnitude	# of Injuries	Property Damages	Crop Damages
		highest reported total from the county coming from Albany, where 7 inches fell. Numerous vehicle accidents occurred due to the poor driving conditions, but no serious injuries were reported.			
Winter Storm	12/27/2015	Several areas across northeast Kansas and northwest Missouri saw ice accumulations approaching a quarter inch as well as sleet ranging from a quarter to a half inch in most locations, with some locations reporting over an inch of sleet. Once the sleet ended another 3 to 4 inches of snow fell before the system moved out.	0	0	0
Ice Storm	1/15/2017	To finish off a prolonged freezing rain event across northeast Kansas and northwest Missouri light rain lifted north into far northern Missouri causing ice to accumulate through the day on Sunday and overnight into Monday morning. Several trained weather spotters from across northern Missouri reported a quarter inch of ice on all surfaces. Several area roads were ice covered through the day on Sunday and into Monday morning before temperatures warmed above freezing Monday morning.	0	0	0
Blizzard	11/25/2018	Blizzard conditions started after a few hours of light to moderately falling snow. Once the heavy snow arrived winds gusted up to 46 mph for nearly 4 hours, creating whiteout conditions, officially measured by the ASOS at nearby KLWD as sub-quarter mile for that duration. Despite the heavy impacts from this system affecting Thanksgiving weekend return traffic, no serious injuries occurred from this event.	0	0	0
Winter Storm	1/11/2019	Between 8 and 10 inches of snow fell across Gentry County, with most of it falling over the course of the first 12 hours. Light snow continued into the next day (January 12), but it was fairly light and only accounted for 1 to 2 inches.	0	0	0
Winter Storm	1/10/2020	Freezing rain occurred through much of the night going into January 11 and caused around a quarter to one-third inch accumulation. This occurred prior to about 2 to 3 inches of snow falling. This resulted in several auto accidents.	0	0	0
Winter Storm	4/16/2020	Light snow fell off and on through the day on Thursday, accumulating about an inch; however, by mid-to-late afternoon the snow picked up intensity. One to two inches per hour snow rates were reported across the area for periods. Numerous reports of very low visibility due to very heavy snow were also received. The heavier snow came to an end on the evening of April 16 and gradually tapered to a stop by early morning on April 17. When all was said and done there was about 6 to 8 inches of snow reported across portions of the county.	0	0	0
Winter Storm	12/29/2020	During the day on December 29, a potent winter storm moved into the area. The precipitation started primarily as snow during the morning hours producing a couple inches of accumulation but switched to freezing rain just before 10 am as warm air aloft moved over the area. Moderate, to at times heavy rain ensued through the rest of the	0	0	0

Type of Event	Date(s)	Magnitude	# of Injuries	Property Damages	Crop Damages
		morning and early to middle afternoon hours, before eventually moving out by the evening hours. The main impact from this storm was several power outages around the area. Due to the rain rates, not all of the nearly 1 inch of liquid precipitation accreted on surfaces, but a quarter to half inch did accrete, causing a significant disruption to the power, and closing numerous roads.			
Winter Storm	1/25/2020	Light to moderate snow moved into far northwest Missouri on the morning of January 25, by mid-day roughly 6 inches of snow fell, and by the end of the event roughly 6 to 7 inches of snow fell across the county.	0	0	0
Heavy Snow	2/11/2025	Northern portions of Gentry County received five inches of snow or more. 5.5 of snow was reported in Albany and 5 was reported in Gentry.	0	0	0
		Totals	0	$25,000	0

Source: NCEI, data accessed 9/29/2025

Winter storms, cold, frost and freeze take a toll on crop production in the planning area. TABLE 3.43 shows the USDA's Risk Management Agency payments for insured crop losses in Gentry County as a result of cold conditions and snow for the past 10 years.

Table 3.43. Crop Insurance Claims Paid due to Cold Conditions or Snow 2010—2019

Crop Year	Crop Name	Cause of Loss Description	Insurance Paid
2010	Corn	Cold Wet Weather	$862
2011	WHEAT	Cold Wet Weather	$1,251
2011	CORN	Cold Wet Weather	$22,112
2011	SOYBEANS	Cold Wet Weather	$3,797
2011	Wheat	Snow	$4,944
2012	Corn	Cold Wet Weather	$1,363
2013	Soybeans	Cold Wet Weather	$67,469
2013	Corn	Cold Wet Weather	$15,458
2013	Wheat	Cold Wet Weather	$2,953
2014	Wheat	Cold Wet Weather	$190,397
2014	Soybeans	Cold Wet Weather	$8,315
2014	Soybeans	Frost/Freeze	$15,542
2014	Wheat	Freeze	$4,963
2014	Corn	Frost	$2,032
2015	Soybeans	Cold Wet Weather	$1,912
2015	Corn	Cold Wet Weather	$1,146
2015	Wheat	Cold Wet Weather	$3,336
2016	Wheat	Cold Winter	$3,264
2017	Corn	Cold Wet Weather	$475
2017	Soybeans	Cold Wet Weather	$37,767
2018	Wheat	Cold Winter	$11,910
2019	Corn	Cold Wet Weather	$14,705
2019	Soybeans	Cold Wet Weather	$21,223
2019	Wheat	Cold Winter	$11,385
		Total	$448,581

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

Probability of Future Occurrence

There were 39 events involving some type of winter weather occurring in the 20-year period summarized in the table above. The average for the period is 1.95 events per year. The duration of these events varied from hours to days. Based on the NCEI information the annualized damage from winter weather events is $1,250 realizing that most damage is not reported to NCEI. The average annual crop insurance payments to the County's farmers was $44,858 for losses related to winter weather. While it is highly likely that Gentry County will experience a winter weather event in any given year, the severity of the event could vary from a nuisance to a life-threatening situation.

Changing Future Conditions Considerations

From the 2023 State HMP: *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 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.

Severe Winter Weather including snow, ice, and severe cold has caused more damage for Missourians in recent years with numerous Presidential Declarations, including all or parts of the state, since 2007.The method used by the State of Missouri 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 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 this statistical data collected, the following factors were considered in determining overall severe winter storm vulnerability as follows: housing density, building exposure, social vulnerability, likelihood of occurrence, and average annual property loss.

The rating values of all factors were then combined to determine the overall vulnerability rating. TABLE 3.44 below, provides the factors considered, the rating values assigned, and the rating that Gentry County received on each factor.

Table 3.44. Vulnerability Analysis of Rating Factors Applied to Gentry County

Factors Considered	Measure	Rating
Housing Density	6.52 per sq. mi.	1 Low
Building Exposure	$689,499,000	1 Low
Social Vulnerability	Score = 4	Medium-High
Annual Likelihood of Occurrence	45 events 1.73 annual average	2 Medium-Low
Annualized Property Loss	$58,654	2 Medium-Low
Overall Vulnerability	Score = 9	Medium-Low

Source: 2023 Missouri State Hazard Mitigation Plan

This most recent analysis in the State HMP places Gentry County in the Medium Low category with a total of 9 points out of a maximum of 25.

Potential Losses to Existing Development

The following, TABLE 3.45, provides the annualized property losses due to different types of severe winter weather. These are the common data elements for the analysis of severe winter weather. The data was compiled from the storm database of NCEI. NCEI damages represent early estimates. It should be noted that the information in the following table is from the 2023 State HMP which used a set of data from a different period of years that was used earlier in this section.

Table 3.45. Annualized Damages due to Winter Weather in Gentry County

Blizzard	Heavy Snow	Ice Storm	Winter Storm	Winter Weather	Total Annualized Property Loss
$0	$57,692	$962	$0	$0	$58,654

Source: 2023 Missouri State Hazard Mitigation Plan

The data from the 2023 update to the state plan lists the annualized property loss at $57,692 and an overall vulnerability rating of Medium-Low for Severe Winter Weather.

Previous and Future Development

With the declining population trend for most of the County, no significant development is anticipated.

Hazard Summary by Jurisdiction

All jurisdictions within the county are equally susceptible to damage stemming from severe winter weather, particularly snow and ice events. In the event of a severe winter storm, 26-50% of any given jurisdiction may be at risk of damage. In the case of extreme cold temperatures, and power outages, special consideration must be given to the potential impact upon the young, disabled, and elderly populations.

Problem Statement

Severe winter weather is common with an average of 1 to 2 events per year affecting all jurisdictions. The electrical grid and transportation systems are most effected by severe winter weather. Shelters with auxiliary power supplies should be available to residents affected by power outages. Preparedness remains the best option to limit the threats of these events on the residents of Gentry County.

3.4.10 Tornado

Hazard Profile

Hazard Description

The NWS defines a tornado as "a violently rotating column of air extending from a thunderstorm to the ground." It is usually spawned by a thunderstorm and produced when cool air overrides a layer of warm air, forcing the warm air to rise rapidly. Often, vortices remain suspended in the atmosphere as funnel clouds. When the lower tip of a vortex touches the ground, it becomes a tornado.

High winds not associated with tornadoes are profiled separately in this document in 3.4.8

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 upwards 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 miles.

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

Any person or structure at any location in Gentry County could be impacted by a tornado. The amount of damage depends on 1) the strength of the tornado, 2) the tornado's proximity to the person/structure, 3) the strength of the structure, 4) how well a person is sheltered.

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 3.46) attempts to rank tornadoes according to wind speed based on the damage caused. This update to the original F Scale was implemented in the U.S. on February 1, 2007.

Table 3.46. 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 Number	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 3.47. 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.

Table 3.47. Enhanced Fujita Scale with Potential Damage

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

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

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

Previous Occurrences

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. 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. As noted for other hazards, a zero in the property or crop damages columns means the amount is unknown. TABLE 3.48 below details the tornado history of Gentry County.

Table 3.48. Recorded Tornadoes in Gentry County, 2000–2025

Date	Beginning Location	Ending Location	Length (miles)	Width (yards)	F/EF Rating	Death	Injury	Property Damage	Crop Damage
2001-04-11	40.38, -94.37	40.4, -94.3	2	100	1	0	0	--	--
2003-04-30	40.37, -94.17	40.38, -94.17	1	50	0	0	0	--	--
2004-05-24	39.95, -93.4	39.95, -93.4	17	250	2	0	1	$10.000,000	--
2005-06-04	40.38, -94.47	40.38, -94.47	.5	100	1	0	0	--	--
2005-06-04	40.23, -94.55	40.23, -94.55	1	50	0	0	0	--	--
2005-06-04	40.17, -94.22	40.17, -94.22	.5	50	0	0	0	--	--
2014-06-30	40.38, -94.30	40.39, -94.3	0.22	50	0	0	0	--	--
2017-06-28	40.29, -94.33	40.28,-94.22	6.06	75	0	0	0	--	--
2017-06-28	40.22, -94.6	40.22, -94.57	1.44	25	0	0	0	--	--

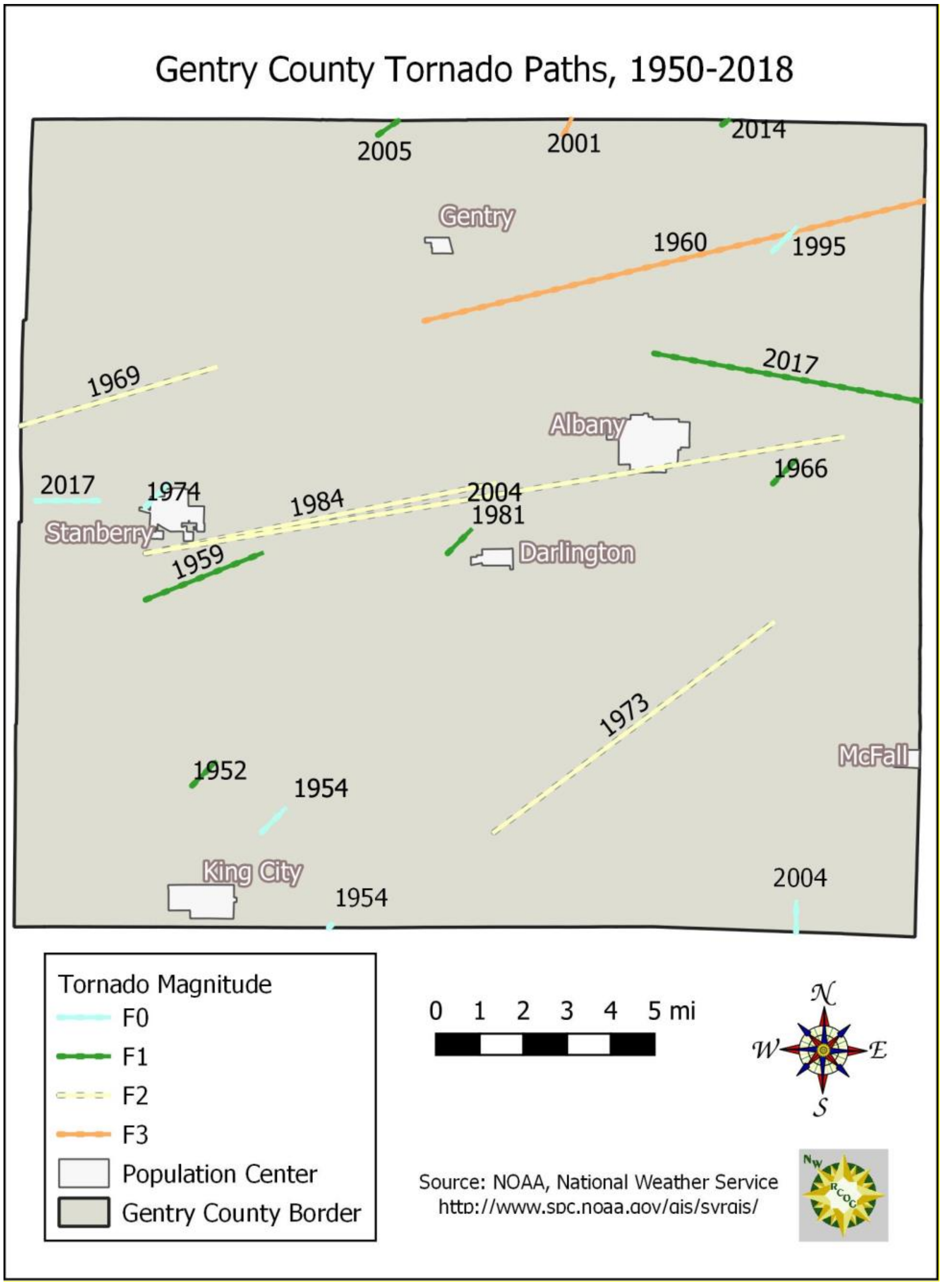
Date	Beginning Location	Ending Location	Length (miles)	Width (yards)	F/EF Rating	Death	Injury	Property Damage	Crop Damage
2024-04-27	40.3, -94.42	40.35, -94.22	11.64	250	1	0	0	--	--
	Total: 10						1	$10,000,000	

Source: National Centers for Environmental Information

The most destructive storm occurred on May 24, 2004. This F2 tornado was consistently on the ground from one mile south of Stanberry east-northeast through Albany. Multiple vortices were noticed on chaser video. Extensive damage was observed in Albany. Three homes were destroyed. There were 34 buildings with major damage and 70 buildings had minor damage.

Using information from the National Centers for Environmental Information the following map Figure 3.32 shows the paths of tornadoes that occurred 1950-2019.

Figure 3.32. Gentry County Map of Historic Tornado Events



According to the USDA Risk Management Agency, there have not been any indemnity payments to

Gentry County farmers during the past 10 years for losses suffered due to tornado activity. It is possible that any damages that occurred from tornadic activity were listed as wind damage or excess precipitation, which usually accompanies the storms that spawn tornadoes.

Probability of Future Occurrence

There have been 10 tornadoes recorded over the last 25 years. This puts Gentry County's risk for a tornado at 4% for any given year.

Changing Future Conditions Considerations

From the 2018 State HMP: *Scientists do not know how the frequency and severity of tornadoes will change. 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 number of days with large outbreaks have been increasing since the 1950s and that densely concentrated tornado outbreaks are on the rise. Areas already subject to tornado activity are seeing more densely packed tornadoes.*

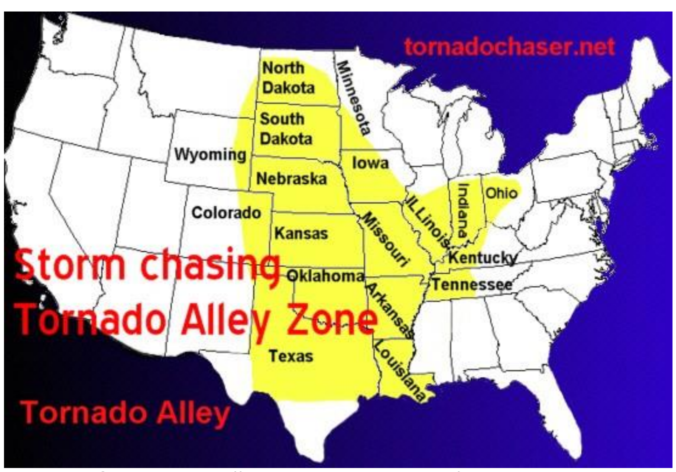
Vulnerability

Vulnerability Overview

Although the boundaries of Tornado Alley, shown in FIGURE 3.33, are debatable (depending on which criteria you use—frequency, intensity, or events per unit area), the region from central Texas, northward to northern Iowa, and from central Kansas and Nebraska east to western Ohio is often collectively known as Tornado Alley. Meteorologically, the region is ideally situated for the formation of supercell thunderstorms, often the producers of violent (EF-2 or greater) tornadoes.

Overall, most tornadoes (around 77%) in the United States are considered weak (EF-0 or EF-1) and about 95% of all United States tornadoes are below EF-3 intensity. The remaining small percentage of tornadoes are categorized as violent (EF-3 and above). Of these violent twisters, only a few (0.1% of all tornadoes) achieve EF-5 status, with estimated winds over 200 mph and nearly complete destruction. However, given that on average over 1,000 tornadoes hit the United States each year, which means that 20 can be expected to be violent and one might possibly be so intense as to be described as incredible.

Figure 3.33. Tornado Alley in the U.S.



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

In the 2023 update to its hazard mitigation plan, the State of Missouri looked at statistical analysis of data from several sources: HAZUS building exposure value data, population density and mobile home data from the U.S. Census (2020 ACS), 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, and storm events data (1950 to December 31, 2016) from the National Centers for Environmental Information (NCEI). 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. The data for Gentry County is given in the following TABLE 3.49.

Table 3.49. Tornado Vulnerability Data for Gentry County

Likelihood of Occurrence	0.278 or 27.8%	Medium-Low
Total Annualized Property Loss	$146,708	Low
Percent Mobile Homes	4.0%	Medium
Social Vulnerability Rating	4	Medium-High
Population Density	13.37	Low
Building Exposure	$734,656,000	Low
Overall Vulnerability	12	Low-Medium

Source: Missouri State Hazard Mitigation Plan 2023

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 and 5-High. The combined vulnerability rating for Gentry County was 12 (Low-Medium).

Potential Losses to Existing Development

The rural nature of the county lessens the likelihood of a tornado striking a densely populated area. The 2010 U.S. Census data showed a population density of 13 persons per square mile and a housing density of 6 units per square mile. This means most damage would probably occur to agricultural assets.

The last several years have seen an increase in the likelihood of tornadoes in the county after a lull between 2005 and 2014; however, the intensity of the storms has been less: all have been F1 or EF0. The damage from these lower scale storms is usually light to moderate which again limits the potential losses to the County. There has been no reported property damage from tornadoes since 2005. However, the annual average property loss was $400,200 from 1995–2019; higher than the historic amount of $157.657.

Previous and Future Development

The county has seen a decrease in population since the last census, with many of the small communities losing residents. The total building exposure at risk to tornadoes is $734,656,000. Only a small increase in exposure is foreseen at this time.

Hazard Summary by Jurisdiction

Mobile homes, which offer little protection from tornadoes, make up about 4% of the housing for Gentry County. These homes are located throughout the county, but a higher percentage of mobile homes are found in Darlington at 30% and in Gentry 70% of the homes were built before 1940. Occupants of mobile homes or in older homes are at greater risk during tornadoes. (See FIGURE 3.18).

Problem Statement

Gentry County has been fortunate that the tornadoes that have occurred over the last 15 years have all been of the lowest intensity. The risk of a devastating tornado cannot be ignored. Residents must immediately be aware when an area will be facing a severe weather incident. Jurisdictions that do not already possess warning systems should plan to purchase a system. Storm shelters are another important means of mitigating the effects of tornados. Additional public awareness also includes coverage by local media sources. A community-wide shelter program should be adopted for residents who may not have adequate shelter in their homes to minimize the potential for loss of life. Schools should consider the construction of safe rooms for their students. A shared facility between city and school is a possibility.

3.4.11 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 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 to 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

Damages due to wildfires would be higher in communities with more wildland-urban interface (WUI) areas. 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.

Wildfires are included in the plan because, like most other natural hazards, there is always a possibility of occurrence. When there are periods of extreme heat and drought the risk of wildfire increases.

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 to 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

Of the 3 fires in Gentry County reported to the Missouri Department of Conservation over the last ten years, no fires were acknowledged as being the result of lightning. The remaining causes with frequency in parentheses were classified as: equipment (1), controlled burn (1), unknown (1). The largest reported fire burned 40 acres with its cause attributed to equipment. The data is summarized in TABLE 3.50.

Table 3.50. Wildfire Reports from Gentry County, 2015–2025

Fire Reporting Agency	# of Fires	Acres Burned
Pattonsburg Rescue & Fire Protection District	1	10
TRI-C Fire Department	1	1
Union Star Fire Protection District	1	40
Totals		51

Source: Missouri Dept. of Conservation: Fire Reporting https://mdc12.mdc.mo.gov/Applications/MDCFireReporting/

There were no records received of fire events affecting school districts, and structural fires are not included in this assessment.

Probability of Future Occurrence

For the period from 2004-2021, there were 316 fires reported in Gentry County. That is an average of 18.5 fires a year, with an average number of acres burned per fire at 460.7 acres. The likelihood of a fire happening in a given year is 17.6%. Sometimes agricultural prescribed fires become out of control and burn more acres than is intended. The lack of details on these fire events makes it difficult to assess the initial causes of the fires. The data that is available supports the idea that most of these fires were caused by human error.

Changing Future Conditions Considerations

The effects of higher temperatures on the potential for wildfires in the County could be offset by higher precipitation levels. Lower rainfall amounts during the warmer summer months have the potential to lead to more drought conditions which increase the likelihood of wildfires.

Vulnerability

Vulnerability Overview

The 2023 Missouri State HMP used Department of Conservation data to assess the vulnerability of each county to the effects of wildfire. The factors considered in the analysis were the likelihood of occurrence and the annualized acres burned.

Potential Losses to Existing Development

The data available from the 2023 update to the State HMP found 5 residential and 10 agricultural structures in Gentry County at risk from wildfire, with the value of structures at $931,713 and the at-risk population at 13 persons. Potential losses are listed at $4,287,329.

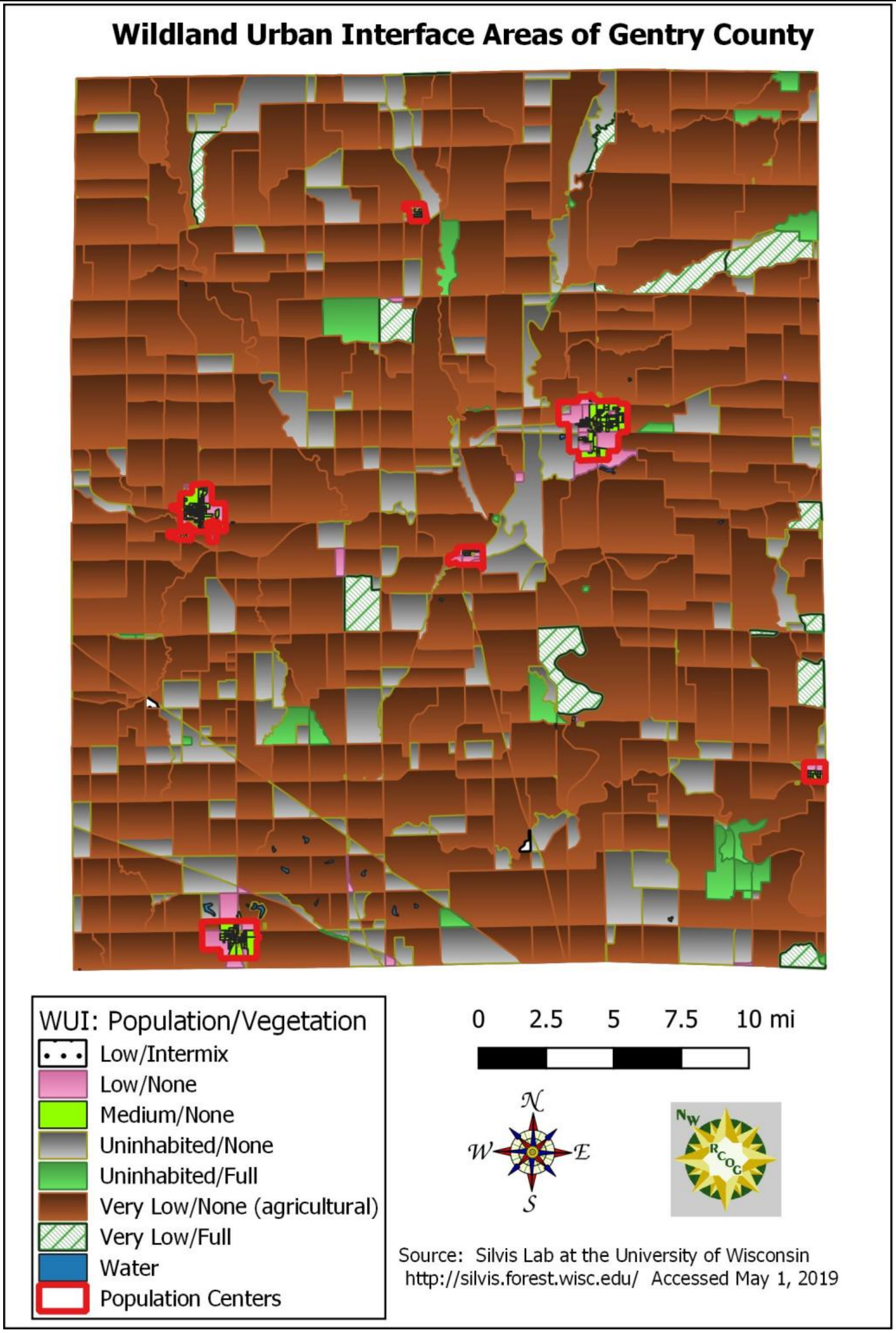
Impact of Previous and Future Development

The areas of WUI in Gentry County are found only in one area of Stanberry. There has been no additional development in this Intermix area or any plans to do so in the near future.

Hazard Summary by Jurisdiction

The map below (FIGURE 3.34) shows the Wildland-Urban Interface for Gentry County. The entire Northwest Region of the State is comparable to Gentry County with low risk for damages in the area. A very small area in the southwest part of Stanberry is the only significant location on the WUI map. This is an area of Intermix WUI where low density housing and vegetation intermingle. There are no other intermix areas are of medium or high population density. The bulk of the county is designated as having NonWUI vegetation as illustrated on the map, reflecting the agricultural nature of the county. Most of the county has low or very low housing density that is located in agricultural or non-vegetated areas so that there will be little difference between jurisdictions for this hazard. None of the public-school buildings are located in intermix zones.

Figure 3.34. Population Density and Vegetation Levels in Gentry County



Problem Statement

While wildfires have no history of causing considerable damage in Gentry County, there is a possibility that a wildfire could happen in any given year. The most-likely type of wildfire would be an out-of-control agricultural grassfire. Communications to reach residents to inform them of impending danger due to a wildfire can be improved by using text/caster and other county-wide warning systems of National

Weather Service issued fire weather watches and red flag warnings. During a wildfire situation, evacuation is essential to save lives. Since wildfires can move very fast if there are high wind conditions, emergency notification of evacuation orders need to be disseminated quickly to provide accurate information to lead residents to safety.