SECTION 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 have better understanding of the potential risk to the identified hazards. It will provide a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events. A clearly defined risk assessment can lead to successful risk management and mitigation opportunities. Creating a comprehensive and accurate assessment within the planning area was the goal of the planning team. The risk assessment for Morgan County consists of the following chapter divided in to four main parts:

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

3.1 HAZARD IDENTIFICATION

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.

With the participation of each jurisdiction, we asked for vital input during the planning process to ensure that we have clearly identified all potential risks. As part of this planning process each participating jurisdiction was asked to evaluate twelve natural hazards that can occur within their community. Each event is then analyzed and evaluated for both the probability of each hazard's occurrence and the severity of damage (both physical damage and economic impact) to assess their jurisdiction's vulnerability. With the consensus of the planning team these natural hazards have been identified as a likely risk to the planning area:

- Dam Failure
- Drought
- Earthquake
- Extreme Heat
- Flooding (River and Flash Flood)
- Hailstorms
- Land Subsidence/Sinkholes
- Levee Failure
- Severe Winter Weather
- Thunderstorms/Lightening/High Winds
- Tornado
- Wildfires

Analysis of Hazards

Upon the completion of the identification stage, the planning team studied and analyzed the defined natural hazards that have the potential to affect the planning area. In this section, you will find a brief synopsis of each of the identified natural hazards and an overview of the potential impact these hazards will have on Morgan County. Historical data is included as a reference to the future probability and severity of the impact felt by Morgan County concerning these natural hazards in the past. In conjunction with each hazard, we have identified general mitigation opportunities about the hazard.

Understanding how each community is susceptible to a natural hazard in both the likelihood that an event will occur (probability), and the lasting effects of an event (severity), was the underlying basis for the vulnerability rating for each jurisdiction, as well as the entire planning area. When developing the vulnerability rating, the planning team considered the geographic location within the planning area, the historical data, and the measures of probability and severity for each hazard in each jurisdiction.

Further consideration was given to how the impact would outweigh the number of natural hazard events. Repeated low severity events could ultimately have a much higher impact on the region. For the most part, the planning team agreed that the severity of any event would take precedence in the rating scale.

3.1.1 Review of Existing Mitigation Plans

Regarding the remaining two natural hazards that the planning team was asked to evaluate, Levee Failure and Land Subsidence/Sinkholes, the consensus was that there are no identified Levees in the planning area and further discussion on the Land Subsidence/Sinkholes also indicated that there was not enough data available relevant to known Sinkholes in Morgan County. These two natural hazards were not addressed in the original Morgan County Hazard Mitigation Plan 2006. These two natural hazards were not addressed in the updated plan in 2013 either. For the 2023 Hazard Mitigation Plan, the planning team incorporated levee failure and sinkholes because even though there is not enough data to calculate the probability of future occurrences, there is still a possibility these natural disasters can occur. After further research to define what and where sinkholes and levee failures are most prevalent or most likely place to occur, the planning team decided to include the research, but not to continue with further risk assessment of these natural hazards.

According to the Missouri State Hazard Mitigation Plan 2018 expansive soils, landslides, and rock falls are identified as a natural hazard that can occur in Missouri, but the frequency and impact are limited so they are not addressed in the State Plan. The planning team agreed with the finding of the State Plan and opted to follow the lead of the State.

Morgan County Missouri is centrally located in the Midwest and is not affected by Coastal Erosion, Coastal Storms, Hurricanes, or Tsunamis so these natural hazards are not addressed in the Morgan County Hazard Mitigation Plan. Avalanches and Volcanoes also are not a threat to the planning area and not included in the assessment and or discussion.

In Missouri, local plans customarily include only natural hazards, as only natural hazards are required by federal regulations to be included. At this time, the MPC determined there were not any previous events of any man-made hazards such as terrorism, cyber threat, or active shooter hazards to mitigate.

3.1.2 Review Disaster Declaration History

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

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

Table 3.1. FEMA Disaster Declarations that included Morgan County, Missouri, 1965-Present

Disaster Number	Description	Declaration Date Incident Period	Individual Assistance (IA) Public Assistance (PA)
4317	Missouri Severe Storms, Tornadoes, Straight-line	2-Jun-17	PA
4250	Missouri Severe Storms, Tornadoes, Straight-line	21-Jan-16	IA
3374	Missouri Severe Storms, Tornadoes, Straight-line Winds,	2-Jan-16	PA
4238	Missouri Severe Storms, Tornadoes, Straight-line	7-Aug-15	PA
1961	Missouri Severe Winter Storm and Snowstorm	23-Mar-11	PA
3317	Missouri Severe Winter Storm	3-Feb-11	PA
3303	Missouri Severe Winter Storm	30-Jan-09	PA
1809	Missouri Severe Storms, Flooding, and a Tornado	13-Nov-08	PA
1773	Missouri Severe Storms and Flooding	25-Jun-08	PA
1749	Missouri Severe Storms and Flooding	19-Mar-08	PA
1736	Missouri Severe Winter Storms	27-Dec-07	PA
3281	Missouri Severe Winter Storms	12-Dec-07	PA
1708	Missouri Severe Winter Storms and Flooding	11-Jun-07	IA
1676	Missouri Severe Winter Storms and Flooding	15-Jan-07	PA
1631	Missouri Severe Storms, Tornadoes and Flooding	16-Mar-06	IA
3232	Missouri Hurricane Katrina Evacuation	10-Sep-05	PA
1463	Missouri Severe Storms, Tornadoes and Flooding	6-May-03	PA
1253	Missouri Severe Storms, Flooding And Tornadoes	14-Oct-98	PA
995	Missouri Flooding, Severe Storm	9- Jul- 93	PA

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

3.1.3 Research Additional Sources

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

- Missouri Hazard Mitigation Plans 2018
- Previously approved planning area Hazard Mitigation Plan (2006, 2013, & 2018)
- Federal Emergency Management Agency (FEMA)
- Missouri Department of Natural Resources (MDNR)
- National Drought Mitigation Center Drought Reporter
- US Department of Agriculture's (USDA) Risk Management Agency Crop Insurance Statistics
- National Agricultural Statistics Service (Agriculture production/losses)
- Data Collection Questionnaires completed by each jurisdiction.
- State of Missouri GIS data
- Environmental Protection Agency
- Flood Insurance Administration
- Hazards US (HAZUS)
- Missouri Department of Transportation
- Missouri Division of Fire Marshal Safety
- Missouri Public Service Commission
- National Fire Incident Reporting System (NFIRS)
- National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information (NCEI);
- Pipeline and Hazardous Materials Safety Administration
- County and local Comprehensive Plans to the extent available
- County Emergency Management
- County Flood Insurance Rate Map, FEMA
- Flood Insurance Study, FEMA
- SILVIS Lab, Department of Forest Ecology and Management, University of Wisconsin
- U.S. Army Corps of Engineers
- U.S. Department of Transportation
- United States Geological Survey (USGS)

The only centralized source of data for many of the weather-related hazards is the National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information (NCEI). Although it is usually the best and most current source, there are limitations to the data which should be noted. The NCEI documents the occurrence of storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce. In addition, it is a partial record of other significant meteorological events, such as record maximum or minimum temperatures or precipitation that occurs in connection with another event. Some information appearing in the NCEI may be provided by or gathered from sources outside the National Weather Service (NWS), such as the media, law enforcement and/or other government agencies, private companies, individuals, etc. An effort is made to use the best available information but because of time and resource

constraints, information from these sources may be unverified by the NWS. Those using information from NCEI should be cautious as the NWS does not guarantee the accuracy or validity of the information.

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

The database currently contains data from January 1950 to March 2014, as entered by the NWS. Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type. The following timelines show the different time spans for each period of unique data collection and processing procedures.

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

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

It is important to have an understanding how each community is susceptible to a natural hazard in both the likelihood that an event will happen (probability) and the lasting effects of an event (severity). Probability and severity factors, geographic location, and historical data were used to determine the vulnerability rating for each jurisdiction as well as the entire planning area.

Further consideration was given to how the impact would outweigh the number of natural hazard events. Repeated low severity events could ultimately have a much higher impact on the region. The planning team agreed that the severity of any event would take precedence in the rating scale.

Table 3.2. Hazards Identified for Each Jurisdiction

Jurisdiction	Dam Failure	Drought	Earthquake	Extreme Temperatures	Flooding (River and Flash)	Land Subsidence/Sinkholes	Levee Failure	Severe Winter Weather	Thunderstorm/Lightning/Hail/High Wind	Tornado	Wildfire	
Morgan County		x	x	x	x	x	x	x	x	x	x	
City of Barnett		x	x	x	x	x	x	x	x	x	x	
City of Laurie		x	x	x	x	x	x	x	x	x	x	
City of Stover		x	x	x	x	x	x	x	x	x	x	
City of Syracuse		x	x	x	x	x	x	x	x	x	x	
City of Versailles		x	x	x	x	x	x	x	x	x	x	
Village of Gravois Mills		x	x	x	x	x	x	x	x	x	x	
Schools and Special Districts												
Morgan County R-I		x	x	x	x	x	x	x	x	x	x	
Morgan County R-II		x	x	x	x	x	x	x	x	x	x	

3.1.5 Multi-Jurisdictional Risk Assessment

The original Morgan County Hazard Mitigation Plan 2013 reviewed all the data about the probability and took the total number of events divided by the total number of years to create a percentage of probability. The 2013 planning team initially took this approach in order to compare to the current data available. However, when it came to considering the severity, there was limited data as to the cost of prior events; it appeared as if the data was simply not collected during that time. The current planning team analyzed data available after 2013 to re-evaluate the probability and severity of events. This plan is an update to the 2018 Morgan County Hazard Mitigation Plan. The differences between the 2018 and current plan are included in each profile. The planning area is uniform in terms of climate, topography, and building construction characteristics.

The Hazard Profile will include the following: Hazard Description, Geographic Location, Severity/Magnitude/Extent, Repetitive Loss/Severe Repetitive Loss Properties, Probability of Future Occurrence, Changing Future Conditions Considerations, Vulnerability Overview, Potential Losses to Existing Development, Hazard Summary by Jurisdiction, and a Problem Statement.

3.1.6 Geographic Locations

Flooding is a hazard throughout the planning area, as detailed in the tables below.

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. A natural hazard event has the potential to cause loss of life, property damage, loss of essential services, loss of critical facilities, and economic disruption. To help understand the full impact of a natural hazard event it is necessary to identify the assets that could be affected within the planning area. Knowing the value of those assets will help each jurisdiction determine the associated costs and economic impact that a natural hazard event may pose. Assets can include but are not limited to buildings, equipment, infrastructure, and furnishings.

Figure 3.1. Morgan County HAZUS Replacement Cost

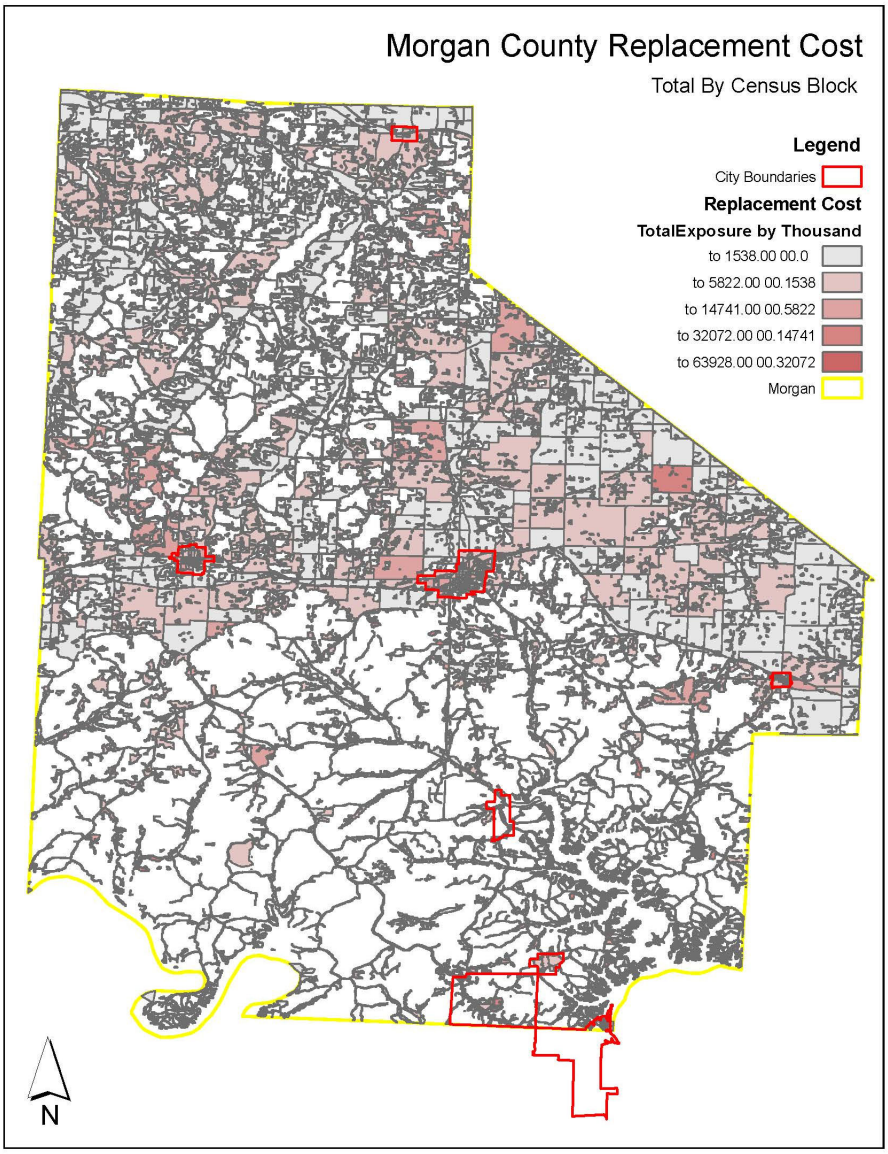


Figure 3.2. Morgan County Flood Map

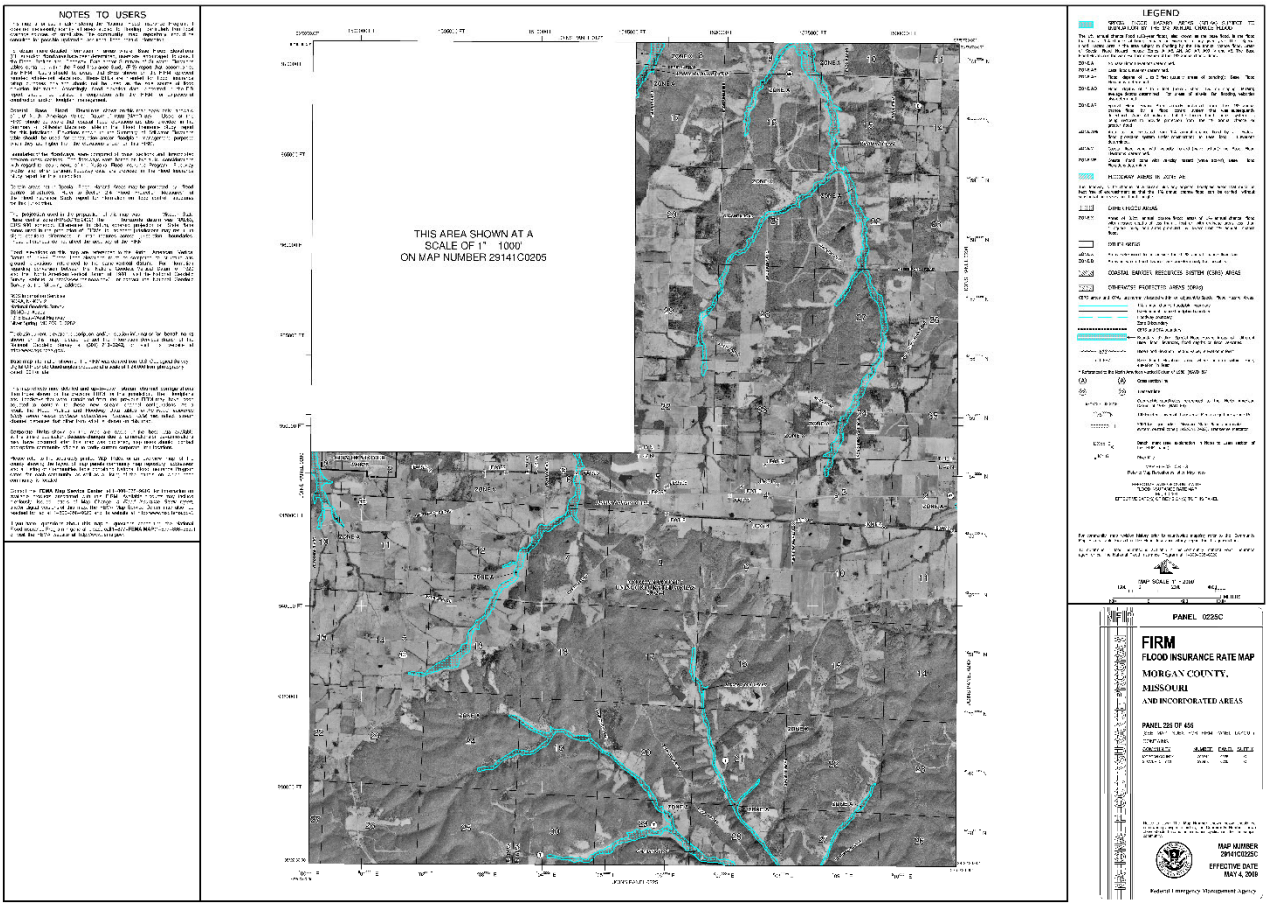


Figure 3.3. City of Barnett Replacement Costs as Identified by HAZUS Map

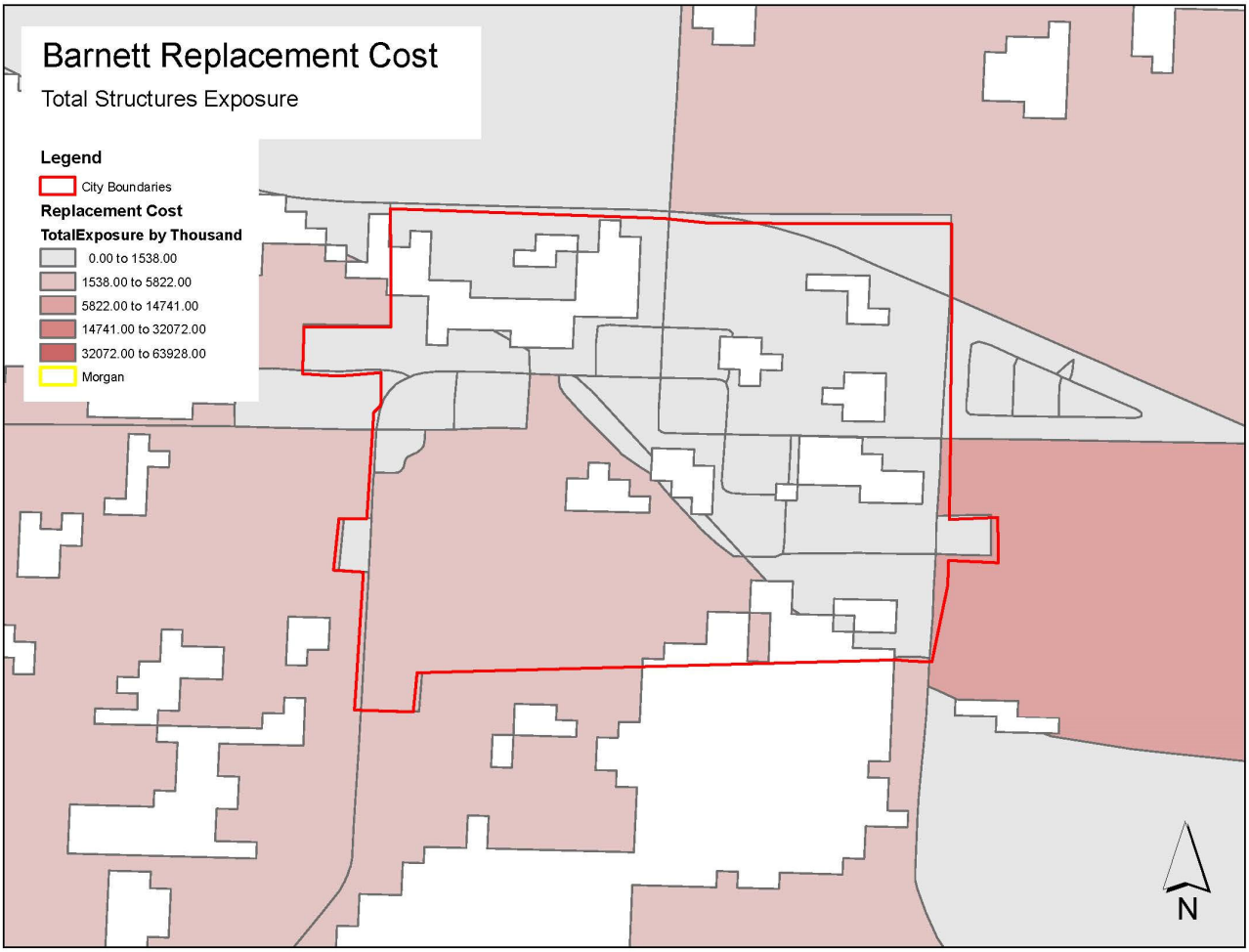


Figure 3.4. City of Barnett Flood Insurance Rate Map (FIRM)

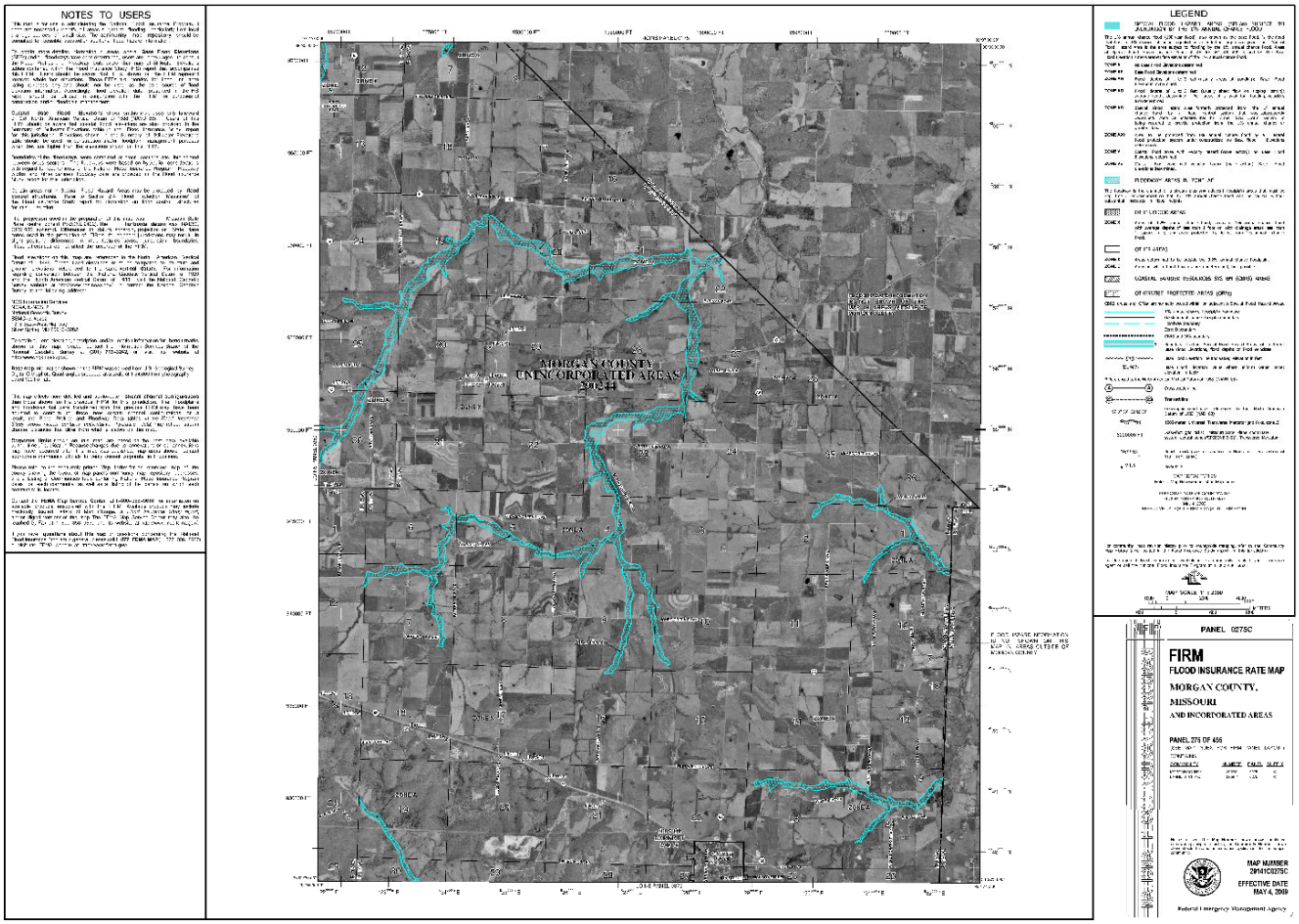


Figure 3.5. City of Laurie Replacement Costs as Identify HAZUS Map

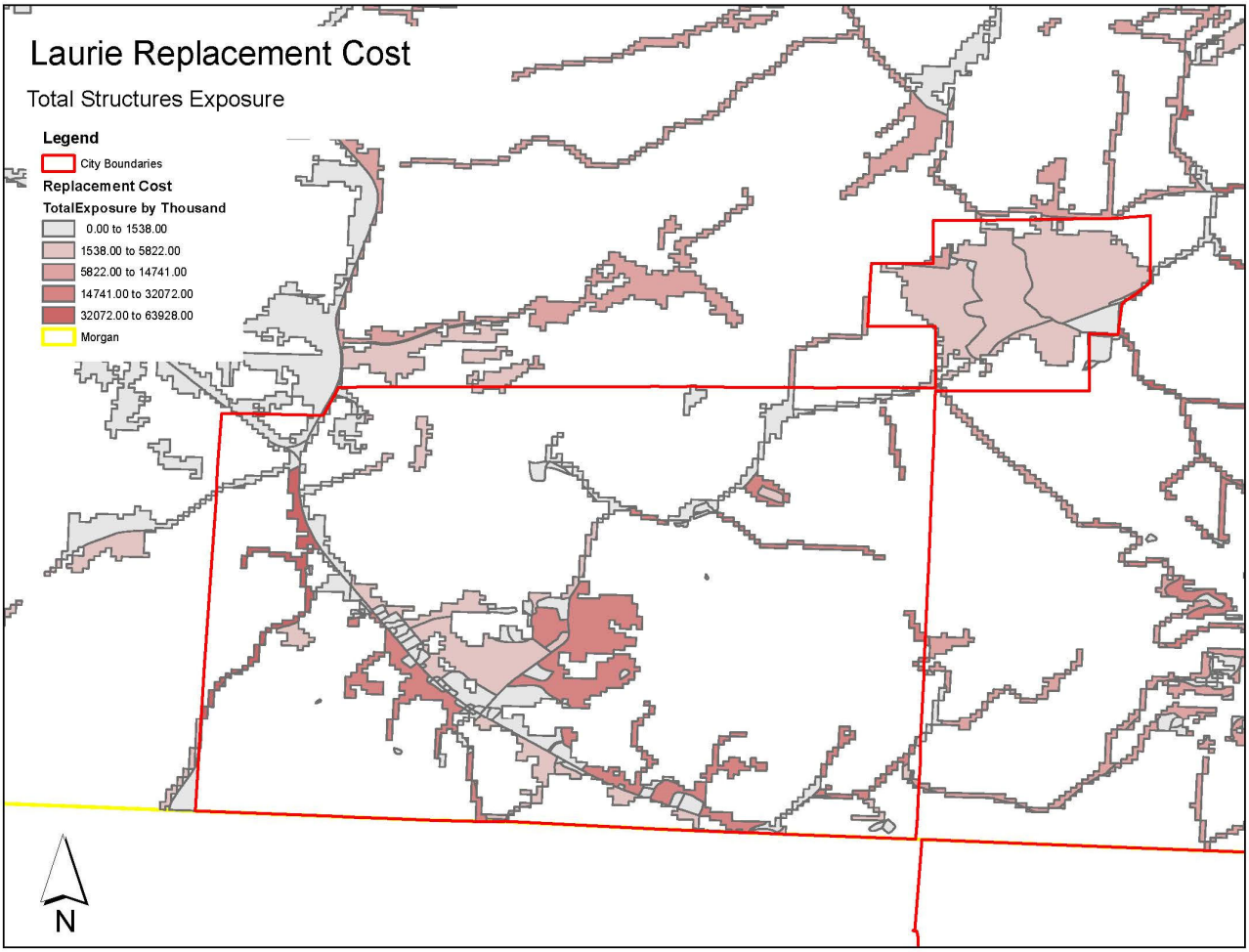


Figure 3.6. City of Laurie Flood Insurance Rate Map (FIRM)

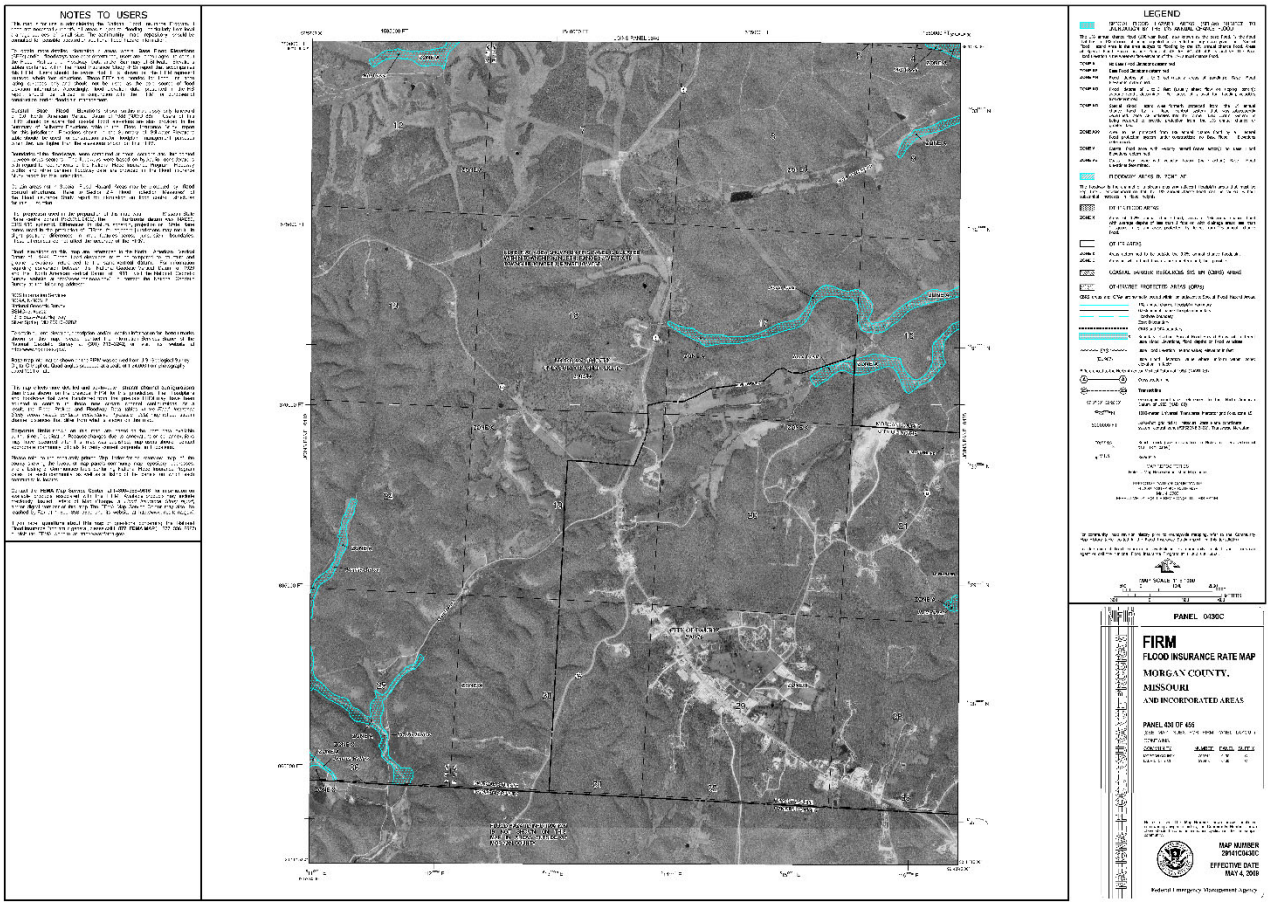


Figure 3.7. City of Stover Replacement Costs as identified by HAZUS.

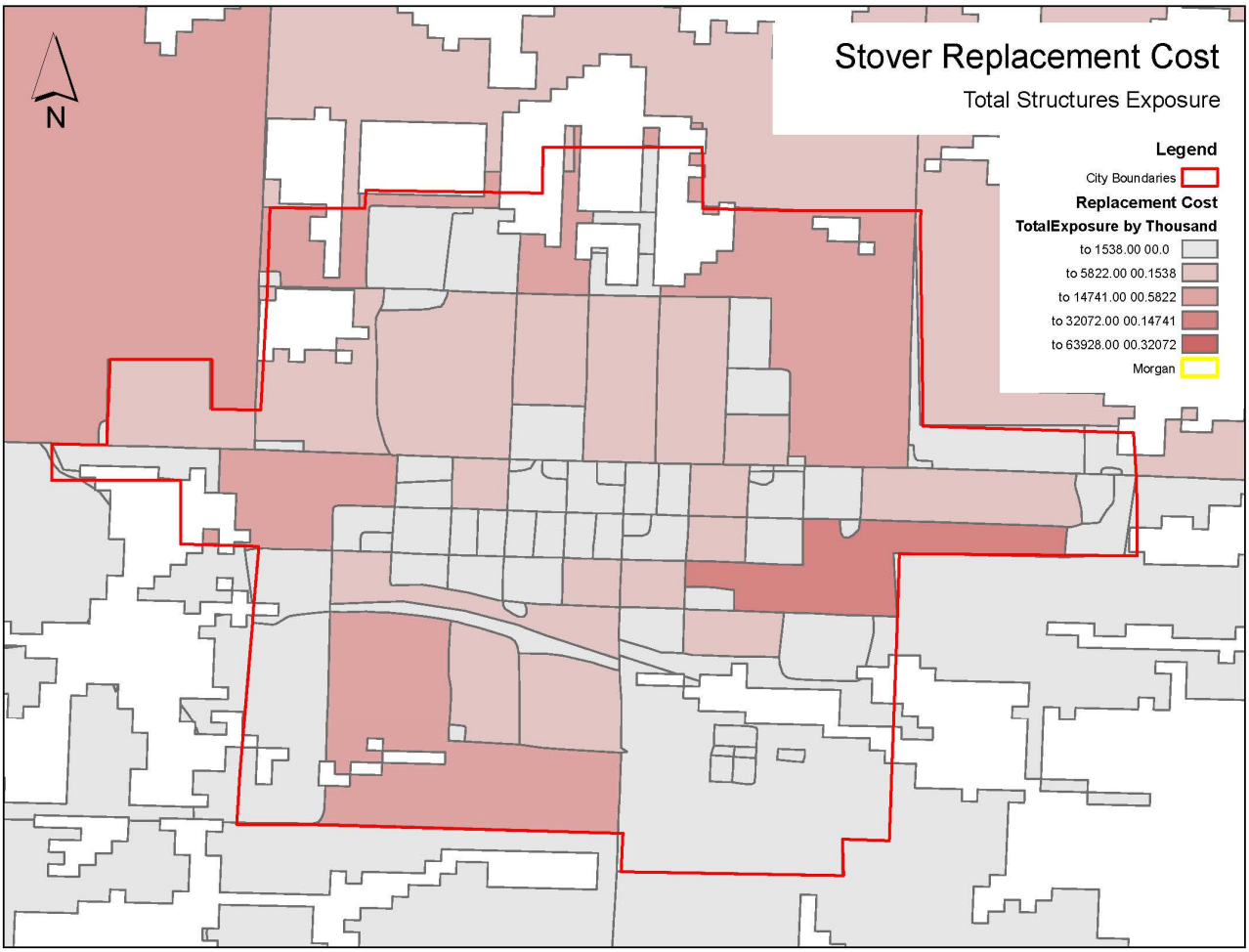


Figure 3.8. City of Stover Flood Insurance Rate Map (FIRM)

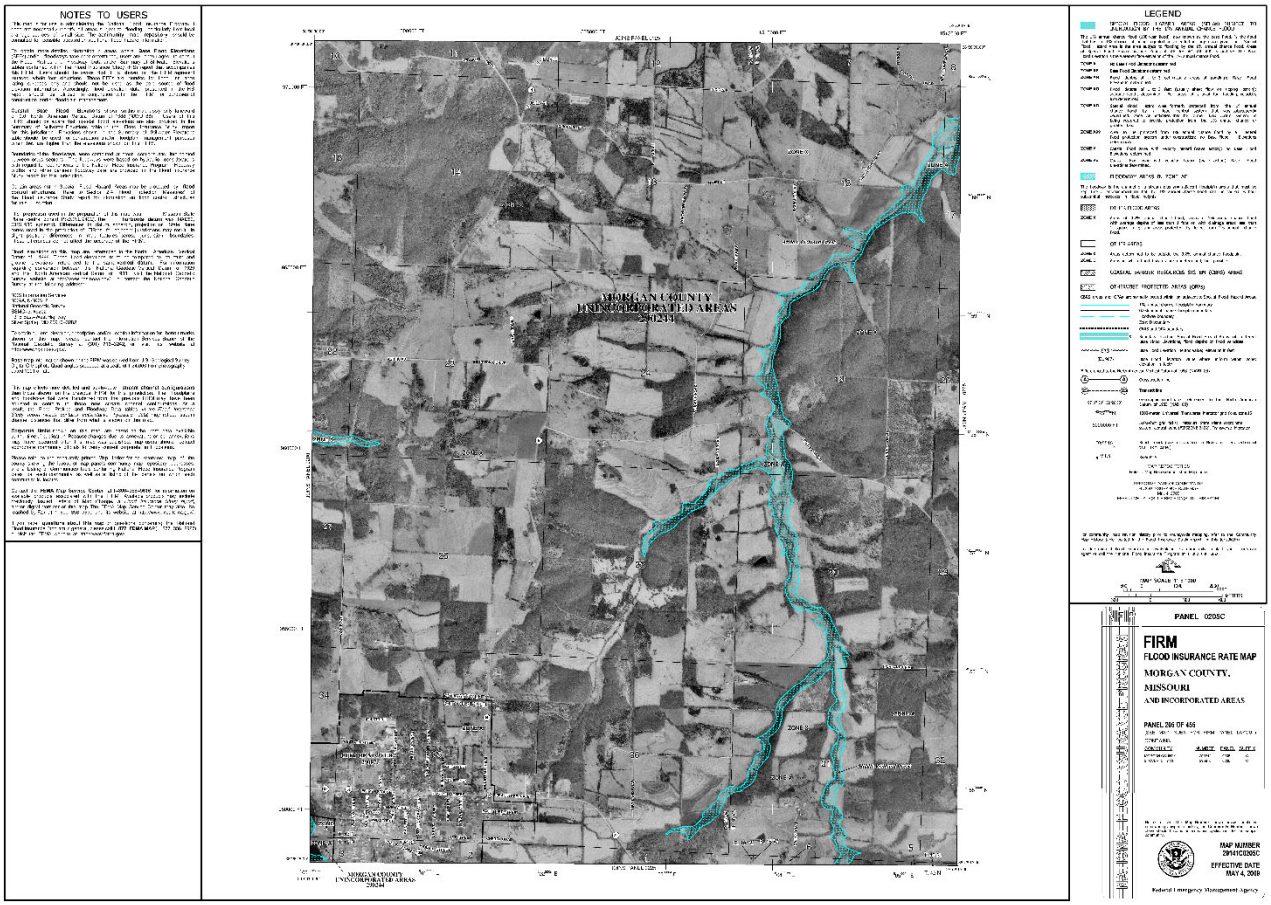


Figure 3.9. City of Syracuse Replacement Costs as identified by HAZUS.

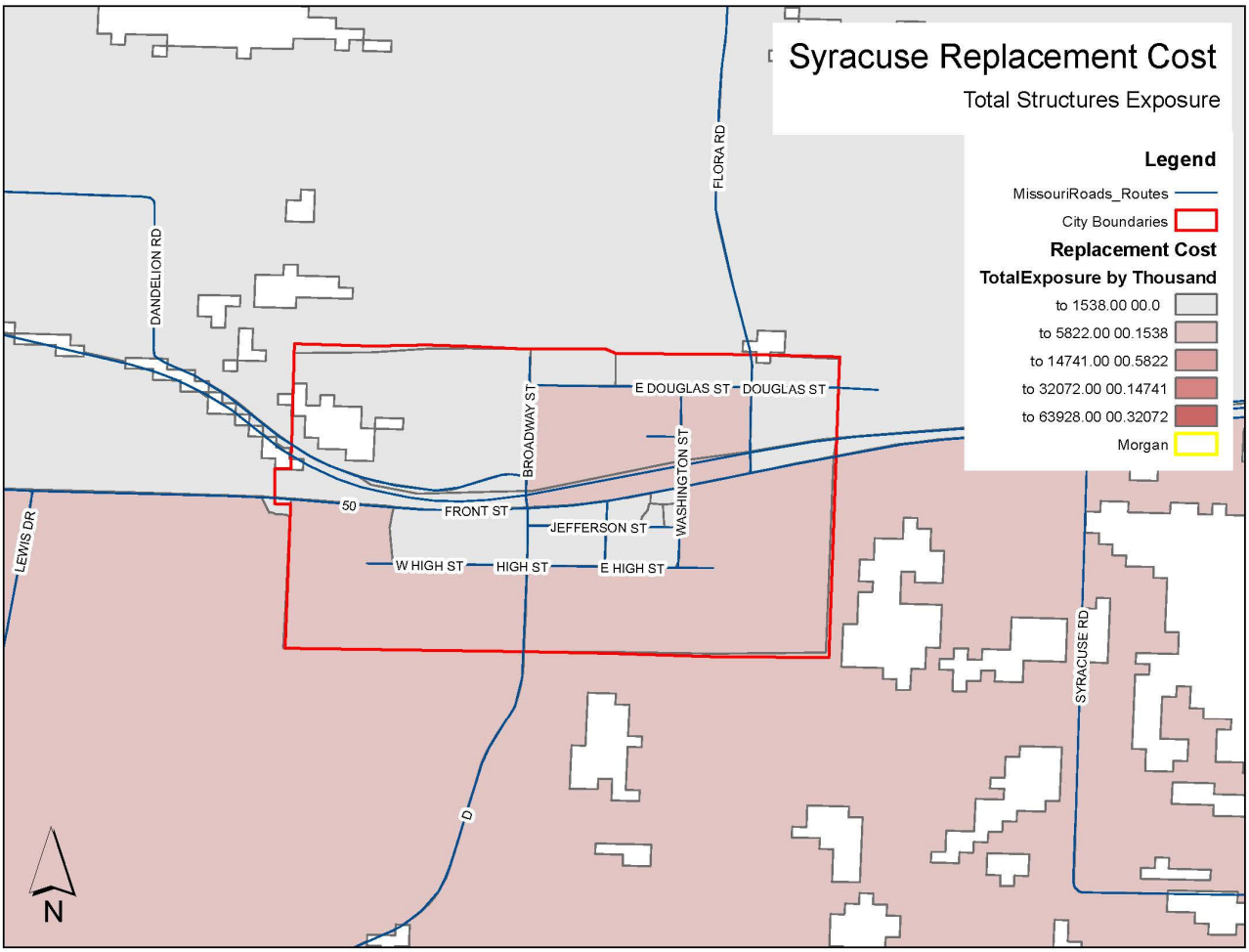


Figure 3.10. City of Syracuse Flood Insurance Rate Map (FIRM)

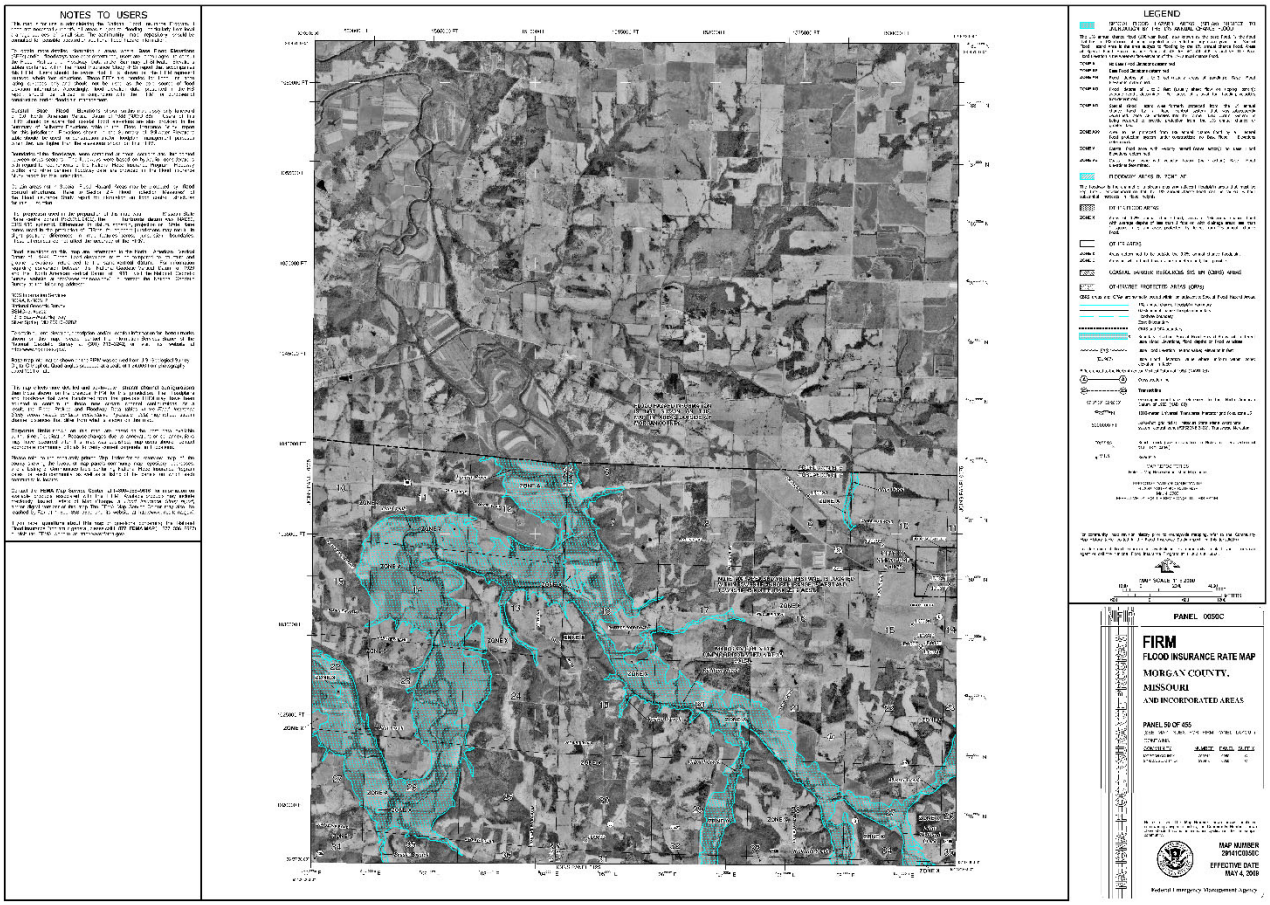


Figure 3.11. City of Versailles Replacement Costs as identified by HAZUS.

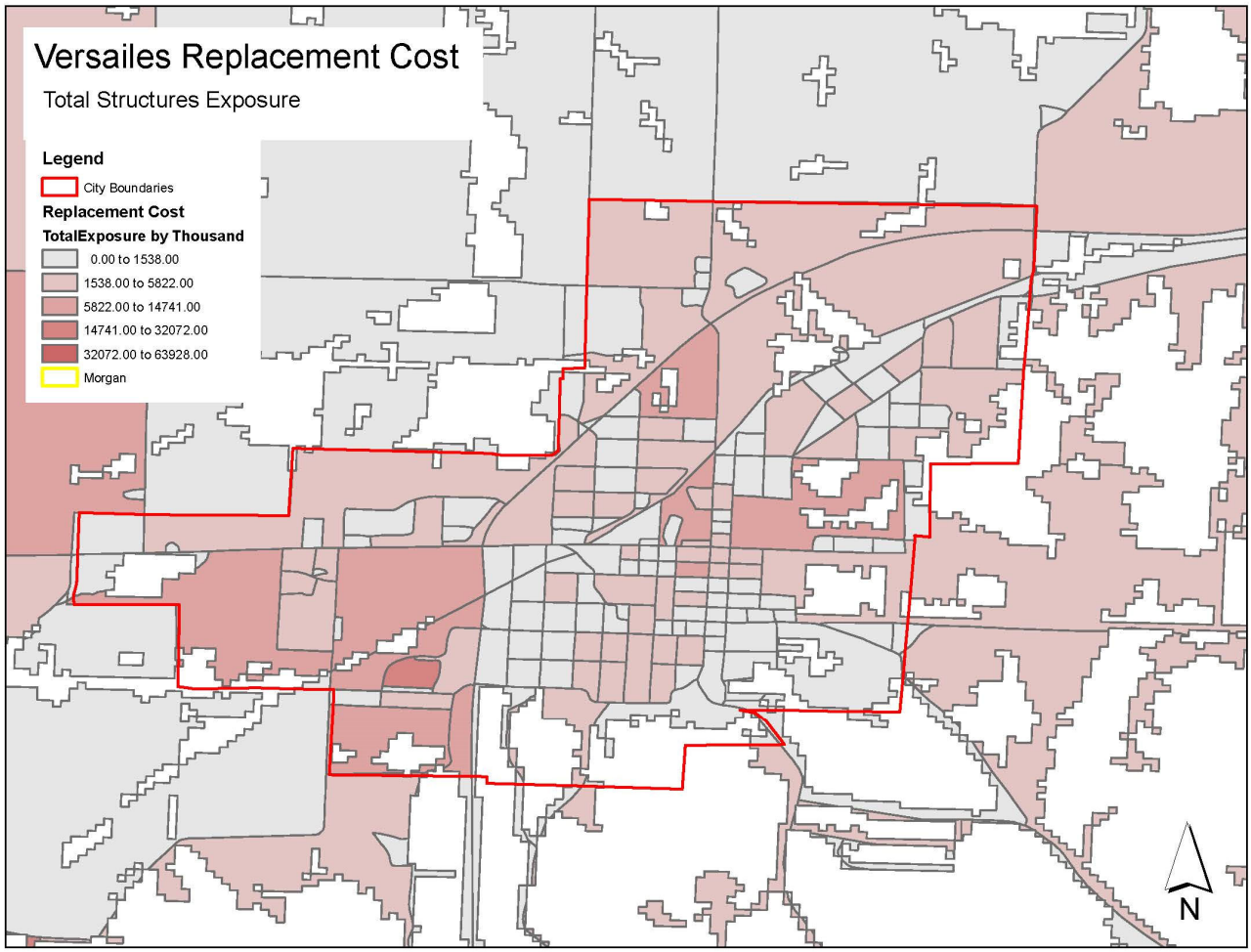


Figure 3.12. City of Versailles Flood Insurance Rate Map (FIRM)

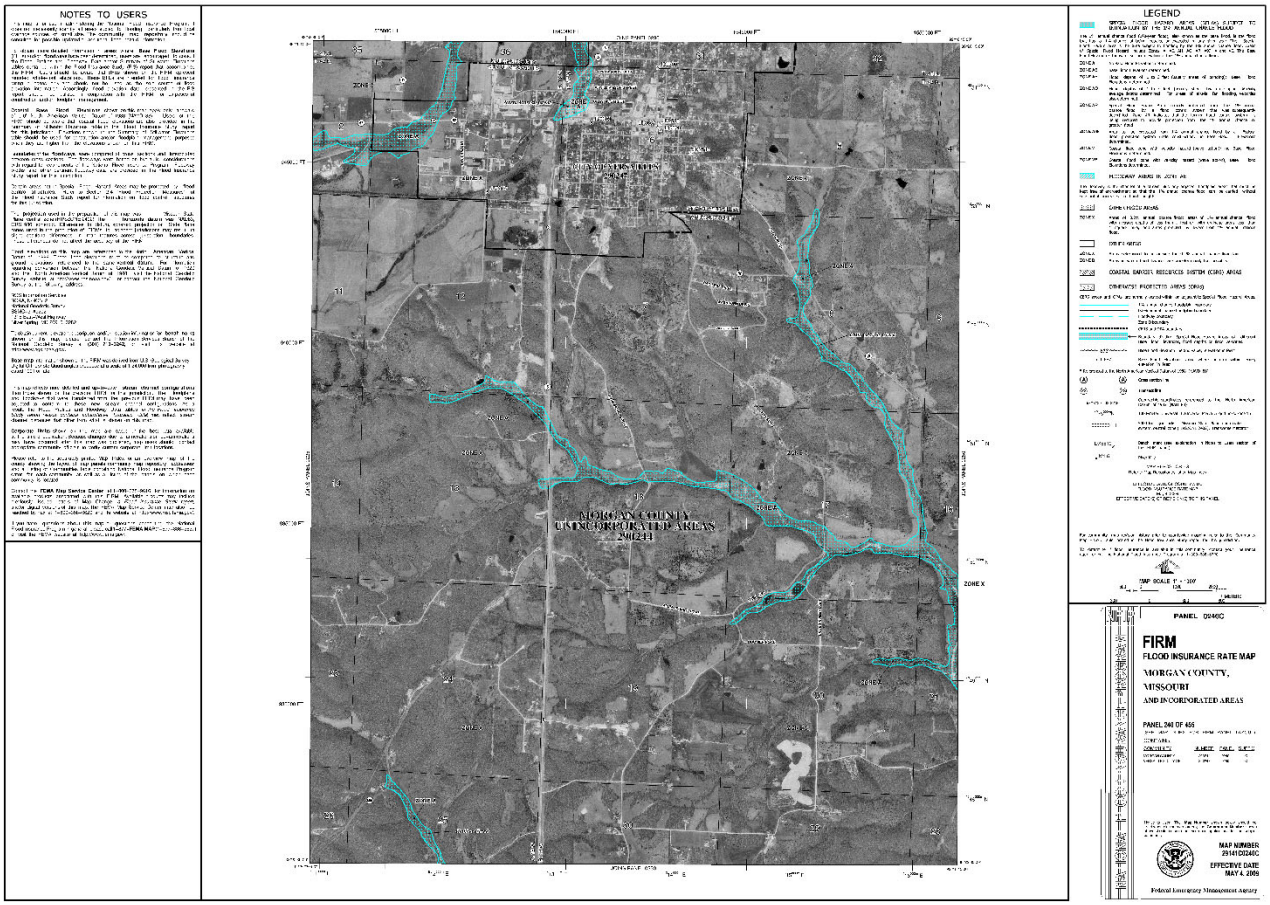


Figure 3.13. Village of Gravois Mills Replacement Costs as identified by HAZUS.

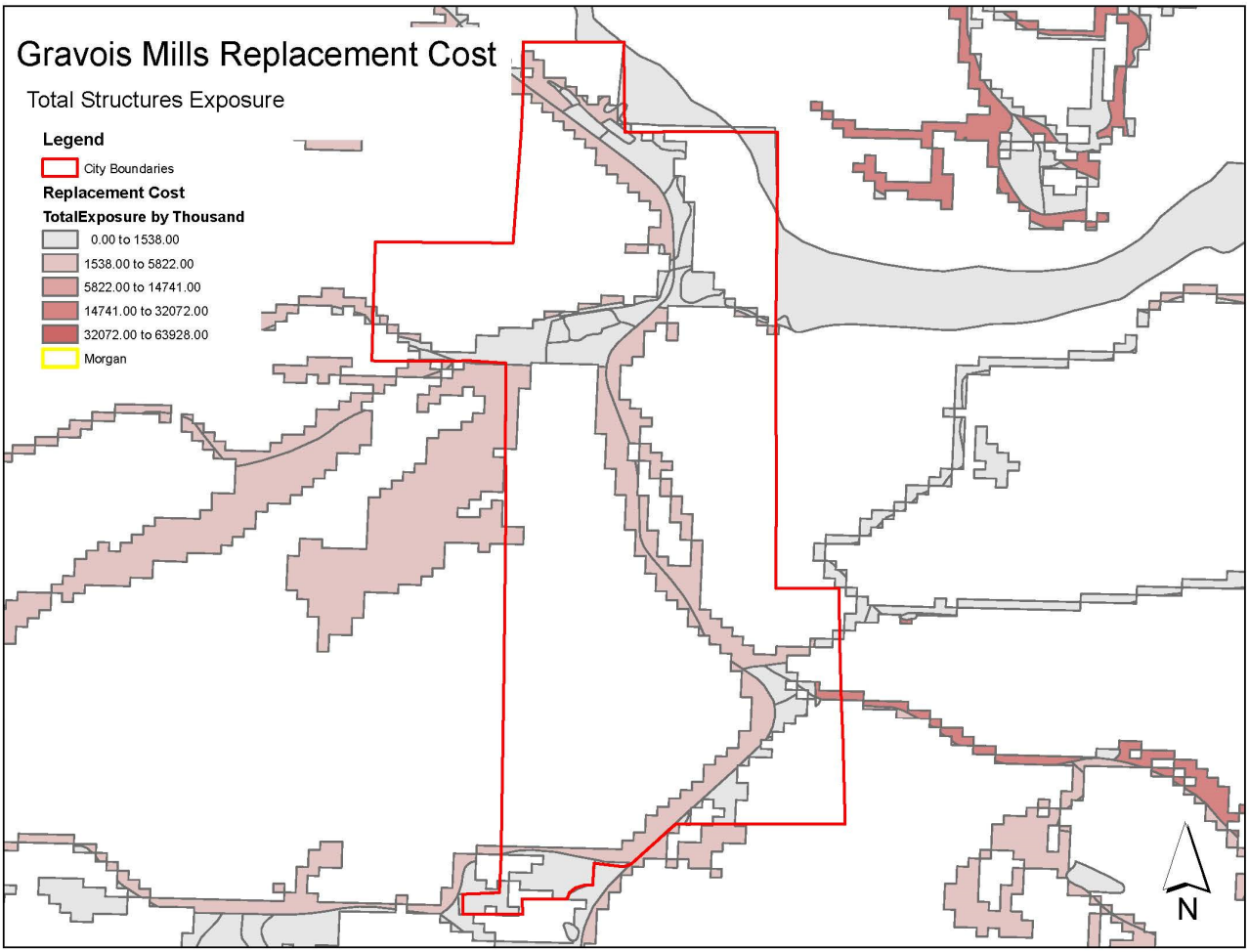
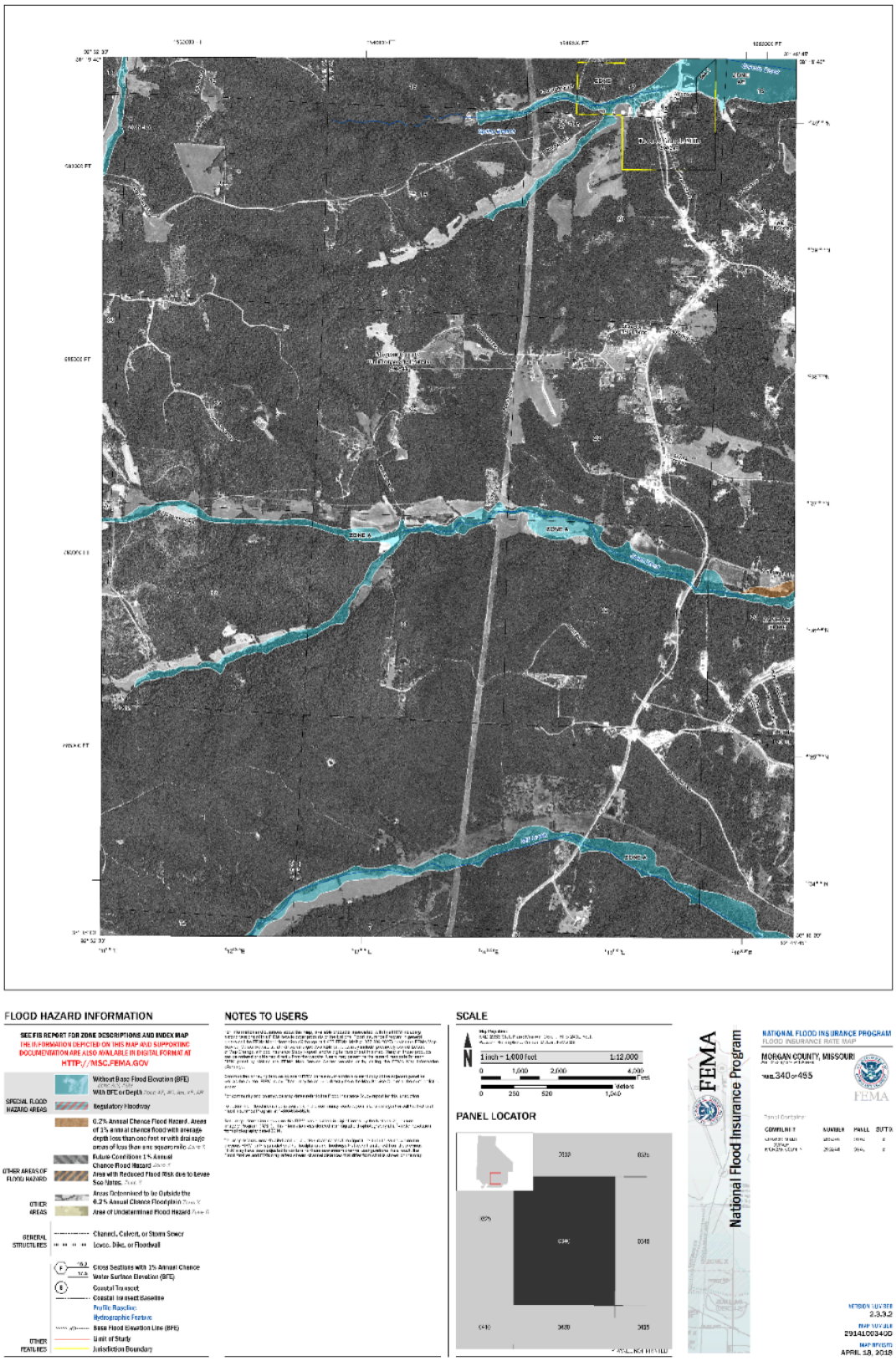


Figure 3.14. Village of Gravois Mills Flood Insurance Rate Map (FIRM)



3.2.1 Total Exposure of Population and Structures

Unincorporated County and Incorporated Cities

In the following three tables, population data is based on 2020 Census Bureau data. Building counts and building exposure values are based on parcel data developed by the State of Missouri Geographic Information Systems (GIS) 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 and are defined below in Table 3.3. Land values have been purposely excluded from consideration because land remains following disasters, and subsequent market devaluations are frequently short term and difficult to quantify. Another reason for excluding land values is that state and federal disaster assistance programs generally do not address loss of land (other than crop insurance). It should be noted that 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.

Table 3.3. Maximum Population and Building Exposure by Jurisdiction

Jurisdiction	2020 Annual Population Estimate	Building Count	Building Exposure ($)	Contents Exposure ($)	Total Exposure ($)
City of Barnett	226	109	$10,054	$5,027	$15,081
City of Laurie	916	533	$50,407	$30,612	$81,019
City of Stover	1,004	568	$61,538	$33,646	$95,184
City of Syracuse	155	123	$12,898	$9,932	$22,830
City of Versailles	2,983	1,231	$137,429	$83,299	$220,728
Village of Gravois Mills	151	169	$13,215	$10,451	$23,666
Morgan County	20,438	27,196	$1,524,481	$824,527	$2,349,008
Totals	25,873	29,929	$1,810,022	$997,494	$2,807,516

Source: U.S. Bureau of the Census, Annual population estimates/ 5-Year American Community Survey 2020; 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 the purposes of these calculations, government, school, and utility were calculated at the commercial contents rate.

Table 3.4. Building Values/Exposure by Usage Type

Jurisdiction	Residential	Commercial	Industrial	Agricultural	Total
City of Barnett	$10,054	$204	$0	$43	$10,301
City of Laurie	$40,822	$3,790	$3,685	$23	$48,320
City of Stover	$61,538	$1,680	$2,834	$71	$66,123
City of Syracuse	$12,898	$227	$3,401	$63	$16,589
City of Versailles	$137,429	$4,222	$12,187	$73	$153,911
Village of Gravois Mills	$13,215	$2,020	$2,834	$3	$18,072
Morgan County	$1,524,481	$137,929	$5,669	$25,140	$1,693,219
Totals	$1,800,437	$150,072	$30,610	$25,416	$2,006,535

Source: Missouri GIS Database, SEMA Mitigation Management Section

Table 3.5. Building Counts by Usage Type

Jurisdiction	Residential Counts	Commercial Counts	Industrial Counts	Agricultural Counts	Total
City of Barnett	83	9	0	17	109
City of Laurie	337	167	13	9	526
City of Stover	443	74	10	28	555
City of Syracuse	76	10	12	25	123
City of Versailles	960	186	43	29	1,218
Village of Gravois Mills	69	89	10	1	169
Morgan County	11,152	6,077	20	9,933	27,182
Totals	13,120	6,612	108	10,042	29,882

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

Even though schools and special districts' total assets are included in the tables above, additional discussion is needed, based on the data that is available from the districts' completion of the Data Collection Questionnaire and district-maintained websites. The number of enrolled students at the participating public-school districts is provided in **Table 3.6** 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 3.6. Population and Building Exposure by Jurisdiction-Public School Districts

Public School District	Enrolment	Building Count	Building Exposure ($)	Contents Exposure ($)	Total Exposure ($)
Morgan County R-I School District	737	5	$28,958,142	$4,061898	$33,020,039
Morgan County R-II School District	1,297	20	$62,617,121	$12,048,205	$74,665,325

Source: http://mcds.dese.mo.gov/quickfacts/Pages/District-and-School-Information.aspx., select the file for the most recent year called "20xx Building Enrollment PK-12", filter the spreadsheet by selecting only the public school districts in the planning area. The Building Exposure, Contents Exposure, and Total Exposure amounts come from the completed Data Collection Questionnaires from Public School Districts. In general, the school districts obtain this information from their insurance coverage amounts.

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 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 3.7 includes a summary of the inventory of critical and essential facilities and infrastructure in the planning area. The list was compiled from the Data Collection Questionnaire as well as the following sources:

Table 3.7. Inventory of Critical/Essential Facilities and Infrastructure by Jurisdiction

Jurisdiction	Airport Facility	Bus Facility	Childcare Facility	Communications Tower	Electric Power Facility	Emergency Operations	Fire Service	Government	Housing	Shelters	Highway Bridge	Hospital/Health Care	Military	Natural Gas Facility	Nursing Homes	Police Station	Potable Water Facility	Rail	Sanitary Pump Stations	School Facilities	Stormwater Pump Stations	Tier II Chemical Facility	Wastewater Facility	TOTAL
Morgan County	0	0	0	0																				
City of Barnett	0	0	1	0	0	0	1	1	83	0	0	0	0	0	0	0	0	0	0	0	0	0	0	86
City of Laurie	0	0	0	0	0	1	1	1	337	5	0	0	0	0	1	1	1	0	0	0	0	0	1	3
City of Stover	1	0	0	0	0	0	1	1	443	2	0	0	0	0	2	1	1	0	1	1	0	0	0	45
City of Syracuse	0	0	0	0	0	0	0	1	76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
City of Versailles	1	0	2	0	0	1	1	1	960	4	0	0	0	1	2	1	1	0	1	1	0	0	1	7
Village of Gravois	1	0	0	0	0	0	1	0	69	1	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Totals	3	0	3	0	0	2	5	5	1,968	12	0	0	0	1	5	3	3	0	2	2	0	0	2	2026

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

Bridges: Scour is a term that 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.

9 – Excellent	excellent Condition	Not Deficient
8 – Very Good	no problems noted	
7 – Good	some minor problems	
6 – Satisfactory	structural elements show some minor deterioration	
5 – Fair	all primary structural elements are sound but may have minor section loss, cracking, spalling or scour	
4 – Poor	advanced section loss, deterioration, spalling or scour	Structurally Deficient
3 – Serious	loss of section, deterioration, spalling or scour have seriously affected primary structural members. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.	
2 – Critical	advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored it may be necessary to close the bridge until corrective action is taken.	
1 – Imminent Failure	major deterioration or section loss present in critical structural members or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic until corrective action is completed.	
0 – Failed	out of service – beyond corrective action	

Source: MoDOT Bridge Conditions - http://www.modot.org/Bridges/

Figure 3.15. Morgan County Bridges

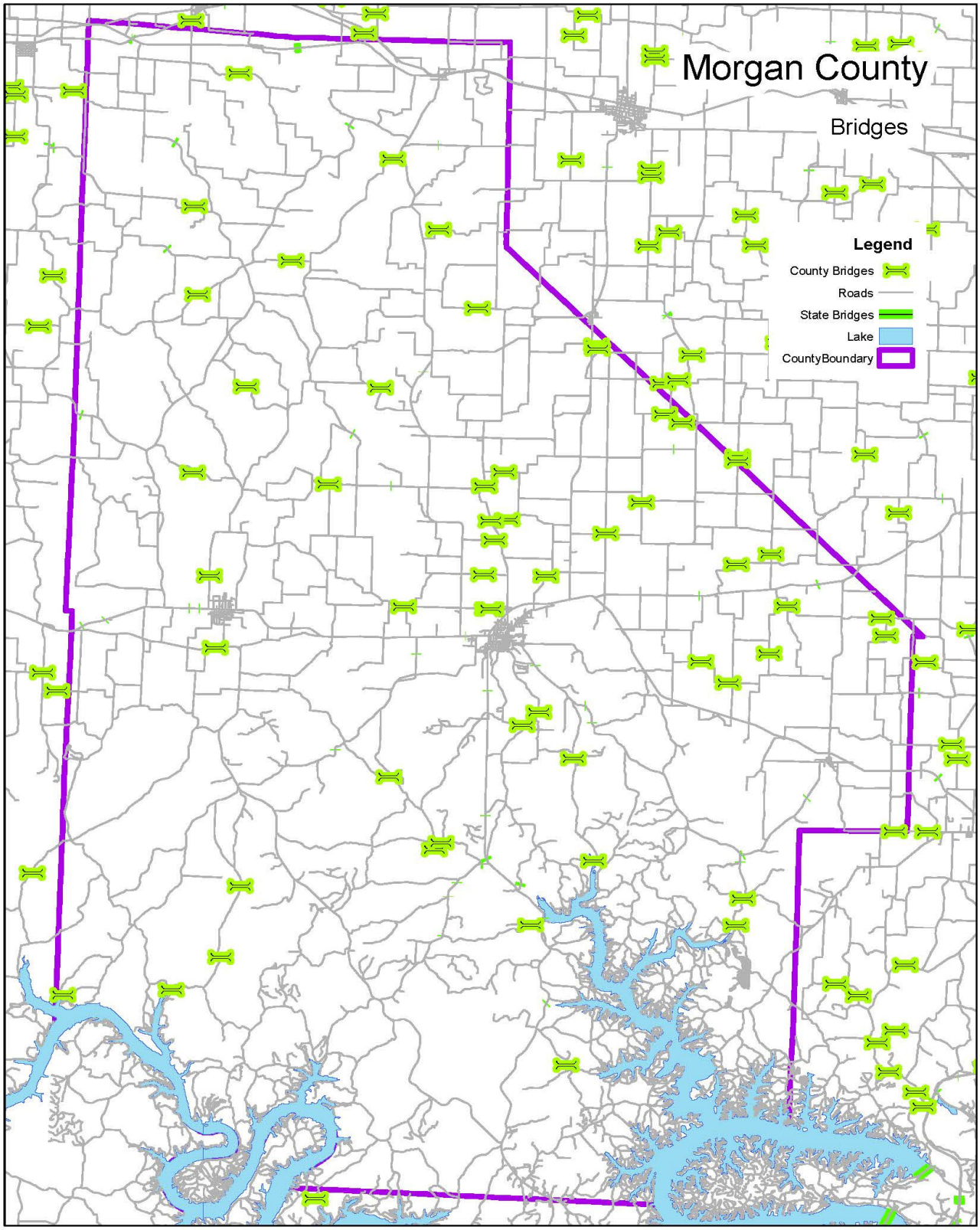
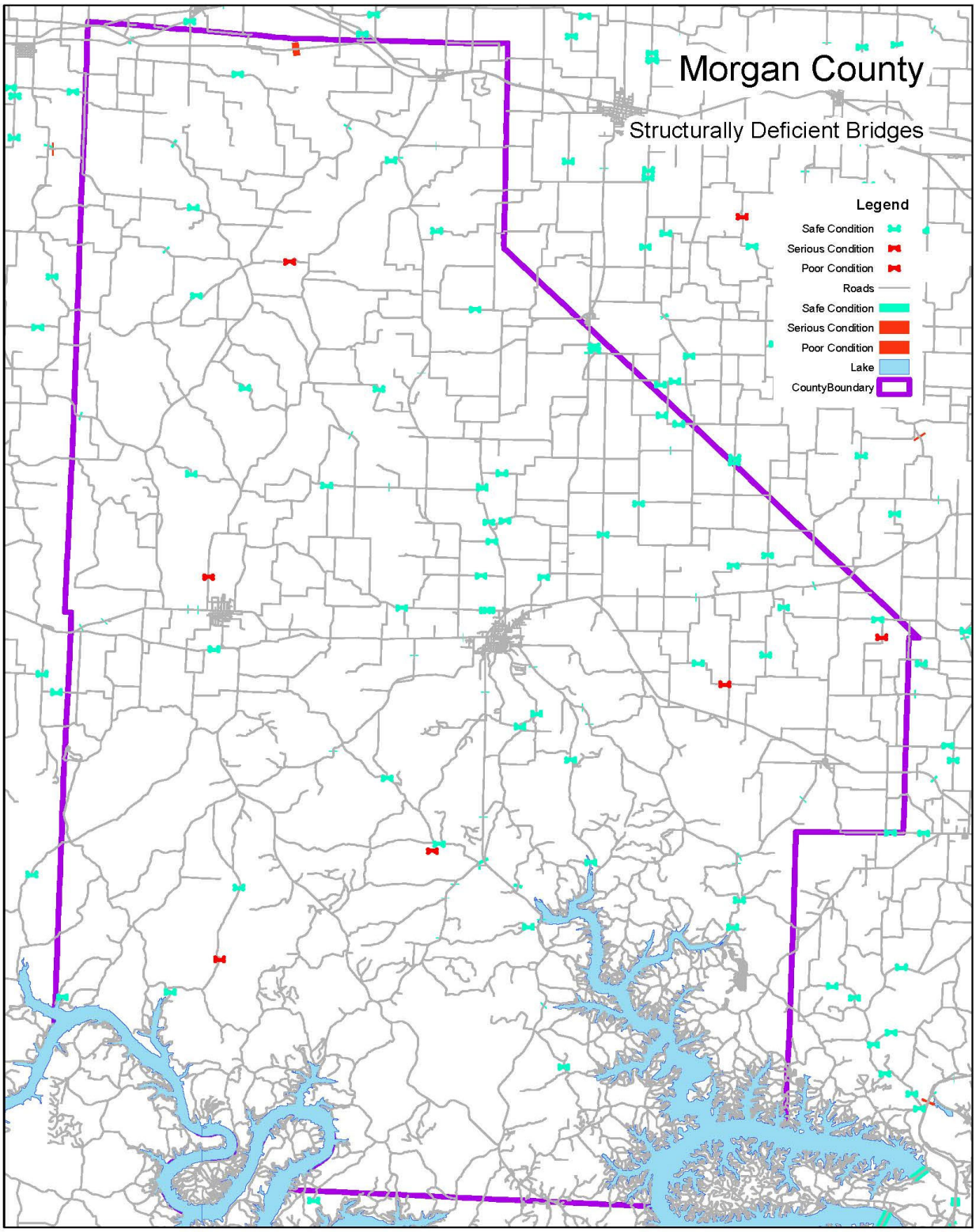


Figure 3.16. Morgan County Structurally Deficient Bridges



The figures above represent the 105 bridges in Morgan County. Morgan County as of 2016 has 27

Deficient Bridges of which 18 are rated as poor condition. The table below depicts the bridge conditions in Morgan County.

Table 3.8. Morgan County Bridges Status

Total #	Good #	Fair #	Poor #	Structurally Deficient #	Total Area	Good Area	Fair Area	Poor Area	Structurally Deficient Area
105	25	62	18	27	24,207	9,091	12,675	2,441	3,669

Source https://www.fhwa.dot.gov/bridge/nbi/no10/county16.cfm

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 damage is higher.
- The rules for reconstruction, restoration, rehabilitation, and/or replacement are often different for these types of designated resources.
- The presence of natural resources can reduce the impacts of future natural hazards, such as wetlands and riparian habitats which help absorb floodwaters.
- Losses to economic assets like these (e.g., major employers or primary economic sectors) could have severe impacts on a community and its ability to recover from disaster.

Table 3.9. Threatened and Endangered Species in Morgan County

Common Name	Scientific Name	Status
Gray bat	Myotis grisescens	Endangered
Indiana bat	Myotis sodalis	Endangered
Northern long -eared bat	Myotis septentrionalis	Threatened
Topeka shiner	Notropis topeka	Endangered

Source: U.S. Fish and Wildlife Service, http://www.fws.gov/midwest/Endangered/lists/missouri-cty.html

Natural Resources: The Missouri Department of Conservation (MDC) provides a database of lands that MDC owns, leases, or manages for public use. In 1946, the State of Missouri acquired some 17,500 acres for a state park. Lake of the Ozarks State Park is the largest state park in Missouri. The land encompassing the park and its access points are all public lands.

Table 3.10. Parks in Morgan County

Park / Conservation Area	Address	City

Laurie Fairgrounds	269 N Fairgrounds Road	Laurie, Mo 65038
Laurie Park Ball Field Recreation Area		Laurie, MO 65038
Stover Park	W 7th Street	Stover, MO 65078
Versailles	West Newton Street	Versailles, MO 65084

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

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

A good article discussing why historic preservation needs to be part of disaster planning is available at the following link:

- http://www.citylab.com/housing/2016/04/why-historic-preservation-needs-to-be-part-of-disaster-planning/477318/?utm_source=nl__link5_041116.

Additional historic preservation resources are below:

- National Park Service's Certified Local Government Program - https://www.nps.gov/clg/
- National Main Street Program - http://www.preservationnation.org/main-street/about-main-street/

The above are both partnerships between national and state agencies and local governments that focus on historic preservation. Communities that have these programs in place already have a good infrastructure to protect historic sites.

Table 3.11. Morgan County Properties on the National Register of Historic Places

Property	Address	City	Date Listed
Martin Hotel	118 North Monroe Street	Versailles, MO 65084	September 6 1978
Morgan County Courthouse	211 E Newton St #4	Versailles, MO 65084	January 5, 1980
Old St. Patrick's Church	O Road	Gravois Mills, MO 65037	March 2, 1979
Radcliffe, Jesse House	Route 1, Box 38	Barnett, MO	April 12, 1982

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

Economic Resources

Table 3.12. Major Non-Government Employers in Morgan County

Employer Name	Main Locations	Product or Service	Employees
The Gates Corporation	Versailles	Manufacturing	261
Morgan County R-II	Versailles	School District	204
Morgan County R-I	Stover	School District	118
Morgan County	Versailles	County Government	111
Martin Metal	Versailles	Metal Works	110
Good Shepard Nursing Home	Versailles	Nursing Home	67
Laurie Care Center	Laurie	Assisted Living	49

Source: Data Collection Questionnaires; local Economic Development Commissions

Agriculture

Sources of data regarding agriculture-related jobs include the following:

- https://www.missourieconomy.org/pdfs/agribusiness_economic_contribution.pdf
- https://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_County_Level/Missouri/st29_2_007_007.pdf;
- http://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Missouri/

Table 3.13. Agriculture-Related Jobs in Morgan County

Item	Number of Workers
Hired Farm Labor (2017)	**211**
Farms with 1 worker	90
Farms with 2 workers	90
Farms with 3 or 4 workers	36
Farms with 5 to 9 workers	17
Farms with 10 workers or more	3
Total Migrant Workers	0
Agriculture, forestry, fishing, hunting, and mining (2012-2016)	**578**
Management, business, science, and arts occupations	2,000
Service occupations	1,168
Sales and office occupations	1,639
Natural resources, construction, and maintenance occupations	941
Production, transportation, and material moving occupations	1,624

3.3 LAND USE AND DEVELOPMENT

3.3.1 Development Since Previous Plan Update

Table 3.14. County Population Growth, 2010-2020

Jurisdiction	Total Population 2010	Total Population 2020	2010-2020 # Change	2000-2020 % Change
Morgan County	20,631	20,438	-193	-1%
City of Barnett	200	226	26	13%
City of Laurie	1,296	916	-380	-29%
City of Stover	1,045	1,004	-41	-4%
City of Syracuse	220	155	-65	-30%
City of Versailles	2,160	2,983	823	38%
Village of Gravois Mills	117	151	34	29%

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

Morgan County has experienced a one percent decline in the overall population from 2010 to 2020. The city with the largest decline in population is the City of Syracuse with a 30 percent decline in population. While the City of Versailles shows a positive increase of 38 percent population growth.

Table 3.15. Change in Housing Units, 2010-2020

Jurisdiction	Housing Units 2010	Housing Units 2020	2010-2020 # Change	2000-2020 % Change
Morgan County	15,342	15,592	250	2%
City of Barnett	97	110	13	13%
City of Laurie	461	507	46	10%
City of Stover	594	506	-88	-14%
City of Syracuse	108	69	-39	-36%
City of Versailles	1,260	1,303	43	3%
Village of Gravois Mills	75	94	19	25%

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

Morgan County housing units have increased 2 percent over the last 10 years. The City of Stover had a decline in housing of 14 percent and the City of Syracuse declined by 36 percent. All other cities had positive housing growth.

Developments within the below Jurisdictions pose no new vulnerabilities since the last plan update.

City of Barnett - No new developments since last plan update

City of Laurie – No new developments since last plan update

City of Stover – Added three new businesses Studio 52, Changes in Time, and Stover Milling

City of Syracuse – Added one new business The Dutch Market

City of Versailles – Added new subdivision on north Monroe Street

Village of Gravois Mills – No new developments since last plan update

3.3.2 Future Land Use and Development

No new development is planned within hazard prone areas.

City of Barnett – Evaluating potential sites for tornado shelter and planning new well tower.

City of Laurie – Awarded TAP Grant and plans to build sidewalk within the city limits. Laurie was also awarded a MO-ARPA grant and plans to upgrade their wastewater management system.

City of Stover – Laundry Mat planned within the next five years.

City of Syracuse - No new growth or new development anticipated within the next five years.

City of Versailles – Potentially adding new housing development to the north part of town and planning expansion to the east and west of the city.

Village of Gravois Mills – No new growth or development planned within the next five years.

No new developments in hazard prone areas for any of the jurisdictions since the last plan update.

School District's Future Development

Morgan County R-I School District – The student population has increased by 32 percent over the last seven years and is expected to increase by more than 1 percent each year. Morgan R-I is planning expansion, but they are still discussing the best avenue to get the most value out of each investment.

Morgan County R-II School District – Enrollment has been steady over the last five years with an anticipated 1 to 5 percent increase expected over the next five years. No new developments planned for the next five 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 3.1.4 will be profiled individually in this section. 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. For some hazards, the entire planning area is at risk.
- **Strength/Magnitude/Extent:** This includes information about the strength, magnitude, and extent of a hazard. For some hazards, this is accomplished with description of a value on an established scientific scale or measurement system, such as an EF2 tornado on the Enhanced Fujita Scale. This section should also include information on the typical or expected strength/magnitude/extent of the hazard in the planning area. Strength, magnitude, and extent can also include the speed of onset and the duration of hazard events. Describing the strength/magnitude/extent of a hazard is not the same as describing its potential impacts on a community. Strength/magnitude/extent defines the characteristics of the hazard regardless of the people and property it affects.
- **Previous Occurrences:** This section includes available information on historic incidents and their impacts. Historic event records form a solid basis for probability calculations.
- **Probability of Future Occurrence:** The frequency of recorded past events is used to estimate the likelihood of future occurrences. Probability can be determined by dividing the number of recorded events by the number of years of available data and multiplying by 100. This gives the percentage chance of the event happening in any given year. For events occurring more than once annually, the probability should be reported as 100% in any given year, with a statement of the average number of events annually. For hazards such as drought that may have gradual onset and extended duration, probability can be based on the number of months in drought in a given time-period and expressed as the probability for any given month to be in drought.
- **Changing Future Conditions Considerations:**

  In addition to the probability of future occurrences, changing future conditions should also be considered, including the effects of long-term changes in weather patterns and climate on the identified hazards. NOAA has a new tool that can provide useful information for this purpose.

  - NOAA Climate Explorer, Https://toolkit.climate.gov/tools/climate-explorer

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

The Missouri Hazard Mitigation Viewer includes a Map Viewer with a legend of clearly labeled features, a north arrow, a base map that is either aerial imagery or a street map, risk assessment data symbolized the same as in the 2018 State Plan for easy reference, search and query capabilities, ability to zoom to county level data and capability to download PDF format maps. The Missouri Hazard Mitigation Viewer can be found at this link: http://bit.ly/MoHazardMitigationPlanViewer2018.

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

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

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

- **Vulnerability Overview:** The plan must provide an overall summary of each jurisdiction's vulnerability to the identified hazards. The overall summary of vulnerability identifies

structures, systems, populations or other community assets as defined by the community that are susceptible to damage and loss for hazard events.

- **Potential Losses to Existing Development:** (including types and numbers, of buildings, critical facilities, etc.) For each participating jurisdiction, the plan must describe the potential impacts of the hazard. Impact means the consequences of the effect of the hazard on the jurisdiction and its assets. Assets are determined by the community and include, for example, people, structures, facilities, systems, capabilities, and/or activities that have value to the community. For example, impacts could be described by referencing historical disaster impacts and/or an estimate of potential future losses.

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

- **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 must conclude with a summary of the problems created by the hazard in the planning area, and possible ways to resolve those problems. Include jurisdiction-specific information in those cases where the risk varies across the planning area. The focus of the problem statements sub-section is 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 should be as specific as possible, relating to specific jurisdictions as well as specific assets or areas of the planning area that are problematic. This will in turn prompt development of specific mitigation actions.

3.4.1 Flooding (Riverine and Flash)

Some specific sources for this hazard are:

- **2018 Missouri State Hazard Mitigation Plan, Chapter 3, Section 3.3.1, Page 3.80**
  https://sema.dps.mo.gov/docs/programs/LRMF/mitigation/MO_Hazard_Mitigation_Plan2018.pdf
- Watershed map, Environmental Protection Agency, https://cfpub.epa.gov/surf/locate/index.cfm
- FEMA Map Service Center, Digital Flood Insurance Rate Maps (DFIRM) for all jurisdictions, if available, msc.fema.gov/portal
- NFIP Community Status Book, http://www.fema.gov/national-flood-insurance-program/national-flood-insurance-program-community-status-book
- NFIP claims status, BureauNet, http://bsa.nfipstat.fema.gov/reports/reports.html
- Flood Insurance Administration—Repetitive Loss List (this must be requested from the State Floodplain Management agency or FEMA)
- National Centers for Environmental Information, Storm Events Database, http://www.NCEI.noaa.gov/stormevents/
- USDA Risk Management Agency, Insurance Claims, https://www.rma.usda.gov/data/cause

- FEMA Data Visualization Tool, https://www.fema.gov/data-visualization-floods-data-visualization
- Missouri Hazard Mitigation Viewer
  http://bit.ly/MoHazardMitigationPlanViewer2018 - Website
  https://drive.google.com/file/d/1bPkc0jgF9ofwQLnTL9N0u-oPFWi9hkst/view - User Guide
  - Risk MAP, DFIRM, and Hazus based depth grids used in Hazus Analysis
  - Flood losses by County 1978-2018
  - Number of flood insurance claims by County
  - Total building exposure to flooding (1% annual chance) by County
  - Buildings impacted by flooding (1% annual chance) by County
  - Flood insurance coverage by County
  - Number of flood insurance policies by County
  - NFIP participation status by County
  - Number of state facilities impacted by flooding (1% annual chance) by County
  - Critical facilities impacted by flooding (1% annual chance) by County
- MSDIS Structure Inventory and All Hazard Risk Dataset
  (available in both GIS and Excel format)
  https://drive.google.com/drive/folders/0Bzg99s866kWocFB5Y3hCRlRuWWM

Hazard Profile

Hazard Description

Lake of the Ozarks is distinctive in the fact that it is one of the largest fabricated lakes. Camden, Miller, and Morgan Counties all have shoreline along Lake of the Ozarks. The lake surface elevation is regulated by Osage (Bagnell) Dam, with normal elevation at 660ft above sea level there is a relatively stable surface elevation for the lake region. Flooding along the shoreline is minimal as the Ameren Missouri regulates the flow of water and draws down the lake water level several times during the year when flooding could be an issue, thus avoiding the potential of flooding on the shorelines around the lake.

Morgan County does have its share of flooding. Characteristically, flooding in Morgan County is associated with heavy rainfall. With these rural communities, low water crossings are common, and when heavy rainfall is experienced, these roadways become impassable. Significant rainfall will also cause streets and ditches to flood. Flooding often causes severe damage to the county's roadway system as Morgan County has over 600 miles of gravel roads.

There are several types of flooding that are prevalent in Morgan County, defining them helps us understand the impact that each can have on the planning area.

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

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 happen in areas not associated with floodplains.

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

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

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

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

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

Geographic Location

Flooding is a continuous hazard throughout Morgan County as detailed in the tables below.

Table 3.16. Morgan County NCEI Flood Events by Location, 1995-2022

Location	# of Events

Morgan County	7
-Morgan County (Gravois Mills Bridge)- flood events – 1998-07-26	
-Morgan County (unspecified area)-__ flood events – 2001-05-31	
-Morgan County (unspecified area)-__ flood events – 2002-05-08	
-Morgan County (unspecified area)-__ flood events – 2002-05-12	
-Morgan County (unspecified area)-__ flood events – 2005-01-04	
-Morgan County (unspecified area)-__ flood events – 2005-01-05	
-Morgan County (unspecified area)-__ flood events – 2005-01-12	
City of Versailles	1
-City of Versailles (Jefferson Street)-__ flood events – 2019-08-26	
Village of Gravois Mills	
-Village of Gravois Mills (Little Buffalo Creek)-__ flood events – 2009-09-05	6
-Village of Gravois Mills (Red Hollow Road)-__ flood events – 2011-05-19	
-Village of Gravois Mills (Seals Road)-__ flood events – 2014-04-03	
-Village of Gravois Mills (unspecified area)-__ flood events – 2015-12-27	
-Village of Gravois Mills (unspecified area)-__ flood events – 2015-12-28	
-Village of Gravois Mills (unspecified area)-__ flood events – 2017-04-30	

Source: National Centers for Environmental Information, Date

Table 3.17. Morgan County NCEI Flash Flood Events by Location, 1995-2022

Location	# of Events
Morgan County	6
-Morgan County (HWY 135 Florence and Pyrmount)-__ flash flood – 1998-03-19	
-Morgan County (unspecified area)-__ flash flood – 1998-06-04	
-Morgan County (unspecified area)-__ flash flood -1998-10-05	
-Morgan County (unspecified area)_flash flood – 1999-05-04	
-Moran County (unspecified area)_flash flood – 1999-06-27	
-Morgan County (Ritchie Rd)_flash flood – 2005-01-05	
City of Barnett	2
-City of Barnett (South side of Hwy AA, Barnett)- flash flood – 2009-07-28	
-City of Barnett (North side of Hwy AA, Barnett)- flash flood – 2015-07-01	
City of Laurie	1
-City of Laurie (unspecified)- flash flood 1996-04-28	
City of Stover	4
-City of Stover (Bridge on Hwy 135 south of Stover)- flash flood – 1996-05-07	
-City of Stover (Intersection of Hwy DD and Little Haw Creek)-__ flash flood – 2005-08-26	
-City of Stover (Intersection of McCasplain RD and RTE 135)-__ flash flood – 2009-11-15	
-City of Stover (Hwy 52 between Stover and Cole Camp)- flash flood – 2019-08-26	
City of Syracuse	3
-City of Syracuse (Hwy 5 North of Syracuse)- flash flood – 2007-06-10	
-City of Syracuse (Tributary of otter creek at Hwy 50)- flash flood – 2008-09-12	
-City of Syracuse (Intersection of Hwy 50 and Tipton Rd)- flash flood – 2008-09-13	
City of Versailles	20
-City of Versailles (unspecified area)- flash flood – 1996-06-06	
-City of Versailles (Hwy W North of Versailles)- flash flood – 2002-06-12	
-City of Versailles (Versailles Community)- flash flood – 2003-07-18	
-City of Versailles (Junction of Hwy 52 and Hwy 5)- flash flood – 2004-08-23	
-City of Versailles (unspecified area)- flash flood – 2004-08-24	
-City of Versailles (unspecified area)- flash flood – 2005-01-12	
-City of Versailles (City of Versailles)- flash flood – 2007-05-01	
-City of Versailles (unspecified area)- flash flood – 2008-06-04	
-City of Versailles (unspecified area)- flash flood – 2009-11-15	
-City of Versailles (Hwy 52 and Westview Rd)- flash flood – 2010-07-11	
-City of Versailles (unspecified area)- flash flood – 2010-09-10	
-City of Versailles (unspecified area)- flash flood – 2014-04-03	
-City of Versailles (Hwy W 2 miles south of Versailles)- flash flood – 2015-06-16	
-City of Versailles (Hwy C 1 Mile east of Versailles)- flash flood – 2015-06-16	

-City of Versailles (Marvin Rd east of Versailles)- flash flood – 2016-09-10	
-City of Versailles (unspecified area)- flash flood – 2019-06-17	
-City of Versailles (Willow Creek near Hwy D at Straight Fork)- flash flood – 2019-08-26	
-City of Versailles (Hwy 52 at Newton and DeKalb Street)- flash flood – 20220-07-30	
-City of Versailles (Hwy 5 North of Syracuse)- flash flood – 2007-06-10	
-City of Versailles (Hwy 5 North of Syracuse)- flash flood – 2007-06-10	

Source: National Centers for Environmental Information, Date

Strength/Magnitude/Extent

Missouri has a long history of flooding over the past century. Flooding along Missouri 's major rivers generally results in slow-moving disasters. River crest levels are forecasted 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.

Flooding presents a danger to life and property, often resulting in injuries, and in some cases, fatalities. Floodwater itself 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. 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. Floodwater can also cause erosion-undermining roadbeds. In some instances, steep slopes that are saturated with water may cause mud or rockslides onto roadways. This damage can cause costly repairs for state, county, and city road and bridge maintenance departments. When sewer backups occur, this can result in costly cleanup for home and business owners as well as present a health hazard.

National Flood Insurance Program (NFIP) Participation

Table 3.18. NFIP Participation in Morgan County

Community ID #	Community Name	NFIP Participant (Y/N/Sanctioned)	Current Effective Map Date	Regular-Emergency Program Entry Date
290974	City of Barnett	Y	NSFHA	11/30/2022
290976	City of Laurie	Y	NSFHA	08/03/2010
290875	City of Stover	Y	05/04/2009	03/09/2010
Not Listed	City of Syracuse	N	NA	NA
290247	City of Versailles	Y	05/04/2009	09/18/1985
390245B	Village of Gravois Mills	Y	5/4/2009	3/09/2010
290244B	Morgan County	Y	4/18/2018	12/01/2001

Source: NFIP Community Status Book, 10/23/2023; BureauNet, http://www.fema.gov/national-flood-insurance-program/national-flood-insurance-program-community-status-book; M= No elevation determined – all Zone A, C, and X: NSFHA = No Special Flood Hazard Area; E=Emergency Program

City of Barnett

a. Adoption of minimum NFIP floodplain management criteria* by local regulation – November 30, 2022

b. Adoption of latest FIRM – May 4, 2009
c. Designee to implement and enforce local floodplain management regulations – None designated at this time.
d. Designee to implement NFIP commitments/requirements – None designated at this time.
e. Substantial improvement/substantial damage provisions implemented after an event are in development. Jeanne Thomas, City Clerk, is the contact person at city@barnettmo.org or 573-392-6482.

City of Laurie

a. Adoption of minimum NFIP floodplain management criteria* by local regulation – August 3, 2010
b. Adoption of latest FIRM – May 4, 2009
c. Designee to implement and enforce local floodplain management regulations – Dean Smith
d. Designee to implement NFIP commitments/requirements – Dean Smith
e. Substantial improvement/substantial damage provisions implemented after an event are in development. Dean Smith, Public Works Manager, is the contact person at 573-374-4871.

City of Stover

a. Adoption of minimum NFIP floodplain management criteria* by local regulation – March 9, 2010
b. Adoption of latest FIRM – May 4, 2009
c. Designee to implement and enforce local floodplain management regulations – Jennifer Hicks
d. Designee to implement NFIP commitments/requirements – Jennifer Hicks
e. Substantial improvement/substantial damage provisions implemented after an event are in development. Jennifer Hicks, City Clerk, is the contact person at jennifer@cityofstover.net or 573-377-4510.

City of Versailles

a. Adoption of minimum NFIP floodplain management criteria* by local regulation – September 18, 1985
b. Adoption of latest FIRM – May 4, 2009
c. Designee to implement and enforce local floodplain management regulations – Jamie Morrow
d. Designee to implement NFIP commitments/requirements – Jamie Morrow
e. Substantial improvement/substantial damage provisions implemented after an event are in development. Jamie Morrow, Mayor, is the contact person at mayorcityversailles@gmail.com or 573-539-2589.

Village of Gravois Mills

a. Adoption of minimum NFIP floodplain management criteria* by local regulation – November 30, 2022
b. Adoption of latest FIRM – May 4, 2009
c. Designee to implement and enforce local floodplain management regulations – John Brooks
d. Designee to implement NFIP commitments/requirements – John Brooks

e. Substantial improvement/substantial damage provisions implemented after an event are in development. John Brooks, Chairman, is the contact person at vetjeb61@gmail.com or 816-390-2972.

Morgan County

a. Adoption of minimum NFIP floodplain management criteria* by local regulation – November 30, 2022
b. Adoption of latest FIRM – May 4, 2009
c. Designee to implement and enforce local floodplain management regulations and implement NFIP commitments/requirements – Presiding Commissioner or EMD
d. Designee to implement NFIP commitments/requirements – Presiding Commissioner or EMD
e. Substantial improvement/substantial damage provisions implemented after an event are in development. Tony Stephens, Presiding Commissioner, and Jason Foster, Emergency Management Director, are the contacts.
   Presiding Commissioner – tstephens@morgancountymo.gov or 573-378-4643
   EMD – 573-539-0095

City of Syracuse – Does not participate in the NFIP due to not having a flood plain administrator.

Table 3.19. NFIP Policy and Claim Statistics as of Date

Community Name	Policies in Force	Insurance in Force	Closed Losses	Total Payments
Morgan County	76	$14,986,400.00	15	$161,897.23
City of Barnett	0	0	0	0
City of Laurie	0	0	0	0
City of Stover	0	0	0	0
City of Syracuse	0	0	0	0
City of Versailles	1	$250,000.00	1	$31,992.39
Village of Gravois Mills	4	$301,000.00		

Source: NFIP Community Status Book, [insert date]; 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 [date] to [date].

Repetitive Loss/Severe Repetitive Loss Properties

Repetitive Loss Properties are those properties with at least two flood insurance payments of $1,000 or more in a 10-year period. According to the Flood Insurance Administration, jurisdictions included in the planning area have a combined total of zero repetitive loss properties. As of March 14, 2023, no properties have been mitigated, leaving no un-mitigated repetitive loss properties. Morgan County has a flood plain administrator that helps manage the county flood plain in participation withjurisdiction officials.

Table 3.20. Morgan County Repetitive Loss Properties

Jurisdiction	# of Properties	Type of Property	# Mitigated	Building Payments	Content Payments	Total Payments	Average Payment	# of Losses
No records from SEMA								

Source: Flood Insurance Administration as of

Severe Repetitive Loss (SRL): A SRL property is defined 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 claim payments have been paid under flood insurance coverage with the amount of each claim payment exceeding $5,000 and with cumulative amounts of such claim payments exceeding $20,000; or (2) for which at least two separate claim payments have been made with the cumulative amount of such claims exceeding the reported value of the property. There are currently no Severe Repetitive loss properties in Morgan County.

Previous Occurrences

Table 3.21. NCEI Morgan County Flash Flood Events Summary, 1995 to 2022

Year	# of Events	# of Deaths	# of Injuries	Property Damages	Crop Damages
1996	5	1	0	26K	0
1997	2	0	0	0	0
1998	4	0	0	0	0
1999	2	0	0	0	0
2000	0	0	0	0	0
2001	2	0	0	0	0
2002	2	0	0	0	0
2003	4	0	0	0	0
2004	4	0	0	0	0
2005	4	0	0	0	0
2006	0	0	0	0	0
2007	4	0	0	0	0
2008	6	0	0	35K	0
2009	8	0	0	3K	0
2010	6	0	0	0	0
2011	0	0	0	0	0
2012	1	0	0	0	0
2013	3	0	0	0	0
2014	4	0	0	1K	0
2015	8	0	0	25K	0
2016	4	0	0	10K	0
2017	1	0	0	10K	0
2018	1	0	0	0	0
2019	8	0	0	25K	0
2020	1	0	0	0	0
2021	0	0	0	0	0
2022	0	0	0	0	0

Source: NCEI, data accessed [insert date]

Table 3.22. NCEI Morgan County Riverine Flood Events Summary, 1995 to 2022

Year	# of Events	# of Deaths	# of Injuries	Property Damages	Crop Damages
		No Data to be Found			

Source: NCEI, Date

Probability of Future Occurrence

The Morgan County Planning Area has experienced 43 reported incidents of flooding from 1995 to March 2023. Countywide totals reflect (12) community-wide incidents. Stover with (2) reported incidents, Versailles with (9) incidents, Laurie with (1) incident, Barnett with (2) incidents, Syracuse with (3) incidents, and Gravois Mills with (8) incidents. Morgan County as a whole experienced 58 percent of all reported flooding incidents. Data reflects Gravois Mills and Versailles both experienced 16 percent of all reported flooding. There is a 100% probability of future flooding and flash flooding using the data from 1995-2022.

There are several types of flooding that are prevalent in Morgan County, defining them helps us understand the impact that each can have on the planning area.

Flood	For NFIP purposes, a partial or complete inundation of normally dry land areas from: Overland flow of a lake, river, stream, creek, slough, or ditch. The unusual and rapid accumulation of rainfall runoff or snowmelt. Mudflows or the collapse of shoreline land.
Riverine Flood	Flooding that occurs along a river, stream, or other non-coastal watercourses.
Flash Flood	A flood in hilly areas that arrives at a location very quickly (minutes instead of hours) after a heavy rain. This can also occur in urban areas where pavement and drainage improvements speed rainfall runoff to a stream

Flooding in Morgan County can happen anytime throughout the year, as the charts reflect flooding incidents in nearly every month of the year.

Changing Future Conditions Considerations

If departure from normal with respect to increased precipitation intensity continues, frequency of floods in Morgan County is likely to increase as well. Over the last half century, average annual precipitation in most of the Midwest has increased by 5 to 10 percent. But rainfall during the four wettest days of the year has increased about 35 percent, and the amount of water flowing in most streams during the worst flood of the year has increased by more than 20 percent.

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

Flooding occasionally threatens navigation and riverfront communities, and greater river flows could increase these threats. In April and May 2011, a combination of heavy rainfall and melting snow caused a flood that closed the Mississippi River to navigation, threatened Caruthersville, and prompted evacuation of Cairo, Illinois, due to concerns that its flood protection levees might fail.

The expected increases in rainfall frequency and intensity are likely to put additional stress on natural hydrological systems and community stormwater systems. Heavier snowfalls in the winter will lead to intensified spring flooding, and groundwater levels will remain high even in non-floodplain areas. Such changes in climate patterns can lead to the development of compounding events that interact to create 3.101 3 Risk Assessment extreme conditions. Flooding caused by high groundwater levels typically recedes more slowly than riverine flooding, slowing the response and recovery process. Groundwater-fed rivers and streams are also likely to experience heightened flooding when

groundwater levels are high.

Jurisdictions updating or installing stormwater management systems should consider potentially larger future discharge amounts when sizing culverts and drainage ways; storage capacity can also be increased by building retention basins to hold excess stormwater. Communities already prone to flooding should be prepared for a potential increase in facility closures and/or damage, as well as an increase in public demand for flood response and assistance. Natural features that experience repeated flooding may manifest changes in the form of stream bank instability and changing shoreline, floodplain, and wetland boundaries. Communities may also wish to plan for the potential loss of cropland and damage to both private property and public infrastructure such as bridges.

The environmental impacts of flooding include erosion, surface and groundwater contamination, and reduced water quality. The threat of more frequent flood events may thus be a concern particularly for communities who depend on lakes, rivers, or trout streams for tourism. Rural communities may experience increases in well contamination and road washouts, while urban areas may be particularly vulnerable to flash flooding as heavy rain events quickly overwhelm the ability of a more impermeable environment to absorb excess stormwater.

Source: 2018 Missouri State Hazard Mitigation Plan

Vulnerability Overview

Measure of Vulnerability: High

Morgan County can expect Flooding to damage structures throughout the entire planning area. It is difficult to predict if the damage will be destruction or just water damage that can be mitigated and the structure can still be used once the building is repaired. There is inconsistent data concerning the costs associated with the historical information available. Another factor to consider when flooding occurs is how much time and money will be invested in the mold remediation of a flooded property. Morgan County experiences relatively high humidity, which can cause a property that has water damage to be enveloped with Black Mold in a very short period. If this occurs, health issues also become a factor.

Potential Losses to Existing Development

There is a moderate chance of loss of life and damage to property, especially during flash floods as there is little or no time to prepare for the event.

Hazard Summary by Jurisdiction

In this section, we have discussed flooding (including riverine flooding, flash flooding, and storm water flooding) all of which affect the entire planning area within Morgan County. The potential adverse impact of flooding is hard to predict and often there is little that can be done to protect against structural and property damage, except to avoid building in identified vulnerable areas.
Problem Statement

Problem Statement

Mitigation: Floodplain mapping and participation in the National Flood Insurance Program (NFIP) play a major role in flood mitigation. The objectives of flood mitigation are to keep people, property, and possessions out of the floodplain area where reasonably achievable or to emplace protective measures to protect and mitigate loss of life and property.

Participation in the NFIP requires that floodplain ordinances, which regulate development in the floodplain, be adopted and enforced by each community. The standard regulations require that buildings be constructed at least 1 foot above the Base Flood Elevation (BFE). [The BFE is the flood level associated with the 1% flood (formerly known as the "100-year flood").]

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 damage 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."

The following are the FEMA publication descriptions of different kinds of levee failure.

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

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

Geographic Location

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

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

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

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 will be discussed and further analyzed. It is noted that increased discharges are being taken into account in revision of the flood maps as part of the RiskMap efforts. This may result in changes to the flood protection level that existing levees are certified as providing.

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

None

Probability of Future Occurrence

Probability cannot be calculated due to no previous occurrences and lack of data.

Changing Future Conditions Considerations

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 the 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).

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

Both Routine and Periodic Inspections result in a rating for operation and maintenance. Each levee segment receives an overall segment inspection rating of Acceptable, Minimally Acceptable, or Unacceptable. **Figure 3.17** below defines the three ratings.

Figure 3.17. Definitions of the Three Levee System Ratings

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

Potential Losses to Existing Development

Data limitations, such as the lack of a centralized database for Missouri levees make it impossible to consider possible losses.

Impact of Previous and Future Development

At this time there is no anticipated future development in the county that could affect the risk of damage from this hazard in the planning area.

Hazard Summary by Jurisdiction

There are no previous occurrences of levee failure in Morgan County

Problem Statement

No issues Currently

3.4.3 Dam Failure

Hazard Profile

Hazard Description

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

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

Table 3.23. MoDNR Dam Hazard Classification Definitions

Hazard Class	Definition
Class I	10 or more permanent dwellings; or any public building
Class II	1-9 permanent dwellings; or one or more campgrounds with permanent water, sewer/electrical services; or one or more industrial buildings.
Class III	Everything else

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

Table 3.24. NID Dam Hazard Classification Definitions

Hazard Class	Definition
Low Hazard	Loss of human life – None expected; Loss of economic, environmental, and lifeline- low and generally limited to the owner.
Significant Hazard	Loss of human life – none expected; Loss of economic environmental lifeline – Yes
High Hazard	Loss of human life – probable, one or more expected; Loss of economic, environmental, lifeline Yes, (But not necessary for this classification.

Source: National Inventory of Dams

Geographic Location

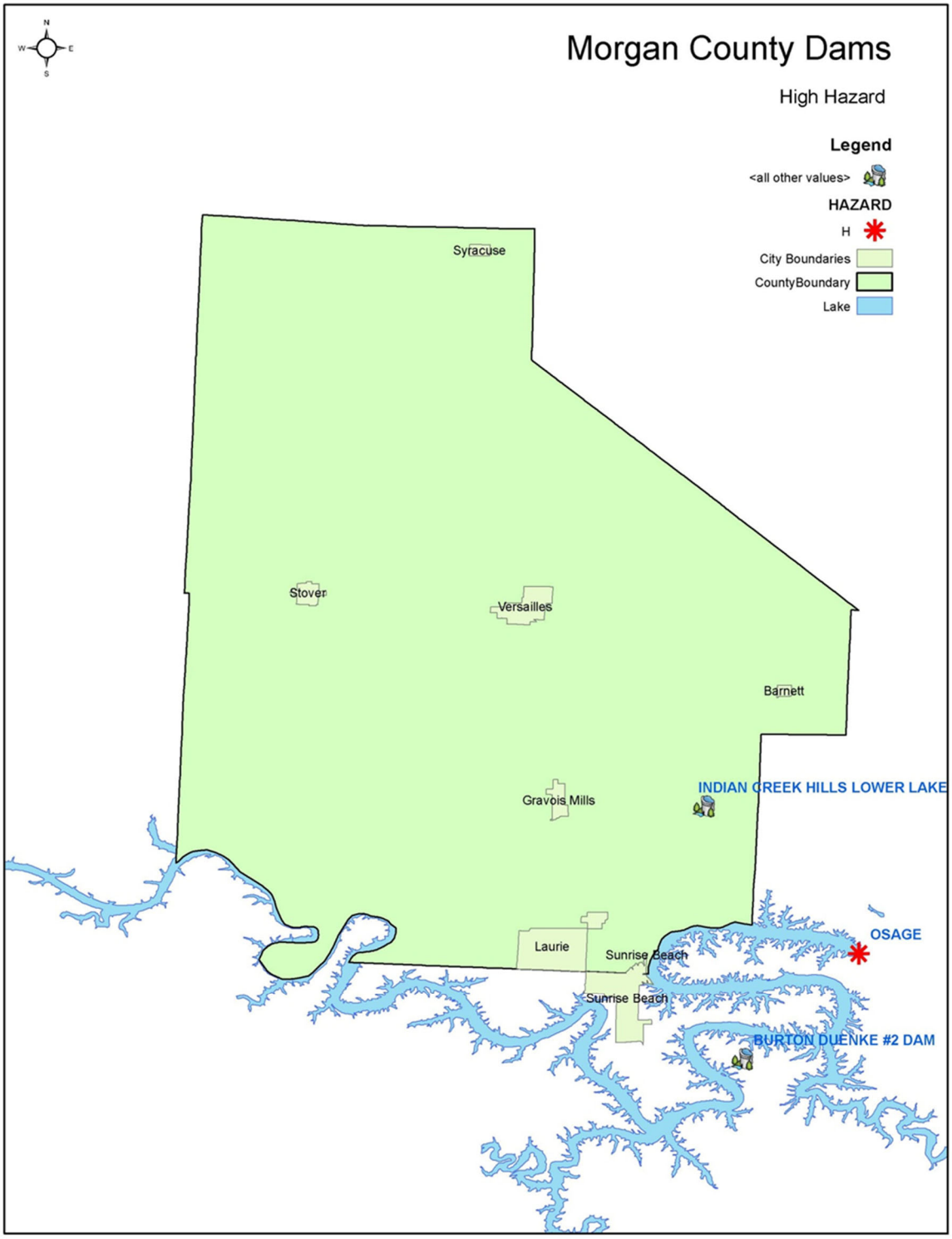
Dams Located Within the Planning Area

Table 3.25. High Hazard Dams in the Morgan 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
Dennis Lake Dam	No	30	55	No Data	30 TR to Little Buffalo Creek	Climax Springs	0	Elvin Dennis

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

Figure 3.18. High Hazard Dam Locations in Morgan County and Areas Impacted in the Event of Breach.



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

The National Inventory of Dams, maintained by the U.S. Army Corps of Engineers, shows three high hazard dams within proximity of Morgan County they are Osage (Bagnell) Dam,

the Harry S. Truman Dam, and the Pomme de Terre Dam. Below is the specific information found on Wikipedia in regard to each of these dams.

> ***Bagnell Dam*** *impounds the Osage River in the U.S. state of Missouri, creating the Lake of the Ozarks. The 148-foot (45 m) tall concrete gravity dam was built by the Union Electric Company (now Ameren) for the purpose of hydroelectric power generation as its Osage Powerplant. It is 2,543 feet (775 m) long, including a 520-foot (160 m) long spillway and a 511-foot (156 m) long power station. The facility with eight generators has a maximum capacity of 215 megawatts. http://en.wikipedia.org/wiki/Bagnell_Dam*
>
> *The* ***Truman Reservoir*** *(also known as Truman Lake) is in the state of Missouri, United States. It is the largest man-made lake in Missouri and the dam that created and manages the lake's water level. It is located between Clinton and Warsaw, on the Osage River and extends south to Osceola. The dam is in Benton County, but the reservoir also extends into parts of Henry, St. Clair, and Hickory counties. http://en.wikipedia.org/wiki/Truman_Reservoir*
>
> ***Pomme de Terre Lake*** *is in southwest Missouri at the confluence of Lindley Creek and the Pomme de Terre River (for which it is named). The lake is in southern Hickory and northern Polk counties, about 50 miles (80 km) north of Springfield. The name is French and literally translated means "earth apple", which in English is a potato.*
> *The lake is part of a series of lakes in the Osage River Basin designed and constructed by the United States Army Corps of Engineers for flood control. Construction began in 1957 and was completed in 1961 at a cost of $14,946,784. Storage of water began on October 29, 1961, and the multipurpose pool was reached on June 15, 1963.*
> *The dam is adjacent to Pomme de Terre State Park and is crossed by Route 254. It consists of a 14-foot (4 m) circular tunnel with two 6.5 X 14-foot (4 m) hydraulic slide service gates and a single 24-inch (610 mm) circular low flow gate. The dam is 7,230 feet (2,204 m) long, 30 feet (9 m) wide at the top and 950 feet (290 m) wide at the base (maximum).*
> *Two arms of the lake extend from the dam site. The Pomme de Terre arm follows the Pomme de Terre River and extends for 17 miles (27 km). The Lindley Arm follows Lindley Creek for 12 miles (19 km).*
> *http://en.wikipedia.org/wiki/Pomme_de_Terre_Lake*

Strength/Magnitude/Extent

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

Previous Occurrences

A thorough search in the National Performance of Dams Program with Stanford University was