Boone County, Illinois Multi-Hazard Mitigation Plan

A 2020 Update of the 2014 Countywide MHMP

FEMA

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ILLINOIS EMERGENCY MANAGEMENT AGENCY

SIU
Southern Illinois University
CARBONDALE

Multi-Hazard Mitigation Plan

Boone County, Illinois

Adoption Date: -- _____ --

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Acknowledgements

The Boone County Multi-Hazard Mitigation Plan would not have been possible without the feedback, input, and expertise provided by the County leadership, citizens, staff, federal and state agencies, and volunteers. We would like to give a special thank you to the citizens not mentioned below who freely gave their time and input in hopes of building a stronger, more resilient County.

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Section 1. Introduction

Hazard mitigation is any sustained action to reduce or eliminate long-term risk to human life and property from hazards. The Federal Emergency Management Agency (FEMA) makes reducing hazards one of its primary goals; hazard-mitigation planning and the subsequent implementation of mitigation projects, measures, and policies is a primary mechanism in achieving FEMA's goal.

The Multi-Hazard Mitigation Plan (MHMP) is a requirement of the Federal Disaster Mitigation Act of 2000 (DMA 2000). The development of a local government plan is required in order to maintain eligibility for certain federal disaster assistance and hazard mitigation funding programs. In order for the National Flood Insurance Program (NFIP) communities to be eligible for future mitigation funds, they must adopt an MHMP.

In recognition of the importance of planning in mitigation activities, FEMA created Hazus Multi-Hazard (Hazus-MH), a powerful geographic information system (GIS)-based disaster risk assessment tool. This tool enables communities of all sizes to estimate losses from floods, hurricanes, earthquakes, and other natural hazards and to measure the impact of various mitigation practices that might help reduce those losses. The Illinois Emergency Management Agency (IEMA) has determined that Hazus-MH should play a critical role in the risk assessments performed in Illinois.

Boone County completed their previous Multi-Hazard Mitigation Plan in 2014. Throughout the five-year planning cycle, the Boone Emergency Management Agency and Mitigation Planning Team reconvened to monitor, evaluate, and update the plan on an annual basis. Southern Illinois University Carbondale (SIU) and Boone County have joined efforts in updating the County's mitigation plan. The update process addressed changes in the probability and impact of specific hazards to the county, as well as changes in land-use, population, and demographics. The plan incorporates detailed GIS and Hazus-MH Level 2 analyses to improve the risk assessment, and finally revised and updated mitigation strategies. This document hereby serves as Boone Multi-Hazard Mitigation Plan update.

Section 2. Planning Process

2.1 Timeline

The MHMP update process is broken into a series of four meetings. These meetings were organized by SIU and hosted by the Boone Emergency Management Agency. At these meetings, various tasks were completed by SIU and the Boone Mitigation Planning Team.

Meeting 1: Introduction of the MHMP process and organize resources. SIU gathered local resources that contributed to the detailed county risk assessment and presented the county's historical hazards. Based on this information, the Planning Team identified natural hazards to include in the plan, and ranked hazard mitigation priority by potential damages and frequency of occurrence.

Meeting 2: The aim of meeting 2 is development of mitigation strategies for the various jurisdictions based on identified needs and the informed by hazard rankings derived from meeting 1. FEMA requires the plan to contain mitigation strategies specific to each hazard and for each incorporated area within the county. This meeting was intended for the third week of March 2020. However, due to the COVID-19 response, the formal assembly was unable to take place. In lieu of this, SIU (Dr. James Conder) and the Boone County EMA director (Dan Zaccard) had a formal phone call on April 6, discussing previous and future mitigation strategies for the county. SIU presented options for funding implementation of different mitigation strategies, including a written guide. It was decided that the county EMA would work directly with the participating jurisdictions to help develop their respective mitigation strategies. This was achieved over the subsequent weeks. The Planning Team lent local knowledge to identify and prioritize mitigation strategies and projects that can address the threats identified in the previously developed risk assessments.

Meeting 3: The aim of meeting three is to invite public involvement. Again, because of the COVID-19 crisis, this could not take place as a formal assembly. In lieu of a formal assembly, the plan including draft risk assessments derived from the Hazus-MH and GIS modeling of the identified disasters and mitigations strategies identified by the planning team were posted on the County website for comment and/or questions. In addition to the website itself, the general public was notified of the week-long comment period through various social media and a newspaper announcement. The gathered public input was utilized in the planning process, fulfilling one of FEMA's requirements for public input.

Meeting 4: The Planning Team reviewed the draft plan and, proposed revisions, and accepted the plan after SIU incorporated the necessary changes. This was accomplished via email with SIU and the County EMA acting as contact points for edit updates. Subsequently, SIU forwarded the county MHMP to the mitigation staff at the Illinois Emergency Management Agency (IEMA) for review prior to submitting it to FEMA.

2.2 Jurisdiction Participation Information

Six jurisdictions participated in the development of this MHMP with the intent of formally adopting the plan and subsequently fulfill the requirements of the DMA 2000. Various representatives from each

jurisdiction were present at the meetings (see Section 2.3 Planning Team Information). Each jurisdiction falls under the one of the following categories: County, City, Village, Town, School, or Non-Profit Organization.

2.3 Planning Team Information

Dan Zaccard, Boone EMA Coordinator, heads the Planning Team. The Planning Team includes representatives from various county departments, municipalities, and public and private utilities. Members of the Planning Team have a common vested interest in the County's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage. All members of the Planning Team actively participated in the meetings, reviewed, and provided comments on the draft plan, participated in the public input process and the county's formal adoption of the plan.

Boone Planning Team Members

Jurisdiction	Name	Title
Boone County	Dan Zaccard	Coordinator
Boone County	Pat Molloy	Lieutenant
Boone County	Joe Shadden	Information Technology Director
Boone County	Dan Streed	Deputy Director of Administration
City of Belvidere	Al Hyser	Fire Chief
City of Belvidere	Brent Anderson	Director of Public Works
Boone County	Sherry Giesecke	Board Member
Boone County	Ellen Genrich	Emergency Response
Winnebago and Boone Counties	Paul Chiodine	Paramedic Supervisor
Poplar Grove	Owen Costanza	Mayor
Timberlane	Steve Rapp	Village President
Capron	Conrad Labinsky	Mayor

The DMA 2000 planning regulations require that Planning Team members from each jurisdiction actively participate in the MHMP process. The Planning Team was actively involved on the following components:

- Attending the MHMP meetings
- Providing available assessment and parcel data and historical hazard information
- Reviewing and providing comments on the draft plans
- Coordinating and participating in the public input process
- Coordinating the formal adoption of the plan by the county

Participating Jurisdictions

Boone County	City of Belvidere	Village of Poplar Grove
Boone County Health Department	Village of Capron	Village of Timberlane

The first MHMP update meeting was held in Belvidere, Illinois on December 9, 2019. Representatives from SIU explained the rationale behind the MHMP update process and answered questions from the jurisdictional representatives and other interested stakeholders. SIU representatives also provided an overview of GIS/Hazus-MH, described the timeline and the process of mitigation planning.

Due to the COVID-19 crisis, the Boone Planning Team was only able to formally assemble for the first meeting, lasting approximately two hours in length. The Additional meetings were held outside of the four formal meetings. Appendix A includes the minutes for all meeting. During these meetings, the Planning Team successfully identified critical facilities, reviewed hazard data and maps, identified and assessed the effectiveness of existing mitigation measures, established mitigation projects for the future, and assisted with preparation of the public participation information.

Planning Meetings

MEETING 1	Dec 9th, 2019
MEETING 2	April 6th, 2020
MEETING 3	May 19th, 2020
MEETING 4	May 30th, 2020

2.4 Public Involvement

The Boone County EMA solicited public input throughout the planning process. The public was explicitly invited to give input from May 19 – May 26, 2020 with the plan posted on the county website enabling review of the County's risk assessment and mitigation strategies. Appendix B contains a press release sent to the local newspaper, The Boone County Journal and screen shots of the county website where the plan was posted for public review.

2.5 Neighboring Community Involvement

The Planning Team invited participation from various representatives of county government, local city and town governments, community groups, local businesses, and universities. The Planning Team also invited participation from adjacent counties to obtain their involvement in the planning process.

Neighboring Community Participation

Person Participating	Neighboring Jurisdiction	Title/Organization
Police Chief Shane Woody	City of Belvidere	Reviewed plan; offered comments
Ellen Genrich	Boone County Health Department	Reviewed plan; offered comments
Conrad Lobinsky	Village of Capron	Reviewed plan; offered comments
Steve Rapp	Village of Timberlane	Reviewed plan; offered comments
Dan Zaccard	Boone County	Reviewed plan; offered comments
Dan Streed	Boone County	Reviewed plan; offered comments
Owen Costanzo	Village of Poplar Grove	Reviewed plan; offered comments

2.6 Review of Technical Documents

The Boone Planning Team identified technical documents from key agencies to assist in the planning process. These documents include land use plans, comprehensive plans, emergency response plans, municipal ordinances, and building codes. The planning process incorporated the existing natural hazard mitigation elements from previous planning efforts. The following technical data, reports, and studies were utilized:

Federal Emergency Management Agency
- *Developing the Mitigation Plan*
- *Mitigation Ideas*
- *Local Mitigation Planning Handbook*
- *Flood Insurance Study*

United States Census Bureau
- *County Profile Information*
- *2018 Census Data*
- *American Community Survey (2013-2017)*

U.S. Army Corp of Engineers
- *2019 Executive Summary - Levee System*

NOAA National Climatic Data Center
- *Climate Data*

NOAA / National Water Service Storm Prediction Center
- *Severe Weather Data*

Illinois Emergency Management Agency
- *2014 Illinois Natural Hazard Mitigation Plan*

Illinois Environmental Protection Agency
- *2014 303d Listed Waters and Watershed Maps*

Illinois State Water Survey
- *Climate Data*

Illinois Department of Commerce and Economic Opportunity
- *Community Profiles*

Boone County
- *2019 Assessment Records*
- *2019 Countywide GIS Parcel Database*
- *2014 Multi-Hazard Mitigation Plan*

2.7 Adoption by Local Government

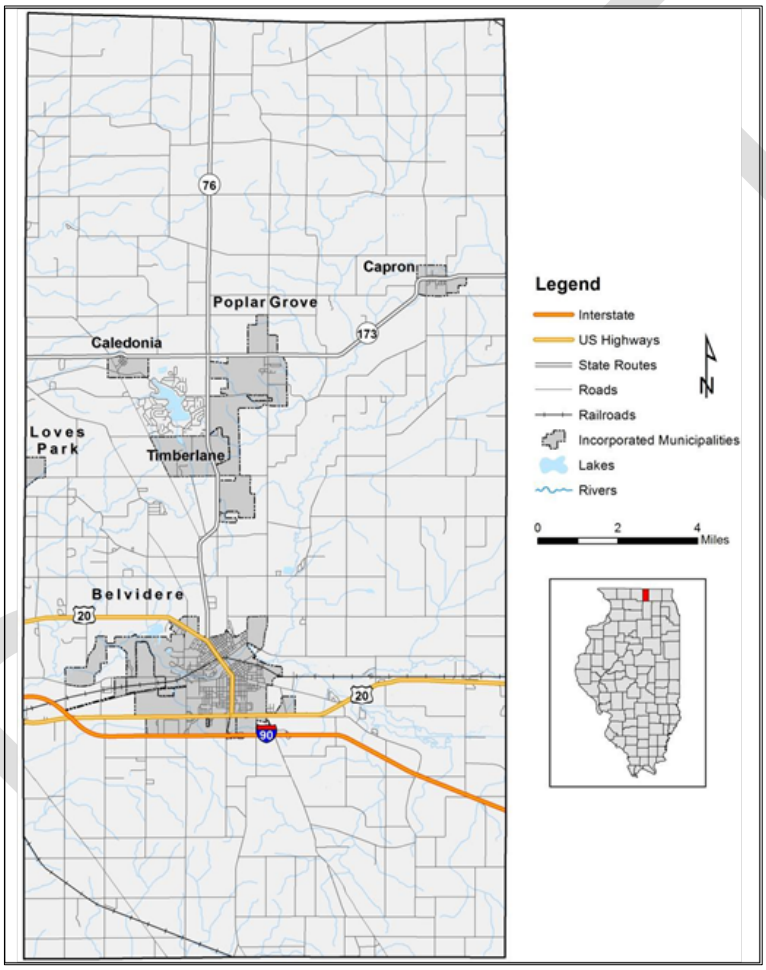
Upon IEMA and FEMA approval, the Planning Team presented and recommended the plan to the County Board for formal adoption. The plan was formally adopted by the Boone County Board on <adoption date>. The Planning Team worked with the County and its jurisdictions to ensure all parties formally adopted the plan. Appendix C contains the Adopting Resolutions for each participating jurisdiction.

Section 3. County Profile

3.1 County Background

Boone County is located in northern Illinois along the Illinois-Wisconsin border. Boone County is surrounded by McHenry County to the east, Winnebago County to the west and DeKalb County to the south. Boone County was formed out of Winnebago County in 1837. The county is named after the American pioneer, Daniel Boone. Figure 3-1 displays the geographical location of Boone County and its incorporated municipalities. Belvidere has remained the county seat since 1843.

Figure 3-1. Boone and Surrounding Region

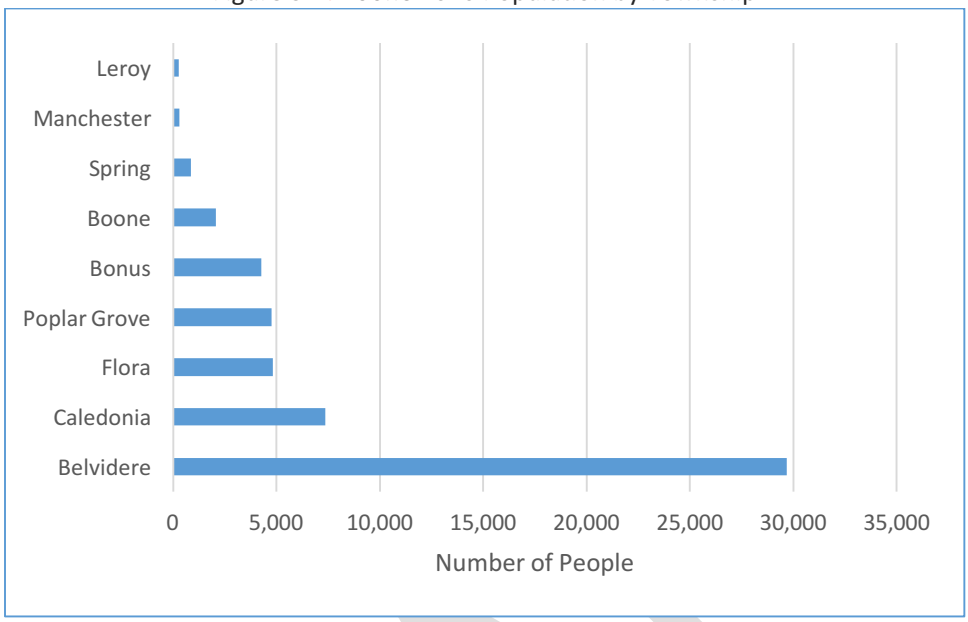


3.2 Demographics

Boone County's population is 53,577, a decrease of 0.97% from 2010 to 2018 (U.S. Census Bureau, 2018 Estimate). The population is spread through nine townships: Belvidere; Bonus; Boone; Caledonia; Flora; Leroy; Manchester; Poplar Grove; and Spring. Boone County has six incorporated jurisdictions, including: Belvidere; Caledonia; Capron; Garden Prairie; Poplar Grove; and Timberlane. The largest incorporated

jurisdiction in Boone County is Belvidere, which has a population of approximately 30,109 (U.S. Census Bureau, 2018 Estimate). Figure 3-2 includes the breakdown of population by township.

Figure 3-2. Boone 2010 Population by Township



3.3 Economy and Industry

The American Community Survey (2013-2017) reported that the civilian labor force comprised 46.8% of the workforce in Boone County. Table 3-1 includes the employment distribution by industrial sector. Manufacturing, retail trade, and education represent the largest sectors, employing 52.4% of the workforce. The annual per capita income in Boone County is $26,105 (American Community Survey, 2013-2017).

Table 3-1. Boone County's Major Employers

Employer	Industry	Approximate Number of Employees
Americold	Warehousing	138
Belvidere School District 100	Education	600
Capron Manufacturing	Manufacturing	150
Chrysler Belvidere Plant	Manufacturing	3900
Dean Foods	Food & Beverage	110
General Mills	Food & Beverage	560
Ipsen USA Belvidere	Heat Treat & Manufacturing	55
North Boone School District 200	Education	200
Syncreon	Logistics	75

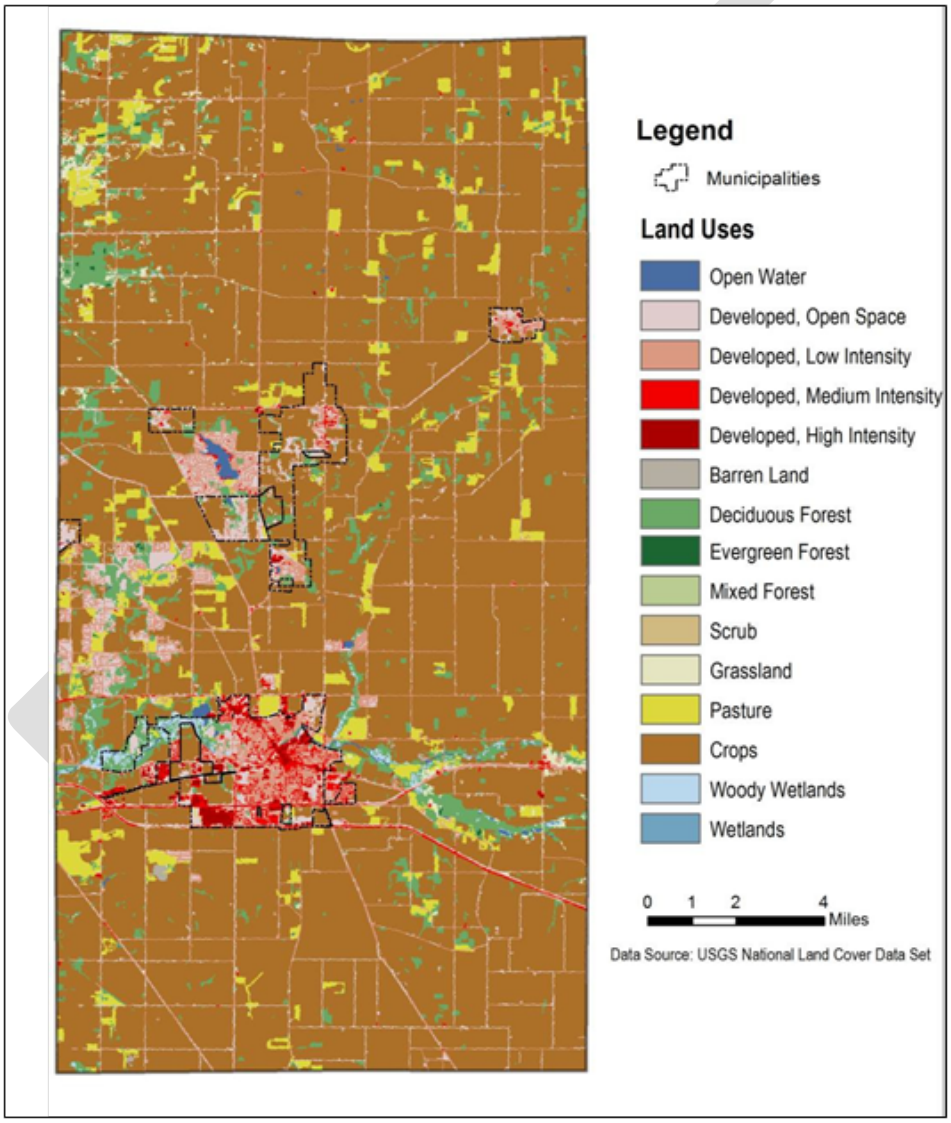
Source: https://factfinder.census.gov/

Land Use and Development Trends

Figure 3-3 depicts the land use within Boone County. The predominant land cover in Boone County is crops, followed by medium and low intensity urban development, pasture, and deciduous forest. Crops

and pastures are distributed throughout the county, while areas of deciduous forest are usually found along rivers or around water bodies. Urban development is predominantly located within the triangle formed by US Business 20, Beloit Road, and the County Line. The city of Belvidere is the area of most significant urban development. Suburban development is located within the City of Belvidere, and to an extent, in the Villages of Capron and Poplar Grove and Candlewick. Small village-character development is located within Caledonia, Capron, Poplar Grove, Garden Prairie, and to some extent, Herbert. There are no state parks in Boone County. Boone County has six structures in the National Register of Historic Places, including the Pettit Memorial Chapel designed by famous architect Frank Lloyd Wright.

Figure 3-3. Land Use in Boone County



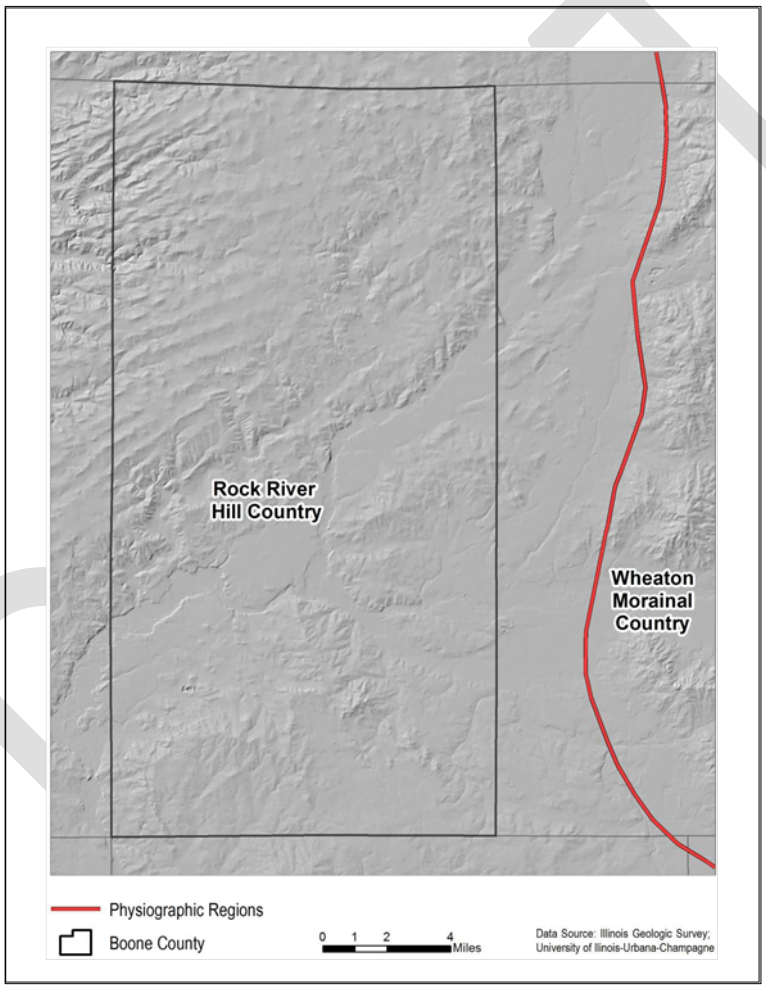
3.4 Climate

Boone County climate is humid continental with warm summers and cold winters. Seasonal temperatures range from highs in the 80s in summer months and lows in the teens in winter months. The highest temperature on record is 109 °F and the lowest is -29 °F. Average annual precipitation is 35.5 inches, with most precipitation occurring in spring and summer months. Average annual snowfall is approximately 34 inches. Annual humidity averages around 75%. Wind is common, frequently with gusts around 20 mph.

3.6 Topography

Boone County is situated in the Rock River Hill County physiographic regions. Figure 3-5 depicts the physiographic regions of Boone County.

Figure 3-4. Physiographic Divisions of Boone and Surrounding Terrain

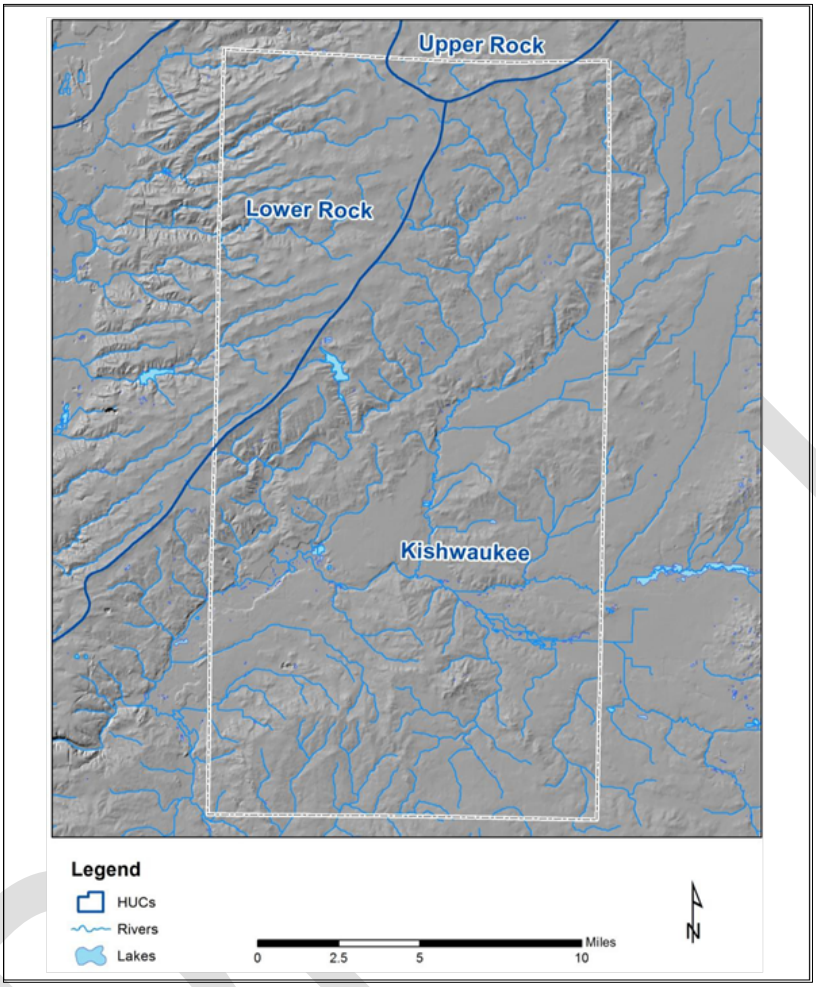


3.7 Major Lakes, Rivers, and Watersheds

Boone County has several water bodies, the most prominent of which is Candlewick Lake. The only major river in Boone County is the Kishwaukee River, which runs through the center of Belvidere. According to

the USGS, Boone County consists of three drainage basins: Upper Rock; Lower Rock; and Kishwaukee. Figure 3-5 depicts the hydrologic units within Boone County.

Figure 3-5. Major drainage basins in Boone County



Section 4. Risk Assessment

The goal of mitigation is to reduce future hazard impacts including loss of life, property damage, disruption to local and regional economies, and the expenditure of public and private funds for recovery. Sound mitigation requires a rigorous risk assessment. A risk assessment involves quantifying the potential loss resulting from a disaster by assessing the vulnerability of buildings, infrastructure, and people. This assessment identifies the characteristics and potential consequences of a disaster, how much the disaster could affect the community, and the impact on community assets. This risk assessment consists of three components—hazard identification, vulnerability assessment, and risk analysis.

4.1 Hazard Identification

4.1.1 Existing Plans

The Planning Team identified technical documents from key agencies to assist in the planning process and incorporated the natural hazard mitigation elements from previous 2014 Boone Multi-Hazard Mitigation Planning efforts. Several other documents were used to profile historical hazards and guide the Planning Team during the hazard ranking exercise. Section 2-6 contains a complete list of the technical documents utilized to develop this plan.

4.1.2 National Hazard Records

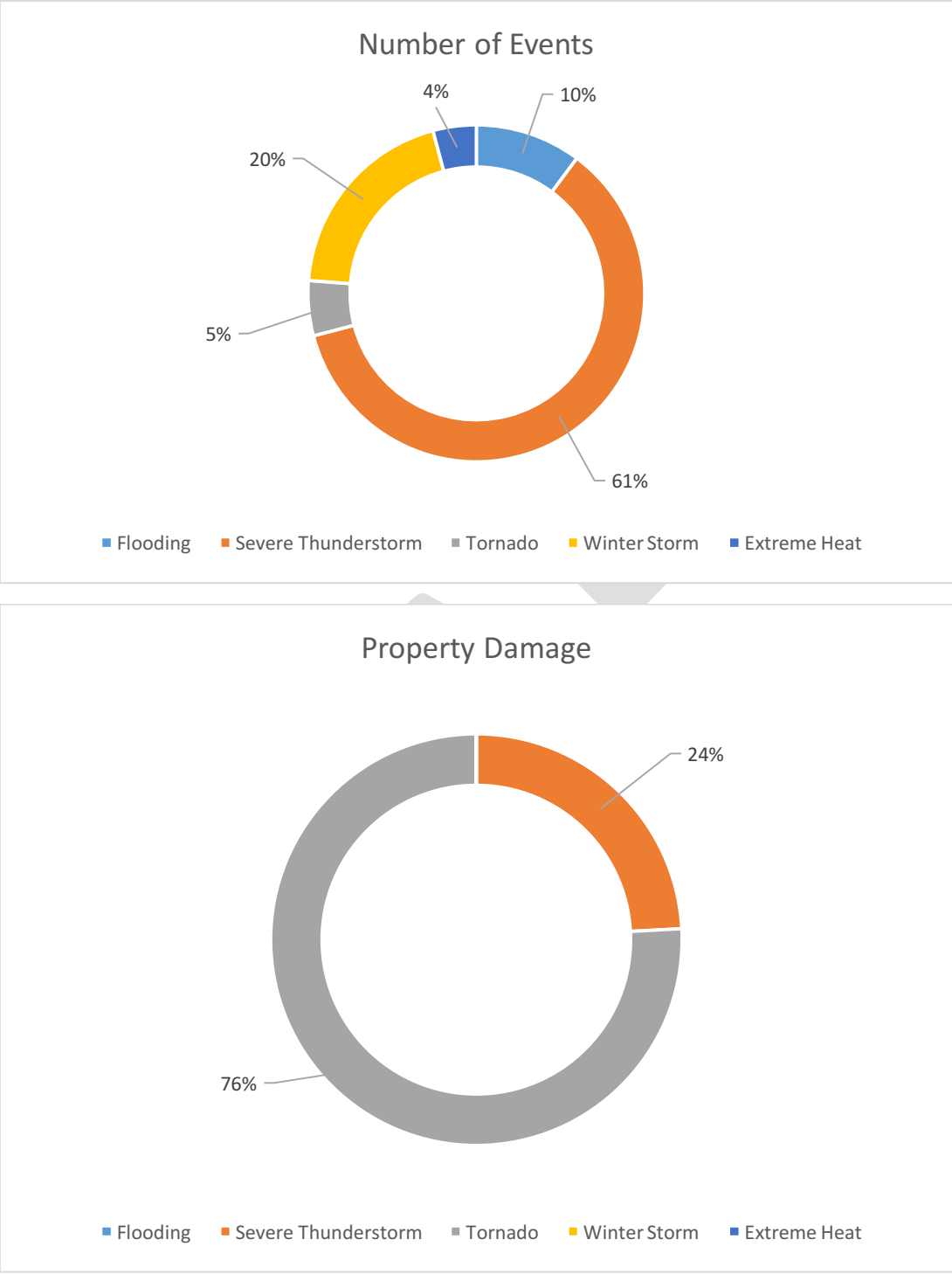
To assist the Planning Team, historical storm event data from the National Climatic Data Center (NCDC) was complied. NCDC records are estimates of damages reported to the National Weather Service from various local, state, and federal sources. However, these estimates are often preliminary in nature and may not match the final assessment of economic and property losses.

The NCDC database included 265 reported meteorological events in Boone from 1950-2020 (the most updated information as of the date of this plan). The following hazard-profile sections each include a summary table of events related to each hazard type. Table 4-1 summarizes the meteorological hazards reported for Boone. Figure 4-1 summarizes the relative frequency of NCDC reported meteorological hazards and the percent of total damage associated with each hazard for Boone. Full details of individual hazard events are on the NCDC website. In addition to NCDC data, Storm Prediction Center (SPC) data associated with tornadoes, strong winds, and hail was mapped using SPC-recorded latitudes and longitudes. Appendix D contains a map of these events.

Table 4-1. Summary of Meteorological Hazards Reported by the NCDC for Boone County

Hazards	Time Period		Number of Events	Property Damage	Deaths	Injuries
	Start	End				
Flooding	1950	2020	27	0	0	0
Severe Thunderstorm	1950	2020	161	0.86	1	0
Tornado	1950	2020	14	2.70	24	414
Winter Storm	1950	2020	52	0.001	11	0
Extreme Heat	1950	2020	11	0	0	0

Figure 4-1. Distribution of NCDC Meteorological Hazards for Boone County



4.1.3 FEMA Disaster Information

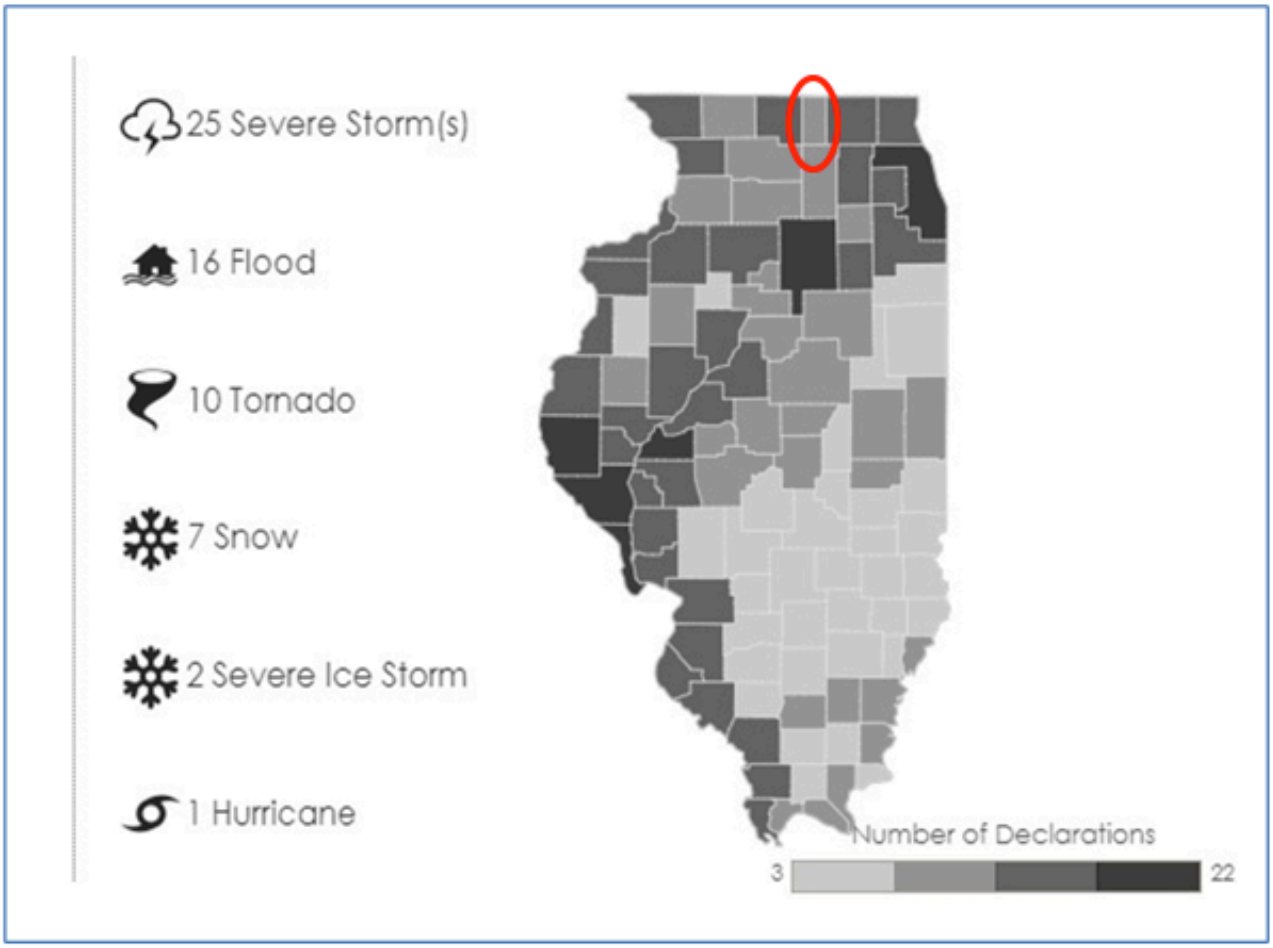
Since 1957, FEMA has declared 61 major disasters and emergencies for the State of Illinois. Emergency declarations allow states to access FEMA funds for Public Assistance (PA); disaster declarations allow for

even more PA funding, including Individual Assistance (IA) and the Hazard Mitigation Grant Program (HMGP). Boone has received federal aid for 6 declared disasters and emergencies since 1957. Table 4-2 lists specific information for each disaster declaration in Boone. Figure 4-2 depicts the disasters and emergencies that have been declared for the State of Illinois since 1957.

Table 4-2. Details of FEMA-declared Emergencies and Disasters in Boone

Declaration Number	Date of Declaration	Description
1112	5/17/1996	Severe Storms/Flooding
1416	4/29/2002	Tornadoes/Flooding
3199	2/1/2005	Severe Winter Storms
1826	3/2/2009	Severe Winter Storms
1850	7/2/2009	Severe Storms
-	5/5/2011	Severe Storms/Flooding

Figure 4-2. FEMA-declared Emergencies and Disasters in Illinois



4.1.4 Hazard Ranking Methodology

Based on Planning Team input, national datasets, and existing plans, the Boone Planning Team re-ranked the list of hazards from the 2014 MHMP. These hazards ranked the highest based on the Risk Priority

Index discussed in Section 4.1.5. In addition to the identified hazards, the Boone Planning Team identified disease epidemic / pandemic as a public health hazard.

Boone County Hazard List

TORNADOES

THUNDERSTORMS

WINTER STORMS

FLOODING

HAZARDOUS MATERIALS RELEASE

FIRE

DAM/LEVEE FAILURE

EXTREME HEAT AND DROUGHT

EARTHQUAKES

4.1.5 Risk Priority Index

The Risk Priority Index (RPI) quantifies risk as the product of hazard probability and magnitude so Planning Team members can prioritize mitigation strategies for high-risk-priority hazards. Planning Team members use historical hazard data to determine the probability, combined with knowledge of local conditions to determine the possible severity of a hazard. Tables 4-3 and 4-4 display the criteria the Planning Team used to quantify hazard probability and magnitude.

Table 4-3. Hazard Probability Ranking

Probability	Characteristics
4 – Highly Likely	Event is probable within the next calendar year This event has occurred, on average, once every 1-2 years in the past
3 – Likely	Event is probable within the next 10 years Event has a 10-50% chance of occurring in any given year This event has occurred, on average, once every 3-10 years in the past
2 – Possible	Event is probable within the next 50 years Event has a 2-10% chance of occurring in any given year This event has occurred, on average, once every 10-50 years in the past
1 – Unlikely	Event is probable within the next 200 years Event has a 0.5-2% chance of occurring in any given year This event has occurred, on average, once every 50-200 years in the past

Table 4-4. Hazard Severity Ranking

Magnitude/Severity	Characteristics

8 – Catastrophic	Multiple deaths Complete shutdown of facilities for 30 or more days More than 50% of property is severely damaged
4 – Critical	Injuries and/or illnesses result in permanent disability Complete shutdown of critical facilities for at least 14 days More than 25% of property is severely damaged
2 – Limited	Injuries and/or illnesses do not result in permanent disability Complete shutdown of critical facilities for more than seven days More than 10% of property is severely damaged
1 – Negligible	Injuries and/or illnesses are treatable with first aid Minor quality of life lost Shutdown of critical facilities and services for 24 hours or less Less than 10% of property is severely damaged

The product of hazard probability and magnitude is the RPI (Risk Priority Index). The Planning Team members ranked specified hazards based on the RPI, with larger numbers corresponding to greater risk. After evaluating the calculated RPI, the Planning Team adjusted the ranking to better suit the County. Table 4-5 identifies the RPI and adjusted ranking for each hazard specified by the Planning Team.

Table 4-5. Boone Hazard Priority Index and Ranking

Hazard	Probability	Magnitude/Severity	Risk Priority Index	Rank
Tornado	3	6	18	1
Thunderstorms	4	3	12	2
Winter Storms	3	2	6	3
Flooding	3	2	6	4
Hazardous Materials Release	1	3	3	5
Fire	1	2	2	6
Dam or Levee Failure	1	4	4	7
Extreme Heat & Drought	2	1	2	8
Earthquakes	1	4	4	9

4.1.6 Jurisdictional Hazard Ranking

Each jurisdiction created its own RPI because hazard susceptibility may differ by jurisdiction. During the five-year review of the plan, the Planning Team will update this table to ensure these jurisdictional rankings accurately reflect each community's assessment of these hazards. Table 4-6 lists the jurisdictions and their respective hazard rankings (Ranking 1 being the highest concern). The individual jurisdictions made these rankings at Meeting 1.

Table 4-6. Hazard Ranking by Jurisdiction

Jurisdiction	Tornado	HAZMAT	Earthquake	T-storms	Flooding	Drought/ Heat	Winter Storms	Dam/ Levee Failure	Fire
Boone County	1	5	9	2	4	8	3	7	6
Belvidere	1	5	9	2	4	8	3	7	6
Caledonia	1	5	9	2	4	8	3	7	6
Capron	1	5	9	2	4	8	3	7	6
Garden Prairie	1	5	9	2	4	8	3	7	6
Poplar Grove	1	5	9	2	4	8	3	7	6
Timberlane	1	5	9	2	4	8	3	7	6

4.2 Vulnerability Assessment

4.2.1 Asset Inventory

Processes and Sources for Identifying Assets

Before meeting one, the Planning Team used their resources to update the list of critical facilities from the 2014 MHMP. Local GIS data was used to verify the locations of all critical facilities. SIU GIS analysts incorporated these updates and corrections to the Hazus-MH data tables prior to performing the risk assessment. The updated Hazus-MH inventory contributed to a Level 2 analysis, which improved the accuracy of the risk assessment. Boone also provided local assessment and parcel data to estimate the actual number of buildings susceptible to damage for the risk assessment.

Essential Facilities List

Table 4-7 identifies the number of essential facilities identified in Boone. Essential facilities are a subset of critical facilities. Appendix E include a comprehensive list of the essential facilities in Boone and Appendix F displays a large format map of the locations of the critical facilities within the county.

Table 4-7. Boone Essential Facilities

Facility	Number of Facilities
Emergency Operations Center	1
Fire Station	7
Government	2
Medical Care Facility*	8
Police Station	1
School	21

Facility Replacement Costs

Table 4-8 identifies facility replacement costs and total building exposure. Boone provided local assessment data for updates to replacement costs. Tax-exempt properties such as government buildings, schools, religious and non-profit structures were excluded from this study because they do not have an assessed value. Table 4-8 also includes the estimated number of buildings within each occupancy class.

Table 4-8. Boone County's Building Exposure

General Occupancy	Estimated Total Buildings	Total Building Exposure
Residential		
Commercial		
Industrial		
Education		
Total:		

Future Development

As the county's population grows, the residential and urban areas will extend further into the county, placing more pressure on existing transportation and utility infrastructure while increasing the rate of farmland conversion. Boone County will address specific mitigation strategies in Section 5 to alleviate such issues.

Boone County is vulnerable to a variety of natural hazards, therefore the county government—in partnership with state government—must make a commitment to hazard mitigation. Boone County is committed to ensuring that county elected, and appointed officials become informed leaders regarding community hazards so that they are better prepared to set and direct policies for emergency management in mitigation, preparedness, response, and recovery.

4.3 Risk Analysis

4.3.1 GIS and Hazus-MH

The third step in the risk assessment is the risk analysis, which quantifies the risk to the population, infrastructure, and economy of the community. The hazards were quantified using GIS analyses and Hazus-MH where possible. This process reflects a Level 2 Hazus-MH analysis. A level 2 Hazus-MH analysis involves substituting selected Hazus-MH default data with local data and improving the accuracy of model predictions.

Updates to the default Hazus-MH data include:

- Updating the Hazus-MH defaults, critical facilities, and essential facilities based on the most recent available data sources.
- Reviewing, revising, and verifying locations of critical and essential point facilities with local input.
- Applying the essential facility updates (schools, medical care facilities, fire stations, police stations, and EOCs) to the Hazus-MH model data.
- Updating Hazus-MH reports of essential facility losses.

The following assumptions were made during analysis:

- Hazus-MH aggregate data was used to model the building exposure for all earthquake analyses. It is assumed that the aggregate data is an accurate representation of Boone.
- The analyses were restricted to the county boundaries. Events that occur near the county boundaries do not contain damage assessments from adjacent counties.
- For each tax-assessment parcel, it is assumed there is only one building that bares all the associated values (both structure and content).
- For each parcel, it is assumed that all structures are wood-framed, one-story, slab-on-grade structures, unless otherwise stated in assessment records. These assumptions are based on sensitivity analyses of Hazus and regional knowledge.

Depending upon the analysis options and the quality of data the user inputs, Hazus-MH generates a combination of site-specific and aggregated loss estimates. Hazus-MH is not intended as a substitute for detailed engineering studies; it is intended to serve as a planning aid for communities interested in assessing their risk to flood-, earthquake-, and hurricane-related hazards. This plan does not fully document the processes and procedures completed in its development, but this documentation is available upon request. Table 4-9 indicates the analysis type (i.e. GIS, Hazus-MH, or historical records) used for each hazard assessment.

Table 4-9. Risk Assessment Tool Used for Each Hazard

Hazard	Risk Assessment Tool(s)
Tornadoes	GIS-based
Earthquakes	Hazus-MH

Hazard	Risk Assessment Tool(s)
Severe Thunderstorm	Historical Records
Winter Storms	Historical Records
Flooding	Hazus-MH
Hazmat Release	GIS-based
Levee / Dam Failure	Historical Records
Drought / Extreme Heat	Historical Records
Ground Failure	GIS-based

4.3.2 Earthquake Hazard

Hazard Definition

An earthquake is the shaking of the earth caused by the energy released when large blocks of rock slip past each other in the earth's crust. While most earthquakes occur at tectonic plate boundaries, earthquakes can occur anywhere within a tectonic plate.

Strong earthquakes can collapse buildings and infrastructure, disrupt utilities, and trigger landslides, avalanches, flash floods, fires, and tsunamis. When an earthquake occurs in a populated area, it may cause death, injury, and extensive property damage. An earthquake might damage essential facilities, such as fire departments, police departments, and hospitals, disrupting emergency response services in the affected area. Strong earthquakes may also require mass relocation; however, relocation may be impossible in the short-term aftermath of a significant event due to damaged transportation infrastructure and public communication systems.

Earthquakes are usually measured by two criteria: intensity and magnitude (M). Earthquake intensity qualitatively measures the strength of shaking produced by an earthquake at a certain location and is determined from effects on people, structures, and the natural environment. Earthquake magnitude quantitatively measures the energy released at the earthquake's subsurface source in the crust, or epicenter. Magnitude in the earthquake hazard analysis. Table 4-EQ1 provides a comparison of magnitude and intensity, and Table 4-EQ2 provides qualitative descriptions of intensity, for a sense of what a given magnitude might feel like.

Table 4-EQ1. Comparison of Earthquake Magnitude and Intensity

Magnitude (M)	Typical Maximum Modified Mercalli Intensity
1.0 – 3.0	I
3.0 – 3.9	II – III
4.0 – 4.9	IV – V
5.0 – 5.9	VI – VII
6.0 – 6.9	VII – IX
7.0 and higher	VIII or higher

Table 4-EQ2. Abbreviated Modified Mercalli Intensity Scale

Mercalli Intensity	Description
I	Not felt except by a very few under especially favorable conditions.
II	Felt only by a few persons at rest, especially on upper floors of buildings.

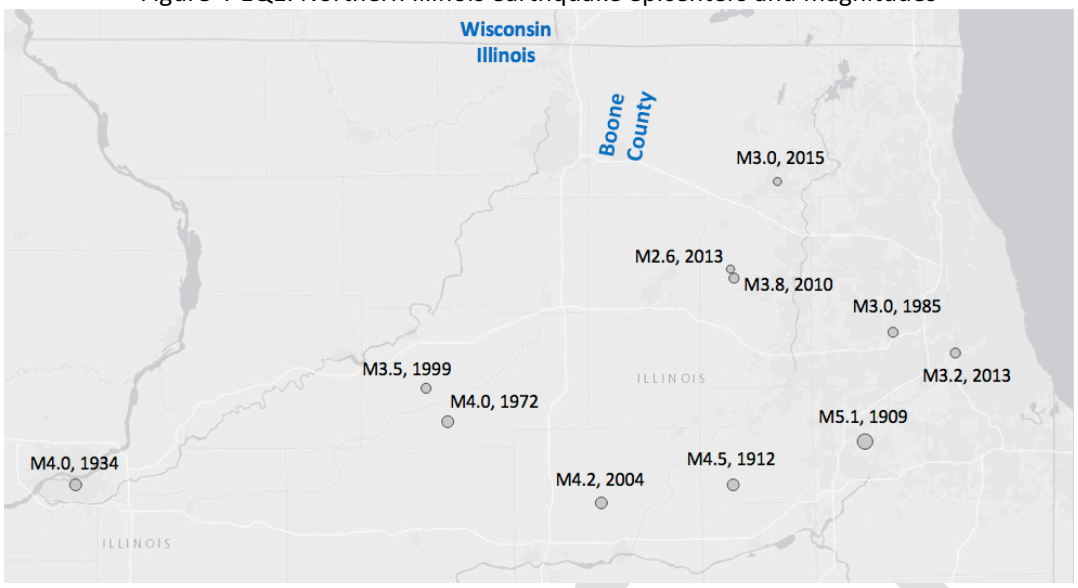
Mercalli Intensity	Description
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, and walls. Heavy furniture overturned.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Previous Occurrences for Earthquakes

Historically, the most significant seismic activity in Illinois is associated with New Madrid Seismic Zone near the southern end of the state. The New Madrid Seismic Zone produced three large earthquakes with magnitudes estimated between 7.0 and 7.7 on December 16, 1811, January 23, 1812, and February 7, 1812. These earthquakes caused violent ground cracking and geyser-like eruptions of sediment (sand blows) over an area >10,500 km^2, and uplifted a 50 km by 23 km zone (the Lake County uplift). The shaking was felt over a total area of over 10 million km^2 (the largest felt area of any historic earthquake). Thousands of aftershocks were felt in the succeeding months. The United States Geological Survey (USGS) and the Center for Earthquake Research and Information (CERI) at the University of Memphis estimate the probability of a repeat of the 1811-1812 type earthquakes (M7.5-8.0) is 7%-10% over the next 50 years (USGS Fact Sheet 2006-3125).

Over the past hundred years, earthquakes in Illinois vary from frequent, but largely unnoticed events of M1-3 events up to a M5.5 event occurring in southeastern Illinois in 1968. The most recent earthquake in Illinois greater than Magnitude 3 —as of the date of this report—was a M3.8 event in September 2017, approximately 8 miles west of Mount Carmel in Wabash County. The last earthquake in Illinois to cause reported damage occurred on April 18, 2008 near Mt. Carmel, IL and measured 5.2 in magnitude. Earthquakes resulting in more serious damage have occurred about every 70 to 90 years and are historically concentrated in southern Illinois. While less frequent, northern Illinois has had a number of earthquakes larger than M3 with the largest being a M5.1 occurring in 1909 (Figure 4-EQ1).

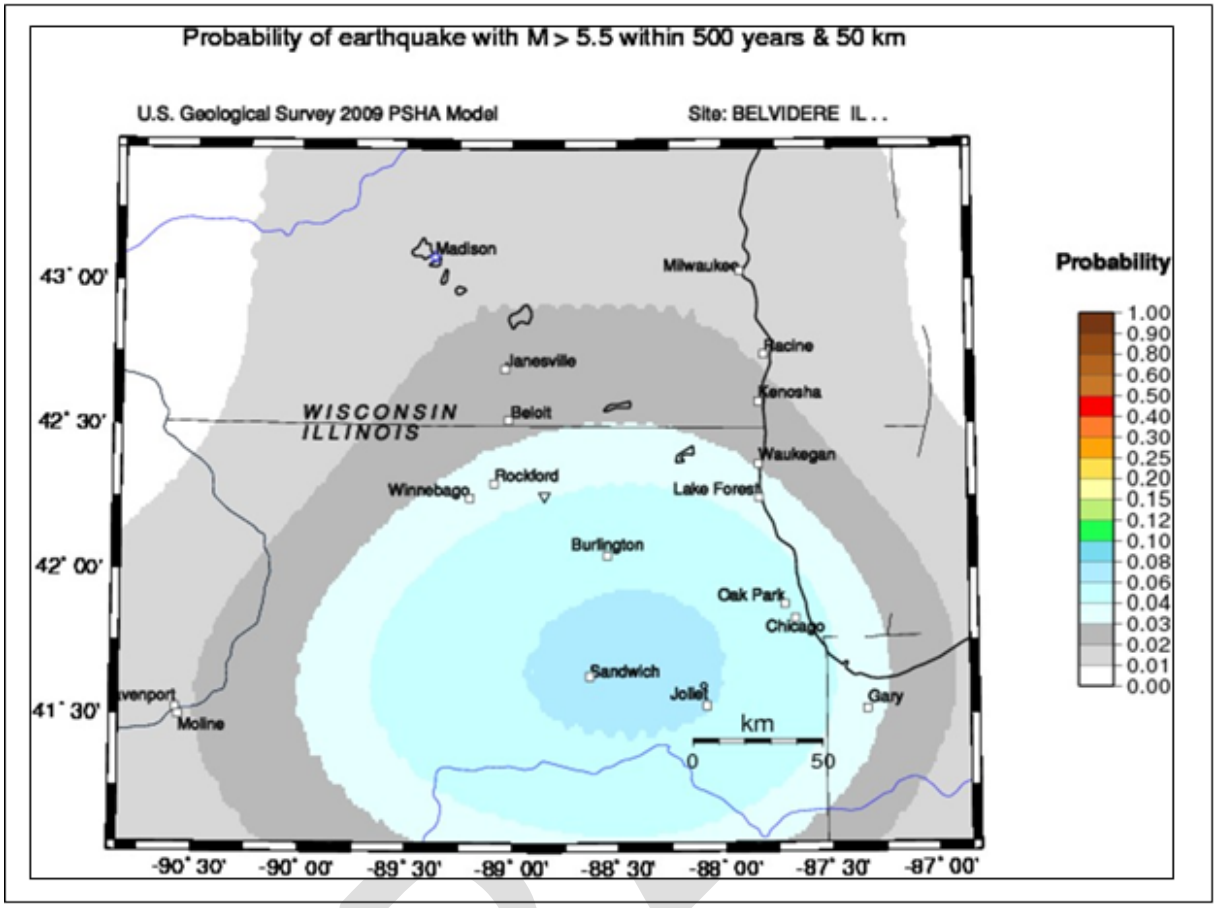
Figure 4-EQ1. Northern Illinois earthquake epicenters and magnitudes



Geographic Location for Earthquake Hazard

The two most significant zones of seismic activity in Illinois are the New Madrid Seismic Zone and the Wabash Valley Fault System along the southern Illinois-Indiana border. There are no recorded earthquakes with epicenters within the boundaries of Boone County, but nearby counties have experienced moderate magnitude earthquakes over the past century with several in the past decade (Figure 4-EQ1). While large earthquakes (>M7.0) experienced during the New Madrid Events of 1811 and 1812 are unlikely in Boone County, moderate earthquakes (≤ 6.0M) in or in the vicinity of Boone County are not out of the question. The USGS estimates the probability of a moderate M5.5 earthquake occurring in Boone County within the next 500- years at approximately 3%, but somewhat more likely in counties just to the south (Figure 4-EQ2).

Figure 4-EQ2. Northern Illinois probability map of M5.5 Earthquake occurring within the next 500 years



Hazard Extent for Earthquake Hazard

Earthquake effects are possible anywhere in Boone County. One of the most critical sources of information that is required for accurate assessment of earthquake risk is soils data. SIU used a National Earthquake Hazards Reduction Program (NEHRP) compliant soils map provided by FEMA for the analysis. The map identifies the soils most susceptible to failure.

Risk Identification for Earthquake Hazard

Based on historical information and current USGS and SIU research and studies, future earthquakes in Boone are possible, but large (>M7.0) earthquakes causing catastrophic damage are unlikely. According to the Boone Planning Team's assessment, earthquakes are ranked as the number nine hazard.

Risk Priority Index

Probability	x	Magnitude	=	RPI
1	x	4	=	4

Vulnerability Analysis for Earthquake Hazard

Earthquakes could impact the entire county equally; therefore, the entire county's population and all buildings are vulnerable to an earthquake. To accommodate this risk, this plan considers all buildings located within the county as vulnerable.

Critical Facilities

All critical facilities are vulnerable to earthquakes. Critical facilities are susceptible to many of the same impacts as any other building within the jurisdiction. These impacts include structural failure and loss of facility functionality (e.g., a damaged police station will no longer be able to serve the community). Table 4-7 lists the types and number of essential facilities for the entire county and Appendix F displays a large format map of the locations of all critical facilities within the county.

Building Inventory

Table 4-8 lists the building exposure in terms of types and numbers of buildings for the entire county. The buildings within the county can expect similar impacts to those discussed for critical facilities. These impacts include structural failure and loss of building function which could result in indirect impacts (e.g., damaged homes will no longer be habitable causing residents to seek shelter).

Infrastructure

During an earthquake, the types of infrastructure that shaking could impact include roadways, utility lines/pipes, railroads, and bridges. Since an extensive inventory of the infrastructure was not available for use in the earthquake models, it is important to emphasize that any number of these items could become damaged in the event of an earthquake. The impacts to these items include broken, failed, or impassable roadways, broken or failed utility lines (e.g., loss of power or gas to community), and railway failure from broken or impassable railways. Bridges could also fail or become impassable, causing risk to motorists.

Hazus-MH Earthquake Analyses

Existing geological information was reviewed prior to the Planning Team selection of earthquake scenarios. A Magnitude 5.5 arbitrary earthquake scenario was performed to provide a reasonable basis for earthquake planning in Boone. The other two scenarios included a Magnitude of 7.7 with the epicenter located on the New Madrid Fault Zone and a Magnitude 7.1 with the epicenter located on the Wabash Fault Zone.

The earthquake-loss analysis for the probabilistic scenario was based on ground-shaking parameters derived from U.S. Geological Survey probabilistic seismic hazard curves for the earthquake with the 500-year return period. This scenario evaluates the average impacts of a multitude of possible earthquake epicenters with a magnitude typical of that expected for a 500-year return period. The New Madrid Fault Zone runs along the Mississippi River through Arkansas, Tennessee, Missouri, Kentucky and Southern Illinois. The Wabash Valley Fault Zone runs through Southeastern Illinois, Western Kentucky and Southwest Indiana. This represents a realistic scenario for planning purposes.

The earthquake hazard modeling scenarios performed:

- Magnitude 5.5 arbitrary earthquake epicenter in Boone County
- Magnitude 7.7 event along the New Madrid Fault Zone
- Magnitude 7.1 event along the Wabash Valley Fault Zone

This report presents two types of building losses: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

Results for M5.5 Earthquake Scenario

The results of the M5.5 arbitrary earthquake scenario are depicted in Tables 4-EQ3, 4-EQ4, and Figure 4-EQ3. Hazus-MH estimates that approximately <number> buildings will be at least moderately damaged. This is <percentage> of the total number of buildings in the Boone. It is estimated that <number> buildings would be damaged beyond repair.

The building related economic losses are approximately <number> dollars. It is estimated that <percentage> of the losses are related to the business interruption of the region. By far, the largest loss is sustained by the residential occupancies which make up over <percentage> of the total loss.

Table 4-EQ3. M5.5 Earthquake Damage Estimates by Building Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture										
Commercial										
Educational										
Government										
Industrial										
Other Residential										
Religion										
Single Family										
Total:										

Table 4-EQ4. M5.5 Earthquake Estimates of Building Economic Losses (in Thousands of Dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Other	Total
Income Losses	Wage						
	Capital-Related						
	Rental						
	Relocation						
	Subtotal:						
Capital Stock Losses	Structural						
	Non-Structural						
	Content						
	Inventory						
	Subtotal:						
	Total:						

Figure 4-EQ3 Boone County M5.5 Earthquake Building Economic Losses

Results for M7.7 New Madrid Earthquake

The results of the M7.7 New Madrid earthquake scenario are depicted in Tables 4-EQ5, 4-EQ6, and Figure 4-EQ4. Hazus-MH estimates that approximately <number> buildings will be at least moderately damaged. This is over <percentage> of the total number of buildings in Boone County. It is estimated that <number> buildings would be damaged beyond repair.

The building related economic are approximately <number> dollars. It is estimated that <percentage> of the losses are related to the business interruption of the region. By far, the largest loss is sustained by the residential occupancies which make up over <percentage> of the total loss.

Table 4-EQ5. New Madrid M7.7 Earthquake Damage Estimates by Building Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture										
Commercial										
Educational										
Government										
Industrial										
Other Residential										
Religion										
Single Family										
Total:										

Table 4-EQ6. New Madrid M7.7 Earthquake Estimates of Building Economic Losses (in Millions of Dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Other	Total
Income Losses	Wage						
	Capital-Related						
	Rental						
	Relocation						
	Subtotal:						
Capital Stock Losses	Structural						
	Non-Structural						
	Content						
	Inventory						
	Subtotal:						
	Total:						

Figure 4-EQ4. New Madrid M7.7 Earthquake Building Economic Losses

Results M7.1 Magnitude Wabash Valley Earthquake – General Building Stock

The results of the Wabash Valley M7.1 earthquake scenario are depicted in Tables 4-EQ7, 4-EQ8, and Figure 4-EQ5. Hazus-MH estimates that approximately <number> buildings will be at least moderately damaged. Three buildings would be damaged beyond repair.

The building related economic are approximately <number> dollars. It is estimated that <percentage> of the losses are related to the business interruption of the region. By far, the largest loss is sustained by the residential occupancies which make up over <percentage> of the total loss.

Table 4-EQ7. Wabash Valley 7.1 Magnitude Earthquake Damage Estimates by Building Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture										
Commercial										
Educational										
Government										
Industrial										
Other Residential										
Religion										
Single Family										
Total:										

Table 4-EQ8. Wabash 7.1 Magnitude Earthquake Estimates of Building Economic Losses (in Millions of Dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Other	Total
Income Losses	Wage						
	Capital-Related						
	Rental						
	Relocation						
	Subtotal:						
Capital Stock Losses	Structural						
	Non-Structural						
	Content						
	Inventory						
	Subtotal:						
	Total:						

Figure 4-EQ5. Wabash Valley M7.1 Scenario Building Economic Losses

Vulnerability to Future Assets/Infrastructure for Earthquake Hazard

New construction, especially critical facilities, should accommodate earthquake mitigation design standards.

Suggestions for Community Development Trends

Community development should occur outside of the low-lying areas in floodplains with a water table within five feet of grade that is susceptible to liquefaction. It is important to harden and protect future and existing structures against the possible termination of public services and systems including power lines, water and sanitary lines, and public communication.

4.3.3 Tornado Hazard

Hazard Definition

Tornadoes are violently rotating columns of air extending from thunderstorms to the ground. Funnel clouds are rotating columns of air not in contact with the ground; however, the violently rotating column of air can reach the ground quickly and become a tornado. If the funnel cloud picks up and blows debris, it has reached the ground and is a tornado.

Tornadoes are a significant risk to Illinois and its citizens. Tornadoes most frequently occur in the afternoon but can occur at any time on any day. The unpredictability of tornadoes makes them one of most dangerous hazards in Illinois. Tornado winds are violently destructive in developed and populated areas. Current estimates place maximum wind velocity at greater than 300 miles per hour. A wind velocity of 200 miles per hour results in a pressure of 102.4 pounds per square foot—a load that exceeds the tolerance limits of most buildings. Thus, it is easy to understand why tornadoes can devastate the communities they hit.

Tornadoes are classified according to the Enhanced Fujita tornado intensity scale. The Enhanced Fujita scale ranges from intensity EF0, with effective wind speeds of 40 to 70 miles per hour, to EF5 tornadoes, with effective wind speeds of over 260 miles per hour. Table 4-TOR1 outlines the Enhanced Fujita intensity scale.

Table 4-TOR1. Enhanced Fujita Tornado Rating

Enhanced Fujita Number	Estimated Wind Speed	Path Width	Path Length	Description of Destruction
0 Gale	40-72 mph	6-17 yards	0.3-0.9 miles	Light damage, some damage to chimneys, branches broken, signboards damaged, shallow-rooted trees blown over.
1 Moderate	73-112 mph	18-55 yards	1.0-3.1 miles	Moderate damage, roof surfaces peeled off, mobile homes pushed off foundations, attached garages damaged.
2 Significant	113-157 mph	56-175 yards	3.2-9.9 miles	Considerable damage, entire roofs torn from frame houses, mobile homes demolished, boxcars pushed over, large trees snapped or uprooted.
3 Severe	158-206 mph	176-566 yards	10-31 miles	Severe damage, walls torn from well-constructed houses, trains overturned, most trees in forests uprooted, heavy cars thrown about.

Enhanced Fujita Number	Estimated Wind Speed	Path Width	Path Length	Description of Destruction
4 Devastating	207-260 mph	0.3-0.9 miles	32-99 miles	Complete damage, well-constructed houses leveled, structures with weak foundations blown off for some distance, large missiles generated.
5 Incredible	261-318 mph	1.0-3.1 miles	100-315 miles	Foundations swept clean, automobiles become missiles and thrown for 100 yards or more, steel-reinforced concrete structures badly damaged.

Previous Occurrences of Tornadoes

The NCDC database reported 14 tornadoes/funnel clouds in Boone County since 1950. The most recent recorded event occurred on 5/17/2017, when a brief EF1 tornado was reported near Belvidere Airport.

Table 4-12 identifies NCDC-recorded tornadoes that caused damage, death, or injury in Boone County. Additional details of individual hazard events are on the NCDC website.

Table 4-TOR2. NCDC-Recorded Tornadoes That Caused Damage, Death, or Injury in Boone

Location or County*	Date	Scale	Deaths	Injuries	Property Damage
Boone County	9/26/1959	F1	0	0	25.00K
Boone County	4/21/1967	F4	24	410	250.00K
Boone County	6/22/1984	F1	0	0	25.00K
Boone County	5/15/1986	F0	0	0	2.50K
Boone County	4/29/1991	F0	0	0	25.00K
Boone County	1/7/2008	EF3	0	4	2.000M
Boone County	6/12/2008	EF1	0	0	25.00K
Boone County	4/9/2015	EF1	0	0	75.00K
Boone County	4/9/2015	EF0	0	0	20.00K
Boone County	4/9/2015	EF1	0	0	150.00K
Boone County	5/17/2017	EF1	0	0	100.00K

*NCDC records are estimates of damage compiled by the National Weather Service from various local, state, and federal sources. However, these estimates are often preliminary in nature and may not match the final assessment of economic and property losses related to a given weather event.

Geographic Location for Tornado Hazard

The entire county has the same risk of tornado occurrence. Tornadoes can occur at any location within the county.

Hazard Extent for Tornado Hazard

Historical tornadoes generally moved from southwest to northeast across the county. The extent of the hazard varies in terms of the size of the tornado, its path, and its wind speed.

Risk Identification for Tornado Hazard

Based on historical information, the probability of future tornadoes in Boone County is likely. The county should expect tornadoes with varying magnitudes to occur in the future. Tornadoes ranked as the number one hazard according to the RPI.

Risk Priority Index

Probability	x	Magnitude	=	RPI
3	x	6	=	18

Vulnerability Analysis for Tornado Hazard

Tornadoes can occur within any area in the county; therefore, the entire county population and all buildings are vulnerable to tornadoes. To accommodate this risk, this plan considers all buildings located within the county as vulnerable. Tables 4-7 and 4-8 display the existing buildings and critical infrastructure in Boone.

Critical Facilities

All critical facilities are vulnerable to tornadoes. Critical facilities are susceptible to many of the same impacts as any other building within the jurisdiction. These impacts vary based on the magnitude of the tornado but can include structural failure, damaging debris (trees or limbs), roofs blown off or windows broken by hail or high winds, and loss of facility functionality (e.g., a damaged police station will no longer be able to serve the community). Table 4-7 lists the types and number of essential facilities for the entire county and Appendix F displays a large format map of the locations of all critical facilities within the county.

Building Inventory

Table 4-8 lists the building exposure in terms of types and numbers of buildings for the entire county. The buildings within the county can all expect the same impacts, similar to those discussed for critical facilities. These impacts include structural failure, damaging debris (trees or limbs), roofs blown off or windows broken by hail or high winds, and loss of building function (e.g., damaged home will no longer be habitable, causing residents to seek shelter).

Infrastructure

The types of infrastructure that could be impacted during a tornado include roadways, utility lines/pipes, railroads, and bridges. Since the county's entire infrastructure is vulnerable, it is important to emphasize that any number of these structures could become damaged during a tornado. The impacts to these structures include broken, failed, or impassable roadways, broken or failed utility lines (e.g., loss of power or gas to community), and railway failure from broken or impassable rail lines. Bridges could fail or become impassable, causing risk to motorists.

GIS-based Tornado Analysis

One tornado scenario was conducted for Boone through the Villages of <names>, and the Cities of <names>. The following analysis quantifies the anticipated impacts of tornadoes in the county in terms of numbers and types of buildings and infrastructure damaged.

GIS-overlay modeling was used to determine the potential impacts of an EF4 tornado. The analysis used a hypothetical path based upon the F4 tornado event that runs < describe track here>. Table 4-TOR3 depicts tornado damage curves and path widths utilized for the modeled scenario. The damage curve is

based on conceptual wind speeds, path winds, and path lengths from the Enhanced-Fujita Scale guidelines.

Table 4-TOR3. Tornado Path Widths and Damage Curves

Fujita Scale	Path Width (feet)	Maximum Expected Damage
5	2,400	100%
4	1,800	100%
3	1,200	80%
2	600	50%
1	300	10%
0	150	0%

Degrees of damage depend on proximity to the path centerline within a given tornado path. The most intense damage occurs within the center of the damage path, with decreasing amounts of damage away from the center. To model the EF4 tornado, a hypothetical tornado path was used in GIS with buffers added (damage zones) around the tornado path. Table 4-TOR4 and Figure 4-TOR1 illustrate the zone analysis. Figure 4-TOR2 depicts the selected hypothetical tornado path.

Table 4-TOR4. EF4 Tornado Zones and Damage Curves

Zone	Buffer (feet)	Damage Curve
1	0-150	100%
2	150-300	80%
3	300-600	50%
4	600-900	10%

Figure 4-TOR1. Tornado Analysis (Damage Curves) Using GIS Buffers

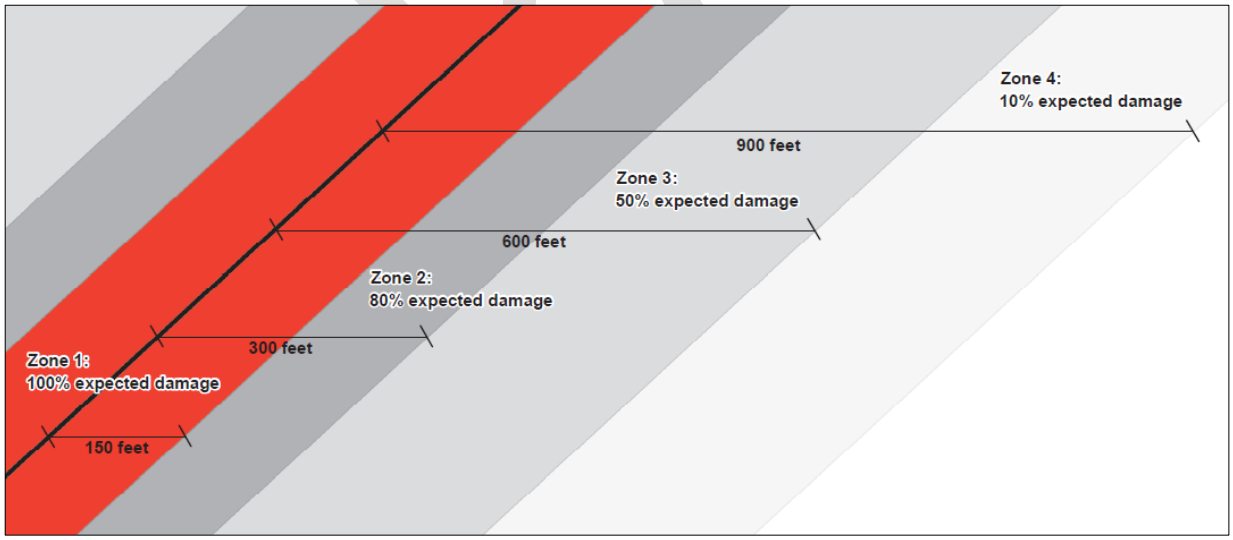


Figure 4-TOR2. Modeled Hypothetical EF4 Tornado Track for Boone County

Modeled Impacts of the EF4 Tornado

<The GIS analysis estimates that the modeled EF4 tornado would damage XX buildings. The estimated building losses are over $XX. The building losses are an estimate of building replacement costs multiplied by the damage percent. Table 4-TOR5 and Figures 4-10 and 4-11 show the results of the EF4 tornado analysis.>

Table 4-TOR5. Estimated Building Loss by Occupancy Type

Occupancy	Zone 1	Zone 2	Zone 3	Zone 4
Residential				
Commercial				
Industrial				
Educational				
Total:				

Figure 4-TOR3. Building Inventory Affected by the EF4 Tornadoes Modeled for Belvidere

Essential Facilities Damage

<There are XX essential facility located within 900 feet of the EF4 tornado path. The model predicts that X care facilities, X schools, X fire stations and X police stations would experience damage across Boone County>. The affected facilities are identified in Table 4-TOR6, and their geographic locations are shown in Figure 4-TOR5.

Table 4-TOR6. Essential Facilities Affected by the EF4 Tornadoes Modeled for Boone

Essential Facility	Facility Name
Care Facilities	
Schools	
Fire Departments	
Police Station	

Figure 4-TOR5. Essential Facilities Affected by the EF4 Tornadoes Modeled for Boone County

Vulnerability to Future Assets/Infrastructure for Tornado Hazard

The entire population and all buildings are at risk because tornadoes can occur anywhere within the state, at any time. Furthermore, any future development in terms of new construction within the county is at risk. Table 4-8 includes the building exposure for Boone. All essential facilities in the county are at risk.

Appendix E include a list of the essential facilities in Boone and Appendix F displays a large format map of the locations of all critical facilities within the county.

Suggestions for Community Development Trends

<Preparing for severe storms will be enhanced if local officials sponsor a range of programs and initiative to address severe storm preparedness. It is suggested that the county should build new structures with construction resistant to high wind shear, and harden existing structures to lessen the potential impacts of severe weather. This is particularly import where the future economic expansion is expected to take place. Additional warning sirens can warn the community of approaching storms to ensure the safety of Boone County residents and minimizing property damage.>

4.3.4 Dam and Levee Failure

Hazard Definition for Dam and Levee Failure

Dams are structures that retain or detain water behind a large barrier. When full or partially full, the difference in elevation between the water above the dam and below creates large amounts of potential energy, creating the potential for failure. The same potential exists for levees when they serve their purpose, which is to confine flood waters within the channel area of a river and exclude that water from land or communities land-ward of the levee. Dams and levees can fail due to either: 1) water heights or flows above the capacity for which the structure was designed; or 2) deficiencies in the structure such that it cannot hold back the potential energy of the water. If a dam or levee fails, issues of primary concern include loss of human life/injury, downstream property damage, lifeline disruption (of concern would be transportation routes and utility lines required to maintain or protect life), and environmental damage.

Many communities view both dams and levees as permanent and infinitely safe structures. This sense of security may very well be false, leading to significantly increased risks. Both downstream of dams and on floodplains protected by levees, security leads to new construction, added infrastructure, and increased population over time. Levees in particular are built to hold back flood waters only up to some maximum level, often the 100-year (1% annual probability) flood event. When that maximum is exceeded by more than the design safety margin, then the levee will be overtopped or otherwise fail, inundating communities in the land previously protected by that levee. It has been suggested that climate change, land-use shifts, and some forms of river engineering may be increasing the magnitude of large floods and the frequency of levee-failure situations.

In addition to failure that results from extreme floods above the design capacity, levees and dams can fail due to structural deficiencies. Both dams and levees require constant monitoring and regular maintenance to assure their integrity. Many structures across the U.S. have been under-funded or otherwise neglected, leading to an eventual day of reckoning in the form either of realization that the structure is unsafe or, sometimes, an actual failure. The threat of dam or levee failure may require substantial commitment of time, personnel, and resources. Since dams and levees deteriorate with age, minor issues become larger compounding problems, and the risk of failure increases.

Previous Occurrences of Dam and Levee Failure

The U.S. army Corps of Engineers notes no previous occurrences of dam or levee failure in Boone County.

Geographic Location of Dams and Levees in Boone County

The U.S. Army Corps of Engineers maintains the National Inventory of Dams (NID) which identified 2 dams in Boone County. According to NID records, one dam in Boone County is classified as a high hazard and one dam has an Emergency Action Plans (EAP). Table 4-DLF1 list of the dams located in Boone County and their respective classification level.

Table 4-DLF1. Boone Dam Inventory

Dam Name	Stream/River	Hazard Rating	EAP
Candlewick Lake Dam	Candlewick Lake	High	Yes
Belvidere Dam	Kishwaukee River	No	No

A review of the US Army Corps of Engineers National Levee Database and IDNR records revealed no levee systems present within Boone County.

Hazard Extent for Dam and Levee Failure

Dams are assigned a low hazard potential classification which means that failure or incorrect operation of the dam will result in no human life losses and no economic or environmental losses. Losses are principally limited to the owner's property. A significant hazard classification means that failure or incorrect operation results in no probable loss of human life; however, dam or levee failure can cause economic loss, environmental damage, and disruption of lifeline facilities. Significant hazard potential dams are often located in predominantly rural or agricultural areas but could be located in populated areas with a significant amount of infrastructure. A high hazard potential classification means that failure or incorrect operation has the highest risk to cause loss of human life and to significantly damage buildings and infrastructure.

According to NID records, one dam in Boone County is classified as high hazard and one dam has an Emergency Action Plans (EAP). An EAP is not required by the State of Illinois but is recommended in the 2003 Illinois Dam Safety & Inspection Manual.

The U.S. Army Corps of Engineers conducts two types of levee inspections: routine and periodic. Both Routine and Periodic Inspections result in a final inspection rating for operation and maintenance. The rating is based on the levee inspection checklist, which includes 125 specific items dealing with operation and maintenance of levee embankments, floodwalls, interior drainage, pump stations, and channels. Each levee segment receives an overall segment inspection rating of Acceptable, Minimally Acceptable, or Unacceptable. If a levee system comprises one or more levee segments (if there are different levee sponsors for different parts of the levee) then the overall levee system rating is the lowest of the segment ratings.

Accurate mapping of the risks of flooding behind levees depends on knowing the condition and level of protection the levees actually provide. FEMA and the U.S. Army Corps of Engineers are working together to make sure that flood hazard maps better reflect the flood protection capabilities of levees and that the maps accurately represent the flood risks posed to areas situated behind them. Levee owners—usually states, communities, or private individuals or organizations such as local levee districts—are responsible for ensuring that the levees they own are maintained to their original design level and condition. In order to be considered creditable flood protection structures on FEMA's flood maps, levee owners must provide documentation to prove that the levee meets design, operation, and maintenance standards for protection against the 1% annual probability (100-year) flood. Both of the levee districts are designed for 50-year events with 2 feet of freeboard. Thus, they do not meet the NFIP criteria.

Risk Identification for Dam and Levee Failure

Based on operation and maintenance requirements and local knowledge of the dams and levees in Boone County, the probability of failure is possible. However, if a high-hazard dam failed, the magnitude and severity of the damage could be great. The warning time and duration of the dam failure event would be

Risk Priority Index

Probability	x	Magnitude	=	RPI
1	x	4	=	4

very short. Based on input from the Planning Team, future occurrence of dam or levee failure in Boone County is unlikely. According to the Risk Priority Index (RPI) and County input, flooding is ranked as the number seven hazard.

Vulnerability Analysis for Dam and Levee Failure

An Emergency Action Plan (EAP) is required to assess the effect of dam failure on these communities. In order to be considered creditable flood protection structures on FEMA's flood maps, levee owners must provide documentation to prove the levee meets design, operation, and maintenance standards for protection against the 1% annual probability flood.

Critical Facilities

All critical facilities within the floodplain are vulnerable to dam and levee failure. An essential facility will encounter many of the same impacts as other buildings within the flood boundary. These impacts can include structural failure, extensive water damage to the facility, and loss of facility functionality (e.g., a damaged police station cannot serve the community). Table 4-7 lists the types and number of essential facilities for the entire county and Appendix F displays a large format map of the locations of all critical facilities within the county.

Building Inventory

All buildings within the floodplain are vulnerable to floods as a result of dam and/or levee failure. These impacts can include structural failure, extensive water damage to the facility, and loss of facility functionality (e.g., damaged home will no longer be habitable, causing residents to seek shelter). This plan considers all buildings located within 100-year flood plain as vulnerable.

Infrastructure

The types of infrastructure potentially impacted by a flood include roadways, utility lines/pipes, railroads, and bridges. Since an extensive inventory of the infrastructure is not available for this plan, it is important to emphasize that a flood could damage any number of these items. The impacts to these items include broken, failed, or impassable roadways; broken or failed utility lines (e.g., loss of power or gas to community); or railway failure from broken or impassable railways. Bridges could also fail or become impassable, causing risk to motorists.

Hazus-MH Flood Analysis

See section 4.3.6 Flooding Hazard for the results of the Hazus-MH Flood Analysis.

Vulnerability to Future Assets/Infrastructure for Dam and Levee Failure

Flooding as a result of dam or levee failure may affect nearly any location within the county; therefore all buildings and infrastructure are vulnerable. Table 4-8 includes the building exposure for Boone. All essential facilities in the county are at risk. Appendix E include a list of the essential facilities Boone and Appendix F displays a large format map of the locations of all critical facilities within the county.

Suggestions for Community Development Trends

Reducing floodplain development is crucial to reducing flood-related damages. Areas with recent development may be more vulnerable to drainage issues. Storm drains and sewer systems are usually most susceptible to drainage issues. Damage to these can cause back-up of water, sewage, and debris into homes and basements, causing structural and mechanical damage as well as creating public health hazards and unsanitary conditions.

4.3.5 Thunderstorm Hazard

Hazard Definition

Severe thunderstorms are weather events with one or more of the following characteristics: strong winds, large and damaging hail, and frequent lightning. Severe thunderstorms most frequently occur in Illinois during the spring and summer months but can occur at any time. A severe thunderstorm's impacts can be localized or can be widespread in nature. A thunderstorm is classified as severe when it meets one or more of the following criteria:

Hail 0.75 inches or greater in diameter

Hail is a possible product of a strong thunderstorm. Hail usually falls near the center of a storm, but strong winds occurring at high altitudes in the thunderstorm can blow the hailstones away from the storm center, resulting in damage in other areas near the storm. Hailstones range from pea-sized to baseball-sized, and some reports note hailstones larger than softballs.

Frequent and dangerous lightning

Lightning is a discharge of electricity from a thunderstorm. Lightning is often perceived as a minor hazard, but lightning damages many structures and kills or severely injures numerous people in the United States each year.

Wind speeds greater than or equal to 58 miles per hour

Straight-line winds from thunderstorms are fairly common in Illinois. Straight-line winds can cause damage to homes, businesses, power lines, and agricultural areas, and may require temporary sheltering of individuals who are without power for extended periods of time.

Previous Occurrences of Thunderstorm Hazards

The National Climatic Data Center (NCDC) database reported 46 hailstorms in Boone since 1950. Hailstorms occur nearly every year in the late spring and early summer months. The most recent reported occurrence was in May of 2018. Table 4-ST1 lists the significant hail storms (such as those that cause death, damage or injury) in Boone.

Table 4-ST1. Selected NCDC-Recorded Hail that Caused Damage, Death, or Injury in Boone County

Location or County*	Date	Deaths	Injuries	Property Damage
Capron	08/09/2001	1	0	0
Belvidere	07/07/2008	0	0	$5,000
	Total:	**1**	**0**	**$5,000**

*NCDC records are estimates of damage compiled by the National Weather Service from various local, state, and federal sources. However, these estimates are often preliminary in nature and may not match the final assessment of economic and property losses related to a given weather event.

The NCDC database reported two lightning events in Boone. The most recent reported event was in July of 2020. Table 4-ST2 identifies NCDC-recorded lightning that caused damage, death, or injury in Boone.

Table 4-ST2. Selected NCDC-Recorded Lightning that Caused Damage, Death, or Injury in Boone

Location or County*	Date	Deaths	Injuries	Property Damage
Capron	08/09/2001	1	0	0
Belvidere	07/07/2008	0	0	$5,000
	Total:	**1**	**0**	**$5,000**

*NCDC records are estimates of damage compiled by the National Weather Service from various local, state, and federal sources. However, these estimates are often preliminary in nature and may not match the final assessment of economic and property losses related to a given weather event.

The NCDC database reported 113 wind storms in Boone. Table 4-ST3 identifies selected NCDC-recorded wind storms that caused major damage (over $100,000), death, or injury in Boone.

Table 4-ST3. Selected NCDC-Recorded Wind Storms that Caused Major Damage (over $100,000), Death, or Injury in Boone

Location or County*	Date	Deaths	Injuries	Property Damage
Belvidere	08/25/2006	0	0	$400,000
	Total:	**0**	**0**	**$400,000**

*NCDC records are estimates of damage compiled by the National Weather Service from various local, state, and federal sources. However, these estimates are often preliminary in nature and may not match the final assessment of economic and property losses related to a given weather event.

Geographic Location of Thunderstorm Hazard

The entire county has the same risk for occurrence of thunderstorms. They can occur at any location within the county.

Hazard Extent for Thunderstorm Hazard

The extent of the hypothetical thunderstorms depends upon the extent of the storm, the wind speed, and the size of hail stones. Thunderstorms can occur at any location within the county.

Risk Identification for Thunderstorm Hazard

Based on historical information, the occurrence of future high winds, hail, and lightning is highly likely. The County should expect high winds, hail, and lightning of widely varying magnitudes in the future. According to the Boone Planning Team's assessment, severe thunderstorms are ranked as the number two hazard.

Risk Priority Index

Probability	x	Magnitude	=	RPI
4	x	3	=	12

Vulnerability Analysis for Thunderstorm Hazard

The entire county's population and all buildings are vulnerable to a severe thunderstorm and can expect the same impacts within the affected area. To accommodate this risk, this plan considers all buildings located within the county as vulnerable. Tables 4-7 and 4-8 display the existing buildings and critical infrastructure in Boone.

Critical Facilities

All critical facilities are vulnerable to severe thunderstorms. A critical facility will encounter many of the same impacts as any other building within the jurisdiction. These impacts include structural failure, damaging debris (trees or limbs), roofs blown off or windows broken by hail or high winds, fires caused by lightning, and loss of building functionality (e.g., a damaged police station cannot serve the community). Table 4-7 lists the types and number of essential facilities for the entire county and Appendix F displays a large format map of the locations of all critical facilities within the county.

Building Inventory

Table 4-8 lists the building exposure in terms of types and numbers of buildings for the entire county. The buildings within the county can expect impacts similar to those discussed for critical facilities. These impacts include structural failure, damaging debris (trees or limbs), roofs blown off or windows broken by hail or high winds, fires caused by lightning, and loss of building functionality (e.g., a person cannot inhabit a damaged home, causing residents to seek shelter).

Infrastructure

A severe thunderstorm could impact roadways, utility lines/pipes, railroads, and bridges. Since the county's entire infrastructure is vulnerable, it is important to emphasize that a severe thunderstorm could damage any number of these structures. The impacts to these structures include broken, failed, or impassable roadways; broken or failed utility lines (e.g., loss of power or gas to community); or impassable railways. Bridges could become impassable causing risk to motorists.

Potential Dollar Losses from Thunderstorm Hazard

According to the NDCD, Boone has incurred approximately $825,000 in damages relating to thunderstorms, including hail, lightning, and high winds since 1950. NCDC records are estimates of damage compiled by the National Weather Service from various local, state, and federal sources. However, these estimates are often preliminary in nature and may not match the final assessment of economic and property losses related to a given weather event. As a result, the potential dollar losses for a future event cannot be reliably constrained; however, based on average property damage in the past decade, SIU estimates that Boone incurs property damages of approximately $15,000 per year related to severe thunderstorms.

Vulnerability to Future Assets/Infrastructure for Thunderstorm Hazard

All future development within the county and all communities will remain vulnerable to severe thunderstorm events.

Suggestions for Community Development Trends

Local officials should enhance severe storm preparedness by sponsoring a wide range of programs and initiatives to address the overall safety of county residents. Flooding Hazard

Hazard Definition for Flooding

Flooding is a significant natural hazard throughout the United States. The type, magnitude, and severity of flooding are functions of the magnitude and distribution of precipitation over a given area, the rate at which precipitation infiltrates the ground, the geometry and hydrology of the catchment, and flow dynamics and conditions in and along the river channel. Floods are classified as one of two types in this plan: upstream floods or downstream floods. Both types of floods are common in Illinois.

Upstream floods, also called flash floods, occur in the upper parts of drainage basins and are generally characterized by periods of intense rainfall over a short duration. These floods arise with very little warning and often result in locally intense damage, and sometimes loss of life, due to the high energy of the flowing water. Flood waters can snap trees, topple buildings, and easily move large boulders or other structures. Six inches of rushing water can upend a person; 18 inches might carry off a car. Generally, upstream floods cause severe damage over relatively localized areas. Urban flooding is a type of upstream flood. Urban flooding involves the overflow of storm drain systems and can result from inadequate drainage combined with heavy rainfall or rapid snowmelt. Upstream or flash floods can occur at any time of the year in Illinois, but they are most common in the spring and summer months.

Downstream floods, sometimes called riverine floods, refer to floods on large rivers at locations with large upstream catchments. Downstream floods are typically associated with precipitation events that are of relatively long duration and occur over large areas. Flooding on small tributary streams may be limited, but the contribution of increased runoff may result in a large flood downstream. The lag time between precipitation and time of the flood peak is much longer for downstream floods than for upstream floods, generally providing ample warning for people to move to safe locations and, to some extent, secure some property against damage. Riverine flooding on the large rivers of Illinois generally occurs during either the spring or summer.

Previous Occurrences of Flooding

The NCDC database reported 27 flood events in Boone County since 1950. The most significant flood event occurred on August 17th, 2007, when four to six inches of rain quickly fell over southern Boone County, resulting several flooded roads and basements. Table 4-F1 identifies NCDC-recorded flooding events that caused damage, death, or injury in Boone.

Table 4-F1. NCDC-recorded Flooding Events that caused Death, Damage (over $100,000) or Injury in Boone

Location or County*	Date	Deaths	Injuries	Property Damage
Belvidere	08/07/2007	0	0	$100,000
Boone County	06/28/2017	0	0	$100,000
	Total:	**0**	**0**	**$200,000**

*NCDC records are estimates of damage compiled by the National Weather Service from various local, state, and federal sources. However, these estimates are often preliminary in nature and may not match the final assessment of economic and property losses related to a given weather event.

There are several structures in Boone County that have experienced repetitive losses due to flooding. FEMA defines a repetitive loss structure as a structure covered by a contract of flood insurance issued under the NFIP that has suffered flood loss damage on two or more occasions during a 10-year period that ends on the date of the second loss, in which the cost to repair the flood damage is ≥ 25% of the market value of the structure at the time of each flood loss.

The Illinois Emergency Management Agency and Illinois Department of Natural Resources were contacted to determine the location of repetitive loss structures in Boone. Records indicate that there are 158

repetitive loss structures within the county. The total amount paid for building replacement and building contents for damage to these repetitive loss structures is $1,525,644. Table 4-F2 describes the repetitive loss structures for each jurisdiction.

Table 4-F2. Repetitive Loss Structures for each Jurisdiction in Boone

Community	Closed Losses	Open Losses	CWOP Losses	Total Losses	Payments
BELVIDERE, CITY OF	24	1	5	30	159,620.12
BOONE COUNTY*	15	1	7	23	199,942.25
CHERRY VALLEY, VILLAGE OF	3	0	2	5	22,547.22
LOVES PARK, CITY OF	68	0	32	100	1,143,535.27

Geographic Location of Flooding

Most riverine flooding in Illinois occurs during either the spring or summer and is the result of excessive rainfall and/or the combination of rainfall and snowmelt. Flash flooding of low-lying areas in Illinois can occur during any time of the year but tends to be less frequent and more localized between mid-summer and early winter.

NOAA's Advanced Hydrologic Prediction Service provides information from stream gauges at points along various rivers across the United States. Boone County has one stream gage on the Kishwaukee River at Belvidere, IL (05438500).

Hazard Extent for Flooding

All floodplains are susceptible to flooding in Boone. The floodplain of concern is for the 100-year flood event which is defined as areas that have a 1% chance of flooding in any given year. However, flooding is dependent on various local factors including, but not limited to, impervious surfaces, amount of precipitation, river-training structures, etc.

Vulnerability Analysis for Flooding

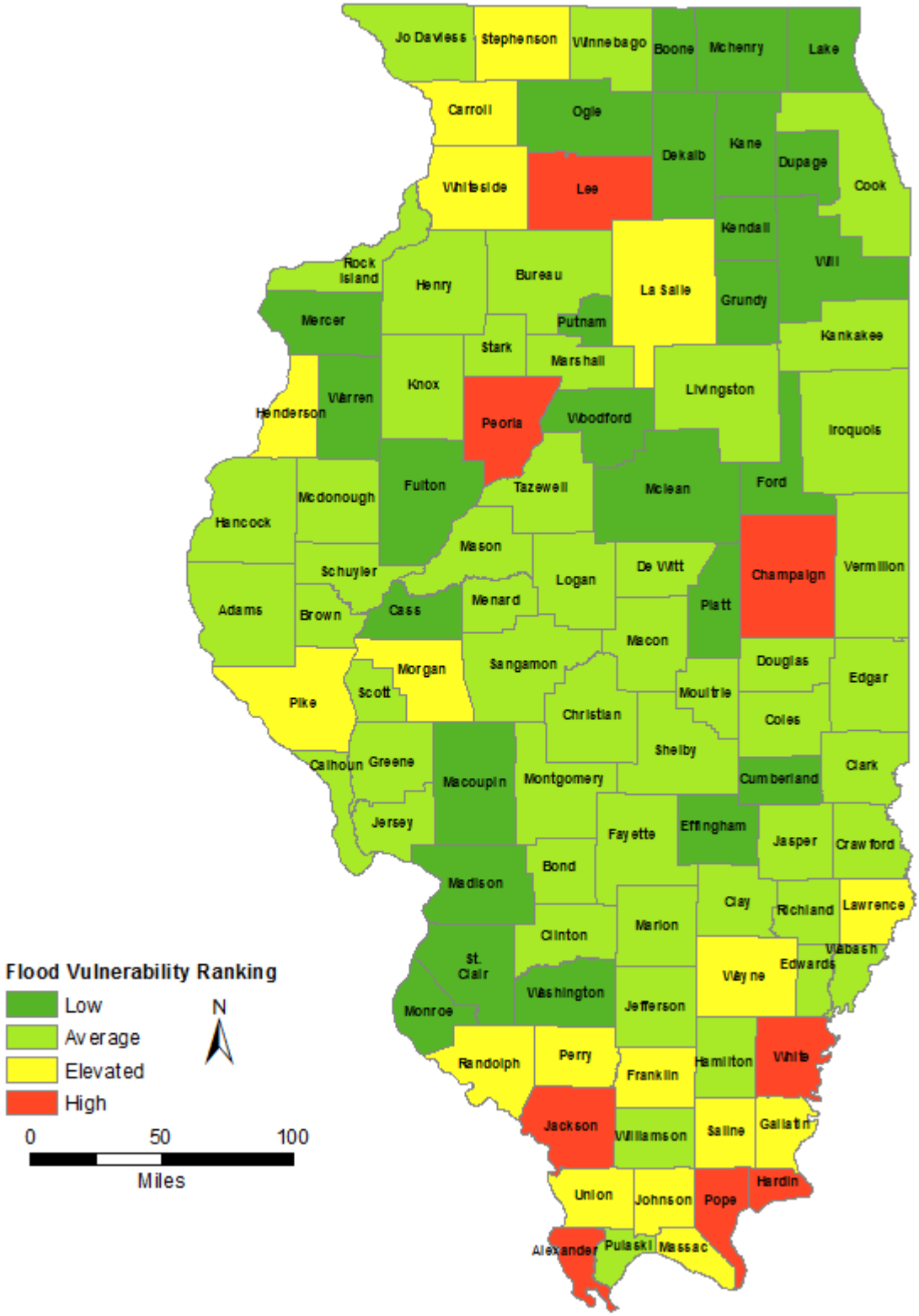
The 2013 Illinois Hazard Mitigation Plan analyzed a variety potential natural hazards including vulnerability to flooding. A Flood Vulnerability Index (FVI) was calculated for all counties and jurisdictions in Illinois. FVI combines Hazus-based estimates of flood exposure and loss with the widely utilized Social Vulnerability Index (SoVI). The highest vulnerability scores and vulnerability ratings were generally in rural counties and communities located along Illinois's large rivers (i.e., Mississippi, Green, Illinois, Kaskaskia, Rock and Ohio Rivers). Figure 4-F1 displays the Flood Vulnerability Ratings for the 102 Counties in Illinois. The vulnerability ratings are categorical representations (low, average, elevated, or high) of the flood vulnerability index. Boone County has a low Flood Vulnerability Rating and ranks X out of the 102 Counties in Illinois in terms of loss estimation according to Hazus-MH for floods.

Table 4-F3 lists the jurisdictional Flood Vulnerability Ratings for Boone. The jurisdictions of Boone all surpass an average Flood Vulnerability Rating.

Table 4-F3. Jurisdictional Flood Vulnerability Ranking for Boone

Jurisdiction	State Ranking	Flood Vulnerability Rating

Figure 4-F1. County Flood Vulnerability Rating for Illinois



All floodplains are susceptible to flooding in Boone; therefore, the population and all buildings located within the floodplain are vulnerable to flooding. To accommodate this risk, this plan considers all buildings located within 100-year flood plain as vulnerable.

Risk Identification for Flood Hazard

Based on historical information and the Flood Vulnerability Rating, future occurrence of flooding in Boone is likely. According to the Risk Priority Index (RPI) and County input, flooding is ranked as the number four hazard.

Risk Priority Index

Probability	x	Magnitude	=	RPI
3	x	2	=	6

Critical Facilities

All critical facilities within the floodplain are vulnerable to floods. An essential facility will encounter many of the same impacts as other buildings within the flood boundary. These impacts can include structural failure, extensive water damage to the facility, and loss of facility functionality (e.g., a damaged police station cannot serve the community). Appendix E include a list of the essential facilities in Boone and Appendix F displays a large format map of the locations of all critical facilities within the county.

Building Inventory

All buildings within the floodplain are vulnerable to floods. These impacts can include structural failure, extensive water damage to the facility, and loss of facility functionality (e.g., damaged home will no longer be habitable, causing residents to seek shelter). This plan considers all buildings located within 100-year flood plain as vulnerable.

Infrastructure

The types of infrastructure potentially impacted by a flood include roadways, utility lines/pipes, railroads, and bridges. Since an extensive inventory of the infrastructure is not available for this plan, it is important to emphasize that a flood could damage any number of these items. The impacts to these items include: broken, failed, or impassable roadways; broken or failed utility lines (e.g., loss of power or gas to community); or railway failure from broken or impassable railways. Bridges could also fail or become impassable, causing risk to motorists.

Hazus-MH Flood Analysis

Hazus-MH was utilized to generate the flood depth grid for a 100-year return period and made calculations by clipping the USGS one-third-arc-second DEM (~10 m) to the flood boundary. Next, Hazus-MH was used to estimate the damages for Boone by utilizing a detailed building inventory database created from assessor and parcel data.

According to this analysis, there are <number> buildings located in the Boone 100-year floodplain. The estimated damage to these structures is <number>. It should be noted that the results should be interpreted as degrees of loss rather than exact number of buildings exposed to flooding. Figure 4-F2

depicts the building inventory within the 100-year floodplain and Table 4-F4 shows the loss estimates by occupancy class.

Figure 4-F2. Building Inventory Located within the 100-year Floodplain in Boone County

Table 4-F4. Estimated Flood Losses within the 100-year Floodplain

Occupancy Class	Number of Structures	Estimated Building Related Losses
Total:		

Essential Facilities Damage

The analysis identified <number> essential facilities that are subject to flooding. Table 4-F5 and Figure 4-F3 identified the essential facilities within the 100-year floodplain.

Table 4-F5. Essential Facilities within the 100-year Floodplain

Essential Facility	Facility Name
School	
Fire Departments	
Police Departments	

Figure 4-F3. Map of Essential Facilities within the 100-year Floodplain

Vulnerability Analysis to Future Assets/Infrastructure

Flooding may affect nearly any location within the county; therefore all buildings and infrastructure are vulnerable. Table 4-8 includes the building exposure for Boone. All essential facilities in the county are at risk. Appendix E includes a list of the essential facilities in Boone and Appendix F displays a large format map of the locations of all critical facilities within the county. <Currently, new developments comply with

the state flood ordinance. Table 5.5 lists local building ordinances. At this time no new construction is planned with the 100-year floodplain.>

Suggestions for Community Development Trends

Reducing floodplain development is crucial to reducing flood-related damages. Areas with recent development may be more vulnerable to drainage issues. Storm drains and sewer systems are usually most susceptible to drainage issues. Damage to these can cause back-up of water, sewage, and debris into homes and basements, causing structural and mechanical damage as well as creating public health hazards and unsanitary conditions.

4.3.6 Winter Storm Hazard

Hazard Definition of Winter Storm Hazard

Severe winter weather consists of various forms of precipitation and weather conditions. This may include one or more of the following: freezing rain, sleet, heavy snow, blizzards, icy roadways, extreme low temperatures, and strong winds. These conditions can cause human health risks such as frostbite, hypothermia, or death and cause property damage and disrupt economic activity.

Ice or sleet, even in small quantities, can result in hazardous driving conditions and can cause property damage. Sleet involves raindrops that freeze completely before reaching the ground. Sleet does not stick to trees and wires. Ice storms, on the other hand, involve liquid rain that falls through subfreezing air and/or onto sub-freezing surfaces, freezing on contact with those surfaces. The ice coats trees, buildings, overhead wires, and roadways, sometimes causing extensive damage.

Ice storms are some of the most damaging winter storms in Illinois. Ice storms occur when moisture-laden Gulf air converges with the northern jet stream causing freezing rain that coats power and communication lines and trees with heavy ice. Strong winds can cause the overburdened limbs and cables to snap; leaving large sectors of the population without power, heat, or communication.

Rapid accumulation of snow, often accompanied by high winds, cold temperatures, and low visibility, characterize significant snowstorms. A blizzard is categorized as a snow storm with winds of 35 miles per hour or greater and/or visibility of less than one-quarter mile for three or more hours. Strong winds during a blizzard blow falling and fallen snow, creating poor visibility and impassable roadways. Blizzards potentially result in property damage.

Blizzards repeatedly affect Illinois. Blizzard conditions cause power outages, loss of communication, and transportation difficulties. Blizzards can reduce visibility to less than one-quarter mile, and the resulting disorientation makes even travel by foot dangerous if not deadly.

Severe cold involves ambient air temperatures that drop to 0°F or below. These extreme temperatures can increase the likelihood of frostbite and hypothermia. High winds during severe cold events can enhance the air temperature's effects. Fast winds during cold weather events can lower the wind chill factor (how cold the air feels

on your skin). As a result, the time it takes for frostbite and hypothermia to affect a person's body will decrease.

Previous Occurrences of Winter Storm Hazard

The NCDC database reported 52 winter storm and extreme cold events for Boone since 1950. <The most recent reported event occurred in February of 2019 when temperatures plummeted across southern Illinois Table 4-WS1 identifies NCDC-recorded winter storm events that caused damage, death, or injury in Boone.

Table 4-WS1. NCDC-Recorded Winter Storms that Caused Damage, Death, or Injury in Boone

Location or County*	Date	Deaths	Injuries	Property Damage
Northern Illinois	12/06/1994	0	0	$10,000
Boone	01/01/1999	1	0	0
Boone	01/23/2003	1	0	0
Boone	02/18/2006	1	0	0
Boone	02/02/1996	3	0	0
Boone	01/15/1997	5	0	0
	Total:	**11**	**0**	**$10,000**

Geographic Location of Winter Storm Hazard

Severe winter storms are regional in nature. Most of the NCDC data are calculated regionally or in some cases statewide.

Hazard Extent of Winter Storm Hazard

The extent of the historical winter storms varies in terms of storm location, temperature, and ice or snowfall. A severe winter storm can occur anywhere in the county.

Risk Identification of Winter Storm Hazard

Based on historical information, the probability of future winter storms in Boone is likely. The county should expect winter storms with varying magnitudes to occur in the future. Winter storms ranked as the number three hazard according to the Boone Planning Team's risk assessment.

Risk Priority Index

Probability	x	Magnitude	=	RPI
3	x	2	=	6

Vulnerability Analysis of Winter Storm Hazard

Winter storm impacts are equally likely across the entire county; therefore, the entire county is vulnerable to a winter storm and can expect impacts within the affected area. To accommodate this risk, this plan considers all buildings located within the county as vulnerable. Tables 4-7 and 4-8 display the existing buildings and critical infrastructure in Boone.

Critical Facilities

All critical facilities are vulnerable to winter storms. A critical facility will encounter many of the same impacts as other buildings within the county. These impacts include loss of gas or electricity from broken

or damaged utility lines, damaged or impassable roads and railways, broken water pipes, and roof collapse from heavy snow. Table 4-7 lists the types and number of essential facilities for the entire county and Appendix F displays a large format map of the locations of all critical facilities within the county.

Building Inventory

Table 4-8 lists the building exposure in terms of types and numbers of buildings for the entire county. The impacts to the general buildings within the county are similar to the damages expected to the critical facilities. These include loss of gas or electricity from broken or damaged utility lines, damaged or impassable roads and railways, broken water pipes, and roof collapse from heavy snow.

Infrastructure

During a winter storm, the types of potentially impacted infrastructure include roadways, utility lines/pipes, railroads, and bridges. Since the county's entire infrastructure is vulnerable, it is important to emphasize that a winter storm could impact any structure. Potential impacts include broken gas and/or electricity lines or damaged utility lines, damaged or impassable roads and railways, and broken water pipes.

Potential Dollar Losses from Winter Storm Hazard

According to the NCDC, Boone has incurred approximately $10,000 in damages relating to winter storms since 1950. NCDC records are estimates of damage compiled by the National Weather Service from various local, state, and federal sources. However, these estimates are often preliminary in nature and may not match the final assessment of economic and property losses related to a given weather event. As a result, the potential dollar losses for a future event cannot be reliably constrained; however, based on average property damage in the past decade, SIU estimates that Boone incurs no property damage per year related to winter storms, including sleet/ice and heavy snow.

Vulnerability to Future Assets/Infrastructure for Winter Storm Hazard

Any new development within the county will remain vulnerable to these events.

Suggestions for Community Development Trends

Because winter storm events are regional in nature, future development across the county will also face winter storms.

4.3.7 Hazardous Material Storage and Transportation Hazard

Hazard Definition

Illinois has numerous active transportation lines that run through many of its counties. Active railways transport harmful and volatile substances across county and state lines every day. Transporting chemicals and substances along interstate routes is commonplace in Illinois. The rural areas of Illinois have considerable agricultural commerce, meaning transportation of fertilizers, herbicides, and pesticides is common on rural roads. These factors increase the chance of hazardous material releases and spills throughout the state of Illinois.

The release or spill of certain substances can cause an explosion. Explosions result from the ignition of volatile products such as petroleum products, natural and other flammable gases, hazardous materials/chemicals, dust, and bombs. An explosion can potentially cause death, injury, and property damage. In addition, a fire routinely follows an explosion, which may cause further damage and inhibit

emergency response. Emergency response may require fire, safety/law enforcement, search and rescue, and hazardous materials units.

Previous Occurrences of Hazardous Materials Storage and Transportation Hazard

Boone has not experienced a significantly large-scale hazardous material incident at a fixed site or during transport resulting in multiple deaths or serious injuries.

Geographic Location of Hazardous Materials Storage and Transportation Hazard

Hazardous material hazards are countywide and are primarily associated with the transport of materials via highway, railroad, and/or river barge.

Hazard Extent of Hazardous Materials Storage and Transportation Hazard

The extent of the hazardous material hazard varies both in terms of the quantity of material being transported as well as the specific content of the container.

Risk Identification of Hazardous Materials Storage and Transportation Hazard

Based on input from the Planning Team, future occurrence of hazardous materials accident in Boone is likely. According to the Risk Priority Index (RPI) and County input, hazardous materials and transportation is ranked as the number five hazard.

Risk Priority Index

Probability	x	Magnitude	=	RPI
1	x	3	=	3

Vulnerability Analysis for Hazardous Materials Storage and Transportation Hazard

The entire county is vulnerable to a hazardous material release and can expect impacts within the affected area. The main concern during a release or spill is the affected population. To accommodate this risk, this plan considers all buildings located within the county as vulnerable. Tables 4-7 and 4-8 display the existing buildings and critical infrastructure in Boone.

Critical Facilities

All critical facilities and communities within the county are at risk. A critical facility will encounter many of the same impacts as any other building within the jurisdiction. These impacts include structural failure due to fire or explosion and loss of function of the facility (e.g., a damaged police station can no longer serve the community). Table 4-7 lists the types and number of essential facilities for the entire county and Appendix F displays a large format map of the locations of all critical facilities within the county.

Building Inventory

Table 4-8 lists the building exposure in terms of types and numbers of buildings for the entire county. The buildings within the county can expect similar impacts to those discussed for critical facilities. These impacts include structural failure due to fire or explosion or debris, and loss of function of the building (e.g., a person cannot inhabit a damaged home, causing residents to seek shelter).

Infrastructure

During a hazardous material release, the types of potentially impacted infrastructure include roadways, utility lines/pipes, railroads, and bridges. Since an extensive inventory of the infrastructure is not available

to this plan, it is important to emphasize that a hazardous materials release could damage any number of these items. The impacts to these items include: broken, failed, or impassable roadways; broken or failed utility lines (e.g., loss of power or gas to community); and railway failure from broken or impassable railways. Bridges could become impassable causing risk to motorists.

ALOHA Hazardous Chemical Release Analysis

The U.S. Environmental Protection Agency's ALOHA (Areal Locations of Hazardous Atmospheres) model was used to assess the impacted area

ALOHA is a computer program designed for response to chemical accidents, as well as emergency planning and training. Ammonia, chlorine, and propane are common chemicals used in industrial operations and are found in either liquid or gas form. Rail and truck tankers haul ammonia, chlorine, and propane to and from facilities.

<Describe chemical of modeled inceident here.>

Figure 4-HAZ1. ALOHA Modeled Hazardous Chemical Plume Origin in Boone

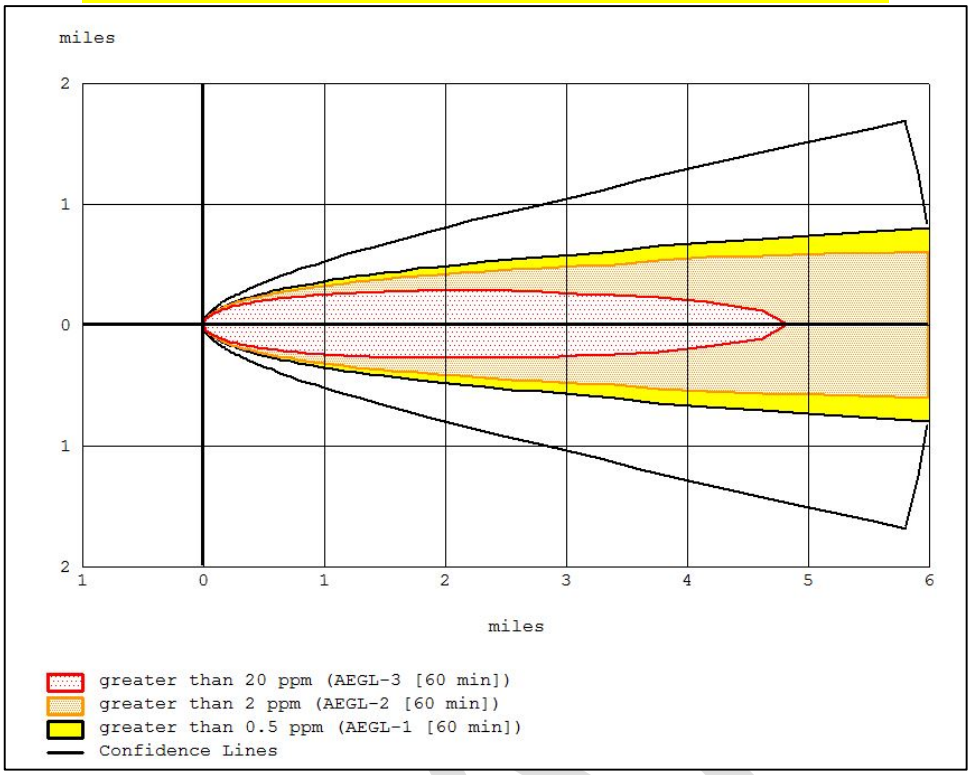
<The source of the chemical spill is ...>

Figure 4-HAZ2. ALOHA Modeling Parameters for Chemical Release

<Using the parameters in Figure 4-HAZ2, approximately X pounds of material would be released per minute. The image in Figure 4-HAZ3 depicts the plume footprint generated by ALOHA. As the substance moves away from the source, the level of substance concentration decreases. Each color-coded area depicts a level of concentration measured in parts per million.>

Chlorine Plume Origin

Figure 4-HAZ3. ALOHA Generated Plume Footprint of Incident Scenario



<The red buffer (20 ppm) extends no more than 4.5 miles from the point of release after one hour. The orange buffer (2 ppm) and yellow buffer (0.5 ppm) extends no more than six miles from the point of release. The dashed line depicts the level of confidence within the confines of the entire plume footprint. The ALOHA model is 95% confident that the release will stay within this boundary.>

Acute Exposure Guideline Levels (AEGL) are intended to describe the risk to humans resulting from once-in-a-lifetime, or rare exposure to airborne chemical (U.S. EPA AEGL Program). The National Advisory Committee for the Development of Acute Exposure Guideline Levels for Hazardous Substances (AEGL Committee) is involved in developing these guidelines to help both national and local authorities, as well as private companies, deal with emergencies involving spills, or other catastrophic exposures. AEGLs represent threshold exposure limits for the general public and are applicable to emergency exposure periods ranging from 10 minutes to 8 hours. The three AEGLs have been defined as follows:

> AEGL-1: the airborne concentration, expressed as parts per million or milligrams per cubic meter (ppm or mg/m3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.
>
> AEGL-2: the airborne concentration (expressed as ppm or mg/m3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

AEGL-3: the airborne concentration (expressed as ppm or mg/m3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

Airborne concentrations below the AEGL-1 represent exposure levels that can produce mild and progressively increasing but transient and non-disabling odor, taste, and sensory irritation or certain asymptomatic, non-sensory effects. With increasing airborne concentrations above each AEGL, there is a progressive increase in the likelihood of occurrence and the severity of effects described for each corresponding AEGL. Although the AEGL values represent threshold levels for the general public, including susceptible subpopulations, such as infants, children, the elderly, persons with asthma, and those with other illnesses, it is recognized that individuals, subject to unique or idiosyncratic responses, could experience the effects described at concentrations below the corresponding AEGL.

Results for Chlorine Release

<An estimate of property exposed to the chlorine spill was calculated by using the building inventory and intersecting these data with each of the AEGL levels (AEGL 3: ≥ 20.0 ppm, AEGL 2: ≥ 2.0 ppm and AEGL 1: ≥ 0.5 ppm). The Boone County assessment and parcel data was utilized for this analysis. There are X buildings within the chemical plume. It should be noted that the results should be interpreted as potential degrees of loss rather than exact number of buildings damaged to the chemical release. Table 4-HAZ1 lists the total amount of building exposure to each AEGL zone. Figure 4-HAZ4 depicts the chemical spill footprint and location of the buildings exposed.>

Table 4-HAZ1. Estimated Building Exposure as a Result of the Chlorine Release

Occupancy	Building Exposure			Number of Buildings		
	AEGL 1	AEGL 2	AEGL 3	AEGL 1	AEGL 2	AEGL3
Total:						

Figure 4-HAZ4. ALOHA Plume Footprint and Buildings Exposed to Chemical Release

Essential Facilities Damage

<There are X essential facilities within the limits of the chemical release scenario. Most are located in the confines of the >2 ppm concentration level. Table 4-HAZ2 and Figure 4-HAZ5 identifies the affected facilities.>

Table 4-HAZ2. Essential Facilities within the Chemical Plume Footprint

Essential Facility	Facility Name
Schools	

Figure 4-HAZ5. Map of Essential Facilities within the Chemical Plume Footprint

Vulnerability to Future Assets/Infrastructure for Hazardous Materials Storage and Transportation Hazard

Boone is expect to see future economic expansion within the city of <location.>These areas are particularly vulnerable to chemical releases because of transportation of hazardous materials.

Hazardous material hazard events may occur anywhere within the county, future development is impacted. The major transportation routes and the industries located in Boone pose a threat of dangerous chemicals and hazardous materials release.

4.3.8 Drought and Extreme Heat Hazard

Hazard Definition for Drought Hazard

Drought is a normal climatic phenomenon that can occur across the state of Illinois and within Boone. The meteorological condition that creates a drought is below-normal rainfall. However, excessive heat can lead to increased evaporation, which enhances drought conditions. Droughts can occur in any month. Drought differs from normal arid conditions found in low-rainfall areas. Drought is the consequence of a reduction in the amount of precipitation over an undetermined length of time (usually a growing season or longer).

The severity of a drought depends on location, duration, and geographical extent. Additionally, drought severity depends on the water supply, usage demands by human activities, vegetation, and agricultural operations. Droughts will affect the quality and quantity of crops, livestock, and other agricultural assets. Droughts can adversely impact forested areas leading to an increased potential for extremely destructive forest and woodland fires that could threaten residential, commercial, and recreational structures.

Drought conditions are often accompanied by extreme heat, which is defined as temperatures that exceed the average high for the area by 10°F or more for the last for several weeks. Such extreme heat can have severe implications for humans. Below are common terms associated with extreme heat:

Heat Wave

Prolonged period of excessive heat often combined with excessive humidity.

Heat Index

A number, in degrees Fahrenheit, which estimates how hot it feels when relative humidity is added to air temperature. Exposure to full sunshine can increase the heat index by 15°F.

Heat Cramps

Muscular pains and spasms due to heavy exertion. Although heat cramps are the least severe, they are often the first signal that the body is having trouble with heat.

Heat Exhaustion

Typically occurs when people exercise heavily or work in a hot, humid place where body fluids are lost through heavy sweating. Blood flow to the skin increases, causing blood flow to decrease to the vital organs, resulting in a form of mild shock. If left untreated, the victim's condition will worsen. Body temperature will continue to rise, and the victim may suffer heat stroke.

Heat and Sun Stroke

A life-threatening condition. The victim's temperature control system, which produces sweat to cool the body, stops working. The body's temperature can rise so high that brain damage and death may result if the body is not cooled quickly.

Previous Occurrences for Drought and Extreme Heat

The NCDC database reported 11 drought/heat wave events in Boone County since 1950. The most recent recorded event occurred in July of 2019.

Geographic Location for Drought and Extreme Heat

Droughts are regional in nature. Most areas of the United States are vulnerable to the risk of drought and extreme heat.

Hazard Extent for Drought and Extreme Heat

The extent of droughts or extreme heat varies both depending on the magnitude and duration of the heat and the range of precipitation.

Risk Identification for Drought and/or Extreme Heat

Based on historical information, the occurrence of future droughts and/or prolonged extreme heat is likely. According to the Boone Planning Team's assessment, drought and/or extreme heat are ranked as the number eight hazard.

Risk Priority Index

Probability	x	Magnitude	=	RPI
2	x	1	=	2

Vulnerability Analysis for Drought and Extreme Heat

Drought and extreme heat are a potential threat across the entire county; therefore, the county is vulnerable to this hazard and can expect impacts within the affected area. According to FEMA, approximately 175 Americans die each year from extreme heat. Young children, elderly, and hospitalized populations have the greatest risk. The entire population and all buildings are at risk. To accommodate this risk, this plan considers all buildings located within the county as vulnerable. Tables 4-7 and 4-8 display the existing buildings and critical infrastructure in Boone. Even though the exact areas affected are not known, a discussion of the potential impact are detailed below.

Critical Facilities

All critical facilities are vulnerable to drought. A critical facility will encounter many of the same impacts as any other building within the jurisdiction, which should involve little or no damage. Potential impacts include water shortages, fires as a result of drought conditions, and residents in need of medical care from the heat and dry weather. Table 4-7 lists the types and number of essential facilities for the entire county and Appendix F displays a large format map of the locations of all critical facilities within the county.

Building Inventory

Table 4-8 lists the building exposure in terms of types and numbers of buildings for the entire county. The buildings within the county can expect similar impacts to those discussed for critical facilities. These impacts include water shortages, fires as a result of drought conditions, and residents in need of medical care from the heat and dry weather.

Infrastructure

During a drought, the types of potentially impacted infrastructure include roadways, utility lines/pipes, railroads, and bridges. The risk to these structures is primarily associated with fire, which could result from hot, dry conditions. Since the county's entire infrastructure is vulnerable, damage to any infrastructure is possible. The impacts to these items include: impassable roadways; broken or failed utility lines (e.g., loss of power or gas to community); or impassable railways. Bridges could become impassable, causing risk to motorists.

Potential Dollar Losses from Drought and Extreme Heat

According to the NDCD, Boone has not incurred damages relating to drought and extreme heat events storms since 1950. NCDC records are estimates of damage compiled by the National Weather Service from various local, state, and federal sources. However, these estimates are often preliminary in nature and may not match the final assessment of economic and property losses related to a given weather event. As a result, the potential dollar losses for a future event cannot be reliably constrained.

Vulnerability to Future Assets/Infrastructure from Drought/Extreme Heat Hazard

Future development will remain vulnerable to droughts. Typically, some urban and rural areas are more susceptible than others. For example, urban areas are subject to water shortages during periods of drought. Excessive demands of densely populated areas put a limit on water resources. In rural areas, crops and livestock may suffer from extended periods of heat and drought. Dry conditions can lead to the ignition of wildfires that could threaten residential, commercial, and recreational areas.

Suggestion of Community Development Trends

Because droughts and extreme heat are regional in nature, future development is susceptible to drought. Although urban and rural areas are equally vulnerable to this hazard, those living in urban areas may have a greater risk from the effects of a prolonged heat wave. The atmospheric conditions that create extreme heat tend to trap pollutants in urban areas, adding contaminated air to the excessively hot temperatures and creating increased health problems. Furthermore, asphalt and concrete store heat longer, gradually releasing it at night and producing high nighttime temperatures. This phenomenon is known as the "urban heat island effect."

Local officials should address drought and extreme heat hazards by educating the public on steps to take before and during the event—for example, temporary window reflectors to direct heat back outside, staying indoors as much as possible, and avoiding strenuous work during the warmest part of the day.

Section 5. Mitigation Strategies

The goal of mitigation is to reduce the future impacts of a hazard, including property damage, disruption to local and regional economies, and the amount of public and private funds spent to assist with recovery. Throughout the planning process, the Boone Planning Team worked to identify existing hazard mitigation policies, develop mitigation goals, and create a comprehensive range of mitigation strategies specific to each jurisdiction. This work provides a blueprint for reducing the potential losses identified in the risk assessment (section 4).

5.1 Existing Hazard Mitigation Policies, Programs and Resources

This section documents each jurisdiction's existing authorities, policies, programs and resources related to hazard mitigation and the ability to improve these existing policies and programs. It is important to highlight the work that has been completed in Boone that pertains to hazard mitigation. In addition, the following information also provides an evaluation of these abilities to determine whether they can be improved in order to more effectively reduce the impact of future hazards.

5.1.1 Successful Mitigation Projects

To be successful, mitigation must be a recurrent process that is continually striving to lessen the impact of natural hazards within the county. The following are projects that were successfully completed after Boone County 2014 Multi-Hazard Mitigation Plan was formally adopted.

Accomplishments here…

Grant Management Program

The Illinois Grant Management Program provides grants to specific local governments, units of government, educational facilities and not-for-profit organizations by members of the General Assembly and the Governor for specific purposes to bolster the State's economy, promote a clean environment and improve the overall quality of life throughout the State of Illinois. Since 2014, Boone received <number> grants under the Grant Management Program totaling <cost>. The following communities utilized the Grant Management Program funds to complete hazard mitigation projects:

- Project descriptions here

5.1.2 National Flood Insurance Program

In 1968, Congress created the National Flood Insurance Program (NFIP) to help provide a means for property owners to financially protect themselves. The NFIP offers flood insurance to homeowners, renters, and business owners if their community participates in the NFIP. Participating communities agree to adopt and enforce ordinances that meet or exceed FEMA requirements to reduce the risk of flooding. This section covers the County's NFIP status, flood insurance policy and claim statistics, repetitive loss structures, and Community Rating System status.

NFIP Status

In Boone County, X incorporated communities participate in the NFIP. Table 5-1 includes a summary of information for Boone participation in the NFIP. Boone will continue to provide information to its non-participating jurisdictions regarding the benefits of the National Flood Insurance Program.

It is important to note that structures within a NSFHA are still at risk. In fact, nearly 1 in 4 NFIP flood claims occur in these moderate- to low-risk areas.

Table 5-1. Information on Boone Participation in the NFIP

Community	Participate in the NFIP	Initial Flood Hazard Boundary Map Identified	Initial FIRM Identified	Current Effective FIRM Date
BOONE COUNTY *	Yes		11/17/1982	2/18/2011
BELVIDERE, CITY OF	Yes		1/6/1982	2/18/2011
CAPRON, VILLAGE OF	Yes		2/18/2011	02/18/11(M)

CHERRY VALLEY, VILLAGE OF	Yes		3/16/1981	2/17/2016
LOVES PARK, CITY OF	Yes		10/17/1978	2/17/2016
POPLAR GROVE, VILLAGE OF	Yes		2/18/2011	2/18/2011

NFIP status and information are documented in the Community Status Book Report updated on 04/07/2015.
(M) – No Elevation Determined – All Zone A, C and X

Flood Insurance Policy and Claim Statistics

As of January 2015, <number> households paid flood insurance, insuring <price> in property value. The total premiums collected for the policies amounted to <price>. Since the establishment of the NFIP in 1978, 158 flood insurance claims were filed in Boone, totaling in $1,525,644 in payments. Table 5-2 summarizes the claims since 1978.

Table 5-2. Flood Insurance Claim Statistics for Boone

Community	Total Losses	Closed Losses	Open Losses	CWOP Losses	Payments
BOONE COUNTY *	23	15	1	7	199,942.25
BELVIDERE, CITY OF	30	24	1	5	159,620.12
CHERRY VALLEY, VILLAGE OF	5	3	0	2	22,547.22
LOVES PARK, CITY OF	100	68	0	32	1,143,535.27

NFIP policy and claim statistics since 1978 until the most recently updated date of 01/31/2015. Closed Losses refer to losses that are paid; open losses are losses that are not paid in full; CWOP losses are losses that are closed without payment; and total losses refers to all losses submitted regardless of status. Lastly, total payments refer to the total amount paid on losses.

Repetitive Loss Structures

There are several structures in Boone County that have experienced repetitive losses due to flooding. FEMA defines a repetitive loss structure as a structure covered by a contract of flood insurance issued under the NFIP that has suffered flood loss damage on two or more occasions during a 10-year period that ends on the date of the second loss, in which the cost to repair the flood damage is ≥ 25% of the market value of the structure at the time of each flood loss. Currently there are over 122,000 Repetitive Loss properties nationwide.

The Illinois Emergency Management Agency and Illinois Department of Natural Resources was contacted to determine the location of repetitive loss structures in Boone County. Records indicate that there are <number> repetitive loss structures within the county. The total amount paid for building replacement and building contents for damage to these repetitive loss structures is <cost>. Table 5-3 describes the repetitive loss structures for each jurisdiction.

Table 5-3. Repetitive Loss Structures for each Jurisdiction in Boone County

Jurisdiction	Number of Properties	Number of Losses	Total Paid
Total:			

Community Rating System Status

The CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the three goals of the CRS: (1) reduce flood losses; (2) facilitate accurate insurance rating; and (3) promote the awareness of flood insurance. More than 1,200 communities from all 50 states participate in the CRS. In Illinois, 51 communities participate in the CRS. Although joining the CRS is free, completing CRS activities and maintain a CRS rating will require a degree of commitment from the community, including dedicating staff.

The CRS uses a Class rating system that is similar to fire insurance rating to determine flood insurance premium reductions for residents. CRS Classes are rated from 9 to 1. Most communities enter the program at a CRS Class 9 or Class 8 rating, which entitles residents in Special Flood Hazard Areas (SFHAs) to a 5% to 10% discount on flood insurance premiums. Each CRS Class improvement produces a 5 percent greater discount on flood insurance premiums.

Table 5-4 displays Boone Community Rating System history. Currently, Boone County and its incorporated areas do not participate in the NFIP'S Community Rating System (CRS). Joining the CRS could be one way Boone County or its incorporated communities improve their existing floodplain management policies and further reduce the flood hazard risk.

Table 5-4 Boone 's Community Rating System History

Jurisdiction	CRS Entry Date	Current Effective Date	Class*	% Discount for SFHA	Status

5.1.3 Jurisdiction Ordinances

Hazard Mitigation related ordinances, such as zoning, burning, or building codes, have the potential to reduce the risk from known hazards. These types of regulations provide many effective ways to address resiliency to known hazards. Table 5-5 list Boone current ordinances that directly pertain, or can pertain, to hazard mitigation. It is important to evaluate the local building codes and ordinances to determine if they have the ability to reduce potential damages caused by future hazards. The Boone Planning Team worked to identify gaps in the current list of ordinances and suggested changes/additions in Section 5.3.

Table 5-5. Boone Jurisdiction Ordinances

Community	Building	Electrical	Stormwater	Flooding	Subdivision	Fire	Land Use	Zoning

*Only those jurisdictions that have ordinances are included in the table.

The adoption of new ordinances, including the adoption of new development standards or the creation of hazard-specific overlay zones tied to existing zoning regulations, present opportunities to discourage hazardous construction and manage the type and density of land uses in areas of known natural hazards. Adopting and enforcing higher regulatory standards for floodplain management (i.e., those that go beyond the minimum standards of the NFIP) is another effective method for minimizing future flood losses, particularly if a community is experiencing growth and development patterns that influence flood hazards in ways that are not accounted for on existing regulatory floodplain maps. Revisions to existing building codes also present the opportunity to address safe growth. Many state and local codes are based off national or industry standard codes which undergo routine evaluations and updates. The adoption of revised code requirements and optional hazard-specific standards may help increase community resilience.

5.1.4 Fire Insurance Ratings

By classifying communities' ability to suppress fires, the Insurance Service Office (ISO) Public Protection Classification Program helps communities evaluate their public fire-protection services. The program provides a countrywide standard that helps fire departments in planning and budgeting for facilities, equipment, and training. Information is collected on municipal fire-protection efforts in communities throughout the United States. In each of those communities, ISO analyzes the relevant data using a Fire Suppression Rating Schedule. Ratings are assigned from 1 to 10 where Class 1 generally represents superior property fire protection, and Class 10 indicates that the area's fire-suppression program doesn't meet ISO's minimum criteria. Table 5-6 displays each Fire Department's insurance rating and total number of employees.

Table 5-6. Boone Fire Departments, Insurance Ratings, and Number of Employees/Volunteers

Fire Department	Fire Insurance Rating	Number of Employees
Belvidere Fire Department	3	30
Boone County Fire Protection District #1	5	21
Boone County Fire Protection District #2	5	43
Boone County Fire Protection District #3	4/5	42

5.2 Mitigation Goals

In Section 4 of this plan, the risk assessment identified Boone as prone to several hazards. The Planning Team members understand that although they cannot eliminate hazards altogether, Boone can work towards building disaster-resistant communities. Below is a generalized list of goals, objectives, and actions. The goals represent long-term, broad visions of the overall vision the county would like to achieve for mitigation. The objectives are strategies and steps that will assist the communities in attaining the listed goals.

Goal 1: Lessen the impacts of hazards to new and existing infrastructure

Objective: Retrofit critical facilities and structures with structural design practices and equipment that will withstand natural disasters and offer weather-proofing.

Objective: Equip public facilities and communities to guard against damage caused by secondary effects of hazards.

Objective: Minimize the amount of infrastructure exposed to hazards.

Objective: Evaluate and strengthen the communication and transportation abilities of emergency services throughout the county.

Objective: Improve emergency sheltering in Boone County.

Goal 2: Create new or revise existing plans/maps for Boone County

Objective: Support compliance with the NFIP for each jurisdiction in Boone County.

Objective: Review and update existing, or create new, community plans and ordinances to support hazard mitigation.

Objective: Conduct new studies/research to profile hazards and follow up with mitigation strategies.

Goal 3: Develop long-term strategies to educate Boone County residents on the hazards

Objective: Raise public awareness on hazard mitigation.

Objective: Improve education and training of emergency personnel and public officials.

5.3 Multi-Jurisdictional Mitigation Strategies

After reviewing the Risk Assessment, the Mitigation Planning Team was presented with the task of individually listing potential mitigation activities using the FEMA STAPLEE evaluation criteria (see table 5-7). FEMA uses their evaluation criteria STAPLEE (stands for social, technical, administrative, political, legal, economic and environmental) to assess the developed mitigation strategies. Evaluating possible natural hazard mitigation activities provides decision-makers with an understanding of the potential benefits and costs of an activity, as well as a basis upon which to compare alternative projects. The Planning Team developed their mitigation strategies in conjunction with Meeting 2.

Table 5-7. FEMA's STAPLEE Evaluation Criteria

Social	Mitigation actions are acceptable to the community if they do not adversely affect a particular segment of the population, do not cause relocation of lower income people, and if they are compatible with the community's social and cultural values.
Technical	Mitigation actions are technically most effective if they provide a long-term reduction of losses and have minimal secondary adverse impacts.
Administrative	Mitigation actions are easier to implement if the jurisdiction has the necessary staffing and funding.
Political	Mitigation actions can truly be successful if all stakeholders have been offered an opportunity to participate in the planning process and if there is public support for the action.
Legal	It is critical that the jurisdiction or implementing agency have the legal authority to implement and enforce a mitigation action.
Economic	Budget constraints can significantly deter the implementation of mitigation actions. Hence, it is important to evaluate whether an action is cost-effective, as determined by a cost benefit review, and possible to fund.
Environmental	Sustainable mitigation actions that do not have an adverse effect on the environment, comply with federal, state, and local environmental regulations, and are consistent with the community's environmental goals, have mitigation benefits while being environmentally sound.

Table 5-8 contains a comprehensive range of specific mitigation actions and projects for each jurisdiction, with an emphasis on new and existing buildings and infrastructure. At least two identifiable mitigation action items have been addressed for each hazard listed in the risk assessment. Each of the incorporated communities within and including Boone County was invited to participate in brainstorming sessions in which goals, objectives, and strategies were discussed and prioritized. Each participant in these sessions was armed with possible mitigation goals and strategies provided by FEMA, as well as information about mitigation projects discussed in neighboring communities and counties.

All potential strategies and goals that arose through this process are included in Table 5-8. The mitigation strategies are arranged by hazard they directly address. In some cases, certain mitigation strategies can address all hazards. If provided by the jurisdiction, each mitigation strategy contains specific details pertaining to the implementation, responsible and/or organizing agency, and potential funding source. Potential funding sources are identified by Federal, State, Local, or Private. A code is assigned to each mitigations strategy for ease of reference when reviewing the prioritization of each mitigations strategies in Section 5.4.

Table 5-8. Boone Multi-Jurisdictional Mitigation Strategies

Mitigation Item	Status	Hazards Addressed	Priority	Comments
Public Education/Awareness	Ongoing	All Hazards	Medium	Boone County recognizes that public education is important and expensive. The county plans to obtain as much funding as possible to raise public awareness of hazards.
Automatic Aid Agreements	Ongoing	All Hazards	High	Automatic aid agreements have been signed by all four fire departments in the county. This historic cooperation will continue. TO that end, the county would like to update and strengthen their training abilities with a training facility
Back-up Generators	Ongoing	All Hazards	High	Boone County plans to obtain back-up generators for each critical facility and county government building (local law enforcement, fire departments, hospitals, city and county buildings, schools, etc).
Enhanced Communication Systems/Emergency Operations Center (EOC)	Ongoing	All Hazards	High	Boone County is currently in the process of updating all communications systems to improve communications between emergency operators and the public.
Dedicated Emergency Operations Center	Proposed	All Hazards	High	The current EOC is a classroom with a few laptop computers and a few phone lines. This is not a functional EOC. The Coronavirus pandemic exposed how inefficient this operation is.
Establish Local Emergency Planning Committee	Ongoing	All Hazards	Medium	Boone County has a robust Local Emergency Planning Committee. This cooperation is continuing, but has no financial support.
County-wide Rescue Squad	Ongoing	All Hazards	High	Having one rescue squad for the entire county alleviates duplication of effort and improves inter-operability of the four existing departments. For instance, each department would not have to buy the same type of vehicle.

Procure a Back-up Water Supply	Ongoing	All Hazards	Low	Boone County wishes to establish an emergency fund to obtain water from an outside source in the event a disaster disrupts the current potable water supply
Obtain Tents/Shelter and Cots	Ongoing	All Hazards	High	Boone County would like to obtain funding for tents and shelters to better address the sheltering needs in the event of a major hazard. The COVID-19 crisis demonstrated a need of cots for relocated people.
Data Center Redundancy	Proposed	All Hazards	High	In the building the Information Technology Center is in is damaged, the entire City of Belvidere and County is without computer and phone access.
Stormwater Management and Floodplain Ordinance	Ongoing	Flood	High	Boone County has recently adopted a Storm Water Ordinance and will continue to monitor its floodplain ordinance.
Updated Starcom Portable Radios	Proposed	All Hazards	High	The Boone County Emergency Management is currently using outdated portable radios. These radios do not allow communications with all the entities necessary.
Installation of Pumping Stations	Ongoing	Flood	High	Boone County is in the process of installing pumping stations but with funding, additional work could be completed to the infrastructure.
Elevate Low-Lying Roads	Ongoing	Flood	High	Boone County is interested in elevating low-lying roads and plans to seek funding. Studies need to be done to research the effects.
Provide and Publicize Locations of Safe Rooms and/or Shelters	Ongoing	Tornado/Severe Storms	High	Boone County is currently working on identifying all shelters in the county to provide this information to the public. The County will work with different associations on getting private shelters installed and advertised.
Tree Management	Ongoing	Tornado/Severe Storms	High	Boone County already has a tree-trimming and management program and will continue to maintain it.
Cooling/Water Shelters	Ongoing	Extreme Temperatures	High	Boone County would like to obtain funding for cooling and warming centers. The local law

				enforcements, fire and emergency management will oversee the project.
Badge Reader/Asset Tracker	Proposed	All Hazards	High	Disasters bring a lot of responders and equipment to a scene. These asset trackers allow much greater accountability of people and equipment by using a bar code system. People are scanned in quickly and their location is known.
Assault vehicle for Police	Proposed	Civil Unrest	High	There was a reported school shooting in the county in Spring 2020. It turned out to be a distraction for a bank robbery. If it had been real, there was no safe rescue vehicle available.
Earthquake Response Plan	Ongoing	Earthquake	Medium	Boone County Emergency Management has an earthquake response plan in place and will continue to monitor and update it in the future.
Fire Training Center	Proposed	All Hazards	Medium	Boone County would like to obtain funding to enhance and update a multi-functional training center.
Emergency Plan/Protocol for HAZMAT	Ongoing	Hazmat	High	Boone County, along with Belvidere Fire departments, Boone County EMA, and Boone County LEPC currently maintains and emergency plan for HAZMAT incidents
Conduct a Commodity Flow Study	Ongoing	Hazmat	Medium	Boone County EMA will oversee this project. Funding will be sought from ILDOT, IEMA, and FEMA.

5.4 Prioritization of Multi-Jurisdictional Mitigation Strategies

Implementation of the mitigation strategies is critical to the overall success of the mitigation plan. It is important to decide, based upon many factors, which action will be undertaken first. In order to pursue the top priority first, an analysis and prioritization of the actions is vital. It is important to note that some actions may occur before the top priority due to financial, engineering, environmental, permitting, and site control issues. Public awareness and input of these mitigation actions can increase knowledge to capitalize on funding opportunities and monitoring the progress of an action. It is also critical to take into account the amount of time it will take the community to complete the mitigation project.

For each participating jurisdiction a rating (high, medium, or low) was assessed for each mitigation item. The ranking is the result of the STAPLEE evaluation and the timeframe the community is interested in completing the strategy: H - High 1-3 years; M - Medium 3-5 years; and L - Low 5+years.

Section 6. Plan Implementation and Maintenance

6.1 Implementation through Existing Programs

Throughout the planning process, the Boone Planning Team worked to identify existing hazard mitigation policies, develop mitigation goals, and a create a comprehensive range of mitigation strategies specific to each jurisdiction. This work provides a blueprint for reducing the potential losses identified in the Risk Assessment (Section 4). The ultimate goal of this plan is to incorporate the mitigation strategies proposed into ongoing planning efforts within the County. The Boone Emergency Management Agency will be the local champion for the mitigation actions. The Boone Board and the city and village councils will be an integral part of the implementation process. Federal and state assistance will be necessary for a number of the identified action.

Continued public involvement is also critical to the successful implementation of the MHMP. Comments from the public on the MHMP will be received by the Boone Emergency Management Agency and forwarded to the Planning Team for discussion. Education efforts for hazard mitigation will be an ongoing effort of Boone. The public will be notified of periodic planning meetings through notices in the local newspaper. Once adopted, a copy of the MHMP will be maintained in each jurisdiction and in the Boone Emergency Management Agency.

6.2 Monitoring, Evaluation, and Updating the MHMP

Throughout the five-year planning cycle, the Boone Emergency Management Agency will reconvene the Planning Team to monitor, evaluate, and update the plan on an annual basis. Additionally, a meeting will be held in 2024 to address the five-year update of this plan. Members of the planning committee are readily available to engage in email correspondence between annual meetings. If the need for a special meeting, due to new developments or the occurrence of a declared disaster in the county, the team will meet to update mitigation strategies. Depending on grant opportunities and fiscal resources, mitigation projects may be implemented independently by individual communities or through local partnerships.

As part of the update process, the Planning Team will review the county goals and objectives to determine their relevance to changing situations in the county. In addition, state and federal policies will be reviewed to ensure they are addressing current and expected conditions. The team will also review the risk assessment portion of the plan to determine if this information should be updated or modified. The plan revision will also reflect changes in local development and its relation to each hazard. The parties responsible for the various implementation actions will report on the status of their projects, and will include which implementation processes worked well, any difficulties encountered, how coordination efforts are proceeding, and which strategies should be revised.

Updates or modifications to the MHMP during the five-year planning process will require a public notice and a meeting prior to submitting revisions to the individual jurisdictions for approval. The plan will be updated via written changes, submissions as the committee deems appropriate and necessary, and as approved by the Boone Board.

The GIS data used to prepare the plan was obtained from existing county GIS data as well as data collected as part of the planning process. This updated Hazus-MH GIS data has been returned to the county for use and maintenance in the county's system. As newer data becomes available, these updated data will be used for future risk assessments and vulnerability analyses.

Definitions

100-year Floodplain	Areas subject to inundation by the 1-percent-annual-chance flood event.
Critical Facility	A structure, because of its function, size, service area, or uniqueness, that has the potential to cause serious bodily harm, extensive property damage, or disruption of vital socioeconomic activities if it is destroyed or damaged or if its functionality is impaired. This includes, but are not limited to, water and wastewater treatment facilities, municipal buildings, educations facilities, and non-emergency healthcare facilities.
Community Rating System (CRS)	A voluntary program for National Flood Insurance Program (NFIP) participating communities. The goals of the CRS are to reduce flood damages to insurable property, strengthen and support the insurance aspects of the NFIP, and encourage a comprehensive approach to floodplain management.
Comprehensive Plan	A document, also known as a "general plan," covering the entire geographic area of a community and expressing community goals and objectives. The plan lays out the vision, policies, and strategies for the future of the community, including all the physical elements that will determine the community's future developments.
Disaster Mitigation Act of 2000 (DMA 2000)	The largest legislation to improve the planning process. It was signed into law on October 30, 2000. This new legislation reinforces the importance of mitigation planning and emphasizes planning for disasters before they occur.
Essential Facility	A subset of critical facilities that represent a substantial hazard to human life in the event of failure. This includes (but not limited to) hospital and fire, rescue, ambulance, emergency operations centers, and police stations.
Federal Emergency Management Agency	An independent agency created in 1979 to provide a single point of accountability for all federal activities related to disaster mitigation and emergency preparedness, response, and recovery.
Hazard	A source of potential danger or adverse condition.
Hazard Mitigation	Any sustained action to reduce or eliminate long-term risk to human life and property from hazards.

Hazard Mitigation Grant Program (HMPG)	Authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, HMGP is administered by FEMA and provides grants to states, tribes, and local governments to implement hazard mitigation actions after a major disaster declaration.
Hazus-MH	A geographic information system (GIS)-based disaster risk assessment tool.
Multi-Hazard Mitigation Planning	Identify policies and actions that can be implemented over the long term to reduce risk and future losses from various hazardous events.
National Flood Insurance Program	Administered by the Federal Emergency Management Agency, which works closely with nearly 90 private insurance companies to offer flood insurance to property owners and renters. In order to qualify for flood insurance, a community must join the NFIP and agree to enforce sound floodplain management standards.
Planning Team	A group composed of government, private sector, and individuals with a variety of skills and areas of expertise, usually appointed by a city or town manager, or chief elected official. The group finds solutions to community mitigation needs and seeks community acceptance of those solutions.
Risk Priority Index	Quantifies risk as the product of hazard probability and magnitude so Planning Team members can prioritize mitigation strategies for high-risk-priority hazards.
Risk Assessment	Quantifies the potential loss resulting from a disaster by assessing the vulnerability of buildings, infrastructure, and people.
Strategy	A collection of actions to achieve goals and objectives.
Vulnerability	Describes how exposed or susceptible to damage an asset is. Vulnerability depends on an asset's construction, contents, and the economic value of its functions.

Acronyms

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

A
AEGL – Acute Exposure Guideline Levels
ALOHA – Areal Locations of Hazardous Atmospheres

C
CERI – Center for Earthquake Research and Information
CRS – Community Rating System

D
DEM – Digital Elevation Model
DFIRM – Digital Flood Insurance Rate Map
DMA – Disaster Mitigation Act of 2000

E
EAP – Emergency Action Plan
EMA – Emergency Management Agency
EPA – Environmental Protection Agency

F
FEMA – Federal Emergency Management Agency
FIRM – Flood Insurance Rate Map

G
GIS – Geographic Information System

H
Hazus-MH – Hazards USA Multi-Hazard
HMGP – Hazard Mitigation Grant Program
HUC – Hydrologic Unit Code

I
IA – Individual Assistance
IDNR – Illinois Department of Natural Resources
IDOT – Illinois Department of Transportation
IEMA – Illinois Emergency Management Agency
ISO – Insurance Service Office
ISGS – Illinois State Geological Survey
ISWS– Illinois State Water Survey

M MHMP – Multi-Hazard Mitigation Plan

N NCDC – National Climatic Data Center
NEHRP – National Earthquake Hazards Reduction Program
NFIP – National Flood Insurance Program
NID – National Inventory of Dams
NOAA – National Oceanic and Atmospheric Administration
NSFHA – Non-Special Flood Hazard Area

P PA – Public Assistance
PHMSA– Pipeline and Hazardous Materials Safety Administration
PPM – Parts Per Million

R RPI – Risk Priority Index

S SIU – Southern Illinois University Carbondale
SPC – Storm Prediction Center
STAPLEE – Social, Technical, Administrative, Political, Legal, Economic, and Environmental

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U USGS – United States Geological Survey

Appendices

Appendices ..... Error! Bookmark not defined.
Appendix A. Meeting Minutes ..... Error! Bookmark not defined.
Appendix B. Local Press Release and Newspaper Articles ..... Error! Bookmark not defined.
Appendix C. Adopting Resolutions ..... Error! Bookmark not defined.
Appendix D. Historical Hazards ..... Error! Bookmark not defined.
Appendix E. List of Essential Facilities ..... Error! Bookmark not defined.
Appendix F. Critical Facilities Map ..... Error! Bookmark not defined.

Appendix A. Meeting Minutes

Formal Mitigation Planning Meetings

Meeting 1 – Dec 9th, 2019

Meeting 2 – April 6th, 2020

Meeting 3 – May 19th, 2020

Meeting 4 – May 30th, 2020

Outside Meetings

See Attached Outside Meeting Minutes and Sign-in Sheets

Meeting 1 – December 9th, 2019

Meeting 2 – April 6th, 2020

Meeting 3 – May 20th, 2020

Meeting 4 – May 30th, 2020

Appendix B. Local Press Release and Screen Shots

Appendix C. Adopting Resolutions

See Attached Adopting Resolutions

Appendix D. Historical Hazards

See Attached Newspaper Clippings and Map

Appendix E. List of Essential Facilities

Not all data is available for every facility. Other facility specifics may be available upon request.

Emergency Operations Center Facilities

Facility Name	Address	City
Emergency Management Agency	615 N Main Street	Belvidere

Fire Station Facilities

Facility Name	Address	City
Belvidere Fire Department	615 N Main St	Belvidere
Belvidere Fire Department	123 S State St	Belvidere
Boone County Fire District 2	353 E 6th St	Belvidere
Boone County Fire District 2	1777 Henry Luckow Ln	Belvidere
Boone County Fire Protection District 1	105 W Ogden St	Capron
North Boone Fire District 3	305 W Grove	Poplar Grove
North Boone Fire District 3	2428 Main St	Caledonia

Police Station Facilities

Facility Name	Address	City
Boone County Sheriff's Office	615 N Main St.	Belvidere
Belvidere Police Department	615 N Main St.	Belvidere

School Facilities

Facility Name	Address	City
Belvidere Central Middle School	8787 Beloit Rd	Belvidere
Belvidere High School	1500 East Ave	Belvidere
Belvidere North High School	9393 Beloit Rd	Belvidere
Belvidere South Middle School	919 E 6th St.	Belvidere
Boone County Center	1320 E Avenue	Belvidere
Caledonia Elementary School	2311 Randolph	Caledonia
Camelot School	7133 Garden Prairie	Garden Prairie
Capron Elementary School	200 N Wooster St.	Capron
Immanuel Lutheran School	1045 Belvidere Rd	Belvidere
Lincoln Elementary School	1011 Bonus Ave	Belvidere
Manchester Elementary School	3501 Blaine Rd	Poplar Grove
Meehan Elementary School	1401 E 6th St.	Belvidere
North Boone High School	17823 Poplar Grove	Poplar Grove
North Boone Middle School	17641 Poplar Grove	Poplar Grove
North Boone Upper Elementary School	6200 N Boone School Rd	Poplar Grove
Perry Elementary School	633 W Perry St.	Belvidere
Poplar Grove Elementary School	208 N State St.	Poplar Grove
Regional Learning Center Ark	620 Logan Ave	Belvidere
Seth Whitman Elementary School	8989 Beloit Rd	Belvidere
St. James Catholic School	320 Logan Avenue	Belvidere
Washington Academy School	1031 5th Ave	Belvidere

Medical Care and Long Term Care Facilities

Facility Name	Address	City	Comments
Crusader Community Health Belvidere	1050 Logan Ave.	Belvidere	Family Practice, Pediatrics, Dental, Podiatry, Medication Resource Center
OSF Medical Group	143 Kishwaukee Street	Belvidere	Family Medicine
OSF Medical Group Poplar Grove	13539 Illinois Route 76	Poplar Grove	Family Medicine – Geriatric Medicine
Physicians Immediate Care	1663 Belvidere Rd	Belvidere	Walk-in Injury and Illness Center
Rockford Health Physicians	1669 Belvidere Road	Belvidere	Primary care services
Shappert Health Center	2170 Pearl Street	Belvidere	Acute and chronic care for all ages
SwedishAmerican Medical Center of Belvidere	1625 S. State St.	Belvidere	SwedishAmerican Medical Hospital System; 24-Hour Emergency Physicians, inpatient unit
SwedishAmerican Medical Group	1700 Henry Luckow Lane	Belvidere	Clinic (primary care services, specialty care services and ancillary services)

Appendix F. Critical Facilities Map

See Attached Large Format Map of Critical Facilities.