VANDERBURGH COUNTY
MULTI-HAZARD MITIGATION PLAN

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Prepared for:

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EXECUTIVE SUMMARY

The Federal Emergency Management Agency (FEMA) defines the disaster life cycle as the process through which emergency managers respond to disasters when they occur; help people and institutions recover from them; reduce the risk of future losses; and prepare for emergencies and disasters. In **Figure i**, each phase in the Emergency Management Life Cycle; Mitigate, Prepare, Respond, and Recover has a description of the phase as well as a time frame within the disaster cycle. Although each of the phases is visually tied to a specific time period within the life cycle of the disaster, mitigation can take place throughout much of the disaster life cycle. The Vanderburgh County Multi-Hazard Mitigation Plan (MHMP) update focuses on the mitigation activities that may be implemented throughout the disaster life cycle.

Figure i: Emergency Management Life Cycle

According to FEMA, mitigation is most effective when it's based on an inclusive, comprehensive, long-term plan that is developed before a disaster occurs. The MHMP planning process identifies hazards, the extent that they affect the municipality, and formulates mitigation practices to ultimately reduce the social, physical, and economic impact of the hazards.

The overall goals of the Vanderburgh County MHMP, which aligns closely with the State of Indiana MHMP, are:

1. Lessen the impacts of disasters and enhance community resilience.
2. Minimize the loss of life and injuries caused by disasters.
3. Promote mitigation activities both prior to and following a disaster.

To achieve the stated goals the community strategy includes the following:

1. Lessen the impacts of disasters and enhance community resilience by:
   a. Supporting resilience opportunities within the community
   b. Incorporating the MHMP into local ordinances, local planning efforts, and the community comprehensive plans
   c. Evaluating and strengthening collaboration among organizations
   d. Making sure essential facilities can withstand disasters
   e. Supporting the NFIP
   f. Identifying opportunities to reduce repetitive loss incidents

2. Minimize the loss of life and injuries caused by disasters by:
   a. Improving warning systems for the residents
   b. Developing public awareness and outreach programs
   c. Improving shelter availability
   d. Improving education and training for emergency personnel and officials
   e. Developing ways to provide education, awareness, and warning of disasters to all members of the community

3. Promote mitigation activities prior to and following a disaster by:
   a. Ensuring better communication between federal, state, and local officials
   b. Seizing opportunities to buy out properties, floodproof buildings, installing storm shelters and/or improving building codes

c. Conducting new studies and/or research opportunities to reduce impacts from disasters and prepare for future events anticipating the impacts of our changing climate
d. Conducting outreach efforts to educate community members of the risks and hazards in their area as well as encouraging the implementation of a variety of mitigation actions

For National Flood Insurance Program (NFIP) communities to be eligible for future mitigation funds, they must either adopt their own MHMP or participate in the development of a multi-jurisdictional MHMP. Further, it is required that local jurisdictions review, revise, and resubmit the MHMP every five years. The following are incorporated communities which have provided information, attended meetings, and participated in the planning process. The planning process used to update the Vanderburgh County MHMP satisfies the requirements of a multi-jurisdictional plan.

- Vanderburgh County
- City of Evansville
- Town of Darmstadt

During planning committee meetings, those in attendance revisited the latest edition of the Vanderburgh County MHMP and identified new critical and essential facilities and local hazards; reviewed the State's mitigation goals and updated the local mitigation goals; reviewed the most recent local hazard data, vulnerability assessment, and maps; evaluated the effectiveness of existing mitigation measures and identified new mitigation projects; and reviewed materials for public participation. Keeping in mind the ever-changing climate, the committee also examined the needs of underserved populations that may be more vulnerable to the impacts of the listed hazards. Meetings were conducted with key groups such as city planners, health department specialists, representatives of organizations serving the underserved populations and various emergency responders. Their information has been incorporated into this MHMP update. This plan update will examine each of the hazards with data from the past five years, where possible.

The review of hazards and risks is based on the methodology described in the Local Mitigation Planning Policy Guide FP 206-21-0002, effective April 19, 2023. The plan identifies the hazards assessed, the nature of each hazard including historic occurrences, vulnerabilities, and the relationship to other hazards. Using a ranking tool known as the Calculated Risk Priority Index (CPRI), the planning committee scored each of the hazards. **Table i** lists the hazards in the plan and the ranking of each. The CPRI scores reflect the hazards of most concern by the planning committee members.

Table i: CPRI Rankling for All Hazards

Hazard	2025 Rank	CPRI Score
Tornado	1	3.26
Hail, Thunder, and Wind Storms	2	3.01
Flood	3	2.98
Drought	4	2.84
Fires and Wildfire	5	2.79
Hazardous Materials Incident	6	2.75
Extreme Temperature	7	2.69
Winter Storms and Ice	8	2.69
Earthquake	9	2.31
Dam and Levee Failure	10	1.91
Landslide, Land Subsidence and Fluvial Erosion	11	1.49

Lastly, the plan concludes with a discussion about mitigation actions. The MHMP lists a variety of mitigation actions the planning committee members would like to accomplish within the next five years to enhance the resilience of Vanderburgh County. In addition, it celebrates the mitigation successes from the previous MHMP and community actions which contribute to mitigating the various risks and hazards identified.

This MHMP is a living document which has a five-year life span. During the next five years, Vanderburgh County and the incorporated communities which adopted this plan will work to complete the mitigation actions as well as regularly noting items for the next plan update. The county EMA and planning committee members will also use tools contained in the appendices, or similar documents, to track progress, and note changes that may impact community resilience.

CHAPTER 1: INTRODUCTION

1.1 DISASTER LIFE CYCLE

The Federal Emergency Management Agency (FEMA) defines the disaster life cycle as the process through which emergency managers respond to disasters when they occur; help people and institutions recover from them; reduce the risk of future losses; and prepare for emergencies and disasters. The disaster life cycle, shown in **Figure 1**, includes four phases:

Figure 1: Emergency Management Life Cycle

Mitigation – to prevent or to reduce the effects of disasters (building codes and zoning, vulnerability analyses, public education)

Preparedness – planning, organizing, training, equipping, exercising, evaluation and improvement activities to ensure effective coordination and the enhancement of capabilities (preparedness plans, emergency exercises/training, warning systems)

Response – the mobilization of the necessary emergency services and first responders to the disaster area (search and rescue; emergency relief)

Recovery – to restore the affected area to its previous state (rebuilding destroyed property, re-employment, and the repair of other essential infrastructure)

The Vanderburgh County Multi-Hazard Mitigation Plan (MHMP) focuses on the mitigation phase of the disaster life cycle. According to FEMA, mitigation is most effective when it's based on an inclusive, comprehensive, long-term plan that is developed before a disaster occurs. Recent reviews of grant programs have determined for every $1 spent on mitigation efforts, between $6 and $10 are saved within the community on efforts following disasters. The MHMP planning process identifies hazards, the extent that they affect the municipality, and formulates mitigation practices to ultimately reduce the social, physical, and economic impact of the hazards.

The following chapters will address the planning process used to complete updating the existing MHMP, basic community information to orient the reader to the county and the incorporated communities, a discussion of nine natural and two manmade hazards detailing their recent occurrence and risks posed to the county , a discussion of the mitigation strategy, outline of the implementation plan and a discussion of how the plan will be maintained. Images and tables in **bold** are linked within the document as well as being linked in the table of contents. By clicking on these bolded features while holding the control key, the document will automatically move to item identified in the bold text.

CHAPTER 2: PLANNING PROCESS

REQUIREMENT 44 CFR 201.6 (d)(3):

A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit it for approval within five years in order to continue to be eligible for mitigation project grant funding.

According to the Code of Federal Regulations (44 CFR §201.1(b)), the purpose of mitigation planning is for State, local, and Indian tribal governments to identify the natural hazards that impact them, to identify actions and activities to reduce any losses from those hazards, and to establish a coordinated process to implement the plan, taking advantage of a wide range of resources.

A FEMA-approved MHMP is required to apply for and/or receive project grants under the Building Resilient Infrastructure and Communities (BRIC), Hazard Mitigation Grant Program (HMGP), and Flood Mitigation Assistance (FMA). Additional detailed studies may need to be completed prior to applying for these grants even though this plan meets the requirements of Disaster Mitigation Act (DMA) 2000 and eligibility requirements of the above listed grant programs. Acronyms referenced throughout this plan are contained in **Appendix 1.**

The NFIP requires participating communities to adopt either their own MHMP or participate in the development of a multi-jurisdictional MHMP to be eligible for future mitigation funds. The Indiana Department of Homeland Security (IDHS) and the United States Department of Homeland Security (US DHS)/FEMA Region V offices administer the MHMP program in Indiana. Local jurisdictions are required to review, revise, and resubmit the MHMP every five years. The MHMP updates must demonstrate that progress has been made in the last five years to fulfill the commitments outlined in the previously approved MHMP. The update may validate the information in the previously approved MHMP or may be a major rewrite depending on community needs and planning guidance. The updated MHMP is not intended to be an annex to the previously approved plan; it stands on its own as a complete and current MHMP. The Vanderburgh County MHMP update is a multi-jurisdictional planning effort led by the Vanderburgh County EMA. This plan was prepared in partnership with Vanderburgh County (referred to in this document as county), the city of Evansville (referred to in this document as city), and the town of Darmstadt (referred to in this document as town).

Representatives from these communities attended the committee meetings, provided valuable information about their community, reviewed and commented on the draft MHMP, and assisted with local adoption of the updated plan. As each of the jurisdictions had an equal opportunity for participation and representation in the planning process, the process used to update the Vanderburgh County MHMP satisfies the requirements of DMA 2000 in which multi-jurisdictional plans may be accepted.

The Community Rating Service (CRS) program is a voluntary incentive program that recognizes and encourages community floodplain activities that exceed the minimum NFIP requirements. As a result, flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions that meet the three goals of the CRS: (1) reduce flood losses; (2) facilitate accurate insurance rating; and (3) promote education and awareness of flood insurance. Savings on flood insurance premiums are proportional to the points assigned to various activities. A minimum of 500 points is necessary to enter the CRS program and receive a 5% flood insurance premium discount. This MHMP could contribute as many as 374 points toward participation in the CRS.

Figure 2: NFIP/CRS

Throughout this Plan, activities that could count toward CRS points are identified with the NFIP/CRS logo (**Figure 2**). **Appendix 2** breaks down how this MHMP can contribute toward participation in the CRS.

2.1 SCHEDULE

REQUIREMENT §201.6(c)(1):

The plan shall document the planning process used to prepare the plan, including how it was prepared, who was involved in the process, and how the public was involved.

Preparation for the Vanderburgh County MHMP update began, when IDHS notified the county of the FEMA grant award and availability of grant funds. The plan update process began immediately upon the hiring of Chrispher B. Burke Engineering, LLC. The planning process to update the 2019 MHMP took 18 months. This did not include a review period by IDHS and FEMA for the draft MHMP update, and time for Vanderburgh County and communities to adopt the final MHMP update.

2.2 PLANNING COMMITTEE AND INTERESTED PARTIES INVOLVEMENT

In September 2024, the EMA began to assemble the planning committee members to guide the MHMP update planning process. These individuals were specifically invited to serve on the committee because they were knowledgeable of local hazards; had been involved in hazard mitigation activities; had the tools necessary to reduce the impact of future hazard events; or served as a representative on the prior planning committee in 2019. The neighboring counties of Posey, Gibson, and Warrick Counties from Indiana and Henderson County, Kentucky were invited to attend the committee meetings and were given an opportunity to provide input and feedback to the plan throughout the planning process and during draft review. No comments or corrections were received from the neighboring EMA offices. **Table 1** lists the individuals that actively participated on the committee and the entity they represented.

Table 1: Vanderburgh County MHMP Planning Committee

Name	Title	Agency/Organization	Community Representing
Nick Adams	Deputy Director	Evansville Vanderburgh County EMA	County
Tim Aldridge	Foreman	County Highway	County
Mary Arnold	Office Manager	Evansville Vanderburgh County EMA	County
Greg Bryant	Superintendent	Street Department	Evansville
Hollie Buchanan	Floodplain Administrator	Building Commission	County
Chris Cooke	EMA Board Member	Town of Newburgh Admin. Manager	Newburgh
James DiMarco	Supervisor	AMR Ambulance Service	County
Justin Dorton	Disaster Program Mgr.	Evansville Red Cross	NGO
Eric Eifert	Deputy Chief	Evansville Fire Department	Evansville
Grant Folz	Supervisor	Evansville SMD	Evansville
Anna Henson	Student	Easter Seals	Public
Rob Henson	Division Commander	Coast Guard Auxiliary	Federal Govt.
David Hurlbut	Deputy Director	Central Dispatch	Evansville
Carrie James	Director	Central Dispatch	Evansville
Tony Knight	Chief	Evansville Fire Department	Evansville
Mike Labitske	City Engineer	City of Evansville	Evansville
Kenny McElwee	Safety Officer	St. Vincent Hospital	Hospital
Lauren Norvell	Director	Evansville Climate Collaborative	Evansville
Tyler Oldham	Deaconess Safety Office	Deaconess Hospital	Hospital
Don Poggs	Regional Director	COAD/SBDC/I-REP	County

Name	Title	Agency/Organization	Community Representing
Nick Raber	Battalion Chief	Evansville Fire Department	Evansville
Ian Ryal	Safety Director	Civic Center City of Evansville	Darmstadt
Kathleen Smith	Administrative Supervisor	Central Dispatch	Evansville
Lee Turpen	Operations Manager	AMR Ambulance Service	EMS
Cliff Weaver	Director	Evansville Vanderburgh County EMA	County
Ryan Winters	Director	Ivy Tech Public Safety Emerg. Prep.	Higher Ed.

Members of the planning committee participated in the MHMP update through various committee meetings as well as outside group meetings where mitigation opportunities are supported or addressed. During the MHMP planning committee meetings, the committee:

- Reviewed the State's mitigation goals and updated the local mitigation goals.
- Reviewed the most recent local hazard data, vulnerability assessment, and maps.
- Comparatively evaluated and ranked the hazards based on probability of occurrence, impact, warning time, and duration of the hazard event
- Revisited existing (in the prior MHMP) critical and essential infrastructure and identified new critical infrastructure and local hazards.
- Evaluated the effectiveness of existing mitigation measures and identified new mitigation projects.
- Reviewed materials for public participation.

A sign-in sheet recorded those present at each meeting to document participation. Meeting agendas and summaries are included in **Appendix 3**. Members of the planning committee also reviewed a draft MHMP, provided comments and suggestions, and assisted with adoption of the Vanderburgh County MHMP update.

2.3 PUBLIC INVOLVEMENT

The Vanderburgh County EMA Director kept the public up to date about the planning process by regularly reporting on the planning effort at public county commissioner's meetings, Local Emergency Planning Committee (LEPC) meetings, and other events. A draft of the Vanderburgh County MHMP update was posted to the Vanderburgh County website Official Website of Vanderburgh County Indiana for public review and comment. A media release indicating the posting of the draft MHMP and the ability to comment was submitted for release. No comments or corrections were received from the public or the committee. The media release, web page posting, and any comments received are included in **Appendix 4**.

Neighboring Emergency Managers from Gibson, Posey, or Warrick Counties in Indiana and Henderson County, Kentucky were invited to attend both planning meetings as well as being provided with an opportunity to review the draft plan. No comments or corrections were received from the neighboring Emergency Management Agencies.

2.4 PLANS, STUDIES, REPORTS AND TECHNICAL INFORMATION

Requirement 201.6(c)(1)

The plan shall include a review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

During the development of the Vanderburgh County MHMP update, several relevant sources of information were reviewed either as a document or through discussions with local personnel. This exercise was completed to gather updated information from the development of the previous Vanderburgh County MHMP, and to assist the planning committee in developing potential mitigation measures to reduce the social, physical, and economic losses associated with hazards affecting Vanderburgh County

This planning effort includes the review of community specific plans and studies for incorporation in this plan update. For the purposes of this planning effort, the following materials (among others) were discussed and utilized:

- MHMP Vanderburgh County 2019
- Evansville-Vanderburgh County Comprehensive Plan 2015-2035, 2016
- Evansville-Vanderburgh County GIS data
- Vanderburgh County Ordinances
- Ordinances for city of Evansville and town of Darmstadt
- Watershed Management Plans for Lower Pigeon Creek WMP (49762), Highland -Pigeon WMP (00-86), and Big Creek WMP (7-6)
- Flood Insurance Rate Maps and Flood Insurance Studies – FEMA and INFIP

The above plans and ordinances target many of the same issues and plans included in this report. The MHMP has and continues to be used to inform decision makers during preparation of various documents in the county. This MHMP planning effort sought to use existing plans to inform the planning committee about mitigation actions that would support the community development, as outlined in the comprehensive plans, and to support and/or enhance existing ordinances.

Each of the incorporated communities independently operates a building and/or planning program to ensure construction is completed in accordance with local and state building and zoning laws. The county building and planning departments likewise address code compliance and zoning needs of the unincorporated communities and areas within Vanderburgh County.

In addition to local agencies and offices such as those listed above, several regional and state agencies were contacted and subsequently provided data for this planning effort. Those contacts, and the information they provided, include:

- Indiana Department of Natural Resources, Division of Water – *Flood insurance policies, claims, and payment information; NFIP Participation; DNR listed Dams and associated records; Dam Breach Inundation App; and IN Floodplain Information Portal.*
- Indiana Department of Natural Resources, Other Divisions – *Mining Records*
- Indiana Geologic Survey and Water – *Earthquakes in Indiana; Liquefaction Potential Map: Karst Regions and Maps of Karst locations*
- Indiana Geographic Information Office - *IndianaMap*
- Indiana Department of Homeland Security – *Current Fire and Building Code Information*
- FEMA, Region V – Repetitive loss structure counts and insurance payments and FIRM Maps and Flood Studies

- Midwest Regional Climate Center – Climate Trends; County specific climate reports
- National Weather Service –- Confirmation of WSSI tool; local storm reports; weather event photos.

The CRS program credits NFIP communities with a maximum of 170 points: up to 15 points for organizing a planning committee composed of staff from various departments; up to 120 points for involving the public in the planning process; and up to 35 points for coordinating among other agencies and departments to resolve common problems relating to flooding and other known natural hazards.

CHAPTER 3: DATA GATHERING

Figure 3: Vanderburgh County Location

Vanderburgh County was formed on January 7, 1818, and is named after Captain Henry Vanderburgh, Revolutionary War veteran and judge for the Indiana Territory.

Located on the banks of the Ohio River, Vanderburgh County has low rolling hills to level farmlands Vanderburgh was the 82nd county in Indiana. It is the 8th largest by population in 2020 and 8th smallest in Indiana by area.

The Evansville Regional Economic Partnership (E-REP) was recently awarded a $60,000 grant to develop a Comprehensive Economic Development Strategy (CEDS) for Vanderburgh, Posey, Warrick, and Gibson counties. This is a strategy-driven plan for regional economic development to be key to guide towards becoming more resilient, equitable, and regionally competitive. In addition, E-REP work together on an Ohio River Vision and Strategic Plan which is a regional effort to strategize around the health and vibrancy of the Ohio River frontage, and to leverage the river for the long-term prosperity of the regional communities. The project is focused on increasing activation and investment in the region for economy and quality of place resources, such as riverfront parks and public spaces, traffic planning, and development potential. Although the Evansville region has a diverse economy with key industries such as advanced manufacturing and life science, Over the past five years, Vanderburgh County employment has declined 3.4% from 95,341 in 2018 to 92,142 in 2023.

Approximately 10,004 people living in Vanderburgh County commute to work outside of the county with the majority traveling to Gibson County for work. An additional 27,493 people commute into Vanderburgh County for employment using local highways. Warrick County is the greatest contributor to the Vanderburgh County workforce. Disaster events such as flooding, and winter storms can create a number of cascading impacts for the commuting work force as travel times increase or come to a standstill. Loss of income due to the inability to reach the workplace can result in financial difficulties for the workforce.

The population of Vanderburgh County has a median age of 38.9 years, only 0.6 years older than the average age of the State of Indiana. Of the 77,198 households in 2023 in Vanderburgh County 46,199 (60%) do not have children, and 42.3% of the population is 45 years old and older. As the population ages our ability to effectively respond to disasters can be impaired.

Vanderburgh County land is predominantly classified as agriculture 44% (39% Cultivated Crops and 5% Pasture Land and Hay), developed land at 37% (13% Low Intensity, 9% Medium Intensity, 12% Open Space and 3% High Intensity), 15% Forest (14% Deciduous Forest, and, 1% Mixed Forest), and 4% is Open Water and Wetlands. The total area of Vanderburgh County is 236.33 square miles of which 233.48 square miles is land and 2.86 square miles is water. It is divided into eight townships, and the City of Evansville serves as the county seat. **Figure 3** shows location of the county within the State of Indiana.

The top 10 employers within Vanderburgh County according to Hoosiers by the Numbers are:

1. Deaconess Health System
2. Toyota of Indiana
3. Berry Global
4. Ascension St. Vincent
5. Kaiser Aluminum
6. Mead Johnson Nutrition
7. AstraZeneca
8. Charles Matin Hall
9. Alcoa
10. Ameriqual

3.1 CRITICAL AND ESSENTIAL INFRASTRUCTURE

REQUIREMENT §201.6(c)(2)(ii)(A):

The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas….

Critical facilities, critical infrastructure, and essential facilities are the assets, systems, and networks, whether physical or virtual, so vital to local governments and the United States that their incapacitation or destruction would have a debilitating effect on security, economic security, public health or safety, or any combination thereof.

Figure 4: Vanderburgh County Courthouse

These structures are vital to the community's ability to provide essential services and protect life and property; are critical to the community's response and recovery activities; and/or are the facilities, the loss of which, would have a severe economic or catastrophic impact. The operation of these facilities becomes especially important following a hazard event.

Utilizing information from the Evansville-Vanderburgh County EMA and GIS Department alongside FEMA data, **Table 2** shows the 654 critical and essential facilities included in this MHMP update. There may be insufficient data to accurately list all critical and essential facilities in the county. **Figure 4** shows the Vanderburgh County Courthouse as one of the critical facilities. The following list identifies the number of each of the critical and essential facilities included.

Table 2: Critical and Essential Facilities

#	Facility Type	#	Facility Type
2	Airports	4	Hospital
29	Civic Location	10	Large Gathering Places
21	Community Centers/Shelters	2	Military Installation
24	Dams	56	Parks
147	Daycares	4	Police Station
2	Emergency Management	64	Schools
1	EMS/Ambulance Service	169	Tier II Facilities
86	Energy Source	3	Wastewater Treatment Plant
23	Fire Stations	7	Water Towers

Information provided by the EMA, Evansville-Vanderburgh County GIS, and the MHMP planning committee members was utilized to identify the types and locations of critical structures throughout Vanderburgh County. Draft maps were provided to the EMA, along with the planning committee for their review and all comments were incorporated into the maps and associated databases.

Exhibit 1, located after the narrative chapters of this document, illustrates the critical infrastructure identified throughout the unincorporated Vanderburgh County and the individual municipalities. **Appendix 5** lists the critical structures in Vanderburgh by facility type. Non-critical structures include residential, industrial, commercial, and other structures that do not meet the definition of a critical facility and are not required for a community to function. The development of this MHMP focused only on critical and essential structures; non-critical structures are neither mapped nor listed.

3.2 COMMUNITY CAPACITY

REQUIREMENT §201.6(c)(3):

The plan shall document each participant's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs.

In Indiana, the Fire Prevention and Building Safety Commission is tasked with the establishment and maintenance of fire and building safety codes. The commission also reviews variance requests, code modification proposals and orders enforcing the fire and building safety law. Only the commission is permitted to adopt codes for the state. Local communities may not adopt editions other than those adopted by the state. All jurisdictions of the state are required to follow the state adopted fire safety and building laws.

Local Building Officials serve as the local authority for building construction matters within their jurisdiction. In Vanderburgh County, the Evansville-Vanderburgh County Area Plan Commission (APC) is the local agency designated to carry out land use planning for the City of Evansville, Vanderburgh County, and the Town of Darmstadt. **Appendix 6** lists the APC official as well as other key positions in each jurisdiction.

Each of the incorporated communities and the county have ordinances to regulate building, zoning, stormwater, burning, general community governance and floodplains. None of the communities nor the county currently have a water conservation ordinance. Vanderburgh County and community leaders take advantage of grant funding to help address non-budgeted activities. The Health Department, the hospitals, and county EMS services work together to ensure community health and safety needs are met. The planning committee did identify a need to coordinate the storm debris removal efforts with the utility providers better. Both the government agencies as well as the utilities work to remove post event debris but could benefit from better coordination of efforts. Such a unified effort would address community needs and allow for innovative solutions to challenges encountered.

The State of Indiana is presently working with subject matter experts to update the current fire and building safety codes to more recent International Code Council versions. Due to the hearing and adoptions processes this is a multi-year effort. It is hoped that within the next five years updated fire safety and building codes will be adopted to assist the community in becoming more resilient. IT is also anticipated local floodplain ordinances will be required to be updated as the state model ordinance language is updated reflecting changes in national regulations and to maintain good standing in the CRS Program.

CHAPTER 4: RISK ASSESSMENT

REQUIREMENT §201.6(c)(2):

The risk assessment shall provide the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessment must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

A risk assessment measures the potential loss from a hazard incident by assessing the vulnerability of buildings, infrastructure, and people in a community. It identifies the characteristics and potential consequences of hazards, how much of the community may be affected by a hazard, and the impact on community assets. The risk assessment conducted for Vanderburgh County and the communities within is based on the methodology described in the Local Mitigation Planning Handbook published by FEMA in 2023 and is incorporated into the following sections:

Section 4.1: Hazard Identification lists the natural, technological, and political hazards selected by the panning committee as having the greatest direct and indirect impact on the county as well as the system used to rank and prioritize the hazards.

Section 4.2: Hazard Profile for each hazard, discusses 1) historic data relevant to the county where applicable; 2) vulnerability in terms of number and types of structures, repetitive loss properties (flood only), estimation of potential losses, and impact based on an analysis of development trends; and 3) the relationship to other hazards identified by the planning committee.

Section 4.3: Hazard Summary provides an overview of the risk assessment process; a table summarizing the relationship of the hazards; and a composite map to illustrate areas impacted by the hazards.

4.1 HAZARD IDENTIFICATION

4.1.1 HAZARD SELECTION

The MHMP planning committee reviewed the list of natural and technological hazards in the 2019 Vanderburgh County MHMP and discussed recent events and the potential for future hazard events. The committee identified those hazards which affected Vanderburgh County and each community selecting the hazards to study in detail as part of this planning effort. As shown in **Table 3**, these hazards include dam and levee failure; drought; earthquake; extreme temperature; fires and wildfire; flood; hail, thunder, and wind storms; hazardous materials incident; landslide, land subsidence, and fluvial erosion; winter storms and ice; and tornado. Since the COVID pandemic, the Health Department continues to develop plans and policies to better respond to and reduce the spread of both routine human disease-causing organisms as well as zoonotic diseases and changes in that field. For this reason, these biologic hazards are not addressed in this plan. Additionally, law enforcement sensitive issues such as terrorism, explosive devices, and civil unrest detection and mitigation are addressed in separate local law enforcement-controlled plans.

Table 3: Hazards Selected

Type of Hazard	List of Hazards	MHMP	
		2019	2025
Natural	Drought	Yes	Yes
	Earthquake	Yes	Yes
	Extreme Temperature	Yes	Yes
	Fires and Wildfire	Yes	Yes
	Flood	Yes	Yes
	Hail, Thunder, and Wind Storm	Yes	Yes
	Landslide, Land Subsidence, and Fluvial Erosion	No	Yes
	Winter Storm and Ice	Yes	Yes
	Tornado	Yes	Yes
Technological	Dam and Levee Failure	Yes	Yes
	Hazardous Materials Incident	No	Yes

4.1.2 HAZARD RANKING

The planning committee ranked the selected hazards in terms of importance and potential for disruption to the community using a modified version of the CPRI. The CPRI is a tool by which individual hazards are evaluated and ranked according to an indexing system. The CPRI value (as modified by Burke) can be obtained by assigning varying degrees of risk probability, magnitude/severity, warning time, and the duration of the incident for each event, and then calculating as index value based on a weighted scheme. For ease of communication, simple graphical scales are used.

Probability:

Probability is defined as the likelihood of the hazard occurring over a given period. The probability can be specified in one of the following categories:

- Unlikely – incident is possible, but not probable, within the next 10 years
- Possible – incident is probable within the next five years
- Likely - incident is probable within the next three years
- Highly Likely – incident is probable within the next calendar year

Magnitude / Severity:

Magnitude/severity is defined by the extent of the injuries, shutdown of critical infrastructure, the extent of property damage sustained, and the duration of the incident response. The magnitude can be specified in one of the following categories:

- Negligible – few injuries OR critical infrastructure shutdown for 24 hours or less OR less than 10% property damaged OR average response duration of less than six hours
- Limited – few injuries OR critical infrastructure shut down for more than one week OR more than 10% property damaged OR average response duration of less than one day
- Significant – multiple injuries OR critical infrastructure shut down of at least two weeks OR more than 25% property damaged OR average response duration of less than one week
- Critical – multiple deaths OR critical infrastructure shut down of one month or more OR more than 50% property damaged OR average response duration of less than one month

Warning Time:

Warning time is defined as the length of time before the event occurs and can be specified in one of the following categories:

- More than 24 hours
- 12-24 hours
- 6-12 hours
- Less than six hours

Duration:

Duration is defined as the length of time that the actual event occurs. This does not include response or recovery efforts. The duration of the event can be specified in one of the following categories:

- Less than six hours
- Less than one day
- Less than one week
- Greater than one week

Calculating the CPRI:

The following calculation illustrates how the index values are weighted and how the CPRI value is calculated. CPRI = (Probability x 0.45) + (Magnitude/Severity x 0.30) + (Warning Time x 0.15) + (Duration x 0.10). For the purposes of this planning effort, the calculated risk is defined as:

- **Low** if the CPRI value is between 1 and 2
- **Elevated** if the CPRI value is between 2 and 3
- **Severe** if the CPRI value is between 3 and 4

The CPRI value provides a means to assess the impact of one hazard relative to other hazards within the community. A CPRI value for each hazard was determined for each incorporated community in Vanderburgh County, and then a weighted CPRI value was computed based on the population size of each community. **Table 4** presents each community, population, and the weight applied to individual CPRI values to arrive at a combined value for the entire county. Weight was calculated based on the average percentage of each community's population in relation to the total population of the county. Thus, the results reflect the relative population influence of each community on the overall priority rank.

Table 4: Determination of Weighted Value for Communities

Community	Population (2024)	% of Total Population	Weighted Value
Vanderburgh County (w/o incorporated communities)	63,574	35.2%	0.352
City of Evansville	115,395	64.0%	0.640
Town of Darmstadt	1,418	0.8%	0.008
Total	**180,387**	**100.0%**	**1.000**

4.2 HAZARD PROFILES

The hazards studied for this report are not equally threatening to all communities throughout Vanderburgh County. While it would be difficult to predict the probability of an earthquake or tornado affecting a specific community, it is much easier to predict where the most damage would occur in a known hazard area such as a floodplain or near a facility utilizing an Extremely Hazardous Substance (EHS). The magnitude and severity of the same hazard may cause varying levels of damage in different communities.

Four FEMA major disasters and one FEMA Emergency Declaration were declared in Indiana over the past six years. Vanderburgh County was included in three of the disaster and one emergency declaration. The full list of disaster declarations can be seen in **Appendix 7**. The county name is bolded where it was included in the declaration.

In addition, the US SBA declared 29 Indiana and neighboring state events as disasters eligible for US SBA loans. Of all the declarations, Vanderburgh County was included in three. The full list of all disasters and emergency declarations can be found in **Appendix 7**.

This section describes each of the hazards identified by the planning committee for detailed study as a part of this MHMP Update. The discussion is divided into the following subsections:

- **Hazard Overview** provides a general overview of the causes, effects, and characteristics that the hazard represents.
- **Historic Data** presents the research gathered from local and national courses on the hazard extent and lists historic occurrences and probability of future incident occurrence.
- **Assessing Vulnerability** describes, in general terms, the current exposure, or risk, to the community regarding potential losses to critical infrastructure and the implications to future land use decisions and anticipated development trends. Impacts on specific populations of communities are also addressed within this section.
- **Relationship to Other Hazards** explores the influence one hazard may have upon another.

4.2.1 DROUGHT

Overview

Drought, in general, means a moisture deficit extensive enough to have social, environmental, or economic effects. Drought is not a rare and random climate incident; rather, it is a normal, naturally recurring feature of climate. Drought may occur in all climactic zones, but its characteristics vary significantly from one region to another. Drought is a temporary aberration and is different from aridity, which is restricted to low rainfall regions.

There are four academic approaches to examining droughts; these are meteorological, hydrological, agricultural, and socio-economic. Meteorological drought is based on the degree, or measure, of dryness compared to a normal, or average amount of dryness, and the duration of the dry period. Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply. Agricultural drought is related to agricultural impacts; and focuses on precipitation shortages, differences between actual and potential evapo-transpiration, soil water deficits, reduced ground water or reservoir levels, and crop yields. Socioeconomic drought relates the lack of moisture to community functions in the full range of societal functions, including power generation, the local economy, and food source.

Figure 5 from the U.S. Drought Monitor, describes the rationale to classify the severity of droughts.

Category	Description	Possible Impacts
D0	Abnormally Dry	Going into drought: • Short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: • Some lingering water deficits • Pastures or crops not fully recovered
D1	Moderate Drought	• Some damage to crops, pastures. • Streams, reservoirs, or wells low. • Some water shortages developing or imminent. • Voluntary water-use restrictions requested
D2	Severe Drought	• Crops or pasture losses likely • Water shortages common • Water restrictions imposed
D3	Extreme Drought	• Major crop/pasture losses • Widespread water shortages and/or restrictions
D4	Exceptional Drought	• Exceptional and widespread crop/pasture losses • Shortages of water in reservoirs, streams, and wells creating water emergencies

Figure 5: U.S. Drought Monitor Classification Descriptions

Location

As rain patterns change there are periodic times when the county is deemed "Abnormally Dry" or D0. Most of these instances are resolved quickly as sufficient rain arrives and the soil rehydrates. On occasion, the rain is insufficient to address the dryness and weather conditions cause the soil to further dry, stressing crops and reducing lake levels. Drought may occur in all

climactic zones, but its characteristics vary significantly from one region to another. Although drought declarations may be made for portions of the county, all of the county is vulnerable to the impacts of drought.

Extent and History

Drought is a temporary aberration and is different from aridity, which is restricted to low rainfall regions. Error! Reference source not found., developed based on data gathered from the U.S. D rought Monitor, shows the distribution of weeks in drought over the January 1, 2019, through December 1, 2025, period.

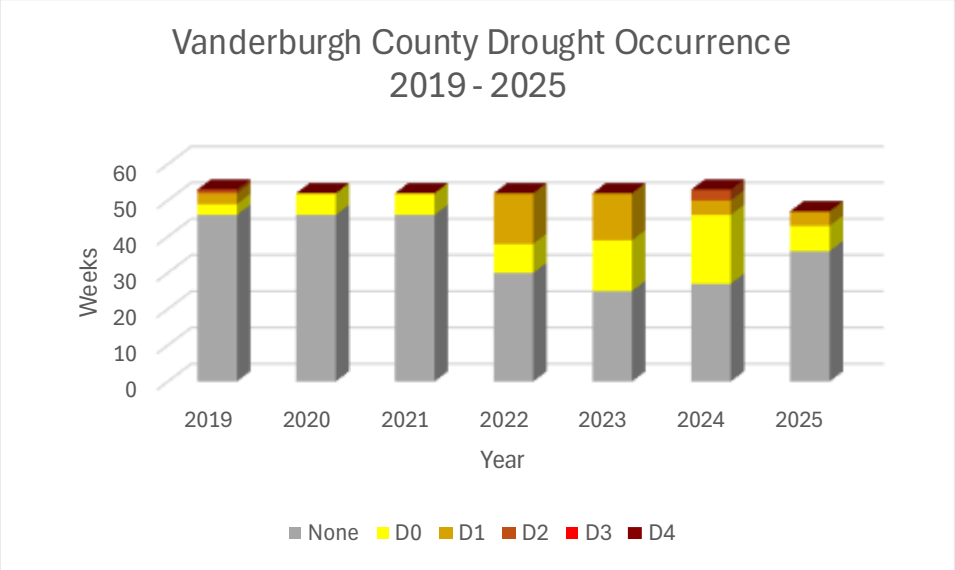


Figure 6: Drought Occurrence in Vanderburgh County 2019-2025

Probability

The planning committee, utilizing the CPRI, determined the overall risk of drought throughout Vanderburgh County is "Elevated." The impact of drought was determined to be the same for all communities and unincorporated areas throughout the county due to the possible agricultural impacts and impacts to water wells. The committee agreed that a drought ranges from "Likely" to "Highly Likely" (to occur within the next year to three years), and the magnitude of drought is anticipated to be "Limited." Further it is anticipated that with the enhanced weather forecasting abilities, the warning time for a drought is 12 hours to greater than 24 hours and the duration will be greater than one week. A CPRI summary is shown in **Appendix 8**

According to the National Drought Mitigation Center, scientists have difficulty predicting droughts more than one month in advance due to numerous variables such as precipitation, temperature, soil moisture, topography, and air-sea interactions. Further anomalies may also enter the equation and create more dramatic droughts or lessen the severity of droughts.

Future Conditions

Climate change has a significant role in the drought conditions. **Figure 7** charts the annual maximum temperatures and shows trends utilizing data from the National Centers for Environmental Information (NCEI).

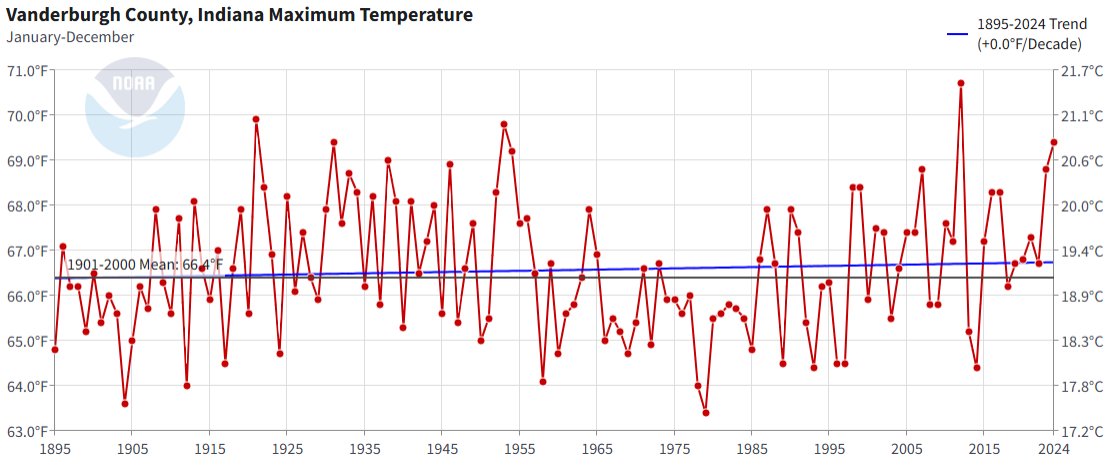


Figure 7: Annual Maximum Temperatures from 1895 - 2025

According to NOAA NCEI the State Climate Summary for Indiana the following observations have been noted based upon climate change:

- The temperatures have risen almost 2°F since the middle of the 19th Century.
- Temperatures in the 2000's have been higher than any other historical period except during the most recent interglacial period, or over 100,000 years ago.

This is also verified in the Indiana Climate Change Assessment report from Purdue University. "This assessment documents that significant changes in Indiana's climate have been underway for over a century, with the largest changes occurring in the past few decades." These projections suggest that the trends that are already occurring will continue, and the rates of these changes will accelerate. They indicate that Indiana's climate will warm dramatically in the coming decades, particularly in summer. Both the number of hot days and the hottest temperatures of the year are projected to increase markedly.

The assessment also notes that seasonal shifts in precipitation may lead to seasonal short-term droughts. In either scenario, changes in precipitation are not anticipated to relieve the area of a probability of a drought occurring.

Prior to expanding municipalities, provisions and considerations should be given regarding the potential additional demand for both water usage and fire response efforts. Following such expansion or development plans, alternative water sources should be explored.

Vulnerability

This type of hazard will generally affect entire counties and even multi-county regions at one time. Within Vanderburgh County, direct and indirect effects from a lengthy period of drought may include:

Direct Effects

Figure 8: Crop Failure Caused by Drought

- Urban, developed areas, and local wildlife areas may experience revenue losses from decreased tourism; landscaping companies, golf courses revenue losses due to lack of growth and plant death; restrictions on industry cooling and processing demands; reduced incomes for businesses dependent on crop yields, and increased potential for fires.
- Rural areas within the county may experience revenue losses from reductions in decreased livestock and crop yields as well as increased incidence of field fires (**Figure 8**).
- Loss of tree canopy due to increased susceptibility to pests and diseases.
- Citizens served by drinking water wells or surface water supplies may be impacted during low water periods and may require drilling of deeper wells or loss of water service for a period.
- According to Purdue's Indiana Climate Change Impacts Assessment, climate change will cause temperatures to rise, and rainfall patterns to shift, which will make managing multiple water needs increasingly difficult. This could result in more drought conditions.

Indirect Effects:

- Loss of income of employees from businesses and industry affected; loss of revenue to support services (food service, suppliers)
- Loss of revenue from recreational or tourism sectors associated with reservoirs, streams, and other open water venues.
- Lower yields from domestic gardens result in increased demand for purchasing produce and increased domestic water usage for landscaping.
- Increased demand for emergency responders and firefighting resources due to grass fires and increased medical calls for people having respiratory issues because of increased dust amounts.
- Drought conditions could make it more difficult for the underserved population as many of them do not have air conditioning, which makes breathing more difficult and air quality conditions can become compromised.

Potential Impacts

It is difficult to estimate the potential losses associated with a drought for Vanderburgh County because of the nature and complexity of this hazard and the limited data on past occurrences. However, for the purpose of this MHMP update, a scenario was used to estimate the potential crop loss and associated revenue lost due to a drought similar to that experienced during the drought of record from 1988. In 2023,Vanderburgh County produced approximately 10.38M bushels of corn and 2.58M bushels of soybeans, as reported by the United States Department of Agriculture (USDA) National Agricultural Statistics Service. Using national averages of $4.70 per bushel of corn and $12.80 per bushel of soybeans, the estimated crop receipts for 2023 would be $81.81M. Using the range of crop yield decreases reported in 1988 and 1989, just after the 1988 drought period (50%-86%) and assuming a typical year, economic losses could range between $40.9M-$70.4M; depending on the crop produced and the market demand.

Relationship to Other Hazards

Discussions with the planning committee were held regarding the similar effects of prolonged periods of extreme heat and the similar impacts that may be experienced during these times. Planning and mitigation efforts for one hazard may benefit the other. It is anticipated that rural areas of the county may be more susceptible to brush and rangeland or woodland fires during a drought, while urban areas may experience these impacts in areas where several abandoned buildings or overgrown lots exist, and this may lead to increased losses associated with a fire.

4.2.2 EARTHQUAKE

Overview

An earthquake is a sudden, rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface. Earthquakes strike suddenly, without warning. Ground shaking from earthquakes can collapse buildings and bridges; disrupt gas, electricity, and phone service; and sometimes trigger landslides, avalanches, flash floods, fires, and huge destructive ocean waves (tsunamis). Buildings with foundations resting on unconsolidated landfill and other unstable soil, and trailers and homes not tied to their foundations are at risk because they can move off their mountings during an earthquake. When an earthquake occurs in a populated area, it may cause deaths, injuries, and extensive property damage.

Location

There are 45 states and territories in the United States at moderate to very high risk from an earthquake, and they are located in every region of the country (**Figure 9**). California experiences the most frequent damaging earthquakes; however, Alaska experiences the greatest number of large earthquakes – most located in uninhabited areas. The largest earthquakes felt in the United States were along the New Madrid Fault in Missouri, where a three-month long series of quakes from 1811 to 1812 occurred over the entire Eastern United States, with Missouri, Tennessee, Kentucky, Indiana, Illinois, Ohio, Alabama, Arkansas, and Mississippi experiencing the strongest ground shaking. Several smaller historic faults are located throughout the state of Indiana.

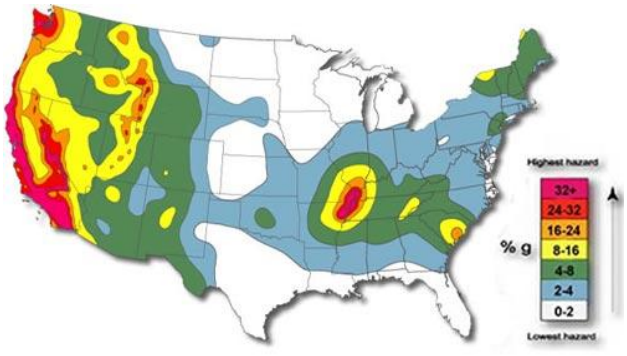


Figure 9: Earthquake Risk Areas in the U.S.

Extent and History

Vanderburgh County is in a very seismically active area. With numerous faults from the Wabash Valley Fault System in neighboring Posey County, Vanderburgh County has experienced numerous earthquakes historically. The county has been preparing for earthquakes stemming from the Wabash Seismic Zone, as well as the New Madrid Fault Zone.

According to Indiana Geological Survey, the three most recent large earthquakes are numbers 67, 53, and 44 shown in **Figure 10.** This figure depicts the location of those nearby earthquakes and magnitude. Number 67 occurred on December 7, 2000,

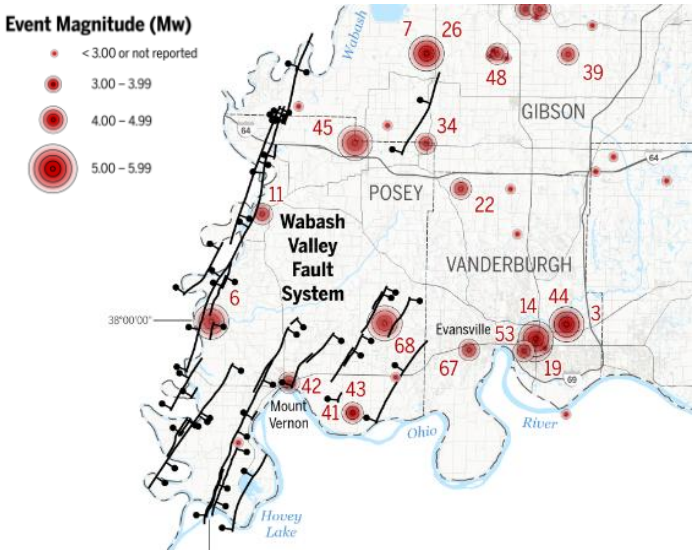


Figure 10: Location and Size of Earthquakes near Vanderburgh County

west of Evansville and was measured at a magnitude M3.84. The USGS received no reports of damage. Of the remaining two larger earthquakes in the county, number 44 was the greatest at a magnitude M4.37 in 1925. This larger quake was felt throughout Indiana as well as Kentucky, Illinois, and Ohio, however, resulted in very little property damage, mainly broken dishes, and a single cracked wall in one home. The most recent earthquake reported in Indiana was on August 9, 2025, and was centered near Cynthiana, Indiana in Posey County and measured a magnitude 2.6.The most recent stronger quake was felt as far north as Chicago, Illinois and as far east as Cincinnati, Ohio on June 17, 2021in Bloomingdale, IN. With a magnitude of 3.8 several reports included descriptions of shaking buildings and feeling the tremors. No injuries or severe damage was reported due to this earthquake.

Additionally, some soils in Indiana are highly susceptible to liquefaction during earthquake conditions. According to the USGS, Liquefaction takes place when loosely packed, water-logged sediments at or near the ground surface lose their strength in response to strong ground shaking. Liquefaction occurring beneath buildings and other structures can cause major damage during earthquakes. Some older riverbeds within Vanderburgh County are shown with a high potential for liquefaction. Areas near the Ohio River also have a high potential for liquefaction, as shown in **Figure 11**. Vanderburgh County communities shown with high liquefaction potential may sustain greater damage during an earthquake since building foundations may not support the structures.

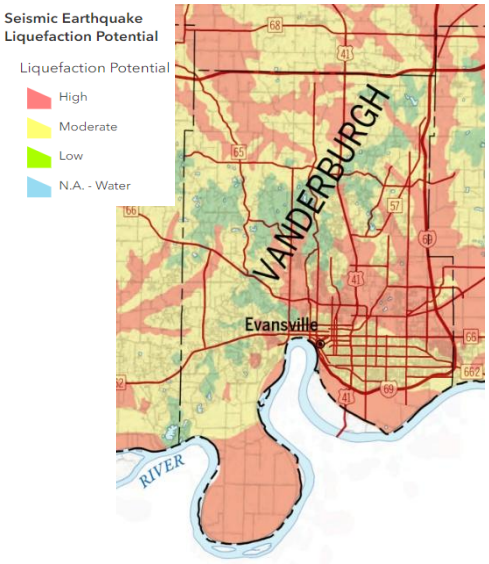


Figure 11: Vanderburgh County Liquefaction Potential Areas

Probability

Based on historical earthquake data, local knowledge of previous earthquakes, and that Vanderburgh County has been directly impacted by a recent earthquake, the committee determined that the probability of an earthquake occurring in Vanderburgh County or any of the communities is "Possible" to "Highly Likely". Should an earthquake occur, the impacts associated with this hazard are anticipated to be "Limited" to "Significant" with the Darmstadt anticipating the greatest impacts. As with all earthquakes, it was determined that the residents of Vanderburgh County would have little to no warning time (less than six hours) and that the duration of the event would be expected to be less than six hours to less than a day with aftershocks lasting longer. A summary of the CPRI is shown in **Appendix 8**.

Future Conditions

While the occurrence of an earthquake near Vanderburgh County may not be the highest priority hazard studied for the development of the plan, it is possible that residents, business owners, and visitors may be affected should an earthquake occur along the New Madrid and Wabash Valley zones or within the state. For that reason, Vanderburgh County should continue to provide education and outreach regarding earthquakes and earthquake insurance along with education and outreach for other hazards. As the county and the communities within grow and develop, the proper considerations for the potential of an earthquake to occur may help to mitigate social, physical, or economic losses in the future.

It can be anticipated that while all structures in Vanderburgh County will remain at risk of earthquake damage and effects, new construction or redevelopment may reduce the overall risks. As redevelopment or growth occurs, the new construction may be significantly sturdier. Further, as blighted or abandoned areas are addressed, those communities and the county are less susceptible to economic and physical damage associated with earthquakes. Since the last planning effort, no significant development has occurred within the county.

Vulnerability

Earthquakes generally affect broad areas and potentially many counties at one time. Within Vanderburgh County, direct and indirect effects from an earthquake may include:

Direct Effects:

- Urban areas may experience more damage due to the number of structures, the multi-story nature of the structures, and critical infrastructure (fire houses, cell phone towers, health care facilities) located in these areas.
- Rural areas may experience losses associated with agricultural structures such as barns and silos.
- Bridges buried utilities (gas lines, waterlines, pipelines), and other infrastructure may be affected throughout the county and municipalities.
- The homeless or underserved population will need to be checked on, especially if they seek shelter under bridges or structures that are not stable.

Indirect Effects:

- Vanderburgh County may be called upon to provide emergency response personnel to assist in the areas with more damage.
- Provide shelter for residents of areas with more damage.
- Delays in delivery of goods or services originating from areas more affected by the earthquake or originating at locations beyond the damaged areas, but that would have to be re-routed to avoid damaged areas.

Potential Impacts

To determine the losses associated with an earthquake, the HAZUS-MH software was utilized in the Vanderburgh County MHMP update. HAZUS-MH is a nationally standardized risk modeling methodology which identifies areas with high risk for natural hazards and estimates physical, economic, and social impacts of earthquakes, hurricanes, floods, and tsunamis. For this plan, an arbitrary earthquake scenario placed a magnitude 5.0 within the county.

Per the HAZUS-MH scenario noted above the following is anticipated to be:

- Total economic losses are anticipated to be near $6.46B with moderate damage to approximately 16,467 buildings, which is over 22% of the buildings, of which 1,097 are anticipated to be damaged beyond repair.
- There are 101 critical facilities (seven hospitals, 61 schools, two EOCs, seven police stations, and 24 fire stations) with 36 facilities having at least 50% or more damage and 28 facilities with functionality of greater than 50% on day one.
- The highway would have no bridges or segments with moderate damage and all bridges, and road segments would have greater than 50% functionality on day 1.
- All other transportation segments (railways, buses, ports, and airports) would be expected to have moderate damage but would have greater than 50% functionality after day 1.

- The utilities (one potable water, three wastewater, two electrical power, and ten communications) would have at least one potable water, two wastewater, two electrical power, and eight communications with at least moderate damage. There would be 276 water leaks, 138 wastewater leaks, one natural gas leak and 69 water breaks, and 35 wastewater breaks.
- There would be 1.45M tons of debris generated of which 42% would be brick/wood and the remaining would be reinforced concrete/steel. It would take 58,080 truckloads (25 tons/truck).
- The model estimates 2,090 households will be displaced and 1,107 people will seek temporary shelter.
- Residential occupancies would be anticipated to sustain the largest level of damage, representing 46% of total damage.
- No fires due to the earthquake were anticipated.

The HAZUS-MH model computes anticipated economic losses for the hypothetical earthquake due to direct building losses and business interruption losses. Direct building losses ($6.25B) are the costs to repair or to replace the damage caused to the building and contents, while the interruption losses ($1.30B) are associated with the inability to operate a business due to the damage sustained. Business interruption losses also include the temporary living expenses for those people displaced from their homes.

The HAZUS-MH Earthquake Model allows local building data to be imported into the analysis. However, these local data are imported as "general building stock," meaning that the points are assigned to a census tract rather than a specific XY coordinate. HAZUS performs the damage analysis as a county wide analysis and reports losses by census tract. While the results of the hypothetical scenario appear to be plausible, care should be taken when interpreting these results.

Relationship to Other Hazards

Hazardous materials incidents may occur because of damage to material storage containers or transportation vehicles involved in road crashes or train derailments. Further, dam failures, levee breaks, or landslides may occur following an earthquake or associated aftershocks due to the shifting of the soils in these hazard areas. These types of related hazards may have greater impacts on Vanderburgh County communities than the earthquake itself. It is not expected that earthquakes will be caused by other hazards studied within this plan.

4.2.3 EXTREME TEMPERATURE

Overview

Extreme Heat

Extreme heat is defined as a temporary elevation of average daily temperatures that hover 10˚F or more above the average high temperature for the region for the duration of several weeks. According to the NWS, "The Heat Index or the "Apparent Temperature" is an accurate measure of how hot it really feels when the Relative Humidity is added to the actual air temperature." To find the Heat Index Temperature, refer to the Heat Index Chart in **Figure 12**. As an example, if the air temperature is 96°F and the relative humidity is 65%, the heat index – how hot it feels – is 121°F.

NOAA's National Weather Service

Heat Index

Temperature (°F)

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

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Figure 12: NWS Heat Index Chart

The NWS has three levels of Excessive Heat Notifications:

1. A Heat Advisory - means that temperatures of at least 100°F or Heat Index values of at least 105°F are expected.
2. An Excessive Heat Watch means that Heat Index values are expected to reach or exceed 110°F and not fall below 75°F for at least a 48-hour period.
3. An Excessive Heat Warning means that Heat Index values are expected to reach or exceed 110°F and not fall below 75°F for at least a 48-hour period, beginning in the next 24 hours. A warning may also be issued for extended periods with afternoon heat index values of 105°F-110°F.

It is important to also note that these heat index values were devised for shady, light wind conditions. Exposure to full sunshine may increase heat index values by up to 15°F. Further, high winds, particularly with very hot, dry air, can also be extremely hazardous.

As **Figure 13** indicates, there are four cautionary categories associated with varying heat index temperatures. Each category provides a heat index range along with effects on the human body. People with underlying health issues, the very old or very young may be impacted at lower temperatures since their systems are less likely to be able to compensate for the heat and humidity.

Classification	Heat Index	Effect on the body
Caution	80°F - 90°F	Fatigue possible with prolonged exposure and/or physical activity
Extreme Caution	90°F - 103°F	Heat stroke, heat cramps, or heat exhaustion possible with prolonged exposure and/or physical activity
Danger	103°F - 124°F	Heat cramps or heat exhaustion likely, and heat stroke possible with prolonged exposure and/or physical activity
Extreme Danger	125°F or higher	Heat stroke highly likely

Figure 13: Extreme Heat Effects by Heat Index

Additionally, as seen in the minimum temperature graphic seen in **Figure 30** shows that over time the minimum temperature in the county is increasing. This increase will exacerbate any heat as it lessens the cooling capacity of the nighttime. This might put more stress on people at night as they won't be able to cool off as much.

Extreme Cold

Extreme cold is defined as a temporary, yet sustained, period of extremely low temperatures. The jet stream winds are strongest during the winter months when continental temperature extremes are greatest. When the jet stream pulls arctic cold air masses over portions of the United States, temperatures can drop below 0° F for one week or more. Sustained extreme cold poses physical danger to all individuals in a community and can affect infrastructure function as well.

Wind Speed (MHP) \ Temperature (F)	30	25	20	15	10	5	0	-5	-10	-15	-20	-25
5	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40
10	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47
15	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51
20	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55
25	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58
30	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60
35	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62
40	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64
45	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65
50	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67
55	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68
60	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69
Frostbite Occurs in 120 minutes or less							Frostbite occurs in 30 minutes or less					
Frostbite occurs in 10 minutes or less							Frostbite occurs in 5 minutes or less					

Figure 14: Wind Chill Guide

In addition to strictly cold temperatures, the wind chill temperature must also be considered when planning for extreme temperatures. The wind chill temperature, according to the NWS, is how cold people and animals feel when outside and it is based on the rate of heat loss from

exposed skin. **Figure 14** presents the Wind Chill Chart and shows how the same ambient temperature may feel vastly different in varying wind speeds.

Extent and History

The effects of extreme temperatures extend across large regions, typically affecting several counties, or states, during a single event. According to the NCEI for the period of January 1, 2019, to December 1, 2025, there have been:

- 20 excess heat events
- Seven extreme cold/wind chill

The most recent reports from NCEI include a month long stretch of heat, beginning June 26, 2024, with each week having at least one to two days where heat index values rose above 105˚F. Air temperature highs remained in the 90's with dewpoints in the mid 70's and higher. The extreme heat closed out on July 30 through August 1, 2024, where heat index values within the county hit 109°F at Evansville Airport.

Most recently, the Paducah NWS reported that an arctic front moved across the region January 19 through 22, 2025. Wind chills dropped to -5˚F as the cold air combined with breezy conditions. Similarly, February 19 and 20, 2025, a Siberian airmass brought sub-freezing temperatures after a major snowstorm. Northwest winds 6-11 mph coming across the fresh snowpack resulted in wind chill temperatures ranging from -5 to -8˚F. Warming shelters were opened across southwest Indiana to assist community members remain warm. No damage or losses associated with the prolonged cold temperatures or heat events were reported for the 2025 events. Unfortunately, on January 15, 2024, during a similar two-day extreme cold event with wind chills between -10 and -15˚F, a homeless man (67 years old), died due to hypothermia. His body was found on 3rd Street in Evansville.

Probability

It is difficult to predict the probability that an extreme temperature event will affect Vanderburgh County residents within any given year. However, based on historic knowledge and information provided by the community representatives, an extreme temperature event is "Likely" to "Highly Likely" (likely within the year to next three years) to occur within the county and if an event did occur, it would result in "Limited" to "Significant" impacts. **Appendix 8** identifies the CPRI for extreme temperatures-both heat and cold events for all communities in Vanderburgh County.

Assessing Vulnerability

As noted above, this type of hazard will generally affect entire counties and even multi-county regions at one time; however, certain portions of the population may be more vulnerable to extreme temperatures. For example, outdoor laborers, very young and very old populations, low-income populations, and those in poor physical condition are at an increased risk to be impacted during these conditions.

By assessing the demographics of Vanderburgh County, a better understanding of the relative risk that extreme temperatures may pose to certain populations can be gained.

- 19.1% of the county's population is over 65 years of age
- 5.8% of the population is below the age of five
- 13.8% of the population is living below the poverty rate

People within these demographic categories are more susceptible to social or health related impacts associated with extreme temperatures. Families below the poverty line are less likely to have functioning air conditioning in their homes. Because of high energy costs those who do have air conditioning may be less likely to use the units in a way to benefit their health and well-being. (**Figure 15**) The same factors are key when looking at heating sources in cold temperatures. Elderly people and those living below the poverty line are more likely to rely on alternative heating sources because of the cost of energy. These alternative heating sources are frequently the cause of carbon monoxide poisoning and/or house fires. (**Figure 16**)

Figure 15: Excessive Heat

In January 2024, subzero windchills impacted the entire State of Indiana with Indianapolis reporting 84 hours of sub-zero windchills between January 13 and 17. Vanderburgh County EMA worked with community and county leadership as well as non-governmental organizations to ensure the warming needs for unsheltered homeless people residing in the county were addressed. Although there are numerous daytime facilities open to warm those who are cold, night-time accommodations can be more challenging as the number of people in need increases.

Figure 16: Extreme Cold

Within Vanderburgh County, direct and indirect effects from a prolonged period of extreme temperatures may include:

Direct Effects:

- Direct effects are primarily associated with health risks to the elderly, infants, people with chronic medical disorders, lower income families, outdoor workers, and athletes. Health risks can range from heat exhaustion or mild hypothermia to death due to heat stroke, amputations due to frost bite or death due to severe hypothermia.

Indirect Effects:

- Increased need for cooling or warming shelters and overnight accommodations.
- Increased medical emergency response efforts.
- Increased number of structure fires as alternative heat sources ignite nearby flammable materials.
- Increased energy demands for heating or cooling.

Estimating Potential Losses

It is difficult to estimate the potential losses due to extreme temperatures as damage is not typically associated with buildings but instead with populations and people. Monetary damages associated with the direct effects of the extreme temperature on structures and infrastructure are not possible to estimate accurately.

Indirect effects:

- Increased expenses for facilities such as healthcare or emergency services due to the increased number of calls and people seeking assistance.
- Manufacturing facilities where temperatures are normally elevated may need to alter work hours or experience loss of revenue if forced to limit production during the heat of the day.
- Energy suppliers may experience demand peaks during the hottest and/or coldest portions of the day.
- Extreme cold indirect effects include pipes freezing resulting in loss of access to water for industrial processes as well as personal hygiene, sanitation and hydration of livestock and people. These effects may disproportionately impact vulnerable populations (elderly people and children) within Vanderburgh County.

Future Considerations

As more citizens are experiencing economic difficulties, local power suppliers along with charitable organizations have implemented programs to provide cooling and heating mechanisms to residents in need. Often, these programs are donation driven and the need for such assistance must be demonstrated. As susceptible populations increase, and/or as local economies are stressed, such programs may become more necessary to protect the county's at-risk populations. Additionally, the increase in the number of unsheltered homeless in the area calls for innovative approaches to addressing heating and cooling needs after traditional business hours when this population is particularly susceptible.

The Indiana Climate Change Assessment identifies several temperature related considerations which communities should be aware of and begin planning to avoid further impacts. For example, rising temperatures will increase the number of extreme heat days, thereby increasing the potential for heat related illnesses, potential hospitalizations, and medication costs to vulnerable populations. In addition, added days of extreme heat will impact agriculture, manufacturing, and potentially, water sources. Increasing green spaces within the cities and towns not only provide benefits of stormwater control, carbon sequestration, and air pollution filtration, but also are great for reducing the energy from the sun reaching the ground surface, thus cooling the area. Future community planning should include the incorporation of heat tolerant green infrastructure to lessen the impacts of extreme heat upon the community.

New construction associated with development of residential areas often brings upgraded and more efficient utilities such as central heating and air units further reducing vulnerabilities to the aging populations in those municipalities mentioned above. Conversely, new developments associated with industrial or large commercial structures in the inner-urban centers often result in increased heat over time, which may cause additional stress to labor-related populations. Since the last planning effort, there has not been significant residential and commercial development within the county.

Relationship to Other Hazards

While extreme temperatures may be extremely burdensome on the power supplies in Vanderburgh County, the committee concluded that this type of hazard is not expected to cause any hazards studied. It is anticipated that due to prolonged extreme temperatures, primarily long periods of elevated temperatures, citizens may become increasingly agitated and irritable, and this may lead to a disturbance requiring emergency responder intervention.

4.2.4 FIRES AND WILDFIRE

Overview

A wildfire, also known as a forest fire, vegetation fire, or a bushfire, is an uncontrolled fire in wildland areas and is often caused by lightning; other common causes are human carelessness and arson. Small wildfires may be contained to areas less than one acre, whereas larger wildfires can extend to areas that cover several hundred or even thousand acres. Weather conditions can determine the nature and severity of a wildfire event. Very low moisture and windy conditions can help to exacerbate combustion in forested or brush areas and turn a small brush fire into a major regional fire event in a very short period. Wildfires can be very devastating for residents and property owners.

A structural fire is an incident where a fire starts within a structure and is largely contained to that structure. Causes of structure fires can be related to electrical shorts, carelessness with ignition sources and/or alternative heating sources, poor storage of flammable materials, as well as arson. These types of fires can be deadly if no warning or prevention measures are present. The most dangerous aspect of structural fires is the production of toxic gases and fumes that can quickly accumulate in enclosed areas of structures and asphyxiate those who might be in the structure.

Problems associated with structural fires are compounded when high-rise buildings catch fire because high-rise fires hinder the ability of rescue workers to fight the fire, reach impacted building occupants, and evacuate impacted occupants. These operations cand be complicated as the height of the structure increases and the occupancy changes within the structure. Rescue efforts are more difficult when people with disabilities are involved in structure fires. Lastly, structural collapse is a concern with larger structure fires especially when people are trapped and severely injured. However, it is important to note that the concern associated with structural collapse, is not limited to high-rise buildings; the collapse of smaller residential buildings can also lead to severe injury and death.

Combating a wildfire or a structure fire is extremely dangerous. If weather conditions change suddenly, the fire may change course and/or increase in strength potentially overtaking neighboring structures and firefighters, causing severe injury or death. Fires can travel at speeds greater than 45 mph. Members of the homeless community, hunters and/or campers may also be in the fire impact area with no means to escape. Fire response capabilities are limited by the staffing shortages at career departments and the ever-dwindling number of volunteer firefighters able to respond, especially during "normal working hours." This further increases the risks for first responders and community members alike.

Extent and History

The NCEI does not record structure fires; therefore, local sources were utilized to provide information regarding fires. Residential fires have been the most common fire hazard affecting Vanderburgh County in the last several years. Information provided in **Table 5** highlights the number of fire calls the county fire departments responded to between January 2019 and December 2024. Damage to structures, contents, crops, forests, and vehicles is significant for each municipality on an annual basis. Social losses, such as being unable to work following a residential structure fire or losses associated with a business fire should also be considered as an impact.

Table 5: Vanderburgh County Fire Calls

Department	2019	2020	2021	2022	2023	2024
Evansville Fire Department	10,162	9,388	9,972	10,503	11,413	11,821
Scott Twp./Vanderburgh Fire Dept.	1,322	1,331	1,559	1,550	1,565	1,917
McCutchanville Fire Department	1,605	1,641	1,768	2,006	2,036	2,178
Perry Township Fire Department	996	1,044	1,193	1,314	1,292	1,297
German Township Fire Department	687	808	722	828	936	967
Total	**14,772**	**14,212**	**15,214**	**16,201**	**17,242**	**18,180**

The NCEI does not routinely record fires or wildfires. No wildfires were reported in the NCEI records for Vanderburgh County. News 44 on July 7, 2025, showed a field fire near Wesselman Woods nature preserve caused by careless fireworks use near the preserve. Error! Reference source not found. shows the d amaged area with the nature preserve in the wooded area on the left. This fire was just a hundred yards away from the nation's largest urban old-growth forest. Fortunately, fire crews were able to extinguish the fire before it reached the forest.

Figure 17: Field Fire near Wesselman Woods

Probability

Vanderburgh County has some managed land, predominantly state and community parks such as Wesselman Woods at 240 acres and Angel Mounds State Historic Site at 600 acres in size. Urban areas, such as the Jacobsville Neighborhood in Evansville, are at risk due to abandoned homes, blighted areas, and/or industrial activities. The majority of the planning committee determined the probability to be "Highly Likely" throughout the County. **Appendix 8** identifies the CPRI rankings for fire and wildfire throughout the County.

Assessing Vulnerability

Physical, economic, and/or social losses impact not only the property owner whose property was damaged by the fire, but also the community. Typically, a structural fire is limited to one or two structures, as the fire response focuses on extinguishment as well as containment thus preventing the fire from spreading to neighboring structures. In mixed use areas such as seen in **Figure 18** nearby structures and residents are impacted by not only the fire itself but also smoke and water damage from the firefighting efforts. Rapid fire response coupled with early detection work to reduce the magnitude and severity. Nonetheless, fires in historic structures, town

Figure 18: Warehouse Fire in Evansville, WHET

squares, and similarly valued structures takes a toll on the community spirit as well as the financial and physical loss.

The more rural portions of the county are susceptible to brush and/or crop fires, especially in times of drought. Since agriculture is a big source of income for the rural communities, field fires, especially during harvest season, or barn fires after crops have been stored have an immense impact.

Direct and indirect effects of fires and wildfires within Vanderburgh County may include:

Direct Effects:

- Loss of structures (historical, residential, high-rise buildings, business, industrial, and agricultural)
- Loss of vital equipment (industrial and agricultural)
- Loss of forests and native plants
- Loss of natural resources and wildlife

Indirect Effects:

- Loss of revenue as businesses may be closed.
- Loss of community members due to loss of emotional and spiritual connections to the community.
- Loss of revenue from reduced tourist activities in the county including events such as the Nut Club Festival, Angel Mounds State Historic Site and Bally's Casino and Hotel.
- Increased emergency response times based on safety of roads.
- Loss of income if dependent on crop production or timber harvest

Estimating Potential Losses

Given the nature and complexity of a potentially large hazard such as a wildfire, it is difficult to quantify potential losses to property and infrastructure. As a result, all critical and non-critical structures and infrastructure may be at some degree of risk.

Monetary damages associated with the direct effects of the fires are difficult to estimate, other than utilizing historic information as provided by local fire departments or property owners. Indirect effects would cause increased efforts associated with emergency response services as wildfires are difficult to contain and may accelerate very quickly. Further, multi-level business or residential structures place increased risks to those who work or live within those structures or nearby structures.

Future Considerations

As populations increase and community growth increases, the need to respond to fire will remain an important municipal effort. As new construction or re-development occurs, especially new or existing critical infrastructure, it is important to ensure that these new structures are equipped to deal with the potential risks associated with this hazard. Those may include increased risk for wooden or flammable outer structures and potential lengthy power outages. With the adverse impacts of extreme temperatures and drought upon the heavily forested areas, consideration must be given to mitigating fire risks for structures that are built in the rural areas to limit losses should a wildland fire take place.

In addition, increased populations require increased housing. Many urban communities develop large multi-family residential structures, or apartment complexes, where structures are not only in close proximity to each other but also house many citizens. As communities age, some structures may fall into disrepair or be abandoned, significantly increasing the risk of fire due to potential vagrant populations and lack of maintenance. These areas should be considered at risk and potentially demolished to avoid such risk and potential hazard.

Firefighting responses can be slowed due to the limited numbers of volunteers available at various times of the day. Increasing numbers of people working outside of the community in which they reside limits volunteer presence to outside of normal working hours. Recruitment initiatives will need to be considered as the firefighting needs and staffing levels change.

Fires can also result in substantial indirect costs. Increased emergency response times, loss of work or the inability to get to work, as well as business interruption, are possible indirect effects of a fire and how it may affect those businesses related to cropland or natural resource areas.

Relationship to Other Hazards

Fires may certainly result in a hazardous materials incident if storage structures are within the path of the fire. Material storage containers farther away from the burn path may become damaged by high winds and embers resulting in a spill or release of materials. Fires may result from lightning either alone or associated with a thunderstorm. Typical wind speeds during a thunderstorm may also exacerbate the impacts from any ignitions from the lightning.

4.2.5 FLOOD

Overview

A flood, as defined by the NFIP, is a general and temporary condition of partial or complete inundation or two or more acres of normally dry land area or of two or more properties from overflow of inland or tidal waters, or unusual and rapid accumulation or runoff of surface waters from any sources, or a mudflow. Floods can be slow or fast rising but generally develop over a period of days.

The traditional benchmark for riverine or coastal flooding is a 1% Annual Exceedance Probability (AEP), formerly known as the 100-year flood. This is a benchmark used by FEMA to establish a standard of flood protection in communities throughout the country. The 1% AEP is referred to as the "regulatory" or "base" flood. Another term commonly used, the "100-year flood", can be misleading. It does not mean that only one flood of that size will occur every 100 years, but rather there is a 1% chance of a flood of that intensity and elevation happening during any given event. In other words, the regulatory flood elevation has a 1% chance of being equaled, or exceeded, in any given event and it could occur more than once in a relatively short time period. The area impacted by the 1% AEP flood event is called the Special Flood Hazard Area (SFHA).

Log jam flooding is a concern for the more populated areas. Although log jams can occur at any time of the year, Log jams accumulate in low flow areas and near bridges and similar structures located in the stream, causing water levels to rise. Bridges and culverts are most frequently impacted since water flow is easily blocked at these locations forcing water outside of the riverbanks into neighborhoods and businesses.

Extent and History

According to the NCEI for the period of January 1, 2019, to December 1, 2025, there have been:

- 13 flash floods
- 23 riverine floods

The 13 flash floods spanned from 2019 to February 2025. The most damaging flash flood occurred on September 3, 2022, with $75K in property damage. Heavy rain of three inches fell in Evansville resulting in widespread street flooding nearly waist deep in some places. The large retail areas north and south of Lloyd Expressway at Green River Road were flooded as well as an area along US 41 in Evansville. Numerous residences were inundated as well. The Courier & Press reported on a similar flash flood which struck Evansville on June 13, 2025. **Figure 19** shows some of the damage shoppers found after the rain stopped.

Figure 19: Flash Flood in Evansville, 6/13/2025

The NCEI reports $167K property damage from flash floods and $30K in riverine floods in the past six years . None of the events reported any crop damage nor any deaths or injuries.

The county is situated on the Ohio Rivers and is impacted by the tributaries of the Pigeon Creek Watershed. There are 34 waterways feeding either directly or indirectly into the Ohio River. **Appendix 9** lists the major waterways and stream gages.

Three stream gages are utilized to monitor surface water elevations and/or discharges at key locations and time periods. Some such gages are further equipped with NWS's National Water Prediction Service (NWPS) capabilities. These gages have the potential to provide valuable information regarding historical high and low water stages, hydrographs representing current and forecasted stages, and a map of the surrounding areas likely to be flooded. Within Vanderburgh County, there is one USGS stream gage. A second gage is located across river at Henderson, KY and a third gage is located upstream of Vanderburgh County at the Newburgh Lock and Dam. **Table 6** provides details for each of the gages.

Table 6: Vanderburgh County Area USGS Gages

		Flood Level				Crest / Year	
Site Number	Site Name	Major	Moderate	Minor	Action	Recent	Historic
03304300	Ohio River at Newburgh Lock and Dam	56′	48	38′	35′	47.90′ 2025	56.60′ 1937
03322000	Ohio River at Evansville	52′	48′	42′	24′	47.67′ 2025	53.75′ 1937
03322190	Ohio River at Henderson	48′	43′	36′	31′	39.59′ 2025	39.59′ 2025

A watershed management plan (WMP) is a strategy for achieving water quality goals by characterizing the watershed, setting goals and actions steps, and developing an implementation plan to address documented problems. Ultimately, the purpose of the WMP is to guide resource managers, watershed coordinators, policy makers, community organizations, and other relevant stakeholders in restoring and protecting the waterbodies within a given watershed. According to Indiana Department of Environmental Management's (IDEM) WMP website, there are two plans that cover Vanderburgh County. They are:

- Lower Pigeon Creek WMP (49762)
- Highland -Pigeon WMP (00-86)
- Big Creek WMP (7-6)

Although Pigeon Creek is a wildlife oasis in the middle of a bustling city, providing habitats for various fish, waterfowl, and mammals, it also is a source of flooding. Burke Engineering, LLC prepared the Pigeon Creek Corridor Flood Risk Management Plan for Evansville and the Vanderburgh Commissioners on May 9, 2023. The study developed some management goals such as creating a joint Drainage Board , or a watershed development commission with Warrick and Gibson Counties, adopting flood-conscious development plans, and promoting soil health practices with cover crops. The Pigeon Creek Watershed Development Commission (PCWDC) was formed in later 2024 and began assembling the needed personnel and hiring a contractor to create their development plan.

Flood insurance is key for flood recovery. Any property having received two insurance claim payments for flood damages totaling at least $1,000, paid by the NFIP within any 10-year period since 1978, is defined as a repetitive loss property. These properties are important to the NFIP

because they account for approximately third of the country's flood insurance payments. **Table 7** identifies the repetitive loss properties and claims in Vanderburgh County per community, as provided by FEMA.

Table 7: Repetitive Loss Properties, and Claims

Community	# Repetitive Loss Properties	Number of Properties by Occupancy			Total # of Claims
		Residence	Business	Non-Residential	
Vanderburgh County	46	46	0	0	144
City of Evansville	45	37	1	7	127
Town of Darmstadt	0	0	0	0	0
TOTAL	**91**	**83**	**1**	**7**	**271**

There have been 271 claims made for damages associated with flooding in Vanderburgh County since 1978. **Table 8** further indicates the current premiums, and coverage totals for individual communities.

Table 8: Insurance Premiums and Coverage

Community	Flood Insurance Coverage	Flood Insurance Premiums
Vanderburgh County	$71.51M	$370.34K
City of Evansville	$110.31M	$392.82K
Town of Darmstadt	$0M	$0K
TOTAL	**$181.82M**	**$763.16K**

Probability

As determined by the committee, the probability of flooding occurring throughout Vanderburgh County is "Likely" to "Highly Likely." This is largely based on recent experiences with the rivers and streams near the communities. The committee also determined that accurate warning time is 12-24 hours. Finally, the duration of such an event is anticipated to last from less than a week to greater than a week. A summary of the flood CPRI is shown in **Appendix 8**.

Assessing Vulnerability

Flood events may affect substantial portions of Vanderburgh County at one time as river systems and areas with limited drainage cover much of the county and the incorporated communities. With an increase in high volume rain events, the low-lying roads within the county are vulnerable to frequent inundation isolating and/or restricting access to some parts of the county such as Old Princeton Road, south of Hilltop Road and North of Schillinger Road; East Virginia Street Viaduct under the railroad tracks east of North Evans Avenue; and Racy Becker Parkway under the railroad tracks east of South Barker Avenue. According to the NCEI the trend is an increase of 0.49 inches in a decade. The average annual rainfall is 47.91 inches. See **Figure 20** below for precipitation trends from 1895 to 2025.

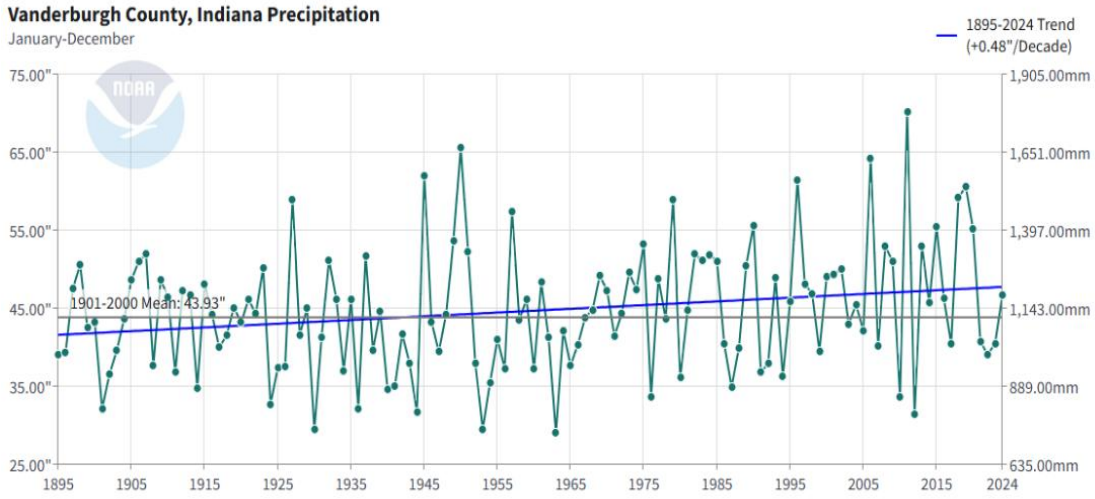


Figure 20: Annual Precipitation from 1895 - 2025

Several locations within the plan discuss the floodplains within the county. The NFIP FIRMs are included in all the references. FIRM Map panels are specifically called out by community in **Appendix 9**. An aggregate map of all the currently effective FIRMs for the county is shown in **Figure 21**. This aggregate map uses the current effective map as identified in Appendix 9. A similar map of the Vanderburgh County floodplain including critical and essential facilities is available in **Exhibit 2**. The local floodplain administrator provides the most recent imaging to community members who request the information and the Indiana Floodplain Information Portal provides the FIRMs as well as the best available data for all communities and counties in Indiana.

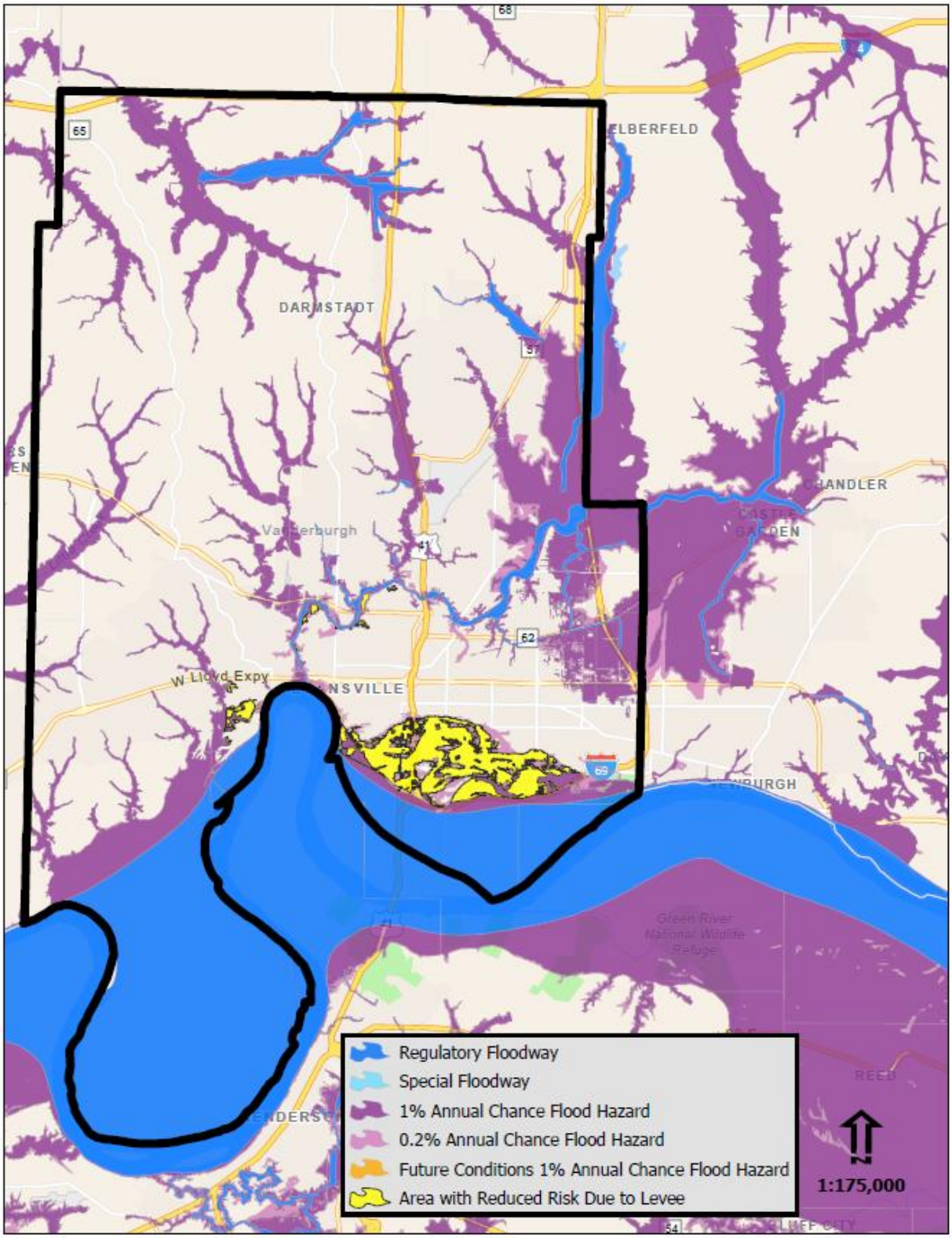


Figure 21: Vanderburgh County NFIP Flood Insurance Rate Map

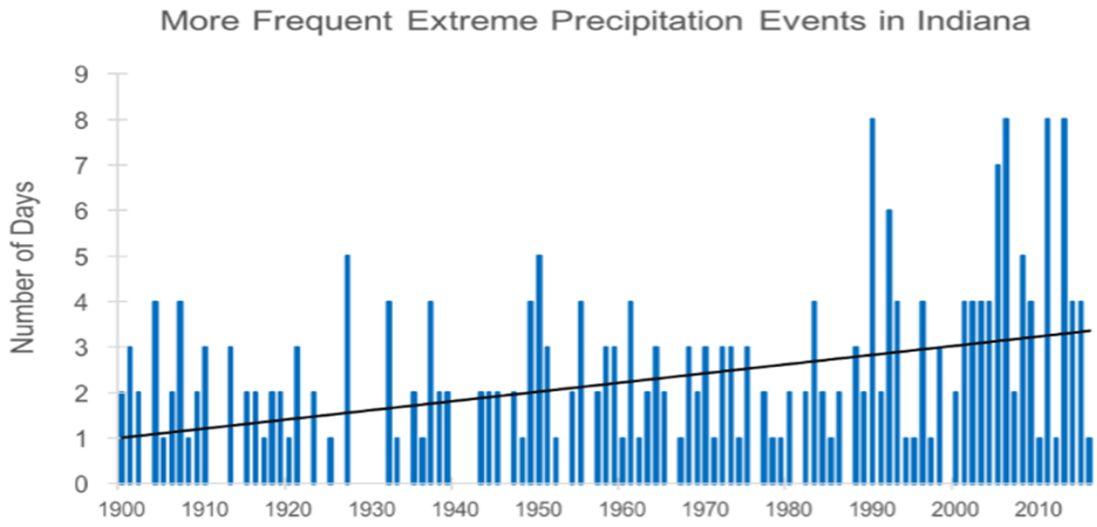


Figure 22: Extreme Precipitation Events in Indiana

Purdue University Indiana Climate Change Impacts Assessment Report analyzed the increased frequency of short duration high volume rain events, also known as extreme precipitation events, in Indiana. According to the report, an extreme rain event occurs when more than 0.86 inches of rain falls in a day. Since 1900, the number of days per year with extreme rain has been increasing by 0.2 days per decade on average. However, most of that increase has occurred since 1990. According to the NCEI, Vanderburgh County has seen a 0.48" per decade increase in precipitation. Planning committee members have identified an increasing trend in heavy rains falling in short time frames, thus overwhelming storm sewers, and other infrastructure. In **Figure 22** the trend line shows an increase in the number of days where the rainfall exceeds 99th percentile. This ever-increasing trend is resulting in more frequent flash flood and overland flood events.

Overall, Indiana has experienced an increase in the number of rain intensity is increasing and rain duration is decreasing. The extreme events are increasing, especially flooding.

This is also verified in the Indiana Climate Change Assessment report from Purdue University. (**Figure 23**). In the report, the authors wrote, "This assessment documents that significant changes in Indiana's climate have been underway for over a century, with the largest changes occurring in the past few decades. These projections suggest that the trends that are already occurring will continue, and the rates of these changes will accelerate.

Food inundation map (FIM) libraries are developed to identify areas impacted by a variety of flood stages. There are no FIM libraries for streams in Vanderburgh County. The closest FIM is on the Wabash River at New Harmony.

Because all of the communities are vulnerable to flooding either from short duration heavy rain events, or the more familiar riverine flooding, all have chosen to participate in the NFIP (**Table 9**).

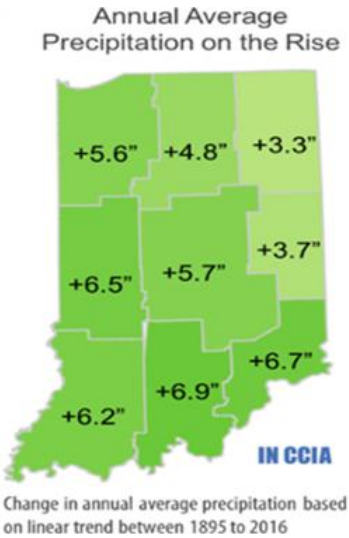


Figure 23: Annual Average Precipitation Rise, Purdue Univ.

Vanderburgh County and Evansville actively participate in the CRS program. The City of Evansville has a 7 rating and the county is currently rated an 8 Participation in the program entitles those residents in the SFHA to receive a discount on their flood insurance based on the community participation in floodplain management practices that exceed the minimum requirements of NFIP. These actions will reduce future potential flood damage and encourage efficient floodplain.

Table 9: Vanderburgh County NFIP Participation

Community		Initial FHBM Identified	Initial FIRM Identified	Current Effective Map Date	Regular-Emergency Program Date
ID	Name				
180126	Vanderburgh County	Not available	02/01/80	01/29/21	02/01/80
180257	City of Evansville	06/14/74	10/15/81	01/29/21	10/15/81
180130	Town of Darmstadt	Not available	03/17/11	03/17/11	03/17/12

Residences in the floodplain are often occupied by families with limited means. With less financial capacity to mitigate, flooding becomes an additional burden on the communities. Flash flooding, being less predictable, does not allow advanced warnings which enable community members to protect property and seek shelter out of harm's way, thus increasing vulnerability throughout the county, especially the underserved and disadvantaged community members.

Within Vanderburgh County, direct and indirect effects of a flood may include:

Direct Effects:

- Structural and content damage and/or loss of revenue for properties affected by increased water.
- Increased costs associated with additional response personnel, evacuations, and sheltering needs.
- Increased potential impacts to infrastructure and buildings located within the SFHA.
- Increased cleanup costs for more frequent flash flood impacts.
- Loss of topsoil and deposition of sand due to flood inundation of farm fields.

Indirect Effects:

- Increased response times for emergency personnel when roads are impassable.
- Increased costs associated with personnel carrying out evacuations in needed areas.
- Increased risk of explosions and other hazards associated with floating propane tanks or other debris.
- Losses associated with missed work or school due to closures or recovery activities.
- Cancellations of special events in impacted areas or water related activities that become too dangerous due to high water.
- Debris removal costs to return local drainage to normal function.
- Getting notifications to the underserved populations that may not have access to radio, television, or social media of evacuations.

Estimating Potential Losses

Critical and non-critical structures located in regulated floodplains, poorly drained areas, or low-lying areas are most at risk for damage associated with flooding. For this planning effort, a GIS Desktop Analysis methodology was utilized to estimate flood damage.

For the GIS Desktop Analysis method, an analysis was completed utilizing the effective Digital FIRMs (DFIRMs) overlaid upon a Modified Building Inventory developed with information provided by Vanderburgh County. Structures located within each flood zone were tallied using GIS analysis techniques.

In the assessment, any structure listed as less than 400 ft2 in area or classified in the Assessor's database as a non-habitable structure was assumed to be an outbuilding. It was assumed that a building was located on a parcel if the value listed in the "Assessed Value (Improvements)" showed a value greater than zero dollars. Parcels that intersected any portion of the FEMA flood zones were considered to be flood prone, and subsequently, further analyzed separately from parcels without structures. Structure values were calculated using:

Residential = Assessed Value x 0.5
Commercial = Assessed Value x 1.0
Industrial = Assessed Value x 1.5
Agricultural = Assessed Value x 1.0
Education = Assessed Value x 1.0
Government = Assessed Value x 1.0
Religious = Assessed Value x 1.0

To estimate anticipated damages associated with each flood zone in Vanderburgh County and communities, it was estimated that 25% of structures in the flood zones would be destroyed, 35% of structures would be 50% damaged, and 40% of structures would be 25% damaged. **Table 10** identifies the estimated losses associated with structures in the floodway, the 1% AEP outside of the floodway, and the 0.2% AEP outside the 1% AEP areas by community within Vanderburgh County. Residual risks behind levees is addressed in 4.2.10 of this document.

Table 10: Vanderburgh County Building Inventory Using Best Available Data

Location	Floodway		1% AEP Outside of Floodway		0.2% AEP Outside of 1% AEP boundaries	
	#	$	#	$	#	$
Vanderburgh County	570	$87.43M	2,456	$305.12M	849	$88.09M
City of Evansville	274	$48.35M	1,192	$216.92M	1,974	$237.53M
Town of Darmstadt	0	$0.00M	42	$23.59M	0	$0.00M
TOTAL	**844**	**$135.78M**	**3,690**	**$545.63M**	**2,823**	**$325.62M**

Using the same GIS information and process, critical infrastructure within each of the flood hazard areas in Vanderburgh County was assessed and are included in **Table 11**. These buildings are included in the overall number of structures and damage estimate information provided in **Table 10**.

Table 11: Critical Infrastructure in the Flood Zones

Community	Floodway	1% AEP Outside of Floodway	0.2% AEP Outside of 1% AEP and Floodway
Vanderburgh County	Sunbeam	Amoco An Energy Source Azteca Stallings Booster	Always We Care Childcare and Dayschool LLC Oakhill Baptist Childcare North Campus Scott Township Station 2

Community	Floodway	1% AEP Outside of Floodway	0.2% AEP Outside of 1% AEP and Floodway
City of Evansville	Modification Energy Source	ABC's and 123's Child Care BMV - East Side Branch Hirsch Road Oak Grove VA Clinic Eagle Crest Perry Township FD #1	2nd to Best Childcare An Energy Source ANIMAL CONTROL Beautiful Creations II Caze Ed Center Child's Play Childcare Colonial COOKIE'S DAYCARE Coomes Childcare Creative Learning Hands Diamond Pump Doodle Bug Child Care EVSC Early Learning Center - Fairlawn EVSC Preschool at Caze Fairlawn Fairlawn Children's Center Fairlawn Ed Center Fulton Happy House Discovery Playschool Hose House 16 Igleheart Just Kid'n Around Lamasco Maryland Nature Explorer Classroom Ohio River Riverside Vanderburgh Sheriff Community Correction Complex Washington Middle School
Town of Darmstadt			

Using the information in **Table 11** regarding the number of structures within each of the flood hazard areas, it is also important to note the number of flood insurance policies within each area in Vanderburgh County. **Table 12** provides the comparison between the number of structures in the 1.0% AEP and the number of flood insurance policies. It is also important to note that flood insurance is voluntary unless the property owner carries a federally subsidized mortgage; insurance coverage may be discontinued when the mortgage is completed.

Table 12: Structures in the 1.0% AEP and Number of Flood Insurance Policies

Community	# Structures in1.0% AEP, and the Floodway	# Policies
Vanderburgh County	3,026	285
City of Evansville	1,466	337
Town of Darmstadt	42	0
Total	**4,534**	**622**

Future Considerations

As the municipalities within Vanderburgh County grow in population and redevelop, it can be anticipated that the number of critical and non-critical infrastructure will also increase accordingly. Vanderburgh County and all the incorporated communities have adopted Floodplain Ordinances. **Table 13** is a compilation of the most recent ordinance adoption dates for each community.

Table 13: Most Recent Ordinance Dates for Each Community

Community	Date Floodplain Ordinance Adopted
Vanderburgh County	No ordinance adopted
City of Evansville	2/24/2021
Town of Darmstadt	1/5/2021

Each of the listed communities discourage critical facilities such as schools, medical facilities, community centers, and municipal buildings from being constructed within the 1% AEP floodplain. New structures must also be protected to that level along with flood-free access to reduce the risk of damage caused by flooding and to ensure that these critical infrastructures will be able to continue functioning during major flood events. Flooding due to poor drainage, low-lying land, or flash flooding is also an important consideration. It will be important for recognition of potential flood impacts to residents and businesses in these areas to be coupled with proper planning for future development and redevelopment of the flood zones. This would also include studying the Best Available Data Layer and inundation areas mapped through the development of the Indiana Floodplain Information Portal as well as studies of all the streams with one square mile or drainage area or greater (**Figure 24**).

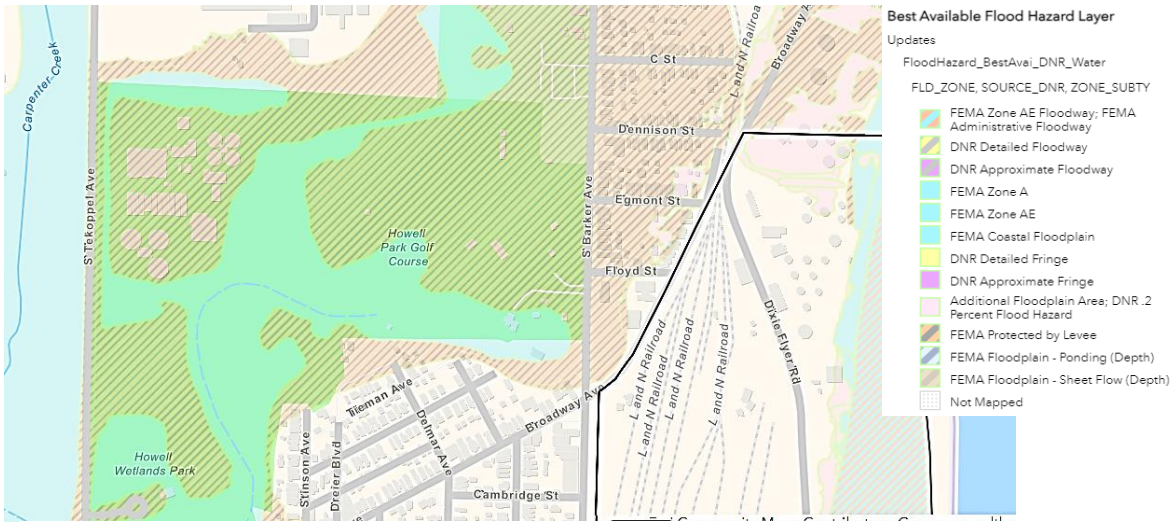


Figure 24: Sample of Flood Designated Areas near Carpenter Creek and the Ohio River

It is important to ensure that owners and occupants of residences and businesses within the known hazard areas, such as delineated or approximated flood zones behind levees, and Fluvial Erosion Hazard (FEH). are well informed about the potential impacts from flooding incidents as well as proper methods to protect themselves and their property.

Increased precipitation, as predicted in the Indiana Climate Change Assessment, is anticipated to come in the form of heavier, shorter events which lead to the increased potential for flooding

and stress on infrastructure such as sanitary and storm sewers. Heavy precipitation events are anticipated to occur more frequently as temperatures rise, replacing rain when previously there was snow.

Despite these efforts, the overall vulnerability and monetary value of damage is expected to increase in the area unless additional measures, such as those discussed later in Chapter 5 of this report, are implemented.

Indirect effects of flooding may include increased emergency response times due to flooded or redirected streets, the danger of dislodged and floating propane tanks causing explosions, and the need for additional personnel to carry out the necessary evacuations. Additional effects may include sheltering needs for those evacuated, and the loss of income or revenue related to business interruptions. Vanderburgh County communities host numerous special events near or on the rivers and waterways. These special events may have to be cancelled or postponed due to flooding or high-water levels.

Relationship to Other Hazards

While flooding creates social, physical, and economic losses, it may also cause other hazards to occur. For example, flooding may increase the potential for a hazardous materials incident to occur. Above ground storage facilities may be toppled or become loosened and migrate from the original location. In less severe situations, the materials commonly stored in homes and garages such as oils, cleaners, and de-greasers, may be mobilized by flood waters. Should roads to hazardous materials handlers become flooded, or if bridges are damaged by flood waters, response times to more significant incidents may be increased, potentially increasing the damage associated with the release.

Increased volumes of water during a flood may also lead to dam failure. As the water levels rise in areas protected by dams, at some point, these structures will overtop or will breach leading to even more water being released. These two hazards, flood, and dam failure, when combined, may certainly result in catastrophic damage.

In a similar fashion, a snowstorm or ice storm can also lead to flooding on either a localized or regional scale. When a large amount of snow or ice accumulates, the potential for a flood is increased. As the snow or ice melts, and the ground becomes saturated or remains frozen, downstream flooding may occur. Ice jams near bridges and culverts may also result in flooding of localized areas and potentially damage the bridge or culvert itself.

Repeated flooding may also create impacts associated with landslides along riverbanks and bluff areas. As floodwaters travel through the systems, saturating shorelines and increasing volumes and velocities of water, the natural process of fluvial erosion may be exacerbated. As these processes are increased, structures and infrastructure located on bluffs or in proximity to the river may be at risk.

Flooding in known hazard areas may also be caused by dams that experience structural damage or failures not related to increased volumes or velocities of water. These “sunny day failures,” while not typical, may occur wherever these structures exist throughout the county.

4.2.6 HAIL, THUNDER, AND WIND STORMS

Overview

Hail occurs when frozen water droplets form inside a thunderstorm cloud and then grow into ice formations held aloft by powerful thunderstorm updrafts, and when the weight of the ice formations become too heavy, they fall to the ground as hail. Hail size ranges from smaller than a pea to as large as a softball, and can be very destructive to buildings, vehicles, and crops. Even small hail can cause considerable damage to young and tender plants. Residents should take cover immediately in a hailstorm, and protect pets and livestock, which are particularly vulnerable to hail, and should be under shelter as well.

Thunderstorms are defined as strong storm systems produced by a cumulonimbus cloud, usually accompanied by thunder, lightning, gusty winds, and heavy rains. All thunderstorms are considered dangerous as lightning is one of the by-products of the initial storm. Although most lightning victims survive, people struck by lightning often report a variety of long-term, debilitating symptoms. Other associated dangers of thunderstorms included tornados, high winds, hail, and flash flooding.

Windstorms or high winds can result from thunderstorm inflow and outflow, or downburst winds when the storm cloud collapses, and can result from strong frontal systems, or gradient winds (high- or low-pressure systems). High winds are speeds reaching 50 mph or greater, either sustained or gusting.

Location, History, and Extent

In Vanderburgh County, between January 1, 2019, and November 15, 2025, the NCEI has recorded

- 10 Hail events
- 78 Thunder/Wind Storm events

According to the Midwest Regional Climate Center (MRCC) hail is considered severe if a thunderstorm produces hail stones larger than one inch in diameter, or larger than the size of a quarter. In the past six years, hail events have been reported at least once every year. The largest hail stone was reported to be 1.5 inches in diameter with the average stone being slightly over one inch. Of all the instances of hailstorms, no property damage or crop damage was reported by the NCEI.

Significant windstorms are characterized by the top wind speeds achieved during the incident. Such high wind events characteristically occur in conjunction with thunderstorms and have historically occurred year-round with the greatest frequency and damage occurring in May, June, and August. Within Vanderburgh County, NCEI reports 15 instances where top wind speeds were 60 mph or greater with the highest wind speed being 83 mph. Of the 78 instances of thunderstorms and high wind events were on 62 different dates. Of those instances there was one injury and one death reported, both due to lightning strikes. Additionally, there were no reports of crop damage associated with these events. However, there was a total of $1.54M in property damage. Many event reports included in the NCEI described tree damage, power poles blown down or broken. The descriptive information on the social, physical, and economic losses resulting from individual storms, however, is very limited. In local storm reports at the NWS, where damages were reported, narrative descriptions of the event rarely extended beyond reports of damage to broken tree limbs, downed power lines or power poles, or roof damage.

The ever-changing climate has impacted on the frequency of hail, thunder, and wind storms. Based on information published by NOAA, the average intensity of rain is increasing while the duration of rain events is decreasing. With these circumstances extreme events will be increasing because there will be more rain in a shorter time period challenging local stormwater systems.

Appendix 10 provides the NCEI information regarding hail, thunder, and wind storms and includes information about injuries, deaths, and monetary damage to property and/or crops.

Probability

The committee determined the probability of a hailstorm, thunderstorm, or windstorm occurring anywhere throughout Vanderburgh County is "Highly Likely" and will typically affect broad portions of the county at one time resulting in potentially "Limited" to "Significant" damage. As advancements in technologies such as weather radar systems and broadcast alerts are continually made, the warning time for such incidents may increase. Currently, the committee feels that the warning time is anticipated to be between less than six hours up to 12-24 hours, and the duration is expected to last less than six hours in most cases with some re-occurring storms lasting up to a day.

Indicative of a regional hazard, the probability, magnitude, warning time, and duration of a hailstorm, thunderstorm, or windstorm are expected to be similar throughout the county. These events are highly unpredictable, and the occurrences are distributed throughout the county, sometimes impacting one community more often or more severely than another. Therefore, the CPRI values, summarized in **Appendix 8**, reflect the distributed risk and associated priority for a hailstorm, thunderstorm, or windstorm.

Specific locations and frequency of hail, thunder, and wind storms are difficult to predict as many of these individual events are without significant warning time and may have impacts on very limited areas or may affect broader areas. However, based on NCEI data and personal experiences of the committee, it was determined that all areas within the county are anticipated to experience hail, thunder, or wind storms within the calendar year. More likely, these communities will be impacted by several of these hazardous events each year. The magnitude is anticipated to be similar based on the number of critical infrastructure and populations of each of the municipalities, or "Limited" to "Significant."

Assessing Vulnerability

The effects of hail, thunder, or wind storms may be minimal to extensive in nature and may affect small or broad ranges of land area. Within Vanderburgh County, direct and indirect effects from a hailstorm, thunderstorm, or windstorm may include:

Direct Effects:

- Damage to infrastructure (power lines)
- Damage to individual property (homes, cars)
- Physical injuries may be experienced by those unable to find shelter during storm events, such as homeless people, hikers, and outdoor workers.

Indirect Effects:

- Downed power lines due to falling tree limbs as seen in **Figure 25**.
- Losses associated with power outages.
- Damage sustained from blowing debris.

- Cancellation or interruption of special events.
- Traffic disruptions due to debris in the roadways and accidents. Rerouted traffic clogs local thoroughfares and can increase maintenance costs due to heavier than normal loads and vehicle count.

Estimating Potential Losses

Figure 25: Damage from High Wind

Due to the unpredictability of this hazard all critical infrastructure and non-critical structures in Vanderburgh County are at risk of damage including temporary or permanent loss of function. For hail, thunder, and wind storms, it is not possible to isolate specific critical infrastructure or non-critical structures that would be vulnerable to damage. However, areas where utility lines are above ground and areas where dead or dying trees have not been removed may be at a higher risk of property damage or power outages during hail, thunder, and wind storms (**Figure 25**). Additionally, mobile homes and accessory buildings such as pole barns and sheds may also be at a higher risk of damage from hail, thunder, and wind storms if not properly anchored to the ground. Homeless individuals and families who have alternative means of sheltering may experience greater losses since the construction materials of tents and alternative structures do not withstand the damaging forces of the storms.

Future Considerations

As the population of the communities in Vanderburgh County develops and redevelops, it can be anticipated that the number of structures will also increase. To reduce the vulnerability for damage resulting from a hail, thunder, or wind storm, measures such as proper anchoring are vital. This includes not only roof anchors but also mobile home anchors. Proper tree maintenance, and burial of power lines should be completed. Adoption and enforcement of the current International Building Codes is key to ensuring structures can withstand the power of wind and hailstorms. While measures can be taken to remove existing structures or prevent future structures from being built in known hazard areas such as floodplains and hazardous materials facility buffers, such measures are not applicable to hailstorms, thunderstorms, and windstorms due to the diffuse nature and regional impacts of this hazard.

Indirect effects resulting from hail, thunder, or wind storms can include power outages caused by downed tree limbs or flying debris, damage resulting from prolonged power outages, and damage to structures or property because of debris. Damage to homeless encampments resulting in loss of personal property and potential injuries are also a concern during storms.

Relationship to Other Hazards

Hail, thunder, and wind storms may be the precursor for other hazards. For example, hazardous materials incidents can be the result of hail, thunder, or wind storms. Material storage containers can become damaged by high winds, debris, or even lightning, and can result in a spill or release of materials. With wind speeds greater than 58 mph, tankers and other transportation vehicles carrying hazardous materials are also at risk while on the road. High winds may also cause

gaseous substances to travel farther distances at a much faster rate, increasing the evacuation area necessary to protect residents and visitors of Vanderburgh County.

Additionally, rainfall typically accompanies thunderstorms and may lead to localized flooding or riverine flooding depending on the amount of rain during the event. Debris from a windstorm may also lead to localized flooding if debris is deposited over drains or if obstructions are created by downed limbs, trees, or other storm related debris. A similar concern due to the potential precipitation would be dam failure. High winds may place debris near spillways, blocking the emergency drainage mechanism for the dams. High winds may also lead to structural damage to a dam or may cause damage to nearby trees or other structures, leading to indirect damage.

The risk of social losses also increases during a hailstorm, thunderstorm, or windstorm, as these hazards often result in downed power lines, utility poles, and trees. Debris such as this may impede traffic patterns and make it difficult for emergency vehicles (Fire, EMS, and Police) to pass through affected areas or people may be directly injured because of falling or flying debris.

4.2.7 LANDSLIDE, LAND SUBSIDENCE AND FLUVIAL EROSION

Overview

Landslide is the most recognized hazard in this category and is associated with the movement of unstable soils on a slope. The USGS defines landslide as "the movement of a mass of rock, debris, or earth down a slope. Landslides are a type of "mass wasting," which denotes any down-slope movement of soil and rock under the direct influence of gravity." Mudflows and rock slides are a subcategory within the definition of landslide. Common causes of landslide rainfall, snowmelt, changes in water level, changes in groundwater, earthquakes, and human disturbance activities.

Land subsidence, according to the USGS, is "a gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials." Further, there are three processes that contribute to subsidence: compaction of aquifer systems, drainage and subsequent oxidation of organic soils, and dissolution and collapse of susceptible rocks.

Another important consideration is FEH. This represents the risk associated with natural stream movements and losses associated with buildings and infrastructure. In some cases, this may be represented by a gradual movement of a stream across a farm field. In other, more extreme instances, homes or other infrastructure may be lost as steep riverbanks or bluffs sluff into the water below.

Location

The USGS identifies and has mapped highly mobile streams or streams whose lateral position changes over time as the stream carves out the earth surrounding them. None of the streams or waterways are shown to be highly mobile streams according to the USGS database. Although the streams in Vanderburgh County are not migrating significantly, there is the potential to increase lateral movement in the future. Development along the banks of waterways could be susceptible to erosion should the river transition to an actively migrating stream. Error! R eference source not found. shows the FEH corridor along Pigeon Creek. The FEH zone, located within the 1% flood event boundaries, appears to be relatively stable based on the USGS publication discussing channel migration rates in Indiana.

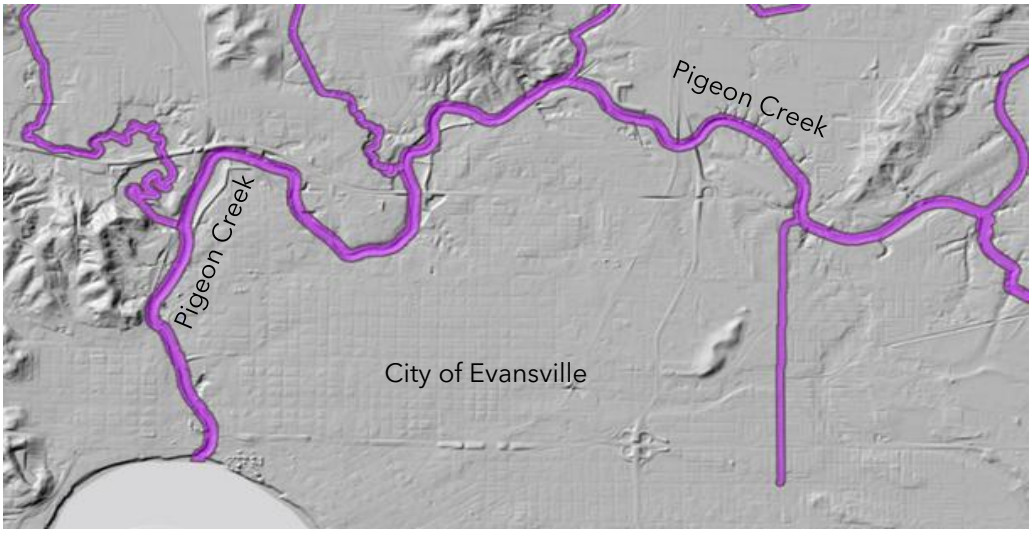


Figure 26: Fluvial Erosion Hazard Corridor along Pigeon Creek

IndianaMap shows that there are no known Karst Sinkhole areas anywhere in the county nor are there any active underground mining operations within the county. Additionally, to date, there have not been any landslides or subsidence events reported in Vanderburgh County.

Extent and History

Vanderburgh County has no known presence of Karst geology and is at a low risk of land subsidence or sink holes. In comparison, portions of the county near the west side of Evansville and the Pigeon Creek confluence with the Ohio River, in the vicinity of Locust Creek to the north, and near Wesselman Woods are considered at relatively high estimated annual loss from landslides. The northeast corner as well as the far northwest corner of the county are at relatively low estimated annual loss according to the National Risk Index for landslide. The risk index considers expected annual loss as well as vulnerabilities by census tract and community resilience. The Risk Index Estimated Annual Loss for landslide in Vanderburgh County is shown in **Figure 27**. There is a large area of the county with no rating (white areas) indicative of no annual losses expected.

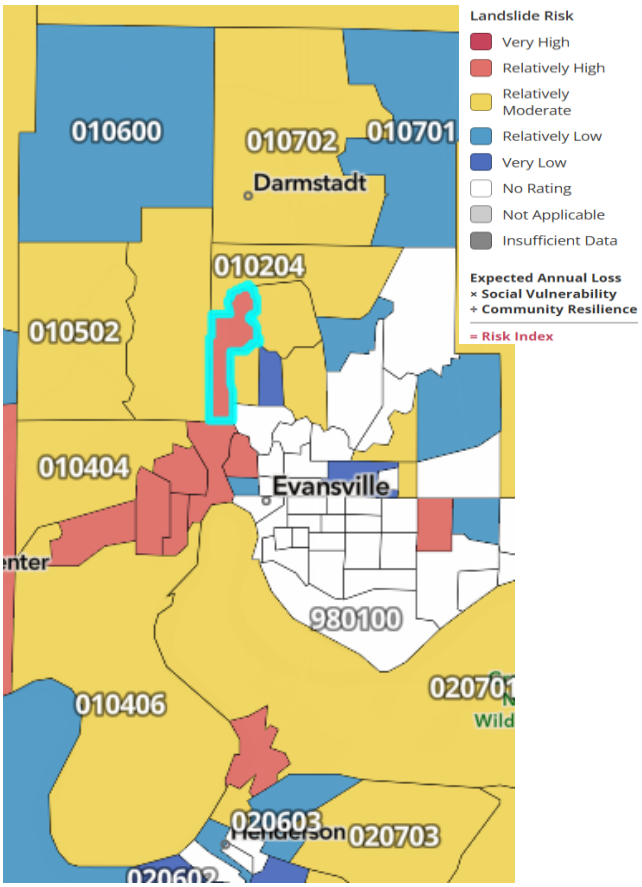


Figure 27: Expected Annual Loss from Landslides in Vanderburgh County

Probability

The committee determined the probability of a landslide or subsidence occurring in most of the communities in Vanderburgh County is "Unlikely." Any event is expected to result in potentially "Negligible" damages. Currently, the committee feels that the warning time is expected to be less than six hours in most cases and the duration is expected to range from less than six hours to greater than a week. These events are highly unpredictable and the risk, although very low according to the committee, is distributed throughout the county. Therefore, the CPRI values reflect the distributed risk and associated priority for a landslide or subsidence event. A summary of the CPRI is provided in **Appendix 8**.

Assessing Vulnerability

Within Vanderburgh County, direct and indirect effects may include:

Direct Effects:

- Damages to infrastructure (power lines, roads, bridges)
- Damage to individual property (homes, cars)
- Loss of cropland immediately adjacent to the rivers or slide areas

Indirect Effects:

- Increased response time for emergency vehicles
- Losses associated with affected land (crop loss)
- Potential contamination of groundwater resources
- Loss of business due to roadway access and power loss.
- Loss of income due to extended commutes to and from work

Estimating Potential Losses

According to the National Risk Index, expected annual losses have been calculated for each census block (some census blocks are identified in Figure 27) in Vanderburgh County. Those census blocks with relatively high estimated annual losses are at risk of damage including temporary or permanent loss of function. The greatest factor involving the higher rating is the potential for larger segments of the population to be exposed to the potential hazard. The census blocks with relatively high estimated annual loss are listed in **Table 14.**

Table 14: Landslide EAL for Relatively High-Risk Census Blocks

	Expected Annual Loss Values	
Census Block	**Building Value**	**Population Equivalence**
18163010205	$9.18K	$1.67K
18163010800	$13.40K	$1.32K
18163002600	$4.06K	$0.54K
18163003000	$8.50K	$2.01K
18163003100	$5.34K	$0.85K
18163003200	$8.08K	$1.72K
18163010405	$6.02K	$1.35K
18163003801	$6.87K	$1.40K
Total	**$61.45K**	**$10.86K**

In addition, areas where FEH meander belt widths (FEH Zones) have been identified, may be at a higher risk of property damage caused by such events. To prepare a community based basic "what-if" scenario, the Indiana FEH GIS layers were overlaid onto parcel data provided by the county. **Table 15** identifies the number of parcels and essential facilities within the FEH areas.

Table 15: Summary of Parcels in the FEH Zone

Community	**Potential Damages**		
	# Parcels	**Structures**	**Essential Facilities**
Vanderburgh County	1,115	312	0
City of Evansville	1,221	908	4
Town of Darmstadt	12	2	0
Total	**2,348**	**1,222**	**4**

Future Considerations

As the populations of the communities in Vanderburgh County grow, it can be anticipated that the number of critical and non-critical structures will also increase. To reduce the vulnerability for damages resulting from a landslide, land subsidence, or FEH, GIS layers identifying hazard areas along with the floodplain information should be integrated into the building permit or approval process. In recent years, there has been mixed growth with some communities in the

county increasing development while others decrease. Caution must be exercised during development and redevelopment activities to reduce vulnerability to this hazard group.

Although the county rivers are considered relatively stable, having little lateral movement annually, extreme precipitation events may cause erosion to take place in previously stable areas. Given this potential it is key the community continues to discourage construction of infrastructure and homes in the meander belt widths for each stream.

As future growth takes place, the indirect effects resulting from a landslide or land subsidence event can cause challenges for the community if transportation routes are damaged, and businesses must close due to access issues and loss of power. Cascading impacts in smaller counties can have long lasting effects on the local economy, community growth, health, and welfare.

Relationship to Other Hazards

A landslide, subsidence event or FEH event may be the precursor for other hazards. Depending on the location of the event, material storage containers can become damaged resulting in a spill or release of materials and potentially contaminating groundwater reserves. Dam failures may occur in much the same fashion if located in the potential hazard areas, or resulting from heavy saturation following a rainstorm, heavy snow, or rapid snowmelt. FEH may result in flooding in areas previously not impacted by flood due to debris clogging drainage ways and loss of earthen berms near the waterways.

Similarly, these types of events may be caused by hail, thunder, or windstorms and their effects on the soils; an earthquake may release the ground enough to set a slide in motion; or a flood may add increased soil saturation or weight to at-risk areas increasing the potential for an event and resulting damages.

4.2.8 TORNADO

Overview

A tornado is generated when conditions in a strong cell are produced that exhibit a wall of cool air that overrides a layer of warm air. The underlying layer of warm air rapidly rises, while the layer of cool air drops – sparking the swirling action. The damage from a tornado is a result of the high wind velocity and wind-blown debris. Tornado season is generally from April through June in Indiana, although tornadoes can occur at any time of year. Tornadoes tend to occur in the afternoons and evenings; over 80%of all tornadoes strike between 3:00 pm and 9:00 pm but can occur at any time of day or night.

Location

The classification of tornadoes utilizes the Enhanced Fujita Scale of tornado intensity and damage. Tornado intensity ranges from low intensity (EF0) tornadoes with effective wind speeds of 65-85 mph to high intensity (EF5+) tornadoes with effective wind speeds of 200+ mph (**Table 16**).

Table 16: Enhanced Fujita Scale for Tornadoes

EF-Scale	Windspeed, mph	Character of Damage	Relative Frequency	Typical Damage
EF0	65-85	Light damage	29%	Shallow rooted trees blown over; damage to roofs, gutters, siding
EF1	86-110	Moderate damage	40%	Mobile homes overturned, roofs stripped, windows broken
EF2	111-135	Considerable damage	24%	Large trees snapped, light-object missiles generated, cars lifted
EF3	136-165	Severe damage	6%	Severe damage to large buildings, trains overturned
EF4	166-200	Devastating damage	2%	Whole houses destroyed; cars thrown
EF5	200+	Incredible damage	<1%	High-rise buildings significantly damaged, strong framed homes blown away

Extent and History

In Vanderburgh County, between January 1, 2019, and December 1, 2025, the NCEI has recorded:

- 9 tornados on 5 separate dates

Two of the recorded tornadoes were rated as EF2, six were rated as EF1, and the remaining event was rated as an EF0. The largest number of tornadoes on a single day in Vanderburgh County was on April 2, 2024, when four tornadoes during a single storm event touched down between 4:46am and 5:00am. NCEI reported $1.06M in property damage. There were no injuries reported nor any deaths or crop damage. The event narratives for the four tornadoes described an overturned semi on I-69, damage to the many roofs, multiple barns, and

outbuildings heavily damaged or destroyed, silos damaged, electrical transmission lines and power distribution poles were broken, and numerous homes were damaged.

Probability

The committee estimated the probability of a tornado occurring in Vanderburgh County "Highly Likely." The magnitude and severity of such an event ranged from "Limited" to "Significant." The overall risk is "Severe" throughout the county. As with many hazardous events, the committee anticipated a general warning time of 6-24 hours with a shorter warning time for specific location (less than six hours), and a short duration, less than six hours to less than a day. The CPRI summary is provided in **Appendix 8**.

The Indiana State Climate Office estimates that throughout Indiana, there is an average of 20 tornado touchdowns per year. Based on the number of tornado touchdowns previously reported through the NCEI and local weather agencies, the committee determined the risk of a future tornado is "Severe" (within the next year).

Assessing Vulnerability

As the path of a tornado is not pre-defined, it is difficult to isolate specific critical infrastructure and non-critical structures, or areas of Vanderburgh County that would be vulnerable to a tornado. Direct and indirect effects from a tornado may include:

Direct Effects:

- Increase damage to older construction including residential and business structures, mobile homes, and accessory structures (pole barns, silos, sheds)
- Damage to structures in the immediate pathway. (businesses, residences, warehouses)
- Loss of alternative housing stock nearby.
- Damages to above ground utility lines and structures

Indirect Effects:

- Loss of revenue for affected businesses.
- Expenses related to community clean-up and debris removal from public rights of way and public facilities.
- Inability for property owners to work while dealing damages from the tornado and debris removal from high winds.
- Affected business owners may experience loss of revenue if they are unable to continue operations following the event. Similarly, if a business is affected and unable to operate, employees may experience a loss of wages during the period of recovery.

Estimating Potential Losses

Due to the unpredictability of this hazard, all critical and non-critical structures within the county are at risk of future damage or loss of function. Estimates of potential physical losses were determined through a hypothetical exercise where an EF2 intensity tornado traveled through portions of the county and the communities. This is intended to present a "what-if" scenario of a tornado incident and associated damages. Damage estimates were derived by assuming that 25% of all structures in the path of the tornado would be completely destroyed, 35% of the structures would be 50% damaged, and 40% of the structures would sustain 25% damage. These estimations were also determined utilizing three wind speed zones based on distance from the tornado path. Zone 1 is nearest the center of the tornado path, while Zone 3 is the farthest from

the path and with a theoretically lower wind speed. **Table 17** provides summary data for the hypothetical tornado, which is identified on **Exhibit 3**. Tables 16-17 only include communities in the path of the tornado and structures not labeled as unclassified, of which there was one in Vanderburgh County

Table 17: Summary of Hypothetical Tornado Damages

	Zone 1		Zone 2		Zone 3		Total	
	#	$	#	$	#	$	#	$
Vanderburgh County	90	$10.05	79	$8.04	99	$10.20	**268**	**$28.28**
City of Evansville	658	$88.90	554	$70.00	579	$73.35	**1,791**	**$232.24**
Total	**748**	**$98.94**	**633**	**$78.03**	**678**	**$83.55**	**2,059**	**$260.53**

Using the same GIS information and process, critical infrastructure within each of the hypothetical tornado zones are included in **Table 18**. These buildings are included in the above table showing the number of structures and damage estimate information.

Table 18: Critical Infrastructure within Hypothetical Tornado Path

Community	Zone 1	Zone 2	Zone 3
Vanderburgh County			Eastside Energy Source
City of Evansville	Christ the King School Holy Rosary School University of Evansville Devon An Energy Source Methodist Temple Children's Center	Deaconess Midtown Hospital Annunciation Catholic School at Christ the King Deaconess Children's Enrichment Center	An Energy Source Deaconess Dexter Elementary School Dexter Extended Day Center East Industrial ECHO Housing Group EVSC Preschool at Dexter Montessori Academy The Salvation Army

Future Considerations

Vanderburgh County hosts numerous events each year in addition to the regular tourist attractions and a variety of recreational opportunities which attract thousands of guests. Due to this, it is imperative that the EMA and local communities place continued importance on the need to maintain their outdoor warning siren coverage and/or support alternative notification methods for people who may not be tuned in to local media. Many of the incorporated communities have invested in mass notification systems to advise community members of severe weather and other threats. In the more rural portions of the county, outdoor warning siren coverage is limited at best. The existing outdoor warning siren locations are identified in **Figure 28**.

While it can be anticipated that new construction associated with development may be stronger than older or existing construction, existing older structures, barns, pole buildings, silos, and mobile homes remain threatened by tornados. The unincorporated portions of the county will remain vulnerable, especially where the outdoor warning siren coverage is not present. It is impossible to predict the path of a tornado and therefore all current and future development will continue to be at risk for damage. Risks to the citizens of the county may be lessened through participation in mass notification programs, use of weather radios, and turning on the emergency alert feature on cell phones. Having multiple means of warning citizens, businesses and visitors about incoming weather is critical to continued economic growth and well-being of the communities and the county.

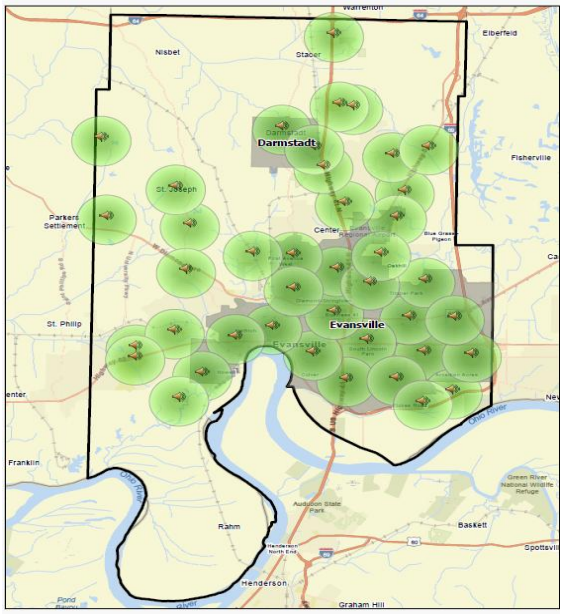


Figure 28: Outdoor Warning Siren Locations in Vanderburgh County

Relationship to Other Hazards

Tornadoes may result in a hazardous materials incident. Material storage containers can become damaged by high winds and debris can result in a spill or release of materials. As wind speeds increase, the potential for damage to above ground storage containers also increases. Tankers and other transportation vehicles carrying hazardous materials are also at an increased risk while on the road or rail.

Tornadoes may also result in dam failure as the increased wind speeds, and debris caused by the tornado may directly impact the dam or cause indirect damage by clogging outlet structures and/or emergency spillways. In addition, tornadoes may lead to structural fires as the destruction path is sometimes long and broad, leading to an increased number of potentially damaged homes, exposed power lines, gas leaks, and substantial amounts of debris.

4.2.9 WINTER STORMS AND ICE

Overview

A winter storm can range from moderate snow over a few hours to blizzard conditions with high winds, ice storms, freezing rain or sleet, heavy snowfall with blinding wind-driven snow, and extremely cold temperatures that can last for several days. Winter storms are typically accompanied by cold temperatures and blowing snow, which can severely reduce visibility. A winter storm is defined as one that drops four or more inches of snow during a 12-hour period, or six or more inches during a 24-hour span.

An ice storm occurs when freezing rain falls from clouds and freezes immediately in contact with a variety of surfaces. All winter storms make driving and walking extremely hazardous. The aftermath of a winter storm can affect a community or region for days, weeks, and even months.

Storm effects such as extreme cold, flooding and snow and ice accumulation can cause hazardous conditions and hidden problems for people in the affected area. People can become stranded on the road or trapped at home, without utilities or other services, including food, water, and fuel supplies. The conditions may overwhelm the capabilities of a local jurisdiction. Winter storms are deceptive killers as they may indirectly cause transportation accidents, and injury and death resulting from exhaustion/overexertion, hypothermia and frostbite from wind chill, and asphyxiation. House fires occur more frequently in the winter due to the use of alternative heat sources, such as space heaters, and lack of proper safety precautions.

Wind chill is a calculation of how cold it feels outside when the effects of temperature and wind speed are combined. On November 1, 2001, the NWS implemented a replacement Wind Chill Temperature (WCT) index for the 2001/2002 winter season. The reason for the change was to improve upon the current WCT Index, which was based on the 1945 Siple and Passel Index.

A winter storm watch indicates that severe winter weather may affect your area. A winter storm warning indicates that severe winter weather conditions are on the way. In the event of a blizzard, a winter storm warning will be issued and include the details of the blizzard.

Location

Being in southwestern Indiana, winter storms are becoming less frequent , however still may result in serious consequences in Vanderburgh County and the surrounding region. Heavy, drifting snow, and ice conditions can result in substantial personal and property damage, even death. These winter weather events take place over the entire county. The NWS consolidated their watch and warning products on October 15, 2018. In doing so, blizzards are no longer separate watches and warnings but instead are detailed as a part of winter storm watches and warnings. Many winter storm weather products, such as the WSSI, are available from the NWS to help communities better understand the potential impacts. **Figure 29** shows the description of the WSSI impacts. As the forecast is refined and the storm

Potential Winter Storm Impacts	
	Winter Weather Area **Expect Winter Weather.** Winter driving conditions. **Drive carefully.**
	Minor Impacts **Expect a few inconveniences to daily life.** Winter driving conditions. **Use caution while driving.**
	Moderate Impacts **Expect disruptions to daily life.** Hazardous driving conditions. **Use extra caution while driving.** Closures and disruptions to infrastructure may occur.
	Major Impacts **Expect considerable disruptions to daily life.** Dangerous or impossible driving conditions. **Avoid travel if possible.** Widespread closures and disruptions to infrastructure may occur.
	Extreme Impacts **Expect substantial disruptions to daily life.** Extremely dangerous or impossible driving conditions. **Travel is not advised.** Extensive and widespread closures and disruptions to infrastructure may occur. Life-saving actions may be needed.

Figure 29: Winter Storm Impacts

approaches the forecast area, the impact statements will become more detailed with depth of snow, wind speeds, timing of the snowfall and more detailed impacts for the community. According to the NCEI, Vanderburgh County averages 10.8" of snow annually.

Figure 30 shows how Vanderburgh County's annual minimum temperature is warming at a rate of 0.1°F each decade since roughly 1895. This increase will likely result in the county experiencing less long-term snow and more frequent ice. This tradeoff is due to the atmosphere's greater likelihood of being above freezing which will melt any snow and then refreeze the drops of rain resulting in freezing rain or sleet.

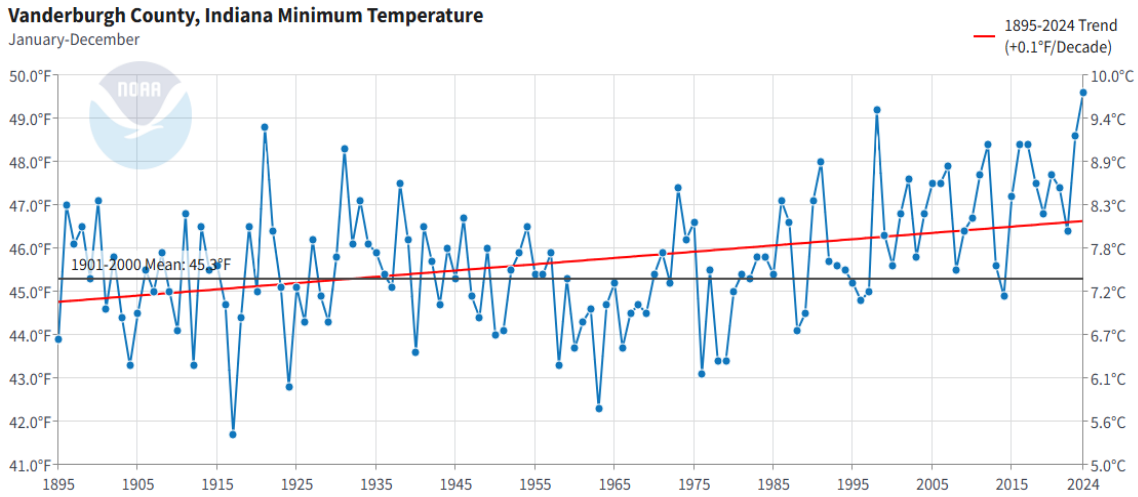


Figure 30: Lake County Minimum Temperatures from 1895 to 2025

Extent and History

In Vanderburgh County, between January 1, 2019, and December 1, 2025, the NCEI has recorded:

- 12 Frost/Freeze
- 3 Heavy Snow
- 20 Winter weather events
- 5 Winter storms

NCEI reports indicated $865K in property damage, no crop damage, two injuries, and one death associated with the heavy snow and winter storms. Many narrative descriptions indicated poor travel conditions, lots of power outages, slide offs and auto accidents, and debris associated with the winter weather events.

On January 5, 2025, a winter storm impacted southwest Indiana with a mix of snow, sleet, and freezing rain. Heavy snow with rates around one inch per hour impacted locations along and north of Interstate 64 beginning in the morning hours before eventually ending as sleet and freezing rain later that day. A lull occurred that evening with areas of freezing drizzle before wrap around moisture caused one final burst of snow into the morning hours on January 6th. Peak accumulations ranged from four to eight inches of snow and sleet along with glazes of ice. In Vanderburgh County, an Amazon semi-truck had slid partially off the road and became stuck near Evansville which experienced some of the greatest impacts. In the vicinity, on U.S. 41 and Baseline Road, a black Chrysler 200 slid off the road. Transformers at one point were blowing left and right due to the weight of ice. Buildings even caught on fire on the southeast side of

Evansville in addition to trees dropping into fences. Part of a tree impaled a home on Graham Ave. Temperatures in the 20s gradually rose above freezing that evening across southern portions of the region, but a shallow cold layer near 1000 ft above ground level made the ice reluctant to melt off the tree branches. The heavy weight on trees led to additional power outages during the day due to wind gusts over 20 mph. Wet surfaces the prior night also resulted in a flash freeze as temperatures quickly plummeted back below freezing into the 20s. Traffic accidents and delays along with power outages were the major impacts for this event.

Probability

The probability, magnitude, warning times, and duration of a snowstorm or ice storm causing disruption to residents and businesses in Vanderburgh County, as determined by the planning committee, is expected to be mostly consistent throughout the county and communities. It is "Likely" to "Highly Likely" that this type of hazard will occur in the area and will typically affect the entire county, and possibly several surrounding counties at one time, resulting in "Limited" damage. The typical warning time for severe temperatures or several inches of snow associated with a winter storm is greater than 24 hours while the duration of the incident is anticipated to range from less than one day to less than one week. An overall CPRI summary is shown in **Appendix 8**.

Based on discussions of the planning committee, snowstorms have changed in quality over recent years in Vanderburgh County with the changing climate, however, ice storms and freezing drizzle are more extensive challenges to the communities. Vanderburgh County communities are well prepared to handle snow and snow removal. Actions have been taken to mitigate many impacts from snow and ice storms. The committee considered only the larger, more detrimental events for this effort.

Assessing Vulnerability

Winter storms and ice typically affect a large regional area with potential for physical, economic, and/or social losses. Direct and indirect effects of a snowstorm or ice storm within the county may include:

Direct Effects:

- A higher number of businesses rely on the outside workforce and may experience loss of production as employees may not be able to get to work. The high number of residents traveling to other areas for work results in loss of income due to the inability to reach their normal worksites.
- Rural (county) roads may be impassable.
- Expenses related to snow removal or brine/sand applications.
- Weight of ice and wet snow impacts older structures roofs as well as powerlines.
- Large ice and snow events interrupt economic activity within the community.

Indirect Effects:

- Loss of revenue as businesses are closed.
- Increased emergency response times based on safety of roads.
- Loss of income if workers are unable to get to their place of employment.
- Delayed impacts due to supply chain disruptions – products not received or shipped on time cause lost wages and revenues.
- Cancellation of special events and reduced tourist activities impact the local economy.

Estimating Potential Losses

Given the nature and complexity of a regional hazard such as a snowstorm, it is difficult to quantify potential losses to property and infrastructure. As a result, all critical and non-critical structures and infrastructure are at risk from snowstorm and ice storm incidents.

For planning purposes, information collected about snowstorms impacting other communities around the nation is also useful in assessing the potential social, physical, and economic impact that a winter storm could have on communities.

In December 2008, Allen County had a wintry combination of freezing rain, snow, and ice. This storm was the largest disaster for Indiana Michigan Power with 110,000 Allen County customers without power. One thousand six hundred (1,600) additional crew members were brought in to restore electrical service to the county. According to the Journal Gazette $10 – $12M was spent to clean up the debris, make repairs and labor costs for this event.

While the above example indicates the wide-ranging and large-scale impact that winter storms can have on a community or region, winter storms generally tend to result in less direct economic impacts than many other natural hazards. According to the Workshop on the Social and Economic Impacts of Weather, which was sponsored by the U.S. Weather Research Program, the American Meteorological Society, the White House Subcommittee on Natural Disaster Relief, and others, winter storms resulted in an average of 47 deaths and more than $1B in economic losses per year between 1988 and 1995. However, these totals account for only 3% of the total weather-related economic loss and only 9% of fatalities associated with all weather-related hazards over the same period.

Future Considerations

As populations increase and communities continue to grow, the need to respond to snowstorms or ice storms will remain an important municipal effort. As new construction or re-development occurs, especially new or existing critical infrastructure, it is important to ensure that these new structures are equipped to deal with the potential risks associated with this hazard. Those may include lengthy power outages and potentially impassable transportation routes, making it difficult to obtain supplies or for passage of response vehicles. These hazard events will typically affect the entire county, perhaps multiple counties, and therefore all developments, current and future, will be at risk for damage associated with snow and ice storms. In addition, there will be a need for additional warming shelters for the underserved populations to take refuge and get warm and safe respite for stranded commuters on their way to or from work. This not only includes daytime available spaces but also overnight accommodation as the winter storms are often accompanied by very cold temperatures and wind chills.

Winter storms can also result in substantial indirect costs. Increased emergency response times, loss of work or the inability to get to work, as well as business interruption, are possible indirect effects of a winter storm. According to a report by the National Center for Environmental Predictions, the cold and snowy winter in late 1977 and early 1978, which impacted several heavily populated regions of the country, was partially responsible for reducing the nation's Gross Domestic Product (GDP) from an estimated growth rate of between 6% and 7% during the first three quarters of 1977 to approximately -1% in the last quarter of 1977 and 3% during the first quarter of 1978.

Relationship to Other Hazards

Winter storms and ice storms can lead to flooding as the precipitation melts and enters local receiving waters. This increased volume of water on already saturated, or still frozen ground can quickly result in flood-related damage to structures and properties as well as within the stream or river channel. Vanderburgh County has an increased risk of flooding following heavy precipitation events. The increased flooding may then lead to a dam failure within the same area, further exacerbating the damage.

Hazardous materials incidents may be caused by poor road conditions during winter storms or ice storms. Many hazardous materials are transported by rail or by tanker over highways and interstates. In the more rural areas of the county, or where open areas are more susceptible to snow drifts on roads, the possibility of a traffic related hazardous materials incident may increase due to road obstruction and lack of visibility.

Power outages and other infrastructure failures may also occur during a winter storm. Weight from snow and ice accumulation can directly or indirectly cause power lines to fail. During extreme cold temperatures, power outages may prove deadly for certain populations such as the homeless, the elderly or ill. Power outages in the winter are especially dangerous as families try to generate heat using alternative heat sources. Alternative heating sources may not be safely used or may be placed too close to combustible materials resulting in fires and burn injuries or death.

4.2.10 DAM AND LEVEE FAILURE

Overview

A dam is defined as a barrier constructed across a watercourse for the purpose of storage, control, or diversion of water. Dams typically are constructed of earth, rock, concrete, or mine tailings. A dam failure is a collapse, breach, or other failure resulting in downstream flooding.

Of the approximately 80,000 dams identified nationwide in the National Inventory of Dams (NID), the majority are privately owned. Each regulated dam is assigned a downstream hazard classification based on the potential loss of life and damage to property should the dam fail. The three classifications are high, significant, and low. With changing demographics and land development in downstream areas, hazard classifications of regulated are updated continually. The following definitions of hazard classification currently apply to dams in Indiana:

> **High-hazard Dam:** a structure, the failure of which may cause the loss of life and severe damage to homes, industrial and commercial buildings, public utilities, major highways, or railroads.
>
> **Significant-hazard Dam**: a structure, the failure of which may damage isolated homes and highways or cause the temporary interruption of public utility services.
>
> **Low-hazard Dam**: a structure, the failure of which may damage farm buildings, agricultural land, or local roads.

In Indiana, not all dams are regulated. To be regulated by the IDNR, the dam must meet at least one of the following criteria:

- The dam has a drainage area of more than one square mile.
- The dam is 20 feet in height or greater.
- The dam impounds a volume of more than 100 acre-feet of water.

A dam's classification may be changed to a high-hazard classification through a successful petition by a downstream property owner. Federally owned and operated dams are not under Indiana DNR's jurisdiction. Examples of Federally regulated dams include Federal Energy Regulatory Commission (FERC) and US Army Corps of Engineers (USACE) structures. Although regulations are similar, there are additional requirements based on the regulating agency.

A levee is a flood control structure engineered and designed to hold water away from a building. Levees protect buildings from flooding as well as from the force of water, from scour at the foundation, and from impacts of floating debris. Flood protection levees principle causes of levee failure, like those associated with dam failure, include overtopping, surface erosion, internal erosion, and slides within the levee embankment or the foundation walls. Levees are designed to protect against a particular flood level and may be overtopped in a more severe event. When a levee system fails or is overtopped, the result can be catastrophic and often more damaging than if the levee were not there, due to increased elevation differences and water velocity. The water flowing through the breach continues to erode the levee and increases the size of the breach until it is repaired or water levels on the two sides of the levee have equalized. The FEMA and US Army Corps of Engineers (USACE) remind people living and working behind levees that there is always a residual risk when living or working in a facility located behind a levee. Levees reduce the risk of a flood, but do not completely eliminate that risk.

Location

Within Vanderburgh County, there are 25 structures listed in the IDNR dams list. Of the 25 structures in the county, nine are classified as high hazard dams, nine are classified as significant hazard, six are classified as low hazard dams, and one is an unclassified not regulated structure. **Table 19** shows all the structures listed on the IDNR database.

Table 19: Dams in Vanderburgh County

State ID	Dam Name	Owner Types	Hazard Class	State Regulated Dam	IEAP Prepared	Notes
82-1	Woodland Lake Dam	Private	Low	Yes	No	
82-2	Mater Dei Provincialate Dam	Private	High	Yes	No	
82-3	Schnacke Lake Number 1 Dam	Private	High	Yes	No	
82-4	Edgewater Lake Dam	Private	Significant	Yes	No	
82-5	Dogwood Lake Dam	Private	Significant	No	No	
82-6	Lake Talahi Lake Dam	Private	Significant	Yes	No	
82-7	Lake Shawnee Dam No. 1	Private	Significant	Yes	No	
82-8	Kahre Lake Dam	Private	High	Yes	No	
82-9	Bell Conservation Lake	Private	Low	Yes	No	
82-10	USI- Reflection Lake Dam	Private	High	Yes	Yes	
82-11	Dr. Mok Lake Dam	Private	Significant	No	No	Under Minimum
82-12	Pavlick Lake Dam No. 6	Private	Low	Yes	No	
82-13	Servel Lake Dam	Private	Low	No	No	Under Minimum
82-15	Schnacke Lake Number 2 Dam	Private	Significant	Yes	No	
82-16	Lloyd Hahn Lake Dam	Private	High	Yes	No	
82-18	North Lake Estates West Lake Dam	Private	High	Yes	No	
82-19	Bittner Lake Dam	Private	High	Yes	No	
82-20	Lake Shawnee Dam No. 2	Private	Low	No	No	
82-21	Schnacke Lake Number 3 Dam	Private	Significant	No	No	
82-22	Evansville St. Hosp. Pond	Private	Not classified	No	No	Under Minimum
82-24	Schnacke Lake Number 4 Dam	Private	Significant	Yes	No	
82-25	Morgan Lake Dam	Private	Low	No	No	Under Minimum
82-26	Ray Nell Lake Dam	Private	Significant	No	No	
82-27	USI Student Residence Complex Lake Dam	Private	High	Yes	Yes	
82-28	Autumn Winds Dam	Private	High	Yes	No	

According to the National Levee Database (NLD) managed by the USACE, there are 11 levees combined into 3 levee systems within the county. **Table 20** summarizes key aspects about each levee system and what protection is provided.

Table 20: Levee Systems in Vanderburgh County

System ID	Location	Behind the Levee				
		Buildings	People	Property Value	Farmland Acres	Critical Facilities
3905100001	Evansville Levee System	29,927	76,619	$20B	79.6	91
3905100002	Howell Unit 1 Northeast Levee System	179	647	$170M	0	1
3905100003	Howell Unit 1 Northwest Levee System	1,588	3,318	$820M	1.8	7
TOTAL		**31,694**	**80,584**	**$20.99B**	**81.4**	**99**

The Indiana Silver Jackets Team completed a survey of levee-like features also known as non-levee embankments. The non-levee embankments are not certified or engineered structures. They are earthen structures which act like levees, however, are not capable of protecting the features behind the structures adequately. In fact, non-levee embankments impose lateral constraints on flood flows, reducing the floodplain storage capacity and increasing the flood velocity. These non-levee embankments can cause stream erosion and downstream flooding. Some farms along the rivers and streams rely on these embankments to keep flood waters out of their fields. These systems are seen throughout the county. Along Pond Flat Ditch non-levee embankments protect agricultural properties whereas in Evansville and the remainder of the unincorporated county roadways act as non-levee embankments.

Extent and History

There are no records of any recent, within the past five years, actual or near levee failures within the county. The certification of the levee system was tested by the 2025 flooding when the flood gates had to be closed as water levels rose to 47.67 feet, the 7th highest crest on record. The levees performed well and no damage due to flooding from the Ohio River was reported. Regular maintenance of the levees is ongoing.

No incidents or emergencies were recorded within the past five years for any of the regulated dams in Vanderburgh County. Most have been inspected according to the schedule based on their hazard rating (biennial – high hazard, every three years - significant hazard, and every five years – low hazard). The DNR Dams database has identified the following dam inspections are overdue: Autumn Winds Dam, Bittner Lake Dam, Dogwood Lake Dam, Lake Shawnee Dam No.1, Lake Shawnee Dam No. 2, Lloyd Hahn Lake Dam, Pavlick Lake Dam No.6, Ray Nell Lake Dam, Schnacke Lake Number 2 Dam, Schnacke Lake Number 3 Dam,and Schnacke Lake Number 4 Dam.

Probability

Based on the information provided to them and their local knowledge, experience, and expertise, the committee determined the probability of a dam failure is "Unlikely." The magnitude of a dam or levee failure can have "Limited" to "Significant" damage, depending upon proximity to the dams or levees and the number of structures within the jurisdiction. The warning time is anticipated to range between under six hours for Darmstadt up to sic to 12 hours for Evansville and Vanderburgh County. Typically dam issues are reported to the DNR which

then reaches out to the County EMA office. Thus the city and county frequently have greater head warnings than Darmstadt. Additionally, Darmstadt is not near any levees and thus is not always aware of issues related to the levees as the city and county agencies. Committee members based their warning time on the nature of the incident, the regulatory status of the dam(s) in particular and the nature of the flood event. **Appendix 8**, CPRI, provides a summary of the planning committee's CPRI scores for a dam or levee failure.

Assessing Vulnerability

The actual magnitude and extent of damage due to a dam or levee failure depends on the nature of the breach, the volume of water that is released, and the width of the floodplain valley to accommodate the flood wave. Due to the conditions beyond the control of the dam or levee owner or engineer, there may be unforeseen structural problems, natural forces, mistakes in operation, negligence, or vandalism that may cause a structure to fail.

The University of Southern Indiana (USI) developed an Incident and Emergency Action Plan (IEAP) for each of their two high hazard dams Reflection Lake and Student Residence Complex Lake Dams. DNR records indicate all the high hazard dams have IEAPs. In the IEAP a breach scenario is modeled for each dam. **Figure 31** shows the dam breach inundation area, as seen on the IDNR Dam and Levee webpage for the two USI dams. The inundation area map provides the best information available for the public and communities to understand potential flood risk from dams in Indiana and empowers them to make more informed decisions in planning and responding to flood events.

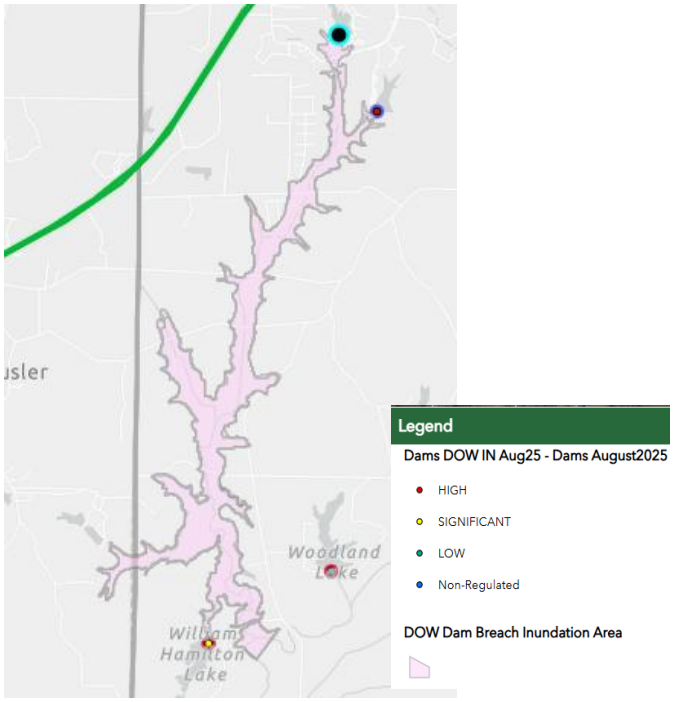


Figure 31: USI Reflection Lake Dam Inundation Area

The Indiana version of an Emergency Action Plan (EAP) is called an IEAP since it includes not only emergencies, but also incidents involving the dam structure. IEAPs are now required for all high hazard dams by state law; however, these plans are not mandated for the significant or low hazard structures. All dam owners are, however, encouraged to prepare an IEAP to help identify whom to notify and what actions may need to take place in the event of an incident or emergency event affecting the dam. For the state regulated high hazard dams, the IDNR dam safety webpage shows which areas may be inundated during a dam failure.

In Vanderburgh County, levee systems protect much of the city of Evansville. Based on the USACE risk assessments, these levee systems had a low risk of overtopping. The operation and maintenance for these levees is performed by the Evansville-Vanderburgh Levee Authority District. The levee Authority District is responsible for the levee, floodwalls, gates, street and railroad closures, pump stations, earth filled sheet pilings, and concrete walls.

Within Vanderburgh County, direct and indirect effects from a dam or levee failure may include:

Direct Effects:

- Potential loss of life and severe damage to downstream homes, industrial and commercial buildings, public utilities, major highways, or railroads
- Loss of use of reservoirs for flood control, recreation, and water supply.

Indirect Effects:

- Environmental damage includes loss of land in the immediate scour area, sudden release of water can alter landscapes, erode soil, destroy habitats, and lead to the loss of wildlife.
- If contamination is in the water, it could affect water quality and potentially cause health problems.
- Increased response times due to damaged or re-routed transportation routes and/or bridges
- Long lasting economic impacts on the community due to business closures, and relocation of impacted property owners.
- Economic impacts also include the cost of property damage, cleanup, and recovery.
- There can be significant social impacts, such as displacement of people and disruption of communities.

Estimating Potential Losses

As of July 1, 2022, the State of Indiana is requiring high hazard dams to have IEAPs developed. These plans have detailed potential dam failure inundation areas identified along with at-risk structures identified. The actual magnitude and extent of damage depend on the type of dam break, the volume of water that is released, and the width of the floodplain valley to accommodate the dam break flood wave. All dam owners are encouraged to develop an IEAP. There has not been a formal equivalent to an IEAP for levee structures, until July 2025 when USACE published a Levee EAP template. In the past a limited number of basic Flood Wall Emergency Evacuation Plans (FWEEPs) were written, however, most have not been updated nor shared with public safety agencies.

Using the IDNR breach inundation map and aerial images, a structure count was conducted similar to the exercise completed for floods. This helps to identify the number of structures which may impacted should a breach occur. Failure of the USI Reflection Pond Dam may result in damage to 11 downstream residential structures, two university buildings and an electrical substation. Roads, especially on or near the USI campus which intersect the inundation area would at a minimum be overtopped and in a worst-case situation be washed out. In comparison, should a breach of the levee system occur, much of the City of Evansville would be impacted.

There is always a residual flood risk behind levees due to overtopping or structural failure. Should a failure occur, the estimated damage for the 8,037 structures behind the levee in Evansville would be $904.38M.

Utilizing GIS maps and orthoimagery, the infrastructure and other features behind these levees can be identified. This imagery will show properties that would be isolated due to the inundation of the roadways leading in and out of the area as well as those properties which would be inundated. **Table 20** enumerates the structures , people, and critical structures behind the levee. The data in the table is from the National Levee Inventory which is maintained by USACE.

Future Considerations

As areas near existing levees and dams continue to grow in population, it can be anticipated that the number of critical and non-critical structures could also increase accordingly. Location of these new facilities should be carefully considered, and precautions should be taken to ensure that schools, medical facilities, municipal buildings, and other critical infrastructure are located outside of the delineated or estimated levee and dam failure inundation areas. Also, flood-free access should be provided for these facilities. Until such development or re-development downstream of a dam is prohibited, those areas remain vulnerable to losses and damage associated with failure of that structure.

It is also particularly important to all downstream communities and property owners that dam IEAPs are developed, kept up-to-date, and routinely exercised to ensure the greatest safety to those within the hazard area. Although not mandated, this is the best management practice for significant and low hazard dams as well.

The levee system will require regular maintenance according to the levee safety program requirements. Although failure is always a possibility with a record-breaking extreme precipitation event, it is not anticipated to take place in the near future (the next 10 years). The protected community continues to work with the levee authority to reduce potential damage through outreach efforts and assuring property owners are informed on ways to mitigate their risks, such as building on higher ground, and maintaining flood insurance policies. These mitigation efforts are a part of the day-to-day operations of the area planning commission and building department, for all levees, as they issue permits and discuss floodplain issues with nearby property owners.

Relationship to Other Hazards

With the potentially large volumes and velocities of water released during a breach, it can be expected that such a failure would lead to flooding and debris flow within the inundation areas downstream of the dam. Nearby bridges and roads are also in danger of being destroyed or damaged due to dam failure. Bridges may become unstable, and portions of road surfaces may be washed away. Entire roads may be undermined by the forces of water and debris. Other infrastructure such as utility poles and lines may be damaged as the water and debris flows along. Buried utility pipes may become exposed due to scouring; all of which may lead to utility failures within the area downstream of the dam failure.

Due to flood and debris flow damage, hazardous materials facilities and transportation routes may be damaged resulting in releases. If LP gas tanks are located nearby, they may be torn from their mountings and would become part of the flowing debris as well as leaking their contents from the ruptured service lines.

4.2.11 HAZARDOUS MATERIALS INCIDENT

Overview

Hazardous materials are substances that pose a potential threat to life, health, property, and the environment if they are released. These releases create a serious hazard for workers, neighbors, and emergency response personnel. Emergency response to a release may require fire, safety/law enforcement, search and rescue, and hazardous materials response units.

As materials are transported for treatment, disposal, or transport to another facility, all infrastructure, facilities, and residences near the transportation routes are at an elevated risk of being affected by a hazardous materials release. Often these releases can cause serious harm to Vanderburgh County and its residents if proper and immediate actions are not taken. Most releases are the result of human error or improper storage and corrective actions to stabilize these incidents may not always be feasible or practical in nature.

Railways often transport materials that are classified as hazardous, and preparations need to be made and exercised for situations such as derailments, train/vehicle crashes, and/or general leaks and spills from transport cars.

Location

During conversations with committee members and through information provided by local news outlets, it was noted that numerous small and moderately sized incidents involving manufacturing facilities and transportation routes have occurred since the development of the original MHMP. However, the number of SARA Title III Tier II facilities utilizing, storing, and/or manufacturing chemicals has decreased over the years as facilities reduce the amount hazardous materials on site. Both Tier II and other chemical facilities as well as businesses and industries rely on just in time delivery which results in an increase in the number of delivery vehicles transporting hazardous materials across the county. Major highways in Vanderburgh County are:

- Interstate 69 runs north and south through the county
- Interstate 64 runs east and west at the northern boundary of the county
- U S Route 41 runs north and south
- State Roads 57,62,65, and 66 (Lloyd Expressway)
- Ohio River Bridge to Kentucky

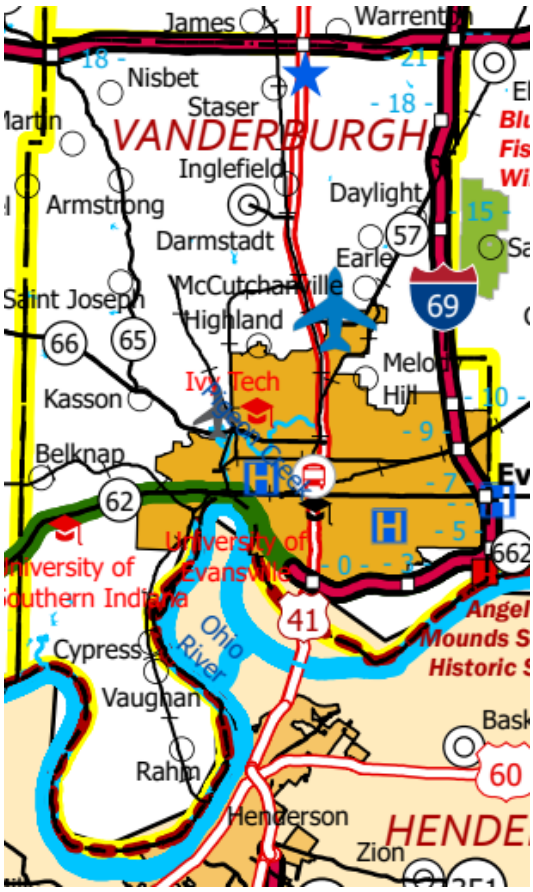


Figure 32: Vanderburgh County Transportation Map

There are several major railroads transporting both commerce and public crossing through the county. They include the following:

- CSX Railroad
- ISW Railroad

Hazardous materials cargo is also transported up and down the Ohio River on barges moving commodities from the seaports in New Orleans, Louisiana to industries in upstate Pennsylvania, linking the east coast to the midwestern and plains states. Most river based spill responses are lead by the US Coast Guard with assistance from local hazardous materials teams.

As the volume of traffic increases the potential for incidents increases as well. (**Figure 32**). Evansville Fire Department has a technician level hazardous materials response team, and the neighboring fire departments also have hazardous materials response capacity. Should multiple large events take place simultaneously, or should an event be of an extended nature, Vanderburgh County has mutual aid hazardous materials agreements to augment their capacity.

Extent and History

According to IDEM Spill Reporting Statistics, from January 1, 2019, to October 1, 2025, 142 hazardous materials spills and/or releases were reported in Vanderburgh County. While this is an extensive list not all spills are reported. Immediate response is required for all spills. Industrial spills of a smaller nature are often handled by on site hazardous materials trained staff members and on call cleanup firms which may not require public safety responders on site.

Hazardous materials spills associated with vehicular accidents are often small releases with a limited response for cleaning up the materials and re-opening the roadway. However, some accidents can cause major traffic issues as interstate or high-volume state roads are closed to address the hazardous materials situation. One such incident was near the county line on August 12, 2019, when the eastbound lanes of State Road 66 between Newburgh and Evansville were closed due to a chemical leak. Four people, a state trooper and three drivers were taken to the hospital as a precaution, and the closure resulted in traffic being re-routed through local streets while the hazardous materials team spill was cleaned up.

Probability

According to the committee, the probability of a hazardous materials release or incident ranges from "Likely" to "Highly Likely." The number transportation routes within each community impacted the probability of a release. "Negligible" to "Limited" damage is anticipated to result from an incident. The level of damage is dependent upon the location of the incident, the size of the release and the material involved. As with hazards of this nature, a short warning time of less than six hours and a short duration for average incidents, less than a day is anticipated. Larger or more complicated hazardous materials incident duration can stretch from less than a day to over a week. A summary is shown in **Appendix 8**.

Vulnerability

Within Vanderburgh County, direct and indirect effects from a hazardous materials incident may include:

Direct Effects:

- Acute or chronic health issues due to chemical exposure.
- Closure of impacted railroad crossings.
- Possible crop or livestock damage from chemical exposure.
- Damage to infrastructure from leaks, accidents, or recovery operations.
- Expense of decontamination and reconstruction of affected structures.

- Damage to plants, trees, and wildlife in the area of the release

Indirect Effects:

- Loss of revenue or production while testing, recovery and/or reconstruction occurs.
- Anxiety or stress related to the event.
- Potential evacuation of neighboring structures or facilities.
- Evacuation and/or relocation of people living in the impacted area, including homeless encampments.
- Added expenses detouring traffic around incident location.
- Expenses are incurred due to response, testing, and cleaning of the affected areas.
- Reduced business and/or tourism in the impacted areas.

While the possibility of an incident occurring may be likely, the vulnerability of Vanderburgh County has been lowered due to the enactment of Superfund Amendments and Reauthorization Act (SARA) Title III national, state, and local requirements. SARA Title III, also known as the Emergency Planning and Community Right to Know Act (EPCRA), establishes requirements for planning and training at all levels of government and industry. EPCRA also establishes provisions for citizens to have access to information related to the type and quantity of hazardous materials being utilized, stored, transported, or released within their communities.

One local result of SARA Title III is the formation of the LEPC. This committee has the responsibility for preparing and implementing emergency response plans, cataloging Safety Data Sheets (SDS) formerly known as Material Safety Data Sheets (MSDS), creating chemical inventories of local industries and businesses, and reporting materials necessary for compliance.

In Vanderburgh County, Tier II facilities are subject to SARA Title III provisions due to the presence of listed hazardous materials in quantities at or above the minimum threshold established by the Act. These facilities are also required to create and distribute emergency plans and facility maps to local emergency responders such as the LEPC, fire departments, and police departments. With this knowledge on hand, emergency responders and other local government officials can be better prepared to plan for an emergency and the response it would require, and to better prevent serious effects to the community involved.

Estimating Potential Losses

In addition, the very nature of these incidents makes predicting the extent of their damage very difficult. A small-scale spill or release might have a minor impact and would require only minimal response efforts. Another slightly larger incident might result in the disruption of business or traffic patterns, and in this situation, might require active control response measures to contain a spill or release, such as in **Figure 33**. However, even small, or moderate events could potentially grow large enough that mass evacuations or shelter in place techniques are needed, multiple levels of response are utilized, and additional hazards such as structural fires and/or additional hazardous materials releases (or explosions) may occur. Given

Figure 33: Hazardous Material Spill

the unpredictable nature of hazardous materials incident, an estimate of potential losses was not generated.

Future Considerations

Additional facilities, both critical and non-critical in nature, may be affected if a hazardous materials release were to occur along a transportation route. All of the Interstates, US Highways and state roads are traveled by carriers of hazardous materials. As businesses and industries increase in the area, the increased use of these routes will increase the number of transportation related incidents.

By restricting development within the known hazardous materials facility buffer zones, future losses associated with a hazardous materials release can be reduced. Critical infrastructure should be especially discouraged from being located within these areas. Further, by restricting construction in these zones, the number of potentially impacted residents may also be reduced, lowering the risk for social losses, injuries, and potential deaths. Future construction of hazardous materials facilities should be located away from critical infrastructure such as schools, medical facilities, municipal buildings, and daycares. Such construction would likely reduce the risk to highly populated buildings and populations with physical or social, emotional, or behavioral challenges or considerations such as children, elderly, and medically fragile individuals.

Many facilities constructed within close proximity to a hazardous materials facility are similar due to local zoning ordinances. This reduces the risk and vulnerability of some populations. However, there are several facilities and numerous transportation routes located throughout each of the communities making current and future development at risk for losses associated with a hazardous materials release.

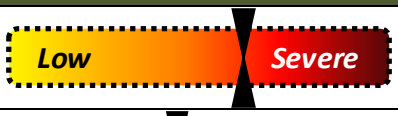
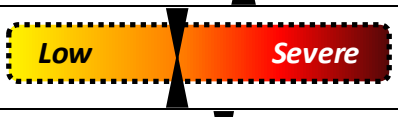
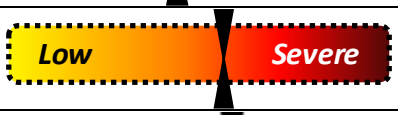
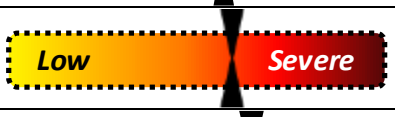
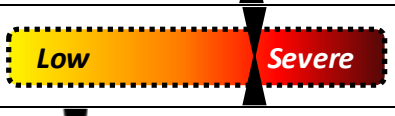
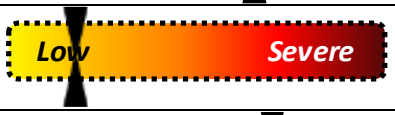
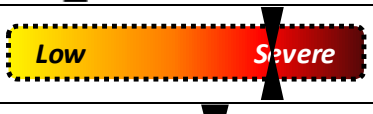
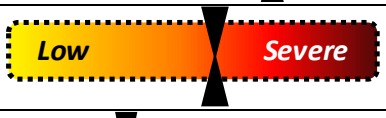
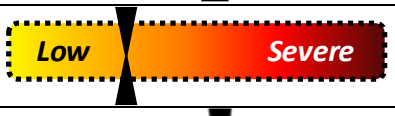
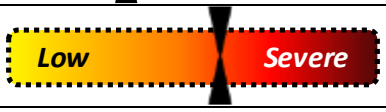
Relationship to Other Hazards

Dependent on the nature of the release, conditions may exist where a fire or spark ignites a flammable or explosive substance. As the fire spreads throughout the facility or the area, structural and/or property damage will increase. If the hazardous substances are enclosed containers such as railroad tank cards, cylinders, or other containers near heat generating events such as a fire, explosion becomes a risk as well. Response times to a hazardous materials incident may be prolonged until all necessary information is collected detailing the type and amount of chemicals potentially involved in the incident. Depending on the nature of the incident, further delays may take place until qualified hazardous materials responders with the appropriate response and monitoring equipment can be transported to the incident location. While this may increase structural losses, it may decrease social losses such as injuries or even deaths.

4.3 HAZARD SUMMARY

For the development of this MHMP, the committee utilized the CPRI method to prioritize the hazards they felt affected Vanderburgh County. Hazards were assigned values based on the probability or likelihood of occurrence, the magnitude or severity of the incident, as well as warning time and duration of the incident itself. A weighted CPRI was calculated based on the percent of the county's population present in the individual communities. **Table 21** summarizes the CPRI values for the various hazards studied within this MHMP and their ranking.

Table 21: Combined CPRI and Ranking for Each Hazard

Type of Hazard	List of Hazards	Weighted Average CPRI	Score	Ranking
Natural	Drought		2.84	4
	Earthquake		2.31	9
	Extreme Temperature		2.69	7
	Fires and Wildfire		2.79	5
	Flood		2.98	3
	Hail, Thunder, and Wind Storms		3.01	2
	Landslide, Land Subsidence, and Fluvial Erosion		1.49	11
	Tornado		3.26	1
	Winter Storms and Ice		2.69	8
Technological	Dam and Levee Failure		1.91	10
	Hazardous Materials Incident		2.75	6

It is important to understand the cause-and-effect relationship between the hazards selected by the committee. **Table 22** can be utilized to identify those relationships. For example, a winter storm (along the side of the table) can result in a flood (along the top of the table). In a similar fashion, a

hazardous materials incident (along the top of the table) can be caused by an earthquake; flood; tornado; or a winter storm or ice storm (along the side of the table).

Table 22: Hazard Reference Table

EFFECT → / CAUSE ↓	Drought	Earthquake	Extreme Temperature	Fires and Wildfire	Flood	Hail, Thunder, and Wind Storms	Landslide, Subsidence, and Fluvial Erosion	Tornado	Winter Storms and Ice	Dam and Levee Failure	Hazardous Materials Incident
Drought				X							
Earthquake				X			X			X	X
Extreme Temperature											X
Fires and Wildfire											X
Flood							X			X	X
Hail, Thunder, and Wind Storms				X	X		X			X	X
Landslide, Subsidence, and Fluvial Erosion					X					X	X
Tornado				X						X	X
Winter Storms and Ice					X					X	X
Dam and Levee Failure					X		X				X
Hazardous Materials Incident				X							

As a method of better identifying the potential relationships between hazards, the community exhibits can be referenced to indicate the proximity of one or more known hazard areas such as the delineated floodplains and the locations of EHS facilities. For this reason, many of the communities in Vanderburgh County may be impacted by more than one hazard at a time, depending on certain conditions. It can be anticipated that if a flood were to occur within these areas, there would be a potentially increased risk of a facility experiencing a hazardous materials incident. These areas may also be at greater risk of a dam or levee failure.

Future development in areas where multiple known hazard areas (dam failure inundation areas, floodplains and surrounding hazardous materials facilities) overlap should undergo careful design, review, and construction protocol to reduce the risk of social, physical, and economic losses due to a hazard incident. While it may certainly be difficult, critical infrastructure should not be constructed within these regions.

The ever-changing climate can also have a significant impact on these hazards. According to NOAA NCEI the State Climate Summary for Indiana the following observations have been observed based upon climate change:

- The global temperatures have risen almost 1.5˚F since the beginning of the 20th Century. Temperatures in the 2000's have been higher than in any other historical period except during the most recent interglacial period, or over 100,000 years ago.
- Indiana has experienced increases in the number and intensity of rain events while the individual duration of the rain events has been decreasing.
- Extreme events are increasing, especially flooding

CHAPTER 5: MITIGATION STRATEGY

This section identifies the overall goal for the development and implementation of the Vanderburgh County MHMP. A summary of existing and proposed mitigation practices discussed by the committee is also provided.

5.1 MITIGATION GOAL

REQUIREMENT §201.6(c)(3)(i):

[The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

The committee reviewed the mitigation goals as outlined within the previous Vanderburgh County MHMP and determined that the goals remain valid and effective. In summary, the overall goal of the Vanderburgh County MHMP is to reduce the social, physical, and economic losses associated with hazard incidents through emergency services, natural resource protection, prevention, property protection, public information, and structural control mitigation practices. The three specific goals to achieve the overall goal of the plan are:

1. Lessen the impacts of disasters and enhance community resilience.
2. Minimize the loss of life and injuries caused by disasters.
3. Promote mitigation activities both prior to and following a disaster.

5.2 MITIGATION PRACTICES

REQUIREMENT §201.6(c)(3)(ii):

[The mitigation strategy shall include a] section that identifies and analyzed a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

REQUIREMENT §201.6(c)(3)(iii):

[The mitigation strategy section shall include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

In 2005, the Multi-Hazard Mitigation Council conducted a study about the benefits of hazard mitigation. This study examined grants over a 10-year period (1993-2003) aimed at reducing future damages from earthquakes, wind, and floods. It found that mitigation efforts were cost-effective at reducing future losses; resulted in significant benefits to society; and represented significant potential savings to the federal treasury in terms of reduced hazard-related expenditures. This study found that every $1 spent on mitigation efforts resulted in an average of $4 savings for the community. The study also found that FEMA mitigation grants are cost-effective since they often lead to additional non-federally funded mitigation activities and have the greatest benefits in communities that have institutionalized hazard mitigation programs.

A more recent (2019) study by the National Institute of Building Sciences reviewed over 23 years of federally funded mitigation grants, not only from FEMA but also from the US Economic

Development Administration (EDA) and the US Department of Housing and Urban Development (HUD). From this broadened review, it has been determined that for every $1 spent on mitigation, $6 is saved on disaster costs. In addition, by designing and construction buildings which exceed select items in the 2018 International Code, a minimum of $6 can be saved for every $1 invested in those changes based on mitigation category with the total benefit for construction to meet the 2018 Residential and Building Codes being $11saved for every $1 invested.

Six primary mitigation practices defined by FEMA are:

- **Emergency Services** – measures that protect people during and after a hazard.
- **Natural Resource Protection** – opportunities to preserve and restore natural areas and their function to reduce the impact of hazards.
- **Prevention** – measures that are designed to keep the problem from occurring or getting worse.
- **Property Protection** – measures that are used to modify buildings subject to hazard damage rather than to keep the hazard away.
- **Public Information** – those activities that advise property owners, potential property owners, and visitors about the hazards, ways to protect themselves and their property from the hazards.
- **Structural Control** – physical measures used to prevent hazards from reaching a property.

5.2.1 EXISTING MITIGATION PRACTICES

As part of this planning effort, committee members were forwarded a copy of the prior MHMP's mitigation actions. Committee members reviewed those actions and were asked to consider any and all other mitigation actions based on the hazards discussed during the first planning committee meeting. At the second planning committee meeting, the committee discussed the strengths and weaknesses of existing mitigation practices and made recommendations for improvements, as well as suggested new practices. The committee also examined practices employed by neighboring communities assessing the viability of those actions within Vanderburgh County. The following is a summary of existing hazard mitigation practices within Vanderburgh County. mitigation measures that were included in the previous MHMP are noted as such. A list of the former mitigation actions included in the previous MHMP and their status may be found in **Appendix 11**.

Emergency Services

- Training and table-top exercises are conducted by the LEPC and EMA. Annual exercises are held for large event gatherings such as the Nut Club Fall Festival as well as for fixed facilities including the Evansville Regional Airport. Exercises typically include the following: police, fire, and local EMS agencies as well as property owners and operators and other impacted agencies.
- There are 41 outdoor warning sirens are located throughout the county especially in areas where higher concentrations of people reside and work. The outdoor warning sirens are maintained in operational condition and are regularly tested using a centralized system.
- The EMA has an active outdoor warning siren purchasing program which includes neighboring counties.
- Water and Sewer Department staff are trained and OSHA certified for confined space operations. Necessary equipment was purchased to allow the staff to operate safely within the confined spaces.

Natural Resource Protection

- Pigeon Creek Watershed Development Commission was formed in 2024.
- The City of Evansville through the Evansville Climate Collaborative (ECC) revised the original Climate Action Plan (CAP) using grant funding from the Department of Energy's Energy Efficiency and Conservation Block Grant program.

Prevention

- Vanderburgh County LEPC provides training regarding the proper storage, transport, and disposal of hazardous materials.
- Information related to natural hazards has been incorporated into plans and guidance materials to better guide future growth and development. Plans include the CAP, the Evansville-Vanderburgh County Comprehensive Plan, and the Emergency Operations Plan.
- Evansville-Vanderburgh County, Bally's Casino, and the Evansville Regional Airport have been designated StormReady by the NWS.
- A burn ban ordinance is in place along with permitting process and educational materials.

Property Protection

- Vanderburgh County continues to encourage the removal of critical facilities from the floodplain.
- The CRS program conducts an annual mailing campaign to property owners in frequent flood impacted areas to encourage flood resilience.

Public Information

- Outreach materials and hazard preparedness materials are routinely provided online, within offices and agencies in Vanderburgh County, at large public events, speaking opportunities within schools, service organizations, and similar opportunities.
- Vanderburgh County established a 5-gallon bucket campaign to help community members be prepared for disaster. A list of bucket contents and demonstration units are available at community events.
- IPAWS is active and is used during disaster events to help inform community members about potential disaster events before, during and after the event as needed.
- Local news media have very informative and timely computer and cellphone apps keeping the community aware of weather-related issues.

Structural Control

- Evansville-Vanderburgh County contracted Burke Engineering to study the flooding challenges associated with Pigeon Creek and propose a variety of ways to address the challenges.
- Utilities have been burying lines in new developments and new construction to reduce the impact of hazards.
- Six Evansville Fire Department stations have hardened the facilities to accommodate community members as places of refuge during storm events.

5.2.2 PROPOSED MITIGATION PRACTICES

After reviewing existing mitigation practices, the committee reviewed mitigation ideas for each of the hazards studied and identified which of these they felt best met their needs as a community according to selected social, technical, administrative, political, and legal criteria. The following identifies the key considerations for each evaluation criteria:

- **Social** – mitigation projects will have community acceptance, they are compatible with present and future community values, and do not adversely affect one segment of the population.
- **Technical** – mitigation projects will be technically feasible, reduce losses in the long-term, and will not create more problems than they solve.
- **Administrative** – mitigation projects may require additional staff time, alternative sources of funding, and have some maintenance requirements.
- **Political** – mitigation projects will have political and public support.
- **Legal** – mitigation projects will be implemented through the laws, ordinances, and resolutions that are in place.
- **Economic** – mitigation projects can be funded in current or upcoming budget cycles.
- **Environmental** – mitigation projects may have negative consequences on environmental assets such as wetlands, threatened or endangered species, or other protected natural resources.

Table 23 lists a summary of all proposed mitigation practices identified for all hazards, as well as information on the local status, local priority, benefit-cost ratio, project location, and responsible entities. Because of the large number of funding opportunities, a list of potential funding sources is located in **Appendix 12**. The proposed mitigation practices were assigned a priority by the planning committee. Projects identified to be of "high" local priority may be implemented within five years from final plan adoption. Projects identified to be of "medium" local priority may be implemented within five to 10 years from final plan adoption, and projects identified by the committee to be of "low" local priority may be implemented within 10+ years from final plan adoption. However, depending on availability of funding, some proposed mitigation projects may take longer to implement.

As part of the process to identify potential mitigation projects, the planning committee weighed the benefit derived from each mitigation practice against the estimated cost of that practice. This basic benefit-cost ratio was based on experience and professional judgement and was utilized to identify the mitigation practices as having a high, moderate, or low benefit-cost ratio. Preparing detailed benefit-cost ratios was beyond the scope of this planning effort and the intent of the MHMP.

The update of this MHMP is a necessary step of a multi-step process to implement programs, policies, and projects to mitigate the effect of hazards in Vanderburgh County. The intent of this planning effort was to identify the hazards and the extent to which they affect the county and to determine what type of mitigation strategies or practices may be undertaken to mitigate these hazards. A FEMA-approved MHMP is required to apply for and/or receive project grants under BRIC, HMGP, and FMA. Although this MHMP meets the requirements of DMA 2000 and eligibility requirements of these grant programs, additional detailed studies may need to be completed prior to applying for these grants. **Section 6** of this plan includes an implementation plan for all high priority mitigation practices identified by the planning committee.

The CRS program credits NFIP communities with a maximum of 97 points for setting goals to reduce the impact of flooding and other known natural hazards (2 points); identifying mitigation projects that include activities for prevention, property protection, natural resource protection, emergency services, structural control projects, and public information (up to 95 points).

Table 23: Proposed Mitigation Measures

Mitigation Practice	Prior Plan or New	Mitigation Strategy	Hazard Addressed	Proposed Enhancements	Priority	Benefit-Cost Ratio	Responsible Entity
Communications							
1. Explore alternative emergency notification tools to ensure community members receive warnings in a timely manner.	New	☒ Emergency Services ☐ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☐ Structural Control	All Hazards	Encourage the use of emergency notification apps on smart phones as an additional warning mechanism.	High	High	EMA PIO Evansville Vanderburgh Co. PIO
Emergency Preparedness and Warning							
1. Coordinate emergency management drills with other agencies and industries in the community.	Prior	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☐ Structural Control	All Hazards	Conduct and expand regular exercise activities with community leaders, businesses, and industry and first response agencies. Partner with neighboring counties	High	High to Moderate	LEPC EMA
2. Consider addition of outdoor warning sirens, where need is identified.	New		Tornado	Conduct a gap analysis to identify areas where outdoor warning siren coverage is still needed.	High		EMA
3. Explore partnerships to provide home safety and resilience tools and classes for homeowners, renters, building professionals, and contractors.	Prior		Fire and Wildfire	Purchase and install home smoke detectors with 10-year batteries, as funds are available. Continue to provide home safety information at fairs and other large group gatherings.	High		Red Cross Evansville and County Fire Departments.
4. Coordinate annual meetings of the Vanderburgh County Multi Hazard Mitigation planning committee to monitor, evaluate, and update the multi-hazard mitigation plan.	Prior		All Hazards	Schedule annual meeting of the MHMP planning committee to assess progress made and goals for the upcoming year.	Medium		EMA
5. Encourage purchase of earthquake hazard insurance throughout Vanderburgh County, including the City of Evansville and the Town of Darmstadt.	Prior		Earthquake	Encourage community members to purchase earthquake insurance using CUSEC outreach materials.	Medium		EMA County, Darmstadt, and Evansville Building Departments
6. Purchase and distribute NOAA weather radios throughout Vanderburgh County, including the City of Evansville and the Town of Darmstadt.	Prior		All Hazards	Purchase additional NOAA weather alert radios for distribution, as funding permits. Use grant funds and large volume purchases wherever possible.	Medium		Red Cross EMA
7. Maintain outdoor warning siren coverage at current levels . Increase number of outdoor warning sirens as needs are identified.	New		All Hazards	Replace aging mechanical outdoor warning sirens (from 1980s) as funding permits. Estimate 10-15 units in next five years.	Medium		EMA
8. Provide equipment and training for confined space entry to perform routine inspections of large diameter storm sewers.	New		All Hazards, except drought	Make available and complete OSHA required confined space entry annual refresher training.	Low		Evansville Water and Sewer Department.
9. Encourage new housing developments to use underground utilities.	Prior		All Hazards	Encourage all new developments to bury utility services.	Low		County and Evansville Building Departments
Emergency Response and Recovery							
1. Coordinate with utilities (CenterPoint) regarding clean up and removal of trees and limbs in streets following hazard event.	Prior	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☐ Property Protection ☒ Public Information ☐ Structural Control	Flood Hail, Thunder, and Wind Storms Tornado	Improve post disaster communications with CenterPoint to help coordinate road clearance efforts.	High	High	EMA CenterPoint City of Evansville Street Dept., Fire Dept., and Water and Sewer Dept.

Mitigation Practice	Prior Plan or New	Mitigation Strategy	Hazard Addressed	Proposed Enhancements	Priority	Benefit-Cost Ratio	Responsible Entity
2. Coordinate with Vanderburgh County Surveyor to utilize "Section Line Grid" to address and prioritize disaster response and recovery activities.	Prior		All Hazards	Create a one square mile grid overlay, similar to search and rescue, for city and county to use if addresses are not available. Train users and implement as a layer on the dispatch cad system.	Medium		EMA 911 Communications Center Vanderburgh County Surveyor
3. Organize post storm debris clearance action plans to coordinate efforts.	New		Flood Hail, Thunder, and Wind Storms Tornado	Coordinate post storm sawyer teams between City/County and CenterPoint. Review debris plans regarding debris removal.	Medium		City of Evansville EMA
Land Use and Zoning							
1. Define process for establishing a burn ban within Vanderburgh County.	Prior	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☐ Public Information ☒ Structural Control	Drought Fire and Wildfire	Bring city and county leaders together to establish a written process/protocol to coordinate burn ban declarations.	High	Moderate	Evansville and all county fire chiefs EMA
2. Encourage new construction to build with seismic resiliency as a goal	New		Earthquake	Use the most current model building code seismic standards and practices.	Medium		County and City Building Department
3. Investigate financial incentives for property owners to make seismic retrofits to existing buildings, particularly un-reinforced masonry structures, located within the earthquake hazard area. Pursue alternative funding sources for structural retrofits for critical facilities.	Prior		Earthquake	Educate members of the public about seismic retrofits and share potential funding sources and/or incentives to pursue such retrofits for their homes.	Low		EMA
Power Back Up Generators							
1. Inventory critical and essential facilities status regarding storm resilience hardening and generator connections and/or generator installation.	New	☒ Emergency Services ☐ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☐ Public Information ☐ Structural Control	All Hazards	Complete a study of critical and essential facilities to identify locations still needing to be hardened and locations requiring generator connections to serve as shelters.	High	Moderate	EMA
2. Monitor implementation of alternative energy sources and encourage additional installations at critical and essential facilities.	New		All Hazards	Develop a data collection tool to measure progress in improving energy security and reliability.	High		Evansville Climate Office
3. Retrofit critical facilities to accept alternative energy sources, i.e., solar.	Prior		All Hazards	Utilize alternative energy sources, i.e., solar or wind, to improve energy security and reliability.	Medium		EMA Evansville Climate Office
Public Education & Outreach							
1. Develop dedicated website pages for multi-hazard mitigation information.	Prior	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☐ Structural Control	All Hazards	Work with new vendor to ensure mitigation information is included in new webpage version. Explore the potential of a separate page dedicated to Mitigation Actions	High	Moderate	Evansville Webmaster EMA
2. Add notification/subscription capabilities to Vanderburgh County Emergency Management / Hazard Mitigation website.	New		All Hazards	Encourage local media stations to continue providing their hazard notification apps	High		EMA
3. Identify website needs and consult with new vendors about the availability of services to meet identified needs.	Prior		All Hazards	Explore with new website vendor the inclusion of hazard notification materials to keep the community informed.	High		EMA Evansville Webmaster

Mitigation Practice	Prior Plan or New	Mitigation Strategy	Hazard Addressed	Proposed Enhancements	Priority	Benefit-Cost Ratio	Responsible Entity
4. Prepare CRS-compliant Program for Public Information (PPI) to revise and replace current public awareness campaign in coordination with the Evansville Vanderburgh School Corporation.	New		Flood	Coordinate the PPI planning effort with city and county officials using the CRS planning requirements.	High		Floodplain Administrators CRS Coordinator
5. Develop public damage reporting app/website to obtain information from the public during hazard events.	New		All Hazards	Encourage IDHS to roll out the damage reporting app and use it at the local level for consistent damage reporting at all levels of government.	High		EMA
6. Reach out to community members on ways they can be better prepared to be more resilient.	New		Drought Extreme Temperature	Share information on cooling kits as included in the climate plan.	High		Climate Office EMA
7. Encourage regular updates of webpages by new vendor.	Prior		All Hazards	Explore the possibility of having an EM staff member who can make interim webpage additions as needed.	Medium		EMA Evansville Webmaster
8. Add to the public awareness campaign information on living "off the grid' for three days ("jump kit") during hazard events.	Prior		All Hazards	Continue to share the five-gallon bucket preparedness kit and encourage people to consider supplies beyond three days for larger events.	Medium		EMA Climate Office
Safe Rooms and Community Shelters							
1. Identify additional means to encourage school systems to consider the installation of safe rooms.	New	☒ Emergency Services ☐ Nat. Res. Protection ☐ Prevention ☐ Property Protection ☒ Public Information ☒ Structural Control	All Hazards except Drought	Encourage the State Building Commission to advocate for the addition of safe rooms at all school buildings. (remodel or new construction)	High	Moderate	EMA Evansville/Vanderburgh County Building Dept.
2. Develop safe refuge mapping for county.	Prior		All Hazards except Drought	Inventory and map all existing shelters and classify based on functionality: cooling/warming place, place of refuge, storm shelter, safe room, or short-term overnight sheltering. For each location include capacities, ADA accessibility, pet friendliness, proximity to bus route, and generator status	High		EMA GIS Coordinator Red Cross
3. Implement mitigation recommendations from the Climate Plan	New		All Hazards except Drought	Identify and implement resilience hubs as discussed in the climate plan	High		Red Cross Evansville Climate Office EMA
4. In coordination with the American Red Cross, identify shelter locations with capabilities/ infrastructure for large capacity and generator hook-up.	Prior		All Hazards except Drought	Continue to identify locations requiring transfer switches to connect traditional and solar generators.	Medium		Evansville Climate Office EMA American Red Cross
5. Incorporate saferoom design into new school buildings.	Prior		All Hazards except Drought	Encourage the incorporation of saferoom designs into new school buildings and/or remodels	Medium		EMA Evansville/Vanderburgh County Building Dept School Corporation
6. Pursue alternative funding sources for structural retrofits to critical facilities.	Prior		All Hazards except Drought	Create an inventory of critical facilities and identify structural retrofits needed at each facility to enable the facility to serve as a safe refuge site, warming or colling site or shelter. Encourage the use of innovative funding sources to make the facilities more resilient.	Low		Evansville and County Fire Chiefs EMA

Mitigation Practice	Prior Plan or New	Mitigation Strategy	Hazard Addressed	Proposed Enhancements	Priority	Benefit-Cost Ratio	Responsible Entity
Building Protection							
1. Review current fire station resilience capabilities to serve as "oasis" during mass/expanded incidents.	Prior	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☐ Public Information ☒ Structural Control	All Hazards	Continue to harden additional Evansville fire stations for greater disaster resilience, as funding permits	Medium	Moderate	Evansville Fire Chief Evansville Mayor Evansville Building Dept.
Community Rating System (CRS)							
1. Update repetitive loss areas adjacent to the repetitive loss properties as new claim information is reported.	Prior	☐ Emergency Services ☐ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☒ Structural Control	Flood	Update the repetitive loss areas study using updated FEMA repetitive loss data.	Medium		Floodplain Administrators CRS Coordinator(s) (County and City joint effort)
2. Pursue and document CRS activities with ultimate goal of improving CRS class rating.	Prior		Flood	Pursue CRS activities to improve the community ratings and save additional monies on flood insurance rates.	Medium		CRS Coordinator(s) Evansville and County Building Department
Dam and Levee Management							
1. Obtain dam inundation mapping for future vulnerability analysis and development regulation.	Prior	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☐ Structural Control	Dam and Levee Failure	Work with IDNR to determine which dams have IEAPs and which do not.	Medium		EMA
Floodplain Management							
1. Purchase and install stream gages and water table gages to provide flood warning capabilities.	Prior	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☒ Structural Control	Flood	Pursue the addition of two gages: one near Lynch and Green River Rd., second in vicinity of Maryland St. bridge.	High	High to Moderate	Pigeon Creek Watershed Development Commission Floodplain Administrators USGS
2. Develop depth grids in coordination with FIRM updates to address roadway access and critical facilities during a flood event.	Prior		Flood	Utilize current flood inundation maps and FIRM data to identify flood impacts on infrastructure such as sewer system to identify areas of potential impact.	Medium		Evansville Water and Sewer Department
3. Develop interactive flood inundation mapping for the County in coordination with FIRM updates.	New		Flood	Encourage studies to develop depth grids to be incorporated into interactive flood inundation maps, as funding permits.	Medium		Pigeon Creek Watershed Development Commission
4. Pursue creek and stream clearing projects and funding.	Prior		Flood	Encourage the Pigeon Creek Watershed Development Commission to consider funding creek and stream clearing, where needed to reduce flooding potential.	Medium		Pigeon Creek Watershed Development Commission
5. Distribute National Flood Insurance Program information.	Prior		Flood	Identify new materials from the NFIP and the State of Indiana Insurance Commission and make available to the community along with all the other flood insurance information	Low		Floodplain Administrators

Mitigation Practice	Prior Plan or New	Mitigation Strategy	Hazard Addressed	Proposed Enhancements	Priority	Benefit-Cost Ratio	Responsible Entity
Stormwater							
1. Establish maximum runoff criteria for areas proposed for development.	Prior	☐ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☐ Public Information ☒ Structural Control	Flood Landslide, Land Subsidence, and Fluvial Erosion	Explore ways to incorporate flood volume in drainage code updates.	High	Moderate to High	City/County attorney Floodplain administrators MS4 Program leads from all Vanderburgh County MS4s (county, cities, towns, universities) City and County Drainage Boards
2. Increase flood resilience by encouraging the addition of local ordinances.	New		Flood	Add compensatory storage to the floodplain and stormwater ordinances.	High		City and County Drainage Boards Pigeon Creek Watershed Development Commission
3. Develop county-wide Stormwater Master Plan to provide relief from run-off and flooding resulting from rainfall events.	Prior		Flood	Encourage the development of a county-wide Stormwater Master Plan to help address run-off and flooding from rainfall events.	Medium		MS4 Programs City and County Drainage Boards
4. Based on existing Evansville Stormwater Master Plan, develop formalized policies (level-of-service and extent-of-service) for maintenance of the storm water drainage system.	Prior		Flood	Update the Evansville Stormwater Plan. Include timing of maintenance of stormwater inlets and drains to reduce flooding.	Medium		Evansville MS4 Program Evansville Water and Sewer Department

CHAPTER 6: IMPLEMENTATION PLAN

The following is a proposed plan for implementing all high priority mitigation practices identified in this plan. It should be noted that implementation of each of these proposed practices may involve several preparatory or intermediary steps. However, to maintain clarity, not all preparatory or intermediary steps are included. Medium and low priority categories are listed but will not show implementation steps. Implementation steps for the medium and low priority actions will be developed as the actions draw closer to execution.

6.1 COMMUNICATIONS

Explore alternative emergency notification tools to ensure community members receive warnings in a timely manner. Encourage the use of emergency notification apps on smart phones as an additional warning mechanism.

- Prepare a listing of available reliable smartphone applications with a description of what information is provided by the application and how to access the application.
- Make the listing available on webpages, during public events and mass gatherings.
- Reach out to local community organizations and churches to enlist their assistance in sharing the information and assisting members in turning on or installing the applications.

6.2 EMERGENCY PREPAREDNESS AND WARNING

Coordinate emergency management drills with other agencies and industries in the community. Conduct and expand regular exercise activities with community leaders, businesses, and industry and first response agencies. Partner with neighboring counties

- Meet with neighboring EMA Directors and public safety agency leaders to gauge interest and ability to provide mutual aid if needed. Establish protocols which will be included as a part of the exercise.
- Provide training materials and background information for participating agencies and include the exercise schedule and participant needs.
- Include assisting agencies in exercise planning meetings to ensure objectives developed address all participants. .

Conduct a gap analysis to identify areas where outdoor warning siren coverage is still needed.

- Identify existing outdoor warning siren locations and monitor the reach of the audible signal in all directions.
- Identify the current locations where the audible signal is not heard, including parks, ball fields, local neighborhoods, and businesses.
- Reach out to the area planning commission to identify the areas where growth is anticipated and where outdoor warning sirens will be required.

Purchase and install home smoke detectors with 10-year batteries, as funds are available. Continue to provide home safety information at fairs and other large group gatherings.

- Reach out to the Evansville Red Cross and identify potential funding available for smoke detector purchases.

- Pursue funding and purchase the smoke detectors. Encourage partner agencies to join forces and establish a single unified effort using volume purchasing capacities where possible.
- Form smoke detector installation teams with an operating protocol and checklist so all installations are completed in a similar manner.

6.3 EMERGENCY RESPONSE AND RECOVERY

Improve post disaster communications with CenterPoint to help coordinate road clearance efforts.

- Meet with the CenterPoint public safety liaison to discuss the challenges seen from the community perspective.
- Review community and company protocols for post disaster cleanup efforts and identify key communications points and ways to share strategies.
- Consider a variety of ways to share cleanup priority locations and progress to avoid redundant efforts.

Coordinate with Vanderburgh County Surveyor to utilize "Section Line Grid" to address and prioritize disaster response and recovery activities. Create a one square mile grid overlay, similar to search and rescue, for city and county to use if addresses are not available. Train users and implement as a layer on the dispatch cad system.

- Work with the surveyor's office and the GIS department to create the overlay layer maps.
- Develop a training program for dispatchers and a similar program for first responders on how to locate properties using the grid system and how to communicate the grids to one another.
- Hold exercises with newly trained staff using the grid system to locate a property. Consider using a model similar to geo cache to make the hands-on training effective.
- Conduct periodic training and hands on exercises to refine and maintain skills.

6.4 FLOODPLAIN MANAGEMENT

Purchase and install stream gages and water table gages to provide flood warning capabilities. Pursue the addition of two gages: one near Lynch and Green River Rd., second in vicinity of Maryland St. bridge.

- Meet with the Pigeon Creek Watershed Development Commission to discuss the need for the two gages.
- Identify potential funding sources and costs for each gage. Identify any possible community partners who would benefit from the gage information and would be willing to share on the annual operation and maintenance costs of the gages.
- Work with the USGS to purchase and install the gages and make use of solar energy to power gage data transmissions and recording.

6.5 LAND USE AND ZONING

Define process for establishing a burn ban within Vanderburgh County. Bring city and county leaders together to establish a written process/protocol to coordinate burn ban declarations.

- Host a meeting with city and county leaders to discuss the current and past methods of determining when to make a burn ban declaration, determine its duration and how it will be renewed or terminated.

- Agree upon which entity or entities have a responsibility to declare a burn ban.
- Prepare a document which is mutually agreed upon and outlines in a stepwise manner how burn bans will be declared and what communications are needed to ensure all are clear on declaration and enforcement of the ban as well as its termination.

6.6 POWER BACK-UP GENERATORS

Secure a fuel reserve or ensure contractual emergency provisions so critical infrastructure may run on power backup for extended periods of time. Explore options for fuel reserves if needed for power backup generators.

- Working with the Red Cross and shelter providers (current and future) assess the facility to identify the types of events the facility is best suited to be used.
- Identify the availability of power within the facility and backup capabilities and needs. Determine if the shelter facility has the financial means to assist with some of the costs for improvements and/or power backup installation.
- Prepare a list of the facilities identifying the facility needs and capacity.

Monitor implementation of alternative energy sources and encourage additional installations at critical and essential facilities. Develop a data collection tool to measure progress in improving energy security and reliability.

- Identify the parameters to be monitored and the time intervals to be monitored.
- Identify a means to gather the data for the tool. Consider self-reporting, installer reporting, survey teams, or similar means.
- Develop an interface that is easy to use and provides value to the user and the community. Ensure if the interface is used by large volume data providers as well as individual's that there are means for batch processing as well as individual data entry.

6.7 PUBLIC EDUCATION AND OUTREACH

Develop dedicated website pages for multi-hazard mitigation information. Work with new vendor to ensure mitigation information is included in new webpage version. Explore the potential of a separate page dedicated to Mitigation Actions

- Meet with the website development team which is working to update and change the current city/county webpage. Discuss EMA webpage portions and identify key portions of the page.
- Provide samples of desired functionality and core information to be shared on the page.
- Discuss the potential development of a mitigation actions page which would identify actions the public can take as well as efforts ongoing in the community.

- Identify what update time frames are planned and how disaster related updates or notices can be made rapidly. Explore if a member of the EMA or city/county staff can be given access to make an update or post.

Encourage local media stations to continue providing their hazard notification apps.

- Meet with media station contacts to both thank them for their notification services and explore any additional information needs the stations may have to enhance the service they are providing.

- Provide links to the media apps on the EMA webpage. Ensure links remain up to date when they are being shared.
- Explore providing an award or an acknowledgement of the media station's contribution to community safety.

Identify website needs and consult with new vendors about the availability of services to meet identified needs. Explore with new website vendor the inclusion of hazard notification materials to keep the community informed.

- After the initial key components of the new webpage are established for Evansville-Vanderburgh County, work with the vendor to explore how hazard notification materials can be added to keep the community informed.
- Consider a scrolling banner at the top or bottom of the webpage as an option.
- Consider a link in the news portion of the webpage.

Prepare CRS-compliant Program for Public Information (PPI) to revise and replace current public awareness campaign in coordination with the Evansville Vanderburgh School Corporation. Coordinate the PPI planning effort with city and county officials using the CRS planning requirements.

- Form a PPI planning team in accordance with CRS guidance, including the school corporation as one of the planning team members.
- Identify PPI materials to be included and conduct a community input opportunity to identify their areas of concern, means of information sharing, and information source preferences.
- Including community leadership input and discussion, outline the goals and milestones to achieve the goals of the PPI plan. Identify key positions and/or organizations responsible for each effort.

Encourage IDHS to roll out the damage reporting app and use it at the local level for consistent damage reporting at all levels of government.

- Discuss with the IDHS liaison IDHS plans for completing and finalizing the availability of the damage assessment reporting application.
- Secure letters of support from community leaders and agency leaders to help encourage IDHS to make the tool available to the county so damage reporting can be consistent and, in a format, acceptable to the agency.
- Offer to test the application at the local level under real event situations to help IDHS finalize the application.

Reach out to community members on ways they can be better prepared to be more resilient. Share information on cooling kits as included in the climate plan.

- Meet with the Evansville Climate Collaborative to identify the best ways to share the cooling kit.
- Add cooling kit information to the disaster preparedness handouts and demonstrations.
- Collaborate with the Evansville Climate Collaborative on ways to cross market personal safety and resilience between the two organizations.

6.8 SAFE ROOMS AND COMMUNITY SHELTERS

Identify additional means to encourage school systems to consider the installation of safe rooms. Encourage the State Building Commission to advocate for the addition of safe rooms at all school buildings. (remodel or new construction).

- Work with IDHS Mitigation Program to identify the best ways to inform the State Building Commission to encourage the inclusion of safe rooms during remodeling efforts and new construction at schools.
- Gather data about the storm risk and the number of "close calls" or damaged schools from storm events.
- Meet with the State Building Commissioner and the IDHS Director to present the data and the need for such encouragement.

Inventory and map all existing shelters and classify based on functionality: cooling/warming place, place of refuge, storm shelter, safe room, or short-term overnight sheltering. For each location include capacities, ADA accessibility, pet friendliness, proximity to bus route, and generator status.

- Identify large group gathering sites which are frequently used within the county. Determine the location of safer areas available during the gatherings or events.
- Identify all current storm shelters, safe rooms, and overnight shelters. Determine if agreements are in place for use of the facilities during storm events, or other needs.
- List and map each of the locations. In the inventory include facts such as level of protection, capacity, ADA accessibility, pet friendly, distance from bus route, and back up power supply.

Implement mitigation recommendations from the CAP. Identify and implement resilience hubs as discussed in the climate plan.

- Work with the Climate Collaborative to identify and prioritize the resilience hubs discussed in the CAP. Identify any actions where activity is already ongoing and might be more easily achieved.
- Using common priorities agree upon an implementation strategy for each item and key milestones to achieving the activity.
- Identify funding opportunities and potential sponsors. Celebrate the completion of activities and draw community attention to the accomplishments, thus encouraging additional forward momentum.

6.9 STORMWATER

Establish maximum runoff criteria for areas proposed for development. Explore ways to incorporate flood volume in drainage code updates.

- Identify best practices of communities who regulate not only rate of runoff but also volume.
- Prepare draft language to be included in the stormwater regulations and identify ways compliance may be achieved.
- Educate community leadership on the impacts of no regulating volume of runoff. Include in the educational materials the benefits achieved by regulating volume as well as rate of runoff. If possible, include case study showing how the inclusion of rate and volume has positively impacted the community.

CHAPTER 7: PLAN MAINTENANCE PROCESS

7.1 MONITORING, EVALUATING, AND UPDATING THE PLAN

REQUIREMENT §201.6(c)(4)(i):

[The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.

To effectively reduce social, physical, and economic losses in Vanderburgh County, it is important that implementation of this MHMP be monitored, evaluated, and updated. The EMA Director is ultimately responsible for the MHMP. As illustrated in Section 4.2 Mitigation Practices, this Plan contains mitigation program, projects, and policies from multiple departments within each incorporated community. Depending on grant opportunities and fiscal resources, mitigation practices may be implemented independently, by individual communities, or through local partnerships. Therefore, the successful implementation of this MHMP will require the participation and cooperation of the entire committee to successfully monitor, evaluate, and update the Vanderburgh County MHMP.

The EMA Director will reconvene with the MHMP committee on an annual basis and following a significant hazard incident. The committee will examine each mitigation action within the plan to evaluate its effectiveness by answering the following questions:

- Has the nature, magnitude, and/or type of risk changed? If so, what new mitigation actions are needed to address this change?
- Are the current resources appropriate for implementation? If not, what additional resources are needed to address the shortfall?
- Are there implementation problems, such as technical, political, legal, or coordination issues with other agencies? How can these issues be addressed?
- Have the outcomes occurred as expected? If not, is something else needed to achieve the desired outcome?
- Have the agencies and other partners participated as originally proposed? If not, determine why and how the action outcomes can be met.

During the annual meetings, the Implementation Checklist provided in **Appendix 10** will be helpful to track any progress, successes, and problems experienced. This will also be a tool to follow up on the progress made and effectiveness of the planned actions.

The data used to prepare this MHMP was based on "best available data" or data that was readily available during the development of this plan. Because of this, there are limitations to the data. As more accurate data becomes available, updates should be made to the list of essential facilities and infrastructure, the risk assessment, and vulnerability analysis.

DMA 2000 requires local jurisdictions to update and resubmit their MHMP within five years (from the date of FEMA approval) to continue to be eligible for mitigation project grant funding. In Vanderburgh County, the EMA Director will once again reconvene the MHMP committee for a series of meetings designed to replicate the original planning process. Information gathered following individual hazard incidents and annual meetings will be utilized along with updated vulnerability assessments to assess the risks associated with each hazard common in Vanderburgh County. These hazards, and associated mitigation goals and practices will be prioritized and detailed as in Section 3.0 this MHMP. Sections 4.0 and 5.0 will be updated to reflect any practices implemented within the interim as well as any additional practices discussed by the committee during the update process.

The plan update process will incorporate new planning guidance and best practices as planning requirements are updated.

Prior to submission of the updated MHMP, at a public meeting, such as the county commissioners meeting, a representative of the planning committee will present information about the plan to residents of Vanderburgh County and will provide them with an opportunity for review and comment of the draft MHMP. A media release will be issued providing information related to the update, the planning process, and details of the public invitation to review and comment on the plan update.

7.2 INCORPORATION INTO EXISTING PLANNING MECHANISMS

REQUIREMENT §201.6(c)(4)(ii):

[The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as the comprehensive or capital improvements, when appropriate.

Many of the mitigation practices identified as part of this planning process are ongoing with some enhancement needed. Where needed, modifications will be proposed for each NFIP communities' planning documents and ordinances during the regularly scheduled update including comprehensive plans, floodplain management plans, zoning ordinances, site development regulations, and permits. Modifications include discussions related to hazardous material facility buffers, floodplain areas, and discouraging development of new essential facilities and infrastructure in known hazard areas.

The MHMP will be used to update stormwater, subdivision and zoning ordinances based upon recommendations from the plan. For example, information in this plan provides documentation to encourage local officials to make changes to reduce release rates, protect floodplains, provide no net loss in special flood hazard areas, and manage erosion and sediment control. These measures would help mitigate flooding. New ordinances and studies could be initiated by the recommendations, such as flood studies, flood response studies, and watershed management studies to protect against floods. The information included in this plan can be very helpful in preparing comprehensive plans, transportation plans, and emergency plans to mitigate hazard material impacts and response to hazards such as tornados. These plans also illustrate the importance of planning on the unserved populations and how to develop mitigation efforts that include them in future plans.

In Vanderburgh County this is a similarly timed process. As the county embarks upon their ordinance updates, information is shared with Evansville and Darmstadt. Each community then evaluates the materials provided by the county and will seek adoption or incorporation on a similar schedule. Similarly, Evansville may initiate the process with the county joining in. This process has worked well in the past and is the anticipated method of future incorporation of materials into plan and ordinance updates. In a similar fashion the updating of comprehensive community plan, parks plan, etc. will be able to incorporate at risk population information as well as mitigation action opportunities. **Table 24** is an example of the process the communities use to incorporate planning elements into other community plans and ordinances.

Table 24: MHMP Incorporation Process

Step	Description of Process Action
1	Adopt MHMP at Commissioner Meeting, City Council Meeting, or Town Board Meeting
2	Identify document update cycles for each of the following: a) Comprehensive Plan b) Capital Improvement Plan c) Zoning Ordinances d) Floodplain Ordinance e) Stormwater Plans f) Other plans not listed above
3	Present Applicable data to the planning committee and committee leaders for inclusion
4	Highlight applicable mitigation actions to be included in the plan
5	Assist with incorporation and adoption of the plans, as needed.

7.3 CONTINUED PUBLIC INVOLVEMENT

REQUIREMENT §201.6(c)(4)(iii):

[The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.

Continued public involvement is critical to the successful implementation of the Vanderburgh County MHMP. Comments gathered from the public on the MHMP will be received by the EMA Director and forwarded to the MHMP committee for discussion. Education efforts for hazard mitigation will be the focus of the annual Severe Weather Awareness Week as well as incorporated into existing stormwater planning, land use planning, climate action planning, and special projects/studies efforts. Once adopted, a copy of this plan will be available for the public to review on the Evansville- Vanderburgh County website. Periodic reminder notices will be placed on social media to continue to solicit feedback and input on changes for the future plans.

Updates or modifications to the Vanderburgh County MHMP require public notice, reconvening the planning committee in accordance with FEMA local mitigation planning guidance and meeting with the incorporated community leaders prior to submitting revisions to the individual jurisdictions for approval and re-adoption.

The CRS program credits NFIP communities with a maximum of 28 points for adopting the Plan (2 points); establishing a procedure for implementation, review, and updating the Plan; and submitting an annual evaluation report (up to 26 points).

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