HENDRICKS COUNTY MULTI-HAZARD MITIGATION PLAN

JANUARY 2021

Prepared for:

Hendricks County Emergency Management Agency
355 S Washington St, Room #G60
Danville, IN 46122

Prepared by:

Christopher B. Burke Engineering, LLC
115 W. Washington St., Ste. 1368 S.
Indianapolis, IN 46204

Burke Project No. 19.R190005.00000

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF EXHIBITS

APPENDICES

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. The Hendricks 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. 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.

In order for National Flood Insurance Program (NFIP) communities to be eligible for future mitigation funds, they must adopt either 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. As representatives from **Hendricks County, Amo, Avon, Brownsburg, Clayton, Coatesville, Danville, Jamestown, Lizton, North Salem, Pittsboro, Plainfield, and Stilesville** have provided information, attended meetings, and participated in the planning process, the planning process used to update the Hendricks County MHMP satisfies the requirements of a multi-jurisdictional plan.

During Planning Committee meetings, those in attendance revisited existing (in the 2009 MHMP) and identified new critical facilities and local hazards; reviewed the State's mitigation goals and updated the local 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. Meetings were also conducted with key groups such as city planners and various emergency responders and their information will continue to be incorporated into the MHMP update.

Risk Assessment

The risk assessment conducted for the Hendricks County MHMP is based on the methodology described in the Local Multi-Hazard Mitigation Planning Guidance published by FEMA in 2013 and is incorporated into the following sections:

1. **Hazard Identification** lists the natural, technological, and political hazards selected as having the greatest direct and indirect impact to the county as well as the system used to rank and prioritize the hazards.
2. **Hazard Profile** for each hazard, discuss the 1) historic data relevant to the municipalities where available; 2) vulnerability in terms of number and type of structures, repetitive loss properties (flood only), estimation of potential losses, and impacts based on an analysis of development trends; and 3) the relationship to other hazards identified.
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 hazards.

When considering the hazards selected for study (drought; earthquake; extreme temperature; fire; flood; hail, thunder, wind; land subsidence; snow and ice storm; tornado; dam/levee failure; and hazardous materials incidents) and the information obtained regarding the hazard profile and the hazard summary, the attached table identifies the hazards studied and ranking outcome. The ranking is completed utilizing the Calculated Risk Priority Index (CPRI), a tool by which individual hazards are evaluated and ranked according to an indexing system considering probability, magnitude, warning time, and duration for any hazard.

1. **Probability** is defined as the likelihood of the hazard occurring over a given period.
2. **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.
3. **Warning Time** is defined as the length of time before the event occurs.
4. **Duration** is defined as the length of time that the actual event occurs. This does not include response or recovery efforts.

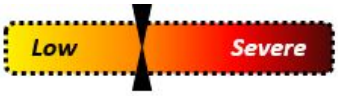
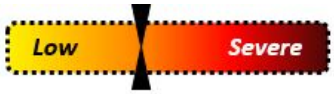
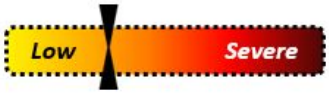
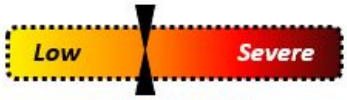
Mitigation Goals and Practices

The overall goal of the Hendricks 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.

As part of the planning process the Planning Committee discussed the strengths and weaknesses of existing mitigation practices and made recommendations for improvements, as well as suggested new practices. To provide further detail, information on the local status, local priority, benefit-cost ratio, project location, responsible entity, and potential funding source will be included with regard to each proposed practice. Those practices ranked by participants as a high priority are anticipated to be implemented within five years from the final Plan adoption and additional steps, or an implementation plan is included for each.

Plan Maintenance

The successful implementation of the MHMP will require the participation and cooperation of the entire Planning Committee to successfully monitor, evaluate, and update the Hendricks County MHMP. Local jurisdictions are required to update and resubmit the MHMP every five years. 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 Hendricks County.

Type of Hazard	List of Hazards	Weighted Average CPRI
Natural	Drought	
	Earthquake	
	Extreme Temperature	
	Fire	
	Flood	
	Hail/Thunder/Windstorm	
	Landslide/Subsidence	
	Tornado	
	Winter Storm/Ice	
Technological	Dam Failure	
	Hazardous Materials Incident	

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, **Figure 1** includes four phases:

Figure 1 Disaster Life Cycle

- **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)
- **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)

The Hendricks 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.

1.2 PROJECT SCOPE & PURPOSE

REQUIREMENT §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 (5) years in order to continue to be eligible for mitigation project grant funding.

A MHMP is a requirement of the Federal Disaster Mitigation Act of 2000 (DMA 2000). According to DMA 2000, 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 occurrences.

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). Although the Hendricks County 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.

For National Flood Insurance Program (NFIP) communities to be eligible for future mitigation funds, they must adopt either their own MHMP or participate in the development of a multi-jurisdictional MHMP. 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. As noted above, it is required that local jurisdictions review, revise, and resubmit the MHMP every five years. 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 updated MHMP may validate the information in the previously approved Plan or may be a major plan rewrite. 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 Hendricks County MHMP Update is a multi-jurisdictional planning effort led by the Hendricks County Emergency Management Agency (EMA). This Plan was prepared in partnership with Hendricks County, the towns of Amo, Avon, Brownsburg, Clayton, Coatesville, Danville, Jamestown, Lizton, North Salem, Pittsboro, Plainfield, and Stilesville. 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 approved Plan. As each of the communities had an equal opportunity for participation and representation in the planning process, the process used to update the Hendricks County MHMP satisfies the requirements of DMA 2000 in which multi-jurisdictional plans may be accepted.

Throughout this Plan, activities that could count toward Community Rating System (CRS) points are identified with the NFIP/CRS logo. The CRS 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 in 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 382 points toward participation in the CRS. At the time of this planning effort, Hendricks County participates in the CRS program at a Class 7.

Funding to update the MHMP was made available through a FEMA/DHS PDM grant awarded to the Hendricks County EMA and administered by IDHS. Hendricks County provided the local 25% match required by the grant. Christopher B. Burke Engineering, LLC (Burke) was hired to facilitate the planning process and prepare the Hendricks County MHMP under the direction of an American Institute of Certified Planners (AICP) certified planner.

1.3 ANALYSIS PROCESS

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 Hendricks County MHMP Update began in 2018 when the County EMA submitted a PDM Grant application to IDHS. The grant request was approved by FEMA and grant funds were awarded in 2019.

Once the grant was awarded, the planning process to update the 2009 MHMP took 15 months. This included a review period by IDHS and FEMA for the draft MHMP Update, and time for Hendricks County and communities to adopt the final MHMP Update.

1.3.1 Planning Committee

In March of 2020, the EMA compiled a list of 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; have been involved in hazard mitigation; have the tools necessary to reduce the impact of future hazard events; and/or served as a representative on the original Planning Committee in 2009. **Table 1** lists the individuals that actively participated on the Committee and the entity they represented.

Table 1: MHMP Update Committee

Name	Office	Representing
Michael Alexander	Amo Fire Department/EMS	Town of Amo
Brent Anderson	Plainfield Fire Department	Town of Plainfield
John Ayers	Engineering Department	Hendricks County
Kevin Basham	North Salem Fire Department	Town of North Salem
Doug Bignell	Clayton Town Council	Town of Clayton
Robin Brandgard	Plainfield Town Council	Town of Plainfield
Pat Bullock	Brownsburg Police Department	Town of Brownsburg
Ryan Cannon	Avon Town Manager	Town of Avon
Polly Carter	Stilesville Clerk-Treasurer	Town of Stilesville
Aaron Clapp	Jamestown Town Council	Town of Jamestown
Brett Clark	Sheriff Department	Hendricks County
Steve Cook	Communications Department	Hendricks County
Jeff Corder	Health Department	Hendricks County
Tonya Cottrell	Floodplain Administrator	Hendricks County
Dennis Dawes	Brownsburg Town Council	Town of Brownsburg
Jerry Decker	Coatesville Town Council	Town of Coatesville
Timothy Dombrosky	Building Department	Hendricks County
Jeffery Eder	Brownsburg Town Manager	Town of Manager
Becky Fancher	North Salem Town Council	Town of North Salem
Bob Gentry	County Commissioner	Hendricks County
Chris Gerald	Danville Town Council	Town of Danville
Jimmie Hieston	Jamestown Fire Department	Town of Jamestown
Jim Hilton	Danville Police Department	Town of Danville
Steve Kershaw	Stilesville Fire Department	Town of Stilesville
Scott King	Pittsboro Police Department	Town of Pittsboro
Andrew Klinger	Plainfield Town Manager	Town of Plainfield
Ron Kneeland	North Salem Town Marshal	Town of North Salem
Jared McKee	Plainfield Police Department	Town of Plainfield
Mark Morgan	Danville Town Manager	Town of Danville
Rob Roberts	Danville Fire Department	Town of Danville
Beth Russell	North Salem Clerk-Treasurer	Town of North Salem
Doug Schnarr	Stilesville Town Marshal	Town of Stilesville
Dan Slattery	Clayton Town Manager	Town of Clayton
Dustin Strahl	Amo Fire Department	Town of Amo
Sean Stoops	Avon Police Department	Town of Avon
Jay Thompson	Pittsboro Town Council	Town of Pittsboro
Ronald Travelsted	Amo Town Council	Town of Amo
Bob Uhrick	Lizton Town Council	Town of Lizton

Name	Office	Representing
Tim Williams	Coatesville Fire Department/Town Marshal	Town of Coatesville
Bill Zeunik	Pittsboro Fire Department	Town of Pittsboro

Members of the Committee participated in the MHMP Update as a Planning Committee member or through various other group meetings. During these meetings, the Committee:

- revisited existing (in the 2009 MHMP) and identified new critical infrastructure 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
- 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 2**. Members of the Committee also reviewed a draft MHMP, provided comments and suggestions, and assisted with adoption of the Hendricks County MHMP Update.

1.3.2 Public Involvement

A draft of the Hendricks County MHMP Update was posted to the Hendricks County website (www.co.hendricks.in.us/) for public review and comment. A media release indicating the posting of the draft MHMP and the ability to comment was submitted for publishing to *The Hendricks County Flyer*. Committee members were provided with an informational flyer regarding the same information to display in their respective offices and to provide to family, friends and colleagues. The media release, informational flyer, and any comments received are included in **Appendix 3**. [add comments when received]

1.3.3 Involvement of Other Interested Parties

Neighboring EMAs (Marion and Morgan Counties) were also invited to review and comment on the MHMP update as these EMAs have a close working relationship with Hendricks County EMA. Information related to the planning process and the availability of the draft Hendricks County MHMP was directly provided to such potentially interested parties via personal conversations, informational flyer, and email correspondence. Successful implementation and future updates of the Hendricks County MHMP Update will rely on the partnership and coordination of efforts between such groups.

1.4 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 Hendricks 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 since the development of the original Hendricks County MHMP, and to assist the Committee in developing potential mitigation measures to reduce the social, physical, and economic losses associated with hazards affecting Hendricks County.

For the purposes of this planning effort, the following materials (among others) were discussed and utilized:

- Hendricks County MHMP, 2009
- Town of Plainfield Comprehensive Plan, 2016
- Avon Indiana Comprehensive Plan, 2017
- Hendricks County Thoroughfare Plan, 2019
- Town of Brownsburg Comprehensive Plan, 2019
- GIS data from contractual contacts

Planning and building ordinances and comprehensive planning efforts for many of the other communities do not exist or are not up to date. Several of the small communities are serviced by the county departments.

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*
- Indiana Department of Natural Resources, Division of Water – *Dam records*
- FEMA, Region V – Repetitive loss structure counts and payments

The CRS program credits NFIP communities a maximum of 155 points for organizing a planning committee composed of staff from various departments; involving the public in the planning process; and coordinating among other agencies and departments to resolve common problems relating to flooding and other known natural hazards.

CHAPTER 2: COMMUNITY INFORMATION

Although much of the information within this section is not required by DMA 2000, this section contains important background information about the physical, social, and economical composition of Hendricks County necessary to better understand the Risk Assessment discussed in **Chapter 3**.

Hendricks County, originally established in 1823, is named for William Hendricks, who was the Governor of Indiana at the time of the creation of the county. Hendricks County is the 32nd of the 92 Indiana counties to be organized and the land became part of the overall United States in 1818 as a part of the New Purchase of the Treaty of St. Mary's. The total area of Hendricks County is approximately 409 square miles and the location of the county within the State of Indiana is identified in **Figure 2**.

2.1 POPULATION AND DEMOGRAPHICS

Figure 2 Hendricks County Location

The most recent data for Hendricks County estimates that the 2019 population was 170,311, which ranks 10th in the State. Of that total, the Town of Plainfield accounts for 1,668 or 12% of the county's population while the Town of Morocco is the second largest community with 1,094 or 7.8% of the population.

In 2019, the median age of the population in the county was 43.7 years of age. The largest demographic age groups in the county are young adults (25-44) with a population of 46,220 and older adults (45-64 years) with a population of 44,136. School age children (5-17) are the third largest age group with a population of 32,273 individuals living in Hendricks County. The approximate median household income in 2018 was reported to be $80,834 while the poverty rate in the same year was reported at 5.9% county-wide. In total, 27.1% of households are married with children, and 32.3% of households are married without children.

Within the county, 93.4% of the adults older than 25, have reportedly completed a High School education. Further, 36.3% of those same adults have also completed a Bachelor of Arts or higher degree.

2.2 EMPLOYMENT

US Census data indicate that of the Hendricks County workforce, 23.2% are employed in "other private" positions. Transportation/warehousing and retail trade account for 15.6% and 15.5% respectively. The total resident labor force according to estimates in 2019 is 90,412 (with 2,446 unemployed) and a September 2020 unemployment rate of 4.4% which places Hendricks County as 60th of 92 counties in the State. **Table 2** lists the ten largest employers within Hendricks County as of 2020.

Table 2: List of Major Employers

Mr. Electric (Plainfield)	Q-edge Corpl (Plainfield)
Amazon Fulfillment Center (Plainfield)	Avon Community School Corp (Avon)
Duke Energy Indiana LLC (Plainfield)	Home Goods (Brownsburg)
Fukai Toyotetsu (Jamestown)	IU Health West Hospital (Avon)
Hendrick's Regional Health (Danville)	O'Reilly Auto Parts Regional Office (Brownsburg)

2.3 TRANSPORTATION AND COMMUTING PATTERNS

Several major transportation routes pass through Hendricks County and the municipalities within. Interstates 70 and 74; US Highways 36, 40, and 136; and State Roads 39, 67, 75, 236, and 267 serve as main routes between the various municipalities. CSX and Indiana Southern also maintain rail lines which travel through the county in the northeast corner and along the southern border respectively. These transportation routes, from the Hendricks County Thoroughfare Plan, are identified in **Figure 3**.

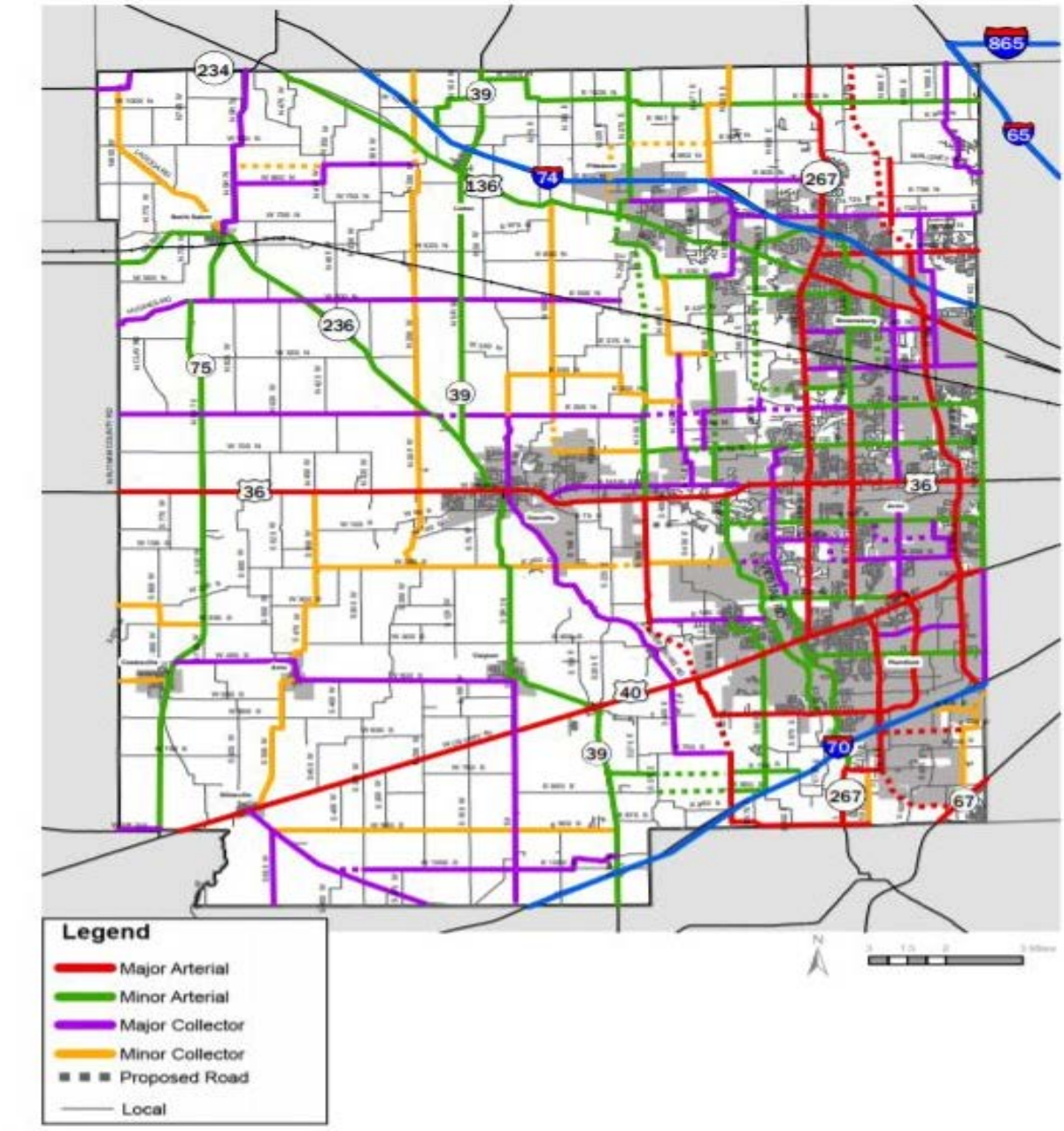


Figure 3 Hendricks County Transportation Routes

According to STATSIndiana, nearly 17,325 people commute into Hendricks County daily. Approximately 63% of commuters travel from Marion County. Further, approximately 39,000 Hendricks County residents commute to other counties, with the majority traveling to Marion County (87%).

Figure 4 indicates the number of workers 16 and older who do not live within Hendricks County but commute into the County for employment purposes. Similarly, **Figure 5** indicates the number of Hendricks County residents 16 and older that commute out of the county for employment.

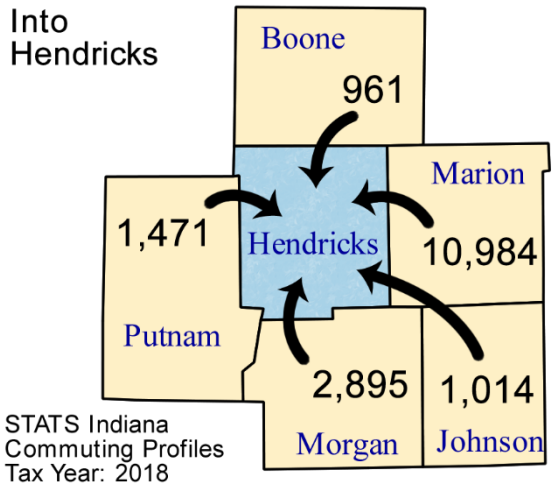


Figure 4 Workers into Hendricks County

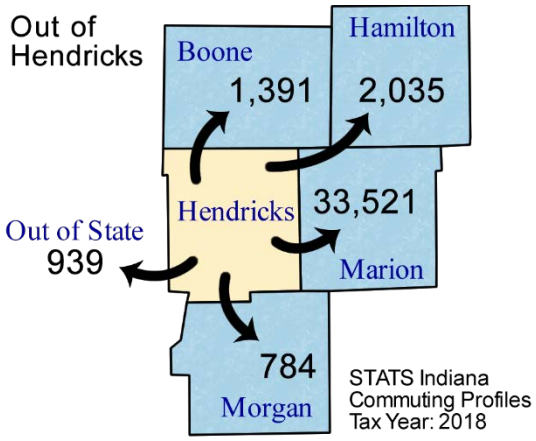


Figure 5 Workers out of Hendricks County

2.4 CRITICAL AND NON-CRITICAL 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, or critical infrastructure, are the assets, systems, and networks, whether physical or virtual, so vital to the 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.

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.

The Hendricks County EMA provided the listing and locations of the following 158 critical infrastructure points for the MHMP update:

- 1 Airport
- 14 Assisted Living Facility
- 16 Child Care Center
- 3 Community Center

- 14 Dams
- 1 Emergency Management Agency
- 19 Fire Stations
- 2 Jails
- 4 Large Gathering Places
- 15 Law Enforcement Facilities
- 6 Libraries
- 38 Medical Facilities
- 1 Military Installation
- 7 Potable Water Treatment Facilities
- 23 Power Stations
- 46 Schools
- 16 Shelters
- 133 Hazardous Materials Facilities
- 1 Transportation Facility
- 9 Wastewater Treatment Plants
- 8 Water Towers

Information provided by the EMA, GIS Department, and the MHMP Planning Committee members was utilized to identify the types and locations of critical structures throughout Hendricks County. Draft maps were provided to the EMA and Planning Committee for their review and all comments were incorporated into the maps and associated databases.

Exhibit 1 illustrates the critical infrastructure identified throughout unincorporated Hendricks County and the individual municipalities. **Appendix 4** lists the critical structures in Hendricks County by community. Non-critical structures include residential, industrial, commercial, and other structures not meeting the definition of a critical facility and are not required for a community to function. The development of this MHMP focused only on critical structures; non-critical structures are neither mapped nor listed.

2.5 MAJOR WATERWAYS AND WATERSHEDS

According to the United States Geological Survey (USGS), there are 89 waterways in Hendricks County; which are listed in **Appendix 5**. The county's main waterways are the Big Walnut Creek, Mill Creek, and White Lick Creek and the county lies within two 8-digit Hydrologic Unit Code (HUC): Lower Eel River and Upper White River. These major waterways, and others, are identified on **Exhibit 2**.

2.6 NFIP PARTICIPATION

The NFIP is a FEMA program that enables property owners in participating communities to purchase insurance protection against losses from flooding. Hendricks County and the towns of Amo, Avon, Brownsburg, Coatesville, Danville, North Salem, Plainfield, and Stilesville participate in the NFIP, while the Town of Lizton and Pittsboro do not. At the time of this planning effort, the Hendricks County Inspection Coordinator is responsible for the administration of the floodplain program in the unincorporated areas of the County along with the programs of Amo, Coatesville, North Salem, and Stilesville. Avon's Building Commission; Brownsburg's Building Services; Danville's Stormwater Department; and Plainfield's Town Engineer are the other offices responsible for administering the floodplain program.

Table 3 lists the NFIP number, effective map date, and the date each community joined the NFIP program.

Table 3: NFIP Participation

NFIP Community	NFIP Number	Effective Map Date	Join Date
Hendricks County	180415#	09/25/2009	03/16/1981
Town of Amo	180530#	09/25/2009(M)	09/25/2009
Town of Avon	180520#	09/25/2009	09/25/2009
Town of Brownsburg	180087#	04/01/1980	09/25/2009
Town of Coatesville	180531#	NSFHA	11/25/2009
Town of Danville	180088#	09/25/2009	11/15/1979
Town of North Salem	180374#	09/25/2009(M)	11/25/2009
Town of Plainfield	180089#	09/25/2009	03/01/1979
Town of Stilesville	180532#	09/25/2009(M)	11/25/2009

2.7 TOPOGRAPHY

Hendricks County is bordered geographically to the west by Montgomery and Putnam Counties, to the east by Marion County, to the north by Boone County, and to the south by Morgan County. The elevation ranges between 800- and 900-feet above sea level throughout Hendricks County with only a few instances where the elevation is over 1,000 feet above sea level.

2.8 CLIMATE

The Midwestern Regional Climate Center (MRCC) provided climate data that includes information retrieved from a weather station located Indianapolis Indiana, identified as station USW00093819. As a station does not exist in Hendricks County, this is the nearest station available. The average annual precipitation is 42.44 inches per year, with the wettest month being May averaging 5.05 inches of precipitation and the driest month being February with an average of 2.32 inches of precipitation. The highest 1-day maximum precipitation was recorded in September of 2003 with 7.2 inches of rain. On average, there are 77.4 days of precipitation greater than or equal to 0.1 inch; 28.8 days with greater than or equal to 0.5 inch; and 10.3 days with greater than or equal to 1.0 inch of precipitation.

Studies have recently been completed by the Indiana Climate Change Impacts Assessment, which is overseen by Purdue University Climate Change Research Center and comprised of a Steering Committee and several topic-oriented Working Groups. These studies indicate that average annual precipitation for Indiana is increasing seasonally during the winter and spring. Conversely, summers and autumns are trending toward less precipitation. In addition, their report shows changes in rain intensity and duration, along with frost-free days and growing seasons. These changes in climate, especially in Indiana, will impact natural hazards and how municipalities prepare for them.

CHAPTER 3: 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 Hendricks County and the communities within is based on the methodology described in the Local Multi-Hazard Mitigation Planning Guidance published by FEMA in 2011 and is incorporated into the following sections:

Section 3.1: Hazard Identification lists the natural, technological, and political hazards selected by the Planning Committee as having the greatest direct and indirect impact to the county as well as the system used to rank and prioritize the hazards.

Section 3.2: 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 3.3: Hazard Summary provides an overview of the risk assessment process; a comparative hazard ranking with other methodologies used by the Hendricks County EMA; a table summarizing the relationship of the hazards; and a composite map to illustrate areas impacted by the hazards.

3.1 HAZARD IDENTIFICATION

3.1.1 Hazard Selection

The MHMP Planning Committee reviewed the list of natural and technological hazards from the 2009 Hendricks County MHMP and discussed recent events and the potential for future hazard events. The Committee identified those hazards that affected Hendricks County and each community and selected the hazards to study in detail as part of this planning effort. As shown in **Table 4** these hazards include dam failure; drought; earthquake; extreme temperature; fire; flooding; hailstorms, thunderstorms, and windstorms; hazardous materials incident; land subsidence/landslides; snowstorms and ice storms; and tornado.

All hazards studied within the 2009 Hendricks County MHMP, except Radon, are included in the update. At the time of the update effort, it was determined that while Radon is still a concern with Hendricks County, mitigation efforts are handled through the Health Department and should not be contained within this plan.

Table 4: Hazard Identification

Type of Hazard	List of Hazards	Detailed Study	
		2009 MHMP	MHMP UPDATE
Natural	Drought	No	Yes
	Earthquake	Yes	Yes
	Extreme Temperature	No	Yes
	Fire	No	Yes
	Flood	Yes	Yes
	Hail/Thunder/Wind	Yes	Yes
	Land Subsidence/Landslide	No	Yes
	Snow / Ice Storm	Yes	Yes
	Tornado	Yes	Yes
Technological	Dam Failure	Yes	Yes
	Hazardous Material Incident	Yes	Yes

3.2 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 Calculated Priority Risk Index (CPRI). The CPRI, adapted from MitigationPlan.com, 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 communications, simple graphical scales are used.

3.2.1 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

3.2.2 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

3.2.3 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

3.2.4 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

3.2.5 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 community in Hendricks County, and then a weighted CPRI value was computed based on the population size of each community. **Table 5** 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 5: Determination of Weighted Value for Communities

Community	Population (2019)	% of Total Population	Weighted Value
Hendricks County	72,139	42.4%	0.42
Town of Amo	431	0.3%	0.00
Town of Avon	18,706	11.0%	0.11
Town of Brownsburg	27,001	15.9%	0.16
Town of Clayton	1,055	0.6%	0.01
Town of Coatesville	564	0.3%	0.00
Town of Danville	10,126	5.9%	0.06
Town of Jamestown	24	0.0%	0.00
Town of Lizton	489	0.3%	0.00
Town of North Salem	538	0.3%	0.00
Town of Pittsboro	3,614	2.1%	0.02
Town of Plainfield	35,287	20.7%	0.21
Town of Stilesville	337	0.2%	0.00
Total	**170,311**	**100.0%**	**1.00**

3.3 HAZARD PROFILES

The hazards studied for this report are not equally threatening to all communities throughout Hendricks 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 damages in different communities.

This section describes each of the hazards that were 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
- **Relationship to Other Hazards** explores the influence one hazard may have upon another hazard.

3.3.1 Drought

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 virtually 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.

Figure 6 Urban Drought Affects

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 6** shows urban grassed areas affected by drought conditions.

Drought: Recent Occurrences

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	▪ Crop or pasture losses likely ▪ Water shortages common ▪ Water restrictions imposed
D3	Extreme Drought	▪ Major crop/pasture losses ▪ Widespread water shortages or restrictions
D4	Exceptional Drought	▪ Exceptional and widespread crop/pasture losses ▪ Shortages of water in reservoirs, streams, and wells creating water emergencies

Figure 7 US Drought Monitor Severity Classification

Data gathered from the U.S. Drought Monitor indicated that between January 2015 and August 2020, there were 48 weeks where some portions of Hendricks County was considered to be in "Abnormally Dry". For six weeks in September and October 2017, portions of Hendricks County were categorized as D1 or a "Moderate Drought". **Figure 7**, from the U.S. Drought Monitor, describes the rationale to classify the severity of droughts.

The National Climate Data Center (NCDC) does not report any events or property or crop losses within Hendricks County during this planning period.

The Planning Committee, utilizing the CPRI, determined the overall risk of drought throughout Hendricks County is "Elevated".

The impact of drought was determined to be the same for all communities and unincorporated area throughout the county due to the possible agricultural impacts and impacts to water wells. The committee agreed that a drought is "Possible" (to occur within the next five 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 greater than 24 hours and the duration will be greater than one week. A summary is shown in **Table 6**.

Table 6 CPRI for Drought

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Hendricks County	Possible	Limited	> 24 Hours	> 1 Week	Severe
Town of Amo	Possible	Limited	> 24 Hours	> 1 Week	Elevated
Town of Avon	Possible	Limited	> 24 Hours	> 1 Week	Elevated
Town of Brownsburg	Possible	Limited	> 24 Hours	> 1 Week	Elevated
Town of Clayton	Possible	Limited	> 24 Hours	> 1 Week	Elevated
Town of Coatesville	Possible	Limited	> 24 Hours	> 1 Week	Elevated
Town of Danville	Possible	Limited	> 24 Hours	> 1 Week	Elevated
Town of Jamestown	Possible	Limited	> 24 Hours	> 1 Week	Elevated
Town of Lizton	Possible	Limited	> 24 Hours	> 1 Week	Elevated
Town of North Salem	Possible	Limited	> 24 Hours	> 1 Week	Elevated
Town of Pittsboro	Possible	Limited	> 24 Hours	> 1 Week	Elevated
Town of Plainfield	Possible	Limited	> 24 Hours	> 1 Week	Elevated
Town of Stilesville	Possible	Limited	> 24 Hours	> 1 Week	Elevated

According to the National Drought Mitigation Center, scientists have difficulty predicting droughts more than one month in advance due to the 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. Based on the previous occurrences of significant droughts and drought related impacts felt within Hendricks County, the Committee estimated that the probability of a drought occurring in the area is "Possible"; or occurrence is probable within the next five years.

"Limited" damages are anticipated throughout the county as many municipalities rely on groundwater supplies for fire response efforts and face a higher risk during times of prolonged drought. Throughout the unincorporated areas of the county, increased crop and livestock damages would also be expected during a significant drought.

Drought: Assessing Vulnerability

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

Direct Effects:

- Urban and developed areas may experience revenue losses from landscaping companies, golf courses, restrictions on industry cooling and processing demands, businesses dependent on crop yields; and increased potential for fires
- Rural areas within the county may experience revenue losses from reductions in livestock and crop yields as well as increased field fires

- Citizens served by drinking water wells may be impacted during low water periods and may require drilling of deeper wells or loss of water service for a period of time

Indirect Effects:

- Loss of income of employees from businesses and industry affected; loss of revenue to support services (food service, suppliers, etc.)
- Loss of revenue from recreational or tourism sectors associated with reservoirs, streams, and other open water venues
- Lower yields from domestic gardens increasing the demand on purchasing produce and increased domestic water usage for landscaping
- Increased demand on emergency responders and firefighting resources

Estimating Potential Losses

Figure 8 Crops Affected by Drought

It is difficult to estimate the potential losses associated with a drought for Hendricks 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 2019, Hendricks County produced approximately 10.3M bushels of corn and 3.6M bushels of soybeans, as reported by the United States Department of Agriculture (USDA) National Agricultural Statistics Service. Using national averages of $4.10 per bushel of corn and $9.10 per bushel of soybeans, the estimated crop receipts for 2019 would be $75.0M. 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 $37.5M-$64.5M; depending on the crop produced and the market demand. Effects of drought on corn crops can be seen in **Figure 8**.

Purdue Agriculture News reports that as of March 2013, Indiana producers received more than $1.0B in crop insurance payments for 2012 corn, soybean, and wheat losses. This amount is nearly double that of the previous record, $522M following 2008 losses, also due to drought.

According to a July 5, 2012 article in The Times (Noblesville, IN), "The effects of drought also could touch agricultural businesses, such as handlers and processors, equipment dealers, and see, fertilizer and pesticide providers". Further, "…consumers are likely to see an increase in food prices of 2.5 percent to 3.5 percent into 2013".

Additional losses associated with a prolonged drought are more difficult to quantify. Drought has lasting impacts on urban trees: death to all or portions of a tree, reduction in the tree's ability to withstand insects and diseases, and interruption of normal growth patterns. Such effects on trees, especially urban trees can lead to additional impacts, both environmentally and monetarily in terms of

the spread of Emerald Ash Borer insect and the weakening of tree limbs and trunks which may lead to increased damages during other hazard events such as wind and ice storms.

Future Considerations

Advancements in plant hybrids and development have eased the impacts from short-lived droughts. Seeds and plants may be more tolerant of dryer seasons and therefore fewer crop losses may be experienced.

As the municipal areas of the county continue to grow and expand, protocols may need to be developed which create a consistency throughout the communities and the unincorporated portions of the county for burn bans and water usage advisories.

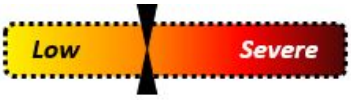
According to the Indiana Climate Change Impacts Assessment, Indiana has experienced a rise in the average annual precipitation between 1895 and 2016; an increase of 5.6 inches for the area of Hendricks County. This increase in precipitation may lessen the likelihood or overall impact of a drought in Hendricks County. However, the assessment also notes seasonal shifts in precipitation which 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 municipalities expanding, 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. Since the previous MHMP was prepared, large scale and significant development has occurred on the borders of the incorporated communities within the central and eastern areas of the county. The western and northern areas of the county remains largely unincorporated.

Drought: 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 cropland 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.

3.3.2 Earthquake



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. For hundreds of millions of years, the forces of plate tectonics have shaped the earth as the huge plates that form the earth's surface move slowly over, under, and past each other. Sometimes the movement is gradual. At other times, the plates are locked together, unable to release the accumulating energy. When the accumulated energy grows strong enough, the plates break free, causing the ground to shake. Most earthquakes occur at the boundaries where the plates meet; however, some earthquakes occur in the middle of the plates.

Ground shaking from earthquakes can collapse buildings and bridges; disrupt gas, electric, 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.

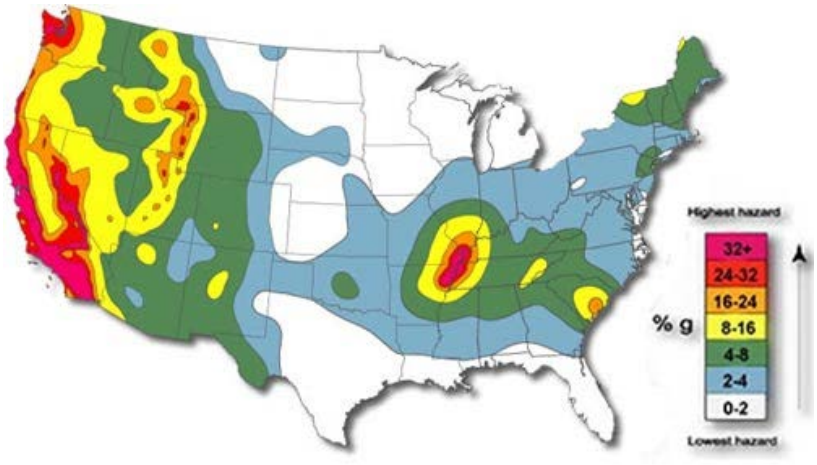


Figure 9 Earthquake Hazard Areas in the US

Earthquakes strike suddenly, without warning. Earthquakes can occur at any time of the year and at any time of the day or night. On a yearly basis, 70-75 damaging earthquakes occur throughout the world. Estimates of losses from a future earthquake in the United States approach $200B.

One method of measuring the magnitude or energy of an earthquake is the Richter Scale. This scale uses whole numbers and decimal fractions whereby each increase of a whole number represents a release of 31 times more energy than the amount associated with the previous whole number on the scale. Scientists are currently studying the New Madrid fault area and have predicted that the chances of an earthquake in the M8.0 range occurring within the next 50 years are approximately 7%-10%. However, the chances of an earthquake at a M6.0 or greater, are at 90% within the next 50 years.

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 county (**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.

Earthquake: Recent Occurrences

Indiana, as well as several other Midwestern states, lies in the most seismically active region east of the Rocky Mountains. Regarding Hendricks County, the nearest area of concern is the Wabash Seismic Zone.

On April 18, 2008, an M5.2 quake, reported by the Central United States Earthquake Consortium, struck southeast Illinois in Wabash County and included reports of strong shaking in southwestern Indiana, Kansas, Georgia, and the upper peninsula of Michigan. With over 25,000 reports of feeling the earthquake, there were no reports of injuries or fatalities caused by the event.

On December 30, 2010, central Indiana experienced an earthquake with a magnitude of 3.8; rare for this area in Indiana as it is only the 3rd earthquake of notable size to occur north of Indianapolis. Even rarer is the fact that scientists believe that the quake was centered in Greentown, Indiana approximately 13 miles southeast of Kokomo, Indiana. According to The Kokomo Tribune, "113 people called 911 in a 15-minute period after the quake, which was the first tremblor centered in Indiana since 2004". Further, a geophysicist from the USGS in Colorado stated, "It was considered a minor earthquake", and "Maybe some things would be knocked off shelves, but as far as some significant damage, you probably wouldn't expect it from a 3.8".

Figure 10 Earthquake Damaged Porch

Most recently, an M5.8 centered in Mineral, Virginia affected much of the East Coast on August 23, 2011. According to USA Today, 10 nuclear power plants were shutdown of precautionary inspections following the quake, over 400 flights were delayed, and the Washington Monument was closed indefinitely pending detailed inspections by engineers.

Based on historical earthquake data, local knowledge of previous earthquakes, results of HAZUS-MH scenarios, and that Hendricks County has not been directly impacted by an earthquake, the Committee determined that the probability of an earthquake occurring in Hendricks County or any of the communities is "Unlikely". Should an earthquake occur, the impacts associated with this hazard are anticipated to be "Limited" to "Significant" within all areas of the county. As with all earthquakes, it was determined that the residents of Hendricks County would have little to no warning time (less than six hours) and that the duration of the event would be expected to also be less than six hours. A summary is shown in **Table 7**.

Table 7 CPRI for Earthquake

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Hendricks County	Unlikely	Limited	< 6 Hours	< 6 Hours	Low
Town of Amo	Unlikely	Limited	< 6 Hours	< 6 Hours	Low
Town of Avon	Unlikely	Limited	< 6 Hours	< 6 Hours	Low
Town of Brownsburg	Unlikely	Limited	< 6 Hours	< 6 Hours	Low
Town of Clayton	Unlikely	Significant	< 6 Hours	< 6 Hours	Elevated
Town of Coatesville	Unlikely	Limited	< 6 Hours	< 6 Hours	Low
Town of Danville	Unlikely	Limited	< 6 Hours	< 6 Hours	Low
Town of Jamestown	Unlikely	Significant	< 6 Hours	< 6 Hours	Elevated
Town of Lizton	Unlikely	Significant	< 6 Hours	< 6 Hours	Elevated
Town of North Salem	Unlikely	Significant	< 6 Hours	< 6 Hours	Elevated
Town of Pittsboro	Unlikely	Limited	< 6 Hours	< 6 Hours	Low
Town of Plainfield	Unlikely	Limited	< 6 Hours	< 6 Hours	Low
Town of Stilesville	Unlikely	Limited	< 6 Hours	< 6 Hours	Low

Per the Ohio Department of Natural Resources Division of Geological Survey, "…it is difficult to predict the maximum-size earthquake that could occur in the state and certainly impossible to predict when such an event would occur. In part, the size of an earthquake is a function of the area of a fault available for rupture. However, because all known earthquake-generating faults in Ohio are concealed beneath several thousand feet of Paleozoic sedimentary rock, it is difficult to directly determine the size of these faults." Further according to the Indiana Geological Survey, "…no one can say with any certainty when or if an earthquake strong enough to cause significant property damage, injury, or loss of life in Indiana will occur…we do indeed face the possibility of experiencing the potentially devastating effects of a major earthquake at some point in the future". The Committee felt that an earthquake occurring within or near to Hendricks County is "Unlikely" to occur within the next ten years.

Figure 11 Minor Earthquake Damages

Earthquake: Assessing Vulnerability

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

Direct Effects:

- Urban areas may experience more damages due to the number of structures and critical infrastructure located in these areas
- Rural areas may experience losses associated with agricultural structures such as barns and silos
- Bridges, buried utilities, and other infrastructure may be affected throughout the county and municipalities

Indirect Effects:

- 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

Types of loss caused by an earthquake could be physical, economic, or social in nature. Due to the unpredictability and broad impact regions associated with an earthquake, all critical and non-critical infrastructure are at risk of experiencing earthquake related damages. Damages to structures, infrastructure, and even business interruptions can be expected following an earthquake. Examples of varying degrees of damages are shown in **Figure 10** and **Figure 11**.

Estimating Potential Losses

In order to determine the losses associated with an earthquake, the HAZUS-MH software was utilized in the Hendricks County MHMP update to determine the potential impacts anticipated from an arbitrary earthquake scenario. This type of modeling is useful for planning efforts such as this.

Per the HAZUS-MH scenario noted above, total economic losses are anticipated to be near $865.5M with moderate damages to approximately 2,800 buildings, of which 2,100 are anticipated to be single-family residential structures. The HAZUS-MH model computes anticipated economic losses for the hypothetical earthquake due to direct building losses and business interruption losses. Direct building losses are the costs to repair or to replace the damage caused to the building and contents, while the interruption losses 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.

Future Considerations

While the occurrence of an earthquake in or near to Hendricks 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 anywhere within the state. For that reason, Hendricks County should continue to provide education and outreach regarding earthquakes and even earthquake insurance along with education and outreach for other hazards. As Hendricks County and the communities within the county continue to grow and develop, the proper considerations for the potential of an earthquake to occur may help to mitigate against social, physical, or economic losses in the future.

It can be anticipated that while all structures in Hendricks County will remain at-risk to earthquake damages and effects, new construction or redevelopment may reduce the overall risks. As redevelopment occurs, the new construction may be significantly sturdier. Further, as blighted or abandoned areas are addressed, those communities and the county as a whole, are less susceptible to economic and physical damages associated with earthquakes.

Earthquake: Relationship to Other Hazards

Hazardous materials incidents may occur as a result of damage to material storage containers or transportation vehicles involved in road crashes or train derailments. Further, dam failures 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 Hendricks County communities than the earthquake itself. It is not expected that earthquakes will be caused by other hazards studied within this plan.

3.3.3 Extreme Temperature

Extreme Temperatures: Overview

Extreme heat is defined as a temporary elevation of average daily temperatures that hover 10 degrees or more above the average high temperature for the region for the duration of several weeks. Humid or muggy conditions, which add to the discomfort of high temperatures, occur when a dome of high atmospheric pressure traps water-laden air near the ground. In a normal year, approximately 175 Americans die from extreme heat.

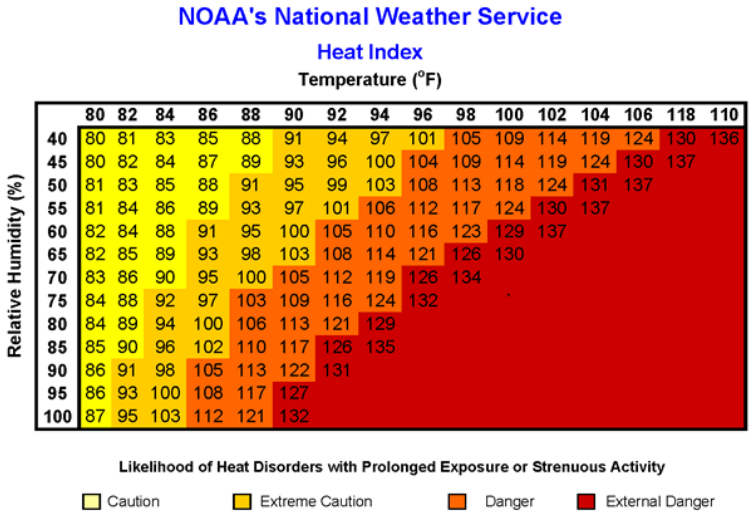


Figure 12 Heat Index Chart

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. The Weather Service will initiate alert procedures when the Heat Index is expected to exceed 105°-110°F for at least two consecutive days.

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, strong winds, particularly with very hot, dry air, can also be extremely hazardous.

As Figure 3-9 indicates, there are four cautionary categories associated with varying heat index temperatures.

- Caution: 80°-90°F: Fatigue is possible with prolonged exposure and physical activity
- Extreme Caution: 90°-95°F: Sunstroke, heat cramps, heat exhaustion may occur with prolonged physical activity
- Danger: 105°-130°F: Sunstroke, heat cramps, or heat exhaustion is likely
- Extreme Danger: >130°F: Heatstroke is imminent

Extreme cold is defined as a temporary, yet sustained, period of extremely low temperatures. Extremely low temperatures can occur in winter months when continental surface temperatures are at their lowest point and the North American Jet Stream pulls arctic air down into the continental United States. The jet stream is a current of fast-moving air found in the upper levels of the atmosphere. This rapid current is typically thousands of kilometers long, a few hundred kilometers wide, and only a few kilometers thick. Jet streams are usually found somewhere between 10-15 km (6-9 miles) above the Earth's surface. The position of this upper-level jet stream denotes the location of the strongest surface temperature contrast over the continent. 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 a physical danger to all individuals in a community and can affect infrastructure function as well.

Wind chill is a guide to winter danger

New wind chill chart

Frostbite occurs in 15 minutes or less

Wind (MPH) \ Temperature (°F)	30	25	20	15	10	5	0	-5	-10	-15	-10	-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

Figure 13 NWS Wind Chill Chart

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 13** identifies the Wind Chill Chart and how the same ambient temperature may feel vastly different in varying wind speeds.

Extreme Temperature: Recent Occurrences

The effects of extreme temperatures extend across large regions, typically affecting several counties, or states, during a single event. According to the NCDC, there have been no extreme heat event or extreme cold events between January 2015 and August 2020. Local reports provide information regarding a period of excessive heat during July 2019 where temperatures stayed in the high 90s for several days. Heat index temperatures were over 100 for this time period. In Hendricks County, and the greater Indianapolis area, several cooling shelters were opened primarily at fire stations and police departments.

It is difficult to predict the probability that an extreme temperature event will affect Hendricks County residents within any given year. However, based on historic knowledge and information provided by the community representatives, an extreme temperature event is "Unlikely" to "Possible" (possible within the next five years) to occur and if an event did occur, it would result in "Negligible" to "Significant" magnitude. identifies the CPRI for extreme temperature events for all communities in Hendricks County. **Table 8**

Table 8 CPRI for Extreme Temperatures

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Hendricks County	Possible	Limited	> 24 Hours	>1 Week	Elevated
Town of Amo	Unlikely	Negligible	> 24 Hours	>1 Week	Low
Town of Avon	Possible	Negligible	> 24 Hours	>1 Week	Low
Town of Brownsburg	Unlikely	Negligible	> 24 Hours	>1 Week	Low
Town of Clayton	Unlikely	Negligible	> 24 Hours	>1 Week	Low
Town of Coatesville	Unlikely	Negligible	> 24 Hours	>1 Week	Low
Town of Danville	Possible	Negligible	> 24 Hours	>1 Week	Low
Town of Jamestown	Possible	Negligible	> 24 Hours	>1 Week	Low
Town of Lizton	Unlikely	Negligible	> 24 Hours	>1 Week	Low
Town of North Salem	Possible	Negligible	> 24 Hours	>1 Week	Low
Town of Pittsboro	Unlikely	Significant	> 24 Hours	>1 Week	Low
Town of Plainfield	Unlikely	Negligible	> 24 Hours	>1 Week	Low
Town of Stilesville	Possible	Negligible	> 24 Hours	>1 Week	Low

As shown in the table, index values remain identical throughout each community due to the regional extent and diffuse severity of this hazard event. The anticipation of experiencing such damages is due to the amount of livestock and cropland within the county and the potential to realize impacts within the urban areas.

Extreme Temperatures: 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 Hendricks County, a better understanding of the relative risk that extreme temperatures may pose to certain populations can be gained. In total, 14% of the county's population is over 65 years of age, nearly 6% of the population is below the age of 5, and approximately 6% of the population is considered to be living below the poverty line. People within these demographic categories are more susceptible to social or health related impacts associated with extreme heat.

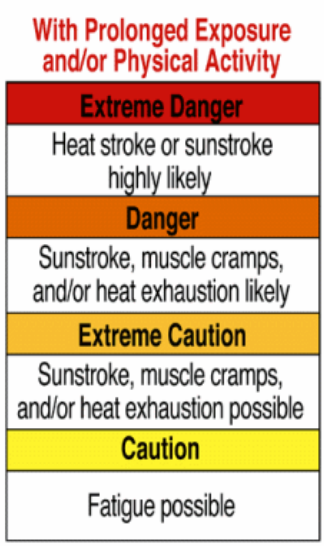


Figure 14 Danger Levels with Prolonged Heat Exposure

Extreme heat can affect the proper function of organ and brain systems by elevating core body temperatures above normal levels. Elevated core body temperatures, usually in excess of 104°F are often exhibited as heat stroke. For weaker individuals, an overheated core body temperature places additional stress on the body, and without proper hydration, the normal mechanisms for dealing with heat, such as sweating in order to cool down, are ineffective. Examples of danger levels associated with prolonged heat exposure are identified in **Figure 14**.

Extreme cold may result in similar situations as body functions are impacted as the temperature of the body is reduced. Prolonged exposure to cold may result in hypothermia, frostbite, and even death if the body is not warmed.

Within Hendricks County, direct and indirect effects from a long period of extreme temperature 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

Indirect Effects:

- Increased need for cooling or warming shelters
- Increased medical emergency response efforts
- Increased energy demands for heating or cooling

Estimating Potential Losses

It is difficult to estimate the potential losses due to extreme temperatures as damages are not typically associated with buildings but instead, with populations and persons.

This hazard is not typically as damaging to structures or critical infrastructure as it is to populations so monetary damages associated with the direct effects of the extreme temperature are not possible to estimate. Indirect effects would cause increased expenses to facilities such as healthcare or emergency services, 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, and energy suppliers may experience demand peaks during the hottest and/or coldest portions of the day.

Future Considerations

As more and 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, or as local economies are stressed, such programs may become more necessary to protect Hendricks County's at-risk populations.

The Climate Change Assessment identifies several temperature related considerations of which communities should be aware 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.

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 development 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 been significant residential and commercial development within the county. This actually decreases the overall vulnerability with the newer construction practices and open space requirements within neighborhoods.

Extreme Temperatures: Relationship to Other Hazards

While extreme temperatures may be extremely burdensome on the power supplies in Hendricks 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 high temperatures, citizens may become increasingly agitated and irritable and this may lead to a disturbance requiring emergency responder intervention.

3.3.4 Fire

Fire: Overview

Figure 15 Wildfire in Forested Area

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 lightening; 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. Generally, ambient weather conditions 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 (**Figure 15**) 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, 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. High-rise fires hinder the ability of rescue workers to fight the fire, reach impacted building occupants, and evacuate impacted occupants. Rescue efforts also become more complicated when handicapped or disabled persons are involved. Complications associated with high-rise fires typically increase as the height and occupancy levels of the buildings increase. Structural collapse is another concern associated with high-rise fires. Structural collapse often results in persons becoming 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.

Typically, a fire will incinerate all structures and objects in its path. A resident may lose all possessions and structures to a wildfire event. Additionally, combating a wildfire or a structure fire may be extremely dangerous. If weather conditions change suddenly, the wildfire may change course and overtake firefighters, causing severe injury or death. Fires can travel at speeds greater than 45 mph. Therefore, these hazard events can pose a serious threat to county residents and response agencies.

Fire: Recent Occurrences

Within the NCDC, there are no reports of wildfires occurring within Hendricks County between January 1950 and August 2020. Within the same time parameter, there were only two reported events within the State of Indiana, both within Pike County and both within 2006. During each of these events over 350 acres were burned.

The NCDC does not report structure fires; therefore, local sources were utilized to provide historical information. According to WTHR Channel 13, an barn fire quickly spread to two adjacent structures near the Town of North Salem in July 2020. (**Figure 16**). No injuries or livestock fatalities were reported as a result of this event although equipment and hay were lost. Seven other fire departments responded to the event along with North Salem Fire Department.

Figure 16 North Salem Barn Fire ***(WTHR)***

Two school buses served as rotating warming centers for over 60 firefighters from multiple departments who responded to the fire at Plainfield's Rays Trash facility in January 2019 (**Figure 17**). Response efforts exacerbated by sub-zero temperatures which quickly led to ice covered pavement and rendered most equipment such as hoses and air regulators useless. Portions of US 40 were closed due to thick smoke from area.

Figure 17 Rays Trash Fire ***(Fox 59)***

In a similar regard, the Indy Star reported an event from June 2015 where three units of a single-story apartment building were destroyed. One person was killed in the fire and several residents displaced, then becoming dependent on the American Red Cross who was on the scene offering assistance.

Due to the expansive acreage of cropland and woods within Hendricks County, and the potential for urban areas to be at risk due to abandoned homes, blighted areas, or industrial activities, the Planning Committee determined the probability to be "Unlikely" to "Likely" throughout the County. **Table 9** identifies the CPRI rankings for fire in Hendricks County.

Table 9 CPRI for Fire

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Hendricks County	Possible	Negligible	< 6 Hours	< 1 Day	Low
Town of Amo	Likely	Negligible	< 6 Hours	< 1 Day	Elevated
Town of Avon	Possible	Negligible	< 6 Hours	< 1 Day	Low
Town of Brownsburg	Unlikely	Negligible	< 6 Hours	< 1 Day	Low
Town of Clayton	Possible	Negligible	< 6 Hours	< 1 Day	Low
Town of Coatesville	Possible	Negligible	< 6 Hours	< 1 Day	Low
Town of Danville	Possible	Negligible	< 6 Hours	< 1 Day	Low
Town of Jamestown	Likely	Negligible	< 6 Hours	< 1 Day	Elevated
Town of Lizton	Possible	Negligible	< 6 Hours	< 1 Day	Low
Town of North Salem	Possible	Negligible	< 6 Hours	< 1 Day	Low
Town of Pittsboro	Possible	Negligible	< 6 Hours	< 1 Day	Low
Town of Plainfield	Possible	Negligible	< 6 Hours	< 1 Day	Low
Town of Stilesville	Possible	Negligible	< 6 Hours	< 1 Day	Low

Information provided in **Table 10** highlights the number of fire runs for some of larger Hendricks County fire departments for the time period January 2016 through November 2020. Based on this information, annual damages to structures, contents, and vehicles may be 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 10 Hendricks County Fire Runs

	Town of Avon	Town of Danville	Town of Plainfield	Total
Fire	913	141	847	**1,901**
Rescue/EMS	17,412	3,291	20,010	**40,713**
Service Call	1,409	118	1,443	**2,970**
Good Intent	4,152	398	4,759	**9,009**
False Alarm	1,403	149	1,438	**2,990**
Other	27	117	60	**204**
TOTAL	**25,316**	**4,214**	**28,557**	**57,787**

Fire: Assessing Vulnerability

A fire typically affects a large regional area with potential for physical, economic, and/or social losses. Typically, a structural fire affects one or two structures, as one of the main functions of fire response is to prevent the fire from spreading to neighboring structures. This type of action works to reduce the magnitude and severity from "Negligible" throughout the county and municipalities.

Much of the western county is rural and agricultural in land use, which may be more susceptible to brush or crop fires, especially in times of drought. As most development has continued to occur within eastern Hendricks County since the last planning effort, vulnerabilities to this hazard have not shifted in location. Urbanized areas within Hendricks County are susceptible to urban and industrial fires, while western Hendricks County remains vulnerable to field, crop, and woodland fires.

Direct and indirect effects of a such an event within Hendricks County may include:

Direct Effects:

- Loss of structures

- Loss of production crop
- Loss of natural resources

Indirect Effects:

- Loss of revenue as businesses may be closed
- Increased emergency response times based on safety of roads
- Loss of income if dependent on crop production

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. 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 communities continue to grow in size, 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.

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 contain a large number of citizens. As communities age, some structures may become 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.

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 directly related to cropland or natural resource areas.

Fire: Relationship to Other Hazards

Fires may certainly result in a hazardous materials incident if storage structures are within the path of the burn. 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 associated with a thunderstorm. Typical wind speeds during a thunderstorm may also exacerbate the impacts from any ignitions from the lightning.

3.3.5 Flood

Flood: Overview

Floods are the most common and widespread of all the natural disasters. Most communities in the United States have experienced some kind of flooding, after spring rains, heavy thunderstorms, or winter snow melts. 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 and 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.

Flooding and associated flood damages is most likely to occur during the spring because of heavy rains combined with melting snow. However, provided the right saturated conditions, intense rainfall of short duration during summer rainstorms are capable of producing damaging flash flood conditions.

The traditional benchmark for riverine or coastal flooding is a 1% Annual Exceedance Probability (AEP), or 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 in any given year. In other words, the regulatory flood elevation has a 1% chance of being equaled, or exceeded, in any given year and it could occur more than once in a relatively short time period.

Flood: Recent Occurrences

The NCDC indicates that between January 2015 and August 2020, there were seven floods and six flash floods reported.

The narrative report through NCDC regarding the July 2015 flash flood event was that several roads were flooded throughout the county due to heavy rainfall, as much as five inches in just three hours. Many homes were damaged by flooding and the storm events also caused a tornado, resulting in downed power lines and trees making response efforts more difficult. There were reportedly $50K in property damages and an additional $5K in crop damages. The most recent event, a flood on June 15, 2019 caused $1K in reported damages as extensive flooding was observed at Saratoga Parkway and Fairfield Road in Plainfield.

A local report from WRTV indicates one Brownsburg neighborhood, Eaker Court (**Figure 18**), routinely experiences flooding which cuts off their area and makes it nearly impossible to get in or out. The area, near CR 800 N has been working with the Hendricks County Surveyor to develop plans to mitigate the impacts.

Figure 18 Flooding in Eaker Court Neighborhood

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' Advanced Hydrologic Prediction Service

(AHPS) 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 Hendricks County, there are four active USGS stream gages with capabilities of issuing forecasts as needed during flood events.

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 1/3 of the country's flood insurance payments. According to FEMA Region V, there are a total of five single-family repetitive loss structures within the unincorporated areas of Hendricks County; one single-family repetitive loss structure in Avon; and one additional single-family structure in Plainfield. A total of 14 losses and payments of $190,489.54 are associated with these properties.

There have been a small number of claims made for damages associated with flooding in Hendricks County. Within the unincorporated areas of the county, there have been 41 claims resulting in slightly over $410.0K in payments. Further, within the Town of Plainfield, there were 18 payments totaling approximately $90.0K. **Table 11** identifies the number of claims per community as well as payments made, as provided by IDNR. Information regarding the Towns of Clayton, Jamestown, Lizton, and Pittsboro was not provided independently as they do not participate in the NFIP program individually and are included within the information for the unincorporated county.

Table 11 Repetitive Properties, Claims, and Payments

Community	# of Repetitive Loss Properties	Claims Since 1978	$$ Paid
Hendricks County	5	41	$412,705
Town of Amo	0	0	$0
Town of Avon	5	0	$0
Town of Brownsburg	0	5	$65,628
Town of Clayton			
Town of Coatesville	0	0	$0
Town of Danville	0	4	$102,473
Town of Jamestown			
Town of Lizton			
Town of North Salem	0	0	$0
Town of Pittsboro			
Town of Plainfield	5	18	$89,297
Town of Stilesville	0	0	$0
TOTAL	**7**	**68**	**$670,103**

Mandatory flood insurance purchase requirements apply to structures in 1% annual chance of flooding delineated areas. Total flood insurance premiums for Hendricks County and the communities is approximately $171K. Total flood insurance coverage for Hendricks County and the communities is nearly $68M. **Table 12** further indicates the premiums and coverage totals for individual communities. Information regarding the Towns of Clayton, Jamestown, Lizton, and Pittsboro was not provided independently as they do not participate in the NFIP program individually and are included within the information for the unincorporated county.

Table 12 Insurance Premiums and Coverage

Community	Flood Insurance Premiums	Flood Insurance Coverage
Hendricks County	$103,498	$36,564,400
Town of Amo	$351	$280,000
Town of Avon	$4,539	$2,362,900
Town of Brownsburg	$11,420	$8,515,100
Town of Clayton		
Town of Coatesville	$415	$350,000
Town of Danville	$5,184	$1,483,700
Town of Jamestown		
Town of Lizton		
Town of North Salem	$986	$250,000
Town of Pittsboro		
Town of Plainfield	$43,934	$17,796,800
Town of Stilesville	$434	$140,000
TOTAL	**$170,761**	**$67,742,900**

As determined by the Committee, the probability of a flood occurring throughout Hendricks County ranges from "Unlikely" in Amo, Clayton, Coatesville, North Salem, Pittsboro, and Stilesville; "Likely" in Avon, Brownsburg, Danville, Lizton, and Plainfield; and "Highly Likely" in the unincorporated county and Jamestown. This is largely based on the presence or absence of rivers or water systems in or near the communities and issues associated with localized drainage. Impacts from such an event are anticipated to range from "Negligible" to "Limited". The Committee also determined that the warning time would be 6-12 hours based on forecasting methods, local knowledge of stream activities, and the warning provided by gages upstream. Finally, the duration of such an event is anticipated to last less than one day for some areas, and less than one week for others. A summary is shown in **Table 13**.

Table 13 CPRI for Flood

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Hendricks County	Highly Likely	Limited	6-12 Hours	< 1 Week	Severe
Town of Amo	Unlikely	Negligible	6-12 Hours	< 1 Day	Low
Town of Avon	Likely	Limited	6-12 Hours	< 1 Week	Elevated
Town of Brownsburg	Likely	Limited	6-12 Hours	< 1 Week	Elevated
Town of Clayton	Unlikely	Negligible	6-12 Hours	< 1 Week	Low
Town of Coatesville	Unlikely	Negligible	6-12 Hours	< 1 Day	Low
Town of Danville	Likely	Limited	6-12 Hours	< 1 Week	Elevated
Town of Jamestown	Highly Likely	Limited	6-12 Hours	< 1 Week	Low
Town of Lizton	Likely	Limited	6-12 Hours	< 1 Week	Elevated
Town of North Salem	Unlikely	Negligible	6-12 Hours	< 1 Day	Low
Town of Pittsboro	Unlikely	Negligible	6-12 Hours	< 1 Day	Low
Town of Plainfield	Likely	Limited	6-12 Hours	< 1 Week	Elevated
Town of Stilesville	Unlikely	Negligible	6-12 Hours	< 1 Day	Low

As mentioned within this section, there is a 1% chance each year that the regulatory flood elevation will be equaled or exceeded, and these types of events may occur more than once throughout each year. Further, based on information provided by the NCDC, and previous experiences, the Committee determined that flooding is "Unlikely" to "Highly Likely" throughout the county. While it appears Jamestown may not be impacted by riverine flooding, the committee discussed problems associated with poor drainage leading to many of the same issues as riverine flooding in other communities.

Flood: Assessing Vulnerability

Flood events may affect large portions of Hendricks County at one time as river systems and areas with poor drainage cover much of the county and several communities. In addition to riverine flooding or flooding in poorly drained areas, is the consideration of fluvial erosion hazard. 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 actually be lost as steep riverbanks or bluffs sluff into the water below.

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

Direct Effects:

- Structural and content damages and/or loss of revenue for properties affected by increased water
- Increased costs associated with additional response personnel, evacuations, and sheltering needs

Indirect Effects:

- Increased response times for emergency personnel if roads are impassable
- Increased costs associated with personnel to carry 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

In the time period since the last planning effort, significant development has occurred within several municipalities near the eastern side of the county. Other incorporated areas have also grown and what has occurred, has been directed away from various floodplains. This mitigation measure helps to reduce the county-wide flood risk and vulnerability. Structures have prevented from being built in the high-risk areas while growth has been directed to more appropriate areas, less at risk from riverine flooding.

Estimating Potential Losses

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

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

Hendricks 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. were excluded from the analysis. 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

In order to estimate anticipated damages associated with each flood zone in Hendricks 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 14** identifies the estimated losses associated with structures in the floodway, the 1% AEP (100-year floodplain), and the 0.2% AEP (500-year floodplain) areas by community within Hendricks County.

Table 14 Manual GIS Analysis Utilizing Best Available Data and Hendricks County Building Inventory

	Floodway		1%		0.2%		DNR			
							Floodway		Fringe	
	#	$	#	$	#	$	#	$	#	$
Hendricks County	140	$6.6M	271	$15.1M	120	$5.7M	79	$0	67	$3.5M
Town of Amo	0	$0	0	$0	0	$0	1	$0.1M	0	$0
Town of Avon	9	$0.6M	32	$1.5M	17	$0.8M	0	$0	0	$0
Town of Brownsburg	5	$0.3M	68	$3.0M	16	$0.7M	0	$0	0	$0
Town of Clayton	0	$0	0	$0	0	$0	0	$0	0	$0
Town of Coatesville	0	$0	0	$0	0	$0	0	$0	0	$0
Town of Danville	10	$0.6M	10	$0.8M	2	$0.2M	0	$0	0	$0
Town of Jamestown	0	$0	0	$0	0	$0	0	$0	0	$0
Town of Lizton	1	$0.1M	1	$0.1M	3	$0.2M	0	$0	0	$0
Town of North Salem	0	$0	0	$0	0	$0	0	$0	2	$0.9M
Town of Pittsboro	0	$0	2	$0.2M	0	$0	0	$0	0	$0
Town of Plainfield	26	$1.4M	40	$2.1M	83	$4.2M	0	$0	4	$0.2M
Town of Stilesville	0	$0	0	$0	0	$0	0	$0	0	$0
Total	**191**	**$9.6M**	**424**	**$22.8M**	**241**	**$11.8M**	**80**	**$4.1M**	**73**	**$4.6M**

Utilizing the same GIS information and process, critical infrastructure within each of the Special Flood Hazard Areas (SFHA) in Hendricks County was assessed and are included in **Table 15**. These buildings are included in the overall number of structures and damage estimate information provided in Table 14.

Table 15 Critical Infrastructure in SFHA in Hendricks County

Community	Floodway	1% AEP	0.2% AEP
Hendricks County	Milestone Contractors Unlimited		Damar Services
Town of Amo			
Town of Avon	Town Hall Lake Dam		
Town of Brownsburg			
Town of Clayton			
Town of Coatesville			
Town of Danville	Residential CRF (Medical); WWTP		
Town of Jamestown			
Town of Lizton		WWTP	
Town of North Salem			
Town of Pittsboro			
Town of Plainfield		Hummel Park	INDOT
Town of Stilesville			

Utilizing the information in Table 14 regarding the number of structures within each SFHA, it is also important to note the number of flood insurance policies within each area in Hendricks County. **Table 16** provides the comparison between the number of structures in the SFHA 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 16 Number of Structures in the SFHA and Number of Flood Insurance Policies

COMMUNITY	# STRUCTURES IN SFHA	# POLICIES
Hendricks County	531	159
Town of Amo	0	1
Town of Avon	58	7
Town of Brownsburg	89	31
Town of Clayton	0	
Town of Coatesville	0	1
Town of Danville	22	5
Town of Jamestown	0	
Town of Lizton	5	
Town of North Salem	0	1
Town of Pittsboro	2	
Town of Plainfield	149	66
Town of Stilesville	0	1
Total	**856**	**272**

Future Considerations

As the municipalities within Hendricks County continue to grow in population, it can be anticipated that the number of critical and non-critical infrastructure will also increase accordingly. Within Hendricks County, it is prohibited for new schools, medical facilities, community centers, municipal buildings, and other critical infrastructure to be located within the 0.2% AEP (500-year) floodplain. New structures must also be protected to that level along with a flood-free access to reduce the risk of damages 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. Since the previous planning effort, no development has occurred within the flood zones of Hendricks County.

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 and fluvial erosion hazard areas, 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 monitory value of damages is expected to increase in the area unless additional measures, such as those discussed later in Chapter 4 of this report, are implemented.

Figure 19 Fire Engine in Flood Waters

Indirect effects of flooding may include increased emergency response times due to flooded or redirected streets (**Figure 19**), 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. As many communities within Hendricks County are closely tied to the river systems, special events occurring near to or on these rivers and waterways may be cancelled or postponed during periods of flooding or high-water levels.

Flood: 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 actually 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 access 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 damages associated with the release.

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

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 in proximity to the river may be at risk.

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

3.3.6 Hailstorms, Thunderstorms, and Windstorms

Hailstorms, Thunderstorms, and Windstorms: 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 becomes 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 (**Figure 20**), and crops. Even small hail can cause significant 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 lightening is one of the by-products of the initial storm. In the United States, on average, 300 people are injured, and 80 people are killed each year by lightning. 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, strong 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.

Hailstorm, Thunderstorm, and Windstorm: Recent Occurrences

Figure 20 Damaging Hail on Vehicles

In Hendricks County, the NCDC has recorded 18 hailstorms and 49 thunderstorms/windstorms between January 2015 and August 2020. The largest recorded hailstone was 2.00 inch in diameter and occurred on May 1, 2016 near Coatesville. The average diameter hailstone occurring throughout Hendricks County is approximately 1.0 inch.

Significant windstorms are characterized by the top wind speeds achieved during the incident, characteristically occur in conjunction with thunderstorms, and have historically occurred year-round with the greatest frequency and damage occurring in May, June, and July. Within Hendricks County, NCDC reports 40 instances between January 2015 and August 2020 where top wind speeds were greater than 60 mph.

Total NCDC recorded damages for hailstorms, thunderstorms, and windstorms throughout Hendricks County are $244.45K in property damages, no additional crop damages, three injuries, and one death associated with these events. Many event reports included in the NCDC did not provide descriptive information on the social, physical, and economic losses resulting from individual storms specific to Hendricks County. Even in instances where monetary damages were reported, narrative descriptions of the event rarely extended beyond reports of damages to broken tree limbs, downed power lines, or roof damages.

During the July 2020 event near Tilden, a building under construction collapsed from wind gusts ending with three people injured and one killed. In addition to these tragic events, approximately $50K in property damages were sustained during the thunderstorm. On May 26, 2017 rounds of thunderstorms passed through the area damaging utility poles and large trees, resulting in widespread power outages and $20K in property damages due to golf ball sized hailstones.

Appendix 6 provides the NCDC information regarding hailstorms, thunderstorms, and windstorms that have resulted in injuries, deaths, and monetary damages to property and/or crops.

According to the Institute for Business and Home Safety, central Indiana can expect to experience damaging hailstorms three to four times over 20 years; the average life of a residential roof. Further, thunderstorms and windstorms are considered a high frequency hazard and may occur numerous times per year.

The Committee determined the probability of a hailstorm, thunderstorm, or windstorm occurring anywhere throughout Hendricks County is "Likely" to "Highly Likely" and will typically affect broad portions of the county at one time resulting in potentially "Negligible" to "Limited" damages. 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 less than six hours (for storms anticipated to result in damages) and the duration is also expected to last less than six hours.

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 through the county, sometimes impacting one community more often or more severely than another. Therefore, the CPRI values reflect the distributed risk and associated priority for a hailstorm, thunderstorm, or windstorm. A summary is provided in **Table 17**.

Table 17 CPRI for Hailstorm, Thunderstorm, and Windstorm

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Hendricks County	Likely	Negligible	< 6 Hours	< 6 Hours	Elevated
Town of Amo	Likely	Limited	< 6 Hours	< 6 Hours	Elevated
Town of Avon	Likely	Negligible	< 6 Hours	< 6 Hours	Elevated
Town of Brownsburg	Highly Likely	Negligible	< 6 Hours	< 6 Hours	Elevated
Town of Clayton	Likely	Limited	< 6 Hours	< 6 Hours	Elevated
Town of Coatesville	Likely	Limited	< 6 Hours	< 6 Hours	Elevated
Town of Danville	Highly Likely	Limited	< 6 Hours	< 6 Hours	Severe
Town of Jamestown	Likely	Limited	< 6 Hours	< 6 Hours	Elevated
Town of Lizton	Likely	Limited	< 6 Hours	< 6 Hours	Elevated
Town of North Salem	Likely	Negligible	< 6 Hours	< 6 Hours	Elevated
Town of Pittsboro	Highly Likely	Negligible	< 6 Hours	< 6 Hours	Elevated
Town of Plainfield	Likely	Negligible	< 6 Hours	< 6 Hours	Elevated
Town of Stilesville	Likely	Limited	< 6 Hours	< 6 Hours	Elevated

Specific locations and frequency of hailstorms, thunderstorms, and windstorms are difficult to predict as many of these individual events are without significant warning time and may have impacts to very limited areas or may affect broader areas. However, based on NCDC data and personal experiences

of the Committee, it was determined that all areas within the County are anticipated to experience a hailstorm, thunderstorm, or windstorm within the calendar year. More likely, these communities will be impacted by several of these hazard 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 "Negligible" to "Limited".

Hailstorm, Thunderstorm, and Windstorm: Assessing Vulnerability

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

Direct Effects:

- Damages to infrastructure (power lines)
- Damages to individual properties (homes, cars)

Indirect Effects:

- Downed power lines due to falling tree limbs
- Losses associated with power outages
- Damages sustained from blowing debris

Estimating Potential Losses

Figure 21 Home Damaged During Windstorm

Due to the unpredictability of this hazard all critical infrastructure and non-critical structures in Hendricks County are at risk of damage including temporary or permanent loss of function. For hailstorms, thunderstorms, and windstorms, it is not possible to isolate specific critical infrastructure or non-critical structures that would be vulnerable to damages. 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 damages or power outages during hailstorms, thunderstorms, and windstorms. Additionally, mobile homes and accessory buildings such as pole barns and sheds may also be at a higher risk of damages from hailstorms, thunderstorms, and windstorms if not properly anchored to the ground. Damages from falling limbs or uprooted trees such as that shown in **Figure 21**, are common.

Future Considerations

As the populations of the communities in Hendricks County continue to 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 hailstorm, thunderstorm, or windstorm, measures such as proper anchoring, enforcement of the International Building Codes, and burial of power lines should be completed. 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 a hailstorm, thunderstorm, or windstorm can include power outages caused by downed tree limbs or flying debris, damages resulting from prolonged power outages, and damages to structures or property as a result of debris.

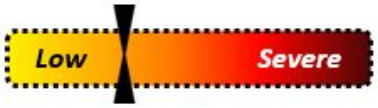
Hailstorm, Thunderstorm, and Windstorm: Relationship to Other Hazards

Hailstorms, thunderstorms, and windstorms may be the precursor for other hazards. For example, hazardous materials incidents can be the result of a hailstorm, thunderstorm, or a windstorm. 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 Hendricks County.

Additionally, rainfall typically occurs with a thunderstorm and this additional precipitation 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 also lead to structural damages to a dam or may cause damages to nearby trees or other structures, leading to indirect damages.

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 debris.

3.3.7 Landslide/Subsidence



Landslide/Subsidence: Overview

The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on an over steepened slope is the primary reason for a landslide, there are other contributing factors. For example, erosion by rivers, glaciers, or ocean waves can cause rock to fall. Rock and soil slopes may be weakened through saturation by snowmelt or heavy rains, earthquakes can create stresses that make weak slopes fail, and excess weight from accumulation of rain or snow, stockpiling of rock or ore, from waste piles, or man-made structures that may stress weak slopes to the point of collapse.

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 attribute to subsidence: compaction of aquifer systems, drainage and subsequent oxidation of organic soils, and dissolution and collapse of susceptible rocks.

Landslide/Subsidence: Recent Occurrences

The potential for any of landslides or land subsidence within Hendricks County was discussed by the Planning Committee. To the knowledge of the Planning Committee, there are no Karst areas or underground mining operations within Hendricks County. In addition of this, to date, there has not been any landslides or subsidence events in Hendricks County.

The Committee determined the probability of a landslide or subsidence occurring in Hendricks County is "Unlikely" resulting in potentially "Negligible" damages. Currently, the Committee feels that the warning time is anticipated to be greater than 24 hours as an event is not anticipated to occur. Similarly, the duration is expected to last less than six hours as it is not anticipated to occur at all. 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 is provided in **Table 18.**

Table 18 CPRI for Landslide/Land Subsidence

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Hendricks County	Unlikely	Negligible	> 24 Hours	< 6 Hours	Low
Town of Amo	Unlikely	Negligible	> 24 Hours	< 6 Hours	Low
Town of Avon	Unlikely	Negligible	> 24 Hours	< 6 Hours	Low
Town of Brownsburg	Unlikely	Negligible	> 24 Hours	< 6 Hours	Low
Town of Clayton	Unlikely	Negligible	> 24 Hours	< 6 Hours	Low
Town of Coatesville	Unlikely	Negligible	> 24 Hours	< 6 Hours	Low
Town of Danville	Unlikely	Negligible	> 24 Hours	< 6 Hours	Low
Town of Jamestown	Unlikely	Negligible	> 24 Hours	< 6 Hours	Low
Town of Lizton	Unlikely	Negligible	> 24 Hours	< 6 Hours	Low
Town of North Salem	Unlikely	Negligible	> 24 Hours	< 6 Hours	Low
Town of Pittsboro	Unlikely	Negligible	> 24 Hours	< 6 Hours	Low
Town of Plainfield	Unlikely	Negligible	> 24 Hours	< 6 Hours	Low
Town of Stilesville	Unlikely	Negligible	> 24 Hours	< 6 Hours	Low

Landslide/Subsidence: Assessing Vulnerability

Hendricks County, without the presence of Karst geology or underground mines, is at a low risk of land subsidence or sink holes; "Unlikely" according to the Planning Committee with "Negligible" magnitude estimates. Fluvial erosion, or erosion and failures along water courses, were considered within the flood discussion.

The effects of a landslide or subsidence event may be minimal to extensive in nature and may affect small or broad ranges of land area. Within Hendricks County, direct and indirect effects may include:

Direct Effects:

- Damages to infrastructure (power lines, roads, bridges)
- Damages to individual properties (homes, cars)

Indirect Effects:

- Increased response time for emergency vehicles
- Losses associated with affected land (crop loss)
- Potential contamination of groundwater resources

Estimating Potential Losses

Due to the unpredictability of this hazard all critical infrastructure and non-critical structures in Hendricks County are at risk of damage including temporary or permanent loss of function. For landslide and subsidence, it is difficult to isolate specific critical infrastructure or non-critical structures that would be more or less vulnerable to damages.

Future Considerations

As the populations of the communities in Hendricks County continue to grow, it can be anticipated that the number of critical and non-critical structures will also increase. In order to reduce the vulnerability for damages resulting from a landslide or land subsidence, soils and mining GIS layers should be integrated into the building permit or approval process.

Indirect effects resulting from a landslide or land subsidence event can include power outages caused by downed tree limbs, increased response times for emergency personnel if transportation routes are damaged, and potentially shot down of businesses.

Landslide/Subsidence: Relationship to Other Hazards

A landslide or a subsidence 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 or levee 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 snow melt.

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.

3.3.8 Tornado

Tornado: Overview

Tornadoes are defined as violently rotating columns of air extending from thunderstorms to the ground. Funnel clouds are rotating columns of air not in contact with the ground. However, the funnel cloud may reach the ground very quickly – becoming a tornado. If there is debris lifted and blown around by the "funnel cloud", then it has reached the ground and is a tornado.

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-clown debris. Tornado season is generally 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 percent of all tornados strike between 3:00 pm and 9:00 pm but can occur at any time of day or night as shown in **Figure 22** Tornadoes occur most frequently in the United States east of the Rocky Mountains. Tornadoes in Indiana generally come from the south through the east.

Figure 22 Funnel Cloud During a Lightning Storm at Night

While most tornadoes (69%) have winds of less than 100 mph, they can be much stronger. Although violent tornadoes (winds greater than 205 mph) account for only 2% of all tornadoes, they cause 70% of all tornado deaths. In 1931, a tornado in Minnesota lifted an 83-ton rail car with 117 passengers and carried it more than 80 feet. In another instance, a tornado in Oklahoma carried a motel sign 30 miles and dropped it in Arkansas. In 1975, a Mississippi tornado carried a home freezer more than a mile.

Tornado: Recent Occurrences

The classification of tornadoes utilizes the Enhanced Fujita Scale of tornado intensity and damages, described in **Table 19**. 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. According to the NCDC, Hendricks County has experienced four tornadoes (1-EF0, 3-EF1), between January 2015 and August 2020.

Table 19 Enhanced Fujita Scale of Tornado Intensity

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

The NCDC reports approximately $35.5K in property damages for the events which all occurred on August 15, 2016. Tornadoes touched down in areas of Clayton, Brownsburg, and Avon in the early evening. Damages sustained were uprooted trees and broken limbs, rolled tractors, and structural damages to barns and homes.

The Committee estimated the probability of a tornado occurring in Hendricks County would be "Possible" to "Likely" and the magnitude and severity of such an event to be "Significant" throughout much of the county. Representatives from Coatesville and throughout the county agreed that Coatesville experiences more weather-related events, thus a higher probability. As with many hazardous events, the Committee anticipated a short warning time of typically less than six hours, and a short duration, also less than six hours. The summary is shown in **Table 20**.

Table 20 CPRI for Tornado

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Hendricks County	Likely	Significant	< 6 Hours	< 6 Hours	Elevated
Town of Amo	Possible	Limited	< 6 Hours	< 6 Hours	Elevated
Town of Avon	Possible	Significant	< 6 Hours	< 6 Hours	Elevated
Town of Brownsburg	Possible	Significant	< 6 Hours	< 6 Hours	Elevated
Town of Clayton	Possible	Significant	< 6 Hours	< 6 Hours	Elevated
Town of Coatesville	Likely	Significant	< 6 Hours	< 6 Hours	Elevated
Town of Danville	Possible	Significant	< 6 Hours	< 6 Hours	Elevated
Town of Jamestown	Possible	Significant	< 6 Hours	< 6 Hours	Elevated
Town of Lizton	Possible	Significant	< 6 Hours	< 6 Hours	Elevated
Town of North Salem	Possible	Significant	< 6 Hours	< 6 Hours	Elevated
Town of Pittsboro	Possible	Significant	< 6 Hours	< 6 Hours	Elevated
Town of Plainfield	Possible	Significant	< 6 Hours	< 6 Hours	Elevated
Town of Stilesville	Possible	Significant	< 6 Hours	< 6 Hours	Elevated

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 NCDC and local weather agencies, the Committee determined the general probability of a future tornado occurring in Hendricks County is "Possible" (within the next five years) to "Likely" (within the next three years).

Tornado: Assessing Vulnerability

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

Direct Effects:

- Damages to older construction structures, mobile homes, and accessory structures (pole barns, sheds, etc.)
- Damages to above ground utility lines and structures

Indirect Effects:

- Expenses related to debris clean-up and/or reconstruction
- Loss of revenue for affected businesses
- Loss of work if employers are affected

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, Avon, Brownsburg, and Danville. 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 A is nearest the center of the tornado path, while Zone C is the farthest from the path and with a theoretically lower wind speed. **Table 21** provides summary data for the hypothetical tornado, which is identified on Exhibit 3.

Table 21 Summary of Hypothetical Tornado Damages

	Zone 1		Zone 2		Zone 3		Total	
	#	$	#	$	#	$	#	$
County	102	$4.9M	96	$4.2M	102	$4.7M	**300**	**$1.2M**
Avon	3	$0.2M	0	$0	1	$0.1M	**4**	**$0.3M**
Brownsburg	195	$8.9M	189	$9.4M	203	$10.1M	**587**	**$28.4M**
Danville	14	$1.7M	10	$1.3M	16	$1.8M	**40**	**$4.8M**
Totals	**314**	**$15.7M**	**295**	**$14.9M**	**322**	**$16.7M**	**931**	**$34.7M**

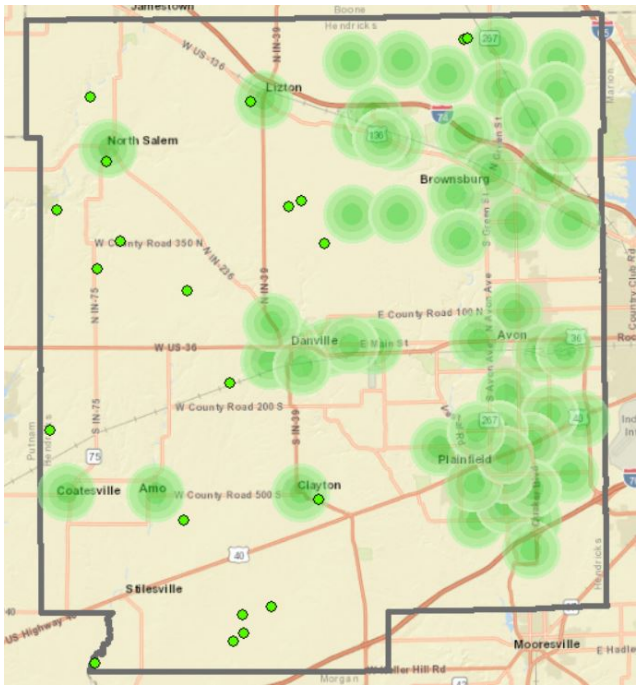


Figure 23 Hendricks County Outdoor Warning Sirens

Within Hendricks County, there are numerous events each year that draw thousands of guests. Due to this, it is imperative that the EMA place continued importance on the need to maintain, and as necessary, upgrade their outdoor warning siren coverage. Currently, much of the more populous areas of the county are covered by the audible ranges of the existing outdoor warning sirens. The existing siren locations and their audible coverage areas (green circles) are provided in **Figure 23.**

While it can be anticipated that new construction associated with development may be stronger than older or existing construction, most of Hendricks County will remain vulnerable in areas left uncovered by outdoor warning sirens. It is impossible to predict the path of a tornado and therefore all current and future development will continue to be at risk for damages. However, risk to the citizens of Hendricks County has been lessened through participation in mass notification programs and outdoor warning siren activations.

There may also be indirect effects of a tornado event. For example, post-event clean-up may result in high expenses or inability to work for property owners that have experienced damages from either the tornado directly or by debris 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.

Tornado: 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 damages 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 a dam failure as the increased wind speeds, and debris caused by the tornado, may directly impact the dam, or cause indirect damages through large debris or downed trees. 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, and large amounts of debris.

3.3.9 Winter Storm and Ice

Winter Storm & 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. Some winter storms may be large enough to affect several states while others may affect only a single community. All winter storms are 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 on impact. 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.

Figure 24 Ice Covered Power Lines

Storm effects such as extreme cold, flooding, and snow and ice accumulation (**Figure 24**) 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 considered 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 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. A blizzard warning means that large amounts of falling or blowing snow and sustained winds of at least 35 mph are expected for several hours. Winter storms are common in Hendricks County and the surrounding region. Such conditions can result in substantial personal and property damage, even death.

Winter Storm & Ice: Recent Occurrences

Since January 2015, the NCDC has recorded five heavy snow events and one icestorm. NCDC reports did not include information related to monetary damages, injuries, or deaths associated with any of the events. Narrative descriptions indicated poor travel conditions, power outages and debris associated with similar events.

The most recently recorded winter storm event occurred on December 15, 2019. Snowfalls in the area ranged from six to seven inches with the heaviest amounts recorded in Brownsburg. An ice storm occurred on November 14, 2018. During this event, an accumulation of 0.3 inches of ice near Clayton was reported to have impacted the area.

The probability, magnitude, warning times, and duration of a snowstorm or ice storm causing disruption to residents and businesses in Hendricks County, as determined by the Planning Committee, is expected to be mostly consistent throughout the county and communities. It is "Likely" that this type of hazard will occur in this area and will typically affect the entire county, and possibly several surrounding counties at one time, resulting in primarily "Significant" damages due to the remoteness of some areas and the amount of critical facilities in others. The warning time for severe temperatures or several inches of snow associated with a winter storm is usually greater than 24 hours while the duration of the incident is anticipated to be greater than one week. A summary is shown in **Table 22**.

Table 22 CPRI for Winter Storm and Ice

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Hendricks County	Likely	Limited	12-24 Hours	< 1 Week	Elevated
Town of Amo	Likely	Limited	12-24 Hours	< 1 Week	Elevated
Town of Avon	Likely	Limited	12-24 Hours	< 1 Week	Elevated
Town of Brownsburg	Likely	Limited	12-24 Hours	< 1 Week	Elevated
Town of Clayton	Likely	Limited	12-24 Hours	< 1 Week	Elevated
Town of Coatesville	Likely	Limited	12-24 Hours	< 1 Week	Elevated
Town of Danville	Likely	Limited	12-24 Hours	< 1 Week	Elevated
Town of Jamestown	Likely	Limited	12-24 Hours	< 1 Week	Elevated
Town of Lizton	Likely	Limited	12-24 Hours	< 1 Week	Elevated
Town of North Salem	Likely	Limited	12-24 Hours	< 1 Week	Elevated
Town of Pittsboro	Likely	Limited	12-24 Hours	< 1 Week	Elevated
Town of Plainfield	Likely	Limited	12-24 Hours	< 1 Week	Elevated
Town of Stilesville	Likely	Limited	12-24 Hours	< 1 Week	Elevated

The Planning Committee determined that the probability for a snowstorm or ice storm to occur in Hendricks County and the communities within is "Likely" or will occur within the next three years. Based on historical data and the experience of the Planning Committee, snowstorms are common within Hendricks County and will continue to be a regular occurrence.

Winter Storm & Ice: Assessing Vulnerability

A snowstorm typically affects a large regional area with potential for physical, economic, and/or social losses. Direct and indirect effects of a snowstorm or ice storm within Hendricks County may include:

Direct Effects:

- More urban area employers may experience loss of production as employees may not be able to get to work
- Rural (County) roads may impassable
- Expenses related to snow removal or brine/sand applications

Indirect Effects:

- Loss of revenue as businesses are closed
- Increased emergency response times based on safety of roads
- Loss of income if unable to get to place of employment

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.

Figure 25 Travel Impacted During Snowstorm

For planning purposes, information collected in 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 Hendricks County communities. For example, a March 2003 snowstorm in Denver, Colorado dropped approximately 31 inches of snow and caused an estimated $34M in total damages. In addition, a February 2003 winter storm dropped an estimated 15-20 inches of snow in parts of Ohio. The Federal and Ohio Emergency Management Agencies and U.S. Small Business Administration surveyed damaged areas and issued a preliminary assessment of $17M in disaster related costs. These costs included snow and debris removal, emergency loss prevention measures, and public utilities repair. The agencies found over 300 homes and businesses either damaged or destroyed in six counties. Snowstorms and blizzards also make road travel difficult and dangerous, as in **Figure 25.**

The Denver, Colorado area snowstorms from December 2006 through January 2007 surpassed the expenses and damages of the 2003 winter storms. In snow removal costs alone, it is estimated that over $19M was spent throughout the area, with approximately $6.4M of that allocated to clearing Denver International Airport. Additional economic expenses are realized when such a large storm closed local businesses and Denver International Airport for nearly 48 hours.

While the above examples indicate 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 as a whole, perhaps multiple counties, and therefore all development, current and future, will be at risk for damages associated with snow and ice storms.

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.

Winter Storm & Ice: Relationship to Other Hazards

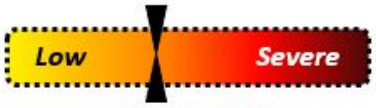
Figure 26 Flooding Caused by Snow Melt

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 damages to structures and properties (**Figure 26**) as well as within the stream or river channel. The increased flooding may then lead to a dam or levee failure within the same area, further exacerbating the damages.

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 Hendricks County, or where open areas are more susceptible to snow drifts on roads, the possibility of a traffic related hazardous materials incident may increase.

Power outages and other infrastructure failures may also occur during a winter storm. Weight from snow and ice accumulations can directly or indirectly cause power lines to fail. During extreme cold temperatures, power outages may prove deadly for certain populations such as the elderly or ill.

TECHNOLOGICAL HAZARDS



3.3.10 Dam Failure

Dam 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.

A dam impounds water in the upstream area, referred to as the reservoir. The amount of water impounded is measured in acre-feet. An acre-foot is the volume of water that covers an acre of land to a depth of one foot. As a function of upstream topography, even a very small dam may impound or detain many acre-feet of water. Two factors influence the potential severity of a full or partial dam failure: the amount of water impounded, and the density, type, and value of development and infrastructure located downstream.

Of the approximately 80,000 dams identified nationwide in the National Inventory of Dams, the majority are privately owned. Each 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 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 serious 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.

A levee is a flood control structure 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. The principle causes of levee failure are like those associated with dam failure and 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 that 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 increase the size of the breach until it is repaired or water levels on the two side of the levee have equalized.

Dam Failure: Recent Occurrences

Within Hendricks County, there are six DNR-regulated High Hazard dams. There are 11 Significant Hazard dams, and eight Low Hazard dams, shown on Exhibit 2. According to local information, there have been no dam failures within Hendricks County. However, owners of the Forest Lake dam in Avon have been in ongoing litigation with IDNR regarding inspections and required improvements to

the dam. As of the last submitted inspection, the condition of the Forest Lake dam was noted as "Conditionally Poor".

According to the National Levee Database (NLD) managed by the USACE, there are no levees systems within Hendricks County. Therefore, levees will not be considered as a hazard within this planning effort.

Based on the information provided to them and their local knowledge, experience, and expertise, the Committee determined the probability of a dam or levee failure is "Possible" in those areas where a dam exists or in area anticipated to be directly impacted by a dam breach (the unincorporated areas). In areas of the county without a dam, or those not anticipated to be affected by a breach, the probability, according to the Planning Committee, was also determined to be "Unlikely". With similar regard, the magnitude ranges from "Significant" (areas within the potential inundation area) to "Negligible" (areas not anticipated to be within the inundation area) damages. For a dam failure that occurs on a sunny day, the warning time is anticipated to be less than six hours; and the duration is anticipated to last less than six hours to less than one day. **Table 23** provides a summary of the Planning Committee's expectations during a dam failure.

Table 23 CPRI for Dam Failure

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Hendricks County	Possible	Negligible	< 6 Hours	< 1 Day	Low
Town of Amo	Unlikely	Negligible	< 6 Hours	< 6 Hours	Low
Town of Avon	Unlikely	Significant	< 6 Hours	< 1 Day	Elevated
Town of Brownsburg	Unlikely	Negligible	< 6 Hours	< 6 Hours	Low
Town of Clayton	Unlikely	Negligible	< 6 Hours	< 6 Hours	Low
Town of Coatesville	Unlikely	Negligible	< 6 Hours	< 6 Hours	Low
Town of Danville	Unlikely	Negligible	< 6 Hours	< 6 Hours	Low
Town of Jamestown	Unlikely	Negligible	< 6 Hours	< 6 Hours	Low
Town of Lizton	Unlikely	Negligible	< 6 Hours	< 6 Hours	Low
Town of North Salem	Unlikely	Negligible	< 6 Hours	< 6 Hours	Low
Town of Pittsboro	Unlikely	Negligible	< 6 Hours	< 6 Hours	Low
Town of Plainfield	Unlikely	Negligible	< 6 Hours	< 6 Hours	Low
Town of Stilesville	Unlikely	Negligible	< 6 Hours	< 6 Hours	Low

Dam Failure: Assessing Vulnerability

The actual magnitude and extent of damages due to a dam failure depend on the type of 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 owner or engineer, there may be unforeseen structural problems, natural forces, mistakes in operation, negligence, or vandalism that may cause a structure to fail.

Within Hendricks County, direct and indirect effects from a dam failure may include:

Direct Effects:

- Loss of life and serious 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:

- Loss of land in the immediate scour area
- Increased response times due to damaged or re-routed transportation routes and/or bridges

Estimating Potential Losses

It is preferred that High Hazard dams have Incident and Emergency Action Plans (IEAP) developed. These plans have detailed potential dam failure inundation areas identified along with at-risk structures identified. Two of the High Hazard dams within Hendricks County have an IEAP developed: the Je-To Lake Dam and Prestwick Lake Dam. The Prestwick Lake Dam IEAP also includes potential inundation mapping, but the Je-To Lake Dam IEAP does not include that mapping at this time. Potential dam failure inundation areas were developed for the other High Hazard dams within Hendricks County to provide an example of anticipated damages. The actual magnitude and extent of damages 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.

These potential inundation areas were overlaid onto recent aerial photography to estimate the number of critical and non-critical structures potentially affected by a sunny-day dam failure. As with previous hazards, damage estimates were derived by assuming 25% of all structures would be completely destroyed, 35% would be 50% damaged, and the remaining 40% of structures would have only 25% in damages. **Table 24** provides overview information of each of the individual dam failures.

Table 24 Hendricks County Potential Dam Failure Impacts

High Hazard Dam	Potential Damages	
	# Structures	$ Damages
Avon Town Hall	262	$11.2M
Danville Conservation Club	16	$1.2M
Forest Lake	106	$4.9M
Je-To Lake		
Prestwick Lake	117	$5.1M
Prock Lake	70	$3.8M

Utilizing the same GIS process, **Table 25** identifies the critical infrastructure within each of the potential dam failure inundation areas in Hendricks County. These buildings are included in the overall number of structures and damage estimates provided in Table 24.

Table 25 Critical Infrastructure Impacted by Dam Failure

High Hazard Dam	Critical Infrastructure
Avon Town Hall	Avon water treatment, outdoor siren, Avon Town Hall, Avon Police Department
Danville Conservation Club	Aqua Indiana, Fire Station 92, Twin Bridges Recycling
Forest Lake	*None*
Je-To Lake	
Prestwick Lake	*None*
Prock Lake	*None*

Future Considerations

As areas near existing 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 dam and levee failure inundation areas. Also, flood-free access should be provided for these facilities. Large areas of new development have not yet occurred downstream of the high hazard dams in Hendricks County. Until such development or re-development downstream of a dam is prohibited, those areas remain vulnerable to losses and damages associated with a failure of that structure.

It is also very 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. This is a good suggestion even for Significant Hazard dams as well.

Dam Failure: 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 within the inundation areas downstream of the dam. Nearby bridges and roads are also in danger of being destroyed or damaged due to a dam failure. Bridges may become unstable and portions of road surfaces may be washed away, or the entire road may be undermined. Other infrastructure such as utility poles and lines may be damaged as the water flows along the surface or pipes may become exposed due to scouring; all of which may lead to utility failures within the area downstream of the dam failure.

3.3.11 Hazardous Materials Incident

Hazardous Materials Incident: Overview

Hazardous materials are substances that pose a potential threat to life, health, property, and the environment if they are released. Examples of hazardous materials include corrosives, explosives, flammable materials, radioactive materials, poisons, oxidizers, and dangerous gases. Despite precautions taken to ensure careful handling during manufacture, transport, storage, use, and disposal, accidental releases are bound to occur. These releases create a serious hazard for workers, neighbors, and emergency response personnel. Emergency response may require fire, safety/law enforcement, search and rescue, and hazardous materials response units.

Figure 27 Drums of Potentially Hazardous Waste

As materials are mobilized 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 Hendricks County and its residents if proper and immediate actions are not taken. Most releases are the result of human error or improper storage (**Figure 27**), 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.

Hazardous Materials Incident: Recent Occurrences

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 facilities utilizing, storing, and/or manufacturing chemicals and the number of high-volume transportation routes increase the likelihood of an incident.

According to the Committee, the probability of a hazardous materials release or incident is "Likely" within many areas (Avon, Jamestown, North Salem, and Plainfield) of the county due to the number of facilities and transportation routes within and through these municipalities. Within Amo, Brownsburg, Clayton, Danville, Lizton, Pittsboro, Stilesville, and the unincorporated areas, the committee and representatives determined the probability of a hazardous materials incident would be "Possible" to occur within the next five years. Representatives from Coatesville determined the probability of an incident within Coatesville is "Unlikely". "Negligible" to "Significant" damages are anticipated to result from an incident dependent upon the location of the event. As with hazards of this nature, a short warning time of less than six hours and a duration of less than one day to less than one week is anticipated in the event of a hazardous materials incident. A summary is shown in **Table 26**.

Table 26 CPRI For Hazardous Materials Incident

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Hendricks County	Possible	Negligible	< 6 Hours	< 1 Day	Low
Town of Amo	Possible	Negligible	< 6 Hours	< 1 Day	Low
Town of Avon	Likely	Significant	< 6 Hours	< 1 Week	Severe
Town of Brownsburg	Possible	Significant	< 6 Hours	< 1 Day	Elevated
Town of Clayton	Possible	Limited	< 6 Hours	< 1 Day	Elevated
Town of Coatesville	Unlikely	Negligible	< 6 Hours	< 1 Day	Low
Town of Danville	Possible	Negligible	< 6 Hours	< 1 Day	Low
Town of Jamestown	Likely	Significant	< 6 Hours	< 1 Day	Severe
Town of Lizton	Possible	Negligible	< 6 Hours	< 1 Day	Low
Town of North Salem	Likely	Significant	< 6 Hours	< 1 Day	Severe
Town of Pittsboro	Possible	Negligible	< 6 Hours	< 1 Day	Low
Town of Plainfield	Likely	Negligible	< 6 Hours	< 1 Day	Elevated
Town of Stilesville	Possible	Limited	< 6 Hours	< 1 Day	Elevated

Relatively small hazardous materials incidents have occurred throughout Hendricks County in the past and may, according to the Committee, occur again. As the number of hazardous materials producers, users, and transporters increase within or surrounding Hendricks County, it can be anticipated that the likelihood of a future incident will also increase.

Hazardous Materials Incident: Assessing Vulnerability

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

Direct Effects:

- More densely populated areas with a larger number of structures, railroad crossings, and heavily traveled routes are more vulnerable
- Expense of reconstruction of affected structures

Indirect Effects:

- Loss of revenue or production while recovery and/or reconstruction occurs
- Anxiety or stress related to event
- Potential evacuation of neighboring structures or facilities

Figure 28 Fuel Tanker Fire

While the possibility of an incident occurring may be likely, the vulnerability of Hendricks 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 Local Emergency Planning Commission (LEPC). This commission has the responsibility for preparing and implementing emergency response plans, cataloging Material Safety Data Sheets (MSDS), creating chemical inventories of local industries and businesses, and reporting materials necessary for compliance.

In Hendricks County, nearly 133 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 events makes predicting the extent of their damage very difficult. A small-scale spill or release might have a minor impact and would likely 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. On the other hand, 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 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. Several routes including railways, Interstates 70 and 74; US Highway 36, 40, and 136; State Routes 39, 67, 75, 236, and 267 are traveled by carriers of hazardous materials.

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 greatly 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 specials needs or considerations such as children, elderly, and medically unfit.

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.

Hazardous Materials Incident: Relationship to Other Hazards

Dependent on the nature of the release, conditions may exist where an ignition source such as a fire or spark ignites a flammable or explosive substance. As the fire spreads throughout the facility or the area, structural and/or property damages will increase. 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. While this may increase structural losses, it may decrease the social losses such as injuries or even deaths.

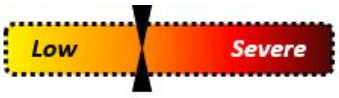
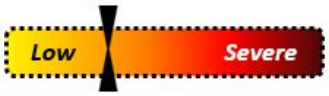
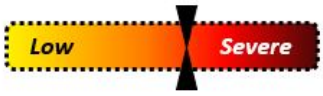
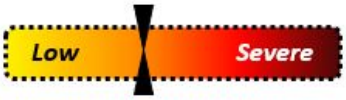
3.4 HAZARD SUMMARY

For the development of this MHMP, the Committee utilized the CPRI method to prioritize the hazards they felt affected Hendricks 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 27 summarizes the CPRI values for the various hazards studied within this MHMP.

- The hazard that ranked as "Low" is Dam Failure; Earthquake; Extreme Temperature; Fire; Land Subsidence.
- "Elevated" risks included Drought; Flood; Hail, Thunder, and Windstorm; Hazardous Materials Incident; Tornado; Winter Storm and Ice.
- No "Severe" values resulted through the work of the committee

Table 27 Combined CPRI

Type of Hazard	List of Hazards	Weighted Average CPRI
Natural	Drought	
	Earthquake	
	Extreme Temperature	
	Fire	
	Flood	
	Hail/Thunder/Windstorm	
	Landslide/Subsidence	
	Tornado	
	Winter Storm/Ice	
Technological	Dam Failure	
	Hazardous Materials Incident	

It can be important to understand the cause and effect relationship between the hazards selected by the Committee. **Table 28** 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 28 Hazard Relationship Table

EFFECT → / CAUSE ↓	Drought	Earthquake	Extreme Temperature	Fire	Flood	Hailstorm/ Thunderstorm/ Windstorm	Landslide / Subsidence	Tornado	Winter Storm / Ice	Dam Failure	Hazardous Materials
Drought											
Earthquake				X			X			X	X
Extreme Temperature											X
Fire											X
Flood							X			X	X
Hailstorm/ Thunderstorm / Windstorm				X	X		X			X	X
Landslide / Subsidence											X
Tornado				X						X	X
Winter Storm/ Ice					X					X	X
Dam Failure					X		X				X
Hazardous Materials				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 Hendricks 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 a greater risk of a dam 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.

CHAPTER 4: MITIGATION GOALS AND PRACTICES

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

4.1 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 2010 Hendricks County MHMP and determined that each of these remain valid and effective. In summary, the overall goal of the Hendricks 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.

4.2 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 earthquake, wind, and flood. 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 (2017) study by the National Institute of Building Sciences, reviewed over 20 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 are saved on disaster costs. In addition, by designing and construction buildings which exceed select items in the 2015 International Code, $4 can be saved for every $1 invested in those changes.

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.

4.2.1 Existing Mitigation Practices

As part of this planning effort, the Committee discussed the strengths and weaknesses of existing mitigation practices and made recommendations for improvements, as well as suggested new practices. The following is a summary of existing hazard mitigation practices within Hendricks County. Mitigation measures that were included in the 2010 Hendricks County MHMP are noted as such.

Emergency Services

- The County has developed a centralized system for testing the existing outdoor warning sirens.
- Stream gages are utilized for flood forecasting and flood warnings for various stream levels and along the School Branch Creek, West Fork White Lick Creek, and White Lick Creek.
- Many communities have developed snow removal routes to keep primary streets clean during and after snowstorms.
- IEAPs have been developed, and are routinely reviewed, for the Je-To Lake Dam and Prestwick Lake Dam.
- Training and table-top exercises are conducted by the LEPC and include response agencies such as police, fire, and local hospitals.
- Many response agencies have mobile data terminals and necessary software utilized by the vehicle fleet and dispatchers.

Natural Resource Protection

- Hendricks County is in good standing with the NFIP Program and has flood protection ordinances which meets or exceeds the minimum requirements.
- Current facility maps and response plans are on file for all Tier II HazMat facilities

Prevention

- Hendricks County utilizes GIS data collection and maintenance which may be used independently and collectively in land use planning decisions and can be utilized in HAZUS-MH "what-if" scenarios. *(2009 Measure)*
- The Hendricks County LEPC provides routine training regarding the proper storage, transport, and disposal of hazardous materials.
- Hendricks County participates in the CRS program as a Class 7. *(2009 Measure)*
- Information related to natural hazards has been incorporated into the Comprehensive Land Use Plan and other plans to better guide future growth and development

- Avon Comprehensive Plan, 2017:
    i. Objectives included to "Identify placed for development clusters" and to "Survey existing natural areas in the township to determine which are the most valuable to our community": to preserve more land for open spaces and a mix of uses will assist in preserving floodplains and wetlands and allow for efficient emergency response efforts when needed
- Plainfield Comprehensive Plan, 2016:
    i. Objectives included to "Consider engaging the Police Department, Fire Department, and school districts to increase communication and preparedness with regard to future growth" and "consider enforcing development buffers around wetlands and floodplains to support stormwater management and preserve natural ecosystems"
- Brownsburg Comprehensive Plan, 2019:
    i. Objectives included to "Enhance existing railroad crossings and explore the feasibility of new grade-separated crossings over the CSX railroad at strategic point within the previously developed core of Brownsburg as well as within the community's growth areas" and to "Coordinate plans for annexation and development with community service and facility providers to ensure adequate and sustainable levels of service throughout the Town and its growth areas"

Property Protection

- Recommendations from completed flood protections studies are implemented as funding becomes available *(2009 Measure)*
- Drainage system maintenance, including repair and replacement of broken tiles and culverts occurs routinely throughout the county. *(2009 Measure)*

Public Information

- Outreach materials and hazard preparedness materials are routinely provided within offices and agencies throughout Hendricks County, large public events, speaking opportunities within schools, etc. *(2009 Measure)*
- Each community participates in Everbridge notification systems during times of impending severe weather.

Structural Control

- Stormwater conveyances and regulated drains are maintained on a routine basis to prevent localized flooding, increased erosion, and material deposition as a result of rainfall or snowmelt. *(2009 Measure)*

4.2.2 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 29 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, responsible entities, and potential funding sources, associated with each proposed practice. The proposed mitigation practices are listed in order of importance to Hendricks County for implementation. Projects identified by the Committee to be of "high" local priority may be implemented within five years from final Plan adoption. Projects identified to be of "moderate" local priority may be implemented within 5-10 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 adoptions. 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 Hendricks County. The intent of this planning effort was to identify the hazards and the extent to which they affect Hendricks County and to determine what type of mitigation strategies or practices may be undertaken to mitigate for these hazards. A FEMA-approved MHMP is required to apply for and/or receive project grants under the HMGP, PDM, 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 5.0** of this plan includes an implementation plan for all high priority mitigation practices identified by the Committee.

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

Table 29 Proposed Mitigation Measures

Mitigation Practice	Mitigation Strategy	Hazard Addressed	Status	Priority	Benefit-Cost Ratio	Responsible Entity	Funding Source
Emergency Preparedness & Warning 1. Improve disaster preparedness and emergency response at the local level through the CERT or similar program 2. Utilize a hazard broadcast system to distribute mass notifications to residents and visitors *(2009 Measure)* 3. Purchase mobile message boards to provide current hazard information *(2009 Measure)* 4. Investigate and propose an ordinance to require developers to pay to install additional sirens for new developments or pay into siren fund as part of new developments 5. Create bilingual notifications and hazard preparedness materials as well as purchase translators 6. Improve outdoor warning siren coverage or complete software upgrades to alert populations of severe weather conditions *(2009 Measure)* 7. Coordinate with private building owners utilizing large dynamic message boards for business to use during hazard events	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☐ Structural Control	☒ Drought ☒ Earthquake ☒ Extreme Temperature ☒ Fire ☒ Flood ☒ Hail/Thunder/Wind ☒ Landslide/Subsidence ☒ Tornado ☒ Winter Storm/Ice ☒ Dam Failure ☒ HazMat Incident	**Ongoing –** 2. Many county residents (approx. 38K) subscribe to Everbridge 3. The county has access to mobile message boards through the District 6. Sirens provide coverage for most populated areas 7. Many private facilities throughout the county operate an electronic message board **Proposed Enhancements –** 1. Investigate options for CERT or similar programs, implement suitable program in prioritized areas, and provide training throughout the year. 2. Increase participation in hazard notification system 3. Purchase message boards for use in Hendricks County (Highway-2; Danville-2; Plainfield-2) 4. Propose and adopt an ordinance to have developers pay into a fund for additional outdoor warning sirens 5. Create alternate forms of printed and voiced messaging in Spanish in an attempt to reach additional residents 6. Additional sirens in unincorporated areas and software upgrades for existing sirens 7. Coordinate with facility owners who operate dynamic message boards and provide them with pre-scripted messages to use during hazard events.	High *(CERT, mass notifications, mobile message boards, siren ordinance)* Moderate *(bilingual notifications, siren coverage)* Low *(private message boards)*	High	EMA CERT Advisors Message Board Owners Large Employers	Existing Budgets Grants

Mitigation Practice	Mitigation Strategy	Hazard Addressed	Status	Priority	Benefit-Cost Ratio	Responsible Entity	Funding Source
Emergency Response & Recovery 1. Establish procedures to evacuate the population in known hazard areas *(2009 Measure)* 2. Coordinate communications, documentation, and record keeping between communities and agencies including a database of accurate and community specific information following each hazard events 3. Enhance existing mobile EOC with additional equipment *(2009 Measure)* 4. Establish secondary EOC within Hendricks County 5. Inventory and prioritize needs to strengthen water/dive/ice rescue capabilities within the county 6. Investigate reciprocal agreements between neighboring communities/counties for structural inspections following hazardous events 7. Purchase mobile sand bagging machine and equipment	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☐ Property Protection ☒ Public Information ☐ Structural Control	☒ Drought ☒ Earthquake ☒ Extreme Temperature ☒ Fire ☒ Flood ☒ Hail/Thunder/Wind ☒ Landslide/Subsidence ☒ Tornado ☒ Winter Storm/Ice ☒ Dam Failure ☒ HazMat Incident	**Ongoing –** 1. Evacuation procedures have been developed for hazmat incidents 2. Post-event information is provided in varying degrees 3. Mobile EOC exists 5. Some Fire Departments have personnel certified for dive and/or water rescue 6. Many communities have Mutual Aid for medical, fire, and police response efforts 7. Sand bagging efforts and plans exist in various areas **Proposed Enhancement –** 1. Establish procedures to evacuate areas during floods and dam failures 2. Create a more consistent reporting and documentation effort following hazard events 3. Inventory capabilities and prioritize needs to strengthen mobile EOC 4. Establish fully functional secondary EOC within the county 5. Determine countywide needs to strengthen capabilities for water/dive/ice rescues 6. Investigate ability to enter into similar agreements for activities related to structural inspections or other activities following hazard events 7. Additional equipment would make the efforts more efficient for some areas and types of events	High *(evacuations, recordkeeping, mobile EOC, secondary EOC)* Moderate *(water/dive/ice)* Low *(reciprocal agreements, sand bagging)*	High	EMA Sheriff Department Police/Marshal *Amo, Avon, Brownsburg, Clayton, Coatesville, Danville, Jamestown, Lizton, North Salem, Pittsboro, Plainfield, Stilesville* Fire Departments *Avon, Brownsburg, Coatesville, Danville, Eel River, Hazelwood, Liberty Twp, Lizton Union Twp, Mill Creek, Pittsboro, Plainfield, Stilesville* Building Department *County (Amo, Coatesville, North Salem, Stilesville), Avon, Brownsburg, Clayton, Danville, Jamestown, Lizton, Pittsboro, Plainfield*	Existing Budget Grant
Building Protection 1. Prohibit development of new critical facilities in SFHA 2. Relocate, buyout, or floodproof existing non-critical facilities that are subject to repetitive flooding *(2009 Measure)* 3. Protect existing critical facilities in floodplains *(2009 Measure)* *(Will assist with NFIP compliance)*	☒ Emergency Services ☒ Nat. Res. Protection ☐ Prevention ☒ Property Protection ☐ Public Information ☒ Structural Control	☐ Drought ☐ Earthquake ☐ Extreme Temperature ☐ Fire ☒ Flood ☐ Hail/Thunder/Wind ☐ Landslide/Subsidence ☐ Tornado ☐ Winter Storm/Ice ☒ Dam Failure ☐ HazMat Incident	**Ongoing –** 1. New facilities are prohibited in the Floodway 3. Danville WWTP, Residential CRF, Milestone Contractors Unlimited, Hummel park, Lizton WWTP, INDOT Plainfield Office, and Damar Services are located in the SFHA **Proposed Enhancements –** 1. Prohibit construction of new critical facilities in the 100- and 500-year floodplains 2. Develop a prioritized list of structures to be relocated, bought out, or floodproofed within each municipality 3. Determine most appropriate measures to protect critical facilities located in the SFHA	High *(new critical facilities, relocate)* Moderate *(protect existing critical facilities)*	Moderate	EMA Facility Owners Floodplain Administrators *County, Amo, Avon, Brownsburg, Coatesville, Danville, North Salem, Plainfield, Stilesville*	Grant Existing Budget

Mitigation Practice	Mitigation Strategy	Hazard Addressed	Status	Priority	Benefit-Cost Ratio	Responsible Entity	Funding Source
Flood Studies and Protection 1. Prepare a detailed Flood Response Plan to improve response and reduce losses from a flood event 2. Evaluate and utilize flood forecasting capabilities including stream gages, flood forecast maps, and flood alerts *(2009 Measure)* 3. Conduct detailed flood protection studies for problem areas and/or areas with repetitive flooding problems *(2009 Measure)* *(Will assist with NFIP compliance)*	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☒ Structural Control	☐ Drought ☐ Earthquake ☐ Extreme Temperature ☐ Fire ☒ Flood ☐ Hail/Thunder/Wind ☐ Landslide/Subsidence ☐ Tornado ☐ Winter Storm/Ice ☐ Dam Failure ☐ HazMat Incident	**Ongoing –** 1. Stream gages have been installed on School Branch, West Fork White Lick Creek and White Lick Creek 2. Studies are completed as funding becomes available **Proposed Enhancements –** 1. Prioritize areas in need of Flood Response Plan and develop team to prepare plan 2. Install additional stream gages on the west side of the county 3. Prioritize listing of needed studies and continue to complete as funding becomes available	High *(FRP)* Moderate *(flood forecasting, problem area studies)*	Moderate	EMA Floodplain Administrators *County, Amo, Avon, Brownsburg, Coatesville, Danville, North Salem, Plainfield, Stilesville*	Existing Budget Grant
Geographic Information Systems 1. Develop and routinely update GIS layers with location and attributes of critical facilities and known hazard areas available to individual municipalities and offices *(2009 Measure)* 2. Train GIS staff in HAZUS-MH to quantitatively estimate losses in "what if scenarios" and continue to use the most recent GIS data in land use planning efforts *(2009 Measure)*	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☐ Public Information ☒ Structural Control	☒ Drought ☒ Earthquake ☒ Extreme Temperature ☒ Fire ☒ Flood ☒ Hail/Thunder/Wind ☒ Landslide/Subsidence ☒ Tornado ☒ Winter Storm/Ice ☒ Dam Failure ☒ HazMat Incident	**Ongoing –** 3. GIS layers have been developed and are utilized by some departments **Proposed Enhancements –** 1. Develop a county-wide GIS consortium to maintain and update collaborative GIS data 2. Provide training opportunities for GIS staff related to HAZUS-MH.	High *(update GIS)* Moderate *(HAZUS-MH)*	Moderate	GIS Department *County* GIS Contract Service Provider	Existing Budget Grant
Transportation 1. Complete transportation survey to determine typical types and quantities of chemicals being transported throughout Hendricks County 2. Require warning (flashing lights, crossing arms, rumbles trips, signage) at each intersection between rail and road to reduce the potential for train/vehicular crashes	☒ Emergency Services ☐ Nat. Res. Protection ☒ Prevention ☐ Property Protection ☒ Public Information ☒ Structural Control	☐ Drought ☐ Earthquake ☐ Extreme Temperature ☐ Fire ☐ Flood ☐ Hail/Thunder/Wind ☐ Landslide/Subsidence ☐ Tornado ☐ Winter Storm/Ice ☐ Dam Failure ☒ HazMat Incident	**Ongoing –** 2. Various types of warnings are used at most rail crossings throughout the county **Proposed Enhancement –** 1. Complete updated commodity flow study for Hendricks County focusing on Interstates 70 and 74, US Routes, and rail lines Inventory rail crossings and determine best warning type for those without	High *(transportation survey)* Moderate *(warnings)*	Moderate	Rail Owners INDOT Highway Department LEPC	Existing Budget Grant

Mitigation Practice	Mitigation Strategy	Hazard Addressed	Status	Priority	Benefit-Cost Ratio	Responsible Entity	Funding Source
Safer Rooms and Community Shelters 1. Develop temporary and/or long-term shelter agreements within the County. Potential for tiered levels of shelters, domestic animal shelters, etc. *(2009 Measure)* 2. Clearly advertise location of safe rooms and community shelters for large gatherings of people 3. Research incentives for private buildings with approved safe rooms	☒ Emergency Services ☐ Nat. Res. Protection ☐ Prevention ☐ Property Protection ☒ Public Information ☒ Structural Control	☐ Drought ☒ Earthquake ☒ Extreme Temperature ☒ Fire ☒ Flood ☒ Hail/Thunder/Wind ☐ Landslide/Subsidence ☒ Tornado ☒ Winter Storm/Ice ☒ Dam Failure ☒ HazMat Incident	**Ongoing –** 1. Shelters locations are spaced throughout the county as available and as needed **Proposed Enhancement –** 1. Continue to evaluate shelter locations and needs throughout the county 2. Develop education materials for large gatherings 3. Research incentives and provide to structures with approved safe rooms	High *(shelter agreements, advertise for large gatherings)* Low *(incentives)*	Low	EMA Large Gathering Liaisons Building Department *County (Amo, Coatesville, North Salem, Stilesville), Avon, Brownsburg, Clayton, Danville, Jamestown, Lizton, Pittsboro, Plainfield* American Red Cross	Existing Budget
Management of Dams 1. Review regular inspection reports and maintenance records of dams regardless of ownership 2. Encourage dam owners to develop an IEAP *(2009 Measure)*	☒ Emergency Services ☐ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☐ Public Information ☒ Structural Control	☐ Drought ☐ Earthquake ☐ Extreme Temperature ☐ Fire ☐ Flood ☐ Hail/Thunder/Wind ☐ Landslide/Subsidence ☐ Tornado ☐ Winter Storm/Ice ☒ Dam Failure ☐ HazMat Incident	**Ongoing –** 2. Je-To Lake and Prestwick Lake Dams have IEAPs drafted **Proposed Enhancements –** 1. Provide inspection reports and maintenance records to the EMA Director for review and overall hazard assessment 2. Develop IEAPs for remaining High Hazard dams	High	Moderate	Dam Owners IDNR EMA	Existing Budget Grant
Power Backup Generators 1. Inventory, prioritize, and retrofit public facilities and/or critical facilities with appropriate wiring and electrical capabilities for utilizing a large generator for power back up 2. Secure a fuel reserve, or ensure contractual emergency provisions so critical infrastructure may run on power backup for extended periods of time	☒ Emergency Services ☐ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☐ Public Information ☐ Structural Control	☐ Drought ☒ Earthquake ☒ Extreme Temperature ☒ Fire ☒ Flood ☒ Hail/Thunder/Wind ☒ Landslide/Subsidence ☒ Tornado ☒ Winter Storm/Ice ☒ Dam Failure ☒ HazMat Incident	**Ongoing –** 1. Many critical facilities have generators or have added since the last plan 2. Some communities have verbal agreements for fuel supplies **Proposed Enhancements –** 1. Inventory generator capabilities and needs and prioritize within each community to determine needs for future purchases 2. Secure a fuel reserve via contract service agreement	High	Low	EMA Community Contacts *County, Amo, Avon, Brownsburg, Clayton, Coatesville, Danville, Jamestown, Lizton, North Salem, Pittsboro, Plainfield, Stilesville* Facility Owners	Existing Budget Grant

Mitigation Practice	Mitigation Strategy	Hazard Addressed	Status	Priority	Benefit-Cost Ratio	Responsible Entity	Funding Source
Land Use Planning & Zoning 1. Incorporate hazard information, risk assessment, and hazard mitigation practices into the Comprehensive Land Use Plan and Development Review to better guide future growth and development	☐ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☐ Structural Control	☒ Drought ☒ Earthquake ☒ Extreme Temperature ☒ Fire ☒ Flood ☒ Hail/Thunder/Wind ☒ Landslide/Subsidence ☒ Tornado ☒ Winter Storm/Ice ☒ Dam Failure ☒ HazMat Incident	**Ongoing –** **Proposed Enhancement –** 1. Update Comprehensive Plans and include information related to hazards, more definitively outline higher risk areas and those that should be avoided for future development	Moderate	Moderate	Planning / Building Department *County (Amo, Coatesville, North Salem, Stilesville), Avon, Brownsburg, Clayton, Danville, Jamestown, Lizton, Pittsboro, Plainfield*	Existing Budget
Water Conservation 1. Research and adopt a water conservation ordinance and contingency plans to implement during water shortages	☒ Emergency Services ☒ Nat. Res. Protection ☐ Prevention ☐ Property Protection ☒ Public Information ☐ Structural Control	☒ Drought ☐ Earthquake ☒ Extreme Temperature ☐ Fire ☐ Flood ☐ Hail/Thunder/Wind ☐ Landslide/Subsidence ☐ Tornado ☐ Winter Storm/Ice ☐ Dam Failure ☐ HazMat Incident	**Ongoing –** **Proposed Enhancement –** 1. Review existing ordinances, and if needed, propose water conservation ordinance	Moderate	Low	EMA Planning Department *County (Amo, Coatesville, North Salem, Stilesville), Avon, Brownsburg, Clayton, Danville, Jamestown, Lizton, Pittsboro, Plainfield*	Existing Budget
Community Rating System 1. Investigate potential to reduce flood insurance premiums through additional participation in the NFIP's CRS Program. *(2009 Measure)* *(Will assist with NFIP compliance)*	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☒ Structural Control	☐ Drought ☐ Earthquake ☐ Extreme Temperature ☐ Fire ☒ Flood ☐ Hail/Thunder/Wind ☐ Landslide/Subsidence ☐ Tornado ☐ Winter Storm/Ice ☐ Dam Failure ☐ HazMat Incident	**Ongoing –** 1. Hendricks County currently participates in the CRS program at a Class 7 **Proposed Enhancement –** 1. Participation from Avon, Brownsburg, and Plainfield	Low	Moderate	Floodplain Administrators *County, Amo, Avon, Brownsburg, Coatesville, Danville, North Salem, Plainfield, Stilesville*	Existing Budget

CHAPTER 5: 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.

5.1 BUILDING PROTECTION

Prohibit development of new critical facilities in SFHA

- Review ordinances of each municipality to determine allowable development in floodplains
- Research language of existing ordinances which prohibit development in at-risk areas
- Propose and adopt language to prohibit development of new critical infrastructure within the floodplain

Relocate, buyout, or floodproof existing non-critical facilities that are subject to repetitive flooding

- Identify areas routinely flooded and the structures within them
- Prioritize areas and structures according to those most at risk
- Seek grant funding or other funding source to implement program to relocate, buyout, or floodproofing for interested property owners

5.2 EMERGENCY PREPAREDNESS AND WARNING

Improve disaster preparedness and emergency response at the local level through the CERT or similar program

- Research CERT program guidelines, training requirements, and equipment needs
- Review geographic locations of existing volunteers and prioritize neighborhoods, regions, or large employers for recruitment based on areas not yet covered
- Provide announcement and press release to partner agencies to increase the reach of the information
- Develop initial roster and begin training sessions

Utilize a hazard broadcast system to distribute mass notifications to residents and visitors

- Determine most appropriate broadcast system for the municipality
- Complete awareness campaign to encourage sign ups within each municipality
- Develop pre-scripted messages to utilize during hazard situation and provide for quick use and dissemination/posting

Purchase mobile message boards to provide current hazard information

- Inventory existing capabilities
- Determine needs based on areas where message boards need to be routinely deployed
- Secure funding and procure message boards
- Store message boards throughout the county

Investigate and propose an ordinance to require developers to pay to install additional sirens for new developments or pay into a siren fund as part of new development

- Research and review existing "siren ordinances"
- Determine language appropriate for Hendricks County and municipalities and develop Hendricks County Siren Ordinance
- Propose ordinance for adoption throughout Hendricks County municipalities
- Implement an education component for local developers once ordinance has been adopted

5.3 EMERGENCY RESPONSE AND RECOVERY

Establish procedures to evacuate the population in known hazard areas

- Determine protocols for when evacuations would be required and agency or municipal officials' roles and responsibilities during events
- Define evacuation routes, any facilities to where evacuated populations will be sent
- Provide information to affected populations, land and/or facility owners, and agency or municipal officials

Coordinate communications, documentation, and record keeping between communities and agencies including a database of accurate and community specific information following each hazard events

- Review current protocols for post-event communications
- Utilize existing IDHS software or develop a county-wide database
- Review database with each municipality to review what information should be collected and reported in a consistent manner

Enhance existing mobile EOC with additional equipment

- Inventory existing equipment, noting maintenance or replacement dates
- Prioritize necessary purchases, including hardware and software upgrades
- Prepare annual schedule for mobile EOC to assist with preparation of materials listing
- Secure funding and purchase needed equipment for additional supplies throughout the year

Establish secondary EOC within Hendricks County

- Prepare list of potential locations for secondary EOC
- Select final location and prioritize needed upgrades to make functional
- Hold training at secondary EOC with ESF Leads to ensure familiarity with site location

5.4 FLOOD STUDIES AND PROTECTION

Prepare a detailed Flood Response Plan to improve response and reduce losses from a flood event

- Work with municipal Floodplain Administrators to prioritize municipalities most at risk for flood damages
- Review existing plans or protocols within each community and surrounding area

- Secure funding needed and develop municipal specific Flood Response Plan

5.5 GEOGRAPHIC INFORMATION SYSTEMS

Develop and routinely update GIS layers with location and attributes of critical facilities and known hazard areas available to individual municipalities and offices

- Compile relevant GIS layers from each municipality and input necessary attributes
- Create a county-wide consortium of GIS data and develop standards for layers and attribute tables
- Complete annual review and update of data

5.6 MANAGEMENT OF DAMS

Review regular inspection reports and maintenance records of dams regardless of ownership

- Coordinate with high hazard dam owners and IDNR to receive copies of regular inspection reports and maintenance records
- Continue coordination and collaboration to ensure inspections are completed, the dam and surrounding area is maintained, and risks are assessed accordingly

Encourage dam owners to develop an IEAP

- Review existing IEAPs
- Work with owners of dams without IEAPs to provide assistance in starting the planning process
- Prepare draft IEAPs
- Hold table-top exercises with response agencies and update IEAP annually

5.7 POWER BACK-UP GENERATORS

Inventory, prioritize, and retrofit public facilities and/or critical facilities with appropriate wiring and electrical capabilities for utilizing a large generator for power back-up

- Utilize listing of critical facilities and coordinate with facility owners or operators
- Determine presence or absence of generator, fuel capacity, and fuel reserve
- Determine if additional needs are required to ensure compatibility with generator
- Secure or allocate funding to make necessary purchases or facility adjustments to ensure functioning generators are present and operable

Secure a fuel reserve, or ensure contractual emergency provisions so critical infrastructure may run on power backup for extended periods of time

- Determine where county and municipal vehicles (and generators) routinely receive fuel
- Review contract language to ensure municipal and critical facilities have ability to receive fuel prior to other clients
- If necessary, add such language to contracts

5.8 SAFER ROOMS AND COMMUNITY SHELTERS

Develop temporary and/or long-term shelter agreements within the county. Potential for tiered levels of shelters or domestic animal shelters

- Review locations and capabilities of existing shelters within the county
- Determine if adequate coverage is provided in populated areas or in centralized areas of the unincorporated areas within the county
- Determine if alternative shelters are available (those which may not be Red Cross certified but may be suitable for short term shelter at the agreement of the client)
- Determine need for sheltering of domestic animals; develop appropriate plans and shelter agreements

Clearly advertise location of safer rooms and community shelters for large gatherings of people

- Partner with event representatives to assess methods possible to advertise safe locations in case of emergencies
- Incorporate advertisement of safe locations into early planning and coordination steps of events such as sporting events, community festivals, and large outdoor events

5.9 TRANSPORTATION

Complete transportation survey to determine typical types and quantities of chemicals being transported throughout Hendricks County

- Review existing commodity studies to determine where updates or revisions are needed
- Work with INDOT to determine parameters for new commodity study
- Focus on heavier traffic areas such as US Routes, State Routes, and rail lines

CHAPTER 6: PLAN MAINTENANCE PROCESS

6.1 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 Hendricks 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 Hendricks County MHMP.

The EMA Director will reconvene the MHMP Committee on an annual basis and follow a significant hazard incident to determine whether:

- the nature, magnitude, and/or type of risk have changed
- the current resources are appropriate for implementation
- there are implementation problems, such as technical, political, legal, or coordination issues with other agencies
- the outcomes have occurred as expected
- the agencies and other partners participated as originally proposed

During the annual meetings the Implementation Checklist provided in **Appendix 6** will be helpful to track any progress, successes, and problems experienced.

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 critical 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 early 2025, 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 Hendricks 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.

Prior to submission of the updated MHMP, a public meeting will be held to present the information to residents of Hendricks County and to provide them 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 meeting.

6.2 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 to be made to each NFIP communities' planning documents and ordinances during the regularly scheduled update. Among other things, local planning documents and ordinances may include comprehensive plans, floodplain management plans, zoning ordinances, building codes, site development regulations, or permits. Modifications include discussions related to hazardous material facility buffers, floodplain areas, and discouraging development of new critical infrastructure in known hazard areas.

Based on added language within each of the Comprehensive Plan updates the appropriate Zoning Ordinances and Floodplain Management Ordinances within each community may also need to be amended.

6.3 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 Hendricks 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, and special projects/studies efforts. Once adopted, a copy of this Plan will be available for the public to review in the EMA Office and the Hendricks County website.

Updates or modifications to the Hendricks County MHMP will require a public notice and/or meeting prior to submitting revisions to the individual jurisdictions for approval.

The CRS program credits NFIP communities a maximum of 37 points for adopting the Plan; establishing a procedure for implementation, review, and updating the Plan; and submitting an annual evaluation report.

REFERENCES

Association of State Floodplain Managers (ASFPM). No Adverse Impact: A Toolkit for Common Sense Floodplain Management. 2019. www.floods.org

Britt, Robert Roy. "New Data Confirms Strong Earthquake Risk to Central U.S.". Live Science. June 22, 2005. www.livescience.com/3871-data-confirms-strong-earthquake-risk-central.html

Business Courier. "Ohio Winter Storm Losses Hit $17.5 Million". March 11, 2003.

Environmental Protection Agency. Multi-Resolution Land Characteristics Consortium. www.mrlc.g

Federal Emergency Management Agency. "Community Ratings System". www.fema.gov/nfip/crs.shtm

Federal Emergency Management Agency. 44 CFR Parts 201 and 206 Hazard Mitigation Planning and Hazard Mitigation Grant Program

Federal Emergency Management Agency. Flood Insurance Rate Maps for Hendricks County, Indiana.

Federal Emergency Management Agency. "HAZUS-MH (v1.3) Earthquake Model". 2007

Federal Emergency Management Agency. "Local Multi-Hazard Mitigation Planning Guidance". July, 2008

Fowler, Kathleen K. "Description and Effects of 1988 Drought on Groundwater Flows, Streamflow, and Reservoir Levels in Indiana". USGS, Water Resource Investigations Report 91-4100. Pg. 91. 1992

Furlow, Steven. The Times of Noblesville, IN. "Quake Shakes Some in County". December 30, 2010.

Hansen, Michael C. "Earthquakes in Ohio". Ohio Department of Natural Resources Division of Geological Survey. Educational Leaflet No. 9. 2005

Indiana Department of Homeland Security. "Hazard Identification and Risk Assessment (HIRA) Tool" DRAFT.

Indiana Department of Homeland Security. "Severe Weather Preparedness" www.in.gov/dhs/3163.htm

Indiana Department of Environmental Management. Impaired Waters – Integrated Water Monitoring and Assessment Report. www.in.gov/idem/nps/2639.htm

Indiana Geological Survey. "Earthquakes in Indiana" www.igs.indiana.edu/earthquakes/

Institute for Business and Home Safety. www.disastersafety.org

Kocin, Paul J. National Centers for Environmental Prediction. "Some Thoughts on the Societal and Economic Impact of Winter Storms." 1997

Midwestern Regional Climate Center. "Climate Summaries" http://mcc.sws.uius.edu/climate_midwest/mwclimate_data_summaries.htm#

National Oceanic and Atmospheric Administration. National Climate Data Center. www.ncdc.noaa.gov/stormevents/

National Oceanic and Atmospheric Administration. National Weather Service Office of Climate, Water, and Weather Services. "Heat: A Major Killer". www.nws.noaa.gov/os/heat/index.shtml#wwa

National Oceanic and Atmospheric Administration. National Weather Service. "Wind Chill". http://www.crh.noaa.gov/ddc/?n=windchill

National Oceanic and Atmospheric Administration. National Weather Service. Central Illinois Weather Forecast Office. "Earthquakes of April 18, 2008 and Aftershocks".

Purdue University. Purdue Agricultural News. "Indiana Crop Insurance Payouts Top $1 billion". March 12, 2013

Runevitch, Jennie. WTHR-TV Channel 13. "Indiana Earthquake Strikes in Rare Location". December 30, 2010. www.wthr.com/story/13760207/indiana-earthquake-strikes-in-rare-location

STATS Indiana. "Hendricks County, Indiana". http://www.stats.indiana.edu/profiles

Strauss, Gary; Carolyn Pesce, and Dan Vergano. USA Today. "East is all shook up after strong earthquake for region". August 25, 2011. www.usatoday.com/news/nation/story/2011-08-23/Easrthquake-rocks-East-Coast/50107542/1

Superfund Amendments and Reauthorization Act & Emergency Planning and Community Right to Know Act. 40 CFR 350-372

US Department of Agriculture. National Agricultural Statistics Service. "Indiana". www.nass.usda.gov/statistics_by_state/indiana/index.asp

US Drought Monitor. http://drought.unl.edu/dm

US Geological Survey. "Stream Gage Data". http://waterdata.usgs.gov/nwis/si