MULTI-HAZARD MITIGATION PLAN UPDATE

Hancock County, Indiana

Prepared for:

Hancock County, Indiana
Town of Cumberland, Indiana
Town of Fortville
City of Greenfield, Indiana
Town of McCordsville, Indiana
Town of New Palestine, Indiana
Town of Spring Lake, Indiana

June 2016

Prepared by

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CBBEL Project No. 14-690

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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 1-1** includes 4 phases:

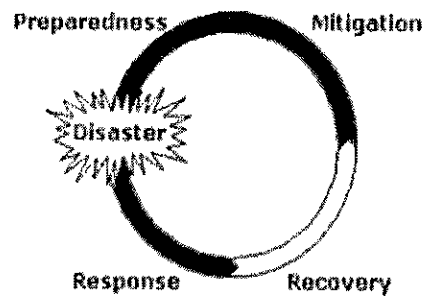

Figure 1-1 Disaster Life Cycle

- **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 Hancock 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.

1.2 PROJECT SCOPE AND 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 in order to apply for and/or receive project grants under the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM), Flood Mitigation Assistance (FMA), and Severe Repetitive Loss (SRL). FEMA may require a MHMP under the Repetitive Flood Claims (RFC) program. Although the Hancock 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.

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. 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 5 years. MHMP updates must demonstrate that progress has been made in the last 5 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 Hancock County MHMP Update is a multi-jurisdictional planning effort led by the Hancock County Surveyor's Office. This Plan was prepared in partnership with Hancock County, the Town of Cumberland, the Town of Fortville, the City of Greenfield, the Town of McCordsville, the Town of New

Palestine, and the Town of Spring Lake. 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 Hancock 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 3 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 are necessary to enter the CRS program and receive a 5% flood insurance premium discount. This MHMP could contribute as many as 294 points toward participation in the CRS. At the time of this planning effort, none of the Hancock County communities participate in the CRS program.

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

1.3 PLANNING 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 Hancock County MHMP Update began in 2013 when the County Surveyor submitted a PDM Grant application to IDHS. The grant request was approved by FEMA and grant funds were awarded in 2015.

Once the grant was awarded, the planning process to update the 2007 MHMP took 12 months. This included a 8 month planning process, followed by a review period by IDHS and FEMA for the draft MHMP Update, and another month for Hancock County, the Town of Cumberland, the Town of Fortville, the City of Greenfield, the Town of McCordsville, the Town of New Palestine, and the Town of Spring Lake to adopt the final MHMP Update.

1.3.1 Planning Committee and Project Team

In June of 2015, the Surveyor's Office 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 2007. **Table 1-1** lists the individuals that participated on the Committee and the entity they represented.

Table 1-1 MHMP Update Committee

NAME	TITLE	REPRESENTING
Robert Allen	LEPC Chair/Fire/Paramedic	Sugar Creek Fire Department
Dede Allender	Program Educator	Hancock County Solid Waste District
Roy Ballard	Extension Educator	Purdue University
Jarrod Beeson	Director of Special Projects	9 Star Connect
John Begovich	Fire Chief	Sugar Creek Fire Department
Tracie Belongia	Program Coordinator/Survey Tech	Hancock County
George Boaz	Deputy Director	Hancock County EMA
Susan Bodkin	Surveyor/Floodplain Admin	Hancock county
Brad Burkhart	Chief Deputy	Hancock County Sheriff's Department
Jeff Conley	Line Superintendent	Ninestar
Lori Cooley		Hancock Regional Hospital
Michael Crider	Indiana Senate	Elected Official
Ron Crider	Public Works	Town of McCordsville
Dennis Cutteridge	Keihin	Keihin - Hancock County
Mike Dale	Planning Director	Hancock County
Martin Ebbert	Maintenance	Town of Shirley
Robert Ehle	Chief	Town of New Palestine
Ben Esterline	District Coordinator	IDHS
Joannie Fitzwater	City Planning Director	City of Greenfield
Michael Fruth	Director of Utilities	City of Greenfield
Chelly Gracy	GIS Tech	Hancock County
David Heiniger	Security Coordinator	Hancock Regional Hospital
Brad Henderson	Facilities and Special Projects Manager	Nine Star Connect
Joe Hollis	Transportation	Hancock County
Terry Hulen	Battalion Chief	Sugar Creek Fire Department

John Jester	Police Chief	City of Greenfield
Matt Kelly	911 Center	Hancock County
Bill Knauer	Police Chief	Town of Fortville
Ben Lipps	E.M. Liaison	Town of Cumberland
John Milburn	GIS Coordinator	Hancock County
Misty Moore	Director	Hancock County EMA
Joe Munden	Captain	Greenfield Police Department
Bruce Nulliner		Sugar Creek Fire Department
Rudy Nylund	Coroner's Office	Hancock County
Christine Owens	Floodplain Admin	Town of Cumberland
Jim Peters	Salvation Army	Hancock County Shelters
George Plinsinski	Engineering Supervisor	Ninestar
Joe Renner	Town Manager	Town of Fortville
Jimmy Roberts	Fire Chief	City of Greenfield
Mike Shepherd	Sheriff	Hancock County
Dave Sutherin	Liaison	Hancock County Firefighters Mutual Aid
Andy Swain	Town Council President	Town of Spring Lake
Teri Sweet	Office Manager	Hancock County Plan Commission
Karla Vincent	Engineer	City of Greenfield
Brent Wakeland	Environmental Health Specialist	Hancock County
Scott Williams	Building Official	Hancock County
Steve Yagelski	Director of Utilities	Town of Cumberland

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 2007 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; and reviewed materials for public participation. A sign-in sheet recorded those present at each meeting to document participation. Although unable to attend a Committee Meeting, the members of the Town of Spring Lake Town Council reviewed the draft plan and discussed the Update at a Town Council meeting. Meeting agendas and summaries are included in **Appendix 2**. Members of the Committee attended a draft review meeting in May 2016, encouraged colleagues and family members to review the draft plan, and assisted with adoption of the Hancock County MHMP Update.

1.3.2 **Public Involvement**

A draft of the Hancock County MHMP Update was placed in the County Surveyor's Office for public review and comment. Committee members were provided with an informational flyer to display in their respective offices.

The media release and informational flyer are located in **Appendix 3.**

1.3.3 Involvement of Other Interested Parties

Interested agencies, businesses, academia, and nonprofits were invited to review and comment on the draft Hancock County MHMP Update (Appendix 3). Information related to the planning process, and the availability of the draft Hancock County MHMP was directly provided to such potentially interested parties via personal conversations, informational flyer, and press releases. Successful implementation and future updates of the Hancock 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 Hancock 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 Hancock County MHMP, and to assist the Committee in developing potential mitigation measures to reduce the social, physical, and economic losses associated with hazards affecting Hancock County.

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

- Hancock County Zoning Ordinance *(2014)*
- City of Greenfield Comprehensive Plan (Draft) *(2015)*
- The Cumberland Comprehensive Plan 2031 *(2011)*
- Town of McCordsville Comprehensive Plan *(2011)*

The CRS program credits NFIP communities a maximum of 100 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, it is important background information about the physical, social, and economical composition of Hancock County necessary to better understand the Risk Assessment discussed in **Chapter 3**.

Hancock County, organized in 1828, is named after John Hancock, President of the Continental Congress, and signatory of the Declaration of Independence. The total area of Hancock County is approximately 307 square miles. The location of Hancock County within the State of Indiana is identified in **Figure 2-1**.

2.1 POPULATION AND DEMOGRAPHICS

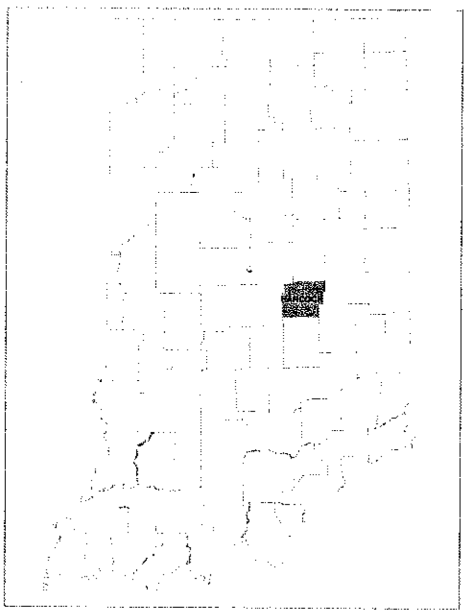

Figure 2-1 Hancock County Location

The most recent data for Hancock County estimates that the 2015 population was 72,520, which ranks 22nd in the State. Of that total, the City of Greenfield accounts for 21,398 or 29.5% of the county's population while the Town of Fortville is the third largest community with 3,953 or 5.5% of the population.

In 2014, the median age of the population in the County was 40.3 years of age. The largest demographic age groups in the County are older adults (45-64 years) with a population of 20,436, and young adults (24-44 years) with a population of 17,584. School aged children (5-17) are the third largest age group with a population of 13,433 individuals living in Hancock County. The approximate median household income in 2014 was reported to be $68,334 while the poverty rate in the same year was reported at 6.9% county-wide. In total, 24.4% of households are married with children, and 34.5% of households are married without children.

Nearly 93.6% of the adults, older than 25, within the County have reportedly completed a High School education. Further, 26.7% of those same adults have also completed a Bachelor of Arts or higher degree.

2.2 EMPLOYMENT

US Census data indicates that of the Hancock County work force, 15.2% are employed in professional or technical positions. Manufacturing and

Other/Private account for 15.1% and 16.6% respectively. The total resident labor force according to estimates in 2015 is 37,332 with 1,562 unemployed and an unemployment rate of 4.2% or 68th in the State out of 92 counties.

Table 2-1 List of Major Employers

Keihin North America Inc	Novelty Inc.
Covance	S Abraham & Sons
Hancock Regional	Formica Corp
Eli Lilly & Co.	Precoat Metals
Indiana Automotive Fasteners	Service Engineering Inc

(Hancock County Economic Development Corporation 2015)

2.3 TRANSPORTATION AND COMMUTIING PATTERNS

There are several major transportation routes passing through Hancock County and the municipalities within. Interstate 70, US Routes 40 and 52, and State Roads 9, 136, 67, and 234 serve as main routes between the various municipalities. A number of rail lines also traverse the county. These transportation routes are identified in **Figure 2-2**.

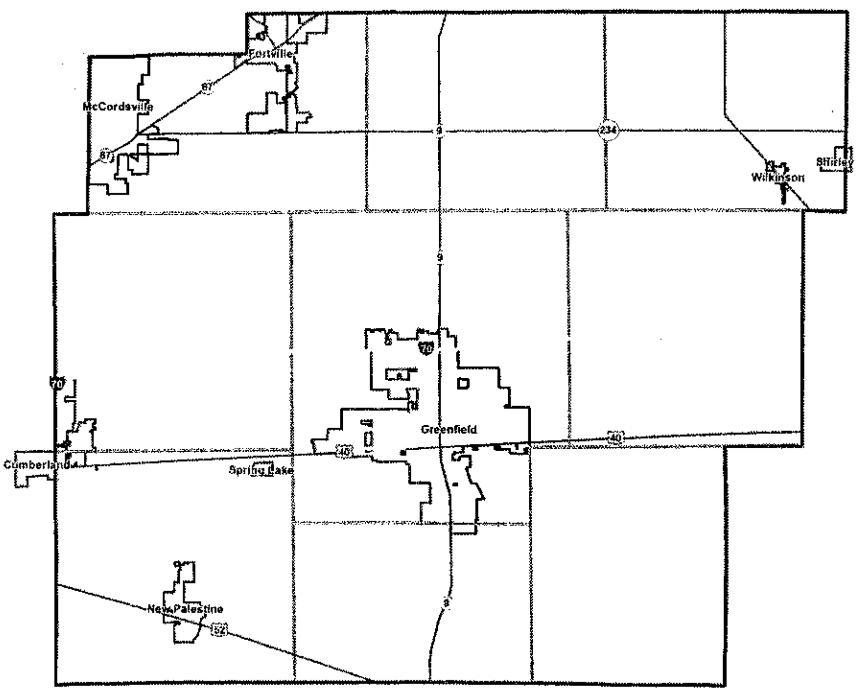

Figure 2-2 Hancock County Transportation Routes

According to the Indiana Business Research Center, nearly 5,100 people commute into Hancock County on a daily basis. Approximately 33% of these commuters travel from Marion County. Further, approximately 18,500 Hancock County residents commute to other counties with the majority traveling to Marion County (37%).

Figure 2-3 indicates the number of workers 16 and older who do not live within Hancock County but commute into Hancock County for employment purposes.

Similarly, **Figure 2-4** indicates the number of Hancock County residents 16 and older that commute out of the county for employment.

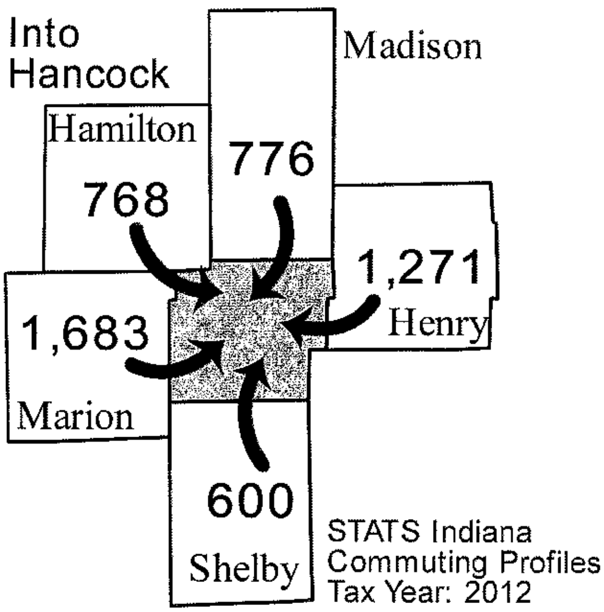

Figure 2-3 Workers Commuting into Hancock County

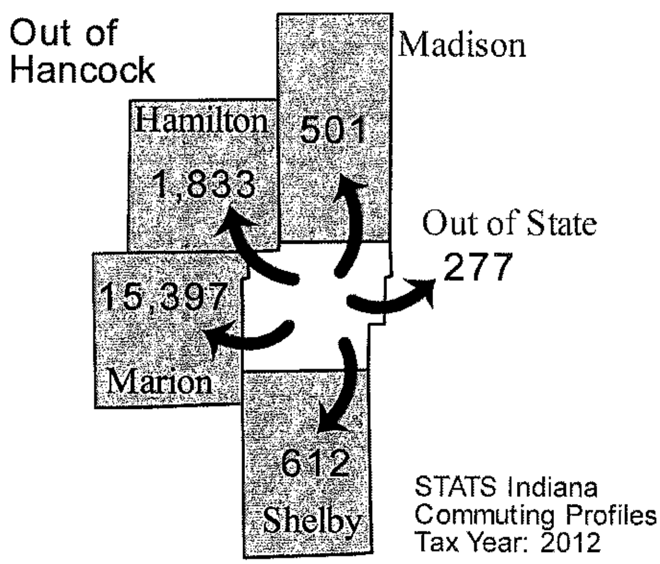

Figure 2-4 Workers Commuting out of Hancock County

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 Hancock County Surveyor's Office provided the listing and locations of the following 450 critical infrastructure points for the MHMP Update:

- 7 Agriculture and Food
- 17 Banking and Finance
- 76 Churches
- 42 Commercial
- 14 Critical Manufacturing
- 59 Communications
- 6 Dams
- 1 Defense Industrial Base
- 51 Daycare
- 49 Energy
- 16 Emergency Services
- 12 Government
- 48 Healthcare and Public Health
- 29 Schools
- 5 Transportation Facility
- 18 Water

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

Exhibit 1 illustrates the critical infrastructure identified throughout Hancock County. **Appendix 4** lists the critical structures in Hancock County by NFIP 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 on critical structures; thus, non-critical structures are not mapped or listed.

2.5 MAJOR WATERWAYS AND WATERSHEDS

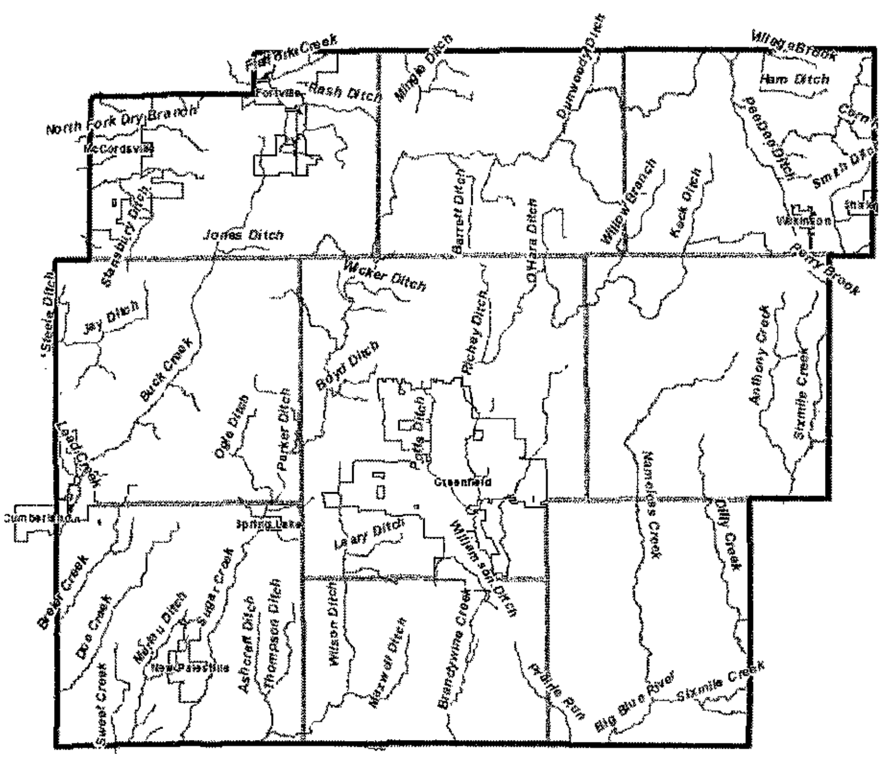

Figure 2-5 Hancock County Waterways

According to the United States Geological Survey (USGS) there are 90 waterways in Hancock County; they are listed in Appendix 5. The County's main waterways are the Big Blue River, Brandywine Creek, and Sugar Creek and the county lies within two 8-digit Hydrologic Unit Codes (HUC): the Upper White (05120201), and the Driftwood (05120204). These major waterways are identified on **Figure 2-5**.

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. Hancock County, the Town of Cumberland, the Town of Fortville, the City of Greenfield, the Town of McCordsville, the Town of New Palestine, and the Town of Spring Lake are participants in the NFIP. Any smaller communities within Hancock County may also be provided coverage by the MHMP through the County's program.

Since the development of the 2007 Hancock County MHMP, these communities continue to participate in the NFIP program. These NFIP communities have also adopted Flood Hazard Ordinances containing language regarding compensatory floodplain storage.

At the time of preparing this MHMP, Hancock County participate in the CRS program at a Class 8. The CRS program is a voluntary incentive program that recognizes and encourages community floodplain activities that exceed the minimum NFIP requirements. As a result, flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions that meet the 3 goals of the CRS: 1) reduce flood losses; 2) facilitate accurate insurance rating; and 3) promote education and awareness of flood insurance. For CRS participating communities, flood insurance premium rates are discounted in increments of 5% for each class level achieved. **Table 2-2** lists the NFIP number, effective map date, and the date each community joined the NFIP program.

Table 2-2 NFIP Participation

NFIP COMMUNITY	NFIP NUMBER	EFFECTIVE MAP DATE	JOIN DATE
Hancock County	180419	03-17-14	10-15-82
Town of Cumberland	180510	03-17-14	12-04-07
Town of Fortville	180372	03-17-14	12-04-07
City of Greenfield	180084	12-04-07	11-04-81
Town of McCordsville	180468	03-17-14	10-15-82
Town of New Palestine	180336	03-17-14	12-04-07
Town of Spring Lake	180346	04-03-84	12-04-07

(FEMA, 2015)

2.7 TOPOGRAPHY

Hancock County is bordered geographically to the east by Henry and Rush Counties, to the west by Marion County, to the North by Madison and Hamilton Counties, and to the south by Shelby County. The County's landscape consists primarily of flat or gently rolling terrain built from glacial outwash materials. Land elevation ranges from 1,030 feet at the highest point in the northeastern portion of the county near Shirley to 780 feet at the lowest along Sugar Creek in the southwestern portion of the county.

2.8 CLIMATE

The Midwestern Regional Climate Center (MRCC) provided climate data that includes information retrieved from a weather station located in Greenfield, identified as station USC00123527. The average annual precipitation is 45.81 inches per year, with the wettest month being July averaging 5.08 inches of precipitation and the driest month being February with an average of 2.42 inches of precipitation. The highest 1-day maximum precipitation was recorded in August of 1968 with 5.2 inches of rain. On average, there are 81.9 days of precipitation greater than or equal to 0.1 inches; 31.1 days with greater than or equal to 0.5 inches; and 10.9 days with greater than or equal to 1.0 inch of precipitation.

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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 Hancock County and the NFIP communities is based on the methodology described in the Local Multi-Hazard Mitigation Planning Guidance published by FEMA in 2008 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 Hancock County; 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, technological, and political hazards from the 2007 Hancock County MHMP and discussed recent and the potential for future hazard events. The Committee identified those hazards that affected Hancock County and the NFIP communities and selected the hazards to study in detail as part of this planning effort. As shown in **Table 3-1** these include: dam failure; drought; earthquake; extreme temperature; flooding; hailstorms, thunderstorms, and windstorms; hazardous materials incident; snow storms and ice storms; and tornado.

All hazards studied with the 2007 Hancock County MHMP are included in the update. Natural hazards studied as a part of the 2014 State of Indiana Standard Multi-Hazard Mitigation Plan (Drought, Earthquake, Extreme Temperature, Flood, Severe Storm, Winter Storm) are included within the Hancock County MHMP. It was determined that Disease outbreak is applicable to Hancock County but preparedness and response efforts are sensitive in nature and are not suitable for public documents. Fluvial Erosion Hazard was considered during discussions related to proposed practices for flood mitigation, and Wildfire is addressed through current efforts taken by the fire departments throughout the County. There are not areas of Karst geology or areas of much topography within Hancock County and therefore, Landslide/Land Subsidence was not studied as a part of this planning effort. If events such as those previously mentioned do occur or it is discovered that a higher risk is possible, the Planning Committee will be reconvened to discuss the hazard in more detail.

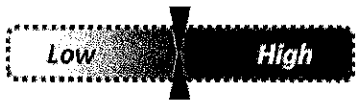
Table 3-1 Hazard Identification

TYPE OF HAZARD	LIST OF HAZARDS	DETAILED STUDY	
		2007 MHMP	MHMP UPDATE
Natural	Drought	Yes	Yes
	Earthquake	Yes	Yes
	Extreme Temperature	Yes	Yes
	Flood	Yes	Yes
	Hail/Thunder/Wind	Yes	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 CBBEL) 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:

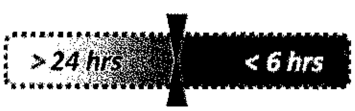
- Unlikely – incident is possible, but not probable, within the next 10 years (1)
- Possible – incident is probable within the next 5 years (2)
- Likely - incident is probable within the next 3 years (3)
- Highly Likely – incident is probable within the next calendar year (4)

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 6 hours (1)
- Limited – few injuries OR critical infrastructure shut down for more than 1 week OR more than 10% property damaged OR average response duration of less than 1 day (2)
- Critical – multiple injuries OR critical infrastructure shut down of at least 2 weeks OR more than 25% property damaged OR average response duration of less than 1 week (3)
- Significant – multiple deaths OR critical infrastructure shut down of r1 month or more OR more than 50% property damaged OR average response duration of less than 1 month (4)

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 (1)
- 12-24 hours (2)
- 6-12 hours (3)
- Less than 6 hours (4)

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 6 hours (1)
- Less than 1 day (2)
- Less than 1 week (3)
- Greater than 1 week (4)

3.2.5 Calculating the CPRI

The following calculation illustrates how the index values are weighted and 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 NFIP community in Hancock County, and then a weighted CPRI value was computed based on the population size of each community. **Table 3-2** 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 3-2 Determination of Weighted Value for NFIP Communities

NFIP COMMUNITY	POPULATION (2014)	% OF TOTAL POPULATION	WEIGHTED VALUE
Hancock County	36,157	50.2%	0.50
Town of Cumberland	2,702	3.8%	0.04
Town of Fortville	3,953	5.5%	0.05
City of Greenfield	21,398	29.7%	0.30
Town of McCordsville	5,445	7.6%	0.08
Town of New Palestine	2,105	2.9%	0.03
Town of Spring Lake	218	0.3%	0.00
TOTAL	**71,978**	**100.0%**	**1.00**

3.3 HAZARD PROFILES

The hazards studied for this report are not equally threatening to all communities throughout Hancock County. While it would be difficult to predict the probability of an earthquake or tornado affected 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 on another hazard.

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Natural Hazards

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.

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; focusing 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 sources. **Figure 3-1** shows soil affected by drought conditions.

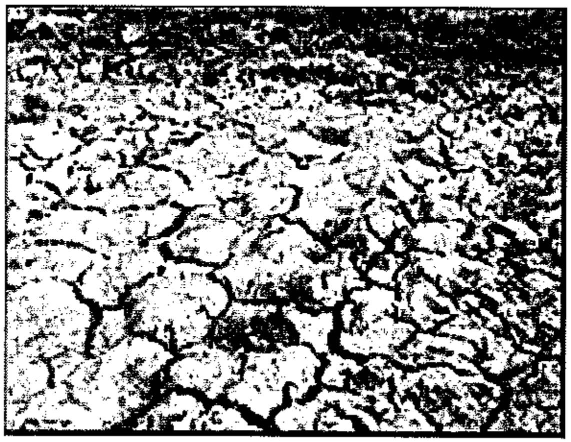


Figure 3-1 Drought Affected Soil

Drought: Recent Occurrences

Data gathered from the U.S. Drought Monitor indicated that between October 2007 and April 2016, there were 32 weeks where some portion of Hancock County was considered to be in a "Severe Drought", 15 weeks in an "Extreme Drought", and 1 week in an "Exceptional Drought". **Figure 3-2**, from the U.S. Drought Monitor, describes the rational to classify the severity of droughts. Those weeks of Extreme and Exceptional Drought are all associated with the summer 2012 event.

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 3-2 US Drought Monitor Drought Severity Classification

In July and August 2012, nearly 100% of Indiana was experiencing drought conditions ranging from "D0-Abnormally Dry" to "D4-Exceptional Drought". **Figure 3-3** identifies those areas and categories of drought throughout Indiana for August 7, 2012. Hancock County is primarily located in the "D3-Extreme" zone. D3 includes the potential impacts of major crop and pasture losses and widespread water shortages and restrictions. D4 includes exceptional and widespread crop or pasture losses are likely and shortages of water in reservoirs, streams and wells creating water emergencies. The September 4, 2012 report shows all of Hancock County within the "D2-Severe Drought" consideration. It wasn't until the October 30, 2012 report that the entire county was considered out of drought condition status.

No property or crop losses have been documented in Hancock County specific to the 6 events listed by the National Climate Data Center (NCDC) between October 2007 and January 2016. Four of these events were related to the 2012 drought. One narrative regarding the October 2010 event indicated that a countywide burn ban was in effect. Narratives throughout the 2012 event reported severely dry weather, burn bans, and record low rainfall amounts.

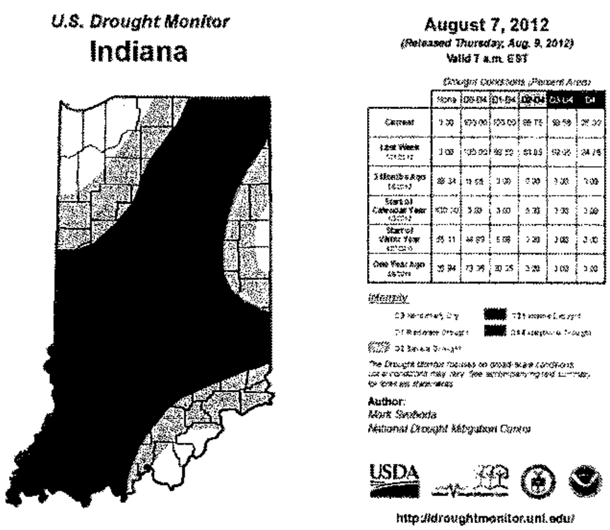


Figure 3-3 August 2012 Indiana Drought Map

The Planning Committee, utilizing the CPRI, determined the overall risk of drought throughout Hancock County is "Elevated". The impact of drought was determined to the same for all communities within Hancock County. The committee agreed that a drought is "Likely" (to occur within the next 3 years) and the magnitude of drought is anticipated to range from "Limited" to "Critical". 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 1 week. A summary is shown in **Table 3-3**.

Table 3-3 CPRI for Drought

	PROBABILITY	MAGNITUDE / SEVERITY	WARNING TIME	DURATION	CPRI
Hancock County	Likely	Critical	> 24 Hours	> 1 Week	Elevated
City of Cumberland	Likely	Limited	> 24 Hours	> 1 Week	Elevated
Town of Fortville	Likely	Limited	> 24 Hours	> 1 Week	Elevated
City of Greenfield	Likely	Limited	> 24 Hours	> 1 Week	Elevated
Town of McCordsville	Likely	Limited	> 24 Hours	> 1 Week	Elevated
Town of New Palestine	Likely	Limited	> 24 Hours	> 1 Week	Elevated
Town of Spring Lake	Likely	Limited	> 24 Hours	> 1 Week	Elevated

According to the National Drought Mitigation Center, scientists have difficulty predicting droughts more than 1 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 droughts and drought related impacts felt within Hancock County, the Committee estimated that the probability of a drought occurring in the area is "Likely"; or occurrence is probable within the next 3 years.

Drought: Assessing Vulnerability

This type of hazard will generally affect entire counties and even multi-county regions at one time. Within Hancock 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

It is difficult to estimate the potential losses associated with a drought for Hancock 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 2015, Hancock County produced approximately 9.7M bushels of corn and 3.5M bushels of soybeans, as reported by the United States Department of Agriculture (USDA) National Agricultural Statistics Service. Using national averages of $3.85 per bushel of corn and $8.85 per bushel of soybeans, the estimated crop receipts for 2015 would be $68.3M. 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 $34.0M-$58.7M; depending on the crop produced and the market demand. Effects of drought on corn crops can be seen in **Figure 3-4**.

Figure 3-4 Crops Affected by Drought

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 more urban 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.

Drought: Relationship to Other Hazards

A drought will not be caused by any other hazard studied during this planning effort. However, it is anticipated that areas of the county may be more susceptible to fires during a drought and this may lead to increased losses associated with a structural 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.

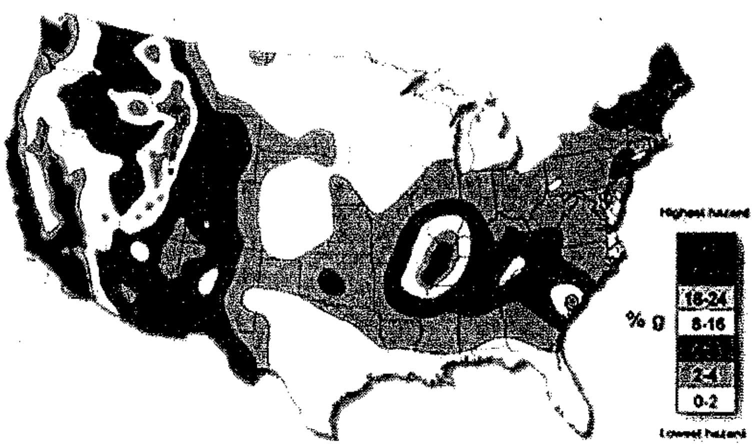


Figure 3-5 Earthquake Hazard Areas in the US

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. 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 earthquake, and they are located in every region of the country (**Figure 3-5**). 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. The county is located just outside the anticipated impact area for the New Madrid Seismic Zone and eastern Hancock lies within the Fort Wayne Rift Zone. In addition, a high angle fault is located in the northwestern corner of Hancock County, just west of Fortville.

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.

Figure 3-6 Earthquake Damaged Porch

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".

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, and the results of a HAZUS-MH scenario, the Committee determined that the probability of an earthquake occurring in Hancock County or any of the communities is "Unlikely". Should an earthquake occur, the impacts associated with this hazard are anticipated to be "Critical" within all areas of the County.

As with all earthquakes, it was determined that the residents of Hancock County would have little to no warning time (less than 6 hours) and that the duration of the event would be expected to be less than 1 week. A summary is shown in **Table 3-4**.

Table 3-4 CPRI for Earthquake

	PROBABILITY	MAGNITUDE/ SEVERITY	WARNING TIME	DURATION	CPRI
Hancock County	**Unlikely**	Critical	< 6 Hours	< 1 Week	Elevated
Town of Cumberland	**Unlikely**	Critical	< 6 Hours	< 1 Week	Elevated
Town of Fortville	**Unlikely**	Critical	< 6 Hours	< 1 Week	Elevated
City of Greenfield	**Unlikely**	Critical	< 6 Hours	< 1 Week	Elevated
Town of McCordsville	**Unlikely**	Critical	< 6 Hours	< 1 Week	Elevated
Town of New Palestine	**Unlikely**	Critical	< 6 Hours	< 1 Week	Elevated
Town of Spring Lake	**Unlikely**	Critical	< 6 Hours	< 1 Week	Elevated

According to 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 Hancock County is "Unlikely" to occur within the next 10 years.

Earthquake: Assessing Vulnerability

Earthquakes generally affect broad areas and potentially many counties at one time. Within Hancock 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

Figure 3-7 Minor Earthquake Damages

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 3-6** and **Figure 3-7**.

Estimating Potential Losses

In order to determine the losses associated with an earthquake, the HAZUS-MH software was utilized to determine the impact anticipated from a moderate earthquake with an epicenter along the Fortville Fault.

According to the HAZUS-MH scenario, total economic loss associated with this earthquake is anticipated to be near $100K. 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. In addition to importing local building data, the Hancock County model was further enhanced by adding localized parameters (i.e., shake maps, liquefaction, soils). 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 Hancock 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. For that reason, Hancock County should continue to provide education and outreach regarding earthquakes and even earthquake insurance along with education and outreach for other hazards. As Hancock 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.

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 Hancock 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

Low | Severe

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.

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 3-8**. 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 2 consecutive days.

NOAA's National Weather Service

Heat Index

Temperature (°F)

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

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | External Danger

Figure 3-8 Heat Index Chart

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 3-7 indicates, there are 4 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 1 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

Temperature (°F)

Wind (MPH)	30	25	20	15	10	5	0	-5	-10	-15	-10	-25
5	25	19	13	7	1	-5	-11	-16	[illegible]	[illegible]	[illegible]	[illegible]
10	21	15	9	3	-4	-10	-16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	19	13	6	0	-7	-13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20	17	11	4	-2	-9	-15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25	16	9	3	-4	-11	-17	-24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30	15	8	1	-5	-12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
35	14	7	0	-7	-14	-21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
40	13	6	-1	-8	-15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
45	12	5	-2	-9	-16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
50	12	4	-3	-10	-17	-24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
55	11	4	-3	-11	[illegible]	-25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
60	10	3	-4	-11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Figure 3-9 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 3-9** identifies the Wind Chill Chart and how the same ambient temperature may feel vastly different in varying wind speeds.

<u>Extreme Temperature: Recent Occurrences</u>

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 0 reported occurrences of extreme heat or extreme cold between October 2007 and January 2016. Local media outlets have provided information related to extreme temperatures occurring since the last planning effort.

In July 2012, the RTV6 *TheIndyChannel.com* reported that "The average high temperature in Indianapolis from June 28 to July 6 was a little more than 100 degrees, and Friday's high temperature of 105 was the hottest since 1936, just one degree shy of the all-time highest temperature in Indianapolis since records began in 1871". Further, the article highlighted the average temperature for the 10-day period was nearly 101 degrees. The record 10-day average high temperature of 103 degrees was set in 1936.

January 2009 brought a string of cold weather that caused school delays, emergency response delays, and several cold weather advisories. Cold weather also slowed emergency response as firefighters were delayed by slick roads, frozen hydrants, and hazards caused by water used to battle the blaze.

More recently, in January 2013 several schools delayed the start of the school day as overnight and early morning temperatures with wind chill adjustments felt like -20°. Wind chill advisories were issued through Central Indiana, residents were urged to learn the warning signs of frostbite, take special precautions for pets, and dress in many warm layers.

It is difficult to predict the probability that an extreme temperature event will affect Hancock County residents within any given year. However, based on historic knowledge and information provided by the NFIP representatives, an extreme temperature event is "Likely" (possible within the next 3 years) to occur and if an event did occur, it would result in "Negligible" to "Limited" magnitude. **Table 3-5** identifies the CPRI for extreme temperature events for all NFIP communities in Hancock County.

Table 3-5 CPRI for Extreme Temperatures

	PROBABILITY	MAGNITUDE / SEVERITY	WARNING TIME	DURATION	CPRI
Hancock County	Likely	**Limited**	**> 24 Hours**	> 1 Week	Elevated
Town of Cumberland	Likely	**Limited**	**> 24 Hours**	> 1 Week	Elevated
Town of Fortville	Likely	**Limited**	**> 24 Hours**	> 1 Week	Elevated
City of Greenfield	Likely	**Negligible**	**> 24 Hours**	> 1 Week	Elevated
Town of McCordsville	Likely	**Limited**	**> 24 Hours**	> 1 Week	Elevated
Town of New Palestine	Likely	**Limited**	**> 24 Hours**	> 1 Week	Elevated
Town of Spring Lake	Likely	**Limited**	**> 24 Hours**	> 1 Week	Elevated

As shown in the table, index values remain identical throughout each NFIP community due to the regional extent and diffuse severity of this hazard event. Based on discussion within the Planning Committee, representatives from the City of Greenfield felt the magnitude of extreme temperatures would be negligible overall due to preparations and overall availability of temporary relief 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 Hancock County, a better understanding of the relative risk that extreme temperatures may pose to certain populations can be gained. In total, nearly 15% of the County's population is over 65 years of age, more than 6% of the population is below the age of 5, and approximately 5.4% 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.

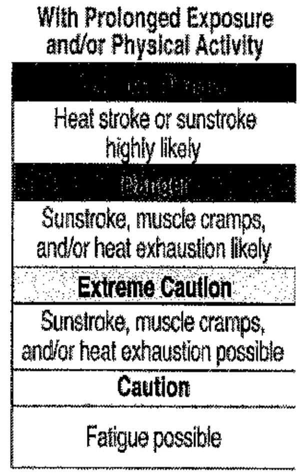


Figure 3-10 Danger Levels with Prolonged Heat

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 3-10.**

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 Hancock 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 Hancock County's at risk populations.

<u>Extreme Temperatures: Relationship to Other Hazards</u>

While extreme temperatures may be extremely burdensome on the power supplies in Hancock County, the Committee concluded that this type of hazard is not expected to cause any hazards studied, with the exception of a potential civil disturbance. 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 Flood

Low Severe

Flood: Overview

Floods are the most common and widespread of all 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 2 or more acres of normally dry land area or of 2 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 chance of flooding, 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% annual chance flood is referred to as the "regulatory" or "base" flood. Another term commonly used, the "100-year flood", is often incorrectly used and can be misleading. It does not mean that only 1 flood of that size will occur every 100 years. What it actually means is that 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 reports that between October 2007 and January 2016, there were 6 flood events (4 floods and 2 flash floods) that resulted in approximately $3.01M in property damages and an additional $0.5K in crop damages. NCDC indicates that during the December 22, 2013 event, flooding resulted in the evacuation of several homes along SR 9 and 4th Street due to high water. Reports for other events also indicated water coming across the roads and localized flooding in areas such as Mohawk, Greenfield, and New Palestine.

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

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 Hancock County, there is one active USGS stream gage equipped with AHPS capabilities; identified on **Exhibit 2**.

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 four properties within the unincorporated area of Hancock County and nine within the City of Greenfield considered to be repetitive loss property.

There have been a number of claims made for damages associated with flooding in Hancock County. Within the City of Greenfield, there have been 56 paid losses resulting in approximately $830K in payments. Further, within the unincorporated areas of the County, there were 44 payments totaling approximately $350K. **Table 3-6** identifies the number of claims per NFIP community as well as payments made.

Table 3-6 Repetitive Loss Properties, Claims, and Payments

NFIP COMMUNITY	# OF REPETITIVE LOSS PROPERTIES	CLAIMS SINCE 1978	$$ PAID
Hancock County	4	44	$350K
Cumberland	0	0	$0
Fortville	0	0	$0
Greenfield	9	56	$830K
McCordsville	0	0	$0
New Palestine	0	0	$0
Spring Lake	0	0	$0
TOTAL	**13**	**19**	**$1.2M**

(IDNR, 2015)
(FEMA Region V, 2015)

Mandatory flood insurance purchase requirements apply to structures in 1% annual chance of flooding delineated areas. Total flood insurance premiums for Hancock County and the NFIP communities is approximately

$290K. Total flood insurance coverage for Hancock County is nearly $57.2M. **Table 3-7** further indicates the premiums and coverage totals for individual NFIP communities.

Table 3-7 Insurance Premiums and Coverage

NFIP COMMUNITY	FLOOD INSURANCE PREMIUMS	FLOOD INSURANCE COVERAGE
Hancock County	$152K	$6.5M
Cumberland	$3K	$0.8M
Fortville	$2K	$0.6M
Greenfield	$125K	$0
McCordsville	$4K	$2.2M
New Palestine	$3K	$0
Spring Lake		
TOTAL	**$290K**	**$57M**

(IDNR, 2015)

As determined by the Committee, the probability of a flood occurring throughout Hancock County is "Highly Likely" in all communities. Impacts from such an event are anticipated to be "Limited". The Committee also determined that the warning time would be short (< 6 hours) based on the limited number of warning measures, and that the duration of such an event is anticipated to last less than 1 week for all areas. A summary is shown in **Table 3-8**.

Table 3-8 CPRI for Flood

	PROBABILITY	MAGNITUDE/ SEVERITY	WARNING TIME	DURATION	CPRI
Hancock County	Highly Likely	Limited	< 6 Hours	< 1 Week	Severe
Town of Cumberland	Highly Likely	Limited	< 6 Hours	< 1 Week	Severe
Town of Fortville	Highly Likely	Limited	< 6 Hours	< 1 Week	Severe
City of Greenfield	Highly Likely	Limited	< 6 Hours	< 1 Week	Severe
Town of McCordsville	Highly Likely	Limited	< 6 Hours	< 1 Week	Severe
Town of New Palestine	Highly Likely	Limited	< 6 Hours	< 1 Week	Severe
Town of Spring Lake	Highly Likely	Limited	< 6 Hours	< 1 Week	Severe

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 USGS/NWS stream gages, the NCDC, and previous experiences, the Committee determined that flooding is "Highly Likely" throughout the county.

Flood: Assessing Vulnerability

Flood events may affect large portions of Hancock County at one time as large river systems and areas with poor drainage cover much of the county and several communities. Within Hancock 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

Estimating Potential Losses

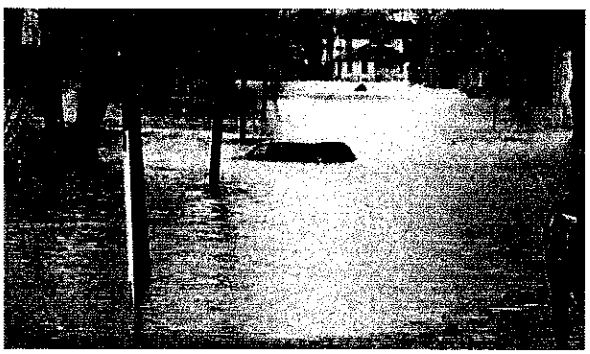


Figure 3-11 Car Submerged on Flooded Street

Critical and non-critical structures located in regulated floodplains, poorly drained areas, or low lying areas (**Figure 3-11**) 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 the Modified Building Inventory provided by Hancock County and structures located within each flood zone were tallied using GIS analysis techniques.

The Modified Building Inventory was created in ESRI ArcGIS by converting parcels to centroids, and joining Assessor Data to these centroids. Assessor data included square footage for the structure, and any structure that was listed as less than 400 ft^2 in area or was classified in the Assessor's database as a non-habitable structure was assumed to be an outbuilding. Also, buildings with an assessed value of $0.00 or buildings that did not match the Assessor Data (parcel numbers did not match) were excluded from the analysis. Replacement 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

The resulting Modified Building Inventory was used in the GIS analyses.

In order to estimate anticipated damages associated with each flood in Hancock County and NFIP 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 3-9** identifies the estimated losses associated with structures in the floodway, the 100-year floodplain, and the 500-year floodplain areas by NFIP community within Hancock County.

Table 3-9 Manual GIS Analysis Utilizing Most Recent Preliminary DFIRM Data and Hancock County Building Inventory

	FLOODWAY		1%		0.2%		UNNUMBERED	
	#	$	#	$	#	$	#	$
Hancock County	117	$18.1M	185	$14.9M	117	$9.5M	244	$26.5M
Cumberland	0	0	2	$0.1M	0	0	0	0
Fortville	2	$0.1M	7	$0.6M	49	$3.9M	7	$2.0M
Greenfield	66	$13.2M	288	$29.3M	645	$56.4M	46	$4.5M
McCordsville	7	$0.6M	8	$0.7M	6	$0.6M	4	$0.3M
New Palestine	27	$2.1M	1	$0.1M	3	$0.2M	3	$0.2M
Spring Lake	0	0	0	0	0	0	1	$0.1M
Total	**279**	**$34.1M**	**491**	**$45.7M**	**820**	**$70.6M**	**305**	**$33.6M**

Structures and damages within each zone are not inclusive

Utilizing the same GIS information and process, **Table 3-10** identifies the number of critical infrastructure within each of the Special Flood Hazard Areas (SFHA) in Hancock County. These buildings are included in the overall number of structures and damage estimate information provided in Table 3-7.

Table 3-10 Critical Infrastructure in SFHA by NFIP Community

NFIP COMMUNITY	FLOODWAY	1%	0.2%	UNNUMBERED
Hancock County	Conservation Club Heartland Campgrounds KOA Campgrounds S&H Campground Doe Creek Sewer Utility Hoosier Propane	Body of Christ New Pal Church of Christ Mt Carmel Primitive Baptist Bell Professional Mortuary Service	Fortville Christian Irving Materials Oaklandon Christian	
Cumberland				
Fortville		Water Tower	Bridge Church	
Greenfield		Friends Church Public Library Boys & Girls Club Eunice Austin Daycare Central High School WWTP Utilities	Church of Bible Covenant Apostolic Pentecostal Church Bluestone Apts Lucky's Daycare Armory	
McCordsville		Promises and Possibilities		
New Palestine				
Spring Lake		Spring Lake Dam		

Structures within each zone are not inclusive

Utilizing the information in Table 3-7 regarding the number of structures within each Flood Hazard Area, it is also important to note the number of flood insurance policies within each NFIP area in Hancock County. **Table 3-11** 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 3-11 Number of Structures in the SFHA and Number of Flood Insurance Policies

NFIP COMMUNITY	# STRUCTURES IN SFHA	# POLICIES
Hancock County	723	174
Cumberland	2	4
Fortville	65	3
Greenfield	1,045	116
McCordsville	25	5
New Palestine	34	5
Spring Lake	1	
Total	**1,895**	**307**

(IDNR, 2015)

Future Considerations

As the municipalities within Hancock County continue to grow in population, it can be anticipated that the number of critical and non-critical infrastructure will also increase accordingly. Location of these new facilities should be carefully considered and precautions should be encouraged to ensure that school, medical facilities, community centers, municipal buildings, and other critical infrastructure are located outside the 0.2% annual chance (500-year) floodplain and/or are 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 infrastructure will be able to continue functioning during major flood events.

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

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.

Indirect effects of flooding may include increased emergency

Figure 3-12 Fire Engine in Flood Waters

response times due to flooded or redirected streets (**Figure 3-12**), 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 Hancock 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 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 failure, when combined, may certainly result in catastrophic damages.

In a similar fashion, a snow storm 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.

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.

3.3.5 Hailstorms, Thunderstorms, and Windstorms

Low Severe

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 3-13**), 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

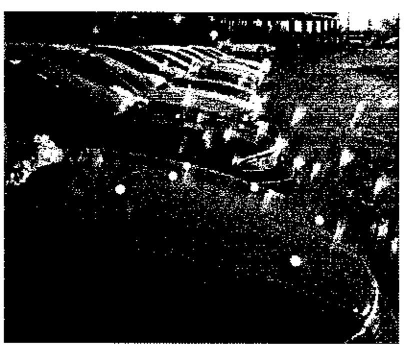


Figure 3-13 Damaging Hail on Vehicles

In Hancock County, the NCDC has recorded 26 hailstorms and 46 thunderstorms/windstorms between October 2007 and January 2016. The largest recorded hailstone was 1.75 inch in diameter and has occurred on several events, most recently September 21, 2012 in Gem. The average diameter hailstone occurring throughout Hancock County is 1.2 inches.

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 Hancock County, NCDC reports 40 instances between October 2007 and January 2015 where top wind speeds were greater than 60 mph.

Total NCDC recorded damages for hailstorms, thunderstorms, and windstorms throughout Hancock County are $329.2K. The NCDC also reports 2 injuries where men were working on a hog barn when wind gusts moved into the area. 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 Hancock County. 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.

On February 28, 2011 thunderstorms, heavy rain, hail, and high winds caused damage to trees and power lines. Most notably was approximately $147K in damages to structures long SR 67 in Fortville. Roofs were blown off homes, a semi-trailer was blown over and two garages were reported to have collapsed.

According to the Institute for Business and Home Safety, central Indiana can expect to experience damaging hailstorms 3-4 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 in Hancock County is "Highly Likely" and will typically affect broad portions of the county at one time resulting in potentially "Limited" damages The Town of McCordsville representatives determined that should such an event occur within their jurisdiction, the damages would be near "Critical". 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 6 hours and the duration is expected to last less than 1 day.

Indicative of a regional hazard, the probability, magnitude, warning time, and duration of a hailstorm, thunderstorm, or windstorm are expected to be much the same throughout the county. These events are highly unpredictable and the occurrences are distributed through the county. Therefore the CPRI values reflect the equally distributed risk and associated priority for a hailstorm, thunderstorm, or windstorm. A summary is provided in **Table 3-12**.

Table 3-12 CPRI for Hailstorm, Thunderstorm, and Windstorm

	PROBABILITY	MAGNITUDE /SEVERITY	WARNING TIME	DURATION	CPRI
Hancock County	Highly Likely	**Limited**	< 6 Hours	< 1 Day	Severe
Town of Cumberland	Highly Likely	**Limited**	< 6 Hours	< 1 Day	Severe
Town of Fortville	Highly Likely	**Limited**	< 6 Hours	< 1 Day	Severe
City of Greenfield	Highly Likely	**Limited**	< 6 Hours	< 1 Day	Severe
Town of McCordsville	Highly Likely	Critical	< 6 Hours	< 1 Day	Severe
Town of New Palestine	Highly Likely	**Limited**	< 6 Hours	< 1 Day	Severe
Town of Spring Lake	Highly Likely	**Limited**	< 6 Hours	< 1 Day	Severe

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.

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 Hancock 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

Due to the unpredictability of this hazard all critical infrastructure and non-critical structures in Hancock 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 more or less 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 shown in **Figure 3-14**, are common.

Figure 3-14 Home Damaged During Windstorm

Future Considerations

As the populations of the communities in Hancock 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 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, 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 Hancock 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 to the dam.

The risk of social losses also increases during a hailstorm, thunderstorm, or windstorm as many times, these hazards 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 as a result of falling debris.

3.3.6 Tornado

Low Severe

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 3-15**. Tornadoes occur most frequently in the United States east of the Rocky Mountains. Tornadoes in Indiana generally come from the south through the east.

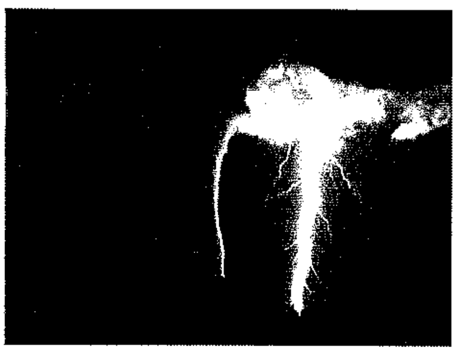


Figure 3-15 Funnel Cloud During a Lightning Storm at Night

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 Fujita Scale of tornado intensity, described in **Table 3-13**. Tornado intensity ranges from low intensity (F0) tornadoes with effective wind speeds of 40-70 mph to high intensity (F5+) tornadoes with effective wind speeds of 261-318+ mph. According to the NCDC, Hancock County has experienced 3 tornadoes (1-F0; 2-F1) between October 2007 and January 2016.

Table 3-13 Fujita Scale of Tornado Intensity

F-SCALE	WINDS	CHARACTER OF DAMAGE	RELATIVE FREQUENCY
F0 (weak)	40-72 mph	Light damage	29%
F1 (weak)	73-112 mph	Moderate damage	40%
F2 (strong)	113-157 mph	Considerable damage	24%
F3 (strong)	158-206 mph	Severe damage	6%
F4 (violent)	207-260 mph	Devastating damage	2%
F5 (violent)	261-318 mph	Incredible damage	<1%

A tornado reported by the NCDC occurred on May 30, 2008 near McCordsville and resulted in approximately $500K in property damages to several farm buildings and homes in the area. Another event, occurring on October 26, 2010, consisted of an EF-0 touch down near Warrington (northwest of Wilkinson) and caused damage to several outbuildings and destroyed a garage.

May 30, 2008 was the date an EF-1 traveled through Marion County into Hancock County near North County Road south of 38th Street. Traveling for 4 miles with a width of 100 yards and winds of near 100 mph, numerous barns, houses, trees and powerlines were damaged along the path.

The Committee estimated the probability of a tornado occurring in the unincorporated areas of Hancock County (including New Palestine and Spring Lake) would be "Likely", while "Possible" within the communities of Cumberland, Fortville, Greenfield, and McCordsville. The magnitude and severity of such an event to be "Critical" if a tornado were to strike any of the municipalities. As with many hazardous events, the Committee anticipated a short warning time, less than 6 hours, and a short duration, also less than 6 hours. The summary is shown in **Table 3-14**.

Table 3-14 CPRI for Tornado

	PROBABILITY	MAGNITUDE/ SEVERITY	WARNING TIME	DURATION	CPRI
Hancock County	Likely	Critical	< 6 Hours	**< 6 Hours**	Elevated
Town of Cumberland	**Possible**	Critical	< 6 Hours	**< 6 Hours**	Elevated
Town of Fortville	**Possible**	Critical	< 6 Hours	**< 6 Hours**	Elevated
City of Greenfield	**Possible**	Critical	< 6 Hours	**< 6 Hours**	Elevated
Town of McCordsville	**Possible**	Critical	< 6 Hours	**< 6 Hours**	Elevated
Town of New Palestine	Likely	Critical	< 6 Hours	**< 6 Hours**	Elevated
Town of Spring Lake	Likely	Critical	< 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 probability of a future tornado occurring in Hancock County is Possible to Likely (within the next 3-5 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 Hancock County that would be more or less 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 F2 intensity tornadoes traveled through portions of the County. 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% would be 50% damaged, and 40% would have only 25% damage. These estimations were also determined utilizing 3 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 theoretical lower wind speed. **Table 3-15** provides summary data for the hypothetical tornado, which is identified on **Exhibit 3**.

Table 3-15 Summary of Hypothetical Tornado Damages

ZONE	NUMBER OF STRUCTURES DAMAGED	ESTIMATED DAMAGE ($)
Zone A	202	$22.1M
Zone B	224	$14.7M
Zone C	356	$21.7M
TOTAL	**782**	**$58.5M**

Future Considerations

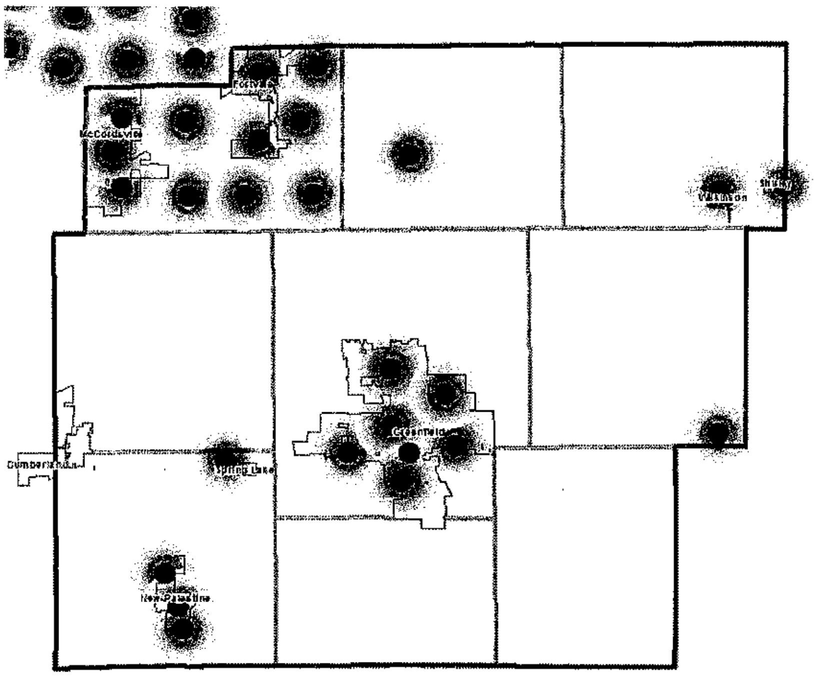


Figure 3-16 Hancock County Outdoor Warning Sirens

Within Hancock 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 coverage areas are provided in **Figure 3-16**.

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 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.

3.3.7 Winter Storm & Ice

Low Severe

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 one that drops 4 or more inches of snow during a 12-hour period, or 6 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 3-17 Ice Covered Power Lines

Storm effects such as extreme cold, flooding, and snow and ice accumulation (**Figure 3-17**) 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; and 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 definitely 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 Hancock County. Such conditions can result in substantial personal and property damage, even death.

<u>Winter Storm & Ice: Recent Occurrences</u>

Since the completion of the September 2007 Hancock County MHMP, the NCDC has recorded 8 winter storms, 3 heavy snow, 1 blizzard, and 1 ice storm events. While no injuries or deaths were reported with these events, approximately $15K in property damages was reported. Narrative descriptions indicated poor travel conditions, power outages and debris associated with similar events. During the March 4, 2008 event, approximately 30 trees feel in Greenfield due to ice accumulation.

Appendix 6 provides the NCDC information regarding snow storms and ice storms that have resulted in injuries, deaths, or monetary damages to property and/or crops.

The probability, magnitude, warning times, and duration of a snow storm or ice storm causing disruption to residents and businesses in Hancock County, as determined by the Planning Committee, is expected to be consistent throughout the County and NFIP communities. It is "Highly Likely" to "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 "Limited" to "Critical" severity. The warning time for severe temperatures or several inches of snow associated with a winter storm is usually less than 6 hours while the duration of the incident is anticipated to last less than 1 day. A summary is shown in **Table 3-16.**

Table 3-16 CPRI for Winter Storm and Ice

	PROBABILITY	MAGNITUDE/ SEVERITY	WARNING TIME	DURATION	CPRI
Hancock County	Likely	Critical	< 6 Hours	< 1 Day	Severe
Town of Cumberland	Highly Likely	Limited	< 6 Hours	< 1 Day	Severe
Town of Fortville	Highly Likely	Limited	< 6 Hours	< 1 Day	Severe
City of Greenfield	Likely	Limited	< 6 Hours	< 1 Day	Elevated
Town of McCordsville	Highly Likely	Limited	< 6 Hours	< 1 Day	Severe
Town of New Palestine	Likely	Limited	< 6 Hours	< 1 Day	Elevated
Town of Spring Lake	Likely	Limited	< 6 Hours	< 1 Day	Elevated

The Planning Committee determined that the probability for a snow storm or ice storm to occur in Hancock County or any of the communities within is "Likely" to "Highly Likely". Based on historical data and the experience of the Planning Committee, snow storms and ice storms are common within Hancock County and will continue to be an annual occurrence.

Winter Storm & Ice: Assessing Vulnerability

A snow storm typically affects a large regional area with potential for physical, economic, and/or social losses. Direct and indirect effects of a snow storm or ice storm within Hancock 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 snow storm, 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 snow storm and ice storm incidents.

For planning purposes, information collected in snow storms 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 Hancock County communities. For example, a March 2003 snow storm 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

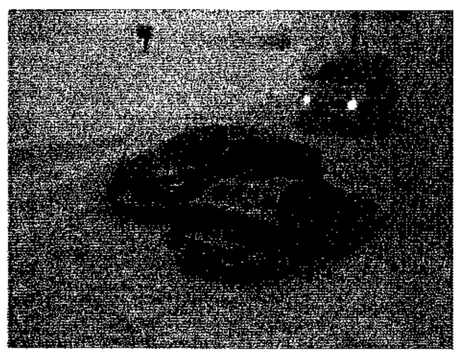


Figure 3-18 Travel Impacted During Snow Storm

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 6 counties. Snow storms and blizzards also make road travel difficult and dangerous, as in **Figure 3-18**.

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 closes 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, in general, winter storms 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 in size, the need to respond to snow storms 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.

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 3 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 3-19 Flooding Caused by Snow Melt

Winter storms and ice storms can lead to flooding as the precipitation melts and enters local receiving water bodies. This increased volume of water on already saturated, or still frozen ground can quickly result in flooding related damages to structures and properties (**Figure 3-19**) as well as within the stream or river channel. The increased flooding may then lead to a dam 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 suburban/rural areas of Hancock County, or where open areas are more susceptible to drifted 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

3.3.8 Dam Failure

Low Severe

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.

Dam Failure: Recent Occurrences

Within Hancock County, there are 2 DNR regulated dams: 1 high hazard dam and 1 low hazard dams as shown on Exhibit 2. The High Hazard dam is the Sugar Hills Lake Dam (**Figure 3-20**). There have been no recorded dam failures within Hancock County.

Based on the information provided to them, the Committee determined the probability of a dam failure is "Unlikely" with an anticipated effect of "Negligible" (areas not anticipated to be within the inundation area) to "Limited" (based on the number of structures or populations downstream of the dam) damages. **Table 3-17** provides a summary of the Planning Committee's expectations during a dam failure.

Table 3-17 CPRI for Dam Failure

	PROBABILITY	MAGNITUDE/ SEVERITY	WARNING TIME	DURATION	CPRI
Hancock County	**Unlikely**	**Limited**	< 6 Hours	**< 6 Hours**	**Low**
Town of Cumberland	**Unlikely**	**Negligible**	< 6 Hours	**< 6 Hours**	**Low**
Town of Fortville	**Unlikely**	**Negligible**	< 6 Hours	**< 6 Hours**	**Low**
City of Greenfield	**Unlikely**	**Negligible**	< 6 Hours	**< 6 Hours**	**Low**
Town of McCordsville	**Unlikely**	**Negligible**	< 6 Hours	**< 6 Hours**	**Low**
Town of New Palestine	**Unlikely**	**Negligible**	< 6 Hours	**< 6 Hours**	**Low**
Town of Spring Lake	**Unlikely**	**Negligible**	< 6 Hours	**< 6 Hours**	**Low**

Dam Failure: Assessing Vulnerability

Within Hancock 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

Indirect Effects:

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

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 dam to fail.

Unfortunately, the Sugar Hills Lake Dam does not have an Incident & Emergency Action Plan (IEAP) prepared along with estimated dam failure inundation mapping.

Estimating Potential Losses

Figure 3-20 Sugar Hills Lake Dam

The potential dam failure inundation area for the Sugar Hills Lake Dam was overlaid onto recent aerial photography to estimate the number of critical and non-critical structures that may be affected by a dam failure. The actual magnitude and extent of damages depend on the type of dam break, volume of water that is released, and the width of the floodplain valley to accommodate the dam break flood wave. There are 156 structures located within the potential inundation area of the Sugar Hills Lake Dam that are anticipated to receive damages, including two campgrounds, a conservation club, and Spring Lake Dam. Following the same calculation of potential damages as other hazards, it is expected that damages will be near $16M, not including damages sustained by transportation routes or the dam itself. **Table 3-18** identifies the potential number of structures and associated damages from a failure of the Sugar Hills Lake Dam.

Table 3-18 Anticipated Damages from Sugar Hills Lake Dam Failure

NFIP COMMUNITY	NUMBER OF STRUCTURES DAMAGED	ESTIMATED DAMAGE ($)
Hancock County	127	$14.1M
New Palestine	28	$2.2M
Spring Lake	1	$0.1M
TOTAL	**156**	**$16.4M**

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 will 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 failure inundation areas. Also, flood-free access should be provided for these facilities.

It is also very important to all downstream communities and property owners that IEAPs are developed for high hazard dams and kept up-to-date as well as routinely exercised to ensure the greatest safety to those within the hazard area.

Dam Failure: Relationship to Other Hazards

With the potentially large volumes and velocities of water released during a dam breach, it can be expected that a dam failure would lead to flooding and within the inundation areas downstream of the dam. Downstream 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.

Several other independent hazards may also lead to a dam failure. Hazards such as flooding, the melting of snow or ice, or rapid precipitation associated with thunderstorms, may all lead to increased pressure on the dam structures or overtopping of the structures, leading to failure. Additionally, earthquakes or tornadoes may cause damage to the structures or earthen components of the dam resulting in irreparable damages or failure.

3.3.9 Hazardous Materials Incident

Low Severe

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 3-21 Drums of Potentially Hazardous Waste

As materials are mobilized for treatment, disposal, or transport to another facility, all infrastructure, facilities, and residences in close proximity to the transportation routes are at an elevated risk of being affected by a hazardous materials release. Often these releases can cause serious harm to Hancock County and its residents if proper and immediate actions are not taken. Most releases are the result of human error or improper storage (**Figure 3-21**), 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 no significant 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 "Possible" to "Likely" within the areas of the County and "Critical" damages are anticipated to result from an incident dependent upon the location of the incident. As with hazards of this nature, a short warning time of less than 6 hours and a duration of less than one day, are anticipated in the event of a hazardous materials incident. A summary is shown in **Table 3-19**.

Table 3-19 CPRI for Hazardous Materials Incident

	PROBABILITY	MAGNITUDE/ SEVERITY	WARNING TIME	DURATION	CPRI
Hancock County	Likely	Critical	< 6 Hours	< 1 Day	Severe
Town of Cumberland	Possible	Critical	< 6 Hours	< 1 Day	Elevated
Town of Fortville	Possible	Critical	< 6 Hours	< 1 Day	Elevated
City of Greenfield	Likely	Critical	< 6 Hours	< 1 Day	Elevated
Town of McCordsville	Likely	Critical	< 6 Hours	< 1 Day	Severe
Town of New Palestine	Likely	Critical	< 6 Hours	< 1 Day	Severe
Town of Spring Lake	Possible	Critical	< 6 Hours	< 1 Day	Elevated

Relatively small hazardous materials incidents have occurred throughout Hancock 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 Hancock County, it can be anticipated that the likelihood of a future incident will also increase.

Hazardous Materials Incident: Assessing Vulnerability

Within Hancock 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 re-construction 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

While the possibility of an incident occurring may be likely, the vulnerability of Hancock 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), chemical inventories of local industries and businesses, and reporting materials necessary for compliance.

In Hancock County, there are extremely hazardous substance (EHS) facilities that 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, the response it would require, and prevent serious affects to the community involved.

Estimating Potential Losses

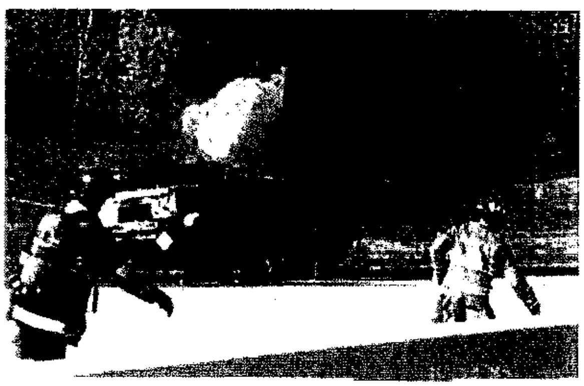


Figure 3-22 Fuel Tanker Fire

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 estimated.

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, Interstate 70, US Highway 36, 40, 52 and State Routes 9, 109, and 234 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 especially should be 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, reducing the risk to highly populated buildings and potentially populations with specials needs or considerations such as children, elderly, and medically unfit.

Hazardous Materials Incident: Relationship to Other Hazards

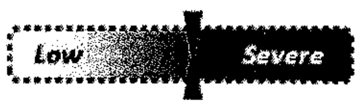
Dependent on the nature of the release, conditions may exist where an ignition source such as a fire or spark is in close proximity to a flammable or explosive substance. As the fire spreads throughout the facility or the area, structural and/or property damages will increase. Response times to a hazardous 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 increases structural losses, it may actually 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 Hancock 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 NFIP communities.

Table 3-20 summarizes the CPRI values for the various hazards studied within this MHMP. "Severe" hazards are flood; hail, thunder, windstorm; and hazardous materials incident. The hazards that ranked as "Elevated" risk were drought; earthquake; extreme temperature; tornado; and winter storm and ice storm. The hazard with a "Low" risk was dam failure.

Table 3-20 Combined CPRI

TYPE OF HAZARD	LIST OF HAZARDS	WEIGHTED AVERAGE CPRI
Natural	Drought	
	Earthquake	
	Extreme Temperature	
	Flood	
	Hail/Thunder/Windstorm	
	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 3-21** 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 3-21 Hazard Relationship Table

EFFECT → / CAUSE ↓	Drought	Earthquake	Extreme Temperatures	Flooding	Hailstorm, Thunderstorm, Windstorm	Tornado	Winter Storm, Ice	Dam Failure	Hazardous Materials
Drought									
Earthquake								X	X
Extreme Temperatures									
Flooding								X	X
Hailstorm, Thunderstorm, Windstorm				X				X	X
Tornado								X	X
Winter Storm, Ice				X				X	X
Dam Failure				X					X
Hazardous Materials									

As a method of better identifying the potential relationships between hazards, Exhibit 2 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, the City of Greenfield or any other community 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 this facility experiencing a hazardous materials incident.

Future development in areas where multiple known hazard areas (dam failure inundations 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.

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CHAPTER 4 MITIGATION GOALS AND PRACTICES

This section identifies the overall goal for the development and implementation of the Hancock 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 2007 Hancock County MHMP and determined that each of these remain valid and effective. In summary, the overall goal of the Hancock 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

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 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. 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 Hancock County. Mitigation measures that were included in the 2007 Hancock County MHMP are noted as such.

<u>Emergency Services</u>

- The County maintains outdoor warning sirens providing coverage for the majority of the populated areas of Hancock County. *(2007 Measure)*
- The County has developed a centralized system for testing, maintenance, and operation of outdoor warning sirens. *(2007 Measure)*
- The County utilizes Blackboard Connect for mass alerts for weather or hazardous events. *(2007 Measure)*
- Weather radios are encouraged throughout the County during presentations, events, and on the EMA website. *(2007 Measure)*

- Stream gages are utilized for flood forecasting and flood warnings for various stream levels. *(2007 Measure)*

Natural Resource Protection

- Hancock County, the Town of Cumberland, Town of Fortville, City of Greenfield, the Town of McCordsville, the Town of New Palestine, and the Town of Spring Lake are in good standing with the NFIP Program and have flood protection ordinances which meet minimum requirements.
- The MS4 communities enforce erosion and sediment control practices during construction activities to prevent the restriction of conveyances from sedimentation. *(2007 Measure)*

Prevention

- Information related to hazard mitigation has been incorporated, where appropriate, into individual Comprehensive Land Use Plans and other long-range plans. *(2007 Measure)*
- Several representatives participate in the Indiana Association of Floodplain and Stormwater Managers (INAFSM) or are certified as a CFM. *(2007 Measure)*
- Hancock County and the City of Greenfield have developed GIS databases which are used in land use planning decisions and can be utilized in HAZUS-MH "what-if" scenarios. *(2007 Measure)*
- The Hancock County LEPC provides routine training regarding the proper storage, transport, and disposal of hazardous materials. *(2007 Measure)*
- Electric providers routinely complete preventative maintenance on trees within the ROW and utility corridor. *(2007 Measure)*
- Local developers routinely bury new and retrofitted utilities to minimize exposure to hazards. *(2007 Measure)*
- The City of Greenfield, the Town of McCordsville, and Hancock County continues to implement the erosion and sediment control BMPs identified in the Storm Water Quality Management Plan (SWQMP) required by Rule 13 *(2007 Measure)*

Property Protection

- All communities follow the International Building Code which includes requirements to minimize damages from natural hazards.

Public Information

- Outreach materials are routinely provided within office and agencies throughout Hancock County, large public events, speaking opportunities within schools, etc. *(2007 Measure)*

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. *(2007 Measure)*
- Sugar Hills Lake Dam is routinely inspected as required by IDNR *(2007 Measure)*

4.2.2 Proposed Mitigation Practices

After reviewing existing mitigation practices, the Committee reviewed the list of mitigation ideas for each of the hazards studied as a part of this planning effort 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** – the proposed 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** – the proposed mitigation project will be technically feasible, reduce losses in the long-term, and will not create more problems than they solve.
- **Administrative** – the proposed mitigation projects may require additional staff time, alternative sources of funding, and have some maintenance requirements.
- **Political** – the proposed mitigation projects will have political and public support.
- **Legal** – the proposed mitigation projects will be implemented through the laws, ordinances, and resolutions that are in place.
- **Economic** – the proposed mitigation projects can be funded in current or upcoming budget cycles.
- **Environmental** – the proposed mitigation projects may have negative consequences on environmental assets such as wetlands, threatened or endangered species, or other protected natural resources.

Table 4-1 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 entity, and potential funding source, associated with each proposed practice. The proposed mitigation practices are listed in order of importance to Hancock County for implementation. Projects identified by the Committee to be of "high" local priority may be implemented within 5 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.

The benefit derived from each mitigation practice along with the estimated cost of that practice was utilized to identify the mitigation practices 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 Hancock County. The intent of this planning effort was to identify the hazards and the extent to which they affect Hancock 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 in order to apply for and/or receive project grants under the HMGP, PDM, FMA, and SRL. FEMA may require a MHMP under the Repetitive Flood Claims (RFC) program. 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.

NFIP/CRS

The CRS program credits NFIP communities a maximum of 72 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.