RESOLUTION NO. 2025 RE-01

A RESOLUTION OF THE COMMON COUNCIL OF THE CITY OF KNOX INDIANA ADOPTING THE STARKE COUNTY MULTI-HAZARD MITIGATION PLAN

WHEREAS, the City of Knox recognizes the threat that natural hazards post to people and property within the City of Knox; and

WHEREAS, Starke County, in conjunction with all participating jurisdictions located within, has prepared a multi-hazard mitigation plan, hereby known as the Starke County Multi-Hazard Mitigation Plan in accordance with federal laws, including the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended; the National Flood insurance Act of 1968, as amended; and the National Dam Safety Program Act, as amended; and

WHEREAS, the 2024 Starke County Multi-Hazard Mitigation Plan identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in the City of Knox from the impacts of future hazards and disasters; and

WHEREAS, adoption by the Common Council of the City of Knox demonstrates its commitment to hazard mitigation and achieving the goals outlined in the 2024 Starke County Multi-Mitigation Plan.

NOW THEREFORE, BE IT RESOLVED, that the City of Knox hereby adopts the 2024 Starke County Multi-Hazard Mitigation Plan as attached hereto (as Exhibit A).

BE IT FURTHER RESOLVED, the adoption of this plan shall supersede the adoption of any prior Multi-Hazard Mitigation Plan for the City of Knox.

BE IT FINALLY RESOLVED, while content related to local government may require revisions to meet the plan approval requirements, changes occurring after adoption will not require local government to re-adopt any further iterations of the plan. Subsequent plan updates following the approval period for this plan will require separate adoption resolutions.

PASSED AND ADOPTED BY THE CITY COUNCIL OF THE CITY OF KNOX THIS 28th DAY OF JANUARY 2025.

Jeff Berg, Council President

Don Kring, Council Member

Sherry Cowen, Council Member

Bill Gustafson, Council Member

Jaime Gruszczynski, Council Member

Approved by the Mayor this 28th day of Jan. 2025.

Dennis Estok, Mayor

Attest: Cyndi Kidder
Cyndi Kidder, Clerk-Treasurer

TOWN OF HAMLET, INDIANA

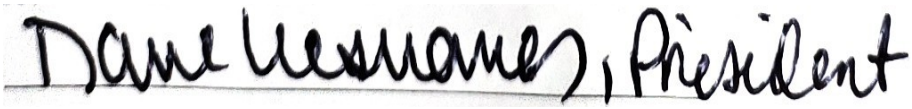
RESOLUTION #202518

A RESOLUTION OF TOWN OF HAMLET ADOPTING THE STARKE COUNTY MULTI-HAZARD MITIGATION PLAN ON JANUARY 8, 2025.

WHEREAS the Town of Hamlet recognizes the threat that natural hazards pose to people and property with the Town of Hamlet; and
WHEREAS, the Town of Hamlet has prepared a multi-hazard mitigation plan, hereby known as Starke County Multi-Hazard plan, January 8, 2025, in accordance with federal laws, including the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended; the National Flood Insurance Act of 1968, as amended; and the National Dam Safety Program Act, as amended; and
WHEREAS, Starke County Multi-Hazard plan, January 8, 2025, identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in the Town of Hamlet from the impacts of future hazards and disasters; and
WHEREAS, adoption by the Town of Hamlet demonstrates its commitment to hazard mitigation and achieving the goals outlined in the Starke County Multi-Hazard plan, January 8,2025.

NOW THEREFORE, BE IT RESOLVED BY THE TOWN OF HAMLET, INDIANA, THAT:
Section 1. In accordance with the Town Board of the Town of Hamlet, adopts the Starke County Multi-Hazard plan, January 8, 2025. While content related to the Town of Hamlet, may require revisions to meet the plan approval requirements, changes occurring after adoption will not require the Town of Hamlet to re-adopt any further iterations of the plan. Subsequent plan updates following the approval period for this plan will require separate adoption resolutions.

ADPOTED by a vote of 3 in favor and 0 against, and 0 abstaining, this 8 day of January, 2025.

By: 

ATTEST BY: 

Incorporated Town Of North Judson, Indiana

A RESOLUTION OF THE TOWN OF NORTH JUDOSN ADOPTING THE 2025 MULTI-HAZARD MITIGATION PLAN

RESOLUTION NO. 2025-02

WHEREAS the Town Council recognizes the threat that natural hazards pose to people and property within the Incorporated Town Of North Judson; and

WHEREAS the Town of North Judson has prepared a multi-hazard mitigation plan, hereby known as the 2025 Multi-Hazard Mitigation Plan in accordance with federal laws, including the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended; the National Flood Insurance Act of 1968, as amended; and the National Dam Safety Program Act, as amended; and

WHEREAS the 2025 Multi-Hazard Mitigation Plan identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in the Town Of North Judson from the impacts of future hazards and disasters; and

WHEREAS adoption by the Town Council of the Town Of North Judson demonstrates its commitment to hazard mitigation and achieving the goals outlined in the 2025 Multi-Hazard Mitigation Plan.

NOW THEREFORE, BE IT RESOLVED BY THE INCORPORATED TOWN OF NORTH JUDSON, INDIANA, THAT:

Section 1. In accordance with T.C. §30.21, the Town Council adopts the 2025 Multi-Hazard Mitigation Plan. While content related to the Town of North Judson may require revisions to meet the plan approval requirements, changes occurring after adoption will not require the Town Council to re-adopt any further iterations of the plan. Subsequent plan updates approval period for this plan will require separate adoption resolutions.

ADOPTED by a vote of 5 in favor and 0 against, and 0 abstaining, this 17th day of February, 2025.

Signature – Town Council President

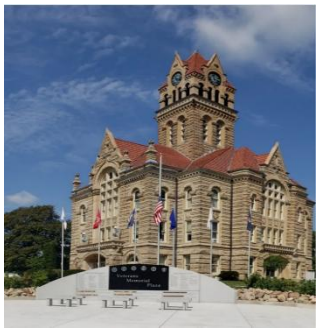
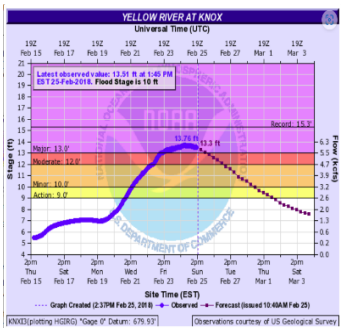
JOHN ROWE
Print

ATTEST: _____
Clerk-Treasurer

STARKE COUNTY MULTI-HAZARD MITIGATION PLAN

Prepared for:

Starke County Emergency Management Agency
53 E. Mound Street
Knox, IN

Prepared by:

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

Burke Project No. 19R.230503

BURKE

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EXECUTIVE SUMMARY

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

Figure i Phases of the Emergency Management Life Cycle

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

The overall goals of the Starke County MHMP, which align closely with the State of Indiana MHMP, are:

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

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

1) Lessen the impacts of disasters and enhance community resilience by:
   a. Supporting resilience opportunities within the community
   b. Incorporating the MHMP into local ordinances, local planning efforts and the community comprehensive plans
   c. Evaluating and strengthening collaboration among organizations
   d. Making sure essential facilities can withstand disasters
   e. Supporting the NFIP
   f. Identifying opportunities to reduce repetitive loss incidents
2) Minimize the loss of life and injures caused by disasters by:
   a. Improving warning systems for the residents
   b. Developing public awareness and outreach programs
   c. Improving shelter availability
   d. Developing a program of affordable housing that is resilient to flooding
   e. Improving education and training for emergency personnel and officials
   f. Developing ways to provide education, awareness, and warning of disasters to the underserved populations
3) Promote mitigation activities prior to and following a disaster by:
   a. Ensuring better communication between federal, state and local officials
   b. Seizing opportunities to buy out properties, floodproof buildings, or improve building codes
   c. Conducting new studies and/or research opportunities to reduce impacts from disasters and prepare for future events anticipating the impacts of our changing climate.

d. Conducting outreach efforts to educate community members of the risks and hazards in their area as well as encouraging the implementation of a variety of mitigation actions.

For National Flood Insurance Program (NFIP) communities to be eligible for future mitigation funds, they must adopt either their own MHMP or participate in the development of a multi-jurisdictional MHMP. Further, it is required that local jurisdictions review, revise, and resubmit the MHMP every five years. As representatives from Starke County, the City of Knox, the Towns of Hamlet, and North Judson have provided information, attended meetings, and participated in the planning process, the planning process used to update the Starke County MHMP satisfies the requirements of a multi-jurisdictional plan.

During Planning Committee meetings, those in attendance revisited existing the 2010 MHMP and identified new critical facilities and local hazards; reviewed the State's mitigation goals and updated the local mitigation goals; reviewed the most recent local hazard data, vulnerability assessment, and maps; evaluated the effectiveness of existing mitigation measures and identified new mitigation projects; and reviewed materials for public participation. Keeping in mind the ever-changing climate, the team also examined the needs of underserved populations that may be more vulnerable to the impacts of the listed hazards. Meetings were conducted with key groups such as city planners, health department specialists, representatives of organizations serving the underserved populations and various emergency responders. Their information has been incorporated into this MHMP update. Due to community challenges and frequent turnover in the Starke County Emergency Management Agency (EMA), no updates were made to the 2010 plan in the past 14 years. This plan update will examine each of the hazards with data from the past 14 years, where possible.

The review of hazards and risks is based on the methodology described in the Local Mitigation Planning Policy Guide FP 206-21-0002, Effective April 19, 2023. The plan identifies the hazards assessed, the nature of each hazard including historic occurrences, vulnerabilities, and the relationship to other hazards. Using a ranking tool known as the Calculated Risk Priority Index (CPRI), the planning team scored each of the hazards. **Table i**: Comparison of CPRI Scores for All Hazards

lists the hazards in the plan and compares the scores to the previous plan. The CPRI scores reflect the hazards of most concern by the planning team members and change from one plan to another based on recent experiences, changes in community demographics, and challenges.

Table i: Comparison of CPRI Scores for All Hazards

Hazard	2024 Rank	CPRI Score	2010 Rank	Hazard
Extreme Temperatures – Heat, Cold	1	3.7	N/A	Not evaluated in 2010
Flash Flooding	2	3.6	N/A	See Flood
Fire and Wildfire	3	3.5	5	Fire
Severe Storms – Hail, Thunder, Wind	4	3.4	1	Summer Storm/Tornado
Winter Weather – Ice, Snow, & Storms	5	2.75	2	Winter Storm
Tornado	6	2.65	1	Summer Storm/Tornado
Drought	7	2.65	6	Drought
Dam and Levee Failure	8	2.5	8	Levee Failure/Dam Failure
Flood - Riverine	9	2.2	4	Flood
Haz Mat	10	2.2	3	Hazmat Spill
Earthquake	11	2.05	7	Earthquake
Land subsidence	12	1.3	N/A	Not evaluated in 2010

Lastly, the plan concludes with a discussion about mitigation actions. The MHMP lists a variety of mitigation actions the planning team members would like to accomplish within the next 5 years to enhance the resilience of Starke County. In addition, it celebrates the mitigation successes from the previous MHMP Plans and community actions which contribute to mitigating the various risks and hazards identified.

This MHMP is a living document which has a 5-year life span. During the next 5 years, Starke County and the incorporated communities that adopt this plan will work to complete the mitigation actions as well as regularly noting items for the 2029 MHMP update. The County EMA and planning team members will also use tools contained in the Appendices, or similar documents, to track progress, and note changes that may impact community resilience.

1.0 INTRODUCTION

1.1 DISASTER LIFE CYCLE

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

Figure 1 Phases of the Emergency Management Life Cycle

Mitigation – to prevent or to reduce the effects of disasters (building codes and zoning, vulnerability analyses, public education)
Preparedness – planning, organizing, training, equipping, exercising, evaluation and improvement activities to ensure effective coordination and the enhancement of capabilities (preparedness plans, emergency exercises/training, warning systems)
Response – the mobilization of the necessary emergency services and first responders to the disaster area (search and rescue; emergency relief)
Recovery – to restore the affected area to its previous state (rebuilding destroyed property, re-employment, and the repair of other essential infrastructure)

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

1.2 PROJECT SCOPE & PURPOSE

REQUIREMENT §201.6(d)(3):

A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit it for approval within five (5) years in order to continue to be eligible for mitigation project grant funding.

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

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

The National Flood Insurance Program (NFIP) requires participating communities adopt either their own MHMP or participate in the development of a multi-jurisdictional MHMP to be eligible for future mitigation funds. The Indiana Department of Homeland Security (IDHS) and the United States Department of Homeland Security (US DHS)/FEMA Region V offices administer the MHMP program in Indiana. Local jurisdictions are required to review, revise, and resubmit the MHMP every five years. The MHMP updates must demonstrate that progress has been made in the last five years to fulfill the commitments outlined in the previously approved MHMP. The update may validate the information in the previously approved MHMP or may be a major rewrite depending on community needs and planning guidance. The updated MHMP is not intended to be an annex to the previously approved Plan; it stands on its own as a complete and current MHMP.

The Starke County MHMP Update is a multi-jurisdictional planning effort led by the Starke County EMA. This Plan was prepared in partnership with Starke County, the City of Knox, the Towns of Hamlet and North Judson. 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 jurisdictions had an equal opportunity for participation and representation in the planning process, the process used to update the Starke County MHMP satisfies the requirements of DMA 2000 in which multi-jurisdictional plans may be accepted.

The Community Rating Service (CRS) program is a voluntary incentive program that recognizes and encourages community floodplain activities that exceed the minimum National Flood insurance Program (NFIP) requirements. As a result, flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions that meet the three goals of the CRS: (1) reduce flood losses; (2) facilitate accurate insurance rating; and (3) promote education and awareness of flood insurance. Savings in flood insurance premiums are proportional to the points assigned to various activities. A minimum of 500 points is necessary to enter the CRS program and receive a 5% flood insurance premium discount. This MHMP could contribute as many as 374 points toward participation in the CRS. At the time of this planning effort, the City of Knox, the Town of Hamlet and Starke County participated in the NFIP, however none of the communities currently participate in the CRS program. Throughout this Plan, activities that could count toward CRS points are identified with the NFIP/CRS logo (**Figure 2**). Acronyms referenced throughout this plan are contained in **Appendix 1**.

Figure 2 NFIP/CRS Logo

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

1.3 ANALYSIS PROCESS

REQUIREMENT §201.6(c)(1):

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

Preparation for the Starke County MHMP Update began in 2019, when the grant request was approved by FEMA and grant funds were awarded in 2019. Due to numerous personnel changes in the Starke County Emergency Management Agency, action regarding the update of this plan was delayed until November 2023.

The plan update process began immediately upon the hiring of Chrispher B. Burke Engineering, LLC. The planning process to update the 2010 MHMP took 8 months. This included a review period by IDHS and FEMA for the draft MHMP Update, and time for Starke County and communities to adopt the final MHMP Update.

1.3.1 Planning Committee and Involvement of Other Interested Parties

In December of 2023, the EMA began to compile 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 activities; have the tools necessary to reduce the impact of future hazard events; and/or served as a representative on the prior Planning Committee in 2010. LaPorte, St. Joseph, Marshall, Fulton, Pulaski, Jasper, and Porter Counties were invited to attend the team meetings and were given an opportunity to provide input and feedback to the plan throughout the planning process and during draft review. No comments or corrections were received from the neighboring EMA offices.

Table 1 lists the individuals that actively participated on the Committee and the entity they represented.

Table 1: Starke County Planning Team

Name	Title	Organization	Representing
Sherry Fagner	Mass Care Lead	American Red Cross	Red Cross
Jim Garner	Assistant Chief	Bass Lake Fire Dept.	Bass Lake CDP
Darrell Crase	Chief	Bass Lake Fire Dept.	Bass Lake CDP
Lonnie Boley	Director	City of Knox Building Dept.	City of Knox
Bill Dulin	School Resource Officer	Culver School Corporation	School Corp.
Todd Jackson	Captain	North Judson Fire Dept.	Town of North Judson
Noah Sanchez	Firefighter/EMT	North Judson Fire Dept.	Town of North Judson
Rachel Fox	Director	Pulaski County EMA	Neighboring EMA
Jim Garner	EMS Director	Starke County	Starke County
Rachel Oesterreich	Auditor/Highway Supt.	Starke County	Starke County
Boz Williams	Plan Commissioner	Starke County	Starke County
Dave Pearman	Councilman	Starke County Council	Starke County
Tori Chessor	Director	Starke County EMA	Starke County
		Town of Hamlet	Town of Hamlet
Joe Leszek	Superintendent	Town of North Judson	Town of North Judson

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

- Reviewed the State's mitigation goals and updated the local mitigation goals.
- Reviewed the most recent local hazard data, vulnerability assessment, and maps.
- Comparatively evaluated and ranked the hazards based on probability of occurrence, impact, warning time and duration of the hazard event.
- Revisited existing (in the 2010 MHMP) critical and essential infrastructure and identified new critical infrastructure and local hazards.
- Evaluated the effectiveness of existing mitigation measures and identified new mitigation projects.
- Reviewed materials for public participation.

A sign-in sheet recorded those present at each meeting to document participation. The following members also represented the underserved populations: Sherry Fagner – Disaster Survivors; Bill Dulin - school aged children; and Jim Garner - Senior Citizens and medically fragile. Both the City of Knox and the Town of North Judson are in Federally identified disadvantage population areas. Representatives of the two communities were able to speak about the needs of the disadvantaged and programs currently underway to assist community members. Meeting agendas and summaries are included in **Appendix 2**. Members of the Committee also reviewed a draft MHMP, provided comments and suggestions, and assisted with adoption of the Starke County MHMP Update.

1.3.2 Public Involvement

A draft of the Starke County MHMP Update was posted to the Starke County website (https://starke.in.gov/) for public review and comment. A media release indicating the posting of the draft MHMP and the ability to comment was submitted for release to WKVI (*https://wkvi.com/).* The newspapers serving Starke County do not have extensive circulation. Most of the community does use the radio station to stay abreast of local information and events. Committee members were provided with an informational flyer regarding the same information to display in their respective offices and to provide to family, friends, and colleagues. No comments or corrections were received from the public or the Committee. The media release, informational flyer, and any comments received are included in **Appendix 3**.

Neighboring Emergency Managers were invited to attend both planning meetings as well as being provided with an opportunity to review the draft plan. No comments or corrections were received from the neighboring Emergency Management Agencies in LaPorte, St. Joseph, Marshall, Fulton, Pulaski, Jasper and Porter Counties.

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 Starke 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 previous Starke County MHMP, and to assist the Committee in developing potential mitigation measures to reduce the social, physical, and economic losses associated with hazards affecting Starke County.

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

MHMP Starke County, 2010
2019 Starke County Comprehensive Plan, approved January 2020
Starke County GIS data shared from WTH Engineering 2023
Town of Hamlet Comprehensive Plan, approved December 11, 2019
City of Knox Comprehensive Plan, 2015
Town of North Judson Comprehensive Plan adopted January 13, 2020
Town of North Judson Master Parks Plan, 2022
Yellow River Sediment Control Evaluation Preliminary Engineering Report, 2012
Kankakee River Flood and Sediment Management Work Plan, 2019

The Starke County Building and Planning Department has jurisdiction over the unincorporated rural areas of Starke County. The City of Knox and the Towns of Hamlet and North Judson have their own Building Departments. Knox and Hamlet also have community Floodplain Administrators as well.

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

- Indiana Department of Natural Resources, Division of Water – *Flood insurance policies, claims, and payment information; NFIP Participation; DNR listed Dams and associated records; Dam Breach Inundation App; and IN Floodplain Information Portal.*
- Indiana Department of Natural Resources, Other Divisions – *Mining Records*
- Indiana Geologic Survey and Water – *Earthquakes in Indiana; Liquefaction Potential Map: Karst Regions and Maps of Karst locations*
- Indiana Geographic Information Office - *IndianaMap*
- Indiana Department of Homeland Security – *Current Fire and Building Code Information*
- FEMA, Region V – Repetitive loss structure counts and insurance payments
- Midwest Regional Climate Center – Climate Trends; County specific climate reports
- National Weather Service – Indianapolis Weather Forecast Office – Confirmation of WSSI tool; local storm reports; weather event photos.

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

2.0 COMMUNITY INFORMATION

Figure 3 Starke County Location in Indiana

Starke County was established in 1850 and is named after Revolutionary War General John Stark. General Stark commanded New Hampshire troops at the Battle of Bunker Hill in 1775 and defeated the British at the Battle of Bennington in 1777. The land now considered as Starke County was inhabited by the Potawatomi Indian Nation. Originally the county included four townships located north of the Kankakee River. However, access across the river was limited to one bridge causing hardship for those living to the north of the river. In 1942, the northern four townships were officially made a part of LaPorte County.

Starke County has low rolling hills covered with vegetation or brush. The total area of Starke County is 312.21 square miles of which 3.07 square miles is water. The county is divided into 9 townships. The City of Knox serves as the county seat. The location of the county within the State of Indiana is identified in **Figure 3.**

2.1 POPULATION AND DEMOGRAPHICS

The US Census Bureau estimates the 2022 population for Starke County was 23,258 which ranks 66 of 92 in the State. Since 2010, Starke County population has decreased by 0.4% reaching its lowest point of 22,958 in 2015. Since 2015, the county population has recovered to its present level of 23,258. The City of Knox is the county's largest incorporated area, accounting for 15.6% of the county's population (3,624 people). Starke County is a predominantly white community, making up 96.8% of the county's racial demographics. The county is 95.3% non-Hispanic and 4.7% Hispanic.

In 2022, the median age of the population in the county was 42.7. That is 4.5 years older than the statewide median age of 38.2. The largest demographic age group in the county is Older Adults (45 to 64) making up 26.7% of the county's population. The second largest is the Young Adult group (25 to recovered to its 44) making up 23.1% of the county and the third largest age group is the Seniors group (65 and older) at 20.4%. The school age group (5 to 17) follows, making up 16.6% of the population; then the college age group (18 to 24) at 7.5% and finally the preschool age group (0 to 4**)** at 5.7%.

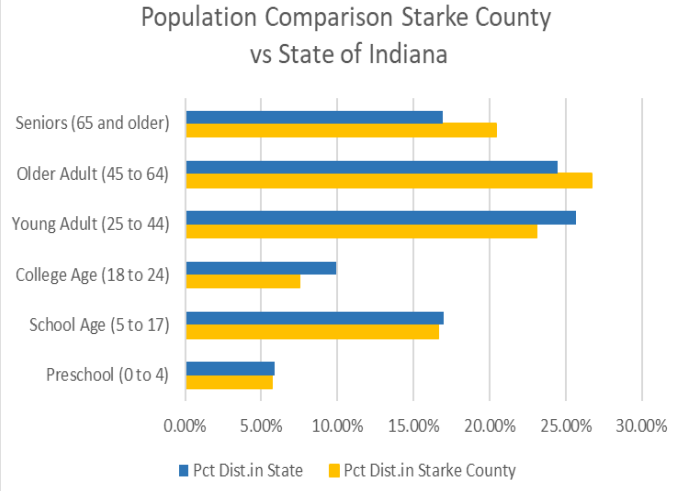


Figure 4 Age Distribution Compared to State Population

Figure 4 shows the age distribution totals compared to the state. Starke County age distribution is somewhat skewed compared to the state with an older adult population and a smaller number of children and young adults. As the senior members of the community continue to age their vulnerability to various hazards will increase as well.

The approximate median household income in 2021 was reported to be $57,994 while the poverty rate in the same year was reported at 14.2% county-wide. In total, 1,516 (17.5%) of households are married

with children, and 2,906 (33.6%) of households are married without children. There are 660 single parents in Starke County with the remaining 2,396 (27.7%) of the population living alone.

Within the county, 85.1% of the adults older than 25, have reportedly completed a High School education. Further, 13.1% of those same adults have also completed a Bachelor of Arts or higher degree.

2.2 EMPLOYMENT

US Census data indicates that of the Starke County workforce, the private sector is the largest employment sector within the county at 78.4%, followed by Government at 14.4% and then by Farming at 7.2%. The "Other Private" category represents the largest group within the Private Sector Employment category at 25.9%. "Other Private" is a catchall category which addresses any employment category not normally reported on the census questionnaires. "Retail trade" is the second largest employment category employing 11.6% of the workforce within the county. The total resident labor force according to estimates in 2022 is 9,567(with 361 unemployed) and as of October 2023, unemployment rate of 3.7%. The top 10 employers within Starke County according to Hoosiers by the Numbers are:

1. Pathfinder Services Inc (Knox)
2. MPI Indiana Fineblanking (Knox)
3. Knox Comm Elementary School (Knox)
4. Northwest Health-Starke (Knox) (formerly Starke Memorial Hospital)
5. Oregon Davis Jr/Sr High School (Hamlet)
6. American Oak Preserving Company Inc (North Judson)
7. Oregon Davis School Corporation (Hamlet)
8. Bailey's Discount Center (North Judson)
9. Starke County Economic Development (Knox)
10. J W Hicks Inc (Knox)

2.3 TRANSPORTATION AND COMMUTING PATTERNS

Several major transportation routes pass through Starke County and the municipalities within. US Routes 30, 35, and 421, and State Roads 8,10,23,and 39 serve as main routes. There are three railways (Norfolk Southern, Chesapeake and Indiana Railroad, and Hoosier Valley RR) in the county. **Figure 5** Shows the location of each of the transportation routes.

According to STATSIndiana, 835 people commute into Starke County daily. Approximately 33.4% travel from Pulaski County. Furthermore, approximately 1,485 Starke County residents

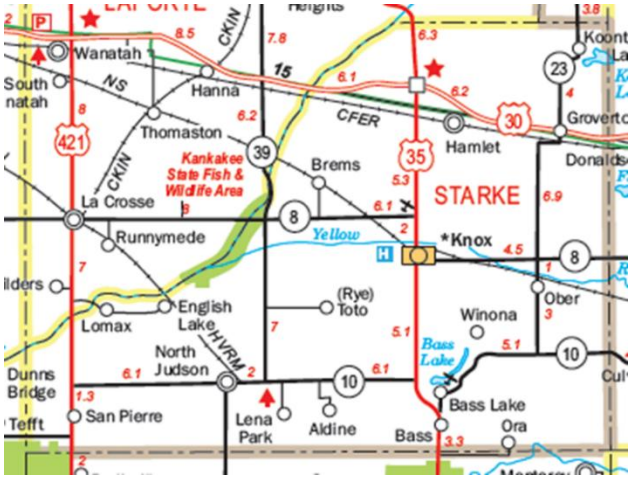


Figure 5 Transportation Routes in Starke County

commute to other counties, with Marshall County receiving the greatest percentage of commuters from Starke County at 41.5%.

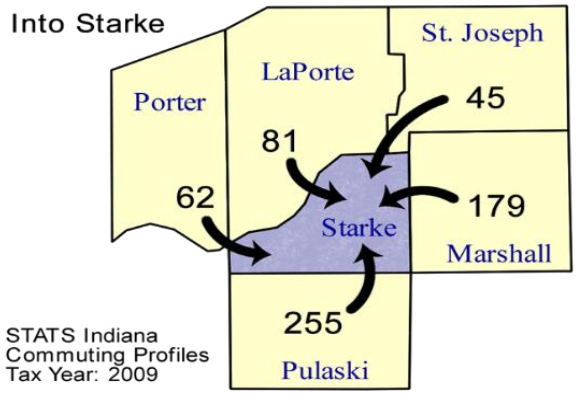


Figure 6 Commuters into Starke County

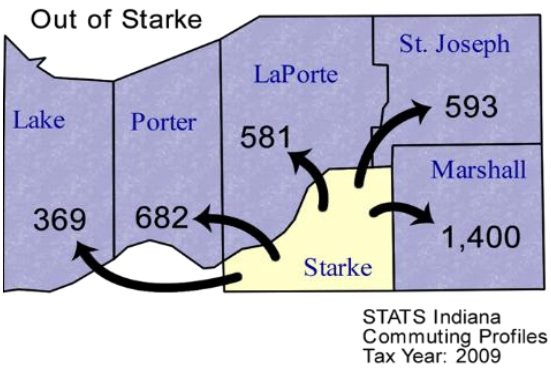


Figure 7 Commuters out of Starke County

Figure 6 indicates the number of workers 16 and older who do not live within Starke County but commute into the County for employment purposes. **Figure 7** indicates the number of Starke County residents 16 and older that commute out of the county for employment.

2.4 CRITICAL AND ESSENTIAL INFRASTRUCTURE

REQUIREMENT §201.6(c)(2)(ii)(A):

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

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

Figure 8 Starke County Courthouse

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

The Starke County EMA and GIS Department Offices provided the listing and locations of the following 179 critical infrastructure points for the MHMP update. **Figure 8** shows the Starke County Courthouse as one of the critical facilities.

The following list identifies the number of each of the critical and essential facilities identified.

- 7 Airports/Airfields
- 2 Daycare Facilities
- 9 Schools
- 9 EMS Stations
- 10 Fire Stations
- 4 Law Enforcement Departments
- 93 Communication Towers
- 6 Substations
- 1 Wastewater Facilities
- 10 Hazardous Materials
- 1 Hospital
- 1 Mobile Home Park
- 1 Gas Station
- 2 Nursing Homes
- 18 Churches/Places of Worship
- 4 Shelters
- 1 Potable Water Facility

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

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

2.5 MAJOR WATERWAYS AND WATERSHEDS

According to the United States Geological Survey (USGS), there are 111 waterways in Starke County, which are listed in **Appendix 5**. The county's main waterways are the Kankakee River and the Yellow River. The county lies within three 8-digit Hydrologic Unit Code (HUC): Kankakee, and Tippecanoe. These major waterways, and others, are identified on **Exhibit 2**. There are 3 USGS river gages located in Starke County. The first is located on Yellow River near Oak Grove. The second one is Yellow River at Knox and the third is Kankakee at Davis.

Starke County is in the northwest part of the state and consists of low rolling hills devoted to agriculture or development. The waterways provide drainage that is necessary for cropland to thrive. There are several regulated drains in Starke County. Some of the other larger waterways in the county include Robbins Ditch, Jain Ditch, Bailey Ditch, Cox Ditch, Eagle Creek, Kline Ditch, Bogus Run, House Ditch, and Pine Creek. Along these waterways are numerous woodlands and wetlands providing rich habitat for waterfowl and many migratory birds such as the Sandhill cranes.

Figure 9 Map of Starke County Rivers and Major Lakes

2.6 NFIP PARTICIPATION

The National Flood Insurance Program (NFIP) is a FEMA program that enables property owners in participating communities to purchase insurance protection against losses from flooding. According to FEMA, participation in the National Flood Insurance Program (NFIP) is voluntary. Starke County and the City of Knox, and the Town of Hamlet participate in the NFIP. The Town of North Judson has not participated since June16, 2015. At the time of this planning effort, according to the Indiana Department of Natural Resources, the Starke County Planning Director is responsible for the administration of the floodplain program in the unincorporated areas of the County. The City of Knox and the Town of Hamlet both have community floodplain administrators. North Judson does not participate in the NFIP since they have no FEMA identified Special Flood Hazard Areas (SFHAs) within the town limits. There is one small corner of undeveloped farm acreage which is shown to be in the flood fringe on the best available data layer from Indiana DNR.

Table 2 lists the NFIP number, effective map date, and the date each community joined the NFIP program.

Table 2: NFIP Participation

NFIP Community	NFIP Number	Effective Map Date	Join Date
Starke County	180240#	04/01/93(L)	09/02/77
City of Knox	180242A	02/01/94(L)	11/30/73
Town of Hamlet	180241A	09/01/86(L)	06/21/74
Town of North Judson	180553#	06/16/14	Not Participating

2.7 TOPOGRAPHY

The Grand Kankakee Swamp, also known as the everglades of the north, once extended from St. Joseph County southwesterly into Illinois. Much of Starke County was in the former Grand Kankakee Swamp**.** **Figure 10** shows the historic Grand Kankakee Swamp. As settlers moved into the county, the large stands of timber were cut down and the land was drained for cropland. Today, Starke County consists of low rolling hills with sections of forest and agricultural use. The geographic center is 41.25984154 degrees north and 86.59948540 degrees west. The highest elevation is 863 feet, at Pigeon Roost Hill near the Starke Pulaski County line and the lowest elevation is 656 feet. The Kankakee River forms the northern boundary of the county.

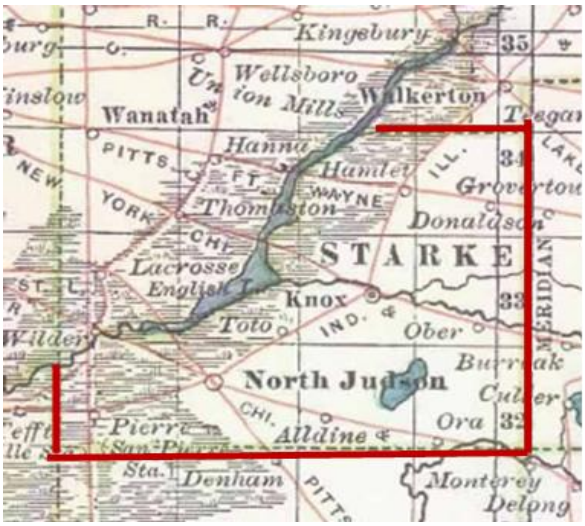


Figure 10 Grand Kankakee Swamp in Starke County

There is one reservoir in the county known as Koontz Lake. Bass Lake is the second large body of water present in the county. Agriculture is the primary land use and is ideal for the area due to the flat land and gentle rolling hills. Much of the Kankakee River is flanked by wetlands and marshes. isolated wetlands dot the county. The Yellow River flows to the west through the central part of the county, joining the Kankakee River in a series of marshes near State Road 39. The Tippecanoe River meanders along the county line between Starke and Pulaski Counties in the southeastern corner west of Langenbaum Lake.

2.8 CLIMATE

In Starke County, the annual average maximum temperature was 59.7 degrees Fahrenheit with an average annual low (minimum) temperature of 40.1 degrees Fahrenheit **Figure 11** and **Figure 12** chart the maximum and minimum temperatures and show trends utilizing data from the National Centers for Environmental Information (NCEI). The coldest month based on this data is January at a mean temperature of 15.6 degrees and the warmest is July with a mean temperature of 83 degrees. According to the Midwest Regional Climate Center (MRCC) between January 2014 and December 2023 at the Knox Wastewater Treatment Plant (the long-term weather data site), the maximum temperature was 95 degrees (5/28/18), and the lowest minimum temperature was -21 degrees (1/30/19 and 1/31/19). The average monthly high was 86.5 degrees, which is 1.8 degrees warmer than the monthly mean within that time frame. Additionally, the lowest average monthly minimum temperature for the same ten-year period was recorded at 4.9 degrees in 2014, 9.7 degrees colder than the monthly mean minimum temperature within that time frame. Comparing the averages within the past 10 years, the average temperature within Starke County was recorded to be 48.8 degrees, with 2014 being the coolest year with an average of 47.2 degrees and 2016 being the warmest at an average of 52.3 degrees.

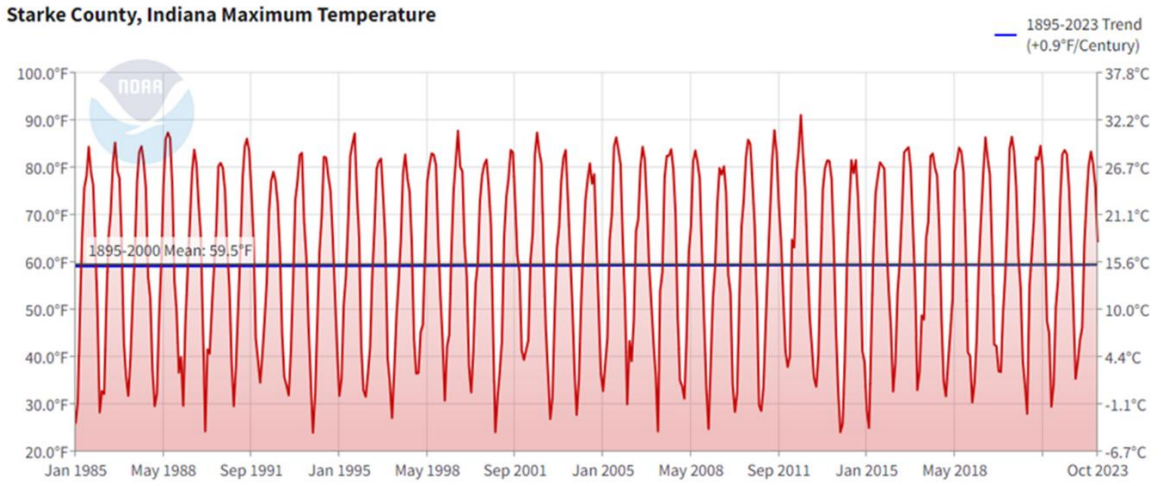


Figure 11 Maximum Temperature 1985-2023

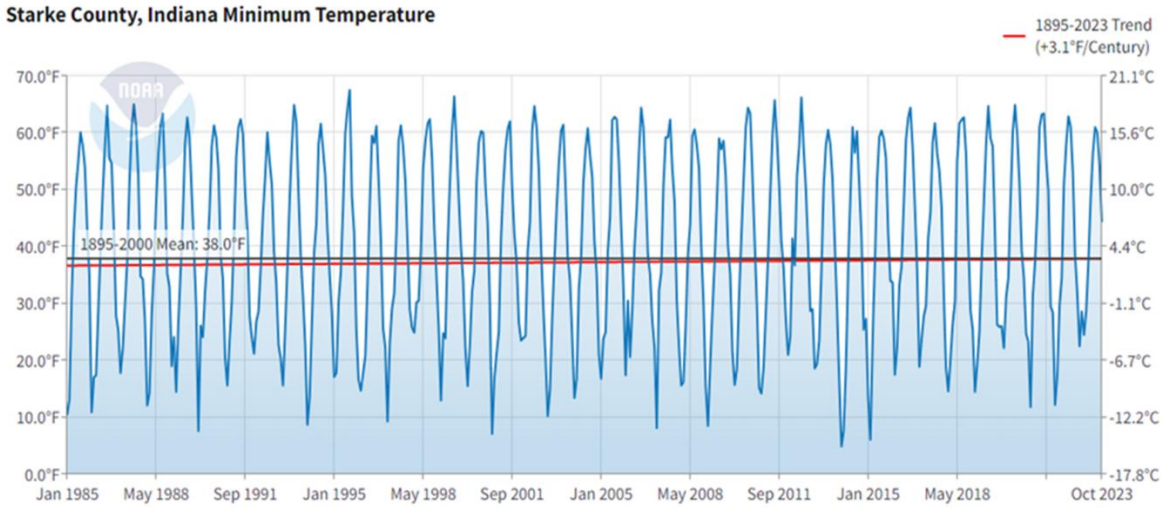


Figure 12 Minimum Temperature 1985-2023

June is typically the wettest month of the year, with February being the driest. The average annual precipitation for Starke County is 37.26 inches. In the past 10 years Starke County had a low of 32.56 inches in 2020 and the highest annual precipitation of 47.92 inches. The number 1 highest monthly precipitation rate occurred in August 2016 where 10.68 inches fell. That is 2.9 times the normal amount for the month August of 3.68 inches. On the opposite end of the spectrum the driest month was November 2023 with 0.61 inches of precipitation.

Figure 13 illustrates the monthly precipitation trends in Starke County.

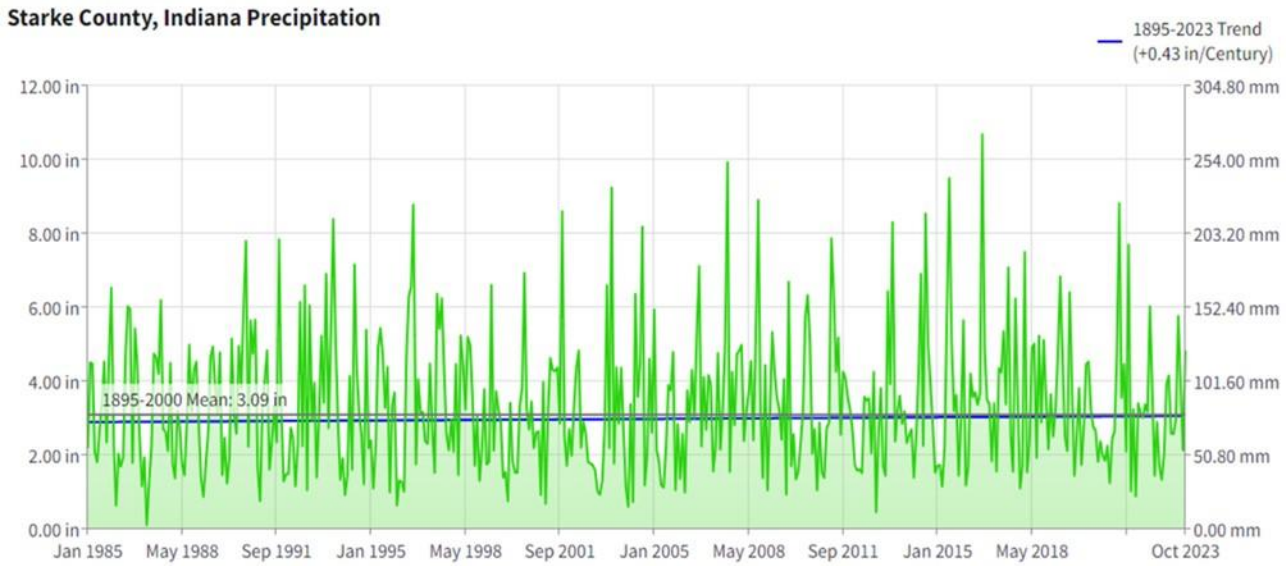


Figure 13 Precipitation Trends for Starke County

Purdue University Indiana Climate Change Impacts Assessment Report analyzed the increased frequency of short duration high volume rain events, also known as extreme precipitation events, in Indiana. According to the report, an extreme rain event occurs when more than 0.86 inches of rain falls in a day. Since 1900, the number of days per year with extreme rain has been increasing by 0.2 days per decade on average. However, most of that increase has occurred since 1990. The northwestern part of the state has seen the largest increase — a rate of about 0.4 days per decade. In **Figure 14** the trend line shows an increase in the number of days where the rainfall exceeds 99th percentile. This ever-increasing trend is resulting in more frequent flash flood

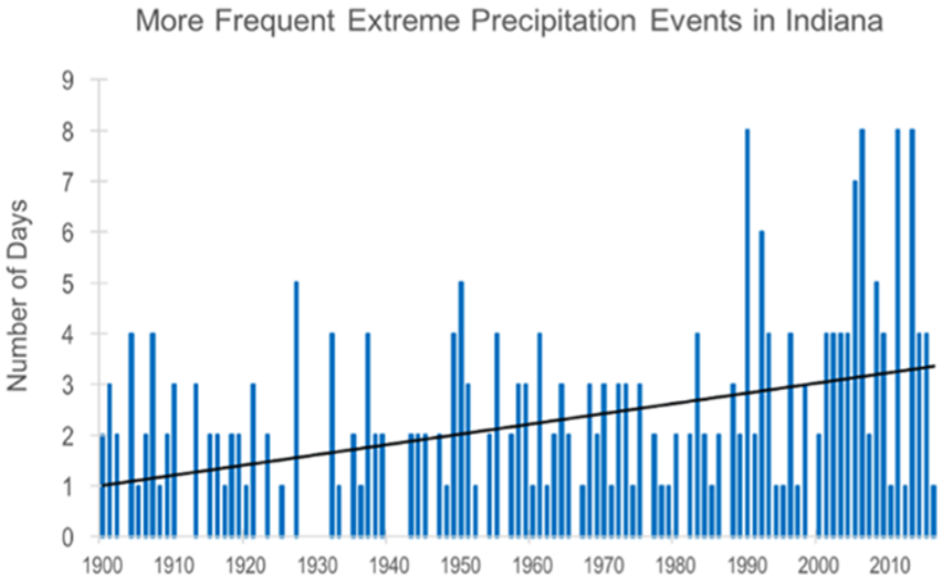


Figure 14 Extreme Precipitation Events in Indiana

and overland flood events.

According to NOAA National Centers for Environmental Information the State Climate Summary for Indiana the following have been observed based upon climate change.:

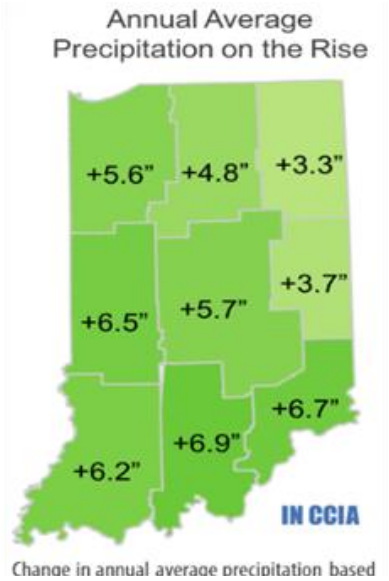


Figure 15 Annual Average Precipitation Change, Purdue University

- The temperatures have risen almost 1.5 degrees Fahrenheit since the beginning of the 20th Century. Temperatures in the 2000's have been higher than in any other historical period except during the early 1930's Dust Bowl era.
- Indiana has experienced an increase in average annual precipitation as shown in **Figure *15*.** Based on the data, the number of and the intensity of rain events are increasing and rain duration is decreasing.
- extreme events are increasing, especially flooding.

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

2.9 UNDERSERVED, DISADVANTAGED AND SOCIALLY VULNERABLE POPULATIONS

For this planning effort, under the new FEMA guidance mitigation plan updates are required to include the perspective of socially vulnerable community members and the underserved communities in the county. The Agency for Toxic Substances and Disease Registry (ATSDR) and the Centers Disease Control (CDC) with higher education facilities to develop the Social Vulnerability Index (SVI). According to ATSDR/CDC, Social Vulnerability refers to the community's capacity to prepare for and respond to the stress of hazardous events ranging from natural disasters, such as tornadoes or disease outbreaks, to human caused threats, such as toxic chemical threats. Sixteen census-derived factors are grouped into 4 general themes which summarize the extent of social vulnerability. **Figure 16** shows the 16 factors and how they are grouped into the four themes. The more factors impacting community members to more vulnerable those members are to the hazardous events.

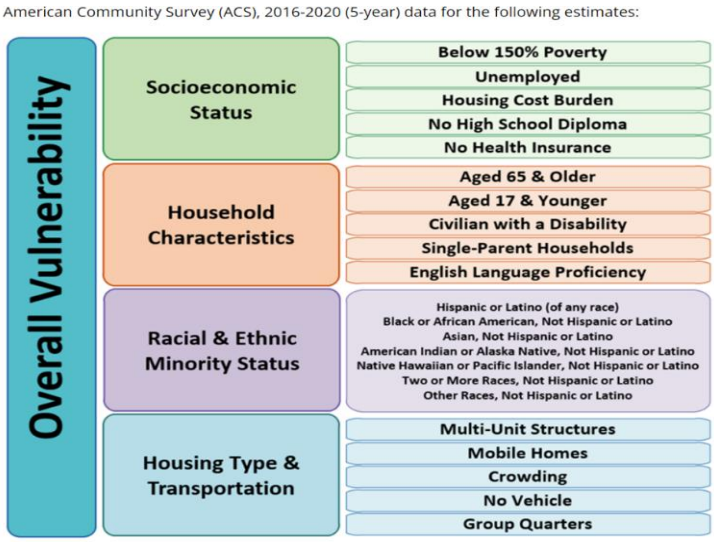


Figure 16 Social Vulnerability Factors

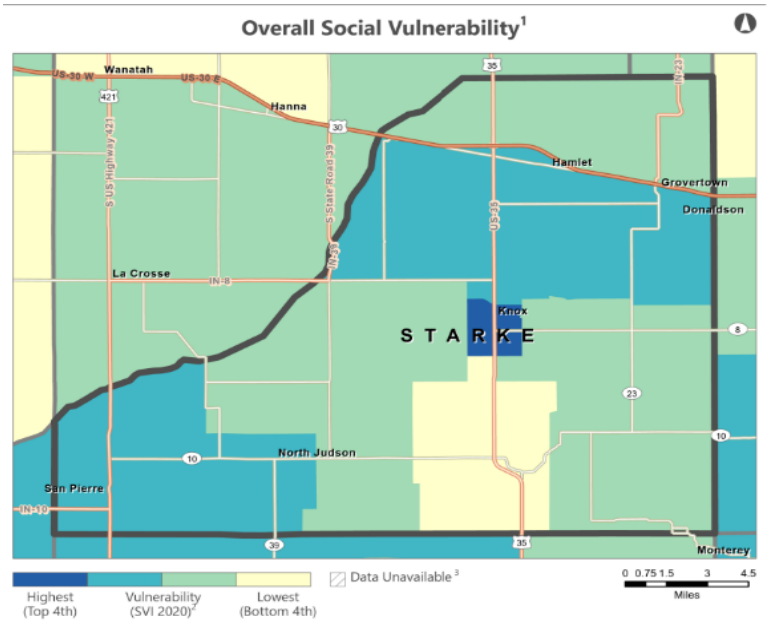


Figure 17 Starke County Social Vulnerability by Census Tract

Figure 17 Is a map of the social vulnerabilty of each of the census tracts in Starke County. Further details, including the 4 thematic maps may be found in **Appendix 11**. The Social Vulnerability Index is used in FEMA's National Risk Index, where the data is paired with expected annual losses, and community resilience to calculate a risk index for each of the hazards. This data is available both on the county level and the census tract level. Overall as a county the social vulnerability is relatively low, however, on closer examination, at the census tract level, the City of Knox and the area immediately adjacent to the City as well as the southwest corner of Starke County encompassing the Town of North Judson and the CDP of San Pierre and the wedge of land between the Yellow River and US 30 tends to be relatively high and relatively moderate in their social vulnerability scores. When struck by the same intensity event, the areas in blue on Figure 17 may require, more support in responding to and recoveirng from the hazardous event.

One last resource reviewed was the Climate and Economic Justice (CEJ) tool. Although the tool shows some similarities to the social vulnerabiltiy index, there are some differences.

The CEJ Tool highlights disadvantaged census tracts across all 50 states, the District of Columbia, and the U.S. territories. If the community is located in a census tract that meets the thresholds for at least one of the tool's categories of burden, or if the community is on land within the boundaries of Federally Recognized Tribes then the people living within the census tract are considered disadvantaged.

Three census tracts within Starke County are considered disadvantaged. (***Figure 18***) Each area is considered disavantaged beause the households from this area are above the 65th percentile for low income. Low income is defined as an income less than or equal to twice the federal poverty level, not including students enrolled in higher education. Additionally each area meets or exceeds one of the other criteria which includes climate change impacts, energy, health, housing, legacy pollution, transportation, water and wastewater and/or workforce development factors. The three identified census tracts account for 48% of the county's population. A more detailed analysis of each area may be found in **Appendix 11**. The team looked at the impacts of social vulnerability on the overall commuity and where possible identified mitigation efforts to address the hazards making these areas of the community more resilient.

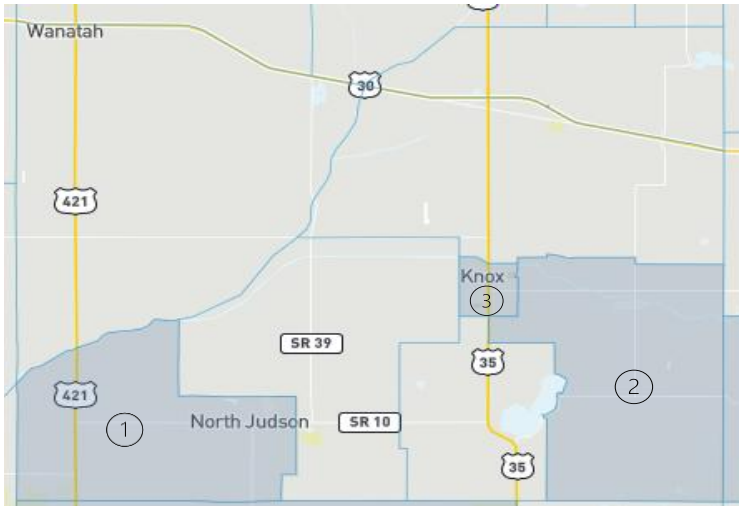


Figure 18 Disadvantaged Population Areas in Starke County

3.0 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 Starke County and the communities within is based on the methodology described in the Local Mitigation Planning Handbook published by FEMA in 2023 and is incorporated into the following sections:

Section 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 table summarizing the relationship of the hazards; and a composite map to illustrate areas impacted by the hazards.

3.1 HAZARD IDENTIFICATION

3.1.1 Hazard Selection

The MHMP Planning Committee reviewed the list of natural and technological hazards in the 2010 Starke County MHMP, discussed recent events, and the potential for future hazard events. The Committee identified those hazards which affected Starke County and each community, selecting the hazards to study in detail as part of this planning effort. As shown in **Table 3**, these hazards include dam failure; drought; earthquake; extreme temperature; fires and wildfire; flooding; hailstorms, thunderstorms, and windstorms; hazardous materials incident; land subsidence, landslides and fluvial erosion; snowstorms and ice storms; and tornado. All hazards studied within the 2010 Starke County MHMP are included in the update. Land Subsidence, Landslide, and Fluvial Erosion as well as Extreme Temperatures (Hot and Cold) were added to the update since they are key hazards in the most recent Indiana State Multi-Hazard Mitigation Plan.

Table 3: Hazards Selected

Type of Hazard	List of Hazards	MHMP	
		2010	2024 UPDATE
Natural	Drought	Yes	Yes
	Earthquake	Yes	Yes
	Extreme Temperature	No	Yes
	Fires and Wildfire	Yes	Yes
	Flood	Yes	Yes
	Hail/Thunder/Wind	Yes	Yes
	Land Subsidence/Landslide	No	Yes
	Snow / Ice Storm	Yes	Yes
	Tornado	Yes	Yes
Technological	Dam Failure	Yes	Yes
	Hazardous Material Incident	Yes	Yes

3.1.2 Hazard Ranking

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

Probability:

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

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

Magnitude / Severity:

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

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

Warning Time:

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

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

Duration:

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

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

Calculating the CPRI:

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

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

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

Table 4: Determination of Weighted Value for Communities

Community	Population (2020)	% of Total Population	Weighted Value
Starke County (w/o other incorporated communities)	17,258	73.5%	0.735
City of Knox	3,576	15.2%	0.152
Town of Hamlet	767	3.3%	0.033
Town of North Judson	1,876	8.0%	0.080
Total	23,477	100.0%	1

3.2 HAZARD PROFILES

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

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. Impacts on specific populations of communities is also addressed within this section.
- **Relationship to Other Hazards** explores the influence one hazard may have upon another hazard.

3.2.1 Drought

Overview

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

There are four academic approaches to examining droughts; these are meteorological, hydrological, agricultural, and socio-economic. Meteorological drought is based on the degree, or measure, of dryness compared to a normal, or average amount of dryness, and the duration of the dry period. Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply. Agricultural drought is related to agricultural impacts; and focuses on precipitation shortages, differences between actual and potential evapo-transpiration, soil water deficits, reduced ground water or reservoir levels, and crop yields. Socioeconomic drought relates the lack of moisture to community functions in the full range of societal functions, including power generation, the local economy, and food source. **Figure 19** shows urban grassed areas affected by drought conditions.

Figure 19 Urban Grass Affected by Drought

Recent Occurrences

Data gathered from the U.S. Drought Monitor indicated that between January 1, 2009 – December 31, 2023, there were 257 weeks where some portions of Starke County was identified as being “Abnormally Dry” or at Drought Monitor Level D0. According to the Drought Monitor, there were 93 weeks within that period where any portion of Starke County was in a drought state higher than a D0. **Figure 20** shows the distribution of weeks in drought over the 14-year time frame.

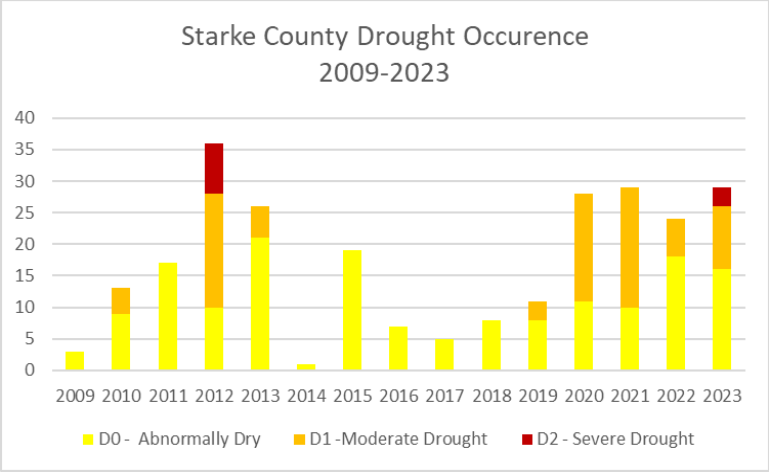


Figure 20 Drought Occurrences 2009-2023

As rain patterns change, there are periodic times when the county is deemed “Abnormally Dry” or D0. Most of these instances are resolved quickly as sufficient rain arrives and the soil rehydrates. On occasion, the rain is insufficient to address the dryness and weather conditions cause the soil to further dry out stressing crops and reducing lake levels. Examples of continued dryness can be found in 2010, 2013, 2019, 2020, 2021, and 2022. During each of these years, Starke County was found to be in “Moderate Drought” or D1. On July 14, 2020, USDA/NASS records showed crop conditions as of July 12 rated poor or very poor have reached or surpassed 10% for corn in Indiana and Ohio, and soy in Illinois, Indiana, and Ohio. The highest level of drought experienced in Starke County is D2 or “Severe Drought”. Many people will recall the summer of 2012 throughout Indiana because drought conditions had intensified and reached D2. Burn bans were common and the fire threat was so great that all July 4 fireworks events were postponed or cancelled. Most recently, June 27 through July 17, 2023, Starke County once again was at D2 for 3 weeks. Although not as severe as 2012, many communities, once again, considered burn bans. **Figure 21**, from the U.S. Drought Monitor, describes the rationale to classify the severity of droughts.

Category	Description	Possible Impacts
D0	Abnormally Dry	Going into drought: ▪ short-term dryness slowing planting, growth of crops or pastures Coming out of drought: ▪ some lingering water deficits ▪ pastures or crops not fully recovered
D1	Moderate Drought	▪ Some damage to crops, pastures ▪ Streams, reservoirs, or wells low, some water shortages developing or imminent ▪ Voluntary water-use restrictions requested
D2	Severe Drought	▪ 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 21 US Drought Monitor Drought Classification Descriptions

Table 5: Starke County Percent of Time in Drought

Year	Percent of the Year in Each Drought Category			
	None	D0	D1	D2
2009	94%	6%	0%	0%
2010	73%	19%	8%	0%
2011	69%	31%	0%	0%
2012	31%	19%	35%	15%
2013	49%	41%	10%	0%
2014	98%	2%	0%	0%
2015	62%	38%	0%	0%
2016	88%	12%	0%	0%
2017	90%	10%	0%	0%
2018	85%	15%	0%	0%
2019	79%	15%	6%	0%
2020	44%	21%	35%	0%
2021	46%	19%	35%	0%
2022	52%	35%	13%	0%
2023	35%	42%	17%	6%

The National Climate Data Center (NCDC) does not report any events nor property or crop losses within Starke County during this planning period in relation to drought. During discussions with the Planning Committee, effects from the drought were highlighted. Committee members recalled the dry conditions and discussed the large field/wildland fires which frequently occur during harvest season. Although NCDC does not show any reports of damage, fires during harvest result in damage to farming equipment even if crops are preserved. **Table 5** depicts the number of weeks per year at each of the drought levels indicated above. Starke County has not exceeded D2- Severe Drought during the past 14 years.

The Planning Committee, utilizing the CPRI, determined the overall risk of drought throughout Starke County is “Elevated.” The impact of drought was determined to be the same for all communities

and unincorporated area throughout the county due to the possible agricultural impacts and impacts to water wells. The committee agreed that a drought is "Highly Likely" (to occur within the next three years), and the magnitude of drought is anticipated to be "Negligible." Further it is anticipated that with the enhanced weather forecasting abilities, the warning time for a drought is greater than 24 hours and the duration will be greater than one week. A summary is shown in **Table *6*.**

Table 6: CPRI for Drought

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Starke County	Highly Likely	Negligible	> 24 hours	> 1 week	Elevated
City of Knox	Highly Likely	Negligible	> 24 hours	> 1 week	Elevated
Town of Hamlet	Highly Likely	Negligible	> 24 hours	> 1 week	Elevated
Town of North Judson	Highly Likely	Negligible	> 24 hours	> 1 week	Elevated

According to the National Drought Mitigation Center, scientists have difficulty predicting droughts more than one month in advance due to numerous variables such as the precipitation, temperature, soil moisture, topography, and air-sea interactions. Further anomalies may also enter the equation and create more dramatic droughts or lessen the severity of droughts. Based on the previous occurrences of significant droughts and drought related impacts felt within Starke County, the Committee estimated that the probability of a drought occurring in the area is "Highly Likely;" or occurrence is probable within the next three to five years. The damage anticipated throughout the county is predicted to be negligible as the municipalities rely on groundwater and surface water supplies for fire response efforts and face a higher risk during times of prolonged drought. Businesses and industry that rely upon water for their processes and products would be impacted by water limitations within the cities and towns. Throughout the unincorporated areas of the county, increased crop and livestock damage would also be expected during a significant drought. In addition, the long-term stress on the forested land could result in additional tree deaths and debris during subsequent high wind events.

Assessing Vulnerability

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

Direct Effects:

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

Indirect Effects:

- Loss of income of employees from businesses and industry affected; loss of revenue to support services (food service, suppliers, 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 for emergency responders and firefighting resources due to grass fires and increased medical calls for people having respiratory issues because of increased dust amounts.
- Drought conditions could make it more difficult for the underserved population as many of them do not have air conditioning which makes breathing more difficult and air quality conditions can become compromised.

Estimating Potential Losses

Figure 22 Drought Effects on Corn Crop

It is difficult to estimate the potential losses associated with a drought for Starke 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 2022, Starke County produced approximately 8.45M bushels of corn and 2.06M bushels of soybeans, as reported by the United States Department of Agriculture (USDA) National Agricultural Statistics Service. Using national averages of $6.65 per bushel of corn and $14.50 per bushel of soybeans, the estimated crop receipts for 2022 would be $86.06M. 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 $43.03M-$74.01M; depending on the crop produced and the market demand. Effects of drought on corn crops can be seen in **Figure 22.**

Purdue Agriculture News reports that as of March 2013, Indiana producers received more than $1.49B 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. These losses are still considered to be record-setting in terms of drought effects, damages, and costs for Indiana. In comparison, in 2022 Indiana received $51,104,285 in crop insurance from the drought and weather-related events.

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.” Additional losses associated with a prolonged drought are more difficult to quantify. Drought has lasting impacts on 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 damage during other hazard events such as wind and ice storms. Loss of trees also alters wildlife habitats causing wildlife to find new areas to live, often causing increased wildlife deaths as they navigate through more urbanized areas to reach new habitats.

Future Considerations

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

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

According to the Indiana Climate Change Impacts Assessment, Indiana has experienced a rise in the average annual precipitation between 1895 and 2016; an increase of 5.6 inches for the area of Starke County. This increase in precipitation may lessen the likelihood or overall impact of a long-term drought in Starke County. However, the assessment also notes seasonal shifts in precipitation may lead to seasonal short-term droughts. In either scenario, changes in precipitation are not anticipated to relieve the area of a probability of a drought occurring.

Prior to municipalities expanding, provisions and considerations should be given regarding the potential additional demand for both water usage and fire response efforts. Following such expansion or development plans, alternative water sources should be explored. Since the previous MHMP was prepared, large scale and significant development has not occurred throughout the county. The majority of Starke County remains largely unincorporated and rural in nature.

Relationship to Other Hazards

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

3.2.2 Earthquake

Overview

An earthquake is a sudden, rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface. 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.

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.

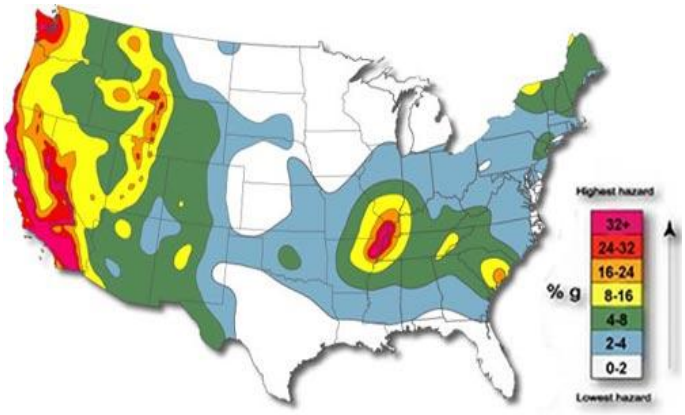


Figure 23 Earthquake Risk Areas in the US

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

There are 45 states and territories in the United States at moderate to very high risk from an earthquake, and they are located in every region of the county **(Figure 23**). California experiences the most frequent damaging earthquakes; however, Alaska experiences the greatest number of large earthquakes – most located in uninhabited areas. The largest earthquakes felt in the United States were along the New Madrid Fault in Missouri, where a three-month long series of quakes from 1811 to 1812 occurred over the entire Eastern United States, with Missouri, Tennessee, Kentucky, Indiana, Illinois, Ohio, Alabama, Arkansas, and Mississippi experiencing the strongest ground shaking. Several smaller historic faults are located throughout the state of Indiana.

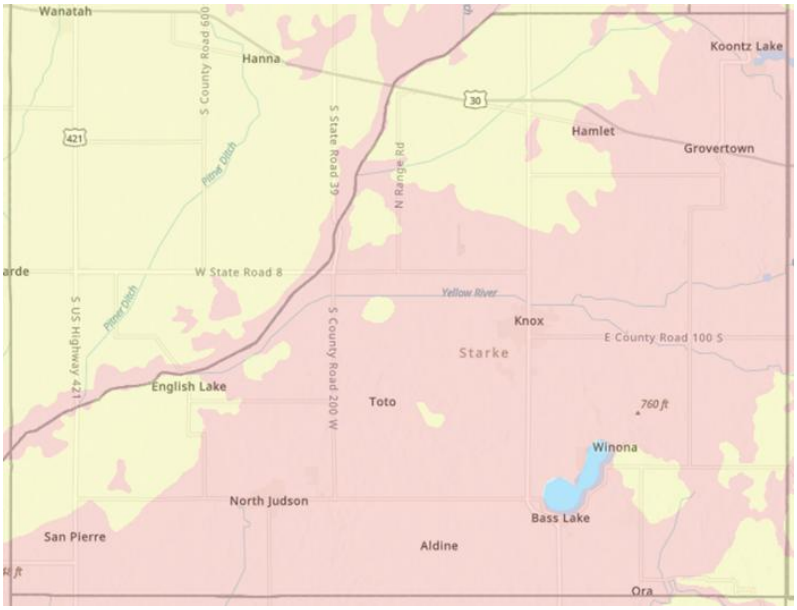


Figure 24 Starke County Liquefaction Potential

Additionally, some soils in Indiana are highly susceptible to liquefaction during earthquake conditions. Much of Starke County is in an area with a high potential for liquefaction (**Figure 24)**

Recent Occurrences

Indiana, as well as several other Midwestern states, lies in the most seismically active region east of the Rocky Mountains. **Figure 25** shows the 2014 Seismic Hazard for Indiana. The nearest known areas of concern for Starke County are the Anna Fault, Wabash Seismic Zone, and the New Madrid Fault Zone.

On June 17, 2021, an earthquake centered near Bloomingdale, Indiana in Parke County was felt as far north as Chicago, Illinois and as far east as Cincinnati, Ohio. With a magnitude of 3.8 several localized reports included descriptions of shaking buildings and feelings of tremors. No injuries or severe damage was reported due to this incident. As reported by the NBC 5 Chicago, “Once the earthquake was confirmed, officials said the 9-1-1 phone line “started ringing immediately.”” Before this event, the last earthquake to be felt in Indiana was a magnitude 5.1 centered in Sparta, North Carolina, and the last event to occur within the state (near this event) was a magnitude 2.3 earthquake centered in Haubstadt, IN on May 28, 2015. No injuries or damage were reported with either of these events.

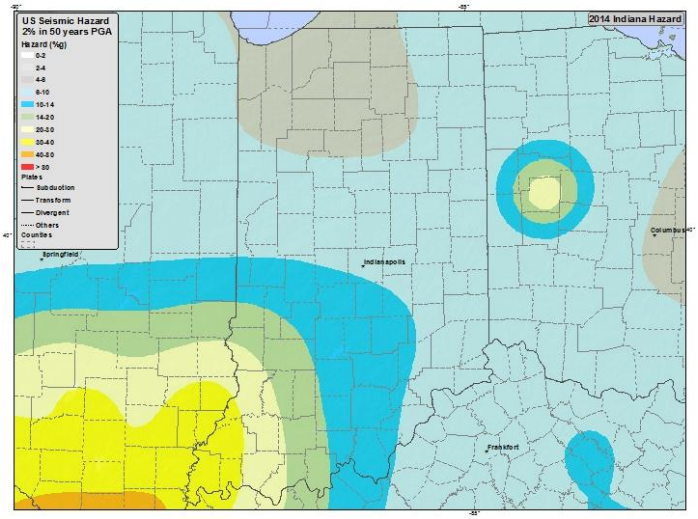


Figure 25 Indiana Seismic Zone Map

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.”

A M5.8 centered in Mineral, Virginia affected much of the East Coast on August 23, 2011. According to USA Today, 10 nuclear power plants were shutdown of precautionary inspections following the

quake, over 400 flights were delayed, and the Washington Monument was closed indefinitely pending detailed inspections by engineers.

Based on historical earthquake data, local knowledge of previous earthquakes, results of HAZUS-MH scenarios, and that Starke County has not been directly impacted by an earthquake, the Committee determined that the probability of an earthquake occurring in Starke County or any of the communities is "Unlikely." Should an earthquake occur, the impacts associated with this hazard are anticipated to be "Significant" in all areas of the county. As with all earthquakes, it was determined that the residents of Starke County would have little to no warning time (less than six hours) and that the duration of the event would be expected to be less than 6 hours. A summary is shown in **Table 7.**

Table 7: CPRI for Earthquake

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Starke County	Unlikely	Significant	< 6 hours	< 6 hours	Elevated
City of Knox	Unlikely	Significant	< 6 hours	< 6 hours	Elevated
Town of Hamlet	Unlikely	Significant	< 6 hours	< 6 hours	Elevated
Town of North Judson	Unlikely	Significant	< 6 hours	< 6 hours	Elevated

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

Figure 26 Minor Earthquake Damage

Assessing Vulnerability

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

Direct Effects:

Urban areas may experience more damage due to the number of structures, the multi-story nature of the structures, and critical infrastructure (fire houses, cell phone towers, health care facilities, etc.) located in these areas.

- Rural areas may experience losses associated with agricultural structures such as barns and silos.
- Bridges buried utilities (gas lines, waterlines, pipelines), and other infrastructure may be affected throughout the county and municipalities.
- The homeless or underserved population needs to be checked on, especially if they seek shelter under bridges or structures that are not stable.

Figure 27 Structural Earthquake Damage

Indirect Effects:

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

The 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 damage. Damage to structures, infrastructure, and even business interruptions can be expected following an earthquake. Examples of varying degrees of damage are shown in **Figure 26** and **Figure 27.**

Estimating Potential Losses

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

Per the HAZUS-MH scenario noted above, total economic losses are anticipated to be near $9.43M with moderate damage to approximately 97 buildings, of which 0 are anticipated to be damaged beyond repair. Further, there are 25 critical facilities (1 hospital, 9 schools, 1 EOC, 4 Police Stations, and 10 Fire Stations) with reduced functionality on day 1, and 0 highway segments with moderate damage. All other transportation segments (railways, buses, etc.) would be expected to remain undamaged. There is no damage anticipated for wastewater facilities. Residential occupancies would be anticipated to sustain the largest level of damage, representing 74% of total damages.

The model estimates that a total of 3,000 tons of debris will be generated and equivalent of 120 – 25 ton truckloads. The model estimates that two households would need to seek shelter away from their home with 1 person seeking temporary public shelter.

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

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

Future Considerations

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

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

Relationship to Other Hazards

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

3.2.3 Extreme Temperature

Overview

Extreme Heat

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 elevated 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 28**. 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 National Weather Service has 3 levels of Excessive Heat Notifications.

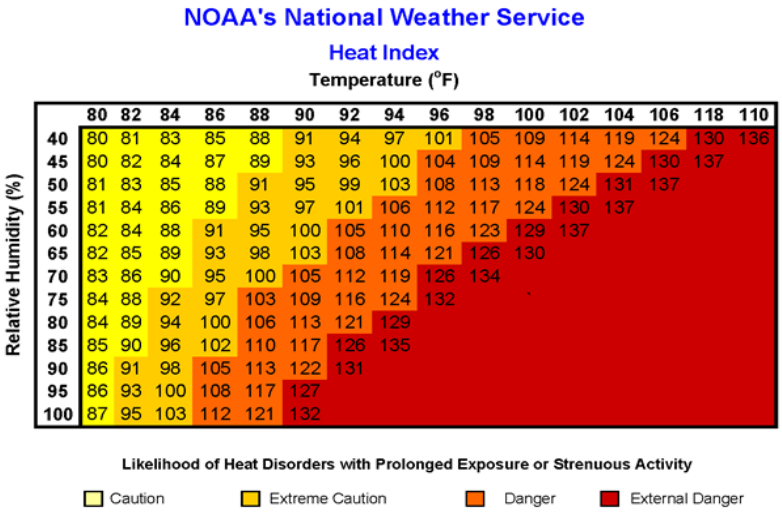


Figure 28 NWS heat Index Chart

1) A Heat Advisory - means that temperatures of at least 100°F* or Heat Index values of at least 105°F* are expected.

2) An Excessive Heat Watch means that Heat Index values are expected to reach or exceed 110°F* and not fall below 75°F* for at least a 48-hour period.

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

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

Figure 29 Extreme Heat Effects by Heat Index

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

As **Figure 29** indicates, there are four cautionary categories associated with varying heat index temperatures. Each category provides a heat index range along with effects on the human body. People with underlying health issues, the very old or very young may be impacted at lower temperatures since their systems are less likely to be able to compensate for the heat and humidity.

Extreme Cold

Extreme cold is defined as a temporary, yet sustained, period of extremely low temperatures. Extremely low temperatures can occur in winter months when continental surface temperatures are at their lowest point and the North American Jet Stream pulls arctic air down into the continental United States. The jet stream is a current of fast-moving air found in the upper levels of the atmosphere. This rapid current is typically thousands of kilometers long, a few hundred kilometers wide, and only a few kilometers thick. Jet streams are usually found somewhere between 10-15 km (6-9 miles) above the Earth's surface. The position of this upper-level jet stream denotes the location of the strongest surface temperature contrast over the continent. The jet stream winds are strongest during the winter months when continental temperature extremes are greatest. When the jet stream pulls arctic cold air masses over portions of the United States, temperatures can drop below 0° F for one week or more. Sustained extreme cold poses a physical danger to all individuals in a community and can affect infrastructure function as well.

Figure 30 Working in Extreme Cold

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

Wind chill is a guide to winter danger

New wind chill chart

Frostbite occurs in 15 minutes or less

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

Figure 31 Wind Chill Guide

Recent Occurrences

The effects of extreme temperatures extend across large regions, typically affecting several counties, or states, during a single event. According to the NCDC, there has been no extreme heat event and one extreme cold event between January 1, 2009 and December 31, 2023. Local reports did not provide any additional information regarding a period of excessive heat during this time period. However, the National Weather Service reported wind chills of -47 degrees Fahrenheit and air temperatures of -20 degrees Fahrenheit in Starke County on January 29 - 31, 2019 during the height of the arctic blast. No additional reports were provided relevant to damages or losses associated with the prolonged cold temperatures.

It is difficult to predict the probability that an extreme temperature event will affect Starke County residents within any given year. However, based on historic knowledge and information provided by the community representatives, an extreme temperature event is "Highly Likely" (event is possible within the next 5 years) to occur within the county and if an event did occur, it would result in "Significant" magnitude. **Table 8** identifies the CPRI for extreme temperatures-both heat and cold events for all communities in Starke County.

Table 8: CPRI for Extreme Temperatures

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Starke County	Highly Likely	Significant	< 6 hours	> 1 week	Severe
City of Knox	Highly Likely	Significant	< 6 hours	> 1 week	Severe
Town of Hamlet	Highly Likely	Significant	< 6 hours	> 1 week	Severe
Town of North Judson	Highly Likely	Significant	< 6 hours	> 1 week	Severe

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 Starke County, a better understanding of the relative risk that extreme temperatures may pose to certain populations can be gained. In total, just over 23.1% of the county's population is over 65 years of age, 5.7% of the population is below the age of 5, and approximately 14.2% 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. Families below the poverty line are less likely to have functioning air conditioning in their homes. Because of high energy costs those who do have air conditioning may be less likely to use the units in a way to benefit their health and well-being. The same factors are key when looking at heating sources in cold temperatures. Elderly and those living below the poverty line are more likely to rely on alternative heating sources because of the cost of energy. These alternative heating sources are frequently the cause of carbon monoxide poisoning and/or house fires.

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 more than 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 to cool down, are ineffective. Examples of danger levels associated with prolonged heat exposure are identified in Error! Reference source not found.**2.** Extreme cold may result in similar situations as normal 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.

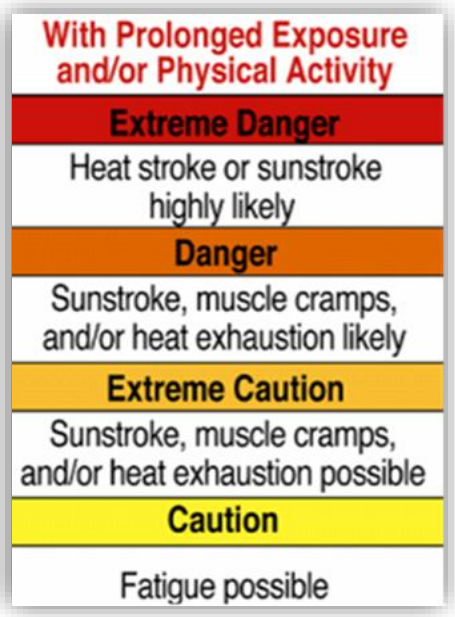


Figure 32 Heat Danger Classification

Within Starke County, direct and indirect effects from a prolonged 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. Health risks can range from heat exhaustion or mild hypothermia to death due to heat stroke, amputations due to frost bite or death due to severe hypothermia.

Indirect Effects:

- Increased need for cooling or warming shelters
- 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 damage is not typically associated with buildings but instead with populations and people.

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 accurately.

Indirect effects:

- Increased expenses for facilities such as healthcare or emergency services due to the increased number of calls and people seeking assistance.

- Manufacturing facilities where temperatures are normally elevated may need to alter work hours or experience loss of revenue if forced to limit production during the heat of the day.

- Energy suppliers may experience demand peaks during the hottest and/or coldest portions of the day.

- Extreme cold indirect effects include pipes freezing resulting in loss of access to water for industrial processes as well as personal hygiene, sanitation and hydration of livestock and people. These effects may disproportionately impact vulnerable populations (elderly and children) within Starke County.

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 Starke County's at-risk populations.

The Climate Change Assessment identifies several temperature related considerations of which communities should be aware of and begin planning to avoid further impacts. For example, rising temperatures will increase the number of extreme heat days, thereby increasing the potential for heat related illnesses, potential hospitalizations, and medication costs to vulnerable populations. In addition, added days of extreme heat will impact agriculture, manufacturing, and potentially, water sources.

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

Extreme Temperatures: Relationship to Other Hazards

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

3.2.4 Fires and Wildfire

Overview

A wildfire, also known as a forest fire, vegetation fire, or a bushfire, is an uncontrolled fire in wildland areas and is often caused by lightning; other common causes are human carelessness and arson. Small wildfires may be contained to areas less than one acre, whereas larger wildfires can extend to areas that cover several hundred or even thousand acres. Generally, ambient weather conditions determine the nature and severity of a wildfire event. Very low moisture and windy conditions can help to exacerbate combustion in forested or brush areas (**Figure *33***) and turn a small brush fire into a major regional fire event in a very short period. Wildfires can be very devastating for residents and property owners.

Figure 33 Forest Fire

A structural fire is an incident where a fire starts within a structure and is largely contained to that structure. Causes of structure fires can be related to electrical shorts, carelessness with ignition sources and/or alternative heating sources, poor storage of flammable materials, as well as arson. These types of fires can be deadly if no warning or prevention measures are present. The most dangerous aspect of structural fires is the production of toxic gases and fumes that can quickly accumulate in enclosed areas of structures and asphyxiate those who might be in the structure. **Figure *34*** shows the structural remains of an extensive residence fire.

Figure 34 Structure Remaining After Residence Fire

Problems associated with structural fires are compounded when multi-story buildings catch fire. Multi-story fires hinder the ability of rescue workers to fight the fire, reach impacted building occupants, and evacuate impacted occupants. Rescue efforts also become more complicated when handicapped or disabled persons are involved. Complications associated with high-rise fires typically increase as the height and occupancy levels of the buildings increase. Structural collapse is another concern associated with high-rise fires. Structural collapse often results in people becoming trapped and severely injured. However, it is important to note that the concern associated with structural collapse, is not limited to high-rise buildings; the collapse of smaller residential buildings can also lead to severe injury and death.

Combating a wildfire or a structure fire is extremely dangerous. If weather conditions change suddenly, the fire may change course and/or increase in strength potentially overtaking neighboring

structures and firefighters, causing severe injury or death. Fires can travel at speeds greater than 45 mph. Members of the homeless community, hunters and/or campers may also be in the area of the fires with no means to escape. Fire response capabilities are limited by the ever-dwindling number of volunteer firefighters able to respond, especially during “normal working hours”. This further increases the risks for first responders and community members alike.

Recent Occurrences

Within the NCDC, there are no reports of wildfires occurring in Starke County between January 1, 2010 to January 1, 2024. Within the same time parameter, there were only two reported events within the State of Indiana, both in Pike County and both occurring in 2006. During each of these events over 350 acres were burned. A drought does not necessarily have to occur in Starke County in order to adversely impact the citizens of the county. Fire ravaged Canada in 2023 like no other year, by a stupendous margin. A record 45.7M acres went up in flames, an area about the size of entire state of Florida, shattering the previous annual record nearly three times over. From the spring onwards, more than 6,500 fires sprang up, unusually, across the whole country, tearing through Nova Scotia in the east to British Columbia in the west. These fires caused News stations and the National Weather Service warned Hoosiers about the adverse impacts of the smoke and haze from the fires issuing air quality alerts and warning people with respiratory difficulties to avoid going outdoors.

The NCDC does not report structure fires; therefore, local sources were utilized to provide information regarding residential and business fires. These fires are the typical hazard affecting Starke County in the last several years. Information provided in **Table 9** highlights the number of fire calls the Starke County fire departments responded to during the time period January 2018 through December 2023. Damage to structures, contents, crops, forests, and vehicles is significant for each municipality on an annual basis. Social losses, such as being unable to work following a residential structure fire or losses associated with a business fire should also be considered as an impact.

Table 9: Starke County Fire Calls

Department	2018	2019	2020	2021	2022	2023
Bass Lake Fire Dept.	96	82	164	165	176	171
Hamlet Fire Dept.	*	*	73	90	90	110
Knox - Center Fire Dept.	210	161	151	166	189	
Koontz Lake Fire Dept.	121	122	127	123	126	164
North Judson Fire Dept.	123	122	127	126	109	105
San Pierre Fire Dept.						
Washington Twp Fire Dept	54	53	53	54	63	**53**

Note: * indicates data is not available due to a change in data recording software.

Starke County has very little managed land. Due to the expansive acreage of agricultural land within Starke County, and the potential for urban areas to be at risk due to abandoned homes, blighted areas, or industrial activities, the Planning Committee determined the probability to be “Highly Likely” throughout the County. **Table 10** identifies the CPRI rankings for fire in Starke County.

Table 10: CPRI for Fire

	Probability	Magnitude / Severity	Warning Time	Duration	CPRI
Starke County	Highly Likely	Significant	< 6 hours	< 1 day	Severe
City of Knox	Highly Likely	Significant	< 6 hours	< 1 day	Severe
Town of Hamlet	Highly Likely	Significant	< 6 hours	< 1 day	Severe
Town of North Judson	Highly Likely	Significant	< 6 hours	< 1 day	Severe

Assessing Vulnerability

Physical, economic, and/or social losses impact not only the property owner whose property was damaged by the fire, but also the community. Typically, a structural fire is limited one or two structures, as the fire response focuses on extinguishment as well as containment thus preventing the fire from spreading to neighboring structures. This type of action works to reduce the magnitude and severity. Nonetheless, the loss of or damage to historic structures, town squares, etc. takes a toll on the community spirit as well as the financial and physical loss.

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

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

Direct Effects:

- Loss of structures (residential as well as agricultural)
- Loss of vital equipment (industrial and agricultural)
- Loss of forests
- Loss of natural resources and wildlife

Indirect Effects:

- Loss of revenue as businesses may be closed.
- Loss of revenue from reduced tourist activities in the county
- Increased emergency response times based on safety of roads.
- Loss of income if dependent on crop production or timber harvest

Estimating Potential Losses

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

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

Future Considerations

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

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

In areas such as Starke County which are reliant on volunteer firefighters, firefighting responses can be slowed due to the limited numbers of volunteers available at various times of the day. Increasing numbers of people working outside of the community in which they reside limits volunteer presence to outside of normal working hours. Recruitment initiatives will need to be considered as the firefighting needs and staffing levels change.

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

Relationship to Other Hazards

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

3.2.5 Flood

Overview

Floods are the most common and widespread of all the natural disasters. Most communities in the United States have experienced flooding because of spring rains, heavy thunderstorms, or winter snow melts. A flood, as defined by the National Flood Insurance Program (NFIP), is a general and temporary condition of partial or complete inundation or two or more acres of normally dry land area or of two or more properties from overflow of inland or tidal waters, or unusual and rapid accumulation or runoff of surface waters from any sources, or a mudflow. Floods can be slow or fast rising but generally develop over a period of days. Flash flooding is a term often used to describe flood events that are due to heavy or excessive rainfall in a short period of time, generally less than 6 hours. Unlike traditional flooding which can be slower developing, these raging torrents rip through river beds, streets and roads, and overland taking anything in its way with the force of the water. Flash floods typically occur within minutes up to a few hours after an excessive rain event.

Figure 35 Flooding in Starke County 2018

Flooding and associated flood damage are 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 rainstorms can produce damaging flash flood conditions. There are no exceptions to when floods may occur. There are times they are less likely, but given the right atmospheric conditions, even then, a flood or flash flood can take place. Climate change has had a direct impact on flooding with the increase in precipitation and the duration of the events being shorter.

The traditional benchmark for riverine or coastal flooding is a 1% Annual Exceedance Probability (AEP), formerly known as the 100-year flood. This is a benchmark used by FEMA to establish a standard of flood protection in communities throughout the country. The 1% AEP is referred to as the “regulatory” or “base” flood. Another term commonly used, the “100-year flood”, can be misleading. It does not mean that only one flood of that size will occur every 100 years, but rather there is a 1% chance of a flood of that intensity and elevation happening 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. The area impacted by the 1% AEP flood event is called the Special Flood Hazard Area (SFHA).

Recent Occurrences

The NCDC indicates that between January 1, 2009 to December 31, 2023, there were two flood events reported one on March 10, 2009, and the other on February 20, 2018. The March 2009 event reported $1M in property damage whereas the February 2018 flood event, was reported to have $1.2M of property damage. Neither event resulted in any additional crop damage reported. There were no flash flood events reported during the same 14-year time frame.

Stream gages are utilized to monitor surface water elevations and/or discharges at key locations and time periods. Some such gages are further equipped with NWS's 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 Starke County, there are 3 active stream gages, pictured in **Figure 36**. One Kankakee River at Davis, one at Yellow River at Knox, and one at Yellow River Near Oak Grove.

Figure 36 Starke County USGS River Gages

The gage located on Yellow River near Oak Grove is a more recently placed gage with recent crests dating from 2013 to present. Because of its relative newness, the gage does not have flood categories assigned. The highest crest was recorded on February 24, 2018, at 14.97 feet. Of the top 5 historic crests four have taken place within the last 5 years.

The next gage downstream from Oak Grove is the gage at Knox. This gage has a much longer period of record and has flood categories assigned. In the past 14 years, since January 1, 2009, 11 crests were recorded at the gage. Six crests were below the action level of 9 feet. Two events rose to or above Action Level; one event exceeded Minor Flood Stage, 10 feet; one event exceeded Moderate Flood stage at 12 feet and the flood of February 24, 2018, exceeded Major Flood Stage at 13 feet, and was considered the second highest historic crest at 13.81 feet.

Much like the Yellow River, the Kankakee River at Davis has a well-documented flood record. Of the listed flood crests most were at minor flood stage. Since January 1, 2009, twenty-seven crests exceed the Minor Flood Stage of 10 feet, eight exceeded Moderate Flood Stage of 12 feet and one event on March 11, 2009, exceeded Major Flood Stage of 13 feet. The flood event of February 2018 was within 0.02 feet of reaching Major Flood Stage. The flooding is further exacerbated by extremes of the river levels. The top 6 low water records for the Kankakee River at Davis have all occurred within the past 10 years.

Flood insurance is a key for flood recovery. Any property having received two insurance claim payments for flood damages totaling at least $1,000, paid by the NFIP within any 10-year period since 1978 is defined as a repetitive loss property. These properties are important to the NFIP because they account for approximately one-third of the country's flood insurance payments. According to FEMA Region V, there are a total of three repetitive loss structures in Starke County. In the unincorporated areas of Starke County there are three single family residence that is considered a repetitive loss structure. No additional repetitive loss structures were reported for the City of Knox or Town of Hamlet. **Table 11** identifies the number of repetitive losses claims per community as well as payments made, as provided by FEMA.

Table 11: Repetitive Properties, Claims, and Payments

Community	# Repetitive Loss Properties	Total Payments
Starke County	3	$454,564.98
City of Knox	0	0
Town of Hamlet	0	0
TOTAL	3	$454,564.98

There have been several claims made for damages associated with flooding in Starke County since 1978. Within the unincorporated areas of the county, there have been 19 claims resulting in $311,085.00 in payments. Further, within the incorporated towns, 4 claims totaling approximately $51,501.00 have been paid. **Table 12** further indicates the premiums and coverage totals for individual communities.

Table 12: Insurance Premiums and Coverage

Community	Flood Insurance Premiums	Flood Insurance Coverage, Millions
Starke County	$31,659	$8.12M
City of Knox	$8,072	$1.94M
Town of Hamlet	0	0
TOTAL	$39,731	$10.06M

As determined by the Committee, the probability of riverine based flooding occurring throughout Starke County is “Possible.” This is largely based on the presence absence of rivers and streams near the communities. The Committee also determined that the warning time would be 12 to 24 hours based on the terrain and flashy nature of the waterways in the county, forecasting methods, and local knowledge of stream activities. Finally, the duration of such an event is anticipated to last over a week. A summary of riverine flooding CPRI is shown in **Table 13**.

Table 13: CPRI for Flood - Riverine

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Starke County	Possible	Limited	12 - 24 hours	> 1 week	Elevated
City of Knox	Possible	Limited	12 - 24 hours	> 1 week	Elevated
Town of Hamlet	Possible	Limited	12 - 24 hours	> 1 week	Elevated
Town of North Judson	Possible	Limited	12 - 24 hours	> 1 week	Elevated

The committee chose to separate the Riverine Flooding from Flash Flooding based upon recent occurrences and the differences between probability, magnitude and severity, warning time, and duration. **Table 14** illustrates these differences and changing climate features have enhanced their awareness. The committee determined that the probability of Flash Flooding to be “Highly Likely”

and the magnitude to be “Significant”. The warning time would be less than 6 hours and the duration to be less than 1 week. This is compounded by the Climate Change of more intense rainfall in short time periods.

Table 14: CPRI for Flood - Flash Flooding

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Starke County	Highly Likely	Significant	> 6 hours	> 1 week	Severe
City of Knox	Highly Likely	Significant	> 6 hours	> 1 week	Severe
Town of Hamlet	Highly Likely	Significant	> 6 hours	> 1 week	Severe
Town of North Judson	Highly Likely	Significant	> 6 hours	> 1 week	Severe

Assessing Vulnerability

Flood events may affect substantial portions of Starke County at one time as river systems and areas with limited drainage cover much of the county and the incorporated communities. With an increase in high volume rain events, the low-lying roads within the county are vulnerable to frequent inundation isolating and/or restricting access to some parts of the county. Wooded areas and farm fields have provided ample supply of debris causing clogs and damage to culverts, and bridges, in the past.

Whenever significant flooding impacts the communities in Starke County, the concern about riverbank erosion also known as fluvial erosion is elevated. Fluvial Erosion Hazard (FEH) represents the risk associated with natural stream movements and losses associated with buildings and infrastructure. In some cases, this may be represented by a gradual movement of a stream across a farm field. In other, more extreme instances, homes or other infrastructure may be lost as riverbanks or bluffs sluff into the water below. This will be discussed in greater detail within the landslide/land subsidence discussion.

For many years the communities in eastern Illinois complained about high volumes of sand being transported by the Kankakee River during flood events. In 2012, Christopher B. Burke Engineering, LLC studied the Yellow River from its headwaters to the confluence with the Kankakee River to determine the source of the sand as well as determining potential solutions. The study concluded that the river segments where little or no human intervention had taken place were continuously transporting small quantities of sand in a natural healthy pattern. The segments of river where the river was dredged and straightened, the flow during low water, did not move sand, but rather deposited it. When high flows occurred during floods, copious quantities of sand were moved and were redeposited downstream in the nearby Illinois communities. As a result of this study a

Figure 37 Study Area in Starke County

pilot project was undertaken in 2017 to determine if the natural river cycles could be restored by reconnecting the river to its flood plain. Over a 5 mile stretch the river channel was reconfigured with a deeper section for low water flows and a wider section with ledges for the higher volume flows. In this way, the river is continuously moving smaller quantities in a natural manner and restoring the balance of the river, thus reducing the amounts of sand deposited in Illinois. **Figure 37** shows the study area.

In 2019, Christopher B. Burke Engineering, LLC developed a comprehensive Work Plan for the management of the Kankakee River and Yellow River in Indiana and Illinois, and as an outcome of the Indiana General Assembly and this effort the Kankakee and Yellow River Basin Development Commission was formed to help address the challenges of the two rivers. The Basin Development Commission directly serves the water resource planning and development of Jasper, Lake, LaPorte, Marshall, Newton, Porter, St. Joseph, and Starke Counties.

Log and ice jam flooding is a concern for the more populated areas. Although log jams can occur at any time of the year, ice jams are predominantly and early or late winter occurrence when air temperature rise after freezing temperatures which allow lake and river ice to form. Flooding occurs when pieces of ice either jam up against stationary sheets of ice or against structures in the river such as bridge pylons. The jammed ice can form a dam causing water levels behind it to rise causing localized flooding and pushing large pieces of ice out of the stream. The force of the moving ice pieces is enough to break off nearby trees and/or damage building foundations and small outbuildings. Log jams similarly accumulate causing water levels to rise. Bridges and culverts are most frequently impacted since water flow is easily blocked at these locations forcing water outside of the riverbanks into neighborhoods and businesses.

There are no flood inundation maps developed to identify areas impacted by a variety of flood stages on either the Kankakee or the Yellow Rivers. The closest flood inundation map is on the Yellow River in the City of Plymouth in neighboring Marshall County. Since the last planning effort in 2009, the gauge on Yellow River at Knox there has been one event exceeding the Moderate Flood Stage (12 feet) (on March 12, 2009). The flood of February 24,2018 exceeded Major Flood Stage (13 feet) and was considered the second highest historic create at 13.81 feet. The Kankakee River stream gauge at Davis there has been 8 times floods have exceeded the Moderate Flood Stage (12 feet) and one event on March 11, 2009, exceeded Major Flood Stage. The Town of North Judson

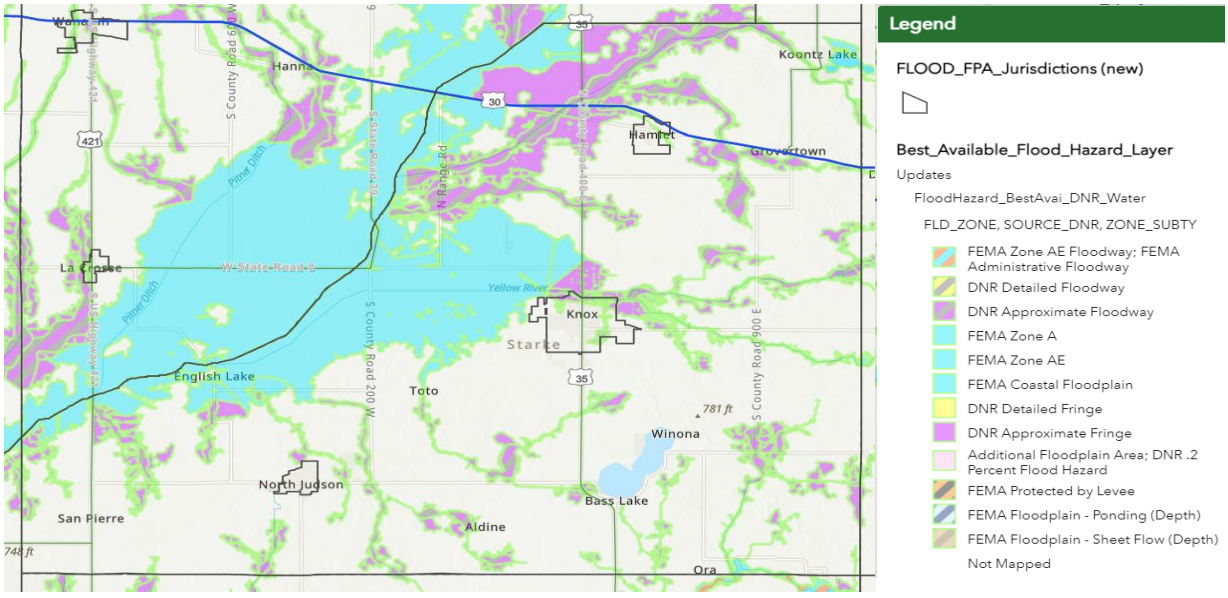


Figure 38 Flood Inundation Map

has little if any SFHA designated within the corporate limits. However, the Town of Hamlet as well as the City of Knox have several areas of concern within their corporate limits, as shown in **Figure 38**. Many of the flood risk areas are located withing the boundaries of the disadvantaged and underserved population census blocks. With less financial capacity to mitigate flooding becomes an additional burden on the communities. Flash flooding, being less predictable, does not allow the advanced warning to be able to protect property and seek shelter out of harm's way, thus increasing vulnerability.

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

Direct Effects:

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

Indirect Effects:

- Increased response times for emergency personnel when roads are impassable.
- Increased costs associated with personnel 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.
- Debris removal costs to return local drainage to normal function.
- Getting notifications to some of the underserved populations that may not have access to radio, television, or social media of evacuations.

Estimating Potential Losses

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

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

In the assessment, any structure listed as less than 400 ft^2 in area or classified in the Assessor's database as a non-habitable structure was assumed to be an outbuilding. It was assumed that a building was located on a parcel if the value listed in the "Assessed Value (Improvements)" showed a value greater than zero dollars. Parcels that intersected any portion of the FEMA flood zones were considered to be flood prone, and subsequently, further analyzed separately from parcels without structures.

Structure values were calculated using:

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

To estimate anticipated damages associated with each flood zone in Starke County and communities, it was estimated that 25% of structures in the flood zones would be destroyed, 35% of structures would be 50% damaged, and 40% of structures would be 25% damaged. ***Table 15*** identifies the estimated losses associated with structures in the floodway, the 1% AEP (100-year floodplain), and the 0.2% AEP (500-year floodplain) areas by community within Starke County.

Table 15: Starke County Building Inventory Utilizing Best Available Data

	Floodway		1% AEP		0.2% AEP		Unnumbered	
	#	$, Million	#	$, Million	#	$. Million	#	$, Million
Starke County	444	89.39	130	17.73	4	0.74	493	117.47
City of Knox	32	5.13	0	0	0	0	61	8.79
Town of Hamlet	4	4.97	0	0	0	0	1	0.14
Town of North Judson	0	0	0	0	0	0	0	0
TOTAL	480	$93.67	130	$17.73	4	$0.74	555	$126.40

Utilizing the same GIS information and process, critical infrastructure within each of the flood hazard areas in Starke County was assessed and are included in **Table *16***. These buildings are included in the overall number of structures and damage estimate information provided in ***Table 15***

Table 16: Critical Infrastructure in the Flood Zones

Community	Floodway	1% AEP	0.2% AEP	DNR Zone A
Starke County	Hook Ditch Dam			Substation 153289, Substation 153290, Sprint Spectrum LP Tower, Thought Transmissions LLC 2 towers, T-Mobile Licenses LLC 1 tower, Starke County Airport, Skitz Lake In Channel Dam
City of Knox	Yellow River Dam (Low Head Dam),			Surf Air Wireless – 2 towers,
Town of Hamlet				Thought Transmission LLC 1 tower, T-Mobile Licenses LLC 1 tower
Town of North Judson				

Utilizing the information in Table 15 regarding the number of structures within each of the flood hazard areas, it is also important to note the number of flood insurance policies within each area in Starke County. **Table 17** provides the comparison between the number of structures in the 1.0% AEP and the number of flood insurance policies. It is also important to note that flood insurance is voluntary unless the property owner carries a federally subsidized mortgage; insurance coverage may be discontinued when the mortgage is completed.

Table 17: Structures in the 1.0% AEP and Number of Flood Insurance Policies

Community	# Structures In 1.0% AEP	# Policies
Starke County	130	53
City of Knox	0	13
Town of Hamlet	0	0
Town of North Judson	0	0
Total	130	66

Future Considerations

As the municipalities within Starke County grow in population and redevelop, it can be anticipated that the number of critical and non-critical infrastructure will also increase accordingly. Starke County updated and adopted the County Floodplain Ordinance in 2014 similarly to the City of Knox adopted their Floodplain Ordinance in 2014. The Town of Hamlet updated their flood ordinance in 2014. Both Starke County and the City of Knox and Town of Hamlet discourage critical facilities such as schools, medical facilities, community centers, municipal buildings, and other critical infrastructure from being located within the 1% AEP (100-year) floodplain. New structures must also be protected to that level along with flood-free access to reduce the risk of damage caused by flooding and to ensure that these critical infrastructures will be able to continue functioning during major flood events. Flooding due to poor drainage, low-lying land, or flash flooding is also an important consideration. It will be important for recognition of potential flood impacts to residents and businesses in these areas to be coupled with proper planning for future development and redevelopment of the flood zones. This would also include studying the inundation areas mapped through the development of the Indiana Floodplain Portal as well as studies of all the streams with 1 square mile or drainage area or greater. Since the previous planning effort, no development has occurred within the flood zones of Starke County or the incorporated communities within the county.

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

Increased precipitation, as predicted in the Indiana Climate Change Assessment, is anticipated to come in the form of heavier, shorter events which lead to the increased potential for flooding and stress on infrastructure such as sanitary and storm sewers. Heavy precipitation events are anticipated to occur more frequently as temperatures rise, replacing rain when previously there was snow.

Despite these efforts, the overall vulnerability and monetary value of 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 response times due to flooded or redirected streets (**Figure 39),** 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. Several communities within Starke County host numerous special events near to or on the rivers and waterways. These special events may have to be cancelled or postponed due to flooding or high-water levels.

Figure 39: Fire Engine in Flood Waters

Relationship to Other Hazards

While flooding creates social, physical, and economic losses, it may also cause other hazards to occur. For example, flooding may increase the potential for a hazardous materials incident to occur. Above ground storage facilities may be toppled or become loosened and migrate from the original location. In less severe situations, the materials commonly stored in homes and garages such as oils, cleaners, and de-greasers, may be mobilized by flood waters. Should 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 damage 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 being released. These two hazards, flood, and dam failure, when combined, may certainly result in catastrophic damage.

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

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

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

3.2.6 Hail, Thunder, and Wind Storms

Overview

Hail occurs when frozen water droplets form inside a thunderstorm cloud, and then grow into ice formations held aloft by powerful thunderstorm updrafts, and when the weight of the ice formations 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 40)** and crops. Even small hail can cause considerable damage to young and tender plants. Residents should take cover immediately in a hailstorm, and protect pets and livestock, which are particularly vulnerable to hail, and should be under shelter as well.

Thunderstorms are defined as strong storm systems produced by a cumulonimbus cloud, usually accompanied by thunder, lightning, gusty winds, and heavy rains. All thunderstorms are considered dangerous as lightning is one of the by-products of the initial storm. 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, high winds, hail, and flash flooding.

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

Recent Occurrences

Figure 40 Damaaging Hail on Vehicles

In Starke County, the NCDC has recorded 10 hailstorms and 48 thunderstorms/windstorm events between January 1st, 2009, to December 31st, 2023. All the reported instances of hail have been within this time frame, ranging between April 8th, 2020, to June 18th, 2021. The average diameter hail stone occurring throughout Starke County ranges from ¾ to 1 inch with the largest one for this period of interest being 3 inches. According to the Midwest Regional Climate Center (MRCC) hail is considered severe if a thunderstorm produces hail stones larger than one inch in diameter, or larger than the size of a quarter. Significant windstorms are characterized by the top wind speeds achieved during the incident. Such high wind events characteristically occur in conjunction with thunderstorms and have historically occurred year-round with the greatest frequency and damage occurring in May, June, and August. Within Starke County, NCDC reports only 4 instances between July 1, 2017 to September 30, 2022 where top wind speeds were greater than 60 mph.

The NCDC recorded damages for hailstorms, thunderstorms, and windstorms throughout Starke County. From January 2009 to January 2024, there were 10 instances of hailstorms, resulting in 12 thousand property damage and no additional crop damage. In the same time frame, there were 48 instances of thunderstorms and high wind events, resulting in 72K in property damage and no additional crop damage. No injuries or deaths associated with these events. Many event reports included in the NCDC did not provide descriptive information on the social, physical, and economic losses resulting from individual storms specific to Starke County. In local storm reports at the

National Weather Service, where damages were reported, narrative descriptions of the event rarely extended beyond reports of damage to broken tree limbs, downed power lines, or roof damage.

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

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

The Committee determined the probability of a hailstorm, thunderstorm, or windstorm occurring anywhere throughout Starke County is "Highly Likely" and will typically affect broad portions of the county at one time resulting in potentially "Significant" damages. As advancements in technologies such as weather radar systems and broadcast alerts are continually made, the warning time for such incidents may increase. Currently, the Committee feels that the warning time is anticipated to be less than six hours and the duration is expected to last less than six hours.

Indicative of a regional hazard, the probability, magnitude, warning time, and duration of a hailstorm, thunderstorm, or windstorm are expected to be similar throughout the county. These events are highly unpredictable, and the occurrences are distributed throughout the county, sometimes impacting one community more often or more severely than another. Therefore, the CPRI values reflect the distributed risk and associated priority for a hailstorm, thunderstorm, or windstorm. A summary is provided in **Table 18.**

Table 18: CPRI for Hailstorm, Thunderstorm, and Windstorm

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Starke County	Highly Likely	Significant	< 6 hours	< 6 hours	Severe
City of Knox	Highly Likely	Significant	< 6 hours	< 6 hours	Severe
Town of Hamlet	Highly Likely	Significant	< 6 hours	< 6 hours	Severe
Town of North Judson	Highly Likely	Significant	< 6 hours	< 6 hours	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. The magnitude is anticipated to be similar based on the number of critical infrastructure and populations of each of the municipalities, or "Significant."

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 Starke 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.
- Cancellation or interruption of special events.

Estimating Potential Losses

Figure 41: Home Damaged During Windstorm

Due to the unpredictability of this hazard all critical infrastructure and non-critical structures in Starke County are at risk of damage including temporary or permanent loss of function. For hailstorms, thunderstorms, and windstorms, it is not possible to isolate specific critical infrastructure or non-critical structures that would be vulnerable to damages. However, areas where utility lines are above ground and areas where dead or dying trees have not been removed may be at a higher risk of property damage 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 damage from hailstorms, thunderstorms, and windstorms if not properly anchored to the ground. Damage from falling limbs or uprooted trees such as that shown in **Figure 41.**

Future Considerations

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

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

Relationship to Other Hazards

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 Starke 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 place debris near spillways, blocking the emergency drainage mechanism for the dams. High winds may also lead to structural damage to a dam or may cause damage to nearby trees or other structures, leading to indirect damage.

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

3.2.7 Landslide/Subsidence/Fluvial Erosion

Overview

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

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

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

Recent Occurrences

The potential for landslides or land subsidence within Starke County was discussed by the Planning Committee. IndianaMap shows that there are no Karst Sinkhole areas anywhere in the County. To the knowledge of the Planning Committee, there are no active underground mining operations within Starke County. Additionally, to date, there have not been any landslides or subsidence events reported in Starke County. There have however been some concerns about Fluvial Erosion Hazard (FEH) along the rivers, especially the Yellow and Kankakee Rivers running through the county. **Figure 42** shows the FEH corridor just east of Knox on the Yellow River.

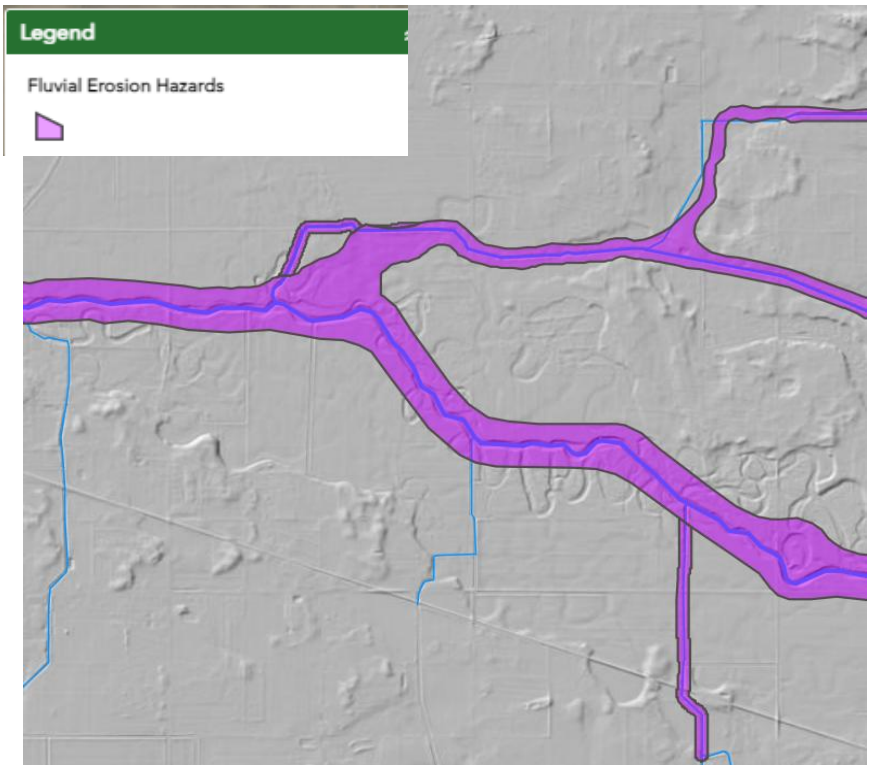


Figure 42 Fluvial Erosion Hazard along the Yellow River near Knox

The Committee determined the probability of a landslide or subsidence occurring in Starke County is “Unlikely”. Any event is expected to result in potentially “Negligible” damages. Currently, the Committee feels that the warning time is expected to be less than twenty-four hours and similarly, the duration is expected to last less than one week. These events are highly unpredictable and the risk, although very low according to the Committee, is distributed throughout the county. Therefore, the CPRI values reflect the distributed risk and associated priority for a landslide or subsidence event. A summary is provided in **Table 19.**

Table 19: CPRI for Land subsidence, Landslide and FEH

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Starke County	Unlikely	Negligible	> 24 hours	> 1 week	Low
City of Knox	Unlikely	Negligible	> 24 hours	> 1 week	Low
Town of Hamlet	Unlikely	Negligible	> 24 hours	> 1 week	Low
Town of North Judson	Unlikely	Negligible	> 24 hours	> 1 week	Low

Assessing Vulnerability

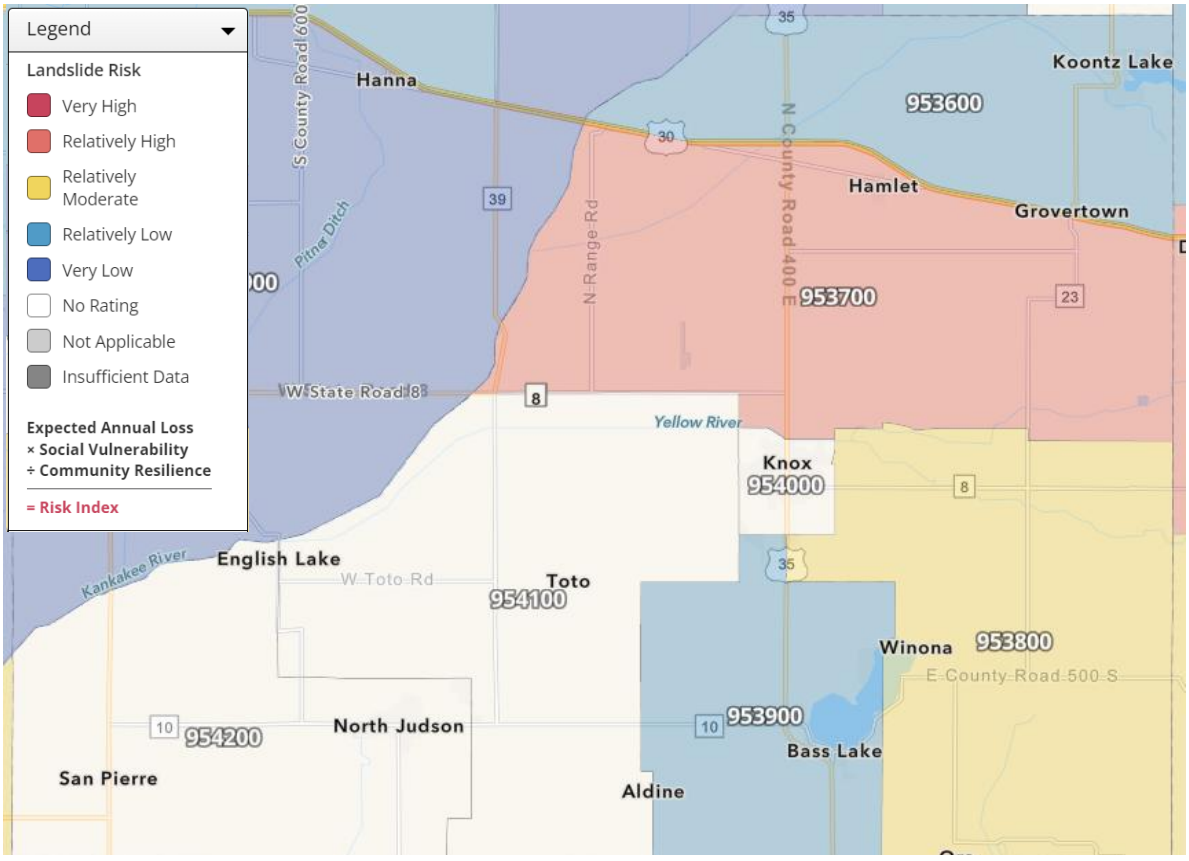


Figure 43 Risk Index for Landslide in Starke County

Although Starke County has no known presence of Karst geology and is at a low risk of land subsidence or sink holes, the portions of the county are considered at relatively high risk according to the National Risk Index. The risk index considers expected annual loss as well as vulnerabilities by census tract and community resilience. The Risk Index for Landslide in Starke County is shown in **Figure 43** The Risk index varies from no rating in the southwestern sections to relatively low in

the areas near Bass Lake and Koontz Lake. The southeastern corner of the county is considered to have a relatively moderate risk whereas the census tract immediately north of Yellow River is considered to be relatively high. This rating is related to the FEH issues along the Yellow River and the social vulnerability of the community living in the area. The planning committee rated the Landslide, Land Subsidence and Fluvial Erosion Hazard as "Unlikely" according to the Planning Committee with "Negligible" severity.

Within Starke County, direct and indirect effects may include:

Direct Effects:

- Damages to infrastructure (power lines, roads, bridges)
- Damages to individual properties (homes, cars)
- Loss of cropland immediately adjacent to the rivers

Indirect Effects:

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

Estimating Potential Losses

According to the National Risk Index, expected annual losses have been calculated for the areas in Starke County which are at risk of damage including temporary or permanent loss of function. Areas where FEH meander belt widths (FEH Zones) have been identified may be at a higher risk of property damage caused by such events. To prepare a community based basic "what-if" scenario, the Indiana FEH GIS layers were overlaid onto parcel data provided by the County. Error! Reference source not found. identifies the number of structures and potential damage within the FEH areas.

Table 20: Summary of Structures in the FEH Zone

Community	Potential Damages	
	# Structures	Damages
Starke County	111	$26.07M
City of Knox	7	$1.64M
Town of Hamlet	14	$3.28M
Town of North Judson	0	$0
Total	132	$31.00M

Future Considerations

As the populations of the communities in Starke County grow, it can be anticipated that the number of critical and non-critical structures will also increase. To reduce the vulnerability for damages resulting from a landslide or land subsidence, FEH area GIS layers along with the floodplain information should be integrated into the building permit or approval process. In recent years, no

significant development has occurred within these areas of Starke County. However, depending on the location, any development may increase the vulnerability to this hazard.

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

Relationship to Other Hazards

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

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

3.2.8 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.

Figure 44 Funnel Cloud During Lightning Storm at Night

A tornado is generated when conditions in a strong cell are produced that exhibit a wall of cool air that overrides a layer of warm air. The underlying layer of warm air rapidly rises, while the layer of cool air drops – sparking the swirling action. The damage from a tornado is a result of the high wind velocity and wind-blown debris. Tornado season is generally from April through June in Indiana, although tornadoes can occur at any time of year. Tornadoes tend to occur in the afternoons and evenings; over 80 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 44.** Tornadoes occur most frequently in the United States east of the Rocky Mountains. Tornadoes in Indiana generally come from the south through the east. 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.

Recent Occurrences

The classification of tornadoes utilizes the Enhanced Fujita Scale of tornado intensity and damage. Tornado intensity ranges from low intensity (EF0) tornadoes with effective wind speeds of 65-85 mph to high intensity (EF5+) tornadoes with effective wind speeds of 200+ mph (see Error! Reference source not found.**)**. According to the NCDC, 3 tornados were reported between January 1, 2009, and December 31, 2023.

Table 21: Enhanced Fujita Scale for Tornados

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

The Committee estimated the probability of a tornado occurring in Starke County would be “Likely” and the magnitude and severity of such an event to be “Limited” and “Elevated” throughout the unincorporated county. As with many hazardous events, the Committee anticipated a short warning time of typically less than six hours, and a short duration, also less than one day. The summary is shown in Error! Reference source not found.**Table 22.**

Table 22: CPRI for Tornado

	Probability	Magnitude / Severity	Warning Time	Duration	CPRI
Starke County	Likely	Limited	< 6 hours	< 6 hours	Elevated
City of Knox	Likely	Limited	< 6 hours	< 6 hours	Elevated
Town of Hamlet	Likely	Limited	< 6 hours	< 6 hours	Elevated
Town of North Judson	Likely	Limited	< 6 hours	< 6 hours	Elevated

The Indiana State Climate Office estimates that throughout Indiana, there is an average of 20 tornado touchdowns per year. Based on the number of tornado touchdowns previously reported through the NCDC and local weather agencies, the Committee determined the general probability of a future tornado occurring in Starke County is “Likely” (within the next five years).

Assessing Vulnerability

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

Direct Effects:

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

Indirect Effects:

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

Estimating Potential Losses

Due to the unpredictability of this hazard, all critical and non-critical structures within the county are at risk of future damage or loss of function. Estimates of potential physical losses were determined

through a hypothetical exercise where an EF2 intensity tornado traveled through portions of the county and the communities. This is intended to present a "what-if" scenario of a tornado incident and associated damages. Damage estimates were derived by assuming that 25% of all structures in the path of the tornado would be completely destroyed, 35% of the structures would be 50% damaged, and 40% of the structures would sustain 25% damage. These estimations were also determined utilizing three wind speed zones based on distance from the tornado path. Zone 1 is nearest the center of the tornado path, while Zone 3 is the farthest from the path and with a theoretically lower wind speed. **Table 23** provides summary data for the hypothetical tornado, which is identified on **Exhibit 3**.

Table 23: Summary of Hypothetical Tornado Damages

	Zone 1		Zone 2		Zone 3		Total	
	#	$, Million	#	$, Million	#	$, Million	#	$, Million
Starke County	103	$17.19	56	$9.39	62	$8.88	221	$35.46
City of Knox	196	$36.9	137	$23.67	137	$19.45	470	$80.02
Town of North Judson	168	$27.31	68	$13.68	52	$8.17	288	$49.16
Totals	467	$81.40	261	$46.74	251	$36.50	979	$164.64

Utilizing the same GIS information and process, critical infrastructure within each of the hypothetical tornado zones are included in **Table 24.** These buildings are included in the above table showing the number of structures and damage estimate information.

Table 24: Critical Infrastructure within Hypothetical Tornado

Community	Zone 1	Zone 2	Zone 3
Starke County			
City of Knox	First Christian Church, Church of Jesus Christ - Bethel – Inc, Calvary Baptist Church, Heritage Baptist Church of Northern Indiana Inc	First Pentecostal Church of Knox Inc	
Town of North Judson	St Peter Lutheran School	North Judson-San Pierre Jr Sr High School, St. Peter Lutheran Church - Preschool	New Community Church of North Judson Inc

Future Considerations

Within Starke County, there are numerous events each year as well as regular tourist attractions that draw thousands of guests. Due to this, it is imperative that the EMA place continued importance on the need to maintain their outdoor warning siren coverage. Because of the dispersed population concentrations, coverage is limited to the more densely populated portions of the county. The existing siren locations are identified in Error! Reference source not found..

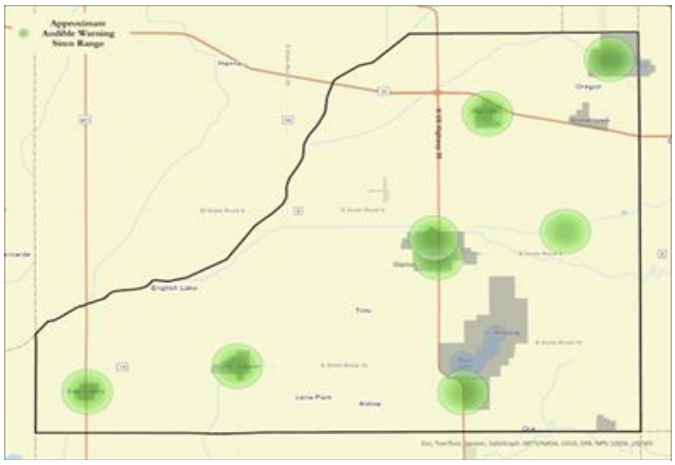


Figure 45 Siren Locations in Starke County

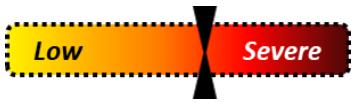
While it can be anticipated that new construction associated with development may be stronger than older or existing construction, existing older structures, barns, pole buildings, silos and mobile homes remain threatened by tornados. The unincorporated portions of Starke County will remain vulnerable especially where the outdoor warning siren coverage is not present. It is impossible to predict the path of a tornado and therefore all current and future development will continue to be at risk for damage. Risks to the citizens of Starke County may be lessened through participation in mass notification programs, use of weather radios, and turning on the emergency alert feature on cell phones. The county is considering purchasing a reverse 911 system to help notify residents and visitors of severe weather and tornados. Having multiple means of warning citizens, businesses and visitors of incoming weather events is critical to continued economic growth and well-being of the communities and the county.

Relationship to Other Hazards

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

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

3.2.9 Winter Storms and Ice



Overview

A winter storm can range from moderate snow over a few hours to blizzard conditions with high winds, ice storms, freezing rain or sleet, heavy snowfall with blinding wind-driven snow, and extremely cold temperatures that can last for several days. Some winter storms may be large enough to affect several states while others may affect only a single community. Winter storms are typically accompanied by cold temperatures and blowing snow, which can severely reduce visibility. A winter storm is defined as one that drops four or more inches of snow during a 12-hour period, or six or more inches during a 24-hour span. An ice storm occurs when freezing rain falls from clouds and freezes immediately on contact with a variety of surfaces. All winter storms make driving and walking extremely hazardous. The aftermath of a winter storm can affect a community or region for days, weeks, and even months.

Figure 47 Power Lines Covered in Ice and Snow

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

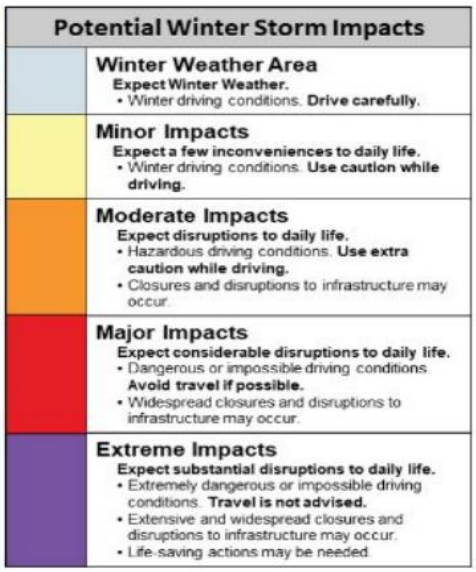


Figure 46 Potential Winter Storm Impacts, NWS

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

A winter storm watch indicates that severe winter weather may affect your area. A winter storm warning indicates that severe winter weather conditions are on the way. In the event of a blizzard, a winter storm warning will be issued and include the details of the blizzard - that large amount of falling or blowing snow and sustained winds of at least 35 mph are expected for several hours. Being in Northern

Indiana, winter storms are somewhat common in Starke County and the surrounding region. Such conditions can result in substantial personal and property damage, even death. The National Weather Service recently (October 15, 2018) consolidated their watch and warning products. In doing so, blizzards and lake effect snows are no longer separate watches and warnings, but instead are detailed as a part of winter storm watches and warnings. A large number of winter storm products are available on the internet from the National Weather Service. One is The Winter Storm Severity Index (WSSI). When a storm is forecast, the NWS can help communities better understand the potential impacts of storm using WSSI. **Figure 47** shows the description of the WSSI impacts. More detailed information with regards to the timing of the storms, etc., is provided as the event gets closer to the forecast area.

Recent Occurrences

Since January 1, 2009 the NCDC has recorded 32 winter weather events, 0 ice storms, and 17 winter storms. NCDC reports indicated no property damage, no additional crop damage and no injuries, or deaths associated with any of the events. Many narrative descriptions indicated poor travel conditions, power outages and debris associated with similar events.

The probability, magnitude, warning times, and duration of a snowstorm or ice storm causing disruption to residents and businesses in Starke County, as determined by the Planning Committee, is expected to be mostly consistent throughout the county and communities. It is "Likely" that this type of hazard will occur in this area and will typically affect the entire county, and possibly several surrounding counties at one time, resulting in primarily "Limited" damages. The typical warning time for severe temperatures or several inches of snow associated with a winter storm is usually greater than 24 hours while the duration of the incident is anticipated to be less than one week. However, the committee decided the accurate warning time in their area is less than 6 hours and the duration is less than one day. A summary is shown in Table *25***.**

Table 25: CPRI Summary for Winter Storms and Ice

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Starke County	Likely	Limited	< 6 hours	<1 day	Elevated
City of Knox	Likely	Limited	< 6 hours	<1 day	Elevated
Town of Hamlet	Likely	Limited	< 6 hours	<1 day	Elevated
Town of North Judson	Likely	Limited	< 6 hours	<1 day	Elevated

The Planning Committee determined that the probability for a snowstorm or ice storm to occur in Starke County and the communities within is "Likely" or may occur within the calendar year. Based on historical data and the experience of the Planning Committee, snowstorms have become less common in Starke County with the changing climate, but actions have been taken to mitigate many impacts from snow and ice storms. Lake effect snowstorms can be less predictable, depositing greater amounts of snow in a contiguous county and lesser amounts in Starke County or the opposite. The Committee considered only the larger, more detrimental events for this effort.

Assessing Vulnerability

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

Direct Effects:

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

Indirect Effects:

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

Figure 48 Travel Impacted During Snowstorm

Estimating Potential Losses

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

For planning purposes, information collected in snowstorms impacting other communities around the nation is also useful in assessing the potential social, physical, and economic impact that a winter storm could have on communities. For example, a March 2003 snowstorm in Denver, Colorado dropped approximately 31 inches of snow and caused an estimated $34M in total damage. In addition, a February 2003 winter storm dropped an estimated 15-20 inches of snow in parts of Ohio. The Federal and Ohio Emergency Management Agencies and U.S. Small Business Administration surveyed damaged areas and issued a preliminary assessment of $17M in disaster related costs. These costs included snow and debris removal, emergency loss prevention measures, and public utilities repair. The agencies found over 300 homes and businesses either damaged or destroyed in six counties. Snowstorms and blizzards also make road travel difficult and dangerous, as seen in **Figure 48**.

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

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

Future Considerations

As populations increase and communities continue to grow, the need to respond to snowstorms or ice storms will remain an important municipal effort. As new construction or re-development occurs, especially new or existing critical infrastructure, it is important to ensure that these new structures are equipped to deal with the potential risks associated with this hazard. Those may include lengthy power outages and potentially impassable transportation routes, making it difficult to obtain supplies or for passage of response vehicles. These hazard events will typically affect the entire county, perhaps multiple counties, and therefore all development, current and future, will be at risk for damage associated with snow and ice storms. In addition, there may be a need for additional warming shelters for the underserved populations to take refuge and get warm and safe respite for stranded commuters on their way to or from work.

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

Relationship to Other Hazards

Figure 49 Flooding Caused by Snow Melt

Winter storms and ice storms can lead to flooding as the precipitation melts and enters local receiving waters. This increased volume of water on already saturated, or still frozen ground can quickly result in flood-related damage to structures and properties (**Figure 49)** as well as within the stream or river channel. Starke County has an increased risk of flooding following heavy precipitation events. The increased flooding may then lead to a dam failure within the same area, further exacerbating the damage.

Hazardous materials incidents may be caused by poor road conditions during winter storms or ice storms. Many hazardous materials are transported by rail or by tanker over highways and interstates. In the more rural areas of Starke County, or where open areas are more susceptible to

snow drifts on roads, the possibility of a traffic related hazardous materials incident may increase due to road obstruction and lack of visibility.

Power outages and other infrastructure failures may also occur during a winter storm. Weight from snow and ice 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 homeless, the elderly or ill. Power outages in the winter are especially dangerous as families try to generate heat using alternative heat sources. Alternative heating sources may not be safely used or may be placed too close to combustible materials resulting in fires and burn injuries or death.

3.2.10 Dam and Levee Failure

Overview

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

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 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 regulated dam is assigned a downstream hazard classification based on the potential loss of life and damage to property should the dam fail. The three classifications are high, significant, and low. With changing demographics and land development in downstream areas, hazard classifications of regulated are updated continually. The following definitions of hazard classification currently apply to dams in Indiana:

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

In Indiana, not all dams are regulated. To be regulated by the Indiana Department of Natural Resources (DNR). To be under the DNR jurisdiction, the dam must meet at least one of the following criteria:

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

A dam's classification may be changed to a High-hazard classification through a successful petition by a downstream property owner. Federally owned and operated dams are not under Indiana DNR's jurisdiction.

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

a residual risk when living or working in a facility located behind a levee. Levees reduce the risk of a flood, but do not completely eliminate that risk.

Recent Occurrences

Within Starke County, there are 4 DNR listed dams. There is a fifth dam located in Marshall County which impacts Starke County. Of the four in Starke County, one is considered a high hazard dam, one is a low hazard lake control structure, one is an under minimum dam considered a low hazard and is considered a low head dam and the last is decommissioned. Locations of the listed dam structures are shown on **Table 26.** According to local information, there have not been any recent dam failures within Starke County.

Table 26: Dams Impacting Starke County

County	Dam Name	Hazard	Notes
Starke	Hook Ditch	Low	Decommissioned
	Skitz Lake	Low	Under Minimum – Low Head Dam
	Bass Lake	Low	Lake Control Structure
	Koontz Lake	High	Has an IEAP
Marshall	Lake Latonka	High	Does NOT have an IEAP

According to the National Levee Database (NLD) managed by the USACE, there are no certified levees systems within Starke County. The Indiana Silver Jackets Team completed a survey of levee like features also known as non-levee embankments. The non-levee embankments are not certified or engineered structures. They are earthen structures which act like levees, however, are not

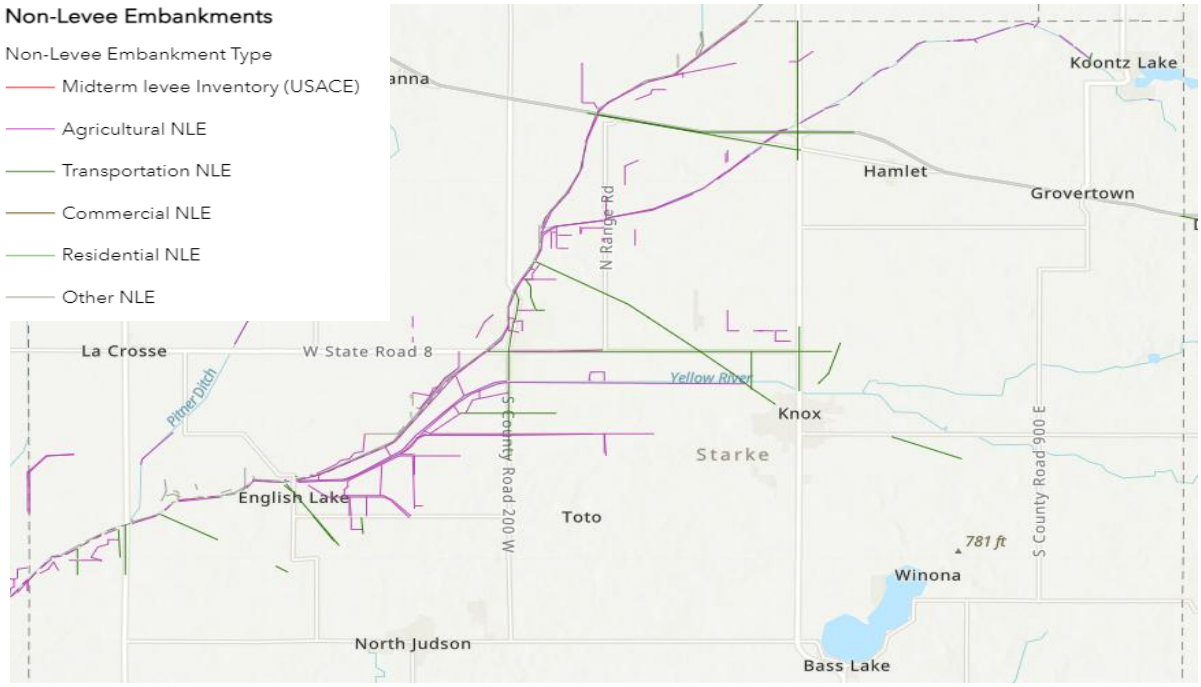


Figure 50 Non-Levee Embankments in Starke County

capable of protecting the features behind the structures adequately. In fact, non-levee embankments impose lateral constraints on flood flows, reducing the floodplain storage capacity and increasing the flood velocity. These non-levee embankments can cause stream erosion and downstream flooding. Many farms along the Yellow and Kankakee Rivers rely on these embankments to keep flood waters out of their fields. **Figure 50** shows the location of the non-levee embankments throughout Starke County.

In 2018, during the large flood event, the non-levee embankments were overtopped and/or breached resulting in the inundation of hundreds of acres of prime farmland and the deposition of thousands of tons of sand ontop of the topsoil. Additionally, the Starke Pulaski Fish and Wildlife area was also filled with up to 20 feet of sand which had to be removed to restore the waterfowl habitats in the area.

Based on the information provided to them and their local knowledge, experience, and expertise, the Committee determined the probability of a dam failure is "Possible." The magnitude of a dam failure can have "Significant" damages. The warning time is under 6 hours. **Table 27** provides a summary of the Planning Committee's expectations during a dam failure.

Table 27: CPRI Summary for Dam and Levee Failure

	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI
Starke County	Possible	Significant	< 6 hours	< 6 hours	Elevated
City of Knox	Possible	Significant	< 6 hours	< 6 hours	Elevated
Town of Hamlet	Possible	Significant	< 6 hours	< 6 hours	Elevated
Town of North Judson	Possible	Significant	< 6 hours	< 6 hours	Elevated

Assessing Vulnerability

The actual magnitude and extent of damage due to a dam failure depends on the nature of the breach, the volume of water that is released, and the width of the floodplain valley to accommodate the flood wave. Due to the conditions beyond the control of the dam owner or engineer, there may be unforeseen structural problems, natural forces, mistakes in operation, negligence, or vandalism that may cause a structure to fail. All the DNR high hazard dams in the county have developed an Incident and Emergency Action Plans (IEAP). **Figure 51** shows the two inundation paths**.** The blue dots signify where data was taken from an existing IEAP, whereas the red dots are dams an IEAP is not available.

Figure 51 Breach Inundation Models for Starke County

Although Lake Latonka Dam in Marshall County has not developed an IEAP, Indiana DNR did perform the necessary modelling to show the projected inundation areas. **Figure 52** shows the inundation area for Lake Latonka.

IEAPs are now required for high hazard dams by state law, however, these plans are not mandated for the low hazard structures. Dam owners are, however, encouraged to prepare an IEAP to help identify whom to notify and what actions may need to take place in the event of an incident or emergency event affecting the dam. The Indiana DNR website shows areas which would be inundated during a dam failure.

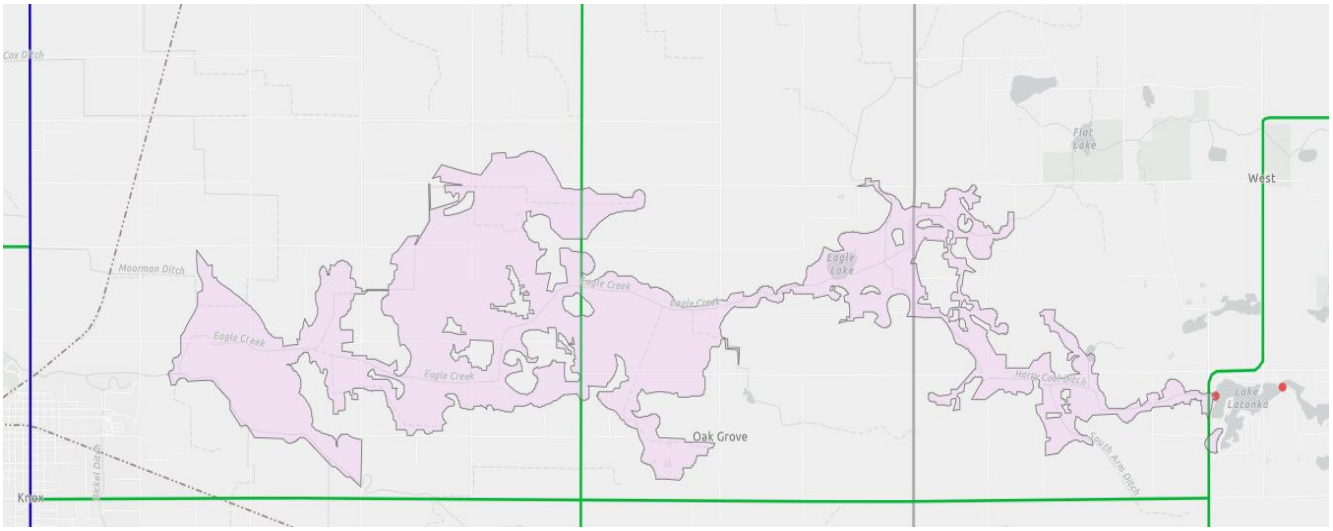


Figure 52 Lake Latonka Dam Breach Model Inundation Area

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

Direct Effects:

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

Indirect Effects:

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

Estimating Potential Losses

As of July 1, 2022, the State of Indiana is requiring High Hazard dams to have Incident and Emergency Action Plans (IEAPs) developed. These plans have detailed potential dam failure inundation areas identified along with at-risk structures identified. The actual magnitude and extent of damage depends on the type of dam break, the volume of water that is released, and the width of the floodplain valley to accommodate the dam break flood wave. All dam owners are encouraged to develop an IEAP.

The greatest impact for Starke County is a high hazard dam located in Marshall County. The DNR inundation map in Figure 52 shows the area which would be impacted should the dam fail. Utilizing GIS maps and orthoimagery, the infrastructure and other features below this dam can be identified.

This imagery will show properties that would be isolated due to the inundation of the roadways leading in and out of the area as well as those properties which would be inundated.

Future Considerations

As areas near existing dams continue to grow in population, it can be anticipated that the number of critical and non-critical structures could also increase accordingly. Location of these new facilities should be carefully considered, and precautions should be taken to ensure that schools, medical facilities, municipal buildings, and other critical infrastructure are located outside of the delineated or estimated dam failure inundation areas. Also, flood-free access should be provided for these facilities. Large areas of new development have not yet occurred downstream of the dams in Starke County. Until such development or re-development downstream of a dam is prohibited, those areas remain vulnerable to losses and damage associated with a failure of that structure.

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

Relationship to Other Hazards

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

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

3.2.11 Hazardous Materials Incident

Overview

Hazardous materials are substances that pose a potential threat to life, health, property, and the environment if they are released. 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 to a release may require fire, safety/law enforcement, search and rescue, and hazardous materials response units.

Figure 53 Potentially Hazardous Waste Drums

As materials are transported for treatment, disposal, or transport to another facility, all infrastructure, facilities, and residences near the transportation routes are at an elevated risk of being affected by a hazardous materials release. Often these releases can cause serious harm to Starke County and its residents if proper and immediate actions are not taken. Most releases are the result of human error or improper storage **(Figure *53*)**, 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.

Recent Occurrences

During conversations with Committee members and through information provided by local news outlets, it was noted that numerous small and moderately sized incidents involving manufacturing facilities and transportation routes have occurred since the development of the original MHMP. However, the number of facilities utilizing, storing, and/or manufacturing chemicals has decreased over the years as facilities reduce the amount hazardous materials on site. However, more businesses and industries rely on just in time delivery which results in a greater number of delivery vehicles transporting the materials across the county on routes which crisscross the county. Heavier traffic on routes such as US 421, US30 and 35, increases the potential for incident. **(Figure 54**) Starke County does not have

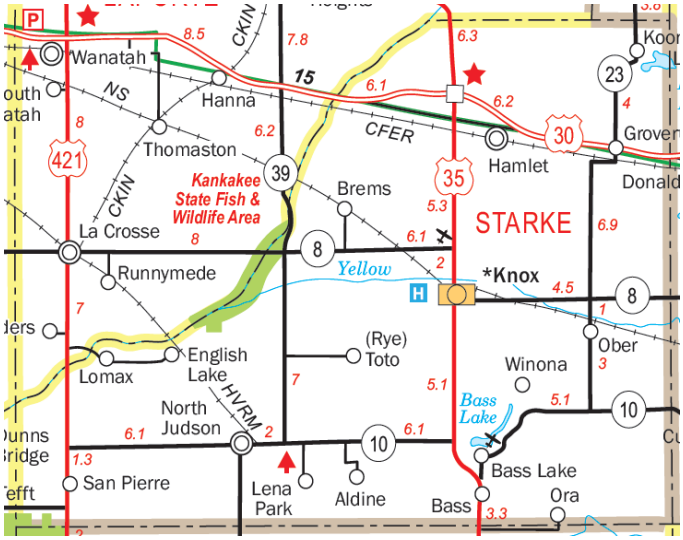


Figure 54 Transportation Routes in Starke County

a hazardous materials team, so spills responses and cleanups are handled by LaPorte County Fire Departments under mutual aid agreements.

According to the Committee, the probability of a hazardous materials release or incident is "Possible" in all areas due to the number transportation routes within and through county. "Limited" damages are anticipated to result from an incident. The level of damages is dependent upon the location of the event. As with hazards of this nature, a short warning time of less than six hours and a short duration, also less than six hours is anticipated in the event of a hazardous materials incident. A summary is shown in **Table 28.**

Table 28: CPRI Summary for Hazardous Materials

	Probability	Magnitude / Severity	Warning Time	Duration	CPRI
Starke County	Possible	Limited	< 6 hours	< 6 hours	Elevated
City of Knox	Possible	Limited	< 6 hours	< 6 hours	Elevated
Town of Hamlet	Possible	Limited	< 6 hours	< 6 hours	Elevated
Town of North Judson	Possible	Limited	< 6 hours	< 6 hours	Elevated

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

Assessing Vulnerability

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

Direct Effects:

- The more densely populated areas including the City of Knox have a greater potential for chemical incidents as the production and distribution facilities are nearby as well as the major crossroads as well as the CSX railroad which traverses the county.
- The rural areas may find greater amounts agricultural chemicals, shipment and deliveries of products, and storage along with railroad crossings that are affected by such events.
- Expense of reconstruction of affected structures.

Indirect Effects:

- Loss of revenue or production while testing, recovery and/or reconstruction occurs.
- Anxiety or stress related to the event.
- Potential evacuation of neighboring structures or facilities.
- Expenses incurred due to response, testing, and cleaning of the affected areas.

While the possibility of an incident occurring may be possible, the vulnerability of Starke 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 Committee (LEPC). This committee has the responsibility for preparing and implementing emergency response plans, cataloging Safety Data Sheets (SDS) formerly known as Material Safety Data Sheets (MSDS), creating chemical inventories of local industries and businesses, and reporting materials necessary for compliance.

Figure 55 Hazardous Materials Incident

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

Estimating Potential Losses

In addition, the very nature of these events makes predicting the extent of their damage very difficult. A small-scale spill or release might have a minor impact and would 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. However, even small, or moderate events could potentially grow large enough that mass evacuations or shelter in place techniques are needed, multiple levels of response are utilized, and additional hazards such as structural fires and/or additional hazardous materials releases (or explosions) may occur. Given the unpredictable nature of hazardous materials incident, an estimate of potential losses was not generated.

Future Considerations

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

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

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

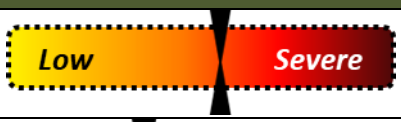
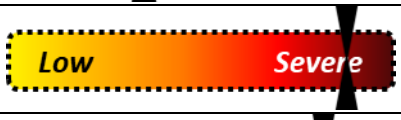
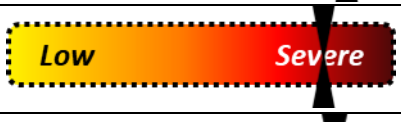
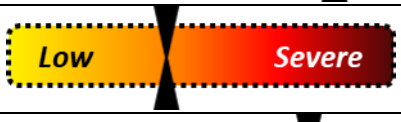
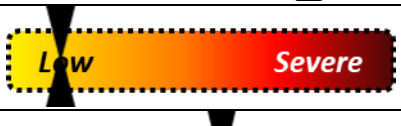
Relationship to Other Hazards

Dependent on the nature of the release, conditions may exist where an ignition source such as a fire or spark ignites a flammable or explosive substance. As the fire spreads throughout the facility or the area, structural and/or property damage 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. Depending on the nature of the incident, further delays may take place until qualified Hazardous Materials Responders with the appropriate response and monitoring equipment can be transported to the incident location. While this may increase structural losses, it may decrease social losses such as injuries or even deaths.

3.3 HAZARD SUMMARY

For the development of this MHMP, the Committee utilized the CPRI method to prioritize the hazards they felt affected Starke County. Hazards were assigned values based on the probability or likelihood of occurrence, the magnitude or severity of the incident, as well as warning time and duration of the incident itself. A weighted CPRI was calculated based on the percent of the county's population present in the individual communities. **Table 29** summarizes the CPRI values for the various hazards studied within this MHMP.

Table 29: All CPRI Scores Combined

Type of Hazard	List of Hazards	Weighted Average CPRI
Natural	Drought	
	Earthquake	
	Extreme Temperatures	
	Fire/Wildfire	
	Flood – Flash	
	Flood – Riverine	
	Hail/Thunder/Windstorm	
	Landslide/Subsidence	
	Tornado	
	Winter Storm/Ice	
Technological	Dam & Levee Failure	
	Hazardous Materials Incident	

It is important to understand the cause-and-effect relationship between the hazards selected by the Committee. **Table 30** 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 30: Hazard Reference Table

EFFECT → / CAUSE ↓	Drought	Earthquake	Extreme Temperature	Fires and Wildfire	Flood	Hailstorm/ Thunderstorm/ Windstorm	Landslide / Subsidence	Tornado	Winter Storm / Ice	Dam & Levee Failure	Hazardous Materials
Drought											
Earthquake				X			X			X	X
Extreme Temperature											X
Fires and Wildfire											X
Flood							X			X	X
Hailstorm/ Thunderstorm / Windstorm				X	X		X			X	X
Landslide / Subsidence/ FEH					X						X
Tornado				X						X	X
Winter Storm/ Ice					X					X	X
Dam & Levee Failure					X		X				X
Hazardous Materials				X							

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

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

4.0 MITIGATION GOALS AND PRACTICES

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

4.1 MITIGATION GOAL

REQUIREMENT §201.6(c)(3)(i):
[The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

The Committee reviewed the mitigation goals as outlined within the 2010 Starke County MHMP and determined that the goals remain valid and effective. In summary, the overall goal of the Starke County MHMP is to reduce the social, physical, and economic losses associated with hazard incidents through emergency services, natural resource protection, prevention, property protection, public information, and structural control mitigation practices.

4.2 MITIGATION PRACTICES

REQUIREMENT §201.6(c)(3)(ii):

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

REQUIREMENT §201.6(c)(3)(iii):

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

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

A more recent (2017) study by the National Institute of Building Sciences, reviewed over 20 years of federally funded mitigation grants, not only from FEMA but also from the US Economic Development Administration (EDA) and the US Department of Housing and Urban Development (HUD). From this broadened review, it has been determined that for every $1 spent on mitigation, $6 is saved on disaster costs. In addition, by designing and construction buildings which exceed select items in the 2015 International Code, $4 can be saved for every $1 invested in those changes.

Six primary mitigation practices defined by FEMA are:

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

4.2.1 Existing Mitigation Practices

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

Emergency Services

- Two stream gages are utilized for flood forecasting and flood warnings for various streams.
- Training and table-top exercises are conducted by the LEPC and include response agencies such as police, fire, and local EMS agencies.
- Starke County has established shelters throughout the County. (2009 Measure)
- Generators have been purchased and installed at all the fire departments. (2009 Measure)

Natural Resource Protection

- Starke County, the City of Knox and the Town of Hamlet are in good standing with the NFIP Program and have flood protection ordinances which meet the minimum requirements.
- Current facility maps and response plans are on file for all Tier II HazMat facilities.
- The LEPC was re-established and is meeting regularly. (2009 Measure)

Prevention

- The Starke County LEPC provides training regarding the proper storage, transport, and disposal of hazardous materials.
- Information related to natural hazards has been incorporated into plans and guidance materials to better guide future growth and development (2009 Measure)

Property Protection

- The Kanakee and Yellow River Basin Alliance is working with County leaders to address flooding and riverbank erosion issues.
- Recommendations from completed flood protections studies are implemented as funding becomes available.
- Drainage system maintenance, including repair and replacement of culverts, occurs throughout the county.

Public Information

- Outreach materials and hazard preparedness materials are routinely provided online, within offices and agencies in Starke County, at large public events, speaking opportunities within schools, etc. Some materials are provided through social media outlets, local radio station WKVI and agency websites; and used during Severe Weather Awareness Week to raise awareness (2009 Measure)
- The EMA and response agencies utilize websites and social media to convey messages to the public prior to, during and following hazardous events.

Structural Control

- County drainage ditches have been cleared and are maintained to prevent localized flooding, increased erosion, and material deposition because of rainfall or snowmelt.
- Utilities throughout the county perform routine tree canopy maintenance along rights of way to reduce damages from trees to electrical lines as well as nearby structures.

4.2.2 Proposed Mitigation Practices

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

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

Table 31 lists a summary of all proposed mitigation practices identified for all hazards, as well as information on the local status, local priority, benefit-cost ratio, project location, responsible entities, and potential funding sources, associated with each proposed practice. The proposed mitigation practices are listed in order of importance to Starke County for implementation.

Projects identified by the Committee to be of “high” local priority may be implemented within five years from final Plan adoption. Projects identified to be of “moderate” local priority may be implemented within 5-10 years from final Plan adoption, and projects identified by the Committee to be of “low” local priority may be implemented within 10+ years from final Plan adoptions. However, depending on availability of funding, some proposed mitigation projects may take longer to implement.

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

The update of this MHMP is a necessary step of a multi-step process to implement programs, policies, and projects to mitigate the effect of hazards in Starke County. The intent of this planning effort was to identify the hazards and the extent to which they affect Starke County and to determine what type of mitigation strategies or practices may be undertaken to mitigate these hazards. A FEMA-approved MHMP is required to apply for and/or receive project grants under the BRIC, HMGP, and FMA. Although this MHMP meets the requirements of DMA 2000 and eligibility requirements of these grant programs additional detailed studies may need to be completed prior to applying for these grants. **Section 5.0** of this plan includes an implementation plan for all high priority mitigation practices identified by the Committee.

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

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Table 31 Proposed Mitigation Measures

Mitigation Practice	Mitigation Strategy	Hazard Addressed	Lifeline Addressed	Status	Priority	Benefit-Cost Ratio	Responsible Entity	Funding Source
Public Education and Outreach 1. Provide hazard preparedness literature (such as warning siren info, radio stations, go-kits, insurance protection, etc.) at public facilities and events, parks, and on social media. 2. Collaborate with community programs to help underserved and disadvantaged populations repair housing to reduce damages from future hazard events such as storms, extreme temperatures, etc. 3. Explore using a Mobile Integrated Healthcare Program to educate participants on low-cost ways to become more disaster resilient.	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☐ Structural Control	☒ Drought ☒ Earthquake ☒ Extreme Temperature ☒ Fire ☒ Flood ☒ Hail/Thunder/Wind ☒ Landslide/Subsidence ☒ Tornado ☒ Winter Storm/Ice ☒ Dam Failure ☒ HazMat Incident	☒ Safety and Security ☒ Food, Water, Shelter ☒ Health & Medical ☐ Energy ☐ Communications ☐ Transportation ☐ Hazardous Materials	**Ongoing** – 1. The EMA provides year-round outreach materials through social media. **Proposed Enhancements –** 1. Continue ongoing outreach efforts, providing additional materials as needed based on community needs and recent hazard events. Topics may include but not be limited to discussing the county's hazards; the meaning of the different tones when outdoor sirens are used, and shelter location information. 2. Encourage community member participation in the annual weatherization program to mitigate damages from severe storms and winter weather. 3. Explore the viability of establishing a hazard outreach component to a future Mobile Integrated Healthcare Program in Starke County	High #1-2 Medium #3	Moderate	EMA Starke County EMS and Hospital	FEMA HMGP Grants and Materials District Health Coalition Donations Foundation Grants
Emergency Preparedness and Warning 1. Maintain a centralized system for testing, maintenance, and operation of outdoor warning sirens. 2. Institute Reverse 911 (2009 measure) 3. Schedule additional training for the fire departments, focusing on fighting wildfires and muck fires. 4. Identify the needs and concerns of underserved and disadvantaged populations during disasters such as tornados, extreme temperatures, summer and winter storms, etc. 5. Assure emergency radio and back up communications can reach all first responders throughout the county. 6. Purchase weather radios for all schools within the county	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☐ Structural Control	☒ Drought ☒ Earthquake ☒ Extreme Temperature ☒ Fire ☒ Flood ☒ Hail/Thunder/Wind ☒ Landslide/Subsidence ☒ Tornado ☒ Winter Storm/Ice ☒ Dam Failure ☒ HazMat Incident	☒ Safety and Security ☒ Food, Water, Shelter ☒ Health & Medical ☐ Energy ☒ Communications ☐ Transportation ☐ Hazardous Materials	**Ongoing –** 1. Schools and critical facilities have received weather alert radios. **Proposed Enhancements –** 1. Inventory existing outdoor warning siren units. Assess needs for each unit, make needed repairs and/or updates, and maintain for future readiness. 2. Explore available reverse 911 systems, identifying costs and benefits of each. Procure the system that best meets County needs. 3. Continue annual fire training especially for muck and wildland fires. 4. Survey the county's elderly and special needs populations to identify additional assistance needed in an emergency. 5. Upgrade or add additional radio towers for emergency communications to boost signals and ensure coverage throughout the county. 6. Continue to distribute weather radios to the community as funds, or units become available.	High # 1, 3 - 5 Medium #2 Low #6	High to Moderate	EMA 911/ Communications Center Township, City, and Town Fire Chiefs	IDHS Foundation Grants General Budget Community Foundation Grants USDA and/or DNR Forestry Special Interest Groups/ Fraternal Organizations
Building Protection 1. Harden public buildings, critical facilities, and utilities to protect against earthquakes or other hazards. 2. Harden communications capabilities from electrical surges and damage.	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☐ Public Information ☒ Structural Control	☐ Drought ☒ Earthquake ☐ Extreme Temperature ☐ Fire ☐ Flood ☒ Hail/Thunder/Wind ☐ Landslide/Subsidence ☒ Tornado ☒ Winter Storm/Ice ☐ Dam Failure ☐ HazMat Incident	☒ Safety and Security ☐ Food, Water, Shelter ☒ Health & Medical ☒ Energy ☒ Communications ☐ Transportation ☐ Hazardous Materials	**Ongoing –** **Proposed Enhancements –** 1. Install inertial valves at critical facilities throughout the county. 2. Install lightning arrestors and surge protectors at radio towers to reduce damage from lightning and electrical surges.	High #2 Medium # 1	Moderate	EMA 911 Center	General Budget Insurance Company (refunds) IDHS HMGP Grants

Mitigation Practice	Mitigation Strategy	Hazard Addressed	Lifeline Addressed	Status	Priority	Benefit-Cost Ratio	Responsible Entity	Funding Source
Floodplain Management 1. Regularly maintain ditches to increase capacity and reduce flooding from rainfall. 2. Review and update existing community plans and ordinances to support hazard mitigation.	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☒ Structural Control	☐ Drought ☐ Earthquake ☐ Extreme Temperature ☐ Fire ☒ Flood ☐ Hail/Thunder/Wind ☒ Landslide/Subsidence ☐ Tornado ☐ Winter Storm/Ice ☐ Dam Failure ☐ HazMat Incident	☒ Safety and Security ☒ Food, Water, Shelter ☐ Health & Medical ☐ Energy ☐ Communications ☒ Transportation ☐ Hazardous Materials	**Ongoing –** **Proposed Enhancements –** 1. Regularly maintain ditches to increase capacity and reduce flooding from rainfall. 2. Encourage adoption of the new LTAP model Ordinances	High #1 Medium #2	High to Moderate	County Floodplain Administrator County Surveyor County Highway	INAFSM USDA DNR OCRA Surveyor Budget
Hazardous Materials 1. Conduct a commodity flow study along major roadways. 2. Continue LEPC reporting and training efforts as required through the SARA Title III and ensure current facility maps and response plans are on file for Tier II facilities.	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☐ Structural Control	☐ Drought ☐ Earthquake ☐ Extreme Temperature ☐ Fire ☐ Flood ☐ Hail/Thunder/Wind ☐ Landslide/Subsidence ☐ Tornado ☐ Winter Storm/Ice ☐ Dam Failure ☒ HazMat Incident	☒ Safety and Security ☒ Food, Water, Shelter ☒ Health & Medical ☐ Energy ☐ Communications ☒ Transportation ☒ Hazardous Materials	**Ongoing –** **Proposed Enhancements –** 1. Conduct a new commodity flow study along major roadways. 2. Maintain an active LEPC with regular meetings, continued training, and exercises.	High #2 Medium #1	High	LEPC Chair EMA All County Fire Chiefs	Tire II Funding HMEP Grants FEMA Training
Emergency Response and Recovery 1. Develop a debris management plan. (2009 Measure) 2. Study the use of dry hydrants within the county. (2009 Measure) 3. Explore communications options to provide consistent coverage countywide. 4. Explore and identify communications gaps that prevent the public and emergency personnel from reaching emergency communications. **5.** Develop an inventory and prioritization of emergency response equipment needs for deployment during hazardous events and procure as funds are available.	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☐ Property Protection ☒ Public Information ☐ Structural Control	☒ Drought ☒ Earthquake ☒ Extreme Temperature ☒ Fire ☒ Flood ☒ Hail/Thunder/Wind ☒ Landslide/Subsidence ☒ Tornado ☒ Winter Storm/Ice ☒ Dam Failure ☒ HazMat Incident	☒ Safety and Security ☒ Food, Water, Shelter ☒ Health & Medical ☐ Energy ☐ Communications ☐ Transportation ☐ Hazardous Materials	**Ongoing –** **Proposed Enhancements –** 1. Develop a debris management plan. 2. Identify locations where dry hydrants would be useful to fire departments. Install as funding is available. (1 is needed at Eagle Creek on 23). 3. Explore communications frequency options including range, cost and compatibility throughout the county. (VHF, 800 MHz, etc.) 4. Identify ownership of cell towers and coverage for community members and emergency services. 5. Evaluate equipment needs for incident response by EMS, Fire and Law Enforcement personnel during disaster events.	High #3-4 Medium #1, 5 Low #2	High	EMA All County Fire Chiefs Police Chiefs and Sherriff County Communication Committee	Health Grants DNR Grants Assistance to Firefighter Grants Foundation Grants IPSIC(State Communication Lead)
Power Back Up Generators **1.** Procure generators for all shelters within the county (2009 measure)	☒ Emergency Services ☐ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☐ Public Information ☐ Structural Control	☐ Drought ☒ Earthquake ☒ Extreme Temperature ☒ Fire ☒ Flood ☒ Hail/Thunder/Wind ☒ Landslide/Subsidence ☒ Tornado ☒ Winter Storm/Ice ☒ Dam Failure ☒ HazMat Incident	☒ Safety and Security ☒ Food, Water, Shelter ☒ Health & Medical ☐ Energy ☒ Communications ☐ Transportation ☐ Hazardous Materials	**Ongoing –** 1. Most shelters and government facilities now have generators. **Proposed Enhancements –** 1. Inventory power backup generators including shelters and warming centers. Identify those facilities needing generator hook ups for portable generators and those needing hookups and stationary generators.	Medium	Moderate	EMA Health Dept.	FEMA BRIC Grants State Revolving Loan Funds General Budget Donations

Mitigation Practice	Mitigation Strategy	Hazard Addressed	Lifeline Addressed	Status	Priority	Benefit-Cost Ratio	Responsible Entity	Funding Source
Safer Rooms and Community Shelters 1. Establish new shelters for the public.	☒ Emergency Services ☐ Nat. Res. Protection ☐ Prevention ☐ Property Protection ☐ Public Information ☒ Structural Control	☒ Drought ☒ Earthquake ☒ Extreme Temperature ☒ Fire ☒ Flood ☒ Hail/Thunder/Wind ☒ Landslide/Subsidence ☒ Tornado ☒ Winter Storm/Ice ☒ Dam Failure ☒ HazMat Incident	☒ Safety and Security ☒ Food, Water, Shelter ☐ Health & Medical ☐ Energy ☐ Communications ☐ Transportation ☐ Hazardous Materials	**Ongoing –** 1. The fire departments are set up for short term shelters. **Proposed Enhancements –** 1. Identify new additional shelters for the public.	Medium	Moderate	EMA Building Commissioner City and County	General Budget Churches/ Shelter Locations Donations
Community Rating System 1. Reduce flood insurance premiums through participation in NFIP Community Ratings System (CRS) program.	☒ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☒ Public Information ☐ Structural Control	☐ Drought ☐ Earthquake ☐ Extreme Temperature ☐ Fire ☒ Flood ☐ Hail/Thunder/Wind ☐ Landslide/Subsidence ☐ Tornado ☐ Winter Storm/Ice ☐ Dam Failure ☐ HazMat Incident	☒ Safety and Security ☐ Food, Water, Shelter ☐ Health & Medical ☐ Energy ☐ Communications ☐ Transportation ☐ Hazardous Materials	**Ongoing –** **Proposed Enhancements –** 1. Inform the Floodplain Administrators and Community leaders about the benefits of participation in the CRS program to reduce flood insurance premiums	Medium	High	EMA Floodplain Administrator	General Budget ISO Local Community Lead for Indiana FEMA
Management of High Hazard Dams 1. Maintain an awareness of Dam maintenance and regulatory issues.	☒ Emergency Services ☐ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☐ Public Information ☒ Structural Control	☐ Drought ☐ Earthquake ☐ Extreme Temperature ☐ Fire ☐ Flood ☐ Hail/Thunder/Wind ☐ Landslide/Subsidence ☐ Tornado ☐ Winter Storm/Ice ☒ Dam Failure ☐ HazMat Incident	☒ Safety and Security ☐ Food, Water, Shelter ☐ Health & Medical ☐ Energy ☐ Communications ☐ Transportation ☐ Hazardous Materials	**Ongoing –** 1. **Proposed Enhancements –** 1. Review inspection reports and encourage the completion of required improvements and repairs. 2. Work with Marshall County to encourage the development of an IEAP for Lake Latonka.	Medium #1 Low #2	High	EMA Marshall Co EMA County Commissioners	General Budget DNR Grant for IEAP
Stormwater 1. Maintain an awareness of the Stormwater Management Program requirements and best management practices.	☐ Emergency Services ☒ Nat. Res. Protection ☒ Prevention ☒ Property Protection ☐ Public Information ☒ Structural Control	☐ Drought ☐ Earthquake ☐ Extreme Temperature ☐ Fire ☒ Flood ☐ Hail/Thunder/Wind ☐ Landslide/Subsidence ☐ Tornado ☐ Winter Storm/Ice ☐ Dam Failure ☐ HazMat Incident	☒ Safety and Security ☒ Food, Water, Shelter ☒ Health & Medical ☐ Energy ☐ Communications ☐ Transportation ☐ Hazardous Materials	**Ongoing –** 1. **Proposed Enhancements –** 1. Explore the erosion and sediment control Best Management Practices (BMPs) identified in neighboring community MS4 plans and programs.	Low	Moderate to High	County and City Floodplain Managers County Highway Dept City Street Dept. City Utilities Dept.	General Budget

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5.0 IMPLEMENTATION PLAN

The following is a proposed plan for implementing all high priority mitigation practices identified in this Plan. It should be noted that implementation of each of these proposed practices may involve several preparatory or intermediary steps. However, to maintain clarity, not all preparatory or intermediary steps are included.

5.1 PUBLIC EDUCATION AND OUTREACH

Continue ongoing outreach efforts, providing additional materials as needed based on community needs and recent hazard events. Topics may include but not be limited to discussing the county's hazards; the meaning of the different tones when outdoor sirens are used, and shelter location information.

- Identify key outreach topics for each year based on community needs and past events.
- Prepare a calendar of outreach events to include special events, fairs, festivals, commemorative days/weeks/months (fire prevention week, severe storms week, etc.)
- Determine method for each selected outreach opportunity (social media, local radio, in person material distribution, presentations at various organizations and/or schools).
- Inventory existing outreach materials, identifying where additional materials are needed and order supplies for upcoming outreach events.
- Develop local materials/flyers, etc. to explain local challenges, needs or protocols such as when outdoor warning sirens are sounded, and which tones are used for fire calls vs severe weather.

Encourage community member participation in the annual weatherization program to mitigate damages from severe storms and winter weather.

- Work with home weatherization organizations to identify services provided and parameters for participation.
- Identify target audience for outreach efforts and determine the best methods to work jointly to reach the underserved and disadvantaged populations targeted by the programs.
- Using Emergency Management outreach opportunities familiarize community members of the severe weather and other natural hazard related benefits of weatherization program activities.

5.2 EMERGENCY PREPAREDNESS AND WARNING

Inventory existing outdoor warning siren units. Assess needs for each unit, make needed repairs and/or updates, and maintain for future readiness.

- Using existing maps create a written inventory of all outdoor warning sirens located throughout the county. The inventory should include location, ownership, who activates the unit, model number, age of unit, single or multiple tones, etc.
- Identify the current operational status of each unit in the inventory and any others identified. If repairs are needed, identify repair needs, potential vendors and cost estimate for repairs.

- Identify the needed maintenance, create a maintenance schedule and identify which entity will be responsible for the regular maintenance and testing of the sirens.
- Prepare a log of testing and maintenance activities, a copy of which should be maintained at the County EMA office.

Continue annual fire training especially for muck and wildland fires.

- Create a listing of desired training topics for fire department personnel as well as other first responders.
- Identify frequency of each topic based on number of personnel needing the training and area of county where training is needed.
- Identify host agency for training sessions and publicize open training events to county first responders.

Survey the county's elderly and special needs populations to identify additional assistance needed in an emergency.

- Working with EMS, Senior Citizen Organizations, Special needs organizations create a task group to create a survey of community members.
- Determine best methods to distribute survey (radio PSA, social media, local gathering places, churches, door to door in person visits, etc.)
- Evaluate responses and prepare a summary of needs for consideration.

Upgrade or add additional radio towers for emergency communications to boost signals and ensure coverage throughout the county.

- Delineate areas where EMS, fire and law enforcement radio communications coverage is marginal to poor or non-existent.
- Consult with experts in the field of radio communications to identify viable solutions such as signal boosters, repeaters, increasing height of existing structures, installation of new structures, etc. and costs for implementation of each viable solution.
- Prepare a summary of recommendations with potential solutions, and a do-nothing option. Identify costs as well as benefits of each including potential liabilities, and/or implementation challenges.

5.3 BUILDING PROTECTION

Install lightning arrestors and surge protectors at radio towers to reduce damage from lightning and electrical surges.

- Explore the options and methods to surge protection within the communications system beginning with the radio towers. Identify other areas where actions may be needed to protect the communications equipment and assure continuous coverage for all first response agencies within Starke County
- Identify the best method, cost for implementation as well as maintenance and funding source(s).
- Install the equipment and train personnel on proper operation and maintenance of the system.

5.4 FLOODPLAIN MANAGEMENT

Regularly maintain ditches to increase capacity and reduce flooding from rainfall.

- Identify key drainage ways (ditches) which play a role in the reduction of flooding from rainfall events. Working with the County Surveyor identify challenges causing the drainage way to have a reduction of capacity and possible solutions for each area.
- Establish a list of drains to be maintained, method of maintenance and frequency for maintenance needed.
- Determine if the County Surveyor has the capacity to address flood reduction needs. If not, identify how the capacity needs may be addressed.
- Working together, secure means to regularly maintain drainageways.

5.5 HAZARDOUS MATERIALS

Maintain an active LEPC with regular meetings, continued training, and exercises.

- Regularly schedule meetings and make the schedule available well in advance so committee members may block their calendars. Utilize the meeting time effectively so people can feel like their time is well spent at the meeting.
- Identify hazardous materials training needs within the county and offer training sessions for all personnel to attend.
- Schedule regular drills and exercises to test participants familiarity with the LEPC plan and response techniques and protocols. Use the outcomes of the drills and exercises to guide additional future training.

5.6 EMERGENCY RESPONSE AND RECOVERY

Explore communications frequency options including range, cost and compatibility throughout the county. (VHF, 800 MHz, etc.)

- Using the county communications team, become informed on all the options available to Starke County. This includes inviting a variety of vendors, and system users to share information about their equipment.
- Devise a list of shared questions and responses to examine the available emergency communications frequencies. In questions include topics such as compatibility with other systems, costs, reliability, ruggedness of equipment, and future needs and trends.
- Examine the viability of each option based on the departments/agencies needs, funding capabilities, maintenance capacity.

Identify ownership of cell towers and coverage for community members and emergency services.

- Inventory the cellular phone carriers who provide service in Starke County and the network used to provide the service.
- Identify the networks with the greatest coverage in Starke County
- Locate areas where signal strength is poor. Identify carriers for each poor signal area and determine if there are areas of overlap.

- Reach out to network representatives to determine what may be done to enhance coverage and improve signal.

Medium and low priority rated mitigation actions will have implementation strategies defined as the actions draw closer to implementation. Each of the categories below was rated at medium or low.

5.7 ENERGY SECURITY - POWER BACKUP GENERATORS

5.8 SAFE ROOMS AND SHELTERS

5.9 COMMUNITY RATING SYSTEM

5.10 MANAGEMENT OF HIGH HAZARD DAMS

5.11 STORMWATER

6.0 PLAN MAINTENANCE PROCESS

6.1 MONITORING, EVALUATING, AND UPDATING THE PLAN

REQUIREMENT §201.6(c)(4)(i):

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

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

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

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

- the agencies and other partners participated as originally proposed.

During the annual meetings, the Implementation Checklist provided in **Appendix 10** will be helpful to track any progress, successes, and problems experienced.

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

DMA 2000 requires local jurisdictions to update and resubmit their MHMP within five years (from the date of FEMA approval) to continue to be eligible for mitigation project grant funding. In Starke County, starting in early 2027, the EMA Director will need to reach out to IDHS to begin securing grant funding for the next planning cycle. Once the grant is approved by March 2029, the EMA Director will secure a contractor to assist with the planning process and will once again reconvene the MHMP Committee for a series of meetings designed to replicate the original planning process. Information gathered following individual hazard incidents and annual meetings will be utilized along with updated vulnerability assessments to assess the risks associated with each hazard common in Starke County. These hazards, and associated mitigation goals and practices will be prioritized and detailed as in Section 3.0 this MHMP. Sections 4.0 and 5.0 will be updated to reflect any practices implemented within the interim as well as any additional practices discussed by the Committee during the update process. The plan update process will incorporate new planning guidance and best practices as planning requirements are updated.

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

6.2 INCORPORATION INTO EXISTING PLANNING MECHANISMS

REQUIREMENT §201.6(c)(4)(ii):

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

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

6.3 CONTINUED PUBLIC INVOLVEMENT

REQUIREMENT §201.6(c)(4)(iii):

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

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

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

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

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