EMERGENCY MANAGEMENT
WARREN COUNTY

HAZARD MITIGATION PLAN 2022

Plan developed by
JEO Consulting Group

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LIST OF ACRONYMS

ACS – American Community Survey
BRIC – Building Resilient Infrastructure and Communities
BTS – Bureau of Transportation Statistics
CDC – Centers for Disease Control and Prevention
CF – Cubic Feet
CFR – Code of Federal Regulations
COVID-19 – Coronavirus Disease 2019
CRS – Community Rating System
CWPP – Community Wildfire Protection Plans
CyanoHABs – Cyanobacterial Harmful Algae Blooms
DMA 2000 – Disaster Mitigation Act of 2000
EAB – Emerald Ash Borer
EAP – Emergency Action Plan
EPA – Environmental Protection Agency
ESL – English as Second Language
FBI – Federal Bureau of Investigation
FEMA – Federal Emergency Management Agency
FIRM – Flood Insurance Rate Map
FMA – Flood Mitigation Assistance Program
FR – FEMA's Final Rule
FRA – Federal Railroad Administration
GIS – Geographic Information Systems
HMA – Hazard Mitigation Assistance
HMGP – Hazard Mitigation Grant Program
HMP – Hazard Mitigation Plan
HPSA – Health Professional Shortage Areas
HPRCC – High Plains Regional Climate Center
HRSA – Health Resources and Services Administration
IDALS – Iowa Department of Agriculture and Land Stewardship
IDNR – Iowa Department of Natural Resources
IDOT – Iowa Department of Transportation
HSEMD - Iowa Department of Homeland Security and Emergency Management
JEO – JEO Consulting Group, Inc.
LGA – Liquid Gallons
MUA – Medically Underserved Areas
MUP – Medically Underserved Populations
NCEI – National Centers for Environmental Information
NDMC – National Drought Mitigation Center
NFIP – National Flood Insurance Program
NOAA – National Oceanic and Atmospheric Administration
NPI – Nonpharmaceutical Interventions
NRC – National Response Center
NTSB - National Transportation Safety Board
NWS – National Weather Service
PDSI – Palmer Drought Severity Index
PHMSA – U.S. Pipeline and Hazardous Material Safety Administration
Risk MAP – Risk Mapping, Assessment, and Planning
RMA – Risk Management Agency
SBA – Small Business Administration
SPIA – Sperry-Piltz Ice Accumulation Index
START – National Consortium for the Study of Terrorism and Responses to Terrorism
TORRO – Tornado and Storm Research Organization
USACE – United States Army Corps of Engineers
USDA – United States Department of Agriculture
USGS – United States Geological Survey
WHO – World Health Organization

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EXECUTIVE SUMMARY

Introduction

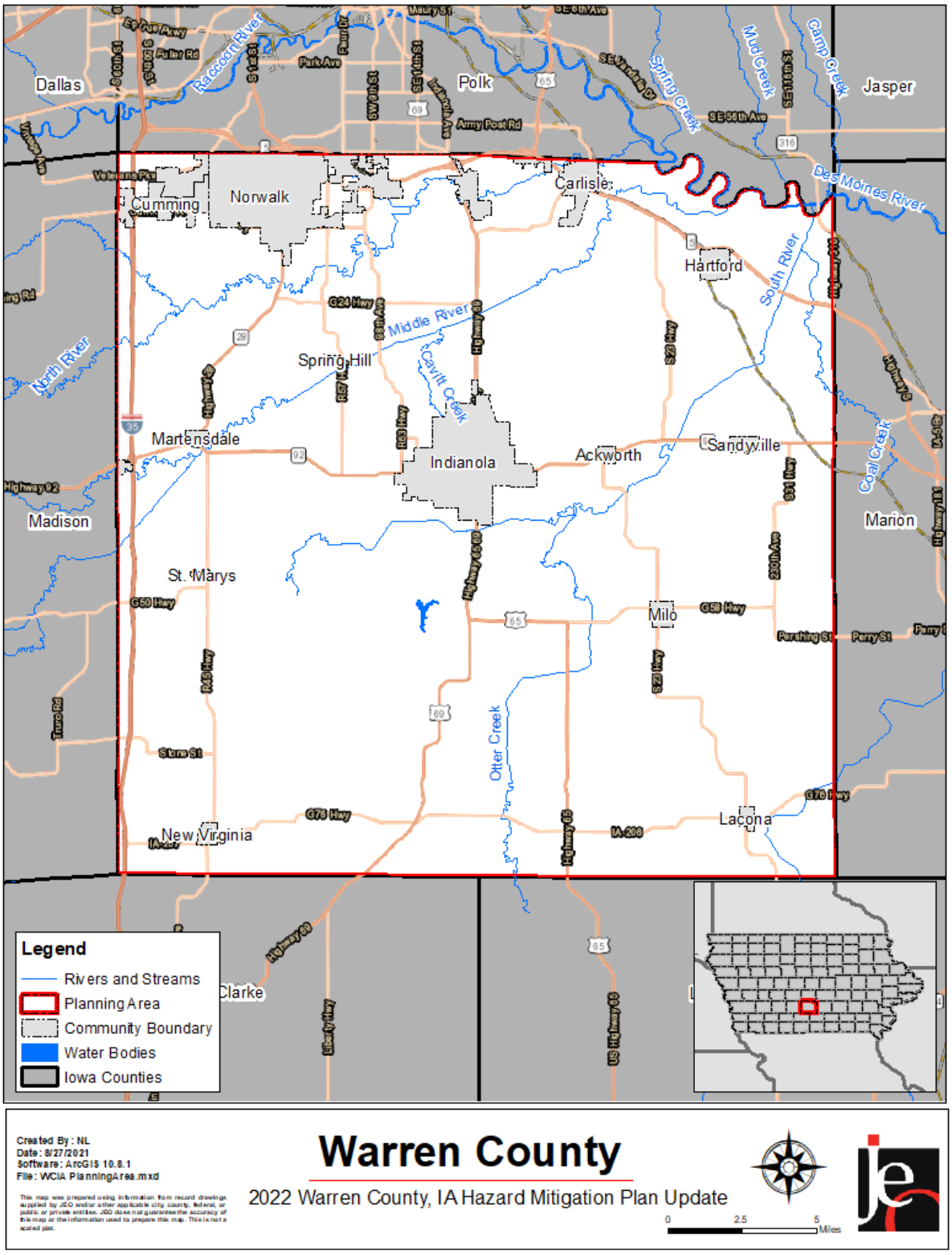
This plan is an update to the Warren County, Iowa Hazard Mitigation Plan (HMP) approved in 2017. The plan update was developed in compliance with the requirements of the Disaster Mitigation Act of 2000 (DMA 2000).

Hazard mitigation planning is a process in which hazards are identified and profiled; people and facilities at-risk are identified and assessed for threats and potential vulnerabilities; and strategies and mitigation measures are identified. Hazard mitigation planning increases the ability of communities to effectively function in the face of natural and human-caused disasters. The goal of the process is to reduce risk and vulnerability, in order to lessen impacts to life, the economy, and infrastructure. Plan participants are listed in the following table and illustrated in the following planning area map.

Table 1: Participating Jurisdictions

Participating Jurisdictions	
Warren County	City of New Virginia
City of Carlisle	City of Norwalk
City of Cumming	City of St. Marys
City of Hartford	Indianola Community School District
City of Indianola	Martensdale-St. Marys Community School District
City of Lacona	Norwalk Community School District
City of Martensdale	Simpson College
City of Milo	Warren Water District

Figure 1: Project Area



Goals and Objectives

The potential for disaster losses and the probability of occurrence of natural and human-caused hazards present a significant concern for the jurisdictions participating in this plan. The driving motivation behind this hazard mitigation plan is to reduce vulnerability and the likelihood of impacts to the health, safety, and welfare of all citizens in the planning area. To this end, the Hazard Mitigation Planning Team reviewed and approved goals which helped guide the process of identifying both broad-based and community-specific mitigation strategies and projects that will, if implemented, reduce their vulnerability, and help build stronger, more resilient communities.

Goals from the 2017 HMP were reviewed, and the Hazard Mitigation Planning Team agreed that they are still relevant and applicable for this plan update. Jurisdictions that participated in this plan update agreed that the goals identified in 2017 would be carried forward and utilized for the 2022 plan, with some additional changes. The goals for this plan update are as follows:

Goal 1: Reduce the Extent of Fatalities and Injuries Due to Hazards

Objective 1.1: Improve countywide warning capabilities against hazards

Objective 1.2: Provide education programs and exercises to first responders and general public about hazards and how to respond

Objective 1.3: Implement non-structural projects that will result in protection of life and safety

Objective 1.4: Implement structural projects that will result in protection of life and safety

Objective 1.5: Ensure proper and adequate equipment for first responders

Goal 2: Reduce the extent of property losses due to hazards on existing properties

Objective 2.1: Improve public infrastructure and critical assets in hazard impact areas

Objective 2.2: Use the most effective approaches to protect buildings from flooding, including acquisition or relocation where warranted

Objective 2.3: Use the most effective approaches to protect buildings from other hazards using both structural and non-structural projects

Objective 2.4: Develop hazard specific plans, conduct studies or assessments to mitigate for hazards and minimize their impact

Goal 3: Improve public response to hazards and make recovery easier

Objective 3.1: Enhance the continuity of government during and after storms

Objective 3.2: Enhance cross-agency and intra- and inter-county communications

Objective 3.3: Review and then either continue, enhance, or establish mutual aid agreements, training, and exercises

Objective 3.4: Ensure the mitigation plan is reviewed and updated as needed

Objective 3.5: Develop or improve Emergency Response Plans, procedures, and abilities; increase the capability to respond.

Goal 4: Improve quality of life in the community

Objective 4.1: Investigate and plan for how mitigation can improve public services and recreation opportunities

Objective 4.2: Ensure that current owners can maintain and improve their properties

Goal 5: Be as efficient as possible with government funding

Objective 5.1: Prioritize mitigation projects, starting with sites facing the greatest threat of life, health, and property, and for critical assets

Objective 5.2: Use public funding on private property only when the benefits exceed the costs

Objective 5.3: Maximize the use of outside sources of funding

Objective 5.4: Maximize owner participation in mitigation efforts to protect their own properties and encourage property-owner self-protection measures

Goal 6: Reduce the extent of property losses due to hazards on future properties

Objective 6.1: Minimize and control the impact of hazard events through enacting or updating ordinances, permits, laws, or regulations.

Objective 6.2: Update maps and ordinances and educate the public on development policies that prevent development where it should not be located

Goal 7: Enhance Overall Resilience and Promote Sustainability

Objective 7.1: Incorporate Hazard Mitigation and Adaptation into Updating Other Existing Planning Endeavors (e.g., Comprehensive Plans, Zoning Ordinance, Subdivision Regulations, etc.)

Summary of Changes

During each plan update, the hazard mitigation planning process undergoes several changes to accommodate the planning area and specific conditions best. Changes from the 2017 Hazard Mitigation Plan and planning process in this update included: greater efforts to reach and include stakeholder groups; effort to include all taxing authorities as participants; a more specific hazard risk assessment applicable to the planning area; the combination of severe thunderstorms, hail, and lightning; the combination of tornadoes and windstorms; changing extreme heat to extreme temperatures; changing human disease to pandemic disease and putting an emphasis on cyber security in the terrorism profile. For this plan update, changes were made to mitigation action language by consolidating and revising titles and descriptions of mitigation actions to be more consistent and improve clarity. This update also works to unify the various planning mechanisms in place throughout the participating communities (i.e. comprehensive plans, local emergency operation plans, zoning ordinances, building codes, etc.) to ensure that the goals and objectives identified in those planning mechanisms are consistent with the strategies and projects included in this plan. Other changes are described in the table below.

Table 2: 2017 Plan Comments and Revisions

Comment/Revision from 2017 Review Tool	Location of Revision	Summary of Change
The Iowa Flood Center has produced a number of non-regulatory flood risk maps that include information such as flood risk gradients, flood depths across 8 recurrence intervals and scour-prone areas that the planning team is highly encouraged to incorporate into future plans.	Section 4, Participant Sections	Flood inundation risk gradients and flood depth maps for each community were added to participant sections where applicable. Maps for scour-prone areas were added to the Warren County participant section.
Future plans could be improved by including a discussion on the specifics on how public review comments were incorporated into the plan.	Section 2	A table for public review revisions has been added to section 2 to outline how comments from public review were incorporated into the HMP.
Future updates could benefit from greater specificity as to how each individual jurisdiction intends to keep the public informed and engaged in the plan's implementation, monitoring and evaluation.	Participant Sections	A plan maintenance section has been added to each jurisdiction's profile to outline who will review the plan, how often the planning team will review the plan, and how the public will be included in the review and revision process.
Greater discussion as to how each community prioritized mitigation activities would give insight into the deliberative process and serve as a foundation for future decision making.	Section 5	Jurisdictions were encouraged to look first at Capital Improvement Plans, master plans, etc. to include and select projects that had already been deemed a high priority because the project had funding allocated or were supported by the community. Then identified projects were given a feasibility review using the Social, Technical, Administrative, Political, Legal, Economic, Environmental (STAPLEE) to prioritize projects.
Several jurisdictions have one or more actions in their mitigation strategies that are emergency response or operational preparedness in nature (e.g., purchase of fire equipment; training/exercise). These need not be removed from the plan, but are not considered mitigation actions. In future updates, jurisdictions are encouraged to focus their strategies on mitigation projects, particularly those eligible for funding under HMA. Additionally, mitigation strategies should include specific projects or actions to reduce or eliminate long-term risk from hazards. Ongoing maintenance activities are not specific projects, nor can their progress be measured. In future updates, the planning team should consider removing these actions.	Section 5, Participant Sections	During public meetings, JEO discussed how maintenance projects are not mitigation actions. Participants were encouraged to identify mitigation-specific projects, especially if they needed funding. Participants were also encouraged to look into other resources to prioritize those projects. A review of past mitigation actions led to combining language to reduce the number of emergency response and preparedness mitigation projects and activities.

Due to the coronavirus disease 2019 (COVID-19), some adjustments were made to the planning process to accommodate plan meeting dates and requirements appropriately. A hybrid meeting style was used for all public meetings so they could be held both in person and virtually online. Additional changes are described in Section Two.

Plan Implementation

Various communities across the planning area have implemented hazard mitigation projects following the 2017 Hazard Mitigation Plan. A few examples of completed projects include improving warning systems, reducing tree damage, becoming a member of Tree City USA, purchasing equipment, mapping infrastructure, and others. In order to build upon these prior successes and to continue implementation of mitigation projects, despite limited resources, communities will need to continue relying upon multi-agency coordination as a means of leveraging resources. Communities across the region have been able to work with a range of entities to complete projects; potential partners for future project implementation include but are not limited to: Iowa Department of Homeland Security and Emergency Management (HSEMD), Iowa Department of Transportation (IDOT), Iowa Department of Natural Resources (IDNR), United States Department of Agriculture (USDA), and United States Army Corps of Engineers (USACE).

Hazard Profiles

The hazard mitigation plan includes a description of the hazards considered, including a risk and vulnerability assessment. Data considered during the risk assessment process include: historic occurrences and recurrence intervals; historic losses (physical and monetary); impacts to the built environment (including privately-owned structures as well as critical facilities); and the local risk assessment. The following tables provide an overview of the risk assessment for each hazard and the losses associated with each hazard.

Table 3: Hazard Occurrences

Hazard		Previous Occurrence Events/Years	Approximate Annual Probability	Likely Extent	
Agricultural Disease		Animal: Unavailable Plant: 8/21	Unknown Plant 24%	Unknown Crop damage or loss	
Dam Failure		0/109	Less than 1%	Varies by structure	
Drought		484/1,513 months	32%	D1-D4	
Earthquakes		0/120	Less than 1%	Less than 5.0 on the Richter Scale	
Expansive Soils		Unknown	Unknown	Varies by extent	
Extreme Temperatures	Cold	Avg. 4 Days a Year	61%	≤ 10°F	
	Heat	Avg. 3 Days a Year	31%	≥100°F	
Flooding		138/26	73%	Some inundation of structures (47% of structures) and roads near streams. Some evacuations of people may be necessary (64% of population)	
Grass/Wildfires		82/13	83%	Avg 7.78 acres Some homes and structures threatened or at risk	
Hazardous Materials Release		51/51	61%	Avg Liquid Spill	i.e. 302 gal
				Avg Gas Spill	i.e. 182 gal
Infrastructure Failure		Unknown	Unknown	Varies by extent	
Levee Failure		0/120	Less than 1%	Varies by extent	
Pandemic Disease		~12,069 cases	N/A	N/A	
Severe Thunderstorms		517/26	96%	≤7.5” rainfall Avg 67 mph winds	
Severe Winter Storms		68/26	92%	0.25” – 1” Ice 25°-35° below zero (wind chill) 3-15” snow 15-53 mph winds	
Sinkholes		Unknown	Unknown	Varies by location/event	
Terrorism		0/48	Less than 1%	Varies by event	

Hazard	Previous Occurrence Events/Years	Approximate Annual Probability	Likely Extent
Tornadoes and Windstorms	51/26	58%	Avg: EF0 Range EF0-EF3
Transportation Incidents	7,539/60	100%	Damages incurred to vehicles involved and traffic delays; substantial damages to aircrafts involved with some aircrafts destroyed

The following table provides loss estimates for hazards with sufficient data. Description of major events are included in *Section Seven: Community Profiles.*

Table 4: Hazard Loss History

Hazard Type		Count	Property	Crop[2]
Agricultural Disease	Animal Disease	Unknown	N/A	N/A
	Plant Disease[1]	8	N/A	$75,115
Dam Failure[2]		0	N/A	N/A
Drought[3]		484 of 1,513 months	$0	$17,814,741
Earthquakes[4]		0	N/A	N/A
Expansive Soils		Unknown	N/A	N/A
Extreme Temperatures[5]	Cold (≤ 0°F)	Avg. 4 Days a Year	$0	$31,581
	Heat (≥ 100°F)	Avg. 3 Days a Year	N/A	$949,447
Flooding[6]	Flash Flood	38	$2,550,000	$6,072,395
	Flood	100	$6,766,500	
Grass/Wildfire[7]		82	655 acres	N/A
Hazardous Materials Release[8]	Fixed Site[8]	34	$350,000	N/A
	Transportation[9]	17	$203,635	N/A
Infrastructure Failure		Unknown	N/A	N/A
Levee Failure[10]		0	N/A	N/A
Pandemic Disease		~12,069 cases	N/A	N/A
Severe Thunderstorms[6] *7 injuries, 1 death*	Thunderstorm Wind Range (mph): 55-109 Average (mph): 67	178	$3,146,000	$25,506,941
	Hail Range (in): 0.75-3.5 Average (in): 1.16	228	$1,488,000	
	Heavy Rain	106	$12,000	
	Lightning	5	$191,500	

Hazard Type		Count	Property	Crop[2]
Severe Winter Storms[6]	Blizzard	11	$360,000	$632,591
	Heavy Snow	20	$3,855,000	
	Ice Storm	11	$393,330	
	Winter Storm	25	$499,900	
	Winter Weather	1	$0	
Sinkholes		Unknown	N/A	N/A
Terrorism[11]		0	$0	N/A
Tornadoes and Windstorms[6]	Tornadoes Range: EF0-EF3 Average: EF0	23	$815,110	$709,391
	Windstorms Range (mph): 40-70 Average(mph): 55	28	$3,077,500	$0
Transportation Incidents	Auto[12]	7,521	N/A	N/A
	Aviation[13]	7	N/A	N/A
	Highway Rail[14]	11	$43,500	N/A
Total		**8,453**	**$23,751,975**	**$51,792,203**

N/A: Data not available
1 – USDA RMA, 2000-2020
2 - IDNR Communication, 2021
3 - NOAA, 1895 - October 2021
4 - USGS, 1900 - August 2021
5 – NOAA Regional Climate Center, 1893 - July 2021
6 - NCEI, 1996 - July 2021
7 - IDNR Communication, 2021
8 - NRC, 1990 - August 2021
9 - PHMSA, 1971 - August 2021
10 - USACE NLD, 1900 - July 2020
11 – University of Maryland, 1970 – 2018
12 – IDOT, 2011-2021
13 - NTSB, 1962 – 2019
14 - FRA, 1975- August 2021

Events like agricultural disease, extreme heat, wildfires, severe thunderstorms, and severe winter storms will occur annually. Other hazards like drought, dam failure, and terrorism will occur less often. The scope of events and how they will manifest themselves locally is not known regarding hazard occurrences. Historically, drought, flooding, and severe thunderstorms have resulted in the most significant damages within the planning area. These hazards are summarized below.

Drought

Drought is a regular and reoccurring phenomenon in the planning area and the State of Iowa. Historical data shows that drought has occurred with regularity across the planning area and recent research indicates that trend will continue and potentially intensify. The most common impacts of drought affect the agricultural sector. Over $17 million in total crop loss was reported for the planning area since 2000.

Prolonged drought events can have a profound effect on the planning area and individual communities within it. Expected impacts from prolonged drought events include but are not limited to economic loss in the agricultural sector; loss of employment in the agricultural sector; and limited water supplies (drinking and fire suppression).

Flooding

Flash flooding and riverine flooding are common for the planning area due to the regular occurrence of severe thunderstorms in spring and summer. The proximity of rivers to many communities and aged or undersized stormwater drainage infrastructure can also contribute to

flooding. Flooding can occur on a local level, affecting only a few streets but may also extend throughout an entire district, affecting whole drainage basins. The NCEI recorded 138 flooding events in 26 years across the planning area. These events caused over $9 million in property damages.

Severe Thunderstorms

Severe thunderstorms are one of the costliest hazards in the planning area. Thunderstorms are generally large in magnitude, have a long duration, and travel across large areas and through multiple jurisdictions within a single region. Additionally, thunderstorms often occur in series, with one area potentially impacted multiple times in one day and producing a range of associated hazards, including strong winds, heavy rain, and lightning strikes. Severe thunderstorms are most likely to occur between May and September, with the highest number of events happening in September. The NCEI recorded 517 severe thunderstorm events in 26 years across the planning area. These events caused over $4 million in property damages. Typical impacts resulting from severe thunderstorms include but are not limited to: loss of power; obstruction of transportation routes; grass/wildfires starting from lightning strikes; localized flooding; and damages discussed in the hazard profiles for hail and high winds.

Vulnerable populations related to severe thunderstorms include residents of mobile homes (4% of housing units in the county), citizens with decreased mobility, and those caught outside during storm events. Most residents within the planning area are familiar with severe thunderstorms and know how to prepare and respond to events appropriately.

Mitigation Strategies

There are a wide variety of strategies that can be used to reduce the impacts of hazards for the built environment and planning area residents. *Section Five: Mitigation Strategy* shows the mitigation actions chosen by the participating jurisdictions to assist in preventing future losses.

SECTION ONE: INTRODUCTION

Hazard Mitigation Planning

Severe weather and hazardous events are occurring more frequently in our daily lives. Pursuing mitigation strategies reduces risk and is socially and economically responsible to prevent long-term risks from natural and human-caused hazard events.

FEMA definition of Hazard Mitigation

"Any sustained action taken to reduce or eliminate the long-term risk to human life and property from [natural] hazards."

Natural hazards, such as severe winter storms, high winds and tornadoes, severe thunderstorms, flooding, extreme heat, drought, agriculture diseases, and wildfires are part of the world around us. Human-caused hazards are a product of the society and can occur with significant impacts to communities. Human-caused hazards can include dam failure, hazardous materials release, transportation incidents, and terrorism. These hazard events can occur as a part of normal operation or as a result of human error. All jurisdictions participating in this planning process are vulnerable to a wide range of natural and human-caused hazards that threaten the safety of residents and have the potential to damage or destroy both public and private property, cause environmental degradation, or disrupt the local economy and overall quality of life.

Warren County has prepared this multi-jurisdictional hazard mitigation plan in an effort to reduce impacts from natural and human-caused hazards and to better protect the people and property of the region from the effects of these hazards. This plan demonstrates a regional commitment to reducing risks from hazards and serves as a tool to help decision makers establish mitigation activities and resources. Further, this plan was developed to ensure the county and participating jurisdictions are eligible for federal pre-disaster funding programs and to accomplish the following objectives:

- Minimize the disruption to each jurisdiction following a disaster.
- Establish actions to reduce or eliminate future damages in order to efficiently recover from disasters.
- Investigate, review, and implement activities or actions to ensure disaster related hazards are addressed by the most efficient and appropriate solution.
- Educate citizens about potential hazards.
- Facilitate development and implementation of hazard mitigation management activities to ensure a sustainable community.

Disaster Mitigation Act of 2000

The U.S. Congress passed the Disaster Mitigation Act 2000 to amend the Robert T. Stafford Disaster Relief and Emergency Assistance Act[1]. Section 322 of the DMA 2000 requires that state and local governments develop, adopt, and routinely update a hazard mitigation plan to remain eligible for pre- and post-disaster mitigation funding.[2] These funds currently include the Hazard Mitigation Grant Program (HMGP)[3], Building Resilient Infrastructure and Communities (BRIC)[4], and the Flood Mitigation Assistance Program (FMA)[5]. The Federal Emergency Management Agency (FEMA) administers these programs under the Department of Homeland Security.[6]

This plan was developed in accordance with current state and federal rules and regulations governing local hazard mitigation plans. The plan shall be monitored and updated on a routine basis to maintain compliance with the legislation – Section 322, Mitigation Planning, of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as enacted by Section 104 of the DMA 2000 (P.L. 106-390)[7] and by FEMA's Final Rule (FR)[8] published in the Federal Register on November 30, 2007, at 44 Code of Federal Regulations (CFR) Part 201.

Hazard Mitigation Assistance

On June 1, 2009, FEMA initiated the Hazard Mitigation Assistance (HMA) program integration, which aligned certain policies and timelines of the various mitigation programs. These HMA programs present a critical opportunity to minimize the risk to individuals and property from hazards while simultaneously reducing the reliance on federal disaster funds.

Each HMA program was authorized by separate legislative actions, and as such, each program differs slightly in scope and intent.

Mitigation is the cornerstone of emergency management. Mitigation focuses on breaking the cycle of disaster damage, reconstruction, and repeated damage. Mitigation lessens the impact disasters have on people's lives and property through damage prevention, appropriate development standards, and affordable flood insurance. Through measures such as avoiding building in damage-prone areas, stringent building codes, and floodplain management regulations, the impact on lives and communities is lessened.

- FEMA Mitigation Directorate

- **HMGP:** To qualify for post-disaster mitigation funds, local jurisdictions must have adopted a mitigation plan that is approved by FEMA. HMGP provides funds to states, territories, Indian tribal governments, local governments, and eligible private non-profits following a presidential disaster declaration. The DMA 2000 authorizes up to seven percent of HMGP funds available to a state after a disaster to be used for the development of state, tribal, and local mitigation plans.

1 Federal Emergency Management Agency, Public Law 106-390. 2000. "Disaster Mitigation Act of 2000." Last modified September 26, 2013. https://www.fema.gov/media-library/assets/documents/4596.
2 Federal Emergency Management Agency. June 2007. "Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended, and Related Authorities." Federal Emergency Management Agency 592: 22. Sec. 322. Mitigation Planning (42 U.S.C. 5165). https://www.fema.gov/media-library/assets/documents/15271
3 Federal Emergency Management Agency. "Hazard Mitigation Grant Program." Last modified July 8, 2017. https://www.fema.gov/hazard-mitigation-grant-program.
4 Federal Emergency Management Agency. "Building Resilient Infrastructure and Communities." Last modified July 10, 2020. https://fema.gov/bric.
5 Federal Emergency Management Agency. "Flood Mitigation Assistance Grant Program." Last modified July 11, 2017. https://www.fema.gov/flood-mitigation-assistance-grant-program.
6 Federal Emergency Management Agency. "Hazard Mitigation Assistance." Last modified March 29, 2017. https://www.fema.gov/hazard-mitigation-assistance.
7 Federal Emergency Management Agency: Federal Register. 2002. "Section 104 of Disaster Mitigation Act 2000: 44 CFR Parts 201 and 206: Hazard Mitigation Planning and Hazard Mitigation Grant Programs; Interim Final Rule." https://www.fema.gov/pdf/help/fr02-4321.pdf.
8 Federal Emergency Management Agency: Federal Register. 2002 "44 CFR Parts 201 and 206: Hazard Mitigation Planning and Hazard Mitigation Grant Programs; Interim Final Rule." https://www.fema.gov/pdf/help/fr02-4321.pdf.

- **FMA:** To qualify to receive grant funds to implement projects such as acquisition or elevation of flood-prone homes, local jurisdictions must prepare a mitigation plan. Furthermore, local jurisdictions must be participating communities in the National Flood Insurance Program (NFIP). The goal of FMA is to reduce or eliminate claims under the NFIP.

- **BRIC:** To qualify for funds, local jurisdictions must adopt a mitigation plan that is approved by FEMA. BRIC assists states, territories, Indian tribal governments, and local governments in implementing a sustained pre-disaster hazard mitigation program.

Plan Financing and Preparation

Regarding the plan financing and preparation, Warren County is the “sub-applicant” that is the eligible entity that submits a sub-application for FEMA assistance to the “Applicant”. The “Applicant” in this case is the State of Iowa. If HMA funding is awarded, the sub-applicant becomes the “sub-grantee” and is responsible for managing the sub-grant and complying with program requirements and other applicable federal, state, territorial, tribal, and local laws and regulations.

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SECTION TWO: PLANNING PROCESS

Introduction

The process utilized to develop a hazard mitigation plan is often as important as the final planning document. For this planning process, Warren County adapted the four-step hazard mitigation planning process outlined by FEMA to fit the needs of the participating jurisdictions. The following pages will outline how the Hazard Mitigation Planning Team was established; the function of the Hazard Mitigation Planning Team; critical project meetings and community representatives; outreach efforts to the general public; key stakeholders and neighboring jurisdictions; general information relative to the risk assessment process; general information relative to local/regional capabilities; plan review and adoption; and ongoing plan maintenance.

Requirement §201.6(b): Planning process. An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:

(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;

(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia, and other private and non-profit interests to be involved in the planning process; and

(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

Requirement §201.6(c)(1): The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

Multi-Jurisdictional Approach

According to FEMA, "A multi-jurisdictional hazard mitigation plan is a plan jointly prepared by more than one jurisdiction." The term 'jurisdiction' means 'local government.' Title 44 Part 201, Mitigation Planning in the CFR, defines a 'local government' as "any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments, regional or interstate government entity, or agency or instrumentality of a local government; any Indian tribe or authorized tribal organization, any rural community, unincorporated town or village, or other public entity." For the purposes of this plan, a 'taxing authority' was utilized as the qualifier for jurisdictional participation. FEMA recommends the multi-jurisdictional approach under the DMA 2000 for the following reasons.

- It provides a comprehensive approach to the mitigation of hazards that affect multiple jurisdictions.
- It allows economies of scale by leveraging individual capabilities and sharing cost and resources.
- It avoids duplication of efforts.
- It imposes an external discipline on the process.

Warren County utilized the multi-jurisdictional planning process recommended by FEMA (Local Mitigation Plan Review Guide[9], Local Mitigation Planning Handbook[10], and Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards[11]) to develop this plan.

Hazard Mitigation Planning Process

The hazard mitigation planning process as outlined by FEMA has four general steps which are detailed in the figure below. The mitigation planning process is rarely a linear process. It is common that ideas developed during the initial risk assessment may need revision later in the process, or that additional information may be identified while developing the mitigation plan or during plan implementation that results in new goals or additional risk assessments.

Organization of Resources

- Focus on the resources needed for a successful mitigation planning process. Essential steps include: Organizing interested community members; and Identifying technical expertise needed.

Assessment of Risk

- Identify the characteristics and potential consequences of the hazard. Identify how much of the jurisdiction can be affected by specific hazards and the potential impacts on local assets.

Mitigation Plan Development

- Determine priorities and identify possible solutions to avoid or minimize the undesired effects. The result is the hazard mitigation plan and strategy for implementation.

Plan Implementation and Progress Monitoring

- Bring the plan to life by implementing specific mitigation projects and changing day-to-day operations. It is critical that the plan remains relevant to succeed. Thus, it is important to conduct periodic evaluations and revisions, as needed.

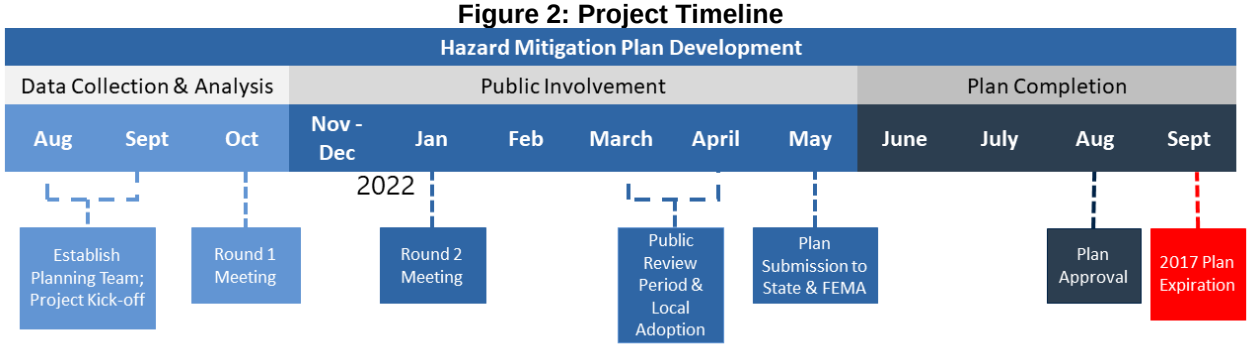
Organization of Resources

Plan Update Process

Warren County financed their multi-jurisdictional hazard mitigation plan in July 2021 through the Warren County Emergency management Commission Budget. JEO Consulting Group, INC. (JEO) was contracted in July 2021 to guide and facilitate the planning process and assemble the multi-jurisdictional hazard mitigation plan. For the planning area, Troy Bass with Warren County Emergency Management led the development of the plan and served as the primary point of contact throughout the project. A clear timeline of this plan update process is provided in Figure 2.

9 Federal Emergency Management Agency. 2011. "Local Mitigation Plan Review Guide." https://www.fema.gov/media-library/assets/documents/23194.
10 Federal Emergency Management Agency. 2013. "Local Mitigation Planning Handbook." https://www.fema.gov/media-library/assets/documents/31598.
11 Federal Emergency Management Agency. 2013. "Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards." https://www.fema.gov/media-library-data/20130726-1904-25045-0186/fema_mitigation_ideas_final508.pdf.

Figure 2: Project Timeline



Planning Team

At the beginning of the planning process, Warren County and JEO staff identified who would be the regional Hazard Mitigation Planning Team. This planning team was established to guide the planning process and review the existing plan. A list of planning team members can be found in Table 5. Staff from HSEMD, IDNR, and IDOT provided additional technical support.

Table 5: Hazard Mitigation Planning Team

Name	Title	Jurisdiction
Aaron Hurt	Fire Captain	City of Indianola
Brad Prichard	Mayor	City of Martensdale
Brent Baughman	Deputy City Clerk	City of New Virginia
Chris Frerichs	Director of Security	Simpson College
Crystal McIntyre	Supervisor	Warren County
Dave Judd	Public Works Supervisor	City of Lacona
David Carrol	Engineer	Warren County
Deven Markley	City Administrator	City of Carlisle
Diane Hall	Mayor	City of Milo
Jennifer Porter	Fire Chief	City of Norwalk
Jessica Smith	Deputy Clerk	City of Cumming
Joe Carico	Sheriff	Warren County
Kandi Petry	Mayor	City of Hartford
Karie Ellwanger	Assistant Zoning Administrator	Warren County
Lou Elbert	Water Superintendent	Indianola Municipal Utilities
Mike Metcalf	Electric Superintendent	Indianola Municipal Utilities
Stan Ripperger	Systems Manager	Warren Water District
Troy Bass	Emergency Manger	Warren County
***Becky Appleford**	Project Coordinator	JEO Consulting Group
***Kayla Vondracek**	Lead Planner	JEO Consulting Group

**Served as a consultant or advisory role.*

A kick-off meeting was held on August 31, 2021 in Indianola, Iowa to discuss an overview of the planning process between JEO staff and members of the Hazard Mitigation Planning Team. Preliminary discussion was held over hazards to be included in this plan, changes to be incorporated since the last plan, goals and objectives, identification of key stakeholders to include in the planning process, and a general schedule for the plan update. This meeting also assisted in clarifying the role and responsibilities of the Hazard Mitigation Planning Team and strategies for public engagement throughout the planning process. Table 6 shows kick-off meeting attendees.

Table 6: Kick-off Meeting Attendees

Name	Title	Jurisdiction
Brent Baughman	Clerk	City of New Virginia
Chris Frerichs	Director of Security	Simpson College
Crystal McIntyre	Supervisor	Warren County
Karie Ellwanger	Assistant Zoning Administrator	Warren County
Lou Elbert	Water Superintendent	Indianola Municipal Utilities
Mike Metcalf	Electric Superintendent	Indianola Municipal Utilities
Troy Bass	Emergency Manager	Warren County
Becky Appleford	Project Coordinator	JEO Consulting Group
Kayla Vondracek	Lead Planner	JEO Consulting Group

Table 7 shows the date, location, and agenda items of for the kick-off meeting.

Table 7: Kick-off Meeting Location and Time

Location and Time	Agenda Items
Indianola, IA August 31, 2021 10:00am	-Consultant and planning team responsibilities -Overview of plan update process and changes from 2017 HMP -Review and adoption of goals and objectives -Plan goals/objectives -Hazard identification -Project schedule and dates/locations for public meetings

Public Involvement and Outreach

To notify and engage the public in the planning process, a wide range of stakeholder groups were contacted and encouraged to participate. There were 20 stakeholder groups or entities that were identified and sent letters to participate. Any comments these stakeholders provided were incorporated into the appropriate community profiles (see *Section Seven*). The general public was encouraged to participate through the project website by providing comments to the Hazard Mitigation Planning Team members. No comments were received from the general public.

Table 8: Notified Stakeholder Groups

Organizations		
Carlisle Care Center for Wellness and Rehab -	North & Middle Rivers Watershed Management Authority	Warren County Economic Development Corporation
Carlisle Center For Assisted Living	Norwalk Nursing and Rehabilitation Center	Warren County Economic Development Corporation
Good Samaritan Society - Indianola	Regency Assisted Living	Warren County Economic Development Corporation
Indianola Chamber of Commerce	Regency Care Center - Norwalk	Warren County Health Services
Iowa Department of Natural Resources	The Village - Indianola	Westview Of Indianola Care Center
Mercy Indianola Medical Clinic	UnityPoint Clinic Family Medicine - Norwalk	Windsor Manor Indianola
Mercy Norwalk Medical Clinic	Vintage Hills Retirement Community	

Neighboring Jurisdictions

Neighboring jurisdictions were notified and invited to participate in the planning process. The following table indicates which neighboring communities or entities were notified of the planning process. Invitation and informational letters were sent to county clerks, county, and regional emergency managers. Jurisdictions outside of the planning area did not participate in the planning process.

Table 9: Notified Neighboring Jurisdictions

Notified Neighboring Jurisdictions	
Clarke County	Marion County
Lucas County	Polk County
Madison County	

Participant Involvement

Participants play a key role in identifying hazards, providing a record of historical disaster occurrences and localized impacts, identifying and prioritizing potential mitigation projects and strategies, and the developing annual review procedures.

To be a participant in the development of this plan update, jurisdictions were required to have, at a minimum, one representative present at the Round 1 or Round 2 meeting or attend a follow-up meeting with a JEO staff member. Some jurisdictions sent multiple representatives to meetings. For jurisdictions who had only one representative, they were encouraged to bring meeting materials back to their governing bodies, to collect diverse input on their jurisdiction's meeting documents. Jurisdictions that were unable to attend the scheduled public meetings were able to request a meeting with JEO staff to satisfy the meeting attendance requirement. This effort enabled jurisdictions which could not attend a scheduled public meeting to participate in the planning process.

Outreach to eligible jurisdictions included notification prior to all public meetings, phone calls and email reminders of upcoming meetings, and reminders to complete worksheets required for the planning process. Table 10 provides a summary of outreach activities utilized in this process.

Table 10: Outreach Activity Summary

Action	Intent
Project Website	Informed the public and local/planning team members of past, current, and future activities (https://jeo.com/warrencounty-HMP).
Round 1 Meeting Letters and Emails (30-day notification)	Sent to participants, stakeholders, and neighboring jurisdictions to discuss the agenda/dates/times/ locations of the first round of public meetings.
Round 2 Meeting Letters and Emails (30-day notification)	Sent to participants to discuss the agenda/dates/times/locations of the second round of public meetings.
Notification Phone Calls	Called potential participants to remind them about upcoming meetings.
Follow-up Emails and Phone Calls	Correspondence was provided to remind and assist participating jurisdictions with the collection and submission of required local data.
Project Flyer	Flyers were posted about the Warren County HMP and how to get involved. Flyers were shared with all Hazard Mitigation Planning team members to distribute.
Word-of-Mouth	Staff discussed the plan with jurisdictions throughout the planning process.

Round 1 Meetings: Hazard Identification

At the Round 1 meetings, jurisdictional representatives (i.e., the local planning teams) reviewed the hazards identified at the kick-off meeting and conducted risk and vulnerability assessments based on these hazards' previous occurrence and the communities' exposure. (For a complete list of hazards reviewed, see *Section Four: Risk Assessment.)*.

Due to COVID-19 numbers across Iowa, the Round 1 meeting was held via a hybrid format with both an in-person and online attendance option via YouTube Live. The hybrid option was done to protect the health of residents and staff members in the planning area and to help reduce the spread of the virus. Table 11 shows the date and location of the Round 1 meeting.

Table 11: Round 1 Meeting Date and Location

Agenda Items	
General overview of the HMP update process, discuss participation requirements, begin the process of risk assessment and impact reporting, update critical facilities, capabilities assessment, and status update on current mitigation projects	
Location and Time	**Date**
Hybrid Meeting In Person or Online Warren County Administration Building 2nd Floor Board Room, 301 N Buxton Indianola, IA 50125	Tuesday, October 26, 2021

The intent of these meetings was to familiarize local planning team members with the plan update process, expected actions for the coming months, the responsibilities of being a participant, and to collect preliminary information to update the HMP. Data collected at these meetings included: updates to mitigation actions from the 2017 Warren County HMP; identify the top concerns from each jurisdiction; and to begin reviewing and updating community profiles for demographics, capabilities, and critical facilities. Information/data reviewed include but was not limited to local hazard prioritization results; identified critical facilities and their location within the community; future development areas; and expected growth trends (refer to *Appendix B*).

The following tables show the attendees for each jurisdiction who attended a Round 1 meeting or had a one-on-one discussion with JEO staff. Follow-up one-on-one meetings were held for communities who did not have representatives present at public meetings either through watching a recording of the meeting or via conference call with a member of the Hazard Mitigation Planning Team.

Table 12: Round 1 Meeting Attendees

Name	Title	Jurisdiction
Hybrid Meeting – Tuesday, October 26, 2021		
Bernie Brueck	Facilities Director	Indianola Community School District
Brad Criswell	School Resource Officer	Norwalk Community School District
Chris Frerichs	Director of Security	Simpson College
Chris Truman	Council Member	City of New Virginia
Crystal McIntyre	Supervisor	Warren County
Dave Judd	Public Works Supervisor	City of Lacona
David Carroll	Engineer	Warren County
Diane Hall	Mayor	City of Milo

Name	Title	Jurisdiction
Dianne Chambers	School Nurse	Southeast Warren Community School District
Doug Richardson	Firefighter/Paramedic	City of Norwalk/Norwalk Fire Department
Eric Wallace	Fire Chief	City of Lacona/Lacona Fire Department
Gregory Chia	Fire Chief	City of Indianola/Indianola Fire Department
Jenn Porter	Fire Chief	City of Norwalk/Norwalk Fire Department
Brent Baughman	Clerk	City of New Virginia
Jessica Smith	Deputy Clerk	City of Cumming
Jodene DeVault	Administrator	Warren County Health Services
Joe Carico	Sheriff	Warren County
Joe Thompson	IT Engineer I	Warren County
Kandi Petry	Mayor	City of Hartford
Kate Honer	Environmental Health Coordinator	Warren County Health Services
Mark Wilson	Conservation Board Member	Warren County
Scott Henson	Fire Chief/Council Member	City of Martensdale/Martensdale Fire Department
Stan Ripperger	Systems Manager	Warren Water District
Ted Bauer	Business Manager	Interstate 35 Community School District
Troy Bass	Emergency Manager	Warren County
Becky Appleford	Project Coordinator	JEO Consulting Group
Kayla Vondracek	Lead Planner	JEO Consulting Group

Table 13: Round 1 One-on-One Meeting Attendees or Watched Video Recording

Name	Title	Jurisdiction
Aaron Hurt	Fire Captain	City of Indianola/ Indianola Fire Department
Chuck Gehringer	Mayor	City of St. Marys
Trent Christensen	Maintenance Director	Martensdale-St Marys CSD

Round 2 Meetings: Mitigation Strategies

Round 2 meetings are designed to identify and prioritize mitigation measures and evaluate potential integration of the HMP alongside other local planning mechanisms. Mitigation actions and plan integration are essential components in effective hazard mitigation plans. Participating jurisdictions were asked to identify any new mitigation actions to pursue alongside continued actions from the 2017 HMP and provide copies or descriptions of current jurisdictional plans in which hazard mitigation goals and principals can be integrated. Participating jurisdictions were also asked to review the information collected from the Round 1 meeting related to their community through this planning process for accuracy. Information/data reviewed included but was not limited to local hazard prioritization results, identified critical facilities and their location within the community, future development areas, and expected growth trends (refer to *Appendix B*).

There was also a brief discussion about the planning process, when the plan would be available for public review and comment, annual review of the plan, and the approval and grant opportunities available once the plan was approved. As with Round 1 meetings, any jurisdictions unable to attend were given the opportunity to have a one-on-one phone conference with the

consultant or view a recording of the meeting in order to meet plan participation requirements and complete required information.

Due to the continuation of the COVID-19 Pandemic, Round 2 meetings were again held via a hybrid option to protect the health of participants and help reduce the spread of the virus. Table 14 shows the date and location of the Round 2 meeting. Meeting attendees are identified in Table 15 and Table 16.

Table 14: Round 2 Meeting Date and Location

Agenda Items	
Identify new mitigation actions, review of local data and community profile, discuss review process, discuss available grants and eligibility, and complete plan integration tool.	
Location and Time	**Date**
Hybrid Meeting In Person or Online Warren County Administration Building 2nd Floor Board Room, 301 N Buxton Indianola, IA 50125	Wednesday, February 16, 2022

Table 15: Round 2 Meeting Attendees

Name	Title	Jurisdiction
Hybrid Meeting – Wednesday, February 16, 2022		
Bernie Brueck	Facilities Director	Indianola Community Schools
Brent Baughman	City Clerk	City of New Virginia
Brett Shiver	Mayor	City of Spring Hill
Chris Frerichs	Director of Security	Simpson College
Chris Truman	Council Member	City of New Virginia
Dave Judd	Public Works Supervisor	City of Lacona
David Carroll	Engineer	Warren County
Diane Hall	Mayor	City of Milo
Doug Richardson	Firefighter/Paramedic	Norwalk Fire Department
Drew Merrifield	Mayor	City of Carlisle
Eric Wallace	Fire Chief	City of Lacona
Gregory Chia	Fire Chief	Indianola Fire Department
Kandi Petry	Mayor	City of Hartford
Kate Honer	Environmental Health Coordinator	Warren County Health Services
Mike Metcalf	Electric Superintendent	Indianola Municipal Utilities
Scott Henson	Council member/Fire Chief	City of Martensdale
Scott Ourth	Mayor	City of Ackworth
Stan Ripperger	Systems Manager	Warren Water District
Troy Bass	Emergency Manager	Warren County
Becky Appleford	Project Coordinator	JEO Consulting Group

Table 16: Round 2 One-on-One Meeting Attendees or Watched Video Recording

Name	Title	Jurisdiction
Cory Glover	Fire Chief	City of Carlisle
Deven Markley	City Administrator	City of Carlisle
Matt Koch	Police Chief	City of Carlisle
Tony Rinehart	Water/Sewer Foreman	City of Carlisle
Tommy Thompson	Water Superintendent	City of Carlisle

Name	Title	Jurisdiction
Chuck Gehringer	Mayor	City of St. Marys
Trent Christensen	Maintenance Director	Martensdale-St Marys CSD

Public Review

Once the draft of the HMP was completed, a public review period was opened to allow for participants and community members at large to review the plan and provide comments and changes, if any at that time. The public review period was open from April 18, 2022 to May 20, 2022. Participating jurisdictions were emailed and mailed a letter notifying them of this public review period. The HMP was also made available on the project website (https://jeo.com/warrencounty-HMP) to download the document. Minor changes (e.g. critical facility changes, mitigation status updates, etc.) were submitted by community representatives that have participated throughout the planning process and were incorporated into the final document. There were no general public comments submitted.

Plan Adoption and Implementation

Based on FEMA requirements, this multi-jurisdictional hazard mitigation plan must be formally adopted by each participant through approval of a resolution. This approval will create individual ownership of the plan by each participant. Formal adoption provides evidence of a participant's full commitment to implement the plan's goals, objectives, and action items. A copy of the resolution draft submitted to participating jurisdictions is located in *Appendix A*. Copies of adoption resolutions may be requested from Iowa Homeland Security and Emergency Management.

Requirement §201.6(c)(5): For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.

Hazard mitigation plans are living documents. Once an HMP has been adopted locally, participants are responsible for implementing identified projects, maintaining the plan with relevant information, and fully updating the plan every five years. The plan must be monitored, evaluated, and updated on a five-year or less cycle. Those who participated directly in the planning process would be logical champions during the annual reviews and five-year cycle update of the plan. It is critical the plan be reviewed and updated annually or when a hazard event occurs that significantly affects the area or individual participants. These annual reviews are the responsibility of each jurisdiction's local planning team and should be documented and reflected in the plan via amendments. However, participants are encouraged to work alongside the plan sponsor, Warren County, or the consultant, JEO, to document updates and revise the HMP.

Additional implementation of the mitigation plan should include integrating HMP goals, objectives, and mitigation actions into county and local comprehensive or capital improvement plans as they are developed or updated. *Section Six* describes the system that jurisdictions participating in the HMP have established to monitor the plan; provides a description of how, when, and by whom the HMP process and mitigation actions will be evaluated; presents the criteria used to evaluate the plan; and explains how the plan will be maintained and updated.

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SECTION THREE: PLANNING AREA PROFILE

Introduction

To identify jurisdictional vulnerabilities, it is vitally important to understand the people and built environment of the planning area. The following section is meant to provide an overall description of the planning area's characteristics to create a summary profile for the region. Specific characteristics are covered in each jurisdiction's community profile, including demographics, transportation routes, and structural inventory. Redundant information will not be covered in this section. Therefore, this section will highlight at-risk populations and characteristics of the built environment that add to regional vulnerabilities.

Planning Area Geographic Summary

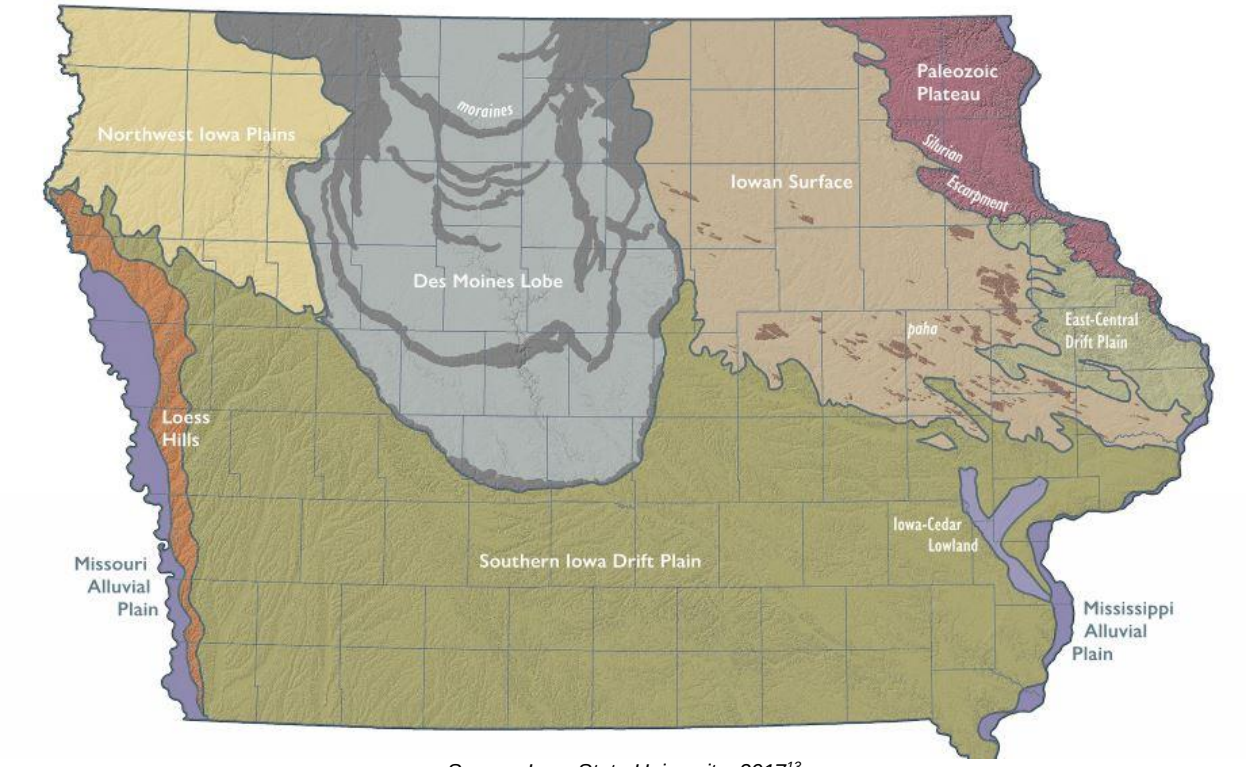
Warren County's planning area includes the south-central portion of Iowa and spans 573 square miles. For the purpose of this plan update, the planning area includes all of Warren County. The planning area resides in the Southern Iowa Drift Plain topographic region, which is the largest of all of Iowa's landform regions (Figure 3). The Southern Iowa Drift Plain is made up of glacial deposits left by ice sheets over 500,000 years ago. Across the landscape, rills, creeks, and rivers branch out and shape the old glacial deposits into rolling hills and valleys.[12,13]

The region resides in the Lake Red Rock watershed. Main waterways in the planning area include the Middle and South Rivers and Lake Ahquabi. The Middle River is a tributary of the Des Moines River, which creates the boundary in the northeast corner of Warren County.

12 Iowa State University Geographic Information Systems Support & Research Facility. 2022. "Iowa – Landforms Regions and Features." https://www.arcgis.com/apps/mapviewer/index.html?layers=6e1858f40e6545ec9f15538cc8c65180

13 Iowa Geological Survey. 2017. "Landform Regions of Iowa." https://www.iihr.uiowa.edu/igs/publications/uploads/2017-04-27_15-04-11_em44.pdf

Figure 3: Iowa's Landforms and Regions



Source: Iowa State University, 2017[13]

Demographics and At-Risk Populations

As noted above, the planning area includes Warren County. The U.S. Census Bureau collects specific demographic information for each county in Iowa, and marked the 2020 population for the county at 52,403.[14] The planning area has displayed an increasing population since 1980 (Figure 4).

Table 17: Estimated Population for Planning Area

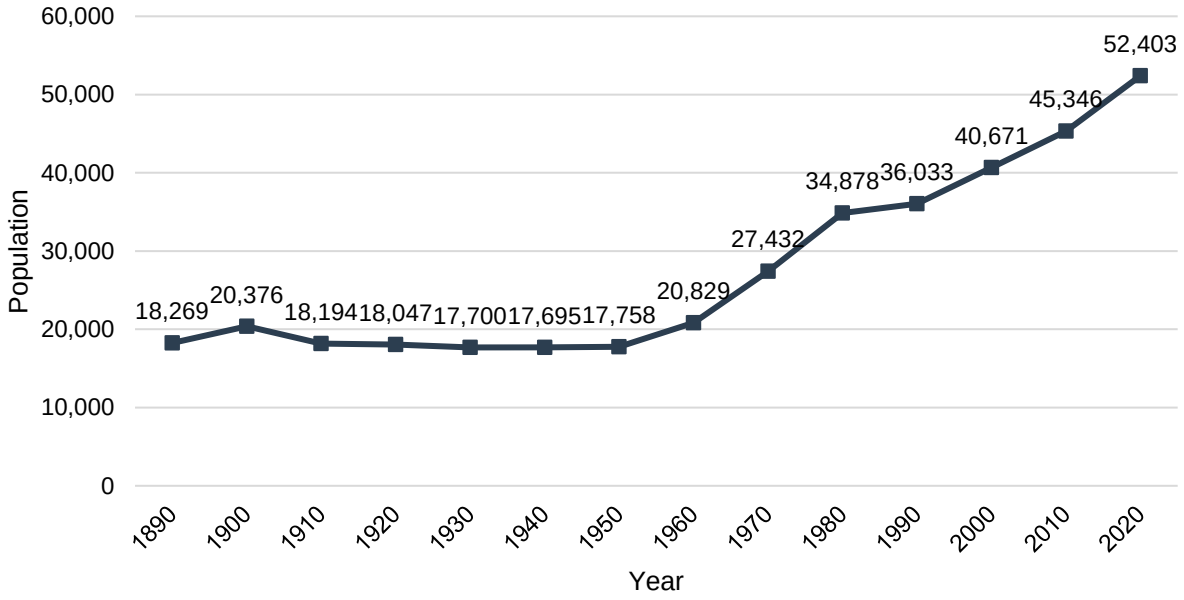
Age	Planning Area	State of Iowa
<5	6.0%	6.3%
5-19	27.9%	26.2%
20-64	56.6%	57.2%
>64	15.5%	16.7%
Median	38.3	38.2

Source: U.S. Census Bureau

Community and regional vulnerability are impacted by growing or declining populations. Communities growing quickly may lack resources to provide services for all members of the community in a reasonable timeframe including snow removal, emergency storm shelters, repairs to damaged infrastructure, or even tracking the location of vulnerable populations. Communities experiencing population decline may be more vulnerable to hazards as a result of vacant and/or dilapidated structures, an inability to properly maintain critical facilities and/or infrastructure, and higher levels of unemployment and populations living in poverty. It is important for communities to monitor their population changes and ensure that potential issues be incorporated into hazard mitigation plans, as well as other planning mechanisms within the community.

14 United States Census Bureau. "2020 Decennial Census: P1: DEC Redistricting Data." https://data.census.gov/cedsci/.

Figure 4: Planning Area Population, 1890-2020



Source: U.S. Census Bureau[15]

At-risk Populations

In general, at-risk populations may have difficulty with medical issues, poverty, extremes in age, and communication issues due to language barriers. Several outliers may be considered when discussing potentially at-risk populations, including:

- Outward appearance does not necessarily mark a person as at-risk;
- A hazard event will, in many cases, impact at-risk populations in different ways.

The National Response Framework defines at-risk populations as "…populations whose members may have additional needs before, during, and after an incident in functional areas, including but not limited to: maintaining independence, communication, transportation, supervision, and medical care."[16]

Dependent children under 20 years old are one of the most vulnerable populations to disasters.[17] The majority of people in this age group do not have access to independent financial resources and transportation. They lack practical knowledge necessary to respond appropriately during a disaster. Despite this vulnerability, children are generally overlooked in disaster planning because the presence of a caretaker is assumed. With approximately 34% of the planning area's population younger than 20, children are a key vulnerable group to address in the planning process.

Schools house a high number of children and adults within the planning area during the daytime hours of weekdays, as well as during special events on evenings and weekends. The following

15 United States Census Bureau. "2020 Decennial Census: P1: DEC Redistricting Data." https://data.census.gov/cedsci/.

16 United States Department of Homeland Security. October 2019. "National Response Framework Third Edition." https://www.fema.gov/media-library/assets/documents/117791.

17 Flanagan, Gregory, Hallisey, Heitgerd, & Lewis. 2011. "A Social Vulnerability Index for Disaster Management." Journal of Homeland Security and Emergency Management, 8(11): Article 3.

table identifies the various school districts located within the planning area, and Figure 5 is a map of the school district boundaries.

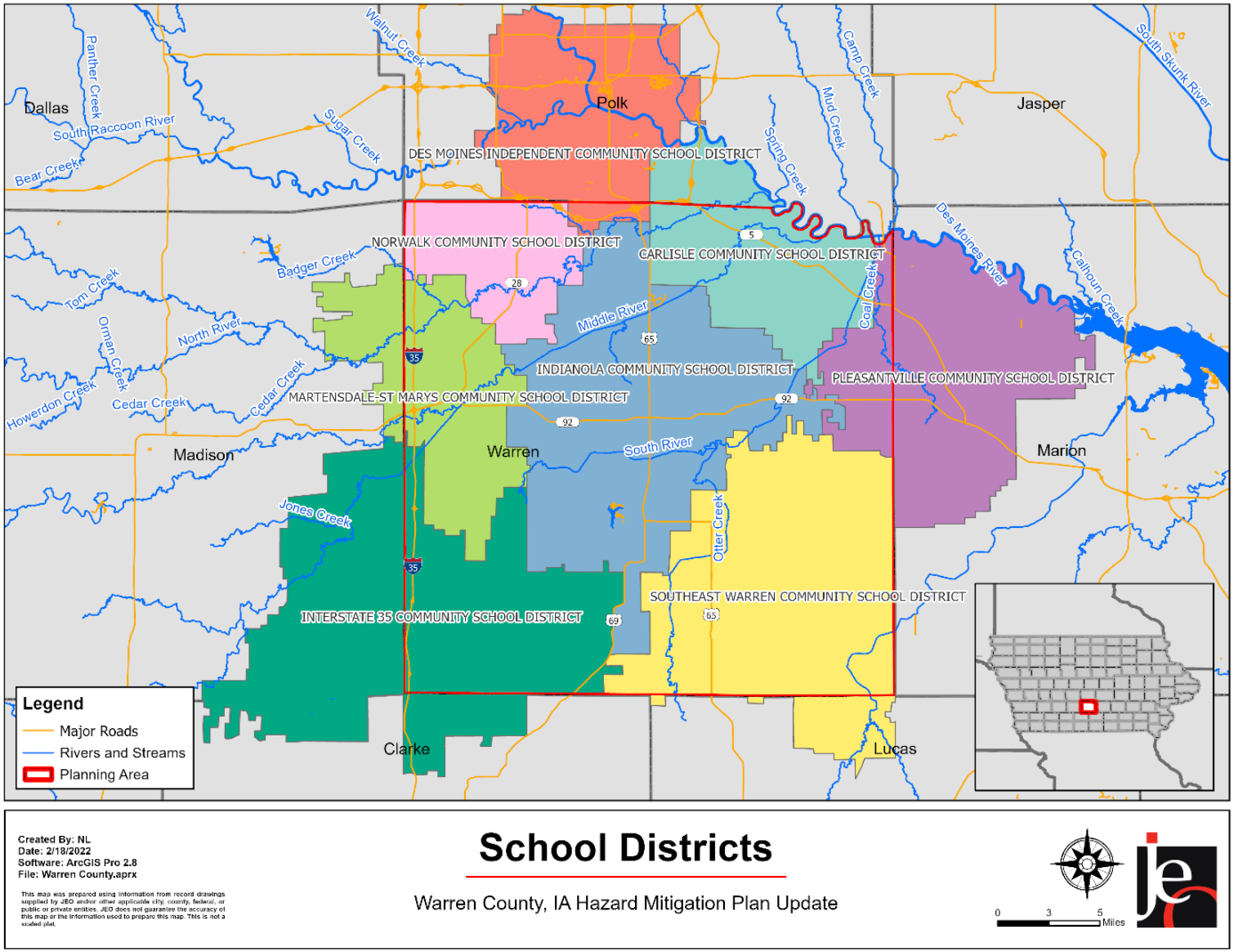
Table 18: School Inventory

School District	Total Enrollment (2020-2021)	Total Teachers
Carlisle Schools	2,262	149
Indianola Schools	3,612	238
Martensdale-St Marys Schools	552	45
Norwalk Schools	3,353	227
Southeast Warren Schools	493	46

Source: Iowa Department of Education[18]

18 Iowa Department of Education. 2021. "Education Statistics." Accessed December 2021. https://educateiowa.gov/data-reporting/education-statistics.

Figure 5: Regional School Districts



Like minors, seniors (age 65 and greater) are often more significantly impacted by hazards and temperature extremes. During prolonged heat waves or periods of extreme cold, seniors may lack resources to effectively address hazard conditions and as a result may incur injury or potentially death. Prolonged power outages (either standalone events or as the result of other contributing factors) can have significant impacts on any citizen relying on medical devices. One study conducted by the Center for Injury Research and Policy found that increases in vulnerability related to severe winter storms (with significant snow accumulations) begin at age 55.[19] The study found that on average there are 11,500 injuries and 100 deaths annually related to snow removal. Men over the age of 55 are 4.25 times more likely to experience cardiac events during snow removal.

While the previously identified populations live throughout the planning area, there is the potential that they will be located in higher concentrations at care facilities. Table 19 identifies the number and capacity of care facilities throughout the planning area.

Table 19: Inventory of Care Facilities

County	Hospitals	Hospital Beds	Health Clinics	Adult Care Homes	Adult Care Beds	Assisted Living Homes	Assisted Living Beds
Warren County	0	0	6	3	113	9	886

Source: Iowa Department of Inspections and Appeals[20], Warren County Health Services

In addition to residents being classified as at-risk by age, there are other specific groups within the planning area that experience vulnerabilities related to their ability to communicate or their economic status. Table 21 provides statistics for the county regarding households with English as a second language (ESL), and the population reported as "in poverty" within the past 12 months.

Table 20: ESL and Poverty At-Risk Populations

County	Percent That Speaks English as Second Language	Families Below Poverty Level
Warren County	2.4%	6.1%

Source: U.S. Census Bureau[21,22]

Residents below the poverty line may lack resources to prepare for, respond to, or recover from hazard events. Residents with limited economic resources might struggle to prioritize the implementation of mitigation measures over more immediate needs. Further, residents with limited economic resources are more likely to live in older, more vulnerable structures. These structures could be mobile homes; located in the floodplain; located in remote rural areas away from urban amenities; located near know hazard sites (i.e., chemical storage areas); or older poorly maintained structures. Residents below the poverty line will be more vulnerable to all hazards within the planning area.

Residents who speak English as a second language may struggle with a range of issues before, during, and after hazard events. General vulnerabilities revolve around what could be an inability to effectively communicate with others or an inability to comprehend materials aimed at notification and/or education of hazard events. When presented with a hazardous situation it is

19 Center for Injury Research and Policy. January 2011. “Snow Shoveling Safety.” Accessed July 2017. http://www.nationwidechildrens.org/cirp-snow-shoveling.
20 Iowa Department of Inspections and Appeals. 2021. "Direct Care Worker Registry & Health Facility Database." https://dia-hfd.iowa.gov/
21 U.S. Census Bureau. “2019 Census Bureau American Community Survey: S1601: Language Spoken at Home.” https://data.census.gov/cedsci/.
22 U.S. United States Census Bureau. “2019 Census Bureau American Community Survey: DP03: Selected Economic Characteristics.” https://data.census.gov/cedsci/.

important that all community members be able to receive, decipher, and act on relevant information. An inability to understand warnings and notifications may prevent non-native English speakers from acting in a timely manner. Further, educational materials related to regional hazards are most often developed in the dominant language for the area, for the planning area that would be English. Residents who struggle with English in the written form may not have sufficient information related to local concerns to effectively mitigate potential impacts. Residents with limited English proficiency would be at an increased vulnerability to all hazards within the planning area.

Similar to residents below the poverty line, racial minorities tend to have access to fewer financial and systemic resources that would enable them to implement hazard mitigation projects and to respond and recover from hazard events, including residence in standard housing and possession of financial stability. The mostly homogenous racial profile of the planning area indicates that racial inequity will not significantly affect the county's vulnerability to hazards (Table 21).

Table 21: Racial Composition Trends

Race	2010		2019		% Change
	Number	% of Total	Number	% of Total	
White, Not Hispanic	42,396	93.3%	48,092	96.0%	2.7%
Black	310	0.7%	260	0.5%	-0.2%
American Indian and Alaskan Native	42	0.1%	61	0.1%	0%
Asian	491	1.1%	348	0.7%	-0.4%
Native Hawaiian and Other Pacific Islander	0	0.0%	173	0.3%	0.3%
Other Races	1439	3.2%	347	0.7%	-2.5%
Two or More Races	759	1.7%	795	1.6%	-0.1%
Total Population	**45,437**	**6.7%**	**50,076**	**4.0%**	**-2.7**

Source: U.S. Census Bureau[23,24]

Built Environment and Structural Inventory

The U.S. Census provides information related to housing units and potential areas of vulnerability as described in the following discussion.

Of the occupied housing units in the planning area, more than 21 percent are renter occupied. Renter-occupied housing units often do not receive many of the updates and retrofits that are needed to make them resilient to disaster impacts. Communities may consider enacting landlord outreach programs aimed at educating property owners about the threats in their area and what they can do to help reduce the vulnerability of the tenants living in their housing units. The City of Indianola, the largest community in the planning area, has more than 34 percent of housing stock occupied by renters.

Approximately 3.7% of housing stock in the county is vacant. Unoccupied homes may not be maintained as well as occupied housing, thus adding to their vulnerability. During disaster events like high winds or tornadoes, these structures may fail and result in debris which can impact other structures as well as people, resulting in injuries or fatalities, as well as higher damage totals.

23 U.S. Census Bureau. 2021. "Race: 2010 ACS 5-year estimate." https://data.census.gov/cedsci/.
24 U.S. Census Bureau. 2021. "Race: 2019 ACS 5-year estimate." https://data.census.gov/cedsci/.

Table 22: Housing Characteristics

Jurisdiction	Total Housing Units				Occupied Housing Units			
	Occupied		Vacant		Owner		Renter	
	#	%	#	%	#	%	#	%
Warren County	19,258	96.3%	746	3.7%	15,215	79.0%	4,043	21.0%
Ackworth	83	100.0%	0	0%	45	54.2%	38	45.8%
Carlisle	1543	96.8%	51	3.2%	1144	74.1%	399	25.9%
Cumming	153	94.4%	9	5.6%	133	86.9%	20	13.1%
Indianola	284	95.6%	13	4.4%	264	93.0%	20	7.0%
Lacona	6196	96.0%	258	4.0%	4084	65.9%	2112	34.1%
Martensdale	156	92.3%	13	7.7%	119	76.3%	37	23.7%
Milo	204	93.2%	15	6.8%	144	70.6%	60	29.4%
New Virginia	337	98.3%	6	1.7%	270	80.1%	67	19.9%
Norwalk	196	90.7%	20	9.3%	144	73.5%	52	26.5%
Sandyville	4239	97.9%	93	2.1%	3322	78.4%	917	21.6%
Spring Hill	71	89.9%	8	10.1%	59	83.1%	12	11.2%
St. Marys	35	100.0%	0	0%	28	80.0%	7	20.0%
Planning Area	**32,780**	**94.4%**	**1,238**	**5.6%**	**24,993**	**77.4%**	**7,787**	**22.2%**

Source: U.S. Census Bureau[25]

The US Census provides information related to housing units and potential areas of vulnerability. The selected characteristics examined in Table 23 include lacking complete plumbing facilities; lacking complete kitchen facilities; no telephone service available; housing units that are mobile homes; and housing units with no vehicles.

Table 23: Selected Housing Characteristics

	Warren County
Occupied Housing Units	19,258 (96.3%)
Lacking Complete Plumbing Facilities	0.2%
Lacking Complete Kitchen Facilities	0.8%
No Telephone Service Available	1.3%
No Vehicles Available	3.4%
Mobile Homes	3.8%

Source: U.S. Census Bureau, 2019[26]

Approximately 1.3 percent of housing units lack access to landline telephone service. This does not necessarily indicate that there is not a phone in the housing unit, as cell phones are now the primary form of telephone service. However, this lack of access to landline telephone service does represent a population at increased risk to disaster impacts. Reverse 911 systems are designed to contact households via landline services and as a result, some homes in hazard prone areas may not receive notification of potential impacts in time to take protective actions. Emergency managers should continue to promote the registration of cell phone numbers with Reverse 911 systems. The AlertIowa system is a free service offered by Warren County and the

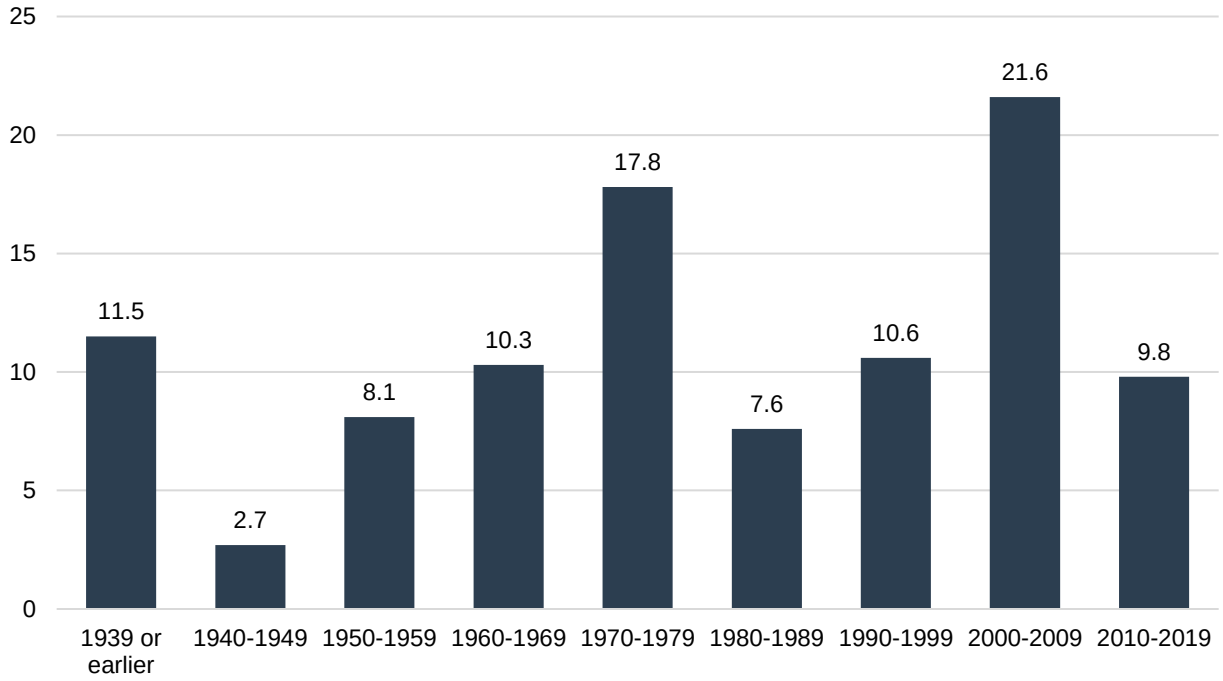
25 U.S. Census Bureau. 2021. "Selected Housing Characteristics: 2019 ACS 5-year estimate." https://data.census.gov/cedsci/.
26 U.S. Census Bureau. 2021. "Selected Housing Characteristics: 2019 ACS 5-year estimate." https://data.census.gov/cedsci/.

State of Iowa and is available for many communities and residents to use in the planning area. This opt-in program sends emergency alerts and hazard event updates to email addresses and cellular devices located within specific geographical areas based on cell tower reception. Additionally, emergency managers, the National Weather Service, and other government agencies can utilize FEMA's Integrated Public Alert and Warning System (IPAWS) to send emergency alerts and weather warnings to cellphones within a designated area. Notifications are sent to all cellphone users within specific geographical areas without needing to opt-in.

Approximately 3.8 percent of housing units in the planning area are mobile homes. In the county, the City of Sandyville has the highest rate of mobile homes in its housing stock at 22.9 percent. Mobile homes have a higher risk of sustaining damages during high wind events, tornadoes, severe thunderstorms, and severe winter storms. Mobile homes that are either not anchored or are anchored incorrectly can be overturned by 60 mph winds. A thunderstorm is classified as severe when wind speeds exceed 58 mph, placing improperly anchored mobile homes at risk. Furthermore, approximately 3.4 percent of all housing units in the planning area do not have a vehicle available. Households without vehicles may have difficulty evacuating during a hazardous event and a reduced ability to access resources in times of need.

The majority of homes within the planning area were built prior to 1990 (58%), with 12% of homes built prior to 1939 (Figure 6). Housing age can serve as an indicator of risk, as structures built prior to the development of state building codes may be more vulnerable. Residents living in these homes maybe at higher risk to the impacts of high winds, tornadoes, severe winter storms, and thunderstorms.

Figure 6: Housing Age in Planning Area



Source: U.S. Census Bureau[27]

27 United States Census Bureau. 2019. "DP04: Selected Housing Characteristics". https://data.census.gov/cedsci/.

State and Federally Owned Properties

The following table provides an inventory of state and federally owned properties within the planning area.

Table 24: State and Federally Owned Facilities

Facility	Nearest Community
Warren County	
Banner Flats Wildlife Management Area	Indianola, IA
Lake Ahquabi State Park	Indianola, IA
Heritage Hills Wildlife Management Area	St. Marys, IA
Hooper Wildlife Management Area	Indianola, IA
North River Wildlife Management Area	Norwalk, IA
Red Rock Wildlife Management Area	Carlisle, IA

Source: Iowa Department of Natural Resources,[28] U.S National Park Service[29]

Simpson College is a private four-year liberal arts institution located in south-central Iowa. The college was founded in 1860 and is affiliated with the United Methodist Church and led by a board of trustees. The college has campuses in Polk and Warren Counties, with one located in Indianola and one located in West Des Moines. Neither campus is located in a floodplain. Simpson College has 1,138 enrolled full-time students and 130 part-time students. Between 20-30 percent of these students are from out of state. The college offers both undergraduate and graduate degree programs, with many pre-professional programs.[30]

Historical Sites

According to the National Register of Historic Places for Iowa by the National Park Service, there are 12 historic sites located in the planning area. The Coal Creek Bridge is located in the one percent annual chance floodplain.

Table 25: Historical Sites

Site Name	Date Listed	Nearest Community, County	In Floodplain
Coal Creek Bridge	4/7/1998	Hartford, IA	Y (1%)
Hoosier Row School	5/4/2011	Indianola, IA	N
Indianola Carnegie Library	Unknown	Indianola, IA	N
Indianola High School	8/28/2002	Indianola, IA	N
Lake Ahquabi State Park, Bathhouse Area (Area B)	10/1/1990	Indianola, IA	N
Lake Ahquabi State Park, Picnic Area (Area A)	10/1/1990	Indianola, IA	N
Lake Ahquabi State Park, Refectory Area (Area C)	10/1/1990	Indianola, IA	N
Octagon Barn, Otter Township	5/27/1986	Milo, IA	N
Palmyra Methodist Episcopal Church	8/21/1979	Palmyra, IA	N
Polled Hereford Breed Origin Site	5/12/1976	St Marys, IA	N

28 Iowa Department of Natural Resources. 2022. "Wildlife Management Areas." https://www.iowadnr.gov/hunting/places-to-hunt-shoot/wildlife-management-areas#13254117-t---w

29 U.S. Department of the Interior National Park Service. 2017. "National Register of Historic Places." [shapefile]. https://irma.nps.gov/DataStore/Reference/Profile/2210280.

30 Simpson College. February 2022. https://simpson.edu/

Site Name	Date Listed	Nearest Community, County	In Floodplain
Science Hall	3/28/1991	Indianola, IA	N
United Presbyterian Church, Summerset	11/7/1976	Carlisle, IA	N
Warren County Courthouse	8/28/2003	Indianola, IA	N

Source: National Park Service[31]

31 National Park Service. January 2022. "National Register of Historic Places NPGallery Database." https://npgallery.nps.gov/nrhp.

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SECTION FOUR: RISK ASSESSMENT

Introduction

The ultimate purpose of this hazard mitigation plan is to minimize the loss of life and property across the planning area. The basis for the planning process is the regional and local risk assessment. This section contains a description of potential hazards, regional vulnerabilities and exposures, probability of future occurrences, and potential impacts and losses. By conducting a regional and local risk assessment, participating jurisdictions can develop specific strategies to address areas of concern identified through this process. The following table defines terms that will be used throughout this section of the plan.

Table 26: Term Definitions

Term	Definition
Hazard	A potential source of injury, death, or damages
Asset	People, structures, facilities, and systems that have value to the community
Risk	The potential for damages, loss, or other impacts created by the interaction of hazards and assets
Vulnerability	Susceptibility to injury, death, or damages to a specific hazard
Impact	The consequence or effect of a hazard on the community or assets
Historical Occurrence	The number of hazard events reported during a defined period of time
Extent	The strength or magnitude relative to a specific hazard
Probability	Likelihood of a hazard occurring in the future

Methodology

The risk assessment methodology utilized for this plan follows the same methodology as outlined in the FEMA Local Mitigation Planning Handbook. This process consists of four primary steps: 1) Describe the hazard; 2) Identify vulnerable community assets; 3) Analyze risk; and 4) Summarize vulnerability.

When describing the hazard, this plan will examine the following items: previous occurrences of the hazard within the planning area; locations where the hazard has occurred in the past or is likely to occur in the future; extent of past events and likely extent for future occurrences; and probability of future occurrences. While the identification of vulnerable assets will be conducted across the entire planning area, *Section Seven* will discuss community-specific assets at risk for relevant hazards. Analysis for regional risk will examine historic impacts and losses and what is possible should the hazard occur in the future. Risk analysis will include both qualitative (i.e., description of historic or potential impacts) and quantitative data (i.e., assigning values and measurements for potential loss of assets). Finally, each hazard identified the plan will provide a summary statement encapsulating the information provided during each of the previous steps of the risk assessment process.

For each of the hazards profiled the best and most appropriate data available have been considered. Further discussion relative to each hazard is discussed in the hazard profile portion of this section.

Requirement §201.6(c)(2): Risk assessment. The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): The risk assessment shall include a] description of the type … of all natural hazards that can affect the jurisdiction.

Requirement §201.6(c)(2)(i): The risk assessment shall include a] description of the … location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii): The risk assessment] must also address National Flood Insurance Program insured structures that have been repetitively damaged floods.

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 area.

Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction's risks where they vary from the risks facing the entire planning area.

Average Annual Damages and Frequency

FEMA *Requirement §201.6(c)(2)(ii) (B)* suggests that when the appropriate data is available, hazard mitigation plans should also provide an estimate of potential dollar losses for structures in vulnerable areas. This risk assessment methodology includes an overview of assets at risk and provides historic average annual dollar losses for all hazards for which historic event data are available. Additional loss estimates are provided separately for those hazards for which sufficient data is available. These estimates can be found within the relevant hazard profiles.

Average annual losses from historical occurrences can be calculated for those hazards which have a robust historic record and for which monetary damages are recorded. There are three main pieces of data used throughout this formula.

- **Total Damages in Dollars:** This is the total dollar amount of all property damages and crop damages as recorded in federal, state, and local data sources. The limitation to these data sources is that dollar figures usually are estimates and often do not include all damages from every event, but only officially recorded damages from reported events.

- **Total Years of Record:** This is the span of years there is data available for recorded events.

- **Number of Hazard Events:** This shows how often an event occurs. The frequency of a hazard event will affect how a community responds. A thunderstorm may not cause much damage during a single event, but multiple storms can have an incremental effect on housing and utilities. In contrast, a rare tornado can have a widespread effect on a community.

An example of the Event Damage Estimate is found below:

$$\textbf{Annual Damages } (\$) = \frac{Total\ Damages\ in\ Dollars\ (\$)}{Total\ Years\ Recorded\ (\#)}$$

Each hazard will be included, while those which have caused significant damages or occurred in significant numbers are discussed in detail. It should be noted NCEI data are not all inclusive and the database provides very limited information on crop losses. To provide a better picture of the crop losses associated with the hazards within the planning area, crop loss information provided by the Risk Management Agency (RMA) of the USDA was also utilized for this update of the plan. The collected data were from 2000 to 2020. Data for all the hazards are not always available, so only those with an available dataset are included in the loss estimation.

Annual probability can be calculated based on the total years of record and the total number of years in which an event occurred. An example of the annual probability estimate is found below:

$$\textbf{Annual Probability } (\%) = \frac{Total\ Years\ with\ an\ Event\ Occuring\ (\#)}{Total\ Years\ of\ Record\ (\#)}\ x\ 100$$

Hazard Identification

The identification of relevant hazards for the planning area began with a review of the 2018 State of Iowa Hazard Mitigation Plan. The Regional Planning Team and participating jurisdictions reviewed the list of hazards addressed in the state mitigation plan and determined which hazards were appropriate for discussion relative to the planning area. The hazards for which a risk assessment was completed are included in the following table.

Table 27: Hazards Addressed in the Plan

Hazards Addressed in the Plan		
Animal & Plant Disease	Flooding	Severe Thunderstorms
Dam Failure	Grass/Wildfires	Severe Winter Storms
Drought	Hazardous Materials Release	Sinkholes
Earthquake	Infrastructure Failure	Terrorism
Expansive Soils	Levee Failure	Tornadoes & Windstorms
Extreme Temperatures (Cold/Heat)	Pandemic Disease	Transportation Incidents

Hazard Elimination

Given the location and history of the planning area, one hazard from the Iowa State HMP was eliminated from further review.

- **Landslides**: According to the 2018 Iowa State HMP, no landslides have occurred in the state and no state agency documents historical data on landslides in Iowa.

Hazard Assessment Summary Tables

The following table provides an overview of the data contained in the hazard profiles. Hazards listed in this table and throughout the section are in alphabetical order. This table is intended to be a quick reference for people using the plan and does not contain source information. Source information and full discussion of individual hazards are included later in this section. Annual probability is based off the number of years that had at least one event.

Table 28: Regional Risk Assessment

Hazard		Previous Occurrence Events/Years	Approximate Annual Probability	Likely Extent	
Agricultural Disease		Animal: Unavailable Plant: 8/21	Unknown Plant 24%	Unknown Crop damage or loss	
Dam Failure		0/109	Less than 1%	Varies by structure	
Drought		484/1,513 months	32%	D1-D4	
Earthquakes		0/120	Less than 1%	Less than 5.0 on the Richter Scale	
Expansive Soils		Unknown	Unknown	Varies by extent	
Extreme Temperatures	Cold	Avg. 4 Days a Year	61%	≤ 10°F	
	Heat	Avg. 3 Days a Year	31%	≥100°F	
Flooding		138/26	73%	Some inundation of structures (47% of structures) and roads near streams. Some evacuations of people may be necessary (64% of population)	
Grass/Wildfires		82/13	83%	Avg 7.78 acres Some homes and structures threatened or at risk	
Hazardous Materials Release		51/51	61%	Avg Liquid Spill	i.e. 302 gal
				Avg Gas Spill	i.e. 182 gal
Infrastructure Failure		Unknown	Unknown	Varies by extent	
Levee Failure		0/120	Less than 1%	Varies by extent	
Pandemic Disease		~12,069 cases	N/A	N/A	
Severe Thunderstorms		517/26	96%	≤7.5” rainfall Avg 67 mph winds	
Severe Winter Storms		68/26	92%	0.25” – 1” Ice 25°-35° below zero (wind chill) 3-15” snow 15-53 mph winds	
Sinkholes		Unknown	Unknown	Varies by location/event	
Terrorism		0/48	Less than 1%	Varies by event	
Tornadoes and Windstorms		51/26	58%	Avg: EF0 Range EF0-EF3	

Hazard	Previous Occurrence Events/Years	Approximate Annual Probability	Likely Extent
Transportation Incidents	7,539/60	100%	Damages incurred to vehicles involved and traffic delays; substantial damages to aircrafts involved with some aircrafts destroyed

The following table provides loss estimates for hazards with sufficient data. Detailed descriptions of major events are included in *Section Seven: Community Profiles.*

Table 29: Loss Estimation for the Planning Area

Hazard Type		Count	Property	Crop[2]
Agricultural Disease	Animal Disease	Unknown	N/A	N/A
	Plant Disease[1]	8	N/A	$75,115
Dam Failure[2]		0	N/A	N/A
Drought[3]		484 of 1,513 months	$0	$17,814,741
Earthquakes[4]		0	N/A	N/A
Expansive Soils		Unknown	N/A	N/A
Extreme Temperatures[5]	Cold (≤ 0°F)	Avg. 4 Days a Year	$0	$31,581
	Heat (≥ 100°F)	Avg. 3 Days a Year	N/A	$949,447
Flooding[6]	Flash Flood	38	$2,550,000	$6,072,395
	Flood	100	$6,766,500	
Grass/Wildfire[7]		82	655 acres	N/A
Hazardous Materials Release[8]	Fixed Site[8]	34	$350,000	N/A
	Transportation[9]	17	$203,635	N/A
Infrastructure Failure		Unknown	N/A	N/A
Levee Failure[10]		0	N/A	N/A
Pandemic Disease		~12,069 cases	N/A	N/A
Severe Thunderstorms[6] *7 injuries, 1 death*	Thunderstorm Wind Range (mph): 55-109 Average (mph): 67	178	$3,146,000	$25,506,941
	Hail Range (in): 0.75-3.5 Average (in): 1.16	228	$1,488,000	
	Heavy Rain	106	$12,000	
	Lightning	5	$191,500	

Hazard Type		Count	Property	Crop[2]
Severe Winter Storms[6]	Blizzard	11	$360,000	$632,591
	Heavy Snow	20	$3,855,000	
	Ice Storm	11	$393,330	
	Winter Storm	25	$499,900	
	Winter Weather	1	$0	
Sinkholes		Unknown	N/A	N/A
Terrorism[11]		0	$0	N/A
Tornadoes and Windstorms[6]	Tornadoes Range: EF0-EF3 Average: EF0	23	$815,110	$709,391
	Windstorms Range (mph): 40-70 Average(mph): 55	28	$3,077,500	$0
Transportation Incidents	Auto[12]	7,521	N/A	N/A
	Aviation[13]	7	N/A	N/A
	Highway Rail[14]	11	$43,500	N/A
Total		**8,453**	**$23,751,975**	**$51,792,203**

N/A: Data not available
1 – USDA RMA, 2000-2020
2 - IDNR Communication, 2021
3 - NOAA, 1895 - October 2021
4 - USGS, 1900 - August 2021
5 – NOAA Regional Climate Center, 1893 - July 2021
6 - NCEI, 1996 - July 2021
7 - IDNR Communication, 2021
8 - NRC, 1990 - August 2021
9 - PHSMA, 1971 - August 2021
10 - USACE NLN, 1900 - July 2020
11 – University of Maryland, 1970 – 2018
12 – IDOT, 2011-2021
13 - NTSB, 1962 – 2019
14 - FRA, 1975- August 2021

Historical Disaster Declarations

The following table shows past disaster declarations that have been granted within the planning area.

Presidential Disaster Declarations

Presidential disaster declarations are available via FEMA from 1953 to 2022. Declarations prior to 1962 are not designated by county on the FEMA website and are not included below. The following table describes presidential disaster declarations within the planning area for the period of record. Note that while data is available from 1953 onward, the planning area has received 24 presidential disaster declarations since 1967.

Table 30: Presidential Disaster Declarations

Disaster Declaration Number	Declaration Date	Title	Public Assistance
386	5/23/1973	Severe Storms, Flooding	-
443	6/24/1974	Severe Storms, Flooding	-
868	5/26/1990	Flooding, Severe Storm	-
879	9/6/1990	Flooding, Severe Storm	-
911	7/12/1991	Flooding, Severe Storm	-

Disaster Declaration Number	Declaration Date	Title	Public Assistance
928	12/26/1991	Ice Storm	-
965	10/2/1992	Flooding, Severe Storm	-
986	4/26/1993	Flooding, Severe Storm	-
996	7/9/1193	Flooding, Severe Storm	-
1121	6/24/1996	Flooding	-
1133	8/21/1996	Flooding	-
1191	11/20/1997	Severe Snowstorms	-
1230	7/2/1998	Severe Weather, Tornadoes, Flooding	-
1518	5/25/2004	Severe Storms, Tornadoes, Flooding	$14,795,286
1737	12/10/2007	Severe Winter Storm	$28,052,065
1763	5/27/2008	Severe Storms, Tornadoes, Flooding	$1,196,822,675
1930	7/29/2010	Severe Storms, Flooding, Tornadoes	$52,178,016
3076	4/6/1979	Severe Storms, Tornadoes	-
3239	9/10/2005	Hurricane Katrina Evacuation	$244,048
4119	5/31/2013	Severe Storms, Straight-line Winds, Flooding	$7,702,752
4234	7/31/2015	Severe Storms, Tornadoes, Straight-line Winds, Flooding	$7,723,277
4386	8/20/2018	Severe Storms, Tornadoes, Straight-line Winds, and Flooding	$16,091,807.51
3840	3/13/2020	Covid-19	-
4483	3/23/2020	Covid-19 Pandemic	$227,710,847.43

Source: Federal Emergency Management Agency, 1953-2022[32]

Climate Adaptation

Long-term climate trends have shifted throughout the 21st century and have created significant changes in precipitation and temperature which have altered the severity and subsequent impacts from severe weather events. The Regional and Local Planning Teams identified changes in the regional climate as a top concern impacting communities, residents, local economies, and infrastructure throughout the planning area. Discussions on temperature, precipitation, and climate impacts are included below.

The planning area is located in the Midwest region of the United States, which includes Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin. The area is well known for agricultural production. The Midwest has many federal, state, and private forests that provide

32 Federal Emergency Management Agency. 2022. "Disaster Declarations." Accessed February 2022. https://www.fema.gov/disasters.

considerable economic and ecological benefits. The Fourth National Climate Assessment has provided an overview of potential impacts within the planning area.[33]

- **Agriculture:** The Midwest is a major producer of a wide range of food and animal feed for national consumption and international trade. Increases in warm-season absolute humidity and precipitation have eroded soils, created favorable conditions for pests and pathogens, and degraded the quality of stored grain. Projected changes in precipitation, coupled with rising extreme temperatures before mid-century, will reduce Midwest agricultural productivity to levels of the 1980s without major technological advances.

- **Forestry:** Midwest forests provide numerous economic and ecological benefits, yet threats from a changing climate are interacting with existing stressors such as invasive species and pests to increase tree mortality and reduce forest productivity. Without adaptive actions, these interactions will result in the loss of economically and culturally important tree species such as paper birch and black ash and are expected to lead to the conversion of some forests to other forest types or even to non-forested ecosystems by the end of the century. Land managers are beginning to manage risk in forests by increasing diversity and selecting for tree species adapted to a range of projected conditions.

- **Biodiversity and Ecosystems:** The ecosystems of the Midwest support a diverse array of native species and provide people with essential services such as water purification, flood control, resource provision, crop pollination, and recreational opportunities. Species and ecosystems, including the important freshwater resources of the Great Lakes, are typically most at risk when climate stressors, like temperature increases, interact with land-use change, habitat loss, pollution, nutrient inputs, and nonnative invasive species. Restoration of natural systems increases in the use of green infrastructure, and targeted conservation efforts, especially of wetland systems, can help protect people and nature from climate change impacts.

- **Human Health:** Climate change is expected to worsen existing health conditions and introduce new health threats by increasing the frequency and intensity of poor air quality days, extreme high temperature events, and heavy rainfalls; extending pollen seasons; and modifying the distribution of disease-carrying pests and insects. By mid-century, the region is projected to experience substantial, yet avoidable, loss of life, worsened health conditions, and economic impacts estimated in the billions of dollars as a result of these changes. Improved basic health services and increased public health measures—including surveillance and monitoring—can prevent or reduce these impacts.

- **Transportation and Infrastructure:** Storm water management systems, transportation networks, and other critical infrastructure are already experiencing impacts from changing precipitation patterns and elevated flood risks. Green infrastructure is reducing some of the negative impacts by using plants and open space to absorb storm water. The annual cost of adapting urban storm water systems to more frequent and severe storms is projected to exceed $500 million for the Midwest by the end of the century.

- **Community Vulnerability and Adaptation:** At-risk communities in the Midwest are becoming more vulnerable to climate change impacts such as flooding, drought, and increases in urban heat islands. Tribal nations are especially vulnerable because of their

33 U.S. Global Change Research Program. 2018. “Fourth National Climate Assessment”. https://nca2018.globalchange.gov/.

reliance on threatened natural resources for their cultural, subsistence, and economic needs. Integrating climate adaptation into planning processes offers an opportunity to better manage climate risks now. Developing knowledge for decision-making in cooperation with vulnerable communities and tribal nations will help to build adaptive capacity and increase resilience.

Iowa's Changing Climate

The United States as a whole is experiencing significant changes in temperature, precipitation, and severe weather events resulting from climate change. According to the Iowa Climate Change Impacts Committee's Report to the Governor and Iowa General Assembly, the following changes can be expected for Iowa's future climate:[34]

Increased Precipitation

- Increased frequency of precipitation extremes that lead to flooding.
- Increase of 8 percent more precipitation from 1873 to 2008.
- A larger increase in precipitation in eastern Iowa than in western Iowa.

Higher Temperatures

- Long-term winter temperatures have increased six times more than summer temperatures.
- Nighttime temperatures have increased more than daytime temperatures since 1970.
- Iowa's humidity has risen substantially, especially in summer, which now has 13 percent more atmospheric moisture than 35 years ago as indicated by a 3 - 5 degree F rise in dew-point temperature. This fuels convective thunderstorms that provide more summer precipitation.

34 Iowa Climate Change Impacts Committee. 2010. "Climate Change Impacts on Iowa". https://www.iowadnr.gov/portals/idnr/uploads/air/environment/climatechange/complete_report.pdf?amp;tabid=1077

Agricultural Challenges

- Climate extremes, not averages, have the greater impact on crop and livestock productivity.
- Increased soil erosion and water runoff.
- Increased challenges associated with manure applications.
- Favorable conditions for survival and spread of many unwanted pests and pathogens.

Habitat Changes

- Plants are leafing out and flowering sooner.
- Birds are arriving earlier in the spring.
- Particular animals are now being sighted farther north than in the past.

Public Health Effects

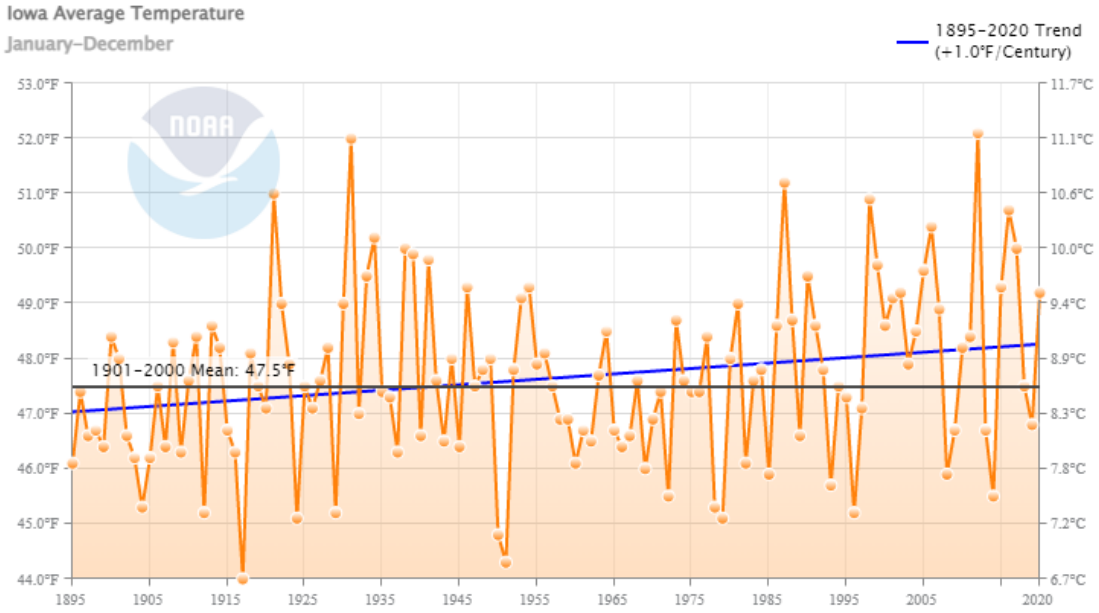
- Increases in heart and lung programs from increasing air pollutants of ozone and fine particles enhanced by higher temperatures.
- Increases in infectious diseases transmitted by insects that require a warmer, wetter climate.
- An increased prevalence of asthma and allergies.

Changes in Temperature

Since 1895 Iowa's overall average temperature has increased by 1°F (Figure 7). Climate modeling suggests warmer temperature conditions will continue in the coming decades and rise steadily into mid-century. Warming has increased the most in winter and spring months with winter minimum temperatures rising 2-4°F. In addition, there is greater warming for nighttime lows than for daytime highs. Since 2000, temperatures in Iowa have been higher than any other historical period, apart from the 1930s dustbowl era. Warming across the state has been mostly in the winter and fall, while summer has not warmed substantially with a below average number of very hot days. Historically unprecedented warming is projected to continue during this century.[35]

35 NOAA. "State Climate Summaries 2022 - Iowa". Accessed February 2022. https://statesummaries.ncics.org/chapter/ia/#:~:text=Precipitation%20varies%20widely%20across%20Iowa,central%20part%20of%20the%20state.

Figure 7: Average Temperature (1895-2020)



Source: NOAA, 2020[36]

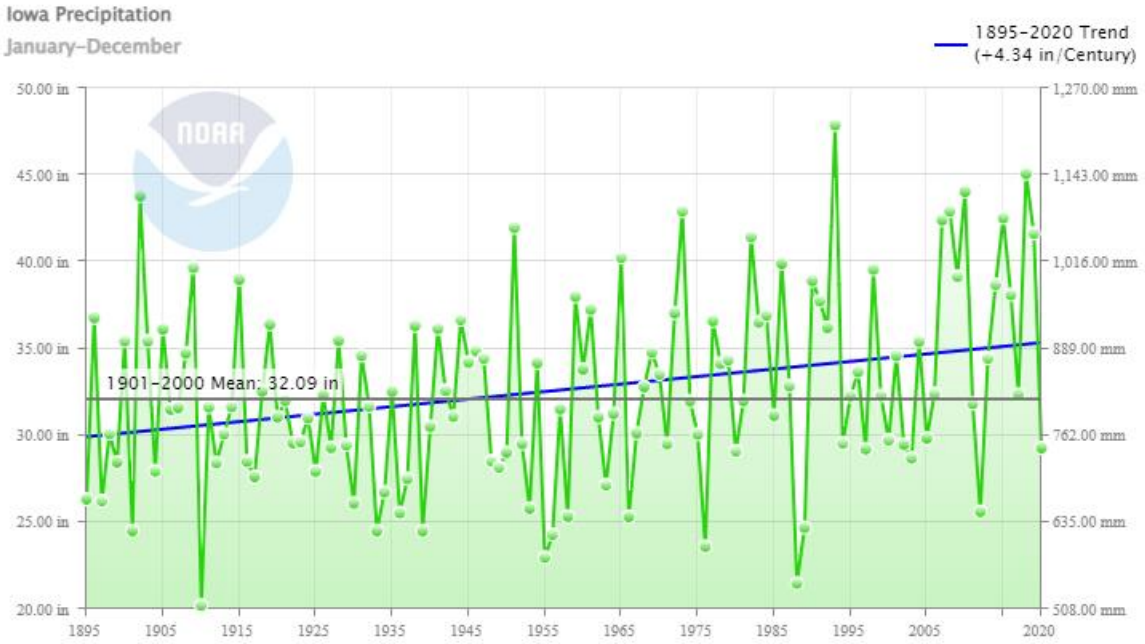
Changes in Precipitation

Changing extremes in precipitation are anticipated in the coming decades, with more significant rain and snowfall events and more intense drought periods. Climatological patterns of precipitation for Iowa consist of an east-west gradient, with drier conditions to the west and wetter to the east The southeastern portion of the state receives around 38 inches annually compared to only 26 inches in the northwest. Much of Iowa's precipitation falls in summer, with an average of 14 inches in the central part of the state. Spring precipitation has been above average since 1990. Since 1895, yearly annual precipitation for Iowa has increased (Figure 8). This trend is expected to continue as the impacts of climate change continue to be felt.[37]

36 NOAA. 2020. "Climate at a Glance: Statewide Time Series.". Accessed February 2022. https://www.ncdc.noaa.gov/cag/statewide/time-series/13/tavg/12/12/1895-2020?base_prd=true&begbaseyear=1901&endbaseyear=2000&trend=true&trend_base=100&begtrendyear=1895&endtrendyear=2022

37 NOAA. "State Climate Summaries 2022 - Iowa". Accessed February 2022. https://statesummaries.ncics.org/chapter/ia/#:~:text=Precipitation%20varies%20widely%20across%20Iowa,central%20part%20of%20the%20state.

Figure 8: Average Precipitation (1895-2020)



Source: NOAA, 2020[38]

Impacts from Climate Change

Observed changes in the intensity and frequency of extreme events are a significant concern now and in the future because of the social, environmental, and economic costs associated with their impacts. Challenges that are expected to affect communities, environments, and residents as a result of climate change include:

- Developing and maintaining sustainable agricultural systems.
- Resolving increasing competition among land, water, and energy resources.
- Conserving vibrant and diverse ecological systems.
- Enhancing the resilience of the region's people to the impacts of climatic extremes.

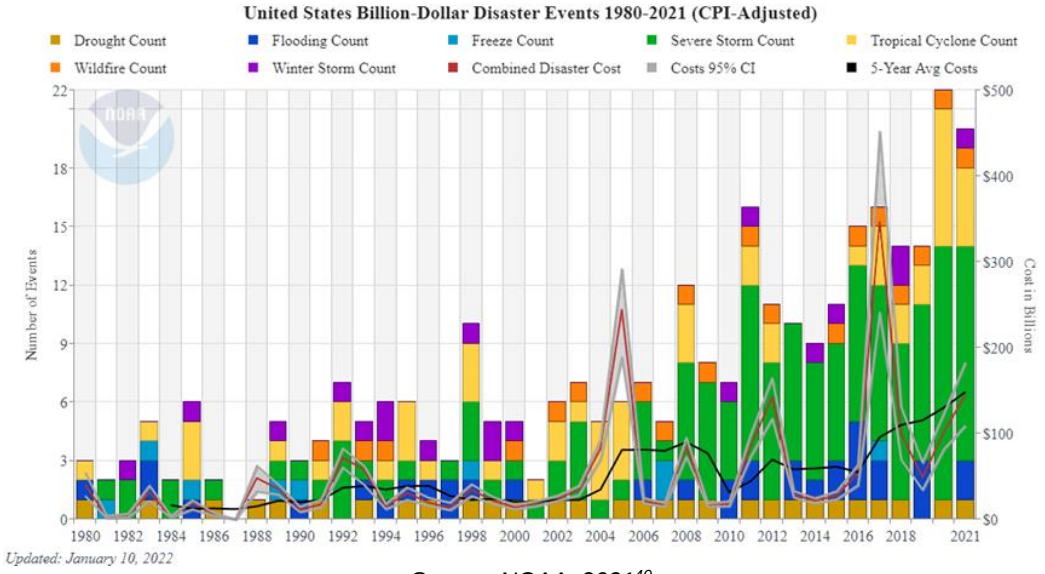
Certain groups of people may face greater difficulty when dealing with the impacts of a changing climate. Older adults, immigrant communities, and those living in poverty are particularly susceptible. Additionally, specific industries and professions tied to weather and climate, like outdoor tourism, commerce, and agriculture, are especially vulnerable.[39]

As seen in the figure below, the United States is experiencing an increase in the number of billion-dollar natural disasters due to increases in development and climate change.

38 NOAA. 2020. "Climate at a Glance: Statewide Time Series.". Accessed February 2022. https://www.ncdc.noaa.gov/cag/statewide/time-series/13/pcp/12/12/18952020?base_prd=true&begbaseyear=1901&endbaseyear=2000&trend=true&trend_base=100&begtrendyear=1895&endtrendyear=2022

39 U.S. Environmental Protection Agency. "Climate Impacts on Society." Accessed February 2022. https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-society_.html.

Figure 9: U.S. Billion-Dollar Disaster Events (1980-2021)

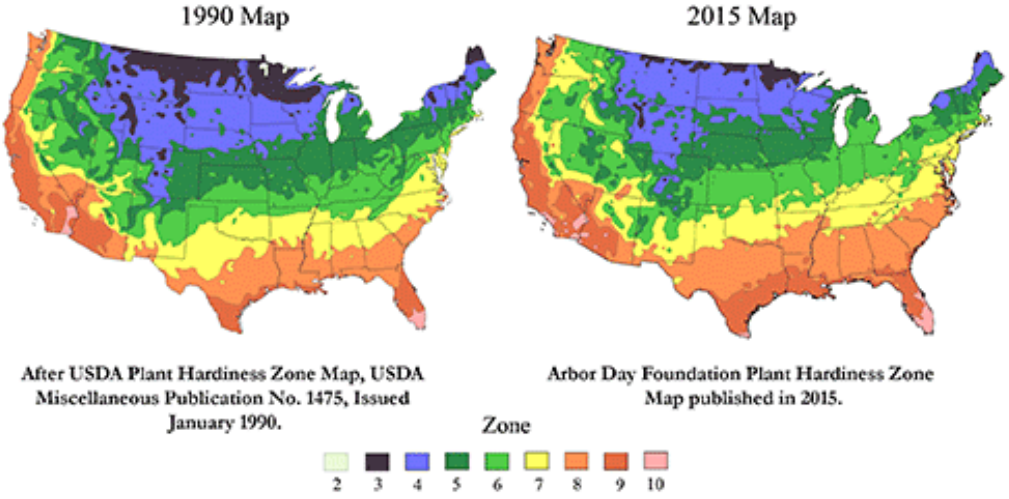


Source: NOAA, 2021[40]

Agriculture

Agriculture is one of the most important sectors in Iowa's economy and is especially vulnerable to extreme weather conditions. The agricultural sector will experience an increase in droughts, an increase in grass and wildfire events, changes in the growth cycle as winters warm, an influx of new and damaging agricultural diseases or pests, and changes in the timing and magnitude of rainfall. As described in the Plant Hardiness Zone map available for the United States (Figure 10), these changes have shifted the annual growing season and expected agricultural production conditions. Iowa is vulnerable to changes in growing season duration and growing season conditions as a heavily agriculturally dependent state. These added stressors on agriculture could have devastating economic effects if new agricultural and livestock management practices are not adopted.

Figure 10: Plant Hardiness Zone Change



Source: Arbor Day Foundation, 2018[41]

40 NOAA National Centers for Environmental Information. 2021. "U.S. Billion-Dollar Weather and Climate Disasters". https://www.ncdc.noaa.gov/billions/
41 Arbor Day Foundation. 2018. "Hardiness Zones." https://www.arborday.org/media/map_change.cfm.

Air Quality

Rising temperatures will also impact air quality. Harmful air pollutants and allergens increase as temperatures increase. More extended periods of warmth contribute to longer pollen seasons that allow plant spores to travel farther and increase exposure to allergens. More prolonged exposure to allergens can increase the risk and severity of asthma attacks and worsen existing allergies in individuals.[42] An increase in air pollutants can occur from the increased number of grass/wildfires. The public can be exposed to harmful particulate matter from smoke and ash that can cause various health issues. Depending on the length of exposure, age, and individual susceptibility, effects from wildfire smoke can range from eye and respiratory irritation to severe disorders like bronchitis, asthma, and aggravation of pre-existing respiratory and cardiovascular diseases.[43]

Water Quality

Increasing temperatures, shifting precipitation patterns, and extreme weather events impact water quality throughout the state. With the increasing intensity and frequency of extreme precipitation events, impacts to water systems ultimately threaten human health. Events can lead to flooding and stormwater runoff that can carry pollutants across landscapes and threaten human health by contaminating water wells, groundwater, and other bodies of water. Common pollutants include pesticides, bacteria, nutrients, sediment, animal waste, oil, and hazardous waste.

As average temperatures increase, water temperatures also rise and put water bodies at risk for eutrophication and excess algal growth that reduce water quality. In agricultural landscapes this can be exacerbated from major storm events that cause sediment and nutrients such as phosphorous and nitrogen to runoff into nearby water sources. The runoff can contribute to the buildup of nutrients in the water, increasing plant and algae growth that can deplete oxygen and kill aquatic life. Nutrient enrichment can lead to toxic cyanobacterial harmful algae blooms (cyanoHABs), which can be harmful to animal and human health. CyanoHABs can cause economic damage such as decreasing property values, reducing recreational revenue, and increasing the costs for treating drinking water.[44]

Zoonotic Disease

Changes in temperature and precipitation can alter the geographic range of disease-carrying insects and pests. Mosquitoes that transmit viruses such as Zika, West Nile and dengue may become more prevalent in Iowa because of the increased temperatures and precipitation. These diseases may initially spread faster as the local population is not aware of the proper steps to reduce their risk.

Energy

As the number of 100°F days increases, along with warming nights, the stress placed on the energy grid will likely increase and possibly lead to more power outages. Severe weather events also stress emergency production, infrastructure transmission, and transportation. Roads, pipelines, and rail lines are all at risk of damages from flooding, extreme heat, erosion, or added stress from increased residential demands.[45] Critical facilities and vulnerable populations that are not prepared to handle periods of power outages, particularly during heat waves, will be at risk.

42 Asthma and Allergy Foundation of America. 2010. "Extreme Allergies and Climate Change." Accessed 2022. https://www.aafa.org/extreme-allergies-and-climate-change/.

43 AirNow. 2019. "Wildfire Smoke: A Guide for Healthcare Professionals." Accessed 2022. https://www.airnow.gov/wildfire-smoke-guide-publications/

44 USGS. "Nutrients and Eutrophication". Accessed February 2021. https://www.usgs.gov/mission-areas/water-resources/science/nutrients-and-eutrophication?qt-science_center_objects=0#qt-science_center_objects.

45 USGCRP, 2018: Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II: Report-in-Brief [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 186 pp.

Drought and Extreme Heat

In Iowa, future droughts are projected to increase in intensity even with an increase in precipitation. An increase in average temperatures will contribute to the raise in the frequency and intensity of hazardous events like extreme heat and drought, which will cause significant economic, social, and environmental impacts on Iowans. Although drought is a natural part of the climate system, increasing temperatures will increase evaporation rates, decrease soil moisture, and lead to more intense droughts in the future, having negative impacts on farming and community water systems. Extreme heat events have adverse effects on both human and livestock health. Heatwaves may also impact plant health, with negative effects on crops during essential growth stages. Increasing temperatures and drought may reduce the potential for aquifers to recharge, which has long-term implications for the viability of agriculture in Iowa.

Grass/Wildfire

Rising temperatures will likely increase the frequency and intensity of grass/wildfires. Warmer temperatures cause snow to melt sooner and create drier soils and forests, which act as kindling to ignite fires. Dry and dead trees will increase fuel loads causing fires to spread much quicker. Additionally, warmer nighttime temperatures contribute to the continued spread of wildfires over multiple days.[46]

Severe Storms and Flooding

Iowa experiences frequent snowstorms and ice storms during winter, which can produce heavy snowfall and high wind gusts that lead to whiteout conditions. Thunderstorms capable of producing floods, hail, and tornadoes are common in the warmer months. As temperatures continue to rise, more water vapor evaporates into the atmosphere, creating increased humidity, which can increase the frequency and intensity of these storms. An increase in severe storms and heavy rain events will lead to more flooding and larger magnitude flood events. These severe storm and flooding events can cause increased damages to structures and put more people at risk of injury or death. A powerful derecho that occurred on August 10, 2020 was one of the most destructive thunderstorms to ever affect the state. The storm produced widespread winds greater than 100 mph and caused significant damage to millions of acres of corn and soybean crops across central Iowa. Homes, businesses, and vehicles were also severely damaged, with major impacts occurring mostly in Cedar Rapids.

Future Adaptation and Mitigation

The planning area will have to adapt to a changing climate and its impacts or experience an increase in economic losses, property damages, agricultural damages, and loss of life. Past events have typically informed HMPs to be more resilient to future events. This HMP includes strategies for the planning area to address these changes and increase resilience. However, future updates of this HMP should consider including adaptation as a core strategy to be better informed by future projections on the frequency, intensity, and distribution of hazards. Jurisdictions in the planning area should consider past and future climate changes and impacts when incorporating mitigation actions into local planning processes.

46 NASA Global Climate Change. September 2019. "Satellite Data Record Shows Climate Change's Impact on Fires." Accessed 2021. https://climate.nasa.gov/news/2912/satellite-data-record-shows-climate-changes-impact-on-fires/.

Hazard Profiles

Information from participating jurisdictions was collected and reviewed alongside hazard occurrence, magnitude, and event narratives as provided by local, state, and federal databases. Based on this information, profiled hazards were determined to either have a historical record of occurrence or the potential for occurrence in the future. The following profiles will broadly examine the identified hazards across the region. Hazards of local concern or events which have deviated from the norm are discussed in greater detail in each respective community profile (see *Section Seven* of this plan). The following table identifies the prioritization of hazards by participating jurisdictions (i.e., hazards of top concern). Local jurisdictional planning teams selected these hazards from the regional hazard list as the prioritized hazards for the community based on historical hazard occurrences, potential impacts, and the jurisdictions' capabilities. However, it is important to note that while a jurisdiction may not have selected a specific hazard to be profiled, hazard events can impact any community at any time and their selection is not a full indication of risk.

Table 31: Top Hazards of Concern

Jurisdiction	Agricultural Disease	Dam Failure	Drought	Earthquake	Expansive Soil	Extreme Temperatures (Cold/Heat)	Flooding	Grass/Wildfire	Hazardous Materials Release	Infrastructure Failure	Levee Failure	Pandemic Disease	Thunderstorms (Includes Hail & Lightning)	Severe Winter Storms	Sinkholes	Terrorism	Tornadoes & Windstorms	Transportation Incidents
Warren County							X		X		X			X		X		
City of Carlisle		X					X					X		X		X	X	X
City of Cumming		X					X					X		X		X	X	X
City of Hartford			X			X	X							X			X	
City of Indianola							X		X	X				X			X	
City of Lacona							X		X					X			X	
City of Martensdale							X						X				X	
City of Milo	X						X			X		X		X			X	
City of New Virginia										X		X	X	X			X	
City of Norwalk					X	X				X				X			X	X

Jurisdiction	Agricultural Disease	Dam Failure	Drought	Earthquake	Expansive Soil	Extreme Temperatures (Cold/Heat)	Flooding	Grass/Wildfire	Hazardous Materials Release	Infrastructure Failure	Levee Failure	Pandemic Disease	Thunderstorms (Includes Hail & Lightning)	Severe Winter Storms	Sinkholes	Terrorism	Tornadoes & Windstorms	Transportation Incidents
City of St. Marys							X		X			X		X			X	
Indianola Community School District							X						X			X	X	X
Norwalk Community School District									X	X			X				X	X
Simpson College							X					X	X			X	X	
Warren Water District			X				X			X			X	X		X		

ANIMAL AND PLANT DISEASE

Agriculture disease is any biological disease or infection that can reduce the quality or quantity of either livestock or vegetative crops. This section looks at both animal disease and plant disease, as both make up a significant portion of Iowa's and the planning area's economy.

The State of Iowa's economy is heavily invested in both livestock and crop sales. According to the Iowa Department of Agriculture and Land Stewardship (IDALS) in 2017, the market value of agricultural products sold was estimated at nearly $28 billion; this total is split between crops (estimated $13.8 billion) and livestock (estimated $15.1 billion). For the planning area, the market value of sold agricultural products exceeded $78 million.[47]

Table 32 shows the population of livestock within the planning area. This count does not include wild populations that are also at risk from animal diseases.

Table 32: Livestock Inventory

County	Market Value of 2017 Livestock Sales	Cattle and Calves	Hogs and Pigs	Poultry Egg Layers	Sheep and Lambs
Warren	$78,965,000	19,834	(D)	3,179	993

Source: U.S. Census of Agriculture, 2017
**(D) Withheld to avoid disclosing data for individual farms.*

The following tables provide the value and acres of land in farms for the planning area. Soybeans are the most prevalent crop type in the region followed by corn.

Table 33: Land and Value of Farms in the Planning Area

County	Number of Farms	Land in Farms (acres)	Market Value of 2017 Crop Sales
Warren	1,214	247,153	$67,084,000

Source: U.S. Census of Agriculture, 2017

47 US Department of Agriculture, National Agricultural Statistics Server. 2022. "2017 Census of Agriculture – County Data." Accessed February 2022. https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/Iowa/.

Table 34: Crop Values

County	Corn		Soybeans		Wheat	
	Acres Planted	Value (2017)	Acres Planted	Value (2017)	Acres Planted	Value (2017)
Warren	64,117	$32,381,000	68,754	$31,113,000	(D)	(D)

Source: U.S. Census of Agriculture, 2017
**(D) Withheld to avoid disclosing data for individual farms.*

Location

Given the strong agricultural presence in the planning area, animal and plant disease have the potential to occur across the planning area. If a major outbreak were to occur, the economy in the entire planning area would be affected, including urban areas.

The primary land uses where animal and plant disease will be observed include agricultural lands, range or pasture lands, and forests. It is possible that animal or plant disease will occur in domestic animals or crops in urban areas.

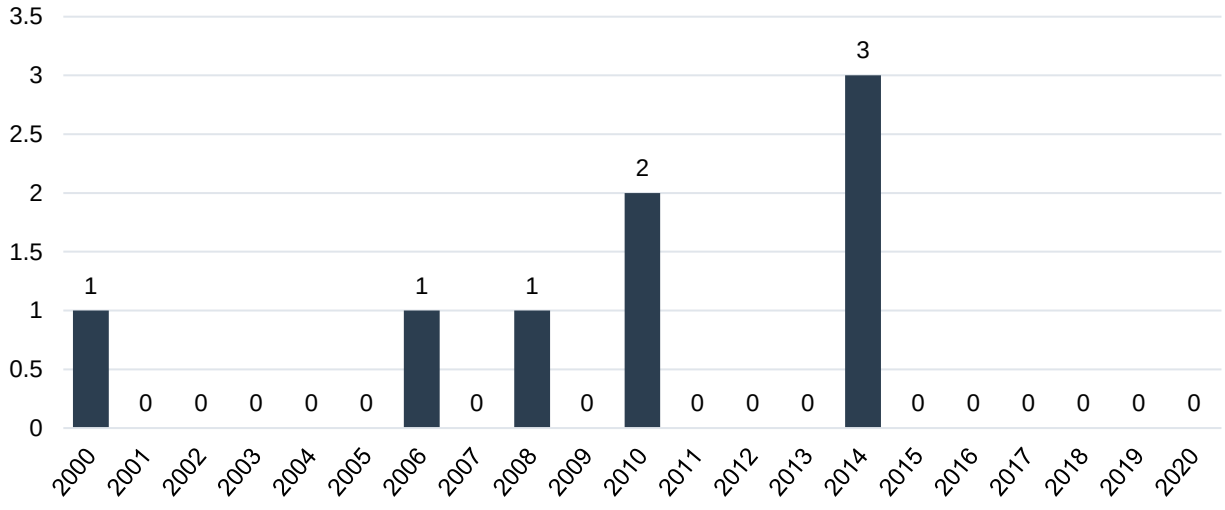
Historical Occurrences

Animal Disease

According to the 2018 Iowa State Plan, in 2015 Iowa experienced impacts to avian populations when 18 counties and 77 sites across the state were affected by highly pathogenic avian influenza (HPAI). More than 33 million birds had to be euthanized and disposed of with the cost of replacement estimated at $83.6 million. The replacement cost does not include economic impacts from unemployment and costs to euthanize and dispose of carcasses.

The RMA provides data on plant disease events and plant losses in the planning area. There are eight instances of plant diseases reported from 2000-2020 by the RMA (Figure 11). These outbreaks caused $75,115 in crop losses.

Figure 11: Plant Disease Events by Year



Source: RMA, 2000-2020

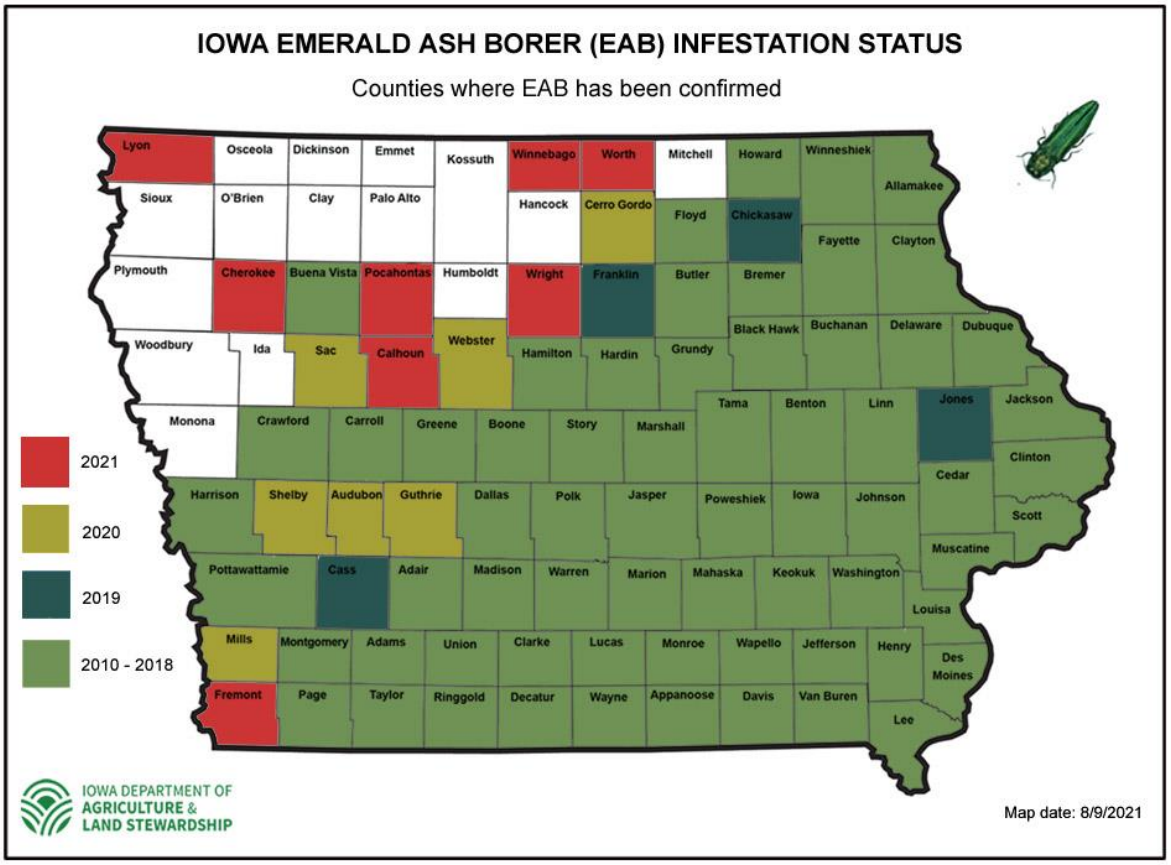
Emerald Ash Borer

The spread and presence of the Emerald Ash Borer (EAB) have become a rising concern for many Iowan communities in recent years. The beetle spreads through transport of infected ash trees, lumber, and firewood. All species of North American ash trees are vulnerable to infestation. Confirmed cases of EAB have been found in three Canadian provinces and 45 US states,

primarily in the eastern, southern, and midwestern regions. The two most recent infestation confirmations came from Georgia and Vermont in 2020. EAB was first confirmed in Iowa on May 14th, 2010. Figure 12 shows the locations of Iowa's confirmed EAB cases as of February 2022. Additional confirmed cases have likely occurred and many communities across the state are prioritizing the removal of ash trees to help curb potential infestations and tree mortality.

While adult beetles cause little damage, larvae damage trees by feeding on the inner bark of mature and growing trees, causing tunnels. Effects of EAB infestation include extensive damage to trees by birds, canopy dieback, bark splitting, and water sprout growth at the tree base, and eventual tree mortality. EAB has impacted millions of trees across North America, killing young trees one to two years after infestation and mature trees three to four years after infestation.[48] In Warren County, EAB was confirmed in the rural area of Milo in 2017.[49] Iowa has an estimated 3.1 million urban ash trees. Estimated costs to Iowa communities for ash tree removal is $1.6 billion and $468 million to replant.[50] Dead or dying trees affected by EAB are also more likely to cause damage during high winds, severe thunderstorms, or severe winter storms from weakened or hazardous limbs and can contribute a significant fuel load to grass/wildfire events.

Figure 12: EAB Infestation Status in Iowa



Source: Iowa Department of Agriculture & Land Stewardship

48 Arbor Day Foundation. 2015. "Emerald Ash Borer." https://www.arborday.org/trees/health/pests/emerald-ash-borer.cfm.

49Iowa Department of Agriculture & Land Stewardship. 2022. "Iowa EAB Locations (Confirmed)." http://iowatreepests.com/documents/Iowa_EAB_Locations_2_17_2022.pdf

50Iowa Department of Natural Resources. 2016. "Emerald Ash Borer." https://www.iowadnr.gov/Portals/idnr/uploads/forestry/Forest%20Health/emerald%20ash%20borer%202016.pdf?ver=2016-12-21-151336-840

Average Annual Losses

Average annual losses for agricultural animal disease cannot be calculated as there is no source in the state for documented historical events. According to the USDA RMA (2000-2020) there were eight plant disease events in the planning area. While the RMA does not track losses for livestock, annual crop losses from plant disease can be estimated.

Table 35: Agricultural Plant Disease Losses

Hazard Type	Number of Events	Events per Year	Total Crop Loss	Average Annual Crop Loss
Plant Disease	8	0.4	$75,115	$3,577

Source: RMA, 2000-2020

Extent

There is no standard for measuring the magnitude of agricultural disease. Historical events have impacted livestock ranging from a single individual to eight individuals. The planning area is heavily dependent on the agricultural economy. Any severe plant or animal disease outbreak which may impact this sector would negatively impact the entire planning area's economy.

Probability

Given the historic record of occurrence for agricultural plant disease events (five out of 21 years with a reported event), for the purposes of this plan, the annual probability of agricultural plant disease occurrence is 24%.

Community Top Hazard Status

The following table lists jurisdictions which identified Animal and Plant Disease as a top hazard of concern:

Jurisdictions	
City of Milo	

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 36: Regional Vulnerabilities

Sector	Vulnerability
People	-Those in direct contact with infected livestock -Potential food shortage during prolonged events -Residents in poverty if food prices increase
Economic	-Regional economy is reliant on the agricultural industry -Large scale or prolonged events may impact tax revenues and local capabilities -Land value may largely drive population changes within the planning area
Built Environment	None
Infrastructure	-Transportation routes can be closed during quarantine
Critical Facilities	None
Climate	-Exacerbate outbreaks, impacts, and/or recovery period -Changes in seasonal normals can promote spread of invasive species and agricultural disease

DAM FAILURE

A dam is defined as a barrier constructed across a water course for the purpose of storage, control, or diversion of water. Dams are typically constructed of earth, rock, concrete, or mine tailings. Dam failure is the uncontrolled release of impounded water resulting in downstream flooding, affecting both life and property. Structural failure can occur during extreme conditions, which include, but are not limited to:

- Reservoir inflows in excess of design flows
- Flood pools higher than previously attained
- Unexpected drop in pool level
- Pool near maximum level and rising
- Excessive rainfall or snowmelt
- Large discharge through spillway
- Erosion, landslide, seepage, settlement, and cracks in the dam or area
- Earthquakes
- Vandalism
- Terrorism

The effective height of a dam is defined as the difference in elevation in feet between the natural bed of the stream or watercourse measured at the downstream toe (or from the lowest elevation of the outside limit of the barrier if it is not across stream) to the auxiliary spillway crest. The effective storage is defined as the total storage volume in acre-feet in the reservoir below the elevation of the crest of the auxiliary spillway. If the dam does not have an auxiliary spillway, the effective height and effective storage should be measured at the top of dam elevation.

The thresholds for state-regulated dams are outlined in Iowa Administrative Code 567-73.3. They are listed below.

- A dam with a height of at least 25 feet and a storage of 15 acre-feet or more at the top of the dam elevation.
- A dam with a storage of 50 acre-feet or more at the top of the dam elevation and a height of at least 6 feet.
- A dam that is assigned a hazard potential of high hazard.

Exceptions include:

- Road embankments or driveways with culverts are exempt unless such structure serves, either primarily or secondarily, a purpose commonly associated with dams, such as the temporary storage of water for flood control.

The State of Iowa assigns existing and proposed dams a hazard potential classification based on future land and impoundment use. Changes in downstream land use, development, impoundment, or critical hydraulic structures to a dam require a reevaluation of the hazard potential. The Iowa Department of Natural Resources periodically performs inspections of dams posing a significant risk to downstream life and property. The three hazard potential classifications are low hazard, significant hazard, and high hazard and are defined below.

Table 37: Dam Hazard Classification

Size	Definition
Low	A dam shall be classified as "low hazard" if failure of the dam would result in no probable loss of human life, low economic losses, and low public damages.
Significant	A dam shall be classified as "significant hazard" if failure of the dam would result in no probable loss of human life but may damage residential structures or industrial, commercial, or public buildings; may negatively impact important public utilities or moderately traveled roads or railroads; or may result in significant economic losses or significant public damages.
High	A dam shall be classified as "high hazard" if located in an area where failure would result in probable loss of human life.

Source: IDNR, 2022[51]

Location

According to USACE's National Institute of Dams, there are a total of 108 dams located within the planning area, with classifications ranging from low to significant hazard. Figure 13 maps the location of these dams in the planning area.

Table 38: Dams in the Planning Area

Low Hazard	Significant Hazard	High Hazard
106	**2**	**0**

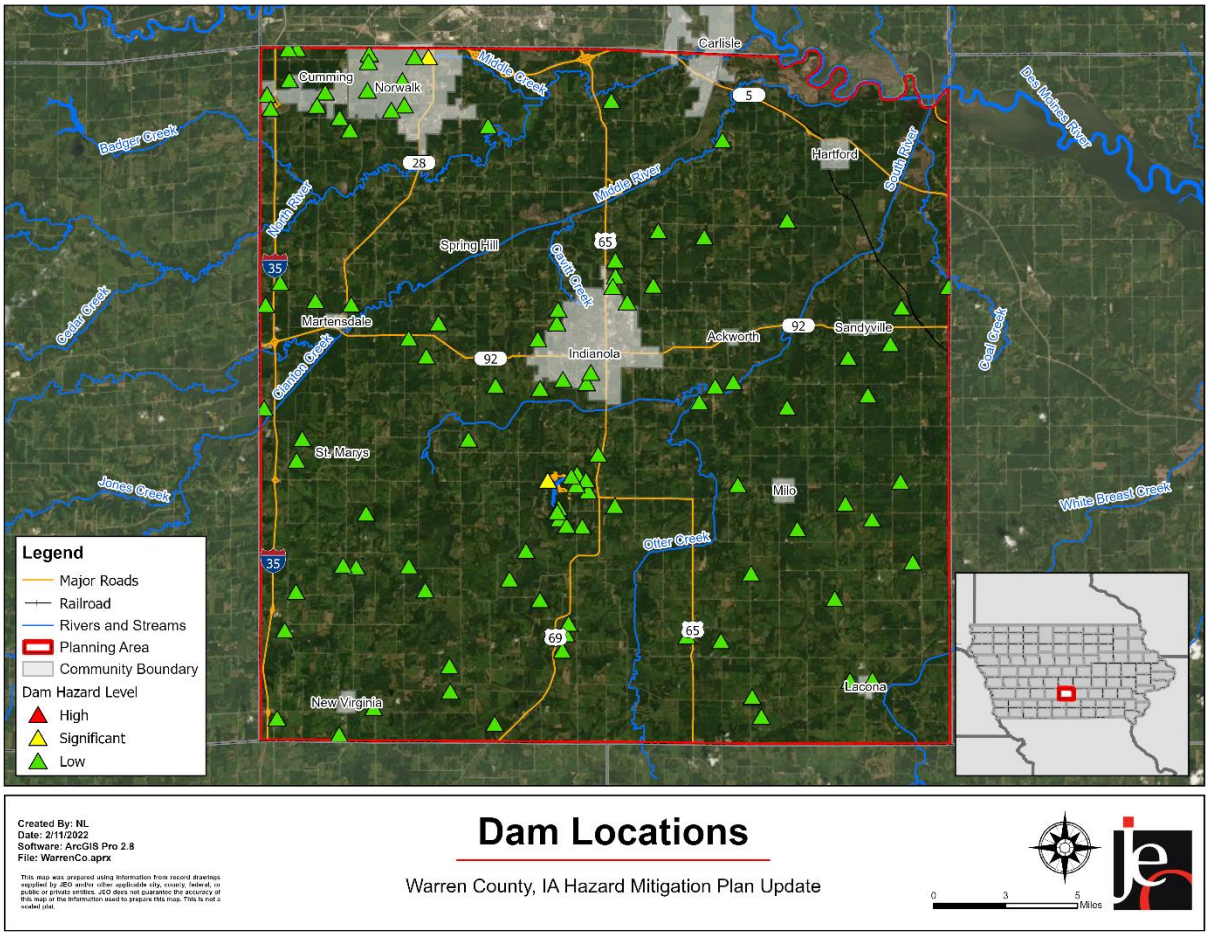
Source: USACE, 2022[52]

Dams classified with high hazard potential require the creation of an Emergency Action Plan (EAP). The EAP defines responsibilities and provides procedures designed to identify unusual and unlikely conditions which may endanger the structural integrity of the dam within sufficient time to take mitigating actions and to notify the appropriate emergency management officials of possible, impending, or actual failure of the dam. The EAP may also be used to provide notification when flood releases will create major flooding. An emergency situation can occur at any time; however, emergencies are more likely to happen when extreme conditions are present. There are no high hazard dams located within the planning area.

51 Iowa Department of Natural Resources. 2022. "Dam Safety Program: Dam Classifications." https://www.iowadnr.gov/Environmental-Protection/Land-Quality/Dam-Safety#Dam-Classifications-111

52 Iowa Department of Natural Resources. January 2021. "Iowa DNR Dam Inventory." https://iowadnr.knack.com/dams#public/?view_136_filters=%5B%7B%22value%22%3A%22Existing%22%2C%22operator%22%3A%22is%22%2C%22field%22%3A%22field_431%22%7D%5D

Figure 13: Dam Locations



Historical Occurrences

According to the Association of State Dam Safety Dam Incident Database, there are no reported dam failures within the planning area.[53]

Average Annual Losses

Due to lack of data and the sensitive nature of this hazard, potential losses are not calculated for this hazard.

Extent

Areas (i.e., agricultural land, out buildings, county roads, and communities) directly downstream of dams are at greatest risk in the case of dam failure. The extent of dam failure is indicated by its hazard classification and location. Note that hazard classification does not indicate the likelihood of a dam failure event to occur, but rather the extent of potential damages that may occur in case of a failure.

[53] Association of State Dam Safety Officials. "Dam incident database search". Accessed February 2022. https://damsafety.org/incidents

Probability

For the purpose of this plan, the probability of dam failure will be stated at less than one percent annually as no dams have failed in the planning area.

Community Top Hazard Status

The following table lists jurisdictions which identified Dam Failure as a top hazard of concern:

Jurisdictions	
City of Carlisle	City of Cumming

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 39: Regional Vulnerabilities

Sector	Vulnerability
People	-Those living downstream of high hazard dams -Those at recreational sites situated near high hazard dams -Evacuation needs likely with high hazard dam failure events -Hospitals, nursing homes, and the elderly at greater risk due to low mobility
Economic	-Loss of downstream agricultural land -Businesses or recreation sites located in inundation areas would be impacted and closed for an extended period of time -Employees of closed businesses may be out of work for an extended period of time
Built Environment	-Damage to facilities, recreation areas, and roads
Infrastructure	-Transportation routes could be closed for extended period of time
Critical Facilities	-Any critical facilities in inundation areas are vulnerable to damages
Climate	-Increased annual precipitation contributes to sustained stress on systems -Changes in water availability and supply can constrain energy production and reservoir stores

DROUGHT

Drought is generally defined as a natural hazard that results from a substantial period of below normal precipitation. Although many erroneously consider it a rare and random event, drought is a normal, recurrent feature of climate. It occurs in virtually all climatic zones, but its characteristics vary significantly from one region to another. A drought often coexists with periods of extreme heat, which together can cause significant social stress, economic losses, and environmental degradation. The planning area is largely rural, which presents an added vulnerability to drought events; drought conditions can significantly and negatively impact the agricultural economic base.

Drought is a slow-onset, creeping phenomenon that can affect a wide range of people, livestock, and industries. While many impacts of these hazards are non-structural, there is the potential that during prolonged drought events structural impacts can occur. Drought normally affects more people than other natural hazards, and its impacts are spread over a larger geographical area. As a result, the detection and early warning signs of drought conditions and assessment of impacts are more difficult to identify than that of quick-onset natural hazards (e.g., flood) that results in more visible impacts. According to the National Drought Mitigation Center (NDMC), droughts are classified into four major types:

> **Drought** is a normal, recurrent feature of climate, although many erroneously consider it a rare and random event. It occurs in virtually all climatic zones, but its characteristics vary significantly from one region to another.
>
> ~National Drought Mitigation Center

- **Meteorological Drought** is defined based on the degree of dryness and the duration of the dry period. Meteorological drought is often the first type of drought to be identified and should be defined regionally as precipitation rates and frequencies (norms) vary.

- **Agricultural Drought** occurs when there is deficient moisture that hinders planting germination, leading to low plant population per hectare and a reduction of final yield. Agricultural drought is closely linked with meteorological and hydrological drought; as agricultural water supplies are contingent upon the two sectors.

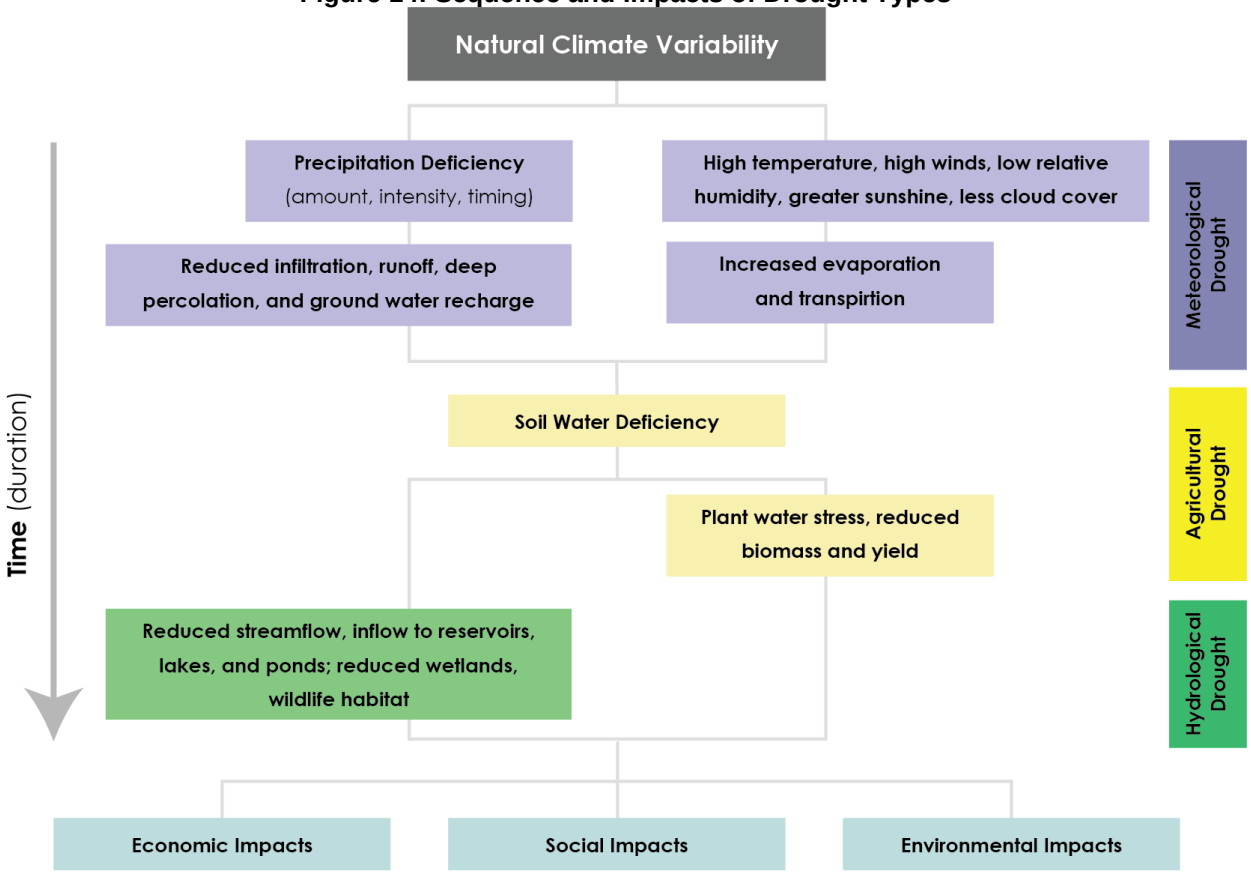
- **Hydrologic Drought** occurs when water available in aquifers, lakes, and reservoirs falls below the statistical average. This situation can arise even when the area of interest receives average precipitation. This is due to the reserves diminishing from increased water usage, usually from agricultural use or high levels of evapotranspiration, resulting from prolonged high temperatures. Hydrological drought often is identified later than meteorological and agricultural drought. Impacts from hydrological drought may manifest themselves in decreased hydropower production and loss of water-based recreation.

- **Socioeconomic Drought** occurs when the demand for an economic good exceeds supply due to a weather-related shortfall in water supply. The supply of many economic goods includes, but are not limited to, water, forage, food grains, fish, and hydroelectric power.[54]

The following figure indicates different types of droughts, their temporal sequence, and the various types of effects they can have on a community.

54 National Drought Mitigation Center. 2017. "Drought Basics." https://drought.unl.edu/.

Figure 14: Sequence and Impacts of Drought Types



Source: National Drought Mitigation Center, University of Nebraska-Lincoln, 2017[55]

Location

The entire planning area is susceptible to drought impacts.

Historical Occurrences

Table 40 indicates it is reasonable to expect extreme drought to occur 8.7% of the time for the planning area (132 extreme drought months in 1,513 months). Severe drought occurred in 90 months of the 1,513 months of record (5.9% of months). Moderate drought occurred in 72 months of the 1,513 months of record (4.8% of months), and mild drought occurred in 190 of the 1,513 months of record (12.6% of months). Non-drought conditions occurred in 1,029 months, or 68% percent of months. These statistics show that the drought conditions of the planning area are highly variable. The average annual planning area precipitation is approximately 36.3 inches according to the NCEI.[56]

55 National Drought Mitigation Center. 2017. "Types of Drought." https://drought.unl.edu/.

56 NOAA National Centers for Environmental Information. October 2021. "Data Tools: 1981-2010 Normals." [datafile]. https://www.ncdc.noaa.gov/cdo-web/datatools/normals.

Table 40: Historic Droughts

Drought Magnitude	Months in Drought	Percent Chance
-1 Magnitude (Mild)	190/1,513	12.6%
-2 Magnitude (Moderate)	72/1,513	4.8%
-3 Magnitude (Severe)	90/1,513	5.9%
-4 Magnitude or Greater (Extreme)	132/1,513	8.7%

Source: NCEI, Jan 1895-July 2021[57]

Extent

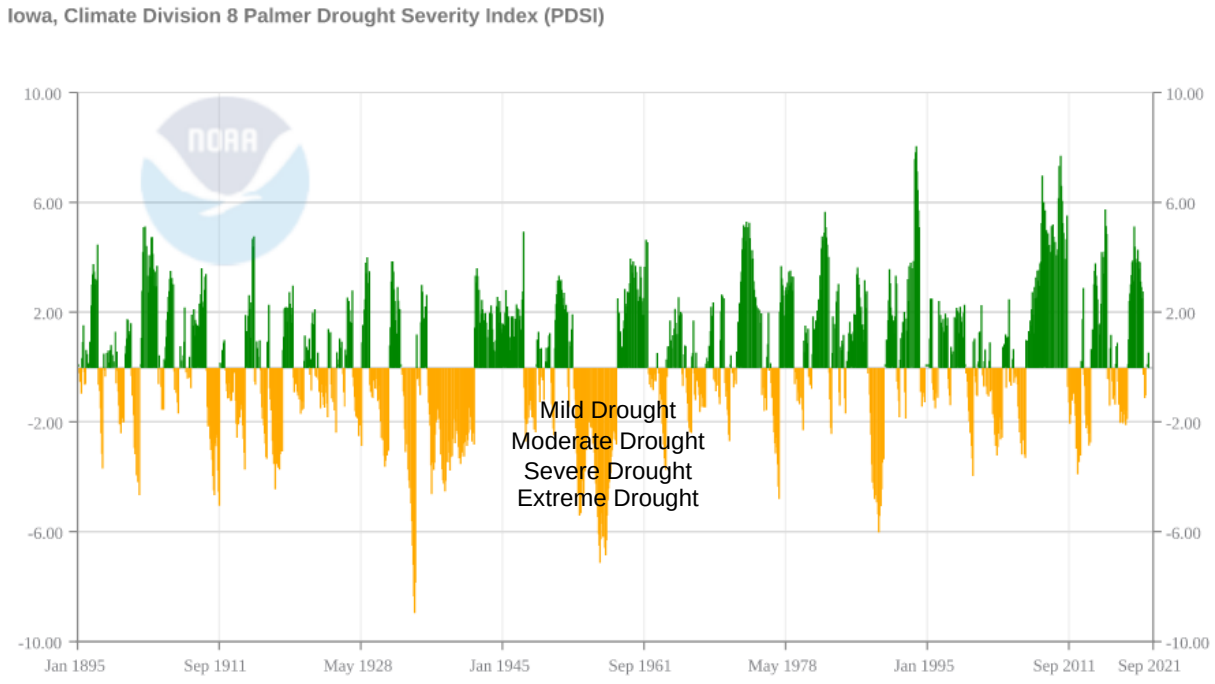
The Palmer Drought Severity Index (PDSI) is utilized by climatologists to standardize global long-term drought analysis. The data for the planning area was collected for Climate Division 8, which includes the planning area. This particular station's period of record started in 1895. Table 41 shows the details of the Palmer classifications. Figure 15 shows drought data from this time period. The negative Y axis represents the extent of a drought, for which '-2' indicates a moderate drought, '-3' a severe drought, and '-4' an extreme drought. The planning area has experienced several extreme droughts and moderate, severe, and extreme droughts are likely in the future.

Table 41: Palmer Drought Severity Index Classification

Numerical Value	Description	Numerical Value	Description
4.0 or more	Extremely wet	-0.5 to -0.99	Incipient dry spell
3.0 to 3.99	Very wet	-1.0 to -1.99	Mild drought
2.0 to 2.99	Moderately wet	-2.0 to -2.99	Moderate drought
1.0 to 1.99	Slightly wet	-3.0 to -3.99	Severe drought
0.5 to 0.99	Incipient wet spell	-4.0 or less	Extreme drought
0.49 to -0.49	Near Normal	--	--

Source: Climate Prediction Center[58]

Figure 15: Palmer Drought Severity Index

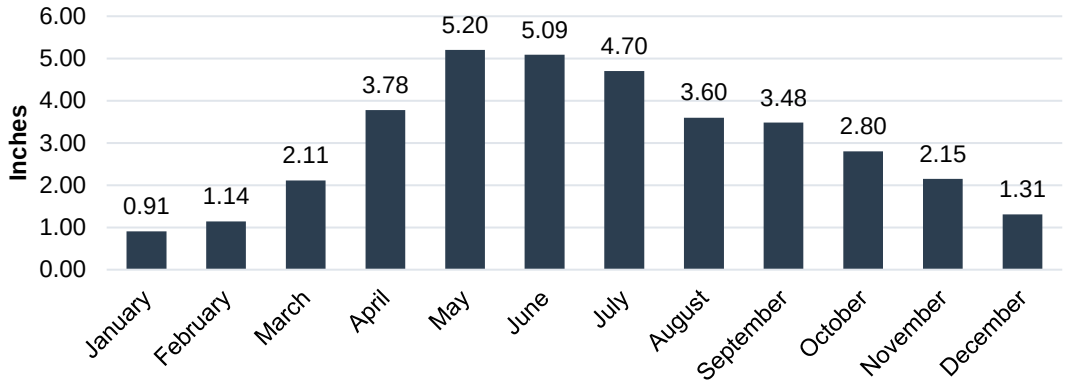


Source: NCEI, Jan. 1895-Sep. 2021

57 National Centers for Environmental Information. 1895-2021. Accessed October 2021. https://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp.
58 National Weather Service. 2017. "Climate Prediction Center." https://www.cpc.ncep.noaa.gov/.

Figure 16 shows the normal average monthly precipitation for the planning area, which is helpful in determining whether any given month is above, below, or near normal in precipitation. Prolonged deviation from the norm showcases drought conditions and influence growing conditions for farmers.

Figure 16: Average Monthly Precipitation for the Planning Area



Source: NCEI, July 2021[59]

Average Annual Losses

The annual property estimate was determined based upon NCEI Storm Events Database since 1996. The annual crop loss was determined based upon the RMA Cause of Loss Historical Database since 2000. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. The direct and indirect effects of drought are difficult to quantify. Potential losses such as power outages could affect businesses, homes, and critical facilities. High demand and intense use of air conditioning or water pumps can overload the electrical systems and damage infrastructure.

Table 42: Loss Estimate for Drought

Hazard Type	Total Property Loss[2]	Average Annual Property Loss[2]	Total Crop Loss[3]	Average Annual Crop Loss[3]
Drought	$12,650,000	$843,333	$17,814,741	$112,751

Source: 1 HPRCC (1895-2021); 2 Indicates data is from NCEI (Jan 1996 to Jul 2021); 3 Indicates data is from USDA RMA (2000 to 2020)

Probability

Drought conditions are also likely to occur regularly in the planning year. The following table summarizes the magnitude of drought and monthly probability of occurrence.

Table 43: Period of Record in Drought

PDSI Value	Magnitude	Drought Occurrences by Month	Monthly Probability
4 or more to -0.99	No Drought	1,029/1,513	68.0%
-1.0 to -1.99	Mild Drought	190/1,513	12.6%
-2.0 to -2.99	Moderate Drought	72/1,513	4.8%
-3.0 to -3.99	Severe Drought	90/1,513	5.9%
-4.0 or less	Extreme Drought	132/1,513	8.7%

Source: NCEI, Jan 1895-July 2021

59 NOAA National Centers for Environmental Information. July 2021. "Data Tools: 1981-2010 Normals." [datafile]. https://www.ncdc.noaa.gov/cdo-web/datatools/normals.

Community Top Hazard Status

The following table lists jurisdictions which identified Drought as a top hazard of concern:

Jurisdictions	
City of Hartford	Warren Water District

Regional Vulnerabilities

The Drought Impact Reporter is a database of drought impacts throughout the United States, with data going back to 2000. The Drought Impact Reporter has recorded a total of 117 drought-related impacts throughout the region. Notable drought impacts are summarized in the following table. This is not a comprehensive list of droughts that may have impacted the planning area, however.

Table 44: Notable Drought Impacts in Planning Area

Category	Date	Title
Agriculture, Relief, Response & Restrictions	9/6/2006	USDA designates 20 Iowa counties natural disaster areas due to drought and other severe weather conditions.
Agriculture, Relief, Response & Restrictions	8/1/2012	USDA designates 42 counties in Iowa as primary natural disaster areas with assistance to producers in surrounding states due to drought.
Agriculture, Relief, Response & Restrictions	8/15/2012	USDA designates 35 counties in Iowa as primary natural disaster areas with assistance to producers in surrounding states due to drought.
Agriculture, Relief, Response & Restrictions	9/19/2012	USDA designates 6 counties in Iowa as primary natural disaster areas with assistance to producers in surrounding states due to drought.

Source: NDMC, 2000-2022[60]

The following table provides information related to regional vulnerabilities. For jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 45: Regional Vulnerabilities

Sector	Vulnerability
People	-Insufficient water supply -Loss of jobs in agricultural sector -Residents in poverty if food prices increase
Economic	-Closure of water intensive businesses (carwashes, pools, etc.) -Short-term interruption of business -Loss of tourism dollars -Decrease in cattle prices -Decrease of land prices→ jeopardizes educational funds
Built Environment	-Cracking foundations (residential and commercial structures) -Damages to landscapes
Infrastructure	-Damages to waterlines below ground -Damages to roadways (prolonged extreme events)
Critical Facilities	-Loss of power and impact on infrastructure
Climate	-Increased risk of wildfire events, damaging buildings and agricultural land

60 National Drought Mitigation Center. 2022. "U.S. Drought Impact Reporter." Accessed February 2022. http://droughtreporter.unl.edu/map/.

EARTHQUAKES

An earthquake is the result of a sudden release of energy in the Earth's tectonic plates that creates seismic waves. The seismic activity of an area refers to the frequency, type, and size of earthquakes experienced over a period of time. Although rather uncommon, earthquakes do occur in Iowa and are usually small, generally not felt, and cause little to no damage. Earthquakes are measured by magnitude and intensity. Magnitude is measured by the Richter Scale, a base-10 logarithmic scale, which uses seismographs around the world to measure the amount of energy released by an earthquake. Intensity is measured by the Modified Mercalli Intensity Scale, which determines the intensity of an earthquake by comparing actual damage against damage patterns of earthquakes with known intensities. The following tables summarize the Richter Scale and Modified Mercalli Scale.

Table 46: Richter Scale

Richter Magnitudes	Earthquake Effects
Less than 3.5	Generally not felt, but recorded.
3.5 – 5.4	Often felt, but rarely causes damage.
Under 6.0	At most, slight damage to well-designed buildings. Can cause major damage to poorly constructed buildings over small regions.
6.1 – 6.9	Can be destructive in areas up to about 100 kilometers across where people live.
7.0 – 7.9	Major earthquake. Can cause serious damage over larger areas.
8 or greater	Great earthquake. Can cause serious damage in areas several hundred kilometers across.

Source: FEMA, 2016[61]

Table 47: Modified Mercalli Intensity Scale

Scale	Intensity	Description of Effects	Corresponding Richter Scale Magnitude
I	Instrumental	Detected only on seismographs	
II	Feeble	Some people feel it	< 4.2
III	Slight	Felt by people resting, like a truck rumbling by	
IV	Moderate	Felt by people walking	
V	Slightly Strong	Sleepers awake; church bells ring	< 4.8
VI	Strong	Trees sway; suspended objects swing, objects fall off shelves	< 5.4
VII	Very Strong	Mild Alarm; walls crack; plaster falls	< 6.1
VIII	Destructive	Moving cars uncontrollable; masonry fractures, poorly constructed buildings damaged	
IX	Ruinous	Some houses collapse; ground cracks; pipes break open	< 6.9
X	Disastrous	Ground cracks profusely; many buildings destroyed; liquefaction and landslides widespread	< 7.3
XI	Very Disastrous	Most buildings and bridges collapse; roads, railways, pipes, and cables destroyed; general triggering of other hazards	< 8.1
XII	Catastrophic	Total destruction; trees fall; ground rises and falls in waves	> 8.1

Source: FEMA, 2016

61 Federal Emergency Management Agency. 2016. "Earthquake." https://www.fema.gov/earthquake.

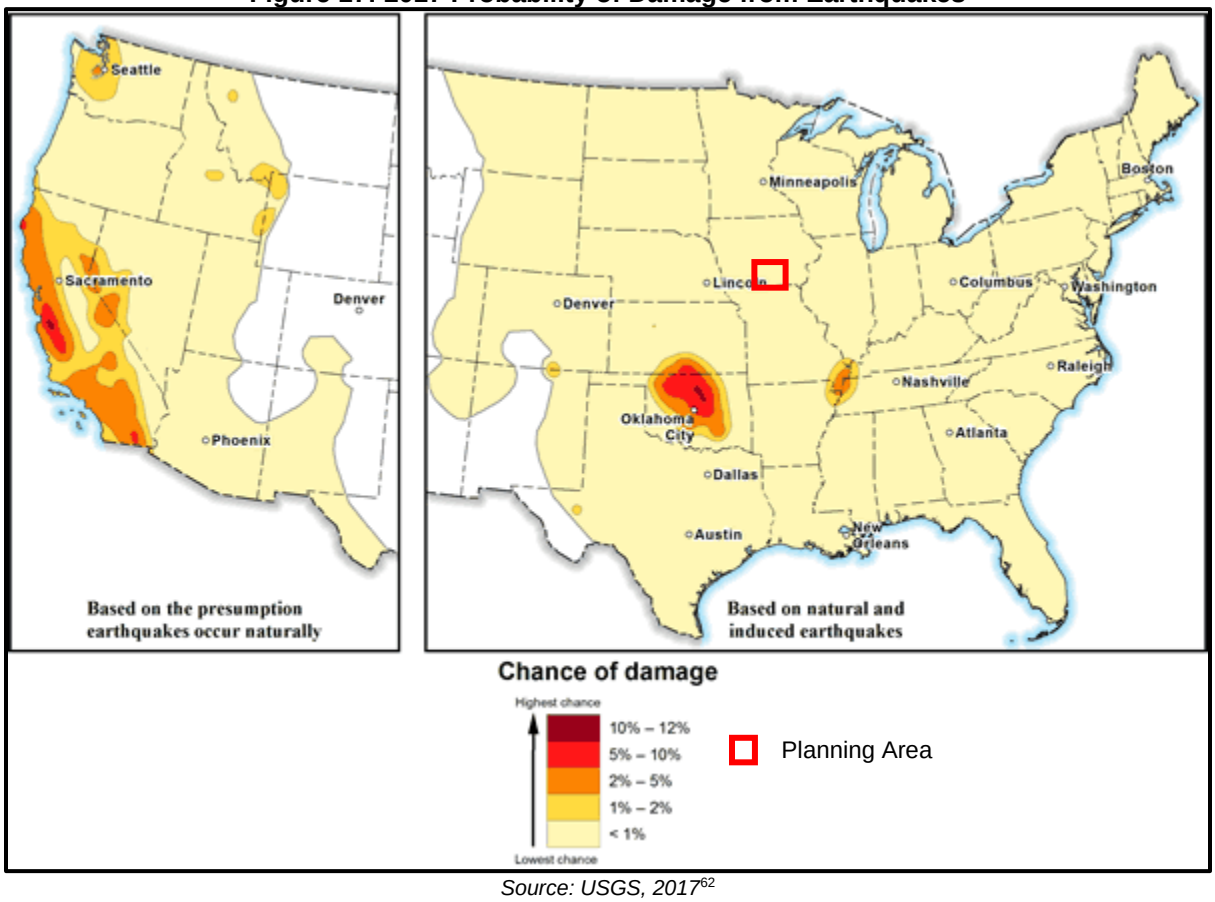
Location
According to the Iowa Department of Natural Resources, there are no fault lines in Iowa.

Historical Occurrences
According to the United States Geological Survey (USGS), there have been zero earthquakes that have occurred in the planning area since 1900.

Extent
If an earthquake were to occur in the planning area, it would likely measure between 5.0 or less on the Richter Scale. Very little to no damage is anticipated from events of these magnitudes.

Average Annual Losses
Due to no historical earthquakes and low earthquake risk for the area, it is not feasible to utilize the 'event damage estimate formula' to estimate potential losses for the planning area. Figure 17 shows the probability of damage from earthquakes, according to the USGS. The figure shows that the planning area has a less than one percent chance of damages from earthquakes.

Figure 17: 2017 Probability of Damage from Earthquakes



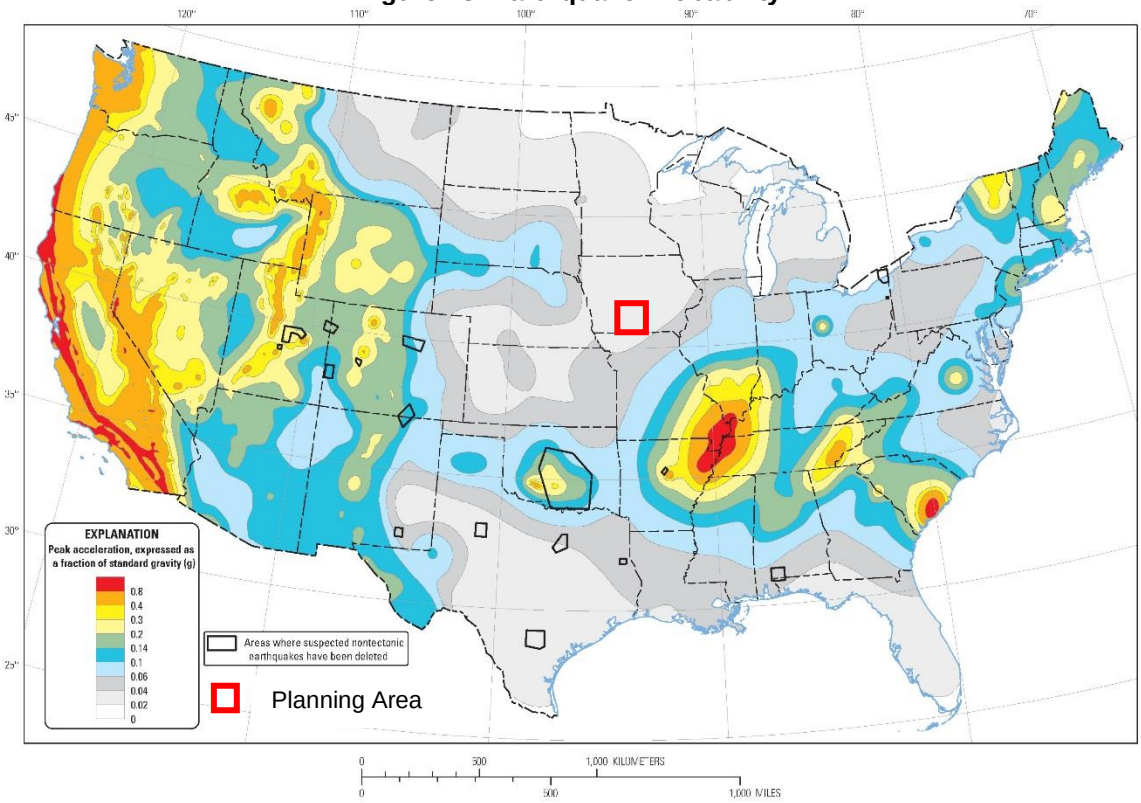
Source: USGS, 2017[62]

Probability

62 United States Geological Survey. 2017. "Short-term Induced Seismicity Models: 2017 One-Year Model." https://earthquake.usgs.gov/hazards/induced/index.php#2017.

The following figure visualizes the probability of a 5.0 or greater earthquake occurring in the planning area within 50 years. Based on zero occurrences of earthquakes over 120-year period, the probability of an earthquake in the planning area in any given year is less than one percent.

Figure 18: Earthquake Probability



Source: USGS 2009 PSHA Model
**Map shows the two-percent probability of exceedance in 50 years of peak ground acceleration.*

Community Top Hazard Status

No participating jurisdiction identified Earthquakes as a top hazard of concern.

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 48: Regional Vulnerabilities

Sector	Vulnerability
People	-Risk of injury or death from falling objects and structures
Economic	-Short term interruption of business
Built Environment	-Damage to buildings, homes, or other structures from foundation cracking, falling objects, shattered windows, etc.
Infrastructure	-Damage to subterranean infrastructure (i.e. waterlines, gas lines, etc.) -Damage to roadways
Critical Facilities	-Same as all other structures
Climate	-None

EXPANSIVE SOILS

A relatively widespread geologic hazard for Iowa is the presence of expansive soils or clay soils, which behave differently than other soils due to their tendency to swell and shrink due to changes in moisture content. Fluctuations in the groundwater table, changes in humidity, and prolonged drought followed by precipitation events can accelerate the swelling and shrinking of expansive soils.

Other factors influencing the behavior of expansive soils are plumbing leaks, site drainage, and irrigation practices that cause differences in moisture volume in the soil. Expansive soils can cause the following problems in structures:

- Structural damage to lightweight structures such as sidewalks and driveways
- Lifting of buildings, damage to basements, and building settlement
- Heaving of roads and highway structures
- Cracks in walls and ceilings
- Damage to pipelines and other public utilities[63]

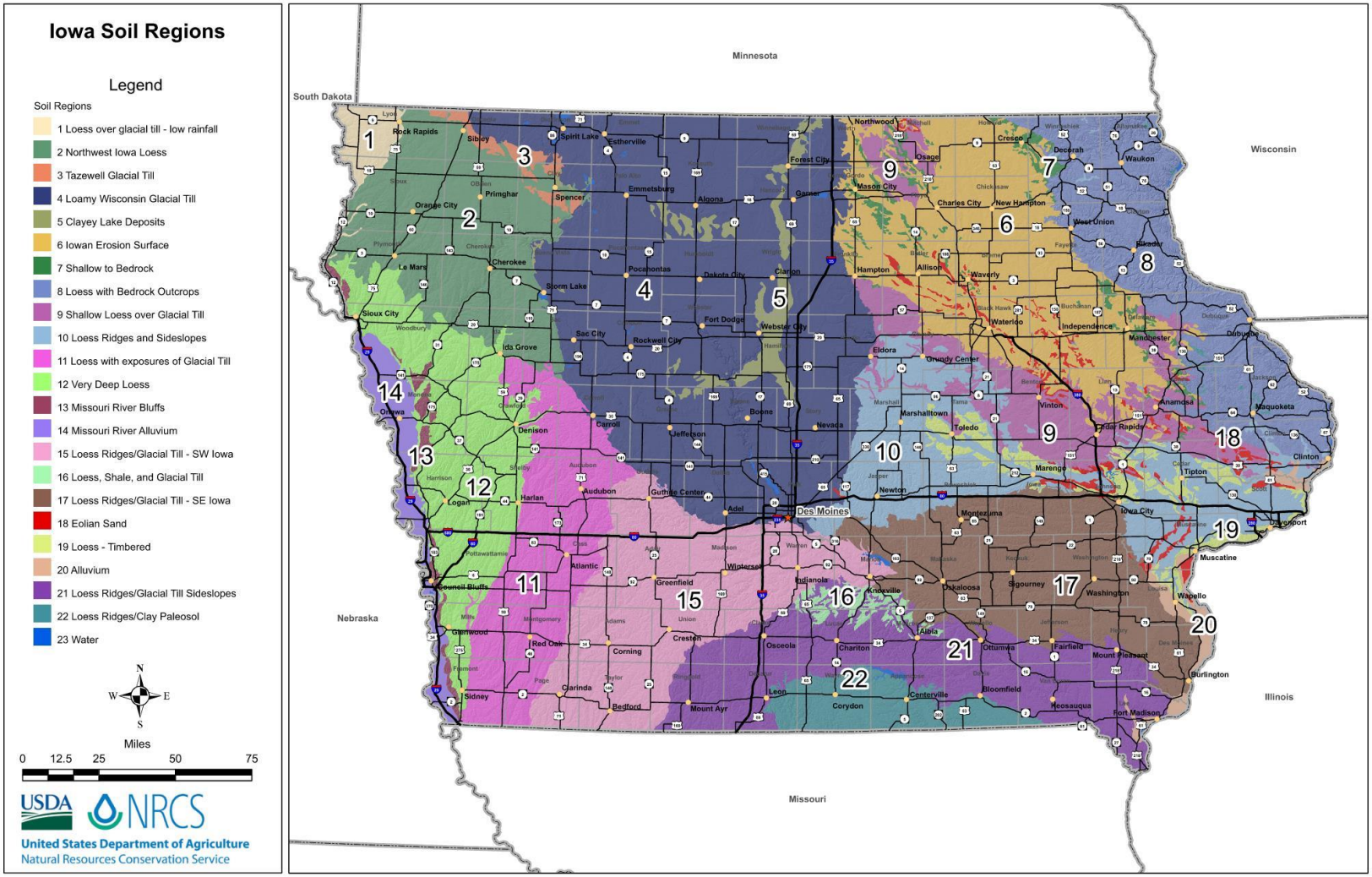
For Iowa, the vulnerability to this hazard most frequently is associated with soils shrinking during periods of drought.

Location

The following figure shows a map of the soil types in Iowa. Warren County is mainly located in Loess, Shale, Glacial Till, and Alluvium soil regions. Loess is a compressive soil comprised mainly of silt. Shale and Alluvium soils typically consist of a mixture of silt and clay. Glacial Till is a high-clay content soil that is prone to expansion.

63 Colorado Geological Survey. Accessed March 2022. "Expansive Soil and Rock". https://coloradogeologicalsurvey.org/hazards/expansive-soil-rock/#:~:text=Expansive%20soils%20are%20one%20of,the%20range%20of%20%242%20billion.

Figure 19: Iowa Soil Regions



Source: NRCS[64]

[64] Iowa Natural Resources Conservation Service. Accessed March 2022. "Iowa Soil Regions Map." https://www.nrcs.usda.gov/wps/portal/nrcs/ia/soils/

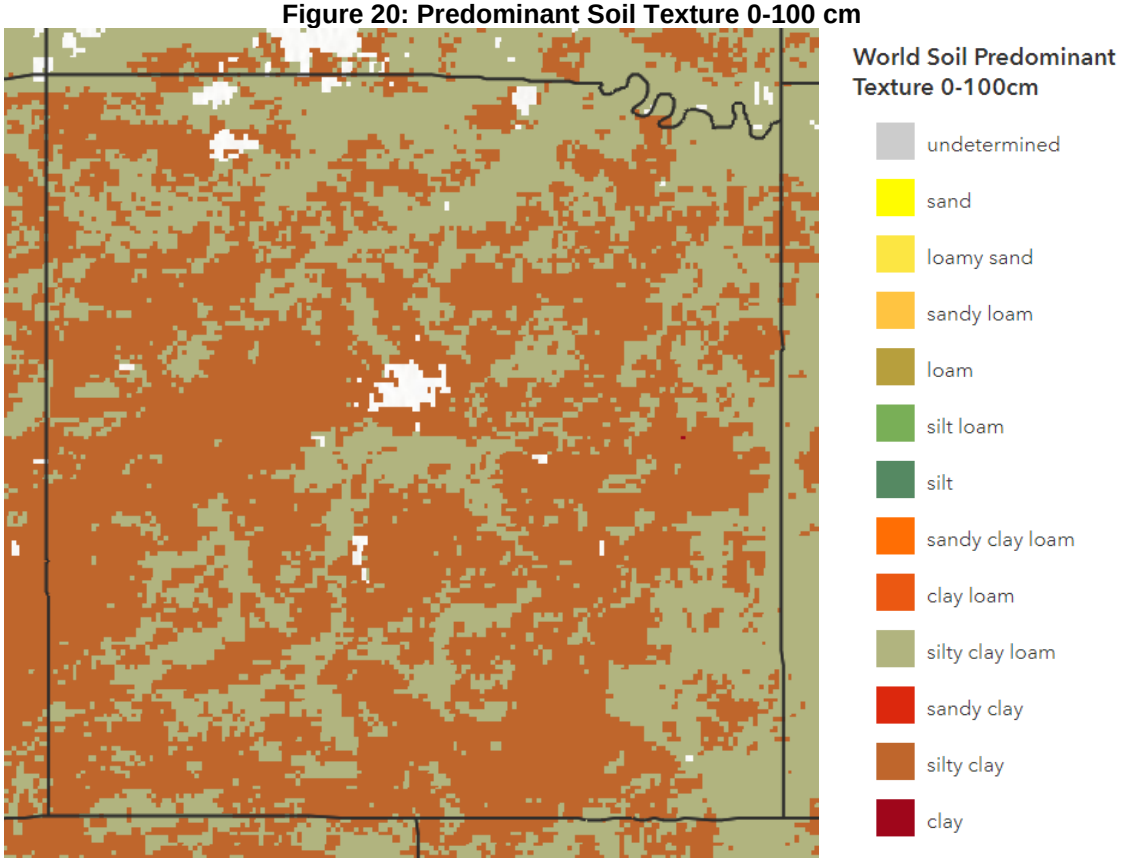
Historical Occurrences

There is no official data pertaining to damages from expansive soils; however, the frequency of damage from expansive soils can be associated with the cycles of drought and heavy rainfall which reflect changes in moisture content. Streets and parking lots throughout Warren County are damaged every year by expansive soils. Similarly, building foundations, patios, and underground utilities are damaged as the soil expands and contracts to varying degrees and depths depending on hydrological conditions. Norwalk and the Southeast Warren Community School District both report a history of infrastructure damage from expansive soils. Damage in Norwalk occurs annually to roadways, sidewalks, driveways, and subterranean infrastructure. The Southeast Warren CSD suffered damages from soil expansion in 1972 and 2010 to the gym at Liberty Center.

Extent

The types of soil texture in Warren County are shown in Figure 20. Soil texture is identified by predominant USDA texture class derived from predicted percent sand, silt, and clay. The figure displays a 100cm depth, which matches many of the worlds crop rooting depths. Warren County primarily consists of silty clay and silty clay loam soil textures.

Figure 20: Predominant Soil Texture 0-100 cm



Source: Esri Environment, 2021[65]

[65] Esri Environment. November 2021. "World Soil Predominant texture 0-100cm". https://www.arcgis.com/home/item.html?id=3988bece11ac44b4a2fc0ecb88c8e081

Average Annual Losses

There is no data available to determine damage estimates for this hazard. In most cases, individual property owners, local governments, and businesses pay for repairs for damages caused by this hazard. However, the Southeast Warren CSD reports estimated damages from expansive soils to the Liberty Center gym facilities totaling $70,000 since its construction.

Probability

Damage to paved areas and foundations in Warren County will continue due to swelling soils. Norwalk and the Southeast Warren CSD have noted damages attributed to expansive soil, indicating that these areas are at higher risk of experiencing this hazard and will experience ongoing damage. Certain building and construction practices can alleviate these impacts. Due to a lack of data surrounding expansive soil occurrences in the planning area, the probability for this hazard occurring annually cannot be calculated.

Community Top Hazard Status

The City of Norwalk identified Expansive Soils as a top hazard of concern.

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities. For jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 49: Regional Vulnerabilities

Sector	Vulnerability
People	-Risk of injury from falling structures.
Economic	-Damages to buildings and property can cause significant losses to business owners and divert tax revenue from social and economic improvement programs
Built Environment	-Basements and subterranean infrastructure can incur damage
Infrastructure	-Roadways, sidewalks, driveways, and bridges can be damaged
Critical Facilities	-Same as all other structures
Climate	-None

EXTREME TEMPERATURES (COLD/HEAT)

Extreme heat is often associated with periods of drought but can also be characterized by long periods of high temperatures in combination with high humidity. During these conditions, the human body has difficulty cooling through the normal method of the evaporation of perspiration. Health risks arise when a person is overexposed to heat. Extreme heat can also cause people to overuse air conditioners, which can lead to power failures. Power outages for prolonged periods increase the risk of heat stroke and subsequent fatalities due to loss of cooling and proper ventilation. The planning area is largely rural, which presents an added vulnerability to extreme heat events; those suffering from an extreme heat event may be farther away from medical resources as compared to those living in an urban setting.

Along with humans, animals also can be affected by high temperatures and humidity. Cattle and other farm animals respond to heat by reducing feed intake, increasing their respiration rate, and increasing their body temperature. These responses assist the animal in cooling itself, but this is usually not sufficient. When animals overheat, they will begin to shut down body processes not vital to survival, such as milk production, reproduction, or muscle building.

Other secondary concerns connected to extreme heat hazards include water shortages brought on by drought-like conditions and high demand. Government authorities report that civil disturbances and riots are more likely to occur during heat waves. In cities, pollution becomes a problem because the heat traps pollutants in densely populated urban areas. Adding pollution to the stresses associated with the heat magnifies the health threat to the urban population.

The National Weather Service (NWS) is responsible for issuing excessive heat outlooks, excessive heat watches, and excessive heat warnings.

- **Excessive heat outlooks** are issued when the potential exists for an excessive heat event in the next three to seven days. Excessive heat outlooks can be utilized by public utility staffs, emergency managers, and public health officials to plan for extreme heat events.

- **Excessive heat watches** are issued when conditions are favorable for an excessive heat event in the next 24 to 72 hours.

- **Excessive heat warnings** are issued when an excessive heat event is expected in the next 36 hours. Excessive heat warnings are issued when an extreme heat event is occurring, is imminent, or has a very high probability of occurring.

Extreme cold

Prolonged exposure to cold causes the human body to lose heat faster than it can be produced and use up the bodies stored energy. As a result, abnormally low body temperature can lead to hypothermia. Frostbite is another symptom of prolonged cold exposure that causes a loss of feeling and color in affected areas of the body. Frostbite most often affects the nose, ears, cheeks, chin, fingers, or toes and can permanently damage body tissues.

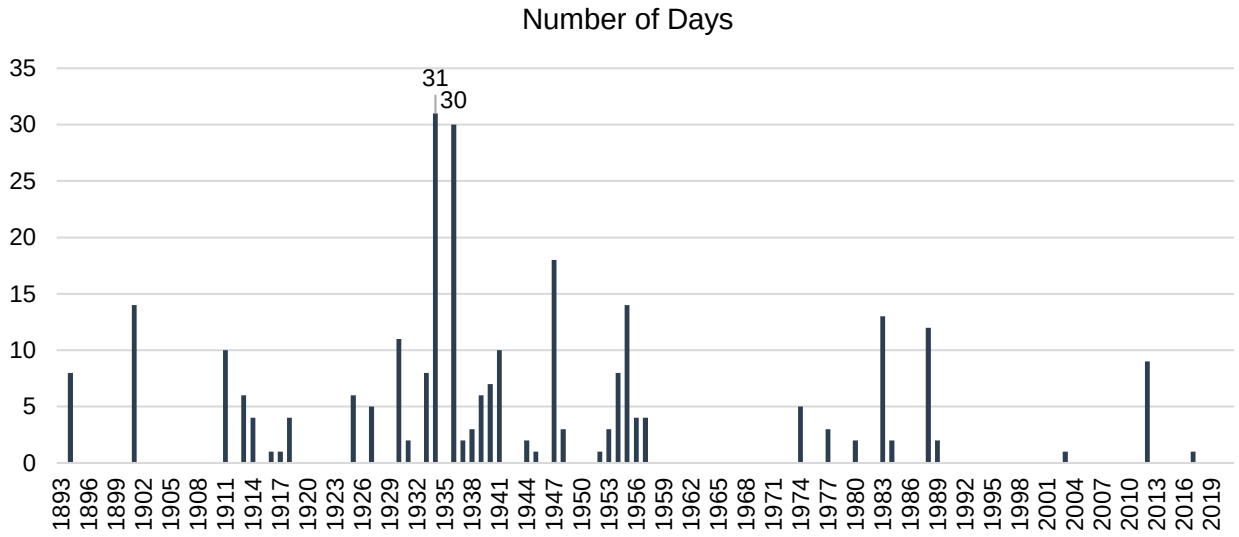
Location

The entire planning area is susceptible to extreme heat and cold impacts.

Historical Occurrences

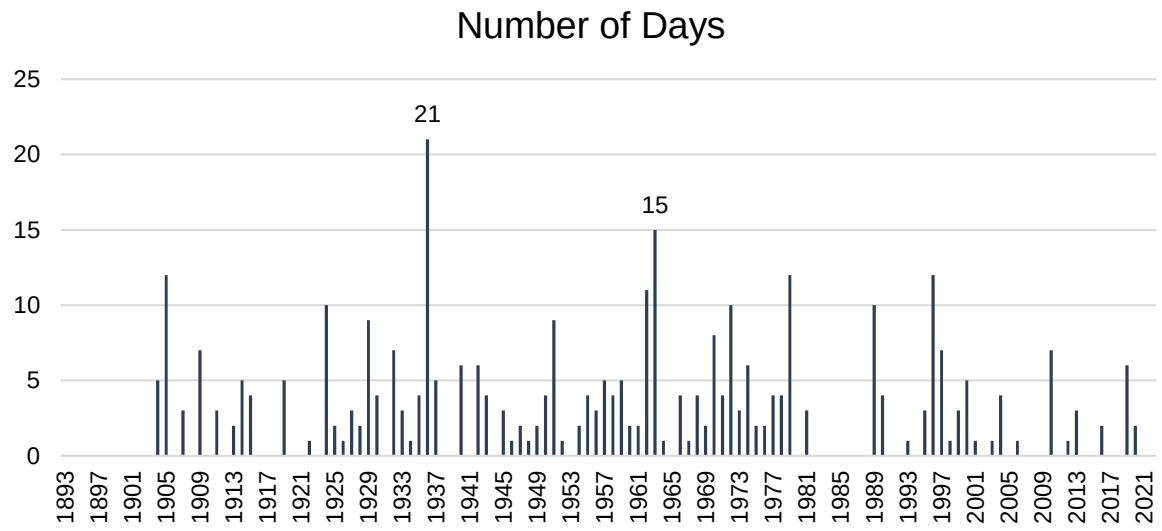
According to the High Plains Regional Climate Center (HPRCC), on average, the planning area experiences three days above 100°F per year. The planning area experienced the most days on record above 100°F in 1934 with 31 days and in 1936 with 30 days (Figure 21). The most recent "coolest" year on record was 2020, with zero days above 100°F. Conversely, the planning area experiences an average of 4 days below 10°F per year and had the most days on record below 10°F in 1937 and in 1963 with 15 days (Figure 22).

Figure 21: Number of Days Above 100°F



Source: HPRCC, 1893-2021

Figure 22: Number of Days Below 10°F



Source: HPRCC, 1893-2021

Extent

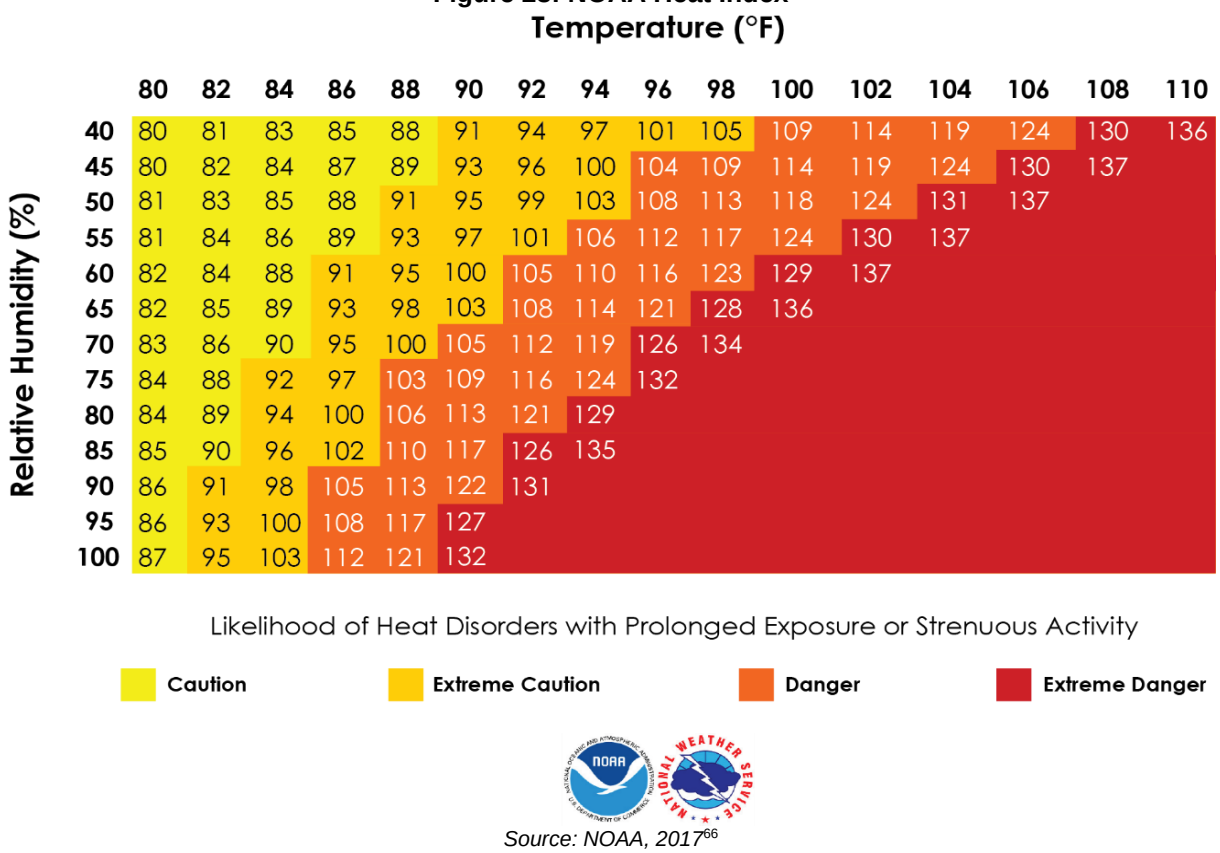
Extreme Heat

A key factor to consider regarding extreme heat situations is the humidity level relative to the temperature. As is indicated in the following figure from the National Oceanic and Atmospheric Administration, as the relative humidity increases, the temperature needed to cause a dangerous situation decreases. For example, for 100% relative humidity, dangerous levels of heat begin at 86°F whereas a relative humidity of 50%, require 94°F. The combination of relative humidity and temperature result in a heat index as demonstrated below:

$$100\%\ Relative\ Humidity + 86°\text{F} = 112°\text{F}\ Heat\ Index$$

Figure 23 is designed for shady and light wind conditions. Exposure to full sunshine or strong winds can increase hazardous conditions and raise heat index values by up to 15°F. For the purposes of this plan, extreme heat is being defined as temperatures of 100°F or greater. In the planning area, the months with the highest temperatures are June, July, and August.

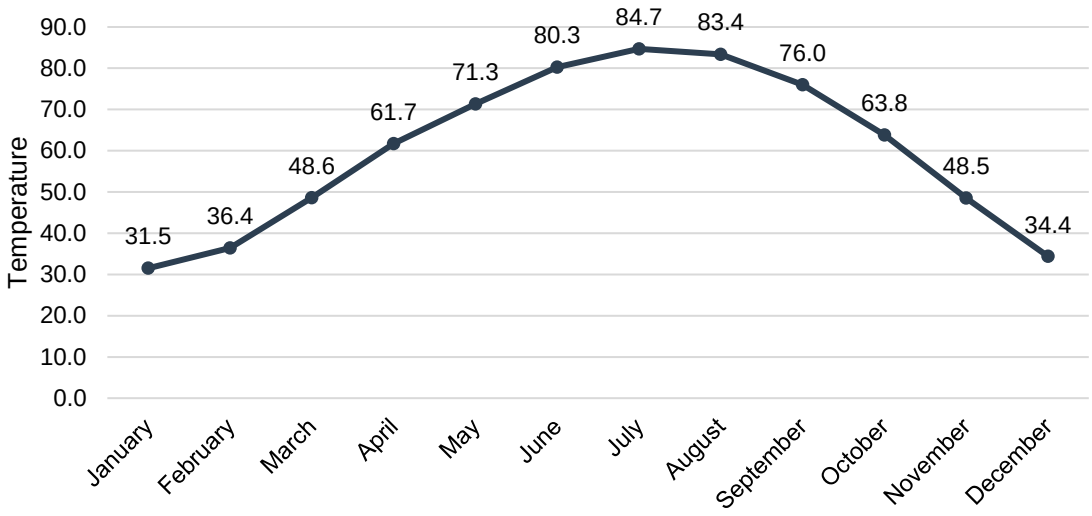
Figure 23: NOAA Heat Index



Source: NOAA, 2017[66]

66 National Oceanic and Atmospheric Administration, National Weather Service. 2017. "Heat Index." http://www.nws.noaa.gov/om/heat/heat_index.shtml.

Figure 24: Monthly Climate Normals Max Temperature (1981-2010)



Source: NCEI, 2021

Extreme Cold

Along with snow and ice storm events, extreme cold is dangerous to the well-being of people and animals. What constitutes extreme cold varies from region to region but is generally accepted as temperatures that are significantly lower than the region's average low temperature. For the purposes of this plan, extreme cold is being defined as temperatures of 0°F or less. For the planning area, the coldest months of the year are December, January, and February (Figure 26). The average low temperature for these months is below freezing (average low for the three months is 14.6°F).[67]

The Wind Chill Index was developed by the NWS to determine the decrease in air temperature felt by the body on exposed skin due to wind. The wind chill is always lower than the air temperature and can quicken the effects of hypothermia or frost bite as it gets lower. Figure 25 shows the Wind Chill Index used by the NWS.

67 High Plains Regional Climate Center. 2021. "Monthly Climate Normals 1981-2010." http://climod.unl.edu/.

Figure 25: Wind Chill Index Chart

Temperature (°F)

Wind (mph)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-82	-89	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

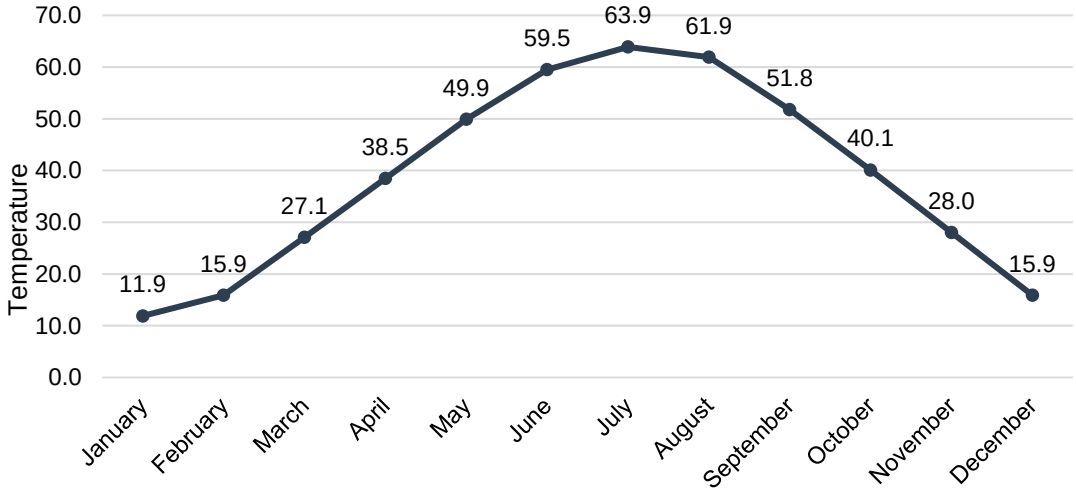
Frostbite Times: 30 Minutes | 10 Minutes | 5 Minutes

Wind Chill (°F) = 35.74 + 0.6215T - 35.75($V^{0.16}$) + 0.4275T($V^{0.16}$)

T = Air Tempurature (°F) **V** = Wind Speed (mph)

Source: NWS, 2017[68]

Figure 26: Monthly Climate Normals Minimum Temperature (1981-2010)



Source: NCEI, 2021

Average Annual Losses

The annual property estimate was determined based upon NCEI Storm Events Database since 1996. The annual crop loss was determined based upon the RMA Cause of Loss Historical Database since 2000. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. The direct and indirect effects of extreme temperatures are

68 National Weather Service. 2001. "Wind Chill Chart." http://www.nws.noaa.gov/om/cold/wind_chill.shtml.

difficult to quantify. Potential losses such as power outages could affect businesses, homes, and critical facilities. High demand and intense use of air conditioning, HVAC systems for heating, or water pumps can overload the electrical systems and damage infrastructure.

Table 50: Loss Estimate for Extreme Heat

Hazard Type	Avg. Number of Days Above 100°F[1]	Total Property Loss[2]	Average Annual Property Loss[2]	Total Crop Loss[3]	Average Annual Crop Loss[3]
Extreme Heat	3 days	$0	$0	$949,447	$47,472

Source: 1 HPRCC (1895-2021); 2 Indicates data is from NCEI (Jan 1996 to Jul 2021); 3 Indicates data is from USDA RMA (2000 to 2020)

Table 51: Loss Estimate for Extreme Cold

Hazard Type	Avg. Number of Days Below 0°F[1]	Total Property Loss[2]	Average Annual Property Loss[2]	Total Crop Loss[3]	Average Annual Crop Loss[3]
Extreme Cold	15 days	$0	$0	$31,581	$1,579

Source: 1 HPRCC (1895-2021); 2 Indicates data is from NCEI (Jan 1996 to Jul 2021); 3 Indicates data is from USDA RMA (2000 to 2020)

Estimated Loss of Electricity

According to the FEMA Benefit Cost Analysis Reference Guide, if an extreme heat event occurred within the planning area, the following table assumes the event could potentially cause a loss of electricity for 10% of the population at a cost of $126 per person per day.[69] In rural areas, the percent of the population affected, and duration may increase during extreme events. The assumed damages do not consider physical damages to utility equipment and infrastructure.

Table 52: Loss of Electricity - Assumed Damage

Jurisdiction	(est.) 2017 Population	Population Affected (Assumed)	Electric Loss of Use Assumed Damage Per Day
Warren County	52,403	5,240	$660,240

Probability

Extreme temperatures are a regular part of the climate for the planning area. Extreme heat events having at least one day of 100°F occurred in 40 out of 129 years. The probability that extreme heat will occur in any given year in the planning area is 31 percent. Extreme cold events having at least one day below 10°F occurred in 79 out of 129 years. The probability that extreme cold will occur in any given year in the planning area is 61 percent.

The Union for Concerned Scientists released a report in July 2019 titled *Killer Heat in the United States: Climate Choices and the Future of Dangerously Hot Days*[70] which included predictions for extreme heat events in the future dependent on future climate actions. The table below summarizes those findings for the planning area.

69 Federal Emergency Management Agency. June 2009. "BCA Reference Guide."

70 Union of Concerned Scientists. 2019. "Killer Heat in the United States: Climate Choices and the Future of Dangerously Hot Days." https://www.ucsusa.org/sites/default/files/attach/2019/07/killer-heat-analysis-full-report.pdf.

Table 53: Extreme Heat Predictions for Days over 100F

Jurisdiction	Midcentury Prediction 2036-2065 (days per year)	Late Century Prediction 2070-2099 (days per year)
Warren County	35	61

Source: Union of Concerned Scientists, 1971-2019[71]

Community Top Hazard Status

The following table lists jurisdictions which identified Extreme Temperatures as a top hazard of concern:

Jurisdictions	
City of Hartford	City of Norwalk

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities. For jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 54: Regional Vulnerabilities

Sector	Vulnerability
People	-Heat exhaustion -Heat stroke -Hypothermia -Heart Disease -Asthma Vulnerable populations include: -People working outdoors -People without air conditioning or heat -Young children outdoors or without air conditioning or heat -Elderly outdoors or without air conditioning or heat
Economic	-Short-term interruption of business -Loss of power -Agricultural losses
Built Environment	-Damage to air conditioning/HVAC systems if overworked
Infrastructure	-Damages to roadways (prolonged extreme events) -Stressing electrical systems (brownouts during peak usage) -Stressing water systems
Critical Facilities	-Loss of power
Climate	-Increased risk of wildfire events -Increases in extreme heat conditions are likely, adding stress on livestock, crops, people, and infrastructure -Increases in extreme cold conditions are likely, adding stress on electrical systems, people, and infrastructure

71 Union of Concerned Scientists. 2019. "Extreme Heat and Climate Change: Interactive Tool". https://www.ucsusa.org/global-warming/global-warming-impacts/extreme-heat-interactive-tool?location=warren-county--ia

FLOODING

Flooding can occur on a local level, sometimes affecting only a few streets, but can also extend throughout an entire district, affecting whole drainage basins and impacting property in multiple states. Heavy accumulations of ice or snow can also cause flooding during the melting stage. These events are complicated by the freeze/thaw cycles characterized by moisture thawing during the day and freezing at night. There are four main types of flooding: riverine flooding, flash flooding, stormwater flooding, and ice jam flooding.

Riverine Flooding

Riverine flooding, typically slower developing with a moderate to long warning time, is defined as the overflow of rivers, streams, drains, and lakes due to excessive rainfall, rapid snowmelt, or ice melt. The areas adjacent to rivers and stream banks that carry excess floodwater called floodplains. A floodplain or flood risk area is defined as the lowland and relatively flat area adjoining a river or stream. The terms “base flood” and “100-year flood” refer to the area in the floodplain that is subject to a one percent or greater chance of flooding in any given year. Floodplains are part of a larger entity called a basin or watershed, which is defined as all the land draining to a river and its tributaries.

Flash Flooding

Flash floods, typically rapidly developing with little to no warning time, result from convective precipitation usually due to intense thunderstorms or sudden releases due to a failure of an upstream impoundment created behind a dam, landslide, or levee. Flash floods are distinguished from regular floods by a timescale of fewer than six hours. Flash floods cause the most flood-related deaths because of this shorter timescale. Flooding from excessive rainfall events in Iowa usually occurs between late spring and early fall.

Stormwater Flooding

In some cases, flooding may not be directly attributable to a river, stream, or lake overflowing its banks. Rather, it may simply be the combination of excessive rainfall or snowmelt, saturated ground, and inadequate drainage capacity. With no place to go, the water will find the lowest elevations – areas that are often not in a floodplain. This type of flooding, often referred to as stormwater flooding, is becoming increasingly prevalent as development exceeds the capacity of drainage infrastructure, therefore limiting its ability to convey stormwater. Flooding also occurs due to combined storm and sanitary sewers being overwhelmed by the high flows that often accompany storm events. Typical impacts range from dangerously flooded roads to water backing up into homes or basements, which damages mechanical systems and can create serious public health and safety concerns.

Ice Jam Flooding

Ice jams occur when ice breaks up in moving waterways, and then stacks on itself where channels narrow, or human-made obstructions constrict the channel. This creates an ice dam, often causing flooding within minutes of the dam formation. Ice formation in streams occurs during periods of cold weather when finely divided colloidal particles called "frazil ice" form. These particles combine to form what is commonly known as “sheet ice.” This type of ice covers the entire river. The thickness of this ice sheet depends upon the degree and duration of cold weather in the area. This ice sheet can freeze to the bottom of the channel in places. During spring thaw or winter freezing, rivers frequently become clogged with this winter accumulation of ice. Because of relatively low stream banks and channels blocked with ice, rivers overtop existing banks and flow overland. This type of flooding tends to ore frequently occur on wide, shallow rivers, although other rivers can be impacted.

Location

The region resides in the Lake Red Rock watershed. Major waterways in the planning area include the Middle and South Rivers. These rivers as well as their tributaries are potential locations for flooding to occur.

Table 55 shows current statuses of Flood Insurance Rate Map (FIRM) panels.

Figure **27** shows the FIRM data for the planning area. For jurisdictional-specific maps as well as an inventory of structures in the floodplain, please refer to *Section Seven: Participant Sections.*

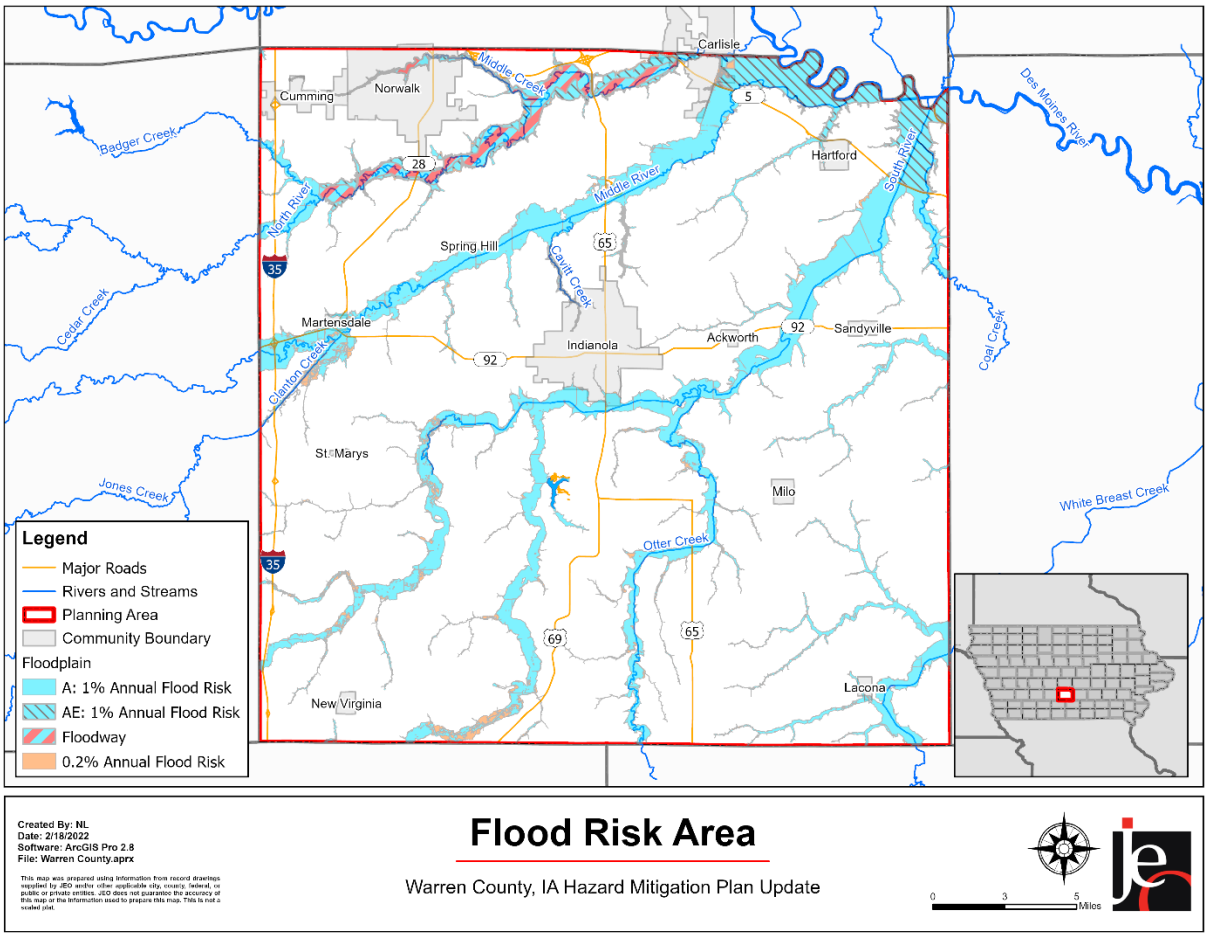
Table 55: FEMA FIRM Panel Status

Jurisdiction	Participating in NFIP? (Y/N)	Panel Number	Effective Date
Warren County	Y	19181CIND0C, 1902270009E, 19153C0189F, 19153C0195F, 19153C0215F, 19153C0220F, 19153C0327F, 19153C0329F, 19153C0335F, 19153C0340F, 19153C0345F, 19153C0355F, 19153C0360F, 19153C0365F, 19153C0370F, 19153C0380F, 19181C0020F, 19181C0039G, 19181C0043G, 19181C0044G, 19181C0065G, 19181C0068G, 19181C0069G, 19181C0070G, 19181C0090F, 19181C0095F, 19181C0107G, 19181C0108F, 19181C0109G, 19181C0120G, 19181C0126G, 19181C0127G, 19181C0128G, 19181C0129G, 19181C0132G, 19181C0133G, 19181C0134G, 19181C0136G, 19181C0137G, 19181C0138F, 19181C0139F, 19181C0145G, 19181C0151G, 19181C0152G, 19181C0153G, 19181C0154G, 19181C0156G, 19181C0157G, 19181C0160F, 19181C0161F, 19181C0162F, 19181C0163F, 19181C0164F, 19181C0166F, 19181C0167F, 19181C0168F, 19181C0169F, 19181C0176F, 19181C0177F, 19181C0178F, 19181C0179F, 19181C0185F, 19181C0190F, 19181C0195F, 19181C0205F, 19181C0215F, 19181C0250F, 19181C0275F, 19181C0276F, 19181C0277F, 19181C0278F, 19181C0279F, 19181C0285F, 19181C0290F, 19181C0295F, 19181C0325F, 19181C0350F, 19181C0375F, 19181C0400F, 19181C0425F, 19181C0450F, 19181C0475F	7/15/1988, 11/16/2018, 2/1/2019
Ackworth	N	19181CIND0C, 19181C0325F	11/16/2018
Carlisle	Y	19181CIND0C, 19181C0068G, 19181C0069G, 19181C0070G, 19181C0090F, 19181C0157G, 19181C0176F	11/16/2018
Cumming	Y	19181CIND0C, 19181C0107G, 19181C0126G	11/16/2018
Hartford	Y	19181CIND0C, 19181C0185F	11/16/2018
Indianola	Y	19181CIND0C, 19181C0164F, 19181C0168F, 19181C0276F, 19181C0277F, 19181C0279F, 19181C0285F	11/16/2018
Lacona	N	19181CIND0C, 19181C0450F	11/16/2018
Martensdale	Y	19181CIND0C, 19181C0138F, 19181C0275F	11/16/2018
Milo	Y	19181CIND0C, 19181C0325F	11/16/2018
New Virginia	N	19181CIND0C, 19181C0400F	11/16/2018

Norwalk	Y	19181CIND0C, 19181C0039G, 19181C0043G, 19181C0044G, 19181C0126G, 19181C0127G, 19181C0129G, 19181C0132G, 19181C0133G	11/16/2018
Sandyville	N	19181CIND0C, 19181C0325F	11/16/2018
Spring Hill	Y	19181CIND0C, 19181C0145G	11/16/2018
St. Marys	N	19181CIND0C, 19181C0275F	11/16/2018

Source: FEMA, 2022[72]

Figure 27: 1% and 0.2% Annual Flood Risk Hazard Areas



Risk Map Products

Risk Mapping, Assessment, and Planning (Risk MAP) is a FEMA program that provides communities with flood information and additional flood risk data (e.g., flood depth grids, percent chance grids, areas of mitigation interest, etc.) that can be used to enhance their mitigation plans and better protect their citizens. Currently, Warren County does not have any Risk MAP products. Polk County has a flood risk assessment that includes the City of Carlisle as part of the city resides in Polk County; however, no data is provided in the assessment for the city. FEMA plans to include data for Carlisle in future Risk MAP activities for Warren County.

The Iowa Flood Center hosts flood risk maps on an interactive web map that contains tools for analyzing scour-prone areas, flood risk gradients, and flood depths. Flood inundation risk gradients and flood depth maps for each community were added to participant sections where

72 Federal Emergency Management Agency. 2022. "FEMA Flood Map Service Center." Accessed February 2022. http://msc.fema.gov/portal/advanceSearch.

applicable. Maps for scour-prone areas can be found in the Warren County participant section. The interactive flood risk maps can be viewed at: https://ifis.iowafloodcenter.org/ifis/newmaps/risk/map/.

Extent

The NWS has three categories to define the severity of a flood once a river reaches flood stage as indicated in Table 56.

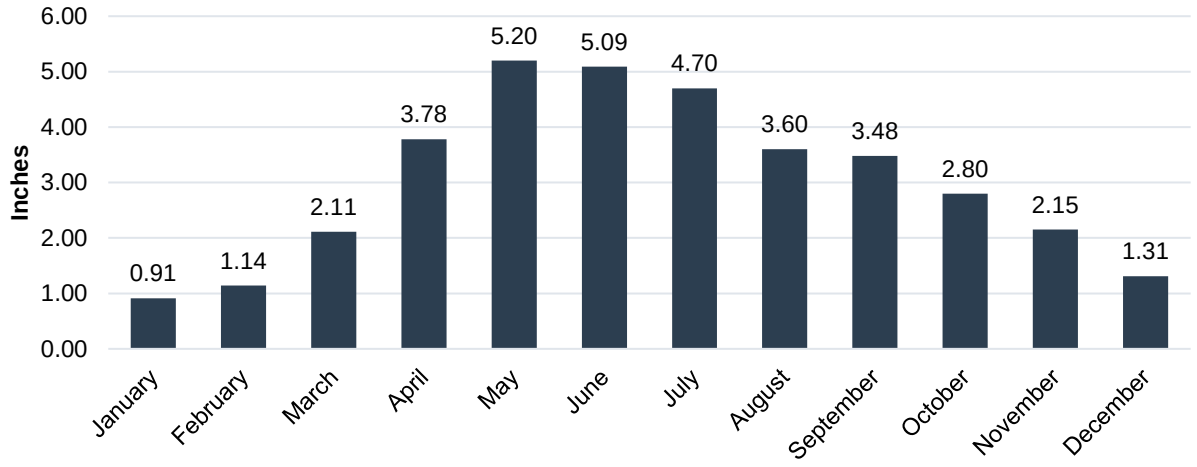
Table 56: Flooding Stages

Flood Stage	Description of flood impacts
Minor Flooding	Minimal or no property damage, but possibly some public threat or inconvenience
Moderate Flooding	Some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary
Major Flooding	Extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations

Source: NOAA, 2017[73]

Figure 28 shows the normal average monthly precipitation for the planning area, which is helpful in determining whether any given month is above, below, or near normal in precipitation. As indicated in Figure 29, the most common months for flooding within the planning area are May, June, and July.

Figure 28: Average Monthly Precipitation for Planning Area

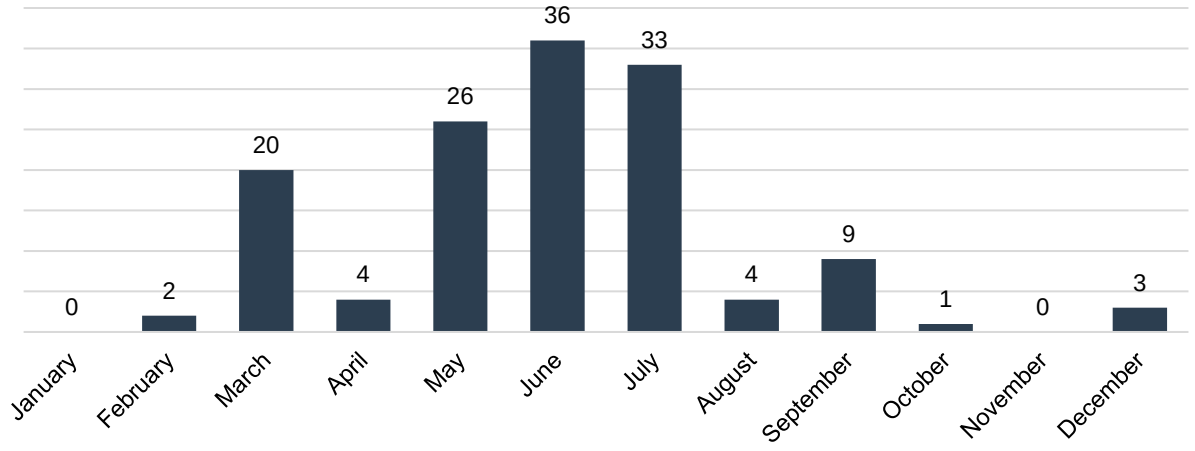


Source: NCEI, 2021[74]

73 National Weather Service. 2017. "Flood Safety." https://www.weather.gov/safety/flood.

74 NOAA National Centers for Environmental Information. January 2021. "Data Tools: 1981-2010 Normals." [datafile]. https://www.ncdc.noaa.gov/cdo-web/datatools/normals.

Figure 29: Monthly Events for Floods/Flash Floods



Source: NCEI, 1996-July 2021

National Flood Insurance Program (NFIP)

The NFIP was established in 1968 to reduce flood losses and disaster relief costs by guiding future development away from flood hazard areas where feasible; by requiring flood resistant design and construction practices; and by transferring the costs of flood losses to the residents of floodplains through flood insurance premiums.

In return for availability of federally backed flood insurance, jurisdictions participating in the NFIP must agree to adopt and enforce floodplain management standards to regulate development in special flood hazard areas as defined by FEMA's flood maps. One of the strengths of the program has been keeping people away from flooding rather than keeping the flooding away from people—through historically expensive flood control projects. The following tables summarize NFIP participation and active policies within the planning area.

Table 57: NFIP Participants

Jurisdiction	Participate in NFIP	Eligible-Regular Program	Date Current Map	Sanction	Suspension	Rescinded
Warren County	Y	07/01/1991	10/16/2014	-	-	-
Ackworth	N	-	-	-	-	-
Carlisle	Y	08/04/1987	11/16/2018	-	-	-
Cumming	Y	01/24/2000	09/30/2005	-	-	-
Hartford	Y	10/07/2008	11/16/2018(M)	-	-	-
Indianola	Y	07/31/1979	11/16/2018	-	-	-
Lacona	N	-	-	-	-	-
Martensdale	Y	09/01/1996	11/16/2018(M)	-	-	-
Milo	Y	04/14/2010	(NSFHA)	-	-	-
New Virginia	N	-	-	-	-	-
Norwalk	Y	11/20/1998	11/16/2018	-	-	-
Sandyville	N	-	-	-	-	-
Spring Hill	Y	05/26/1998	(NSFHA)	-	-	-

Jurisdiction	Participate in NFIP	Eligible-Regular Program	Date Current Map	Sanction	Suspension	Rescinded
St. Marys	N	-	-	-	-	-

Source: Federal Emergency Management Agency, National Flood Insurance Program, 2022[75]
**(M) indicates no elevation determined – All Zone A, C, and X*
**(NSFHA) indicates No Special Flood Hazard Area – All Zone C*

The NFIP Emergency Program allows a community to voluntarily participate in the NFIP if no flood hazard information is available for their area; the community has a Flood Hazard Bound Map but no FIRM; or the community has been identified as flood-prone for less than a year.

Table 58: NFIP Policies in Force and Total Payments

Jurisdiction	Policies In-force	Total Coverage	Total Premiums	Total Losses	Total Payments
Carlisle	7	$1,657,500	$3,322	0	$0
Indianola	8	$2,177,000	$3,640	0	$0
Martensdale	2	$513,900	$821	1	$0
Norwalk	3	$816,000	$2,408	1	$0
Warren County	8	$2,374,100	$4,332	15	$233,326

Source: FEMA, HUDEX Policy Loss Data, October 2021[76]

This plan highly recommends and strongly encourages plan participants to enroll, participate, and remain in good standing with the NFIP. Compliance with the NFIP should remain a top priority for each participant. Jurisdictions are encouraged to initiate activities above the minimum participation requirements, which are described in the Community Rating System (CRS) Coordinator's Manual.[77] Currently no jurisdictions in the planning area participate in the CRS program.

NFIP Repetitive Loss Structures

IDNR was contacted to determine if any existing buildings, infrastructure, or critical facilities are classified as NFIP Repetitive Loss Structures. As of April 2022, there is one repetitive loss property in unincorporated Warren County, and it is a single-family dwelling. There are no additional repetitive loss or severe repetitive loss properties located in the county. It is important that the county works with the property owner to identify a solution to mitigate the repetitive flood damages into the future and is included as a project in the county's profile. Definitions of a structure identified as a NFIP Repetitive Loss (RL) and Severe Repetitive Loss (SRL) are given below.

NFIP RL: Repetitive Loss Structure refers to a structure covered by a contract for flood insurance under the NFIP that has incurred flood-related damage on two occasions during a 10-year period, each resulting in at least a $1,000 claim payment.

NFIP SRL: Severe Repetitive Loss Properties are defined as single or multifamily residential properties that are covered under an NFIP flood insurance policy and:

(1) That have incurred flood-related damage for which four or more separate claims payments have been made, with the amount of each claim (including building and contents payments)

75 Federal Emergency Management Agency. 2022. "Community Status Book Report." Accessed February 2022. https://www.fema.gov/cis/IA.html
76 Federal Emergency Management Agency. October 2021. "Policy & Claim Statistics for Flood Insurance." Accessed February 2022. https://nfipservices.floodsmart.gov/reports-flood-insurance-data
77 Federal Emergency Management Agency. 2017. "National Flood Insurance Program Community Rating System: Coordinator's Manual FIA-15/2017." Accessed February 2022. https://www.fema.gov/floodplain-management/community-rating-system#manual

exceeding $5,000, and with the cumulative amount of such claim payments exceeding $20,000; or

(2) For which at least two separate claims payments (building payments only) have been made under such coverage, with cumulative amount of such claims exceeding the market value of the building.

(3) In both instances, at least two of the claims must be within 10 years of each other, and claims made within 10 days of each other will be counted as one claim.

Historical Occurrences

The NCEI reports events as they occur in each community. A single flooding event can affect multiple communities and counties at a time; the NCEI reports these large scale, multi-county events as separate events. A single flood event covering a large portion of the planning area could be reported by the NCEI as several events as a result. According to the NCEI, 38 flash flooding events resulted in $2,550,000 in property damage, while 100 riverine flooding events resulted in $6,766,500 in property damage. USDA RMA data does not distinguish the difference between riverine flooding damages and flash flooding damages. The total crop loss according to the RMA is $6,072,395. Descriptions of the most damaging flood events from the NCEI are below:

- **June 11, 2011 – Flood:** Another round of severe weather and heavy rain took place during the late afternoon and evening hours of the 9th, lasting into the early morning of the 10th. A strong shortwave lifted northeast across the area. This resulted in considerable overrunning of the stalled cold front to the south of Iowa. Daily rainfall totals of 3 to nearly 5.5 inches were common over parts of central into south central Iowa. In Warren County at St. Marys, 5.4 inches was recorded, with 5.21 inches in Marion County at Swan. Polk City in Polk County received 5.01 inches, with 4.61 in Windsor Heights by midnight. Northeast of Patterson in Warren County reported a 24-hour rainfall total of 6.7 inches, with a total for the storm approaching 10 inches. There were numerous other reports of 4 to 6 inches of rain in Warren and Marion Counties. The heaviest two-day rainfall total was 9.31 inches, with 6.78 falling between the morning of the 9th and morning of the 10th. Flash flooding occurred in Polk, Marion, and Warren Counties. Local rivers and streams overflowed their banks with reports of 8 to 10 inches of rapidly flowing water in the streets. On the east side of Des Moines, four feet of water flooded streets. Once the flash flooding subsided, areal flooding was a significant problem in Warren, Marion, and Mahaska Counties. Numerous roads were flooded and closed with countless homes flooded. Water over Highway 5 between County Roads S31 and S23 in Warren County were reported by the IDOT. There were $500,000 in damages from the event.

- **July 12, 2014 – Flash Flood:** A cold front continued to move southeast across the state. Deep moisture was available with 2 to 2.25 inches of precipitable water present. Thunderstorms formed and dropped very heavy rainfall. Flash flooding was reported in Marion County as well as Warren County. Warren County was hardest hit with water up to 5 feet deep in the Milo area. Much of the town of Milo was left in standing water. There were $300,000 in damages from the event.

- **June 25, 2015 – Flood:** Thunderstorms produced very heavy rainfall of 3 to 6 inches across Warren County. Hail and damaging winds were also reported. The Emergency Manager reported Highway 92 closed between S23 and S31. Three bridges were

destroyed across the county and numerous culverts washed out. Numerous farm to market roads sustained damage including bridge approaches and also several structures were damaged. The event caused $1,000,000 in property damages.

Average Annual Damages

The average damage per event estimate was determined based upon NCEI Storm Events Database since 1996 and the number of historical occurrences. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. Flooding causes an average of $358,326 in property damages and $303,620 in crop losses per year for the planning area.

Table 59: Flood Loss Estimate

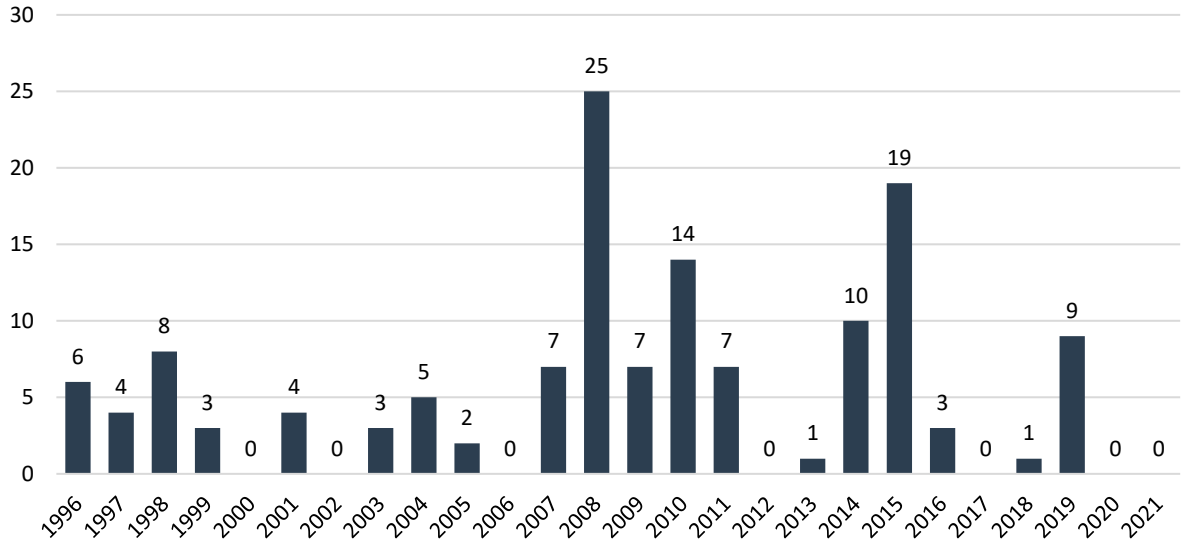
Hazard Type	Number of Events[1]	Average Events Per Year	Total Property Loss[1]	Average Annual Property Loss [1]	Total Crop Loss[2]	Average Annual Crop Loss [2]
Flooding	138	5.3	$9,316,500	$358,326	$6,072,395	$303,620

Source: 1 Indicates data is from NCEI (Jan 1996 to July 2021); 2 Indicates data is from USDA RMA (2000 to 2020)

Probability

The NCEI reports 100 flooding and 38 flash flooding events for a total of 138 events from January 1996 to July 2021. Some years had multiple flooding events. Figure 30 shows the events broken down by year. Based on the historic record and reported incidents by participating communities, there is a 73 percent probability that flooding will occur annually in the planning area.

Figure 30: Yearly Events for Floods/Flash Floods



Source: NCEI, 1996-July 2021

Community Top Hazard Status

The following table lists jurisdictions which identified Flooding as a top hazard of concern:

Jurisdictions	
Warren County	City of Indianola
City of Carlisle	City of Lacona
City of Cumming	City of Martensdale
City of Hartford	City of Milo
Indianola Community School District	City of St. Marys
Warren Water District	Simpson College

Regional Vulnerabilities

Low-income and minority populations are disproportionately vulnerable to flood events.[78] These groups may lack needed resources to mitigate potential flood events as well as resources that are necessary for evacuation and response. In addition, low-income residents are more likely to live in areas vulnerable to the threat of flooding but lack the resources necessary to purchase flood insurance. The study found that flash floods are more often responsible for injuries and fatalities than prolonged flood events.

Other groups that may be more vulnerable to floods, specifically flash floods, include the elderly, those outdoors during rain events, and those in low-lying areas. Elderly residents may suffer from a decrease or complete lack of mobility and as a result, be caught in flood-prone areas. Residents in campgrounds or public parks may be more vulnerable to flooding events. Many of these areas exist in natural floodplains and can experience rapid rise in water levels resulting in injury or death.

To analyze parcels and populations located in the floodplain, GIS parcel data were acquired from the Warren County Assessor. This data was analyzed for the location, number, and value of property improvements at the parcel level. Property improvements include any built structures such as roads, buildings, and paved lots. The data did not contain the number of structures on each parcel. A summary of the results of this analysis for the planning area is provided in the following table. Specific jurisdictional parcel improvements in the floodplain can be found in the corresponding community profiles in *Section Seven*.

Table 60: Warren County Parcel Improvements and Value in the 1% Annual Flood Risk Area

Number of Improvements	Total Improvement Value	Number of Improvements in Floodplain	Value of Improvements in Floodplain	Percentage of Improvements in Floodplain
3,435	$41,198,730,905	461	$42,455,500	13.4%

Source: Warren County Assessor, 2022

78 Cutter, Susan and Finch, Christina. February 2008. "Temporal and Spatial Changes in Social Vulnerability to Natural Hazards".

Table 61: Warren County Parcel Improvements & Value in the 1% & 0.2% Annual Flood Risk Area

Number of Improvements	Total Improvement Value	Number of Improvements in Floodplain	Value of Improvements in Floodplain	Percentage of Improvements in Floodplain
3,435	$41,198,730,905	484	$44,416,700	14.1%

Source: Warren County Assessor, 2022

In Iowa, Watershed Management Authorities (WMA) are a tool to help cities, counties, Soil and Water Conservation Districts (SWCDs) and stakeholders to work towards watershed planning and management. Currently there are six watershed management authorities that have been established in the Greater Des Moines area. The North and Middle Rivers WMA, which encompasses the northwestern portion of Warren County, has been formed by Chapter 28E Agreement but is not yet formally meeting. As that group organizes over the next few years it is encouraged that the county participates in that planning effort moving forward and to incorporate that work into the HMP. More information on the Greater Des Moines Watershed Management Authorities can be found at the following link: https://dmampo.org/watershed-management-authorities/.

The following table is a summary of regional vulnerabilities. For jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles.*

Table 62: Regional Vulnerabilities

Sector	Vulnerability
People	-Low income and minority populations may lack the resources needed for evacuation, response, or to mitigate the potential for flooding -Elderly or residents with decreased mobility may have trouble evacuating -Residents in low-lying areas, especially campgrounds, are vulnerable during flash flood events -Residents living in the floodplain may need to evacuate for extended periods
Economic	-Business closures or damages may have significant impacts -Agricultural losses from flooded fields or cattle loss -Closed roads and railways would impact commercial transportation of goods
Built Environment	-Buildings may be damaged
Infrastructure	-Damages to roadways and railways
Critical Facilities	-Wastewater facilities are at risk, particularly those in the floodplain -Critical facilities, especially those in the floodplain, are at risk to damage (critical facilities are noted within individual community profiles)
Climate	-Changes in seasonal and annual precipitation normals will likely increase frequency and magnitude of flood events

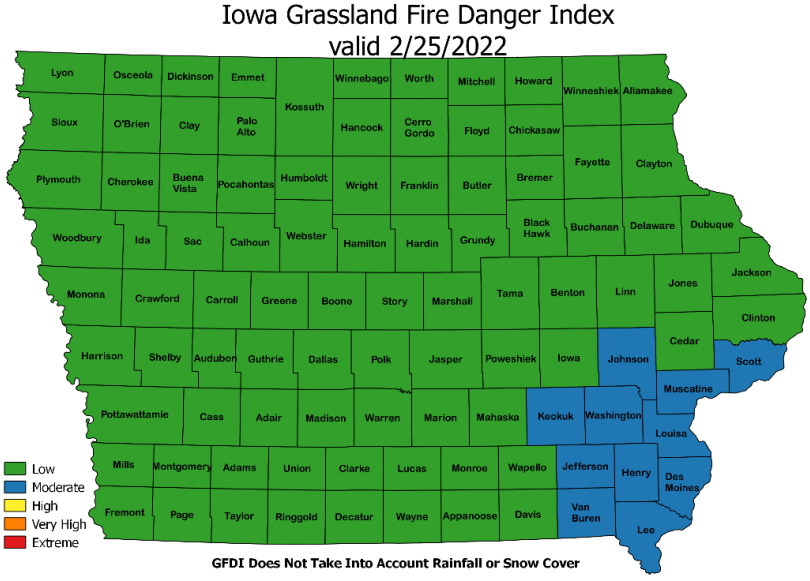
GRASS/WILDFIRE

Wildfires, also known as grassfires, brushfires, forest fires, or wildland fires, are any uncontrolled fire that occurs in the countryside or wildland. Wildland areas may include but are not limited to: grasslands; forests; woodlands; agricultural fields; pastures; and other vegetated areas. Wildfires range in size from a few acres (the most common) to thousands of acres in some cases. Fire events can quickly spread from their original source, change direction quickly, and jump gaps (such as roads, rivers, and fire breaks). Wildfire events are particularly dependent on the surrounding conditions including temperature, humidity, wind speed, wind direction, slope, and available fuel load. While some wildfires burn in remote forested regions, others can cause extensive destruction of homes and other property located in the wildland-urban interface (WUI), the zone of transition between developed areas and undeveloped wilderness.

Wildfires are a growing hazard in most regions of the United States, posing a threat to life and property, particularly where rural or native ecosystems meet urban developed areas or where local economies are heavily dependent on open agricultural land. Although fire is a natural and often beneficial process, fire suppression can lead to more severe fires due to the buildup of vegetation, which creates more fuel and increases the intensity and devastation of future fires.

Wildfires are characterized in terms of their physical properties including topography, weather, and fuels. Wildfire behavior is often complex and variably dependent on factors such as fuel type, moisture content in the fuel, humidity, wind speed, topography, geographic location, ambient temperature, the effect of weather on the fire, and the cause of ignition. Fuel and structure durability are the primary factors can control and are the target of most mitigation efforts. The NWS monitors the risk factors including high temperature, high wind speed, fuel moisture (greenness of vegetation), low humidity, and cloud cover in the state on a daily basis (Figure 31). Fire danger predictions are updated regularly and should be reviewed frequently by community leaders and fire department officials.

Figure 31: Grassland Fire Danger Index



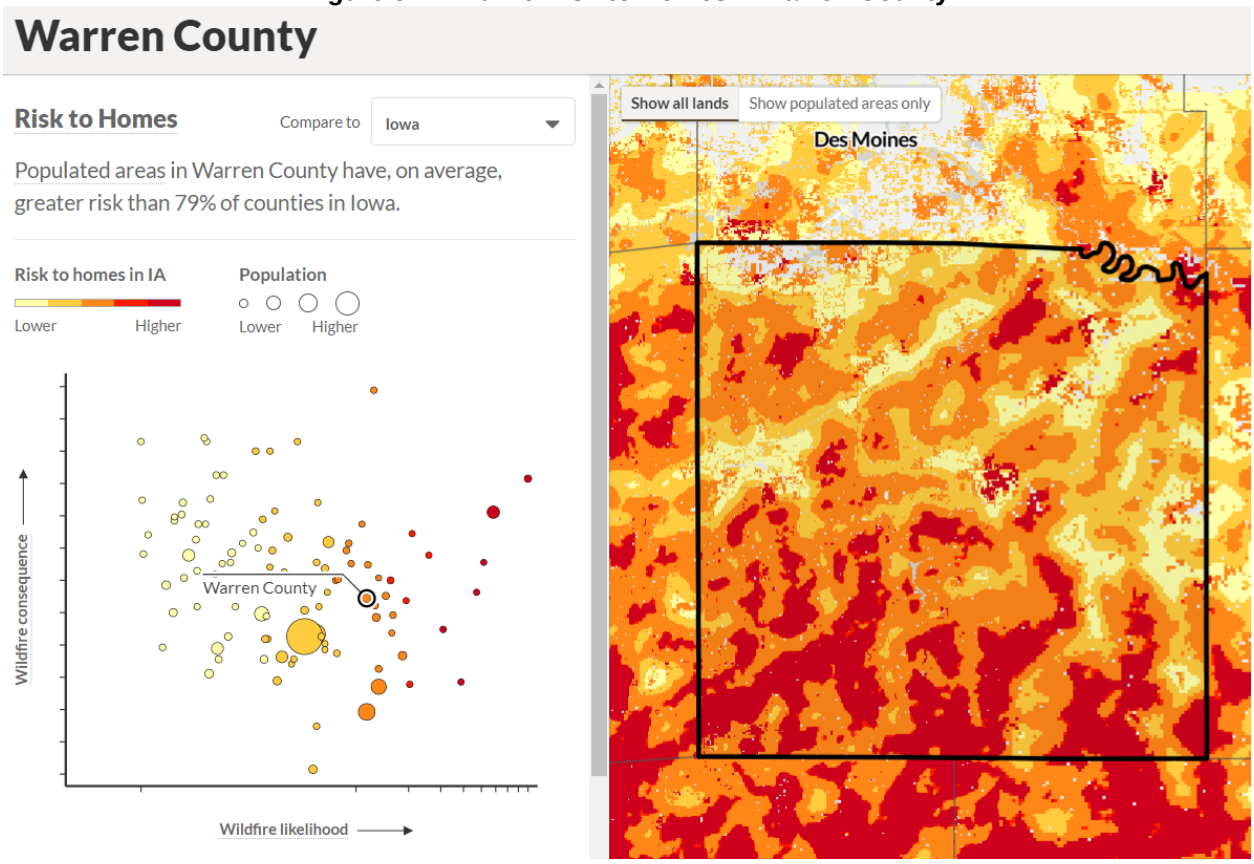
Source: NWS, 2022[79]

79 National Weather Service. February 2022. "Iowa Grassland Fire Danger Index." https://www.weather.gov/dmx/fire

Location

Grass/wildfires can occur throughout the planning area. The United States Department of Agriculture Forest Service created the interactive web resource *Wildfire Risk to Communities* to help communities and jurisdictions understand, explore, and reduce wildfire risk. The following figures show wildfire risk to homes by county in the planning area.

Figure 32: Wildfire Risk to Homes – Warren County



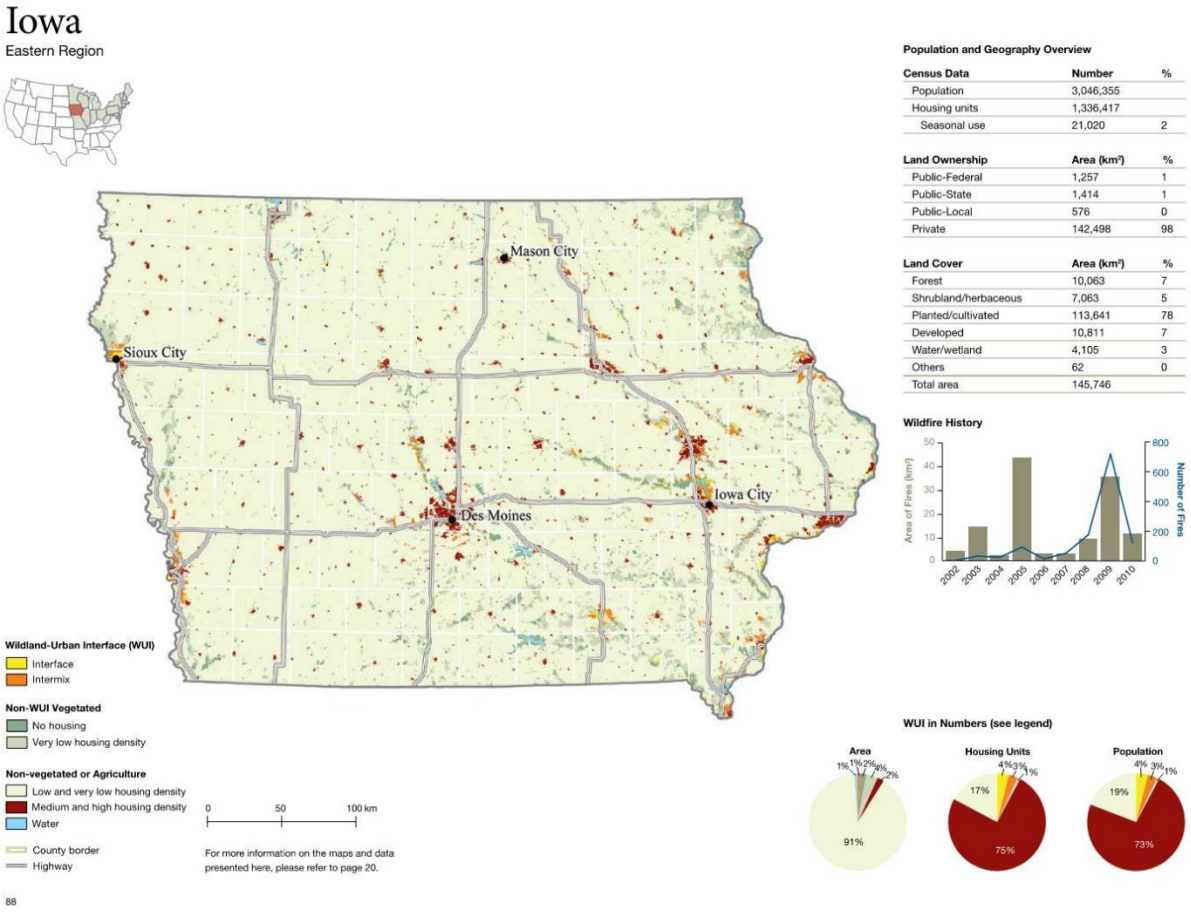
Source: Wildfire Risk to Communities[80]

In recent decades, as the population of the United States has decentralized and residents have moved farther away from the center of villages and cities, the area known as the wildland urban interface (WUI) has developed significantly, in both terms of population and building stock. The WUI is defined as the zone of transition between developed areas and undeveloped wilderness, where structures and other human development meet wildland. The expansion of the WUI increases the likelihood that wildfires will threaten people and homes, making it the focus of the majority of wildfire mitigation efforts.

The following figure produced by the USDA Forest Service displays the State of Iowa's WUI conditions as of 2010. The WUI indicates that the planning area has areas of interface (yellow) and intermix (orange) around major cities such as Indianola and in the northern part of Warren County (Figure 33). Medium and high housing density resides in these areas as well. The rest of the county has a mix of non-WUI vegetated, non-vegetated, and agricultural land.

80 United States Department of Agriculture, United States Forest Service. 2022. "Wildfire Risk to Communities." https://wildfirerisk.org/.

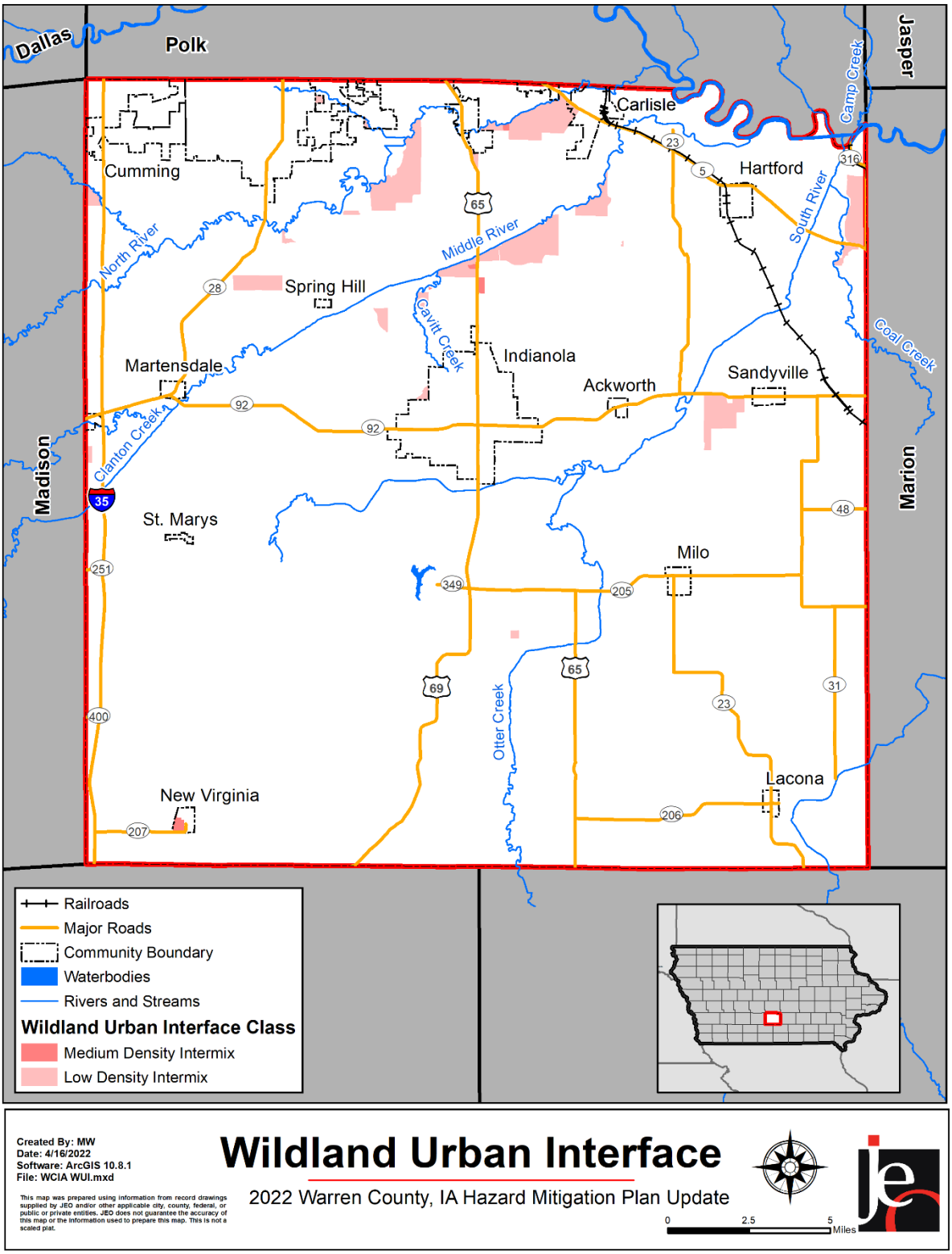
Figure 33: 2010 Wildland Urban Interface Map of Iowa



Source: USDA, 2010[81]

81 USDA, USFS, & University of Wisconsin. 2010. "The 2010 Wildland-Urban Interface of the Conterminous United States." https://www.fs.fed.us/nrs/pubs/rmap/rmap_nrs8.pdf

Figure 34: Wildland-Urban Interface Map of Planning Area



Extent

For the planning area, the following fire departments were identified to report events: New Virginia/Virginia Fire Department, Norwalk Fire Department, Jackson/St. Marys Fire Department, and Pleasantville Emergency Services. Fire districts respond to both wildfires and structural fires in cities.

As the number of reported wildfires by department indicates, wildfire is a threat throughout the planning area. The New Virginia/Virginia Fire Department has reported the greatest number of fires and has the greatest number of acres burned.

Table 63: Reported Wildfires by Department

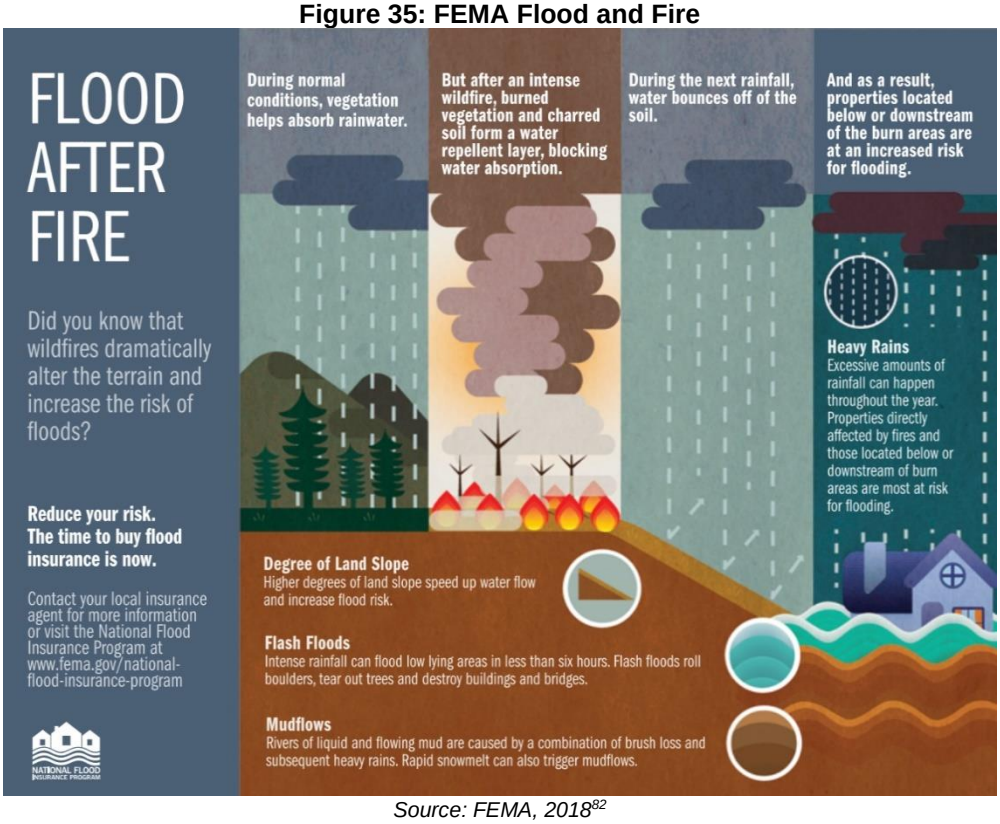
Department	Reported Wildfires	Acres Burned
Jackson Township/St Marys Fire Department	2	38.5
New Virginia/Virginia Fire Department	71	573
Norwalk Fire Department	2	5
Pleasantville Emergency Services	7	38.5
Total	**82**	**655**

Source: IDNR Fire Supervisor, 2009-September 2021

As seen in Table 63 above, wildfires have burned 655 acres of land. In total, there were 82 reported wildfires in the planning area. Of these, one fire burned over 409 acres in 2016.

Grass/Wildfire also contributes to an increased risk from other hazard events, compounding damages and straining resources. FEMA has provided additional information in recent years detailing the relationship between wildfire and flooding. Wildfire events remove vegetation and harden soil, reducing infiltration capabilities during heavy rain events. Subsequent severe storms that bring heavy precipitation can then escalate into flash flooding, dealing additional damage to jurisdictions.

Figure 35: FEMA Flood and Fire

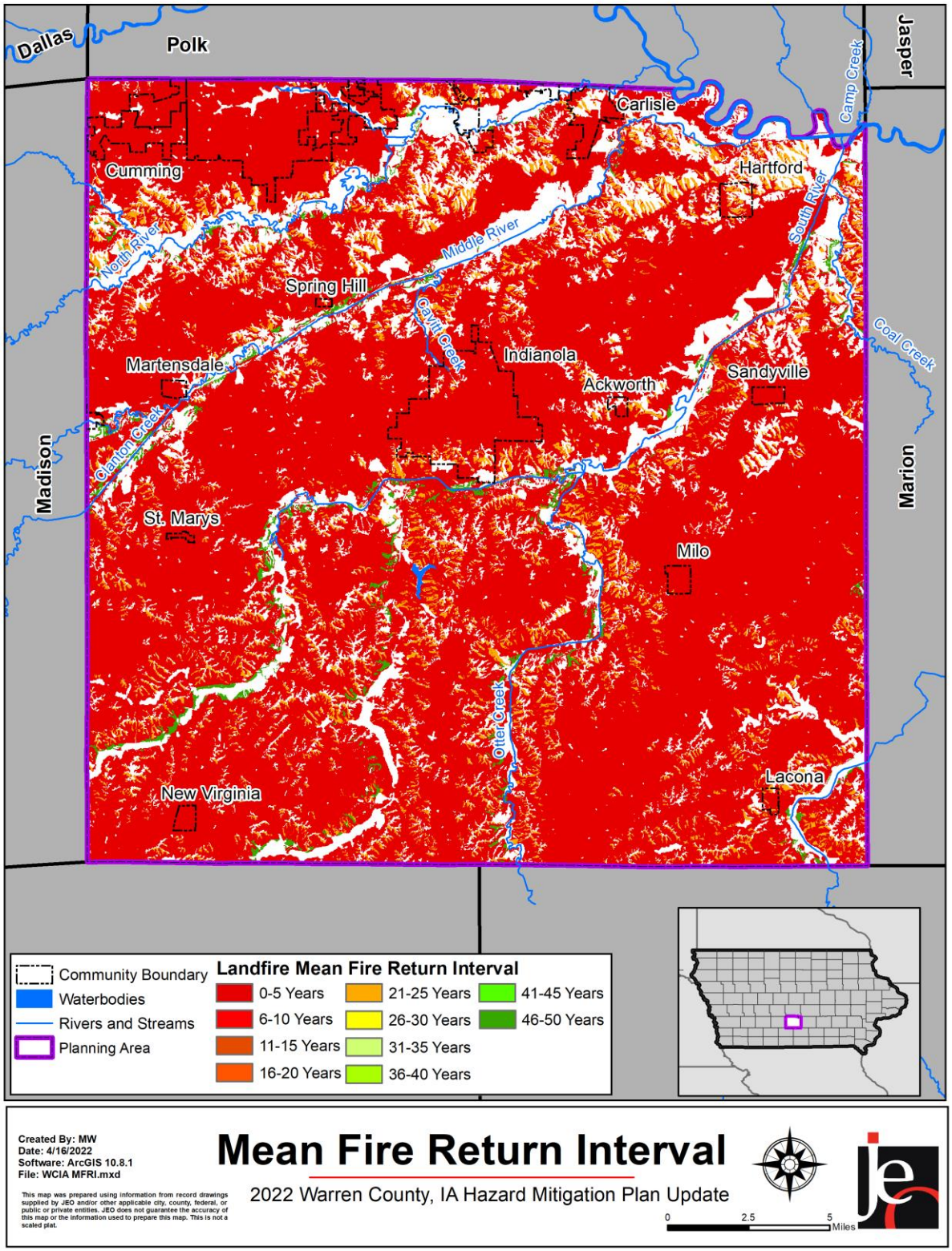


Source: FEMA, 2018[82]

Figure 36 shows the USGS' Mean Fire Return Interval. This model considers a variety of factors, including landscape, fire dynamics, fire spread, fire effects, and spatial context. These values show how often fires occur in each area under natural conditions.

[82] Federal Emergency Management Agency. 2018. "Flood After Fire." https://www.fema.gov/flood-after-fire.

Figure 36: Mean Fire Return Interval

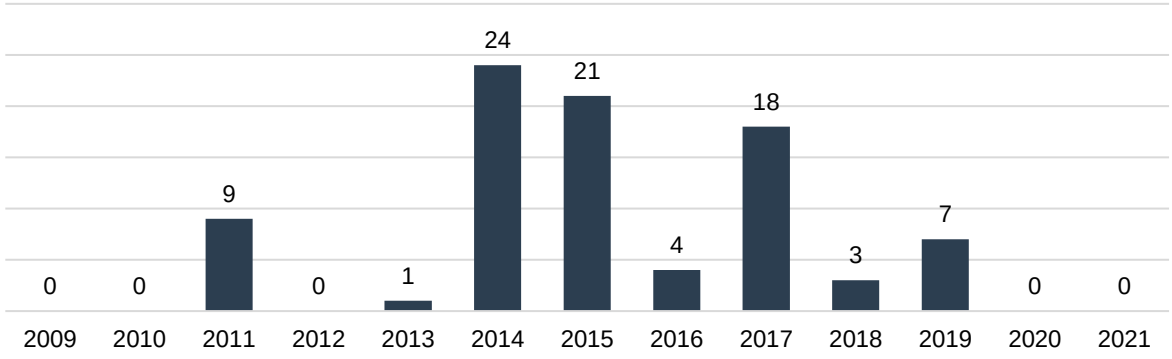


Historical Occurrences

Local fire districts reported a total of 82 wildfires, according to the Iowa Department of Natural Resources, from 2009 to September 2021. Most fires occurred in 2014 (Figure 37). The reported events burned 655 acres.

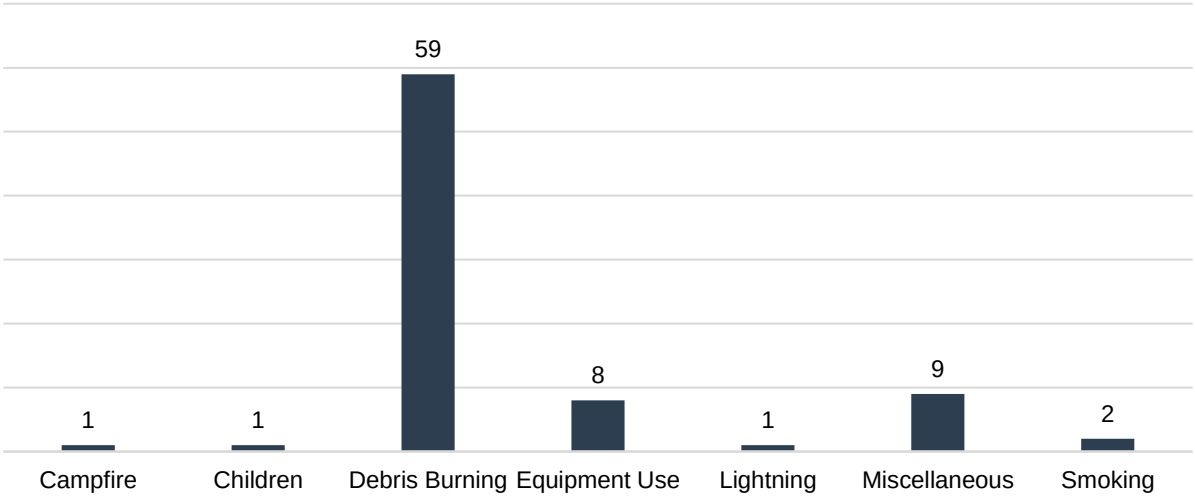
The majority of wildfires in the planning area are caused by debris burning (72%), with miscellaneous as the second leading cause (11%) (Figure 38). Wildfires in the planning area have ranged from zero to 409 acres, with an average event burning 7.78 acres.

Figure 37: Number of Wildfires by Year in the Planning Area



Source: IDNR, 2009-September 2021

Figure 38: Wildfires by Cause in the Planning Area



Source: IDNR, 2009-September 2021

Average Annual Losses

No damages were reported by NCEI or from IDNR, so it is not possible to calculate the average annual damages for wildfire.

Table 64: Wildfire Loss Estimation

Hazard Type	Number of Events[2]	Events Per Year	Total Property Loss[1]	Total Crop Loss[1]	Total Acres Burned[2]	Average Acres Per Fire[2]
Grass/Wildfires	82	6.8	N/A	N/A	655 acres	7.78

Source: 1 indicates data is from NCEI (1996-2021), 2 indicates data is from IDNR, 2009-September 2021

Probability

The probability of wildfire occurrence is based on the historic record provided by the Iowa Department of Natural Resources and reported potential by participating jurisdictions. With a grass/wildfire occurring eight out of 13 years (Figure 37), there is a 62 percent annual probability of grass/wildfires occurring in the planning area each year.

Community Top Hazard Status

No participating jurisdictions identified Grass and Wildfire as a top hazard of concern.

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles.*

Table 65: Regional Vulnerabilities

Sector	Vulnerability
People	-Risk of injury or death for residents and firefighting personnel -Displacement of people and loss of homes -Lack of transportation poses risk to low-income individuals, families, and elderly -Transportation routes may be blocked by fire, preventing evacuation efforts
Economic	-Damages to buildings and property can cause significant losses to business owners -Loss of businesses
Built Environment	-Property damages
Infrastructure	-Damage to power lines and utility structures -Potential loss of firefighting equipment and resources
Critical Facilities	-Risk of damages
Climate	-Increase chance of landslides and erosion -May lead to poor water quality -Post fire, flash flooding events may be exacerbated

HAZARDOUS MATERIALS RELEASE

The following description for hazardous materials is provided by the Federal Emergency Management Agency (FEMA):

> *Chemicals are found everywhere. They purify drinking water, are used in agriculture and industrial production, fuel our vehicles and machines, and simplify household chores. But chemicals also can be hazardous to humans or the environment if used or released improperly. Hazards can occur during production, storage, transportation, use, or disposal. The community is at risk if a chemical is used unsafely or released in harmful amounts.*

Hazardous materials in various forms can cause fatalities, serious injury, long-lasting health effects, and damage to buildings, homes, and other property. Many products containing hazardous chemicals are used and stored in homes routinely. Chemicals posing a health hazard include carcinogens, toxic agents, reproductive toxins, irritants, and many other substances that can harm human organs or vital biological processes.

Chemical manufacturers are one source of hazardous materials, but there are many others, including service stations, hospitals, and hazardous materials waste sites. Varying quantities of hazardous materials are manufactured, used, or stored at an estimated 4.5 million facilities in the United States—from major industrial plants to local dry-cleaning establishments or gardening supply stores.

Hazardous materials come in the form of explosives, flammable and combustible substances, poisons, and radioactive materials. Hazardous material incidents are technological (meaning non-natural hazards created or influenced by humans) events that involve large-scale releases of chemical, biological or radiological materials. Hazardous materials incidents generally involve releases at fixed-site facilities that manufacture, store, process or otherwise handle hazardous materials or along transportation routes such as major highways, railways, navigable waterways, and pipelines.

Fixed sites are those that involve chemical manufacturing sites and stationary storage facilities. The Environmental Protection Agency (EPA) requires the submission of the types and locations of hazardous chemicals being stored at any facility within the state over the previous calendar year. This is completed by submitting a Tier II form to the EPA as a requirement of the Emergency Planning and Community Right-to-Know Act of 1986. Likewise, the U.S. Department of Transportation, through the U.S. Pipeline and Hazardous Materials Safety Administration (PHMSA), has broad jurisdiction to regulate the transportation of hazardous materials, including the discretion to decide which materials shall be classified as hazardous. These materials are placed into one of nine hazard classes based on their chemical and physical properties. The hazard schedules may be further subdivided into divisions based on their characteristics. Because the properties and characteristics of materials are crucial in understanding the dynamics of a spill during a transportation incident, it is important for response personnel to understand the hazard classes and their divisions.

The transportation of hazardous materials is defined by PHMSA as "…a substance that has been determined to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce…" According to PHMSA, hazardous materials traffic in the U.S. now exceeds 1,000,000 shipments per day. Nationally, the U.S. has had 108 fatalities associated with the transport of hazardous materials between 2007 through 2016. While such fatalities are a low probability risk, even one event can harm many people.

Table 66 demonstrates the nine classes of hazardous material according to the 2020 Emergency Response Guidebook.

Table 66: Hazardous Material Classes

Class	Type of Material	Divisions
1	Explosives	Division 1.1 – Explosives with a mass explosion hazard Division 1.2 – Explosives with a projection hazard Division 1.3 – Explosives predominantly a fire hazard Division 1.4 – Explosives with no significant blast hazard Division 1.5 – Very insensitive explosives with a mass explosion hazard Division 1.6 – Extremely insensitive articles
2	Gases	Division 2.1 – Flammable gases Division 2.2 – Non-flammable, non-toxic gases Division 2.3 – Toxic gases
3	Flammable liquids (and Combustible liquids)	
4	Flammable solids; Spontaneously combustible materials	Division 4.1 – Flammable solids Division 4.2 – Spontaneously combustible materials Division 4.3 – Water-reactive substances/Dangerous when wet materials
5	Oxidizing substances and Organic peroxides	Division 5.1 – Oxidizing substances Division 5.2 – Organic peroxides
6	Toxic substances and infections substances	Division 6.1 – Toxic substances Division 6.2 – Infectious substances
7	Radioactive materials	-
8	Corrosive materials	-
9	Miscellaneous hazardous materials/products, substances, or organisms	-

Source: Emergency Response Guidebook, 2016[83]

Location

Iowa has approximately 4,602 facilities across the state that house hazardous materials according to the Tier II reports submitted to the Iowa Department of Natural Resources. Of those, 45 locations are located in the planning area. These locations are shown in the following figure. A listing of hazardous material storage sites can be found in *Section Seven: Community Profiles* for each jurisdiction.

83 U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration. 2016. "2016 Emergency Response Guidebook." https://www.phmsa.dot.gov/hazmat/outreach-training/erg

Figure 39: Fixed Chemical Sites in the Planning Area

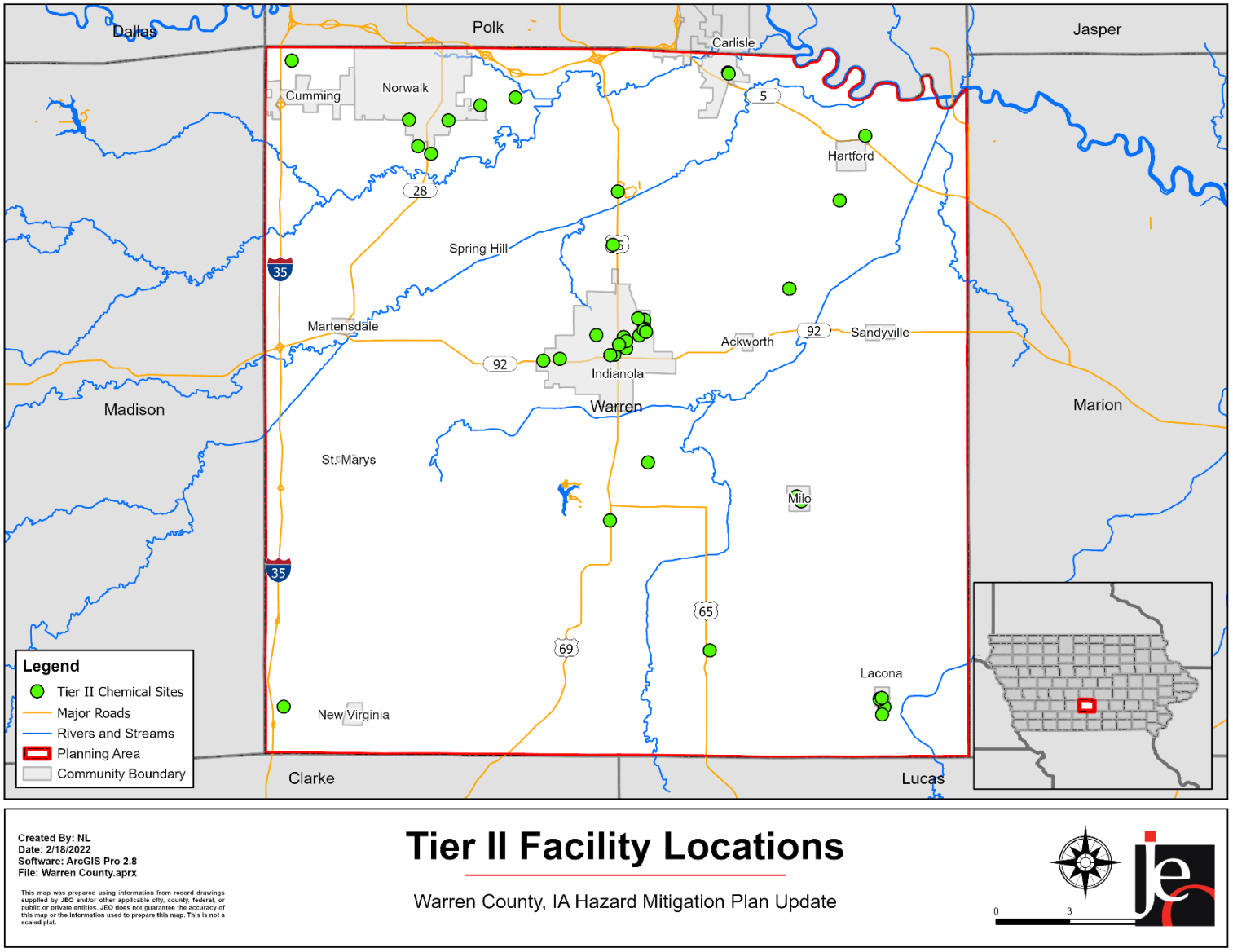
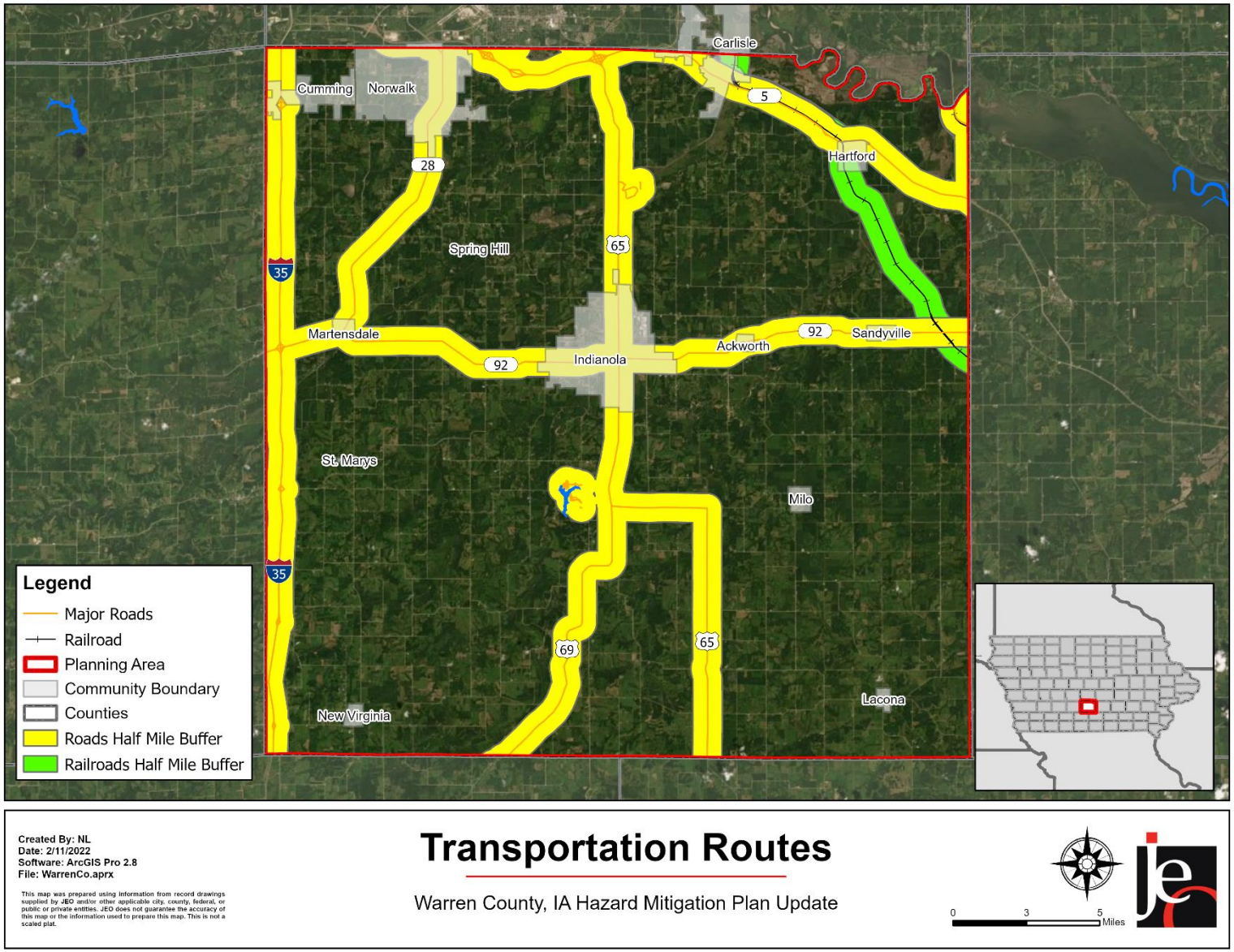


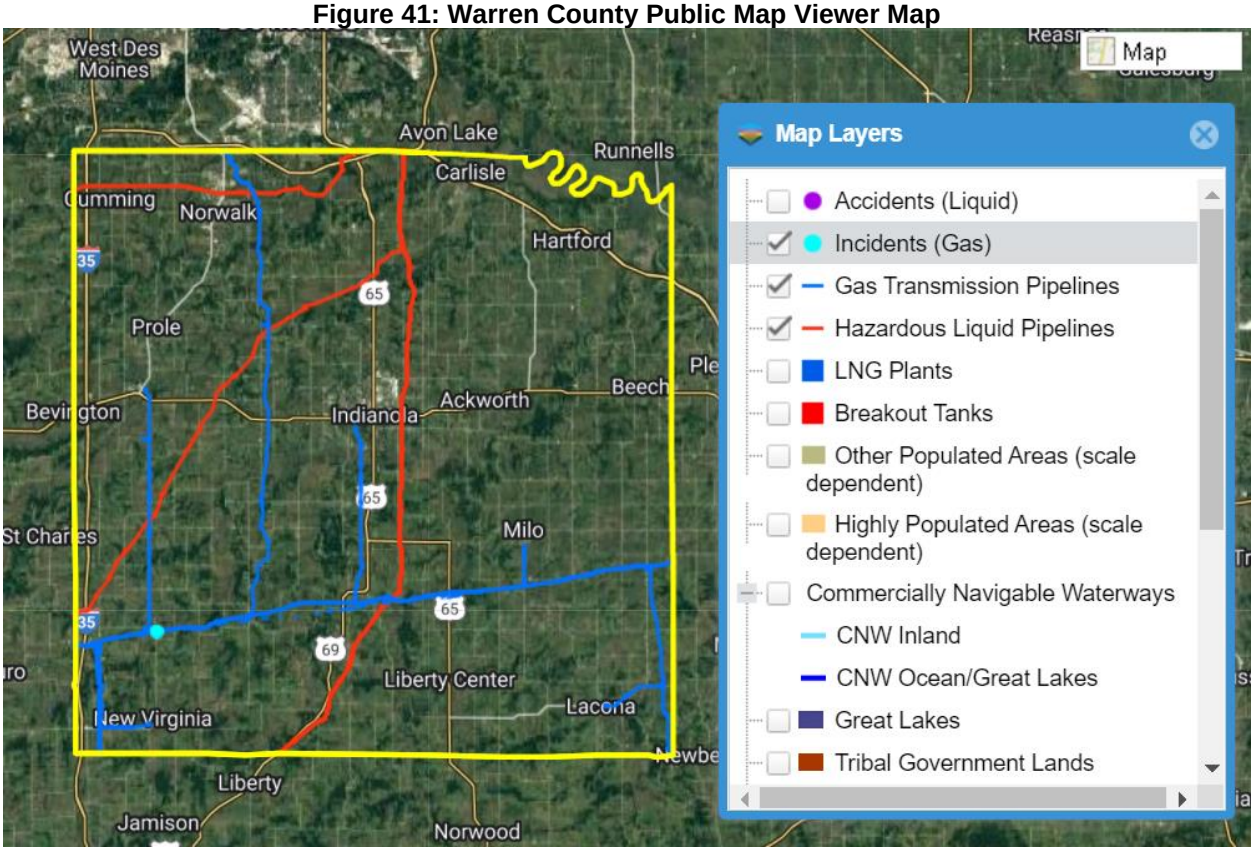
Figure 40: Major Transportation Routes with Half Mile Buffer



Hazardous material releases during transportation primarily occur on major transportation routes as identified in Figure 40. Railroads providing service through the planning area have developed plans to respond to chemical releases along rail routes. A large number of spills also typically occur during the loading and unloading of chemicals for highway and pipeline chemical transport. Transportation corridors in the planning area are primarily US Routes, State Routes, and one Interstate.

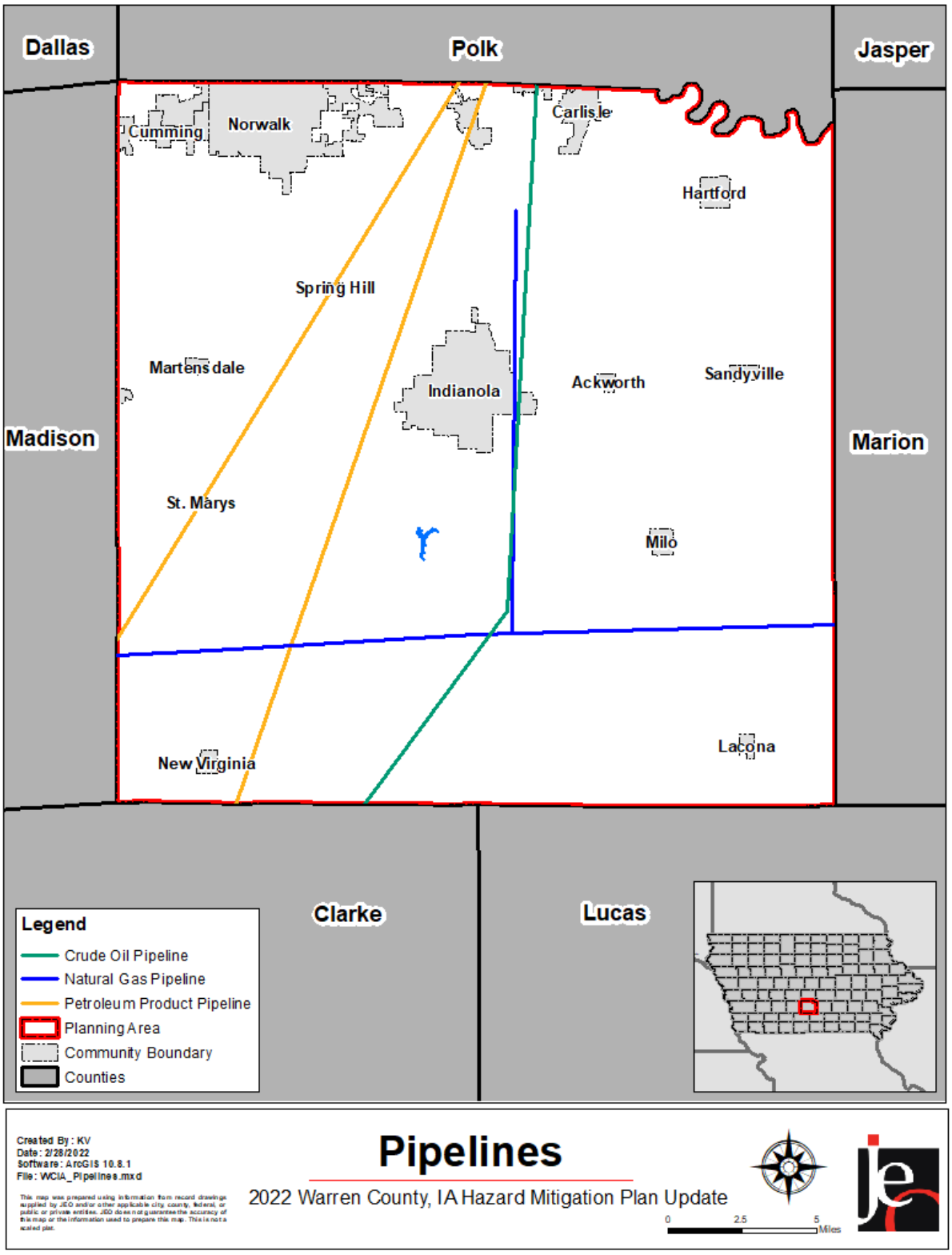
According to PHMSA, there are several gas transmission and hazardous liquid pipelines located in the planning area. A map of the pipelines and incidents from PHMSA for Warren County can be seen below (Figure 41).[84] According to the U.S. Energy Information Administration (EIA) there is one crude oil pipeline, one natural gas pipeline, and two petroleum product pipelines that run through the county (Figure 42).[85]

Figure 41: Warren County Public Map Viewer Map



84 Pipeline and Hazardous Materials Safety Administration. 2020. "National Pipeline Mapping System." https://www.npms.phmsa.dot.gov/ .
85 U.S. Energy Information Administration. 2022. "Maps – Crude Oil Pipelines, Natural Gas Interstate and Intrastate Pipelines, Petroleum Products Pipelines." https://www.eia.gov/maps/layer_info-m.php

Figure 42: Warren County Pipelines Map



Iowa has established a Weapons of Mass Destruction (WMD)/HazMat team to provide statewide coverage for identifying, assessment and support of render-safe procedures involving explosive devices and those that may contain chemical, biological, radioactive, nuclear, or explosive (CBRNE) materials. The team is made up of personnel from Council Bluffs, Davenport, and Des Moines and helps enhance the capabilities of existing fire department hazmat teams across the state.[86]

Extent

The extent of chemical spills at fixed sites varies and depends on the type of chemical that is released with a majority of events localized to the facility. The probable extent of chemical spills during transportation is difficult to anticipate and depends on the type and quantity of chemical released. In total 34 fixed site releases have occurred in the planning area, and the total amount spilled ranged from 0 gallons to 2,700 gallons. Of the 34 chemical spills, one spill led to the evacuation of 100 people and one spill led to an injury. In total 17 releases have occurred during transportation in the planning area. Transportation spills ranged from no material released to over 3,427 liquid gallons of material with an average quantity spilled of 380 liquid gallons. Of the 17 chemical spills, one spill led to the evacuation of 21 people, and another spill resulted in one injury. Based on historic records, it is likely that any spill involving hazardous materials will not affect an area larger than a quarter mile from the spill location.

Historical Occurrences

Fixed Site Spills

According to the U.S. Coast Guard's National Response Center database (NRC), there have been 34 fixed site chemical spills from 1990 – August 2021 in the planning area. There were $350,000 in property damages reported for these chemical spills. The following table displays the larger spills that have occurred throughout the planning area (>500 gallons).

Table 67: Fixed Site Chemical Spills

Date of Event	Location of Release	Quantity Spilled	Material Involved	Number of Injuries	Property Damage
2009	925972	1,440 Gallons	Propane	0	$0
2013	1047343	700 Gallons	Anhydrous Ammonia	0	$0
2020	1275927	2,700 Pounds	Anhydrous Ammonia	0	$0

Source: National Response Center, 1990-August 2021

Transportation Spills

According to PHMSA, 17 hazardous materials releases occurred during transportation in the planning area between 1971 and August 2021. During these events, there was one injury, no fatalities, and $203,635 in damages. The following table provides a list of the historical transportation chemical spills.

86 HSEMD. 2020. "Iowa's Emergency Response Teams." https://homelandsecurity.iowa.gov/programs/special-teams/

Table 68: Historical Chemical Transportation Spills

Date	Location of Release	Material Involved	Method of Transportation	Quantity Spilled	Total Damages
11/10/1972	Norwalk	Paint Related Material Including Paint Thinning Drying Removing or Reducing Compound	Highway	0 LGA	$0
4/30/1973	Indianola	Gasoline Includes Gasoline Mixed with Ethyl Alcohol with not more than 10% Alcohol	Highway	0 LGA	$0
5/4/1976	Indianola	Fuel Oil	Highway	2 LGA	$0
11/8/1976	Carlisle	Fuel Oil	Highway	30 LGA	$0
12/22/1976	Carlisle	Fuel Oil	Highway	7 LGA	$0
12/10/1980	Indianola	Fuel Oil (No. 1, 2, 4, 5, or 6)	Highway	100 LGA	$0
12/18/1984	New Virginia	Caustic Alkali Liquids N.O.S.	Highway	0.75 LGA	$0
12/18/1984	New Virginia	Compounds Cleaning Liquid	Highway	0.75 LGA	$0
11/23/1988	Lacona	Gasoline Includes Gasoline Mixed with Ethyl Alcohol with not more than 10% Alcohol	Highway	3,427 LGA	$0
4/16/1990	Indianola	Combustible Liquid N.O.S.	Highway	2 LGA	$10
2/23/1996	Carlisle	Gasoline Includes Gasoline Mixed with Ethyl Alcohol with not more than 10% Alcohol	Highway	5 LGA	$50,106
12/10/2004	Norwalk	Petroleum Gases Liquefied or Liquified Petroleum Gas	Highway	8 LGA	$36,019
1/30/2007	Hartford	Liquified Petroleum Gas	Highway	0 LGA	$30,000
9/28/2008	New Virginia	Potassium Nitrate	Highway	2,800 LGA	$65,300
11/7/2015	Norwalk	Batteries Wet Filled with Acid Electric Storage	Highway	80 LGA	$13,000
7/2/2020	Norwalk	Sodium Hydroxide Solution	Highway	1 LGA	$9,200
9/16/2020	Martensdale	Fuel Oil (No. 1, 2, 4, 5, or 6)	Highway	1 LGA	0

Source: PHMSA, 1971-August 2021

Average Annual Damages

There have been 34 fixed site spills in the planning area reported from the NRC and 17 transportation spills as reported by PHMSA. Neither the NRC nor PHMSA track crop losses from chemical spills. These events reported $553,635 in property damages. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life.

Table 69: Hazardous Materials Release Loss Estimate

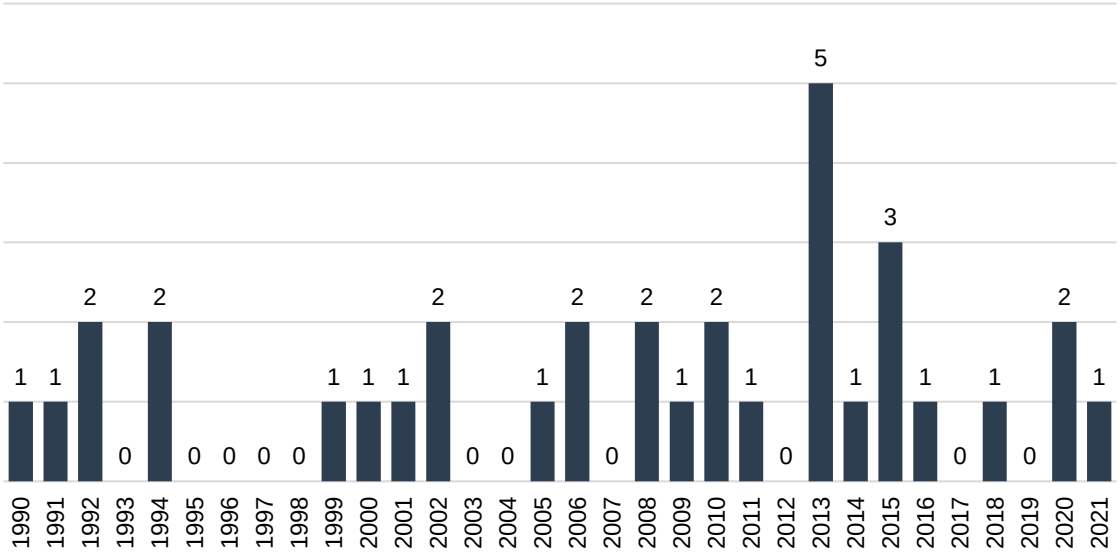
Hazard Type	Number of Events	Events Per Year	Injuries	Total Evacuated	Total Damages	Average Annual Loss
Hazardous Materials Release (Fixed Site)	34	1.1	1	100	$350,000	$10,938
Hazardous Materials Release (Transportation)	17	0.3	1	21	$203,635	$3,993

Source: National Response Center, 1990-Aug 2021; PHMSA, 1971-Aug 2021

Probability

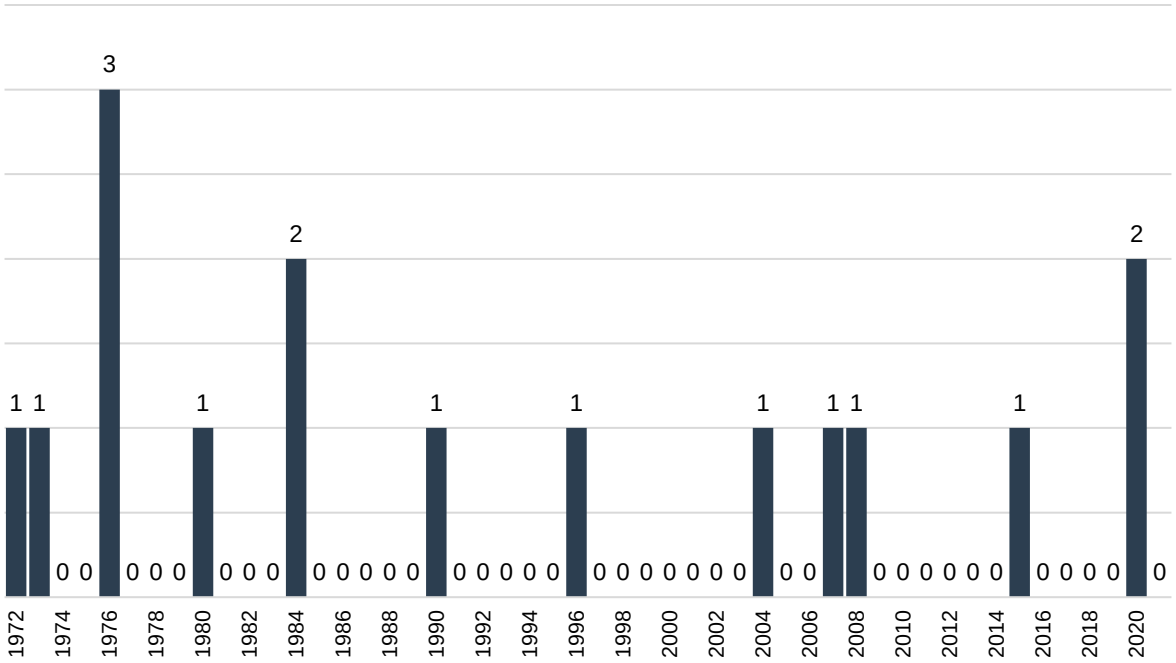
Given the historic record of occurrence for fixed chemical spill events (at least one chemical spill reported in 21 of 32 years), for the purposes of this plan, the annual probability of a fixed chemical spill is 66 percent. Given the historic record of occurrence for chemical transportation spill events (12 out of 51 years with a reported event), for the purposes of this plan, the annual probability of chemical transportation occurrence is 24%.

Figure 43: Chemical Fixed Site Events by Year



Source: National Response Center, 1990-Aug 2021

Figure 44: Chemical Transportation Events by Year



Source: PHMSA, 1990-Aug 2021

Community Top Hazard Status

The following table lists jurisdictions which identified Hazardous Materials Release as a top hazard of concern:

Jurisdictions	
Warren County	City of St. Marys
City of Indianola	Norwalk Community School District
City of Lacona	

Regional Vulnerabilities

To reduce the risk to people and property damage, future development should encourage chemical storage and manufacturing facilities to be built away from critical facilities such as hospitals, schools, daycares, nursing homes, and other residential areas. Likewise development and critical facilities should be built away from major transportation corridors used for chemical transportation. Specific vulnerabilities exist for critical facilities or vulnerable population centers (schools, daycares, hospital, etc.) which are most heavily populated during the daytime as most chemical transportation incidents occur during the weekday daytime hours.

The following table provides information related to regional vulnerabilities; for jurisdictional specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 70: Regional Vulnerabilities

Sector	Vulnerability
People	-Those in close proximity could have minor to moderate health impacts -Possible evacuations -Hospitals, nursing homes, and the elderly at greater risk due to low mobility
Economic	-A chemical plant shutdown in smaller communities would have significant impacts to the local economy -Evacuations and closed transportation routes could impact businesses near spill
Built Environment	-Risk of fire or explosion
Infrastructure	-Transportation routes can be closed during evacuations or cleanup
Critical Facilities	-Risk of fire, explosion, or other damages -Risk of evacuation
Climate	-More extreme weather events and flood events put sites at risk of flooding at greater risk

INFRASTRUCTURE FAILURE

The Iowa Hazard Mitigation Plan notes a variety of different occurrences which may be classified as infrastructure failure; including communication failure, energy failure, structural failure, and structural fire. The plan goes on to note that one potential cause of infrastructure failure is space weather/solar flares. Any sort of disruption in cell, electric, radio or other service may be considered a form of infrastructure failure. Community infrastructure that provides vital supplies such as electrical and water utilities are also vulnerable to both natural and technological hazards.

Vulnerability can largely be measured as a result of aging infrastructure. According to FEMA's *Strategic Foresight Initiative* published in June 2011, "…infrastructure in the United States is becoming more prone to failure as the average age of structures increases." The publication goes on to state that many necessary updates to infrastructure failure may be considered cost prohibitive due to rising construction costs.

According to the American Society of Civil Engineers' (ASCE) 2019 Infrastructure Report Card, Iowa received an overall grade of C. The Infrastructure Report Card is updated every four years with the goal of depicting the condition and performance of infrastructure systems. The Report Card utilizes letter grades similar to those used for school report cards. Using this classification, an "A" would indicate a state is exceeding expectations; an "F" is failing to meet expectations. Thus, a "C" indicates slightly below expected standards. Specifically, for Iowa, bridges, dams, wastewater, inland waterways, received a below expected score (C- to D-). This is largely consistent with reports from local planning teams.[87]

Some jurisdictions have mentioned concerns of infrastructure failure, such as Carlisle, Milo, New Virginia, Norwalk, and Warren Water District. Concerns range from crumbling roadways and bridges, threats to water supplies and utilities, inadequate sewer systems, and an unreliable electrical grid.

Location

Infrastructure failure is not correlated to a specific geographic area.

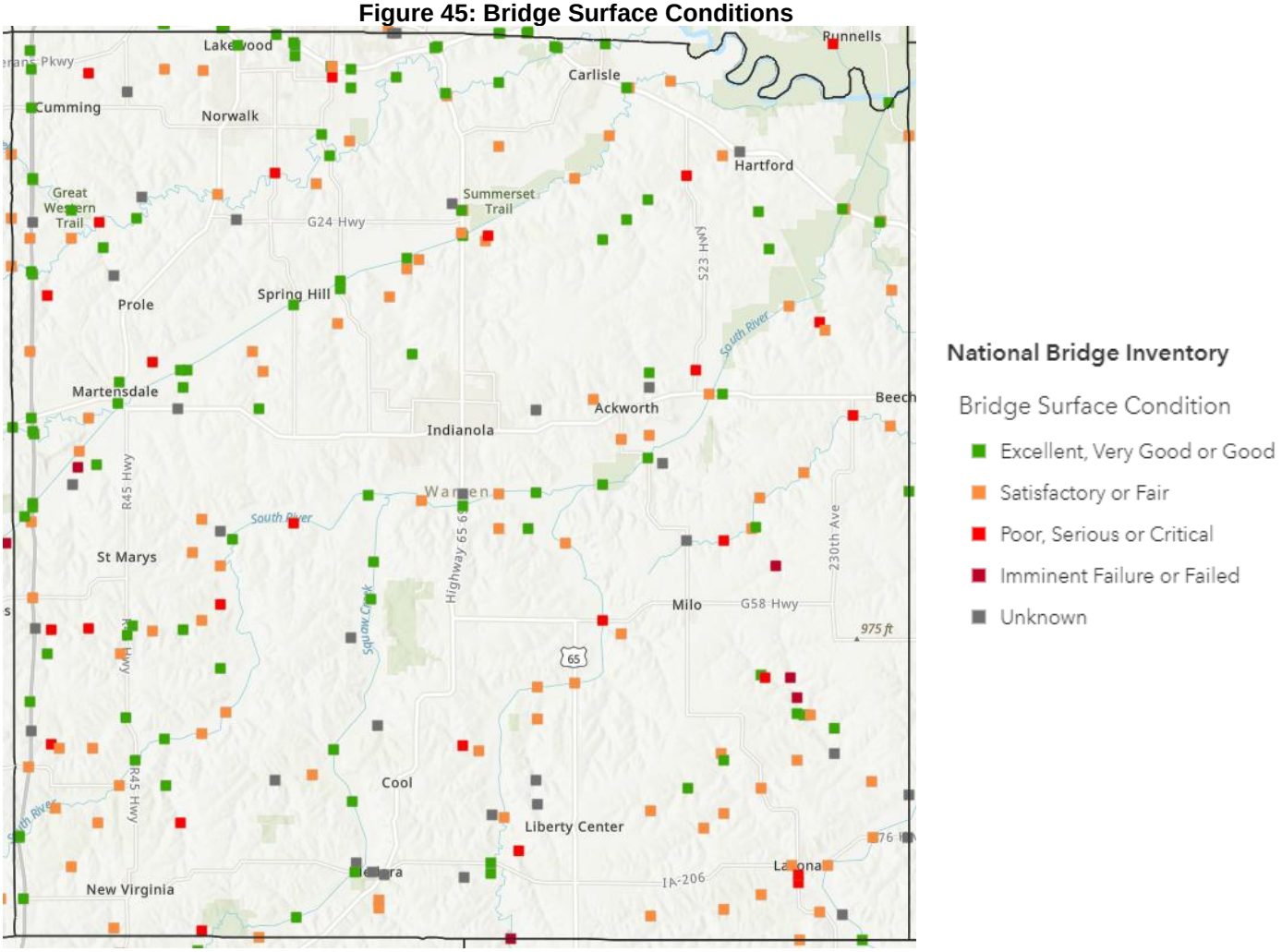
Extent

The extent of infrastructure failure events is hard to quantify given the lack of recorded events. Potential losses will likely be related to aging structures. The Bureau of Transportation Statistics (BTS) National Bridge Inventory displays information describing the location, description, classification, and general condition of bridges located on public roads, such as interstate highways, U.S. highways, state and county roads, and publicly accessible bridges on federal and tribal lands. According to BTS, Warren County has 254 bridges with 29% of those bridges in poor condition and 71% in medium to fair condition.[88] The following figure displays the bridge surface conditions for Warren County.

87 American Society of Civil Engineers. 2019. "2019 Iowa Infrastructure Report Card." https://infrastructurereportcard.org/state-item/iowa/

88 Bureau of Transportation Statistics. March 2022. "County Transportation Profiles." https://data.bts.gov/Research-and-Statistics/County-Transportation-Profiles/qdmf-cxm3/data

Figure 45: Bridge Surface Conditions



Source: BTS, 2022[89]

Historical Occurrences

There is no known database for recording infrastructure failure, and thus, previous occurrences may not be calculated.

Average Annual Losses

Due to lack of data, potential losses are not calculated for this hazard.

Probability

With no recorded past events, future occurrences may not be calculated.

89 Bureau of Transportation Statistics. March 2022. "National Bridge Inventory." https://www.arcgis.com/home/item.html?id=a0fa29a39fe444ac97d4337c569b9801

Community Top Hazard Status

The following table lists jurisdictions which identified Infrastructure Failure as a top hazard of concern:

Jurisdictions	
City of Indianola	City of Norwalk
City of Milo	Norwalk Community School District
City of New Virginia	Warren Water District

Regional Vulnerabilities

The following table summarizes regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 71: Regional Vulnerabilities

Sector	Vulnerability
People	-Vulnerable populations including the very young and the very old may not have the capability to properly care for their aging private infrastructure
Economic	-Building, bridge, or road closures may cause businesses to close temporarily, which could lead to significant revenue loss and loss of income for workers
Built Environment	-Aging fixtures such as roofs and siding make buildings vulnerable to failure
Infrastructure	-Aging infrastructure is particularly vulnerable
Critical Facilities	-Critical facilities may close if they are not properly maintained
Climate	-Space weather/solar flares can disrupt cell, electric, and radio services which could result in infrastructure failure
Other	-Severe winter storms, severe thunderstorms, and tornadoes can exacerbate this hazard

LEVEE FAILURE

According to FEMA:

> The United States has thousands of miles of levee systems. These manmade structures are most commonly earthen embankments designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water to provide some level of protection from flooding. Some levee systems date back as far as 150 years. Some levee systems were built for agricultural purposes. Those levee systems designed to protect urban areas have typically been built to higher standards. Levee systems are designed to provide a specific level of flood protection. No levee system provides full protection from all flooding events to the people and structures located behind it. Thus, some level of flood risk exists in these levee-impacted areas.

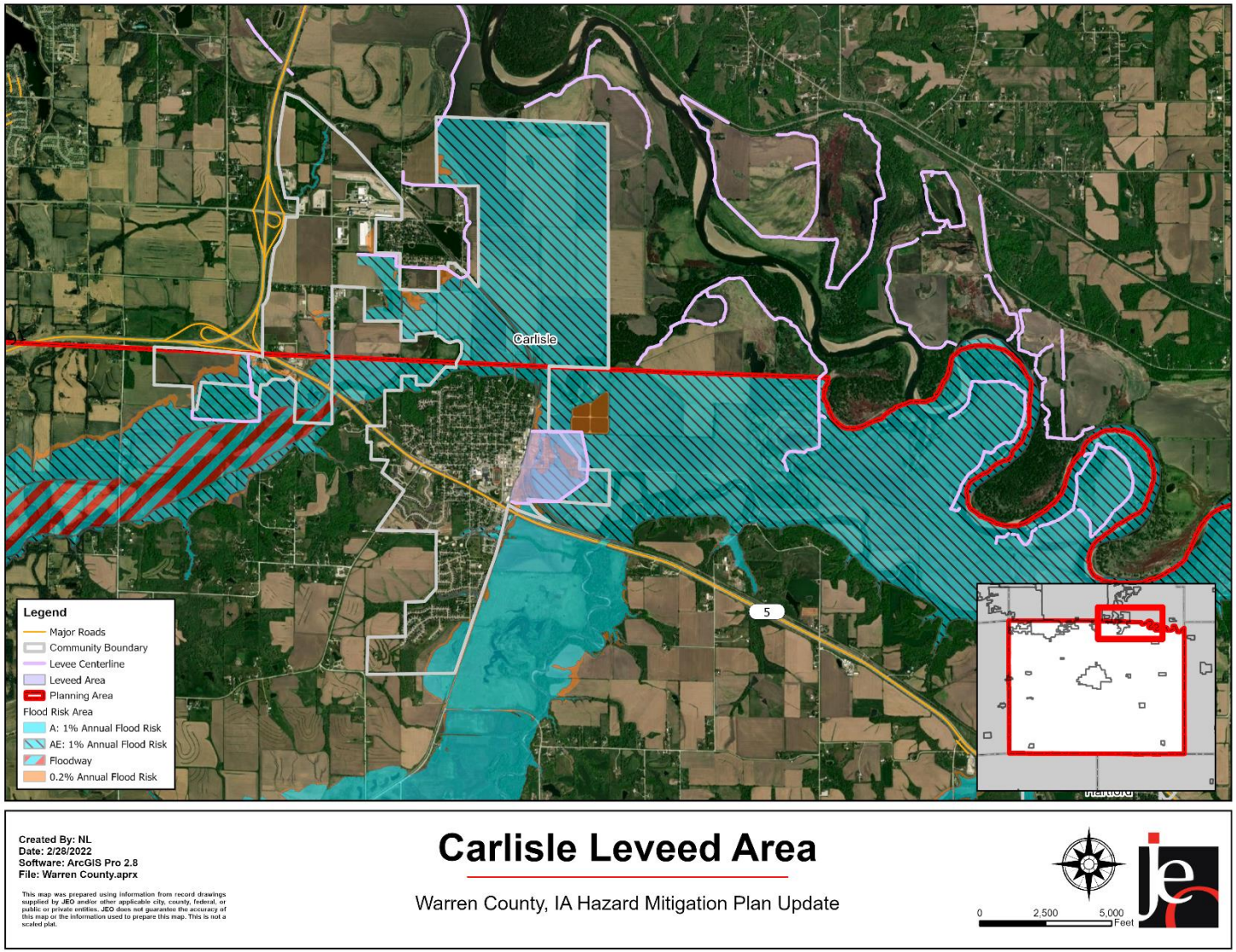
Levee failure can occur several ways. A breach of a levee is when part of the levee breaks away, leaving a large opening for floodwaters to flow through. A levee breach can be gradual by surface or subsurface erosion, or it can be sudden. A sudden breach of a levee often occurs when there are soil pores in the levee that allow water to flow through causing an upward pressure greater than the downward pressure from the weight of the soil of the levee. This under seepage can then resurface on the backside of the levee and can quickly erode a hole to cause a breach. Sometimes the levee actually sinks into a liquefied subsurface below.

Another way a levee failure can occur is when the water overtops the crest of the levee. This happens when the flood waters simply exceed the lowest crest elevation of the levee. An overtopping can lead to significant erosion of the backside of the levee and can result to a breach and thus a levee failure.

Location

According to USACE's National Levee Database, there is one levee in the planning area located in Carlisle. The Red Rock Remedial Works levee spans 1.34 miles in length and protects 55 residents and 38 structures. The levee is sponsored and maintained by the City of Hannibal, MO. The levee can be seen in the following figure.

Figure 46: Red Rock Remedial Works Levee



Beyond the USACE's National Levee Database, there is no known comprehensive list of levees that exists in the planning area especially for private agricultural levees. Thus, it is not possible at this time to document the location of non-federal levees, the areas they provide flood risk reduction, nor the potential impact of these levees.

Table 72: USACE Levees in Planning Area

Name	Sponsor	Location	Length (Miles)	Risk Level	Population in Leveed Area	Structures in Leveed Area	Property Value in Leveed Area
Carlisle, IA - Red Rock Remedial Works	City of Hannibal, MO	Carlisle (Warren County)	1.34	Low	55	38	$11,300,000

Source: USACE Levee Database

According to USACE, the City of Carlisle resides on high ground located between the North and Middle Rivers, which are tributaries of the Des Moines River in the upper areas of the Red Rock Reservoir. The levee was federally constructed in 1969 to prevent adverse impacts from high reservoir levels during periods of flooding on the Des Moines River. The levee system includes an earthen levee, two sandbag railroad closures, two gate wells, a ponding area and incidental works that are operated and maintained by personnel from Rock Island District's Lake Red Rock Reservoir.

Historical Occurrences

There have been no recorded instances of levee failure in the planning area.

Extent

There is one federal levee in the planning area located east of Carlisle within Warren County. If the levee were to fail approximately 38 structures would be inundated.

USACE, who is responsible for federal levee oversight and inspection of levees, has three ratings for levee inspections. Any levee failure events in the planning area will fall within USACE's rating system; however, it is not currently possible to determine what level of damage each levee system will experience. Non-federal levees are not inspected and thus do not have ratings.

Table 73: USACE Levee Rating Categories

Ratings	Description
Acceptable	All inspection items are rated as Acceptable
Minimally Acceptable	One or more inspection items are rated as Minimally Acceptable, or one or more items are rated as Unacceptable, and an engineering determination concludes that the Unacceptable inspection items would not prevent the segment/system from performing as intended during the next flood event
Unacceptable	One or more items are rated as Unacceptable and would prevent the segment/system from performing as intended, or a serious deficiency noted in past inspections has not been corrected within the established timeframe, not to exceed two years

Source: USACE

Potential Losses

To determine potential losses for levee failure, a parcel inventory from leveed areas was utilized. Based on the nature of the assessor's parcel data, it is not possible to do a true structural inventory with structure-specific impacts. Instead, inundated parcels were used as a proxy for structural data. The number of improvements and value of improvements were determined based on

assessor data from Warren County. The population in the leveed area was determined based on information from the USACE Levee Database. The following table shows the number of improvements included in the leveed areas for the Red Rocks Remedial Works levee located near Carlisle. A population of 55 people resides in the leveed area. A total of 83 improvements are within the leveed area and are valued at $6,522,900.

Table 74: Potential Losses in Levee Breach Area

Levee	Number of Improvements in Leveed Area[1]	Value of Improvements within Leveed Area[1]	Population in Leveed Area[2]
Carlisle , IA - Red Rock Remedial Works	83	$6,522,900	55

Source: 1 Warren County Assessor; 2 Indicates data is from USACE Levee Database

Probability

Given no historical occurrences of federal levee failure in the planning area, the annual probability of this event occurring is considered to be less than one percent. While it is possible for levee failure to occur in the future, this is considered a low probability.

Community Top Hazard Status

The following table lists jurisdictions which identified Levee Failure as a top hazard of concern:

Jurisdictions
Warren County

Regional Vulnerabilities

The following table summarizes regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 75: Regional Vulnerabilities

Sector	Vulnerability
People	-Minimal risk from unmapped private levees and berms
Economic	-Minimal impact to agricultural lands
Built Environment	-All buildings within leveed areas are at risk to damages
Infrastructure	-Minimal impact to infrastructure. Likely to be localized
Critical Facilities	-None. There are no critical facilities in leveed areas
Climate	-Changes in seasonal precipitation and temperature normals can increase strain on any unmapped private levees and berms

PANDEMIC DISEASE

According to the World Health Organization (WHO), a public health emergency is:

> "an occurrence or imminent threat of an illness or health condition, caused by bio terrorism, epidemic or pandemic disease, or (a) novel and highly fatal infectious agent or biological toxin, that poses a substantial risk of a significant number of human facilities or incidents or permanent or long-term disability" (WHO/DCD, 2001). The declaration of a state of public health emergency permits the governor to suspend state regulations and change the functions of state agencies.[90]

The number of cases that qualifies as a public health emergency depends on several factors including the illness, its symptoms, ease in transmission, incubation period, and available treatments or vaccinations. With the advent of sanitation sewer systems and other improvements in hygiene since the 19th century, the spread of infectious disease has greatly diminished. Additionally, the discovery of antibiotics and the implementation of universal childhood vaccination programs have played a major role in reducing human disease impacts. Today, human disease incidences are carefully tracked by the Centers for Disease Control and Prevention (CDC) and state organizations for possible epidemics and to implement control systems. Novel illnesses or diseases have the potential to develop annually and significantly impact residents and public health systems.

Some of the best actions or treatments for public health emergencies are nonpharmaceutical interventions (NPI). These are readily available behaviors or actions, and response measures people and communities can take to help slow the spread of respiratory viruses such as influenza. Understanding NPIs and increasing the capacity to implement them in a timely way, can improve overall community resilience during a pandemic. Using multiple NPIs simultaneously can reduce influenza transmission in communities even before vaccination is available.[91]

Pandemics are global or national disease outbreaks. These types of illnesses, such as influenza, can easily spread person-to-person, cause severe illness, and are difficult to contain. An especially severe pandemic can lead to high levels of illness, death, social disruption, and economic turmoil. Past pandemic events include:

- 1918 Spanish Flu: the H1N1 influenza virus spread world-wide during 1918 and 1919. It is estimated that at least 50 million people worldwide died during this pandemic with about 675,000 deaths alone in the United States. No vaccine was ever developed, and control efforts included self-isolation, quarantine, increased personal hygiene, disinfectant use, and social distancing.

- 1957 H2N2 Virus: a new influenza A virus emerged in Eastern Asia and eventually crossed into coastal U.S. cities in summer of 1957. In total 1.1 million people worldwide died of the flu with 116,000 of those in the United States.

- 1968 H3N2 Virus: an influenza A virus discovered in the United States in September 1968 which killed over 100,000 citizens. The majority of deaths occurred in people 65 years and older.

90 World Health Organization. 2008. Accessed April 2020. "Glossary of humanitarian Terms." https://www.who.int/hac/about/definitions/en/.
91 U.S. Department of Health and Human Services. 2017. "Pandemic Influenza Plan: 2017 Update." https://www.cdc.gov/flu/pandemic-resources/pdf/pan-flu-report-2017v2.pdf.

- 2009 H1N1 Swine Flu: a novel influenza A virus discovered in the United States and spread quickly across the globe. This flu was particularly prevalent in young people while those over 65 had some antibody resistance. The CDC estimated the U.S. had over 60.8 million cases and 12,469 deaths.

- 2019 COVID-19: the novel influenza A virus which originated in Wuhan China and spread globally. As of February 2, 2021, the CDC reported over 78,900,375 cases and 950,112 deaths attributed to COVID-19 in the United States. Efforts to control and limit the virus included self-isolation, quarantine, increased cleaning measures, social distancing, and vaccinations. Significant impacts to the national and global economy have been caused by COVID-19.

The Iowa Department of Public Health requires doctors, hospitals, and laboratories to report on many communicable diseases and conditions to monitor disease rates for epidemic events. Additionally, regional or county health departments monitor local disease outbreaks and collect data relevant to public health. Warren County Health Services covers Warren County

Location

Human disease outbreaks can occur anywhere in the planning area. Public heath emergencies or pandemic threshold levels are dependent on the outbreak type, transmission vectors, location, and season. Normal infectious disease patterns are changing due to increasing human mobility and climate change. Rural populations are particularly at risk for animal-related diseases while urban areas are at greater risk from community spread type illnesses. All residents throughout the planning area are at risk during public health emergencies. All areas within the planning area experienced impacts from COVID-19 specifically during 2020.

Historical Occurrences

Cases and fatalities associated with Public Health Emergencies vary between illness types and severity of outbreak. Past major outbreaks in Iowa have specifically included the H1N1 Swine Flu in 2009 and COVID-19 in 2020.

- H1N1 Swine Flu (2009) – outbreaks were first reported in mid-April 2009 and spread rapidly. The new flu strand for which immunity was nonexistent in persons under 60 years old was similar in many ways to typical seasonal influenza. Symptoms of H1N1 included fever greater than 100°F, cough, and sore throat. County specific counts of H1N1 are not available, however a total of 92 confirmed cases were reported for Iowa by June 12, 2009.[92] Outbreaks in Iowa were typically seen sporadically. The U.S. Public Health Emergency for the H1N1 Influenza outbreak expired on June 23, 2010. The CDC developed and encouraged all US residents to receive a yearly flu vaccination to protect against potential exposures. The H1N1 continues to appear annually and persons in the planning area are at risk of infection in the future.

- COVID-19 (2020) – In January 2020, the CDC confirmed the first case of COVID-19 in the United States, and it quickly spread across the country. By March 2020, the World Health Organization declared COVID-19 a pandemic and travel bans were instituted around the globe. Primary symptoms of the infection included cough, fever or chills, shortness of breath or difficulty breathing, fatigue, muscle and body aches, headache, loss of taste or smell, sore throat, and others. The first confirmed cases of COVID-19 in the State of Iowa were three residents in Johnson County. Cities throughout the county have instituted directed health measures to protect residents from the spread of COVID-19.

92 Centers for Disease Control and Prevention. June 2009. “Novel H1N1 Flu Situation Update.” https://www.cdc.gov/h1n1flu/updates/061209.htm.

The table below displays COVID-19 confirmed cases and deaths as of February 11, 2022. This data will likely increase as time goes on until the entire population can be vaccinated.

Table 76: COVID-19 Cases in Warren County

Population	Total Number of Tests	Confirmed Cases	Fatalities
51,466	40,423	12,069	127

Source: Iowa Department of Public Health[93]

Extent

Those most affected by public heath emergencies are typically the very young, the very old, the immune-compromised, the economically vulnerable, and the unvaccinated. Roughly 25% of the planning area's population is 18 years or younger, and 23% of the planning area is 65 years or older. These factors increase vulnerability to the impacts of pandemics. Refer to *Section Three: Planning Area Profile* for further discussion of age and economic vulnerability in the planning area. It is not possible to determine the extent of individual public health emergency events, as the type and severity of a novel outbreak cannot be predicted. However, depending on the disease type, a significant portion of residents may be at risk to illness or death.

The extent of a public health emergency is closely tied to the proximity or availability of health centers and services. It should be noted that there are no hospitals located in the county.

Immunodeficiency disorders (such as diabetes), obesity, or other pre-existing health complications reduce the ability of the body to fight infection. Diabetes prevalence in Warren County and for the state are listed in the table below.

Table 77: Diabetes Prevalence in the Planning Area

Planning Area	Diagnosed Diabetes Rate (Total Adults Age 20+)
Warren County	8.7%
State of Iowa*	8.8%

Source: Centers of Disease Control and Prevention, 2019[94]
**State data is from 2018.*

Iowa Code, Chapter 139a.8(6) and Iowa Administrative Code, 641-7.7(139) outline the immunization requirement for students attending licensed childcare centers and elementary or secondary schools. Requirements are for the following vaccinations: Pneumococcal, diphtheria, pertussis, tetanus, polio, measles, rubella, Hepatitis B, meningococcal, and varicella (chicken pox). The Vaccines for Children program is a federally funded and state-operated vaccine supply program that provides free vaccines to children under 18 who are of American Indian or Alaska Native descent, enrolled in Medicaid, uninsured, or underinsured. Additionally, the HPV vaccination series is recommended for teenagers and influenza vaccinations are recommended yearly for those over six months old. Individuals without vaccinations are at greater risk of contracting diseases or carrying diseases to others.

Average Annual Losses

The national economic burden of influenza medical costs, medical costs plus lost earnings, and total economic burden was $10.4 billion, $26.8 billion, and $87.1 billion respectively in 2007.[95] However, associated costs with pandemic response are much greater. Current estimated costs for COVID-19 in the United States exceed $16 trillion. Specific costs do not include losses from

93 Iowa Department of Public Health. February 1, 2022. "Covid-19 Reporting". https://idph.iowa.gov/Emerging-Health-Issues/Novel-Coronavirus/COVID-19-Reporting

94 Centers for Disease Control and Prevention. 2017. "Diagnosed diabetes prevalence – Iowa." https://gis.cdc.gov/grasp/diabetes/DiabetesAtlas.html.

95 Molinari, N.M., Ortega-Sanchez, I.R., Messonnier, M., Thompson, W.W., Wortley, P.M., Weintraub, E., & Bridges, C.B. April 2007. "The annual impact of seasonal influenza in the US: measuring disease burden and costs." DOI: 10.1016/j.vaccine.2007.03.046.

displacement, functional downtime, economic loss, injury, or loss of life. The direct and indirect effects of significant health impacts are difficult to quantify.

Probability

There is no pattern as to when public health emergencies will occur. Based on historical records, it is likely that small-scale disease outbreaks will occur annually within the planning area. However, large scale emergency events (such as seen with COVID-19) cannot be predicted.

Community Top Hazard Status

The following table lists jurisdictions which identified Pandemic Disease as a top hazard of concern:

Jurisdictions	
City of Carlisle	City of New Virginia
City of Cumming	City of St. Marys
City of Milo	Simpson College

Regional Vulnerabilities

The following table summarizes regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 78: Regional Vulnerabilities

Sector	Vulnerability
People	-Vulnerable populations include the very young, the very old, the unvaccinated, the economically vulnerable, and those with immunodeficiency disorders. -Institutional settings such as prisons, dormitories, long-term care facilities, day cares, and schools are at higher risk to contagious diseases -Poverty, rurality, underlying health conditions, and drug or alcohol use increase chronic and infectious disease rates
Economic	-Large scale or prolonged events may cause businesses to close, which could lead to significant revenue loss and loss of income for workers
Built Environment	-Increased number of unoccupied business structures
Infrastructure	-Transportation routes may be closed if a quarantine is put in place -Healthcare facilities in the planning area may be overwhelmed quickly by widespread events
Critical Facilities	-Healthcare facilities in the planning area may be overwhelmed quickly by widespread events -Critical facilities could see suspended action or reduced resources due to sick staff
Climate	-Climate change impacts on extreme weather, air quality, transmission of disease via insects and pests, food security, and water quality increase threats of disease

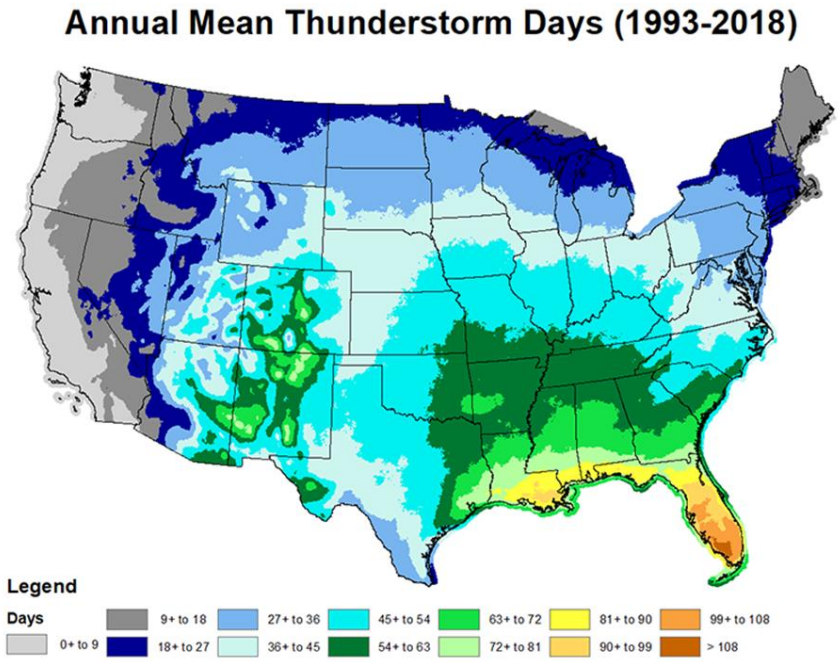
SEVERE THUNDERSTORMS

Severe thunderstorms are common and unpredictable seasonal events throughout Iowa. A thunderstorm is defined as a storm that contains lightning and thunder, which is caused by unstable atmospheric conditions. When the cold upper air sinks and the warm, moist air rises, storm clouds or "thunderheads" develop, resulting in thunderstorms. This can occur singularly, in clusters, or in lines.

Thunderstorms can develop in fewer than 30 minutes and can grow to an elevation of eight miles into the atmosphere. Lightning, by definition, is present in all thunderstorms and can cause harm to humans and animals, fires to buildings and agricultural lands, and electrical outages in municipal electrical systems. Lightning can strike up to 10 miles from the portion of the storm depositing precipitation. There are three primary types of lightning: intra-cloud, inter-cloud, and cloud to ground. While intra and inter-cloud lightning are more common, communities are potentially impacted when lightning comes in contact with the ground. Lightning generally occurs when warm air mixes with colder air masses resulting in atmospheric disturbances necessary for polarizing the atmosphere. Severe thunderstorms usually occur in the evening during the spring and summer months.

Economically, thunderstorms are generally beneficial in that they provide moisture necessary to support Iowa's largest industry, agriculture. The majority of thunderstorms do not cause damage, but when they escalate to severe storms, the potential for damages increases. Damages can include crop losses from wind; property losses due to building and automobile damages from high wind, flash flooding, and death or injury to humans and animals from lightning, drowning, or getting struck by falling or flying debris. Figure 47 displays the average number of days with thunderstorms across the country each year. The planning area experiences an average of 45 to 54 thunderstorms over the course of one year.

Figure 47: Average Annual Thunderstorms



Source: NWS, 2018[96]

96 National Weather Service. 2022. "Global Weather: Introduction to Thunderstorms." http://www.weather.gov/jetstream/tstorms_intro.

Location

The entire planning area is at risk of severe thunderstorms and associated damages from heavy rain, lightning, hail, and thunderstorm level wind.

Extent

The geographic extent of a severe thunderstorm event may be large enough to impact the entire planning area (such as in the case of a squall line, derecho, or long-lived supercell) or just a few square miles, in the case of a single cell that marginally meets severe criteria.

The NWS defines a thunderstorm as severe if it contains hail that is one inch in diameter or capable of wind gusts of 58 mph or higher. The Tornado and Storm Research Organization (TORRO) scale is used to classify hailstones and provides some detail related to the potential impacts from hail. Table 79 outlines the TORRO Hail Scale.

Table 79: TORRO Hail Rankings

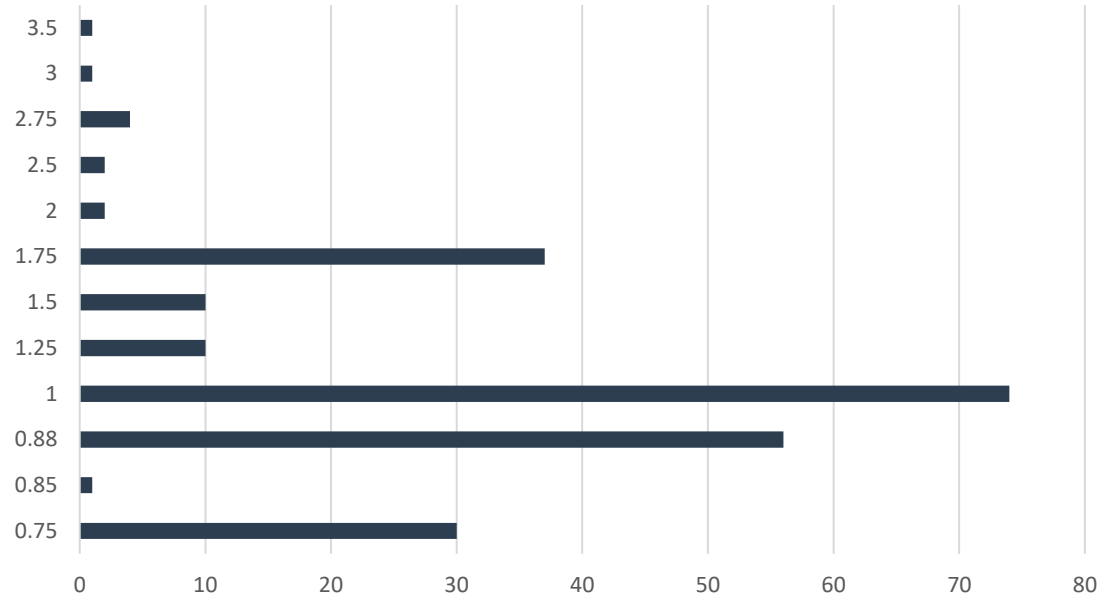
Class	Type of Material	Divisions
H0: Hard Hail	5 mm; 0.2 in (pea size)	No damage
H1: Potentially Damaging	5-15 mm; 0.2-0.6in (marble)	Slight general damage to plants and crops
H2: Significant	10-20 mm; 0.4-0.8 in (grape)	Significant damage to fruit, crops, and vegetation
H3: Severe	20-30 mm; 0.8-1.2 in (walnut)	Severe damage to fruit and crops, damage to glass and plastic structures
H4: Severe	30-40mm; 1.2-1.6 in (squash ball)	Widespread damage to glass, vehicle bodywork damaged
H5: Destructive	40-50 mm; 1.6-2.0 in (golf ball)	Wholesale destruction of glass, damage to tiled roofs; significant risk of injury
H6: Destructive	50-60 mm; 2.0-2.4 in (chicken egg)	Grounded aircrafts damaged, brick walls pitted; significant risk of injury
H7: Destructive	60-75 mm; 2.4-3.0 in (tennis ball)	Severe roof damage; risk of serious injuries
H8: Destructive	75-90 mm; 3.0-3.5 in (large orange)	Severe damage to structures, vehicles, airplanes, risk of serious injuries
H9: Super Hail	90-100 mm; 3.5-4.0 in (grapefruit)	Extensive structural damage, risk of severe or even fatal injuries to persons outdoors
H10: Super Hail	>100 mm; >4 in (melon)	Extensive structural damage; risk of severe or even fatal injuries to persons outdoors.

Source: TORRO, 2017[97]

The NCEI reported 228 individual hail events across the planning area between 1996 and 2021. The average hailstone size was 1.16 inches. Events of this magnitude correlate to an H3 Severe classification. It is reasonable to expect H3 classified events to occur several times in a year throughout the planning area. In addition, it is reasonable, based on the number of occurrences, to expect larger hailstones to occur in the planning area annually. The planning area has ensured two H8 hail events (3.0-3.5 inches) during the period of record. Figure 48 shows hail events based on the size of the hail.

[97] Tornado and Storm Research Organization. 2022. "Hail Scale". https://www.torro.org.uk/research/hail/hscale

Figure 48: Hail Events by Magnitude

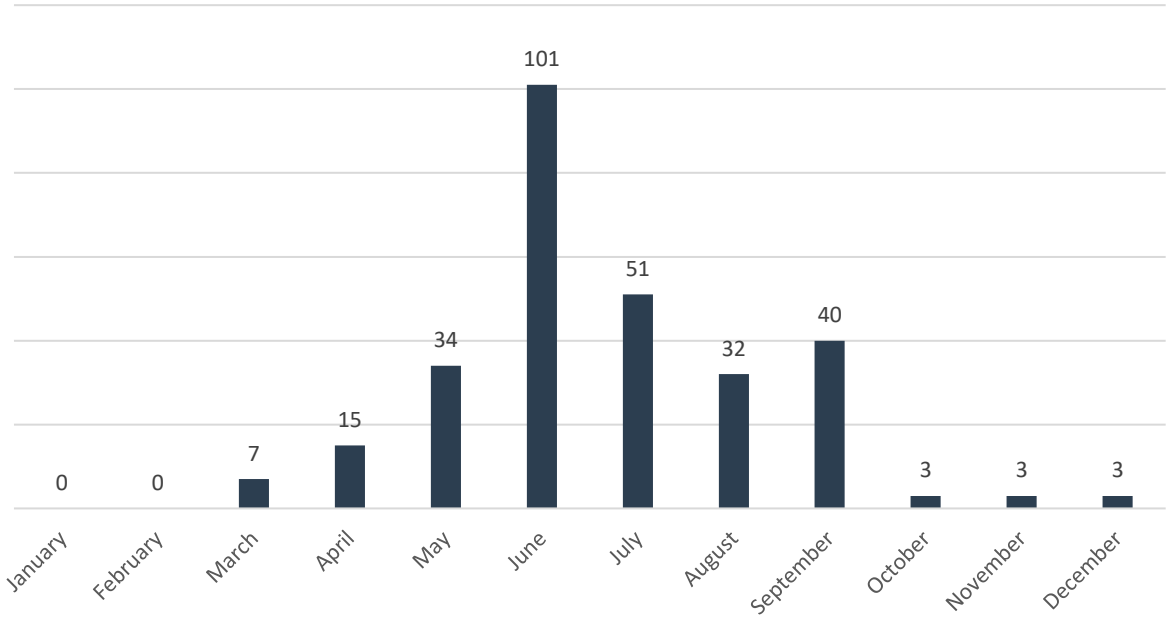


Source: NCEI, 1996-July 2021

Historical Occurrences

Severe thunderstorms in the planning area usually occur in the afternoon and evening during the summer months (Figure 49).

Figure 49: Severe Thunderstorm Events by Months



Source: NCEI, 1996-July 2021

The NCEI reports events as they occur in each community. A single severe thunderstorm event can affect multiple communities and counties at a time; the NCEI reports these large scale, multi-

county events as separate events. The result is a single thunderstorm event covering the entire region could be reported by the NCEI as several events.

The NCEI reports a total of 178 thunderstorm wind, 106 heavy rain, and five lightning events in the planning area from January 1996 to July 2021. In total these events were responsible for $4,837,500 in property damages. The USDA RMA data shows that severe thunderstorms caused $25,506,941 in crop damages. There were seven injuries and one fatality reported in association with these storms.

Average Annual Damages

The average damage per event estimate was determined based upon recorded damages from NCEI Storm Events Database since 1996 and number of historical occurrences. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. Severe thunderstorms cause an average of $133,980 per year in property damages.

Table 80: Severe Thunderstorms Loss Estimate

Hazard Type	Number of Events[1]	Average Events Per Year	Total Property Loss[1]	Average Annual Property Loss	Total Crop Loss[2]	Average Annual Crop Loss
Heavy Rain	106	4.24	$12,000	$480	$25,506,941	$1,275,347
Lightning	5	0.2	$191,500	$7,660		
Thunderstorm Wind	178	7.12	$3,146,000	$125,840		
Total	**289**	**11.56**	**$3,349,500**	**$133,980**	**$25,506,941**	**$1,275,347**

Source: 1 Indicates data is from NCEI (January 1996 to July 2021); 2 Indicates data is from USDA RMA (2000 to 2020)

Probability

Based on historical records and reported events, severe thunderstorms events are likely to occur on an annual basis. The NCEI reported a severe thunderstorm event (hail, lightning, heavy rain, or thunderstorm winds) in every year on record (1996-2020), resulting in a 100 percent chance for thunderstorms annually.

Community Top Hazard Status

The following table lists jurisdictions which identified Severe Thunderstorms as a top hazard of concern:

Jurisdictions	
City of Martensdale	Norwalk Community School District
City of New Virginia	Simpson College
Indianola Community School District	Warren Water District

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 81: Regional Vulnerabilities

Sector	Vulnerability
People	-Elderly citizens with decreased mobility may have trouble evacuating or seeking shelter -Mobile home residents are risk of injury and damage to their property if the mobile home is not anchored properly -Injuries can occur from not seeking shelter, standing near windows, and shattered windshields in vehicles
Economic	-Damages to buildings and property can cause significant losses to business owners and employees
Built Environment	-Buildings are at risk to hail damage -Downed trees and tree limbs -Roofs, siding, windows, gutters, HVAC systems, etc. can incur damage
Infrastructure	-High winds and lightning can cause power outages and down power lines -Roads may wash out from heavy rains and become blocked from downed tree limbs
Critical Facilities	-Power outages are possible -Critical facilities may sustain damage from hail, lightning, and wind
Climate	-Changes in seasonal precipitation and temperature normals can increase frequency and magnitude of severe storm events
Other	-High winds, hail, lightning, heavy rain, and possibly tornadoes can occur with this hazard

SEVERE WINTER STORMS

Severe winter storms are an annual occurrence in Iowa. Winter storms can bring extreme cold, freezing rain, heavy or drifting snow, and blizzards. Blizzards are particularly dangerous due to drifting snow and the potential for rapidly occurring whiteout conditions which greatly inhibit vehicular traffic. Generally, winter storms occur between the months of November and March but may occur as early as October and as late as April. Heavy snow is usually the most defining element of a winter storm. Large snow events can cripple an entire jurisdiction by hindering transportation, knocking down tree limbs and utility lines, and structurally damaging buildings.

Freezing Rain

Along with snow events, winter storms also have the potential to deposit significant amounts of ice. Ice buildup on tree limbs and power lines can cause them to collapse. This is most likely to occur when rain falls that freezes upon contact, especially in the presence of wind. Freezing rain is the name given to rain that falls when surface temperatures are below freezing. Unlike a mixture of rain and snow, ice pellets or hail, freezing rain is made entirely of liquid droplets. Freezing rain can also lead to many problems on the roads, as it makes them slick, causing automobile accidents, and making vehicle travel difficult.

Blizzards

Blizzards are particularly dangerous due to drifting snow and the potential for rapidly occurring whiteout conditions, which greatly inhibits vehicular traffic. Heavy snow is usually the most defining element of a winter storm. Large snow events can cripple an entire jurisdiction for several days by hindering transportation, knocking down tree limbs and utility lines, structurally damaging buildings, and injuring or killing crops and livestock.

Location

The entire planning area is at risk of severe winter storms.

Extent

The Sperry-Piltz Ice Accumulation Index (SPIA) was developed by the NWS to predict the accumulation of ice and resulting damages. The SPIA assesses total precipitation, wind, and temperatures to predict the intensity of ice storms. Ice Storm Warnings are issued when accumulation of at least 0.25 inches is expected from a storm, which controlling for high winds, would tend to classify ice storms in Warren County as SPIA Level 2 or higher. The most common accumulation during ice storms was 0.38 inches. The following figure shows the SPIA index.

Figure 50: SPIA Index

ICE DAMAGE INDEX	*AVERAGE ICE AMOUNT (in inches) *Revised: Oct. 2011*	WIND (mph)	DAMAGE AND IMPACT DESCRIPTIONS
0	<0.25	<15	Minimal risk of damage to exposed utility systems; no alerts or advisories needed for crews, few outages.
1	0.10 – 0.25	15 – 25	Some isolated or localized utility interruptions are possible, typically lasting only a few hours. Roads and bridges may become slick and hazardous.
	0.25 – 0.50	>15	
2	0.10 – 0.25	25 – 35	Scattered utility interruptions expected, typically lasting 12 to 24 hours. Roads and travel conditions may be extremely hazardous due to ice accumulation.
	0.25 – 0.50	15 – 25	
	0.50 – 0.75	>15	
3	0.10 – 0.25	> – 35	Numerous utility interruptions with some damage to main feeder lines and equipment expected. Tree limb damage is excessive. Outages lasting 1 – 5 days.
	0.25 – 0.50	25 – 35	
	0.50 – 0.75	15 – 25	
	0.75 –1.00	>15	
4	0.25 – 0.50	> – 35	Prolonged and widespread utility interruptions with extensive damage to main distribution feeder lines and some high voltage transmission lines/structures. Outages lasting 5 – 10 days.
	0.50 – 0.75	25 – 35	
	0.75 –1.00	15 – 25	
	1.00 –1.50	>15	
5	0.50 – 0.75	> – 35	Catastrophic damage to entire exposed utility systems, including both distribution and transmission networks. Outages could last several weeeks in some areas. Shelters needed.
	0.75 –1.00	> – 25	
	1.00 –1.50	> – 15	
	> 1.50	Any	

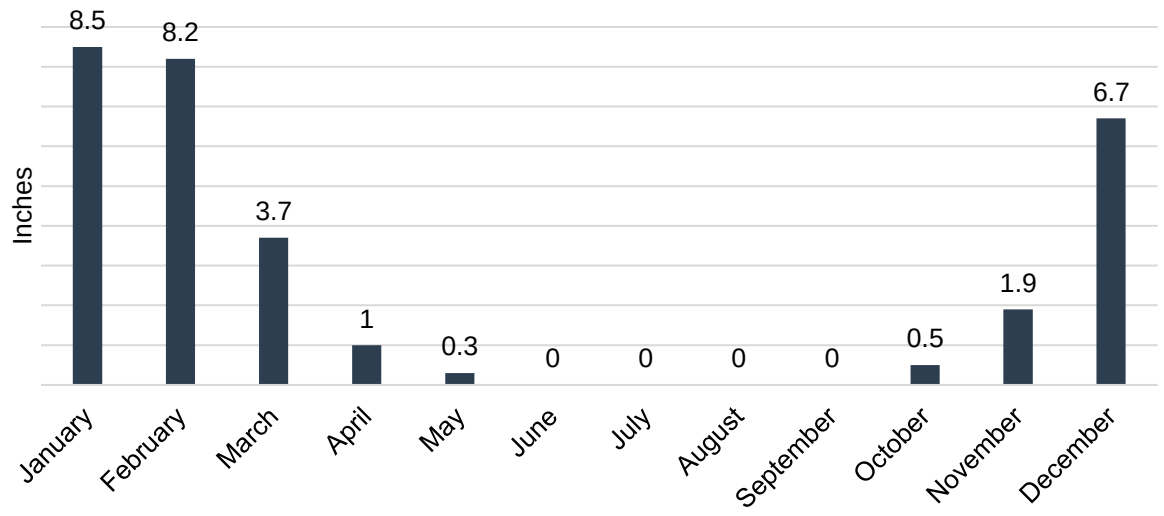
(Categories of damage are based upon combinations of precipitation totals, temperatures and wind speeds/directions.)

Source: SPIA-Index, 2022[98]

Average monthly snowfall for the planning area is shown in Figure 51, which shows the snowiest months are between January and February. A common snow event (likely to occur annually) will result in accumulation totals between one and five inches. Often these snow events are accompanied by high winds. It is reasonable to expect wind speeds of 25 to 35 mph with gusts reaching 50 mph or higher. Strong winds and low temperatures can combine to produce extreme wind chills of 20°F to 40°F below zero.

98 SPIA-Index. 2009. "Sperry-Piltz Ice Accumulation Index." Accessed March 2022. http://www.spia-index.com/index.php .

Figure 51: Monthly Normal (1981-2010) Snowfall in Inches



Source: High Plains Regional Climate Center, 2021

Historical Occurrences

Due to the regional scale of severe winter storms, the NCEI reports events as they occur in each county. According to the NCEI, there were a combined 77 severe winter storm events for the planning area from January 1996 to January 2021. January had the most recorded events for the planning area. These recorded events caused a total of $5,108,230 in reported property damages and $6,600,000 in crop damages.

According to the NCEI, there were no injuries or fatalities associated with winter storms in the planning area. Additional information from these events from NCEI and reported by each community are listed in *Section Seven: Community Profiles*.

Average Annual Damages

The average damage per event estimate was determined based upon NCEI Storm Events Database since 1996 and includes aggregated calculations for each of the six types of winter weather as provided in the database. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. Severe winter storms have caused an average of $204,329.20 per year in property damage and $264,000 per year in crop damages for the planning area.

Table 82: Severe Winter Storm Loss Estimate

Hazard Type	Number of Events[1]	Average Events Per Year[1]	Total Property Loss[1]	Average Annual Property Loss [1]	Total Crop Loss[2]	Average Annual Crop Loss [2]
Blizzard	11	0.44	$360,000	$14,400	$6,600,000	$264,000$
Frost/Freeze	9	0.36	$0	$0		
Heavy Snow	20	0.8	$3,855,000	$154,200		
Ice Storm	11	0.44	$393,330	$14,533.20		
Winter Storm	25	1	$499,900	$1,999.60		
Winter Weather	1	0.01	$0	$0		
Total	**77**	**3.08**	**$5,108,230**	**$204,329.20**	**$6,600,000**	**$264,000**

Source: 1 Indicates data is from NCEI (Jan 1996 to July 2021); 2 Indicates data is from USDA RMA (2000 to 2019)

Probability

Based on historical records and reported events, severe winter storm events are likely to occur on an annual basis. The NCEI reported a severe winter storm event in every year except 2002 and 2006, resulting in a 92 percent chance annually for severe winter storms.

Community Top Hazard Status

The following table lists jurisdictions which identified Severe Winter Storm as a top hazard of concern:

Jurisdictions	
Warren County	City of Lacona
City of Carlisle	City of Milo
City of Cumming	City of New Virginia
City of Hartford	City of St. Marys
City of Indianola	Warren Water District

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 83: Regional Vulnerabilities

Sector	Vulnerability
People	-Elderly citizens are at higher risk to injury or death, especially during extreme cold and heavy snow accumulations -Citizens without adequate heat and shelter at higher risk of injury or death
Economic	-Closed roads and power outages can cripple a region for days, leading to significant revenue loss and loss of income for workers
Built Environment	-Heavy snow loads can cause roofs to collapse -Significant tree damage possible, downing power lines and blocking roads
Infrastructure	-Heavy snow and ice accumulation can lead to downed power lines and prolonged power outages -Transportation may be difficult or impossible during blizzards, heavy snow, and ice events
Critical Facilities	-Emergency response and recovery operations, communications, water treatment plants, and others are at risk to power outages, impassable roads, and other damages
Climate	-Changes in seasonal precipitation and temperature normals can increase frequency and magnitude of severe winter storm events

SINKHOLES

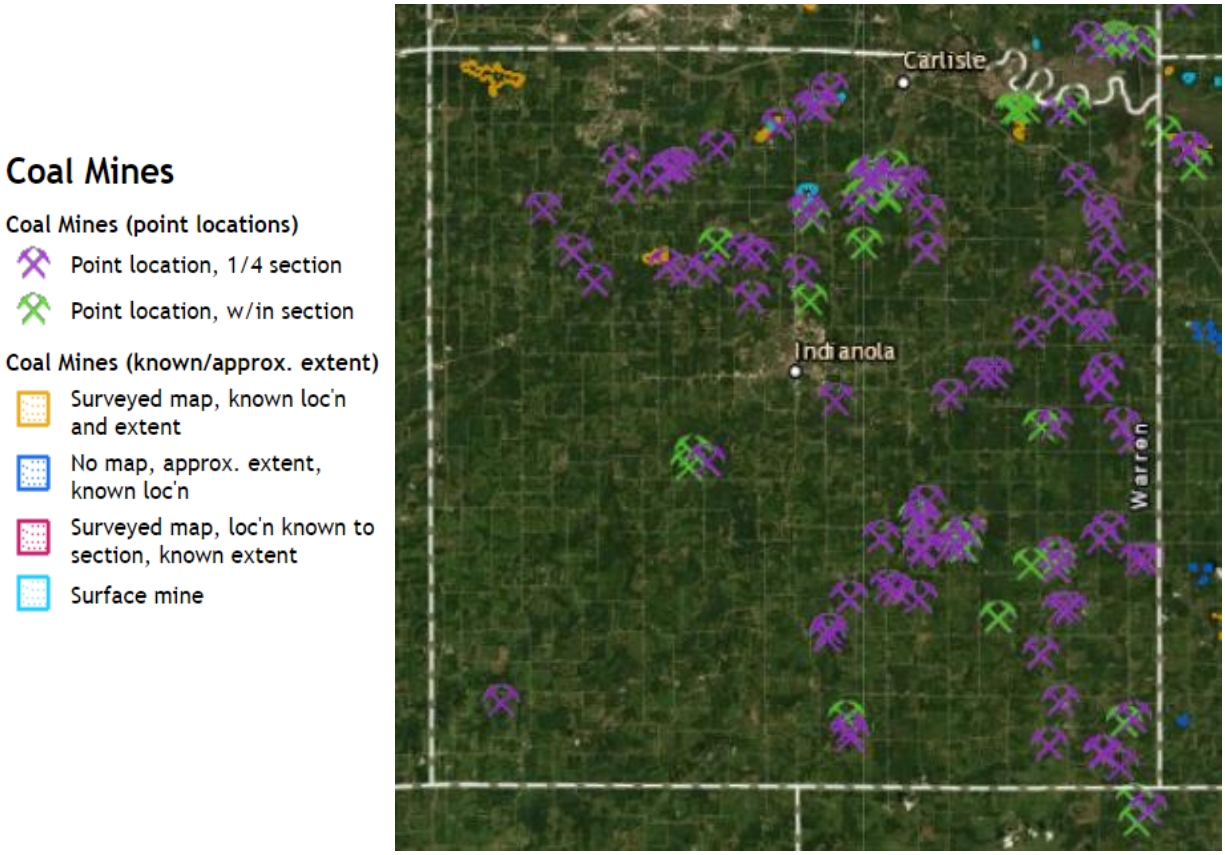
A sinkhole is defined as the loss of surface elevation due to the removal of subsurface support. Sinkholes can range from broad, regional lowering of the land surface to localized collapse. The primary causes of most subsidence are human activities such as: underground mining of coal, groundwater or petroleum withdraw, and drainage of organic soils. Sinkholes can also be due to erosion of limestone of the subsurface.

As a result of Iowa's former mining operations and unique geology, sinkholes are found throughout much of the state, but the majority of the sinkholes are located in the northeast quadrant of the state. The vulnerability of sinkholes in Warren County primarily stems from the existence of old mines.

Location

The following map (Figure 52) shows historic coal mining areas reported by IDNR. These documented coal mines may be prone to a sinkhole event. The 2012 Warren County HMP notes that there have been previous sinkhole disturbances primarily in Indianola and Carlisle due to improperly filled wells, poor construction methods, or underground utilities.

Figure 52: Historic Coal Mining Areas



Source: IDNR, 2022[99]

99 IDNR. Accessed March 2022. "Iowa Coal Mines." https://programs.iowadnr.gov/maps/coalmines/

Extent
Any sinkhole that might occur would be isolated to a small area.

Historical Occurrences
The only occurrences of previous sinkhole events may be found in the 2012 Warren County HMP. It notes that a limited number of small sinkholes have occurred on private property, including residential yards, where wells have been improperly filled or structures have been built upon them. Several years ago, the Indianola Wal-Mart parking lot began to sink in what some attributed to construction using fill over a small stream bed. Additionally, a small sinkhole appeared several years ago, near one of the Carlisle School buildings. Lastly, the county has numerous old sewer lines that have collapsed, causing minor sinkholes near streets and sidewalks. No major damages or injuries have been reported in the county.

Average Annual Losses
There is no data available to determine damage estimates for this hazard. In most cases, individual property owners, local governments, and businesses pay for repairs for damages caused by this hazard.

Probability
Future occurrences of sinkholes are possible, but without a well-documented record of events, it is difficult to determine the overall probability of this hazard. However, for the purposes of this plan, the probability of sinkholes will be estimated as ten percent annually.

Community Top Hazard Status
No participating jurisdiction identified Sinkholes as a top hazard of concern.

Regional Vulnerabilities
The following table summarizes regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 84: Regional Vulnerabilities

Sector	Vulnerability
People	-Citizens living near old mining operations in the northern half of the Country are at risk
Economic	-If a business is impacted, employees may be temporarily out of work
Built Environment	-All building stock has a small risk of damage
Infrastructure	-All underground infrastructure at risk to damages
Critical Facilities	-Roadways may be damaged
Climate	-Fluctuating precipitation extremes (drought or heavy rain events) can cause sinkholes

TERRORISM

According to the Federal Bureau of Investigation (FBI), there is no single, universally accepted, definition of terrorism. Terrorism is defined in the Code of Federal Regulations as “the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof in furtherance of a political or social objectives” (28 C.F.R. Section 0.85).

The FBI further describes terrorism as either domestic or international, depending on the origin, base, and objectives of the terrorist organization. For the purpose of this plan, the following definitions from the FBI will be used:

- Domestic terrorism is the unlawful use, or threatened use, of force or violence by a group or individual based and operating entirely within the United States or Puerto Rico without foreign direction committed against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof in furtherance of political or social objectives.

- International terrorism involves violent acts or acts dangerous to human life that are a violation of the criminal laws of the United States or any state, or that would be a criminal violation if committed within the jurisdiction of the United States or any state. These acts appear to be intended to intimidate or coerce a civilian population, influence the policy of a government by intimidation or coercion, or affect the conduct of a government by assassination or kidnapping. International terrorist acts occur outside the United States or transcend national boundaries in terms of the means by which they are accomplished, the persons they appear intended to coerce or intimidate, or the locale in which their perpetrators operate or seek asylum.

There are different types of terrorism depending on the target of attack, which are:

- Political Terrorism
- Bio-Terrorism
- Cyber-Terrorism
- Eco-Terrorism
- Nuclear-Terrorism
- Narco-Terrorism
- Agro-Terrorism

Terrorist activities are also classified based on motivation behind the event such as ideology (i.e. religious fundamentalism, national separatist movements, and social revolutionary movements). Terrorism can also be random with no ties to ideological reasoning.

The FBI also provides clear definitions of a terrorist incident and prevention:

- A terrorist *incident* is a violent act or an act dangerous to human life, in violation of the criminal laws of the United States, or of any state, to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives.

- Terrorism *prevention* is a documented instance in which a violent act by a known or suspected terrorist group or individual with the means and a proven propensity for violence is successfully interdicted through investigative activity.

Note: The FBI investigates terrorism-related matters without regard to race, religion, national origin, or gender. Reference to individual members of any political, ethnic, or religious group in this report is not meant to imply that all members of that group are terrorists. Terrorists represent a small criminal minority in any larger social context.

Primarily, threat assessment, mitigation and response to terrorism are federal and state directives and work primarily with local law enforcement. The Office of Infrastructure Protection within the Federal Department of Homeland Security is a component within the National Programs and Protection Directorate.

Cyber-Terrorism

Cyber-terrorism is an incident involving the theft or modification of information on computer systems that can compromise the system or potentially disrupt essential services. A cyber-terrorism incident can impact city agencies, private utilities, or critical infrastructure/key resources like a power grid, public transportation system, and wireless networks. Cyber infrastructure includes electronic information and communications systems, and the information contained in those systems. Computer systems, control systems such as Supervisory Control and Data Acquisition (SCADA) systems, and networks such as the Internet are all part of cyber infrastructure.

Nation-states, criminal organizations, terrorists, and other malicious actors conduct attacks against critical cyber infrastructure on an ongoing basis. The impact of a serious cyber incident or successful cyber-attack would be devastating to state, local, tribal, and territorial governments' assets, systems, and/or networks; the information contained in those networks; and the confidence of those who trust governments to secure those systems.

A cyber incident can affect a system's:

- Confidentiality: protecting a user's private information
- Integrity: ensuring that data is protected and cannot be altered by unauthorized parties
- Availability: keeping services running and giving administration access to key networks and controls.

"Many of the Nation's essential and emergency services, as well as our critical infrastructure, rely on the uninterrupted use of the Internet and the communications systems, data, monitoring, and control systems that comprise our cyber infrastructure. A cyber-attack could be debilitating to our highly interdependent critical infrastructure and key resources and ultimately to our economy and national security."

The Office of Infrastructure Protection leads the coordinated national program to reduce and mitigate risk within 18 national critical infrastructure and key resources (CIKR) sectors from acts of terrorism and natural disasters and to strengthen sectors' ability to respond and quickly recover from an attack or other emergency. This is done through the National Infrastructure Protection Plan (NIPP).

Under the NIPP, a Sector-Specific Agency (SSA) is the federal agency assigned to lead a collaborative process for infrastructure protection for each of the 18 sectors. The NIPP's

comprehensive framework allows the Office of Infrastructure Protection to provide the cross-sector coordination and collaboration needed to set national priorities, goals, and requirements for effective allocation of resources. More importantly, the NIPP framework integrates a broad range of public and private CIKR protection activities.

The SSAs provide guidance about the NIPP framework to state, tribal, territorial, and local homeland security agencies and personnel. They coordinate NIPP implementation within the sector, which involves developing and sustaining partnerships and information-sharing processes, as well as assisting with contingency planning and incident management.

The Office of Infrastructure Protection has SSA responsibility for six of the 18 CIKR sectors. Those six are:

- Chemical
- Commercial Facilities
- Critical Manufacturing
- Dams
- Emergency Services
- Nuclear Reactors, Materials and Waste

SSA responsibility for the other 12 CIKR sectors is held by other Department of Homeland Security components and other federal agencies. Those 12 are:

- Agriculture and Food – Department of Agriculture; Food and Drug Administration
- Banking and Finance – Department of the Treasury
- Communications – Department of Homeland Security
- Defense Industrial Base – Department of Defense
- Energy – Department of Energy
- Government Facilities – Department of Homeland Security
- Information Technology – Department of Homeland Security
- National Monuments and Icons – Department of the Interior
- Postal and Shipping – Transportation Security Administration
- Healthcare and Public Health – Department of Health and Human Services
- Transportation Systems – Transportation Security Administration; U.S. Coast Guard
- Water – Environmental Protection Agency

The NIPP requires that each SSA prepare a Sector-Specific Plan, review it annually, and update it as appropriate.

The Department of Homeland Security and its affiliated agencies are responsible for disseminating any information regarding terrorist activities in the country. The system in place is the National Terrorism Advisory System (NTAS). NTAS replaced the Homeland Security Advisory System (HSAS) which was the color-coded system put in place after the September 11th attacks by Presidential Directive 5 and 8 in March of 2002. NTAS replaced HSAS in 2011.

NTAS is based on a system of analyzing threat levels and providing either an imminent threat alert or an elevated threat alert.

An ***Imminent Threat Alert*** warns of a credible, specific, and impending terrorist threat against the United States.

An ***Elevated Threat Alert*** warns of a credible terrorist threat against the United States.

The Department of Homeland Security, in conjunction with other federal agencies, will decide whether a threat alert of one kind or the other should be issued should credible information be available. Each alert provides a statement summarizing the potential threat and what if anything should be done to ensure public safety.

The NTAS Alerts will be based on the nature of the threat: in some cases, alerts will be sent directly to law enforcement or affected areas of the private sector, while in others, alerts will be issued more broadly to the American people through both official and media channels.

An individual threat alert is issued for a specific time period and then automatically expires. It may be extended if new information becomes available or the threat evolves. The ***sunset provision*** contains a specific date when the alert expires as there will not be a constant NTAS Alert or blanket warning that there is an overarching threat. If threat information changes for an alert, the Secretary of Homeland Security may announce an updated NTAS Alert. All changes, including the announcement that cancels an NTAS Alert, will be distributed the same way as the original alert.

Location
Terrorism can occur throughout the entire planning area. Urban area, schools, and government buildings are more likely to see terroristic activity. Concerns are primarily related to political unrest, activists' groups, and others that may be targeting businesses police, and federal buildings. In schools, concerns center on political terrorism and are generally perpetrated erratically by loners. In rural areas, concerns are primarily related to agro-terrorism and tampering with water supplies. However, water systems of any size could be vulnerable.

Extent
Terrorist attacks can vary greatly in scale and magnitude, depending on the location of the attack.

Historical Occurrences
Previous accounts of terrorism in the planning area were gathered from the Global Terrorism Database, maintained by the University of Maryland and the National Consortium for the Study of Terrorism and Responses to Terrorism (START). This database contains information for over 140,000 terrorist attacks. According to this database, there have been no terrorist incidents in Warren County since 1970.[100] The Carlisle Community School District has had two bomb threats and one incidence of an incomplete bomb placed between the school and highway boundary. The Indianola Community School District has also experienced a terrorism incident.

Average Annual Damages
The average damage per event estimate was not determined because the Global Terrorism Database does not have record of any terrorism incidents in Warren County. The Carlisle and Indianola Community School Districts did not report any damage attributable to their terror threat incidents.

Probability
Given that no terrorism events have occurred in the past, the annual probability for terrorism in the planning area is low.

100 National Consortium for the Study of Terrorism and Responses to Terrorism. October 2018. Global Terrorism Database [Data file]. Retrieved from https://www.start.umd.edu/gtd.

Community Top Hazard Status

The following table lists jurisdictions which identified Terrorism as a top hazard of concern:

Jurisdictions	
Warren County	Indianola Community School District
City of Carlisle	Simpson College
City of Cumming	Warren Water District

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles.*

Table 85: Regional Vulnerabilities

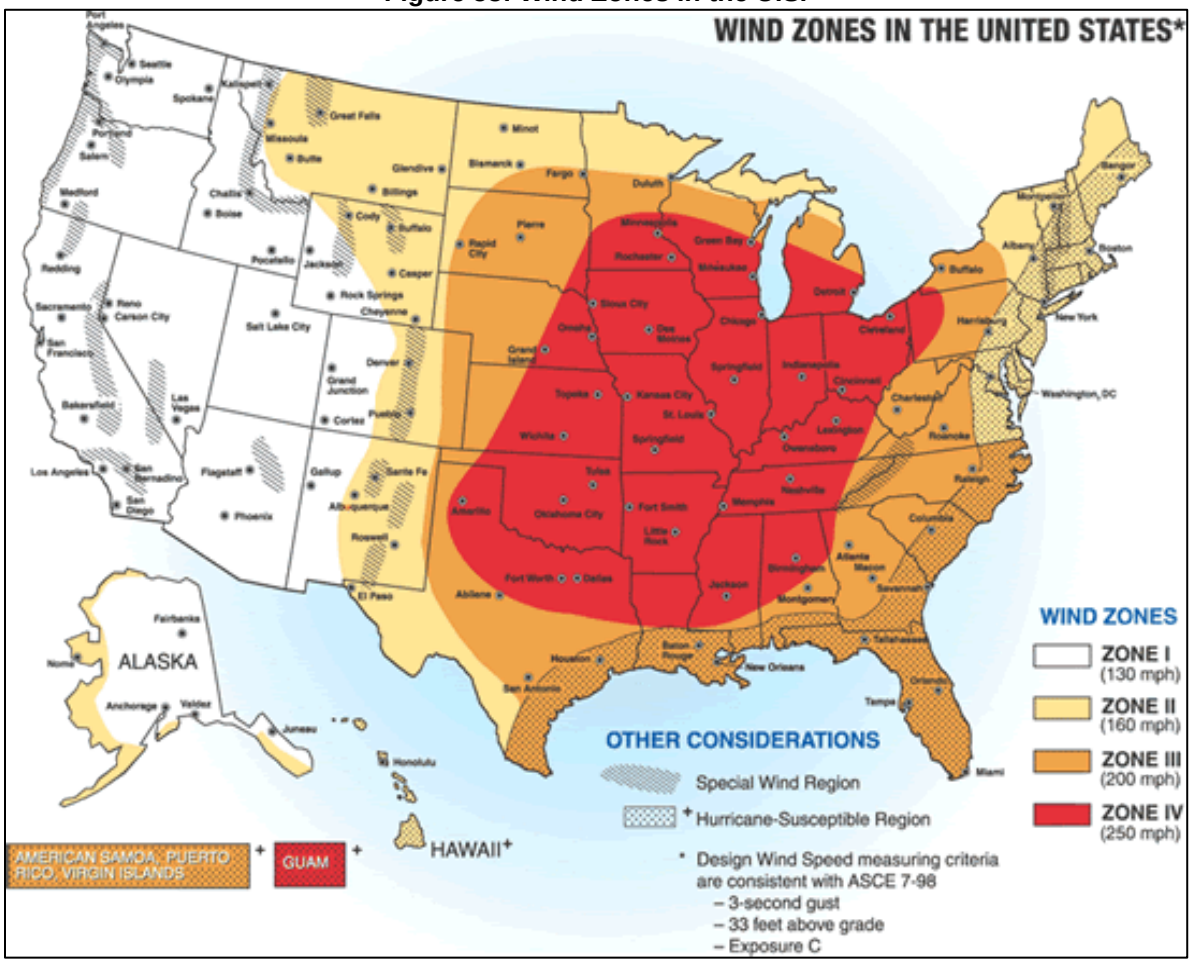
Sector	Vulnerability
People	-Police officers and first responders at risk of injury or death -Civilians at risk of injury or death -Students and staff at school facilities at risk of injury or death from school shootings
Economic	-Damaged businesses can cause loss of revenue and loss of income for workers -Agricultural attacks could cause significant economic losses for the region -Risk of violence in an area can reduce income flowing into and out of that area
Built Environment	-Targeted buildings may sustain heavy damage
Infrastructure	-Water supply, power plants, utilities may be damaged
Critical Facilities	-Police stations, government offices, and schools are at a higher risk

TORNADOES & WINDSTORMS

Windstorms typically accompany severe thunderstorms, severe winter storms, tornadoes, and other large low-pressure systems, which can cause significant crop damage, downed power lines, loss of electricity, traffic flow obstructions, and significant property damage including to trees and center-pivot irrigation systems.

The National Weather Service (NWS) defines high winds as sustained wind speeds of 40 mph or greater lasting for 1 hour or longer, or winds of 58 mph or greater for any duration[101] The NWS issues High Wind Advisories when there are sustained winds of 25 to 39 miles per hour and/or gusts to 57 mph. Figure 53 shows the wind zones in the United States. The wind zones are based on the maximum wind speeds that can occur from a tornado or hurricane event. The planning area is located in Zone IV which has maximum winds of 250 mph equivalent to an EF5 tornado.

Figure 53: Wind Zones in the U.S.



Source: FEMA

101 National Weather Service. 2017. "Glossary." http://w1.weather.gov/glossary/index.php?letter=h.

A tornado is typically associated with a supercell thunderstorm. For a rotation to be classified as a tornado, three characteristics must be met:

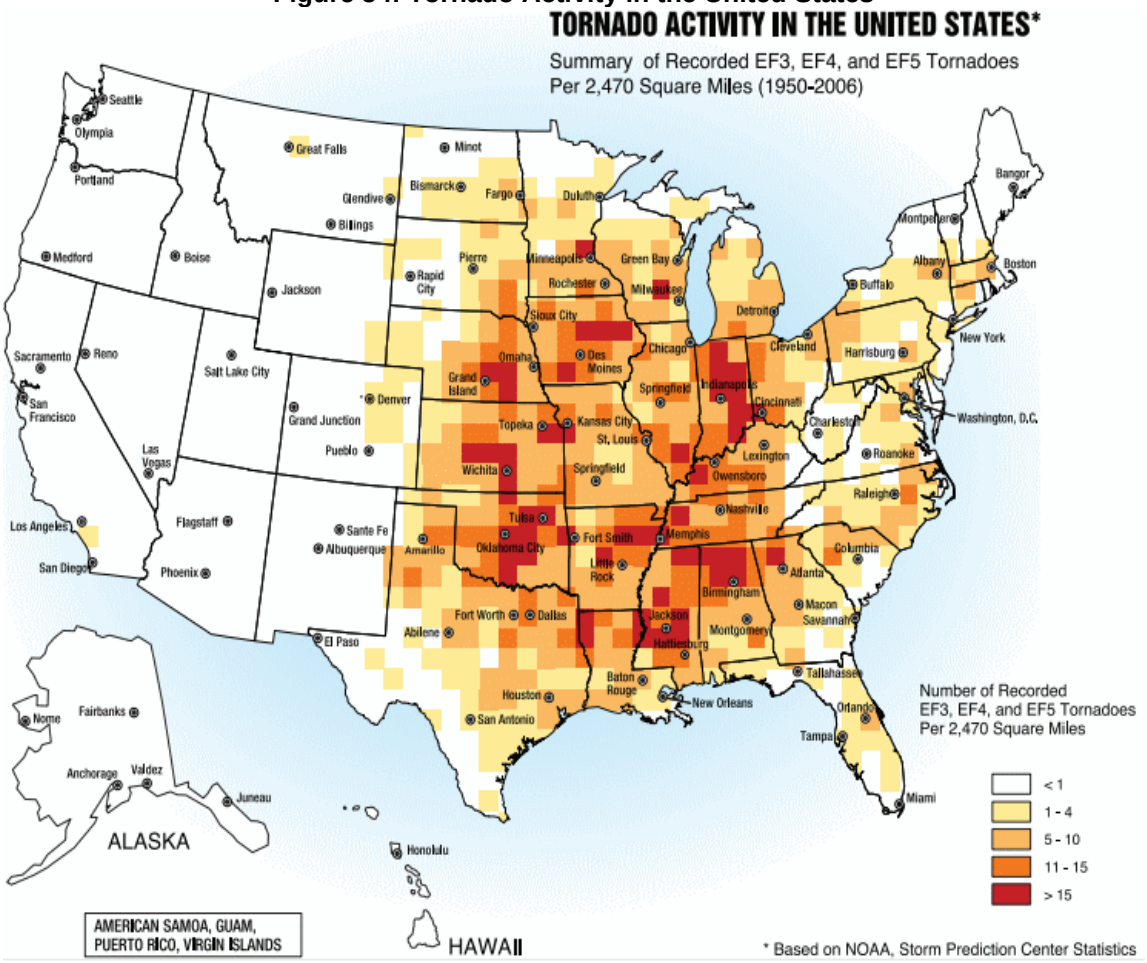
- There must be a microscale rotating area of wind, ranging in size from a few feet to a few miles wide;
- The rotating wind, or vortex, must be attached to a convective cloud base and must be in contact with the ground; and,
- The spinning vortex of air must have caused enough damage to be classified by the Fujita Scale as a tornado.

Once tornadoes are formed, they can be extremely violent and destructive. They have been recorded all over the world but are most prevalent in the American Midwest and South, in an area known as "Tornado Alley." Approximately 1,000 tornadoes are reported annually in the contiguous United States (NOAA 2012). Tornadoes can travel distances over 100 miles and reach over 11 miles above ground. Tornadoes usually stay on the ground no more than 20 minutes. Nationally, the tornado season typically occurs between April and July. On average, 80 percent of tornadoes occur between noon and midnight. In Iowa, 64 percent of all tornadoes occur in the months of May, June, and July.

Iowa is ranked sixth in the nation for tornado frequency with an annual average of 47 tornadoes between 1985 and 2014[102].

[102] NOAA. "U.S. Annual Averages: Tornadoes by State (1985-2014)". Accessed March 2022. https://www.spc.noaa.gov/wcm/ustormaps/1985-2014-stateavgtornadoes.png

Figure 54: Tornado Activity in the United States



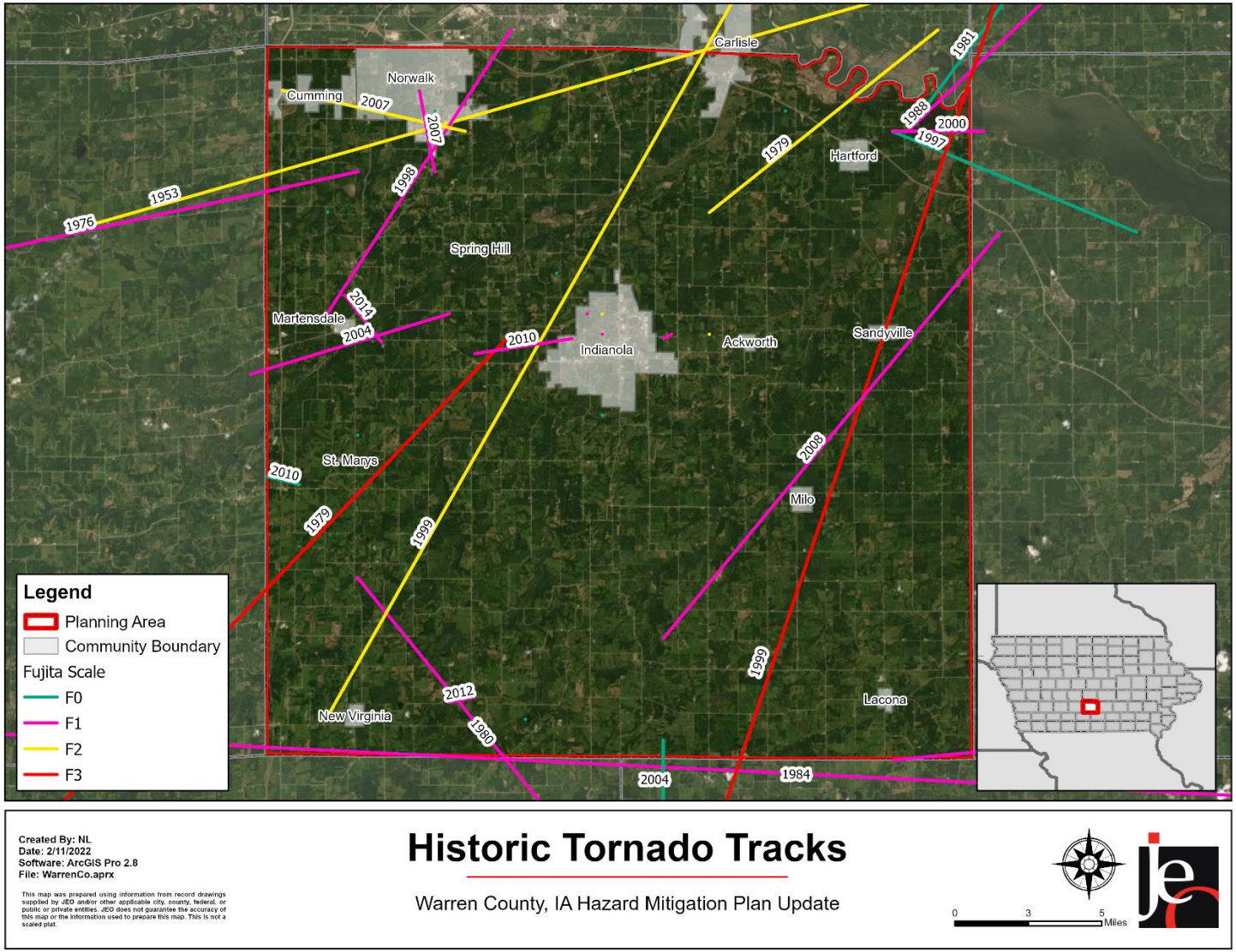
Source: FEMA[103]

Location

Windstorms commonly occur throughout the planning area. Tornadoes can occur anywhere in the planning area. The impacts would likely be greater in densely populated areas, such as Indianola or Norwalk. The following map shows the historical track locations across the region according to the Midwestern Regional Climate Center. Few significant tornado events have directly impacted communities located in the planning area between 1997 and 2021, but touchdowns and tornado events can occur anywhere within the planning area.

[103] Federal Emergency Management Agency. August 2008. "Taking Shelter From the Storm: Building a Safe Room for Your Home or Small Business, 3rd edition."

Figure 55: Historic Tornado Tracks (1950-2017)



Extent

The Beaufort Wind Scale can be used to classify wind strength while the magnitude of tornadoes is measured by the Enhanced Fujita Scale. The following table outlines the Beaufort scale including wind speed ranking, range of wind speeds per ranking, and a brief description of conditions for each.

Table 86: Beaufort Wind Ranking

Beaufort Wind Force Ranking	Range of Wind	Conditions
0	<1 mph	Smoke rises vertically
1	1-3 mph	Direction shown by smoke but not wind vanes
2	4-7 mph	Wind felt on face; leaves rustle; wind vanes move
3	8-12 mph	Leaves and small twigs in constant motion
4	13-18 mph	Raises dust and loose paper; small branches move
5	19-24 mph	Small trees in leaf begin to move
6	25-31 mph	Large branches in motion; umbrellas used with difficulty
7	32-38 mph	Whole trees in motion; inconvenience felt when walking against the wind
8	39-49 mph	Breaks twigs off tree; generally, impedes progress
9	50-54 mph	Slight structural damage; chimneypots and slates removed
10	55-63 mph	Trees uprooted; considerable structural damages; improperly or mobiles homes with no anchors overturned
11	64-72 mph	Widespread damages; very rarely experienced
12 - 17	72 - > 200 mph	Hurricane; devastation

Source: Storm Prediction Center, 2017[104]

The Enhanced Fujita Scale replaced the Fujita Scale in 2007. The Enhanced Fujita Scale does not measure tornadoes by their size or width, but rather the amount of damage caused to human-built structures and trees after the event. The official rating category provides a common benchmark that allows comparisons to be made between different tornadoes. The enhanced scale classifies EF0-EF5 damage as determined by engineers and meteorologists across 28 different types of damage indicators, including different types of building and tree damage. To establish a rating, engineers and meteorologists examine the damage, analyze the ground-swirl patterns, review damage imagery, collect media reports, and sometimes utilize photogrammetry and videogrammetry. Based on the most severe damage to any well-built frame house, or any comparable damage as determined by an engineer, an EF-Scale number is assigned to the tornado.

The following tables summarize the Enhanced Fujita Scale and damage indicators. According to the National Institute of Science and Technology on the Joplin Tornado, tornadoes rated EF3 or lower account for around 96 percent of all tornado damages.[105]

104 Storm Prediction Center: National Oceanic and Atmospheric Administration. 1805. "Beaufort Wind Scale." http://www.spc.noaa.gov/faq/tornado/beaufort.html.
105 Kuligowski, E.D., Lombardo, F.T., Phan, L.T., Levitan, M.L., & Jorgensen, D.P. March 2014. "Final Report National Institute of Standards and Technology(NIST) Technical Investigation of the May 22, 2011, Tornado in Joplin, Missouri."

Table 87: Enhanced Fujita Scale

Storm Category	3 Second Gust (mph)	Damage Level	Damage Description
EF0	65-85 mph	Gale	Some damages to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards.
EF1	86-110 mph	Weak	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages might be destroyed.
EF2	111-135 mph	Strong	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
EF3	136-165 mph	Severe	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
EF4	166-200 mph	Devastating	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
EF5	200+ mph	Incredible	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-enforced concrete structures badly damaged.
EF No Rating	--	Inconceivable	Should a tornado with the maximum wind speed in excess of F5 occur, the extent and types of damage may not be conceived. A number of missiles such as iceboxes, water heaters, storage tanks, automobiles, etc. will create serious secondary damage on structures.

Source: NOAA; FEMA

Table 88: Enhanced Fujita Scale Damage Indicator

Number	Damage Indicator	Number	Damage Indicator
1	Small barns, farm outbuildings	**15**	School – 1 story elementary (interior or exterior halls)
2	One- or two-family residences	**16**	School – Junior or Senior high school
3	Single-wide mobile homes (MHSW)	**17**	Low-rise (1-4 story) buildings
4	Double-wide mobile homes (MHDW)	**18**	Mid-rise (5-20 story) buildings
5	Apartment, condo, townhouse (3 stories or less)	**19**	High-rise (over 20 stories)
6	Motel	**20**	Institutional buildings (hospital, government, or university)
7	Masonry apartment or motel	**21**	Metal building systems
8	Small retail buildings (fast food)	**22**	Service station canopy
9	Small professional (doctor office, branch bank)	**23**	Warehouse (tilt-up walls or heavy timber)
10	Strip mall	**24**	Transmission line tower
11	Large shopping mall	**25**	Free-standing tower
12	Large, isolated (“big box”) retail building	**26**	Free standing pole (light, flag, luminary)
13	Automobile showroom	**27**	Tree- hardwood
14	Automotive service building	**28**	Tree -softwood

Source: NOAA; FEMA

Using the NCEI reported events, the most common high wind event in the planning area is a level 9 on the Beaufort Wind Ranking scale. The reported high wind events ranged from 30 mph to 61

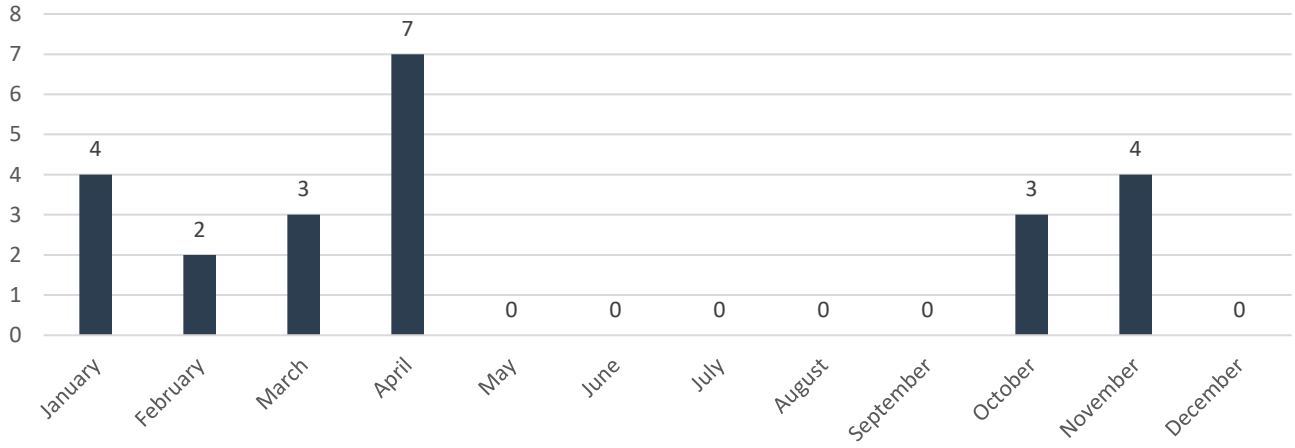
mph, with an average speed of 48 mph. Based on the historical record, it is most likely that tornadoes that occur within the planning area will be between an EF0 and EF1 strength. Of the 28 reported tornado events between 1997 and 2021, 12 were EF/F0, 12 were EF/F1, three were EF/F2, one event was F3. In 2022, an EF4 tornado path went through the planning area, which is an unusual occurrence in March[106].

Historical Occurrences

Due to the regional scale of windstorms, the NCEI reports events as they occur in each county. While a single event can affect two or more counties at a time, the NCEI reports them as separate events. There were 22 windstorm events that occurred between 1996 and 2021 and 29 tornadic events ranging from a magnitude of EF0 to F3. NCEI data for tornado events were collected up to December 2021 and does not include the recent tornado event that occurred in March 2022. A description of the March 2022 event is included in the NCEI event descriptions below. These events were responsible for $3,892,610 in property damages and $101,700 in crop damages. No deaths or injuries were reported.

The most damaging tornado occurred in 2010, causing $750,000 in damages. This EF1 tornado damaged 22 buildings, with 5 sustaining major damage. A second EF1 tornado touched down during the same storm and damaged garage doors and metal outbuildings. As seen in the following figures, the majority of windstorm events occur in the spring and winter months, while most tornado events occur in the summer.

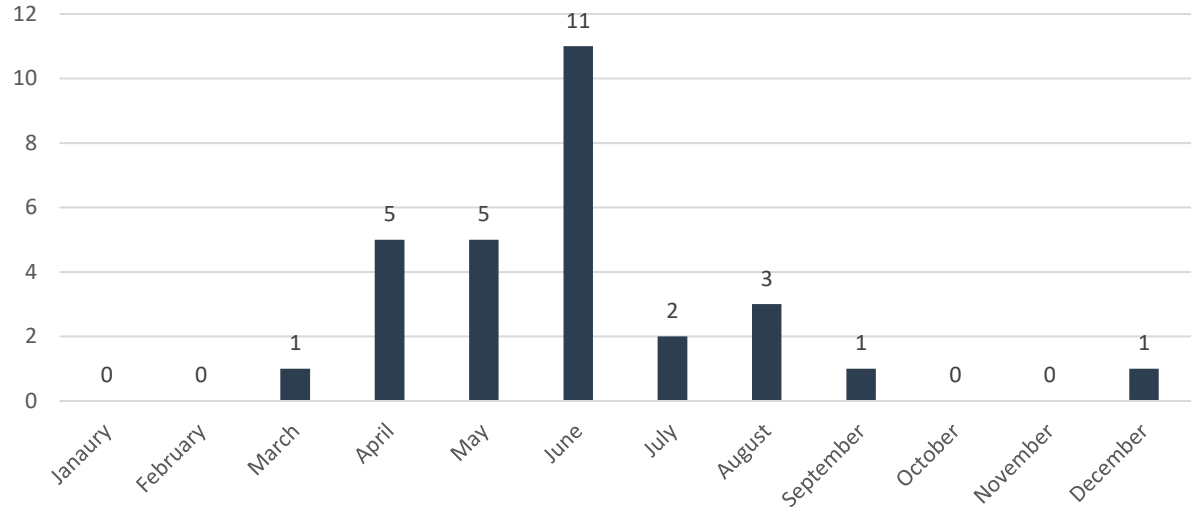
Figure 56: High Wind Events by Month



Source: NCEI, 1996-July 2021

[106] NOAA. "March 5th 2022 Central and Southern Iowa Tornadoes". Accessed March 2022. https://www.weather.gov/dmx/March5th2022Tornadoes

Figure 57: Tornado Events by Month



Source: NCEI, 1996-December 2021

Event descriptions from NCEI for the most damaging events are provided below.

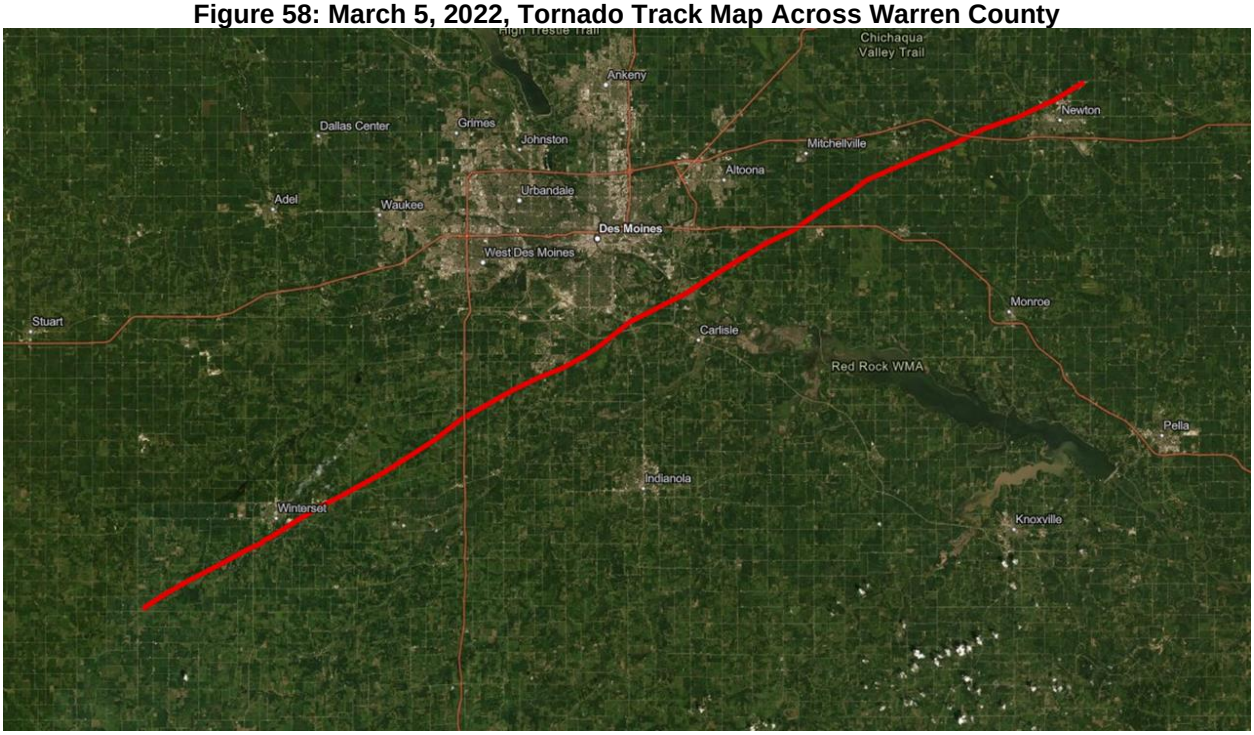
- **7/23/2010 Tornado –** $750,000 in property damages, $10,000 in crop damage. *One storm produced two tornadoes in the Indianola area of Warren County. Several houses were damaged near Euclid St and Y Street. Houses and barns were damaged at the intersection of R63 and Hover Street. The total number of homes damages was 22 with 5 sustaining major damage. The major damage included wall damage to homes, collapsed walls on garages, and uplift of decks and roofs. The second tornado touched down east of Indianola and caused building damage. Damage included inward and outward collapse of overhead doors to a garage and metal outbuildings.*
- **6/22/2007 Tornado -** $1,000,000 in property damages, $25,000 in crop damage. *Two tornadoes touched down in Warren County. First structural damage (EF1) noted at a farmhouse at G14 and 20th Ave. Continuous ground contact southeast to farmstead at G14 and 25th Ave where north facing garage was destroyed (EF1) and outbuildings and trailer damaged. The tornado continued SE and reached widest point of approximately 200 yards striking outbuildings. A farmstead at 30th Ave and Clark Street sustained EF1 damage to grain bin and outbuildings. Corn from grain bin was noted well downstream at end of track, some corn impacted side of Phillips home in SE Norwalk. Next structural damage occurred to a light garage (EF0). The second tornado was first verified over the Legacy Golf Course, just NW of the Norwalk Fire Station. It is interesting to note the tornado passed directly over the fire station, producing a circular pattern in the gravel on the roof, and blowing out two overhead doors. The tornado was narrow, with most damage consisting of tree damage up to EF1 and light structural damage as it moved to the SE. A farmstead on R57 south of Coolidge St. sustained tree damage from tornado #2. This is just south of the Phillips home that was damaged by the first tornado.*
- **8/20/2019 Tornado -** $350,000 in property damages, $1,000 in crop damage. *The second of three tornadoes associated with a fast-moving QLCS. The particularly strong tornado moved across rural Warren County producing mainly crop and tree damage. However, the tornado encountered the several large steel buildings with I-beam construction. Significant damage occurred to these buildings producing EF3 damage. The tornado continued to the southeast beyond this area remaining in rural crop and woodland areas.*

Not included in the NCEI dataset, a significant tornado event occurred in Iowa on March 5, 2022. This tornado event included the first EF4 tornado in the state since 2013, which ran through the northwestern portion of Warren County and was the second longest tornado in Iowa since 1980. The tornado track developed north of Macksburg and produced significant damage on the southeast sides of Winterset and Norwalk and some communities in between (Figure 58). The event severely impacted two businesses, Windsor Windows and Bedwell Gardens, located in Norwalk. Windsor Windows had roof damage (Figure 59), and Bedwell Gardens lost all five of its greenhouses (Source: *Des Moines Register, 2022*

Figure 60). According to estimates from Warren County Emergency Management, the event caused approximately $20 million in damages, with most of the damages occurring in the north part of the county. The state issued a disaster proclamation on March 7, 2022, for nine counties, including Warren County. On March 8, 2022, the Warren County Board of Supervisors also issued a county disaster declaration in response to the event.

During this tornado event, the NWS warning system had technical issues, resulting in a nearly 10-minute delay in some messages being delivered to Iowans in the path of the tornadoes. This event showcased the importance of having additional communication tools beyond cell phones to ensure all residents of areas in the tornado's path were alerted to the danger. The NWS used backup systems such as hotlines, phone calls, webinars, and social media to overcome the delay in warning texts.

Figure 58: March 5, 2022, Tornado Track Map Across Warren County



Source: National Weather Service, 2022[107]

[107] NWS. "Des Moines, IA Weather Forecast Office March 5th, 2022, Central and Southern Iowa Tornadoes". Accessed March 2022. https://www.weather.gov/dmx/March5th2022Tornadoes

Figure 59: Damage to the Roof of Windsor Windows in Norwalk, Iowa

Source: Des Moines Register, 2022

Figure 60: Damage to Greenhouses in Norwalk, Iowa

Source: Des Moines Register, 2022

Average Annual Damages

The average damage per event estimate was determined based upon NCEI Storm Events Database since 1996 and number of historical occurrences. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. It is estimated that windstorm events can cause an average of $815,110 per year in property damages and $709,391 per year in crop damages. Tornadoes have caused an average of over $3,077,500 per year in property damages; however, damages from tornadoes vary greatly depending on the severity or magnitude of each event.

Table 89: High Winds and Tornado Losses

Hazard Type	# Of Events[1]	Average # events per year	Total Property Loss[1]	Average Annual Property Loss	Total Crop Loss[2]	Average Annual Crop Loss
Windstorms	22	0.88	$815,110	$32,604	$709,391	$28,376
Tornadoes	28	1.12	$3,077,500	$123,100	$0	$0

Source: 1 NCEI (1996-December 2021), 2 USDA RMA (2000-2021)

Probability

Given the historic record of occurrence for high wind events (14 out of 25 years with reported events), for the purposes of this plan, the annual probability of wind event occurrence is 56 percent. However, high wind events may be more common than presented here but have simply not been reported in past years.

Given the historic record of occurrence for tornado events (13 out of 25 years with reported events), for the purposes of this plan, the annual probability of tornado occurrence is 52 percent. However, it is worth noting that data utilized during this analysis only encompassed through December 2021. Tornado events in 2022, such as those that occurred in March 2022, were not reflected here.

Community Top Hazard Status

The following table lists jurisdictions which identified Tornadoes and Windstorms as a top hazard of concern:

Jurisdictions	
City of Carlisle	City of New Virginia
City of Cumming	City of Norwalk
City of Hartford	City of St. Marys
City of Indianola	Indianola Community School District
City of Lacona	Norwalk Community School District
City of Martensdale	Simpson College
City of Milo	

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities; for jurisdictional specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 90: Regional Vulnerabilities

Sector	Vulnerability
People	-Vulnerable populations include those living in mobile homes (especially if improperly anchored), nursing homes, schools, or in substandard housing -People outside during events -Citizens without access to shelter below ground or in reinforced rooms -Elderly with decreased mobility or poor hearing may be at higher risk -Lack of multiple ways to receive weather warnings, especially at night
Economic	-Agricultural losses to both crops and livestock -Damages to businesses and prolonged power outages can cause significant impacts to the local economy, especially with EF3 tornadoes or greater
Built Environment	-All building stock is at risk of significant damages
Infrastructure	-Downed power lines and power outages -All above ground infrastructure at risk to damages -Impassable roads due to debris blocking roadways
Critical Facilities	-All critical facilities are at risk to damages and power outages
Climate	-Changes in seasonal precipitation and temperature normals can increase frequency and magnitude of events

TRANSPORTATION INCIDENTS

A transportation accident involves an incident between one or more conveyances on land, sea, or air. Transportation accidents can cause property damage, bodily injury, and death. Accidents are influenced by several factors, including the type of driver, road condition, weather conditions, density of traffic, type of roadway, signage, and signaling.

In the planning area, automobile accidents are likely to be the most common type of incident as there are few rail lines and bodies of water. In addition, most of the airports in the county are smaller with a low number of takeoffs and landings.

Location

Transportation incidents can occur anywhere along transportation routes in the planning area but are most likely to occur along major highways due to increased speeds and the higher number of vehicles.

There are five private airports and one heliport in Warren County, all located in and around Indianola. It should also be noted that the Des Moines International Airport is only two miles northeast of Norwalk in Polk County. Des Moines International Airport, Iowa's largest airport, serves over 1 million passengers per year plus 120,000+ tons of cargo and some military use. Additionally, Indianola hosts the National Balloon Classic every summer when about 100 hot air balloons take flight over a nine-day period.

Table 91 lists the location of the public and private airports in the planning area. Figure 61 shows the location of the major transportation routes in the planning area.

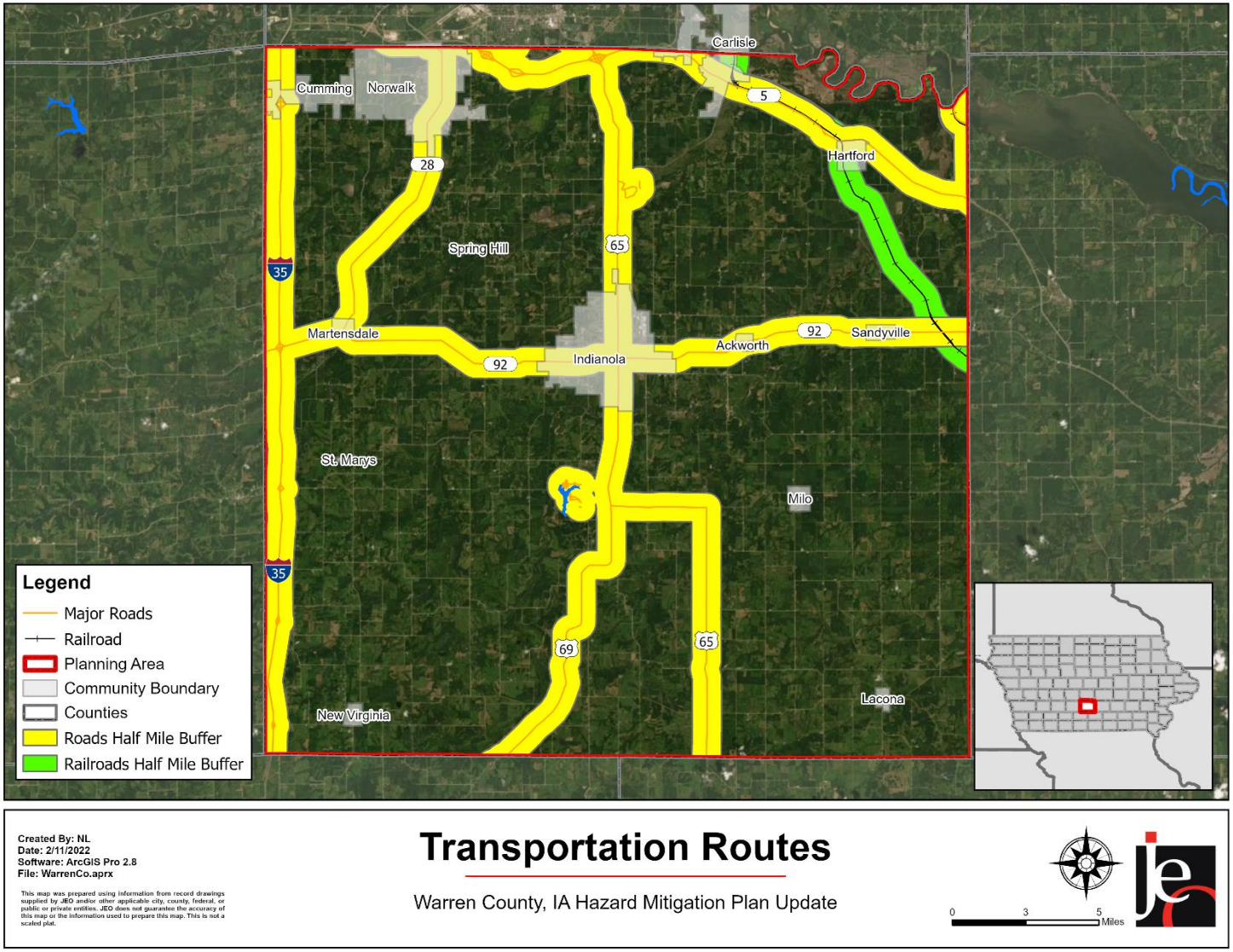
Table 91: Planning Area Airports

Airport	Type	Nearest Community
Hedgewood Landing	Private	Indianola
Laverty Field	Private	Indianola
Nash Field Indianola	Private	Indianola
Too Short	Private	Indianola
Tuinstra Airfield	Private	Indianola
Indianola Heliport	Public	Indianola

Extent

The extent of automobile, rail, and air incidents is usually localized, however catastrophic events can occur and may require assistance from outside jurisdictions. Transportation incidents can also cause hazard materials releases, which can further increase damages and risk of injury.

Figure 61: Transportation Corridors

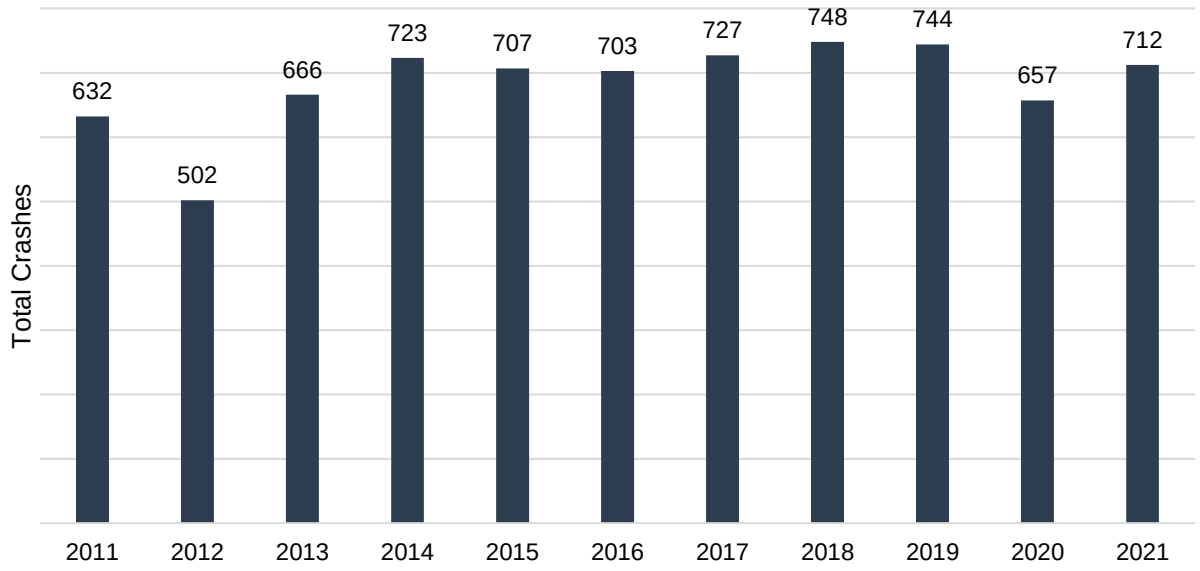


Historical Occurrences

Automobile

The Iowa Department of Transportation (IDOT) maintains records at the county level for certain automobile related accidents. The following figure shows total crashes from 2011 to 2021. These events resulted in a total of 7,521 crashes, 1,101 injuries, and 66 fatalities.

Figure 62: Automobile Crashes 2011-2021



Source: IDOT[108]

Highway Rail

The Federal Railroad Administration (FRA) keeps data on all highway rail accidents since 1975. Table 92 shows the number of highway rail accidents that have occurred in the county since 1975. Five injuries resulted from these events.

Table 92: Historical Highway Rail Incidents

Number of Incidents	Injuries	Fatalities
11	5	0

Source: Federal Railroad Administration, 1975-2021[109]

108 Iowa Department of Transportation. 2021. "ICAT-Iowa Crash Analysis Tool." https://icat.iowadot.gov/
109 Federal Railroad Administration. 2021. "Highway Rail Accidents". https://safetydata.fra.dot.gov/OfficeofSafety/publicsite/on_the_fly_download.aspx.

Aviation

From 1962 through 2021, there have been 9 aviation accidents in the planning area, as reported by the National Transportation Safety Board (NTSB) database. The events resulted in two injuries and three fatalities.

Table 93: Historical Aviation Incidents

Date	Phase of Flight	Injuries	Fatalities	Nearest Community
10/16/1983	Cruise	0	0	Carlisle
8/30/1983	Landing	1	0	Indianola
3/14/1985	Cruise	0	0	Norwalk
6/9/1985	Maneuvering	0	1	Carlisle
8/4/1991	Cruise	0	0	Indianola
6/5/1993	Cruise	0	0	Indianola
12/28/1999	Climb	1	0	Indianola
8/5/2016	Cruise	0	0	Indianola
4/17/2017	Cruise	0	2	Indianola

Source: National Transportation Safety Board, 1962-2019[110]

Average Annual Damages

The average damage per event estimate was determined for each incident type based upon records from IDOT, FRA, NTSB, and number of historical occurrences. Only transportation events from FRA included damage totals. This does not include losses from functional downtime, economic loss, injury, or loss of life. Transportation incidents have caused an average of $926 per year in property damages to the planning area. RMA data is not available for transportation incidents, but crop damage would be expected to be minimal.

Table 94: Transportation Incidents Loss Estimate

Hazard Type	Number of Events	Average Events Per Year	Total Property Loss	Average Annual Property Loss
Auto[1]	7,521	683.73	N/A	N/A
Aviation[2]	7	0.12	N/A	N/A
Highway Rail[3]	11	0.23	$43,500	$926
Total	**7,539**	**684.08**	**$43,500**	**$926**

Source:1 IDOT, 2011-2021;2 NTSB 1962-2019;3 FRA 1975-Aug 2021

Probability

The probability of transportation incidents is based on the historic record provided by the IDOT, FRA, and NTSB. Based on the historic record, there is a 100% annual probability of auto incidents, a 12% annual probability for aviation incidents and a 19% probability for highway rail incidents occurring in the planning area each year.

[110] National Transportation Safety Board. 1962-2019. “Aviation Accident Database & Synopses”. https://www.ntsb.gov/_layouts/ntsb.aviation/index.aspx.

Community Top Hazard Status

The following table lists jurisdictions which identified Transportation Incidents as a top hazard of concern:

Jurisdictions	
City of Carlisle	Indianola Community School District
City of Cumming	Norwalk Community School District
City of Norwalk	

Regional Vulnerabilities

The following table provides information related to regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles.*

Table 95: Regional Vulnerabilities

Sector	Vulnerability
People	-Injuries and fatalities to drivers and passengers -Injuries and fatalities to those nearby if hit
Economic	-Prolonged road closures and detours for clean-up
Built Environment	-Potential damage to nearby buildings
Infrastructure	-Damage to roadways, utility poles, and other infrastructure if struck by a vehicle
Critical Facilities	-Roadway closures -Damage to facilities if located near transportation routes
Climate	-None

SECTION FIVE: MITIGATION STRATEGY

Introduction

The primary focus of the mitigation strategy is to identify action items to reduce the effects of hazards on existing infrastructure and property based on the established goals and objectives. These actions should consider the most cost effective and technically feasible manner to address risk.

The establishment of goals and objectives took place during the kick-off meeting with the Hazard Mitigation Planning Team. Meeting participants reviewed the goals from the 2017 HMP and discussed recommended additions and modifications. The intent of each goal and set of objectives is to develop strategies to account for risks associated with hazards and identify ways to reduce or eliminate those risks.

The Hazard Mitigation Planning Team made some revisions to the 2017 HMP goals and objectives. These updated goals and objectives were then shared with all planning team members at the Round 1 public meetings.

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.

Requirement §201.6(c)(3)(ii): [The mitigation strategy shall include a] section that identifies and analyzes 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)(ii): [The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program, and continued compliance with NFIP requirements, as appropriate.

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.

Requirement §201.6(c)(3)(iv): For multi-jurisdictional plans, there must be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan.

Summary of Changes

The development of the mitigation strategy for this plan update includes the addition of new mitigation actions, updated status or removal of past mitigation actions, and revisions to the mitigation action selection process or descriptions of mitigation actions for consistency across the planning area.

Goals

Below is the final list of goals as determined for this plan update. These goals provide direction to guide participants in reducing future hazard related losses.

Goal 1: Reduce the Extent of Fatalities and Injuries Due to Hazards

Goal 2: Reduce the extent of property losses due to hazards on existing properties

Goal 3: Improve public response to hazards and make recovery easier

Goal 4: Improve quality of life in the community

Goal 5: Be as efficient as possible with government funding

Goal 6: Reduce the extent of property losses due to hazards on future properties

Goal 7: Enhance Overall Resilience and Promote Sustainability

Selected Mitigation Actions

After establishing the goals, local planning teams evaluated and prioritized mitigation actions. These actions included: the mitigation actions identified per jurisdiction in the previous plan and additional mitigation actions discussed during the planning process. Jurisdictions were encouraged to first review their Capital Improvement Plans, Master Plans, and other planning mechanisms where available to identify and include projects that had already been deemed a priority by their communities and/or allocated funding. The Hazard Mitigation Planning Team also provided each participant links to several FEMA resources (e.g. Mitigation Action Portfolio) to assist them in identifying projects align with the overall goals and the hazards identified. Participants were also encouraged to think of actions that may need FEMA grant assistance and to review their hazard prioritization for potential mitigation actions. These suggestions helped participants determine which actions would best assist their respective jurisdiction in alleviating damages in the event of a disaster. The listed priority rating does not indicate which actions will be implemented first but serves as a guide in determining the order in which each action should be implemented. Participants were informed of the STAPLEE (Social, Technical, Administrative, Political, Legal, Economic, Environmental) feasibility review process and were encouraged to use it when determining priorities.

These projects are the core of a hazard mitigation plan. The local planning teams were instructed that each action must directly relate to the goals of the plan and the hazards of top concern for their jurisdiction. Actions must be specific activities that are concise and can be implemented individually. Mitigation actions were evaluated based on referencing the community's risk assessment and capability assessment. Jurisdictions were encouraged to choose mitigation actions that were realistic and relevant to the concerns identified.

A final list of alternatives was established including the following information: description of action; which hazard(s) the action mitigates; responsible party; priority; cost estimate; potential local funding sources; and estimated timeline. This information was established through input from participants and determination by the Hazard Mitigation Planning Team.

It is important to note that not all the mitigation actions identified by a jurisdiction may ultimately be implemented due to limited capabilities, prohibitive costs, low benefit-cost ratio, or other concerns. These factors may not be identified during this planning process. The cost estimates, priority rating, potential funding, and identified agencies are used to give communities an idea of what actions may be most feasible over the next five years. This information will serve as a guide

for the participants to assist in hazard mitigation for the future. Additionally, some jurisdictions may identify and pursue additional mitigation actions not identified in this HMP.

Participant Mitigation Actions

Mitigation actions identified by participants of the Warren County HMP are found in the Mitigation Actions Project Matrix below. Additional information about selected actions can be found in respective *Section Seven: Community Profiles.* Each action includes the following information in the respective community profile.

- Mitigation Action: General title of the action item.
- Description: Brief summary of what the action item(s) will accomplish.
- Hazard(s) Addressed: Which hazard the mitigation action aims to address.
- Estimated Cost: General cost estimate for implementing the mitigation action for the appropriate jurisdiction.
- Funding: A list of any potential local funding mechanisms to fund the action.
- Timeline: General timeline as established by planning participants.
- Priority: General description of the importance and workability in which an action may be implemented (high/medium/low); priority may vary between each community, mostly dependent on funding capabilities and the size of the local tax base.
- Lead agency: Listing of agencies or departments which may lead or oversee the implementation of the action item.
- Status: A description of what has been done, if anything, to implement the action item.

Implementation of the actions will vary between individual plan participants based upon the availability of existing information; funding opportunities and limitations; and administrative capabilities of communities. Establishing a cost-benefit analysis is beyond the scope of this plan and could potentially be completed prior to submittal of a project grant application or as part of a five-year update. Completed, removed, and ongoing or new mitigation actions for each participating jurisdiction can be found in *Section Seven: Community Profiles.*

Mitigation Actions Project Matrix

During public meetings, each participant was asked to review mitigation projects listed in the 2017 HMP and identify new potential mitigation actions, if needed, to reduce the effects of hazards. Selected projects varied per jurisdiction depending upon the significance of each hazard present. The information listed in the following tables is a compilation of new and ongoing mitigation actions identified by jurisdiction. Completed and removed mitigation actions can be found in respective community profiles.

Table 96: Mitigation Actions Selected by Each Jurisdiction

Mitigation Actions	Goal/Objective	Warren County	Carlisle	Cumming	Hartford	Indianola	Lacona	Martensdale	Milo	New Virginia	Norwalk	St. Marys	Indianola Schools	Martensdale-St. Marys Schools	Norwalk Schools	Simpson College	Warren Water District
Accessible Public Facilities	4.1				X									X			
Aid Agreements and Community Drills	3.3, 7.1				X	X	X	X			X						
Animal Control	1.4			X													
Backup and Emergency Generators	2.1								X			X				X	
Building Codes	6.1									X							
Community Education and Awareness	1.2	X		X	X	X	X			X			X				
Community Rating System	2.2										X						
Community Safe/Shelter Rooms	1.4		X	X		X		X						X			
Comprehensive Disaster/Emergency Response Plan	3.3			X				X	X	X	X						
Contact List in School Vehicles	1.5													X			
Construct Secondary Water Tower	2.1										X						
County GIS Participation	6.2		X							X							
Data Collection	1.3												X				
Debris Disposal	2.1			X	X												
Demolition and Destruction Program	2.1						X	X									
Develop GIS Maps	3.5								X								
Develop Secondary Alert Systems	1.1				X				X	X				X			
Disaster and Continuity Planning	3.1	X	X	X		X					X				X	X	

Mitigation Actions	Goal/Objective	Warren County	Carlisle	Cumming	Hartford	Indianola	Lacona	Martensdale	Milo	New Virginia	Norwalk	St. Marys	Indianola Schools	Martensdale-St. Marys Schools	Norwalk Schools	Simpson College	Warren Water District
Electronic Resource Directory	1.3				X												
Emergency Communications	3.2		X														
Emergency Water Connection	3.1																X
Equipment and Facilities Upgrade	1.5					X											
Establish Disaster Response Agreements and Assets	3.3									X							
Evaluate Alert Systems	1.1				X												
Fire Preparedness	2.3	X								X							
First Responder and Public Works Equipment Upgrade	1.5	X			X		X										
First Responder Interagency Operability and Training	1.5						X		X		X						
Floodplain Mitigation	2.2										X					X	
GPS Units	1.3													X			
Guard Vulnerable Facilities	2.3		X														
Harden Infrastructure	2.1			X	X					X					X		
Hazard Mitigation Plan and Legislation	3.4															X	
HAZMAT Response	2.3				X			X									
Housing Fire Codes	6.1							X									
Improve Bridges and Culverts	2.1	X									X						
Improve Electrical System	2.1			X	X	X	X			X	X				X		

Mitigation Actions	Goal/Objective	Warren County	Carlisle	Cumming	Hartford	Indianola	Lacona	Martensdale	Milo	New Virginia	Norwalk	St. Marys	Indianola Schools	Martensdale-St. Marys Schools	Norwalk Schools	Simpson College	Warren Water District
Improve Facility Security	1.4	X		X	X	X	X							X			
Improve Police/Fire Infrastructure and Equipment	1.5		X			X											
Improve Private Residences	2.3							X									
Improve Roads	2.1						X										
Improve Sewer System	2.1	X			X	X	S	X	X		X						
Improve Stormwater System	2.1, 2.2	X	X		X	X	S	X	X	X	X						
Increase Landscaping Efforts	2.3	X	X														
Increase Water Capacity	1.4					X											
Inspect Water Lines	2.3							X									
Install Hazard Signs	1.4	X															
Install New/Upgraded Communication Technology	3.2							X								X	
Lake Dredging	2.2										X						
Lightning Preparedness and Protection	4.1														X	X	
Overhead Utility Lines	2.1				X												
Prepare and Adopt an EOP	3.5													X		X	
Prepare for Extreme Heat and Power Failure	2.1				X										X	X	
Property Acquisition	2.2	X															
Protect City Records	1.3									X					X		
Protect Power at Critical Facilities	2.1	X	X						X				X				
Purchase Snow Trucks, Plows, and Sanders	1.4				X			X			X						

Mitigation Actions	Goal/Objective	Warren County	Carlisle	Cumming	Hartford	Indianola	Lacona	Martensdale	Milo	New Virginia	Norwalk	St. Marys	Indianola Schools	Martensdale-St. Marys Schools	Norwalk Schools	Simpson College	Warren Water District
Purchase Trailers	1.5	X															
Purchase Weather Radios	1.1	X															
Regional Retention Pond	1.4										X						
Remove Hazardous Trees	1.3									X							
Reunification Plan	1.3												X				
Road Barricades and Signage	1.3	X															
Safe Rooms and Storm Shelters	1.4	X			X				X	X	X				X	X	
School Continuity Plan	3.1												X				
Stormwater Control	1.3			X													
Terrorism Response Plan	1.3													X			
Transportation Plan	1.3													X			
Tornado Sirens	1.1		X														
Training and Exercise Plan	3.5	X	X														
Training for Chemical Spills	1.2												X				
Transportation Planning, Reconstruction	3.5										X						
Tree Trimming Plan	1.2														X		
Vegetation Maintenance	1.3										X						
Vulnerable Populations Registration Program	1.3			X						X							
Water Infrastructure Upgrades	1.4		X														
Water Supply Shortage Plan	1.4								X								
Water Tower Fencing	2.3																X

Mitigation Actions	Goal/Objective	Warren County	Carlisle	Cumming	Hartford	Indianola	Lacona	Martensdale	Milo	New Virginia	Norwalk	St. Marys	Indianola Schools	Martensdale-St. Marys Schools	Norwalk Schools	Simpson College	Warren Water District
Well Rehabilitation and Testing	1.4	X															
Windbreaks	1.4				X												

SECTION SIX: PLAN IMPLEMENTATION AND MAINTENANCE

Monitoring, Evaluating, and Updating the Plan

Each participating jurisdiction in the Warren County HMP is responsible for monitoring (annually at a minimum), evaluating, and updating the plan during its five-year lifespan. Hazard mitigation projects will be prioritized by each participant's governing body with support and suggestions from the public and business owners. Unless otherwise specified by each participant's local planning team, the governing body will be responsible for implementing the recommended projects. The responsible party for the various implementation actions will report on the status of all projects and include which implementation processes worked well, any difficulties encountered, how coordination efforts are proceeding, and which strategies could be revised.

As projects or mitigation actions are implemented, a detailed timeline of how that project was completed should be written and attached to the plan in a format selected by the governing body. Information that will be included will address project timelines, agencies involved, area(s) benefited, total cost (if complete), etc. At the discretion of each governing body, local planning team members, and other identified relevant stakeholders should review the original draft of the mitigation plan and recommend applicable changes.

Plan review and updates will occur every five years at the minimum. At the discretion of each governing body, updates may be incorporated more frequently, especially in the event of a major hazard or as additional mitigation needs are identified. Local planning team members should engage with the public, other elected officials, and multiple departments as they review and update the plan. The persons overseeing the evaluation process will review the goals and objectives of the previous plan and evaluate them to determine whether they are still pertinent and current. Among other questions, they may want to consider the following:

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.

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 comprehensive or capital improvement plans, when appropriate.

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.

- Do the goals and objectives address current and expected conditions?
- If any of the recommended projects have been completed, did they have the desired impact on the goal for which they were identified? If not, what was the reason it was not successful (lack of funds/resources, lack of political/popular support, underestimation of the amount of time needed, etc.)?
- Have either the nature, magnitude, and/or type of risks changed?
- Are there implementation problems?

- Are current resources appropriate to implement the plan?
- Were the outcomes as expected?
- Did the plan partners participate as originally planned?
- Are there other agencies which should be included in the revision process?

Worksheets in *Appendix C* may also be used to assist with plan review and updates.

In addition, the governing body will be responsible for ensuring that the HMP's goals are incorporated into applicable revisions of other planning mechanisms per jurisdiction. These plans may include: Comprehensive Plan, Capital Improvement Plans, Zoning Ordinances, Floodplain Ordinances, Building Codes, and/or Watershed Management Plans. Future updates of this HMP will review and update discussions of plan integration per community as appropriate.

Continued Public Involvement

To ensure continued plan support and input from the public and business owners, public involvement should remain a top priority for each participating jurisdiction. Notices for public meetings involving discussion of an action on mitigation updates should be published and posted in the following locations:

- Public spaces around the jurisdiction
- City Hall
- Websites
- Social media
- Local radio stations
- Local newspapers
- Regionally distributed newsletters

Any amendments to the HMP as determined through public involvement or community actions must be submitted to HSEMD for inclusion in the final HMP.

Integrating Other Capabilities

There are a number of state and federal agencies with capabilities that can be leveraged during HMP updates or mitigation action implementation. A description of some regional resources is provided below.

Iowa Department of Homeland Security and Emergency Management

HSEMD is the coordinating body for homeland security and emergency management activities across the state of Iowa. HSEMD is responsible for emergency management, which is usually divided into five phases: preparedness, response, recovery, prevention, and mitigation.

The governor appoints the Iowa homeland security advisor and the director of the Iowa Department of Homeland Security and Emergency Management (HSEMD). The HSEMD director serves as the state administrative agent for grants administered by the federal government: such as HMGP, FMA and BRIC. HSEMD is responsible for developing the state hazard mitigation plan, which serves as a comprehensive set of guidelines for hazard mitigation across the state. The state hazard mitigation officer (SHMO) is responsible for the coordination of plan updates and maintenance. The SHMO also serves as the lead coordinator for the State Hazard Mitigation Team (SHMT), which provides input on the state hazard mitigation planning process.

For more information regarding HSEMD responsibilities as well as their ongoing projects and programs, please go to https://homelandsecurity.iowa.gov/.

Iowa Department of Natural Resources

The IDNR is committed to providing Iowa's citizens and leaders with the data and analyses they need to make appropriate natural resource decisions for the benefit of all Iowan's both now and in the future. This state agency is responsible in the areas of forest and prairie management, fish and wildlife programs, fire prevention, surface water and groundwater, floodplain management, dam safety, natural resource planning, animal feeding operations, permitting, solid waste management, household hazardous materials and many other programs and services. IDNR also coordinates with the US Forest Service, State and private forest agencies, the Big Rivers Forest Fire Management Compact to support natural resource managers and fire departments in fire prevention efforts.

For more information regarding IDNR's responsibilities as well as their ongoing projects, please go to https://www.iowadnr.gov/.

Silver Jackets Program

The Silver Jackets program is also worth mentioning for their extensive role in providing a formal and consistent strategy for an interagency approach to planning and implementing measures to reduce the risks associated with flooding and other natural hazards. It brings together multiple state, federal, and sometimes tribal and local agencies to learn from one another and apply their knowledge to reduce risk. The State Hazard Mitigation Team and the Iowa Flood Risk Management Team, also known as the Silver Jackets, coordinate efforts related to the review and update of the Iowa Hazard Mitigation Plan. The State Hazard Mitigation Team has largely delegated flood mitigation interagency coordination to the Silver Jackets.

At this time the Silver Jackets do not have any projects taking place in the Warren County planning area.

Unforeseen Opportunities

If new, innovative mitigation strategies arise that could impact the planning area or elements of this plan, which are determined to be of importance, a plan amendment may be proposed and considered separate from the annual review and other proposed plan amendments. Warren County as the plan sponsor, provides an opportunity for jurisdictions to compile proposed amendments annually and send them to HSEMD, and subsequently to FEMA, for a plan amendment. Such amendments should include all applicable information for each proposal including description of changes, identified funding, responsible agencies, etc.

Incorporation into Existing Planning Mechanisms

The Regional Planning Team utilized a variety of plan integration tools to help communities determine how their existing planning mechanisms were related to the Hazard Mitigation Plan. Utilizing FEMA's *Integrating the Local Natural Hazard Mitigation Plan into a Community's Comprehensive Plan*[111] guidance, as well as FEMA's *2015 Plan Integration*[112] guide, each jurisdiction engaged in a plan integration discussion. This discussion was facilitated by a Plan

111 Federal Emergency Management Agency. November 2013. "FEMA Region X Integrating the Local Natural Hazard Mitigation Plan into a Community's Comprehensive Plan." https://www.fema.gov/media-library-data/1388432170894-6f744a8afa8929171dc62d96da067b9a/FEMA-X-IntegratingLocalMitigation.pdf.

112 Federal Emergency Management Agency. July 2015. "Plan Integration: Linking Local Planning Efforts." https://www.fema.gov/media-library-data/1440522008134-ddb097cc285bf741986b48fdcef31c6e/R3_Plan_Integration_0812_508.pdf.

Integration Worksheet, created by the Hazard Mitigation Planning Team. This document offered an easy way for participants to notify the Hazard Mitigation Planning Team of existing planning mechanisms, and if they interface with the HMP.

Each jurisdiction referenced all relevant existing planning mechanisms and provided information on how these did or did not address hazards and vulnerability. Summaries of plan integration are found in each participant's *Community Profile*. For jurisdictions that lack existing planning mechanisms, especially smaller communities, the HMP may be used as a guide for future activity and development in the jurisdiction.

SECTION SEVEN: COMMUNITY PROFILES

Purpose of Community Profiles

Community Profiles contain information specific to jurisdictions participating in the Warren County planning effort. Community Profiles were developed with the intention of highlighting each jurisdiction's unique characteristics that affect its risk to hazards. Community Profiles may serve as a short reference of identified vulnerabilities and mitigation actions for a jurisdiction as they implement the mitigation plan. Information from individual jurisdictions was collected at public and one-on-one meetings and used to establish the plan. Community Profiles may include the following elements:

- Local Planning Team
- Location and Geography
- Demographics
- Employment and Economics
- Housing
- Governance
- Capability Assessment
- Plan Integration
- Future Development Trends
- Community Lifelines
- Historical Occurrences
- Hazard Prioritization
- Mitigation Strategy
- Plan Maintenance

In addition, maps specific to each jurisdiction are included, such as jurisdiction identified critical facilities, flood-prone areas, and a future land use map (when available).

The hazard prioritization information, as provided by individual participants, varies due in large part to the extent of the geographical area, the jurisdiction's designated representatives (who were responsible for completing meeting worksheets), identification of hazards, and occurrence and risk of each hazard type.

The overall risk assessment for the identified hazard types represents the presence and vulnerability to each hazard type throughout the entire planning area. A discussion of certain hazards selected for each Community Profile was prioritized by the local planning team based on the identification of hazards of greatest concern, hazard history, and the jurisdiction's capabilities. The hazards not examined in depth can be found in *Section Four: Risk Assessment*.