Worth County, Iowa

Multi-Jurisdictional Hazard Mitigation Plan

2024-2029

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1 Introduction

1.1 Executive Summary

The following jurisdictions have prepared and adopted this 2024 update of the Worth County Hazard Mitigation Plan (HMP):

- Worth County
- City of Fertile
- City of Grafton
- City of Hanlontown
- City of Joice
- City of Kensett
- City of Manly
- City of Northwood
- Central Springs Public School District
- Northwood-Kensett Public School District

The purpose of hazard mitigation is to reduce or eliminate long-term risk to people and property from disasters or hazardous events. Studies have found that hazard mitigation is extremely cost-effective, with every dollar spent on mitigation saving an average of $6 in avoided future losses. The Federal Emergency Management Agency (FEMA) requires that Hazard Mitigation Plans (HMPs) be updated every five years for the jurisdictions to be eligible for federal mitigation assistance. All sections of the 2018 Worth County HMP were reviewed and updated to address natural and human-caused hazards for the purpose of saving lives and reducing losses from future disasters or hazard events.

The goals of the 2024 Worth County HMP are:

1. **Goal 1:** Minimize vulnerability of the people and their property in Worth County to the impact of hazards
2. **Goal 2:** Protect the critical facilities, infrastructure, and other community assets from the impacts of hazards
3. **Goal 3:** Improve education and awareness regarding hazards in risk in Worth County
4. **Goal 4:** Strengthen communication among agencies and between agencies and the public

The Hazard Mitigation Plan update for Worth County and its collaborating jurisdictions has been developed to provide a strategic framework for mitigating hazards, aimed at enhancing the safeguarding of people and property within the planning area. By mitigating vulnerability to identified hazard risks, these communities aspire to preserve lives, protect property, and alleviate the societal, economic, and environmental repercussions often associated with hazard events. This plan demonstrates the jurisdictions' commitment to reducing risks from hazards and serves as a tool to help decision makers direct mitigation activities and resources.

This plan was also developed to retain Worth County's and the participating jurisdictions' eligibility for federal grant programs, specifically the FEMA hazard mitigation grants including the Hazard Mitigation Grant Program (HMGP), Building Resilient Infrastructure and Communities (BRIC) grant program, and Flood Mitigation Assistance (FMA) program.

Chapter 1 contains this Executive Summary, along with the Plan's background and scope.

Chapter 2 describes the Planning Process followed to update the Plan. A broad range of public and private stakeholders, including agencies, local businesses, nonprofits, and other interested parties were invited to participate. Public input was sought throughout the planning process including online surveys and public review of the draft Plan.

Chapter 3 Community Profile describes the planning area, consisting of Worth County and the participating jurisdictions listed above, with updated information on demographics, social vulnerability, and changes in development. Chapter 3 also include a Capability Assessment that describes programs and policies currently in place across the County to reduce hazard impacts, or that could be used to implement hazard mitigation activities and identifies opportunities to enhance those capabilities.

Chapter 4 Risk Assessment identifies the natural and human-caused hazards of greatest concern to the County and describes the risk from those hazards. The information generated through the risk assessment helps communities to prioritize and focus their efforts on those hazards of greatest concern and those assets or areas facing the greatest risk(s). The best available information on the impacts of changing weather conditions was taken into account for each hazard. The hazards profiled in the 2018 Plan and their assessed significance are listed in **Table 1-1**.

Table 1-1 Hazard Risk Summary

Hazard	Geographic Extent	Magnitude/ Severity	Extent	Overall Significance
Animal/Plant/Crop	Occasional	Critical	Significant	Low
Cyber Attack	Likely	Moderate	Significant	Medium
Dam/Levee Failure	Unlikely	Negligible	Limited	Low
Drought & Extreme Heat	Likely	Moderate	Extensive	Medium
Earthquake	Unlikely	Negligible	Limited	Low
Flooding (Flash & Riverine)	Likely	Catastrophic	Significant	High
Grass/Wildland Fire	Likely	Moderate	Significant	Medium
Hazardous Materials Incident	Likely	Moderate	Significant	Medium
Human Disease	Likely	Moderate	Significant	Medium
Infrastructure Failure	Likely	Critical	Significant	Medium
Severe Summer Weather	Highly Likely	Critical	Extensive	High
Severe Winter Storm	Highly Likely	Critical	Extensive	High
Sinkhole	Unlikely	Negligible	Significant	Low
Tornado/Windstorm	Likely	Critical	Extensive	High
Transportation Incident	High Likely	Negligible	Limited	Low

Chapter 5 Mitigation Strategy describes what the County and jurisdictions will do to reduce their vulnerability to the hazards identified in Chapter 4. It presents the goals and objectives of the mitigation program and details a broad range of targeted mitigation actions to reduce losses from hazard events. It also describes mitigation activities that have been conducted in the last five years.

Chapter 6 Plan Implementation and Maintenance details how the Plan will be implemented, monitored, evaluated, and updated, and how mitigation will be integrated into other planning mechanisms.

Ensuring active participation from local decision-makers is crucial for contributing innovative ideas and valuable perspectives to future updates of the Worth County Hazard Mitigation Plan (HMP). A long-term objective is the seamless integration of the HMP and its identified mitigation strategies into the day-to-day decision-making processes of the local government. Achieving this goal demands ongoing commitment, diligence, and concentrated efforts. Therefore, the current plan updates represent a continued endeavor to enhance the resilience of Worth County.

1.2 Purpose

Worth County, its participating cities, and public-school districts prepared this Multijurisdictional Hazard Mitigation Plan update to guide hazard mitigation planning to better protect the people and property of the planning area from the effects of hazard events.

This plan demonstrates the jurisdictions' commitments to reducing risks from hazards and serves as a tool to help decision makers direct mitigation activities and resources. This plan was also developed to make Worth County and the participating jurisdictions eligible for certain federal grant programs, specifically the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Assistance (HMA) grants including the Hazard Mitigation Grant Program, Pre-Disaster Mitigation Program, and Flood Mitigation Assistance Program.

1.3 Background and Scope

Each year in the United States, disasters take the lives of hundreds of people and injure thousands more. Nationwide, taxpayers pay billions of dollars annually to help communities, organizations, businesses, and individuals recover from disasters. These monies only partially reflect the actual cost of disasters because additional expenses to insurance companies and nongovernmental organizations are not reimbursed by tax dollars. Many disasters are predictable, and much of the damage caused by these events can be alleviated or even eliminated.

Hazard mitigation is defined by FEMA as "any sustained action taken to reduce or eliminate long-term risk to human life and property from a hazard event." The results of a three-year, congressionally mandated independent study to assess future savings from mitigation activities provides evidence that mitigation activities are highly cost-effective. On average, each dollar spent on mitigation saves society $6 in avoided future losses, in addition to saving lives and preventing injuries (National Institute of Building Science Multi-Hazard Mitigation Council 2017).

Hazard mitigation planning is the process through which hazards that threaten communities are identified, likely impacts of those hazards are determined, mitigation goals are set, and appropriate strategies to lessen impacts are determined, prioritized, and implemented. Worth County and the incorporated cities that participated in this plan update developed a Multijurisdictional Hazard Mitigation Plan in 2018, and subsequently began the process to update the plan in 2022. This current planning effort serves to update the previous plan.

This plan documents the hazard mitigation planning process undertaken by the Worth County Hazard Mitigation Planning Committee (HMPC). It identifies relevant hazards and vulnerabilities in the planning area and sets forth an updated mitigation strategy to decrease vulnerability and increase resiliency and sustainability in Worth County.

The Worth County Multijurisdictional Hazard Mitigation Plan is a multijurisdictional plan that geographically covers the participating jurisdictions within Worth County's boundaries (hereinafter referred to as the planning area). This plan was prepared pursuant to the requirements of the Disaster Mitigation Act of 2000 (Public Law 106-390) and the implementing regulations set forth by the Interim Final Rule published in the *Federal Register* on February 26, 2002 (44 CFR §201.6) and finalized on October 31, 2007. (Hereafter, these requirements and regulations will be referred to collectively as the Disaster Mitigation Act.) Additionally, this plan is prepared in accordance with FEMA's 2022 Local Mitigation Planning Policy Guide and 2023 Local Mitigation Planning Handbook.

While the Disaster Mitigation Act emphasized the need for mitigation plans and more coordinated mitigation planning and implementation efforts, the regulations established the requirements that local hazard mitigation plans must meet in order for a local jurisdiction to be eligible for certain federal disaster assistance and hazard mitigation funding under the Robert T. Stafford Disaster Relief and Emergency Act (Public Law 93-288).

Information in this plan will be used to help guide and coordinate mitigation activities and decisions for local land use policy in the future. Proactive mitigation planning will help reduce the cost of disaster response and recovery to communities and their residents by protecting critical community facilities, reducing liability exposure, and minimizing overall community impacts and disruptions. The Worth County planning area has been affected by hazards in the past and the participating jurisdictions are therefore committed to reducing future impacts from hazard events and becoming eligible for mitigation-related federal funding.

1.4 Plan Organization

This Worth County Multijurisdictional Hazard Mitigation Plan update is organized as follows:

- Chapter 1: Introduction
- Chapter 2: Planning Process
- Chapter 3: Community Profile
- Chapter 4: Risk Assessment
- Chapter 5: Mitigation Strategy
- Chapter 6: Plan Implementation
- Appendices

2 Planning Process

44 CFR 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.

The following jurisdictions participated in the development of this plan:

- Worth County
- City of Fertile
- City of Grafton
- City of Hanlontown
- City of Joice
- City of Kensett
- City of Manly
- City of Northwood
- Central Springs Public School District
- Northwood-Kensett Public School District

This plan was collaboratively prepared between 2023 and March 2024 by Worth County and the participating jurisdictions and stakeholders. Professional planning assistance was provided by WSP USA Environment and Infrastructure (WSP) through a contract with Iowa Homeland Security and Emergency Management Division. WSP's role was to:

- Assist in establishing the Hazard Mitigation Planning Committee (HMPC) as defined by the Disaster Mitigation Act (DMA),
- Ensure the updated plan meets the DMA requirements as established by federal regulations and following FEMA's planning guidance,
- Facilitate the entire planning process,
- Identify the data requirements that HMPC participants could provide and conduct the research and documentation necessary to augment that data,
- Assist in facilitating the public input process,
- Produce the draft and final plan update documents, and
- Coordinate the Iowa Homeland Security and Emergency Management Department and FEMA plan reviews.

2.1 Multijurisdictional Participation

44 CFR Requirement §201.6(a)(3)
Multijurisdictional plans may be accepted, as appropriate, as long as each jurisdiction has participated in the process and has officially adopted the plan.

Worth County invited the incorporated cities, public school districts, and various other stakeholders in mitigation planning (identified in Appendix B) to participate in the Worth County Multijurisdictional Hazard Mitigation Plan update process. The jurisdictions that elected to participate in this plan are listed above. The DMA requires that each jurisdiction that participates in the planning process must officially adopt the multijurisdictional hazard mitigation plan. Each jurisdiction that chose to participate in the planning process and development of the plan was required to meet plan participation requirements defined at the first planning meeting, which includes the following:

- Designate a representative to serve on the HMPC;
- Participate in at least one of the three HMPC planning meetings by either direct representation or authorized representation;

- Provide data for and assist in the development of the updated risk assessment that describes how various hazards impact their jurisdiction;
- Provide data to describe current capabilities;
- Develop/update mitigation actions (at least one) specific to each jurisdiction;
- Provide comments on plan drafts as requested;
- Inform the public, local officials, and other interested parties about the planning process and provide opportunities for them to comment on the plan; and
- Formally adopt the mitigation plan.

All of the jurisdictions listed as official participants in this plan met all of these participation requirements. **Table 2-1** shows the representation of each participating jurisdiction at the planning meetings, provision of Data Collection Guides, and update/development of mitigation actions.

Table 2-1 Jurisdictional Participation in Planning Process

Jurisdiction	Kickoff Meeting	Meeting 2	Meeting 3	Data Collection Guide	Action Statuses	New Mitigation Action
Worth County	X	X	X	X	X	X
Fertile		X	X		X	X
Grafton	X			X	X	X
Hanlontown			X		X	X
Joice	X				X	X
Kensett	X	X	X		X	X
Manly			X		X	X
Northwood			X	X	X	X
Central Springs PSD	X			X	X	X
Northwood-Kensett PSD	X		X		X	X

2.2 The Planning Steps

WSP and Worth County worked together to establish the framework and process for this planning effort. The plan update followed four general phases:

1. Organize resources,
2. Assess risks,
3. Develop the mitigation plan, and
4. Implement the plan and monitor progress.

Into this process, WSP integrated a detailed 10-step planning process adapted from FEMA's Community Rating System (CRS) and Flood Mitigation Assistance programs. Thus, the process used for this plan meets the requirements of the Disaster Mitigation Act (DMA) of 2000 as well as the basic requirements for activity 510 under the CRS. **Table 2-2** shows how the process followed fits into FEMA's original four-phase DMA process as well as the revised Nine Task Process outlined in the 2023 *Local Mitigation Planning Handbook* and the 10-step CRS process.

Table 2-2 Mitigation Planning Process Used to Update the Worth County Hazard Mitigation Plan

Phase	Community Rating System (CRS) Planning Steps (Activity 510)	Local Mitigation Planning Handbook Tasks (44 CFR Part 201)
Phase I: Organize Resources	Step 1. Organize	Task 1: Determine the Planning Area and Resources
		Task 2: Build the Planning Team 44 CFR 201.6(c)(1)
	Step 2. Involve the public	Task 3: Create an Outreach Strategy 44 CFR 201.6(b)(1)
	Step 3. Coordinate	Task 4: Review Community Capabilities 44 CFR 201.6(b)(2) & (3)
Phase II: Assess Risks	Step 4. Assess the hazard	Task 5: Conduct a Risk Assessment 44 CFR 201.6(c)(2)(i) 44 CFR 201.6(c)(2)(ii) & (iii)
	Step 5. Assess the problem	
Phase III: Develop the Mitigation Plan	Step 6. Set goals	Task 6: Develop a Mitigation Strategy 44 CFR 201.6(c)(3)(i); 44 CFR 201.6(c)(3)(ii); and 44 CFR 201.6(c)(3)(iii)
	Step 7. Review possible activities	
	Step 8. Draft an action plan	
Phase IV: Implement and Monitor Progress	Step 9. Adopt the plan	Task 8: Review and Adopt the Plan
	Step 10. Implement, evaluate, revise	Task 7: Keep the Plan Current
		Task 9: Create a Safe and Resilient Community 44 CFR 201.6(c)(4)

2.2.1 Phase I Organize Resources

Step 1: Organize the Planning Team (Handbook Tasks 1 & 2)

The planning process resulting in the preparation of this plan document officially began with an initial coordination Conference Call/Webinar on May 30th, 2023. Participants of the meeting included the Worth County Emergency Management Coordinator, Iowa Homeland Security and Emergency Management Department Hazard Mitigation Planner and GIS Coordinators, and the WSP Mitigation Planners and GIS Technician. The purpose of this meeting was to determine the jurisdictions and other stakeholders that would be invited to participate on the HMPC (Step 1), set tentative planning meeting dates, identify GIS needs and resources, discuss the hazards to be included in the plan update and options for the flood risk assessment methodology, and develop an initial public participation strategy.

A formal project kick-off meeting was held virtually on June 29th, 2023. Additional planning meetings were held on September 14th (virtual), and November 2nd, 2023 (in person). A complete list of all representatives of the agencies and organizations that participated on the Worth County HMPC is provided in Appendix A.

The HMPC communicated during the planning process with a combination of webinars, face-to-face meetings, phone interviews, and email correspondence. The meeting schedule and topics are listed in **Table 2-3**.

Table 2-3 Schedule of HMPC Meetings

Meeting	Topic	Date
Informational Meeting	General overview of planning process/requirements and schedule.	May 30, 2023

Meeting	Topic	Date
Kick off Meeting	Introduction to DMA, the planning process, hazard identification and input strategy. Distribution of data collection guide to jurisdictions.	June 29, 2023
Planning Meeting #2	Review of draft Risk Assessment, update plan goals, instructions to update status of previous mitigation actions	September 14, 2023
Planning Meeting #3	Development of new mitigation actions, mitigation action planning and prioritization. Determine process to monitor, evaluate, and update plan.	November 2, 2023

During the first planning meeting, WSP presented information on the scope and purpose of the plan, participation requirements of HMPC members, and the proposed project work plan and schedule. Plans for public involvement (Step 2) and coordination with other agencies and departments (Step 3) were discussed. WSP also introduced hazard identification requirements and data needs. The HMPC discussed potential hazards as well as past events and impacts and refined the identified hazards to be relevant to Worth County. The hazard ranking methodology utilized by Iowa Homeland Security and Emergency Management Department in the State Hazard Mitigation Plan was introduced and preliminary information was presented for each hazard identified.

Participants were given the WSP Data Collection Guide to facilitate the collection of information needed to support the plan, such as data on historic hazard events, values at risk, and current capabilities. Several participating jurisdictions completed and returned the worksheets in the Data Collection Guide to WSP. WSP integrated this information into the plan, supporting the development of Chapter 2 and Chapter 3.

Step 2: Plan for Public Involvement (Handbook Task 3)

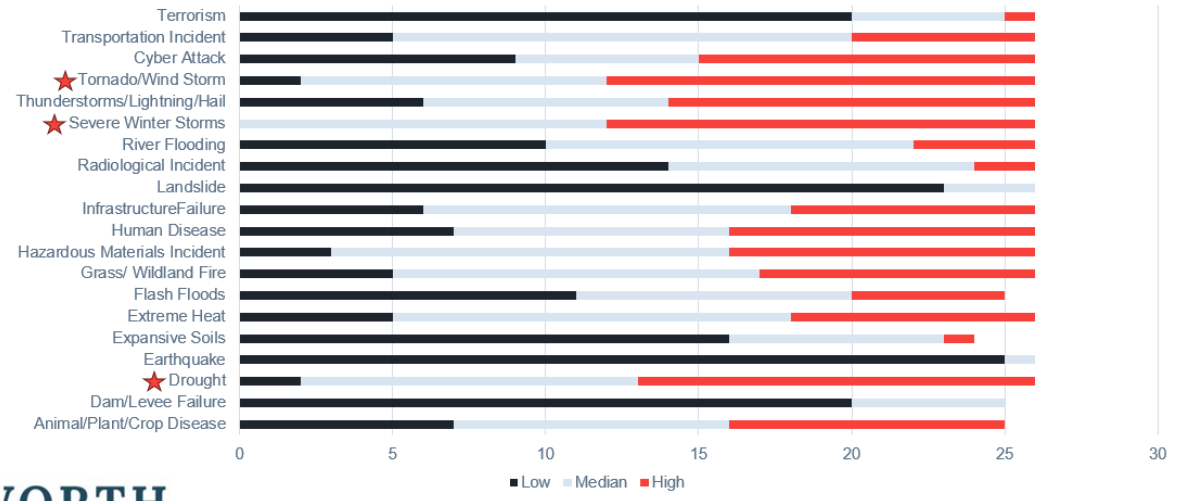
44 CFR Requirement 201.6(b)
An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: (1) an opportunity for the public to comment on the plan during the drafting stage and prior to plan approval.

At the kick-off meeting, the HMPC discussed options for soliciting public input on the mitigation plan. To provide an opportunity for the public to comment during the drafting stage, the committee determined that the most effective method would be dissemination of a survey. The survey was announced on the County's website and Facebook page. A screenshot of these announcements is included in Appendix B.

The public survey was developed specific to the Worth County Mitigation Plan and provided a brief plan summary as well as a questionnaire to capture public and stakeholder input. The survey was made available online and in hard copy in locations throughout the County from September 12 to October 5, 2023. In addition to notification through media outlets described above, committee members distributed the survey link to members of the public and key stakeholders in their own jurisdiction. In all, 27 surveys were completed. A copy of the survey is provided in Appendix B.

One question asked respondents to rank their perception of which hazards were most significant to the planning area. The summary results of this question are provided in **Figure 2-1**. This shows that the public perception is tornado/windstorms, severe winter storms, and drought are the most significant hazards in Worth County.

Figure 2-1 Survey Results—Hazard Level of Significance



In the survey, the public was also asked to review 16 types of mitigation actions. The Worth County HMPC also considered these types of projects in the Worth County Multi-Jurisdictional Hazard Mitigation Plan. The survey asked the public to identify mitigation project types that they felt could benefit their community. **Figure 2-2** provides the compiled results of this question. The public opinion is that generators for critical facilities, stormwater drainage improvements, and expanded indoor/outdoor warning would benefit their jurisdiction the most**.**

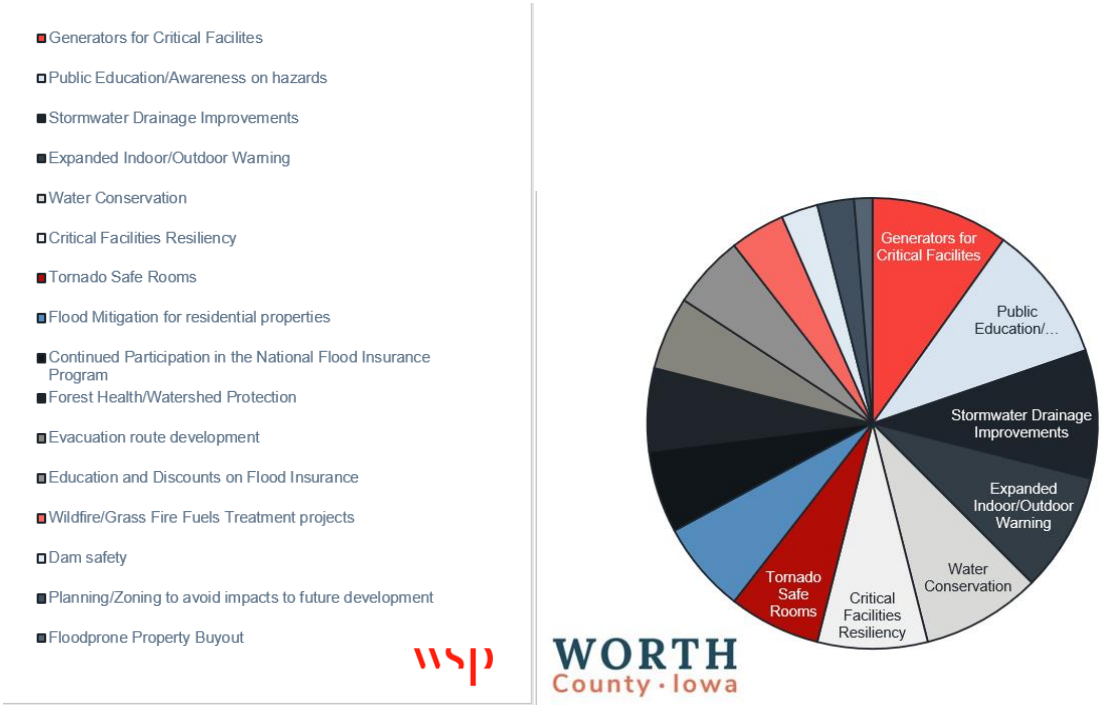
The HMPC reviewed the survey responses and took them into account when ranking hazards and prioritizing mitigation actions.

Worth County announced the availability of the final draft plan and public comment period on the County website and via social media, as well as the Northwood Anchor newspaper and the Manly Signal newspaper. Copies of the announcements are provided in Appendix B. The public comment period ran from April 15th through April 30th, 2024. Four Public Comments were received, which were reviewed with the HMPC and resulted in revisions to the hazardous materials section (Section 4.3.9).

The HMPC also invited other targeted stakeholders to comment on the draft plan via an email letter, which is described in greater detail in Step 3: Coordinate with Other Departments and Agencies. Minor comments were received and incorporated.

Due to the rural nature of Worth County, there are a limited number of organizations working with or represent underserved communities and vulnerable populations planning area. Appendix A lists the organizations that were included in the planning process. Those communities/populations were included in the public outreach done by/through those organizations, and their feedback was included along with other stakeholders and members of the general public. An area of improvement for the next plan update is to conduct more targeted outreach to those communities and collate their input in a more systematic manner.

Figure 2-2 Survey Results—Types of Mitigation Projects



Step 3: Coordinate with Other Departments and Agencies and Incorporate Existing Information (Handbook Task 3)

44 CFR Requirement 201.6(b)
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: (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 nonprofit interests to be involved in the planning process. (3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

There are numerous organizations whose goals and interests' interface with hazard mitigation in Worth County. Coordination with these organizations and other community planning efforts is vital to the success of this plan. Many stakeholder agencies were contacted throughout the planning process to obtain data in preparation of the Risk Assessment. This included contact with specific representatives of stakeholder agencies, as well as accessing stakeholder data that has been made available to the public via the internet. These sources have been identified where data is presented.

Worth County invited neighboring counties, other local, state, and federal departments and agencies to review and comment on the final draft of the Worth County Multijurisdictional Hazard Mitigation Plan prior to final submittal to FEMA. Other stakeholders invited to comment included business groups, institutions of higher learning, and groups that work with underserved communities and vulnerable populations.

The complete list of invited stakeholders can be found in Appendix A, along with the emails inviting them to participate.

Integration of Other Data, Reports, Studies, and Plans

In addition, input was solicited from many other agencies and organizations that provided information. As part of the coordination with other agencies, the HMPC collected and reviewed existing technical data, reports, and plans. These included:

- State of Iowa Hazard Mitigation Plan (September 2023);
- Worth County Hazard Mitigation Plan (December 2018);
- National Flood Insurance Program Policy and Loss Statistics;
- Flood Insurance Administration, Repetitive/Severe Repetitive Loss Property Data;
- Flood Insurance Rate Maps for all of Worth County;
- Iowa Department of Natural Resources, Dam Safety Program Inventory of Dams for Worth County;
- National Inventory of Dams;
- National Levee Database;
- Wildland/Urban Interface and Intermix areas from the SILVIS Lab, Department of Forest Ecology and Management, University of Wisconsin;
- Various local plans such as Comprehensive Plans, Economic Development Plans, Capital Improvement Plans, etc. For a complete list of local plans that were reviewed and incorporated, see Chapter 2;
- US Department of Agriculture's (USDA) Risk Management Agency Crop Insurance Statistics.

This information was used in the development of the hazard identification, vulnerability assessment, and capability assessment and in the formation of goals, objectives, and mitigation actions. These sources, as well as additional sources of information, are documented throughout the plan and in Appendix C, References.

2.2.2 Phase 2 Assess Risk (Handbook Task 5)

Step 4: Assess the Hazard: Identify and Profile Hazards

WSP assisted the HMPC in a process to identify/update the hazards that have impacted or could impact communities in Worth County. At the kick-off meeting, the HMPC examined the history of disaster declarations in Worth County, the list of hazards considered in the 2023 Iowa State Hazard Mitigation Plan, and the hazards identified in the previous Worth County Hazard Mitigation Plan. The committee then worked through this list of all potential hazards that could affect the planning area. They discussed past hazard events, types of damage, and where additional information might be found. Additional information on the hazard identification process and which hazards were identified for each jurisdiction is provided in Chapter 3.

The HMPC discussed past events and impacts, analyzed risk assessment data, and came to consensus on the preliminary probability, magnitude, and severity levels on a county-wide basis. Each jurisdiction completed an Update Guide, including information on previous hazard events in their community. Utilizing the information from the Plan Update Guides as well as existing plans, studies, reports, and technical information as well as information available through internet research and GIS analysis, the profile for each hazard identified was updated. Additional information on the hazard identification process and the methodology and resources used to identify and profile the hazards can be found in Chapter 4.

Step 5: Assess the Problem: Identify Assets and Estimate Losses

Assets for each jurisdiction were identified through a combination of several resources. The Worth County Assessor's office provided access to datasets with parcel and building data as well as corporate boundaries, school district boundaries, and other available GIS layers. Methodologies and results of the critical facility analysis as well as sources for data utilized are provided in Chapter 3.

Additional assets such as historic, cultural, and economic assets as well as specific vulnerable populations and structures were obtained from a variety of sources as described in Chapter 3.

The HMPC also analyzed development trends from data available from the US Census Bureau as well as information obtained from each jurisdiction such as Comprehensive Plans. For each hazard, there is a discussion regarding future development and how it may impact vulnerability to that specific hazard.

Existing mitigation capabilities were also considered in developing loss estimates. This assessment consisted of identifying the existing mitigation capabilities of participating jurisdictions. This involved collecting information about existing government programs, policies, regulations, ordinances, and plans that mitigate or could be used to mitigate risk from hazards. Participating jurisdictions collected information on their regulatory, personnel, fiscal, and technical capabilities, as well as previous and ongoing mitigation initiatives. This information is included in Chapter 3 Worth County Community Profile

Specific capabilities such as participation in the National Flood Insurance Program as well as designation as Fire Wise Communities or Storm Ready Communities and placement of storm sirens are incorporated in the vulnerability analysis discussions, where applicable.

Taking into consideration the vulnerability and capability assessments, a variety of methods was used to estimate losses for each profiled hazard. For geographic hazards such as river flooding, specific assets at risk and loss estimates were determined through GIS analysis. For other hazards such as weather-related hazards and hazardous materials, loss estimates were developed based on statistical analysis of historic events. For hazards such as dam failure of state-regulated dams, GIS data was not available to identify specific geographic boundaries at risk. Therefore, the risk assessment provides descriptions of the types of improvements located in approximated risk areas downstream of high and significant hazard dams. For some human-caused hazards and the tornado hazard, loss estimates were scenario-based. The methodologies for each loss estimate are described in detail in Chapter 4. Within each hazard section, the text provides details on how the hazard varies by jurisdiction, where applicable.

Results of the preliminary risk assessment were presented at Meeting #2 to inform the planning process as the basis for updating the mitigation strategy.

2.2.3 Phase 3 Develop the Mitigation Plan (Handbook Task 6)

Step 6: Set Goals

During Meeting #2, the HMPC reviewed the goals of the 2023 State HMP. Common categories of mitigation goals were presented for comparison, along with the goals from the 2023 Iowa State HMP. The HMPC then discussed and updated the goals for the 2023 HMP, as described in Section 5.1.

The recommended mitigation action details to meet the identified goals are in Chapter 4. The HMPC developed an implementation plan for each action, which identifies priority level, background information, responsible agency, timeline, cost estimate, potential funding sources, and more.

Step 7: Review Possible Activities

Meeting #3 focused on updating the mitigation strategy. The HMPC reviewed mitigation actions from the 2018 Worth County HMP, identified progress that had been made on those actions, and identified any actions that should be deleted from future consideration. The HMPC then identified new actions and prioritized both new and continuing actions. Details on this process can be found in Chapter 5.

Step 8: Draft an Action Plan

A complete draft of the plan was made available to the HMPC for review. Following that review a second draft was posted online and in hard copy for review and comment by the public, other agencies and interested stakeholders. Methods for inviting interested parties and the public to review and comment on the plan were discussed in Steps 2 and 3, and materials are provided in Appendix B. A final plan was then created for submittal to the Iowa HSEMD and FEMA for review and approval per the DMA requirements.

2.2.4 Phase 4 Implement the Plan and Monitor Progress

Step 9: Adopt the Plan (Handbook Task 8)

To secure buy-in and officially implement the plan, the governing bodies of each participating jurisdiction adopted the plan following FEMA's "approval pending adoption" of the plan. Scanned copies of resolutions of adoption are included in Appendix D of this plan.

Step 10: Implement, Evaluate, and Revise the Plan (Handbook Tasks 7 & 9)

The HMPC developed and agreed upon an overall strategy for plan implementation and for monitoring and maintaining the plan over time during Meeting #3. This strategy is described in Chapter 5, Plan Maintenance Process.

3 Commuinity Profile and Capabilities

This chapter provides a general profile of Worth County and participating jurisdictions, including details on existing capabilities, plans, and programs that enhance their ability to implement mitigation strategies.

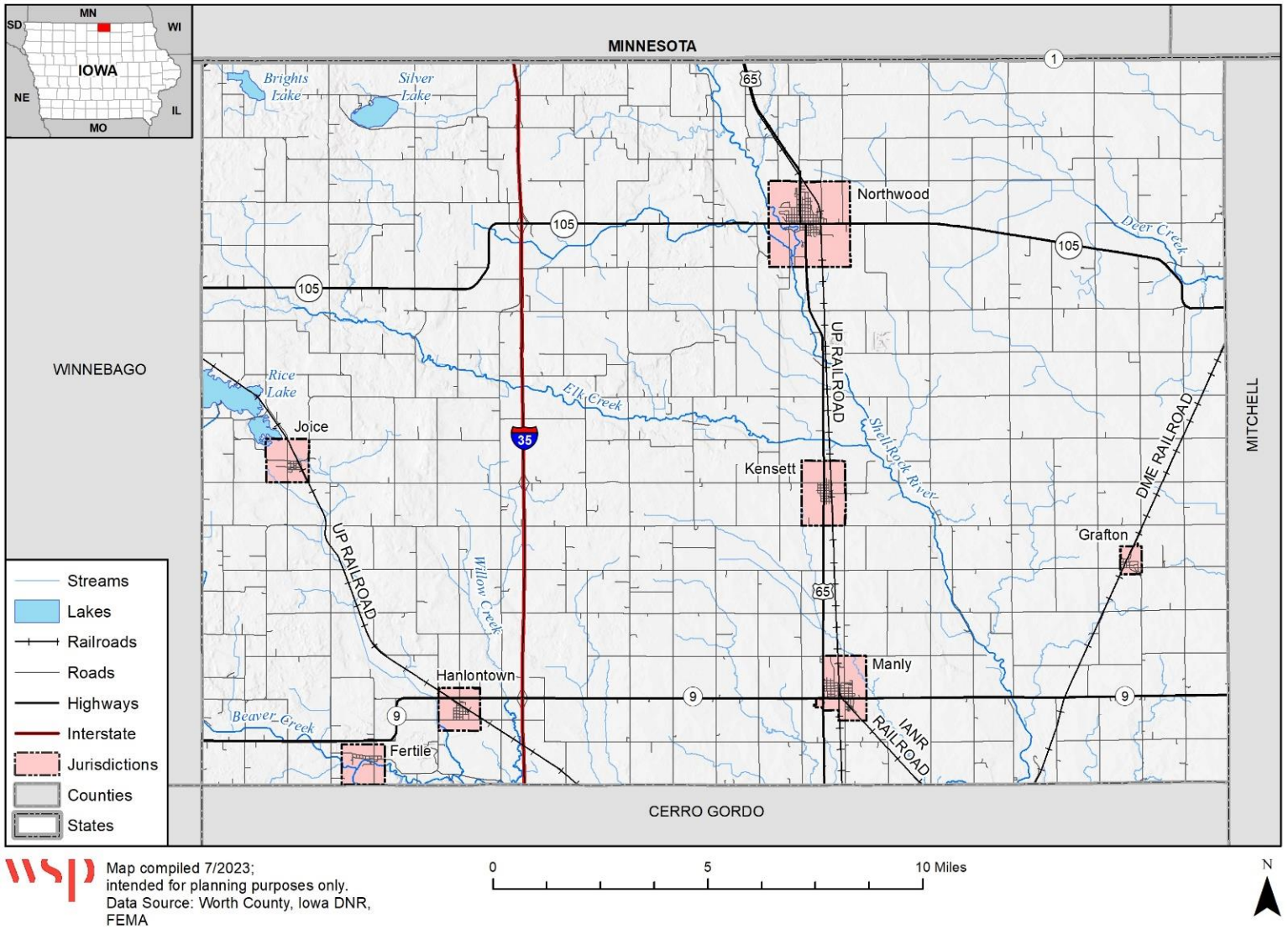
3.1 Worth County Planning Area Profile

Figure 3-1 provides a map of the Worth County planning area. The planning area boundaries include the unincorporated areas of Worth County as well as the following incorporated cities:

- Worth County
- City of Fertile
- City of Grafton
- City of Hanlontown
- City of Joice
- City of Kensett
- City of Manly
- City of Northwood

Central Springs Public School District and Northwood-Kensett Public School District participated in development of this plan and are included in the planning area. They are discussed in additional detail in **Section 3.3**.

Figure 3-1 Worth County Planning Area



3.1.1 Geography and Topography

Worth County is located in north central Iowa along the border with Minnesota. The County has a total area of 402 square miles. There are several highways that run through the County including Interstate 35/Iowa Highway 27, which travels north and south through the western central portion of the county; Iowa Highway 65, which travels north and south through the eastern central portion of the county and through the cities of Northwood, Kensett, and Manly; and Iowa Highway 9, which travels east and west through the southern portion of the county and passes through the cities of Fertile, Hanlontown, and Manly. The rest of the roads in the county are county highways and local roads.

Adjacent counties:

- Freeborn County, Minnesota (north)
- Mower County, Minnesota (northeast)
- Mitchell County (east)
- Cerro Gordo County (south)
- Winnebago County (west)

The soils within Woth County exhibit favorable characteristics for agricultural purposes, encompassing crop cultivation and pasture activities. The primary crops cultivated in the region include corn, soybeans, oats, hay, and pasture grass. The prevalent soils in the county range from poorly drained to moderately well-drained. The landscape of much of the county features rolling prairies, as detailed in the Soil Survey provided by the Natural Resources Conservation Service.

3.1.2 Major Rivers and Watersheds

The primary waterway features in Worth County are Shell Rock River, Deer Creek, Winnebago River, and Bear Creek. As depicted in **Figure 3-2**, Worth County crosses three watersheds as follows:

- 07080201 Upper Cedar Watershed
- 07080202 Shell Rock Watershed
- 07080203 Winnebago Watershed

Figure 3-2 Worth County, Iowa Watersheds (Worth County is red square)

Source: Environmental Protection Agency, https://www.epa.gov/waterdata/hows-my-waterway

3.1.3 History

Worth County was established in 1857 under a court order of the Mitchell County judge, which divided the county into two townships: Northwood and Bristol. The first elections were held that year. The town of Bristol was the first County seat, however the citizens of Northwood repeatedly fought to have it moved, and eventually succeeded in 1863. Aside from these two small towns, most of the county was rural, and the majority of settlers were farmers.

In 1864, the first county courthouse was built. In 1879, a new courthouse was planned and completed the following year. By 1893, a special election decided that another courthouse would be built. This third structure remains the county courthouse to this day.

The Worth County Courthouse is listed on the National Register of Historic Places along with four other properties and a historic district. These historic structures are detailed in **Table 3-1** below.

Table 3-1 Worth County Listings in National Register of Historic Places

Listing	Date Listed	Location
Chicago, Milwaukee, and St. Paul Railroad-Grafton Station	June 23, 1976	Grafton
First Methodist Episcopal Church	August 16, 2000	Kensett
Northwood Central Avenue Historic District	September 19, 2006	Northwood
Old Worth County Courthouse	July 2, 1981	Northwood
Rhodes Mill	November 24, 1978	Fertile
Worth County Courthouse	July 2, 1981	Northwood

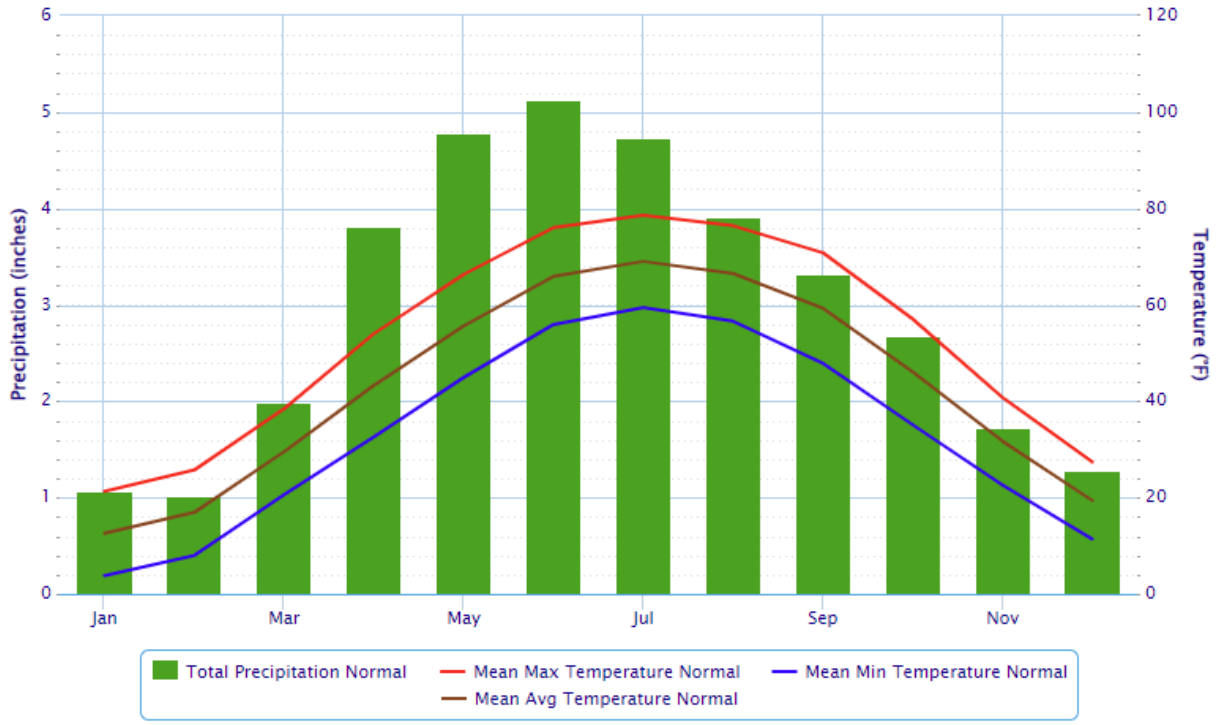
Source: National Register of Historic Places

3.1.4 Climate

The climate in Worth County is described as hot-summer humid continental with cold winters and hot and humid summers. The average winter temperature (December through January) is 16.3 degrees Fahrenheit. The average summer temperature (June through August) is 67.1 degrees Fahrenheit, with an average annual precipitation of 35 inches.

The coldest winter month is January with an average low of 3.8 degrees Fahrenheit and the hottest summer month is July with an average high of 78.6 degrees Fahrenheit. Seasons fluctuate from being very wet to very dry, with a peak precipitation normal of 5.13 inches in June to a minimum precipitation normal of 1.02 inches in February. **Figure 3-3** and **Table 3-2** provide monthly climate normals for Northwood, Iowa from 1981 to 2010.

Figure 3-3 Monthly Climate Normals (1981-2010), Northwood, IA



Source: High Plains Regional Climate Center, http://climod.unl.edu/

Table 3-2 Monthly Climate Normals (1981-2020), Northwood, IA

Month	Total Precipitation Normal (inches)	Mean Max Temperature Normal (°F)	Mean Min Temperature Normal (°F)	Mean Avg Temperature Normal (°F)
January	1.07	21.3	3.8	12.6
February	1.02	25.7	8	16.9
March	1.99	38.4	20.6	29.5
April	3.82	54	32.6	43.3
May	4.78	66.3	44.9	55.6
June	5.13	76	55.9	65.9
July	4.73	78.6	59.4	69
August	3.92	76.4	56.6	66.5

Month	Total Precipitation Normal (inches)	Mean Max Temperature Normal (°F)	Mean Min Temperature Normal (°F)	Mean Avg Temperature Normal (°F)
September	3.32	70.8	47.9	59.3
October	2.68	57.1	35.1	46.1
November	1.73	40.8	22.6	31.7
December	1.28	27.4	11.4	19.4
Annual	**35.47**	**52.7**	**33.2**	**43**

Source: High Plains Regional Climate Center, http://climod.unl.edu/

3.1.5 Population/Demographics

According to the US Census Bureau, the Worth County population remained largely stable from 2016 to 2022, with only a 1.9% decline overall. Over this period, Hanlontown, Joice, and Northwood experienced growth.

The greatest absolute population decline was seen in the unincorporated county, yet the City of Grafton experienced the greatest relative decline, with a nearly 40% drop in population. **Table 3-3** provides the populations for each city and the unincorporated county for the 2016 and 2022 American Community Survey (ACS) 5-Year Estimates with the number and percent change from 2016 to 2022.

Table 3-3 Worth County Population 2016-2022 by Jurisdiction

Jurisdiction	2016 Census Population	2022 Population Estimate	# Change 2016-2022	% Change 2016-2022
Unincorporated Worth County	2,628	2,151	-477	-18.2%
Fertile	793	742	-51	-6.4%
Grafton	355	215	-140	-39.4%
Hanlontown	211	230	19	9.0%
Joice	195	247	52	26.7%
Kensett	345	275	-70	-20.3%
Manly	1,551	1,415	-136	-8.8%
Northwood	1,931	2,142	211	10.9%
Total	**7,562**	**7,417**	**-145**	**-1.9%**

Source: US Census Bureau, ACS 2016 and 2022 5-Year Estimates. Unincorporated Worth County Population was estimated by subtracting populations of incorporated cities from the total Worth County populations.

According to the ACS 2022 5-Year Estimates, 5.4% of the population is under age 5 and 21.6% of the population is over age 65 in Worth County. In total, there were 3,190 households with an average household size of 2.3 people.

Social vulnerability is broadly defined as the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood. Social vulnerability considers the social, economic, demographic, and housing characteristics of a community that influence its ability to prepare for, respond to, cope with, recover from, and adapt to environmental hazards. The 2022 ACS reports a 9.1% increase of people over the age of 65 since 2016 and a 9.6% increase of people with disabilities. This indicates a large portion of the population may be especially vulnerable to various hazards and have special needs in response and recovery efforts. Additional details on specific ways vulnerable populations may be impacted by hazards are provided in each hazard profile in Chapter 4.

Table 3-4 County Demographic and Social Characteristics, 2016-2022

Worth County	2016	2022	% Change
Population	7,562	7,417	-0.019
Median Age	44.6	43.9	-0.015
% of Population under 5	5.5%	5.4%	-1.81%
% of Population over 65	19.8%	21.6%	9.09%
Housing Occupancy Rate	89.3%	91.5%	2.46%
% of Owner-Occupied Housing	79.9%	77.3%	-3.25%
% of Renter Occupied Housing	20.1%	22.7%	12.94%
% of Housing Units with no Vehicles Available	5.2%	4.8%	-7.69%
Median Household Income	$49,472	$87,750	77.37%
Per Capita Income	$25,661	$36,585	42.57%
% of Individuals Below Poverty Level	24.7%	16.9%	-31.58%
# of Households	3,144	3,190	1.463%
Average Household Size	2.37	2.30	-2.95%
% of Population Over 25 with High School Diploma	92.3%	94.3%	2.17%
% of Population Over 25 with bachelor's degree or Higher	15.3%	19.5%	27.45%
% with Disability	13.5%	14.8%	9.63%
% Speak English less than "Very Well"	0.7%	0.3%	-57.14%

urce: US Census Bureau, 2022 5-Year Estimates

Table 3-5 Demographics by Race and Sex, 2022

Worth County	Population	%
Total Population	7,417	(x)
Male	3,814	51.4%
Female	3,603	48.6%
White, not Hispanic	7,076	95.4%
Hispanic or Latino	241	3.2%
Black	77	1.0%
Asian	22	0.3%
American Indian and Alaska Native	2	0.0%
Native Hawaiian and Other Pacific Islander	0	0.0%
Some other race	0	0.0%
Two or more races	217	2.9%

Source: U.S. Census, 2022 ACS 5-Year Estimates

3.1.6 Occupations/Employers

Table 3-6 provides occupation statistics for the incorporated cities and the county as a whole for the civilian employed population 16 years and over.

Table 3-6 Occupation Statistics, Worth County, Iowa

	Worth County	Fertile	Grafton	Hanlon-town	Joice	Kensett	Manly	North-wood
Civilian employed population 16 years and over	3,994	171	145	119	111	127	793	1,088
Management, business, science, and arts occupations	33.4%	24.0%	22.1%	26.1%	29.7%	14.2%	24.1%	26.9%
Service occupations	14.8%	8.8%	11.0%	11.8%	9.0%	18.1%	18.3%	21.6%
Sales and office occupations	17.1%	26.9%	27.6%	21.8%	11.7%	19.7%	11.6%	16.0%
Natural resources, construction, and maintenance occupations	11.0%	15.2%	29.7%	10.9%	26.1%	10.2%	13.2%	8.9%
Production, transportation, and material moving occupations	23.6%	25.1%	9.7%	29.4%	23.4%	37.8%	32.8%	26.6%

Source: US Census, 2022 ACS, 5-year Estimates

3.1.7 Agriculture

Because of the fertility of the soils in Worth County and the climate conditions, agricultural crops and livestock are important contributors to the economy of Worth County.

According to the 2017 Census of Agriculture there were 582 farms in the County covering 238,824 acres of land. The average size of farms in the County is 410 acres. Crop and livestock production are visible parts of the agricultural economy, but many related businesses contribute by producing, processing, and marketing farm and food products. These businesses generate income, employment, and economic activity throughout the region. Worth County agriculture and agriculture-related industries provide 305 jobs, representing 8.1%% of the County's workforce. Worth County agriculture and economy contributions are summarized in additional detail in Section 3.2.2 of Chapter 3.

3.1.8 FEMA Hazard Mitigation Assistance Grants in Planning Area

According to the Iowa Homeland Security and Emergency Management Department, Worth County has not received any HMA Grants since 1996. Data was not available for any grants that may have been received prior to 1996.

3.2 City/County Capabilities

Unincorporated Worth County is governed by a three-member Board of Supervisors. Each incorporated city is governed by a six-member Mayor/City Council. Worth County has an active Emergency Management Agency that coordinates emergency management capabilities in the County. Worth County's mitigation capabilities, such as comprehensive plans, zoning ordinances, and land use regulations, play a crucial role

in supporting the county's mitigation goals, actions, and strategies by guiding development and reducing disaster risk. Zoning ordinances help limit construction in hazard-prone areas like floodplains, while comprehensive plans promote resilient growth by balancing economic development with disaster preparedness. Capital improvement programs ensure critical infrastructure like stormwater systems and emergency shelter receive priority funding. However, these capabilities can face limitation, including financial constraints, outdated policies, and resistance from stakeholders opposed to development restrictions. Additionally, vulnerable populations may encounter barriers to accessing mitigation resources due to socioeconomic factors. To enhance mitigation strategy, Worth County could regularly update its policies, invest in staff training, engage the community in planning process, and collaborate with neighboring counties and state for technical and financial support.

Table 3-7 that follows provides additional capability information for the unincorporated county and incorporated cities.

Table 3-7 Mitigation Capabilities

	Worth County	Fertile	Grafton	Hanlontown	Joice	Kensett	Manly	Northwood
Policies/Ordinance								
Comprehensive/Land Use Plan	Yes	No	No	No	No	No	No	Yes
Capital Improvement Plan	No	No	No	No	Yes	No	Yes	No
Local/County Emergency Plan	Yes	Yes	Yes, Jan 2018	Yes	Yes	Yes, Jan 2018	No	Yes
Local Mitigation Plan	Yes	Yes	Yes, EOP, 2018	Yes	Yes	Yes, Jan 2018	No	No
Flood Mitigation Assistance (FMA) Plan	No	No	No	No	No	No	No	No
Watershed Plan	Yes, Deer Creek	Winnebago	No	Yes	No	No	No	No
Critical Facilities Plan (Mitigation/Response/Recovery)	Yes	Yes	Yes, EOP, 2018	No	Yes	Yes, EOP 2018	No	No
Economic Development	Same	No	No	No	Yes	No	No	No
Transportation Plan	No	No	No	No	No	No	No	No
Firewise or other Fire Mitigation Plan	No	Yes	No	No	No	No	No	No
Zoning Ordinance	Yes, all 12 Townships now	Yes	No	Yes	No	No	Yes	Yes, 2023
Restricted Residential District	No	No	No	Yes	Yes	No	No	No
Subdivision Ordinance	No	Yes	No	No	No	No	No	Yes
Building Code	No	Yes	Yes. 2013	Yes	Yes	Yes	Yes	No
Building Permit Ordinance	Yes	Yes	Yes, 2013	Yes	Yes	Yes	Yes	No
Floodplain Ordinance	Yes	Yes	Yes	No	No	Yes	Yes	Yes, updated 7/10/23
Tree Trimming Ordinance	No	Yes	Yes	No	Yes	Yes	Yes	Yes
Nuisance Ordinance	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stormwater Ordinance	No	Yes	No, completed storm	No	No	No	Yes	Yes

	Worth County	Fertile	Grafton	Hanlontown	Joice	Kensett	Manly	Northwood
			drainage study in 2010					
Drainage Ordinance	No	Yes	No, completed storm drainage study in 2010	No	No, but study in 2020	No	No	No
Site Plan Review Requirements	Yes, Zoning Administration	No	No	Yes	Yes	No	No	No
Historic Preservation Ordinance	No	No	No	No	No	No	No	No
Landscape Ordinance	No	No	Mowing ordinance, 2013	No	Moving 2023	Yes	No	No
Iowa Wetlands and Riparian Areas Conservation Plan	No	No	No	No	No	No	No	No
Debris Management Plan	No	No	No	No	Yes	No	No	No
Programs								
Zoning/Land Use Restrictions	Yes, all 12 townships	Yes	No	Yes	No	No	No	No
Codes Building Site/Design	No	Yes	Yes, building permits 2013	No	Yes, 2023	No	No	No
National Flood Insurance Program (NFIP) Participant	Yes	Yes	No	Yes	No	No	Yes	Yes
NFIP Community Rating System (CRS) Participant	No	No	No	No	No	No	No	No
Hazard Awareness Program	No	No	No	No	No	No	No	No
Planning/Zoning Boards	Yes	No	No	No	No	No	Yes	Yes
Tree Trimming Program	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Engineering Studies for Streams (Local/County/Regional)	No	No	No	No	No	No	No	No

	Worth County	Fertile	Grafton	Hanlontown	Joice	Kensett	Manly	Northwood
National Weather Service (NWS) Storm Ready	No	No	No	No	No	No	No	No
Building Code Effectiveness Grading (BCEGs)	No	No	No	No	No	No	No	No
ISO Fire Rating	No	Yes	No	No	No	No	No	No
Economic Development Program	Yes	No	No	Yes, WWB	Yes, 2020	No	No	Yes
Land Use Program	No	No	No	No	No	No	No	No
Public Education and Awareness	Yes	Yes	Yes, Iowa Energizers sent with utility bills quarterly	Yes: social media, info sent with water bills	Yes	No	No	No
Property Acquisition	No	No	No	No	Yes	No	No	No
Planning/Zoning Boards	Yes	No	No	No	No	No	Yes	Yes
Steam Maintenance Program	No	No	No	No	No	No	No	No
Tree Trimming Program ***	No	No	Yes	Yes	Yes	Yes	No	No
Mutual Aid Agreement	No	Yes	Yes	Yes	Yes	Yes	No	No
Emergency Notification Systems (Sirens, CodeRed, IPAWS, etc.)	Yes, Alert Iowa	Yes	No	Yes	Yes	Yes	Yes	No
Staff/Departments								
Building Code Official	No	No	No	No	No	No	Yes	No
Building Inspector	No	No	No	No	No	No	No	No
Mapping Specialist (GIS)	Yes	No	No	No	No	No	Yes	Yes, worth County
Engineering Studies for Streams (Local/County/Regional)	No	No	No, contract out when needed	No	No	No	No	City no, County yes
Public Works Official	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Emergency Response Team	No	No	No	Yes	No	No	No	no

	Worth County	Fertile	Grafton	Hanlontown	Joice	Kensett	Manly	Northwood
NFIP Floodplain Administrator	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Development Planner	No	No	No	No	No	No	No	No
Emergency Management Coordinate	Yes	Yes	No	Yes	No	No	Yes	Yes, Worth County
Hazardous Materials Expert	No	No	No	Yes, Fire Chief	No	No	No	No
Local Emergency Planning Committee	Yes	Yes	Yes, EOP, updated 2018	Yes	Yes	No	No	No
County Emergency Management Commission	Yes	Yes	No	Yes	Yes	Yes, Worth	Yes	Yes, Worth County
Sanitation Department	No	No	No, contract out of Absolute Waste	Yes, contract	Yes, contract	No	Yes	Yes, contract NWP Sanitation
Transportation Department	No	No	No	No	No	No	No	Yes
Economic Development Department	Yes	No	No	No	No	No	Yes	Yes
Housing Department	No	No	No	No	No	No	No	No
Planning Consultant	No	No	No	No	No	No	No	No
Regional Planning Agencies	No	No	Yes	NIACOG	Yes	No	Yes	No
Historic Preservation	Worth County Historic Committee	No	No	No	No	No	No	None
Non-Governmental Organization (NGOs)								
American Red Cross	No	No	No	No	No	No	No	Yes
Salvation Army	No	No	No	No	No	No	No	Yes
Veterans Groups	No	No	American Legion	No	No	No	Yes	Yes
Environmental Groups	No	No	No	No	No	No	No	No
Homeowner Associations	No	No	No	No	No	No	No	No

	Worth County	Fertile	Grafton	Hanlontown	Joice	Kensett	Manly	Northwood
Neighborhood Associations	No	No	No	No	No	No	No	No
Chamber of Commerce	No	No	No	No	No	No	No	Yes
Community Organizations (Lions, Kiwanis, etc.)	No	No	GCA, Grafton Community Action	No	No	Yes, Lions	No	Yes
Local Funding Availability								
Ability to fund projects through Capital Improvement Funding	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ability to incur debt through general obligation bonds	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ability to incur debt through special tax bonds	Yes	Yes	No	Yes	No	No	Yes	Yes
Ability to incur debt through private activities	No	No	No	Yes	No	No	?	Yes
Ability to withhold spending in hazard prone area	Yes	No	No	Yes	No	No	?	Yes
Fees for water, sewer, gas, or electric services	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Apply for Community Development Block Grants	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Authority to levy taxes for a specific purpose	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Impact fees for a new development	Yes	No	No	No	No	No	Yes	Yes
Other local Funding Availability	No	No	No	Yes	No	No	Yes	Yes

Table 3-8 summarizes the jurisdictions' participation in the National Flood Insurance Program (NFIP).

Table 3-8 Worth County NFIP Participation and Floodplain Management Summary

Jurisdiction	Adoption of NFIP Min. Floodplain Management Criteria	Adoption of Latest Effective FIRM	Implementation & Enforcement of Local Flood-Plain Regulation on Development in SFHAs	Designee/ Agency to Implement NFIP Requirements	Describe How Jurisdiction Implements Substantial Improvement/ Substantial Damage Provision
Worth County	Yes	08/02/12	Yes (Floodplain Management Ordinance)	Zoning Officer	Building improvements determined to be a SI/SD based on an improvement of 50% of market value or damage more than 50% of market value are required to submit a floodplain application to be reviewed and approved prior to a floodplain construction permit being issued.
Fertile	Yes	08/02/12	Yes (Floodplain Management Ordinance)	City Clerk	Building improvements determined to be a SI/SD based on an improvement of 50% of market value or damage more than 50% of market value are required to submit a floodplain application to be reviewed and approved prior to a floodplain construction permit being issued.
Hanlontown	Yes	08/02/12	Yes (Floodplain Management Ordinance)	City Clerk	Building improvements determined to be a SI/SD based on an improvement of 50% of market value or damage more than 50% of market value are required to submit a floodplain application to be reviewed and approved prior to a floodplain construction permit being issued.
Joice	Yes	08/02/12	No	NA	Sanctioned 08/13/77
Kensett	Yes	08/02/12	No	NA	Sanctioned 08/13/77
Manly	Yes	08/02/12	Yes (Floodplain Management Ordinance)	City Clerk	Building improvements determined to be a SI/SD based on an improvement of 50% of market value or damage more than 50% of market value are required to submit a floodplain application to be reviewed and approved prior to a floodplain construction permit being issued.
Northwood	Yes	08/02/12	Yes (Floodplain Management Ordinance)	City Clerk	Building improvements determined to be a SI/SD based on an improvement of 50% of market value or damage more than 50% of market value are required to submit a floodplain application to be reviewed and approved prior to a floodplain construction permit being issued.

Source: HMPC, NFIP Community Information System

3.2.1 Opportunities for Improvement

The CPT has noted gaps in capabilities that leave communities vulnerable. These gaps include the absence of essential components such as building codes, comprehensive land use zoning and regulations, critical

facilities plan, fire safety programs, and hazard awareness programs. Below are some opportunities for improvement:

Worth County

- To address these deficiencies, it is recommended that the County explores innovative approaches to engage the public in discussions on hazard mitigation and awareness. Establishing an ongoing local mitigation committee could also help keep organizations and residents engaged in these issues.
- Consider joining the NFIP Community Rating System (CRS) Program for discounts on flood insurance.
- The County should increase the publics ability to get emergency warnings and implement an outdoor warning system within campgrounds and areas that might have bad cellphone or internet service.
- Work and collaborate with Non-Government Organization (NGO's) such as those listed in Table 3-7.

Fertile

- Consider joining the NFIP Community Rating System (CRS) Program for discounts on flood insurance.
- Consider creating an emergency response team and adding positions such as building code official, building inspector, and Emergency Management Coordinator.
- Work and collaborate with NGOs such as those listed in Table 3-7.

Grafton

- Consider joining the National Flood Insurance Program as well as the NFIP Community Rating System (CRS) Program for discounts on flood insurance.
- Join the Firewise USA program, which empowers communities to reduce the risk of wildfire damage by implementing fire-safe practices.
- Work to increase public awareness of potential hazards and mitigation actions they should take through education outreach programs.
- Consider adopting a system for emergency notification and warnings such as Sirens and CodeRed.

Hanlontown

- Consider partnering with jurisdictions on a comprehensive Critical Facilities Plan that identifies and prioritizes key infrastructure and facilities critical for community functioning. This plan should include strategies for mitigation, response, and recovery.
- Consider joining the NFIP Community Rating System (CRS) Program for discounts on flood insurance and working with an NFIP Flood Administrator.

Joice

- Join the Firewise USA program, which empowers communities to reduce the risk of wildfire damage by implementing fire-safe practices.
- Consider joining the National Flood Insurance Program as well as the NFIP Community Rating System (CRS) Program for discounts on flood insurance.
- Start working with an NFIP Flood Administrator.
- Work and collaborate with NGOs such as those listed in Table 3-7 on hazard mitigation planning.

Kensett

- Consider creating an emergency response team and adding positions such as building code official, building inspector, and Emergency Management Coordinator respectively.
- Join the Firewise USA program, which empowers communities to reduce the risk of wildfire damage by implementing fire-safe practices.

- Consider joining the National Flood Insurance Program as well as the NFIP Community Rating System (CRS) Program for discounts on flood insurance.
- Work to increase public awareness of potential hazards and mitigation actions they should take through education outreach programs.
- Consider implementing a capital improvement plan to help facilitate the inclusion of hazard mitigation principles into project identification, prioritization, and design.
- Work and collaborate with NGOs such as those listed in Table 3-7 on hazard mitigation planning.

Manly

- Join the Firewise USA program, which empowers communities to reduce the risk of wildfire damage by implementing fire-safe practices.
- Consider partnering with jurisdictions on a comprehensive Critical Facilities Plan that identifies and prioritizes key infrastructure and facilities critical for community functioning. This plan should include strategies for mitigation, response, and recovery.
- Consider joining the National Flood Insurance Program as well as the NFIP Community Rating System (CRS) Program for discounts on flood insurance.
- Work to increase public awareness of potential hazards and mitigation actions they should take through education outreach programs.
- Consider creating an emergency response team and adding positions such as building inspector and Emergency Management Coordinator respectively.

Northwood

- Consider partnering with jurisdictions on a comprehensive Critical Facilities Plan that identifies and prioritizes key infrastructure and facilities critical for community functioning. This plan should include strategies for mitigation, response, and recovery.
- Consider joining the National Flood Insurance Program as well as the NFIP Community Rating System (CRS) Program for discounts on flood insurance.
- Work to increase public awareness of potential hazards and mitigation actions they should take through education outreach programs.
- Join the Firewise USA program, which empowers communities to reduce the risk of wildfire damage by implementing fire-safe practices.
- Consider creating an emergency response team and adding positions such as building inspector and Emergency Management Coordinator respectively .
- Consider adopting a system for emergency notification and warnings such as Sirens and CodeRed.

3.3 Public School District Profiles and Mitigation Capabilities

This section includes general profile information for the two Worth County school districts that are participants of this plan. The school districts with buildings or territory in the planning area are as follows:

- Central Springs Public School District
- Northwood-Kensett Public School District
- Forest City Public School District
- St. Ansgar Public School District
- Lake Mills Public School District

Figure 3-4 provides the boundaries of the school districts in Worth County and **Table 3-9** that follows provides location and enrollment information for each participating school district.

Figure 3-4 Worth County, Iowa Public School Districts

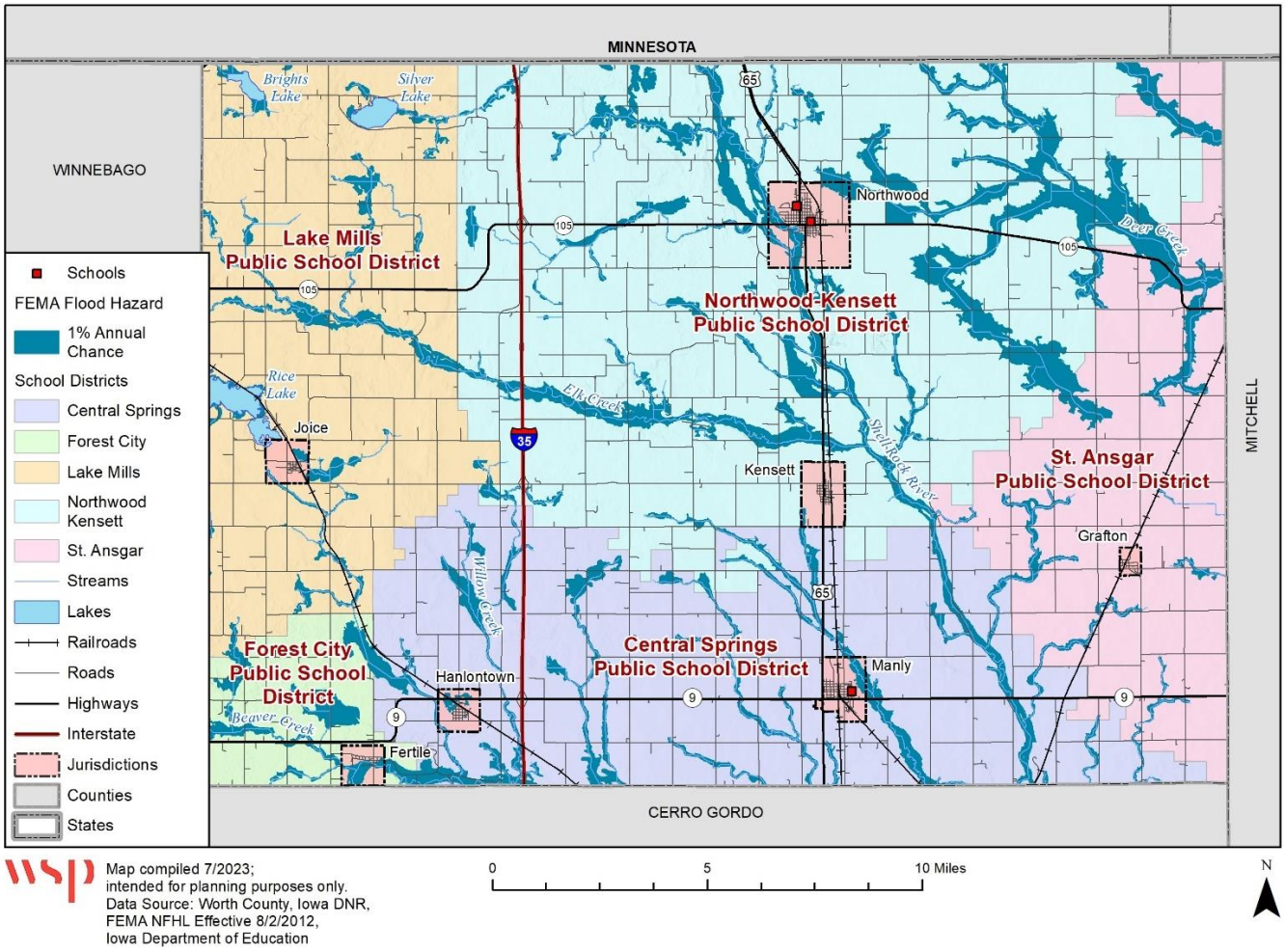


Table 3-9 Worth County School Buildings and Enrollment Data, 2022-2023

District Name/Building Name	Total Enrollment
Central Springs School District	626
Northwood- Kensett School District	474
Grand Total	1,100

Source: Iowa Department of Education, Bureau of Planning, Research and Evaluation
http://educateiowa.gov/index.php?option=com_content&view=article&id=346&Itemid=4439

Potential capabilities to implement mitigation programs and projects can vary among school districts. To determine mitigation capabilities, each of the participating school districts was asked to complete a Data Collection Guide to report planning, personnel, fiscal, and other capabilities related to implementation of mitigation programs and projects. **Table 3-10** provides a summary of the reported capabilities for each participating school district.

Table 3-10 Summary of Mitigation Capabilities, Worth County Public School Districts

	Central Springs PSD	Northwood-Kensett PSD
Planning Elements		
Master Plan	Yes	Yes
Capital Improvement Plan	Yes	Yes
School Emergency Plan	Yes	Yes
Weapons Policy	Yes	Yes
Personnel Resources		
Full-time building official (i.e., principal)	Yes	Yes
Emergency Manager	No	No
Grant Writer	No	No
Public Information Officer	Yes	No
Financial Resources		
Capital Improvements project funding	Yes	Yes
Local funds	Yes	Yes
General obligation bonds	No	Yes
Special tax bonds	No	No
Private activities/donations	Yes	Yes
State and federal funds	Yes	Yes
Other		
Public Address/Emergency Alert System	Yes	Yes
NOAA Weather Radios	Yes	Yes
Mitigation Programs to reduce losses / Public Education Programs	No	No
Tornado Shelter/Saferoom	Yes	No
Campus Police	No	No

Source: Data Collection Guides completed by each school district

4 Risk Assessment

Disaster Mitigation Act Requirements: 44CFR§201.6
[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. The risk assessment shall include: *(i) A description of the type, 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.* *(ii) 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. The plan should describe vulnerability in terms of:* *(A) The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas;* *(B) An estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate;* *(C) Providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.* *(ii) For multi-jurisdictional plans, the risk assessment section must assess each jurisdiction's risks where they vary from the risks facing the entire planning area.*

The risk assessment process identifies and profiles relevant hazards and assesses the exposure of lives, property and infrastructure within Worth County, Iowa to these hazards. The goal of the risk assessment is to estimate the potential loss in the planning area, including loss of life, personal injury, property damage and economic loss, from a hazard event. The risk assessment process allows communities in the planning area to better understand their potential risk to the identified hazards and provides a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events.

A key step to mitigate disaster losses is to develop a comprehensive understanding of the community's hazards, vulnerabilities, and risks. The following terms are used throughout the Plan to facilitate comparisons between communities.

- **Hazard:** Event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, other types of harm or loss. Hazard may be naturally occurring (flood, tornado, etc.) or human-caused (active threat, hazmat, etc.).
- **Vulnerability:** Degree of susceptibility to physical injury, harm, damage, or economic loss; depends on an asset's construction, contents, and economic value of its functions.
- **Risk:** The potential for damage, loss, or other impacts created by the interaction of hazards with vulnerabilities.

The risk assessment evaluates potential loss from hazards by assessing the vulnerability of the County's population, built environment, critical facilities, and other assets. Environmental and social impacts are also taken into consideration wherever possible. This risk assessment covers the entire geographical area of Worth County. Since this is a multi-jurisdictional plan, the Planning Team also evaluated how the hazards and risks vary from jurisdiction to jurisdiction.

The results of this risk assessment for the planning area as a whole are summarized in **Table 4-1**. Further details on the risk assessment scoring methodology are provided in Section 3.1.3.

Table 4-1 Hazard Risk Summary

Hazard	Probability	Magnitude Severity	Location/Area	Hazard Ranking
Animal/Crop/Plant Disease	Occasional	Critical	Significant	**Low**
Cyber Attack	Likely	Moderate	Significant	**Medium**
Dam/Levee Failure	Unlikely	Negligible	Limited	**Low**
Drought	Likely	Moderate	Extensive	**Medium**
Earthquake	Unlikely	Negligible	Limited	**Low**
Extreme Heat	Likely	Moderate	Extensive	**Medium**
Flooding (Flash & River)	Highly Likely	Catastrophic	Significant	**High**
Grass or Wildland Fire	Likely	Moderate	Significant	**Medium**
Hazardous Materials	Highly Likely	Moderate	Significant	**Medium**
Human Disease	Likely	Moderate	Significant	**Medium**
Infrastructure Failure	Likely	Critical	Significant	**Medium**
Landslide	Unlikely	Negligible	Limited	**Low**
Radiological Incident	Unlikely	Negligible	Limited	**Low**
Severe Winter Storm	Highly Likely	Critical	Extensive	**High**
Terrorism	Unlikely	Moderate	Limited	**Medium**
Thunderstorms/Lightning/Hail	Highly Likely	Critical	Extensive	**High**
Tornado/Windstorm	Likely	Critical	Extensive	**High**
Transportation Incident	Highly Likely	Negligible	Limited	**Low**

Location/Spatial Extent
Extensive: 50-100% of planning area
Significant: 10-50% of planning area
Limited: Less than 10% of planning area

Potential Magnitude/Severity
Catastrophic: Multiple deaths, shutdown of facilities for 30 days or more, >50% of property is severely damaged
Critical: Multiple severe injuries, shutdown of facilities for at least 2 weeks, >25% of property is severely damaged
Moderate: Some injuries, shutdown of critical facilities for more than one week, >10% of property is severely damaged
Negligible: Minor injuries, minimal quality-of-life impact, interruption of facilities and services for 24 hours or less, less than 10% of property is severely damaged.

Probability of Future Occurrence
Highly Likely: Near 100% probability each year.
Likely: Between 10 and 100% probability per year or at least one chance in ten years.
Occasional: Between 1 and 10% probability per year or at least one chance in next 100 years.
Unlikely: Less than 1% probability in next 100 years.

Overall Significance
(Based on the preceding three factors)
High: widespread potential impact
Medium: moderate potential impact
Low: minimal potential impact

4.1 Hazard Identification

The Hazard Identification and Risk Assessment (HIRA) focuses attention on areas most in need by analyzing the populations and facilities that are most vulnerable to hazards and to what extent damages may occur. The risk assessment identifies how people properties and structures will be damaged due to a hazardous event. If the hazard can harm structures or people, that is considered a vulnerability. Finding weak points in the system include identifying building types that are vulnerable to damage and anticipating the loss in high-risk areas. This will help the community to decide what mitigation efforts are required or should be undertaken and how to implement the selected activities.

The HMPC reviewed the 20 natural and human-caused hazards profiled in the 2018 Worth County HMP, along with the 19 natural and human-caused hazards in the 2018 State of Iowa HMP. The HMPC then discussed if there had been any changes since 2018 or any new information that would change the hazards that can affect Worth County. **Table 4-2** compares the hazards profiled in these three plans.

Table 4-2 Hazard Comparison Chart

2018 State Plan	2018 Worth County Plan	2023 Worth County Plan
Animal/Plant/Crop Disease	Animal/Crop/Plant Disease	Animal/Crop/Plant Disease
		Cyber Attack
Dam/Levee Failure	Dam/Levee Failure	Dam/Levee Failure
Drought	Drought	Drought
Earthquake	Earthquake	Earthquake
Expansive Soils	Expansive Soils	--
Extreme Heat	Extreme Heat	Extreme Heat
Flooding	Flash Flooding	Flooding (Flash & River)
	River Flooding	
Grass Fire or Wildland Fire	Grass or Wildland Fire	Grass or Wildland Fire
Hazardous Materials	Hazardous Materials	Hazardous Materials
Pandemic Human Disease	Human Disease	Human Disease
Infrastructure Failure	Infrastructure Failure	Infrastructure Failure
Landslide	Landslide	Landslide
Radiological Incident	Radiological Incident	Radiological Incident
Severe Winter Storm	Severe Winter Storm	Severe Winter Storm
Sinkhole	Sinkholes	--
Terrorism	Terrorism	Terrorism
Thunderstorm/Lightning/Hail	Thunderstorms/Lightning/Hail	Thunderstorms/Lightning/Hail
Tornado/Windstorm	Tornado/Windstorm	Tornado/Windstorm
Transportation Incident	Transportation Incident	Transportation Incident

In order to align with the 2018 State of Iowa plan, flash flooding and river flooding have been combined into one flooding chapter. Expansive Soils and Sinkholes were removed as hazards due to their extremely low risk and lack of incidents in the planning area. Cyber-Attack was added to the plan as a new hazard for 2023.

The hazards detailed above which have been evaluated in this plan include those that have occurred historically or have the potential to cause significant human and/or monetary losses in the future.

4.1.1 Disaster Declaration History

Additional information utilized to identify hazards relevant for inclusion in the Worth County plan update was obtained by examining events that triggered federal disaster declarations. Federal and/or state declarations may be granted when the severity and magnitude of an event surpasses the ability of the local government to respond and recover. Disaster assistance is supplemental and sequential. When the local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. If the disaster is so severe that both the local and state governments' capacities are exceeded, a federal emergency or disaster declaration may be issued allowing for the provision of federal assistance.

FEMA also issues emergency declarations, which are more limited in scope and do not include the long-term federal recovery programs of major disaster declarations. Determinations for declaration type are based on scale and type of damages and institutions or industrial sectors affected.

Table 4-3 lists federal disaster declarations that included Worth County for the period from 1965 to 2016. There were no additional disasters since the completion of the previous plan.

Table 4-3 Disaster Declarations that included Worth County, Iowa, 1965-2023

Disaster Number	Declaration Date	Title	Incident Begin Date	Incident End Date
193	4/22/1965	Flooding	4/22/1965	4/22/1965
269	8/14/1969	Heavy Rains & Flooding	8/14/1969	8/14/1969
879	9/6/1990	Severe Storms & Flooding	7/25/1990	8/31/1990
928	12/26/1991	Ice Storm	10/31/1991	11/29/1991
996	7/9/1993	Severe Storms & Flooding	4/13/1993	10/1/1993
1282	7/22/1999	Severe Storms And Flooding	7/2/1999	8/10/1999
1518	5/25/2004	Severe Storms, Tornadoes, And Flooding	5/19/2004	6/24/2004
3239	9/10/2005	Hurricane Katrina Evacuation	8/29/2005	10/1/2005
1688	3/14/2007	Severe Winter Storms	2/23/2007	3/2/2007
1763	5/27/2008	Severe Storms, Tornadoes, And Flooding	5/25/2008	8/13/2008
4126	7/2/2013	Severe Storms, Tornadoes, And Flooding	5/19/2013	6/14/2013
4421	3/23/2019	Flooding	3/12/2019	CONT.
3480	3/13/2020	Biological – Covid19 Pandemic	1/20/2020	5/11/2023
4483	3/23/2020	Biological – Covid19 Pandemic	3/17/2020	5/11/2023
4642	2/23/2022	Severe Storms	12/15/2021	12/15/2021

Source: Federal Emergency Management Agency, www.fema.gov/

Since 2019, the Governor of Iowa has issued four disaster emergency proclamations for Worth County. These proclamations activate the Iowa Individual Assistance Grant Program, providing financial assistance to individuals and families affected by the disaster. The state disaster proclamations that pertain to Worth County can be found in **Table 4.4**.

Table 4-4 State Governor Disaster Proclamations that include Worth County, Iowa, 2019-2023

Declaration Date	Hazard Description	Effective Date	Expiration Date
3/13/2019	Flooding and flash flooding due to rapid snow melt combined with heavy rains	3/14/2019	4/13/2019
8/24/2021	Severe storm system; damaging winds, straight-line winds, heavy rains, thuderstorms, and flash flooding	9/1/2021	10/1/2021
12/15/2021	Severe storm system; damaging winds, straight-line winds, heavy rains, thunderstorms, tornadoes, and fires	12/15/2021	1/15/2022
4/12/2022	Severe storm system; damaging winds, straight-line winds, heavy rains, thunderstorms, flash flooding, and tornadoes	4/13/2022	5/13/2022

The U.S. Department of Agriculture's Secretary of Agriculture is authorized to designate counties as disaster areas to make emergency loans (EM) to producers suffering losses in those counties, and in counties that are contiguous to a designated county. In addition to EM eligibility, other emergency assistance programs, such as Farm Service Agency (FSA) disaster assistance programs, have historically used disaster designations as an eligibility requirement trigger.

Table 4-5 provides the USDA Secretarial disaster declarations that included Worth County from 2012 to 2022. Details on USDA declarations prior to 2012 are not available.

Table 4-5 USDA Secretarial Disaster Declarations Including Worth Co. (2012-2022)

Crop Year	Design. No.	Drought	Flood, Flash Flooding	Excessive rain, moisture	Wind, High Winds	Fire, Wildfire	Heat, High Temperatures	Winter Storms	Frost, Freeze	Insects	Begin Date	Description of Disaster
2012	S3337	1			1	1	1			1	8/7/2012	Drought-Fast Track
2012	S3361	1			1	1	1			1	8/21/2012	Drought-Fast Track
2012	S3390	1			1	1	1			1	7/17/2012	Drought-Fast Track
2012	S3390	1			1	1	1			1	7/17/2012	Drought-Fast Track
2013	S3553			1					1		1/1/2013	Heavy rainfall followed by freezing temperatures, and multiple periods of thawing and refreezing, resulting in winterkill
2013	S3588		1	1				1	1		1/1/2013	The combined effects of severe freezing and excessive snow followed by excessive rainfall, and flooding
2013	S3605		1	1							4/1/2013	Excessive rain, flooding, cool temperatures
2021	S5026	1									6/8/2021	Drought-Fast Track
2021	S5037	1									6/15/2021	Drought-Fast Track
2021	S5038	1									6/15/2021	Drought-Fast Track

Source: US Department of Agriculture; https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/disasterdesignation-information/index

4.1.2 Data Sources

Hazard data was obtained from various federal, state, and local sources such as FEMA, the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI), the United States Geological Survey (USGS), and others. Together, these sources were examined to assess the significance of these hazards to the County. The hazards evaluated in this plan include those that have occurred historically or have the potential to cause significant human and/or monetary losses in the future.

Additional data on locations and past impacts of hazards in the planning area was collected from the following sources:

- Worth County Flood Insurance Rate Map, FEMA
- Worth County Emergency Management
- Worth County Multijurisdictional Hazard Mitigation Plan, 2018
- Data Collection Guides completed by each jurisdiction
- Environmental Protection Agency
- Federal Emergency Management Agency (FEMA)
- Flood Insurance Administration
- Iowa Department of Agriculture and Land Stewardship, Division of Soil Conservation
- Iowa Department of Education, Bureau of Information and Analysis Services
- Iowa Department of Natural Resources
- Iowa Department of Public Safety
- Iowa Department of Transportation, Office of Traffic and Safety
- Iowa State Hazard Mitigation Plan (2018)
- Iowa Utilities Board
- National Drought Mitigation Center Drought Reporter
- National Fire Incident Reporting System (NFIRS)
- National Oceanic and Atmospheric Administration's (NOAA) National Center for Environmental Information (NCEI)
- Pipeline and Hazardous Materials Safety Administration
- U.S. Army Corps of Engineers
- U.S. Department of Agriculture's (USDA) Risk Management Agency Crop Insurance Statistics
- U.S. Department of Transportation
- United States Geological Survey

Various articles and publications available on the internet (sources are indicated where data is cited)

While this plan takes advantage of the data that is available through NOAA's National Center for Environmental Information (NCEI) Storm Events Database and other sources, some hazards have a shorter span of time for which data is available. The NCEI database is used as a primary source for many hazards discussed in this plan, but for some hazards and/or some communities, only partial records of significant events are available. In addition, details about each hazard event may not be available if the data is older. For example, tornado data from the 1950's classifies tornado events at the county level and often does not give a specific location of the event within the county. Historical trends can help us predict the probability of each hazard, but realistically, many hazards analyzed in this plan could occur at any point in time. The hazard identification and risk assessment activities rank hazards according to the data that was available at the time of the plan update.

For flash flooding, communities described flood events in which short periods of heavy rainfall flooded streets, basements, and backed up sewer systems. In some cases, any period of prolonged rainfall could cause streets or sewers to flood; NCEI data did not capture the frequency of these events, but communities

did not feel that it was necessary to add to the events that NCEI data already reported. It should be noted that these events may not cause substantial damage to houses or structures, but they may result in flood costs that the county taxpayers and individual property owners must finance.

Data frames vary for each hazard. For most hazards with established data sets (i.e.: NCEI, IDNR hazardous spills summary reports, Iowa Department of Public Health, etc.), the data frame begins with the earliest year in which data was available and ends with 2022. Unless otherwise noted, the year 2022 was used as an ending date for data to allow for a complete year of data, as data collection and the planning process began in 2023.

4.1.3 Risk Assessment Methodology

The planning committee's next step was to profile each hazard that was identified from the first step. Through the profiling process the planning committee discussed: historical occurrences; the probability of the hazard occurring again in the future; the vulnerability of the population that will be affected by the hazard; the maximum geographic extent; the magnitude or severity of the hazard in terms of injuries/fatalities, personal property, and infrastructure; the amount of warning time available before the hazard occurs; and the duration of the hazard event.

The economic impact of disasters is a relatively new area of record-keeping and is generally restricted to major disasters involving both state and federal funding. Smaller, less significant events often do not reflect the economic impact of the incident. For these smaller events, there is a greater reliance on local information and records of impacts.

As described in Section 4.1.4 below, the anticipated impacts of climate change on each hazard were also taken into account, to ensure the profiles reflected the likely hazard behavior in the future, rather than just looking at past behavior.

Hazards were profiled and ranked based on the following factors:

- **Location (Spatial Extent):** How much of the planning area is potentially at risk from the hazard?
  - Extensive: 50-100% of planning area.
  - Significant: 10-50% of planning area.
  - Limited: Less than 10% of planning area.
- **Magnitude/Severity:** What are the likely impacts of the hazard?
  - Catastrophic: Multiple deaths, shutdown of facilities for 30 days or more, >50% of property is severely damaged.
  - Critical: Multiple severe injuries, shutdown of facilities for at least 2 weeks, >25% of property is severely damaged.
  - Moderate: Some injuries, shutdown of critical facilities for more than one week, >10% of property is severely damaged.
  - Negligible: Minor injuries, minimal quality-of-life impact, interruption of facilities and services for 24 hours or less, less than 10% of property is severely damaged.
- **Probability of Future Occurrence:** How often is the hazard likely to occur?
  - Highly Likely: Near 100% probability each year.
  - Likely: Between 10 and 100% probability per year or at least one chance in ten years.
  - Occasional: Between 1 and 10% probability per year or at least one chance in next 100 years.

  - Unlikely: Less than 1% probability in next 100 years.

- **Overall Significance:** Based on a combination of the previous three factors.
  - High: widespread potential impact.
  - Medium: moderate potential impact.
  - Low: minimal potential impact.

4.1.4 Climate Change

In accordance with FEMA Administrator Policy 2011-OPPA-01, where possible, this plan update has considered the potential impacts of climate change on the hazards profiled. In 2010, the Iowa Climate Change Advisory Council reported to the Governor and the Iowa General Assembly on Climate Change Impacts in Iowa. The Report summarized the following climate changes Iowa is already experiencing:

More 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 Fahrenheit (°F) rise in dew point temperature. This fuels convective thunderstorms that provide more summer precipitation.

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.

Climate change considerations are further discussed under each hazard profile.

4.2 Assets at Risk

It is important for communities to be prepared and minimize risks from the direct and indirect impacts of natural and manmade hazards. Assessing future development was something that Worth County took into account when looking at their vulnerability to hazards. Critical facilities were identified by the planning team and each jurisdictions vulnerability to hazards are addressed in the hazard profiles. The following table is a generalized inventory of assets broken down by land uses.

4.2.1 Property

Building Exposure values are based on the 2023 tax year parcel data provided by the Worth County GIS Department. Contents Exposure Values were calculated by factoring a multiplier to the Building Exposure Values based on property type. According to the assessor's data, the sum of the actual value improvements in the County (total building exposure) is $541 million. Contents exposure is added to that, estimated as a percent of the improvement value (specifically, 50% of the improvement value for agriculture dwelling, residential and multi-family structures, 150% for industrial structures, 100% for agricultural, commercial, exempt, and mixed-use structures), based on standard FEMA methodologies. Together they come to $894 million in total value. **Table 4-6** below provides a summary of the improved parcel counts and values by jurisdiction. **Table 4-7** breaks those values down by property type and gives improved parcel counts by type per jurisdiction for the 3,898 improved parcels in the planning area, and **Table 4-8** provides structure counts by jurisdiction and structure use.

Table 4-6 Worth County Total Exposure by Jurisdiction Summary

Jurisdiction	Improved Parcel Count	Improved Value	Estimated Content Value	Total Value
Fertile	184	$15,477,784	$8,117,991	$23,595,775
Grafton	150	$11,969,892	$6,753,589	$18,723,481
Hanlontown	111	$11,796,859	$7,499,027	$19,295,886
Joice	121	$9,438,735	$5,875,414	$15,314,149
Kensett	157	$11,148,929	$6,633,798	$17,782,727
Manly	617	$62,659,183	$36,464,069	$99,123,252
Northwood	976	$120,502,052	$72,199,634	$192,701,686
Unincorporated	1,582	$297,636,767	$209,705,455	$507,342,222
Total	**3,898**	**$540,630,201**	**$353,248,975**	**$893,879,176**

Sources: Worth County GIS Department, WSP Analysis

Table 4-7 Worth County Total Exposure of Improved Properties by Jurisdiction and Property Type

Jurisdiction	Property Type	Improved Parcel Count	Improved Value	Estimated Content Value	Total Value
Fertile	Agriculture	1	$8,220	$8,220	$16,440
	Agriculture Dwelling	5	$641,842	$320,921	$962,763
	Commercial	17	$716,216	$716,216	$1,432,432

Jurisdiction	Property Type	Improved Parcel Count	Improved Value	Estimated Content Value	Total Value
	Exempt	4	$33,761	$33,761	$67,522
	Multi-Family	1	$44,862	$22,431	$67,293
	Residential	156	$14,032,883	$7,016,442	$21,049,325
	Total	**184**	**$15,477,784**	**$8,117,991**	**$23,595,775**
Grafton	Agriculture	2	$94,345	$94,345	$188,690
	Agriculture Dwelling	2	$279,910	$139,955	$419,865
	Commercial	25	$1,442,940	$1,442,940	$2,885,880
	Exempt	3	$0	$0	$0
	Residential	118	$10,152,697	$5,076,349	$15,229,046
	Total	**150**	**$11,969,892**	**$6,753,589**	**$18,723,481**
Hanlontown	Agriculture	1	$2,737	$2,737	$5,474
	Commercial	19	$3,198,458	$3,198,458	$6,396,916
	Exempt	1	$0	$0	$0
	Multi-Family	1	$243,643	$121,822	$365,465
	Residential	89	$8,352,021	$4,176,011	$12,528,032
	Total	**111**	**$11,796,859**	**$7,499,027**	**$19,295,886**
Joice	Commercial	16	$2,203,956	$2,203,956	$4,407,912
	Exempt	1	$0	$0	$0
	Mixed Use	2	$108,137	$108,137	$216,274
	Multi-Family	1	$131,129	$65,565	$196,694
	Residential	101	$6,995,513	$3,497,757	$10,493,270
	Total	**121**	**$9,438,735**	**$5,875,414**	**$15,314,149**
Kensett	Agriculture	3	$57,009	$57,009	$114,018
	Agriculture Dwelling	4	$505,841	$252,921	$758,762
	Commercial	14	$1,795,058	$1,795,058	$3,590,116
	Exempt	1	$0	$0	$0
	Mixed Use	2	$266,600	$266,600	$533,200
	Multi-Family	1	$169,268	$84,634	$253,902
	Residential	132	$8,355,153	$4,177,577	$12,532,730
	Total	**157**	**$11,148,929**	**$6,633,798**	**$17,782,727**
Manly	Agriculture	2	$6,630	$6,630	$13,260
	Agriculture Dwelling	3	$582,816	$291,408	$874,224

Jurisdiction	Property Type	Improved Parcel Count	Improved Value	Estimated Content Value	Total Value
	Commercial	72	$9,056,489	$9,056,489	$18,112,978
	Exempt	7	$114,933	$114,933	$229,866
	Industrial	2	$446,026	$669,039	$1,115,065
	Mixed Use	3	$198,851	$198,851	$397,702
	Multi-Family	12	$2,137,671	$1,068,836	$3,206,507
	Residential	516	$50,115,767	$25,057,884	$75,173,651
	Total	**617**	**$62,659,183**	**$36,464,069**	**$99,123,252**
Northwood	Agriculture	4	$27,605	$27,605	$55,210
	Agriculture Dwelling	3	$466,574	$233,287	$699,861
	Commercial	110	$16,491,946	$16,491,946	$32,983,892
	Exempt	9	$0	$0	$0
	Industrial	7	$3,049,494	$4,574,241	$7,623,735
	Mixed Use	14	$1,278,676	$1,278,676	$2,557,352
	Multi-Family	12	$2,988,168	$1,494,084	$4,482,252
	Residential	817	$96,199,589	$48,099,795	$144,299,384
	Total	**976**	**$120,502,052**	**$72,199,634**	**$192,701,686**
Unincorporated	Agriculture	225	$5,465,803	$5,465,803	$10,931,606
	Agriculture Dwelling	588	$105,873,939	$52,936,970	$158,810,909
	Commercial	53	$44,330,009	$44,330,009	$88,660,018
	Exempt	1	$0	$0	$0
	Industrial	14	$34,746,568	$52,119,852	$86,866,420
	Mixed Use	8	$2,485,194	$2,485,194	$4,970,388
	Residential	693	$104,735,254	$52,367,627	$157,102,881
	Total	**1,582**	**$297,636,767**	**$209,705,455**	**$507,342,222**
	Grand Total	**3,898**	**$540,630,201**	**$353,248,975**	**$893,879,176**

Sources: Worth County GIS Department, WSP Analysis

Table 4-8 Worth County Structure Counts by Jurisdiction and Use

Jurisdiction	Agriculture	Agriculture Dwelling	Commercial	Exempt	Industrial	Mixed Use	Multi-Family	Residential	Total
Fertile	1	5	17	4	-	-	1	156	**184**
Grafton	2	2	25	3	-	-	-	118	**150**
Hanlontown	1	-	19	1	-	-	1	89	**111**
Joice	-	-	16	1	-	2	1	101	**121**
Kensett	3	4	14	1	-	2	1	132	**157**
Manly	2	3	72	7	2	3	12	516	**617**
Northwood	4	3	110	9	7	14	12	817	**976**
Unincorporated	225	588	53	1	14	8	-	693	**1,582**
Total	**238**	**605**	**326**	**27**	**23**	**29**	**28**	**2,622**	**3,898**

Sources: Worth County GIS Department, WSP Analysis

4.2.2 People

Population numbers come from the 2021 U.S. Census Bureau estimates, reported by Iowa State University Iowa Community Indicators Program. Population estimates, used for the purpose of estimating the number of residents living in hazard areas in the following hazard profiles, come from multiplying the number of residences by the average household size for each jurisdiction.

Table 4-9 Worth County Population Data

Jurisdiction	2021 Average Household Size	2021 Population Estimate
Fertile	1.92	305
Grafton	2.15	216
Hanlontown	2.24	206
Joice	1.82	208
Kensett	1.93	257
Manly	2.58	1,256
Northwood	2.53	2,072
Unincorporated	2.36	2,923
Total		**7,443**

Sources: U.S. Census Bureau

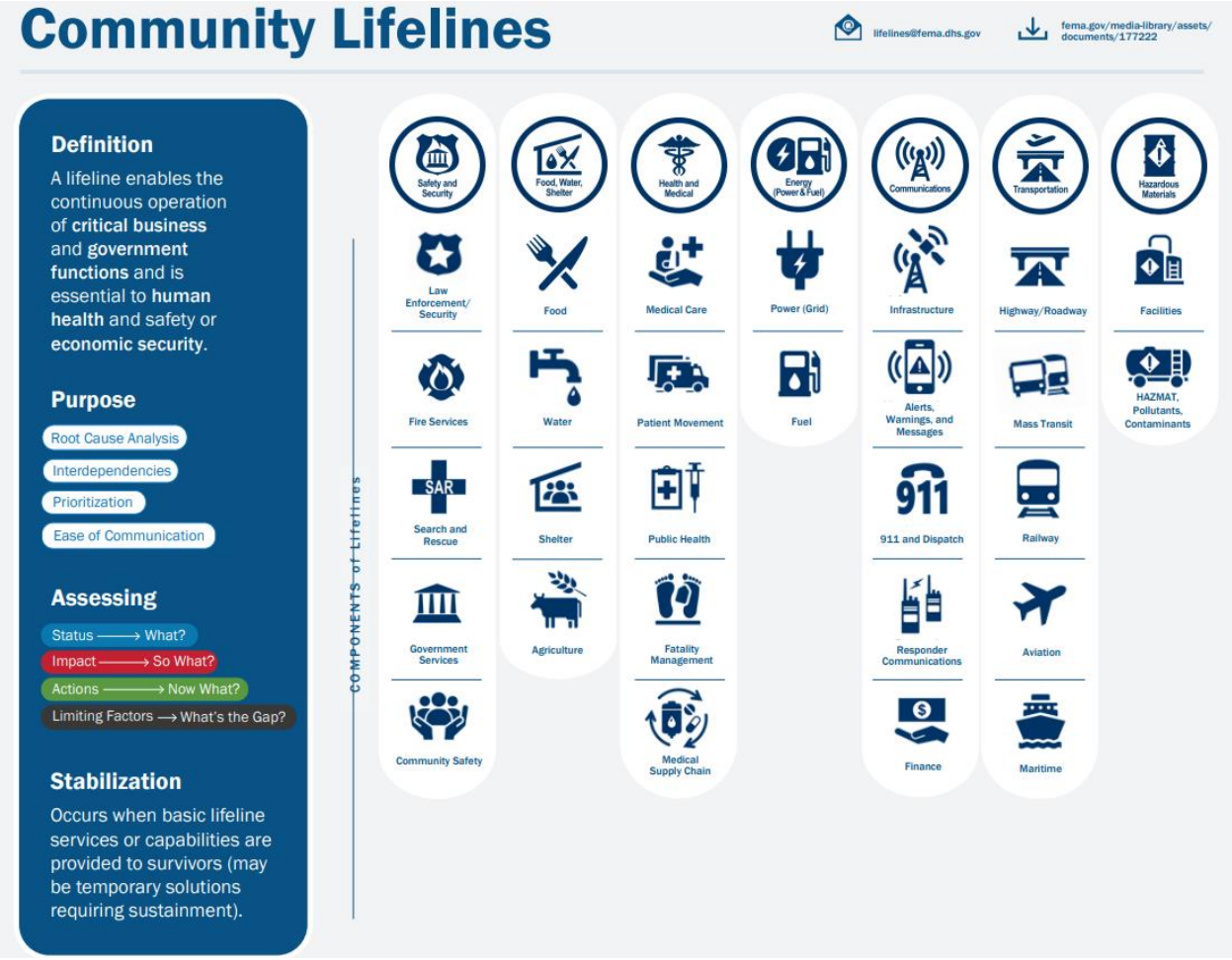
4.2.3 Critical Facilities and Infrastructure

For the purposes of this plan, a critical facility is defined as one that is essential in providing utility or direction either during the response to an emergency or during the recovery operation. FEMA organizes critical facilities into seven lifeline categories as shown in **Figure 4-1**.

These lifeline categories standardize the classification of critical facilities and infrastructure that provide indispensable service, operation, or function to a community. A lifeline is defined as providing indispensable service that enables the continuous operation of critical business and government functions, and is critical to human health and safety, or economic security. These categorizations are particularly useful as they:

- Enable effort consolidations between government and other organizations (e.g. infrastructure owners and operators).
- Enable integration of preparedness efforts among plans; easier identification of unmet critical facility needs.
- Refine sources and products to enhance awareness, capability gaps, and progress towards stabilization.
- Enhance communication amongst critical entities, while enabling complex interdependencies between government assets.
- Highlight lifeline related priority areas regarding general operations as well as response efforts.

Figure 4-1 FEMA Lifeline Categories



Source: FEMA

To develop a comprehensive list of critical facilities in Worth County the best available data was used from multiple sources, but some limitations include lack of complete or comprehensive data and values such as replacement costs. These databases were used in vulnerability assessments for hazards such as dam and flood and are represented in maps and tables in the vulnerability by hazard section that follows.

Table 4-10 Critical Facilities by Jurisdiction and Lifeline

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
Fertile	-	-	1	1	-	2	1	**5**
Grafton	-	-	3	2	1	2	-	**8**
Hanlontown	-	-	2	1	1	1	1	**6**

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
Joice	-	-	2	-	1	1	-	**4**
Kensett	1	-	3	-	-	1	-	**5**
Manly	2	-	2	1	3	10	-	**18**
Northwood	-	1	8	10	4	17	5	**45**
Unincorporated	14	315	29	17	-	10	113	**498**
Total	**17**	**316**	**50**	**32**	**10**	**44**	**120**	**589**

Sources: Worth County, DNR, HIFLD, National Bridge Inventory, WSP Analysis

Table 4-11 Critical Facilities by Jurisdiction and Facility Type

Jurisdiction	FEMA Lifeline	Facility Type	Count
Fertile	Food, Water, Shelter	Water Use Well	1
	Hazardous Material	EHS Tier II Facility	1
	Safety and Security	Fire Station	1
		Solid Waste Facility	1
	Transportation	Non-Scour Good Condition Bridge	1
	Total		**5**
Grafton	Food, Water, Shelter	Water Treatment Plant	1
		Water Use Well	2
	Hazardous Material	Contaminated Facilities	1
		Tier II Facility	1
	Health and Medical	EMS Station	1
	Safety and Security	Fire Station	1
		Solid Waste Facility	1
	Total		**8**
Hanlontown	Food, Water, Shelter	Water Treatment Plant	1
		Water Use Well	1
	Hazardous Material	Tier II Facility	1
	Health and Medical	EMS Station	1
	Safety and Security	Fire Station	1
	Transportation	Non-Scour Good Condition Bridge	1

Jurisdiction	FEMA Lifeline	Facility Type	Count
	Total		**6**
Joice	Food, Water, Shelter	Water Treatment Plant	1
		Water Use Well	1
	Health and Medical	EMS Station	1
	Safety and Security	Fire Station	1
	Total		**4**
Kensett	Communications	Microwave Service Tower	1
	Food, Water, Shelter	Water Treatment Plant	1
		Water Use Well	2
	Safety and Security	Fire Station	1
	Total		**5**
Manly	Communications	Microwave Service Tower	2
	Food, Water, Shelter	Water Use Well	2
	Hazardous Material	Tier II Facility	1
	Health and Medical	EMS Station	1
		Nursing Home	2
	Safety and Security	Childcare	4
		Fire Station	1
		Law Enforcement	1
		Public School	2
		Solid Waste Facility	2
	Total		**18**
Northwood	Energy	Substation	1
	Food, Water, Shelter	Water Treatment Plant	1
		Water Use Well	7
	Hazardous Material	Contaminated Facilities	1
		EHS Tier II Facility	6
		Tier II Facility	3
	Health and Medical	EMS Station	1
		Nursing Home	2
		Public Health Office	1
	Safety and Security	Childcare	9
		Courthouse	1
		EOC	1

Jurisdiction	FEMA Lifeline	Facility Type	Count
		Fire Station	1
		Law Enforcement	2
		Public School	2
		Solid Waste Facility	1
	Transportation	Airport	1
		Non-Scour Fair Condition Bridge	3
		Non-Scour Good Condition Bridge	1
	Total		**45**
Unincorporated	Communications	Cellular Tower	4
		Microwave Service Tower	10
	Energy	Power Plant	1
		Substation	9
		Turbine	305
	Food, Water, Shelter	Open Feedlot	2
		Water Treatment Plant	8
		Water Use Well	19
	Hazardous Material	Contaminated Facilities	1
		EHS Tier II Facility	7
		Tier II Facility	9
	Safety and Security	Childcare	2
		Solid Waste Facility	8
	Transportation	Non-Scour Fair Condition Bridge	57
		Non-Scour Good Condition Bridge	38
		Non-Scour Poor Condition Bridge	17
		Scour Good Condition Bridge	1
	Total		**498**
	Grand Total		**589**

Sources: Worth County, DNR, HIFLD, National Bridge Inventory, WSP Analysis

4.2.4 Historic, Cultural, and Natural Resources

Assessing the vulnerability of the planning area to disaster also involves inventorying the natural, historic, cultural, and economic assets of the area. This is important for the following reasons:

- The plan participants may decide that these types of resources warrant a greater degree of protection due to their unique and irreplaceable nature and contribution to the overall economy.
- If these resources are impacted by a disaster, knowing about them ahead of time allows for more prudent care in the immediate aftermath, when the potential for additional impacts is higher.

- The rules for reconstruction, restoration, rehabilitation, and/or replacement are often different for these types of designated resources.
- Natural resources can have beneficial functions that reduce the impacts of natural hazards, such as wetlands and riparian habitat, which help absorb and attenuate floodwaters.
- Losses to economic assets (e.g., major employers or primary economic sectors) could have severe impacts on a community and its ability to recover from disaster.

Historic Properties

The National Register of Historic Places is the official list of the Nation's cultural resources worthy of preservation. Authorized under the National Historic Preservation Act of 1966, the National Register is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect our historic and archeological resources. The National Register is administered by the National Park Service under the Secretary of the Interior. Properties listed in the National Register include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archeology, engineering and culture. **Table 4-12** provides the list of properties on the National Register in Worth County.

Table 4-12 Properties/Landmarks on the National Register of Historic Places, Worth County

City	Resource	Address	Year Listed
Fertile	Rhodes Mill	Main St.	1978
Grafton	Chicago, Milwaukee, and St. Paul Railroad-Grafton Station	Directly west for 50 feet of Lot 11, Block 4, original town of Grafton	1976
Kensett	First Methodist Episcopal Church	401 2nd St.	2000
Northwood	Northwood Central Avenue Historic District	Roughly, Central Ave. W near 5th St. to 9th St on the East	2006
Northwood	Old Worth County Courthouse	921 Central Ave.	1981
Northwood	Worth County Courthouse	Central Ave. between 10th and 11th Sts.	1981

Source: National Park Service, https://www.nps.gov/nr/research/index.htm

As defined by the National Environmental Policy Act (NEPA), any property over 50 years of age may be considered a historic resource and is potentially eligible for the National Register. Thus, in the event that the property is to be altered, or has been altered, as the result of a major federal action, the property must be evaluated under the guidelines set forth by NEPA. Structural mitigation projects are considered alterations for the purpose of this regulation.

Threatened and Endangered Species

Table 4-13 includes Federally Threatened, Endangered, Proposed and Candidate Species in Worth County, Iowa.

Table 4-13 Threatened and Endangered Species in Worth County

Common Name	Scientific Name	Status
Northern long-eared bat	Myotis septentrionalis	Threatened
Prairie bush clover	Lespedeza leptostachya	Threatened
Western prairie fringed orchid	Platanthera praeclara	Threatened

Source: US Fish and Wildlife Service, http://www.fws.gov/midwest/endangered/lists/iowa_cty.html

Natural Resources

The Worth County Conservation Board manages 28 parks, natural areas, prairies, memorial sites, and rest areas, encompassing over 3,190 acres throughout the county. The Worth County Conservation Board manages the following parks and wildlife areas in Worth County:

1. Brunsvold Haugen timber – oak timber
2. Christianson-Taylor WMA – marsh and uplands
3. Dean Mueller Wildlife Area
4. Deer Creek Forest – mixed woodland along the Deer Creek drainage ditch
5. Deer Creek Rest Area (31 acres)
6. Deer Creek Wildlife Management Area
7. Fertile Mill
8. Hanson's Corner – old road right of way with native plants
9. Harrier Wetlands – upland habitat with restored wetlands
10. Kuennen's Quarry (58 acres)
11. Land of Two Waters – upland habitat, three restored wetlands, food plots, winter planting
12. Myre Timber – aspen/cottonwood timber
13. Northern Prairie WMA – restored wetland with upland
14. Ochee Yahola Park (160 acres) – upland timber with small marsh
15. Panicum Prairie – native grass, seasonal wetlands, food plots, brushy areas
16. Plymouth Pit – old sand pit seeded to native grasses with mixed woodland/scrub brush
17. Sawin WMA – upland with winter cover plantings
18. Shellrock WMA – upland habitat with oxbow wetland, food plots, winter cover plantings
19. Silver Lake Access (4 acres)
20. Silver lake Park (28.7 acres)
21. Silver lake Wildlife Management Area – oak timber with a prairie pothole
22. Stimes Woods – oak timber with some upland and wetlands
23. Storre WMA – river access
24. Sydney Swensrud Area – river access, riparian habitat, restored native grass upland
25. Tostenson Wildlife Refuge – tree planting
26. Turkeyfoot Prairie – upland habitat with sedge meadow, two wetlands
27. Turvols Wood – oak timber
28. Wally's Woods – river bottom timber with food plot and uplands
29. Willow Creek WMA – upland habitat with seasonal wetlands
30. Woodduck Hollow
31. Worth County Lake (28 acres)

4.3 Hazard Profiles and Vulnerability

The following hazard profiles are organized as follows:

- **Description:** General description of the hazard and associated problems, followed by details on the hazard specific to Worth County.
- **Location:** Discusses what parts of the County are most likely to be affected by the hazard.
- **Historic Occurrences:** Overview history of the hazard's occurrences, compiled from multiple data sources, to include information provided by the Planning Team and the public. Significant incidents are profiled in greater detail and include scope, severity, and magnitude, and known impacts.
- **Probability of Future Occurrence:** Estimates the likelihood or probability of future occurrences of the hazard.

- **Magnitude/Severity:** Summarizes the anticipated magnitude and severity of a hazard event based largely on previous occurrences and specific aspects of the planning area. Speed of onset and duration are also factored in.
- **Climate Change Considerations:** Discusses how the projected impacts of climate change may affect the likelihood and severity of the hazard in the future.
- **Vulnerability:** Describes the likely impacts of the hazard on people, property, critical infrastructure, government services, the economy, and historical, cultural, and natural resources.
- **Development Trends:** Summarizes how projected trends in land use, and development have the potential to increase or decrease the impact of the hazard.
- **Risk Summary:** Summarizes the key pieces of information for each hazard.

4.3.1 Animal/Plant/Crop Disease

Probability	Magnitude/Severity	Location/Area	Hazard Ranking
Occasional	Critical	Significant	**Low**

Hazard Description

Agricultural infestation is the naturally occurring infection of vegetation, crops or livestock with insects, vermin, or diseases that render the crops or livestock unfit for consumption or use. Because of Iowa's substantial agricultural industry and related facilities and locations, the potential for infestation of crops or livestock poses a significant risk to the economy of the State. Iowa cropland is vulnerable to disease and other agricultural pests.

Some level of agricultural infestation is normal in Iowa. The concern is when the level of an infestation escalates suddenly, or a new infestation appears, overwhelming normal control efforts. The levels and types of agricultural infestation appear to vary by many factors, including cycles of heavy rains and drought.

Animal Disease

Agricultural incidents are naturally occurring infection of livestock with insects, vermin, or diseases that render the livestock unfit for consumption or use. The livestock inventory for the state of Iowa includes nearly 4 million cattle and calves. According to the USDA National Agricultural Statics Service, as of January 1, 2023, Worth County ranked 93rd in the state with 7,200 head of cattle and calves. According to the 2017 Census of Agriculture, there were also 12,389 head of hogs and pigs in Worth County.

With this substantial agricultural industry and related facilities throughout the County, the potential for infestation of livestock poses a significant risk to the economy in the planning area.

The Iowa Department of Agriculture and Land Stewardship (IDALS) monitors and reports on the following animal reportable diseases in Iowa:

- Avian Influenza
- Bovine Spongiform Encephalopathy (BSE) Disease
- Chronic Wasting Disease
- Exotic Newcastle Disease
- Foot and Mouth Disease
- Johne's Disease
- Pseudo rabies
- Scrapie, and
- West Nile Virus.

Producers are required by state law to report any of the reportable animal diseases to the IDALS's Bureau of Animal Industry. The IDALS's Bureau of The Center for Agriculture Security is the lead coordinating bureau for any emergency response for an agriculture incident.

- **Avian influenza** continues to be of concern in Iowa. According to the 2017 Census of Agriculture, Iowa is ranked 11th in poultry and egg sales, totaling approximately $1.5 billion in sales.

- **Bovine Spongiform Encephalopathy (BSE)** "mad cow" disease is a chronic, degenerative disease affecting the central nervous system of cattle. Cases have been found worldwide since 1986, but in Canada and the US only a single cow was reported with BSE in 2003.

- **Chronic Wasting Disease (CWD)** is a fatal, neurological disease of farmed and wild deer and elk. The disease has been identified in wild and captive mule deer, white-tailed deer, and North American elk, and in captive black-tailed deer. The first case of CWD in Iowa was found in 2012 on a hunting preserve in the southeastern part of the State.

- **Exotic Newcastle disease (END)** is a contagious and fatal viral disease affecting all species of birds. There was an epidemic of END in California in 2003 that resulted in the death of millions of chickens and other birds, and cost millions of dollars. END is probably one of the most infectious diseases of poultry in the world. END is so virulent that many birds die without showing any clinical signs.

- **Johne's** (yo-knees) disease is a contagious, chronic, and eventually fatal infection that affects the small intestine of ruminants, including cattle, sheep and goats. Johne's, also called Para tuberculosis, is a slow progressive wasting disease with an incubation period of usually two or more years. Johne's is a reportable disease, but not a quarantinable disease.

- **Pseudo rabies** is a viral disease most prevalent in swine, often causing newborn piglets to die. Older pigs can survive infection, becoming carriers of the pseudo rabies virus for life. Other animals infected from swine die from pseudo rabies, which is also known as Aujeszky's disease and "mad itch." Infected cattle and sheep can first show signs of pseudo rabies by scratching and biting themselves. In dogs and cats, pseudo rabies can cause sudden death. The virus does not cause illness in humans. Due to an extensive eradication program, Iowa and the rest of United States are free of pseudo rabies.

- **Scrapie** is a fatal, degenerative disease affecting the central nervous system of sheep and goats that is very similar to BSE (mad cow disease), although it does not cause disease in humans, and has been present in the US for over 50 years. Infected flocks that contain a high percentage of susceptible animals can experience significant production losses. In these flocks, over a period of several years, the number of infected animals increases and the age at onset of clinical signs decreases making these flocks economically unviable. Animals sold from infected flocks spread scrapie to other flocks. The presence of scrapie in the US also prevents the export of breeding stock, semen, and embryos to many other countries. Currently there is a national program underway to eradicate scrapie in the US

Disease outbreaks can also occur in wild animal populations. The IDALS's Bureau of Animal Industry also monitors wild animal species and game throughout the state as well as diseases that may impact them.

Crop Pests/Diseases

A plant disease outbreak or a pest infestation could negatively impact crop production and agriculturally dependent businesses. An extreme outbreak or infestation could potentially result in billions of dollars in production losses across the US The cascading net negative economic effects could result in widespread business failures, reduction of tax revenues, harm to other state economies, and diminished capability for this country to compete in the global market.

Many factors influence disease development in plants, including hybrid/variety genetics, plant growth stage at the time of infection, weather (e.g., temperature, rain, wind, hail, etc.), single versus mixed infections, and genetics of the pathogen populations. The two elements of coordination and communication are essential when plant diseases or pest infestations occur.

The United States Department of Agriculture/ Animal Plant Health Inspection Service, Iowa Department of Agriculture and Land Stewardship, local producers, local government, assessment teams and state

government entities must work together to effectively diagnose the various plant hazards to determine if immediate crop quarantine and destruction is required.

Iowa State University, College of Agriculture and Life Sciences, has The Plant and Insect Diagnostic Clinic http://www.ipm.iastate.edu/ipm/info/insects that provides diagnosis of plant problems (plant diseases, insect damage, and assessment of herbicide damage) and the identification of insects and weeds from the field garden, and home. Specific plant pests can vary from year to year. For complete details of all insects and diseases that can impact crops in Worth County, see the website above.

Emerald Ash Borer

The Hazard Mitigation Planning Team is also aware of the emerald Ash Borer pest that threatens Iowa's forests and urban landscape. This pest is a slender, emerald-green beetle that is ½ inch long, and responsible for the destruction of approximately 20 million ash trees in Ohio, Michigan, Indiana, Illinois, and Ontario, Canada. Emerald Ash Borer has made its way into Iowa and has become an increasing threat, including in Worth County where its presence was confirmed in 2021.

Wildlife

Iowa farmers lose a significant amount of crops each year because of wildlife foraging. This can be particularly problematic in areas where natural habitat has been diminished or in years where weather patterns such as early/late frost deep snow, or drought has caused the wild food sources to be limited.

Location

All of Worth County is subject to animal/livestock incidents and agricultural infestations. According to the 2017 Census of Agriculture there were 582 farms in the County covering 238,824 acres of land (64.9% of the 575 sq. miles of land area (368,000 acres) in the County).

Table 4-14 provides a summary of the value of agricultural products sold in the planning area. Agricultural infestation of crops or livestock in the planning area would severely impact the economy.

Table 4-14 Market Value of Agricultural Products Sold, 2017 - Worth County, IA

Market Value of Products Sold	$144,410,000
Market Value of Crops	$124,367,000 (86.1%)
Market Value of Livestock	$20,044,000 (13.9%)
Average Per Farm	$248,127

Source: USDA National Agricultural Statistics Service, 2017 Census of Agriculture.

Animal Location/Extent

In addition to the animal farm operations, there are also confined and open feeding operations in Worth County. According to data from the Iowa NRGIS Repository, there are 14 Animal Feeding Operation listed in the Iowa Department of Natural Resources Animal Feeding Operations Database. This includes 13 Confined Animal Feeding Operations and one Open Feedlot.

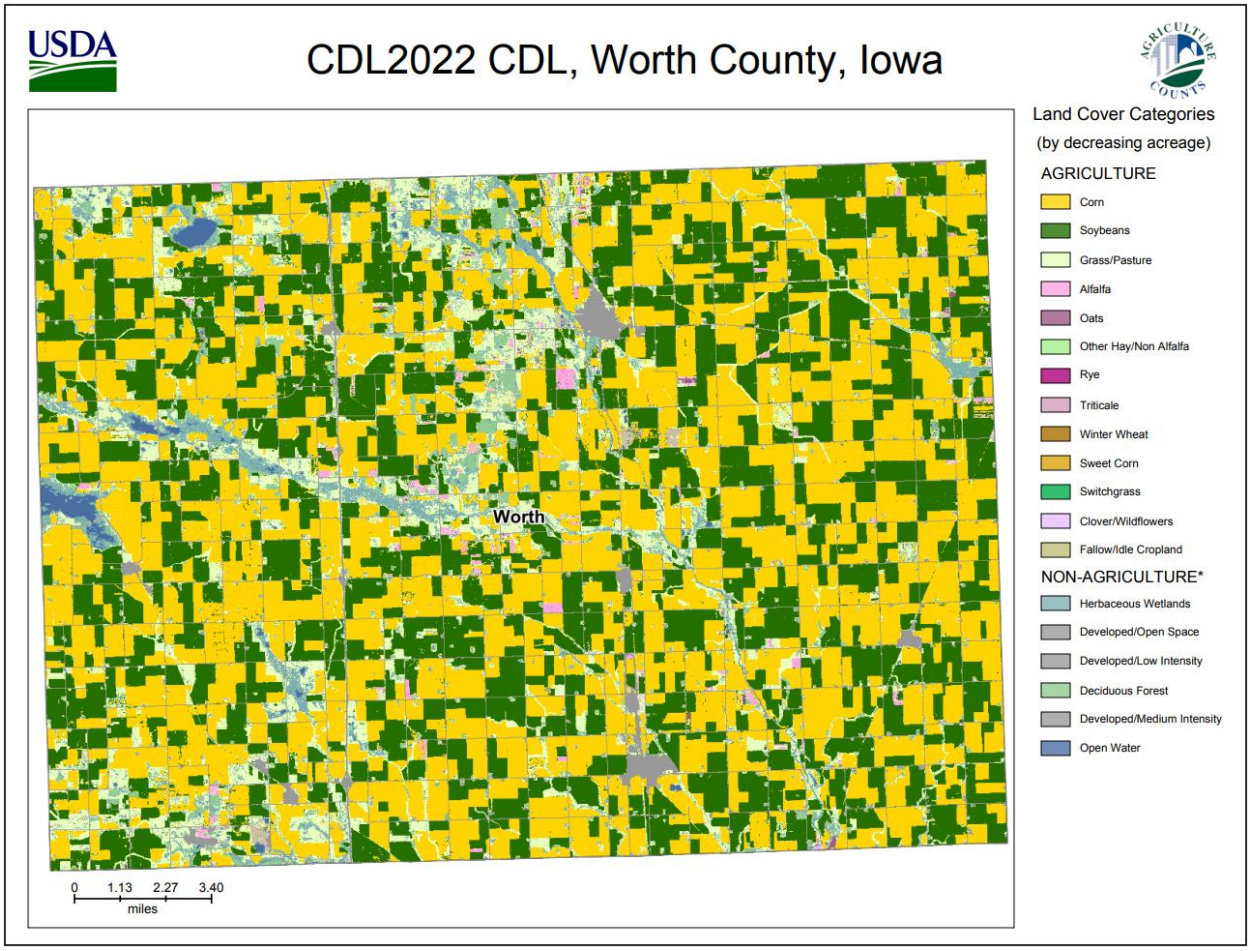
Crop Location/Extent

According to the National Agricultural Statistics Service, in 2021 Worth County's top crop items included the following:

- Corn for Grain (State Rank 58) 105,900 acres harvested
- Soybeans (State Rank 45) 89,800 acres harvested
- Oats (State Rank 23) 200 acres harvested

As can be seen in the USDA Cropland Data Layer (CDL) in **Figure 4-2**, the majority of land in Worth County outside the incorporated areas is in agricultural use, with primary crops of corn and soybeans.

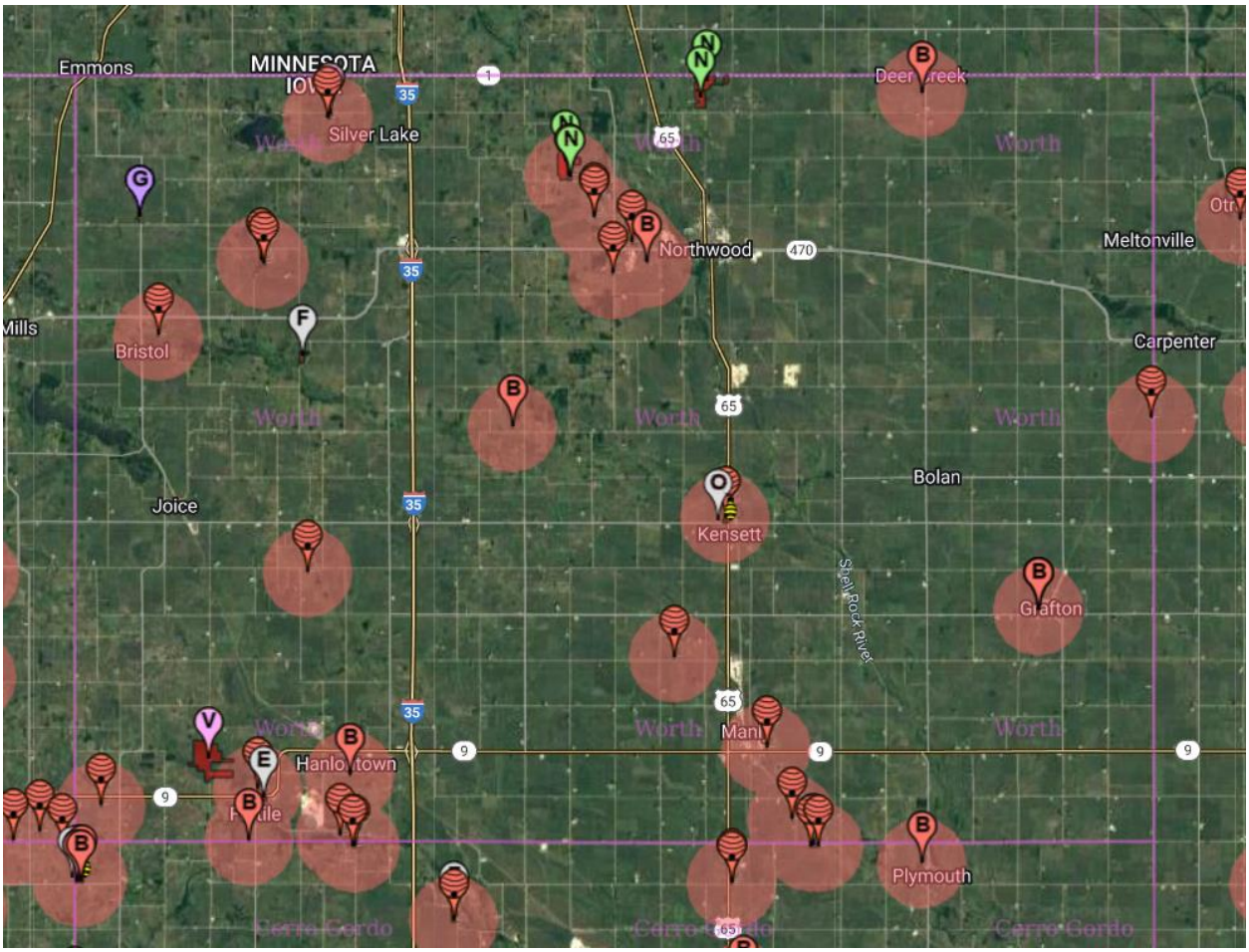
Figure 4-2 Worth County Cropland Data Layer



Source: USDA, produced by CropScape, https://nassgeodata.gmu.edu/CropScape/

Figure 4-3 provides the locations of the sites included on the Sensitive Crops Registry according to the Iowa Department of Agriculture and Land Stewardship, Pesticide Bureau. The types of sensitive crops in the county include berries, orchard, non-specified organic, and beehives.

Figure 4-3 Sensitive Crops Registered Sites, Worth County, IA

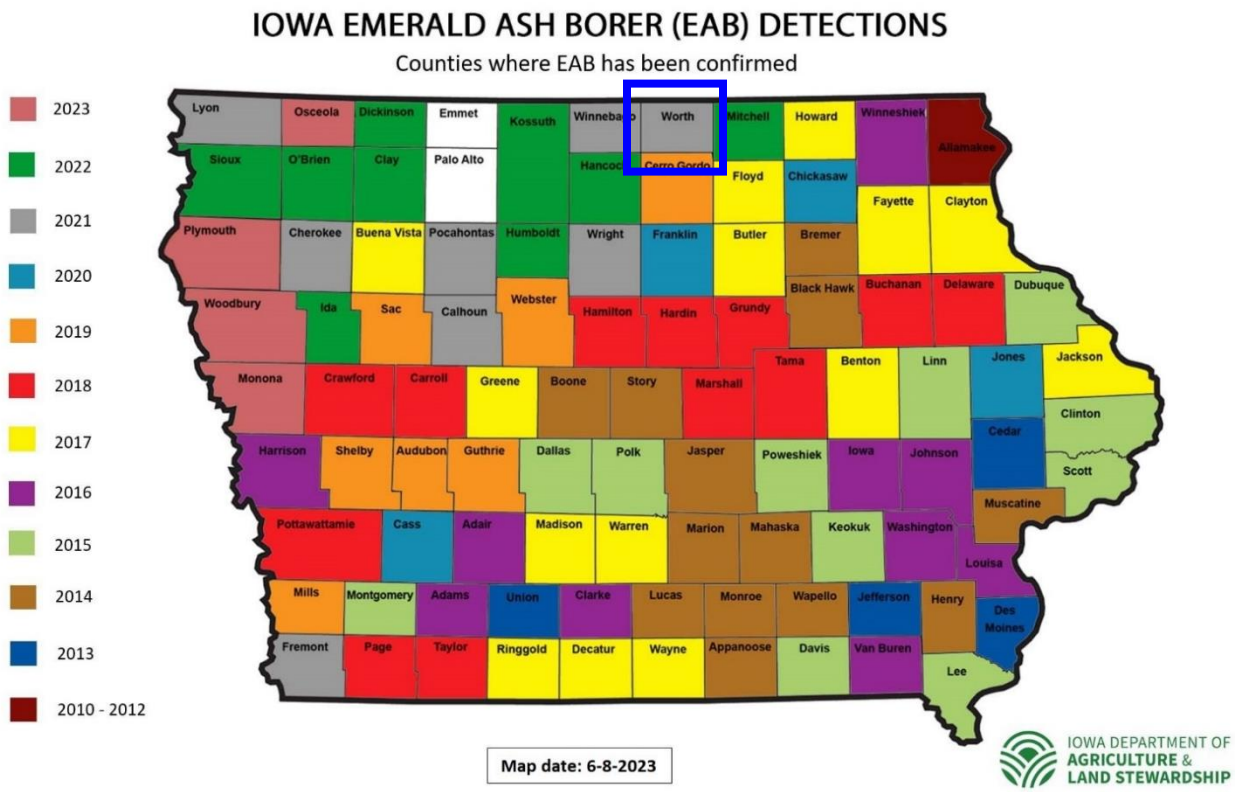


Source: Iowa Specialty Crop Site Registry, https://ia.driftwatch.org/map

Emerald Ash Borer Location/Extent

Figure 4-4 shows the counties in the US in which the Emerald Ash Borer has been detected. Worth County is shaded grey, indicating Emerald Ash Borer was detected in the county in 2021.

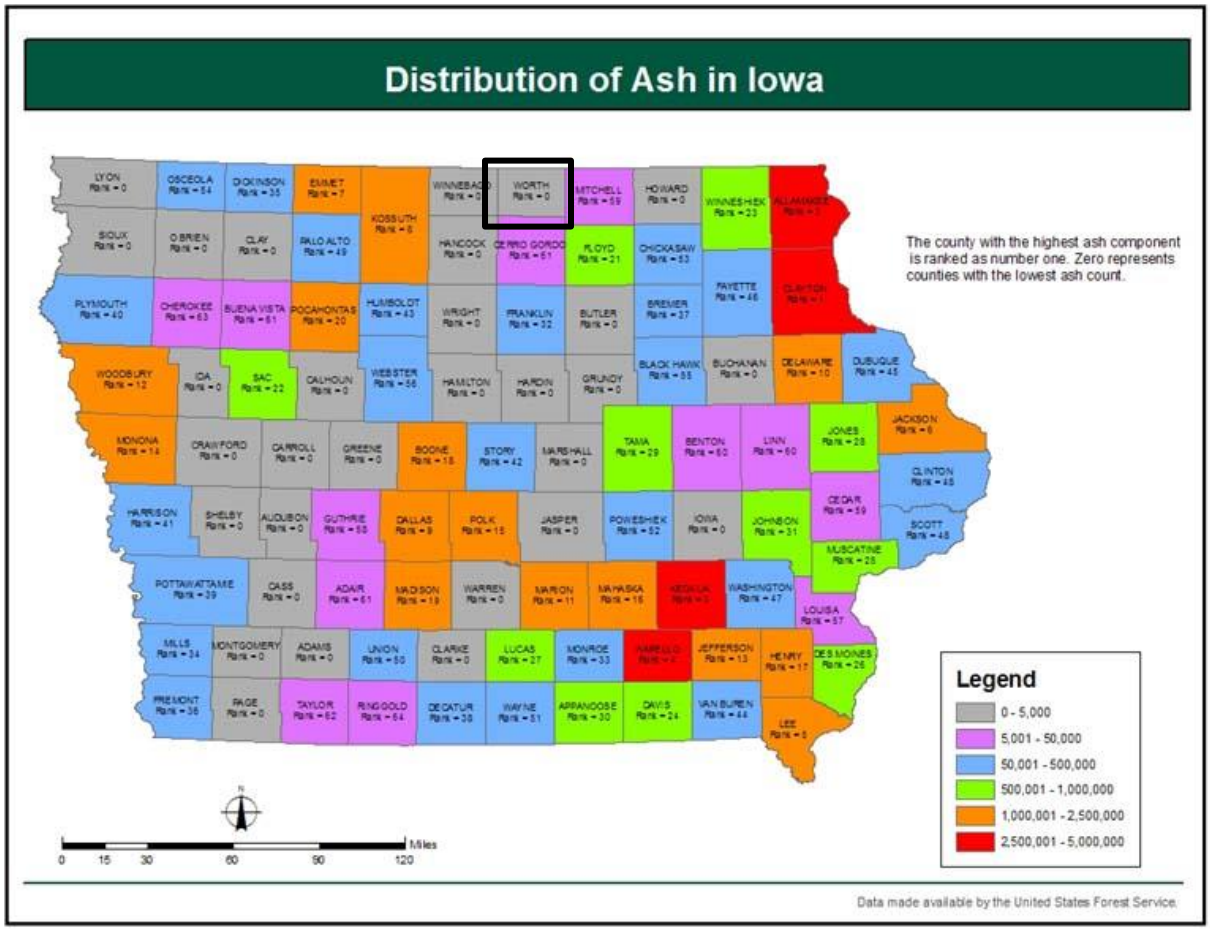
Figure 4-4 Iowa Counties Affected by Emerald Ash Borer, by Detection Date



Source: Iowa Department of Agriculture and Land Stewardship, Entomology and Plant Science Bureau
Blue square identifies Worth County

It is estimated by the Iowa Department of Natural Resources – Forestry Bureau that approximately 16 percent of public trees in Iowa cities are ash trees, although that number can be as high as 50% in some areas (AP 2022). Statewide, there are over 50 million ash trees (green, white, and black) in forested areas and another 3 million in urban areas (AP 2022). As seen in **Figure 4-5** below, Worth County ranks on the lower end in the state with 0 to 5,000 ash trees in the County according to data from the U.S. Forest Service. Also, a cooperative state and federal effort has developed the "Iowa Emerald Ash Borer Readiness Plan" https://www.iowadnr.gov/Portals/idnr/uploads/forestry/Forest%20Health/IA%20EAB%20Readiness%20Plan%202%20JAN%202013%20DRAFT.pdf to help stop this pest by education, monitoring, surveillance, containment and communication.

Figure 4-5 Distribution of Ash Trees in Iowa

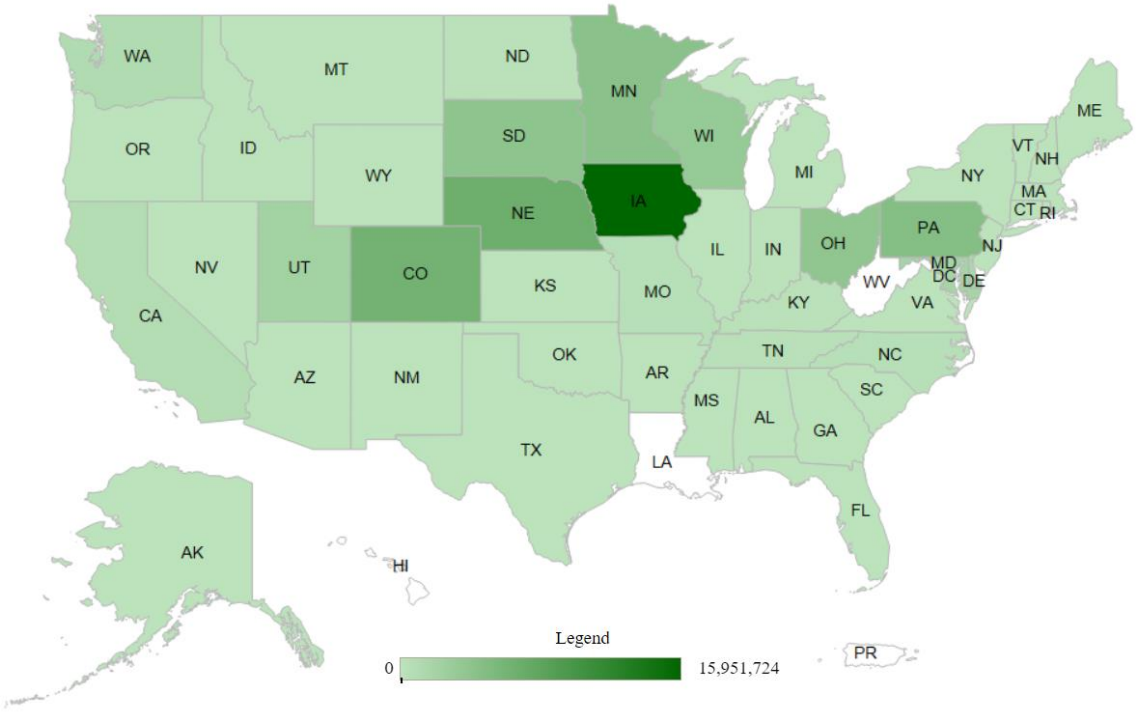


Source: Iowa State University Extension Office
http://www.extension.iastate.edu/pme/EAB%20other%20forms/Iowa%20Ash%20Tree%20Distribution%202006%20map.jpg
Note: Worth County is outlined in black.

Past Occurrences

As of August 2023, 58.8 million birds had been impacted by the 2022-2023 highly pathogenic avian influenza (HPAI). A total of 839 confirmed flocks in 47 US States had confirmed cases of HPAI. As shown in **Figure 4-6**, Iowa has been hit hardest by this outbreak with 15.9 million confirmed detections. The Governor issued a series of emergency declarations related to the outbreak, although Worth County was not included.

Figure 4-6 Birds Affected by 2022-2023 HPAI by State



Source: APHIS 2023

Bovine Spongiform Encephalopathy (BSE) (A.K.A. Mad Cow Disease)

To date, BSE has been confirmed in Great Britain, Belgium, France, Germany, Spain, Switzerland, Japan, Canada, and the United States. In the United States, the first positive BSE cow was discovered in Washington. As a result of a surveillance program from June 2004 to March 2006, two additional positive domestic cows were found; one each in Texas and Alabama. Since 1997 FDA implemented a feed ban prohibiting the feeding of feedstuff derived from ruminants to other ruminants. The results of this ban and enhanced surveillance indicate that while BSE is present, it is at an extremely low level in US cattle.

Chronic Wasting Disease

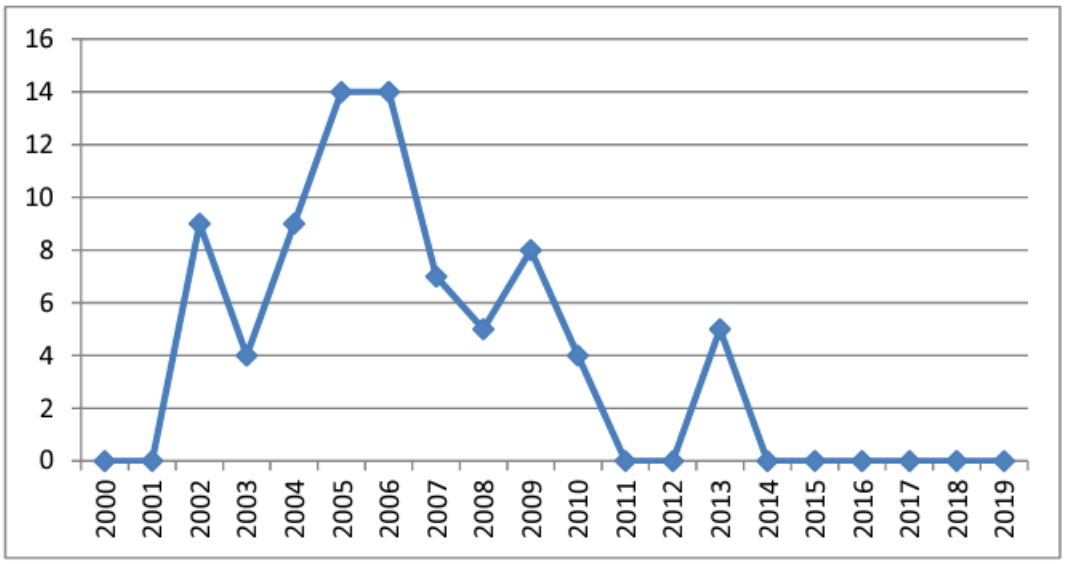
The first case of CWD in Iowa was found in 2012 on a hunting preserve in the southeastern part of the state. In that case, it was determined the CWD-positive mature buck had been transferred to the hunting preserve from a deer farm in north central Iowa. Subsequent testing found CWD at the deer farm. The farm was placed under quarantine, but the owners sued for compensation. The litigation prevented the farm from being depopulated of deer until August 2014. The Iowa Department of Agriculture and Land Stewardship conducted testing. Results were released in early October 2014, stating that 284 of 356 deer (80 percent) from a captive herd in north-central Iowa tested positive for CWD. This finding represents the highest number of CWD-positive animals detected at a facility, according to wildlife health officials (Milwaukee-Wisconsin Journal Sentinel, October 4, 2014). In 2014, the first case of CWD was found in a wild deer in Allamakee County. Then in 2015, two wild deer tested positive for CWD in Allamakee County.

As of August 2023, there were 260 confirmed cases of CWD in wild deer in Iowa, up from 96 cases in 2022 and 53 in 2021. Confirmed cases were reported in 16 counties, however none were recorded in Worth County.

Scrapie

A total of 86 herds in Iowa have been found to be infected with Scrapie since the accelerated national Scrapie Eradication Program started in November 2001. The last case of Scrapie in an Iowa producer's herd was in a found in January 2014, from a heard that had been diagnosed in 2013. **Figure 4-7** shows the progress of scrapie eradication in Iowa since 2001.

Figure 4-7 Iowa Infected & Source Flocks by Year



Source: IDALS 2020

Rabies

According to the Iowa Department of Public Health, Center for Acute Disease Epidemiology, there were 12 confirmed animal rabies cases in Iowa in 2015. In 2014, there were 15. In 2013, there were 12. In 2012, there were 31 and in 2011 there were 25. In 2016, there were 16 confirmed cases in the state. However, in Worth County, there have not been any cases of rabies since 2011. **Table 4-15** summarizes the occurrence of rabies in Iowa from 2011-2018, which is the most current comprehensive data available.

Table 4-15 Rabies Cases in Iowa and Worth County, 2011-2018

Year	Confirmed Rabies Cases in Worth County (#/Animal)	Confirmed Rabies Cases in Iowa
2018	0	10
2017	0	10
2016	0	19
2015	0	12
2014	0	15
2013	0	12
2012	0	31
2011	0	25

Source: Iowa Department of Public Health, Center for Acute Disease Epidemiology, https://idph.iowa.gov/rabies/resources

Crop Disease Past Occurrences

According to the US Department of Agriculture's Risk Management Agency, during the 15-year period from 2007-2022, combined crop insurance payments for damages resulting from disease and insects was $3,561 in Worth County. The Iowa statewide average for insurable crop acres with insurance is 93.0 percent (RMA 2022). **Table 4-16** provides a summary of insured crop losses because of crop infestations.

Table 4-16 Crop Insurance Payments for Crop Pests/Diseases 2007-2022

Damage Cause	Sum of Indemnity Amount	Sum of Determined Acres
Insects	$2,404.00	50
2011	$2,404.00	50
Mycotoxin (Aflatoxin)	$824.00	76
2009	$824.00	76
Plant Disease	$333.00	7
2014	$333.00	7
2017	$9,326	66
Grand Total	**$12,887**	**199**

Source: USDA Risk Management Agency

Probability of Future Occurrence

The planning area experiences some level of agricultural loss every year because of naturally occurring diseases that impact animals/livestock. The concern is when the level of an infestation escalates suddenly, or a new infestation appears, overwhelming normal control efforts. Normal control efforts include crop insurance and employment of various other agricultural practices that limit impact. For purposes of determining probability of future occurrence, the HMPC defined "occurrence" as an infestation occurring suddenly, a new infestation, or infestation that overwhelmed normal control efforts. Research did not reveal any infestations in Worth County that have reached this level of defined "occurrence." Therefore, it was determined that the probability of this defined "occurrence" of agricultural infestation is "Unlikely."

Magnitude/Severity

Animal/plant/crop disease is considered to have **critical** magnitude and severity. The duration of an animal/plant/crop disease will typically last more than one week. This hazard can take a significant amount of time to manage and stop the disease. The economic impacts of these hazards will be felt for months and years to follow given the agricultural nature of the State of Iowa.

Animal health emergencies can take many forms: disease epidemics, large-scale incidents of feed and water contamination, extended periods without adequate water, harmful exposure to chemical, radiological, or biological agents, and large-scale infestations of disease-carrying insects or rodents, to name a few. One of the principal dangers of disease outbreaks is that they can rapidly overwhelm the animal care system. However, state and federal animal health programs have been very successful in preventing or limiting the scope and magnitude of animal emergencies. If all these safeguards failed, a disease outbreak might cause injury, illness, or major property damage (in the form of agricultural losses). Critical facilities and emergency services could be shut down or overwhelmed for more than 24 hours.

The private practitioner is the first line of defense and will undoubtedly be the first to witness the symptoms of animal/crop/plant diseases. The USDA monitors reports submitted by veterinarians and labs to identify patterns. The department is proactive in providing information to the agricultural community on medical concerns. Conditions related to scope and magnitude can escalate quickly in certain circumstances, but farmers would be given at least a 24-hour notice.

Climate Change Impacts

The climate change impacts below are excerpted from the 2010 Report on *Climate Change Impacts on Iowa* developed by the Iowa Climate Change Impacts Committee.

Crops

Despite great improvements in yield potential over the last several years, crop production remains highly dependent on climate in conjunction with other variables. The overall effect of climate change on crop productivity in Iowa remains unclear, as positive climatic events could be overridden by the impacts of poor management or genetics, or favorable management and genetics could override negative climate events.

Regardless of these interactions, it is certain that climate changes will affect future crop production. Greenhouse and growth chamber studies suggest increases in atmospheric carbon dioxide (CO_2) will generally have a substantial positive effect on crop yields by increasing plant photosynthesis and biomass accumulation.

Greater precipitation during the growing season, as we have been experiencing in Iowa, has been associated with increased yields; however, excessive precipitation early in the growing season adversely affects crop productivity. Waterlogged soil conditions during early plant growth often result in shallower root systems that are more prone to diseases, nutrient deficiencies, and drought stress later in the season.

An increase in temperature, especially during nighttime, reduces corn yield by shortening the time in which grain is accumulating dry matter (the grain fill period). According to research, Iowa's nighttime temperatures have been increasing more rapidly than daytime temperatures.

The current changes in precipitation, temperature, wind speeds, solar radiation, dew point temperatures, and cloud cover imply less ventilation of crops and longer dew periods. Soybean plants in particular readily absorb moisture, making harvest problematic. One adaptive approach to these conditions involves farmers purchasing larger harvesting equipment to speed harvest, compensating for the reduced daily time suitable for soybean harvest.

The recent extreme weather events involving greater intensity and amount of rainfall have increased the erosive power of Iowa's precipitation, resulting in significant erosion of topsoil. The impact of climate change on the erosive force of precipitation in the US is expected to increase by as much as 58%. These rates are expected to increase exponentially as precipitation continues to rise. Plant disease can also increase as temperature, soil wetness, and humidity increase as these conditions favor the development of various plant diseases.

Animals

Even though Iowa ranks first in hog and fifth in cattle production nationwide, there is a lack of information about the effects of climate change on animal production in Iowa. Nevertheless, our general knowledge and principles pertaining to livestock and extreme weather events are applicable to Iowa's changing climate conditions. High temperatures have been shown to reduce summer milk production, impair immunological and digestive functions of animals, and increase mortality rates among dairy cattle. In general, domestic livestock can adapt to gradual changes in environmental conditions; however, extended periods of exposure to extreme conditions greatly reduce productivity and is potentially life-threatening.

Vulnerability

People

A widespread infestation of animals/livestock and crops could impact the economic base of the county and its communities. According to the USDA 2017 Census of Agriculture, Worth County has 582 farms. Jobs could be negatively impacted during an agriculture emergency; jobs tangentially tied to the agriculture industry could also be affected. Disease can exacerbate the impacts from other hazards, and an example of this is adverse weather. Dead branches weakened by Emerald Ash Borer can be broken by high winds, and there are reports of these branches falling and causing harm to people.

Property

Buildings, infrastructure, and critical facilities are not vulnerable to this hazard. Its impacts are primarily economic and environmental, rather than structural effects.

Critical Facilities and Infrastructure

Animal, crop, or plant disease is not expected to have any impacts on critical facilities or infrastructure.

Economy

A widespread infestation of animals/livestock and crops could impact the economy of the County. According to the 2019 Iowa Agricultural Economic Contribution Study, 1,240 jobs (or 32% of jobs) in Worth County are derived from agriculture. The total value-added of Worth County's agricultural products sold was $91.5 million. With this contribution of agriculture to the economy, a wide-scale agricultural infestation could severely impact the economic stability of the County.

Rough estimates of potential direct losses from a maximum threat event fall in a range of 1-50 percent of annual crop receipts. The market value of all crops grown in Worth County in 2017 was $144,410,000. Based on a worst-case scenario where 50 percent of crop production is lost each year due to agricultural infestations, the total direct costs could exceed $72 million.

Environment and Cultural Resources

The U.S. Forest Service estimates that Worth County has less than 5,000 ash trees in the County. Removal of debris if an EAB infestation would occur would be challenging and costly. If only 10 percent of the ash trees in the County were impacted, that could translate to 500 impacted trees. It is estimated that it costs $2,000 to $5,000 to replace each ash tree (AP 2022). In Worth County, the cost of a 10 percent loss could translate to over $2.5 million.

Invasive species typically harm native species through predation, habitat degradation and competition for shared resources. They can have a significant impact on crops by reducing crop yields, increasing production costs, or even causing the loss of entire crops. Invasive species can also spread diseases that can affect crops and livestock.

Development Trends

Future development is not expected to significantly impact the planning area's vulnerability to this hazard. However, if crop production and numbers of animals/livestock increases, the amount vulnerable to infestation also increases. Regarding the Emerald Ash Borer, the Iowa Department of Natural Resources recommends that other native tree species be planted in lieu of Ash trees to avoid increasing vulnerability to infestation of the Emerald Ash Borer.

Risk Summary

Animal/plant/crop disease is ranked as an overall low significance hazard.

- The magnitude of animal/crop/plant disease would be slightly less in the cities and for the school districts due to less agriculture within city limits.
- An infestation of the Emerald Ash Borer would likely have a larger impact in the incorporated areas.
- The economy of incorporated areas is heavily dependent on agriculture
- Animal/plant/crop disease vulnerability may increase over time as demand for corn, soy, poultry, and pork products grow.
- The duration of an animal/plant/crop disease will last more than one week. This hazard can take a significant amount of time to manage and stop the disease.
- Climate change may result in an increase in the frequency and severity of animal/plant/crop disease which could severely affect the local economy.
- Related hazards: Extreme Heat, Drought, Human Disease.

4.3.2 Cyber Attack

Probability	Magnitude/Severity	Location/Area	Hazard Ranking
Likely	Moderate	Significant	**Medium**

Description

Cyber attacks use malicious code to alter computer operations or data. The vulnerability of computer systems to attacks is a growing concern as people and institutions become more dependent upon networked technologies. The Federal Bureau of Investigation (FBI) reports that, "cyber intrusions are becoming more commonplace, more dangerous, and more sophisticated," with implications for private- and public-sector networks. Cyber threats can take many forms, including:

- **Distributed Denial of Service (DDoS) attack:** Perhaps the most common type of cyber attack, a DDoS attack seeks to overwhelm a network and causes it to either be inaccessible or shut down. A DDoS typically uses other infected systems and internet connected devices to "request" information from a specific network or server that is not configured or powerful enough to handle the traffic.
- **Data breach:** Hackers gaining access to large amounts of personal, sensitive, or confidential information has become increasingly common in recent years. In addition to networked systems, data breaches can occur due to the mishandling of external drives.
- **Phishing attacks:** Phishing attacks are fraudulent communications that appear to come from legitimate sources. Phishing attacks typically come through email but may come through text messages as well. Phishing may also be considered a type of social engineering meant to exploit employees into paying fake invoices, providing passwords, or sending sensitive information.
- **Malware attacks:** Malware is malicious code that may infect a computer system. Malware typically gains a foothold when a user visits an unsafe site, downloads untrusted software, or may be downloaded in conjunction with a phishing attack. Malware can remain undetected for years and spread across an entire network.
- **Ransomware:** Ransomware typically blocks access to a jurisdiction's/agency's/ business' data by encrypting it. Perpetrators will ask for a ransom to provide the security key and decrypt the data, although many ransomware victims never get their data back even after paying the ransom.
- **Critical Infrastructure/SCADA System attack:** There have been recent critical infrastructure Supervisory Control and Data Acquisition (SCADA) system attacks aimed at taking down lifelines such as power plants and wastewater facilities. These attacks typically combine a form of phishing, malware, or other social engineering mechanisms to gain access to the system.

Location

Cyber attacks can and have occurred in every location regardless of geography, demographics, and security posture. Incidents may involve a single location or multiple geographic areas. A disruption can have far-reaching effects beyond the location of the targeted system; disruptions that occur far outside the state can still impact people, businesses, and institutions within the city. All servers in Worth County and participating jurisdictions are potentially vulnerable to cyber attacks. The geographic extent is significant.

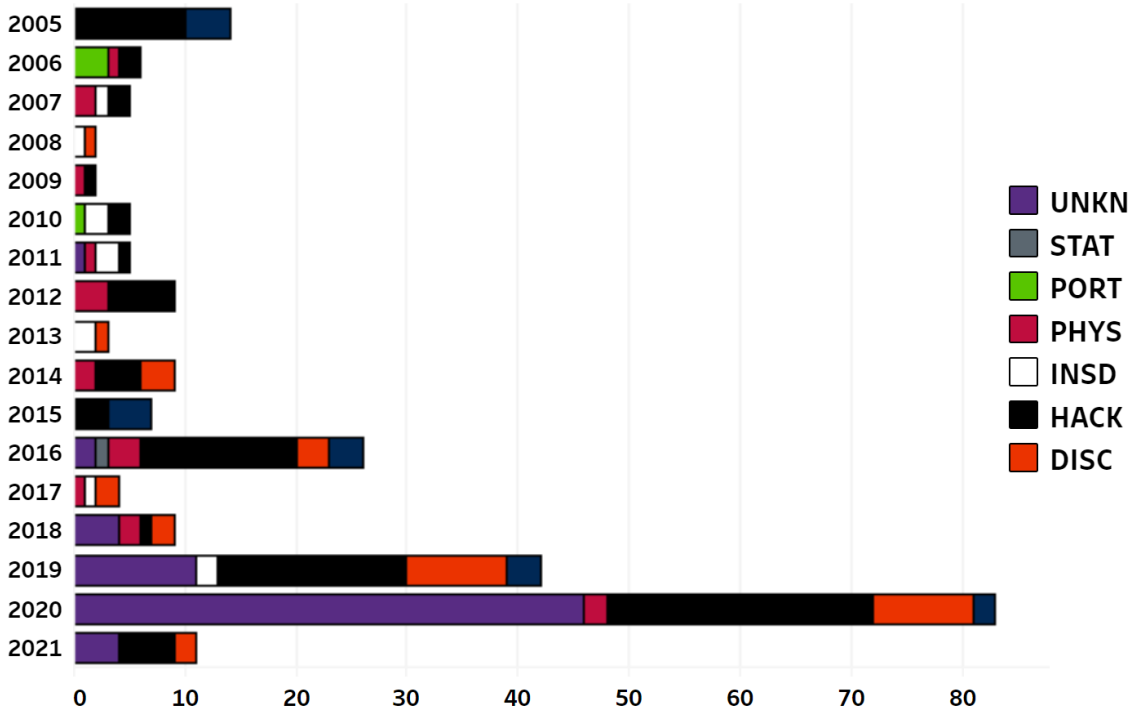
Past Occurrences

According to the FBI's 2021 Internet Crime Report, the FBI received 2.76 million complaints with $18.7 billion in losses over the last five years due to cyber-attacks. The Crime Report also noted a trend of

increasing cyber-crime complaints and losses each year. Nationwide losses in 2021 alone exceeded $6.9 billion, a 392% increase since 2017.

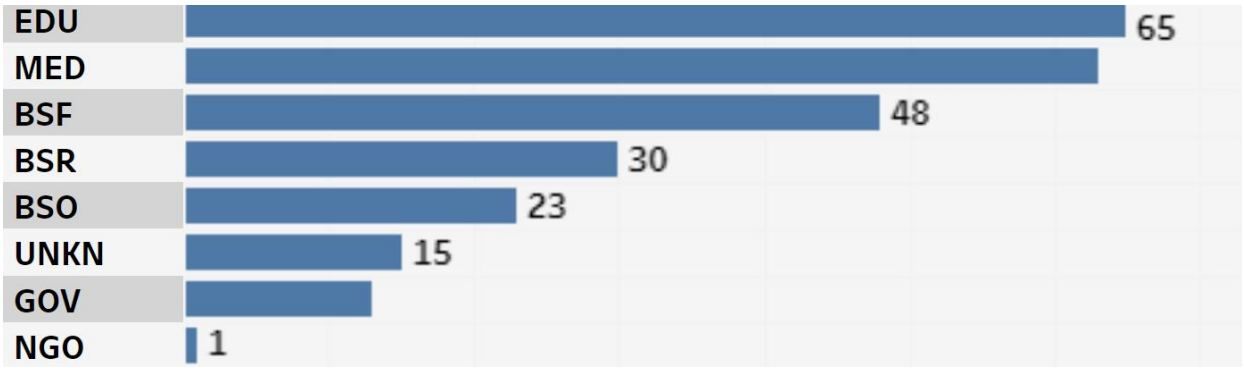
Data on past cyber-attacks impacting Iowa was gathered from the Privacy Rights Clearinghouse which shows there to be 258 total breaches on file in Iowa compared to the 702,202 breaches across the US from 2005-2022. Attacks happening outside of the state can also impact local businesses, personal identifiable information, and credit card information. **Figure 4-8** shows the type of breaches that have occurred in Iowa since 2005 while **Figure 4-9** shows the number of breaches by organization type.

Figure 4-8 Iowa Cyber Attacks Breaches by Type, 2005-2022



Source: Privacy Rights Clearinghouse

Figure 4-9 Iowa Reported Breaches by Organization Type, 2005-2022



Source: Privacy Rights Clearinghouse

Probability of Future Occurrence

Small-scale cyber attacks such as DDoS attacks occur daily, but most have negligible impacts at the local or regional level. Data breaches are also extremely common, but again most have only minor impacts on government services.

Perhaps of greatest concern to the county and jurisdictions are ransomware attacks, which are becoming increasingly common. It is difficult to calculate the odds of Worth County or one of its municipal governments being hit with a successful ransomware attack in any given year, but it is safe to say it is likely to be attacked in the coming years.

The possibility of a larger disruption affecting systems within the county is a constant threat, but it is difficult to quantify the exact probability due to such highly variable factors as the type of attack and intent of the attacker. Major attacks specifically targeting systems or infrastructure in the county cannot be ruled out. Despite the low history of events in the planning area, cyber attacks are rapidly becoming much more common. The probably of future cyber attack is **likely**.

Magnitude/Severity

There is no universally accepted scale to explain the severity of cyber-attacks. The strength of a DdoS attack is often explained in terms of a data transmission rate. One of the largest DdoS disruptions ever, known as the Dyn Attack which occurred on October 21, 2016, peaked at 1.2 terabytes per second and impacted some of the internet's most popular sites, including Amazon, Netflix, PayPal, Twitter, and several news organizations.

Data breaches are often described in terms of the number of records or identities exposed. The largest data breach ever reported occurred in August 2013, when hackers gained access to all three billion Yahoo accounts. The hacking incidents associated with Iowa in the Privacy Rights Clearinghouse database are of a smaller scale.

Ransomware attacks are typically described in terms of the amount of ransom requested, or the amount of time and money spent to recover from the attack. One report from cybersecurity firm Emsisoft estimates the average successful ransomware attack costs $81 million and can take 287 days to recover from. Therefore, the potential magnitude and severity of cyber-attack is **Moderate**.

Climate Change Considerations

There are no known effects of climate induced impacts on cyber attacks.

Vulnerability

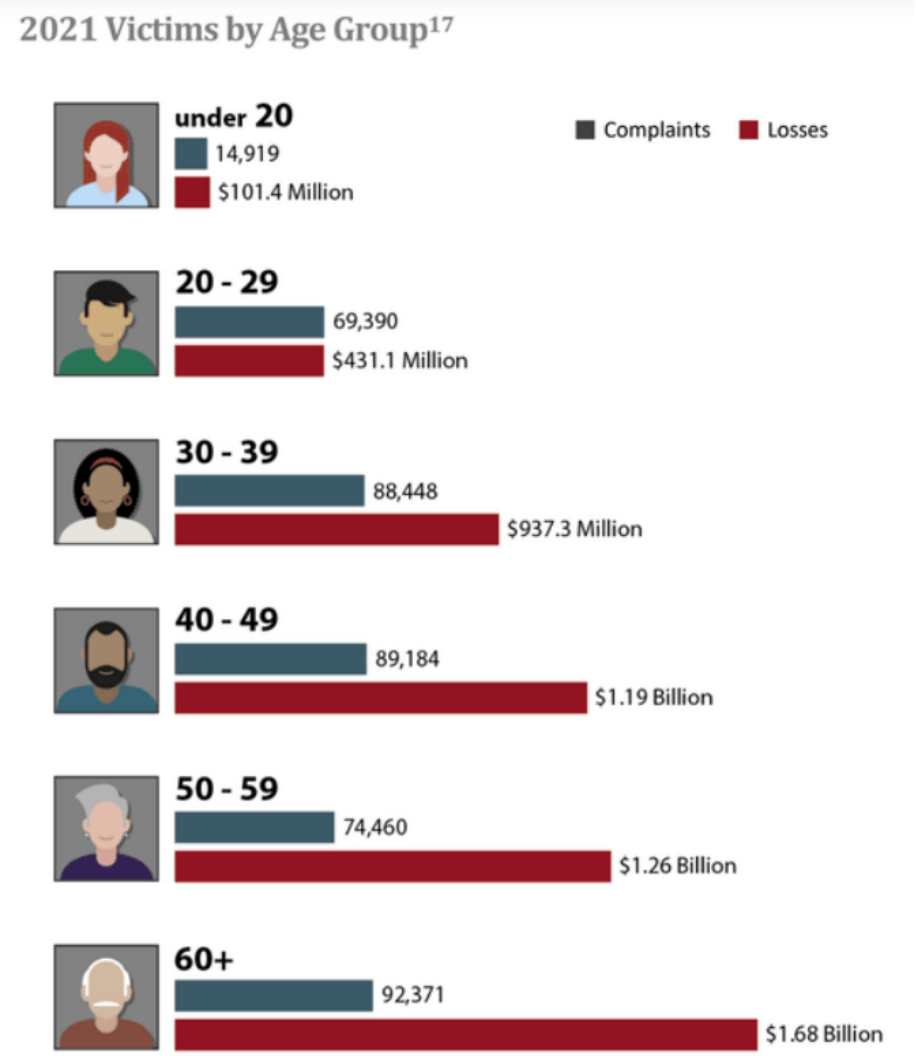
People

Injuries or fatalities from cyber-attacks would generally only be possible from a major cyber-terrorist attack against critical infrastructure. More likely impacts on the public are financial losses and an inability to access systems such as public websites and permitting sites. Indirect impacts could include interruptions to traffic control systems or other infrastructure.

The FBI Internet Crime Reports on the victims of cyber-attack by age group. While the number of cyber-attack complaints is comparable across age groups, the losses increase significantly as age group increases, with individuals 60 years and older experiencing the greatest losses. This is likely due to seniors being less aware of cyberthreats, lack of the tools to identify cyberthreats, and so-called "Grandparent Scams", which is a cyber-attack where criminals impersonate a loved one in need, such as a grandchild,

and ask for money. In the Western Region, 37.6% of the population was reported to be 60+ in 2020, according to the U.S. Census. **Figure 4-10** displays the breakdown of victims by age group in 2021.

Figure 4-10 Victims by Age Group in 2021



Source: The FBI Internet Crime Report 2021

Property

Most cyber-attacks affect only data and computer systems and have minimal impact on the general property. However, sophisticated attacks have occurred against the SCADA systems of critical infrastructure, which could potentially result in system failures on a scale equal to natural disasters. Facilities and infrastructure such as the electrical grid could become unusable. A cyber-attack took down the power grid in Ukraine in 2015, leaving over 230,000 people without power. A ransomware attack on the Colonia Pipeline in 2021 caused temporary gas shortages on the East Coast. The 2003 Northeast Blackout, while not the result of a cyber-attack, caused 11 deaths and an estimated $6 billion in economic loss.

Critical Facilities and Infrastructure

An article posted on July 31, 2022, by government technology mentions that despite the lack of major headline-grabbing cyber-attacks against U.S. critical infrastructure so far in 2022, our global cyber battles continue to increase. Worldwide cyber actions are becoming less covert. Besides, according to IBM's 2022 annual Cost of a Data Breach Report, almost 80 percent of critical infrastructure organizations studied do not adopt zero-trust strategies, seeing average breach costs rise to $5.4 million – a $1.17 million increase compared to those that do. All while 28 percent of breaches amongst these organizations were ransomware or destructive attacks (Lohrmann 2022).

Cyber-attacks can interfere with emergency response communications, access to mobile data terminals, and access to critical pre-plans and response documents. According to the Cyber & Infrastructure Security Agency (CISA), cyber risks to 9-1-1 systems can have "severe impacts, including loss of life or property; job disruption for affected network users; and financial costs for the misuse of data and subsequent resolution." CISA also compiled a recent list of attacks on 9-1-1 systems including a DdoS in Arizona, unauthorized access with stolen credentials in Canada, a network outage in New York, and a ransomware attack in Baltimore.

Moreover, the delivery of services can be impacted since governments rely to a great extent on the electronic delivery of services. Most agencies rely on server backups, electronic backups, and remote options for Continuity of Operations/Continuity of Government. Access to documents on the network, OneDrive access, and other operations that require collaboration across the Western Region will be significantly impacted.

In addition, public confidence in the government will likely suffer if systems such as permitting, DMV, voting, or public websites are down for a prolonged amount of time. An attack could raise questions regarding the security of using electronic systems for government services.

Economy

Data breaches and subsequent identity thefts can have huge impacts on the public. Economic impacts from a cyber-attack can be debilitating. The cyber-attack in 2018 that took down the City of Atlanta cost at least $2.5 million in contractor costs and an estimated $9.5 million additional funds to bring everything back online. The attack in Atlanta took more than a third of the 424 software programs offline and recovery lasted more than 6 months. The 2018 cyber-attack on the Colorado Department of Transportation (CDOT) cost an estimated $1.5 million. None of these statistics consider the economic losses to businesses and ongoing IT configuration to mitigate from a future cyber-attack.

Additionally, a 2016 study by Kaspersky Lab found that roughly one in five ransomware victims who pay their attackers never recover their data. A 2017 study found ransomware payments over a two-year period totaled more than $16 million. Even if a victim is perfectly prepared with full offline data backups, recovery from a sophisticated ransomware attack typically costs far more than the demanded ransom.

Environment and Cultural Resources

Most cyber incidents have little to no impact on historic, cultural, or natural resources. A major cyber terrorism attack could potentially impact the environment by triggering a release of hazardous materials, or by causing an accident involving hazardous materials by disrupting traffic control devices. There are cases, such as a cyber-attack on a hydroelectric dam, that could result in catastrophic consequences to natural and human-built environments in the case of a flood. If a cyber-attack occurred on several upstream dams and released significant amounts of water downstream, the additional pressure put on downstream dams could fail, resulting in massive flood events. This would not only jeopardize the energy system that relies on these dams but also cause significant damage to the natural environment.

Development Trends

Changes in development have no impact on the threat, vulnerability, and consequences of a cyber-attack. Cyber-attacks can and have targeted small and large jurisdictions, multi-billion-dollar companies, small mom-and-pop shops, and individual citizens. The decentralized nature of the internet and data centers means that the cyber threat is shared by all, regardless of new construction and changes in development.

Risk Summary

In summary, the cyber-attack hazard is considered to be overall **Medium** significance for Worth County. Variations in risk by jurisdiction are summarized in the table below, as well as key issues from the vulnerability assessment.

- Overall, cyber-attacks are rated as a Medium significance in the planning area
- Cyber-attacks can occur anywhere and on any computer network, therefore, this hazard is rated as Significant location
- There is an increasing trend in the number of cyber-attacks in the U.S. each year, therefore, the frequency of cyber-attack is rated as Likely
- Cyber-attacks can result in significant economic losses, interruptions of critical facilities and services, and confidential data leaks; therefore, magnitude is ranked as Critical
- People ages 60+ are the most likely age group to experience the greatest monetary losses, although anyone of any age can be a victim to a cyber-attack
- Small businesses worth less than $10 million and local governments are increasingly becoming targets for cyber-attack, with criminals assuming these smaller organizations will lack the resources to prevent an attack
- Critical infrastructure, such as the energy grid and first responder communication, is vulnerable to cyber-attack and disruption
- Significant economic losses can result from cyber-attacks if the attackers ask for ransom
- Jurisdictions with a significantly large population and advanced infrastructure are most likely to experience cyber-attacks, but rural areas can also be targets.

4.3.3 Dam/Levee Failure

Probability	Magnitude/Severity	Location/Area	Hazard Ranking
Unlikely	Negligible	Limited	**Low**

Description

Many of Iowa's community settlements were founded along rivers and streams due to their reliance on water resources. Often, these streams or rivers later needed a dam or levee for flood control or a reservoir for a constant water source. This section discusses both dam and levee failure.

Dam Failure

A dam is defined as a barrier constructed across a watercourse 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. Dam failure can be caused by any of the following: flooding; earthquakes, flow blockages, landslides, lack of maintenance, improper operation, poor construction, vandalism, or terrorism.

Levee Failure

According to FEMA, a levee is defined as a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound and engineering practices to contain, control, or divert the flow of water to reduce risk from temporary flooding. Levee Failure is the uncontrolled release of water resulting from a structural failure. Possible causes of the failure could include flooding, earthquakes, blockages, landslides, lack of maintenance, improper operation, poor construction, vandalism, terrorism, erosion, piping, saturation, or under seepage.

Location

Dams in Planning Area

The thresholds for when a dam falls under State regulation are outlined in Iowa Administrative Code 567-71.3 and are listed below. The thresholds are primarily based on both dam height and water storage volumes. State-regulated dams are those dams that meet the following:

In Rural Areas:

a. *Any dam designed to provide a sum of permanent and temporary storage exceeding 50 acre-feet at the top of dam elevation, or 25 acre-feet if the dam does not have an emergency spillway, and which has a height of 5 feet or more.*
b. *Any dam designed to provide permanent storage in excess of 18 acre-feet and which has a height of 5 feet or more.*
c. *Any dam across a stream draining more than 10 square miles.*
d. *Any dam located within 1 mile of an incorporated municipality, if the dam has a height of 10 feet or more, stores 10 acre-feet or more at the top of dam elevation, and is situated such that the discharge from the dam will flow through the incorporated area.*

In Urban Areas:

Any dam which exceeds the thresholds in 71.3 (1) "a", "b", or "d".

Low Head Dams:

Any low head dam on a stream draining 2 or more square miles in an urban area, or 10 or more square miles in a rural area.

Dams are classified by the State of Iowa into three categories based on the potential risk to people and property in the event of failure (see **Table 4-17**). The classification can change over time due to changes in development downstream from the dam. In addition, older dams may not have been built to the standards of their updated classification when this occurs. The Iowa Department of Natural Resources performs annual inspections on all high hazard dams in the State.

Table 4-17 Dam Hazard Classification Definitions

Hazard Class	Definition
High	A structure shall be classified as high hazard if located in an area where failure may create a serious threat of loss of human life or result in considerable damage to residential, industrial, or commercial areas, important public utilities, public buildings, or major transportation facilities.
Significant	A structure shall be classified as moderate hazard if located in an area where failure may damage isolated homes or cabins, industrial or commercial buildings, moderately traveled roads or railroads, or interrupt major utility services, but without substantial risk of loss of human life. In addition, structures where the dam and its impoundment are of themselves of public importance, such as dams associated with public water supply systems, industrial water supply or public recreation, or which are an integral feature of a private development complex, shall be considered moderate hazard for design and regulatory purposes unless a higher hazard class is warranted by downstream conditions.
Low	A structure shall be classified as low hazard if located in an area where damages from a failure would be limited to loss of the dam, loss of livestock, damages to farm outbuildings, agricultural lands, and lesser used roads, and where loss of human life is considered unlikely.

Source: Iowa Department of Natural Resources; *the term "moderate" is used by the Iowa Department of Natural Resources. However, the National Inventory of Dams uses the term "significant" to identify the same general hazard classification

For this plan update, both the National Inventory of Dams as well as the State-regulated dam inventory were consulted. There are seven dams inside the county boundaries of Worth County, and all seven are Low Hazard dams that can be seen on **Figure 4-11**. There are no High or Significant dams within the County.

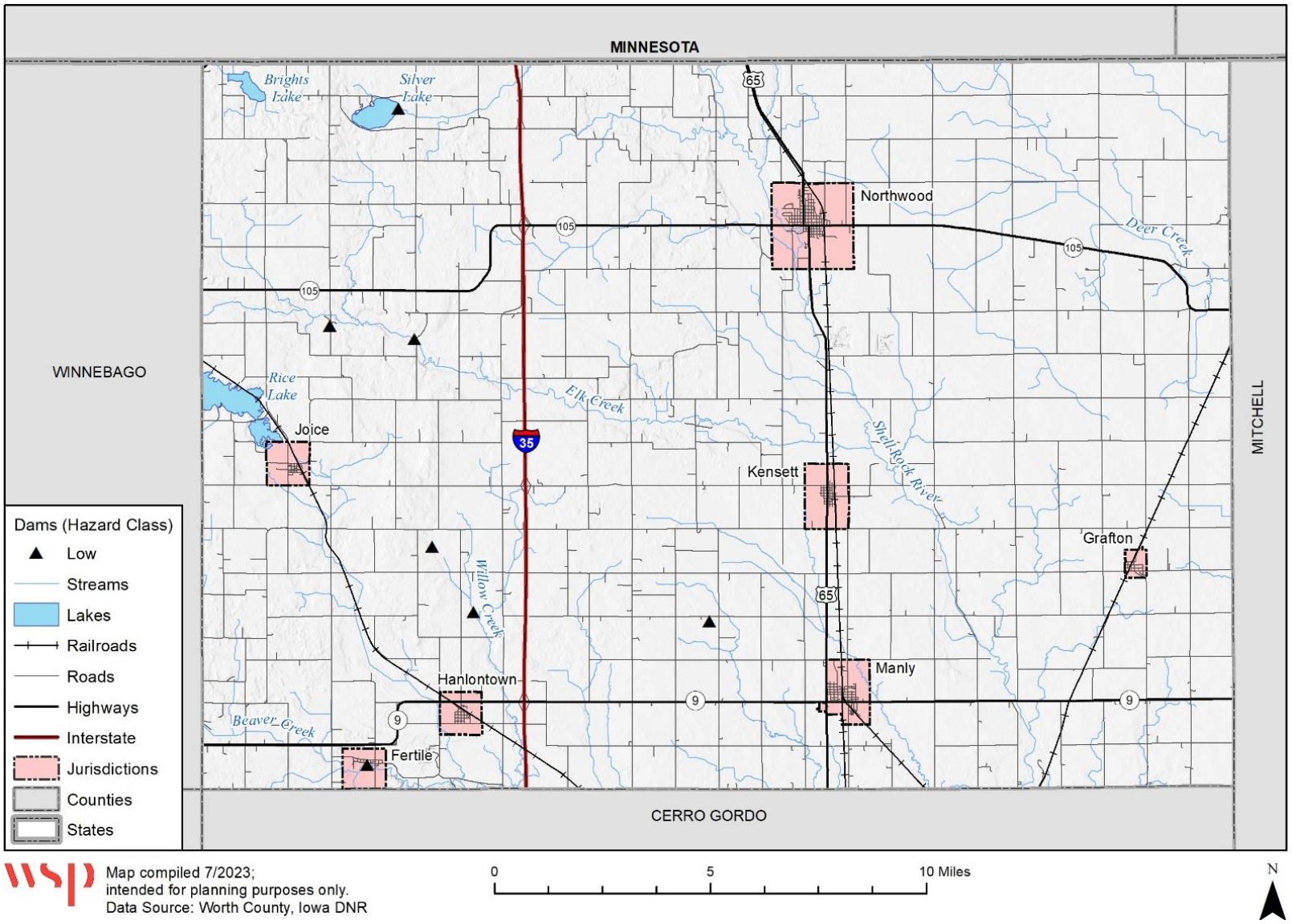
Table 4-18 provides the names, locations, and other pertinent information for all dams in the planning area. There are no dams upstream from the County that would be expected to cause damage to County assets. The Vulnerability Analysis section provides additional information about the dams based on data that was extracted from available inspection reports.

Table 4-18 Dams in the Worth County Planning Area

Dam Name	NID #	Hazard Class	EAP	Dam Height (ft.)	Max Storage (acre ft.)	Normal Storage (acre ft.)	River	Nearest Downstream City/Distance (miles)
Cutler Dam	IA03428	L	NR	7	190	58	TTR- WILLOW CREEK	Mason City (16)
Elk Creek Game Management Dam 1	IA01200	L	NR	18	2,553.00	1,150.00	ELK CREEK	Kensett (12)
Elk Creek Game Management Dam 2	IA01205	L	NR	17	2,097.00	787	ELK CREEK	Kensett (14)
Fertile Mill Dam	IA01967	L	NR	11	116	116	WINNEBAGO RIVER	Fertile (0)
Hanlontown Slough – Hagen Site	IA03349	L	NR	6	61	23	TR- WILLOW CREEK	N/A
Hanlontown Slough Dam 1.1	IA03897	L	NR	11	191	32	TR- WILLOW CREEK	Hanlontown (3)
Hanlontown Slough Site 3	IA03429	L	NR	8	592	121	TR- WILLOW CREEK	Mason City (19)

Source: Iowa Department of Natural Resources; L= Low; NR= Not Required; N/A = Not Available; EAP = Emergency Action Plan

Figure 4-11 Dams in Worth County



The National Levee Database (NLD) was consulted to identify levees in the planning area. The NLD does not list any levees in Worth County.

Past Occurrences

To determine previous occurrences of dam failure within Worth County, the *2013 Worth County Multijurisdictional Hazard Mitigation Plan*, the *Iowa State Hazard Mitigation Plan*, and Stanford University's National Performance of Dams Program (NPDP) (https://npdp.stanford.edu/) were reviewed for historical dam failures. The following incident is reported in NPDP records:

- **Fertile Mill Dam, August 1979** – A section of the earth dike washed out, possibly due to a piping or seepage-induced slope failure. There was some minor sediment and flood damage to a downstream park area. No consequence data was reported.

No other incidents of dam failure are reported within Worth County.

Probability of Future Occurrence

There is no reported history of dam or levee failure in Worth County. As previously mentioned, all dams in the county are low hazard. Based on past performance, the HMPC determined that the probability of future occurrence of dam failure is **unlikely**.

Magnitude/Severity

A failure of a low hazard dam, which includes all dams in Worth County, would result in damages that are limited to loss of the dam, livestock, farm outbuildings, agricultural lands, and lesser-used roads. Low hazard dam failure would likely not have an impact on the property beyond where the dam is located. The loss of human life is considered highly unlikely.

A failure of a significant hazard dam may damage isolated homes or cabins, industrial or commercial buildings, moderately traveled roads, or interrupt major utility services, but are without substantial risk of loss of human life. Dams are also classified as Moderate Hazard where the dam and its impoundment are themselves of public importance, such as dams associated with public water supply systems, industrial water supply or public recreation or which are an integral feature of a private development complex.

A failure of a high hazard dam creates a serious threat of loss of human life or would result in serious damage to residential, industrial, or commercial areas, important public utilities, public buildings, or major transportation facilities. All the dams located in The County are rated as a low hazard.

Worth County does not contain any Significant or High Hazard dams. However, two of the dams in the County are considered major structures, and therefore have regular inspections, which provide additional information on potential vulnerability to failure of these dams.

The most recent inspection reports were provided for the following dams:

Elk Creek Game Management Dam 1—6/7/2016: satisfactory rating; the dam is expected to have safe performance under all anticipating loading conditions. However, it is critical that any maintenance or repair items in the report be addressed, including removal of trees on the upstream and downstream embankments and along the toe as well as ongoing maintenance to provide new seals on the radial gates.

Elk Creek Game Management Dam 2—6/7/2016: satisfactory rating; the dam is expected to have safe performance under all anticipating loading conditions. However, ongoing maintenance is needed, including

removal of trees on the upstream and downstream embankments and along the toe of the embankment and prevention of new tree growth.

A magnitude rating of "**negligible**" is appropriate due to the limited physical vulnerability and the improbability of loss of life from failure of the low hazard dams.

Climate Change Considerations

Increased frequency of precipitation and precipitation extremes leading to flooding could cause additional stress on dam and levee structures. Although dam failure is unlikely in this county, it should be noted that the amount of precipitation could increase due to climate change causing a higher risk of dam failure or flooding within the county in future conditions. The volume of water that a dam can hold and operate water may have to increase as precipitation events occur more often.

Vulnerability

People

Persons located underneath or downstream of a dam are at risk of a dam failure, though the level of risk can be tempered by topography (specifically where populations are located within the inundation path of a dam), amount of water in the reservoir and time of day of the breach. Injuries and fatalities can occur from debris, bodily injury, and drowning. Once a dam has breached, standing water presents all the same hazards to people as floodwater from other sources. People in the inundation area may need to be evacuated, need medical assistance, and possibly permanently relocated. Impacts could include thousands of evacuations and likely hundreds of casualties, depending on the dam involved.

The populations most vulnerable are those that have the least time to evacuate and need assistance. Populations that may need assistance to evacuate include the elderly, disabled and young. The vulnerable population also includes those who may not have an adequate warning about evacuation from emergency notification systems. The loss of life is impacted by the amount of early warning time first responders and the public has prior to the incident.

However as mentioned above, dam inundation data is not available for the dams located in the County and each of the dams are low hazard. Therefore, specific GIS analysis on the population that may be at risk of dam incidents is not performed.

Property

Based on the definition of high hazard dams, failure of these dams could create a serious threat of loss of human life or result in serious damage to residential, industrial, or commercial areas, important public utilities, public buildings, or major transportation facilities.

In general, communities located below a high or significant hazard dam and along a waterway are potentially exposed to the impacts of a dam failure. Inundation maps that identify anticipated flooded areas (which may not coincide with known floodplains) are typically produced for all high hazard dams and included in the Emergency Action Plan (EAP) required for each dam.

A total dam failure can cause catastrophic impacts to areas downstream of the water body, including critical infrastructure. Any critical asset located under the dam in an inundation area would be susceptible to the impacts of a dam failure. Of particular risk would be roads and bridges that could be vulnerable to washouts, further complicating response and recovery by cutting off impacted areas. Impacts to cities would affect key infrastructure including hospitals, fire stations, clinics, and businesses.

Critical Facilities and Infrastructure

A total dam failure can cause impacts to areas downstream of the water body, including critical infrastructure. Any critical asset located under the dam in an inundation area would be susceptible to the impacts of a dam failure. Of particular risk would be roads and bridges that could be vulnerable to washouts, further complicating response and recovery by cutting off impacted areas. Impacts to cities would affect key infrastructure including hospitals, fire stations, clinics, and businesses.

Economy

Economic impacts due to a dam or levee failure event will be related to both the event (i.e. damage to containment structure) and the recovery after the event. However, due to the lack of dam inundation data, an estimate of economic damages that could result from dam incidents is then not available. Additionally, due to the lack of significant or high hazard dams in Worth County, it can be presumed that economic impacts would be short-lived and minimal in impact.

Environment and Cultural Resources

A dam failure event in Worth County could cause damage to agricultural land or recreational facilities. No historic or cultural resources were noted. However, there were recent inspections to Elk Creek Game Management Dam in 2016 due to maintenance being report due to the removal of trees on the upstream and downstream embankments.

Development Trends

There are no high or significant hazard dams or any regulated levees in Worth County. Although minor flooding and damages could result from the failure of a low hazard dam, the extent of such flooding has not been determined. Therefore, there is no specific information on the vulnerability of physical structures to this hazard. Since Worth County only contains low hazard dams, the county overall is at low risk for dam failure. However, development below this dam or other significant hazard dams could change this classification. Development trends are not anticipated to change risk significantly.

Risk Summary

Overall, significance of this hazard is **low**.

- There is no high hazard dam in Worth County.
- The only incident was related to maintenance being reported to remove tress on the upstream and downstream embankments to the Elk Creek Game Management Dam.
- Related hazards: Flooding, Earthquake, Landslide.

4.3.4 Drought

Probability	Magnitude/Severity	Location/Area	Hazard Ranking
Likely	Moderate	Extensive	**Medium**

Description

Drought is generally defined as a condition of moisture levels significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. There are four different types of drought conditions:

Meteorological drought is defined based on the degree of dryness (in comparison to some "normal" or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

Agricultural drought focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.

Socioeconomic drought refers to when physical water shortage begins to affect people.

The four different types of drought can all occur in Iowa. A meteorological drought is the easiest to determine based on rainfall data and is an easier drought to monitor from rain gauges and reports. A hydrological drought means that stream and river levels are low, which also has an impact for surface water and ground water irrigators. In addition, in-stream discharges that fall below a pre-required level also place the State in regulatory difficulty with US Fish and Wildlife and with neighboring states over cross-border flowage rights. An agricultural drought represents difficulty for Iowa's agricultural-based economy and is also relatively easy to monitor based on crop viabilities for different regions.

The National Drought Mitigation Center (NDMC) located at the University of Nebraska in Lincoln provides a clearinghouse for information on the effects of drought, based on reports from media, observers, and other sources. NDMC's website is found at http://www.drought.unl.edu/. Specific drought impacts by county are recorded at http://droughtreporter.unl.edu/.

The NDMC categorizes impacts of drought as economic, environmental, or social. Many economic impacts occur in agriculture and related sectors, including forestry and fisheries, because of the reliance of these sectors on surface and subsurface water supplies. In addition to obvious losses in yields in both crop and livestock production, drought is associated with increases in insect infestations, plant disease and wind

erosion. Droughts also bring increased problems with insects and disease to forests and reduce growth. The incidence of forest and range fires increases substantially during extended droughts, which in turn places both human and wildlife populations at higher levels of risk. Income loss is another indicator used in assessing the impacts of drought because so many sectors are affected.

Although drought is not predictable, long-range outlooks may indicate an increased chance of drought, which can serve as a warning. A drought period can last for months, years, or even decades. It is rarely a direct cause of death, though the associated heat, dust and stress can all contribute to increased mortality.

Location

According to the 2017 Census of Agriculture there were 582 farms in the County covering 238,824 acres of land (64.9% of the 575 sq. miles of land area (368,000 acres) in the County). Given that so much land is the County is in agricultural use, Worth County is at particularly high risk to drought because agricultural areas are more vulnerable to the immediate effects of drought. However, it should be noted that other land uses experience the effects of drought, and all of Worth County is at risk to drought. The map in Figure 4-2 in the Animal/Plant/Crop Disease hazard section displays the locations of various cropland uses in Worth County.

Past Occurrences

According to the Iowa Environmental Mesonet, the mean annual precipitation for Worth County is 32.94 inches. In average years, this represents enough rainfall to prevent drought; however, successive years of below-average rainfall are the cause of drought impacts in the planning area.

Table 4-19 provides the damage causing events that drought has caused on property and crops.

Table 4-19 Damages Caused by Drought in Worth County, 1950-2022

Date	Property Damage	Crop Damage
8/1/2001	$0	$11,350,000
8/1/2003	$12,650,000	$0
7/1/2012	$0	$45,000,000
8/1/2012	$0	$6,000,000
Total	**$12,650,000**	**$62,350,000**

Source: NOAA NCEI

According to the NDMC's Drought Impact Reporter, during the 14-year period from January 2008 through December 2022, 574 listed drought impacts were noted for the State of Iowa. Of these impacts, four were reported to affect Worth County. The following are the categories and reported number of impacts. Note: some impacts have been assigned to more than one category:

- Agriculture – 2
- Fire – 1
- Relief, Response & Restrictions – 2
- Water Supply & Quality – 1

Impacts of recent drought periods in Iowa that affected Worth County are provided below. Unless otherwise indicated, these impacts are from the NCEI.

- **July 6, 2016** — According to the Drought Impact Reporter, corn yield potential down in Iowa

- **October 16, 2015** – According to the Drought Impact Reporter, dry conditions led to Iowa burn bans.
- **October 1-13, 2012** – Drought conditions that began in late June continued through the summer and into October. Very warm and dry weather that began in the spring continued through the summer. Temperatures remained well above normal into August, but began to temper during the latter portion of the month. Temperatures cooled in October with the month averaging near to a little below normal. It was the first cooler than normal month in 13 months across the County Warning Area (CWA). More widespread rainfall began by the middle of the month with a fairly widespread event on the 13th. The rapid deterioration of the corn and soybean crop that took place in July slowed as much of the damage had already occurred in July. No significant damage occurred in September despite the dry conditions and early freeze across much of the state on the 23rd. Harvest activities continued at a fast pace with nearly all activities complete by the middle of October. This was three to four weeks ahead of normal. Indications were that yields of the corn crop were around 140 bu/ac and 43.5 bu/ac for the bean crop. These values were about 20% and 15% below normal for corn and beans, respectively. At the current price, the loss total was more than $2.6 billion. By late September, the USDA reported that Secretarial Primary Drought Designations had been listed for all 51 of the counties in the Des Moines CWA. The drought conditions continued through the month and into November as it will take many months to recharge the soil. No significant damage occurred in October and it is unlikely that water restrictions would occur before the spring, thus this will be the final entry unless conditions worsen.
- **September 1-30, 2012** – Drought conditions that began in late June continued through the summer and into September. Very warm and dry weather that began in the spring continued through the summer. Temperatures remained well above normal into August, but began to temper during the latter portion of the month. September began well above normal for the first week, but the fall transition began after that. For the month of September, temperatures averaged fairly close to normal. Rainfall was in short supply across the state. Much of the state recorded less than 50% of normal rainfall for the month, with a few locations under 25% of normal. The rapid deterioration of the corn and soybean crop that took place in July slowed as much of the damage had already occurred in July. No significant damage occurred in September despite the dry conditions and early freeze of much of the state on the 23rd. Harvest activities were more than 2 weeks ahead of normal. Indications were that yields of the corn crop were around 140 bu/ac and 43.5 bu/ac for the bean crop. These values were about 20% and 15% below normal for corn and beans, respectively. At the current price, the loss total was more than $2.6 billion. As of 03 October, the USDA reported that Secretarial Primary Drought Designations had been listed for all 51 of the counties in the Des Moines CWA. The drought conditions continued into October.
- **August 1-30, 2012** – Drought conditions that began in late June continued through July and into August. Very warm and dry weather that began in the spring continued through the summer. Temperatures warmed sharply the last few days of June. The heat persisted into August. Temperatures for the month of August were cooler than July, and in fact, just above normal. For the three summer months of June, July, and August, temperatures were among the top 10 warmest on record. Rainfall was in short supply across the state. Much of the state recorded less than 50% of normal rainfall for the month, with a few locations under 25% of normal. The south quarter fared a little better with a few locations receiving close to normal rainfall for the month. In addition, extended periods of temperatures above 90 °F combined with dewpoint temperatures falling into the 50s at times, resulted in additional stress. The rapid deterioration of the corn and soybean crop that took place in July slowed as much of the damage had already occurred in July. By the end of the month, officials estimated that 15% of the soybean crop and 20% of the corn crop yield had been lost to the drought. At the current price, the loss total was more than $2.6 billion. As of 31 August, the USDA reported that Secretarial Primary Drought Designations had been listed for 42 of the counties in the Des Moines CWA, with the remaining 9 receiving Contiguous Designations. The drought conditions continued into September.

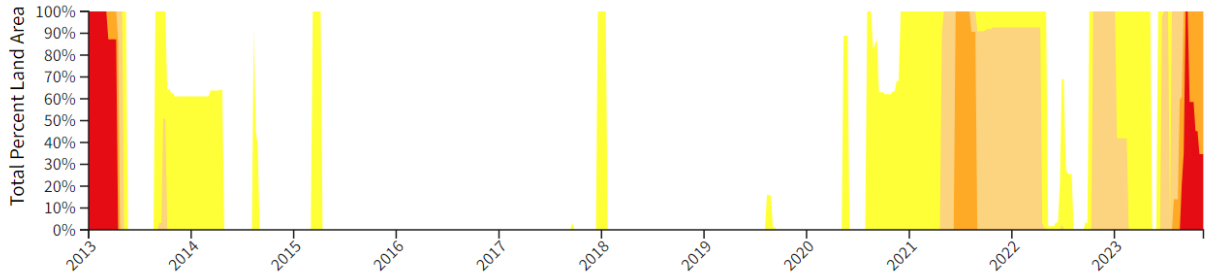
- **July 1-30, 2012** – Very warm and dry weather that began in the spring continued into the summer. Temperatures warmed sharply the last few days of June. The heat persisted into July. Temperatures for the month of July were among the warmest on record. In Des Moines, the monthly mean temperature was the second highest of record, only eclipsed by July of 1936. Rainfall was in short supply across the state. Much of the state recorded less than 50% of normal rainfall for the month, with a few locations under 10% of normal. In addition, extended periods of temperatures above 95 °F resulted in problems with pollination of the crops. Rapid deterioration of the corn and soybean crop took place with several periods of temperatures more than 100 °F. By the end of the month, officials estimated that 20% of the crop yield had been lost to the drought. At the current price, the loss total was more than $2.25 billion. As of 31 July, the USDA reported that Secretarial Primary Drought Designations had been listed for 21 counties in the Des Moines CWA, with 11 receiving Contiguous Designation. The primary counties were Butler, Bremer, Hamilton, Hardin, Grundy, Black Hawk, Boone, Story, Marshall, Tama, Polk, Jasper, Poweshiek, Marion, Mahaska, Lucas, Monroe, Wapello, Wayne, Appanoose, and Davis. Contiguous counties included Wright, Franklin, Webster, Greene, Dallas, Madison, Warren, Clarke, Taylor, Ringgold, and Taylor. The drought conditions continued into August.
- **August 29, 2012** – According to the Drought Impact Reporter, The USDA designated three counties in Iowa as primary natural disaster areas due to damages and losses caused by the recent drought. Farmers in adjacent counties in Iowa and Minnesota were also eligible for low-interest emergency loans from the FSA.
- **July 13, 2012** – According to the Drought Impact Reporter, corn showed signs of moisture stress in Iowa.
- **September 12, 2012** – According to the Drought Impact Reporter, The US Department of Agriculture Sept. 12, 2012, designated 23 counties in Minnesota, Iowa, North Dakota, South Dakota, and Wisconsin as disaster areas due to drought, which means that low interest loans are available to farmers in those counties who meet eligibility requirements.
- **August 1-31, 2003** – Dry weather settled in over Iowa during the month. The last widespread rain occurred on 09 July. With the increasingly dry conditions became a primary concern as the month progressed. An extended period of heat and humidity from the 15th to 25th saw highs into the 90s to over 100 °F. in some locations. By month's end drought indices had worsened to severe to extreme drought across south central Iowa and at least moderate drought over the remainder of the HSA. Waterloo had its driest August on record, Des Moines its 3rd driest and Ottumwa its 8th driest. A cold front brought only a brief respite from the intense heat, as temperatures rebounded into the 90s to near 100 °F. on the 24-26th. Des Moines Airport reached the century mark for the first time since July 29, 1999, reaching 100 F. on the 24th and 101 °F. on the 25th. This was followed by a slow cool down as several pushes of cooler air traversed the state. Unfortunately, there was only widely scattered convection across the HSA on the 27th and 28th, providing little significant drought relief. Light to moderate rainfall on the 31st fell across primarily the southern one half of the HSA, with the heaviest amounts in the southeast. The end of the month saw numerous records approached or established for a record dry August. At Waterloo, the 0.08" broke the previous dry August record of 0.37" set in 1955, while Des Moines had its 3rd driest August ever with 0.31" (driest 0.14" in 1909). Many stations had from 10 to 25 percent of normal rainfall. The drought in south central Iowa as shown by the Palmer Drought Index reached the Extreme category (-4.09) for the first time in this event by August 30th. Statewide NWS Cooperative station data compiled by the Iowa State Climatologist's office showed August temperatures averaged 74.3 °F. or 3.0° above the 30-year (1971-2000) mean, ranking as the 18th warmest in 131 years. Precipitation statewide was 0.96" or 3.23" below than normal, ranking as the driest August on record. For the summer as a whole (June-August) it was the 65th warmest (72.0 °F. or 0.4° above normal) and the 18th driest (9.55" or 1.93" below normal). The dry conditions caused

deterioration in the states crops. Estimates place yield reductions of about 10% on the corn crop, or a loss of about $210 million. Losses on the soybean crop were around 30%, or a loss of about $435 million.

- **August 1-23, 2001** – In what became a rather tough growing season, drought developed in Iowa during the month of July, and became serious in August. During the early part of the growing season, excessive rainfall caused significant planting delays across the state. Once the crop was planted, cool and cloudy weather settled into the state slowing crop maturation. Once the warm weather finally arrived, rainfall tailed off significantly. Very little rainfall was reported during the month of July, however crops flourished with the moisture that was available. During the last half of July, temperatures began to soar into the 90s quite regularly. Temperatures were in the 90s to around 100 °F for most of the first 10 to 12 days of August with virtually no rainfall. Moisture reserves ran out during the critical time of pod filling for the soybeans and at the tasseling for the corn. Another factor that complicated the situation was the soil moisture profile over central and southwest Iowa. After two years of drought, rain began falling during the last fall of 2000 and continued into the spring of 2001. Though soil moisture was replenished in part, a layer of dry soil remained below the moistened layer, preventing root development below the moist layer. Reports indicate losses estimated between one third and one half in parts of central and southwest Iowa. A few locations had verifiable corn crop losses approaching 80%. Overall, losses for the season were closer to the 15% range. Damage to the corn crop was a little over $350 million, with about $225 million in losses to the soybean crop, and about a two-million-dollar loss to the oat crop.

Figure 4-12 below provided by the U.S. Drought Monitor, summarizes the historical drought conditions for Worth County by intensity and percent area from 2013 through 2023. The county periodically experiences moderate to severe drought; extreme and severe drought intensity was experienced in 2012 and 2013.

Figure 4-12 Historic Drought Intensity (Percent Area) Worth County, Iowa 2013-2023



Source: US Drought Monitor, http://droughtmonitor.unl.edu/Data/DataDownload/ComprehensiveStatistics.aspx

According to the USDA's Risk Management Agency, payments for insured crop losses in Worth County because of drought conditions occurred in seven of the ten years from 2007-2021 and totaled $16,841,081 (see **Table 4-20**). With the extensive drought conditions during the years of 2012 and 2013, 86.1 percent of the 10-year crop losses came from these two years alone.

Table 4-20 Crop Insurance Claims Paid from Drought, 2007-2021

Year	Commodity Affected	Determined Acres	Insurance Paid
2007	Corn, Soybeans	2,550.9	$320,072
2008	Corn, Soybeans	3,069.8	$328,131
2009	Oats, Corn, Soybeans	3,179.4	$197,700

Year	Commodity Affected	Determined Acres	Insurance Paid
2011	Corn, Soybeans	2,385.9	$172,487
2012	Corn, Soybeans	54,764.9	$11,822,771
2013	Corn, Soybeans	10,289.8	$2,017,472
2014	Oats, Corn, Soybeans	11,827.7	$1,209,033
2017	Corn, Soybeans	1,086.4	$84,933
2018	Soybeans	11.1	$82
2019	Soybeans	151.2	$2,106
2020	Corn, Soybeans	1,970.41	$194,753
2021	Corn, Soybeans	3,414,.6	$491,541
Total		**91,287.51**	**$16,841,081**

Source: USDA Risk Management Agency

Probability of Future Occurrence

NOAA's National Centers for Environmental Information uses the US Palmer Drought Indices and the Standardized Precipitation Index to monitor and predict drought conditions. Lack of precipitation for a given area is the primary contributor to drought conditions. Since precipitation levels cannot be predicted in the long-term, the following indices can be used to determine the probability of future occurrences of drought.

The following are the indices:

- **Palmer Z Index** monitors short-term monthly moisture conditions when depart from normal.
- **Palmer Drought Severity Index** measures the duration and intensity of the long-term (meteorological) drought patterns.
- **Palmer Hydrological Drought Index** measures long-term (hydrological) drought and wet conditions reflecting groundwater and reservoir levels.
- **Standardized Precipitation Index** is a probability index that considers only precipitation. This is important to farmers to estimate soil moisture.

In the past 10 years, there have been seven years with crop insurance claims because of drought in Worth County. If this trend continues, this results in a probability of 70% of agricultural impacts because of drought in any given year. The probability rating for this hazard is "Highly Likely."

Magnitude/Severity

The magnitude of drought in Worth County can be **moderate**. Those dependent on rain would be the most vulnerable during a drought. This means that agriculture, agribusiness, and consumers would be impacted. A drought limits the ability to produce goods and provide services. Because citizens draw their drinking water from groundwater sources, a prolonged severe drought may impact all citizens if there were to be a dramatic drop in the water table. Fire suppression can also become a problem due to the dryness of the vegetation and possible lack of water. Generally, a drought event may directly or indirectly impact 50-75% of people and property in Worth County. A prolonged drought would have a larger impact.

Drought warning is based on a complex interaction of many different variables, water uses, and consumer needs. Drought warning is directly related to the ability to predict the occurrences of atmospheric conditions that produce the physical aspects of drought, primarily precipitation and temperature. There are so many variables that can affect the outcome of climatic interactions, and it is difficult to predict a drought in advance. An area may already be in a drought before it is recognized. While the warning of the

drought may not come until the drought is already occurring, the secondary effects of a drought may be predicted and warned against weeks in advance.

Drought in the U.S. seldom results directly in the loss of life. Deaths associated with drought are usually related to a heat wave. Drought more directly affects agricultural crops, livestock, natural vegetation, and stream flows that include fish and aquatic vegetation. Impacts are costly to the economy, environment, and general population. Drought may cause short-term property damage until drought conditions dissipate.

Climate Change Considerations

For the most part, climate change studies have shown increases in precipitation, rather than decreases. However, drought cycles continue. Climate change studies have also shown some increases in average temperatures and decreases in the number of overall days with precipitation. If this occurs during a drought cycle, the drought impacts will be exacerbated and increased agricultural losses will be sustained. There are close ties between droughts, heat waves, and grassland fires, with warmer temperatures and drier conditions exaggerating the effects of all three hazards. Although there will be an increase in the intensity of rainfall events, longer periods of drought and warmer temperatures can cause more destruction during grassland fires. Although droughts received a moderate rating for Worth County, there should still be consideration for climate change factors and other hazards that can cause worse droughts, like heat waves.

Vulnerability

Worth County jurisdictions are impacted by drought because it is an expensive weather disaster; it reduces agricultural productivity and causes a strain on water supplies. In Worth County, farmers bear the most direct stress from drought as wells may run dry; crops wilt and die, and forage for livestock becomes scarce and costly.

According to 2023 Census of Agriculture, Worth County has 582 farms that cover 238,824 acres of land. This translates to 91.8 percent of the surface land in the County being used for agriculture. Therefore, the planning area has an extremely high exposure to this hazard. Aside from agricultural impacts, other losses related to drought include increased costs of fire suppression and damage to roads and structural foundations due to the shrink dynamic of expansive soils during excessively dry conditions. Drought also presents hazards to public health in extreme cases, where drinking water production cannot keep up with demand. Water wells become less productive during drought and a failure of remaining productive wells (due to power outage, etc.) can cause public drinking water supplies to become compromised.

Losses associated with this hazard can be very high, particularly associated with agriculture. Crop insurance coverage mitigates the adverse economic impacts somewhat.

People

The historical and potential impacts of drought on populations include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Other public health issues can include impaired drinking water quality, increased incidence of mosquito-borne illness, an increase in wildlife-human confrontations and respiratory complications because of declined air quality in times of drought.

Property

No structures will be directly affected by drought conditions, though some structures may become more vulnerable to wildfires, which are more likely following years of drought. Droughts can also have significant impacts on landscapes, which could cause a financial burden to property owners. However, these impacts are not considered critical in planning for impacts from the drought hazard.

Critical Facilities and Infrastructure

Drought typically affects crops and cropland more than it affects structures, but all critical facilities in the area could still experience effects. These critical facilities include, but are not limited to, schools, health care facilities, police and fire stations, water towers, lift stations, city and county buildings, and sirens.

As noted above, drought has significant impacts on water supply. To better understand this vulnerability, in February 2024 Worth County EMA send a survey to all water providers in the planning area. While not all providers responded, those that did indicated that they had plans and resources in place and were not overly concerned about possibility of running out of water during the current drought.

Economy

Losses associated with this hazard can be very high, depending on the region, particularly for agriculture. Crop insurance coverage mitigates some adverse economic impacts somewhat, but secondary impacts such as reduced revenue throughout the planning region or even the state may not be as easy to mitigate. As noted above, the sum of claims paid for crop damage from 2007-2021 was $16,841,080.60. Nevertheless, Worth County in particular tends to suffer less frequently from drought hazards than other counties (especially those towards the south). As such, the expected magnitude of the hazard risk is "moderate."

Environment and Cultural Resources

Worth County jurisdictions are impacted by drought because it is an expensive weather disaster, it reduces agricultural productivity and causes a strain on water supplied. In the county, farmers bear the most direct stress from drought as wells may run dry, crops wilt and die, and forage for livestock becomes scarce and costly.

When droughts do occur in Worth County, crops and grassland areas may be more susceptible to fire, water for fire suppression may be limited, and jurisdictions may have to limit water consumption or look for alternative water sources. Cultural facilities would likely not be impacted by drought unless water usage was limited, or a facility was affected by a grass or wildland fire.

Development Trends

Each municipal planning partner in this effort has an established comprehensive plan that includes policies directing land use and dealing with issues of water supply and the protection of water resources. These plans provide the capability at the local municipal level to protect future development from the impacts of drought. All planning partners reviewed their general plans under the capability assessments performed for this effort. Deficiencies identified by these reviews can be identified as mitigation initiatives to increase the capability to deal with future trends in development. Currently population is decreasing but vulnerability to drought will increase if population growth increases in the future, putting more demands on existing water supplies. Future water use planning should consider increases in population as well as potential impacts of climate change.

Risk Summary

Overall, drought is ranked **medium**.

- Drought vulnerability may increase over time as demand for water from different sectors increases and as the Couty plans for economic development around the use of water resources.
- Climate change may result in an increase in the frequency and severity of drought which could lead to impacts to the recreation and tourism industry in the County.
- The effects of recent droughts have exposed the vulnerability of the planning area's economy to drought events.
- Related hazards: Extreme Heat, Wildfire

4.3.5 Earthquake

Probability	Magnitude/Severity	Location/Area	Hazard Ranking
Unlikely	Negligible	Limited	**Low**

Hazard Description

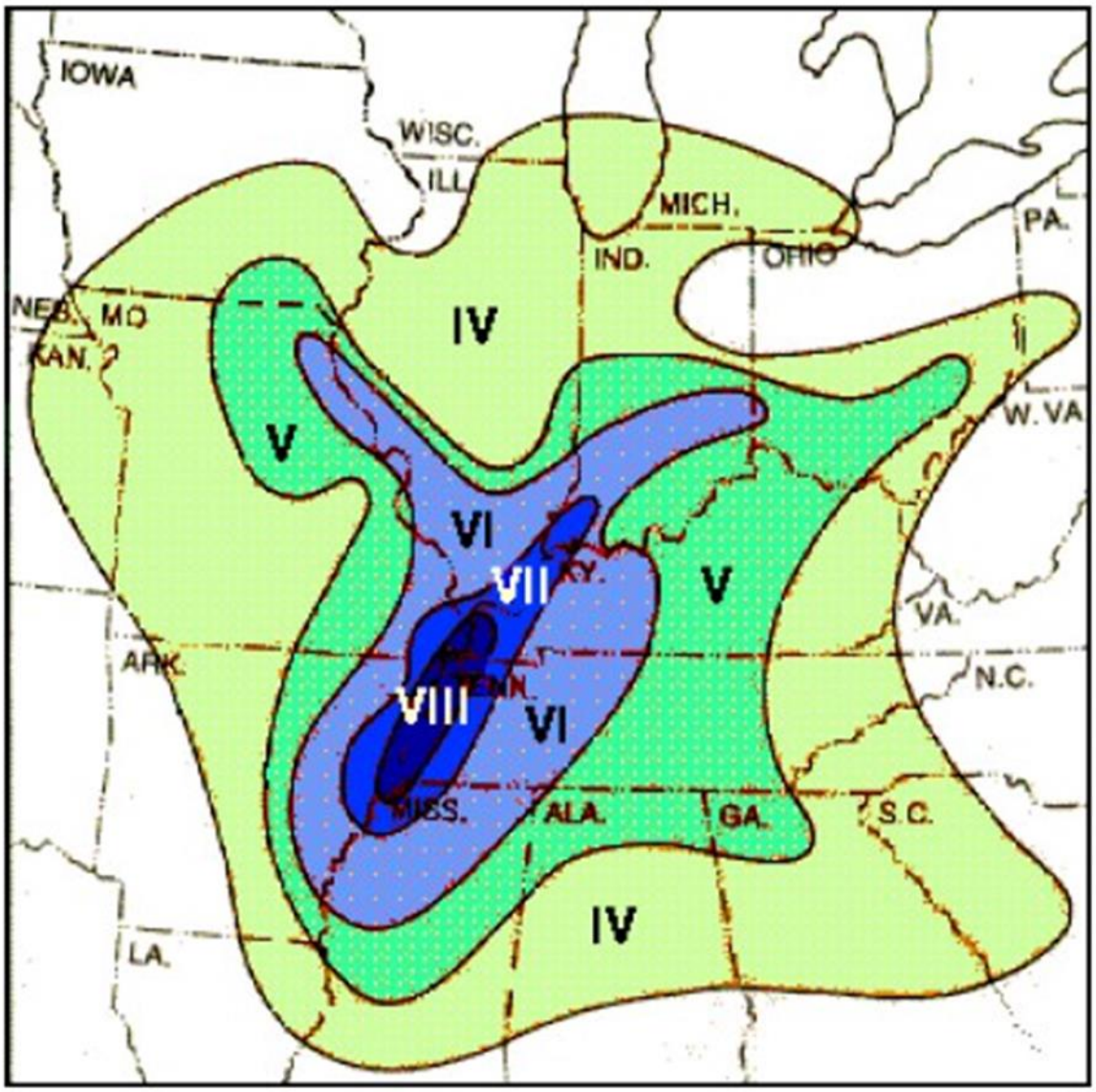
An earthquake is a sudden motion or trembling that is caused by a release of energy accumulated within or along the edge of Earth's tectonic plates. Earthquakes occur primarily along fault zones, tears in the Earth's crust, along which stresses build until one side of the fault slips, generating compressive and shear energy that produces the shaking and damage to the built environment. Heaviest damage generally occurs nearest the epicenter which is that point on the Earth's surface directly above the point of fault movement. The composition of geologic materials between these points is a major factor in transmitting the energy to buildings and other structures on the Earth's surface.

Location

While geologists often refer to the Midwest as the "stable midcontinent," because of its lack of major crustal movements, there are two regions of active seismicity, the Nemaha Ridge and the New Madrid Fault Zone. The Nemaha Ridge in Kansas and Nebraska, associated with the Humboldt Fault, is characterized by numerous small earthquakes that release stresses before they build to dangerous levels. The fault is not considered a threat to Iowa. The New Madrid Fault Zone, on the other hand, has greater destructive potential. It is located along the valley of the Mississippi River, from its confluence with the Ohio River southward, and includes portions of Illinois, Kentucky, Tennessee, Missouri, Arkansas, and Mississippi. The Earth's crust in the midcontinent is older, and therefore thicker, cooler, and more brittle than that in California for example. Consequently, earthquake shock waves travel faster and farther in the Midwest, making quakes here potentially more damaging than similar sized events in other geologic settings.

Iowa counties are located in low-risk zones as a whole. **Figure 4-13** shows the estimated effects of a 6.5 Richter magnitude earthquake scenario along the New Madrid Fault Zone. The southeastern part of the State is more at risk to earthquake effects from the New Madrid Fault and could experience effects ranging from trembling buildings, some broken dishes and cracked windows, and movement and falling of small unstable objects, to vibrations like the passing of a heavy truck, rattling of dishes and windows, and creaking of walls. Worth County sits entirely outside this risk zone, therefore, it is unlikely that Worth County would experience any of these effects, though they can vary considerably with differences in local geology and construction techniques.

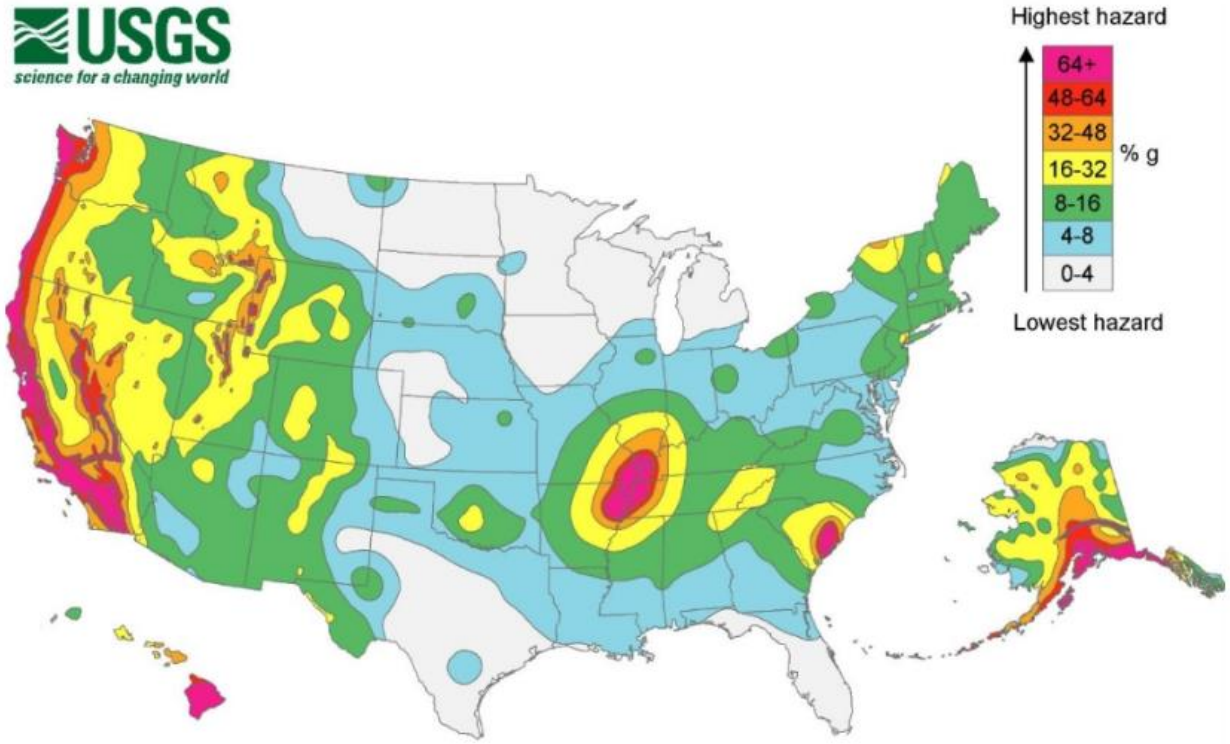
Figure 4-13 New Madrid Fault Zone, 6.5 Richter Magnitude Earthquake Scenario



Source: https://ohiocountykentuckyhistory.blogspot.com/2012/07/new-madrid-earthquake.html

Figure 4-14 below displays the USGS earthquake risk map for the United States. The USGS reports that Worth County is in Seismic Zone 0, the lowest risk zone in the United States. While it is highly unlikely for a significant earthquake to occur in Worth County or Northern Iowa, tremors from a large magnitude earthquake could shake the ground in the County.

Figure 4-14 United States Earthquake Map



Source: United States Geologic Survey (USGS), http://america.aljazeera.com/articles/2014/1/4/new-seismic-zonecouldspelltroubleforuppersouth.html

Past Occurrences

Iowa has experienced little effects from only a few earthquakes in the past 177 years. The epicenters of 14 earthquakes have been in the State, with the majority along the Mississippi River. The strongest earthquake in Iowa occurred in Davenport in 1934 but resulted in only slight damage according to the State of Iowa Hazard Mitigation Plan 2018.

While more than twenty (20) earthquakes have occurred in or around Iowa over the past 177 years, they have not seriously impacted the state. None of these earthquakes were centered in Worth County. The strongest earthquake in Iowa occurred in Davenport in 1934 which is located in Scott County. The 1934 Davenport earthquake resulted in only slight damage. (Source: *State of Iowa Hazard Mitigation Plan*, 2013). Details of the several notable Iowa Earthquakes are provided below:

Table 4-21 Iowa Earthquakes 1867-2022

Date	Nearest Town	Mercalli Intensity
6/30/2021	Rembrandt, IA	III
7/16/2004	Shenandoah, IA	III
4/20/1948	Oxford, IA	IV
11/24/1939	Davenport, IA / Rock Island, IL	II-III
11/8/1938	Dubuque, IA	-II

Date	Nearest Town	Mercalli Intensity
10/11/1938	Inwood, IA	V
2/26/1935	Burlington, IA	III
1/5/1935	Rock Island, IL / Davenport, IA	III
1/5/1935	Rock Island, IL / Davenport, IA	IV
11/12/1934	Davenport, IA \ Rock Island, IL	VI
1/26/1925	Waterloo, IA	II
4/13/1905	Wayland, MO / Keokuk, IA	IV-V
12/9/1875	Sidney, IA / Nebraska City, NE	III
4/28/1867	Sidney, IA / Nebraska City, NE	IV

Source: State of Iowa Hazard Mitigation Plan 2018, USGS https://earthquake.usgs.gov/earthquakes/map/

Probability of Future Occurrence

Based on historical occurrence, Worth County has less than a 1% chance of an earthquake occurring in any given year in the county. Future probability is **unlikely**.

Seismologists attempt to forecast earthquake size and frequency based on data from previous events. In the New Madrid Fault Zone, this analysis is difficult because there are few historic moderate to large earthquakes, and the active faults are too deeply buried to monitor effectively. Based on recurrence intervals for small earthquakes, scientists estimate a 90% chance of a Richter magnitude 6.0 earthquake in the New Madrid Fault Zone by 2040. A magnitude 6.5 in New Madrid would create a magnitude 4 effect in Iowa resulting in little or no damage or casualties.

However, earthquake prediction is an inexact science. Even in areas that are well monitored with instruments, such as California's San Andreas Fault Zone, scientists only very rarely predict earthquakes.

Magnitude/Severity

The extent or severity of earthquakes is generally measured in two ways: 1) Magnitude Measurement utilizes the Richter Magnitude Scale and 2) Severity Measurement utilizes the Modified Mercalli Intensity Scale. The table below summarizes these measurements.

Table 4-22 Earthquake Magnitude: Modified Mercalli and Richter Scales

Modified Mercalli Scale		Level Of Damage	Richter Scale
1-4	Instrumental to Moderate	No damage.	</= 4.3
5	Rather Strong	Damage negligible. Small, unstable objects displaced or upset; some dishes and glassware broken.	4.4 - 4.8
6	Strong	Damage slight. Windows, dishes, glassware broken. Furniture moved or overturned. Weak plaster and masonry cracked.	4.9 - 5.4
7	Very Strong	Damage slight-moderate in well-built structures; considerable in poorly built structures. Furniture and weak chimneys broken. Masonry damaged. Loose bricks, tiles, plaster, and stones will fall.	5.5 - 6.1
8	Destructive	Structure damage considerable, particularly to poorly built structures. Chimneys, monuments, towers, elevated tanks may fail. Frame houses moved. Trees damaged. Cracks in wet ground and steep slopes.	6.2 - 6.5

Modified Mercalli Scale		Level Of Damage	Richter Scale
9	Ruinous	Structural damage severe; some will collapse. General damage to foundations. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground; liquefaction.	6.6 - 6.9
10	Disastrous	Most masonry and frame structures/foundations destroyed. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Sand and mud shifting on beaches and flat land.	7.0 - 7.3
11	Very Disastrous	Few or no masonry structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Rails bent. Widespread earth slumps and landslides.	7.4-8.1
12	Catastrophic	Damage nearly total. Large rock masses displace. Lines of sight and level distorted.	>8.1

Source: State of Iowa Hazard Mitigation Plan 2018

Richter Magnitude Scale

The Richter Magnitude Scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The magnitude of an earthquake is determined from the logarithm of the amplitude of waves recorded by seismographs. Adjustments are included for the variation in the distance between the various seismographs and the epicenter of the earthquakes. On the Richter Scale, magnitude is expressed in whole numbers and decimal fractions. For example, a magnitude 5.3 might be computed for a moderate earthquake, and a strong earthquake might be rated as magnitude 6.3. Because of the logarithmic basis of the scale, each whole number increase in magnitude represents a tenfold increase in measured amplitude; as an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

Modified Mercalli Intensity Scale

The effect of an earthquake on the Earth's surface is called the intensity. The intensity scale consists of a series of certain key responses such as people awakening, movement of furniture, damage to chimneys, and finally – total destruction. Although numerous *intensity scales* have been developed over the last several hundred years to evaluate the effects of earthquakes, the one currently used in the United States is the Modified Mercalli (MM) Intensity Scale. It was developed in 1931 by the American seismologists Harry Wood and Frank Neumann. This scale, composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals. It does not have a mathematical basis; instead, it is an arbitrary ranking based on observed effects.

The MM Intensity value assigned to a specific site after an earthquake has a more meaningful measure of severity to the nonscientist than the magnitude because intensity refers to the effects actually experienced.

The **lower** numbers of the intensity scale generally deal with the way the earthquake is felt by people. The **higher** numbers of the scale are based on observed structural damage. Structural engineers usually contribute information for assigning intensity values of VIII or above.

Most of Iowa is located in Seismic Zone 0, the lowest risk zone in the United States. Most structures in Iowa are not built to earthquake standards, but because of the relatively low magnitude of the possible quake, property damage would likely be very minimal. The most vulnerable structures are those built on poorly consolidated substrate, especially floodplain materials.

In general, peak ground acceleration (PGA) is a measure of the strength of ground movements. More specifically, the PGA measures the rate in change of motion relative to the established rate of acceleration due to gravity. According to the United States Geological Services, for Worth County the peak acceleration with a 2% probability of exceeding in 50 years is 2% g, which means the County is under a very small threat in regard to earthquakes. Earthquakes are therefore considered to have **negligible** magnitude and severity for the County, with less than 10% of property severely damaged, shutdown of facilities and services for less than 24 hours, and/or injuries/illnesses treatable with first aid.

Climate Change Considerations

The impacts of global climate change on earthquake intensity and probability are largely unknown, but there is not expected to be a direct correlation.

Vulnerability

People

The main impacts to Worth County from a New Madrid earthquake would most likely be related to incoming evacuees from areas more heavily damaged by the event. This could result in a shortage of short-term lodging, such as hotel rooms and extended stay establishments. Depending on the magnitude of the earthquake, shelters may be designated in Worth County as evacuee shelter locations. If this occurred, assistance would be coordinated through the Emergency Management Assistance Compact (EMAC) between the State of Iowa and State governments of impacted areas.

Property

Most structures in Worth County are not built to withstand earthquake shaking, but because of the relatively low magnitude of a possible quake, property damage would likely be very minor damage.

Critical Facilities and Infrastructure

Critical facilities are potentially vulnerable to an earthquake event, but anticipated impacts are likely to be minor and mostly to be to non-structural items.

Economy

Economic impacts due to an earthquake event will be related to both the event and the recovery after the event, but both are expected to be minor.

Environment and Cultural Resources

Older and historic buildings will typically be more vulnerable to damage in an earthquake. Historic building stock is commonly made of unreinforced masonry, which is more vulnerable to damage from earthquakes.

Development Trends

Overall, the planning area has a low vulnerability to earthquake risk. Future development is not expected to increase the risk other than contributing to the overall exposure of what could become damaged because of an unlikely event.

Risk Summary

Overall, earthquake hazard is ranked as low for the County.

- The overall significance of this hazard in Worth County is **low**.
- Due to Worth County's location well outside areas likely to experience shaking due to an earthquake, the geographic extent is rated as **limited**.
- Based on historic data, Worth County has not experienced any recorded earthquake event in the past 177 years, therefore, future occurrence is **unlikely**.
- Impacted properties can require cleanup, but the effects are usually localized during minor events.
- Extended road closures and power outages can result in economic losses and impact tourism.
- Related hazards: Infrastructure failure, transportation incident, sinkhole, landslide, hazmat incident

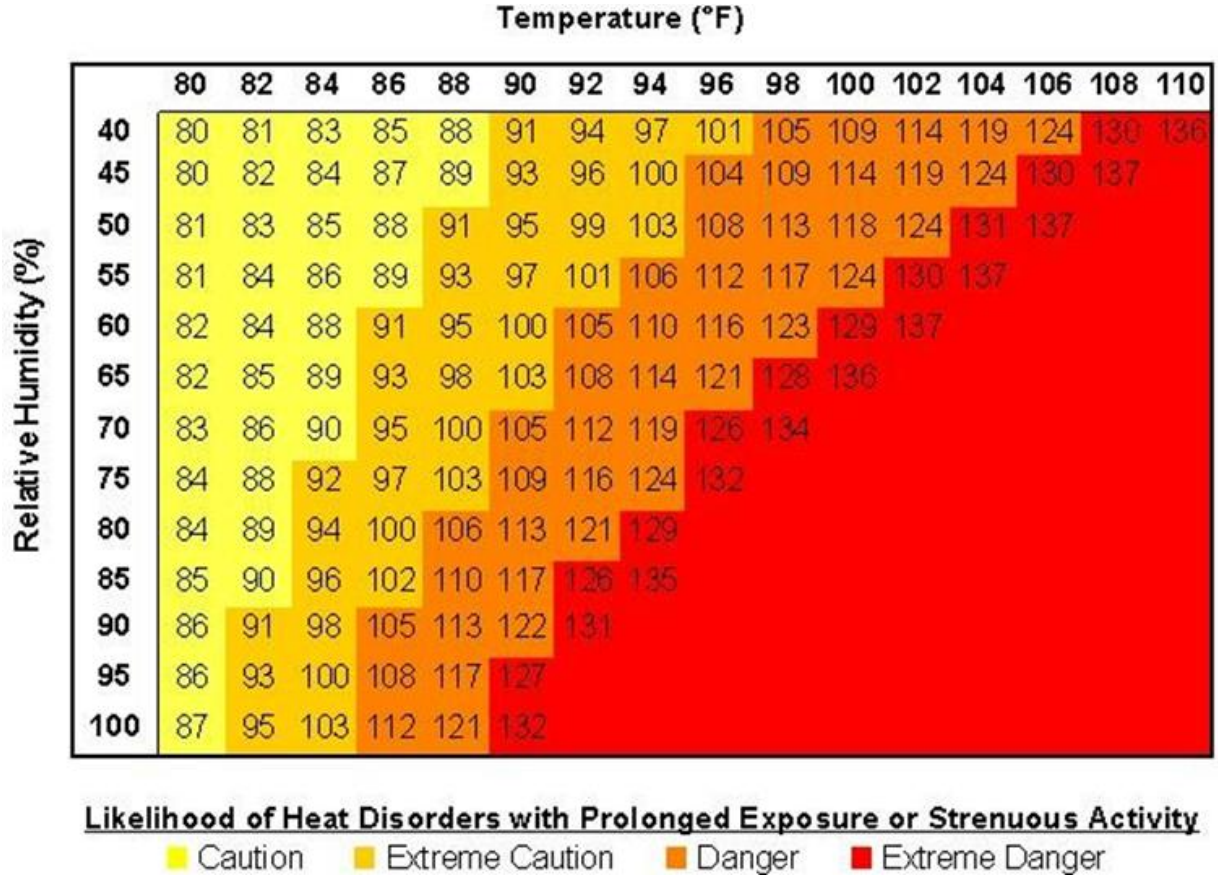
4.3.6 Extreme Heat

Probability	Magnitude/Severity	Location/Area	Hazard Ranking
Likely	Moderate	Extensive	**Medium**

Hazard Description

FEMA defines extreme heat as a long period (2 to 3 days) of high heat and humidity with temperatures above 90 degrees. Ambient air temperature is one component of heat conditions, with relative humidity being the other. The relationship of these factors creates what is known as the apparent temperature. The heat index, shown in **Figure 4-15**, is a number in degrees Fahrenheit that tells how hot it really feels when relative humidity is added to the actual air temperature. Exposure to full sunshine can increase the heat index by at least 15°. Extreme heat can impose stress on animals and humans, especially the elderly, sick and young children.

Figure 4-15 Heat Index (HI) Chart



Source: National Weather Service (NWS) http://www.nws.noaa.gov/os/heat/heat_index.shtml
Note: Exposure to direct sun can increase Heat Index values by as much as 15 °F. The shaded zone above 105 °F corresponds to a HI that may cause increasingly severe heat disorders with continued exposure and/or physical activity.

During these conditions, the human body has difficulties cooling through the normal method of the evaporation of perspiration. Health risks rise when a person is overexposed to heat. Heatstroke, sunstroke, cramps, exhaustion, and fatigue are possible with prolonged exposure and/or physical activity due to the body's inability to dissipate the heat. Urban areas are particularly at risk because of air stagnation and large

quantities of heat absorbing materials such as streets and buildings. Extreme heat can also result in distortion and failure of structures and surfaces such as roadways and railroad tracks. Buildings, structures, and public facilities are generally not affected by extreme heat directly, unless the magnitude of extreme heat is such to cause an indirect negative impact on the jurisdiction such as loss of power or strain on a community's utilities to keep up with local demand.

According to a study from the Centers for Disease Control and Prevention, an average of 702 heat-related deaths occurred annually nationwide between 2004 and 2018 (Vaidyanathan 2020). One of the most dangerous places to be is in a home with little or no air conditioning. Those at greatest risk for heat-related illness include people 65 years of age and older, people who are overweight, and people who are ill or on certain medications. However, even young and healthy individuals are susceptible if they participate in strenuous physical activities during hot weather. In agricultural areas, the exposure of farm workers, as well as livestock, to extreme heat is a major concern.

Location

Given the regional nature of extreme heat, the spatial extent of this hazard is **extensive** for Worth County. The entire planning area is subject to extreme heat and all participating jurisdictions are affected. Cities are typically more affected by extreme heat than surrounding rural areas due to the urban heat island effect. **Table 4-23** lists typical symptoms and health impacts of exposure to extreme heat.

Table 4-23 Typical Health Impacts of Extreme Heat

Heat Index (HI)	Disorder
80-90 °F (HI)	Fatigue possible with prolonged exposure and/or physical activity
90-105 °F (HI)	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and/or physical activity
105-130 °F (HI)	Heatstroke/sunstroke highly likely with continued exposure

Source: National Weather Service Heat Index Program, https://www.weather.gov/safety/heat-index

The National Weather Service has a system in place to initiate alert procedures (advisories or warnings) when the heat index is expected to have a significant impact on public safety. The expected severity of the heat determines whether advisories or warnings are issued. A common guideline for issuing excessive heat alerts is when the maximum daytime heat index is expected to equal or exceed 105 °F and the nighttime minimum heat index is 80 °F or above for two or more consecutive days. A heat advisory is issued when temperatures reach 105 °F and a warning is issued at 115 °F.

Past Occurrences

According to information obtained from the NWS for Worth County Zone on the Iowa Environmental Mesonet, Iowa State University Department of Agronomy website, there have been a combined 43 excessive heat advisories, watches, and warnings between 2005 and 2023. These events are summarized in **Table 4-24** below. The greatest number of heat warnings issued in a given year was 6 warnings, which occurred in 2023. Historic data tells us that extreme heat is a fairly common occurrence in Worth County.

Table 4-24 Heat Advisories, Watches, and Warnings, 2005-2023, Worth County Zone

Year	Heat Advisory	Excessive Heat Warning	Excessive Heat Watch
2005	1	0	0
2006	2	0	0

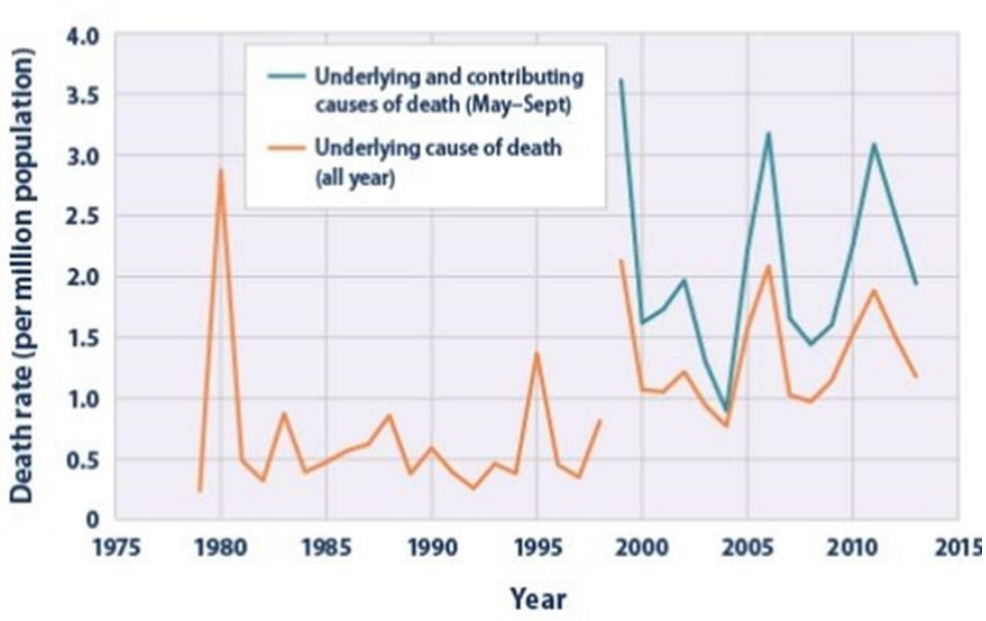
Year	Heat Advisory	Excessive Heat Warning	Excessive Heat Watch
2007	0	0	0
2008	0	0	0
2009	1	0	0
2010	2	0	1
2011	3	1	1
2012	2	1	0
2013	1	0	0
2014	1	0	0
2015	0	0	0
2016	0	1	1
2017	1	0	0
2018	4	1	0
2019	2	1	1
2020	4	0	0
2021	1	0	1
2022	2	0	0
2023	3	1	2
Totals	**30**	**6**	**7**

Source: Iowa State University Environmental Mesonet

Figure 4-16 shows heat-related deaths in the United States using two methodologies. One method shows deaths for which excessive natural heat was stated as the underlying cause of death from 1979 to 2013. The other data series shows deaths for which heat was listed as either the underlying cause or a contributing cause, based on a broader set of data that at present can only be evaluated back to 1999. For example, in a case where cardiovascular disease was determined to be the underlying cause of death, heat could be listed as a contributing factor because it can make the individual more susceptible to the effects of this disease. Because excessive heat events are associated with summer months, the 1999–2013 analysis was limited to May through September.

According to the National Weather Service, in 2022, 148 people died nationally because of extreme heat. In 2021, that number was even higher with 375 heat-related deaths. The 10-year average for heat-related fatalities nationally is 153. Only one heat-related death has been reported for Iowa within the last 10 years, occurring in 2019. Additionally, the National Weather Service data also indicates a 30-year average of 168 heat deaths annually nationwide. (http://www.nws.noaa.gov/om/hazstats.shtml).

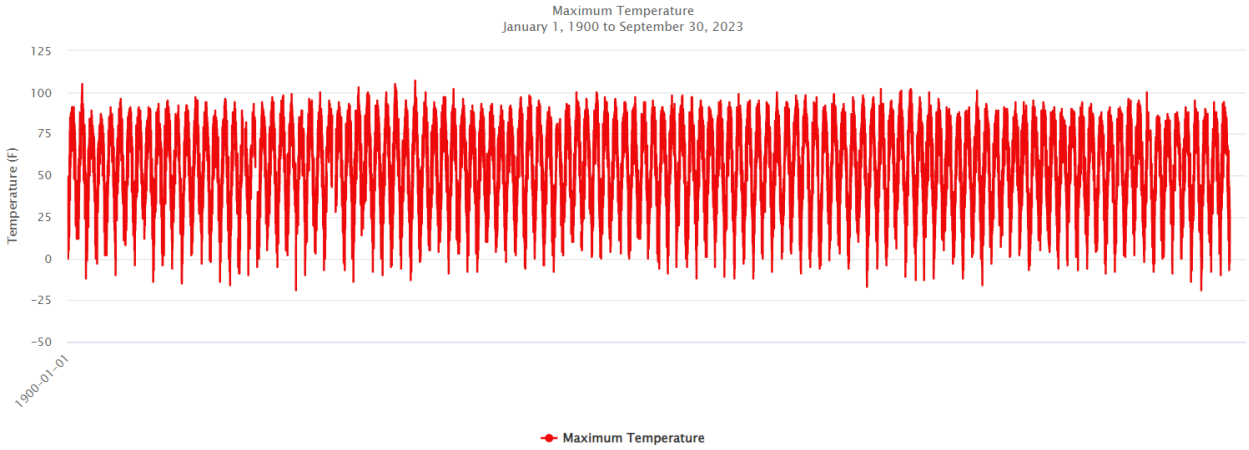
Figure 4-16 Deaths Classified as "Heat-Related" in the United States, 1979-2015



Source: Environmental Protection Agency, https://www3.epa.gov/climatechange/pdfs/print_heat-deaths-2015.pdf

Figure 4-17 shows the daily maximum temperatures for the Northwood, Iowa weather station for the period of record from 1900 through Summer of 2023 from the High Plains Regional Climate Center. This data shows that a temperature of 107 °F was reached in 1936 as the highest recorded temperature during the 123-year timeframe. The months of the year with the highest temperatures are generally July and August.

Figure 4-17 Maximum Temperature, Northwood, Iowa (1900-2023)



Source: High Plains Regional Climate Center

Probability of Future Occurrence

Extreme heat is considered **highly likely** in Worth County. More than 33% probability in any given year (event has up to a 1 in 1 chance of occurring), history of events is greater than 33% likely or the event is

highly likely to occur. Based on the past record of 43 heat advisories, watches, or warnings over an 18-year period, then approximately 2.4 extreme heat events per year can be expected in the planning area.

The planning team also noted another method in describing that successive days more than 90° F or one day in excess of 100° F occur on an almost annual basis across northwest Iowa and not are all recorded. According to the Southwest Climate and Environmental Information Collaborative (SCENIC), there are an average of 15 days per year with temperatures more than 90° F.

Magnitude/Severity

Extreme heat is considered to have negligible magnitude and severity. This means that less than 10% of property is severely damaged, shutdown of facilities and services for less than 24 hours, and/or injuries/illnesses treatable with first aid. However, it should be noted that it is still possible for extreme heat to cause physical damage to property in the future. Extreme heat events typically occur with ample warning time. Weather forecasters predict heat events several days before they will occur.

Climate Change Considerations

According to the Iowa Department of Natural Resources, the effects of climate change have already been felt in Iowa. Several of the climatic changes related to extreme heat which have been noted by the Department of Natural Resources are:

- 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 Fahrenheit rise in dew-point temperature. This fuels convective thunderstorms that provide more summer precipitation.

Each of these changes could have direct impacts on human health in terms of heat related illness. With the general trend of increased warming of average temperatures, extreme high temperatures will likely increase as well. Cascading impacts include increased stress on water quantity and quality, degraded air quality, and increased potential for more severe or catastrophic natural events such as heavy rain, droughts, and wildfire. Another cascading impact includes increased duration and intensity of wildfires with warmer temperatures.

Vulnerability

People

The impacts of extreme heat on health are a consideration in evaluating the overall vulnerability of Worth County. According to the US Census Bureau 2020 American Community Survey estimates, approximately 21% of Worth County residents are over the age of 65. Traditionally, the very young and very old are considered at higher risk to the effects of extreme heat, but any populations outdoors exposed, including otherwise young and healthy adults and homeless populations, are at risk of adverse health impacts. Arguably, the young-and-otherwise-healthy demographic may be more exposed and experience a higher vulnerability because of the increased likelihood that they will be out in the extreme temperature deviation, whether due to commuting for work or school, conducting property maintenance, working in the agricultural sector, or for recreational reasons.

Elderly people, small children, chronic invalids, those on certain medications or drugs (especially tranquilizers and anticholinergics), and persons with weight and alcohol problems are particularly susceptible to heat reactions. Healthy individuals working outdoors in the sun and heat are vulnerable as well. Individuals and families with low budgets as well as inner city dwellers can also be susceptible due to

poor access to air-conditioned housing. Generally, all people and property in Worth County are affected when this type of hazard occurs.

Property

Recent research indicates that the impact of extreme heat has been historically under-represented. The risks of extreme temperatures are often profiled as part of larger hazards, such as drought. However, as temperature variances may occur outside of larger hazards or outside of the expected seasons but still incur large costs, it is important to examine them as stand-alone hazards. Extreme heat may overload demands for electricity to run air conditioners in homes and businesses during prolonged periods of exposure and presents health concerns to individuals outside in the temperatures.

Critical Facilities and Infrastructure

Prolonged heat exposure can have significant impacts on infrastructure. Extreme heat can reduce transmission capacity over electric systems. Extreme heat can also cause a strain on electricity delivery infrastructure which can be overloaded during peak use of electricity to power air conditioning during extreme heat events. Another type of infrastructure damage that can occur because of extreme heat is road damage. When asphalt is exposed to prolonged extreme heat, it can cause buckling of asphalt paved roads, driveways, and parking lots. According to Iowa Department of Transportation (DOT), repairs and replacement of pavement due to heat-caused buckling and rupture costs an average of $400,000 annually across the State.

Economy

Extreme heat impacts on the economy may be more indirect compared to other hazards. According to the ACS estimates, 5.6% of all employment in Worth County is in the agriculture sector, and 9.5% is in the construction sector. As noted previously outdoor laborers who are exposed to extreme heat are at a high risk of heat related illnesses, and a long-term heat event could cause work interruptions. Crops are also impacted by heat events and could have an impact on the overall economy in the county.

Environment and Cultural Resources

Extreme heat may cause temporary drought-like conditions. For example, several weeks of extreme heat increases evapotranspiration and reduces moisture content in vegetation, leading to higher wildfire vulnerability for that time period even if the rest of the season is relatively moist.

Development Trends

Since Worth County is not experiencing significant population growth, the number of people vulnerable to extreme heat is not necessarily increasing. Structures are not usually directly impacted by extreme heat; therefore, continued development is less impacted by this hazard than others in the plan. Public education efforts should continue to help the population understand the risks and vulnerabilities of outdoor activities, property maintenance, and regular exposures during periods of extreme heat.

Risk Summary

This hazard does not vary substantially by jurisdiction.

- The overall significance of extreme heat is **Medium.**
- Climate change may result in an increase in the frequency and severity of extreme heat which could lead to impacts to the agriculture industry in the County.
- Extreme heat events are likely throughout the County, and the magnitude of heat events is low.
- Related hazards: Drought, Wildfire.

4.3.7 Flooding (Flash & Riverine)

Probability	Magnitude/Severity	Location/Area	Hazard Ranking
Highly Likely	Catastrophic	Significant	**High**

Hazard Description

Flooding can be broken into two main categories: River Flooding and Flash Flooding.

Riverine flooding 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 during rapid runoff are called floodplains. A floodplain 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, which is defined as all the land drained by a river and its branches.

Gauges along streams and rain gages throughout the state provide for an early flood warning system. River flooding usually develops over the course of several hours or even days depending on the basin characteristics and the position of the particular reach of the stream. The NWS provides flood forecasts for Iowa. Flood warnings are issued over emergency radio and television messages as well as the NOAA Weather Radio. People in the paths of river floods may have time to take appropriate actions to limit harm to themselves and their property.

A **flash flood** is an event that occurs when water levels rise at an extremely fast rate because of intense rainfall over a brief period, sometimes combined with rapid snowmelt, ice jam release, frozen ground, saturated soil or impermeable surfaces.

Ice jam flooding is a form of flash flooding that occurs when ice breaks up in moving waterways, and then stacks on itself where channels narrow. This creates a natural dam, often causing flooding within minutes of the dam formation.

Most flash flooding is caused by slow-moving thunderstorms or thunderstorms repeatedly moving over the same area. Flash flooding is an extremely dangerous form of flooding which can reach full peak in only a few minutes and allows little or no time for protective measures to be taken by those in its path. Flash flood waters move at very fast speeds and can move boulders, tear out trees, scour channels, destroy buildings, and obliterate bridges. Flash flooding often results in higher loss of life, both human and animal, than slower developing river and stream 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. 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 sheet flooding, is becoming increasingly prevalent as development outstrips the ability of the drainage infrastructure to properly carry and disburse the water flow.

In certain areas, aging storm sewer systems are not designed to carry the capacity currently needed to handle the increased storm runoff. Typically, the result is water backing into basements, which damages mechanical systems and can create serious public health and safety concerns. This combined with rainfall trends and rainfall extremes all demonstrate the high probability, yet generally unpredictable nature of flash flooding in the planning area.

Although flash floods are somewhat unpredictable, there are factors that can point to the likelihood of flash floods occurring. Weather surveillance radar is being used to improve monitoring capabilities of intense rainfall. This, along with knowledge of the watershed characteristics, modeling techniques, monitoring, and advanced warning systems increases the warning time for flash floods.

With the Beaver Creek, Elk Creek and the Shell Rock River running through the county flooding from these waterways and their tributaries has been a significant problem for many of the communities in Worth County. Many of the communities were settled and developed largely because of their proximity to water resources. A flood is partial or complete inundation of normally dry land areas. Heavy precipitation can cause flooding either in the region of precipitation or in areas downstream. 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.

Location

Worth County crosses three HUC-8 watersheds as follows (see **Figure 4-18**):

- Upper Cedar Watershed (07080201)—this watershed crosses the northeast corner of Worth County.
- Shell Rock Watershed (07080202)—this watershed crosses from the northwest to southeast, through the central part of the county.
- Winnebago Watershed (07080203)—this watershed touches very slightly over the western edge, then encompasses the southwestern area of the county.

Figure 4-18 Worth County, Iowa Watersheds (Worth County is red square)

Source: Environmental Protection Agency, https://cfpub.epa.gov/surf/county.cfm?fips_code=19195

For purposes of this hazard profile and vulnerability analysis, the geographic locations/coverages for river flooding will be considered as those areas at risk to the 100-year flood (also known as the 1-percent annual

chance flood). The 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes.

Jurisdictional Flood Hazard Maps

FEMA Special Flood Hazard Areas (SFHAs) in Worth County were not initially mapped however jurisdictions were mapped in the 1970's with Flood Hazard Boundary Maps. The county incorporated and created Flood Insurance Rate Maps (FIRMs) with the effective date of August 2, 2012. DNR is currently working on updating the flood mapping for the County.

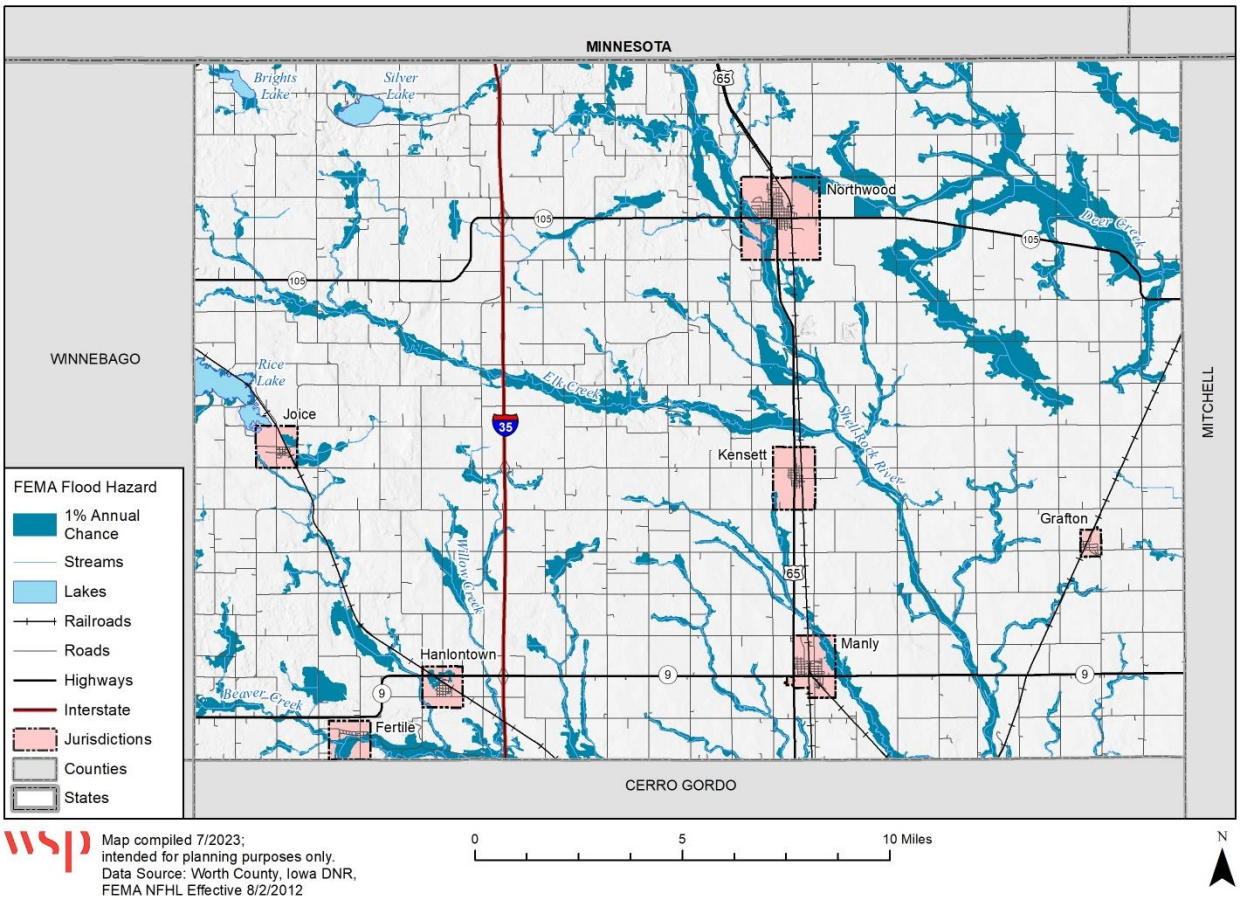
The FIRMs delineate areas at-risk within the 1-percent annual floodplain (i.e., 100-year floodplain) however the county does not have any 0.2-percent annual chance floodplains mapped (the 500-year floodplain). The City of Northwood has the highest number of properties and total value at risk to flooding within the County. Shell Rock Creek flows through the western portion of Northwood but does not affect the most populated areas of the city. All but 2 jurisdictions, Grafton and Kensett, are at risk of flooding from the 1-percent annual chance flood as well, but to lower degrees.

Figure 4-19 through **Figure 4-26** provide the 1-percent annual floodplains for all jurisdictions in the planning area affected by this hazard. The county-level map is provided first for context, and city/town maps are next, in alphabetical order. The School Districts Figure 4-27 is provided last preceding each map is a general description of the flooding sources applying to each jurisdiction. According to the National Levee Database (NLD) there are not any Levees within the Worth County. A levee is a man-made structure constructed with engineering methods to contain, control, or divert the flow of water to reduce risk from temporary flooding.

Worth County

The main sources of flooding in the county are the Shell Rock River, Deer Creek, Winnebago River, and Beaver Creek, with smaller streams including Winan's Creek having a slight impact.

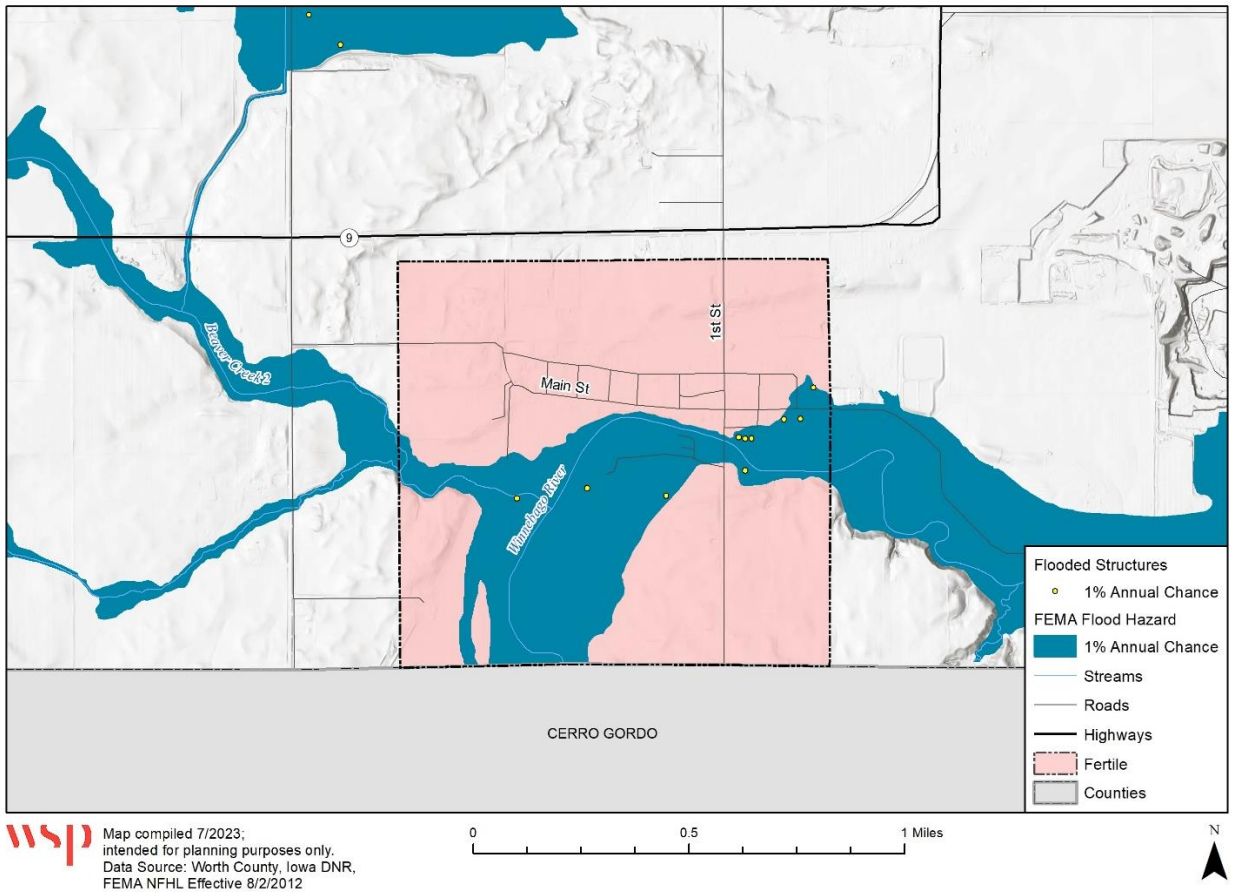
Figure 4-19 Worth County 1 Percent Annual Chance Floodplain



Fertile

The main source of flooding in the City of Fertile is the Winnebago River, which crosses in an east to southwest fashion through the middle of the city. Beaver Creek connects to the Winnebago River through the west, adding to the flood risk.

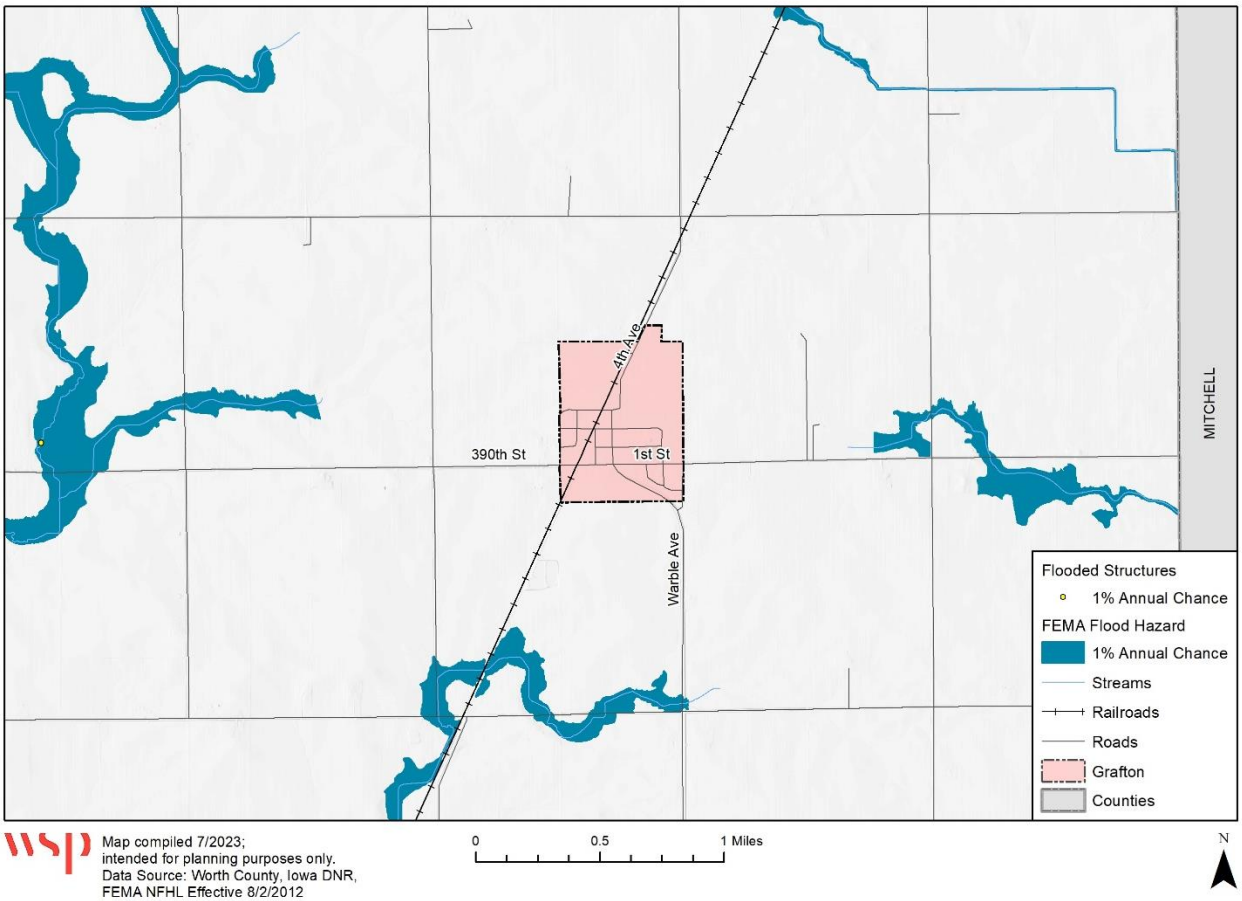
Figure 4-20 City of Fertile 1 Percent Annual Chance Floodplain



Grafton

The City of Grafton does not have any special flood hazard zones crossing its jurisdictional boundaries.

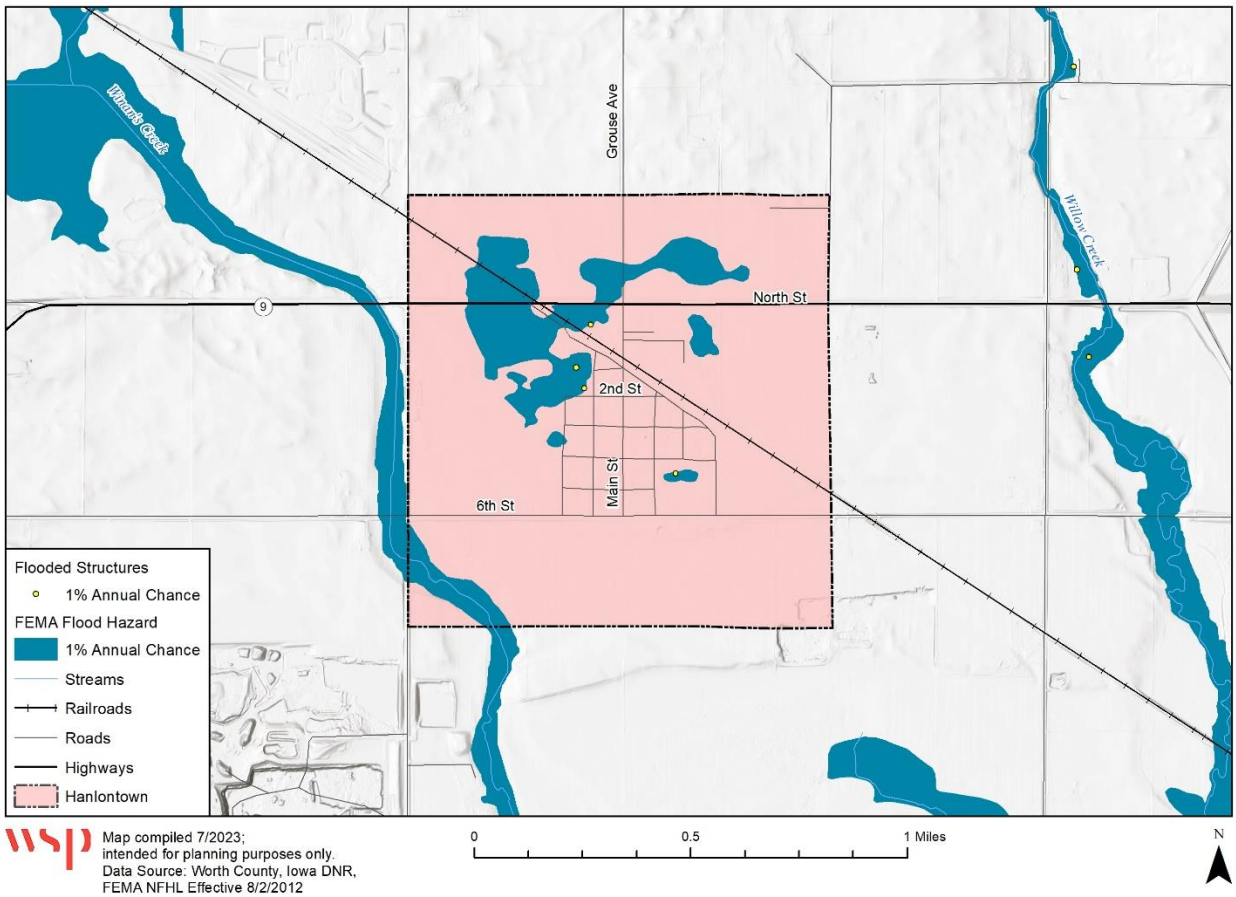
Figure 4-21 City of Grafton 1 Percent Annual Chance Floodplain



Hanlontown

The Narrow floodplains of Winan's Creek cross into the City of Hanlontown from the southwestern boundary.

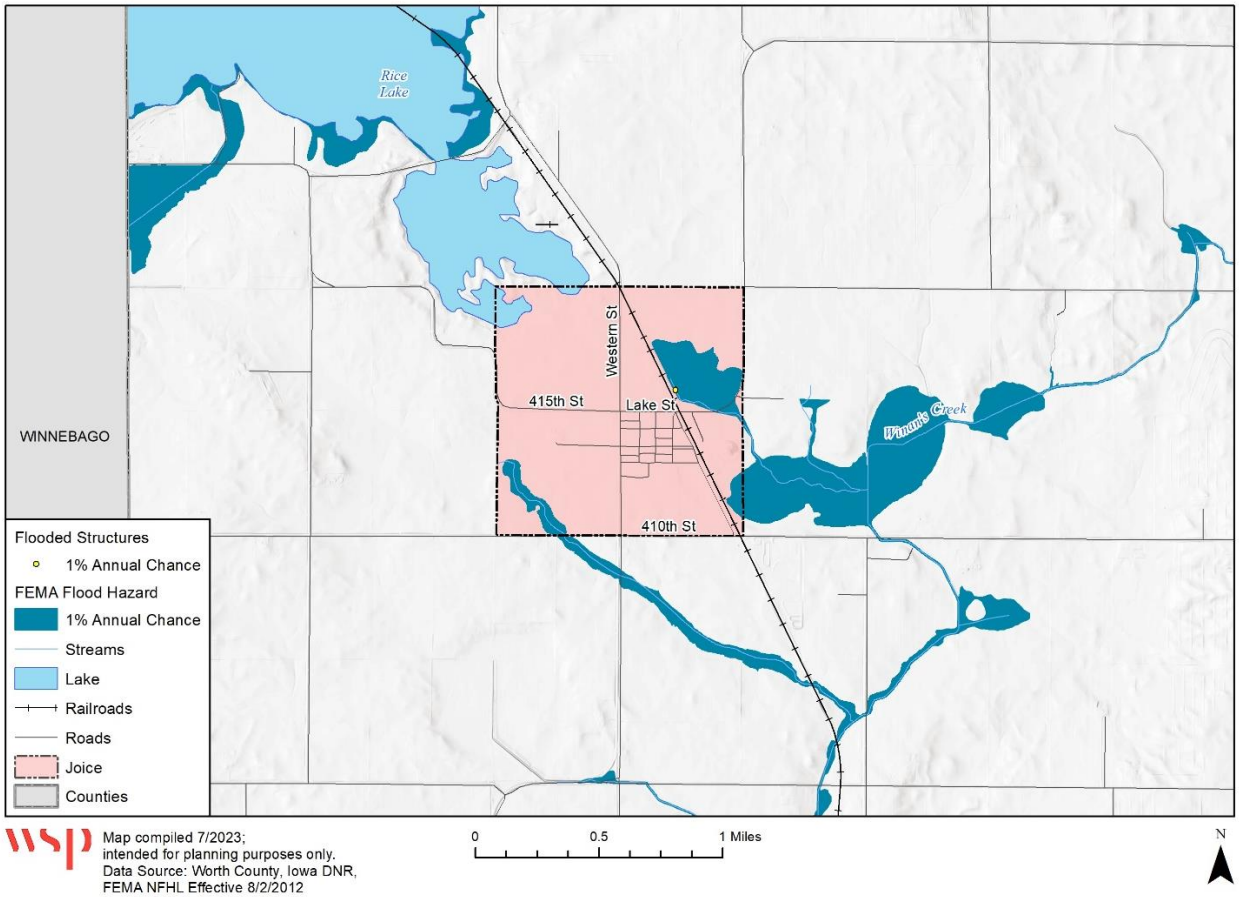
Figure 4-22 City of Hanlontown 1 Percent Annual Chance Floodplain



Joice

Small portions of the eastern, southeastern, and southwestern corners of the City of Joice lie in the floodplain of Winan's Creek.

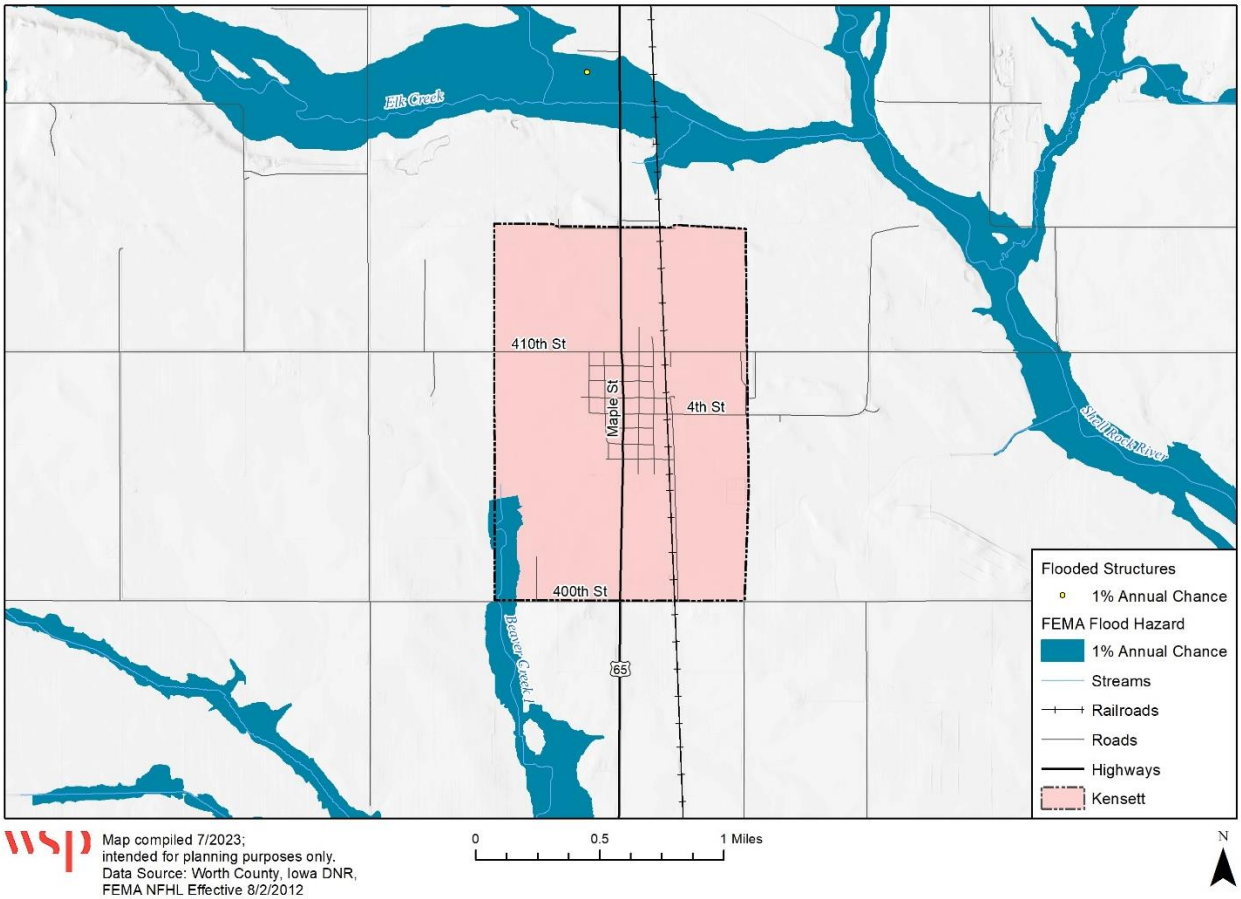
Figure 4-23 City of Joice 1 Percent Annual Chance Floodplain



Kensett

A small area of the Beaver Creek floodplain crosses the City of Kensett, touching its southwestern corner.

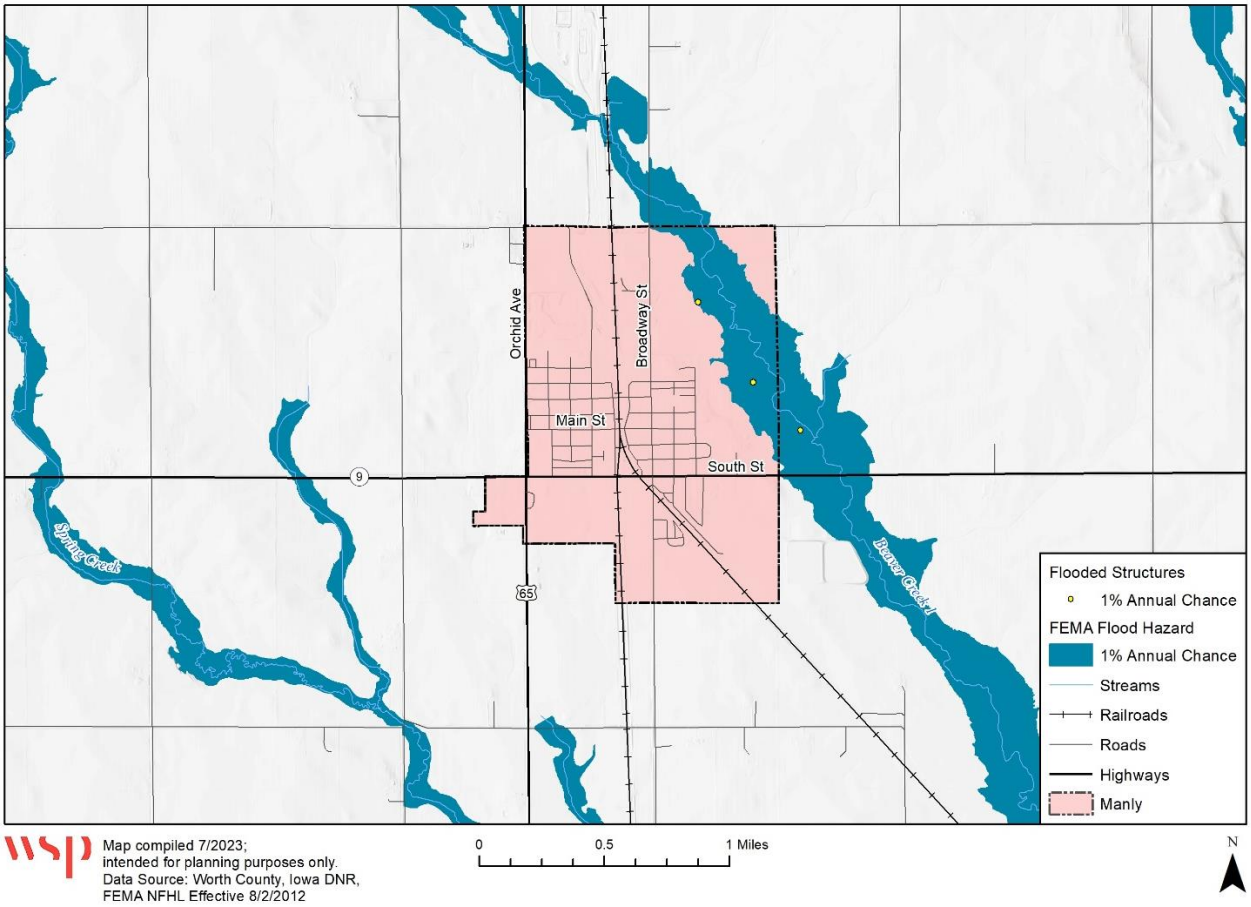
Figure 4-24 City of Kensett 1 Percent Annual Chance Floodplain



Manly

The Beaver Creek floodplain crosses the City of Manly from the north-central to the east-central portion.

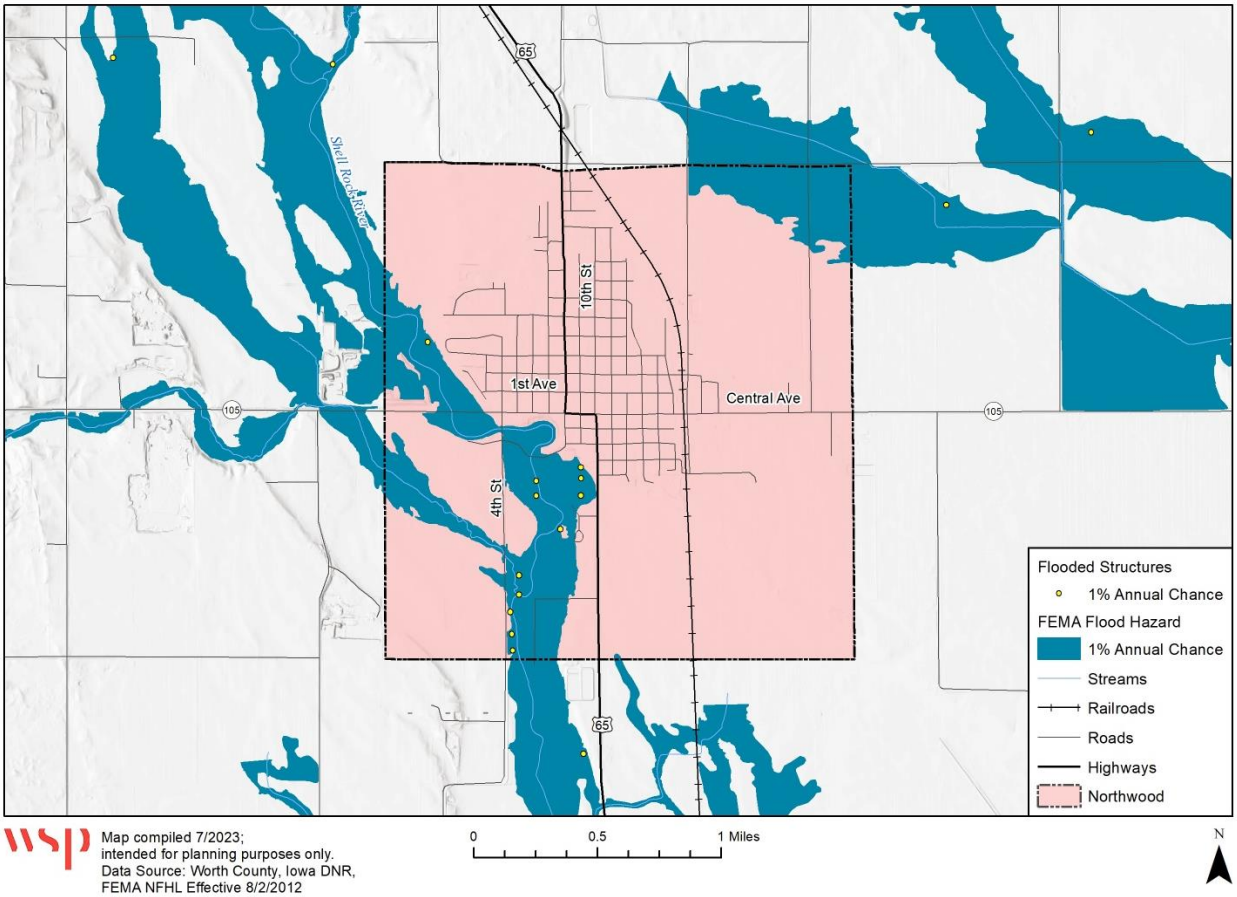
Figure 4-25 City of Manly 1 Percent Annual Chance Floodplain



Northwood

Parts of the Shell Rock River primarily flood the City of Northwood, coming in from the northwest and crossing through to the south of the city. A series of ditches in the northeast have floodplains that can affect the northeast boundaries as well.

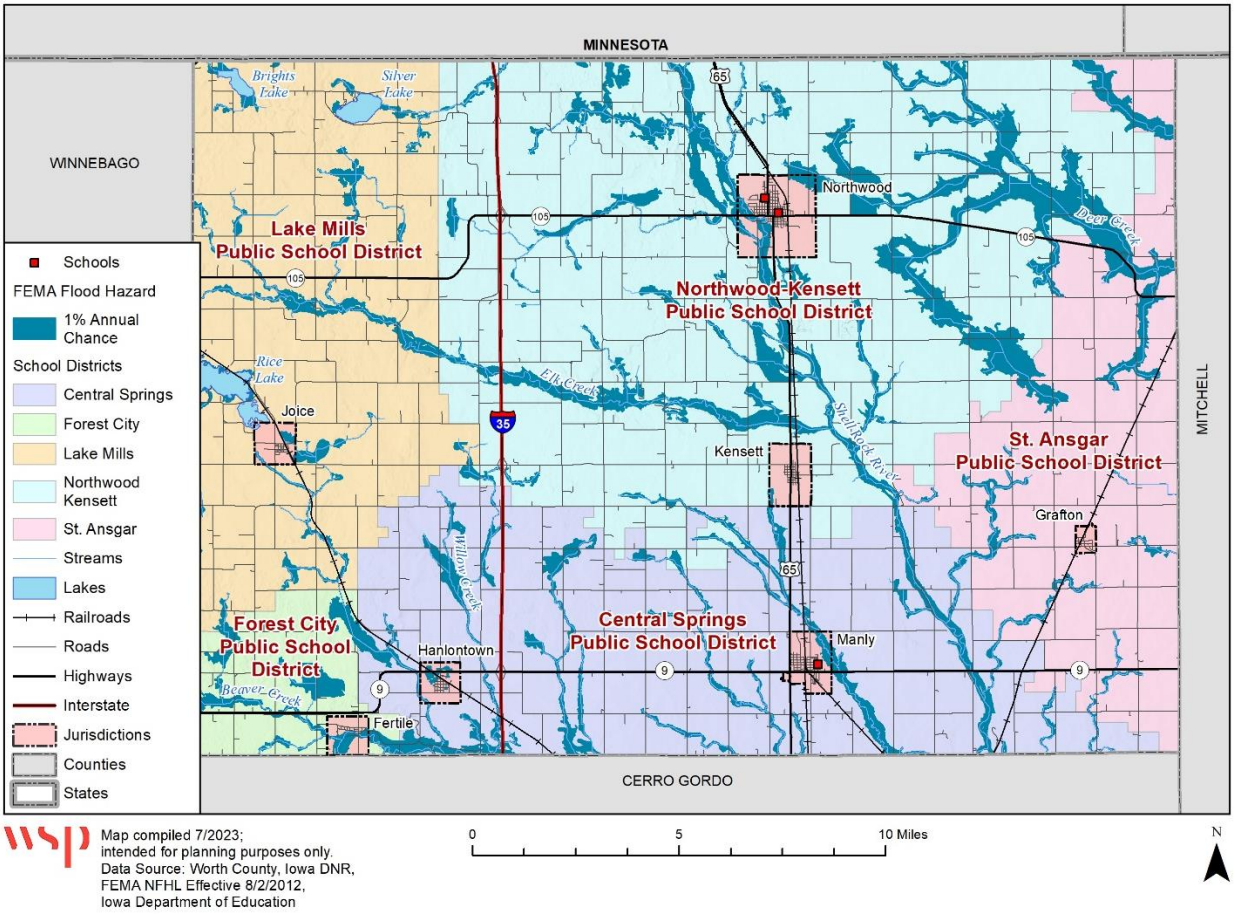
Figure 4-26 City of Northwood 1 Percent Annual Chance Floodplain



Worth County School Districts

All five school districts are at some level of risk of the 1-percent annual chance flood, though Northwood-Kensett is at greater risk due to its size, and to the fact that the Deer Creek, Elk Creek, and Shell Rock River floodplains all have a significant drain impact on the district.

Figure 4-27 Worth County School Districts and the 1 Percent Annual Chance Floodplain



Past Occurrences

Worth County and its jurisdictions have witnessed several major floods and flashfloods. To date there has been 4 Presidential Disaster Declaration disasters in Worth County due to flooding since 1965. Some of the more noteworthy floods and recent floods are profiled in this section.

According to the NCEI, there were 19 reported flood events from 1997 to 2023 (the last one being in 2013). While no human deaths or injuries were sustained from the events in the recorded years, flooding still occurs fairly frequently and can prove costly. Details are provided below in **Table 4-25**.

Table 4-25 NCEI Flood Events in Worth County, 1997-2023

Year	Number of Events	Deaths	Injuries	Property Damages	Crop Damages
1997	2	0	0	$0	$0
1998	1	0	0	$75,000	$10,000
1999	3	0	0	$160,000	$225,000
2000	1	0	0	$25,000	$25,000
2001	5	0	0	$262,500	$50,000
2004	2	0	0	$150,000	$398,039
2006	1	0	0	$5,000	$0
2010	1	0	0	$0	$20,000,000
2013	3	0	0	$450,000	$0
Grand Total	**19**	**0**	**0**	**$1,127,500**	**$20,708,039**

Source: NOAA NCEI

The NCEI also reported that there were 28 flash flood events from 1997 to 2023 (the last events being in 2021). While no human deaths or injuries were sustained from the events in the recorded years, flash flooding still occurs fairly frequently and can prove costly. Details are provided below in **Table 4-26**.

Table 4-26 NCEI Flash Flood Events in Worth County, 1997-2023

Year	Number of Events	Deaths	Injuries	Property Damages	Crop Damages
1999	2	0	0	$1,200,000	$300,000
2000	1	0	0	$50,000	$75,000
2004	2	0	0	$200,000	$75,000
2007	2	0	0	$20,000	$0
2008	4	0	0	$185,000	$0
2011	3	0	0	$70,000	$0
2013	8	0	0	$780,000	$0
2016	1	0	0	$10,000	$0
2018	1	0	0	$100,000	$100,000
2021	4	0	0	$0	$0
Grand Total	**28**	**0**	**0**	**$2,615,000**	**$550,000**

Source: NCEI

The following section provides previous major occurrences in the jurisdictions and unincorporated places within Worth County. First, major historical events for the county are described, followed by reported events for each city/location.

Worth County

Countywide, many minor and medium-size flooding events have taken place over the years. For example, there was one event starting mid-April of 2006, across a large part of the northwest and north central areas,

where flooding was limited to lowland agricultural areas, and damage was very minor. Other occurrences have involved thousands of dollars in damages and crop losses as well.

Kensett

Seven tornado events near Wright and Franklin counties triggered major flooding to occur in many areas of northern Iowa, beginning with the City of Kensett, mid-June of 2013. The event in Kensett was initially of flash flooding nature but morphed into general flooding affecting many public infrastructures.

Northwood

A cold front originating to the west of Iowa caused storms and heavy rains around the 20th of June 1998. Urban flooding was reported for this event as well as river inundation, which lasted several hours and ended near the City of Northwood. Both property damages and crop losses were incurred during this flood.

Unincorporated Areas

A flooding began in mid-June 2010 near Silver Lake, northwest Worth County. Heavy rains caused considerable crop losses, due to both drowning and the crops not being able to sustain planting (from oversaturated soils). Estimates claim about 10% of the crop (or about 1 billion dollars) was lost across the state due to this flooding event.

Flooding near Meltonville, eastern Worth County, took place early June of 2013, due to heavy rains. Soil oversaturation occurred as well in this event, leading to flash flood conditions and even road closings. Over $100,000 in property damages were reported.

In northwestern Worth county, another major flooding event began mid-June of 2013, near Bristol. Flooding began as flash flooding but morphed into general flooding overnight. Rescue operations had to be sent as populations were stranded. No crop damages were incurred.

Probability of Future Occurrence

With the history of flooding in many areas across Worth County, it is **likely** that flooding of various levels will continue to occur. According to the NCEI, 19 reported flood events have taken place in the 27-year period from 1996 to 2023, or approximately 0.7 events per year on average. Therefore, the probability rating for Worth County to suffer from riverine flooding in the future is "Highly Likely".

Magnitude/Severity

Magnitude and severity can be described or evaluated in terms of a combination of the different levels of impact that a community sustains from a hazard event. Specific examples of negative impacts from flooding on Worth County span a comprehensive range and are summarized as follows:

- Floods cause damage to private property that often creates financial hardship for individuals and families.
- Floods cause damage to public infrastructure resulting in increased public expenditures and demand for tax dollars;
- Floods cause loss of personal income for agricultural producers that experience flood damages;
- Floods cause loss of income to businesses relying on recreational uses of County waterways;
- Floods cause emotional distress on individuals and families; and

- Floods can cause injury and death.

The magnitude and severity of the flood hazard is usually determined by not only the extent of impact it has on the overall geographic area, but also by identifying the most catastrophic event in the previous flood history. Sometimes it is referred to as the "event of record." The flood of record is almost always correlated to a peak discharge at a gage, but that event may not have caused the worst historic flood impact in terms of property damage, loss of life, etc.

The impact of a flood event can vary based on geographic location to waterways, soil content and ground cover, and construction. The extent of the damage of flooding ranges from very narrow to widespread based on the type of flooding and other circumstances such as previous rainfall, rate of precipitation accumulation, and the time of year.

The HMPC estimates that the potential magnitude for a flood event in Worth County is **catastrophic**. An event of critical magnitude could result in multiple severe injuries, complete shutdown of critical facilities and services for at least two weeks, and severe damage to more than 25% of property in the planning area. Roads closed due to floods can result in serious transportation disruptions due to the limited number of roads in the County. Mud and debris flow also often accompany floods.

Climate Change Considerations

Use of historical hydrologic data has long been the standard of practice for designing and operating water supply and flood protection projects. For example, historical data are used for flood forecasting models and to forecast snowmelt runoff for water supply. This method of forecasting assumes that the climate of the future will be similar to that of the period of historical record. However, the hydrologic record cannot be used to predict changes in frequency and severity of extreme climate events such as floods. Climate change is already impacting water resources, and resource managers have observed the following:

- Historical hydrologic patterns can no longer be solely relied upon to forecast the water future.
- Precipitation and runoff patterns are changing, increasing the uncertainty for water supply and quality, flood management, and ecosystem functions.
- Extreme climatic events will become more frequent, necessitating improvement in flood protection, drought preparedness, and emergency response.

The amount of snow is critical for water supply and environmental needs, but so is the timing of snowmelt runoff into rivers and streams. Rising snowlines caused by climate change will allow more areas to contribute to peak storm runoff. High frequency flood events (e.g., 10-year floods) in particular will likely increase with a changing climate. Along with reductions in the amount of the snowpack and accelerated snowmelt, scientists project greater storm intensity, resulting in more direct runoff and flooding. Changes in watershed vegetation and soil moisture conditions will likewise change runoff and recharge patterns. As stream flows and velocities change, erosion patterns will also change, altering channel shapes and depths, possibly increasing sedimentation behind dams, and affecting habitat and water quality. With potential increases in the frequency and intensity of wildfires due to climate change, there is potential for more floods following fire, which increase sediment loads and water quality impacts.

Vulnerability

A flood vulnerability assessment was performed for Worth County using Geographic Information Systems (GIS). The flood vulnerability assessment was performed for Worth County using the following GIS methodology. The County's parcel layer and associated assessor's building improvement valuation data were provided by the County and were used as the basis for the inventory. GIS was used to convert the parcels into centroids to represent structures for analysis. Only parcels with improvement values greater than zero were used in the analysis except for Exempt properties with government structures which don't

have values sometimes, this method assumes that improved parcels have a structure of some type. The National Flood Hazard Layers (NFHL) were then overlaid in GIS on the parcel centroid layer to identify structures that would likely be inundated during a 1% annual chance flood event. Worth County does not have any mapped 0.2% annual chance flood hazards.

People

The flood analysis estimated that the exposed population for the entire county is 182 people within the 100-year floodplain. For the unincorporated portions of the county, it is estimated that the exposed population consist of 130 people within the 100-year floodplain. The City of Northwood has the highest population at risk to flooding with an estimated population of 30. **Table 4-27** summarizes the total populations in the 100-year floodplains by municipality.

Table 4-27 Worth County Population at Risk to 1% Annual Chance of Flooding

Jurisdiction	Population
Fertile	15
Hanlontown	7
Joice	0
Manly	0
Northwood	30
Unincorporated	130
Total	**182**

Sources: Worth County, Population - U.S. Census Bureau reported by Iowa State University of Science and Technology, FEMA NFHL Effective 8/2/2012, WSP Analysis

Property

As noted in **Figure 4-19** and **Table 4-28** below, there is a substantial amount of property value within Worth County's flood hazard areas. There is a total of $21,032,371 in total property value with the largest amount being located in the commercial and residential sectors within Worth County's 1% floodplain. The City of Northwood possesses the highest amounts of total values with $3 million with the highest amount being in the commercial sectors within the 1% floodplain. Northwood also has the highest loss estimations amounting to $764 thousand total.

Table 4-28 Worth County Properties at Risk to FEMA 1% Annual Chance of Flooding

Jurisdiction	Property Type	Improved Parcel Count	Improved Value	Estimated Content Value	Total Value	Loss Estimate
Fertile	Agriculture Dwelling	1	$112,510	$56,255	$168,765	$42,191
	Commercial	2	$180,092	$180,092	$360,184	$90,046
	Residential	7	$338,672	$169,336	$508,008	$127,002
	Total	**10**	**$631,274**	**$405,683**	**$1,036,957**	**$259,239**
Hanlontown	Commercial	1	$714,422	$714,422	$1,428,844	$357,211
	Residential	3	$172,886	$86,443	$259,329	$64,832
	Total	**4**	**$887,308**	**$800,865**	**$1,688,173**	**$422,043**
Joice	Commercial	1	$60,576	$60,576	$121,152	$30,288

Jurisdiction	Property Type	Improved Parcel Count	Improved Value	Estimated Content Value	Total Value	Loss Estimate
	Total	**1**	**$60,576**	**$60,576**	**$121,152**	**$30,288**
Manly	Agriculture	1	$2,926	$2,926	$5,852	$1,463
	Commercial	1	$32,340	$32,340	$64,680	$16,170
	Total	**2**	**$35,266**	**$35,266**	**$70,532**	**$17,633**
Northwood	Agriculture Dwelling	1	$207,454	$103,727	$311,181	$77,795
	Residential	11	$1,830,356	$915,178	$2,745,534	$686,384
	Total	**12**	**$2,037,810**	**$1,018,905**	**$3,056,715**	**$764,179**
Unincorporated	Agriculture	12	$67,388	$67,388	$134,776	$33,694
	Agriculture Dwelling	36	$6,003,959	$3,001,980	$9,005,939	$2,251,485
	Commercial	6	$668,113	$668,113	$1,336,226	$334,057
	Residential	19	$3,054,601	$1,527,301	$4,581,902	$1,145,475
	Total	**73**	**$9,794,061**	**$5,264,781**	**$15,058,842**	**$3,764,711**
	Grand Total	**102**	**$13,446,295**	**$7,586,076**	**$21,032,371**	**$5,258,093**

Sources: Worth County, Population - U.S. Census Bureau reported by Iowa State University of Science and Technology, FEMA NFHL Effective 8/2/2012, WSP Analysis

National Flood Insurance Program (NFIP) Participation

Table 4-29 provides details on NFIP participation for the communities in the planning area as well as the number of policies in force, amount of insurance in force, number of closed losses, and total payments for each jurisdiction, where applicable. The claims information is for the period from January 1, 1977 to September 28, 2023.

As noted previously, the City of Grafton does not have any mapped SFHA. The Cities of Joice and Hanlontown are sanctioned under the NFIP as of August 13, 1977. Due to limited staffing and resources, and the limited number of properties at risk of flooding in those jurisdictions (see Section 4.3.37), the Cities do not anticipate rejoining the NFIP in the near future.

Table 4-29 Worth County NFIP Participation, Policy, and Claim Statistics

Community Name	NFIP Participant	Current Effective Map Date	Reg Emer Date	Policies In-force	Insurance In-force	Total Claims Since 1978	Total Payments Since 1978
Fertile	Yes	08/02/12 (M)	08/04/87	1	$375,000	2	$0
Grafton	No	NSFHA	N/A	N/A	N/A	N/A	N/A
Hanlontown	Yes	08/02/12 (M)	08/02/12	0	$0	0	$0
Joice	No	08/02/12 (M)	08/13/77	0	$0	0	$0
Kensett	No	08/02/12 (M)	11/05/77	0	$0	0	$0
Manly	Yes	08/02/12 (M)	05/01/11	0	$0	0	$0
Northwood	Yes	08/02/12 (M)	08/01/87	3	$557,000	2	$7,347
Worth County	Yes	08/02/12 (M)	08/02/12	1	$350,000	0	$0

Source: FEMA Community Information System; M= No elevation determined – all Zone A, C, and X: NSFHA = No Special Flood Hazard Area; E=Emergency Program: Policy and Loss Statistics from BureauNet, https://nfipservices.floodsmart.gov/reports-flood-insurance-data; *Closed Losses are those flood insurance claims that resulted in payment. Loss statistics are for the period from January 1, 1977 to September 28, 2023.

Repetitive Loss/Severe Repetitive Loss Properties

Repetitive Loss: Repetitive Loss Properties are those properties with at least two flood insurance payments of $5,000 or more in a 10-year period.

Severe Repetitive Loss (SRL): SRL properties are defined as "a single-family property" (consisting of one-to-four residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which four or more separate claims payments have been paid under flood insurance coverage with the amount of each claim payment exceeding $5,000 and with cumulative amounts of such claims payments exceeding $20,000; or for which at least two separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property.

As of February 25, 2024, FEMA reports there are no repetitive loss or severe repetitive loss properties in Worth County.

Critical Facilities and Infrastructure at Risk

Key support facilities and structures most necessary to withstand the impacts of, and respond to, natural disasters are referred to as critical facilities. Examples of these critical facility types include utilities, transportation infrastructure, and emergency response and services facilities. Failures of components along major lifelines or even closures or inaccessibility to key emergency facilities could limit if not completely cut off transmission of commodities, essential services, and lead to other potentially catastrophic repercussions.

This analysis determined of the 589 total facilities that there are 113 critical facilities/infrastructure in the 1% annual chance floodplain. The Transportation sector has the highest critical facilities total located with the Special Flood Hazard Areas as there are 98 in the 100-year floodplain hazard. Road and bridge infrastructure are vital to Worth County and there are a limited number of highways and local roads in the County. When these roads are rendered impassable by an event such as a flood, ingress or egress can be severely limited. These bridges have been impacted by previous flooding in the past. **Table 4-30** provides a summary of the critical facilities in the 1-percent annual chance floodplains broken out by FEMA Lifeline.

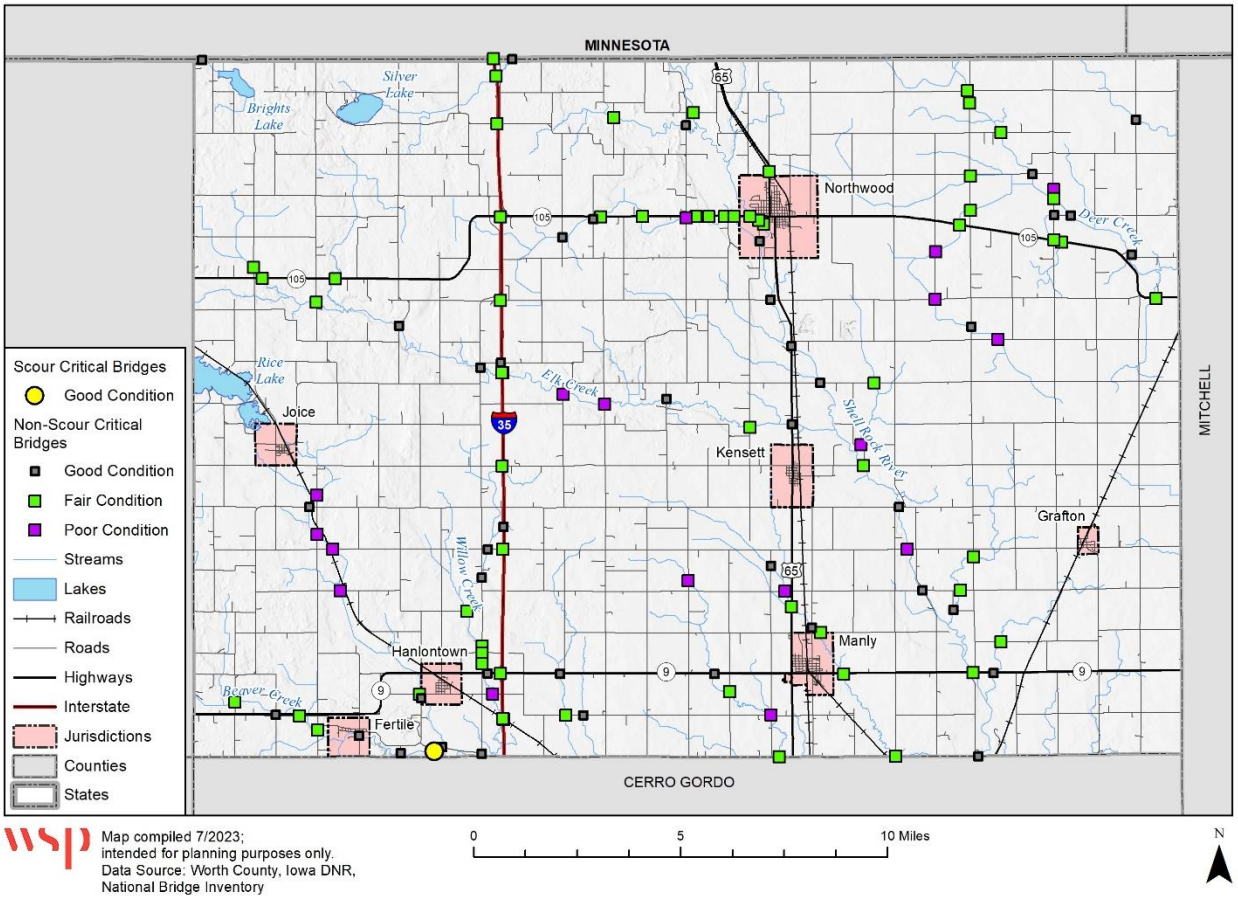
Table 4-30 Critical Facilities at risk to the 1-percent Annual Chance Flood

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
Fertile	-	-	-	-	-	-	1	**1**
Grafton	-	-	-	-	-	-	-	**0**
Hanlontown	-	-	-	-	-	-	1	**1**
Joice	-	-	-	-	-	-	-	**0**
Kensett	-	-	-	-	-	-	-	**0**
Manly	-	-	-	-	-	-	-	**0**
Northwood	-	-	-	-	-	-	2	**2**
Unincorporated	-	13	2	-	-	-	94	**109**
Total	**0**	**13**	**2**	**0**	**0**	**0**	**98**	**113**

Sources: Worth County, DNR, HIFLD, National Bridge Inventory, FEMA NFHL Effective 8/2/2012, WSP Analysis

According to the National Bridge Inventory, there is one scour critical bridge being in a "Good Condition" in Worth County. However, there are seventeen non-scour "Poor Condition" bridges as well. All bridges within county boundaries are depicted in **Figure 4-28.** Note that not every bridge infrastructure will be at risk of the 1-percent annual chance flood.

Figure 4-28 Worth County National Bridge Inventory



Economy

Economic damages related to flooding include crop loss, building damage, and recovery efforts after flood events. Flood insurance can help mitigate some of the costs of flood damages. Participation in the NFIP helps flood-prone communities reduce their economic risk to flooding.

Environment and Cultural Resources

Next to people and property, natural resources impact from flooding could be severe. Flooding events are common and naturally occurring phenomenon in forested areas and can benefit forest health in many respects. Yet the trend for more flooding can make it more difficult for the environment to recover, and lead to even more increased flood hazards. This can severely impact water quality and watershed health for years following.

Development Trends

Any future development in floodplains would increase risk in those areas. For those communities that participate in the National Flood Insurance Program, enforcement of the floodplain management regulations will ensure mitigation of future construction in those areas.

Risk Summary

- The overall significance of flooding is **High.** However, there is significant variation between communities.
- Fertile, Hanlontown, Joice, Manly, Northwood, and the unincorporated County all have properties in the floodplain.
- Flash flooding that occurs with little or no warning will continue to impact the planning area.
- Flooding may be exacerbated by other hazards, such as wildfires.
- Flooding frequently causes other related hazards, such as erosion and mudflows.
- There is $21 million worth of property values in the 1%, with potential losses estimated at $5.2 million.
- There is an estimated population of 182 in the 1% floodplain.
- Related hazards: Drought, Levee/Dam Failure, Wildfire.

4.3.8 Grass or Wildland Fire

Probability	Magnitude/Severity	Location/Area	Hazard Ranking
Likely	Moderate	Significant	**Medium**

Description

Iowa's urban/rural interface (areas where development occurs within or immediately adjacent to wildland, near fire-prone trees, brush, and/or other vegetation), is growing as metro areas expand into natural forest, prairies and agricultural areas that are in permanent vegetative cover through the Conservation Reserve Program (CRP). The State has the largest number of CRP contracts in the nation, totaling over 1.5 million acres. Most of this land is planted in cool and warm season grass plantings, tree plantings and riparian buffer strips. There is an additional 230,000 acres in federal ownership and conservation easements.

Wildfires are frequently associated with lightning and drought conditions, as dry conditions make vegetation more flammable. As new development encroaches into the wildland/urban interface more and more structures and people are at risk. On occasion, ranchers and farmers intentionally set fire to vegetation to restore soil nutrients or alter the existing vegetation growth. Also, individuals in rural areas frequently burn trash, leaves, and other vegetation debris. These fires have the potential to get out of control and turn into wildfires.

The risk of wildfires is a real threat to landowners across the State. The National Weather Service monitors the conditions supportive of wildfires in the State daily so that wildfires can be predicted, if not prevented.

The risk factors considered are:

- High temperature
- High wind speed
- Fuel moisture (greenness of vegetation)
- Low humidity
- Little or no cloud cover

Location

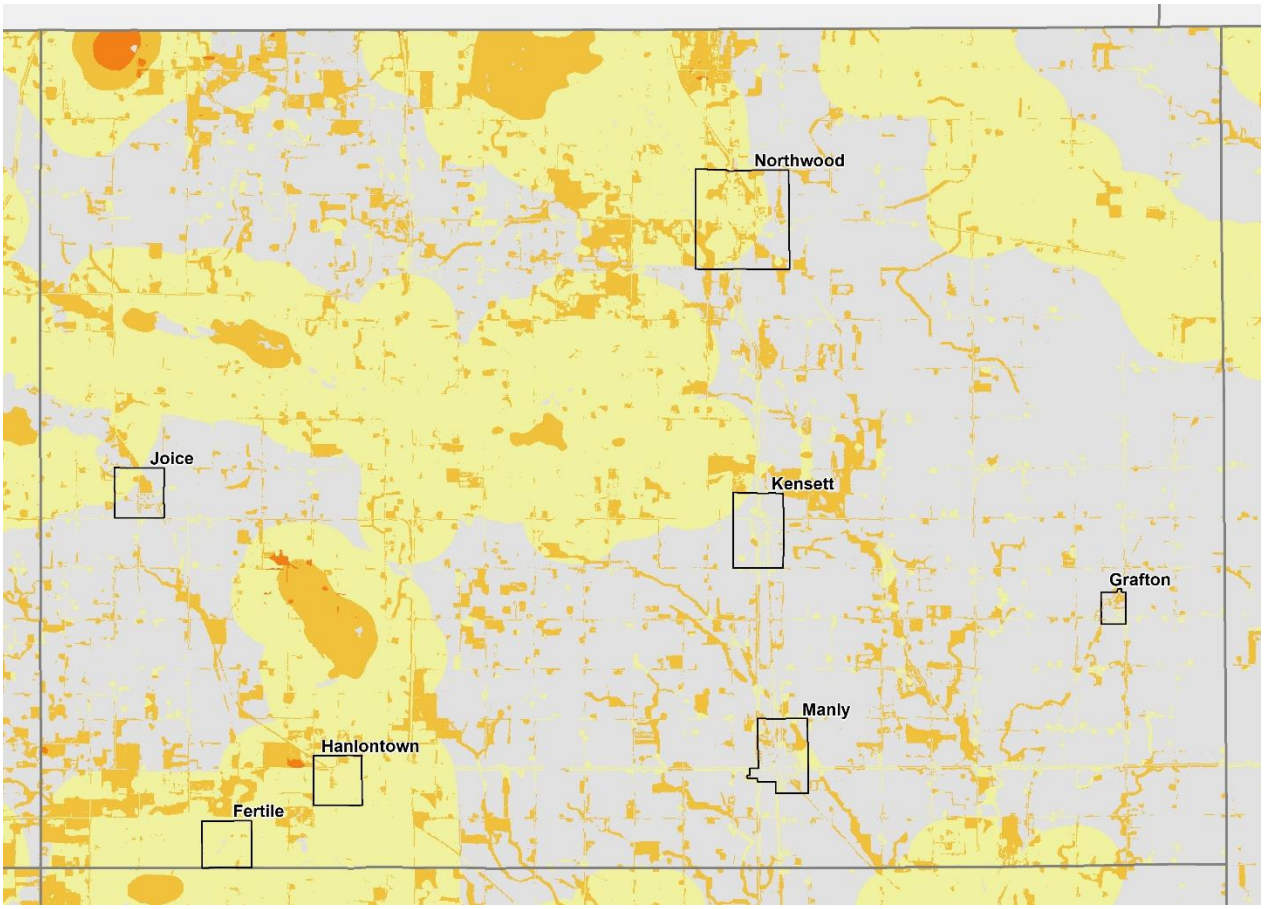
The USDA Forest Service, under the direction of Congress in the 2018 Consolidated Appropriations Act (H.R. 1625, Section 210), developed a nationwide wildfire risk assessment. The Wildfire Risk to Communities study results were used to assess risk to Wildfire in Worth County. Wildfire Risk to Communities uses the best available science data to identify risk and provide resources for communities to manage and mitigate risk. This is a national analysis for comparing risk that varies across a state, region, or county to help prioritize actions to mitigate risk.

The Wildfire Risk to Homes wildfire analysis categories were reviewed to represent risk. Risk to Homes combines wildfire likelihood and intensity with generalized results to a home within the planning area. The Risk to Homes data integrates wildfire likelihood and wildfire intensity from simulation modeling to represent wildfire hazard. Wildfire Risk to Communities uses a generalized concept of susceptibility that all homes that encounter wildfire will be damaged and the degree of damage is directly related to the fire's intensity.

Figure 4-29 shows the Risk to Homes within Worth County and **Figure 4-30** displays the legend, which represents where the planning area falls in relation to the other counties in Iowa. The size of the circles in the legend is a proportional representation of the county's population compared to other counties in the

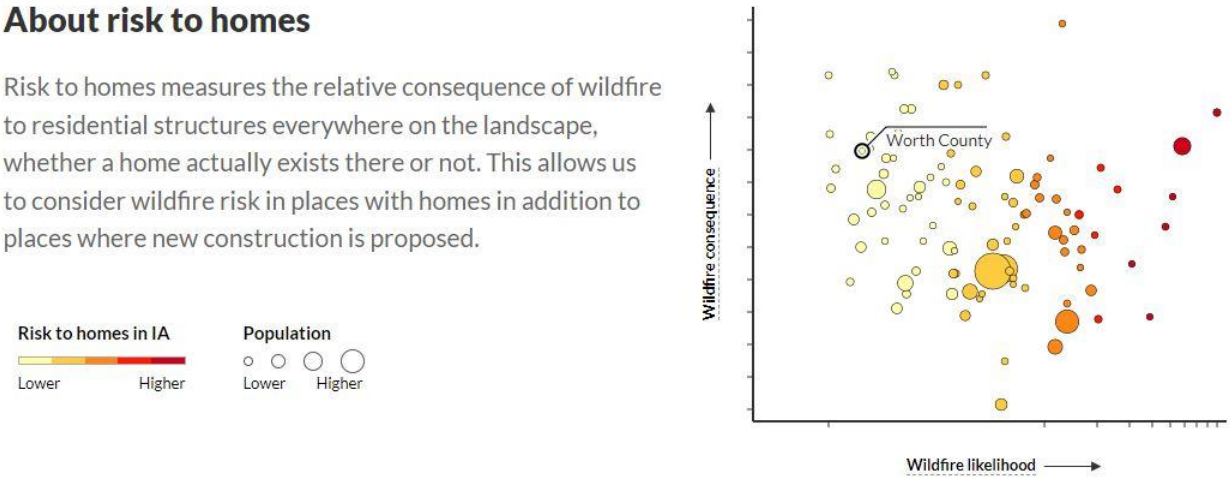
state. Worth County has a Low Risk to wildfire, lower than 97% of other counties within the State. The greatest risk to homes in the County is scattered throughout the County with Moderate to Less Risk in all the jurisdictions and large areas in the unincorporated county. Fertile, Hanlontown, and Northwood have the most area at lowest risk, although Manly and Joice have significant areas of moderate risk to homes.

Figure 4-29 Worth County Wildfire Risk to Homes



Source: Wildfire Risk to Communities, https://wildfirerisk.org

Figure 4-30 Worth County Wildfire Risk to Homes Relative to Other Iowa Counties



Source: Wildfire Risk to Communities, https://wildfirerisk.org

Past Occurrences

According to the NCEI database there were no wildland or forest fire events with significant impact that have been reported in Worth County from 1950 to 2022, however, this does not account for small or contained grass fires that may not have been reported. Complete and comprehensive data on wildfire occurrences in Iowa is maintained by the Iowa State Fire Marshal's Office, through the National Fire Incident Reporting System (NFIRS). NFIRS is a repository of statistical data reported by participating fire departments. However, this data is not available to the public and was not included in this plan update. According to the Iowa Department of Public Safety, there have been 25 fire related fatalities in Iowa so far in 2023, one of which occurred in Worth County. Additionally, the Iowa Forest Action Plan notes that there have been 5,473 reported wildland fires statewide over the 10-year period from 2009-2018, burning a total of 86,192 acres. This is summarized in **Table 4-31** below.

Table 4-31 Reported Wildfires in Iowa 2009-2018

Year	Number of Wildland Fires Reported	Acres of Wildland Fires Reported
2009	844	9,303
2010	375	4,835
2011	745	11,548
2012	720	7,969
2013	285	2,548
2014	718	13,789
2015	594	16,210
2016	182	1,557
2017	588	10,501
2018	422	7,932
Total	**5,473**	**86,192**

Source: Iowa Forest Action Plan, 2020

The type of fires common to Worth County rarely result in any damage to property; however, cropland is at a higher risk. In addition, many communities in Worth County have adequate fire gear, or have standing mutual aid agreements, to respond to most grassland fires and do not consider small grassland fires significant hazard events. Unincorporated Worth County is the jurisdiction with the highest likelihood of grassfire because of the large amount of cropland and open space.

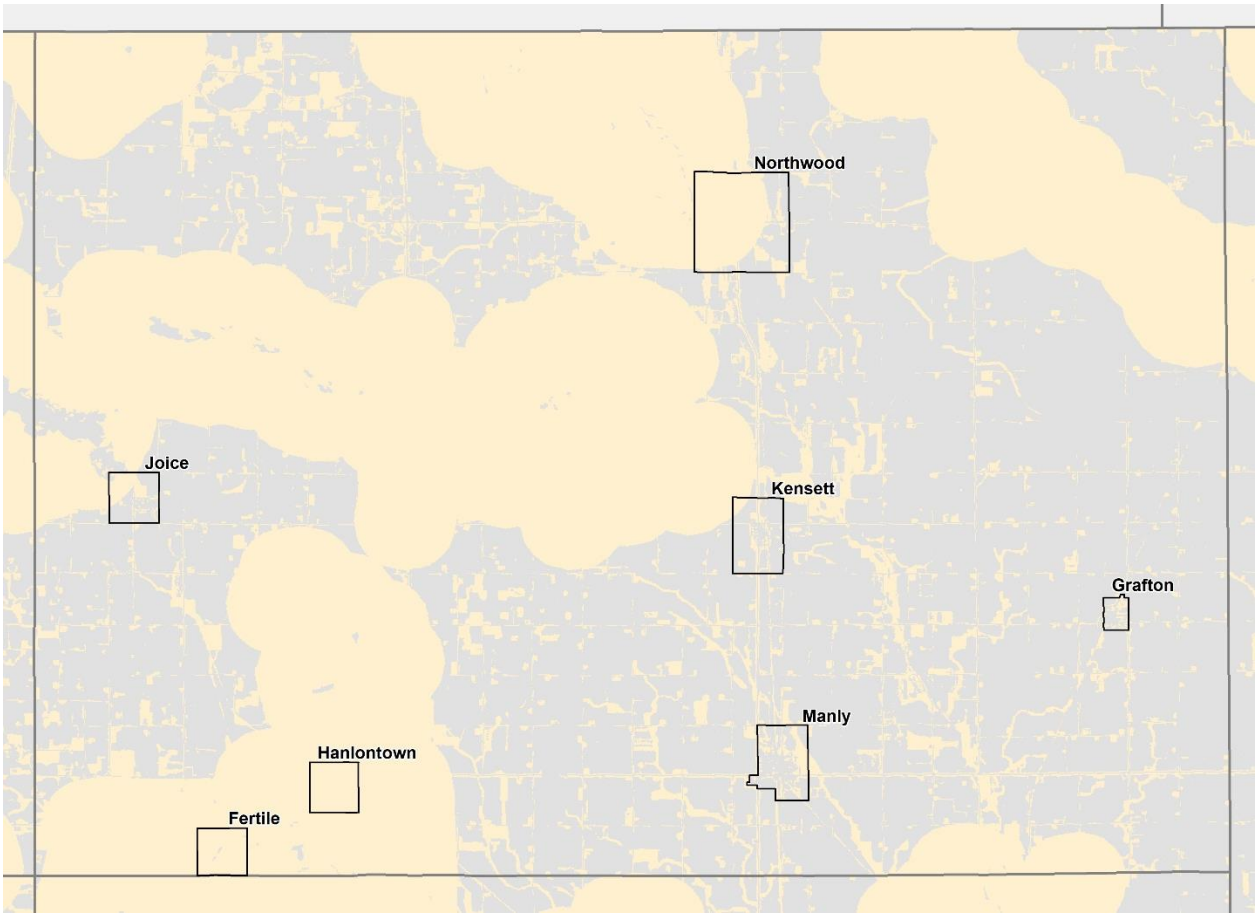
Probability of Future Occurrence

Updated historical data was not available to document the wildland/grass fires in late years, or information related to the events (e.g., losses incurred, population affected). Since updated statistical data was unavailable to determine a quantitative probability, a qualitative probability is based on the anecdotal descriptions from the HMPC. The planning committee determined that, although damaging fires do not take place frequently, wildfires still occur on an annual basis. Therefore, the probability rating for events of this nature is "Likely."

To supplement the qualitative probability, the Wildfire Risk to Communities study mentioned above was also used. Wildfire Likelihood is the annual probability based on fire behavior modeling across thousands of simulations of possible fire seasons. Each simulation factor contributes to the probability of a fire occurring through weather, topography, and ignitions. These models do not reflect current wildfire foresting or conditions but can be used for prevention efforts through fuel and ignition prevention projects. **Figure 4-31** shows the Wildfire Likelihood in Worth County and **Figure 4-32** displays the legend, which represents where the planning area is in relation to the other counties in Iowa. The jurisdictions with the highest likelihood of wildfire are Fertile, Hanlontown, and Northwood.

Like the Wildfire Risk map shown previously, the size of the circles in the legend is a proportional representation of the county's population compared to other counties in the state. Populated areas in nearly all other the US counties, on average, have greater wildfire likelihood than in Worth County and a 9% likelihood within Iowa. Like wildfire risk, the greatest likelihood to wildfire in the County is scattered throughout the County with a Lower Risk to all the jurisdictions and large areas in the unincorporated county. According to study, 42% of Worth County is not exposed to wildfire and 30% is indirectly exposed to wildfire risk.

Figure 4-31 Worth County Wildfire Likelihood



Source: Wildfire Risk to Communities, https://wildfirerisk.org

Figure 4-32 Worth County Wildfire Likelihood Relative to Other Iowa Counties

Source: Wildfire Risk to Communities, https://wildfirerisk.org

Magnitude/Severity

Grass and wildland fire is considered to have **moderate** magnitude and severity. Most grass fires burn only the grasses, crops, or other low land cover. Injuries and deaths from fighting the fire most often occur by natural causes such as heart attack or stroke. Property damage is usually limited to grass, small trees, and other vegetative matter. Occasionally, a house or outbuilding can be damaged or destroyed.

Grass and wildland fire events often occur with minimal or no warning (up to 6 hours warning). Certain conditions could be the right mix for a grass or wildland fire to occur, but often these incidents cannot be predicted ahead of time. The rate at which fires can travel depends upon conditions at the time such as moisture, wind, and land cover.

Climate Change Considerations

Iowa is already experiencing the effects of climate change. The Iowa Climate Change Impacts Committee's Report to the Governor and the Iowa General Assembly has highlighted many expected effects, many of which may impact the severity and frequency of grass or wildland fires in the coming years:

- 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˚F rise in dew-point temperature. This fuels convective thunderstorms that provide more summer precipitation.

The impacts of higher temperatures listed above could also impact the frequency and severity of drought, which in turn could help fuel more severe wildland fires. The complexities of the impacts of climate change related to wildland fires in Iowa will likely lead to many cascading hazards, such as increased erosion and flooding following fires.

Vulnerability

Most vulnerable to wildfire are agricultural areas where land is burned, rural areas where trash and debris are burned, and the wildland-urban interface/intermix areas. The HMPC noted that corn stover fires are a major issue in the County, and that areas along the river are particularly vulnerable to fire.

Most grass fires are contained to highway right-of-way and rail right-of-way ditches and are less than a few acres in size. High winds can turn a small flame into a multi-acre grass fire within a matter of minutes, but the extent is dependent upon conditions such as land use/land cover, moisture, and wind. Grass fires are equally likely to affect Worth County communities where there is dense or high vegetation. Rural areas are much more likely to experience grass or wildland fires. Grass fires are often more easily contained and extinguished before there is damage to people or developed property. Fires often burn large portions of field crops in the fall when the crops are dry, and the harvesting equipment overheats or throws sparks. It should be noted that all communities stressed that their vulnerability to damage from grass or wildland fires is extremely low due to the ability of fire departments throughout the county to respond to and put out fires before they are able to spread.

People

Smoke and air pollution from wildfires can be a severe health hazard, especially for sensitive populations, including children, the elderly, and those with respiratory and cardiovascular diseases. Smoke generated by wildfire consists of visible and invisible emissions that contain particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen oxides), and toxics (formaldehyde, benzene). Emissions from wildfires depend on the type of fuel, the moisture content of the fuel, the efficiency (or temperature) of combustion, and the weather. Public health impacts associated with wildfire include difficulty in breathing, odor, and reduction in visibility.

Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke.

Property

Direct property damage and losses of buildings due to wildland fire is a rare occurrence in Worth County. According to the USDA Forest Service wildfire risk tool referenced above, populated areas in Worth County have, on average, a greater risk to homes than 8% of counties in Iowa.

Critical Facilities and Infrastructure

Critical facilities of wood frame construction are especially vulnerable during grass or wildland fire events. Power lines in the unincorporated areas of the county are the most at risk from wildfire because most poles are made of wood and susceptible to burning. Fires can create conditions that block or prevent access and can isolate residents and emergency service providers.

Some jurisdictions in Worth County are more vulnerable to grass or wildland fires that others due to the large amount of cropland in the surrounding areas. The Cities of Manly and Northwood have the highest concentration of critical facilities and infrastructure and are therefore most susceptible to burning. A list of critical infrastructure by Jurisdiction and lifeline or facility type can be found above in Table 4-10 and Table 4-11.

Economy

Fire suppression may result in increased costs to local and state government for water acquisition and delivery, especially during periods of drought when water resources are scarce. Fires can also cause direct economic losses in the destruction of buildings and their contents, or indirectly through the forced closures of businesses.

Environment and Cultural Resources

Fire is a natural and critical ecosystem process in most terrestrial ecosystems, dictating in part the types, structure, and spatial extent of native vegetation. However, severe wildfires can cause negative environmental impacts:

- **Soil Erosion**—The protective covering provided by foliage and dead organic matter is removed, leaving the soil fully exposed to wind and water erosion. Accelerated soil erosion occurs, causing landslides and threatening aquatic habitats.
- **Spread of Invasive Plant Species**—Non-native woody plant species frequently invade burned areas. When weeds become established, they can dominate the plant cover over broad landscapes, and become difficult and costly to control.
- **Disease and Insect Infestations**—Unless diseased or insect-infested trees are swiftly removed, infestations and disease can spread to healthy forests and private lands. Timely active management actions are needed to remove diseased or infested trees.
- **Destroyed Endangered Species Habitat**—Catastrophic fires can have devastating consequences for endangered species.
- **Soil Sterilization**—Topsoil exposed to extreme heat can become water repellant, and soil nutrients may be lost. It can take decades or even centuries for ecosystems to recover from a fire. Some fires burn so hot that they can sterilize the soil.

Many ecosystems are adapted to historical patterns of fire occurrence. These patterns, called "fire regimes," include temporal attributes (e.g., frequency and seasonality), spatial attributes (e.g., size and spatial complexity), and magnitude attributes (e.g., intensity and severity), each of which have ranges of natural variability. Ecosystem stability is threatened when any of the attributes for a given fire regime diverge from its range of natural variability.

Development Trends

Iowa's urban/rural interface is generally growing, however specific to Worth County the overall population is decreasing in recent years. Any future development in the wildland-urban interface/intermix areas could increase the planning areas vulnerability to this hazard, but not by a significant degree. Most growth in the county has occurred in the Cities of Grafton and Kensett and the most new residential development has occurred in the City of Northwood but the overall trend in Northwood has been a decline in housing units, so overall vulnerability is not expected to increase.

Risk Summary

Overall, grass/wildland hazard is ranked as **medium** for the County.

- The greatest risk to homes and highest likelihood in the County is spread throughout. Manly and Northwood have the highest areas of moderate risk of the jurisdictions.
- Less than half of the area in the County is vulnerable to grass/wildland fires; therefore, extent is rated as significant.
- Smoke and air pollution from wildfires can be a severe health hazard, especially for sensitive populations, including children, the elderly, and those with respiratory and cardiovascular diseases.
- Power lines in the unincorporated areas of the county are the most at risk from wildfire because most poles are made of wood and susceptible to burning. Fires can create conditions that block or prevent access and can isolate residents and emergency service providers.
- Fire suppression may result in increased costs to local and state government for water acquisition and delivery.

- Environmental impacts from wildfire include soil erosion, destroyed habitats, and soil sterilization.
- Related hazards: Drought, Extreme Heat, Infrastructure Failure, Lightning. Windstorm

4.3.9 Hazardous Materials

Probability	Magnitude/Severity	Location/Area	Hazard Ranking
Highly Likely	Moderate	Significant	**Medium**

Description

A hazardous substance is one that may cause damage to persons, property, or the environment when released to soil, water, or air. Chemicals are manufactured and used in increasing types and quantities. Each year over 1,000 new synthetic chemicals are introduced and as many as 500,000 products pose physical or health hazards and can be defined as "hazardous chemicals". Hazardous substances are categorized as toxic, corrosive, flammable, irritant, or explosive. Hazardous materials incidents generally affect a localized area.

Fixed Hazardous Materials Incident

A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

Transportation Hazardous Materials Incident

A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during transport. Transportation Hazardous Materials Incidents in Worth County can occur during highway, rail, or air transport. Highway accidents involving hazardous materials pose a great potential for public exposures. Both nearby populations and motorists can be impacted and become exposed by accidents and releases. If airplanes carrying hazardous cargo crash, or otherwise leak contaminated cargo, populations and the environment in the impacted area can become exposed. Derailed train cars that are potentially holding hazardous materials can contaminate soil, waterways, etc. Transportation related to hazardous materials may require coordinated efforts to mitigate long term effects on human health and environment.

Pipeline Incident

A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Location

The geographic extent of hazmat incidents is **moderate**. This section provides geographic locations within Worth County impacted by each type of potential hazardous materials incident.

Fixed Hazardous Materials Incident

According to the Iowa Department of Natural Resources, there are sites in Worth County that because of the volume or toxicity of the materials on site were designated as Tier II Facilities under the Superfund Amendments and Reauthorization Act. A Tier II facility is one that has greater than or equal to 10,000 pounds of any hazardous chemical as defined by OSHA criteria.

Table 4-32 provides the number of Tier II Facilities for each jurisdiction in the planning area as well as the number of facilities housings Extremely Hazardous Substances (EHS). An EHS Facility stands for

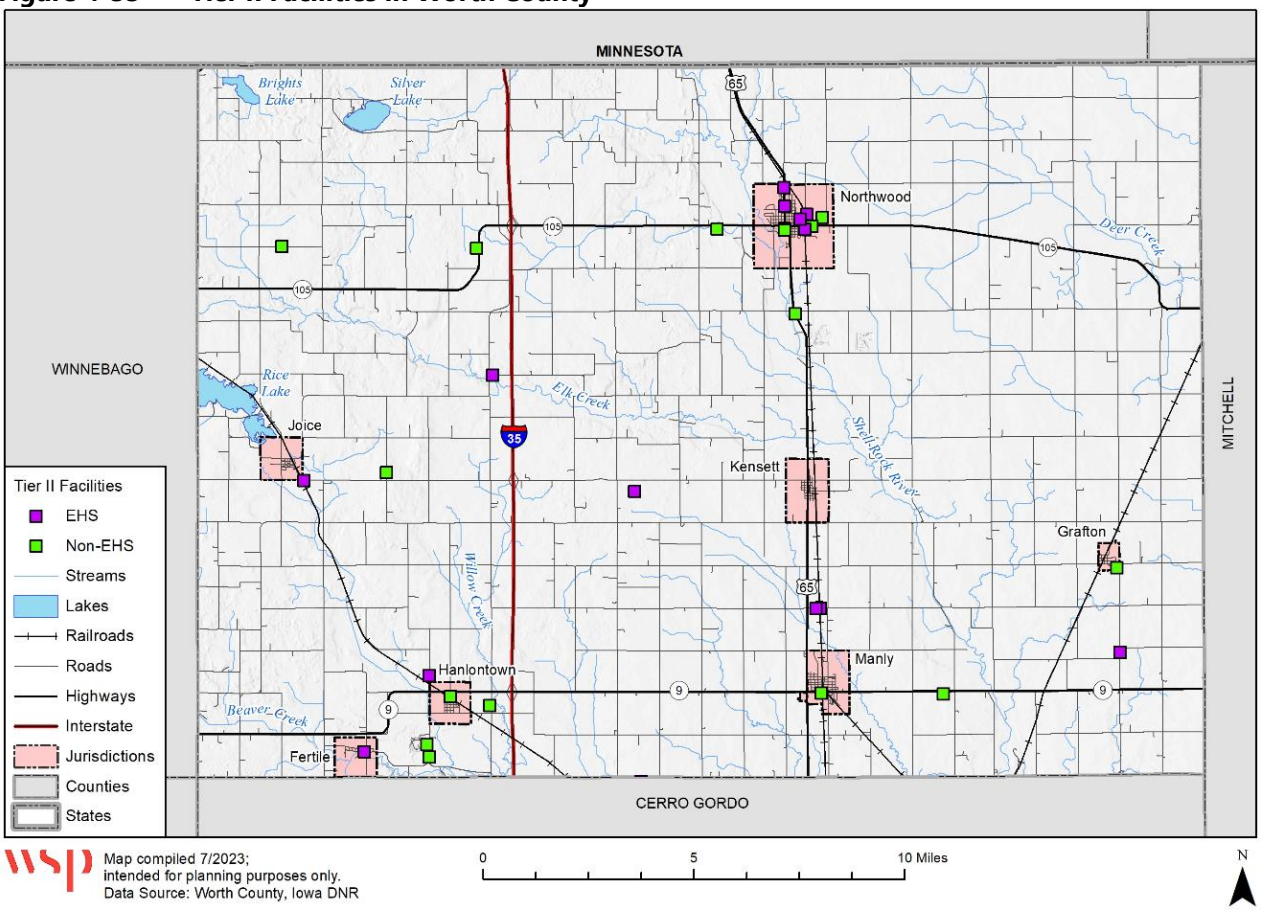
Environment, Health, and Safety. It's a general term used to refer to laws, rules, regulations, professions, programs, and workplace efforts to protect the health and safety of employees and the public as well as the environment from hazards associated with the workplace. Note: The jurisdiction is assigned from the address. Some facilities do fall within the unincorporated areas but are identified with the nearest city. **Figure 4-33** that follows is a map showing the locations of Tier II Facilities.

Table 4-32 Number of Tier II Facilities by Jurisdiction

Jurisdiction	# of Facilities	# of EHS Facilities
Fertile	1	-
Grafton	-	1
Hanlontown	-	1
Joice	-	-
Kensett	-	-
Manly	-	1
Northwood	6	3
Unincorporated County	7	9
Total	**14**	**15**

Source: Worth County, DNR, WSP Analysis

Figure 4-33 Tier II Facilities in Worth County



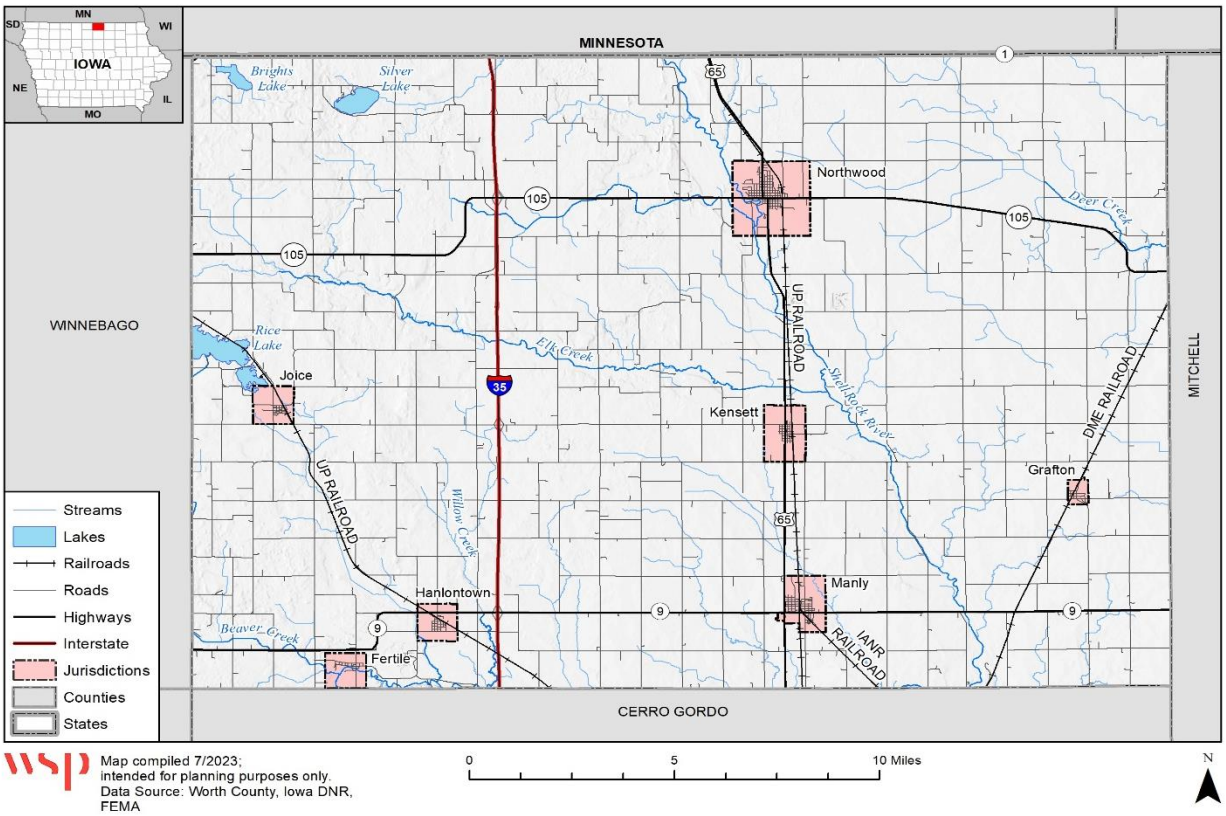
Transportation Hazardous Materials Incident

The transport of hazardous materials in Worth County occurs via trucks on the highways/roads, trains along railway lines, and airplanes carrying hazardous cargo.

Truck Transport

Hazardous materials can be transported on any of the roads in Worth County. Main conduits of transport include Interstate 35, US Highway 65, Iowa Highway 105, and Iowa Highway 9, shown in **Figure 4-34** below. Agriculture is important to the economy of Worth County; as a result, chemicals utilized in agriculture are frequently transported along county and local roadways.

Figure 4-34 Worth County Highways and Railroads



Source: Google Maps

Rail Transport

Union Pacific Railroad (UP), Iowa Northern Ry. Co (IANR), and Dakota, Minnesota and Eastern RR. CO. (DME) operate in Worth County. Additionally, Canadian National Railway Co./Cedar River Railroad Co. (CEDR) operates just north of the County boundary. There is one UP Railroad line that runs northwest-southeast through Joice and Hanlontown, as well as a line that runs north-south through Northwood, Kensett, and Manly. The Iowa Northern Ry. Co. line runs southeast out of Manly, and the Dakota, Minnesota, and Eastern RR Co. line runs southwest through Carpenter and Grafton.

Air Freight

The Northwood Municipal Airport located approximately one mile east of the City of Northwood is owned by the City of Northwood. Local access to the Northwood airport is provided via County Road 105.

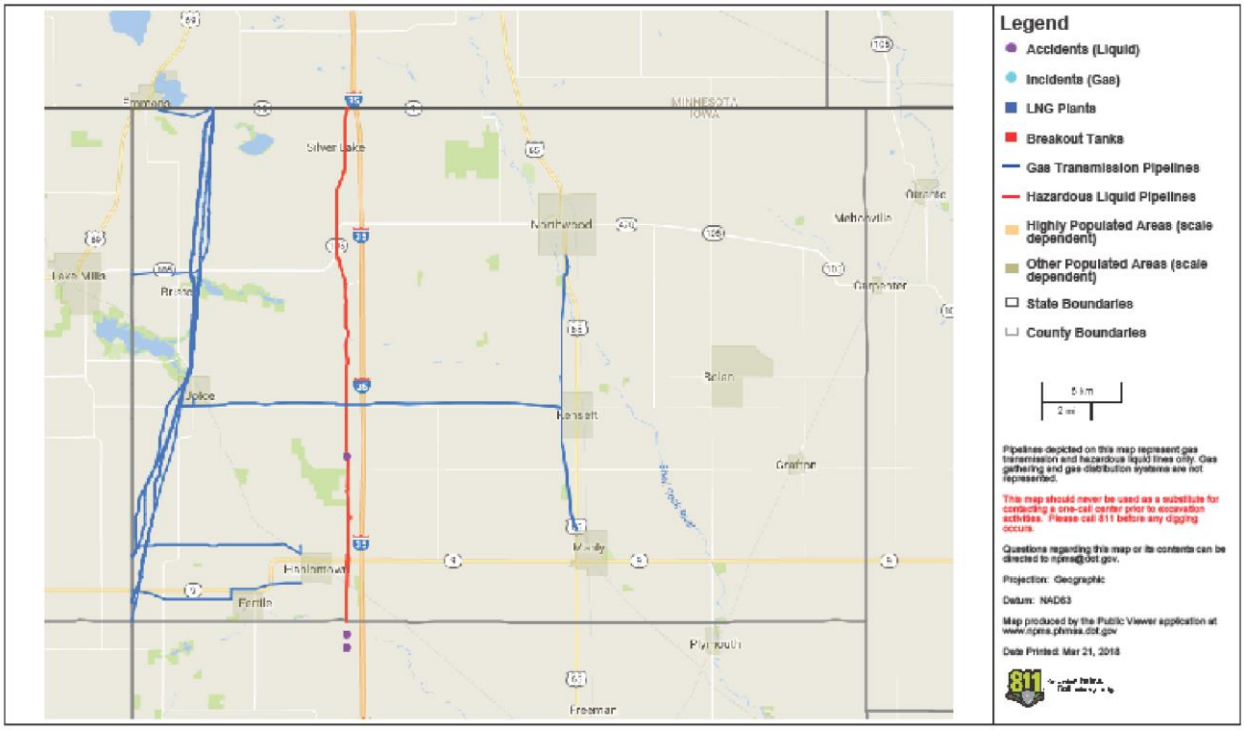
Figure 4-35 Northwood Municipal Airport

Source: Iowa Department of Transportation, http://www.iowadot.gov/aviation/airports/municipal.aspx

Pipeline Incident

Figure 4-36 shows the locations of pipelines in Worth County. The data for this map consists of gas transmission pipelines and hazardous liquid trunklines. It does not contain gathering or distribution pipelines, such as lines which deliver gas to a customer's home. Therefore, not all pipelines in the County will be visible.

Figure 4-36 Pipelines in Worth County



Source: Pipeline and Hazardous Materials Safety Administration, National Pipeline Mapping System, https://pvnpms.phmsa.dot.gov/PublicViewer/

Any large release of hazardous materials within or adjacent to a city could affect large areas of the city in the right conditions, possibly even the entire city. This could necessitate evacuation of large areas. In the rural unincorporated areas where population densities are low, even in a large release the number of homes that may need to be evacuated would be significantly lower than in an urban environment.

Immediate dangers from hazardous materials include fires and explosions. The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources may be unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin. Contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community. The occurrence of a hazmat incident often shuts down transportation corridors for hours at a time while the scene is stabilized, the product is off-loaded, and reloaded on a replacement container.

Past Occurrences

In Iowa, hazardous materials spills are reported to the Department of Natural Resources. According to Iowa Administrative Code Chapter 131, *Notification of Hazardous Conditions*, any person manufacturing, storing, handling, transporting, or disposing of a hazardous substance must notify the Department of Natural Resources and the local police department or the office of the sheriff of the affected county of the occurrence of a hazardous condition as soon as possible but not later than six hours after the onset of the hazardous condition or the discovery of the hazardous condition. The Department of Natural Resources maintains a database of reported spills.

According to the DNR database, from 2000 to 2022 (23 years), there have been 148 hazardous materials spills reported in Worth County. **Table 4-33** provides a summary of the reported spills during this time period for each jurisdiction indicated in the database as well as the mode of the spill. According to this data, the most spills occurred in Hanlontown (35), and most spills occurred during the handling and storage process (69). **Table 4-34** that follows summarizes the spills by material type. Petroleum is the most common material type spilled with 66 spills.

Table 4-33 Worth County Hazardous Materials Spills Reported to Iowa DNR, 2000-2022 by Jurisdiction and Mode

Jurisdiction	Fire	Handling and Storage	Manure	Other	Pipeline	Railroad	Theft	Transformer	Transportation	Unknown	Grand Total
Fertile		1		1					1		**3**
Forest City									1		**1**
Grafton		2				1		1			**4**
Hanlontown		21			3		2		8	1	**35**
Joice		9	1	1	5				8		**24**
Kensett		1							5	1	**7**
Lake Mills		15									**15**
Manly		6		1		2	1		6	1	**17**
Northwood	3	14		2				5	12	1	**37**
Plymouth			1					1			**2**
Saint Ansgar									2		**2**
Unincorporated County				1							**1**
Grand Total	**3**	**69**	**2**	**6**	**8**	**3**	**3**	**7**	**43**	**4**	**148**

Source: Iowa Department of Natural Resources, http://www.iowadnr.gov/InsideDNR/RegulatoryLand/EmergencyPlanningEPCRA/SpillReporting.aspx

Table 4-34 Worth County Hazardous Materials Spills Reported to Iowa DNR, 2000-2022 by Material Type

Jurisdiction	Acids/Bases	Animal/Vegetable Product	Fertilizer/Pesticide	Inorganic Chemical	Manure	Organic Chemical	Other Chemical	Petroleum	Propane/LPG/Natural Gas	Transformer oil/PCB	Not Reported	Grand Total
Fertile						1		2				**3**
Forest City								1				**1**
Grafton		1	1					1		1		**4**
Hanlontown	3	9	3			3	3	14				**35**
Joice	1		5	4	1	1	3	8			1	**24**
Kensett		1	1				1	4				**7**
Lake Mills				2		2		11				**15**
Manly	3		1			3	2	7			1	**17**
Northwood		4	6	1		1	3	15	1	5	1	**37**
Plymouth				1						1		**2**
Saint Ansgar								2				**2**
Unincorporated County								1				**1**
Grand Total	**7**	**15**	**17**	**8**	**1**	**11**	**12**	**66**	**1**	**7**	**3**	**148**

Source: Iowa Department of Natural Resources, http://www.iowadnr.gov/InsideDNR/RegulatoryLand/EmergencyPlanningEPCRA/SpillReporting.aspx

Pipelines

The U.S. DOT Pipeline and Hazardous Materials Safety Administration maintains a database of pipeline incidents and mileage reports. In 2017, an underground pipeline, known as the Magellan Pipeline, leaked approximately 138,000 gallons of diesel fuel.

Probability of Future Occurrence

From 2000 to 2022 (23 years), there have been 148 hazardous materials spills reported to Iowa DNR. This computes to an annual average of over 6.4 hazardous materials spills per year. Therefore, the probability of future occurrence of hazardous materials incidents is determined to be **highly likely**.

Magnitude/Severity

Most of the hazardous materials incidents that have occurred in Worth County are localized and are quickly contained or stabilized. Depending on the characteristic of the hazardous material or the volume of product involved, the affected area can be as small as a room in a building or as large as five square miles or more. Many times, additional regions outside the immediately affected area are evacuated for precautionary reasons. More widespread effects occur when the product contaminates the municipal water supply or water system such as rivers, lakes, or aquifers. Spills can be costly to clean-up due to the specialized equipment and training, and disposal sites that are necessary.

Hazmat incidents often occur with minimal or no warning (up to six hours warning). The County can prepare and practice how to respond to a hazmat incident, but there is often no warning time when an incident occurs. The duration of hazmat incidents is often less than one week. Depending on the spill, it may take more than a day, but generally less than a week, to clean up. Since many spills maintained within existing capabilities, the magnitude of this hazard was determined to be **moderate**.

Climate Change Considerations

There are not expected to be climate change impacts on human-caused hazards such as hazardous materials incidents.

Vulnerability

People

A hazardous materials incident can occur almost anywhere. So, all jurisdictions are considered to have at least some vulnerability to this hazard. People, pets, livestock, and vegetation in close proximity to facilities producing, storing, or transporting hazardous substances are at higher risk. Populations downstream, downwind, and downhill of a released substance are particularly vulnerable. Depending on the characteristics of the substance released, more people, in a larger area may be in danger from explosion, absorption, injection, ingestion, or inhalation.

Property

The impact of a fixed hazardous facility, such as a chemical processing facility is typically localized to the property where the incident occurs. The impact of a small spill (i.e. liquid spill) may also be limited to the extent of the spill and remediated if needed. A blanket answer for potential impacts is hard to quantify, as different chemicals may present different impacts and issues. Property within a half mile in either direction of designated hazardous materials routes is at increased risk of impacts. While cleanup costs from major spills can be significant, they do not typically cause significant long-term impacts to property. However, some larger incidents involving pipelines, railroads, or explosive materials may cause significant and overwhelming damage to the surrounding communities.

Critical Facilities and Infrastructure

There is a total of 14 Tier II Facilities and 15 EHS Facilities within Worth County (see Table 4-32 and Figure 4-33 above. Seven of these Tier II facilities are located in the unincorporated County, along with nine EHS facilities.

Economy

It is difficult to determine the potential economic costs of a hazardous materials incident due of the variable nature of spills. For example, a spill of a toxic airborne chemical in a populated area could have greater potential for loss of life. By contrast a spill of a very small amount of a chemical in a remote rural area would be much less costly and possibly limited to remediation of soil.

Data provided by the Iowa Department of Natural Resources did not provide information on costs associated with cleaning up any of the spills or of any property damage that occurred. Without data on costs of previous events, it is not possible to determine potential costs associated with future spills. However, most costs associated with hazardous materials incidents are typically borne by the company responsible for the spill.

Environmental and Cultural Resources

Hazardous materials incidents can cause extensive harm to the environment. Hazardous materials that are released into the environment can contaminate soil, leading to soil pollution and harm to plant and microbial life. Spills into water bodies can result in water pollution, affecting aquatic ecosystems and potentially harming drinking water supplies for both humans and wildlife. Some hazardous materials can vaporize into the air, causing air pollution that may lead to respiratory problems for people and damage to animals and vegetation. Wildlife is at risk from direct exposure to spilled materials, contaminating their habitats, food sources, and water, potentially causing acute poisoning and long-term health issues. These spills can disrupt local ecosystems and habitats, leading to imbalances and potentially endangering species. Groundwater contamination poses risks to both ecosystems and human health.

Development Trends

The number and types of hazardous chemicals stored and transported through Worth County will likely continue to increase. As populations grow, this also increases the number of people vulnerable to the impacts of hazardous materials spills. Population and business growth along major transportation corridors increases the vulnerability to transportation hazardous materials spills.

There are currently several proposals to build carbon capture pipelines through Iowa, including one from the POET Bioprocessing plant in Hanlontown. As previously noted, there are already a number of pipelines that cross Worth County; however this would be the first carbon capture pipeline in the county, which may necessitate additional training and equipment. The overall increase to the hazardous materials risk in Worth County would likely be minimal. This is however a great deal of public concern surrounding this topic – of the four comments received during the public comment period, three directly addressed the proposed pipeline. If the project is approved, additional public engagement may be necessary to better understand concerns and provide accurate risk assessment information.

Risk Summary

The impact of this type of disaster will likely be localized to the immediate area surrounding the incident. The initial concern will be for people, then the environment. If contamination occurs, the spiller is responsible for the cleanup actions and will work closely with responders in the local jurisdiction, the Iowa Department of Natural Resources, and the Environmental Protection Agency to ensure that cleanup is done safely and in accordance with federal and state laws.

- The overall significance of hazardous materials incidents in the planning area is medium.
- Risk is greatest along transportation and pipeline routes and in the immediate vicinity of hazardous materials facilities.
- From 2000 to 2022 (23 years), there have been 148 hazardous materials spills reported to Iowa DNR. This computes to an annual average of over 6.4 hazardous materials spills per year.
- Spills were most common during handling and storage, and petroleum is the most common material type spilled.
- There is a total of 14 Tier II Facilities and 15 EHS Facilities within the County.
- Related hazards: Terrorism, Dam Failure, Transportation Incident, Earthquake, Flood, Thunderstorms, Tornado, Wildfire

4.3.10 Human Disease

Probability	Magnitude/Severity	Location/Area	Hazard Ranking
Likely	Moderate	Significant	**Medium**

Description

A human disease outbreak is a medical, health or sanitation threat to the general public (such as contamination, epidemic, plague and insect infestation). The outbreak may be spread by direct contact with an infected person or animal, ingesting contaminated food or water, vectors such as mosquitoes or ticks, contact with contaminated surroundings such as animal droppings, infected droplets, or by aerosolization.

Iowa's public health and health care communities work to protect Iowans from infectious diseases and preserve the health and safety of Iowans by rapidly identifying and containing a wide range of biological agents. Local public health departments and the Iowa Department of Public Health, Center for Acute Epidemiology investigate disease outbreaks of routine illnesses. There are a number of biological diseases/agents that are of concern to the State of Iowa such as vaccine preventable disease, foodborne disease and community associated infections having significant impact on the morbidity of Iowans. The following descriptions are general; individuals may experience more or less severe consequences.

Vaccine Preventable Disease

In the US, there are common infectious diseases that include polio, measles, diphtheria, pertussis, rubella, mumps, tetanus and *Haemophilus influenzae* type b, which are now rare because of widespread use of vaccines. Routine childhood immunizations have helped protect both individuals and communities each year saving nearly $14 billion in direct medical costs and $69 billion in costs to society according to the US Department of Health and Human Services, Centers for Disease Control and Prevention.

The Immunization rates in Iowa are consistent with national average (see Table 4-38**)**. Vaccine preventable diseases continue to threaten the health of Iowans when children, adolescents and adults are un-immunized or under-immunized.

Influenza

Influenza (flu) is a viral infection of the nose, throat, bronchial tubes, and lungs. There are two main types of virus: A and B. Each type includes many different strains, which tend to change each year. In Iowa, influenza occurs most often in the winter months. Illnesses resembling influenza may occur in the summer months, but these are usually the result of other viruses that exhibit symptoms commonly referred to as influenza-like illness or ILI.

Influenza is highly contagious and is easily transmitted through contact with droplets from the nose and throat of an infected person during coughing and sneezing. Typical symptoms include headache, fever, chills, cough, and body aches. Although most people are ill for only a few days some may have secondary infections, such as pneumonia, and may need to be hospitalized. Anyone can get influenza, but it is typically more serious in the elderly and people with chronic illnesses such as cancer, emphysema, or diabetes or weak immune systems. It is estimated that thousands of people die each year in the United States from flu or related complications.

Pandemic Influenza

A pandemic is a global disease outbreak. A pandemic flu is a human flu that causes a global outbreak, or pandemic, of serious illness. A flu pandemic occurs when a new influenza virus emerges for which people have little or no immunity, and for which there is no vaccine.

This disease spreads easily person-to-person, causing serious illness, and can sweep across the country and around the world in a very short time. The Centers for Disease Control and Prevention (CDC) has been working closely with other countries and the World Health Organization to strengthen systems to detect outbreaks of influenza that might cause a pandemic and to assist with pandemic planning and preparation.

During 2009 and 2010, health professionals around the globe worked to combat the H1N1 influenza virus. This relatively mild and stable influenza virus circulated across the globe and caused one of the most robust worldwide vaccination campaigns since the 1970s. Health professionals continue to monitor the possibility of an avian (bird) flu pandemic associated with a highly pathogenic avian H5N1 virus. Since 2003, avian influenza has been spreading through Asia. A growing number of human H5N1 cases contracted directly from handling infected poultry have been reported in Asia, Europe, and Africa, and more than half the infected people have died. There has been no sustained human-to-human transmission of the disease, but the concern is that H5N1 will evolve into a virus capable of human-to-human transmission.

An especially severe influenza pandemic could lead to high levels of illness, death, social disruption, and economic loss. Impacts could range from school and business closings to the interruption of basic services such as public transportation, health care, and the delivery of food and essential medicines.

Pandemics are generally thought to be the result of novel strains of viruses. Because of the process utilized to prepare vaccines, it is impossible to have vaccine pre-prepared to combat pandemics. A portion of the human and financial cost of a pandemic is related to lag time to prepare a vaccine to prevent future spread of the novel virus. In some cases, current vaccines may have limited activity against novel strains.

Foodborne Disease

There are several agents that can cause illness when consumer in contaminated food, beverages, or water. Foodborne illness (food poisoning) can also be spread person-to-person as well as from contact with animals. **Table 4-35** is a list of common foodborne diseases.

Table 4-35 Common Foodborne Diseases

Organism	Onset of Symptoms	Associated Food(s)
Botulism	12 – 36 hours	Canned fruits and vegetables
Campylobacter	2 – 5 days, range 1 – 10 days	Undercooked chicken or pork, unpasteurized milk
Cholera	12 – 72 hours	Undercooked or raw seafood, especially oysters
Cryptosporidium	7 days, range 1 – 12 days	Unpasteurized beverages, contaminated food or water, person-to-person
E. coli (shiga-toxin)	3 – 4 days, range 2 – 10 days	Undercooked ground meats, unpasteurized milk, contaminated fruits or vegetables, person-to-person
Giardia	7 – 10 days, range 3 – 25 days	Contaminated water, person-to-person
Hepatitis A	28 – 30 days, range 15 – 50 days	Raw produce, undercooked foods, person-to-person
Listeria	3 weeks, range 3 – 70 days	Soft cheeses, unpasteurized milk, ready-to-eat deli meats, hot dogs, undercooked poultry, unwashed raw vegetables

Organism	Onset of Symptoms	Associated Food(s)
Norovirus	24 – 48 hours, range 10 – 50 hours	Contaminated ready-to-eat food, undercooked shellfish, person-to-person
Salmonella	12 – 36 hours, range 6 – 72 hours	Contaminated eggs, poultry, beef, raw fruits and vegetables, unpasteurized milk or juice, cheese
Shigella	1 – 3 days, range 12 – 96 hours	Contaminated food or water, person-to-person
Trichinosis	8 – 15 days, range 5 – 45 days	Raw or undercooked pork or wild game meat

Source: Iowa Department of Public Health, Center for Acute Disease Epidemiology http://www.idph.state.ia.us/Cade/Foodborne.aspx).

Location

A human disease outbreak has no geographic boundaries. Because of our highly mobile society, disease can move rapidly through a school, business and across the nation within days, weeks, or months. Many of the infectious diseases that are designated as notifiable at the national level result in serious illness if not death. Some are treatable; for others only, the symptoms are treatable.

Past Occurrences

The World Health Organization tracks and reports on epidemics and other public health emergencies through the Global Alert and Response (see historic epidemics at www.who.int/en/). There have been four acknowledged pandemics in the past century:

- **2020-Ongoing COVID-19:** The COVID-19 or novel coronavirus pandemic began in December 2019 and was declared a pandemic in March of 2020. As of December 16, 2022, over 647 million cases have been reported around the world, resulting in over 6.6 million deaths, including over 98 million cases and 1 million deaths in the U.S.
- **2009 H1N1 Influenza**—The 2009 H1N1 Pandemic Influenza caused 659 hospitalizations with lab confirmed H1N1 since 9/1/09 and resulting in 41 fatalities. Typically, people who became ill were the elderly, the very young and people with chronic medical conditions and high-risk behaviors.
- **1968–69 Hong Kong flu (H3N2)** —This strain caused approximately 34,000 deaths in the United States and more than 700,000 deaths worldwide. It was first detected in Hong Kong in early 1968 and spread to the United States later that year. Those over age 65 were most likely to suffer fatal consequences. This virus returned in 1970 and 1972 and still circulates today.
- **1957–58 Asian flu (H2N2)** —This virus was quickly identified because of advances in technology, and a vaccine was produced. Infection rates were highest among school children, young adults, and pregnant women. The elderly had the highest rates of death. A second wave developed in 1958. In total, there were about 70,000 deaths in the United States. Worldwide deaths were estimated between one and two million.
- **1918–19 Spanish flu (H1N1)** —This flu is estimated to have sickened 20-40 percent of the world's population. Over 20 million people lost their lives. Between September 1918 and April 1919, 500,000 Americans died. The flu spread rapidly; many died within a few days of infection, others from secondary complications. The attack rate and mortality were highest among adults 20-50 years old; the reasons for this are uncertain.

Other Reportable Diseases

Table 4-36 shows the historical reported deaths in the Worth County and Iowa from Influenza and Pneumonia as well as Infective and Parasitic Disease

Table 4-36 Deaths by Year 2007-2021, Influenza and Pneumonia and Infective and Parasitic Disease, Worth County and State of Iowa

Year	Influenza/Pneumonia Deaths, Worth County	Influenza/Pneumonia Deaths, Iowa	Infective/Parasitic Disease Deaths, Worth County	Infective/Parasitic Disease Deaths, Iowa
2021	*	366	*	591
2020	*	538	*	608
2019	*	585	*	634
2018	*	697	*	532
2017	*	578	*	564
2016	*	483	*	429
2015	*	592	*	488
2014	*	549	*	448
2013	*	755	*	511
2012	*	656	*	511
2011	*	657	*	464
2010	*	557	0	441
2009	*	633	*	457
2008	*	825	*	493
2007	*	748	*	427

Source: Iowa Department of Public Health, Bureau of Health Statistics-Vital Statistics of Iowa in Brief, http://idph.iowa.gov/healthstatistics/data
* Counts are suppressed to protect confidentiality.

Table 4-37 lists the number of common reportable diseases in Worth County from 2018 to 2023 from the Iowa Department of Public Health, Center for Acute Epidemiology Annual Reports.

Table 4-37 Iowa Common Reportable Diseases by Year 2018-2023, in Worth County

Year	2018	2019	2020	2021	2022	2023
Anaplasmosis/Ehrlichiosis	13	16	4	16	9	13
Campylobacteriosis	727	614	502	548	511	555
Cryptosporidiosis	303	244	182	155	227	185
Cyclosporidiosis	139	28	230	48	13	18
Dengue		1	1		1	2
E.coli (STEC)	241	250	159	230	229	194
Enteric-HUS	2	4		8	1	1
Giardia	121	108	51	84	99	93
Haemophilus influenzae type b			1	2	1	
Hansens disease	1		1		2	2
HepB						1
Hepatitis A	5	4	5	3	6	8
Hepatitis D	2	1	3	5	3	4
Hepatitis E		1		1		1
Legionellosis	21	16	16	20	22	13
Listeria	4	5	4	3	1	2
Lyme	158	158	131	195	83	83
M COVID-19			5	21	10	1

Year	2018	2019	2020	2021	2022	2023
Malaria	13	9	2	12	4	13
Measles		2				
Mpoxvirus					2	1
Mumps	12	6	5	5	2	7
N. meningitidis	1	1	1		2	9
Pertussis	57	115	21	6	16	31
Q fever acute and chronic	6	8	3	2	3	3
Rocky Mountain spotted fever	11	4	2	1	3	1
Salmonellosis	681	406	219	310	301	326
Shigellosis	48	41	39	40	64	56
West Nile virus	2	2	1	2		1

Source: Iowa Department of Public Health, Center for Acute Disease Epidemiology Annual Reports. 2007-2016, *only 1-3 HIV diagnoses reported, http://idph.iowa.gov/CADE

Probability of Future Occurrence

For purposes of determining probability of future occurrence, the HMPT defined "occurrence" of human disease outbreak as a medical, health or sanitation threat to the general public (such as contamination, epidemic, or plague). In the last century, there have been four pandemic flu events. With the swine flu (H1N1) outbreak in 2009-2010 within the last 10 years), the HMPT determined the possibility of a human disease outbreak causing a threat to the general public to be "Occasional".

Magnitude/Severity

The magnitude of a public health emergency will range significantly depending on the aggressiveness of the virus in question and the ease of transmission. Pandemic influenza is more easily transmitted from person-to-person but advances in medical technologies have greatly reduced the number of deaths caused by influenza over time.

Improvements in sanitation and hygiene, the discovery of antibiotics, and the implementation of universal childhood vaccination programs have decreased the number and severity of human diseases. IDPH also provides consultation to county and local health agencies on diseases requiring public health intervention, collaborates with Centers for Diseases Control and Prevention by weekly reporting of nationally reportable diseases, and offers health education opportunities. Programs guide community-based prevention planning, monitor current infectious disease trends, prevent transmission of infectious disease, provide early detection and treatment for infected persons, and ensure access to health care for refugees in Iowa. These safeguards work to limit the severity of impact of human disease.

Human disease is considered to have **limited** magnitude and severity. This means that 10% to 25% of property severely damaged, shutdown of facilities and services for more than a week, and/or injuries/illnesses that do not result in permanent disability.

Climate Change Considerations

The following is an excerpt from the 2010 *Climate Change Impacts on Iowa* Report.

> *Investigations of the past two decades indicate that the health effects of climate change can be serious. The World Health Organization estimated that in 2002, 2.4% of worldwide diarrhea cases, 6% of malaria cases, 7% of dengue fever cases, and 170,000 deaths (0.3% of worldwide deaths) were attributed to climate change (Beggs and Bambrick 2005, WHO 2002). A major 2010 study included a range of diseases in its listing of potential effects of climate change, ranging from*

obvious illnesses such as asthma and vector-borne disease to less obvious cancer and neurological disease (Portier 2010).

The report details the following as climate change contributors to negative consequences for public health in Iowa:

- Extreme Precipitation Events, Rising Humidity, and Associated Disease
- Illness and Death Associated with Extreme Heat and Heat Waves
- Warming, Air Quality and Respiratory Problems
- Pollen Production and Allergies
- Diseases Transferred by Food, Water, and Insects

Vulnerability

Although infectious diseases do not respect geographic boundaries, several populations in Worth County are at specific risk to infectious diseases. Communicable diseases are most likely to spread quickly in institutional settings such as nursing home facilities, day care facilities, and schools. There are 4 facilities that are classified as nursing homes, 6 school facilities and 3 group day care facilities in the county.

According to the Iowa Department of Public Health 2014 Immunization Program Annual Report, Worth County had 98.69 percent with immunization certificates in kindergarten through 12th grade. The County Immunization Assessment for 2-year old and 13-15-year old coverage from the 2020 Annual Report is provided in **Table 4-38** The percent of up-to-date children is above the county average of 73 percent, and the percent of adolescents up-to-date is nearly on par with the state average of 92.9 percent.

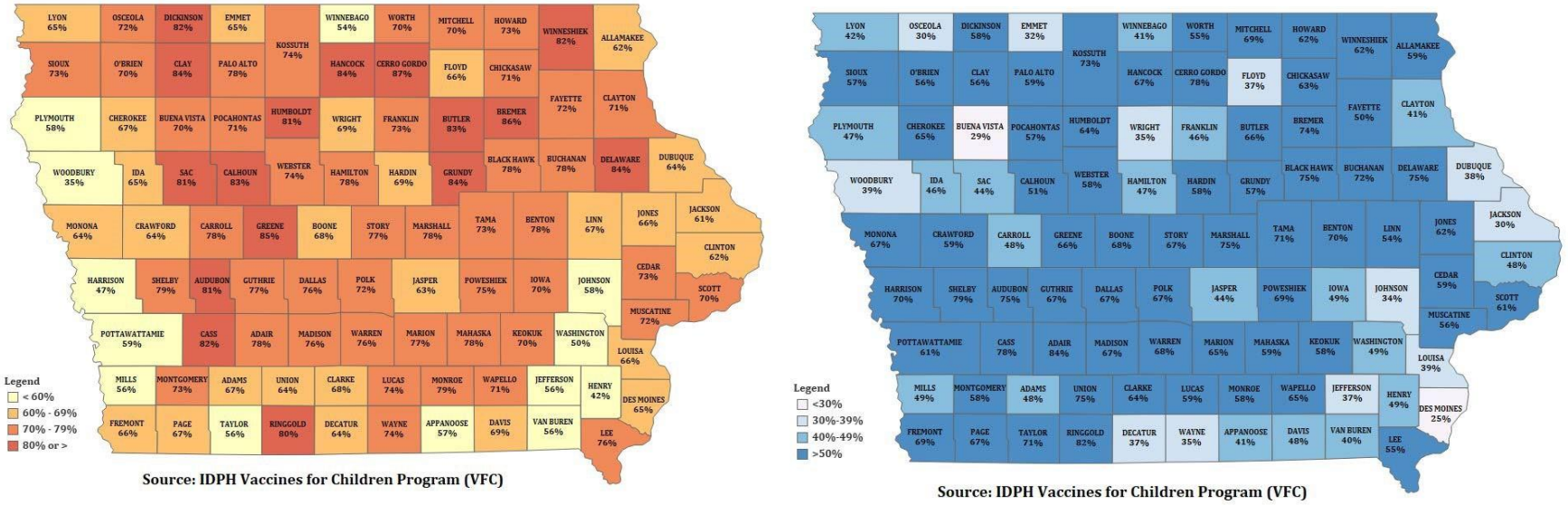
Table 4-38 2016 Vaccination Coverage Percent of Individual Vaccines and Selected Vaccination Series in Worth County (2-year old coverage and 13-15 year old coverage)

	County Population Born 2020 Estimate	Total Records Analyzed from IRIS	Percent of Population in IRIS	4 dTaP Coverage Percent	3 Polio Coverage Percent	1 MMR Coverage Percent	3 Hib Coverage Percent	3 Hep B Coverage Percent	1 Varicella Coverage Percent	4 PCV Coverage Percent	Up-To-Date 4-31-3-3-1-4 Coverage Percent
2-Year Old Coverage	89	89	100.0	76.3	87.3	84.8	83.7	87.9	84.1	77.1	70.9
	County Population 2020 Estimate	**Total Records Analyzed from IRIS7**	**Percent of Population in IRIS**	**3 Hep B Coverage Percent**	**1 Meningitis Coverage Percent**	**2 MMR Coverage Percent**	**1 Td/Tdap Coverage Percent**	**2 Varicella Coverage Percent**	**Up-to-Date 3-1-2-1-2 Coverage Percent**	**3 HPV Female Coverage Percent**	**3 HPV Male Coverage Percent**
13-15 Year Old Coverage	255	299	117.3	82.9	77.9	84.0	79.0	82.6	71.3	Not Available	Not Available

Source: Iowa Department of Public Health, Iowa Immunization Program 2016 Annual Report, 2016 County Immunization Assessment, http://www.idph.state.ia.us/ImmTB/Immunization.aspx?prog=Imm&pg=ImmHome

* Note: Up-to-date are 2-year old children who have completed the 4 dTaP, 3 Polio, 1 MMR, 3 Hib, 3 Hep B, 1 Varicella, 4 PCV by 24 months of age or adolescents 13- to 15-year-olds who have completed the 3 Hep B, 1 Meng, 2 MMR, 1 Td or Tdap, 2 Varicella series.

Figure 4-37 County Immunization Assessment Maps (2-year Old Coverage-left, 13-15-year Old Coverage-right)



Source: Iowa Department of Public Health, Iowa Immunization Program Annual Report 2016 County Immunization Assessment, http://www.idph.state.ia.us/ImmTB/Immunization.aspx?prog=Imm&pg=ImmHome

Human disease outbreak could be catastrophic based on a pandemic scenario. The magnitude of an infectious disease outbreak is related to the ability of the public health and medical communities to stop the spread of the disease. Most disease outbreaks that cause critical numbers of deaths are communicable in nature, meaning that they are spread from person-to-person. The key to reducing the critical nature of the event is to stop the spread of disease. This is generally done in three ways:

1. identification and isolation of the ill,
2. quarantine of those exposed to the illness to prevent further spread, and
3. education of the public about methods to prevent transmission.

The public health and health care providers in Worth County routinely utilize all three methods to reduce morbidity and mortality from infectious disease.

Spread of disease is also limited by Worth County's low population density of 19.0 people per square mile, which is far below the national average of 87.4 people per square mile and suggests that the opportunity for disease to spread from person-to-person in the County would be low.

People

Although infectious diseases do not respect geographic boundaries, several populations in Worth County are at specific risk to infectious diseases. Communicable diseases are most likely to spread quickly in institutional settings such as nursing home facilities, day care facilities, and schools. However, risk groups cannot be predicted with certainty – the elderly, people with underlying medical conditions, and young children are usually at higher risk, but this is not always true. People without health coverage or access to good medical care are also likely to be more adversely affected. Mental health of the public could also be impacted depending on the length of the event and public health guidance on prevention.

Property

There is no historical data for previous structural losses due to human disease epidemics. Therefore, a loss estimate was not completed for this hazard. This hazard was also not spatially analyzed because it does not typically cause structural damage.

Critical Facilities and Infrastructure

Health care facilities and emergency service personnel would likely be affected in the event of a human disease epidemic. While buildings, infrastructure, and critical facilities are not considered vulnerable to this hazard, access to facilities and infrastructure in the area of the incident may be denied until decontamination is complete. Workplace closures due to social distancing and quarantine requirements can make facility operation more difficult.

Economy

According to *the Annual Impact of Seasonal Influenza in the US: Measuring disease burden and costs* by Molinari et al., nationally the economic burden of influenza medical costs, medical costs plus lost earnings, and the total economic burden were $10.4 billion, $26.8 billion, and $87.1 billion, respectively. The financial burden of healthcare-associated infections nationally has been estimated at $33 billion annually. Specific amounts for Worth County are not available.

The pandemic predictions for Iowa from the *Iowa Pandemic Influenza Annex*, 2006 are that 1535 percent of the population may be affected with a "medium level" case scenario with no vaccine and no antiviral drugs, which could cause 900-2,000 deaths and 3,000-7,000 hospitalizations statewide. Also, the predictions state that if a pandemic were to occur, it is likely that it would not be a worst-case scenario. Most

agricultural-related jobs could continue, and school and other congregating activities could be cancelled, resulting in less spreading of a disease outbreak.

Based upon 2011 research on foodborne pathogens, the US Centers for Disease Control and Prevention (CDC) estimates that 48 million people suffer foodborne illnesses each year in the United States, accounting for 128,000 hospitalizations and 3,000 deaths. Salmonella and norovirus cause the most illnesses and hospitalizations. Foodborne disease is extremely costly. According to 2013 estimates from the USDA's Economic Research Service, the 15 major pathogens that cause over 95 percent of the illnesses and deaths from foodborne illnesses in the US cost over $15 billion per year in direct medical expenses and lost productivity. Infections with the bacteria Salmonella alone account for over $3.5 billion yearly in direct and indirect medical costs.

Buildings, infrastructure, and critical facilities are not vulnerable to this hazard; it affects only persons susceptible to the illness. The impacts and potential losses are largely economic and are dependent on the type, extent, and duration of the illness. However, a major disease outbreak could reduce staffing levels at critical facilities, potentially impacting their ability to operate.

Environment and Cultural Resources

Impacts to these resources are typically minimal. However, reduced tourism during outbreaks could lead to additional economic impacts.

Development Trends

Population growth and development contribute the greatest to epidemic exposure. As populations increase and the cost of health care climbs, potential losses can be expected to rise. It is possible that infrastructure may not be able to be maintained as necessary during a pandemic because of a significantly decreased workforce. While the population in Worth County is not increasing, with 22.7% percent of the population over 65 years old the County has a large percent of population more susceptible to disease.

Risk Summary

- Overall, Human Disease is ranked **Medium**.
- The duration of a human disease epidemic will last more than one week. This hazard can take a significant amount of time to manage and stop the disease.
- Given the history of epidemics in Iowa and pandemics in the United States, probability of a future disease outbreak is **likely**.
- Advances in sanitation practices and medicine has decreased the likely severity of human disease. However, it is impossible to predict with certainty the severity of future outbreaks. Based on historical events, the severity of human disease in Worth County is **limited**.
- While human disease tends to have the most severe effect on the old and young, recent outbreaks have shown that human disease can have detrimental effects on all people, therefore its extent is **extensive**.
- Related hazards: Animal/Plant/Crop Disease

4.3.11 Infrastructure Failure

Probability	Magnitude/Severity	Location/Area	Hazard Ranking
Likely	Critical	Significant	**Medium**

Description

Critical infrastructure involves several different types of facilities and systems including electric power, transportation routes, natural gas and oil pipelines, water and sewer systems, storage networks and internet/telecommunications systems. Failure of utilities or other components of the infrastructure in the planning area can seriously impact public health, functioning of communities and the economy. Disruption of any of these services could result from many of the natural, technological, and manmade hazards described in this plan. In addition to a secondary or cascading impact from another primary hazard, utilities and infrastructure can fail due to faulty equipment, lack of maintenance, degradation over time, or accidental damage such as damage to buried lines or pipes during excavation.

To maintain consistency with the State plan, this hazard encompasses a variety of different types of infrastructure failure, including communications failure, energy failure, structural failure, and structural fire.

Communications Failure

Communications failure is the widespread breakdown or disruption of normal communication capabilities. This could include major telephone outages, internet interruption, loss of cellular telephone service, loss of local government radio facilities, long-term interruption of electronic broadcast services, or emergency 911. Law enforcement, fire, emergency medical services, public works, and emergency warning systems are just a few of the vital services which rely on communications systems to effectively protect citizens. In addition, business and industry rely heavily on various modes of communication. Mechanical failure, traffic accidents, power failure, line severance, and weather can all affect communications systems and disrupt service. Disruptions and failures can range from localized and temporary to widespread and long-term.

The types of hazards and impacts to internet and telecommunications infrastructure are very similar to electric power supply. Landline phone lines often utilize the same poles as electric lines; when weather events cause lines to break, both electricity and telephone services experience outages. With the increasing utilization of cellular phones, hazard events such as tornadoes can damage cellular repeaters and cause outages. In addition, during any hazard event, internet and telecommunications systems can become overwhelmed due to the surge in call/usage volume.

Energy Failure

Energy failure includes interruption of service to electric, petroleum, or natural gas. Disruption of electric power supply can be a cascading impact of several other hazards. Electric power is the type of energy failure that is most often a secondary impact of other hazard events. The most common hazards analyzed in this plan that disrupt power supply are flood, tornado, windstorm, and winter weather, as these hazards can cause major damage to power infrastructure. To a lesser extent, extreme temperatures, dam failure, lightning, and terrorism can also disrupt power. Extreme heat can disrupt power supply when air conditioning use spikes during heat waves which can cause brownouts. Dam failure is similar to flood in that infrastructure can be damaged or made inaccessible by water. Lightning strikes can damage substations and transformers, but is usually isolated to small areas of outage. Many forms of terrorism could impact power supply either by direct damage to infrastructure or through cyberterrorism targeting power supply networks.

Primary hazards that can impact natural gas and oil pipelines are earthquake, expansive soils, land subsidence, landslide, and terrorism.

Other Utility Failure

Interruption of other utilities such as water and sewer systems can be a devastating, costly impact. The primary hazards that can impact water supply systems are drought, flood, hazardous materials, and terrorism. Winter storms can also impact water supply if low temperatures cause failure/breakage of water infrastructure. The primary hazard that can impact sewer systems is flood.

Structural Failure / Structure Fire

The collapse (partial or total) of any structure including roads, bridges, towers, and buildings is considered a structural failure. A road, bridge, or building may collapse due to the failure of the structural components or because the structure was overloaded. Natural events such as heavy snow may also cause the roof of a building to collapse (under the weight of snow). Heavy rains and flooding can undercut and washout a road or bridge. The age of the structure is sometimes independent of the cause of the failure. Enforcement of building codes can better guarantee that structures are designed to hold-up under normal conditions. Routine inspection of older structures may alert inspectors to weak points. The level of damage and severity of the failure is dependent on factors such as the size of the building or bridge, the number of occupants of the building, the time of day, day of week, amount of traffic on the road or bridge, and the type and amount of products stored in the structure.

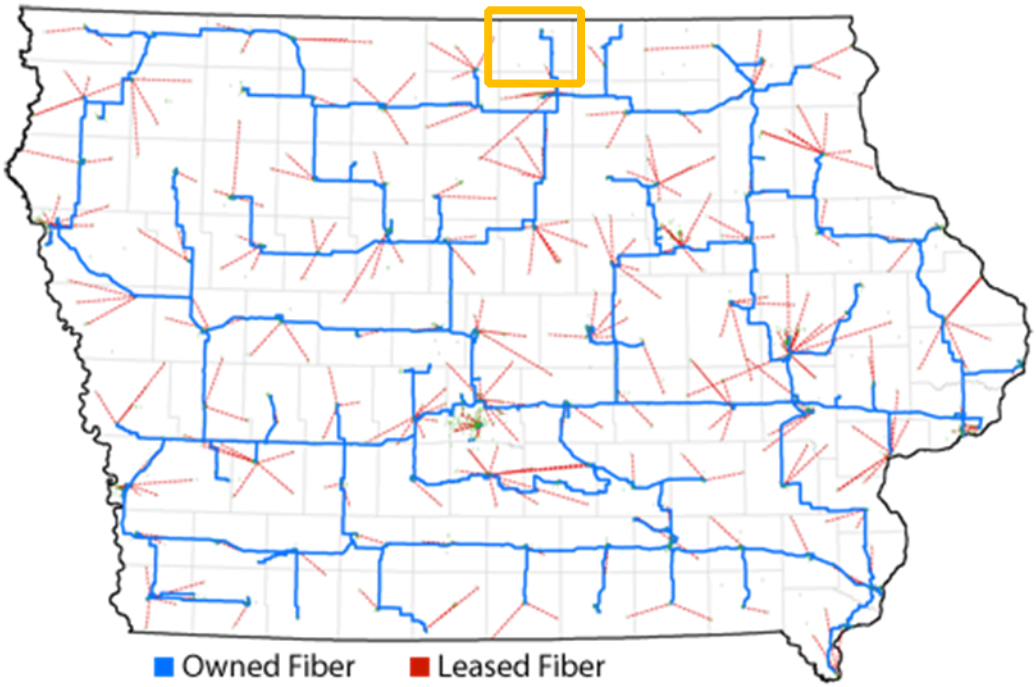
A structural fire is an uncontrolled fire in a populated area that threatens life and property and is beyond normal day-to-day response capability. Structural fires present a far greater threat to life and property and the potential for much larger economic losses. Modern fire codes and fire suppression requirements in new construction and building renovations, coupled with improved firefighting equipment, training, and techniques lessen the chance and impact of a major urban fire. Most structural fires occur in residential structures, but the occurrence of a fire in a commercial or industrial facility could affect more people and pose a greater threat to those near the fire or fighting the fire because of the volume or type of the material involved. Less severe structural fires are almost a common occurrence in some communities.

Location

The entire planning area is at risk to all types of infrastructure failure included in the hazard description section, either from primary failure due to malfunction, degradation, or accidental or intentional damage or as a result of a secondary impact related to another hazard event. Therefore, the geographic extent of infrastructure damage is **significant**.

Figure 4-38 shows the Iowa Communications Network (ICN) that administers Iowa's statewide fiber optic telecommunications network.

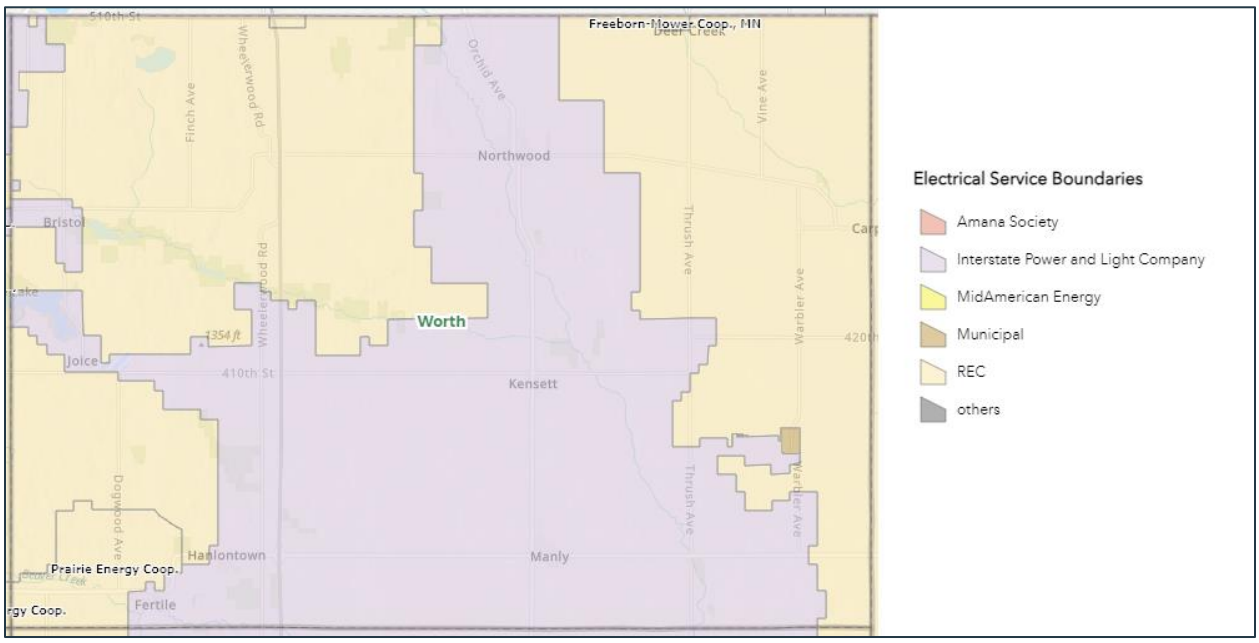
Figure 4-38 Map of Iowa Communication Network



Note: Orange box outlines Worth County.

Power outages can occur in outlying areas with more frequency than in more developed areas. A loss of electric power can also interrupt supply of water from a well. Food in freezers or refrigerators may also be lost. Power outages can cause problems with computers and other devices as well. **Figure 4-39** is the electrical service area map for Worth County.

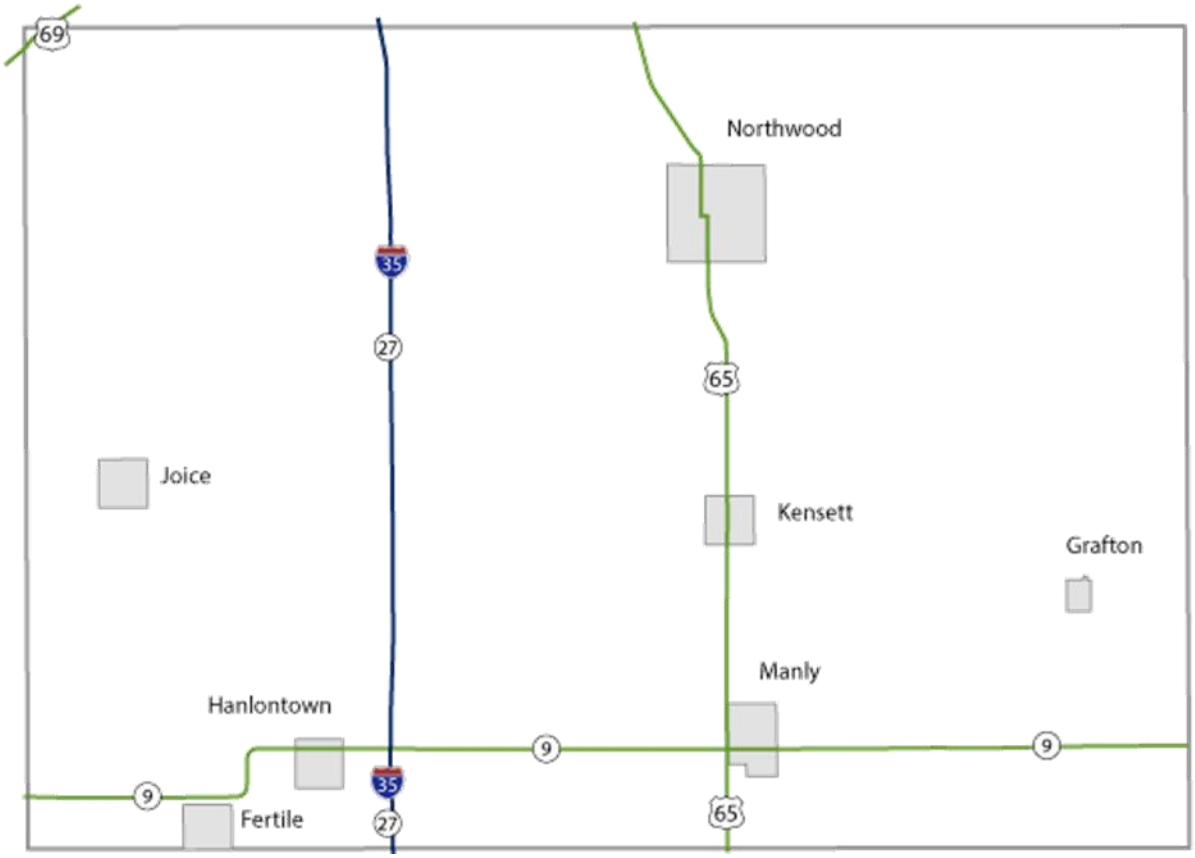
Figure 4-39 Electrical Service Areas in Worth County



Source: https://iowa.maps.arcgis.com/apps/webappviewer/index.html?id=d595a7d431bc4c789065348a8f454dbb

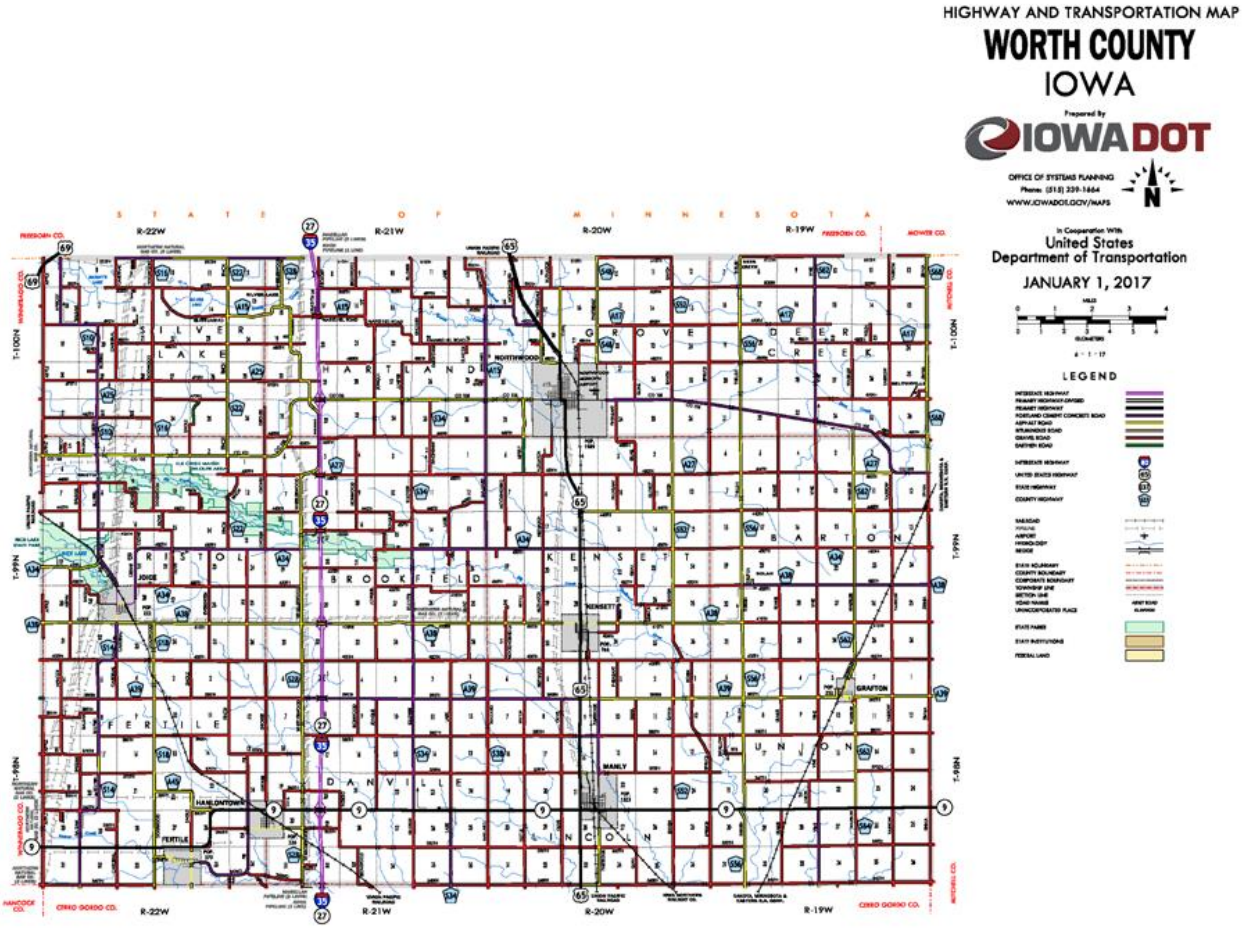
The Highway map for Worth County is provided in **Figure 4-40**. The detailed Highway and Transportation Map that includes other transportation infrastructure in the county is provided in **Figure 4-41**.

Figure 4-40 Worth County Highway Map



Source: Iowa Department of Transportation, http://www.iowadot.gov/maps/msp/pdfview/counties.html

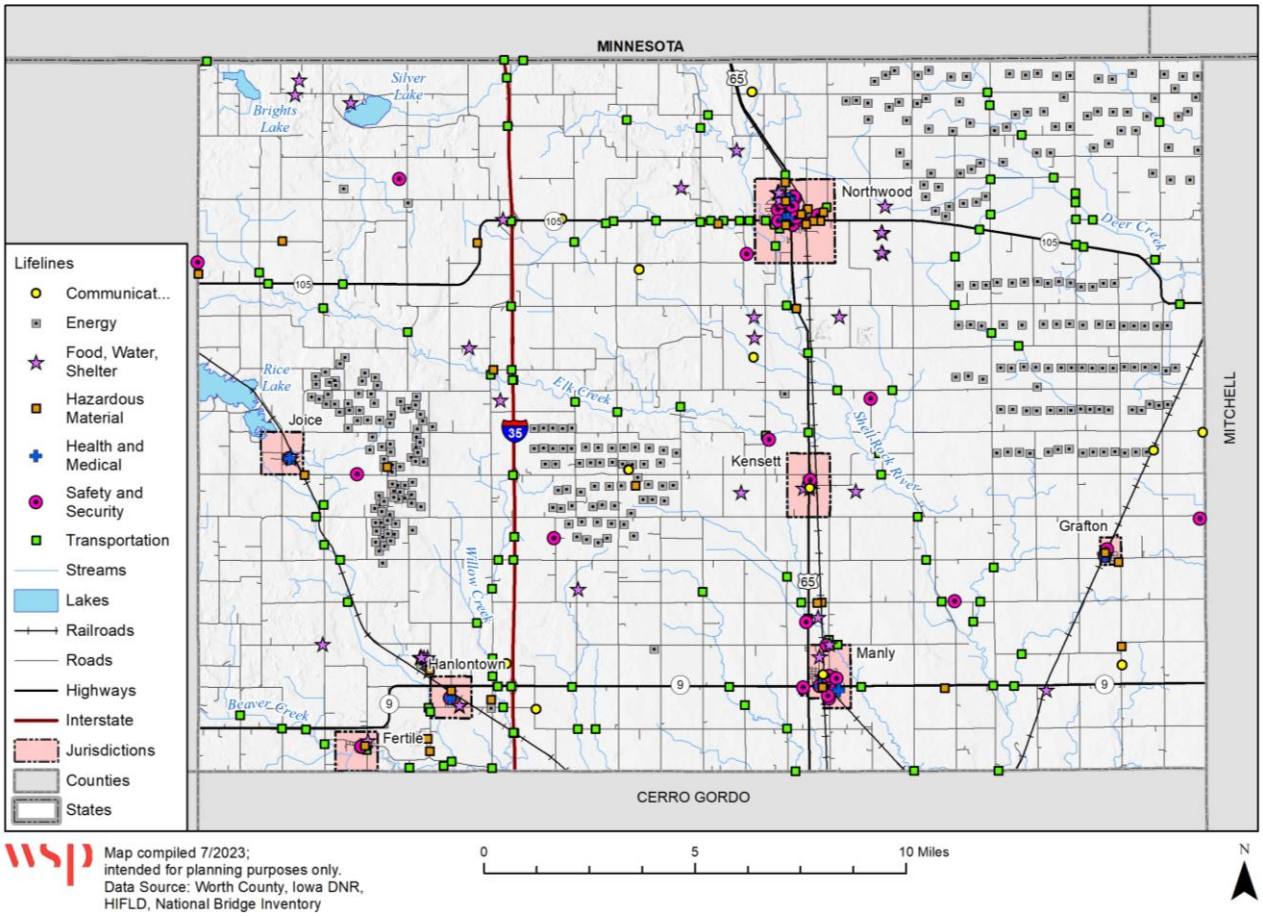
Figure 4-41 Worth County Transportation Map



Source: Iowa Department of Transportation, http://www.iowadot.gov/maps

Figure 4-42 shows the distribution of critical facilities across the County. Most of the energy facilities in the County are in the northeastern quarter, and the unincorporated County has the greatest concentration of critical facilities in the County (498), followed by the City of Northwood (45).

Figure 4-42 Worth County Critical Facilities



Past Occurrences

As indicated in the Hazard Description Section, infrastructure failure often occurs as a secondary impact to other hazard events. For specific descriptions, please see the Previous Occurrences section of the other hazards included in this plan. In addition to failure/impacts as a result of other hazard events, Infrastructure Failure can also occur as a result of lack of maintenance, human error, and age deterioration.

According to the *2018 Worth County Multi-jurisdictional Hazard Mitigation Plan*, structural fires are almost a daily occurrence in Worth County, but nearly all are extinguished easily within the normal day-to-day response capability of local fire departments.

Probability of Future Occurrences

As discussed in other hazard sections in this plan, infrastructure failure occurs as a secondary or cascading impact from several primary hazards such as winter storm, windstorm, and tornado as well as lack of maintenance and age deterioration and other human-caused incidents such as human error, and various forms of terrorism. Structure fire events also occur annually. Therefore, the HMPC determined the probability of future occurrence of this hazard to be **likely**.

Magnitude/Severity

Severity of impact is dependent on the event. Energy disruptions and communications failures generally do not result in injuries or illnesses, have a limited impact on property damage, and results in a brief interruption of essential facilities or services. Structural fires, bridge failures, and dam failures could potentially cause serious injury and major property damage that threatens structural stability.

Infrastructure failure cannot be predicted; there would be minimal or no warning time if an infrastructure failure occurred. The magnitude of this hazard was determined to be **critical**.

Climate Change Considerations

Please refer to the Climate Change Impacts sections of the following primary hazards that can cause a cascading or secondary impact of infrastructure failure: River Flood, Severe Winter Storm, Tornado/Windstorm, Thunderstorm/Lightning Hail, Extreme Heat, Flash Flood and Terrorism.

Vulnerability

People

People can be impacted by critical infrastructure in many ways. In the case of road or bridge failure, transportation routes can be closed or altered, preventing people from easily leaving an area. Additionally, supply chain issues can occur during road closures, preventing the transportation of goods in and out of the County. Communication infrastructure failures can result in delayed first responders and public warning messages. Damages to energy infrastructure jeopardize individuals who are dependent on electricity to survive.

Property

Damaged critical infrastructure can cause damage to property in some situations. For instance, poor roadway or railway conditions can cause damage to the vehicles. Structural fires can completely destroy homes and buildings. Water main breaks can result in local flooding.

Critical Facilities and Infrastructure

As mentioned above, critical infrastructure failure can result from a hazard or on its own. One infrastructure failure can result in other infrastructure failures. A power failure could impact police stations and emergency service personnel's ability to respond to emergencies. Failure of bridges or other road infrastructure could increase response times or limit transportation options or affect delivery of emergency supplies for all residents. Power losses and sewer backups can affect businesses and recreational facilities. Redundancies within these systems can prevent losses during period of damaged critical infrastructure.

Iowa is almost entirely dependent on out-of-state resources for energy. Iowans purchase oil, coal, and natural gas from outside sources. As a result, world and regional fuel disruptions are felt in Iowa. Generally, the smaller utility suppliers such as small electrical suppliers have limited resources for mitigation. This could mean greater vulnerability in the event of a major, widespread disaster, such as a major flood, severe winter storm or ice storm. The municipal utilities that exist in the County purchase power on the wholesale market for resale to their customers. This may make them more vulnerable to regional shortages of power as well.

In the event of a large-scale event impacting water supply or wastewater treatment, homes and businesses with well-supplied water and septic systems for waste treatment would be largely unaffected. However, these systems may be prone to individual failure and do not have backup systems in place in the event of failure, as larger systems might.

Economy

Every community in the planning area is at risk to some type of utility/infrastructure failure. Business and industry in the urban areas are reliant on electricity to power servers, computers, automated systems, etc. Rural areas of the County are vulnerable as well, as modern agricultural practices are reliant on energy, such as electric milking machines and irrigation pivots.

Since utility/infrastructure failure is generally a secondary or cascading impact of other hazards, it is not possible to quantify estimated potential losses specific to this hazard due to the variables associated with affected population, duration of outages, etc. Although the variables make it difficult to estimate specific future losses, FEMA has developed standard loss of use estimates in conjunction with their Benefit-Cost Analysis methodologies to estimate the cost of lost utilities on a per person, per-use basis (See **Table 4-39**).

Table 4-39 FEMA Standard Values for Loss of Service for Utilities and Roads/Bridges

Loss of Electric Power	Cost of Complete Loss of Service
Total Economic Impact	$126 per person per day
Loss of Potable Water Service	Cost of Complete Loss of Service
Total Economic Impact	$93 per person per day
Loss of Wastewater Service	Cost of Complete Loss of Service
Total Economic Impact	$41 per person per day
Loss of Road/Bridge Service	Cost of Complete Loss of Service
Vehicle Delay Detour Time	$38.15 per vehicle per hour
Vehicle Delay Mileage	$0.55 per mile (or current federal mileage rate)

Source: FEMA BCA Reference Guide, June 2009

Environmental and Cultural Resources

Some critical infrastructure failures can have significant impacts on the environment. Sewer backups and water main breaks can pollute the environment. Dam failures can result in erosion, sedimentation, threaten local fish populations, and impact the local fishing economy.

Development Trends

Increases in development and population growth would increase the demand for utilities and use of infrastructure as well as the level of impacts when the utilities or infrastructure fail. Worth County's population has experienced a slight decline in population over the past decade, and this trend is expected to continue. Therefore, no significant changes to utility demand are expected to occur. However, as technological advances are made and more systems become automated and dependent on power and communications infrastructure, the impacts of infrastructure failure could increase regardless of population declines.

Risk Summary

Overall, infrastructure failure hazard is ranked as medium for the County.

- The entire County is vulnerable to communication and energy failure; therefore, the geographic area is **significant**. Other types of infrastructure failures, such as a dam and bridge failures, typically impact a more localized area.
- It is **likely** that infrastructure failures will happen again in the future.

- The potential magnitude of infrastructure failure can be catastrophic. Communication failures can prevent emergency responders from assisting the community and spreading warning messages to residents. Power failures can jeopardize the health and safety of residents who depend on electricity to survive. Road and bridge failures can injure commuters.
- Property, particularly vehicles, can be damaged due to road and bridge failure. Significant damages to buildings can occur as a result of structure fire.
- Infrastructure failure can create loss of revenue from halted business. FEMA found that loss of electricity costs, on average, $126 per person per day.
- Environmental impacts from infrastructure failure include erosion and sedimentation (dam failure and water main break), as well as polluting the environment with debris (dam failure, bridge failure, and structure fire)
- Related hazards: River Flood, Severe Winter Storm, Tornado/Windstorm, Thunderstorm/Lightning Hail, Extreme Heat, Flash Flood and Terrorism.

4.3.12 Landslide

Probability	Magnitude/Severity	Location/Area	Hazard Ranking
Unlikely	Negligible	Limited	**Low**

Description

A landslide is a general term for a variety of mass movement processes that generate a downslope movement of soil, rock, and vegetation under gravitational influence. Landslides are a serious geologic hazard common to almost every state in the United States. It is estimated that nationally they cause up to $2 billion in damages and from 25 to 50 deaths annually. Some landslides move slowly and cause damage gradually, whereas others move so rapidly that they can destroy property and take lives suddenly and unexpectedly. Gravity is the force driving landslide movement. Factors that allow the force of gravity to overcome the resistance of earth material to landslide include saturation by water, erosion or construction, alternate freezing or thawing, earthquake shaking, and volcanic eruptions.

Landslides are typically associated with periods of heavy rainfall or rapid snow melt and tend to worsen the effects of flooding that often accompanies these events. In areas burned by forest and brush fires, a lower threshold of precipitation may initiate landslides. Generally significant land sliding follows periods of above-average precipitation over an extended period, followed by several days of intense rainfall. It is on these days of intense rainfall that slides are most likely.

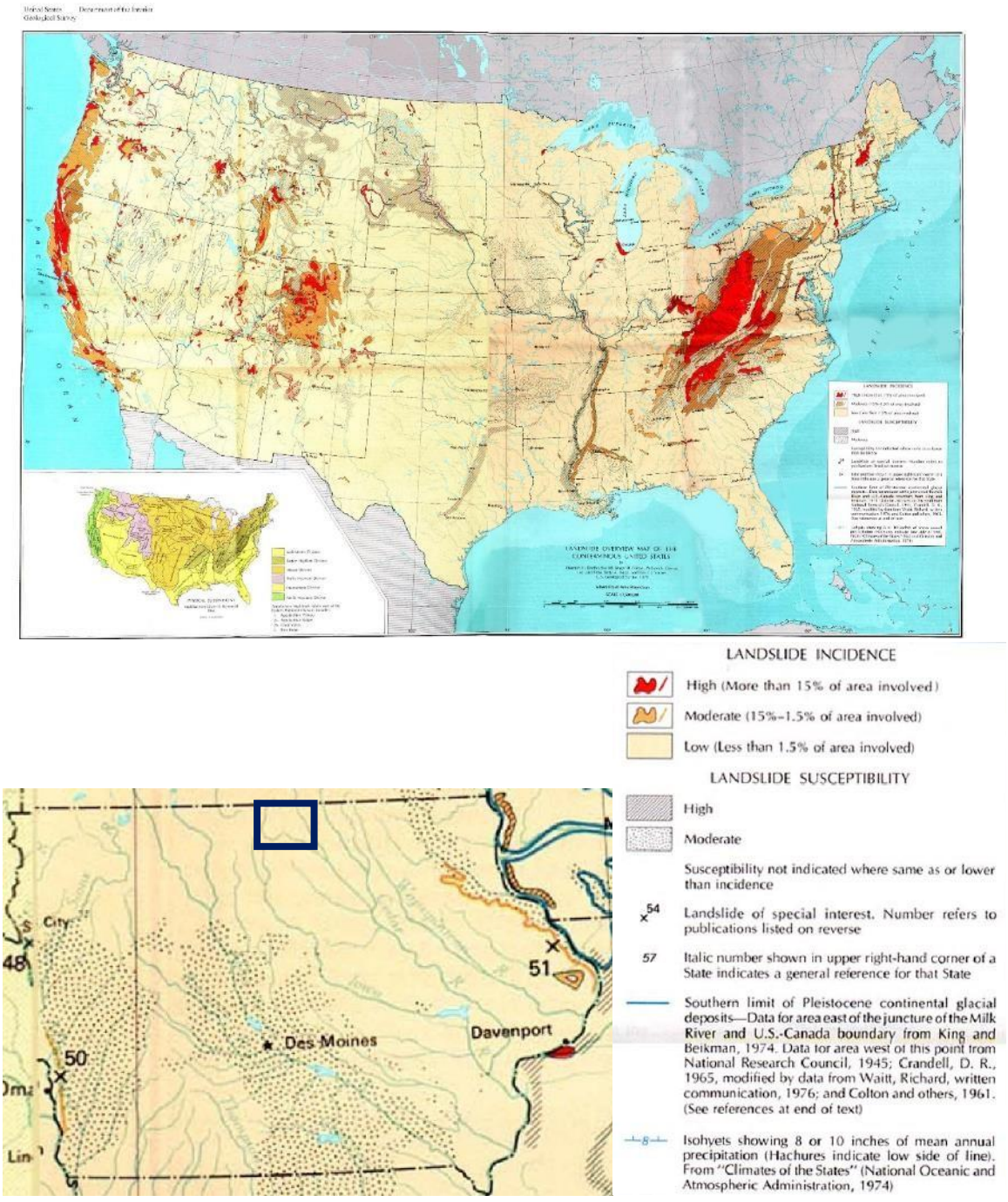
Areas that are generally prone to landslide hazards include existing old landslides; the bases of steep slopes; the bases of drainage channels; and developed hillsides where leach-field septic systems are used. Landslides are often a secondary hazard related to other natural disasters. Landslide triggering rainstorms often produce damaging floods. Earthquakes often induce landslides that can cause additional damage.

Slope failures are capable of damaging or destroying portions of roads and railroads, sewer and water lines, homes and public buildings, and other utility lines. Even small-scale landslides are expensive due to clean up costs that may include debris clearance from streets, drains, streams and reservoirs; new or renewed support for road and rail embankments and slopes; minor vehicle and building damage; personal injury; and livestock, timber, crop and fencing losses and damaged utility systems. Specific to Iowa and Worth County, landslides are primarily very small, non-damaging events.

Location

The maps below in **Figure 4-43** and **Figure 4-44** depicts landslide susceptibility and incidents rates in the United States according to the USGS, and in Iowa according to the Iowa Department of Natural Resources. This shows that Worth County is not susceptible to landslides and has a low incident rate of landslide.

Figure 4-43 Landslide Susceptibility and Incident Rates

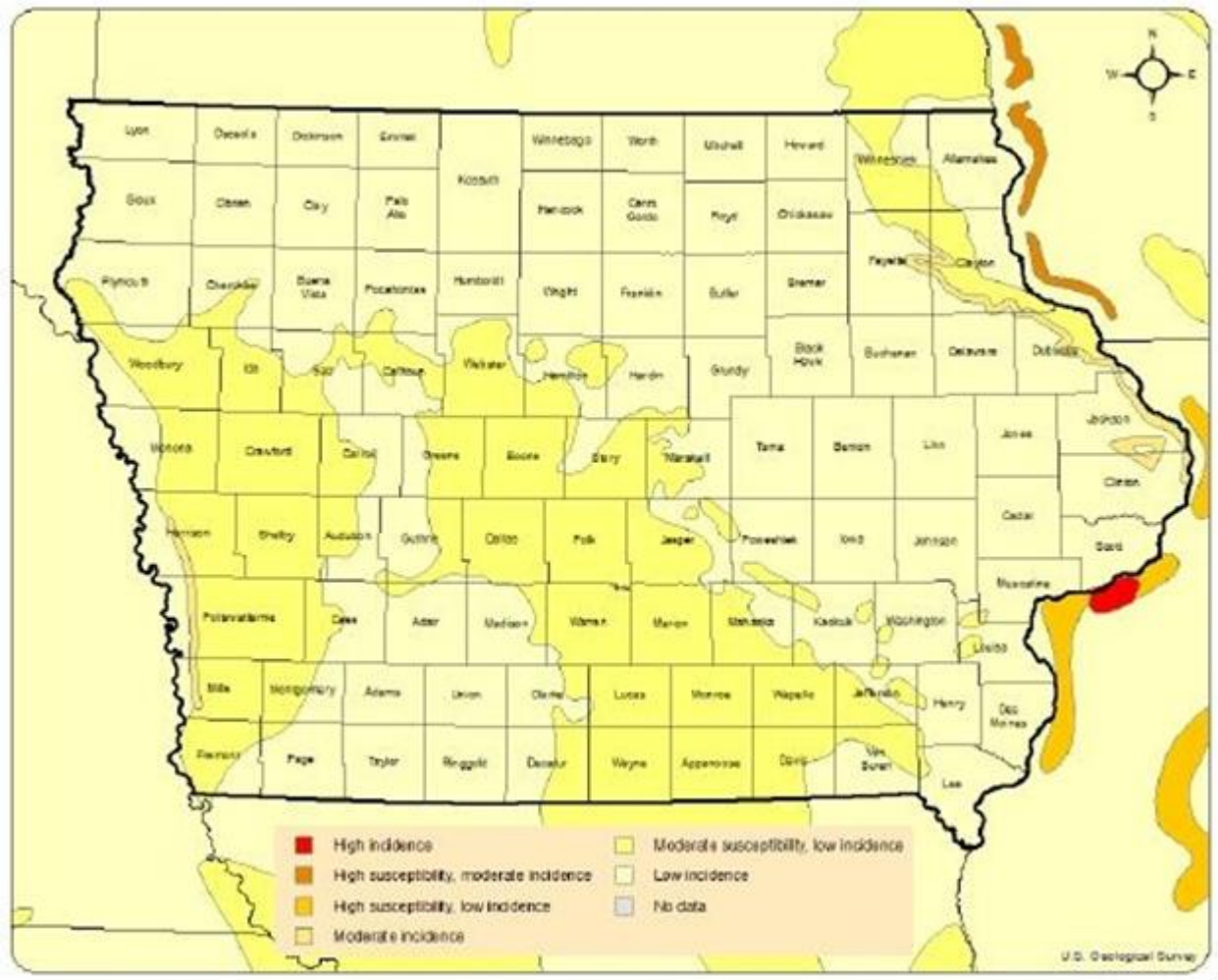


Source: US Geological Survey, http://pubs.usgs.gov/pp/p1183/figures/map.jpg; Approximate location of Worth County is the black rectangle.

A portion of the State is moderately susceptible to landslides. In northeastern Iowa, along the Silurian Escarpment, you can find blocks of dolomite slumped onto the underlying Maquoketa shale. In the hilly terrain of central Iowa, areas of Pennsylvanian shale are susceptible to slides where it is overlain by loess or till. Susceptible areas are found along the adjacent steep terrain associated with the major river valleys such as the Mississippi, Missouri, Des Moines, and Iowa and in the Loess Hills of western Iowa.

While locations of areas more susceptible than others are mapped, the likelihood or probability of landslides is not well understood in Iowa. The entirety of Worth County is shown as having low incidence of landslides.

Figure 4-44 Landslide Susceptibility in Iowa by County



Source: Iowa State Hazard Mitigation Plan, 2018

Past Occurrences

No specific previous occurrences of landslide were reported by the HMPC or discovered during research. However, it was reported that during periods of heavy rain, some areas across the County on steep slopes have become saturated with water and slide onto roadways. There have also been no reported landslide events in Iowa resulting in injury or death. The geographic extent of the documented historic events has been limited to less than a city block in size and has run out over the stretch of less than 100 yards. However, as no State agency documents historical data on landslides in Iowa, there may be undocumented past events that were larger.

According to the 2018 Worth County Multijurisdictional Hazard Mitigation Plan, minor landslides do occur in Worth County, but these events have only caused limited damages and do not threaten human safety or property.

Probability of Future Occurrence

The probability of a landslide causing damage in Worth County is difficult to determine because of the lack of historic data on past events. Due to the limited presence of steep slopes and areas susceptible to landslides throughout the planning area, impacts of landslides will not likely create measurable impacts on the County. The lack of recorded instances implies the probability of future landslides is occasional at best.

Magnitude/Severity

As mentioned throughout this chapter, the majority of this hazard's significance is drawn from the exposure of existing development to areas susceptible to landslide. There is very limited, essentially non-existent, extent of this hazard throughout Worth County. As such, losses to existing development from landslides is **negligible**.

Climate Change Considerations

Increased temperatures are projected to contribute to more water evaporation making drought more common, which could increase the probability of wildfire, reducing the vegetation that helps to support steep slopes. Additionally, increases in the occurrence of extreme precipitation events could lead to oversaturated hillsides, which are at increased risk of landslide.

One of the climate change impacts noted in the *2010 Climate Change Impacts on Iowa* report by the Iowa Climate Change Impacts Committee is the increase in frequency of severe precipitation events. As heavy precipitation can trigger landslides, this could result in an increase in landslide incidents in the future. It's important to take into account the likelihood of more intense precipitation events and the damage that can occur from landslides during these events.

Vulnerability

There will continue to be intense rainfall events that may cause landslides in the planning area. But the damages are relatively minimal and not widespread.

People

Exposure to landslide risk is the greatest danger to people. However, a landslide of sufficient magnitude to cause death or injury is very unlikely in Worth County. As mentioned previously, there have been no reported landslide events in Iowa resulting in injury or death.

Property

Due to the lack of information regarding previous occurrences of this hazard, it is not possible to estimate potential losses. There is very little exposure of property to landslide hazards in Worth County.

Critical Facilities and Infrastructure

No critical facilities are found in the highest landslide-prone areas or in areas of previous landslide events.

Economy

The most likely economic impact of landslides in Worth County would be the blocking of roads with debris, which can isolate residents and businesses and delay commercial, public, and private transportation. This scenario would likely be very short lived in duration but would require resources to clear and reopen roads.

Environment and Cultural Resources

Landslides are a natural environmental process. Environmental impacts can include the removal of vegetation, soil, and rock. Landslides that fall into streams may significantly impact fish and wildlife habitat, as well as affecting water quality. Hillsides that provide wildlife habitat can be lost for prolonged periods of time.

Development Trends

Future development down slope from areas prone to landslide will increase vulnerability to this hazard. However, as susceptibility to landslide is low throughout the county and there are no known landslide hazard areas, new development is unlikely to cause a significant increase in landslide risk in the county.

Risk Summary

- The overall risk of landslide in the county is low and does not vary significantly by jurisdiction.
- There will continue to be intense rainfall events that may cause landslides in the planning area. But the damages are relatively minimal and not widespread.
- A portion of the State is moderately susceptible to landslides. In northeastern Iowa, along the Silurian Escarpment, you can find blocks of dolomite slumped onto the underlying Maquoketa shale. In the hilly terrain of central Iowa, areas of Pennsylvanian shale are susceptible to slides where it is overlain by loess or till. Susceptible areas are found along the adjacent steep terrain associated with the major river valleys such as the Mississippi, Missouri, Des Moines, and Iowa and in the Loess Hills of western Iowa.
- Related Hazards: Flooding, Sinkholes.

4.3.13 Radiological Incident

Probability	Magnitude/ Severity	Extent	Hazard Ranking
Unlikely	Negligible	Limited	**Low**

Description

A radiological incident is an occurrence resulting in the release of radiological materials at a fixed facility (such as power plants, hospitals, laboratories, etc.) or in transit.

Transportation of radioactive materials through Iowa over the interstate highway system or via rail is considered a radiological hazard. The transportation of radioactive materials by any means of transport is licensed and regulated by the federal government. As a rule, there are two categories of radioactive materials that are shipped over the highways and railways:

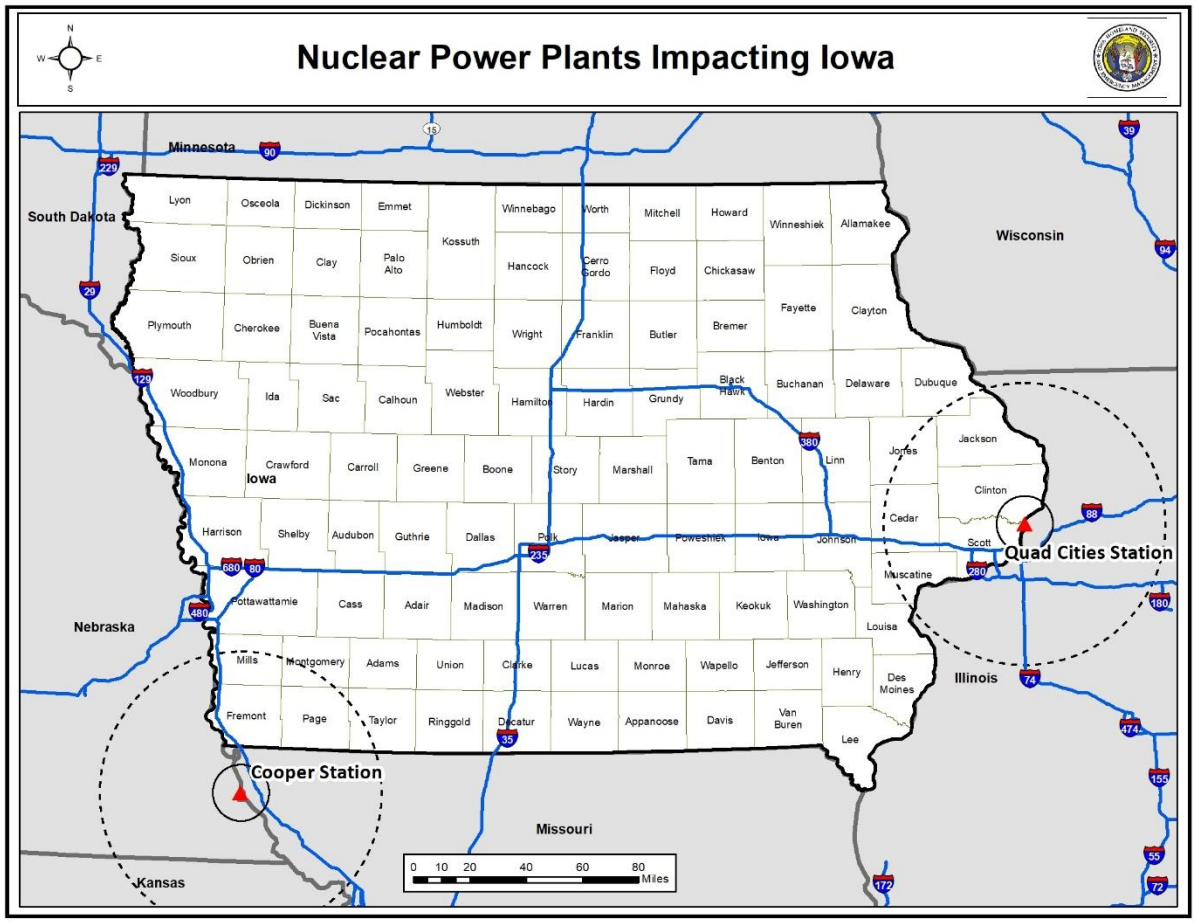
1. Low level materials such as medical radiological isotopes, or waste that has been contaminated by low level radioactive substances. These materials are shipped in sealed drums or packages within placarded trailers. While the possibility of a release resulting from an accident exists, the low level of radioactivity involved poses no serious threat except through long-term exposure.
2. High level materials such as radiological gauges used in construction, or high level waste such as spent fuel from nuclear power plants. These materials must be transported in specially constructed casks that are built to withstand severe crashes. Thus, while the impact from a release of high level radioactive materials is potentially high, the probability of such a release is quite low.

Location

Fixed Facilities

An incident resulting in a release of radiological material at a fixed facility is a fixed radiological incident. The last operating nuclear power plant in Iowa, Duane Arnold Energy Center near Palo in Linn County, closed August 2020. There are two nuclear facilities in adjacent states with planning buffer zones that cross into Iowa: Cooper Nuclear Power Plant south of Nebraska City, Nebraska and Quad Cities Nuclear Power Plant in Cordova, Illinois. However, neither of these powerplants are in close proximity to Worth County.

Figure 4-45 Map of Nuclear Power Plants Impacting Iowa



Source: Iowa Homeland Security and Emergency Management; 2021.

Other fixed facilities that host radioactive materials may include hospitals and some industrial sites. Sources of radioactive materials may include medical products, radioactive waste from hospitals and laboratories, and industrial products. Small amounts of industrial, medical, and lab materials exist in a few locations, all within buildings. Trained people use the equipment and it is properly handled and stored. A few to a few dozen people, in a lab in a hospital, for example, may be impacted by an immediate release with a small amount of contamination.

Transportation Radiological Incidents

There is also potential for the transport of radioactive materials through and within Worth County. Since 1990, hundreds of shipments of radiological materials have been made through Iowa. There have been no occurrences of radiological incidents in Iowa. Generally, small or minor shipments will go through the community in support of medical facilities with radiology services and other small quantity users. Other major roads near hospitals may have small and rare shipments. UP Railroad, Iowa Northern Ry. Co, and Dakota, Minnesota and Eastern RR. Co. might also carry radiological shipments, but data is not confirmed.

Past Occurrences

According to the 2018 Iowa State Hazard Mitigation Plan, there have been no reported occurrences of a radiological transportation incident in Iowa since 1990. The events that have occurred in other states have

been limited; there have been no known serious radiation exposures resulting from a transportation incident because the nature of the materials being transported, and the use of protective packaging is commensurate with the potential hazard of the radioactive materials contained.

Probability of Future Occurrence

Operators of facilities that use radioactive materials and transporters of radioactive waste are trained in the packaging, handling, and shipment of the radioactive waste; and, since they are closely regulated by a variety of federal, state, and local organizations, the likelihood of an incident is remote. When these materials are moved across Iowa highways, Iowa officials are notified, and appropriate escorts are provided. The planning team, in light of the tight regulations on transport and the amount of fuels transported, put the annual risk of an incident requiring outside intervention is at less than 1%.

Magnitude/Severity

Worth County faces a low risk of radiological incidents. The magnitude and severity of such incidents is negligible, considering Worth County does not host any nuclear power plants and the transportation of radioactive material is highly regulated. However, the rail and highway network come into close proximity to highly populated communities and thus the proper precautions need to me made to eliminate risk of radiological exposure.

Climate Change Impacts

Although, Worth County is not in the Emergency Planning Zones for any nuclear reactors, generally speaking, drought can impact water levels for intake pipes that carry water from the Mississippi River to cool the reactors. See Section 3.3.3 for discussion of Climate Change Impacts for Drought.

Vulnerability

People

Those working with or near sources of radiation are at a greater risk than the general citizens in the planning area. This includes individuals working in hospitals or industrial facilities as well as individuals acting as transport for radiological material or first responders to a radiological incident. Those responding should be trained in recognizing a radiological incident and minimize exposure to radioactive materials.

Property

Properties located near transportation routes for radioactive materials are susceptible to potential incidents, especially during unloading at medical facilities. Although the impact is expected to be limited to a few blocks at best, the proximity to transportation routes increases the vulnerability of nearby properties. Fixed facilities, including hospitals and industrial sites, pose risks to properties in close proximity due to the potential for incidents involving radioactive materials. Adequate precautions and emergency response planning are essential to mitigate potential impacts on properties.

Critical Facilities and Infrastructure

The highest risk may be present during unloading at medical facilities. Incidents during transportation or mishaps at medical facilities could impact critical infrastructure, necessitating careful planning and response. However, the amounts shipped in the county are likely very low and would not cause significant loss. The impact would be a few blocks at best (1,000 feet from the transportation route.

Economy

The local economy may be impacted by incidents at critical facilities, particularly if they lead to temporary closures or disruptions in services. Additionally, public perception plays a crucial role, as even minor incidents involving radioactive materials may generate negative attention that could affect local businesses and property values.

Environment and Cultural Resources

Incidents involving the release of radiological materials, whether during transportation or at fixed facilities, could have environmental consequences if not well contained. Contamination of soil, water, and air may occur, impacting local ecosystems. While not explicitly mentioned, incidents involving radiological materials may potentially impact cultural resources, particularly if they occur near historically or culturally significant sites within Worth County.

Development Trends

Increased development along transportation corridors would increase the number of people vulnerable to this hazard in the planning area.

Risk Summary

Worth County is not within the 50-mile planning buffer of any power plants. Because the County and jurisdictions are outside the planning buffer, it is extremely unlikely that they would have negative impacts from an event at these fixed facilities. Any events at a hospital or other medical facilities with radiology services would likely be isolated events with minimal exposure areas. The magnitude for the unincorporated county and jurisdictions is negligible.

The overall significance of radiological incident is **low**.

- Radiological incidents can occur at a fixed facility (nuclear plant, hospital, industrial facility) or by transport to said fixed facility. This hazard has a limited extent impact based on location.
- Iowa closed their last operating nuclear power plant August 2020.
- Hospitals and industrial facilities house radioactive materials, posing localized risks in the event of an incident. Those most vulnerable are the handlers of the radiological material and the first responders to the incident.
- Public concern about radiation may lead to heightened anxiety and media attention, even for minor incidents.

4.3.14 Severe Winter Storm

Probability	Magnitude/Severity	Location/Area	Hazard Ranking
Highly Likely	Critical	Extensive	**High**

Description

Severe winter storms are an annual occurrence in Iowa. A major winter storm can last for several days and be accompanied by high winds, freezing rain or sleet, heavy snowfall, cold temperatures and drifting snow, creating blizzards. The NWS describes different types of winter storm events as follows:

- **Blizzard**—Winds of 35 mph or more with snow and blowing snow reducing visibility to less than ¼ mile for at least three hours.
- **Blowing Snow**—Wind-driven snow that reduces visibility. Blowing snow may be falling snow and/or snow on the ground picked up by the wind.
- **Snow Squalls**—Brief, intense snow showers accompanied by strong, gusty winds. Accumulation may be significant.
- **Snow Showers**—Snow falling at varying intensities for brief periods of time. Some accumulation is possible.
- **Freezing Rain**—Measurable rain that falls onto a surface with a temperature below freezing. This causes it to freeze to surfaces, such as trees, cars, and roads, forming a coating or glaze of ice. Most freezing rain events are short lived and occur near sunrise between the months of December and March.
- **Sleet**—Rain drops that freeze into ice pellets before reaching the ground. Sleet usually bounces when hitting a surface and does not stick to objects.

Heavy accumulations of ice, often the result of freezing rain, can bring down trees, utility poles, and communications towers and disrupt communications and power for days. Even small accumulations of ice can be extremely dangerous to motorists and pedestrians.

Severe winter storms include extreme cold, heavy snowfall, ice, and strong winds, which can push the wind chill well below zero degrees in the planning area. Heavy snow can bring a community to a standstill by inhibiting transportation (in whiteout conditions), weighing down utility lines, and causing structural collapse in buildings not designed to withstand the weight of the snow. Repair and snow removal costs can be significant. Ice buildup can collapse utility lines and communication towers, as well as make transportation difficult and hazardous. Ice can also become a problem on roadways if the air temperature is high enough so that precipitation falls as freezing rain rather than snow.

Extreme cold often accompanies severe winter storms and can lead to hypothermia and frostbite in people who are exposed to the weather without adequate clothing protection. Cold can cause fuel to congeal in storage tanks and supply lines, stopping electric generators. Cold temperatures can also overpower a building's heating system and cause water and sewer pipes to freeze and rupture. When combined with high winds from winter storms, extreme cold becomes extreme wind chill, which is extremely hazardous to health and safety.

Wind can greatly amplify the impact of cold ambient air temperatures. Provided by the National Weather Service**, Figure 4-46** below shows the relationship of wind speed to apparent temperature and typical time periods for the onset of frostbite.

Figure 4-46 Wind Chill Chart

Wind (mph) \ Temperature (°F)	Calm	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	-81	-88	-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

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

Where, T= Air Temperature (°F) V= Wind Speed (mph) *Effective 11/01/01*

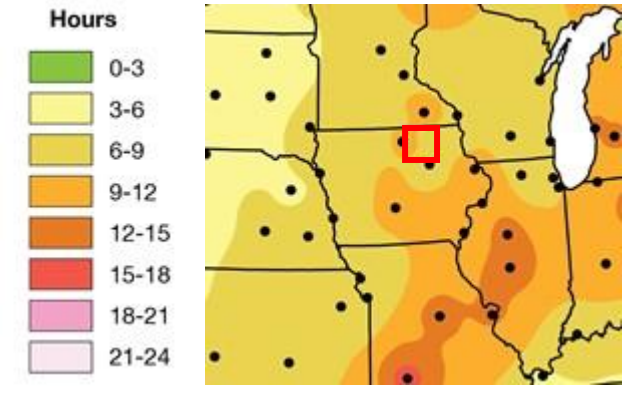
Source: National Weather Service; https://www.weather.gov/safety/cold-wind-chill-chart

Location

As this hazard has the capacity of affecting all parts of the planning region, including impacting the entire County simultaneously, the geographic extent of severe winter storms is **extensive**.

The entire state of Iowa is vulnerable to heavy snow, extreme cold temperatures, and freezing rain. Generally, winter storms occur between the months of November and March but can occur as early as October and as late as April. **Figure 4-47** shows that the planning area (approximated within the red square) is in the light orange shaded area that receives 9-12 hours of freezing rain per year.

Figure 4-47 Average Number of Hours per Year with Freezing Rain



Source: Midwestern Regional Climate Center; http://mcc.sws.uiuc.edu/living_wx/icestorms/index.html
Note: Red square provides approximate location of planning area.

According to the High Plains Regional Climate Center, the planning area has a County-wide average maximum temperature of 28.84 ºF in December, 22.46 ºF in January, and 27.46 ºF in February. Average minimum temperatures for those same three months are 13.12 ºF, 5.85 ºF and 9.74 ºF (using data from 1991 to 2020). Average snowfall is highest in December, January, and February with an annual average of 38 inches.

Past Occurrences

Historically, there have been two Presidential Disaster Declarations for Severe Winter Storms that included Worth County since 1965; an ice storm in 1991 and a severe winter storm in 2007 (See **Table 4-3** in the Hazard Identification Section). From 1996 thru 2022, the National Centers for Environmental Information (NCEI) Storm Events Database recorded 119 severe winter weather events, summarized in **Table 4-40**.

Table 4-40 Severe Winter Weather Events in Worth County, 1996-2022

Event Type	# of Event Type	Property Damage	Crop Damage
Blizzard	32	$580,000	–
Cold/Wind Chill	9	–	$294,118
Extreme Cold/Wind Chill	16	–	–
Heavy Snow	21	$205,000	–
Ice Storm	10	$141,280	–
Sleet	1	–	–
Winter Storm	29	$395,900	–
Winter Weather	1	–	–
Grand Total	**119**	**$1,322,180**	**$294,118**

Source: NCEI Storm Events Database, https://www.ncdc.noaa.gov/stormevents/

During this 27-year period, 92 of the events caused property damage. This translates to over three damaging winter storm/cold temperature events each year. The total crop and property damages for these 92 events were over $1.6 million with the most damaging event occurring on February 24, 2007, causing $250,000 in property damage. NOAA's NWS has issued 647 Advisories, Watches, and/or Warnings for winter weather phenomena between June 1986 and October 2023, detailed in **Table 4-41**.

Table 4-41 National Weather Service Issuances for Winter Weather in Worth County, 1986-2023

Phenomenon/Significance	Advisory	Warning	Watch	Total
Blizzard	–	26	8	**34**
Blowing Snow	10	–	–	**10**
Freeze	–	26	7	**33**
Freezing Fog	1	–	–	**1**
Freezing Rain	9	–	–	**9**
Frost	26	–	–	**26**
Heavy Snow	–	1	–	**1**
Ice Storm	–	1	–	**1**
Snow	13	–	–	**13**
Snow and Blowing Snow	7	–	–	**7**
Wind Chill	145	29	5	**179**
Winter Storm	–	67	74	**141**

Phenomenon/Significance	Advisory	Warning	Watch	Total
Winter Weather	192	–	–	**192**
Total	**403**	**150**	**94**	**647**

Probability of Future Occurrence

According to the NCEI Storm Events Database, during the 27-year period from 1996 thru 2022, the planning area experienced a total of 92 damaging blizzards, winter storms, ice storms, and extreme cold events. This translates to an annual probability of over three severe winter weather events per year. Therefore, the probability rating is **highly likely**.

Magnitude/Severity

The entire planning area is vulnerable to the impacts of winter storms. Winter storms increase the likelihood of utility and infrastructure failures due to freezing rain accumulation on utility poles and power lines. During these storms, people, pets, and livestock are at risk of frostbite and hypothermia. To ensure the safety of children and bus drivers, schools often close during extreme cold or heavy snow conditions.

The hazardous driving conditions caused by snow and ice on highways and bridges lead to traffic accidents, which can disrupt the response of emergency vehicles. Police, fire, and ambulance services may be unable to respond due to road conditions. This, in turn, affects the ability to meet the emergency needs of remote or isolated residents, including the supply of food, fuel, and shelter for livestock.

The leading cause of death during winter storms is transportation accidents, with about 70 percent of winter-related deaths occurring in automobiles due to traffic accidents, and another 25 percent resulting from people being caught outside in the storm. Additionally, the use of kerosene heaters and alternative heating methods by citizens can pose additional hazards, including structural fires and carbon monoxide poisoning.

Warning time for severe winter storms falls within the range of 6-12 hours. Additionally, this hazard can last more than a week. According to the *2013 Iowa Hazard Mitigation Plan*, of the eight hazards for which data was available to estimate annualized losses, severe winter storm ranked 6th with $2.2 million in annualized losses based on data spanning a 13-year period. The magnitude for severe winter storms is therefore **critical**.

Climate Change Impacts

According to the 2010 report on *Climate Change Impacts on Iowa*, Iowa has experienced a long-term upward trend in temperature.

- Long-term winter temperatures have increased six times more than summer temperatures.
- Nighttime temperatures have increased more than daytime temperatures since 1970.
- Since 1970, daily minimum temperatures have increased in summer and winter; daily maximum temperatures have risen in winter but declined substantially in summer.

If this trend continues, future occurrences of the extreme cold/wind chill aspects of winter storms should decrease. In addition, higher winter temperatures bring higher probability of rain, rather than snow. As a result, the amount of precipitation falling as snow should decrease.

Vulnerability

People

The threat to public safety is typically the greatest concern when it comes to impacts of winter storms. The highest risk will be to travelers that attempt to drive during adverse conditions. People can also become isolated from essential services in their homes and vehicles. While virtually all aspects of the population are vulnerable to the potential indirect impacts of a winter storm, others may be more vulnerable, such as individuals with access and functional needs, who may become isolated to essential services.

Elderly populations are at increased risk to winter storms and associated extreme cold events. According to the 2023 US Census Bureau American Community Survey 5-year estimates, approximately 22.4% of Worth County's population is over the age of 65. This is slightly higher than the statewide average of 17.8%, and is highest in Fertile (36%) and Kensett (26%). Additionally, the US Department of Health and Human Services estimates that there are 111 electricity-dependent Medicare beneficiaries in the County. These individuals are extremely vulnerable during power outages, which commonly accompany severe winter storm events.

Those without shelter or who are stranded, or who live in a home that is poorly insulated or without heat are also vulnerable to severe winter storms. Other impacts of extreme cold include asphyxiation (unconsciousness or death from a lack of oxygen) from toxic fumes from emergency heaters, from household fires, which can be caused by fireplaces and emergency heaters, and from frozen/burst pipes.

Property

Buildings with overhanging tree limbs are more vulnerable to damage during winter storms. Businesses experience loss of income as a result of closure during power outages. In general, heavy winter storms increase wear and tear on roadways though the cost of such damages is difficult to determine. High snow loads can cause damage to buildings and roofs. Most property damages with winter storms are related to the heavy snow loads and vehicle accidents. Older buildings are more at risk, as are buildings with large flat rooftops (often found in public buildings such as schools). Vulnerability is influenced both by architecture and type of construction material and should be assessed on a building-by-building basis.

Critical Facilities and Infrastructure

Roads are especially susceptible to the effects of a severe winter storm, which can temporarily hinder transportation and require resources for snow removal. As noted under the people section, heavy snow accumulation may also lead to downed power lines, not only causing disruption to customers but also have potentially negative impacts on critical facilities in the county which may have cascading impacts on the local governments' ability to operate. Potential losses would include cost of repair or replacement of damaged facilities and lost economic opportunities for businesses. Secondary effects from loss of power could include burst water pipes in homes without electricity during winter storms. Public safety hazards include risk of electrocution from downed power lines. Specific amounts of estimated losses are not available due to the complexity and multiple variables associated with this hazard.

Economy

Worth County's economy is heavily reliant on agriculture. Winter storms, cold, frost, and freeze take a toll on crop production. USDA Risk Management Agency (RMA) indemnity payments in Worth County as a result of cold conditions and snow from 2007-2023 totaled $1.5 million, summarized in **Table 4-42**.

Table 4-42 Crop Insurance Claims Paid in Worth County as a Result of Severe Winter Storms, 2007-2021

Year	Cold Wet Weather	Cold Winter Weather	Freeze	Frost	Total Insurance Claims Paid
2007	–	–	–	–	–
2008	$6,052	–	–	–	**$6,052**
2009	$96,439	–	$649	$3,128	**$100,216**
2010	–	–	–	$1,006	**$1,006**
2011	$3,440	–	–	$2,391	**$5,831**
2012	$6,688	–	–	–	**$6,688**
2013	$568,619	–	–	$176,691	**$745,310**
2014	$219,697	–	–	–	**$219,697**
2016	$7,001	–	–	–	**$7,001**
2017	$54,774	–	–	–	**$54,774**
2018	$1,795	–	–	–	**$1,795**
2019	$90,259	$10,543	–	–	**$100,802**
2020	$7,841	–	–	–	**$7,841**
2021	$6,211	–	$96,587	$218,497	**$321,295**
Grand Total	**$1,068,815**	**$10,543**	**$97,236**	**$401,713**	**$1,578,307**

Source: USDA Risk Management Agency

Snow removal costs can also impact budgets significantly. Power outages may lead to business closures as well, with impacts possibly lasting for multiple days. According to FEMA standard values for loss of service for utilities reported in the 2009 Benefit Cost Analysis Reference Guide, the economic impact as a result of loss of power is $126 per person per day of lost service.

Environmental and Cultural Impacts

Natural resources may be damaged by the severe winter weather, including broken trees and death of wildlife and livestock. Unseasonable storms may damage or kill plants and wildlife, which may impact natural food chains until the next growing seasons. Most of these impacts would be short-term. As noted previously, older, historic buildings could potentially be more vulnerable to roof and structural damage from heavy snow. Cultural facilities in Worth County can shut down as a result of severe winter weather. Cultural facilities include restaurants, parks, community centers, museums, and businesses.

Development Trends

Future development could potentially increase vulnerability to this hazard by increasing demand on the utilities and increasing the exposure of infrastructure networks.

Risk Summary

The overall significance of severe winter storms is **high**.

- Worth County averages over 3 damaging severe winter storms annually.
- Potential losses include cost of repair or replacement of damaged facilities and lost economic opportunities for businesses.
- Secondary effects from loss of power could include burst water pipes in homes without electricity during winter storms.
- Public safety hazards include risk of electrocution from downed power lines.

- Specific amounts of estimated losses are not available due to the complexity and multiple variables associated with this hazard.
- Although crop loss due to winter storm occurs more in the unincorporated portions of the planning area, the crop losses are not high since corn and soybeans are not in the ground during winter months and only get affected by unusual weather events.
- Transportation incidents related to winter storms impact all jurisdictions.
- Related hazards: Flooding, Windstorm.

4.3.15 Terrorism

Probability	Magnitude/Severity	Location/Area	Hazard Ranking
Unlikely	Moderate	Limited	**Medium**

Description

This hazard encompasses the following sub-hazards: enemy attack, biological terrorism, agroterrorism, chemical terrorism, conventional terrorism, cyberterrorism, radiological terrorism, and public disorder. These hazards can occur anywhere and demonstrate unlawful force, violence, and/or threat against persons or property causing intentional harm for purposes of intimidation, coercion, or ransom in violation of the criminal laws of the United States. These actions may cause massive destruction and/or extensive casualties. The threat of terrorism, both international and domestic, is ever present, and an attack can occur when least expected.

Enemy attack is an incident that could cause massive destruction and extensive casualties throughout the world. Some areas could experience direct weapons' effects: blast and heat; others could experience indirect weapons' effect. International political and military activities of other nations are closely monitored by our federal government and the State of Iowa would be notified of any escalating military threats.

The use of biological agents against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion or ransom can be described as biological terrorism. Liquid or solid contaminants can be dispersed using sprayers/aerosol generators or by point of line sources such as munitions, covert deposits and moving sprayers. Biological agents vary in the amount of time they pose a threat. They can be a threat for hours to years depending upon the agent and the conditions in which it exists.

Agroterrorism consists of acts to intentionally contaminate, ruin, or otherwise make agricultural products unfit or dangerous for consumption or further use. Agriculture is an important industry in Iowa and Worth County. The introduction of a biological agent into the population of 7,600 cattle and calves, or the 199,100 acres of yield and production in Worth County would be financially devastating and would have a major impact on the food supply of the state and the nation. A major attack involving the nation's food supply could be launched in a rural area that has little capacity to respond. Potential terrorists' targets for livestock disease introduction would be concentration points, such as the County's licensed feedlots or livestock markets discussed later in the Geographic Location section.

Chemical terrorism involves the use or threat of chemical agents against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion, or ransom. Effects of chemical contaminants are similar to biological agents.

Use of conventional weapons and explosives against persons or property in violation of the criminal laws of the United States for purposes of intimidations, coercion, or ransom is conventional terrorism. Hazard effects are instantaneous; secondary devices may be used, lengthening the time duration of the hazard until the attack site is determined to be clear. The extent of damage is determined by the type and quantity of explosive. Effects are generally static other than cascading consequences and incremental structural failures. Conventional terrorism can also include tactical assault or sniping from remote locations.

Electronic attack using one computer system against another in order to intimidate people or disrupt other systems is a cyber-attack. All governments, businesses and citizens that conduct business utilizing computers face these threats. Cyber-security and critical infrastructure protection are among the most

important national security issues facing our country today. As such, the Iowa Division of Criminal Investigation has a Cyber Crime Unit tasked with analysis and retrieval of digital information for investigations.

Radiological terrorism is the use of radiological materials against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion, or ransom. Radioactive contaminants can be dispersed using sprayers/aerosol generators, or by point of line sources such as munitions, covert deposits and moving sprayers or by the detonation of a nuclear device underground, at the surface, in the air or at high altitude.

Mass demonstrations, or direct conflict by large groups of citizens, as in marches, protect rallies, riots, and non-peaceful strikes are examples of public disorder. These are assembling of people together in a manner to substantially interfere with public peace to constitute a threat, and with use of unlawful force or violence against another person, or causing property damage or attempting to interfere with, disrupting, or destroying the government, political subdivision, or group of people. Labor strikes and work stoppages are not considered in this hazard unless they escalate into a threat to the community. Vandalism is usually initiated by a small number of individuals and limited to a small target or institution. Most events are within the capacity of local law enforcement.

The Southern Poverty Law Center reports four active hate groups in Iowa: National Socialist Movement (Neo-Nazi, National Socialist); Gallows Tree Wotansvolk Alliance (Neo-Nazi); the Daily Stormer (Neo Nazi); and ACT for America (Anti-Muslim).

Location

According to the FBI, the most common targets of terrorist attacks in the US are:

- Businesses: 27%
- Government: 17%
- Private Citizens & Property: 13%
- Abortion-related: 9%
- Military: 6%
- Police: 6%
- Religious: 5%

The entire planning area has a low potential for terrorist activity. However, any venue with a large gathering of people could be a potential target for terrorists. Likely targets of a conventional terrorism attack in Worth County include public school system facilities, the Worth County Courthouse and law enforcement centers within the County.

In terms of cyberterrorism, our society is highly networked and interconnected. An attack could be launched from anywhere on earth and could range in impacts from small and localized to a far-reaching global scale. Depending on the attack vector and parameters, a cyber-attack could impact all of Worth County and its associated municipal jurisdictions.

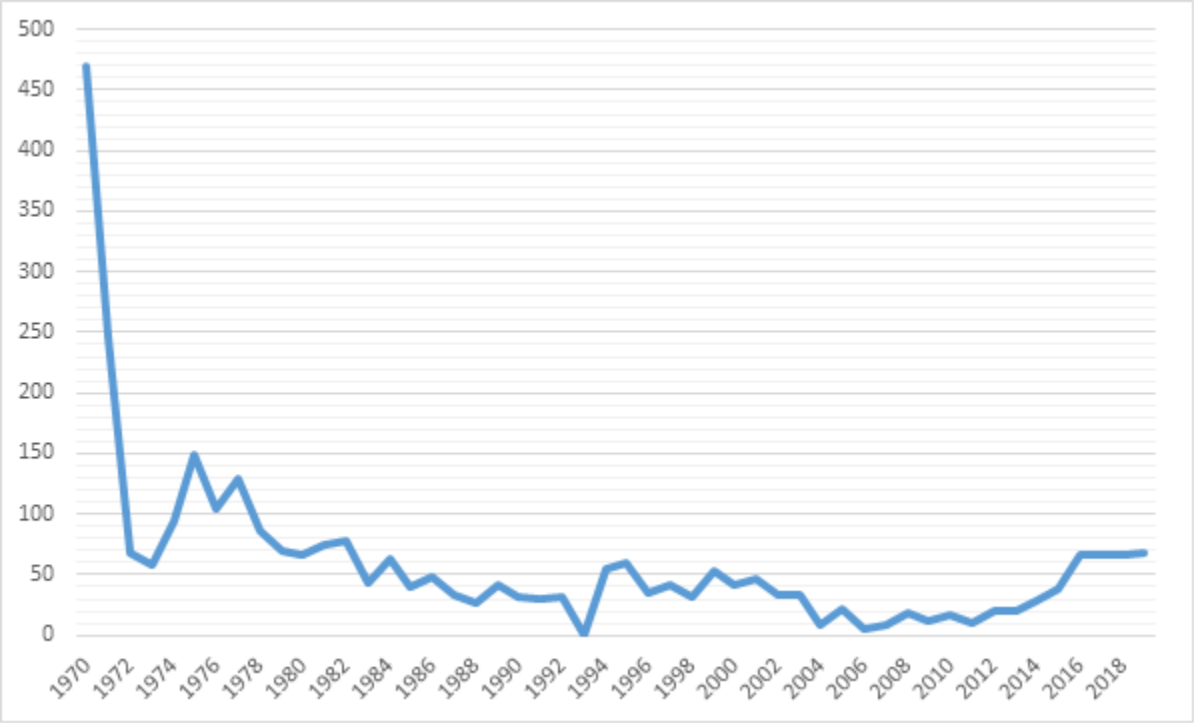
Previous Occurrences

The Global Terrorism Database (GTD) catalogs more than 200,000 terrorist attacks dating back to 1970. As shown in **Figure 4-48**, GTD data shows that despite public perception the number of terrorist attacks on US soil decreased for most of past 50 years. From an average of 148 incidents per year in the 1970s, the frequency of attacks had declined to less than 23 per year in the 2000s. An increase in attacks starting

around 2014 has brought that average back-up to 43 incidents per year for 2011 through 2019 (the most recent year the GTD has analyzed), the highest since the 1980s.

In most years, the number of people killed or injured by terrorists on American soil is fairly low, with a median of 25 casualties per year. (The average is significantly higher due to a handful of high-casualty incidents such at the 9-11 attacks.) According to the GTD data, there have only been 11 years since 1970 where 100 or more Americans were killed or injured in terrorist attacks; however, six of those years have been in the last 10 years.

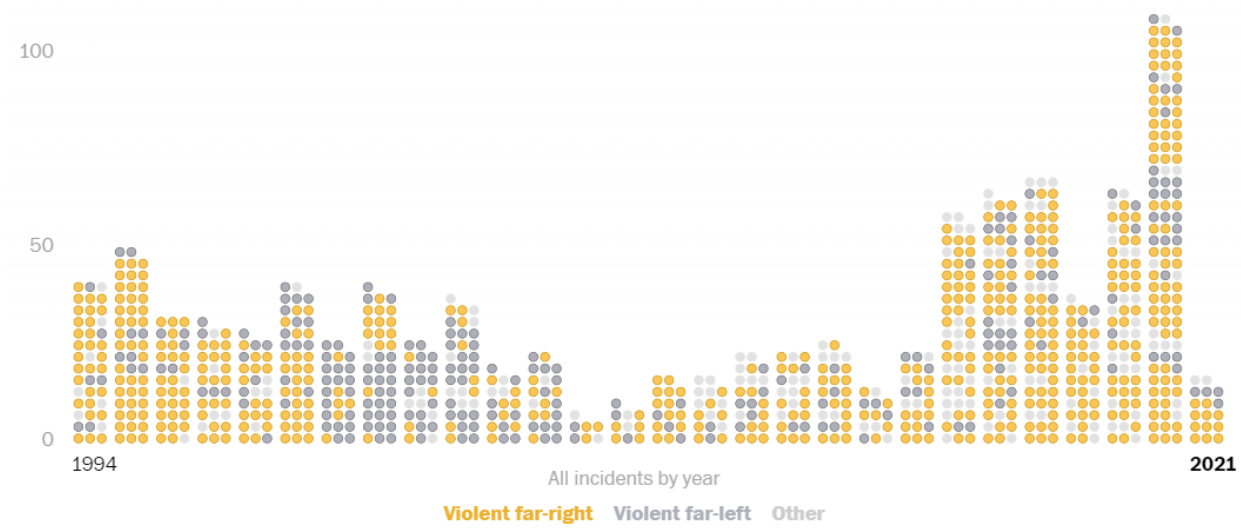
Figure 4-48 Terrorist Attacks in The US 1970-2019



Source: GTD, https://www.start.umd.edu/gtd/

The increase in attacks over the last decade has been driven almost entirely by domestic terrorism, not international terrorism. A recent report by the Center for Strategic & International Studies records 980 domestic terrorist attacks in the US since 1994, with sharp growth over the last 10-15 years. **Figure 4-49** shows a breakdown of terrorist attacks based on the ideology of the attacker.

Figure 4-49 Domestic Terrorist Attacks in The US 1994-2021



Source: Center for Strategic & International Studies

There have not been any large-scale enemy attacks or acts of radiological terrorism in Iowa. There have been biological and chemical agent threats, animal rights activists' vandalism and many bomb threats. In 2002, pipe bombs were found in 18 states including Iowa and six people were injured in the bombings in Iowa and Illinois. In 2005 and 2006, pipe bombs were used in attempted murder cases in two Iowa cities.

The Iowa Department of Public Safety issued a *2016 Iowa Uniform Crime Report* showing 18 hate/bias crimes were reported statewide in 2016.

According to the Southern Poverty Law Center, there were 47 hate incidents reported in Iowa from 2003 to 2016. None of the incidents reported were in Worth County.

Probability of Future Occurrence

While difficult to estimate, the probability for a terrorist event is "Unlikely" within the next 10 years in Worth County.

Magnitude/Severity

The severity of impact varies tremendously depending on the form of terrorism. The HMPC determined that, although some terroristic activity could result in serious injury and major property damage, the most likely terroristic threat that Worth County would experience would involve little to no injuries, illness, or property damage, or minor injuries, illness, or property damage.

Terrorism occurs with minimal or no warning. No jurisdiction in Worth County would have advanced notice of a terrorism event.

Climate Change Impacts

There are no known climate change impacts relevant to this hazard.

Vulnerability

People

In Worth County, vulnerability to various terrorist attacks varies across demographics. Enemy attacks pose indiscriminate risks to all residents, with densely populated areas and vulnerable populations facing higher casualties. Biological and chemical terrorism particularly threatens those with compromised health, the elderly, and young children. Agroterrorism directly impacts farmers, while the broader community, especially the food insecure, may suffer economically and in terms of food supply. Conventional terrorism in public spaces endangers students and commuters. Cyberterrorism indirectly affects everyone but may disproportionately impact vulnerable groups with limited digital access.

Property

Public facilities like schools, courthouses, and law enforcement centers are vulnerable to attacks, with potential for significant property damage. Mitigation involves enhancing security measures for these potential targets.

Critical Facilities and Infrastructure

Worth County's critical facilities and infrastructure face vulnerabilities to terrorism, particularly those essential for public services, healthcare, transportation, and daily life. Attacks on hospitals, public resources, roadways, and other critical spaces could have severe repercussions on the community's well-being and functioning.

Economy

The County's agricultural industry is a major local employer and supplier. In the event of an agroterrorism attack, Worth County and neighboring benefactors of their products would experience major impact and severe economic disruptions. Financial devastation and impacts on the food supply necessitate enhanced security for agricultural facilities and diversification.

Environmental and Cultural Resources

An agroterrorism attack targeting Worth County crops could result in the introduction of harmful biological agents or chemicals that can contaminate the soil, affect its fertility, and pose a threat to the health and ability to consume of future crops. There terrorism types that seek gathering locations, often preserved historical structures (court houses, governmental buildings, stadiums), would greatly impact cultural resources.

Risk Summary

The overall significance of this hazard is **medium**.

- Has potential to occur in a limited area or over the entire county at once.
- Key vulnerabilities include property damage and personal injuries, disruptions to continuity of operations, economic disruptions, public confidence in government can be affected.
- Includes many sub-hazards, perhaps most likely for Worth County is agro-terrorism.
- Related hazards: Radiological incident, hazardous materials incidents, infrastructure failure.

4.3.16 Thunderstorm with Lightning and Hail

Probability	Magnitude/Severity	Location/Area	Hazard Ranking
Highly Likely	Critical	Extensive	**High**

Description

A thunderstorm is defined as a storm that contains lightning and thunder, which is caused by unstable atmospheric conditions. When the colder upper air sinks and warm moist air rises, storm clouds or 'thunderheads' develop, resulting in thunderstorms. This can occur singularly, in clusters, or in lines. Severe thunderstorms most often occur in Iowa in the spring and summer, during the afternoon and evenings, but can occur at any time. Other hazards associated with thunderstorms and lightning include: heavy rains causing flash flooding (discussed separately in **Section 4.3.7**) and tornadoes and windstorms (discussed further in **Section 4.3.17**).

Lightning

All thunderstorms produce lightning, which often strikes outside of the area where it is raining, and has been known to strike more than 10 miles away from the rainfall area. Thunder is simply the sound that lightning makes. Lightning is a huge discharge of electricity. When lightning strikes, electricity shoots through the air and causes vibrations creating the sound of thunder. Nationwide, lightning kills 75 to 100 people each year. Lightning strikes can also start building fires and wildland fires, and damage electrical systems and equipment.

Hail

According to the National Oceanic and Atmospheric Administration (NOAA), hail is precipitation that is formed when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere causing them to freeze. The raindrops form into small frozen droplets and then continue to grow as they come into contact with super-cooled water which will freeze on contact with the frozen rain droplet. This frozen rain droplet can continue to grow and form hail. As long as the updraft forces can support or suspend the weight of the hailstone, hail can continue to grow.

At the time when the updraft can no longer support the hailstone, it will fall down to the earth. For example, a ¼" diameter or pea-sized hail requires updrafts of 24 mph, while a 2 ¾" diameter or baseball-sized hail requires an updraft of 81 mph. The largest hailstone recorded in the United States was found in Vivian, South Dakota on July 23, 2010, measuring eight inches in diameter, almost the size of a soccer ball. Soccer-ball-sized hail is the exception, but even small pea-sized hail can do damage.

Hailstorms in Iowa cause damage to property, crops, and the environment, and kill and injure livestock. In the United States, hail causes more than $1 billion in damage to property and crops each year. Much of the damage inflicted by hail is to crops. Even relatively small hail can shred plants to ribbons in a matter of minutes. Vehicles, roofs of buildings and homes, and landscaping are the other things most commonly damaged by hail. Hail has been known to cause injury to humans; occasionally, these injuries can be fatal.

Location

Thunderstorms and the associated hail and lightning impact the entire County with relatively similar frequency, therefore the geographic extent of this hazard is **extensive**. Although, these events occur

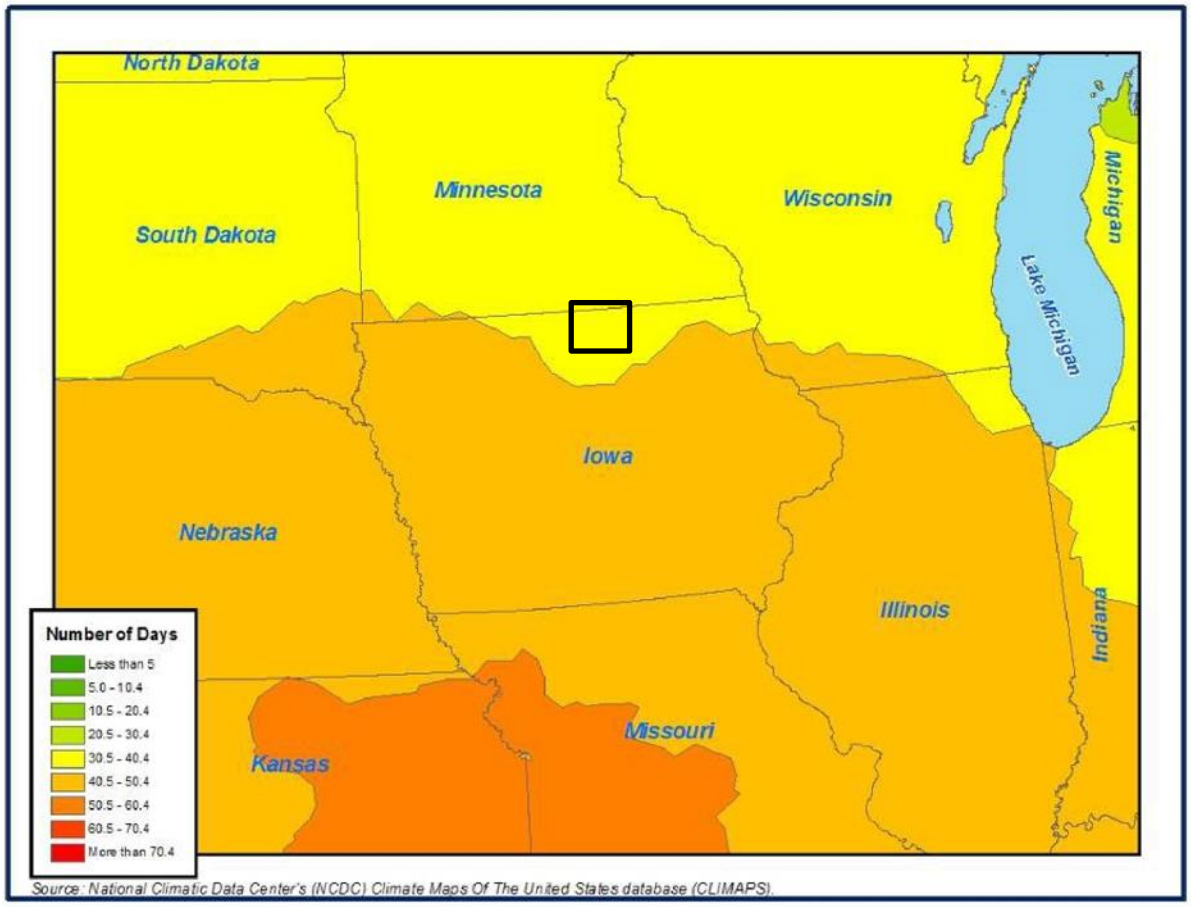
similarly throughout the planning area, they are more frequently reported in more urbanized areas. In addition, damages are more likely to occur in more densely developed urban areas.

Past Occurrences

Since 1965, Worth County has been included in eight Presidential Disaster declarations that included severe storms/weather, most recently on February 12, 2022 (see Table 4-3 in the Hazard Identification Section). Some of the damages that resulted in the declarations were from tornadoes and flooding that accompanied the severe weather.

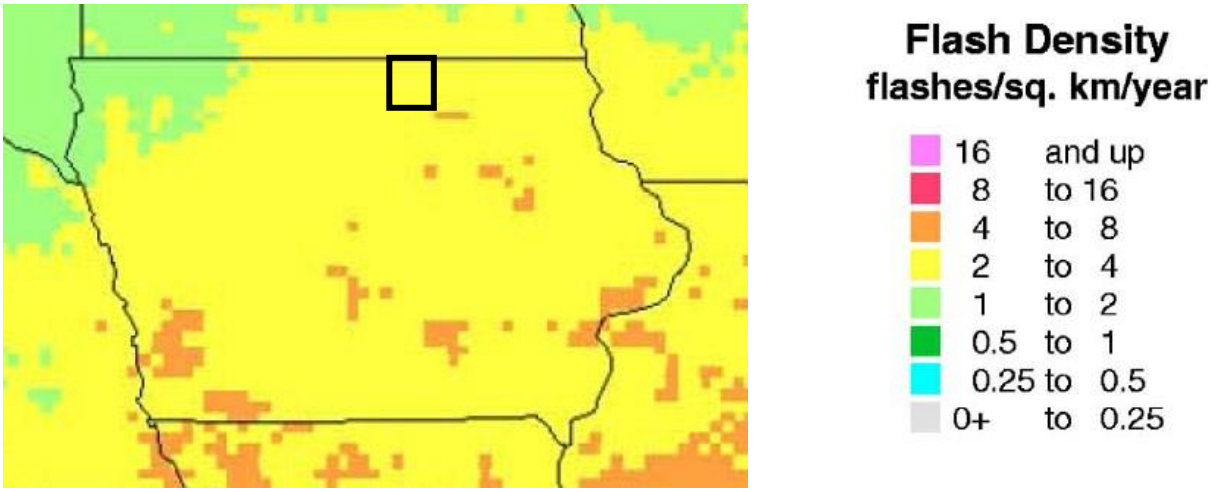
Figure 4-50 displays the average number of days with thunder experienced throughout different areas of the state each year, showing the County experiences between 30.5 to 40.4 days with thunder per year per the orange shaded area. **Figure 4-51** shows 2 to 4 lightning strikes per square kilometer per year with the yellow shaded area. **Figure 4-52** illustrates past recorded instances of notable hail throughout the county since 1955 by size of the hailstone. Overall, the county occurrence is high, and thunderstorms will continue to occur annually.

Figure 4-50 Distribution and Frequency of Thunderstorms



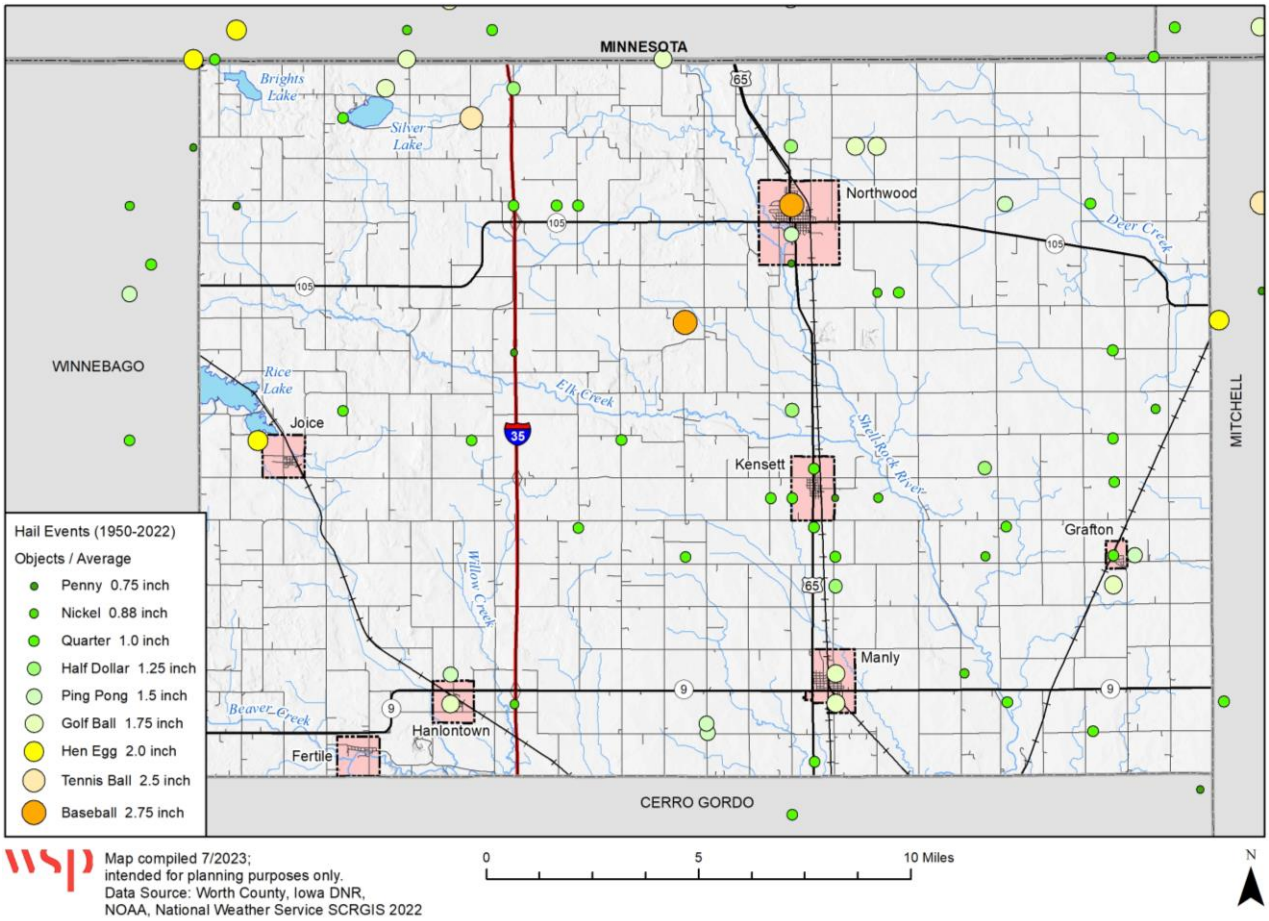
Note: Black Square indicates approximate location of Worth County

Figure 4-51 Location and Frequency of Lightning in Iowa



Source: National Weather Service, www.lightningsafety.noaa.gov/lightning_map.htm
Note: Black Square indicates approximate location of Worth County

Figure 4-52 Worth County Hail Events, 1950-2022



Probability of Future Occurrence

Thunderstorms/lightning/hail are considered **highly likely** in Worth County. Based on the number of Severe Thunderstorm Watches and Warnings issued since 1986, the county can expect to see an average of 8 to 9 severe thunderstorms per year. This means there is essentially a 100% chance of a thunderstorm/lightning/hail event on an annual basis.

Magnitude/Severity

It is possible for the entire County to be affected by a large thunderstorm and lightning event, but effects are often localized. Thunderstorms can bring large hail that can damage homes and businesses, break glass, destroy vehicles, and cause bodily injury to people, pets, and livestock. One or more severe thunderstorms occurring over a short period can lead to flooding and cause extensive damage, power and communication outages, and agricultural damage.

In extreme or isolated circumstances, severe thunderstorms can bring straight-line winds in excess of 100 mph. Straight-line winds are responsible for most thunderstorm damage. High winds can damage trees, homes (especially mobile homes), and businesses and can knock vehicles off of the road. The power of lightning's electrical charge and intense heat can electrocute people and livestock on contact, split trees, ignite fires, and cause electrical failures. Therefore, the potential magnitude of this hazard is **critical**.

Based on information provided by the Tornado and Storm Research Organization, **Table 4-43** below describes typical damage impacts of the various sizes of hail.

Table 4-43 Tornado and Storm Research Organization Hailstorm Intensity Scale

Intensity Category	Diameter (mm)	Diameter (inches)	Size Description	Typical Damage Impacts
Hard Hail	5-9	0.2-0.4	Pea	No damage
Potentially Damaging	10-15	0.4-0.6	Mothball	Slight general damage to plants, crops
Significant	16-20	0.6-0.8	Marble, grape	Significant damage to fruit, crops, vegetation
Severe	21-30	0.8-1.2	Walnut	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
Severe	31-40	1.2-1.6	Pigeon's egg > squash ball	Widespread glass damage, vehicle bodywork damage
Destructive	41-50	1.6-2.0	Golf ball > Pullet's egg	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
Destructive	51-60	2.0-2.4	Hen's egg	Bodywork of grounded aircraft dented; brick walls pitted
Destructive	61-75	2.4-3.0	Tennis ball > cricket ball	Severe roof damage, risk of serious injuries
Destructive	76-90	3.0-3.5	Large orange > Soft ball	Severe damage to aircraft bodywork
Super Hailstorms	91-100	3.6-3.9	Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
Super Hailstorms	>100	4.0+	Melon	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Source: Tornado and Storm Research Organization (TORRO), Department of Geography, Oxford Brookes University

Notes: In addition to hail diameter, factors including number and density of hailstones, hail fall speed and surface wind speeds affect severity.

Climate Change Considerations

A report done in 2022 by Climate Central using data from the National Weather Service and the National Oceanic Atmospheric Administration shows that the parts of the Mississippi River basin, including Worth County, receive 8 more inches of rain per year than they did 50 years ago. This trend has a lot to do with heat as greenhouse gas emissions heat the Earth and warming extends to the oceans and the Gulf of Mexico. This heat and moisture are then trapped in the center of the country which can deliver more precipitation in a short window of time to areas like Worth County. These intense periods of precipitation not only cause damage from thunderstorms but also exaggerate damage from hazards such as flooding and landslides. The economic consequences of lightning strikes and flash flood will only increase as emissions heat the earths surface.

Vulnerability

In general, various assets in the County, such as people, crops, vehicles, and structures, are vulnerable to thunderstorms, winds, lightning, and hail. According to the 2013 Iowa Hazard Mitigation Plan, thunderstorms with lightning and hail ranked fourth among hazards, resulting in $30 million in annualized losses over a 17-year period. Although this hazard leads to significant annual losses, most are covered by private property and crop insurance, which serves as a recovery capability and mitigates the economic impact. Hail can cause substantial damage to vehicles and buildings, rarely resulting in direct loss of life but potentially causing injuries. The effects of this hazard range from minimal, localized property damage to significant damage affecting a large portion of the jurisdiction. Additionally, some jurisdictions lack safe rooms for their residents, further impacting vulnerability to thunderstorm, lightning, and hail events in each community.

People

People in unprotected areas, mobile homes, or automobiles during a storm are especially at risk of thunderstorm, lightning, and hailstorms. Sudden strong winds often accompany a severe thunderstorm and may blow down trees across roads and power lines, posing a significant hazard to those in mobile homes and vehicles. Lightning presents the greatest immediate danger to people and livestock during a thunderstorm. Livestock and individuals who are outdoors, especially under a tree or other natural lightning rods, in or on water, or on or near hilltops are also at risk from lightning. Hail can be very dangerous to people, pets, and livestock if shelter is not available. Flash floods and tornadoes can develop during thunderstorms as well, making people in automobiles, mobile homes, or along low-lying areas vulnerable.

As previously noted, there are an estimated 111 electricity-dependent Medicare beneficiaries in the County. These individuals are extremely vulnerable during power outages that may result from lightning or downed power lines.

Property

Most lightning damages occur to electronic equipment located inside buildings, as well as communications equipment or warning transmitters and receivers which can be knocked out by lightning strikes. Additionally, structural damage may occur if a lightning strike leads to a structural fire. Lightning strikes can also cause crop damages when fields catch fire.

Thunderstorm winds and hail can cause damage to property, vehicles, trees, and crops. Hail, in particular, can inflict considerable damage on vehicles and buildings. According to the NCEI Storm Events Database, Worth County experienced over $2.9 million in property and crop damages from hail and lightning between 1971 and 2022, summarized in **Table 4-44** below.

Table 4-44 NCEI Recorded Damages Resulting from Severe Thunderstorms, 1971-2022

Event Type	Property Damage	Crop Damage	Total
Hail	$477,000	$677,000	**$1,154,000**
Lightning	$27,000	$0	**$27,000**
Thunderstorm Wind	$1,385,000	$372,050	**$1,757,050**
Total	**$1,889,000**	**$1,049,050**	**$2,938,050**

Source: NOAA NCEI

Critical Facilities and Infrastructure

Hail can lead to the temporary incapacitation of roads when hail stones build up enough to block roads. Hail has also been observed to block storm drains and prevent proper runoff, potentially resulting in flooding as a secondary hazard. Most structures, including the County's critical facilities, should be able to provide adequate protection from hail but the structures could suffer broken windows and dented exteriors. Those facilities with back-up generators are better equipped to handle a severe weather situation should the power go out. Critical facilities and infrastructure can potentially be damaged by a direct lightning strike. The effect of wind, combined with lightning, rain and hail, on power delivery is a significant factor when assessing development exposure.

Economy

The economic impact of severe thunderstorms is typically short-term. Lightning and high wind events can lead to power outages and fires, but long-term economic impacts often stem from secondary hazards, such as wildfires ignited by lightning. Lightning can also cause structural damage and damage to electrical systems in both private buildings and critical infrastructure. Similarly, hail and high wind damage can necessitate the temporary or extended closure of businesses, resulting in lost income and wages, in addition to the recovery costs for repairing the damage. According to the USDA Risk Management Agency, hail has damaged 10,590 acres of crops since 2007, resulting in over $900,000 in crop indemnity payments made, with agricultural crops like corn and beans being particularly susceptible to hailstorms that strip the plants of their leaves. **Table 4-45** provides the insured crop losses resulting from hail and wind.

Table 4-45 Estimated Insurable Annualized Crop Damages Resulting from Severe Thunderstorms (Hail & Wind)

Event Type	Sum of Determined Acres	Sum of Indemnity Amount
Hail	9,112.5	$793,564
Wind	1,477.7	$106,791
Total	**10,590.2**	**$900,354**

Source: USDA's Risk Management Agency for 2007-2021, https://www.rma.usda.gov/

Environmental and Cultural Resources

While hail and lightning are natural environmental processes, it can cause significant environmental damage, breaking tree limbs, damaging trees and other plants in bloom, and destroying crops. Some cultural and historic properties may also potentially be at risk of damage from hail.

Development Trends

All future development in Worth County will be affected by thunderstorms, hail, and lightning. The ability to withstand and adapt to impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction. Land use policies should be identified in master plans and enforced through zoning code and the permitting process to address the secondary impacts of this hazard. With these tools, the planning partnership will be well equipped to deal with future growth and the associated impacts of severe weather.

Risk Summary

Thunderstorms, hail, and lightning have an overall significance of **high**.

- Severe thunderstorms most often occur in Iowa in the spring and summer, during the afternoon and evenings, but can occur at any time.
- Based on the number of Severe Thunderstorm Watches and Warnings issued since 1986, the county can expect to see an average of 8 to 9 severe thunderstorms per year. This means there is essentially a 100% chance of a thunderstorm/lightning/hail event on an annual basis.
- Over 100 Medicare beneficiaries in the County rely on electricity-dependent medical equipment to live independently in their own homes making them vulnerable to lightning and severe wind events that may result in power outages.
- Although structural property damages are higher in the urban areas, the rural areas have higher damages to agriculture.
- Related hazards: Heavy Rain, Flooding, Tornado/Windstorm.

4.3.17 Tornado/Windstorm

Probability	Magnitude/Severity	Location/Area	Hazard Ranking
Likely	Critical	Extensive	**High**

Description

This hazard section discusses tornadoes and windstorms.

Tornado: The NWS defines a tornado as "a violently rotating column of air extending from a thunderstorm to the ground." It is usually spawned by a thunderstorm and produced when cool air overrides a layer of warm air, forcing the warm air to rise rapidly. Often, vortices remain suspended in the atmosphere as funnel clouds. When the lower tip of a vortex touches the ground, it becomes a tornado and a force of destruction.

Tornadoes are the most violent of all atmospheric storms and are capable of tremendous destruction. Wind speeds can exceed 250 miles per hour, and damage paths can be more than one mile wide and 50 miles long. Tornadoes have been known to lift and move objects weighing more than 300 tons a distance of 30 feet, toss homes more than 300 feet from their foundations, and siphon millions of tons of water from water bodies. Tornadoes also generate a tremendous amount of flying debris or "missiles," which often become airborne shrapnel that causes additional damage. If wind speeds are high enough, missiles can be thrown at a building with enough force to penetrate windows, roofs, and walls. However, less spectacular damage is much more common.

Iowa is located in "Tornado Alley", which consists of Texas, Oklahoma, Kansas, Missouri, Nebraska, and Iowa. Tornados have been known to lift and move huge objects, destroy, or move whole buildings long distances, and siphon large volumes from bodies of water. Historically, 40 - 50 tornados are confirmed in Iowa per year. Developed areas occupy a growing portion of Iowa and stand a likely chance of having a tornado occur in the next ten years. Those most at risk from tornados include people living in mobile homes, campgrounds and other dwellings without secure foundations or basements. People in automobiles are also very vulnerable. The elderly, very young, and the physically and mentally handicapped are most vulnerable because of the lack of mobility to escape the path of destruction. People who may not understand watches and warnings due to language barriers are also at risk.

Windstorm: Windstorms for purposes of this plan refer to other non-tornadic damaging winds of thunderstorms including downbursts, microbursts, and straight-line winds. Downbursts are localized currents of air blasting down from a thunderstorm, which induce an outward burst of damaging wind on or near the ground. Microbursts are minimized downbursts covering an area of less than 2.5 miles across. They include a strong wind shear (a rapid change in the direction of wind over a short distance) near the surface. Microbursts may or may not include precipitation and can produce winds at speeds of more than 150 miles per hour. Straight-line winds are generally any thunderstorm wind that is not associated with rotation. It is these winds, which can exceed 100 mph, which represent the most common type of severe weather and are responsible for most wind damage related to thunderstorms. Since thunderstorms do not have narrow tracks like tornadoes, the associated wind damage can be extensive and affect entire (and multiple) counties. Objects like trees, barns, outbuildings, high-profile vehicles, and power lines/poles can be toppled or destroyed, and roofs, windows, and homes can be damaged as wind speeds increase.

Strong winds can occur year-round in Iowa. These winds typically develop with strong pressure gradients and gusty frontal passages. The closer and stronger two systems are, (one high pressure, one low pressure)

the stronger the pressure gradient and, therefore, the stronger the winds are. Downbursts can be particularly dangerous to aviation.

The NWS issues High Wind Watches, High Wind Warnings, and Wind Advisories to the public. The following are the definitions of these issuances:

- High Wind Watch—This is issued when there is the potential of high wind speeds developing that may pose a hazard or are life-threatening.
- High Wind Warning—The 1-minute surface winds of 35 knots (40 mph) or greater lasting for one hour or longer, or winds gusting to 50 knots (58 mph) or greater, regardless of duration, which are either expected or observed over land.
- High Wind Advisory—This is issued when high wind speeds may pose a hazard. Sustained winds 25 to 39 mph and/or gusts to 57 mph.

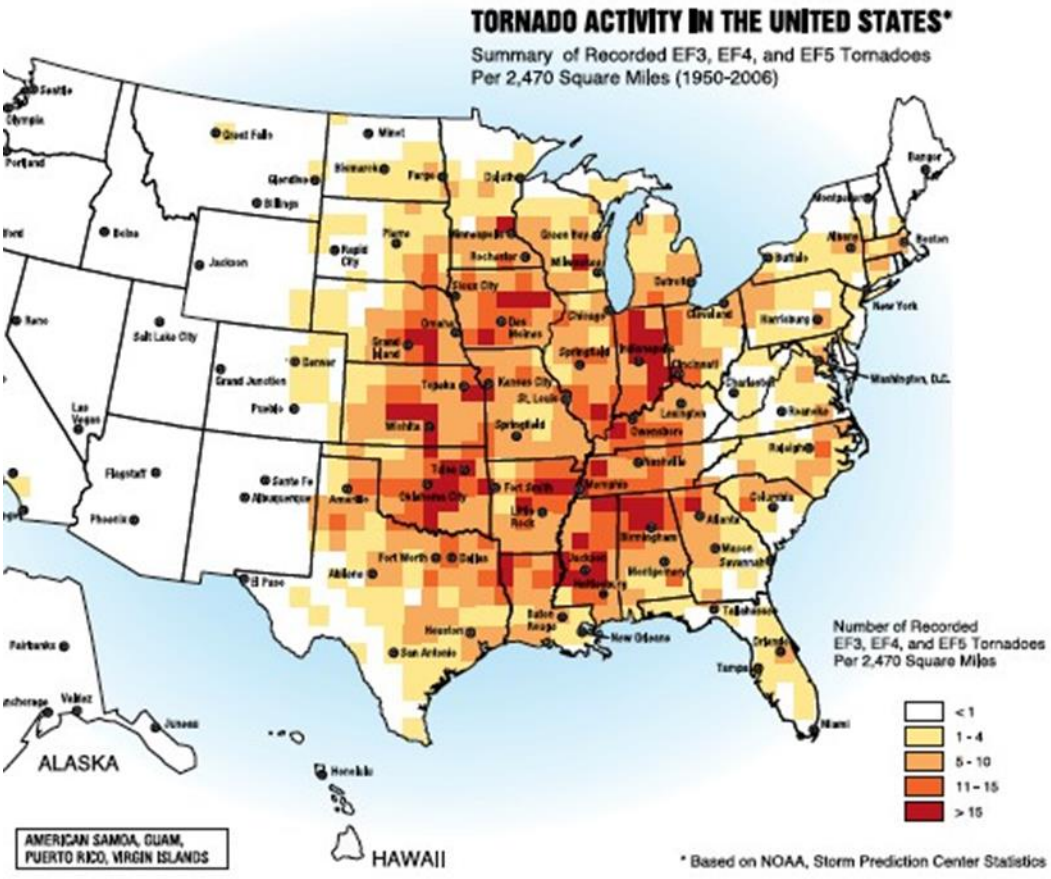
Location

Iowa is located in a part of the United States where tornadoes are a common occurrence.

According to The Tornado History Project.com, Iowa has experienced 2,468 tornadoes from 1950 through 2016 (67-year period) and only one F5 rated tornado has occurred in Iowa during this timeframe (Parkersburg in 2008). Since 1950, there have been on average 37 tornadoes per year in Iowa. Most tornadoes occurred in May and June but can occur during any month. Also, mid-afternoon until around sunset is the peak time of day for tornado activity. Since 1950 there have been 2,274 injuries and 87 deaths attributable to tornadoes (source: http://www.tornadohistoryproject.com/tornado/Iowa/map).

Tornadoes can occur in the entire planning area. **Figure 4-53** illustrates the number of EF3, EF4, and EF5 tornadoes recorded in the United States per 3,700 square miles between 1950 and 2006. Worth County is in the section with light-orange shading, indicating between 5 and 10 tornadoes of this magnitude during this 57-year period.

Figure 4-53 Tornado Activity in the United States



Source: FEMA 320, Taking Shelter from the Storm, 3rd edition
Note: Blue arrow is approximate location of Worth County

Tornadoes are classified according to the latest Enhanced Fujita (EF) Scale. The EF Scale (see **Table 4-46** and **Table 4-47**) attempts to rank tornadoes according to wind speed based on the damage caused. This update to the original F Scale was implemented in the US on February 1, 2007.

Table 4-46 Enhanced Fujita Scale for Tornado Damage Comparison

FUJITA SCALE		OPERATIONAL F SCALE	DERIVED EF SCALE		OPERATIONAL EF SCALE	
F Number	Fastest 1/4-mile (mph)	3 Second Gust (mph)	EF Number	3 Second Gust (mph)	EF Number	3 Second Gust (mph)
0	40-72	45-78	0	65-85	0	65-85
1	73-112	79-117	1	86-109	1	86-110
2	113-157	118-161	2	110-137	2	111-135
3	158-207	162-209	3	138-167	3	136-165
4	208-260	210-261	4	168-199	4	166-200
5	261-318	262-317	5	200-234	5	Over 200

Source: The National Weather Service, www.spc.noaa.gov/faq/tornado/ef-scale.html

The wind speeds for the EF scale and damage descriptions are based on information on the NOAA Storm Prediction Center as listed in Table 3.69. The damage descriptions are summaries. For the actual EF scale, it is necessary to look up the damage indicator (type of structure damaged) and refer to the degrees of damage associated with that indicator. Information on the Enhanced Fujita Scale's damage indicators and degrees of damage is located online at www.spc.noaa.gov/efscale/ef-scale.html.

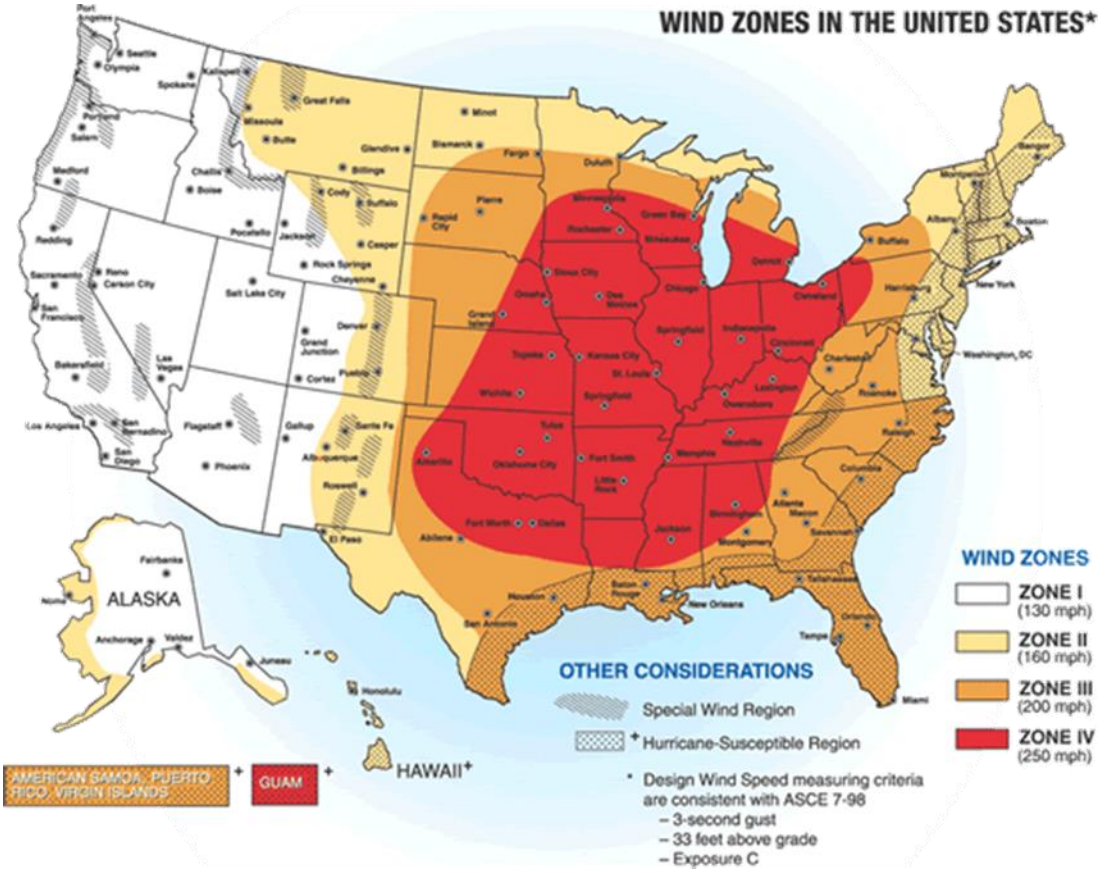
Table 4-47 Enhanced Fujita Scale with Potential Damage

Enhanced Fujita Scale			
Scale	**Wind Speed (mph)**	**Relative Frequency**	**Potential Damage**
EF0	65-85	53.5%	Light. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0).
EF1	86-110	31.6%	Moderate. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111-135	10.7%	Considerable. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes complete destroyed; large trees snapped or uprooted; light object missiles generated; cars lifted off ground.
EF3	136-165	3.4%	Severe. Entire stores of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	166-200	0.7%	Devastating. Well-constructed houses and whole frame houses completely levelled; cars thrown and small missiles generated.
EF5	>200	<0.1%	Explosive. Strong frame houses levelled off foundations and swept away; automobile-sized missiles fly through the air in excess of 300 ft.; steel reinforced concrete structure severely damaged; high rise buildings have significant structural deformation; incredible phenomena will occur.

Source: NOAA Storm Prediction Center

All of Worth County is susceptible to high wind events. The County is located in Wind Zone IV, which is susceptible to winds up to 250 mph. All of the participating jurisdictions are vulnerable to this hazard. **Figure 4-54** shows the wind zones of the United States based on maximum wind speeds; the entire state of Iowa is located within wind zone IV, the highest inland category.

Figure 4-54 Wind Zones in the United States



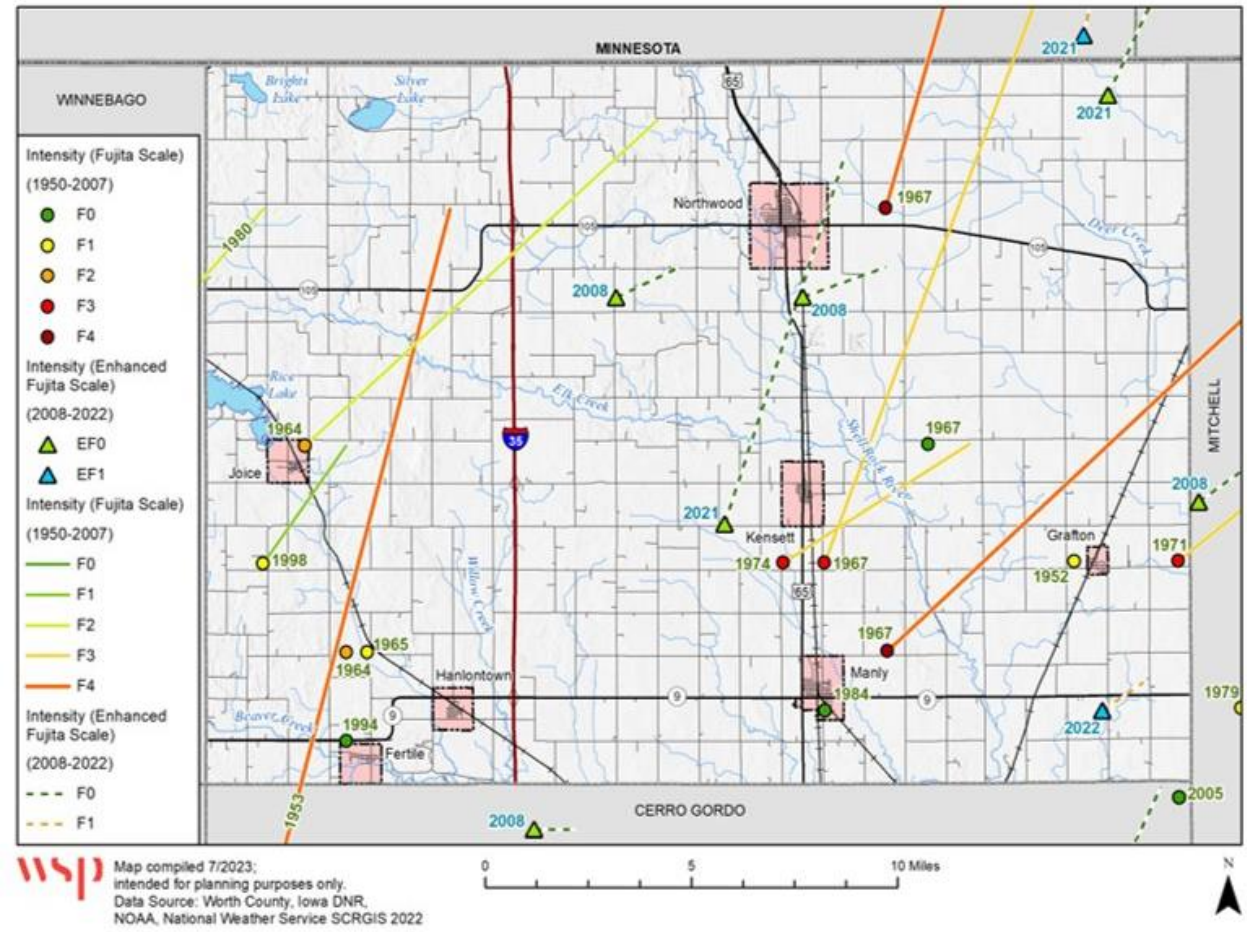
Source: FEMA; http://www.fema.gov/plan/prevent/saferoom/tsfs02_wind_zones.shtm
Note: Black square indicates approximate location of Worth County

The advancement in weather forecasting has provided for the ability to predict severe weather that is likely to produce tornadoes days in advance. Tornado watches can be delivered to those in the path of these storms several hours in advance. Lead time for actual tornado warnings is about 30 minutes. Tornadoes have been known to change paths very rapidly, thus limiting the time in which to take shelter. Tornadoes may not be visible on the ground if they occur after sundown or due to blowing dust or driving rain and hail.

Past Occurrences Tornadoes

According to NOAA statistics Worth County had 21 recorded tornado events from 1950 to 2022. These tornadoes caused no fatalities, four injuries, $21,050 in crop damages, and over $13 million in property damages. One notable tornado in the region (Floyd County) occurred on May 15, 1968, known as the "Charles City Tornado." It was part of a larger outbreak, causing 13 fatalities and over 450 injuries in Charles City, with significant impact on neighboring areas, including Worth County.

Figure 4-55 Recorded Tornadoes in Worth County, 1950 – 2022

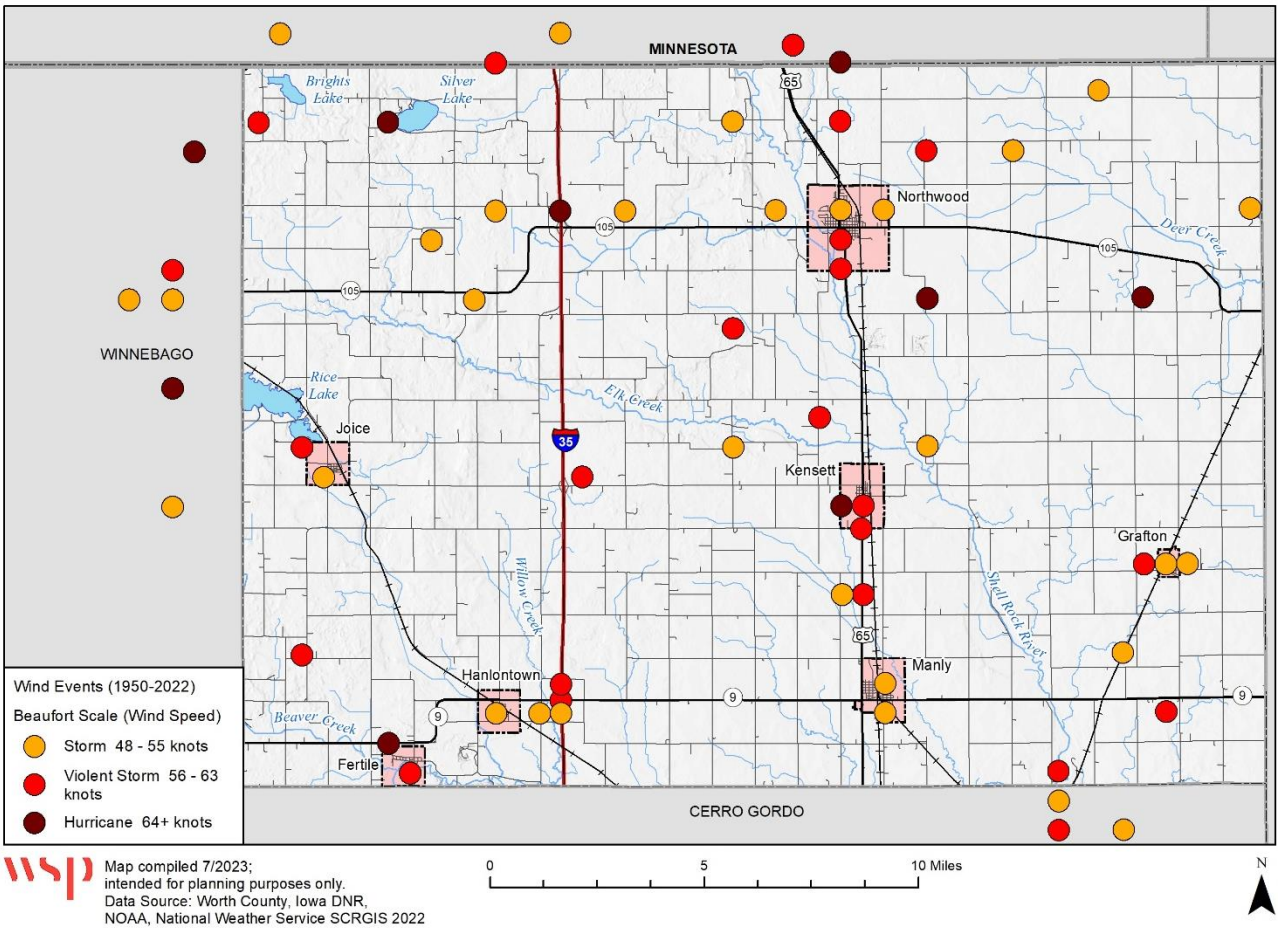


Worth County has been included in three Presidential Disaster Declarations that involved tornadoes since 1965. The NCDC database did not include descriptions for the tornadoes associated with those Declarations. NCDC noted that on July 12, 1971, an F3 tornado severely damaged 15 farmsteads near Grafton, causing $2.5M in property damage. An F3 tornado on May 28, 1974 also caused $2.5M in property damage, including unroofing school buildings, and a large fertilizer plant.

Past Occurrences Windstorms

According to the NCEI database, there were 37 high wind events in Worth County from 1996 to 2022. During this time period, there were no reported deaths or injuries. There were an estimated $1,210,000 in property damages and $130,100 in crop damages recorded. Recorded wind gusts ranged from a high of 70 knots (80.5 mph) to a low of 35 knots (40 mph).

Figure 4-56 Wind Events in Worth County, 1950 - 2022



Probability of Future Occurrence

NOAA reported 21 tornadoes in Worth County from 1950 to 2022, which calculates to 29-percent chance of a tornado in any given year. Therefore, it is a high probability that some portion of Worth County will experience tornado activity in any given year.

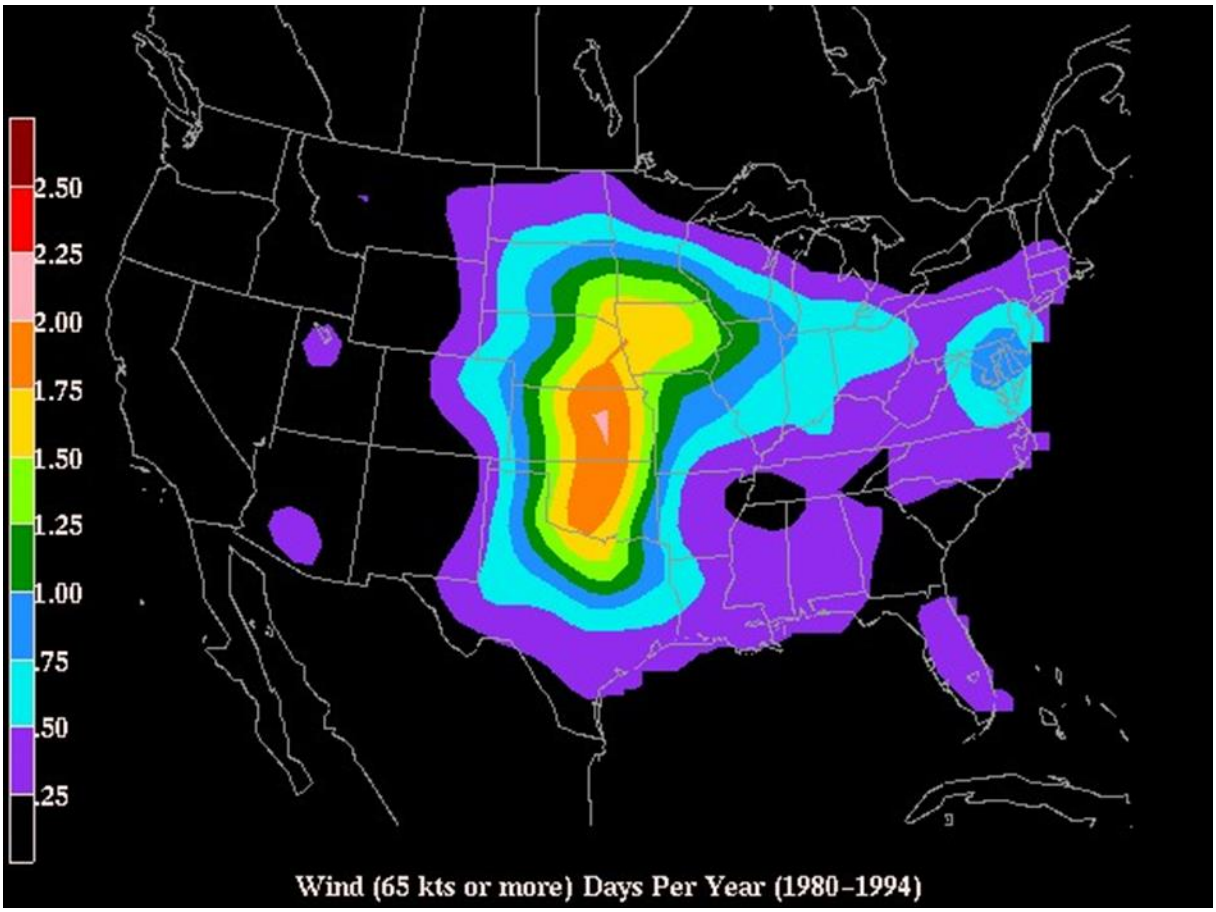
According to NCEI, there were 37 separate high wind events from 1996 to 2022 (26-year period) in Worth County. Based on this data there is an over 100-percent annual probability of high wind events in any given year. Therefore, the probability rating is "Highly Likely."

Figure 4-57 below shows the probability of a windstorm event (65 knots or greater) in the US The Worth County planning area is colored yellow, showing that 65+ knot winds are probable to occur 1.50 to 1.75 times a year.

Magnitude/Severity

Historically, tornados and windstorms in Worth County have been of moderate/likely magnitude. However larger and more damaging tornadoes and windstorms have occurred within Iowa and within the County in the past and remain possible in the planning area.

Figure 4-57 Annual Windstorm Probability (65+ knots), United States 1980-1994



Source: NSSL, http://www.nssl.noaa.gov/users/brooks/public_html/bigwind.gif;
Note: Blue square indicates approximate location of Worth County

Climate Change Considerations

Climate change impacts on the frequency and severity of tornadoes are unclear at this time due to the events occur over a much shorter time periods and tend to impact smaller areas compared to other extreme events such as heat waves and droughts (U.S. Global Change Research Program 2018). An update from a study done by Yale Climate Connections in 2021 the monthly variability of EF1+ tornadoes has increased with some years having more destructive tornadoes than others. Although a link between tornadoes and climate change still couldn't be made. However, weather conditions that can cause tornadoes and windstorms have shift eastward, with traditional Tornado Alley states having less frequent tornado conditions. This could be due to the strong multidecadal warming across the U.S. Southwest, with the increase in heat generating air above the earth's surface. This air could be hot enough to reliably suppress tornadic thunderstorm development as the air flows eastward. On the other side of the country, sea surface temperatures in the Gulf of Mexico are increasing which generate warm and humid surface air, feeding into severe thunderstorms.

The influence of climate change on wind is not fully understood at this time. While there have been several significant wind events in recent years, there is not enough observations to determine if there are any long-term trends in frequency of severity of events (US Global Change Research Program 2018).

According to the 2010 Climate Change Impacts on Iowa report and a study done by Climate Central in 2022, growing evidence points to stronger summer storm systems in the Midwest. Studies have not been done to conclusively say that severe storms, including tornadoes, are increasing. However, with summer temperatures becoming warmer and humidity levels increasing, an increase in the likelihood of tornadic activity is plausible.

Vulnerability

Worth County is located within a region of the US with high frequency of dangerous and destructive tornadoes and is referred to as "Tornado Alley." **Figure 4-58** is based on areas where dangerous tornadoes are most likely to take place.

Figure 4-58 Tornado Alley in the US.

Source: http://www.tornadochaser.net/tornalley.htm

People

It can be assumed that the entire planning area is exposed to some extent to tornadoes. Certain areas are more exposed due to geographic location and local weather patterns. Likelihood of injuries and fatalities would increase if warning time was limited before the event or if residents were unable to find adequate shelter.

Vulnerable populations are the elderly, low income or linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Power outages can be life-threatening to those dependent on electricity for life support. Isolation of these populations is a significant concern. These populations face isolation and exposure after tornado events and could suffer more secondary effects of the hazard. Additionally, there are Medicare Beneficiaries in the County who rely on electricity-dependent medical equipment to be able to live independently in their homes. These populations face isolation and exposure after tornado events and could suffer more secondary effects of the hazard. These populations face isolation and exposure after tornado events and could suffer more secondary effects of the hazard.

Individuals caught in the path of a tornado who are unable to seek appropriate shelter are especially vulnerable. This may include individuals who are out in the open, in cars, or who do not have access to basements, cellars, or safe rooms.

Property

All property is vulnerable during tornado and high wind events, but properties in poor condition or in particularly vulnerable locations may risk the most damage. Generally, damage is minimal and goes unreported. Property located at higher elevations may be more prone to wind damage. Property located under or near overhead lines or near large trees may be damaged in the event of a collapse. Wind pressure can create a direct and frontal assault on a structure, pushing walls, doors, and windows inward. Conversely, passing currents can create lift and suction forces that act to pull building components and surfaces outward. The effects of winds are magnified in the upper levels of multi-story structures. As positive and negative forces impact the building's protective envelope (doors, windows, and walls), the result can be roof or building component failures and considerable structural damage.

Light frame structures, such as mobile homes, outbuildings and sheds are considered especially vulnerable to damage from tornadoes. Those most at risk from tornadoes include people living in mobile homes, campgrounds, and other dwellings without secure foundations or basements. People in automobiles are also very vulnerable to twisters. The number and percent of mobile homes compared to total housing units for each jurisdiction is provided in **Table 4-48** below according to the US Census Bureau. Considering officially participating communities, with 62 mobile homes, the unincorporated county has the most. However, mobile homes do not represent more than 4.5 percent of the housing mix in any of the participating communities.

Table 4-48 Number and Percent of Mobile Homes by Jurisdiction in Worth County

Jurisdiction	Total Housing Units	# of Mobile home	% Mobile Homes
Worth County, Iowa	3,522	62	1.8%
City of Fertile	166	7	4.2%
City of Grafton	166	2	1.2%
City of Hanlontown	102	0	0.0%
City of Joice	108	2	1.9%
City of Kensett	177	8	4.5%
City of Manly	660	4	0.6%
City of Northwood	915	25	2.7%

Source: US Census Bureau, 2015 5-Year American Community Survey

The elderly (65 and older), young (less than 18 years old), and the physically and mentally handicapped are most vulnerable because of the lack of mobility to escape the path of destruction. People who may not understand watches and warnings due to language barriers are also at risk.

According to the 2013 Iowa Hazard Mitigation Plan, of the 8 hazards for which data was available to estimate annualized losses, tornadoes ranked 3rd with $36 million in annualized losses based on data spanning a 63-year period.

Due to the potential for damaging tornadoes in the planning area, the magnitude was determined to be "Catastrophic."

Critical Facilities and Infrastructure

In Worth County, the NCEI estimate for past property damages resulting from tornadoes from 1950 – 2016 (67 years) was $4,429,530; this translates to an annualized loss of over $194,447. For windstorms, NCEI loss estimates were $1,185,110 from 1996 to 2016 (20 years). This translates to an annualized loss of over $59,255.

Economy

In terms of economic loss, overhead power lines and infrastructure are vulnerable to damages from windstorms. Potential losses would include cost of repair or replacement of damaged facilities and lost economic opportunities for businesses. Public safety hazards include risk of electrocution from downed power lines. Specific amounts of estimated losses are not available due to the complexity and multiple variables associated with this hazard. Refer to the electric power loss of use estimates in the Winter Storm hazard section.

Environment and Cultural Resources

While tornados and windstorms are natural environmental processes, they can cause significant environmental damage, breaking tree limbs, damaging trees and other plants in bloom, and destroying crops. Some cultural and historic properties may also potentially be at risk of damage from both of these hazards. Development Trends

Future Development

All future development in Worth County will be influenced by the presence of tornados and windstorms. The capacity to endure and adapt to these impacts hinges on the implementation of sound land use practices, along with the steadfast enforcement of codes and regulations governing new construction. It is imperative that land use policies are clearly outlined in master plans and rigorously upheld through zoning codes and the permitting process, specifically addressing the secondary effects of this hazard. Armed with these essential tools, the planning partnership will be fully prepared to navigate future growth and effectively manage the consequential challenges posed by severe weather events.

Risk Summary

The magnitude was rated as a level 4 for all the participating jurisdictions, as they are all vulnerable to tornado and windstorm damage. The factors of probability, warning time, and duration are also equal across the planning area. This hazard does not substantially vary by jurisdiction.

- The overall significance of tornados/windstorms is High.
- Based on Iowa's location in Tornado Alley and the record of past events, the future probability of tornadoes and windstorms in Worth County has been determined to be likely.
- One notable tornado in the region occurred on May 15, 1968, known as the "Charles City Tornado." It was part of a larger outbreak, causing 13 fatalities and over 450 injuries in Charles City, with significant impact on neighboring areas, including Worth County. The extent is considered significant, as tornadoes and windstorms have the potential to occur anywhere in Worth County and could impact large portions of the county in a single event.
- According to NOAA statistics Worth County had 21 recorded tornado events from 1950 to 2022. These tornadoes caused no fatalities, four injuries, $21,050 in crop damages, and over $13 million in property damages.
- Related hazards: Flooding, Wildfire, Thunderstorm/Lightning/Hail

4.3.18 Transportation Incident

Probability	Magnitude/Severity	Location/Area	Hazard Ranking
Highly Likely	Negligible	Limited	**Low**

Description

This hazard encompasses the following: air transportation, highway transportation, and rail transportation. The transportation incidents can involve any mode of transportation that directly threatens life and which results in property damage and/or death(s)/injury(s) and/or adversely impact a community's capabilities to provide emergency services. Incidents involving buses and other high occupancy vehicles could trigger a response that exceeds the normal day-to-day capabilities of response agencies.

An air transportation incident may involve a military, commercial or private aircraft. Air transportation is playing a more prominent role in transportation as a whole. Airplanes and helicopters are used to transport passengers for business and recreation as well as thousands of tons of cargo. A variety of circumstances can result in an air transportation incident; mechanical failure, pilot error, enemy attack, terrorism, weather conditions and on-board fire can all lead to an air transportation incident.

Highway transportation incidents are very complex. Contributing factors can include a roadway's design and/or pavement conditions (e.g., rain, snow, and ice), a vehicle's mechanical condition (e.g., tires, brakes, lights), a driver's behavior (e.g., speeding, inattentiveness and seat belt usage), the driver's condition (e.g., alcohol use, age-related conditions, physical impairment) and driver inattention by using a wireless device. In fact, the driver's behavior and condition factors are the primary cause in an estimated 67 percent of highway crashes and a contributing factor in an estimated 95 percent of all crashes.

A railway transportation incident is a train accident that directly threatens life and/or property, or adversely impacts a community's capabilities to provide emergency services. Railway incidents may include derailments, collisions and highway/rail crossing accidents. Train incidents can result from a variety of causes; human error, mechanical failure, faulty signals, and/or problems with the track. Results of an incident can range from minor "track hops" to catastrophic hazardous material incidents and even human/animal casualties. With so many miles of track in Iowa, vehicles must cross the railroad tracks at numerous at-grade crossings.

Location

The overall location rating for transportation incidents is **limited**, as this hazard can occur anywhere there are roadways, railways, or air travel infrastructure, but the effects of an incident are most often very localized to the immediate vicinity.

Highways/Roads

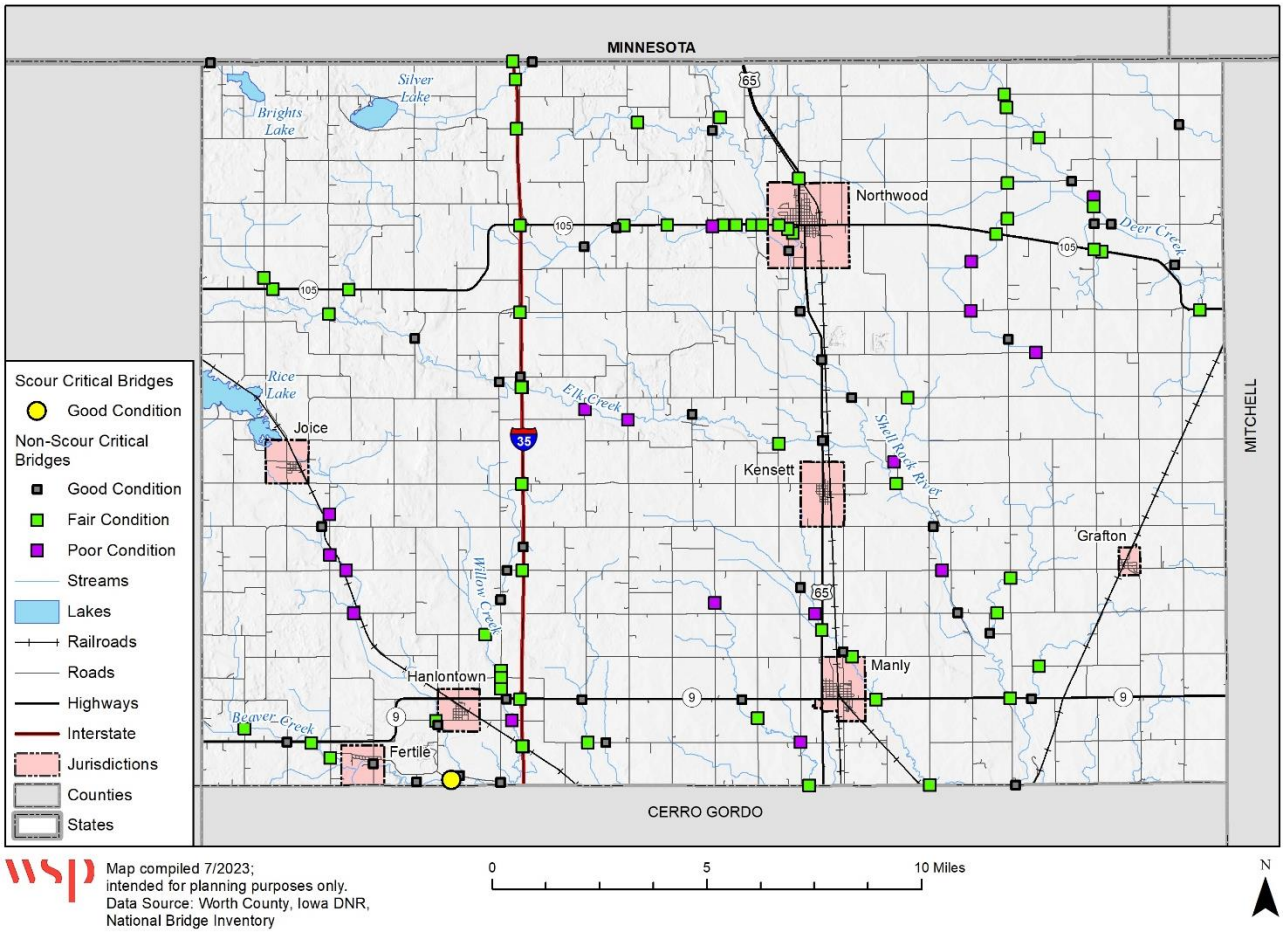
Numerous major US and state highways run through Worth County. Interstate 35 runs from the Minnesota boarder to the Cerro Gorgo County Boarder in Hartland, Brookfield, and Danville Townships. US Highway 65 runs north-south through Northwood, Kensett, and Manly in the east of the county. Iowa Highway 9 runs east-west through the southern County through Fertile, Hanlontown and Manly, while Iowa Highway 105 runs east-west through the northern County through Northwood. At the intersection of I-35 and 105 is significant development with two hotels, a casino, a state welcome center and rest area, along with two fuel stations and a convenience store.

Numerous paved county roads connect all of the incorporated cities and unincorporated areas throughout the county.

Figure 4-40 in the Infrastructure Failure Incident section shows the major highways in Worth County.

According to the Iowa Department of Transportation, the total daily traffic in Worth County is 136,845 and the total daily truck traffic is 32,647. (Source: http://iowadot.maps.arcgis.com/apps/MapSeries/index.html?appid=db6cb43313354a4f85505089ab317e7a)

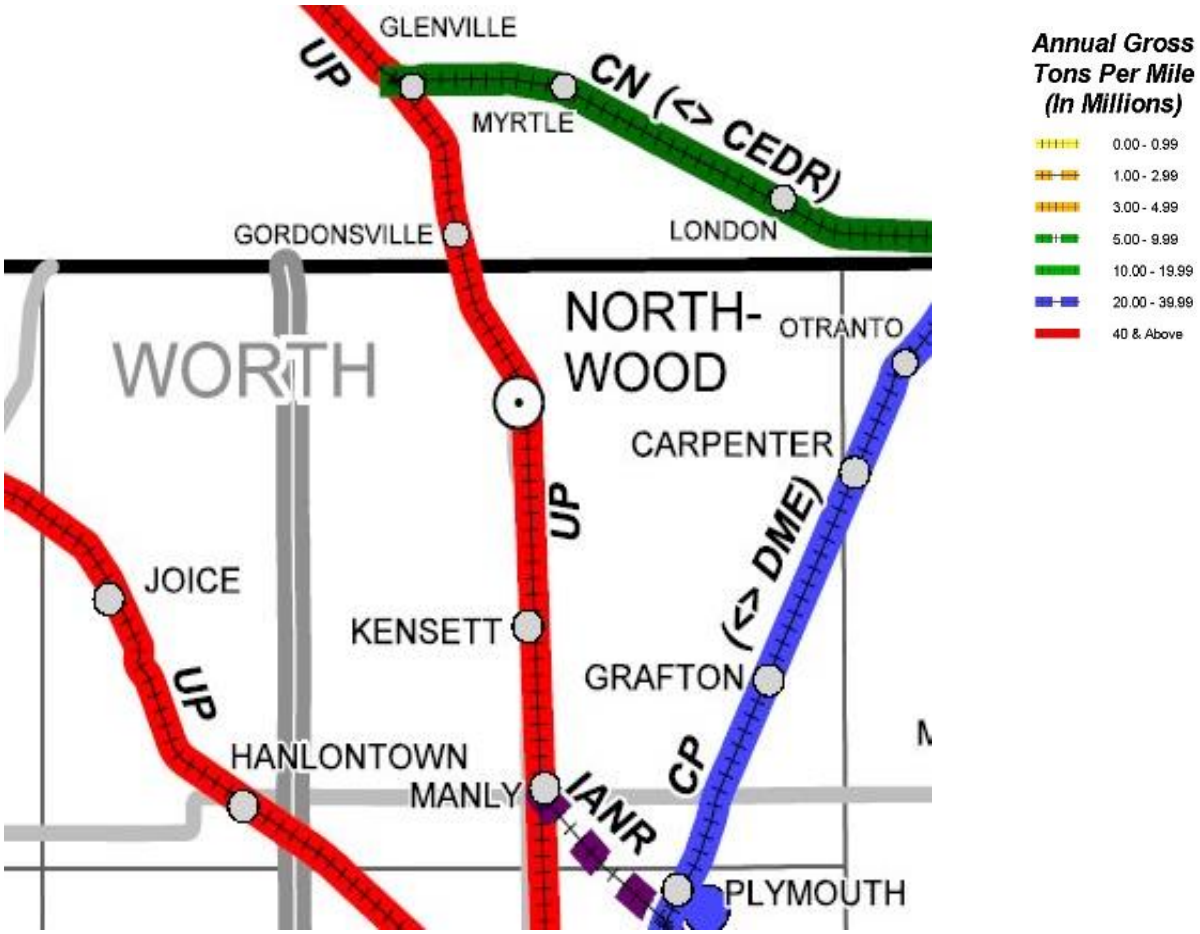
Figure 4-59 Worth County Bridges



Rail Transport

Union Pacific Railroad (UP), Iowa Northern Ry. Co (IANR), and Dakota, Minnesota and Eastern RR. CO. (DME) operate in Worth County. Additionally, Canadian National Railway Co./Cedar River Railroad Co. (CEDR) operates just north of the County boundary. There is one Union Pacific Railroad line that runs northwest-southeast through Joice and Hanlontown, as well as a line that runs north-south through Kensett, Northwood and Manly. The Iowa Northern Ry. Co. line runs southeast out of Manly, and the Dakota, Minnesota, and Eastern RR Co. line runs southwest through Carpenter and Grafton. **Figure 4-60** shows the railroads that operate in Worth County.

Figure 4-60 Railroad lines in Worth County



Source: Iowa Department of Transportation, http://www.iowadot.gov/iowarail/railroads/maps/maphome.htm

Air Transport

The Mason City Municipal is the primary commercial airport that services Worth County. Within Worth County, the Northwood Municipal Airport, located approximately one mile east of the City of Northwood is owned by the City of Northwood. Local access to the Northwood airport is provided via County Road 105. The Northwood airport does serve as a base of operations for Aerial Chemical Application during mid to late summer.

The Iowa Aviation System Plan identifies the Northwood Municipal Airport as a Local Service airport. General Service airports have runways less than 3,000 feet or have turf runways as the primary runway. Local Service airports generally have limited, if any, airport services that support local aviation activity.

Figure 4-61 Northwood Municipal Airport

Source: Iowa Department of Transportation, http://www.iowadot.gov/aviation/airports/municipal.aspx

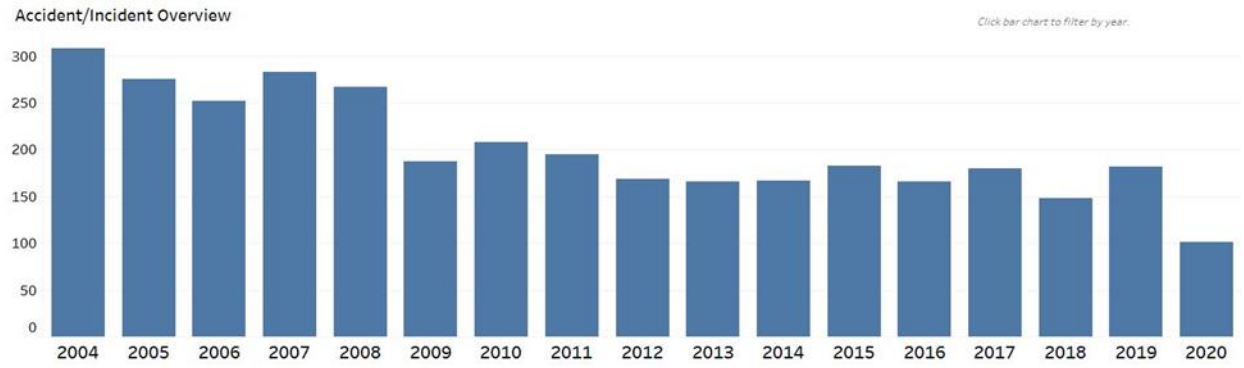
Past Occurrences

Rail Transportation Incidents

Railway transportation incidents involving derailments have become a more common, and dangerous, occurrence with the increased shipment of oil and oil products. The Federal Railway Administration reported 22 railway accidents from 2001-2021 statewide in Iowa. Of these accidents, 18 were highway-rail incidents. From 2018-2021 railway incidents in Iowa led to 1 death, 9 injuries, and $19,715,043 in reportable damages.

Throughout Iowa, rail car traffic has increased but the number of derailments in relationship to the traffic is trending downward according to the Iowa Department of Transportation (see **Figure 4-62**). Iowa has 5,157 public highway-rail crossings in the State on state, city, and county highways.

Figure 4-62 Iowa Railway Accidents/Incidents, 2004-2020



Source: U.S. Department of Transportation Federal Railroad Administration, Overview Reports

Air Transportation Incidents:

Table 4-49 provides details of five air transportation incidents in (or near) Worth County from 1967 to 2023 (50 years) from the National Transportation Safety Board (NTSB).

Table 4-49 Worth County Aircraft Incidents/Accidents (1967-2023)

Event Date	Location	Injury Severity	Aircraft Damage	Make	Broad Phase of Flight
07/26/2023	Hanlontown, IA	Non-Fatal	Substantial	Robinson Helicopter	
08/01/2011	Joice, IA	Non-Fatal	Substantial	Texas Helicopter Corp.	Maneuvering
07/21/2001	Grafton, IA	Fatal (2)	Destroyed	Beech	Cruise
03/20/1973	Hanlontown, IA	Non-Fatal		Bell	
07/15/1972	Northwood, IA	Non-Fatal		Grumman	

Source: http://www.ntsb.gov/_layouts/ntsb.aviation/index.aspx.

Highway Transportation Incidents:

The Iowa Department of Transportation's Office of Traffic and Safety maintains traffic crash statistics and location maps by county and cities in Iowa. **Table 4-50** shows the reportable crash history for urban crashes in Worth County, Iowa from 2007-2015. It should be noted that this table does not include any information beyond 2015 because there was no data specifically categorizing crashes as "urban" beyond this year, however it is all but certain that auto accidents in urban environments have continued to occur since 2015. **Table 4-51** that follows shows the reportable crash history for rural crashes in Worth County for the same time period.

Table 4-50 Worth County Urban Crashes 2007- 2015

Crash Counts/Classification					
Year	Crashes	Fatal	Major	Minor	Poss/Unk
2007	21	0	1	10	3
2008	18	0	0	2	1
2009	20	0	4	1	0
2010	21	0	0	1	4
2011	12	0	0	1	0
2012	7	0	1	0	0
2013	10	0	0	2	0
2014	13	0	0	0	1
2015	9	0	0	0	0
Total	**131**	**0**	**6**	**17**	**9**

Source: https://icat.iowadot.gov/

Table 4-51 Worth County Rural Crashes 2007-2023

Crash Counts/ Classification					
Year	Crashes	Fatal	Major	Minor	Poss/Unk
2007	112	3	5	16	20
2008	121	1	6	16	16
2009	99	2	2	6	17
2010	93	3	1	9	12
2011	87	3	2	10	13
2012	93	6	3	14	13
2013	75	0	5	7	10
2014	92	1	3	6	13
2015	87	2	4	10	11
2016	76	2	2	7	6
2017	100	0	3	19	17
2018	90	2	3	14	10
2019	94	2	1	16	15
2020	88	0	2	10	6
2021	109	3	2	11	6
2022	109	2	5	9	13
2023	75	0	2	20	8
Total	**1,600**	**32**	**52**	**200**	**206**

Source: https://icat.iowadot.gov/

Probability of Future Occurrence

A major transportation incident can occur at any time. Even though traffic engineering, inspection of traffic facilities and land use management of areas adjacent to roads and highways has increased, incidents continue to occur. The combination of cars and trucks, farm equipment, wildlife, unpredictable weather conditions, potential mechanical problems and human error always leaves the potential for a transportation accident.

Based on the available information, the probability of air transportation or highway incident that directly threatens life and which results in property damage and/or death(s)/injury(s) and/or adversely impact a community's capabilities to provide emergency services is **highly likely** with greater than 33 percent likelihood to occur in any given year.

Magnitude/ Severity

Historically, most transportation incidents in Worth County have been at most **negligible** magnitude. However larger and more serious incidents have occurred within Iowa and remain possible in the planning area.

Highway incidents threaten the health and lives of people in the vehicles and pedestrians, as well as the wider vicinity if hazardous materials are involved. Mass casualty events can occur if mass transit vehicles are involved. Community bus and school buses have a good safety record, but accidents can and do occur. Numerous injuries are a realistic possibility in situations involving mass transit vehicles. Property damage would be limited to vehicles and cargo involved; roads, bridges, and other infrastructure; utilities such as light and power poles; and third-party property adjacent to the accident scene such as buildings and yards.

Railway incidents can result in death, injury, and property damage. Deaths and injuries can range from those directly involved, to citizens in the community affected by hazardous materials.

Depending on the materials involved, evacuations may occur, moving residents away from dangerous products and the possibility of explosion. Gases, liquids, and solids can contaminate air, soil, and water in and near the incident scene. If a railway incident occurred in an urban area, the health and welfare of thousands of people could be put in jeopardy. Damage may be limited to the train, railcars, and cargo involved, but it can also include loss of production, business disruption due to evacuations, and business disruptions of those served by the railroad. Business and traffic disruptions could last several days until the clean-up efforts are complete.

Climate Change Considerations

If projections of milder winter materialize, the effects of climate change may lead to a decrease in transportation incidents linked to severe weather conditions. Nonetheless, if ice becomes more prevalent instead of snow, this could potentially lead to an increase in weather-related accidents.

Vulnerability

Transportation incidents can almost always be expected to occur in specific areas, on or near airports, roadways, or other transportation infrastructure. The exception is air transportation incidents, which can occur anywhere. However, it is difficult to predict the magnitude of any specific event because these types of events are accidental and the circumstances surrounding these events will impact the extent of damage or injuries that occur. The number of urban and rural highway/roadway transportation accidents from 2007 to 2023 was a total of 1,731 crashes during this 16-year period. 32 fatalities occurred during this period. Transportation incident has resulted in the most deaths historically in the county compared to other hazards.

Due to the potential for fatalities to occur, this hazard received a magnitude rating of "negligible."

People

Those who use the roadway transportation system are most vulnerable. Travelers, truckers, delivery personnel, and commuters are at risk the entire time they are on the road. During high traffic hours and holidays the number of people on the road in Worth County is higher. Pedestrians and citizens of the community are less vulnerable but still not immune from the impacts of a highway incident.

For railway transportation incidents, people, and property near the railway lines, crossing, sidings, switching stations, and loading/unloading points are most at risk. Those away from railroad tracks and facilities are vulnerable only to large-scale incidents including those in which hazardous materials are involved.

Property

No countywide or jurisdictional loss estimate were calculated due to lack of data. Generally, private property involved in such an event is likely to be insured, while impacts would be smaller, localized, and unlikely to last for a long period of time.

Critical Facilities and Infrastructure

Incidents involving highway accidents could result in injuries, fatalities, closed roads, rerouted traffic, and a strain on the capacity of emergency service personnel who must respond to the incident. In general, all critical facilities in all jurisdictions could be vulnerable to transportation incident. Highway accidents could affect the flow of traffic and ability of residents to travel within and out of the jurisdiction. For those cities vulnerable to railway transportation incidents, large areas of the city could be affected by a train derailment.

Economy

The U.S. Department of Transportation Federal Highway Administration issued a technical advisory in 1994 providing suggested estimates of the cost of traffic crashes to be used for planning purposes. These figures were converted from 2016 dollars to 2023 dollars using the U.S. Bureau of Labor Statistics Consumer Price Index Inflation Calculator. The costs are listed below in **Table 4-52**.

Table 4-52 Costs of a Traffic Crash

Severity	Cost per injury (in 2023 dollars $)
Fatal	$5,733,135.90
Evident Injury	$79,279.26
Possible Injury	$42,027.44
Property Damage Only	$4,410.61

Source: US Department of Transportation Federal Highway Administration Technical Advisory T 7570.2, 2016. Adjusted to 2023 dollars.

Environment and Cultural Resources

Most likely environmental vulnerabilities to transportation incidents would be related to pollution and hazardous materials spills resulting from crashes.

Development Trends

As population increases, the volume of traffic on the county roads, highways and interstates increases as well. With increases in traffic, transportation accidents will likely also increase. The Iowa Department of Transportation, Office of Aviation, has an Aviation System Plan 2010-2030 that makes recommendations for future development of the air transportation system until 2030. The plan describes the role of air transportation for Iowans for moving people and goods. A 2009 Iowa Department of Transportation study determined that the Iowa air transportation system contributes about $5.4 billion a year to Iowa's economy and supports an estimated 47,034 jobs.

(source: http://www.iowadot.gov/aviation/studiesreports/systemplanreports.html)

Risk Summary

Overall, transportation incident hazard is ranked as **Low** for the County.

- There are hundreds of road transportation accidents in the County every year, therefore, probability of future occurrence is ranked as **highly likely**.
- While airplane incidents can occur anywhere in the County, most transportation accidents are most likely to occur along roadways and railways; therefore, geographic area is ranked as **limited**.
- Most transportation incidents in Worth County have been of **negligible** magnitude. However larger and more serious incidents have occurred within Iowa and remain possible in the county.

- The vast majority of deaths from transportation accidents in the County are due to roadway accidents.
- Transportation incidents can disrupt the distribution of goods and delay first responders.
- Related hazards: Infrastructure Failure, Severe Winter Weather, Hazmat Incident

4.4 Hazard Analysis Summary

Table 4-53 below provides a tabular summary of the hazard ranking for each jurisdiction in the planning area.

Table 4-53 Hazard Ranking Summary by Jurisdiction

Jurisdiction	Animal/Plant/Crop Disease	Cyber Attack	Dam/Levee Failure	Drought	Earthquake	Extreme Heat	Flooding (Flash & Riverine)	Grass or Wildland Fire	Hazardous Materials	Human Disease	Infrastructure Failure	Landslide	Radiological Incident	Severe Winter Storm	Terrorism	Thunderstorm/Lightning/Hail	Tornado/Windstorm	Transportation Incident
Worth County, Iowa	L	M	L	M	L	M	H	M	M	M	M	L	L	H	M	H	H	L
City of Fertile	L	M	N/A	M	L	M	H	M	L	M	M	L	L	H	M	H	H	L
City of Grafton	L	M	N/A	M	L	M	M	M	L	M	M	L	L	H	M	H	H	L
City of Hanlontown	L	M	N/A	M	L	M	M	M	M	M	M	L	L	H	M	H	H	L
City of Joice	L	M	N/A	M	L	M	M	M	M	M	M	L	L	H	M	H	H	L
City of Kensett	L	M	N/A	M	L	M	M	M	L	M	M	L	L	H	M	H	H	L
City of Manly	L	M	N/A	M	L	M	H	M	M	M	M	L	L	H	M	H	H	L
City of Northwood	L	M	N/A	M	L	M	H	M	M	M	M	L	L	H	M	H	H	L
Central Springs Schools	N/A	M	N/A	M	L	M	M	M	L	M	L	L	L	H	M	H	H	L
Northwood-Kensett Schools	N/A	M	N/A	M	L	M	M	M	L	M	L	L	L	H	M	H	H	L

5 Mitigation Strategy

44 CFR Requirement §201.6(c)(3):
[The plan shall include] a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools. This section shall include:
(i) A description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.
(ii) 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.
(iii) 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.

This section presents the mitigation strategy updated by the HMPC based on the updated risk assessment. The mitigation strategy was developed through a collaborative group process and consists of updated general goal statements to guide the jurisdictions in efforts to lessen disaster impacts, as well as specific mitigation actions that can be put in place to directly reduce vulnerability to hazards and losses. The following definitions are based upon those found in FEMA's *Local Mitigation Planning Handbook*:

- **Goals** are broad policy statements that explain what the community wants to achieve with the plan.
- **Objectives** are optional strategies to attain the goals and are more specific and measurable.
- **Mitigation Actions** are specific actions that help achieve goals.

5.1 Mitigation Goals and Objectives

The HMPC reviewed the goals and objectives from the 2018 HMP, and determined they still captured what the jurisdictions want to accomplish. The HMPC participated in a facilitated discussion during their third meeting to review and update the plan goals. To ensure that the goals are comprehensive and support State goals, the 2018 State of Iowa Hazard Mitigation Plan goals were reviewed as well. The HMPC also reviewed common categories of mitigation goals from other plans. Ultimately, the HMPC determined that the goals from 2018 still aligned with the needs of the community and chose to carry them forward for the 2024-2029 update as written.

The planning committee determined that all four goals from the previous plan remain valid; no changes were made. The validated plan goals for the Worth County Hazard Mitigation Plan are below:

- Goal 1: Minimize vulnerability of the people and their property in Worth County to the impacts of hazards
- Goal 2: Protect the critical facilities, infrastructure, and other community assets from the impacts of hazards
- Goal 3: Improve education and awareness regarding hazards in risk in Worth County
- Goal 4: Strengthen communication among agencies and between agencies and the public Mitigation Action Status Updates

5.2 Progress on Previous Mitigation Actions

The jurisdictions reviewed and updated the status of each mitigation action identified in the 2018 HMP. Actions were listed as Not Started, In Progress, Continuous Implementation, Completed, or Deleted. As

shown in Table 5-1, of the 59 actions in the 2018 HMP, 4 actions have been completed showing that the jurisdictions are making good progress in implementing mitigation activities. The remaining 55 actions were continued over into the 2024 HMP, along with 14 new actions.

Table 5-1 Completed and Deleted Actions

Jurisdiction	Action #	Mitigation Action	Comments
Worth County	Worth County-13	Mitigate vulnerabilities in county communications system	Completed
Grafton	Grafton-3	Continuity of Operations Plan (COOP). In time of disasters the functions of government must be able to continue. Organization of government operations in time of chaos	Completed. In 2022 COOP was completed. Going forward Grafton will review & revise COOP plan as needed
Joice	Joice-18	Provide generator use for Community Center for citizens who have lost electricity and publicize availability of this resource.	Completed. A total of 1 more generator was purchased for the city. We now have 3.
Kensett	Kensett-4	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems	Completed. Retrofitted well house one/new lift station

5.3 Identification and Analysis of Mitigation Actions

To identify and select mitigation measures to support the mitigation goals, each hazard identified in Chapter 4 was evaluated. The HMPC analyzed a comprehensive set of viable mitigation alternatives for both new and existing buildings and infrastructure that would support identified goals and objectives.

Potential mitigation measures were considered as part of the following six categories:

Prevention: Government administrative or regulatory measures or processes that influence the way land and buildings are developed and built. These measures also include public activities to reduce hazard losses. Examples include:

- Planning and zoning
- Hazard mapping
- Building codes
- Subdivision regulations
- Studies/data collection and analysis to support prevention measures
- Floodplain regulations
- Storm water management regulations
- Multi-jurisdictional agreements that reduce hazard risks
- Other regulatory measures or processes that reduce hazard risks

Property Protection: Measures that involve modifying existing buildings or structures to protect them from a hazard, or removing buildings or structures from the hazard area, or providing insurance to cover potential losses. Examples include:

- Acquisition, elevation, or relocation of hazard-prone property
- Safe room/storm shelter retrofits
- Security retrofits
- Critical facility protection
- Risk reduction retrofits (modifications) to hazard prone properties
- Studies/data collection and analysis to develop property protection measures
- National Flood Insurance Program (NFIP) participation

Structural Projects: Measures that involve the construction and maintenance of structures and infrastructure that will reduce the impact of a hazard or redirect the impact away from people and property. Examples include:

- Channel modification/maintenance
- Dam and reservoir construction/maintenance
- Levee and floodwall construction and maintenance
- Safe room construction
- Infrastructure construction and maintenance – roads and bridges
- Infrastructure construction and maintenance – utility systems
- Infrastructure construction and maintenance – urban and rural drainage systems
- Studies and data collection to develop structural projects

Natural Resource Protection: Measures that, in addition to minimizing hazard losses; preserve or restore the functions of natural systems. Examples include:

- Sediment and erosion control
- Stream corridor restoration, watershed management
- Forest and vegetation management
- Wetland restoration and preservation

Public Education and Awareness: Measures to inform and educate citizens, elected officials, and property owners about the hazards and potential ways to mitigate them. Examples include:

- Programs to improve awareness of hazard risk
- Programs to improve awareness of hazard risk prevention and reduction
- Education programs directed toward specialized audience, i.e., buildings, developers, and hazard prone neighborhoods.

Emergency Services: Measures taken before, during and after a hazard event to protect people, and property; although these measures are not typically considered "mitigation, they significantly minimize the events impact and preserve the community's health and safety. Examples include:

- Emergency/response facilities and personnel
- Hazard warning systems and equipment
- Health/safety/environmental risk prevention/reduction
- Emergency/response infrastructure
- Emergency/response planning
- Emergency/response training
- Emergency/response vehicles, equipment, and protective gear
- Emergency/response services studies and data collection
- Emergency/response communication systems

The HMPC reviewed the hazards and vulnerabilities covered in Section 5, and looked for ways to reduce losses from those hazards by achieving the four A's of mitigation:

- **Alter** the physical nature of the hazard: wildfire defensible space and fuels treatments, snow fences etc.
- **Avert** the hazard away from people, buildings, and infrastructure: engineered solutions, drainage, and channel improvements, floodproofing, fuel breaks.
- **Adapt** to the hazard: land use planning, building codes and design standards, warning systems etc.
- **Avoid** the hazard: natural systems protection, open space, acquisition, or relocation of properties out of hazardous areas.

To facilitate the brainstorming process, the HMPC referred to a matrix of typical mitigation alternatives organized by CRS category for the hazards identified in the plan, in addition to a handout that explains the categories and provided examples. HMPC members were encouraged to develop mitigation alternatives that would protect future, as well as existing, development from hazards per the DMA 2000 regulations. With an understanding of the alternatives, a brainstorming session was conducted to generate a list of preferred mitigation actions. The result was new and updated project ideas with the intent of meeting the identified goals and mitigating identified hazards.

5.3.1 Prioritization Process

The Planning Team discussed a wide range of possible mitigation actions and employed the STAPLEE methodology (see description below) to evaluate and prioritize each proposed action. For each recommended action, the Planning Team developed a project summary that included a description of the action, the department or agency responsible for implementing it, and an estimated timeframe for completion. While STAPLEE provided a template for the Planning Team to evaluate a range of specific mitigation actions and projects, the results of the risk assessment were also considered (i.e., probability and severity of impacts for each hazard). Planning Team members also weighed the pros and cons of proposed actions based on their judgement, subject matter expertise and experience with local hazards.

STAPLEE criteria were used as one method for evaluating the effectiveness of each action item. STAPLEE considers social, technical, administrative, political, legal, economic, and environmental constraints and benefits of a proposed activity.

- **Social:** Does the measure treat people fairly?
- **Technical:** Will it work? Does it solve the problem? Is it feasible?
- **Administrative:** Is there capacity to implement and manage the project?
- **Political:** Who are the stakeholders? Did they get to participate? Is there public support? Is political leadership willing to support the project?
- **Legal:** Does your organization have the authority to implement? Is it legal? Are there liability implications?
- **Economic:** Is it cost-beneficial? Is there funding? Does it contribute to the local economy or economic development? Does it reduce direct property losses or indirect economic losses?
- **Environmental:** Does it comply with environmental regulations or have adverse environmental impacts?

In accordance with the DMA requirements, an emphasis was placed on the importance of a benefit-cost analysis in determining project priority (the economic factor of STAPLEE). Other criteria used to recommend what actions might be more important, more effective, or more likely to be implemented than another included:

- Does the action protect lives?
- Does the action address hazards or areas with the highest risk?
- Does the action protect critical facilities, infrastructure, or community assets?
- Does the action meet multiple goals or address multiple hazards?

At the mitigation strategy meeting, the HMPC reviewed and discussed the STAPLEE considerations to determine which of the identified actions were most likely to be implemented and effective. Prioritization of previous mitigation actions identified in the 2018 HMP that are continuing in the updated plan were revisited during a HMPC meeting. New actions identified during 2023 were also prioritized based on discussions and review with the STAPLEE considerations in mind.

5.3.2 Financial Resources

The availability of funding can play a significant role in the formulation, implementation, and proposed project mitigation actions. There are a wide variety of Federal grant programs that can potentially be used to fund local mitigation activities, to include the following FEMA grants:

- **Hazard Mitigation Grant Program (HMGP):** Post-disaster multi-hazard mitigation funding for federally declared disasters. HMGP Post Fire funds are available for FMAG declarations.
- **Building Resilient Infrastructure & Communities (BRIC):** Pre-disaster/annual cycle addressing all natural hazards, with an emphasis on infrastructure & lifelines.
- **Flood Mitigation Assistance (FMA) Program:** Pre-disaster/annual cycle for repetitive flood loss property reduction and projects that mitigate losses to NFIP insured properties.
- **High Hazard Potential Dam Program (HHPD):** Pre-disaster/annual cycle, for non-Federal dams in Unsatisfactory conditions.

5.3.3 Continue Compliance with the National Flood Insurance Program

As described in Section 4.3.12, Worth County, and the Cities of Fertile, Hanlontown, Joice, Kensett, Manly, and Northwood all participate in the NFIP. All these jurisdictions will continue to participate and comply with NFIP standards. The City of Joice is actively working on joining the NFIP.

Given the flood hazard and risk in the planning area and recognizing the importance of the NFIP in mitigating flood losses, an emphasis is placed on continued compliance with the NFIP by Worth County and all NFIP-participating jurisdictions. As NFIP participants, these communities have and will continue to make every effort to remain in good standing with NFIP. This includes continuing to comply with the NFIP's standards for updating and adopting floodplain maps and maintaining and updating the floodplain zoning ordinance. There are several action items identified in that address specifics related to NFIP continued compliance. Other details related to NFIP participation are noted in Chapter 3 under the Jurisdictional Capabilities Section 3.4 and the flood vulnerability discussion in Section 4.3.8.

5.4 Mitigation Action Plan

This section outlines the development of the updated mitigation action plan. The action plan consists of the specific projects, or actions, designed to meet the plan's goals. As noted in Section 4.2, a number of mitigation activities have already been completed or are in progress. Over time the implementation of new and continuing projects will be tracked as a measure of demonstrated progress on meeting the plan's goals.

The total number of actions identified by each jurisdiction is summarized in Table 5-2, as well as those actions completed, deleted, or continued from the 2018 HMP.

Table 5-2 Mitigation Action Plan Summary

Jurisdiction	2018 Actions	Actions Completed	Actions Deleted	Actions Continued	New Actions	Total Actions
Worth County	10	1	0	9	1	**10**
Fertile	10	0	0	10	0	**10**
Grafton	7	1	0	6	1	**7**
Hanlontown	6	0	0	6	1	**7**
Joice	6	1	0	5	3	**8**
Kensett	7	1	0	6	1	**7**

Jurisdiction	2018 Actions	Actions Completed	Actions Deleted	Actions Continued	New Actions	Total Actions
Manly	6	0	0	6	0	**6**
Northwood	6	0	0	6	1	**7**
Central Springs	1	0	0	1	2	**3**
Northwood-Kensett	1	0	0	1	2	**3**
Total	**60**	**4**	**0**	**56**	**12**	**68**

The results of the project identification and prioritization exercise for each participating jurisdiction are summarized in Table 5-3 through Table 5-11 below. These projects detail specific actions for reducing future hazard-related losses within Worth County. The projects are organized by jurisdiction and include notes about the department and partners necessary to implement the project, estimated cost, potential funding sources, timeline, which goal(s) that the projects support, and their relative level of priority high, medium, and low. The lead agency responsible for each action has been **bolded**.

The Cost Estimate column describes the estimated project costs using the following categories:

- Little to no cost
- Low: Less than $10,000
- Moderate: $10,000-$100,000
- High: $100,000-$1,000,000
- Very High: More than $1,000,000

The Timeline column describes the estimated time of completion for each project using the following categories:

- Short Term: 1-2 years
- Medium Term: 3-5 years
- Long Term: 5+ years
- Ongoing: action is implemented every year

The tables also provide status/implementation notes that describe progress made on the actions so far, using the following categories, and, where applicable, notes if there were changes in the priority level from the previous plan:

- **Not Started:** Work has not begun.
- **In Progress:** Work has begun but not completed.
- **Continuous:** Ongoing annually with no specific end date.
- **Completed:** The action has been finished.
- **Deleted:** The action is no longer relevant due to changing priorities, lack of funds, etc.

The mitigation action summary table presenting the summary of continuing and new mitigation actions for each jurisdiction is provided in Table 5-2. In addition to the 55 actions that were continued from the previous plan, 14 new actions were identified, for a combined total of 69 actions in this updated mitigation strategy. The Action ID for each action is based on jurisdiction and sequential order, with continuing actions numbered first and new actions developed in 2024 numbered last.

Table 5-3 Worth County Mitigation Actions

Action #	Mitigation Action	Hazards Addressed	Lead and Support Agencies	Estimated Cost & Potential Funding	Timeline	Priority	Status & Implementation Notes
Worth County - 1	Public education and awareness of all hazards. By increasing individuals' awareness and preparedness we hope to decrease demand on local resources and improve resiliency of the whole community, creating a more informed and prepared community. Ongoing public information campaigns via social media outlets and the county's website will be continual and focused on seasonally appropriate pamphlets.	Animal/Plant/Crop Disease, Cyber Attack, Dam/Levee, Drought, Earthquake, Extreme Heat, Flooding, Wildland Fire, Hazmat, Human Disease, Infrastructure Failure, Landslide, Radiological, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind, Transportation Incident	**Emergency Management.** Schools, Local Emergency Response Agencies, Law Enforcement, Red Cross, FEMA.	Minimal staff time; County operating budget, Private Non-Profit, programs online to implement (be the help).	Medium Term	High	Ongoing and continuing with revisions as needed.
Worth County - 2	Continuity of Operations Plan (COOP). The County Government needs to have a plan of action to continue to function during times of disaster and damage. A local government that would return to a functional and operational condition in a minimal amount of time	Animal/Plant/Crop Disease, Cyber Attack, Dam/Levee, Drought, Earthquake, Extreme Heat, Flooding, Wildland Fire, Hazmat, Infrastructure Failure, Landslide, Radiological, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind, Transportation Incident	**Board of Supervisors.** EMA, IT/GIS, Dept. Heads.	Minimal staff time; County operating budget.	Short Term	Medium	In progress. Will continue to review and revise as needed.
Worth County - 3	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems. While several improvements have been made in areas others need to continue to upgrade or retrofit systems to provide for service demands that have increased or are vulnerable. Improved capacity, better protection, able to continue operations when power is out	Drought, Flooding, Infrastructure Failure, Thunderstorm	**Board of Supervisors.** County Engineer, Conservation, Community Development.	High; HMGP, BRIC, FMA, County capital budget, Worth County Development Asso.	Long Term	Low	In progress. No major projects or issues at this time.
Worth County - 4	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities. Even though historically Worth County has been subject to violent storms in the past, limited public access to shelters is an issue. Citizens have relied on family and neighbors for shelter. Improved survivability for persons exposed to tornados and storms	Winter Storm, Tornado/Wind, Thunderstorm	**Board of Supervisors.** EMA, Conservation, Local churches, private institutions.	High; HMGP, BRIC, County capital budget, WCDA.	Long Term	Medium	In progress. As or if funding is available

Action #	Mitigation Action	Hazards Addressed	Lead and Support Agencies	Estimated Cost & Potential Funding	Timeline	Priority	Status & Implementation Notes
Worth County - 5	Acquire flood prone properties for conversion into green space; or elevate structures in or above base flood elevation; construction of levees, dams, and culverts to ensure adequate capacity and protection levels for property and critical facilities. River flooding is not a significant life safety, property hazard to residents in the unincorporated parts of Worth County - most vulnerable areas are vacant of dwellings. Reduces potential flood damage exposure.	Flooding	**Board of Supervisors.** EMA, Assessor, GIS.	Moderate; HMGP, BRIC, FMA.	Medium Term	Medium	Not much opportunity for Worth County to do this.
Worth County - 6	Critical infrastructure generator hookups. While Worth County has added backup generators to several facilities not all assessed have a generator dedicated solely to it. Critical infrastructure and facilities that could continue to run.	Animal/Plant/Crop Disease, Cyber Attack, Dam/Levee, Drought, Earthquake, Extreme Heat, Flooding, Wildland Fire, Hazmat, Infrastructure Failure, Landslide, Radiological, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind, Transportation Incident	**Worth County Sheriff's Office.** Board of Supervisors, EMA, Conservation, Recycling Center.	High; HMGP, BRIC, County capital budget, WCDA.	Medium Term	High	In progress. The County has placed stationary backup generators at several of its most critical facilities and communications sites.
Worth County - 7	NFIP participation. Without participation flood losses could go on costing residents significant dollars to rebuild and replace. Flood losses would be reduced	Flooding	**Board of Supervisors.** Assessor's office, IT/GIS, EMA.	High; HMGP, BRIC, FMA.	Medium Term	Medium	In Progress. Worth County continues to participate in the NFIP and requires review and permitting of properties being considered for building in a flood plain.
Worth County - 8	Infrastructure study and improvements. As infrastructure ages it can become unsafe. A regular inspection can detect items that need to be replaced or improved long before they fail. Better planning of replacement cycle, improved safety.	Earthquake, Flooding, Infrastructure Failure	**County Engineer.** Board of Supervisors, IT/GIS, EMA, Secondary Roads.	Very High; HMGP, BRIC, County capital budget.	Long Term	High	In Progress. Program in place that uses 3rd party engineering firm to inspect all bridge structures over 20 feet in length every 2 years for issues.
Worth County - 9	Operation Emergency ALERT. Increase the public's ability to receive warnings and pertinent information from trusted sources.	Animal/Plant/Crop Disease, Cyber Attack, Dam/Levee, Drought, Earthquake, Extreme Heat, Flooding, Wildland Fire, Hazmat, Infrastructure Failure, Landslide, Radiological, Winter Storm, Terrorism,	**EMA**	Moderate; WCDA, EMPG, NOAA NWS	Medium Term	High	Ongoing. Improving the smart 911 system known to the visitors of the county's campgrounds and recreational areas as

Action #	Mitigation Action	Hazards Addressed	Lead and Support Agencies	Estimated Cost & Potential Funding	Timeline	Priority	Status & Implementation Notes
		Thunderstorm, Tornado/Wind, Transportation Incident					well with some simple signage and pamphlets.
Worth County - 10	Campground outdoor warning siren project. Worth County has several parks/campgrounds in areas that are not covered by the outdoor warning sirens located in the cities. Adding a siren with voice capability to those areas would allow for emergency notification of facility users for several hazards.	Dam/Levee, Earthquake, Flooding, Wildland Fire, Hazmat, Infrastructure Failure, Radiological, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind	**Worth County EMA;** Worth County Supervisors, Worth County Conservation, Worth County Sheriff	High; WCDA Grants, County capital budget, HMGP, BRIC	Short Term	High	New in 2024

Table 5-4 City of Fertile Mitigation Action Plan

Action #	Mitigation Action	Hazards Addressed	Lead and Support Agencies	Estimated Cost & Potential Funding	Timeline	Priority	Status & Implementation Notes
Fertile - 1	Public education and awareness of all hazards. People need to know about hazards and how to be ready for them. Informed citizens make better decisions. Partner with Worth County for an ongoing public information campaign via social media outlets and websites will be continual and focused on seasonally appropriate pamphlets.	Animal/Plant/Crop Disease, Cyber Attack, Dam/Levee, Drought, Earthquake, Extreme Heat, Flooding, Wildland Fire, Hazmat, Human Disease, Infrastructure Failure, Landslide, Radiological, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind, Transportation Incident	**City Hall & Staff;** Worth Co EMA, FEMA, IA HSEMD.	Minimal staff time; HMGP, BRIC, FMA, City operating budget, In-Kind, Private Non-Profit.	Ongoing	Medium	In Progress
Fertile - 2	Continuity of Operations Plan (COOP). Loss of leadership and accountability along with line of succession can cripple government's ability to operate and provide needed services. Improved organization and operation of local government.	Radiological, Terrorism, Tornado	**City Hall & Staff;** Worth Co EMA, NIACOG, FEMA, IA HSEMD.	Low; City operating budget.	Medium Term	Medium	In Progress
Fertile – 3	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems. Often times older systems fail when under pressure / times of disasters. Resilient systems that will withstand outside factors.	Drought, Flooding, Infrastructure Failure, Thunderstorm	**City Operations;** City Hall, FEMA.	High; HMGP, BRIC, FMA, City CIP budget.	Long Term	Low	In Progress
Fertile – 4	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities. There is a general lack of shelters / safe rooms for large numbers of people in the City. Safe and secure locations for shelter.	Winter Storm, Tornado/Wind, Thunderstorm	**City Hall;** FEMA.	Moderate; HMGP, BRIC, City operating budget, WCDA.	Long Term	Medium	In Progress
Fertile – 5	Acquire flood prone properties for conversion into green space; or elevate structures in or above base flood elevation; construction of levees, dams, and culverts to ensure adequate capacity and protection levels for property and critical facilities. Repeatedly repairing flood damaged property is costly. Reduced or deleted costs for repeat damage.	Flooding	**City Hall;** Worth Co EMA.	Varies by property, High-Very High; HMGP, BRIC, FMA, City CIP budget.	Long Term	Medium	In Progress
Fertile – 6	Purchase and install generator for City Hall. We use this as our primary shelter site, command center, and animal shelter. Shelter for residents and animals.	Cyber Attack, Earthquake, Extreme Heat, Grass or Wildland Fire, Flooding, Hazardous Materials Incident, Human	**City Hall;** Worth Co EMA.	Moderate; HMGP, BRIC, FMA.	Short Term	High	In Progress

Action #	Mitigation Action	Hazards Addressed	Lead and Support Agencies	Estimated Cost & Potential Funding	Timeline	Priority	Status & Implementation Notes
		Disease, Infrastructure Failure, Landslide, Radiological, Severe Winter Storm, Tornado/Wind, Terrorism, Transportation Incident					
Fertile – 7	Purchase and install generator for Community Center. We use this as our primary shelter area, command center, and animal shelter. Shelter for residents and animals.	Dam/Levee Failure, Extreme Heat, Flooding, Hazardous Materials Incident, Infrastructure Failure, Severe Winter Storm, Tornado/Wind, Transportation Incident	**City Hall;** Worth Co EMA.	Moderate; HMGP, BRIC, FMA.	Short Term	High	In Progress
Fertile – 8	Purchase and install generator for Sewer Plant. If pumps go down at sewer plant this generator would come on and keep sewer from backing up into homes. Avoids sewer backup into homes.	Flooding, Infrastructure Failure, Tornado/Windstorm	**City Hall;** Worth Co EMA.	Moderate; HMGP, BRIC, FMA.	Short Term	High	In Progress
Fertile – 9	Critical infrastructure generator hookups. In order to provide backup generator to critical facilities, City Hall & Community Center would need natural gas line and sewer plant would need LP lines run. Shelter for residents and animals, avoiding sewer backup into homes	Animal/Plant/Crop Disease, Cyber Attack, Dam/Levee, Drought, Earthquake, Extreme Heat, Flooding, Wildland Fire, Hazmat, Infrastructure Failure, Landslide, Radiological, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind, Transportation Incident	**City Hall;** Worth Co EMA.	Low; HMGP, BRIC, FMA.	Short Term	High	In Progress
Fertile – 10	NFIP participation. Floodplain maps for City of Fertile shows homes that need flood insurance; City must continue to participate to remain eligible. Homes that are in flood plain need to have maps for the banks to finance home	Flooding	**Floodplain Manager;** City Hall, Worth Co EMA.	Minimal staff time; HMGP, BRIC, FMA, City operating budget.	Ongoing	High	In Progress

Table 5-5 City of Grafton Mitigation Action Plan

Action #	Mitigation Action	Hazards Addressed	Lead and Support Agencies	Estimated Cost & Potential Funding	Timeline	Priority	Status & Implementation Notes
Grafton - 1	Public education and awareness of all hazards. People need to know about hazards and how to be ready for them. Informed citizens make better decisions. Grafton has been sending out some hazards information in our "Iowa Energizers" inserts in utility bills every quarter.	Animal/Plant/Crop Disease, Cyber Attack, Dam/Levee, Drought, Earthquake, Extreme Heat, Flooding, Wildland Fire, Hazmat, Human Disease, Infrastructure Failure, Landslide, Radiological, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind, Transportation Incident	**Mayor/Council,** City Staff; Worth Co EMA, Worth Co Sheriff, Grafton Fire Dept.	Minimal staff time; City operating budget, In- Kind, Private Non-Profit, WCDA.	Long Term	Medium	In progress. Grafton does send out some hazard information in its "Iowa Energizer" inserts in utility bills every quarter.
Grafton - 2	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems. Drainage system improvements are needed to reduce flood risk. Resilient public water/sewer services	Drought, Flooding, Infrastructure Failure, Thunderstorm	**City Clerk and City Superintendent,** Mayor, Council; FEMA, IA HSEMD, Worth Co EMA	Very High; HMGP, BRIC, FMA, City CIP budget, WCDA.	Long Term	Medium	In Progress. We replaced culverts on 2nd street & 2nd Avenue. We put a new culvert in the ditch on 1st street.
Grafton - 3	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities. Iowa has an ever-increasing number of severe windstorms and tornados; adequate safe space is needed to protect citizens and visitors. Safe space for vulnerable persons	Winter Storm, Tornado/Wind, Thunderstorm	**City Clerk and City Superintendent,** Mayor, Council; FEMA, Worth Co EMA	High; HMGP, BRIC, City CIP budget, WCDA.	Long Term	Low	Not started. Pursuing funding.
Grafton - 4	Acquire flood prone properties for conversion into green space; or elevate structures in or above base flood elevation; construction of levees, dams, and culverts to ensure adequate capacity and protection levels for property and critical facilities. To reduce repeat damage, vulnerable properties need to be removed from floodplains. Elimination of repeat damage and expenses	Flooding	**City Clerk and City Superintendent,** Mayor, Council; FEMA	Very High; HMGP, BRIC, FMA, City CIP budget.	Long Term	Low	Not started.
Grafton - 5	Install and maintain security measures at all critical facilities and training of emergency response personnel. Critical infrastructure has become a target of opportunity for terrorist and thieves. Better protection and security for critical infrastructure	Terrorism	**City Clerk and City Superintendent,** Elected officials; FEMA, IA HSEMD	Moderate; HMGP, BRIC, FMA, City operating budget.	Long Term	Low	Not started.
Grafton - 6	Implement natural resource measures to prevent damage to critical facility functions. Critical facilities can be exposed to many hazards.	Animal/Plant/Crop Disease, Cyber Attack, Dam/Levee, Drought, Earthquake, Extreme Heat, Flooding, Wildland Fire, Hazmat,	**City Clerk and City Superintendent,** elected officials;	Moderate; HMGP, BRIC, FMA, City operating budget, In-	Long Term	Low	Not started.

Action #	Mitigation Action	Hazards Addressed	Lead and Support Agencies	Estimated Cost & Potential Funding	Timeline	Priority	Status & Implementation Notes
		Infrastructure Failure, Landslide, Radiological, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind, Transportation Incident	FEMA, Worth Co EMA, Worth Co Conservation, Grafton Fire Dept.	Kind, Private Non-Profit, WCDA.			
Grafton - 7	Removal of ash trees on city property. Due to high tree mortality from the emerald ash borer, ash trees in the city need to be cut down before they fall and damage infrastructure, such as roads, culverts, utility lines, etc.	Tornado/Wind, Thunderstorms, Winter Storm	**City Clerk and City Superintendent;** Worth County Conservation	Moderate; City operating budget	Long Term	Medium	New in 2024

Table 5-6 City of Hanlontown Mitigation Action Plan

Action #	Mitigation Action	Hazards Addressed	Lead and Support Agencies	Estimated Cost & Potential Funding	Timeline	Priority	Status & Implementation Notes
Hanlontown - 1	Public education and awareness of all hazards. People need to know about hazards and how to be ready for them. Informed citizens make better decisions. Partner with Worth County for an ongoing public information campaign via social media outlets and websites will be continual and focused on seasonally appropriate pamphlets.	Animal/Plant/Crop Disease, Cyber Attack, Dam/Levee, Drought, Earthquake, Extreme Heat, Flooding, Wildland Fire, Hazmat, Human Disease, Infrastructure Failure, Landslide, Radiological, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind, Transportation Incident	**City Hall;** Worth Co EMA, FEMA.	Minimal staff time; City operating budget.	Short Term	High	In Progress. Social media posts, bulletin boards in public spaces, fliers in utilities bills
Hanlontown - 2	Continuity of Operations Plan (COOP). A prepared council is an effective council. Prepared City Hall	Animal/Plant/Crop Disease, Cyber Attack, Dam/Levee, Drought, Earthquake, Extreme Heat, Flooding, Wildland Fire, Hazmat, Infrastructure Failure, Landslide, Radiological, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind, Transportation Incident	**City Hall;** Worth Co EMA, FEMA.	Minimal staff time; City operating budget.	Short Term	High	In Progress. Basic plan in place, working to improve and add details.
Hanlontown - 3	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems. In case of power outage, water supply is maintained. In case of power outage fire department can still get water	Drought, Flooding, Infrastructure Failure, Thunderstorm	**Mayor, City Hall;** WCDA, FEMA.	Low; HMGP, BRIC, FMA, City operating budget, Private Non-Profit.	Short Term	High	In Progress. Standby generator for pump house is on order.
Hanlontown - 4	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities. City needs a safe place for residents and visitors to take shelter. Not determined.	Tornado/Wind, Thunderstorm	**City Hall;** None.	Minimal staff time; City operating budget, Private Non-Profit.	Short Term	Low	Not started due to lack of funding.
Hanlontown - 5	Critical infrastructure generator hookups. In case of power outage, City Hall and Fire & Rescue can operate as normal. City Hall / Fire Rescue	Animal/Plant/Crop Disease, Cyber Attack, Dam/Levee, Drought, Earthquake, Extreme Heat, Flooding, Wildland Fire, Hazmat, Infrastructure Failure, Landslide, Radiological, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind, Transportation Incident	**City Hall, Mayor;** WCDA.	Moderate; Private Non-Profit.	Short Term	High	In Progress. City Hall and Fire Station have backup power; generator for pump house is on order.

Action #	Mitigation Action	Hazards Addressed	Lead and Support Agencies	Estimated Cost & Potential Funding	Timeline	Priority	Status & Implementation Notes
Hanlontown - 6	NFIP participation. City must stay in compliance with the NFIP requirements. Continued eligibility for flood insurance coverage	Flooding	**City Council, Mayor**	Minimal staff time; City operating budget.	Ongoing	High	In Progress. City continues to participate.
Hanlontown - 7	Removal of diseased ash trees and dead trees. Falling trees can damage infrastructure, cause power outages, and injure people.	Animal/Plant/Crop Disease, Winter Storm, Thunderstorm, Tornado/Wind	**City Council, Mayor**	$10,000/year; City operating budget.	Long Term	Medium	New in 2024

Table 5-7 City of Joice Mitigation Action Plan

Action #	Mitigation Action	Hazards Addressed	Lead and Support Agencies	Estimated Cost & Potential Funding	Timeline	Priority	Status & Implementation Notes
Joice - 1	Continuity of Operations Plan (COOP). The city needs a Continuity of Operations Plan to ensure that procedures are in place for disaster preparedness and response and that the City's critical facilities will be able to operate as needed during an emergency.	Animal/Plant/Crop Disease, Cyber Attack, Dam/Levee, Drought, Earthquake, Extreme Heat, Flooding, Wildland Fire, Hazmat, Infrastructure Failure, Landslide, Radiological, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind, Transportation Incident	**City Council;** Fire Department, First Responders, other departments.	Low; City operating budget.	Medium Term	High	In Progress. Will be working with Worth County to develop a plan specific for our city.
Joice -2	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems. The city needs to continue with preventive maintenance to the drainage system to ensure it functions properly in managing stormwater to prevent flooding. property damage from flooding avoided	Drought, Flooding, Infrastructure Failure, Thunderstorm	**Public Works**	Moderate; City operating budget.	Ongoing	High	In Progress. Replaced drainage title on two streets so far.
Joice - 3	Field Fires. Dry weather conditions can cause field fires and put city residents in danger. 110 build structures and 200 plus lives	Grass/Wildland Fire	**Fire Department and Emergency Management;** Area fire departments, sheriff department.	High; HMGP, BRIC, FMA, City CIP budget, In-Kind, grants.	Medium Term	High	In Progress. We have a new emergency siren to alert residents of danger and would also use Worth County's notification of emergencies in place.
Joice - 4	Hazardous Materials Incident. Spill at 5 Star Coop or Gavilon Grain. Loss of life or physical harm	Hazmat	**Fire Dept. and First Responders;** City.	Low; HMGP, BRIC, FMA, City operating budget, Elevator and Fertilizer Plant.	Short Term	High	In Progress. Fire department receives training on these emergencies
Joice - 5	Snow fence on Lake Street, north side of city. Throughout the winter months there is a lot of pile up and drifting of snow on the northern most street of Joice. A snow fence will help and has helped in the past for the road filling up and closing. Save on street cleaning for the city and residents along that street	Drought, Winter Storm	**Maintenance;** County Maintenance if too much snow.	Minimal staff time; City operating budget.	Short Term	Medium	In Progress. Snow fence is installed on the north field across from Lake Street, approved by the landowner, by city maintenance and removed in the spring.

Action #	Mitigation Action	Hazards Addressed	Lead and Support Agencies	Estimated Cost & Potential Funding	Timeline	Priority	Status & Implementation Notes
Joice - 6	Public education and awareness of all hazards. People need to know about hazards and how to be ready for them. Informed citizens make better decisions by mailing information in their monthly newsletter as to how residents can be informed.	Animal/Plant/Crop Disease, Cyber Attack, Dam/Levee, Drought, Earthquake, Extreme Heat, Flooding, Wildland Fire, Hazmat, Human Disease, Infrastructure Failure, Landslide, Radiological, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind, Transportation Incident	**City Council, City Administration; Worth County EM,** FEMA, IA HSEMD	Minimal staff time; City operating budget.	Short Term	Medium	New in 2024
Joice - 7	Solar panel installation. Install and maintain solar panel system at city water plan to provide renewable energy to all necessary equipment	Cyber Attack, Earthquake, Flooding, Infrastructure Failure, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind	**City Council, City Administration;** Worth County EM, FEMA, IA HSEMD	High; City CIP budget, HMGP, BRIC, FMA	Short Term	Medium	New in 2024
Joice - 8	Install and maintain security measures, such as cameras, at all critical facilities. In the last 5 years the city has installed some expensive equipment in the two newest buildings: the Community Center and City Hall/Library. These could be a target for theft, as well as sabotage.	Cyber Attack, Terrorism	**City Administration;** All city staff, Law Enforcement Agencies	Moderate; City operating budget, HMGP, BRIC, FMA	Short Term	Medium	New in 2024

Table 5-8 City of Kensett Mitigation Action Plan

Action #	Mitigation Action	Hazards Addressed	Lead and Support Agencies	Estimated Cost & Potential Funding	Timeline	Priority	Status & Implementation Notes
Kensett - 1	Public education and awareness of all hazards. People need to know about hazards and how to be ready for them. Informed citizens make better decisions. Partner with Worth County for an ongoing public information campaign via social media outlets and websites will be continual and focused on seasonally appropriate pamphlets.	Animal/Plant/Crop Disease, Cyber Attack, Dam/Levee, Drought, Earthquake, Extreme Heat, Flooding, Wildland Fire, Hazmat, Human Disease, Infrastructure Failure, Landslide, Radiological, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind, Transportation Incident	**City Hall & Staff;** Worth Co EMA, FEMA, IA HSEMD.	Minimal staff time; HMGP, BRIC, FMA, City operating budget, In-Kind, Private Non-Profit.	Ongoing	Medium	In progress. Put up shelter location signage.
Kensett - 2	Continuity of Operations Plan (COOP). Loss of leadership and accountability along with line of succession can cripple government's ability to operate and provide needed services. Improved organization and operation of local government	Earthquake, Hazardous Materials Incident, Human Disease, Infrastructure Failure, River Flooding, Severe Winter Storm, Tornado/Windstorm, Transportation Incident	**City Hall & Staff;** Worth Co EMA, NIACOG, FEMA, IA HSEMD.	Low; City operating budget.	Medium Term	Medium	In progress. Repaired tornado siren.
Kensett - 3	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities. There is a general lack of shelters / safe rooms for large numbers of people in the City. Safe and secure locations for shelter	Drought, Flooding, Infrastructure Failure, Thunderstorm	**City Hall;** FEMA.	Moderate; HMGP, BRIC, FMA, City operating budget, WCDA.	Long Term	Medium	Not Started. Where to find funding to cover high costs of construction
Kensett - 4	Acquire flood prone properties for conversion into green space; or elevate structures in or above base flood elevation; construction of levees, dams, and culverts to ensure adequate capacity and protection levels for property and critical facilities. Repeatedly repairing flood damaged property is costly. Reduced or deleted costs for repeat damage	Flooding, Dam/Levee Failure, Sinkholes	**City Hall;** FEMA, Worth Co EMA.	Will be case by case; HMGP, BRIC, FMA, City CIP budget.	Long Term	Low	In progress. State repaired drainage at maple.
Kensett - 5	Install and maintain security measures at all critical facilities and training of emergency response personnel. Critical facilities are vulnerable to damage. Secure facilities	Animal/Plant/Crop Disease, Cyber Attack, Dam/Levee, Drought, Earthquake, Extreme Heat, Flooding, Wildland Fire, Hazmat, Infrastructure Failure, Landslide, Radiological, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind, Transportation Incident	**City Hall;** FEMA, Law enforcement.	Moderate; HMGP, BRIC, FMA, City operating budget.	Long Term	Low	In progress. Purchased cameras and need to install.

Action #	Mitigation Action	Hazards Addressed	Lead and Support Agencies	Estimated Cost & Potential Funding	Timeline	Priority	Status & Implementation Notes
Kensett - 6	Natural resource measures to prevent the damage to critical facility functions. Critical facilities are exposed to lots of hazards. Uncertain	Animal/Plant/Crop Disease, Cyber Attack, Dam/Levee, Drought, Earthquake, Extreme Heat, Flooding, Wildland Fire, Hazmat, Infrastructure Failure, Landslide, Radiological, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind, Transportation Incident	**City Hall;** Worth Co EMA, Worth Co Conservation, FEMA, Kensett Fire Department.	Moderate; HMGP, BRIC, FMA, City operating budget, WCDA.	Medium Term	Low	Not started. Lack of funding with small town budget.
Kensett - 7	Removal of abandoned/dilapidated properties. Removal of 6 properties that contain vermin that can cause a risk to public health and safety.	Animal/Plant/Crop Disease, Wildfire, Hazmat, Human Disease	**City Hall;** 28E agreement with Mason City to condemn and remove properties	High - $20,000 per property; City CIP budget	Medium Term	High	New in 2024

Table 5-9 City of Manly Mitigation Action Plan

Action #	Mitigation Action	Hazards Addressed	Lead and Support Agencies	Estimated Cost & Potential Funding	Timeline	Priority	Status & Implementation Notes
Manly - 1	Public education and awareness of all hazards. People need to know about hazards and how to be ready for them. Informed citizens make better decisions. Partner with Worth County for an ongoing public information campaign via social media outlets and websites will be continual and focused on seasonally appropriate pamphlets.	Animal/Plant/Crop Disease, Cyber Attack, Dam/Levee, Drought, Earthquake, Extreme Heat, Flooding, Wildfire, Hazmat, Human Disease, Infrastructure Failure, Landslide, Radiological, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind, Transportation Incident	**City Administration**	Minimal staff time; City operating budget	Short Term	High	In Progress
Manly - 2	Continuity of Operations Plan (COOP). This will allow the city to perform in the event of a disaster. to allow for normal daily operations in each emergency	Extreme Heat, Flooding, Infrastructure Failure, Severe Winter Storm, Thunderstorm/ Lightning/Hail, Tornado/Windstorm	**City Administration** County EMS	Low; HMGP, BRIC, FMA, City operating budget, WCDA	Medium Term	High	In Progress
Manly - 3	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems. To allow for storm water and sewage to be moved quickly from the city. As our sanitary and storm systems are aging and need to be replaced or repaired. Prevent sewage and storm water from backing up into homes.	Flash Flood, River Flooding, Infrastructure Failure	**City Administration**	High; HMGP, BRIC, FMA, WCDA	Medium Term	High	In Progress
Manly – 4	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities. Would allow for shelters needed in areas where community activities would be held. Would allow for a larger number of people to seek shelter. Allow for public safety.	Extreme Heat, Flash Flood, Infrastructure Failure, River Flooding, Severe Winter Storm, Thunderstorm/ Lightning/Hail, Tornado/Windstorm	**City Administration,** School, Manly Care Center	High; HMGP, BRIC, FMA, City CIP budget, WCDA	Medium Term	High	In Progress
Manly - 5	Critical infrastructure generator hookups. This will allow the city to perform daily duties as needed without interruption. Also to act as possible command center if needed. To allow for normal daily operations	Infrastructure Failure	**City Administration**	Moderate; WCDA	Short Term	Medium	In Progress
Manly - 6	NFIP participation. The City of Northwood has participated with NFIP since 8/1/87. Last map was 8/2/12. The city will continue to ensure compliance with the NFIP.	Flooding	**Floodplain Administrator;** FEMA NFIP	Minimal staff time; City operating budget	Short Term	Medium	In Progress

Table 5-10 City of Northwood Mitigation Action Plan

Action #	Mitigation Action	Hazards Addressed	Lead and Support Agencies	Estimated Cost & Potential Funding	Timeline	Priority	Status & Implementation Notes
Northwood - 1	Public education and awareness of all hazards. People need to know about hazards and how to be ready for them. Informed citizens make better decisions. Partner with Worth County for an ongoing public information campaign via social media outlets and websites will be continual and focused on seasonally appropriate pamphlets.	Animal/Plant/Crop Disease, Cyber Attack, Dam/Levee, Drought, Earthquake, Extreme Heat, Flooding, Wildland Fire, Hazmat, Human Disease, Infrastructure Failure, Landslide, Radiological, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind, Transportation Incident	**City Administration,** Schools, County Emergency Management	Minimal staff time; City operating budget	Medium Term	Medium	Not Started
Northwood - 2	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems. Preventive maintenance on water and sewer plants. The city has built a new sewer plant.	Drought, Flooding, Infrastructure Failure, Thunderstorm	**Northwood Public Works;** City Administration	Very High; City CIP budget	Medium Term	Medium	Not Started
Northwood - 3	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities. A safe room for the public	Winter Storm, Tornado/Wind, Thunderstorm	**Northwood Public Works;** City Administration, County Emergency Management	Very High; HMGP, BRIC	Long Term	Medium	Not Started
Northwood - 4	Acquire flood prone properties for conversion into green space; or elevate structures in or above base flood elevation; construction of levees, dams, and culverts to ensure adequate capacity and protection levels for property and critical facilities. Keep citizens in flood prone areas safe and out from the potential flooding of home	Flooding, Dam/Levee Failure, Sinkholes	**Northwood Public Works;** City Administration, NFIP	High; HMGP, BRIC, FMA	Long Term	Low	Not Started
Northwood - 5	Critical infrastructure generator hookups. The city purchased a generator to be used on all water, sewer, and other City buildings if needed in an emergency. The city will review if additional generators are needed.	Animal/Plant/Crop Disease, Cyber Attack, Dam/Levee, Drought, Earthquake, Extreme Heat, Flooding, Wildland Fire, Hazmat, Infrastructure Failure, Landslide, Radiological, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind, Transportation Incident	**Northwood Public Works;** City Administration	Low; City operating budget	Short Term	Medium	Not Started
Northwood - 6	NFIP participation. The City of Northwood has participated with NFIP since 8/1/87. Last map was	Flooding	**City Administration;** FEMA NFIP	Minimal staff time; City operating budget, FMA	Medium Term	Medium	Not Started

Action #	Mitigation Action	Hazards Addressed	Lead and Support Agencies	Estimated Cost & Potential Funding	Timeline	Priority	Status & Implementation Notes
	8/2/12. The city will continue to ensure compliance with the NFIP.						
Northwood - 7	Northwood Tornado Shelters. The City will identify locations where shelters are needed and feasible, assess those sites for suitability to include accessibility and backup power, and implement improvements as needed.	Tornado/Wind, Thunderstorm	**City Administration;** County EMA	Moderate; City CIP budget	Short Term	Medium	New in 2023

Table 5-11 Public School District Mitigation Action Plans

Action #	Mitigation Action	Hazards Addressed	Lead and Support Agencies	Estimated Cost & Potential Funding	Timeline	Priority	Status & Implementation Notes
Northwood-Kensett - 1	Ensure that the school buildings' cooling systems remain operational during periods of extreme heat. During periods of extreme heat, residents will need to use the school buildings as cooling centers. Preservation of life for residents without A/C	Extreme Heat	**Superintendent's office;** Local law enforcement and emergency responders	High; HMGP, BRIC, Operating budget	Medium Term	High	In Progress
Northwood-Kensett - 2	Generators for school buildings. Purchase and install generators for key school buildings to ensure operations during power outages.	Cyber Attack, Dam/Levee, Earthquake, Extreme Heat, Flooding, Wildland Fire, Infrastructure Failure, Landslide, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind	**Superintendent's office;** Worth County EMA	Very High; HMGP, BRIC	5 years	High	New in 2024
Northwood-Kensett - 3	Public education and awareness campaign for students and families. People need to know about hazards and how to be ready for them. Informed citizens make better decisions. Partner with Worth County for an ongoing public information campaign via social media outlets and websites, supplemented by seasonally appropriate pamphlets.	Animal/Plant/Crop Disease, Cyber Attack, Dam/Levee, Drought, Earthquake, Extreme Heat, Flooding, Wildland Fire, Hazmat, Human Disease, Infrastructure Failure, Landslide, Radiological, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind, Transportation Incident	**Superintendent's office;** County Emergency Management. Local Emergency Response Agencies, Red Cross, FEMA.	Minimal staff time; Operating budget, Private Non-Profit, programs online to implement (be the help).	Medium Term	Low	New in 2024
Central Springs - 1	Tornado Saferoom Project. Current locations do not meet FEMA guidelines and standards for saferooms; schools use restrooms and locker rooms currently for tornado safety. Locations for saferooms in each location are picked out. Project will add saferooms to two sites. This will promote life safety	Tornado/Windstorm	**Superintendent's office;** School staff, Worth County Development Authority (WCDA)	Very High; HMGP, BRIC, Capital budget, WCDA	Medium Term	Low	Not Started. Financial feasibility
Central Springs - 2	Purchase and install backup generators. The ability to install a backup generator would allow schools to be a safe environment for the community if there were power outage issues.	Cyber Attack, Earthquake, Extreme Heat, Flooding, Infrastructure Failure, Landslide, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind	**Superintendent's office;** Worth County EMA	High; HMGP, BRIC, Operating budget, WCDA	Medium Term	Medium	New in 2024
Central Springs - 3	Public education and awareness campaign for students and families. People need to know about hazards and how to be ready for them. Informed citizens make better decisions. Partner with Worth County for an ongoing public information campaign via social media outlets and websites, supplemented by seasonally appropriate pamphlets.	Animal/Plant/Crop Disease, Cyber Attack, Dam/Levee, Drought, Earthquake, Extreme Heat, Flooding, Wildland Fire, Hazmat, Human Disease, Infrastructure Failure, Landslide, Radiological, Winter Storm, Terrorism, Thunderstorm, Tornado/Wind, Transportation Incident	**Superintendent's office;** County Emergency Management. Local Emergency Response Agencies, Red Cross, FEMA.	Minimal staff time; Operating budget, Private Non-Profit, programs online to implement (be the help).	Medium Term	Low	New in 2024

6 Plan Maintenance Process

DMA Requirement §201.6(c)(4)(ii):
[The plan shall include] a plan maintenance process that includes: *(i) A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.* *(ii) A process by which local governments incorporate the requirements of the mitigation plan into other planning 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.* *(iii) Discussion on how the community will continue public participation in the plan maintenance process.*

This chapter provides an overview of the overall strategy for plan maintenance and outlines the method and schedule for monitoring, updating, and evaluating the plan. The chapter also discusses incorporating the plan into existing planning mechanisms and how to address continued public involvement.

6.1 Monitoring, Evaluating, and Updating the Plan

6.1.1 Hazard Mitigation Planning Committee (HMPC)

With adoption of this plan, the HMPC will continue to be tasked with plan monitoring, evaluation, and maintenance. The participating jurisdictions and agencies, led by the Worth County Emergency Management Coordinator, agree to:

- Meet annually to review the Hazard Mitigation Plan;
- Act as a forum for hazard mitigation issues;
- Disseminate hazard mitigation ideas and activities to all participants;
- Pursue the implementation of high priority, low- or no-cost recommended actions;
- Maintain vigilant monitoring of multi-objective, cost-share, and other funding opportunities to help the community implement the plan's recommended actions for which no current funding exists;
- Monitor and assist in implementation and update of this plan;
- Keep the concept of mitigation in the forefront of community decision making by identifying plan recommendations when other community goals, plans, and activities overlap, influence, or directly affect increased community vulnerability to disasters;
- Report on plan progress and recommended changes to the Worth County Board of Supervisors and governing bodies of participating jurisdictions; and
- Inform and solicit input from the public.

The HMPC is an advisory body and can only make recommendations to county, city, town, or district elected officials. Its primary duty is to see the plan successfully carried out and to report to the community governing boards and the public on the status of plan implementation and mitigation opportunities. Other duties include reviewing and promoting mitigation proposals, hearing stakeholder concerns about hazard mitigation, passing concerns on to appropriate entities, and posting relevant information in areas accessible to the public.

6.1.2 Plan Maintenance Schedule

The HMPC agrees to meet annually to monitor progress, discuss recent hazard events and changes in development that impact vulnerability, and update the mitigation strategy. The Worth County Emergency Management Coordinator will be responsible for initiating the plan reviews.

In coordination with the other participating jurisdictions, a written update of the plan will be submitted to the Iowa Homeland Security and Emergency Management Department and FEMA Region VII for approval within the required five-year cycle per Requirement §201.6(c)(4)(i) of the DMA of 2000, unless disaster or other circumstances (e.g., changing regulations) require a change to this schedule. During the third interim annual meeting, the HMPC will outline steps to begin the next plan update process so that the effort can be completed during year four and five; this will ensure there is time for completion, approval, and re adoption within the five-year time frame.

6.1.3 Plan Maintenance Process

Evaluation of progress can be achieved by monitoring changes in vulnerabilities identified in the plan. Changes in vulnerability can be identified by noting:

- Decreased vulnerability as a result of implementing recommended actions,
- Increased vulnerability as a result of failed or ineffective mitigation actions, and/or
- Increased vulnerability as a result of new development (and/or annexation).

The annual reviews and updates to this plan will:

- Consider changes in vulnerability due to action implementation,
- Document success stories where mitigation efforts have proven effective,
- Document areas where mitigation actions were not effective,
- Document any new hazards that may arise or were previously overlooked,
- Incorporate new data or studies on hazards and risks,
- Incorporate new capabilities or changes in capabilities,
- Incorporate growth and development-related changes to inventories, and • Incorporate new action recommendations or changes in action prioritization.

To best evaluate the mitigation strategy during plan review and update, the participating jurisdictions will follow the following process:

- A representative from the responsible office identified in each mitigation action will be responsible for tracking and reporting the action status on an annual basis to the jurisdictional HMPC member and providing input on any completion details or whether the action still meets the defined objectives and is likely to be successful in reducing vulnerabilities.
- If the action does not meet identified objectives, the jurisdictional HMPC member will determine what additional measures may be implemented, and an assigned individual will be responsible for defining action scope, implementing the action, monitoring success of the action, and making any required modifications to the plan.
- As part of the annual review process, the Worth County Emergency Management Coordinator will provide the updated Mitigation Strategy with the current status of each mitigation action to the County Board of Supervisors and County Department Heads as well as all Mayors, City Clerks, and School District Superintendents requesting that the mitigation strategy be incorporated, where appropriate in other planning mechanisms.

Modifications to the plan will occur to address actions that have either failed or are deemed impractical after a thorough assessment of their alignment with established criteria, time constraints, community priorities, and available funding resources. Additionally, actions with lower rankings that were identified as potential mitigation measures will undergo a reevaluation during the monitoring and update processes of this plan to assess their feasibility for future implementation. Updates to the plan will be made through written changes and submission, as deemed suitable and necessary by the Worth County HMPC and will require approval from both the Worth County Board of Supervisors and the governing boards of other participating jurisdictions.

6.2 Incorporation into Existing Planning Mechanisms

Many of the small jurisdictions in Worth County do not have standing formal planning mechanisms such as a Comprehensive Plan or Capital Improvement Plan through which formal integration of mitigation actions can be documented. As a result, activities that occur in these small communities are developed through annual budget planning, regular City Council Meetings, and other community forums rather than a formal planning process. Planning mechanisms that do exist to some degree within the participating jurisdictions include:

- Comprehensive Plans;
- Various ordinances of participating jurisdictions, including floodplain management ordinances in NFIP-participating communities;
- Capital Improvement Plans.

For a detailed summary of planning mechanisms and other mitigation-related capabilities, see Chapter 2.

6.2.1 Incorporation of Updated Hazard Mitigation Plan into existing Planning Mechanisms

Where possible, plan participants will use existing plans and/or programs to implement hazard mitigation actions. After the annual review of the Hazard Mitigation Plan, the Worth County Emergency Management Coordinator will provide the updated Mitigation Strategy with the current status of each mitigation action to the County Board of Supervisors and County Department Heads as well as all Mayors, City Clerks, and School District Superintendents requesting that the mitigation strategy be incorporated, where appropriate in other planning mechanisms.

Table 6.1 provides additional details on each jurisdiction regarding how the 2018 Hazard Mitigation Plan was integrated into existing planning mechanisms as well as the strategy going forward to integrate this plan update into existing planning mechanisms.

Table 6.1 Integration of Previous Plan and Strategies to Integrate Plan Update

Jurisdiction	Incorporation of 2018 Plan into Existing Planning Mechanisms	Integration Process for Plan Update
Worth County	Plan will be incorporated into changes of the Comprehensive Plan and the Continuity of Government Plan; mitigation actions will be reviewed as the County implements drainage, bridge, and new County construction plans	The plan will be incorporated into local mitigation plans and future infrastructure projects.

Jurisdiction	Incorporation of 2018 Plan into Existing Planning Mechanisms	Integration Process for Plan Update
Fertile	Plan was incorporated into the Emergency Operations Plan and the five-year improvement plan.	The plan will continue to improve the City's infrastructure plan.
Grafton	The plan was incorporated with infrastructure projects and local/county Emergency Plan	The plan will continue to incorporate infrastructure plans and public education/awareness.
Hanlontown	None reported.	The plan will incorporate with future infrastructure projects.
Joice	The plan incorporated with the City's Comprehensive Plan.	The plan update will continue to be incorporated with the developments.
Kensett	The plan was incorporated with the infrastructure projects.	The plan update will continue to improve infrastructure projects.
Manly	The plan was incorporated into the Comprehensive Plan and the City's infrastructure Plan.	The plan will continue to be integrated in comprehensive planning and capital improvements planning.
Northwood	None reported.	The plan will incorporate Comprehensive/Land Use plan and improvements to local/county emergency plans.
Central Springs CSD	The plan updated its Capital Improvement and School Emergency Plans.	The plan will incorporate its Capital Improvement.
Northwood-Kensett CSD	The plan incorporated capital improvement and infrastructure projects.	The plan will continue to be integrated in comprehensive planning and capital improvements planning.

6.3 Continued Public Involvement

The public will be involved in the plan maintenance process by publication of a Press Release after each annual review indicating the committee has met with a summary of mitigation action status updates and highlights of specific completed mitigation actions, as applicable. The public will be invited to provide comments on HMPC meeting outcomes and/or attend HMPC meetings.

The update process provides an opportunity to publicize success stories from the plan's implementation and seek additional public comment. When the HMPC reconvenes for the update, it will coordinate with all stakeholders participating in the planning process, including those who joined the HMPC after the initial effort, to update and revise the plan. Public notice will be posted through available website postings, community message boards, and social media outlets.

The public will be involved in the plan maintenance process by including a member of the press to attend the annual review where he will be able to report that the committee has met with a summary of mitigation action status updates and highlights of specific completed mitigation actions, as applicable. The public will be invited to provide comments on HMPC meeting outcomes and/or attend HMPC meetings. The update process provides an opportunity to publicize success stories from the plan's implementation and seek additional public comment. When the HMPC reconvenes for the update, it will coordinate with all stakeholders participating in the planning process, including those who joined the HMPC after the initial

effort, to update and revise the plan. Public notice will be posted through available website postings, community message boards, and social media outlets and local newspapers. Efforts will be made to include nontraditional populations such as minorities and anabaptist religion-based communities.

Appendix A: Worth County Hazard Mitigation Planning Committee (HMPC) Membership and Stakeholder Participation

Jurisdictional and Stakeholder Representatives That Attended Meetings

First Name	Last Name	Title	Department	Jurisdiction/Organization
Ken	Abrams	Supervisor	Board of Supervisors	Worth County
Jacki	Backhaus	Auditor		Worth County
Merlin	Bartz	Supervisor	Board of Supervisors	Worth County
John	Bork	Mayor	Grafton FD	Grafton
Dan	Fank	Sheriff		Worth County
Keith	Fritz	Principal	NK Schools	Northwood-Kensett CSD
Scott	Heagel	City Council		Manly
Ray	Huftalin	Coordinator	Worth County Emergency Management	Worth County
Randy	Hulshizer	City Council		Grafton
Kris	Kerison	Reporter		Northwood Anchor, Inc.
Doug	Moehle	Mayor		Northwood
Corey	Pulju	Mayor		Kensett
Joel	Rohne	Technology Director		Worth County
Joyce	Russell	Mayor		Fertile
Rick	Scholbrock	Mayor		Hanlontown
Mark	Smeby	Supervisor	Board of Supervisors	Worth County
Duane	Tabbert	Asst Fire Chief	Grafton FD	Grafton

Stakeholder Representatives Invited to Participate

First Name	Last Name	Title	Agency	Type
Tony	Loeser	Water Resources Engineer	Iowa State University, Iowa Flood Center	Academia
Andy	Buffington	Emergency Management Coordinator	Winnebago County EM	Adjacent County
Eric	Whipple	Emergency Management Coordinator	Cerro Gordo County EM	Adjacent County
Ray	Huftalin	Emergency Management Coordinator	Mitchell County EM	Adjacent County
Amy	Lammey	Emergency Management Director	Mower County, Minnesota EM	Adjacent County
Kurt	Freitag	Emergency Management Director	Freeborn County, Minnesota EM	Adjacent County
Melissa	Michaelis	Executive Director	Northwood Chamber of Commerce and Winnebago and Worth Counties Betterment Council	Business Group*

First Name	Last Name	Title	Agency	Type
Tom	Taylor	Program Coordinator	EPA/Water Resources Protection Branch	Federal Agency
Joe	Chandler	Senior Planner	FEMA Region VII	Federal Agency
Jeff	Johnson	Lead Forecaster	NWS	Federal Agency
Jeff	Zogg	Senior Service Hydrologist	NWS	Federal Agency
Andrew	Leichty	Project Manager	USACE Rock Island District	Federal Agency
Steve	Russell	Assistant Chief, Operations Division	USACE Rock Island District	Federal Agency
Jerry	Skalak	Project Manager	USACE Rock Island District	Federal Agency
Rob	Middlemis-Brown	Geololgist	USGS	Federal Agency
Blake	Severson	Preparedness Coordinator	Service Area 2 Health Care Coalition	Nonprofit*
Jay	Knox	Executive Director	Safeguard Iowa	Nonprofit *
Anna	Miller	Adult Service Coordinator	Care Connections of Northern Iowa	Nonprofit *
Terri	Sculley	Pantry Manager	Manna of Worth County	Nonprofit *
Terry	Jensen	Bureau Chief	Dept of Ag & Land Stewardship	State Agency
Scott	Ralston	Floodplain Mapping Coordinator	DNR	State Agency
Casey	Welty	Dam Safety Engineer	DNR, Dam Safety Program	State Agency
Gail	Kantak	Wildland Fire Supervisor	DNR-Forestry	State Agency
Mathew	Noble	State Hazard Mitigation Officer	Iowa Homeland Security and Emergency Management	State Agency
Jack	Stinogel	Hazard Mitigation Planner	Iowa Homeland Security and Emergency Management	State Agency

* Groups that work with or represent underserved communities and vulnerable populations

Appendix B: Planning Process Documentation

Planning Committee Kickoff Meeting, June 29, 2023

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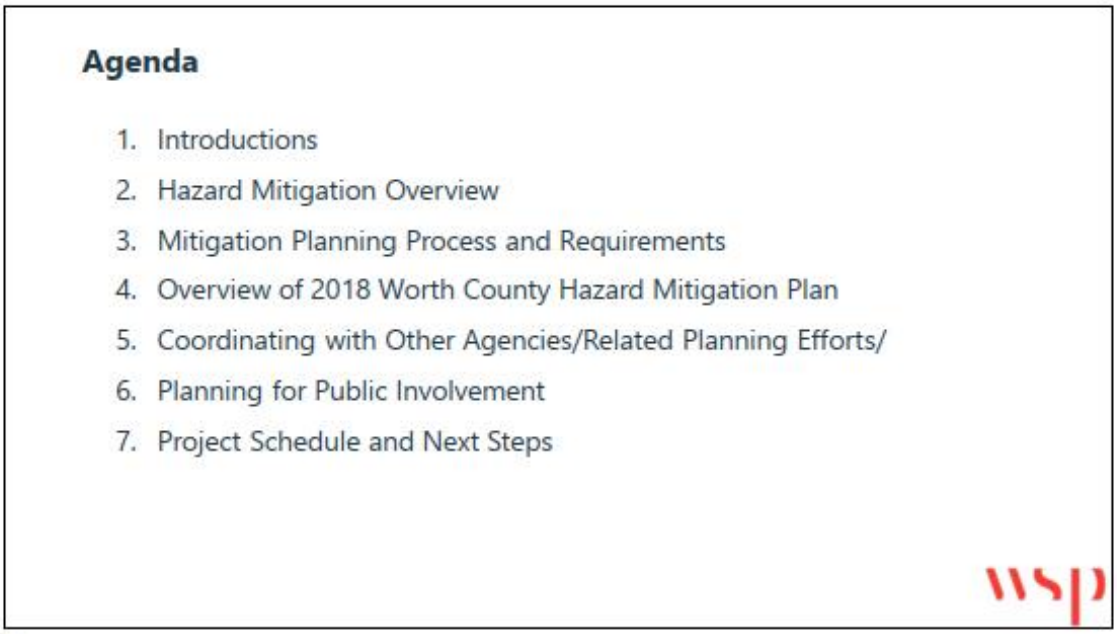

2

Planning Committee Meeting #2, September 14, 2023

WORTH
County · Iowa

Worth County Hazard Mitigation Plan Update

Hazard Mitigation Planning Committee Meeting #2 – Risk Assessment

September 14, 2023 – 7:00 pm- 9:00 pm CDT

Please enter your name, title, and organization in the chat.

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Agenda

- Introductions
- Planning Process Update
- Hazard Identification and Risk Assessment Update
- Mitigation Capability Assessment Update
- Review of Mitigation Goals
- Next Steps

WORTH
County · Iowa

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Planning Committee Meeting #3, November 2, 2023

WORTH County · Iowa

Worth County Iowa 2023 Hazard Mitigation Plan Update

Hazard Mitigation Planning Committee Meeting #3 – Mitigation Strategy Update

November 2, 2023
7:30-9:30 p.m. CST

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Agenda

1. Introductions
2. Planning process update
3. Review of mitigation goals
4. Progress on 2018 mitigation actions
5. Mitigation action categories and alternatives
6. Development of new mitigation actions
   - Brainstorming Activity
7. Prioritizing mitigation actions
   - Prioritization Activity
8. Plan implementation and maintenance
9. Next steps

WORTH County · Iowa

wsp

2

Meeting handouts are shown on the following pages.

Mitigation Action Selection and Prioritization Criteria

- Does the proposed action protect lives or vulnerable populations?
- Does the proposed action address hazards or areas with the highest risk?
- Does the proposed action protect critical facilities, infrastructure, or community assets?
- Does the proposed action meet multiple objectives (multi-objective management)?
- Is there a strong advocate for the action or project that will support the action's implementation?

STAPLE/E

Developed by FEMA, this method of applying evaluation criteria enables the planning team to consider in a systematic way the social, technical, administrative, political, legal, economic, and environmental opportunities and constraints of implementing a particular mitigation action. For each action, the HMPC should ask, and consider the answers to, the following questions:

Social - Does the measure treat people fairly (different groups, different generations)? Does it consider social equity, disadvantaged communities, or vulnerable populations?

Technical - Will it work? (Does it solve the problem? Is it feasible?)

Administrative - Is there capacity to implement and manage project?

Political - Who are the stakeholders? Did they get to participate? Is there public support? Is political leadership willing to support it?

Legal - Does your organization have the authority to implement? Is it legal? Are there liability implications?

Economic - Is it cost-beneficial? Is there funding? Does it contribute to the local economy or economic development? Does it reduce direct property losses or indirect economic losses?

Environmental - Does it comply with environmental regulations or have adverse environmental impacts?

1

wood.

Example Mitigation Action Items

Alternative Mitigation Actions	Dam Failure	Floods	Hazardous Materials	Drought	Weather Extremes (hail, lightning, temps,)	Wind/ Tornado	Wildland Fires	Severe Winter Storm
PREVENTION								
Building codes and enforcement		■	■	■	■	■	■	■
Comprehensive Watershed Tax		■						
Density controls	■	■	■				■	
Design review standards		■	■	■		■	■	
Easements		■	■				■	
Environmental review standards		■	■				■	
Floodplain development regulations	■	■	■					
Hazard mapping	■	■	■				■	
Floodplain zoning	■	■	■					
Forest fire fuel reduction			■				■	
Housing/landlord codes			■	■	■			
Slide-prone area/grading/hillside development regulations							■	
Manufactured home guidelines/regulations		■			■	■		
Minimize hazardous materials waste generation			■					
Multi-Jurisdiction Cooperation within watershed	■	■		■				
Open space preservation	■	■					■	
Performance standards	■	■		■	■	■	■	■
Periodically contain/remove wastes for disposal			■					
Pesticide/herbicide management regulations			■					
Special use permits	■	■	■				■	
Stormwater management regulations		■	■					
Subdivision and development regulations	■	■	■	■		■	■	
Surge protectors and lightning protection					■			
Tree Management				■	■	■	■	■
Transfer of development rights		■					■	
Utility location			■		■	■		■

PROPERTY PROTECTION								
Acquisition of hazard prone structures	■	■					■	
Facility inspections/reporting	■	■	■					
Construction of barriers around structures	■	■	■					
Elevation of structures	■	■						
Relocation out of hazard areas	■	■	■				■	
Structural retrofits (e.g., reinforcement, floodproofing, bracing, etc.)		■	■	■	■	■	■	■
PUBLIC EDUCATION AND AWARENESS						■		
Debris Control		■				■		
Flood Insurance	■	■						
Hazard information centers	■	■	■	■	■	■	■	■
Public education and outreach programs	■	■	■	■	■	■	■	■
Real estate disclosure	■	■	■		■		■	■
Crop Insurance				■	■			
Lightning detectors in public areas					■			
NATURAL RESOURCE PROTECTION								
Best Management Practices (BMPs)		■	■	■	■		■	
Forest and vegetation management	■	■		■	■		■	■
Hydrological Monitoring	■	■	■	■	■			
Sediment and erosion control regulations	■	■	■	■				
Stream corridor restoration		■						
Stream dumping regulations		■	■					
Urban forestry and landscape management		■		■	■		■	■
Wetlands development regulations		■	■				■	
EMERGENCY SERVICES								
Critical facilities protection	■	■	■	■	■	■	■	■
Emergency response services	■	■	■		■	■	■	■
Facility employee safety training programs	■	■	■		■	■	■	■
Hazard threat recognition	■	■	■	■	■	■	■	■
Hazard warning systems (community sirens, NOAA weather radio)	■	■	■		■	■	■	■
Health and safety maintenance	■	■	■	■	■	■	■	■
Post-disaster mitigation	■	■	■	■	■	■	■	■
Evacuation planning	■	■	■				■	

2

STRUCTURAL PROJECTS								
Channel maintenance		■						
Dams/reservoirs (including maintenance)	■	■						
Isolate hazardous materials waste storage sties			■					
Levees and floodwalls (including maintenance)		■						
Safe room/shelter					■	■		■
Secondary containment system			■					
Site reclamation/restoration/revegetation		■	■	■				
Snow fences								■
Water supply augmentation				■	■			

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Federal Mitigation Grants

Agency	Grant	Purpose of Funding
BIA	Tribal Wildfire Prevention	Provides leadership, training and guidance to develop strategies to reduce the number of human caused fires on Indian Reservations. The Fuels Management Program provides funding to reduce hazardous vegetation both in and outside the WUI.
Bureau of Reclamation	Water2025 Challenge Grant Program for Western States	Up to $250,000 for projects that can be completed within 24 months and that reduce conflicts through water conservation, efficiency, and markets
Bureau of Reclamation	Water Conservation Field Services Program	Up to $25,000 for projects that improve water use efficiency and improve water management practices
Bureau of Reclamation	WaterSMART – Drought Response Program	Provides for contingency planning, resiliency projects, and emergency response actions.
CDC	Public Health Emergency Preparedness (PHEP) Cooperative Agreement	Helps health departments build and strengthen their abilities to effectively respond to a range of public health threats, including infectious diseases, natural disasters, and biological, chemical, nuclear, and radiological events. Preparedness activities funded by the PHEP cooperative agreement specifically target the development of emergency-ready public health departments that are flexible and adaptable.
Corporation for National & Community Service	AmeriCorps	Provides funding for volunteers to serve communities, including disaster prevention. AmeriCorps/Vista has assisted local communities with wildfire mitigation projects.
Department of Homeland Security	Homeland Security Grant Program (HSGP)	Homeland security activities identified in the state and local strategic plans. Funding supports threat & hazard and risk identification for natural, technological, and human-caused hazards. Some prevention activities may be considered mitigation.
Department of Homeland Security	State and Local Cybersecurity Grant Program (SLCGP)	Better equip state, local, and tribal gov'ts to address cybersecurity risks, strengthen the cybersecurity of their critical infrastructure, and ensure resilience against persistent cyber threats for the services SLT governments provide their communities.
DOJ, OJP	US Department of Justice (DOJ) Office of Justice Programs (OJP)	DOJ-ODP provides a number of grants and awards focused on crime prevention to state and local law enforcement agencies and other eligible recipients.
EPA	Clean Water Act Section 319 Grants	Provides grants for a wide variety of activities related to non-point source pollution runoff mitigation.
FEMA	Assistance to Firefighters program - Fire Prevention & Safety (FP&S) Grants	Fire Prevention & Safety (FP&S) Grants support projects that enhance the safety of the public and firefighters from fire and related hazards.
FEMA	Building Resilient Infrastructure & Communities (BRIC)	Pre-disaster/annual cycle addressing all natural hazards, emphasis on infrastructure & lifelines
FEMA	Emergency Management Performance Grant (EMPG)	The EMPG program provides a yearly allocation of funding to support state and local emergency management programs. This has included providing some funding for local mitigation plans, mitigation-oriented studies, and related activities.

As of 12/8/2022

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Federal Mitigation Grants

Agency	Grant	Purpose of Funding
FEMA	Fire Management Assistance Grants (FMAG)	Provides fire suppression support to states when loss of life and property are imminent. Wildfire mitigation is also eligible under emergency protection if life is in imminent danger.
FEMA	Flood Mitigation Assistance (FMA) Program	Repetitive flood loss property reduction and projects that mitigate losses to NFIP insured properties.
FEMA	Hazard Mitigation Grant Program (HMGP)	Post-disaster multi-hazard mitigation funding for federally-declared disasters. HMGP Post Fire funds are available for FMAG declarations.
FEMA	High Hazard Potential Dam Program (HHPD)	Pre-disaster/annual cycle, for non-Federal high hazard dams rated Unsatisfactory. Local match varies.
FEMA	National Earthquake Hazards Reduction Program (NEHRP)	Provides money to support enhanced earthquake risk assessments in local hazard mitigation plans and other earthquake hazard mitigation and preparedness activities.
FEMA, NFIP	Community Assistance Program (CAP)	Product-oriented financial assistance program directly related to the flood loss reduction objectives of the NFIP.
FEMA, NFIP	Risk MAP Program	Establishes or updates floodplain mapping and multi-hazard risk products.
FEMA	Individual Assistance (IA)	Following a disaster, funds can be used to mitigate hazards when repairing individual and family homes.
FEMA	Public Assistance (PA) Section 406 funds	Following a disaster, funds can be used to mitigate hazards when repairing damages to a public structure or infrastructure. Wildfire mitigation is also eligible under emergency protection if life is in imminent danger.
FHWA	Highway Bridge Replacement and Rehabilitation Program	Provides funding to enable states to improve the condition of highway bridges through replacement, rehabilitation and systematic preventive maintenance. Also includes the National Historic Covered Bridge Preservation Program.
FHWA	Surface Transportation Block Grant (STBG) Program	This program replaces the former Transportation Enhancement (TE) and Transportation Alternatives Program (TAP) grants. STBG provides funding for transportation alternatives and environmental mitigation projects.
HUD	Community Development Block Grant – Disaster Recovery (CDBG-DR)	Often following a disaster, the state may receive a CDBG-DR Supplement intended for mitigation and disaster recovery projects in the affected areas. Funding can be used to acquire properties in hazard prone areas. Since CDBG funds lose their federal identify they can also be used to supplement state or local match requirements on other funds such as FEMA HMA grants. Funding also supports public facilities including water and wastewater.
HUD	Various grants	Provides a number of grants related to safe housing initiatives.
NIFC	Rural Fire Assistance Grant	Funds fire mitigation activities in rural communities.
NOAA	Hydrologic Research Grants	Up to $125,000 to conduct joint research and development on pressing surface water hydrology issues common to national, regional, local operational offices. Eligible applicants are federally recognized agencies of state or local governments, quasi-public institutions such as water supply or power companies, hydrologic consultants and companies involved in using and developing hydrologic forecasts.

As of 12/8/2022

Federal Mitigation Grants

Agency	Grant	Purpose of Funding
NOAA - NWS	National Weather Service (NWS)	NWS offers storm spotter training, along with weather and flooding safety guides. They can also sometimes provide funding to support severe weather signage in parks or other public places.
SBA	Pre-Disaster Mitigation Loan Program	Provides low-interest loans to small businesses for mitigation projects.
U.S. DOC, EDA	Economic Development Administration Grants and Investments	Invests and provides grants for community construction projects, including mitigation activities.
US DOT - FHWA	Emergency Relief (ER) Program	Provides funds for roads and bridges on Federal-aid highways that are damaged as a direct result of a natural disaster or catastrophic failure from an external cause.
USACE	In-Lieu Fee Program Mitigation Projects	Restoration, establishment, enhancement, and/or preservation of aquatic resources through funds paid to a governmental or non-profit natural resources management entity to satisfy compensatory mitigation requirements for Department of the Army permits.
USACE	Mitigation Banks*	Mitigation Banks are sites approved by the Corps to sell compensatory mitigation credits for projects resulting in unavoidable impacts to waters of the U.S. When a permit is issued that requires compensatory mitigation, the permit will specify how many credits are required to be purchased at an approved mitigation bank.
USACE	Planning Assistance to States	Provides assistance to states in planning for the development, utilization, and conservation of water and related land resources.
USACE	Small Flood Control Projects (USACE Section 205)	Authorizes use of USACE to do feasibility and construction of small flood control projects
USACE	Silver Jackets	Can provide funding for flood related studies, public awareness, risk analysis, and flood response plans. Construction of small flood control projects.
USCG	United States Coast Guard (USCG)	USCG administers two grant programs designed to promote boating safety.
USDA	Community Fire Protection Program	Mitigation delivered via USDA Forest Service and Private Forestry Coop Fire Program.
USDA	Emergency Community Water Assistance Grants	$150,000 to $500,000 available to rural communities with populations over 10,000 people with a median household income less than $65,900. Provides assistance to communities who have experienced a decline in quantity or quality of drinking water as a result of an emergency including drought.
USDA	Watershed Processes and Water Resources	$100,000 available. Sponsors research that address two areas: (1) understanding fundamental watershed processes; and (2) developing appropriate technology and management practices for improving the effective use of water (consumptive and nonconsumptive) and protecting or improving water quality for agriculture and forestry production
USDA	Watershed Processes and Water Resources – National Research Initiative Standard Research (Part T)	$500,000 available. Innovative research in understanding fundamental processes that affect the quality and quantity of water resources at diverse spatial and temporal scales, ways on improving water resource management in agriculture, forested, and rangeland watersheds, and developing appropriate technology to reach those goals.

Federal Mitigation Grants

Agency	Grant	Purpose of Funding
USDA, DOI	National Fire Plan	Provides pre-disaster funding for primarily wildland fire mitigation, but also planning for all hazards.
USDA, NRCS	Emergency Watershed Protection (EWP)	Provides funding and technical assistance for emergency measures such as floodplain easements in impaired watersheds. Funding available through the Simplified Acquisition Procedures (SAP) ranges from $25K to $100K. Funded through contracts between project sponsors and the NRCS. There are no grants. The NRCS pays 75% of the costs.
USDA, NRCS	Environmental Quality Incentives Program (EQUIP)	Provides funding and technical assistance to farmers and ranchers to promote agricultural production and environmental quality as compatible goals.
USDA, NRCS	Forest Land Enhancement Program	Provides educational, technical, and financial assistance to help landowners implement sustainable forestry management objectives
USDA, NRCS	NRCS Conservation Programs	Provides funding through a number of programs for the conservation of natural resources.
USDA-Rural Development	Rural Development Grants	Provides grants and loans for infrastructure and public safety development and enhancement in rural areas. Provides $100,000 or 75% of the total project, whichever is less.
USDA-Rural Development	Rural Utilities Service (RUS)	RUS administers programs that provide much-needed infrastructure or infrastructure improvements to rural communities. These include water and waste treatment, electric power and telecommunications services.
USFS	Forest Legacy Program	Program providing funding to protect private forest lands that are environmentally, economically, and socially critical. This program reduces development in the wildland-urban interface.
USFWS	National Wildlife Wetland Refuge System	Provides funding for the acquisition of lands into the federal wildlife refuge system.
USFWS	North American Wetland Conservation Fund	Provides funding for wetland conservation projects.
USFWS	Partners for Fish and Wildlife	Provides financial and technical assistance to landowners for wetland restoration projects in "Focus Areas" of the state.
USGS	State Water Resources Research Act Program	USGS in cooperation with the National Institutes for Water Resources supports an annual call for proposals to focus on water problems and issues that are of a regional or interstate nature or relate to a specific program priority identified by the Secretary of the Interior and the Institutes.
USGS	United States Geological Survey (USGS)	USGS issues competitive grants and cooperative agreements to support research in earthquake hazards, the physics of earthquakes, earthquake occurrence, and earthquake safety policy.

Worth County 2023 Hazard Mitigation Plan Update
New Mitigation Action Worksheet

Use this sheet to record new potential mitigation projects (1 form per project) identified during the planning process. Provide as much detail as possible and use additional pages as necessary.

Mitigation Action/Project Title	
Project Description, Issue/Background/Benefit	
Hazards Mitigated (Include all that apply)	
Goal(s) Addressed	
Priority (High, Medium, Low)	
Lead Agency and Partners	
Timeline for Completion	
Cost Estimate	
Potential Funding	
Which infrastructure lifelines does this project address?	

Prepared by: _____
Jurisdiction: _____
Title/Dept: _____
Phone: _____
Email: _____

Please return worksheets by email to:
Scott Field
scott.field@wsp.com
Phone: 563 581-4283

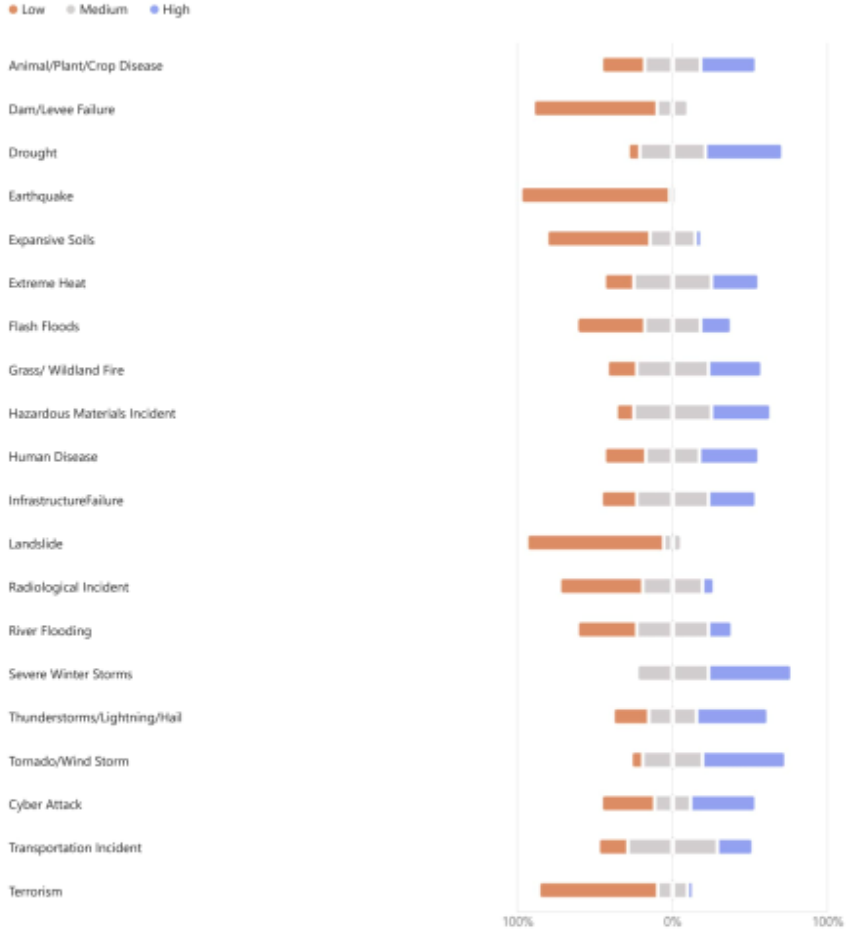
Public Survey Responses

10/22/24, 2:49 PM Worth County Hazard Planning Public Input Survey

Responses Overview Closed

Responses	Average Time	Duration
27	11:02	407 Days

1. The hazards addressed in the Worth County Hazard Mitigation plan update are listed below. Please indicate the level of significance in Worth County that you perceive for each hazard.



2. How many times has a natural hazard disrupted your daily life in the last five years?

Feedback

10/22/24, 2:49 PM Worth County Hazard Planning Public Input Survey

3. Do you have information on specific hazard issues/problem areas that you would like the planning committee to consider? Note the jurisdiction to which it applies:

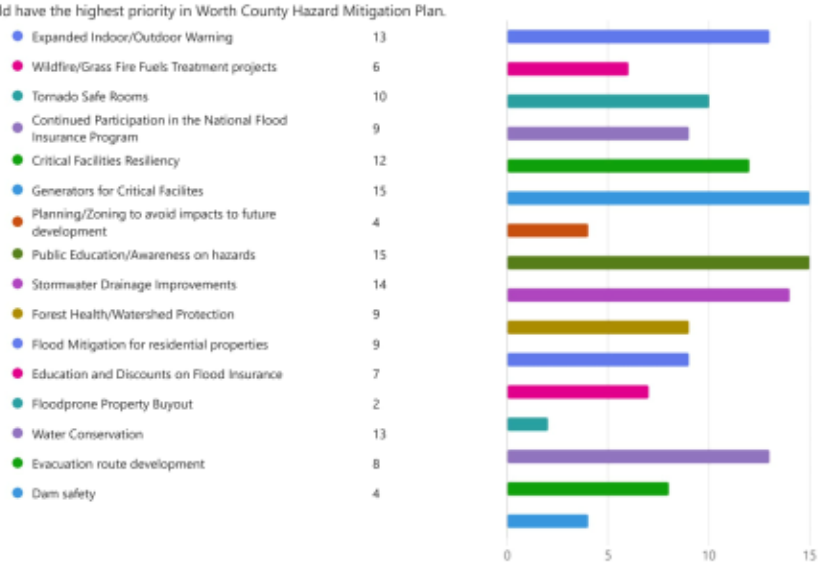
10
Responses

Latest Responses
...

4 respondents (40%) answered county for this question.

4. Mitigation is actions that can be taken to reduce or eliminate the long-term risk to hazards.

The following types of mitigation actions may be considered in Story County. Please indicate the types of mitigation actions that you think should have the highest priority in Worth County Hazard Mitigation Plan.



5. Please comment on any other pre-disaster strategies that the planning committee should consider for reducing future losses caused by natural disasters:

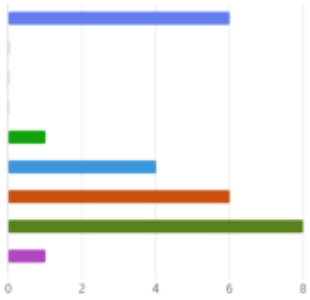
2
Responses

Latest Responses
...

10/22/24, 2:49 PM Worth County Hazard Planning Public Input Survey

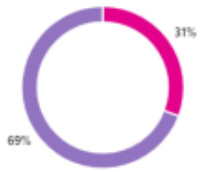
6. Please Indicate the community where you live

City of Fertile	6
City of Grafton	0
City of Hanlontown	0
City of Joice	0
City of Kensett	1
City of Manly	4
City of Northwood	6
Unincorporated Worth County	8
Other	1



7. How long have you lived in this community?

Less than 1 year	0
1-5 years	8
5-10 years	0
Over 10 years	18



8. Optional: Provide your name and email address if you would like to be added to a distribution list for upcoming activities related to the planning process:

7
Responses

Latest Responses
"dickmackin56@gmail.com"
...

Public Comments on the Draft Worth County HMP

Public comments on the draft 2024 Worth County HMP	Where do you live?
You included electrical substation for Northwood but missed all the others both in communities and county.	Unincorporated Worth County
Your draft addresses hazardous material risk as it now stands. This does nothing to address the risk if the carbon capture pipeline comes into Worth county. Our fire departments do not have electric vehicles and air packs necessary to make rescues possible in the areas that would be impacted by a leak. They want to bury them 3-5 feet underground and we have all seen tractors buried that deep. Ground shifts, frost boils and they feel a 300 foot setback from residences is adequate. In cold weather the gas doesn't dissipate and will put lives at risk up to four miles from the leak. We need to have equipment and training if this misuse of our tax monies is allowed to occur.	Unincorporated Worth County
The Poet plant in Hanlontown has intentions of hooking into the proposed Summit CO2 pipeline. This would indicate the need to plan for hazard identification and planning for a probable future hazard event. Page 133 of the plan mentions hazardous material pipelines but fails to delineate the dangers endemic specifically to a CO2 pipeline. I can not find any sections of this plan that address this future building/infrastructure hazard. There are several identified regulatory gaps in dealing with pipelines that carry high pressure dense phase CO2. "Standards for pipe carrying CO2 are being updated by the Pipeline and Hazardous Materials Safety Administration (PHMSA) under the Department of Transportation (DOT)." "Codes such as ASME B31. 8, ASME B31. 4, IP6, BS EN 14161, BS PD 8010, and DNV OSF101 may be applicable to pipelines transporting CO2, but they do not explicitly include transportation of anthropogenic CO2 in supercritical/dense/ liquid phase.Mar 12, 2024 CO2 PiPeline SyStem DevelOPment anD DeSign - ASME Digital Collection " I strongly believe that any hazardous mitigation plan should account for a probable CO2 pipeline failure incident as happened in Satartia, Mississippi. There should be more of a plan than cordoning off any affected area by local fire departments. A mitigation plan that represents future construction of infrastructure and transportation pipelines should be a valuable tool to be utilized by the county supervisors in planning and zoning for future housing developments and necessary setbacks needed from applicable plume studies. Supercritical CO2 pipelines which are sensitive to temperature and pressure changes along their route, need monitoring/telemetry for temperature, pressure and flow rates, for H2O contamination, frequent recompression stations, safety valves and safety shutdown systems. The pipelines may rupture explosively. The high concentrations of CO2 can cause asphyxiation to humans and damage to ecosystems. As is, this plan is insufficient for the planned development of the Summit CO2 pipeline to the Hanlontown Poet ethanol plant and the safety of the people of Worth County.	Unincorporated Worth County
This doesn't address the hazards made possible by the upcoming CO2 pipeline. Our Volunteers need electric vehicles, training and SCBA gear when, not if, there is a leak.	Unincorporated Worth County

Public Outreach

Wednesday, July 12, 2023 - No. 28

Northwood, IA 50459

Northwood namesakes

The annual Fourth of July festivities included the naming of young people as Miss and Mr. Northwoods, and their younger counterparts. The ceremony was once again hosted by Northwood's favorite MC, Dewey Krager, and organized by Northwood Chamber event organizer Teresa George-Zenz. Pictured are the winners of this year's contest. The 2023 royalty includes (seated, from left) Junior Miss Northwood Hallie Hanson, Little Miss Northwood Solara Navratil, Little Mr. Northwood Zander Duvall, Miss Northwood Haddie Hanson, (standing) Junior Mr. Northwood Kale Bode and Mr. Northwood Grady Buenzow.

Work begins on local county Hazard Mitigation Plan update

Representatives of local government in Worth County met recently to begin the process of updating plans for how they would utilize their community resources in response to a variety of emergency situations.

The information is contained in each government's Hazard Mitigation Plan (HMP). The document is used as a plan for how to respond to emergencies and disasters, and a list of the resources and community connections that are available in those situations.

Updated HMPs are also required by the federal government in order to qualify for emergency funding.

Besides making sure Worth County and its communities qualify for funding, the plan helps those in the county prepare for hazards that affect more than just one city, school or rural area, helps share costs and resources in preparing mitigation efforts, helps avoid duplicating efforts amongst those involved; and improves the coordination between the local governments.

Representatives of several Worth County cities, schools and the county itself took part in the recent meeting.

Each community is required to update their Hazard Mitigation Plan every five years to be eligible for funds.

The process of updating the plan includes building a team of representatives from the local governments in the plan, including school districts and cities, as well as the county as a whole. Other steps involve informing the public of the process and getting their input at various steps along the way; reviewing community capabilities; conducting risk assessments; developing mitigation strategies; and reviewing and adopting the plan.

Leading the discussion was Scott Field, from WSP USA, a firm that guides similar updating processes.

Goals set by the county's existing plan include minimizing the vulnerabilities of residents and facilities in the county, protecting critical infrastructure and assets, improving education and awareness of hazards in the county and strengthening communication among agencies and the public in regard to hazards.

Hazard mitigation plans include specific information on a variety of hazards, including how much warning people would have and how long the hazardous conditions would last; where they are most likely to occur; how often they've occurred in the past; how

Hazard. See Page 2

The Northwood Anchor

Wednesday, September 20, 2023 · No. 38

Northwood, IA 50459

14 Pages

Tie vote leaves alcohol service age at 18 in Northwood

Despite a change in state laws, those under 18 years old will remain unable to serve alcohol in the city of Northwood, following stalled action at the most recent council meeting.

Amongst new state laws passed this year in the Iowa legislature was one that lowered the age of the youngest people that could legally serve alcohol, from 18 to as young as 16.

With new state legislation in place, the City of Northwood works with a company to update City codes and ordinances to match the State changes.

That typically means little discussion as the City updates its codes to accommodate State Law.

The server age change has raised more concerns amongst some on the Council.

At the previous council meeting on August 28, a first reading of an ordinance to update the City's code to allow those 16 and over to serve alcohol was on the table.

The reading passed with a vote of 3-2. Council members Teresa George-Zenz, Steve Peterson and Dave Tenold voted to pass the first reading. Council members Dan Reeder and Gary Nerlien opposed.

At the September 11 meeting of the council, a second reading was on the agenda.

Nerlien revisited his concerns. He said that it's their jobs as adults to protect children from things, saying who knows what may happen if they work at bars.

Nerlien said that he was not in favor of lowering the age at all. He said he didn't like what the

Vote, See Page 2

The Northwood city council last week officially approved the intersection of Highway 65 and Sixth Avenue North as a school crossing.

Next week is Homecoming at N-K

Northwood-Kensett will celebrate the Viking spirit with Homecoming set for next week.

The annual events will once again include a week of dress up days. Monday will be a day to dress as a favorite Adam Sandler character. Tuesday will be PJ Day on Tuesday night time vs. night out day, with the option of wearing favorite pajamas or dress clothes for a night out on the town. Class Color Day on Wednesday will have seniors in black, juniors in blue, sophomores in red, freshmen in pink, eighth grade in green, seventh grade in orange, sixth grade in yellow and staff in purple. Thursday is Ken and Barbie Day. Friday is Spirit Day.

The Elementary School will have their own Dress Up Days for Homecoming, with Team Day on Monday, Favorite Color Day on Tuesday, followed by the Power Puff Football Game at 7:30 p.m. Friday's activities will

N-K, See Page 2

Governor signs harvest proclamation

Last week, Iowa Governor Kim Reynolds signed a proclamation relating to the weight limits and transportation of grain, fertilizer, and manure.

The proclamation is effective through October 11, 2023. The proclamation allows vehicles transporting corn, soybeans, hay, straw, silage, stover, fertilizer (dry, liquid, and gas), and manure (dry and liquid) to be overweight (not exceeding 90,000 pounds gross weight) without a permit for the duration of this proclamation.

This proclamation applies to loads transported on all highways within Iowa (excluding the interstate system) and those which not exceed a maximum 90,000 pounds gross do not exceed the axle weight limits mined under the mary highway gross weight table Code § 321.463 (b), by more than cent, do not exceed maximum axle of 20,000 pounds ply with posted roads and bridges

Public input sought for hazard plan

Worth County is updating its Hazard Mitigation Plan (HMP). Public input is being sought through a survey now available online.

The HMP analyzes the county's vulnerabilities to natural and human-caused hazards and identifies mitigation options to minimize property damage and reduce losses of life and health impacts.

The HMP is updated every five years to comply with the federal Disaster Mitigation Act.

Having an updated HMP in place helps the county, cities and schools access federal dollars for mitigation planning projects and expenses.

As local governments update the HMP, the public's help is a part of the process. The purpose of the survey is to collect information from the public and those potentially impacted by hazards in the community.

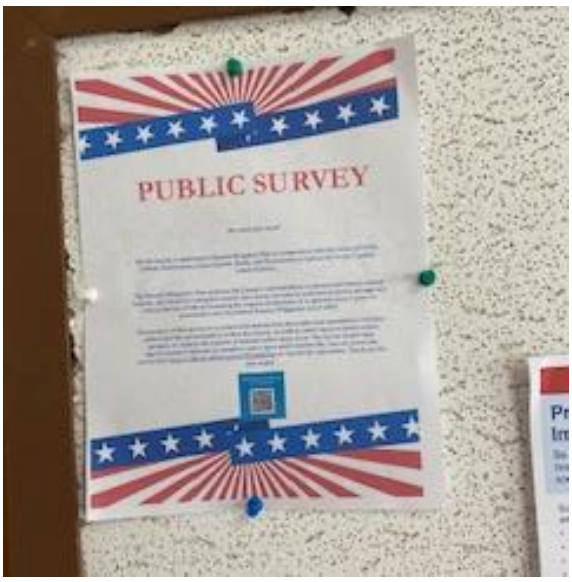
The survey lists potential hazards and asks how significant they would be in the county; how often hazards have impacted people's lives; mitigation action priorities; and some basic information about where people live.

The survey can be accessed online at forms.office.com/e/EGs8ehb5yc.

Briefs

City/school candidate


PUBLIC SURVEY
GRAFTON
MULTI GARAGE SALES
Fri, Sept 15: 4 – 7 PM
Sat, Sept 16: 8AM – 1PM
Anyone wanting to have a sale, just put a sign in front of your place.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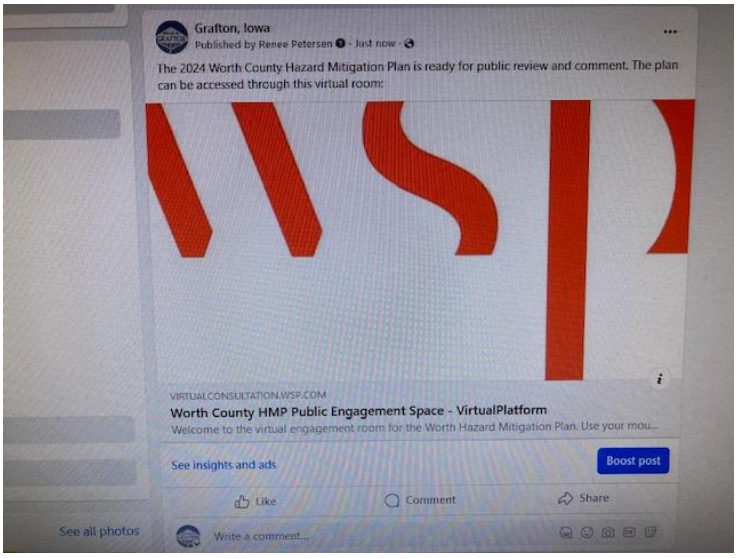
PUBLIC SURVEY


GARAGE SALE
Fri, Sept 15: 4 – 7 PM
Sat, Sept 16: 8AM – 1PM
PUBLIC SURVEY


MINIMUM AGE 55
BENEFIT
for Nate Levang
September 16th 1-8pm
@ Moose Lodge
Silent Auction 1-4pm
Live Auction 5pm
Music 6-8pm
Meal - Free will donation
PUBLIC SURVEY


Grafton, Iowa
Published by Renee Petersen · Just now ·
The 2024 Worth County Hazard Mitigation Plan is ready for public review and comment. The plan can be accessed through this virtual room:
VIRTUALCONSULTATION.WSP.COM
Worth County HMP Public Engagement Space - VirtualPlatform
Welcome to the virtual engagement room for the Worth Hazard Mitigation Plan. Use your mou...
See insights and ads
Boost post
Like
Comment
Share
See all photos
Write a comment...

Appendix C: References

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- US Census Bureau, Building Permit Data
- US Census Bureau, 2020 Decennial Census
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- US Fish and Wildlife Service, Threatened and Endangered Species
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- University of Nebraska, National Drought Mitigation Center
- University of Wisconsin-Madison, Department of Forest Ecology and Management, SILVIS Lab
- Worth County Assessor's Office
- Worth County Conservation Board
- Worth County, Iowa Multijurisdictional Hazard Mitigation Plan, 2018

Appendix D: Adoption Resolutions

<Placeholder for resolutions after FEMA provides approval pending adoption letter>