Table of Contents

1 Introduction 1-1
1.1 Executive Summary 1-1
1.1 Purpose 1-3
1.2 Background and Scope 1-3
1.3 Plan Organization 1-2
2 Planning Process 2-1
2.1 Multi-Jurisdictional Participation 2-1
2.2 The Planning Steps 2-2
2.2.1 Phase I Organize Resources 2-3
2.2.2 Phase 2 Assess Risk (Handbook Task 5) 2-8
2.2.3 Phase 3 Develop the Mitigation Plan (Handbook Task 6) 2-9
2.2.4 Phase 4 Implement the Plan and Monitor Progress 2-10
3 Planning Area Profile and Capabilities 1
3.1 Emmet County Planning Area Profile 1
3.1.1 Geography and Topography 3
3.1.2 Major Rivers and Watersheds 3
3.1.3 History 4
3.1.4 Climate 5
3.1.5 Population/Demographics 6
3.1.6 Occupations/Employers 8
3.1.7 Agriculture 9
3.1.8 Land Use Patterns and Trends 9
3.2 City/County Capabilities 10
3.2.1 NFIP Participation 15
3.2.2 Summary of Capabilities 18
3.2.3 Opportunities for Enhancement 18
3.3 Community College Profiles and Mitigation Capabilities 20
4 Risk Assessment 4-1
4.1 Hazard Identification 4-3
4.1.1 Disaster Declaration History 4-4
4.1.2 Data Sources 4-6
4.1.3 Risk Assessment Methodology 4-7
4.1.4 Climate Change 4-8
4.2 Assets at Risk 4-9
4.2.1 Property 4-9
4.2.2 People 4-11
4.2.3 Critical Facilities and Infrastructure 4-12
4.2.4 Historic, Cultural, and Natural Resources 4-15
4.3 Hazard Profiles and Vulnerability 4-17
4.3.1 Animal/Plant/Crop Disease 4-18
4.3.2 Drought 4-31
4.3.3 Extreme Heat 4-42
4.3.4 Flooding (Flash and Riverine) 4-49
4.3.5 Grass or Wildland Fire 4-73
4.3.6 Hazardous Materials 4-80
4.3.7 Human Disease 4-89

4.3.8 Infrastructure Failure 4-99
4.3.9 Landslide 4-107
4.3.10 Severe Winter Storm 4-111
4.3.11 Terrorism 4-118
4.3.12 Thunderstorm with Lightning and Hail 4-123
4.3.13 Tornado/Windstorm 4-131
4.3.14 Transportation Incident 4-145
4.4 Hazard Analysis Summary 4-153
5 Mitigation Strategy 5-1
5.1 Goals 5-1
5.2 Progress on Previous Mitigation Actions 5-2
5.3 Identification and Analysis of Mitigation Actions 5-4
5.3.1 Prioritization Process 5-6
5.3.2 Financial Resources 5-7
5.3.3 Continued Compliance with the National Flood Insurance Program 5-7
5.4 Mitigation Action Plan 5-7
6 Plan Maintenance Process 6-1
5.1 Monitoring, Evaluating, and Updating the Plan 6-1
5.1.1 Hazard Mitigation Planning Committee (HMPC) 6-1
5.1.2 Plan Maintenance Schedule 6-2
5.1.3 Plan Maintenance Process 6-2
5.2 Incorporation into Existing Planning Mechanisms 6-3
5.2.1 Incorporation of Updated Hazard Mitigation Plan into existing Planning Mechanisms 6-3
5.3 Continued Public Involvement 6-4

1 Introduction

1.1 Executive Summary

The following jurisdictions have prepared and adopted this 2023 update of the Emmet County Hazard Mitigation Plan (HMP) that will be effective for the 2024-2029 time period:

- Emmet County
- Armstrong
- Estherville
- Dolliver
- Gruver
- Ringsted
- Wallingford
- Iowa Lakes Community College

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 Emmet 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 Emmet County HMP are:

- **Goal 1:** Natural hazards that cause injuries, illness, deaths, property loss, utility service disruption, and economic loss will be reduced and mitigated against by planning for the protection of property and life.
- **Goal 2:** Protect critical facilities, infrastructure, and jurisdictional operations from disruptions due to hazard impacts.
- **Goal 3:** Educate the public on natural hazards and what necessary information is needed to protect themselves and their property.

Emmet County and its participating jurisdictions developed this 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. By reducing vulnerability to known hazard risks, communities will save lives and property and minimize the social, economic, and environmental disruptions that commonly follow 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 Emmet 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 Emmet 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 2024 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	Unlikely	Critical	Significant	Low
Drought	Likely	Critical	Extensive	Medium
Extreme Heat	Likely	Critical	Extensive	Medium
Flooding (Flash & Riverine)	Likely	Catastrophic	Significant	High
Grass/Wildland Fire	Likely	Limited	Significant	Medium
Hazardous Materials Incident	Likely	Critical	Significant	Medium
Human Disease	Occasional	Limited	Significant	Medium
Infrastructure Failure	Likely	Critical	Significant	Medium
Landslide	Unlikely	Negligible	Limited	Low
Thunderstorm/Lightning/Hail	Highly Likely	Critical	Extensive	Medium
Severe Winter Storm	Highly Likely	Limited	Extensive	High
Terrorism	Unlikely	Limited	Extensive	Medium
Tornado/Windstorm	Highly Likely	Limited	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 Emmet 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 Emmet County.

1.1 Purpose

Emmet County, its participating cities and public school district, and the community college prepared this Multi-Jurisdictional 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 Emmet 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.

1.2 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 true 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. Emmet County and the incorporated cities and community college initially developed a multi-jurisdictional Hazard Mitigation Plan in 2014, and subsequently began the process to update that plan in 2018. This current planning effort serves to update the 2018 plan.

This plan documents the hazard mitigation planning process undertaken by the Emmet 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 Emmet County.

The Emmet County Multi-Jurisdictional Hazard Mitigation Plan is a multi-jurisdictional plan that geographically covers the participating jurisdictions within Emmet County's boundaries (hereinafter referred to as the planning area). The following jurisdictions officially participated in the planning process:

- Emmet County
- Armstrong

- Dolliver
- Estherville
- Gruver
- Ringsted
- Wallingford
- Iowa Lakes Community College

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 the 2013 Local Mitigation Planning Handbook published by FEMA.

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 Emmet 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.

1.3 Plan Organization

This Emmet County Multi-Jurisdictional Hazard Mitigation Plan update is organized as follows:

- Executive Summary
- Chapter 1: Introduction
- Chapter 2: Planning Process
- Chapter 3: Community Profile and Capability Assessment
- Chapter 4: Hazard Identification and Risk Assessment
- Chapter 5: Mitigation Strategy
- Chapter 6: Plan Implementation and Maintenance
- 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 plan was collaboratively prepared between January 2023 and January 2024 by Emmet County and the participating jurisdictions and stakeholders. Professional planning assistance was provided by WSP USA Environment and Infrastructure (WSP) through a contract with the County. WSP's role was to:

- Assist in establishing the Hazard Mitigation Planning Committee (HMPC) as defined by the Disaster Mitigation Act (DMA) and the FEMA policy guide,
- 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 Multi-Jurisdictional Participation

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

Emmet County invited the incorporated cities, public school districts, and various other stakeholders in mitigation planning (identified in Appendix B) to participate in the Emmet County Multi-Jurisdictional Hazard Mitigation Plan update process. The jurisdictions that elected to participate in this plan are listed above in section 1.2 and are mostly the same that participated in the previous planning effort five years earlier, with the addition of the City of Dolliver which did not participate in the previous plan. The DMA requires that each jurisdiction that participates in the planning process must officially adopt the multi-jurisdictional 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; or participate directly with County Emergency Management Coordinator to provide input on the mitigation plan.
- 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.
- 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 Plan Update Guides, and update/development of mitigation actions. Sign-in sheets are included in Appendix C: Planning Process Documentation.

Table 2-1 Jurisdictional Participation in Planning Process

Jurisdiction	Plan Update Guide	Action Reporting	New Mitigation Action	Kickoff Meetings	Meeting 2	Meeting 3
Emmet County	X	X	X	X	X	X
Armstrong	X		X	X	X	X
Dolliver	X	-	X			X
Estherville	X	X	X	X	X	X
Gruver			X	X	X	X
Ringsted	X	X	X	X	X	X
Wallingford	X	X	X	X	X	X
Iowa Lakes Community College		X	X	X	X	X

2.2 The Planning Steps

WSP and Emmet 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 of 2000 as well as the basic requirements for activity 510 under the Community Rating System. 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 *2013 Local Mitigation Planning Handbook* and the 10-step CRS process. (note: an update to the Local Mitigation Planning Handbook was released in May 2023 while this plan update was in process, but the Tasks largely remain the same).

Table 2-2 Mitigation Planning Process Used to Develop the Emmet County Multi-Jurisdictional Local Hazard Mitigation Plan

Phase	Community Rating System (CRS) Planning Steps (Activity 510)	Local Mitigation Planning Handbook Tasks (44 CFR Part 201)
Phase I	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	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	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	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 January 10, 2023. Participants of the meeting included the Emmet County Emergency Management Coordinator; Iowa Homeland Security and Emergency Management Department Hazard Mitigation Office, Hazard Mitigation Planner, and GIS Coordinator; and the Wood 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. Detailed meeting minutes are included in Appendix C.

After the initial coordination meeting, a formal Kick-off meeting/webinar was held on March 13, 2023, followed by two additional planning meetings held on July 12, 2023 and August 23, 2023. A complete list of all representatives of the agencies and organizations that participated on the Emmet County HMPC is provided in Appendix B.

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. The meeting minutes for each of the meetings are included in Appendix C.

Table 2-3 Schedule of HMPC Meetings

Meeting	Topic	Date
Coordination Call	General overview of planning process/requirements and schedule.	January 10, 2023

Meeting	Topic	Date
Kick-off Meeting	Introduction to DMA, the planning process, hazard identification and public input strategy. Distribution of Plan Update Guide to jurisdictions. Preliminary hazard data. Discussion critical facility inventory.	March 13, 2023
Planning Meeting #2	Review of draft Risk Assessment, update plan goals, instructions to update status of previous mitigation actions	July 12, 2023
Planning Meeting #3	Development of new mitigation actions, mitigation action planning and prioritization. Determine process to monitor, evaluate, and update plan.	August 23, 2023

During the kick-off 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. Wood 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 Emmet 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 Plan Update 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. Each participating jurisdiction completed and returned the worksheets in the Plan Update Guide to WSP. WSP integrated this information into the plan, supporting the development of Chapters 2 and 3.

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

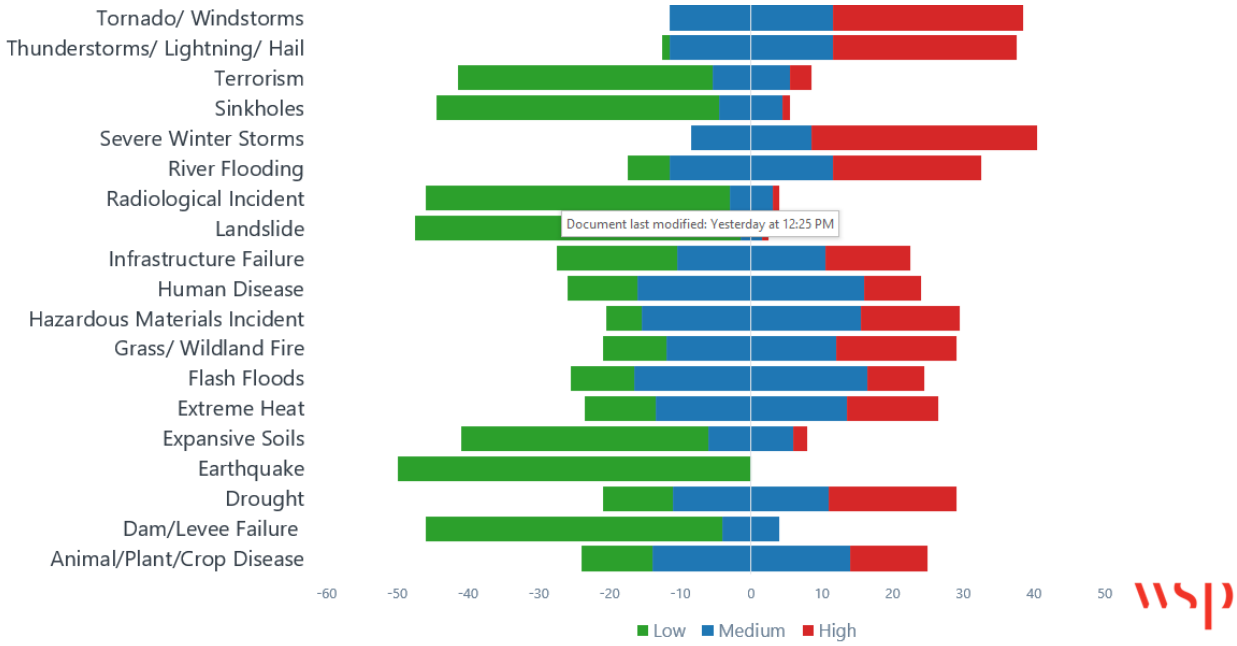
44 CFR Requirement 201.6(b)
An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: (1) an opportunity for the public to comment on the 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 the dissemination of a survey. The survey was announced via a press release from the County and was posted on community websites. Newspaper clippings, posters, and website and social media postings announcing the survey are included in Appendix C.

The public survey was developed specific to the Emmet 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 post offices throughout the County. A copy of the survey is provided in Appendix C.

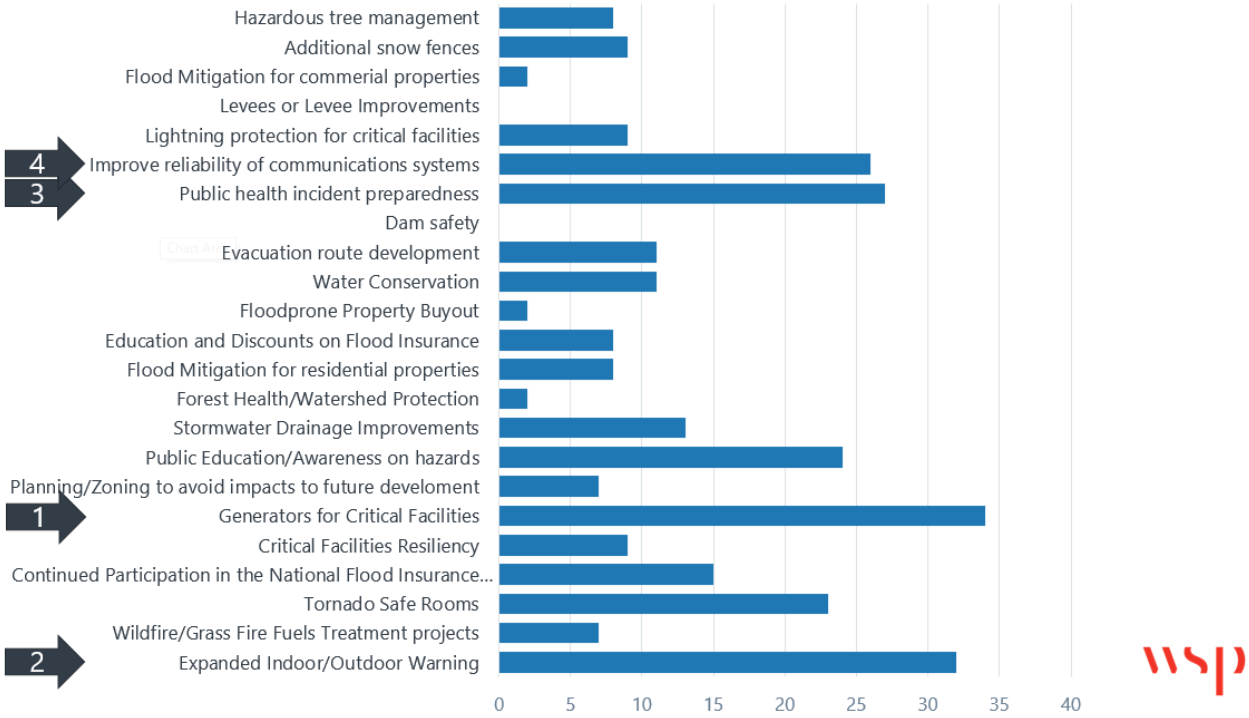
In addition to notification through media outlets described above, committee members distributed the survey link to members of the public and key stakeholders in their own jurisdiction. In all, 50 surveys were completed. One question asked respondents to rank their perception of which hazards were most significant to the planning area. The summary results of this question are provided in Error! Reference source not found.. This shows that the public perception is tornado/windstorms, severe winter storms, and thunderstorms (severe summer weather) are the most significant hazards in Emmet County.

Figure 2-1 Survey Results—Hazard Level of Significance



In the survey, the public was also asked to review 23 types of mitigation actions. The Emmet County HMPC also considered these types of projects in the Emmet County Multi-Jurisdictional Hazard Mitigation Plan. The survey asked the public to identify mitigation project types that they felt could benefit their community. Figure 1.2 provides the compiled results of this question. The public opinion is that generators for critical facilities, expanded indoor/outdoor warning, planning/zoning to avoid impact, and continued participation would benefit their jurisdiction the most.

Figure 2-2 Survey Results—Types of Mitigation Projects



The public was also given an opportunity to provide input on the final draft of the complete plan. A link to the entire plan draft was made available on the Emmet County website.

Emmet County announced the availability of the entire final draft plan and the two-week final public comment period on the County website and via the following media outlets: xxx. Copies of the announcements are provided in Appendix C. The final public comment period was from January X to X, 2024. X comments were received resulting in Y changes in the final plan.

The HMPC invited other targeted stakeholders to comment on the draft plan via an e-mail letter, which is described in greater detail in Step 3: Coordinate with Other Departments and Agencies. No comments were received.

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 non-profit 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 Emmet 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. In addition, Emmet County invited neighboring counties, other local, state, and federal departments and agencies, as well as institutions of higher learning to review and comment on the final draft of the Emmet County Multi-Jurisdictional Hazard Mitigation Plan prior to final submittal to FEMA. The stakeholders that were invited to comment on the final plan draft are included below:

Stakeholders

- State of Iowa – Department of Natural Resources/Dam Safety
- State of Iowa – Department of Natural Resources/Floodplain Management
- State of Iowa Homeland Security and Emergency Management Department
- State of Iowa Department of Public Safety – State Fire Marshal Division

Private and nonprofit organizations

- Avera Holy Family Hospital

Adjacent Counties and Cities

- Palo Alto County Emergency Management
- Kossuth County Emergency Management
- Clay County Emergency Management
- Dickinson County Emergency Management
- Jackson County Emergency Management
- Martin County Emergency Management

Appendix C includes a copy of the email letter that was sent providing a link to the draft plan during the final public comment period.

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:

- Iowa Hazard Mitigation Plan (June 2018)
- Emmet County Hazard Mitigation Plan (2018)
- Plan Update Guides completed by each jurisdiction
- FEMA Community Information System, National Flood Insurance Program (NFIP), Repetitive Loss Property Data
- Dam Inventory and Inspection Reports for Clinton County, Iowa Department of Natural Resources
- National Drought Mitigation Center Drought Impact Reporter
- US Drought Monitor
- Environmental Protection Agency
- 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 Public Safety

- Iowa Department of Transportation (DOT), Office of Traffic and Safety
- Iowa State University (ISU) Department of Agronomy
- Iowa Utilities Board
- National Oceanic and Atmospheric Administration's (NOAA) National Center for Environmental Information
- National Weather Service
- Pipeline and Hazardous Materials Safety Administration
- Emmet County Emergency Management
- Emmet County National Flood Hazard Layer
- US Department of Agriculture, Risk Management Agency
- US Department of Agriculture, US Forest Service (USFS)
- US Department of Transportation
- United States Geological Survey
- National Flood Insurance Program Policy and Loss Statistics
- 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 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 D, References.

2.2.2 Phase 2 Assess Risk (Handbook Task 5)

Step 4: Assess the Hazard: Identify and Profile Hazards

The HMPC identified the hazards that have impacted or could impact communities in Emmet County. The HMPC examined the history of disaster declarations in Emmet County. They discussed past hazard events, types of damage, and where additional information might be found. The committee identified 19 natural and human-caused hazards that have the potential to impact the planning area.

The HMPC discussed past events and impacts, analyzed risk assessment data, and came to a 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 from the Emmet County Assessor's Department which provided public datasets with parcel and building data. The Emmet County Emergency Management Coordinator worked with the Emmet County GIS Department to populate an inventory of critical facilities in the planning area. Population data was obtained from the US Census Bureau. Methodologies and results of the analyses are provided in Chapter 4.

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 Chapters 3 and 4.

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.

After profiling the hazards that could affect Emmet County and identifying assets, the HMPC collected information to describe the likely impacts of future hazard events on the participating jurisdictions.

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 Emmet County Community Profile.

Specific capabilities such as participation in the NFIP, designation as FireWise 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 were 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 2018 State HMP. Common categories of mitigation goals were presented for comparison, along with the goals from the 2018 Iowa State HMP. The HMPC then discussed and updated the goals for the 2024-2029 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 Emmet 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 C. 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 will adopt the plan following FEMA's "approval pending adoption" of the plan. Scanned copies of resolutions of adoption are included in Appendix A 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 Planning Area Profile and Capabilities

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

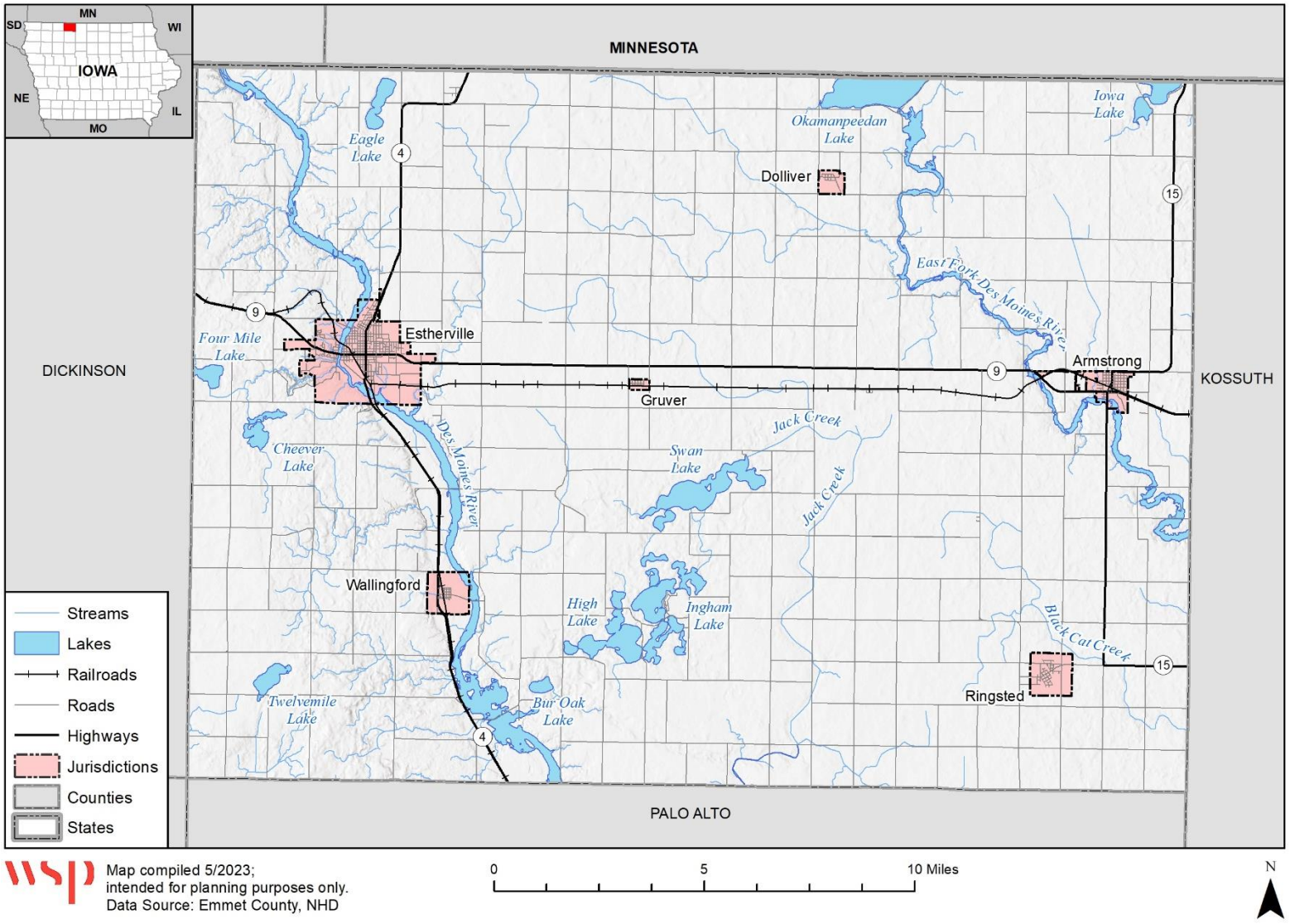
3.1 Emmet County Planning Area Profile

Figure 2-3 provides a map of the Emmet County planning area. The planning area boundaries include the unincorporated areas of Emmet County as well as the following incorporated cities:

- Emmet County
- Armstrong
- Dolliver
- Estherville
- Gruver
- Ringsted
- Wallingford

Iowa Lakes Community College participated in the development of this plan and is also included in the planning area.

Figure 2-3 Emmet County Planning Area



3.1.1 Geography and Topography

Emmet County is located in northwestern Iowa along the border with Minnesota. The County has a total area of 408 square miles. There are several highways that run through the County including Iowa Highway 4, which travels north and south through the western portion of the county and through the cities of Estherville and Wallingford; Iowa Highway 9, which travels east and west through the central portion of the county and through the cities of Estherville, Gruver, and Armstrong; and Iowa Highway 15, which travels north and south through the eastern portion of the county and passes through the City of Armstrong. The rest of the roads in the county are county highways and local roads.

Adjacent counties:

- Jackson County, Minnesota (northwest)
- Martin County, Minnesota (northeast)
- Kossuth County (east)
- Palo Alto County (south)
- Dickinson County (west)

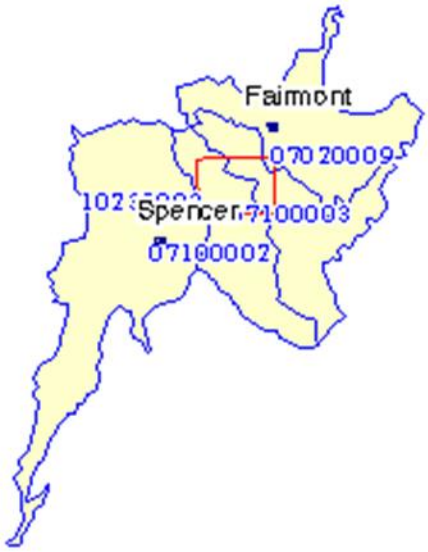
The soils that are found within Emmet County are well suited to agricultural uses, including crop production and pasture. The principal crops are corn and soybeans. Predominant soils in the County range from poorly drained to moderately well drained. Though agriculture is now the predominant land use, it was originally restricted to high areas because much of the county was covered in swamps; however, drainage and reclamation of these lands began in 1882, converting much of these lands to agricultural use. Much of the county's landscape is comprised of rolling prairie. Elevation in the county ranges from 1,225 to 1,480 feet above sea level. (Source: Natural Resources Conservation Service, Soil Survey).

3.1.2 Major Rivers and Watersheds

The primary waterway features in Emmet County are the Des Moines River and the East Fork Des Moines River. As depicted in Figure 2-4, Emmet County crosses four watersheds as follows:

- 07020009 Blue Earth
- 07100002 Upper Des Moines
- 07100003 East Fork Des Moines
- 10230003 Little Sioux

Figure 2-4 Emmet County, Iowa Watersheds (Emmet County is red square)



Source: Environmental Protection Agency, https://cfpub.epa.gov/surf/locate/index.cfm

3.1.3 History

The Third General Assembly of 1851 created or established 50 counties in Iowa. When this session closed, every part of Iowa was included in some designated county for the first time. Emmet County was created by this wholesale legislation. At that time, Emmet County was attached to Webster County for governmental purposes because the area was so sparsely settled by non-Natives. The first white settlers began to arrive in 1856. In 1859 a petition was circulated, and Emmet County separated from Webster County.

Emmet County was named after the Irish orator, nationalist, and poet, Robert Emmet, who was executed in 1803 for his activity in the Irish rebellion. The county seat was originally established in Estherville despite opposition from some parts of the county. A courthouse was partially constructed in Estherville before financing was stopped. The courthouse was instead established in a schoolhouse until 1876 when it was destroyed in a fire. In 1879, Swan Lake was chosen in an election to decide the new county seat, a position it held until another election in 1882 moved the county seat back to Estherville where it has since remained.

In 1882, a rail connection was made to Estherville by the Burlington, Cedar Rapids & Northern Railroad. Additionally, a courthouse and a public library were built in Estherville. In 1903, a Carnegie library was built.

In 1954, a grand jury voted to recommend the construction of a new courthouse, which was considered long overdue. Construction began on the current courthouse in June 1957 and was completed in July of the following year. (Source: Dorothy Mergen, Emmet County Recorder via 2013 Emmet County Multi-jurisdictional Hazard Mitigation Plan).

Emmet County has several properties listed in the National Register of Historic Places, detailed in Table 2-4 below.

Table 2-4 Emmet County Listings in National Register of Historic Places

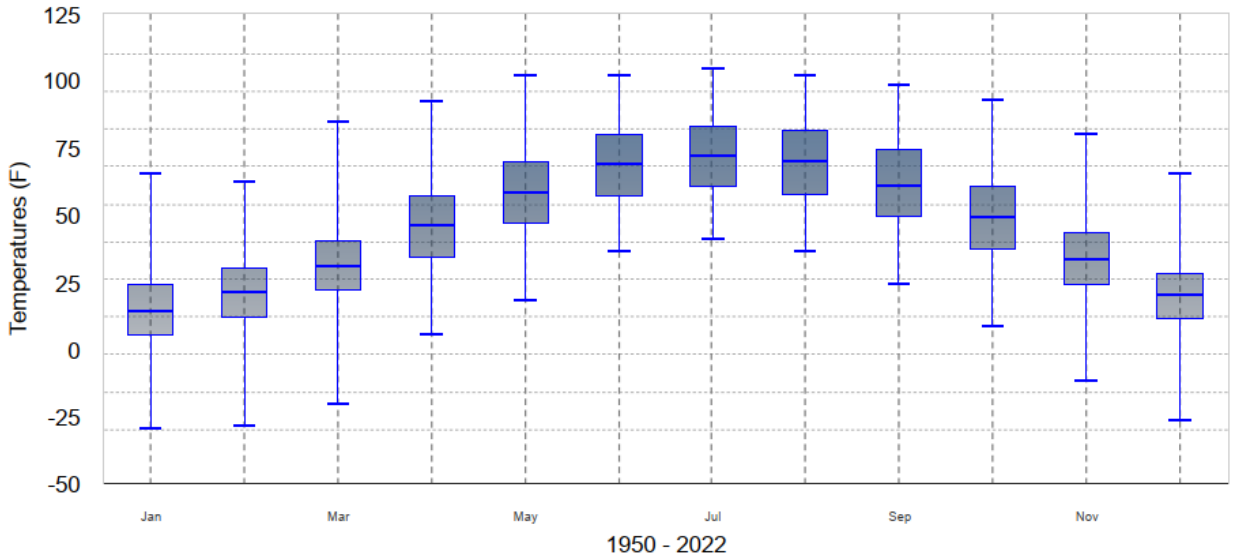
Listing	Date Listed	Location
Brugjeld-Peterson Family Farmstead District	April 6, 2000	Wallingford
Ellsworth Ranch Bridge	July 15, 1998	Armstrong
Thomsen Round Barn	June 30, 1986	Armstrong

Source: National Register of Historic Places

3.1.4 Climate

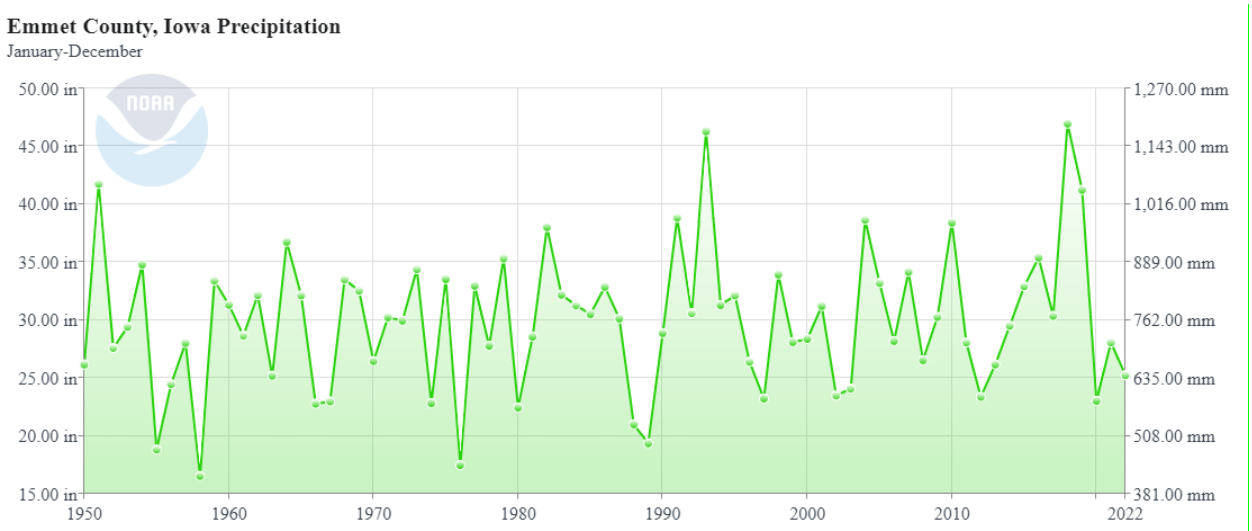
The climate of Emmet County in northwest Iowa is described as hot-summer humid continental with cold winters and hot and humid summers. The average annual temperature is 46.5 degrees Fahrenheit (F.) with an average high in July of 73.2 degrees F. and an average low in January of 11.4 degrees F. The annual precipitation averages 28.19 inches. Figure 2-5**Error! Reference source not found.** and Figure 2-6 provide the average annual temperatures and monthly precipitation from 1950 to 2022.

Figure 2-5 Estherville, Iowa Average Annual Temperatures, 1950-2022



Source: Southwest Climate and Environmental Information Collaborative

Figure 2-6 Emmet County Monthly Precipitation, 1950-2022



Source: NOAA, Climate at a Glance County Time Series

3.1.5 Population/Demographics

According to the U.S. Census Bureau, the Emmet County population declined by 4.8% from 2016 to 2022 overall. This decline has been a trend since 2010. Over this period, the cities and towns within Emmet County have seen a drop in population apart from the City of Dolliver. The City of Gruver experienced a drastic decline in population (55%). **Error! Reference source not found.** 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 2-5 Emmet County Population 2016-2022 by Jurisdiction

Jurisdiction	2016 Census Population	2022 Population Estimate	# Change 2016-2022	% Change 2016-2022
Armstrong	898	755	-143	-15.9%
Dolliver	81	89	8	9.9%
Estherville	6,027	5,881	-146	-2.4%
Gruver	105	47	-58	-55.2%
Ringsted	479	430	-49	-10.2%
Wallingford	180	167	-13	-7.2%
Unincorporated Emmet County	2,120	1,980	-140	-6.6%
Total	9,820	9,349	-471	-4.8%

Source: U.S. Census Bureau: 2022 ACS 5-Year Estimates. Unincorporated Emmet County Population was estimated by subtracting populations of incorporated cities from the total Emmet County populations.

According to the ACS 2022 5-Year Estimates, 4.2 percent of the population is under age 5 and 23 percent of the population is over age 65 in Emmet County. In total, there were 4,513 households with an average household size of 2.23 people. The following tables provide additional demographic and economic indicators to identify social vulnerability factors in Emmet County.

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 3.3 percent increase of people over the age of 65 since 2016 and a 4.4 percent 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 2-6 Emmet County Demographic and Social Characteristics, 2016-2022

Emmet County	2016	2022	% Change
Population	9,820	9,349	-4.8%
Median Age	42.5	44.8	5.4%
% of Population under 5	5.3%	4.2%	-1.1%
% of Population over 65	19.7%	23%	3.3%
Housing Occupancy Rate	86.5%	86%	-0.5%
% of Owner Occupied Housing	77.7%	77.6%	-0.1%
% of Renter Occupied Housing	22.3%	22.4%	0.1%
% of Housing Units with no Vehicles Available	5.3%	3.8%	-1.5%
Median Household Income	$45,536	$64,461	41.6%
Per Capita Income	$27,807	$34,657	24.6%
% of Individuals Below Poverty Level	13.6%	12.7%	-0.9%
# of Households	4,773	4,513	-5.4%
Average Household Size	2.19	2.23	1.8%
% of Population Over 25 with High School Diploma	34.1%	33.4%	-0.7%
% of Population Over 25 with Bachelor's Degree or Higher	17.5%	15.2%	-2.3%
% with Disability	14.4%	18.8%	4.4%
% Speak English less than "Very Well"	4.1%	3.9%	-0.2%

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

Table 2-7 Emmet County Demographic and Social Characteristics Compared to the State and Nation, 2022

Demographic & Social Characteristics (as of 2019)	County	Iowa	U.S.
Median Age	44.8	38.9	39.0
% of Population under 5	4.2%	5.6%	5.5%
% of Population over 65	23%	18.4%	17.3%
Housing Occupancy Rate	86%	92.5%	90.3%
% of Owner Occupied Housing	77.6%	72.0%	65.2%

Demographic & Social Characteristics (as of 2019)	County	Iowa	U.S.
% of Renter Occupied Housing	22.4%	28.0%	34.8%
% of Housing Units with no Vehicles Available	3.8%	5.6%	8.3%
Median Household Income	$64,461	$69,588	$74,755
Per Capita Income	$34,657	$38,917	$41,804
% of Individuals Below Poverty Level	12.7%	11.0%	12.6%
Average Household Size	2.23	2.33	2.50
% of Population Over 25 with High School Diploma	33.4%	29.5%	26.1%
% of Population Over 25 with bachelor's degree or Higher	15.2%	32.3%	35.7%
% with Disability	18.8%	12.8%	13.4%
% Speak English less than "Very Well"	3.9%	3.6%	8.4%

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

Table 2-8 Emmet County Demographics: Race and Sex, 2022

Emmet County	Population	%
Total Population	9349	--
Male	4635	49.6%
Female	4714	50.4%
White, not Hispanic	8083	86.5%
Hispanic or Latino	922	9.9%
Black	340	3.6%
Asian	23	0.2%
American Indian and Alaska Native	23	0.2%
Native Hawaiian and Other Pacific Islander	8	0.1%
Some other race	186	2.0%
Two or more races	686	7.3%

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

3.1.6 Occupations/Employers

Table 2-9 provides occupation statistics for the incorporated cities and the county as a whole for the civilian employed population 16 years and over.

Table 2-9 Emmet County, Iowa, Occupation Statistics

Geography	Civilian employed population 16 years and over	Management, business, science, and arts occupations	Service occupations	Sales and office occupations	Natural resources, construction, and maintenance occupations	Production, transportation, and material moving occupations
Emmet County, Iowa	4,871	27.8%	17.9%	17.4%	9.9%	27.0%
Armstrong	310	26.8%	23.9%	13.2%	7.1%	29.0%
Dolliver	45	31.1%	4.4%	15.6%	24.4%	24.4%
Estherville	2,996	23.3%	21.3%	15.4%	9.3%	30.7%
Gruver	26	23.1%	7.7%	11.5%	23.1%	34.6%
Ringsted	231	22.1%	11.7%	33.3%	5.6%	27.3%
Wallingford	81	14.8%	14.8%	19.8%	27.2%	23.5%

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

3.1.7 Agriculture

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

According to the 2021 Census of Agriculture, there were 488 farms in the County covering 229,814 acres of land (87.8 percent of the 408 sq. miles of land area (261,120 acres) in the County). 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. Farms on average were 471 acres. Emmet County agriculture and agriculture-related industries account for 6.5% of the county workforce providing 317 jobs according to the 2022 ACS Census. Emmet County's agriculture and economic contributions are summarized in additional detail in Section 3.2.2 of Chapter 3.

3.1.8 Land Use Patterns and Trends

Emmet County's physical characteristics consist of rolling hills and expansive prairies. The landscape previously was covered in swamps however, drainage and reclamation transformed the space to be compatible for agricultural use. A prominent waterway is the Des Moines River that flows along the west side of the county. In the northeast sections of the county, Tuttle (Okamanpadu) Lake is the primary water source. The water sources hold significant economic importance, contributing to agricultural activities, recreation, and natural habitats. The county is a source of outdoor recreation host to parks, trails, natural areas, and historic sites that total in 302 acres.

All jurisdictions in Emmet County, with the exception of Dolliver, have experienced a significant decline in population since 2016. Data suggest the elder population is remaining in the County while the younger adults are leaving. Data that supports this 3.3% increase in population over the age of 65 and 4.4% increase in people with disabilities. The county has a much higher age average than the state and country average.

3.2 City/County Capabilities

Unincorporated Emmet County is governed by a five-member Board of Supervisors. Each incorporated city is governed by a six-member Mayor/City Council. Emmet County has an active Emergency Management Office that coordinates emergency management capabilities in the County. The Emmet County Emergency Notification System (ECENS) provides emergency notifications for weather, emergency, and public safety warnings throughout the County. This service is part of the Alert Iowa statewide emergency messaging system. Table 2-10 that follows provides additional capability information for the unincorporated county and incorporated cities.

Table 2-10 Mitigation Capabilities

	Emmet County	Armstrong	Estherville	Dolliver	Gruver	Ringsted	Wallingford
Planning Capabilities							
City Hall (City Clerk)	N/A	Yes	Yes	Yes	Yes	Yes	Yes
Fire Department	N/A	Yes	Yes	Yes	Yes	Yes	Yes
Police Department	Yes, County Sherif	Yes, County Sherif	Yes	Yes, County Sherif	Yes, County Sheriff	Yes	Yes, County Sheriff
Public Works Department	N/A	Yes	Yes	No	No	Yes	No
Planning & Zoning Commission	N/A	Yes	Yes	No	Yes	Yes	Yes
Board of Adjustments	N/A	Yes	Yes	No	No	Yes	No
Library Board of Trustees	N/A	Yes	Yes	No	Yes	Yes	No
Electric Board of Trustees	N/A	Yes	No	No	No	N/A	N/A
Community Center Board	N/A	Yes	No	No	No	N/A	N/A
Policies/Ordinance							
Comprehensive/Land Use Plan	Yes, updated 2019	Yes	Yes, 2017	No	Yes	Yes, Aug-03	N/A
Capital Improvement Plan	No	No	No	No	No	N/A	N/A
Local/County Emergency Plan	Yes	Yes	Yes, 2017	Yes, completed by EMA	Yes, completed by EMA	Yes, completed by EMA	Yes, completed by EMA
Local Mitigation Plan	Yes, updated 2023	Yes, County Plan	Yes, County Plan	Yes, County Plan	Yes, County Plan	Yes, County Plan	Yes, County Plan
Flood Mitigation Assistance (FMA) Plan	No	No	No	No	No	No	Yes

	Emmet County	Armstrong	Estherville	Dolliver	Gruver	Ringsted	Wallingford
Watershed Plan	No	No	No	No	No	No	No
Critical Facilities Plan (Mitigation/Response/Recovery)	Yes, ESF 10	No	No	No	No	No	No
Economic Development Plan	No	No	No	No	No	No	No
Transportation Plan	Yes, ESF 1 Update 2020	No	No	No	No	No	No
Firewise or other fire mitigation plan	No	No	No	No	No	No	No
Zoning Ordinance	Yes	Yes	Yes, 2017	No	No	Yes	Yes
Restricted Residential District	No	Yes	Yes	No	No	No	No
Subdivision Ordinance	Yes	Yes	Yes, 2017	No	No	No	No
Building Code	No	Yes	No	No	No	No	No
Building Permit Ordinance	Yes	Yes	No	No	No	Yes	Yes
Floodplain Ordinance	Yes	N/A	Yes, 2021	N/A	N/A	N/A	Yes, 2000
Tree Trimming Ordinance	No	Yes	Yes, 2015	No	Yes	Yes	No
Nuisance Ordinance	No	Yes	Yes, 2015	No	Yes	Yes	Yes
Stormwater Ordinance	No	Yes	No	No	Yes, Iowa Lakes Regional Water	Yes	No
Drainage Ordinance	No	Yes	No	No	No	No	No
Site Plan Review Requirements	No	No	Yes	No	No	No	No
Historic Preservation Ordinance	No	No	No	No	No	No	No
Landscape Ordinance	No	Yes	No	No	No	No	No
Iowa Wetlands and Riparian Areas Conservation Plan	N/A	N/A	No	No	No	No	No
Debris Management Plan	N/A	No	No	No	No	No	No
Program							
Zoning/Land Use Restrictions	Yes	Yes	Yes	No	No	Yes	No
Codes Building Site/Design	Yes, State Code	Yes	No	No	No	No	No
National Flood Insurance Program (NFIP) Participant	Yes	No	Yes	No	No	No	Yes

	Emmet County	Armstrong	Estherville	Dolliver	Gruver	Ringsted	Wallingford
NFIP Community Rating System (CRS) Participant	No	No	No	No	No	No	No
Hazard Awareness Program	Yes	No	No	No	No	No	No
Engineering Studies for Streams (Local/County/Regional)	No	Yes	Yes	No	No	No	N/A
National Weather Service (NWS) Storm Ready	Yes	No	No	No	No	No	No
Building Code Effectiveness Grading (BCEGs)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ISO Fire Rating	Yes	No	No	No	No	No	No
Economic Development Program	Yes	No	Yes	No	No	No	No
Land Use Program	Yes	Yes	No	No	No	No	No
Public Education/Awareness	Yes	Yes	No	No	No	No	No
Property Acquisition	Thru Taxes	N/A	No	No	No	No	No
Stream Maintenance Program	No	No	No	No	No	No	No
Mutual Aid Agreements	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Emergency Notification Systems (Sirens, CodeRed, IPAWS/WEA, etc.)	Yes	Yes	Yes	Yes	Yes	Yes	No, applied for grant 2022-2023
Staff/Department							
Building Code Official	No	Yes	No	No	No	No	No
Building Inspector	No	Yes	No	No	No	No	No
Mapping Specialist (GIS)	Yes, County Assessor's Office	Yes	No	No	No	No	No
Engineer	Yes	No	No	No	No	No	No
Public Works Official	N/A	Yes	Yes	No	No	Yes	No
NFIP Floodplain Administrator	Yes, Assessor's Office	No	Yes	No	No	No	Yes
Development Planner	Yes	No	No	No	No	No	No
Emergency Management Coordinator	Yes	No	No	No	No	No	No
Emergency Response Team	Yes, HEAT and Mart Team, Mason City Hazmat	Yes, County	Yes, County	Yes, County	Yes, County	Yes, County	Yes, County

	Emmet County	Armstrong	Estherville	Dolliver	Gruver	Ringsted	Wallingford
Hazardous Materials Expert	Yes, Estherville Fire has a Hazmat Tech	Yes, County	Yes, County	Yes, County	Yes, County	Yes, County	Yes, County
Local Emergency Planning Committee	Yes	Yes, County	Yes, County	Yes, County	Yes, County	Yes, County	Yes, County
County Emergency Management Commission	Yes	Yes, County	Yes, County	Yes, County	Yes, County	Yes, County	Yes, County
Sanitation Department	Yes	Yes	Yes	No	No	Yes	Yes
Transportation Department	No	No	No	No	No	No	No
Economic Development Department	Yes, Lexie Ruter	No	No	No	No	No	No
Housing Department	No	No	No	No	No	No	No
Planning Consultant	No	No	No	No	No	No	No
Regional Planning Agencies	Yes, Northwest Iowa Planning & Development Commission	Yes	No	No	No	No	No
Historic Preservation	Yes, Historical Society	Yes	No	No	No	No	No
Non-Governmental Organizations (NGOs)							
American Red Cross	Yes, Covered by Sioux City	Yes, Covered by Sioux City	Yes, Covered by Sioux City	Yes, Covered by Sioux City	Yes, Covered by Sioux City	Yes, Covered by Sioux City	Yes, Covered by Sioux City
Salvation Army	Yes, Covered by Sioux City	Yes, Covered by Sioux City	Yes, Covered by Sioux City	Yes, Covered by Sioux City	Yes, Covered by Sioux City	Yes, Covered by Sioux City	Yes, Covered by Sioux City
Veterans Groups	Yes	Yes	Yes	No	No	No	No
Environmental Groups	No	No	No	No	No	No	No
Homeowner Associations	No	No	No	No	No	No	No
Neighborhood Associations	No	No	Yes	No	No	No	No
Chamber of Commerce	Yes	No	Yes	No	No	No	No
Community Organizations (Lions, Kiwanis, etc.)	Yes	No	No	No	No	No	No

	Emmet County	Armstrong	Estherville	Dolliver	Gruver	Ringsted	Wallingford
Local Funding Availability							
Ability to fund projects through Capital Improvements funding	Yes	No	Yes	No	Yes	No	No
Ability to incur debt through general obligation bonds	Yes	Yes	Yes	No	No	No	No
Ability to incur debt through special tax bonds	Yes	Yes	Yes	No	No	No	No
Ability to incur debt through private activities	No	N/A	No	No	No	No	No
Ability to withhold spending in hazard prone areas	No	No	No	No	No	No	No
Fees for water, sewer, gas, or electric services	No	Yes	Yes	No	Yes	No	Yes
Apply for Community Development Block Grants	No	Yes	Yes	No	Yes	No	No
Authority to levy taxes for a specific purpose	No	Yes	Yes	No	Yes	No	No
Impact fees for new development	No	No	No	No	No	No	No
Other Local Funding Availability	yes	No	No	No	No	No	Yes

3.2.1 NFIP Participation

In support of the NFIP, FEMA identifies flood hazard areas through the US and its territories by producing Flood Hazard Boundary Maps (FHBMs), Flood Insurance Maps (FIRMs) and Flood Boundary and Floodway Maps (FBFMs). Several areas of flood hazards are commonly identified on these maps. One of these areas is the Special Flood Hazard Area (SFHA) or high-risk area defined as any land that would be inundated by a flood having a 1% chance of occurring any given year (also referred to as the base flood level). Communities with a SFHA must join the NFIP in order for constituents to have access to federal flood insurance. Without a SFHA, participation in the NFIP is completely voluntary. Participating in the program allows those who want to purchase flood insurance for their insurable property, whether it is a home or other property. Almost every type of walled and roofed building that is principally above ground and not entirely over water may be insured if it is in a participating community.

Three of the four jurisdictions with SFHA participate in the NFIP and are detailed in the table below along with details on floodplain regulations and enforcement. Armstrong has an area of SFHA within its boundaries but does not participate and is sanctioned, meaning residents cannot access flood insurance through the NFIP. Reasons for not participating include lack of staffing available to support participation in the program. Additionally, the small portion of the river that runs through the city has no residential housing in the area. Also, the East Des Moines River states just north of Armstrong, we no historical flooding occurring.

Table 2-11 Emmet County NFIP Participating Jurisdictions 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
Emmet County	Yes	9/24/2021	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.
Estherville	Yes	9/24/2021	Yes (Floodplain Management Ordinance)	Community Development Director	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.

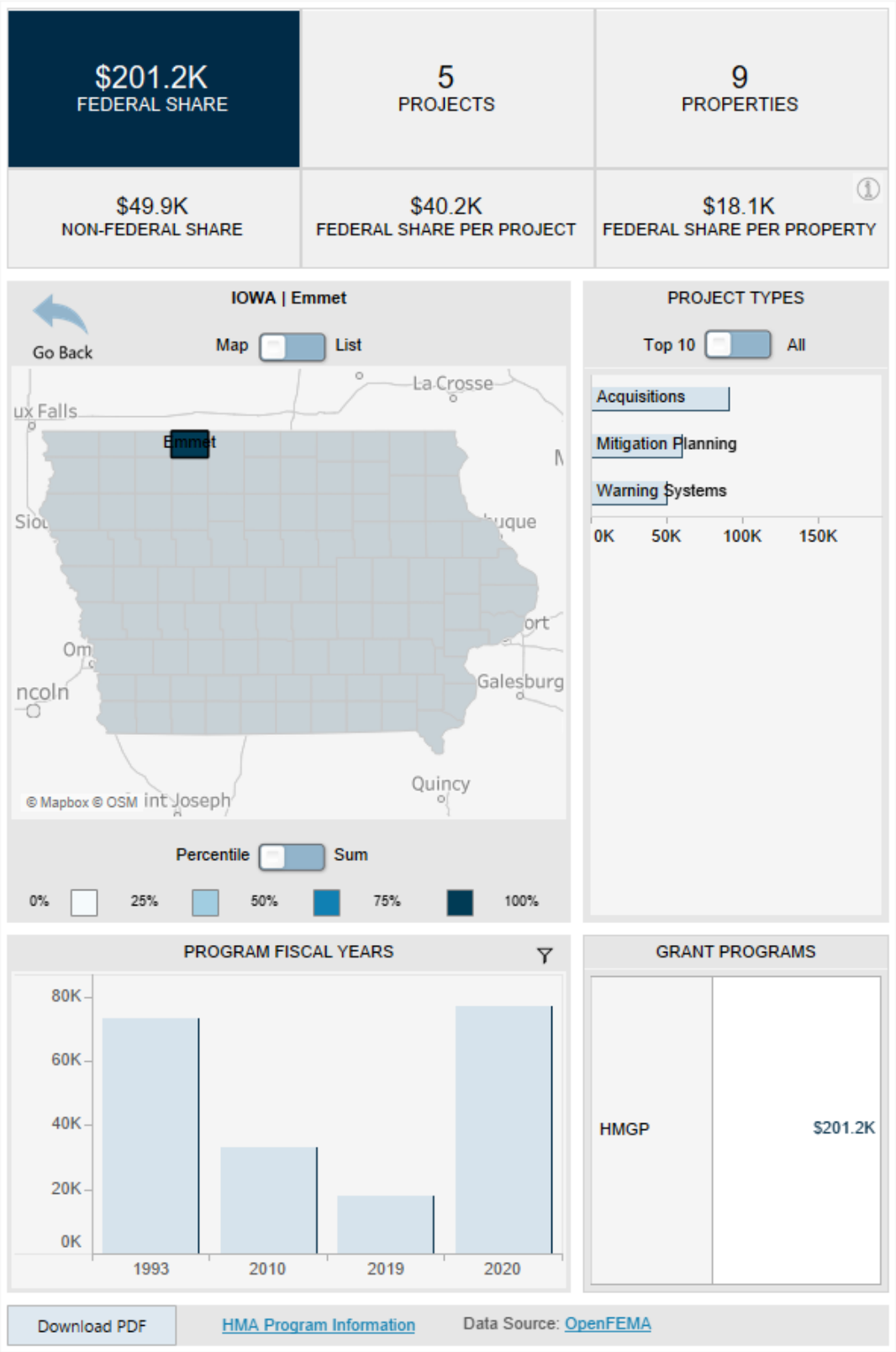
Jurisdiction	Adoption of NFIP Min. Floodplain Management Criteria	Adoption of Latest Effective FIRM	Implementation & Enforcement of Local Flood-Plain Regulation on Development in SFHAs	Designee/ Agency to Implement NFIP Requirements	Describe How Jurisdiction Implements Substantial Improvement/ Substantial Damage Provision
Wallingford	Yes	9/24/2021	Yes (floodplain ordinance)	City Clerk/ Administrator	Building improvements determined to be a SI/SD based on an improvement of 50% of market value or damaged 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

FEMA Hazard Mitigation Assistance Grants in Planning Area

According to FEMA, Emmet County has received Hazard Mitigation Assistance (HMA) funds for 5 different projects since 1996, totaling approximately $200,000 in federal assistance funds. These grants were used for property acquisitions, mitigation planning, and the installation of hazard warning systems. Data was not available for any grants that may have been received prior to 1996. Figure 2-7 below provides a visualization summary of the HMA funds received by Emmet County, as well as information on how the funds were utilized, what fiscal years they were received in, and the program funding was secured through.

Figure 2-7 Emmet County Hazard Mitigation Assistance Visualization



3.2.2 Summary of Capabilities

Emmet County has shown commendable capabilities in mitigating hazard events. The incorporation of information from the 2018 Emmet County Hazard Mitigation Plan into various planning mechanisms, including the Comprehensive Plan and Emergency Support Function (ESF), reflects a comprehensive approach to integrating hazard mitigation strategies into broader community planning efforts.

At the local level, the City of Estherville is taking steps to bury electrical lines, reducing vulnerability to power disruptions. While the city has its own power plant and generators, ensuring power generation capabilities during emergencies remains a key focus. Similarly, the City of Armstrong Is addressing storm drainage issues to mitigate residential flooding, showcasing a commitment to local hazard concerns. The community's response to the COVID-19 pandemic has highlighted the importance of maintaining a constant supply of Personal Protective Equipment (PPE) and considering long-term economic recovery strategies during a pandemic.

Areas identified for improvement by Emmet County and the HMPC center around building codes and community-specific vulnerabilities. Recent census data reveals an increase in the elderly and disabled population, emphasizing the need for a central focus on these vulnerable groups. Developing a comprehensive plan to address their specific needs becomes imperative.

To address these deficiencies, Emmet County can explore innovative approaches to engage the public in discussions on hazard mitigation and awareness. Establishing an ongoing local mitigation committee can play a pivotal role in keeping organizations and residents actively engaged in these critical issues.

Moreover, enhancing the accessibility of information on incorporated jurisdictions' websites related to potential hazards, emergency preparedness, and response measures is essential. Creating a dedicated webpage with consolidated information, including evacuation routes, emergency alerts, and links to County, State, and Federal resources, would empower residents to learn more about potential hazards and easily access information in the event of an incident.

3.2.3 Opportunities for Enhancement

The 2023 update process provided the County and participating jurisdictions an opportunity to review and update the capabilities currently in place to mitigate hazards. There are also opportunities for the County and jurisdictions to expand or improve on their policies, programs and fiscal capabilities and further protect the community. Future improvements may include providing training for staff members related to hazards or hazard mitigation grant funding in partnership with the County, City, School Districts, and Iowa Homeland Security and Emergency Management Department (IHSEMD). Additional training opportunities will help to inform County, City, and District staff members on how best to integrate hazard information and mitigation projects into their departments.

The following are specific examples of potential opportunities for enhancing existing capabilities identified by the HMPC:

Emmet County

- Additional partnerships with area agencies to further develop hazard mitigation programs.
- Consider leveraging community groups to organize public outreach and awareness campaigns to educate the community on potential hazards and mitigation actions.
- Consider adopting State building codes to mitigate potential impacts of hazards.

City of Armstrong

- Join the NFIP to allow access to flood insurance and implement floodplain management to reduce potential risk to new development.
- Work to increase public awareness of potential hazards and mitigation actions they should take through education outreach programs.
- Partner with state, county, or neighboring jurisdictions on sharing staff resources such as a grant writer or GIS mapping specialist.

City of Estherville

- Consider partnering with other 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.
- Partner with State, County and area agencies on funding opportunities to advance hazard mitigation programs.
- Consider adopting building codes to mitigate potential impacts of hazards.

City of Dolliver

- Partner with state, county, or neighboring jurisdictions on sharing staff resources such as a grant writer or GIS mapping specialist.

City of Gruver

- Partner with State, County and area agencies on funding opportunities to advance hazard mitigation programs.
- Partner with state, county, or neighboring jurisdictions on sharing staff resources such as a grant writer or GIS mapping specialist.
- Consider adopting a system for emergency notification and warnings.

City of Ringsted

- Consider adopting a system for emergency notification and warnings.
- Partner with State, County and area agencies on funding opportunities to advance hazard mitigation programs.

City of Wallingford

- Consider adopting a system for emergency notification and warnings.

Iowa Lakes CC

- Update the 2016 Emergency Plan and integrate the 2024 Emmet County HMP where possible.

3.3 Community College Profiles and Mitigation Capabilities

This section includes general profile information for the Iowa Lakes Community College, which is a participant of this plan. Iowa Lakes Community College is the largest higher education institution in Emmet County, granting342 degrees in 2021.

Potential capabilities to implement mitigation programs and projects can vary among school districts. To determine mitigation capabilities, each of the participating school districts and the community college completed a Plan Update Guide to report planning, personnel, fiscal, and other capabilities related to implementation of mitigation programs and projects. Table 2-12 provides a summary of the reported capabilities for each participating school district.

Table 2-12 Summary of Mitigation Capabilities, Iowa Lakes Community College

	Iowa Lakes Community College
Planning Elements	
Master Plan	Yes, updated 9/21/2021
Capital Improvement Plan	Yes, updated 9/21/2021
School Emergency Plan	Yes, updated 9/21/2021
Weapons Policy	Yes, updated 9/21/2021
Personnel Resources	
Full-time building official (i.e. principal)	Yes, Campus Dean
Emergency Manager	Yes, Facilities Management
Grant Writer	Yes, Grants
Public Information Officer	Yes, Marketing
Financial Resources	
Capital Improvement project funding	Yes
Local funds	Yes
General obligation bonds	Yes
Special tax bonds	No
Private activities/donations	Yes
State and federal funds	Yes
Other	
Public Address/Emergency Alert System	No; emergency alert system through RAVE to send via voice, text, and email
NOAA Weather Radios	Yes
Mitigation Programs to Reduce Losses / Public Education Programs	No
Tornado Shelter/Saferoom	Yes
Campus Police	No

Source: Plan Update Guides completed by Iowa Lakes Community College

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 Emmet 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 Emmet 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 4.1.3.

Table 4-1 Hazard Risk Summary

Hazard	Probability	Magnitude/ Severity	Extent/ Location	Hazard Ranking
Animal/Crop/Plant Disease	Unlikely	Critical	Significant	**Low**
Drought	Likely	Critical	Extensive	**Medium**
Extreme Heat	Likely	Critical	Extensive	**Medium**
Flooding (Flash & River)	Highly Likely	Catastrophic	Significant	**High**
Grass or Wildland Fire	Likely	Limited	Significant	**Medium**
Hazardous Materials	Likely	Critical	Significant	**Medium**
Human Disease	Occasional	Limited	Significant	**Medium**
Infrastructure Failure	Likely	Critical	Significant	**Medium**
Landslide	Unlikely	Negligible	Limited	**Low**
Severe Winter Storm	Highly Likely	Limited	Extensive	**High**
Terrorism	Unlikely	Limited	Extensive	**Medium**
Thunderstorms/Lightning/Hail	Highly Likely	Critical	Significant	**Medium**
Tornado/Windstorm	Highly Likely	Limited	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 Emmet County HMP, along with the 19 natural and human-caused hazards in the 2018 State of Iowa HMP. The HMPC then discussed changes in priority and probability of these various hazards or any new information that would change the hazards that can affect Emmet County. Table 4-2 provides the details of the comparison.

Table 4-2 Hazard Comparison Chart

2018 State of Iowa HMP	2018 Emmet County HMP	2023 Emmet County HMP
Animal/Plant/Crop Disease	Animal/Plant/Crop Disease	Animal/Plant/Crop Disease
Dam/Levee Failure	Dam/Levee Failure	--
Drought	Drought	Drought
Earthquake	Earthquake	--
Expansive Soils	Expansive Soils	--
Extreme Heat	Extreme Heat	Extreme Heat
Flooding	Flash Flooding	Flooding (Flash and Riverine)
Grass Fire or Wildland Fire	Grass/Wildland Fire	Grass/Wildland Fire
Hazardous Materials	Hazardous Materials Incident	Hazardous Materials Incident
Infrastructure Failure	Human Disease	Human Disease
Landslide	Infrastructure Failure	Infrastructure Failure
Pandemic Human Disease	Landslide	Landslide
Radiological Incident	Radiological Incident	---
	River Flooding	
Severe Winter Storm	Severe Winter Storm	Severe Winter Storm
Sinkhole	Sinkhole	---
Terrorism	Terrorism	Terrorism
Thunderstorm/Lightning/Hail	Thunderstorm/Lightning/Hail	Thunderstorm/Lightning/Hail
Tornado/Windstorm	Tornado/Windstorm	Tornado/Windstorm
Transportation Incident	Transportation Incident	Transportation Incident

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. Based on these criteria, the HMPC determined the following hazards were not relevant to the planning area:

- **Dam/Levee Failure:** It was decided that the few dams which are present in Emmet County do not present a major threat to populated areas or infrastructure. Relevant details have been incorporated in the Flooding chapter.

- **Earthquake**: As the planning area is a relatively aseismic region with little to no potential for strong ground shaking, and no major history of damaging past events, the HMPC agreed that this hazard did not present a major concern for Emmet County.
- **Expansive Soils**: This hazard is recognized as a likely geologic process to occur in the planning area, but one that is very unlikely to cause major damages or casualties. As such, the HMPC agreed this hazard did not present a significant concern for Emmet County.
- **Sinkhole**: No specific previous occurrences of sinkholes were reported by the HMPC or discovered during research, and the HMPC did not identify any specific assets or areas of development vulnerable to possible sinkholes. This hazard does not present a significant concern for damage or loss of life in Emmet County.
- **Radiological Incident:** Emmet County is not located near any nuclear power plants or major radiological materials transportation routes. The 2023 HMPC determined this hazard was not a risk to the County and excluded it from the 2023 Plan.

Additionally, while the 2018 Plan profiled Flash Flood & River Flood separately, the HMPC elected to combine them into one hazard profile for the 2023 Plan.

4.1.1 Disaster Declaration History

Information utilized to identify hazards relevant for inclusion in the Emmet 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 Emmet County for the period from 1965 to 2023.

Table 4-3 Disaster Declarations that included Emmet 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
259	4/25/1969	FLOODING	4/25/1969	4/25/1969
269	8/14/1969	HEAVY RAINS, FLOODING	8/14/1969	8/14/1969
911	7/12/1991	FLOODING, SEVERE STORM	6/1/1991	6/15/1991
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
1230	7/2/1998	SEVERE STORMS, TORNADOES AND FLOODING	6/13/1998	7/15/1998
1877	2/25/2010	SEVERE WINTER STORMS AND SNOWSTORM	12/23/2009	12/27/2009
1880	3/2/2010	SEVERE WINTER STORM	1/19/2010	1/26/2010
1930	7/29/2010	SEVERE STORMS, FLOODING, AND TORNADOES	6/1/2010	8/31/2010
4184	7/24/2014	SEVERE STORMS, TORNADOES, STRAIGHT-LINE WINDS, AND FLOODING	6/14/2014	6/24/2014
4386	8/20/2018	Severe Storm	6/6/2018	7/2/2018

Disaster Number	Declaration Date	Title	Incident Begin Date	Incident End Date
4421	3/23/2019	Flooding	3/12/2019	Cont.
3480	3/13/2020	Biological	1/20/2020	5/11/2023
4483	3/23/2020	Biological	3/17/2020	5/11/2023
4642	2/23/2022	Severe Storm	12/15/2021	12/15/2021

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

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

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

County	Crop Year	Designation No.	Drought	Wind, High Winds	Fire, Wildfire	Excessive rain, moisture, humidity	Heat, Excessive heat High temp. (incl. low humidity)	Frost, Freeze	Insects	Begin Date	Description of disaster
Emmet	2012	S3337	1	1	1	0	1	0	1	8/7/2012	Drought-FAST TRACK
Emmet	2012	S3361	1	1	1	0	1	0	1	8/21/2012	Drought-FAST TRACK
Emmet	2012	S3375	1	1	1	0	1	0	1	8/28/2012	Drought-FAST TRACK
Emmet	2012	S3390	1	1	1	0	1	0	1	7/17/2012	Drought-FAST TRACK
Emmet	2012	S3390	1	1	1	0	1	0	1	7/17/2012	Drought-FAST TRACK
Emmet	2012	S3398	1	1	1	0	1	0	1	7/24/2012	Drought-FAST TRACK
Emmet	2012	S3446	0	0	0	0	0	1	0	4/9/2012	Frosts, freezes
Emmet	2013	S3498	1	1	1	0	1	0	1	3/15/2013	Drought-FAST TRACK
Emmet	2013	S3553	0	0	0	0	0	1	0	1/1/2013	Heavy rainfall followed by freezing temperatures, and multiple periods of thawing and refreezing, resulting in winterkill
Emmet	2019	S4631	0	0	0	1	0	0	0	2/19/2020	Excessive Rain
Emmet	2020	S4835	1	0	0	0	0	0	0	10/16/2020	Drought-FAST TRACK
Emmet	2021	S4933	1	0	0	0	0	0	0	4/2/2021	Drought-FAST TRACK
Emmet	2021	S4980	1	0	0	0	0	0	0	6/22/2021	Drought-FAST TRACK
Emmet	2021	S5028	1	0	0	0	0	0	0	8/11/2021	Drought-FAST TRACK
Emmet	2022	S5249	1	0	0	0	0	0	0	8/8/2022	Drought-FAST TRACK
Emmet	2022	S5254	1	0	0	0	0	0	0	8/15/2022	Drought-FAST TRACK
Emmet	2022	S5293	1	0	0	0	0	0	0	9/26/2022	Drought-FAST TRACK

Source: U.S. Department of Agriculture; https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/disaster-designation-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.

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

- Emmet County Flood Insurance Rate Map, FEMA
- Emmet County Emergency Management
- Emmet County Flood Insurance Study, FEMA
- Emmet County Multi-Jurisdictional Hazard Mitigation Plan, 2013
- Data Collection Guides completed by jurisdictions
- Environmental Protection Agency
- Federal Emergency Management Agency (FEMA)
- Flood Insurance Administration
- Hazards US (HAZUS)
- 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 (September 2013)
- Iowa State University
- Iowa Utilities Board
- National Drought Mitigation Center Drought Reporter
- National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information
- SILVIS Lab, Department of Forest Ecology and Management, University of Wisconsin
- U.S. Army Corps of Engineers, National Levee Database
- 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. 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. Some instances use half-year data for 2023, which is noted on a case-by-case basis. For hazards that relied more on the knowledge of city officials, public works employees, firefighters, and emergency responders as a data source, a ten-year data frame was used. The ten-year period for this type of data allows people to recall events and problems to the best of their knowledge. Hazards that used a ten-year period include grass or wildland fire, infrastructure failure, terrorism, and transportation incidents. Note that some of these hazards used supplementary data in addition to local knowledge; this data also concentrated on a ten-year time frame.

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.

The results of this risk assessment for the planning area as a whole are summarized above in Table 4-1 Hazards were profiled and ranked based on the following factors that are defined in the table including probability, magnitude/severity, and location/spatial extent. The general combination of these factors yields an overall significance. The table below summarizes hazard significance for the county overall. Jurisdictional variations in the significance rating are described in Section 4.4.

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 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 increase prevalence of asthma and allergies.
- Climate change considerations are further discussed under each hazard profile.

4.2 Assets at Risk

This section inventories the population, structures, critical facilities and infrastructure, and other important assets in the planning area that may be at risk to hazards. 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 Emmet 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.

4.2.1 Property

Building counts and building exposure values are calculated based on parcel data provided by the Emmet County Assessor's Office. The methodology employed to extract the summary of building/improvement counts and values from the parcel data is provided below:

- Parcel values that had an associated dwelling or improvement value were used to determine the number of improved parcels;
- The contents exposure values were calculated by factoring a multiplier to the building exposure values based on usage type. The contents multipliers were derived from FEMA and are defined below;
- Land values have been purposely excluded from the tables because land remains following disasters, and subsequent market devaluations are frequently short-term and difficult to quantify. Additionally, state and federal disaster assistance programs generally do not address loss of land or its associated value (other than crop insurance).

Building Exposure values are based on the 2023 tax year parcel data provided by the Emmet 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 $571 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 $938 million in total value. Table 4-5 below provides a summary of the improved parcel counts and values by usage type. Table x-x breaks those values down by property type. Table x-x gives structure counts by type per jurisdiction for the 5,445 improved parcels in the planning area.

Table 4-5 Emmet County Total Exposure by Jurisdiction Summary

Jurisdiction	Improved Parcel Count	Improved Value	Estimated Content Value	Total Value
Armstrong	525	$53,247,700	$33,315,550	$86,563,250
Dolliver	61	$2,758,700	$1,974,650	$4,733,350
Estherville	2,844	$290,546,550	$184,368,600	$474,915,150
Gruver	57	$10,899,500	$12,850,800	$23,750,300
Ringsted	273	$10,512,900	$6,892,650	$17,405,550
Wallingford	125	$8,960,600	$6,467,700	$15,428,300
Unincorporated	1,560	$193,858,000	$121,661,450	$315,519,450
Total	**5,445**	**$570,783,950**	**$367,531,400**	**$938,315,350**

Sources: Emmet County, Population - U.S. Census Bureau reported by Iowa State University of Science and Technology, WSP Analysis

Table 4-6 Emmet County Total Exposure by Property Type

Jurisdiction	Property Type	Improved Parcel Count	Improved Value	Estimated Content Value	Total Value
Armstrong	Agriculture	1	$900	$900	$1,800
	Commercial	85	$6,140,500	$6,140,500	$12,281,000
	Exempt	15	$203,200	$203,200	$406,400
	Industrial	4	$3,471,500	$5,207,250	$8,678,750
	Mixed Use	1	$95,800	$95,800	$191,600
	Multi-Family	7	$2,445,000	$1,222,500	$3,667,500
	Residential	412	$40,890,800	$20,445,400	$61,336,200
	Total	**525**	**$53,247,700**	**$33,315,550**	**$86,563,250**
Dolliver	Agriculture	2	$52,900	$52,900	$105,800
	Commercial	14	$1,137,700	$1,137,700	$2,275,400
	Exempt	4	$0	$0	$0
	Residential	41	$1,568,100	$784,050	$2,352,150
	Total	**61**	**$2,758,700**	**$1,974,650**	**$4,733,350**
Estherville	Agriculture Dwelling	9	$728,100	$364,050	$1,092,150
	Commercial	305	$40,633,050	$40,633,050	$81,266,100
	Exempt	55	$436,200	$436,200	$872,400
	Industrial	24	$17,902,800	$26,854,200	$44,757,000
	Mixed Use	20	$1,315,800	$1,315,800	$2,631,600
	Multi-Family	42	$10,664,500	$5,332,250	$15,996,750
	Residential	2,389	$218,866,100	$109,433,050	$328,299,150
	Total	**2,844**	**$290,546,550**	**$184,368,600**	**$474,915,150**
Gruver	Commercial	6	$507,200	$507,200	$1,014,400
	Exempt	4	$0	$0	$0
	Industrial	1	$7,103,900	$10,655,850	$17,759,750

Jurisdiction	Property Type	Improved Parcel Count	Improved Value	Estimated Content Value	Total Value
	Mixed Use	1	$87,100	$87,100	$174,200
	Residential	45	$3,201,300	$1,600,650	$4,801,950
	Total	**57**	**$10,899,500**	**$12,850,800**	**$23,750,300**
Ringsted	Agriculture	4	$93,100	$93,100	$186,200
	Agriculture Dwelling	5	$295,100	$147,550	$442,650
	Commercial	49	$3,114,300	$3,114,300	$6,228,600
	Exempt	10	$65,000	$65,000	$130,000
	Multi-Family	2	$261,700	$130,850	$392,550
	Residential	203	$6,683,700	$3,341,850	$10,025,550
	Total	**273**	**$10,512,900**	**$6,892,650**	**$17,405,550**
Wallingford	Agriculture	9	$58,100	$58,100	$116,200
	Agriculture Dwelling	3	$367,600	$183,800	$551,400
	Commercial	19	$3,916,700	$3,916,700	$7,833,400
	Exempt	4	$0	$0	$0
	Residential	90	$4,618,200	$2,309,100	$6,927,300
	Total	**125**	**$8,960,600**	**$6,467,700**	**$15,428,300**
Unincorporated	Agriculture	470	$21,239,400	$21,239,400	$42,478,800
	Agriculture Dwelling	468	$71,415,700	$35,707,850	$107,123,550
	Commercial	56	$4,967,700	$4,967,700	$9,935,400
	Exempt	11	$37,500	$37,500	$75,000
	Industrial	9	$11,388,300	$17,082,450	$28,470,750
	Mixed Use	1	$443,700	$443,700	$887,400
	Multi-Family	2	$470,400	$235,200	$705,600
	Residential	543	$83,895,300	$41,947,650	$125,842,950
	Total	**1,560**	**$193,858,000**	**$121,661,450**	**$315,519,450**
	Grand Total	**5,445**	**$570,783,950**	**$367,531,400**	**$938,315,350**

Sources: Emmet County, Population - U.S. Census Bureau reported by Iowa State University of Science and Technology, WSP Analysis

4.2.2 People

Population numbers come from the 2020 Census and estimates come from multiplying the number of residences by the average household size for each jurisdiction, as shown in Table 4-7. This allows for the estimation of residents living in hazard areas in the following hazard profiles.

Table 4-7 Emmet County Population Data

Jurisdiction	2020 Population	2021 Average Household Size	2021 Population
Armstrong	875	2.04	819
Dolliver	65	2.28	86
Estherville	5,904	2.28	5,904

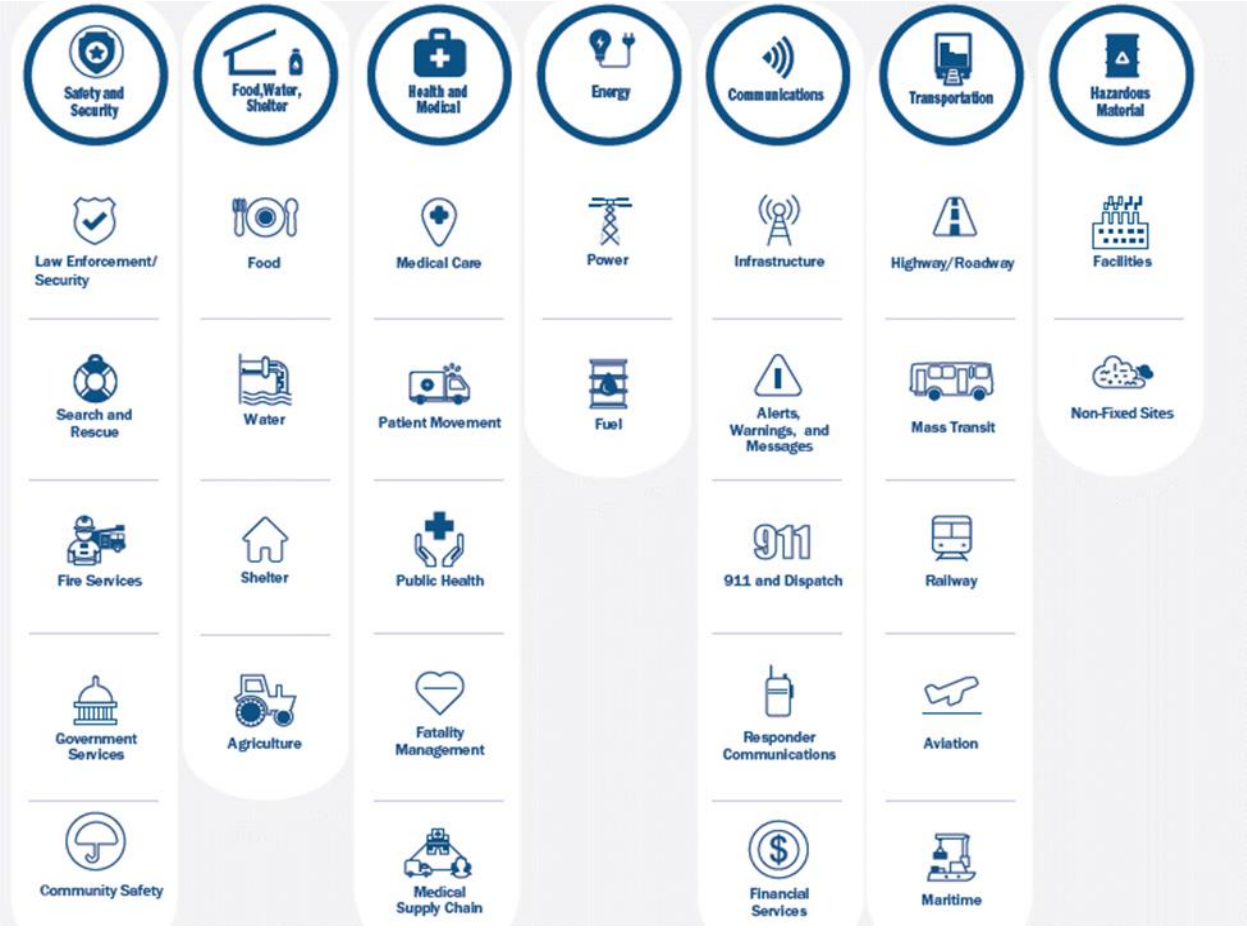
Jurisdiction	2020 Population	2021 Average Household Size	2021 Population
Gruver	63	2.05	63
Ringsted	365	2.17	401
Wallingford	165	2.35	228
Unincorporated	1,951	2.28	1,932
Total	9,388	2	9,433

Source: 2020 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.

Figure 4-1 FEMA Lifeline Categories



Source: FEMA

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.

To develop a comprehensive list of critical facilities in Emmet County, three data sources were compiled and broken down along the three aforementioned critical asset categories.

The best available data was used, but some limitations include a 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 4-8 Critical Facilities by Jurisdiction and Lifeline

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
Armstrong	2	1	5	2	3	4	-	**17**
Dolliver	-	-	1	1	-	1	-	**3**
Estherville	11	4	6	10	8	23	4	**66**
Gruver	1	-	3	1	-	1	-	**6**
Ringsted	-	-	4	1	-	1	-	**6**
Wallingford	-	-	1	1	1	1	-	**4**
Unincorporated	10	6	52	14	-	3	79	**164**
Total	**24**	**11**	**72**	**30**	**12**	**34**	**83**	**266**

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

Table 4-9 Critical Facilities by Jurisdiction and Facility Type

Jurisdiction	FEMA Lifeline	Facility Type	Count
Armstrong	Communications	Microwave Service Tower	2
	Energy	Substation	1
	Food, Water, Shelter	Water Treatment Plant	2
		Water Use Well	3
	Hazardous Material	EHS Tier II Facility	2

Jurisdiction	FEMA Lifeline	Facility Type	Count
	Health and Medical	EMS Station	1
		Nursing Home	2
	Safety and Security	Childcare	1
		Fire Station	1
		Law Enforcement	1
		Public School	1
		Total	**17**
Dolliver	Food, Water, Shelter	Water Treatment Plant	1
	Hazardous Material	Tier II Facility	1
	Safety and Security	Fire Station	1
		Total	**3**
Estherville	Communications	Cellular Tower	1
		Microwave Service Tower	4
		Tornado Siren	6
	Energy	Power Plant	2
		Substation	2
	Food, Water, Shelter	Water Treatment Plant	1
		Water Use Well	5
	Hazardous Material	Contaminated Facilities	1
		EHS Tier II Facility	5
		Tier II Facility	4
	Health and Medical	EMS Station	2
		Hospital	1
		Nursing Home	3
		Public Health Office	1
		Urgent Care Facility	1
	Safety and Security	Childcare	10
		College/University	1
		Courthouse	1
		EOC	1
		Fire Station	1
		Law Enforcement	2
		Public School	3
		Solid Waste Facility	4
	Transportation	Non-Scour Fair Condition Bridge	3
		Non-Scour Good Condition Bridge	1
		Total	**66**
Gruver	Communications	Microwave Service Tower	1
	Food, Water, Shelter	Water Treatment Plant	3
	Hazardous Material	Tier II Facility	1
	Safety and Security	Fire Station	1
		Total	**6**

Jurisdiction	FEMA Lifeline	Facility Type	Count
Ringsted	Food, Water, Shelter	Water Treatment Plant	1
		Water Use Well	3
	Hazardous Material	EHS Tier II Facility	1
	Safety and Security	Fire Station	1
		Total	**6**
Wallingford	Food, Water, Shelter	Water Treatment Plant	1
	Hazardous Material	Tier II Facility	1
	Health and Medical	EMS Station	1
	Safety and Security	Fire Station	1
		Total	**4**
Unincorporated	Communications	Cellular Tower	4
		Microwave Service Tower	5
		Tornado Siren	1
	Energy	Substation	6
	Food, Water, Shelter	Open Feedlot	40
		Water Treatment Plant	6
		Water Use Well	6
	Hazardous Material	Contaminated Facilities	1
		EHS Tier II Facility	7
		Tier II Facility	6
	Safety and Security	Solid Waste Facility	3
	Transportation	Airport	1
		Non-Scour Fair Condition Bridge	46
		Non-Scour Good Condition Bridge	18
		Non-Scour Poor Condition Bridge	14
		Total	**164**
		Grand Total	**266**

Sources: Emmet 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 4-10 provides the list of properties on the National Register in Emmet County.

Table 4-10 Properties/Landmarks on the National Register of Historic Places, Emmet County

City	Resource	Address	Year Listed
Wallingford	Brugjeld-Peterson Family Farmstead District	2349 450th Ave.	2000
Armstrong	Ellsworth Ranch Bridge	130th St., over E fork of Des Moines River	1998

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 4-11 includes Federally Threatened, Endangered, Proposed and Candidate Species in Emmet County, Iowa.

Table 4-11 Threatened and Endangered Species in Emmet County

Common Name	Scientific Name	Status
Northern long-eared bat	*Myotis septentrionalis*	Threatened
Poweshiek skipperling	*Oarisma Poweshiek*	Endangered and Critical Habitat
Prairie bush clover	*Lespedeza leptostachya*	Threatened
Western prairie fringed orchid	*Platanthera praeclara*	Threatened

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

Natural Resources

The Emmet County Conservation Board manages the following parks and nature preserve areas in Emmet County:

- Emmet County Nature Center
- Peterson Point Historic Farmstead: 40 acres, included on National Register of Historic Places
- Wolden Rec Area: 65 acres
- Wolden Arboretum: 2 acres, features over 50 species of trees
- Tuttle Lake Recreation Area: 2,294 acres (981 in Iowa)
- Pappy's Lakeside: 4 acres
- Jim Hall Habitat Area: 37 acres of water, 46 acres of upland and timber, wildlife refuge
- Ringham Habitat Area: 76 acres

- Iowa Lake Wildlife Area: on Iowa Lake, 802 acres (308 in Iowa)
- North Trailhead: 4 acres
- Peterson Access: 3 acres

Additional details about managed areas listed above can be found at https://www.emmetcountyconservationboard.com/.

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 Emmet 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	Extent/Location	Hazard Ranking
Unlikely	Critical	Significant	**Low**

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 overall 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 over 4 million cattle and calves. According to the USDA National Agricultural Statistics Service, as of January 1, 2023, Emmet County ranked 81st in the state with 14,600 head of cattle and calves. According to the 2017 Census of Agriculture, there were also 146,105 head of hogs and pigs in Emmet 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 world-wide since 1986, but in Canada and the U.S. 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. 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 U.S. 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 U.S. 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 U.S.

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 U.S. The cascading net negative economic effects could result in wide-spread 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 Emmet County, see the website above.

Emerald Ash Borer (EAB)

The Emeral Ash Borer is a 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. EAB has made its way into all of Iowa's counties, excluding Emmet and Palo Alto.

Wildlife

Iowa farmers lose a significant amount of crops each year as a result 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 or late frost deep snow, or drought has caused the wild food sources to be limited.

Location

All of Emmet County is subject to animal/livestock incidents and agricultural infestations. According to the 2017 Census of Agriculture there were 488 farms in the County, covering 229,814 acres of land (76.9 percent of the 467 sq. miles of land area (298,880 acres) in the County).

Table 4-12 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 affect the economy.

Table 4-12 Market Value of Agricultural Products Sold, 2012 – Emmet County, IA

Market Value of Products Sold	$117,253,000
Market Value of Crops	$117,253,000 (49.9 percent)
Market Value of Livestock	$117,668,000 (50.1 percent)
Average Per Farm	$481,396

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 Emmet County. According to data from the Iowa NRGIS Repository, there are 99 Animal Feeding Operations in Emmet County listed in the Iowa Department of Natural Resources Animal Feeding Operations Database. This includes 95 Confined Animal Feeding Operations and 14 Open Feedlots, and 10 combination Confined/Open feedlot.

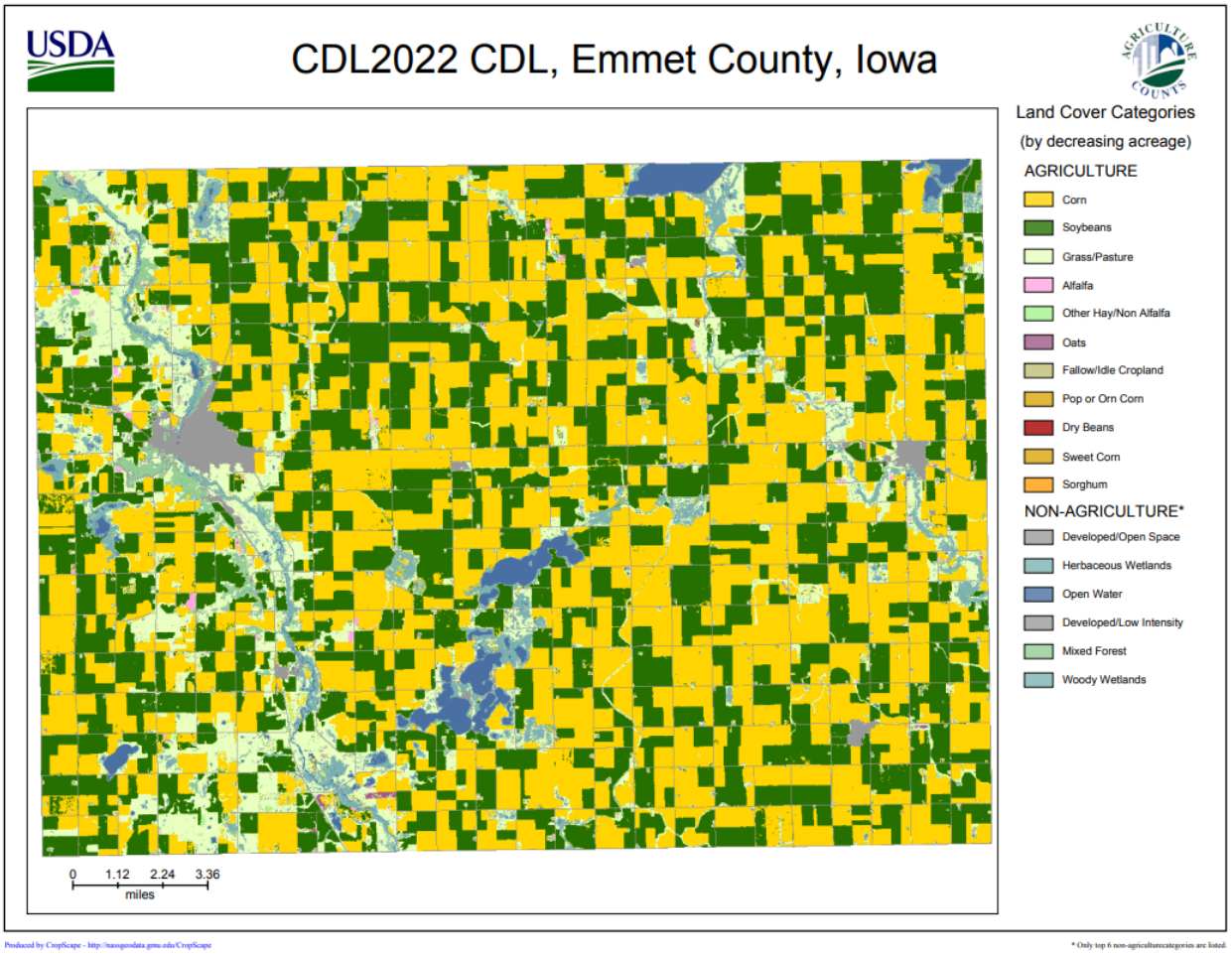
Crop Location/Extent

According to the National Agricultural Statistics Service, in 2022 Emmet County's top crop items included the following:

- Corn for Grain (State Rank 67th) - 109,200 acres harvested
- Soybeans (State Rank 61st) - 89,800 acres harvested

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

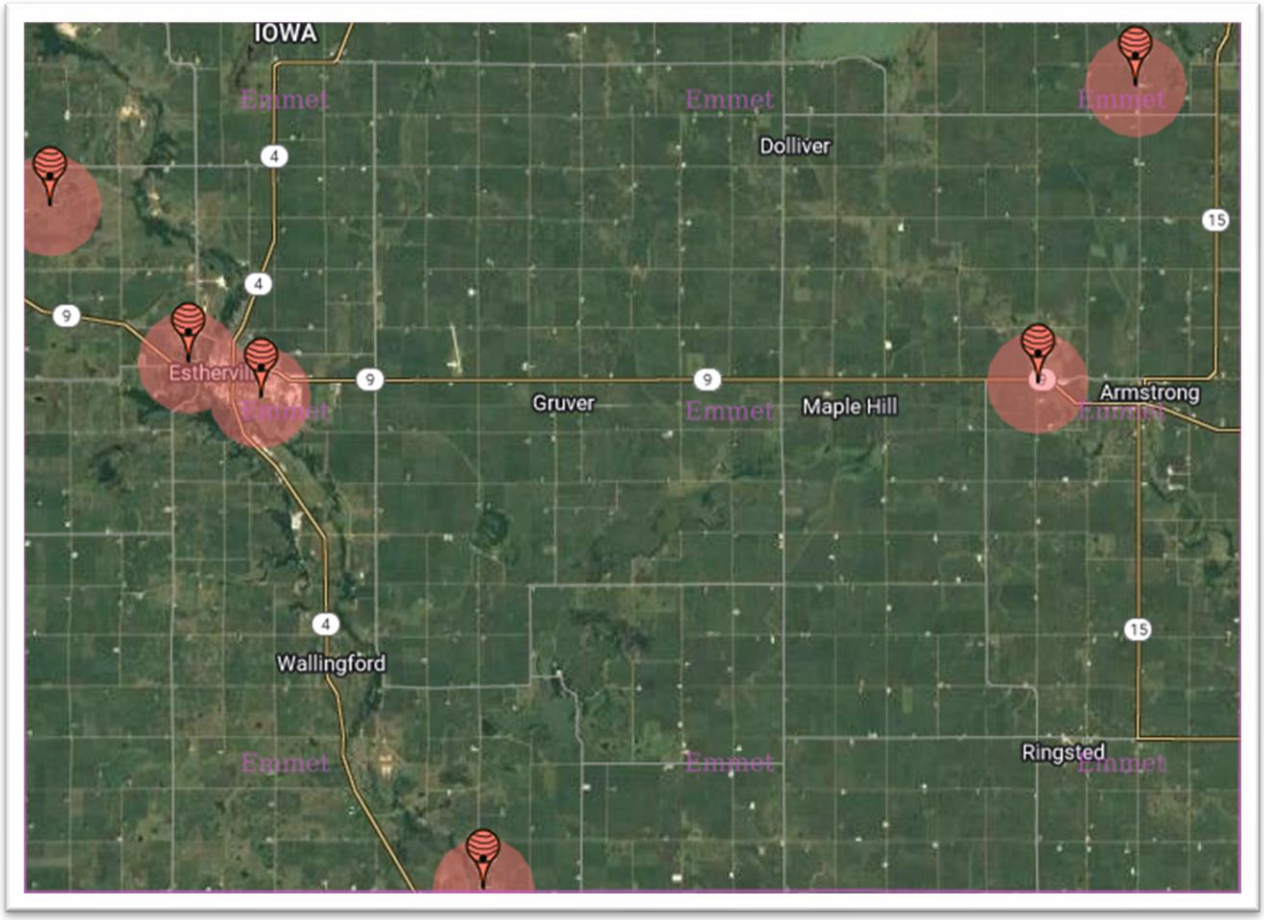
Figure 4-2 Emmet County Cropland Data Layer



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, Emmet County, IA

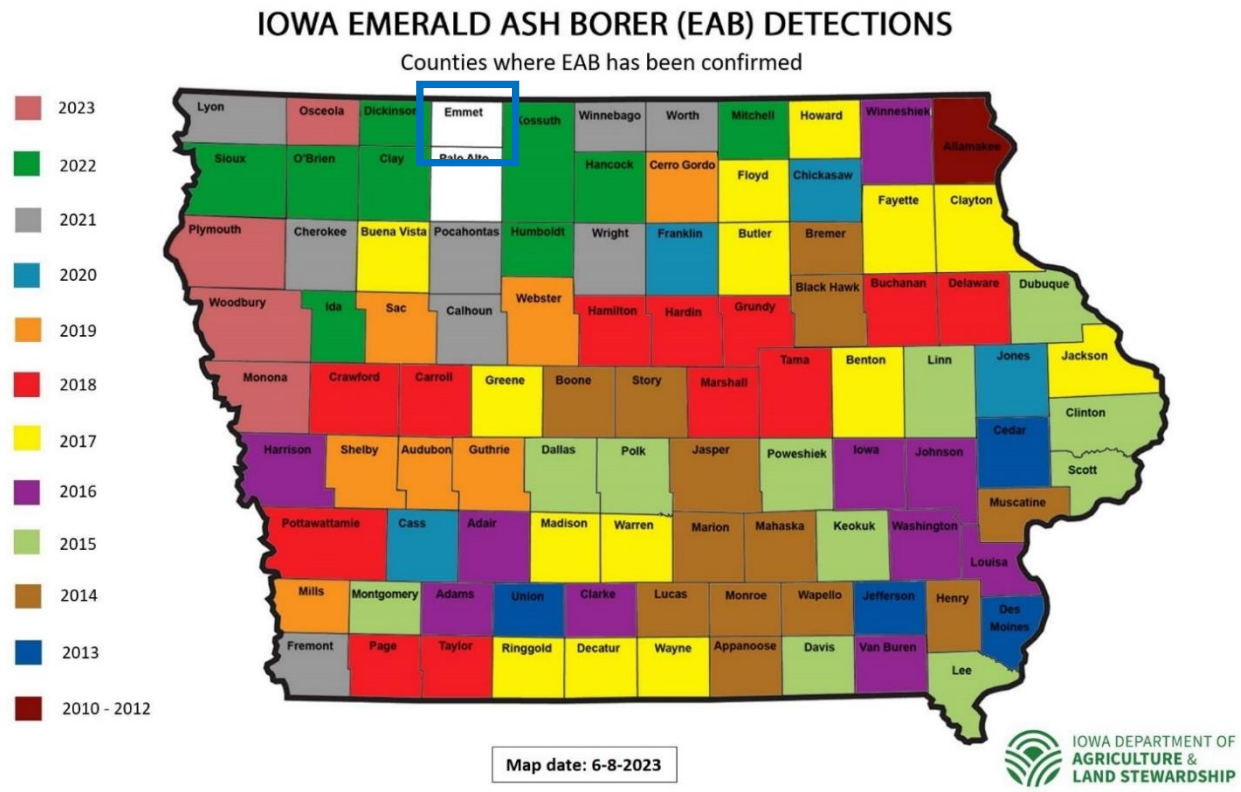


Source: Iowa Specialty Crop Site Registry, https://ia.driftwatch.org/map

Emerald Ash Borer Location/Extent

Figure 4-4 shows the counties in Iowa in which EAB has been detected. Emmet and Palo Alto Counties are not shaded, indicating there has not been EAB detected in the County between 2002 and 2023. However, neighboring counties Dickinson and Kossuth are shaded green, indicating EAB was detected within county limits in 2022.

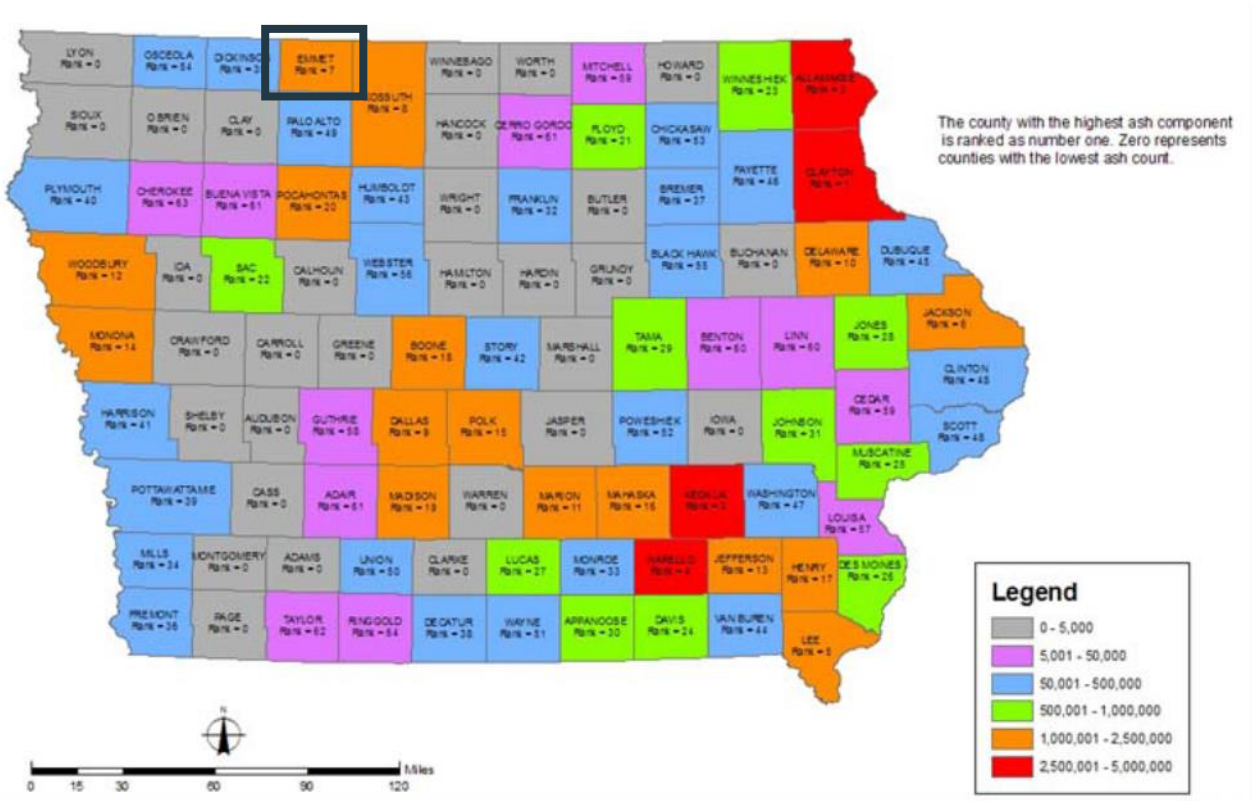
Figure 4-4 USDA Emerald Ash Borer County Detection Map



Source: http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/index.shtml; Blue square identifies Emmet 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, Emmet County ranks 7th in the state with up to 2,500,000 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" http://www.extension.iastate.edu/pme/EAB%20other%20forms/IA%20EAB%20Readiness%20Plan%2010MAY2010.pdf to help stop this pest by education, monitoring, surveillance, containment, and communication.

Figure 4-5 Distribution of Ash Trees in Iowa



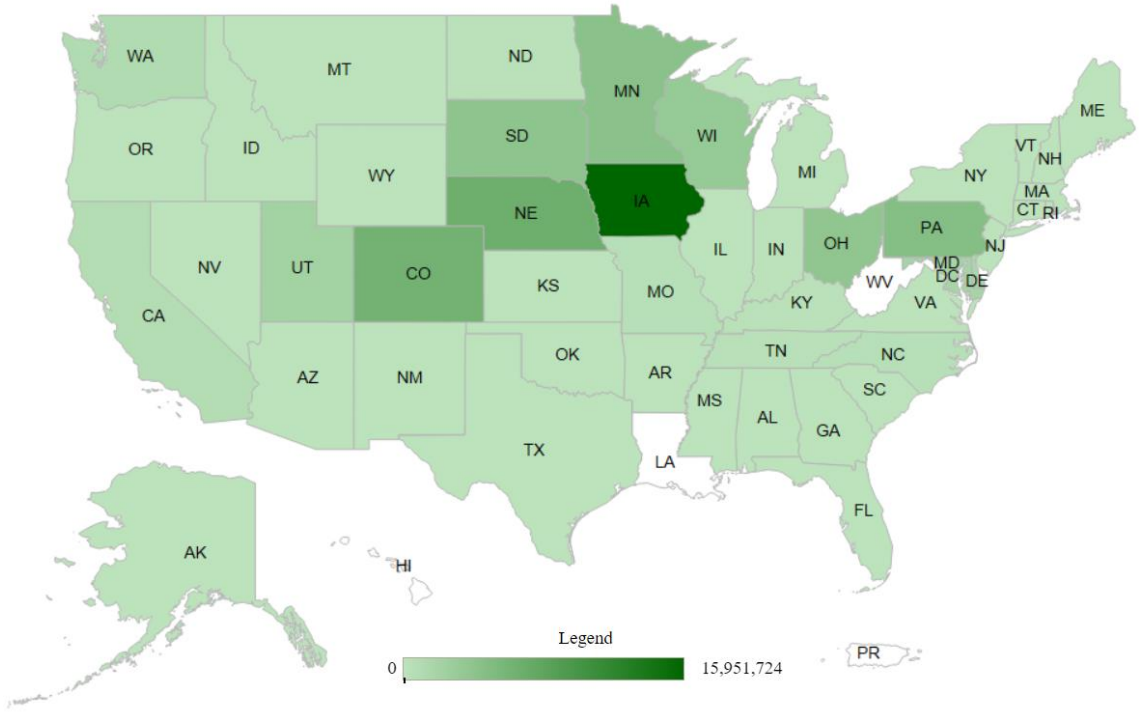
Source: Iowa State University Extension Office
http://www.extension.iastate.edu/pme/EAB%20other%20forms/Iowa%20Ash%20Tree%20Distribution%202006%20map.jpg
Note: Emmet County is outlined in black.

Past Occurrences

Animal Disease 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 Emmet County was not included.

Figure 4-6 Birds Affected by 2022-23 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 U.S. cattle.

Chronic Wasting Disease

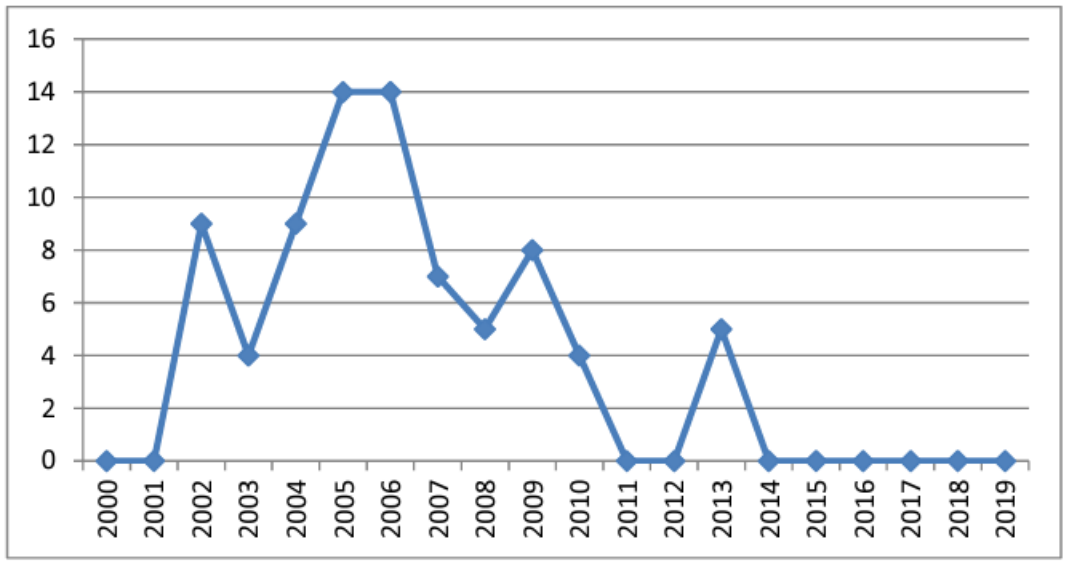
The first case of CWD in Iowa was found in 2012 on a hunting preserve in the southeastern part of the state. In that case, it was determined the CWD-positive mature buck had been transferred to the hunting preserve from a deer farm in north central Iowa. Subsequent testing found CWD at the deer farm. The 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 chronic wasting disease.

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. Cases in Iowa are mainly clustered in the northeast and south-central parts of the State; there have been no confirmed cases in Emmet during the 2022-2023 season.

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 10 confirmed animal rabies cases in Iowa in each 2017 and 2018. In Emmet County, there has been one confirmed case of rabies since 2011. Table 4-13 summarizes the occurrence of rabies in Emmet County from 2011-2018, the most current data available.

Table 4-13 Rabies Cases in Emmet County, 2011-2016

Year	Confirmed Rabies Cases in Emmet County #/Animal	Confirmed Rabies Cases in Iowa
2017	0	10
2017	0	10
2016	0	19
2015	0	12
2014	0	15
2013	0	12
2012	1/Skunk	31
2011	0	25

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

Crop Disease

According to the U.S. Department of Agriculture's Risk Management Agency (RMA), during the 15-year period from 2007-2021, combined crop insurance payments for damages resulting from agricultural disease

in Emmet County totaled $24,468. The Iowa Statewide average for insurable crop acres with insurance is 93.0 percent (RMA 2022). Table 4-14 provides a summary of insured crop losses as a result of crop infestations The HMPC noted that the county had experienced problems with Asian Beetle but has since mitigated the issue through a spraying program.

Table 4-14 Crop Insurance Payments for Crop Pests/Diseases 2007-2016

Damage Cause	Sum of Indemnity Amount	Sum of Determined Acres
Asian Soybean Rust	**$22,108**	**312**
2014	$22,108	312
Mycotoxin (Aflatoxin)	**$13,607**	**42**
2010	$13,607	42
Plant Disease	**$17,753**	**193**
2017	$6,333	135
2010	$3,416	5
2014	$9,004	53
Grand Total	**$54,468**	**547**

Source: USDA Risk Management Agency

Probability of Future Occurrence

The planning area experiences some level of agricultural loss every year as a result 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 Emmet 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 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.

Animal/plant/crop disease is considered to have limited 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 could be felt for months and years to follow given the agricultural nature of the State of Iowa.

Climate Change Considerations

The climate change impacts below are excerpted from the 2010 Report on Climate Change Impacts on Iowa, the most recent report available, developed by the Iowa Climate Change Impacts Committee.

Animals

Despite the fact that Iowa ranks first in hog and fourth 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.

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 (CO2) 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 U.S. 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.

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, Emmet County has 488 farms. Jobs could be negatively impacted during an agriculture emergency and 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 crop disease 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 livestock or crops could impact the economy of the County. According to the 2019 Iowa Agricultural Economic Contribution Study, Emmet County agriculture provides 2,698 jobs, representing 45 percent of total jobs in the County. 7 percent of total jobs in the County are derived from crops, 24 percent of total jobs in the County are derived from livestock, and 14 percent of total jobs in the County are derived from other agricultural products. The total value-added of Emmet County's agricultural products sold was $242.9 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 Emmet County in 2017 was $117,253,000. Based on a worst-case scenario where 50 percent of crop production is lost in a given year due to agricultural infestations, the total direct costs could exceed $58 million.

Rough estimates of potential direct losses from a maximum threat event fall in a range of 1-75 percent of livestock receipts. The market value of all livestock in Emmet County in 2017 was $117,668,000. Based on a worst-case scenario where 75 percent of livestock is lost in a given year due to animal disease, the total direct costs could exceed $88 million.

Environment and Cultural Resources

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 EAB, 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.

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.

- Agriculture plays a big part in the economy of Emmet County
- 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 Drought

Location	Magnitude/Severity	Future Probability	Overall Significance
Extensive	Critical	Likely	**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 types of drought conditions relevant to Iowa:

Meteorological drought is defined on the basis of 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 U.S. 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 2012 Census of Agriculture, of the 253,364 acres of land area in Emmet County, 86.4 percent (218,987 acres) is utilized for agricultural purposes. There were 475 farms with an average size of 461 acres per farm. Although the entire planning area in Emmet County is at risk to drought, the agricultural areas are more vulnerable to the immediate effects of drought. The map in Figure 4-2 in the Animal/Plant/Crop Disease hazard section displays the locations of various cropland uses in Emmet County.

Past Occurrences

According to the Iowa Environmental Mesonet, the mean annual precipitation for Emmet County is 28.91 inches. This total is lower than the state's average of approximately 34 inches per year, but on average still represents enough rainfall to prevent drought. However, successive years of below-average rainfall are the cause of drought impacts in the planning area.

Table 4-15 provides the damage causing events that drought has caused on property and crops. August of 2001 had the most impact on crops in Emmet County which led to a total of $11,350,000 in crop damage. This year, much of the State of Iowa recorded less than 50% of normal rainfall for the month, with a few locations under 10% of normal rainfall. This created a rapid deterioration of the corn and soybean crops. Over the years, majority of drought conditions begin in late June into July and August.

Table 4-15 Damages Caused by Drought in Emmet 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	$4,500,000
8/1/2012	$0	$6,000,000
8/1/2013	$0	$21,000,000
Total	**$12,650,000**	**$42,850,000**

Source: NCEI, 1950-2022

According to the National Drought Mitigation Center's Drought Impact Reporter, during the 10-year period from January 2013 through December 2022, 146 listed drought impacts were noted for the State of Iowa. Of these impacts, 7 were reported to affect Emmet 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 – 1
- Society & Public Health – 1
- Water Supply & Quality – 2

Impacts of recent drought periods in Iowa that affected Emmet County are provided below. Unless otherwise indicated, these impacts are from the National Centers for Environmental Information (NCEI).

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

August 1-31, 2013 – Serious drought conditions gripped the state through the summer months. Initial sub-soil moisture was good at the beginning of the growing season. The recharged soil was sufficient to maintain the crops through a good part of the summer. Rainfall remained low through August as well and crops deteriorated rapidly under the warmer than normal and very dry conditions. Rainfall for the summer was between 1/3 and 2/3rds of normal across much of the Des Moines CWA. A large part of the CWA received under 5% of normal rainfall in August, with most areas under 20%. Crop loss through the month was around 10%. This translated to over $600 million in crop loss for the corn crop, and about $350 million for soybeans.

January 9 – May 16, 2013 – According to the Drought Impact Reporter, there were drought-related USDA disaster declarations in 2013.

May 12 – July 1, 2013 – According to the Drought Impact Reporter, drought-stressed crops left unused fertilizer in Iowa fields, impacting water quality.

September 1, 2012 – June 11, 2013 – According to the Drought Impact Reporter, groundwater levels remain low in much of northwestern Iowa after blistering drought in 2012.

September 19, 2012 – According to the Drought Impact Reporter, The U.S. Department of Agriculture on Sept. 19, 2012, designated six counties in Iowa as disaster areas due to damages and losses caused by the recent drought. Farmers in adjacent counties in Iowa, Minnesota, and Missouri were also eligible for low-interest emergency loans from the Farm Service Agency.

August 29, 2012 – According to the Drought Impact Reporter, The U.S. Department of Agriculture (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 Farm Service Agency.

September 12, 2012 – According to the Drought Impact Reporter, The U.S. Department of Agriculture on 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.

September 5, 2012 – The U.S. Department of Agriculture (USDA) on Sept. 5, 2012, designated Palo Alto County in Iowa as a primary natural disaster area due to damages and losses caused by the recent drought. Farmers there and in seven contiguous counties are eligible for low interest emergency loans from the Farm Service Agency. All other Iowa counties that would be eligible under 7 CFR 759.5 (a), already have been designated as primary natural disaster counties.

January 29, 2012 – According to the Drought Impact Reporter, some private wells in northwestern Iowa went dry.

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 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 in spite of 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 in excess of $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 in spite of 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 in excess of $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 1-31, 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 in excess of $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 1-31, 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 in excess of 100 degrees. 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 in excess of $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 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 degrees 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 degrees 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 an all-time 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 degrees 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 degrees 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 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.

Losses due to drought reported on the NCEI Storm Events database total $12.65 million in property damage and $83.35 million in crop damage.

Table 4-16 below provided by the U.S. Drought Monitor, summarizes the historical drought conditions for Iowa by intensity and percent area from 2008 through 2017. Portions of Emmet County were in extreme drought intensity in 2012 and 2013 during this 10-year timeframe.

Table 4-16 Historic Drought Intensity (Percent Area) Emmet County, Iowa 2008-2017

Drought Intensity	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2008 - 2017 Average
None	90.02	93.92	100.0	66.90	0.65	13.62	53.03	69.74	9.58	89.12	67.68
D0 Abnormally Dry	9.82	6.08	0.00	9.45	12.82	20.15	3.63	30.24	0.42	10.44	10.28
D1 – Moderate	0.16	0.00	0.00	5.62	7.69	35.47	43.34	0.02	0.00	0.44	9.32
D2 – Severe	0.00	0.00	0.00	18.03	55.44	5.76	0.00	0.00	0.00	0.00	7.89
D3 – Extreme	0.00	0.00	0.00	0.00	23.41	25.01	0.00	0.00	0.00	0.00	4.82
D4 – Exceptional	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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

The Emmet County Emergency Management Agency recorded the following photo of severe drought conditions causing the East Fork of the Des Moines River to stop flowing. The conditions affected irrigation for crops and cattle watering.

Source: Emmet County Emergency Management Agency

According to the USDA's Risk Management Agency, payments for insured crop losses in Emmet County as a result of drought conditions occurred in nine of the ten years from 2007-2021 and totaled $15,624,597 (see Table 4-17). With the extensive drought conditions during the years of 2013 and 2022, 66 percent of the 10-year crop losses came from these two years alone.

Table 4-17 Crop Insurance Claims Paid from Drought, 2007-2016

Year	Insurance Paid
2007	$191,055.00
2008	$1,297,907.00
2009	$2,189.00
2011	$223,508.00
2012	$2,084,982.00
2013	$6,935,657.00
2014	$36,264.00
2015	$20,998.00
2016	$13,974.00
2017	$122,878.80
2020	$1,226,788.00
2022	$3,468,395.97
Insurance Paid	$15,624,596.77

Source: USDA Risk Management Agency

Table 3-31 summarizes the last fourteern years' agricultureal losses as reported in the RMA system:

Table 3-31 Crop Losses Resulting from Drought in Emmet County, Iowa 2007-2021

Year	Commodity Affected	Determined Acres	Indemnity Amount
2007	Corn, Soybeans	2,825.00	$191,055
2008	Corn, Soybeans, All Other Crops	17,524	$1,297,907
2009	Soybeans	40	$2,189

Year	Commodity Affected	Determined Acres	Indemnity Amount
2011	Corn, Soybeans	2,895	$223,508
2012	Corn, Soybeans	15,999	$2,084,982
2013	Corn, Soybeans	46,436	$6,935,657
2014	Corn, Soybeans	598.78	$36,264
2015	Corn, Soybeans	457.7	$20,998
2016	Corn, Soybeans	167	$13,974
2017	Corn, Soybeans	1192.29	$122,879
2020	Oats, Corn, Soybeans	18,943.75	$1,226,788
2021	Oats, Corn, Soybeans	28,576	$3,468,396
TOTAL		**135,654**	**$15,624,597**

Source: USDA Risk Management Agency

Probability of Future Occurrence

NOAA's National Climatic Data Center uses the U.S. 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 nine years with crop insurance claims as a result of drought in Emmet County. If this trend continues, this results in a probability of 90% that drought will result in agricultural impacts in any given year. The probability rating for this hazard is "Highly Likely".

Magnitude/Severity

The magnitude of drought in Emmet County can be **critical**. 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 Emmet 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

According to the Fourth National Climate Assessment, climate change impacts in the Midwest will include increased frequency of late-growing season drought conditions. Future conditions of surface soil moisture are projected to increase in insufficient levels in summer driven by an increase in temperatures leading to greater loss of moisture through evaporation (U.S. Global Change Research Program 2018).

For the most part, climate change studies have shown increases in precipitation, rather than decreases. However, drought cycles still continue. Climate change studies have also shown some increases in average temperatures and decreases in the overall number of days with precipitation. If this occurs during a drought cycle, the drought impacts will be exacerbated and increased agricultural losses will be sustained.

Vulnerability

Emmet County jurisdictions are impacted by drought because it is an expensive weather disaster; it reduces agricultural productivity and causes a strain on urban water supplies. In Emmet 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.

Emmet County has 475 farms in the County that cover 218,987 acres of land. This translates to 86.4 percent of the surface land in the County being used for agriculture. Therefore, the planning area has a 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.

According to the *2013 Iowa Hazard Mitigation Plan*, of the 8 hazards for which data was available to estimate annualized losses, drought ranked 2nd with $424 million in annualized losses based on data spanning an 18-year period. 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 as a result of declined air quality in times of drought.

Property

No structures will be directly affected by drought conditions, though some structures may become 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.

Economy

Areas associated with agricultural use are vulnerable to drought conditions which could result in a decrease in crop production or a decrease in available grazing area for livestock. Drought has no real effect on houses and buildings. The impacts would be minimal in terms of landscaping. Rationing water supplies would most likely be the worst case scenario impact.

According to the USDA's Risk Management Agency, during the ten-year period from 2007-2021, the amount of claims paid for crop damage as a result of drought in Emmet County was $15,624,597. According to the 2016 Iowa Crop Insurance Profile from USDA's Risk Management Agency, 89 percent of the insurable crops in Iowa are insured with USDA Crop Insurance. To factor in estimated losses to insurable crops that are not insured, the 66 percent crop insurance coverage was factored in to provide an adjusted estimate of losses. According to this calculation, estimated annualized losses total $1,562,459.60.

Considering the value of crops from the 2012 Census of Agriculture as baseline crop exposure, the estimated annual losses from drought was determined minimal compared to the value of the insurable crops.

Table 4-18 Estimated Insurable Annual Crops Lost Resulting from Drought

10-Year Drought Insurance Paid	Adjusted 10-Year Drought Losses (considering 66% insured)	Estimated Annualized Losses	2012 Value of Crops	Annualized Crop Loss Ratio (Losses/Value)
$15,624,597	$12,142,173	$1,562,459.60	$156,881,000	0.77%

Source: Crop value is from USDA 2012 Census of Agriculture; Crop Insurance Paid is from the USDA's Risk Management Agency for 2007-2016.; Crop Insurance Coverage is from USDAs 2016 State Crop Insurance Profile for Iowa

Environment and Cultural Resources

If a drought event were to occur in Emmet 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 County 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.
- Extreme heat events are unlikely throughout the County, and the magnitude of heat events is low.
- The effects of recent droughts have exposed the vulnerability of the planning area's economy to drought events.
- Related hazards: Extreme Heat, Wildfire

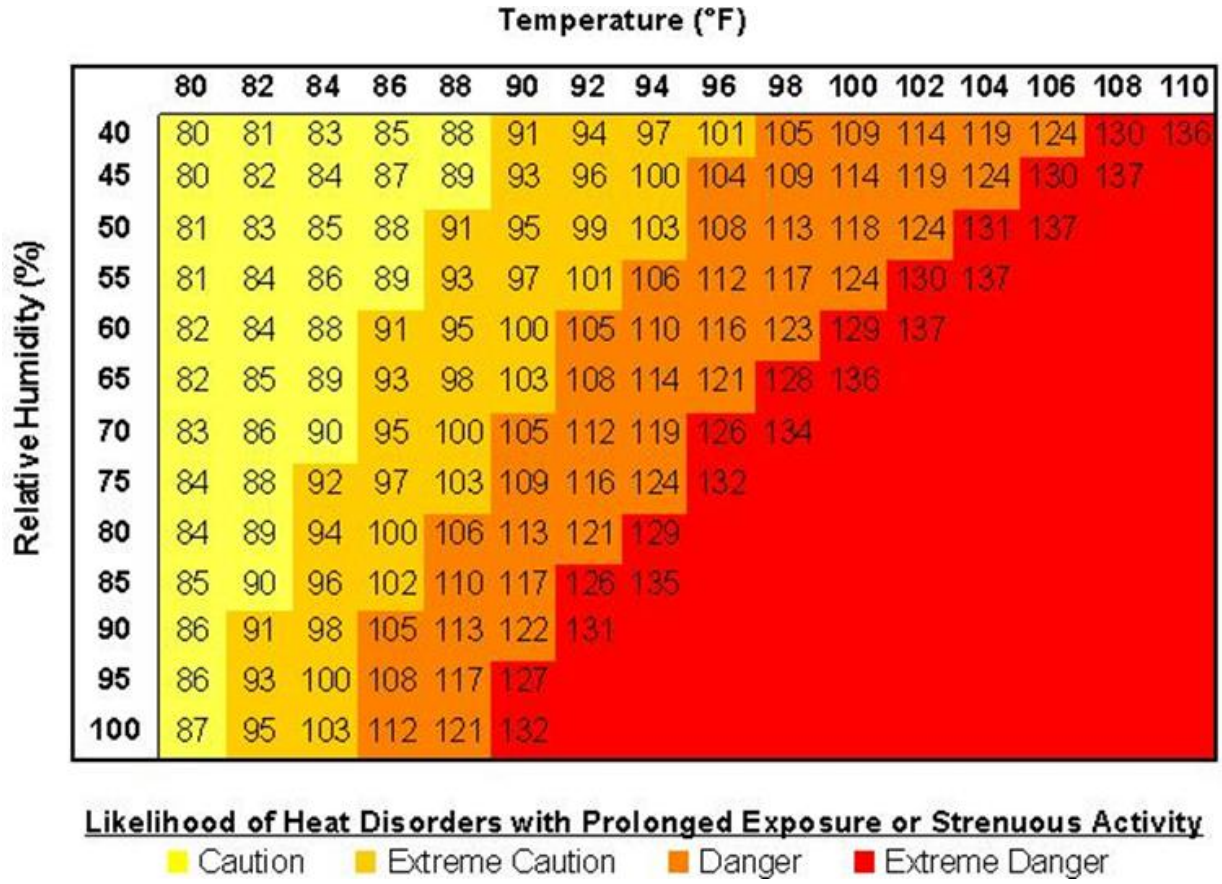
4.3.3 Extreme Heat

Location	Magnitude/Severity	Future Probability	Overall Significance
Extensive	Critical	Likely	**Medium**

Description

According to information provided by FEMA, extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks. 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 Chart in Figure 4-8 uses both of these factors to produce a guide for the apparent temperature or relative intensity of heat conditions.

Figure 4-8 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.

The most dangerous place to be is in a permanent home, with little or no air conditioning. Those at greatest risk for heat-related illness include people 65 years of age and older, young children, people with chronic health problems such as heart disease, people who are obese, people who are socially isolated, and people who are on certain medications, such as tranquilizers, antidepressants, sleeping pills, or drugs for Parkinson's disease. However, even young and healthy individuals are susceptible if they participate in strenuous physical activities during hot weather or are not acclimated to hot weather. In agricultural areas, the exposure of farm workers, as well as livestock, to extreme heat is a major concern. Table 4-19 lists typical symptoms and health impacts of exposure to extreme heat.

Table 4-19 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, www.weather.gov/os/heat/index.shtml

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 degrees Fahrenheit (°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 degrees, and a warning is issued at 115 degrees.

Location

Given the regional nature of extreme heat, the spatial extent of drought is **extensive** for Emmet 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 surround rural areas due to the urban hear island effect.

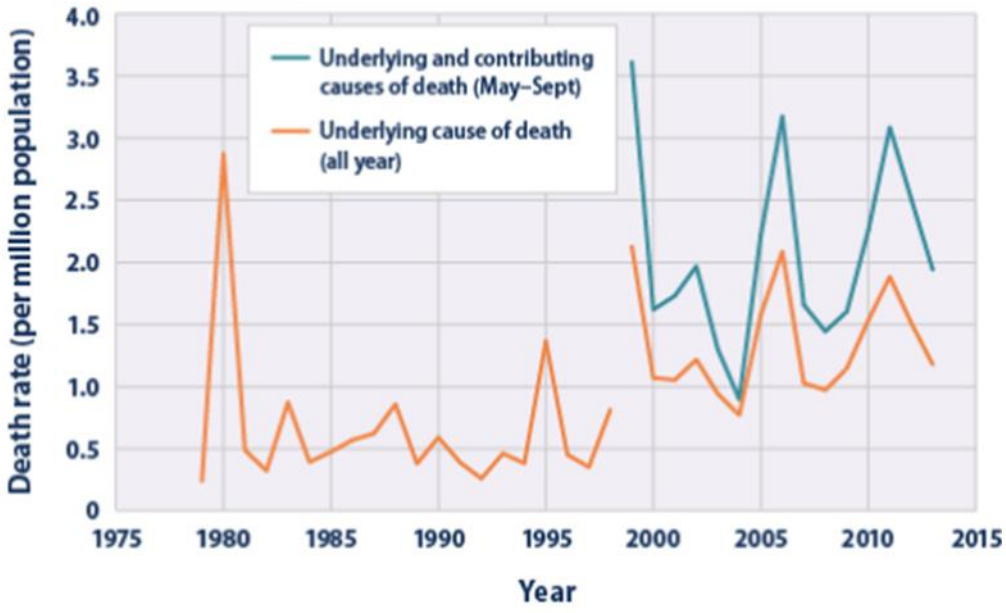
The NWS has a system in place to initiate alert procedures (advisories or warnings) when the Heat Index is expected to have a significant impact on public safety. The expected severity of the heat determines whether advisories or warnings are issued. A common guideline for issuing excessive heat alerts is when the maximum daytime Heat Index is expected to equal or exceed 105 degrees Fahrenheit (°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 degrees, and a warning is issued at 115 degrees.

Past Occurrences

Figure 4-9 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, 45 148 people died nationally as a result 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 4-9 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

The 2013 Iowa State Hazard Mitigation Plan reports the following additional instances of agricultural losses due to extreme heat:

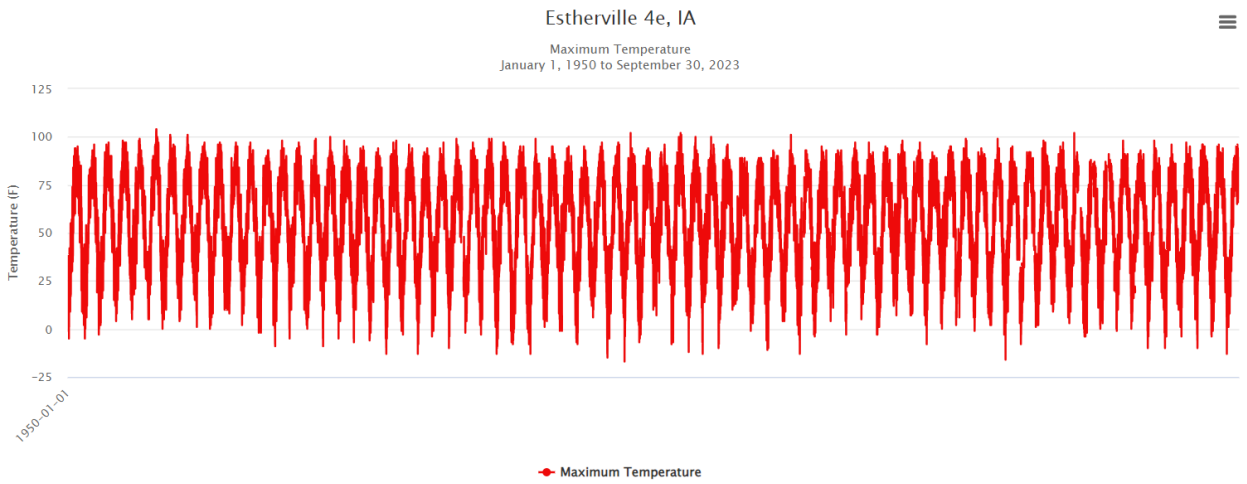
- **July 2011** – The Iowa Cattlemen's Association reported that approximately 4,000 cattle died due to extreme heat.
- **1995** – livestock-related economic losses due to heat stress were estimated to be $31 million in Iowa.

On average, the hottest months of the year are July and August. According to the High Plains Regional Climate Center, the average temperature in Emmet County for the month of July is 71.4 degrees Fahrenheit (ºF) with an average maximum temperature of 82.6 ºF; and the average temperature for the month of August is 68.8 ºF with an average maximum temperature of 79.9 ºF. (Source: http://climod.unl.edu/)

According to data from High Plains RCC, from 1996 to 2017, there were 74 days with temperatures 93 degrees Fahrenheit or above (at least 10 degrees above normal). When looking at only those events with a high temperature of 93 degrees Fahrenheit and higher that lasted for 3 consecutive days or more, there were two occurrences during the 20-year period from 1996 through 2017.

Figure 4-10 shows the daily maximum temperatures for the Estherville, Iowa weather station for the period of record from 1950 through Summer of 2023 from the High Plains Regional Climate Center. This data shows that a temperature of 103 °F was reached in 1955 as the highest recorded temperature during the 73-year timeframe. The months of the year with the highest temperatures are generally July and August.

Figure 4-10 Maximum Temperature, Estherville, Iowa (1950 – 2023)



Source: High Plains Regional Climate Center

The National Climatic Data Center reported one regional heat event and three regional excessive heat events in and around the Emmet County planning area:

August 5, 2001 – Regional Heat Event – Very warm and humid conditions that began in the last part of July continued into August. Temperatures during the day warmed into the 90s, with overnight lows remaining in the 70s. Dew point temperatures held in the mid-70s to low 80s through most of the time. An elderly woman passed away in Des Moines on the 5th. She was found in her home with the windows closed and temperatures in the house in excess of 100 degrees F. She had succumbed to the heat.

July 15-28, 2011 – Regional Excessive Heat Event – A large area of high pressure developed in the upper atmosphere by the middle of July. Heat built up over Iowa, aided by the severe drought to the south across Kansas, Oklahoma, and Texas. Temperatures rose into the 90s each day through the period. Though most days did not see 100-degree heat, the dewpoint and overnight lows were very significant. Low temperatures during most of the nights were in the 70s, with many of the nights in the mid to upper 70s. Dewpoint temperatures failed to fall below 70 through most of the period, with frequent excursions in the upper 70s to low 80s. These conditions caused considerable stress on livestock. Reports indicated that at least 4000 head of cattle and thousands of turkeys were killed by the suffocating heat. Livestock losses were estimated in the $5 to $10 million-dollar range.

July 20-23, 2016 – Regional Excessive Heat Event – A warm front lifted through the state on the 20th, allowing southerly winds to bring about high temperatures in the low 90s along with dew points in the upper 70s to 80 at times. As a result, heat index values easily eclipsed the 100-105-degree range and at times exceeded 110. Additionally, overnight lows did not provide much in the way of relief with many areas seeing lows in the mid and even upper 70s at times.

July 19, 2019- Regional Excessive Heat Event - A large area of high pressure strengthened across the area through the week resulting in hot temperatures and high humidity values in place across Iowa for a prolonged period of time. This led to high heat index values through much of the period, especially during the afternoon and early evening hours. Little relief was felt during the overnight hours as low temperatures remained in the 70s to around 80. Heat index values were consistently in the 105 to 115 degree range during much of the daytime period.

According to the USDA's Risk Management Agency, insured payments in Emmet County for damages to crops as a result of heat and hot wind from 2007-2021 totaled $61,708.

Table 4-20 shows the insurable crop insurance claims paid in Emmet County as a result of heat and hot wind.

Table 4-20 Claims Paid in Emmet County for Crop Loss as a Result of Heat and Hot Wind (2007-2021)

Year	Hazard	Insurance Paid
2007	Hot Wind	$399.00
2009	Heat	$3,728.00
2011	Heat	$16,633.00
2012	Heat	$40,948.00
Insurance Paid		**$61,708.00**

Source: Crop Insurance Paid is from the USDA's Risk Management Agency for 2007-2016;
Note: There were no claims paid as a result of Hot Wind in 2008 through 2016; or Heat in 2007, 2008, 2010, or 2013 through 2016.

Probability of Future Occurrence

Based on seven National Weather Service Heat/Excessive Heat Warnings and Watches from 1996 to 2023 (27 years), the probability of occurrence is 31.8 percent. This translates to a probability rating of "Likely".

Magnitude/Severity

Extreme heat is considered to have **critical** 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 Emmet County. According to the US Census Bureau 2020 American Community Survey estimates, approximately 21.1% of Emmet 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 Emmet County are affected when this type of hazard occurs.

Overall, Iowa is already older than the country as a whole. About 17.1 percent of its population is over 65 years, compared with 16.8 percent nationally. Emmet County's population over 65 years is even higher than the national and state average at 21.1 percent. The City of Armstrong population has the highest percent of 65 years and older of their population that make up their city.

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. Another type of infrastructure damage that can occur as a result of extreme heat is road damage. Prolonged high heat exposure increases the potential of pavement deterioration, as well as railroad warping or buckling. As mentioned above, high heat also puts a strain on energy systems and consumption, as air conditioners are run at a higher rate and for longer. Extreme heat can also 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 as a result 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 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 USDA's Risk Management Agency, during the 14-year period from 2007-2021, the sum of claims paid for crop damages as a result of heat and hot wind was $61,309, which can be considered an example of direct damages due to heat. Impacts to workers and resultant impacts to their respective industries are also likely to occur. According to the ACS estimates, 6.7% of all employment in Emmet County is in the agriculture sector, and 11% 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.

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

Although Emmet County is not experiencing significant growth, there is a population decline of 8.9 percent from 2010 to 2020, the number of people vulnerable to extreme heat is not increasing. Therefore, 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.

4.3.4 Flooding (Flash and Riverine)

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

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 as a result 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.

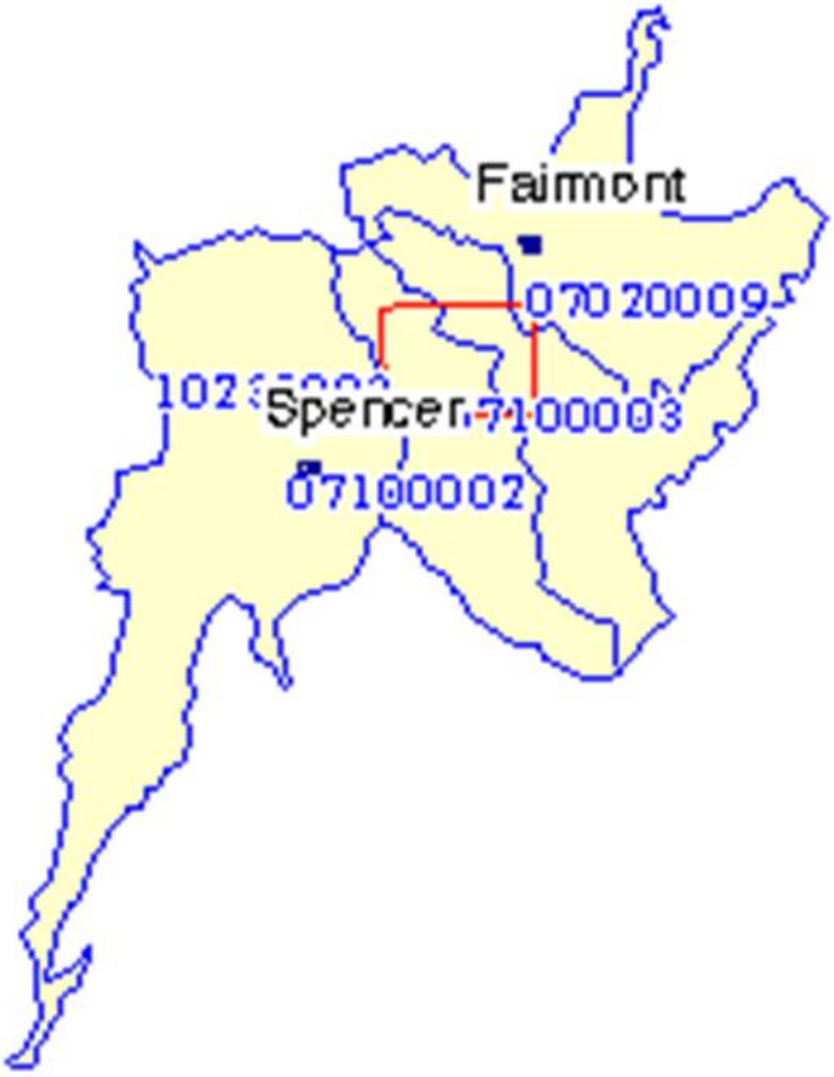
Location

The geographic extent of flooding in the planning area is **significant.** Emmet County crosses four HUC-8 watersheds as follows (see Figure 4-11):

- Blue Earth (07020009)—this watershed crosses the county minimally, on the northeast corner.
- Upper Des Moines (07100002)—this watershed covers the majority of the county, in a north to south fashion towards the left of the county.
- East Fork Des Moines (07100003)—this county covers the second largest part of the county, from the northeast to southeast.
- Little Sioux (10230003)—this watershed barely touches the county boundaries, crossing slightly on the southwest corner.

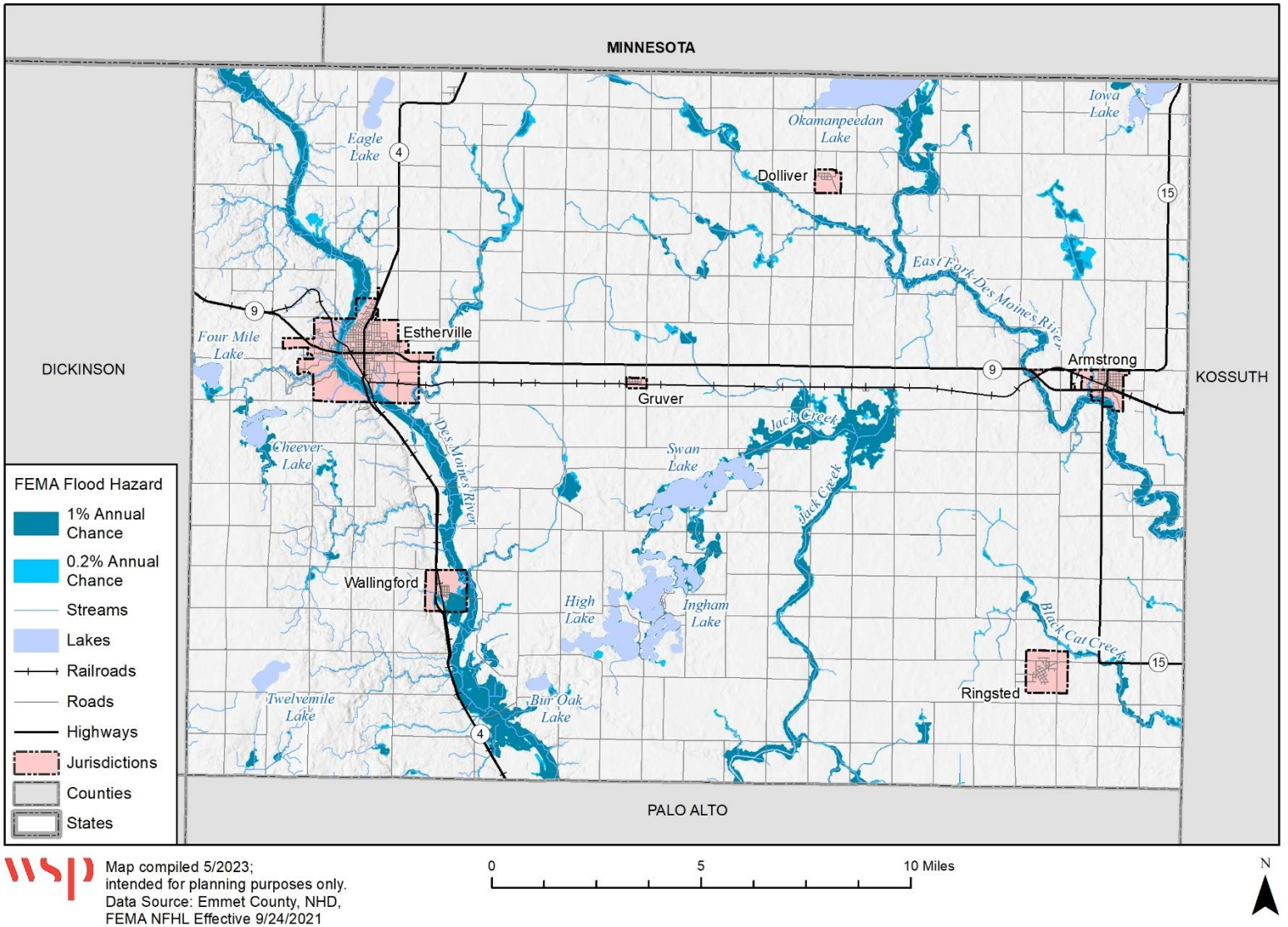
These watersheds are the main source of flood problems for the planning area. The smaller channels also can quickly become overwhelmed and overtop their banks. These rivers and creeks are highly subject to snowmelt and rainfall flooding. Figure 4-11 below displays the extent of FEMA mapped floodplains in Emmet County.

Figure 4-11 Emmet County, Iowa Watersheds (Emmet County is the red square)



Source: Environmental Protection Agency, https://cfpub.epa.gov/surf/county.cfm?fips_code=19063

Figure 4-12 Emmet County FEMA Flood Hazard



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

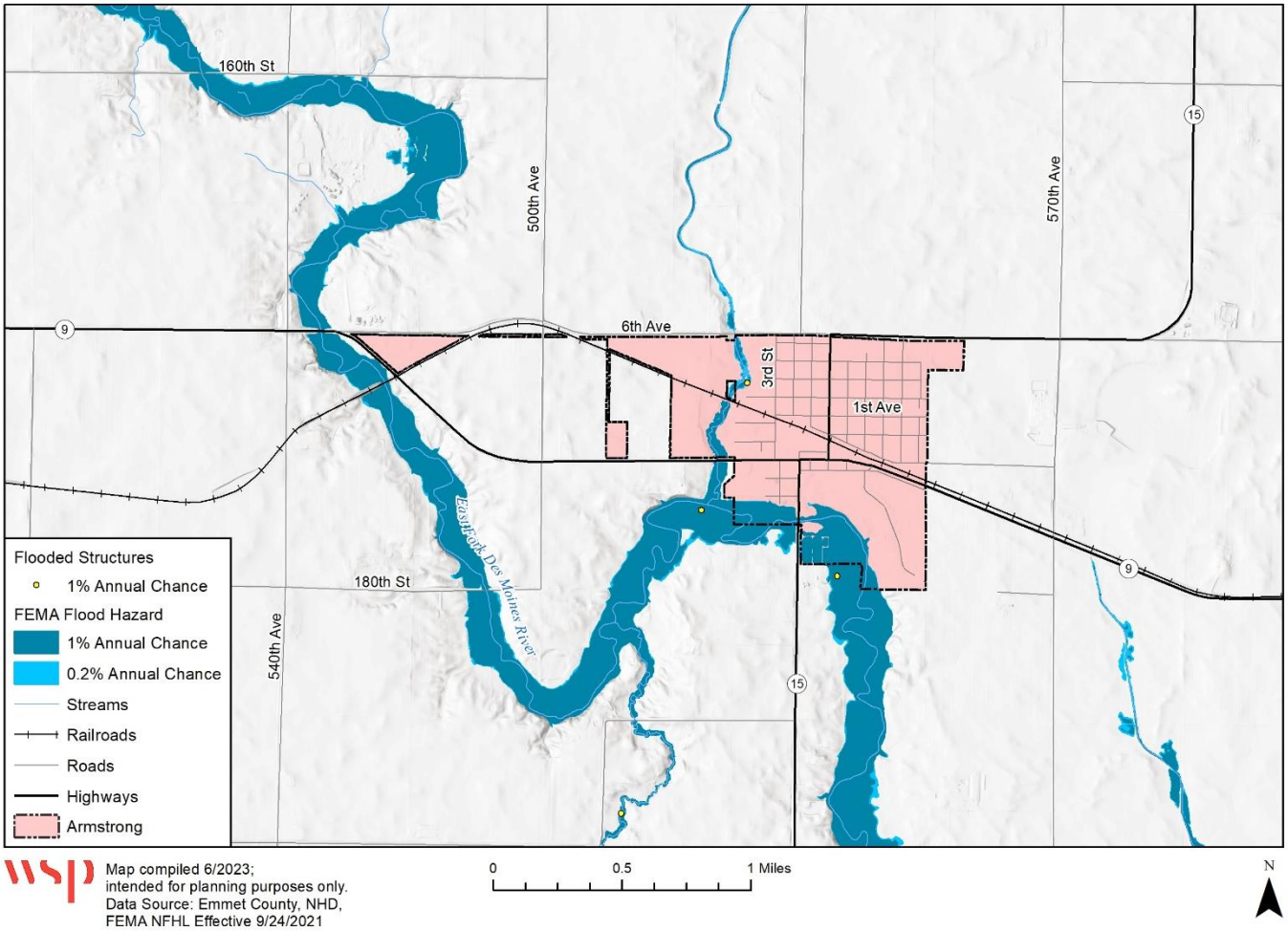
FEMA Special Flood Hazard Areas (SFHAs) in Emmet County were first mapped in September 1988. The most recent Flood Insurance Rate Maps (FIRMs) are dated September 24, 2021. The FIRMs delineate areas at-risk within the 1-percent annual floodplain (i.e., 100-year floodplain) and the 0.2-percent annual chance floodplain (the 500-year floodplain). Because of its size and location on the Des Moines River, Estherville is the most heavily affected by flood. The cities of Armstrong and Wallingford, as well as unincorporated Emmet County all have risk of flooding from the 1-percent annual chance flood as well. None of the other incorporated jurisdictions have mapped flood risk from the 1-percent annual chance flood.

Figure 4-13 through Figure 4-18 provide the 1-percent annual floodplains for all jurisdictions in the planning area affected by this hazard. The county-level map is provided above for context Preceding each map is a general description of the flooding sources applying to each jurisdiction.

Armstrong

The City of Armstrong is found within the path of the East Fork Des Moines River 1-percent annual chance floodplain, which touches city boundaries primarily on the south and southwest, and hence poses as a hazard to the jurisdiction. A small tributary floodplain also crosses the city in a north-south fashion, though to a minor extent.

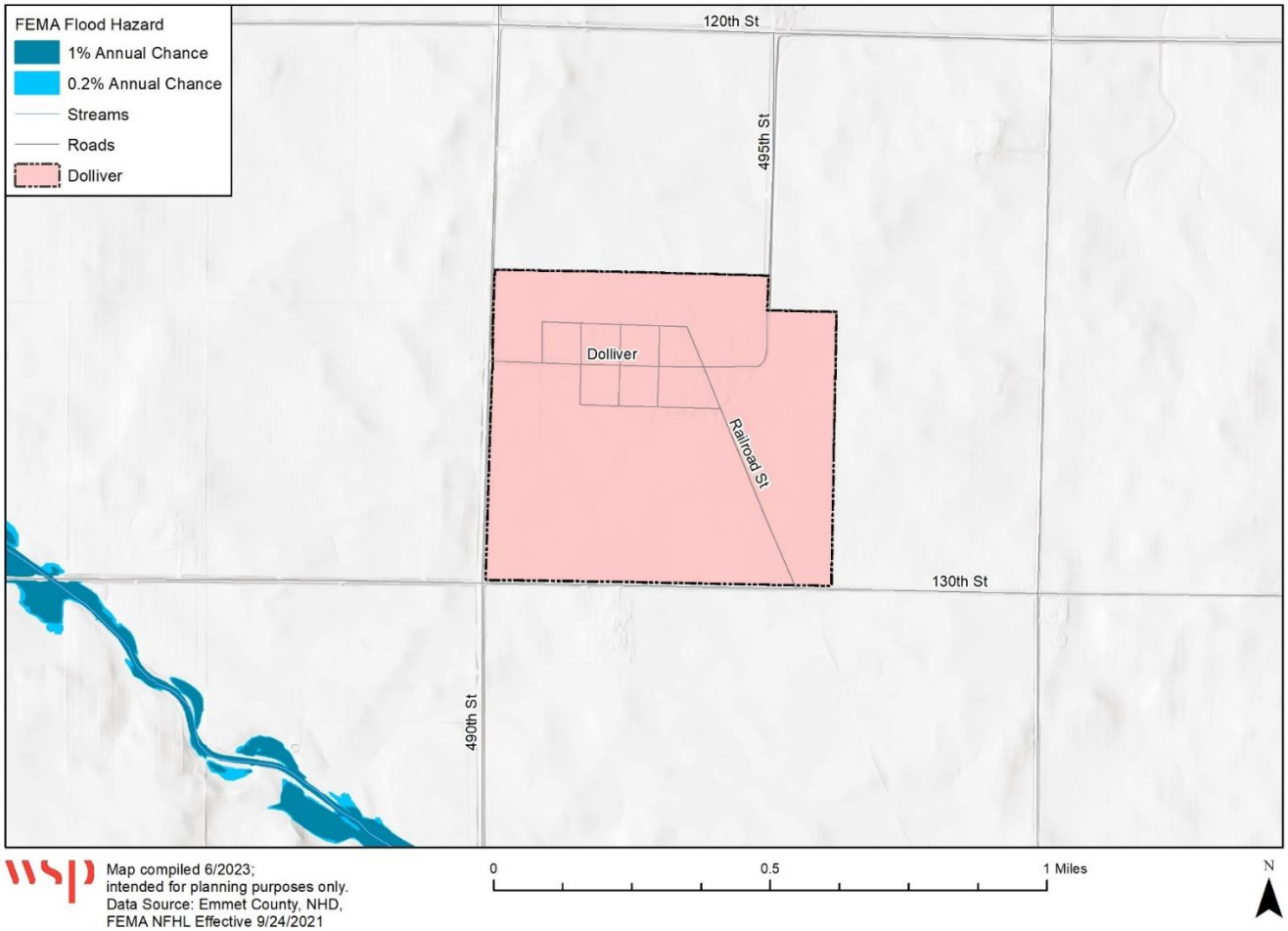
Figure 4-13 City of Armstrong 1-Percent Annual Chance Floodplain (100-Year Floodplain)



Dolliver

While there is a small floodplain from a minor creek about 0.5 mile to the southwest of the City of Dolliver, no actual crossing occurs with city boundaries. As such, riverine flooding does not pose a direct risk to Dolliver.

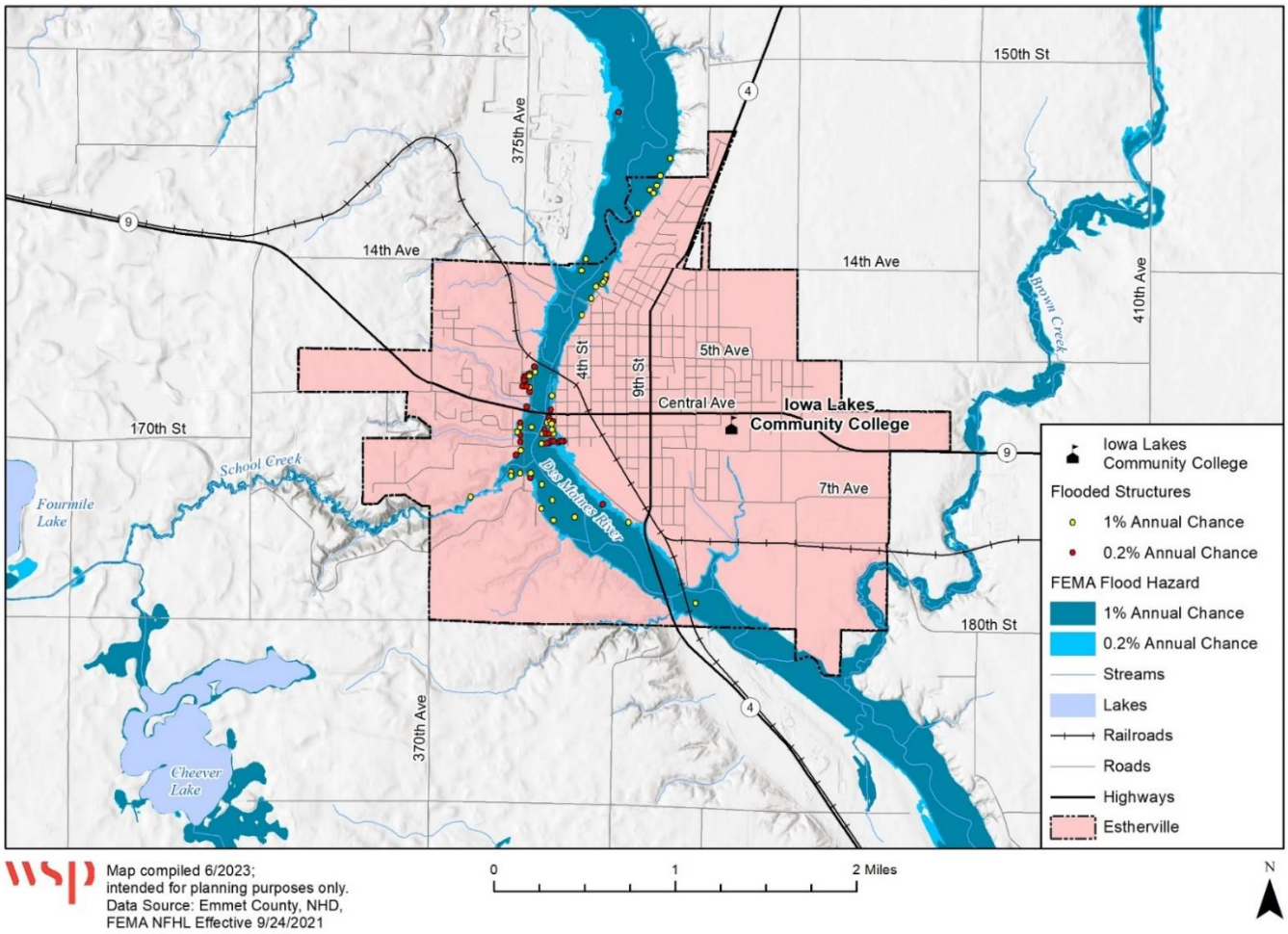
Figure -14 City of Dolliver 1-Percent Annual Chance Floodplain (100-Year Floodplain)



Estherville

The City of Estherville's primary source of riverine flooding is the Des Moines River, which runs north to southeast of the jurisdiction. School Creek to the southwest and Brown Creek to the southeast also pose some flooding hazard, though to a very limited extent.

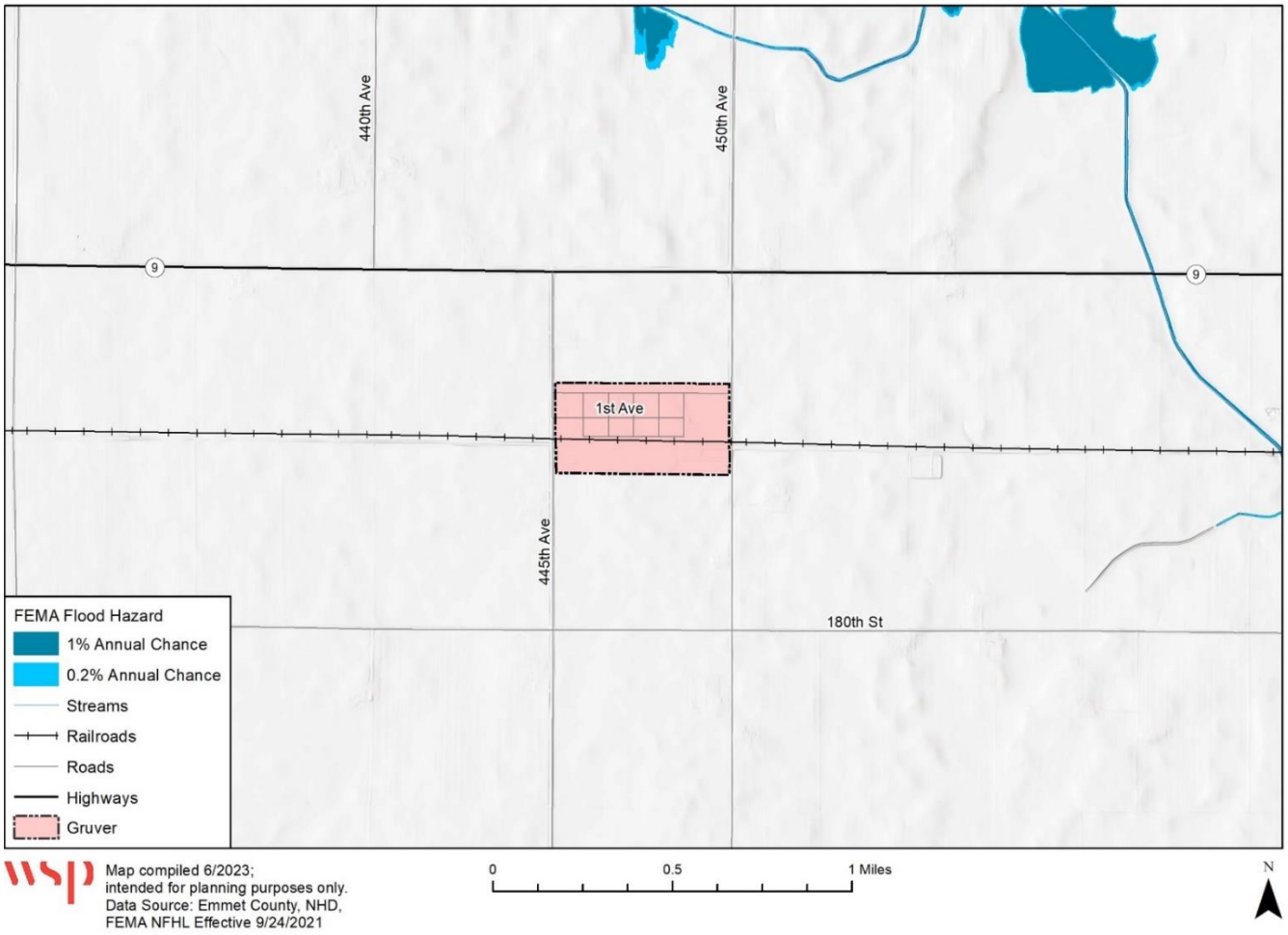
Figure -15 City of Estherville 1-Percent Annual Chance Floodplain (100-Year Floodplain)



Gruver

The City of Gruver is not found within the path of any stream or floodplain. As such, there is not apparent risk of riverine flooding for this jurisdiction.

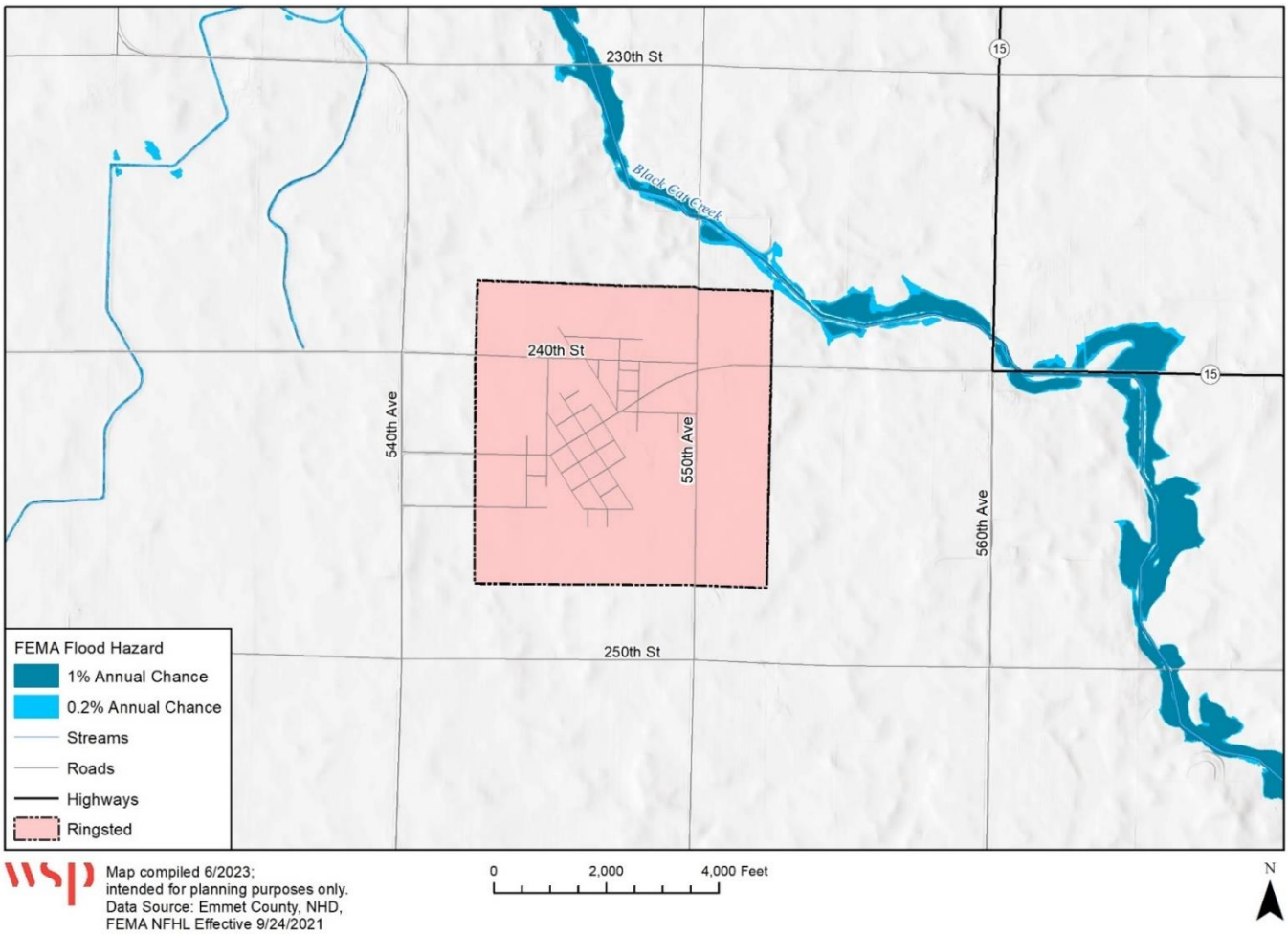
Figure 4-16 City of Gruver 1-Percent Annual Chance Floodplain (100-Year Floodplain)



Ringsted

Ringsted does not cross the path of the Black Cat Creek 100-year floodplain, though the city's northeast corner almost reaches the creek. As such, Ringsted is not at direct risk of riverine flooding.

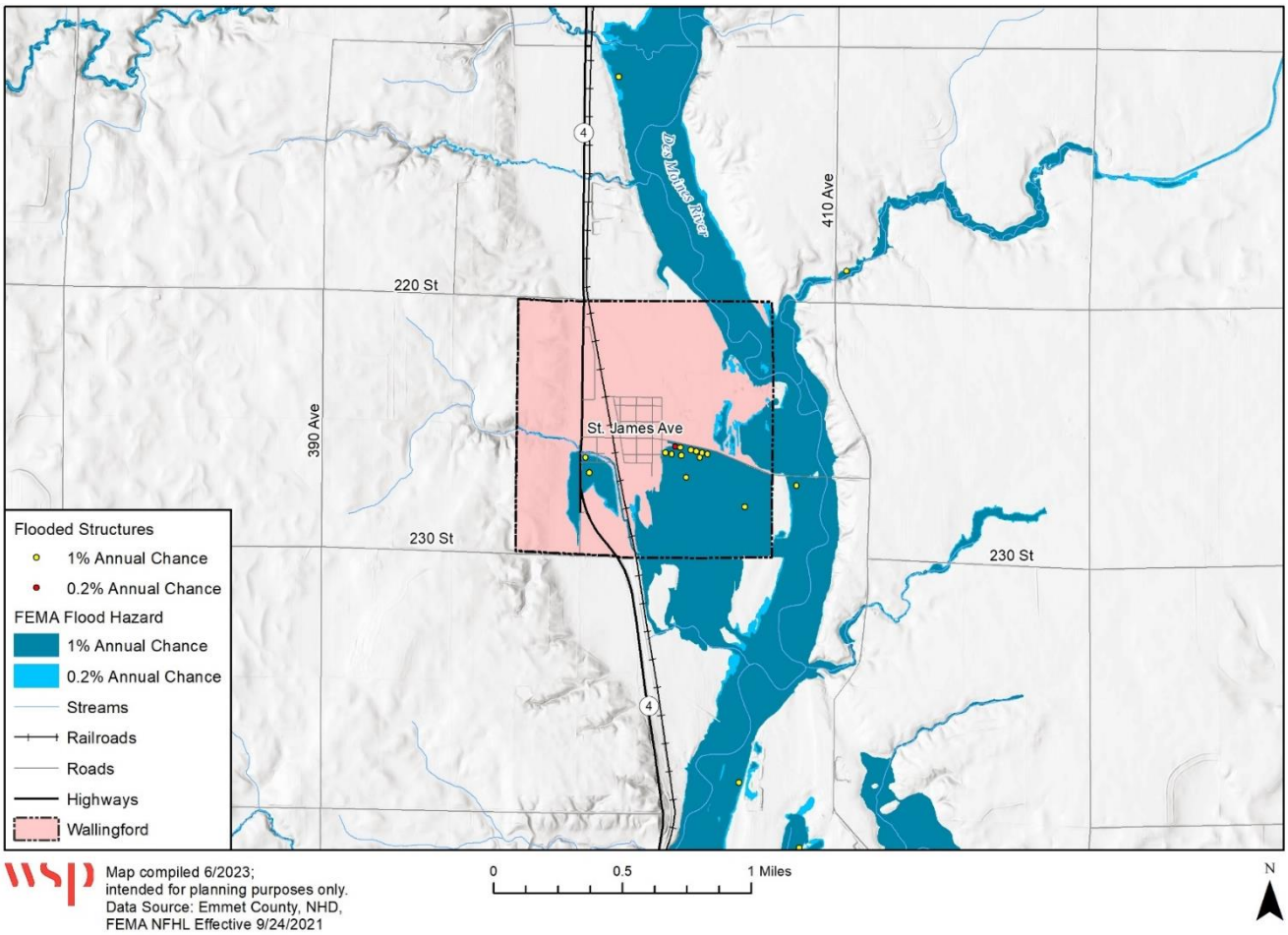
Figure 4-17 City of Ringsted 1-Percent Annual Chance Floodplain (100-Year Floodplain)



Wallingford

The City of Wallingford is located approximately 5 miles southeast of the City of Estherville, on the path of the Des Moines River (though slightly). This river is the primary flooding source, though minor streams to the west of the city are also present. As shown in the map below, the northeast, east, southeast, and central south areas of the city boundary are most at-risk to the 1-percent annual chance flood.

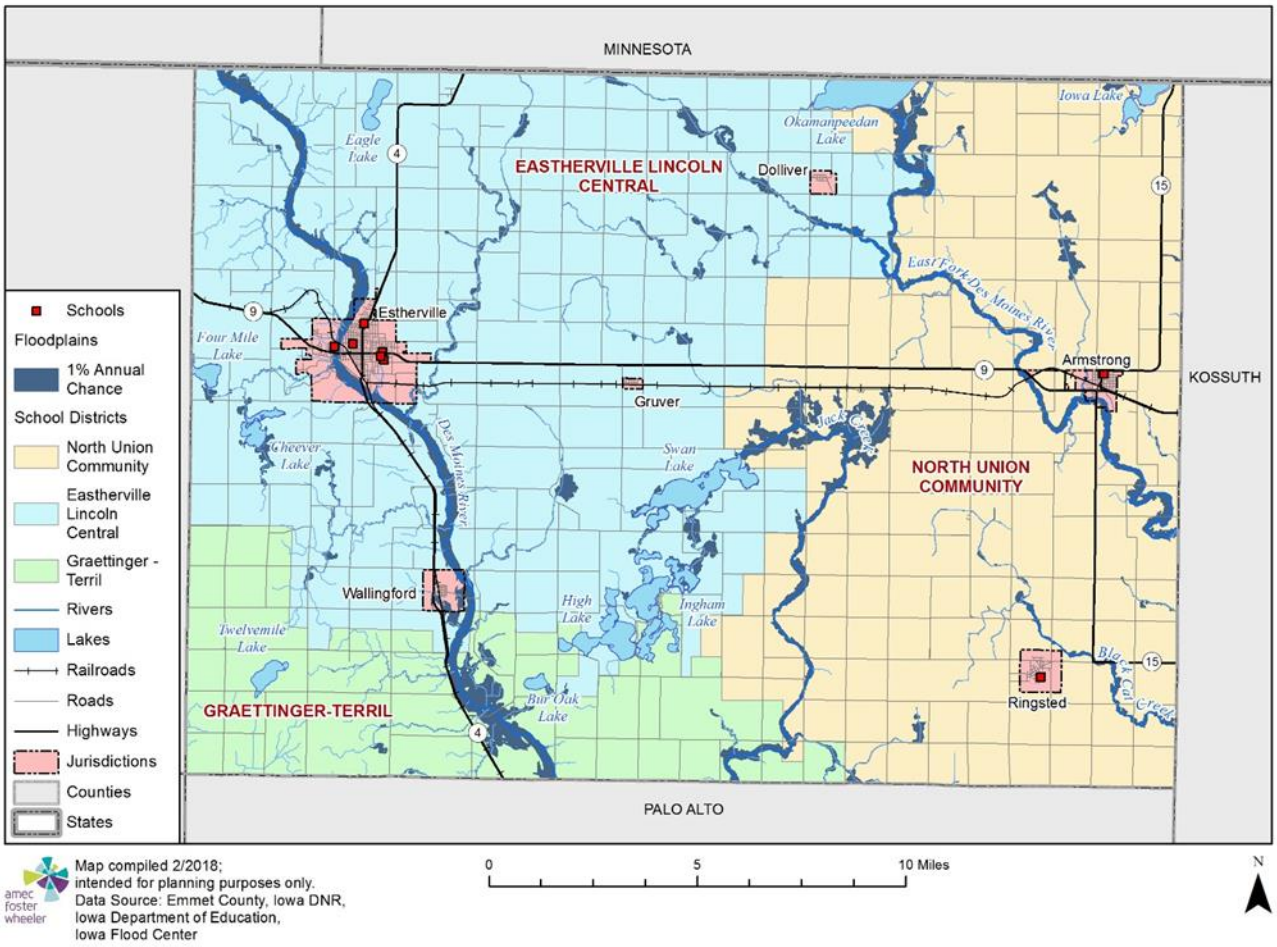
Figure 4-18 City of Wallingford 1-Percent Annual Chance Floodplain (100-Year Floodplain)



Emmet County School Districts

All three school districts are affected by flooding from the 1-percent annual chance floodplains.

Figure 4-19 Emmet County School Districts and the 1-Percent Annual Chance Floodplain (100-Year Floodplain)



Past Occurrences

Emmet County and its jurisdictions have witnessed several major floods. To date there has been eight federally declared disasters in Emmet County due to flooding since 1965. Some of the more noteworthy floods and recent floods are profiled in this section.

According to the NCEI, 80 flood and flash flood events have taken place from 1997-2022 in the County alone. While no human deaths or injuries were caused from the recorded events during these years, flooding still occurs fairly frequently, and can prove costly. Details are provided below in Table 4-21.

Table 4-21 NCEI Flood Events in Emmet County, 1997-2022

Year of Flooding	Number of Events	Deaths	Injuries	Property Damages	Crop Damages
1997	2	0	0	$200,000	$0
1998	2	0	0	$95,000	$30,000
1999	6	0	0	$417,000	$260,000
2000	1	0	0	$50,000	$75,000
2001	7	0	0	$342,500	$60,000
2003	3	0	0	$15,000	$10,000
2004	3	0	0	$350,000	$448,039
2005	4	0	0	$90,000	$50,000
2006	2	0	0	$30,000	$0
2007	4	0	0	$110,000	$10,000
2008	1	0	0	$50,000	$100,000
2010	10	0	0	$1,235,000	$21,275,000
2011	9	0	0	$625,000	$150,000
2012	1	0	0	$15,000	$0
2014	1	0	0	$500,000	$5,000
2016	4	0	0	$45,000	$0
2017	2	0	0	$100,000	$0
2018	12	0	0	$1,050,000	$500,000
2019	5	0	0	$200,000	$0
2020	1	0	0	$0	$0
Total	**80**	**0**	**0**	**$5,519,500**	**$23,023,039**

Source: NCEI

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

Emmet County

A small flooding event happened through a large part of the northwest and north central Iowa during the beginning of April 2006. This was triggered by a significant rainfall event starting late March, which provided 2 to 4 inches of precipitation to the main river stems in the mentioned region of the County. The flooding affected lowland agricultural areas, though damage was very minor. By the middle of April, the flood had subsided.

Armstrong

Heavy rains during June of 2010 affected agricultural crops across the State, including in the Armstrong area. While river flooding did not directly affect the crop losses, riverine inundation did occur, affecting many counties nearby. This flood episode caused Emmet and other affected counties in northern and central Iowa to apply for a Presidential Disaster Declaration, though it was not approved.

Estherville

Three flood events took place in 2007, in March, May, and October. The March event involved the sudden melt of accumulated snow over previous blizzards, causing flooding along the Des Moines River in Estherville, though damage was limited. The May event began on the sixth, triggered by a major contrast in precipitation across the State. Some damage was incurred, although not severe, and the flooding was

confused to the Des Moines, Raccoon, Nishnabotna, and Grand Basins. The October event was preceded by a wet few weeks. Bloomfield was also affected, though not to a large extent.

Wallingford

Three events were noted for Wallingford as well, one in 2016 and two in 2017. Heavy rains mid-May took place in the earliest event, causing riverine flooding on the Des Moines River. This event affected both Wallingford and Estherville. In May of 2017, another flooding event took place, again on the Des Moines River, but also the Raccoon River. This was triggered by heavy rainfall preceding the event. In October of the same year, another heavy rain flooded the Des Moines River along Wallingford and Estherville.

Unincorporated Areas

The Huntington area has had multiple flooding events since 2008, primarily due to heavy rains and/or rapid snow melt occurrences. Other flood events in the unincorporated areas of Emmet County heavily revolve around inundation of various areas of the Des Moines River and range from 1997 to 2017; some of these affected agricultural crops and downstream towns/cities.

Probability of Future Occurrence

With the history of flooding in many areas across Emmet County, it is likely that flooding of various levels will continue to occur. According to the NCEI, 80 flood events have taken place in the county over a 25-year period, which equates to approximately 3.2 events per year. Therefore, the probability rating for Emmet County to suffer from 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 Emmet 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 Emmet 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 mountain area 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 Emmet County using Geographic Information Systems (GIS) with the following 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 aren't typically valued. This method assumes that improved parcels have a structure of some type. The FEMA National Flood Hazard Layer (NFHL) was then overlaid in GIS on the parcel centroid layer to identify structures that would likely be inundated during a 1% annual chance and 0.2% annual chance flood event.

People

The flood analysis estimated that the exposed population for the entire county is 146 people within the 100-year floodplain. For the unincorporated portions of the county, it is estimated that the exposed population consist of 36 people within the 100-year floodplain. The City of Estherville has the highest population at risk to flooding with an estimated population of 84. Table 4-22 summarizes the total populations in the 100-year floodplains by municipality.

Table 4-22 Emmet County Population at Risk to 1% Annual Chance of Flooding

Jurisdiction	Population
Armstrong	2
Estherville	84
Wallingford	24
Unincorporated	36
Total	**146**

Sources: Emmet County Assessor's Office, Population - U.S. Census Bureau reported by Iowa State University of Science and Technology, FEMA NFHL, WSP Analysis

The 0.2% annual chance of flooding in Emmet County has a total of 66 people at risk to the 500-year floodplain. The City of Estherville has the highest population at risk to flooding with an estimated population of 59. These areas are not regulated but subject to lower premiums for flood insurance. Table 4-23 summarizes the total population in the 500-year annual chance of flooding flood zone by jurisdiction. These structures within the Special Flood Hazard Area directly reflect the people at risk due to flooding hazards.

Table 4-23 Emmet County Population at Risk to 0.2% Annual Chance of Flooding

Jurisdiction	Population
Estherville	59
Wallingford	2
Unincorporated	5
Total	**66**

Sources: Emmet County Assessor's Office, Population - U.S. Census Bureau reported by Iowa State University of Science and Technology, FEMA NFHL, WSP Analysis

Property

Utilizing the GIS methodology described above, numbers and estimated values of vulnerable structures in Emmet County were determined. Building improvement values for those points were then extracted from the parcel/assessor's data and summed for each jurisdiction in the study area. Contents values were estimated for the buildings based on their occupancy type, based on FEMA methodology. This includes 100% of the structure value for agriculture, commercial, exempt, and mixed-use structures, 50% for agriculture dwelling, multi-family and residential structures, and 150% for industrial structures. Building and contents values were totaled, and a 25% loss factor was applied to the totals, also based on FEMA depth damage functions, assuming a two-foot-deep flood. Figure 4-20 and Figure 4-21 below illustrate the extent of the floodplains utilized for the vulnerability assessment.

Figure 4-20 Emmet County FEMA Flood Hazard

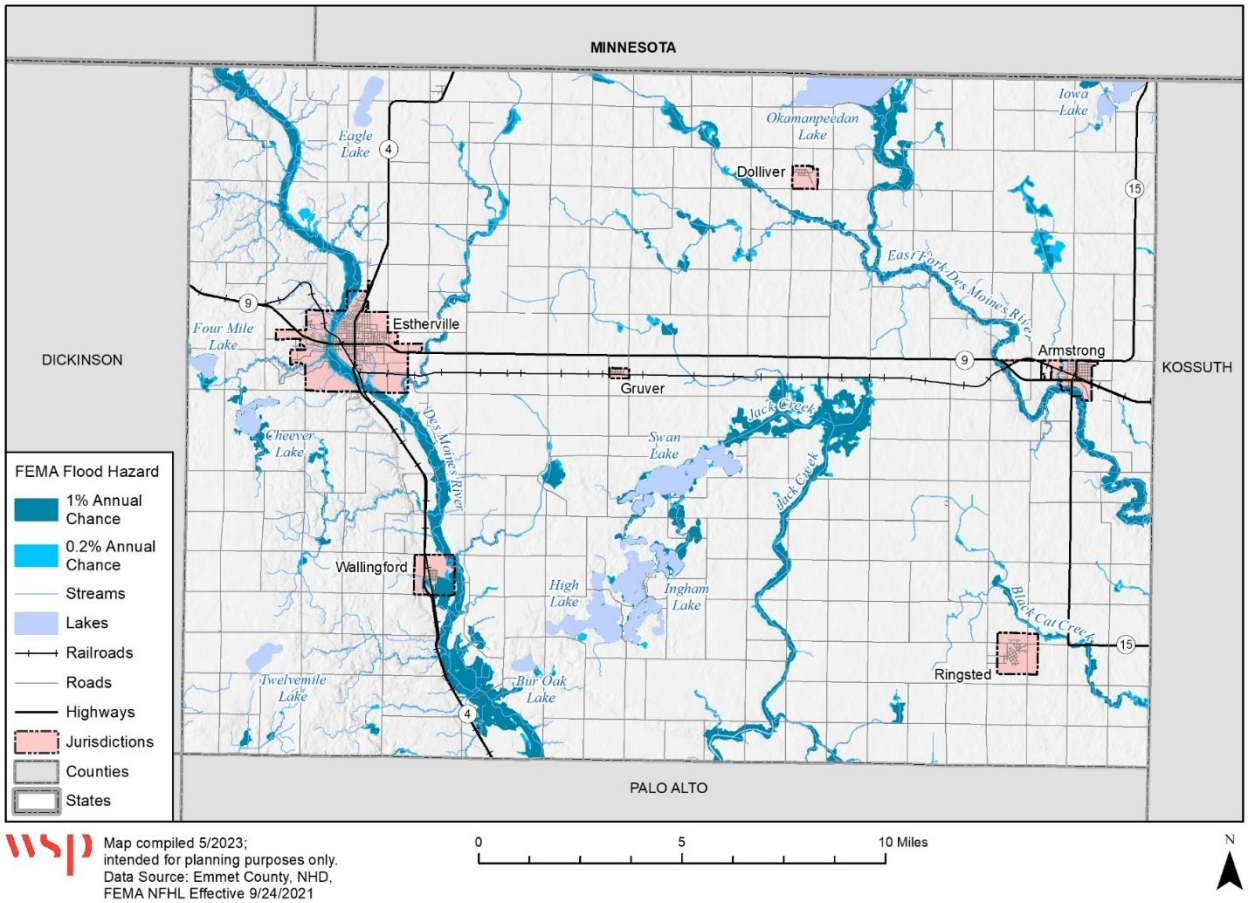
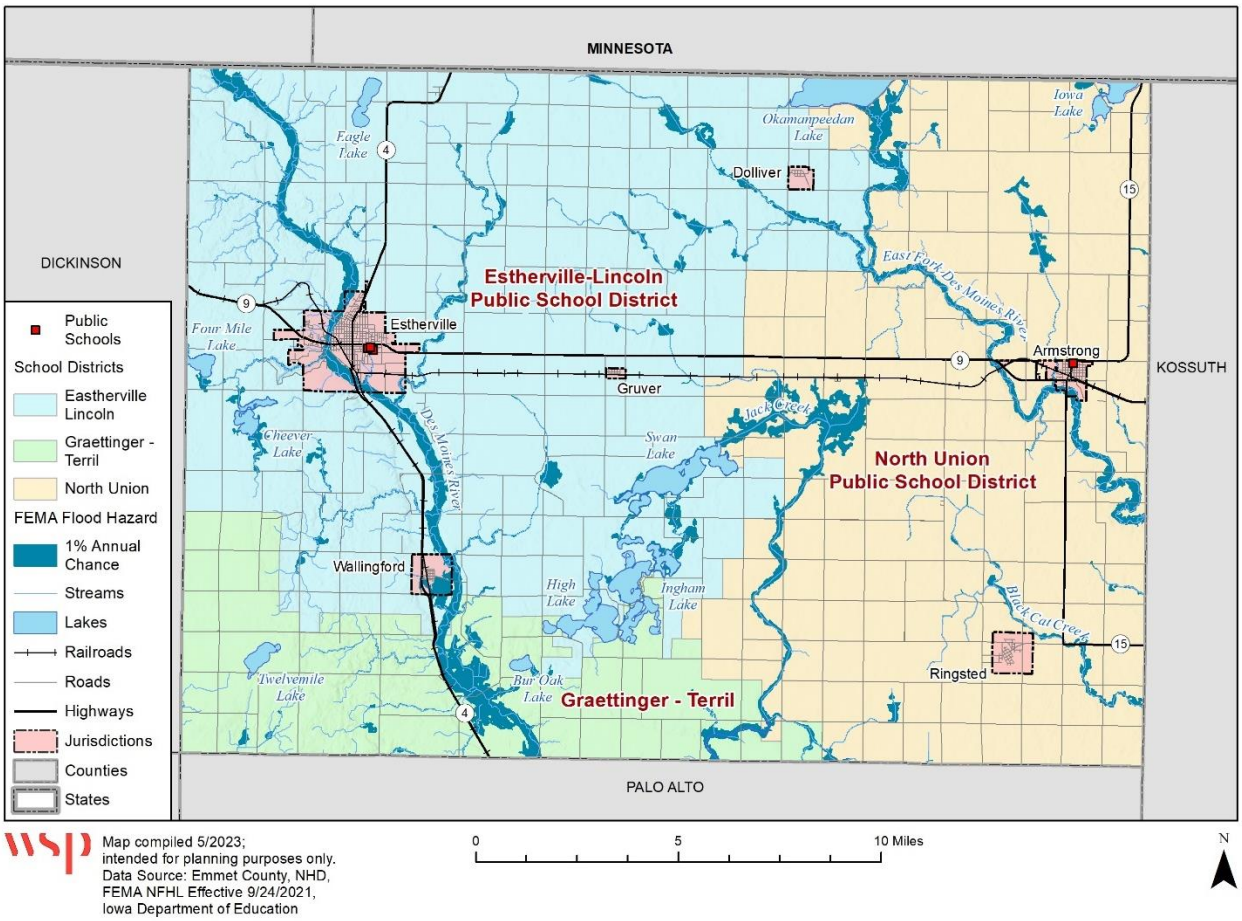


Figure 4-21 Emmet County School Districts and Floodplains



As noted in Table 4-24 and Table 4-25 below, there is a substantial amount of property value within Emmet County's flood hazard areas. There is a total of $13 million in estimated property value with the largest amount being located in the residential sectors within Emmet County's 1% floodplain. The unincorporated areas of the county hold the greatest amount of estimated vulnerable property values, while the City of Estherville holds the greatest number of vulnerable improved parcels.

Table 4-24 Emmet 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
Armstrong	Multi-Family	1	$765,200	$382,600	$1,147,800	$286,950
	Total	**1**	**$765,200**	**$382,600**	**$1,147,800**	**$286,950**
Estherville	Agriculture Dwelling	4	$386,800	$193,400	$580,200	$145,050
	Exempt	3	$0	$0	$0	$0
	Multi-Family	2	$40,800	$20,400	$61,200	$15,300
	Residential	31	$2,814,500	$1,407,250	$4,221,750	$1,055,438
	Total	**40**	**$3,242,100**	**$1,621,050**	**$4,863,150**	**$1,215,788**
Wallingford	Agriculture	3	$19,500	$19,500	$39,000	$9,750

Jurisdiction	Property Type	Improved Parcel Count	Improved Value	Estimated Content Value	Total Value	Loss Estimate
	Residential	10	$494,100	$247,050	$741,150	$185,288
	Total	**13**	**$513,600**	**$266,550**	**$780,150**	**$195,038**
Unincorporated	Agriculture	12	$210,700	$210,700	$421,400	$105,350
	Agriculture Dwelling	12	$2,415,800	$1,207,900	$3,623,700	$905,925
	Industrial	1	$9,200	$13,800	$23,000	$5,750
	Residential	4	$1,431,300	$715,650	$2,146,950	$536,738
	Total	**29**	**$4,067,000**	**$2,148,050**	**$6,215,050**	**$1,553,763**
	Grand Total	**83**	**$8,587,900**	**$4,418,250**	**$13,006,150**	**$3,251,538**

Sources: Emmet County, FEMA NFHL, WSP Analysis

Similar to the 100-year floodplain, Emmet County has property vulnerable to flooding within the 0.2% Annual Chance floodplain. There is a total of $4.5 million in property value exposed. The City of Estherville has the largest amount of property value at risk with $3.7 million to the 0.2% floodplain.

Table 4-25 Emmet County Properties at Risk to FEMA 0.2% Annual Chance of Flooding

Jurisdiction	Property Type	Improved Parcel Count	Improved Value	Estimated Content Value	Total Value	Loss Estimate
Estherville	Commercial	4	$489,000	$489,000	$978,000	$244,500
	Exempt	1	$0	$0	$0	$0
	Residential	26	$1,827,900	$913,950	$2,741,850	$685,463
	Total	**31**	**$2,316,900**	**$1,402,950**	**$3,719,850**	**$929,963**
Wallingford	Residential	1	$47,100	$23,550	$70,650	$17,663
	Total	**1**	**$47,100**	**$23,550**	**$70,650**	**$17,663**
Unincorporated	Agriculture Dwelling	1	$164,400	$82,200	$246,600	$61,650
	Commercial	2	$96,500	$96,500	$193,000	$48,250
	Residential	1	$201,400	$100,700	$302,100	$75,525
	Total	**4**	**$462,300**	**$279,400**	**$741,700**	**$185,425**
	Grand Total	**36**	**$2,826,300**	**$1,705,900**	**$4,532,200**	**$1,133,050**

Sources: Emmet County, FEMA NFHL, WSP Analysis

National Flood Insurance Program (NFIP) Participation

Table 4-26 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 30, 2023.

Table 4-26 NFIP Participation, Policies, and Claim Statistics

Community Name	NFIP Participant	Current Effective Map Date	Reg Emer Date	Policies In-force	Insurance In-force	Closed Losses	Total Payments
Emmet County	Yes	9/24/2021	09/30/88	1	$350,000	2	$15,608
Armstrong	NP	Never Mapped	N/A	N/A	N/A	N/A	N/A
Dolliver	NP	N/A	N/A	N/A	N/A	N/A	N/A
Estherville	Yes	9/24/2021	10/14/77	1	$99,000	16	$28,204
Gruver	NP	N/A	N/A	N/A	N/A	N/A	N/A
Ringsted	NP	9/24/2021	N/A	N/A	N/A	N/A	N/A
Wallingford	Yes	07/01/87	07/01/87	0	$0	0	$0

Source: FEMA Community Information System; M= No elevation determined – all Zone A, C, and X: NSFHA = No Special Flood Hazard Area; NP = Not Participating; E=Emergency Program: Policy and Loss Statistics from BureauNet, http://bsa.nfipstat.fema.gov/reports/reports.html; *Closed Losses are those flood insurance claims that resulted in payment. Loss statistics are for the period from January 1, 1978 to December 31, 2017.

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.

There are no repetitive loss or severe repetitive loss properties in Emmet County.

Critical Facilities and Infrastructure

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 226 total facilities in the county, there are 31 critical facilities in the 1% annual chance floodplain, and 9 critical facilities/infrastructure in the 0.2% annual chance floodplain. The Transportation sector has the highest critical facilities total located with the Special Flood Hazard Areas. Road and bridge infrastructure are vital to Emmet 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 4-27 and Table 4-28 provide a summary of the critical facilities in the 1-percent and 0.2-percent annual chance floodplains broken out by FEMA Lifeline.

Table 4-27 Emmet County Critical Facilities at risk to 1% Annual Chance Flood

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
Armstrong	-	-	-	-	-	-	-	**0**
Dolliver	-	-	-	-	-	-	-	**0**
Estherville	-	-	1	-	-	-	4	**5**
Gruver	-	-	-	-	-	-	-	**0**
Ringsted	-	-	-	-	-	-	-	**0**
Wallingford	-	-	-	-	-	-	-	**0**
Unincorporated	-	-	-	-	-	-	26	**26**
Total	**0**	**0**	**1**	**0**	**0**	**0**	**30**	**31**

Sources: Emmet County, DNR, HIFLD, National Bridge Inventory, FEMA NFHL, WSP Analysis

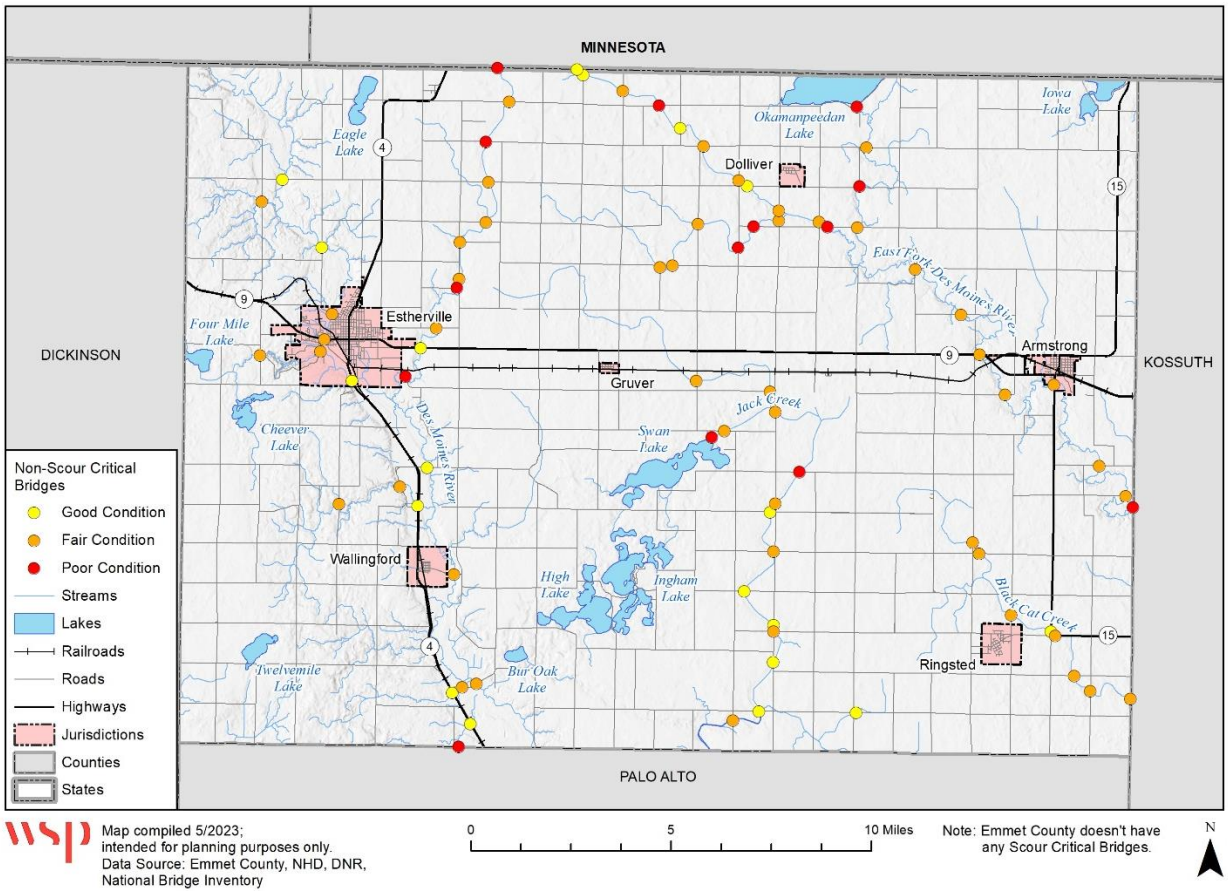
Table 4-28 Emmet County Critical Facilities at risk to 0.2% Annual Chance Flood

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
Armstrong	-	-	-	-	-	-	-	**0**
Dolliver	-	-	-	-	-	-	-	**0**
Estherville	-	2	-	-	1	-	-	**3**
Gruver	-	-	-	-	-	-	-	**0**
Ringsted	-	-	-	-	-	-	-	**0**
Wallingford	-	-	-	-	-	-	-	**0**
Unincorporated	-	-	-	-	-	-	6	**6**
Total	**0**	**2**	**0**	**0**	**1**	**0**	**6**	**9**

Sources: Emmet County, DNR, HIFLD, National Bridge Inventory, FEMA NFHL, WSP Analysis

According to the National Bridge Inventory, there is a total of 82 bridges in the County. All bridges in the county are non-scour critical bridges, with 14 in poor condition, 49 in fair condition, and the remainder in good condition. These bridges are depicted in Figure 4-22 Note that not every bridge infrastructure displayed on the map will be at risk of the 1-percent annual chance flood.

Figure 4-22 Emmet County Bridges w/ Scour Critical Bridges Identified



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.

Future Development

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.

River Flooding Hazard Summary by Jurisdiction

- The overall significance of flooding is **High.** However, there is significant variation between communities.
- Armstrong, Estherville, Wallingford 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.
- The City of Estherville's Fire Station is located within the 1% annual chance floodplain.
- Flooding frequently causes other related hazards, such as erosion and mudflows.
- There is $13 million worth of property values in the 1% and $4.5 million in the 0.2% floodplain, with potential losses estimated at $3.2 million and $1.1 million, respectively.
- Related hazards: Drought, Levee/Dam Failure, Wildfire.

4.3.5 Grass or Wildland Fire

Probability	Magnitude/ Severity	Extent	Hazard Ranking
Likely	Limited	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 on a daily basis 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

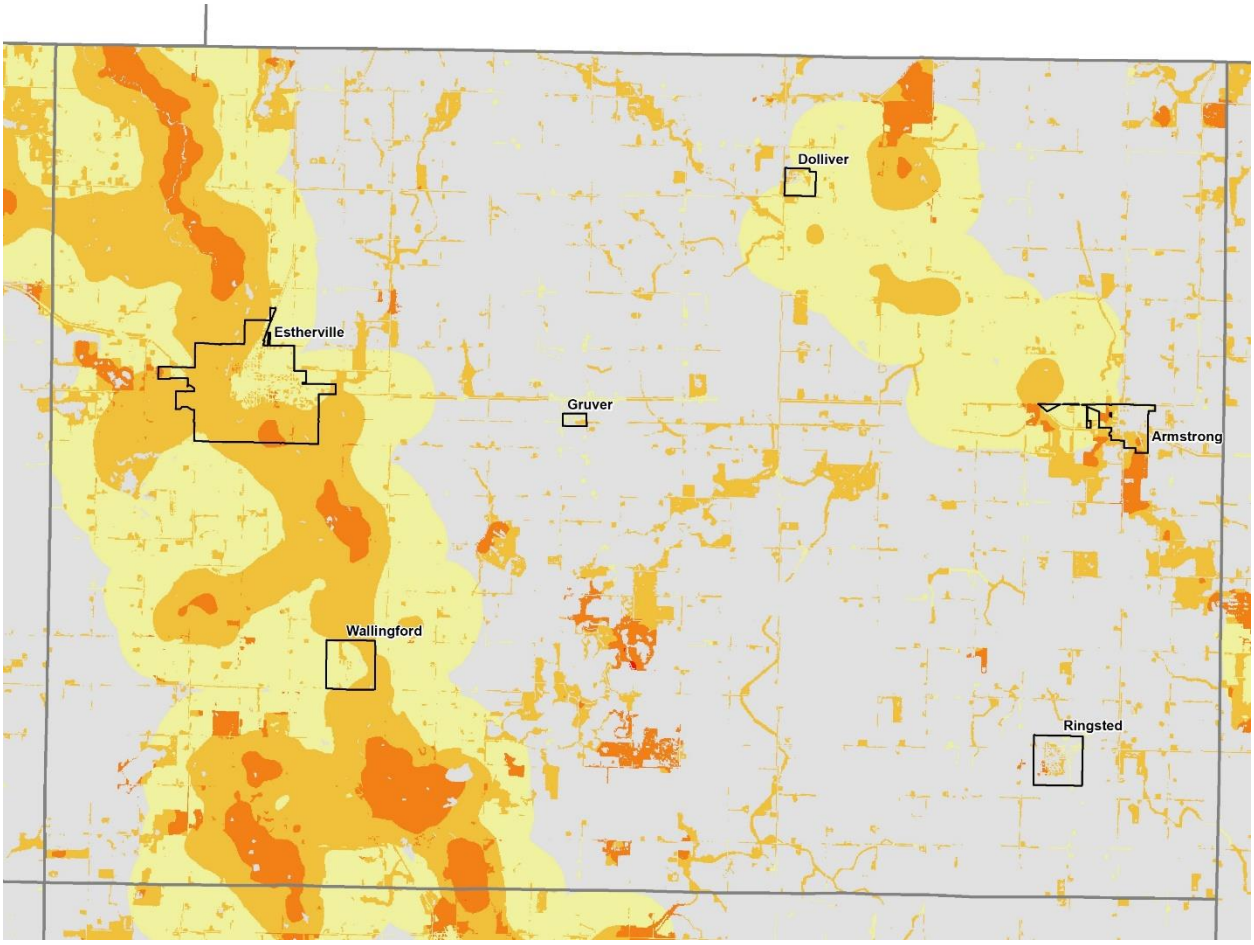
The USDA Forest Service, under the direction of Congress in the 2018 Consolidated Appropriations Act (H.R. 1625, Section 210), developed a nationwide wildfire risk assessment. The Wildfire Risk to Communities study results were used to assess risk to Wildfire in Emmet County. Wildfire Risk to Communities uses the best available 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 category was reviewed to represent risk. Figure 4-23 shows the Risk to Homes within Emmet County and Figure 4-24 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. Emmet County has a relatively Low Risk to wildfire, lower than 62% of other counties within the State. The greatest risk to homes in the County is largely concentrated in the western half and northeastern corner of the

county. Estherville, Wallingford, and portions of Armstrong have the highest areas of moderate risk of the jurisdictions.

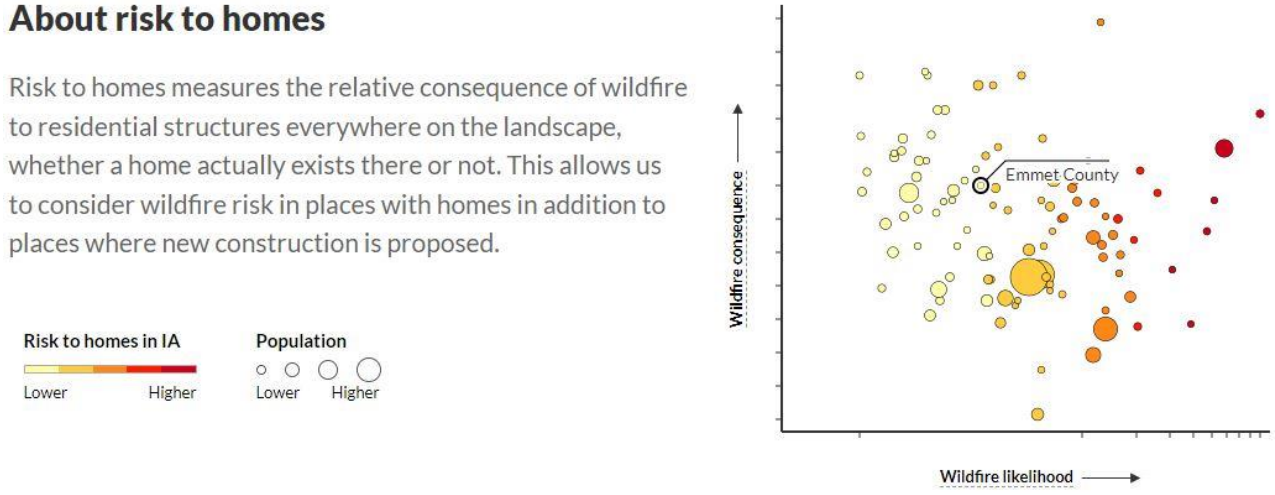
Risk to Homes combines wildfire likelihood and intensity with generalized results to a home within the planning area. The Risk to Homes data integrates wildfire likelihood and wildfire intensity from simulation modeling to represent wildfire hazard. Wildfire Risk to Communities uses a generalized concept of susceptibility that all homes that encounter wildfire will be damaged and the degree of damage is directly related to the fire's intensity. Wildfire likelihood as defined by this study is further detailed in the Probability of Future Occurrence section.

Figure 4-23 Emmet County Wildfire Risk to Homes



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

Figure 4-24 Emmet County Wildfire Risk to Homes Relative to Other Iowa Counties



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

Past Occurrences

Data was requested from the Iowa Department of Public Safety, State Fire Marshal Division to provide information on previous occurrences of grass/wildland fires in the planning area. Through the National Fire Incident Reporting System (NFIRS), the Iowa State Fire Marshal's Office collects and reports fire incidents throughout the State. NFIRS is a repository of statistical data reported by participating fire departments. The State Fire Marshal's Division was unable to provide the historical grass/wildland fire data at this time.

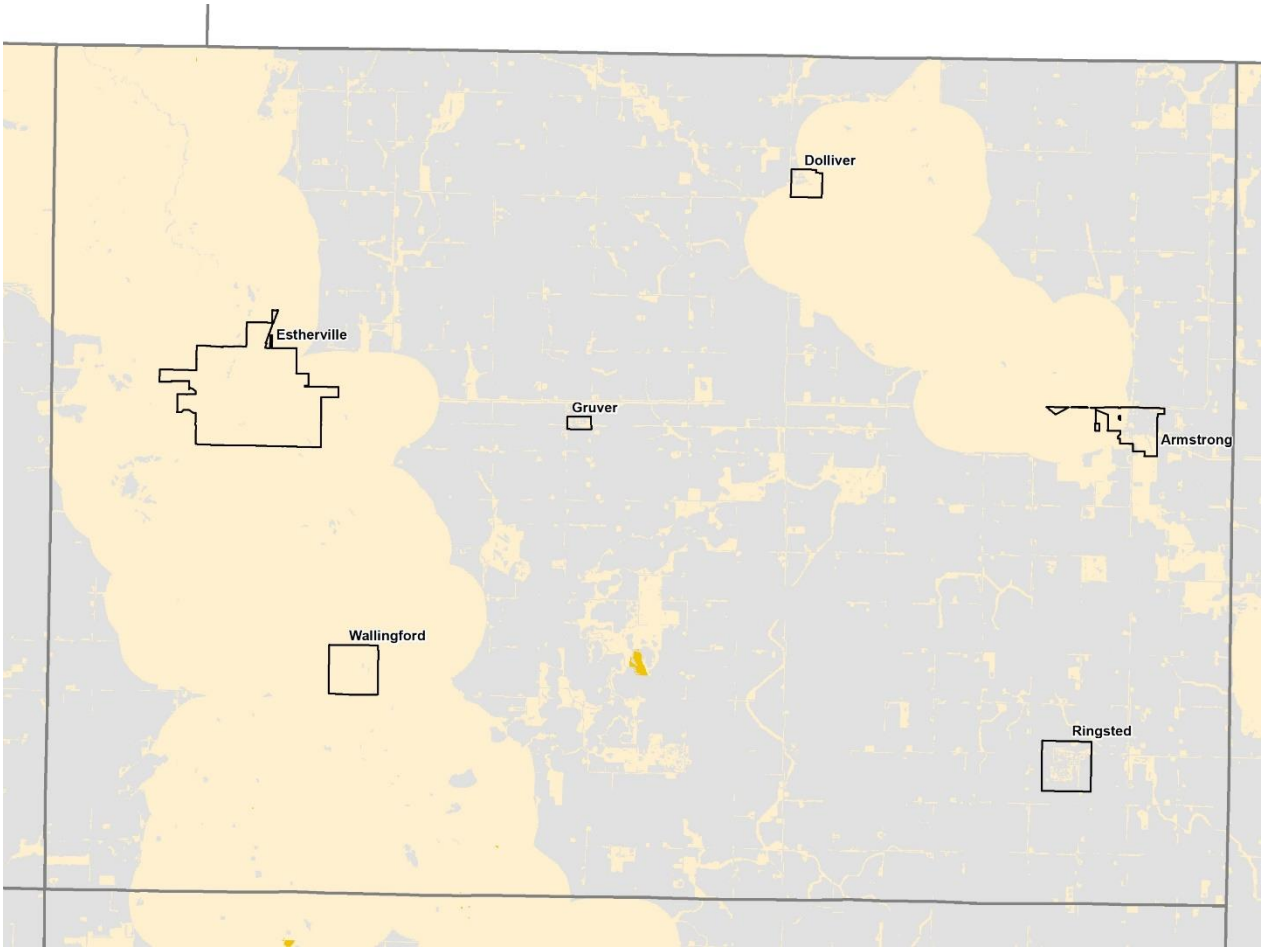
Probability of Future Occurrence

Updated historical data was not available to document the average number of wildland/grass fires per year. Since updated statistical data was unavailable to determine a quantitative probability, a qualitative probability is based on the anecdotal descriptions from the HMPC.

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 4-25 shows the Wildfire Likelihood in Emmet County and Figure 4-26 displays the legend, which represents where the planning area is in relation to the other counties in Iowa. Like the Wildfire Risk maps, 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 Emmet County have, on average, a greater likelihood for wildfire then 14% of counties within the US and 37% of counties within Iowa. Like wildfire risk to homes, the greatest likelihood for wildfire in the County is largely concentrated to the western half of the County as well as a band of higher likelihood stretching roughly between the cities of Dolliver and Armstrong. A significant portion of the county is at lower risk.

Based on this, future grassland fires in Emmet County are considered **likely** to occur.

Figure 4-25 Emmet County Wildfire Likelihood



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

Figure 4-26 Emmet County Wildfire Likelihood Relative to Other Counties

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

Magnitude/Severity

Grass and wildland fire is considered to have **limited** magnitude and severity. Severe or extensive property damage, or shutdown of facilities and services are considered very unlikely to occur, as are direct injuries or fatalities. 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 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 Emmet 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 Emmet County. According to the USDA Forest Service wildfire risk tool referenced above, populated areas in Emmet County have, on average, a greater risk to homes than 38% 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 Emmet County may be more vulnerable to grass or wildland fires than others due to the large amount of cropland or open space in the surrounding areas.

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

Future development in the wildland-urban interface/intermix areas would increase vulnerability to this hazard. Wildfires can be responsible for extensive damage to crops, the environment and occasionally residential or business facilities. Homes built in rural areas are more vulnerable since they are in closer proximity to land that is burned, and homeowners are more likely to burn trash and debris in rural locations. The vulnerability of structures in rural areas is exacerbated due to the lack of hydrants in these areas for firefighting and the distance required for firefighting vehicles and personnel to travel to respond. Potential losses to crops and rangeland are additional concerns.

Risk Summary

Grass or Wildland fires can occur in all jurisdictions. However, the magnitude is potentially worse in jurisdictions with more wildland/urban intermix areas.

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

- Populated areas in Emmet County have, on average, a greater likelihood for wildfire then 14% of counties within the US and 37% of counties within Iowa. However, small grassland fires are not uncommon in the County. Therefore, this hazard is ranked as likely for probability of future occurrence.
- The greatest risk to homes and highest likelihood in the County is in the western and northeastern portions.
- 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

4.3.6 Hazardous Materials

Location	Magnitude/Severity	Future Probability	Overall Significance
Significant	Critical	Likely	**Medium**

Description

A hazmat incident is an unintentional hazardous materials release from a fixed site, pipeline, or in transportation. This can include the accidental release of flammable or combustible, explosive, toxic, noxious, corrosive, oxidizable, irritant, or radioactive substances or mixtures that can pose a risk to life, health, or property possibly requiring evacuation. 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. Hazardous substances are categorized as toxic, corrosive, flammable, irritant, or explosive. Hazardous material incidents generally affect a localized area. Hazardous materials incidents can arise through a number of different mechanisms, such as:

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 Emmet County can occur during highway 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.

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

This section provides geographic locations within Emmet County impacted by each type of potential hazardous materials incident.

Fixed Hazardous Materials Incident

According to the Iowa Department of Natural Resources, there are 13 sites in Emmet 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.

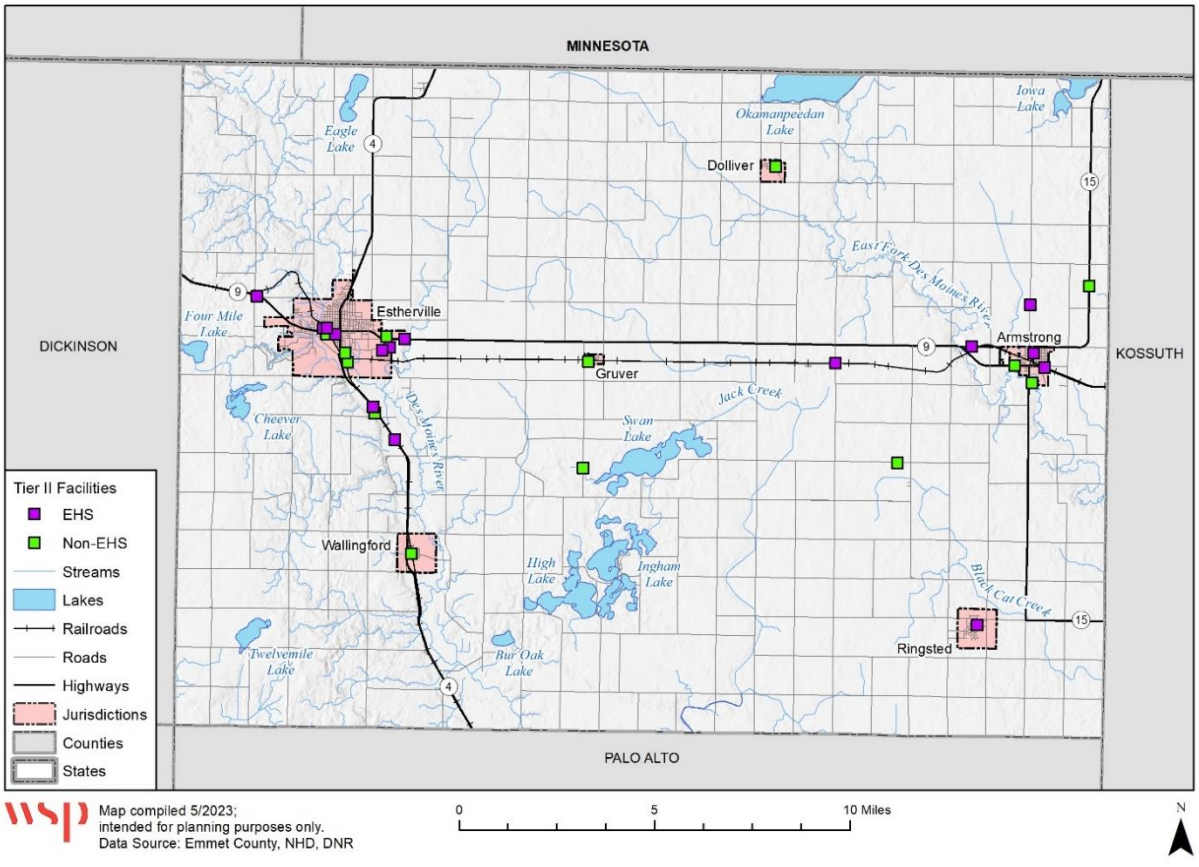
Table 4-29 provides the number of Tier II Facilities for each jurisdiction in the planning area. Note: The jurisdiction is assigned from the address. Some facilities do fall within the unincorporated areas but are identified with the nearest city. Figure 4-27 that follows is a map showing the locations of Tier II Facilities.

Table 4-29 Number of Tier II Facilities by Jurisdiction

Jurisdiction	# of Facilities	# of EHS Facilities
Armstrong	--	2
Dolliver	1	--
Estherville	4	5
Gruver	1	--
Ringsted	--	1
Wallingford	1	--
Unincorporated	6	7
Total	**13**	**15**

Sources: Emmet County, DNR, WSP Analysis

Figure 4-27 Tier II Facilities in Emmet County



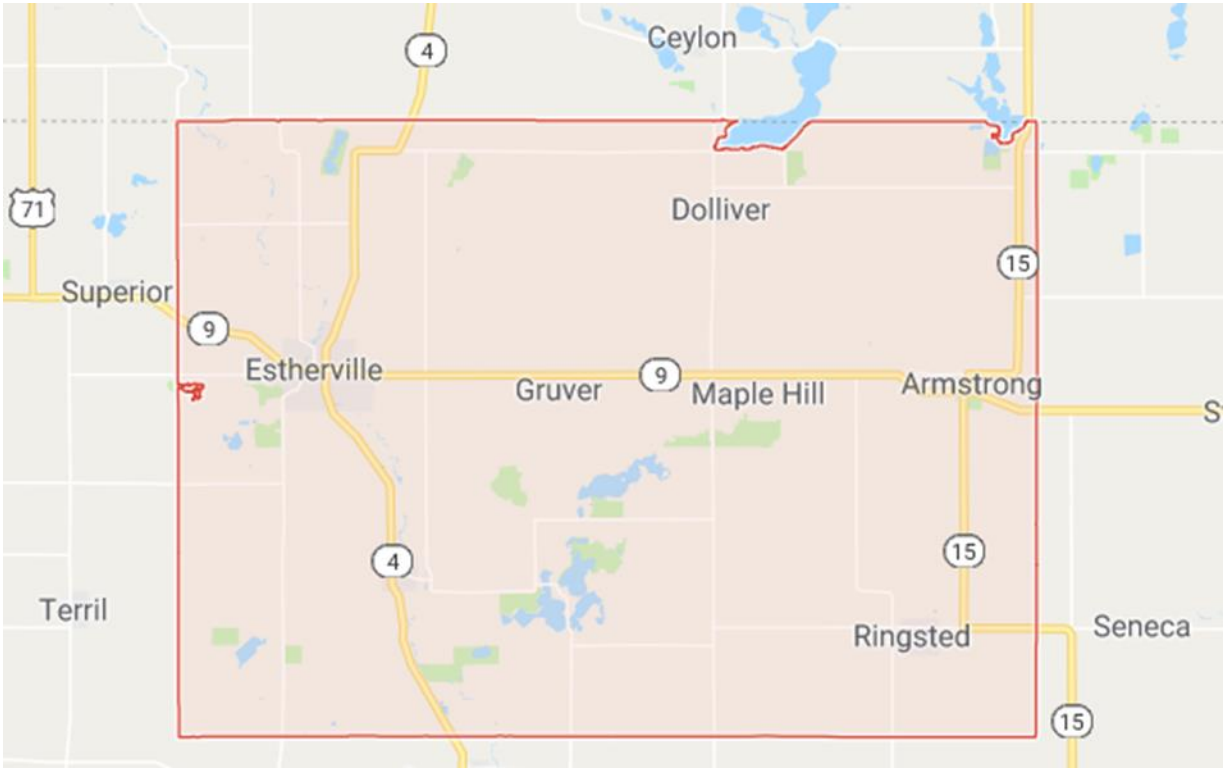
Transportation Hazardous Materials Incident

The transport of hazardous materials in Emmet County occurs via trucks on the highways/roads and airplanes carrying hazardous cargo.

Truck Transport

Hazardous materials can be transported on any of the roads in Emmet County. Main conduits of transport include Iowa Highway 9, Iowa Highway 4, and Iowa Highway 15. Agriculture is important to the economy of Emmet County As a result, chemicals utilized in agriculture are frequently transported along county and local roadways.

Figure 4-28 Emmet County Highways



Source: Google Maps

Rail Transport

Union Pacific Railroad, Ltd. (UP) operates in Emmet County with a line running east-west from Estherville, through Gruver, Maple Hill, and Armstrong. A line also runs northwest-southeast through Estherville and Wallingford.

Air Freight

Estherville Municipal Airport is a publicly owned airport located 4 miles west of the City of Estherville.

Figure 4-29 Estherville Municipal Airport

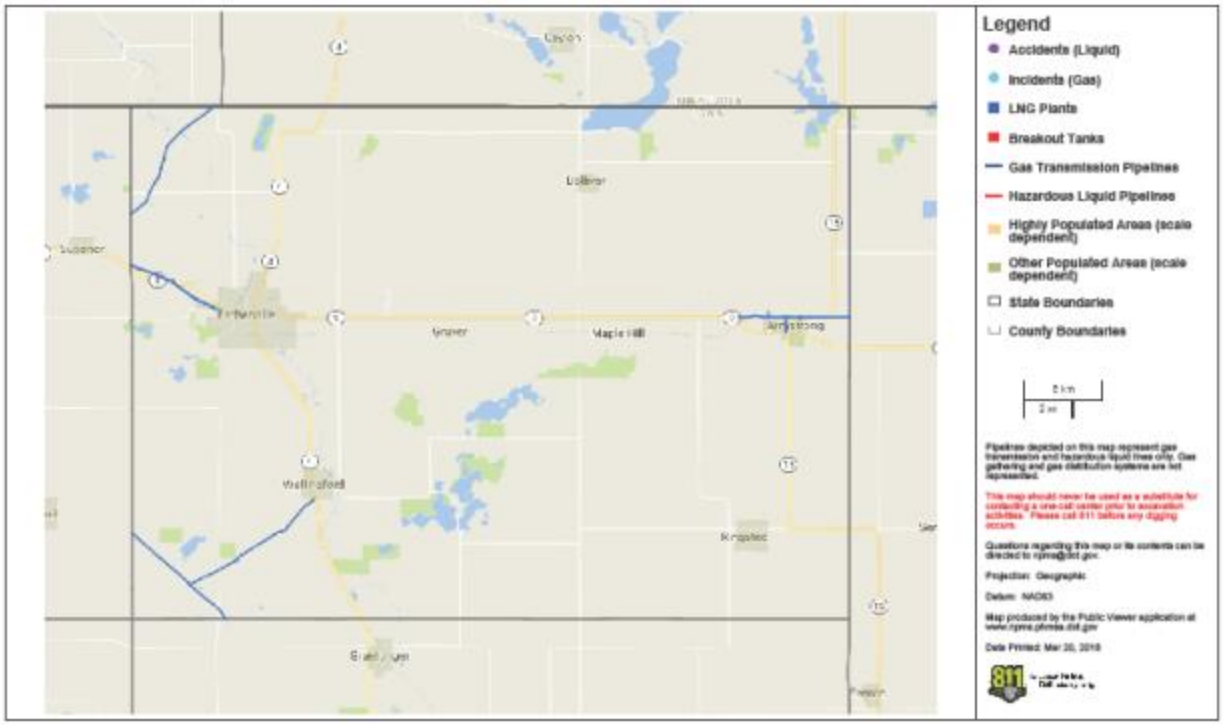
Source: Iowa Department of Transportation, http://www.iowadot.gov/aviation/airports/municipal.aspx

Pipeline Incident

According to the National Pipeline Mapping System (NPMS), there approximately 16 miles of gas pipelines and there are no liquid pipelines in Emmet County. Pipeline operators include Northern Natural Gas Co, Black Hills Energy, Alliance Pipeline L.P., Pembina Cochin LLC, Amoco Oil Co, and Fairbank City.

Figure 4-30 provides the locations of pipelines in Emmet 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 4-30 Pipelines in Emmet County



Source: Pipeline and Hazardous Materials Safety Administration, National Pipeline Mapping System, https://www.npms.phmsa.dot.go/PublicViewer/

Any type of hazardous materials incident within a city that includes a large release of hazardous materials 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 the event of 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 many times 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 2023 (23 years), there have been 117 hazardous materials spills reported in Emmet County. Table 4-30 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. Most spills involved manure (58). Table 4-31 that follows summarizes the spills by material type. Inorganic chemical is the most common material type spilled with 27 spills of this type.

Table 4-30 Emmet County Hazardous Materials Spills Reported to Iowa DNR, 2000-2023 by Jurisdiction and Mode

Cause/Mode	Number of Incidents
Dumping	2
Handling and Storage	17
Manure	60
Other	2
Pipeline	1
Theft	1
Transformer	1
Transportation	33
Grand Total	**117**

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

Table 4-31 Emmet County Hazardous Materials Spills Reported to Iowa DNR, 2000-2023 by Material Type

Material Type	Number of Incidents
Acids/Bases	2
Animal/Vegetable Products	2
Fertilizer/Pesticide	9
Inorganic Chemical	27
Manure	20
Organic Chemical	2
Petroleum	30
Propane/LPG/Natural Gas	2
Transformer Oil/PCB	1
Not Reported	22
Grand Total	**117**

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

The Emmet County Emergency Management Agency documented the following photo of a hazardous materials incident in which a semi-truck rolled over, spilling 600+ marine batteries. The incident required major environmental cleanup and assistance from a HazMat team from Mason City.

Source: Emmet County Emergency Management Agency

Pipelines

The U.S. Department of Transportation (DOT) Pipeline and Hazardous Materials Safety Administration maintains a database of pipeline incidents and mileage reports. From 1996 to 2023, there were no reported pipeline incidents in Emmet County.

Probability of Future Occurrence

From 2000 to 2022 (22 years), there have been 12 spills reporting according to the NRC Hazmat Data. This computes to an annual average of over 1.8 hazardous materials spills per year. Therefore, the probability of future occurrence of hazardous materials incidents is determined to be **Likely.**

Magnitude/Severity

Hazmat incidents have **critical** magnitude in Emmet County. This mean that more than 25% to 50% of property severely damaged, shutdown of facilities and services for at least 2 weeks, and/or injuries/illnesses that result in permanent disability Although DNR and Emmet County Emergency Management did report the number of hazmat incidents, there have been relatively limited economic losses or casualties associated with the hazard impacting Emmet County when compared to other hazards.

Hazmat incidents often occur with minimal or no warning (up to 6 hours warning). You can prepare and practice how to respond to a hazmat incident, but there is often no warning time when an incident occurs.

Climate Change Vulnerability

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 13 Tier II Facilities within Emmet County as shown in Table 4-29 . 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. 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.

Economy

Hazardous materials incidents can also interrupt transportation and delivery services, potentials resulting in economic losses. As mentioned, it is difficult to determine the potential losses to existing development because of the variable nature of a hazardous materials spill. 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 relative to 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.

Environment and Cultural Resources

Impacts to the environment from hazmat incidents can be severe. Widespread effects occur when the product contaminates the municipal water supply or water system such as river, lake, or aquifer. Spills can be costly to clean up due to the specialized equipment and training, and disposal sites that are necessary. Air and water quality may be reduced for extended periods of time depending on the scale of the event. The majority of spills in the county are small and quickly maintained within existing capabilities, but due to the presence of the pipelines and rail transport, the possibility of more serious events exists.

Development Trends

The number and types of hazardous chemicals stored and transported through Emmet 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.

Risk Summary

Although spills do occur in the unincorporated area, they are primarily recorded in the database associated with the nearest city. The overall significance of hazardous materials incidents in Emmet County is **Medium.**

- According to Iowa DNR, there have been 12 reported spills of the last 29 years.
- There are 13 Tier II facilities in the County, most located in Estherville.
- Related Hazards: Transportation Incidents, Flood, Thunderstorm/Lightning/Hail, Grass/Wildland Fire.

4.3.7 Human Disease

LOCATION	MAGNITUDE/ SEVERITY	FUTURE PROBABILITY	OVERALL SIGNIFICANCE
Significant	Limited	Occasional	**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, and it should be noted that individuals may experience more or less severe consequences.

Vaccine Preventable Disease

In the U.S., there are common infectious diseases that include polio, measles, diphtheria, pertussis, rubella, mumps, tetanus and *Haemophilus influenzae* type b that 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 U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

The immunization rates in Iowa are consistent with national average (see Table 4-35). 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, diabetes, or weak immune systems. It is estimated that thousands of people die each year in the United States from flu or related complications.

In 2016, influenza and pneumonia combined was the 8th leading causes of death in Iowa with 483 deaths, followed by all infective and parasitic diseases with 429 deaths. In 2008, there were over 800 influenza/pneumonia deaths. See Table 4-33 under Previous Occurrence for the number of deaths and rate from 2007-2016 in Emmet County and throughout Iowa.

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 (WHO) to strengthen systems to detect outbreaks of influenza that might cause a pandemic and to assist with pandemic planning and preparation.

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 consuming contaminated food, beverages, or water. Foodborne illness (food poisoning) can also be spread person-to-person as well as from contact with animals. Table 4-32 is a list of common foodborne diseases.

Table 4-32 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
Norovirus	24 – 48 hours, range 10 – 50 hours	Contaminated ready-to-eat food, undercooked shellfish, person-to-person

Organism	Onset of Symptoms	Associated Food(s)
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 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 WHO 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 five acknowledged pandemics in the past century:

***2019 COVID-19* Pandemic** – The COVID-19 pandemic, caused by the novel coronavirus SARS-CoV-2, has had a profound impact on global public health since its emergence in late 2019. The pandemic has gone through several phases, including introduction, local transmission, community spread, and mitigation efforts. Governments worldwide implemented various measures, such as lockdowns, social distancing, mask mandates, and vaccination campaigns, to control transmission. Several vaccines have been developed and distributed globally to combat the virus. Vaccination campaigns have played a crucial role in reducing severe illness and death, though challenges like vaccine hesitancy and supply issues persist.

2009 H1N1 Influenza – The 2009 H1N1 Pandemic Influenza caused 659 confirmed hospitalizations and 41 fatalities. The CDC estimated that 80% of H1N1 deaths were in people younger than 65 years of age, which differs from the typical season influenza epidemics during which 80-90% of deaths are estimated to occur in people 65 years of age and older.[1]

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

1 https://www.cdc.gov/flu/spotlights/pandemic-global-estimates.htm

Americans died. The flu spread rapidly; many died within a few days of infection, others from secondary complications. The attack and mortality rate were highest among adults 20-50 years old; the reasons for this are uncertain.

Other Reportable Diseases

In 2021, influenza and pneumonia combined was the 10th leading causes of death in Iowa with 361 deaths, followed by all infective and parasitic diseases with 148 deaths. In 2008, there were over 800 influenza/pneumonia deaths in Iowa. Table 4-33 shows the historical reported deaths in Emmet County from Influenza and Pneumonia as well as Infective and Parasitic Disease.

Table 4-33 Deaths by Year 2007-2021, Influenza and Pneumonia and Infective and Parasitic Disease, Emmet County and State of Iowa

Year	Influenza/Pneumonia Deaths, Emmet County	Influenza/Pneumonia Deaths, Iowa	Infective/Parasitic Disease Deaths, Emmet County	Infective/Parasitic Disease Deaths, Iowa
2021	*	361	*	148
2020	*	536	*	158
2019	*	583	*	186
2018	*	688	*	186
2017	*	567	*	554
2016	*	483	*	429
2015	*	592	*	488
2014	*	549	*	448
2013	*	755	*	511
2012	*	656	*	511
2011	*	657	0	464
2010	0	557	0	441
2009	*	633	*	457
2008	4	825	*	493
2007	4	748	*	427

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

Table 4-34 lists the number of common reportable diseases in the State of Iowa from 2018 to 2023 from the Iowa Department of Public Health, Center for Acute Epidemiology Annual Reports.

Table 4-34 Iowa Common Reportable Diseases by Year in Emmet County

	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	0	1	1	0	1	2
E.coli (STEC)	241	250	159	230	229	194
Enteric-HUS	2	4	0	8	1	1
Giardia	121	108	51	84	99	93
Haemophilus influenzae type b	0	0	1	2	1	0
Hansens disease	1	0	1	0	2	2
HepB	0	0	0	0	0	1

	2018	2019	2020	2021	2022	2023
Hepatitis A	5	4	5	3	6	8
Hepatitis D	2	1	3	5	3	4
Hepatitis E	0	1	0	1	0	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	0	0	5	21	10	1
Malaria	13	9	2	12	4	13
Measles	0	2	0	0	0	0
Mpoxvirus	0	0	0	0	2	1
Mumps	12	6	5	5	2	7
N. meningitidis	1	1	1	0	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	0	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). Within the last century, there have been five pandemic events, and with the H1N1 outbreak and the covid-19 pandemic both occurring within the same decade, the possibility of a human disease outbreak causing a threat to the general public has been determined 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.

Climate Change Impacts

As the Earth's climate continues to warm, researchers predict wild animals will be forced to relocate their habitats — likely to regions with large human populations — dramatically increasing the risk of a viral jump to humans that could lead to the next pandemic. In addition, rising temperatures caused by climate change

will impact bats, which account for the majority of novel viral sharing. Bats' ability to fly will allow them to travel long distances and share viruses in geographically dispersed places.

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 WHO 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

People

Although infectious diseases do not respect geographic boundaries, several populations in Emmet 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. According to the critical facilities inventory provided by Emmet County GIS, there are 5 nursing homes, 16 school facilities (including a college/university, schools, and daycare) in the county.

According to the Iowa Department of Public Health 2022-2023 Immunization Program Annual Report, Emmet County had 96.0 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 2022 Annual Report is provided in Table 4-35. The percent of up-to-date children is slightly under the State average of 70.1 percent, and the percent of adolescents up-to-date is also under the state average of 71.3 percent.

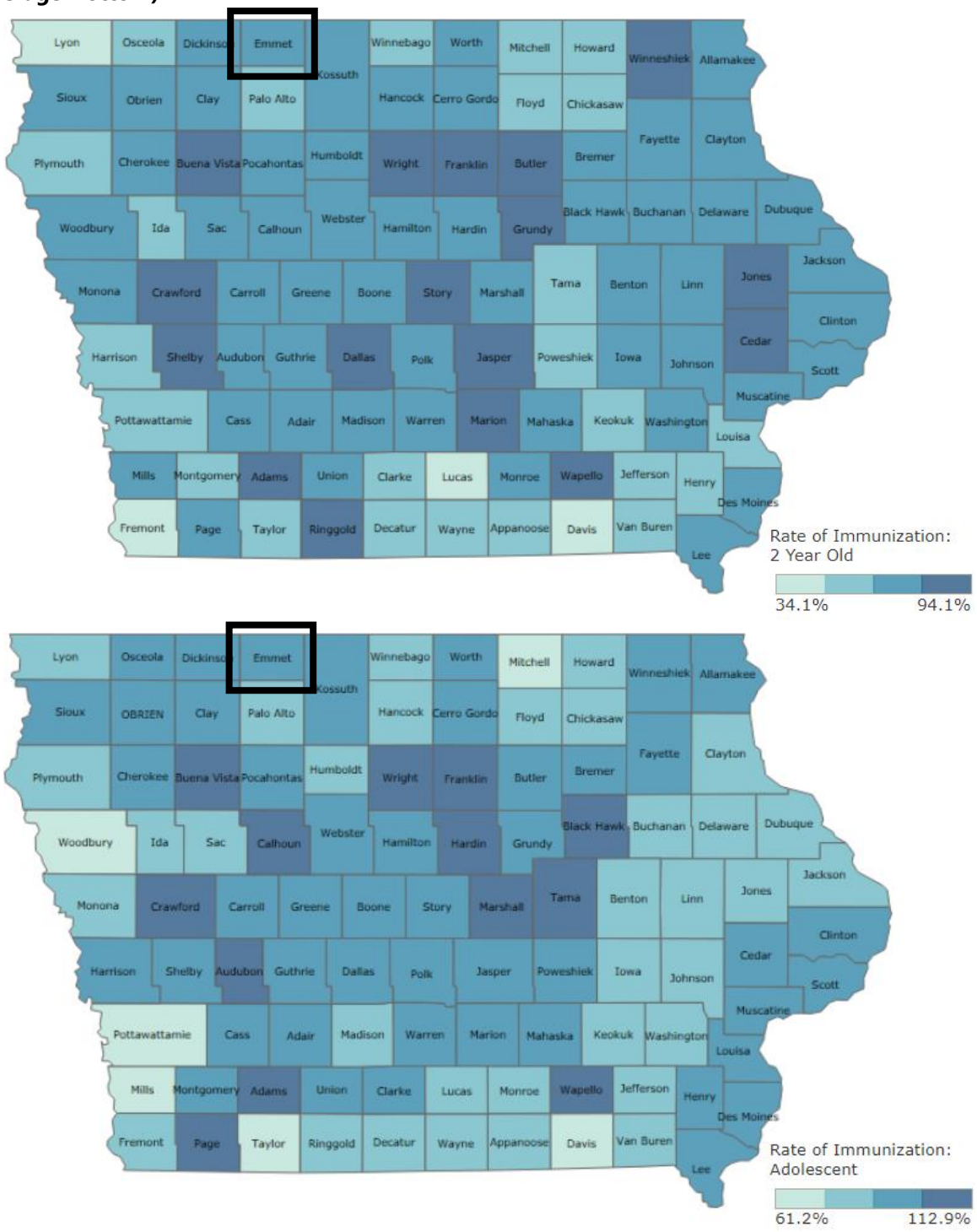
Table 4-35 2022 Vaccination Coverage Percent of Individual Vaccines and Selected Vaccination Series in Emmet County (2-year old coverage and 13-15 year old coverage)

	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 4-3-1-3-3-1-4 Coverage Percent
2-Year Old Coverage	95	100	105.3	76.8	89.0	87.0	83.0	91.0	85.0	76.0	69.0
	County Population 2022 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	347	504	145.2	88.7	71.4	82.7	72.6	81.7	67.3	26	26

Source: Iowa Department of Public Health, Iowa Immunization Program 2022 Annual Report, 2022 County Immunization Assessment, https://tracking.idph.iowa.gov/Health/Immunization

* 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 4-31 County Immunization Assessment Maps (2-year Old Coverage-Top, 13-15-year Old Coverage-Bottom)



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,
5. quarantine of those exposed to the illness to prevent further spread, and

6. education of the public about methods to prevent transmission.

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

Spread of disease is also limited by Emmet County's low population density of 23.7 people per square mile, which is far below the national average of 93.8 people per square mile and suggests that the opportunity for disease to spread from person to person in the County would be low.

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

Local economy and finances may be adversely affected, possibly for an extended period of time. Unscheduled sick leave from a large portion of the workforce could result in millions of dollars lost in productivity. Business restrictions due to social distancing requirements can also be significant. In a normal year, lost productivity due to illness costs U.S. employers an estimated $530 billion. During a pandemic, that figure would likely be considerably high and could trigger a recession or even a depression. Some indirect consequences may be the diversion of resources that may be otherwise available.

Based upon 2011 research on foodborne pathogens, the 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 2018 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 U.S. cost over $17 billion per year in direct medical expenses and lost productivity. Infections with the bacteria Salmonella alone account for over $4 billion yearly in direct and indirect medical costs.

The impact of the COVID-19 pandemic and associated closures has been significant, triggering a recession and high unemployment. The national unemployment rate jumped from 4.4% in March of 2020 to 14.7% in April and stayed in the double-digits through most of the summer. Some studies estimate that 1 in 5 renters are at risk of eviction. The stock market suffered major losses in the early days of the pandemic. The

restaurant, retail, and oil and gas industries have been particularly hard hit, with numerous businesses closing or filing for bankruptcy. Among household with children, food insecurity – defined as when a household does not have sufficient food for its members to maintain healthy and active lives and lacks the resources to obtain more food –more than doubled from 14% in 2018 to 32% in July 2020.

Environment and Cultural Resources

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

Development Trends

The population in Emmet County is declining, falling from 10,389 in 2010 to 9,176 in 2020. Thus, there are not as many people to potentially fall ill from a human disease. However, at the time of the 2020 Census, 23.3 percent of the population was over 65 years old. Those over 65 are more susceptible to health complications as a result of disease. Therefore, while the overall number of people at risk may be declining, those who remain face higher than average vulnerability to human disease.

Buildings, infrastructure, and critical facilities are not vulnerable to this hazard, as it affects only persons susceptible to the illness. Therefore, future development in the county should not change projected losses. The impacts and potential losses are largely economic and are dependent on the type, extent and duration of the illness.

Risk Summary

- Human Disease is ranked as an overall medium-significance hazard.
- Given the history of epidemics in Iowa and pandemics in the United States, the probability of a future disease outbreak is likely.
- Advances in sanitation practices and medicine have decreased the likely severity of human disease – however, it is impossible to predict with certainty the severity of future outbreaks.
- 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.
- The duration of a human disease epidemic will last more than one week and can take a significant amount of time to manage and stop the disease.
- The relatively low density of the County reduces the risk of disease spread. However, school districts have an increased risk.

4.3.8 Infrastructure Failure

Probability	Magnitude/ Severity	Extent	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 the majority 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 as a result of 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. Land line phone lines often utilize the same poles as electric lines. So, when weather events such as windstorm or winter weather cause lines to break, both electricity and telephone services experience outages. With the increasing utilization of cellular phones, hazard events such as tornado that can damage cellular repeaters can 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 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 cyber-terrorism targeting power supply networks.

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

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). In 1983 a KWWL television tower collapsed due to ice buildup. Heavy rains and flooding can undercut and washout a road or bridge. This occurred twice in 2008 when railway bridges failed in Waterloo and Cedar Rapids due to flooding. 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 number of products stored in the structure. There have been structural failures across the state in the past as mentioned above. They have included homes, commercial structures, and communications towers. There is no central collection point for this information, but news articles document infrastructure failure.

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 fire-fighting 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.

Other Utility Failure

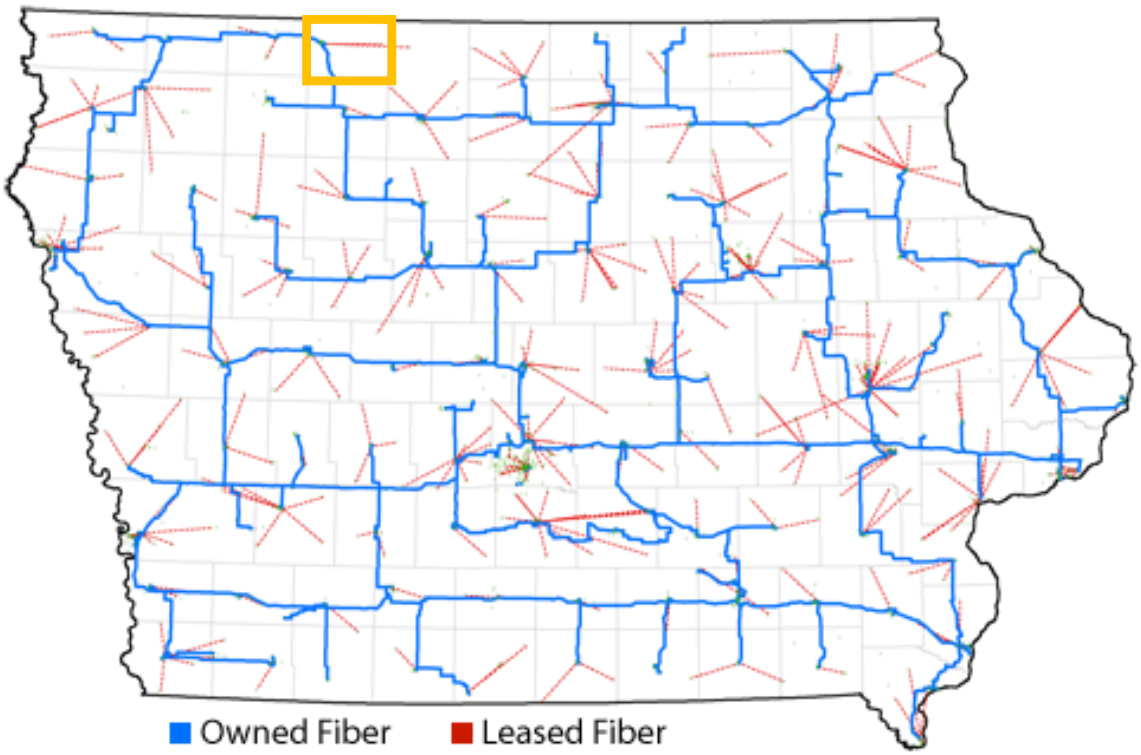
Interruption of other utilities such as water and sewer systems can be a devastating, costly impact. The primary hazards that can impact water supply systems are drought, flood, hazardous materials, and terrorism. Winter storm can also impact water supply if low temperatures cause failure/breakage of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

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. Power outages can occur in outlying areas with more frequency than in more developed areas. A loss of electric power can also interrupt your supply of water from a well. You may also lose food in freezers or refrigerators and power outages can cause problems with computers as well.

Figure 4-32 shows the Iowa Communications Network (ICN) that administers Iowa's statewide fiber optic telecommunications network.

Figure 4-32 Map of Iowa Communication Network

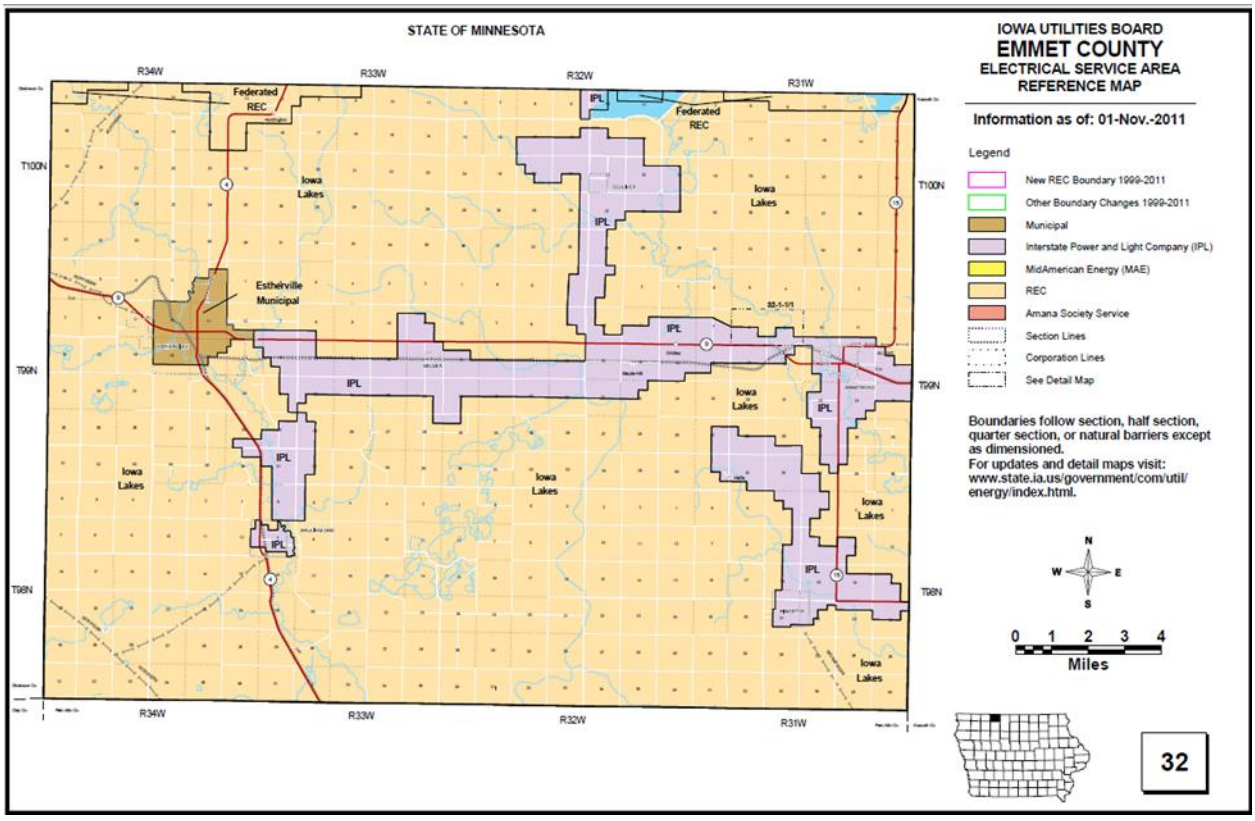


Source: http://icn.iowa.gov/about-icn/agency-information-icn-story
Note: Orange box outlines Emmet County.

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 4-33 is the electrical service area map for Emmet County.

Figure 4-33 Electrical Service Areas in Emmet County



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

Other Utilities (Water/Sewer)

Water

There are 8 Water Supply Systems in Emmet County, Iowa as follows:

- Estherville Water Treatment Plant (serves 6,780 people)
- Armstrong Water Supply (serves 986 people)
- Ringsted Water Supply (serves 436 people)
- Wallingford Municipal Waterworks (serves 212 people)
- Iowa Lakes Regional Water – Gruver (serves 126 people)
- Forest Ridge – Center (serves 120 people)
- Dolliver Muni Water Supply (serves 77 people)
- Ridgeroad Development (serves 31 people)

(Source: https://www.nytimes.com/interactive/projects/toxic-waters/contaminants/ia/emmet/index.html)

Sewer

There are 10 permitted wastewater treatment discharge sites in Emmet County, Iowa according to the Department of Natural Resources (see Table 4-36).

Table 4-36 Permitted Wastewater Sites in Emmet County

Facility Name	Facility City	Permit Type	Class	Sic Code	Treatment Type
Armstrong City of STP	Armstrong	Municipal	Minor	4952	Aerated Lagoon
Dolliver, City of STP	Dolliver	Municipal	Minor	4952	Trickling Filter
East Fork Land & Cattle Company, LLC (Formerly Ulrich Feedlot)	Armstrong	Agricultural	Minor	0211	
Estherville City of STP	Estherville	Municipal	Major	4952	Trickling Filter
Greig & Company, Inc.	Estherville	Agricultural	Minor	0211	
Gruver City of (Iowa Lakes Regional Water)	Gruver	Municipal	Minor	4952	Waste Stabilization Lagoon
Ringsted City of STP	Ringsted	Municipal	Minor	4952	Waste Stabilization Lagoon
Stateline Cooperative	Armstrong	Industrial	Minor	2048	Other
Wallingford City of STP	Wallingford	Municipal	Minor	4952	Waste Stabilization Lagoon

Source: Iowa Department of Natural Resources, http://www.iowadnr.gov/Environmental-Protection/Water-Quality/NPDES-Wastewater-Permitting/Current-NPDES-Permits

Past Occurrences

As indicated in the 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. For instance, the HMPC noted that people accidentally sever fiber lines, gas lines, and other buried utilities in the county on a regular basis, leading to outages. Additionally, the City of Armstrong storm sewer system often has large scale failures during large precipitation events.

The structural fires that have occurred in Emmet County have been within the normal day-to-day response capability, including use of pre-arranged mutual aid and do not fall into the category of uncontrolled fires in a populated area that threatens life and property.

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, wind storm, 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 "Highly 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.

Climate Change Considerations

As mentioned throughout, since this hazard typically is a result of other hazard events, with changes in the expected frequency and severity of various hazards as a result of climate change, impacts to frequency of infrastructure failures may occur as well. Please refer to the Climate Change Considerations sections of other profiled hazards that often cause a cascading or secondary impact of infrastructure failure, such as Flooding, Tornado/Windstorm, Severe Summer Weather, Severe Winter Storms, Grass/Wildland Fire, and Extreme Heat.

Vulnerability

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.

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.

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 back-up systems in place in the event of failure, as larger systems might.

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.

The Iowa Department of Transportation has conducted inspections of bridges in the state. Table 4-37provides a summary of the condition of the 78 bridges in Emmet County.

Table 4-37 Emmet County Bridge Condition, SDFO Ratings, Weight Restrictions

Condition Index Rating—All Bridges in Emmet County		
Good	Fair	Poor
18	48	12
Structurally Deficient/Functionally Obsolete (SDFO) Rating—All Bridges in Emmet County		
Not Deficient	Structurally Deficient	Functionally Obsolete
66	12	0
Weight Restrictions—All Bridges in Emmet County		
Unrestricted	Restricted	Closed
66	10	2

Source: Iowa Department of Transportation, http://iowadot.maps.arcgis.com/apps/MapSeries/index.html?appid=db6cb43313354a4f85505089ab317e7a

Economy

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 4-38).

Table 4-38 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, Appendix C

Environment and Cultural Resources

Some critical infrastructure failures can have significant impacts on the environment. For instance, sewer backups and water main breaks can pollute the environment, while 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. Emmet County has seen an overall population decrease of about 8.9% between the 2010 and 2020 census years. As technological

advances are made, and systems become more and more automated and dependent on power and communications infrastructure, the impacts of infrastructure failure could increase even though population is decreasing slightly.

Risk Summary

- Overall, Infrastructure Failure 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.
- Historically the vast majority of infrastructure failures in Emmet County have had negligible impacts. However, 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: All hazards

4.3.9 Landslide

Probability	Magnitude/ Severity	Extent	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.

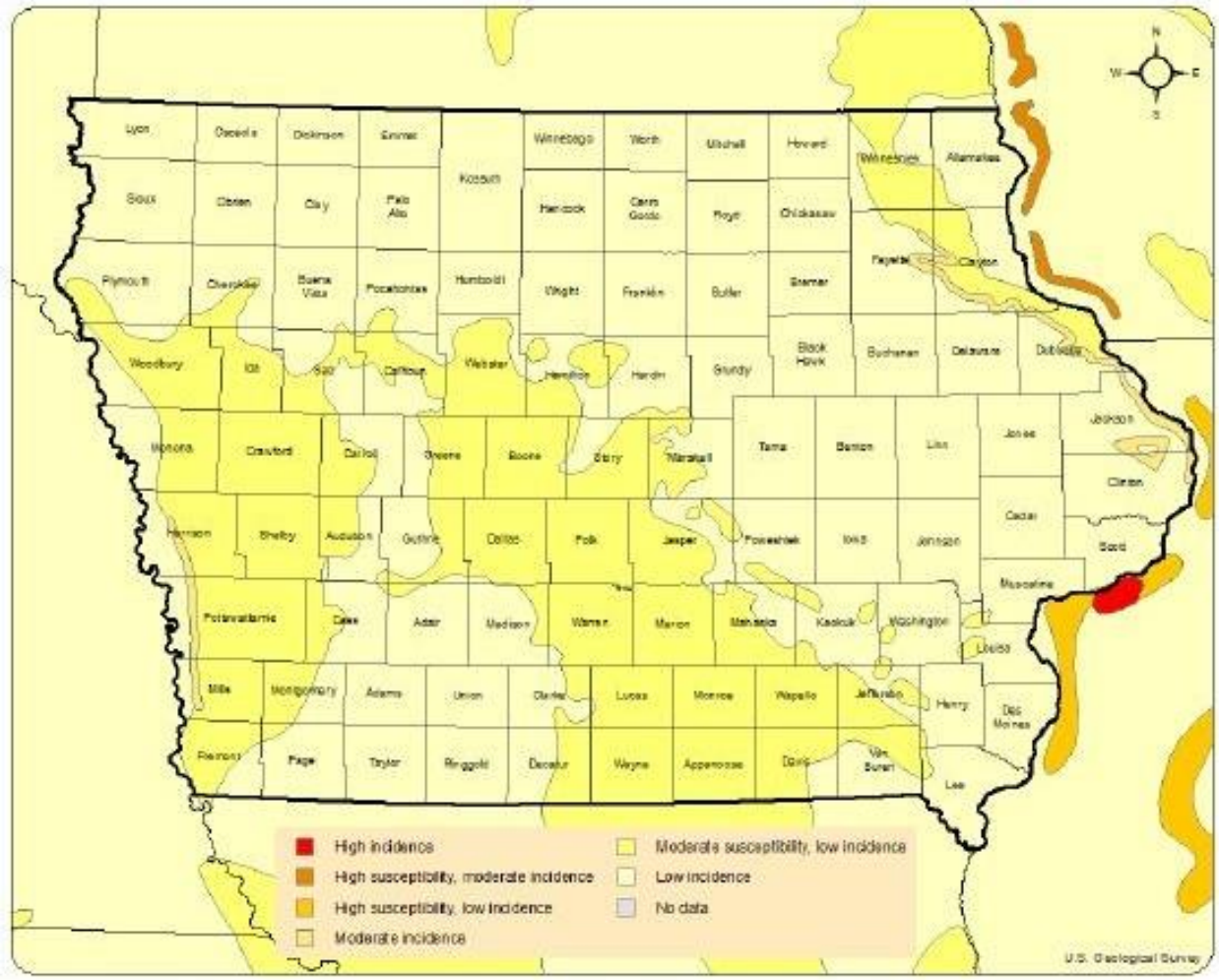
Slope failures are capable of damaging or destroying portions of roads and railroads, sewer and water lines, homes and public buildings, and other utility lines. Even small-scale landslides are expensive due to clean up costs that may include debris clearance from streets, drains, streams and reservoirs; 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 Emmet County, landslides are primarily very small, non-damaging events.

Location

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 (see Figure 4-34 below), the likelihood or probability of landslides is not well understood in Iowa. The entirety of Emmet County is shown as having low incidence of landslides.

Figure 4-34 Landslide Susceptibility in Iowa



Source: Iowa State Hazard Mitigation Plan, 2018

Past Occurrences

The Emmet County Emergency Management Agency has recorded several incidents of minor landslides. The following photo shows a landslide that occurred as a result of flooding in May 2005. Landslides have occurred on several occasions along roadsides, presenting the possibility for danger to traveling vehicles.

Source: Emmet County Emergency Management Agency

Probability of Future Occurrence

The probability of a landslide causing damage in Emmet 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 **unlikely** 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 Emmet 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.

Vulnerability

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 Emmet 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 Emmet County and the planning committee did not identify any specific assets or areas of development that are vulnerable to landslide.

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 Emmet 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

Emmet County's population is shrinking, and new development has been limited in recent years, therefore future development is not likely to increase vulnerability to this hazard, especially given there are not areas with moderate or high susceptibility to landslide in the county.

Risk Summary

- The overall significance of landslides is **low.**
- There is little history of damaging landslides, and also little mapping of landslide risk in the County.
- No critical facilities are found in landslide-prone areas or in areas of previous landslide events.
- Related hazards: Expansive Soil, Flooding, Thunderstorms

4.3.10 Severe Winter Storm

Location	Magnitude/Severity	Future Probability	Overall Significance
Extensive	Limited	Highly Likely	**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 National Weather Service 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.

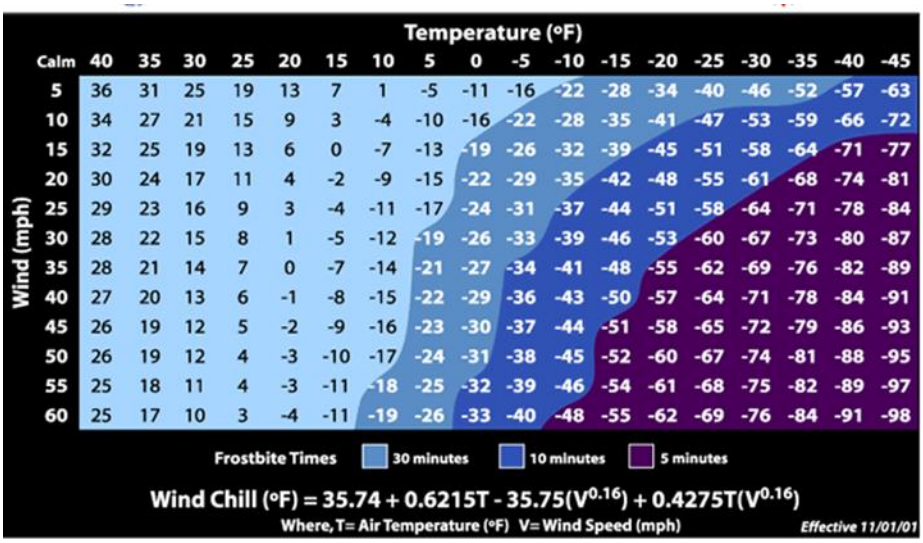
Extreme cold often accompanies severe winter storms and can lead to hypothermia and frostbite in people who are exposed to the weather without adequate clothing protection. Cold can cause fuel to congeal in storage tanks and supply lines, stopping electric generators. Cold temperatures can also overpower 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.

The National Institute on Aging estimates that more than 2.5 million Americans are especially vulnerable to hypothermia, with the isolated elderly being most at risk. About 10 percent of people over the age of 65 have some kind of temperature-regulating defect, and 3-4 percent of all hospital patients over 65 are hypothermic.

Others at risk are those without shelter or who are stranded, or who live in a home that is poorly insulated or without heat. 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.

Wind can greatly amplify the impact of cold ambient air temperatures. Provided by the National Weather Service, Figure 4-35 below shows the relationship of wind speed to apparent temperature and typical time periods for the onset of frostbite.

Figure 4-35 Wind Chill Chart



Source: National Weather Service

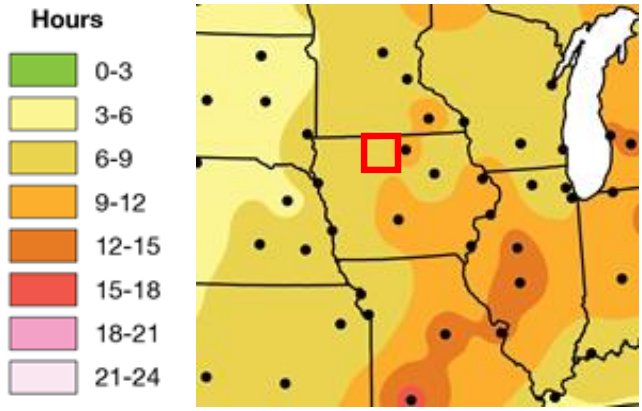
Location

According to the High Plains Regional Climate Center, the planning area has an average maximum temperature of 27.63 °F in December, 24.55 °F in January, and 29.17 °F in February. Average minimum temperatures for those same three months are 10.39 °F, 6.18 °F and 10.92 °F. Average snowfall is highest in December, January, and February with an annual average of 31 inches. (Source: High Plains RCC CLIMOD Monthly Climate Normals)

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 4-36 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 4-36 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.

Past Occurrences

Historically, there have been two Presidential Disaster Declarations for Severe Winter Storms that included Emmet County since 1965; an ice storm in 1991 and a winter storm in 2010 (See Table 4-3 in the Hazard Identification Section).

From 1996 thru 2023, the National Climatic Data Center reports the following 123 severe winter weather events:

- 33 – Blizzard
- 10 – Cold/Wind Chill
- 16 – Extreme Cold/Wind Chill
- 17 – Heavy Snow
- 12 – Ice Storm
- 34 – Winter Storm
- 1 – Winter Weather

During this 27-year period, there have been 123 events caused by severe winter weather. Of these 123 events, 43 of the events caused property damage. This translates to roughly two damaging winter storm/cold temperature events each year. The total property damage for these 43 events was $1,751,725 with the most damaging event occurring on February 24, 2007 causing $250,000 in property damage resulting from a winter storm. This winter event caused power outages across Emmet County as well as some surrounding areas, leaving nearly 265,000 people without power.

The Emmet County Emergency Management Agency recorded the following photo of a snow accumulation on Highway 9 east of Estherville following the blizzard of 2010.

Source: Emmet County Emergency Management Agency

Probability of Future Occurrence

According to NCEI, during the 27-year period from 1996 thru 2023, the planning area experienced a total of 43 damaging blizzards, winter storms, ice storms, and extreme cold events. This translates to an annual probability of about two Severe winter weather events per year. Therefore, the probability rating is "Highly Likely".

Magnitude/Severity

Certain areas may experience local variations in storm intensity and quantity of snow or ice. The Iowa Department of Transportation, county road departments, and local public works agencies are responsible for the removal of snow and treatment of snow and ice with sand and salt on the hundreds of miles of streets and highways in the area. Poor road conditions, immobilized transportation, and downed trees and electrical wire can impair snow removal on roads and road treatment.

Building and communication tower collapse and bodily injury or death are just a few of the impacts of a severe winter storm. Vehicle batteries and diesel engines are stressed, and the fuel often gels in extreme cold weather. This impacts transportation, trucking, and rail traffic. Rivers and lakes freeze, and subsequent ice jams threaten bridges and can close major highways. Ice jams can also create flooding problems when temperatures begin to rise.

An ice coating at least ¼ inch in thickness is heavy enough to damage trees, overhead wires, and similar objects and to produce widespread power outages. Buried water pipes can burst causing massive ice problems, loss of water, and subsequent evacuations during sub-zero temperatures.

Fire during winter storms presents a great danger because water supplies may freeze, and firefighting equipment may not function effectively, or personnel and equipment may be unable to get to the fire. If power is out, interiors of homes become very cold, causing pipes to freeze and possibly burst.

Cold temperature impacts on agriculture are frequently discussed in terms of frost and freeze impacts early or late in growing seasons and on unprotected livestock. The cost of snow removal, repairing damage, and loss of business can have large economic impacts on a community.

The National Weather Service has developed effective weather advisories that are promptly and widely distributed. Radio, television, and All-hazard Radios provide the most immediate means to do this. Accurate information is made available to public officials and the public at least 12-24 hours in advance as storms form and totals are estimated.

Climate Change Considerations

Climate change has the potential to exacerbate the severity and intensity of winter storms, including potential heavy amounts of snow. A warming climate may also result in warmer winters, the benefits of which may include lower winter heating demand, less cold stress on humans and animals, and a longer growing season. However, these benefits are expected to be offset by the negative consequences of warmer summer temperatures.

The effects of a changing climate in Iowa in relation to temperatures and precipitation have already been observed. According to the report Climate Change in the Midwest: A Synthesis Report for the National Climate Assessment, referenced in the 2018 Iowa State Hazard Mitigation Plan, average winter temperatures in Iowa have trended 0.031 F° cooler per year from 1981-2010 and winter precipitation averages have increased by 0.031 inches per year over the same time period. These changes in average climate may impact the frequency and severity of winter weather in the coming years.

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 considered to be at increased risk to Winter Storms and associated extreme cold events.

Property

The total property loss reported by the NCEI for a total of 43 winter events that impacted the planning area during the 27-year time-period from 1996 thru 2021 was $1,751,725. However, damages for winter and ice

storms are reported for all weather zones impacted. So, it is extremely difficult to determine the damages from these events that apply specifically to Emmet County.

USDA crop insurance claims for cold conditions and snow for the 14-year period of 2007-2021 totaled $889,914, resulting in $63,565 in estimated annualized losses.

Critical Facilities and Infrastructure

Overhead power lines and infrastructure are also vulnerable to damages from winter storms. In particular, ice accumulation during winter storm events can cause damages to power lines due to the ice weight on the lines and equipment, as well as damage caused to lines and equipment from falling trees and tree limbs weighted down by ice. 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.

The electric power loss of use estimates provided in Table 4-39 below were calculated using FEMA's Standard Values for Loss of Service for Utilities published in the June 2009 BCA Reference Guide. These figures are used to provide estimated costs associated with the loss of power in relation to the populations in Emmet County's jurisdictions. The loss of use estimates for power failure associated with winter storms is provided as the loss of use cost per person, per day of loss. The estimated loss of use provided for each jurisdiction represents the loss of service of the indicated utility for one day for 10 percent of the population. It is understood that in rural areas, the typical loss of use may be for a larger percentage of the population for a longer time during weather extremes. These figures do not take into account physical damages to utility equipment and infrastructure.

Table 4-39 Loss of Use Estimates for Power Failure (One Day)

Jurisdiction	2016 Population Estimate	Estimated Affected Population 10%	Electric Loss of Use Estimate ($126 per person per day)
City of Armstrong	898	90	$ 11,315
City of Dolliver	81	8	$ 1,021
City of Estherville	6,027	603	$ 75,940
City of Gruver	105	11	$ 1,323
City of Ringsted	479	18	$ 2,268
City of Wallingford	180	205	$ 25,830
Unincorporated Emmet County	2,050	982	$ 123,732
County Total	**9,820**	**90**	**$ 11,315**

Source: Loss of Use Estimates from FEMA BCA Reference Guide, 2009; Population Estimates, U.S. Census Bureau, 5-year American Community Survey

Economy

Winter storms, cold, frost and freeze take a toll on crop production in the planning area. According to the USDA's Risk Management Agency, payments for insured crop losses in the planning area as a result of cold conditions and snow from 2007-2021 totaled $911,218. (see Table 4-40).

Table 4-40 Crop Insurance Claims Paid in Emmet County as a Result of Cold Conditions and Snow (2007-2021)

Year	Cold Wet Weather	Cold Winter Weather	Freeze	Frost	Total Insurance Claims Paid
2007	--	--	--	--	$0
2008	$7,177	--	--	--	$7,177
2009	$22,250	$9,425	$859	$2,274	$34,808
2010	--	--	--	--	$0
2011	$1,056	$14,344	$507	$5,416	$21.323
2012	$2,527	--	--	--	$2,527
2013	$68,672	--	$3,794	--	$72,466
2014	$410,801	$13,248	--	$52,192	$476,241
2015	--	--	--	--	$0
2016	$63,117	--	--	--	$63,117
2017	--	$4,852	--	--	$4,852
2018	$10,557	--	--	--	$10,557
2019	$165,999	--	--	--	$165,999
2021	$1,424	--	$7,949	$42,776	$52,149
Total	**$753,580**	**$ 41,869**	**$ 13,109**	**$102,658**	**$ 889,914**

Source: USDA Risk Management Agency

Environment and Cultural Resources

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. Businesses can experience loss of income as a result of closure during winter storms.

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 winter storms is **high**.
- Winter storms of varying severity can be expected to impact the planning area multiple times each year.
- Winter storms have not historically caused significant damage or casualties in Emmet County, however the potential for these issues exists.
- There is a significant risk for vehicle accidents and stranded motorists, who may be unprepared to protect themselves from exposure, during winter storms.
- The largest impacts typically involve utility and transportation disruptions.
- Related hazards: Infrastructure Failure, Flooding, Transportation Incident, Windstorm.

4.3.11 Terrorism

Probability	Magnitude/ Severity	Extent	Hazard Ranking
Unlikely	Limited	Extensive	**Medium**

Description

This hazard encompasses the following sub-hazards: enemy attack, biological terrorism, agro-terrorism, chemical terrorism, conventional terrorism, cyber terrorism, 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.

Agro-terrorism 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 Emmet County. The introduction of a biological agent into the population of 22,000 cattle and calves, or the 191,652 hogs and pigs, or the 120,500 acres of corn in Emmet 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.

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 affects are instantaneous; additional 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 reported in 2022 that there were two active hate groups in Iowa: National Alliance (Neo-Nazi) and Patriot Front (White Nationalist); both identified as being statewide.

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. The most likely targets of a conventional terrorism attack in Emmet County include public school system facilities, the County Courthouse and law enforcement centers within the County.

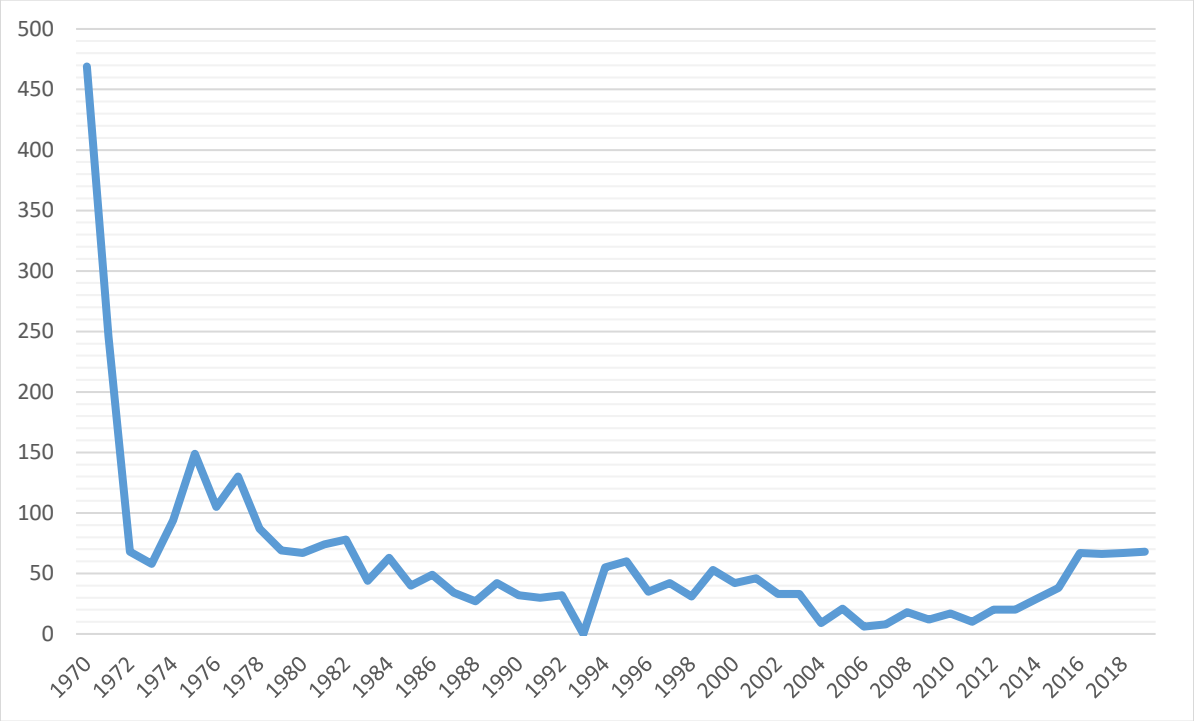
In terms of cyber-terrorism, our society is highly networked and interconnected. An attack could be launched from anywhere on earth and could range in impacts from small and localized to a far-reaching global scale. Depending on the attack vector and parameters, a cyber-attack could impact all of Emmet County and its associated municipal jurisdictions.

Past Occurrences

The Global Terrorism Database (GTD) catalogs more than 200,000 terrorist attacks dating back to 1970. As shown in Figure 4-37, 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.

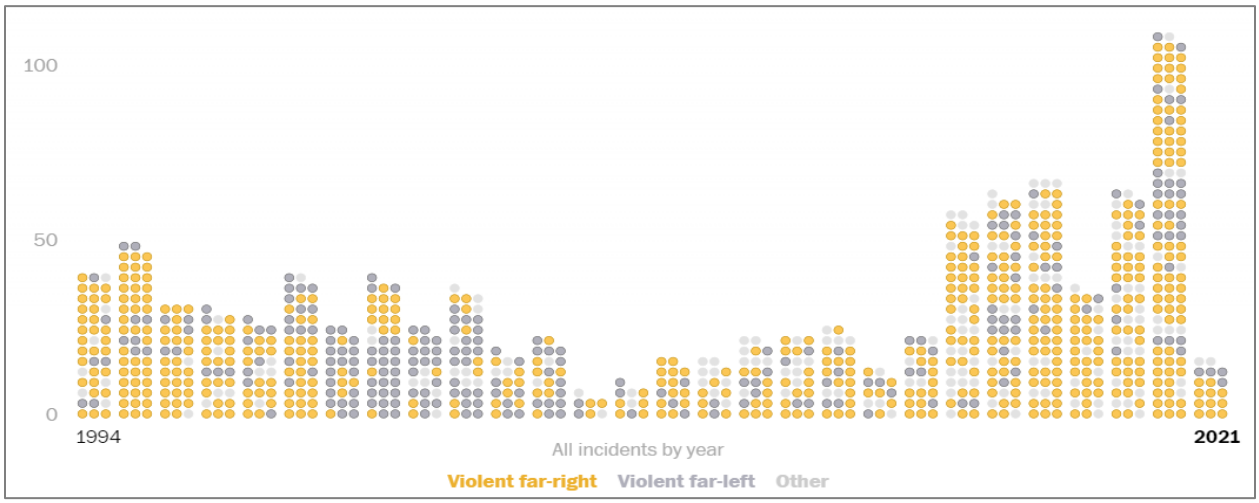
Figure 4-37 Terrorist Attacks in The US 1970-2019



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 4-38 shows a breakdown of terrorist attacks based on the ideology of the attacker.

Figure 4-38 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 Emmet County.

Probability of Future Occurrence

While difficult to estimate, the probability for a terrorist event is "Unlikely" within the next 10 years in Emmet 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 Emmet 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 Emmet County would have advanced notice of a terrorism event.

Climate Change Considerations

There are no known climate change impacts relevant to this hazard.

Vulnerability

People

People would be the greatest vulnerability in the event of a terrorism incident in Emmet County. A terrorism event would inevitably also result in significant property losses. Analysis of vulnerable populations is aided by a program developed by Johns Hopkins University in 2006 called Electronic Mass Casualty Assessment and Planning Scenarios (EMCAPS) http://www.hopkins-cepar.org/EMCAPS/EMCAPS.html which utilizes scenarios developed by the DHSEM.

Property

A terrorism event would inevitably also result in significant property losses. The degree of impact would be directly related to the type of incident and the target. Potential losses could include cost of repair or replacement of damaged facilities, lost economic opportunities for businesses, loss of human life, injuries to persons, loss of food supplies, disruption of the food supply chain, and immediate damage to the surrounding environment.

Critical Facilities and Infrastructure

Critical facilities and infrastructure are vulnerable as these assets would be likely targets for a direct attack. Depending on the extent of damages or disruptions in the aftermath of an event, the ability of first responders and medical personnel to respond could be hindered.

Economy

Potential economic losses could include cost of repair or replacement of damaged facilities, lost economic opportunities for businesses, loss of food supplies, disruption of the food supply chain, and immediate damage to the surrounding environment.

Environment and Cultural Resources

Agro-terrorism or chemical terrorism could result in significant damage to the environment in Emmet County. These events can pollute the environment and cause nearby plants and animals to get sick or die. Contaminated material that gets into the air or water supply can affect humans further away from the incident site.

Development Trends

As public events are held at various venues in the County, the potential may exist for these locations to become targets of attack. With human-caused hazards such as this that can have multiple variables involved, increase in development is not always a factor in determining risk, although the physical damages of the event may increase with the increased or newly developed areas.

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 Emmet County is agro-terrorism.
- Related hazards: Radiological incident, hazardous materials incidents, infrastructure failure.

4.3.12 Thunderstorm with Lightning and Hail

Location	Magnitude/Severity	Future Probability	Overall Significance
Significant	Critical	Highly Likely	**Medium**

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 4.3.4) and tornadoes and windstorms (discussed further in Section 4.3.13).

Lightning

All thunderstorms produce lightning, which often strikes outside of the area where it is raining and is known to fall 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.

Table 4-41 below describes typical damage impacts of the various sizes of hail.

Table 4-41 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

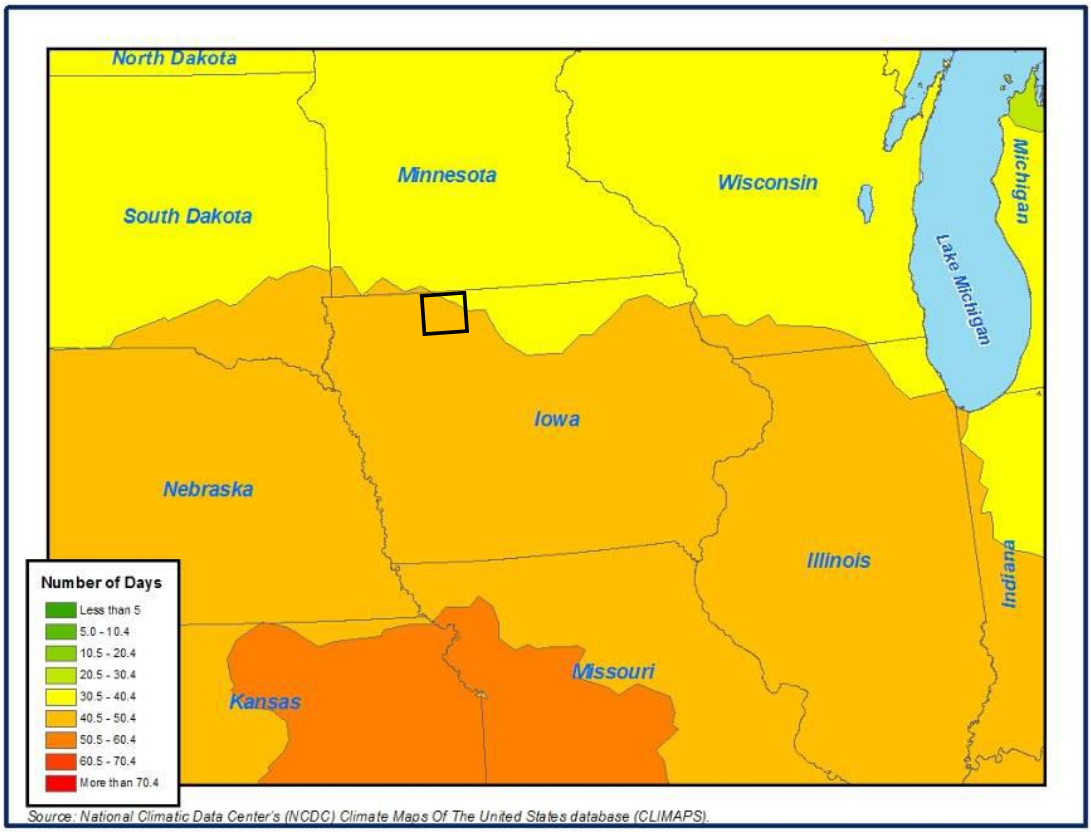
Source: Tornado and Storm Research Organization (TORRO), Department of Geography, Oxford Brookes University
Notes: In addition to hail diameter, factors including number and density of hailstones, hail fall speed and surface wind speeds affect severity.

The onset of thunderstorms with lightning and hail is generally rapid. However, advancements in meteorological forecasting allow for some advance warning.

Location

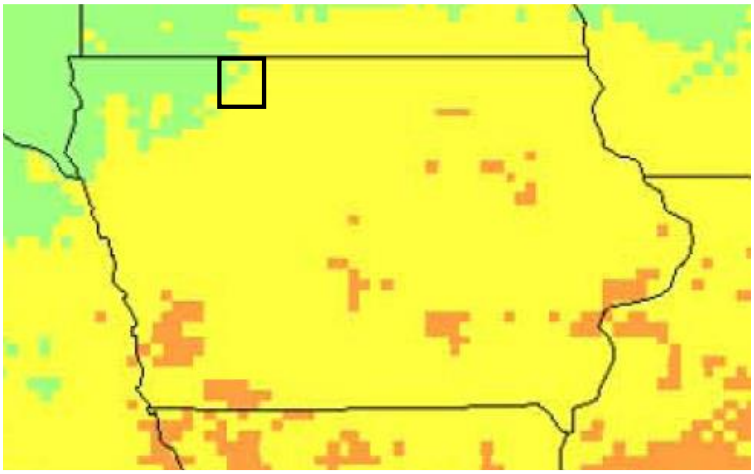
Thunderstorms and the associated hail and lightning impact the entire County with relatively similar frequency. Although these events occur similarly throughout the planning area, they are more frequently reported in more urbanized areas. In addition, damages are more likely to occur in more densely developed urban areas as well as to cropland. Figure 4-39 displays the average number of days with thunder experienced throughout different areas of the county each year, showing most of the County experiences between 40.5 to 50.4 days with thunder per year per the orange shaded area, and portions to the east (shaded in yellow) experience 30.5 to 40.4 days with thunder per year. Figure 4-40 shows 1 to 4 lightning strikes per square kilometer per year with the green and yellow shaded areas.

Figure 4-39 Distribution and Frequency of Thunderstorms



Note: Black Square indicates approximate location of Emmet County

Figure 4-40 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 Emmet County

Past Occurrences

Since 1965, Emmet County has been included in six Presidential Disaster declarations that included severe storms/weather (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.

The NCEI reported 198 total thunderstorm events for the Emmet County planning area from 1996 to 2023. Of the reported events, there was $1,559,000 in total property damage and no injuries or fatalities.

Table 4-42 Thunderstorm Summary for Emmet County (1996-2023)

Hazard type	Total Events	Events with Damage	Property Damage	Injuries	Fatalities
Hail	96	36	$194,000	0	0
Lightning	4	4	$85,000	0	0
Thunderstorm Wind	98	15	$1,280,000	0	0
Totals	**198**	**55**	**$1,559,000**	**0**	**0**

Source: NCEI

Hail

Table 4-43 shows the number of hail events 0.75 inches and larger by the size of the hail.

Table 4-43 Hail Events Summarized by Hail Size

Hail Size (inches)	# of Events 1996-2023
3.00	1
2.75	3
2.00	2
1.75	9
1.50	7
1.25	1
1.00	20
0.88	31
0.75	22
Grand Total	**90**

Source: NCEI

Thunderstorm Winds

Information concerning tornadoes and windstorms, separate from thunderstorms, can be found in Section 0.

The National Weather Service (NWS) will issue a Severe Thunderstorm Warning whenever a thunderstorm is forecasted to produce wind gusts to 58 miles per hour (50 knots) or greater and/or hail size one-inch (quarter-size) diameter which can produce significant damage (source: http://www.nws.noaa.gov/oneinchhail/). The data is kept on Iowa Environmental Mesonet, Iowa State University Department of Agronomy website, (http://mesonet.agron.iastate.edu/vtec/search.php). During the 27-year period from 1996 through 2023, there were 166 severe thunderstorm watches and 266 warnings. This calculates to an annual average of 16.3 watches and 10.2 warnings.

The Emmet County Emergency Management Agency recorded one incident of a lightning strike hitting U.S. 9 east of Estherville and causing a hole in the road surface nearly 2 feet deep and over 10 inches wide.

Source: Emmet County Emergency Management Agency

Although NCEI provides estimates of crop losses, crop insurance payment statistics are considered a more accurate resource for this data. According to the USDA Risk Management Agency, insured crop losses in Emmet County as a result of hail from 2007 to 2021 totaled $7,635,828.45 (see Table 4-44) and $617,098.03 from windstorms.

Table 4-44 Crop Insurance Claims Paid in Emmet County from Hailstorms and Windstorms, 2007-2021

Year	Hail	Wind/Excess Wind	Insurance Paid
2007	$14,441.00	$40,929.00	$55,370.00
2008	$26,929.00	$247,390.00	$274,319.00
2009	$556,389.00		$556,389.00
2010	$25,874.00		$25,874.00
2011			
2012	$41,772.00	$7,766.00	$49,538.00
2013	$146,642.00		$146,642.00
2014	$6,612,223.85		$6,612,223.85
2015	$1,836.60		$1,836.60
2016	$15,849.40	$3,978.00	$19,827.40
2017	$62,446.00	$11,092.00	$73,538.00
2018	$93,528.10	$84,047.00	$177,575.10
2019	$29,507.00	$29,512.00	$59,019.00
2020	$8,390.50	$12,995.00	$12,995.00
2021		$220,318.03	$220,318.03
Total	**$7,635,828.45**	**$617,098.03**	**$8,285,464.98**

Source: USDA Risk Management Agency

Probability of Future Occurrence

NCEI-reported damaging lightning events occurred four times from 1996 through 2021. Since lightning accompanies thunderstorms, it can be assumed that lightning occurs more often than damages are reported. These rates of occurrence are expected to continue in the future.

Based on NCEI data, there have been 36 damaging hail events and 15 damaging thunderstorm wind events.. Based on this history, damaging hail and thunderstorm wind occur in the planning area multiple times each year making the probability for damaging events "**Highly Likely**" in any given year.

Magnitude/Severity

It is possible for the entire county to be affected by a large thunderstorm and lightning event that moves across the entire county, 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.

Communities considered these factors and typical incidents when assessing the severity of potential impacts. Those communities that assigned lower scores (indicating minimal to no property damage, limited environmental consequences, and short-term disruptions to critical facilities) considered the impact of an average storm within their region. Conversely, communities that assigned higher scores (indicating significant property damage, serious injuries, and extended closures of critical facilities) based their assessments on a worst-case scenario storm.

Based on information provided by the Tornado and Storm Research Organization, **Table 4-45** below describes typical damage impacts of the various sizes of hail.

Table 4-45 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

Intensity Category	Diameter (mm)	Diameter (inches)	Size Description	Typical Damage Impacts
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

According to the 2010 Climate Change Impacts on Iowa report, growing evidence points to stronger summer storm systems in the Midwest. Studies have not been done to conclusively say that severe storms, including hail, lightning, and strong winds, are increasing. However, with summer temperatures becoming warmer and humidity levels increasing, an increase in the likelihood of these hazards is plausible.

Vulnerability

People

Individuals in protected areas, such as those in mobile homes or automobiles during a storm, are particularly susceptible to the hazards of thunderstorms, lightning, and hailstorms. Severe thunderstorms often bring sudden, powerful winds that can topple tress onto roads and power lines. Lightning poses the most immediate threat to both people and livestock during a thunderstorm and ranks as the second leading cause of weather- related fatalities, on the other hand, are the primary cause of weather-related deaths in the United States.

While hailstorms rarely directly lead to loss of life, injuries can still occur. Lightning can be perilous for those outdoors, especially those seeking shelter under trees or other natural lightning rods, those near or in bodies of water, or individuals on or near hilltops. In the absence of shelter, hail can pose a significant risk to people, pets, and livestock. Thunderstorms can also give rise to flash floods and tornadoes, increasing the danger for those automobiles or low-lying areas during flash flood events and those residing in mobile homes.

Property

Hail can also do considerable damage to vehicles and buildings. According to the NCEI Storm Events Database, between 1950 and 2020 approximately $137,000 in property damages and $365,000 in crop damages occurred in Emmet County from hail and lightning. As mentioned throughout this section, these damages are often insured.

Table 4-46 provides the estimated annualized property damages resulting from thunderstorms, including lightning, hail and wind.

Table 4-46 Estimated Annualized Property Damages Resulting from Severe Thunderstorms (Hail/Lightning/Wind, 1996-2021)

Hail/Lightning/Thunderstorm Wind Property Damages	
Hail	$194,000
Lightning	$85,000
Thunderstorm Wind	$1,280,000
Total	**$1,559,000**

Source: NCDC

Critical Facilities and Infrastructure

Hail can temporarily render roads impassable when small hailstones accumulate to the extent that they block roadways. Additionally, hail has been observed to obstruct storm drains, impeding proper runoff and potentially leading to secondary flooding hazards. Most structures, including critical County facilities, generally offer sufficient protection from hail, although they may experience issues like broken windows and dented exterior, Facilities equipped with backup generators are better prepared to handle severe weather events, ensuring functionality in case of power outages. It's worth noting that critical facilities and infrastructure can be vulnerable to direct lightning strikes. When evaluating current development exposure, the combined impact of wind, lightning, rain, and hail on power delivery stands as a significant consideration.

Economy

The economic impact of a severe thunderstorm is typically short term. Lightning and high wind events can cause power outages and fires. Generally, long-term economic impacts center more around hazards that cascade from a severe thunderstorm, including wildfires ignited by lightning. Similarly, with the previous sections, lightning can cause structural damage or damage to electrical systems to private buildings as well as critical infrastructure. Hail and high wind damage can also force the temporary or extended closure of businesses, resulting in lost income and wages in addition to the recovery costs of repairing damage.

Additionally, the USDA Risk Management Agency reports approximately $8,285,464.98 in crop insurance claims paid since 2007. Agricultural crops such as corn and beans are particularly vulnerable to hailstorms stripping the plant of its leaves.

Environment and Cultural Resources

Though hail and lightning are natural elements of environment, they can result in substantial environmental harm. This included the breakage of tree limbs, harm to trees and flowering plants, and the destruction of crops. Furthermore, certain cultural and historical assets may be susceptible to potential hail-related damage.

Development Trends

Any additional future development will result in more property being vulnerable to damages from severe thunderstorms, lightning and hail. To minimize vulnerability, protective measures could be implemented such as wind-resistant construction, lightning rods, surge protection, and use of materials less prone to hail/wind damage. 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 as well 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 **Medium.**
- There have been 100 hail and lightning events in Emmet County since 1996, according to NCEI, which have caused nearly $1,559,000 worth of damage including thunderstorm winds as well.
- Related Hazards: flooding, Wildfire, Tornado/Windstorm

4.3.13 Tornado/Windstorm

Location	Magnitude/Severity	Future Probability	Overall Significance
Extensive	Limited	Highly Likely	**High**

Description

This hazard section discusses both tornado and windstorm.

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, the less spectacular damage is much more common.

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 Watch, High Wind Warning, and Wind Advisory 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, that are either expected or observed over land.

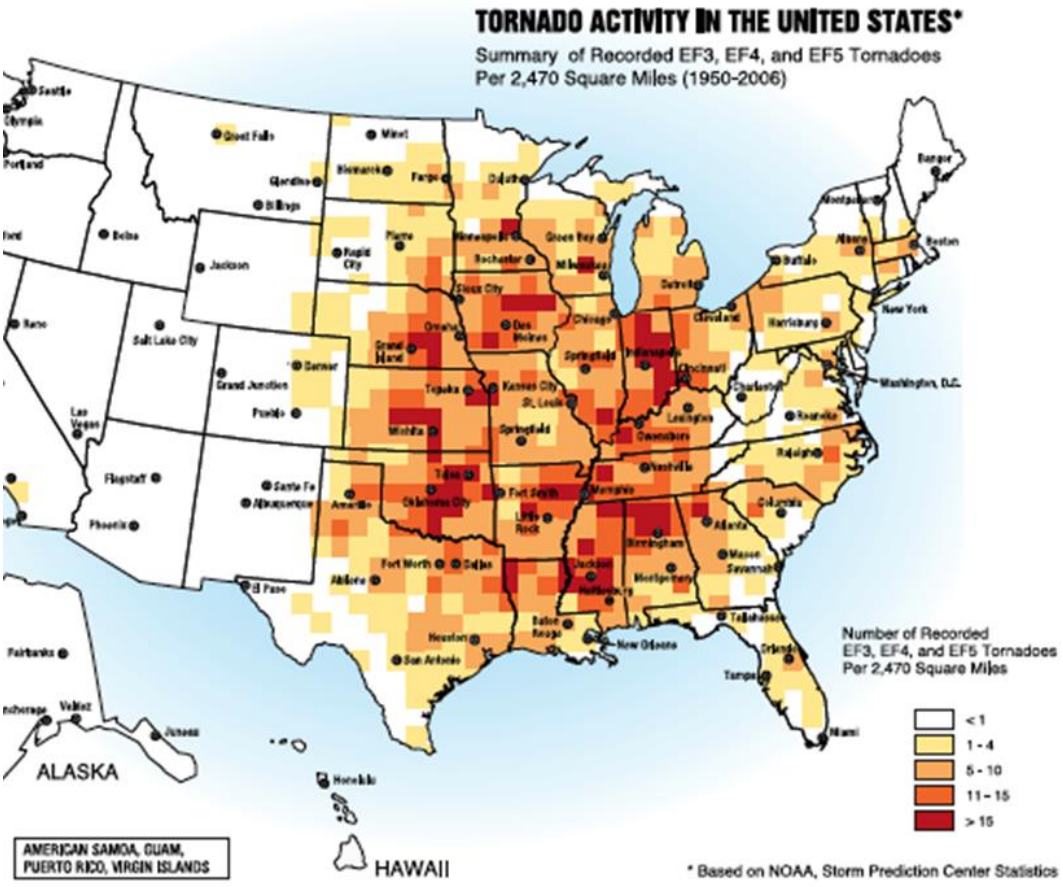
- **High Wind Advisory** – This is issued when high wind speeds may pose a hazard. Sustained winds 25 to 39 mph and/or gusts to 57 mph.

Location

Iowa is located in a part of the United States where tornadoes are a common occurrence. According to The Des Moines Register, Iowa has experienced 3,241 tornadoes from 1950 through 2023 (73-year period). During this period, six of these are F5/EF5 rated tornado that occurred in Iowa during this timeframe (Parkersburg in 2008). Since 1950, there have been on average 44 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 2,291 injuries and 93 deaths attributable to tornadoes (source: https://datacentral.desmoinesregister.com/tornado-archive/).

Tornadoes can occur in the entire planning area. Figure 4-41 illustrates the number of F3, F4, and F5 tornadoes recorded in the United States per 3,700 square miles between 1950 and 2006. Emmet County is in the section with light orange shading, indicating between 5 and 10 tornadoes of this magnitude during this 57-year period.

Figure 4-41 Tornado Activity in the United States



Source: FEMA 320, Taking Shelter from the Storm, 3rd edition
Note: Blue arrow is approximate location of Emmet County

Tornadoes are classified according to the EF Scale. The Enhanced F Scale (see 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 U.S. on February 1, 2007.

Table 4-47 Enhanced F Scale for Tornado Damage

Fujita 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 4-48. 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 4-48 Enhanced Fujita Scale with Potential Damage

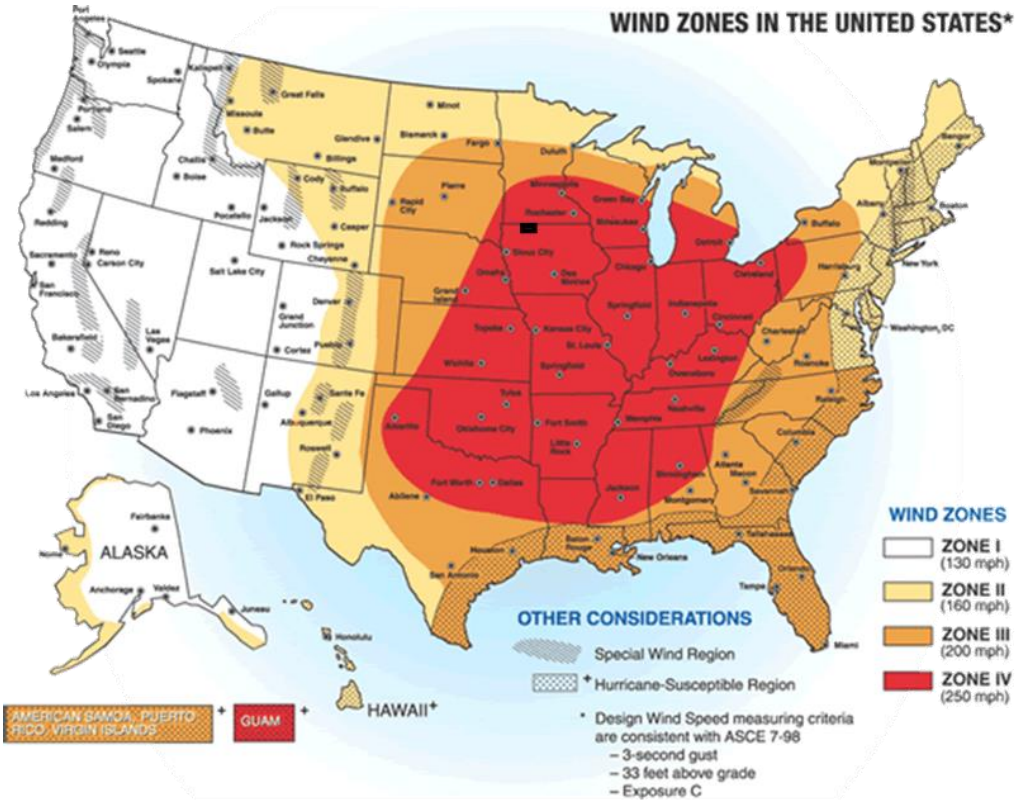
Scale	Wind Speed (mph)	Relative Frequency	Potential Damage
EF0	65-85	53.5%	Light. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e. those that remain in open fields) are always 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 badly damaged; high rise buildings have significant structural deformation; incredible phenomena will occur.

Source: NOAA Storm Prediction Center

All of Emmet 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

4-42 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 4-42 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 Emmet 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 Emmet County had 21 recorded tornado events from 1950 to 2022. Of these, one was an F3; three were rated F2; five were rated F1/EF1; ten were rated F0/EF0; and two received no rating. These tornadoes caused no fatalities or injuries, over $3 million in property damages and $8,500 in damage to crops. Historically, tornadoes in the county have occurred in undeveloped areas and had relatively little impact. Table 4-49 summarizes these events.

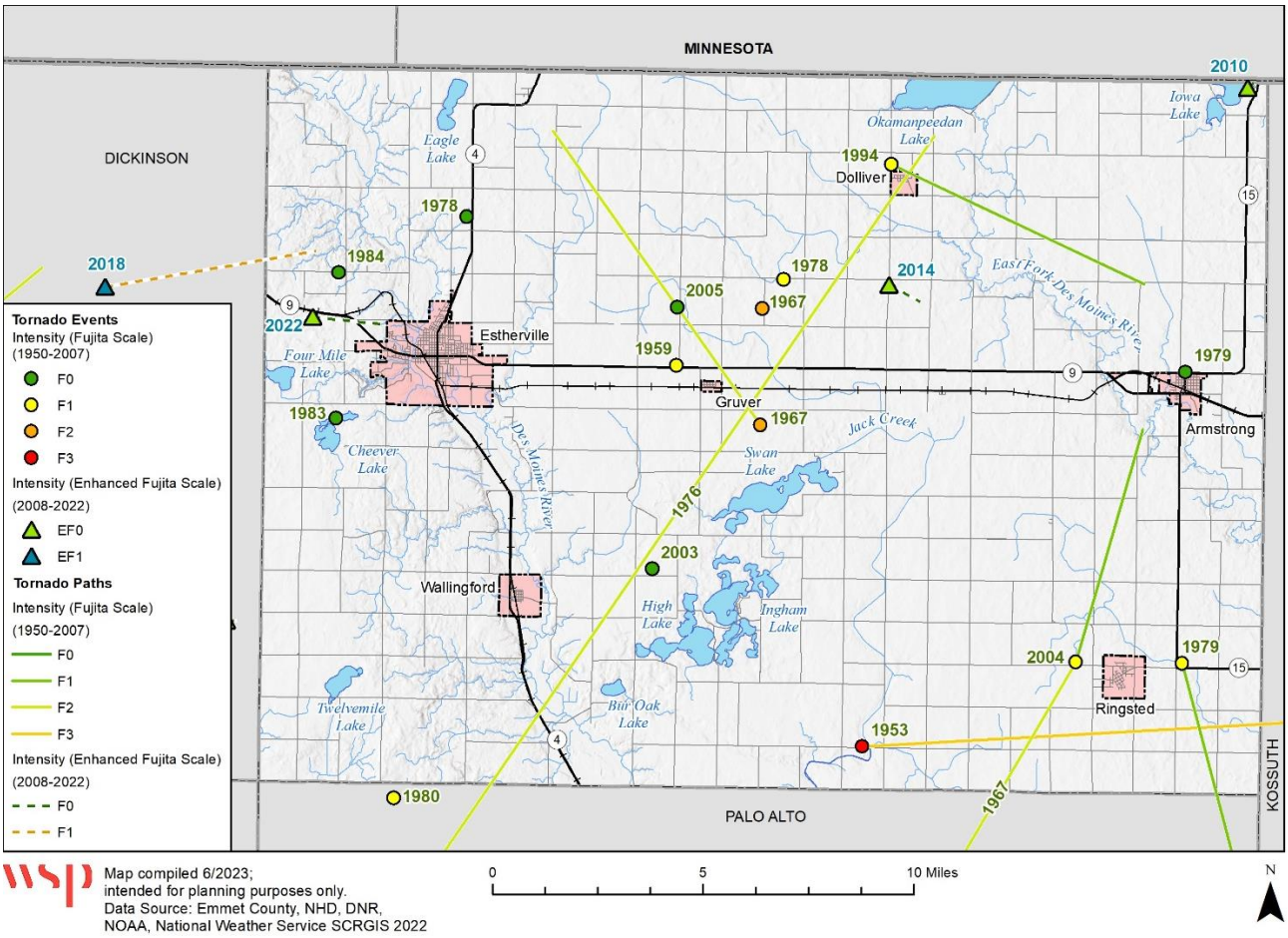
Table 4-49 Recorded Tornadoes in Emmet County, 1950 – 2022

Location	Date	Magnitude	Deaths	Injuries	Property Damage	Crop Damage	Length	Width
Emmet County	3/21/1953	F3	0	0	$250,000	$0	31.8	400
Emmet County	5/30/1959	F1	0	0	$2,500	$0	2	200
Emmet County	4/30/1967	F2	0	0	$2,500,000	$0	8.2	300
Emmet County	4/30/1967	F2	0	0	$250,000	$0	1	200
Emmet County	6/14/1976	F2	0	0	$2,500	$0	18.3	33
Emmet County	7/14/1978	N/A	0	0	$25,000	$0	5	100
Emmet County	7/14/1978	N/A	0	0	$0	$0	0.5	30
Emmet County	6/28/1979	F0	0	0	$0	$0	0.5	30
Emmet County	6/28/1979	F1	0	0	$25,000	$0	2.3	40
Emmet County	8/18/1980	F1	0	0	$25,000	$0	0.2	30
Emmet County	6/13/1983	F0	0	0	$30	$0	0.1	10
Emmet County	7/16/1984	F0	0	0	$0	$0	0.1	3
Dolliver	5/4/1994	F1	0	0	$5,000	$0	7.5	45
Swea City	8/13/1995	F0	0	0	$1,000	$1,000	0.2	25
Wallingford	7/14/2003	F0	0	0	$0	$1,000	0.1	25
Ringsted	6/11/2004	F1	0	0	$5,000	$5,000	6	200
Gruver	6/20/2005	F0	0	0	$0	$0	0.2	30
Armstrong	8/10/2010	EF0	0	0	$0	$0	0.18	40
Maple Hill	8/17/2014	EF0	0	0	$0	$1,000	0.83	25
Estherville	9/20/2018	EF0	0	0	$0	$0	1.18	35
Estherville	7/5/2022	EF0	0	0	$1,000	$500	1.63	80

Source: NOAA

The map in Figure 4-43 shows the paths of the previous events. Note: Not all events had available latitude and longitude coordinates. As a result, not all events are displayed.

Figure 4-43 Tornado Paths in Emmet County, 1950-2022



Emmet County has been included in three Presidential Disaster Declarations that involved tornadoes since 1965. See Table 4-3 in the Hazard Identification Section for additional details. Descriptions of notable previous tornado events are provided below:

April 30, 1967 – An F2 tornado touched down near Gruver at approximately 4 PM, traveling a total of seven miles and causing an estimated $250,000 in property damage northeast of Gruver and in Dolliver. An additional F2 tornado touched down north of Emmetsburg at approximately 4:10 PM and traveled eight miles to the area west of Ringsted. Total property damages for both tornadoes were estimated at **$2.5 million.**

June 28, 1979 – A small F1 tornado touched down in an open field east of Armstrong, causing $25,000 in crop and property damage.

August 18, 1980 – An F1 tornado briefly touched down 10 miles south of Estherville, destroying a barn and twisting the tops of trees; the incident caused an estimated $25,000 in crop damage.

Windstorms

According to the NCEI database, there were 51 high wind events in Emmet County from 1996 to 2023. During this time period, there were no reported deaths or injuries. There were an estimated $1.366M in

property damages, and over $55,000 in crop damages recorded. Recorded wind gusts ranged from a high of 70 knots (80.55 mph) to a low of 35 knots (40.28 mph). Table 4-50 provides a summary of the wind speeds reported for the wind events.

Table 4-50 Reported Wind Speeds, NCDC Events from 1996 to 2016

Wind Speed	# of Events
35-40	10
41-45	1
46-50	9
51-55	22
56-60	4
60+	3
N/A	2
Total	**51**

Source: NCEI; N/A – data not available

Probability of Future Occurrence

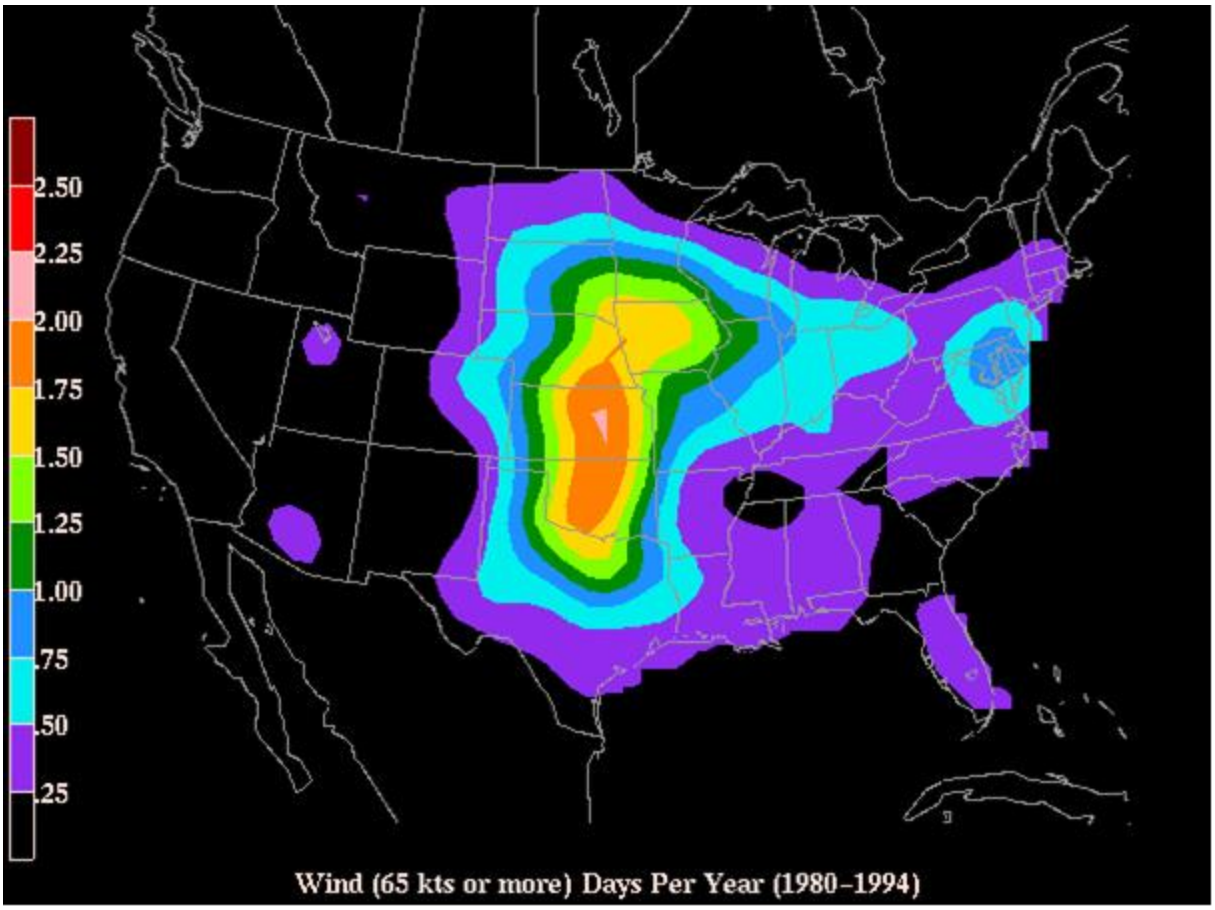
NOAA reported 21 tornadoes in Emmet County in a 73-year time period, which calculates to

28% chance of a tornado occurring somewhere in the County in any given year. Therefore, it is a likely probability that some portion of Emmet County will experience tornado activity in any given year.

According to NCEI, there were 51 separate high wind events from 1996 to 2023 (27-year period) in Emmet 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 4-44 below shows the probability of a windstorm event (65 knots or greater) in the U.S. The Emmet County planning area is colored yellow, showing that 65+ knot winds are probable to occur 1.50 to 1.75 times a year.

Figure 4-44 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 Emmet County

Magnitude/Severity

Historically, tornados and windstorms in Emmet County have been of **limited** magnitude. However larger and more damaging tornadoes and windstorms have occurred within Iowa and remain possible in the planning area.

Tornadoes are classified according to the EF- Scale (the original F – Scale was developed by Dr. Theodore Fujita, a renowned severe storm researcher). The Enhanced Fujita Scale (see Table 4-51) attempts to rank tornadoes according to wind speed based on the damage caused. This update to the original F scale was implemented in the U.S. on February 1, 2007. Tornadoes up through EF 5 are possible in the planning area.

Table 4-51 Enhanced Fujita Scale

EF-Scale	Wind Speed	Classification	Type of Damage Done
EF-0	65-85 mph (105-137 km/h)	Light damage	Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.
EF-1	86-110 mph (138-178 km/h)	Potential damage	Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.

EF-Scale	Wind Speed	Classification	Type of Damage Done
EF-2	111-135 mph (179-218 km/h)	Considerable damage	Roofs torn off houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF-3	136-165 mph (219-266 km/h)	Severe damage	Entire stories 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.
EF-4	166-200 mph (267-322 km/h)	Devastating damage	Well-constructed houses and whole frame houses completely leveled; cars thrown, and small missiles generated.
EF-5	200 mph + (322 km +)	Total destruction	Strong frame houses leveled off foundations and swept away; automobile- sized missiles fly through the air in excess of 100 m (109 yd); steel reinforced concrete structure badly damaged; high-rise buildings have significant structural deformation; incredible phenomena will occur.

Source: Tornado EF Scale.com

Since the Enhanced Fujita Scale was introduced on February 1, 2007, there have only been two EF5 tornados recorded in the United States. The most recent one occurred in Parkersburg, Iowa on May 25, 2008 and leveled half the city.

Damage from windstorms can be difficult to quantify. Wind, by itself, has not historically caused high insured dollar losses. For the insurance industry to track a weather event, it must be a large enough storm that insurance companies may declare it a catastrophe, and then damage estimates for auto and homeowner claims are collected and published. This generally equates to damages in excess of $25 million, though significant events impacting small communities are also tracked occasionally.

Similar to tornados, there are various scales to measure and convey the intensity of windstorms. The NWS can issue High Wind Watch, High Wind Warning, and Wind Advisory 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, that 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.

Table 4-52 shows The Beaufort Wind Scale used to measure windstorm strength.

Table 4-52 The Beaufort Wind Scale

Force	Wind (Knots)	WMO Classification	Appearance of Wind Effects	
			On the Water	On Land
0	Less than 1	Calm	Sea surface smooth & mirror-like	Calm, smoke rises vertically
1	1-3	Light Air	Scaly ripples, no foam crests	Smoke drift indicates wind direction, still wind vanes
2	4-6	Light Breeze	Small wavelets, crests glassy, no breaking	Wind felt on face, leaves rustle, vanes begin to move

Force	Wind (Knots)	WMO Classification	Appearance of Wind Effects	
			On the Water	On Land
3	7-10	Gentle Breeze	Large wavelets, crests begin to break, scattered whitecaps	Leaves and small twigs constantly moving, light flags extended
4	11-16	Moderate Breeze	Small waves 1-4 ft. becoming longer, numerous whitecaps	Dust, leaves, and loose paper lifted, small branches move
5	17-21	Fresh Breeze	Moderate waves 4-8 ft taking longer form, many whitecaps, some spray	Small trees in leaf begin to sway
6	22-27	Strong Breeze	Larger waves 8-13 ft, whitecaps common, more spray	Larger tree branches moving, whistling in wires
7	28-33	Near Gale	Sea heaps up, waves 13-20 ft, white foam streaks off breakers	Whole trees moving, resistance felt walking against wind
8	34-40	Gale	Moderately high (13-20 ft) waves of greater length, crests begin to break into spindrift, foam blown in streaks	Whole trees in motion, resistance felt walking against wind
9	41-47	Strong Gale	High waves (20 ft), sea begins to roll, dense streaks of foam, spray may reduce visibility	Slight structural damage occurs, slate blows off roofs
10	48-55	Storm	Very high waves (20-30 ft) with overhanging crests, densely blown foam, heavy rolling, lowered visibility	Seldom experienced on land, trees broken or uprooted, considerable structural damage
11	56-63	Violent Storm	Exceptionally high (30-45 ft) waves, foam patches cover sea, visibility more reduced	
12	64+	Hurricane	Air filled with foam, waves over 45 ft, sea completely white with driving spray, visibility greatly reduced	

Source: Storm Prediction Center & NOAA

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). NASA's Earth Observatory has conducted studies in 2013, which aim to understand the interaction between climate change and tornadoes. Based on these studies meteorologists are unsure why some thunderstorms generate tornadoes and others don't, beyond knowing that they require a certain type of wind shear. Tornadoes spawn from approximately one percent of thunderstorms, usually supercell thunderstorms that are in a wind shear environment that promotes rotation. Some studies show a potential for a decrease in wind shear in mid-latitude areas. The level of significance of this hazard should be revisited over time.

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).

Environmental features are exposed to tornado risk, although damages are generally localized to the path of the tornado however, if tornadoes impact facilities that store HAZMAT areas impacted by material releases may be especially vulnerable. Historic buildings built prior to modern building codes would be more prone to damage. Cultural facilities could also be temporarily shut down until debris is cleaned and residents are accounted for. Some cultural facilities such as community centers, parks, or gas stations may be turned into impromptu emergency centers where emergency supplies can be distributed, and emergency personnel can organize.

Vulnerability

Overview

Emmet County is located within a region of the U.S. with high frequency of dangerous and destructive tornadoes and is referred to as "Tornado Alley". Figure 4-45 is based on areas where dangerous tornadoes are most likely to take place.

Figure 4-45 Tornado Alley in the U.S.

Source: http://www.tornadochaser.net/tornalley.html

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. According to the US Census Bureau American Community Survey results for 2020, 3.9% of homes in Iowa are considered mobile homes.

The elderly (65 and older), young (less than 18 years old), and the physically and mentally handicapped are most vulnerable to tornadoes and wind due to 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."

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. According to the U.S. Health and Human Services emPOWER database, 8% of Medicare Beneficiaries in the County 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.

In Emmet County, the NCEI estimate for past property damages resulting from tornadoes from 1950 – 2023 (73 years) was $3,092,030 This translates to an annualized loss of over $46,134.

For windstorms, NCEI loss estimates were $1,365,630 from 1996 to 2016 (21 years). This translates to an annualized loss of over $65,030.

Critical Facilities and Infrastructure

All critical facilities and infrastructure are likely exposed to tornadoes and windstorms, though the likelihood of damage to any critical facilities or infrastructures from this hazard is extremely limited. The most common problems associated with this hazard are utility losses. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water, and sewer systems may not function. Roads may become impassable due to downed trees or other debris.

Tornadoes and windstorms can cause significant damage to trees and power lines, blocking roads with debris, incapacitating transportation, isolating population, and disrupting ingress and egress. Of particular concern are roads providing access to isolated areas and to the elderly. Loss of electricity and phone connection would leave certain populations isolated because residents would be unable to call for assistance. Any facility that is in the path of a tornado is likely to sustain damage.

Additionally, fires may result from damages to natural gas infrastructure. Hazardous materials may be released if a structure is damaged that houses such materials or if such a material is in transport.

Economy

As mentioned above, tornadoes and windstorms can impact exposed critical infrastructure; depending on the impact and the function, this could cause a short-term economic disruption. The most common problems associated with tornadoes and damaging winds are loss of utilities. Downed power lines can cause power outages, leaving large parts of the County isolated, and without electricity, water, and communication. Damage may also limit timely emergency response and the number of evacuation routes.

Overhead power lines and infrastructure are also 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 provided in Table 4-39 in the Winter Storm hazard section.

Crop insurance payments for wind damage are discussed in Section 0, Thunderstorms with Lightning and Hail.

Environment and Cultural Resources

Environmental features are exposed to tornado risk, although damages are generally localized to the path of the tornado however, if tornadoes impact facilities that store HAZMAT areas impacted by material releases may be especially vulnerable. Historic buildings built prior to modern building codes would be more prone to damage. Cultural facilities could also be temporarily shut down until debris is cleaned and residents are accounted for. Some cultural facilities such as community centers, parks, or gas stations may be turned into impromptu emergency centers where emergency supplies can be distributed, and emergency personnel can organize.

Development Trends

Given that the County's overall population has been declining and development in recent years has been minimal, development trends in the coming years are not anticipated to increase vulnerability to tornados. Future development that does occur in growing cities such as Dolliver, Gruver, and Ringsted should consider tornado hazards at the planning, engineering and architectural design stages. Public buildings such as schools, government offices, as well as other buildings with a high occupancy and mobile home parks, should consider inclusion of a tornado saferoom to shelter occupants in the event of a tornado.

Windstorm is primarily a public safety and economic concern, and the planning area is located in a region with very high frequency of occurrence. Windstorm can cause damage to structures and power lines which in turn create hazardous conditions for people. Debris flying from high wind events can shatter windows in structures and vehicles and can harm people that are not adequately sheltered.

Although windstorms occur frequently in the planning area and damages to property occur, much of the damage is generally covered by private insurance. This results in less impact to individuals and the community since recovery is facilitated by insurance.

Risk Summary

- The overall significance of tornados/windstorms is **High**.
- According to NCEI, there have been 21 tornado events recorded in Emmet County from 1950 to 2022.
- The strongest tornado recorded in the county has been an F3 in magnitude which occurred in 1953. Tornadoes up to magnitude EF5 have occurred in the State of Iowa and are possible in the planning area.
- Related hazards: Flooding, Wildfire, Thunderstorm/Lightning/Hail

4.3.14 Transportation Incident

Location	Magnitude/Severity	Future Probability	Overall Significance
Limited	Negligible	Highly Likely	**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

Highways/Roads

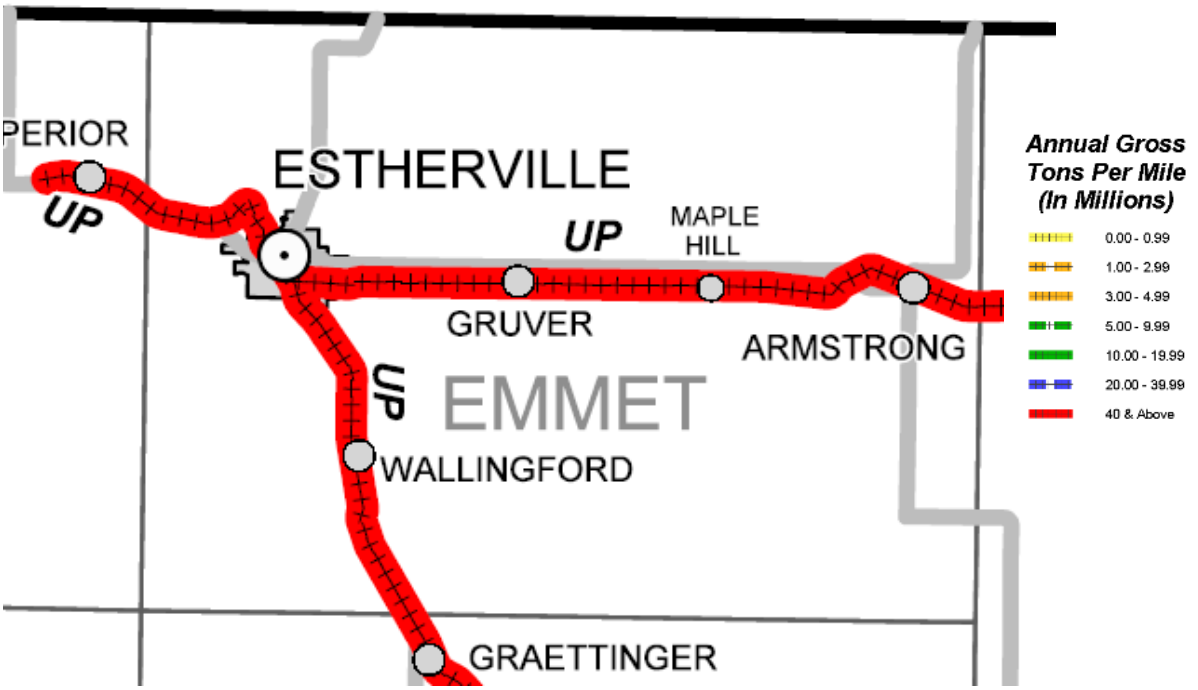
Though there are not any interstates or federal highways, there are a few major state highways that run through Emmet County. Iowa Highway 9 runs east-west through Armstrong, Maple Hill, Gruver and Estherville. Iowa Highway 4 north-south through Estherville, and Iowa Highway 15 runs north-south across the Minnesota border through Armstrong and Ringsted. Numerous paved county roads connect all of the incorporated cities and unincorporated towns throughout the county.

According to the Iowa Department of Transportation, the total daily rural and municipal traffic in Emmet County is 36,276, and the total daily truck traffic is 4,916. (Source: http://iowadot.maps.arcgis.com/apps/MapSeries/index.html?appid=db6cb43313354a4f85505089ab317e7a)

Rail Transport

Union Pacific Railroad, Ltd. (UP) operates in Emmet County with a line running east-west from Estherville, through Gruver, Maple Hill, and Armstrong. A line also runs northwest-southeast through Estherville and Wallingford. Figure 4-46 shows the railroads that operate in Emmet County.

Figure 4-46 Railroad lines in Emmet County



Source: Iowa Department of Transportation, http://www.iowadot.gov/iowarail/railroads/maps/maphome.htm

Air Transport

The Mason City Municipal Airport in Gordo County is the primary commercial airport that services Emmet County. Within Emmet County, the Estherville Municipal Airport, located approximately 4 miles west of the Estherville central business district is owned by the City of Estherville. Local access to the Perry airport is provided via Iowa Highway 9.

The Iowa Aviation System Plan identifies the Estherville Municipal Airport as a General Service airport. General Service airports have runways 4,000 feet or greater in length with facilities and services customized to support most general aviation activity, including small to mid-size business jets.

Figure 4-47 Estherville Municipal Airport

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

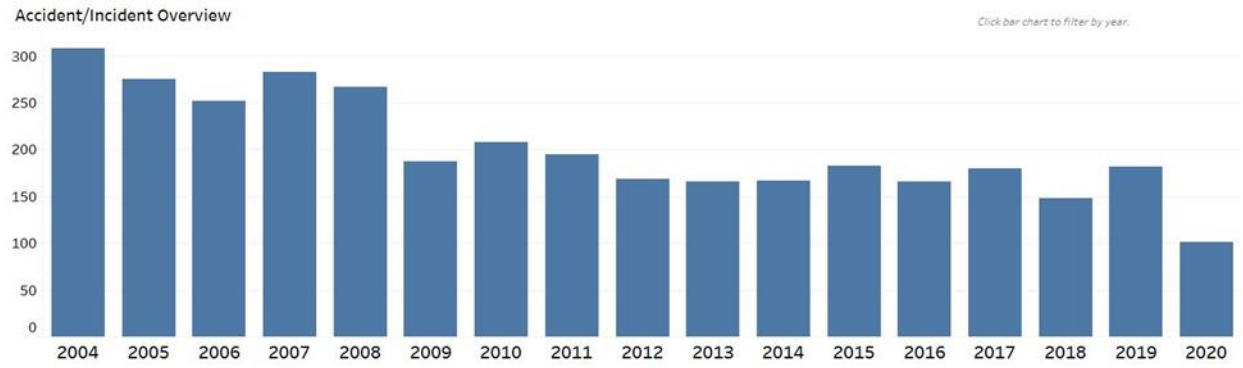
Past Occurrences

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 4-48). Iowa has 5,157 public highway-rail crossings in the State on state, city, and county highways.

Figure 4-48 Iowa Railway Accidents/Incidents, 2004-2020



Source: U.S. Department of Transportation Federal Railroad Administration, Overview Reports

Air Transportation Incidents

Table 4-53 provides details of 9 air transportation incidents in (or near) Emmet County from 1967 to 2023 (50 years) from the National Transportation Safety Board (NTSB).

Table 4-53 Emmet County Aircraft Incidents/Accidents (1967-2023)

Event Date	Location	Injury Severity	Aircraft Damage	Make	Broad Phase of Flight
6/1/2021	Wallingford, IA	Non-Fatal	Substantial	Ultra-Light	
06/14/2017	Estherville, IA	Non-Fatal	Substantial	Piper	
02/11/2003	Estherville, IA	Non-Fatal	Substantial	Cessna	Taxi
11/11/1995	Estherville, IA	Non-Fatal	Substantial	Forney	Landing
04/29/1982	Estherville, IA	Non-Fatal	Substantial	Piper	Landing
01/16/1975	Estherville, IA	Non-Fatal		Piper	
08/02/1971	Estherville, IA	Non-Fatal		Piper	
01/10/1969	Estherville, IA	Non-Fatal		Piper	
12/06/1968	Estherville, IA	Non-Fatal		Cessna	

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 4-54 and Table 4-55 show the crash history in Emmet County from 2007-2023 for urban and rural crashes, respectively.

Table 4-54 Emmet County Urban Crashes, 2007-2023

Year	Crashes	Fatal	Major	Minor	Possible Injuries
2007	124	0	2	5	11
2008	125	0	1	13	18
2009	139	0	0	8	10
2010	111	0	1	11	14
2011	90	0	1	3	8
2012	117	0	4	11	14
2013	109	1	3	10	8
2014	87	0	2	5	8
2015	93	0	2	9	12
2016	86	0	1	6	8
2017	79	0	2	2	11
2018	96	0	0	4	10
2019	119	0	0	5	27
2020	81	1	0	10	7
2021	103	1	1	10	8
2022	84	0	0	7	6

Year	Crashes	Fatal	Major	Minor	Possible Injuries
2023	77	0	1	12	7
Total	**1720**	**3**	**21**	**131**	**187**

Source: Iowa Department of Transportation's Office of Traffic and Safety

Table 4-55 Emmet County Rural Crashes, 2007- 2023

Year	Crashes	Fatal	Major	Minor	Possible Injuries
2007	106	0	1	7	14
2008	66	0	3	5	13
2009	94	1	5	9	17
2010	96	0	2	18	9
2011	83	3	4	10	11
2012	92	3	4	17	3
2013	80	1	3	8	11
2014	97	1	4	15	5
2015	70	1	1	8	6
2016	85	0	1	13	5
2017	103	0	0	13	9
2018	94	0	4	18	7
2019	108	1	3	20	15
2020	72	0	0	9	9
2021	74	3	1	8	1
2022	154	3	2	10	4
2023	66	0	4	10	7
Total	**1540**	**17**	**42**	**198**	**146**

Source: Iowa Department of Transportation's Office of Traffic and Safety

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 Emmet County have been of 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 regarding milder winters come to fruition, climate change impacts may reduce the number of transportation incidents associated with some severe weather. However, if ice occurs, rather than snow, this could result in higher incidents of 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.

Due to the potential for fatalities to occur, this hazard received a magnitude rating of **Low**.

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 Emmet County is higher. This is also true before and after major gatherings such as sporting events, concerts, conventions, and major events around Iowa State University, such as the start and end of semesters. 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 1994 dollars to 2023 dollars using the U.S. Bureau of Labor Statistics Consumer Price Index Inflation Calculator. The costs are listed below in Table 4-56.

Table 4-56 Costs of a Traffic Crash

Severity	Cost per injury (in 2016 dollars $)
Fatal	$5,733,135.90
Evident Injury	$79,379.26
Possible Injury	$41,897.53
Property Damage Only	$4,410.61

Source: U.S. Department of Transportation Federal Highway Administration Technical Advisory T 7570.2, 1994. Adjusted to 2016 dollars.

Estimated losses as a result of railway transportation and air transportation are not available for this analysis.

Environment and Cultural Resources

The primary environmental susceptibilities concerning transportation incidents often pertain to pollution and the release of hazardous materials following incidents.

Development Trends

Overall population in Emmet County has been decreasing, with growth focused on smaller cities. Current development trends do not suggest that this hazard will increase significantly in the near future.

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).

According to the Iowa Department of Transportation, there are no major federal interstate or state highway projects scheduled in Emmet County at the time of this planning effort.

The Ames Area Metropolitan Planning Organization has a 2035 Ames Area Long Range Transportation Plan to address its growing population and employment that are supplemented with increased transportation needs. This plan includes roadways, pedestrian, bicycle and transit system of the Ames area and makes recommendations for future transportation needs in the Ames area. The County's 5-year Plan and Capital Improvements Program also address future road development.

Risk Summary

Overall, transportation incident hazard is ranked as **Low** for the County.

- There are hundred of road transportation incidents 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 **significant**.
- Most transportation incidents in Emmet County have been of the **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

This table below provides a tabular summary of the hazard ranking for each jurisdiction in the planning area.

Table 4-57 Emmet County Hazard Ranking Summary by Jurisdiction

Jurisdiction	Animal/Plant/Crop Disease	Drought	Extreme Heat	Flooding	Grass/Wildland Fire	Hazardous Materials	Human Disease	Infrastructure Failure	Landslide	Severe Winter Storm	Terrorism	Thunderstorm/Lightning/Hail	Tornado/Windstorm	Transportation Incident
Unincorporated Emmet County	L	M	M	H	M	M	M	M	L	H	M	M	H	L
City of Armstrong	L	M	M	M	M	M	M	M	L	H	M	M	H	L
City of Dolliver	L	M	M	L	M	L	M	M	L	H	M	M	H	L
City of Estherville	L	M	M	H	H	M	M	M	L	H	M	M	H	L
City of Gruver	L	M	M	L	M	L	M	M	L	H	M	M	H	L
City of Ringsted	L	M	M	L	M	M	M	M	L	H	M	M	H	L
City of Wallingford	L	M	M	H	M	L	M	M	L	H	M	M	H	L
Iowa Lakes Community College	L	M	M	L	M	L	M	M	L	H	M	M	H	L

Note: H = High, M = Medium, L = Low, N/A = Not Applicable

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 Hazard Mitigation Planning Committee (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 the March 2013 Local Mitigation Planning Handbook:

- **Goals** are general guidelines that explain what the community wants to achieve with the plan. They are usually broad policy-type statements that are long-term, and they represent visions for reducing or avoiding losses from the identified hazards.
- **Mitigation Actions** are specific projects and activities that help achieve goals. They are measures, projects, plans or activities proposed to reduce the current and future vulnerabilities described in the risk assessment.

5.1 Goals

During the update process, the HMPC participated in a facilitated discussion during their second and third planning meetings to review the plan goals and ensure they are still relevant. 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.

The planning committee determined that all three goals from the previous plan remain valid and chose to carry them forward unchanged for the 2024-2029 plan update. The validated plan goals for the Emmet County Hazard Mitigation Plan are below:

- **Goal 1:** Natural hazards that cause injuries, illness, deaths, property loss, utility service disruption and economic loss will be reduced and mitigated against by planning for the protection of property and life.
- **Goal 2:** Protect critical facilities, infrastructure, and jurisdictional operations from disruptions due to hazard impacts.
- **Goal 3:** Educate the public on natural hazards and what necessary information is needed to protect themselves and their property.

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 74 actions in the 2018 HMP, 18 actions have been completed showing that the jurisdictions are making good progress in implementing mitigation activities. One action from the City of Estherville was deleted as it was duplicative of another action being carried forward in the plan, and another action from the City of Wallingford was deleted due to the lack of progress since its original development. The remaining 52 actions were continued over into the 2023 HMP, along with 22 new actions, which are detailed in Section 5.4 below.

Table 5-1 Completed and Deleted Actions

Jurisdiction	Action #	Mitigation Action	Hazards Addressed	Comments
Emmet County	Emmet County - 65	Hazardous Materials Response- Permanent Decon facilities will be built at Avera Holy Family Hospital in Estherville, IA.	Hazardous Materials Incident	Completed
Armstrong	Armstrong - 4	NOAA Weather Radios (buy/distribute). Alert people in their homes of severe weather	Extreme Heat, Flash Flood, Hailstorm, River Flood, Severe Winter Storm, Thunderstorm and Lightning, Tornado, Windstorm, Grass or Wildland Fire	Completed.
Armstrong	Armstrong - 5	Designating Community Shelter. county needs a list of all shelters	Extreme Heat, Flash Flood, River Flood, Severe Winter Storm, Thunderstorm and Lightning, Tornado, Windstorm	Completed. Fire Department, Community Center, High School
Armstrong	Armstrong - 8	Tornado Safe Room (build). City needs a safe area for the residents without basements	Thunderstorm and Lightning, Tornado, Windstorm	Completed.
Armstrong	Armstrong - 25	Purchase Portable Pumps. prone to flooding	Flash Flood, River Flood	Completed. 1-Electric, 2-Gas Powered
Armstrong	Armstrong - 54	Improve water quality/quantity.	Drought	Completed. New Plant
Armstrong	Armstrong - 55	Purchase generator for water plant. If there is no electricity there is no water to the city	Infrastructure Failure, Severe Winter Storm, Thunderstorm/Lightning/Hail, Tornado/Windstorm	Completed.
Estherville	Estherville - 46	Storm Sewer Rerouting Project. Street flooding occurs during heavy rain at intersection of S. 9th Street (Hwy 4) and 1st Ave S.	Flash Flood	Completed.

Jurisdiction	Action #	Mitigation Action	Hazards Addressed	Comments
Estherville	Estherville - 41	Test Warning sirens monthly. To ensure sirens work when needed	Hailstorm, Thunderstorm and Lightning, Tornado, Windstorm	Deleted. Duplicative action to Estherville 18.
Gruver	Gruver - 22	Replace Sewer Lines, Move sewer lift station to different location. The current lift station is sitting in a very low area that is prone to flooding with heavy rain	Flash Flood, River Flood	Completed. Finished in 2022
Gruver	Gruver - 30	Create Dry Hydrant. When fires out in the rural area, the need for water is huge. We have one installed already at Tuttle Lake	Grass or Wildland Fire	Completed.
Wallingford	Wallingford-3	Bury Utility Lines. Power outage during strong storms and winter weather	Hailstorm, Severe Winter Storm, Thunderstorm/ Lightning/Hail, Tornado, Windstorm, Grass or Wildland Fire	Completed in 2022.
Wallingford	Wallingford-4	NOAA Weather Radios (buy/distribute). Community has no warning siren at this time.	Extreme Heat, Flash Flood, Hailstorm, River Flood, Severe Winter Storm, Thunderstorm and Lightning, Tornado, Windstorm, Grass or Wildland Fire	Completed. Some citizens purchased their own radios.
Wallingford	Wallingford-9	Outdoor Warning Sirens (build or update). City needs a way to inform residents of approaching hazards	Thunderstorm/Lightning/Hail, Tornado/Windstorm	Completed.
Wallingford	Wallingford-11	Promote Landscaping Practices. Drains need to be kept clear of debris to ensure the stormwater system can operate to it's full capacity.	Landslide, River Flood	? Completed 2021-2022
Wallingford	Wallingford-17	Public Education/ Awareness. Regular messaging should be maintained to ensure the public is aware of potential hazards and knows how to prepare to keep themselves and their families safe	Drought, Extreme Heat, Flash Flood, Hailstorm, Landslide, River Flood, Severe Winter Storm, Thunderstorm and Lightning, Tornado, Windstorm, Dam Failure, Levee Failure, Grass or Wildland Fire	Completed. Wave Alerts and will be having our city website to post information to the public.
Wallingford	Wallingford-63	Add new tornado siren for the City of Wallingford. Currently Wallingford does not have a tornado siren	Tornado/Windstorm	Completed.

Jurisdiction	Action #	Mitigation Action	Hazards Addressed	Comments
Walingford	Wallingford-30	Create Dry Hydrant. Have trouble getting water to lake homes out in the county	Grass or Wildland Fire	Deleted. No progress being made
Iowa Lakes Community College	Iowa Lakes Community College - 17	Public Education/Awareness. The community needs continued awareness training on all hazards and Iowa Lakes Community College is a willing host.	Dam/Levee Failure, Drought, Extreme Heat, Flash Flood, Grass/Wildland Fire, Hazardous Materials Incident, River Flooding, Severe Winter Storm, Thunderstorm/Lightning/Hail, Tornado/Windstorm	Completed. Ongoing trainings, annual updates to content
Iowa Lakes Community College	Iowa Lakes Community College - 9	Outdoor Warning Sirens (build or update). The college would install or update outdoor warning system/sirens that ties into the county/city system to alert community members of potential severe weather activity. Nearby community trailer park, college students and employees and other community members attending outdoor activates on or near campus. (Softball, soccer, football practice field.	Thunderstorm/Lightning/Hail, Tornado/Windstorm	Completed.

5.3 Identification and Analysis of Mitigation Actions

To identify and select mitigation measures to support the mitigation goals, each hazard identified in Chapter 3 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 audiences, i.e., buildings, developers, and hazard prone neighborhoods.

Emergency Services: Measures taken before, during and after a hazardous 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 provides 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 Continued Compliance with the National Flood Insurance Program

As described in Section 3.3.4, Emmet County, and the Cities of Estherville and Wallingford all participate in the NFIP. Each of these jurisdictions will continue to participate and comply with NFIP standards.

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 Emmet 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 the 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 2 under the Jurisdictional Capabilities Section and the flood vulnerability discussion in Section 3.3.4.

Armstrong does not participate in the NFIP but will be considering the potential benefits of doing so, and the implications of not, in the future.

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 5.2, 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	Grand Total Moving Forward
Emmet County	18	1	-	17	6	**23**
Armstrong	13	6	-	7	3	**10**
Dolliver	-	-	-	-	3	**3**
Estherville	7	1	1	5	3	**8**
Gruver	7	2	-	5	1	**6**
Ringsted	5	-	-	5	4	**9**
Wallingford	18	6	1	11	1	**12**
Iowa Lakes Community College	4	2	-	2	1	**3**
Grand Total	**74**	**18**	**2**	**52**	**22**	**74**

The results of the project identification and prioritization exercise for each participating jurisdiction are summarized in Table 5-3 through Table 5-10 below. These projects detail specific actions for reducing future hazard-related losses within Emmet 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 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 59 actions that were continued from the previous plan, 22 new actions were identified, for a combined total of 81 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 2023 numbered last.

Table 5-3 Emmet County Mitigation Action Plan

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
Emmet-1	Backup Power Generator (buy). To maintain Critical infrastructure by providing backup generators to remote communication tower sites.	Hailstorm, Severe Winter Storm, Thunderstorm and Lightning, Tornado, Windstorm	EMA; City/County Government Utilities/FEMA/HS	High; State Grants, Local Government. FEMA HMA Grants	Long Term	High	In Progress.
Emmet-2	NOAA Weather Radios (buy/distribute). Notify the at-risk population of weather issues	Extreme Heat, Flash Flood, Hailstorm, River Flood, Severe Winter Storm, Thunderstorm and Lightning, Tornado, Windstorm, Grass or Wildland Fire	EMA; Public Health/ Law enforcement Elderly/waiver homes Senior Centers	Low; State Grants, Local Budget	Medium Term	Medium	Annual Implementation.
Emmet-3	Designating Community Shelter. Review existing list of community shelters, adding shelters as appropriate and removing designated sites that are no longer applicable. To protect loss of human life	Extreme Heat, Flash Flood, River Flood, Severe Winter Storm, Thunderstorm and Lightning, Tornado, Windstorm	EMA; Local Townships, County	Little to no cost; FEMA HMA Grant, Local funds, Private/Non-Profit	Medium Term	High	Annual Implementation. Added the Christensen Building to Estherville. Still waiting on generated back switch to be installed
Emmet-4	Maintain Outdoor Warning Sirens. Outdoor warning systems need to be installed at County parks and campgrounds.	Thunderstorm/Lightning/Hail, Tornado/Windstorm	County, EMA; County, County Conservation	Moderate; County, FEMA HMA Grants, NWS	Medium Term	High	In Progress. Added two warning sirens to the County Parks. Wallingford is in the process of adding a warning siren.

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
							I'm working with Estherville, Dolliver and Ringsted to update their warning sirens.
Emmet-5	Backup of City/County Records - convert paper records to electronic. Loss of vital records	Flash Flood, River Flood, Severe Winter Storm, Thunderstorm and Lightning, Tornado, Windstorm	Government entities; Local Government	Moderate; Local Government funding	Short Term	High	Not Started.
Emmet-6	Create Dry Hydrant. To get water in an emergency to the city of Dolliver.	Grass or Wildland Fire	Fire departments; Fire Departments, EMA	Moderate; Local Govt. funding, Insurance company grants	Medium Term	High	Not Started.
Emmet-7	Remain Compliant with NFIP.	Flash Flood, River Flood	EMA; NFIP	Little to no cost; County Dollars	Short Term	High	Annual Implementation.
Emmet-8	Enforce Floodplain ordinance to reduce losses to new development or substantial improvements on existing development.	Flash Flood, River Flood	EMA; DNR, Geological Survey, County Engineer	Little to no cost; County Dollars	Medium Term	Medium	Annual Implementation.
Emmet-9	Stream gauge monitoring system. Redundant ability to measure the river height	Flash Flooding, River Flooding	EMA; DNR, United States Geological Survey, Jacov Westergard, Landowners	Little or no cost; County Funds, Volunteers	Short Term	Medium	Not Started.
Emmet-10	Extreme Heat mitigation to protect livestock health and crop commodity	Drought, Extreme Heat	EMA; Livestock/ Crop entities	Little to no cost; FEMA HMA Grant,	Medium Term	High	Not Started.

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
	production. Extreme heat is dangerous to livestock/crop production. Develop program to educate our residents how to mitigate the effects of extreme heat on themselves, homes, and livestock. Educate producers on the selection of heat tolerant livestock and crops.			Local funds, Private/Non-Profit			
Emmet-11	Animal/Crop/Plant Disease. Loss of animal and crop production would result in property and economic loss for citizens. Encourage purchase of crop insurance. Provide guidance for biosecurity measures for livestock producers. Encourage crop diversification.	Animal/Plant/Crop Disease, Terrorism	Emmet County EMA; Farm Service Agency; IDOL; Multi-State Partnership for Agriculture	Little to no cost; FEMA HMA Grant, Local funds, Other - Emmet County Foundation Grant	Medium Term	High	Not Started.
Emmet-12	Identify storage facilities of hazardous materials and see that hazardous material placards are in place and conduct feasibility studies for the construction of protection and containment structures for the identified hazardous materials. Provide	Animal/Plant/Crop Disease, Flooding, Hazmat, Infrastructure Failure, River Flooding, Terrorism, Tornado/Windstorm, Transportation Incident	EMA; Fire Service, Mason City Hazmat Response Team, Chemtrec, Avera Holy Family Hospital	High; FEMA HMA Grant, Local funds, Private Non-Profit	Medium Term	High	Annual Implementation.

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
	education of the public and responders on the identification of hazardous materials. Ensure that all response entities have updated Emergency Response Guidebooks.						
Emmet-13	Human Disease. To protect the population from spread of disease. There is an increased risk of disease spread in more densely populated areas and in some other countries, but with our mobile society, a risk to all populations. Influenza and pneumonia were the 8th leading cause of death in Iowa in 2016. Continued concern of bioterrorism. Promote education of public on disease prevention, encourage immunizations, and surveillance of disease trends.	Animal Plant/Crop Disease, River Flooding, Terrorism, Human Disease	Emmet County Public Health; Hospitals/clinics, EMA	Low; FEMA HMA Grant, Local funds, Other - Federal and State funds	Medium Term		Annual Implementation.
Emmet-14	Infrastructure Failure. Maintain the necessary roadway system and utilities for economic growth and safety. Aging roadway system and the need for enhancement of	Extreme Heat, Infrastructure Failure, River Flooding, Severe Winter Storm, Terrorism, Thunderstorm/Lightning/Hail, Tornado/Windstorm, Transportation Incident	EMA; Emmet County Engineer; Iowa DOT; USGS; Utility Companies; MISO (Midcontinent	High; FEMA HMA Grant, Local funds, Private Non-Profit	Long Term	High	Annual Implementation.

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
	the electrical distribution system.		Independent Systems Operator), Iowa Pipeline Safety				
Emmet-15	Terrorism. To protect the citizens, food & water supplies, essential Government function/services from terroristic actions. Educate the public to create an awareness of potential target/issues/vulnerabilities. See something – say something. Evaluate targets of terrorism and make recommendations for security improvements. Conduct cyber threat training to Governmental entities. Education to agriculture producers about agro-terrorism.	Animal/Plant/Crop Disease, Terrorism	EMA; Law Enforcement, IT, Iowa State Extension, FSA, Iowa Dept. of Land Stewardship, Multi-State Partnership for Agriculture	Little to no cost; Local funds, Private Non-Profit	Medium Term	High	Annual Implementation.
Emmet-16	Minimize loss of life and impact to the environment. The increased potential of transportation incidents due to 3 state highways, as well as a railroad line that transports alcohol from a local ethanol plant. Education of motorists by social media, public safety	Hazmat, Transportation Incident	Law Enforcement; EMA, Iowa State Patrol, Emmet County Engineer, Iowa DOT, Governor's Traffic Safety Board	Little or No Cost; Local funds, Private Non-Profit	Medium Term	High	Annual Implementation.

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
	announcements, and public presentations. Identification of problem areas and improvement of them. Enhanced enforcement of traffic laws.						
Emmet-17	Human Disease- We have a process to screen all patients for immunization status, travel history, and contact with certain disease processes. We provide education to the public, patients, and staff as indicated. We provide immunizations as indicated. We want to keep patients, staff, and the public up to date on information related to Human Disease outbreaks	Human Disease	Avera Holy Family Hospital; Emmet County Public Health	Little or No Cost; Local funds, Private Non-Profit	Short Term	High	Annual Implementation.
Emmet-18	The project is the for the purchase of equipment and labor costs associated with the addition of a remote public safety radio repeater site. The State of Iowa has recently invested millions of dollars in the Iowa State Interoperability Communications System (ISICs) that serves public safety entities in Iowa to	Animal/Plant/Crop Disease, Extreme Heat, Grass/Wildland Fire, Hazmat, Human Disease, Infrastructure Failure, Landslide, Flooding, Severe Winter Storms, Terrorism, Thunderstorms, Tornado/Windstorm, Transportation Incidents	Emmet County Board of Supervisors, Sheriff's Office, Emergency Management	Very High; FEMA HMA Grants	Short Term	High	New in 2023 Some examples of the public safety entities would be: Law Enforcement, Fire Services, Emergency Medical Services, Public Schools, Road Maintenance,

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
	provide for interoperability between different public safety platforms and disciplines and with enhanced communication ranges.						Emergency Management, Hospitals, Public Works Entities and road maintenance operations.
Emmet-19	Living snow fences. Plant trees and/or bushes in high snow areas to try to limit drifting snow on roads. Would possibly be in conjunction with IDOT	Drought, Extreme Heat, Winter Storm, Transportation Incidents	Emmet County; Iowa DOT	Low; IDOT, FEMA HMA grants	Long Term	Low	New in 2023
Emmet-20	Critical Infrastructure/Electrical Grid Protection. Many electrical distribution transformers in the county are unprotected and vulnerable to accidental or intentional damage, potentially leaving the county without power. Retrofits and upgrades to these sites are needed to protect the electrical grid and prevent cascading impacts of a long-term outage.	Extreme Heat, Infrastructure Failure, Severe Winter Storm, Thunderstorm, Tornado/Windstorm, Terrorism	Emmet County EMA; Sheriff's Office, Alliant Energy	High; FEMA HMA Grants, Alliant Energy	Long Term	Medium	New in 2023
Emmet-21	Tornado/Fire Drills. Review and promote/remind employees and the public of the proper lifesaving procedures during and	Grass/Wildland Fire, Flooding, Severe Winter Storms, Thunderstorms, Tornado/Windstorm	Emmet County EMA	Little to no cost; Existing budget and staff time	Ongoing	Low	New in 2023

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
	after a hazard event, specifically while in County public buildings.						
Emmet-22	Review and update pandemic response plans/policies. Review existing pandemic response plans, look for improvements and Best Management Practices to adopt following COVID pandemic. Ensure response covers potential threats.	Human Disease	Emmet County Public Health; Hospitals/clinics, EMA	Little to no cost; Existing budget and staff time	Short Term	Medium	New in 2023
Emmet-23	Backup generators for all shelters. Each town needs backup generators for every shelter identified in the County Plan.	Extreme Heat, Infrastructure Failure, Severe Winter Storm, Thunderstorm/Lightning/Hail, Tornado/Windstorm	Emmet County; Each municipality	High; Local funds, State Grants, FEMA HMA Grants	Long Term	High	New in 2023

Table 5-4 City of Armstrong Mitigation Action Plan

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
Armstrong-1	Enforce Tree Trimming. When storms hit the city is responsible for clean up	Hailstorm, Severe Winter Storm, Thunderstorm and Lightning, Tornado, Windstorm	City of Armstrong. Armstrong	Little or no cost.	Medium Term	Medium	In Progress. Send Letters to homeowners that have trees in need of trimming.

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
Armstrong-2	Backup Power Generator (buy). During severe storms and power goes out	Extreme Heat, Flash Flood, Hailstorm, Severe Winter Storm, Thunderstorm and Lightning, Tornado, Windstorm	City of Armstrong. Armstrong	Moderate; Budgets, grants FEMA	Medium Term	High	In Progress.
Armstrong-3	Bury Utility Lines. During severe storms and power goes out	Hailstorm, Severe Winter Storm, Thunderstorm and Lightning, Tornado, Windstorm, Grass or Wildland Fire	Alliant. Alliant/city of Armstrong	Very High; Existing Budget, FEMA HMA Grants, BRIC	Medium Term	Medium	In Progress.
Armstrong-4	Clean/Enlarge Sewage Lagoons. 30 yr old lagoon only 3 ft deep needs to be 9 ft deep	Flash Flood, Levee Failure	Armstrong. SRF funding,	Very High; Existing Budget, FEMA HMA Grants, BRIC	Medium Term	High	In Progress.
Armstrong-5	Construct Sewer Lift Station. needs updated	Flash Flood	Armstrong. SRF funding,	Very High; Existing Budget, FEMA HMA Grants, BRIC	Long Term	High	In Progress.
Armstrong-6	Shelter rations (cots, blankets, water, etc.). Need supplies in case of Emergency	Thunderstorm and Lightning, Tornado, Windstorm	City of Armstrong. EMA, County	High; Donations, Existing Budgets, FEMA HMA Grants	Medium Term	Medium	In Progress.
Armstrong-7	Maintain & expand debris removal site. Need more room in case of emergency	Flash Flood, Hailstorm, River Flood, Severe Winter Storm, Thunderstorm and Lightning, Tornado, Windstorm	City of Armstrong. EMA, County	High; Existing Budgets, FEMA HMA Grants	Medium Term	Low	In Progress.
Armstrong-8	Water Replacement for areas of Armstrong that have new development. 4-inch water line supplies 40 homes and is not looped. Fire hydrants	Grass/Wildland Fire, Severe Winter Storm, Thunderstorm, Tornado	City of Armstrong	Very High; FEMA HMA Grants	Long Term	Medium	New in 2023

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
	have low pressure in this neighborhood.						
Armstrong-9	Structural Retrofits to town water infrastructure. Removal of lead-based paint from north water tower in Armstrong. Water tower needs to have exterior sand blasted and repainted	Human Disease, Infrastructure Failure, Drought	City of Armstrong	High; Possible SRF Loan, billing to residents, BRIC	Medium Term	High	New in 2023
Armstrong-10	Road maintenance efforts. Replacement of storm sewer, waterline, and road on Golf Course Drive Line sanitary sewer to keep current line from collapsing.	Flooding, Severe Winter Storm, Thunderstorm	City of Armstrong	Very High; Property Tax Levy, FEMA HMA Grants, BRIC	Short Term	High	New in 2023

Table 5-5 City of Dolliver Mitigation Action Plan

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
Dolliver-1	Generator for the City of Dolliver	Extreme Heat, Severe Winter Storms, Thunderstorms, Tornado/Windstorm	City of Dolliver; County EMA	Low; State or FEMA HMA Grants	Short Term	High	New in 2023
Dolliver-2	Bury power lines for the City of Dolliver	Grass/Wildland Fire, Infrastructure Failure, Severe Winter Storms, Terrorism, Thunderstorms,	City of Dolliver; County EMA, Alliant Energy	Very High; FEMA HMA Grants, BRIC	Medium Term	High	New in 2023

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
		Tornado/Windstorm, Transportation Incidents					
Dolliver-3	Install weather sirens for the City of Dolliver	Severe Winter Storm, Thunderstorm, Tornado/Windstorm	City of Dolliver, County EMA	Very High; FEMA HMA Grants, BRIC	Short Term	High	New in 2023

Table 5-6 City of Estherville Mitigation Action Plan

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
Estherville-1	Bury Utility Lines. To lessen impact of weather on electric transmission lines	Hailstorm, Severe Winter Storm, Thunderstorm and Lightning, Tornado, Windstorm, Grass or Wildland Fire	City Administrator / Elect Dist. Supt. N/A	Moderate; Other - Elect. Dist. Budget	Ongoing	High	Annual Implementation. Approximately 88% of our electric distribution system is buried. We will continue with a project annually until complete.
Estherville-2	Maintain Outdoor Warning Sirens. To ensure sirens, work when needed	Hailstorm, Thunderstorm and Lightning, Tornado, Windstorm	Emergency Management - City Electrical Distribution. Same	Little or no cost; Local funds	Ongoing	High	Annual Implementation.
Estherville-3	Replace Sewer Lines. Fix infiltration of storm water and River water into sewer system	Flash Flood, River Flood	City of Estherville. City of Estherville, EMA	Very High; Local Funds, FEMA HMA, BRIC, Grants	Long Term	Low	Not Started.

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
Estherville-4	Remain Compliant with NFIP. Need to remain compliant with the NFIP to ensure flood insurance is available to residents	Flash Flood, River Flood	Community Development Director. None identified	Little or no cost; Local funds	Ongoing	High	Annual Implementation.
Estherville-5	Enforce Floodplain ordinance. Floodplain ordinance must be regularly reviewed and enforced	Flash Flood, River Flood	Community Development Director. None identified	Little or no cost; Local funds	Ongoing	High	Annual Implementation.
Estherville-6	West Fork Des Moines Riverbank berm project. Increase the height of the banks through the City of Estherville.	Flooding	Emmet County; USACE	Very High; FEMA HMA Grants, BRIC, USACE	Long Term	Medium	New in 2023
Estherville-7	Tornado Shelter. Construct a tornado shelter at the new city campground.	Thunderstorm, Tornado/Windstorm	City of Estherville	High; Local Budgets, FEMA HMA Grants	Medium Term	High	New in 2023
Estherville-8	Estherville Fire Station. Construct a new fire station away from the railroad tracks.	Hazmat, Transportation Incident	City of Estherville, Estherville FD	Very High; FEMA HMA Grants, BRIC, Bonds, LOST	Short Term	High	New in 2023

Table 5-7 City of Gruver Mitigation Action Plan

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
Gruver-1	Outdoor Warning Sirens (build or update). To warn people within the city of a tornado or bad storm	Thunderstorm/Lightning/Hail, Tornado/Windstorm	City of Gruver;	Low; FEMA HMA Grant, Local funds	Short Term	Low	Not Started.
Gruver-2	Public Education/Awareness of hazards and options to mitigate them.	Drought, Extreme Heat, Flash Flood, Grass/Wildland Fire, Hazardous Materials Incident, Human Disease, Infrastructure Failure, River Flood, Severe Winter Storm, Thunderstorm/Lightning/Hail, Tornado/Windstorm, Transportation Incident	City of Gruver, Emmet County First Responders;	Low; FEMA HMA Grant, Local funds, In-Kind	Ongoing	Medium	Not Started.
Gruver-3	List of residents who may need more help in an emergency.	Extreme Heat, Flash Flood, Hailstorm, Severe Winter Storm, Thunderstorm and Lightning, Tornado, Windstorm	City of Gruver Fire Dept.; Public Health, EMA	Little or no cost;	Medium Term	Medium	Not Started.
Gruver-4	Determine which areas are most prone to flood. In process of fixing tile issues within the City of Gruver to keep water away from homes	Flooding	City of Gruver, County Engineer; Emmet County, EMA, Engineer	Moderate; FEMA HMA Grant, Local funds	Medium Term	Medium	Not Started.
Gruver-5	Alternate Water Supply Plan. If we have a major water issue that takes long to fix,	Drought, Extreme Heat, Grass/Wildland Fire	City of Gruver, EMA; Iowa Lakes Rural Water	Moderate; FEMA Grant, local funds	Medium Term	High	Not Started.

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
	we may need to look for a different source						
Gruver-6	Powerline hardening/burial. Bury all city powerlines to prevent outages in severe weather.	Grass/Wildland Fire, Infrastructure Failure, Severe Winter Storms, Terrorism, Thunderstorms, Tornado/Windstorm, Transportation Incidents	City of Gruver; Alliant Energy	Very High; FEMA HMA Grants, Utility Company budgets	Medium Term	Medium	New in 2023

Table 5-8 City of Ringsted Mitigation Action Plan

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
Ringsted-1	Backup Power Generator (buy). When electrical grid goes down, Main infrastructure lose power.	Extreme Heat, Flash Flood, Hailstorm, Severe Winter Storm, Thunderstorm and Lightning, Tornado, Windstorm	City of Ringsted, EMA; Ringsted, FEMA, EMA	Moderate; Existing Budget, FEMA HMA Grants	Medium Term	Medium	Not Started. Trying to save money
Ringsted-2	Maintain Outdoor Warning Sirens. Need to replace with one that is activated by PSAP	Thunderstorm/Lightning/Hail, Tornado/Windstorm	Cities, EMA; Ringsted, FEMA, EMA	Moderate; Existing Budget, FEMA HMA Grants	Medium Term	High	In Progress. Got a quote for next year's budget
Ringsted-3	Look into NFIP Participation. Need to look into	Flooding	Ringsted, EMA; County	Low; Existing Budget, Staff Time	Medium Term	Low	Not Started.
Ringsted-4	Purchase Portable Pumps. Flooding during major events	Flooding	Ringsted, EMA; Ringsted, FEMA, EMA	Moderate; Existing Budget, FEMA HMA Grants	Long Term	Medium	Not Started.

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
Ringsted-5	Storm Water System Improvements. The City has hired a firm the summer of 2018 to locate infiltration of storm water into the sewer system. The Storm system is taking too long to take up the rainwater on streets, causing more water to build up on property due to some areas are hooked to the sewer system and this also causes more backups in basements due to excess storm water going into the sewer system.	Flooding	City Superintendent; None identified	Moderate; Local funds	Medium Term	High	In Progress. Located some bad areas and fixed them. Continue work in this area
Ringsted-6	Tree trimming. Trees on city property are a problem time wise and on the budget. Ash tree removal also	Winter Storm, Thunderstorm/Lightning/Hail, Tornado/Windstorm	City of Ringsted; Ringsted	Low; Municipal Budget, Staff Time	Short Term	Medium	New in 2023
Ringsted-7	Sewer Jetter. Cleaning Sanitary and storm main	Flooding, Winter Storm, Thunderstorm/Lightning/Hail, Tornado/Windstorm	City Ringsted; Ringsted	Moderate; Local Funding or Grants	Short Term	High	New in 2023
Ringsted-8	Install snow fences. Plant trees and/or bushes, or install non-living snow fences, in high snow areas to try	Drought, Extreme Heat, Winter Storm, Transportation Incidents	City of Ringsted	Moderate; City Budget, Tree Forever	Short Term	Medium	New in 2023

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
	to limit drifting snow on roads.						
Ringsted-9	Replace the warning siren in Ringsted. The warning sire in Ringsted is an older siren that is activated by someone having to physically go turn it one at the site location. We need to purchase a newer siren that is activated by Emmet County Dispatch Center that is manned 24/7.	Flooding, Summer Weather, Winter Weather, Tornado/Windstorm	City of Ringsted, Emmet County EMA	Moderate; Local Budget, State Grants, FEMA HMA Grants	Medium Term	Medium	New in 2023

Table 5-9 City of Wallingford Mitigation Action Plan

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
Wallingford-1	Tornado Safe Room (build). Residents need a place to take shelter	Thunderstorm/Lightning/Hail, Tornado/Windstorm	EMA	Moderate; FEMA HMA Grants, Budgets	Medium Term	High	Continue – Not Started.
Wallingford-2	Watershed study & implement. The City wishes to better understand and manage flood issues on a watershed level	Flooding	BOS.	Moderate; City of Wallingford	Medium Term	High	Continue – In Progress. Drainage ditch south of town was cleaned in 2021.

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
Wallingford-3	Clean/Enlarge Sewage Lagoons. The sewage lagoons need to be regularly maintained to prevent overflow	Flooding	City of Wallingford.	Low; City of Wallingford	Long Term	High	Annual Implementation
Wallingford-4	Construct Sewer Lift Station. Sewer lift station will ensure continued operation during a flood event	Flooding	City of Wallingford, EMA.	High; City of Wallingford, BRIC	Long Term	High	Continue – Not Started.
Wallingford-5	Replace Sewer Lines. Sewer lines are aging. Preventative maintenance is needed.	Flooding	City of Wallingford.	High; City of Wallingford, BRIC	Long Term	High	Continue – In Progress. Some repair work and camera views conducted.
Wallingford-6	Purchase Portable Pumps. Flooding issues in the town	Flooding	City of Wallingford.	Moderate; City of Wallingford, BRIC	Long Term	High	Continue – Not Started. The City has one portable pump.
Wallingford-7	List of those of elderly, disabled or medically distressed. Vulnerable populations may require special response during emergencies	Extreme Heat, Flooding, Hailstorm, Severe Winter Storm, Thunderstorm and Lightning, Tornado, Windstorm	Public Health.	Little to no cost; City of Wallingford, Staff Time	Medium Term	High	Continue – Not Started.
Wallingford-8	Backup of City/County Records. Power outage or equipment failure and we could lose records. All paper files could be lost in firer.	Flooding, Severe Winter Storm, Thunderstorm and Lightning, Tornado, Windstorm	Wallingford.	Low; City of Wallingford	Short Term	Medium	Continue – Not Started. 2023 and 2024 working on this now.
Wallingford-9	Remain Compliant with NFIP. NFIP	Flooding	EMA. City Clerk, administration	Little to no cost; Staff Time	Short Term	High	Annual Implementation

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
	compliance reduces flood risks and ensures residents can maintain flood insurance which protects property.						
Wallingford-10	Storm Water Sewer Service. When it rains water has nowhere to go. Citizens have to use sump pumps to get rid of water	Flooding, Severe Winter Storm, Thunderstorm/Lightning/Hail	City of Wallingford. Contractors	Very High; FEMA HMA Grants, BRIC	Other	High	Continue – Not Started.
Wallingford-11	Cleaning and Maintaining Drainage Ditch. When it rains and floods water can go towards houses and other buildings when it reaches or goes over the banks, creating damage	Flooding	City of Wallingford. local excavation services	Low; FEMA HMA Grant, Local funds	Other	High	Continue – Not Started. The City id complete this a few years ago and will address in 2024-2025 FY
Wallingford-12	The Dredge Ditch South of Wallingford going under HWY 4 needs to be expanded to allow more water to flow under the road.	Flooding, Summer Weather, Winter Weather	Iowa DOT, City of Wallingford, Emmet County EMA	Moderate; Iowa DOT Budget, FEMA HMA Grants	Medium Term	Medium	New in 2023. A couple of years ago during the early spring we still had enough snow on the ground with extremely warm temperatures, with a large amount of rain. The culverts and field tiles became overran

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
							with water. County crews were out opening the culverts due to ice, so that water could continue to flow. Because of the ice blocking the dredge ditch under HWY 4, to town of Wallingford had a river running down the middle of town. Nearby residents' basements flooded due to the issue

Table 5-10 Iowa Lakes Community College Mitigation Action Plan

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
ILCC-1	Backup Power Generator (buy). The county has identified specific critical sites that are vulnerable to	Extreme Heat, Infrastructure Failure, Severe Winter Storm, Thunderstorm/Lightning/Hail, Tornado/Windstorm	EMA; County engineer, County critical asset holders, Community	Moderate; FEMA HMA Grant, Local funds, in-Kind	Medium Term	High	Continue In-Progress

Action ID	Action Title	Hazards Addressed	Lead Agency and Supporting Agencies	Estimated Cost & Potential Funding Sources	Timeline	Priority	Status & Implementation Notes
	power loss. The sites provide critical functions.		critical asset holders				
ILCC-2	Tornado Safe Room (build). The college is used as a tornado shelter for the nearby community trailer park, college students and employees and other community members attending outdoor activates on or near campus.	Thunderstorm/Lightning/Hail, Tornado/Windstorm	EMA, ILCC; County engineer, County critical asset holders, Community critical asset holders	Moderate; FEMA HMA Grant, Local funds, in-Kind	Medium Term	High	Continue Not Started
ILCC-3	Backup Generators - Power for shelters. Christensen Building & Main Campus Building are identified surge and storm shelters. If major severe weather were to occur, backup power would be needed to keep the facility open and operational to support the needs of the public.	Extreme Heat, Infrastructure Failure, Severe Winter Storm, Thunderstorm/Lightning/Hail, Tornado/Windstorm	ILCC, City of Estherville, Emmet County, EMA	Moderate; FEMA HMA Grant, Local funds, in-Kind	Short term	High	New in 2023

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.

5.1 Monitoring, Evaluating, and Updating the Plan

5.1.1 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 Emmet 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 Emmet County Board of Supervisors and governing bodies of participating jurisdictions.
- 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.

5.1.2 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 Emmet 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 Disaster Mitigation Act 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. This should include the identification and pursuit of grant funding to procure assistance with the five-year update.

5.1.3 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.

In order 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 Emmet 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, School District Superintendent, and governing board members requesting that the mitigation strategy be incorporated, where appropriate in other planning mechanisms.

Adjustments to the plan will be made to address activities that have either proven unsuccessful or are considered impractical after a thorough evaluation of their alignment with established criteria, time constraints, community priorities, and available funding resources. Additionally, actions with lower priority ranking, previously identified as potential mitigation measures, will undergo reassessment during the monitoring and updated stages of this plan to determine their feasibility for future implementation. Updates to the plan will be implemented through documented modifications and submission, as deemed appropriate and necessary by the Emmet County HMPC. Approval from both Emmet County Board of Supervisors and the governing boards of other participating jurisdictions will be required for these changes.

5.2 Incorporation into Existing Planning Mechanisms

Many of the small jurisdictions in Emmet County do not have standing formal planning mechanisms such as a Comprehensive Plan or Capital Improvements 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 (CIP).

For a detailed summary of planning mechanisms and other mitigation-related capabilities, see Chapter 2.

5.2.1 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 Emmet 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, School District Superintendent, and governing boards 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 2013 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
Emmet County	The plan updated the County's Comprehensive and Land Use plan.	The County is continuing to update the Comprehensive and Land Use plan.
Armstrong	No integration occurred	The city is continuing to update the Local Mitigation Plan.
Dolliver	No integration occurred	The City is planning to improve their Comprehensive and Land Use plan.

Jurisdiction	Incorporation of 2018 Plan into Existing Planning Mechanisms	Integration Process for Plan Update
Estherville	No integration occurred	The plan will continue to integrate engineering studies for streams.
Gruver	The plan was not incorporated much in the last 5 years.	The plan will help the City to prioritize planned projects and identify problem areas. Information from the plan will be incorporated into comprehensive planning, capital improvement planning, and infrastructure plans.
Ringsted	No integration occurred.	The plan will be integrated with existing projects and identify problem areas.
Wallingford	Little incorporation over the past five years.	The plan will help the City to prioritize the projects that need to be implemented and identify problem areas so that this information can be integrated with capital improvement planning, comprehensive planning, and infrastructure plans.
Iowa Lakes Community College	Mitigation plan is part of the College's master plan.	Plan will continue to be incorporated into the master plan and the risk assessment as well as the infrastructure plan

5.3 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. Public notice will be posted through available website postings, community message boards, and social media outlets.

The update process also 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.