Worth County, Iowa

Multi-Jurisdictional Hazard Mitigation Plan

2018 Plan Update

Developed by Worth County with professional assistance from
Amec Foster Wheeler Environment & Infrastructure, Inc.
Homeland Security and Emergency Management

SPECIAL THANKS AND ACKNOWLEDGEMENTS

Worth County Hazard Mitigation Planning Committee

Jurisdictional Representatives

Name		Title	Department	Jurisdiction/Organization
Ken	Abrams	Supervisor	Worth County	Worth County
Jacki	Backhaus	Auditor	Worth County	Worth County
Merlin	Bartz	Supervisor	Worth County	Worth County
John	Bork	Mayor	Grafton FD	Grafton
Dan	Fank	Sheriff	Worth County	Worth County
Keith	Fritz	Principal	NK Schools	Northwood-Kensett CSD
Scott	Heagel	City Council	City of Manly	Manly
Ray	Huftalin	Coordinator	Worth County Emergency Management	Worth County
Randy	Hulshizer	City Council	City of Grafton	Grafton
Mardene	Lien	City Clerk	Joice	Joice
Doug	Moehle	Mayor	Northwood	Northwood
Corey	Pulju	Mayor	Kensett	Kensett
Joel	Rohne	Technology Director	Worth County	Worth County
Joyce	Russell	Mayor	City of Fertile	Fertile
Rick	Scholbrock	Mayor	Hanlontown	Hanlontown
Mark	Smeby	Supervisor	Worth County	Worth County
Duane	Tabbert	Asst Fire Chief	Grafton FD	Grafton
Mark	Tomlinson	Coordinator	Worth County Emergency Management	Worth County
Steve	Ward	Superintendent	Central Springs CSD	Central Springs CSD

Stakeholder Representatives

Name		Title	Department	Agency
Kris	Kerison	Reporter		Northwood Anchor, Inc.

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EXECUTIVE SUMMARY

The purpose of hazard mitigation is to reduce or eliminate long-term risk to people and property from hazards. Worth County and participating jurisdictions developed this multi-jurisdictional local hazard mitigation plan update to reduce future losses to the County and its communities as a result of hazard events. The plan was prepared pursuant to the requirements of the Disaster Mitigation Act of 2000 and to achieve eligibility for the Federal Emergency Management Agency (FEMA) Hazard Mitigation Assistance Grant Programs.

The Worth County Multi-Jurisdictional Hazard Mitigation Plan covers the following jurisdictions that participated in the planning process:

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

Worth County, the incorporated areas, and public school districts listed above developed a Multi-Jurisdictional Hazard Mitigation Plan that was approved by FEMA on December 17, 2013 (hereafter referred to as the *2013 Worth County Hazard Mitigation Plan*). Therefore, this current planning effort serves to update the previous plan.

Additional stakeholders were also invited to include private businesses, community groups, private non-profit entities, adjacent communities, state and federal agencies, academia, and local regional agencies that have a state in mitigation planning in Worth County.

The plan update process followed a methodology prescribed by FEMA, which began with the assembly of the Hazard Mitigation Planning Committee (HMPC) comprising representatives from Worth County, participating jurisdictions, and stakeholders. The HMPC updated the risk assessment that identified and profiled hazards that pose a risk to the Worth County planning area, assessed the vulnerability to these hazards, and examined the capabilities in place to mitigate them. The planning area is vulnerable to several hazards that are identified, profiled, and analyzed in this plan.

Based upon the risk assessment, the HMPC reviewed the previously developed goals for reducing risk from hazards. The committee determined that all four previous goals remain valid; no changes were made. The validated goals are listed below:

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

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.

PREREQUISITES

44 CFR requirement 201.6(c)(5): The local hazard mitigation plan shall include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan. For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.

***Note to Reviewers**: When this plan has been reviewed and approved pending adoption by FEMA Region VII the adoption resolutions will be signed by the participating jurisdictions and added to Appendix D. A model resolution is provided.*

The following jurisdictions participated in the development of this plan and have adopted the multi-jurisdictional plan. Resolutions of Adoptions are included in Appendix D.

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

Model Resolution

Resolution # _____

Adopting the Worth County Multi-Jurisdictional Local Hazard Mitigation Plan

Whereas, the (Name of Government/District/Organization seeking FEMA approval of hazard mitigation plan) recognizes the threat that natural hazards pose to people and property within our community; and

Whereas, undertaking hazard mitigation actions will reduce the potential for harm to people and property from future hazard occurrences; and

Whereas, the U.S Congress passed the Disaster Mitigation Act of 2000 ("Disaster Mitigation Act") emphasizing the need for pre-disaster mitigation of potential hazards;

Whereas, the Disaster Mitigation Act made available hazard mitigation grants to state and local governments; and

Whereas, an adopted Local Hazard Mitigation Plan is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

Whereas, the (Name of Government/District/Organization) fully participated in the hazard mitigation planning process to prepare this Multi-Jurisdictional Local Hazard Mitigation Plan; and

Whereas, the Iowa Homeland Security and Emergency Management Department and the Federal Emergency Management Agency Region VII officials have reviewed the "Worth County Multi-Jurisdictional Local Hazard Mitigation Plan," and approved it contingent upon this official adoption of the participating governing body; and

Whereas, the (Name of Government/District/Organization) desires to comply with the requirements of the Disaster Mitigation Act and to augment its emergency planning efforts by formally adopting the Worth County Multi-Jurisdictional Local Hazard Mitigation Plan; and

Whereas, adoption by the governing body for the (Name of Government/District/Organization) demonstrates the jurisdictions' commitment to fulfilling the mitigation goals outlined in this Multi-Jurisdictional Local Hazard Mitigation Plan;

Whereas, adoption of this legitimizes the plan and authorizes responsible agencies to carry out their responsibilities under the plan;

Now, therefore, be it resolved, that the (Name of Government/District/Organization) adopts the "Worth County Multi-Jurisdictional Local Hazard Mitigation Plan" as an official plan; and

Be it further resolved, the (Name of Government/District/Organization) will submit this Adoption Resolution to the Iowa Homeland Security and Emergency Management Department and Federal Emergency Management Agency Region VII officials to enable the plan's final approval.

Date: _____

Certifying Official: _____

1 INTRODUCTION AND PLANNING PROCESS

1.1 Purpose

Worth County, its participating cities, and public school districts 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 Worth County and the participating jurisdictions eligible for certain federal grant programs, specifically the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Assistance (HMA) grants including the Hazard Mitigation Grant Program, Pre-Disaster Mitigation Program, and Flood Mitigation Assistance Program.

1.2 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. Worth

County and the incorporated cities that participated in this plan update developed a Multi-Jurisdictional Hazard Mitigation Plan that was approved by FEMA on October 30, 2013 (hereafter referred to as the *2013 Worth County Hazard Mitigation Plan*). Therefore, this current planning effort serves to update the previous plan.

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

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

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

This plan was 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 Worth County planning area has been affected by hazards in the past and the participating jurisdictions are therefore committed to reducing future impacts from hazard events and becoming eligible for mitigation-related federal funding.

1.3 Plan Organization

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

- Executive Summary
- Chapter 1: Introduction and Planning Process
- Chapter 2: Planning Area Profile and Capabilities
- Chapter 3: Risk Assessment
- Chapter 4: Mitigation Strategy
- Chapter 5: Plan Implementation and Maintenance
- Appendices

This is the same general order that was used for the 2013 Worth County Hazard Mitigation Plan. However, several chapters from the previous plan have been condensed for the plan update. **Table 1.1** below provides details on changes that were made to the plan format:

Table 1.1. Changes in Organization 2013 Plan Vs. 2018 Update

2013 Plan	2018 Plan Update
Chapter 1: Introduction & Background	Executive Summary Chapter 1: Introduction and Planning Process Appendix D – Adoption Resolutions
Chapter 2: Community Profile	Chapter 2: Planning Area Profile and Capabilities
Chapter 3: Hazard Analysis & Risk Assessment	Chapter 3: Risk Assessment
Chapter 4: Hazard Scoring & Prioritization	
Chapter 5: Vulnerability Assessment & Loss Estimates	
Chapter 6: Current Mitigation Activities	Chapter 4: Mitigation Strategy
Chapter 7: Mitigation Goals & Measures Analysis	
Chapter 8: Action Plan	
Chapter 9: Plan Maintenance, Review, & Update	Chapter 5: Plan Implementation and Maintenance
Appendices	
Appendix A. Maps	Integrated throughout all plan chapters
Appendix B. Agendas & Minutes	Appendix B: Documentation of Planning Process
Appendix C. Planning Committee and Sign-in Sheets	
Appendix D. Letters to Communities	Available upon request
Appendix E. References	Appendix A: References
Appendix F. Acronym List	Acronyms defined when used in text
Appendix G. Update Sheets	
Appendix H. Adoption Resolutions	Appendix D: Adoption Resolutions

1.4 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.

In February 2017, the State of Iowa Homeland Security and Emergency Management Department contracted with Amec Foster Wheeler, Environment & Infrastructure, Inc. to facilitate the update of the Worth County Multi-Jurisdictional Local Hazard Mitigation Plan. Amec Foster Wheeler's role was to:

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

1.4.1 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.

Worth County invited the incorporated cities, public school districts, and various other stakeholders in mitigation planning (identified in Appendix B) to participate in the Worth County Multi-Jurisdictional Hazard Mitigation Plan update process. The jurisdictions that elected to participate in this plan are listed above in section 1.2. 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;
- Provide data for and assist in the development of the updated risk assessment that describes how various hazards impact their jurisdiction;
- Provide data to describe current capabilities;
- Develop/update mitigation actions (at least one) specific to each jurisdiction;

- Provide comments on plan drafts as requested;
- Inform the public, local officials, and other interested parties about the planning process and provide opportunities for them to comment on the plan; and
- Formally adopt the mitigation plan.

All of the jurisdictions listed as official participants in this plan met all of these participation requirements. **Table 1.2** shows the representation of each participating jurisdiction at the planning meetings, provision of Data Collection Guides, and update/development of mitigation actions. Sign-in sheets are included in Appendix B: Planning Process Documentation.

Table 1.2. Jurisdictional Participation in Planning Process

Jurisdiction	Kick-off Meeting	Planning Meeting #2	Supplemental Project Meeting	Data Collection Guide	Status of Previous Actions	Mitigation Action Plans	Integration Worksheet
Worth County	x	x	N/A	x	x	x	x
Fertile		x	N/A	x	x	x	x
Grafton	x	x	N/A	x	x	x	x
Hanlontown	x	x	N/A	x	x	x	
Joice			x	x	x	x	x
Kensett	x	x	N/A	x	x	x	x
Manly		x	N/A	x	x	x	x
Northwood		x	N/A	x	x	x	x
Central Springs PSD			x	x	N/A	x	x
Northwood-Kensett PSD	x	x	N/A	x	N/A	x	x

1.4.2 The Planning Steps

Amec Foster Wheeler and Worth County worked together to establish the framework and process for this planning effort using FEMA's *Local Mitigation Planning Handbook* (March 2013). The plan update was completed utilizing the 9-task approach within a broad four-phase process:

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

Into this process, Amec Foster Wheeler 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 1.3** 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.

Table 1.3. Mitigation Planning Process Used to Develop the Worth 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)

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 September 28, 2017. Participants of the meeting included the Worth County Emergency Management Coordinator, Iowa Homeland Security and Emergency Management Department Hazard Mitigation Planner and GIS Coordinators, and the Amec Foster Wheeler 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 B.

After the initial coordination meeting, two additional planning meetings were held on January 24, 2018 and March 28, 2018. A supplemental meeting was held in August for two jurisdictions unable to attend the first two meetings. A complete list of all representatives of the agencies and organizations that participated on the Worth 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 1.4**. The meeting minutes for each of the meetings are included in Appendix B.

Table 1.4. Schedule of HMPC Meetings

Meeting	Topic	Date
Informational Meeting	General overview of planning process/requirements and schedule.	September 28, 2017
Planning Meeting #1	Introduction to DMA, the planning process, hazard identification and public input strategy. Distribution of data collection guide to jurisdictions. Preliminary hazard data. Discussion critical facility inventory.	January 24, 2018
	Review of draft Risk Assessment, update plan goals, instructions to update status of previous mitigation actions	
Planning Meeting #2	Development of new mitigation actions, mitigation action planning and prioritization. Determine process to monitor, evaluate, and update plan.	March 28, 2018

During the first planning meeting, Amec Foster Wheeler 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. Amec Foster Wheeler also introduced hazard identification requirements and data needs. The HMPC discussed potential hazards as well as past events and impacts and refined the identified hazards to be relevant to Worth County. The hazard ranking methodology utilized by Iowa Homeland Security and Emergency Management Department in the State Hazard Mitigation Plan was introduced and preliminary information was presented for each hazard identified.

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

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

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

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

The public survey was developed specific to the Worth County Mitigation Plan and provided a brief plan summary as well as a questionnaire to capture public and stakeholder input. The survey was made available online and in hard copy in locations throughout the County. A copy of the survey is provided in Appendix B.

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, 109 surveys were completed.

The survey asked the public and stakeholders to indicate their opinion on the likelihood for each hazard to impact their jurisdiction. They were asked to rate the probability of each hazard profiled in this plan as 1-unlikely, 2-occasional, 3-likely, and 4-highly likely. The summary results of this question are provided in **Figure 1.1**.

Figure 1.1. Survey Results—Probability of Hazards in Jurisdiction

	UNLIKELY	OCCASIONAL	LIKELY	HIGHLY LIKELY	TOTAL	WEIGHTED AVERAGE
Animal/Plant/Crop Disease	22.02% 24	35.78% 39	31.19% 34	11.01% 12	109	2.31
Dam/Levee Failure	86.11% 93	7.41% 8	2.78% 3	3.70% 4	108	1.24
Drought	16.51% 18	39.45% 43	28.44% 31	15.60% 17	109	2.43
Earthquake	94.39% 101	2.80% 3	0.93% 1	1.87% 2	107	1.10
Expansive Soils	55.34% 57	33.98% 35	6.80% 7	3.88% 4	103	1.59
Extreme Heat	12.84% 14	36.70% 40	39.45% 43	11.01% 12	109	2.49
Flash Flood	25.00% 27	39.81% 43	26.85% 29	8.33% 9	108	2.19
Grass or Wildland fire	27.52% 30	41.28% 45	23.85% 26	7.34% 8	109	2.11
Hazardous Materials Incident	21.30% 23	49.07% 53	20.37% 22	9.26% 10	108	2.18
Human Disease	21.50% 23	42.99% 46	26.17% 28	9.35% 10	107	2.23
Infrastructure Failure	35.85% 38	43.40% 46	14.15% 15	6.60% 7	106	1.92
Landslide	97.17% 103	0.94% 1	0.00% 0	1.89% 2	106	1.07
Radiological Incident	87.74% 93	7.55% 8	1.89% 2	2.83% 3	106	1.20
River Flooding	20.37% 22	37.04% 40	24.07% 26	18.52% 20	108	2.41
Severe Winter Storm	0.92% 1	16.51% 18	37.61% 41	44.95% 49	109	3.27
Sinkholes	66.67% 72	25.93% 28	6.48% 7	0.93% 1	108	1.42
Terrorism	69.44% 75	18.52% 20	10.19% 11	1.85% 2	108	1.44
Thunderstorm/Lightning/Hail	0.00% 0	11.93% 13	39.45% 43	48.62% 53	109	3.37
Tornado/Windstorm	1.85% 2	15.74% 17	45.37% 49	37.04% 40	108	3.18
Transportation Incident	16.82% 18	41.12% 44	28.04% 30	14.02% 15	107	2.39

Source: SurveyMonkey Results

The survey also asked the public and stakeholders to indicate their opinion on the potential magnitude of each hazard on their jurisdiction. They were asked to rate the probability of each hazard profiled in this plan as 1-negligible, 2-limited, 3-critical, and 4-catastrophic. The summary results of this question are provided in **Figure 1.2.**

Figure 1.2. Survey Results—Magnitude of Hazards in Jurisdiction

	NEGLIGIBLE	LIMITED	CRITICAL	CATASTROPHIC	TOTAL	WEIGHTED AVERAGE
Animal/Plant/Crop Disease	22.22% 24	50.00% 54	23.15% 25	4.63% 5	108	2.10
Dam/Levee Failure	74.53% 79	20.75% 22	1.89% 2	2.83% 3	106	1.33
Drought	9.26% 10	45.37% 49	38.89% 42	6.48% 7	108	2.43
Earthquake	83.96% 89	8.49% 9	4.72% 5	2.83% 3	106	1.26
Expansive Soils	55.77% 58	36.54% 38	4.81% 5	2.88% 3	104	1.55
Extreme Heat	9.26% 10	49.07% 53	35.19% 38	6.48% 7	108	2.39
Flash Flood	14.95% 16	56.07% 60	23.36% 25	5.61% 6	107	2.20
Grass or Wildland Fire	20.37% 22	51.85% 56	20.37% 22	7.41% 8	108	2.15
Hazardous Materials Incident	16.82% 18	43.93% 47	25.23% 27	14.02% 15	107	2.36
Human Disease	16.98% 18	50.00% 53	26.42% 28	6.60% 7	106	2.23
Infrastructure Failure	26.42% 28	51.89% 55	18.87% 20	2.83% 3	106	1.98
Landslide	85.85% 91	11.32% 12	0.94% 1	1.89% 2	106	1.19
Radiological Incident	64.15% 68	21.70% 23	10.38% 11	3.77% 4	106	1.54
River Flooding	13.08% 14	59.81% 64	22.43% 24	4.67% 5	107	2.19
Severe Winter Storm	2.78% 3	39.81% 43	48.15% 52	9.26% 10	108	2.64
Sinkholes	58.88% 63	34.58% 37	4.67% 5	1.87% 2	107	1.50
Terrorism	50.47% 54	21.50% 23	16.82% 18	11.21% 12	107	1.89
Thunderstorm/Lightning/Hail	2.78% 3	44.44% 48	42.59% 46	10.19% 11	108	2.60
Tornado/Windstorm	2.80% 3	26.17% 28	44.86% 48	26.17% 28	107	2.94
Transportation Incident	18.87% 20	55.66% 59	17.92% 19	7.55% 8	106	2.14

Source: SurveyMonkey Results

In the survey, the public was also asked to review 11 types of mitigation actions considered by the Iowa Homeland Security and Emergency Management Department for FEMA funding. The HMPC also considered these types of projects in the Worth County Multi-Jurisdictional Hazard

Mitigation Plan. The survey asked the public to place a check next to the mitigation project types that they felt could benefit their community. **Figure 1.3** provides the compiled results of this question.

Figure 1.3. Survey Results—Types of Projects

ANSWER CHOICES	RESPONSES	
Flood-prone Property Acquisition & Structure Demolition/Relocation	26.73%	27
Flood-prone Structure Elevation	20.79%	21
Floodproofing of Historical and/or Non-residential Structures	22.77%	23
Minor Localized Flood Reduction Projects (stormwater management or other localized flood control projects)	50.50%	51
Structural Retrofitting of Existing Buildings to Add a Tornado Saferoom	63.37%	64
Retrofitting of Existing Buildings and Facilities to Prevent Wind Damage	42.57%	43
New Tornado Safe Room Construction	65.35%	66
Electrical Utilities Infrastructure Retrofit (i.e. strengthening lines/connections to withstand ice/wind damages, burying power lines)	73.27%	74
Soil Erosion Stabilization	28.71%	29
Wildfire Mitigation	14.85%	15
Total Respondents: 101		

Source: SurveyMonkey Results

The public was also asked to comment on any other issues that the Worth County HMPC should consider in developing a strategy to reduce future losses caused by natural hazard events. Some of the additional issues and concerns the public indicated in need of attention are provided below:

- Chemical release from ag co-op
- Chemical spill from semis or trains in town carrying farm chemicals; grainary fire explosions; storm wind damage
- Localized written plans and SOPs for EMS, law enforcement, and fire to include community leaders
- Planning and back up communication equipment to mitigate potential impacts of solar flare or EMP pulse on the power grid
- Ice storm preparedness
- Flooding, storm shelter, infrastructure
- Better or more tornado sirens in the City of Northwood; update or add more storm sewers

The public was also given an opportunity to provide input on the final draft of the complete plan. The entire plan draft was made available on Worth County's website as a PDF document. In addition, two hard copies were made available at the Worth County Emergency Management office and the Manly City Hall.

Worth 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: the Northwood Anchor newspaper, the Manly Signal newspaper. Copies of the announcements are

provided in Appendix B. The final public comment period was from December 10 to December 21, 2018.

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. Minor comments were received and incorporated.

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 Worth County. Coordination with these organizations and other community planning efforts is vital to the success of this plan. Many stakeholder agencies were contacted throughout the planning process to obtain data in preparation of the Risk Assessment. This included contact with specific representatives of stakeholder agencies, as well as accessing stakeholder data that has been made available to the public via the internet. These sources have been identified where data is presented. In addition, Worth 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 Worth 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 in **Table 1.5.**

Table 1.5. Stakeholder Involvement

Stakeholder	Type	Provided Data for Risk Assessment	Invited to Comment on Final Draft
Iowa State University, Iowa Flood Center	Academia	x	x
Mitchell County	Adjacent County		x
Cerro Gordo County	Adjacent County		x
Winnebago County	Adjacent County		x
Freeborn County, Minnesota	Adjacent County		x
Mower County, Minnesota	Adjacent County		x
Environmental Protection Agency	Federal Agency	x	x
Federal Emergency Management Agency	Federal Agency	x	x
National Weather Service	Federal Agency	x	x
U.S. Army Corps of Engineers	Federal Agency	x	x
U.S. Geological Survey	Federal Agency	x	x
Iowa Department of Agriculture and Land Stewardship	State Agency	x	x
Iowa Department of Natural Resources	State Agency	x	x
Iowa Homeland Security and Emergency Management	State Agency	x	x

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 (September 2013);
- Worth County Hazard Mitigation Plan (December 2013);
- National Flood Insurance Program Policy and Loss Statistics;
- Flood Insurance Administration, Repetitive/Severe Repetitive Loss Property Data;
- Flood Insurance Rate Maps for all of Worth County;
- Iowa Department of Natural Resources, Dam Safety Program Inventory of Dams for Worth County;
- National Inventory of Dams;
- National Levee Database;
- Wildland/Urban Interface and Intermix areas from the SILVIS Lab, Department of Forest Ecology and Management, University of Wisconsin;
- Various local plans such as Comprehensive Plans, Economic Development Plans, Capital Improvement Plans, etc. For a complete list of local plans that were reviewed and incorporated, see Chapter 2;
- US Department of Agriculture's (USDA) Risk Management Agency Crop Insurance Statistics

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

Phase 2 Assess Risk (Handbook Task 5)

Step 4: Assess the Hazard: Identify and Profile Hazards

Amec Foster Wheeler assisted the HMPC in a process to identify/update the hazards that have impacted or could impact communities in Worth County. At the kick-off meeting, the HMPC examined the history of disaster declarations in Worth County, the list of hazards considered in the 2013 Iowa State Hazard Mitigation Plan, and the hazards identified in the previous Worth County Hazard Mitigation Plan. The committee then worked through this list of all potential hazards that could affect the planning area. They discussed past hazard events, types of damage, and where additional information might be found. Additional information on the hazard identification process and which hazards were identified for each jurisdiction is provided in Chapter 3.

During the kick-off meeting, the HMPC discussed past events and impacts on a county-wide basis to contribute to the risk assessment update. After the kick-off meeting, each jurisdiction completed a Data Collection Guide, including information on previous hazard events in their community. Utilizing the information from the Data Collection Guides as well as existing plans, studies, reports, and technical information as well as information available through internet research and GIS analysis, a profile was developed for each hazard identified. More

information on the methodology and resources used to identify and profile the hazards can be found in Chapter 3.

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

Assets for each jurisdiction were identified through a combination of several resources. The Worth County Assessor's office provided access to datasets with parcel and building data as well as corporate boundaries, school district boundaries, and other available GIS layers. GIS layers, including data for critical facilities was supplemented with data available from the Department of Natural Resources GIS Repository (NRGIS) as well as data available from the Homeland Security Infrastructure Program (HSIP) Freedom 2015 dataset. Population data was obtained from the U.S. Census Bureau. Methodologies and results of the critical facility analysis as well as sources for data utilized are provided in Chapter 3 and Appendix E.

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

The HMPC also analyzed development since the last plan update and future development trends from data provided by each jurisdiction on the Data Collection Guide as well as minutes of the annual review meetings. Data was also obtained from the U.S. Census Bureau and from jurisdictions through other planning mechanisms such as Comprehensive Plans and Future Development Plans.

After profiling the hazards that could affect Worth County and identifying assets, the HMPC collected information to describe the likely impacts of future hazard events on the participating jurisdictions. For each hazard, there is a discussion regarding future development as well as climate change impacts regarding how vulnerability to that specific hazard might be impacted in the future.

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 2, Planning Area Profile and Capabilities.

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

Taking into consideration the vulnerability and capability assessments, and where sufficient information was available, a variety of methods was used to estimate losses for each profiled hazard. For riverine flooding, Hazus was used to determine assets/areas at risk and determine loss estimates. For other geographic hazards such as fixed chemical facilities and grass/wildland fire, assets/areas at risk were determined through GIS analysis. For other hazards such as weather-related hazards, loss estimates were developed based on statistical analysis of historic events. For some human-caused hazards, loss estimates were scenario-based. The methodologies for each loss estimate are described in detail in Chapter 3. Within

each hazard section, the text provides details on how the hazard varies by jurisdiction, where applicable. In addition, at the conclusion of each hazard section, a summary table indicates the specific probability, magnitude, warning time, and duration rating of the hazard for each jurisdiction, to show how the hazard varies. Where applicable, introductory text preceding the table highlights noted variables.

Results of the preliminary risk assessment were presented at Meeting #2 and the Draft Risk Assessment (Chapter 3) was provided to the HMPC for review and comment. Several comments, corrections, and suggestions were provided to Amec Foster Wheeler and incorporated into the risk assessment as appropriate.

Phase 3 Develop the Mitigation Plan (Handbook Task 6)

Step 6: Set Goals

Amec Foster Wheeler facilitated a discussion session with the HMPC during Meeting #2 to review and update goals. Common categories of mitigation goals were presented as well as the 2013 State Hazard Mitigation Plan goals.

This planning effort is an update to an existing hazard mitigation plan. As a result, the goals from the *2013 Worth County Multi-Jurisdictional Hazard Mitigation Plan* were reviewed.

The committee determined that all four previous goals remain valid; no changes were made. The validated goals are listed below:

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

Step 7: Review Possible Activities

At Meeting #1, a handout of previous actions was provided to all jurisdictions with instructions to provide updates for each action. Jurisdictions were encouraged to maintain a focused approach and continue forward only those actions that are aimed at implementing long-term solutions to prevent losses from hazards. The focus of Meeting #2 was to update the mitigation strategy by discussing relevant new actions considered necessary as a result of the updated risk assessment. The HMPC reviewed the following: plan goals, previous actions from the 2013 plan, key issues from the risk assessment, Iowa Homeland Security and Emergency Management's HMA funding priorities, public opinion survey results on types of actions desired, and FEMA's Mitigation Action Ideas publication.

The group discussed the types of mitigation actions/projects that could be done by the jurisdictions in Worth County. Consideration was given to the analysis results provided in the risk assessment and the anticipated success for each project type. Projects relating to emergency response were discussed, but participants were encouraged to focus on long-term mitigation solutions since response-related mitigation actions occur on a routine basis as

requirements of other plans. Complex projects that would necessitate use of large numbers of county resources were also discussed. This opportunity to discuss a broad range of mitigation alternatives allowed the jurisdictions to understand the overall priorities of the committee and to allow for discussion of the types of project most beneficial to each jurisdiction. As part of this discussion, consideration was given to the potential cost of each project in relation to the anticipated future cost savings.

The jurisdictions were also provided instructions for completing the Mitigation Action Plan for each continuing and newly developed action. The details from the Action Plan for each Continuing and New action are provided in Chapter 4. The completed and deleted actions are provided in Appendix C. Chapter 4 provides additional details regarding the process undertaken to refine the mitigation strategy to make Worth County and its jurisdictions more disaster resistant.

Step 8: Draft an Action Plan

A complete draft of the plan was made available online and in hard copy for review and comment by the public, other agencies and interested stakeholders. This review period was from December 10 to December 21, 2018. Methods for inviting interested parties and the public to review and comment on the plan were discussed in Steps 2 and 3, and materials are provided in Appendix B. Comments were integrated into a final draft for submittal to the Iowa Homeland Security and Emergency Management Department and FEMA.

Phase 4 Implement the Plan and Monitor Progress

Step 9: Adopt the Plan (Handbook Task 8)

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

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

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

2 PLANNING AREA PROFILE AND CAPABILITIES

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

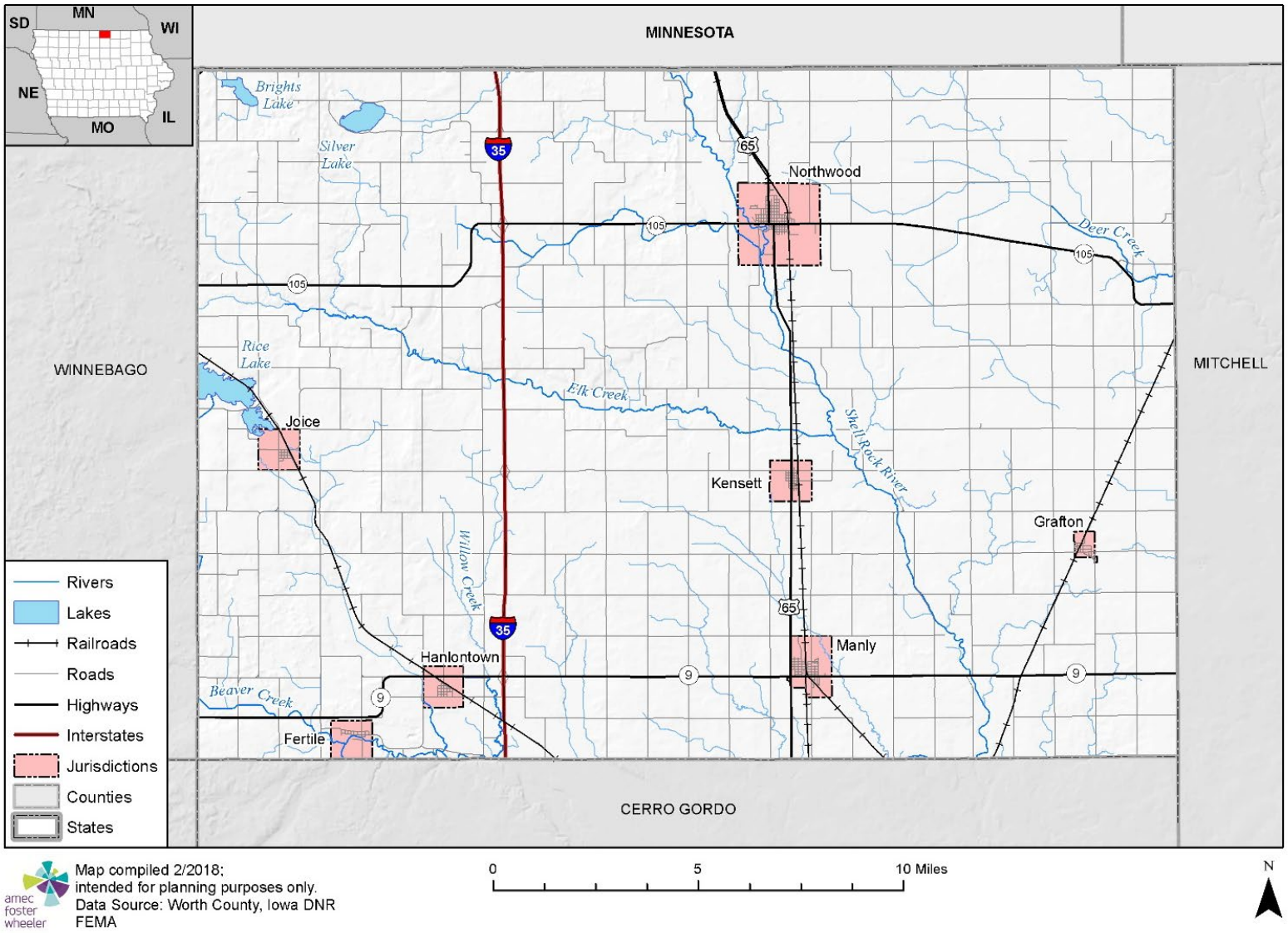
2.1 Worth County Planning Area Profile

Figure 2.1 provides a map of the Davis County planning area. The planning area boundaries include the unincorporated areas of Davis County as well as the following incorporated cities:

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

Central Springs Public School District and Northwood-Kensett Public School District participated in development of this plan and are also included in the planning area. They are discussed in additional detail in **Section 2.3**.

Figure 2.1. Worth County Planning Area



2.1.1 Geography and Topography

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

Adjacent counties:

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

The soils that are found within Worth County are well suited to agricultural uses, including crop production and pasture. The principal crops are corn, soybeans, oats, hay, and pasture. Predominant soils in the County are poorly drained to moderately well drained. Much of the county's landscape is comprised of rolling prairie. (Source: Natural Resources Conservation Service, Soil Survey).

2.1.2 Major Rivers and Watersheds

The primary waterway features in Worth County are Shell Rock River, Deer Creek, Winnebago River, and Bear Creek. As depicted in **Figure 2.2**, Worth County crosses three watersheds as follows:

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

Figure 2.2. Worth County, Iowa Watersheds (Worth County is red square)

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

2.1.3 History

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

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

The Worth County Courthouse is listed on the National Register of Historic Places along with four other properties and a historic district. These historic structures are detailed in **Table 2.1** below.

Table 2.1. Worth County Listings in National Register of Historic Places

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

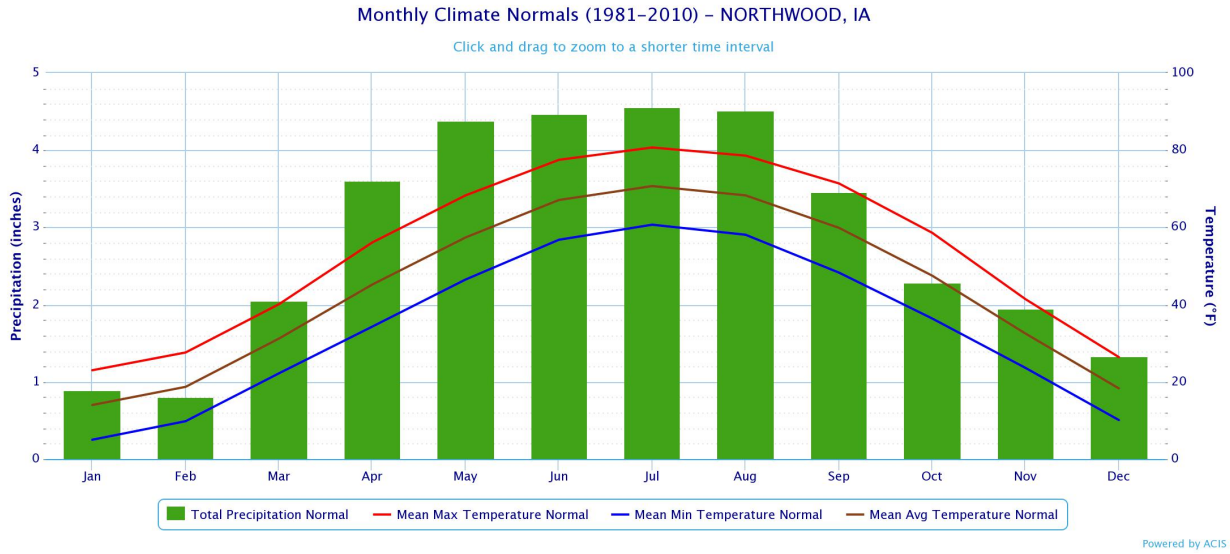
Source: National Register of Historic Places

2.1.4 Climate

The climate in Worth County is described as hot-summer humid continental with cold winters and hot and humid summers. The average winter temperature is 17.7 degrees Fahrenheit. The average summer temperature is 69.9 degrees Fahrenheit, with an average annual rainfall of 34 inches.

The coldest winter month is January with an average low of 5.0 degrees Fahrenheit and the hottest summer month is July with an average high of 80.7 degrees Fahrenheit. Seasons fluctuate from being very wet to very dry, with a peak precipitation normal of 4.56 inches in July to a minimum precipitation normal of 0.90 inches in January. **Figure 2.4** and **Table 2.2** provide monthly climate normals for Northwood, Iowa from 1981 to 2010.

Figure 2.3. Monthly Climate Normals (1981-2010), Northwood, IA



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

Table 2.2. Monthly Climate Normals (1981-2010), Northwood, IA

Month	Total Precipitation Normal (inches)	Mean Max Temperature Normal (°F)	Mean Min Temperature Normal (°F)	Mean Avg Temperature Normal (°F)
January	0.90	23.0	5.0	14.0
February	0.81	27.6	9.8	18.7
March	2.05	40.1	22.2	31.2
April	3.61	56.1	34.3	45.2
May	4.38	68.3	46.5	57.4
June	4.47	77.5	56.8	67.1
July	4.56	80.7	60.7	70.7
August	4.52	78.6	58.1	68.3
September	3.46	71.4	48.3	59.9
October	2.29	58.6	36.4	47.5
November	1.95	41.4	23.6	32.5
December	1.33	26.4	10.1	18.3
Annual	34.33	54.1	34.3	44.2

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

2.1.5 Population/Demographics

According to the U.S. Census Bureau, the Worth County population remained stable from 2010 to 2016, with only a 0.5 pecent decline overall. Over this period, only the Cities of Grafton, Kensett, and Manly experienced growth. The greatest absolute population decline was seen in the unincorporated county, yet the City of Joice experienced the greatest relative decline, with a 12.2 percent drop in population. **Table 2.3** provides the populations for each city and the unincorporated county for the 2010 decennial census and the 2016 American Community Survey (ACS) 5-Year Estimates with the number and percent change from 2010 to 2016.

Table 2.3. Worth County Population 2010-2016 by Jurisdiction

Jurisdiction	2010 Census Population	2016 Population Estimate	# Change 2010-2016	% Change 2010-2016
Unincorporated Worth County	2,950	2,628	-322	-10.9
Fertile	370	346	-24	-6.5
Grafton	252	355	103	40.9
Hanlontown	226	211	-15	-6.6
Joice	222	195	-27	-12.2
Kensett	266	345	79	29.7
Manly	1,323	1,551	228	17.2
Northwood	1,989	1,931	-58	-2.9
Total	**7,598**	**7,562**	**-36**	**-0.5**

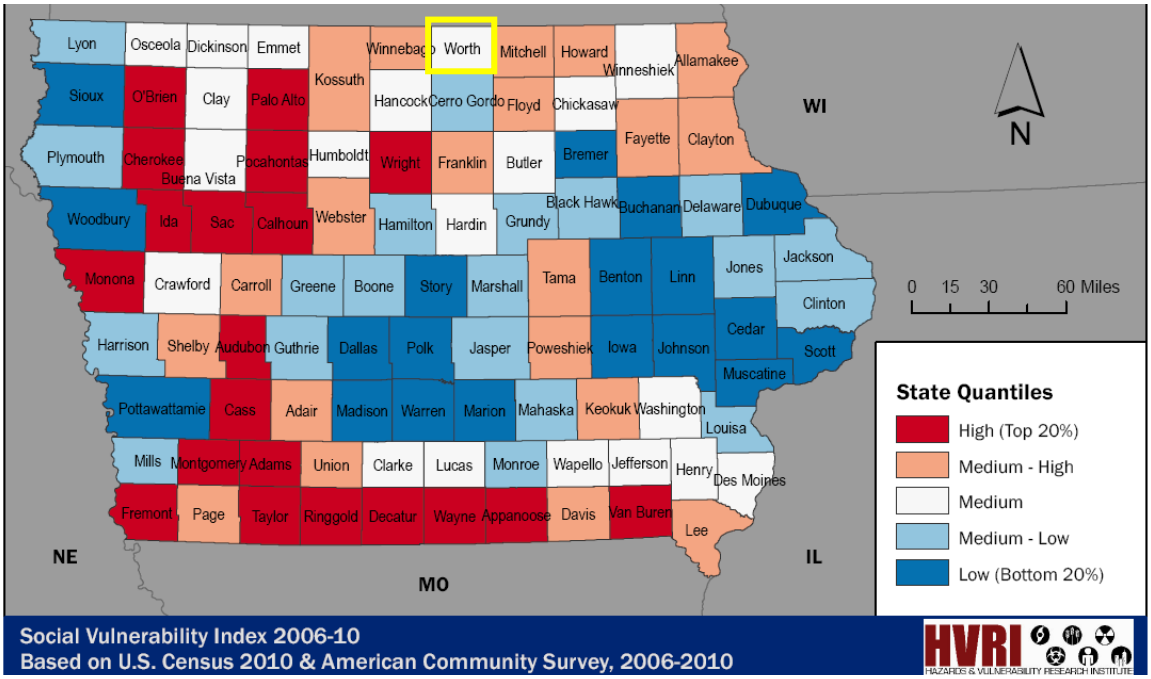
Source: U.S. Census Bureau: 2010 Decennial Census, ACS 2012-2016 5-Year Estimates. Unincorporated Worth County Population was estimated by subtracting populations of incorporated cities from the total Worth County populations.

According to the ACS 2016 5-Year Estimates, 5.5 percent of the population is under age 5 and 19.8 percent of the population is over age 65 in Worth County. In total, there were 3,522 households with an average household size of 2.37 people.

The Hazards and Vulnerability Research Institute at the University of South Carolina developed the Social Vulnerability Index (SoVI ®) to evaluate and rank the ability to respond to, cope with, recover from, and adapt to disasters. The index synthesizes 30 socioeconomic variables, which the research literature suggests contribute to reduction in a community's ability to prepare for, respond to, and recover from hazards. SoVI ® data sources include primarily those from the United States Census Bureau.

Figure 2.5 shows that Worth County has a medium Social Vulnerability Index. The medium index indicates that Worth County is generally less able to cope and recover from disasters as counties with a lower index. It should be noted that SoVI does not reveal variations in social vulnerability each county; however, some portions of Worth County may experience more difficulty coping and recovering from disasters than others.

Figure 2.4. County Comparison Within the State for Social Vulnerability Index, 2006-2010



Source: Hazards and Vulnerability Research Institute, http://webra.cas.sc.edu/hvri/products/sovi2010_img/PDF/Iowa_0610.pdf
http://webra.cas.sc.edu/hvri/products/sovi2010_data.aspx

Table 2.4 and **Table 2.5** provide additional demographic and economic indicators for Worth County. The Worth County values are for the whole County, including the incorporated cities.

Table 2.4. Unemployment, Income, and Poverty Demographics, Worth County, Iowa

Jurisdiction	Population 16 Years and Over	Population 16 Years and Over in the Labor Force	Unemployment Rate	Median Household Income ($)	Percent Below Poverty Level
Worth County, Iowa	6,163	4,028	6.3%	49,472	10.5
Fertile	282	193	1.6%	39,861	0.6
Grafton	305	196	0.0%	35,000	10.91
Hanlontown	176	131	8.4%	56,875	3.9
Joice	164	113	3.5%	37,500	8.7
Kensett	309	207	20.3%	28,333	18.6
Manly	1,227	846	3.5%	48,214	18.1
Northwood	1,550	984	11.2%	44,345	13.1

Source: U.S. Census, 2016 American Community Survey, 5-year Estimates

Table 2.5. Educational Attainment, Worth County, Iowa

Geography	Population 25 years and over	Percent less than 9th grade*	Percent high school graduate or higher*	Percent bachelor's degree or higher*
Worth County, Iowa	5,316	2.1	92.3	15.3
Fertile	243	0.4	92.2	14.8
Grafton	253	3.6	91.3	8.7
Hanlontown	146	2.1	94.5	17.1
Joice	150	0.0	93.3	16.7
Kensett	281	0.4	89.0	10.3
Manly	948	3.4	89.9	12.4
Northwood	1,387	3.6	91.3	16.9

Source: U.S. Census, 2016 American Community Survey, 5-year Estimates *percentage of population 25 years and over

2.1.6 Occupations/Employers

Table 2.6 provides occupation statistics for the incorporated cities and the county as a whole for the civilian employed population 16 years and over.

Table 2.6. Occupation Statistics, Worth County, Iowa

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
Worth County, Iowa	3,776	23.8%	18.5%	23.2%	15.0%	19.5%
Fertile	190	15.3%	14.7%	32.1%	18.9%	18.9%
Grafton	196	25.5%	17.9%	7.7%	30.1%	18.9%
Hanlontown	120	18.3%	26.7%	30.0%	12.5%	12.5%
Joice	109	31.2%	20.2%	14.7%	6.4%	27.5%
Kensett	165	12.1%	23.0%	23.0%	20.0%	21.8%
Manly	816	12.7%	22.3%	35.2%	14.2%	15.6%
Northwood	874	24.4%	20.8%	22.5%	11.2%	21.1%

Source: U.S. Census, 2016 American Community Survey, 5-year Estimates

Table 2.7 lists the major employers in Worth County according to data provided by County and jurisdiction representatives as reported in Data Collection Guides. Note: The Cities of Fertile and Hanlontown were the only jurisdictions to report major employers.

Table 2.7. Major Employers, Worth County, Iowa

Employer	Estimated # of Employees	Jurisdiction
POET Biorefining	40	Hanlontown/Fertile
Five Star Coop	12	Hanlontown

Source: Data Collection Guides completed 2017

2.1.7 Agriculture

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

According to the 2012 Census of Agriculture there were 640 farms in the County covering 234,958 acres of land (91.8 percent of the 400 sq. miles of land area (256,000 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 367 acres. Worth County agriculture and agriculture-related industries provide 1,399 jobs, representing 33.1 percent of the County's workforce. Worth County agriculture and economy contributions are summarized in additional detail in Section 3.2.2 of Chapter 3.

2.1.8 FEMA Hazard Mitigation Assistance Grants in Planning Area

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

2.2 City/County Capabilities

Unincorporated Worth County is governed by a three-member Board of Supervisors. Each incorporated city is governed by a six-member Mayor/City Council. Worth County has an active Emergency Management Agency that coordinates emergency management capabilities in the County. **Table 2.8** that follows provides additional capability information for the unincorporated county and incorporated cities.

Table 2.8. Mitigation Capabilities

	Worth County	Fertile	Grafton	Hanlontown	Joice	Kensett	Manly	Northwood
Planning Capabilities								
Comprehensive Plan	no	yes, 1/4/2005	no	yes	yes	NR	no	N/A
Builder's Plan	no	N/A	no	N/A	no	NR	no	N/A
Capital Improvement Plan	no	N/A	no	N/A	yes 8/2017	NR	no	
Local Emergency Operations Plan		yes, 1/3/2018	yes, Jan 2018	yes	yes 9/6/2018	NR	no	8/18/2017
County Emergency Operations Plan	yes	yes	no	yes	N/A	NR	N/A	County
Local Recovery Plan		yes, 10/2/2012	yes, EOP, Jan 2018	yes	no	NR	no	N/A
County Recovery Plan	yes	N/A	no	N/A	N/A	NR	N/A	County
City Mitigation Plan		yes, 10/2/2012	yes, EOP, Jan 2018	yes	yes 9/6/2018	NR	yes	8/17/2018
County Mitigation Plan	yes	yes	no	yes	yes 8/2018	NR	N/A	County
Debris Management Plan	no	yes	no	yes	no	NR	no	
Economic Development Plan	Winn-Worth Betco	yes	no	yes	yes 11/2017	NR	no	N/A
Transportation Plan	no	yes, 10/2/2012	no	yes	no	NR	no	N/A
Land-use Plan	no	N/A	no	N/A	no	NR	no	N/A
Flood Mitigation Assistance (FMA) Plan	no	yes, 1/4/2004	no	N/A	no	NR	no	2016
Watershed Plan	yes - Deer Creek	yes, 1/4/2004	no	N/A	no	NR	no	N/A
Firewise or other fire mitigation plan	No	no	no	N/A	no	NR	no	N/A
Critical Facilities Plan (Mitigation/Response/Recovery)	No	yes, 1/4/2004	yes, EOP, Jan 2018	N/A	no	NR	no	

	Worth County	Fertile	Grafton	Hanlontown	Joice	Kensett	Manly	Northwood
Policies/Ordinances								
Zoning Ordinance	3 townships only	yes	no	yes	ours is a non-residence area ordinance	yes	yes	yes
Building Code	no	yes	2013	N/A	no	yes	no	
Floodplain Ordinance	no	yes	no	N/A	no	N/A	no	2012
Subdivision Ordinance	no	N/A	N/A		no	N/A	no	yes
Tree Trimming Ordinance	no	yes	yes	yes	no	N/A	no	yes
Nuisance Ordinance	no	yes	yes	yes	yes	yes	yes	yes
Storm Water Ordinance	no	yes	no, but completed storm drainage study in 2010	N/A	no	yes	yes	yes
Drainage Ordinance	no	yes	no, but completed storm drainage study in 2010	N/A	yes	yes	no	yes
Site Plan Review Requirements	no	yes	no	no	no	no	yes	yes
Historic Preservation Ordinance	no	yes	no	no	no	no	no	yes
Landscape Ordinance	no	yes	yes, mowing ordinance, 2013	no	no	no	no	no
Iowa Wetlands and Riparian Areas Conservation Plan	yes	N/A	no	N/A	no	yes - DNR	no	no
Programs								
Zoning/Land Use Restrictions	3 townships - west	yes	no	yes	yes in ordinances	no	yes	no
Codes Building Site/Design	no	yes	yes, building permits 2013	yes	no	no	no	no
National Flood Insurance Program	yes	yes	no	N/A	no	no	no	no
NFIP Community Rating System (CRS) Participating Community	yes	yes	no	N/A		no	no	no

	Worth County	Fertile	Grafton	Hanlontown	Joice	Kensett	Manly	Northwood
Hazard Awareness Program	yes	yes	no	no	no	yes	no	no
National Weather Service (NWS) Storm Ready	no	yes	no	N/A	N/A	no	no	no
Firewise Community Certification	no	yes	no	yes		N/A	unknown	no
Building Code Effectiveness Grading (BCEGs)	no	yes	no	N/A	no	N/A	no	no
ISO Fire Rating	9			5		N/A	4	no
Economic Development Program	W/W Betco	yes	no	N/A	yes	yes - Winn Worth Betco	no	yes, Winn-Worth Betco
Land Use Program	no	yes	no	N/A	no	no	no	no
Public Education/Awareness	yes	yes	yes, we send out Iowa Energizers quarterly with our utility bills	N/A	yes	yes	no	no
Property Acquisition	yes - conservation	yes	no	N/A	yes	N/A	no	no
Planning/Zoning Boards	yes	N/A	no	no	no	no	yes	yes
Stream Maintenance Program	no - conservation	yes	no	no	no	yes - DNR	no	no
Tree Trimming Program	no	yes	yes	N/A	no	yes	no	yes, ordinance
Engineering Studies for Streams (Local/County/Regional)	no	yes	no	no	no	yes - DNR	no	no
Mutual Aid Agreements	yes	NR	yes	yes	yes, garbage - sheriff of worth co	no	yes	no
Studies/Reports/Maps								
Hazard Analysis/Risk Assessment (City)	N/A	yes, Fertile	yes	N/A	yes	N/A	no	no
Hazard Analysis/Risk Assessment (County)	sort of - in progress	yes, Worth	no	yes, Worth	yes	N/A	N/A	no
Flood Insurance Maps	yes, 2012	yes, 2012	yes, 2012	yes, 2012	yes, 2012	yes, 2012	yes, 2012	yes, 2012
FEMA Flood Insurance Study (Detailed)	no	no	no	no	no	no	no	no
Evacuation Route Map	no	yes	no	yes	no	N/A	no	no
Critical Facilities Inventory	no	yes	no	yes	no	N/A	no	no
Vulnerable Population Inventory	no	yes	no	yes	no	N/A	no	no
Land Use Map	yes	yes	no	yes	yes	N/A	no	no

	Worth County	Fertile	Grafton	Hanlontown	Joice	Kensett	Manly	Northwood
Staff/Department								
Building Code Official	no	yes	no	no	N/A	no	no	no
Building Inspector	no	yes	no	no	N/A	no	no	no
Mapping Specialist (GIS)	yes	yes	no	no	no	no	no	yes, County
Engineer	yes	N/A	no - contract out when needed	no	no	no	no	yes, County
Development Planner	W/W Betco	N/A	no	no	no	no	no	no
Public Works Official	yes - secondary roads	yes	yes - Chris Kruger	no	yes, City Maintenance	no	yes	yes, Craig Taft
Emergency Management Coordinator	yes	yes	no	yes, Worth County	yes, Mark Tomlinson, County	no - Worth County	no	yes, County
NFIP Floodplain Administrator	no	N/A	no	no	no	N/A	no	no
Bomb and/or Arson Squad	no	yes, Worth County Sheriff	no	yes, Sheriff Dept.	no	no	no	no
Emergency Response Team	no	yes	no	yes, Fire Dept.	no	yes - Kensett Fire Dept.	yes	no
Hazardous Materials Expert	yes - EMA	N/A	no	yes, Fire Dept.	no	no	yes	no
Local Emergency Planning Committee	yes	yes	yes, EOP, updated Jan 2018	no	yes, Council	no	no	no
County Emergency Management Commission	yes	yes	no	yes	no	yes - Kensett Fire Dept.	no	yes, County
Sanitation Department	no	yes, Waste Mgmt.	no, contract out to Absolute Waste	no	yes, Peterson Sanitation	yes - Waste Mgmt.	yes	yes, contract with northwood Sanitation
Transportation Department	no	N/A	no	no	no	no	no	yes
Economic Development Department	W/W Betco	yes	no	no	yes, Council	no	no	yes, Winn-Worth Betco
Housing Department	no	yes	no	no	no	no	no	no
Regional Planning Agencies	Yes, NIACOG	yes	yes	yes	yes	yes	yes	yes

	Worth County	Fertile	Grafton	Hanlontown	Joice	Kensett	Manly	Northwood
Historic Preservation	yes	yes	no	yes, museum	no	yes - Worth County Historical Society	no	yes
Non-Governmental Organizations (NGOs)								
American Red Cross	yes - Souix City	yes, Mason City, IA	no	yes, Mason City	no	no	yes	yes
Salvation Army	yes - Mason City	yes	no	yes, Mason City	no	no	yes	yes
Veterans Groups	yes - American Legion, VFW	yes	American Legion	yes, Forest City	no	no	yes	yes
Local Environmental Organization	no	N/A	no	N/A	no	no	no	no
Homeowner Associations	no	N/A	no	N/A	no	no	no	no
Neighborhood Associations	no	N/A	no	N/A	no	no	no	no
Chamber of Commerce	yes - cities	N/A	no	no	no	yes	no	yes
Community Organizations (Lions, Kiwanis, etc.	yes - cities & county	yes, Fertile Days Comm.	GCA - Grafton Community Action	yes, Library, men's club, Park Bd.	no	yes	yes	yes
Financial Resources								
Ability to apply for Community Development Block Grants	no	yes	yes	no	yes, water system	N/A	yes	yes
Ability to fund projects through Capital Improvements funding	yes	yes	yes	yes	yes	no	yes	yes
Authority to levy taxes for a specific purpose	yes	yes	yes	yes	yes	N/A	yes	yes
Fees for water, sewer, gas, or electric services	yes	yes	yes	yes	yes	yes - water/sewer	yes	yes
Impact fees for new development	no	yes	no	N/A	yes	N/A	no	yes
Ability to incur debt through general obligation bonds	yes	N/A	yes	yes	yes	yes	yes	yes
Ability to incur debt through special tax bonds	yes - TIF	yes	no	yes	yes	N/A	yes	yes
Ability to incur debt through private activities	no	N/A	no	no	yes	N/A	yes	yes
Ability to withhold spending in hazard prone areas	unsure	yes	no	no	no, do not know	N/A	no	yes

N/A = Not Applicable; NR = No Response

2.3 Public School District Profiles and Mitigation Capabilities

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

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

Figure 2.6 provides the boundaries of the school districts in Worth County and **Table 2.8** that follows provides location and enrollment information for each participating school district.

Figure 2.5. Worth County, Iowa Public School Districts

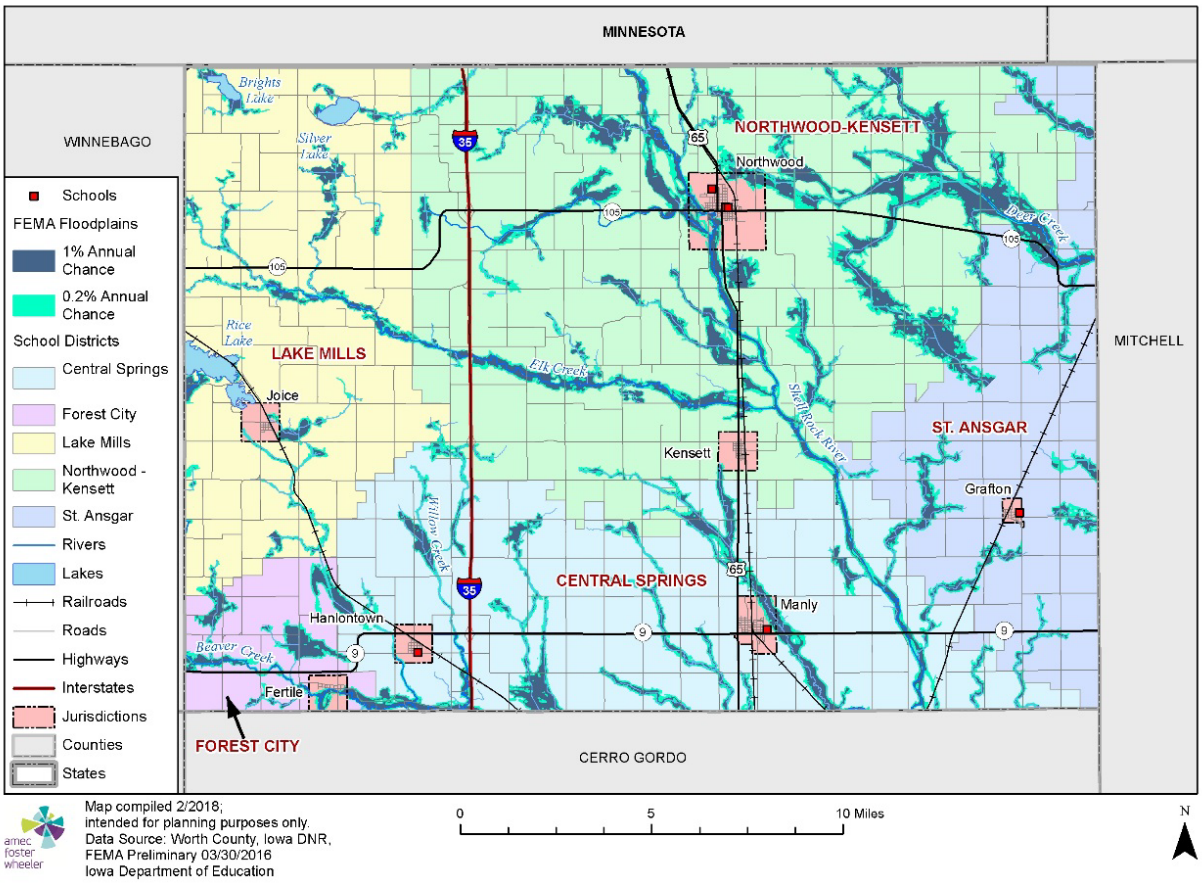


Table 2.9. Worth County School Buildings and Enrollment Data, 2015-2016

District Name/Building Name	Total Enrollment
Central Springs	**812**
Central Springs High School	236
Central Springs Middle School	169
Central Springs Elem. Manly Campus	161
Central Springs Elem. School - Nora Springs	246
Northwood-Kensett	**591**
Northwood-Kensett Jr-Sr High School	250
Northwood-Kensett Elementary	341
Grand Total	**1,403**

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

Potential capabilities to implement mitigation programs and projects can vary among school districts. To determine mitigation capabilities, each of the participating school districts was asked to complete a Data Collection Guide to report planning, personnel, fiscal, and other capabilities related to implementation of mitigation programs and projects. **Table 2.9** provides a summary of the reported capabilities for each participating school district.

Table 2.10. Summary of Mitigation Capabilities, Worth County Public School Districts

	Central Springs PSD	Northwood-Kensett PSD
Planning Elements		
Master Plan	No	
Capital Improvement Plan	Creating	
School Emergency Plan	Yes, 7.18	Yes
Weapons Policy	Yes, 5.16	Yes
Personnel Resources		
Full-time building official (i.e. principal)	Yes, High School & Elementary	Yes, Principal in each building
Emergency Manager	No	No
Grant Writer	No	No
Public Information Officer	Yes, Superintendent	Yes, Superintendent
Financial Resources		
Capital Improvements project funding	Yes	
Local funds	Yes	
General obligation bonds	No	
Special tax bonds	No	
Private activities/donations	Yes, if available	
State and federal funds	No	
Other		
Public Address/Emergency Alert System	Yes, intercom system; telephones in each classroom/office; email/Google chat	phone systems can broadcast messages and emergency signals; fire alarm systems
NOAA Weather Radios	Yes	yes
Mitigation Programs to reduce losses / Public Education Programs	Yes, but not to FEMA standards	
Tornado Shelter/Saferoom	-2%	no
Campus Police	no, rely on Manly Police Dept.	school resource officer dedicated 5 hours per week

Source: Data Collection Guides completed by each school district – 2018

3 RISK ASSESSMENT

44 CFR Requirement §201.6(c)(2): [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 process identifies and profiles relevant hazards and assesses the exposure of lives, property and infrastructure within Worth County, Iowa to these hazards. The goal of the risk assessment is to estimate the potential loss in the planning area, including loss of life, personal injury, property damage and economic loss, from a hazard event. The risk assessment process allows communities in the planning area to better understand their potential risk to the identified hazards and provides a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events.

The risk assessment for Worth County and participating jurisdictions followed the methodology described in the 2013 FEMA *Local Mitigation Planning Handbook*, which includes a four-step process:

Step 1—Describe Hazards
Step 2—Identify Community Assets
Step 3—Analyze Risks
Step 4—Summarize Vulnerability

This chapter is divided into six main parts:

- **Section 3.1 Hazard Identification** identifies the hazards that threaten the planning area and the methodology utilized to score or rank the hazards;
- **Section 3.2 Assets at Risk** provides the planning area's total exposure to natural hazards, considering critical facilities and other community assets at risk;
- **Section 3.3 Development Since 2013 Plan Update** discusses what changes in development have occurred since the previous Hazard Mitigation Plan;
- **Section 3.4 Future Land Use and Development** discusses areas of planned future development;
- **Section 3.5 Hazard Profiles and Vulnerability** for each hazard; this section is divided into two parts: 1) Hazard Profile discusses the threat to the planning area, the geographic location/extent at risk, previous occurrences of hazard events and probability of future occurrence; and 2) Vulnerability Assessment further discusses specific assets at risk as well as loss estimates. Specifically, where data is available, this section defines and quantifies populations, buildings, critical facilities and other community assets at risk to natural hazards with estimates of potential losses to those assets, where possible;
- **Section 3.6 Hazard Analysis Summary** provides a tabular summary of the hazard ranking for each jurisdiction in the planning area.

3.1 Hazard Identification

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

The hazards identified for this plan update are listed below in alphabetical order

- Animal/Plant/Crop Disease
- Dam/Levee Failure
- Drought
- Earthquake
- Expansive Soils
- Extreme Heat
- Flash Flooding
- Grass/Wildland Fire
- Hazardous Materials
- Human Disease
- Infrastructure Failure
- Landslide
- Radiological Incident
- River Flooding
- Severe Winter Storm
- Sinkholes
- Terrorism
- Thunderstorm/Lightning/Hail
- Tornado/Windstorm
- Transportation Incident

Sections 3.1.1 through 3.1.4 describe how these hazards were identified for this plan update.

3.1.1 Review of Existing Mitigation Plans

Prior to 2012, Hazard Mitigation Planning in Worth County was implemented on a jurisdictional basis. In 2012 the unincorporated county and incorporated municipalities came together to coordinate multi-jurisdictional mitigation planning for the entire Worth County planning area. This coordinated effort resulted in the *Worth County Multi-Jurisdictional Hazard Mitigation Plan*, approved by FEMA on December 17, 2013. To identify hazards to include in the Risk Assessment update, a comparison was performed between the hazard identification in the *2013 Iowa State Hazard Mitigation Plan* and the *2013* Worth *County Multi-Jurisdictional Hazard Mitigation Plan*. **Table 3.1** provides the details of the comparison.

Table 3.1. Hazard Comparison Chart

	2013 State Plan	2013 Worth County Plan
NATURAL HAZARDS	Animal/Crop/Plant Disease	Animal/Crop/Plant Disease
	Dam/Levee Failure	Dam Failure
	Drought	Drought
	Earthquake	Earthquake
	Expansive Soils	
	Extreme Heat	Extreme Heat
	Flash Flood	Flash Flood
	River Flooding	River Flooding
	Grass or Wildland Fire	Grass or Wildland Fire
	Landslide	Landslide
	Severe Winter Storm	Severe Winter Storm
	Sinkholes	Sinkholes
	Thunderstorm/Lightning/Hail	Hailstorm
		Thunderstorm & Lightning
	Tornado/Windstorm	Tornado
		Windstorm
TECHNOLOGICAL	Hazardous Materials	Hazardous Materials
	Human Disease	Human Disease
	Infrastructure Failure	Infrastructure Failure
	Radiological	Radiological
	Transportation Incident	Transportation Incident
HUMAN CAUSED	Terrorism	Terrorism

3.1.2 Review Disaster Declaration History

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

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

Table 3.2 lists federal disaster declarations that included Worth County for the period from 1965 to 2016. There were no additional disasters since the completion of the previous plan.

Table 3.2. Disaster Declarations that included Worth County, Iowa, 1965-2016

Disaster Number	Declaration Date	Title	Incident Begin Date	Incident End Date
193	4/22/1965	FLOODING	4/22/1965	4/22/1965
269	8/14/1969	HEAVY RAINS & FLOODING	8/14/1969	8/14/1969
879	9/6/1990	SEVERE STORMS & FLOODING	7/25/1990	8/31/1990
928	12/26/1991	ICE STORM	10/31/1991	11/29/1991
996	7/9/1993	SEVERE STORMS & FLOODING	4/13/1993	10/1/1993
1282	7/22/1999	SEVERE STORMS AND FLOODING	7/2/1999	8/10/1999
1518	5/25/2004	SEVERE STORMS, TORNADOES, AND FLOODING	5/19/2004	6/24/2004
3239	9/10/2005	HURRICANE KATRINA EVACUATION	8/29/2005	10/1/2005
1688	3/14/2007	SEVERE WINTER STORMS	2/23/2007	3/2/2007
1763	5/27/2008	SEVERE STORMS, TORNADOES, AND FLOODING	5/25/2008	8/13/2008
4126	7/2/2013	SEVERE STORMS, TORNADOES, AND FLOODING	5/19/2013	6/14/2013

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 3.3 provides the USDA Secretarial disaster declarations that included Worth County from 2012 to 2017. Details on USDA declarations prior to 2012 are not available.

Table 3.3. USDA Secretarial Disaster Declarations Including Worth Co. (2012-2017)

Crop Year	Desig. No.	Drought	Flood, Flash Flooding	Excessive rain, moisture, humidity	Wind, High Winds	Fire, Wildfire	Heat, Excessive heat High temp. (incl. low humidity)	Winter Storms, Ice Storms, Snow, Blizzard	Frost, Freeze	Insects	Begin Date	Description of disaster
2012	S3337	1			1	1	1			1	8/7/2012	Drought-Fast Track
2012	S3361	1			1	1	1			1	8/21/2012	Drought-Fast Track
2012	S3390	1			1	1	1			1	7/17/2012	Drought-Fast Track
2012	S3390	1			1	1	1			1	7/17/2012	Drought-Fast Track
2013	S3553			1					1		1/1/2013	Heavy rainfall followed by freezing temperatures, and multiple periods of thawing and refreezing, resulting in winterkill
2013	S3588		1	1				1	1		1/1/2013	The combined effects of severe freezing and excessive snow followed by excessive rainfall, and flooding

Crop Year	Desig. No.	Drought	Flood, Flash Flooding	Excessive rain, moisture, humidity	Wind, High Winds	Fire, Wildfire	Heat, Excessive heat High temp. (incl. low humidity)	Winter Storms, Ice Storms, Snow, Blizzard	Frost, Freeze	Insects	Begin Date	Description of disaster
2013	S3605		1	1							4/1/2013	Excessive rain, flooding, cool temperatures

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

3.1.3 Research Additional Sources

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

- Worth County Flood Insurance Rate Map, FEMA
- Worth County Emergency Management
- *Worth County Multi-Jurisdictional Hazard Mitigation Plan*, 2013
- Data Collection Guides completed by each jurisdiction
- 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 Utilities Board
- National Drought Mitigation Center Drought Reporter
- National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center
- 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)

3.1.4 Hazards Identified

Through the hazard identification review process, it was determined that all hazards profiled in the 2013 plan would be included in the plan update. It was decided to also include Expansive Soils, which is identified in the 2013 State Hazard Mitigation Plan. The hazards identified for this plan update are listed below in alphabetical order

- Animal/Plant/Crop Disease
- Dam/Levee Failure
- Drought
- Earthquake
- Expansive Soils
- Extreme Heat
- Flash Flooding
- Grass/Wildland Fire
- Hazardous Materials
- Human Disease
- Infrastructure Failure
- Landslide
- Radiological Incident
- River Flooding
- Severe Winter Storm
- Sinkholes
- Terrorism
- Thunderstorm/Lightning/Hail
- Tornado/Windstorm
- Transportation Incident

Additionally, to maintain consistency and to facilitate the roll-up or summarization of hazards in the next State Plan Update, it was agreed that the hazard grouping/hazard naming for this update will be consistent with the 2013 State Plan.

3.1.5 Multi-Jurisdictional Risk Assessment

For this multi-jurisdictional plan, the risks are assessed for each jurisdiction where they deviate from the risks facing the entire planning area. The planning area is fairly uniform in terms of climate and topography as well as building construction characteristics. Accordingly, the geographic areas of occurrence for weather-related hazards do not vary greatly across the planning area for most hazards. The more urbanized areas within the planning area have more assets that are vulnerable to the weather-related hazards, and varied development trends impact the future vulnerability. Similarly, more rural areas have more assets (crops/livestock) that are vulnerable to drought. These differences are discussed in greater detail in the vulnerability sections of each hazard.

Although 20 hazards with the potential to significantly affect the planning area were identified and selected for additional analysis, not all hazards impact every jurisdiction. **Table 3.4** provides a summary of the jurisdictions impacted by each hazard. An “x” indicates the jurisdiction is impacted by the hazard. A "-" indicates the hazard is not applicable to that jurisdiction.

Table 3.4. Hazards Identified for Each Jurisdiction

Jurisdiction	Animal/Crop/Plant Disease	Dam/Levee Failure	Drought	Earthquake	Expansive Soils	Extreme Heat	Flash Flood	Grass or Wildland Fire	Hazardous Materials	Human Disease	Infrastructure Failure	Landslide	Radiological Incident	River Flooding	Severe Winter Storm	Sinkholes	Terrorism	Thunderstorm/Lightning/Hail	Tornado/Windstorm	Transportation Incident
Worth County	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Fertile	x	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Grafton	x	-	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x
Hanlontown	x	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Joice	x	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Kensett	x	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Manly	x	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Northwood	x	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Central Springs Schools	x	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Northwood-Kensett Schools	x	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

3.1.6 Hazard Scoring Methodology

To maintain reporting format consistent with the *2013 Iowa State Hazard Mitigation Plan*, the Worth County Hazard Mitigation Planning Committee (HMPC) used the same methodology to score and prioritize the hazards. This prioritization was based on a hazard scoring system that considers four elements of risk: probability, magnitude/severity, warning time, and duration. **Table 3.5** provides definitions for each of the four elements along with associated rating levels.

Table 3.5. Hazard Score Element Definitions and Rating Scales

Element/Score	Definitions
Probability: Reflects the likelihood of the hazard occurring again in the future, considering both the hazard's historical occurrence and the projected likelihood of the hazard occurring in any given year.	
1—Unlikely	Less than 10% probability in any given year (up to 1 in 10 chance of occurring), history of events is less than 10% likely or the event is unlikely but there is a possibility of its occurrence.
2—Occasional	Between 10% and 20% probability in any given year (up to 1 in 5 chance of occurring), history of events is greater than 10% but less than 20% or the event could possibly occur.
3—Likely	Between 20% and 33% probability in any given year (up to 1 in 3 chance of occurring), history of events is greater than 20% but less than 33% or the event is likely to occur.
4—Highly Likely	More than 33% probability in any given year (event has up to a 1 in 1 chance of occurring), history of events is greater than 33% likely or the event is highly likely to occur.
Magnitude / Severity: Assessment of severity in terms of injuries and fatalities, personal property, and infrastructure and the degree and extent with which the hazard affects the jurisdiction.	
1—Negligible	Less than 10% of property severely damaged, shutdown of facilities and services for less than 24 hours, and/or injuries /illnesses treatable with first aid.
2—Limited	10% to 25% of property severely damaged, shutdown of facilities and services for more than a week, and/or injuries/illnesses that do not result in permanent disability.
3—Critical	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.
4—Catastrophic	More than 50% of property severely damaged, shutdown of facilities and services for more than 30 days, and/or multiple deaths.
Warning Time: Rating of the potential amount of warning time that is available before the hazard occurs. This should be taken as an average warning time.	
1	More than 24 hours warning time
2	More than 12 to 24 hours warning time
3	6 to 12 hours warning time
4	Minimal or no warning time (less than6 hours warning)
Duration: A measure of the duration of time that the hazard will affect the jurisdiction.	
1	Less than 6 hours
2	More than 6 hours but Less than 1 day
3	More than 1 day but Less than 1 week
4	More than one week

Using the rating scales described in the table above, the formula used to determine each hazard's score, including weighting factors, is provided below:

(Probability x .45) + (Magnitude/Severity x .30) + (Warning Time x .15) + (Duration x .10) = SCORE

Based on the hazard's overall weighted score, the hazards are categorized as follows: High (3.0-4.0), Moderate (2.0-2.9), and Low (1.0-1.9).

These terms relate to the level of planning analysis to be given to the particular hazard in the risk assessment process and are not meant to suggest that a hazard would have only limited impact. In order to focus on the most critical hazards, those assigned a level of high or moderate were given more extensive attention in the remainder of the risk assessment (e.g., quantitative analysis or loss estimation), while those with a low planning significance were addressed in more general or qualitative ways.

The HMPC determined overview hazard ranking scores for the planning area as a whole. The results of this overview are provided below in **Table 3.6**. Additionally, the hazard ranking overview is provided at the beginning of each hazard profile and vulnerability section. A detailed hazard summary by jurisdiction for participating jurisdictions is provided at the conclusion of each hazard profile and vulnerability section to provide a summary of how the hazard varies by jurisdiction.

Table 3.6. Worth County Planning Area Hazard Ranking Results

Hazard	Probability	Magnitude	Warning Time	Duration	CPRI	Planning Significance
Tornado/Windstorm	4	4	4	1	3.70	High
Transportation Incident	4	4	4	1	3.70	High
Infrastructure Failure	4	2	4	3	3.30	High
River Flooding	4	3	1	4	3.25	High
Severe Winter Storm	4	2	3	4	3.25	High
Drought	4	2	1	4	2.95	Moderate
Flash Flood	4	2	3	1	2.95	Moderate
Thunderstorm/Lightning/Hail	4	2	2	2	2.90	Moderate
Grass or Wildland Fire	3	2	4	1	2.65	Moderate
Terrorism	1	4	4	4	2.65	Moderate
Human Disease	2	3	2	4	2.50	Moderate
Hazardous Materials	3	1	4	1	2.35	Moderate
Animal/Plant/Crop Disease	1	3	4	4	2.35	Moderate
Extreme Heat	2	2	1	4	2.05	Moderate
Radiological Incident	1	1	4	4	1.75	Low
Dam/Levee Failure	1	1	4	4	1.70	Low
Earthquake	1	1	4	1	1.45	Low
Expansive Soils	2	1	1	1	1.45	Low
Landslide	1	1	2	1	1.15	Low
Sinkholes	1	1	2	1	1.15	Low

3.1.7 Climate Change

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

More Precipitation

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

Higher Temperatures

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

Agricultural Challenges

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

Habitat Changes

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

Public Health Effects

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

3.2 Assets at Risk

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

3.2.1 Total Exposure of Population and Structures

3.2.1.1 Unincorporated County and Incorporated Cities

Table 3.7 shows the total population and building/improvement counts and values for the county and each city in the planning area broken down by usage type based on parcel and assessor's data provided by Worth County. A recognized data limitation associated with utilizing parcel data with assessed values is the exclusion of tax exempt properties in the planning area.

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 as the structure file. Since building footprints and/or building counts per parcel were not available, the parcels with dwelling or improvement value were counted as one building/improvement;
- Parcel polygons were converted to points; and
- Parcel points were spatially joined to the political area (jurisdiction).

Population data is based on the U.S. Census Bureau's annual population estimates. Building counts and building exposure values are based on parcel data provided by Worth County. The contents exposure values were calculated based on usage type. The contents multipliers were derived from HAZUS and are defined below **Table 3.7**. 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).

Table 3.7. Population and Building Exposure by Jurisdiction-Unincorporated County and Incorporated Cities

Jurisdiction & Population	Property Class	Parcel Counts	Improved Value	Content Value	Total Value
Fertile 346	Commercial	13	$391,214	$391,214	$782,428
	Industrial	6	$221,061	$331,592	$552,653
	Multi-Residential	2	$62,589	$31,295	$93,884
	Residential	157	$10,330,792	$5,165,396	$15,496,188
	Total	**178**	**$11,005,656**	**$5,919,496**	**$16,925,152**
Grafton 355	Agriculture	2	$46,430	$46,430	$92,860
	Commercial	15	$413,102	$413,102	$826,204
	Industrial	3	$457,861	$686,792	$1,144,653
	Multi-Residential	1	$23,756	$11,878	$35,634
	Residential	122	$6,890,028	$3,445,014	$10,335,042
	Total	**143**	**$7,831,177**	**$4,603,216**	**$12,434,393**
Hanlontown 211	Agriculture	2	$4,563	$4,563	$9,126
	Commercial	8	$329,577	$329,577	$659,154
	Exempt	1	$19,254	$19,254	$38,508
	Industrial	5	$1,932,214	$2,898,321	$4,830,535
	Multi-Residential	1	$138,556	$69,278	$207,834
	Residential	85	$5,523,441	$2,761,721	$8,285,162
	Total	**102**	**$7,947,605**	**$6,082,714**	**$14,030,319**
Joice 195	Commercial	15	$2,414,203	$2,414,203	$4,828,406
	Exempt	2	$32,933	$32,933	$65,866
	Industrial	4	$29,755	$44,633	$74,388
	Multi-Residential	2	$126,227	$63,114	$189,341
	Residential	97	$4,343,164	$2,171,582	$6,514,746
	Total	**120**	**$6,946,282**	**$4,726,464**	**$11,672,746**
Kensett 345	Agriculture	3	$38,165	$38,165	$76,330
	Commercial	11	$817,884	$817,884	$1,635,768
	Industrial	2	$12,364	$18,546	$30,910
	Multi-Residential	2	$124,631	$62,316	$186,947
	Residential	129	$5,710,010	$2,855,005	$8,565,015
	Total	**147**	**$6,703,054**	**$3,791,916**	**$10,494,970**
Manly 1,551	Agriculture	2	$3,084	$3,084	$6,168
	Commercial	49	$2,203,154	$2,203,154	$4,406,308
	Exempt	1	$104,832	$104,832	$209,664
	Industrial	8	$4,171,256	$6,256,884	$10,428,140
	Multi-Residential	15	$1,836,263	$918,132	$2,754,395
	Residential	504	$27,340,040	$13,670,020	$41,010,060
	Total	**579**	**$35,658,629**	**$23,156,106**	**$58,814,735**
Northwood	Agriculture	2	$13,000	$13,000	$26,000

Jurisdiction & Population	Property Class	Parcel Counts	Improved Value	Content Value	Total Value
1,931	Commercial	112	$10,054,178	$10,054,178	$20,108,356
	Exempt	1	$364,424	$364,424	$728,848
	Industrial	14	$4,668,161	$7,002,242	$11,670,403
	Multi-Residential	37	$4,656,331	$2,328,166	$6,984,497
	Residential	780	$64,308,453	$32,154,227	$96,462,680
	Total	**946**	**$84,064,547**	**$51,916,236**	**$135,980,783**
Unincorporated 2,628	Agriculture	226	$1,631,380	$1,631,380	$3,262,760
	Commercial	39	$15,909,076	$15,909,076	$31,818,152
	Industrial	22	$7,961,101	$11,941,652	$19,902,753
	Multi-Residential	3	$32,233,589	$16,116,795	$48,350,384
	Residential	1,280	$124,012,576	$62,006,288	$186,018,864
	Total	**1,570**	**$181,747,722**	**$107,605,190**	**$289,352,912**
Pop Total: 7,562	**Grand Total**	**3,785**	**$341,904,672**	**$207,801,336**	**$549,706,008**

Sources: Population Estimate, U.S. Census Bureau, American Community Survey 2012-2016 5-Year Estimates; Building/Improvement Count and Values, Worth County GIS Department. Contents Exposure derived by applying multiplier to Building Exposure based on HAZUS MH 2.2 standard contents multipliers per usage type as follows: Multi-Res. and Residential (50%), Agricultural and Commercial (100%), Industrial (150%)

Table 3.8. Year Structure Built

Jurisdiction	Total Housing Units	Built 2014 or later	Built 2010 to 2013	Built 2000 to 2009	Built 1990 to 1999	Built 1980 to 1989	Built 1970 to 1979	Built 1960 to 1969	Built 1950 to 1959	Built 1940 to 1949	Built 1939 or earlier
Worth County	3522	1	20	185	206	118	428	287	348	294	1635
Fertile	166	1	0	5	18	5	22	11	22	14	68
Grafton	166	0	0	0	7	23	12	22	12	10	80
Hanlontown	102	0	0	5	1	6	10	9	18	10	43
Joice	108	0	0	0	3	2	23	10	5	13	52
Kensett	177	0	0	2	7	4	20	15	14	15	100
Manly	660	0	0	7	66	18	94	62	79	81	253
Northwood	915	0	10	67	53	24	168	105	105	67	316

Source: U.S. Census Bureau 2016 American Community Survey 5-Year Estimates.

3.2.1.2 **Public School Districts**

The 2015-2016 enrolled number of students at the participating public school districts is provided in **Table 3.9,** as well as the number of buildings, building values (building exposure) and contents value (contents exposure).

Table 3.9. Enrollment and Building Exposure by Jurisdiction-Public School Districts

Public School District	Enrollment	Building Count	Building Exposure ($)	Contents Exposure ($)	Total Exposure ($)
Central Springs Schools	812	2	21,315,322	2,387,550	**23,702,872**
Northwood-Kensett Schools	591	-	-	-	**-**

Source: Enrollment Statistics from 2015-2016 Iowa Public School PreK-12 Enrollments by District – Iowa Department of Education, Bureau of Information and Analysis Services; Building Count and Exposure from Data Collection Guides from Public School Districts; *includes non-school buildings/assets such as administration building, bus barns, sport complexes.

3.2.2 Critical and Essential Facilities and Infrastructure

As part of the update to the *Worth County Multi-Jurisdictional Hazard Mitigation Plan*, participating jurisdictions assessed the vulnerability of the following types of facilities below:

- **Critical Facilities**: Those facilities that are essential in providing utility or direction either during the response to an emergency or during the recovery operation.
- **Essential Facilities**: Those facilities that if damaged, would have devastating impacts on disaster response and/or recovery.
- **High Potential Loss Facilities**: Those facilities that would have a high loss or impact on the community.
- **Transportation and Lifeline Facilities**: Those facilities and infrastructure that are critical to transportation, communications, and necessary utilities.

Table 3.10 is a summary of the inventory of critical and essential facilities and infrastructure in the planning area. This inventory was compiled from the *2013 Worth County Multi-Jurisdictional Hazard Mitigation Plan* and was updated by the Worth County GIS Department for this plan update. The full list of critical facilities is included in Appendix E. This is a non-public appendix and is maintained by Worth County Emergency Management.

Table 3.10. Inventory of Critical/Essential Facilities and Infrastructure by Jurisdiction

Facility Type	Worth County	Fertile	Grafton	Hanlontown	Joice	Kensett	Manly	Northwood	Grand Total
Air Facility								1	1
Communications	25							2	27
Day Care Center							1	2	3
EMS			1	1	1		1	1	5
Fire Station		1	1	1	1	1	1	1	7
Law Enforcement							1	2	3
Local EOC								1	1
Nursing Home							2	2	4
Power Plant	4								4
Public Health Department								1	1
School K-12			1	1			1	3	6
Tier II Facility	13	1	1				3	7	25
Wastewater Treatement Plant	8					1	1		10
Grand Total	**50**	**2**	**4**	**3**	**2**	**2**	**11**	**23**	**97**

Source: *2013 Worth County Multi-Jurisdictional Hazard Mitigation Plan, HSIP Freedom 2015*

Other Assets

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.

In the planning area, specific assets include the following:

Threatened and Endangered Species: **Table 3.11** includes Federally Threatened, Endangered, Proposed and Candidate Species in Worth County, Iowa.

Table 3.11. Threatened and Endangered Species in Worth County

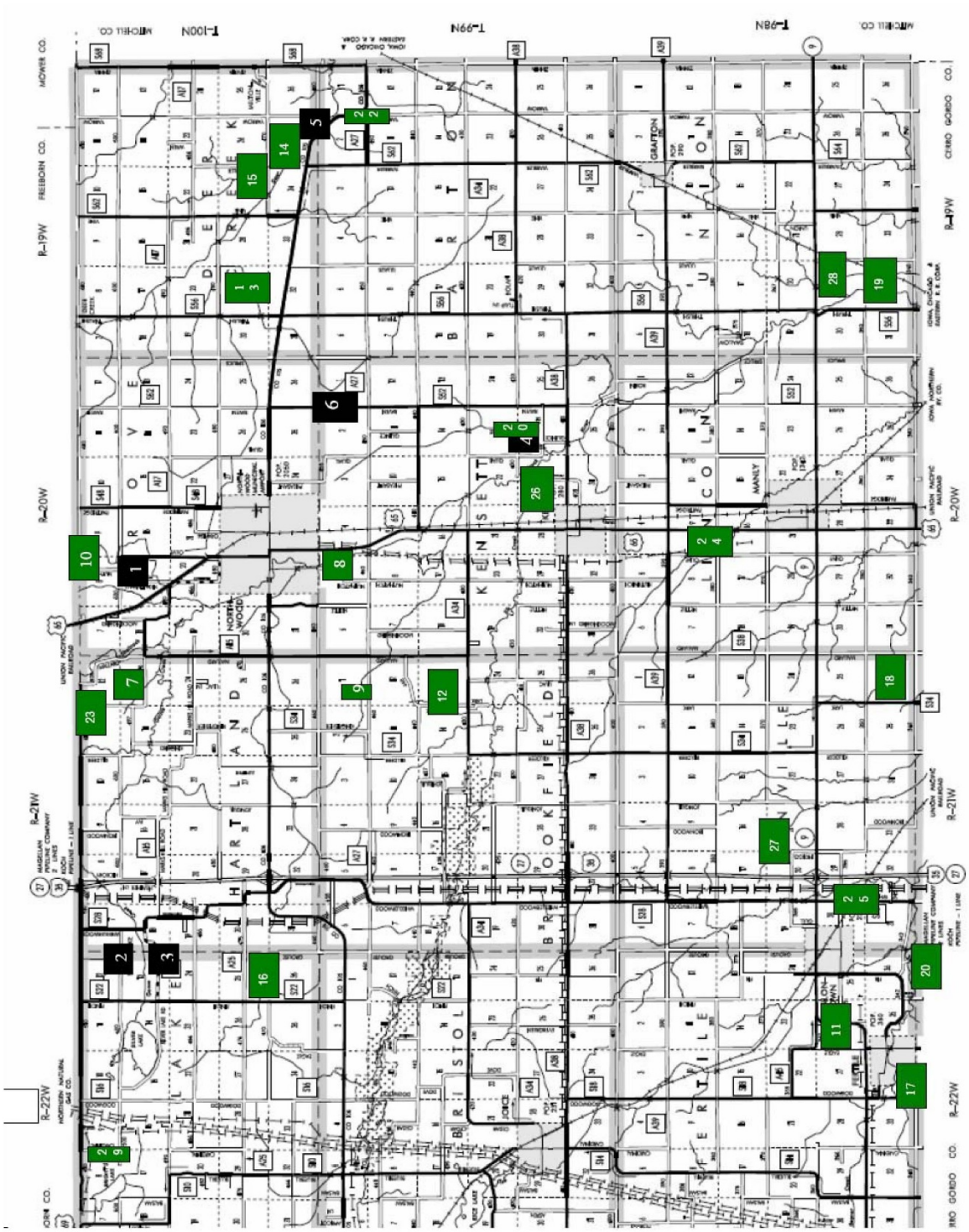
Common Name	Scientific Name	Status
Northern long-eared bat	Myotis septentrionalis	Threatened
Prairie bush clover	Lespedeza leptostachya	Threatened
Western prairie fringed orchid	Platanthera praeclara	Threatened

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

Natural Resources: The Worth County Conservation Board manages the following parks and wildlife areas in Worth County, which are mapped in **Figure 3.1**:

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

Figure 3.1. Worth County Parks and Wildlife Areas



Additional details about managed areas listed above can be found at:
http://www.worthcounty.org/pview.aspx?id=2077&catid=25

Historic Resources: 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 3.12** provides the list of properties on the National Register in Worth County.

Table 3.12. Properties/Landmarks on the National Register of Historic Places, Worth County

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

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

Agriculture and the Economy: Agriculture plays an important role in the Worth County economy (see **Table 3.13**).

Table 3.13. Agricultural Statistics for Worth County

2012 Census of Agriculture	
Total Land in Farms (acres)	234,958
Number of Farms	640
Average Farm Size (acres)	367
Average Age of Farmers	56.6
Market Value of All Farm Products	$188,119,000
Market Value of All Crops	$163,330,000
Market Value of All Livestock	$24,789,000
Production Expenses	$130,268,000
Hogs & Pigs Inventory (head)	54,765
Cattle as of January 1, 2015	
All Cattle and Calves (State Rank 75)	5,600
Crops-2014 Acreage, Yield, and Production	**Harvested Acres**
Corn for Grain (State Rank 61)	122,200
Soybeans (State Rank 70)	75,200
Other Hay (State Rank 33)	520

Source: Iowa Agricultural Statistics Bulletin, USDA, National Agricultural Statistics Service, http://www.nass.usda.gov/Statistics_by_State/Iowa/Publications/Annual_Statistical_Bulletin/2015/115_15.pdf

3.3 Development Since 2013 Plan Update

This section provides information on development that has occurred since the 2013 Worth County Multi-Jurisdictional Hazard Mitigation Plan Update.

According to the U.S. Census Bureau, the Worth County population remained fairly constant from 2010 to 2016 with a 0.47 percent decrease overall. This trend shows a slight stabilization compared to previous years; from 2000 to 2010 the County population decreased by 3.93 percent. **Table 3.14** provides the population change statistics for all cities in Worth County as well as the county as a whole.

Table 3.14. Worth County Population Change, 2010-2016

Jurisdiction	2000 Census Population	2010 Census Population	2016 ACS Population Estimate	# Change 2010-2016	% Change 2010-2016
Worth County, Iowa	7,909	7,598	7,562	-36	-0.47
Fertile city, Iowa	360	370	346	-24	-6.49
Grafton city, Iowa	290	252	355	103	40.87
Hanlontown city, Iowa	229	226	211	-15	-6.64
Joice city, Iowa	231	222	195	-27	-12.16
Kensett city, Iowa	280	266	345	79	29.70
Manly city, Iowa	1,342	1,323	1,551	228	17.23
Northwood city, Iowa	2,050	1,989	1,931	-58	-2.92

Source: U.S. Census Bureau: 2000 Decennial Census, 2010 Decennial Census, ACS 2016 5-Year Estimates.

Table 3.15 provides the change in numbers of housing units in the planning area from 2010 to 2016.

Table 3.15. Change in Housing Units, 2010-2016

Jurisdiction	2010 Housing Units	2016 Housing Units	# Change 2010-2016	% Change 2010-2016
Worth County, Iowa	1,312	1,228	-84	-6.40
Fertile city, Iowa	161	166	5	3.11
Grafton city, Iowa	126	166	40	31.75
Hanlontown city, Iowa	96	102	6	6.25
Joice city, Iowa	106	108	2	1.89
Kensett city, Iowa	142	177	35	24.65
Manly city, Iowa	601	660	59	9.82
Northwood city, Iowa	1,004	915	-89	-8.86

Source: U.S. Census Bureau: 2010 Decennial Census and 2015 American Community Survey, 5-year Estimates,
Note: Unincorporated Worth County Housing Units were estimated by subtracting populations of incorporated cities from the total Worth County populations.

The tables below provide information on the number of buildings and structure values for privately-owned residential building permits from 2012-2016.

Table 3.16. Privately-owned Residential Building Permits, 2012

Place Name	1-unit Units			2-unit Units			3-4 unit Units			5+ unit Units		
	Buildings	Units	Value	Buildings	Units	Value	Buildings	Units	Value	Buildings	Units	Value
Worth County	0	0	0	0	0	0	0	0	0	0	0	0
Fertile	0	0	0	0	0	0	0	0	0	0	0	0
Grafton	-	-	-	-	-	-	-	-	-	-	-	-
Hanlontown	-	-	-	-	-	-	-	-	-	-	-	-
Joice	-	-	-	-	-	-	-	-	-	-	-	-
Kensett	0	0	0	0	0	0	0	0	0	0	0	0
Manly	0	0	0	0	0	0	0	0	0	0	0	0
Northwood	0	0	0	0	0	0	0	0	0	0	0	0

Source: U.S. Census Bureau, https://www.census.gov/construction/bps/

Table 3.17. Privately-owned Residential Building Permits, 2013

Place Name	1-unit Units			2-unit Units			3-4 unit Units			5+ unit Units		
	Buildings	Units	Value	Buildings	Units	Value	Buildings	Units	Value	Buildings	Units	Value
Worth County	1	1	$50,000	0	0	0	0	0	0	0	0	0
Fertile	0	0	0	0	0	0	0	0	0	0	0	0
Grafton	-	-	-	-	-	-	-	-	-	-	-	-
Hanlontown	0	0	0	0	0	0	0	0	0	0	0	0
Joice	-	-	-	-	-	-	-	-	-	-	-	-
Kensett	0	0	0	0	0	0	0	0	0	0	0	0
Manly	0	0	0	0	0	0	0	0	0	0	0	0
Northwood	4	4	$670,000	0	0	0	0	0	0	0	0	0

Source: U.S. Census Bureau, https://www.census.gov/construction/bps/

Table 3.18. Privately-owned Residential Building Permits, 2014

Place Name	1-unit Units			2-unit Units			3-4 unit Units			5+ unit Units		
	Buildings	Units	Value	Buildings	Units	Value	Buildings	Units	Value	Buildings	Units	Value
Worth County	1	1	$40,000	0	0	0	0	0	0	0	0	0
Fertile	0	0	0	0	0	0	0	0	0	0	0	0
Grafton	-	-	-	-	-	-	-	-	-	-	-	-
Hanlontown	0	0	0	0	0	0	0	0	0	0	0	0
Joice	-	-	-	-	-	-	-	-	-	-	-	-
Kensett	0	0	0	0	0	0	0	0	0	0	0	0
Manly	1	1	$280,000	0	0	0	0	0	0	0	0	0
Northwood	2	2	$250,000	0	0	0	0	0	0	0	0	0

Source: U.S. Census Bureau, https://www.census.gov/construction/bps/

Table 3.19. Privately-owned Residential Building Permits, 2015

Place Name	1-unit Units			2-unit Units			3-4 unit Units			5+ unit Units		
	Buildings	Units	Value	Buildings	Units	Value	Buildings	Units	Value	Buildings	Units	Value
Worth County	1	1	$150,000	0	0	0	0	0	0	0	0	0
Fertile	1	1	$201,483	0	0	0	0	0	0	0	0	0
Grafton	-	-	-	-	-	-	-	-	-	-	-	-
Hanlontown	1	1	$100,000	0	0	0	0	0	0	0	0	0
Joice	-	-	-	-	-	-	-	-	-	-	-	-
Kensett	0	0	0	0	0	0	0	0	0	0	0	0
Manly	0	0	0	0	0	0	0	0	0	0	0	0
Northwood	3	3	$490,000	0	0	0	0	0	0	0	0	0

Source: U.S. Census Bureau, https://www.census.gov/construction/bps/

Table 3.20. Privately-owned Residential Building Permits, 2016

Place Name	1-unit Units			2-unit Units			3-4 unit Units			5+ unit Units		
	Buildings	Units	Value	Buildings	Units	Value	Buildings	Units	Value	Buildings	Units	Value
Worth County	1	1	$150,000	0	0	0	0	0	0	0	0	0
Fertile	0	0	0	0	0	0	0	0	0	0	0	0
Grafton	-	-	-	-	-	-	-	-	-	-	-	-
Hanlontown	0	0	0	0	0	0	0	0	0	0	0	0
Joice	-	-	-	-	-	-	-	-	-	-	-	-
Kensett	0	0	0	0	0	0	0	0	0	0	0	0
Manly	1	1	$180,000	0	0	0	0	0	0	0	0	0
Northwood	3	3	$370,000	0	0	0	0	0	0	0	0	0

Source: U.S. Census Bureau, https://www.census.gov/construction/bps/

As demonstrated in the above tables, the City of Northwood has had the most new residential construction, followed by the unincorporated county.

Neither of the participating school districts reported any new development in the last five years; however, Central Springs CSD did make some improvements to their outdoor athletic facilities.

3.4 Future Land Use and Development

The following sections provide details regarding future growth, land use and development. The information in this section comes from the *Worth County 2013 Multi-jurisdictional Hazard Mitigation Plan*, information provided by each of the participating jurisdictions as well as other sources, cited throughout.

Table 3.21 provides the Population projections for Worth County by Woods & Poole Economics, Inc. These projections suggest a trend of minor shrinking in population over the coming decades.

Worth County

Table 3.21. Worth County 2010 Population and Population Projections, 2010-2040

2010 Population	2020 Population Projection	2025 Population Projection	2030 Population Projection	2035 Population Projection	2040 Population Projection
7,598	7,575	7,557	7,540	7,525	7,512

Source: 2010 Population from the U.S. Census Bureau 2010 Decennial Census; Population Projections from the "2010 State Profile: Iowa", Woods & Poole Economics, Inc, Inc., www.woodsandpoole.com Prepared by: http://www.iowadatacenter.org State Library of Iowa, State Data Center Program

Unincorporated County

None reported.

City of Fertile

The City of Fertile's planning representatives report that there are no plans for future development nor is growth expected in any known hazard areas. Additionally, the City is not planning for construction of any critical facilities or infrastructure within the next five years.

City of Grafton

The City of Grafton is already largely built out. There is no new development expected to occur as most land within the City limits is already developed. The City is planning to update its water treatment systems at an approximate cost of $610,000; however, the plant will still remain in its current location.

City of Hanlontown

None expected.

City of Joice

The City has purchased several derelict properties and has had asbestos removed from them. Three have been demolished and another is still being worked on. In terms of future development, the City hopes to purchase additional acres of land north of the City but within the city limits; the current landowner is a farmer. The purchase is expected to occur within the next year.

The City is also hoping to have another building constructed where three derelict buildings were recently demolished on Main Street.

City of Kensett

None reported.

City of Manly

None reported.

City of Northwood

None expected.

School Districts' Future Development

This section summarizes future development for the participating school districts:

Central Springs Schools

The district is planning to take bids on a 500-seat performing arts center/auditorium for construction to being in the spring of 2019. This project will be an addition attached to the existing high school building.

Northwood-Kensett Schools

The school district is planning for some remodeling and construction projects to occur within the next five years.

3.5 Hazard Profiles and Vulnerability

Hazard Profiles

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

Each hazard identified in Section **3.1.4** is profiled individually in this section in alphabetical order.

The level of information presented in the profiles varies by hazard based on the information available. With each update of this plan, new information will be incorporated to provide for better evaluation and prioritization of the hazards that affect the planning area. Detailed profiles for each of the identified hazards include information categorized as follows:

Hazard Description

This section consists of a general description of the hazard and the types of impacts it may have on a community. It also includes the ratings assigned to the hazard relative to typical warning times and duration of hazard events as described in **Table 3.5**.

Geographic Location/Extent

This section describes the geographic location of the hazard in the planning area. Where available, maps are utilized to indicate the specific locations of the planning area that are vulnerable to the subject hazard. This section also provides information as to the extent of the hazard (i.e. the size or degree of impacts).

Previous Occurrences

This section includes information on historic incidents and their impacts.

Probability of Future Occurrence

The frequency of past events is used to gauge the likelihood of future occurrences. Where possible, the probability or chance of occurrence was calculated based on historical data. Probability was determined by dividing the number of events observed by the number of years and multiplying by 100. This gives the percent chance of the event happening in any given year. An example would be three droughts occurring over a 30-year period, which suggests a 10 percent chance of a drought occurring in any given year. For each hazard, the probability is assigned a rating as defined in **Table 3.5**.

Vulnerability Assessments

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

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate.

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] 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.

Requirement §201.6(c)(2)(ii): (As of October 1, 2008) [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged in floods.

Following the hazard profile for each hazard is the vulnerability assessment. The vulnerability assessment further defines and quantifies populations, buildings, critical facilities and other community assets at risk to natural hazards. The vulnerability assessments were conducted based on the best available data and the significance of the hazard.

Detailed profiles for each of the identified hazards include information categorized as follows:

Vulnerability Overview

This section consists of a general overview narrative of the planning area's vulnerability to the hazard. Within this section, the magnitude/severity of the hazard is discussed. The magnitude of the impact of a hazard event (past and perceived) is related directly to the vulnerability of the people, property and the environment it affects. This is a function of when the event occurs, the location affected, the resilience of the community and the effectiveness of the emergency response and disaster recovery efforts.

For each hazard, the magnitude/severity is assigned a rating as defined in **Table 3.5**.

Potential Losses to Existing Development

This section provides the potential losses to existing development. Where data is available, this section provides estimated financial losses as well as the methodology used. For hazards with an overall "Low" rating, potential losses may not be discussed.

Future Development

This section provides information on how vulnerability to this hazard will be impacted by planned future development, as well as information for jurisdictions to consider in planning future development.

Climate Change Impacts

This section will discuss any potential impacts to this hazard as a result of climate change.

Hazard Summary by Jurisdiction

For hazards that vary by jurisdiction, this section will provide an overview of how the hazard varies, followed by a table indicating the probability, magnitude, warning time and duration rankings for each participating jurisdiction with the resulting hazard score and level.

3.5.1 Animal/Plant/Crop Disease

Hazard Score Calculation					
Probability	Magnitude/Severity	Warning Time	Duration	Weighted Score	Level
1	3	4	4	2.35	Moderate

Profile

Hazard Description

Agricultural infestation is the naturally occurring infection of vegetation, crops or livestock with insects, vermin, or diseases that render the crops or livestock unfit for consumption or use. Because of Iowa's 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 nearly 4 million cattle and calves. According to the USDA National Agricultural Statics Service, as of January 1, 2015, Worth County ranked 75th in the state with 5,600 head of cattle and calves. According to the 2012 Census of Agriculture, there were also 54,765 head of hogs and pigs in Worth County.

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

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

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

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

Avian influenza continues to be of concern in Iowa as the State is number one in poultry egg layers (approximately 40 million). Source: Iowa Poultry Association, 2014.

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. There was an epidemic of END in California in 2003 that is resulting in the death of millions of chickens and other birds, and costing millions of dollars. END is probably one of the most infectious diseases of poultry in the world. END is so virulent that many birds die without showing any clinical signs.

Johne's (yo-knees) disease is a contagious, chronic and eventually fatal infection that affects the small intestine of ruminants, including cattle, sheep and goats. Johne's, also called Para tuberculosis, is a slow progressive wasting disease with an incubation period of usually 2 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 Worth County, see the website above.

Emerald Ash Borer

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

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/late frost deep snow, or drought has caused the wild food sources to be limited.

Warning Time Score: 4—minimal or no warning time

Duration Score: 4—more than 1 week

Geographic Location/Extent

All of Worth County is subject to animal/livestock incidents and agricultural infestations. According to the 2012 Census of Agriculture there were 640 farms in the County covering 234,958 acres of land (63.8 percent of the 575 sq. miles of land area (368,000 acres) in the County).

Table 3.22 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 3.22. Market Value of Agricultural Products Sold, 2012 - Worth County, IA

Market Value of Products Sold	$188,119,000
Market Value of Crops	$163,330,000 (86.8 percent)
Market Value of Livestock	$24,789,000 (13.2 percent)
Average Per Farm	$293,934

Source: USDA National Agricultural Statistics Service, 2012 Census of Agriculture.

Animal Location/Extent

In addition to the animal farm operations, there are also confined and open feeding operations in Worth County. According to data from the Iowa NRGIS Repository, there are 16 Animal Feeding Operations listed in the Iowa Department of Natural Resources Animal Feeding Operations Database. This includes 14 Confined Animal Feeding Operations and 2 Open Feedlots. There is also one registered Captive Cervid Herd in Worth County (deer and elk).

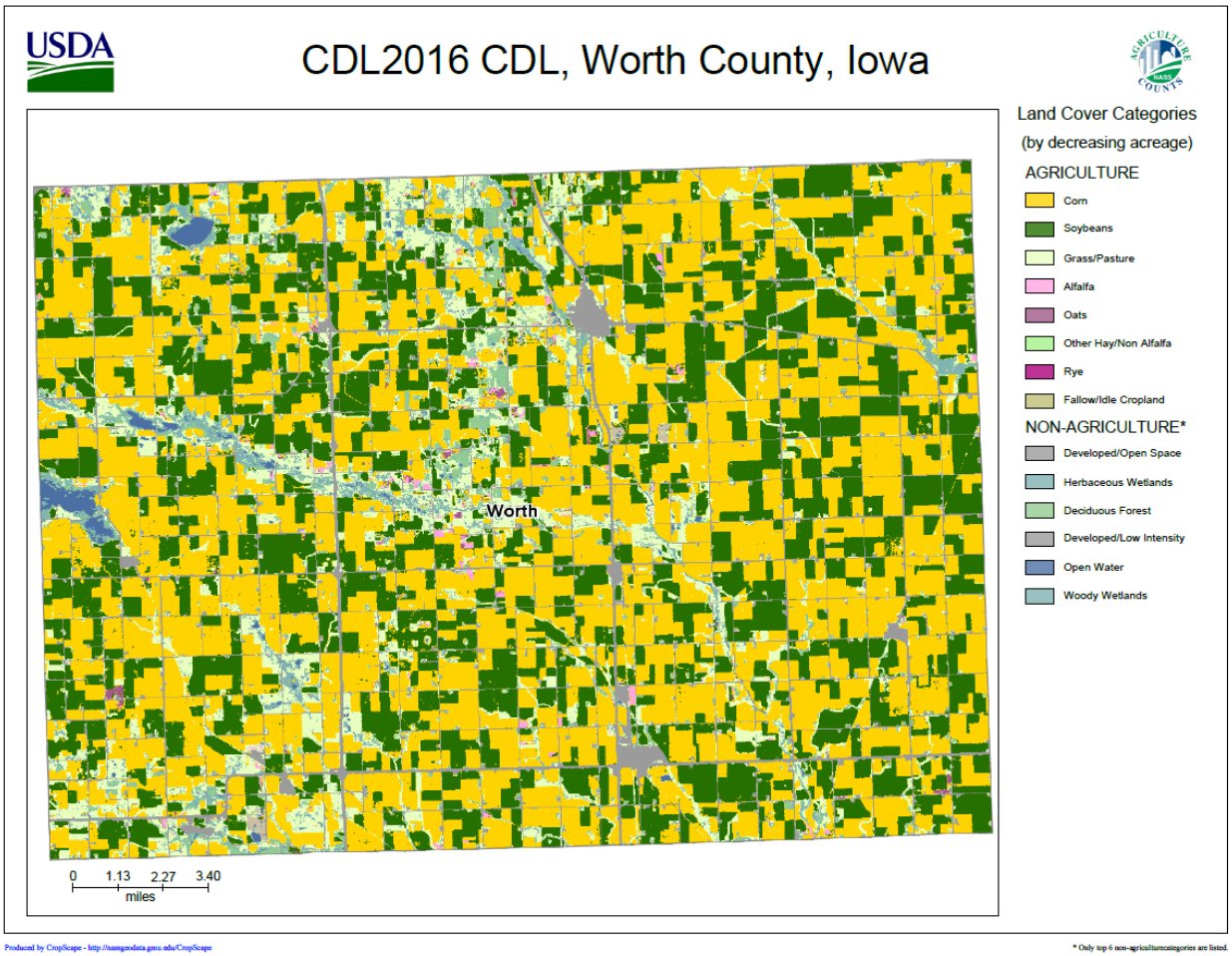
Crop Location/Extent

According to the National Agricultural Statistics Service, in 2014 Worth County's top crop items included the following:

- Corn for Grain (State Rank 61) 122,200 acres harvested
- Soybeans (State Rank 70) 75,200 acres harvested

As can be seen in the USDA Cropland Data Layer (CDL) in **Figure 3.2**, the majority of land in Worth County outside the incorporated areas is in agricultural use, with primary crops of corn and soybeans.

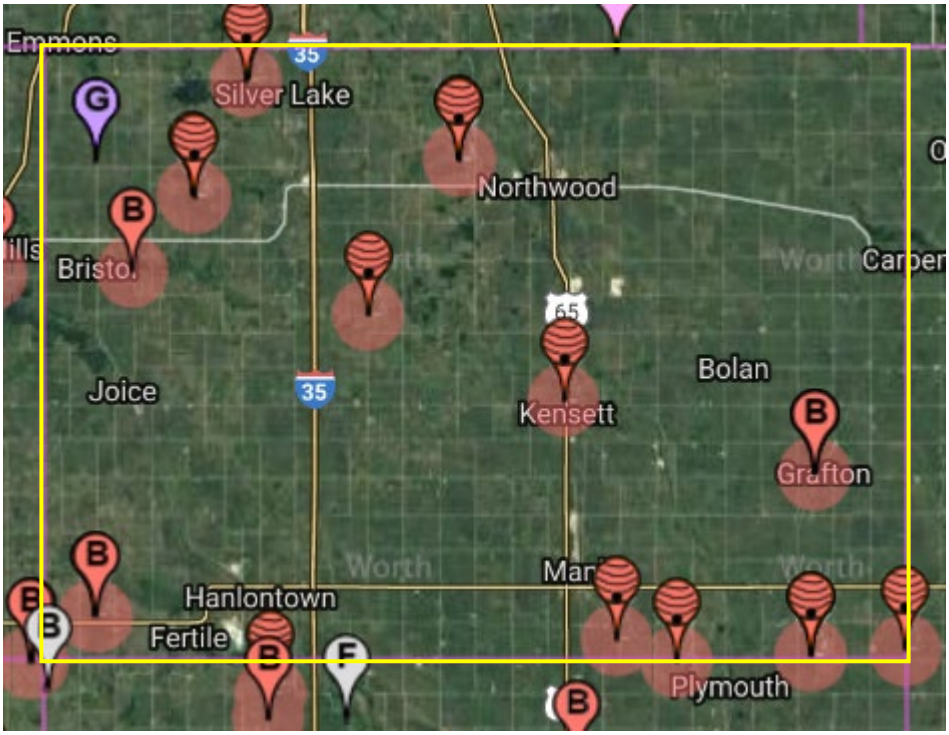
Figure 3.2. Worth County Cropland Data Layer



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

Figure 3.3 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 3.3. Sensitive Crops Registered Sites, Worth County, IA

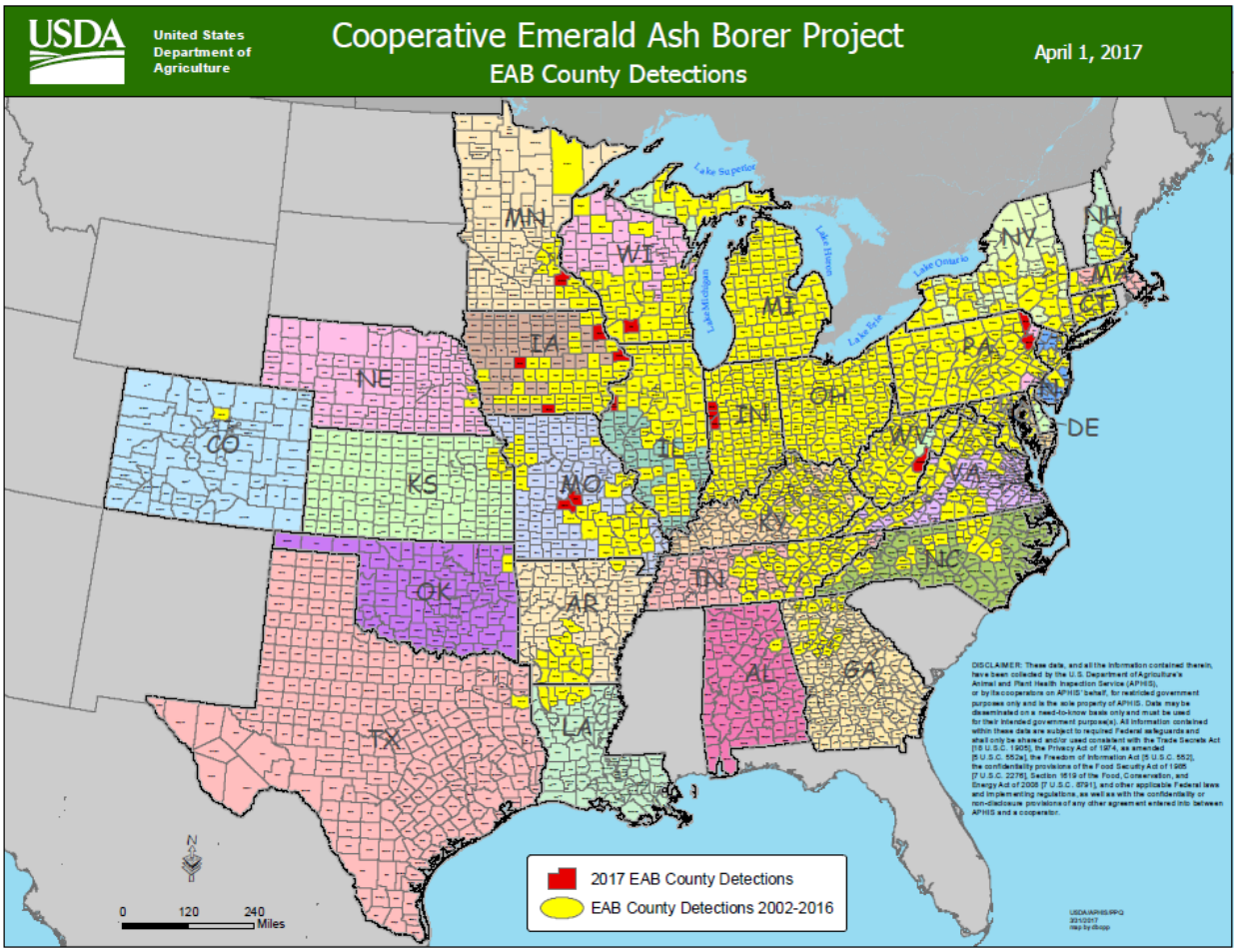


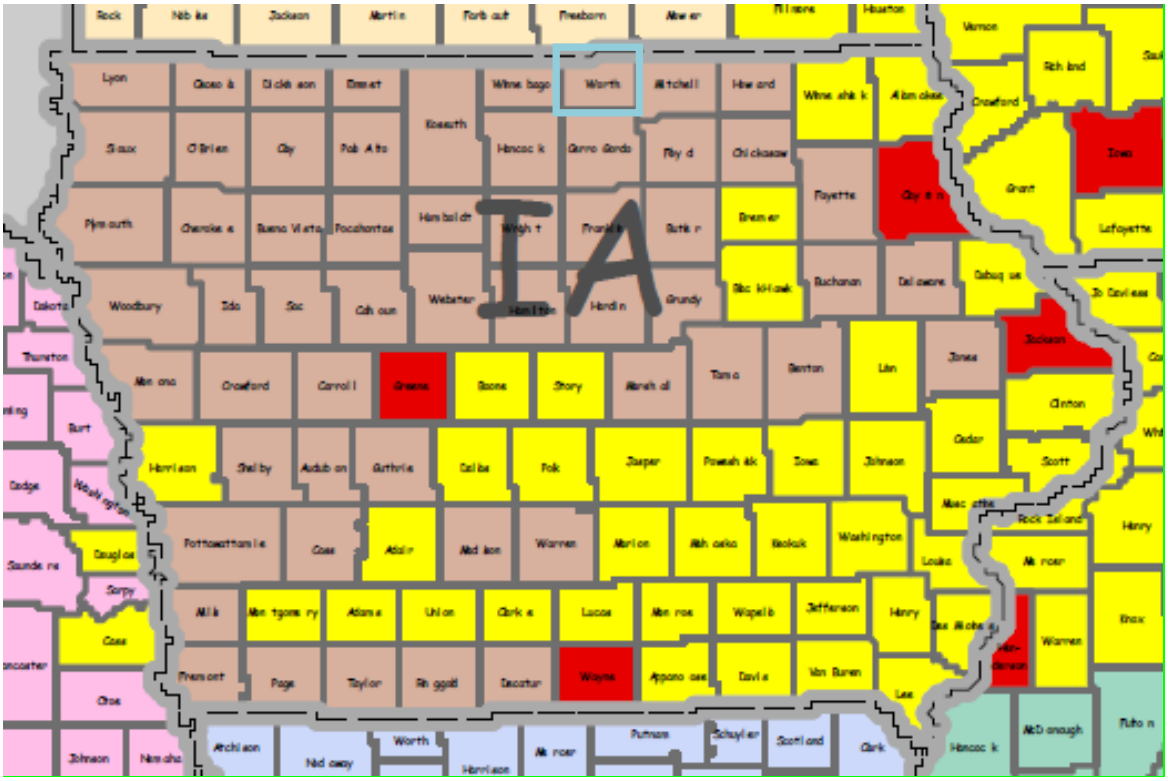
Source: Iowa Specialty Crop Site Registry, https://ia.driftwatch.org/map

Emerald Ash Borer Location/Extent

Figure 3.4 shows the counties in the U.S. in which the Emerald Ash Borer has been detected. Worth County is not shaded yellow nor red, indicating there has not been Emerald Ash Borer detected in the County between 2002 and 2017.

Figure 3.4. USDA Emerald Ash Borer County Detection Map



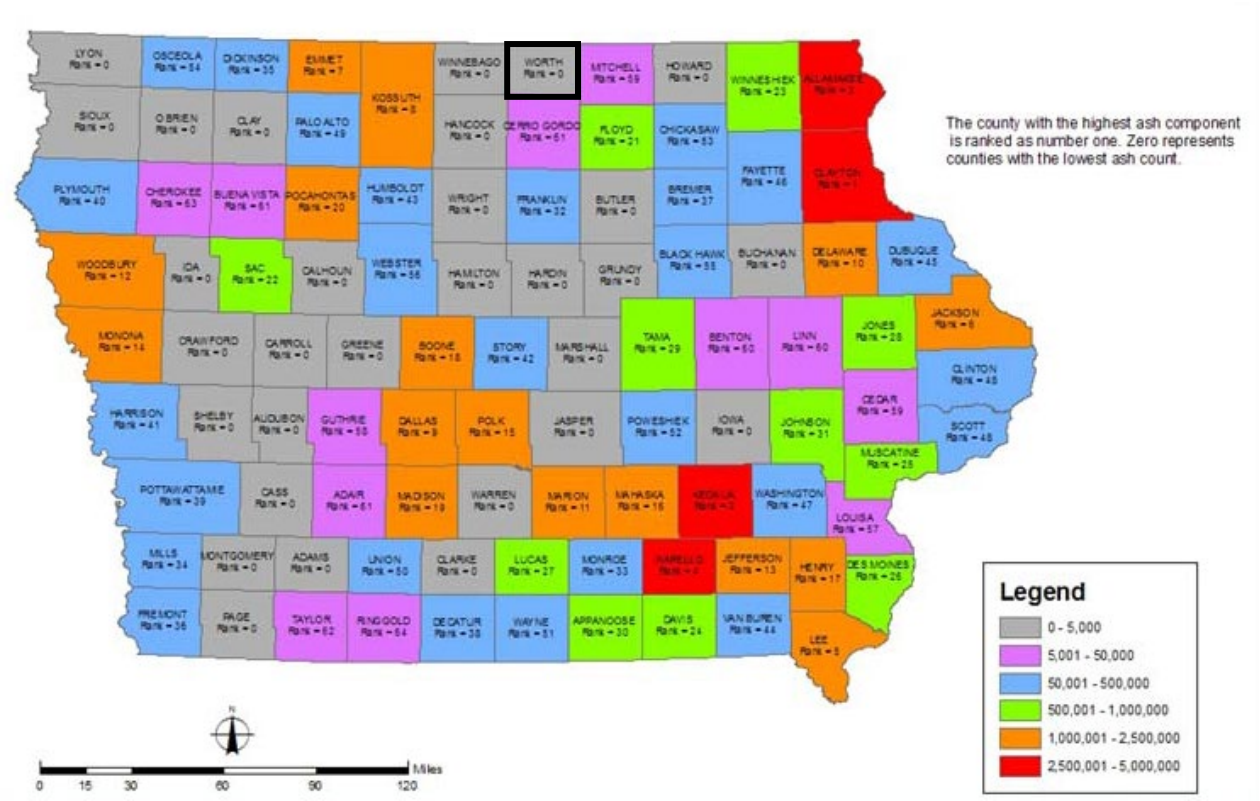


Source: http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/index.shtml;
Blue square identifies Worth County

It is estimated by the Iowa Department of Natural Resources – Forestry Bureau that approximately 15-20 percent of public trees in Iowa cities are green ash. In some communities, ash comprises more than 60 percent of the public trees. Statewide, there are over 50 million ash trees (green, white and black) in bottomland and upland forests (2005 USDA Forest Service, Forest Inventory Data) and another 30 million urban ash trees (Iowa Department of Natural Resources – Forestry Bureau).

As seen in **Figure 3.5** below, Worth County has less than 5,000 ash trees 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 3.5. Distribution of Ash Trees in Iowa



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

Avian Influenza

Previous Occurrences

Beginning in April of 2015, there were a significant number of confirmed diagnoses of avian influenza in the State of Iowa. As a result, on Friday May 1, 2015, Governor Branstad declared a state of emergency. The last positive flock was detected on June 16, 2015. Confirmed cases occurred in the following counties: Buena Vista, Calhoun, Cherokee, Clay, Hamilton, Kossuth, Lyon, Madison, O'Brien, Osceola, Palo Alto, Plymouth, Pocahontas, Sac, Sioux, Webster, and Wright. Infected flocks were depopulated and composted and clean up and disinfection occurred. There were 77 total premises and 34 million birds affected. This included 35 commercial turkey flocks, 22 commercial egg production flocks, 13 pullet flocks, 1 breeding flock for a mail order hatchery, and 6 backyard flocks. More than 2,300 USDA staff and contractors were dispatched to Iowa to assist with the response to the avian influenza situation, including a USDA Incident Management Team (IMT). More than 300 state employees also participated in the disaster response (http://www.iowaagriculture.gov/AvianInfluenza.asp). There were no reported infected flocks in Worth County.

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

Scrapie

There has been a total of 37 sheep flocks in Iowa that have been found to be infected with Scrapie since the accelerated national Scrapie Eradication Program started in November 2001. Of those, 10 have been depopulated and 27 have completed, or are currently completing a genetic flock plan. Iowa's last infected flock was found in June 2010.

Rabies

According to the Iowa Department of Public Health, Center for Acute Disease Epidemiology, there were 12 confirmed animal rabies cases in Iowa in 2015. In 2014, there were 15. In 2013, there were 12. In 2012, there were 31 and in 2011 there were 25. In 2016, there were 16 confirmed cases in the state. However, in Worth County, there have not been any cases of rabies in the past five years.

According to the U.S. Department of Agriculture's Risk Management Agency, during the 10-year period from 2007-2016, combined crop insurance payments for damages resulting from disease and insects was $3,561 in Worth County. The Iowa Statewide average for insurable crop acres with insurance is 89 percent (USDA Risk Management Agency, 2015 Iowa Crop Insurance Profile.) **Table 3.23** provides a summary of insured crop losses as a result of crop infestations

Table 3.23. Crop Insurance Payments for Crop Pests/Diseases 2007-2016

Damage Cause	Sum of Indemnity Amount	Sum of Determined Acres
Insects	**$2,404.00**	**50**
2011	$2,404.00	50
Mycotoxin (Aflatoxin)	**$824.00**	**76**
2009	$824.00	76
Plant Disease	**$333.00**	**7**
2014	$333.00	7
Grand Total	**$3,561.00**	**133**

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 Worth County that have reached this level of defined "occurrence". Therefore, it was determined that the probability of this defined "occurrence" of agricultural infestation is "Unlikely".

Probability Score: 1—Unlikely

Vulnerability

Overview

A widespread infestation of animals/livestock and crops could impact the economy of the County. According to the USDA 2012 Census of Agriculture, Worth County agriculture provides 4,227 jobs representing 33.1 percent of Worth County's total workforce (Source: Coalition to Support Iowa's Farmers, http://www.supportfarmers.com/Assets/2014/cntydata/Worth.pdf).

In 2012 the total market value of Worth County's agricultural products sold was $188,119,000. With this contribution of agriculture to the economy, a wide-scale agricultural infestation could severely impact the economic stability of the County.

Magnitude Score: 3—Critical

Potential Losses to Existing Development

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

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 Worth County in 2012 was $24,800,000. Based on a worst-case scenario where 75 percent of livestock is lost in a given year due to agricultural infestations, the total direct costs could exceed $18.6 million.

Table 3.24 provides the annual crop losses for insurable crops. The insurable loss is adjusted to estimate losses to all insurable crops by considering that 89 percent of insurable crops in the State were insured (2015 Iowa Crop Insurance Profile from USDA's Risk Management Agency).

Table 3.24. Estimated Insurable Crop Losses Resulting from Disease, Infestation, and Wildlife

Crop Insurance Paid-10 yrs.	Adjusted 10-year Losses	Annual Estimated Losses
$3,561	$4,001	$440

Source: USDA Risk Management Agency; adjust loss calculation by Amec Foster Wheeler

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 sold in Worth County in 2012 was $163,300,000. 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 $81.6 million.

The U.S. Forest Service estimates that Worth County does not have any ash trees in the County. Removal of debris if an infestation would occur would be challenging and costly. It is estimated that it costs $682 to replace each Ash tree, however, this is not an issue for Worth County.

Future Development

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

Climate Change Impacts

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

Crops

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

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

Greater precipitation during the growing season, as we have been experiencing in Iowa, has been associated with increased yields; however, excessive precipitation early in the growing season adversely affects crop productivity. Waterlogged soil conditions during early plant

growth often result in shallower root systems that are more prone to diseases, nutrient deficiencies and drought stress later in the season.

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

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

The recent extreme weather events involving greater intensity and amount of rainfall have increased the erosive power of Iowa's precipitation, resulting in significant erosion of topsoil. The impact of climate change on the erosive force of precipitation in the 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.

Animals

Despite the fact that Iowa ranks first in hog and fifth in cattle production nationwide, there is a lack of information about the effects of climate change on animal production in Iowa. Nevertheless, our general knowledge and principles pertaining to livestock and extreme weather events are applicable to Iowa's changing climate conditions.

High temperatures have been shown to reduce summer milk production, impair immunological and digestive functions of animals, and increase mortality rates among dairy cattle.

In general, domestic livestock can adapt to gradual changes in environmental conditions; however, extended periods of exposure to extreme conditions greatly reduce productivity and is potentially life threatening.

Animal/Crop/Plant Disease Hazard Summary by Jurisdiction

The magnitude determinations discussed in the vulnerability overview sections were factored into the following hazard summary table to show how this hazard varies by jurisdiction. It has been determined that 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 and minimal impacts of animal/plant/crop disease on schools. However, the economy of unincorporated areas is heavily dependent on agriculture;. therefore, the magnitude in the unincorporated area was determined to be a 3, whilethe magnitude was determined to be a 2 in the incorporated areas and a 1 in the school districts.

Jurisdiction	Probability	Magnitude	Warning Time	Duration	Score	Level
Worth County, Iowa	1	3	4	4	2.35	Moderate
City of Fertile	1	2	4	4	2.05	Moderate
City of Grafton	1	2	4	4	2.05	Moderate
City of Hanlontown	1	2	4	4	2.05	Moderate
City of Joice	1	2	4	4	2.05	Moderate
City of Kensett	1	2	4	4	2.05	Moderate
City of Manly	1	2	4	4	2.05	Moderate
City of Northwood	1	2	4	4	2.05	Moderate
Central Springs Schools	1	1	4	4	1.75	Low
Northwood-Kensett Schools	1	1	4	4	1.75	Low

3.5.2 Dam/Levee Failure

Hazard Score Calculation					
Probability	Magnitude/Severity	Warning Time	Duration	Weighted Score	Level
1	1	4	4	1.70	Low

Profile

Hazard Description

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

Dam Failure

A dam is defined as a barrier constructed across a watercourse for the purpose of storage, control, or diversion of water. Dams are typically constructed of earth, rock, concrete, or mine tailings. Dam failure is the uncontrolled release of impounded water resulting in downstream flooding, affecting both life and property. Dam failure can be caused by any of the following: flooding; earthquakes, flow blockages, landslides, lack of maintenance, improper operation, poor construction, vandalism, or terrorism.

Levee Failure

Levee Failure is the uncontrolled release of water resulting from a structural failure. Possible causes of the failure could include flooding, earthquakes, blockages, landslides, lack of maintenance, improper operation, poor construction, vandalism, terrorism, erosion, piping, saturation, or under seepage.

Warning Time Score: 4—Minimal or no warning (up to 6 hrs. warning)

Duration Score: 4—More than 1 week

Geographic Location/Extent

Dams in Planning Area

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

In rural areas:

a. *Any dam designed to provide a sum of permanent and temporary storage exceeding 50 acre-feet at the top of dam elevation, or 25 acre-feet if the dam does not have an emergency spillway, and which has a height of 5 feet or more.*
b. *Any dam designed to provide permanent storage in excess of 18 acre-feet and which has a height of 5 feet or more.*
c. *Any dam across a stream draining more than 10 square miles.*

d. *Any dam located within 1 mile of an incorporated municipality, if the dam has a height of 10 feet or more, stores 10 acre-feet or more at the top of dam elevation, and is situated such that the discharge from the dam will flow through the incorporated area.*

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

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

Dams are classified by the State of Iowa into three categories based on the potential risk to people and property in the event of failure (see **Table 3.25**). The classification can change over time due to changes in development downstream from the dam. In addition, older dams may not have been built to the standards of their updated classification when this occurs. The Iowa Department of Natural Resources performs annual inspections on all high hazard dams in the State.

Table 3.25. Dam Hazard Classification Definitions

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

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

For this plan update, both the National Inventory of Dams as well as the State-regulated dam inventory were consulted. There are seven dams inside the county boundaries of Worth County, and all seven are Low Hazard dams.

Table 3.26 provides the names, locations, and other pertinent information for all dams in the planning area. There are no dams upstream from the County that would be expected to cause damage to County assets. The Vulnerability Analysis section provides additional information about the dams based on data that was extracted from available inspection reports.

Table 3.26. Dams in the Worth County Planning Area

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

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

Levees in Planning Area

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

Previous Occurrences

Dam Failure

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

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

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

Probability of Future Occurrence

Based on past performance, the Hazard Mitigation Planning Committee determined that the probability of future occurrence of dam failure is unlikely.

Probability Score: 1--Unlikely

Vulnerability

Overview

Dam Failure

Dam or levee failure is typically an additional or secondary impact of another disaster such as flooding or earthquake.

Worth County does not contain any Moderate or High Hazard dams. By definition, failure of a Low Hazard dam is limited to loss of the dam, loss of livestock, damages to farm outbuildings, agricultural lands, and lesser used roads, and unlikely to result in loss of human life. However, two of the dams in the County are considered major structures, and therefore have regular inspections, which provide additional information on potential vulnerability to failure of these dams.

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

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

Elk Creek Game Management Dam 2—6/7/2016: satisfactory rating; the dam is expected to have safe performance under all anticipating loading conditions. However, ongoing maintenance is needed, including removal of trees on the upstream and downstream embankments and along the toe of the embankment and prevention of new tree growth.

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

Magnitude/Severity Score: 1—Negligible

Potential Losses to Existing Development

There are no high or moderate hazard dams or any regulated levees in Worth County. Although minor flooding and damages could result from the failure of a low hazard dam, the extent of such flooding has not been determined. Therefore, there is no specific information on the vulnerability of physical structures to this hazard.

Future Development

Future development located downstream from dams in floodplains or inundation zones and/or in levee protected areas would increase vulnerability to dam or levee failure. Worth County's population has remained relatively constant, declining 0.3 percent from 2010 to 2016. The County is unlikely to see a significant increase in downstream risk in the near future.

Climate Change Impacts

Increased frequency of precipitation and precipitation extremes leading to flooding could cause additional stress on dam and levee structures.

Dam/Levee Failure Hazard Summary by Jurisdiction

Unincorporated Worth County was assigned a hazard rating of "low" for dam failure due to the presence of dams within that county that are monitored by the Iowa Department of Natural Resources. For the remaining jurisdictions that would be impacted by failure of low hazard dams or levees or that would not by impacted by any dams or levees, this hazard was determined to be "not applicable".

Jurisdiction	Probability	Magnitude	Warning Time	Duration	Score	Level
Worth County, Iowa	1	1	4	4	1.70	Low
City of Fertile	1	1	4	4	N/A	N/A
City of Grafton	1	1	4	4	N/A	N/A
City of Hanlontown	1	1	4	4	N/A	N/A
City of Joice	1	1	4	4	N/A	N/A
City of Kensett	1	1	4	4	N/A	N/A
City of Manly	1	1	4	4	N/A	N/A
City of Northwood	1	1	4	4	N/A	N/A
Central Springs Schools	1	1	4	4	N/A	N/A
Northwood-Kensett Schools	1	1	4	4	N/A	N/A

3.5.3 Drought

Hazard Score Calculation					
Probability	Magnitude/Severity	Warning Time	Duration	Weighted Score	Level
4	2	1	4	2.95	Moderate

Profile

Hazard 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.

Warning Time Score: 1—24+ Hours

Duration Score: 4—more than 1 week

Geographic Location/Extent

According to the 2012 Census of Agriculture, of the 256,079 acres of land area in Worth County, 91.8 percent (234,958 acres) is utilized for agricultural purposes. There were 640 farms with an average size of 367 acres per farm. Given that so much land is the County is in agricultural use, Worth County is at particularly high risk to drought because agricultural areas are more vulnerable to the immediate effects of drought. However, it should be noted that other land uses experience the effects of drought, and all of Worth County is at risk to drought. The map in **Figure 3.2** in the Animal/Plant/Crop Disease hazard section displays the locations of various cropland uses in Worth County.

Previous Occurrences

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

Table 3.27 provides the rainfall history at the Northwood weather station from 1951 to December 2017. Complete years with less than 30 inches of rain include 1952, 1955, 1956, 1958, 1960, 1963, 1964, 1966, 1967, 1969, 1974, 1976, 1985, 1987, 1988, 1989, 1997, 2003, 2009, and 2012. The lowest annual precipitation on record occurred in 1976 with 16.47 inches.

Table 3.27. Monthly and Annual Precipitation Totals, 1951 to December 2017, Northwood, Iowa Weather Station

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
1951	0.36	1.51	4.98	4.54	2.08	6.27	0.00	6.42	3.48	2.31	1.04	0.96	33.95
1952	2.17	0.38	1.99	1.28	3.77	4.69	3.78	4.99	0.42	0.00	1.15	0.90	25.52

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
1953	1.64	0.82	1.96	3.67	2.45	4.56	6.50	5.64	0.65	0.15	2.05	1.55	31.64
1954	0.65	0.57	0.00	3.96	5.10	11.01	3.12	4.34	3.02	3.25	0.46	0.00	35.48
1955	0.30	1.14	1.03	2.49	2.11	5.27	6.79	1.29	1.31	0.58	0.16	0.36	22.83
1956	1.42	0.00	2.86	3.18	3.71	2.57	5.30	3.35	1.10	0.91	0.88	0.48	25.76
1957	0.57	0.14	1.81	1.24	11.29	5.13	3.22	4.12	1.20	1.86	3.80	0.37	34.75
1958	0.49	0.12	0.86	3.78	0.96	2.47	3.65	2.23	2.77	0.27	0.95	0.16	18.71
1959	0.45	1.75	3.27	1.65	7.89	6.75	1.48	9.45	4.82	1.79	1.33	1.32	41.95
1960	0.25	0.59	1.00	2.25	6.34	6.50	2.51	3.35	3.07	0.63	0.60	1.14	28.23
1961	0.18	1.66	4.05	1.87	3.09	2.32	7.40	2.06	3.41	5.09	1.26	1.35	33.74
1962	0.13	1.93	1.06	3.34	3.49	3.19	5.08	7.08	2.95	2.34	0.00	0.22	30.81
1963	0.59	0.77	2.07	2.29	4.07	4.71	6.04	2.15	1.24	0.70	1.61	0.50	26.74
1964	0.39	0.03	1.15	5.96	3.84	1.90	1.46	3.41	5.88	0.09	1.41	0.95	26.47
1965	0.71	1.34	3.87	3.76	4.54	2.45	4.36	2.42	15.19	0.40	1.60	1.90	42.54
1966	0.70	1.00	3.04	2.16	1.58	4.71	2.73	2.23	1.32	2.10	0.27	0.84	22.68
1967	1.58	0.85	1.52	2.82	3.17	7.09	3.64	2.41	1.11	1.63	0.24	0.59	26.65
1968	0.74	0.11	0.70	5.39	3.56	5.90	5.72	3.41	7.15	2.68	0.24	1.94	37.54
1969	2.61	0.46	0.50	1.73	3.80	8.57	4.21	0.18	1.94	2.75	0.71	2.46	29.92
1970	0.14	0.15	1.41	2.21	6.62	1.90	4.84	1.03	4.68	4.84	2.08	1.20	31.10
1971	2.14	3.08	0.99	0.41	2.30	8.69	1.63	0.61	2.59	4.97	3.35	0.85	31.61
1972	0.60	0.35	0.81	2.09	4.27	3.06	5.89	2.58	9.13	3.20	1.15	2.08	35.21
1973	1.18	0.00	3.05	4.38	4.67	3.78	4.30	2.73	6.86	3.48	2.66	1.77	38.86
1974	0.29	0.47	2.35	2.19	5.93	3.40	3.16	4.52	1.08	2.14	1.28	0.59	27.40
1975	1.88	0.46	1.96	4.84	3.65	7.74	1.31	8.19	0.57	0.21	3.80	1.06	35.67
1976	0.27	0.79	3.58	2.54	2.77	1.60	0.83	1.59	0.92	1.03	0.04	0.51	16.47
1977	0.32	0.70	3.56	3.12	1.71	4.31	2.96	5.52	3.62	2.87	0.93	0.68	30.30
1978	0.85	0.47	0.25	2.80	4.89	8.98	7.46	2.03	5.26	1.44	1.90	0.65	36.98
1979	1.20	0.29	3.37	2.06	2.92	1.66	4.20	7.99	0.96	4.07	2.14	0.42	31.28
1980	1.51	0.59	0.60	1.09	4.75	4.35	3.88	12.51	2.72	1.38	0.02	0.35	33.75
1981	0.11	1.29	1.08	5.50	4.30	4.08	6.14	9.84	1.11	2.33	0.88	1.09	37.75
1982	1.98	0.41	1.54	2.90	6.76	2.47	3.56	7.70	5.55	2.49	3.29	2.70	41.35
1983	0.67	1.20	2.86	2.57	3.26	4.39	1.27	3.67	5.64	1.95	4.55	0.80	32.83
1984	0.34	1.64	1.44	3.92	4.12	7.88	3.30	1.36	1.15	5.76	1.01	1.55	33.47
1985	0.56	0.25	1.97	2.10	2.68	3.54	1.96	4.50	7.37	1.37	2.58	0.84	29.72
1986	0.20	0.21	2.62	4.29	4.83	3.13	5.15	5.45	4.20	3.81	0.98	0.39	35.26
1987	0.32	0.16	1.41	1.09	1.75	1.97	5.31	3.60	1.54	0.76	2.61	2.34	22.86
1988	1.32	0.08	0.90	3.45	1.04	1.30	2.24	3.79	5.66	0.33	3.01	1.31	24.43
1989	0.22	0.22	1.97	2.46	1.61	1.56	4.35	2.85	2.92	1.32	0.61	0.01	20.10
1990	0.86	0.60	4.45	4.74	4.19	3.86	11.58	12.92	1.86	2.01	0.56	2.40	50.03
1991	0.65	0.29	3.82	5.80	7.49	3.26	5.62	4.78	4.04	1.39	5.65	1.35	44.14
1992	1.29	0.89	2.79	2.75	4.12	2.27	2.97	2.18	3.57	1.79	3.98	1.68	30.28
1993	0.92	1.15	1.99	6.39	6.12	8.99	7.24	7.93	2.55	0.86	0.78	1.07	45.99
1994	1.38	1.08	0.00	3.55	2.56	5.74	6.85	3.18	4.29	2.85	1.35	0.91	33.74
1995	0.59	0.07	3.07	3.63	5.54	3.84	2.38	5.07	3.22	3.01	0.69	0.49	31.60
1996	2.11	0.00	2.76	1.24	3.53	5.21	1.65	4.67	1.40	2.99	4.33	1.15	31.04
1997	1.44	0.81	1.90	2.01	3.62	4.45	7.38	2.07	2.69	2.56	0.33	0.62	29.88
1998	1.70	0.43	2.21	4.74	3.34	7.60	1.87	6.99	2.62	4.22	0.89	0.22	36.83
1999	1.35	0.80	1.21	6.70	6.48	6.05	10.76	1.57	1.33	1.37	0.58	0.52	38.72
2000	1.33	1.27	1.25	1.73	4.89	6.62	3.81	4.27	0.73	2.01	3.47	2.17	33.55
2001	1.46	1.67	1.25	5.55	6.56	4.27	4.69	1.19	2.68	1.43	1.90	1.30	33.95
2002	0.35	1.04	1.04	3.62	1.44	2.27	5.62	7.63	2.62	4.31	0.19	0.50	30.63
2003	0.23	0.31	2.14	2.38	5.51	6.18	4.66	1.55	1.11	0.35	1.62	0.60	26.64
2004	0.37	1.52	2.34	2.96	12.00	2.70	9.20	3.62	7.42	1.56	1.66	0.53	45.89
2005	1.63	1.21	2.48	4.89	4.78	4.49	4.51	2.96	6.16	1.58	1.87	1.22	37.78
2006	0.37	0.65	3.15	5.81	2.21	3.48	1.07	6.67	4.70	1.40	2.24	1.98	33.73
2007	0.92	2.17	2.45	2.48	4.66	1.92	2.61	11.58	4.64	4.01	0.22	1.81	39.47
2008	0.69	0.96	0.52	4.36	3.21	8.99	5.01	1.84	1.61	2.82	2.50	1.52	34.04
2009	0.84	0.68	1.47	2.51	3.50	3.55	2.72	1.73	1.44	7.40	0.17	2.73	28.74
2010	0.48	1.17	1.33	1.63	2.29	6.13	7.66	1.70	7.28	0.68	2.52	2.90	35.78
2011	0.96	1.35	2.11	4.87	4.68	4.71	6.39	1.66	2.45	1.59	0.26	1.29	32.32

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
2012	0.83	1.47	1.22	3.53	3.66	2.38	0.47	3.99	1.51	1.54	0.59	1.40	22.59
2013	0.45	0.94	2.20	7.05	9.97	9.09	2.75	0.00	0.00	4.92	1.21	0.78	39.37
2014	1.10	1.34	1.12	5.53	2.34	8.47	0.84	7.43	3.67	1.90	0.69	0.98	35.42
2015	0.43	1.08	0.74	5.30	4.03	6.57	5.83	3.95	2.99	1.20	3.32	4.06	39.50
2016	0.74	0.75	2.90	1.50	4.99	5.21	8.14	8.41	9.37	3.86	1.24	1.91	49.02
2017	2.18	1.54	2.36	4.11	4.42	2.52	4.64	3.28	2.48	5.61	0.41	0.41	33.96
MEAN	**0.89**	**0.82**	**1.97**	**3.35**	**4.24**	**4.73**	**4.32**	**4.29**	**3.37**	**2.25**	**1.55**	**1.16**	**32.94**

Source: Iowa Environmental Mesonet, Report generated January 3, 2018, Site information: IA6103 Northwood, https://mesonet.agron.iastate.edu/climodat/index.phtml?network=IACLIMATE&station=IA6103&report=17

According to the National Drought Mitigation Center's Drought Impact Reporter, during the 10-year period from January 2008 through December 2017, 117 listed drought impacts were noted for the State of Iowa. Of these impacts, 6 were reported to affect Worth County. The following are the categories and reported number of impacts. Note: some impacts have been assigned to more than one category:

- Agriculture – 5
- Fire – 1
- Relief, Response & Restrictions – 4
- Water Supply & Quality – 1

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

- **July 6, 2016** — According to the Drought Impact Reporter, corn yield potential down in Iowa
- **October 16, 2015** – According to the Drought Impact Reporter, dry conditions led to Iowa burn bans.
- **October 1-13, 2012** – Drought conditions that began in late June continued through the summer and into October. Very warm and dry weather that began in the spring continued through the summer. Temperatures remained well above normal into August, but began to temper during the latter portion of the month. Temperatures cooled in October with the month averaging near to a little below normal. It was the first cooler than normal month in 13 months across the 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 County Warning Area (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 1-30, 2012** – Drought conditions that began in late June continued through July and into August. Very warm and dry weather that began in the spring continued through the summer. Temperatures warmed sharply the last few days of June. The heat persisted into August. Temperatures for the month of August were cooler than July, and in fact, just above normal. For the three summer months of June, July, and August, temperatures were among the top 10 warmest on record. Rainfall was in short supply across the state. Much of the state recorded less than 50% of normal rainfall for the month, with a few locations under 25% of normal. The south quarter fared a little better with a few locations receiving close to normal rainfall for the month. In addition, extended periods of temperatures above 90 °F combined with dewpoint temperatures falling into the 50s at times, resulted in additional stress. The rapid deterioration of the corn and soybean crop that took place in July slowed as much of the damage had already occurred in July. By the end of the month, officials estimated that 15% of the soybean crop and 20% of the corn crop yield had been lost to the drought. At the current price, the loss total was 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 1-30, 2012** – Very warm and dry weather that began in the spring continued into the summer. Temperatures warmed sharply the last few days of June. The heat persisted into July. Temperatures for the month of July were among the warmest on record. In Des Moines, the monthly mean temperature was the second highest of record, only eclipsed by July of 1936. Rainfall was in short supply across the state. Much of the state recorded less than 50% of normal rainfall for the month, with a few locations under 10% of normal. In addition, extended periods of temperatures above 95 °F resulted in problems with pollination of the crops. Rapid deterioration of the corn and soybean crop took place with several periods of temperatures in excess of 100 °F. By the end of the month, officials estimated that 20% of the crop yield had been lost to the drought. At the current price, the loss total was 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 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.
- **July 13, 2012** – According to the Drought Impact Reporter, corn showed signs of moisture stress in Iowa.
- **September 12, 2012** – According to the Drought Impact Reporter, The U.S. Department of Agriculture Sept. 12, 2012, designated 23 counties in Minnesota, Iowa, North Dakota, South Dakota and Wisconsin as disaster areas due to drought, which means that low-interest loans are available to farmers in those counties who meet eligibility requirements.
- **August 1-31, 2003** – Dry weather settled in over Iowa during the month. The last widespread rain occurred on 09 July. With the increasingly dry conditions became a primary concern as the month progressed. An extended period of heat and humidity from the 15th to 25th saw highs into the 90s to over 100 °F. in some locations. By month's end drought indices had worsened to severe to extreme drought across south central Iowa and at least moderate drought over the remainder of the HSA. Waterloo had its driest August on record, Des Moines its 3rd driest and Ottumwa its 8th driest. A cold front brought only a brief respite from the intense heat, as temperatures rebounded into the 90s to near 100 °F. on the 24-26th. Des Moines Airport reached the century mark for the first time since July 29, 1999, reaching 100 F. on the 24th and 101 °F. on the 25th. This was followed by a slow cool down as several pushes of cooler air traversed the state. Unfortunately, there was only widely scattered convection across the HSA on the 27th and 28th, providing little significant drought relief. Light to moderate rainfall on the 31st fell across primarily the southern one half of the HSA, with the heaviest amounts in the southeast. The end of the month saw numerous records approached or established for 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 it's 3rd driest August ever with 0.31" (driest 0.14" in 1909). Many stations had from 10 to 25 percent of normal rainfall. The drought in south central Iowa as shown by the Palmer Drought Index reached the Extreme category (-4.09) for the first time in this event by August 30th. Statewide NWS Cooperative station data compiled by the Iowa State Climatologist's office showed August temperatures averaged 74.3 °F. or 3.0° above the 30-year (1971-2000) mean, ranking as the 18th warmest in 131 years. Precipitation statewide was 0.96" or 3.23" below than normal, ranking as the driest August on record. For the summer as a whole (June-August) it was the 65th warmest (72.0 °F. or 0.4° above normal) and the 18th driest (9.55" or 1.93" below normal). The dry conditions caused deterioration in the states crops. Estimates place yield reductions of about 10% on the corn crop, or a loss of about $210 million. Losses on the soybean crop were around 30%, or a loss of about $435 million.
- **August 1-23, 2001** – In what became a rather tough growing season, drought developed in Iowa during the month of July, and became serious in August. During the early part of the growing season, excessive rainfall caused significant planting delays across the state. Once the crop was planted, cool and cloudy weather settled into the state slowing crop

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

Table 3.28 below provided by the U.S. Drought Monitor, summarizes the historical drought conditions for Worth County by intensity and percent area from 2008 through 2017. Portions of Worth County were in extreme drought intensity in 2012 and 2013 during this 10-year timeframe.

Table 3.28. Historic Drought Intensity (Percent Area) Worth County, Iowa 2008-2017

Drought Intensity	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2008-2017 Average
None	76.65	76.44	100.0	35.87	0.00	35.78	77.42	90.38	100.0	96.09	**71.80**
D0 Abnormally Dry	23.12	21.72	0.00	14.13	0.01	28.22	22.58	9.62	0.00	3.91	**12.38**
D1 - Moderate	0.22	1.84	0.00	6.67	20.18	6.05	0.00	0.00	0.00	0.00	**3.49**
D2 - Severe	0.00	0.00	0.00	13.32	44.71	2.85	0.00	0.00	0.00	0.00	**6.07**
D3 - Extreme	0.00	0.00	0.00	0.00	35.10	27.10	0.00	0.00	0.00	0.00	**6.25**
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

According to the USDA's Risk Management Agency, payments for insured crop losses in Worth County as a result of drought conditions occurred in seven of the ten years from 2007-2016 and totaled $16,067,666 (see **Table 3.29**). With the extensive drought conditions during the years of 2012 and 2013, 86.1 percent of the 10-year crop losses came from these two years alone.

Table 3.29. Crop Insurance Claims Paid from Drought, 2007-2016

Year	Insurance Paid
2007	$320,072.00
2008	$328,131.00
2009	$197,700.00
2011	$172,487.00
2012	$11,822,771.00
2013	$2,017,472.00
2014	$1,209,033.00
Insurance Paid	**$16,067,666.00**

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 seven years with crop insurance claims as a result of drought in Worth County. If this trend continues, this results in a probability of 70% of agricultural impacts as a result of drought in any given year. The probability rating for this hazard is "Highly Likely".

Probability Score: 4—Highly Likely

Vulnerability

Overview

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

Worth County has 640 farms that cover 234,958 acres of land. This translates to 91.8 percent of the surface land in the County being used for agriculture. Therefore, the planning area has an extremely high exposure to this hazard. Aside from agricultural impacts, other losses related to drought include increased costs of fire suppression and damage to roads and structural foundations due to the shrink dynamic of expansive soils during excessively dry conditions. Drought also presents hazards to public health in extreme cases, where drinking water production cannot keep up with demand. Water wells become less productive during drought and a failure of remaining productive wells (due to power outage, etc.) can cause public drinking water supplies to become compromised.

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.

Magnitude Score 2 – Limited

Potential Losses to Existing Development

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 2007-2016, the sum of claims paid for crop damage as a result of drought in Worth County was $16,067,666. 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 89 percent crop insurance coverage was factored in to provide an adjusted estimate of losses. According to this calculation, estimated annualized losses total $1,805,356 (see **Table 3.30**).

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 3.30. Estimated Insurable Annual Crops Lost Resulting from Drought

10-Year Drought Insurance Paid	Adjusted 10-Year Drought Losses (considering 89% insured)	Estimated Annualized Losses	2012 Value of Crops	Annualized Crop Loss Ratio (Losses/Value)
$16,067,666	$18,053,557	$1,805,356	$163,330,000	1.11%

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

Future Development

Increases in acreage planted with crops would increase the exposure to drought-related agricultural losses. In addition, increases in population add additional strain on water supply systems to meet the growing demand for treated water.

Climate Change Impacts

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 number of overall days with precipitation. If this occurs during a drought cycle, the drought impacts will be exacerbated and increased agricultural losses will be sustained.

Drought Hazard Summary by Jurisdiction

As discussed in the drought previous occurrences and vulnerability sections, the majority of the damages seen historically as a result of drought are to crops and other agriculture-related activities. Therefore, the magnitude of the impacts is greater in the unincorporated areas. In the cities, the frequency of drought conditions would be the same, but the magnitude would be less with lawns and local gardens affected, and leading to expansive soil problems around foundations. If drought conditions are severe and prolonged, water supplies could also be affected.

Jurisdiction	Probability	Magnitude	Warning Time	Duration	Score	Level
Worth County, Iowa	4	2	1	4	2.95	Moderate
City of Fertile	4	1	1	4	2.65	Moderate
City of Grafton	4	1	1	4	2.65	Moderate
City of Hanlontown	4	1	1	4	2.65	Moderate
City of Joice	4	1	1	4	2.65	Moderate
City of Kensett	4	1	1	4	2.65	Moderate
City of Manly	4	1	1	4	2.65	Moderate
City of Northwood	4	1	1	4	2.65	Moderate
Central Springs Schools	4	1	1	4	2.65	Moderate
Northwood-Kensett Schools	4	1	1	4	2.65	Moderate

3.5.4 Earthquake

Hazard Score Calculation					
Probability	Magnitude/Severity	Warning Time	Duration	Weighted Score	Level
1	1	4	1	1.40	Low

Profile

Hazard Description

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

Warning Time Score: 4—less than 6 hours

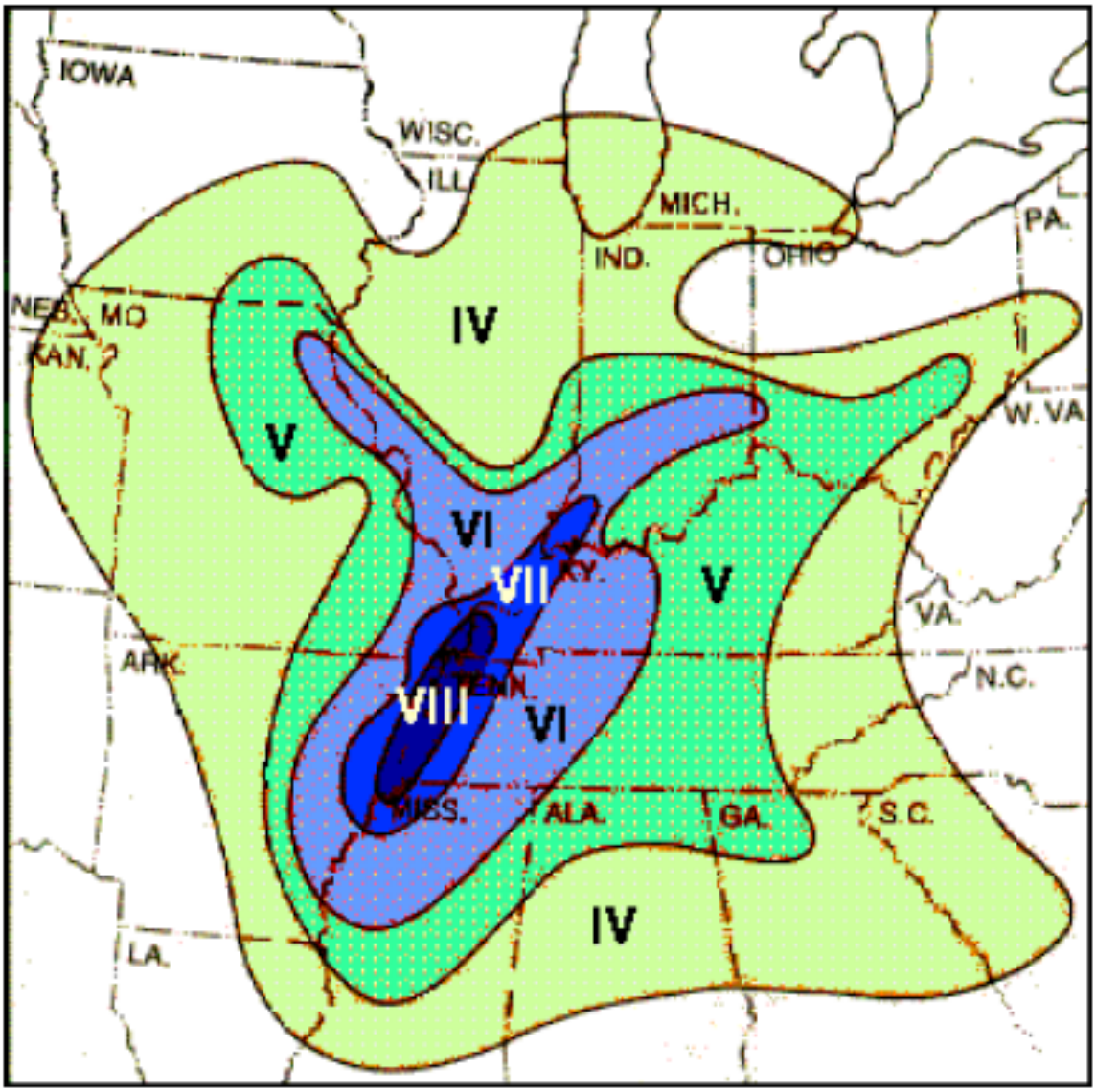
Duration Score: 1—less than 6 hours

Geographic Location/Extent

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

Iowa counties are located in low risk zones as a whole. **Figure 3.6** shows the estimated effects of a 6.5 Richter magnitude earthquake scenario along the New Madrid Fault Zone. The southeastern part of the State is more at risk to earthquake effects from the New Madrid Faultand could experience effects ranging from trembling buildings, some broken dishes and cracked windows, and movement and falling of small unstable objects, to vibrations similar to the passing of a heavy truck, rattling of dishes and windows, and creaking of walls. Worth County sits entirely outside this risk zone, therefore, it is unlikely that Worth County would experience any of these effects, though they can vary considerably with differences in local geology and construction techniques.

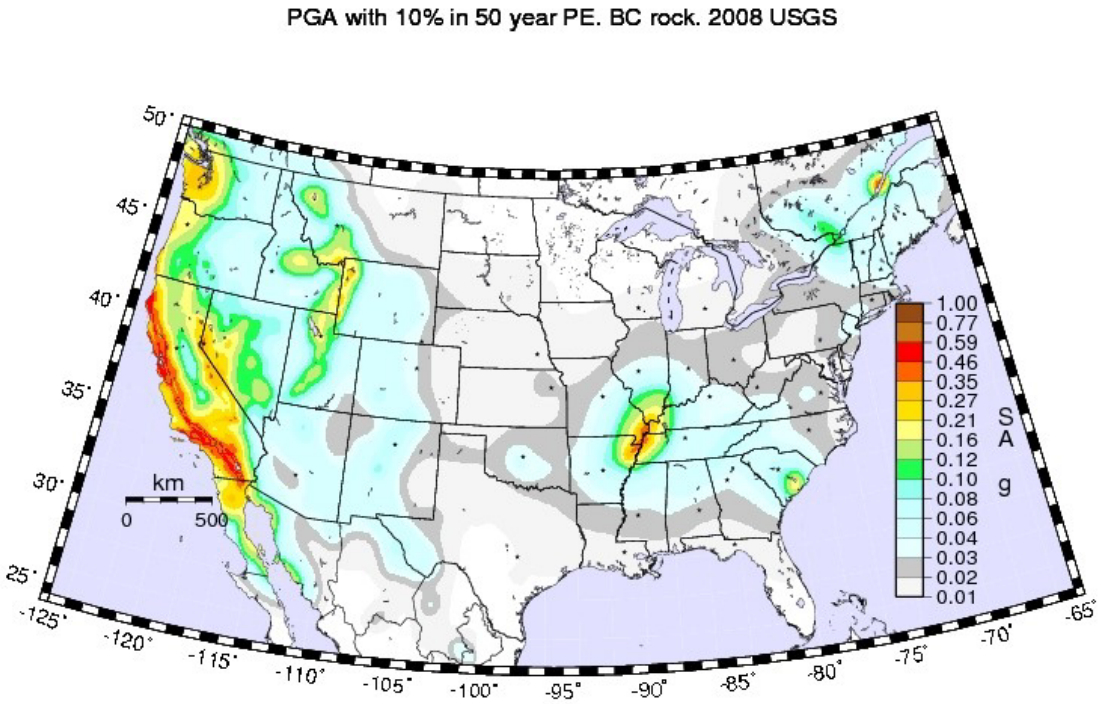
Figure 3.6. 6.5 Richter Magnitude Earthquake Scenario, New Madrid Fault Zone



Source: http://www.igsb.uiowa.edu/Browse/quakes/quakes.htm

Figure 3.7 shows the Seismic Hazard Map for the U.S. showing the peak ground acceleration of 10 percent in a 50-year timeframe.

Figure 3.7. United States Seismic Hazard Map



Source: United States Geological Survey, http://earthquake.usgs.gov/hazards/products/conterminous/2008/maps/

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

Richter Magnitude Scale

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

Modified Mercalli Intensity Scale

The effect of an earthquake on the Earth's surface is called the intensity. The intensity scale consists of a series of certain key responses such as people awakening, movement of furniture, damage to chimneys, and finally - total destruction. Although numerous *intensity scales* have been developed over the last several hundred years to evaluate the effects of earthquakes, the one currently used in the United States is the Modified Mercalli (MM) Intensity Scale. It was developed in 1931 by the American seismologists Harry Wood and Frank Neumann. This

scale, composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals. It does not have a mathematical basis; instead it is an arbitrary ranking based on observed effects.

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

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

Previous Occurrences

Iowa has experienced little effects from only a few earthquakes in the past 175 years. The epicenters of 13 earthquakes have been located in the State with the majority along the Mississippi River. None of these earthquakes were centered in Worth County. The strongest earthquake in Iowa occurred in Davenport in 1934 which is located in Scott County. The 1934 Davenport earthquake resulted in only slight damage. (Source: *State of Iowa Hazard Mitigation Plan*, 2013). Details of the 13 Iowa Earthquakes are provided below:

Table 3.31. Historical Earthquakes in Iowa

Date	Nearest Town	Mercalli Intensity
7/16/2004	Shenandoah, IA	III
4/20/1948	Oxford, IA	IV
11/24/1939	Davenport, IA / Rock Island, IL	II-III
11/8/1938	Dubuque, IA	-II
10/11/1938	Inwood, IA	V
2/26/1935	Burlington, IA	III
1/5/1935	Rock Island, IL / Davenport, IA	III
1/5/1935	Rock Island, IL / Davenport, IA	IV
11/12/1934	**Davenport, IA \ Rock Island, IL**	**VI**
1/26/1925	Waterloo, IA	II
4/13/1905	Wayland, MO / Keokuk, IA	IV-V
12/9/1875	Sidney, IA / Nebraska City, NE	III
4/28/1867	Sidney, IA / Nebraska City, NE	IV

Source: State of Iowa Hazard Mitigation Plan, 2013

Probability of Future Occurrence

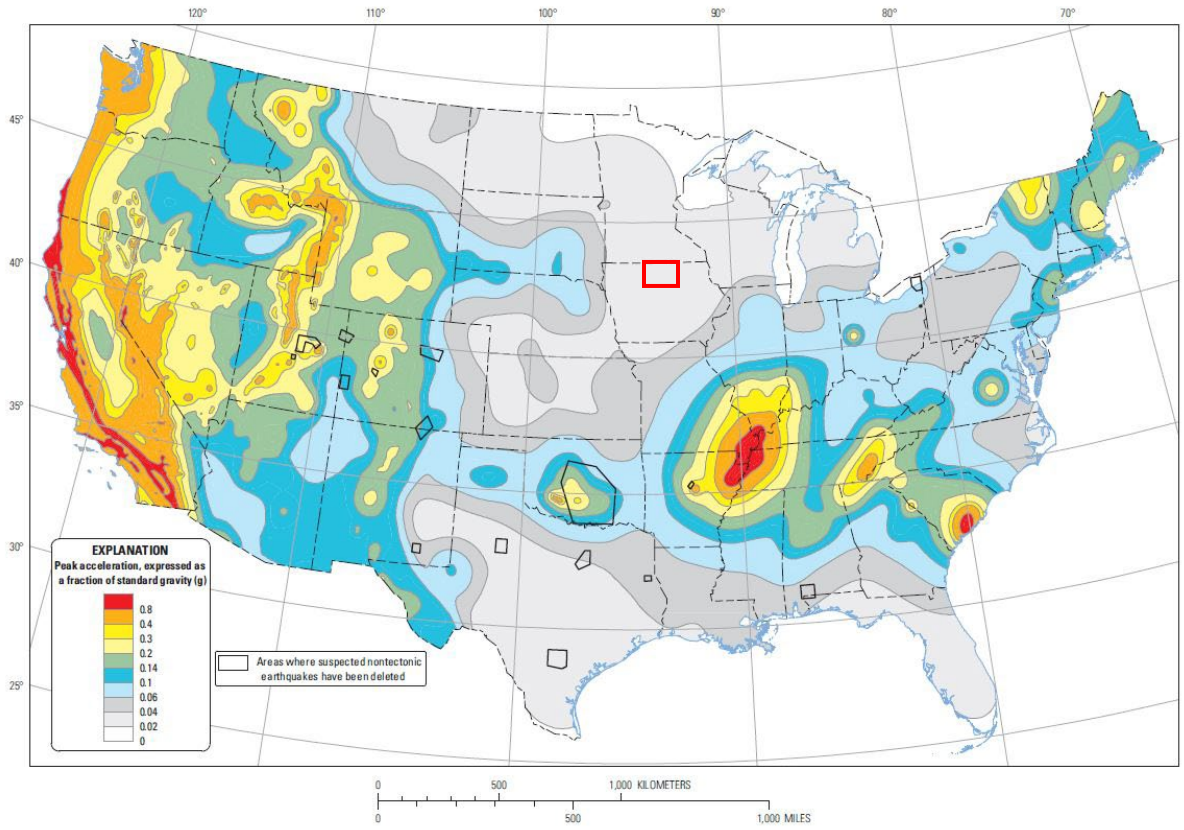
Figure 3.8 demonstrates the probabilistic ground motions with a 2 percent probability of exceedance. The red square shows the approximate Worth County boundary. As shown in this graphic, the probabilistic ground motions with a 2 percent probability of exceedance in the next 50 years is 0.04 peak acceleration, expressed as a fraction of standard gravity (g). The probability of a significant earthquake in any given year is “Unlikely”.

The 2014 U.S. Geological Survey (USGS) National Seismic Hazard Maps display earthquake ground motions for various probability levels across the United States and are applied in seismic provisions of building codes, insurance rate structures, risk assessments, and other public policy. The updated maps represent an assessment of the best available science in earthquake

hazards and incorporate new findings on earthquake ground shaking, faults, seismicity, and geodesy. The USGS National Seismic Hazard Mapping Project developed these maps by incorporating information on potential earthquakes and associated ground shaking obtained from interaction in science and engineering workshops involving hundreds of participants, review by several science organizations and State surveys, and advice from expert panels and a Steering Committee. The new probabilistic hazard maps represent an update of the seismic hazard maps; previous versions were developed by Petersen and others (2008) and Frankel and others (2002), using the methodology developed Frankel and others (1996). Algermissen and Perkins (1976) published the first probabilistic seismic hazard map of the United States which was updated in Algermissen and others (1990).

The National Seismic Hazard Maps are derived from seismic hazard curves calculated on a grid of sites across the United States that describe the annual frequency of exceeding a set of ground motions. Data and maps from the 2014 U.S. Geological Survey National Seismic Hazard Mapping Project are available for download below. Maps for available periods (0.2 s, 1 s, PGA) and specified annual frequencies of exceedance can be calculated from the hazard curves. Figures depict probabilistic ground motions with a 2 percent probability of exceedance. Spectral accelerations are calculated for 5 percent damped linear elastic oscillators. All ground motions are calculated for site conditions with Vs30=760 m/s, corresponding to NEHRP B/C site class boundary.

Figure 3.8. Two-percent probability of exceedance in 50 years map of peak ground acceleration



Source: United States Geological Survey, https://earthquake.usgs.gov/static/lfs/nshm/conterminous/2014/2014pga2pct.pdf Note: Red square shape is approximate location of Worth County, IA

Probability Score: 1—Unlikely

Vulnerability

Overview

Although a damaging event is unlikely, the potential impacts could be costly in the more urban areas of the County. Most structures in Worth County are not built to withstand earthquake shaking, but because of the relatively low magnitude of a possible quake, property damage would likely be very minor damage.

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

Magnitude Score: 1—Negligible

Potential Losses to Existing Development

FEMA's loss estimation software, HAZUS was utilized to analyze a 2,500-year probabilistic scenario earthquake event. This earthquake scenario is equivalent to a 2 percent probability of exceedence in 50 years. The earthquake scenario utilized is based on a probabilistic scenario, rather than a deterministic scenario. Therefore, this is not a magnitude-based scenario, but is rather based on ground shaking using the probabilistic mapping done by USGS (see http://earthquake.usgs.gov/hazards/products/conterminous/). The HAZUS Earthquake module reports earthquake damage by census tract. As a result, it is not possible to separate the resulting damage amounts by incorporated area, as the census tract boundaries are not the same as the incorporated area boundaries. **Table 3.32** below provides the results of the HAZUS analysis for Worth County. This analysis estimates that the total direct structural damage would be nearly $300,000. The combined building, contents and related economic losses such as lost wages, rental, and relocation costs are calculated to be nearly $1.25 million.

Table 3.32. Worth County, Iowa Estimated Economic Losses—2,500 Year Probabilistic Earthquake Event

	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses						
Wage	-	-	$40,000	-	$10,000	$70,000
Capital-Relocated	-	-	$40,000	-	-	$40,000
Rental	$10,000	$10,000	$30,000	-	-	$60,000
Relocation	$40,000	$10,000	$40,000	$10,000	$30,000	$140,000
Subtotal	**$60,000**	**$30,000**	**$150,000**	**$20,000**	**$50,000**	**$300,000**
Capital Stock Losses						
Structural	$90,000	$20,000	$50,000	$20,000	$60,000	$240,000
Non-Structural	$250,000	$40,000	$60,000	$20,000	$40,000	$410,000
Content	$50,000	-	$20,000	$10,000	$20,000	$100,000
Inventory	-	-	-	-	-	-
Subtotal	**$390,000**	**$60,000**	**$120,000**	**$60,000**	**$120,000**	**$750,000**
Total	**$450,000**	**$80,000**	**$270,000**	**$80,000**	**$180,000**	**$1,050,000**

Source: HAZUS-MH 2.2, January 2018

Table 3.33 provides the anticipated numbers of buildings by type and damage category that would result according to the HAZUS analysis. The estimated building types and counts are from the HAZUS damage outputs utilizing census block data. According to this analysis, 2 buildings would have extensive damage, 16 would have moderate damage, and 62 would have slight damage. Most buildings in the planning area (over 3,000) would not be damaged.

Table 3.33. Expected Building Damage by Building Occupancy Type

Use Type	None	Slight	Moderate	Extensive	Complete
Agricultural	171	6	2	0	0
Commercial	261	9	3	0	0
Education	13	0	0	0	0
Government	22	1	0	0	0
Industrial	84	3	1	0	0
Other Residential	212	9	3	0	0
Religious	27	1	0	0	0
Single Family	3,020	34	6	1	0
Total	**3,811**	**62**	**16**	**2**	**0**

Source: HAZUS-MH 2.2

Based on the estimate of 7 single-family and 3 other residential buildings with moderate, extensive, or complete damage, and considering the average household size in the county of 2.4, the displaced population would be approximately 24 people.

Future Development

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

Climate Change Impacts

No information was available to discuss the impacts that climate change might have on the frequency or severity of earthquakes.

Earthquake Hazard Summary by Jurisdiction

The following hazard summary table shows that this hazard does not significantly vary by jurisdiction. Although damage amounts would be higher in the more urban areas, damage ratios would be relatively the same.

Jurisdiction	Probability	Magnitude	Warning Time	Duration	Score	Level
Worth County, Iowa	1	1	4	1	1.40	Low
City of Fertile	1	1	4	1	1.40	Low
City of Grafton	1	1	4	1	1.40	Low
City of Hanlontown	1	1	4	1	1.40	Low
City of Joice	1	1	4	1	1.40	Low
City of Kensett	1	1	4	1	1.40	Low
City of Manly	1	1	4	1	1.40	Low
City of Northwood	1	1	4	1	1.40	Low
Central Springs Schools	1	1	4	1	1.40	Low
Northwood-Kensett Schools	1	1	4	1	1.40	Low

3.5.5 Expansive Soils

Hazard Score Calculation					
Probability	**Magnitude/Severity**	**Warning Time**	**Duration**	**Weighted Score**	**Level**
2	1	1	1	1.45	Low

Profile

Hazard Description

A relatively widespread geologic hazard for Iowa is the presence of soils that expand and shrink in relation to their water content. Expansive soils can cause physical damage to building foundations, roadways, and other components of the infrastructure when clay soils swell and shrink due to changes in moisture content. The effects of expansive soils are most prevalent in regions of moderate to high precipitation where prolonged periods of drought are followed by long periods of rainfall. These conditions exist in Worth County from time to time.

Warning Time Score: 1—24 + hours

The warning time for expansive soils is consistent with other geologic hazards that occur slowly overtime.

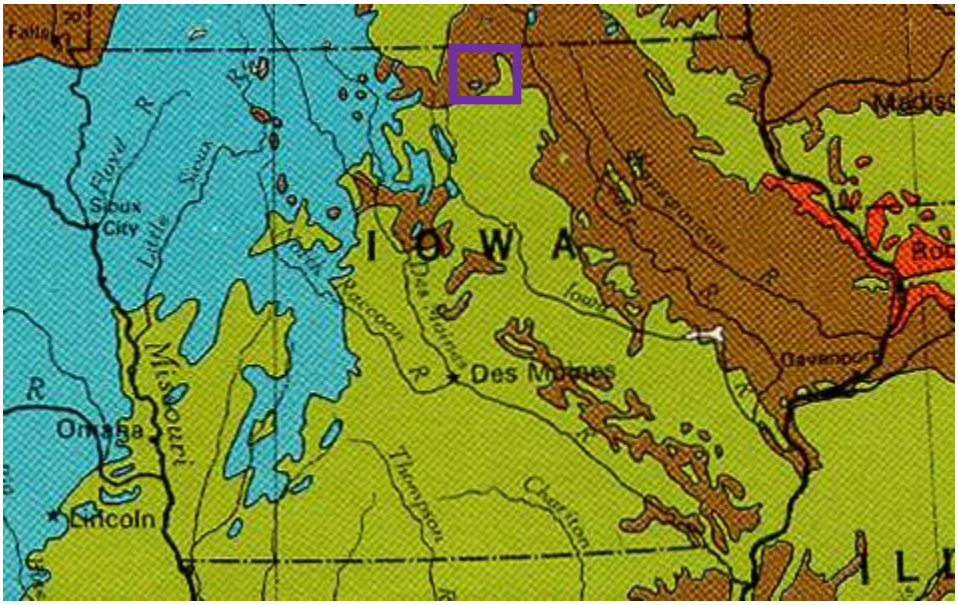
Duration Score: 1—Less than 6 hours

The duration of response to this hazard is limited in the State of Iowa. Although prolonged periods of drought are a primary indicator of risk followed by forecasted periods of precipitation, the response to expansive soils in Iowa is limited and is in large part coupled with response to flash flooding and river flooding.

Geographic Location/Extent

Figure 3.9 shows a map of the swelling potential of soils in Iowa. The majority of Worth County is located in an area with little or no swelling clay in the soil; however, in the southeastern portions of the county some areas may fall on soils where less than 50 percent of the soil unit consists of clay having slight to moderate swelling potential.

Figure 3.9. U.S. Geological Survey Swelling Clays Map of Iowa



MAP LEGEND

- Unit contains abundant clay having high swelling potential
- Part of unit (generally less than 50%) consists of clay having high swelling potential
- Unit contains abundant clay having slight to moderate swelling potential
- Part of unit (generally less than 50%) consists of clay having slight to moderate swelling potential
- Unit contains little or no swelling clay
- Data insufficient to indicate clay content of unit and/or swelling potential of clay (Shown in westernmost states only)

Source: U.S. Geological Survey publication "Swelling Clays Map of the Conterminous United States" by W.W. Olive, A.F. Chleborad, C.W. Frahme, Julius Schlocker, R.R. Schneider, and R.L. Shuster, 1989: Purple square indicates approximate location of Worth County.

Previous Occurrences

The Worth County planning committee does not report and past occurrences of damage caused by expansive soils. The *2013 Worth County Multi-Jurisdictional Hazard Mitigation Plan* excluded expansive soils from its risk assessment due to the low probability of occurrence. However, given the presence of some clays with slight to moderate swelling potential, the possibility for damages occurring remains. The frequency of damage from expansive soils can be associated with the cycles of drought and heavy rainfall, which reflect changes in moisture content. Damages occur with isolated incidents and affected property owners, local governments, and businesses generally make any necessary repairs.

Probability of Future Occurrence

It is unlikely that any damages resulting from expansive soils will become greater in the future unless new development occurs in areas where the hazard is more severe. In most cases, certain building and construction practices can be put in place to lessen these impacts.

Probability Score: 2—Occasional

Vulnerability

Overview

There is no data available to determine damage estimates for this hazard. In most cases, individual property owners, local governments, and businesses pay for repairs to damages caused by this hazard. Underground utility lines such as water and sewer pipes are also at risk to damages associated with expansive soils. Damages may occur gradually over time. There is no data to support damages and costs associated with this hazard at this time. This hazard does not impact human safety.

Magnitude Score: 1—Negligible

Potential Losses to Existing Development

Existing development will continue to be vulnerable to expansive soils.

Future Development

Additional future development in the planning area that occurs in areas with swelling clays present will also be vulnerable to this hazard. However, certain construction practices can be used to reduce physical vulnerability.

Expansive Soils Hazard Summary by Jurisdiction

This hazard does not vary substantially among jurisdictions.

Jurisdiction	Probability	Magnitude	Warning Time	Duration	Score	Level
Worth County, Iowa	2	1	1	1	1.45	Low
City of Fertile	2	1	1	1	1.45	Low
City of Grafton	2	1	1	1	1.45	Low
City of Hanlontown	2	1	1	1	1.45	Low
City of Joice	2	1	1	1	1.45	Low
City of Kensett	2	1	1	1	1.45	Low
City of Manly	2	1	1	1	1.45	Low
City of Northwood	2	1	1	1	1.45	Low
Central Springs Schools	2	1	1	1	1.45	Low
Northwood-Kensett Schools	2	1	1	1	1.45	Low

3.5.6 Extreme Heat

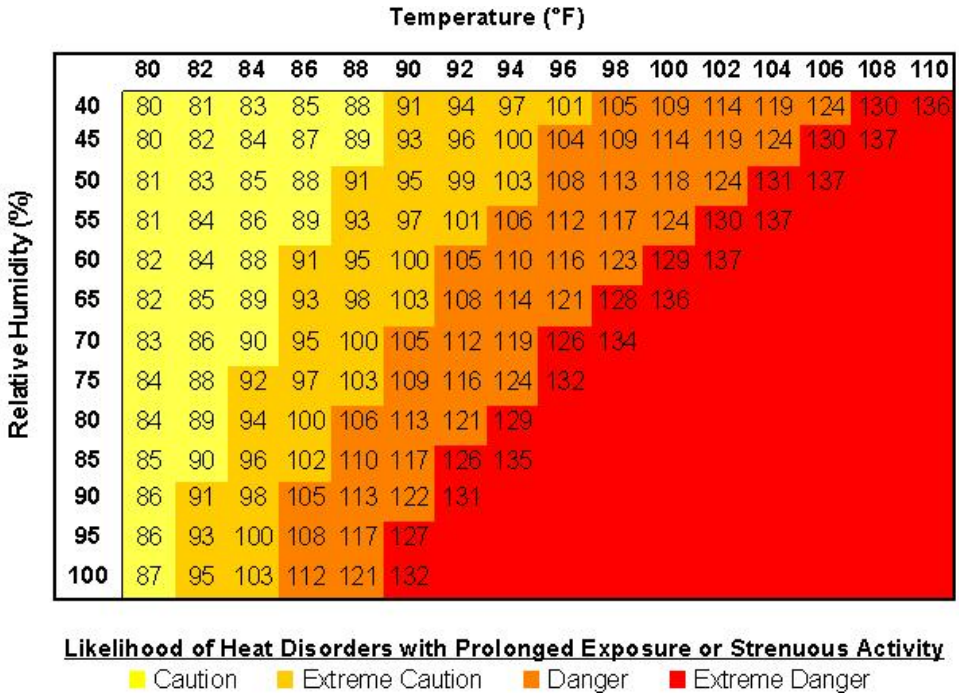
Hazard Score Calculation					
Probability	Magnitude/Severity	Warning Time	Duration	Weighted Score	Level
2	2	1	4	2.05	Moderate

Profile

Hazard Description

According to information provided by FEMA, extreme heat is defined as temperatures that hover 10 degrees Fahrenheit (°F) 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 3.10** uses both of these factors to produce a guide for the apparent temperature or relative intensity of heat conditions.

Figure 3.10. 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 over exposed 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, people who are overweight, and people who are ill or on certain medications. However, even young and healthy individuals are susceptible if they participate in strenuous physical activities during

hot weather. In agricultural areas, the exposure of farm workers, as well as livestock, to extreme heat is a major concern.

Table 3.34 lists typical symptoms and health impacts of exposure to extreme heat.

Table 3.34. 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 °F and the night time minimum Heat Index is 80 °F or above for two or more consecutive days. A heat advisory is issued when temperatures reach 105 °F and a warning is issued at 115 °F.

Warning Time Score: 1—More than 24 hours warning time

Duration Score: 4—More than one week

Geographic Location/Extent

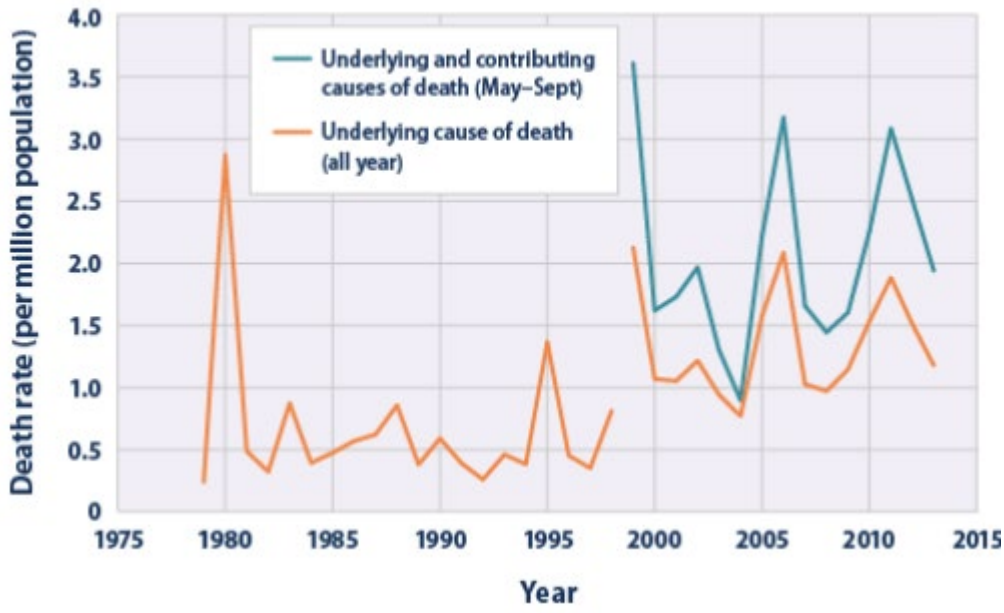
The entire planning area is subject to extreme heat and all participating jurisdictions are affected.

Previous Occurrences

Figure 3.11 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 2015, 45 people died nationally as a result of extreme heat. In 2014, there were 20 heat-related deaths. In 2013 there were 92 and in 2012, there were 155 deaths. The 10-year average for heat related fatalities is 124. Only one heat-related death has been reported for Iowa within the last 10 years, occurring in 2006. (Source: http://www.nws.noaa.gov/om/hazstats.shtml).

Figure 3.11. 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 Worth County for the month of July is 70.7º F with an average maximum temperature of 80.7º F; and the average temperature for the month of August is 68.3º F with an average maximum temperature of 78.6º F. (Source: http://climod.unl.edu/)

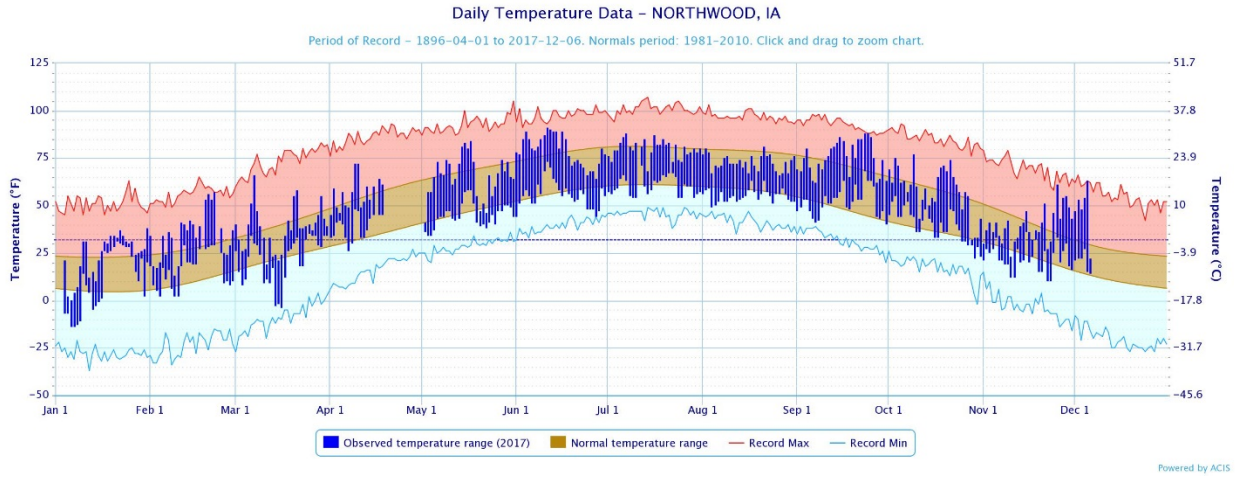
Accordint to data from High Plains RCC, from 1996 to 2017, there were 60 days with temperatures 91 °F or above (at least 10° above normal). When looking at only those events with a high temperature of 91 °F and higher that lasted for 3 consecutive days or more, there were six occurrences during the 20-year period from 1996 through 2017.

The following summarizes the National Weather Service Advisories, Watches, and Warnings for Heat or Excessive Heat in the Worth County zone from 1986 through 2016 (31 years of data):

- 13 Advisories
- 3 Watches
- 3 Warnings

Figure 3.12 provides the daily temperature averages and extremes at the Northwood, Iowa weather station for the period from 1981 to 2010 along with actual observed temperatures for 2017 from the High Plains Regional Climate Center.

Figure 3.12. Daily Temperature Averages and Extremes, Northwood, Iowa (1981 – 2017)



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

The National Climatic Data Center reported one regional heat event and two regional excessive heat events in and around the Worth 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 °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 °F 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 °F range and at times exceeded 110 °F. 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.

According to the USDA's Risk Management Agency, insured payments in Worth County for damages to crops as a result of heat and hot wind from 2007-2016 totaled $352,717. **Table 3.35** shows the insurable crop insurance claims paid in Worth County as a result of heat and hot wind.

Table 3.35. Claims Paid in Worth County for Crop Loss as a Result of Heat and Hot Wind (2007-2016)

Year	Hazard	Insurance Paid
2011	Heat	$42,302.00
2012	Heat	$307,158.00
	Hot Wind	$313.00
2013	Heat	$2,944.00
Insurance Paid		**$352,717.00**

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 2007 through 2011 and 2013 through 2016; or Heat in 2009, 2010, 2014, 2015, and 2016.

Probability of Future Occurrence

Based on six National Weather Service Heat/Excessive Heat Warnings and Watches from 1986 to 2016 (31 years), the probability of occurrence is 19.4 percent. This translates to a probability rating of "Occasional".

Probability Score: 2—Occasional

Vulnerability

Overview

Those at greatest risk for heat-related illness and deaths include people 65 years of age and older, people who are overweight, and people who are ill or on certain medications. To determine jurisdictions within the planning area with populations that may be more vulnerable to extreme heat, demographic data was obtained from the U.S. Census Bureau on numbers of people in each jurisdiction that are over the age of 65 are seen in **Table 3.36.** Data was not available on rates of obesity or those on certain medications.

Overall, Iowa is already older than the country as a whole. About 15 percent of its population is over 65 years, compared with 13 percent nationally. Worth County's population over 65 years is even higher than the national and state average at 19.8 percent. The participating jurisdictions with the highest percent of adults 65 and over in descending order are the cities of Notrhwood, Kensett, and Fertile.

Table 3.36. Worth County Population 65 years and Over, 2012-2016 American Community Survey 5-Year Estimates

Jurisdiction	Total Population	Population 65 yrs. and over	Percent 65 yrs. and over
Worth County, Iowa	7,562	1,494	19.8%
City of Fertile	346	68	19.7%
City of Grafton	355	67	18.9
City of Hanlontown	211	26	12.3
City of Joice	195	30	15.4

Jurisdiction	Total Population	Population 65 yrs. and over	Percent 65 yrs. and over
City of Kensett	345	69	20.0
City of Manly	1,551	248	16.0
City of Northwood	1,931	402	20.8
Central Springs Schools	N/A	N/A	N/A
Northwood-Kensett Schools	N/A	N/A	N/A

Source: U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates
N/A = data not available

Magnitude Score: 2—Limited

Estimated Losses to Existing Development

According to the USDA's Risk Management Agency, during the ten-year period from 2007-2016, the sum of claims paid for crop damages as a result of heat and hot wind was $352,717.00. According to the 2016 Iowa Crop Insurance Profile Report issued by the USDA's Risk Management Agency, 89 percent of Iowa insurable crops were insured. To factor in estimated losses to insurable crops that are not insured, the 89 percent crop insurance coverage was factored in to provide an adjusted estimate of losses. According to this calculation, estimated annualized losses total $19,446 (see **Table 3.37**).

Considering the value of crops from the 2012 Census of Agriculture as baseline crop exposure, the estimated annual losses from heat and hot wind was determined to be minimal (0.02%) compared to the value of the insurable crops.

Table 3.37. Estimated Insurable Annual Crops Lost Resulting from Heat

10-Year Extreme Heat Insurance Paid	Adjusted 10-Year Heat Losses (considering 89% insured)	Estimated Annualized Losses	2012 Value of Crops	Annualized Crop Loss Ratio (Losses/Value)
$352,717	$396,311	$39,631	$163,330,000	0.02%

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 USDA's 2016 State Crop Insurance Profile for Iowa

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-caued buckling and rupture costs an average of $400,000 annually across the State.

Future Development

Since Worth County is not experiencing large population growth, the number of people vulnerable to extreme heat is not increasing.

Climate Change Impacts

The following climate change impacts relative to Extreme Heat were included in the *2010 Climate Change Impacts on Iowa* report developed by the Iowa Climate Change Impacts Committee.

- 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.

Both of these impacts could increase the number extreme heat events in the planning area as well as the potential for negative impacts on people and agriculture.

Extreme Heat Hazard Summary by Jurisdiction

This hazard does not vary substantially by jurisdiction.

Jurisdiction	Probability	Magnitude	Warning Time	Duration	Score	Level
Worth County, Iowa	2	2	1	4	2.05	Moderate
City of Fertile	2	2	1	4	2.05	Moderate
City of Grafton	2	2	1	4	2.05	Moderate
City of Hanlontown	2	2	1	4	2.05	Moderate
City of Joice	2	2	1	4	2.05	Moderate
City of Kensett	2	2	1	4	2.05	Moderate
City of Manly	2	2	1	4	2.05	Moderate
City of Northwood	2	2	1	4	2.05	Moderate
Central Springs Schools	2	2	1	4	2.05	Moderate
Northwood-Kensett Schools	2	2	1	4	2.05	Moderate

3.5.7 Flash Flooding

Hazard Score Calculation					
Probability	Magnitude/Severity	Warning Time	Duration	Weighted Score	Level
4	2	3	1	2.95	Moderate

Profile

Hazard Description

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.

Riverine flooding is discussed separately in **Section 3.5.14** and flooding caused by dam failure is discussed in **Section 3.5.2**.

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.

Warning Time Score: 3 – 6 to 12 hours warning time. This refers to the period of time prior to the event with heightened awareness that a flash flood could occur, not the issuance of a "flash flood warning" by the National Weather Service.

Duration Score: 1—Less than 6 hours

Geographic Location/Extent

Worth County is located in nothern Iowa. The primary sources of flooding are the Shell Rock River, Deer Creek, Winnebago River, and Beaver Creek, with smaller streams including Winan's Creek having a slight impact

Flash flooding occurs in those locations of the planning area that are low-lying and/or do not have adequate drainage to carry away the amount of water that falls during intense rainfall events. According to NCDC and specific reports from planning committee members, flash flooding events have occurred in all of the Worth County jurisdictions participating in this plan, including the unincorporated county.

The National Weather Service has various flash flooding products that are issued to the public to provide information regarding upcoming and current flash flood threats (see **Table 3.44**).

Table 3.44 National Weather Service Flash Flooding Products

Product	What It Means	You Should...
Hazardous Weather Outlook	Will there be any threat of flash flooding in the next several days?	If there is a threat of flash flooding, check back later for updated forecasts and possible watches and warnings. Latest Hazardous Weather Outlook
Flash Flood Watch	There is a threat of flash flooding within the next 48 hours, either as a result of heavy rain, ice jams, or the threat of a dam break.	Monitor weather conditions closely, especially if you live in an area prone to flash flooding.
Flash Flood Warning	There is an immediate threat for flash flooding in the warned area, especially in low-lying and poor drainage areas. These warnings are updated frequently with Flash Flood Statements.	If you live in an area susceptible to flash flooding, be prepared to evacuate and head to higher ground. Be very cautious when driving in the warned area, especially at night or while it is still raining. You may not be able to see a flooded road until it is too late!
A *Flash Flood Emergency* may be declared when a severe threat to human life and catastrophic damage from a flash flood is imminent or ongoing. The declaration of a *Flash Flood Emergency* would typically be found in either a Flash Flood Warning or Flash Flood Statement. People are strongly encouraged to avoid the geographic area of concern in a *Flash Flood Emergency*. The *Flash Flood Emergency* wording is used very rarely and is reserved for exceptionally rare and hazardous events.		
Areal Flood Warning	The threat of flash flooding is over, but there is still significant standing water in the affected area.	Areal flood warnings will typically list locations and roads impacted by the flooding. Try to avoid these locations until the water has receded.

Source: National Weather Service, website accessed 8/26/2013 http://www.crh.noaa.gov/dmx/?n=preparefloodproducts

Previous Occurrences

Table 3.45 provides details regarding the flashflood and areal flood watches and warnings issued for Worth County forecast zone by National Weather Service. Areal flooding is a type of flash flooding that is generally over a large area usually due to the amount and duration of rainfall.

Table 3.45 Flash Flood-Related National Weather Service Watches and, Warnings Issued for Worth County and Worth County, Iowa Forecast Zone (1986 to 2017)

Type of Flood / Product Issued	1993	1996	1999	2000	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Areal Flood																				
Advisory										1	1	3								5
Warning										10			1		3	4		1		19
Watch								3	5	1										9
Flash Flood																				
Warning	1	4	5	2	3	2	1	1	3	7	2	5	2	1	4	3	2	9	1	57
Watch								1	4	6	1	10	1	3	3	5	4	2	1	40
Grand Total	**1**	**4**	**5**	**2**	**3**	**2**	**1**	**5**	**12**	**25**	**4**	**18**	**4**	**4**	**10**	**12**	**6**	**12**	**2**	**130**

Source: Iowa State University Department of Agronomy http://mesonet.agron.iastate.edu/vtec/search.php

As discussed in the Description Section, flash flooding can be caused by intense rainfall over a brief period. **Table 3.46** provides the top 30 rainfall events at the Northwood Climate Station from January 1, 1951 to July 2017.

Table 3.46 Top 30 Rainfall Events, Northwood Climate Station, 1951 to July 2017

Date	Amount (inches)
1990-08-19	6.65
2004-09-15	5.24
1978-06-15	5.06
2011-07-16	4.71
2016-08-24	4.55
1962-08-31	4.47
2004-05-22	4.43
2004-07-06	4.24
2016-09-22	4.13
1959-08-22	4.00
1969-06-26	3.70
1978-09-13	3.70
2008-06-08	3.63
1990-07-29	3.56
1983-09-19	3.45

Date	Amount (inches)
2002-08-05	3.37
1955-07-05	3.28
1954-06-19	3.17
2016-07-17	3.15
1975-08-22	3.15
1963-07-19	3.14
1978-07-06	3.08
1993-08-15	3.05
1986-08-26	3.02
1957-05-29	3.00
1959-08-23	3.00
1981-07-15	2.98
1999-06-06	2.96
2010-07-28	2.93
2014-08-18	2.81

Source: Iowa State University Department of Agronomy
http://mesonet.agron.iastate.edu/climodat/index.phtml?network=IACLIMATE&station=IA6566&report=02

Information from the NCDC was obtained from 1996 to 2016 to determine previous occurrences for flash flood in the planning area. This search did not reveal any flash flood incidents recorded from 1996 to 1998. Between 1999 and 2017, there were 23 flash flood events and 26 heavy rain events. During this time-frame, there were no injuries or deaths reported. Total property

damages for these events were estimated to be $2,515,000. **Table 3.47** provides a summary of the NCDC data.

Table 3.47 NCDC Worth County, Iowa Flash Flood Events Summary, 1996-2016

Date	# of Events	Property Loss
Flash Flood		
7/19/1999	1	$110,0000
7/20/1999	1	$100,000
7/9/2000	1	$50,000
5/21/2004	1	$100,000
9/15/2004	1	$100,000
8/21/2007	2	$20,000
6/7/2008	2	$150,000
6/8/2008	1	$10,000
6/12/2008	1	$25,000
7/15/2011	3	$70,000
6/1/2013	1	$200,000
6/12/2013	1	$100,000
7/13/2013	6	$480,000
8/24/2016	1	$10,000
Total	**23**	**$2,515,000**
Heavy Rain		
7/10/2009	1	$0
7/15/2011	6	$0
5/17/2013	2	$0
6/12/2013	2	$0
7/13/2013	3	$0
7/23/2015	2	$0
12/12/2015	1	$0
6/10/2016	1	$0
6/21/2016	2	$0
7/16/2016	1	$0
8/23/2016	2	$0
9/21/2016	3	$0
Total	**26**	$0
Grand Total	**49**	**$2,515,000**

Source: NCDC

Of the 23 flash flood events recorded in NCDC for Worth County during the 24-year period:

- 7 were located in Manly
- 4 were located in Northwood
- 3 were located in Hanlontown
- 3 were reported countywide
- 2 were located in Fertile
- 2 were located in Grafton
- 1 was located in Joice
- 1 was located in Kensett

Flash flood events with significant property loss include the following:

- July 19, 1999 - A nearly stationary frontal boundary was draped across Iowa during the afternoon of the 18th into the night. Thunderstorms erupted in the vicinity of the front as

dew point temperatures in the mid 70s to around 80 °F pooled just south of front. Most of the storms produced heavy rain and gusty winds with very few producing severe weather. Two distinct mesoscale convective systems moved across northern Iowa. The main problem was flash flooding over north central Iowa. Near Manly in Worth County, 5.75 inches of rain was recorded in a 4 hour period just after midnight. Numerous basements were flooded and roads overtopped by water. Heavy rains also fell over northeast Cerro Gordo County, overtopping many roads with 1 to 2 feet of water. The heaviest rainfall occurred over Worth County. A bucket survey indicated spot 9 to 12 inch rainfall amounts northeast of Manly, with the highest unofficial measurement at 13.5 inches, though there was one report of an incredible 20 inches of rain. The county Emergency Manager reported that 25% of the county was covered by water with at least 75 washouts. It was reported that 550 of the buildings in town, or about half, had water in the basement. A 54 car train was derailed in the area just southwest of Grafton and at least 3 major highways were closed, Iowa Highway 9, U.S. Highway 18, and U.S. Highway 65. Flooding hit a campground southeast of Manly near the town of Rock Falls. One hundred and fifty people were evacuated in the town of Rock Falls itself. The water flooded the campground and debris was recovered three miles downstream of the campground. Flooding affected the town of Greene where half of the businesses in town were flooded. There were several other evacuations as well; one of the larger was along the Winnebago River in the Mason City area where 400 homes along the river were ordered evacuated. Some of the totals in property damage include 2 homes destroyed in Worth County, 56 suffered major damage, and 249 sustained minor damage Governor Vilsack declared 8 counties in Iowa disaster areas. In the Des Moines CWA, these included Bremer, Butler, Cerro Gordo and Worth. Crop damage was also quite extensive in these two counties with many fields under water. It will be some time before the true extent of the damage is known however.

- May 21, 2004 - A very unstable airmass was over Iowa and helped kick off the seasons first severe weather outbreak. At the surface a warm frontal boundary extended nearly east to west across the state and provided the focus for thunderstorm development. By the late afternoon, lifted indices were approaching -10 C. with CAPE values around 5000 J/kg over western Iowa. Thunderstorms continued to fire along and north of the boundary through the afternoon and into the evening. This resulted in widespread flash flooding as very heavy rains fell on areas that had had significant rainfall the previous night. There were reports in north central into northeast Iowa of 2 to 4 inches of rainfall in a little more than an hour's time. Major flooding took place in the Mason City area where evacuations were taking place. The thunderstorms became most intense during the afternoon into the early evening.

- September 15, 2004 - A strong southerly flow developed over Iowa as a cold frontal boundary slid southeast into the state. Heavy rainfall fell over northern Iowa. The rain fell in areas that had about 1.5 inches of rain the previous night. Flash flooding occurred in Worth County, where 8 inches of rain washed out roads in the Joice area.

- June 7, 2008 - Low pressure developed over Kansas with a strong southerly flow of very moist air streaming into Iowa ahead of it. The most significant weather feature with this event was the heavy rainfall. The antecedent soil conditions in Iowa were extremely

wet, such that flash flooding was caused by rainfall of an inch or more in an hour, even in rural areas. Heavy rainfall of 3 to 6 inches occurred in a broad swath extending from west central into north central, and parts of central and northeast Iowa. This resulted in widespread flash flooding. Eventually, the rain lead to major to record flooding along many of the rivers in the state. At one point or another, about 40 of the DMX 51 counties in the CWA were under flash flood warning. The situation was very serious over the north central and northeast counties.

- June 1, 2013 - A cold front dropped slowly southeast into Iowa. The severe parameters were not strong, however a narrow line of thunderstorms developed over north central Iowa into western Wisconsin. The storms trained along a slow-moving line. Shear was strong with about 65 kts of shear available. CAPE was a little over 1500 J/kg, with around 400 J/kg of CAPE available in the -10 to -30 C layer of the atmosphere. The storms produced hail up to golf ball size over north central Iowa. They also produced heavy rainfall of 2 to 3 inches in a short period of time in parts of Worth County in spite of the precipitable water values that were just under an inch. Antecedent soil conditions were nearly saturated. The heavy rains caused road closings as the water flooded over county roads. Flooding continued in the Grafton area well into the day Saturday once the flash flooding ended.

- July 13, 2013 - A large convective complex developed to the northwest of Iowa during the night of the 12th into the morning of the 13th. Precipitable water values were very high, in excess of 2.1 inches over Minnesota. Thunderstorms began to turn south into Iowa in the morning and continue to feed into the inflow of moisture. In spite of the precipitable water values being much lower over Iowa, moisture convergence was strong making the storms very efficient rain producers. Three to six inches of rain fall over parts of north central IA. Some of the heavier rainfall, 4.75 to 5.5 inches, fell in the Lake Mills area of Winnebago County. The heavy rain caused flash flooding in Worth County with several streets flooded. Basement flooding was extensive in the town of Fertile. Flash flooding was also reported in parts of Winnebago County. Due to the relatively dry soil condition at the beginning of the rainfall, flooding was not as serious as would normally be expected. General flooding continued into the night in Winnebago County.

The US Army Corps of Engineers, Cold Regions Research and Engineering Laboratory (CRREL) maintains a database of historic ice jams. According to a query of that database from 1950 to the present, no ice jams have occurred in the Worth County planning area (Source: http://rsgisias.crrel.usace.army.mil/apex/f?p=524:1:0::NO).

Probability of Future Occurrence

The frequency of past events is used to gauge the likelihood of future occurrences. The events from NCDC that occurred on the same day were combined to determine the total number of 23 damaging flash flooding events in the planning area over the 21-year period from 1996 through 2016. This translates to over a 100-percent likelihood of flash flooding somewhere in the planning area in any given year. Therefore, the probability rating is “Highly Likely”.

Probability Score: 4—Highly Likely

Vulnerability

Vulnerability Overview

Water over low-lying roads and bridges is the most frequent impact associated with flash flooding that has occurred in the planning area. This can cause washout of bridge abutments and erosion/scour damage on roads. There is potential for loss of life if motorists drive into moving water. However, public education campaigns have helped to educate citizens about not driving through moving water. Building damage is generally limited to water in basements where rain is too intense for drainage systems and natural drainage to carry water away from the structure. In addition, when combined storm/sanitary sewer systems are overloaded, this can result in sewer back-up. Generally, flash-flooding is short in duration and government services and business operations are not impacted.

Based on the number of historical occurrences, 49 flash flooding related events within a 24-year period; and the narrative descriptions of previous events, the magnitude was determined to be limited.

Magnitude Score: 2—Limited

Potential Losses to Existing Development

When roads and bridges are inundated by water, damage often occurs as the water scours materials around bridge abutments and gravel roads.

The water can also cause erosion undermining road beds. In some instances, steep slopes that are saturated with water may cause mud or rock slides onto roadways. These damages can cause costly repairs for state, county, and city road/bridge maintenance departments. When sewer back-up occurs, this can result in costly clean-up for home and business owners as well as present a health hazard.

Based on loss estimates reported by NCDC, property losses averaged $119,792 per year over the 21-year period from 1996 through 2016.

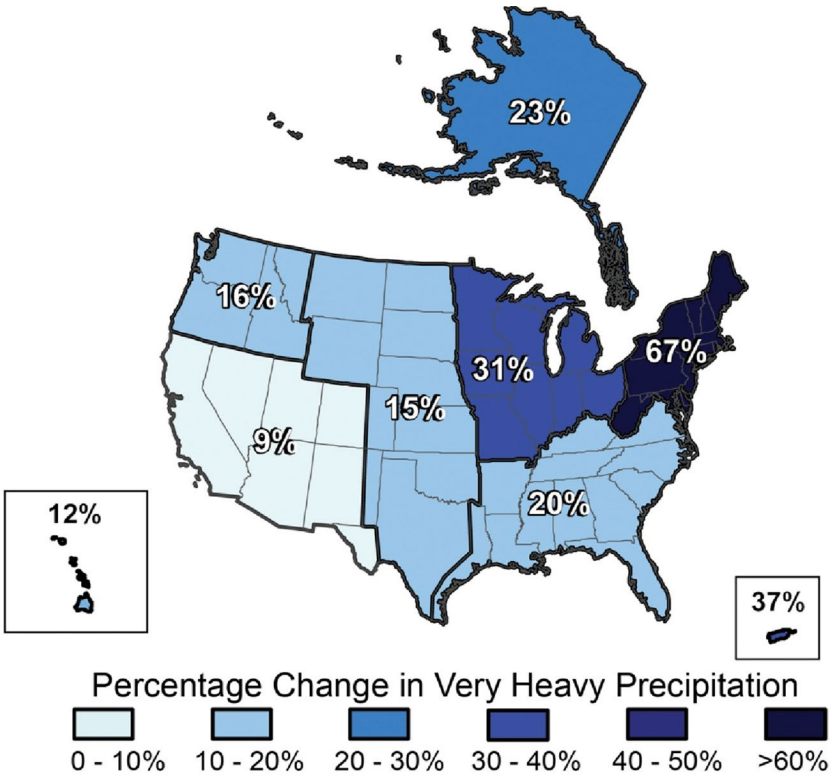
Future Development

In planning future development, jurisdictions in the planning area should avoid development in low-lying areas near rivers and streams or where interior drainage systems are not adequate to provide drainage during heavy rainfall events. Future development should also take into consideration the impact of additional impervious surfaces to water run-off and drainage capabilities during heavy rainfall events.

Climate Change Impacts

One of the climate change impacts noted in the *2010 Climate Change Impacts on Iowa* report by the Iowa Climate Change Impacts Committee is the increase in frequency of severe precipitation events. **Figure 3.50** shows that all of Iowa is in the region with a 31% increase in very heavy precipitation from 1958 to 2007. For this study, very heavy precipitation was defined as the heaviest 1% of all events.

Figure 3.31. Increase in Very Heavy Precipitation in the U.S., 1958-2007



Source: Karl, T.R., J.M. Melillo, and T.C. Peterson(eds). 2009. G*lobal Climate Change Impacts in the United States*. U.S. Global Climate Change Research Program. Cambridge University Press and http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts as cited in the *2010 Climate Change Impacts on Iowa* report by the Iowa Climate Change Impacts Committee

If this trend increases, flash flooding events and their associated impacts will likely occur more often in the planning area.

Flash Flood Hazard Summary by Jurisdiction

For all participating jurisdictions, the magnitude was determined to be limited due to the large number of flash flooding events reported in NCDC and by the planning representatives for these jurisdictions. For the remaining jurisdictions, the magnitude was determined to be negligible due to the small number of reported flash flooding events or no flash flooding events reported for these areas.

Jurisdiction	Probability	Magnitude	Warning Time	Duration	Score	Level
Worth County, Iowa	1	2	4	4	2.05	Moderate
City of Fertile	1	2	4	4	2.05	Moderate
City of Grafton	1	2	4	4	2.05	Moderate
City of Hanlontown	1	2	4	4	2.05	Moderate
City of Joice	1	2	4	4	2.05	Moderate
City of Kensett	1	2	4	4	2.05	Moderate
City of Manly	1	2	4	4	2.05	Moderate
City of Northwood	1	2	4	4	2.05	Moderate
Central Springs Schools	1	2	4	4	2.05	Moderate
Northwood-Kensett Schools	1	2	4	4	2.05	Moderate

3.5.8 Grass or Wildland Fire

Hazard Score Calculation					
Probability	**Magnitude/Severity**	**Warning Time**	**Duration**	**Weighted Score**	**Level**
3	2	4	1	2.65	Moderate

Profile

Hazard 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

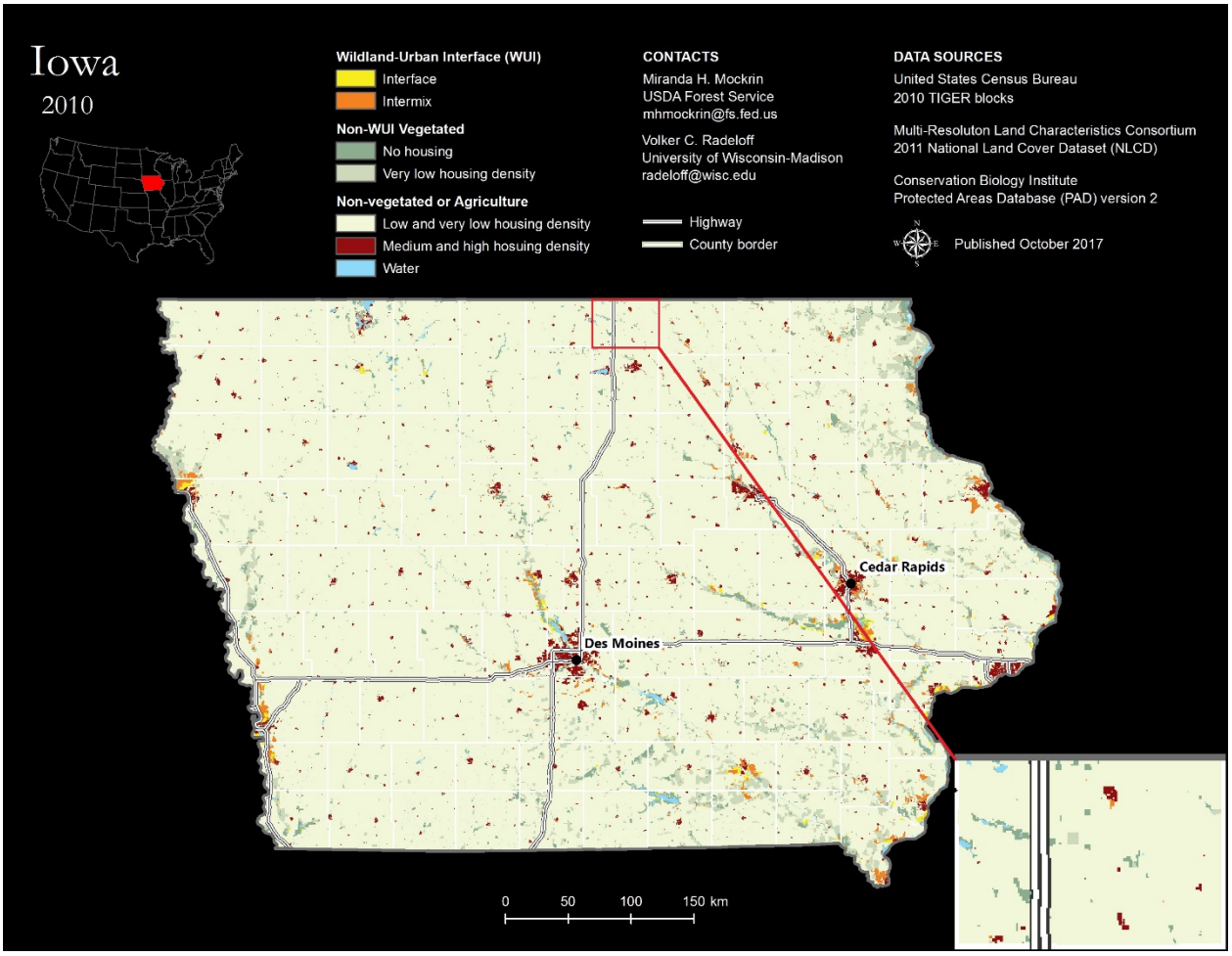
Warning Time Score: 4—Minimal or no warning time.

Duration Score: 1—Less than 6 hours

Geographic Location/Extent

Wildland/Grass fires are most likely to occur in the Wildland Urban Interface (WUI). This is the area where houses meet or intermingle with undeveloped wildland vegetation. Within the WUI, there are two specific areas identified: 1) Interface and 2) Intermix. The interface areas are those areas that abut wildland vegetation and the Intermix areas are those areas that intermingle with wildland areas. As can be seen in **Figure 3.32**, Worth County has a moderate amount of intermix areas (orange) near Northwood as well as sprinkled throughout other parts of the county.

Figure 3.32. Worth County Wildland Urban Interface, 2010



Source: SILVIS Lab, Department of Forest Ecology and Management, University of Wisconsin-Madison; WUI 2010, http://silvis.forest.wisc.edu/maps/wui/state10

Previous 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. For the 2013 plan the planning committee determined that the probability of a grass or wildland fire in any given year was more than 33 percent based on the amount of fires typically reported. Although grass/wildland fires do occur annually, not all are significant enough to cause notable damage. Therefore, the probability rating for damaging events for this hazard is "Likely".

Probability Score: 3—Likely

Vulnerability

Overview

Areas that are most vulnerable to wildfire are agricultural areas where land is burned, rural areas where trash and debris are burned, and the wildland-urban interface/intermix areas.

To demonstrate how vulnerability to this hazard varies by jurisdiction, the 2010 spatial data indicating acreage of Wildland Urban Interface/Intermix areas from the SILVIS Lab, Department of Forest Ecology and Management, University of Wisconsin-Madison was compared against the corporate boundary layer for the planning area. **Table 3.38** and **Table 3.39** provide additional details.

Table 3.38. Worth County Wildland/Urban Interface and Intermix Acres

Jurisdiction	Intermix (acres)	Interface (acres)
Fertile	0	0
Grafton	0	0
Hanlontown	0	0
Joice	0	0
Kensett	0	0
Manly	0	0
Northwood	157	0
Unincorporated	291	0
Total	**448**	**0**

Source: SILVIS Lab, Department of Forest Ecology and Management, University of Wisconsin-Madison; WUI 2010, http://silvis.forest.wisc.edu/maps/wui/2010/download

Table 3.39. Wildland Urban Intermix / Interface Acreage by WUI Class

WUI Class	Acres
High Density Intermix	0.3
Medium Density Intermix	118
Low Density Intermix	329
Total	**447**

Source: SILVIS Lab, Department of Forest Ecology and Management, University of Wisconsin-Madison; WUI 2010, http://silvis.forest.wisc.edu/maps/wui/2010/download

Potential Losses to Existing Development

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.

Magnitude Score: 2—Limited

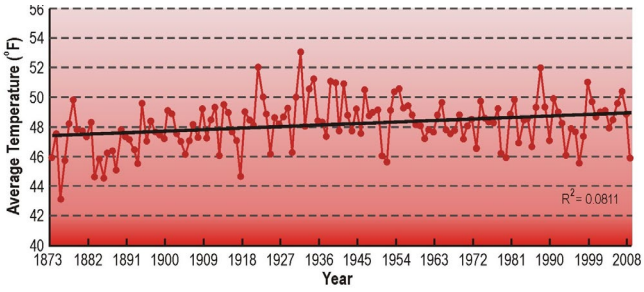
Future Development

Future development in the wildland-urban interface/intermix areas would increase vulnerability to this hazard. Most growth in the county has occurred in the Cities of Grafton and Kensett, neither of which contain areas of Wildland-Urban Interface or Intermix. Most new residential development has occurred in the City of Northwood, which does contain Wildland-Urban Intermix, but the overall trend in Northwood has been a decline in housing units, so overall vulnerability is not expected to increase.

Climate Change Impact

According to the *2010 Climate Change Impacts on Iowa* report, by the Iowa Climate Change Impacts Committee, the annual average temperature has been increasing over the last 136 years. **Figure 3.33** shows this data graphically.

Figure 3.33. Annual Average of Statewide Daily Average Temperatures (^{0} F)



Source: *2010 Climate Change Impacts on Iowa* report, by the Iowa Climate Change Impacts Committee, Data from the Iowa Climatology Bureau, 2010

If Iowa were to experience a severe drought, as has occurred frequently in the past, the slow and steady rise in statewide annual mean temperature, masked in summer by moist surface conditions during non-drought years, could lead to an abrupt switch to extreme summer heat comparable to the summers of 1983 or 1988. If these conditions occur, the occurrence of wildfire would be expected to increase as was seen recently in 2012.

Grass or Wildland Fires Hazard Summary by Jurisdiction

Grass or Wildland fires can occur in all jurisdictions. However, the magnitude is potentially worse in jurisdictions with more wildland/urban intermix areas. Jurisdictions with more than 100 acres of intermix/interface were assigned a magnitude of 2, limited and jurisdictions with less than 100 acres of intermix/interface were assigned a magnitude of 1, negligible. There is less potential for wildland/grass fires impacting schools due to general locations away from Wildland Urban Interface Areas. Again, if a wildland/grass fire were to occur near school buildings, the magnitude would be lower due to close proximity to firefighting services.

Jurisdiction	Probability	Magnitude	Warning Time	Duration	Score	Level
Worth County, Iowa	3	2	4	1	2.65	Moderate
City of Fertile	3	1	4	1	2.35	Moderate
City of Grafton	3	1	4	1	2.35	Moderate
City of Hanlontown	3	1	4	1	2.35	Moderate
City of Joice	3	1	4	1	2.35	Moderate
City of Kensett	3	1	4	1	2.35	Moderate
City of Manly	3	1	4	1	2.35	Moderate
City of Northwood	3	2	4	1	2.65	Moderate
Central Springs Schools	3	1	4	1	2.35	Moderate
Northwood-Kensett Schools	3	1	4	1	2.35	Moderate

3.5.9 Hazardous Materials

Hazard Score Calculation					
Probability	Magnitude/Severity	Warning Time	Duration	Weighted Score	Level
3	1	4	1	2.35	Moderate

Profile

Hazard Description

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

Fixed Hazardous Materials Incident

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

Transportation Hazardous Materials Incident

A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during transport. Transportation Hazardous Materials Incidents in Worth County can occur during highway 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.

Warning Time Score: 4—Less than six hours warning time

Duration Score: 1—Less than 6 hours

Geographic Location/Extent

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

Fixed Hazardous Materials Incident

According to the Iowa Department of Natural Resources, there are 25 sites in Worth County that because of the volume or toxicity of the materials on site were designated as Tier II Facilities under the Superfund Amendments and Reauthorization Act.

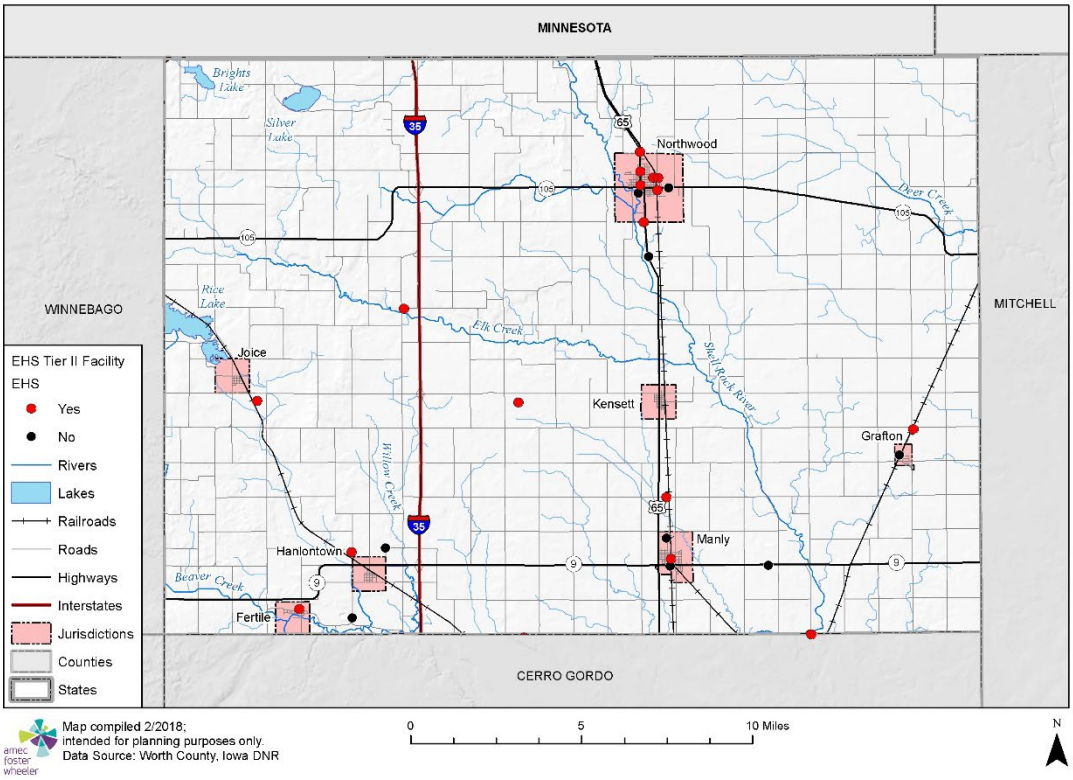
Table 3.40 provides the number of Tier II Facilities for each jurisdiction in the planning area as well as the number of facilities housing Extremely Hazardous Substances (EHS). Note: The jurisdiction is assigned from the address. Some facilities do fall within the unincorporated areas but are identified with the nearest city. **Figure 3.34** that follows is a map showing the locations of Tier II Facilities.

Table 3.40. Number of Tier II Facilities by Jurisdiction

Jurisdiction	# of Facilities	# of EHS Facilities
Fertile	2	1
Grafton	2	1
Hanlontown	2	1
Joice	1	1
Kensett	1	1
Manly	5	2
Northwood	12	8
Total	**25**	**15**

Source: Department of Natural Resources, NRGIS

Figure 3.34. Tier II Facilities in Worth County



Transportation Hazardous Materials Incident

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

Truck Transport

Hazardous materials can be transported on any of the roads in Worth County. Main conduits of transport include Interstate 35, U.S Highway 65, Iowa Highway 1, Iowa Highway 105, and Iowa Highway 9. Agriculture is important to the economy of Worth County; as a result, chemicals utilized in agriculture are frequently transported along county and local roadways.

Figure 3.35. Worth County Highways

Source: Google Maps

Rail Transport

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

Air Freight

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

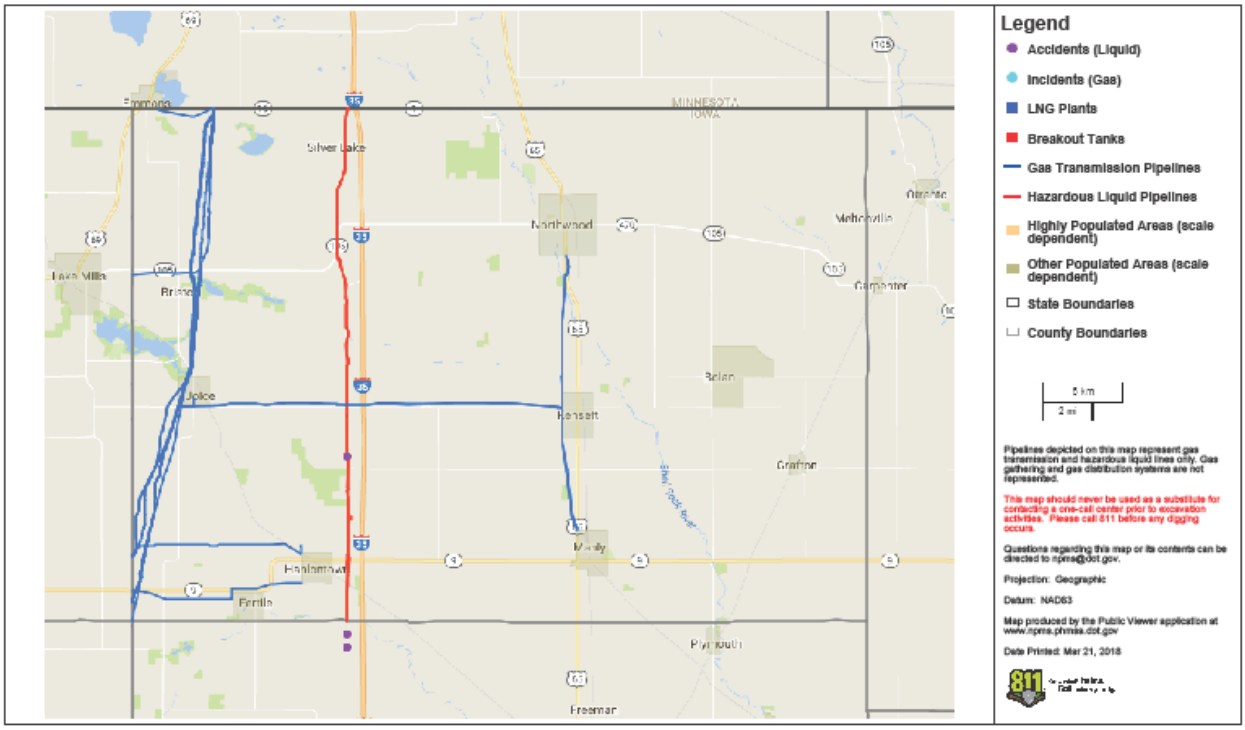
Figure 3.36. Northwood Municipal Airport

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

Pipeline Incident

Figure 3.37 provides the locations of pipelines in Worth County. The data for this map consists of gas transmission pipelines and hazardous liquid trunklines. It does not contain gathering or distribution pipelines, such as lines which deliver gas to a customer's home. Therefore, not all pipelines in the County will be visible.

Figure 3.37. Pipelines in Worth County



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

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

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

Previous 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 2016 (17 years), there have been 108 hazardous materials spills reported in Worth County. **Table 3.41** provides a summary of the reported spills during this time period for each jurisdiction indicated in the database as well as the mode of the spill. According to this data, the most spills occurred in the Estherville (35) and most spills occurred during the handling and storage process (58). **Table 3.42** that follows summarizes the spills by material type. Petroleum is the most common material type spilled with 63 spils of this type.

Table 3.41. Worth County Hazardous Materials Spills Reported to Iowa DNR, 2000-2016 by Jurisdiction and Mode

Jurisdiction	Fire	Handling and Storage	Manure	Other	Pipeline	Railroad	Theft	Transformer	Transportation	Unknwon	Grand Total
Fertile				1					1		2
Forest City									1		1
Grafton		2						1			3
Hanlontown		16			4		2		4		26
Joice		9	1	1	5				8		24
Kensett		1							3		4
Lake Mills		14									14
Manly		3		4		1	1		5	1	15
Northwood	3	13		2				5	12	1	36
Plymouth			1					1			2
Saint Ansgar									2		2
Unincorporated County				1							1
Grand Total	**3**	**58**	**2**	**9**	**9**	**1**	**3**	**7**	**36**	**2**	**130**

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

Table 3.42. Worth County Hazardous Materials Spills Reported to Iowa DNR, 2000-2016 by Material Type

Jurisdiction	Acids/Bases	Animal/Vegetable Product	Fertilizer/Pesticide	Inorganic Chemical	Manure	Organic Chemical	Petroleum	Propane/LPG/Natural Gas	Transformer oil/PCB	Not Reported	Grand Total
Fertile							2				2
Forest City							1				1
Grafton			1				1		1		3
Hanlontown		8	2			2	10			4	26
Joice	1		3	4	1	1	8			6	24
Kensett							2			2	4
Lake Mills				1		2	11				14
Manly	2					2	10			1	15
Northwood		1	5	1		1	15	1	5	7	36
Plymouth				1					1		2
Saint Ansgar							2				2
Unincorporated County							1				1
Grand Total	**3**	**10**	**11**	**7**	**1**	**8**	**63**	**1**	**7**	**1**	**130**

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

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 2015, there were no reported pipeline incidents in Worth County.

Probability of Future Occurrence

From 2000 to 2016 (17 years), there have been 130 spills reported to Iowa DNR. This computes to an annual average of over 7.6 hazardous materials spills per year. Therefore, the probability of future occurrence of hazardous materials incidents is determined to be "Highly Likely".

Probability Score: 4—Highly Likely

Vulnerability

Vulnerability Overview

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.

Most of the hazardous materials incidents that have occurred in Worth County are localized and are quickly contained or stabilized. Depending on the characteristic of the hazardous material or the volume of product involved, the affected area can be as small as a room in a building or as large as 5 square miles or more. Many times, additional regions outside the immediately affected area are evacuated for precautionary reasons. More widespread effects occur when the product contaminates the municipal water supply or water system such as river, lake, or aquifer. Spills can be costly to clean up due to the specialized equipment and training, and disposal sites that are necessary. Since the majority of spills in the county are small and quickly maintained within existing capabilities, the magnitude was determined to be "Negligible".

Magnitude Score: 1—Negligible

Potential Losses to Existing Development

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

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

To analyze critical facilities at risk in the planning area, the inventory of critical and essential facilities and infrastructure in the planning area was compiled from various sources including Worth County, the Department of Natural Resources NRGIS, and HSIP Freedom 2015. The compiled inventory consisted of 97 critical facilities. A comparison was made of the critical facilities with the locations of Tier II Facilities to determine those critical/essential facilities/functions (other than Tier II facilities themselves) that are within ½ mile of Tier II fixed chemical facilities. This analysis revealed 37 critical or essential facilities within ½ mile of fixed chemical facilities with the Tier II reporting requirement. Appendix E contains the results of analysis. This Appendix is redacted from the public version of this plan. To obtain access for official use, contact the Worth County Emergency Manager.

Future Development

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

Hazardous Materials Hazard Summary by Jurisdiction

Although spills do occur in the unincorporated area, they are primarily recorded in the database associated with the nearest city. The probability score was based on the number of spills for each jurisdiction during this period. Jurisdictions that recorded more than 20 spills correspond to a probability score of 4; 10-20 spills correspond to a score of 3; 0-10 spills correspond to a score of 2; and jurisdictions with no spills received a score of 1. The magnitude was determined to be "negligible" based on the general types and quantities of spills that have occurred. Probability and magnitude for the schools and community college were unlikely and negligible, as hazardous materials are not generally stored on site in large quantities.

Jurisdiction	Probability	Magnitude	Warning Time	Duration	Score	Level
Worth County, Iowa	1	1	4	1	1.45	Low
City of Fertile	2	1	4	1	1.90	Low
City of Grafton	2	1	4	1	1.90	Low
City of Hanlontown	4	1	4	1	2.80	Moderate
City of Joice	4	1	4	1	2.80	Moderate
City of Kensett	2	1	4	1	1.90	Low
City of Manly	3	1	4	1	2.35	Moderate
City of Northwood	4	1	4	1	2.80	Moderate
Central Springs Schools	1	1	4	1	1.45	Low
Northwood-Kensett Schools	1	1	4	1	1.45	Low

3.5.10 Human Disease

Hazard Score Calculation					
Probability	Magnitude/Severity	Warning Time	Duration	Weighted Score	Level
2	3	2	4	2.50	Moderate

Profile

Hazard 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 3.46)**. Vaccine preventable diseases continue to threaten the health of Iowans when children, adolescents and adults are un-immunized or under-immunized.

Influenza

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

Influenza is highly contagious and is easily transmitted through contact with droplets from the nose and throat of an infected person during coughing and sneezing. Typical symptoms include headache, fever, chills, cough, and body aches. Although most people are ill for only a few days some may have secondary infections, such as pneumonia, and may need to be hospitalized. Anyone can get influenza, but it is typically more serious in the elderly and people

with chronic illnesses such as cancer, emphysema, or diabetes or weak immune systems. It is estimated that thousands of people die each year in the United States from flu or related complications.

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 3.44** under Previous Occurrence for the number of deaths and rate from 2007-2016 for Worth County and Iowa as a whole.

Pandemic Influenza

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

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

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

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

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

Foodborne Disease

There are several agents that can cause illness when consumer in contaminated food, beverages or water. Foodborne illness (food poisoning) can also be spread person-to-person as well as from contact with animals. **Table 3.43** is a list of common foodborne diseases.

Table 3.43. 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
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).

Warning Time Score: 2—12-24 hours

Duration Score: 4—More than 1 week

Geographic Location/Extent

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

Previous Occurrences

The World Health Organization tracks and reports on epidemics and other public health emergencies through the Global Alert and Response (see historic epidemics at www.who.int/en/).

There have been four acknowledged pandemics in the past century:

- **2009 H1N1 Influenza**—The 2009 H1N1 Pandemic Influenza caused 659 hospitalizations with lab confirmed H1N1 since 9/1/09 and resulting in 41 fatalities. Typically people who became ill were the elderly, the very young and people with chronic medical conditions and high risk behaviors.
- **1968–69 Hong Kong flu (H3N2)** —This strain caused approximately 34,000 deaths in the United States and more than 700,000 deaths worldwide. It was first detected in Hong Kong in early 1968 and spread to the United States later that year. Those over age 65 were most

likely to suffer fatal consequences. This virus returned in 1970 and 1972 and still circulates today.

- **1957–58 Asian flu (H2N2)** —This virus was quickly identified because of advances in technology, and a vaccine was produced. Infection rates were highest among school children, young adults and pregnant women. The elderly had the highest rates of death. A second wave developed in 1958. In total, there were about 70,000 deaths in the United States. Worldwide deaths were estimated between one and two million.
- 1**918–19 Spanish flu (H1N1)** —This flu is estimated to have sickened 20-40 percent of the world's population. Over 20 million people lost their lives. Between September 1918 and April 1919, 500,000 Americans died. The flu spread rapidly; many died within a few days of infection, others from secondary complications. The attack rate and mortality was highest among adults 20-50 years old; the reasons for this are uncertain.

Other Reportable Diseases

Table 3.44 shows the historical reported deaths in Worth County from Influenza and Pneumonia as well as Infective and Parasitic Disease

Table 3.44. Deaths by Year 2007-2016, Influenza and Pneumonia and Infective and Parasitic Disease, Worth County and State of Iowa

Year	Influenza/Pneumonia Deaths, Worth County	Influenza/Pneumonia Deaths, Iowa	Infective/Parasitic Disease Deaths, Worth County	Infective/Parasitic Disease Deaths, Iowa
2016	*	483	*	429
2015	*	592	*	488
2014	*	549	*	448
2013	*	755	*	511
2012	*	656	*	511
2011	*	657	*	464
2010	*	557	0	441
2009	*	633	*	457
2008	*	825	*	493
2007	*	748	*	427

Source: Iowa Department of Public Health, Bureau of Health Statistics-Vital Statistics of Iowa in Brief, http://idph.iowa.gov/health-statistics/data

* Counts are suppressed to protect confidentiality.

Table 3.45 lists the number of common reportable diseases in Worth County from 2007 to 2016 from the Iowa Department of Public Health, Center for Acute Epidemiology Annual Reports.

Table 3.45. Iowa Common Reportable Diseases by Year in Worth County

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
AIDS (Diagnosis)	0	0	0	0	*	0	0	0	N/A	N/A
HIV (Diagnosis)	0	0	0	*	0	0	0	0	N/A	N/A
Campylobacteriosis	1	0	0	3	4	2	1	0	3	5
Chlamydia	5	9	8	12	7	8	5	6	N/A	N/A
Cryptospora	2	0	0	0	0	0	1	0	0	6
E.Coli	1	0	1	1	0	0	0	1	0	1
Ehrlich (HME)	0	0	0	0	0	0	0	0	0	0
Giardia	1	0	1	0	0	0	0	0	0	0
Gonorrhea	0	0	1	2	0	2	0	1	N/A	N/A

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
HUS	0	0	0	0	0	0	0	0	0	0
Hep A	0	0	0	0	0	0	0	0	0	0
Hep B, Acute	0	0	0	0	0	0	0	0	0	0
Hep B, Chron	0	0	0	0	0	0	0	0	0	0
Legion	0	0	0	0	0	0	0	0	0	0
Listeria	0	0	0	0	0	0	0	0	0	0
Lyme	1	0	1	1	1	0	0	0	0	0
Meningo.Inf	0	0	0	0	0	0	0	0	0	0
Mumps	0	0	0	0	0	0	0	0	0	1
Pertussis	0	0	2	1	0	26	0	0	0	0
Rabies (Animal)	0	0	0	0	0	0	0	0	N/A	N/A
RMSF	0	0	0	0	0	0	0	0	0	0
Salmonellosis	0	1	0	2	0	1	0	2	1	2
Shigella	0	0	0	1	0	0	0	0	0	0
Syphilis	0	1	0	0	0	0	0	0	N/A	N/A
TB	0	0	0	0	0	0	0	0	N/A	N/A
West Nile Virus	N/A	0	0	0	0	0	0	0	0	0

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

Probability of Future Occurrence

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

Probability Score: 2—Occasional

Vulnerability

Overview

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

According to the Iowa Department of Public Health 2014 Immunization Program Annual Report, Worth County had 98.69 percent with immunization certificates in kindergarten through 12th grade. The County Immunization Assessment for 2-year old and 13-15-year old coverage from the 2016 Annual Report is provided in **Table 3.46**. The percent of up-to-date children is above the state average of 69 percent, and the percent of adolescents up-to-date is nearly on par with the state average of 58 percent.

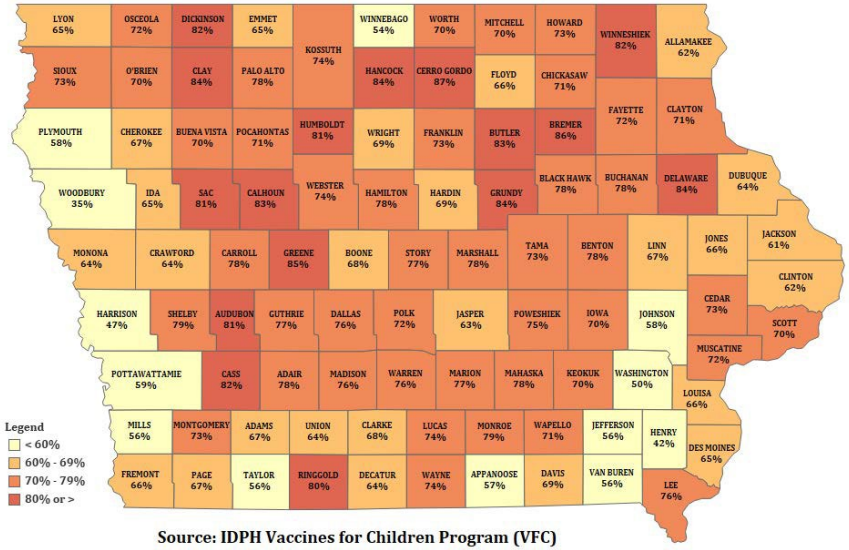
Table 3.46. 2016 Vaccination Coverage Percent of Individual Vaccines and Selected Vaccination Series in Worth County (2-year old coverage and 13-15 year old coverage)

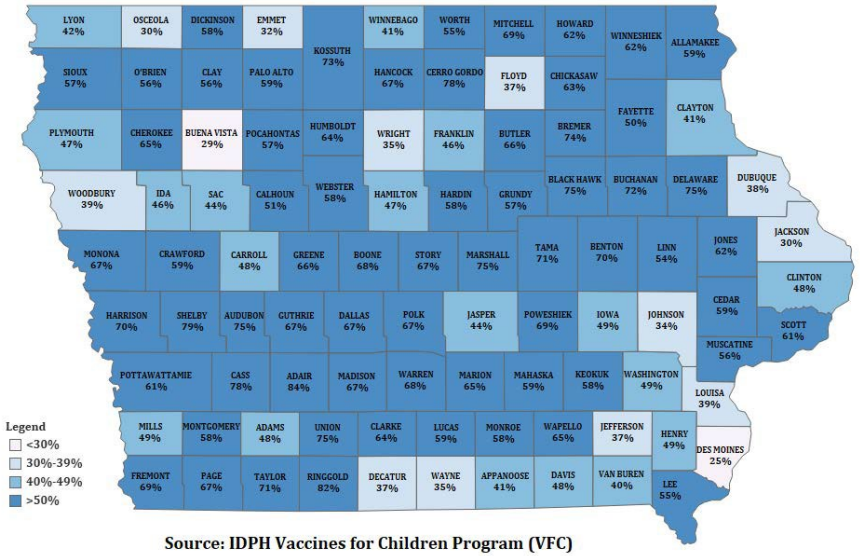
	County Population Born 2014 Estimate	Total Records Analyzed from IRIS	Percent of Population in IRIS	4 DTaP Coverage Percent	3 Polio Coverage Percent	1 MMR Coverage Percent	3 Hib Coverage Percent	3 Hep B Coverage Percent	1 Varicella Coverage Percent	4 PCV Coverage Percent	Up-To-Date 4-3-1-3-3-1-4 Coverage Percent
2-Year Old Coverage	74	91	123.0	76	90	98	91	86	98	75	70
	County Population 2014 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	250	283	113.2	95	63	89	86	78	55	31	19

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

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

Figure 3.38. County Immunization Assessment Maps (2-year Old Coverage-left, 13-15-year Old Coverage-right)





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

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

(1) identification and isolation of the ill,

(2) quarantine of those exposed to the illness to prevent further spread, and

(3) education of the public about methods to prevent transmission.

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

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

Magnitude Score: 3—Critical

Potential Losses to Existing Development

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

The pandemic predictions for Iowa from the *Iowa Pandemic Influenza Annex*, 2006 are that 15-35 percent of the population may be affected with a "medium level" case scenario with no vaccine and no antiviral drugs, which could cause 900-2,000 deaths and 3,000-7,000 hospitalizations statewide. Also, the predictions state that if a pandemic were to occur, it is likely that it would not be a worst-case scenario. Most agricultural-related jobs could continue and school and other congregating activities could be cancelled, resulting in less spreading of a disease outbreak.

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

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

Future Development

The population in Worth County is declining, falling from 7,628 in 2010 to 7,562 in 2016. Thus, there are not as many people to potentially fall ill from a human disease. However, 19.8 percent of the population is 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.

Climate Change Impacts

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

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

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

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

Human Disease Hazard Summary by Jurisdiction

Due to disease spreading more quickly in areas with high density, the community school districts were given a magnitude of 4. Due to their small populations and low population densities, the unincorporated county and cities, which all have with populations less than 2,000, were given a magnitude of 3. The rest of the elements are not varied across jurisdictions.

Jurisdiction	Probability	Magnitude	Warning Time	Duration	Score	Level
Worth County, Iowa	2	3	2	4	2.50	Moderate
City of Fertile	2	3	2	4	2.50	Moderate
City of Grafton	2	3	2	4	2.50	Moderate
City of Hanlontown	2	3	2	4	2.50	Moderate
City of Joice	2	3	2	4	2.50	Moderate
City of Kensett	2	3	2	4	2.50	Moderate
City of Manly	2	3	2	4	2.50	Moderate
City of Northwood	2	3	2	4	2.50	Moderate
Central Springs Schools	2	4	2	4	2.80	Moderate
Northwood-Kensett Schools	2	4	2	4	2.80	Moderate

3.5.11 Infrastructure Failure

Hazard Score Calculation					
Probability	Magnitude/Severity	Warning Time	Duration	Weighted Score	Level
4	2	4	3	3.30	High

Profile

Hazard 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.

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.

Structural Failure / Structure Fire

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

Warning Time Score: 4—less than six hours warning time

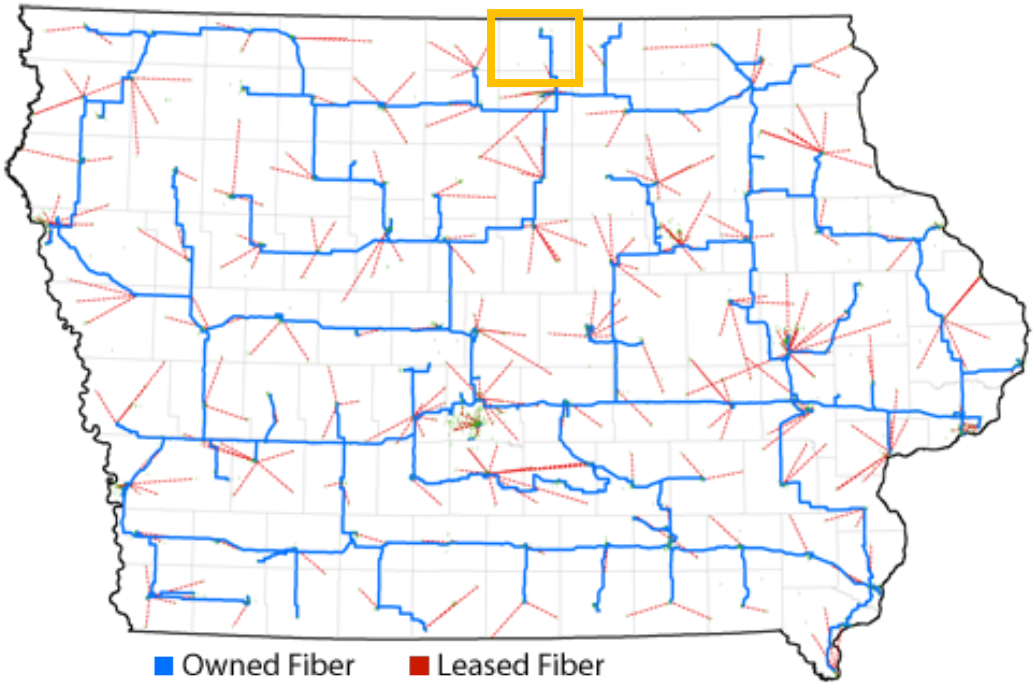
Duration Score: 3—less than 1 week

Geographic Location/Extent
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.

Communications

Figure 3.39 shows the Iowa Communications Network (ICN) that administers Iowa's statewide fiber optic telecommunications network.

Figure 3.39. Map of Iowa Communication Network



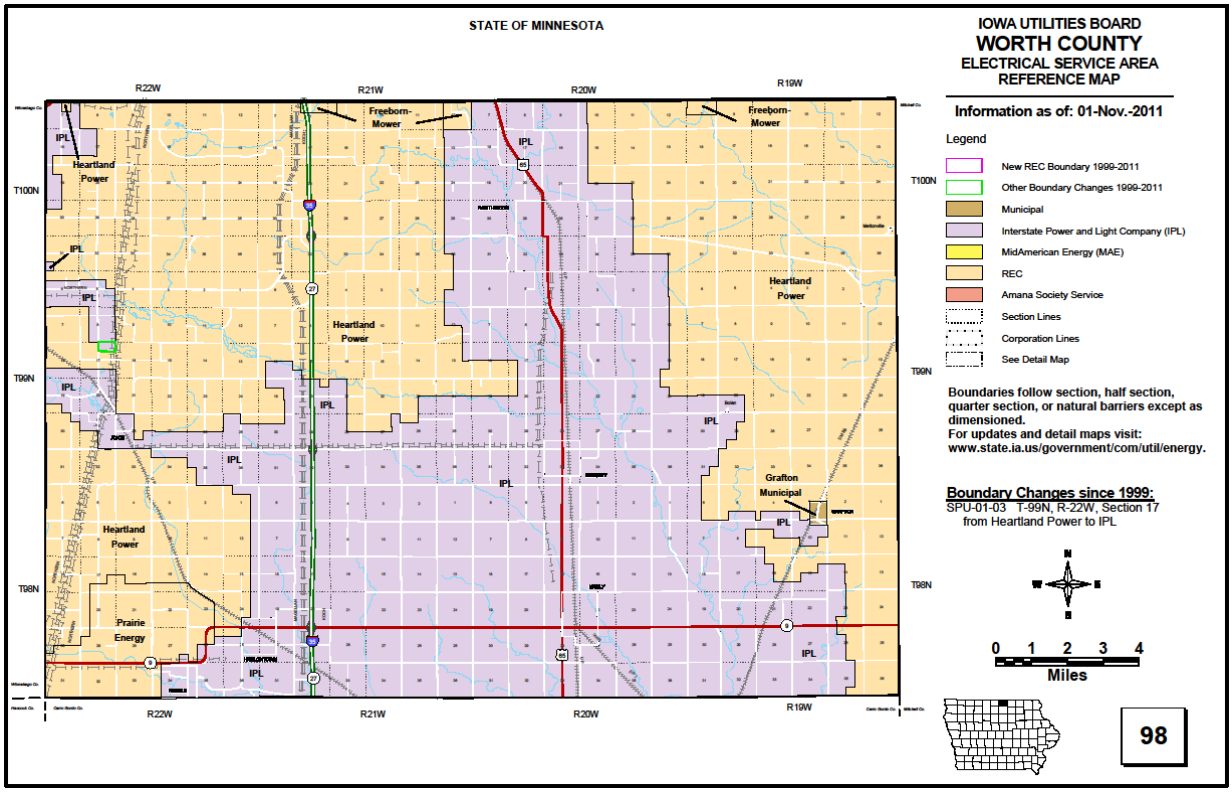
Source: http://icn.iowa.gov/about-icn/agency-information-icn-story
Note: Orange box outlines Worth County.

Energy

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 3.40 is the electrical service area map for Worth County.

Figure 3.40. Electrical Service Areas in Worth County



Source: http://www.iowadot.gov/maps/msp/electrical/electrical.html

Other Utilities (Water/Sewer)

Water

There are seven Water Supply Systems in Worth County, Iowa as follows:

- Northwood Waterworks (Serves 2,050 people)
- Manly Water Supply (Serves 1,342 people)
- Fertile Municipal Water (Serves 360 people)
- Grafton Water Supply (Serves 290 people)
- Kensett Water Supply (Serves 280 people)
- Joice Water Supply (Serves 231 people)
- Hanlontown Water Supply System (Serves 229 people)

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

Sewer

There are 10 permitted wastewater treatment discharge sites in Worth County, Iowa according to the Department of Natural Resources (see **Table 3.47)**.

Table 3.47. Permitted Wastewater Sites in Worth County

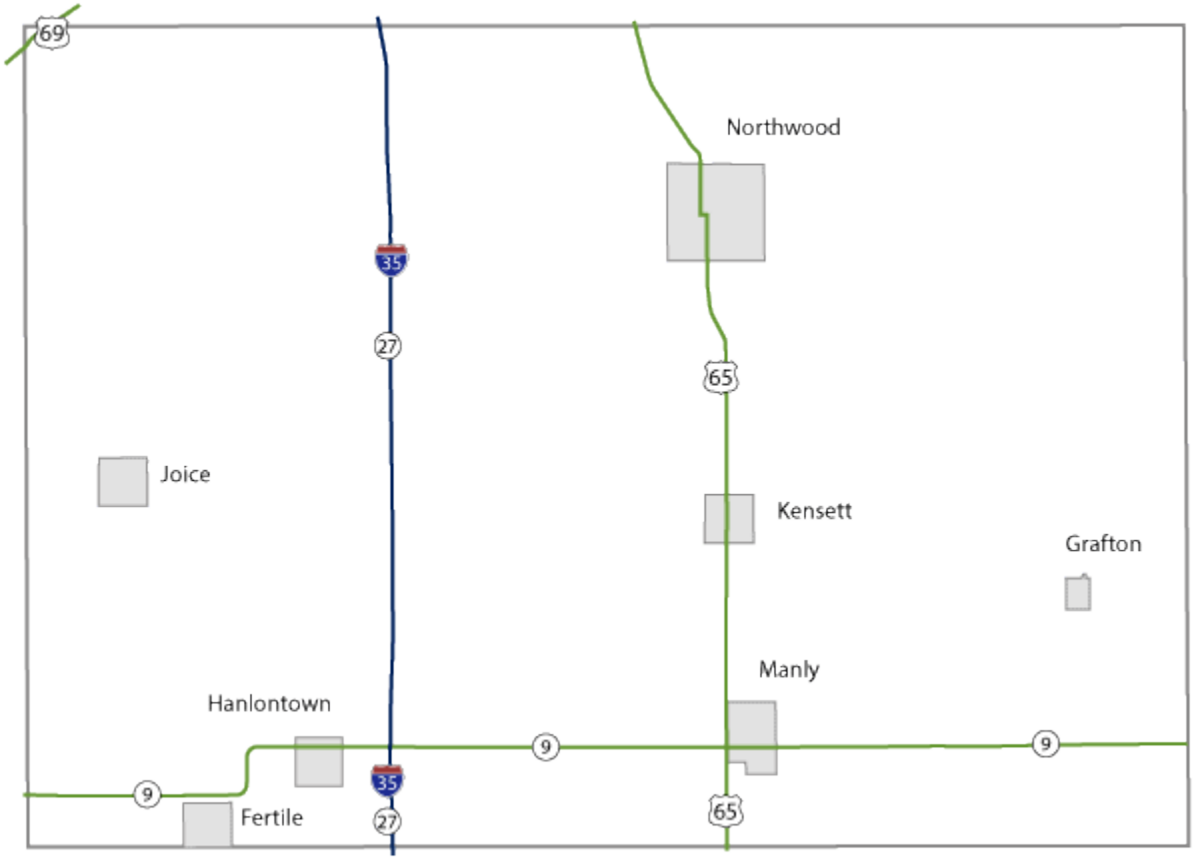
Facility Name	Facility City	Permit Type	Class	Sic Code	Treatment Type
Fertile, City of STP	Fertile	Municipal	Minor	4952	Waste Stabilization Lagoon
Grafton, City of STP	Grafton	Municipal	Minor	4952	Waste Stabilization Lagoon
I35-105 Interchange Commercial District	Northwood	Semi-Public	Minor	7993	Activated Sludge
Iowa Ethanol LLC D/B/A Poet Biorefining Hanlontown	Hanlontown	Industrial	Minor	2869	Primary Treatment
Joice, City of STP	Joice	Municipal	Minor	4952	Waste Stabilization Lagoon
Kensett, City of STP	Kensett	Municipal	Minor	4952	Waste Stabilization Lagoon
Manly, City of STP	Manly	Municipal	Minor	4952	Waste Stabilization Lagoon
New Heaven Chemicals Iowa LLC – SMO Manufacturing Plant	Manly	Industrial	Minor	2869	Other
Northern Natural Gas Co. – Lake Mills Compressor Station	Lake Mills	Operation	Minor	4922	No Treatment
Northwood, City of STP	Northwood	Municipal	Minor	4952	Aerated Lagoon

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

Infrastructure/Structures

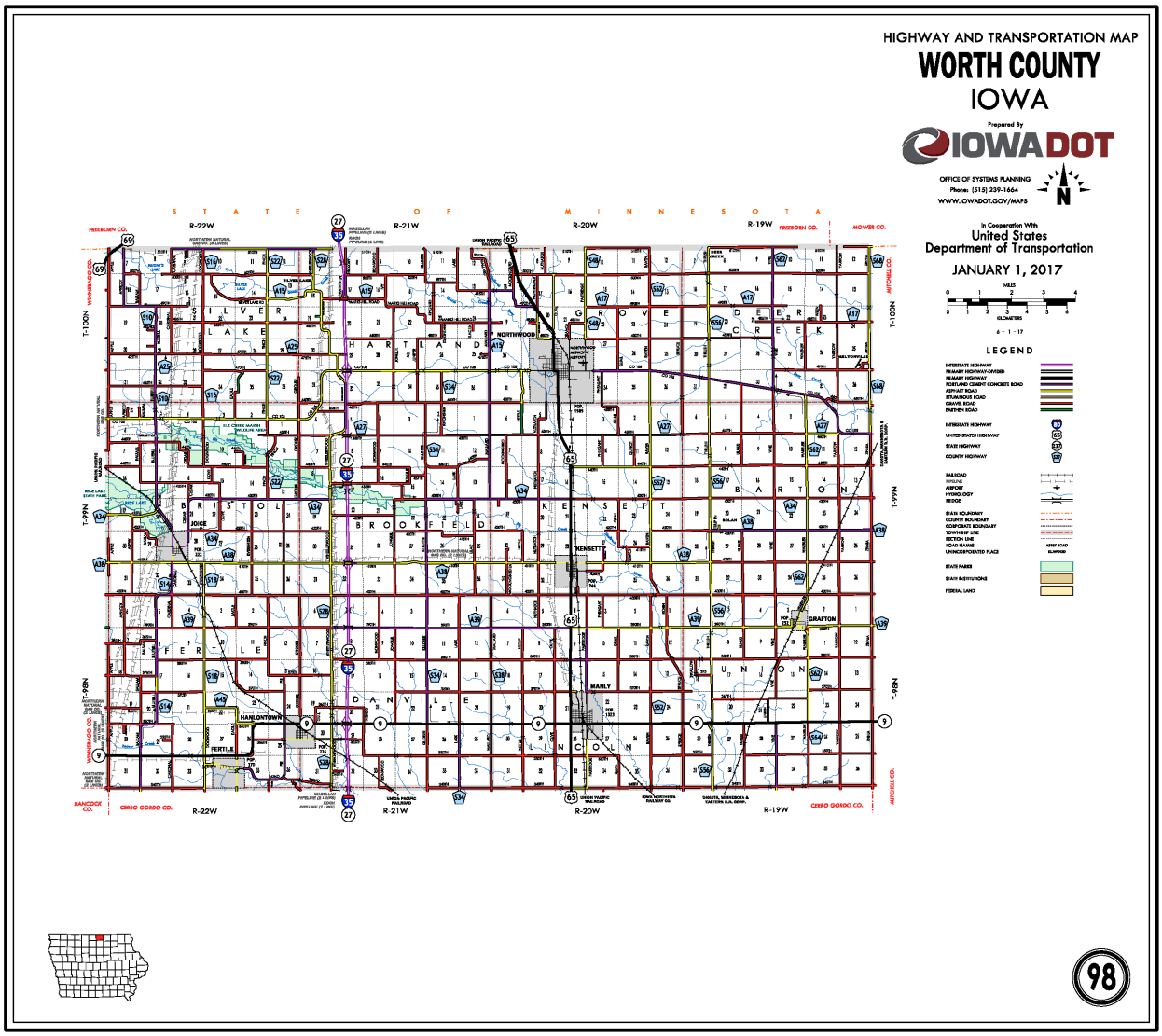
The Highway map for Worth County is provided in **Figure 3.41**. The detailed Highway and Transportation Map that includes other transportation infrastructure in the county is provided in **Figure 3.42**.

Figure 3.41. Worth County Highway Map



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

Figure 3.42. Worth County Transportation Map



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

There is a total of 114 bridge structures in Worth County as follows:

- 25 state-owned bridges
- 85 county-owned bridges
- 4 city-owned bridges

Previous Occurrences

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

According to the *2013 Worth County Multi-Jurisdictional Hazard Mitigation Plan*, structural fires are almost a daily occurrence in Worth County, but nearly all are extinguished easily within the normal day-to-day response capability of local fire departments.

Probability of Future Occurrences
As discussed in other hazard sections in this plan, infrastructure failure occurs as a secondary or cascading impact from several primary hazards such as winter storm, 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".

Probability Score: 4—Highly Likely

Vulnerability

Vulnerability Overview
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.

The Iowa Department of Transportation has conducted inspections of bridges in the state. **Table 3.48** provides a summary of the condition of the 114 bridges in Worth County.

Table 3.48. Worth County Bridge Condition, SDFO Ratings, Weight Restrictions

Condition Index Rating—State-Owned Bridges		
Good	Fair	Poor
14	11	0
Condition Index Rating-County-Owned Bridges		
Good	Fair	Poor
35	47	3
Condition Index Rating-City-Owned Bridges		
Good	Fair	Poor
2	2	0
Condition Index Rating—All Bridges in Worth County		
Good	Fair	Poor
51	60	3
Structurally Deficient/Functionally Obsolete (SDFO) Rating—All Bridges in Worth County		
Not Deficient	Structurally Deficient	Functionally Obsolete
93	21	0
Weight Restrictions—All Bridges in Worth County		
Unrestricted	Restricted	Closed
100	10	1

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

Magnitude Score: 2—Limited

Potential Losses to Existing Development

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 3.49**).

Table 3.49. 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

Future Development

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

Climate Change Impacts

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

Infrastructure Failure Incident Hazard Summary by Jurisdiction

All jurisdictions within the planning area are at risk to infrastructure failure.

Jurisdiction	Probability	Magnitude	Warning Time	Duration	Score	Level
Worth County, Iowa	4	2	4	3	3.30	High
City of Fertile	4	2	4	3	3.30	High
City of Grafton	4	2	4	3	3.30	High
City of Hanlontown	4	2	4	3	3.30	High
City of Joice	4	2	4	3	3.30	High
City of Kensett	4	2	4	3	3.30	High
City of Manly	4	2	4	3	3.30	High
City of Northwood	4	2	4	3	3.30	High
Central Springs Schools	4	2	4	3	3.30	High
Northwood-Kensett Schools	4	2	4	3	3.30	High

3.5.12 Landslide

Hazard Score Calculation					
Probability	Magnitude/Severity	Warning Time	Duration	Weighted Score	Level
1	1	2	1	1.15	Low

Profile

Hazard Description

A landslide is the downhill movement of masses of soil and rock by gravity. The basic ingredients for landslides are gravity, susceptible soil or rock, sloping ground and water. Landslides occur when susceptible rock, earth, or debris moves down a slope under the force of gravity and water. Landslides may be very small or very large and can move at slow to very high speeds. A natural phenomenon, small scale landslides have been occurring in slide-prone areas of Iowa long before human occupation. New landslides can occur because of rainstorms, fires, earthquakes and various human activities that modify slope and drainage.

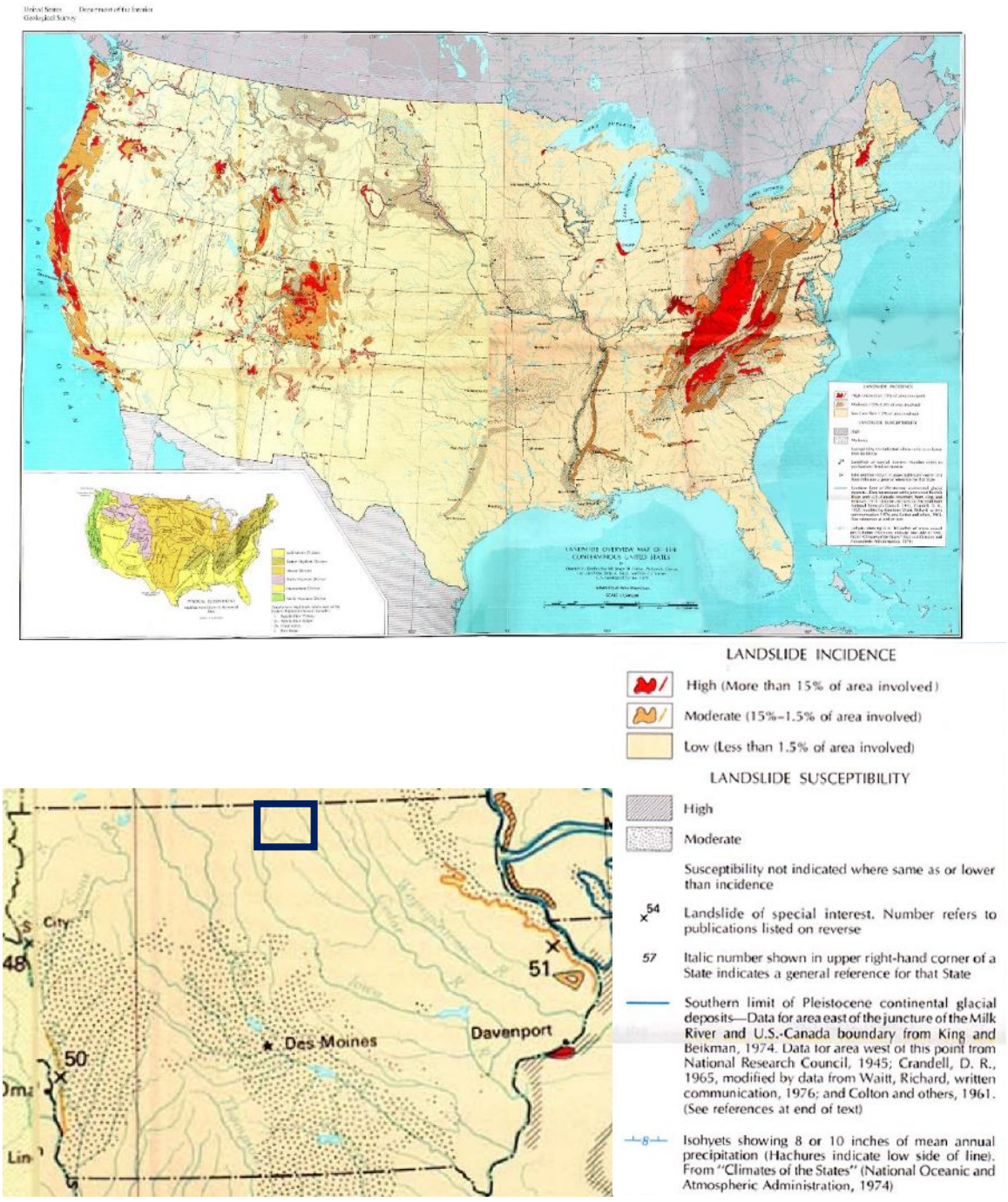
Warning Time Score: 2—12 to 24 hours warning time

Duration Score: 1—Less than 6 hours

Geographic Location/Extent

The map in **Figure 3.43** depicts landslide susceptibility and incidents rates in Iowa according to the Iowa Department of Natural Resources. This shows that Worth County is not susceptible to landslides and has a low incident rate of landslide.

Figure 3.43. Landslide Susceptibility and Incident Rates



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

Previous Occurrences
According to the 2013 Worth County Multi-Jurisdictional Hazard Mitigation Plan, minor landslides and rockfalls do occur in Worth County, but these events have only caused limited damages and to not threaten human safety or property.

Probability of Future Occurrence
The HMPC determined the probability of future occurrence of landslide in the planning area to be "Occasional" due to the low susceptibility and limited past occurrences.

Probability Score: 1—Unlikely

Vulnerability

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

Magnitude Score: 1—Negligible

Potential Losses to Existing Development
There are no specific areas in the county that are known to be vulnerable to landslide.

Future Development
Future development down slope from areas prone to landslide will increase vulnerability to this hazard. However, as susceptibility to landslide is low throughout the county and there are no known landslide hazard areas, new development is unlikely to cause a significant increase in landslide risk in the county.

Climate Change Impacts
One of the climate change impacts noted in the *2010 Climate Change Impacts on Iowa* report by the Iowa Climate Change Impacts Committee is the increase in frequency of severe precipitation events. As heavy precipitation can trigger landslides, this could result in an increase in landslide incidents in the future. See the "Climate Change Impacts" discussion in the Flash Flood Hazard Section (**3.5.7**)

Landslide Hazard Summary by Jurisdiction

The overall risk of landslide in the county is low and does not not vary significantly by jurisdiction.

Jurisdiction	Probability	Magnitude	Warning Time	Duration	Score	Level
Worth County, Iowa	1	1	2	1	1.15	Low
City of Fertile	1	1	2	1	1.15	Low
City of Grafton	1	1	2	1	1.15	Low
City of Hanlontown	1	1	2	1	1.15	Low
City of Joice	1	1	2	1	1.15	Low
City of Kensett	1	1	2	1	1.15	Low
City of Manly	1	1	2	1	1.15	Low
City of Northwood	1	1	2	1	1.15	Low
Central Springs Schools	1	1	2	1	1.15	Low
Northwood-Kensett Schools	1	1	2	1	1.15	Low

3.5.13 Radiological Incident

Hazard Score Calculation					
Probability	Magnitude/Severity	Warning Time	Duration	Weighted Score	Level
1	1	4	4	1.75	Low

Profile

Hazard Description

A radiological incident is an occurrence resulting in the release of radiological materials at a fixed facility (such as power plants, hospitals, laboratories, etc.) or in transit.

Radiological incidents related to transportation are described as an incident resulting in a release of radioactive material during transportation. Transportation of radioactive materials through Iowa over the interstate highway system or via rail is considered a radiological hazard. The transportation of radioactive materials by any means of transport is licensed and regulated by the federal government. As a rule, there are two categories of radioactive materials that are shipped over the highways and railways:

1. Low level materials such as medical radiological isotopes, or waste that has been contaminated by low level radioactive substances,. These materials are shipped in sealed drums or packages within placarded trailers. While the possibility of a release resulting from an accident exists, the low level of radioactivity involved poses no serious threat except through long term exposure.
2. High level materials such as radiological gauges used in construction, or high level waste waste such as spent fuel from nuclear power plants. These materials must be transported in specially constructed casks that are built to withstand severe crashes. Thus, while the impact from a release of high level radioactive materials is potentially high, the probability of such a release is quite low.

Warning Time Score: 4—less than six hours warning time

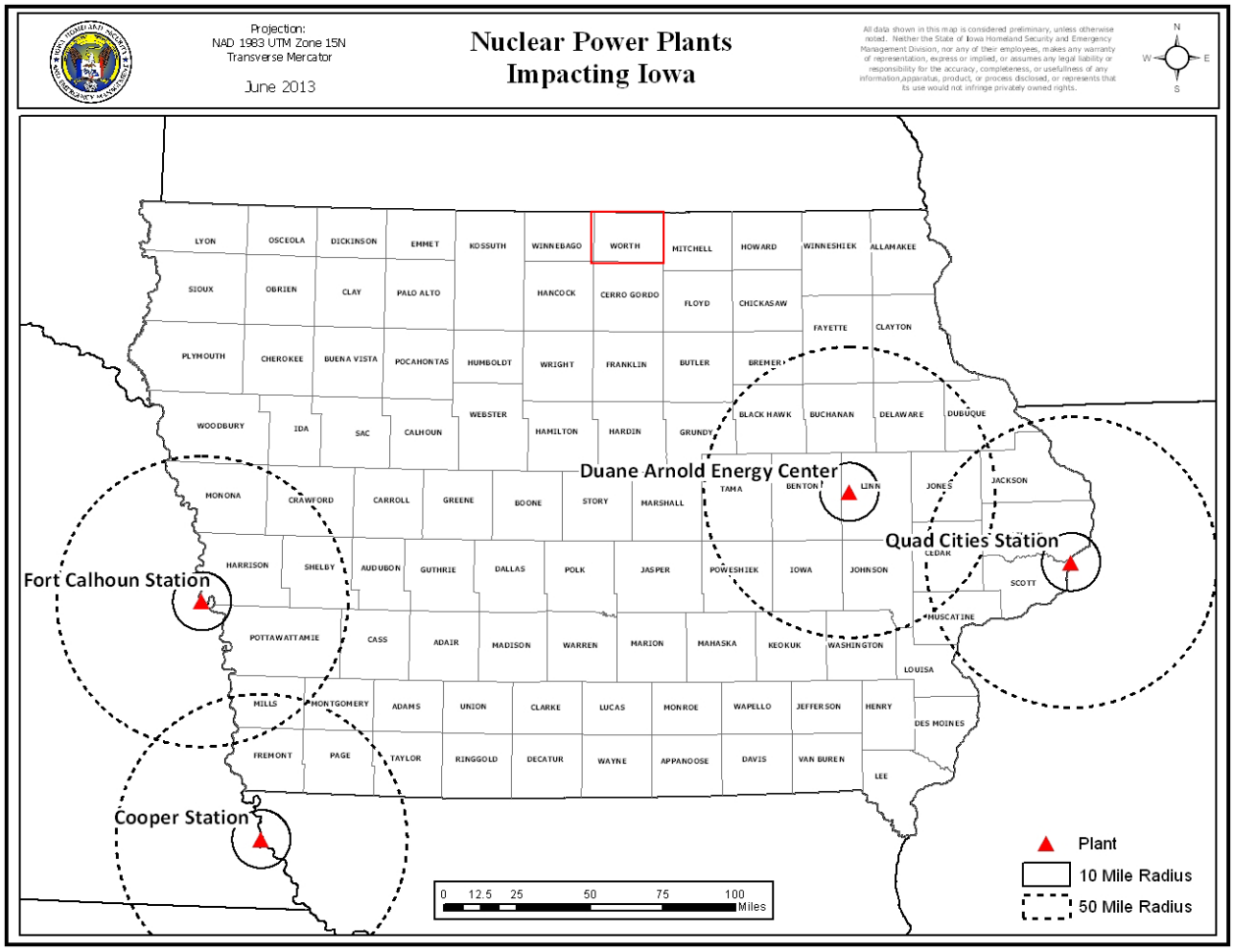
Duration Score: 4—More than 1 week

Geographic Location/Extent

Fixed Facilities

An incident resulting in a release of radiological material at a fixed facility is a fixed radiological incident. There is one nuclear power plant located within Iowa: the Duane Arnold Energy Center near Palo in Linn County. There are three additional nuclear facilities in adjacent states with planning buffer zones that cross into Iowa: Ft. Calhoun Nuclear Power Plant north of Omaha, Nebraska, Cooper Nuclear Power Plant south of Nebraska City, Nebraska, and Quad Cities Nuclear Power Plant in Cordova, Illinois. None of these powerplants are in close proximity to Worth County.

Figure 3.44. Map of Nuclear Power Plants Impacting Iowa



Source: Iowa Homeland Security and Emergency Management; red rectangle is approximate boundary of Worth County.

Hospitals and some industrial facilities are other types of fixed facilities that may house radioactive materials. Sources of radioactive materials may include medical products, radioactive waste from hospitals and laboratories, and industrial products. Small amounts of industrial, medical, and lab materials exist in a few locations, all within buildings. Trained people use the equipment and it is properly handled and stored. A few to a few dozen people, in a lab in a hospital, for example, may be impacted by an immediate release with a small amount of contamination.

Transportation Radiological Incidents

There is also potential for the transport of radioactive materials through and within Worth County.

Since 1990, hundreds of shipments of radiological materials have been made through Iowa. There have been no occurrences of radiological incidents in Iowa. Generally, small or minor shipments will go through the community in support of medical facilities with radiology services

and other small quantity users. Other major roads near hospitals may have small and rare shipments. Union Pacific Railroad, Iowa Northern Ry. Co, and Dakota, Minnesota and Eastern RR. Co., might also carry radiological shipments, but data is not confirmed

Previous Occurrences
According to the Iowa State Hazard Mitigation Plan, 2013, there have been no reported occurrences of a radiological transportation incident in Iowa since 1990. The events that have occurred in other states have been limited; there have been no known serious radiation exposures resulting from a transportation incident because the nature of the materials being transported and the use of protective packaging is commensurate with the potential hazard of the radioactive materials contained.

Probability of Future Occurrence
Operators of facilities that use radioactive materials and transporters of radioactive waste are trained in the packaging, handling, and shipment of the radioactive waste; and, since they are closely regulated by a variety of federal, state, and local organizations, the likelihood of an incident is remote. When these materials are moved across Iowa highways, Iowa officials are notified and appropriate escorts are provided. The planning team, in light of the tight regulations on transport and the amount of fuels transported, put the annual risk of an incident requiring outside intervention is at less than 1%.

Probability Score: 1—Unlikely

Vulnerability

Vulnerability Overview
In general, danger to the public in the planning area is less than a wide array of other hazardous materials. However, it should be noted that due to high public concern about radiation, even minor radioactive materials incidents can generate a high degree of public concern and media attention. Those working with or near sources of radiation are at a greater risk than the general citizens in the planning area. Those responding to a radiological incident should be trained in recognizing a radiological incident and minimize exposure to radioactive materials. The amounts shipped in the county are likely very low and would not cause significant loss. The impact would be a few blocks at best (1,000 feet from the transportation route). The highest risk may be present during unloading at medical facilities such as Avera Holy Family Hospital in Estherville.

Magnitude Score: 1—Negligible

Potential Losses to Existing Development
Response to the effects of a radiological incident in the planning area would vary depending on the type and quantity of release. Response may require resources and assistance from several state and federal agencies to determine and evaluate the threat to life and the environment. Due to the variable nature of this hazard, it is not possible to quantify potential losses.

Future Development
Increased development in the planning buffer zones and along transportation corridors would increase the number of people vulnerable to this hazard in the planning area.

Climate Change Impacts

Although, Worth County is not in the Emergency Planning Zones for any nuclear reactors, generally speaking, drought can impact water levels for intake pipes that carry water from the Mississippi River to cool the reactors. See **Section 3.5.3** for discussion of Climate Change Impacts for Drought.

Radiological Incident Hazard Summary by Jurisdiction

Worth County is not within the 50-mile planning buffer of any power plants. Because the County and jurisdictions are outside the planning buffer, it is extremely unlikely that they would have negative impacts from an event at these fixed facilities. Any events at the hospital or other medical facilities with radiology services would likely be isolated events with minimal exposure areas. The magnitude for the unincorporated county and jurisdictions is 1.

Jurisdiction	Probability	Magnitude	Warning Time	Duration	Score	Level
Worth County, Iowa	1	1	4	4	1.75	Low
City of Fertile	1	1	4	4	1.75	Low
City of Grafton	1	1	4	4	1.75	Low
City of Hanlontown	1	1	4	4	1.75	Low
City of Joice	1	1	4	4	1.75	Low
City of Kensett	1	1	4	4	1.75	Low
City of Manly	1	1	4	4	1.75	Low
City of Northwood	1	1	4	4	1.75	Low
Central Springs Schools	1	1	4	4	1.75	Low
Northwood-Kensett Schools	1	1	4	4	1.75	Low

3.5.14 River Flooding

Hazard Score Calculation					
Probability	**Magnitude/Severity**	**Warning Time**	**Duration**	**Weighted Score**	**Level**
4	3	1	4	3.25	High

Profile

Hazard Description

Many of the communities were settled and developed largely because of their proximity to water resources. A flood is characterized by partial or complete inundation of normally dry land areas. Heavy precipitation can cause flooding either in the region of precipitation or in areas downstream. Heavy accumulations of ice or snow can also cause flooding during the melting stage; these events are complicated by the freeze/thaw cycles characterized by moisture thawing during the day and freezing at night. There are two main types of flooding in the planning area: riverine flooding, and flash flooding which includes ice jam flooding. Flash flooding is discussed separately in **Section 3.5.7.** A specific type of flash flooding can occur as a result of dam failure or levee failure. Flooding caused by dam or levee failure is discussed in **Section 3.5.2.**

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 into which a river and its branches/triburatries drain their water.

Gauges along streams and rain gauges 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 National Weather Service provides flood forecasts for Iowa. Flood warnings are issued over emergency radio, television messages, through NOAA Weather Radio, and electronically (e.g., online and sometimes via text messages to local citizens). People in the paths of river floods may have time to take appropriate actions to limit harm to themselves and their property.

Warning Time Score: 1—More than 24 hours warning time

Duration Score: 4—More than 1 week

Geographic Location/Extent
Worth County crosses three HUC-8 watersheds as follows (see **Figure 3.45**):

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

Figure 3.45. Worth County, Iowa Watersheds (Worth County is red square)

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

For purposes of this hazard profile and vulnerability analysis, the geographic locations/coverages for river flooding will be considered as those areas at risk to the 100-year flood (also known as the 1-percent annual chance flood). The 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes.

Jurisdictional Flood Hazard Maps

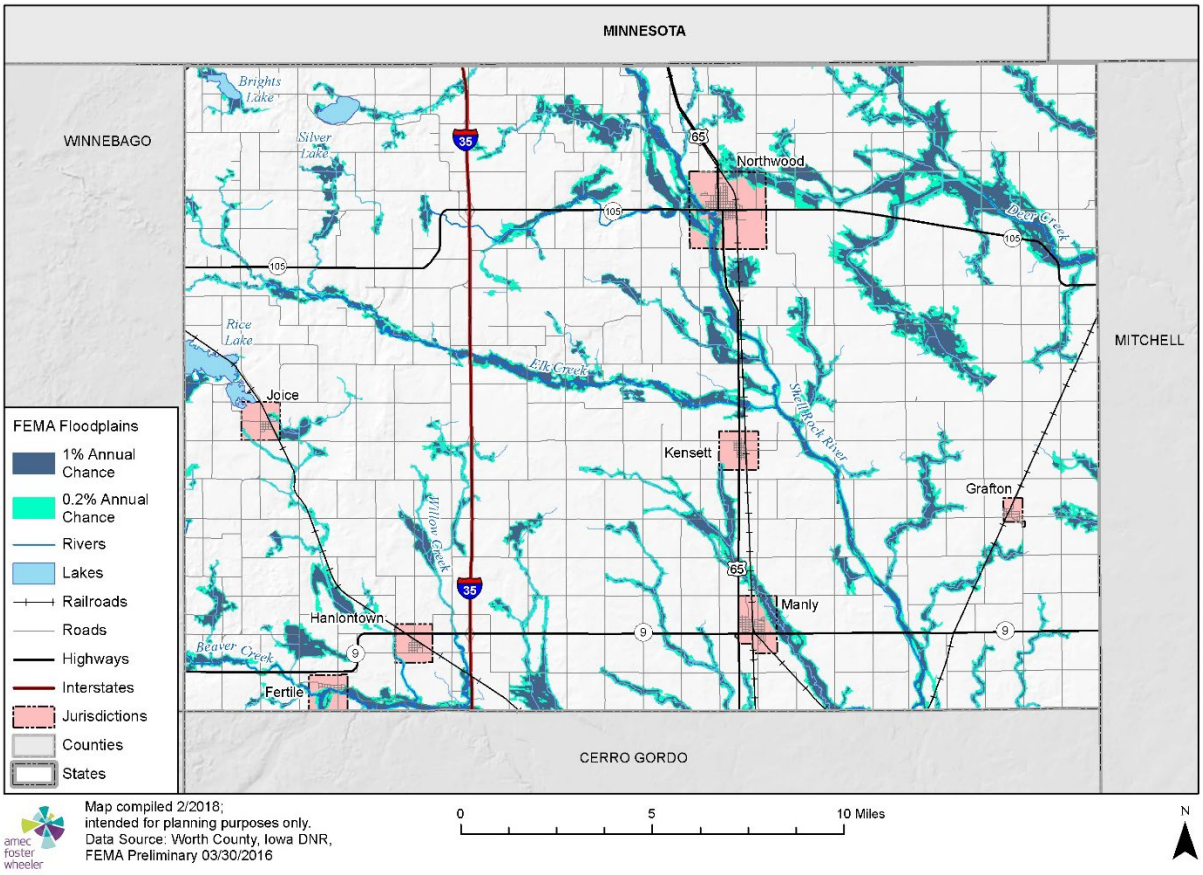
FEMA has identified special flood hazards across Worth County. **Figure 3.46**. to **Figure 3.54** provide both the 1-percent annual chance floodplains and the 0.2-percent annual chance floodplains (where the 0.2-percent equates to a 1 in 500 chance of flooding, and are hence the

500-year floodplains), for all jurisdictions in the planning area affected by this hazard. The county-level map is provided first for context, and city/town maps are next, in alphabetical order. The map with the School Districts is provided following the city/town maps. Preceding each map is a general description of the flooding sources and or issues applying to each jurisdiction.

Worth County

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

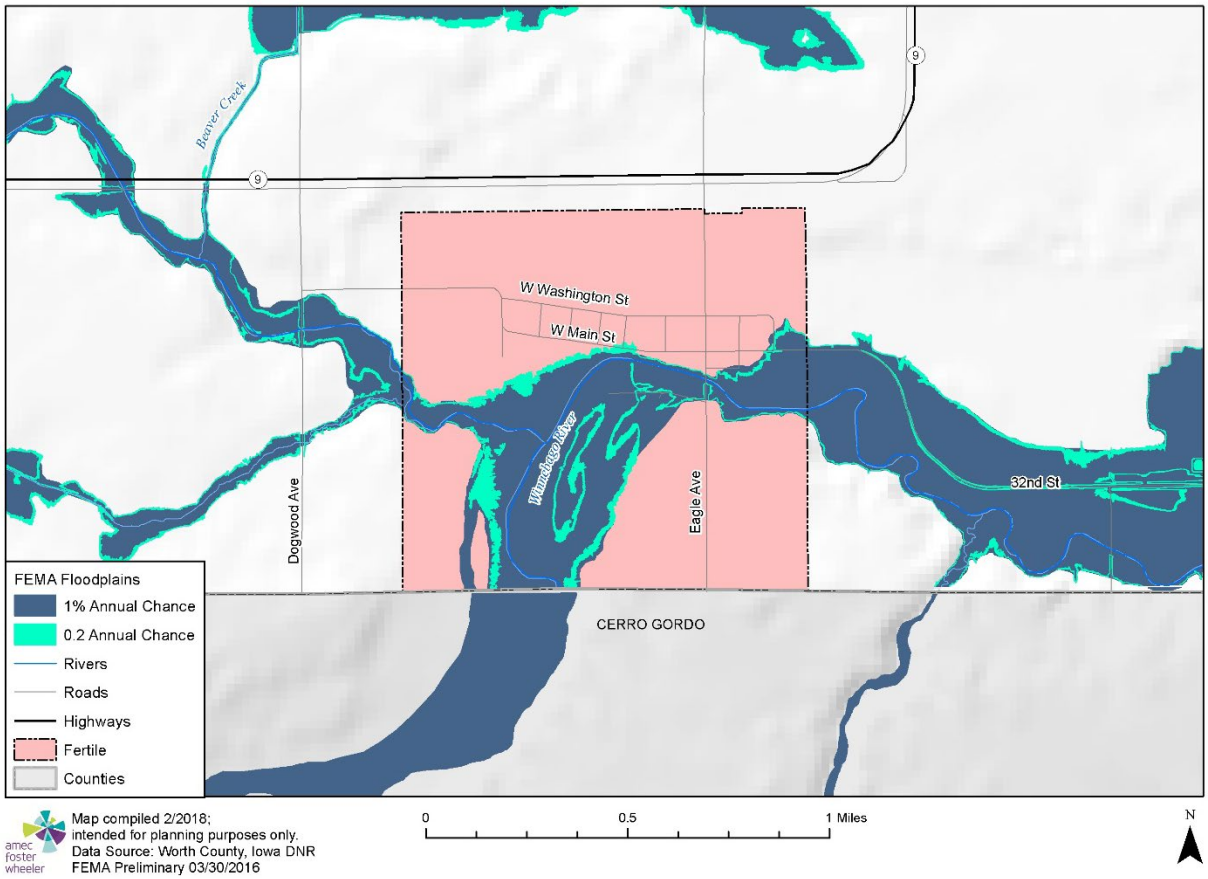
Figure 3.46. Worth County 1- and 0.2-Percent Annual Chance Floodplain



Fertile

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

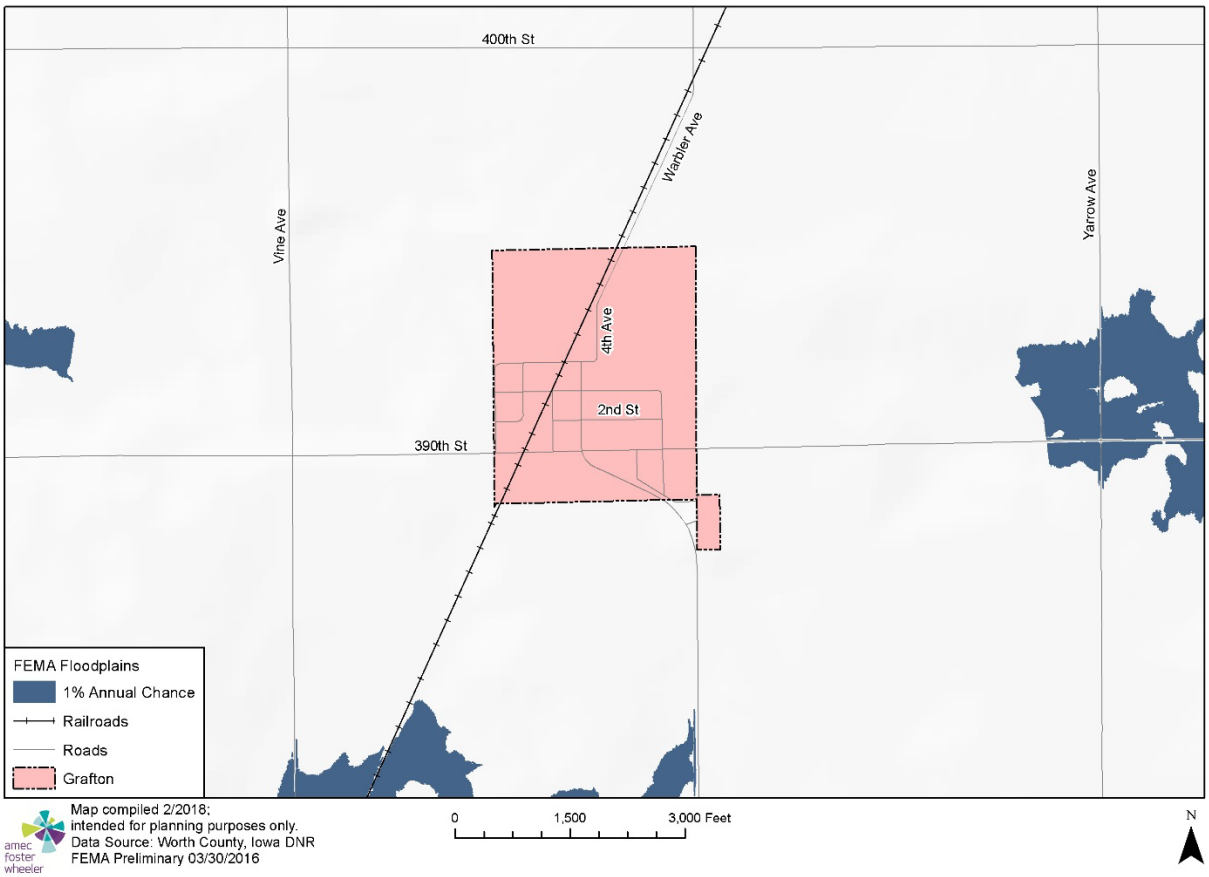
Figure 3.47. City of Fertile 1- and 0.2-Percent Annual Chance Floodplain



Grafton

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

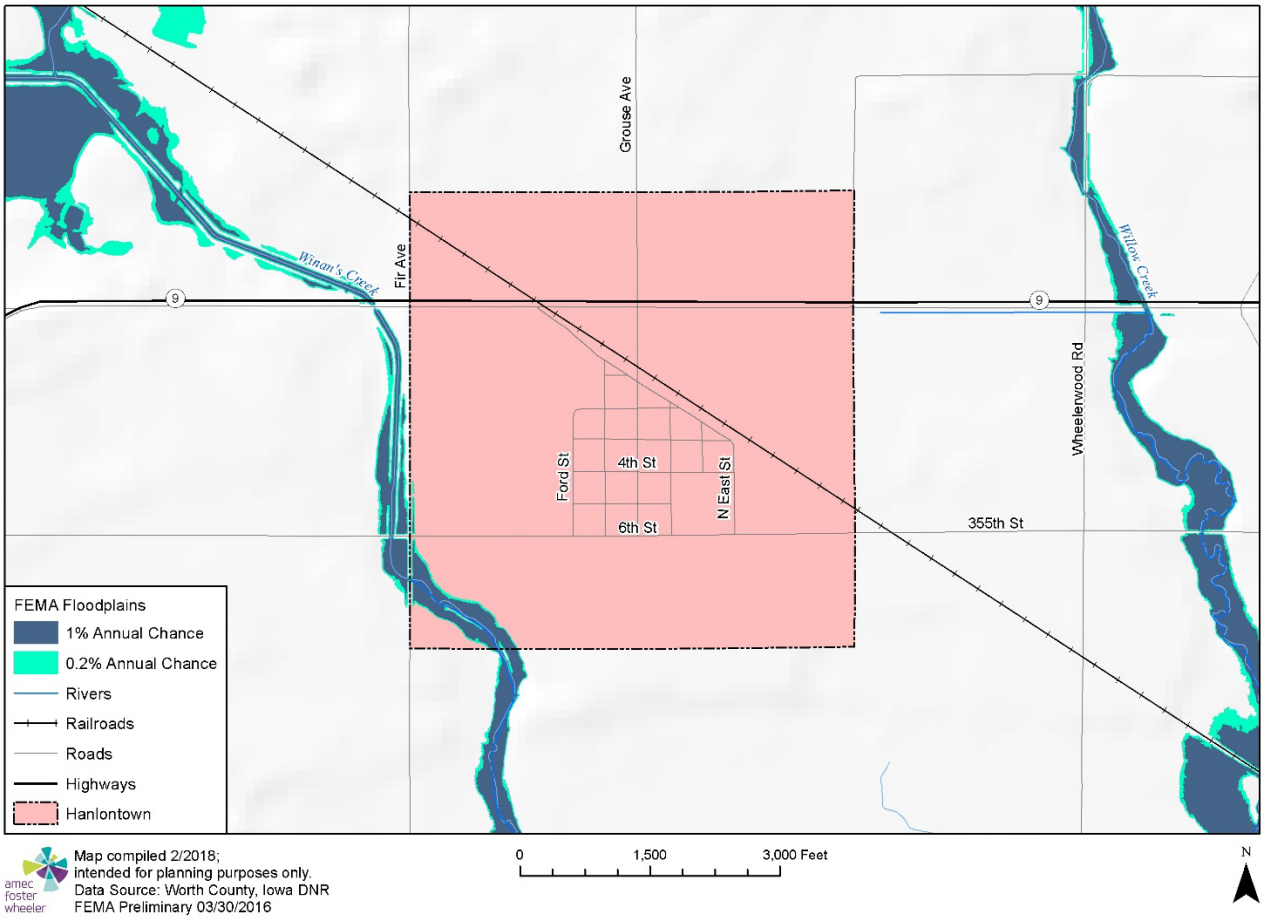
Figure 3.48. City of Grafton 1-Percent Annual Chance Floodplain



Hanlontown

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

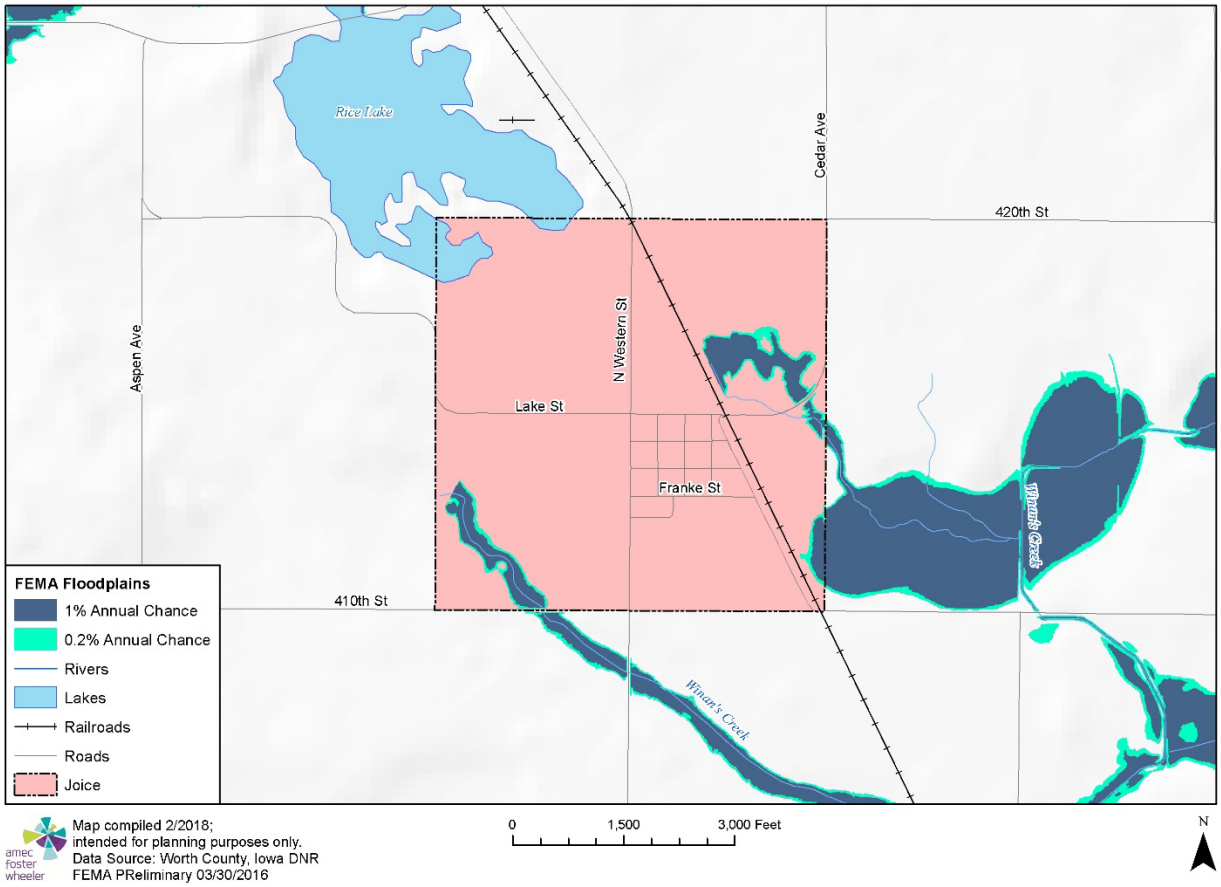
Figure 3.49. City of Hanlontown 1- and 0.2-Percent Annual Chance Floodplain



Joice

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

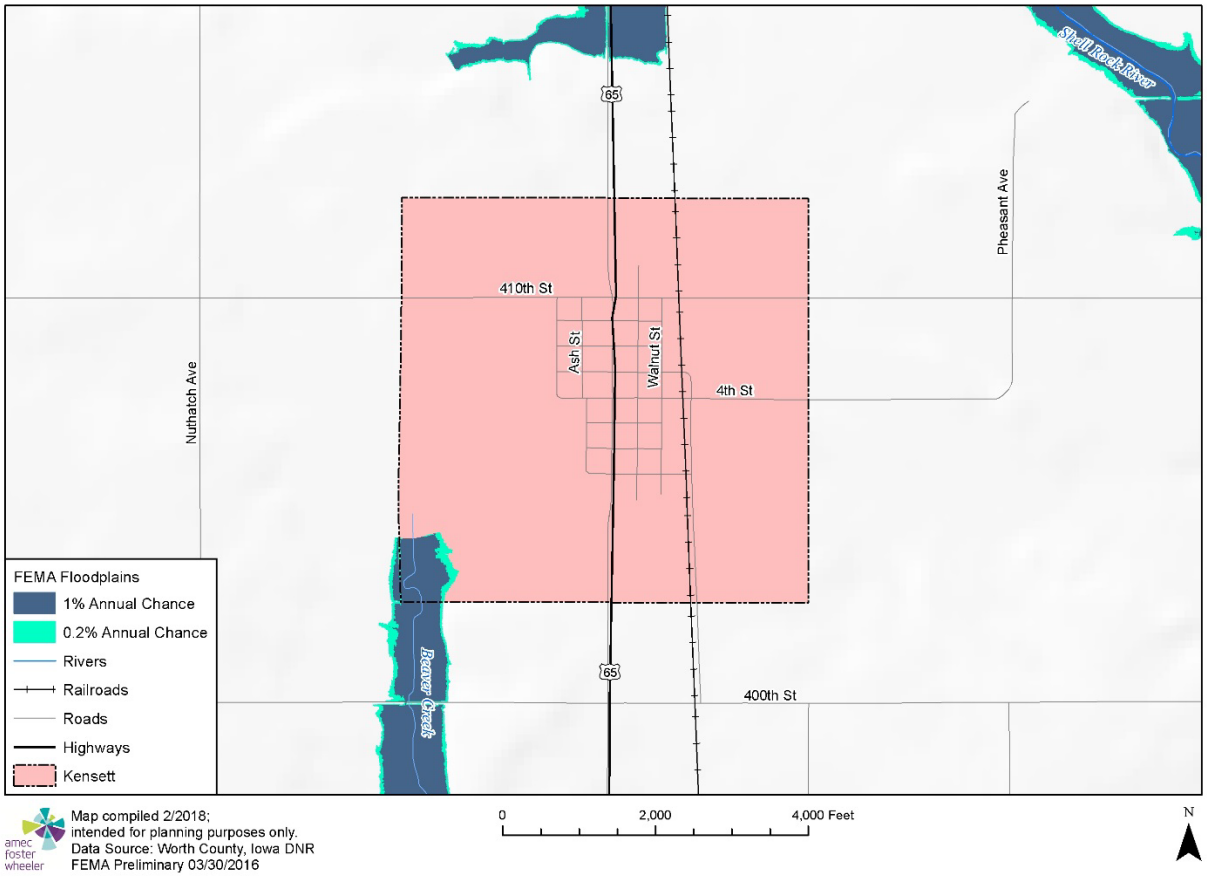
Figure 3.50. City of Joice 1- and 0.2-Percent Annual Chance Floodplain



Kensett

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

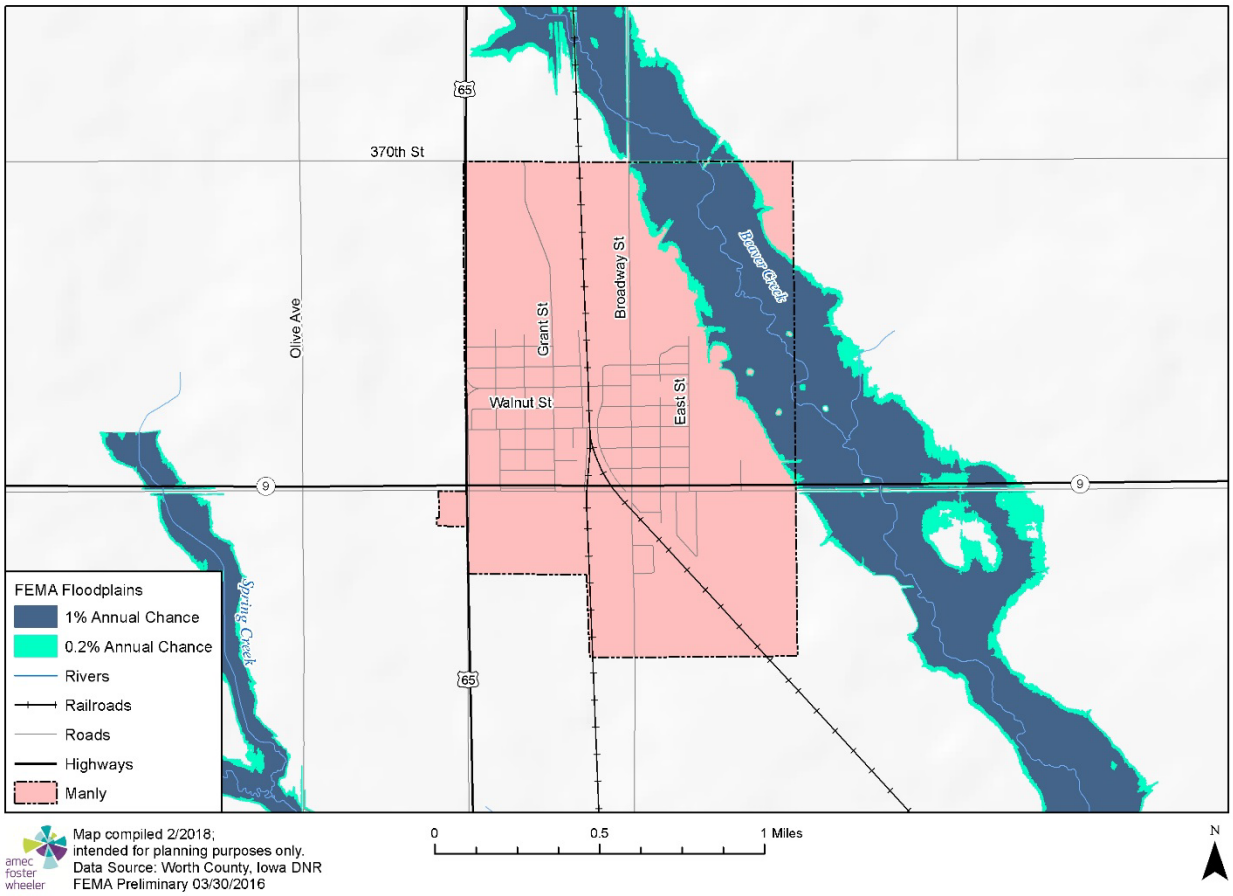
Figure 3.51. City of Kensett 1- and 0.2-Percent Annual Chance Floodplain



Manly

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

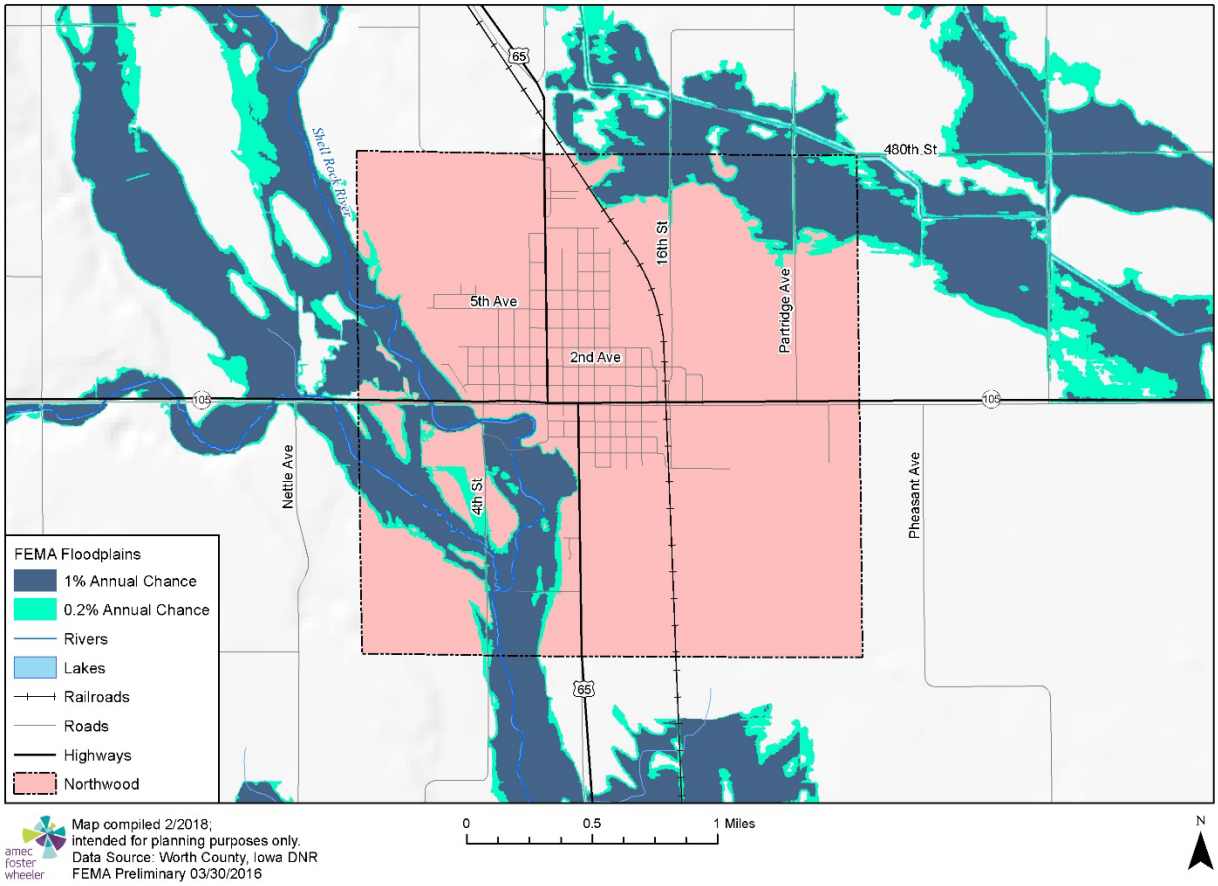
Figure 3.52. City of Manly 1- and 0.2-Percent Annual Chance Floodplain



Northwood

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

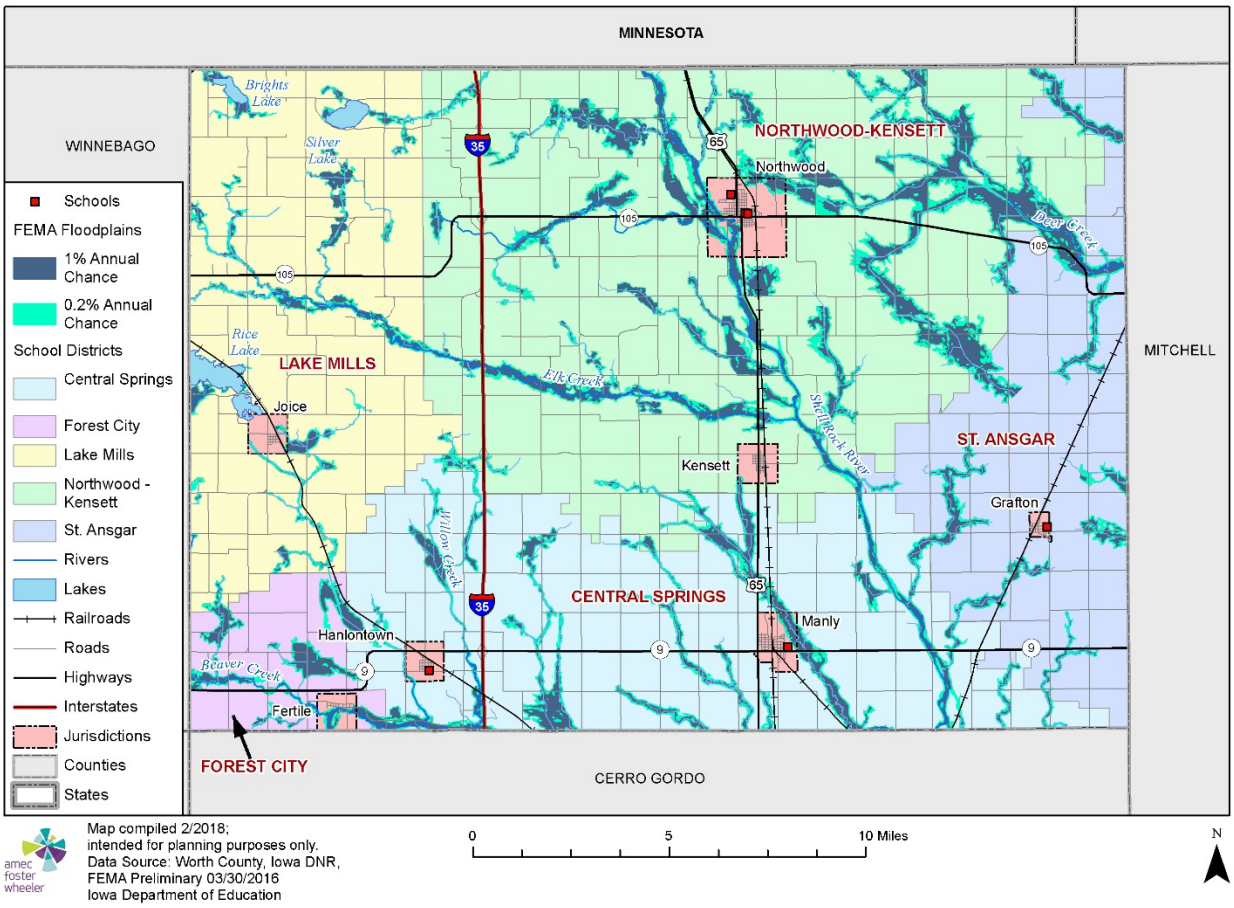
Figure 3.53. City of Northwood 1- and 0.2-Percent Annual Chance Floodplain



Worth County School Districts

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

Figure 3.54. Worth County School Districts and the 1- and 0.2-Percent Annual Chance Floodplain



Previous Occurrences

This section provides information on previous occurrences of riverine flooding in the planning area.

Presidential Declarations for Flooding in Planning Area

Since 1965 there have been 4 Presidential Disaster Declarations that included flooding in Worth County.

General Flooding Events in Planning Area

According to the National Climatic Data Center, there were 19 reported flood events from 1997-2017 (the last one being in 2013). While no human deaths or injuries were sustained from the events in the recorded years, flooding still occurs fairly frequently and can prove costly. Details are provided below in **Table 3.50**.

Table 3.50. NCDC Flood Events in Worth County, 1997-2017

Year	Number of Flood Events Reported	Deaths	Injuries	Property Damages
1997	2	0	0	$0
1998	1	0	0	$75,000
1999	3	0	0	$160,000
2000	1	0	0	$25,000
2001	5	0	0	$262,500
2004	2	0	0	$150,000
2006	1	0	0	$5,000
2010	1	0	0	$0
2013	3	0	0	$450,000
Grand Total	**19**	**0**	**0**	**$1,127,500**

Source: NCDC

Previous Flooding Occurrence Details by Jurisdiction

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

Worth County

Countywide, many minor and medium-size flooding events have taken place over the years. For example, there was one event starting mid-April of 2006, across a large part of the northwest and north central areas, where flooding was lmited to lowland agricultural areas, and damage was very minor. Other ocurrences have involved thousands of dollars in damages and crop losses as well.

Kensett

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

Northwood

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

Unincorporated Areas

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

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

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

Previous Agricultural Impacts

Flooding has historically taken a toll on crop production and harvesting in the planning area. According to the USDA's Risk Management Agency (RMA), payments for insured crop losses in the planning area as a result of riverine flooding alone (without taking into account excess moisture or other related conditions) from 2007-2017 totaled $560,463. This translates to an annual average of $56,046. According to the RMA's 2016 Iowa Crop Insurance Profile, 83% of insurable crops in Iowa were insured. **Table 3.51** summarizes the indemnity claims paid by year in Worth County.

Table 3.51. Crop Insurance Claims Paid in Worth County for Crop Losses as a Result of Floods/Flooding Events (2007-2017)

Year of Flooding Claim	Indemnity Amount	Determined Acres
2008	1,272	$116,078
2009	159	$18,747
2011	148	$29,955
2013	1,416	$394,968
2014	21	$716
Grand Total	**3,016**	**$560,463**

Source: USDA Risk Management Agency

National Flood Insurance Program (NFIP) Participation

Table 3.52 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 December 31, 2017.

Table 3.52. NFIP Participation, Policy and Claim Statistics

Community Name	NFIP Participant	Curr Eff Map Date	Reg Emer Date	Policies In-force	Insurance In-force	Closed Losses	Total Payments
Fertile	Yes	08/02/12; M	08/04/87	1	$175,000	0	$0
Grafton	No	08/02/12; M	N/A	N/A	N/A	N/A	N/A
Hanlontown	Yes	08/02/12; M	08/02/12	0	$0	0	$0
Joice	No	08/02/12; M	08/13/77	N/A	N/A	0	$0
Kensett	No	08/02/12; M	11/05/77	N/A	N/A	0	$0
Manly	Yes	08/02/12; M	05/01/11	0	$0	0	$0
Northwood	Yes	08/02/12; M	08/01/87	3	$641,200	1	$2,959
Worth County	Yes	08/02/12; M	08/02/12	1	$350,000	0	$0

Source: FEMA Community Information System; M= No elevation determined – all Zone A, C, and X: NSFHA = No Special Flood Hazard Area; E=Emergency Program: Policy and Loss Statistics from BureauNet, 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, 1977 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 Worth County.

Probability of Future Occurrence

With the history of flooding in many areas across Worth County, it is likely that flooding of various levels will continue to occur. According to the NCDC, 19 general flood events have taken place in the recorded years alone (1997-2017). Therefore, the probability rating for Worth County to suffer from riverine flooding in the future is "Highly Likely".

Probability Score: 4—Highly Likely

Vulnerability

Overview

To determine vulnerability of people and property to riverine flood, an enhanced flood risk analysis was performed utilizing FEMA's HAZUS software. This analysis included Level 2 enhancements to both the hazard and inventory inputs to the HAZUS model to enhance the accuracy of flood risk modelling. The data utilized includes the following:

- Depth Grids provided by University of Iowa's Iowa Flood Center (IFC)
- Parcel layer provided by Worth County
- Assessor's data provided by Worth County

The Depth Grids provided by the IFC were used as the best available data since older FEMA depth grids are difficult to obtain. In addition, the IFC data complements the efforts that the Iowa Homeland Security and Emergency Management Department is carrying for the State Plan. It should be noted that the IFC depth grids are very similar to the effective FEMA products; however, there are some differences in the detailed areas for the 1-percent annual chance floodplain.

Default HAZUS inventories for structures were replaced with data supplied by Worth County using the respective parcels layer and additional structure attributes from the Assessor's data. GIS was used to create a centroid or point representing the center of the parcel polygon in the parcel layer to represent the location of the primary structure on each parcel. The structure inventory data set was formatted for use in HAZUS using the HAZUS Comprehensive Data

Management System (CDMS) tool. This tool syncs data and attribute fields necessary for HAZUS analysis, and imports the enhanced dataset into the HAZUS study region.

After the hazard and inventory data was imported into HAZUS, analysis was completed to determine the potential losses as a result of a 1-percent annual chance flood. The following jurisdiction would have losses as a result of a 1-percent annual chance flood: City of Fertile, City of Joice, City of Manly, City of Northwood, and Unincorporated areas. The cities of Grafton, Hanlontown, and Kensett did not have any estimated losses. The detailed results of this analysis are provided in the following section on Potential Losses to Existing Development.

For the planning area ranking, the HMPC determined the magnitude of river flooding to be "Critical". Individual jurisdictional ratings are provided at the end of this hazard section.

Magnitude Score: 3—Critical (from 25% to 50% of propery damages and injuries to populations)

Potential Losses to Existing Development

The potential losses to existing development will be provided for the following categories of losses:

- Building/Contents Losses
- Estimated Population Displaced
- Agricultural Impacts
- Critical Facilities and Infrastructure at Risk

Building/Contents Losses

Figure 3.27 displays the 1-percent annual chance floodplain depth grids, and **Table 3.53** provides the summary of potential flood loss estimates and impacted population for the 1-percent annual chance flood by jurisdiction based on the HAZUS Level 2 Analysis described in the Overview section above.

Figure 3.55. Worth County 1-Percent Annual Chance Floodplain with Depth Grids

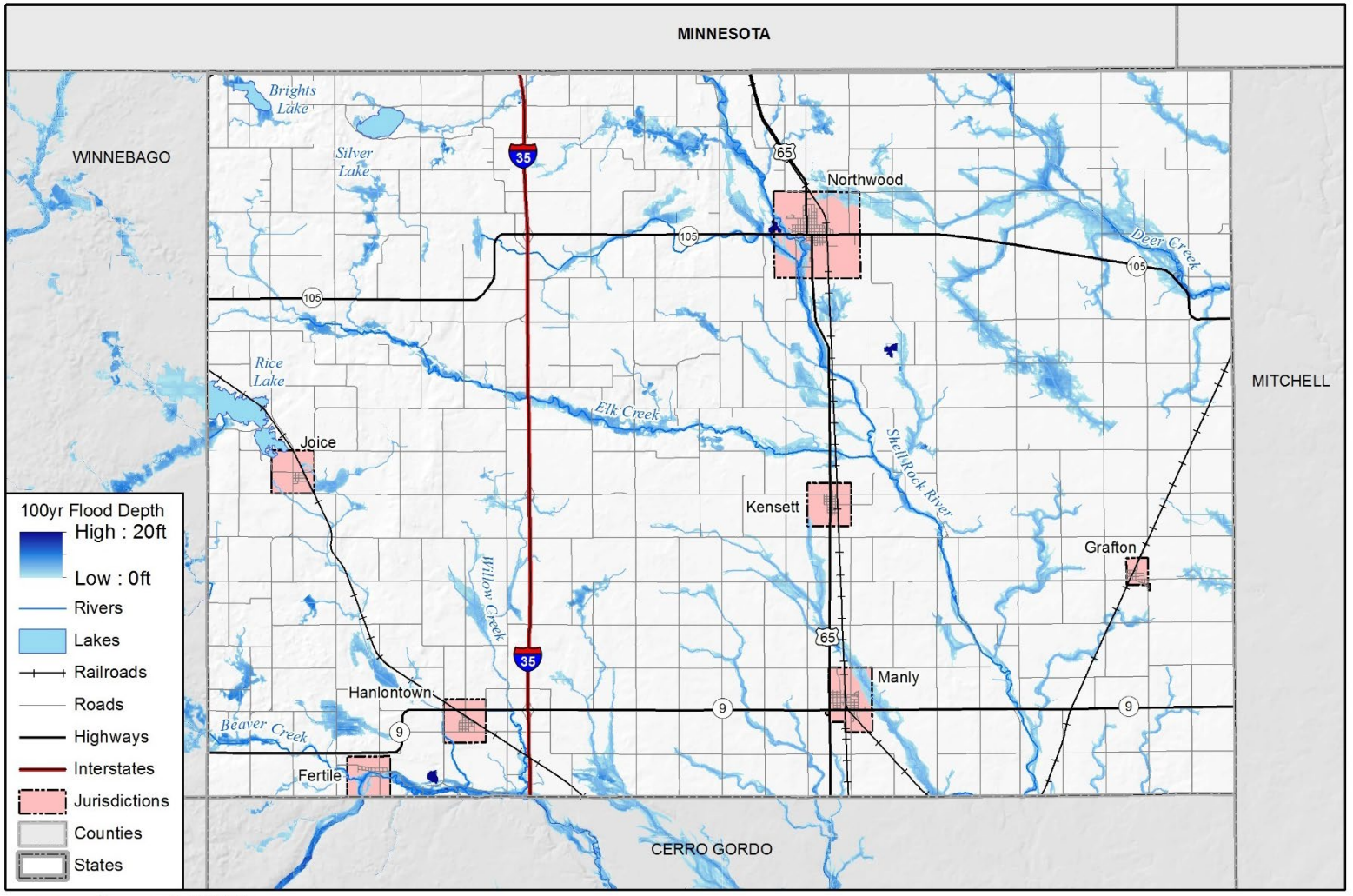


Table 3.53. Potential Flood Loss Estimates by Jurisdiction and Property Type, 1-Percent Annual Chance Flood

Jurisdiction	Property Type	Improved Parcel Counts	Improved Value	Content Value	Total Exposed Value	Structures w/Losses	Improved Losses	Content Losses	Inventory Losses	Total Losses
Fertile	Residential	6	$267,317	$133,659	$400,976	6	$20,220	$7,648	$0	$27,868
	Total	**6**	**$267,317**	**$133,659**	**$400,976**	**6**	**$20,220**	**$7,648**	**$0**	**$27,868**
Joice	Commercial	1	$28,857	$28,857	$57,714	1	$1,501	$4,213	$5,245	$10,958
	Total	**1**	**$28,857**	**$28,857**	**$57,714**	**1**	**$1,501**	**$4,213**	**$5,245**	**$10,958**
Manly	Agriculture	1	$1,510	$1,510	$3,020	1	$26	$150	$106	$282
	Commercial	1	$21,099	$21,099	$42,198	1	$1,072	$6,186	$0	$7,258
	Total	**2**	**$22,609**	**$22,609**	**$45,218**	**2**	**$1,097**	**$6,336**	**$106**	**$7,540**
Northwood	Residential	10	$1,050,675	$525,338	$1,576,013	10	$63,766	$23,378	$0	$87,144
	Total	**10**	**$1,050,675**	**$525,338**	**$1,576,013**	**10**	**$63,766**	**$23,378**	**$0**	**$87,144**
Unincorporated	Agriculture	14	$32,357	$32,357	$64,714	14	$1,403	$5,690	$6,022	$13,115
	Commercial	5	$7,097,639	$7,097,639	$14,195,278	5	$480,012	$1,185,511	$1,135,239	$2,800,762
	Industrial	2	$168,594	$252,891	$421,485	2	$9,645	$24,756	$21,783	$56,184
	Residential	54	$5,114,935	$2,557,468	$7,672,403	48	$416,232	$153,845	$0	$570,077
	Total	**75**	**$12,413,525**	**$9,940,355**	**$22,353,880**	**69**	**$907,293**	**$1,369,802**	**$1,163,043**	**$3,440,138**
	Grand Total	**94**	**$13,782,983**	**$10,650,817**	**$24,433,800**	**88**	**$993,877**	**$1,411,377**	**$1,168,394**	**$3,573,648**

Source: Hazus Analysis, Iowa Flood Center, Worth County Assessor

Estimated Population Displaced

To estimate population displaced by a 1-percent annual chance flood, the number of residential structures impacted was multiplied by the average household size for each jurisdiction. Building count data were generated from block group and block level census data within HAZUS. According to the HAZUS Level 2 analysis, there would be a total of 70 residential structures impacted within Worth County, and 165 people would be diplaced during a 100-year flood event. **Table 3.54** provides the estimated population impacted for each jurisdiction that had estimated flood losses.

Table 3.54. Estimated Displaced Population

Jurisdiction	Estiamted Residential Structures Impacted	Average Household Size	Estimated Displaced Population
Fertile	6	2.23	13
Northwood	10	2.23	22
Unincorporated	54	2.37	128
Total	**70**		**164**

Source: U.S. Census Bureau,,Average Household Size: HSIP Freedom 2015, Residential Properties Impacted: Hazus Analysis

FEMA's HAZUS Average Annualized Losses

In 2010, FEMA conducted a Level 1 HAZUS MR4 flood analysis to estimate average annualized losses (AAL). This AAL study examined riverine and coastal flood hazards in the 48 contiguous states (including the District of Columbia) by county. Hawaii, Alaska, and Puerto Rico, and US territories were not analyzed as part of this study. The AAL study estimated flood losses for the following storm events, which were then used to develop the annualized loss estimate: 10% annual chance (10-year), 2% annual chance (50-year), 1% annual chance (100-year), 0.5% annual chance (200-year), and 0.2% annual chance (500-year).

The data from the AAL Study was calculated at the census block level, based on HAZUS' hydrology and hydraulic analysis of streams draining 10 square miles or greater and utilizing 30m Digital Elevation Model (DEM) data. It includes estimated replacement values and flood losses for both buildings and contents, based on 2000 census data, and is aggregated by structure type (residential, commercial, and other). For certain reaches of stream, the hydrology or hydraulics failed during the AAL study, and loss estimates were not able to be calculated. In some of the coastal areas, both riverine and coastal loss estimates were calculated, but may not be distinct in the AAL results. In spite of these known data gaps, the AAL study represents a baseline level of flood risk assessment results which can be used where more refined analyses are not conducted or available.

The AAL Study estimates $836,000 in Average Annual Losses (AAL) for Worth County, Iowa.

Critical Facilities and Infrastructure at Risk

To analyze critical facilities at risk in the planning area, the inventory of critical and essential facilities and infrastructure in the planning area was compiled by analyzing datasets sourcing from the State of Iowa's Homeland Security and Emergency Management office as well as the Iowa Flood Center. A comparison was made between Worth County's 97 critical facilities,

bridge infrastructure from the National Bridge Inventory, and the Iowa Flood Center's flood data, to determine which facilities would be damaged in the 1-percent (100-year) annual chance flood events. This analysis determined that there are 2 critical facilities in the 1-percent annual chance floodplain.**Table 3.55** provides a summary of the critical facilities in the 1-percent annual chance floodplain.

Table 3.55. Critical Facilities at risk to the 1-percent Annual Chance Flood

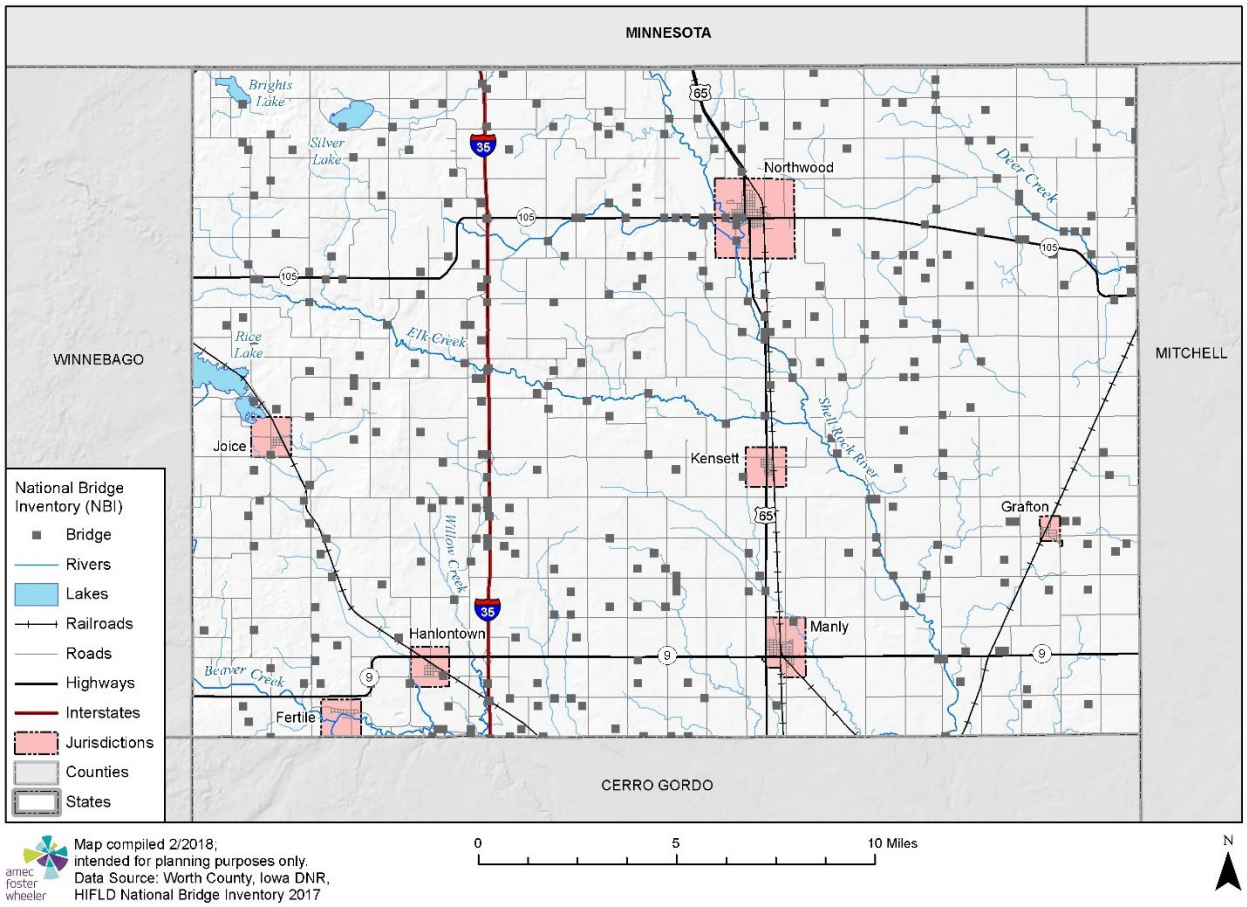
Jurisdiction	Facility Type	Facility Name
Fertile	Fire Station	Fertile Fire Department

Source: HSIP Freedom 2015, FEMA NFIP

Appendix E provides the list of critical facilities that were inventoried and analyzed. This Appendix is redacted from the public version of this plan. To obtain access for official use, contact the Worth County Emergency Management Agency.

According to the National Bridge Inventory, there are 0 scour critical bridges in Worth County. All bridges within county boundaries are depicted in **Figure 3.56.** Note that not every bridge infrastructure will be at risk of the 1-percent annual chance flood.

Figure 3.56. Worth County Bridges (With No Scour Critical Bridges Identified)



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.

Climate Change Impacts

One of the climate change impacts noted in the *2010 Climate Change Impacts on Iowa* report by the Iowa Climate Change Impacts Committee is the increase in frequency of severe precipitation events. This climate change impact was also noted in the Flash Flood hazard analysis. Although very heavy precipitation does not always result in riverine flooding, it can if/when the very heavy precipitation occurs frequently without enough time for the watershed to drain away the large amounts of water.

0 in the Flash Flood section shows that all of Iowa is in the region with a 31% increase in very heavy precipitation from 1958 to 2007. For this study, very heavy precipitation was defined as the heaviest 1% of all events. If this trend increases, riverine flooding events and their associated impacts will likely occur more often in the planning area.

River Flooding Hazard Summary by Jurisdiction

To demonstrate how river flooding additionally varies by jurisdiction, all were rated in terms of their riverine flooding hazard characteristics. Probability scrores are estimated from historical flood events. Magnitude ratings are based on the number of structures present or in very close proximity to the flooding area. Warning times of 24 hours or more (i.e., receiving a rank of 1) are plausible, given the many methods available to communicate hazard warnings thanks to technology and emergency management staff efforts. Durations are also estimated from historical flood events and patterns. For those jurisdictions with no floodplain areas found to intersect with city boundaries, all elements indicate Not Applicable (N/A). **Table 3.24** summarizes these rankings, and gives the overall score and level of hazard for each jurisdiction. (For a reminder on the general hazard scoring methodology, please refer back to Section 3.1.6).

Table 3.56. Flooding Hazard Rankings for Each Jurisdiction

Jurisdiction	Probability	Magnitude	Warning Time	Duration	Score	Level
Worth County, Iowa	4	4	1	4	3.55	High
City of Fertile	4	4	1	4	3.55	High
City of Grafton	N/A	N/A	N/A	N/A	N/A	N/A
City of Hanlontown	3	1	1	2	2.06	Moderate
City of Joice	3	2	1	2	2.3	Moderate
City of Kensett	3	1	1	2	2	Moderate
City of Manly	4	3	1	3	3.15	High
City of Northwood	4	4	1	4	3.55	High
Central Springs Schools	3	1	1	2	2.06	Moderate
Northwood-Kensett Schools	3	1	1	2	2.06	Moderate

3.5.15 Severe Winter Storm

Hazard Score Calculation					
Probability	Magnitude/Severity	Warning Time	Duration	Weighted Score	Level
4	2	3	4	3.25	High

Profile

Hazard 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

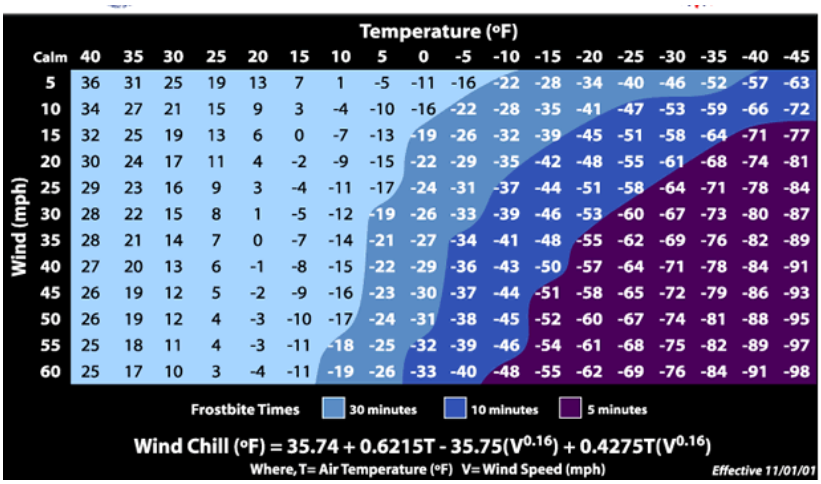
to freeze and rupture. When combined with high winds from winter storms, extreme cold becomes extreme wind chill, which is extremely hazardous to health and safety.

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.

Also 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 3.57** below shows the relationship of wind speed to apparent temperature and typical time periods for the onset of frostbite.

Figure 3.57. Wind Chill Chart



Source: National Weather Service

Warning Time Score: 3—6-12 hours

Duration Score: 4—more than 1 week

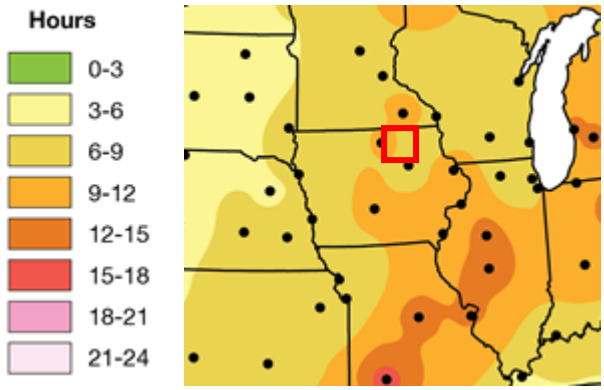
Geographic Location/Extent

According to the High Plains Regional Climate Center, the planning area has an average maximum temperature of 2.13 ºF in December, 23.56 ºF in January, and 28.40 ºF in February. Average minimum temperatures for those same three months are 10.82 ºF, 5.85 ºF and 10.73 ºF. Average snowfall is highest in December, January, and February with an annual average of 38 inches.
(Source: http://www.hprcc.unl.edu/datasets.php?set=CountyData#)

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 3.58 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 3.58. 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.

Previous Occurrences

Historically, there have been two Presidential Disaster Declarations for Severe Winter Storms that included Worth County since 1965; an ice storm in 1991 and a severe winter storm in 2007 (See **Table 3.2** in the Hazard Identification Section**)**.

From 1996 thru 2017, the National Climatic Data Center reports the following 90 severe winter weather events:

- 27 - Blizzard
- 8 - Cold/Wind Chill
- 5 - Extreme Cold/Wind Chill
- 19 - Heavy Snow
- 9 - Ice Storm
- 15 - Winter Storm
- 1 - Winter Weather

During this 22-year period, 42 of the events caused property damage. This translates to almost two damaging winter storm/cold temperature events each year. The total property damage for these 42 events was $1,322,180 with the most damaging event occurring on February 24, 2007 causing $250,000 in property damage.

NOAA's National Weather Service has issued 294 Advisories, Watches, and/or Warnings for winter weather phenomena between 1986 and 2016 (see **Table 3.57**). The data is kept with Iowa Environmental Mesonet, Iowa State University Department of Agronomy website, (http://mesonet.agron.iastate.edu/vtec/search.php).

Table 3.57. National Weather Service Issuances for Winter Weather in Worth County, IA

Phenomenon/Significance	Advisory	Warning	Watch	Total
Blizzard		18	8	**26**
Blowing Snow				
Freeze		18	5	**23**
Freezing Fog				
Freezing Rain				
Frost				
Heavy Snow		1		**1**
Snow				
Snow and Blowing Snow				
Wind Chill	102	17	2	**121**
Winter Storm				
Winter Weather	123			**123**
Grand Total	**225**	**81**	**55**	**294**

Source: Environmental Mesonet, Iowa State University Department of Agronomy website, http://mesonet.agron.iastate.edu/vtec/search.php

Agricultural Impacts

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 2007-2016 totaled $908,585. (see **Table 3.58**).

Table 3.58. Crop Insurance Claims Paid in Worth County as a Result of Cold Conditions and Snow (2007-2016)

Year	Cold Wet Weather	Cold Winter Weather	Freeze	Total Insurance Claims Paid
2007				$0
2008	$6,052			$6,052
2009	$96,439		$649	$97,088
2010				$0
2011	$3,440			$3,440
2012	$6,688			$6,688
2013	$568,619			$568,619
2014	$219,697			$219,697
2015				$0
2016	$7,001			$7,001
Total	**$907,936**	**$0**	**$649**	**$908,585**

Source: USDA Risk Management Agency

Probability of Future Occurrence

According to NCDC, during the 22-year period from 1996 thru 2017, the planning area experienced a total of 42 damaging blizzards, winter storms, ice storms, and extreme cold

events. This translates to an annual probability of almost two severe winter weather events per year. Therefore, the probability rating is "Highly Likely".

Probability Score: 4—Highly Likely

Vulnerability

Vulnerability Overview

The entire planning area is vulnerable to the effects of winter storm. Hazardous driving conditions due to snow and ice on highways and bridges lead to many traffic accidents, and can impact the response of emergency vehicles. The leading cause of death during winter storms is transportation accidents. About 70 percent of winter-related deaths occur in automobiles due to traffic accidents and about 25 percent are from people caught outside in a storm. Emergency services such as police, fire, and ambulance are unable to respond due to road conditions. Emergency needs of remote or isolated residents for food or fuel, as well as for feed, water and shelter for livestock are unable to be met. The probability of utility and infrastructure failure increases during winter storms due to freezing rain accumulation on utility poles and power lines. People, pets, and livestock are also susceptible to frostbite and hypothermia during winter storms. Those at risk are primarily either engaged in outdoor activity (shoveling snow, digging out vehicles, or assisting stranded motorists), or are the elderly. Schools often close during extreme cold or heavy snow conditions to protect the safety of children and bus drivers. Citizens' use of kerosene heaters and other alternative forms of heating may create other hazards such as structural fires and carbon monoxide poisoning.

According to the *2013 Iowa Hazard Mitigation Plan*, of the 8 hazards for which data was available to estimate annualized losses, severe winter storm ranked 6th with $2.2 million in annualized losses based on data spanning a 13-year period.

Magnitude Score: 2—Limited

Potential Losses to Existing Development

Vulnerable Buildings, Infrastructure, and Critical Facilities

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 closures during winter storms.

Loss of Use

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 could 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 3.59** 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 Worth 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 3.59. 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 Fertile	346	35	$ 4,360
City of Grafton	355	36	$ 4,473
City of Hanlontown	211	21	$ 2,659
City of Joice	195	20	$ 2,457
City of Kensett	345	35	$ 4,347
City of Manly	1,551	155	$ 19,543
City of Northwood	1,931	193	$ 24,331
Unincorporated Worth County	2,628	263	$ 33,113
County Total	**7,562**	**756**	**$ 95,281**

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

Property Losses

The total property loss reported by the NCDC for a total of 42 winter events that impacted the planning area during the 22-year time-period from 1996 thru 2017 was $1,322,180. 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 Worth County.

USDA crop insurance claims for cold conditions and snow for the ten-year period of 2007-2016 totaled $907,936. The 2015 Iowa Crop Insurance Profile from USDA, RMA shows that 89 percent of crops are insured in Iowa and the adjusted losses calculate to $1,020,152 for the period and $102,015 in estimated annualized losses.

Considering the $163 million market value of crops from the 2012 Census of Agriculture as baseline crop exposure, the estimated annual losses from cold conditions and snow was determined minimal (0.62%) compared to the value of the insurable crops.

Increased Risk Populations
Elderly populations are considered to be at increased risk to Winter Storms and associated extreme cold events. **Table 3.36** in the Extreme Heat Profile Section provides the number of population over 65 in each jurisdiction in the planning area.

Future Development
Future development could potentially increase vulnerability to this hazard by increasing demand on the utilities and increasing the exposure of infrastructure networks.

Climate Change Impacts
According to the 2010 report on *Climate Change Impacts on Iowa*, Iowa has experienced a long-term upward trend in temperature.

- Long-term winter temperatures have increased six times more than summer temperatures.
- Nighttime temperatures have increased more than daytime temperatures since 1970.
- Since 1970, daily minimum temperatures have increased in summer and winter; daily maximum temperatures have risen in winter, but declined substantially in summer.

If this trend continues, future occurrences of the extreme cold/wind chill aspects of winter storms should decrease. In addition, higher winter temperatures bring higher probability of rain, rather than snow. As a result, the amount of precipitation falling as snow should decrease.

Severe Winter Storm Hazard Summary by Jurisdiction
Although crop loss as a result of winter storm occurs more in the unincorporated portions of the planning area, the crop losses are not high since corn and soybeans are not in the ground during winter months and only get affected by unusual weather events. The density of vulnerable populations is higher in the cities. Transportation incidents related to winter storm could also impact all jurisdictions. With these vulnerabilities that apply to both urban and rural jurisdictions, the magnitude of this hazard is relatively equal. The factors of probability, warning time, and duration are also equal across the planning area. This hazard does not substantially vary by jurisdiction.

Jurisdiction	Probability	Magnitude	Warning Time	Duration	Score	Level
Worth County, Iowa	4	2	3	4	3.25	High
City of Fertile	4	2	3	4	3.25	High
City of Grafton	4	2	3	4	3.25	High
City of Hanlontown	4	2	3	4	3.25	High
City of Joice	4	2	3	4	3.25	High
City of Kensett	4	2	3	4	3.25	High
City of Manly	4	2	3	4	3.25	High
City of Northwood	4	2	3	4	3.25	High
Central Springs Schools	4	2	3	4	3.25	High
Northwood-Kensett Schools	4	2	3	4	3.25	High

3.5.16 Sinkholes

Hazard Score Calculation					
Probability	Magnitude/Severity	Warning Time	Duration	Weighted Score	Level
1	1	2	1	1.15	Low

Profile

Hazard Description
The loss of surface elevation due to the removal of subsurface support defines a sinkhole. Sinkholes range from broad, regional lowering of the land surface to localized collapse.

Sinkholes are common where the rock below the land surface is limestone, carbonate rock, salt beds, or rocks that can naturally be dissolved by ground water circulating through them. As the rock dissolves, void spaces and caverns develop underground. The sudden collapse of the land surface can be dramatic and range in size from broad, regional lowering of the land surface to localized collapse. Although subsidence can be a naturally occurring hazard, the primary causes of most incidents of subsidence are human activities: underground mining of coal, groundwater or petroleum withdraw, and drainage of organic soils. Land subsidence occurs slowly and continuously over time or on occasion abruptly, as in the sudden formation of sinkholes. Sinkholes can be aggravated by flooding.

Karst is a landscape formed from the dissolution of soluble rocks including limestone, dolomite and gypsum. Sinkholes are a common indication of karst; caves and underground drainage systems are other indicators.

Land subsidence occurs slowly and continuously over time or on occasion abruptly, as in the sudden formation of sinkholes. Sinkholes can be aggravated by flooding.

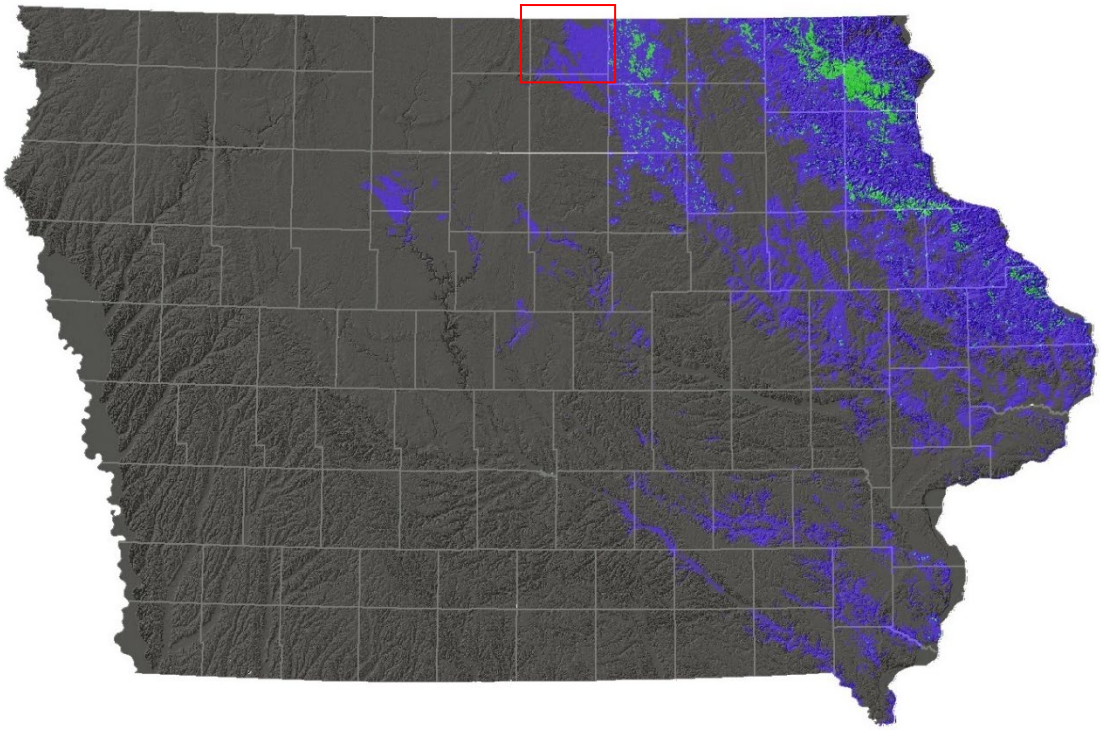
Warning Time Score: 2—12-24 hours

Duration Score: 1—Less than 6 hours

Geographic Location/Extent
There are three areas in Iowa where large numbers of sinkholes exist: 1) within the outcrop belt of the Ordovician Galena Group carbonates in Allamakee, Clayton, and Winneshiek Counties; 2) in Devonian carbonates in Bremer, Butler, Chickasaw and particularly Floyd and Mitchell Counties; and 3) along the erosional edge of silurian carbonates in Dubuque and Clayton Counties.

According to the Department of Natural Resources, there are no known sinkholes in Worth County. However, much of the County, particularly to the east and south, is likely composed of karst terrain. The image in **Figure 3.59** shows areas with sinkhole potential in Iowa. Areas identified as green are within 1,000 feet of a known sinkhole and the blue areas show greater than 1,000 feet but less than a mile from a known sinkhole or an area with carbonate bedrock close to the surface.

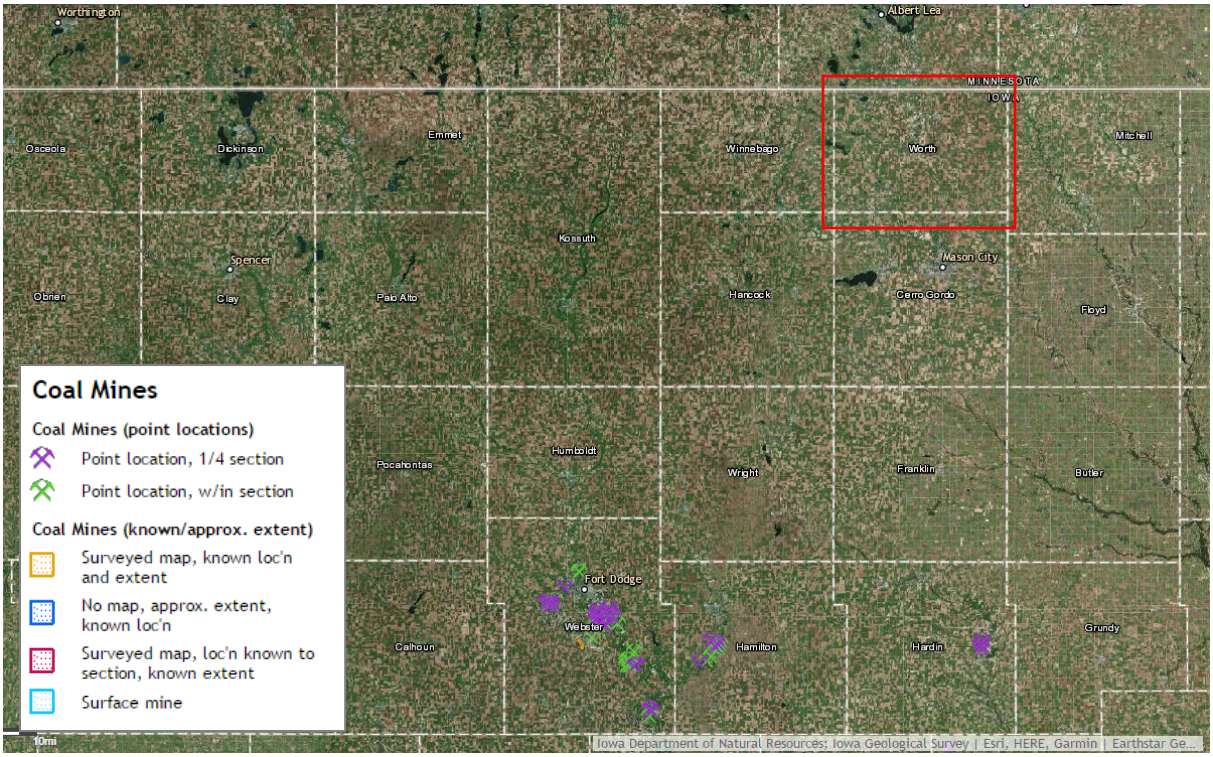
Figure 3.59. Karst Terrain (Sinkhole Location and Potential, Worth County)



Source: Iowa Department of Natural Resources, http://iagiservicebureau.blogspot.com/2013/05/caution-karst-below.html

Mining activity can also lead to sinkhole development. The map in **Figure 3.60** shows historic coal mining areas as reported by the Iowa Department of Natural Resources. As shown in this map, there are no locations in Worth County with historic coal mining areas that could potentially be susceptible to sinkholes (Worth County is identified by the red rectangle).

Figure 3.60. Historic Mining Areas in Worth County



Source: Iowa Department of Natural Resources

Previous Occurrences

The sinkhole inventory maintained by the Iowa Department of Natural Resources did not include any known previous sinkhole occurrences in Worth County.

Probability of Future Occurrence

Despite the presence of karst terrain, based on no known past occurrences and no known historic mine sites, the probability of this hazard is unlikely.

Probability Score: 1—Unlikely

Vulnerability

Vulnerability Overview

Sinkholes have not historically occurred in Worth County, and there are no coal mine sites that would present the conditions for sinkholes to occur. However, due to the presence of subsurface limestone that could erode in the southern and eastern portions of the County, the potential exists. If subsidence or sinkholes were to occur, it would most likely be an isolated event with localized damages.

Magnitude Score: 1—Limited

Potential Losses to Existing Development

Due to the lack of information regarding previous occurrences of this hazard, it is not possible to estimate potential losses.

Future Development
Future development should avoid areas of known subsurface void spaces such as old coal mines.

Climate Change Impacts
There are no noted trends in climate change that would not have a significant effect on the occurrence of sinkholes.

Sinkhole Hazard Summary by Jurisdiction
The overall risk to sinkholes and land subsidence is low and does not vary substantially among jurisdictions.

Jurisdiction	Probability	Magnitude	Warning Time	Duration	Score	Level
Worth County, Iowa	1	1	2	1	1.15	Low
City of Fertile	1	1	2	1	1.15	Low
City of Grafton	1	1	2	1	1.15	Low
City of Hanlontown	1	1	2	1	1.15	Low
City of Joice	1	1	2	1	1.15	Low
City of Kensett	1	1	2	1	1.15	Low
City of Manly	1	1	2	1	1.15	Low
City of Northwood	1	1	2	1	1.15	Low
Central Springs Schools	1	1	2	1	1.15	Low
Northwood-Kensett Schools	1	1	2	1	1.15	Low

3.5.17 Terrorism

Hazard Score Calculation					
Probability	Magnitude/Severity	Warning Time	Duration	Weighted Score	Level
1	4	4	4	2.65	Moderate

Profile

Hazard 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 Worth County. The introduction of a biological agent into the population of 3,236 cattle and calves, or the 54,765 hogs and pigs, or the 148,900 acres of corn and soybeans in Worth County would be financially devastating and would have a major impact on the food supply of the state and the nation. A major attack involving the nation's food supply could be launched in a rural area that has little capacity to respond. Potential terrorists' targets for livestock disease introduction would be concentration points, such as the County's licensed feedlots or livestock markets discussed later in the Geographic Location section.

Chemical terrorism involves the use or threat of chemical agents against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion or ransom. Effects of chemical contaminants are similar to biological agents.

Use of conventional weapons and explosives against persons or property in violation of the criminal laws of the United States for purposes of intimidations, coercion, or ransom is conventional terrorism. Hazard effects are instantaneous; secondary devices may be used, lengthening the time duration of the hazard until the attack site is determined to be clear. The

extent of damage is determined by the type and quantity of explosive. Effects are generally static other than cascading consequences and incremental structural failures. Conventional terrorism can also include tactical assault or sniping from remote locations.

Electronic attack using one computer system against another in order to intimidate people or disrupt other systems is a cyber-attack. All governments, businesses and citizens that conduct business utilizing computers face these threats. Cyber-security and critical infrastructure protection are among the most important national security issues facing our country today. As such, the Iowa Division of Criminal Investigation has a Cyber Crime Unit tasked with analysis and retrieval of digital information for investigations.

Radiological terrorism is the use of radiological materials against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion or ransom. Radioactive contaminants can be dispersed using sprayers/aerosol generators, or by point of line sources such as munitions, covert deposits and moving sprayers or by the detonation of a nuclear device underground, at the surface, in the air or at high altitude.

Mass demonstrations, or direct conflict by large groups of citizens, as in marches, protect rallies, riots, and non-peaceful strikes are examples of public disorder. These are assembling of people together in a manner to substantially interfere with public peace to constitute a threat, and with use of unlawful force or violence against another person, or causing property damage or attempting to interfere with, disrupting, or destroying the government, political subdivision, or group of people. Labor strikes and work stoppages are not considered in this hazard unless they escalate into a threat to the community. Vandalism is usually initiated by a small number of individuals and limited to a small target or institution. Most events are within the capacity of local law enforcement.

The Southern Poverty Law Center reports four active hate groups in Iowa: National Socialist Movement (Neo-Nazi, National Socialist); Gallows Tree Wotansvolk Alliance (Neo-Nazi); the Daily Stormer (Neo Nazi); and ACT for America (Anti-Muslim).

Warning Time Score: 4—Minimal or no warning

Duration Score: 4—More than 1 week

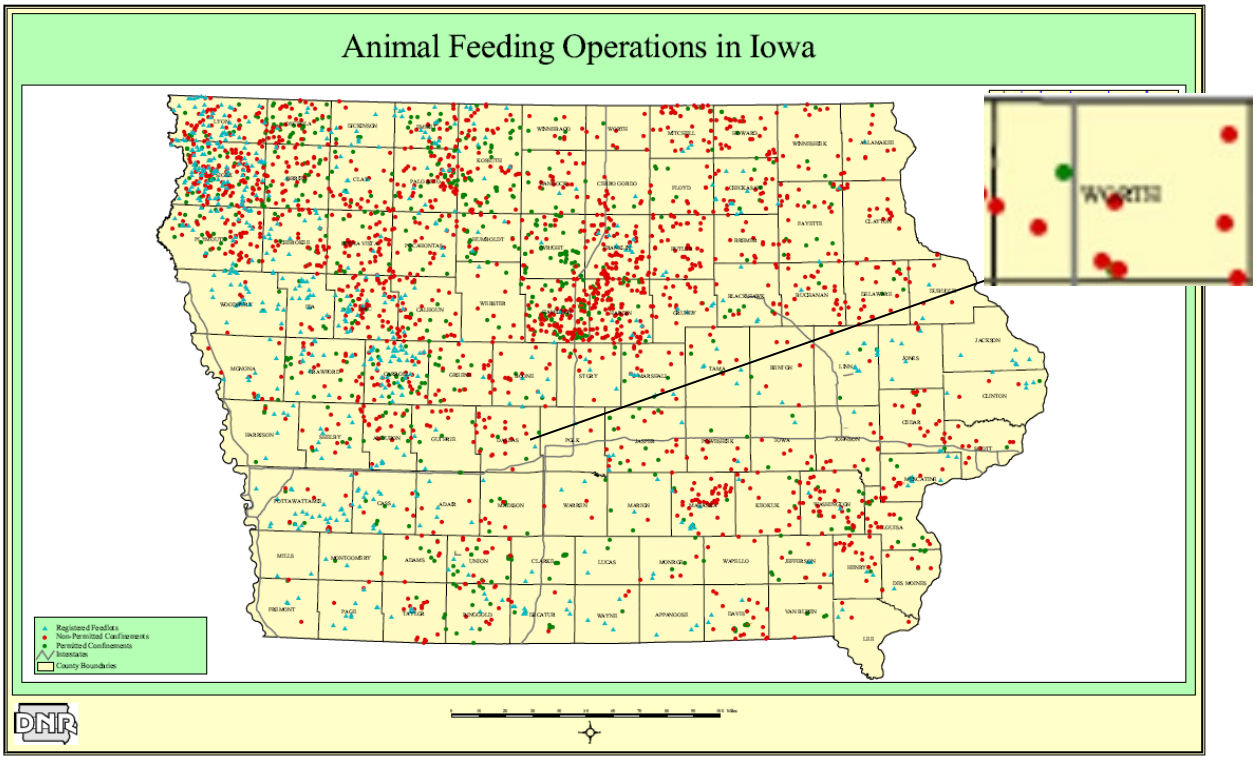
Geographic Location/Extent

The entire planning area has a low potential for terrorist activity. However, any venue with a large gathering of people could be a potential target for terrorists. Likely targets of a conventional terrorism attack in Worth County include public school system facilities, the Worth County Courthouse and law enforcement centers within the County.

In terms of 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 Worth County and its associated municipal jurisdictions.

For agro-terrorism planning, **Figure 3.61** shows the locations of animal feeding operations in Worth County. Additional agricultural assets are discussed in **Section 3.5.1**, Animal/Plant/Crop Disease.

Figure 3.61. Animal Feeding Operations in Iowa



Source: Department of Natural Resources

Previous Occurrences

There have not been any large-scale enemy attacks or acts of radiological terrorism in Iowa. There have been biological and chemical agent threats, animal rights activists' vandalism and many bomb threats. In 2002, pipe bombs were found in 18 states including Iowa and six people were injured in the bombings in Iowa and Illinois. In 2005 and 2006, pipe bombs were used in attempted murder cases in two Iowa cities.

The Iowa Department of Public Safety issued a *2016 Iowa Uniform Crime Report* showing 18 hate/bias crimes were reported statewide in 2016.

According to the Southern Poverty Law Center, there were 47 hate incidents reported in Iowa from 2003 to 2016. None of the incidents reported were in Worth County.

Probability of Future Occurrence

While difficult to estimate, the probability for a terrorist event is "Unlikely" within the next 10 years in Worth County.

Probability Score: 1—Unlikely

Vulnerability

Overview
A terrorism event could occur in either limited area of a jurisdiction or over the entire jurisdiction at once. This hazard has the ability to directly cause substantial structural losses and potentially loss of life.

Magnitude Score: 4—Catastrophic

Potential Losses to Existing Development
Potential losses from Terrorism include fatalities to people, damage to property, infrastructure, critical facilities, crops, and animals. 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. Secondary effects of infrastructure failure could include public safety hazards, spread of disease, increased morbidity and mortality among the local and distant populations, public panic and long-lasting damage to the environment. Terrorism events are rare occurrences and specific amounts of estimated losses for previous occurrences are not available due to the complexity and multiple variables associated with these types of hazards. In some instances, information about these events is secure and unavailable to the public in order to maintain national security and prevent future attacks.

As discussed previously, it is difficult to quantify potential losses in terms of the jurisdictions most threatened by CBRNE (chemical, biological, radiological, nuclear, and high yield explosive) attack events due to the many variables and human element. Therefore, for the purposes of this plan, the loss estimates will take into account a hypothetical scenario. The attack scenario is staged at a Friday night high school football game. The hypothetical football stadium has approximately 500 persons in the stadium and concession areas on any home football game nights during the fall.

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 Department of Homeland Security.

****THE FOLLOWING HYPOTHETICAL SCENARIO IS FOR INSTRUCTIONAL AND ILLUSTRATIVE PURPOSES ONLY****

Chemical Attack – Toxic Gas – Chlorine Release

***Scenario Overview*:** A bomb is attached to a truck trailer tanker carrying compressed chlorine and enters the high school football stadium parking lot. The entire contents of the tank escape to the atmosphere and the plume spreads to the stadium and the immediate surrounding parking lot area. This particular type of attack would cause harm to humans and could render portions of the stadium unusable for a short time period in order to allow for a costly clean-up. There might also be a fear by the public of long-term contamination of the stadium and the high school, subsequently closing the high school.

Assumptions: (1) The population density is approximately 500 persons around the high school stadium. (2) Chlorine is toxic and may damage eyes, skin and respiratory tract. (3) The rate of "worried well" is equal to 9 times the number of infected cases or the full exposed population, whichever is least.

Table 3.60. Described Losses from a Chemical Attack – Chlorine Scenario

Eye pain & swelling, headache, restricted airflow – difficulty breathing, possible chemical burns	22 persons
Eye pain & swelling, headache, rapid breathing, skin irritation	42 persons
Eye pain & swelling, headache, rapid breathing, coughing, chest pain, skin irritation	86 persons
Eye irritation, headache, throat irritation, coughing, skin irritation	119 persons
Eye irritation, headache, coughing, skin irritation	82 persons
Total "Worried Well" Cases (total exposed population)	500 persons
Deaths	16 persons
Cost of Decontamination @ $12/person (assumes all persons with skin injuries will require decontamination and approximately 1/10 of the worried well will demand to be decontaminated) - total persons =417	$5,004

Notes: Victims will require decontamination and both long and short-term treatment.

Improvised Explosive Device Attack – ANFO

Scenario Overview: An Improvised Explosive Device (IED) utilizing an ammonium nitrate/fuel oil (ANFO) mixture is carried in a panel van to a high school parking area at the beginning of a home football game when people are leaving their cars and entering the stadium. Potential losses with this type of scenario include both human and structural assets.

Assumptions: (1) The population density in the parking lot during the beginning and ending of the game is high, at least 1 person /1 square feet. (2) The quantity of ANFO used is 500 lbs.

Table 3.61. Described Losses from an Improvised Explosive Device Attack - ANFO

Total Dead	86 persons
Total Traumatic Injuries	151 persons
Total Urgent Care Injuries	745 persons
Injuries not Requiring Hospitalization	279 persons
Structures and Other Physical Assets (Damages would certainly occur to vehicles and depending on the proximity of other structures, damages would occur to the stadium complex itself. The exact amount of these damages is difficult to predict because of the large numbers of factors, including the type of structures nearby and the amount of insurance held by vehicle owners.)	Vehicles – Replacement cost for approximately 350 vehicles @ $10,000 per vehicle inside the 200 ft. BATF described Lethal Air Blast range = $ 3,500,000 Repair / repainting cost for approximately 70 vehicles @ $ 4,000 per vehicle inside the BATF described Falling Debris Hazard = $280,000

Note: These are the numbers of persons that could be injured from an IED Attack if they are in the area.

Future Development
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.

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

Terrorism Hazard Summary by Jurisdiction
The overall rating for any type of terrorism in the County is 2.65 “Moderate”. This rating score applies to all jurisdictions in the planning area due to the variables and unknowns involved in terrorism events. If a wide scale event occurred in any jurisdiction, it could have devastating consequences.

Jurisdiction	Probability	Magnitude	Warning Time	Duration	Score	Level
Worth County, Iowa	1	4	4	4	2.65	Moderate
City of Fertile	1	4	4	4	2.65	Moderate
City of Grafton	1	4	4	4	2.65	Moderate
City of Hanlontown	1	4	4	4	2.65	Moderate
City of Joice	1	4	4	4	2.65	Moderate
City of Kensett	1	4	4	4	2.65	Moderate
City of Manly	1	4	4	4	2.65	Moderate
City of Northwood	1	4	4	4	2.65	Moderate
Central Springs Schools	1	4	4	4	2.65	Moderate
Northwood-Kensett Schools	1	4	4	4	2.65	Moderate

3.5.18 Thunderstorm with Lightning and Hail

Hazard Score Calculation					
Probability	**Magnitude/Severity**	**Warning Time**	**Duration**	**Weighted Score**	**Level**
4	2	2	2	2.90	Moderate

Profile

Hazard 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 3.5.7**) and tornadoes and windstorms (discussed further in **Section 3.5.18**).

Lightning

All thunderstorms produce lightning, which often strikes outside of the area where it is raining, and has been known to strike more than 10 miles away from the rainfall area. Thunder is simply the sound that lightning makes. Lightning is a huge discharge of electricity. When lightning strikes, electricity shoots through the air and causes vibrations creating the sound of thunder. Nationwide, lightning kills 75 to 100 people each year. Lightning strikes can also start building fires and wildland fires, and damage electrical systems and equipment.

Hail

According to the National Oceanic and Atmospheric Administration (NOAA), hail is precipitation that is formed when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere causing them to freeze. The raindrops form into small frozen droplets and then continue to grow as they come into contact with super-cooled water which will freeze on contact with the frozen rain droplet. This frozen rain droplet can continue to grow and form hail. As long as the updraft forces can support or suspend the weight of the hailstone, hail can continue to grow.

At the time when the updraft can no longer support the hailstone, it will fall down to the earth. For example, a ¼" diameter or pea sized hail requires updrafts of 24 mph, while a 2 ¾" diameter or baseball sized hail requires an updraft of 81 mph. The largest hailstone recorded in the United States was found in Vivian, South Dakota on July 23, 2010, measuring eight inches in diameter, almost the size of a soccer ball. Soccer-ball-sized hail is the exception, but even small pea sized hail can do damage.

Hailstorms in Iowa cause damage to property, crops, and the environment, and kill and injure livestock. In the United States, hail causes more than $1 billion in damage to property and crops each year. Much of the damage inflicted by hail is to crops. Even relatively small hail can shred plants to ribbons in a matter of minutes. Vehicles, roofs of buildings and homes, and

landscaping are the other things most commonly damaged by hail. Hail has been known to cause injury to humans; occasionally, these injuries can be fatal.

Table 3.62 below describes typical damage impacts of the various sizes of hail.

Table 3.62. 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.

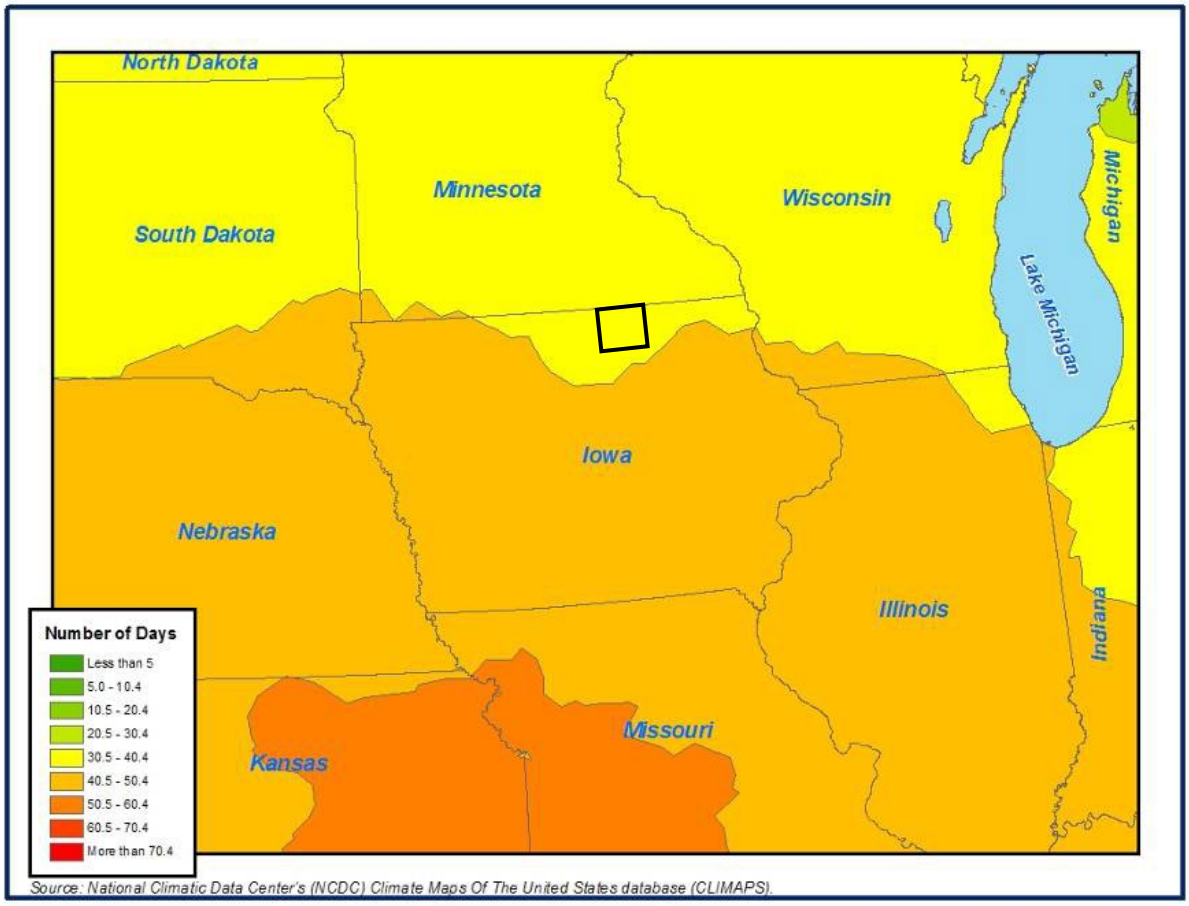
Warning Time Score: 2—12-24 hours

Duration Score: 2—Less than 1 day

Geographic Location/Extent

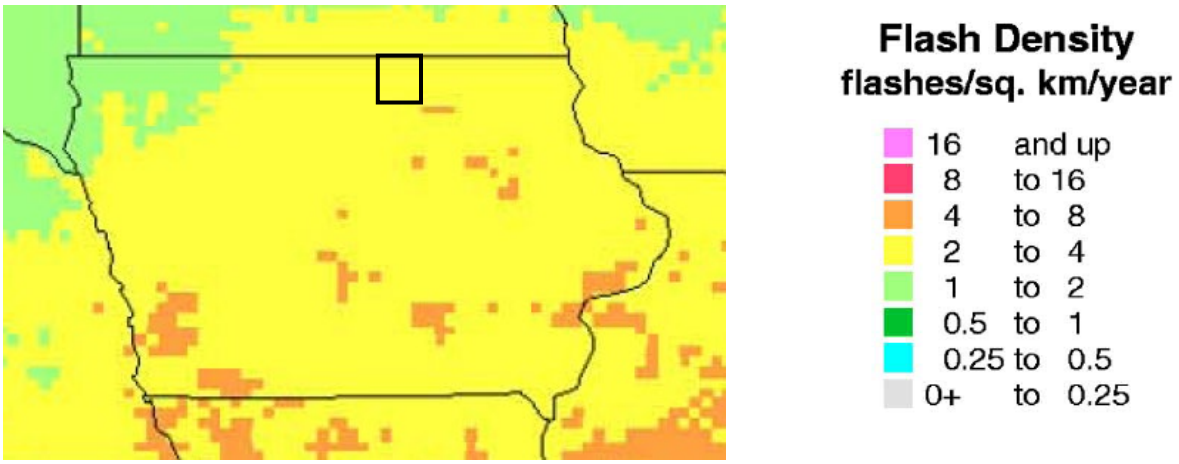
Thunderstorms and the associated hail and lightning impact the entire County with relatively similar frequency. Although these events occur similarly throughout the planning area, they are more frequently reported in more urbanized areas. In addition, damages are more likely to occur in more densely developed urban areas as well as to cropland. **Figure 3.62** displays the average number of days with thunder experienced throughout different areas of the state each year, showing the County experiences between 30.5 to 40.4 days with thunder per year per the orange shaded area. **Figure 3.63** shows 2 to 4 lightning strikes per square kilometer per year with the yellow shaded area.

Figure 3.62. Distribution and Frequency of Thunderstorms



Note: Black Square indicates approximate location of Worth County

Figure 3.63. Location and Frequency of Lightning in Iowa



Source: National Weather Service, www.lightningsafety.noaa.gov/lightning_map.htm
Note: Black Square indicates approximate location of Worth County

Previous Occurrences

Since 1965, Worth County has been included in six Presidential Disaster declarations that included severe storms/weather (see **Table 3.2** 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 NCDC reported 132 total thunderstorm events for the Worth County planning area from January 1996 through December 2017. Of the reported events, there was $1,638,500 in total property damage and two recorded injuries.

Table 3.63. Thunderstorm Summary for Worth County (1996-2017)

Hazard type	Total Events	Events with Damage	Property Damage	Injuries	Fatalities
Hail	68	53	$364,500	2	0
Lightning	2	2	$25,000	0	0
Thunderstorm Wind	62	55	$1,249,000	0	0
Totals	**132**	**110**	**$1,638,500**	**2**	**0**

Source: NCDC

Hail

Table 3.64 shows the number of hail events 0.75 inches and larger by the size of the hail.

Table 3.64. Hail Events Summarized by Hail Size

Hail Size (inches)	# of Events 1996-2017
2.75	1
2.50	1
2.00	2
1.75	5
1.50	5
1.25	5
1.00	28
0.88	14
0.75	7
Grand Total	**68**

Source: NCDC

Thunderstorm Winds

Information concerning tornadoes and windstorms, separate from thunderstorms, can be found in **Section 3.5.18**.

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 32-year period from 1986-2017, there were 75 severe thunderstorm watches and 149 warnings. This calculates to an annual average of 2.3 watches and 4.7 warnings.

Although NCDC 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 Worth County as a result of hail from 2007 to 2016 totaled $647,475.40 (see **Table 3.65**) and $24,408.00 from windstorms. There was no crop damage reported from lightning.

Table 3.65. Crop Insurance Claims Paid in Worth County from Hailstorms and Windstorms, 2007-2016

Year	Hail	Wind/Excess Wind	Insurance Paid
2008	$89,978.00	$8,778.00	$98,756.00
2009	$223,541.00		$223,541.00
2010			
2011	$25,609.00	$4,521.00	$30,130.00
2012	$54,505.00	$7,957.00	$62,462.00
2013	$148,161.00		$148,161.00
2014	$25,677.40		$25,677.40
2015			
2016	$80,004.00	$3,152.00	$83,156.00
Total	**$647,475.40**	**$24,408.00**	**$671,883.40**

Source: USDA Risk Management Agency

Probability of Future Occurrence

NCDC-reported damaging lightning events occurred two times from 1996 through 2017. 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 NCDC data, there have been 53 damaging hail events and 55 damaging thunderstorm wind events. This translates to an annual average of 2.5 and 2.6 damaging events per year, respectively. 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.

Probability Score: 4—Highly Likely

Vulnerability

Overview

In general, assets in the County are vulnerable to thunderstorms, winds, lightning and hail including people, crops, vehicles, and built structures. According to the 2013 Iowa Hazard Mitigation Plan, of the 8 hazards for which data was available to estimate annualized losses, thunderstorm with lightning and hail ranked 4th with $30 million in annualized losses based on data spanning a 17-year period. Although this hazard results in high annual losses, generally private property insurance and crop insurance cover the majority of losses. Considering insurance coverage as a recovery capability and therefore mitigation of devastating impacts to the economy, the overall impact on jurisdictions is reduced; therefore, this hazard's magnitude score to the planning area is "limited".

Magnitude Score: 2—Limited

Potential Losses to Existing Development

Most lightning damages occur to electronic equipment located inside buildings. But structural damage can also occur when a lightning strike causes a building fire. In addition, lightning strikes can cause crop damages if fields light on fire. Communications equipment and warning transmitters and receivers can also be knocked out by lightning strikes. There have not been any fatalities in Worth County from lightning strikes.

Thunderstorm winds and hail can cause damage to property, vehicles, trees, and crops.

Property and Crop Losses

Table 3.66 provides the estimated annualized property damages resulting from thunderstorms, including lightning, hail and wind.

Table 3.66. Estimated Annualized Property Damages Resulting from Severe Thunderstorms (Hail/Lightning/Wind, 1996-2017)

Hail/Lightning/Thunderstorm Wind Property Damages		Annualized Property Damages
Hail	$364,500	
Lightning	$25,000	
Thunderstorm Wind	$1,249,000	
Total	**$1,638,500**	$78,024

Source: NCDC

Table 3.67 provides the insured crop losses resulting from hail and wind. The insured loss has been adjusted to estimate losses to all insurable crops by considering that 89 percent of insurable crops in the State were insured (2016 Iowa Crop Insurance Profile from USDA's Risk Management Agency).

Table 3.67. Estimated Insurable Annualized Crop Damages Resulting from Severe Thunderstorms (Hail//Wind)

Crop Exposure (2012)	Insurance Paid (2007-2016)		Adjusted Crop Damages Considering 89% Insured	Annualized Adjusted Crop Damages
	Hail	$647,475.40		
$163,330,000	Wind/Excess Wind	$24,408.00		
	Total	**$671,883.40**	$754,925.17	$75,493

Source: Crop Exposure 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

Future Development

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.

Climate Change Impacts

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.

Thunderstorm, Lightning and Hail Hazard Summary by Jurisdiction

The following hazard summary table shows that this hazard does not vary significantly by jurisdiction. Although structural property damages are higher in the urban areas, the rural areas have higher damages to agriculture.

Jurisdiction	Probability	Magnitude	Warning Time	Duration	Score	Level
Worth County, Iowa	4	2	2	2	2.90	Moderate
City of Fertile	4	2	2	2	2.90	Moderate
City of Grafton	4	2	2	2	2.90	Moderate
City of Hanlontown	4	2	2	2	2.90	Moderate
City of Joice	4	2	2	2	2.90	Moderate
City of Kensett	4	2	2	2	2.90	Moderate
City of Manly	4	2	2	2	2.90	Moderate
City of Northwood	4	2	2	2	2.90	Moderate
Central Springs Schools	4	2	2	2	2.90	Moderate
Northwood-Kensett Schools	4	2	2	2	2.90	Moderate

3.5.19 Tornado/Windstorm

Hazard Score Calculation					
Probability	Magnitude/Severity	Warning Time	Duration	Weighted Score	Level
4	4	4	1	3.70	High

Profile

Hazard 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, 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 Watches, High Wind Warnings, and Wind Advisories to the public. The following are the definitions of these issuances:

- High Wind Watch—This is issued when there is the potential of high wind speeds developing that may pose a hazard or are life-threatening.
- High Wind Warning—The 1-minute surface winds of 35 knots (40 mph) or greater lasting for one hour or longer, or winds gusting to 50 knots (58 mph) or greater, regardless of duration, 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.

Warning Time Score: 4— Minimal or no warning time (up to 6 hours warning)

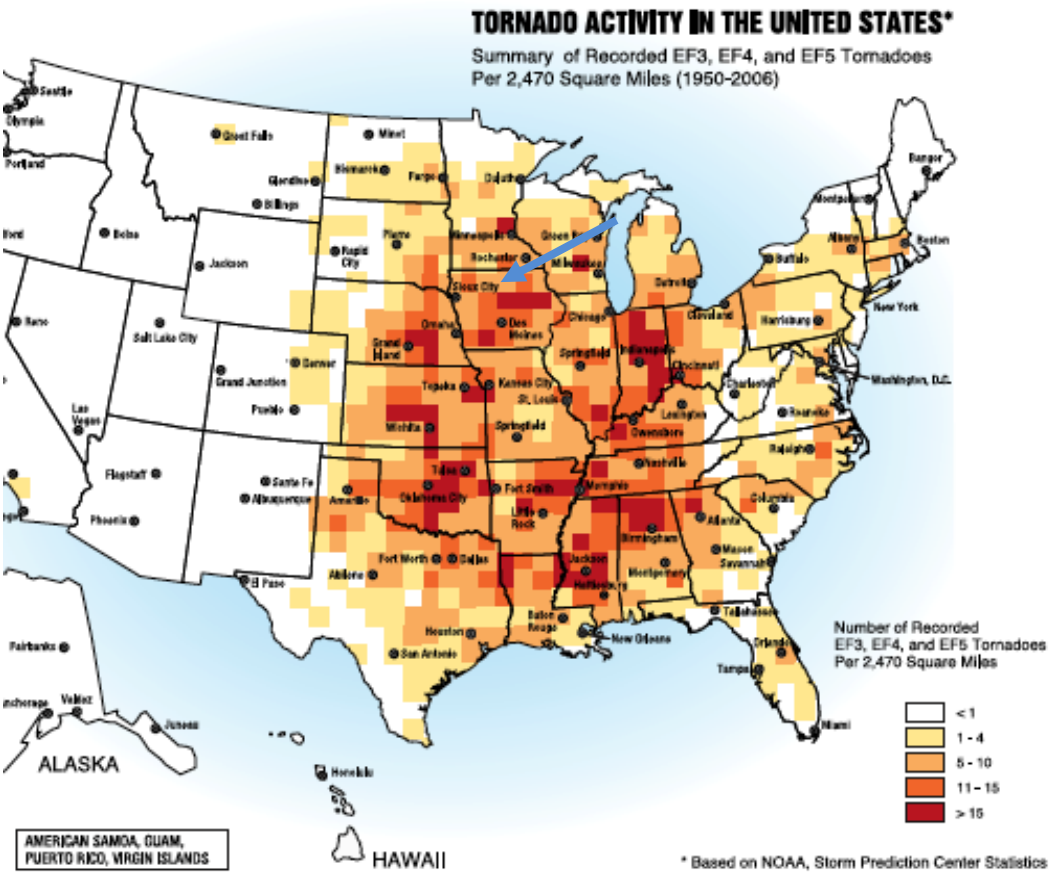
Duration Score: 1—less than 6 hours

Geographic Location/Extent

Iowa is located in a part of the United States where tornadoes are a common occurrence. According to The Tornado History Project.com, Iowa has experienced 2,468 tornadoes from 1950 through 2016 (67-year period) Only one F5 rated tornado has occurred in Iowa during this timeframe (Parkersburg in 2008). Since 1950, there have been on average 37 tornadoes per year in Iowa. Most tornadoes occurred in May and June but can occur during any month. Also, mid-afternoon until around sunset is the peak time of day for tornado activity. Since 1950 there have been 2,274 injuries and 87 deaths attributable to tornadoes (source: http://www.tornadohistoryproject.com/tornado/Iowa/map).

Tornadoes can occur in the entire planning area. **Figure 3.64** illustrates the number of F3, F4, and F5 tornadoes recorded in the United States per 3,700 square miles between 1950 and 2006. Worth County is in the section with light orange shading, indicating between 5 and 10 tornadoes of this magnitude during this 57-year period.

Figure 3.64. Tornado Activity in the United States



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

Tornadoes are classified according to the EF Scale. The Enhanced F Scale (see **Table 3.68**) 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 3.68. 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 3.69**. The damage descriptions are summaries. For the actual EF scale, it is necessary to look up the damage indicator (type of structure damaged) and refer to the degrees of damage associated with that indicator. Information on the Enhanced Fujita Scale's damage indicators and degrees of damage is located online at www.spc.noaa.gov/efscale/ef-scale.html.

Table 3.69. Enhanced Fujita Scale with Potential Damage

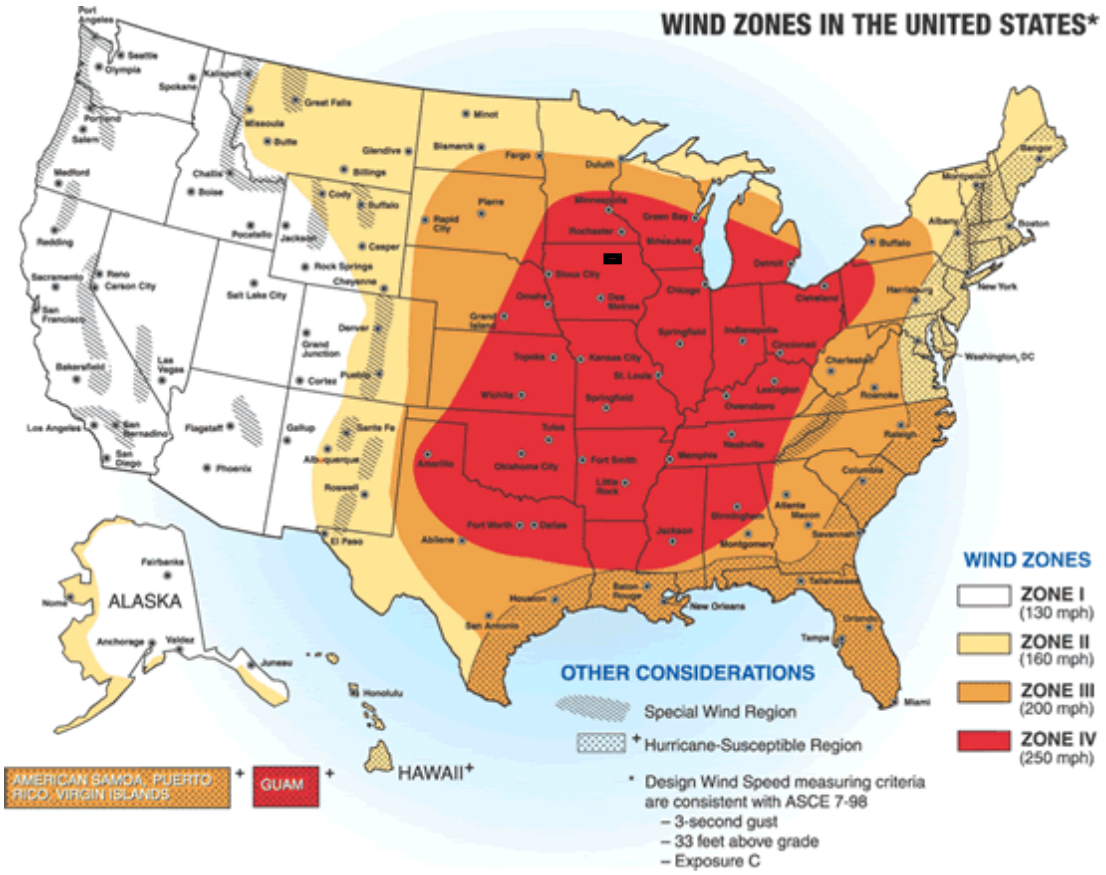
Enhanced Fujita Scale			
Scale	Wind Speed (mph)	Relative Frequency	Potential Damage
EF0	65-85	53.5%	Light. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e. those that remain in open fields) are always rated EF0).
EF1	86-110	31.6%	Moderate. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111-135	10.7%	Considerable. Roofs torn off well constructed houses; foundations of frame homes shifted; mobile homes complete destroyed; large trees snapped or uprooted; light object missiles generated; cars lifted off ground.
EF3	136-165	3.4%	Severe. Entire stores of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	166-200	0.7%	Devastating. Well-constructed houses and whole frame houses completely levelled; cars thrown and small missiles generated.
EF5	>200	<0.1%	Explosive. Strong frame houses levelled off foundations and swept away; automobile-sized missiles fly through the air in excess of 300 ft.; steel reinforced concrete structure badly damaged; high rise buildings have significant structural deformation; incredible phenomena will occur.

Source: NOAA Storm Prediction Center

All of Worth County is susceptible to high wind events. The County is located in Wind Zone IV, which is susceptible to winds up to 250 mph. All of the participating jurisdictions are vulnerable

to this hazard. **Figure 3.65** 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 3.65. Wind Zones in the United States



Source: FEMA; http://www.fema.gov/plan/prevent/saferoom/tsfs02_wind_zones.shtm
Note: Black square indicates approximate location of Worth County

The advancement in weather forecasting has provided for the ability to predict severe weather that is likely to produce tornadoes days in advance. Tornado watches can be delivered to those in the path of these storms several hours in advance. Lead time for actual tornado warnings is about 30 minutes. Tornadoes have been known to change paths very rapidly, thus limiting the time in which to take shelter. Tornadoes may not be visible on the ground if they occur after sundown or due to blowing dust or driving rain and hail.

Previous Occurrences

Tornadoes

According to NOAA statistics Worth County had 49 recorded tornado events from 1950 to 2016. Of these, one was an F4; three were an F3; four were an F2; three were an F1; and six were F0/EF0. These tornadoes caused no fatalities, four injuries, and over $13 million in property damages. **Table 3.70** summarizes these events.

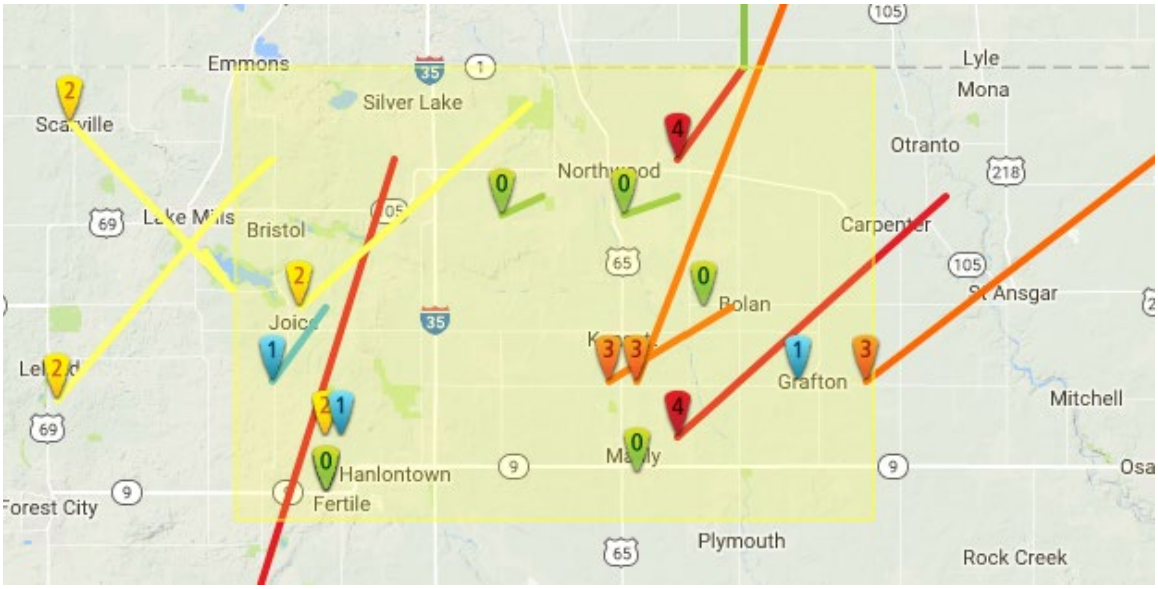
Table 3.70. Recorded Tornadoes in Worth County, 1950 - 2016

Location	Date	Time	Rating	Deaths	Injuries	Property Damage	Crop Damage	Length (mi)	Width (yds)
Worth County	5/23/1952	1500	F1	0	0	$0	$0	0	33
Worth County	8/29/1964	1755	F2	0	0	$25,000	$0	11.2	150
Worth County	8/29/1964	1800	F2	0	0	$25,000	$0	2	100
Worth County	8/7/1965	1420	F1	0	0	$25,000	$0	0	33
Worth County	4/30/1967	1728	F4	0	0	$250,000	$0	13.3	400
Worth County	4/30/1967	1730	F3	0	0	$2.5	$0	17.2	800
Worth County	4/30/1967	1820	F4	0	1	$2.5M	$0	3	500
Worth County	5/7/1967	1640	F0	0	0	$0	$0	0	200
Worth County	7/12/1971	1650	F3	0	0	$2.5M	$0	15.4	833
Worth County	5/28/1974	2010	F3	0	3	$2.5M	$0	3.8	150
Worth County	9/20/1980	1830	F2	0	0	$2.5M	$0	0	33
Worth County	6/16/1984	1756	F0	0	0	$0	$0	0	33
Worth County	6/16/1984	1820	F0	0	0	$0	$0	0	33
Fertile	7/7/1994	1621	F0	0	0	$500	$50	0.1	25
Joice	5/15/1998	1516	F1	0	0	$150,000	$15,000	2.8	50
Joice	8/9/1999	2022	F2	0	0	$50,000	$5,000	3.5	40
Northwood	6/7/2008	1516	EF0	0	0	$0	$1,000	1.66	75
Northwood	6/7/2008	1523	EF0	0	0	$5,000	$0	2.12	50
			Total	**0**	**4**	**$13.03M**	**$21,050**		

Source: NOAA; N/A – data not available

The map in **Figure 3.66** 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 3.66. Tornado Paths in Worth County, 1950-2016



Source: tornadohistoryproject.com

Worth County has been included in three Presidential Disaster Declarations that involved tornadoes since 1965. See **Table 3.2** in the Hazard Identification Section for additional details. The NCDC database did not include descriptions for the tornadoes associated with those

Declarations. NCDC noted that on July 12, 1971, an F3 tornado severely damaged 15 farmsteads near Grafton, causing $2.5M in property damage. An F3 tornado on May 28, 1974 also caused $2.5M in property damage, including unroofing school buildings, and a large fertilizer plant.

Windstorms

Previous Occurrences

According to the NCDC database, there were 34 high wind events in Worth County from 1996 to 2016. During this time period, there were no reported deaths or injuries. There were an estimated $1,185,110 in property damages and $130,100 in crop damages recorded. Recorded wind gusts ranged from a high of 70 knots (80.5 mph) to a low of 35 knots (40 mph). **Table 3.71** provides a summary of the wind speeds reported for the wind events.

Table 3.71. Reported Wind Speeds, NCDC Events from 1996 to 2016

Wind Speed (knots)	# of Events
35	14
40	1
50	6
51	0
52	2
54	2
55	2
56	1
57	2
61	1
70	1
N/A	2
Total	**34**

Source: NCDC; N/A – data not available

Probability of Future Occurrence

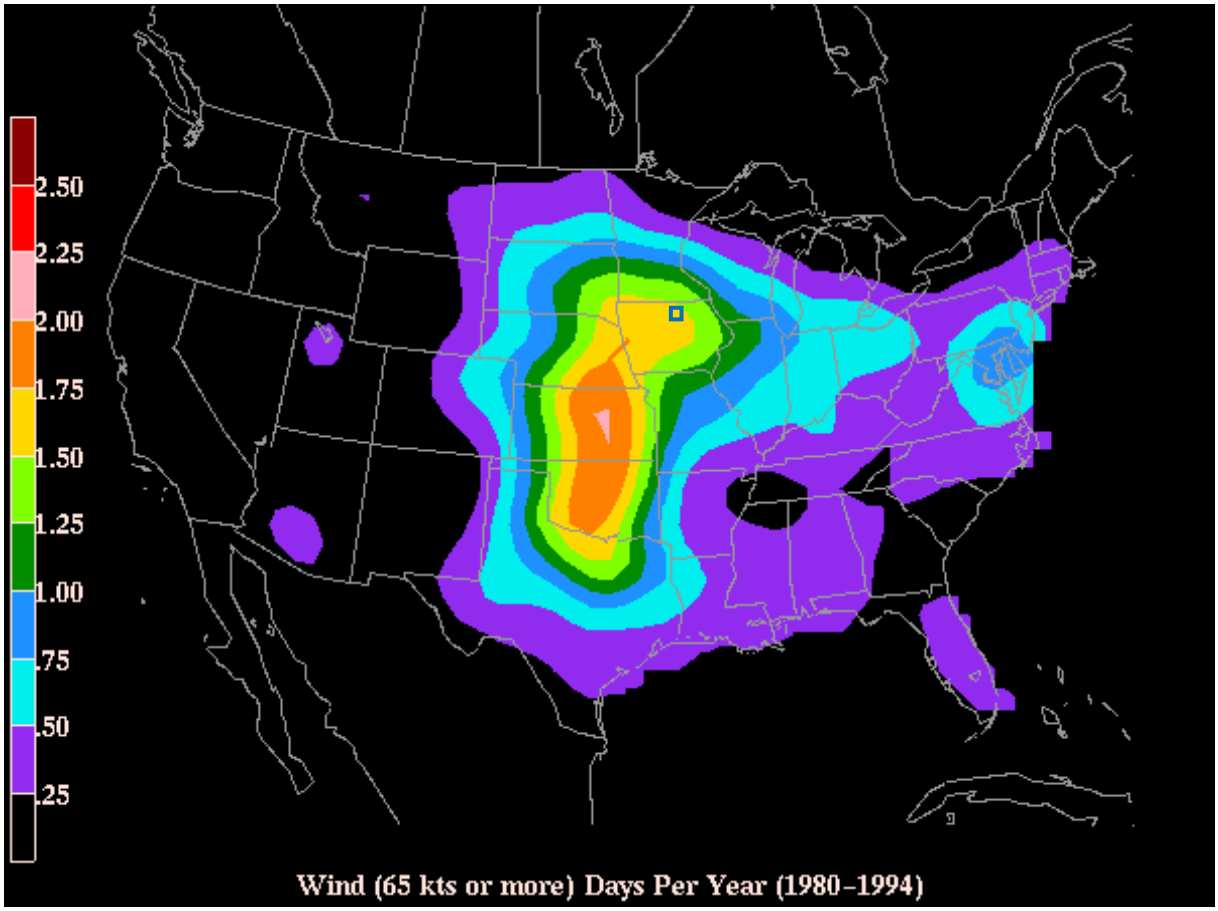
NOAA reported 18 tornadoes in Worth County in a 67-year time period, which calculates to 27-percent chance of a tornado in any given year. Therefore, it is a high probability that some portion of Worth County will experience tornado activity in any given year.

According to NCDC, there were 34 separate high wind events from 1996 to 2016 (20-year period) in Worth County. Based on this data there is an over 100-percent annual probability of high wind events in any given year. Therefore, the probability rating is “Highly Likely”.

Probability Score: 4—Highly Likely

Figure 3.67 below shows the probability of a windstorm event (65 knots or greater) in the U.S. The Worth County planning area is colored yellow, showing that 65+ knot winds are probable to occur 1.50 to 1.75 times a year.

Figure 3.67. Annual Windstorm Probability (65+ knots), United States 1980-1994



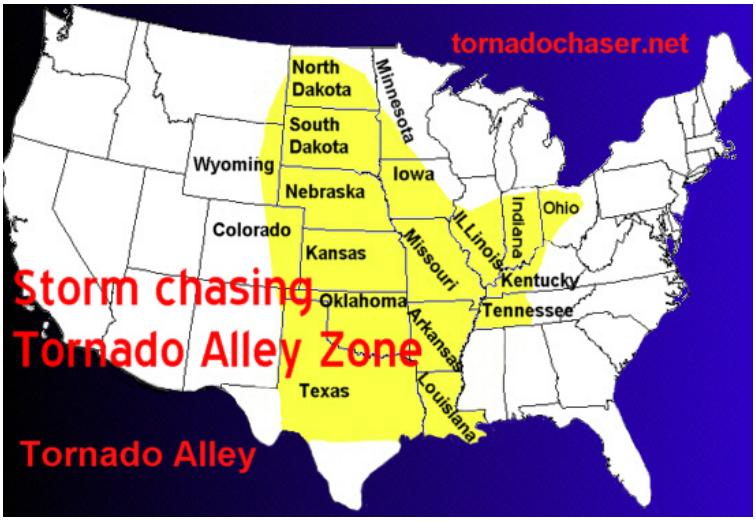
Source: NSSL, http://www.nssl.noaa.gov/users/brooks/public_html/bigwind.gif;
Note: Blue square indicates approximate location of Worth County

Vulnerability

Overview

Worth 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 3.68** is based on areas where dangerous tornadoes are most likely to take place.

Figure 3.68. 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. The number and percent of mobile homes compared to total housing units for each jurisdiction is provided in **Table 3.72** below according to the U.S. Census Bureau. Considering officially participating communities, with 62 mobile homes, the unincorporated county has the most. However, mobile homes do not represent more than 4.5 percent of the housing mix in any of the participating communities.

Table 3.72. Number and Percent of Mobile Homes by Jurisdiction in Worth County

Jurisdiction	Total Housing Units	# of Mobile home	% Mobile Homes
Worth County, Iowa	3,522	62	1.8%
City of Fertile	166	7	4.2%
City of Grafton	166	2	1.2%
City of Hanlontown	102	0	0.0%
City of Joice	108	2	1.9%
City of Kensett	177	8	4.5%
City of Manly	660	4	0.6%
City of Northwood	915	25	2.7%

Source: U.S. Census Bureau, 2015 5-Year American Community Survey

The elderly (65 and older), young (less than 18 years old), and the physically and mentally handicapped are most vulnerable because of the lack of mobility to escape the path of destruction. People who may not understand watches and warnings due to language barriers are also at risk.

According to the 2013 Iowa Hazard Mitigation Plan, of the 8 hazards for which data was available to estimate annualized losses, tornadoes ranked 3rd with $36 million in annualized losses based on data spanning a 63-year period.

Due to the potential for damaging tornadoes in the planning area, the magnitude was determined to be a 4, ”Catastrophic.”

Magnitude Score: 4—Catastrophic

Potential Losses to Existing Development
In Worth County, the NCDC estimate for past property damages resulting from tornadoes from 1950 – 2016 (67 years) was $4,429,530; this translates to an annualized loss of over $194,447. For windstorms, NCDC loss estimates were $1,185,110 from 1996 to 2016 (20 years). This translates to an annualized loss of over $59,255.

Loss of Use
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 3.59** in the Winter Storm hazard section.

Crop Losses
Crop insurance payments for wind damage are discussed in **Section 3.5.18**, Thunderstorms with Lightning and Hail.

Future Development
Due to the slow but steady decrease in population and limited growth in the County, development trends are not expected to increase vulnerability to tornados. Future development that does occur in growing cities such as Grafton, Kensett, and Manly 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.

Windstorms are primarily a public safety and economic concern, and the planning area is located in a region with very high frequency of occurrence. Windstorms 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.

Climate Change Impacts
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 tornadoes, are increasing. However, with summer temperatures becoming warmer and humidity levels increasing, an increase in the likelihood of tornadic activity is plausible.

Tornado/Windstorm Hazard Summary by Jurisdiction

The magnitude was rated as a level 4 for all the participating jurisdictions, as they are all vulnerable to tornado and windstorm damage. The factors of probability, warning time, and duration are also equal across the planning area. This hazard does not substantially vary by jurisdiction.

Jurisdiction	Probability	Magnitude	Warning Time	Duration	Score	Level
Worth County, Iowa	4	4	4	1	3.70	High
City of Fertile	4	4	4	1	3.70	High
City of Grafton	4	4	4	1	3.70	High
City of Hanlontown	4	4	4	1	3.70	High
City of Joice	4	4	4	1	3.70	High
City of Kensett	4	4	4	1	3.70	High
City of Manly	4	4	4	1	3.70	High
City of Northwood	4	4	4	1	3.70	High
Central Springs Schools	4	4	4	1	3.70	High
Northwood-Kensett Schools	4	4	4	1	3.70	High

3.5.20 Transportation Incident

Hazard Score Calculation					
Probability	Magnitude/Severity	Warning Time	Duration	Weighted Score	Level
4	4	4	1	3.70	High

Profile

Hazard 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.

Warning Time Score: 4—Minimal or no warning

Duration Score: 1—Less than 6 hours

Geographic Location/Extent

Highways/Roads

Numerous major US and state highways run through Worth County. Interstate 35 runs from Silverlake in the north corner of the county to Hanlontown. U.S. Highway 65 runs north-south through Northwood, Kensett, and Manly in the east of the county. Iowa Highway 9 runs east-west through the southern County through Fertile, Hanlontown and Manly, while Iowa Highway 105 runs east-west through the northern County through Bristol and Northwood.

Numerous paved county roads connect all of the incorporated cities and unincorporated towns throughout the county.

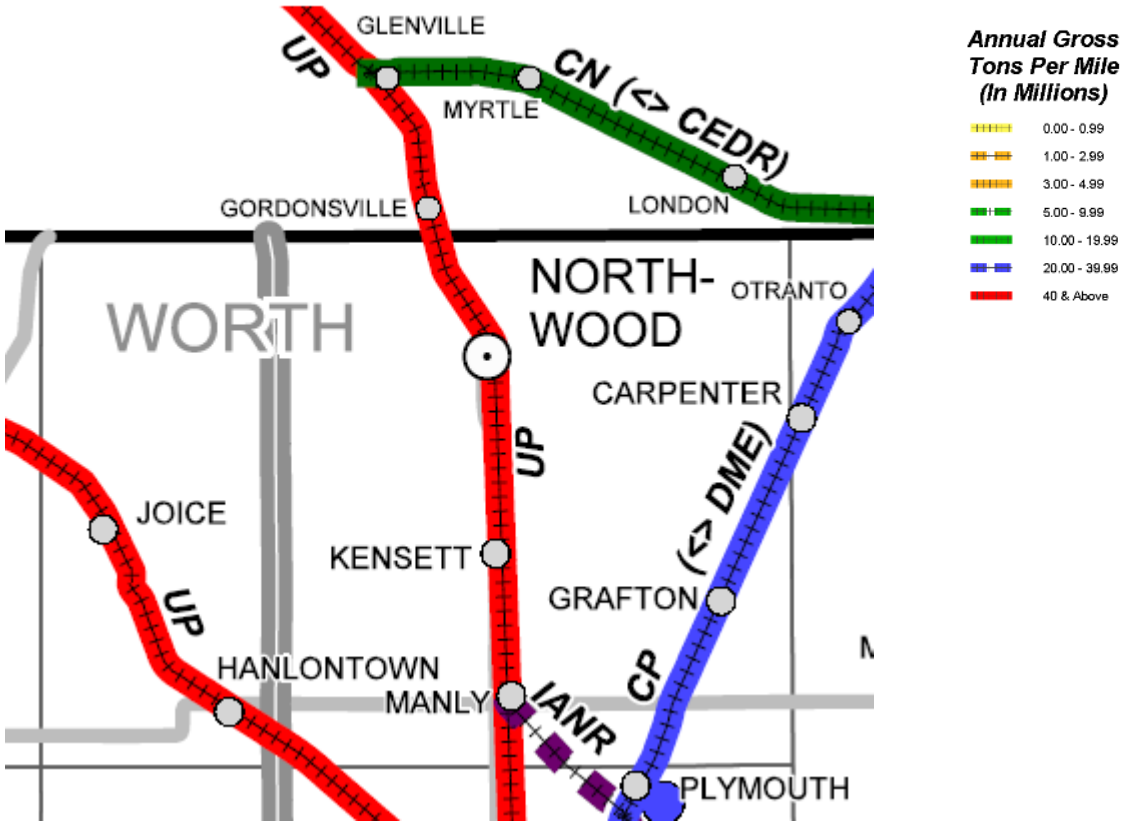
Figure 3.41 in the Infrastructure Failure Incident section shows the major highways in Worth County.

According to the Iowa Department of Transportation, the total daily traffic in Worth County is 600,073 and the total daily truck traffic is 143,067. (Source: http://iowadot.maps.arcgis.com/apps/MapSeries/index.html?appid=db6cb43313354a4f85505089ab317e7a)

Rail Transport

Union Pacific Railroad (UP), Iowa Northern Ry. Co (IANR), and Dakota, Minnesota and Eastern RR. CO. (DME) operate in Worth County. Additionally, Canadian National Railway Co./Cedar River Railroad Co. (CEDR) operates just north of the County boundary. There is one Union Pacific Railroad line that runs northwest-southeast through Joice and Hanlontown, as well as a line that runs north-south through Kensett and Manly. The Iowa Northern Ry. Co. line runs southeast out of Manly, and the Dakota, Minnesota, and Eastern R.R. Co. line runs southwest through Carpenter and Grafton. **Figure 3.69** shows the railroads that operate in Worth County.

Figure 3.69. Railroad lines in Worth County



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

Air Transport

The Mason City Municipal is the primary commercial airport that services Worth County. Within Worth County, the Northwood Municipal Aiport, located approximately one mile east of the City of Northwood is owned by the City of Northwood. Local access to the Northwood airport is provided via County Road 105.

The Iowa Aviation System Plan identifies the Northwood Municipal Airport as a Local Service airport. General Service airports have runways less than 3,000 feet or have turf runways as the primary runway. Local Service airports generally have limited, if any, airport services that support local aviation activity.

Figure 3.70. Northwood Municipal Airport

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

Previous Occurrences

Rail Transportation Incidents

Table 3.73 provides details of 39 train-vehicle accidents in Worth County since 1975 from the Des Moines Register News Data Central.

Table 3.73. Train-Vehicle Accidents in Worth County since 1975

Railroad	Year	City	Highway	Total Killed	Total Injured
UP	2012	Joice	Lake Street	0	1
DME	2012	Grafton	420th St.	0	0
UP	2009	Hanlontown	Main Street	0	0
UP	2008	Northwood	4th Avenue South	0	0
UP	2007	Hanlontown	Fir Avenue	0	1
UP	2007	Kensett	Private	0	0
UP	2003	Joice	A39/Lake St	0	0
UP	2001	Kensett	440th St/60E NWC	0	0
IMRL	2001	Grafton	3rd Street	0	0
IMRL	2000	Grafton	A38	0	2
UP	2000	Manly	HWY A39	0	0
IMRL	2000	Plymouth	340th St	0	0
UP	2000	Northwood	City HWY C16	0	0
DME	1994	Northwood	2nd Ave. N.	0	0
CNW	1993	Northwood	Highway 105	0	0
CNW	1992		County Gravel Road	0	1
CNW	1991	Joice	Lake St.	0	1
CNW	1991	Kensett	Main Street	0	0

Railroad	Year	City	Highway	Total Killed	Total Injured
CNW	1990	Northwood	US 65 Detour	0	0
CNW	1988	Joice	County Rd S-14	0	0
CNW	1988		County Road A38	0	1
SOO	1987	Plymouth	HWY #9	0	1
CNW	1983	Hanlontown	Main St	0	0
CNW	1983	Northwood	Second Ave North	0	0
CNW	1982	Manly	1 ML S. of Manly IA	0	0
CNW	1982		County Line Rd.	1	2
CNW	1982	Manly	Harris St.	0	0
CNW	1980		HWY 105	0	2
CNW	1978		Pruivate Farm Crossing	0	0
CNW	1978	Joice	Lake Street	0	0
CNW	1977	Kensett	A-38	0	0
CNW	1976	Kensett	No. 73 OR A #38	0	1
CNW	1976	Joice	Main Street	0	1
MILW	1976		A38	1	1
RI	1976	Manly	Harris Street	0	0
CNW	1975	Manly	Main Street	0	0
CNW	1975		County Black Top	1	0
RI	1975	Kensett	4th Street	0	0

Air Transportation Incidents:

Table 3.74 provides details of four air transportation incidents in (or near) Worth County from 1967 to 2016 (50 years) from the National Transportation Safety Board (NTSB).

Table 3.74. Worth County Aircraft Incidents/Accidents (1967-2016)

Event Date	Location	Injury Severity	Aircraft Damage	Make	Broad Phase of Flight
08/01/2011	Joice, IA	Non-Fatal	WSubstantial	Texas Helicopter Corp.	Maneuvering
07/21/2001	Grafton, IA	Fatal (2)	Destroyed	Beech	Cruise
03/20/1973	Hanlontown, IA	Non-Fatal		Bell	
07/15/1972	Northwood, IA	Non-Fatal		Grumman	

Source: http://www.ntsb.gov/_layouts/ntsb.aviation/index.aspx.

Highway Transportation Incidents:

The Iowa Department of Transportation's Office of Traffic and Safety maintains traffic crash statistics and location maps by county and cities in Iowa. **Table 3.75** shows the reportable crash history for urban crashes in Worth County, Iowa from 2007-2016. **Table 3.76** that follows shows the reportable crash history for rural crashes in Worth County for the same time period.

Table 3.75. Worth County Urban Crashes 2007- 2016

	Crash Counts/Classification						Injury/Fatality Counts/Classification					
Year	**Crashes**	**Fatal**	**Major**	**Minor**	**Poss/Unk**	**Property Damage Only**	**Injuries**	**Fatalities**	**Major**	**Minor**	**Possible**	**Unknown**
2007	21	0	1	10	3	17	5	0	1	0	4	0
2008	18	0	0	2	1	15	4	0	0	3	1	0
2009	20	0	4	1	0	15	5	0	4	1	0	0
2010	21	0	0	1	4	16	6	0	0	1	5	0
2011	12	0	0	1	0	11	1	0	0	1	0	0
2012	7	0	1	0	0	6	1	0	1	0	0	0
2013	10	0	0	2	0	8	3	0	0	3	0	0
2014	13	0	0	0	1	12	1	0	0	0	1	0
2015	9	0	0	0	0	9	0	0	0	0	0	0
2016	6	0	0	1	1	4	2	0	0	1	1	0
Total	**137**	**0**	**6**	**8**	**10**	**113**	**28**	**0**	**6**	**10**		**12**

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

Table 3.76. Worth County Rural Crashes 2007-2016

	Crash Counts/Classification						Injury/Fatality Counts/Classification					
Year	Crashes	Fatal	Major	Minor	Poss/Unk	Property Damage Only	Injuries	Fatalities	Major	Minor	Possible	Unknown
2007	112	3	5	16	20	68	61	3	6	25	26	1
2008	121	1	6	16	16	82	60	1	8	27	24	0
2009	99	2	2	6	17	72	32	2	3	6	21	0
2010	93	3	1	9	12	68	34	3	1	14	16	0
2011	87	3	2	10	13	59	39	3	2	17	15	2
2012	93	6	3	14	13	57	56	7	5	24	19	1
2013	75	0	5	7	10	53	29	0	6	8	15	0
2014	92	1	3	6	13	69	33	1	3	12	17	0
2015	87	2	4	10	11	60	35	2	5	14	14	0
2016	76	2	2	7	6	59	33	3	3	16	11	0
Total	**935**	**23**	**33**	**101**	**131**	**647**	**412**	**25**	**42**	**163**		**182**

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.

Probability Score: 4—Highly Likely

Vulnerability

Overview

Transportation incidents can almost always be expected to occur in specific areas, on or near airports, roadways or other transportation infrastructure. The exception is air transportation incidents, which can occur anywhere. However, it is difficult to predict the magnitude of any specific event because these types of events are accidental and the circumstances surrounding these events will impact the extent of damage or injuries that occur. The number of urban and rural highway/roadway transportation accidents from 2007 to 2016 was a total of 1,072 crashes during this 10-year time period (average over 100 per year). 25 fatalities occurred during this time period (averaging over two per year). Transportation incident has resulted in the most deaths historically in the county compared to other hazards.

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

Magnitude Score: 4—Catastrophic

Potential Losses to Existing Development

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 2016 dollars using an annual inflation rate of 2.85 percent. The costs are listed below in **Table 3.77.**

Table 3.77. Costs of a Traffic Crash

Severity	Cost per injury (in 2016 dollars $)
Fatal	$4,412,996
Evident Injury	$61,101
Possible Injury	$32,250
Property Damage Only	$3,395

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

Using the traffic crash costs per type of severity from **Table 3.77** and combining major and minor injuries as "evident injury" and possible and unknown as "possible injury" the total costs of traffic crashes is figured in **Table 3.78** for Worth County based on previous events.

Table 3.78. Costs of Traffic Crashes in Worth County, 2007-2016

Urban/Rural	Fatalities	Evident Injury	Possible Injury	Property Damage	Total
Urban	25	205	182	647	
Rural	0	16	12	113	
Total	25	221	194	760	
Estimated Cost	**$110,324,900**	**$13,503,321**	**$6,256,500**	**$2,580,200**	**$132,664,921**

Sources: U.S. Department of Transportation Federal Highway Administration Technical Advisory T 7570.2, 1994. Adjusted to 2014 dollars and Iowa Department of Transportation's Office of Traffic and Safety, http://www.iowadot.gov/crashanalysis/index.htm?

Based on the 10 years of data, the annual average cost of highway transportation accidents in Worth County is $12,266,492. Estimated losses as a result of rail and air transportation are not available for this analysis.

Future Development

As population increases, the volume of traffic on the county roads, highways and interstates increases as well. With increases in traffic, transportation accidents will likely also increase.

Climate Change Impact

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.

Transportation Hazard Summary by Jurisdiction

All jurisdictions within the planning area are at risk to some kind of transportation incident.

Jurisdiction	Probability	Magnitude	Warning Time	Duration	Score	Level
Worth County, Iowa	4	4	4	1	3.70	High
City of Fertile	4	4	4	1	3.70	High
City of Grafton	4	4	4	1	3.70	High
City of Hanlontown	4	4	4	1	3.70	High
City of Joice	4	4	4	1	3.70	High
City of Kensett	4	4	4	1	3.70	High
City of Manly	4	4	4	1	3.70	High
City of Northwood	4	4	4	1	3.70	High
Central Springs Schools	4	4	4	1	3.70	High
Northwood-Kensett Schools	4	4	4	1	3.70	High

3.6 Hazard Analysis Summary

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

Table 3.79. Hazard Ranking Summary by Jurisdiction

Jurisdiction	Animal/Plant/Crop Disease	Dam/Levee Failure	Drought	Earthquake	Expansive Soils	Extreme Heat	Flash Flooding	Grass or Wildland Fire	Hazardous Materials	Human Disease	Infrastructure Failure	Landslide	Radiological Incident	River Flooding	Severe Winter Storm	Sinkholes	Terrorism	Thunderstorm/Lightning/Hail	Tornado/Windstorm	Transportation Incident
Worth County, Iowa	M	L	M	L	L	M	M	M	L	M	H	L	L	H	H	L	M	M	H	H
City of Fertile	M	N/A	M	L	L	M	M	M	L	M	H	L	L	H	H	L	M	M	H	H
City of Grafton	M	N/A	M	L	L	M	M	M	L	M	H	L	L	N/A	H	L	M	M	H	H
City of Hanlontown	M	N/A	M	L	L	M	M	M	M	M	H	L	L	M	H	L	M	M	H	H
City of Joice	M	N/A	M	L	L	M	M	M	M	M	H	L	L	M	H	L	M	M	H	H
City of Kensett	M	N/A	M	L	L	M	M	M	L	M	H	L	L	M	H	L	M	M	H	H
City of Manly	M	N/A	M	L	L	M	M	M	M	M	H	L	L	H	H	L	M	M	H	H
City of Northwood	M	N/A	M	L	L	M	M	M	M	M	H	L	L	H	H	L	M	M	H	H
Central Springs Schools	L	N/A	M	L	L	M	M	M	L	M	H	L	L	M	H	L	M	M	H	H
Northwood-Kensett Schools	L	N/A	M	L	L	M	M	M	L	M	H	L	L	M	H	L	M	M	H	H

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 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 actions that help achieve goals.

4.1 Goals

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

This planning effort is an update to an existing hazard mitigation plan. Therefore, the goals from the *2013 Worth County Hazard Mitigation Plan* were reviewed to determine if they are still valid. The HMPC participated in a facilitated discussion during their second meeting to review and update the plan goals. To ensure that the goals are comprehensive and support State goals, the *2013 State 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 four goals from the previous plan remain valid; no changes were made. The validated plan goals for the Worth County Hazard Mitigation Plan are below:

- Goal 1: Minimize vulnerability of the people and their property in Worth County to the impacts of hazards
- Goal 2: Protect the critical facilities, infrastructure, and other community assets from the impacts of hazards

- Goal 3: Improve education and awareness regarding hazards in risk in Worth County
- Goal 4: Strengthen communication among agencies and between agencies and the public Mitigation Action Status Updates

4.2 Identification and Analysis of Mitigation Actions

44 CFR Requirement §201.6(c)(3)(ii): The mitigation strategy shall include a section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

During the second meeting of the HMPC, sample results of the risk assessment update were provided to the HMPC members. To lay the framework for the impacts to be addressed by the updated mitigation strategy, the full draft of the Risk Assessment Chapter was also provided for review by the HMPC members. Also at Meeting #2, each jurisdiction was provided with a handout listing the actions they included in the previous hazard mitigation plan. The mitigation strategy of the previous plan consisted of 96 individual jurisdictional actions.

Jurisdictional representatives were instructed to work with others in their jurisdiction to update the status of each of the previous actions. The status updates were provided after Meeting #1. Of the 96 previous actions, 18 have been completed, 38 are continuing (17 Continue In-process and 21 Continue Not Started), and 40 were deleted (see **Table 4.1**). The list of the completed and deleted actions is provided in Appendix C with comments providing additional details, as available.

Table 4.1. Status of Previous Actions

Jurisdiction	Completed	Delete	Continue In-Progress	Continue Not Started	Grand Total
Worth County	2	5	4	1	**12**
Fertile	2	5	2	3	**12**
Grafton	2	3	2	5	**12**
Hanlontown	2	6	2	2	**12**
Joice	3	7	1	1	**12**
Kensett	2	3	2	5	**12**
Manly	2	6	2	2	**12**
Northwood	3	5	2	2	**12**
Grand Total	**18**	**40**	**17**	**21**	**96**

For a comprehensive range of mitigation actions to consider, the jurisdictions were provided relevant information and sources to be used in development of new mitigation actions including:

- Validated Plan Goals
- Previous Actions from 2013 Plan
- Key Issues from Risk Assessment
- FEMA's Mitigation Ideas booklet
- State Priorities for Hazard Mitigation Assistance Grants

- Public Opinion from Surveys

To facilitate discussion and ideas on new actions that jurisdictions may want to submit to the plan update, the planning committee reviewed the plan goals that were updated at Meeting #1. Key issues/problem statements for sample hazards in the risk assessment were also discussed, as well as the actions from the 2013 plan that were identified relative to each hazard. The discussion was geared toward identifying any gaps that may exist between the problems identified and actions already developed to address the problems to develop new actions. To provide consideration of a comprehensive range of alternatives, FEMA's Mitigation Ideas Booklet was also reviewed for additional ideas/alternatives for new actions. After the committee meeting, jurisdictions reviewed the materials to determine final mitigation actions to submit to the plan update.

The jurisdictions were encouraged to be comprehensive and include all appropriate actions to work toward becoming more disaster resistant. They were encouraged to maintain a realistic approach and were reminded that the hazard mitigation plan is a "living document". As capabilities, vulnerabilities, or the nature of hazards that threaten each jurisdiction change, the mitigation actions can and should be updated to reflect those changes, including addition or deletion of actions, as appropriate.

As part of the meeting discussion, jurisdictions were instructed to consider the potential cost of each project in relation to the anticipated future cost savings. This type of discussion allowed the committee as a whole to understand the broad priorities and enable discussion of the types of projects most beneficial to all jurisdictions within Worth County.

4.3 Implementation of Mitigation Actions

44 CFR Requirement §201.6(c)(3)(ii): The mitigation strategy shall include an action strategy describing how the actions identified in paragraph (c)(2)(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 benefits review of the proposed projects and their associated costs.

Jurisdictional representatives worked with others in their community to finalize the actions to be submitted to the updated mitigation strategy. Throughout the discussion of the types of projects that the committee would include in the mitigation plan, emphasis was placed on the importance of a benefit-cost analysis in determining project priority. The Disaster Mitigation Act regulations state that benefit-cost review is the primary method by which mitigation projects should be prioritized. Recognizing the federal regulatory requirement to prioritize by benefit-cost, and the need for any publicly funded project to be cost-effective, the HMPC decided to pursue implementation according to when and where damage occurs, available funding, political will, jurisdictional priority, and priorities identified in the Iowa State Hazard Mitigation Plan. Due to many variables that must be examined during project development, the benefit/cost review at the planning stage primarily consisted of a qualitative analysis. For each action, the jurisdictions included a narrative describing the types of benefits that could be realized with implementation of the action. Where possible, the cost was estimated as closely as possible with further refinement to occur as project development occurs. Cost-effectiveness will be considered in additional detail if/when seeking FEMA Hazard Mitigation Assistance grant funding or other

grant funding for eligible projects identified in this plan. At that time, additional information will be researched to provide for a quantitative benefit-cost analysis.

To provide a mechanism for jurisdictions to prioritize actions, a modified STAPLEE worksheet was completed by the jurisdictions for each new and continued action submitted for the updated mitigation strategy. The modified STAPLEE worksheet includes elements to consider protection of life and reduction of damages. Although a similar STAPLEE method was a component of the prioritization method utilized for the 2013 plan, the scoring elements were slightly different. For the plan update, the modified STAPLEE worksheet was chosen to re-evaluate all continuing and new actions, as this was deemed a more simplified approach and ensured a consistent methodology for all continuing and new actions.

The STAPLEE prioritization method in general is a tool used to assess the costs, benefits, and overall feasibility of mitigation actions. STAPLEE stands for the following:

- **Social**: Will the action be acceptable to the community? Could it have an unfair effect on a particular segment of the population?
- **Technical**: Is the action technically feasible? Are there secondary impacts? Does it offer a long-term solution?
- **Administrative**: Are there adequate staffing, funding, and maintenance capabilities to implement the project?
- **Political**: Will there be adequate political and public support for the project?
- **Legal**: Does your jurisdiction have the legal authority to implement the action?
- **Economic**: Is the action cost-beneficial? Is there funding available? Will the action contribute to the local economy?
- **Environmental**: Will there be negative environmental consequences from the action? Does it comply with environmental regulations? Is it consistent with community environmental goals?

Additional questions were added to the modified STAPLEE worksheet to include elements to consider mitigation effectiveness related to protection of life and reduction of damages as well as reduction in the need for response actions, and the potential for benefits to exceed the cost.

Figure 4.1 is a sample of the Action Plan worksheet. The Prioritization Section is at the bottom of the worksheet. There is a total possible prioritization score of 19. Those actions that scored 13 or higher were given a priority rating of “High”. Those actions that scored 7-12 were given a priority rating of “Medium”. And those actions that scored less than 7 were given a rating of “Low”.

Figure 4.1. Action Plan Worksheet

Worth County Multi-Jurisdictional Hazard Mitigation Plan
Mitigation Action Plan Worksheet

Jurisdiction:	**2018 Action Status** ☐ Continue Not Started ☐ Continue In-Progress ☐ New	**Action ID:** Refer to handout for continuing actions For new actions number with next sequential number after last action #.
Hazards Addressed: ☐ Animal/Plant/Crop Disease ☐ Dam /Levee Failure ☐ Drought ☐ Earthquake ☐ Extreme Heat ☐ Flash Flood	Check all that apply ☐ Grass/Wildland Fire ☐ Hazardous Materials Incident ☐ Human Disease ☐ Infrastructure Failure ☐ Radiological Incident ☐ River Flooding	☐ Severe Winter Storm ☐ Sinkholes ☐ Terrorism ☐ Thunderstorm/Lightning/Hail ☐ Tornado/Windstorm ☐ Transportation Incident
Action Title/ Description:		
Applicable Goal Statement: Check one	☐ Goal 1: ☐ Goal 2: ☐ Goal 3: ☐ Goal 4:	
Issue/Background: Why is this action needed? What is the problem?		
Obstacles to Implementing?		
Responsible Office: Which department in Jurisdiction would implement/track?		
Partners: Who would help?		
Potential Funding Source: (Grants-specific if known, local funds, combination, etc.) Check all that may apply	☐ FEMA Hazard Mitigation Assistance Grant (HMGP, PDM, or FMA) ☐ Local funds, ☐ In-Kind (donated), ☐ Private Non-Profit, ☐Other (specify)	
Cost Estimate:	☐ Little or no cost ☐ Less than $10,000 ☐$10,000 to $50,000 ☐ $50,000 to $100,000 ☐ $100,000 to $500,000 ☐$500,000 to $1,000,000 ☐Over $1,000,000	
Benefits: (Describe Losses Avoided)		
Timeline: How many years to complete?	☐ 1 yr ☐ 2-3 yrs ☐ 3-5 yrs ☐ More than 5 yrs. ☐ Other	Completed by: (name/title/phone #)
Prioritization: Rate the questions from 0-3 0-unlikely, 1-maybe, 2-probably, or 3-definitely	If implemented, will the action result in lives saved? ☐ 0, ☐ 1, ☐ 2, ☐ 3 If implemented, will the action result in reduced property damages? ☐ 0, ☐ 1, ☐ 2, ☐ 3 If implemented, will the action reduce the need for response actions? ☐ 0, ☐ 1, ☐ 2, ☐ 3 If implemented, will the benefits exceed the cost? ☐ 0, ☐ 1, ☐ 2, ☐ 3	
STAPLEE Rating: Give the action a rating for each element as follows: Positive (+) Neutral (0) Negative (-)	**S**ocially Acceptable **T**echnically Feasible **A**dministrative Capability **P**olitically Desirable **L**egal Authority Exists **E**conomically Beneficial **E**nvironmentally Beneficial	☐ **+**, ☐ **0**, ☐ **-** ☐ **+**, ☐ **0**, ☐ **-** ☐ **+**, ☐ **0**, ☐ **-** ☐ **+**, ☐ **0**, ☐ **-** ☐ **+**, ☐ **0**, ☐ **-** ☐ **+**, ☐ **0**, ☐ **-** ☐ **+**, ☐ **0**, ☐ **-**

The mitigation action summary table presenting the summary of continuing and new mitigation actions for each jurisdiction is provided in **Table 4.2.** In addition to the 38 actions that were continued from the previous plan, 21 new actions were identified, for a combined total of 59 actions in this updated mitigation strategy.

The Action ID for each action has been carried over from the 2013 plan for continuing actions. As a result of completed and deleted actions, the Action ID does not follow a sequential order. New actions were assigned the next sequential Action ID for each jurisdiction. Following the action summary table, additional details are provided for each continuing and new action in **Table 4.3**. The detailed table serves as the action plan describing how each action will be implemented and administered by the local jurisdiction. The final table, **Table 4.4**, provides the results from the action prioritization.

Table 4.2. Mitigation Action Summary—Continuing and New Actions

Action ID	Action Title	2018 Action Status	2018 Action Status Comment	Hazards Addressed	Applicable Goal	Score	Priority
Unincorporated Worth County-2	Public education and awareness of all hazards	Continue in progress	Severe weather awareness in schools; information published in newspaper; siren testing and info	All	4	15	H
Unincorporated Worth County-3	Continuity of Operations Plan (COOP)	Continue in progress	County has been working on plan	Radiological Incident, Terrorism, Tornado/Windstorm	4	10	M
Unincorporated Worth County-4	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems	Continue in progress	Northwood has done a complete rebuild, including major water upgrades and sewer upgrades; all communities have done preventive maintenance; Manly raised a pump station along Highway 9 in 2016, along with all equipment	Flash Flood, River Flooding, Infrastructure Failure	2	10	M
Unincorporated Worth County-5	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities	Continue in progress	County Extension building basement functioning as safe room, though not certified as such	Tornado, Windstorm, Thunderstorm, Lightning, Hail	1	11	M
Unincorporated Worth County-6	Acquire flood prone properties for conversion into green space; or elevate structures in or above base flood elevation; construction of levees, dams, and culverts to ensure adequate capacity and protection levels for property and critical facilities	Continue not started	No progress reported	Flash Flood, River Flooding	1	7	L
Unincorporated Worth County-13	Mitigate vulnerabilities in county communications system	NEW	N/A	All	4	11	M
Unincorporated Worth County-18	Critical infrastructure generator hookups	NEW	N/A	All	2	12	M
Unincorporated Worth County-23*	NFIP participation	NEW	N/A	River Flood	1	12	M
Unincorporated Worth County-24	Infrastructure study and improvements	NEW	N/A	Earthquake, Flash Flood, River Flood, Infrastructure Failure	2	14	H
Fertile-2	Public education and awareness of all hazards	Continue In-Progress	Severe weather awareness in schools; information published in newspaper; siren testing and info	All	3	11	M

Action ID	Action Title	2018 Action Status	2018 Action Status Comment	Hazards Addressed	Applicable Goal	Score	Priority
Fertile-3	Continuity of Operations Plan (COOP)	Continue not started	No progress reported	Radiological, terrorism, Tornado	1	9	M
Fertile-4	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems	Continue In-Progress	Northwood has done a complete rebuild, including major water upgrades and sewer upgrades; all communities have done preventive maintenance; Manly raised a pump station along Highway 9 in 2016, along with all equipment	Flash Flood, River Flooding, Infrastructure Failure	2	6	L
Fertile-5	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities	Continue not started	County Extension building basement functioning as safe room, though not certified as such	Tornado, Windstorm, Thunderstorm, Lightning, Hail	1	9	M
Fertile-6	Acquire flood prone properties for conversion into green space; or elevate structures in or above base flood elevation; construction of levees, dams, and culverts to ensure adequate capacity and protection levels for property and critical facilities	Continue not started	No progress reported	Flash Flood, River Flooding	1	8	M
Fertile-14	Purchase and install generator for City Hall	NEW	N/A	Dam/Levee Failure, Extreme Heat, Flash Flood, Hazardous Materials Incident, Infrastructure Failure, River Flooding, Severe Winter Storm, Tornado/Windstorm, Transportation Incident	1	16	H
Fertile-15	Purchase and install generator for Community Center	NEW	N/A	Dam/Levee Failure, Extreme Heat, Flash Flood, Hazardous Materials Incident, Infrastructure Failure, River Flooding, Severe Winter Storm, Tornado/Windstorm, Transportation Incident	1	16	H
Fertile-16	Purchase and install generator for Sewer Plant	NEW	N/A	Flash Flood, Infrastructure Failure, River Flood, Tornado/Windstorm	2	19	H
Fertile-17	Critical infrastructure generator hookups	NEW	N/A	All	1	19	H

Action ID	Action Title	2018 Action Status	2018 Action Status Comment	Hazards Addressed	Applicable Goal	Score	Priority
Fertile-18*	NFIP participation	NEW	N/A	River Flood, Flash Flood	4	16	H
Grafton-2	Public education and awareness of all hazards	Continue In-Progress	Severe weather awareness in schools; information published in newspaper; siren testing and info	All	3	10	M
Grafton-3	Continuity of Operations Plan (COOP)	Continue not started	No progress reported	Radiological, terrorism, Tornado	1	8	M
Grafton-4	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems	Continue In-Progress	Preventive maintenance; deepened ditch in 2013 underneath Warbler; added new culvert	Flash Flood, River Flooding, Infrastructure Failure	2	5	L
Grafton-5	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities	Continue not started	County Extension building basement functioning as safe room, though not certified as such	Tornado, Windstorm, Thunderstorm, Lightning, Hail	1	7	L
Grafton-6	Acquire flood prone properties for conversion into green space; or elevate structures in or above base flood elevation; construction of levees, dams, and culverts to ensure adequate capacity and protection levels for property and critical facilities	Continue not started	No progress reported	Flash Flood, River Flooding	1	7	L
Grafton-9	Install and maintain security measures at all critical facilities and training of emergency response personnel	Continue Not Started	County and communities have done various improvements to critical infrastructure; replaced with Action 13	All	2	8	M
Grafton-12	Natural resource measures to prevent the damage to critical facility functions.	Continue not started	County added a mitigation pond at DD21 West; county and communities have done projects for drainage, wetlands mitigation, flood control	All	2	4	L
Hanlontown-2	Public education and awareness of all hazards	Continue In-Progress	Severe weather awareness in schools; information published in newspaper; siren testing and info	All hazards	3	14	H
Hanlontown-3	Continuity of Operations Plan (COOP)	Continue not started	No progress reported	All hazards	3	13	H

Action ID	Action Title	2018 Action Status	2018 Action Status Comment	Hazards Addressed	Applicable Goal	Score	Priority
Hanlontown-4	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems	Continue In-Progress	Preventive maintenance	Flash Flood, River Flooding, Infrastructure Failure	3	13	H
Hanlontown-5	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities	Continue not started	County Extension building basement functioning as safe room, though not certified as such	Tornado, Windstorm, Thunderstorm, Lightning, Hail	1	5	L
Hanlontown-18	Critical infrastructure generator hookups	NEW	N/A	All	3	17	H
Hanlontown-20*	NFIP participation	NEW	N/A	River Flood	1	15	H
Joice-3	Continuity of Operations Plan (COOP)	Continue Not Started	No progress reported	Radiological, terrorism, Tornado	2, 4	12	M
Joice-4	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems	Continue In-Progress	Preventive maintenance	Flash Flood, River Flooding, Infrastructure Failure	1	16	H
Joice-18	Provide generator use for Community Center for citizens who have lost electricity and publicize availability of this resource.	NEW	N/A	All	1	13	H
Joice-19	Field Fires	NEW		Grass/Wildland Fire	1	16	H
Joice-20	Hazardous Materials Incident	NEW		Hazardous Materials Incident	1, 2, 3, 4	16	H
Joice-21	Snow fence on Lake Street, north side of city	NEW		Severe Winter Storm	1	11	M
Kensett-2	Public education and awareness of all hazards	Continue In-Progress	Severe weather awareness in schools; information published in newspaper; siren testing and info	All	3	11	M
Kensett-3	Continuity of Operations Plan (COOP)	Continue not started	No progress reported	Earthquake, Hazardous Materials Incident, Human Disease, Infrastructure Failure, River Flooding, Severe Winter Storm, Tornado/Windstorm, Transportation Incident	1	9	M
Kensett-4	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems	Continue In-Progress	Preventive maintenance	Flash Flood, River Flooding, Infrastructure Failure, Thunderstorm/Lightning/Hail, Tornado/Windstorm	2	6	L

Action ID	Action Title	2018 Action Status	2018 Action Status Comment	Hazards Addressed	Applicable Goal	Score	Priority
Kensett-5	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities	continue not started	County Extension building basement functioning as safe room, though not certified as such	Severe Winter Storm, Thunderstorm/Lightning/Hail, Tornado/Windstorm	1	9	M
Kensett-6	Acquire flood prone properties for conversion into green space; or elevate structures in or above base flood elevation; construction of levees, dams, and culverts to ensure adequate capacity and protection levels for property and critical facilities	Continue not started	No progress reported	Flash Flood, River Flooding, Dam/Levee Failure, Sinkholes	1	8	M
Kensett-9	Install and maintain security measures at all critical facilities and training of emergency response personnel	Continue Not Started	County and communities have done various improvements to critical infrastructure; replaced with Action 13	All	2	5	L
Kensett-12	Natural resource measures to prevent the damage to critical facility functions.	Continue not started	County added a mitigation pond at DD21 West; county and communities have done projects for drainage, wetlands mitigation, flood control	All	1	4	L
Manly-2	Public education and awareness of all hazards	Continue In-Progress	Severe weather awareness in schools; information published in newspaper; siren testing and info	All	2	13	H
Manly-3	Continuity of Operations Plan (COOP)	Continue not started	No progress reported	Extreme Heat, Flash Flood, Infrastructure Failure, Severe Winter Storm, Thunderstorm/Lightning/Hail, Tornado/Windstorm	1	17	H
Manly-4	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems	Continue In-Progress	Preventive maintenance; Manly raised a pump station along Highway 9 in 2016, along with all equipment	Flash Flood, River Flooding, Infrastructure Failure	1	17	H

Action ID	Action Title	2018 Action Status	2018 Action Status Comment	Hazards Addressed	Applicable Goal	Score	Priority
Manly-5	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities	Continue not started	County Extension building basement functioning as safe room, though not certified as such	Extreme Heat, Flash Flood, Infrastructure Failure, River Flooding, Severe Winter Storm, Thunderstorm/Lightning/Hail, Tornado/Windstorm	1	15	H
Manly-18	Critical infrastructure generator hookups	NEW	N/A	Infrastructure Failure	1	12	M
Manly-22*	NFIP participation	NEW	N/A	River Flood	1	8	M
Northwood-2	Public education and awareness of all hazards	Continue In-Progress	Severe weather awareness in schools; information published in newspaper; siren testing and info	All	1	12	M
Northwood-4	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems	Continue In-Progress	Northwood has done a complete rebuild, including major water upgrades and sewer upgrades; preventive maintenance	Flash Flood, River Flooding, Infrastructure Failure	3	12	M
Northwood-5	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities	Continue Not Started	County Extension building basement functioning as safe room, though not certified as such	Tornado, Windstorm, Thunderstorm, Lightning, Hail	1	10	M
Northwood-6	Acquire flood prone properties for conversion into green space; or elevate structures in or above base flood elevation; construction of levees, dams, and culverts to ensure adequate capacity and protection levels for property and critical facilities	Continue Not Started	No progress reported	Flash Flood, River Flooding	1	1	L
Northwood-18	Critical infrastructure generator hookups	NEW	N/A	All	2	9	M
Northwood-22*	NFIP participation	NEW	N/A	River Flood	1	8	M
Northwood-Kensett CSD-18	Ensure that the school buildings' cooling systems remain operational during periods of extreme heat	NEW	N/A	Extreme Heat	1	13	H
Central Springs Community School District-25	Tornado Saferoom Project	NEW	N/A	Tornado/Windstorm	1	15	H

*Denotes Actions related to continued compliance with the NFIP; H=High, M=Medium, L=Low

Table 4.3. Mitigation Action Implementation Strategy—Continuing and New Actions

Action ID	Issue/Background	Obstacles	Responsible Office	Partners	Potential Funding Source(s)	Cost Estimate	Benefits	Timeline
Unincorporated Worth County-2	By increasing individuals' awareness and preparedness we hope to decrease demand on local resources and improve resiliency of the whole community	Attracting the interest of the public to attend classes or commit to taking the time to implement plans	Emergency Management	Local Emergency Response Agencies, Law Enforcement, Red Cross, FEMA	Local funds, Private Non-Profit, Other - programs online to implement (be the help)	Little or no cost	A more informed and prepared community	2-3 yrs
Unincorporated Worth County-3	The County Government needs to have a plan of action to continue to function during times of disaster and damage	Limited- Dept. heads may not give feedback in a timely fashion	Board of Supervisors	EMA, IT/GIS, Dept. Heads	Local funds	Little or no cost	A local government that would return to a functional and operational condition in a minimal amount of time	1 yr
Unincorporated Worth County-4	While several improvements have been made in areas others need to continue to upgrade or retrofit systems to provide for service demands that have increased or are vulnerable	Financial limits	Board of Supervisors	County Engineer, Conservation, Community Development	FEMA Grant, Local funds, Other - Worth County Development Asso.	$100,000 to $500,000	Improved capacity, better protection, able to continue operations when power is out	More than 5 yrs
Unincorporated Worth County-5	Even though historically Worth County has been subject to violent storms in the past, limited public access to shelters is an issue. Citizens have relied on family and neighbors for shelter	Cost	Board of Supervisors	EMA, Conservation, Local churches, private institutions	FEMA Grant, Local funds, Other - WCDA	$500,000 to $1,000,000	Improved survivability for persons exposed to tornados and storms	More than 5 yrs
Unincorporated Worth County-6	River flooding is not a significant life safety, property hazard to residents in the unincorporated parts of Worth County - most vulnerable areas are vacant of dwellings	Cost, resistance to buy out offers	Board of Supervisors	EMA, Assessor, GIS	FEMA Grant	$50,000 to $100,000	Reduces potential flood damage exposure	3-5 yrs
Unincorporated Worth County-13	Worth County has been using older communications equipment	Funding, training	Worth County Sheriff's Office	E911, EMA, Board of	FEMA Grant, Local funds, Other - WCDA	Over $1,000,000	Improved communications in	2-3 yrs

Action ID	Issue/Background	Obstacles	Responsible Office	Partners	Potential Funding Source(s)	Cost Estimate	Benefits	Timeline
	multiple tower locations and a lack of interoperable equipment. Worth County is in process of going to statewide radio system.	employees on new equipment		Supervisors, IT/GIS			and out of the County	
Unincorporated Worth County-18	While Worth County has added backup generators to several facilities not all assessed have a generator dedicated solely to it	Funding	Worth County Sheriff's Office	Board of Supervisors, EMA, Conservation, Recycling Center	FEMA Grant, Local funds, Other - WCDA	$500,000 to $1,000,000	Critical infrastructure and facilities that could continue to run	2-3 yrs
Unincorporated Worth County-23	Without participation flood losses could go on costing residents significant dollars to rebuild and replace	Minimal	Board of Supervisors	Assessor's office, IT/GIS, EMA	FEMA Grant	$100,000 to $500,000	Flood losses would be reduced	3-5 yrs
Unincorporated Worth County-24	As infrastructure ages it can become unsafe. A regular inspection can detect items that need to be replaced or improved long before they fail.	Time & money for inspections	County Engineer	Board of Supervisors, IT/GIS, EMA, Secondary Roads	FEMA Grant, Local funds	Over $1,000,000	Better planning of replacement cycle, improved safety	More than 5 yrs
Fertile-2	People need to know about hazards and how to be ready for them	Reaching different ages - different ways of getting info	City Hall & staff	Worth Co EMA, FEMA, IA HSEMD	FEMA Grant, Local funds, In-Kind, Private Non-Profit	Little or no cost	Informed citizens make better decisions	Other - continuous process
Fertile-3	Loss of leadership and accountability along with line of succession can cripple government's ability to operate and provide needed services	City staff time and knowledge on developing plans	City Hall & staff	Worth Co EMA, NIACOG, FEMA, IA HSEMD	Local funds	Less than $10,000	Improved organization and operation of local government	2-3 years
Fertile-4	Often times older systems fail when under pressure / times of disasters	funding	City operations	City Hall, FEMA	FEMA Grant, Local funds	$500,000 to $1,000,000	Resilient systems that will withstand outside factors	More than 5 yrs
Fertile-5	There is a general lack of shelters / safe rooms for large numbers of people in the City.	Cost, availability of existing structures to retrofit	City Hall	FEMA	FEMA Grant, Local funds, Other - WCDA	$50,000 to $100,000	Safe and secure locations for shelter	More than 5 yrs
Fertile-6	Repeatedly repairing flood damaged property is costly	Reluctance to sell by owners	City Hall	FEMA, Worth Co EMA	FEMA Grant, Local funds	Will be case by case	Reduced or deleted costs for repeat damage	More than 5 yrs
Fertile-14	We use this as our primary shelter site, command center, and animal shelter	No funding	FEMA and City	None	FEMA Grant	$10,000 to $50,000	Shelter for residents and animals	1 yr

Action ID	Issue/Background	Obstacles	Responsible Office	Partners	Potential Funding Source(s)	Cost Estimate	Benefits	Timeline
Fertile-15	We use this as our primary shelter area, command center, and animal shelter	No funding	FEMA and City	None	FEMA Grant	$10,000 to $50,000	Shelter for residents and animals	1 yr
Fertile-16	If pumps go down at sewer plant this generator would come on and keep sewer from backing up into homes	No funding	FEMA and City	None	FEMA Grant	$10,000 to $50,000	Avoids sewer backup into homes	1 yr
Fertile-17	In order to provide back up generator to critical facilities, City Hall & Community Center would need natural gas line and sewer plant would need LP lines run	None	FEMA and City	None	FEMA Grant	Less than $10,000	Shelter for residents and animals, avoiding sewer backup into homes	1 yr
Fertile-18	Floodplain maps for City of Fertile shows homes that need flood insurance; City must continue to participate to remain eligible	None	City Hall	None	FEMA Grant, Local funds	Little or no cost	Homes that are in flood plain need to have maps for the banks to finance home	Other - Ongoing
Grafton-2	An informed public can recognize hazards and mitigate against and prepare for them	time constraints on staff	Mayor/Council, City Staff	Worth Co EMA, Worth Co Sheriff, Grafton Fire Dept.	Local funds, In-Kind, Private Non-Profit, Other - WCDA	Little or no cost	An informed, aware, and prepared population	More than 5 yrs
Grafton-3	In time of disasters the functions of government must be able to continue	time constraints on staff	City staff, Mayor, Council	Worth Co EMA	Local funds	Little or no cost	Organization of government operations in time of chaos	More than 5 yrs
Grafton-4	Drainage system improvements are needed to reduce flood risk	Cost	City staff, Mayor, Council	FEMA, IA HSEMD, Worth Co EMA	FEMA Grant, Local funds, Other - WCDA	Over $1,000,000	Resilient public water/sewer services	More than 5 yrs
Grafton-5	Iowa has an ever increasing number of severe wind storms and tornados, adequate safe space is eneded to protect citizens and visitors	Cost	City staff, Mayor, Council	FEMA, Worth Co EMA	FEMA Grant, Local funds, Other - WCDA	$100,000 to $500,000	Safe space for vulnerable persons	More than 5 yrs
Grafton-6	In order to reduce repeat damage, vulnerable properties need to be removed from floodplains	Cost, property owners reluctance to sell	City staff, Mayor, Council	FEMA	FEMA Grant, Local funds	Unknown	Elimination of repeat damage and expenses	More than 5 yrs
Grafton-9	Critical infrastructure has become a target of opportunity for terrorist and thieves	Cost, knowing what to protect and what type of protection is needed	City Staff, Elected officials	FEMA, IA HSEMD	FEMA Grant, Local funds	$50,000 to $100,000	Better protection and security for critical infrastructure	More than 5 yrs

Action ID	Issue/Background	Obstacles	Responsible Office	Partners	Potential Funding Source(s)	Cost Estimate	Benefits	Timeline
Grafton-12	Critical facilities can be exposed to many hazards	Cost	City staff, elected officials	FEMA, Worth Co EMA, Worth Co Conservation, Grafton Fire Dept.	FEMA Grant, Local funds, In-Kind, Private Non-Profit, Other - WCDA	Unknown	Not determined	More than 5 yrs
Hanlontown-2	A more informed public is a better prepared public	Ability to reach all ages of citizens	City Hall staff	Worth Co EMA, FEMA	Local funds	Little or no cost	Improved public awareness	1 yr
Hanlontown-3	A prepared council is an effective council	None	City Hall, staff	Worth Co EMA, FEMA	Local funds	Little or no cost	Prepared City Hall	1 yr
Hanlontown-4	In case of power outage, water supply is maintained	Filling out grants	Mayor, City Hall	WCDA, FEMA	FEMA, Local funds, Private Non-Profit	$10,000 to $50,000	In case of power outage fire department can still get water	1 yr
Hanlontown-5	City needs a safe place for residents and visitors to take shelter	None	City Hall	None	Local funds, Private Non-Profit	Little or no cost	Not determined	1 yr
Hanlontown-18	In case of power outage, City Hall and Fire & Rescue can operate as normal	None	City Staff, Mayor	WCDA	Private Non-Profit	$10,000 to $50,000	City Hall / Fire Rescue	1 yr
Hanlontown-20	City must stay in compliance with the NFIP requirements		City Council, Mayor	None	Local funds	Little or no cost	Continued eligibility for flood insurance coverage	Other - Ongoing
Joice-3	The City needs a Continuity of Operations Plan to ensure that procedures are in place for disaster preparedness and response and that the City's critical facilities wll be able to operate as needed during an emergency.	time, participation of all involved departments/agencies	City Council	Fire Department, First Responders, other departments	Local funds	Less than $10,000		2-3 yrs
Joice-4	The City needs to continue with preventive maintenance to the drainage system to ensure it functions properly in managing stormwater to prevent flooding.	funding			Local funds	$10,000 to $50,000	property damage from flooding avoided	Ongoing
Joice-18	Can be available if electricity lost due to a storm/tornado. Citizens can use community room to stay warm or cool during storm or extreme heat or	Funding, communicating so everyone knows it is available.	City Maintenance	City Council Members	Local funds	Little or no cost	Citizens have a safe place to go during power loss	1 yr

Action ID	Issue/Background	Obstacles	Responsible Office	Partners	Potential Funding Source(s)	Cost Estimate	Benefits	Timeline
	cold, and after effects of storm. Recently re-inforced building for well/pump usage. Emergency statement listing resource availability needs development.							
Joice-19	Dry weather conditions can cause field fires and put city residents in danger.	Costs to purchasing equipment to control fires	Fire Department and Emergency Management	Area fire departments, sheriff department	FEMA Grant, Local funds, In-Kind, Other - grants	$100,000 to $500,000	110 build structures and 200 plus lives	3-5 yrs
Joice-20	Spill at 5 Star Coop or Gavilon Grain	Training residents and Fire Dept.	Fire Dept. and First Responders	City	FEMA Grant, Local funds, Other - Elevator and Fertilizer Plant	Less than $10,000	Loss of life or physical harm	1 yr
Joice-21	Throughout the winter months there is a lot of pile up and drifting of snow on the northern most street of Joice. A snow fence will help and has helped in the past for the road filling up and closing.		Maintenance	County Maintenance if too much snow	Local funds	Little or no cost	Save on street cleaning for the city and residents along that street	
Kensett-2	People need to know about hazards and how to be ready for them	Reaching different ages - different ways of getting info	City Hall & staff	Worth Co EMA, FEMA, IA HSEMD	FEMA Grant, Local funds, In-Kind, Private Non-Profit	Little or no cost	Informed citizens make better decisions	Other - continuo us process
Kensett-3	Loss of leadership and accountability along with line of succession can cripple government's ability to operate and provide needed services	City staff time and knowledge on developing plans	City Hall & staff	Worth Co EMA, NIACOG, FEMA, IA HSEMD	Local funds	Less than $10,000	Improved organization and operation of local government	2-3 years
Kensett-4	Often times older systems fail when under pressure / times of disasters	funding	City operations	City Hall, FEMA	FEMA Grant, Local funds	$500,000 to $1,000,000	Resilient systems that will withstand outside factors	More than 5 yrs
Kensett-5	There is a general lack of shelters / safe rooms for large numbers of people in the City.	Cost, availability of existing structures to retrofit	City Hall	FEMA	FEMA Grant, Local funds, Other - WCDA	$50,000 to $100,000	Safe and secure locations for shelter	More than 5 yrs
Kensett-6	Repeatedly repairing flood damaged property is costly	Reluctance to sell by owners	City Hall	FEMA, Worth Co EMA	FEMA Grant, Local funds	Will be case by case	Reduced or deleted costs for repeat damage	More than 5 yrs

Action ID	Issue/Background	Obstacles	Responsible Office	Partners	Potential Funding Source(s)	Cost Estimate	Benefits	Timeline
Kensett-9	Critical facilities are vulnerable to damage	Cost, knowledge of all threats	City Hall	FEMA, Law enforcement	FEMA Grant, Local funds	Unknown	Secure facilities	More than 5 years
Kensett-12	Critical facilities are exposed to lots of hazards	Cost	City Hall	Worth Co EMA, Worth Co Conservation, FEMA, Kensett Fire Department	FEMA Grant, Local funds, Other - WCDA	$10,000 to $50,000	Uncertain	3-5 years
Manly-2	To give the people of Manly the info to proceed in case any of the hazards were to happen	None	City of Manly	N/A	Other - n/a	Little or no cost	To help people become prepared	1 yr
Manly-3	This will allow the city to perform in the event of a disaster	None	City of Manly, County EMS	N/A	FEMA Grant, Local funds, Other - WCDA	Less than $10,000	to allow for normal daily operations in each emergency	2-3 yrs
Manly-4	To allow for storm water and sewage to be moved quickly from the city. As our sanitary and storm systems are aging and need to be replaced or repaired.	None	City of Manly	N/A	FEMA Grant, Other - WCDA	$500,000 to $1,000,000	Prevent sewage and storm water from backing up into homes	2-3 yrs
Manly-5	Would allow for shelters needed in areas where community activities would be held. Would allow for a larger number of people to seek shelter	None	City of Manly	School, Manly Care Center	FEMA Grant, Local funds, Other - WCDA	$500,000 to $1,000,000	Allow for public safety	3-5 yrs
Manly-18	This will allow the city to perform daily duties as needed without interruption. Also to act as possible command center if needed.	None	City of Manly	N/A	Other - WCDA	$10,000 to $50,000	To allow for normal daily operations	Other - 1-2 yrs
Manly-22	The City of Northwood has participated with NFIP since 8/1/87. Last map was 8/2/12. The city will continue to ensure compliance with the NFIP.	City of Northwood	None	FEMA Grant,	Little or no cost		2-3 yrs	1
Northwood-2	To teach both kids and adults about severe weather and what to do and where to go	None	School, City, County	School, City, County	None identified	Little or No Cost		2-3 yrs
Northwood-4	Preventive maintenance on water and sewer plants.	None	City of Northwood	None identified	Local funds	Over $1,000,000		2-3 yrs

Action ID	Issue/Background	Obstacles	Responsible Office	Partners	Potential Funding Source(s)	Cost Estimate	Benefits	Timeline
	The city has built a new sewer plant.							
Northwood-5	A safe room for the public	Space/building	City of Northwood	Worth County	FEMA Grant	Over $1,000,000		More than 5 yrs
Northwood-6	Keep citizens in flood prone areas safe and out from the potential floding of home	Residents do not want to sell or leave home	City of Northwood	None	None identified	$500,000 to $1,000,000		More than 5 yrs
Northwood-18	The city purchased a generator to be used on all water, sewer, and other City buildings if needed in an emergency. The city will review if additional generators are needed.	None	City of Northwood	None	Local funds	Less than $10,000		1 yr
Northwood-22	The City of Northwood has participated with NFIP since 8/1/87. Last map was 8/2/12. The city will continue to ensure compliance with the NFIP.	None	City of Northwood	None	FEMA Grant,	Little or no cost		2-3 yrs
Northwood-Kensett CSD-18	During periods of extreme heat, local residents will need to use the school buildings as cooling centers.	only obstacle may be prohibitive costs	Superintendent's office	Local law enforcement and emergency responders	FEMA Grant, Local funds	$100,000 to $500,000	Preservation of life for residents without A/C	2-3 yrs
Central Springs Community School District-25	Current locations do not meet FEMA guidelines and standards for saferooms; schools use restrooms and locker rooms currently for tornado safety. Locations for saferooms in each location are picked out. Project will add saferooms to two sites.	Funding	Superintendent's office	School staff, Worth County Development Authority (WCDA)	FEMA Grant, Local funds, Other - WCDA	$500,000 to $1,000,000	Life safety	2-3 yrs

Table 4.4. Action Prioritization

Action ID	Mitigation Action Title / Description	Lives Saved?	Reduced Property Damages?	Reduce need for response actions?	Will benefits exceed cost?	Social	Technical	Administrative	Political	Legal	Economic	Environment	Score	Priority
		0-unlikely, 1-maybe, 2-probably, or 3-definitely				Positive (1) Neutral (0) Negative (-1)								
Unincorporated Worth County-2	Public education and awareness of all hazards	3	2	2	3	1	1	1	0	1	1	0	15	H
Unincorporated Worth County-3	Continuity of Operations Plan (COOP)	1	1	0	2	1	1	1	1	1	1	0	10	M
Unincorporated Worth County-4	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems	1	2	1	2	0	1	0	0	1	1	1	10	M
Unincorporated Worth County-5	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities	3	0	1	2	1	1	1	0	1	1	0	11	M
Unincorporated Worth County-6	Acquire flood prone properties for conversion into green space; or elevate structures in or above base flood elevation; construction of levees, dams, and culverts to ensure adequate capacity and protection levels for property and critical facilities	1	2	1	1	0	1	0	0	1	0	0	7	L
Unincorporated Worth County-13	Mitigate vulnerabilities in county communications system	2	2	0	2	1	1	1	1	1	0	0	11	M
Unincorporated Worth County-18	Critical infrastructure generator hookups	2	1	1	2	1	1	1	0	1	1	1	12	M
Unincorporated Worth County-23	NFIP participation	1	2	1	2	1	1	1	1	1	1	0	12	M
Unincorporated Worth County-24	Infrastructure study and improvements	2	2	2	2	1	1	1	1	1	1	0	14	H
Fertile-2	Public education and awareness of all hazards	3	1	1	3	1	1	1	0	0	0	0	11	M
Fertile-3	Continuity of Operations Plan (COOP)	1	0	1	1	1	1	1	1	1	1	0	9	M
Fertile-4	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems	0	2	1	1	1	-1	0	0	0	1	1	6	L

Action ID	Mitigation Action Title / Description	Lives Saved?	Reduced Property Damages?	Reduce need for response actions?	Will benefits exceed cost?	Social	Technical	Administrative	Political	Legal	Economic	Environment	Score	Priority
		0-unlikely, 1-maybe, 2-probably, or 3-definitely				Positive (1) Neutral (0) Negative (-1)								
Fertile-5	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities	3	0	2	3	1	0	0	0	0	0	0	9	M
Fertile-6	Acquire flood prone properties for conversion into green space; or elevate structures in or above base flood elevation; construction of levees, dams, and culverts to ensure adequate capacity and protection levels for property and critical facilities	1	2	2	1	0	0	1	0	1	0	0	8	M
Fertile-14	Purchase and install generator for City Hall	3	0	3	3	1	1	1	1	1	1	1	16	H
Fertile-15	Purchase and install generator for Community Center	3	0	3	3	1	1	1	1	1	1	1	16	H
Fertile-16	Purchase and install generator for Sewer Plant	3	3	3	3	1	1	1	1	1	1	1	19	H
Fertile-17	Critical infrastructure generator hookups	3	3	3	3	1	1	1	1	1	1	1	19	H
Fertile-18	NFIP participation	1	3	2	3	1	1	1	1	1	1	1	16	H
Grafton-2	Public education and awareness of all hazards	1	1	1	2	1	1	0	1	0	1	1	10	M
Grafton-3	Continuity of Operations Plan (COOP)	1	1	2	1	1	0	0	1	1	0	0	8	M
Grafton-4	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems	1	0	1	1	1	0	0	1	0	0	0	5	L
Grafton-5	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities	2	0	1	2	1	0	0	1	0	0	0	7	L
Grafton-6	Acquire flood prone properties for conversion into green space; or elevate structures in or above base flood elevation; construction of levees, dams, and culverts to ensure adequate capacity and protection levels for property and critical facilities	1	2	2	1	1	0	0	0	0	0	0	7	L
Grafton-9	Install and maintain security measures at all critical facilities and training of emergency response personnel	1	2	1	1	1	0	0	1	1	0	0	8	M

Action ID	Mitigation Action Title / Description	Lives Saved?	Reduced Property Damages?	Reduce need for response actions?	Will benefits exceed cost?	Social	Technical	Administrative	Political	Legal	Economic	Environment	Score	Priority
		0-unlikely, 1-maybe, 2-probably, or 3-definitely				Positive (1) Neutral (0) Negative (-1)								
Grafton-12	Natural resource measures to prevent the damage to critical facility functions.	0	0	1	1	1	0	0	1	0	0	0	4	L
Hanlontown-2	Public education and awareness of all hazards	2	2	1	3	1	1	1	1	1	1	0	14	H
Hanlontown-3	Continuity of Operations Plan (COOP)	3	2	2	1	1	1	1	1	1	1	-1	13	H
Hanlontown-4	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems	2	2	2	2	1	1	1	1	1	1	-1	13	H
Hanlontown-5	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities	0	0	0	0	1	1	1	1	1	1	-1	5	L
Hanlontown-18	Critical infrastructure generator hookups	3	3	3	3	1	1	1	1	1	1	-1	17	H
Hanlontown-20	NFIP participation	1	3	1	3	1	1	1	1	1	1	1	15	H
Joice-3	Continuity of Operations Plan (COOP)	2	1	1	2	1	1	1	1	1	1	0	12	M
Joice-4	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems	1	3	2	3	1	1	1	1	1	1	1	16	H
Joice-18	Provide generator use for Community Center for citizens who have lost electricity and publicize availability of this resource.	2	0	2	3	1	1	1	1	1	1	0	13	H
Joice-19	Field Fires	3	3	1	3	1	1	1	1	1	0	1	16	H
Joice-20	Hazardous Materials Incident	3	3	0	3	1	1	1	1	1	1	1	16	H
Joice-21	Snow fence on Lake Street, north side of city	0	1	1	3	1	1	1	1	1	1	0	11	M
Kensett-2	Public education and awareness of all hazards	3	1	1	3	1	1	1	0	0	0	0	11	M
Kensett-3	Continuity of Operations Plan (COOP)	1	0	1	1	1	1	1	1	1	1	0	9	M
Kensett-4	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems	0	2	1	1	1	-1	0	0	0	1	1	6	L

Action ID	Mitigation Action Title / Description	Lives Saved?	Reduced Property Damages?	Reduce need for response actions?	Will benefits exceed cost?	Social	Technical	Administrative	Political	Legal	Economic	Environment	Score	Priority
		0-unlikely, 1-maybe, 2-probably, or 3-definitely				Positive (1) Neutral (0) Negative (-1)								
Kensett-5	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities	3	0	2	3	1	0	0	0	0	0	0	9	M
Kensett-6	Acquire flood prone properties for conversion into green space; or elevate structures in or above base flood elevation; construction of levees, dams, and culverts to ensure adequate capacity and protection levels for property and critical facilities	1	2	2	1	0	0	1	0	1	0	0	8	M
Kensett-9	Install and maintain security measures at all critical facilities and training of emergency response personnel	0	0	1	2	0	0	1	0	1	0	0	5	L
Kensett-12	Natural resource measures to prevent the damage to critical facility functions.	2	2	1	1	0	0	0	0	0	-1	-1	4	L
Manly-2	Public education and awareness of all hazards	1	0	3	3	1	1	1	1	1	1	0	13	H
Manly-3	Continuity of Operations Plan (COOP)	3	2	3	3	1	1	1	1	1	1	0	17	H
Manly-4	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems	1	3	3	3	1	1	1	1	1	1	1	17	H
Manly-5	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities	3	0	3	3	1	1	1	1	1	1	0	15	H
Manly-18	Critical infrastructure generator hookups	0	0	3	3	1	1	1	1	1	1	0	12	M
Manly-22	NFIP participation	2	1	0	1	1	0	0	0	1	1	8	M	
Northwood-2	Public education and awareness of all hazards	3	2	1	0	1	1	1	1	0	1	1	12	M
Northwood-4	Construct, retrofit, or maintain water supply, drainage, sewage, retention, and detention systems to provide for the proper functioning of those systems	1	1	2	1	1	1	1	1	1	1	1	12	M

Action ID	Mitigation Action Title / Description	Lives Saved?	Reduced Property Damages?	Reduce need for response actions?	Will benefits exceed cost?	Social	Technical	Administrative	Political	Legal	Economic	Environment	Score	Priority
		0-unlikely, 1-maybe, 2-probably, or 3-definitely				Positive (1) Neutral (0) Negative (-1)								
Northwood-5	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities	2	1	2	1	1	1	1	0	1	0	0	10	M
Northwood-6	Acquire flood prone properties for conversion into green space; or elevate structures in or above base flood elevation; construction of levees, dams, and culverts to ensure adequate capacity and protection levels for property and critical facilities	1	2	1	0	0	-1	0	-1	0	-1	0	1	L
Northwood-18	Critical infrastructure generator hookups	1	1	1	0	1	1	1	1	0	1	1	9	M
Northwood-22	NFIP participation	1	2	1	0	1	1	0	0	0	1	1	8	M
Northwood-Kensett CSD-18	Ensure that the school buildings' cooling systems remain operational during periods of extreme heat	3	0	2	3	1	1	1	0	1	1	0	13	H
Central Springs Community School District-25	Tornado Saferoom Project	3	1	2	3	1	1	1	1	1	1	0	15	H

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

44 CFR Requirement 201.6(c)(4): The plan maintenance process shall include a section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.

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 Worth County Emergency Management Coordinator, agree to:

- Meet annually to review the Hazard Mitigation Plan;
- Act as a forum for hazard mitigation issues;
- Disseminate hazard mitigation ideas and activities to all participants;
- Pursue the implementation of high priority, low- or no-cost recommended actions;
- Maintain vigilant monitoring of multi-objective, cost-share, and other funding opportunities to help the community implement the plan's recommended actions for which no current funding exists;
- Monitor and assist in implementation and update of this plan;
- Keep the concept of mitigation in the forefront of community decision making by identifying plan recommendations when other community goals, plans, and activities overlap, influence, or directly affect increased community vulnerability to disasters;
- Report on plan progress and recommended changes to the Worth County Board of Supervisors and governing bodies of participating jurisdictions; and
- Inform and solicit input from the public.

The HMPC is an advisory body and can only make recommendations to county, city, town, or district elected officials. Its primary duty is to see the plan successfully carried out and to report to the community governing boards and the public on the status of plan implementation and mitigation opportunities. Other duties include reviewing and promoting mitigation proposals, hearing stakeholder concerns about hazard mitigation, passing concerns on to appropriate entities, and posting relevant information in areas accessible to the public.

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 Worth County Emergency Management Coordinator will be responsible for initiating the plan reviews.

In coordination with the other participating jurisdictions, a written update of the plan will be submitted to the Iowa Homeland Security and Emergency Management Department and FEMA Region VII for approval within the required five-year cycle per Requirement §201.6(c)(4)(i) of the Disaster Mitigation Act of 2000, unless disaster or other circumstances (e.g., changing regulations) require a change to this schedule.

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 Worth County Emergency Management Coordinator will provide the updated Mitigation Strategy with the current status of each mitigation action to the County Board of Supervisors and County Department Heads as well as all Mayors, City Clerks, and School District Superintendents requesting that the mitigation strategy be incorporated, where appropriate in other planning mechanisms.

Changes will be made to the plan to accommodate for actions that have failed or are not considered feasible after a review of their consistency with established criteria, time frame, community priorities, and/or funding resources. Actions that were not ranked high but were identified as potential mitigation activities will be reviewed as well during the monitoring and update of this plan to determine feasibility of future implementation. Updating of the plan will be by written changes and submissions, as the Worth County HMPC deems appropriate and necessary, and as approved by the Worth County Board of Supervisors and the governing boards of the other participating jurisdictions.

5.2 Incorporation into Existing Planning Mechanisms

44 CFR Requirement §201.6(c)(4)(ii): [The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.

Many of the small jurisdictions in Worth County do not have standing formal planning mechanisms such as a Comprehensive Plan or Capital Improvement Plan through which formal integration of mitigation actions can be documented. As a result, activities that occur in these small communities are developed through annual budget planning, regular City Council Meetings and other community forums rather than a formal planning process. Planning mechanisms that do exist to some degree within the participating jurisdictions include:

- Comprehensive Plans;
- Various ordinances of participating jurisdictions, including floodplain management ordinances in NFIP-participating communities;
- Capital Improvement Plans

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

Incorporation of Updated Hazard Mitigation Plan into existing Planning Mechanisms

Where possible, plan participants will use existing plans and/or programs to implement hazard mitigation actions. After the annual review of the Hazard Mitigation Plan, the Worth County Emergency Management Coordinator will provide the updated Mitigation Strategy with the current status of each mitigation action to the County Board of Supervisors and County Department Heads as well as all Mayors, City Clerks, and School District Superintendents requesting that the mitigation strategy be incorporated, where appropriate in other planning mechanisms.

Table 5.1 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 5.1. Integration of Previous Plan and Strategies to Integrate Plan Update

Jurisdiction	Incorporation of 2013 Plan into Existing Planning Mechanisms	Integration Process for Plan Update
Unincorporated Worth County	None reported	Plan will be incorporated into changes of the Comprehensive Plan and the Continuity of Government Plan; mitigation actions will be reviewed as the County implements drainage, bridge, and new County construction plans
Fertile	Previous plan was incorporated into the Fertile Emergency Operations Plan	Plan will be incorporated into the Emergency Operations Plan and the five-year improvements plan.
Grafton	The plan was not incorporated	The plan will be reviewed when the Town is planning future infrastructure projects.
Hanlontown	None reported.	None reported
Joice	Integration did not occur	The plan update will be incorporated with the City's Comprehensive Plan, action worksheets will be used in preparing annual budgets and in future growth plans, and the plan will be shared with the community.
Kensett	None reported.	Plan will be incorporated into City Infrastructure Plan
Manly	Implemented multiple mitigation projects, including raising lift station, installing more powerful pumps, new back up generator, new tornado sirens with battery back up, and iron removal system at water treatment plant	Plan will be integrated into Comprehensive Plan and the City's Infrastructure Plan; the plan will be used to fix or update surface water removal systems
Northwood	None reported.	Plan will be reviewed when planning all future projects
Central Springs CSD	N/A	The plan will be reviewed as the district updates its Capital Improvement and School Emergency Plans.
Northwood-Kensett CSD	N/A	Mitigation actions will be reviewed when planning future capital improvement and infrastructure projects. The plan will be integrated into the School's Infrastructure Plan and Emergency Plan

5.3 Continued Public Involvement

44 CFR Requirement §201.6(c)(4)(iii): [The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.

The public will be involved in the plan maintenance process by publication of a Press Release after each annual review indicating the committee has met with a summary of mitigation action status updates and highlights of specific completed mitigation actions, as applicable. The public will be invited to provide comments on HMPC meeting outcomes and/or attend HMPC meetings.

The update process provides an opportunity to publicize success stories from the plan's implementation and seek additional public comment. When the HMPC reconvenes for the update, it will coordinate with all stakeholders participating in the planning process, including those who joined the HMPC after the initial effort, to update and revise the plan. Public notice will be posted through available website postings, community message boards, and social media outlets.

- Coalition to Support Iowa's Farmers
- Des Moines Register News Data Central
- Environmental Protection Agency, heat-related deaths
- Environmental Protection Agency, Surf Your Watershed
- Federal Emergency Management Agency, BCA Reference Guide, 2009
- Federal Emergency Management Agency, Community Status Book
- Federal Emergency Management Agency, National Flood Hazard Layer
- Federal Emergency Management Agency, Presidential Disaster Declarations
- Federal Emergency Management Agency, Taking Shelter from the Storm, 3rd Edition
- Federal Emergency Management Agency, Worth County Flood Insurance Study (2012 Effective)
- Flood Insurance Administration, Policy and Loss Statistics
- Hazards US MH 2.2 (HAZUS)
- Hazards US MH 4.0 (HAZUS)
- Hazards Vulnerability Research Institute, Social Vulnerability Index
- High Plains Regional Climate Center
- Iowa Communications Network
- Iowa Department of Agriculture and Land Stewardship, Division of Soil Conservation
- Iowa Department of Agriculture and Land Stewardship, Pesticide Bureau - Sensitive Crop Registry
- Iowa Department of Agriculture, Agricultural Statistics bulletin
- Iowa Department of Education, Bureau of Planning, Research and Evaluation
- Iowa Department of Natural Resources, Animal Feeding Operations
- Iowa Department of Natural Resources, Dam Safety Program
- Iowa Department of Natural Resources, NPDES
- Iowa Department of Natural Resources, NRGIS Library
- Iowa Department of Public Health Center for Acute Disease Epidemiology
- Iowa Department of Transportation’s Office of Traffic and Safety
- Iowa Homeland Security and Emergency Management Department
- Iowa State Hazard Mitigation Plan, 2013
- Iowa State University, College of Agriculture and Life Sciences
- Iowa State University, Department of Agronomy, Environmental Mesonet
- Iowa State University, Extension Office, Distribution of Ash Trees in Iowa
- Karl, T.R., J.M. Melillo, and T.C. Peterson (eds). 2009. Global Climate ChangeImpacts in the United States. U.S. Global
- Midwestern Regional Climate Center
- National Drought Mitigation Center, U.S. Drought Monitor & Drought Impact Reporter
- National Oceanic and Atmospheric Administration, Storm Prediction Center
- National Oceanic and Atmospheric Administration, National Climatic Data Center
- National Park Service, National Register of Historic Places
- National Severe Storms Laboratory
- National Transportation Safety Board
- National Weather Service
- Natural Resources Conservation Service, Soil Survey of Worth County, Iowa, 1976

- Natural Resources Conservation Service, Web Soil Survey
- New York Times.com, Water Supply Systems
- Pipeline and Hazardous Materials Safety Administration
- Stanford University, National Performance of Dams Program
- Tornado and Storm Research Organization (TORRO), Department of Geography, Oxford Brooks University
- TornadoChaser.net
- TornadoHistoryProject.com
- U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory
- U.S. Army Corps of Engineers, National Inventory of Dams
- U.S. Army Corps of Engineers, National Levee Database
- U.S. Census Bureau, American Community Survey, 5-Year Estimates, 2016
- U.S. Census Bureau, Building Permit Data
- U.S. Census Bureau, Decenniel Census, 2000, 2010
- U.S. Census Bureau, Population Estimates, 2016
- U.S. Department of Agriculture Cropland Data Layer (CropScape)
- U.S. Department of Agriculture National Agricultural Statistics Service, 2012 Census of Agriculture
- U.S. Department of Agriculture, Emerald Ash Borer County Detection Map
- U.S. Department of Agriculture, Risk Management Agency Crop Insurance Statistics
- U.S. Department of Agriculture, Secretarial Disaster Declarations
- U.S. Department of Transportation
- U.S. Fish and Wildlife Service, Threatened and Endangered Species
- U.S. Geological Survey
- University of Nebraska, National Drought Mitigation Center
- University of Wisconsin-Madison, Department of Forest Ecology and Management, SILVIS Lab
- Worth County Assessor's Office
- Worth County Conservation Board
- Worth County, Iowa Multi-jurisdictional Hazard Mitigation Plan, 2013

The following materials are provided to document the planning process:

B.1 Worth County Hazard Mitigation Planning Committee (HMPC) Members

Jurisdictional and Stakeholder Representatives that Attended Meetings

Name		Title	Department	Jurisdiction/Organization
Ken	Abrams	Supervisor		Worth County
Jacki	Backhaus	Auditor		Worth County
Merlin	Bartz	Supervisor		Worth County
John	Bork	Mayor	Grafton FD	Grafton
Dan	Fank	Sheriff		Worth County
Keith	Fritz	Principal	NK Schools	Northwood-Kensett CSD
Scott	Heagel	City Council		Manly
Ray	Huftalin	Coordinator	Worth County Emergency Management	Worth County
Randy	Hulshizer	City Council		Grafton
Kris	Kerison	Reporter		Northwood Anchor, Inc.
Doug	Moehle	Mayor		Northwood
Corey	Pulju	Mayor		Kensett
Joel	Rohne	Technology Director		Worth County
Joyce	Russell	Mayor		Fertile
Rick	Scholbrock	Mayor		Hanlontown
Mark	Smeby	Supervisor		Worth County
Duane	Tabbert	Asst Fire Chief	Grafton FD	Grafton

Stakeholder Representatives Invited to Provide Comments

First Name	Last Name	Title	Agency	Type
Tony	Loeser	Water Resources Engineer	Iowa State University, Iowa Flood Center	Academia
Andy	Buffington	Emergency Management Coordinator	Winnebago County EM	Adjacent County
Steve	O'Neil	Emergency Management Coordinator	Cerro Gordo County EM	Adjacent County
Ray	Huftalin	Emergency Management Coordinator	Mitchell County EM	Adjacent County
Amy	Lammey	Emergency Management Director	Mower County, Minnesota EM	Adjacent County
Kurt	Freitag	Emergency Management Director	Freeborn County, Minnesota EM	Adjacent County
Tom	Taylor		EPA/Water Resources Protection Branch	Federal Agency
Joe	Chandler		FEMA Region VII	Federal Agency
Jeff	Johnson		NWS	Federal Agency
Jeff	Zogg		NWS	Federal Agency
Andrew	Leichty		USCOE Rock Island District	Federal Agency
Steve	Russell		USCOE Rock Island District	Federal Agency
Jerry	Skalak		USCOE Rock Island District	Federal Agency
Rob	Middlemis-Brown		USGS	Federal Agency
Terry	Jensen		Dept of Ag & Land Stewardship	State Agency
Scott	Ralston	Floodplain Mapping Coordinator	DNR	State Agency
Casey	Welty	Dam Safety Engineer	DNR, Dam Safety Program	State Agency
Gail	Kantak	Wildland Fire Supervisor	DNR-Forestry	State Agency
Aimee	Bartlett	State Hazard Mitigation Officer	Iowa Homeland Security and Emergency Management	State Agency
Terry	Brown	GIS Coordinator	Iowa Homeland Security and Emergency Management	State Agency
Jim	Marwedel	Mitigation Planner	Iowa Homeland Security and Emergency Management	State Agency
Jennifer	Jones	Project Officer	Iowa Homeland Security and Emergency Management	State Agency
Jessica	Turba	Planner	Iowa Homeland Security and Emergency Management	State Agency

B.2 Meeting #1 Invite

Subject: Worth County Kickoff/HIRA Meeting
Location: 99N 9th St, Northwood, IA

Start: Wed 1/24/2018 6:00 PM
End: Wed 1/24/2018 8:00 PM

Recurrence: (none)

Meeting Status: Meeting organizer

Organizer: Karsjen, Kyle
Required Attendees: Pluss, Madeleine; Brislawn, Jeff P; Ray Huftalin; Joel Rohne; hotrod89@hotmail.com; drtabbert@hotmail.com; pbratt@wctatel.net; jfd@wctatel.net; kfire@wctatel.net; firerush@msn.com; fertilech@wctatel.net; grafton@wctatel.net; scholbrockrs@yahoo.com; jakejackson303@gmail.com; cityofkensett@wctatel.com; clerk@northwoodia.org; mcrozier@nwood-kensett.k12.ia.us; kfritz@nwood-kensett.k12.ia.us; sward@centralsprings.net; kestes@centralsprings.net; manlypolice219@yahoo.com; dfank@worthcounty.org; jim.hanson@worthcounty.org; auditor@worthcounty.org; merlin.bartz@worthcounty.org; ken.abrams@worthcounty.org; mark.smeby@worthcounty.org; hansonnvfc@hotmail.com; markthoma@wctatel.com; borke4@wctatel.net; mayor@northwoodia.org

Worth County is beginning the process of updating the Worth County Multi-Jurisdictional Multi-Hazard Mitigation Plan, approved by FEMA in December of 2013. The plan will expire in December 2018; in order to ensure that Worth County remains compliant with hazard mitigation planning, the county is commencing a process to update the plan before the expiration date. My name is Kyle Karsjen, and I work for Amec Foster Wheeler, the firm contracted to manage the update of the mitigation plan.

Each community and school district in Worth County is invited to participate in the plan update. For the 2018, participating jurisdictions are Fertile, Grafton, Hanlontown, Joice, Kensett, Manly, Northwood and unincorporated Worth County, as well as the Central Springs Public School District and the Northwood-Kensett Public School District. **It is vitally important that each community is represented at this meeting.**

Hazard mitigation planning provides many benefits to the county, including a better understanding of the hazards each community and the county as a whole faces, as well as ensuring the county and participating jurisdictions remain eligible for any potential federal funding that comes available for mitigation projects to reduce community risk to disasters and their impacts.

On behalf of Worth County Emergency Management, you are invited to attend the kickoff meeting for this process. At the kickoff, we will review the needs and requirements surrounding mitigation planning, as well as discuss hazards that impact each community. The meeting will be held at 99N 9th Street in Northwood from 7-9 PM CST.

If you are unable to attend, please identify an alternate to represent the community on your behalf; potential attendees could include elected officials, floodplain managers, engineers/public works directors, county/city planners, school principals/superintendents, and/or school facilities directors.

If you have any questions about mitigation planning or this process, please contact Ray Huftalin, Worth County Emergency Management Coordinator at (641) 324-1535 or ema@worthcounty.org.

B.3 Meeting #1 Agenda

Worth County
Multi-Jurisdictional Hazard Mitigation Plan Update
Planning Meeting #1
January 24, 2018
5:00-7:00 pm

Agenda

Welcome/Introductions

Hazard Mitigation Planning Purpose

Grant Programs Linked to Approved Plan

Multi-Jurisdictional Approach

Planning/Participation Requirements

Data Collection Guides

Discussion/Prioritization of Hazards

Sample Results of Countywide Risk Assessment Update

Update Mitigation Goals

Discuss Mitigation Action Updates

Next Steps

DRAFT RISK ASSESSMENT CHAPTER AVAILABLE FOR REVIEW

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B.4 Meeting #1 Minutes

To	**Worth County Hazard Mitigation Planning Team**
From	**Kyle Karsjen, Amec Foster Wheeler Mitigation Planner**
Tel / E-mail	**303-820-4661 / kyle.karsjen@amecfw.com**
Date	**2/14/2018**
Subject	**Minutes from Worth County Hazard Mitigation Planning Meeting #2 held on 1/24/2018**

This document is a record of attendance and a summary of the issues discussed during the above meeting, including: an overview of the mitigation planning process and review of the purpose of a Hazard Mitigation Plan, discussion on the public survey for the plan update, discussion of participation requirements and the status of each jurisdiction, presentation of the plan update format, sample results of the risk assessment update, a discussion to update the plan's mitigation goals, discussion of status updates of previous mitigation actions, and the next steps in this process.

Attendees

First Name	Last Name	Title	Jurisdiction/Organization
Joel	Rohne	IT/GIS	Worth County IT/GIS
Doug	Moehle	Northwood Mayor	City of Northwood
Joyce	Russell	Mayor of Fertile	City of Fertile
Mark	Smeby	Supervisor	Worth County
Kenneth	Abrams	Supervisor	Worth County
Ray	Huftalin	Coordinator	Emergency Management
John W.	Bork	Mayor	City of Grafton
Randy	Hulshizer	City Council	City of Grafton
Duane	Tabbert	Assistant Fire Chief	Grafton
Keith	Fritz	Principal	N-K Central School District
Jacki	Backhaus	Auditor	Worth County
Kris	Kerson	Report	Northwood Anchor, Inc.
Merlin	Bartz	County Supervisor	Worth County
Rick	Sholbrock	Mayor	City of Hanlontown
Dan	Fank	Sheriff	Worth County Sheriff
Corey	Pulju	Mayor	City of Kensett

Introductions

Ray Huftalin, Emergency Management Coordinator with Worth County Emergency Management began the meeting by welcoming and thanking the attendees. Kyle Karsjen, with Amec Foster Wheeler Environment & Infrastructure, Inc., the firm contracted to assist in the development of the Worth County multi-jurisdictional hazard mitigation plan update, facilitated the remainder of the presentation.

Purpose/Public Survey/Data Collection Guide

Kyle provided an overview of the purpose of the Hazard Mitigation Plan and the Disaster Mitigation Act of 2000 that codified the requirement of local governments to adopt a hazard mitigation plan to maintain eligibility for FEMA Hazard Mitigation Assistance Grants. The nine-task planning process was summarized and participants were informed that at the conclusion of the meeting, the planning team will have completed at least portions of Tasks 1-6.

Kyle discussed the public survey with attendees. Public input is important to ensure community participation in the hazard mitigation planning process. The survey can be found at https://www.surveymonkey.com/r/Worth-CO-IA. Planning team representatives were encouraged to publicize the availability of the surveys and to notify Amec Foster Wheeler of these publication efforts so that they can be described in the planning process section of the plan, including a copy of the proof of publication for newspaper postings, and screenshots of Facebook or website posts.

Kyle also discussed the Data Collection Guide, which provides jurisdictional baseline information on capabilities. Each jurisdiction and school district participating in the plan is required to provide one copy of the Data Collection Guide to kyle.karsjen@amecfw.com. Kyle noted that there are two data collection guides – one for a community/county and one for school districts; each jurisdiction should ensure they are filling out the correct version.

Plan Format/Sample Results of Countywide Risk Assessment

Kyle provided the overall format of the plan update document as follows:

- Executive Summary
- Chapter 1—Planning Process
- Chapter 2—Jurisdiction Profiles
- Chapter 3—Risk Assessment
- Chapter 4—Mitigation Strategy
- Chapter 5—Plan Maintenance
- Appendices

The draft hazard analysis and risk assessment will be available soon; Kyle told the jurisdictions that they would have at least two weeks to review the document once released. Jurisdictions were specifically requested to review the hazard ranking tables at the end of each hazard section to review/validate the ranking of each hazard for their jurisdiction. There may be areas in the draft risk assessment that are highlighted in blue, indicating information is needed from jurisdictions. Green highlighting in the risk assessment indicates further analysis or research to be completed by Amec Foster Wheeler.

The overview presentation provided just some of the details that are included in the full Draft Risk Assessment. All hazards identified for Worth County are included in the Draft Risk Assessment chapter that will be available for review.

The group discussed several hazard incidents that have occurred in the county. Highlights of the discussion are noted by hazard in the table below.

Hazard or Topic	Meeting Discussion
Flash Flood	• Fertile—water in basement • County has culvert problems • Fertile added culvert under 1st Street to assist in handling water
Wildfire	• A few places throughout county at risk for forest fires • The county primarily suffers from crop, ditch and grass fires
Hazardous Materials	• Magellan pipeline break in January 2017

	• There are buried pipelines throughout the County, and potential for a new pipeline in the near future • A hazardous materials incident in 2014 lead to the evacuation of Northwood due to chemical fire • Many miles of rail/storage in county; ethanol moves across county by rail • Regional HazMat team is currently conducting a commodity flow study.
Infrastructure Failure	• In 2008 Manly almost lost water treatment plant; they've now raised tanks to mitigate issues • Confinement houses are releasing manure into rivers, which may cause a hazmat issue
Sinkholes	• No significant sinkhole incidents
Terrorism	• Various groups have been active in the county at various times • The county has experienced credible threats • Protests have occurred against proposed pipeline
Tornado	• Data is not accurate (looks low) • F4 tornado in 1967 • F3 tornadoes in 1971 and 1974

Mitigation Goals

Following the discussion of the risk assessment, Kyle facilitated a discussion of the mitigation goals. Common categories of mitigation goals were presented as well as the 2013 State Hazard Mitigation Plan goals.

This planning effort is an update to an existing hazard mitigation plan. As a result, the goals from the *2013 Worth County Multi-Jurisdictional Hazard Mitigation Plan* were reviewed. The planning committee determined that all four previous goals remain valid. No changes were made.

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

The final meeting planned for March will focus on reporting on mitigation actions from the previous plan, and development of any new mitigation actions. Planning team members were asked to consider what actions could reduce/eliminate damages as they review the Draft Risk Assessment as well as discuss mitigation alternatives with other representatives from their jurisdiction.

WORTH COUNTY MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN UPDATE
MEETING #1—SIGN-IN SHEET

Project:	Worth County, Iowa Multi-Jurisdictional Hazard Mitigation Plan Update	**Meeting Date/Time:**	January 24, 2018 5:00-7:00 pm
Facilitator:	Kyle Karsjen, Amec Foster Wheeler	**Place/Room:**	99N 9th Street, Northwood, IA, 50459

Name	Title	Department/Agency	Email	Phone #	Signature
John W Bork	Mayor	Grafton	dorky4@wctatelnet	641-420-5409	John W. Bork
Randy Hulshizer	City Council	Grafton	shizers@wcta.telnet	641-748-2149	Randy Hulshizer
Duane Tabbert	Assistant Fire chief	Grafton	dstabbert@hotmail.com	641-748-2260	Duane Tabbert
Keith Fritz	Principal	N-K CSD	kfritz@nkvikings.com	641-324-2142	Keith Fritz
Jacki Backhaus	Auditor	Worth County	auditor@worthcounty.org	641-324-2316	Jacki A. Backhaus
Kris Kerison	reporter	Northwood Anchor, inc.	kris@northwoodanchor.net	641-324-1051	Kris Kerison
Merlin Bartz	county supervisor	Worth County	merlin.bartz@worthcounty.org	641-903-9548	Merlin Bartz
Rick Scholbrock	Mayor Hanlontown	City	scholbrock@wctatel.net	641-425-6211	Rick Scholbrock
Dan Fank	Sheriff	Worth County Sheriff	dfank@WorthCounty.org	641-324-2481	Dan Fank
Corey Pulju	Mayor Kensett	City	coreynpulju@gmail.com	507-581-0280	Corey Pulju

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B.6 Meeting #2 Agenda

Worth County
Multi-Jurisdictional Hazard Mitigation Plan Update
Planning Meeting #3

Wednesday, March 28, 2018
5:30 - 7:30 pm

Agenda

- Introductions/Remarks
- Review Purpose/Requirements
- Public Survey Results
- Updating the Mitigation Strategy
  - Review Updated Plan Goals
  - Status of Previous Actions
  - Development of New Actions
  - Prioritization of Mitigation Actions
- Hazard Mitigation Assistance Grants
- Plan Maintenance
- Next Steps

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B.7 Meeting #2 Minutes

To	**Worth County Hazard Mitigation Planning Committee**
From	**Kyle Karsjen, Amec Foster Wheeler Mitigation Planner**
Tel / E-mail	**303-820-4661/**kyle.karsjen@amecfw.com
Date	**4/10/2018**
Subject	**Minutes from Worth County Hazard Mitigation Planning Meeting #3 held on 3/28/2018**

This document is a record of attendance and a summary of the issues discussed during the above meeting, including: a brief review of the purpose of a Hazard Mitigation Plan, the public survey results, updating the mitigation strategy, Hazard Mitigation Assistance grants, plan maintenance and the next steps in this process.

Attendees

Name		Title	Department	Jurisdiction Name
Ray	Huftalin	Coordinator	Worth County Emergency Management	Worth County
Randy	Hulshizer	City Councilman	Grafton City Council	Grafton
Rick	Scholbrock	Mayor	City of Hanlontown	Hanlontown
Marlin	Bartz	Supervisor	Board of Supervisors	Worth County
Kris	Kerison		Worth County Newspapers	
Keith	Fritz	Principal	Northwood-Kensett Schools	Northwood-Kensett Schools
Joyce	Russell	Mayor	City of Fertile	City of Fertile
Dan	Fank	Sheriff	Worth County Sheriff's Department	Worth County
Corey	Pulju	Mayor	City of Kensett	City of Kensett
Jacki	Backhaus	Auditor	Worth County	Worth County
Mark	Smeby	Supervisor	Board of Supervisors	Worth County
Doug	Moehle	Mayor	City of Northwood	City of Northwood
Ken	Abrams	Supervisor	Board of Supervisors	Worth County
Scott	Heagel	Councilperson	City Council	City of Manly
Joel	Rohne	IT/GIS	Worth County	Worth County
Kyle	Karsjen	Planner	N/A	Amec Foster Wheeler

Kyle Karsjen, with Amec Foster Wheeler, the firm contracted to assist in the development of the Worth County multi-jurisdictional hazard mitigation plan update, facilitated the meeting.

Note: The PowerPoint presentation utilized during the meeting is available, along with other planning materials at the following location:
https://drive.google.com/open?id=1Yy74ISCjVpS6zQhxcLjz8W7nrKAT-JNI

Review Purpose/Participation Status

Kyle provided a brief recap of the purpose of the Hazard Mitigation Plan and the Disaster Mitigation Act of 2000 that codified the requirement of local governments to adopt a hazard mitigation plan to maintain eligibility for FEMA Hazard Mitigation Assistance Grants. The nine-task planning process was summarized and participants were informed that at the conclusion of the meeting, the planning committee will have completed at least portions of Tasks 1-6.

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A review of the requirements for jurisdictions to officially participate in the Multi-jurisdictional Hazard Mitigation Plan was provided. Kyle presented a summary of participation requirements met by each jurisdiction. Communities are asked to return info as soon as possible. Kyle will follow up with participation requirements and needs separately.

Public Survey Results

Kyle presented a summary of the public survey results; 109 surveys were completed.

Survey responses showed that of the hazards evaluated, the top three in terms of probability of occurrence were Thunderstorm/Lightning/Hail, Severe Winter Storm and Tornado/ Windstorm. The top three hazards in terms of potential magnitude were Tornado/Windstorm, Severe Winter Storm, and Thunderstorm/Lightning/Hail.

Mitigation Strategy

Kyle reviewed the following information related to update of the mitigation strategy:

- Plan Goals
- Previous Actions from Previous Plan
- Key Issues from Risk Assessment (identified hazards)
- FEMA's Mitigation Ideas booklet
- State Priorities for Hazard Mitigation Assistance Grants
- Public Opinion from Surveys

Goals

To facilitate discussion and ideas on new actions that jurisdictions may want to submit to the plan update, Kyle reminded the planning of the plan goals that were updated at meeting #1.

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

Previous Actions

The group reviewed mitigation actions present in the previous Worth County Mitigation Plan. Kyle discussed status updates for previous actions. Previous actions that are considered "continue in-progress" or "continue not started" will be included as mitigation actions in the new plan.

The group walked through the mitigation actions identified in the previous plan. Kyle developed a first draft of the county mitigation strategy based on this discussion, which will be shared with the HMPC members. Specific comments for each mitigation action in the updated mitigation action strategy are as follows:

Action 1: Emergency management plans – group consensus was to delete, as this wasn't a mitigation action.

Action 2: Public education and hazard awareness – continue in progress. Needed information – We had some comments about teaching severe weather awareness in schools and publishing information in newspapers. However, what specifically are you going to share? How are you going to do it? Let's make this more specific for each community.

Action 3: Continuity of Operations planning – started at county level, no progress at city level. Kyle's recommendation is to delete, as this is in that gray area of whether something is mitigation or not.

Action 4: Maintain water supply – Continue in progress. Most communities had only done preventive maintenance. For the next plan, let's try to get some more specificity per community. Exactly what projects are you planning to do, and how will they help with hazard mitigation in particular?

Action 5: Safe rooms – either continue in progress or continue not started, based on community. For the next plan, let's try to be more specific. Where do you want to put the safe room in your community? For the school districts – usually schools will put in a safe room project. Do you want to do so? And if so, will they be built for all communities?

Action 6: Flood prone properties – continue not started. What properties do the communities want to acquire or elevate? If you want to build dams, where will they go? Do the communities that have no flood risk and aren't part of the NFIP want to include this action?

Action 7: Purchase/install backup generators – deleted as it was too vague. For Worth County and Fertile, new mitigation actions were added that were more specific to the specific facilities you had mentioned during our meeting. Kyle also added a mitigation action for every community regarding having the proper hookups to ensure a generator can be attached to critical infrastructure. For the new mitigation actions, can each community provide any more specificity as to where the generators would go (if they can indeed be supported) and what facilities they would power?

Action 8: Heating/cooling shelters – deleted due to completion of the action mitigation.

Action 9: Security measures at critical facilities – deleted due to vague description. Are there specific security measures each community is looking to implement for specific critical facilities? Security measures for the county's communications system were discussed; added an action related to this (Action 13).

Action 10: FIRM maps – completed; also added in NFIP strategies for the County, Fertile, Hanlontown, Manly and Northwood (actions 19 -23). For communities that aren't part of the NFIP but are mapped, do you want to add in strategies to join the NFIP?

Action 11: Land use and ordinances – deleted per group consensus; no appetite for additional zoning and land use planning in the county.

Action 12: Natural resource measures to prevent damage to critical facility functions – deleted; if we include this per community, what measures are we taking? What infrastructure are we protecting?

Actions 13-24: Added per group discussion. Please review any that pertain to your community and either validate or provide feedback.

Key Issues

Key issues/problem statements for selected hazards in the risk assessment were discussed, and a handout was provided. The discussion was geared toward identifying any gaps that may exist between the problems identified and actions already developed to address the problems. The planning committee was encouraged to develop new actions to fill any gaps. Planning committee members will work with others in their jurisdiction to determine any additional new mitigation actions that are necessary for the hazards in the plan.

FEMA Requirements - Actions

Kyle reminded the group of FEMA's requirements for mitigation actions in the new mitigation plan:

- Each jurisdiction must have AT LEAST ONE new or continuing mitigation action
- There must be AT LEAST ONE new or continuing mitigation action for each hazard identified in the plan

FEMA Mitigation Ideas Booklet

A link to FEMA's Mitigation Ideas Booklet at http://www.fema.gov/hazard-mitigation-planning-resources was provided to the HMPC; the document can be accessed directly at https://www.fema.gov/media-library-data/20130726-1904-25045-0186/fema_mitigation_ideas_final508.pdf. The PDF document of this Mitigation Ideas Booklet was shown to the planning committee and action ideas were reviewed for several of the hazards. Jurisdictions were encouraged to review this document with others in their jurisdiction to determine final mitigation actions to submit to the plan update.

State Priorities

Kyle also discussed the priorities set by the Iowa Homeland Security and Emergency Management Division for use of Hazard Mitigation Assistance Grants, as well as the results of the public survey related to mitigation actions that the public considers important and effective. Per Iowa Homeland Security and Emergency Management, the two biggest current state priorities are property acquisition and structure demolition and relocation, though shovel-ready projects are also a priority.

Public Opinion

The survey results for the question asking the public about the mitigation actions that they felt should be considered resulted in the following percent of public support for each action type presented:

Answer Choices	Responses
Flood-prone Property Acquisition & Structure Demolition/Relocation	26.73%
Flood-prone Structure Elevation	20.79%
Floodproofing of Historical and/or Non-residential Structures	22.77%
Minor Localized Flood Reduction Projects (stormwater management or other localized flood control projects)	50.50%
Structural Retrofitting of Existing Buildings to Add a Tornado Saferoom	63.37%
Retrofitting of Existing Buildings and Facilities to Prevent Wind Damage	42.57%
New Tornado Safe Room Construction	65.35%
Electrical Utilities Infrastructure Retrofit (i.e. strengthening lines/connections to withstand ice/wind damages, burying power lines)	73.27%
Soil Erosion Stabilization	28.71%
Wildfire Mitigation	14.85%

Action Plans

Kyle discussed the excel spreadsheet that has been created capturing each jurisdiction's previous actions and the updated status. The spreadsheet has been emailed to the planning committee members and is uploaded to the Google Drive account with these minutes. The spreadsheet reflects all updates from the action plan discussion at the meeting, as well as any new additional mitigation actions discussed during the meeting. The spreadsheet can be sorted by community; if you need any assistance or the information in a different format, please let Kyle know.

Jurisdictions must provide a completed Action Plan Worksheet for all continuing and all new actions; jurisdictions can also just fill this data in on the spreadsheet instead if they choose.

Communities participating in the National Flood Insurance Program were informed that they must have at least one action addressing continued compliance with the National Flood Insurance Program; these actions have been added to the updated action list. NFIP jurisdictions are:

- Unincorporated Worth County
- Fertile
- Hanlontown
- Manly
- Northwood

The due date for completion and return of Action Plan worksheets for ALL continuing and All new actions is Monday, April 30, 2018.

In discussing the action plans, the concept of cost-effectiveness of actions was discussed. For planning purposes, benefits will be recorded for each action in qualitative terms. For example, an action to construct a community safe room will provide life-safety benefits. Kyle explained that for actions that will be submitted as Hazard Mitigation Assistance grant applications, a quantitative benefit-cost analysis must be completed to demonstrate that the benefits that will be

realized after implementation outweigh the cost of completing the project. FEMA has benefit-cost analysis modules available for this purpose.

Hazard Mitigation Assistance Grants

The Hazard Mitigation Plan is a requirement for jurisdictions to be eligible to apply for FEMA's Hazard Mitigation Assistance Grants. Jurisdictions were informed that Iowa's Homeland Security and Emergency Management Department is the State agency responsible for administration of these grants. Kyle also presented a list of agencies and grant programs of other state and federal grants that fund mitigation activities.

Plan Implementation

The communities discussed how the previous plan had been implemented in conjunction with previous planning efforts over the last five years, and how the new plan will be implemented in conjunction with planning efforts through 2023. Attendees at the meeting filled out Integration in Existing Planning Mechanisms questionnaires for their communities; communities that did not attend the meeting will need to return this questionnaire as part of their required documentation.

Plan Maintenance

Kyle discussed the requirements for the plan to provide a formal plan maintenance process to ensure that the mitigation plan remains an active and relevant document. After discussion, the following plan maintenance process is proposed:

- The HMPC will meet annually to review the Hazard Mitigation Plan;
- The Worth County Emergency Management Coordinator will organize the meetings;
- After the annual review, the Emergency Management Coordinator will forward the updated Mitigation Strategy with status updates to mayors, city clerks, and school superintendents for consideration in other planning mechanisms/discussions;
- The Worth County Emergency Management Coordinator will coordinate the formal plan update/re-submittal to IA HSEMD and FEMA every 5 years;
- The public will be involved in the plan maintenance process by publication of a Press Release indicating the team has met with a summary of mitigation action status updates and highlights of specific completed mitigation actions, as applicable.

Next Steps

The meeting concluded with a discussion of the remaining steps to complete the planning process as follows:

- **ASAP – Data Collection Guides/Action Statuses**
- 4/30/2018—Project Worksheets for all new and all continuing actions due
- June 2018 —Final draft for committee review
- August 2018 - Final public comment period/State review
- October 2018—Submit Plan to FEMA
- November 2018—Anticipate FEMA's Approval Pending Adoption (preliminary approval)
- December 2018—Jurisdictions adopt plan

WORTH COUNTY MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN UPDATE
MEETING #3—SIGN-IN SHEET

Project:	Worth County, Iowa Multi-jurisdictional Hazard Mitigation Plan Update	**Meeting Date/Time:**	March 28, 2018 5:30-7:30 pm
Facilitator:	Kyle Karsjen, Amec Foster Wheeler	**Place/Room:**	Worth County Emergency Management 99N 9th Street, Northwood IA

Name	Title	Department/Agency	Email	Phone #	Signature
Ray Hufstader	EM A Coordinat	Worth Co	ema@worthcounty.org		Ray Hufstader
Randy Hulshizer	City Councilman	Grafton	shizers@wcTATel.net	641-748-2149	Randy Hulshizer
Rick Scholbrock	Mayor Hanlontown	Hanlontown	scholbrock@wcTatel.net	641-825-641	
Merlin Bartz	Worth county Supervisor	Worth Co	merlin.bartz@worthcounty.org	641-903-9578	
Kris Kenison	WC Newspapers →		kris@northwood.anchor.net	641-324-1051	
Keith Fritz	Principal	Northwood-Kensett	kfritz@nkvikings.com	641-324-2442 ext. 101	
Joyce C. Russell	MAYOR	City of Fertile	gjr@wcTatel.net	641-590-1715	Joyce C. Russell
Dan Funk	Sheriff	Worth County S.O.	dfunk@Worthcounty.org	641-324-2481	
Corey Pulju	Mayor	City of Kensett	coreypulju@gmail.com	507-581-0280	
Jacki Backhaus	Worth County Auditor	Worth County	auditor@worthcounty.org	641-324-2316	Jacki A. Backhaus

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WORTH COUNTY MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN UPDATE
MEETING #3—SIGN-IN SHEET

Project:	Worth County, Iowa Multi-jurisdictional Hazard Mitigation Plan Update	**Meeting Date/Time:**	March 28, 2018 5:30-7:30 pm
Facilitator:	Kyle Karsjen, Amec Foster Wheeler	**Place/Room:**	Worth County Emergency Management 99N 9th Street, Northwood IA

Name	Title	Department/Agency	Email	Phone #	Signature
Mark Smeby	county Supervisor		marksmeby@worthcounty.org	641-590-6609	Mark Smeby
Doug Mahle	mayor	city of Northwood	mayor@northwoodia.org	641-324-9992	Doug Mahle
Ken ABRAMS	Supervisor	Worth Co	Ken.Abrams@northwood.org	6413901224	Ken Abrams
Scott Heagel	City Council	City of Manly	heagele centurylink.net	641-583-2142	Scott Heagel
Joel Rohne	IT/GIS	worth county	joel.rohne@northwood.org	641-324-3668	Joel Rohne

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B.9 Public Notice During Drafting Stage

B.10 Plan Summary/Questionnaire for Public Comment during Drafting Stage

Online Survey was available at SurveyMonkey.com and hard copies were available at post office locations throughout the County.

Public Survey: Worth County Multi-jurisdictional Hazard Mitigation Plan

The federal government requires all states and local governments to have hazard mitigation plans approved by FEMA that are consistent with the Disaster Mitigation Act of 2000. This is required to maintain eligibility for certain types of federal Hazard Mitigation Assistance Grants. Mitigation planning is the process of identifying hazards to which jurisdictions are at risk as well as development of actions that will reduce or prevent damages from those hazards.

A planning committee comprised of representatives from Worth County, the incorporated cities, public school districts, and other stakeholders including private businesses, private non-profits, and others is currently developing an update to the comprehensive Worth County Multi-Jurisdictional Hazard Mitigation Plan with a strategy to reduce the vulnerability of people and property in the planning area to the impacts of hazards and to remain eligible for mitigation funding programs from FEMA.

One of the key components of a hazard mitigation plan is public input during the planning process. The planning committee will be evaluating information on the hazards that impact each jurisdiction within Worth County. The committee is seeking your input on the hazards that will be evaluated as well as your opinions on the types of activities that should be considered to reduce future impacts. Your comments will be considered by your community's representatives on the planning committee as the plan is developed. Please take a few moments to answer the following questions. Thank you for your participation.

1. Please select your jurisdiction from the list. You may only select one jurisdiction for each survey completed. If you belong to more than one jurisdiction in this list, please complete multiple surveys.

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

2. The hazards addressed in the Multi-Jurisdictional Hazard Mitigation Plan Update are listed below. Please indicate your opinion on the likelihood for each hazard to impact YOUR JURISDICTION (identified above).
Please rate EACH hazard 1 through 4 as follows:
1=Unlikely, 2=Occasional, 3=Likely, 4=Highly Likely

- ☐ Animal/Plant/Crop Disease
- ☐ Dam/Levee Failure
- ☐ Drought
- ☐ Earthquake
- ☐ Expansive Soils
- ☐ Extreme Heat
- ☐ Flash Flood
- ☐ Grass or Wildland Fire
- ☐ Hazardous Materials Incident
- ☐ Human Disease
- ☐ Infrastructure Failure
- ☐ Landslide
- ☐ Radiological Incident
- ☐ River Flooding
- ☐ Severe Winter Storm
- ☐ Sinkholes
- ☐ Terrorism
- ☐ Thunderstorm/Lightning/Hail
- ☐ Tornado/Windstorm
- ☐ Transportation Incident

Optional Online Survey: https://www.surveymonkey.com/r/Worth-CO-IA

Public Survey: Worth County
Multi-jurisdictional Hazard Mitigation Plan

3. Please indicate your opinion on the potential magnitude of each hazard's impact on YOUR JURISDICTION (identified above). **Please rate EACH hazard 1 through 4 as follows:**
1=Negligible, 2=Limited, 3=Critical, 4=Catastrophic

- ☐ Animal/Plant/Crop Disease
- ☐ Dam/Levee Failure
- ☐ Drought
- ☐ Earthquake
- ☐ Expansive Soils
- ☐ Extreme Heat
- ☐ Flash Flood
- ☐ Grass or Wildland Fire
- ☐ Hazardous Materials Incident
- ☐ Human Disease
- ☐ Infrastructure Failure
- ☐ Landslide
- ☐ Radiological Incident
- ☐ River Flooding
- ☐ Severe Winter Storm
- ☐ Sinkholes
- ☐ Terrorism
- ☐ Thunderstorm/Lightning/Hail
- ☐ Tornado/Windstorm
- ☐ Transportation Incident

4. FEMA Hazard Mitigation Assistance Grants can fund projects identified in the Hazard Mitigation Plan. These grants are administered by the Iowa Homeland Security & Emergency Management Department. Listed below are some types of projects considered.
Please check all those that could benefit your jurisdiction, in your opinion:

- ☐ Flood-prone Property Acquisition & Structure Demolition /Relocation
- ☐ Flood-Prone Structure Elevation
- ☐ Dry Floodproofing of Historical Residential Structures and/or Non-residential Structures
- ☐ Minor Localized Flood Reduction Projects (storm water management or localized flood control projects)
- ☐ Structural Retrofitting of Existing Buildings to Add a Tornado Safe Room
- ☐ Non-structural Retrofitting of Existing Buildings, and Facilities from Wind Damage.
- ☐ New Tornado Safe Room Construction
- ☐ Electrical Utilities Infrastructure Retrofit
- ☐ Soil Erosion Stabilization
- ☐ Wildfire Mitigation
- ☐ Other (please specify)

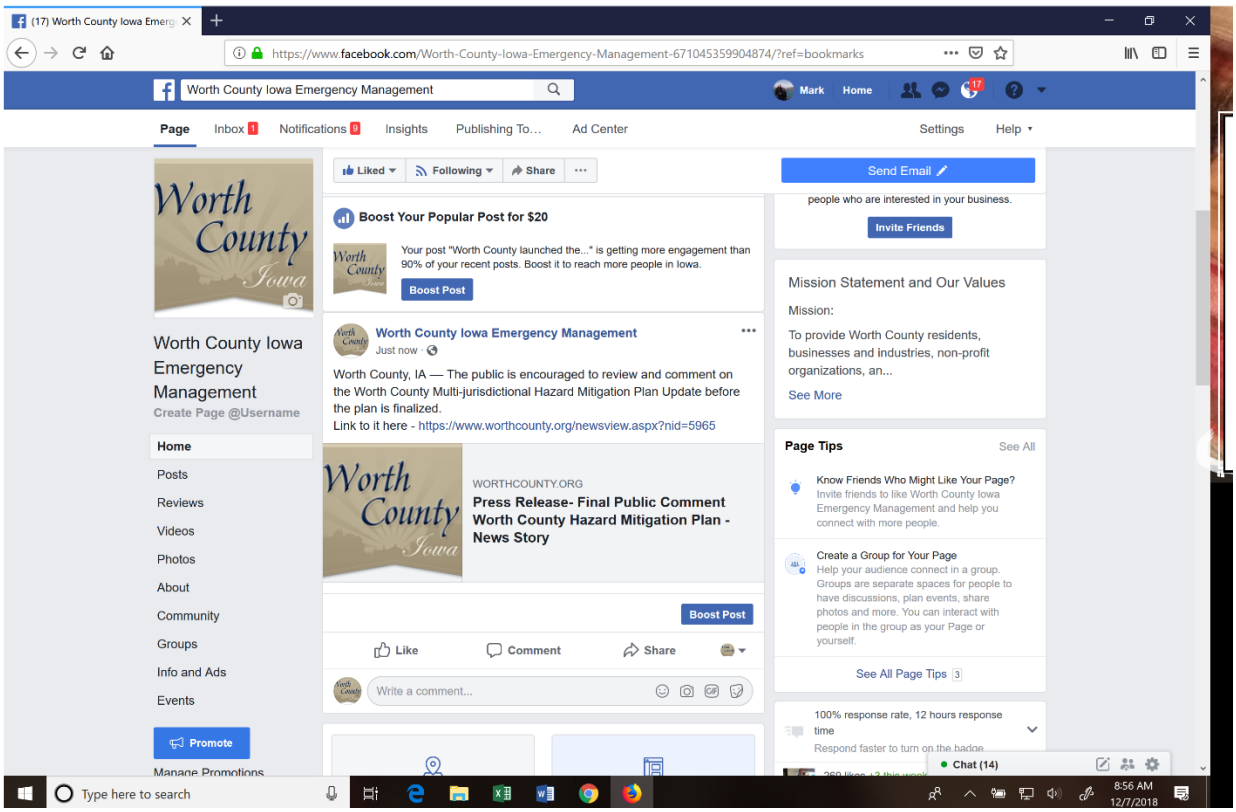
_____

5. Please comment on any other issues that the Worth County Hazard Mitigation Planning Committee should consider in developing a strategy to reduce future losses caused by hazard events.

Return / Contact Information: Ray Huftalin, Coordinator, Worth County Emergency Mgmt.
ema@worthcounty.org, 641-732-5872, 211 S. 6th St., Osage, IA 50461

Optional Online Survey: https://www.surveymonkey.com/r/Worth-CO-IA

B.11 Announcement for Final Public Comment Period



From: Tomlinson, Mark <ema@worthcounty.org>

Sent: Monday, December 17, 2018 6:13 AM

To: Karsjen, Kyle

Subject: HMP public input in newspaper

Attachments: 20181217_064656.jpg

Kyle

Here is a photo of the 1st part of the article the paper ran in the Northwood Anchor in regards to the public input. The Manly Signal one would be the exact same article since it's the same publisher. It tucked right in with all the other juicy news of the wekk for sure. Happy Holidays!

Mark Tomlinson

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Northwood IA 50459

641-324-1535

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Briefs

Santa visits Northwood tomorrow

With Christmas just under two weeks away, Santa Claus has a busy schedule ahead of him. That includes taking some time to meet with some of the children on his list in Northwood.

Santa will be at Santa's Village in Central Park tomorrow, Thursday, December 13, and on Thursday, December 20, from 5-6 p.m.

Santa, see Page 2

Free holiday movies continue

The Northwood Theatre, thanks to local business sponsors, is offering several free holiday movie matinees as Christmas approaches.

The next movie, "Jack Frost," will be shown this Saturday, December 15, at 1:30 p.m. Following that are "Home Alone" on Wednesday, December 19, at 1:55 p.m.; and "Elf" on Saturday, December 22, at 1:30 p.m.

For more information on the free holiday matinees, visit northwoodtheatre.com.

Conversing with Kris Kringle

Despite his busy schedule, Santa has visited Northwood several times recently. That includes his time spent at the Cookies with Santa event hosted by Chapter ES P.E.O. of Northwood on December 1, pictured above. A number of children discussed their wishlists and verified that they belong on Santa's nice list before getting their pictures taken. Santa will be at Santa's Village in Northwood's Central Park several more times before his big delivery day. See more pictures of Christmas events in Northwood on page 6B.

Public weighs in before county renewable energy ordinance adopted

A public hearing was held on December 3, where the Worth County supervisors heard comments regarding an ordinance that would provide qualifying renewable energy projects with exemptions from zoning regulations.

The ordinance, written, researched and introduced by supervisor Merlin Bartz, whose term in office ends in 2018, would exempt any renewable energy developments, including solar and wind projects, from zoning regulation, if the taxes to be collected on those projects are being used as financing for county projects.

County projects in the works that may be financed with renewable energy taxes, include courthouse repairs or replacement, a natural gas pipeline and development of water/sewer and road infrastructure at the Highway 105/Interstate 35 interchange to support development near the casino.

The ordinance would apply to renewable energy projects in the townships that aren't already zoned. Zoned townships include those that Interstate 35 passes through.

Before action was to be taken on the ordinance at the December 3 supervisors meeting, a public hearing was held, offering a chance for the supervisors to receive comments on the ordinance.

First to speak was Teresa Nicholson, with Worthwhile Wind and Solar Farm. Nicholson noted the company's support of alternative energy development. She noted the economic benefits that renewable energy projects have provided in the county, including tax income, money spent in the county and jobs, in addition to the use and developments at the Manly Terminal.

Hannah Pawelczyk, with Invenergy, discussed that company's plans, including 58 wind turbines in the northeast corner of the county, a second wind development being considered to the south and a solar energy project also in the works. She said that the company would be pursuing further studies to minimize the environmental impact of the project. She also noted that dozens of Worth County landowners had signed on for the projects.

Besides representatives of compani

Ordinance, see Page

N-K accepts resignation of FACS teacher arrested on drug charges

At a special meeting held on December 3, the Northwood-Kensett Board of Education approved the resignation of a teacher that had been placed on leave after she was taken into custody on drug-related charges.

Now-former N-K family and consumer sciences (FACS) teacher Sara Fenske was taken into custody in November after a search warrant was conducted where she was living in Northwood.

As a result of the search, Fenske was arrested on charges related to the possession of marijuana, methamphetamine and drug paraphernalia.

Following the incident, Fenske had been placed on administrative leave, awaiting further investigation into the incident.

At a brief meeting of

N-K, see Page 2

Worth Co. Historical Society meets

The Worth County Historical Society will gather at the Worth Brewing Company in Northwood at noon on Tuesday, December 18, for a meeting and a Christmas potluck.

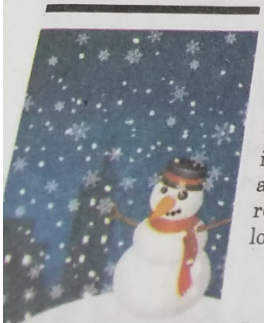
Rural Kensett man found deceased

A rural Kensett man who had been reported missing by his wife was found deceased about a quarter of a mile from his home on December 4, according to the Worth County Sheriff's Department.

Francis Soukup, 77, of rural Kensett, was reported missing by his wife, Gloria, that morning at approximately a.m., and was about an hour l

Assisting Worth County iff's Departm the Iowa S trol, Kensett teer Fire De Northwood Fire Depa partment Resource County Manage

Public input requested on Worth County Hazard Mitigation Plan



The public is encouraged to review and comment on the Worth County Multi-jurisdictional Hazard Mitigation Plan Update before the plan is finalized. The plan includes an updated strategy to reduce damage and losses caused by hazard events. The final draft of the plan will be available online and in hard-copy from December 10 to December 21. The purpose is to provide information to the public on the Multi-jurisdictional Hazard Mitigation Plan Update as well as gain public input.

Taxpayers pay billions of dollars each year for disaster recovery. Some events are predictable, and often, damages can be reduced or eliminated. The Federal Disaster Mitigation Act of 2000

Public, see Page 3

Worth Count clinic set fo

Each year, Worth fea County Extension pres- Co ents a day that offers I area farmers and agri- culture professionals with information and resources about a variety of topics. The day

Inconsistency is the theme of 2018 crop season

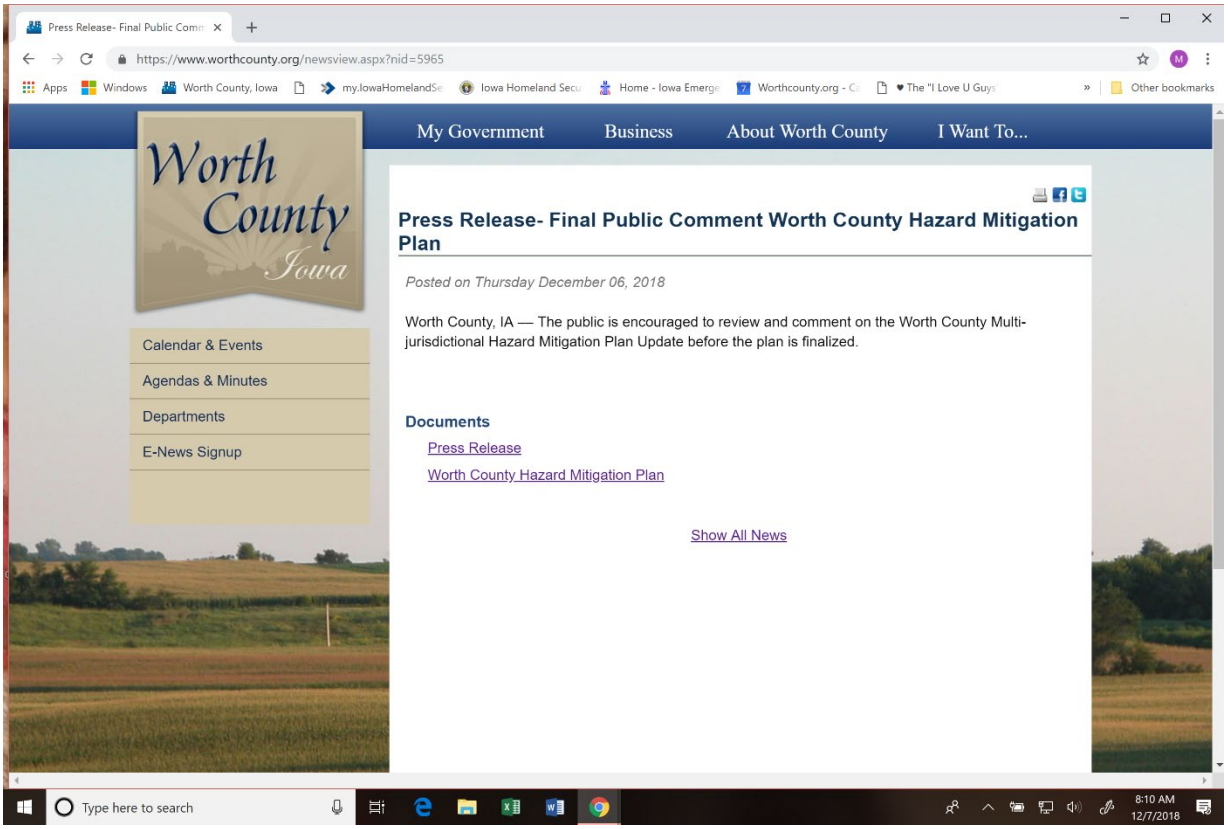

Press Release- Final Public Comm
https://www.worthcounty.org/newsview.aspx?nid=5965
Apps
Windows
Worth County, Iowa
Other bookmarks
Worth County Iowa
My Government
Business
About Worth County
I Want To...
Calendar & Events
Agendas & Minutes
Departments
E-News Signup
Press Release- Final Public Comment Worth County Hazard Mitigation Plan
Posted on Thursday December 06, 2018
Worth County, IA — The public is encouraged to review and comment on the Worth County Multi-jurisdictional Hazard Mitigation Plan Update before the plan is finalized.
Documents
Press Release
Worth County Hazard Mitigation Plan
Show All News
Type here to search
8:10 AM
12/7/2018

Table C.1 provides the disposition of actions from the previous Worth County Hazard Mitigation Plan that the jurisdictions did not continue forward in the mitigation strategy of this plan update. This includes actions with the following statuses:

- Completed
- Delete

Action ID	Action Title	2018 Action Status	2018 Action Status Comment
Fertile-1	Develop/update/publicize emergency management plans, including preparedness, response, recover, operations, long term recovery, and mitigation plans and maintain data inventory	Delete	Items made available through County Emergency Management Agency; booth at County Fair; information posted to County and community websites
Fertile-7	Purchase/install backup power generators	Delete	No progress reported; DELETE and replace with Actions 14, 15, 16
Fertile-8	Heating/Cooling centers/shelters	Complete	Each community has designated shelters for housing, heating and cooling
Fertile-9	Install and maintain security measures at all critical facilities and training of emergency response personnel	Delete	County and communities have done various improvements to critical infrastructure; replaced with Action 13
Fertile-10	Complete FIRM (Flood Insurance Rate Maps) and encourage NFIP community and individual participation, and survey of flood prone areas, and river channel studies, and update of existing flood maps.	Complete	All maps updated for the county and communities; Fertile has stayed in good standing with NFIP; replaced with Action 19
Fertile-11	Develop and promote comprehensive, cost-effective, common sense recommendations for adoption and enforcement of land use, ordinances, and regulations, zoning, and building codes that decrease risk in areas susceptible to hazards	Delete	NFIP communities have implemented program measures to guide development; County has zoning in 3 center townships; Fertile has restricted residential/commercial; no appetite in county for further zoning
Fertile-12	Natural resource measures to prevent the damage to critical facility functions.	Delete	County added a mitigation pond at DD21 West; county and communities have done projects for drainage, wetlands mitigation, flood control
Grafton-1	Develop/update/publicize emergency management plans, including preparedness, response, recover, operations, long term recovery, and mitigation plans and maintain data inventory	Delete	Items made available through County Emergency Management Agency; booth at County Fair; information posted to County and community websites
Grafton-7	Purchase/install backup power generators	Delete	No progress reported
Grafton-8	Heating/Cooling centers/shelters	Complete	Each community has designated shelters for housing, heating and cooling
Grafton-10	Complete FIRM (Flood Insurance Rate Maps) and encourage NFIP community and individual participation, and survey of flood prone areas, and river channel studies, and update of existing flood maps.	Complete	All maps updated for the county and communities; NFIP communities have stayed in good standing with NFIP
Grafton-11	Develop and promote comprehensive, cost-effective, common sense recommendations for adoption and enforcement of land use, ordinances, and regulations, zoning, and building codes that decrease risk in areas susceptible to hazards	Delete	NFIP communities have implemented program measures to guide development; County has zoning in 3 center townships; Fertile has restricted residential/commercial; no appetite in county for further zoning

Action ID	Action Title	2018 Action Status	2018 Action Status Comment
Hanlontown-1	Develop/update/publicize emergency management plans, including preparedness, response, recover, operations, long term recovery, and mitigation plans and maintain data inventory	Delete	Items made available through County Emergency Management Agency; booth at County Fair; information posted to County and community websites
Hanlontown-6	Acquire flood prone properties for conversion into green space; or elevate structures in or above base flood elevation; construction of levees, dams, and culverts to ensure adequate capacity and protection levels for property and critical facilities	Delete	No progress reported
Hanlontown-7	Purchase/install backup power generators	Delete	No progress reported
Hanlontown-8	Heating/Cooling centers/shelters	Complete	Each community has designated shelters for housing, heating and cooling
Hanlontown-9	Install and maintain security measures at all critical facilities and training of emergency response personnel	Delete	County and communities have done various improvements to critical infrastructure; replaced with Action 13
Hanlontown-10	Complete FIRM (Flood Insurance Rate Maps) and encourage NFIP community and individual participation, and survey of flood prone areas, and river channel studies, and update of existing flood maps.	Complete	All maps updated for the county and communities; Hanlontown has stayed in good standing with NFIP; replaced with Action 20
Hanlontown-11	Develop and promote comprehensive, cost-effective, common sense recommendations for adoption and enforcement of land use, ordinances, and regulations, zoning, and building codes that decrease risk in areas susceptible to hazards	Delete	NFIP communities have implemented program measures to guide development; County has zoning in 3 center townships; Fertile has restricted residential/commercial; no appetite in county for further zoning
Hanlontown-12	Natural resource measures to prevent the damage to critical facility functions.	Delete	County added a mitigation pond at DD21 West; county and communities have done projects for drainage, wetlands mitigation, flood control
Joice-1	Develop/update/publicize emergency management plans, including preparedness, response, recover, operations, long term recovery, and mitigation plans and maintain data inventory	Delete	Items made available through County Emergency Management Agency; booth at County Fair; information posted to County and community websites
Joice-2	Public education and awareness of all hazards	Delete	Severe weather awareness in schools; information published in newspaper; siren testing and info
Joice-5	Construction or retrofit existing structures into public safe rooms at government facilities, recreational facilities, recreational areas, manufactured home parks, schools, day care centers, and other critical facilities	Complete	County Extension building basement functioning as safe room, though not certified as such; fire hall and community meeting room have generator accessible and serve as shelters/safe rooms; no manufactured home parks in the City
Joice-6	Acquire flood prone properties for conversion into green space; or elevate structures in or above base flood elevation; construction of levees, dams, and culverts to ensure adequate capacity and protection levels for property and critical facilities	Delete	No progress reported
Joice-7	Purchase/install backup power generators	Delete	No progress reported
Joice-8	Heating/Cooling centers/shelters	Complete	Each community has designated shelters for housing, heating and cooling
Joice-9	Install and maintain security measures at all critical facilities and training of emergency response personnel	Delete	County and communities have done various improvements to critical infrastructure; replaced with Action 13

Action ID	Action Title	2018 Action Status	2018 Action Status Comment
Joice-10	Complete FIRM (Flood Insurance Rate Maps) and encourage NFIP community and individual participation, and survey of flood prone areas, and river channel studies, and update of existing flood maps.	Complete	All maps updated for the county and communities; NFIP communities have stayed in good standing with NFIP
Joice-11	Develop and promote comprehensive, cost-effective, common sense recommendations for adoption and enforcement of land use, ordinances, and regulations, zoning, and building codes that decrease risk in areas susceptible to hazards	Delete	NFIP communities have implemented program measures to guide development; County has zoning in 3 center townships; Fertile has restricted residential/commercial; no appetite in county for further zoning
Joice-12	Natural resource measures to prevent the damage to critical facility functions.	Delete	County added a mitigation pond at DD21 West; county and communities have done projects for drainage, wetlands mitigation, flood control
Kensett-1	Develop/update/publicize emergency management plans, including preparedness, response, recover, operations, long term recovery, and mitigation plans and maintain data inventory	Delete	Items made available through County Emergency Management Agency; booth at County Fair; information posted to County and community websites
Kensett-7	Purchase/install backup power generators	Delete	Kensett purchased generator to run well in 2018
Kensett-8	Heating/Cooling centers/shelters	Complete	Each community has designated shelters for housing, heating and cooling
Kensett-10	Complete FIRM (Flood Insurance Rate Maps) and encourage NFIP community and individual participation, and survey of flood prone areas, and river channel studies, and update of existing flood maps.	Complete	All maps updated for the county and communities; NFIP communities have stayed in good standing with NFIP
Kensett-11	Develop and promote comprehensive, cost-effective, common sense recommendations for adoption and enforcement of land use, ordinances, and regulations, zoning, and building codes that decrease risk in areas susceptible to hazards	Delete	NFIP communities have implemented program measures to guide development; County has zoning in 3 center townships; Fertile has restricted residential/commercial; no appetite in county for further zoning
Manly-1	Develop/update/publicize emergency management plans, including preparedness, response, recover, operations, long term recovery, and mitigation plans and maintain data inventory	Delete	Items made available through County Emergency Management Agency; booth at County Fair; information posted to County and community websites
Manly-6	Acquire flood prone properties for conversion into green space; or elevate structures in or above base flood elevation; construction of levees, dams, and culverts to ensure adequate capacity and protection levels for property and critical facilities	Delete	No progress reported
Manly-7	Purchase/install backup power generators	Delete	No progress reported
Manly-8	Heating/Cooling centers/shelters	Complete	Each community has designated shelters for housing, heating and cooling
Manly-9	Install and maintain security measures at all critical facilities and training of emergency response personnel	Delete	County and communities have done various improvements to critical infrastructure; replaced with Action 13
Manly-10	Complete FIRM (Flood Insurance Rate Maps) and encourage NFIP community and individual participation, and survey of flood prone areas, and river channel studies, and update of existing flood maps.	Complete	All maps updated for the county and communities; Manly has stayed in good standing with NFIP; replaced with Action 21

Action ID	Action Title	2018 Action Status	2018 Action Status Comment
Manly-11	Develop and promote comprehensive, cost-effective, common sense recommendations for adoption and enforcement of land use, ordinances, and regulations, zoning, and building codes that decrease risk in areas susceptible to hazards	Delete	NFIP communities have implemented program measures to guide development; County has zoning in 3 center townships; Fertile has restricted residential/commercial; no appetite in county for further zoning
Manly-12	Natural resource measures to prevent the damage to critical facility functions.	Delete	County added a mitigation pond at DD21 West; county and communities have done projects for drainage, wetlands mitigation, flood control
Northwood-1	Develop/update/publicize emergency management plans, including preparedness, response, recover, operations, long term recovery, and mitigation plans and maintain data inventory	Delete	Items made available through County Emergency Management Agency; booth at County Fair; information posted to County and community websites
Northwood-3	Continuity of Operations Plan (COOP)	Complete	No progress reported
Northwood-7	Purchase/install backup power generators	Delete	No progress reported
Northwood-8	Heating/Cooling centers/shelters	Complete	Each community has designated shelters for housing, heating and cooling
Northwood-9	Install and maintain security measures at all critical facilities and training of emergency response personnel	Delete	County and communities have done various improvements to critical infrastructure; replaced with Action 13
Northwood-10	Complete FIRM (Flood Insurance Rate Maps) and encourage NFIP community and individual participation, and survey of flood prone areas, and river channel studies, and update of existing flood maps.	Complete	All maps updated for the county and communities; Northwood has stayed in good standing with NFIP; replaced with Action 22
Northwood-11	Develop and promote comprehensive, cost-effective, common sense recommendations for adoption and enforcement of land use, ordinances, and regulations, zoning, and building codes that decrease risk in areas susceptible to hazards	Delete	NFIP communities have implemented program measures to guide development; County has zoning in 3 center townships; Fertile has restricted residential/commercial; no appetite in county for further zoning
Northwood-12	Natural resource measures to prevent the damage to critical facility functions.	Delete	County added a mitigation pond at DD21 West; county and communities have done projects for drainage, wetlands mitigation, flood control
Unincorporated Worth County-1	Develop/update/publicize emergency management plans, including preparedness, response, recover, operations, long term recovery, and mitigation plans and maintain data inventory	Delete	Items made available through County Emergency Management Agency; booth at County Fair; information posted to County and community websites
Unincorporated Worth County-7	Purchase/install backup power generators	Delete	County added three at FAA site, county courthouse and Worth Emergency Management Agency
Unincorporated Worth County-8	Heating/Cooling centers/shelters	Complete	Each community has designated shelters for housing, heating and cooling
Unincorporated Worth County-9	Install and maintain security measures at all critical facilities and training of emergency response personnel	Delete	County and communities have done various improvements to critical infrastructure; replaced with Action 13
Unincorporated Worth County-10	Complete FIRM (Flood Insurance Rate Maps) and encourage NFIP community and individual participation, and survey of flood prone areas, and river channel studies, and update of existing flood maps.	Complete	All maps updated for the county and communities; Unincorporated Worth County has stayed in good standing with NFIP; replaced with Action 23

Action ID	Action Title	2018 Action Status	2018 Action Status Comment
Unincorporated Worth County-11	Develop and promote comprehensive, cost-effective, common sense recommendations for adoption and enforcement of land use, ordinances, and regulations, zoning, and building codes that decrease risk in areas susceptible to hazards	Delete	NFIP communities have implemented program measures to guide development; County has zoning in 3 center townships; Fertile has restricted residential/commercial; no appetite in county for further zoning
Unincorporated Worth County-12	Natural resource measures to prevent the damage to critical facility functions.	Delete	County added a mitigation pond at DD21 West; county and communities have done projects for drainage, wetlands mitigation, flood control

APPENDIX D: ADOPTION RESOLUTIONS

<Placeholder for resolutions after FEMA provides approval pending adoption letter>