Upper Loup
Natural Resources District

HAZARD MITIGATION PLAN

2019

PLAN PREPARED BY
JEO CONSULTING GROUP

HAZARD MITIGATION PLANNING TEAM

NAME	TITLE
Alma Beland	Director, Region 26 Emergency Management
Anna Baum	General Manager, Upper Loup Natural Resources District
Gary Eng	Thomas County Emergency Manager
Sean Carson	Logan County Emergency Manager
Wynn Wiens	Hooker County Emergency Manager
*Brooke Welsh	JEO Consulting Group
*Mary Baker	JEO Consulting Group
*Ellana Haakenstad	JEO Consulting Group

THIS PAGE IS INTENTIONALLY BLANK

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

ACS – American Community Survey
BCA – Benefit Cost Analysis
CFR – Code of Federal Regulations
CRS – Community Rating System
DFIRM – Digital Flood Insurance Rate Map
DHS – Department of Homeland Security
DMA 2000 – Disaster Mitigation Act of 2000
EAP – Emergency Action Plan
ELAP – Emergency Assistance for Livestock, Honeybees, and Farm-Raised Fish Program
EPA – Environmental Protection Agency
EPZ – Emergency Planning Zone
ESL – English as Second Language
FEMA – Federal Emergency Management Agency
FIRM – Flood Insurance Rate Map
FMA – Flood Mitigation Assistance Program
FR – FEMA's Final Rule
GIS – Geographic Information Systems
HMA – Hazard Mitigation Assistance
HMGP – Hazard Mitigation Grant Program
HMP – Hazard Mitigation Plan
HPRCC – High Plains Regional Climate Center
JEO – JEO Consulting Group, Inc.
LEOP – Local Emergency Operations Plan
LFD – Livestock Forage Disaster Assistance Program
LGA – Liquid Gallon
LIP – Livestock Indemnity Program
MHSW – Mobile Home Single Wide
MPH – miles per hour
NCEI – National Centers for Environmental Information
NDA – Nebraska Department of Agriculture
NDEE – Nebraska Department of Environmental and Energy
NDOT – Nebraska Department of Transportation
NDMC – National Drought Mitigation Center
NeDNR – Nebraska Department of Natural Resources
NEMA – Nebraska Emergency Management Agency
NFIP – National Flood Insurance Program
NFS – Nebraska Forest Service
NIST – National Institute of Standards and Technology
NOAA – National Oceanic and Atmospheric Administration
NPDP – National Performance of Dams Program
NRC – National Response Center
NRD – Natural Resources District
NWS – National Weather Service
PDM – Pre-Disaster Mitigation Program
PDSI – Palmer Drought Severity Index
PHMSA – U.S. Pipeline and Hazardous Material Safety Administration
P.L. – Public Law
PSHA – Probabilistic Seismic Hazard Analysis
RMA – Risk Management Agency
SBA – Small Business Administration
SFHA – Special Flood Hazard Area
SPEED – Social Political and Economic Event Database Project
SPIA – Sperry-Piltz Ice Accumulation Index
START – National Consortium for the Study of Terrorism and Responses to Terrorism
SURE – Supplemental Revenue Assistance Payments
TAP – Tree Assistance Program
TORRO – Tornado and Storm Research Organization
ULNRD – Upper Loup Natural Resources District
USDA – United States Department of Agriculture
USGS – United States Geological Survey
WUI – Wildland Urban Interface

EXECUTIVE SUMMARY

INTRODUCTION

This plan is an update to the Upper Loup Natural Resources District (ULNRD) Multi-Hazard Mitigation Plan (HMP) approved in 2015. The plan update was developed in compliance with the requirements of the Disaster Mitigation Act of 2000 (DMA 2000).

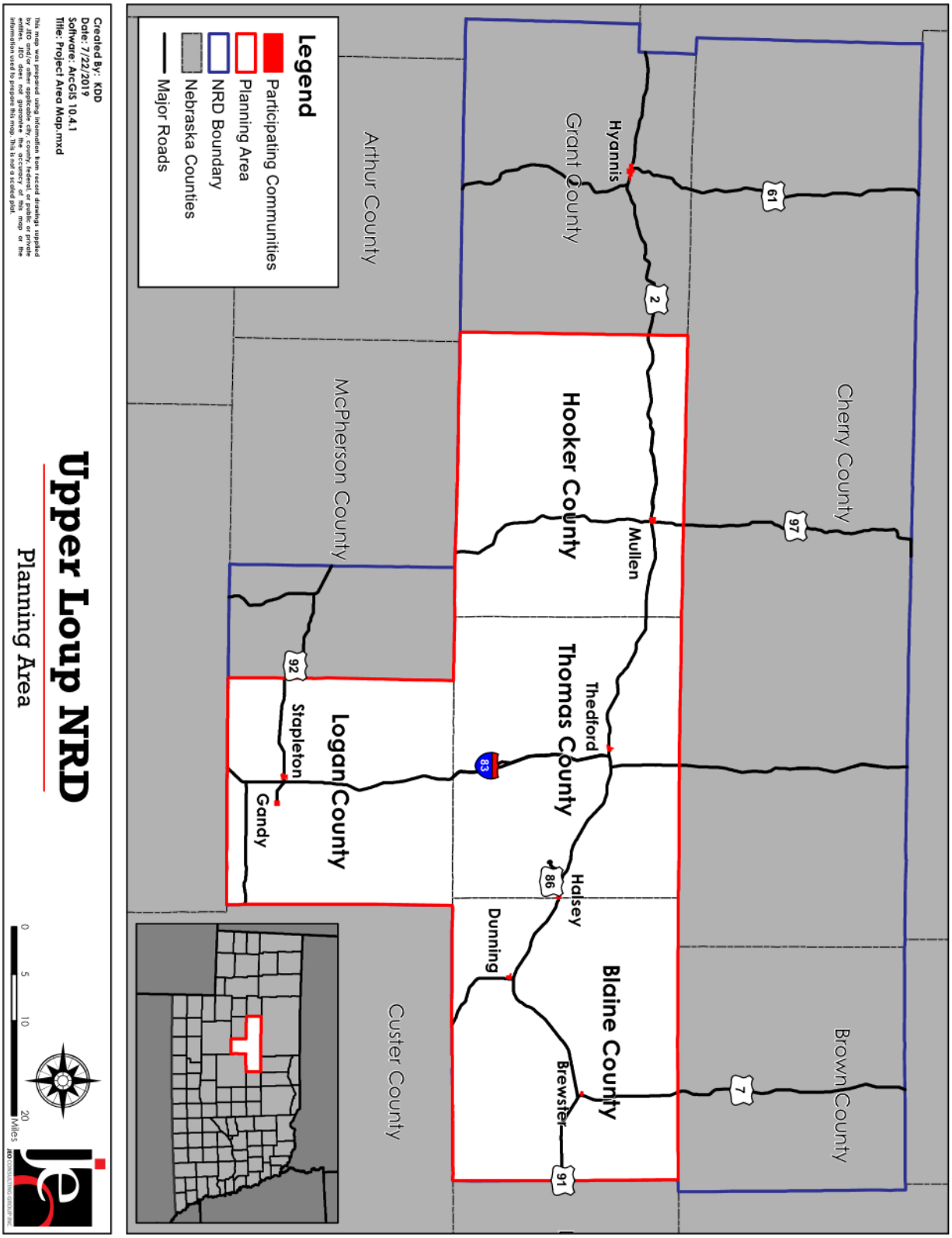
Hazard mitigation planning is a process in which hazards are identified and profiled; people and facilities at-risk are identified and assessed for threats and potential vulnerabilities; and strategies and mitigation measures are identified. Hazard mitigation planning increases the ability of communities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

Table 1: Participating Jurisdictions

Participating Jurisdictions	
Upper Loup Natural Resources District	
Blaine County	**Logan County**
Village of Brewster	Village of Gandy
Village of Dunning	Village of Stapleton
Hooker County	Sandhills Public Schools
Village of Mullen	**Thomas County**
Mullen Public Schools	Village of Halsey
Village of Hyannis*	Village of Thedford

*Hyannis is a village located in Grant County. Grant County did not participate in this plan update.

Figure 1: Map of Planning Area



GOALS AND OBJECTIVES

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

Goals from the 2015 HMP were reviewed, and the Planning Team agreed that they are still relevant and applicable for this plan update. Jurisdictions that participated in this plan update agreed that the goals identified in 2015 would be carried forward and utilized for the 2020 plan. The goals for this plan update are as follows:

GOAL 1: PROTECT HEALTH AND SAFETY OF RESIDENTS

Objective 1.1: Reduce or prevent damage to property or prevent loss of life or serious injury (overall intent of the plan).

GOAL 2: REDUCE FUTURE LOSSES FROM HAZARD EVENTS

Objective 2.1: Provide protection for existing structures, future development, critical facilities, services, utilities, and trees to the greatest extent possible.

Objective 2.2: Develop hazard specific plans, conduct studies or assessments, and retrofit jurisdiction to mitigate for hazards and minimize their impact.

Objective 2.3: Minimize and control the impact of hazard events through enacting or updating ordinances, permits, laws, or regulations.

GOAL 3: INCREASE PUBLIC AWARENESS AND EDUCATION ON THE VULNERABILITY TO HAZARDS

Objective 3.1: Develop and provide information to residents and businesses about the types of hazards they are exposed to, what the effects may be, where they occur, and what they can do to be better prepared.

GOAL 4: IMPROVE EMERGENCY MANAGEMENT CAPABILITIES

Objective 4.1: Develop or improve Emergency Response Plan and procedures and abilities; increase the capability to respond.

Objective 4.2: Develop or improve Evacuation Plan and procedures.

Objective 4.3: Improve warning systems and ability to communicate to residents and businesses during and following a disaster or emergency.

GOAL 5: ENHANCE OVERALL RESILIENCE AND PROMOTE SUSTAINABILITY

Objective 5.1: Incorporate hazard mitigation and adaptation into updating other local planning endeavors (e.g., comprehensive plans, zoning ordinance, subdivision regulation, etc.)

GOAL 6: PURSUE MULTI-OBJECTIVE OPPORTUNITIES (WHENEVER POSSIBLE)

Objective 6.1: When possible, use existing resources, agencies, and programs to implement the projects.

Objective 6.2: When possible implement projects that achieve several goals.

SUMMARY OF CHANGES

Several changes were made to the 2015 Hazard Mitigation Plan and planning process, including: greater efforts to reach out to and include stakeholder groups; an expanded risk assessment for the entire area; and the inclusion of additional mitigation strategies. This update also works to unify the various planning mechanisms in place throughout the participating communities (i.e. comprehensive plans, local emergency operation plans, zoning ordinances, building codes, etc.) to ensure that the goals and objectives identified in those planning mechanisms are consistent with the strategies and projects included in this plan.

PLAN IMPLEMENTATION

Various communities across the planning area have implemented hazard mitigation projects following the 2015 Hazard Mitigation Plan. A few examples of completed projects include sharing relevant hazard relating information with residents, participating in a Community Wildfire Protection Plan, and improving warning siren systems and weather radio availability.

In order to build upon these prior successes and to continue implementing mitigation projects, despite limited resources, communities will need to continue relying upon multi-agency coordination as a means of leveraging resources. Communities across the ULNRD have been able to work with a range of entities to complete projects; potential partners for future project implementation include, but are not limited to: Nebraska Forest Service (NFS), Nebraska Department of Transportation (NDOT), Nebraska Department of Natural Resources (NeDNR); Nebraska Emergency Management Agency (NEMA); and United States Department of Agriculture (USDA).

HAZARD PROFILES

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

Table 2: Hazard Occurrences

HAZARD	PREVIOUS OCCURRENCE EVENTS/YEARS	APPROXIMATE ANNUAL PROBABILITY	LIKELY EXTENT
AGRICULTURAL ANIMAL DISEASE	14/5	100%	~5 animals per event
AGRICULTURAL PLANT DISEASE	0/19	<1%	Unavailable
CHEMICAL FIXED SITES	0/29	<1%	Unknown
CHEMICAL TRANSPORTATION	8/39	20%	0 to 1,000 Gallons
CIVIL DISORDER	0/73	<1%	Unknown
DAM FAILURE	0/106	<1%	Varies by Structure
DROUGHT	483/1,486 months	33%	D1-D2
EARTHQUAKES	3/119	3%	>2.5 Magnitude
EXTREME HEAT	Avg 4 days per year	100%	>100°F
FLOODING	9/23	40%	Some inundation of structures (<1% of structures) and roads near streams. Some evacuations of people may be necessary (<1% of population)
GRASS/WILDFIRES	456/19	100%	<200 acres Some homes and structures threatened or at risk
HAIL	651/23	100%	H2-H5 Avg 1.17"; Range 0.75-4.0"
HIGH WINDS	75/23	100%	≤50 mph Avg 47mph; Range 35-59 EG
SEVERE THUNDERSTORMS	194/23	100%	≥1" rainfall Avg 55 mph winds; Range 50-87 EG
SEVERE WINTER STORMS	280/23	100%	0.25" – 0.5" Ice 10°-20° below zero (wind chill) 4-8" snow 35-50 mph winds
TORNADOES	23/23	100%	Avg: EF0 Range EF0-EF2

**Quantification of vulnerable structures provided in Section Four: Risk Assessment and Section Seven: Community Profiles. EG – estimated gusts*

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

Table 3: Hazard Loss History

HAZARD TYPE		Count	Property	Crop[2]
Agricultural Disease	Animal Disease[1]	14	63 animals	N/A
	Plant Disease[2]	0	$0	$0
Chemical Fixed Sites[3]		0	$0	N/A
Chemical Transportation[4] *1 injury*		8	$80,826	N/A
Civil Disorder[5,6]		0	$0	N/A
Dam Failure[7]		0	$0	N/A
Drought[8]		483/1,486 months	$5,000,000	$3,287,926
Earthquake[9]		3	$0	$0
Extreme Heat[8,10]		Avg 4 days per year	$0	$572,800
Flooding[8]	Flash Flood	6	$525,000	$13,449
	Flood	3	$230,000	
Grass/Wildfires[11]		456	73,483 acres	$139,538
Hail[8]		651	$1,554,500	$2,436,341
High Winds[8]		75	$6,000	$259,920
Severe Thunderstorms[8]	Thunderstorm Wind	189	$522,000	$181,163
	Heavy Rain	3	$0	
	Lightning	2	$3,000	
Severe Winter Storms[8] *2 deaths, 1 injury*	Blizzard	39	$145,000	$293,368
	Extreme Cold/Wind Chill	34	$0	
	Heavy Snow	22	$10,000	
	Ice Storm	2	$16,000	
	Winter Storm	183	$315,000	
	Winter Weather	0	$0	
Tornadoes[8]		23	$104,500	$0
Total		**1,713**	**$8,511,826**	**$7,184,505**

N/A: Data not available
1 NDA (2014-2018)
2 USDA RMA (2000-2018)
3 U.S. Coast Guard NRC (1990-2018)
4 PHMSA (1980-2018)
5 SPEED (1946-2018)
6 START (1970-2018)
7 Stanford NPDP (1911-2016)
8 NOAA (1895-2018)
9 USGS (1900-2018)
10 HPRCC (1902-2018)
11 NFS (2000-2018)

Events like agricultural disease, extreme heat, grass and wildfires, hail, severe thunderstorms, and severe winter storms will occur annually. Other hazards like drought, dam failure, earthquakes, and civil disorder will occur less often. The scope of events and how they will manifest themselves locally is not known regarding hazard occurrences. Historically, hail, grass/wildfire, drought, severe thunderstorms, and severe winter storms have resulted in the most significant damages within the planning area or are of top concern for the planning teams across the planning area. These hazards are summarized below.

HAIL

Hail occurs on an annual basis across the planning area, typically in conjunction with severe thunderstorms. Hail is one of the most frequently occurring hazards and impacts both the agricultural sector and physical properties. The National Centers for Environmental Information (NCEI) has recorded 651 hail events in 23 years. These events have caused over a million dollars in property damages and two million dollars in crop

losses. Common impacts resulting from hail include, but are not limited to: damage to roofs, windows, and siding; damage to mechanical systems located outdoors including HVAC systems; damage to vehicles; destruction of crops; and injuries or deaths to cattle.

GRASS/WILDFIRE

Grass/wildfire events can occur annually and have the ability to span between a few to millions of acres per event. Grass/wildfire events are closely tied to other hazard events, such as drought, flooding, or lightning in thunderstorms. Over 70,000 acres have burned due to grass/wildfire in the planning area since 2000 which has damaged rangeland, homes, structures, or other jurisdictional assets. Impacts from widespread grass/wildfire events can include, but are not limited to: economic loss in agricultural sector; damage to homes, buildings, and infrastructure; destruction of crops; injuries or death to cattle; obstruction of transportation routes; loss of power; and loss of recreational opportunities.

DROUGHT

Drought is a regular and reoccurring phenomenon in the planning area and the state of Nebraska. Historical data shows that droughts have occurred with regularity across the planning area and the state, with recent research indicating this trend will continue and potentially intensify. The most common impacts of drought affect the agricultural sector. Over three million dollars in total crop loss was reported for the planning area since 2000, but drought impacts rangeland as well by reducing the total amount of cattle pastures can support.

Prolonged drought events can have a profound effect on the planning area and the individual communities. Expected impacts from prolonged drought include, but are not limited to: economic loss in the agricultural sector; loss of employment in the agricultural sector; limited or strained water supplies for both residential and fire fighting uses; and decrease in recreational opportunities.

SEVERE THUNDERSTORMS

Thunderstorms differ from many other hazards in that they are generally large in magnitude, have a long duration, and travel across large areas and through multiple jurisdictions within a single region. Additionally, thunderstorms often occur in series, with one area potentially impacted multiple times in one day. Severe thunderstorms are most likely to occur between the months of May and August with the highest number of events occurring in June. The NCEI recorded 194 severe thunderstorm events in 23 years. These events caused $525,000 in property damages. Typical impacts resulting from severe thunderstorms include, but are not limited to: loss of power; obstruction of transportation routes; grass/wildfires starting from lightning strikes; localized flooding; and damages discussed in the hazard profiles for hail and high winds.

Vulnerable populations related to severe thunderstorms include: residents of mobile homes (15% of housing units); citizens with decreased mobility; and those caught outside during storm events. Most residents within the planning area are familiar with severe thunderstorms and know how to appropriately prepare and respond to events. Several jurisdictions have reported updating or joining weather alert programs (CodeRed/AlertSense/Reverse 911) or have discussed a need for updates to emergency warning sirens.

SEVERE WINTER STORMS

Severe winter storms are an annual occurrence for the planning area. Winter storms can bring extreme cold temperatures, freezing rain and ice, and heavy or drifting snow. Blizzards are particularly dangersous and can have significant impacts throughout the planning area. Severe winter storms typically occur between November and March. The NCEI reported 280 severe winter storm events that caused over $486,000 in property damages. Impacts resulting from severe winter storms include, but are not limited to: hypothermia and frost bite; closure of transportation routes; downed power lines and power outages; collapsed roofs from heavy snow loads; closure of critical facilities; and injury or death to cattle. The most vulnerable citizens within the planning area are children, the elderly, individuals and families below the poverty line, and those new to the area. Residents in this planning area may also be more at risk to severe winter storms due to occupations which require them to be outside despite hazardous weather conditions.

MITIGATION STRATEGIES

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

SECTION ONE
INTRODUCTION

HAZARD MITIGATION PLANNING

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

FEMA definition of Hazard Mitigation

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

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

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

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

DISASTER MITIGATION ACT OF 2000

The U.S. Congress passed the Disaster Mitigation Act 2000 to amend the Robert T. Stafford Disaster Relief and Emergency Assistance Act[1]. Section 322 of the DMA 2000 requires that state and local governments develop, adopt, and routinely update a hazard mitigation plan to remain eligible for pre- and post-disaster mitigation funding.[2] These funds include the Hazard Mitigation Grant Program (HMGP)[3], Pre-Disaster

[1] Federal Emergency Management Agency, Public Law 106-390. 2000. "Disaster Mitigation Act of 2000." Last modified September 26, 2013. https://www.fema.gov/media-library/assets/documents/4596.

[2] Federal Emergency Management Agency. June 2007. "Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended, and Related Authorities." Federal Emergency Management Agency 592: 22. Sec. 322. Mitigation Planning (42 U.S.C. 5165). https://www.fema.gov/pdf/about/stafford_act.pdf.

[3] Federal Emergency Management Agency. "Hazard Mitigation Grant Program." Last modified July 8, 2017. https://www.fema.gov/hazard-mitigation-grant-program.

Mitigation Program (PDM)[4], and the Flood Mitigation Assistance Program (FMA)[5]. The Federal Emergency Management Agency (FEMA) administers these programs under the Department of Homeland Security (DHS).[6]

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

HAZARD MITIGATION ASSISTANCE

On June 1, 2009, FEMA initiated the Hazard Mitigation Assistance (HMA) program integration, which aligned certain policies and timelines of the various mitigation programs. These HMA programs present a critical opportunity to minimize the risk to individuals and property from hazards while simultaneously reducing the reliance on federal disaster funds.[9]

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

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

- FEMA Mitigation Directorate

- **HMGP:** To qualify for post-disaster mitigation funds, local jurisdictions must have adopted a mitigation plan that is approved by FEMA. HMGP provides funds to states, territories, Indian tribal governments, local governments, and eligible private non-profits following a presidential disaster declaration. The DMA 2000 authorizes up to seven percent of HMGP funds available to a state after a disaster to be used for the development of state, tribal, and local mitigation plans.
- **FMA:** To qualify to receive grant funds to implement projects such as acquisition or elevation of flood-prone homes, local jurisdictions must prepare a mitigation plan. Furthermore, local jurisdictions must be participating communities in the National Flood Insurance Program (NFIP). The goal of FMA is to reduce or eliminate claims under the NFIP.
- **PDM:** To qualify for pre-disaster mitigation funds, local jurisdictions must adopt a mitigation plan that is approved by FEMA. PDM assists states, territories, Indian tribal governments, and local governments in implementing a sustained pre-disaster hazard mitigation program.

PLAN FINANCING AND PREPARATION

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

[4] Federal Emergency Management Agency. "Pre-Disaster Mitigation Grant Program." Last modified July 11, 2017. https://www.fema.gov/pre-disaster-mitigation-grant-program.
[5] Federal Emergency Management Agency. "Flood Mitigation Assistance Grant Program." Last modified July 11, 2017. https://www.fema.gov/flood-mitigation-assistance-grant-program.
[6] Federal Emergency Management Agency. "Hazard Mitigation Assistance." Last modified March 29, 2017. https://www.fema.gov/hazard-mitigation-assistance.
[7] Federal Emergency Management Agency: Federal Register. 2002. "Section 104 of Disaster Mitigation Act 2000: 44 CFR Parts 201 and 206: Hazard Mitigation Planning and Hazard Mitigation Grant Programs; Interim Final Rule." https://www.fema.gov/pdf/help/fr02-4321.pdf.
[8] Federal Emergency Management Agency: Federal Register. 2002 "44 CFR Parts 201 and 206: Hazard Mitigation Planning and Hazard Mitigation Grant Programs; Interim Final Rule." https://www.fema.gov/pdf/help/fr02-4321.pdf.

SECTION TWO
PLANNING PROCESS

INTRODUCTION

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

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

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

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

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

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

MULTI-JURISDICTIONAL APPROACH

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

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

Both FEMA and NEMA recommend this multi-jurisdictional approach through the cooperation of counties, regional emergency management, and natural resource districts. The ULNRD utilized the multi-jurisdiction planning process recommended by FEMA (Local Mitigation Plan Review Guide[10], Local Mitigation Planning Handbook[11], and Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards[12]) to develop this plan.

[10] Federal Emergency Management Agency. 2011. "Local Mitigation Plan Review Guide." https://www.fema.gov/media-library-data/20130726-1809-25045-7498/plan_review_guide_final_9_30_11.pdf.

[11] Federal Emergency Management Agency. 2013. "Local Mitigation Planning Handbook." https://www.fema.gov/media-library-data/20130726-1910-25045-9160/fema_local_mitigation_handbook.pdf.

[12] Federal Emergency Management Agency. 2013. "Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards." https://www.fema.gov/media-library-data/20130726-1904-25045-0186/fema_mitigation_ideas_final508.pdf.

HAZARD MITIGATION PLANNING PROCESS

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

Organization of Resources

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

Assessment of Risk

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

Mitigation Plan Development

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

Plan Implementation and Progress Monitoring

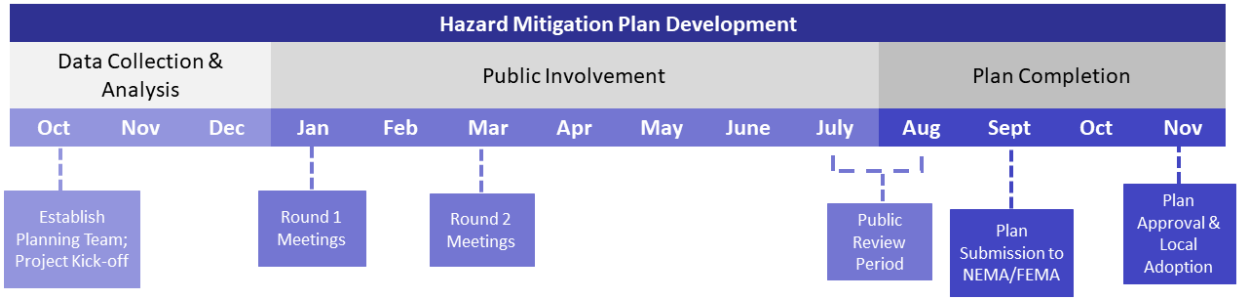
- Bring the plan to life by implementing specific mitigation projects and changing day-to-day operations. It is critical that the plan remains relevant to succeed. Thus, it is important to conduct periodic evaluations and revisions, as needed.

ORGANIZATION OF RESOURCES

PLAN UPDATE PROCESS

The ULNRD secured funding for their multi-jurisdictional hazard mitigation plan (HMP) in July 2018. JEO Consulting Group, INC. (JEO) was contracted in September 2018 to guide and facilitate the planning process and assemble the multi-jurisdictional hazard mitigation plan. For the planning area, Anna Baum (General Manager with ULNRD) led the development of the plan and served as the primary point-of-contact throughout the project. A clear timeline of this plan update process is provided in Figure 2.

Figure 2: Project Timeline



PLANNING TEAM

At the beginning of the planning process the ULNRD and JEO staff identified key contacts who would be the regional Hazard Mitigation Planning Team. This Planning Team, comprised of local participants and the consultant, was established to guide the planning process, review the existing plan, and serve as a liaison to plan participants throughout the planning area. A list of Planning Team members can be found in Table 4. Additional technical support was provided to the Planning Team by staff from NEMA and the NeDNR.

Table 4: Hazard Mitigation Planning Team

Name	Title	Jurisdiction
Anna Baum	General Manager	Upper Loup NRD
Alma Beland	Director	Region 26 (Blaine County)
Wynn Wiens	Emergency Manager/Sheriff	Hooker County
Sean Carson	Emergency Manager/Sheriff	Logan County
Gary Eng	Emergency Manager/Sheriff	Thomas County
***Brooke Welsh**	Project Coordinator	JEO Consulting Group
***Ellana Haakenstad**	Planner	JEO Consulting Group
***Mary Baker**	Resiliency Strategist	JEO Consulting Group

**Served as a consultant or advisory role*

A kick-off meeting was held on October 31st, 2018 to discuss an overview of the planning process between JEO staff and the Planning Team. Preliminary discussion was held over hazards to be included in this plan, changes to be incorporated since the last plan, goals and objectives, identification of key stakeholders to include in the planning process, and a general schedule for the plan update. This meeting also assisted in clarifying the role and responsibilities of the Planning Team and strategies for public engagement throughout the planning process. Table 5 shows Kick-off Meeting attendees.

Table 5: Kick-off Meeting Attendees

Name	Title	Jurisdiction
Ann Wurst	Region 26 Office Manager	Region 26 Emergency Management
Anna Baum	General Manager	Upper Loup NRD
Gary Eng	Emergency Manager/Sheriff	Thomas County
Lexi Hingtgen	Information and Education Coordinator	Upper Loup NRD
Wynn Wiens	Emergency Manager/Sheriff	Hooker County
Brooke Welsh	Project Coordinator	JEO Consulting Group
Mary Baker	Resiliency Strategist	JEO Consulting Group

Table 6 shows the data and location of meetings held for the Kick-off Meeting.

Table 6: Meeting Locations and Times

Location and Time	Agenda Items
Upper Loup NRD 39252 Hwy 2 Thedford, NE October 31st, 2018 1:00pm	-Consultant and Planning Team Responsibilities -Overview of plan update process and changes from 2015 HMP -Dates/Locations for meetings -Plan Goals/Objectives

PUBLIC INVOLVEMENT AND OUTREACH

At the kick-off meeting, the Regional Planning Team worked to identify stakeholder groups that could serve as “hubs of communication” and should be involved throughout the planning process. A wide range of stakeholder groups were contacted and encouraged to participate. There were 41 stakeholder groups or entities that were identified and sent letters to participate. These included six airports, five assisted living facilities, three hospitals or health care providers, and nine fire and rescue departments. The following groups were also invited to participate in the planning process. While no other entities were incorporated as participating jurisdictions, the following entities attended meetings: Cherry County, Logan/Lincoln County, Pioneer Memorial Rest Home, and Sandhills Resource Conservation & Development. These entities provided input which was incorporated into the appropriate community profiles (see *Section Seven*).

Table 7: Notified Stakeholder Groups

Organizations		
American Red Cross	Grant County Airport	Purdum Rural Fire Department
Ashby Volunteer Fire Department	Great Plains Regional Medical Center	Region 23 Emergency Management
Brosius Field Airport	Greater Nebraska Medical and Surgical Services	Sandhills Area 4H
Brown County Hospital	Halsey Rural Fire District	Sandhills District Health Department
Central Sandhills Area Extension Office	Halsey Rural Fire District	Sandhills Fire Protection District
Consolidated Telephone	Halsey United Church of Christ	Sandhills Resource Conservation and Development
Custer Public Power District	Hooker County Airport	Stapleton Chamber of Commerce
Davis Ranch Airport	Loup Basin Health Department	Stapleton Volunteer Fire Department
Department of Roads	Loup Basin Health Department	Thedford Volunteer Fire Department
Diamond Bar Jones Airport	Loup Basin Resource Conservation and Development	Thomas County Airport
Dunning Volunteer Fire Department	Mullen Volunteer Fire Department	Thomas County Fair Board
Farm Service Agency	Panhandle Public Power District	USDA Forest Service
Glen Coble & Sons, Inc.	Pioneer Memorial Community Hospital Association	West Central Health Department

Neighboring Jurisdictions

Neighboring jurisdictions were notified and invited to participate in the planning process. The following table indicates which neighboring communities or entities were notified of the planning process. Invitation and informational letters were sent to county/city/village clerks, county and regional emergency managers, and NRDs. Region 26 Emergency Management attended and represented Blaine County on their planning team and community members from Cherry County and Lincoln County attended meetings. There was no other participation from jurisdictions outside of the planning area.

Table 8: Notified Neighboring Jurisdictions

Notified Nebraska Jurisdictions	
Arthur County	Village of Arnold
Brown County	Village of Arthur
Cherry County	Village of Bassett
City of Broken Bow	Village of Berwyn
City of Gordon	Village of Brady
City of North Platte	Village of Callaway
City of Oshkosh	Village of Clinton
City of Rushville	Village of Cody
City of Sargent	Village of Comstock
City of Valentine	Village of Crookston
Custer County	Village of Hay Springs
Garden County	Village of Hershey
Lincoln County	Village of Johnstown
Loup County	Village of Kilgore
Lower Loup NRD	Village of Lewellen
McPherson County	Village of Long Pine
Middle Niobrara NRD	Village of Mason City
North Platte NRD	Village of Maxwell

Notified Nebraska Jurisdictions	
Region 23 Emergency Management	Village of Merna
Region 24 Emergency Management	Village of Merriman
Region 26 Emergency Management	Village of Nenzel
Rock County	Village of Newport
Sheridan County	Village of Oconto
Twin Platte NRD	Village of Sutherland
Upper Elkhorn NRD	Village of Taylor
Village of Ainsworth	Village of Wallace
Village of Anselmo	Village of Wellfleet
Village of Ansley	Village of Wood Lake

Participant Involvement

Participants play a key role in reviewing goals and objectives, identifying hazards, providing a record of historical disaster occurrences and localized impacts, identification and prioritization of potential mitigation projects and strategies, and the development of annual review procedures.

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

Outreach to eligible jurisdictions included notification prior to all public meetings, phone calls and email reminders of upcoming meetings, and invitations to complete surveys and worksheets required for the planning process. Table 9 provides a summary of outreach activities utilized in this process.

Table 9: Outreach Activity Summary

Action	Intent
Project Website	Informed the public and local/planning team members of past, current, and future activities (https://jeo.com/ulnrdhmp and http://www.upperloupnrd.org/hazard-mitigation-plan-update/)
Project Announcement	Project announcement posted on the project websites
Round 1 Meeting Letters or Postcards (30-day notification)	Sent to participants, stakeholders, and neighboring jurisdictions to discuss the agenda/dates/times/ locations of the first round of public meetings
Round 2 Meeting Letters or Postcards (30-day notification)	Sent to participants to discuss the agenda/dates/times/locations of the second round of public meetings
Press Release	Sent to local newspapers to announce the plan and describe the purpose of the plan
Notification Phone Calls	Called potential participants to remind them about upcoming meetings
Follow-up Emails and Phone Calls	Correspondence was provided to remind and assist participating jurisdictions with the collection and submission of required local data
Project Flyer	Flyers were posted about the ULNRD HMP and how to get involved. Flyers were posted at multiple locations throughout all counties
Word-of-Mouth	Staff discussed the plan with jurisdictions throughout the planning process

Assessment of Risk

Round 1 Meetings: Hazard Identification

At the Round 1 meetings, jurisdictional representatives (i.e. the local planning teams) reviewed the hazards consistent with the 2014 Nebraska State Hazard Mitigation Plan to conduct further risk and vulnerability assessments based on these hazards' previous occurrence and the communities' exposure to the various hazards. (For a complete list of hazards reviewed, see *Section Four: Risk Assessment.)*.

Table 10 shows the date and location of meetings held for the Round 1 meeting phase of the project.

Table 10: Round 1 Meeting Dates and Locations

Agenda Items	
General overview of the HMP planning process, discuss participation requirements, begin the process of risk assessment and impact reporting, update critical facilities, capabilities assessment, and status update on current mitigation projects	
Location and Time	**Date**
Village Office, Mullen NE: 6:00PM MT	Tuesday, January 15th, 2019
ULNRD Office, Thedford NE: 9:00AM CT	Wednesday, January 16th, 2019
Logan County Courthouse, Stapleton NE: 3:00PM CT	Wednesday, January 16th, 2019

The intent of these meetings was to familiarize the jurisdictional representatives with an overview of the work to be completed over the next several months, discuss the responsibilities of being a participant, and to collect preliminary information to update the HMP. Data collected at these meetings included: updates to mitigation actions from the 2015 ULNRD HMP; identify the top concerns from each jurisdiction; and to begin reviewing community profiles for demographics and capabilities.

These meetings also served as an opportunity to gather input on the identification of hazards, records of historical occurrences, establishment of goals and objectives, and potential future mitigation projects from jurisdictional representatives (refer to *Appendices A* and *B).* In addition to the primary data collection objectives for the workshop, representatives also identified critical facilities, and reviewed preliminary Community Profiles for each jurisdiction.

The following tables show the attendees for each jurisdiction who attended Round 1 meetings or had a one-on-one discussion for Round 1 information with JEO staff. Follow up one-on-one meetings were held for communities who did not have representatives present at public meetings. These one-on-one's were held via conference call and covered information presented at the public meetings including a description of the planning process and what hazard mitigation plans are. Data was collected from the conference call and included: localized information about the community, identification of top hazards of concern, updates to past mitigation actions, and descriptions of past events which have impacted the jurisdiction.

Table 11: Round 1 Meeting Attendees

Name	Title	Jurisdiction
Mullen – Tuesday, January 15, 2019		
Deb Daly	Village Clerk	Village of Mullen
Tom Corbin	Utility Superintendent	Village of Mullen
Wade Marsh	Village Board	Village of Mullen
Joshua Barnes	Firefighter/Village Board	Village of Mullen/Mullen VFD
Dan Daly	Firefighter	Mullen VFD
Chris Kunel	Superintendent	Mullen Public Schools
Julie Kraye	County Commissioner	Hooker County
Wynn Wiens	Sheriff/Emergency Manager	Hooker County
Anna Baum	Manager	Upper Loup NRD
Brooke Welsh	Project Coordinator	JEO Consulting Group
Ellana Haakenstad	HMEP Planner	JEO Consulting Group
Thedford – Wednesday, January 16, 2019		
Dianna Rodicher	Village Clerk	Village of Halsey
Dawn Bryant	Firefighter	Thedford VFD
Alma Beland	Emergency Manager	Region 26/Blaine County
Gary J. Eng	Sheriff	Thomas County
Lexi Hingtgen	Information and Education Coordinator	Upper Loup NRD
Anna Baum	Manager	Upper Loup NRD

Brooke Welsh	Project Coordinator	JEO Consulting Group
Ellana Haakenstad	HMEP Planner	JEO Consulting Group
Stapleton – Wednesday, January 16, 2019		
Bob Doyle	County Commissioner	Logan County
Rich Cook	Highway Superintendent	Logan County
Sean Carson	Emergency Manager	Logan County
Howard Gaffney	Superintendent	Stapleton Public Schools
Anna Baum	Manager	Upper Loup NRD
Brooke Welsh	Project Coordinator	JEO Consulting Group
Ellana Haakenstad	HMEP Planner	JEO Consulting Group

Table 12: Round 1 One-on-One Meeting Attendees

Name	Title	Jurisdiction
Grant County – Thursday, January 17, 2019		
Thomas L White	County Commissioner (Chair)	Grant County
Daniel Vinton	County Commissioner	Grant County
Mike Rath	Sheriff	Grant County
Amanda Macy	Planning and Zoning Administrator	Grant County
Elizabeth Sillasen	Emergency Manager	Grant County
Brooke Welsh	Project Coordinator	JEO Consulting Group
Ellana Haakenstad	HMEP Planner	JEO Consulting Group

While the local planning team for Grant County attended a one-on-one meeting with JEO staff, the County chose not to participate in this plan update. Future updates to this plan should engage with the County to discuss participation in the HMP.

Table 13: Round 1 Follow Up with Jurisdictions

Name	Title	Jurisdiction
Village of Brewster – Tuesday, January 29, 2019		
Ken Johnston	Village Clerk/Fire Chief	Village of Brewster
Brooke Welsh	Project Coordinator	JEO Consulting Group
Village of Stapleton – Wednesday, January 30, 2019		
Mark Frey	Village Maintenance	Village of Stapleton
Brooke Welsh	Project Coordinator	JEO Consulting Group
Village of Hyannis – Thursday, February 13, 2019		
Allison Ferguson	Village Clerk	Village of Hyannis
Darrell Seidler	Fire Chief	Village of Hyannis
Lee Ferguson	Board Member	Village of Hyannis
Make Rath	Sheriff/Emergency Manager	Grant County
Brooke Welsh	Project Coordinator	JEO Consulting Group
Village of Dunning – Monday, April 15, 2019		
Jason Coffman	Village Board Member	Village of Dunning
Brooke Welsh	Project Coordinator	JEO Consulting Group

Mitigation Plan Development

Round 2 Meetings: Mitigation Strategies

The identification and prioritization of mitigation measures is an essential component in developing effective hazard mitigation plans. At the Round 2 meetings, participating jurisdictions identified new mitigation actions in addition to the mitigation actions continued from the 2015 HMP. Participating jurisdictions were also asked to review the information collected from the Round 1 meeting related to their community through this planning process. Local planning teams were asked to ensure all information included was up-to-date and

accurate. Information/data reviewed include, but was not limited to: local hazard prioritization results; identified critical facilities and their location within the community; future development areas; and expected growth trends (refer to *Appendix B*).

There was also a brief discussion about the planning process, when the plan would be available for public review and comment, annual review of the plan, the grant application process once the plan was approved, and submitting Notice of Intent forms for HMP related projects. Table 14 shows the date and location of meetings held for Round 2 Meetings. Meeting attendees are identified in Table 14.

Table 14: Round 2 Meeting Dates and Locations

Agenda Items	
Identify new mitigation actions, review of local data and community profile, discuss review process, complete plan integration tool.	
Location and Time	**Date**
Village Office, Mullen NE: 6:00PM MT	Tuesday, April 23, 2019
ULNRD Office, Thedford NE: 9:00AM CT	Wednesday, April 24, 2019
Logan County Courthouse, Stapleton NE: 6:00PM CT	Wednesday, April 24, 2019

Table 15: Round 2 Meeting Attendees

Name	Title	Jurisdiction
	Mullen	
Anna Baum	General Manager	Upper Loup NRD
Bell Meyer		Logan/Lincoln County
Chris Kuncl	Superintendent	Mullen Public Schools
Dan Daly	Volunteer Fire Department	Village of Mullen
Deb Daly	Clerk	Village of Mullen
Dennis Bresion		Cherry County
Julie Kraye	County Commissioner	Hooker County
Lee Fergusen	Board Member	Village of Hyannis
Mike Peterson	County Commissioner	Blaine County
Nicole Hoffmann	Administrator	Pioneer Memorial Rest Home
Tony Corbin	Utility Superintendent	Village of Mullen
Twila Phillips	Secretary	Sandhills RC&D
Wade Marsin	Board Chairman	Village of Mullen
Wynn Wiens	Sheriff/EM	Hooker County
Brooke Welsh	Project Coordinator	JEO Consulting Group
Mary Baker	Resiliency Strategist	JEO Consulting Group
	Thedford	
Alma Beland	Director	Region 26 Emergency Management
Anna Baum	General Manager	Upper Loup NRD
Dale Hafer	Superintendent	Sandhills Public Schools
Dan Sheets	Village Chairman	Village of Dunning
Dawn Bryant	Volunteer Fire Department	Village of Thedford
Dianna Rodocker	Village Clerk	Village of Halsey
Gary Eng	Sheriff	Thomas County
Brooke Welsh	Project Coordinator	JEO Consulting Group
Mary Baker	Resiliency Strategist	JEO Consulting Group
	Stapleton	
Rich Cook	Highway Superintendent	Logan County/Village of Gandy
Sean Carson	Emergency Manager	Logan County
Brooke Welsh	Project Coordinator	JEO Consulting Group
Mary Baker	Resiliency Strategist	JEO Consulting Group

Table 16: Round 2 Follow Up with Jurisdictions

Name	Title	Jurisdiction
Village of Brewster – Thursday, May 9, 2019		
Ken Johnston	Village Clerk/Fire Chief	Village of Brewster
Brooke Welsh	Project Coordinator	JEO Consulting Group
Village of Stapleton – Wednesday, May 29, 2019		
Mark Frey	Village Maintenance	Village of Stapleton
Brooke Welsh	Project Coordinator	JEO Consulting Group

Data Sources and Information

Effective hazard mitigation planning requires the review and inclusion of a wide range of data, documents, plans, and studies. The following table identifies many of the sources utilized during this planning process. Individual examples of plan integration are identified in *Section Seven: Community Profiles.*

Table 17: General Plans, Documents, and Information

Documents	
Disaster Mitigation Act of 2000 DMA https://www.fema.gov/media-library/assets/documents/4596?id=1935	Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards (2013) https://www.fema.gov/media-library/assets/documents/30627
Final Rule (2007) https://www.fema.gov/media-library/assets/documents/23672	National Flood Insurance Program Community Status Book (2018) https://www.fema.gov/national-flood-insurance-program-community-status-book
Hazard Mitigation Assistance Unified Guidance (2013) https://www.fema.gov/media-library/assets/documents/103279	National Response Framework (2016) https://www.fema.gov/media-library/assets/documents/117791
Hazard Mitigation Assistance Guidance and Addendum (2015) https://www.fema.gov/media-library/assets/documents/103279	Robert T. Stafford Disaster Relief and Emergency Assistance Act (2016) https://www.fema.gov/media-library/assets/documents/15271
Local Mitigation Plan Review Guide (2011) https://www.fema.gov/media-library/assets/documents/23194	The Census of Agriculture (2012) https://www.agcensus.usda.gov/Publications/2012/Full_Report/Census_by_State/Nebraska/
Local Mitigation Planning Handbook (2013) https://www.fema.gov/media-library/assets/documents/31598	What is a Benefit: Guidance on Benefit-Cost Analysis on Hazard Mitigation Projects http://www.fema.gov/benefit-cost-analysis
Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards (2013) https://www.fema.gov/media-library/assets/documents/30627	
Plans and Studies	
Upper Loup NRD Hazard Mitigation Plan (2015) https://jeo.com/sites/default/files/inline-files/Upper-Loup-NRD-Hazard-Mitigation-Plan-Final-.pdf	National Climate Assessment (2014) https://nca2014.globalchange.gov/
Flood Insurance Studies http://www.fema.gov/floodplain-management/flood-insurance-study	Nebraska Drought Mitigation and Response Plan (2000) http://carc.nebraska.gov/docs/NebraskaDrought.pdf
Fourth National Climate Assessment (2018) https://nca2018.globalchange.gov/	State of Nebraska Hazard Mitigation Plan (2014) https://nema.nebraska.gov/sites/nema.nebraska.gov/files/doc/hazmitplan.pdf
Data Sources/Technical Resources	

Arbor Day Foundation – Tree City Designation https://www.arborday.org/	Nebraska Department of Natural Resource – Geographic Information Systems (GIS) https://dnr.nebraska.gov/data
Environmental Protection Agency - Chemical Storage Sites https://myrtk.epa.gov/info/search.jsp	Nebraska Department of Natural Resources http://www.dnr.ne.gov
Federal Emergency Management Agency http://www.fema.gov	Nebraska Department of Natural Resources – Dam Inventory http://prodmaps2.ne.gov/html5DNR/?viewer=daminventory
FEMA Flood Map Service Center https://msc.fema.gov/portal/advanceSearch	Nebraska Department of Revenue – Property Assessment Division www.revenue.ne.gov/PAD
High Plains Regional Climate Center http://climod.unl.edu/	Nebraska Department of Transportation http://dot.nebraska.gov/
National Agricultural Statistics Service http://www.nass.usda.gov/	Nebraska Emergency Management Agency http://www.nema.ne.gov
National Centers for Environmental Information https://www.ncei.noaa.gov/	Nebraska Forest Service – Wildland Fire Protection Program http://nfs.unl.edu/fire
National Consortium for the Study of Terrorism and Responses to Terrorism (START) http://www.start.umd.edu/gtd/	Nebraska Forest Service (NFS) http://www.nfs.unl.edu/
National Drought Mitigation Center – Drought Impact Reporter http://droughtreporter.unl.edu/map/	Nebraska Public Power District Service http://econdev.nppd.com/
National Drought Mitigation Center – Drought Monitor http://droughtmonitor.unl.edu/	Nebraska State Historical Society http://www.nebraskahistory.org/histpres/index.shtml
National Environmental Satellite, Data, and Information Service http://www.nesdis.noaa.gov/	Stanford University - National Performance of Dams Program https://npdp.stanford.edu/
National Fire Protection Association https://www.nfpa.org/	Storm Prediction Center Statistics http://www.spc.noaa.gov
National Flood Insurance Program https://www.fema.gov/national-flood-insurance-program	United States Army Corps of Engineers – National Levee Database http://nld.usace.army.mil/egis/f?p=471:1:0::NO
National Flood Insurance Program https://dnr.nebraska.gov/floodplain/flood-insurance	United States Census Bureau http://www.census.gov
National Historic Registry http://www.nps.gov/nr	United States Census Bureau https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml
National Oceanic Atmospheric Administration (NOAA) http://www.noaa.gov/	United States Department of Agriculture http://www.usda.gov
National Weather Service http://www.weather.gov/	United States Department of Agriculture – Risk Assessment Agency http://www.rma.usda.gov
Natural Resources Conservation Service www.ne.nrcs.usda.gov	United States Department of Agriculture – Web Soil Survey https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx
Nebraska Association of Resources Districts http://www.nrdnet.org	United States Department of Commerce http://www.commerce.gov/

Nebraska Climate Assessment Response Committee http://carc.agr.ne.gov	United States Department of Transportation – Pipeline and Hazardous Materials Safety Administration https://www.phmsa.dot.gov/
Nebraska Department of Education http://nep.education.ne.gov/	United States Geological Survey http://www.usgs.gov/
Nebraska Department of Education http://educdirsrc.education.ne.gov/	United States National Response Center http://www.nrc.uscg.mil/
Nebraska Department of Environmental Quality http://www.deq.state.ne.us/	United States Small Business Administration http://www.sba.gov
Nebraska Department of Health and Human Services http://dhhs.ne.gov/Pages/default.aspx	UNL – College of Agricultural Sciences and Natural Resources – Schools of Natural Resources http://casnr.unl.edu

Public Review

Once the draft of the HMP was completed, a public review period was opened to allow for participants and community members at large to review the plan and provide comments and changes. The public review period was open from July 29, 2019 through August 30, 2019. Participating jurisdictions were mailed a letter notifying them of this public review period. The HMP was also made available on the project website (https://jeo.com/ulnrdhmp or http://www.upperloupnrd.org/hazard-mitigation-plan-update/) to download the document, and a notification was posted to the ULNRD website. Received comments and suggested changes were incorporated into the plan.

Plan Adoption

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

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

Once adopted, participants are responsible for implementing and updating the plan every five years. Those who participated directly in the planning process would be logical champions for updating the plan. In addition, the plan will need to be reviewed and updated annually or when a hazard event occurs that significantly affects the area or individual participants.

Plan Implementation and Progress Monitoring

Hazard mitigation plans need to be living documents. To ensure this, the plan must be monitored, evaluated, and updated on a five-year or less cycle. This includes incorporating the mitigation plan into county and local comprehensive or capital improvement plans as they stand or are developed. *Section Six* describes the system that jurisdictions participating in the ULNRD HMP have established to monitor the plan; provides a description of how, when, and by whom the HMP process and mitigation actions will be evaluated; presents the criteria used to evaluate the plan; and explains how the plan will be maintained and updated.

THIS PAGE IS INTENTIONALLY BLANK

SECTION THREE
PLANNING AREA PROFILE

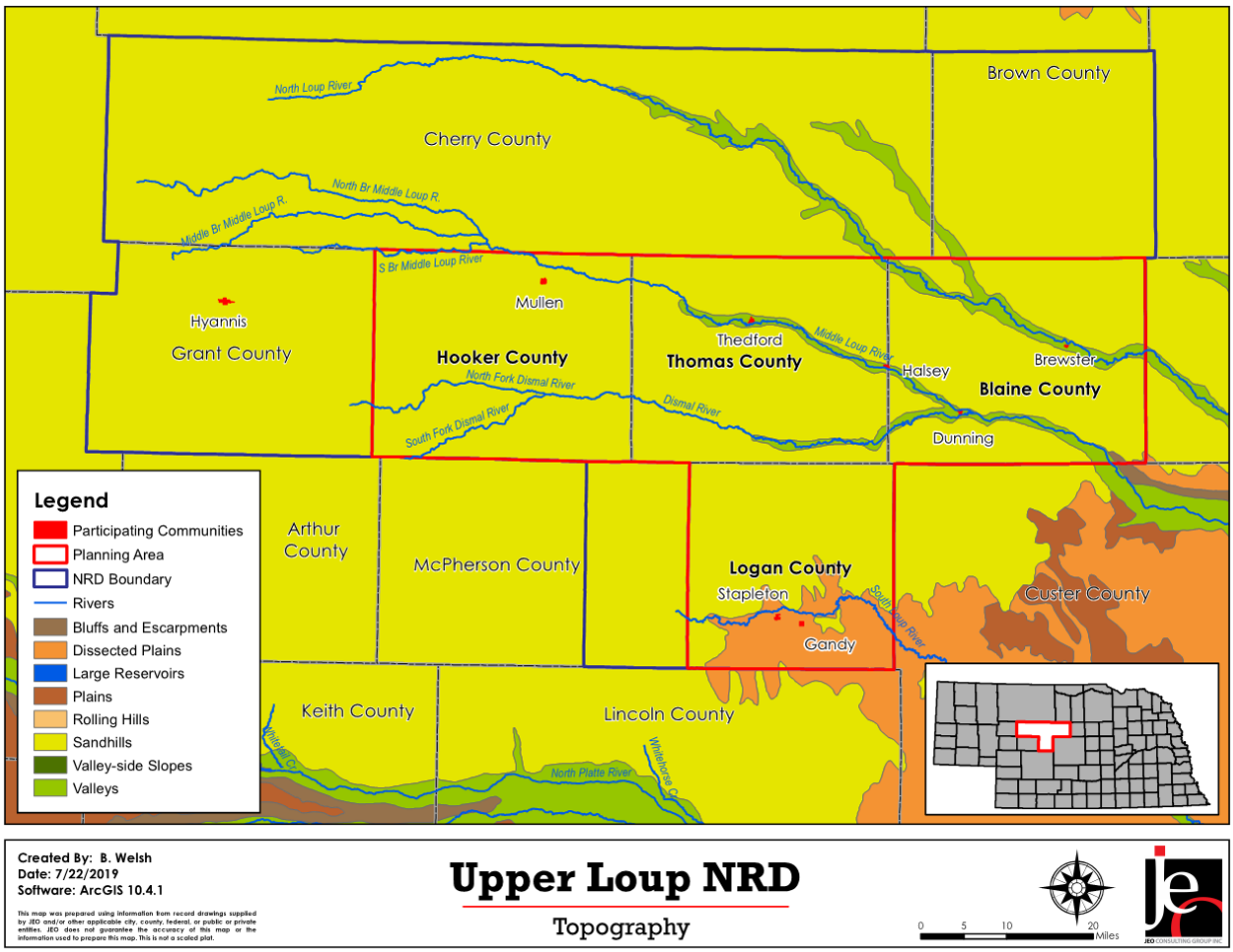
INTRODUCTION

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

PLANNING AREA GEOGRAPHIC SUMMARY

The ULNRD is located in central Nebraska and covers 6,690 square miles and includes all of Grant, Hooker, Thomas, Blaine, and Logan Counties and parts of McPherson, Brown, and Cherry Counties. For the purposes of this plan update, the planning area covers Blaine, Hooker, Logan, and Thomas Counties and the Village of Hyannis, which resides within Grant County. However, Grant County opted to not participate in the plan, and McPherson, Brown, and Cherry Counties are covered under other neighboring multi-jurisdictional HMPs. The majority of the over four million acres of land in the NRD lies within the Nebraska Sandhills region, with some small areas in the southeast corner including valleys and dissected plains topography (Figure 3). Dissected plains are represented by hilly land with moderate to steep slopes and sharp ridge crests. Valleys are flat-lying land along major streams and include stream-deposited silt, clay, sand, and gravel materials. There are five main rivers in the planning area, which include the North Loup, Middle Loup, South Loup, Calamus, and Dismal Rivers, as well as several important tributaries: Goose Creek, Calf Creek, Big Creek, Wild Horse Creek, and Rifle Creek. The planning area is comprised of primarily pasture and rangeland, with small amounts of cropland, national forest, and water bodies.

Figure 3: Planning Area Topography



Demographics and At-Risk Populations

As noted above, the planning area includes all of Blaine, Hooker, Logan, and Thomas Counties. While neither the NRD or U.S. Census Bureau collects specific demographic information for the NRD, it serves an estimated population of 3,400. This population includes a range of demographics and persons at risk to natural and human-made disasters.

Table 18: Estimated Population for Planning Area

Age	Planning Area	State of Nebraska
<5	5.1%	6.9%
5-19	19.0%	20.7%
20-64	51.5%	57.6%
>64	24.5%	14.8%
Median	47.8	36.3

Source: U.S. Census Bureau
**Numbers include estimates from Blaine, Grant, Hooker, Logan, and Thomas Counties*

At-Risk Populations

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

- Not all people who are considered “at-risk” are at-risk;

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

The National Response Framework defines at-risk populations as "…populations whose members may have additional needs before, during, and after an incident in functional areas, including but not limited to: maintaining independence, communication, transportation, supervision, and medical care."[13]

Dependent children under 19 years old are one of the most vulnerable populations to disasters.[14] The majority of people in this age group do not have access to independent financial resources, transportation, or cellular telephones. They also lack practical knowledge necessary to respond appropriately during a disaster. Despite this vulnerability, children are generally overlooked in disaster planning because the presence of a care-taker is assumed. With 24% of the planning area's population younger than 19, children are a key vulnerable group to address in the planning process. Nearly a quarter of these children are under the age of five, further exacerbating their vulnerability.

Schools house a high number of children within the planning area during the daytime hours of weekdays, as well as during special events on evenings and weekends. The following table identifies the various school districts located within the planning area, and Figure 4 is a map of the school district boundaries. This list is comprehensive and does not represent only the school districts participating in this plan.

Table 19: School Inventory

School District	Total Enrollment (2017-2018)
Ainsworth Public Schools	443
Anselmo Public Schools	273
Arnold Public Schools	169
Hyannis Public Schools	160
McPherson County Schools	73
Mullen Public Schools	154
Sandhills Public Schools	90
Stapleton Public Schools	199
Thedford Public Schools	115
Valentine Public Schools	572

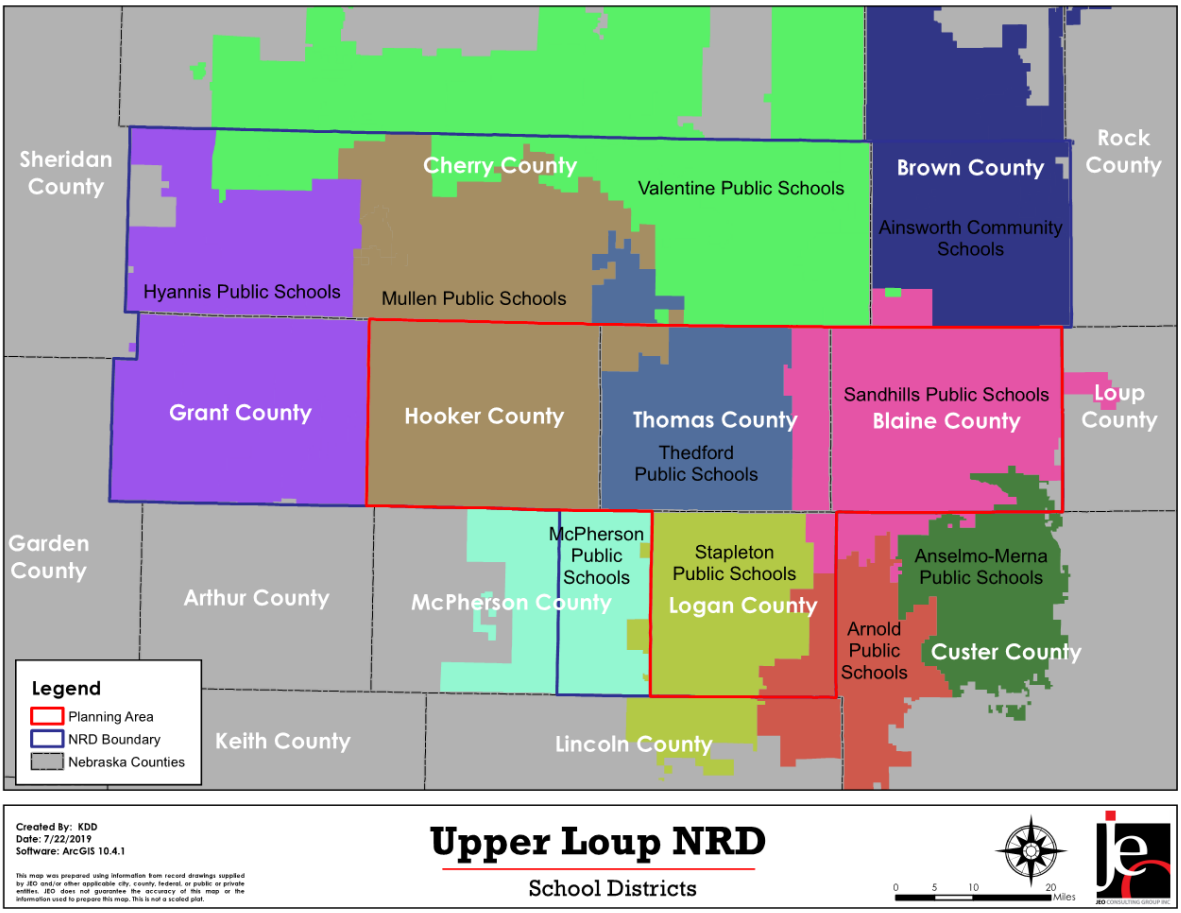
Source: Nebraska Department of Education[15]

[13] United States Department of Homeland Security. June 2016. "National Response Framework Third Edition." https://www.fema.gov/media-library-data/1466014682982-9bcf8245ba4c60c120aa915abe74e15d/National_Response_Framework3rd.pdf.

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

[15] Nebraska Department of Education. 2018. "Nebraska Education Profile." Accessed December 2018. http://nep.education.ne.gov/.

Figure 4: Regional School Districts



Like minors, seniors (age 65 and greater) are often more significantly impacted by temperature extremes. During prolonged heat waves, seniors may lack resources to effectively address hazard conditions and as a result may incur injury or potentially death. Prolonged power outages (either standalone events or as the result of other contributing factors) can have significant impacts on any citizen relying on medical devices for proper bodily functions. One study conducted by the Center for Injury Research and Policy found that increases in vulnerability related to severe winter storms (with significant snow accumulations) begin at age 55.[16] The study found that on average there are 11,500 injuries and 100 deaths annually related to snow removal. Males over the age of 55 are 4.25 times more likely to experience cardiac symptoms during snow removal.

While the previously identified populations do live throughout the planning area, there is the potential that they will be located in higher concentrations at care facilities. Table 20 identifies the number and capacity of care facilities throughout the planning area. In addition to the facilities listed below, there is one long-term care facility located in Mullen, Nebraska with 30 registered beds, and one rural health clinic in Hyannis, Nebraska. These facilities are the only health care facilities located within the planning area.

[16] Center for Injury Research and Policy. January 2011. "Snow Shoveling Safety." Accessed July 2017. http://www.nationwidechildrens.org/cirp-snow-shoveling.

Table 20: Inventory of Care Facilities

Jurisdiction	Hospitals	Hospital Beds	Health Clinics	Adult Care Homes	Adult Care Beds	Assisted Living Homes	Assisted Living Beds
Blaine County	0	0	0	0	0	0	0
Grant County	0	0	0	0	0	0	0
Hooker County	0	0	0	1	30	0	0
Logan County	0	0	0	0	0	0	0
Thomas County	0	0	0	0	0	0	0

Source: Nebraska Department of Health and Human Services[17,18,19,20]

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

Table 21: ESL and Poverty At-Risk Populations

County	Percent That Speaks English as Second Language	Families Below Poverty Level
Blaine County	2.0%	14.7%
Grant County	0%	9.4%
Hooker County	1.4%	8.0%
Logan County	0.5%	6.5%
Thomas County	4.3%	6.6%

Source: U.S. Census Bureau[21,22]
**Numbers include estimates from Blaine, Grant, Hooker, Logan, and Thomas Counties*

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

Residents who speak English as a second language may struggle with a range of issues before, during, and after hazard events. General vulnerabilities revolve around what could be an inability to effectively communicate with others or an inability to comprehend materials aimed at notification and/or education. When presented with a hazardous situation it is important that all community members be able to receive, decipher, and act on relevant information. An inability to understand warnings and notifications may prevent non-native English speakers from reacting in a timely manner. Further, educational materials related to regional hazards are most often developed in the dominant language for the area, for the planning area that would be English. Residents who struggle with English in the written form may not have sufficient information related to local concerns to effectively mitigate potential impacts. Residents with limited English proficiency would be at an increased vulnerability to all hazards within the planning area.

Similar to residents below the poverty line, racial minorities tend to have access to fewer financial and systemic resources that would enable them to implement hazard mitigation projects and to respond and

[17] Department of Health and Human Services. November 2018. "Assisted Living Facilities." http://dhhs.ne.gov/publichealth/Documents/ALF%20Roster.pdf.
[18] Department of Health and Human Services. November 2018. "Hospitals." http://dhhs.ne.gov/publichealth/Documents/Hospital%20Roster.pdf.
[19] Department of Health and Human Services. November 2018. "Long Term Care Facilities." http://dhhs.ne.gov/publichealth/Documents/LTCRoster.pdf.
[20] Department of Health and Human Services. November 2018. "Rural Health Clinic." http://dhhs.ne.gov/publichealth/Documents/RHC_Roster.pdf.
[21] U.S. Census Bureau. 2018. "Language Spoken at Home: 2016 American Community Survey (ACS) 5-year estimates." https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#.
[22] U.S. Census Bureau. 2018. "Selected Economic Characteristics: 2016 ACS 5-year estimate." https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#.

recover from hazard events, including residence in standard housing and possession of financial stability. The mostly homogenous racial profile of the planning area indicates that racial inequity will not significantly affect the community's vulnerability to hazards (Table 22).

Table 22: Racial Composition Trends

RACE	2010 NUMBER	2010 % OF TOTAL	2017 NUMBER	2017 % OF TOTAL	% CHANGE
WHITE, NOT HISPANIC	3,233	97.2%	3,358	97.9%	0.7%
BLACK	1	0.03%	18	0.52%	0.49%
AMERICAN INDIAN AND ALASKAN NATIVE	15	0.45%	4	0.12%	-0.33%
ASIAN	9	0.27%	3	0.09%	-0.18%
NATIVE HAWAIIAN AND OTHER PACIFIC ISLANDER	0	0%	7	0.2%	0.2%
OTHER RACES	0	0%	14	0.41%	0.41%
TWO OR MORE RACES	70	2.1%	39	1.14%	-0.97%
TOTAL POPULATION	3,325	-	3,430	-	

Source: U.S. Census Bureau[23,24]
**Numbers include estimates from Blaine, Grant, Hooker, Logan, and Thomas Counties*

[23] U.S. Census Bureau. 2018. "Race: 2010 ACS 5-year estimate." https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#.
[24] U.S. Census Bureau. 2018. "Race: 2016 ACS 5-year estimate." https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#.

BUILT ENVIRONMENT AND STRUCTURAL INVENTORY

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

Table 23: Selected Housing Characteristics

	Blaine	Grant	Hooker	Logan	Thomas	Total
Occupied housing units	**251 (71.3%)**	**272 (70.6%)**	**301 (70.5%)**	**353 (83.6%)**	**298 (76.2%)**	**1,475**
Lacking complete plumbing facilities	2.4%	0.0%	0.0%	0.6%	0.7%	**10**
Lacking complete kitchen facilities	0.0%	0.0%	0.0%	0.6%	0.7%	**4**
No telephone service available	0.0%	1.5%	0.0%	0.6%	0.7%	**8**
Housing unit with no vehicles available	1.6%	2.9%	0%	1.7%	0.7%	**20**
Mobile Homes	11.4%	16.4%	11.0%	9.5%	7.4%	**219**

Source: U.S. Census Bureau, 2018[25]
**Indicated percentages are determined based on total housing units*

Less than one percent of housing units lack access to landline telephone service. This does not necessarily indicate that there is not a phone in the housing unit, as cellular telephones are increasingly a primary form of telephone service. However, this lack of access to landline telephone service does represent a population at increased risk to disaster impacts. Reverse 911 systems are designed to contact households via landline services and as a result, some homes in hazard prone areas may not receive notification of potential impacts in time to take protective actions. Emergency managers should continue to promote the registration of cell phone numbers with Reverse 911 systems.

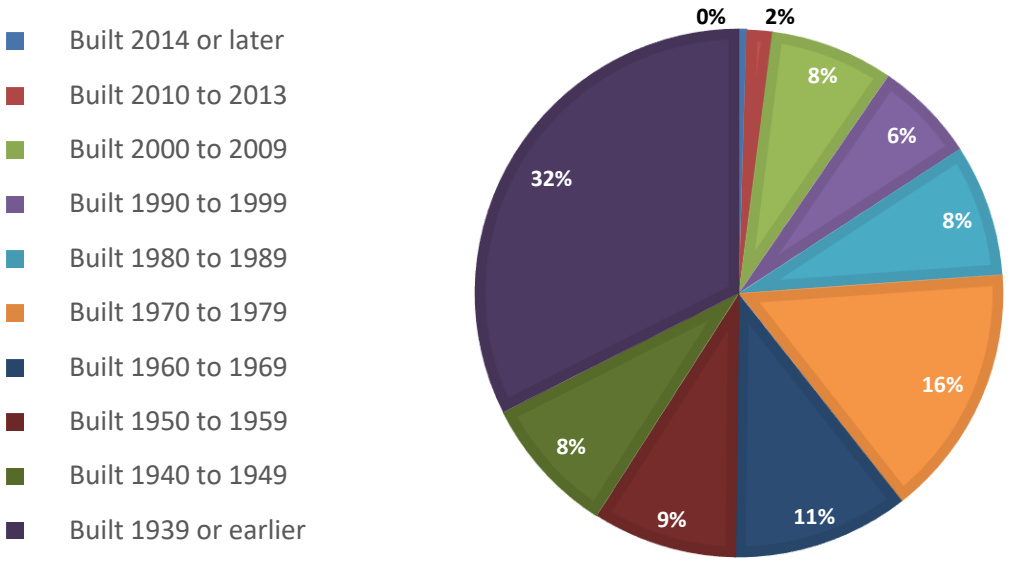
Approximately 15 percent of housing units in the planning area are mobile homes. While unincorporated Grant County has the highest rate of mobile homes, many of these are not located within the Village of Hyannis who is participating in this HMP. For the purpose of this plan, Blaine County has the highest rate of mobile homes in its housing stock at 11.4 percent. Mobile homes have a higher risk of sustaining damages during high wind events, tornadoes, severe thunderstorms, and severe winter storms. Mobile homes that are either not anchored or are anchored incorrectly can be overturned by 60 mph winds. A thunderstorm is classified as severe when wind speeds exceed 58 mph, placing improperly anchored mobile homes at risk.

Hooker County has the highest percentage of unoccupied housing units. Unoccupied homes may not be maintained as well as occupied housing, thus adding to their vulnerability. Furthermore, approximately one percent of all housing units in the planning area do not have a vehicle available. Households without vehicles may have difficulty evacuating during a hazardous event and a reduced ability to access resources in time of need.

The majority of homes within the planning area were built prior to 1970, with 32% of homes built prior to 1939 (Figure 5). Housing age can serve as an indicator of risk, as structures built prior to state building codes being developed may be more vulnerable. Residents living in these homes maybe at higher risk to the impacts of high winds, tornadoes, severe winter storms, and thunderstorms.

[25] U.S. Census Bureau. 2018. "Selected Housing Characteristics: 2016 ACS 5-year estimate." https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#.

Figure 5: Housing Age in Planning Area



State and Federally Owned Properties

The following table provides an inventory of state and federally-owned properties within the planning area by county. Note that this list includes Cherry, Brown, and McPherson Counties which have parts of the county within the Upper Loup NRD's jurisdictional boundaries. Only properties located within the NRD boundaries are included here.

Table 24: State and Federally-Owned Facilities

Facility	Nearest Community
Blaine County	
Nebraska Department of Roads	County-wide
Various Federal properties	Dunning
US Forest Service	Brewster
Grant County	
Avocet Wildlife Management Area	Hyannis
Various State-owned properties (Likely Department of Education)	County-wide
Nebraska Department of Roads	County-wide
Nebraska Game and Parks	County-wide
Various Federal properties	Whitman and Hyannis
Hooker County	
Various State-owned properties (Likely Department of Education)	County-wide
Nebraska Department of Roads	County-wide
Logan County	
Various State-owned properties (Likely Department of Education)	County wide
Thomas County	
Nebraska State Forest	Thedford and Halsey
US Forest Service	Thedford and Halsey
Nebraska Department of Roads	County-wide
Various State-owned properties (Likely Department of Education)	County-wide
McPherson County	
Various State-owned properties (Likely Department of Education)	County-wide
Cherry County	
Various State-owned properties (Likely Department of Education)	County-wide
Various Federal properties	County-wide
Nebraska Game and Parks	County-wide
Nebraska Department of Roads	County-wide

Facility	Nearest Community
Brown County	
US Fish and Wildlife Service	County-wide
Various Federal properties	County-wide
Nebraska Game and Parks	County-wide
Various State-owned properties (Likely Department of Education)	County-wide
Nebraska Department of Roads	County-wide

Source: County Assessors

HISTORICAL SITES

According to the National Register of Historic Places for Nebraska by the National Park Service (NPS), there are five historic sites located in the planning area.

Site Name	Date Listed	Nearest Community, County	In Floodplain?
Bessey Nursury	5/24/1978	Halsey, Thomas County	N
Hotel DeFair	10/29/1976	Hyannis, Grant County	N
Hooker County Courthouse	1/10/1990	Mullen, Hooker County	N
Humphrey Archeological Site	1/21/1974	Mullen, Hooker County	N
Kelso Site	1/21/1974	Mullen, Hooker County	N

Source: National Park Service[26]

26 National Park Service. January 2019. "National Register of Historic Places NPGallery Database." https://npgallery.nps.gov/nrhp.

THIS PAGE IS INTENTIONALLY BLANK

SECTION FOUR
RISK ASSESSMENT

INTRODUCTION

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

Table 25: Term Definitions

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

METHODOLOGY

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

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

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

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

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

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

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

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

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

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

AVERAGE ANNUAL DAMAGES AND FREQUENCY

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

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

- **Total Damages in Dollars:** This is the total dollar amount of all property damages and crop damages as recorded in federal, state, and local data sources. The limitation to these data sources is that dollar figures usually are estimates and often do not include all damages from every event, but only officially recorded damages from reported events.
- **Total Years of Record:** This is the span of years there is data available for recorded events. During this planning process, vetted and cleaned up National Centers for Environmental Information (NCEI) data is available for January 1996 to July 2018. Although some data is available back to 1950, this plan update only utilizes the more current and more accurate data available. Wildfire data is available from the Nebraska Forest Service from 2000 to 2018.
- **Number of Hazard Events:** This shows how often an event occurs. The frequency of a hazard event will affect how a community responds. A thunderstorm may not cause much damage each time, but multiple storms can have an incremental effect on housing and utilities. In contrast, a rare tornado can have a widespread effect on a city.

An example of the Event Damage Estimate is found below:

$$\textbf{Annual Frequency}\ (\#) = \frac{Total\ Events\ Recorded\ (\#)}{Total\ Years\ of\ Record\ (\#)}$$

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

Each hazard will be included, while those which have caused significant damages or occurred in significant numbers are discussed in detail. It should be noted NCEI data is not all inclusive and it provides very limited information on crop losses. To provide a better picture of the crop losses associated with the hazards within the planning area, crop loss information provided by the Risk Management Agency (RMA) of the USDA was also utilized for this update of the plan for counties with available data. The collected data was from 2000 to 2018. Data for all the hazards are not always available, so only those with an available dataset are included in the loss estimation.

HAZARD IDENTIFICATION

The identification of relevant hazards for the planning area began with a review of the 2014 State of Nebraska Hazard Mitigation Plan. The Regional Planning Team and participating jurisdictions reviewed the list of hazards addressed in the state mitigation plan and determined which hazards were appropriate for discussion relative to the planning area. The hazards for which a risk assessment was completed are included in the following table.

Table 26: Hazards Addressed in the Plan

Hazards Addressed in the Plan		
Agricultural Disease (Animal and Plant)	Drought	Hail
Chemical Fixed Sites	Earthquakes	High Winds
Chemical Transportation	Extreme Heat	Severe Thunderstorms
Civil Disorder	Flooding	Severe Winter Storms
Dam Failure	Grass/Wildfires	Tornadoes

HAZARD ELIMINATION

Given the location and history of the planning area, several hazards from the 2015 Upper Loup NRD HMP as well as the State HMP were eliminated from further review. These hazards are listed below with a brief explanation of why the hazards were eliminated.

ELIMINATED HAZARDS FROM 2015 UPPER LOUP NRD HAZARD MITIGATION PLAN:

- **Landslides -** While there is data available related to landslides across the state, no events have occurred within the planning area. The following table outlines the number of recorded landslide events that have occurred in the planning area. This is consistent with the 2014 Nebraska State HMP.

Table 27: Known Landslides in the Planning Area by County

County	Number of Landslides	Total Estimated Damages
Blaine	0	$0
Grant	0	$0
Hooker	0	$0
Logan	0	$0
Thomas	0	$0

Source: Nebraska Hazard Mitigation Plan, 2014[27]; University of Nebraska-Lincoln, 2018[28]

- **Levee Failure* -** There are no documented levees located in the planning area. Therefore, levee failures are not expected to occur in the planning area.

- **Radiological Fixed Facilities* -** Both state and local agencies have developed appropriate and extensive plans and protocols relative to the two nuclear facilities located in the state. The existing plans and protocols are reviewed, updated, and exercised on a regular basis. Due to the extensive planning and regulations related to this threat it will not be further profiled in this plan. This approach is consistent with the 2014 Nebraska State Hazard Mitigation Plan.

- **Radiological Transportation* -** There have been no incidents reported in the planning area or the state that have required assistance beyond what is considered regular roadside services. Further, the transportation of radiological materials is heavily regulated and monitored. There are other plans across the state that have thoroughly addressed this threat, therefore it will not be further profiled for this plan. This approach is consistent with the 2014 Nebraska HMP.

[27] Nebraska Emergency Management Agency. 2014. "State of Nebraska Hazard Mitigation Plan."
[28] University of Nebraska-Lincoln. 2018. "Database of Nebraska Landslides." http://snr.unl.edu/data/geologysoils/landslides/landslidedatabase.aspx.

- **Terrorism* -** The Planning Team indicated terrorism is not a hazard of top concern. The 2014 Nebraska State HMP identifies terrorism as a medium risk in Region 4 (which includes the entire planning area). Given that no acts of terrorism have been recorded in the planning area, this hazard will not be profiled further in this plan. Civil disorder is profiled in this plan with an emphasis on local concerns and capabilities.

- **Urban Fire* -** Fire departments across the planning area have mutual aid agreements in place to address this threat, and typically this hazard is addressed through existing plans and resources. As such, urban fire will not be fully profiled for this plan. Discussion relative to fire will be focused on wildfire and the potential impacts they could have on the built environment. This approach is consistent with the 2014 Nebraska State Hazard Mitigation Plan.

Note: Eliminated hazards marked with an Asterix (*) were also listed in the 2014 State of Nebraska HMP and were eliminated for further review.

ELIMINATED HAZARDS FROM 2014 STATE OF NEBRASKA HAZARD MITIGATION PLAN

- **Power Failure –** Descriptions of power failure vulnerabilities and occurrences are included, as appropriate, in hazard profiles. Additionally, local power utilities across the state have extensive regulation and recovery plans related to power failure. Therefore, power failure will not be fully profiled for this plan.

- **Public Health Emergency –** The 2014 Nebraska HMP identifies Public Health Emergencies as low risk for Region 4 (which includes the entire planning area) with a composite ranking score of 0.00. Additionally, the Planning Team did not identify public health emergencies as a top priority. As such, this hazard will not be fully profiled in this plan.

- **Transportation –** The 2014 Nebraska HMP identifies Transportation as medium risk for Region 4 (which includes the entire planning area). However, descriptions of major transportation routes, airports, rail lines, uses, and significant accident events are described throughout the plan and in hazard profiles as appropriate. Due to this, this hazard is not fully profiled in this plan.

HAZARD ASSESSMENT SUMMARY TABLES

The following table provides an overview of the data contained in the hazard profiles. Hazards listed in this table and throughout the section are in alphabetical order. This table is intended to be a quick reference for people using the plan and does not contain source information. Source information and full discussion of individual hazards are included later in this section.

Table 28: Regional Risk Assessment

HAZARD	PREVIOUS OCCURRENCE EVENTS/YEARS	APPROXIMATE ANNUAL PROBABILITY	LIKELY EXTENT
AGRICULTURAL ANIMAL DISEASE	14/5	100%	~5 animals per event
AGRICULTURAL PLANT DISEASE	0/19	<1%	Unavailable
CHEMICAL FIXED SITES	0/29	<1%	Unknown
CHEMICAL TRANSPORTATION	8/39	20%	0 to 1,000 Gallons
CIVIL DISORDER	0/73	<1%	Unknown
DAM FAILURE	0/106	<1%	Varies by Structure
DROUGHT	483/1,486 months	33%	D1-D2
EARTHQUAKES	3/119	3%	>2.5 Magnitude
EXTREME HEAT	Avg 4 days per year	100%	>100°F
FLOODING	9/23	40%	Some inundation of structures (<1% of structures) and roads near streams. Some evacuations of people may be necessary (<1% of population)
GRASS/WILDFIRES	456/19	100%	<200 acres Some homes and structures threatened or at risk
HAIL	651/23	100%	H2-H5 Avg 1.17"; Range 0.75-4.0"
HIGH WINDS	75/23	100%	≤50 mph Avg 47mph; Range 35-59 EG
SEVERE THUNDERSTORMS	194/23	100%	≥1" rainfall Avg 55 mph winds; Range 50-87 EG
SEVERE WINTER STORMS	280/23	100%	0.25" – 0.5" Ice 10°-20° below zero (wind chill) 4-8" snow 35-50 mph winds
TORNADOES	23/23	100%	Avg: EF0 Range EF0-EF2

**Quantification of vulnerable structures provided in Section Seven: Community Profiles*

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

Table 29: Loss Estimation for the Planning Area

HAZARD TYPE		Count	Property	Crop[2]
Agricultural Disease	Animal Disease[1]	14	63 animals	N/A
	Plant Disease[2]	0	0	$0
Chemical Fixed Sites[3]		0	$0	N/A
Chemical Transportation[4] *1 injury*		8	$80,826	N/A
Civil Disorder[5,6]		0	0	N/A
Dam Failure[7]		0	$0	N/A
Drought[8]		483/1,486 months	$5,000,000	$3,287,926
Earthquake[9]		3	$0	$0
Extreme Heat[8,10]		Avg 4 days per year	$0	$572,800
Flooding[8]	Flash Flood	6	$525,000	$13,449
	Flood	3	$230,000	
Grass/Wildfires[11]		456	73,483 acres	$139,538
Hail[8]		651	$1,554,500	$2,436,341
High Winds[8]		75	$6,000	$259,920
Severe Thunderstorms[8]	Thunderstorm Wind	189	$522,000	$181,163
	Heavy Rain	3	$0	
	Lightning	2	$3,000	
Severe Winter Storms[8] *2 deaths, 1 injury*	Blizzard	39	$145,000	$293,368
	Extreme Cold/Wind Chill	34	$0	
	Heavy Snow	22	$10,000	
	Ice Storm	2	$16,000	
	Winter Storm	183	$315,000	
	Winter Weather	0	$0	
Tornadoes[8]		23	$104,500	$0
Total		**1,713**	**$8,511,826**	**$7,184,505**

N/A: Data not available
1 NDA (2014-2018)
2 USDA RMA (2000-2018)
3 U.S. Coast Guard NRC (1990-2018)
4 PHMSA (1980-2018)
5 SPEED (1946-2018)
6 START (1970-2018)
7 Stanford NPDP (1911-2016)
8 NOAA (1895-2018)
9 USGS (1900-2018)
10 HPRCC (1902-2018)
11 NFS (2000-2018)

Historical Disaster Declarations

The following tables show past disaster declarations that have been granted within the planning area.

Farm Service Agency Small Business Administration Disasters

The U.S. Small Business Administration (SBA) was created in 1953 as an independent agency of the federal government to aid, counsel, assist, and protect the interests of small business concerns, to preserve free competitive enterprise, and maintain and strengthen the overall economy of our nation. A program of the SBA includes disaster assistance for those affected by major natural disasters. The following table summarizes the SBA Disasters involving the planning area in the last decade.

Table 30: SBA Declarations

Disaster Declaration Number	Declaration Date	Description	Primary Counties	Contiguous Counties
NE-00049	8/1/2012	Drought	Statewide	Statewide
NE-00021	6/20/2008	Severe Storms, Tornadoes, and Flooding	Blaine, Logan, Thomas	
NE-00020	6/20/2008	Severe Storms, Tornadoes, and Flooding		Blaine, Logan
NE-00014	7/24/2007	Severe Storms and Flooding	Logan	
NE-00013	6/6/2007	Severe Storms, Tornadoes, and Flooding	Thomas	
NE-00011	1/7/2007	Severe Winter Storms	Blaine, Logan	
NE-00007	7/13/2006	High Temperatures, High Winds, Excessive Heat, and Ongoing Drought	Blaine, Hooker, Logan, Thomas	
NE-00006	7/13/2006	High Winds, Excessive Heat, Late freeze, and Ongoing Drought		Blaine

Source: Small Business Administration, 2005-2018[29]

Presidential Disaster Declarations

Presidential disaster declarations are available via FEMA from 1953 to 2019. Declarations prior to 1962 are not designated by county on the FEMA website and are not included below. The following table describes presidential disaster declarations within the planning area for the period of record. Note that while data is available from 1953 onward, the planning area has only received 15 presidential disaster declarations since 2001.

Table 31: Presidential Disaster Declarations

Disaster Declaration Number	Declaration Date	Title	Affected Counties	Public Assistance
1373	5-16-2001	SEVERE WINTER STORMS, FLOODING AND TORNADOES	Hooker, Thomas, Logan, Blaine	$2,982,075.51
1517	5-25-2004	SEVERE STORMS, TORNADOES AND FLOODING	Blaine	$13,351,657.77
3245	9-13-2005	HURRICANE KATRINA EVACUEES	Grant, Logan, Blaine, Thomas, Hooker	$393,813.27
1627	1-26-2006	SEVERE WINTER STORM	Logan	$5,444,137.27
1674	1-7-2007	SEVERE WINTER STORMS	Blaine, Logan	$124,357,843.32
1706	6-6-2007	SEVERE STORMS, FLOODING, AND TORNADOES	Thomas, Blaine	$6,109,252.52
1714	7-24-2007	SEVERE STORMS AND FLOODING	Logan	$2,306,258.82

[29] Small Business Administration. 2001-2018. "Office of Disaster Assistance | Resources." https://www.sba.gov/offices/headquarters/oda/resources/1407821.

Disaster Declaration Number	Declaration Date	Title	Affected Counties	Public Assistance
1770	6-20-2008	SEVERE STORMS, TORNADOES, AND FLOODING	Blaine, Logan, Thomas	$36,258,650.19
1924	7-15-2010	SEVERE STORMS AND FLOODING	Logan, Hooker, Thomas, Blaine	$49,926,354.50
2900	4-22-2011	THEDFORD FIRE	Thomas	N/A
4014	8-12-2011	SEVERE STORMS, TORNADOES, STRAIGHT LINE WINDS, AND FLOODING	Logan	$3,362,468.45
4321	6-26-2017	SEVERE WINTER STORM AND STRAIGHT-LINE WINDS	Blaine	$2,653,954.12
4375	6-29-2018	SEVERE WINTER STORM AND STRAIGHT-LINE WINDS	Logan, Blaine	$83,371.64
4387	8-27-2018	SEVERE STORMS, TORNADOES, STRAIGHT-LINE WINDS, AND FLOODING	Thomas, Logan	$252,445.02
4420	3-21-2019	SEVERE WINTER STORM, STRAIGHT-LINE WINDS, AND FLOODING	Blaine, Logan	$1,872,997.37

Source: Federal Emergency Management Agency, 1953-2019[30]

CLIMATE ADAPTATION

Long term climate trends have increased and will continue to increase the vulnerability to hazards across the planning area. Since 1895, Nebraska's overall average temperature has increased by about 2°F (Figure 6). This trend will likely contribute to an increase in the frequency and intensity of hazardous events, which will cause significant economic, social, and environmental impacts on Nebraskans.

As seen in Figure 7 and Figure 8, the United States is experiencing an increase in the number of billion-dollar natural disasters. Regardless of whether this trend is due to a change in weather patterns or due to increased development, the trend exists.

According to a recent University of Nebraska report (*Understanding and Assessing Climate Change: Implications for Nebraska,* 2014),[31] Nebraskans can expect the following from the future climate:

- Increase in extreme heat events
- Decrease in soil moisture by 5-10%
- Increase in drought frequency and severity
- Increase in heavy rainfall events
- Increase in flood magnitude
- Decrease in water flow in the Missouri River from reduced snowpack in the Rocky Mountains
- Additional 30-40 days in the frost-free season

[30] Federal Emergency Management Agency. 2019. "Disaster Declarations." Accessed July 2019. https://www.fema.gov/openfema-dataset-disaster-eclarations-summaries-v1.

[31] Rowe, C.M., Bathke, D.J., Wilhite, D.A., & Oglesby, R.J. 2014. "Understanding and Assessing Climate Change: Implications for Nebraska."

Figure 6: Average Temperature (1895-2018)

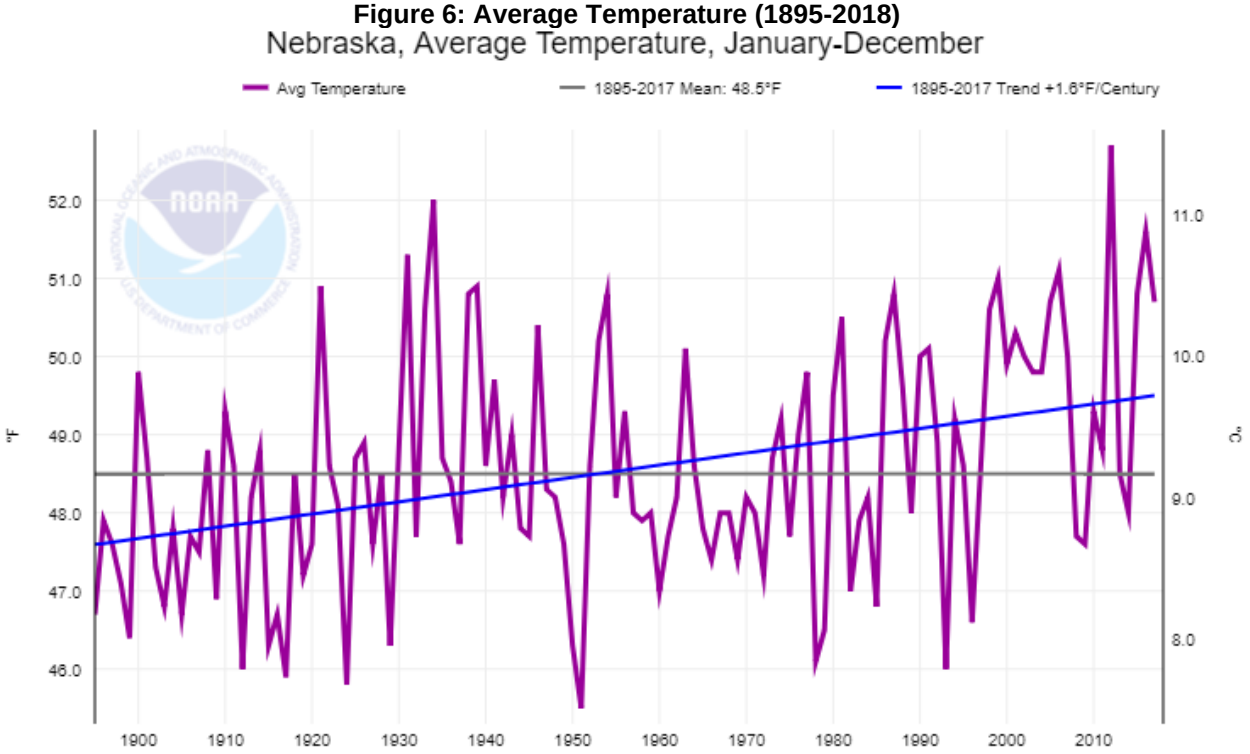
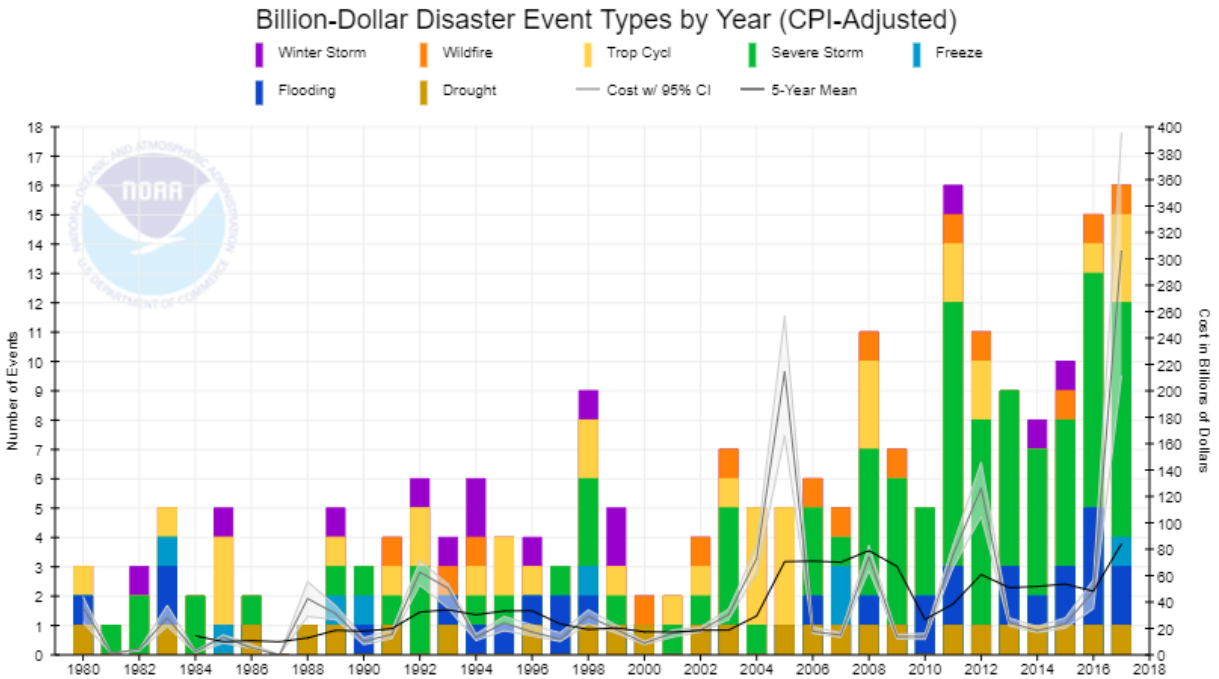
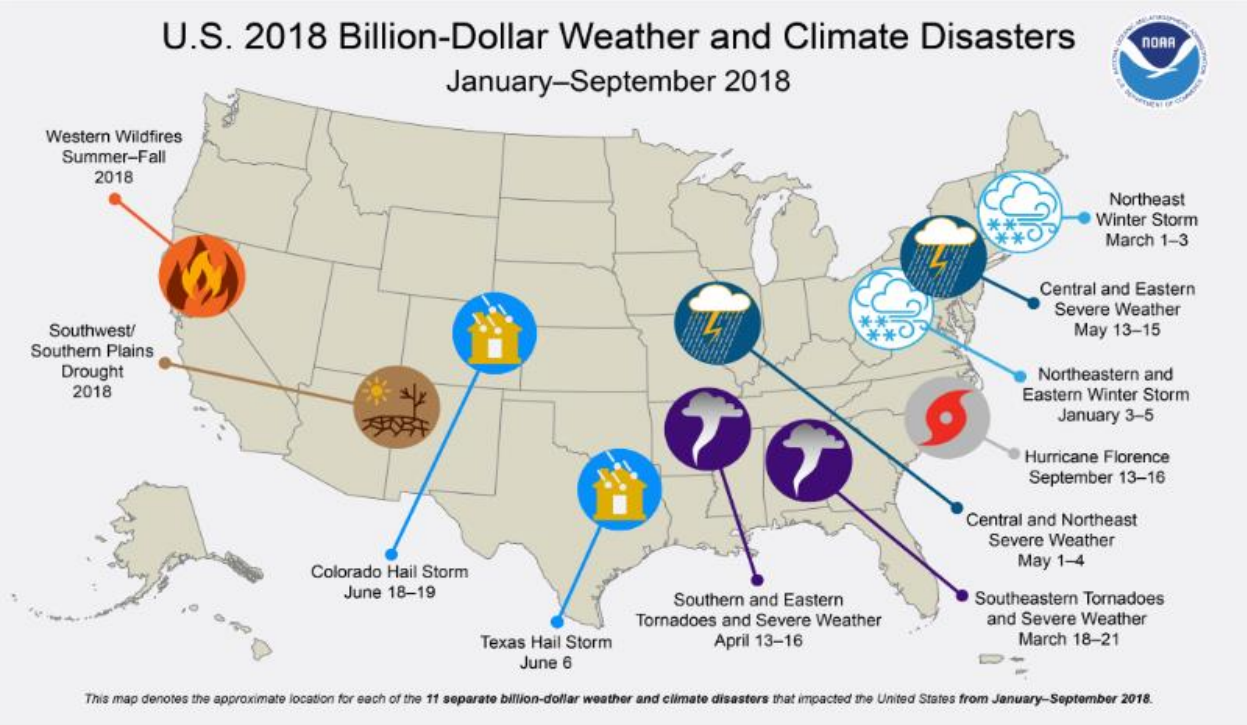


Figure 7: Billion Dollar Disasters



Source: NOAA, 2018

Figure 8: Billion Dollar Weather and Climate Disasters

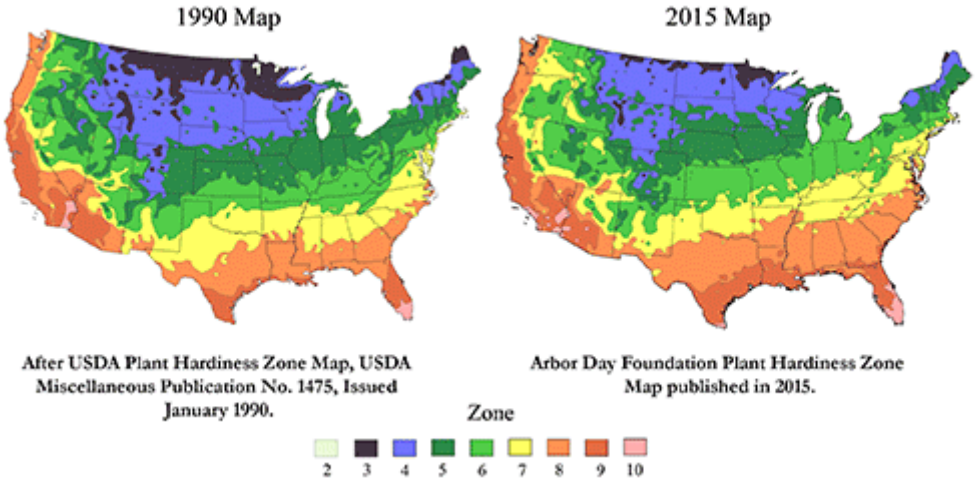


During the first 9 months of 2018, the U.S. has experienced an active year of billion-dollar disaster events. During 2018, the U.S. has experienced the fourth highest total number of events, only behind the very active years of 2017, 2011 and 2016.

Source: NOAA, 2018

These trends will have a direct impact on water and energy demands. As the number of 100°F days increase, along with warming nights, the stress placed on the energy grid will likely increase and possibly lead to more power outages. Critical facilities and vulnerable populations that are not prepared to handle periods of power outages, particularly during heat waves, will be at risk. Furthermore, the agricultural sector will experience an increase in droughts, an increase in grass and wildfires, changes in the growth cycle as winters warm, and changes in the timing and magnitude of rainfall. These added stressors on agriculture could have devastating economic effects if new agricultural and livestock management practices are not adopted.

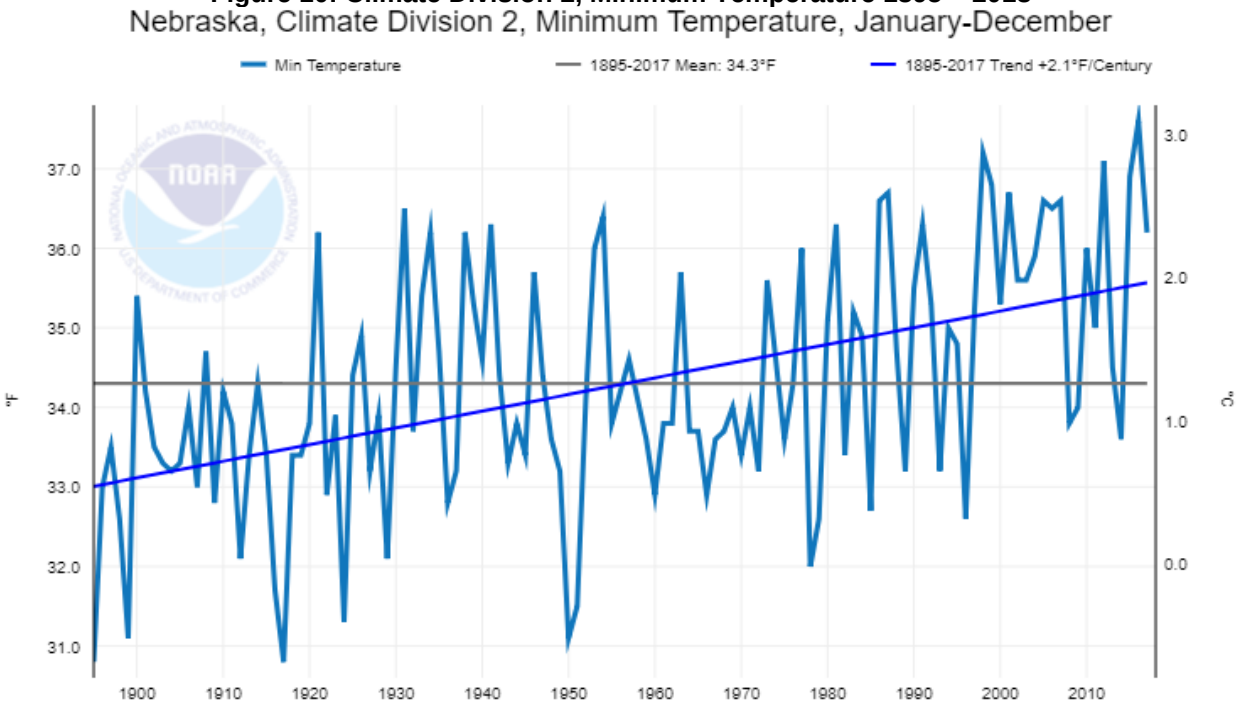
Figure 9: Plant Hardiness Zone Change



Source: Arbor Day Foundation, 2018[32]

Figure 10 shows a trend of increasing minimum temperatures in Climate Division 2, which includes the planning area. High nighttime temperatures can reduce grain yields, increase stress on animals, and lead to an increase in heat-related deaths.

Figure 10: Climate Division 2, Minimum Temperature 1895 – 2018



Source: NOAA, 2019

The planning area will have to adapt to these changes or experience an increase in economic losses, loss of life, property damages, and agricultural damages. HMPs have typically been informed by *past* events in order to be more resilient to future events, and this HMP includes strategies for the planning area to address these changes and increase resilience. However, future updates to this plan should consider including adaptation as a core strategy to be better informed by *future* projections on the frequency, intensity, and distribution of hazards as well.

[32] Arbor Day Foundation. 2018. "Hardiness Zones." https://www.arborday.org/media/map_change.cfm.

HAZARD PROFILES

Based on research and experiences of the participating jurisdictions, the hazards profiled were determined to either have a historical record of occurrence or the potential for occurrence in the future. As the planning area is generally uniform in climate, topography, building characteristics, and development trends, overall hazards and vulnerability do not vary greatly across the planning area. The following profiles will broadly examine the identified hazards across the region. Hazards of local concern or events which have deviated from the norm are discussed in greater detail in its respective community profile (see *Section Seven* of this plan).

AGRICULTURAL ANIMAL AND PLANT DISEASE

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

The economy of the state of Nebraska is heavily vested in both livestock and crop sales. According to the Nebraska Department of Agriculture (NDA) in 2012, the market value of agricultural products sold was estimated at more than $23 billion; this total is split between crops (estimated $11.37 billion) and livestock (estimated $11.69 billion). For the planning area, the market value of sold agricultural products exceeded $145 million.[33]

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

Table 32: Livestock Inventory

County	Market Value of 2012 Livestock Sales	Cattle and Calves	Hogs and Pigs	Poultry Egg Layers	Sheep and Lambs
Blaine	$29,015,000	26,085	(D)	116	(D)
Grant	(D)	23,839	0	(D)	(D)
Hooker	$15,382,000	14,267	68	56	0
Logan	$15,764,000	17,326	0	246	(D)
Thomas	(D)	15,661	(D)	100	0
Total	**$60,161,000**	**97,178**	**68**	**518**	**0**

Source: U.S. Census of Agriculture, 2012
**(D) Withheld to avoid disclosing data for individual farms*

According to the NDA, the primary crops grown throughout the state include alfalfa, corn, sorghum, soybeans, and wheat. However, the majority of the planning area is comprised of ranchland and forage acreage. The following tables provide the value and acres of land in farms for the planning area.

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

County	Number of Farms	Land in Farms (acres)	Market Value of 2012 Crop Sales
Blaine	117	402,530	$5,641,000
Grant	80	493,352	(D)
Hooker	82	436,820	$1,879,000
Logan	149	330,151	$26,232,000
Thomas	87	367,535	(D)
Total	**515**	**$2,030,388**	**$33,752,000**

Source: U.S. Census of Agriculture, 2012
**(D) Withheld to avoid disclosing data for individual farms*

[33] US Department of Agriculture, National Agricultural Statistics Server. 2012. "2012 Census of Agriculture – County Data."

Table 34: Crop Values

County	Corn		Soybeans		Wheat	
	Acres Planted	Value (2012)	Acres Planted	Value (2012)	Acres Planted	Value (2012)
Blaine	2,491	(D)	(D)	(D)	-	-
Grant	-	-	-	-	-	-
Hooker	-	-	-	-	-	-
Logan	22,904	$19,539,000	3,818	$2,479,000	859	(D)
Thomas	1,638	$1,596,000	-	-	-	-
Total	27,033	$21,135,000	3,818	$2,479,000		

Source: U.S. Census of Agriculture, 2012
**(D) Withheld to avoid disclosing data for individual farms*

LOCATION

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

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

HISTORICAL OCCURRENCES

ANIMAL DISEASE

The NDA provides reports on diseases occurring in the planning area. There were 14 instances of animal diseases reported between January 2014 and September 2018 by the NDA (Table 35). These outbreaks affected 63 animals.

Table 35: Livestock Diseases Reported in the Planning Area

Year	County	Disease	Population Impacted
2014	Grant	Blue Tongue	1
2014	Grant	Paratuberculosis	1
2014	Logan	Enzootic Bovine Leukosis	1
2016	Grant	Paratuberculosis	3
2016	Grant	Leptospirosis	1
2016	Hooker	Blue Tongue	1
2016	Hooker	Paratuberculosis	1
2016	Logan	Enzootic Bovine Leukosis	1
2017	Grant	Paratuberculosis	5
2017	Logan	Enzootic Bovine Leukosis	1
2018	Grant	Paratuberculosis	5
2018	Grant	Leptospirosis	1
2018	Thomas	Paratuberculosis	40
2018	Thomas	Leptospirosis	1

Source: Nebraska Department of Agriculture, January 2014- Sept 2018[34]

[34] Nebraska Department of Agriculture. 2018. "Livestock Disease Reporting." http://www.nda.nebraska.gov/animal/reporting/index.html.

Plant Disease

A variety of diseases can impact crops and often vary from year to year. The NDA provides information on some of the most common plant diseases, which are listed below.

Table 36: Common Crop Diseases in Nebraska by Crop Types

CROP DISEASES		
Corn	Anthracnose	Southern Rust
	Bacterial Stalk Rot	Stewart's Wilt
	Common Rust	Common Smut
	Fusarium Stalk Rot	Gross's Wilt
	Fusarium Root Rot	Head Smut
	Gray Leaf Spot	Physoderma
	Maize Chlorotic Mottle Virus	
Soybeans	Anthracnose	Pod and Stem Blight
	Bacterial Blight	Purple Seed Stain
	Bean Pod Mottle	Rhizoctonia Root Rot
	Brown Spot	Sclerotinia Stem Rot
	Brown Stem Rot	Soybean Mosaic Virus
	Charcoal Rot	Soybean Rust
	Frogeye Leaf Spot	Stem Canker
	Phytophthora Root and Stem Rot	Sudden Death Syndrome
Wheat	Barley Yellow Dwarf	Leaf Rust
	Black Chaff	Tan Spot
	Crown and Root Rot	Wheat Soy-borne Mosaic
	Fusarium Head Blight	Wheat Streak Mosaic
Sorghum	Ergot	Zonate Leaf Spot
	Sooty Stripe	

Average Annual Losses

According to the USDA RMA (2000-2018) there were no plant disease events or damages for the planning area. This does not mean that plant disease outbreaks did not occur, simply that they were not recorded. Additionally, Grant County and Hooker County do not have RMA data available. The RMA also does not track losses for livestock, so it is not possible to estimate losses due to animal disease.

Extent

There is no standard for measuring the magnitude of agricultural disease. Historical events have impacted a relatively small numbers of livestock and/or crops. The planning area is heavily dependent on the agricultural economy. Any severe plant or animal disease outbreak which may impact this sector would negatively impact the entire planning area.

Probability

Given the historic record of occurrence for animal disease (eight outbreaks reported in five years) and the role of agriculture in the planning area, for the purposes of this plan, the annual probability of agricultural disease occurrence is 100 percent.

Regional Vulnerabilities

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

Table 37: Regional Agricultural Vulnerabilities

SECTOR	VULNERABILITY
PEOPLE	-Those in direct contact with infected livestock -Potential food shortage during prolonged events -Residents in poverty if food prices increase
ECONOMIC	-Regional economy is reliant on the agricultural industry -Large scale or prolonged events may impact tax revenues and local capabilities -Land value may largely drive population changes within the planning area
BUILT ENVIRONMENT	None
INFRASTRUCTURE	-Transportation routes can be closed during quarantine
CRITICAL FACILITIES	None

CHEMICAL FIXED SITES

The following description for hazardous materials is provided by FEMA:

> Chemicals are found everywhere. They purify drinking water, increase crop production and simplify household chores. But chemicals also can be hazardous to humans or the environment if used or released improperly. Hazards can occur during production, storage, transportation, use or disposal. You and your community are at risk if a chemical is used unsafely or released in harmful amounts into the environment where you live, work or play.[35]

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

Chemical manufacturers are one source of hazardous materials, but there are many others, including service stations, hospitals, and hazardous materials waste sites.

Varying quantities of hazardous materials are manufactured, used, or stored in an estimated 4.5 million facilities in the United States—from major industrial plants to local dry-cleaning establishments or gardening supply stores.

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

The Environmental Protection Agency (EPA) requires the submission of the types and locations of hazardous chemicals being stored at any facility within the state over the previous calendar year. This is completed by submitting a Tier II form to the EPA as a requirement of the Emergency Planning and Community Right-to-Know Act of 1986.[36]

Fixed-sites are those that involve chemical manufacturing sites and stationary storage facilities. Table 35 demonstrates the nine classes of hazardous material according to the 2016 Emergency Response Guidebook.

[35] Federal Emergency Management Agency. 2017. "Hazardous Materials Incidents." https://www.ready.gov/hazardous-materials-incidents.
[36] Emergency Planning and Community Right-to-Know Act of 1986, Pub. L. No. 116 § 10904. 1986.

Table 38: Hazardous Material Classes

CLASS	TYPE OF MATERIAL	DIVISIONS
1	Explosives	Division 1.1 – Explosives with a mass explosion hazard Division 1.2 – Explosives with a projection hazard but not a mass explosion hazard Division 1.3 – Explosives which have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard Division 1.4 – Explosives which present no significant blast hazard Division 1.5 – Very insensitive explosives with a mass explosion hazard Division 1.6 – Extremely insensitive articles which do not have a mass explosion hazard
2	Gases	Division 2.1 – Flammable gases Division 2.2 – Non-flammable, non-toxic gases Division 2.3 – Toxic gases
3	Flammable liquids (and Combustible liquids)	
4	Flammable solids; Spontaneously combustible materials	Division 4.1 – Flammable solids, self-reactive substances and solid desensitized explosives Division 4.2 – Substances liable to spontaneous combustion Division 4.3 – Substances which in contact with water emit flammable gases
5	Oxidizing substances and Organic peroxides	Division 5.1 – Oxidizing substances Division 5.2 – Organic peroxides
6	Toxic substances and infections substances	Division 6.1 – Toxic substances Division 6.2 – Infectious substances
7	Radioactive materials	
8	Corrosive materials	
9	Miscellaneous hazardous materials/products, substances, or organisms	

Source: Emergency Response Guidebook, 2016[37]

LOCATION

There are 11 locations across the planning area that house hazardous materials, according to the Tier II reports submitted to the Nebraska Department of Environmental and Energy (NDEE) in 2017. The following table lists all hazardous chemical fixed sites and a listing of chemical storage sites can be found in *Section Seven: Community Profiles* for each jurisdiction.

Table 39: Livestock Diseases Reported in the Planning Area

Facility Name	County	Address
Guggenmos River Ranch Ltd	Blaine	43778 N Pleasant Valley Rd, Brewster
Great Western Gas Co	Blaine	Jct Highways 91 & 7, Brewster
NDOT Hyannis Yard	Grant	401 E Highway 2, Hyannis
Grant County Airport	Grant	306 N Bal St, Hyannis
K S Plus Inc	Hooker	202 SW 1st St, Mullen

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

NDOT Mullen Yard	Hooker	402 SE 1st St, Mullen
Neal Oil & Auto Center Inc	Hooker	E Railroad St, Mullen
Country Partners Cooperative	Logan	34 Highway 83, Stapleton
Eastside Service	Logan	504 3rd St, Stapleton
Frey Propane Inc	Logan	Old Slaughterhouse Rd, Stapleton
NDOT Stapleton Yard	Logan	122 Highway S57A, Stapleton

Source: NDEE, 2018[38]

Extent

The extent of chemical spills at fixed sites varies and depends on the type of chemical that is released. According to the U.S. Coast Guard's National Response Center (NRC) database, there have been no fixed site releases in the planning area. Based on historic records, it is likely that any spill involving hazardous materials will not affect an area larger than a quarter mile from the spill location.

Historical Occurrences

Chemical Fixed Sites

According to the NRC database, there have been no fixed site chemical spills between January 1990 – June 2018 in the planning area.

Average Annual Damages

As there were no chemical fixed site events in the planning area, it is not possible to determine average annual damages.

Probability

Chemical releases at fixed site storage areas are not likely in the future. Given the historic record of occurrence (zero chemical fixed site spills reported in 29 years), the probability of occurrence for chemical fixed site spills is less than one percent annually.

Regional Vulnerabilities

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

Table 40: Regional Chemical Fixed Site Vulnerabilities

SECTOR	VULNERABILITY
PEOPLE	-Those in close proximity could have minor to moderate health impacts -Possible evacuation -Hospitals, nursing homes, and the elderly at greater risk due to low mobility
ECONOMIC	-A chemical plant shutdown in smaller communities would have significant impacts to the local economy -A long-term evacuation of the emergency planning zone (EPZ) would have a negative effect on the economy in the area
BUILT ENVIRONMENT	-Risk of fire or explosion
INFRASTRUCTURE	-Transportation routes can be closed during evacuations
CRITICAL FACILITIES	-Critical facilities are at risk of evacuation

[38] Nebraska Department of Environmental Quality. January 2018. "Nebraska DEQ Tier 2 Data Download: Blaine, Grant, Hooker, Logan, Thomas County 2017." https://deq-iis.ne.gov/tier2/tier2Download.html..

CHEMICAL TRANSPORTATION

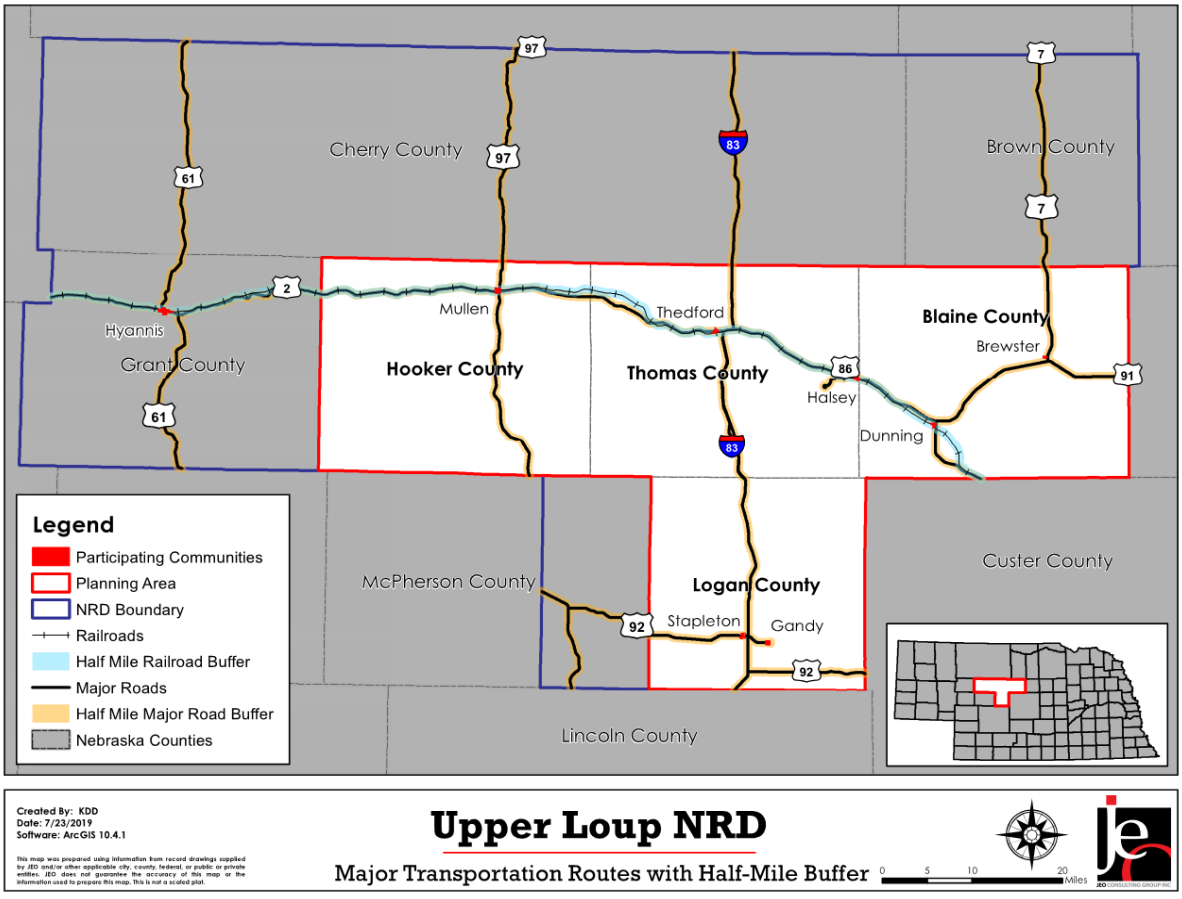
The transportation of hazardous materials is defined by the U.S. Pipeline and Hazardous Materials Safety Administration (PHMSA) as "…a substance that has been determined to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce…"[39] According to PHMSA, hazardous materials traffic in the U.S. now exceeds 1,000,000 shipments per day.[40]

Nationally, the U.S. has had 116 fatalities associated with the transport of hazardous materials between 2007 through 2017.[41] While such fatalities are a low probability risk, even one event can harm many people. For example, a train derailment in Crete, Nebraska in 1969 allowed anhydrous ammonia to leak from a rupture tanker. The resulting poisonous fog killed nine people and injured 53.

LOCATION

Chemical releases can occur during transportation, primarily on major transportation routes as identified in Figure 11. A large number of spills also typically occur during the loading and unloading of chemicals. Participating communities specifically reported transportation along railroads as having the potential to impact communities. Railroads providing service through the planning area have developed plans to respond to chemical release along rail routes. According to PHMSA there are no gas transmission or hazardous liquid pipelines located in the planning area.[42]

Figure 11: Major Transportation Routes with Half Mile Buffer



39 Pipeline and Hazardous Materials Safety Administration. 2018. "Hazmat Safety Community FAQ." https://phmsa.dot.gov/regulations.
40 U.S. Department of Transportation. 2015. "2012 Economic Census: Transportation." https://www.census.gov/econ/cfs/2012/ec12tcf-us-hm.pdf.
41 Pipeline and Hazardous Materials Safety Administration. 2017. "10 Year Incident Summary Reports." https://www.phmsa.dot.gov/hazmat/library/data-stats/incidents.
42 Pipeline and Hazardous Materials Safety Administration. 2019. "National Pipeline Mapping System." https://www.npms.phmsa.dot.gov/.

EXTENT

The probable extent of chemical spills during transportation is difficult to anticipate and depends on the type and quantity of chemical released. Releases that have occurred during transportation in the planning area ranged from zero to 8,800 liquid gallons (LGA). One event led to injuries to a driver.

HISTORICAL OCCURRENCES

PHMSA reports that eight chemical spills occurred during transportation in the planning area between 1980 and 2018. During these events, there were no fatalities, one injury, and $80,826 in damages.

The following table provides a list of historical chemical spills during transportation in the planning area.

Table 41: Historical Chemical Spills 1980-2018

Date of Event	Location of Release	Failure Description	Material Involved	Method of Transportation	Amount in Gallons	Total Damage	Injuries (Yes/No)
5/18/2001	Grant County	Loose Closure Component or Device	Flammable Liquids	Highway	0	$0	No
1/7/2015	Hyannis	Valve Open	Argon	Rail	0	$0	No
4/12/2006	Thedford	Loose Closure Component or Device	Ammonium Fertilizer	Rail	0.5	$3,202	No
9/17/2006	Dunning	Vehicular Crash or Accident Damage	Phosphoric Acid	Highway	9	$12,425	No
11/2/2015	Hooker County	Improper Preparation for Transportation	Fuel	Rail	46	$4,675	No
1/16/2001	Hyannis	Loose Closure Component or Device; Derailment	Fuel	Rail	50	$4,550	No
6/18/1996	Mullen	Unknown	Gasoline	Highway	100	$2,150	No
4/2/1990	Thedford	Rollover Accident; Vehicular Crash or Accident Damage	Gasoline	Highway	8,800	$53,824	Yes – 1

Source: PHMSA, April 1980– December 2018[43]

AVERAGE ANNUAL DAMAGES

The average damage per event estimate was determined based upon PHMSA's Incidents Reports since 1980 and the number of historical occurrences. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. This hazard causes an average of $2,072 per year in property damages.

[43] Pipeline and Hazardous Materials Safety Administration. 2018. "Office of Hazardous Materials Safety: Incident Reports Database Search." Accessed December 6, 2018. https://www.phmsa.dot.gov/hazmat/library/data-stats/incidents.

Table 42: Chemical Transportation Losses

Hazard Type	Number of Events	Events Per Year	Total Property Loss	Average Annual Property Loss
Chemical Transportation Spills	8	0.2	$80,826	$2,072

Source: PHMSA April 1980 – December 2018

PROBABILITY

The historical record indicates that chemical releases during transport have a 20 percent chance of occurring annually in the planning area, with eight events over a 39-year period.

REGIONAL VULNERABILITIES

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

Table 43: Regional Chemical Transportation Vulnerabilities

SECTOR	VULNERABILITY
PEOPLE	-Those in close proximity to transportation corridors -Possible evacuation -Hospitals, nursing homes, and the elderly at greater risk due to low mobility
ECONOMIC	-Evacuations and closed transportation routes could impact businesses near spill
BUILT ENVIRONMENT	-Risk of fire or explosion
INFRASTRUCTURE	-Transportation routes can be closed
CRITICAL FACILITIES	-Critical facilities near major transportation corridors are at risk

CIVIL DISORDER

Civil disorder is a broad term that is typically used by law enforcement to describe a group of people/ protesting major socio-political problems by choosing not to observe a law or regulation. Though peaceful public demonstrations are allowed under US Federal law, any domestic situations such as a strike or riot involving three or more people could be considered civil disorder if the demonstration has devolved into having a potential for causing injuries, casualties, or property damage.[44]

U.S. Code on civil disorder considers the following actions to be civil disorder:

(1) Whoever teaches or demonstrates to any other person the use, application, or making of any firearm or explosive or incendiary device, or technique capable of causing injury or death to persons, knowing or having reason to know or intending that the same will be unlawfully employed for use in, or in furtherance of, a civil disorder which may in any way or degree obstruct, delay, or adversely affect commerce or the movement of any article or commodity in commerce or the conduct or performance of any federally protected function; or
(2) Whoever transports or manufactures for transportation in commerce any firearm, or explosive or incendiary device, knowing or having reason to know or intending that the same will be used unlawfully in furtherance of a civil disorder; or
(3) Whoever commits or attempts to commit any act to obstruct, impede, or interfere with any fireman or law enforcement officer lawfully engaged in the lawful performance of his official duties incident to and during the commission of a civil disorder which in any way or degree obstructs, delays, or adversely affects commerce or the movement of any article or commodity in commerce or the conduct or performance of any federally protected function

Threat assessment, mitigation, and response to civil disorder are federal and state directives that work in conjunction with local law enforcement. Civil disorder is addressed at the federal level by the US Department of Homeland Security and at the state level by the Nebraska Emergency Management Agency.

LOCATION

Civil disorder can occur throughout the entire planning area. Urban areas are more likely to see protesters, while rural areas may experience environmental justice protesters. Local concerns centered around the vulnerability of water systems located throughout the planning area and the tampering of water supplies.

EXTENT

Incidents of civil disorder can vary greatly in scale and magnitude, depending on the location of the attack, number of protesters, and reasoning for unrest.

HISTORICAL OCCURRENCES

To identify any incidence of civil disorder events, the University of Illinois Social, Political and Economic Event Database Project (SPEED), maintained since the end of World War II (1946-2018) was consulted.[45] For any identified events, details of the incidents were found in the Global Terrorism Database between 1970-2018, as maintained by the University of Maryland and National Consortium for the Study of Terrorism and Responses to Terrorism (START) database and archival newspaper reports. [46] According to these sources database, there have been no civil disorder events in the planning area. The Planning Team did not report any accounts of water supplies being tampered with to date.

[44] Civil Disorders, 18 U.S. Code § 231-233 (1992)
[45] The Social, Political and Economic Event Database Project (SPEED). 2018. Event Data File [Data file]. Retrieved from https://clinecenter.illinois.edu/project/human-loop-event-data-projects/SPEED.
[46] National Consortium for the Study of Terrorism and Responses to Terrorism (START). 2016. Global Terrorism Database [Data file]. Retrieved from https://www.start.umd.edu/gtd.

AVERAGE ANNUAL DAMAGES

According to the START Global Terrorism Database (1970-2018) and the SPEED database of civil disorder events (1946-2018), there have been no civil disorder events that have occurred in the planning area. As there were no terrorist events within the planning area, there were no average annual damages.

PROBABILITY

Given zero incidences over a 74-year period, the annual probability for civil disorder in the planning area has a less than one percent chance of occurring during any given year. This does not indicate that an event will never occur within the planning area, only that the likelihood of such an event is incredibly low.

REGIONAL VULNERABILITIES

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

Table 44: Regional Civil Disorder Vulnerabilities

SECTOR	VULNERABILITY
PEOPLE	-Police officers and first responders at risk of injury or death -Protestors and civilians at risk of injury or death
ECONOMIC	-Damaged businesses can cause loss of revenue and loss of income for workers -Agricultural attacks could cause significant economic losses for the region -Severe civil disorder events are often accompanied by looting -Risk of violence in an area can reduce income flowing into and out of that area
BUILT ENVIRONMENT	-Targeted buildings may sustain heavy damage -Public property may be at risk of damage
INFRASTRUCTURE	-Water supply, power plants, utilities may be damaged -Public property including signs, community art, or public park facilities may be at risk to damage
CRITICAL FACILITIES	-Police stations and government offices are at a higher risk

DAM FAILURE

According to the Nebraska Administrative Code, dams are "any artificial barrier, including appurtenant works, with the ability to impound water, wastewater, or liquid-borne materials and which is:

- twenty-five feet or more in height from the natural bed of the stream or watercourse measured at the downstream toe of the barrier, or from the lowest elevation of the outside limit of the barrier if it is not across a stream channel or watercourse, to the maximum storage elevation or
- has an impounding capacity at maximum storage elevation of fifty acre-feet or more, except that any barrier described in this subsection which is not in excess of six feet in height or which has an impounding capacity at maximum storage elevation of not greater than fifteen acre-feet shall be exempt, unless such barrier, due to its location or other physical characteristics, is classified as a high hazard potential dam.

Dams do not include:

- an obstruction in a canal used to raise or lower water;
- a fill or structure for highway or railroad use, but if such structure serves, either primarily or secondarily, additional purposes commonly associated with dams it shall be subject to review by the department;
- canals, including the diversion structure, and levees; or
- water storage or evaporation ponds regulated by the United States Nuclear Regulatory Commission."[47]

The NeDNR uses a classification system for dams throughout the state, including those areas participating in this plan. The classification system includes three classes, which are defined in the table below.

Table 45: Dam Size Classification

SIZE	EFFECTIVE HEIGHT (FEET) X EFFECTIVE STORAGE (ACRE-FEET)	EFFECTIVE HEIGHT
SMALL	≤ 3,000 acre-feet	and ≤ 35 feet
INTERMEDIATE	> 3,000 acre-feet to < 30,000 acre-feet	or > 35 feet
LARGE	≥ 30,000 acre-feet	Regardless of Height

Source: NeDNR, 2013[48]

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

[47] Nebraska Department of Natural Resources. "Department of Natural Resources Rules for Safety of Dam and Reservoirs." Nebraska Administrative Code, Title 458, Chapter 1, Part 001.09.

[48] Nebraska Department of Natural Resources. 2013. "Classification of Dams: Dam Safety Section." https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/dam-safety/resources/Classification-Dams.pdf.

Dam failure, as a hazard, is described as a structural failure of a water impounding structure. Structural failure can occur during extreme conditions, which include, but are not limited to:

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

The NeDNR regulates dam safety and has classified dams by the potential hazard each poses to human life and economic loss. The following are classifications and descriptions for each hazard class:

- **Minimal Hazard Potential** - failure of the dam expected to result in no economic loss beyond the cost of the structure itself and losses principally limited to the owner's property.

- **Low Hazard Potential** - failure of the dam expected to result in no probable loss of human life and in low economic loss. Failure may damage storage buildings, agricultural land, and county roads.

- **Significant Hazard Potential** - failure of the dam expected to result in no probable loss of human life but could result in major economic loss, environmental damage, or disruption of lifeline facilities. Failure may result in shallow flooding of homes and commercial buildings or damage to main highways, minor railroads, or important public utilities.

- **High Hazard Potential** - failure of the dam expected to result in loss of human life is probable. Failure may cause serious damage to homes, industrial or commercial buildings, four-lane highways, or major railroads. Failure may cause shallow flooding of hospitals, nursing homes, or schools.

In total, there are three dams located within the planning area, with classifications of Low and Minimal Hazard. Two dams are rated low with the remaining one classified as minimal hazard level. Figure 12 maps the location of these dams in the planning area.

Table 46: Dams in the Planning Area

County	Minimal Hazard	Low Hazard	Significant Hazard	High Hazard
Blaine	0	1	0	0
Grant	0	0	0	0
Hooker	0	0	0	0
Logan	0	0	0	0
Thomas	1	1	0	0
Total	**1**	**2**	**0**	**0**

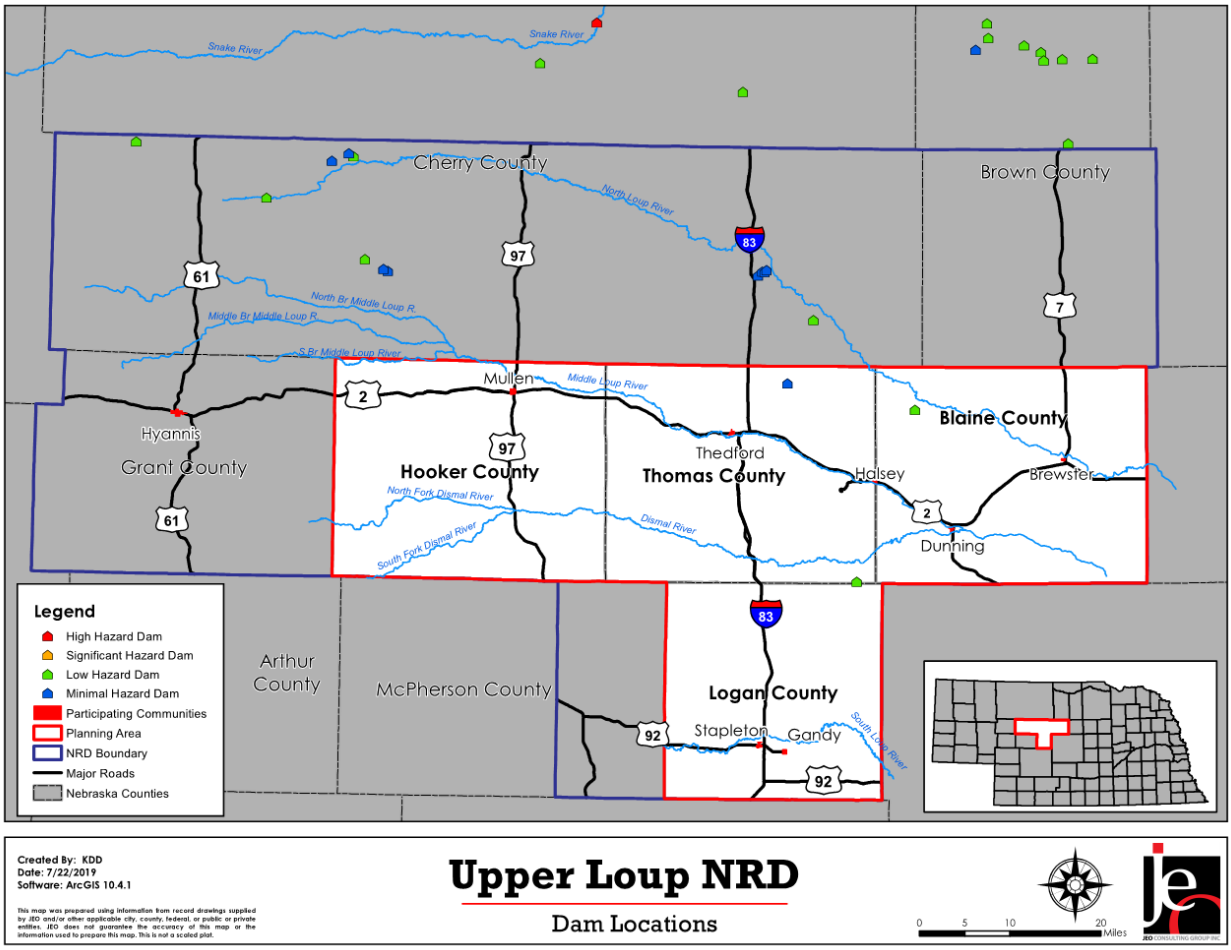
Source: NeDNR, 2018[49]
**The southern portions of Cherry County and Brown County are located within the NRD boundary, but outside of the planning area. Dams in these counties located outside of the Upper Loup NRD are not included here.*

Dams classified with high hazard potential require the creation of an Emergency Action Plan (EAP). The EAP defines responsibilities and provides procedures designed to identify unusual and unlikely conditions

[49] Nebraska Department of Natural Resources. 2018. "Nebraska Dam Inventory." https://dnr.nebraska.gov/dam-safety/nebraska-dam-inventory.

which may endanger the structural integrity of the dam within sufficient time to take mitigating actions and to notify the appropriate emergency management officials of possible, impending, or actual failure of the dam. The EAP may also be used to provide notification when flood releases will create major flooding. An emergency situation can occur at any time; however, emergencies are more likely to happen when extreme conditions are present. While there are no high hazard dams located within the planning area, there is one high hazard dam in Cherry County north of the planning area.

Figure 12: Dam Locations



No dams in the planning area or surrounding areas are included in the 2014 Nebraska State HMP's list of "Top 30 Ranked High Hazard Dams Based on Population at Risk."

Upstream Dams Outside the Planning Area

According to the Counties' Local Emergency Operations Plan (LEOPs),[50][51][52][53] there are no upstream dams which could affect the planning area.

[50] Thomas County Emergency Management Agency. March 2015. "Thomas County Nebraska Local Emergency Operations Plan."
[51] Hooker County Emergency Management Agency. May 2015. "Hooker County Nebraska Local Emergency Operations Plan."
[52] Blaine County Emergency Management Agency. 2015. "Blaine County Nebraska Local Emergency Operations Plan."
[53] Logan County Emergency Management Agency. 2019. "Logan County Nebraska Local Emergency Operations Plan."

LOCATION
Areas (i.e. agricultural land, out buildings, and county roads) downstream of a dam in Blaine and Thomas Counties, are at greatest risk of dam failure. There are no dams in the planning area located in direct proximity to communities. Additionally, dam owners and the NeDNR have opted, at this time, to not include dam breach maps or inundation maps in hazard mitigation plans due to the sensitive nature of this information. Requests can be made of the dam owner or the Dam Safety Division of NeDNR to view an inundation map specific to a dam.

EXTENT
Inundation maps are not made publicly available for security reasons and there are no high hazard dams in the planning area. Any dam that were to fail in the planning area would likely produce minimal damages.

HISTORICAL OCCURRENCES
According to the Stanford University National Performance of Dams Program, there have been no dam failure events within the planning area.[54]

AVERAGE ANNUAL DAMAGES
Due to lack of data and the sensitive nature of this hazard, potential losses are not calculated for this hazard. However, as the dams located within the planning area are low or minimal hazard dams, a failure would be confined to damage of storage buildings, agricultural land, and county roads. Community members in the planning area that wish to quantify the threat of dam failure should contact their County Emergency Management, ULNRD, or the NeDNR.

PROBABILITY
For the purpose of this plan, the probability of dam failure will be stated at less than one percent annually as no dams have failed in the planning area over the past 100 years.

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

Table 47: Regional Dam Failure Vulnerabilities

SECTOR	VULNERABILITY
PEOPLE	-None as there are no significant or high hazard dams within the planning area and existing dams in the planning area are not located near residential areas or communities
ECONOMIC	-Loss of downstream agricultural land
BUILT ENVIRONMENT	-Damage to storage and out buildings
INFRASTRUCTURE	-Rural county transportation routes could be closed for extended period of time
CRITICAL FACILITIES	-None

[54] Stanford University. 1911-2016. "National Performance of Dams Program Dam Incident Database." Accessed August 2017. http://npdp.stanford.edu/dam_incidents.

DROUGHT

Drought is generally defined as a natural hazard that results from a substantial period of below normal precipitation. Although many erroneously consider it a rare and random event, drought is a normal, recurrent feature of climate. It occurs in virtually all climatic zones, but its characteristics vary significantly from one region to another. A drought often coexists with periods of extreme heat, which together can cause significant social stress, economic losses, and environmental degradation.

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

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

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

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

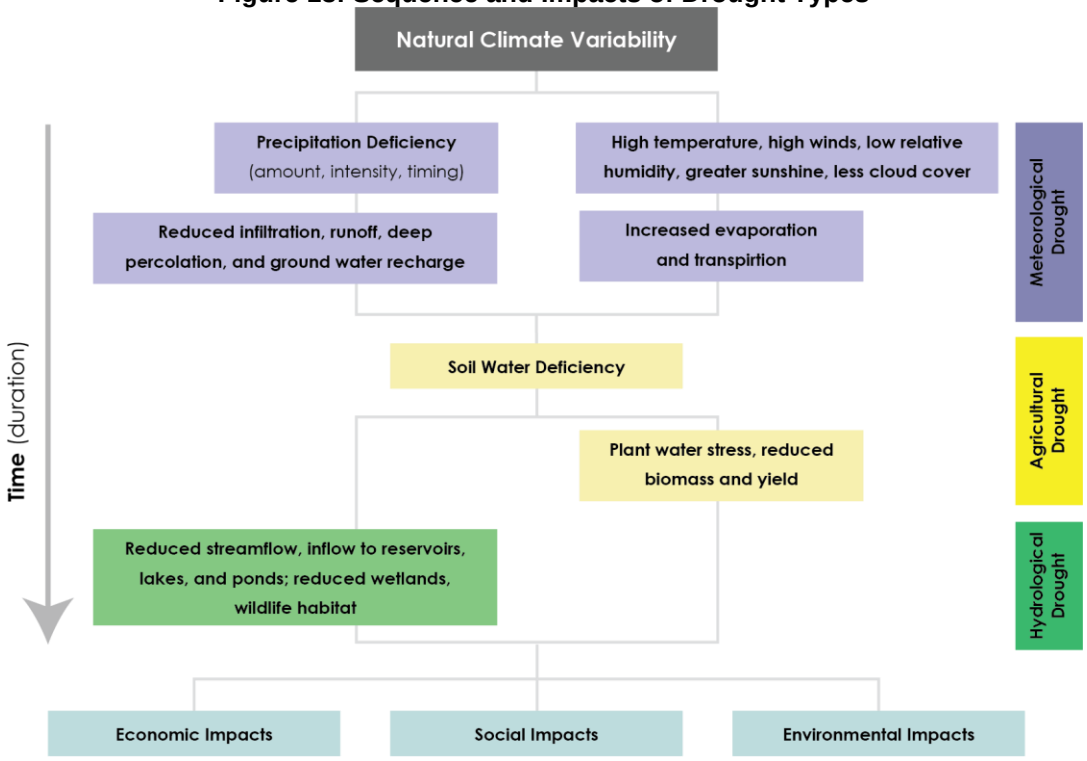
- **Hydrologic Drought** – occurs when water available in aquifers, lakes, and reservoirs falls below the statistical average. This situation can arise even when the area of interest receives average precipitation. This is due to the reserves diminishing from increased water usage, usually from agricultural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

- **Socioeconomic Drought** – occurs when the demand for an economic good exceeds supply due to a weather-related shortfall in water supply. The supply of many economic goods includes, but are not limited to, water, forage, food grains, fish, and hydroelectric power.[55]

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

[55] National Drought Mitigation Center. 2017. "Drought Basics." http://drought.unl.edu/DroughtBasics.aspx.

Figure 13: Sequence and Impacts of Drought Types



Source: National Drought Mitigation Center, University of Nebraska-Lincoln, 2017[56]

HISTORICAL OCCURRENCES

The Palmer Drought Severity Index (PDSI) is utilized by climatologists to standardize global long-term drought analysis. The data for the planning area was collected for Climate Division 2, which includes the planning area. This particular station's period of record started in 1895. Figure 14 shows the data from this time period. The negative Y axis represents a drought, for which '-2' indicates a moderate drought, '-3' a severe drought, and '-4' an extreme drought. Table 48 shows the details of the Palmer classifications.

Table 48: Palmer Drought Severity Index Classification

NUMERICAL VALUE	DESCRIPTION	NUMERICAL VALUE	DESCRIPTION
4.0 or more	Extremely wet	-0.5 to -0.99	Incipient dry spell
3.0 to 3.99	Very wet	-1.0 to -1.99	Mild drought
2.0 to 2.99	Moderately wet	-2.0 to -2.99	Moderate drought
1.0 to 1.99	Slightly wet	-3.0 to -3.99	Severe drought
0.5 to 0.99	Incipient wet spell	-4.0 or less	Extreme drought
0.49 to -0.49	Near normal	--	--

Source: Climate Prediction Center[57]

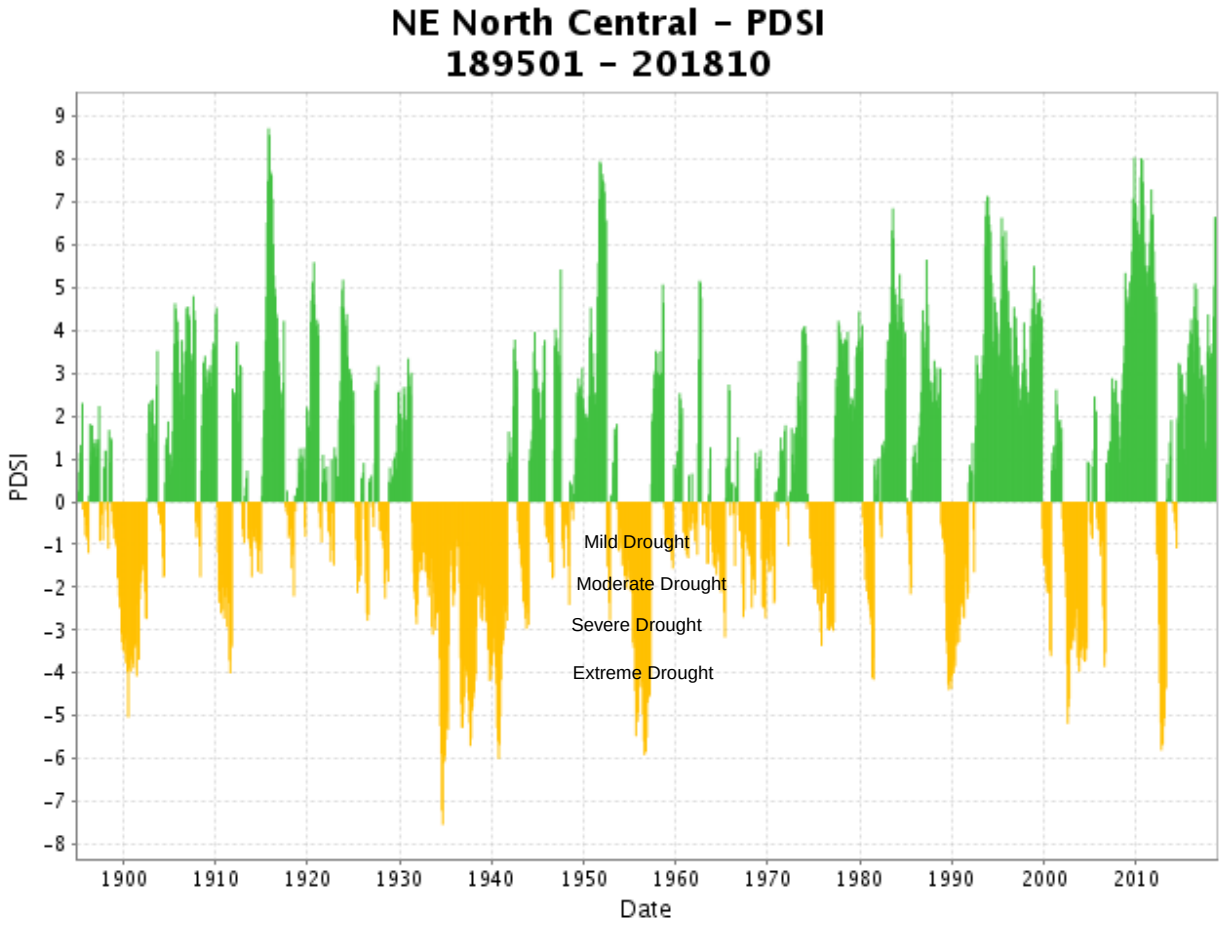
[56] National Drought Mitigation Center. 2017. "Types of Drought." http://drought.unl.edu/DroughtBasics/TypesofDrought.aspx.
[57] National Weather Service. 2017. "Climate Prediction Center." http://www.cpc.noaa.gov/.

Table 49: Historic Droughts

DROUGHT MAGNITUDE	MONTHS IN DROUGHT	PERCENT CHANCE
-1 MAGNITUDE (MILD)	183/1,486	12.3%
-2 MAGNITUDE (MODERATE)	133/1,486	9.0%
-3 MAGNITUDE (SEVERE)	87/1,486	5.9%
-4 MAGNITUDE OR GREATER (EXTREME)	80/1,486	5.4%

Source: NCEI, Jan 1895-Oct 2018[58]

Figure 14: Palmer Drought Severity Index



Source: NCEI, Jan. 1895-Oct 2018

LOCATION

The entire planning area is susceptible to impacts resulting from drought.

EXTENT

Using the data from Table 49 it is reasonable to expect extreme drought to occur in 5.4 percent of years of months for the planning area (80 extreme drought months in 1,486 months). Severe drought occurred in 87 months of the 1,486 months of record (5.9 percent of months). Moderate drought occurred in 133 months of the 1,486 months of record (9.0 percent of months), and mild drought occurred in 183 of the 1,486 months of record (12.3 percent of months). Non-drought conditions (incipient dry spell, near normal, or incipient wet spell conditions) occurred in 332 months, or 22.3% percent of months. These statistics show that the drought conditions of the planning area are highly variable.

[58] National Centers for Environmental Information. 1895-2018. Accessed December 6, 2018. https://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp.

AVERAGE ANNUAL LOSSES

The annual property estimate was determined based upon NCEI Storm Events Database since 1996. The annual crop loss was determined based upon the RMA Cause of Loss Historical Database since 2000. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. Grant County and Hooker County do not have RMA data available.

Table 50: Loss Estimate for Drought

Hazard Type	Total Property Loss[1]	Average Annual Property Loss[1]	Total Crop Loss[2]	Average Annual Crop Loss[2]
Drought	$5,000,000	$217,391	$3,287,926	$173,049

Source: 1 Indicates data is from NCEI (January 1996 to July 2018); 2 Indicates data is from USDA RMA (2000 to 2018)

The extreme drought in 2012 significantly affected the agricultural sector of the state. According to the PDSI, 2012's average severity index was ranked at a -4.47, with extremes in August and September of -7.35 and -7.57 respectively. The Farm Credit Services reported total indemnity payments to Nebraska totaled $1.49 billion from crop loss. Cattle ranching is a large driver of the local planning area's economy. The 2012 drought forced ranchers to cull herds by as much as 60% to cope with reduced forage production with an estimated loss of $200 per head by taking cattle to market earlier than normal.[59]

The USDA reported a total of $139,957,809 in drought relief to Nebraska from 2008 to 2011 for all five disaster programs: Supplemental Revenue Assistance Payments (SURE); Livestock Forage Disaster Assistance Program (LFD); Emergency Assistance for Livestock, Honeybees, and Emergency Assistance for Livestock, Honey Bees, and Farm-Raised Fish Program (ELAP); Livestock Indemnity Program (LIP); and Tree Assistance Program (TAP).

PROBABILITY

The following table summarizes the magnitude of drought and monthly probability of occurrence.

Table 51: Period of Record in Drought

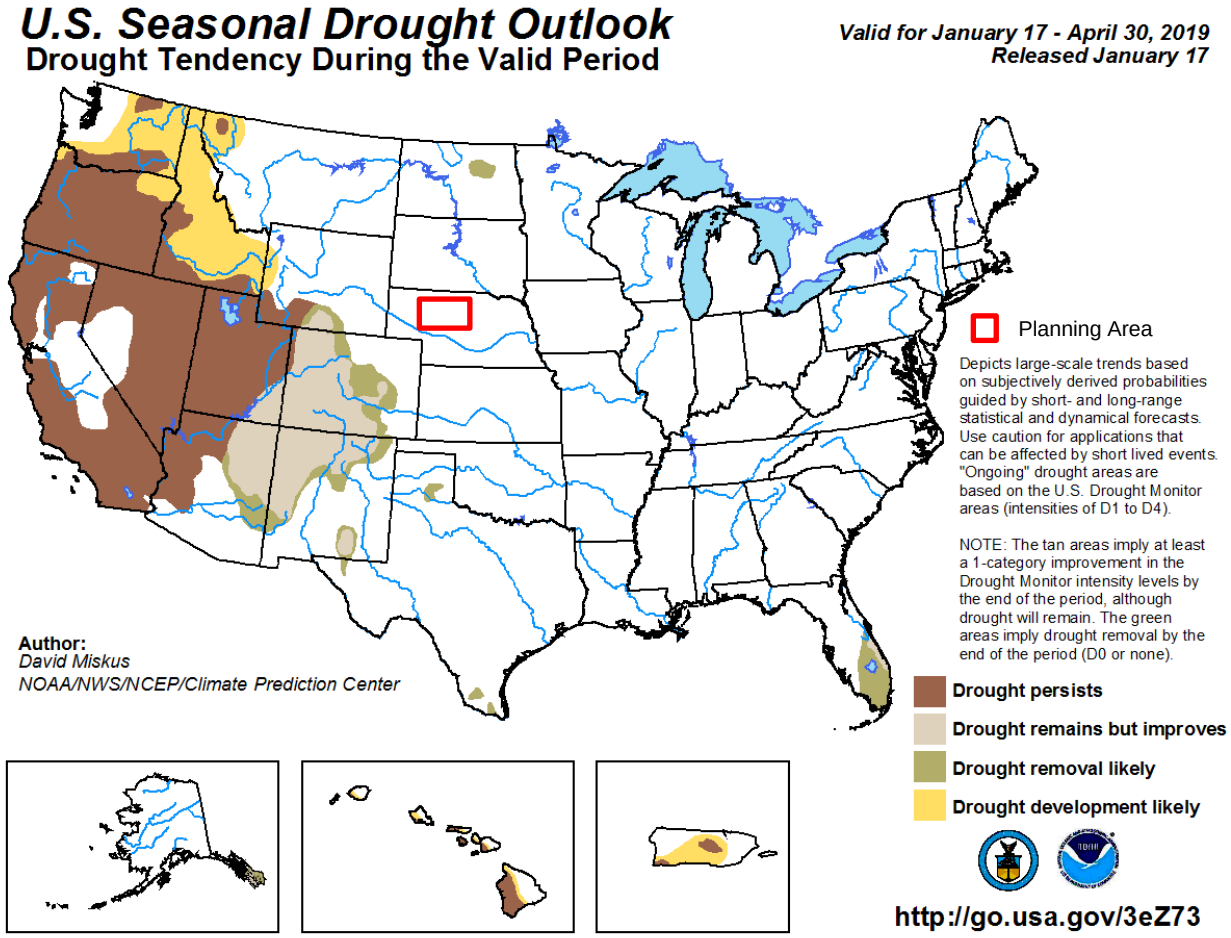
PDSI Value	Magnitude	Drought Occurrences by Month	Monthly Probability
4 or more to -0.99	No Drought	1,003/1,486	67.4%
-1.0 to -1.99	Mild Drought	183/1,486	12.3%
-2.0 to -2.99	Moderate Drought	133/1,486	9.0%
-3.0 to -3.99	Severe Drought	87/1,486	5.9%
-4.0 or less	Extreme Drought	80/1,486	5.4%

Source: NCEI, Jan 1895-Oct 2018

The U.S. Seasonal Drought Outlook (Figure 15) provides a short-term drought forecast that can be utilized by local officials and residents to examine the likelihood of drought developing or continuing depending on the current situation. The following figure provides the drought outlook for November 15, 2018 through February 28, 2019. According to the U.S. Seasonal Drought Outlook, drought is likely to persist in the southwest United States, but the planning area should experience seasonal norms relative to precipitation and temperatures.

[59] National Integrated Drought Information System, National Drought Mitigation Center, and University of Nebraska-Lincoln. 2015. "From Too Much to Too Little: how the central U.S. drought of 2012 evolved out of one of the most devastating floods on record in 2011." https://www.drought.gov/drought/sites/drought.gov.drought/files/media/reports/regional_outlooks/CentralRegion2012DroughtAssessment_1-5-15.pdf.

Figure 15: U.S. Seasonal Drought Outlook



Source: NCEI, January 2019

Regional Vulnerabilities

The Drought Impact Reporter is a database of drought impacts throughout the United States with data going back to 2000. The Drought Impact Reporter has recorded a total of 24 drought-related impacts throughout the region. This is not a comprehensive list of droughts which may have impacted the planning area. These impacts are summarized in the following table.

Table 52: Drought Impacts in Planning Area

Category	Date	Affected Counties	Title
Fire	7/31/2005	Thomas	Fire impact from Media submitted on 7/31/2005
Agriculture, Fire, Water Supply & Quality	9/28/2005	Grant	Agriculture, Fire, Water Supply & Quality impact from Public submitted on 9/28/2005
Relief, Response & Restrictions	9/30/2005	Blaine, Thomas	Relief, Response & Restrictions impact from Media submitted on 9/30/2005
Relief, Response & Restrictions	10/14/2005	Logan	Relief, Response & Restrictions impact from Media submitted on 10/14/2005

Category	Date	Affected Counties	Title
Relief, Response & Restrictions	11/1/2005	Blaine, Grant, Hooker, Logan, Thomas	Relief, Response & Restrictions impact from Media submitted on 11/1/2005
Relief, Response & Restrictions	11/7/2005	Grant	Relief, Response & Restrictions impact from Media submitted on 11/7/2005
Plants & Wildlife	11/7/2005	Blaine	Plants & Wildlife impact from Media submitted on 11/7/2005
Relief, Response & Restrictions	11/17/2005	Logan	Relief, Response & Restrictions impact from Media submitted on 11/17/2005
Relief, Response & Restrictions	12/15/2005	Grant, Hooker, Logan, Thomas	Relief, Response & Restrictions impact from Government submitted on 12/15/2005
Agriculture	2/17/2006	Blaine, Grant, Hooker, Logan, Thomas	Agriculture impact from Media submitted on 2/17/2006
Relief, Response & Restrictions	2/22/2006	Grant, Hooker, Logan, Thomas	Relief, Response & Restrictions impact from Government submitted on 2/22/2006
Relief, Response & Restrictions	3/1/2006	Blaine, Grant, Hooker, Logan, Thomas	Relief, Response & Restrictions impact from Media submitted on 3/1/2006
Relief, Response & Restrictions	7/17/2006	Blaine, Grant, Hooker, Logan, Thomas	Relief, Response & Restrictions impact from Media submitted on 7/17/2006
Relief, Response & Restrictions	9/14/2006	Blaine, Grant, Hooker, Logan, Thomas	Relief, Response & Restrictions impact from Media submitted on 9/14/2006
Fire	7/26/2007	Blaine, Thomas	Fire impact from Media submitted on 7/26/2007
Relief, Response & Restrictions	8/6/2007	Grant, Hooker, Logan, Thomas	Relief, Response & Restrictions impact from Media submitted on 8/6/2007
Agriculture	10/24/2007	Blaine, Grant, Hooker, Logan, Thomas	Agriculture impact from Media submitted on 10/24/2007
Agriculture, Society & Public Health	10/4/2012	Grant	A cattle rancher in western Nebraska was losing $200 on the sale of each calf
Agriculture, Plants & Wildlife	12/17/2012	Blaine, Grant, Hooker, Logan, Thomas	Drought led ranchers in western Nebraska to cull cow herds by 25 to 60 percent
Agriculture, Relief, Response & Restrictions	5/17/2013	Blaine, Grant, Hooker, Logan, Thomas	Drought-related USDA disaster declarations in 2013
Plants & Wildlife	6/13/2013	Blaine, Grant, Hooker, Logan, Thomas	Many trees in western Nebraska died from drought, high temperatures and strong winds in 2012
Fire, Relief, Response & Restrictions, Tourism & Recreation	9/3/2013	Blaine, Grant, Hooker, Logan, Thomas	Campers in western Nebraska were urged to be particularly careful with campfires over the Labor Day weekend

Category	Date	Affected Counties	Title
Fire, Relief, Response & Restrictions	2/22/2018	Blaine, Grant, Hooker, Logan, Thomas	Nebraskans urged to leave the fireworks to the professionals

Source: NDMC, 2000-2018[60]
**Numbers include estimates from Blaine, Grant, Hooker, Logan, and Thomas Counties*

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

Table 53:Regional Drought Vulnerabilities

SECTOR	VULNERABILITY
PEOPLE	-Insufficient water supply -Loss of jobs in agricultural sector -Residents in poverty if food prices increase
ECONOMIC	-Closure of water intensive businesses (carwashes, pools, etc.) -Loss of tourism dollars -Decrease in cattle prices -Decrease of land prices→ jeopardizes educational funds
BUILT ENVIRONMENT	-Cracking of foundations (residential and commercial structures) -Damages to landscapes
INFRASTRUCTURE	-Damages to waterlines below ground -Damages to roadways (prolonged extreme events) -Stressing of electrical systems (brownouts during peak usage)
CRITICAL FACILITIES	None
OTHER	-Increased risk of grass and wildfire, damaging buildings and agricultural land

[60] National Drought Mitigation Center. 2018. "U.S. Drought Impact Reporter." http://droughtreporter.unl.edu/map/.

EARTHQUAKES

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

Table 54: Richter Scale

RICHTER MAGNITUDES	EARTHQUAKE EFFECTS
LESS THAN 3.5	Generally not felt, but recorded.
3.5 – 5.4	Often felt, but rarely causes damage.
UNDER 6.0	At most, slight damage to well-designed buildings. Can cause major damage to poorly constructed buildings over small regions.
6.1 – 6.9	Can be destructive in areas up to about 100 kilometers across where people live.
7.0 – 7.9	Major earthquake. Can cause serious damage over larger areas.
8 OR GREATER	Great earthquake. Can cause serious damage in areas several hundred kilometers across.

Source: FEMA, 2016[61]

Table 55: Modified Mercalli Intensity Scale

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

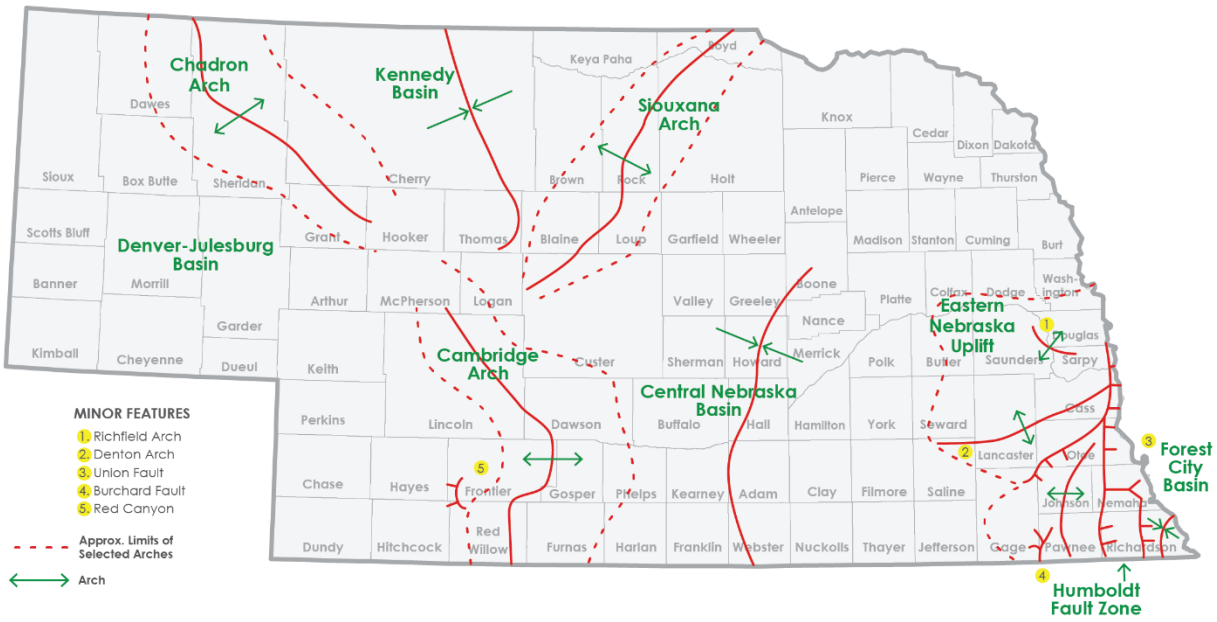
Source: FEMA, 2016

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

LOCATION

The most likely locations in the planning area to experience an earthquake are near a fault line (Figure 16). The Kennedy Basin, Chadron Arch, Siouxana Arch, and Cambridge Arch fault lines would affect the planning area.

Figure 16: Fault Lines in Nebraska



Source: Nebraska Department of Natural Resources

EXTENT

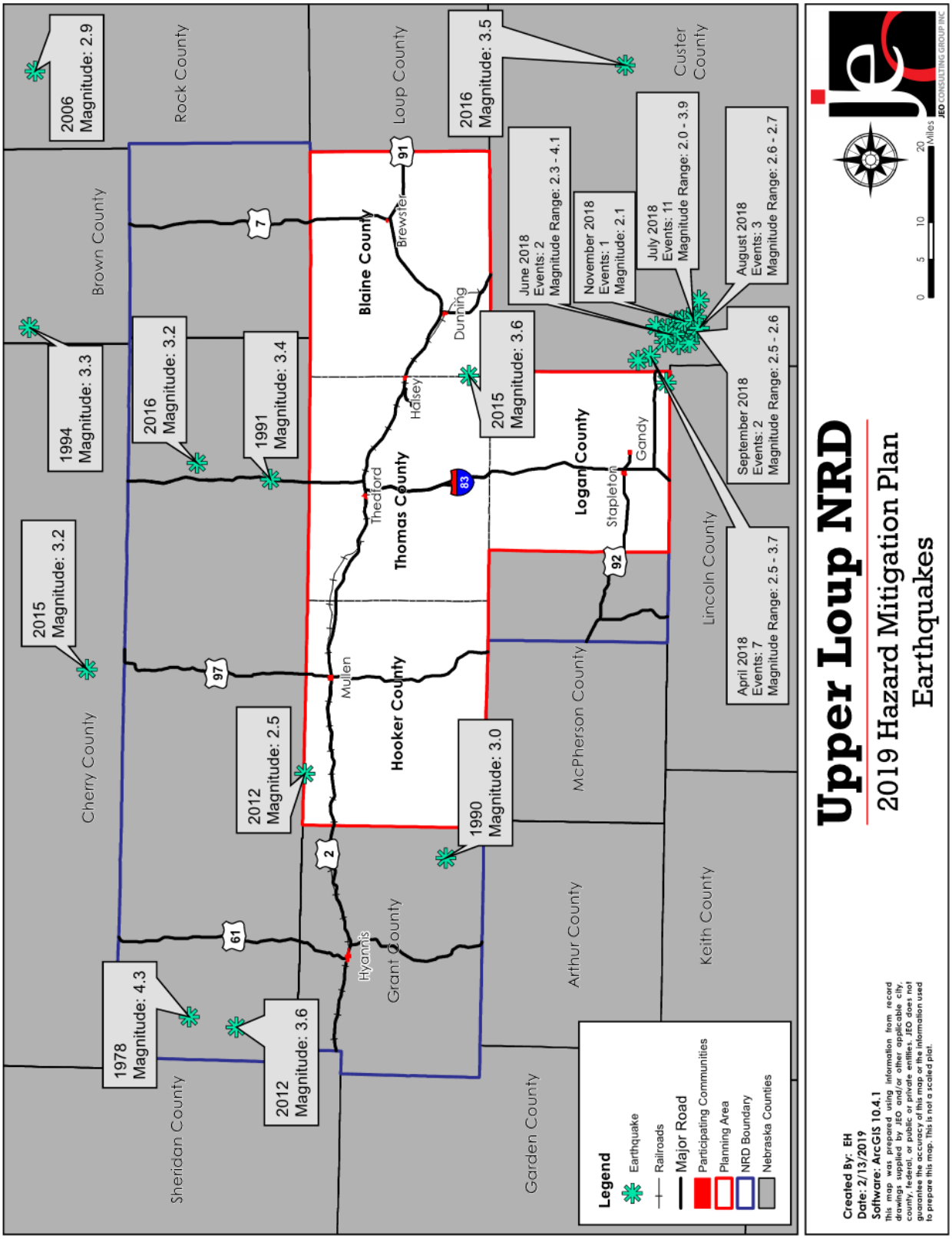
If an earthquake were to occur in the planning area, it would likely measure between 2.5 and 5.0 on the Richter Scale. Very little to no damage is anticipated from events of these magnitudes.

HISTORICAL OCCURRENCES

According to the United States Geological Survey (USGS), there have been three earthquakes that have occurred within the planning area since 1900 (Figure 17).[62]

[62] United States Geological Survey. 2018. "Information by Region – Nebraska." https://earthquake.usgs.gov/earthquakes/byregion/nebraska.php.

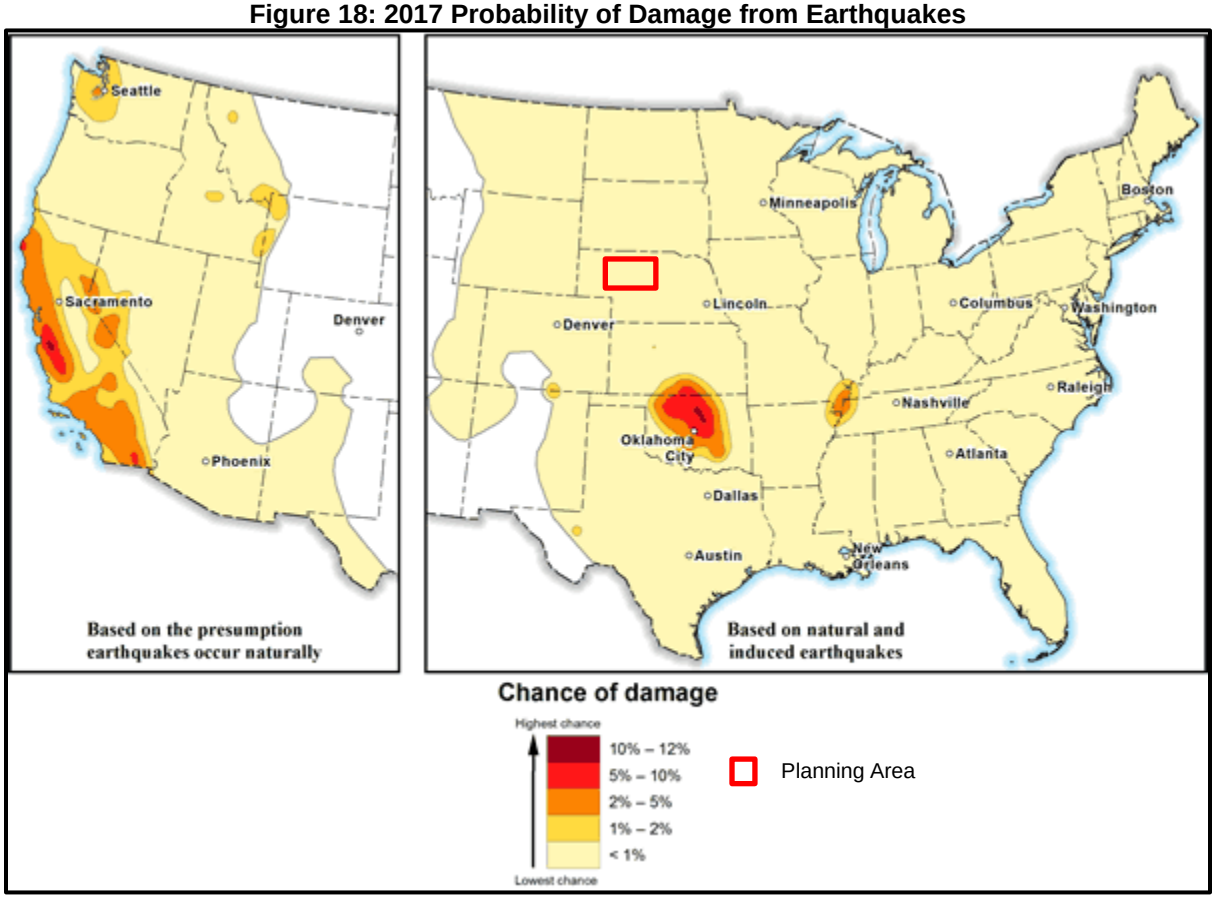
Figure 17: Earthquakes in Planning Area



AVERAGE ANNUAL LOSSES

Due to the lack of sufficient earthquake data, limited resources, low earthquake risk for the area, and no recorded damages with the reports of historical occurrences, it is not feasible to utilize the 'event damage estimate formula' to estimate potential losses for the planning area. Figure 18 shows the probability of damage from earthquakes, according to the USGS. The figure shows that the planning area has a less than one percent chance of damages from earthquakes.

Figure 18: 2017 Probability of Damage from Earthquakes



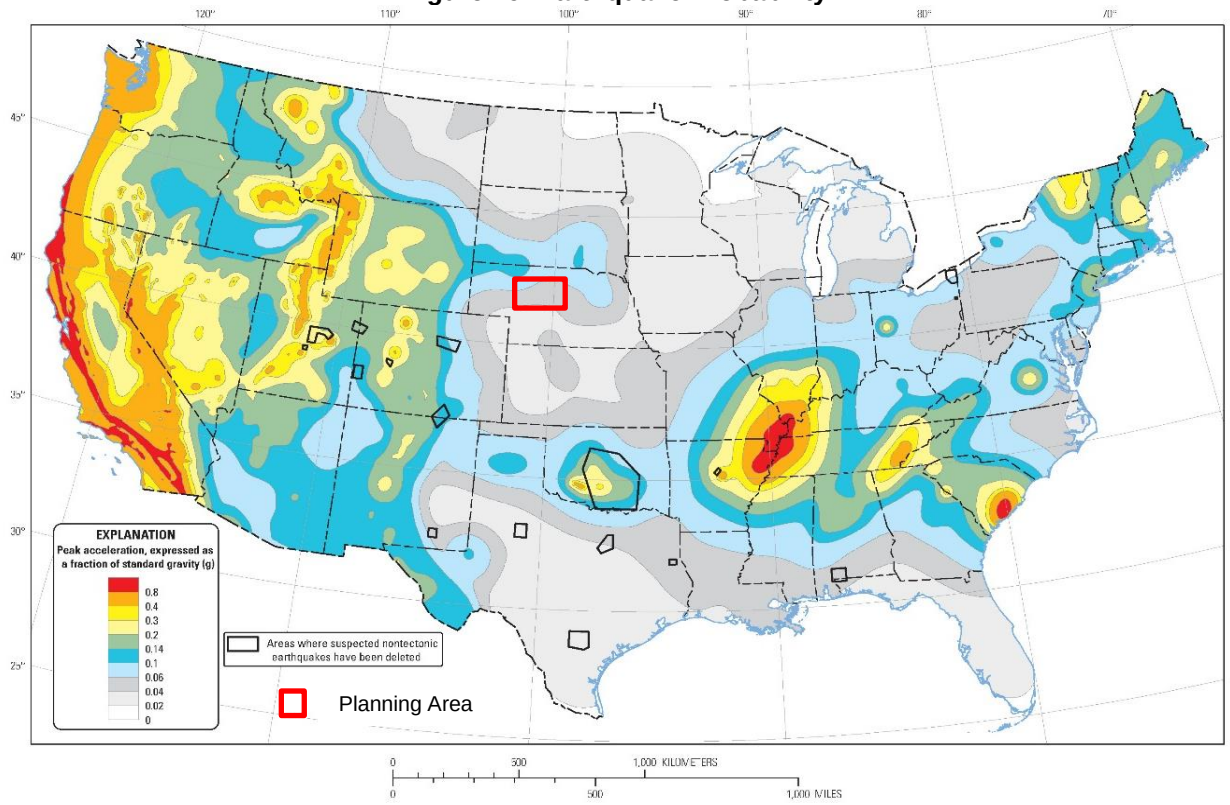
Source: USGS, 2017[63]

PROBABILITY

The following figure summarizes the probability of a 5.0 or greater earthquake occurring in the planning area within 50 years. The planning area has experienced three earthquakes with no damages reported in 119 years, for the purposes of this plan, there is a three percent chance of an earthquake occurring in any given year.

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

Figure 19: Earthquake Probability



Source: USGS 2009 Probabilistic Seismic Hazard Analysis (PSHA) Model
**Map shows the two-percent probability of exceedance in 50 years of peak ground acceleration*

REGIONAL VULNERABILITIES

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

Table 56: Regional Earthquake Vulnerabilities

SECTOR	VULNERABILITY
PEOPLE	-Risk of injury or death from falling objects and structures
ECONOMIC	-Short-term interruption of business
BUILT ENVIRONMENT	-Damage to buildings, homes, or other structures from foundation cracking, falling objects, shattered windows, etc.
INFRASTRUCTURE	-Damage to subterranean infrastructure (i.e. waterlines, gas lines, etc.) -Damage to roadways
CRITICAL FACILITIES	-Same as all other structures

EXTREME HEAT

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

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

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

For the planning area, the months with the highest temperatures are June, July, and August. The National Weather Service (NWS) is responsible for issuing excessive heat outlooks, excessive heat watches, and excessive heat warnings.

- **Excessive heat outlooks** are issued when the potential exists for an excessive heat event in the next 3 to 7 days. Excessive heat outlooks can be utilized by public utility staffs, emergency managers, and public health officials to plan for extreme heat events.
- **Excessive heat watches** are issued when conditions are favorable for an excessive heat event in the next 24 to 72 hours.
- **Excessive heat warnings** are issued when an excessive heat event is expected in the next 36 hours. Excessive heat warnings are issued when an extreme heat event is occurring, is imminent, or has a very high probability of occurring.

LOCATION

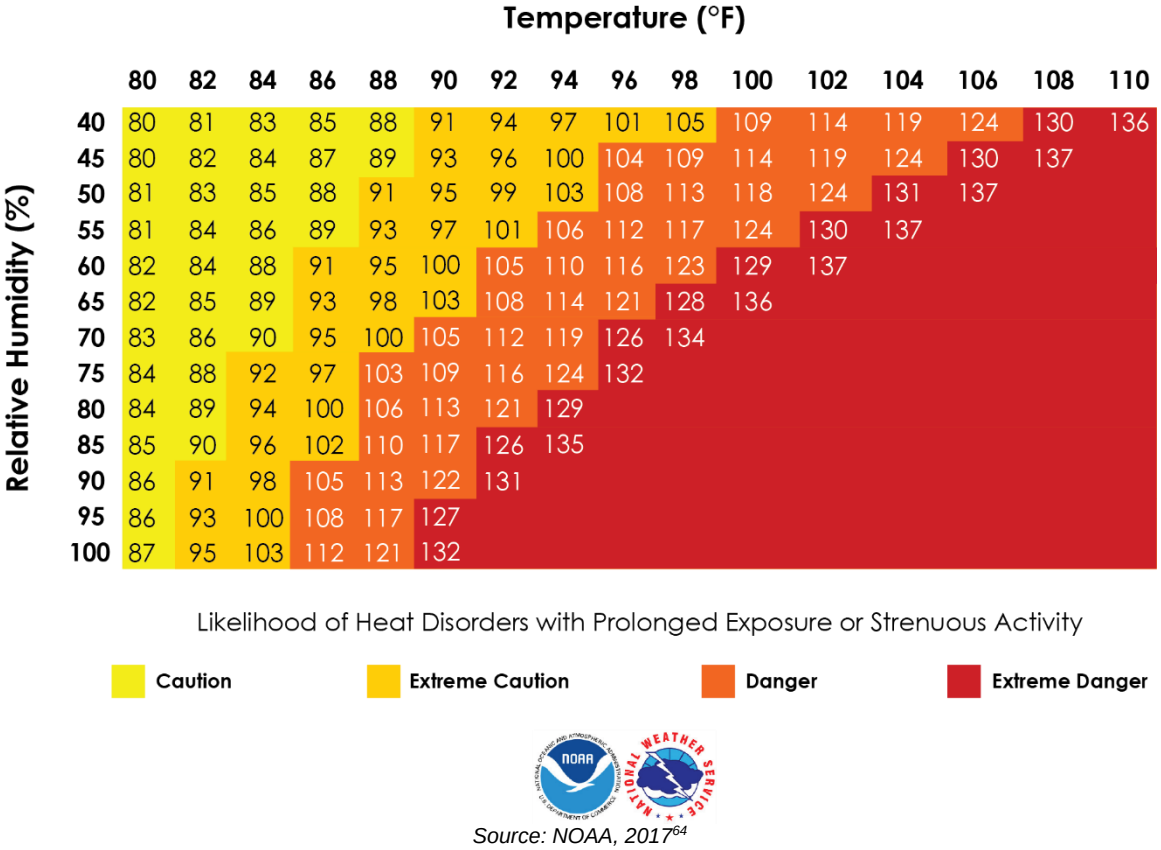
This hazard may occur throughout the planning area.

EXTENT

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

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

Figure 20: NOAA Heat Index



Source: NOAA, 2017[64]

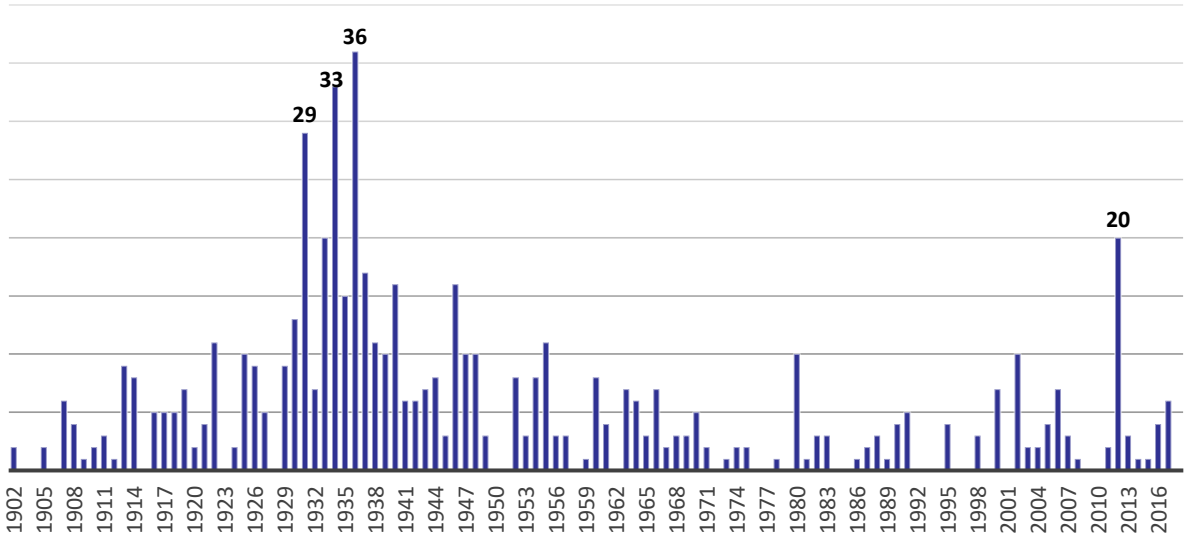
The figure above is designed for shady and light wind conditions. Exposure to full sunshine or strong winds can increase hazardous conditions and raise heat index values by up to 15°F. For the purposes of this plan, extreme heat is being defined as temperatures of 100°F or greater.

HISTORICAL OCCURRENCES

According to the High Plains Regional Climate Center (HPRCC), on average, the planning area experiences four days above 100°F per year. The planning area experienced the most days on record above 100°F in 1936 with 36 days. More recently, in 2002 and 2012 there were 10 and 20 days above 100°F respectively. Conversely, 2010 was the most recent "coolest" year on record, with zero days above 100°F.

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

Figure 21: Number of Days Above 100°F



Source: HPRCC, 1902-2018

AVERAGE ANNUAL LOSSES

The direct and indirect effects of extreme heat are difficult to quantify. Potential losses such as power outages could affect businesses, homes, and critical facilities. High demand and intense use of air conditioning can overload the electrical systems and cause damages to infrastructure.

The NCEI database did not report any property damage due to extreme heat events.

Table 57: Extreme Heat Loss Estimation

Hazard Type	Average Number of Days Above 100°F[1]	Property Damages[2]	Average Annual Property Damage[2]	Total Crop Loss[3]	Annual Crop Loss[3]
Extreme Heat	4	$0	$0	$572,800	$30,147

Sources: 1 HPRCC (1902-2018); 2 NCEI (1996-2018); 3 USDA RMA (2000-2018)

ESTIMATED LOSS OF ELECTRICITY

According to the FEMA Benefit Cost Analysis (BCA) Reference Guide, if an extreme heat event occurred within the planning area, the following table assumes the event could potentially cause a loss of electricity for 10 percent of the population at a cost of $126 per person per day.[65] In rural areas, the percent of the population affected and duration may increase during extreme events. The assumed damages do not take into account physical damages to utility equipment and infrastructure.

[65] Federal Emergency Management Agency. June 2009. "BCA Reference Guide."

Table 58: Loss of Electricity - Assumed Damage by Jurisdiction

Jurisdiction	2016 Population	Population Affected (Assumed)	Electric Loss of Use Assumed Damage Per Day
Blaine	551	55	$6,930
Grant	769	77	$9,702
Hooker	669	67	$8,442
Logan	669	67	$8,442
Thomas	675	66	$8,316

PROBABILITY

Extreme heat is a regular part of the climate for the planning area; there is a 100 percent probability that temperatures greater than 100°F will occur annually.

REGIONAL VULNERABILITIES

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

Table 59: Regional Extreme Heat Vulnerabilities

SECTOR	VULNERABILITY
PEOPLE	-Heat exhaustion -Heat Stroke -Vulnerable populations include: -People working outdoors -People without air conditioning -Young children outdoors or without air conditioning -Elderly outdoors or without air conditioning
ECONOMIC	-Short-term interruption of business -Loss of power -Agricultural losses
BUILT ENVIRONMENT	-Damage to air conditioning units if overworked
INFRASTRUCTURE	-Overload of electrical systems -Damages to roadways
CRITICAL FACILITIES	-Loss of power
CLIMATE CHANGE	-Increases in extreme heat conditions are likely, adding stress on livestock, crops, people, and infrastructure

FLOODING

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

RIVERINE FLOODING

Riverine flooding, slower in nature, 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 or flood risk area is defined as the lowland and relatively flat area adjoining a river or stream. The terms “base flood” and “100-year flood” refer to the area in the floodplain that is subject to a one percent or greater chance of flooding in any given year. Floodplains are part of a larger entity called a basin or watershed, which is defined as all the land drained by a river and its tributaries.

FLASH FLOODING

Flash floods, faster in nature than the other types of floods, result from convective precipitation usually due to intense thunderstorms or sudden releases from an upstream impoundment created behind a dam, landslide, or levee. Flash floods are distinguished from regular floods by a timescale of fewer than six hours. Flash floods cause the most flood-related deaths as a result of this shorter timescale. Flooding from excessive rainfall in Nebraska usually occurs between late spring and early fall.

SHEET 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 exceeds the capacity of the drainage infrastructure, therefore limiting its ability to properly carry and disburse the water flow. Flooding also occurs due to combined storm and sanitary sewers being overwhelmed by the tremendous flow of water that often accompanies storm events. Typically, the result is water backing into basements, which damages mechanical systems and can create serious public health and safety concerns.

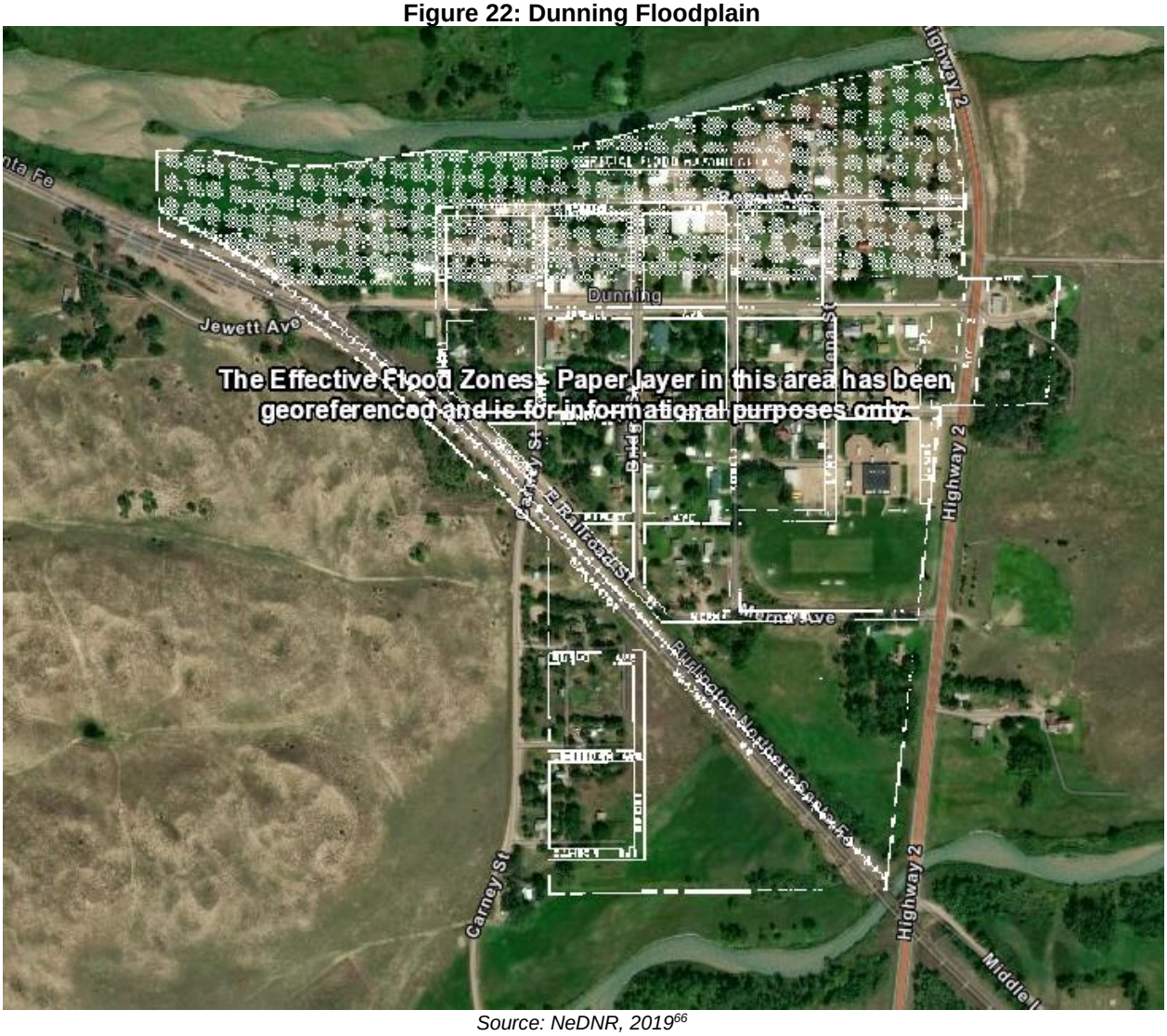
ICE JAM FLOODING

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

LOCATION

Table 60 shows current statuses of Flood Insurance Rate Map (FIRM) panels. Only two jurisdictions in the planning area have FIRMs at the municipal level, the Village of Dunning in Blaine County and the Village of Thedford in Thomas County. There are no Digital Flood Insurance Rate Maps (DFIRMs) available for the planning area, but copies of paper maps can be viewed at the FEMA Flood Map Service Center (https://msc.fema.gov/portal/advanceSearch). The available map for the Village of Dunning is below. For additional jurisdictional-specific vulnerabilities and available maps, refer to *Section Seven: Community Profiles.*

Figure 22: Dunning Floodplain



Source: NeDNR, 2019[66]

Table 60: FEMA FIRM Panel Status

Jurisdiction	Panel Number	Effective Date
Blaine County	-	-
Brewster	-	-
Dunning	310079999A, 31007A	07/01/1987
Grant County	-	-
Hyannis	-	-
Hooker County	-	-
Mullen	-	-
Logan County	-	-
Gandy	-	-
Stapleton	-	-
Thomas County	-	-
Halsey	-	-
Thedford	310326	07/11/1975

Source: FEMA, 2017[67]

[66] Nebraska Department of Natural Resources. 2018. "Floodplain Interactive Map." https://prodmaps2.ne.gov/Html5DNR/index.html?viewer=dnr_floodplain.
[67] Federal Emergency Management Agency. 2017. "FEMA Flood Map Service Center." http://msc.fema.gov/portal/advanceSearch.

EXTENT

The NWS has three categories to define the severity of a flood once a river reaches flood stage as indicated in Table 61.

Table 61: Flooding Stages

FLOOD STAGE	DESCRIPTION OF FLOOD IMPACTS
Minor Flooding	Minimal or no property damage, but possibly some public threat or inconvenience
Moderate Flooding	Some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary
Major Flooding	Extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations

Source: NOAA, 2017[68]

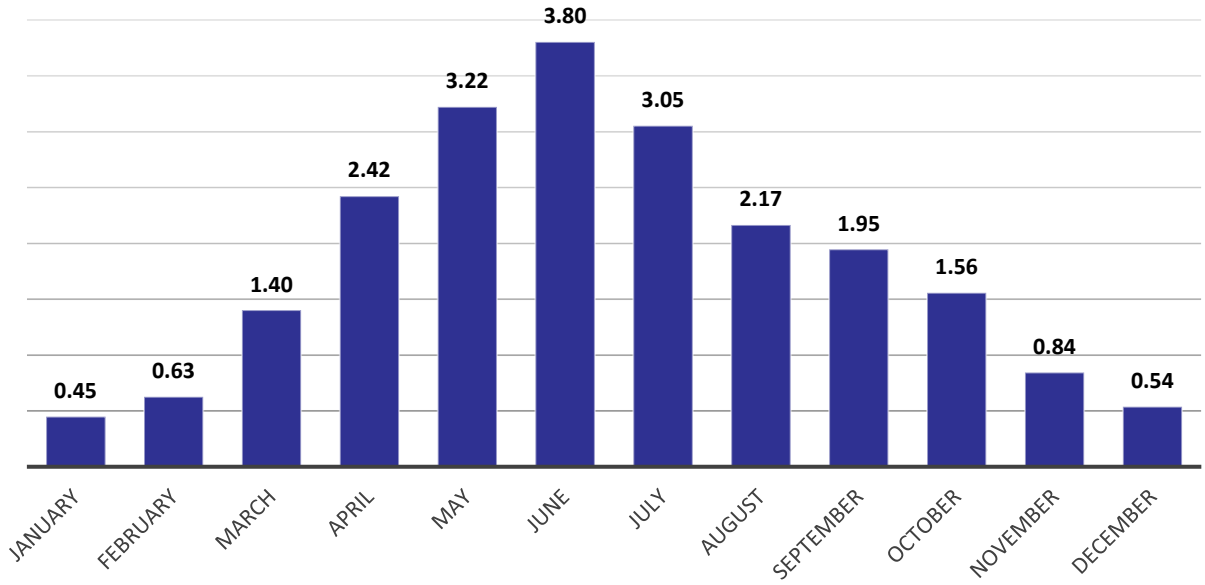
Figure 24 shows the normal average monthly precipitation for the planning area, which is helpful in determining whether any given month is above, below, or near normal in precipitation. As indicated in Figure 25 and 26, the most common month for flooding within the planning area is in June. While it is possible that major flood events will occur, the likely extent of flood events within the planning area is classified as minor.

Figure 23: Localized Flooding in Blaine County

Source: Photos courtesy of Region 26 Emergency Management – past HMP 2015

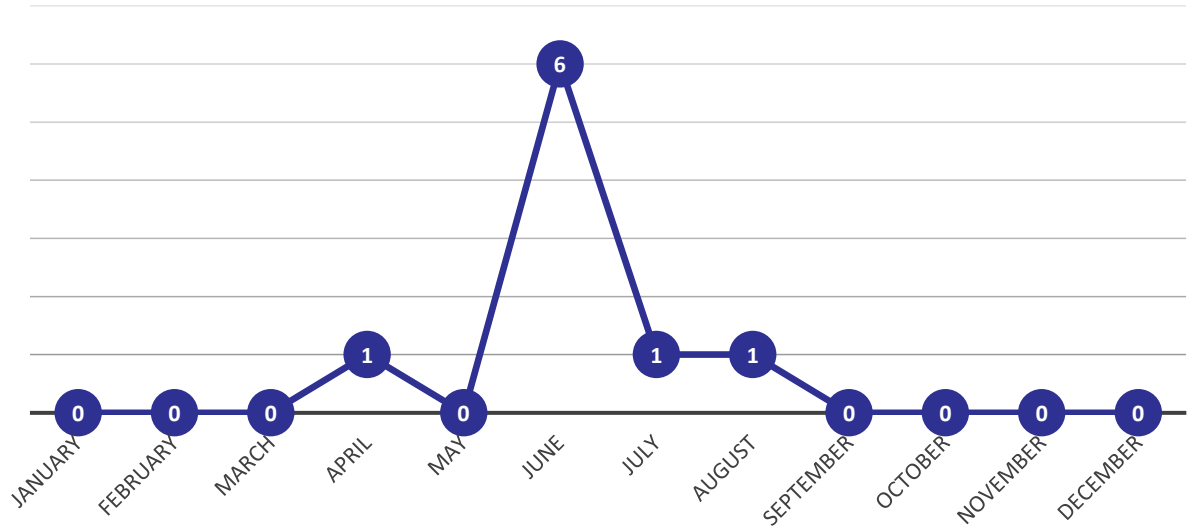
[68] National Weather Service. 2017. "Flood Safety." http://www.floodsafety.noaa.gov/index.shtml.

Figure 24: ULNRD Average Monthly Precipitation



Source: NCEI, 2018

Figure 25: Monthly Events for Floods/Flash Flood in the ULNRD



Source: NCEI, 1996-2018

NATIONAL FLOOD INSURANCE PROGRAM (NFIP)

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

In return for availability of federally-backed flood insurance, jurisdictions participating in the NFIP must agree to adopt and enforce floodplain management standards to regulate development in special flood hazard areas (SFHA) as defined by FEMA's flood maps. One of the strengths of the program has been keeping people away from flooding rather than keeping the flooding away from people – through historically expensive flood control projects.

The following tables summarize NFIP participation and active policies within the planning area.

Table 62: NFIP Participants

Jurisdiction	Eligible-Regular Program	Date Current Map	Sanction	Suspension	Rescinded	Participation in NFIP
Blaine County	--	--	--	--	--	No
Brewster	--	--	--	--	--	No
Dunning	12/20/1974	7/1/1987(L)	--	--	--	Yes
Grant County	--	--	--	--	--	No
Hyannis	--	--	--	--	--	No
Hooker County	--	--	--	--	--	No
Mullen	--	--	--	--	--	Yes (E)
Logan County	--	--	--	--	--	No
Gandy	--	--	--	--	--	No
Stapleton	--	--	--	--	--	No
Thomas County	--	--	--	--	--	No
Halsey	--	--	--	--	--	No
Thedford	7/11/1975	7/11/1975	7/11/1976	--	--	No

Source: Federal Emergency Management Agency, National Flood Insurance Program, 2017
**(L) Indicates Original FIRM by Letter – All Zone A, C, and X; (E) Indicates Entry in Emergency Program - community is part of the Emergency Program and subject to limited coverage.*

According to the NFIP Community Status Book, only the Village of Dunning currently participates in the program. The Village of Thedford has participated in the NFIP in the past but was sanctioned in 1976 and the Village of Mullen participates in the Emergency Program.[69] The NFIP Emergency Program allows a community to voluntarily participate in the NFIP if: no flood hazard information is available for their area; the community has a Flood Hazard Boundary Map but no FIRM, or the community has been identified as flood-prone for less than a year.

This plan highly recommends and strongly encourages plan participants to enroll, participate, and remain in good standing with the NFIP. Compliance with the NFIP should remain a top priority for each participant, regardless of whether or not a flooding hazard area map has been delineated for the jurisdiction. Jurisdictions are encouraged to initiate activities above the minimum participation requirements, which are described in the Community Rating System (CRS) Coordinator's Manual (FIA-15/2017).[70] Currently no jurisdictions in the planning area participate in the CRS program.

NFIP Repetitive Loss Structures

NeDNR was contacted to determine if any existing buildings, infrastructure, or critical facilities are classified as NFIP Repetitive Loss Structures. As of January 2019, there were no repetitive loss properties located in the planning area.

[69] Federal Emergency Management Agency: National Flood Insurance Program. April 2017. "Policy & Claim Statistics for Flood Insurance." Accessed August 2017. https://www.fema.gov/policy-claim-statistics-flood-insurance.
[70] Federal Emergency Management Agency. May 2017. "National Flood Insurance Program Community Rating System: Coordinator's Manual FIA-15/2017." Accessed August 2017. https://www.fema.gov/media-library/assets/documents/8768.

Historical Occurrences

The NCEI reports events as they occur in each community. A single flooding event can affect multiple communities and counties at a time; the NCEI reports these large scale, multi-county events as separate events. The result is a single flood event covering a large portion of the planning area could be reported by the NCEI as several events. According to the NCEI, six flash flooding events resulted in $525,000 in property damage, while three riverine flooding events caused $230,000 in property damage. USDA RMA data does not distinguish the difference between riverine flooding damages and flash flooding damages. The total crop loss according to the RMA is $13,449.

Average Annual Damages

The average damage per event estimate was determined based upon NCEI Storm Events Database since 1996 and the number of historical occurrences. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. Flooding causes an average of $32,826 in property damages and $708 in crop losses per year for the planning area.

Table 63: Flood Loss Estimate

Hazard Type	Number of Events[1]	Average Events Per Year	Total Property Loss[1]	Average Annual Property Loss [1]	Total Crop Loss[2]	Average Annual Crop Loss [2]
Flood Events	9	0.4	$755,00	$32,826	$13,449	$708

Source: 1 Indicates data is from NCEI (January 1996 to July 2018); 2 Indicates data is from USDA RMA (2000 to 2018)

Probability

The NCEI reports three flooding and six flash flooding events for a total of nine events from January 1996 to July 2018. Based on the historic record and reported incidents by participating communities, there is a 40 percent probability that flooding will occur annually in the planning area.

Regional Vulnerabilities

A 2008 national study examining social vulnerability as it relates to flood events found that low-income and minority populations are disproportionately vulnerable to flood events. These groups may lack needed resources to mitigate potential flood events as well as resources that are necessary for evacuation and response. In addition, low-income residents are more likely to live in areas vulnerable to the threat of flooding, but lack the resources necessary to purchase flood insurance. The study found that flash floods are more often responsible for injuries and fatalities than prolonged flood events.

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

On a state level, the Nebraska's State National Flood Insurance Coordinator's office has done some interesting work, studying who lives in special flood hazard areas. According to the NeDNR, floodplain areas have a few unique characteristics which differ from non-floodplain areas:

- Higher vacancy rates within floodplain
- Far higher percentage of renters within floodplain
- Higher percentage of non-family households in floodplain
- More diverse population in floodplain
- Much higher percentage of Hispanic/Latino populations in the floodplain

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

Table 64:Regional Flooding Vulnerabilities

SECTOR	VULNERABILITY
PEOPLE	-Low income and minority populations may lack the resources needed for evacuation, response, or to mitigate the potential for flooding -Elderly or residents with decreased mobility may have trouble evacuating -Residents in low-lying areas, especially campgrounds, are vulnerable during flash flood events -Residents living in the floodplain may need to evacuate for extended periods
ECONOMIC	-Business closures or damages may have significant impacts -Agricultural losses from flooded fields or cattle loss -Closed roads and railways would impact commercial transportation of goods
BUILT ENVIRONMENT	-Building may be damaged
INFRASTRUCTURE	-Damages to roadways and railways
CRITICAL FACILITIES	-Wastewater facilities are at risk, particularly those in the floodplain -Critical facilities, especially those in the floodplain, are at risk to damage (critical facilities are noted within individual community profiles)

GRASS/WILDFIRE

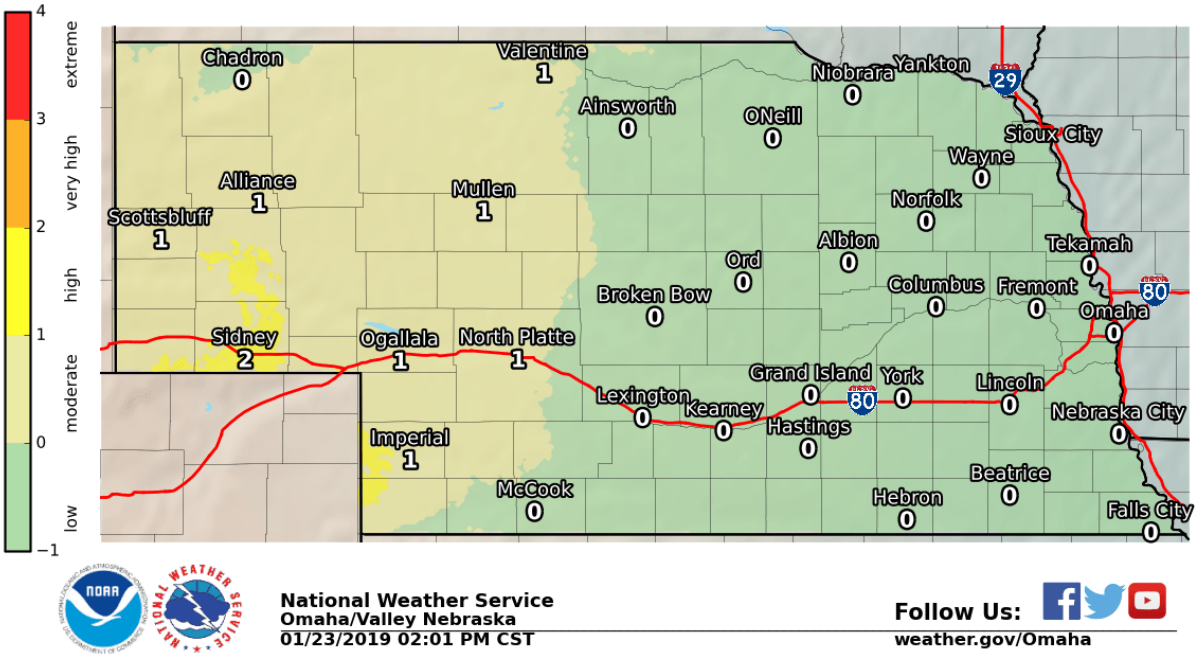
Wildfires, also known as brushfires, forest fires, or wildland fires, are any uncontrolled fire that occurs in the countryside or wildland. Wildland areas may include, but are not limited to: grasslands; forests; woodlands; agricultural fields; pastures; and other vegetated areas. Wildfires differ from other fires by their extensive size, the speed at which they can spread from the original source, their ability to change direction unexpectedly, and to jump gaps (such as roads, rivers, and fire breaks). While some wildfires burn in remote forested regions, others can cause extensive destruction of homes and other property located in the wildland-urban interface (WUI), the zone of transition between developed areas and undeveloped wilderness.

> Lightning starts approximately 10,000 forest fires each year, yet ninety percent of forest fires are started by humans.
>
> ~National Park Service

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

Wildfires are characterized in terms of their physical properties including topography, weather, and fuels. Wildfire behavior is often complex and variably dependent on factors such as fuel type, moisture content in the fuel, humidity, wind speed, topography, geographic location, ambient temperature, the effect of weather on the fire, and the cause of ignition. Fuel is the only physical property humans can control and is the target of most mitigation efforts. The NWS monitors the risk factors including high temperature, high wind speed, fuel moisture (greenness of vegetation), low humidity, and cloud cover in the state on a daily basis (Figure 26).

Figure 26: Rangeland Fire Danger
Valid: January 23, 2019

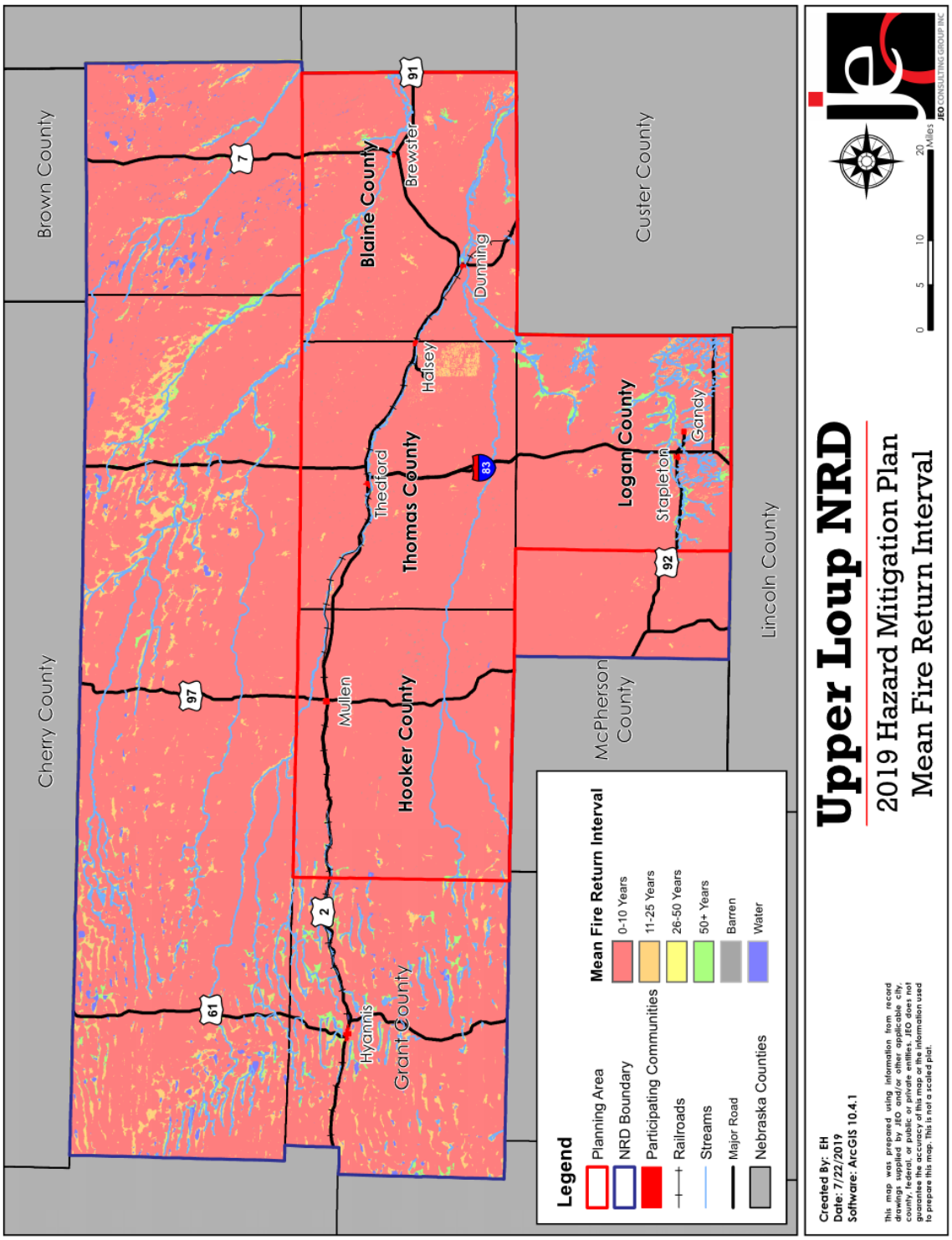


Source: NWS, 2019[71]

[71] National Weather Service. January 2019. "Nebraska Fire Danger Map." https://www.weather.gov/oax/fire.

Figure 27 shows the USGS' Mean Fire Return Interval. This model considers a variety of factors, including landscape, fire dynamics, fire spread, fire effects, and spatial context. These values show how often fires occur in each area under natural conditions.

Figure 27: Mean Fire Return Interval



Source: USGS LANDFIRE Database[72]

[72] United States Geological Survey. 2017. "Landfire Data Distribution Site." https://landfire.cr.usgs.gov/viewer/viewer.html.

LOCATION

As the number of reported wildfires by county indicates, wildfire is nearly an equally great threat throughout the planning area. Blaine County has reported the greatest number of fires; however, Thomas County has had the greatest number of acres burned.

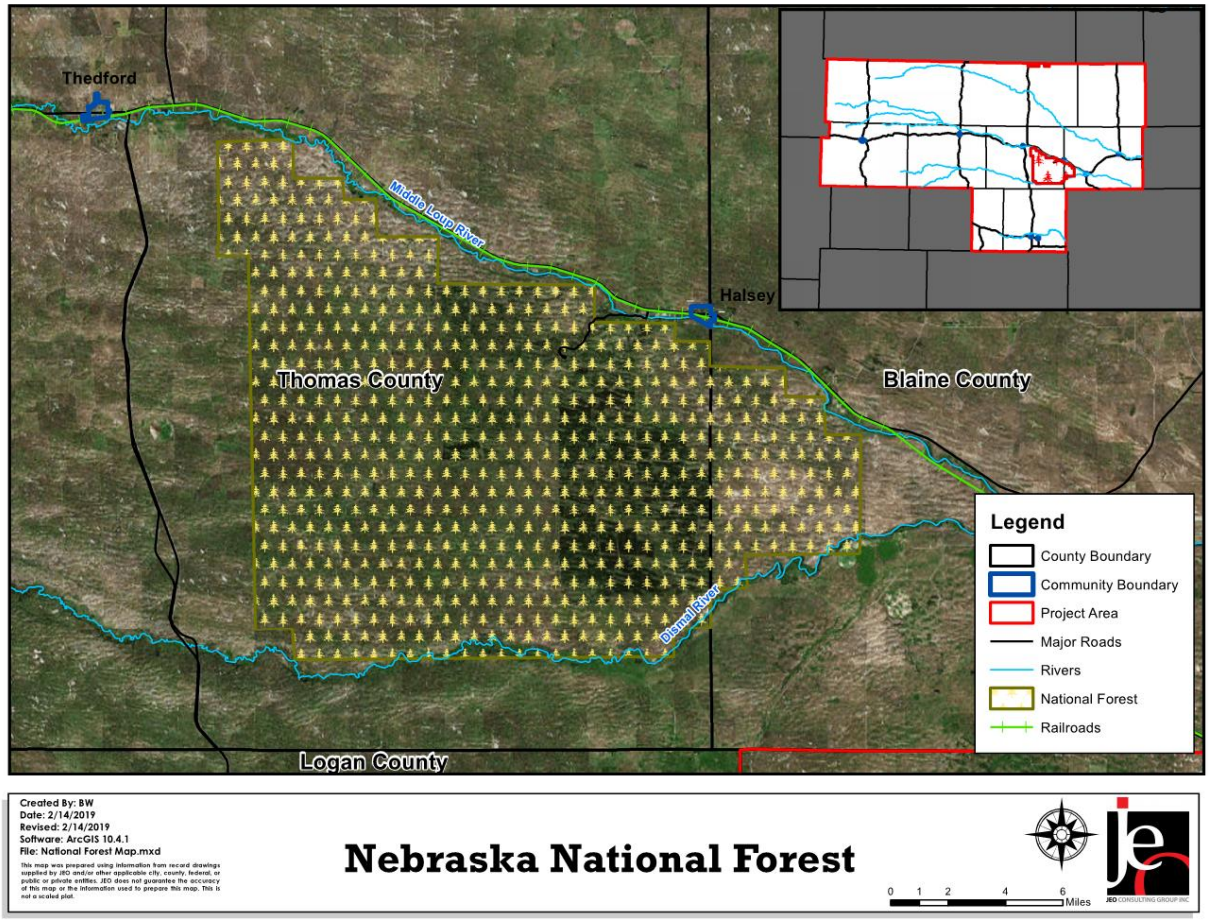
Table 65: Reported Wildfires by County

County	Reported Wildfires	Acres Burned
Blaine County	125	4,070
Grant County	95	18,182
Hooker County	113	19,012
Logan County	40	12,451
Thomas County	83	19,768
Total	**456**	**73,483**

Source: Nebraska Forest Service, 2000-2018[73]

Additionally, the Nebraska National Forest is located in Thomas and Blaine Counties and covers 141,864 acres. The forest is at higher risk to wildfire due to high fuel loads. Wildfires that begin in the forest may spread into surrounding range land areas. The Nebraska Forestry Service conducts fuel load management programs in the forest areas.

Figure 28: National Forest Area



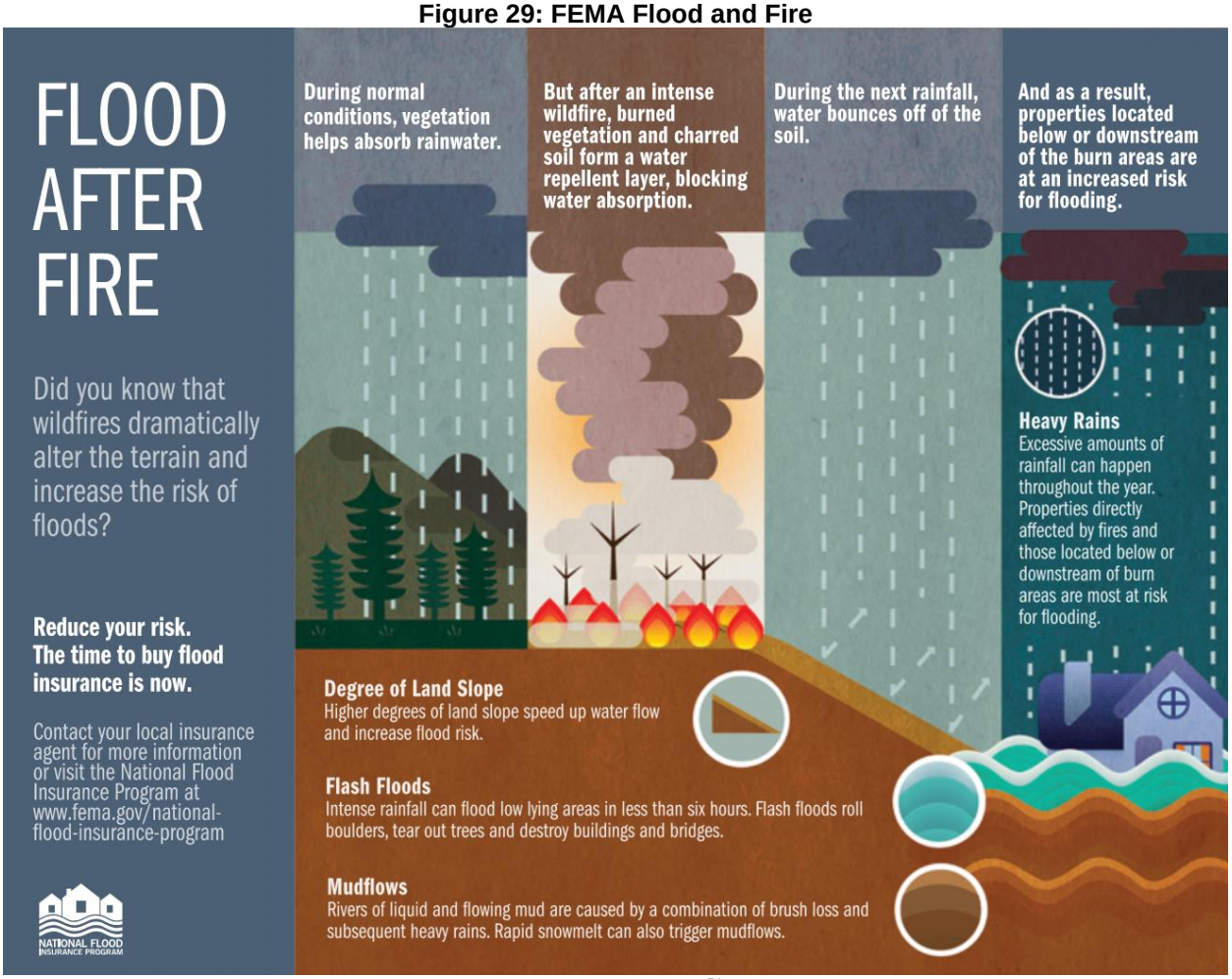
[73] Nebraska Forest Service. 2000-2014. "Fire Incident Type Summary." Data Files 2000-2018.

EXTENT

Figure 30 illustrates the number of wildfires by cause in the planning area from 2000 to 2018, which burned 73,483 acres in total. In total, there were 456 reported wildfires in the planning area. Of these, 58 fires burned 100 acres or more, with the largest wildfire burning 10,000 acres in Logan County in October of 2000.

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

Figure 29: FEMA Flood and Fire



Source: FEMA, 2018[74]

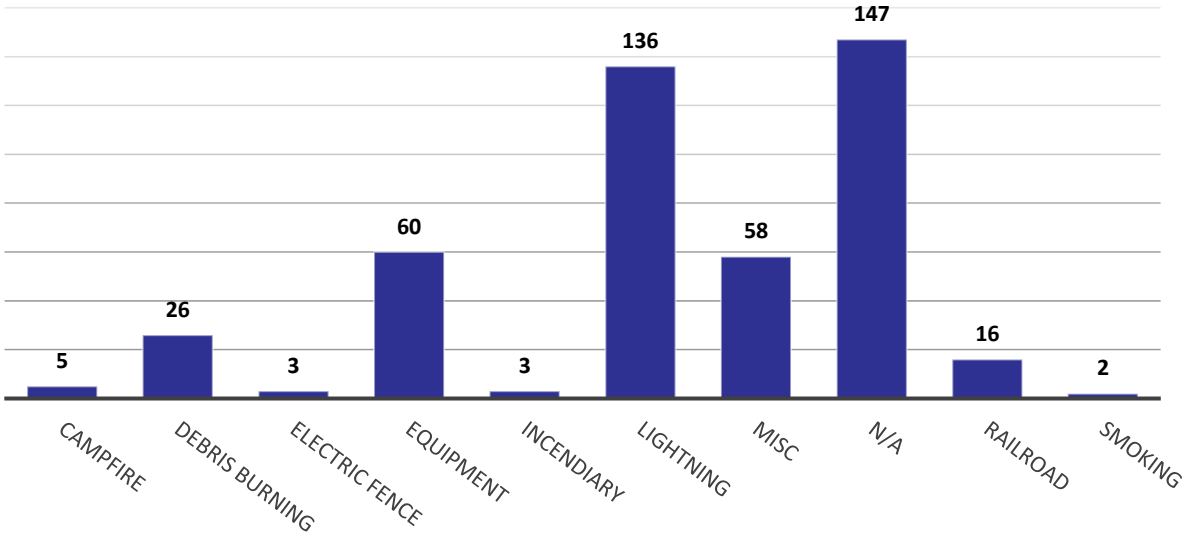
[74] Federal Emergency Management Agency. 2018. "Flood After Fire." https://www.fema.gov/flood-after-fire.

HISTORICAL OCCURRENCES

For the planning area, eight different fire departments reported a total of 456 wildfires, according to the National Forest Service (NFS), from 2000 to 2018. Most fires occurred in 2012 (Figure 31). The reported events burned 73,483 acres. While the RMA lists no damages from fire in the planning area, the NFS reported $139,538 in crop loss.

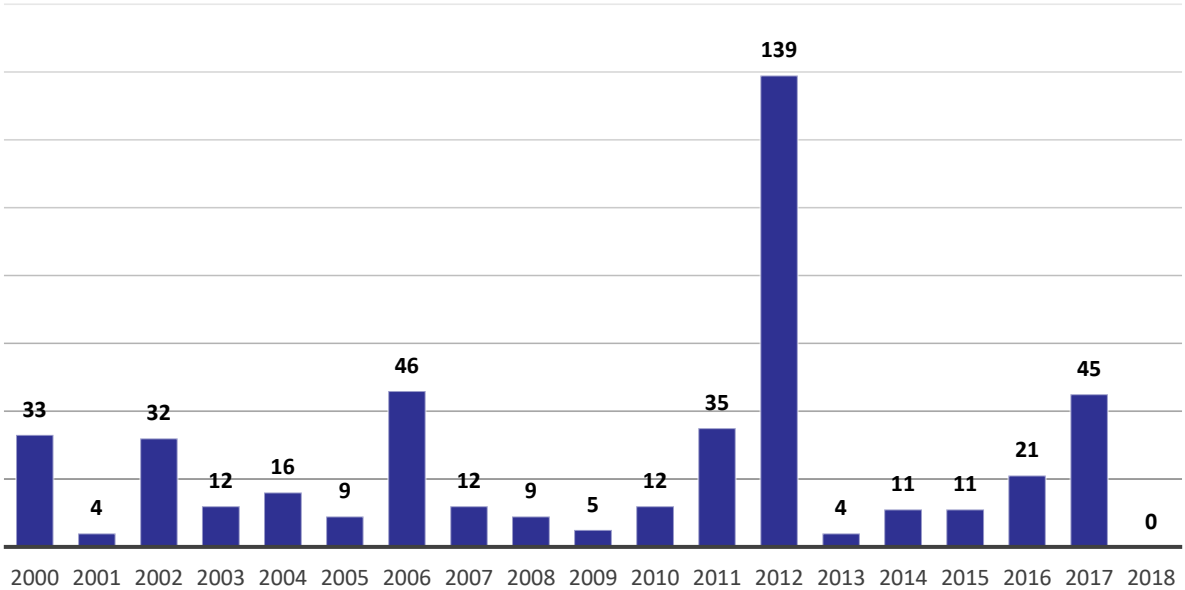
The majority of wildfires in the planning area do not have a listed cause, however lightning is the second most prevalent cause of wildfire in the planning area (Figure 30). Wildfires in the planning area have ranged from zero to 10,000 acres, with an average event burning 161 acres.

Figure 30:Wildfires by Cause in the Planning Area



Source: Nebraska Forest Service, 2000-2018

Figure 31: Number of Wildfires by Year in the Planning Area



Source: Nebraska Forest Service, 2000-2018

Nebraska Thedford Fire

A presidentially declared disaster was issued on April 22, 2011 for what became known as the Nebraska Thedford Fire. Mid 60's temperatures, low relative humidity, and 30 to 50 mph winds contributed to a quickly growing wildfire which began mid-afternoon on private property. Fire-fighting response included over 28 fire departments throughout the north central region and airplane response. Two fire fighters from the Valentine Volunteer Fire Department in northern Cherry County were injured in the fire. Over the span of three hours, the wildfire burned over 11,000 acres in Thomas County.

Figure 32: Sign at Nebraska National Forest

Average Annual Damages

The average damage per event estimate was determined based upon records from the Nebraska Forest Service Wildfires Database from 2000 to 2018 and number of historical occurrences. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. During the 19-year period, 456 wildfires burned 73,483 acres and caused $139,538 in crop damage in the planning area.

Table 66: Wildfire Loss Estimation

Hazard Type	Number of Events	Events Per Year	Average Acres Per Fire	Total Property Loss	Total Crop Loss	Average Annual Crop Loss
Grass/Wildfires	456	24	161	73,483 acres	$139,538	$7,344

Source: Nebraska Forest Service, 2000-2018

Table 67: Wildfire Threats

Hazard Type	Injuries	Homes Threatened or Destroyed	Other Structures Threatened or Destroyed
Grass/Wildfires	0	20	19

Source: Nebraska Forest Service, 2000-2018

Probability

Probability of grass/wildfire occurrence is based on the historic record provided by the Nebraska Forest Service and reported potential by participating jurisdictions. Based on the historic record, there is a 100 percent annual probability of wildfires occurring in the planning area each year.

Regional Vulnerabilities

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

Table 68: Regional Wildfire Vulnerabilities

SECTOR	VULNERABILITY
PEOPLE	-Risk of injury or death for residents and firefighting personnel -Displacement of people and loss of homes -Lack of transportation poses risk to low income individuals, families, and elderly -Transportation routes may be blocked by fire, preventing evacuation efforts
ECONOMIC	-Damages to buildings and property can cause significant losses to business owners -Loss of businesses
BUILT ENVIRONMENT	-Property damages
INFRASTRUCTURE	-Damage to power lines and utility structures
CRITICAL FACILITIES	-Risk of damages
OTHER	-Increase chance of landslides and erosion -May lead to poor water quality -Post fire, flash flooding events may be exacerbated

HAIL

Hail is commonly associated with severe thunderstorms, and this association makes hail just as unpredictable as severe thunderstorms. Additionally, hail events in thunderstorms often occur in series, with one area having the potential to be hit multiple times in one day. Severe thunderstorms usually occur in the evening during the spring and summer months. These, often large, storms can include heavy rain, hail, lightning, and high winds. Hail can destroy property and crops with sheer force, as some hail stones can fall at speeds up to 100 mph.

While the moisture from thunderstorms associated with hail events can be beneficial, when thunderstorms do produce hail, there is potential for crop losses, property losses due to building and automobile damages, injury or death to cattle and other livestock, and personal injury from people not seeking shelter during these events or standing near windows. The potential for damages increases as the size of the hail increases.

LOCATION

The entire planning area is at risk to hail due to the regional nature of this type of event.

EXTENT

The Tornado and Storm Research Organization (TORRO) scale is used to classify hailstones and provides some detail related to the potential impacts from hail. Table 69 outlines the TORRO Hail Scale.

Table 69: TORRO Hail Scale

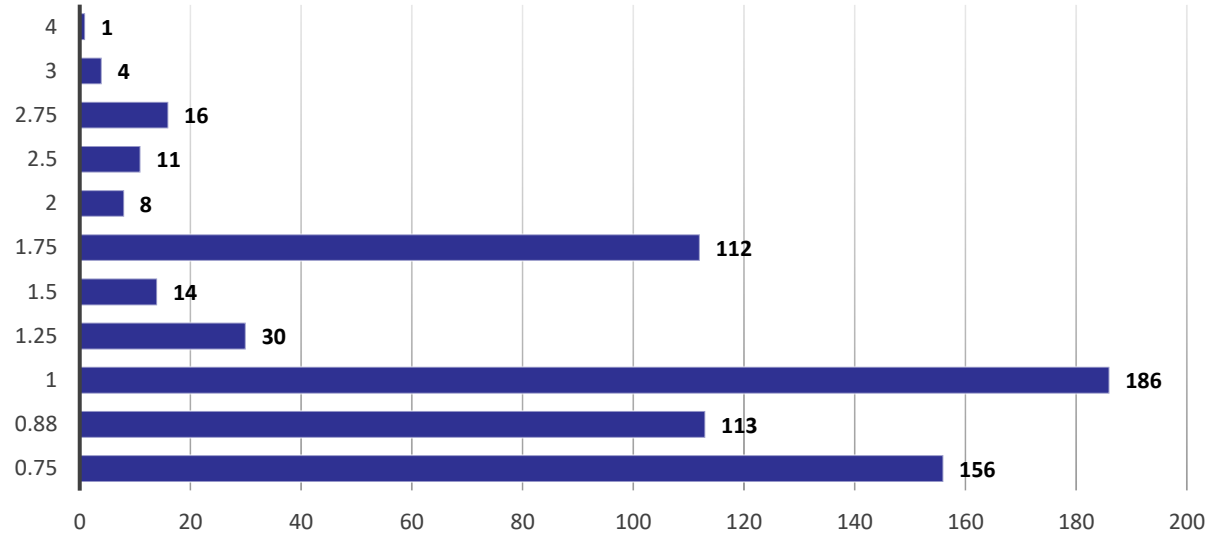
CLASS	TYPE OF MATERIAL	DIVISIONS
H0: Hard Hail	5 mm; (Pea size); 0.2 in	No damage
H1: Potentially Damaging	5 -15 mm (Marble); 0.2 – 0.6 in	Slight general damage to plants and crops
H2: Significant	10 -20 mm (Grape); 0.4 – 0.8 in.	Significant damage to fruit, crops, and vegetation
H3: Severe	20 -30 mm (Walnut); 0.8 – 1.2 in	Severe damage to fruit and crops, damage to glass and plastic structures
H4: Severe	30 -40 mm (Squash Ball); 1.2 – 1.6 in	Widespread damage to glass, vehicle bodywork damaged
H5: Destructive	40 – 50 mm (Golf ball); 1.6 – 2.0 in.	Wholesale destruction of glass, damage to tiled roofs; significant risk or injury
H6: Destructive	50 – 60 mm (chicken egg); 2.0 – 2.4 in	Grounded aircrafts damaged, brick walls pitted; significant risk of injury
H7: Destructive	60 – 75 mm (Tennis ball); 2.4 – 3.0 in	Severe roof damage; risk of serious injuries
H8: Destructive	75 – 90 mm (Large orange); 3.0 – 3.5 in.	Severe damage to structures, vehicles, airplanes; risk of serious injuries
H9: Super Hail	90 – 100 mm (Grapefruit); 3.5 – 4.0 in	Extensive structural damage; risk of severe or even fatal injuries to persons outdoors
H10: Super Hail	>100 mm (Melon); > 4.0 in	Extensive structural damage; risk or severe or even fatal injuries to persons outdoors

Source: TORRO, 2017[75]

[75] Tornado and Storm Research Organization. 2017. "Hail Scale." http://www.torro.org.uk/hscale.php.

Of the 651 hail events reported across the planning area, the average hailstone size was 1.17 inches. Events of this magnitude correlate to an H3 classification. It is reasonable to expect H3 classified events to occur several times in a year throughout the planning area. In addition, it is reasonable, based on the number of occurrences, to expect larger hailstones to occur in the planning area annually. The planning area has endured one H10 hail events (>4.0 inches) during the period of record. Figure 33 shows hail events based on the size of the hail.

Figure 33: Hail Events by Magnitude



Source: NCEI, 1996-2018

HISTORICAL OCCURRENCES

The NCEI reports events as they occur in each community. A single hail event can affect multiple communities and counties at a time; the NCEI reports these large scale, multi-county events as separate events. The result is a single hail event covering a large portion of the planning area could be reported by the NCEI as several events. The NCEI reports a total of 651 hail events in the planning area between January 1996 and July 2018. These events were responsible for $1,554,500 in property damages and $2,436,341 in crop damages. Hooker and Grant Counties do not have RMA data available, thus crop damage estimates are lower than may have actually occurred in the planning area. These events resulted in no injuries or fatalities.

Specific hail events from NCEI reported by each community are listed in *Section Seven: Community Profiles*.

AVERAGE ANNUAL DAMAGES

The average damage per event estimate was based on the NCEI Storm Events Database since 1996 and number of historical occurrences as described above. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life.

Table 70: Hail Loss Estimate

Hazard Type	Number of Events[1]	Average Events Per Year	Total Property Loss[1]	Average Annual Property Loss[1]	Total Crop Loss[2]	Average Annual Crop Loss[2]
Hail Events	651	28.3	$1,554,500	$67,587	$2,436,341	$128,228

Source: 1 Indicates data is from NCEI (January 1996 to July 2018); 2 Indicates data is from USDA RMA (2000 to 2018)

PROBABILITY

Based on historic records and reported events, hail events are likely to occur several times annually within the planning area. The NCEI reported 651 hail events between 1996 and 2018, or approximately 28 hail occurrences per year.

REGIONAL VULNERABILITIES

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

Table 71: Regional Hail Vulnerabilities

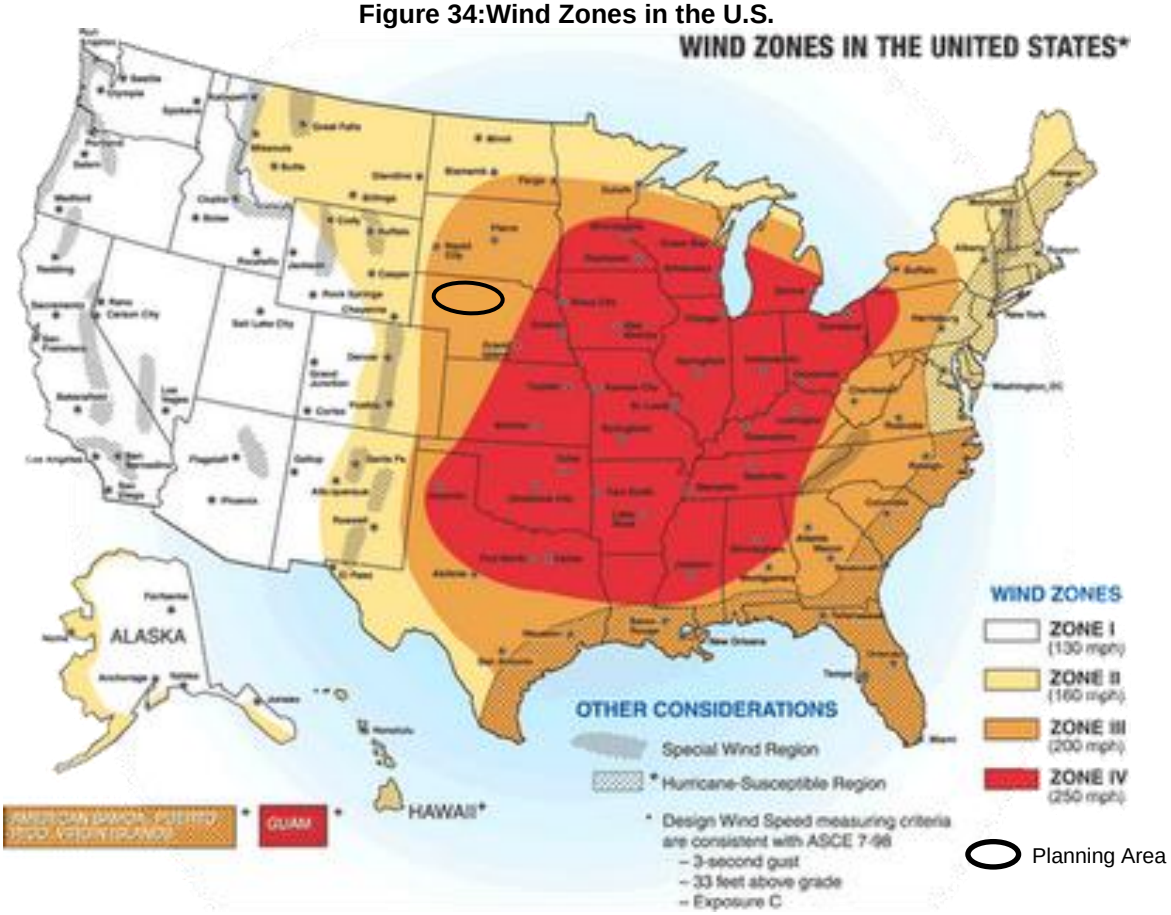
SECTOR	VULNERABILITY
PEOPLE	-Injuries can occur from: not seeking shelter, standing near windows, and shattered windshields in vehicles
ECONOMIC	-Damages to buildings and property can cause significant losses to business owners
BUILT ENVIRONMENT	-Roofs, siding, windows, gutters, HVAC systems, etc. can incur damage
INFRASTRUCTURE	-Power lines and utilities can be damaged
CRITICAL FACILITIES	-Property damages and power outages
OTHER	-High winds, lightning, heavy rain, and possibly tornadoes can occur with this hazard

HIGH WINDS

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

The National Weather Service (NWS) defines high winds as sustained wind speeds of 40 mph or greater lasting for 1 hour or longer, or winds of 58 mph or greater for any duration.[76] The NWS issues High Wind Advisories when there are sustained winds of 25 to 39 miles per hour and/or gusts to 57 mph. Figure 34 shows the wind zones in the United States. The wind zones are based on the maximum wind speeds that can occur from a tornado or hurricane event. The planning area is located in Zone III/IV which has maximum winds of 250 mph equivalent to an EF5 tornado.

Figure 34:Wind Zones in the U.S.



Source: FEMA, 2016

LOCATION

High winds commonly occur throughout the planning area.

EXTENT

The Beaufort Wind Scale can be used to classify wind strength. Table 72 outlines the scale, provides wind speed ranking, range of wind speeds per ranking, and a brief description of conditions for each ranking.

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

Table 72: Beaufort Wind Ranking

BEAUFORT WIND FORCE RANKING	RANGE OF WIND	CONDITIONS
0	<1 mph	Smoke rises vertically
1	1 – 3 mph	Direction shown by smoke but not wind vanes
2	4 – 7 mph	Wind felt on face; leaves rustle; wind vanes move
3	8 – 12 mph	Leaves and small twigs in constant motion
4	13 – 18 mph	Raises dust and loose paper; small branches move
5	19 – 24 mph	Small trees in leaf begin to move
6	25 – 31 mph	Large branches in motion; umbrellas used with difficulty
7	32 – 38 mph	Whole trees in motion; inconvenience felt when walking against the wind
8	39 – 46 mph	Breaks twigs off tree; generally, impedes progress
9	47 – 54 mph	Slight structural damage; chimneypots and slates removed
10	55 – 63 mph	Trees uprooted; considerable structural damages; improperly or mobiles homes with no anchors turned over
11	64 – 72 mph	Widespread damages; very rarely experienced
12 - 17	72 - > 200 mph	Hurricane; devastation

Source: Storm Prediction Center, 2017[77]

Using the NCEI reported events, the most common high wind event is a level 9. The reported high wind events had an average of 47 mph winds. It is likely that this level of event will occur annually.

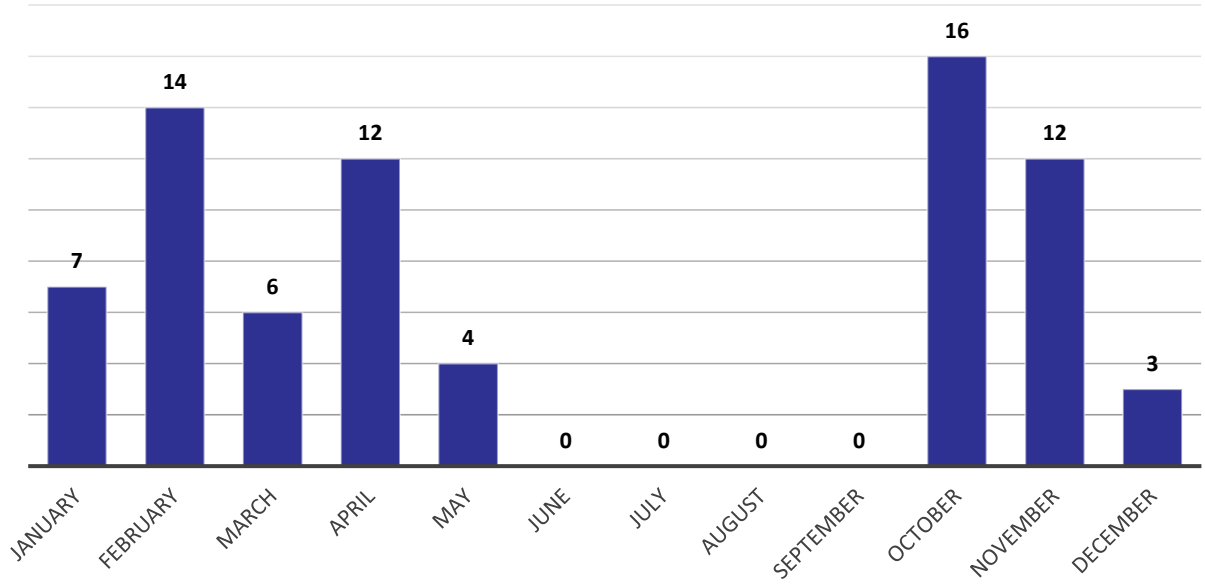
HISTORICAL OCCURRENCES

Due to the regional scale of high winds, the NCEI reports events as they occur in each county. While a single event can affect two or more counties at a time, the NCEI reports them as separate events.

There were 75 high wind events that occurred between January 1996 and July 2018. As seen in Figure 35, most high wind events occur in the spring and winter months. No high wind events led to injuries or fatalities. The events identified by the NCEI are listed in *Section Seven: Community Profiles* for each county.

[77] Storm Prediction Center: National Oceanic and Atmospheric Administration. 1805. "Beaufort Wind Scale." http://www.spc.noaa.gov/faq/tornado/beaufort.html.

Figure 35: High Wind Events by Month



Source: NCEI, 1996-2018

Average Annual Damages

The average damage per event estimate was determined based upon NCEI Storm Events Database since 1996 and number of historical occurrences. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. It is estimated that high wind events can cause an average of $260 per year in property damage, and an average of $13,680 per year in crop damage for the planning area. Hooker and Grant Counties do not have RMA data, causing crop damage estimates to be lower than in reality.

Table 73: High Wind Loss Estimate

Hazard Type	Number of Events[1]	Average Events Per Year	Total Property Loss[1]	Average Annual Property Loss[1]	Total Crop Loss[2]	Average Annual Crop Loss[2]
High Winds	75	3.3	$6,000	$260	$259,920	$13,680

Source: 1 Indicates data is from NCEI (January 1996 to July 2018); 2 Indicates data is from USDA RMA (2000 to 2018)

Probability

Based on historical records and reported events, it is likely that high winds will occur within the planning area annually. For the 23 years examined, there were 75 reported high wind events reported.

Regional Vulnerabilities

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

Table 74: Regional High Wind Vulnerabilities

SECTOR	VULNERABILITY
PEOPLE	-Vulnerable populations include those living in mobile homes, especially if they are not anchored properly -People outdoors during events
ECONOMIC	-Agricultural losses to both crops and livestock -Damages to businesses and prolonged power outages can cause significant impacts to the local economy
BUILT ENVIRONMENT	-All building stock are at risk to damages from high winds
INFRASTRUCTURE	-Downed power lines and power outages -Downed trees blocking road access
CRITICAL FACILITIES	-All critical facilities are at risk to damages from high winds

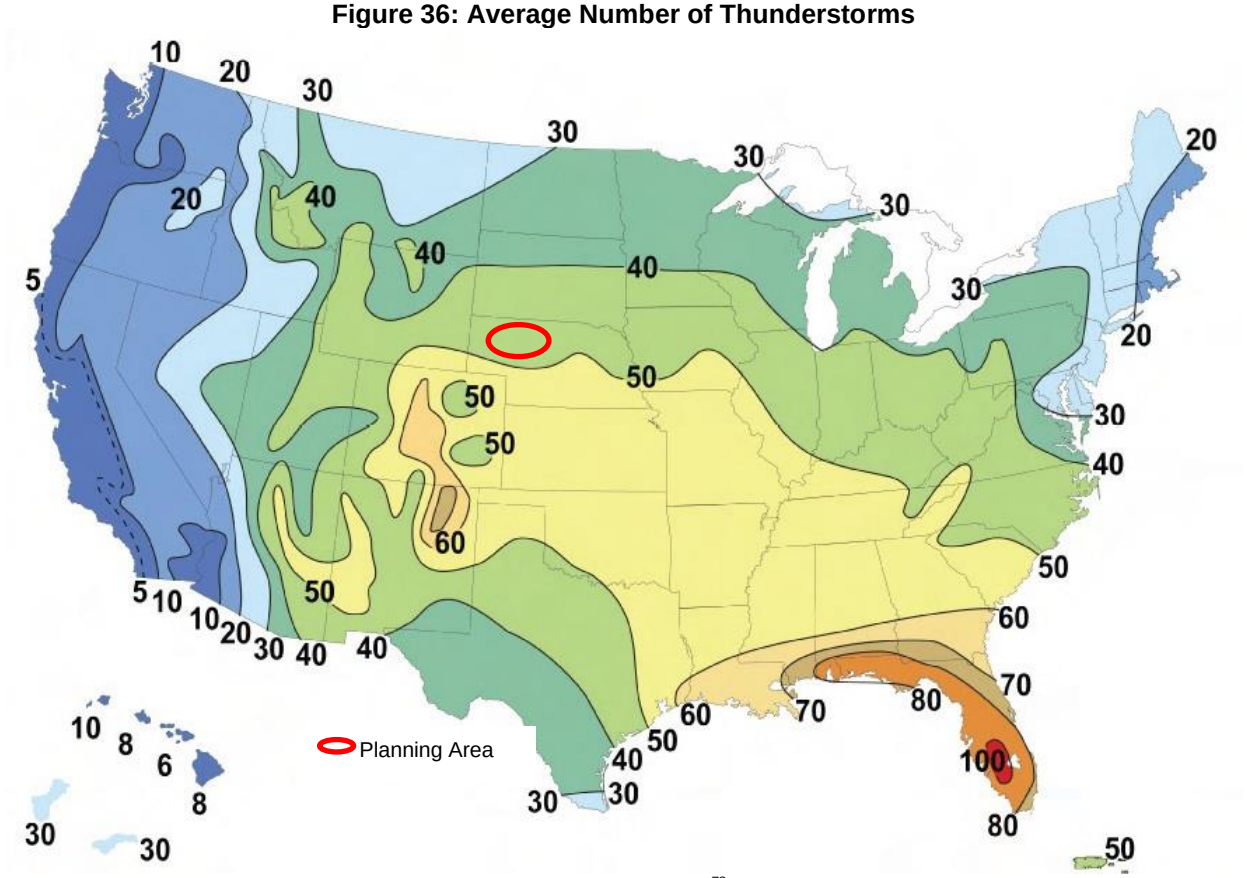
SEVERE THUNDERSTORMS

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

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

Economically, thunderstorms are generally beneficial in that they provide moisture necessary to support Nebraska's largest industry, agriculture. The majority of thunderstorms do not cause damage, but when they escalate to severe storms, the potential for damages increases. Damages can include: crop losses from wind and hail; property losses due to building and automobile damages from hail; high wind; flash flooding; and death or injury to humans and animals from lightning, drowning, or getting struck by falling or flying debris. Figure 36 displays the average number of days with thunderstorms across the country each year. The planning area experiences an average of 40 to 50 thunderstorms over the course of one year.

Figure 36: Average Number of Thunderstorms



Source: NWS, 2017[78]

[78] National Weather Service. 2017. "Introduction to Thunderstorms." http://www.srh.noaa.gov/jetstream/tstorms/tstorms_intro.html.

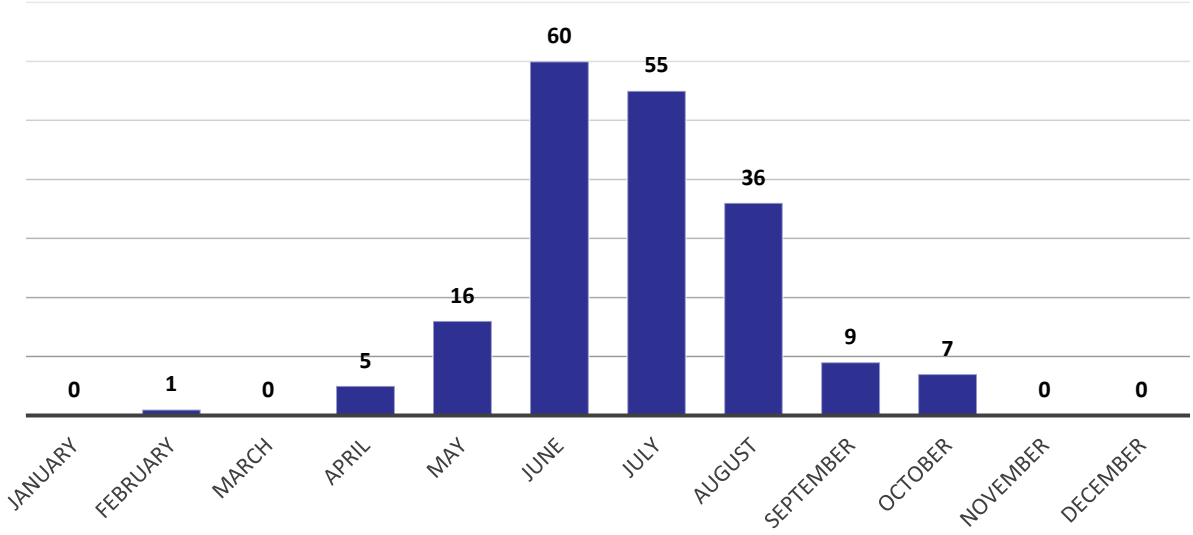
LOCATION
The entire planning area is at risk of severe thunderstorms.

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

The NWS defines a thunderstorm as severe if it contains hail that is one inch in diameter or capable of winds gusts of 58 mph or higher.

HISTORICAL OCCURRENCES
Severe thunderstorms in the planning area usually occur in the afternoon and evening during the summer months (Figure 37).

Figure 37: Thunderstorm Wind Events by Month



Source: NCEI, 1996-2018

The NCEI reports events as they occur in each community. A single severe thunderstorm event can affect multiple communities and counties at a time; the NCEI reports these large scale, multi-county events as separate events. The result is a single thunderstorm event covering the entire region could be reported by the NCEI as several events.

The NCEI reports a total of 189 thunderstorm wind, three heavy rain, and two lightning events in the planning area from January 1996 to July 2018. Severe thunderstorm events were responsible for $525,000 in property damages. The USDA RMA data does not specify severe thunderstorms as a cause of loss, however heavy rains which may be associated with severe thunderstorms caused $181,163 in crop damages. However, Hooker and Grant County do not have RMA data available so crop damages are likely higher than reported here. There were no injuries or deaths reported in association with these storms.

AVERAGE ANNUAL DAMAGES
The average damage per event estimate was determined based upon recorded damages from NCEI Storm Events Database since 1996 and number of historical occurrences. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. Severe thunderstorms and lightning cause an average of $22,826 per year in property damages.

Table 75: Severe Thunderstorms Loss Estimate

Hazard Type	Number of Events[1]	Average Events Per Year	Total Property Loss[1]	Average Annual Property Loss	Total Crop Loss[2]	Average Annual Crop Loss
Thunderstorm Wind	189	8.3	$522,000	$22,696	N/A	N/A
Heavy Rain	3	0.1	$0	$0	$181,163	$9,535
Lightning	2	0.1	$3,000	$130	N/A	N/A
Total	**194**	**8.5**	**$525,000**	**$22,826**	**$181,163**	**$9,535**

Source: 1 Indicates data is from NCEI (January 1996 to July 2018); 2 Indicates data is from USDA RMA (2000 to 2018)

Probability

Based on historical records and reported events, severe thunderstorms are likely to occur on an annual basis. The NCEI reported 194 severe thunderstorm events between 1996 and 2018; resulting in 100 percent chance annually for thunderstorms.

Regional Vulnerabilities

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

Table 76: Regional Thunderstorm Vulnerabilities

SECTOR	VULNERABILITY
PEOPLE	-Elderly citizens with decreased mobility may have trouble evacuating or seeking shelter -Mobile home residents are risk of injury and damage to their property if the mobile home is not anchored properly
ECONOMIC	-Damages to buildings and property can cause significant losses to business owners and employees
BUILT ENVIRONMENT	-Buildings are at risk to hail damage -Downed trees and tree limbs
INFRASTRUCTURE	-High winds and lightning can cause power outages and down power lines -Roads may wash out from heavy rains and become blocked from downed tree limbs
CRITICAL FACILITIES	-Power outages are possible -Critical facilities may sustain damage from hail, lightning, and wind

SEVERE WINTER STORMS

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

EXTREME COLD

Along with snow and ice storm events, extreme cold is dangerous to the well-being of people and animals. What constitutes extreme cold varies from region to region, but is generally accepted as temperatures that are significantly lower than the average low temperature. For the planning area, the coldest months of the year are January, February, and December. The average low temperature for these months are all below freezing (average low for the three months is 13.5°F). The average high temperatures for the months of January, February, and December are near 39°F.[79]

FREEZING RAIN

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

BLIZZARDS

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

LOCATION

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

EXTENT

The Sperry-Piltz Ice Accumulation Index (SPIA) was developed by the NWS to predict the accumulation of ice and resulting damages. The SPIA assesses total precipitation, wind, and temperatures to predict the intensity of ice storms. Figure 38 shows the SPIA index.

[79] High Plains Regional Climate Center. 2017. “Monthly Climate Normals 1981-2010.” http://climod.unl.edu/.

Figure 38: SPIA Index

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

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

Source: SPIA-Index, 2017[80]

The Wind Chill Index was developed by the NWS to determine the decrease in air temperature felt by the body on exposed skin due to wind. The wind chill is always lower than the air temperature and can quicken the effects of hypothermia or frost bite as it gets lower. Figure 39 shows the Wind Chill Index used by the NWS.

[80] SPIA-Index. 2009. "Sperry-Piltz Ice Accumulation Index." Accessed June 2017. http://www.spia-index.com/index.php.

Figure 39: Wind Chill Index Chart

Temperature (°F)

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

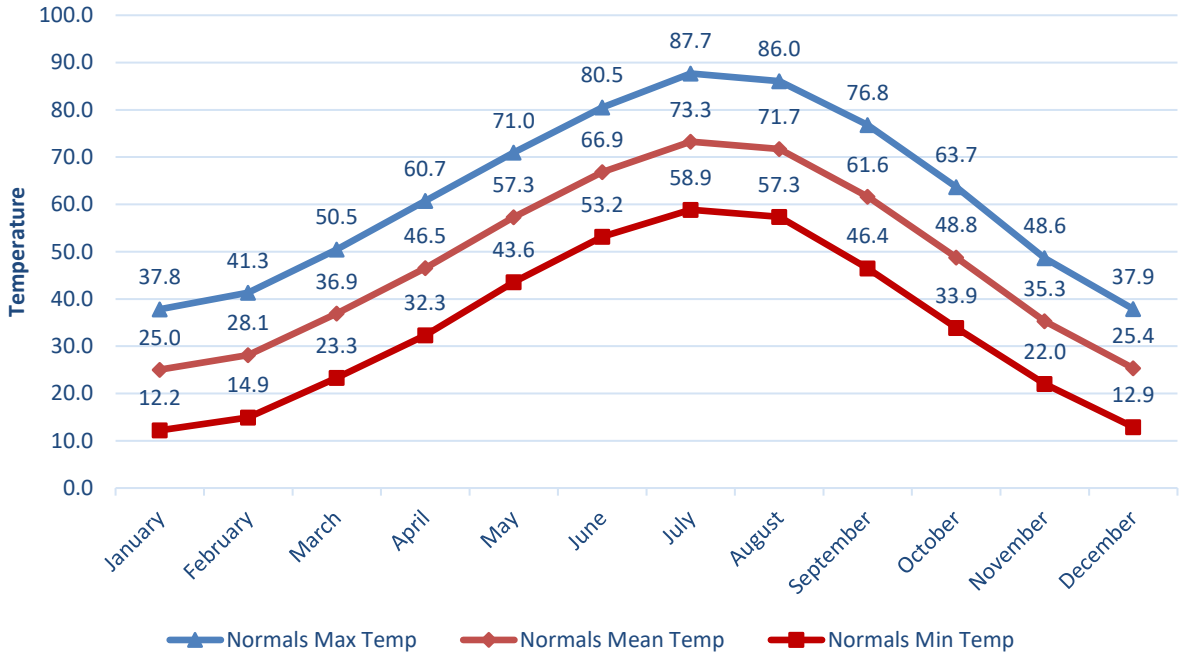
Frostbite Times: 30 Minutes | 10 Minutes | 5 Minutes

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

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

Source: NWS, 2017[81]

Figure 40: Monthly Climate Normals Temperature (1981-2010)



Source: NCEI, 2018

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

Historical Occurrences

Due to the regional scale of severe winter storms, the NCEI reports events as they occur in each county. According to the NCEI, there were a combined 280 severe winter storm events for the planning area from January 1996 to July 2018. These recorded events caused a total of $486,000 in property damages and $293,368 in crop damages.

According to the NCEI, two ice storms were reported between January 1996 and July 2018 which caused $16,000 in damages. One of these storms led to the deaths of two individuals and injured one other in vehicular accidents from icy road conditions. Ice accumulation was not reported.

Additional information from these events from NCEI and reported by each community are listed in *Section Seven: Community Profiles*.

Average Annual Damages

The average damage per event estimate was determined based upon NCEI Storm Events Database since 1996 and includes aggregated calculations for each of the six types of winter weather as provided in the database. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. Severe winter storms have caused an average of $21,131 per year in property damage for the planning area.

Table 77: Severe Winter Storm Loss Estimate

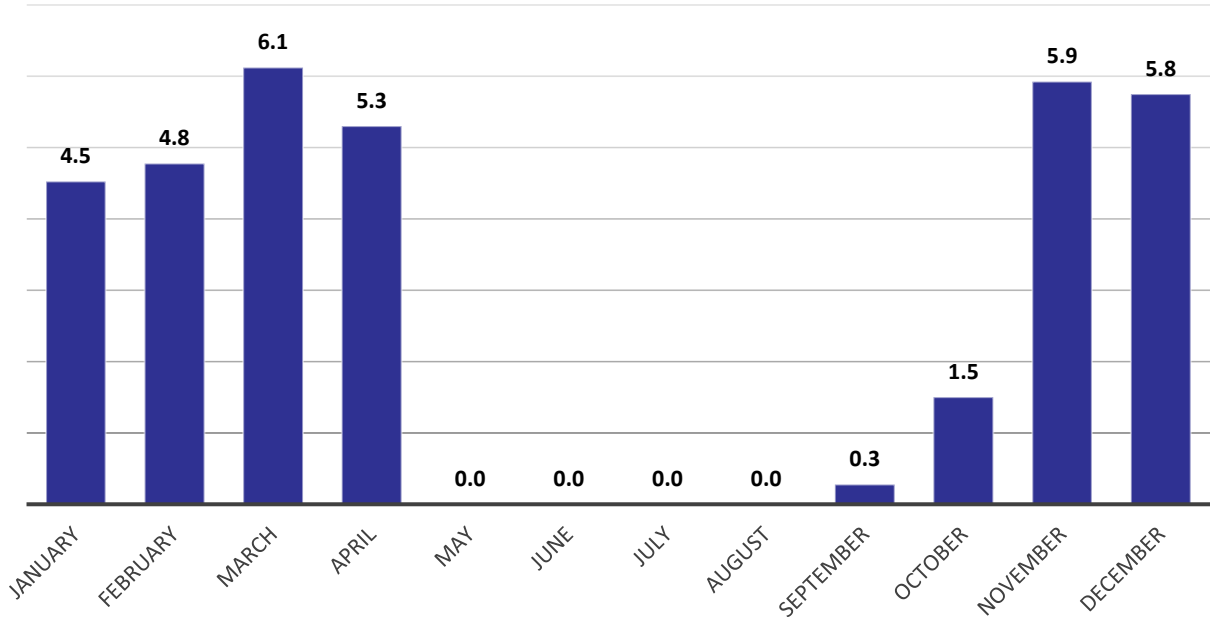
Hazard Type	Number of Events[1]	Average Events Per Year[1]	Total Property Loss[1]	Average Annual Property Loss [1]	Total Crop Loss[2]	Average Annual Crop Loss [2]
Blizzard	39	1.7	$145,000	$6,304	$293,368	$15,440
Heavy Snow	22	1.0	$10,000	$435		
Ice Storm	2	0.1	$16,000	$696		
Winter Storm	183	8.0	$315,000	$13,696		
Winter Weather	0	0	$0	$0		
Extreme Cold/Wind Chill	34	1.5	$0	$0		
Total	**280**	**12.3**	**$486,000**	**$21,131**	**$293,368**	**$15,440**

Source: 1 Indicates data is from NCEI (January 1996 to July 2018); 2 Indicates data is from USDA RMA (2000 to 2018)

Probability

Average monthly snowfall for the planning area is shown in Figure 41, which shows the snowiest months are between November and March. A common snow event (likely to occur annually) will result in accumulation totals between one and five inches. Often these snow events are accompanied by high winds. It is reasonable to expect wind speeds of 25 to 35 mph with gusts reaching 50 mph or higher. Strong winds and low temperatures can combine to produce extreme wind chills of 20°F to 40°F below zero.

Figure 41: Monthly Normal (1981-2010) Snowfall in Inches



Source: High Plains Regional Climate Center, 2018

REGIONAL VULNERABILITIES

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

Table 78: Regional Severe Winter Storm Vulnerabilities

SECTOR	VULNERABILITY
PEOPLE	-Elderly citizens are at higher risk to injury or death, especially during extreme cold and heavy snow accumulations -Citizens without adequate heat and shelter at higher risk of injury or death
ECONOMIC	-Closed roads and power outages can cripple a region for days, leading to significant revenue loss and loss of income for workers
BUILT ENVIRONMENT	-Heavy snow loads can cause roofs to collapse -Significant tree damage possible, downing power lines and blocking roads
INFRASTRUCTURE	-Heavy snow and ice accumulation can lead to downed power lines and prolonged power outages -Transportation may be difficult or impossible during blizzards, heavy snow, and ice events
CRITICAL FACILITIES	-Emergency response and recovery operations, communications, water treatment plants, and others are at risk to power outages, impassable roads, and other damages

TORNADOES

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

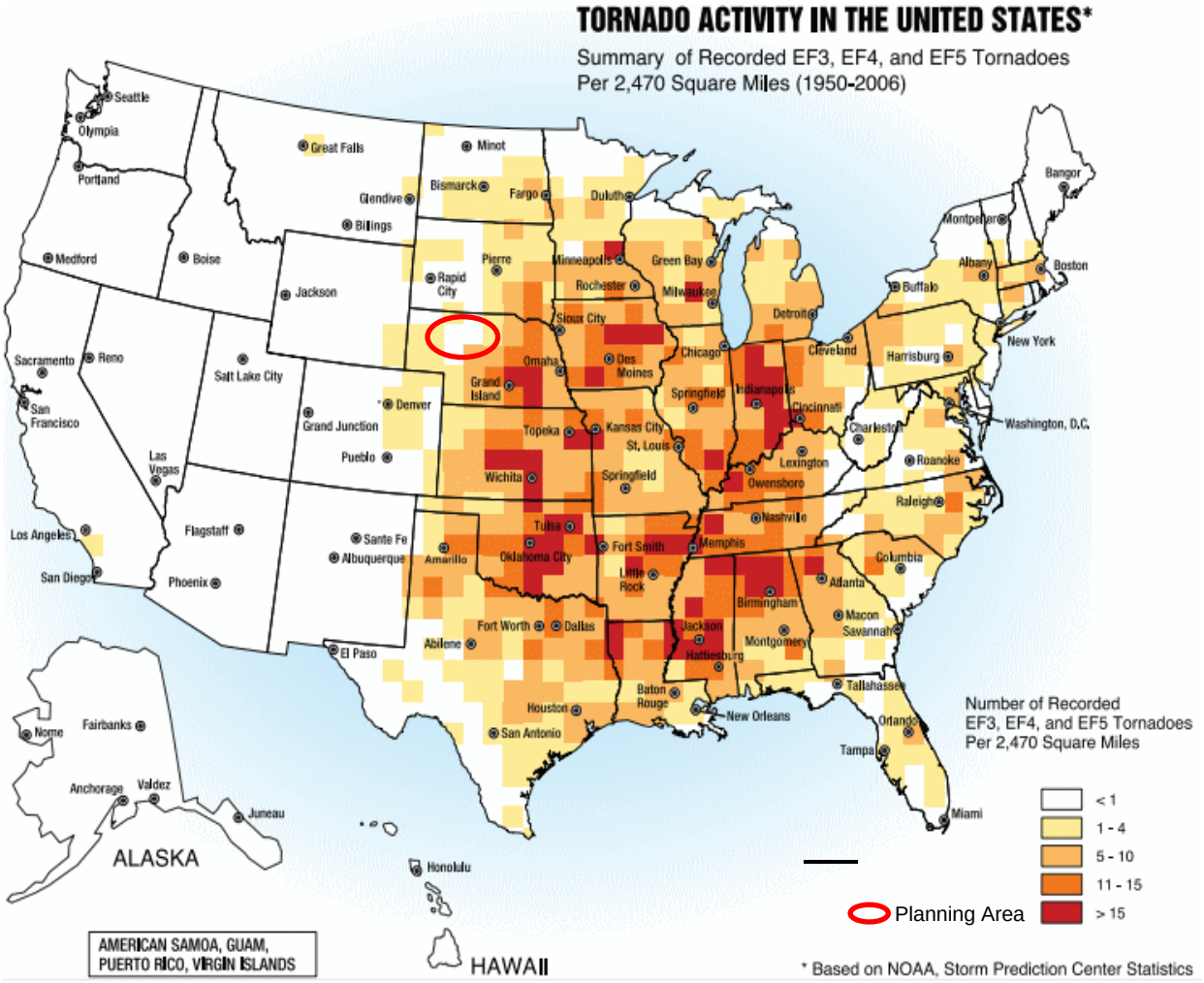
- There must be a microscale rotating area of wind, ranging in size from a few feet to a few miles wide;
- The rotating wind, or vortex, must be attached to a convective cloud base and must be in contact with the ground; and,
- The spinning vortex of air must have caused enough damage to be classified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

Once tornadoes are formed, they can be extremely violent and destructive. They have been recorded all over the world, but are most prevalent in the American Midwest and South, in an area known as "Tornado Alley." Approximately 1,250 tornadoes are reported annually in the contiguous United States. Tornadoes can travel distances over 100 miles and reach over 11 miles above ground. Tornadoes usually stay on the ground no more than 20 minutes. Nationally, the tornado season typically occurs between April and July. On average, 80 percent of tornadoes occur between noon and midnight. In Nebraska, 77 percent of all tornadoes occur in the months of May, June, and July.

Nebraska is ranked fifth in the nation for tornado frequency with an annual average of 57 tornadoes between 1991 to 2010.[82] The following figure shows the tornado activity in the United States as a summary of recorded EF3, EF4, and EF5 tornadoes per 2,470 square miles from 1950-2006.

[82] National Centers for Environmental Information. 2013. "U.S. Tornado Climatology." https://www.ncdc.noaa.gov/climate-information/extreme-events/us-tornado-climatology.

Figure 42: Tornado Activity in the United States



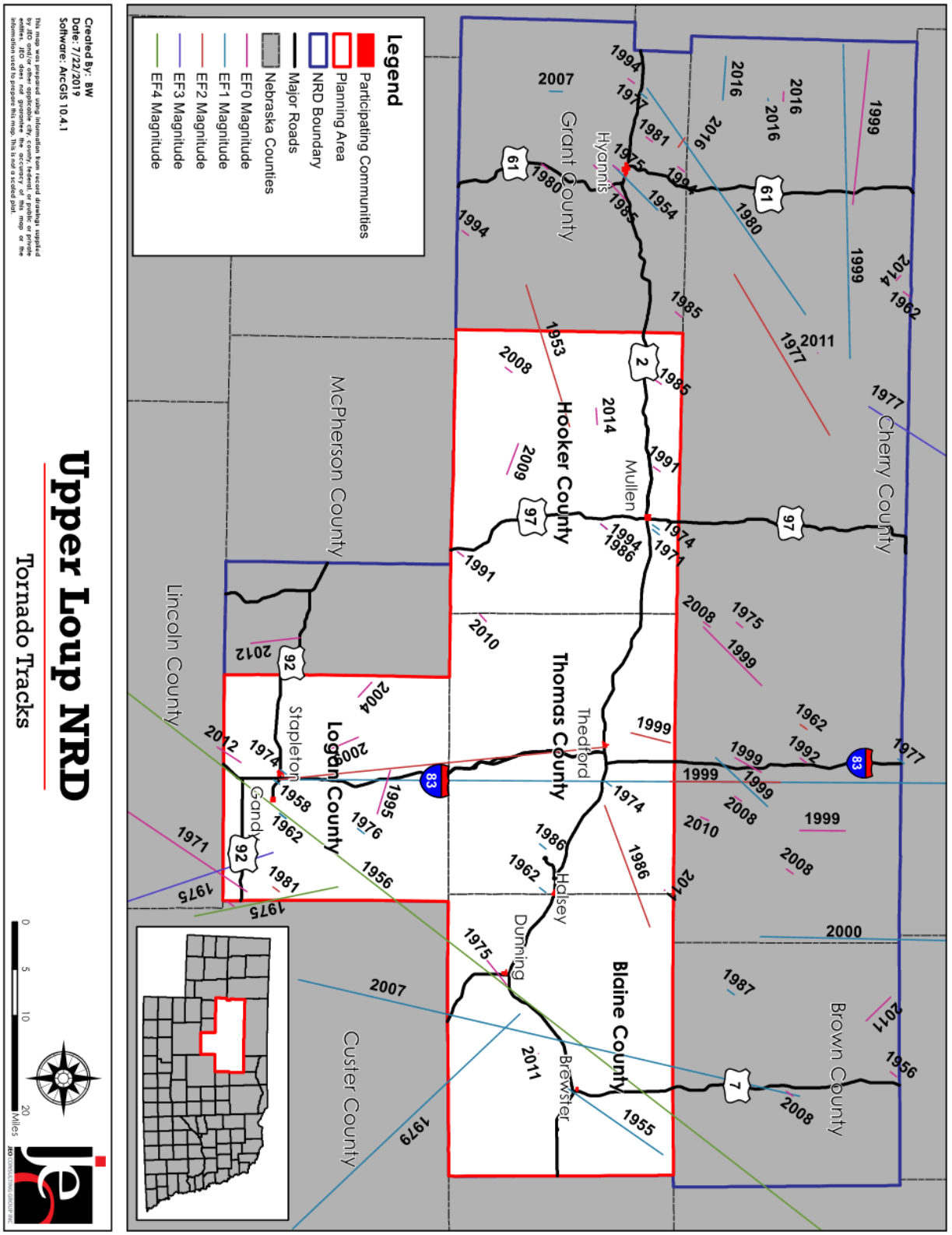
Source: FEMA, 2008[83]

LOCATION

Tornadoes can occur anywhere in the planning area. The impacts would likely be greater in more densely populated areas. The following map shows the historical track locations across the region from 1950 to 2017 according to the Midwestern Regional Climate Center. Note that this map shows tornado tracks both within or that cross into the boundaries of the Upper Loup NRD, including southern Cherry and Brown Counties and eastern McPherson County.

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

Figure 43: Historic Tornado Tracks



EXTENT

After a tornado passes through an area, an official rating category is determined, which provides a common benchmark that allows comparisons to be made between different tornadoes. The magnitude of tornadoes is measured by the Enhanced Fujita Scale. The Enhanced Fujita Scale does not measure tornadoes by their size or width, but rather the amount of damage caused to human-built structures and trees. The Enhanced Fujita Scale replaced the Fujita Scale in 2007. The enhanced scale classifies EF0-EF5 damage as determined by engineers and meteorologists across 28 different types of damage indicators, including different types of building and tree damage. To establish a rating, engineers and meteorologists examine the damage, analyze the ground-swirl patterns, review damage imagery, collect media reports, and sometimes utilize photogrammetry and videogrammetry. Based on the most severe damage to any well-built frame house, or any comparable damage as determined by an engineer, an EF-Scale number is assigned to the tornado. Table 79 and Table 80 summarize the Enhanced Fujita Scale and damage indicators. According to a recent report from the National Institute of Science and Technology on the Joplin Tornado, tornadoes rated EF3 or lower account for around 96 percent of all tornado damages.[84]

Table 79: Enhanced Fujita Scale

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

Source: NOAA; FEMA

[84] Kuligowski, E.D., Lombardo, F.T., Phan, L.T., Levitan, M.L., & Jorgensen, D.P. March 2014. "Final Report National Institute of Standards and Technology (NIST) Technical Investigation of the May 22, 2011, Tornado in Joplin, Missouri."

Table 80: Enhanced Fujita Scale Damage Indicator

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

Source: NOAA; FEMA

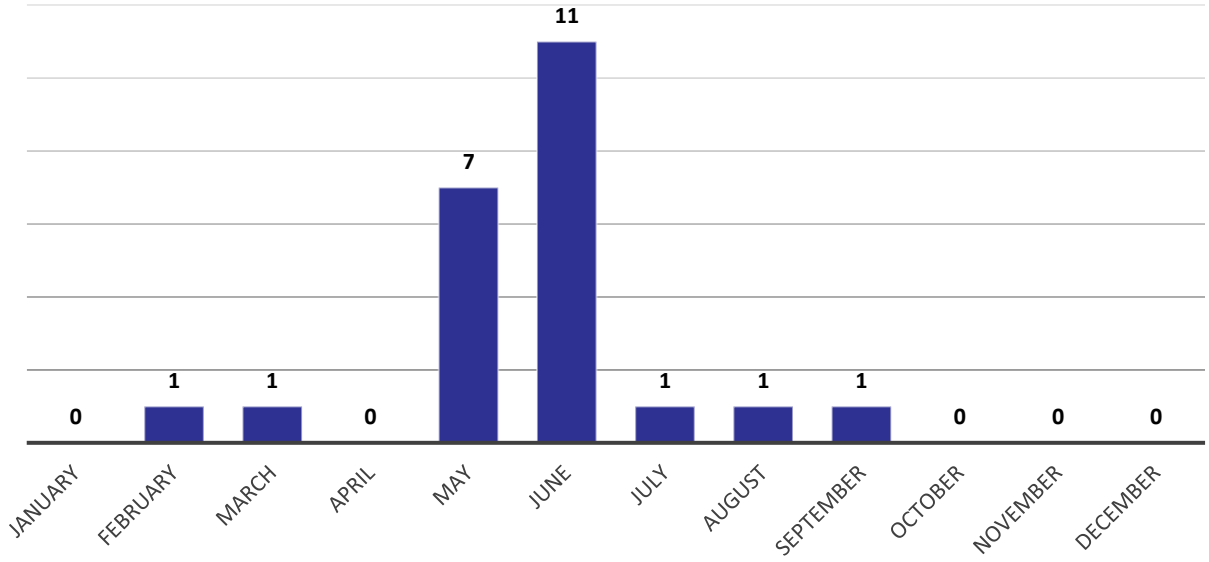
Based on the historic record, it is most likely that tornadoes that occur within the planning area will be of EF0 strength. Of the 23 reported events, two were EF1 and one was EF2.

Historical Occurrences

NCEI cites 23 tornadic events ranging from a magnitude of EF0 to EF2 between 1996 and 2018. These events were responsible for $104,500 in property damages. No deaths or injuries were reported for these events. The most damaging tornadoes occurred in Thomas County, an EF2 with $50,000 in damages in 1999 and an EF1 with $20,000 in damages in 2007.

The jurisdiction-specific events from NCEI and reported by each community are listed in *Section Seven: Community Profiles*. The following figure shows that the month of June is the busiest month of the year with the highest number of tornadoes in the planning area.

Figure 44: Tornadoes by Month in the Planning Area



Source: NCEI, 1996-2018

AVERAGE ANNUAL DAMAGES

The average damage per event estimate was determined based upon NCEI Storm Events Database since 1996 and number of historical occurrences. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. Tornadoes cause an average of $4,543 per year in property damage. The RMA did not report crop damages due to tornadic events, but damage to rangeland from tornadoes is still a concern for the planning area.

Table 81: Tornado Loss Estimate

Hazard Type	Number of Events[1]	Average Events Per Year	Total Property Loss[1]	Average Annual Property Loss [1]
Tornadoes	23	1	$104,500	$4,543

Source: 1 Indicates data is from NCEI (January 1996 to July 2018); 2 Indicates data is from USDA RMA (2000 to 2018)

PROBABILITY

Given the 23 events over the course of 23 years, there is roughly a 100 percent probability that a tornadic event will occur in the planning area in any given year.

REGIONAL VULNERABILITIES

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

Table 82: Regional Tornado Vulnerabilities

SECTOR	VULNERABILITY
PEOPLE	-Citizens living in mobile homes are at risk to death or injury -Citizens without access to shelter below ground or in safe room -Elderly with decreased mobility or poor hearing may be higher risk -Vulnerable populations including nursing homes and children at schools -Lack of multiple ways of receiving weather warnings, especially at night
ECONOMIC	-Significant economic losses possible, especially with EF3 tornadoes or greater
BUILT ENVIRONMENT	-All building stock are at risk of significant damages
INFRASTRUCTURE	-All above ground infrastructure at risk to damages -Impassable roads due to debris blocking roadways
CRITICAL FACILITIES	-All critical facilities at risk to significant damages and power outages

SECTION FIVE
MITIGATION STRATEGY

INTRODUCTION

The primary focus of the mitigation strategy is to establish goals and objectives, and identify action items to reduce the effects of hazards on existing infrastructure and property in a cost effective and technically feasible manner. The establishment of goals and objectives took place during the kick-off meeting with the regional planning team.

Meeting participants reviewed the goals from the 2015 HMP and discussed recommended additions and modifications. The intent of each goal and set of objectives is to develop strategies to account for risks associated with hazards and identify ways to reduce or eliminate those risks. Each goal and set of objectives is followed by 'mitigation alternatives,' or actions.

A preliminary list of goals and objectives was provided to the Planning Team and participants at the Round 1 public meetings. The Regional Planning Team voted to maintain the same list of goals from the 2015 HMP.

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

Requirement §201.6(c)(3)(ii): [The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

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

Requirement: §201.6(c)(3)(iii): [The mitigation strategy section shall include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

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

SUMMARY OF CHANGES

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

GOALS

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

- **GOAL 1: PROTECT HEALTH AND SAFETY OF RESIDENTS**
- **GOAL 2: REDUCE FUTURE LOSSES FROM HAZARD EVENTS**
- **GOAL 3: INCREASE PUBLIC AWARENESS AND EDUCATION ON THE VULNERABILITY TO HAZARDS**
- **GOAL 4: IMPROVE EMERGENCY MANAGEMENT CAPABILITIES**
- **GOAL 5: ENHANCE OVERALL RESILIENCE AND PROMOTE SUSTAINABILITY**
- **GOAL 6: PURSUE MULTI-OBJECTIVE OPPORTUNITIES (WHENEVER POSSIBLE)**

MITIGATION ALTERNATIVES (ACTION ITEMS)

After establishing the goals, mitigation alternatives were prioritized. The alternatives considered included: the mitigation actions identified per community/jurisdiction in the previous plan; additional mitigation actions discussed during the planning process; and recommendations from JEO for additional mitigation actions based on identified needs. JEO provided each participant a preliminary list of mitigation alternatives to be

used as a starting point which was tailored to the hazards of top concern identified by jurisdictions. This prioritized list of alternatives helped participants determine which actions will best assist their respective jurisdiction in alleviating damages in the event of a disaster. The listed priority does not indicate which actions will be implemented first, but will serve as a guide in determining the order in which each action should be implemented.

These projects are the core of a hazard mitigation plan. The planning teams were instructed that each alternative must be directly related to the goals of the plan. Alternatives must be specific activities that are concise and can be implemented individually. Mitigation alternatives were evaluated based on referencing the community's risk assessment and capability assessment. Communities were encouraged to choose mitigation actions that were realistic and relevant to the concerns identified.

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

It is important to note that not all of the mitigation actions identified by a community may ultimately be implemented due to limited capabilities, prohibitive costs, low benefit/cost ratio, or other concerns. These factors may not be identified during the planning process. Participants have not committed to undertaking identified mitigation actions in the plan. The cost estimates, priority ranking, potential funding, and identified agencies are used to give communities an idea of what actions may be the most feasible over the next five years. This information will serve as a guide for the participants to assist in hazard mitigation for the future. Additionally, some jurisdictions may identify and pursue additional mitigation actions not identified in this HMP.

PARTICIPANT MITIGATION ALTERNATIVES

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

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

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

MITIGATION ALTERNATIVE PROJECT MATRIX

During public meetings, each participant was asked to review mitigation projects listed in the 2015 HMP and identify new potential mitigation alternatives, if needed, to reduce the effects of hazards. Selected projects varied from community to community depending upon the significance of each hazard present. The information listed in Table 83 is a compilation of new and on-going mitigation alternatives identified by jurisdiction. Completed and removed mitigation alternatives can be found in the respective community profile.

Table 83: Mitigation Alternatives Selected by Each Jurisdiction

Upper Loup NRD HMP Update - 2020 Mitigation Alternatives	Goal	ULNRD ULNRD	Hyannis Grant	Hooker County Mullen Hooker	Thomas County Thedford Halsey Thomas	Blaine County Brewster Dunning Blaine	Logan County Stapleton Gandy Logan	Mullen Public Schools Sandhills Public Schools Schools
Acquire Identification Resources	3	X						
Alert/Warning Sirens	1, 4, 6			X X	X X X	X X X	X X	X
Assess Vulnerability to Drought Risk	2, 5, 6				X			
Backup Generators	1, 5, 6	X	X	X X	X X X	X X X	X X	X
Backup Municipal Records	2				X			
Bury Power and Service Lines	2, 5, 6			X				
Civil Service Improvements	4				X	X	X	
Complete/Update Wildfire Protection Plan	2, 4, 5, 6							X
Continuity Planning	2, 5				X			
Develop a Drought Management Plan	2, 4, 5, 6	X			X			
Drainage Improvements	2, 5, 6			X	X	X X	X X	
Education Regarding CodeRed Warning Protocols	3	X						
Electrical System looped Distribution/Redundancies	2, 5, 6			X				
Emergency Communication	4			X		X		
Emergency Exercise: Hazardous Spill	3, 4, 6						X	X

Upper Loup NRD HMP Update - 2020 Mitigation Alternatives	Goal	ULNRD ULNRD	Hyannis Grant	Hooker County Mullen Hooker		Thomas County Thedford Halsey Thomas			Blaine County Brewster Dunning Blaine			Logan County Stapleton Gandy Logan			Mullen Public Schools Sandhills Public Schools Schools	
Emergency Fuel Supply Plan	2, 4, 5, 6								X							
Emergency Operations Center	4						X									
Enroll in NFIP	2, 5, 6						X	X								
Fan and Air Conditioning Program	1	X														
Fire Wise Defensible Space	2			X	X	X	X	X	X	X				X		
Groundwater/Irrigation/Water Conservation Management Plan and Practices	2, 4, 5, 6	X														
Hail Resistant Building Materials	2, 5			X												
Hazardous Tree Removal Program	2							X			X			X	X	
Improve and Revise Snow/Ice Removal Program	1, 4, 6				X											
Improve Communications	4	X														
Improve/Provide Facilities for Vulnerable Populations	1			X												
Infrastructure Hardening	2						X									
Lightning Rods	2															X
Promote First Aid	1, 3, 6														X	X
Public Awareness/Education	1, 3, 4, 6	X			X	X	X	X	X	X	X	X	X	X		X

Upper Loup NRD HMP Update - 2020 Mitigation Alternatives	Goal	ULNRD ULNRD	Hyannis Grant	Hooker County Mullen Hooker	Thomas County Thedford Halsey Thomas	Blaine County Brewster Dunning Blaine	Logan County Stapleton Gandy Logan	Mullen Public Schools Sandhills Public Schools Schools
Railroad Crossing Guard	1			X				
Replace Water Tower and Improve Water System	2		X					
Rescue/Snow Removal Resources	4		X			X	X	
Sheltering in Place	1, 4, 6				X			
Source Water Contingency Plan	2, 4, 5, 6			X				
Storm Shelters/Safe Rooms	1, 2, 6	X		X	X	X	X	
Surge Protectors	2							X
Training and Equipment for Volunteer Wildfire Fighters	2, 4				X			
Transportation System Improvements	2		X					
Tree City USA	3, 5, 6				X		X	
Tree Removal Equipment	2			X				
Update Comprehensive Plan	2, 4, 5, 6			X				
Warning Systems - Internet Signals	1, 3, 4, 6		X					
Warning Systems - Radio Signals	1, 3, 4, 6		X					
Warning Systems - TV and Telephone	1, 3, 4, 6				X			
Water Storage	2	X		X				

Upper Loup NRD HMP Update - 2020 Mitigation Alternatives	Goal	ULNRD ULNRD	Hyannis Grant	Hooker County Mullen Hooker	Thomas County Thedford Halsey Thomas	Blaine County Brewster Dunning Blaine	Logan County Stapleton Gandy Logan	Mullen Public Schools Sandhills Public Schools Schools
Water System Improvements	2			X		X		
Weather Radios	1, 4, 6					X	X	
Weather Spotter Training	3, 4, 6	X						
Well Improvements	2			X				
Wildfire and High Winds Emergency Response and Rescue Plan	2, 4, 5, 6				X			
Windbreaks and Snow Fences	2, 5, 6	X		X				

THIS PAGE IS INTENTIONALLY BLANK

SECTION SIX
PLAN IMPLEMENTATION AND MAINTENANCE

MONITORING, EVALUATING, AND UPDATING THE PLAN

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

Requirement §201.6(c)(4)(i): [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.

Requirement §201.6(c)(4)(ii): [The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.

Requirement §201.6(c)(4)(iii): [The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.

To assist with monitoring of the plan, as each recommended project is completed, a detailed timeline of how that project was completed will be written and attached to the plan in a format selected by the governing body. Information that will be included will address project timelines, agencies involved, area(s) benefited, total funding (if complete), etc. At the discretion of each governing body, a local task force will be used to review the original draft of the mitigation plan and to recommend changes.

Review and updating of this plan will occur at least every five years. At the discretion of each governing body, updates may be incorporated more frequently, especially in the event of a major hazard. The governing body will start meeting to discuss mitigation updates at least six months prior to the deadline for completing the plan review. The persons overseeing the evaluation process will review the goals and objectives of the previous plan and evaluate them to determine whether they are still pertinent and current. Among other questions, they may want to consider the following:

- Do the goals and objectives address current and expected conditions?
- If any of the recommended projects have been completed, did they have the desired impact on the goal for which they were identified? If not, what was the reason it was not successful (lack of funds/resources, lack of political/popular support, underestimation of the amount of time needed, etc.)?
- Have either the nature, magnitude, and/or type of risks changed?
- Are there implementation problems?
- Are current resources appropriate to implement the plan?
- Were the outcomes as expected?
- Did the plan partners participate as originally planned?
- Are there other agencies which should be included in the revision process?

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

In addition, the governing body will be responsible for ensuring that the HMP's goals are incorporated into applicable revisions of each participant's comprehensive plan and any new planning projects undertaken

by the participant. The HMP will also consider any changes in comprehensive plans, and incorporate the information accordingly in its next update.

CONTINUED PUBLIC INVOLVEMENT

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

- Public spaces around the jurisdiction
- City/Village Hall
- Websites
- Local radio stations
- Local newspapers
- Regionally-distributed newspaper

UNFORESEEN OPPORTUNITIES

If new, innovative mitigation strategies arise that could impact the planning area or elements of this plan, which are determined to be of importance, a plan amendment may be proposed and considered separate from the annual review and other proposed plan amendments. The ULNRD will compile a list of proposed amendments received annually and prepare a report for NEMA, by providing applicable information for each proposal, and recommend action on the proposed amendments.

INCORPORATION INTO EXISTING PLANNING MECHANISMS

The Planning Team utilized a variety of plan integration tools to help communities determine how their existing planning mechanisms were related to the Hazard Mitigation Plan. Utilizing FEMA's *Integrating the Local Natural Hazard Mitigation Plan into a Community's Comprehensive Plan*[85] guidance, as well as FEMA's *2015 Plan Integration*[86] guide, each community engaged in a plan integration discussion. This discussion was facilitated by a Plan Integration Worksheet. This document offered an easy way for participants to notify the Planning Team of existing planning mechanisms, and if they interface with the HMP.

Each community referenced all relevant existing planning mechanisms and provided information on how these did or did not address hazards and vulnerability. Summaries of plan integration are found in each participant's *Community Profile*. For communities that lack existing planning mechanisms, especially smaller villages, the HMP may be used as a guide for future activity and development in the community.

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

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

SECTION SEVEN: COMMUNITY PROFILES

PURPOSE OF COMMUNITY PROFILES

Community Profiles contain information specific to jurisdictions participating in the ULNRD planning effort. Community Profiles were developed with the intention of highlighting each jurisdiction's unique characteristics that affect its risk to hazards. Community Profiles may serve as a short reference of identified vulnerabilities and mitigation actions for a jurisdiction as they implement the mitigation plan. Information from individual communities was collected at public and one-on-one meetings and used to establish the plan. Community Profiles may include the following elements:

- Local Planning Team
- Location/Geography
- Climate (County Level)
- Demographics
- Transportation
- Future Development Trends
- Parcel Improvements and Valuations
- Critical Infrastructure and Key Resources
- Historical Hazard Events (County Level)
- Hazard Prioritization
- Governance
- Capability Assessment
- Plan Integration
- Mitigation Actions

In addition, maps specific to each jurisdiction are included such as: jurisdiction identified critical facilities; flood prone areas; and a future land use map (when available).

The hazard prioritization information, as provided by individual participants, in *Section Seven: Community Profiles* varies due in large part to the extent of the geographical area, the jurisdiction's designated representatives (who were responsible for completing meeting worksheets), identification of hazards, and occurrence and risk of each hazard type.

The overall risk assessment for the identified hazard types represents the presence and vulnerability to each hazard type area wide throughout the entire planning area. A discussion of certain hazards selected for each Community Profile were prioritized by the local planning team based on the identification of hazards of greatest concern, hazard history, and the jurisdiction's capabilities. The hazards not examined in depth can be found in *Section Four: Risk Assessment.*