HAZARD MITIGATION PLANNING TEAM

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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
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
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 Energy and Environment
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
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
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
UNWNRD – Upper Niobrara White 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 Region 23 Emergency Management Agency 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).

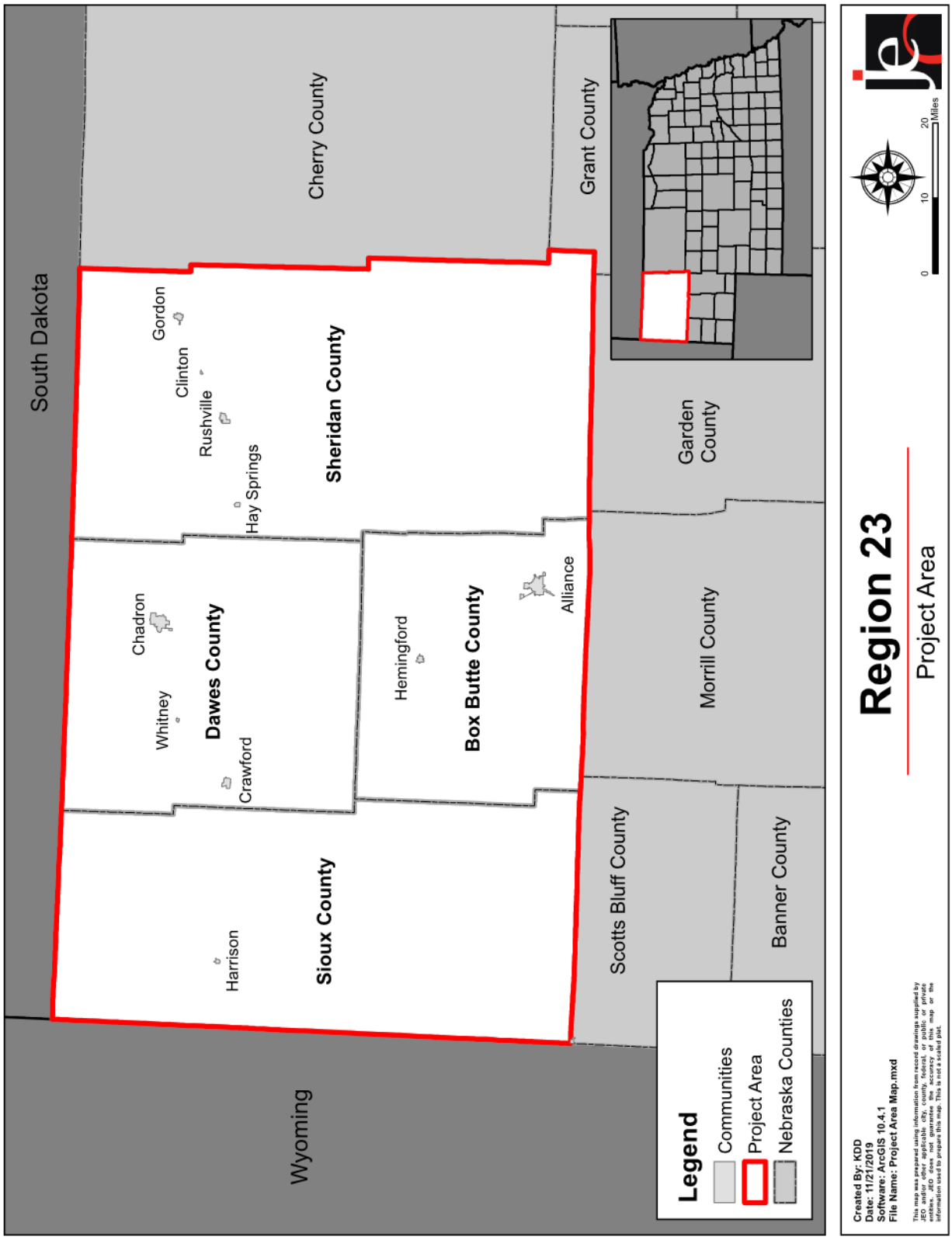
Hazard mitigation planning is a process in which hazards are identified and profiled; people and facilities at-risk are identified and assessed for threats and potential vulnerabilities; and strategies and mitigation measures are identified. Hazard mitigation planning increases the ability of communities 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. Chadron Public Schools and Hemingford Public Schools were new participating jurisdictions in this plan update. The communities of Whitney and Clinton did not participate in the HMP.

Table 1: Participating Jurisdictions

PARTICIPATING JURISDICTIONS	
REGION 23 EMERGENCY MANAGEMENT AGENCY	
BOX BUTTE COUNTY	**SHERIDAN COUNTY**
CITY OF ALLIANCE	CITY OF GORDON
VILLAGE OF HEMINGFORD	CITY OF HAY SPRINGS
DAWES COUNTY	CITY OF RUSHVILLE
CITY OF CHADRON	**SIOUX COUNTY**
CITY OF CRAWFORD	VILLAGE OF HARRISON
CHADRON PUBLIC SCHOOLS	Hemingford Public Schools
CHADRON STATE COLLEGE*	UPPER NIOBRARA WHITE NRD

**Chadron State College participated in this planning process and is integrated within the City of Chadron's Community Profile in Section Seven.*

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 with minor modifications. Objective 6.2 was a new addition for this process. 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.

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.

Objective 4.4: Increase regional EOC capacity.

Objective 4.5: Provide Shelters for the public.

GOAL 5: PURSUE MULTI-OBJECTIVE OPPORTUNITIES (WHENEVER POSSIBLE)

Objective 5.1: When possible, use existing resources, agencies, and programs to implement the projects.

Objective 5.2: When possible implement projects that achieve several goals

GOAL 6: ENHANCE OVERALL RESILIENCE AND PROMOTE SUSTAINABILITY

Objective 6.1: Incorporate hazard mitigation and adaptation into updating other local planning endeavors (e.g., comprehensive plans, zoning ordinance, subdivision regulation, etc.)

Objective 6.2: Integrate the Community Wildfire Protection Plan update to align with Hazard Mitigation Plan goals and actions.

SUMMARY OF CHANGES

The hazard mitigation planning process undergoes several changes during each plan update to best accommodate the planning area and specific conditions. Changes from the 2015 Hazard Mitigation Plan and planning process in this update included: a full invitation of all jurisdictions to project kick-off meeting; greater efforts to reach out to and include stakeholder groups, such as fire districts; a more specific hazard risk assessment applicable to the planning 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. Other changes as described in the 2015 Region 23 Hazard Mitigation Plan review are described in the table below.

COMMENT/REVISION FROM 2015 REVIEW TOOL	LOCATION OF REVISION	SUMMARY OF CHANGE
Describe use of Survey Monkey	N/A	Survey Monkey was not used in this HMP update.
Indicate any dams or levees outside of the planning area whose failure could impact people and property in the planning area.	Section Four: Dam Failure	Table 42 identifies potential upstream dams whose failure could impact the planning area.
Communities participating in NFIP's designated mitigation action status	Community profiles as appropriate	Newest guidance by NEMA and FEMA has indicated continued participation in the NFIP is not a mitigation action. While communities will continue to participate in the program, this action has been removed from mitigation action lists.
Plans updating comprehensive plans should include Hazard Mitigation goals or an explanation for exclusion	Community profiles as appropriate	Community profiles Plan Integration sections discuss Comprehensive Plans as available
Plans should describe changes in development and impact to hazard prone areas	Community profiles as appropriate	A description of development changes since last plan is included in "Future Development Trends" section of each community profile.
Written proof of all jurisdiction's governing bodies have adopted the plan must be submitted to FEMA.	Appendix A	Adoption resolution template provided to each community post-plan approval is provided in Appendix A. As resolutions are passed by local bodies, scanned copies are provided to NEMA.

The most notable change in this Hazard Mitigation Plan update was the concurrent update to the Pine Ridge Area Community Wildfire Protection Plan (CWPP). The HMP and CWPP were developed together to build upon wildfire risk assessment and mitigation strategies for the planning area. All local fire districts in the four-county planning area were encouraged to attend meetings and engage in the planning process.

It should be noted as well that due to the COVID-19 outbreak, numerous changes were made in the midst of the planning process to plan meeting dates and requirements. To best protect residents and staff members in the planning area, Round 2 meetings were held via an online or phone one-on-one format rather than in-person public workshop meetings. Additional changes are described in Section Two.

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 comprehensive and stormwater master plan updates, equipment upgrades, alert and warning sirens, floodplain regulation, and others. 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 Region have been able to work with a range of entities to complete projects; potential partners for future project implementation include, but are not limited to: 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	42/6	100%	~13 animals per event
Agricultural Plant Disease	111/20	100%	Unavailable
Dam Failure	1/109	<1%	Varies by Structure
Drought & Extreme Heat	437/1,489 months of drought	29%	D1-D2
	Avg 4 days per year >100°F	100%	>100°F
Flooding	24/24	100%	Some inundation of structures (<1% of structures) and roads near streams. Some evacuations of people may be necessary (<1% of population)
High Winds & Tornadoes	217/24	100%	Avg: EF0 Range EF0-EF2 ≤50 mph Avg 47mph; Range 35-59 EG
Severe Thunderstorms	1,302/24	100%	≥1” rainfall Avg 55 mph winds; Hail range 0.75-4.25” (H2-H4); average 1.24”
Severe Winter Storms	362/24	100%	0.5” – 0.75” Ice 20°-40° below zero (wind chill) 4-9” snow 35-50 mph winds
Terrorism & Civil Disorder	0/73	<1%	Varies by event
Wildfire	2,098/19	100%	<250 acres Some homes and structures threatened or at risk

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]	42	530 animals	N/A
	Plant Disease[2]	111	N/A	$1,989,865
Dam Failure[5]		1	$0	N/A
Drought[6]		437/1,489 months	$0	$20,688,052
Extreme Heat[7,8]		Avg 4 days per year	$0	$5,533,235
Flooding[7]	Flash Flood	22	$562,000	$109,388
	Flood	2	$0	
High Winds and Tornadoes[7] *1 fatality*	High Winds	146	$129,000	$11,996,572
	Tornadoes	71	$1,355,000	
Severe Thunderstorms[7] *8 injuries*	Hail	993	$2,302,200	$9,253,643
	Heavy Rain	36	$0	
	Lightning	5	$1,467,000	
	Thunderstorm Wind	286	$1,211,400	
Severe Winter Storms[7] *1 death, 2 injuries*	Blizzard	50	$74,000	$22,145,515
	Extreme Cold/Wind Chill	50	$0	
	Heavy Snow	42	$0	
	Ice Storm	0	$0	
	Winter Storm	169	$85,000	
	Winter Weather	51	$15,000	
Terrorism and Civil Disorder[3,4]		0	$0	N/A
Wildfire[9] *12 injuries*		2,098	445,416 acres	$222,905
Total		**4,383**	**$7,200,600**	**$71,939,175**

N/A: Data not available
1 NDA (2014-2019)
2 USDA RMA (2000-2019)
3 SPEED (1946-2018)
4 START (1970-2018)
5 Stanford NPDP (1911-2019)
6 NOAA (1895-2019)
7 NOAA (1996-2019)
8 HPRCC (1902-2018)
9 NFS (2000-2018)

Events like agricultural disease, extreme heat, wildfires, hail, severe thunderstorms, and severe winter storms will occur annually. Other hazards like drought, dam failure, 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, drought, severe thunderstorms, severe winter storms, and wildfire 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.

DROUGHT

Drought can be a slow onset and long lasting phenomenon which occurs regularly in the state and planning area. 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, particularly to livestock production in the western panhandle. Over twenty 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 and producing a range of associated hazards including hail, strong winds, heavy rain, and lightning strikes. 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 1,320 severe thunderstorm events in 24 years across the four county planning area. These events caused nearly $5 million in property damages. Typical impacts resulting from severe thunderstorms include, but are not limited to: loss of power; obstruction of transportation routes; grass/wildfires starting from lightning strikes; localized flooding; and damages discussed in the hazard profiles for hail and high winds.

Vulnerable populations related to severe thunderstorms include: residents of mobile homes (10% 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. The Region utilizes a Code Red alert system which participating jurisdictions encourage residents to sign up for.

SEVERE WINTER STORMS

Severe winter storms occur regularly across the entire State of Nebraska and in the planning area. Winter storms can bring extreme cold temperatures, freezing rain and ice, and heavy or drifting snow. Blizzards are particularly dangerous and can have significant impacts for residents, the local economy, transportation corridors, and infrastructure. Severe winter storms typically occur between November and March. The NCEI reported 362 severe winter storm events that caused over $174,000 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. Additionally, proximity to the Pine Ridge Reservation increases risk to those traveling in the area or sharing resources. 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 especially cattle ranching.

WILDFIRE

Wildfire has occurred across all portions of the planning area and is a hazard of top concern for all communities. Due to the topographic and vegetative composition of the Nebraska panhandle, wildfire events occur regularly and with great magnitude. Wildfire is exacerbated by drought, extreme heat, and flooding conditions which modify vegetative and soil conditions. There are two main fire seasons in the planning area. The early fire season occurs once snowmelt and the last spring frost (when the previous year's cured vegetation dries) occurs until early May. The late season begins mid- to late summer as fine fuels, such as grasses and forbs, begin to dry. In most years the late season extends to mid-November, coinciding with agriculture crop harvests, leaf drop, and curing of prairie grasses.

Vulnerable areas to wildfire include remote or rural areas without sufficient transportation corridors for emergency response; areas of heavy fuel loads such as forested parks; community boundaries near heavy fuel loads or as part of the WUI; and previously burned areas with dead trees or brush. The planning area is serviced by 13 volunteer fire departments with mutual aid agreements. According to the NFS, 2,098 fires between 2000 and 2018 burned over 445,000 acres of land within the fire district boundaries.

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, high winds and tornadoes, severe thunderstorms, flooding, extreme heat, drought, agriculture diseases (plant and animal), and wildfires are part of the world around us. Human-caused hazards are a product of the society and can occur with significant impacts to communities. Human-caused hazards can include 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 Region 23 Emergency Management Agency (EMA) 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 Region 23 EMA 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, Region 23 EMA 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, Region 23 EMA 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. Region 23 EMA 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

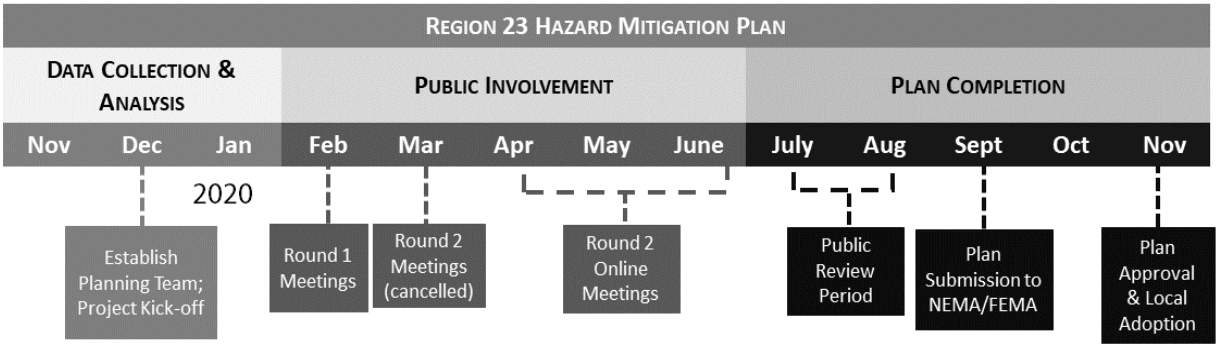
- Bring the plan to life by implementing specific mitigation projects and changing day-to-day operations. It is critical that the plan remains relevant to succeed. Thus, it is important to conduct periodic evaluations and revisions, as needed.

ORGANIZATION OF RESOURCES

PLAN UPDATE PROCESS

Region 23 EMA secured funding for their multi-jurisdictional hazard mitigation plan (HMP) in January 2019. JEO Consulting Group, INC. (JEO) was contracted in January 2019 to guide and facilitate the planning process and assemble the multi-jurisdictional hazard mitigation plan. For the planning area, Nan Gould (Region 23 EMA Director) 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 Region 23 and JEO staff identified key contacts who would be the regional Hazard Mitigation Planning Team. This Planning Team, comprised of local participants, officials, engaged agencies, 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 Members

NAME	TITLE	JURISDICTION
BARB STRAUB	Village Administrator	Village of Hemingford
BARBARA KEEGAN	Highway Superintendent	Box Butte County
BRENDA BARRY-SCHOMMER	Safety Coordinator	Chadron State College
BRENT KUSEK	Community Development Director	City of Alliance
CAROLINE WINCHESTER	Superintendent	Chadron Public Schools
CHARLES ISOM	Superintendent	Hemingford Public Schools
CHERYL WELCH	Council Member	City of Chadron
CONNIE ROFFERS	City Clerk	City of Rushville
CONNIE SHELL	Mayor	City of Crawford
DAN BISHOP	Public Works Director	City of Gordon
DASHIELL ROHAN	Board Member	Village of Harrison
DAWN RAY	Support Services	Pioneer Manor/City of Hay Springs
DOAK NICKERSON	Northwest District Forester	Nebraska Forest Service
DUSTY BRYNER	Police Chief	Village of Hemingford
EVERET LANGFORD	Fire Fighter and Deputy	City of Hay Springs, Sheridan County
FRED MCCARTNEY	Forest Fuel Management Specialist	Nebraska Forest Service
GLEN SPAUGH	City Manager	City of Gordon
GREGORY YANKER	City Manager	City of Chadron
J.W. GEISER	Commissioner	Sioux County
JAKE STEWART	Board Member	Dawes County
JAMES KROTZ	County Commissioner	Sheridan County
JANE DAILEY	City Clerk	City of Crawford
JANET JOHNSON	Building/Zoning Official	City of Chadron
JERRY MACK	High School Principal	Chadron Public Schools
JIM KEEGAN	Deputy	Region 23 EMA
JIM MILES	Maintenance Supervisor	Hemingford Public Schools
JOHN ANNEN	Board Member	Village of Hemingford
KARL DAILEY	Sheriff	Dawes County
LYNN WEBSTER	Assistant Manager	UNW NRD
MIKE MCGINNIS	Commissioner	Box Butte County
MILO RUST	Public Works Director	City of Chadron
MISTY SKAVDAHL	Region 23 Deputy	Region 23 EMA
NAN GOULD	Director	Region 23 EMA
PAT O'BRIEN	General Manager	UNW NRD
PHILLIP SKAVDAHL	Board Chairman	Village of Harrison
RICHARD MCKAY	Mayor	City of Hay Springs
RICK WACKER	Board Member	Village of Hemingford
SETH PETERSON	Fire Management Specialist	Nebraska Forest Service
SHAD BRYNER	Fire Chief	Village of Hemingford
TIM BUSKIRK	District Ranger	USFS Pine Ridge District
TROY SHOEMAKER	Fire Chief	City of Alliance

NAME	TITLE	JURISDICTION
*BROOKE WELSH	Project Coordinator	JEO Consulting Group
*PHIL LUEBBERT	Planner	JEO Consulting Group

**Served as a consultant or advisory role*

A kick-off meeting was held on December 4th, 2019 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
CHERYL WELCH	Council Member	City of Chadron
CONNIE SHELL	Mayor	City of Crawford
DASHIELL ROHAN	Board Member	Village of Harrison
DOAK NICKERSON	Northwest District Forester	Nebraska Forest Service
EVERETTE LANGFORD	Commissioner	Sheridan County
FRED MCCARTNEY	Forest Fuel Management Specialist	Nebraska Forest Service
GLEN SPAUGH	City Manager	City of Gordon
GREGORY YANKER	City Manager	City of Chadron
J.W. GEISER	Commissioner	Sioux County
JANE DAILEY	City Clerk	City of Crawford
JIM KEEGAN	Deputy	Region 23 EMA
KARL DAILEY	Sheriff	Dawes County
MILO RUST	Public Works Director	City of Chadron
MISTY SKAVDAHL	Region 23 Deputy	Region 23 EMA
NAN GOULD	Director	Region 23 EMA
PHILLIP SKAVDAHL	Board Chairman	Village of Harrison
SETH PETERSON	Fire Management Specialist	Nebraska Forest Service
TIM BUSKIRK	District Ranger	USFS Pine Ridge District
TROY SHOEMAKER	Fire Chief	City of Alliance
*BROOKE WELSH	Project Coordinator	JEO Consulting Group
*PHIL LUEBBERT	Planner	JEO Consulting Group

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

Table 6: Kick-off Meeting Location and Time

LOCATION AND TIME	AGENDA ITEMS
REGION 23 EMA 250 MAIN ST CHADRON, NE DECEMBER 4TH, 2019 6:00PM	-Consultant and Planning Team Responsibilities -Overview of plan update process and changes from 2015 HMP -Review and adoption of goals and objectives -Dates/Locations for meetings -Plan Goals/Objectives -Overview of CWPP update and integration

PUBLIC INVOLVEMENT AND OUTREACH

To notify and engage the public in the planning process a wide range of stakeholder groups were contacted and encouraged to participate. There were 33 stakeholder groups or entities that were identified and sent letters to participate. These included five airports, seven assisted living facilities, three hospitals or health

care providers, four chamber of commerce, four county extension offices, four Farm Service Agencies, two National Weather Service stations, two local public power districts, and the American Red Cross. While no other entities were incorporated as participating jurisdictions, the following entities attended meetings: Panhandle Public Power District, Nebraska Forest Service, Nebraska Emergency Management Agency, Chadron Community Hospital, Pioneer Manor Nursing Home, Panhandle Public Health District, and Chadron State College. These entities provided input which was incorporated into the appropriate community profiles (see *Section Seven*).

Table 7: Notified Stakeholder Groups

ORGANIZATIONS		
Alliance Chamber of Commerce	Gordon Chamber of Commerce	Niobrara Electric Association
Alliance Municipal Airport	Gordon Countryside Care	Oglala Sioux Lakota Nursing Home
American Red Cross	Gordon Memorial Hospital District	Panhandle Public Health Department
Box Butte County Extension	Gordon Municipal Airport	Panhandle Public Power District
Box Butte County Farm Service Agency	Hay Springs Municipal Airport	Pioneer Manor Nursing Home
Box Butte General Hospital	Hemingford Chamber of Commerce	Ponderosa Villa
Chadron Chamber of Commerce	Hemingford Community Care Center	Rushville Farm Service Agency
Chadron Community Hospital Corp.	Highland Park Care Center	Scotts Bluff Farm Service Agency
Chadron Municipal Airport	Modisett Airport	Sheridan County Extension
Crest View Care Center	National Weather Service	Sioux County Extension
Dawes County Extension	National Weather Service	
Dawes County Farm Service Agency	Nebraska DOT	

Neighboring Jurisdictions

Neighboring jurisdictions were notified and invited to participate in the planning process. The following table indicates which neighboring communities or entities were notified of the planning process. Invitation and informational letters were sent to county clerks, county and regional emergency managers, Regional Emergency Management Agencies, and NRDs. There was no other participation from jurisdictions outside of the planning area.

Table 8: Notified Neighboring Jurisdictions

NOTIFIED NEBRASKA JURISDICTIONS	
Cherry County, NE	Oglala Lakota County, SD
Fall River County, SD	Oglala Sioux Tribe
Garden County, NE	Region 21 Emergency Management
Goshen County, WY	Region 22 Emergency Management
Middle Niobrara NRD	Region 24 Emergency Management
Morrill County, NE	Region 26 Emergency Management
Niobrara County, WY	Scotts Bluff County, NE
North Platte NRD	Upper Loup NRD

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/region-23-hazard-mitigation-plan-update)
PROJECT ANNOUNCEMENT	Project announcement shared with local media outlets and participating jurisdictions to be posted on social media
ROUND 1 MEETING LETTERS OR EMAILS (30-DAY NOTIFICATION)	Sent to participants, stakeholders, and neighboring jurisdictions to discuss the agenda/dates/times/ locations of the first round of public meetings
ROUND 2 MEETING LETTERS OR EMAILS (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 Region 23 EMA HMP and how to get involved. Flyers were posted at multiple locations throughout all counties and shared with all planning team members and stakeholders at meetings
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 team members) reviewed the hazards identified at the kick-off meeting and conducted risk and vulnerability assessments based on these hazards' previous occurrence and the communities' exposure. (For a complete list and regional overview 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 and CWPP plan update process, discuss participation requirements, begin the process of risk assessment and impact reporting, update critical facilities, capabilities assessment, and status update on current mitigation projects	
Location and Time	**Date**
Region 23 EMA Office Chadron NE, 6:00PM MT	Wednesday, February 12th, 2020
Panhandle Public Health Department Hemingford NE, 6:00PM MT	Thursday, February 13th, 2020

The intent of these meetings was to familiarize local planning team members with the plan update process, expected actions for the coming months, the responsibilities of being a participant, and to collect preliminary information to update the HMP. Data collected at these meetings included: updates to mitigation actions from the 2015 Region 23 HMP; review, confirm, or update hazards of top concerns from each jurisdiction; and to begin reviewing and updating community profiles for demographics and capabilities.

These meetings also served as an opportunity to discuss the integration of the Pine Ridge Area Community Wildfire Protection Plan (CWPP) alongside the HMP. CWPPs do not have a federally regulated update cycle. Region 23 EMA, as the project sponsor, combined the update process for the HMP and CWPP for the area. An introduction to the CWPP and preliminary data collection was completed at Round 1 Meetings as well.

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. All county and community jurisdictions attended a Round 1 Meeting or an in-person one-on-one meeting.

Table 11: Round 1 Meeting Attendees

NAME	TITLE	JURISDICTION
Chadron – Wednesday, February 12, 2020		
Aaron Forsberg	Emergency Preparedness Coordinator	Chadron Community Hospital
Brenda Barry-Schommer	Safety Coordinator	Chadron State College
Cheryl Welch	Council Member	City of Chadron
Dan Ray	Support Services	Pioneer Manor of Hay Springs
Dashiell Rohan	Board Member	Village of Harrison
Dr. Caroline Winchester	Superintendent	Chadron Public Schools
Everette Langford	Commissioner	Sheridan County
Glen Spaugh	City Manager	City of Gordon
Gregory Yanker	City Manager	City of Chadron
Jake Stewart	Commissioner	Dawes County
James Krotz	Commissioner	Sheridan County
Jane Dailey	City Clerk	City of Crawford
Karl Dailey	Sheriff	Dawes County
Lynn Webster	Assistant Manager	Upper Niobrara White NRD
Milo Rust	Public Works Director	City of Chadron
Nan Gould	Coordinator	Region 23 EMA
Pat O'Brien	General Manager	Upper Niobrara White NRD
Phillip Skavdahl	Board Chairman	Village of Harrison
Richard McKay	Mayor	City of Hay Springs

NAME	TITLE	JURISDICTION
BROOKE WELSH	Project Coordinator	JEO Consulting Group
PHIL LUEBBERT	Planner	JEO Consulting Group
HEMINGFORD – THURSDAY, FEBRUARY 13, 2020		
BARBARA KEEGAN	Highway Superintendent	Box Butte County
CHARLES ISON	Superintendent	Hemingford Public Schools
J.W. GEISER	Commissioner	Sioux County
JIM KEEGAN	Board Chairman	Village of Hemingford
JOSEPH GREEN	Recovery Planning Specialist	NEMA
RICHARD WACKER	Board Member	Village of Hemingford
RYAN REIBER	Manager	Panhandle Public Power District
SETH PETERSON	Fire Management Specialist	Nebraska Forest Service
SHAD BRYNER	Fire Chief	Hemingford Fire District
SHAVIN BARNHART	Preparedness and Community Health Educator	Panhandle Public Health District
TABI PROCHEZKA	Deputy Director of Health and Preparedness	Panhandle Public Health District
TROY SHOEMAKER	Fire Chief	City of Alliance
BROOKE WELSH	Project Coordinator	JEO Consulting Group
PHIL LUEBBERT	Planner	JEO Consulting Group

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

NAME	TITLE	JURISDICTION
RUSHVILLE – THURSDAY, FEBRUARY 13, 2020		
CONNIE ROFFERS	City Clerk	City of Rushville
BROOKE WELSH	Project Coordinator	JEO Consulting Group
PHIL LUEBBERT	Planner	JEO Consulting Group

MITIGATION PLAN DEVELOPMENT

ROUND 2 MEETINGS: MITIGATION STRATEGIES

Round 2 meetings are designed to identify and prioritize mitigation measures and evaluate potential integration of the HMP alongside other local planning mechanisms. Mitigation actions and plan integration are essential components in effective hazard mitigation plans. Participating jurisdictions were asked to identify any new mitigation actions to pursue alongside continued actions from the 2015 HMP and provide copies or descriptions of current community plans in which hazard mitigation goals and principals can be integrated. Participating jurisdictions were also asked to review the information collected from the Round 1 meeting related to their community through this planning process for accuracy. Information/data reviewed 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*).

Round 2 meetings were originally scheduled for late March 2020. However, due to the prevalence of and the state's imposed directed health measures surrounding the coronavirus disease 2019 (COVID-19) pandemic, in person meetings were cancelled and materials and information was shared via online formats. All participating jurisdictions were provided Round 2 materials to review and complete. Regular email updates were provided to planning team members as changes to the schedule were determined to suit the COVID-19 response. Also, all jurisdictions were given the opportunity to have a one-on-one video or phone conference with the consultant in order to meet plan participation requirements and complete required information. The following table lists the dates and times of one-on-one meetings for communities who selected this route.

Table 13: Round 2 Alternate Meeting Dates

COMMUNITY	DATE
REGION 23 EMA	April 17, 2020
BOX BUTTE COUNTY	June 16, 2020
CITY OF ALLIANCE	June 2, 2020
VILLAGE OF HEMINGFORD	May 18, 2020
DAWES COUNTY	June 16, 2020
CITY OF CHADRON	April 23, 2020
CITY OF CRAFORD	June 5, 2020
SHERIDAN COUNTY	May 26, 2020
CITY OF GORDON	June 1, 2020
CITY OF HAY SPRINGS	June 17, 2020
CITY OF RUSHVILLE	June 16, 2020
SIOUX COUNTY	June 20, 2020
VILLAGE OF HARRISON	June 1, 2020
CHADRON PUBLIC SCHOOLS	April 21, 2020
HEMINGFORD PUBLIC SCHOOLS	April 28, 2020
UPPER NIOBRARA WHITE NRD	June 10, 2020

During one-on-one Round 2 calls, the general schedule, public review period, and submission and adoption requirements were also shared with local planning teams.

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. Specific references as included as footnotes when used as applicable. The following table is not exhaustive as many studies, plans, or data resources at the local level are not publicly available. Individual examples of plan integration are identified in *Section Seven: Community Profiles.*

Table 14: 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 (2020) 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	The Census of Agriculture (2017) https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/Nebraska/
Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards (2013)	What is a Benefit: Guidance on Benefit-Cost Analysis on Hazard Mitigation Projects http://www.fema.gov/benefit-cost-analysis

https://www.fema.gov/media-library/assets/documents/30627	
PLANS AND STUDIES	
Region 23 Hazard Mitigation Plan (2015) https://jeo.com/sites/default/files/inline-files/Main%20Section.pdf_min.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 (2019) https://nema.nebraska.gov/sites/nema.nebraska.gov/files/doc/hazmitplan2019.pdf
DATA SOURCES/TECHNICAL RESOURCES	
Arbor Day Foundation – Tree City Designation https://www.arborday.org/	Nebraska Department of Natural Resources http://www.dnr.ne.gov
Environmental Protection Agency - Chemical Storage Sites https://myrtk.epa.gov/info/search.jsp	Nebraska Department of Natural Resources – Dam Inventory http://prodmaps2.ne.gov/html5DNR/?viewer=daminventory
Federal Emergency Management Agency http://www.fema.gov	Nebraska Department of Natural Resources – Flood Risk Map Products https://prodmaps2.ne.gov/Html5DNR/index.html?viewer=outreach
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 Army Corps of Engineers – National Inventory of Dams https://nid.sec.usace.army.mil/ords/f?p=105:1::::::
National Historic Registry http://www.nps.gov/nr	United States Census Bureau http://www.census.gov
National Oceanic Atmospheric Administration (NOAA) http://www.noaa.gov/	United States Census Bureau https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml
National Weather Service http://www.weather.gov/	United States Department of Agriculture http://www.usda.gov
Natural Resources Conservation Service www.ne.nrcs.usda.gov	United States Department of Agriculture – Risk Assessment Agency http://www.rma.usda.gov

Nebraska Association of Resources Districts http://www.nrdnet.org	United States Department of Agriculture – Web Soil Survey https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx
Nebraska Climate Assessment Response Committee http://carc.agr.ne.gov	United States Department of Commerce http://www.commerce.gov/
Nebraska Department of Education http://nep.education.ne.gov/	United States Department of Transportation – Pipeline and Hazardous Materials Safety Administration https://www.phmsa.dot.gov/
Nebraska Department of Education http://educdirsrc.education.ne.gov/	United States Geological Survey http://www.usgs.gov/
Nebraska Department of Environment and Energy http://www.deq.state.ne.us/	United States National Response Center http://www.nrc.uscg.mil/
Nebraska Department of Health and Human Services http://dhhs.ne.gov/Pages/default.aspx	United States Small Business Administration http://www.sba.gov
Nebraska Department of Natural Resource – Geographic Information Systems (GIS) https://dnr.nebraska.gov/data	UNL – College of Agricultural Sciences and Natural Resources – Schools of Natural Resources http://casnr.unl.edu

Public Review

All participating jurisdictions were provided an opportunity to review and provide comments on the draft HMP prior to its submission. A copy of the draft HMP and community profiles were posted to the project website and all planning team members were notified of its posting via email. Due to changes in the planning process from COVID-19, many jurisdictions conducted one-on-one meetings with the consultant or completed necessary reviews with provided information. As jurisdictions met requirements and provided completed materials and follow up, individual sections of the plan were provided to them. Received comments and suggested changes were incorporated into the draft plan prior to final review by participating jurisdictions. The final draft of the HMP was available online at https://jeo.com/region-23-hazard-mitigation-plan-update from July 1, 2020 through July 15, 2020. A shortened public review period was utilized to submit the HMP for state and federal approval prior to previous plan expiration.

Plan Adoption

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.

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

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 are developed or updated. *Section Six* describes the system that jurisdictions participating in the Region 23 HMP have established to monitor the plan; provides a description of how, when, and by whom the HMP process and mitigation actions will be evaluated; presents the criteria used to evaluate the plan; and explains how the plan will be maintained and updated.

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SECTION THREE
PLANNING AREA PROFILE

INTRODUCTION

To identify jurisdictional vulnerabilities, it is vitally important to understand the people and built environment of the planning area. The following section is meant to provide an overall profile description of the characteristics of the planning area. 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

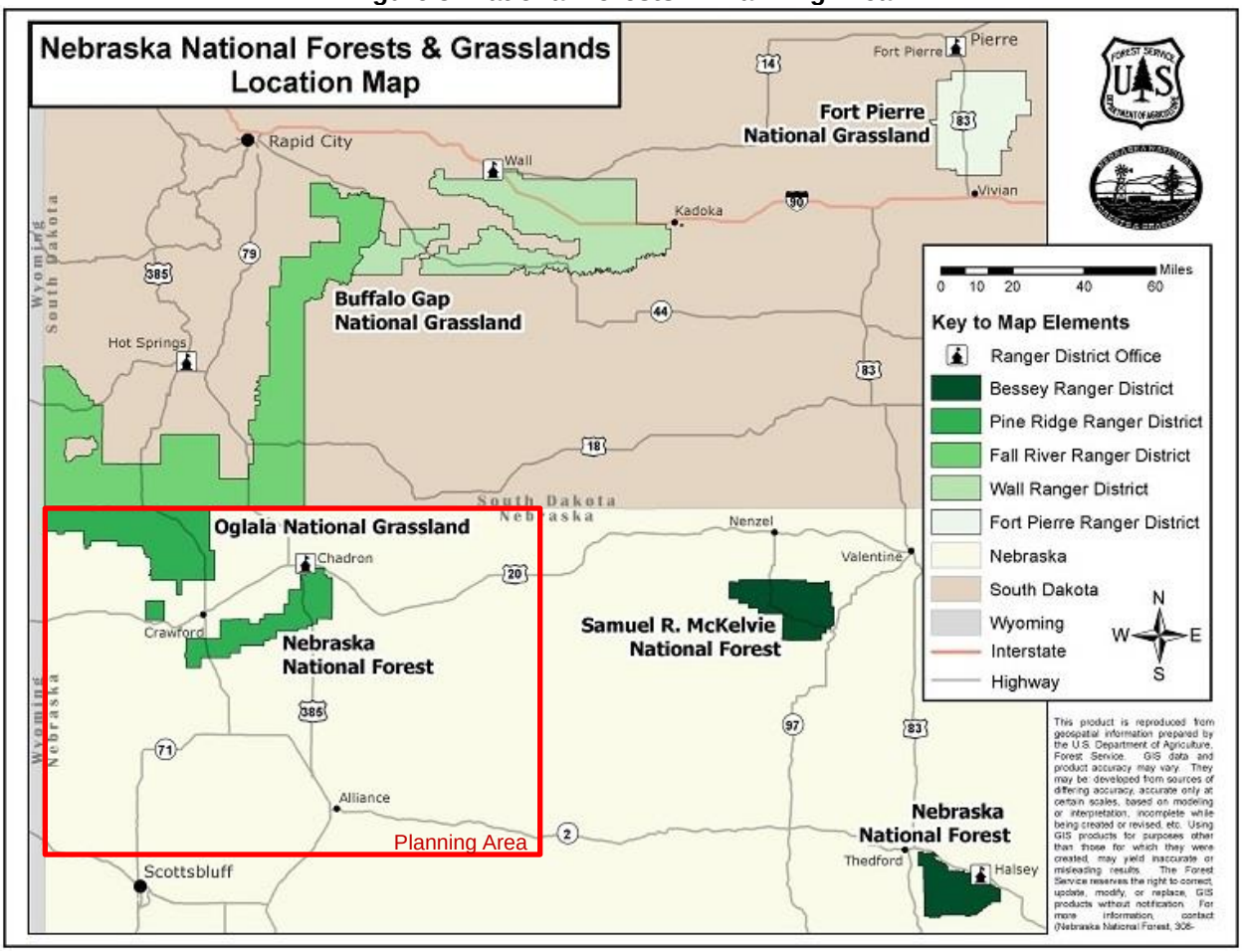
Region 23 EMA's jurisdiction includes the far northwestern corner of Nebraska and spans 7,016 square miles. For the purpose of this plan update the planning area includes all of Box Butte, Dawes, Sheridan, and Sioux counties. The planning area has a diverse range of topographic regions including: valley-side slopes, rolling hills, dissected plains, sandhills, and bluffs and escarpments (Figure 4). Descriptions of these topographic regions are below:

- **Dissected plains**: hilly land with moderate to steep slopes and sharp ridge crests.
- **Valleys**: flat-lying land along major streams and include stream-deposited silt, clay, sand, and gravel materials.
- **Valley-side slopes**: moderately sloping land occurring between escarpments and major stream valleys
- **Rolling Hills**: hilly land with moderate to steep slopes and rounded ridge crests
- **Sandhills**: hilly land composed of low to high dunes of sand stabilized by grass cover
- **Bluffs and Escarpments**: rugged land with very steep and irregular slopes. Exposed bedrock may include shale and limestone.[13]

This region lies in a topographic region of with both plains and a rocky escarpment known as 'Pine Ridge.' Pine Ridge landscape is a rocky escarpment that rises several hundred feet from the surrounding plains. Ponderosa pine woodlands and forest occupy many of the north and east facing slopes with Pine woodland and mixed grass prairie occupying the south and west facing slopes in the region. The region also includes several national forests and grasslands including the southern portion of the Oglala National Grassland and the Nebraska National Forest at Chadron (Figure 3). The region resides in the White River Watershed and the Niobrara River Watershed. Main waterways in the planning area include White River and the Niobrara River. The White River flows into South Dakota where it joins with the Missouri River. The Niobrara River Watershed is comprised of the river as is comes out of Wyoming and flows into Box Butte Reservoir. After it exits the region the Niobrara River is joined by the Snake River. Region 23 in located in the Upper Niobrara White Natural Resources District.

[13] Conservation and Survey Division/Institute of Agriculture and Natural Resources. 2001. "Topographic regions map of Nebraska." https://digitalcommons.unl.edu/caripubs/62.

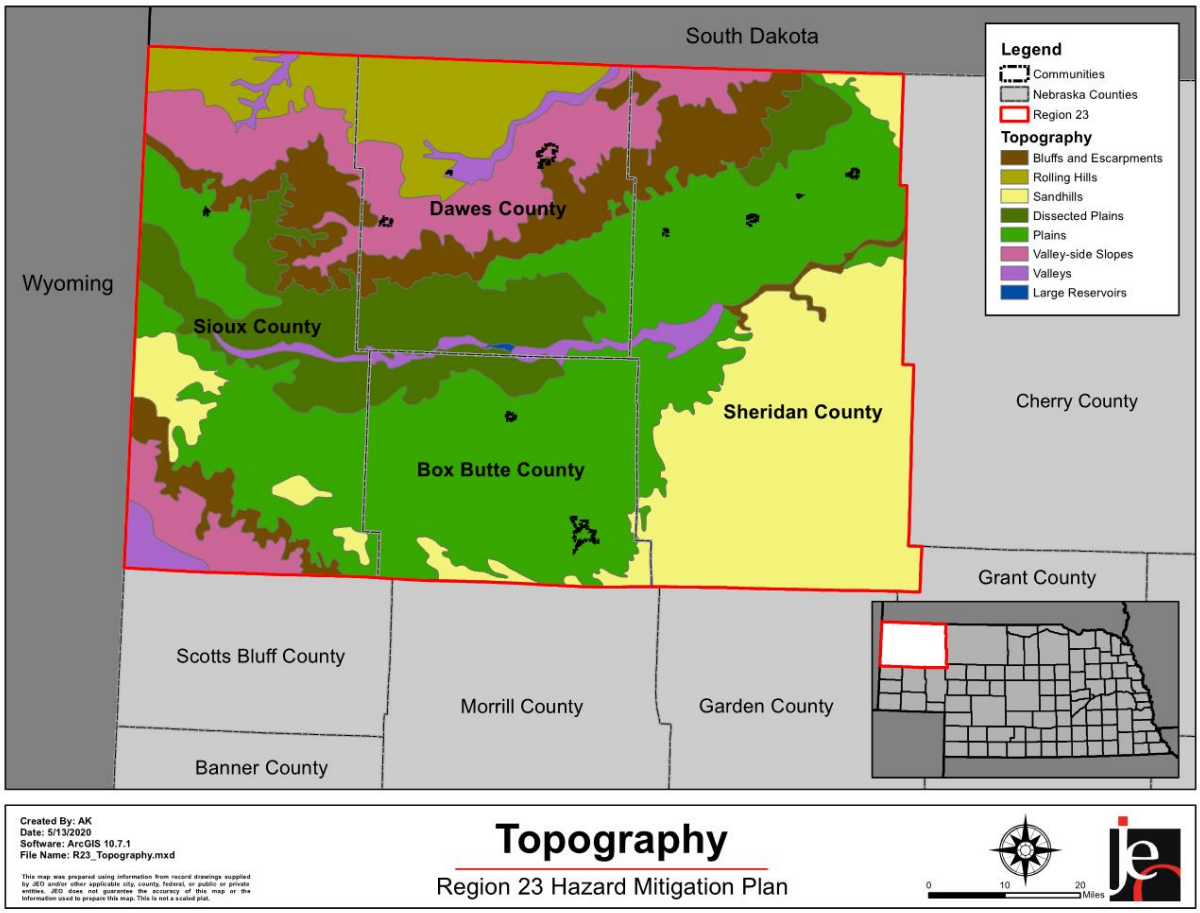
Figure 3: National Forests in Planning Area



Source: USDA Forest Service[14]

[14] United States Department of Agriculture Forest Service. N.d. "Nebraska National Forests and Grasslands." Accessed January 2020. https://www.fs.usda.gov/nebraska

Figure 4: Planning Area Topography



Demographics and At-Risk Populations

As noted above, the planning area includes all of Box Butte, Dawes, Sheridan, and Sioux counties. While neither the Region 23 EMA or U.S. Census Bureau collects specific demographic information for the region, overall county population served is 26,669. This population includes a range of demographics and persons at risk to natural and human-made disasters.

Table 15: Estimated Population for Planning Area

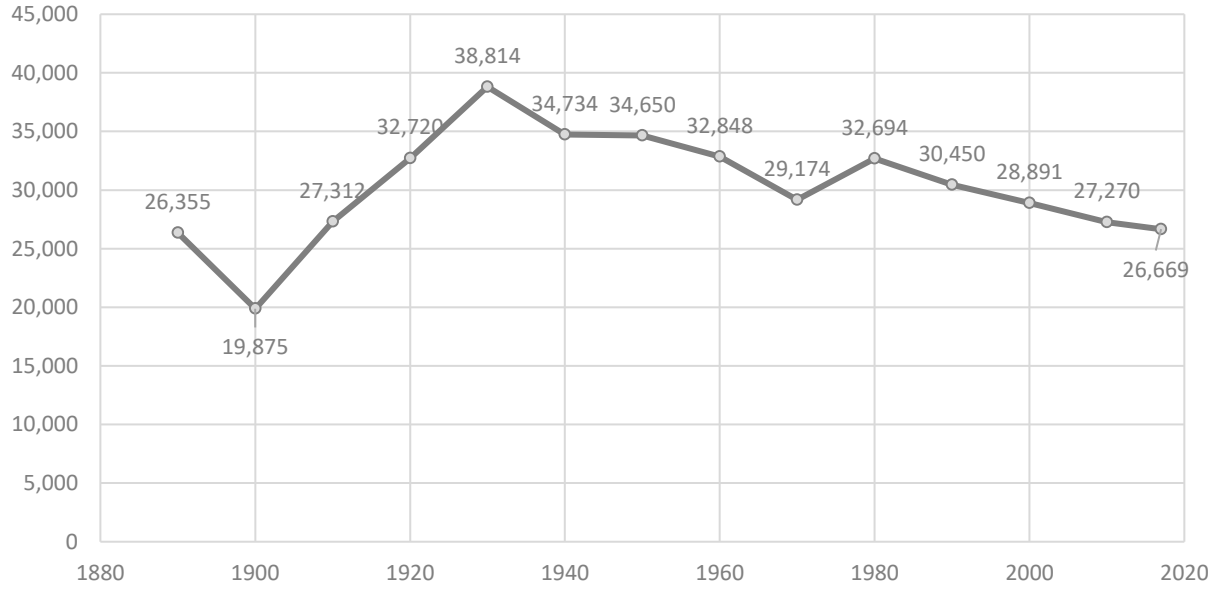
Age	Planning Area	State of Nebraska
<5	5.8%	6.9%
5-19	21.0%	20.7%
20-64	54.2%	57.6%
>64	19.0%	14.8%
Median	43.1	36.3

Source: U.S. Census Bureau

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

incorporated into hazard mitigation plans, as well as other planning mechanisms within the community. Communities with decreasing population are located primarily in more rural areas, away from larger city centers and major transportation corridors.

Figure 5: Planning Area Population, 1890-2017



Source: U.S. Census Bureau[15]

The planning area has displayed an overall decline in total population since the 1980s. While the U.S. Census Bureau conducts a formal census every ten years, the estimated population of the four-county planning area in 2017 was 26,669. Subsequent updates to this HMP should include updated census data from the 2020 census to determine if the trend is continuing.

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."[16]

Dependent children under 19 years old are one of the most vulnerable populations to disasters.[17] The majority of people in this age group do not have access to independent financial resources, 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

[15] United States Census Bureau. "2017 American Fact Finder: S0101: Age and Sex." [database file]. https://factfinder.census.gov.
[16] 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.
[17] Flanagan, Gregory, Hallisey, Heitgerd, & Lewis. 2011. "A Social Vulnerability Index for Disaster Management." Journal of Homeland Security and Emergency Management, 8(11): Article 3.

presence of a caretaker is assumed. With nearly 27% of the planning area's population younger than 19, children are a key vulnerable group to address in the planning process.

Schools house a high number of children and adults within the planning area during the daytime hours of weekdays, as well as during special events on evenings and weekends. The following table identifies the various school districts located within the planning area, and Figure 6 is a map of the school district boundaries. This list is comprehensive and does not represent only the school districts participating in this plan.

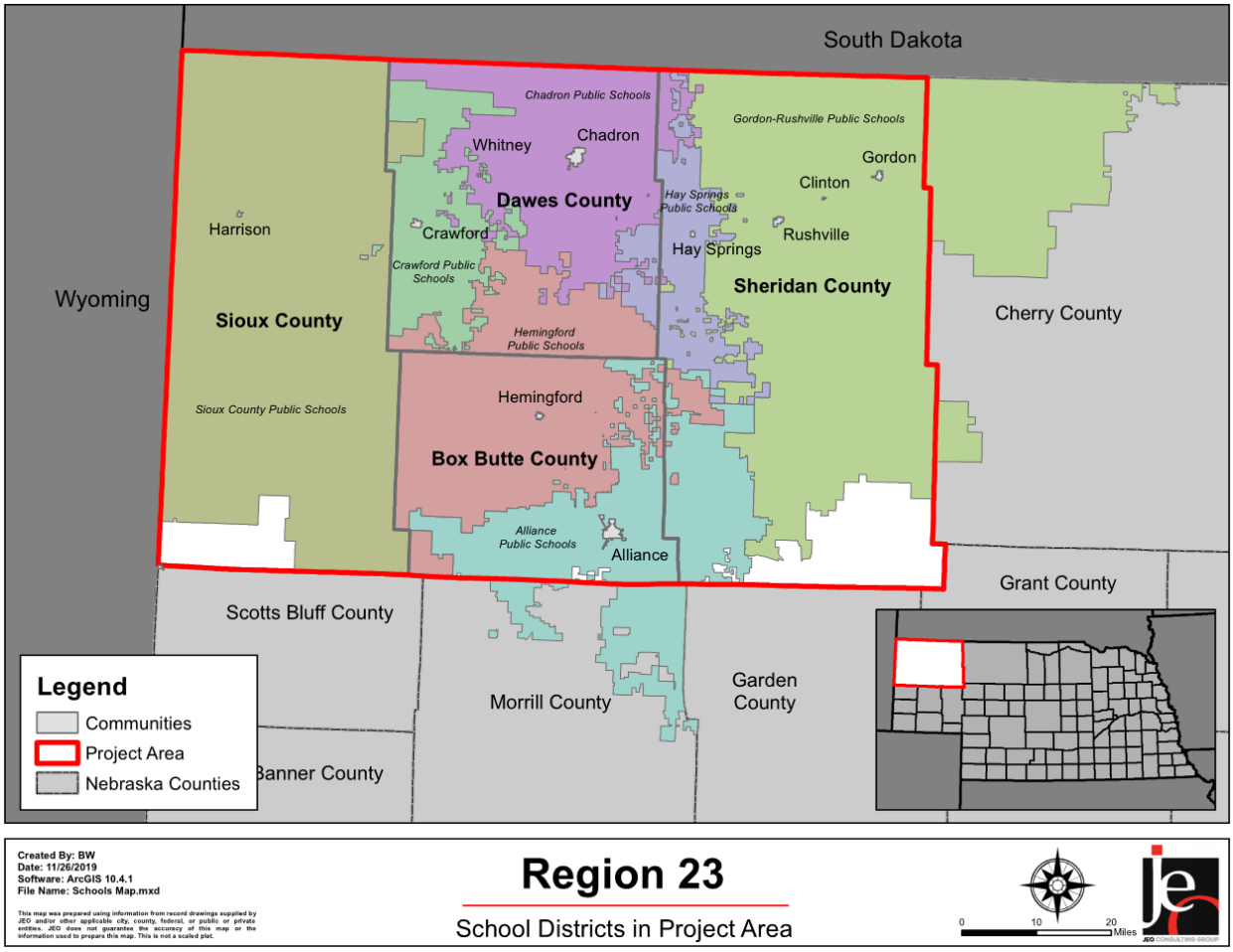
Table 16: School Inventory

School District	Total Enrollment (2018-2019)	Total Teachers
Alliance Public Schools	1,385	90
Chadron Public Schools	920	70
Crawford Public Schools	204	18
Gordon-Rushville Public Schools	616	55
Hay Springs Public Schools	201	20
Hemingford Public Schools	449	38
Sioux County Public Schools	100	18

Source: Nebraska Department of Education[18]

[18] Nebraska Department of Education. 2019. "Nebraska Education Profile." Accessed January 2019. http://nep.education.ne.gov/.

Figure 6: Regional School Districts



Like minors, seniors (age 65 and greater) are often more significantly impacted by temperature extremes. During prolonged heat waves or periods of extreme cold, seniors may lack resources to effectively address hazard conditions and as a result may incur injury or potentially death. Prolonged power outages (either standalone events or as the result of other contributing factors) can have significant impacts on any citizen relying on medical devices 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.[19] 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 17 identifies the number and capacity of care facilities throughout the planning area. In addition to the facilities listed below, a health clinic facility in Chadron also has three extension offices located in Crawford, Alliance, and Gordon.

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

Table 17: Inventory of Care Facilities

Jurisdiction	Hospitals	Hospital Beds	Health Clinics	Adult Care Homes	Adult Care Beds	Assisted Living Homes	Assisted Living Beds
Box Butte	1	25	1	2	96	3	69
Dawes	1	25	2	2	105	2	38
Sheridan	1	25	0	3	157	2	36
Sioux	0	0	0	0	0	0	0

Source: Nebraska Department of Health and Human Services[20,21,22,23]

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 18 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 18: ESL and Poverty At-Risk Populations

County	Percent That Speaks English as Second Language	Families Below Poverty Level
Box Butte	6.8%	4.1%
Dawes	5.0%	12.8%
Sheridan	4.0%	7.9%
Sioux	0.0%	10.8%

Source: U.S. Census Bureau[24,25]

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.

The four county planning area resides to the south and southwest of two tribal Indian reservations in South Dakota: the Oglala Sioux Tribe and the Rosebud Indian Reservation. Residents in the planning area may be part of or travel to these reservations regularly. Native peoples traditionally have a heritage language and tribal elders may only speak their traditional language. 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.

[20] Department of Health and Human Services. December 2019. "Assisted Living Facilities." http://dhhs.ne.gov/publichealth/Documents/ALF%20Roster.pdf.
[21] Department of Health and Human Services. December 2019. "Hospitals." http://dhhs.ne.gov/publichealth/Documents/Hospital%20Roster.pdf.
[22] Department of Health and Human Services. December 2019. "Long Term Care Facilities." http://dhhs.ne.gov/publichealth/Documents/LTCRoster.pdf.
[23] Department of Health and Human Services. December 2019. "Rural Health Clinic." http://dhhs.ne.gov/publichealth/Documents/RHC_Roster.pdf.
[24] U.S. Census Bureau. 2019. "Language Spoken at Home: 2017 American Community Survey (ACS) 5-year estimates." https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#.
[25] U.S. Census Bureau. 2019. "Selected Economic Characteristics: 2017 ACS 5-year estimate." https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#.

Similar to residents below the poverty line, racial minorities tend to have access to fewer financial and systemic resources that would enable them to implement hazard mitigation projects and to respond and recover from hazard events, including residence in standard housing and possession of financial stability. The mostly homogenous racial profile of the planning area indicates that racial inequity will not significantly affect the community's vulnerability to hazards (Table 19). The largest racial minority group within the planning area is American Indian and Alaskan Native, which is likely strongly influenced by the close proximity of the Oglala Lakota Nation and Rosebud Reservations in South Dakota.

Table 19: Racial Composition Trends

RACE	2010		2017		
	NUMBER	% OF TOTAL	NUMBER	% OF TOTAL	% CHANGE
WHITE, NOT HISPANIC	24,529	90%	23,803	89%	(-1%)
BLACK	219	1%	245	1%	0%
AMERICAN INDIAN AND ALASKAN NATIVE	1,251	5%	1,128	4%	(-1%)
ASIAN	179	1%	144	1%	0%
NATIVE HAWAIIAN AND OTHER PACIFIC ISLANDER	3	0%	228	1%	1%
OTHER RACES	577	2%	186	1%	(-1%)
TWO OR MORE RACES	641	2%	935	4%	2%
TOTAL POPULATION	**27,399**	**-**	**26,669**	**-**	**-**

Source: U.S. Census Bureau[26,27]

BUILT ENVIRONMENT AND STRUCTURAL INVENTORY

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

Of the occupied housing units in the planning area, more than 33 percent are renter occupied. Renter occupied housing units often do not receive many of the updates and retrofits that are needed to make them resilient to disaster impacts. Communities may consider enacting landlord outreach programs aimed at educating property owners about the threats in their area and what they can do to help reduce the vulnerability of the tenants living in their housing units. It should be noted that Dawes County has the highest percentage of renter occupied housing units in the planning area, which is likely due to the present of Chadron State College and renting college students. The City of Chadron, the largest community in the planning area, has more than 48 percent of housing stock occupied by renters.

Sioux 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. During disaster events like high winds or tornadoes, these structures may fail and result in debris which can impact other structures as well as humans, resulting in higher damage totals and injuries or fatalities. Some of the participating communities in this planning process have already identified the concern related to older building stock and revitalization efforts. Some of the participating jurisdictions have completed housing or blight studies to help define their needs and an approach to address the concerns.

[26] U.S. Census Bureau. 2019. "Race: 2010 ACS 5-year estimate." https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#.
[27] U.S. Census Bureau. 2019. "Race: 2017 ACS 5-year estimate." https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#.

Table 20: Housing Characteristics

Jurisdiction	Total Housing Units				Occupied Housing Units			
	Occupied		Vacant		Owner		RENTER	
	#	%	#	%	#	%	#	%
Box Butte County	4,610	84.4%	849	15.6%	3,305	71.7%	1,305	28.3%
Alliance	3,475	85.8%	575	14.2%	2,353	67.7%	1,122	32.3%
Hemingford	343	75.2%	113	24.8%	257	74.9%	86	25.1%
Dawes County	35,557	83.9%	683	16.1%	2,222	62.5%	1,335	37.5%
Chadron	2,180	86.6%	337	13.4%	1,125	51.6%	1,055	48.4%
Crawford	502	79.3%	131	20.7%	388	77.3%	114	22.7%
Sheridan County	2,306	79.1%	610	20.9%	1,622	70.3%	684	29.7%
Gordon	777	87.7%	109	12.3%	491	63.2%	286	36.8%
Hay Springs	274	81.3%	63	18.7%	207	75.5%	67	24.5%
Rushville	409	47.2%	142	25.8%	249	60.9%	160	39.1%
Sioux County	579	72.0%	225	28.0%	438	75.6%	141	24.4%
Harrison	131	64.9%	71	35.1%	103	78.6%	28	21.4%
REGION 23	51,143	92.9%	3,908	7.1%	12,760	66.7%	6,383	33.3%

Source: U.S. Census Bureau[28]

The US Census provides information related to housing units and potential areas of vulnerability. The selected characteristics examined in Table 21 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 21: Selected Housing Characteristics

	Box Butte	Dawes	Sheridan	Sioux	Total
Occupied housing units	4,610 (84.4%)	3,557 (83.9%)	2,306 (79.1%)	579 (72.0%)	11,052
Lacking complete plumbing facilities	0.2%	0.0%	0.3%	0.5%	19 (0.2%
Lacking complete kitchen facilities	2.1%	3.1%	1.8%	0.3%	252 (2.3%)
No telephone service available	3.1%	1.8%	2.4%	1.2%	270 (2.4%)
Housing unit with no vehicles available	4.5%	5.3%	6.2%	3.8%	557 (5.0%)
Mobile Homes	6.4%	10.8%	8.1%	11.7%	1,139 (10.3%)

Source: U.S. Census Bureau, 2019[29]
**Indicated percentages are determined based on total housing units*

Approximately two 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 now the primary form of telephone service. However, this lack of access to landline telephone service does represent a

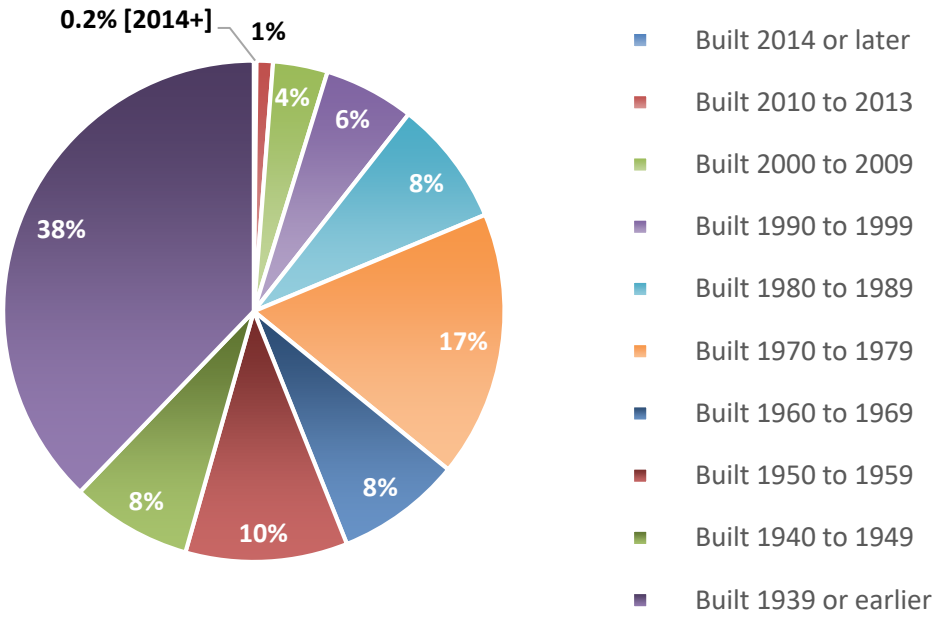
[28] U.S. Census Bureau. 2019. "Selected Housing Characteristics: 2017 ACS 5-year estimate." https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#.
[29] U.S. Census Bureau. 2019. "Selected Housing Characteristics: 2017 ACS 5-year estimate." https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#.

population at increased risk to disaster impacts. Reverse 911 systems are designed to contact households via landline services and as a result, some homes in hazard prone areas may not receive notification of potential impacts in time to take protective actions. Emergency managers should continue to promote the registration of cell phone numbers with Reverse 911 systems. The CodeRed system is available for many communities and residents to use in the planning area. This opt-in program sends emergency alerts and hazard event updates to cellular devices located within specific geographical areas based on cell tower reception.

Approximately ten percent of housing units in the planning area are mobile homes. Dawes County has the highest rate of mobile homes in its housing stock at 10.8 percent. Mobile homes have a higher risk of sustaining damages during high wind events, tornadoes, severe thunderstorms, and severe winter storms. Mobile homes that are either not anchored or are anchored incorrectly can be overturned by 60 mph winds. A thunderstorm is classified as severe when wind speeds exceed 58 mph, placing improperly anchored mobile homes at risk. Furthermore, approximately five 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 1980 (81%), with 38% of homes built prior to 1939 (Figure 7). 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.

Figure 7: Housing Age in Planning Area



State and Federally Owned Properties

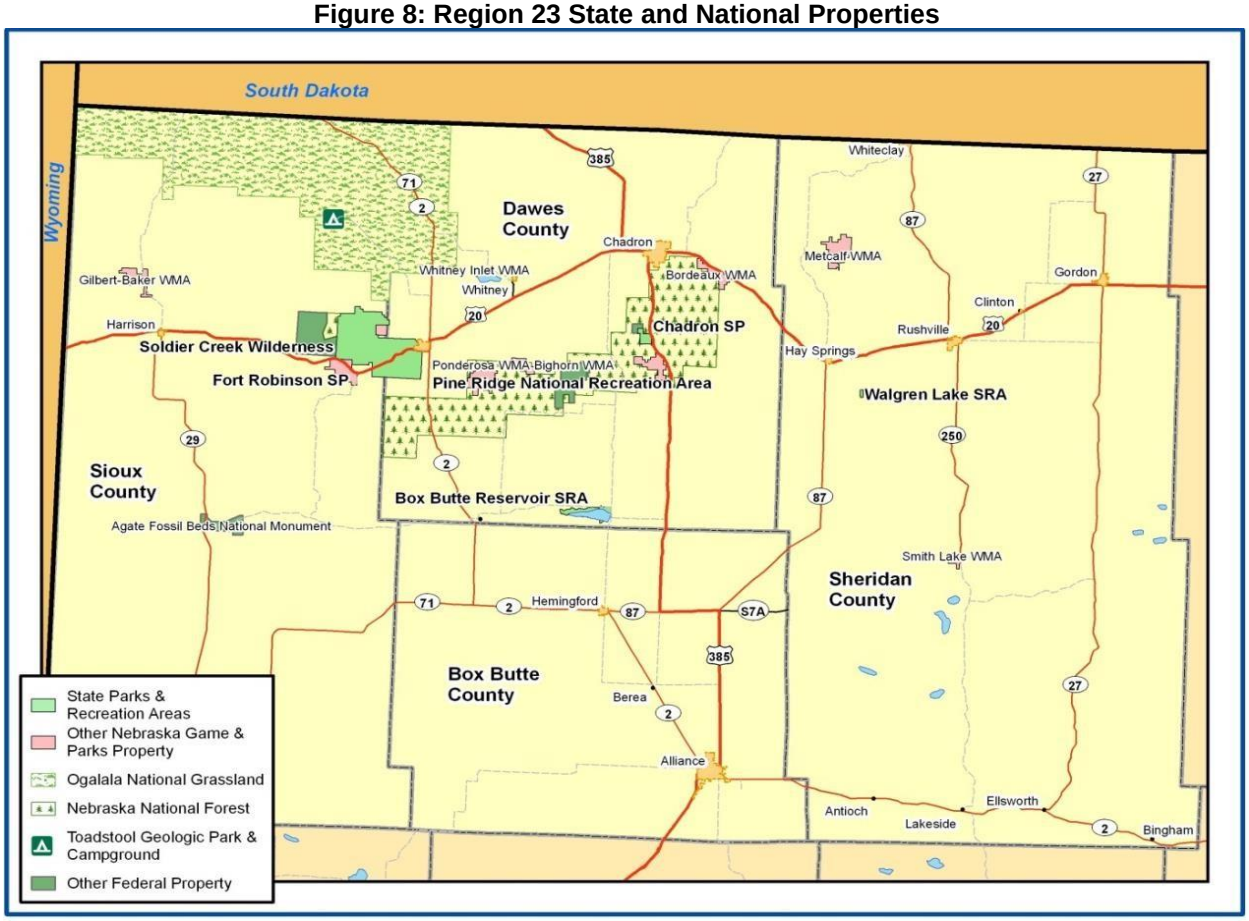
The following table provides an inventory of state and federally-owned properties within the planning area by county. Due to the scenic nature of the Pine Ridge, Niobrara River, and Nebraska National Forest in the planning area numerous state and federal properties are dispersed across the planning area. Many of these scenic areas include campgrounds and other highly vulnerable areas such as picnic areas and nature trails. Visitors or residents in these areas may be unaware of impending hazardous weather, experience difficulty finding adequate shelter, or are in remote areas where emergency services cannot reach them.

Table 22: State and Federally-Owned Facilities

FACILITY	COUNTY OR NEAREST COMMUNITY
Nebraska Department of Roads	Box Butte, Dawes, Sheridan, and Sioux Counties
Nebraska Board of Education	Box Butte, Dawes, Sheridan, and Sioux Counties
Box Butte Reservoir SRA	9 miles north of Hemingford
Ponderosa WMA	Box Butte County
Bighorn WMA	Box Butte County
Bordelaux WMA	Box Butte County
Fort Robinson State Park	West of Crawford
Oglala National Grassland	Northern border with SD and Sioux County
Nebraska National Forest	South of Chadron
Smith Lake WMA	Highway 250, central Sheridan County
Agate Fossil Beds National Monument	Agate
Gilbert-Baker Wildlife Area	Sioux County
Soldier Creek Wilderness	Sioux County
Walgren Lake SRA	Sheridan County
Metcalf WMA	Sheridan County

Source: County Assessors, Nebraska Forest Service

Figure 8: Region 23 State and National Properties



HISTORICAL SITES

According to the National Register of Historic Places for Nebraska by the National Park Service (NPS), there are 35 historic sites located in the planning area. Some of the historic sites are in the 1% annual floodplain. This would include the City of Alliance Central Park Fountain in Box Butte County. In Sheridan

County, Colclessar Bridge and Loosveldt Bridge are both in the 1% annual floodplain. Dawes County does not have any historic sites within the 1% annual floodplain. Sioux County does not have a floodplain map.

Table 23: Historical Sites

Site Name	Date Listed	Nearest Community, County
Agate Fossil Beds National Monument	10/30/2013	Harrison, Sioux
Alliance Commercial Historic District	3/21/2007	Alliance, Box Butte
Antioch Potash Plants	5/16/1979	Antioch, Sheridan
Army Theatre	7/7/1988	Crawford, Sioux
Bordeaux Trading Post	3/16/1972	Chadron, Dawes
Box Butte County Courthouse	1/10/1990	Alliance, Box Butte
Camp Sheridan and Spotted Tail Indian Agency	11/19/1974	Hay Springs, Sheridan
Chadron Commercial Historic District	3/27/2007	Chadron, Dawes
Chadron Public Library	6/21/1990	Chadron, Dawes
City of Alliance Central Park Fountain	11/28/1990	Alliance, Box Butte
Colclesser Bridge	6/29/1992	Rushville, Sheridan
Harold J. Cook Homestead Cabin	8/24/1977	Agate, Sioux
Co-operative Block Building	9/12/1985	Crawford, Dawes
Crites Hall	9/8/1983	Chadron, Dawes
Dawes County Courthouse	7/5/1990	Chadron, Dawes
District #119 North School	8/30/2010	Ellsworth, Sheridan
Fort Robinson and Red Cloud Agency	10/15/1966	Crawford, Dawes
Lee and Gottliebe Fritz House	11/28/2003	Gordon, Sheridan
Gourley's Opera House	7/6/1988	Rushville, Sheridan
Hotel Chadron	8/15/2002	Chadron, Dawes
Hudson-Meng Bison Kill Site	8/28/1973	Crawford, Dawes
Library	9/8/1983	Chadron, Dawes
Loosveldt Bridge	6/29/1992	Rushville, Sheridan
Miller Hall	9/8/1983	Chadron, Dawes
Running Water Stage Station Site	2/20/1975	Marsland, Box Butte
Sandford Dugout	3/9/2000	Mitchell, Sioux
Sheridan County Courthouse	1/10/1990	Rushville, Sheridan
Sioux County Courthouse	7/5/1990	Harrison, Sioux
Spade Ranch	2/28/1980	Ellsworth, Sheridan
Spade Ranch Store	9/3/2010	Ellsworth, Sheridan
Sparks Hall	9/8/1983	Chadron, Dawes
US Post Office-Crawford	5/11/1992	Crawford, Dawes
Wind Springs Ranch Historic and Archeological District	11/22/2000	Scottsbluff, Sioux
Henry Wohlers, Sr., Homestead	10/15/2004	Crawford, Dawes
Edna Work Hall	9/8/1983	Chadron, Dawes

Source: National Park Service[30]

In addition to regular government and municipal lands in the planning area, Chadron State College is located in the planning area. Chadron State College is a four-year public college located in the southeast portion of Chadron on the outskirts of the community adjacent to grasslands and the Pine Ridge forest. Chadron State College was founded in 1909 by the Nebraska Legislature to provide a higher education

30 National Park Service. January 2020. "National Register of Historic Places NPGallery Database." https://npgallery.nps.gov/nrhp.

institution in northwest Nebraska. The Board of Education of State Normal Schools selected Chadron as the location of its fourth institution in January, 1910. The school opened in June 1911, although a previous institution dated from the late 1800s.

The 281 acre campus has 25 major buildings, five of which are listed in the National Register of Historic Places. Their replacement value is more than $60 million and they provide more than 1 million square feet of floor space.

The college has an annual enrollment of approximately 3,000 students. Many majors are offered, but the college specializes in education. Chadron State College is accredited by the Higher Learning Commission of the North Central Association of Colleges and Schools and subject-oriented accrediting agencies. The college's theme is "A tradition of excellence in education and service." For more information about the college, see the City of Chadron's Community Profile in Section Seven.

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SECTION FOUR
RISK ASSESSMENT

INTRODUCTION

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

Table 24: 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 September 2019. 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 2019. 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 25: Hazards Addressed in the Plan

HAZARDS ADDRESSED IN THE PLAN		
Agricultural Disease (Animal and Plant)	Flooding	Severe Winter Storms
Dam Failure	High Winds and Tornadoes	Terrorism
Drought and Extreme Heat	Severe Thunderstorms	Wildfire

HAZARD ELIMINATION

Given the location and history of the planning area, several hazards from the 2015 Region 23 EMA 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 REGION 23 HAZARD MITIGATION PLAN:

- **Chemical and 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. One active and one inactive nuclear power stations are located along the Missouri River and are not located within or near the planning area. These facilities are tightly regulated by federal agencies. This approach is consistent with the 2019 Nebraska State Hazard Mitigation Plan. Chemical fixed sites as identified by NDEE are listed, as appropriate, in community profiles.

- **Chemical and 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 2019 Nebraska HMP. A discussion of local chemical transportation is included, as appropriate, in community profiles.

- **Civil Disorder –** Civil disorder events have reportedly occurred in large metropolitan areas outside of the planning area and have primarily stemmed from racial tensions, political movements, or economic and labor disputes. No state emergencies related to civil disorder have occurred. Given that no civil disorder events have been recorded in the planning area, this hazard will not be profiled further in this plan. Additionally, other planning mechanisms have been developed to specifically respond to civil disorder events in local law enforcement. Terrorism is profiled in this plan with an emphasis on local concerns and capabilities and brief overview of civil disorder.

- **Earthquake –** The regional planning team indicated earthquakes are not a hazard of top concern. The planning area has experienced seven earthquakes since 1900, none of which exceeded a magnitude of 4.3 on the Richter Scale or had reported damages, injuries, or fatalities. Due to the low probability of events and associated impacts this hazard is not fully profiled in this HMP.

- **Landslides-** While there is data available related to landslides across the state, only two events have occurred within the planning area and neither reported damages. The following table outlines the number of recorded landslide events that have occurred in the planning area. Landslides across the state have been highly localized and did not exceed local capabilities to respond. This approach is consistent with the 2019 Nebraska HMP.

Table 26: Known Landslides in the Planning Area by County

COUNTY	NUMBER OF LANDSLIDES	TOTAL ESTIMATED DAMAGES
BOX BUTTE	0	$0
DAWES	2	$0
SHERIDAN	0	$0
SIOUX	0	$0

Source: Nebraska Hazard Mitigation Plan, 2014[31]*; University of Nebraska-Lincoln, 2018*[32]

- **Levee Failure –** According to the Army Corps of Engineers National Levee Database there are no documented levees located in the planning area. Therefore, levee failure events are not expected to occur in the planning area. Any agricultural berm failure events which may produce localized flooding issues are discussed in more detail in *Section Four: Flooding*.

- **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 2019 Nebraska State Hazard Mitigation Plan.

HAZARD IDENTIFICATION CHANGES

Additionally, several hazards from the 2015 Region 23 EMA HMP have been modified and combined to provide a more robust and interconnected discussion. The following hazards from the previous HMP have combined hazard profiles in the following section:

- Drought and Extreme Heat
- High Winds and Tornadoes
- Severe Thunderstorms and Hail

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

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 27: Regional Risk Assessment

HAZARD	PREVIOUS OCCURRENCE EVENTS/YEARS	APPROXIMATE ANNUAL PROBABILITY	LIKELY EXTENT
AGRICULTURAL ANIMAL DISEASE	42/6	100%	~13 animals per event
AGRICULTURAL PLANT DISEASE	111/20	100%	Unavailable
DAM FAILURE	1/109	<1%	Varies by Structure
DROUGHT & EXTREME HEAT	437/1,489 months of drought	29%	D1-D2
	Avg 4 days per year >100°F	100%	>100°F
FLOODING	24/24	100%	Some inundation of structures (<1% of structures) and roads near streams. Some evacuations of people may be necessary (<1% of population)
HIGH WINDS & TORNADOES	217/24	100%	Avg: EF0 Range EF0-EF2 ≤50 mph Avg 47mph; Range 35-59 EG
SEVERE THUNDERSTORMS	1,302/24	100%	≥1” rainfall Avg 55 mph winds; Hail range 0.75-4.25” (H2-H4); average 1.24”
SEVERE WINTER STORMS	362/24	100%	0.5” – 0.75” Ice 20°-40° below zero (wind chill) 4-9” snow 35-50 mph winds
TERRORISM & CIVIL DISORDER	0/73	<1%	Varies by event
WILDFIRE	2,098/19	100%	<250 acres Some homes and structures threatened or at risk

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

Table 28: Loss Estimation for the Planning Area

HAZARD TYPE		Count	Property	Crop[2]
Agricultural Disease	Animal Disease[1]	42	530 animals	N/A
	Plant Disease[2]	111	N/A	$1,989,865
Dam Failure[5]		1	$0	N/A
Drought[6]		437/1,489 months	$0	$20,688,052
Extreme Heat[7,8]		Avg 4 days per year	$0	$5,533,235
Flooding[7]	Flash Flood	22	$562,000	$109,388
	Flood	2	$0	
High Winds and Tornadoes[7] *1 fatality*	High Winds	146	$129,000	$11,996,572
	Tornadoes	71	$1,355,000	
Severe Thunderstorms[7] *8 injuries*	Hail	993	$2,302,200	$9,253,643
	Heavy Rain	36	$0	
	Lightning	5	$1,467,000	
	Thunderstorm Wind	286	$1,211,400	
Severe Winter Storms[7] *1 death, 2 injuries*	Blizzard	50	$74,000	$22,145,515
	Extreme Cold/Wind Chill	50	$0	
	Heavy Snow	42	$0	
	Ice Storm	0	$0	
	Winter Storm	169	$85,000	
	Winter Weather	51	$15,000	
Terrorism and Civil Disorder[3,4]		0	$0	N/A
Wildfire[9] *12 injuries*		2,098	445,416 acres	$222,905
Total		**4,383**	**$7,200,600**	**$71,939,175**

N/A: Data not available
1 NDA (2014-2019)
2 USDA RMA (2000-2019)
3 SPEED (1946-2018)
4 START (1970-2018)
5 Stanford NPDP (1911-2019)
6 NOAA (1895-2019)
7 NOAA (1996-2019)
8 HPRCC (1902-2018)
9 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. According to the SBA, there were no reported SBA disasters in the planning area between 2001 and 2019.[33]

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

[33] Small Business Administration. 2001-2019. [data files]. "Office of Disaster Assistance | Resources." https://www.sba.gov/offices/headquarters/oda/resources/1407821.

presidential disaster declarations within the planning area for the period of record. Note that while data is available from 1953 onward, the planning area has received 12 presidential disaster declarations since 1991.

Table 29: Presidential Disaster Declarations

Disaster Declaration Number	Declaration Date	Title	Affected Counties	Public Assistance
908	5/28/1991	SEVERE STORMS & FLOODING	Dawes, Sioux	N/A
1373	5/16/2001	SEVERE WINTER STORMS, FLOODING AND TORNADOES	Box Butte, Sioux	$2,982,075.51
1853	7/31/2009	SEVERE STORMS, FLOODING, AND TORNADOES	Box Butte (County)	$4,491,366.48
1924	7/15/2010	SEVERE STORMS AND FLOODING	Dawes, Sheridan, Sioux	$49,926,354.50
2660	7/28/2006	DAWES COUNTY FIRE COMPLEX	Dawes (County)	$1,418,573.71
2661	7/29/2006	SIOUX COUNTY FIRE COMPLEX	Sioux (County)	$1,773,269.52
3245	9/13/2005	HURRICANE KATRINA EVACUEES	Box Butte, Dawes, Sheridan, Sioux	$393,813.27
4156	11/26/2013	SEVERE STORMS, WINTER STORMS, TORNADOES AND FLOODING	Dawes, Sheridan, Sioux	$2,670,513.58
4325	8/1/2017	SEVERE STORMS, TORNADOES, AND STRAIGHT-LINE WINDS	Box Butte, Sheridan, Sioux	$15,588,072.47
4225	6/25/2015	SEVERE STORMS, TORNADOES, STRAIGHT-LINE WINDS, AND FLOODING	Box Butte, Dawes, Sioux	$14,267,337.31
4420	3/21/2019	SEVERE WINTER STORM, STRAIGHT-LINE WINDS, AND FLOODING	Box Butte, Dawes, Sheridan, Sioux	$24,581,846.75
5009	8/30/2012	REGION 23 FIRE COMPLEX	Dawes, Sheridan, Sioux	$5,281,075.21

Source: Federal Emergency Management Agency, 1953-2019[34]

Climate Adaptation

Located on the Great Plains far from the moderating influence of mountains or large bodies of water, the planning area possesses a highly variable four-season humid continental climate: winters are cold, but relatively dry; springs are generally warm with a regular wind; summers are hot and humid; and fall is generally pleasant but can produce an early season snow event. With little precipitation falling during winter, precipitation is concentrated in the warmer months, when thunderstorms frequently roll in, often producing tornados. Snow tends to fall in light amounts, though blizzards are possible. Snow cover is not very reliable due to both the low precipitation and the frequent thaws during winter.

[34] Federal Emergency Management Agency. 2019. "Disaster Declarations." Accessed January 2020. https://www.fema.gov/openfema-dataset-disaster-eclarations-summaries-v1.

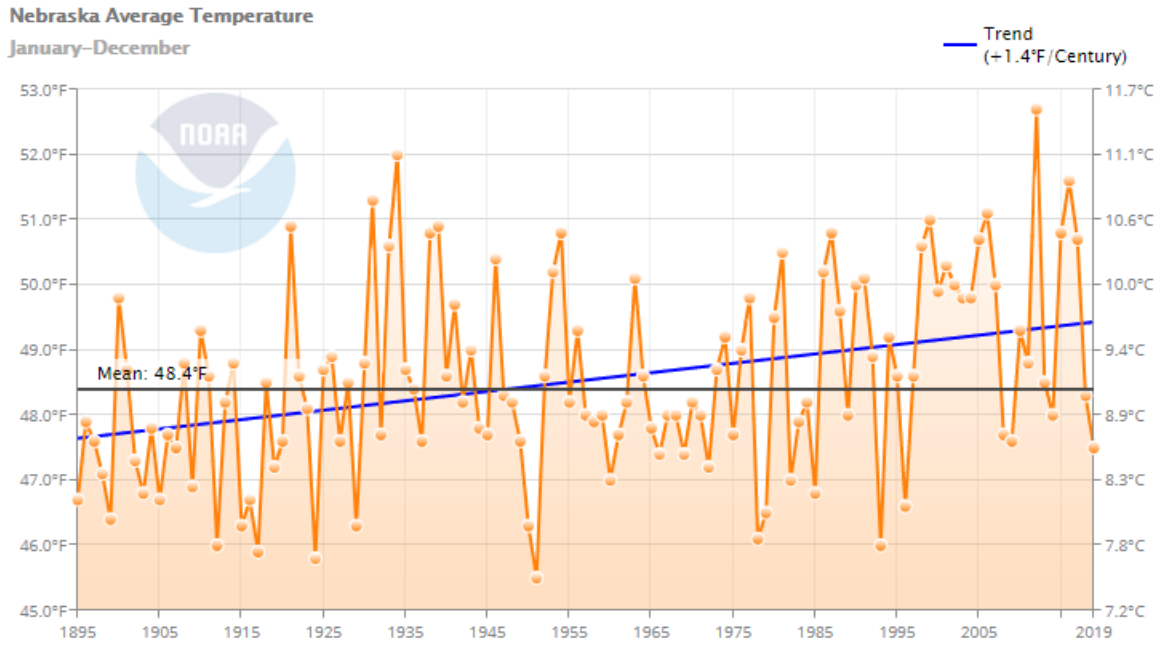
Long term climate trends have increased and will continue to increase the vulnerability to hazards across the planning area. Since 1895, Nebraska's overall average temperature has increased by about 2°F (Figure 9). This trend will likely contribute to an increase in the frequency and intensity of hazardous events, which will cause significant economic, social, and environmental impacts on Nebraskans.

As seen in Figure 10 and Figure 11, 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),[35] Nebraskans can expect the following from the future climate:

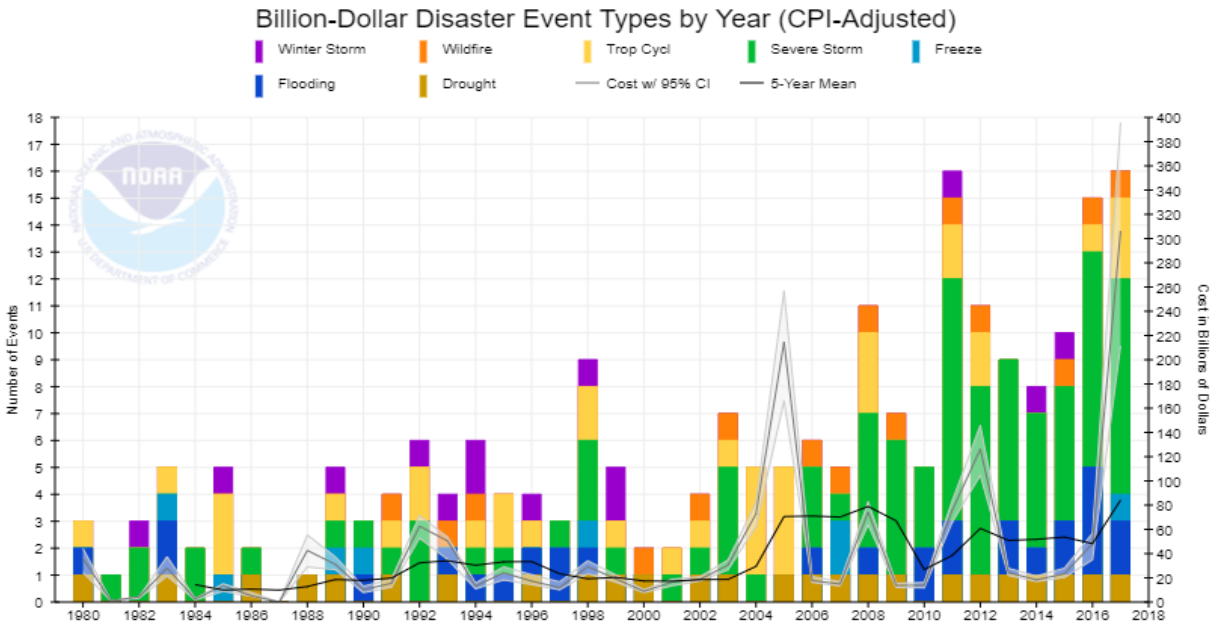
- Increase in extreme heat events
- Decrease in soil moisture by 5-10%
- Increase in drought frequency and severity
- Increase in heavy rainfall events
- Increase in flood magnitude
- Decrease in water flow in the Missouri River from reduced snowpack in the Rocky Mountains
- Additional 30-40 days in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

Figure 9: Average Temperature (1895-2019)



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

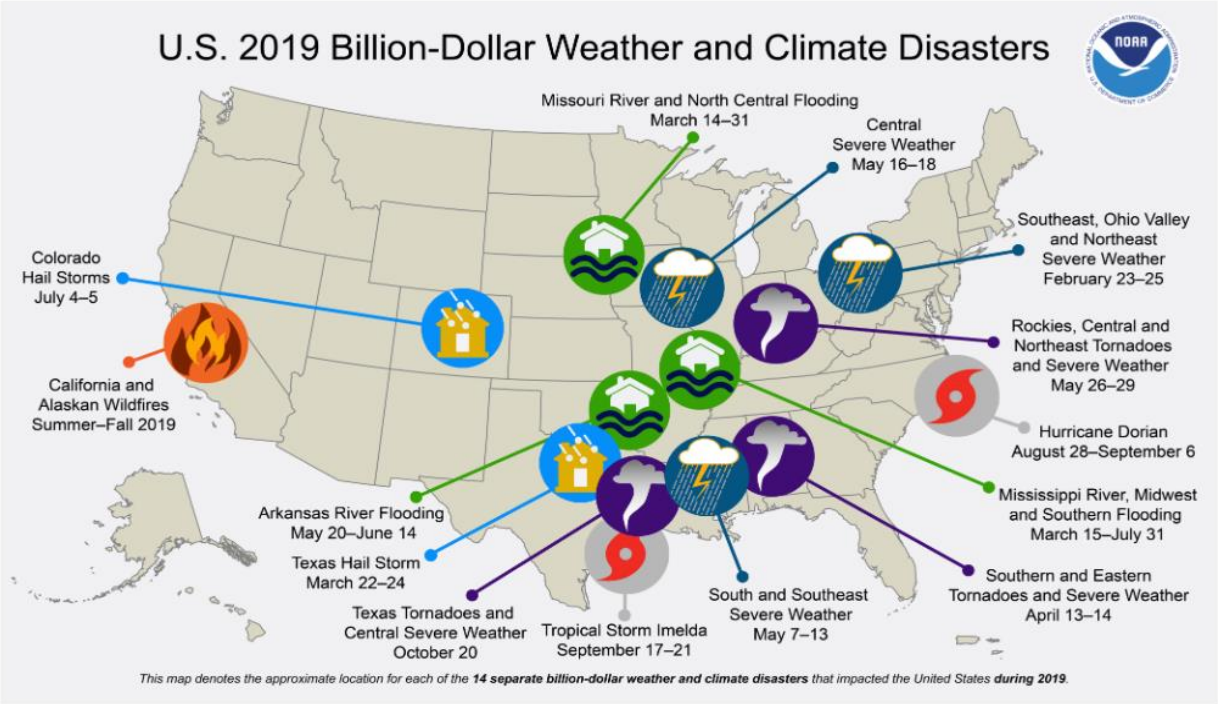
Figure 10: Billion Dollar Disasters



Source: NOAA, 2018

Figure 11: Billion Dollar Weather and Climate Disasters

In 2020 (as of April 8), there have been 2 weather and climate disaster events with losses exceeding $1 billion each across the United States. These events included 2 severe storm events. Overall, these events resulted in the deaths of 35 people and had significant economic effects on the areas impacted. The 1980–2019 annual average is 6.6 events (CPI-adjusted); the annual average for the most recent 5 years (2015–2019) is 13.8 events (CPI-adjusted).

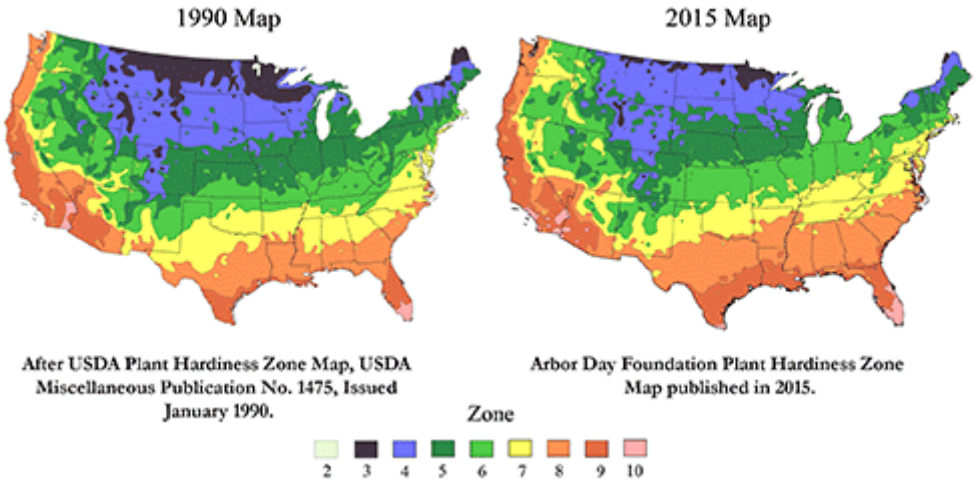


2019 is the fifth consecutive year (2015-2019) in which 10 or more billion-dollar weather and climate disaster events have impacted the United States. Over the last 40 years (1980-2019), the **years with 10 or more** separate billion-dollar disaster events include **1998, 2008,** 2011-2012, and 2015-2019.

Source: NOAA, 2020

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.

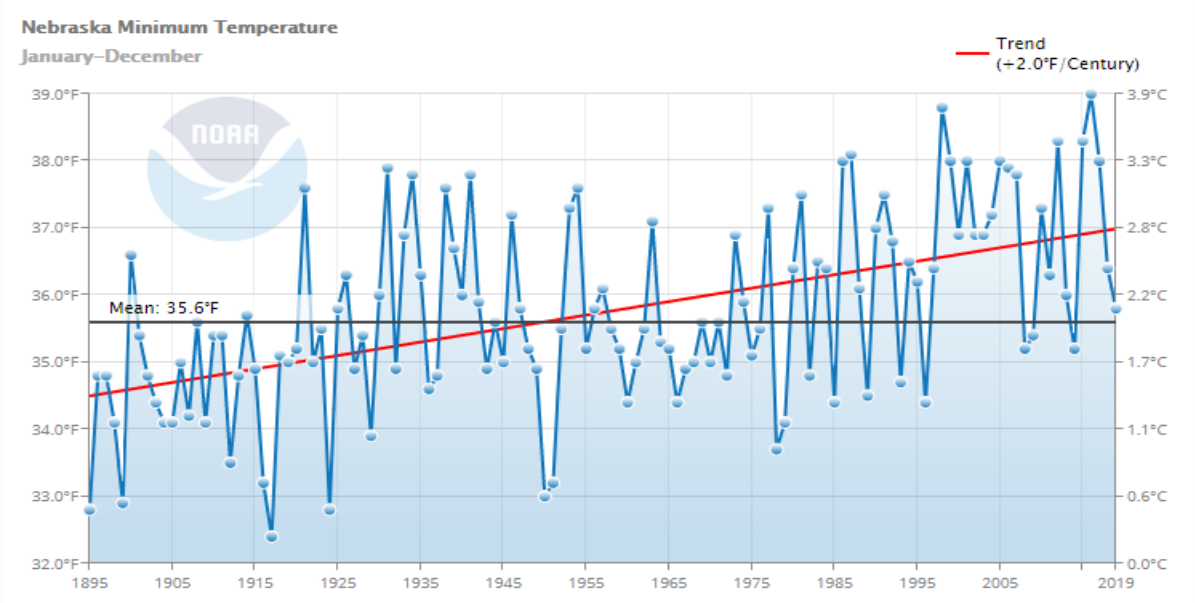
Figure 12: Plant Hardiness Zone Change



Source: Arbor Day Foundation, 2018[36]

Figure 13 shows a trend of increasing minimum temperatures in the state. High nighttime temperatures can reduce grain yields, increase stress on animals, and lead to an increase in heat-related deaths.

Figure 13: Minimum Temperature 1895 – 2018



Source: NOAA, 2020

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

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. In an effort to account for future events, this HMP was developed alongside the CWPP to examine increased risk to wildfire events. Due to recorded changes in temperature and precipitation trends, it is reasonable to expect more frequent and severe wildfire events in the future.

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). The following table identifies the top hazards of concern for participating jurisdictions.

Table 30: Top Hazards of Concern by Jurisdiction

Jurisdiction	Ag. Disease	Dam Failure	Drought and Extreme Heat	High Winds and Tornadoes	Flooding	Severe Thunderstorms	Severe Winter Storms	Terrorism	Wildfire
Region 23 EMA				X		X	X		X
UNWNRD			X	X	X	X	X		
Box Butte Co				X		X	X		X
Alliance				X		X	X		X
Hemingford				X		X	X		X
Dawes Co				X		X	X		X
Chadron				X		X	X		X
Crawford				X		X			X
Sheridan Co			X			X	X		X
Gordon				X		X	X		X
Hay Springs			X	X		X			
Rushville			X	X	X	X	X		X
Sioux Co			X			X	X		X
Harrison			X	X		X	X		X
Chadron Schools				X				X	
Hemingford Schools				X	X	X	X		X

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 2017, the market value of agricultural products sold was estimated at nearly $22 billion; this total is split between crops (estimated $9.31 billion) and livestock (estimated $12.67 billion). For the planning area, the market value of sold agricultural products exceeded $521 million.[37]

Table 31 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 31: Livestock Inventory

County	Market Value of 2017 Livestock Sales	Cattle and Calves	Hogs and Pigs	Poultry Egg Layers	Sheep and Lambs
Box Butte	$69,093,000	53,999	245	631	1,120
Dawes	$46,980,000	60,912	(D)	777	2,525
Sheridan	$93,144,000	121,175	667	511	144
Sioux	$58,420,000	93,493	10,244	365	1,896
Total	**$267,637,000**	**329,579**	**11,156**	**2,284**	**5,685**

Source: U.S. Census of Agriculture, 2017
**(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 32: Land and Value of Farms in the Planning Area

County	Number of Farms	Land in Farms (acres)	Market Value of 2017 Crop Sales
Box Butte	431	677,164	$107,840,000
Dawes	491	750,204	$13,953,000
Sheridan	525	1,561,598	$57,459,000
Sioux	307	1,229,719	$17,619,000
Total	**1,754**	**4,218,685**	**$196,871,000**

Source: U.S. Census of Agriculture, 2017

[37] US Department of Agriculture, National Agricultural Statistics Server. 2019. "2017 Census of Agriculture – County Data." Accessed January 2020. https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/Nebraska/.

Table 33: Crop Values

County	Corn		Soybeans		Wheat	
	Acres Planted	Value (2017)	Acres Planted	Value (2017)	Acres Planted	Value (2017)
Box Butte	73,375	$38,657,000	0	-	79,026	$11,788,000
Dawes	9,547	$5,730,000	871	$305,000	17,970	$2,324,000
Sheridan	51,598	$27,270,000	1,497	$577,000	25,380	$3,612,000
Sioux	15,954	$9,422,000	0	-	2,756	$451,000
Total	**150,477**	**$81,079,000**	**2,368**	**$882,000**	**125,132**	**$18,175,000**

Source: U.S. Census of Agriculture, 2012

Location

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

The 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. Due to the presence of multiple national forests in the planning area, animal disease outbreaks in wild populations are possible and have the potential to spread to agricultural livestock.

Historical Occurrences

Animal Disease

The NDA provides reports on diseases occurring in the planning area. There were 42 instances of animal diseases reported between January 2014 and November 2019 by the NDA (Table 34). These outbreaks affected 530 animals.

Table 34: Livestock Diseases Reported in the Planning Area

Year	County	Disease	Population Impacted
2014	Box Butte	Anaplasmosis	1
2014	Sheridan	Blue Tongue	7
2014	Sheridan	Paratuberculosis	7
2014	Sheridan	Enzootic Bovine Leukosis	6
2014	Sheridan	Bovine Viral Diarrhea	2
2014	Sheridan	Leptospirosis	9
2014	Sheridan	Rabies	1
2014	Sheridan	Infectious Bovine Rhinotracheitis	2
2014	Sioux	Paratuberculosis	2
2015	Sheridan	Infectious Bovine Rhinotracheitis	60
2016	Box Butte	Paratuberculosis	1
2016	Sheridan	Blue Tongue	6
2016	Sheridan	Paratuberculosis	5
2016	Sheridan	Enzootic Bovine Leukosis	4
2016	Sheridan	Leptospirosis	12
2016	Sheridan	Trichomoniasis	1
2017	Box Butte	Paratuberculosis	1
2017	Dawes	Anaplasmosis	1
2017	Sheridan	Blue Tongue	6
2017	Sheridan	Paratuberculosis	8
2017	Sheridan	Enzootic Bovine Leukosis	6

YEAR	COUNTY	DISEASE	POPULATION IMPACTED
2017	Sheridan	Bovine Viral Diarrhea	1
2017	Sheridan	Leptospirosis	15
2018	Box Butte	Paratuberculosis	3
2018	Box Butte	Bovine Viral Diarrhea	1
2018	Sheridan	Blue Tongue	11
2018	Sheridan	Paratuberculosis	2
2018	Sheridan	Enzootic Bovine Leukosis	3
2018	Sheridan	Bovine Viral Diarrhea	1
2018	Sheridan	Leptospirosis	6
2018	Sheridan	Epizootic Hemorrhagic Disease	2
2019	Box Butte	Bovine Viral Diarrhea	25
2019	Box Butte	Leptospirosis	1
2019	Dawes	Paratuberculosis	1
2019	Dawes	Vesicular Stomatitis	1
2019	Sheridan	Blue Tongue	63
2019	Sheridan	Paratuberculosis	1
2019	Sheridan	Enzootic Bovine Leukosis	10
2019	Sheridan	Bovine Viral Diarrhea	160
2019	Sheridan	Anaplasmosis	13
2019	Sheridan	Leptospirosis	17
2019	Sheridan	Epizootic Hemorrhagic Disease	45

Source: Nebraska Department of Agriculture, January 2014- November 2019[38]

The most prevalent agricultural diseases seen across the planning area and the state include: Chronic Wasting Disease, Vesicular Stomatitis, Epizootic Hemorrhagic Disease, and Bovine Tuberculosis. The economic impacts of outbreaks can negatively impact businesses, farmers, ranchers, and communities reliant on the agricultural sector.

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 35: 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

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

CROP DISEASES		
	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	
OTHER PESTS	Grasshoppers	Western Bean Cutworm
	European Corn Borer	Corn Rootworm
	Corn Nematodes	Bean Weevil
	Mexican Bean Beatle	Soybean Aphids
	Rootworm Beatles	Eastern Ash Borer

At this time, there are no reports of Emerald Ash Borer within the planning area.

AVERAGE ANNUAL LOSSES

According to the USDA RMA (2000-2019) there were 111 plant disease events in the planning area. While the RMA does not track losses for livestock, annual crop losses from plan disease can be estimated. Agricultural livestock disease losses are determined from the Nebraska Department of Agriculture.

Table 36: Agricultural Plant Disease Losses

HAZARD TYPE	NUMBER OF EVENTS	EVENTS PER YEAR	TOTAL CROP LOSS	AVERAGE ANNUAL CROP LOSS
PLANT DISEASE	111	5.6	$1,989,865	$99,493

Source: RMA, 2000-2019

Table 37: Agricultural Livestock Disease Losses

HAZARD TYPE	NUMBER OF EVENTS	EVENTS PER YEAR	TOTAL ANIMAL LOSSES	AVERAGE ANIMAL LOSSES PER EVENT
ANIMAL DISEASE	43	7	530	13

Source: NDA, 2014-2019

EXTENT

There is no standard for measuring the magnitude of agricultural disease. Historical events have impacted livestock ranging from a single individual to 160 individuals. The planning area is heavily dependent on the agricultural economy. Any severe plant or animal disease outbreak which may impact this sector would negatively impact the entire planning areas economy.

PROBABILITY

Given the historic record of occurrence for animal disease (42 outbreaks reported in six years) and plant disease (111 outbreaks in 20 years), for the purposes of this plan, the annual probability of agricultural disease occurrence is 100 percent.

REGIONAL VULNERABILITIES

According to local planning teams, it is likely that animal and plant diseases will continue to impact the planning area to a moderate extent. While there have not been significant impacts reported in the planning

area previously, due to the economic and regional impacts associated with this hazard, it is a concern for many residents. Large incidents may increase food and basic essential costs, resulting in impacts to the entire population. The following table provides information related to regional vulnerabilities; for jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 38: Regional Agricultural Disease Vulnerabilities

SECTOR	VULNERABILITY
PEOPLE	-Those in direct contact with infected livestock -Potential food shortage during prolonged events -Residents in poverty if food prices increase
ECONOMIC	-Regional economy is reliant on the agricultural industry -Large scale or prolonged events may impact tax revenues and local capabilities -Land value may largely drive population changes within the planning area
BUILT ENVIRONMENT	None
INFRASTRUCTURE	-Transportation routes can be closed during quarantine
CRITICAL FACILITIES	None
CLIMATE	-Exacerbate outbreaks, impacts, and/or recovery period -Changes in seasonal normals can promote spread of invasive species and agricultural disease

DAM FAILURE

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."[39]

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 39: 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[40]

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.

[39] 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.

[40] 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 and U.S. Army Corps of Engineers (USACE) regulate dam safety in Nebraska and across the county. Dams are classified by the potential hazard each poses to human life and economic loss. The following are classifications and descriptions for each hazard class:

- **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.

LOCATION

According to USACE's National Institute of Dams, there are a total of 146 dams located within the planning area, with classifications ranging from low to high hazard. Figure 14 maps the location of these dams in the planning area.

Table 40: Dams in the Planning Area

COUNTY	LOW HAZARD	SIGNIFICANT HAZARD	HIGH HAZARD
BOX BUTTE	8	0	0
DAWES	40	5	1
SHERIDAN	21	4	2
SIOUX	60	5	0
TOTAL	**129**	**14**	**3**

Source: USACE, 2020[41]

Dams classified with high hazard potential require the creation of an Emergency Action Plan (EAP). The EAP defines responsibilities and provides procedures designed to identify unusual and unlikely conditions which may endanger the structural integrity of the dam within sufficient time to take mitigating actions and to notify the appropriate emergency management officials of possible, impending, or actual failure of the dam. The EAP may also be used to provide notification when flood releases will create major flooding. An emergency situation can occur at any time; however, emergencies are more likely to happen when extreme

[41] United States Army Corps of Engineers. January 2020. "National Inventory of Dams." https://nid.sec.usace.army.mil/ords/f?p=105:1:::::::.

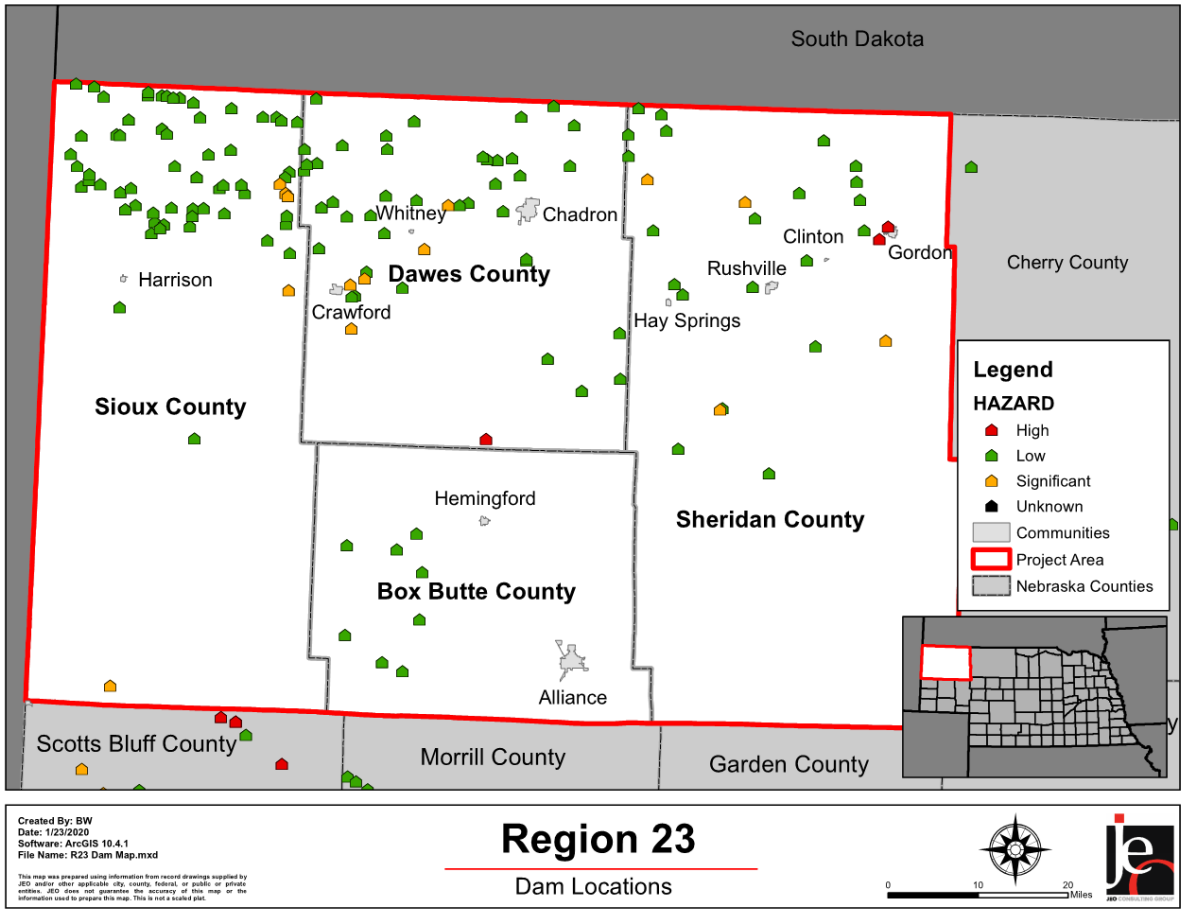
conditions are present. There are three high hazard dams located within the planning area, one in Dawes County and two in Sheridan County.

Table 41: High Hazard Dams in the Planning Area

County	Dam Name	NID ID	Purpose	Dam Height	Max Storage	Last Inspection Date
Dawes	Box Butte Dam	NE01069	Irrigation	87	47,800	11/1/2016
Sheridan	Antelope Creek 20-A	NE00793	Flood Control	24	450	6/21/2018
Sheridan	Antelope Creek 40-B	NE00795	Flood Control	32	8,655	6/21/2018

Source: USACE, 2020[42]

Figure 14: Dam Locations



[42] United States Army Corps of Engineers. January 2020. "National Inventory of Dams." https://nid.sec.usace.army.mil/ords/f?p=105:1::::::.

Upstream Dams Outside the Planning Area
Additionally, there are several High Hazard dams located upstream of the planning area which, if they were to fail, would likely impact the region. No County Local Emergency Operations Plan (LEOPs) specifically identify upstream dams which could affect the planning area.[43,44,45,46]

Table 42: High Hazard Dams outside the Planning Area

County, State	Dam Name	NID ID	Purpose	Dam Height	Max Storage	Last Inspection Date
Natrona, WY	Pathfinder	WY01296	Hydroelectric	214	1,016,500	9/22/2017
Oglala Lakota, SD	White Clay	SD00965	Recreation	41	0	8/8/2012
Oglala Lakota, SD	Oglala	SD00969	Recreation	57	10,800	8/9/2012

Source: USACE, 2020

Areas (i.e. agricultural land, out buildings, county roads, and communities) directly downstream of dams are at greatest risk in the case of dam failure. Both high hazard dams located in Sheridan County are located outside of the community of Gordon. At this time, dam owners, USACE, and the NeDNR have opted 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, USACE, or the Dam Safety Division of NeDNR to view an inundation map specific to a dam.

Historical Occurrences
According to the Stanford University National Performance of Dams Program and the local planning teams, there has been one dam failure event within the planning area.[47] The Johnson Dam in Sheridan county had an unknown incident in 1945. As described by NPDP, "This is the second of two incidents at this dam. Failure the result of loss of filter through riprap (not sure if this applies to both incidents). This is the same Johnson Dam (NPDP ID No. 640) that had an incident in 1942. This dam & incident used to have the NPDP ID No. 642." Provided information does not indicate the 1942 event led to a failure. No damages were reported with this event.

Average Annual Losses
Due to lack of data and the sensitive nature of this hazard, potential losses are not calculated for this hazard. In general, dam failure events would be confined to damage in the inundation area including buildings, agricultural land, and roads. Community members in the planning area that wish to quantify the threat of dam failure should contact Region 23 Emergency Management, Upper Niobrara White NRD, or the Nebraska Department of Natural Resources to view EAPs and breach inundation area maps.

Extent
Inundation maps are not publicly available due to concerns of vandalism and terrorism. Instead the extent of a dam failure is indicated by its hazard classification and location. Note that hazard classification does not indicate the likelihood of a dam failure event to occur, but rather the extent of potential damages that may occur in the case of a failure. Thus, the high hazard dams in the planning area would have the greatest impact if they were to fail.

Probability
For the purpose of this plan, the probability of dam failure will be stated at less than one percent annually as only one dam has failed in the planning area over the past 100 years.

[43] Box Butte County Emergency Management Agency. November 2017. "Box Butte County Nebraska Local Emergency Operations Plan."
[44] Dawes County Emergency Management Agency. June 2017. "Dawes County Nebraska Local Emergency Operations Plan."
[45] Sheridan County Emergency Management Agency. May 2018. "Sheridan County Nebraska Local Emergency Operations Plan."
[46] Sioux County Emergency Management Agency. August 2017. "Sioux County Nebraska Local Emergency Operations Plan."
[47] Stanford University. 1911-2019. "National Performance of Dams Program Dam Incident Database." Accessed December 2019. http://npdp.stanford.edu/dam_incidents.

REGIONAL VULNERABILITIES

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

Table 43: Regional Dam Failure Vulnerabilities

SECTOR	VULNERABILITY
PEOPLE	-Those living downstream of high hazard dams -Those at recreational sites situated near high hazard dams -Evacuation needs likely with high hazard dam failure events -Hospitals, nursing homes, and the elderly at greater risk due to low mobility
ECONOMIC	-Loss of downstream agricultural land -Businesses or recreation sites located in inundation areas would be impacted and closed for an extended period of time -Employees of closed businesses may be out of work for an extended period of time
BUILT ENVIRONMENT	-Damage to facilities, recreation areas, and roads
INFRASTRUCTURE	-Rural county transportation routes could be closed for extended period of time
CRITICAL FACILITIES	-Any critical facilities in inundation areas are vulnerable to damages
CLIMATE	-Increased annual precipitation contributes to sustained stress on systems -Changes in water availability and supply can constrain energy production and reservoir stores

DROUGHT AND EXTREME HEAT

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. Extreme heat 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 or prolonged drought conditions. 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 and drought events; those suffering from an extreme heat event may be farther away from medical resources as compared to those living in an urban setting while drought conditions can significantly and negatively impact the agricultural economic base.

Drought is a slow-onset, creeping phenomenon that can affect a wide range of people, livestock, and industries. While many impacts of these hazards are non-structural, there is the potential that during extreme heat 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 or long-term extreme heat 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.[48]

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

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

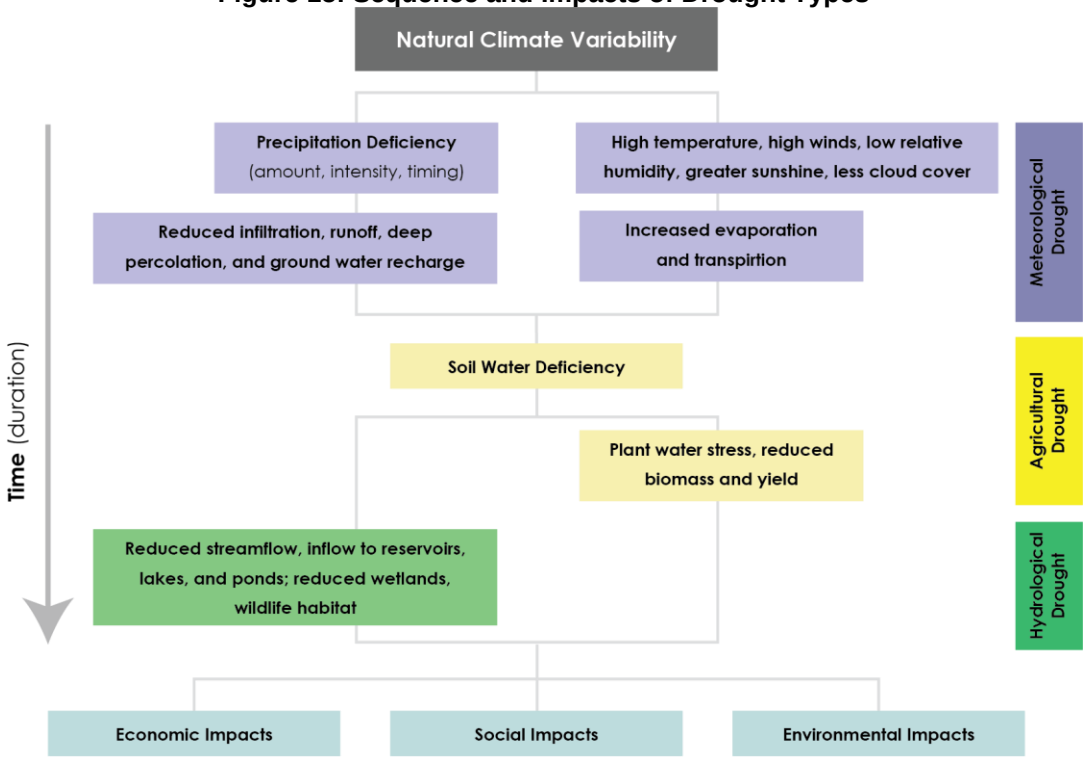
- **Excessive heat outlooks** are issued when the potential exists for an excessive heat event in the next 3 to 7 days. Excessive heat outlooks can be utilized by public utility staffs, emergency managers, and public health officials to plan for extreme heat events.
- **Excessive heat watches** are issued 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.

Along with humans, animals also can be affected by high temperatures, drought conditions, and humidity levels. 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.

Additionally, government authorities report that civil disturbances and riots are more likely to occur during heat waves or when water supplies are threatened. In cities, pollution becomes a problem with high heat as the heat traps pollutants in densely populated urban areas. Adding pollution to the stresses associated with the heat magnifies the health threat to the urban population.

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

Figure 15: Sequence and Impacts of Drought Types



Source: National Drought Mitigation Center, University of Nebraska-Lincoln, 2017[49]

LOCATION

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

[49] National Drought Mitigation Center. 2017. "Types of Drought." http://drought.unl.edu/DroughtBasics/TypesofDrought.aspx.

HISTORICAL OCCURRENCES

Table 44 indicates it is reasonable to expect extreme drought to occur in 4.4 percent of years of months for the planning area (65 extreme drought months in 1,489 months). Severe drought occurred in 60 months of the 1,489 months of record (4.0 percent of months). Moderate drought occurred in 128 months of the 1,489 months of record (8.6 percent of months), and mild drought occurred in 184 of the 1,489 months of record (12.4 percent of months). Non-drought conditions (incipient dry spell, near normal, or incipient wet spell conditions) occurred in 359 months, or 24.1% percent of months. These statistics show that the drought conditions of the planning area are highly variable. The average annual planning area precipitation is approximately 17 inches according to the NCEI.[50]

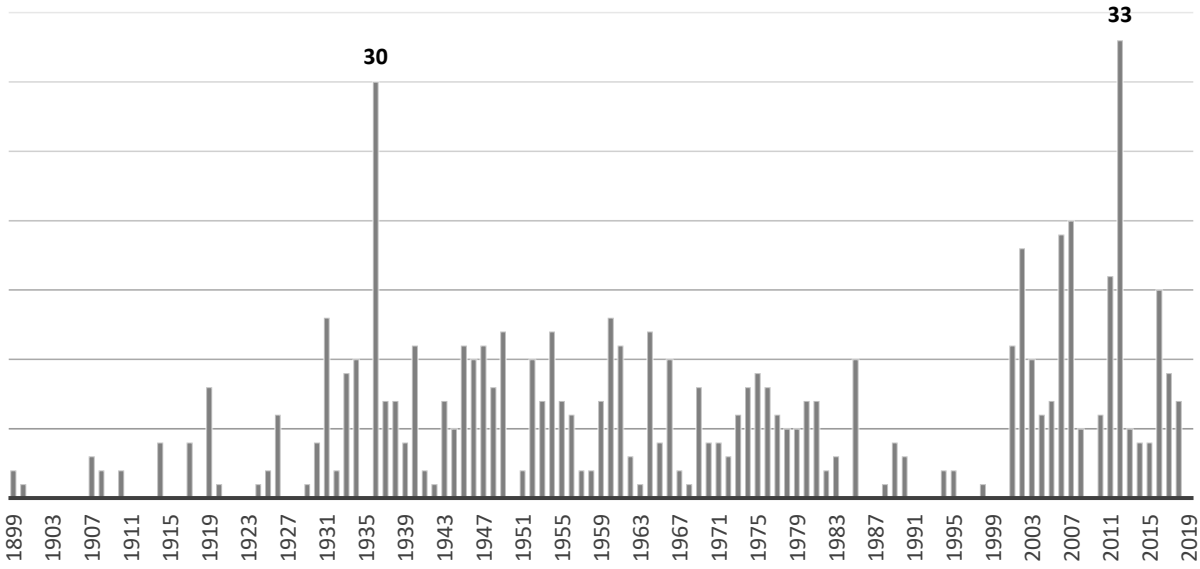
Table 44: Historic Droughts

DROUGHT MAGNITUDE	MONTHS IN DROUGHT	PERCENT CHANCE
-1 MAGNITUDE (MILD)	184/1,489	12.4%
-2 MAGNITUDE (MODERATE)	128/1,489	8.6%
-3 MAGNITUDE (SEVERE)	60/1,489	4.0%
-4 MAGNITUDE OR GREATER (EXTREME)	65/1,489	4.4%

Source: NCEI, Jan 1895-Jan 2019[51]

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 2012 with 33 days and in 1936 with 30 days. Conversely, 2019 was the most recent "coolest" year on record, with zero days above 100°F. However, this is likely attributed to lack of reportable data.

Figure 16: Number of Days Above 100°F



Source: HPRCC, 1899-2019

The 2012 drought event is the most significant events on record for the planning area; however, the overall event did not warrant a presidential disaster declaration within Nebraska. The whole state of Nebraska was in severe drought conditions from the middle of July in 2012 to the end of May in 2013 and over 70% of the state was in exceptional drought conditions for over eight months. Numerous cities implemented mandatory water restrictions, and some encouraged voluntarily water conservation during the period of drought.

[50] NOAA National Centers for Environmental Information. December 2019. "Data Tools: 1981-2010 Normals." [datafile]. https://www.ncdc.noaa.gov/cdo-web/datatools/normals.

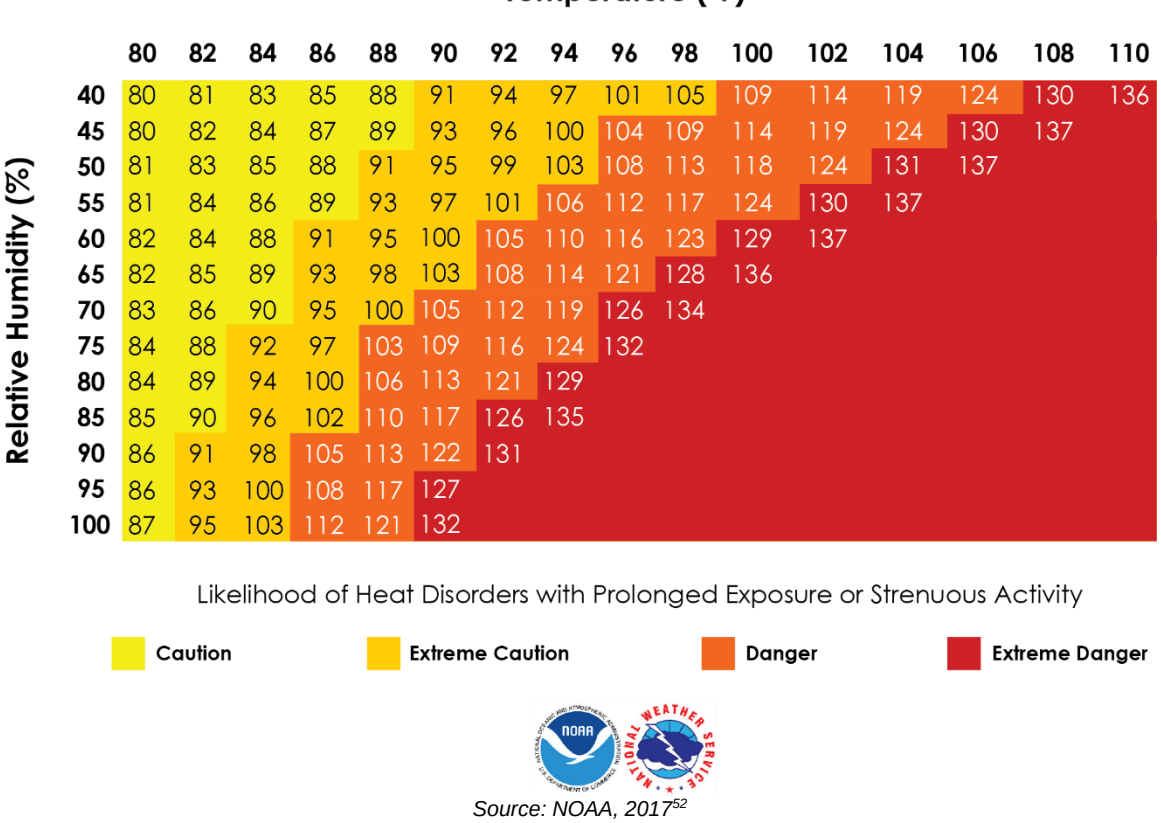
[51] National Centers for Environmental Information. 1895-2018. Accessed December 6, 2018. https://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp.

EXTENT

A key factor to consider regarding drought and 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 whereas a relative humidity of 50 percent, require 94°F. The combination of relative humidity and temperature result in a Heat Index as demonstrated below:

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

Figure 17: NOAA Heat Index



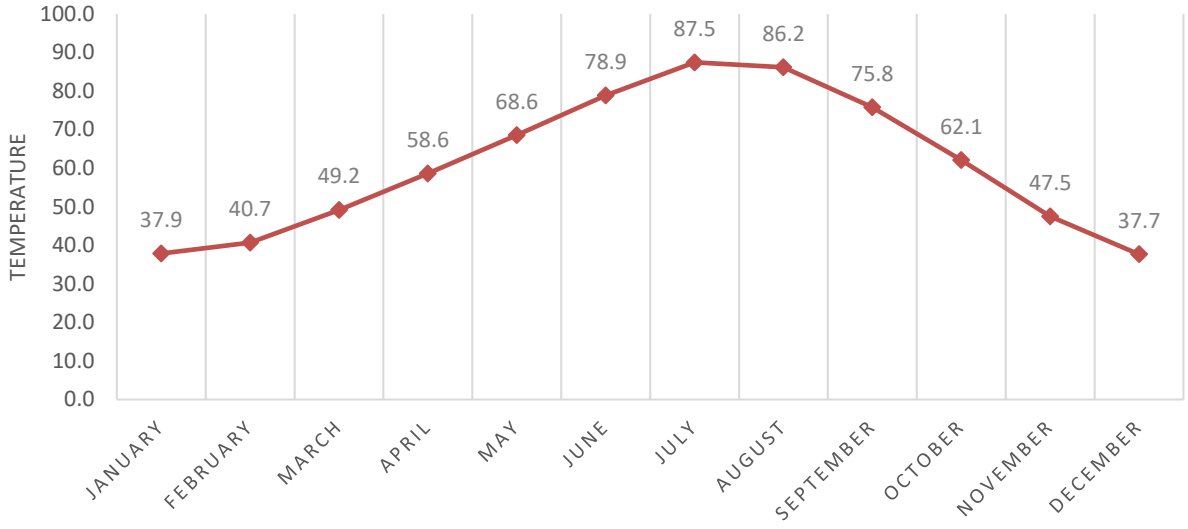
Source: NOAA, 2017[52]

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.

For the planning area, the months with the highest temperatures are June, July, and August.

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

Figure 18: Monthly Climate Normals Max Temperature (1981-2010)



Source: NCEI, 2019

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 1 [Panhandle], which includes the planning area. This particular station's period of record started in 1895. Table 45 shows the details of the Palmer classifications. Figure 19 shows drought data from this time period. The negative Y axis represents the extent of a drought, for which '-2' indicates a moderate drought, '-3' a severe drought, and '-4' an extreme drought. The planning area has experienced several 'extreme' droughts and future moderate, severe, and extreme droughts are likely in the future.

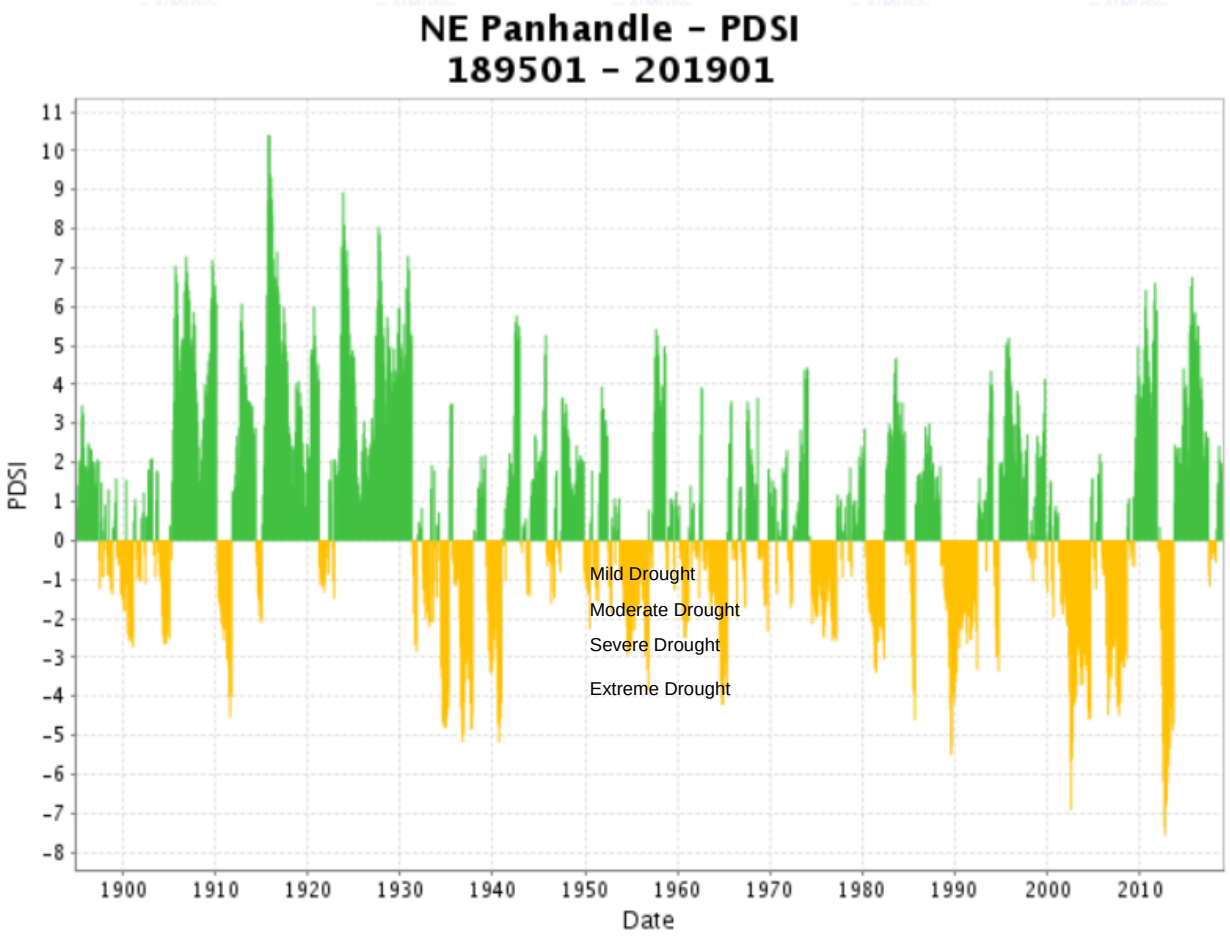
Table 45: Palmer Drought Severity Index Classification

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[53]

[53] National Weather Service. 2017. "Climate Prediction Center." http://www.cpc.noaa.gov/.

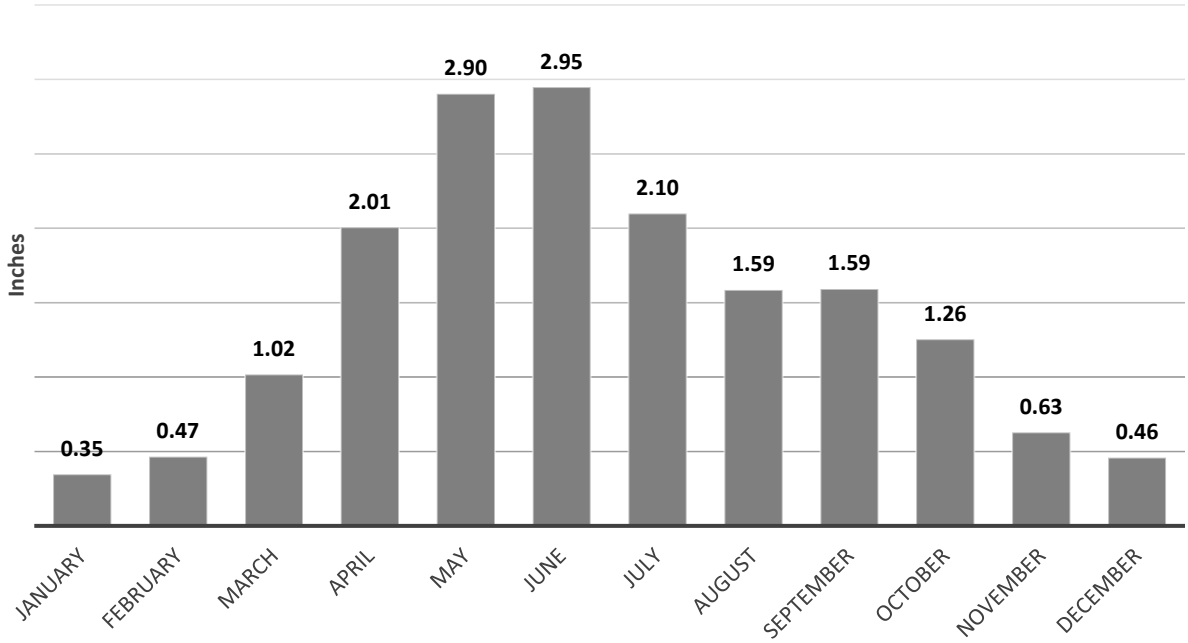
Figure 19: Palmer Drought Severity Index



Source: NCEI, Jan. 1895-Jan-2019

On average, the planning area receives approximately 17 inches of precipitation annually. The following figure shows average precipitation per month in the planning area. Prolonged deviations from the norm showcase drought conditions and influence growing conditions for farmers or resource management needs for ranchers.

Figure 20: Region 23 Average Monthly Precipitation



Source: NCEI, 2019[54]

AVERAGE ANNUAL LOSSES

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

Table 46: Loss Estimate for Drought

HAZARD TYPE	AVG. NUMBER OF DAYS ABOVE 100°F[1]	TOTAL PROPERTY LOSS[2]	AVERAGE ANNUAL PROPERTY LOSS[2]	TOTAL CROP LOSS[3]	AVERAGE ANNUAL CROP LOSS[3]
DROUGHT	-	$0	$0	$20,688,052	$1,034,402
EXTREME HEAT	4 days	$0	$0	$5,533,235	$276,662

Source: 1 HPRCC (1899-2019); 2 Indicates data is from NCEI (Jan 1996 to Sept 2019); 3 Indicates data is from USDA RMA (2000 to 2019)

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).

The extreme drought in 2012 significantly affected the agricultural sector across the State of Nebraska and for the planning area. According to the PDSI, 2012's average severity index was ranked at a -4.47, with

[54] NOAA National Centers for Environmental Information. December 2019. "Data Tools: 1981-2010 Normals." [datafile]. https://www.ncdc.noaa.gov/cdo-web/datatools/normals.

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. Neighborhood plots and small organic farms up to large-scale corn and soybean productions and ranches all faced agricultural declines. Hay production was down 28%, corn was down 16%, and soybean production dropped by 21%.[55] Local planning teams indicated drought conditions had negative impacts to the local economy and agricultural production as increased hay prices and reduced cattle herds harmed residents financially. Additionally, a greater volume of wildfire events in 2012 strained local resources and fire suppression equipment, while destroying many acres of pine forests in the area.

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.[56] 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.

Table 47: Loss of Electricity - Assumed Damage by Jurisdiction

JURISDICTION	(EST.) 2017 POPULATION	POPULATION AFFECTED (ASSUMED)	ELECTRIC LOSS OF USE ASSUMED DAMAGE PER DAY
BOX BUTTE	11,200	1,120	$141,120
DAWES	8,972	897	$113,022
SHERIDAN	5,241	524	$66,024
SIOUX	1,256	126	$15,876
TOTAL	**26,669**	**2,667**	**$336,042**

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

Table 48: Period of Record in Drought

PDSI VALUE	MAGNITUDE	DROUGHT OCCURRENCES BY MONTH	MONTHLY PROBABILITY
4 OR MORE TO -0.99	NO DROUGHT	1,052/1,489	70.6%
-1.0 TO -1.99	MILD DROUGHT	184/1,489	12.4%
-2.0 TO -2.99	MODERATE DROUGHT	128/1,489	8.6%
-3.0 TO -3.99	SEVERE DROUGHT	60/1,489	4.0%
-4.0 OR LESS	EXTREME DROUGHT	65/1,489	4.4%

Source: NCEI, Jan 1895-Jan 2019

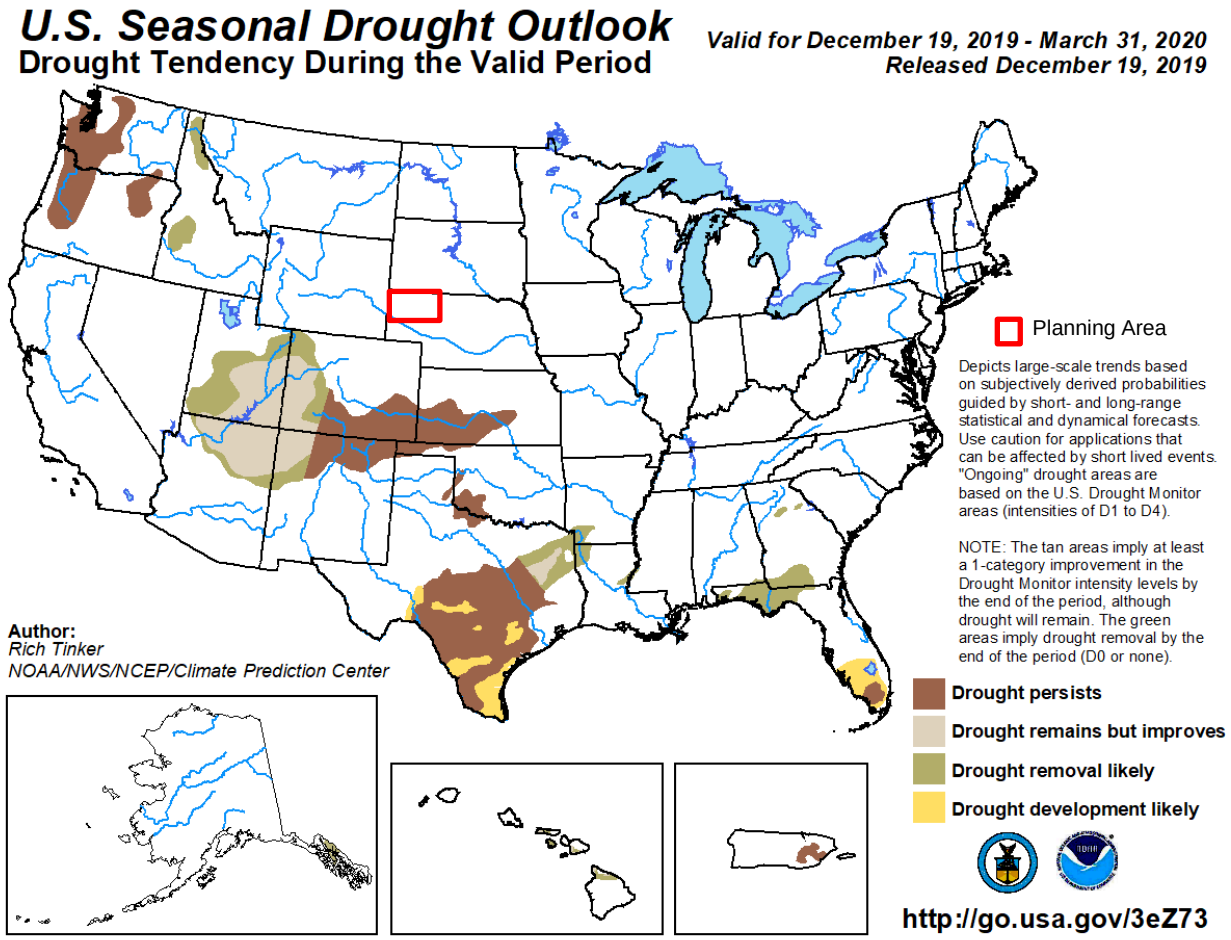
The U.S. Seasonal Drought Outlook (Figure 21) provides a short-term drought forecast that can be utilized by local officials and residents to examine the likelihood of drought developing or continuing depending on the current situation. The drought outlook is updated consistently throughout the year and should be reviewed on an ongoing basis. The following figure provides the drought outlook for December 19, 2019 through March 31, 2020 as an example. According to the U.S. Seasonal Drought Outlook, drought is likely

[55] 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.

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

to persist in the southern United States, but the planning area should experience seasonal norms relative to precipitation and temperatures.

Figure 21: U.S. Seasonal Drought Outlook



Source: NCEI, January 2020

The Union for Concerned Scientists released a report in July 2019 titled *Killer Heat in the United States: Climate Choices and the Future of Dangerously Hot Days*[57] which included predictions for extreme heat events in the future dependent on future climate actions. The table below summarizes those findings for the planning area.

Table 49: Extreme Heat Predictions for Days over 100F

Jurisdiction	Historical Average 1971-2000 (days per year)	Midcentury Prediction 2036-2065 (days per year)	Late Century 2070-2099 (days per year)
Box Butte	0	4	20
Dawes	0	7	26
Sheridan	0	6	25
Sioux	0	3	17

Source: Union of Concerned Scientists, 1971-2000[58]

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

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

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 15 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 50: Drought Impacts in Planning Area

CATEGORY	DATE	AFFECTED COUNTIES	TITLE
AGRICULTURE, RELIEF, RESPONSE & RESTRICTIONS	2/7/2014	Sheridan	Drought-Related USDA Disaster Declarations in 2014
AGRICULTURE	10/17/2013	Dawes, Sioux	Cattle producers in Dawes and Sioux counties in the Nebraska panhandle have struggled to hang onto their cattle through a drought and wildfire
FIRE, RELIEF, RESPONSE & RESTRICTIONS, TOURISM & RECREATION	9/3/2013	Box Butte, Dawes, Sheridan, Sioux	Campers in western Nebraska were urged to be particularly careful with campfires over the Labor Day weekend
AGRICULTURE	8/10/2013	Box Butte, Dawes, Sheridan, Sioux	Exceptional drought conditions and late freezes cut into the amount of certified wheat produced in southeastern Colorado, leading to reduced supplies of seed for the next planting
AGRICULTURE, FIRE, RELIEF, RESPONSE & RESTRICTIONS	6/5/2013	Dawes	Nebraska Legislature to seek federal funds for restoring fencing burned in 2012 wildfire in Pine Ridge
SOCIETY & PUBLIC HEALTH	3/1/2013	Box Butte, Dawes, Sheridan, Sioux	County roads in the Nebraska Panhandle and Goshen County, Wyoming deteriorated during the drought
AGRICULTURE, RELIEF, RESPONSE & RESTRICTIONS	5/17/2013	Box Butte, Dawes, Sheridan, Sioux	Drought-related USDA disaster declarations in 2013
AGRICULTURE	10/24/2012	Dawes, Sheridan	Drought and limited feed resources led many ranchers in the Nebraska Panhandle to sell an unusually large number of livestock
AGRICULTURE, WATER SUPPLY & QUALITY	4/23/2019	Box Butte, Dawes, Sheridan, Sioux	Nebraska ranchers hauling water to livestock
AGRICULTURE, RELIEF, RESPONSE & RESTRICTIONS	11/20/2012	Sioux	USDA Designates 8 Counties in Wyoming as Primary Natural Disaster Areas with Assistance to Producers in Surrounding States
AGRICULTURE, RELIEF, RESPONSE & RESTRICTIONS	3/20/2018	Dawes	Cattle sales in Dawes County, Nebraska

Category	Date	Affected Counties	Title
Fire, Relief, Response & Restrictions	2/22/2018	Box Butte, Dawes, Sheridan, Sioux	Nebraskans urged to leave the fireworks to the professionals
Agriculture, Relief, Response & Restrictions	3/1/2018	Sheridan	Nebraska senator sought action on relief request
Plants & Wildlife	6/13/2013	Box Butte, Dawes, Sheridan, Sioux	Many trees in western Nebraska died from drought, high temperatures and strong winds in 2012
Agriculture, Plants & Wildlife	12/17/2012	Box Butte, Dawes, Sheridan, Sioux	Drought led ranchers in western Nebraska to cull cow herds by 25 to 60 percent

Source: NDMC, 2000-2019[59]

As identified in Nebraska's Drought Mitigation and Response Plan, drought is a common feature of the Nebraska landscape and often causes significant economic, environmental, and social impacts. Although agriculture is the major sector affected, impacts on rural and municipal water supplies, fish and wildlife, tourism, recreation, water quality, soil erosion, the incidence of wildland fires, electricity demand, and other sectors are also significant. Also, the indirect impacts of drought on personal and business incomes, tax revenues, unemployment, and other areas are also important. In general, drought produces a complex web of impacts that ripple through many sectors of the economy. This is largely due to the dependence of so many sectors on water for producing goods and providing services. It is impossible to predict all the potential impacts, but the common impacts of drought have been compiled by the NDMC and are illustrated in the following table.

Table 51:Drought Related Impacts

Sector	Potential Impacts
Economic	• Annual and perennial crop losses; damage to crop quality Reduced productivity of cropland (wind erosion, etc.) Insect infestation • Plant disease • Loss from dairy and livestock production; Reduced productivity of range land; Forced reduction of foundation stock • Closure/limitation of public lands to grazing; High cost/unavailability of water for livestock; High cost/unavailability of feed for livestock; High livestock mortality rates • Range fires; Loss from timber production; Forest fires; Tree disease • Loss from fishery production; Damage to fish habitat; Loss of young fish due to decreased flows • Loss of national economic growth, retardation of economic development • Income loss for farmers and others directly affected; Loss of farmers through bankruptcy • Loss to recreational and tourism industry • Loss to manufacturers and sellers of recreational equipment • Increased energy demand and reduced supply because of drought-related power curtailments • Costs to energy industry and consumers associated with substituting more expensive fuels (oil) for Hydroelectric power • Loss to industries directly dependent on agricultural production (e.g., machinery) • Decline in food production/disrupted food supply; Increase in food prices • Unemployment from drought-related production declines

[59] National Drought Mitigation Center. 2019. "U.S. Drought Impact Reporter." Accessed January 2020. http://droughtreporter.unl.edu/map/.

SECTOR	POTENTIAL IMPACTS
	• Strain on financial institutions (foreclosures, greater credit risk s, capital shortfalls, etc.) • Revenue losses to federal, state, and local governments (from reduced tax base) • Deterred capital investment, expansion • Dislocation of businesses • Loss from impaired navigability of streams, rivers, and canals • Cost of water transport or transfer; Cost of new or supplemental water resource development
ENVIRONMENTAL	• Reduction and degradation of fish and wildlife habitat; Damage to animal species • Lack of feed and drinking water • Increased vulnerability to predation (e.g., from species concentration near water • Loss of biodiversity • Wind and water erosion of soils • Reservoir and lake drawdown • Damage to plant species • Water quality effects (e.g., salt concentration, increased water temperatures, pH, dissolved oxygen) • Air quality effects (dust, pollutants) • Visual landscape quality (dust, vegetative cover, etc.) • Increased fire hazard • Estuarine impacts; changes in salinity levels, reduced flushing
SOCIAL	• Increased groundwater depletion (mining), land subsidence • Loss of wetlands, cultural sites, recreational areas • Food shortages (decreased nutritional level, malnutrition, famine) • Loss of human life (e.g., food shortages, heat) • Public safety from forest and range fires • Conflicts between water users, public policy conflicts • Increased anxiety • Health-related low flow problems (e.g., diminished sewage flows, increased pollutant concentrations, etc.) • Recognition of institutional constraints on water use • Inequity in the distribution of drought impacts/relief; Decreased quality of life in rural areas; Increased poverty and impacts of poverty • Social unrest, civil strife; loss of confidence in government officials

Source: NDMC

All segments of the population are vulnerable to the effects of extreme heat, some specific groups have higher levels of vulnerability to extreme heat include the elderly (55 years and older), residents of nursing homes or care facilities, children, those isolated from social interactions, and low-income groups. Elderly residents and people living in nursing homes and care facilities have less tolerance for temperature extremes and can quickly feel the effects of extreme temperatures. Low-income elderly in urban areas are especially at risk from extreme temperatures. Young children under the age of 5 are highly susceptible to the effects of extreme heat. Young children have a smaller body mass to surface ratio making them more vulnerable to heat-related morbidity and mortality. Children also become dehydrated more quickly than adults making for greater concern. Low-income people and families may lack resources that mitigate the impacts of extreme heat such as air conditioning. The following table provides information related to regional vulnerabilities for drought and extreme heat. For jurisdictional-specific vulnerabilities, refer to *Section Seven: Community Profiles*.

Table 52:Regional Drought and Extreme Heat Vulnerabilities

SECTOR	VULNERABILITY
PEOPLE	-Insufficient water supply -Loss of jobs in agricultural sector -Residents in poverty if food prices increase

SECTOR	VULNERABILITY
	-Health impacts: heat exhaustion; heat stroke; those working outdoors; people without air conditioning; young children/elderly outside or without air conditioning
ECONOMIC	-Closure of water intensive businesses (carwashes, pools, etc.) -Short-term interruption of business -Loss of tourism dollars -Losses in crop production -Decrease in cattle prices -Decrease of land prices→ jeopardizes educational funds
BUILT ENVIRONMENT	-Cracking of foundations (residential and commercial structures) -Damages to landscapes -Damage to air conditioning/HVAC systems if overworked
INFRASTRUCTURE	-Damages to waterlines below ground -Damages to roadways (prolonged extreme events) -Stressing of electrical systems (brownouts during peak usage)
CRITICAL FACILITIES	-Loss of power and impact on infrastructure
CLIMATE	-Increased risk of wildfire events, damaging buildings and agricultural land -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 53 shows current statuses of Flood Insurance Rate Map (FIRM) panels. Most of the jurisdictions throughout the planning area also have FIRMs at the municipal level. Figure 22 shows the preliminary firm data for the planning area. For jurisdictional-specific maps as well as an inventory of structures in the floodplain, please refer to *Section Seven: Participant Sections.*

Table 53: FEMA FIRM Panel Status

Jurisdiction	Participating in NFIP? (Y/N)	Panel Number	Effective Date
Box Butte County	No	310416IND0, 310416IND0, 3104160001A, 3104160002A, 3104160003A, 3104160004A, 3104160005A, 3104160006A, 3104160007A, 3104160008A, 3104160009A, 3104160010A, 3104160011A, 3104160012A, 3104160013A, 3104160014A, 3104160015A, 3104160016A	8/23/1977
Alliance	Yes	310011IND0, 3100110005A, 3100110015A	7/16/1987
Hemingford	No	-	-
Dawes County	Yes	31045CIND0A, 31045CIND0A, 3104C0025C, 31045C0050C, 31045C0075C, 31045C0125C, 31045C0150C, 31045C0200C, 31045C0225C, 31045C0250C, 31045C0275C, 31045C0300C, 31045C0325C, 31045C0350C, 31045C0375C, 31045C0400C, 31045C0420C, 31045C0425C, 31045C0450C, 31045C0460C, 31045C0475C, 31045C0480C, 31045C0500C, 31045C0525C, 31045C0530C, 31045C0535C, 31045C0540C, 31045C0545C, 31045C0575C, 31045C0600C, 31045C0625C, 31045C0650C, 31045C0675C, 31045C0700C, 31045C0725C, 31045C0750C, 31045C0775C, 31045C0800C, 31045C0825C, 31045C0850C, 31045C0875C, 31045C0900C, 31045C0925C, 31045C0950C, 31045C0975C	6/16/2011
Chadron	Yes	31045CIND0A, 31045C0460C, 31045C0475C, 31045C0480C, 31045C0500C	6/16/2011
Crawford	Yes	31045CIND0A, 31045C0535C, 31045C0545C	6/16/2011
Whitney	No	31045CIND0A, 31045C0420C	6/16/2011
Sheridan County	Yes	310475IND0A, 310475IND0A, 3104759999A, 3104750001B, 3104750002B, 3104750003B, 3104750004B, 3104750005B, 3104750006B, 3104750007B, 3104750008B, 3104750009B, 3104750010B, 3104750011B,	12/1/2008

Jurisdiction	Participating in NFIP? (Y/N)	Panel Number	Effective Date
		3104750012B, 3104750013B, 3104750014B, 3104750015B, 3104750016B, 3104750017B, 3104750018B, 3104750019B, 3104750020B, 3104750021B, 3104750022B, 3104750023B, 3104750024B, 3104750025B, 3104750026B, 3104750027B, 3104750028B, 3104750029B, 3104750030B, 3104750031B, 3104750032B	
Gordon^	Yes	0007A	11/22/1977
Hay Springs	Yes	3102139999B, 310213B	2/1/1993
Rushville	Yes	310214A	4/2/1976
Sioux County	No	-	-
Harrison	No	-	-

Source: FEMA, 2020[60,61]
^The City of Gordon adopted Panel 0007A of Sheridan County FHBM dated November 22, 1977 to use in determining those areas of special flood hazard within the 1-mile extra territorial jurisdiction.

The following figures show available flood hazard area maps for the four county planning area. Dawes County has an available Digital Floor Insurance Map (DFIRM) as provided by FEMA. Box Butte County and Sheridan County flood hazard areas were rendered using HAZUS for this planning effort. There is currently no flood hazard area mapping information available for Sioux County; however, a map of rivers and streams is provided. It is expected that, in general, any floodplain areas will be adjacent to major waterways.

Additionally, it should be noted that there are currently no RiskMap efforts going on in the planning area by the Nebraska Department of Natural Resources.[62] There are also no USGS Water Alert stations located within the planning area.[63]

[60] Federal Emergency Management Agency. 2019. "FEMA Flood Map Service Center." Accessed January 2020. http://msc.fema.gov/portal/advanceSearch.
[61] Federal Emergency Management Agency. 2020. "Community Status Book Report." Accessed January 2020. https://www.fema.gov/cis/NE.html.
[62] Nebraska Department of Natural Resources. 2020. "Floodplain Map Interactive Maps: Risk MAP Flood Risk Products Map." https://prodmaps2.ne.gov/Html5DNR/index.html?viewer=outreach
[63] Nebraska Department of Natural Resources. 2020. "Floodplain Map Interactive Maps: USGS Water Alert System." https://maps.waterdata.usgs.gov/mapper/wateralert/

Figure 22: 1% Annual Flood Risk Hazard Area in Box Butte County

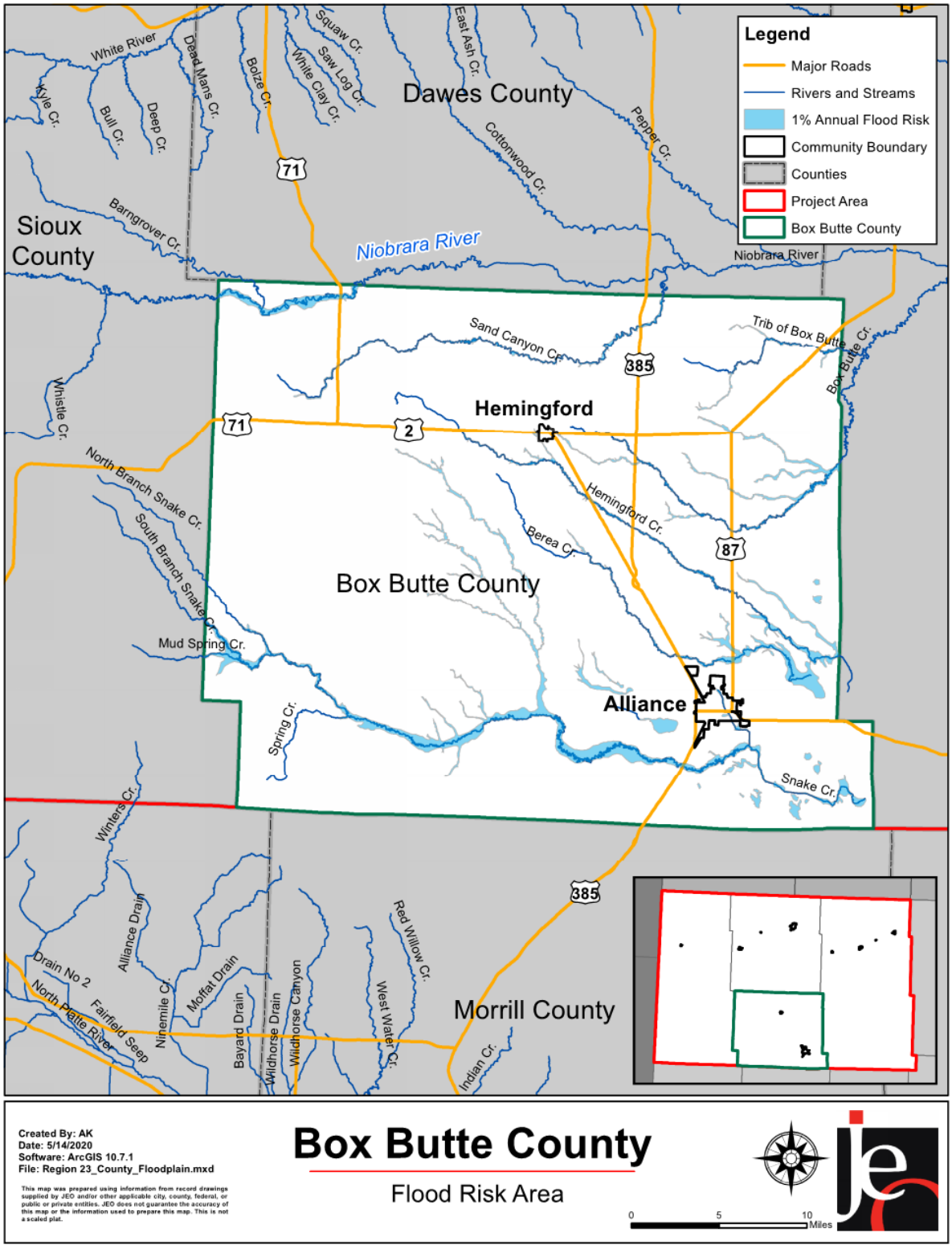


Figure 23: 1% Annual Flood Risk Hazard Area in Dawes County

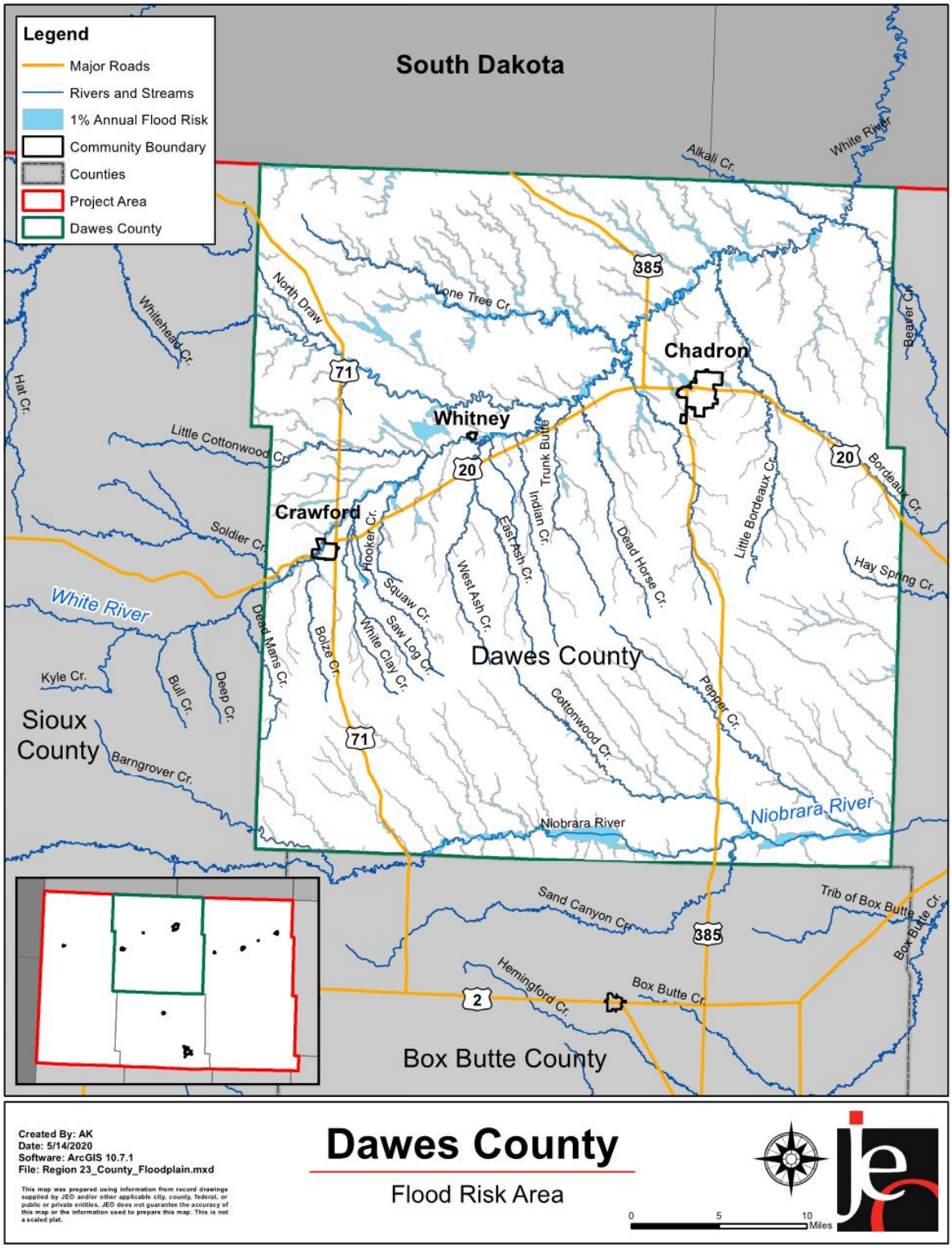


Figure 24: 1% Annual Flood Risk Hazard Area in Sheridan County

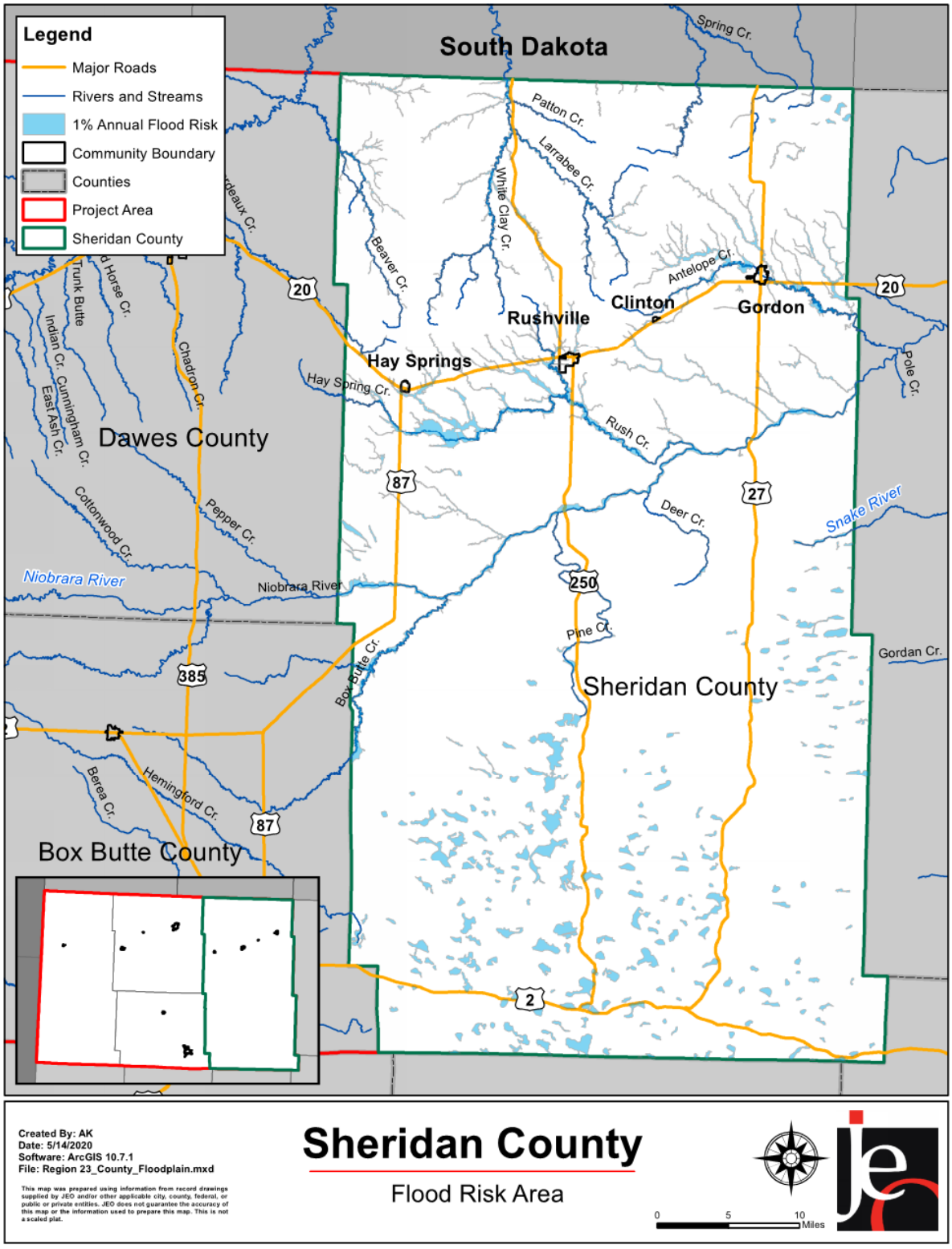
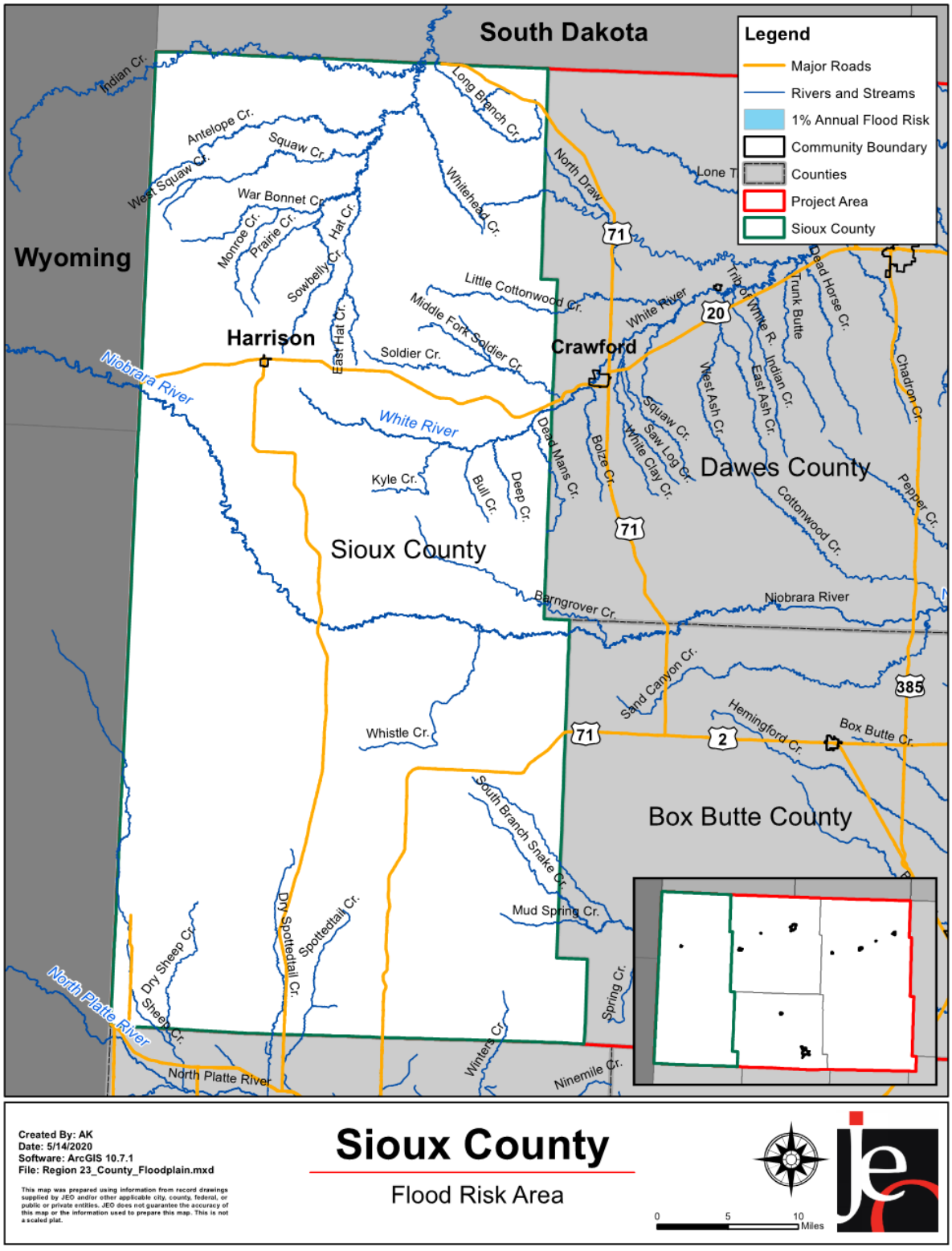


Figure 25: Major Rivers and Streams in Sioux County



EXTENT

The NWS has three categories to define the severity of a flood once a river reaches flood stage as indicated in Table 54.

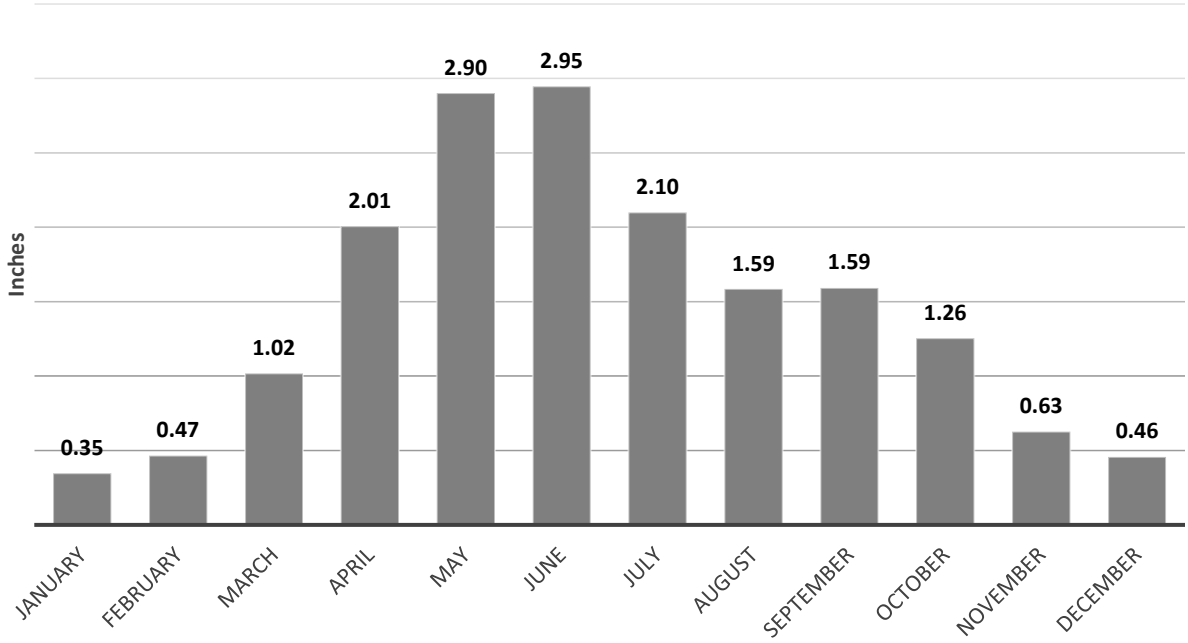
Table 54: Flooding Stages

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[64]

Figure 26 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 27, the most common months for flooding within the planning area are June and July.

Figure 26: Region 23 Average Monthly Precipitation

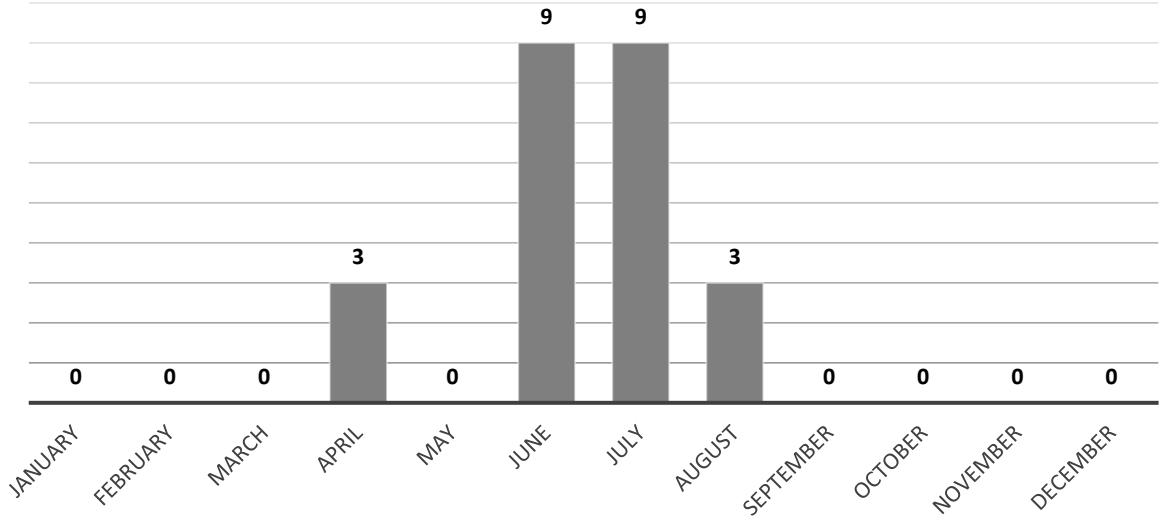


Source: NCEI, 2019[65]

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

[65] NOAA National Centers for Environmental Information. December 2019. "Data Tools: 1981-2010 Normals." [datafile]. https://www.ncdc.noaa.gov/cdo-web/datatools/normals.

Figure 27: Monthly Events for Floods/Flash Floods



Source: NCEI, 1996-2019

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 55: NFIP Participants

JURISDICTION	PARTICIPATE IN NFIP	ELIGIBLE-REGULAR PROGRAM	DATE CURRENT MAP	SANCTION	SUSPENSION	RESCINDED
BOX BUTTE COUNTY	No	-	8/23/1977	-	-	-
ALLIANCE	Yes	7/16/87	7/16/87(M)	-	-	-
HEMINGFORD	No	-	-	-	-	-
DAWES COUNTY	Yes	6/16/2011	06/16/11(M)	-	-	-
CHADRON	Yes	8/1/2009	06/16/11(M)	-	-	-
CRAWFORD	Yes	8/1/1986	06/16/11(M)	-	-	-
WHITNEY	No	6/16/2011	6/16/2011	-	-	-
SHERIDAN COUNTY	Yes	12/1/2008	12/01/08(L)	-	-	-
GORDON^	Yes	-	(NSFHA)	-	-	-
HAY SPRINGS	Yes	2/1/1993	02/01/93(L)	-	-	-

Jurisdiction	Participate in NFIP	Eligible-Regular Program	Date Current Map	Sanction	Suspension	Rescinded
Rushville	Yes	-	4/2/1976	-	-	-
Sioux County	No	-	-	-	-	-
Harrison	No	-	-	-	-	-

Source: Federal Emergency Management Agency, National Flood Insurance Program, 2017[66]
**(M) indicates no elevation determined – All Zone A, C, and X; (NSFHA) indicates no special flood hazard area – all Zone C*
^The City of Gordon adopted Panel 0007A of Sheridan County FHBM dated November 22, 1977 to use in determining those areas of special flood hazard within the 1-mile extra territorial jurisdiction.

Table 56: NFIP Policies in Force and Total Payments

Jurisdiction	Policies In-force	Total Coverage	Total Premiums	Closed Losses*	Total Payments
Box Butte County	0	$0	$0	0	$0
Alliance	5	$945,200	$5,053	2	0
Hemingford	0	$0	$0	0	$0
Dawes County	5	$861,600	$4,646	0	$0
Chadron	2	$460,000	$2,576	0	$0
Crawford	0	$0	$0	0	$0
Whitney	0	$0	$0	0	$0
Sheridan County	7	$773,000	$6,788	0	$0
Gordon	0	$0	$0	0	$0
Hay Springs	3	$346,400	$4,211	0	$0
Rushville	0	$0	$0	0	$0
Sioux County	0	$0	$0	0	$0
Harrison	0	$0	$0	0	$0

Source: Federal Emergency Management Agency, National Flood Insurance Program, NFIP Community Status Book, 2019[67]
**Closed Losses are those flood insurance claims that resulted in payment*

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).[68] Currently no jurisdictions in the planning area participate in the CRS program.

[66] Federal Emergency Management Agency: National Flood Insurance Program. September 2018. "Policy & Claim Statistics for Flood Insurance." Accessed December 2019. https://www.fema.gov/policy-claim-statistics-flood-insurance.
[67] Federal Emergency Management Agency: National Flood Insurance Program. December 2019. Policy & Claim Statistics for Flood Insurance." Accessed December 2019. https://www.fema.gov/policy-claim-statistics-flood-insurance.
[68] Federal Emergency Management Agency. December 2019. "National Flood Insurance Program Community Rating System: Coordinator's Manual FIA-15/2017." Accessed December 2019. https://www.fema.gov/media-library/assets/documents/8768.

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 November 2019, there were no repetitive loss properties located in the planning area.

Flooding from Levee Failure

While there are no federal or non-federal levees located within the four-county planning area, numerous unmapped agricultural levees and berms are spread out throughout the counties. These levees are not inventoried or mapped, preventing a full risk assessment. However, in the case of an agricultural levee failure event flood impacts would likely be limited to agricultural lands and outbuildings.

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, 22 flash flooding events resulted in $562,000 in property damage, while two riverine flooding events did not report any 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 $109,388. Descriptions of the most damaging flood events from the NCEI are below:

- **August 3, 1996 –** Rush Creek bridge washed out three miles south of Rushville. Five feet of water present in basements 6 miles north of Rushville. Rainfall of five to six inches in and around Rushville.
- **August 15, 1996 –** Road washed out 1 mile north of Rushville.
- **July 10, 2005 -** Over 2 inches of rain fell in 45 minutes to produce lowland flooding with at least one road washed out.
- **July 9, 2010 –** A warm front moved north out of northeastern Colorado the afternoon of 9 June 2010 into southeast Wyoming and the Nebraska Panhandle. The warm front interacted with pre-existing outflow boundaries and later in the evening of the 9th, an approaching upper level jet streak, to produce severe thunderstorms and heavy rainfall across portions of western Nebraska and extreme southeast Wyoming. A rural road was washed out 5 miles north of Rushville.
- **July 11, 2011 –** Isolated thunderstorms developed in the Nebraska Panhandle along and north of a stationary front. As storms moved east into deeper low level moisture, coverage and severity increased. Damaging winds, large hail and flash flooding was reported over the eastern Nebraska Panhandle along with portions of north central Nebraska. Report of 6-8 inches of water over 5th Street in Chadron. Canal out of its banks and flowing rapidly.

It should be noted that reported damages do not include impacts from the March 2019 winter storm and flood event. While flooding impacts across central and eastern Nebraska have dominated national media, the concurrent winter storm impacts primarily impacted the planning area. Winter Storm Ulmer developed on March 12 and slowly moved across the Midwest including Nebraska, producing severe blizzard conditions across the panhandle and the planning area. Due to heavy precipitation on frozen ground and melting snowpack, numerous water systems were overwhelmed and failed. In other areas, released ice jams destroyed roads, bridges, and levees. All major transportation routes in the northwestern portion of the country experienced closures or delays during these conditions. Significant snow fall, high winds, and extreme low temperatures buffeted ranchers across the panhandle and threatened cattle and livestock. This event also occurred in the midst of calving season, resulting in the loss of hundreds of calves for ranchers across the state. At least three fatalities occurred during the event while the Nebraska National Guard performed dozens of rescues in inundated areas. No fatalities were reported within the Region 23 planning area during this event. In total, 104 cities, 81 counties, and 5 tribal nations in Nebraska received State or Federal Disaster Declarations due to the flood events.

The NeDNR has collected and reviewed extensive data records from the flood event. An event-wide storymap has been developed and provides an excellent resource to understand the cause, duration,

impacts, and recovery efforts from this event. The storymap can be viewed at: https://storymaps.arcgis.com/stories/9ce70c78f5a44813a326d20035cab95a.

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 $26,417 in property damages and $5,469 in crop losses per year for the planning area.

Table 57: 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	24	1	$562,000	$26,417	$109,388	$5,469

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

Probability

The NCEI reports two flooding and 22 flash flooding events for a total of 24 events from January 1996 to September 2019. Based on the historic record and reported incidents by participating communities, there is a 100 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 58: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

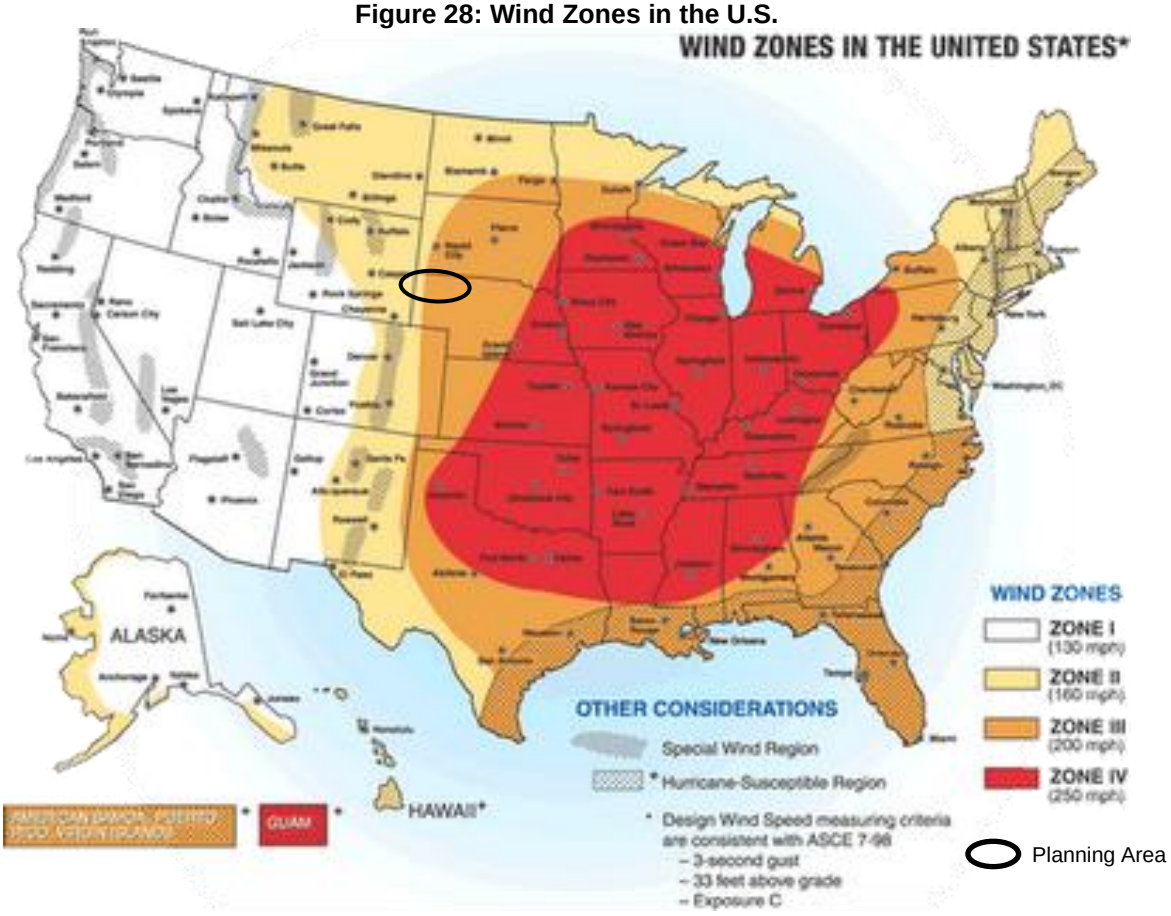
SECTOR	VULNERABILITY
	-Elderly or residents with decreased mobility may have trouble evacuating -Residents in low-lying areas, especially campgrounds, are vulnerable during flash flood events -Residents living in the floodplain may need to evacuate for extended periods
ECONOMIC	-Business closures or damages may have significant impacts -Agricultural losses from flooded fields or cattle loss -Closed roads and railways would impact commercial transportation of goods
BUILT ENVIRONMENT	-Buildings may be damaged
INFRASTRUCTURE	-Damages to roadways and railways
CRITICAL FACILITIES	-Wastewater facilities are at risk, particularly those in the floodplain -Critical facilities, especially those in the floodplain, are at risk to damage (critical facilities are noted within individual community profiles)
CLIMATE	-Changes in seasonal and annual precipitation normals will likely increase frequency and magnitude of flood events

HIGH WINDS AND TORNADOES

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

The National Weather Service (NWS) defines high winds as sustained wind speeds of 40 mph or greater lasting for 1 hour or longer, or winds of 58 mph or greater for any duration.[69] 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 28 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 II/III which has maximum winds of 200 mph equivalent to an EF4/5 tornado.

Figure 28: Wind Zones in the U.S.



Source: FEMA, 2016

High winds are a critical component of tornado formation. A tornado is typically associated with a supercell thunderstorm. For a rotation to be classified as a tornado, three characteristics must be met:

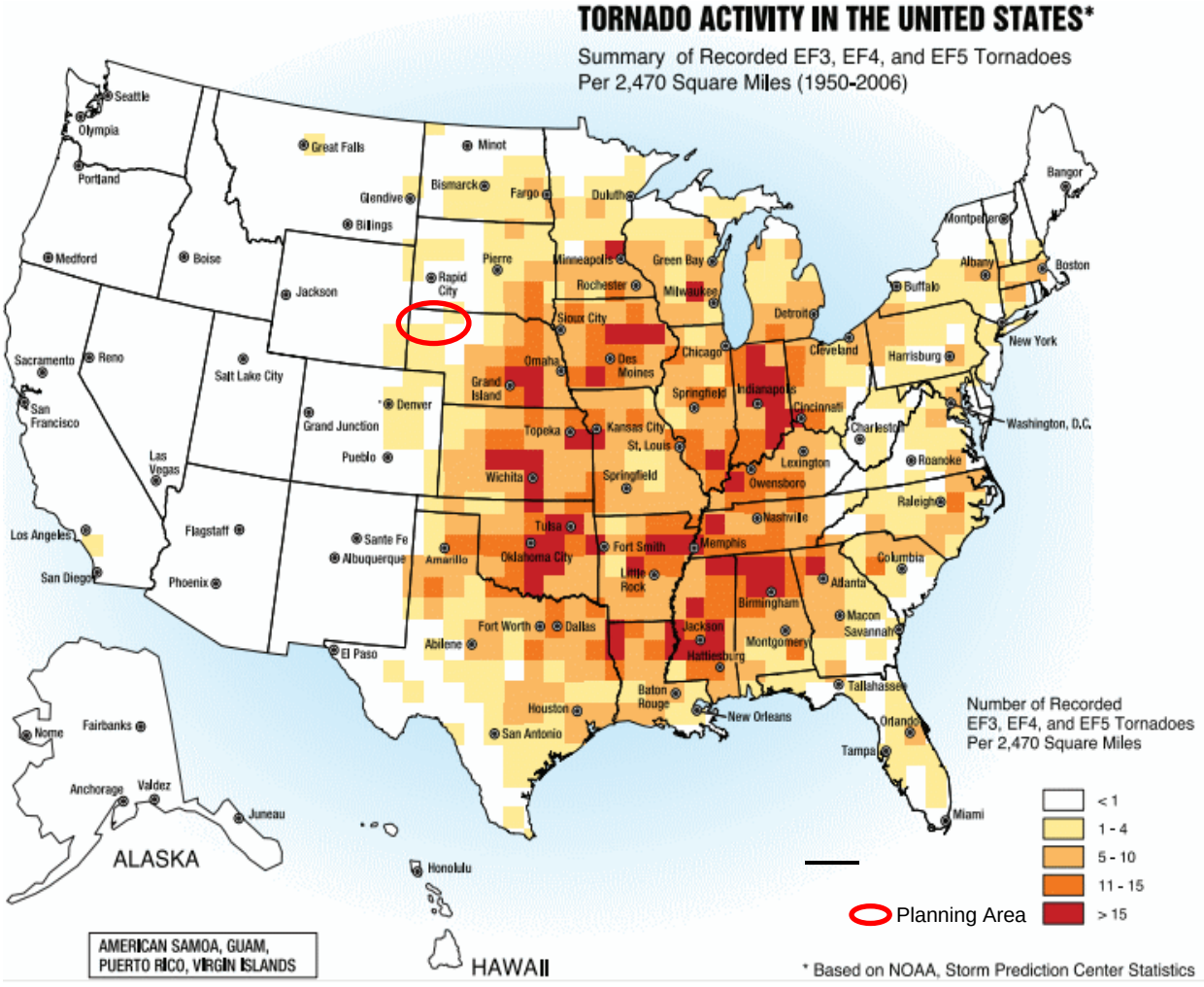
- There must be a microscale rotating area of wind, ranging in size from a few feet to a few miles wide;
- The rotating wind, or vortex, must be attached to a convective cloud base and must be in contact with the ground; and,

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

- 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.

Figure 29: Tornado Activity in the United States



Source: FEMA, 2008[70]

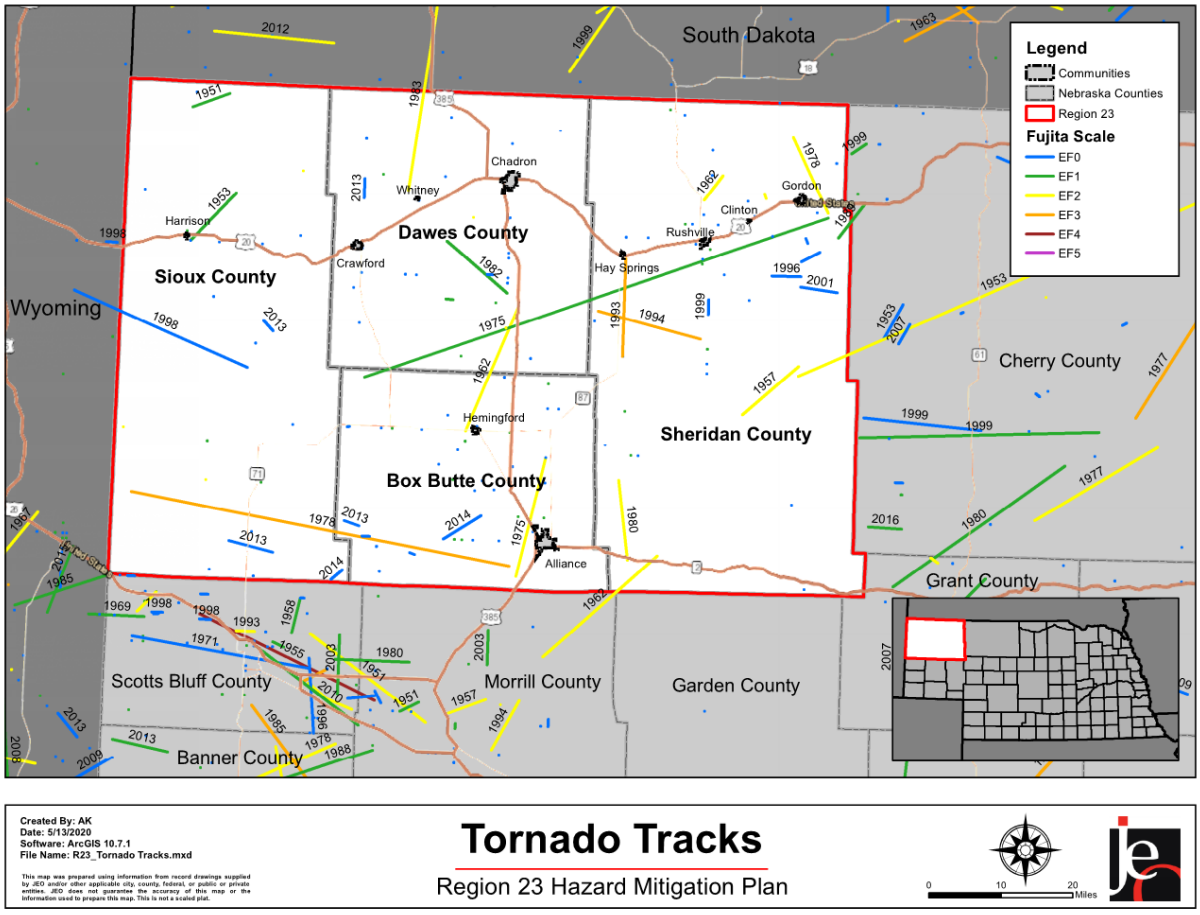
Nebraska is ranked fifth in the nation for tornado frequency with an annual average of 57 tornadoes between 1991 to 2010.[71] The following figure shows the tornado activity in the United States as a summary of recorded EF3, EF4, and EF5 tornadoes per 2,470 square miles from 1950-2006.

[70] Federal Emergency Management Agency. August 2008. "Taking Shelter From the Storm: Building a Safe Room for Your Home or Small Business, 3rd edition."
[71] National Centers for Environmental Information. 2013. "U.S. Tornado Climatology." https://www.ncdc.noaa.gov/climate-information/extreme-events/us-tornado-climatology.

LOCATION

High winds and tornadoes commonly occur throughout 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 2018 according to the Midwestern Regional Climate Center. Few significant tornado events have directly impacted communities located in the planning area, but touchdowns and tornado events can occur anywhere within the four-county planning area.

Figure 30: Historic Tornado Tracks



EXTENT

The Beaufort Wind Scale can be used to classify wind strength while the magnitude of tornadoes is measured by the Enhanced Fujita Scale. Table 59 outlines the Beaufort scale, provides wind speed ranking, range of wind speeds per ranking, and a brief description of conditions for each ranking.

Table 59: 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[72]

The Enhanced Fujita Scale replaced the Fujita Scale in 2007. The Enhanced Fujita Scale does not measure tornadoes by their size or width, but rather the amount of damage caused to human-built structures and trees after the event. The official rating category provides a common benchmark that allows comparisons to be made between different tornadoes. The enhanced scale classifies EF0-EF5 damage as determined by engineers and meteorologists across 28 different types of damage indicators, including different types of building and tree damage. To establish a rating, engineers and meteorologists examine the damage, analyze the ground-swirl patterns, review damage imagery, collect media reports, and sometimes utilize photogrammetry and videogrammetry. Based on the most severe damage to any well-built frame house, or any comparable damage as determined by an engineer, an EF-Scale number is assigned to the tornado. The following tables summarize the Enhanced Fujita Scale and damage indicators. According to 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.[73]

Table 60: 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.

[72] Storm Prediction Center: National Oceanic and Atmospheric Administration. 1805. "Beaufort Wind Scale." http://www.spc.noaa.gov/faq/tornado/beaufort.html.
[73] 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."

Storm Category	3 Second Gust (mph)	Damage Level	Damage Description
EF4	166-200 mph	Devastating	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown, and large missiles generated.
EF5	200+ mph	Incredible	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-enforced concrete structures badly damaged.
EF NO RATING	--	Inconceivable	Should a tornado with the maximum wind speed in excess of F5 occur, the extent and types of damage may not be conceived. A number of missiles such as iceboxes, water heaters, storage tanks, automobiles, etc. will create serious secondary damage on structures.

Source: NOAA; FEMA

Table 61: 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

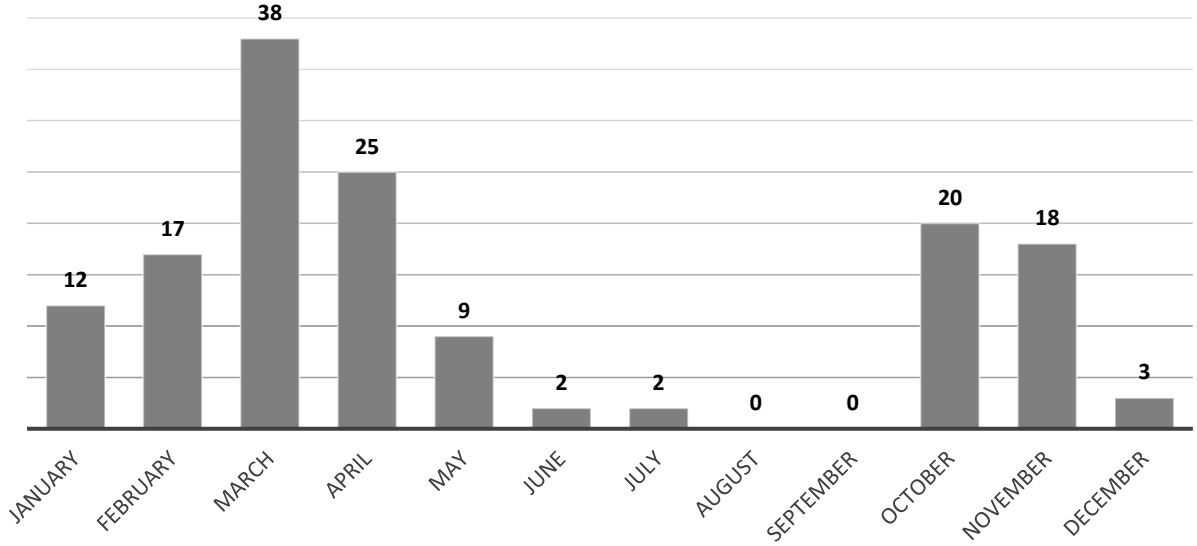
Source: NOAA; FEMA

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. Based on the historic record, it is most likely that tornadoes that occur within the planning area will be of EF0 strength. Of the 71 reported events, four were EF1 and two were EF2. High wind and tornadoes are likely to occur annually in the planning area.

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 146 high wind events that occurred between January 1996 and September 2019 and 71 tornadic events ranging from a magnitude of EF0 to EF2. These events were responsible for $104,500 in property damages. As seen in Figure 31, most high wind events occur in the spring and winter months. One tornado in 2017 caused one fatality. The most damaging tornadoes occurred in Box Butte County (2017, $1,000,000) and Sheridan County (2006, $150,000). Significant hazards which impacted communities in the planning area are described in the appropriate Community Profiles.

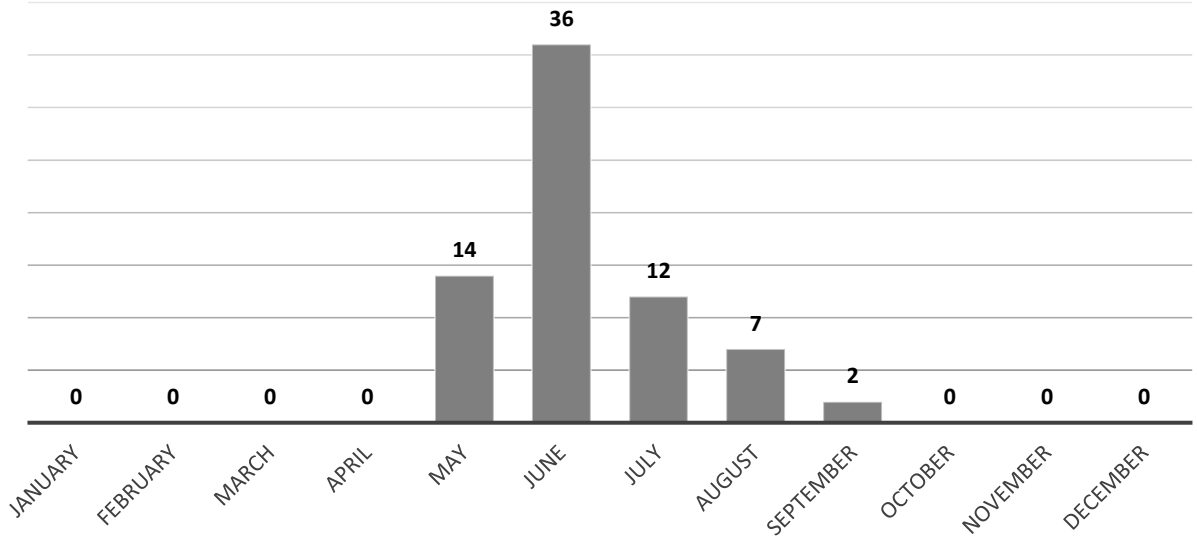
Figure 31: High Wind Events by Month



Source: NCEI, 1996-2019

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. Overall the planning area is vulnerable to high wind or tornado events throughout the entire year.

Figure 32: Tornadoes by Month in the Planning Area



Source: NCEI, 1996-2019

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 $5,375 per year in property damage, and an average of $599,829 per year in crop damage for the planning area. Tornadoes cause an average of $56,458 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 62: 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	146	6.1	$129,000	$5,375	$11,996,572	$599,829
Tornadoes	71	3	$1,355,000	$56,458	$0	$0

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

Probability

Based on historical records and reported events, it is likely that high winds and tornadic events will occur within the planning area annually. For the 24 years examined, there were 146 reported high wind events and 71 tornadoes.

Regional Vulnerabilities

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

Table 63: Regional High Wind and Tornado Vulnerabilities

Sector	Vulnerability
People	-Vulnerable populations include those living in mobile homes (especially if they are not anchored properly), nursing homes, and/or schools -People outdoors during events -Citizens without access to shelter below ground or in safe room -Elderly with decreased mobility or poor hearing may be higher risk -Lack of multiple ways of receiving weather warnings, especially at night
Economic	-Agricultural losses to both crops and livestock -Damages to businesses and prolonged power outages can cause significant impacts to the local economy, especially with EF3 tornadoes or greater
Built Environment	-All building stock is at risk of significant damages
Infrastructure	-Downed power lines and power outages -All above ground infrastructure at risk to damages -Impassable roads due to debris blocking roadways
Critical Facilities	-All critical facilities are at risk to damages and power outages
Climate	-Changes in seasonal precipitation and temperature normals can increase frequency and magnitude of severe storm events

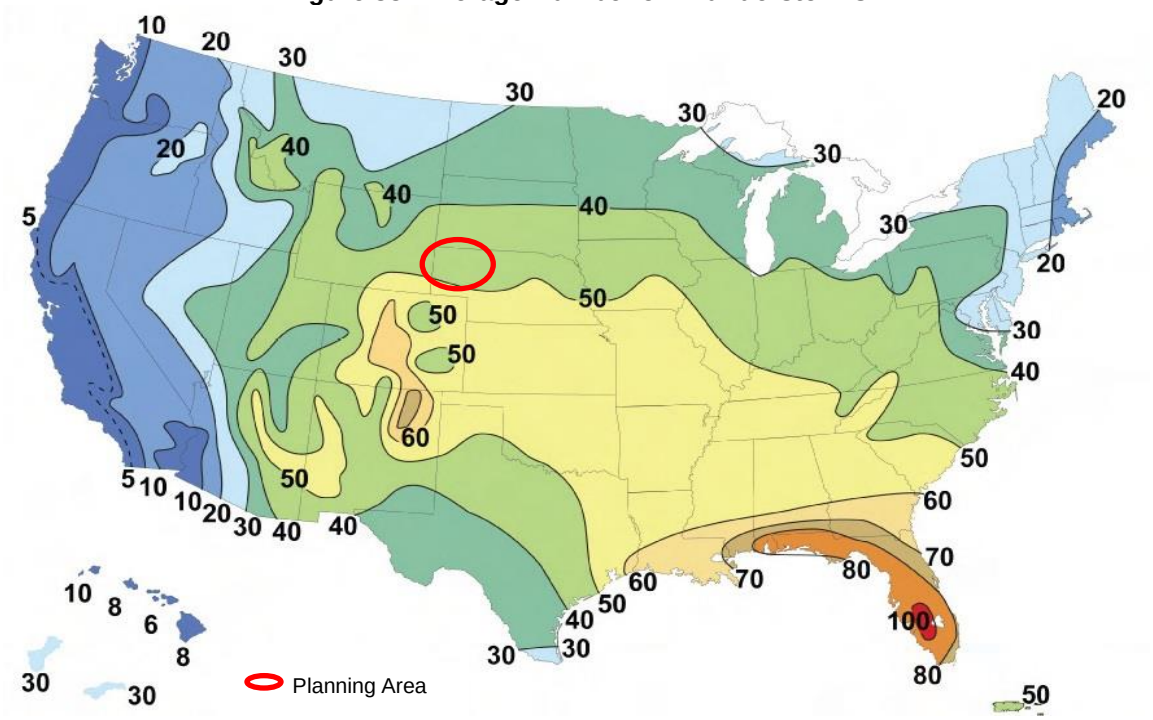
SEVERE THUNDERSTORMS

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. Additionally, hail is a common component of thunderstorms and 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. Hail can destroy property and crops with sheer force, as some hail stones can fall at speeds up to 100 mph.

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 and/or produce hail, 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; death or injury to humans and animals from lightning, drowning, or getting struck by falling or flying debris; 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. Figure 33 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 33: Average Number of Thunderstorms



Source: NWS, 2017[74]

[74] 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 to thunderstorms and hail due to the regional nature of this type of event.

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. 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 64 outlines the TORRO Hail Scale.

Table 64: TORRO Hail Scale

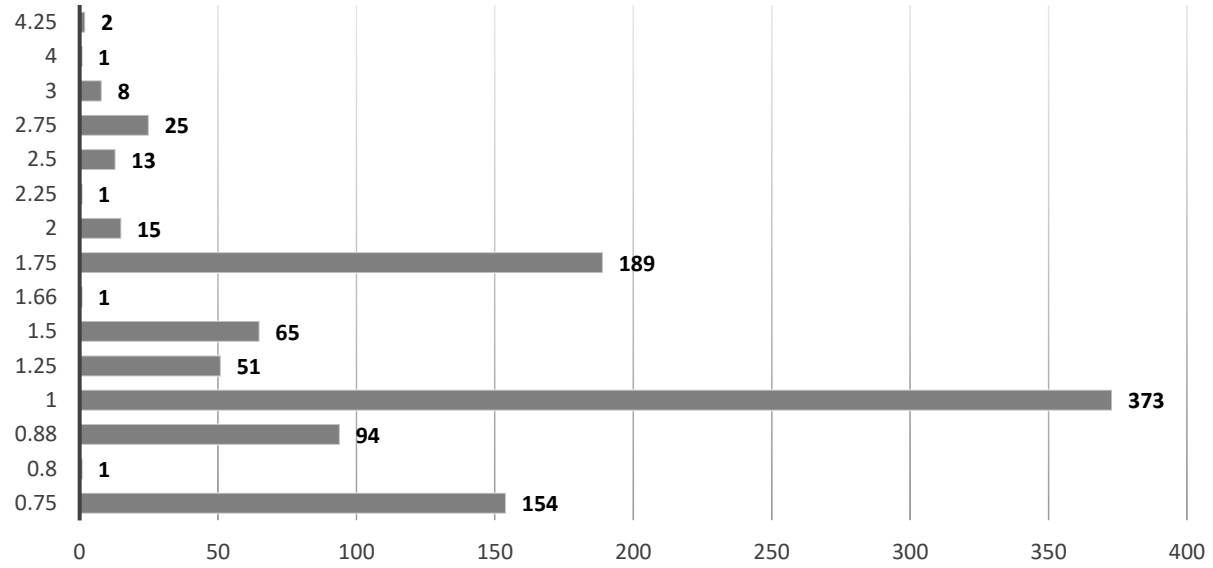
CLASS	TYPE OF MATERIAL	DIVISIONS
H0: Hard Hail	5 mm; (Pea size); 0.2 in	No damage
H1: Potentially Damaging	5 -15 mm (Marble); 0.2 – 0.6 in	Slight general damage to plants and crops
H2: Significant	10 -20 mm (Grape); 0.4 – 0.8 in.	Significant damage to fruit, crops, and vegetation
H3: Severe	20 -30 mm (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]

The NCEI reported 993 individual hail events across the planning area. As the NCEI reports events per county, this value overestimates the total amount of thunderstorm events. The average hailstone size was 1.24 inches. Events of this magnitude correlate to an H4 Severe classification. It is reasonable to expect H4 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 two H10 hail events (>4.0 inches) during the period of record. Figure 34 shows hail events based on the size of the hail.

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

Figure 34: Hail Events by Magnitude

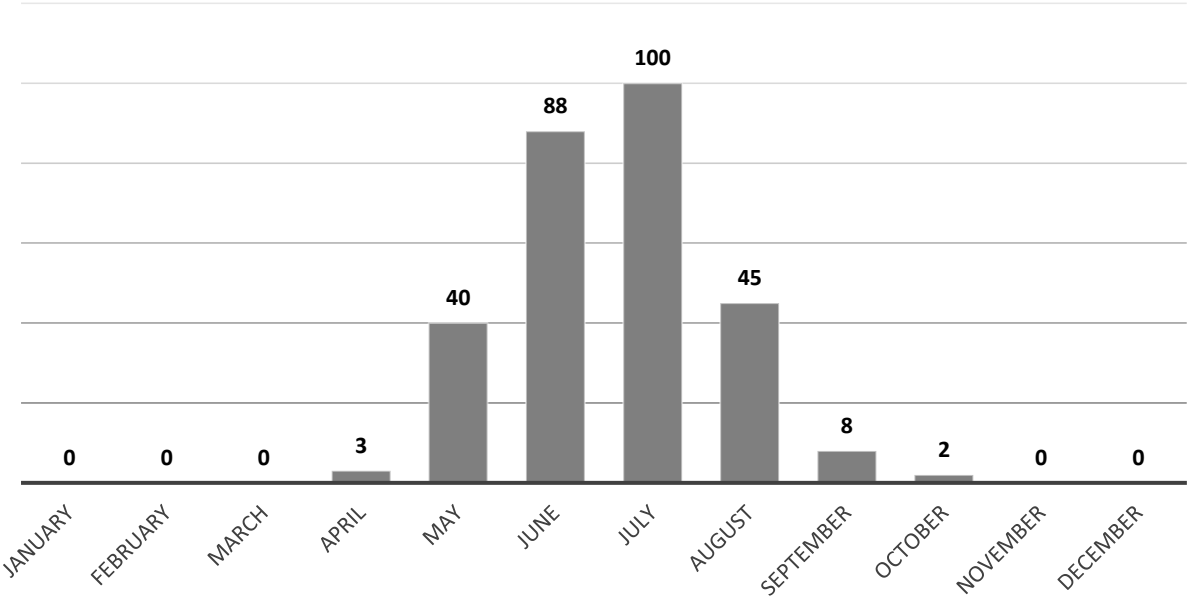


Source: NCEI, 1996-2019

HISTORICAL OCCURRENCES

Severe thunderstorms in the planning area usually occur in the afternoon and evening during the summer months (Figure 35).

Figure 35: Thunderstorm Wind Events by Month



Source: NCEI, 1996-2019

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 286 thunderstorm wind, 36 heavy rain, five lightning, and 993 hail events in the planning area from January 1996 to September 2019. In total these events were responsible for $4,980,600 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 $9,253,643 in crop damages. There were eight injuries reported in association with these storms, but no fatalities.

Average Annual Damages

The average damage per event estimate was determined based upon recorded damages from NCEI Storm Events Database since 1996 and number of historical occurrences. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. Severe thunderstorms cause an average of $207,525 per year in property damages.

Table 65: 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
Hail	993	41.4	$2,302,200	$95,925	$9,253,643	$462,682
Heavy Rain	36	1.5	$0	$0		
Lightning	5	0.2	$1,467,000	$61,125		
Thunderstorm Wind	286	11.9	$1,211,400	$50,475		
Total	**1,302**	**55**	**$4,980,600**	**$207,525**	**$9,253,643**	**$462,682**

Source: 1 Indicates data is from NCEI (January 1996 to Sept 2019); 2 Indicates data is from USDA RMA (2000 to 2019)

Probability

Based on historical records and reported events, severe thunderstorms events and storms with hail are likely to occur on an annual basis. The NCEI reported a total of 1,302 severe thunderstorm events between 1996 and 2019; 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 66: 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 -Injuries can occur from: not seeking shelter, standing near windows, and shattered windshields in vehicles
Economic	-Damages to buildings and property can cause significant losses to business owners and employees
Built Environment	-Buildings are at risk to hail damage -Downed trees and tree limbs -Roofs, siding, windows, gutters, HVAC systems, etc. can incur damage
Infrastructure	-High winds and lightning can cause power outages and down power lines -Roads may wash out from heavy rains and become blocked from downed tree limbs

SECTOR	VULNERABILITY
CRITICAL FACILITIES	-Power outages are possible -Critical facilities may sustain damage from hail, lightning, and wind
CLIMATE	-Changes in seasonal precipitation and temperature normals can increase frequency and magnitude of severe storm events
OTHER	-High winds, hail, lightning, heavy rain, and possibly tornadoes can occur with this hazard

SEVERE WINTER STORMS

Severe winter storms are an annual occurrence in 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 12.3°F). The average high temperatures for the months of January, February, and December are near 39°F.[76]

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 36 shows the SPIA index.

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

Figure 36: 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[77]

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 37 shows the Wind Chill Index used by the NWS.

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

Figure 37: 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

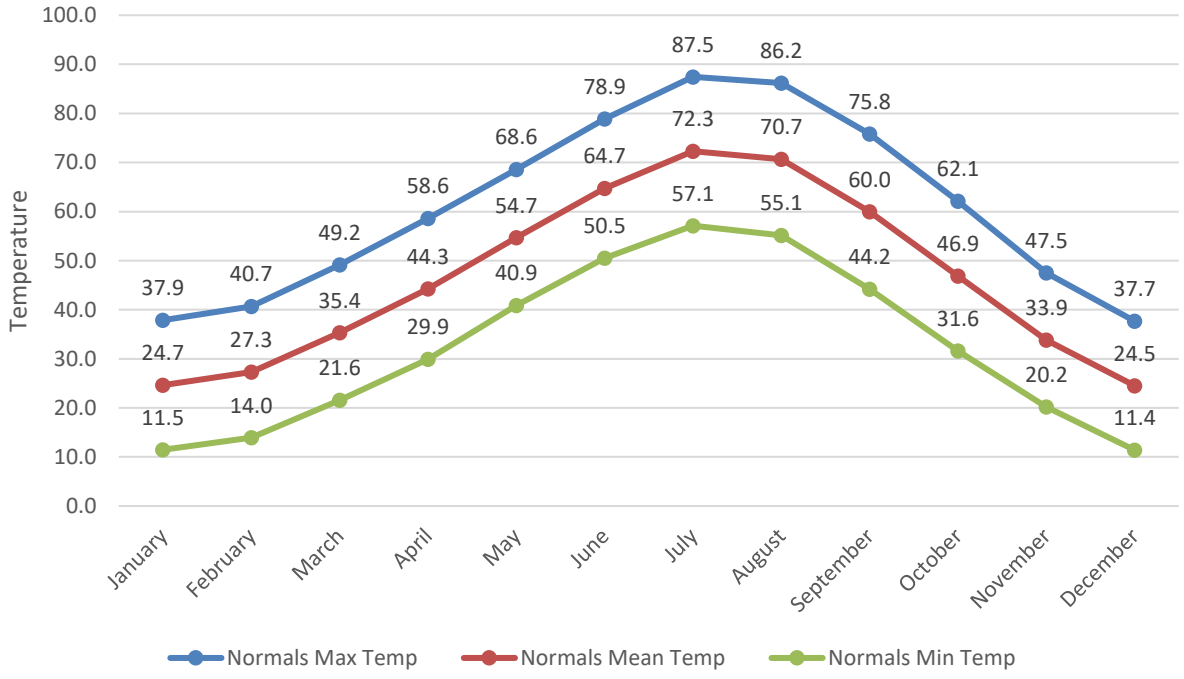
Frostbite Times — 30 Minutes — 10 Minutes — 5 Minutes

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[78]

Figure 38: Monthly Climate Normals Temperature (1981-2010)



Source: NCEI, 2019

[78] 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 362 severe winter storm events for the planning area from January 1996 to September 2019. These recorded events caused a total of $174,000 in reported property damages and $22,145,515 in crop damages.

According to the NCEI, one winter storm event lead to one death in 2013 and two winter weather events in 1997 and 1999 caused one injury respectively in vehicular accidents from icy road conditions. Ice accumulation was not reported.

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 $7,250 per year in property damage and $1,107,276 per year in crop damages for the planning area.

Table 67: Severe Winter Storm Loss Estimate

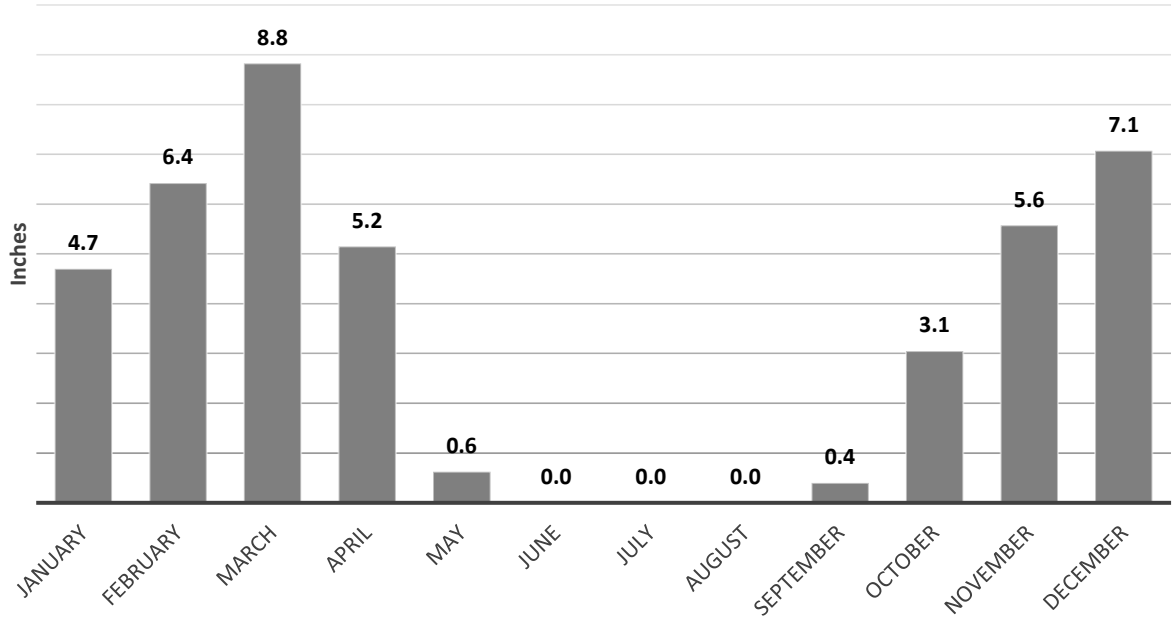
HAZARD TYPE	NUMBER OF EVENTS[1]	AVERAGE EVENTS PER YEAR[1]	TOTAL PROPERTY LOSS[1]	AVERAGE ANNUAL PROPERTY LOSS [1]	TOTAL CROP LOSS[2]	AVERAGE ANNUAL CROP LOSS [2]
BLIZZARD	50	2.1	$74,000	$3,083	$22,145,515	$1,107,276
HEAVY SNOW	42	1.8	$0	$0		
ICE STORM	0	0	$0	$0		
WINTER STORM	169	7	$85,000	$3,542		
WINTER WEATHER	51	2.1	$15,000	$625		
EXTREME COLD/WIND CHILL	50	2.1	$0	$0		
TOTAL	**362**	**15.1**	**$174,000**	**$7,250**	**$22,145,515**	**$1,107,276**

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

PROBABILITY

Average monthly snowfall for the planning area is shown in Figure 39, which shows the snowiest months are between November and April. 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 39: Monthly Normal (1981-2010) Snowfall in Inches



Source: High Plains Regional Climate Center, 2019

REGIONAL VULNERABILITIES

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

Table 68: 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

TERRORISM AND CIVIL DISORDER

Terrorism and civil disorder are broad terms typically used by law enforcement to describe groups of people protesting major socio-political problems by choosing not to observe a law or regulation or the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof in furtherance of political or social objectives. 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.[79,80]

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 and terrorism are federal and state directives that work in conjunction with local law enforcement. Civil disorder and terrorism 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 or terrorism 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, the tampering of water supplies, or protests occurring on campus at Chadron State College by students, faculty, or residents.

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 or terroristic 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.[81] 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. [82] According to these sources database, there have been no civil disorder events in the planning area. However, the

[79] Civil Disorders, 18 U.S. Code § 231-233 (1992)
[80] Terrorism, 28 U.S. Code § 0.85.
[81] 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.
[82] 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.

Chadron Public School District experienced the first school shootings in Nebraska in February 1995 when a middle school student shot and injured one staff member. No other injuries were reported from the event.

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 73-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. One school shooting has taken place in the planning area. Due to the volatile nature of school shootings, the probability of future events can not be determined.

REGIONAL VULNERABILITIES

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

Table 69: Regional Terrorism and 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
CLIMATE	-Activism pertaining to climate can place first responders and residents at risk

WILDFIRE

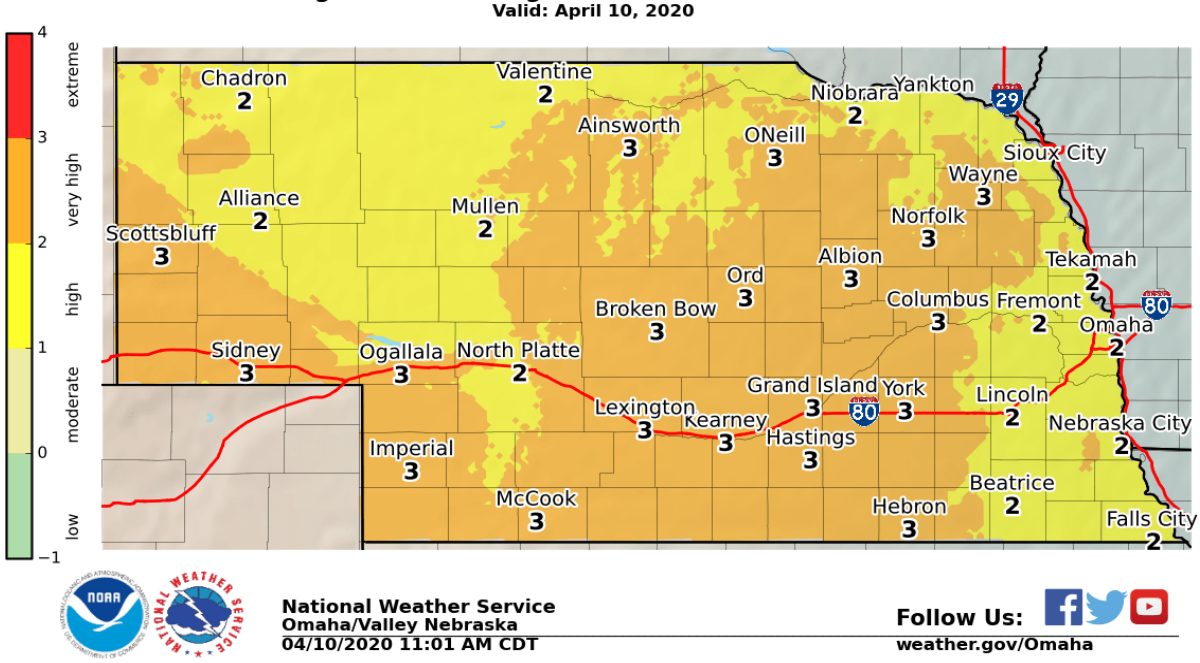
Wildfires, also known as brushfires, forest fires, or wildland fires, are any uncontrolled fire that occurs in the countryside or wildland. Wildland areas may include, but are not limited to: grasslands; forests; woodlands; agricultural fields; pastures; and other vegetated areas. Wildfires range is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

> 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 rural or native ecosystems meet urban developed areas or where local economies are heavily dependent on open agricultural land. Although fire is a natural and often beneficial process, fire suppression can lead to more severe fires due to the buildup of vegetation, which creates more fuel and increases the intensity and devastation of future fires.

Wildfires are characterized in terms of their physical properties including topography, weather, and fuels. Wildfire behavior is often complex and variably dependent on factors such as fuel type, moisture content in the fuel, humidity, wind speed, topography, geographic location, ambient temperature, the effect of weather on the fire, and the cause of ignition. Fuel is the only factor 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 40). Fire danger predictions are updated regularly and should be reviewed frequently by community leaders and fire department officials.

Figure 40: Rangeland Fire Danger



Source: NWS, 2019[83]

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

COMMUNITY WILDFIRE PROTECTION PLAN

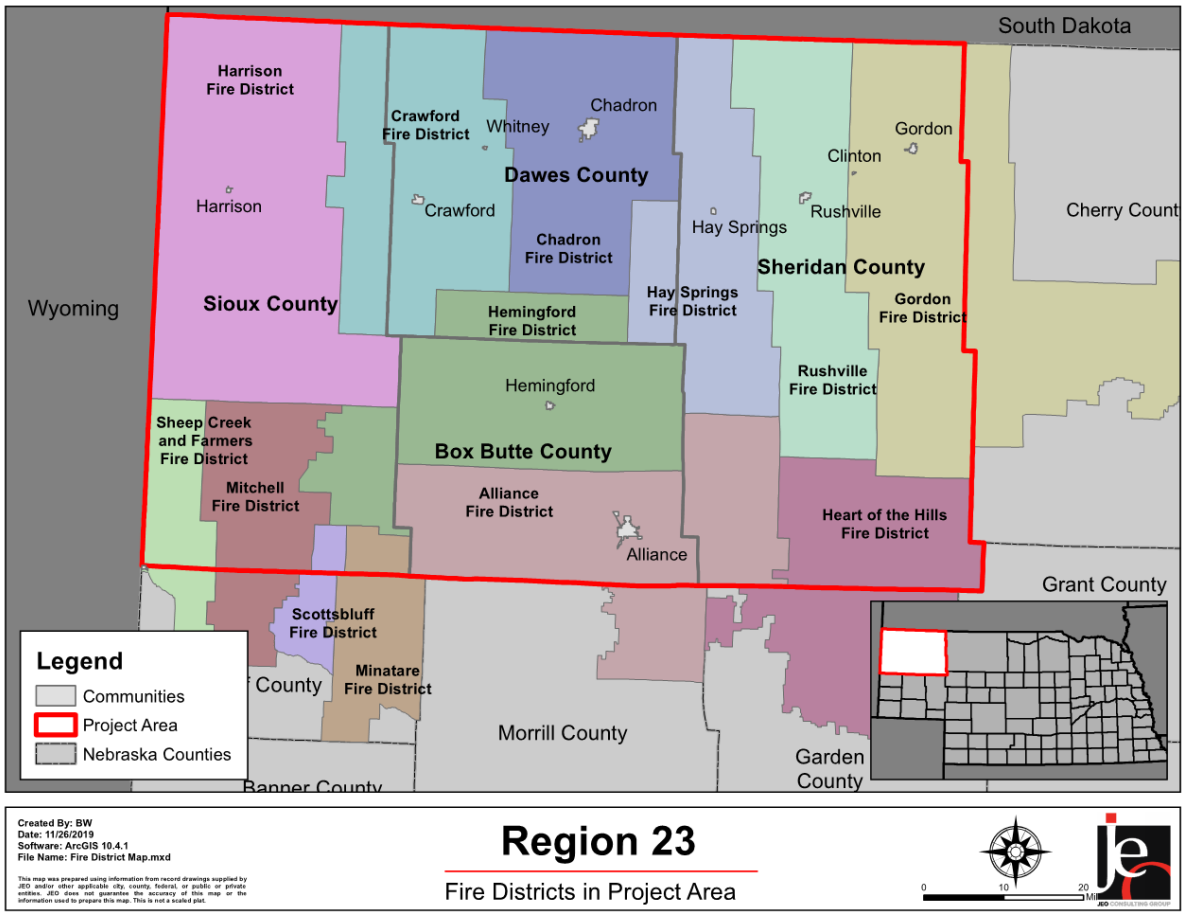
The NFS updated the 2013 Community Wildfire Protection Plan concurrently with this HMP update. The update of this plan allows the NFS to build and expand upon the original plan that was developed in 2003. The 2020 plan update expanded the CWPP planning area to include the entirety of Box Butte, Dawes, Sheridan and Sioux Counties. The plan also expands the WUI to include the all of the new CWPP boundary. The expanded WUI will allow the NSF to utilize US Forest Service grant funding to cost share fuel mitigation treatments throughout the Pine Ridge region.

The CWPP includes a discussion of fire history and characteristics in the planning area; regulatory support and standards of CWPPs; planning area goals and objectives to reduce overall fire hazard risk; priority landscapes, wildland urban interface areas, areas of concern for fire districts in the planning area; response procedures and capabilities; and an action plan to evaluate risk, devise response actions, and improve overall resiliency. Included in the CWPP is a county-specific considerations profile which identifies fire events and impacts specific to that county, as well as county specific capabilities and areas of top concern. Specific concerns per county or applicable community are discussed in more detail in *Section Seven: Community Profiles* as appropriate.

LOCATION

For the planning area, thirteen fire districts were identified to report events: Alliance Fire Department, Hemingford Fire Department, Chadron Fire Department, Crawford Fire Department, Gordon Fire Department, Hay Springs Fire Department, Heart of the Hills Fire Department, Rushville Fire Department, Harrison Fire Department, Minatare Fire Department, Mitchell Fire Department, Scottsbluff Rural Fire Department, and Sheep Creek and Farmers Fire District (part of the Morrill Fire District).

Figure 41: Fire Districts in the Planning Area



The Wildland Urban Interface has been expanded for this plan update and as part of the 2020 CWPP update. The new WUI and CWPP boundary includes the entire four-county planning area.

As the number of reported wildfires and number of acres burned indicates, wildfire is a severe threat throughout the planning area.

Table 70: Reported Wildfires by Agency

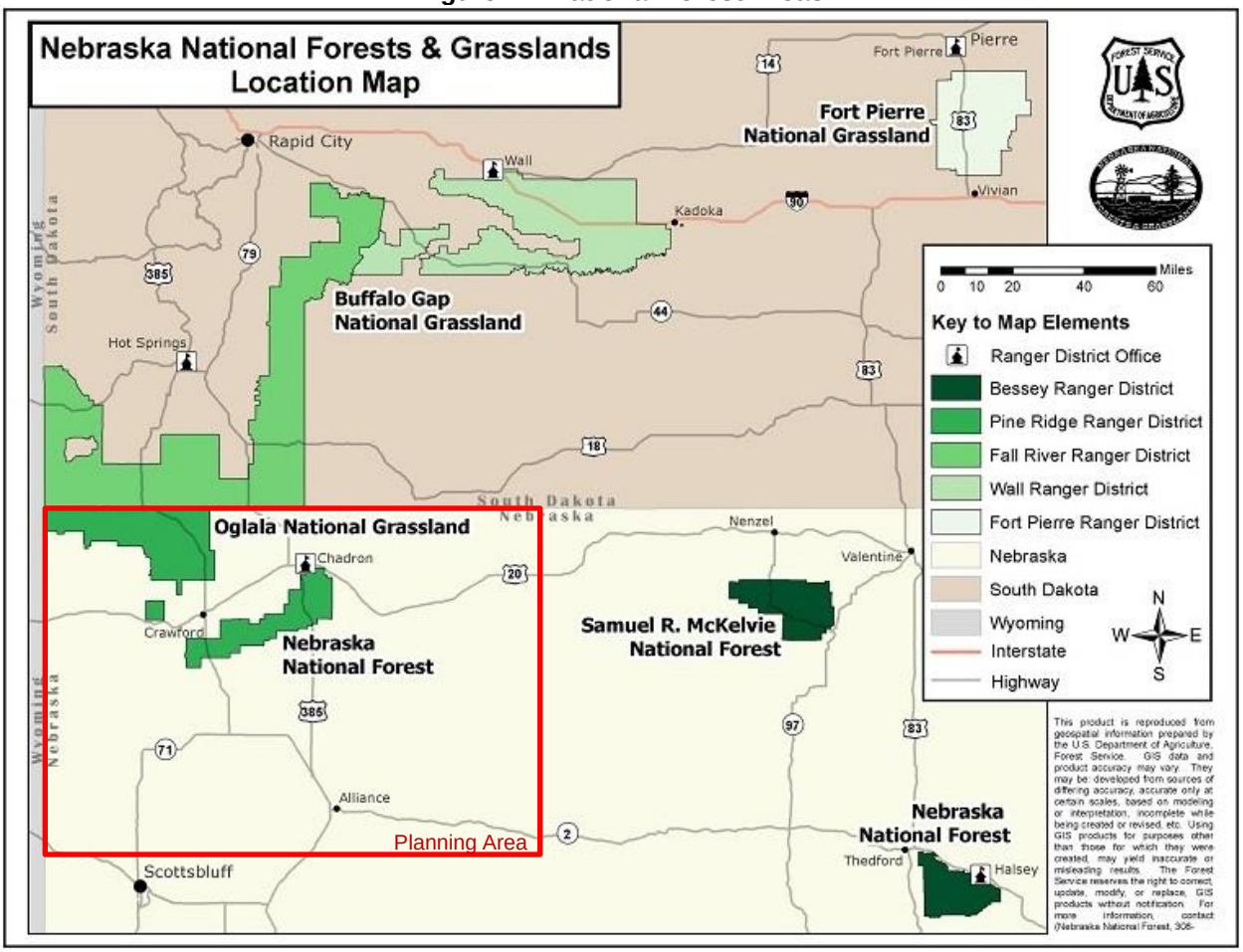
Fire District	Reported Wildfires	Acres Burned
Alliance	256	4,292
Chadron	86	465
Crawford	133	982
Gordon	48	5,224
Harrison	27	252
Hay Springs	68	722
Heart-of-the-Hills	19	1,595
Hemingford	14	98
Minatare	269	6,139
Mitchell	34	4,088
Morrill (Sheep Creek & Farmers)	55	1,515
Rushville	76	5,251
Scottsbluff Rural	322	2,473
Total	**2,098**	**445,416**

Source: Nebraska Forest Service, 2000-2018[84]

Additionally, the Nebraska National Forest at Chadron, the Oglala National Grassland, and Fort Robinson State Park are located within the planning area. In total, these areas encompass more than 1.2 million acres in Nebraska and South Dakota. Only the most southern portion of the Oglala National Grassland is located within the planning area (Figure 42). These areas are at higher risk to wildfire due to high fuel loads and long distances from fire department resources. Wildfires that begin in the forest may spread into surrounding range land areas. For more information about these areas, fuel load reduction strategies, and the WUI, refer to the CWPP.

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

Figure 42: National Forest Areas



Source: USDA Forest Service[85]

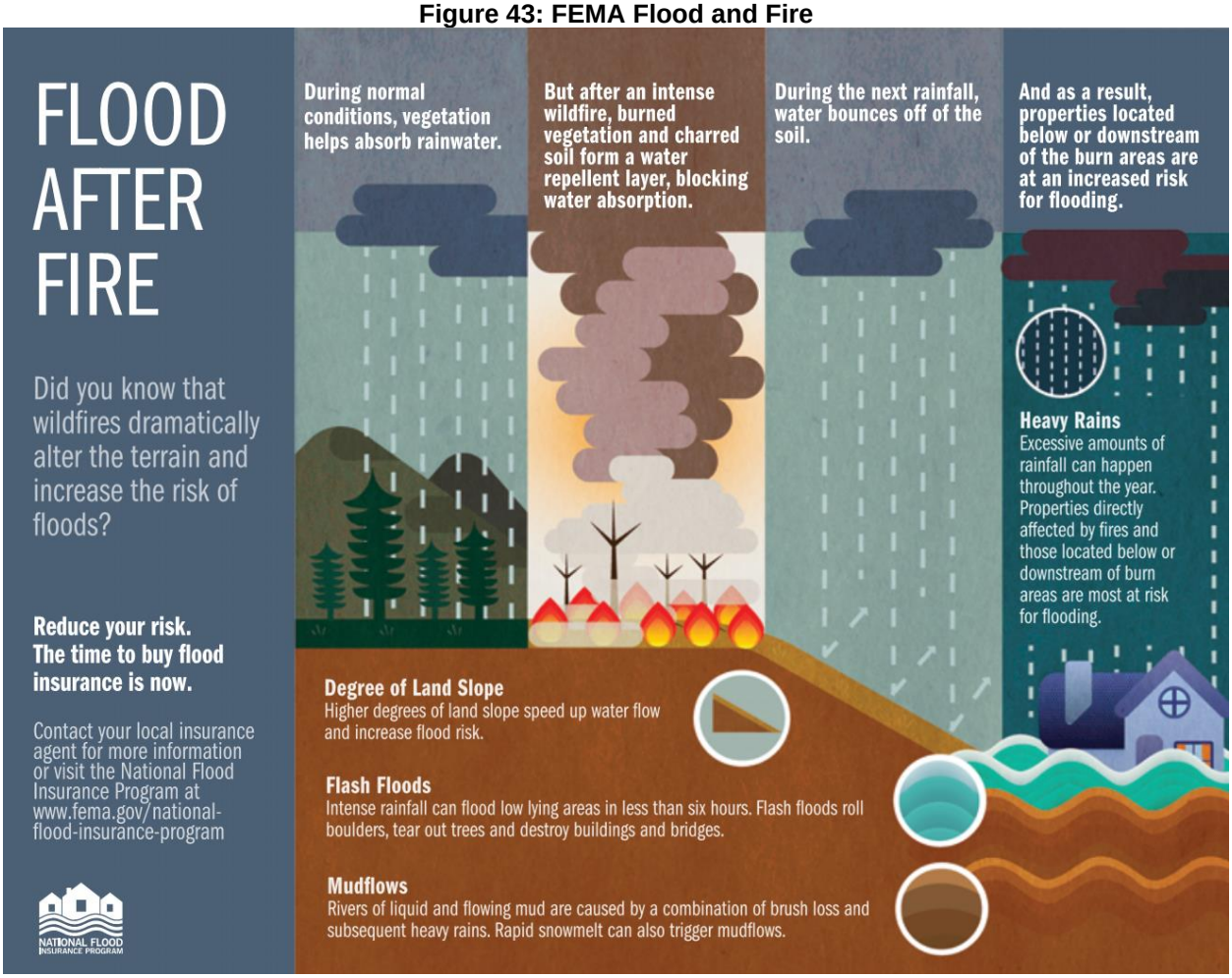
[85] United States Department of Agriculture Forest Service. N.d. "Nebraska National Forests and Grasslands." Accessed January 2020. https://www.fs.usda.gov/nebraska

EXTENT

Figure 44 illustrates the number of wildfires by cause in the planning area from 2000 to 2018, which burned 445,416 acres in total. In total, there were 2,098 reported wildfires in the planning area. Of these, 118 fires burned 100 acres or more, with the largest wildfire burning over 77,000 acres in Sheridan County in August 2012. The Region 24 (Cherry, Brown, Rock, Keya Paha, and Boyd counties) Complex fire burned in three of the four counties in the planning area as well as in South Dakota in late July 2012. These concurrent wildfire systems strained resources across the panhandle. .

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 43: FEMA Flood and Fire



Source: FEMA, 2018[86]

HISTORICAL OCCURRENCES

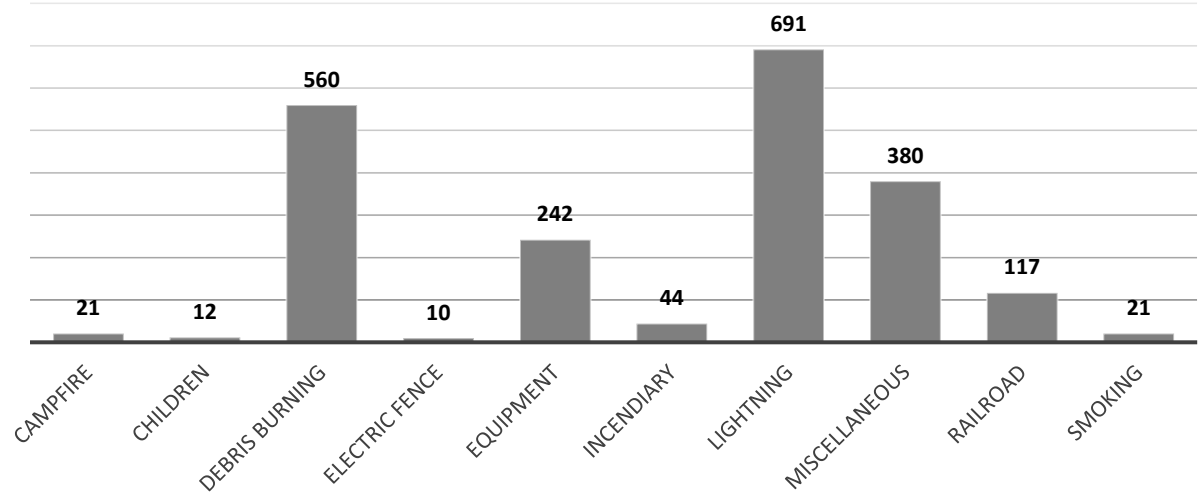
The western portion of the State of Nebraska is particularly vulnerable to wildfire events. Local fire districts reported a total of 2,098 wildfires, according to the Nebraska Forest Service (NFS), from 2000 to 2018. Most fires occurred in 2006 and 2012 (Figure 45). The reported events burned 445,416 acres. The NFS also reported $227,420 in crop damages and $1,267,162 in property damages. Wildfire events caused 12 injuries, threatened 118 homes and 127 other structures, and destroyed 12 homes and 57 other structures.

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

Between 1953 and 2019, three presidential disaster declarations have been issued regarding wildfire events in the planning area. These include the Dawes County Fire Complex (2006, #2660), Sioux County Fire Complex (2006, #2661), and the Region 23 Fire Complex (2012, #5009).

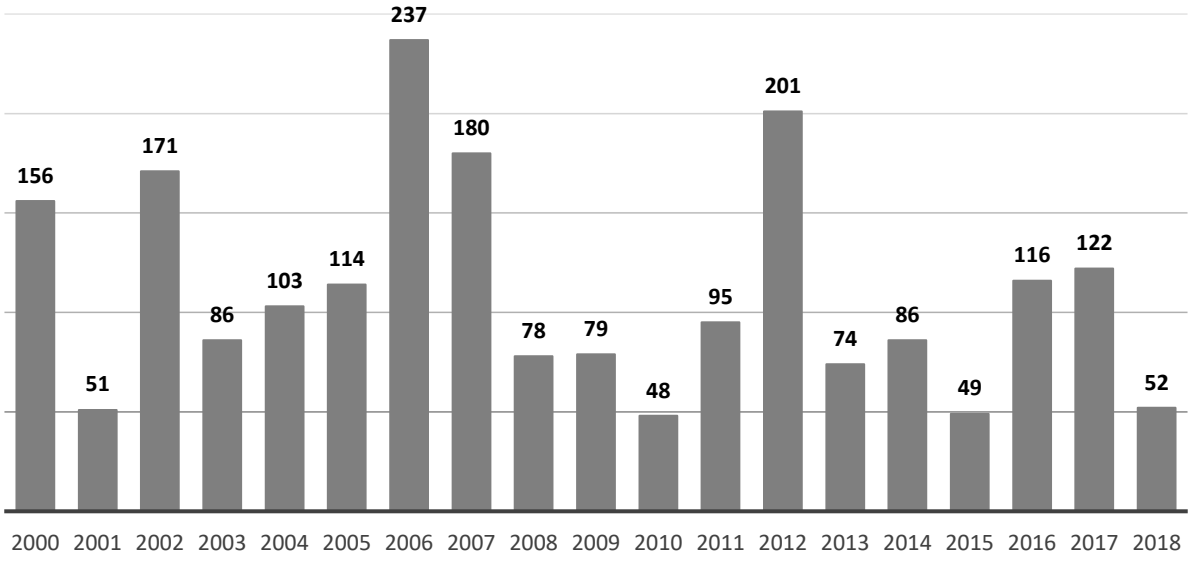
The majority of wildfires in the planning area are caused by lightning (29.4%), with debris burning as the second leading cause (22.8%) (Figure 44). Wildfires in the planning area have ranged from zero to 77,159 acres, with an average event burning 218 acres.

Figure 44: Wildfires by Cause in the Planning Area



Source: Nebraska Forest Service, 2000-2018

Figure 45: Number of Wildfires by Year in the Planning Area



Source: Nebraska Forest Service, 2000-2018

Fires in the planning area have occurred in most years. Major fire events which burned more than 10,000 acres are listed below. For a comprehensive list of past wildfire events in the planning area, please see the *Local Fire History* section of the CWPP.

- **1989 - Fort Robinson Fire Complex:** burned 49,000 acres in Dawes and Sioux Counties
- **2000 - Warbonnet Fire:** burned 11,504 acres in northwest Sioux County.
- **2000 - Sheridan Co. Fire:** the Gordon Fire District reported a 26,000 acre lightning fire and a 2,500 acre equipment fire.
- **2006 - Thayer Fire:** burned over 40,000 acres northeast of Harrison.
- **2006 - Spotted Tail Fire:** threatened Chadron and much of the city had to be evacuated. According to the *Rapid City Journal*, "Some 68,000 acres of Pine Ridge forest in Dawes and Sioux counties burned following a string of intense lightning fires on July 26. At least four homes and several other structures along with about 500 miles of fences were destroyed. One of the fires, the Spotted Tail Fire, began about 12 miles south of Chadron and burned to the edge of the Chadron State College campus. At least 1,000 firemen from 20 states helped battle the blazes. Temperatures of more than 100 degrees added to the misery."
- **2012 - Region 23 Complex:** two fires burned 58,450 acres in the Crawford and Chadron Fire Districts.
    - Douthit Fire: Burned 29,730 acres in the Cottonwood/Little Cottonwood watersheds in Sioux and Dawes Counties.
    - West Ash Fire: The 28,720-acre fire forced an evacuation of Whitney. Intense suppression efforts kept this fire from crossing US 385 and moving into the 2006 Spotted Tail burn area. Had these efforts failed, it is likely Chadron would have again been threatened. Many of the areas previously burned, again burned, with great intensity.
- **2012 - Wellnitz Fire:** burned 77,684 acres in Sheridan County, Nebraska and South Dakota. 48,681 of these acres were in the Hay Springs and Rushville fire districts. A successful back fire was all that kept the fire from threatening Hay Springs.

It is important to note that there is no comprehensive fire event database. Fire events, magnitude, and local responses are reported voluntarily by local fire departments and local reporting standards can vary between departments. Actual fire events and their impacts are likely underreported in the available datasets.

AVERAGE ANNUAL DAMAGES

Wildfires can cause extensive damage to property, recreational areas, crop and rangeland, and to human life. 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, 2,098 wildfires burned 445,416 acres and caused $1,267,162 in property damages and $227,420 in crop damages to the planning area. Damages caused by wildfires extend past the loss of building stock, recreation areas, timber, forage, wildlife habitat, and scenic views. Secondary effects of wildfires, including erosion, landslides, introduction of invasive species, and changes in water quality, all increase due to the exposure of bare ground and loss of vegetative cover following a wildfire, and can often be more disastrous than the fire itself in long-term recovery efforts.

Table 71: Wildfire Loss Estimation

Hazard Type	Number of Events	Events Per Year	Property Loss	Average Annual Property Loss	Total Crop Loss	Average Annual Crop Loss
Wildfires	2,098	110	$1,267,162	$66,693	$227,420	$11,969

Source: Nebraska Forest Service, 2000-2018

Table 72: Wildfire Threats

Hazard Type	Injuries	Homes Threatened or Destroyed	Other Structures Threatened or Destroyed	Total Acres Burned	Average Acres Per Fire
Wildfires	12	130	184	445,416 acres	212

Source: Nebraska Forest Service, 2000-2018

PROBABILITY

The probability of 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. The majority of fires are likely to be small and short-lived in nature. Large fire events or those that exceed 100 acres are likely to occur annually and require multi-agency response from fire departments.

REGIONAL VULNERABILITIES AND CAPABILITIES

Periods of drought can occur throughout the year while extreme heat conditions during summer months greatly increase the potential for and magnitude of wildland fires. Drought has a high probability of occurring in the planning area and the planning area sees, on average, four days above 100°F. During a severe drought, dry conditions, and/or windy conditions, large wildfires can easily spread throughout the region.

Wildfire poses a threat to a range of demographic groups. Wildfire, wildfire within the WUI, and urban fire could result in major evacuations of residents in impacted and threatened areas. Groups and individuals lacking reliable transportation could be trapped in dangerous locations. Lack of transportation is common among the elderly, low income individuals, and racial minorities. Wildfires can cause extensive damage to both urban and rural building stock and properties including critical facilities and infrastructure, as well as crop and rangeland which support the local industry and economy. Damaged homes can reduce available housing stock for residents, causing residents to leave the area. Additionally, fire events threaten the health and safety of residents and emergency response personnel. Recreation areas, timber and grazing land, wildlife habitat, and scenic views can also be threatened by wildfires.

Development across the planning area will be located within the WUI. Local officials can adopt codes and ordinances that can guide growth in ways to mitigate potential losses from wildfires. These may include more stringent building code standards, setback requirements, or zoning regulations.

The following table provides more information related to regional vulnerabilities; for jurisdictional-specific vulnerabilities or identified mitigation actions to reduce wildfire risk, refer to *Section Seven: Community Profiles.*

Table 73: 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	-The entire planning area is located within the WUI and is at risk of damage during wildfire events -Property damages
INFRASTRUCTURE	-Damage to power lines and utility structures

SECTOR	VULNERABILITY
	-Potential loss of firefighting equipment and resources
CRITICAL FACILITIES	-All community critical facilities are at risk of damages
CLIMATE	-Increase chance of landslides and erosion -May lead to poor water quality -Post fire, flash flooding events may be exacerbated
OTHER	-Several fire departments in the planning area have conflicting communication equipment (radios), which prevent clear and easy communication during hazard event response

SECTION FIVE
MITIGATION STRATEGY

INTRODUCTION

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

The establishment of goals and objectives took place during the kick-off meeting with the 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.

The Regional Planning Team voted to maintain the same list of goals from the 2015 HMP. These goals and objectives were then shared with all planning team members at the Round 1 public meetings.

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

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

Requirement: §201.6(c)(3)(ii): [The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program (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: PURSUE MULTI-OBJECTIVE OPPORTUNITIES (WHENEVER POSSIBLE)**
- **GOAL 6: ENHANCE OVERALL RESILIENCE AND PROMOTE SUSTAINABILITY**

MITIGATION ALTERNATIVES (ACTION ITEMS)

After establishing the goals, mitigation alternatives were evaluated and prioritized by local planning teams. These actions 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 and the hazards of top concern for their jurisdiction. 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 Region 23 HMP are found in the Mitigation Alternative Project Matrix below. Additional information about selected actions can be found in respective *Section Seven: Community Profiles.* Each action includes the following information in the respective community profile:

- Mitigation Action – general title of the action item
- Description – brief summary of what the action item(s) will accomplish
- Hazard(s) Addressed – which hazard the mitigation action aims to address
- Estimated Cost – 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 per jurisdiction depending upon the significance of each hazard present. The information listed in the following tables 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 74: Mitigation Alternatives Selected by Each Jurisdiction

Region 23 HMP Update - 2020		Region 23 EMA	UNWNRD	Chadron Public Schools	Hemingford Public Schools	Chadron State College	Box Butte County	Alliance	Hemingford	Dawes County	Chadron	Crawford	Sheridan County	Gordon	Hay Springs	Rushville	Sioux County	Harrison
Mitigation Alternatives	**Goal**	**Special Districts**					**Box Butte County**			**Dawes County**			**Sheridan County**				**Sioux County**	
Adopt a No-Adverse Impact Approach to Floodplain Management	2						X							X				
Alert/Warning Sirens	4	X									X	X					X	
Backup Power Generators	2		X	X	X	X	X	X	X	X	X	X		X		X	X	
Become a Tree City USA	2											X		X				
Civil Service Improvements	4					X	X	X	X		X			X				
Complete/Update Community Wildfire Protection Plan	2, 6							X										
Comprehensive City Disaster/Emergency Response Rescue Plan	4	X					X	X	X									
Dam Engineering Analysis/Repairs and Reinforcement	2		X											X				
Database of Vulnerable Populations	2									X								
Develop Continuity Plans for Critical Community Services	2, 3						X		X	X				X				
Drainage Study/Stormwater Master Plan	2						X	X	X			X		X		X		

Region 23 HMP Update - 2020		Region 23 EMA	UNWNRD	Chadron Public Schools	Hemingford Public Schools	Chadron State College	Box Butte County	Alliance	Hemingford	Dawes County	Chadron	Crawford	Sheridan County	Gordon	Hay Springs	Rushville	Sioux County	Harrison
Drought Monitoring Plan and Procedures	2										X							
Educate Businesses in the Value of Continuity Planning	3						X											
Electrical System Looped Distribution/Redundancies	2								X				X					
Emergency Communication	4			X			X	X	X					X				
Evacuation Plan	4						X	X									X	X
Evaluate Flood Risk	2		X															
Expand Water Storage Capacity	2		X					X			X							
Fire Prevention Program	4		X								X			X				X
Fire Wise Community	2						X				X							
First Aid Training	3						X											
Floodplain Mapping	2						X											
Floodplain Regulation Enforcement and Updates	2												X	X				
Groundwater/Irrigation/Water Conservation and Management Practices	2						X	X					X	X			X	

Region 23 HMP Update - 2020		Region 23 EMA	UNWNRD	Chadron Public Schools	Hemingford Public Schools	Chadron State College	Box Butte County	Alliance	Hemingford	Dawes County	Chadron	Crawford	Sheridan County	Gordon	Hay Springs	Rushville	Sioux County	Harrison
Hail Resistant Roofing	2						X			X								
Hazardous Fuels Reduction	2	X											X				X	
Hazardous Tree Removal	2						X		X	X	X			X				
Implement Low Impact Development Practices	2						X											
Improve Snow/Ice Removal Programs	4						X	X	X		X			X				
Install Vehicular Barriers	2						X											
New Municipal Well	2								X									
Participate in NFIP	2																X	
Power and Service Lines	2								X				X	X				
Preserve Natural and Beneficial Functions of a Floodplain	2													X				
Promote Use of Higher Building Codes	6						X											
Public Education/Awareness	3	X	X				X	X	X	X	X	X	X	X	X		X	X
Re-Evaluate Flood Zone	2														X			
Safe Rooms	2				X		X	X	X			X		X			X	
Source Water Contingency Plan	2		X						X		X							
Stabilize/Anchor Fertilizer, Fuels, and Propane Tanks	2						X											

Region 23 HMP Update - 2020		Region 23 EMA	UNWNRD	Chadron Public Schools	Hemingford Public Schools	Chadron State College	Box Butte County	Alliance	Hemingford	Dawes County	Chadron	Crawford	Sheridan County	Gordon	Hay Springs	Rushville	Sioux County	Harrison
Stormwater System and Drainage Improvements	2						X	X	X		X	X	X	X	X	X	X	
Stream Bank Stabilization/Grade Control Structures/Channel Improvements	2										X			X				
Vulnerable Populations Housing	1													X				
Warning Systems	4						X		X	X								
Weather Radios	4									X				X		X	X	
Wildfire Hazard Identification and Mitigation System	2												X	X				
Windbreaks/Living Snow Fence	2						X		X	X			X	X				

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SECTION SIX
PLAN IMPLEMENTATION AND MAINTENANCE

MONITORING, EVALUATING, AND UPDATING THE PLAN

Each participating jurisdiction in the Region 23 HMP is responsible for monitoring (annually at a minimum), evaluating, and updating the plan during its five-year lifespan. Hazard mitigation projects will be prioritized by each participant's governing body with support and suggestions from the public and business owners. Unless otherwise specified by each participant's 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.

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

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

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

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

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

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

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

In addition, the governing body will be responsible for ensuring that the HMP's goals are incorporated into applicable revisions other planning mechanisms per community, as identified in the *Plan Integration* section

of each participant's profile. These plans may include: Comprehensive Plan, Capital Improvement or 1&6 year Plans, Zoning Ordinances, Floodplain Ordinances, Building Codes, and/or Watershed Management Plans. Future updates of this HMP will review and update discussions of plan integration per community as appropriate.

CONTINUED PUBLIC INVOLVEMENT

To ensure continued plan support and input from the public and business owners, public involvement should remain a top priority for each participating jurisdiction. Notices for public meetings involving discussion of an action on mitigation updates 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
- Social Media
- Local radio stations
- Local newspapers
- Regionally-distributed newspaper

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

INTEGRATING OTHER CAPABILITIES

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

Nebraska Emergency Management Agency

NEMA is an agency as part of the Military Department in the State of Nebraska. NEMA is responsible for emergency management, which is usually divided into four phases: preparedness, response, recovery, and mitigation.

NEMA is responsible for developing the state hazard mitigation plan, which serves as a comprehensive set of guidelines for hazard mitigation across the state. The state hazard mitigation officer and other mitigation staff members play an active role in assisting in the development local hazard mitigation plans. Representatives from the state hazard mitigation program serve as technical guides to local planning teams and regularly participate in local mitigation planning meetings. The state hazard mitigation program also oversees the HMGP, PDM, and FMA; and works with the Governor's taskforce to prioritize projects requesting funding assistance through the HMGP, PDM, and FMA.

The main objective in NEMA's preparedness process is to develop plans and procedures to help facilitate any response that may need to occur during a hazard event. NEMA assists communities in the development of county or city/village planning documents; assists with the development of exercises for existing plans and procedures; conducts trainings for communities officials, assist emergency management related groups (Citizen Emergency Response Teams, Citizen Corps, Medical Reserve Corps, Fire Corps, and other interest groups); and provide technical resources and expertise throughout the state.

NEMA's role during a response is to assist communities in responding to hazard events *when the need for assistance exceeds the local capabilities and resources*. This includes facilitating and tracking grants, coordinating local needs, providing state and federal level assistance through activation of Emergency Operation Centers (EOC) , Mass Critical Shelters, Emergency Alert Systems (EAS) and providing technical, logistical, and administrative resources and expertise before, during, and after incidents. The main purpose of the recovery phase is to perform actions that allow the return of normal living, or better conditions, which may include vital life saving measures. The secondary role of the recovery phase is grant administration and tracking, project monitoring, damage assessment, collaborating with communities on effective recovery

options and opportunities, serving as liaison between federal level entities and local representatives, and serving as a technical resource throughout the recovery process.

For more information regarding the plans and NEMA's responsibilities as well as their ongoing projects, please go to http://www.nema.ne.gov.

Nebraska Department of Natural Resources
The NeDNR is committed to providing Nebraska's citizens and leaders with the data and analyses they need to make appropriate natural resource decisions for the benefit of all Nebraskans both now and in the future. The state agency is responsible in the area of surface water, groundwater, floodplain management, dam safety, natural resource planning, integrated water management, storage of natural resources and related data, and administration of state funds.

NeDNR plays a significant role in protecting and conserving water resources through the oversight of surface and groundwater status and integrated water management. The NeDNR is also responsible for a non- structural program of floodplain management, coordination and assistance with the National Flood Insurance Program as well as the Flood Mitigation Assistance Program, reviewing and approving engineering plans for new dams, rehabilitating old dams, and high hazard dam emergency preparedness plans. NeDNR was very active throughout the hazard planning process and provided extensive resources and technical support for hazard risk and vulnerability analysis such as flood and dam failure. NeDNR also works with communities in many capacities including assisting in the completion of Benefit Cost Analysis (BCA).

For more information regarding NeDNR's responsibilities as well as their ongoing projects, please go to **http://dnr.ne.gov/**.

The Silver Jackets program is also worth mentioning for their extensive role in providing a formal and consistent strategy for an interagency approach to planning and implementing measures to reduce the risks associated with flooding and other natural hazards. It brings together multiple state, federal, and sometimes tribal and local agencies to learn from one another and apply their knowledge to reduce risk. At this time the Silver Jackets do not have any projects taking place in the Region 23 planning area.

Nebraska Forest Service
The NFS is responsible for the care of existing forests within the state. The state agency is responsible for ensuring the health of state forests, ensuring that the forests are managed so they can provide logs for lumber, protection of wildland from fire.

The NFS achieves these goals through a variety of programs. The Rural Forestry Assistance program provides assistance to landowners in need of forest management help. Some of these services include assistance and advice on forest and woodlot management, windbreak establishment, and management, reforestation and other forestry related issues. The forest health program is responsible for maintain a list of the most prominent pest problems in Nebraska along with the trees affected, control recommendations, and timing. The wildland fire protection program is responsible for protecting wildlands from fire. The state does not have a fire suppression force within the forest service like other states. They rely on local firefighters to handle the suppression of these fires. The agency does provide air support and equipment to the local firefighters if the assistance is needed. The agency also focuses on prevention of fire.

The Nebraska Forest Service facilitated the development of the CWPP as part of this HMP update.

For more information regarding the NFS's responsibilities as well as their ongoing projects, please go to http://nfs.unl.edu/

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. Region 23 EMA, as the plan sponsor,

provides an opportunity to jurisdictions to compile proposed amendments annually and send them to NEMA for a plan amendment. Such amendments should include all applicable information for each proposal including description of changes, identified funding, responsible agencies, etc.

INCORPORATION INTO EXISTING PLANNING MECHANISMS

The 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*[87] guidance, as well as FEMA's *2015 Plan Integration*[88] 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.

[87] 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.

[88] 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 Region 23 EMA 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.*