HAZARD MITIGATION PLANNING TEAM

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**Served as an advisory or consultant role*

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ACS – American Community Survey
CDBG – Community Development Block Grant
CDC – Center for Disease Control
CF – Critical Facilities
CFR – Code of Federal Regulations
CIKR – Critical Infrastructure and Key Resources
CLABSI – Central Line-Associated Bloodstream Infections
CRS – Community Rating System
CWD – Chronic Wasting Disease
DEM – Digital Elevation Model
DFIRM – Digital Flood Insurance Rate Map
DHHS – Department of Health and Human Services
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
EOC – Emergency Operation Center
EPZ – Emergency Planning Zone
ESL – English as Second Language
FBI – Federal Bureau of Investigations
FEMA – Federal Emergency Management Agency
FIRM – Flood Insurance Rate Map
FMA – Flood Mitigation Assistance Program
FR – FEMA's Final Rule
GIS – Geographic Information Systems
HAZUS-MH – Hazards United States Multi-Hazard
HMA – Hazard Mitigation Assistance
HMGP – Hazard Mitigation Grant Program
HMP – Hazard Mitigation Plan
HSAS – Homeland Security Advisory System
HUD – Department of Housing and Urban Development
IBC – International Building Code
JEO – JEO Consulting Group, Inc.
LEOP – Local Emergency Operations Plan
LFD – Livestock Forage Disaster Assistance Program
LGA – Liquid Gallon
LIP – Livestock Indemnity Program
LLNRD – Lower Loup Natural Resource District
MHSW – Mobile Home Single Wide
MPH – miles per hour
MRCC – Midwestern Regional Climate Center
MRS – Medical Response System
NCEI – National Centers for Environmental Information
NDA – Nebraska Department of Agriculture
NDEQ – Nebraska Department of Environmental Quality
NDMC – National Drought Mitigation Center
NDNR – Nebraska Department of Natural Resources
NDOR – Nebraska Department of Roads
NEMA – Nebraska Emergency Management Agency

NFIP – National Flood Insurance Program
NFS – Nebraska Forest Service
NIPP – National Infrastructure Protection Plan
NOAA – National Oceanic and Atmospheric Administration
NRC – National Response Center
NRD – Natural Resources District
NTAS – National Terrorism Advisory System
NWS – National Weather Service
PDM – Pre-Disaster Mitigation Program
PDSI – Palmer Drought Severity Index
PHMSA – U.S. Pipeline and Hazardous Material Safety Administration
RMA – Risk Management Agency
SBA – Small Business Administration
SFHA – Special Flood Hazard Area
SEP – Syringe Exchange Program
SPIA – Sperry-Piltz Ice Accumulation Index
SSA – Sector-Specific Agency
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
TRIMRS – Tri-City Medical Response System
UNMC – University of Nebraska Medical Center
USDA – United States Department of Agriculture
USGS – United States Geological Survey
WMA – Wildlife Management Area
WUI – Wildland Urban Interface

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EXECUTIVE SUMMARY

INTRODUCTION

This plan is an update to the Lower Loup Natural Resources District (LLNRD) Multi-Hazard Mitigation Plan (HMP) approved in 2017. 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. The goal of the process is to reduce risk and vulnerability, in order to lessen impacts to life, the economy, and infrastructure. Hazard mitigation planning increases the ability of communities to effectively function in the face of natural and human-caused disasters.

Plan participants are listed in the following table and illustrated in the following planning area map. New participating jurisdictions in this plan update included the Village of Berwyn, Village of Duncan, Village of Merna, and Village of Oconto. Arcadia Public Schools, Duncan Fire and Rescue, Wheeler County Rural Fire are new special jurisdictions.

Table 1: Participating Jurisdictions

Participating Jurisdictions	
Lower Loup NRD	**Loup County**
Boone County	Taylor
City of Albion and Albion Fire and Rescue*	**Nance County**
Village of Cedar Rapids	Village of Belgrade
Village of Petersburg	City of Fullerton
Village of Primrose	City of Genoa
Village of St. Edward	**Platte County**
Custer County	Village of Duncan
Village of Anselmo	City of Columbus
Village of Ansley	**Sherman County**
Village of Arnold	Village of Ashton
Village of Berwyn	Village of Hazard
City of Broken Bow	Village of Litchfield
Village of Callaway	City of Loup City
Village of Comstock	Village of Rockville
Village of Mason City	**Valley County**
Village of Oconto	Village of Arcadia
City of Sargent	Village of North Loup
Garfield County	City of Ord
Village of Burwell	**Wheeler County**
Greeley County	Village of Bartlett
Village of Greeley	Village of Ericson
Village of Scotia	**Special Jurisdictions**
Village of Spalding	Arcadia Public Schools
Village of Wolbach	Duncan Fire District
Howard County	Elba Fire and Rescue District
Village of Boelus	Farwell Irrigation District
Village of Cotesfield	Loup Basin Public Health Department

Participating Jurisdictions	
Village of Cushing	Sargent Irrigation District
Village of Dannebrog	Twin Loups Irrigation District
Village of Elba	Wheeler Central Schools
Village of Farwell	Wheeler County Rural Fire Protection District
City of St. Paul	

**Albion Fire and Rescue receives joint funding from the city and surrounding areas and is thus included as a participant in the city profile.*

PROJECT GOALS

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, overarching goals were developed to help 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 were identified during the first Lower Loup NRD HMP development in 2012. These goals were reviewed by the Regional Planning Team in subsequent updates in 2017 and 2021 at the Kick-off Meeting. The Regional Planning Team agreed these goals were still relevant and applicable for this plan update. Participating jurisdictions in this plan update agreed that the goals identified would be carried forward and utilized for the 2022 plan. The goals for this plan update are as follows:

Goal 1: Protect Public Health and Safety from Hazard Events

Goal 2: Protect Existing and New Properties from Hazard Events

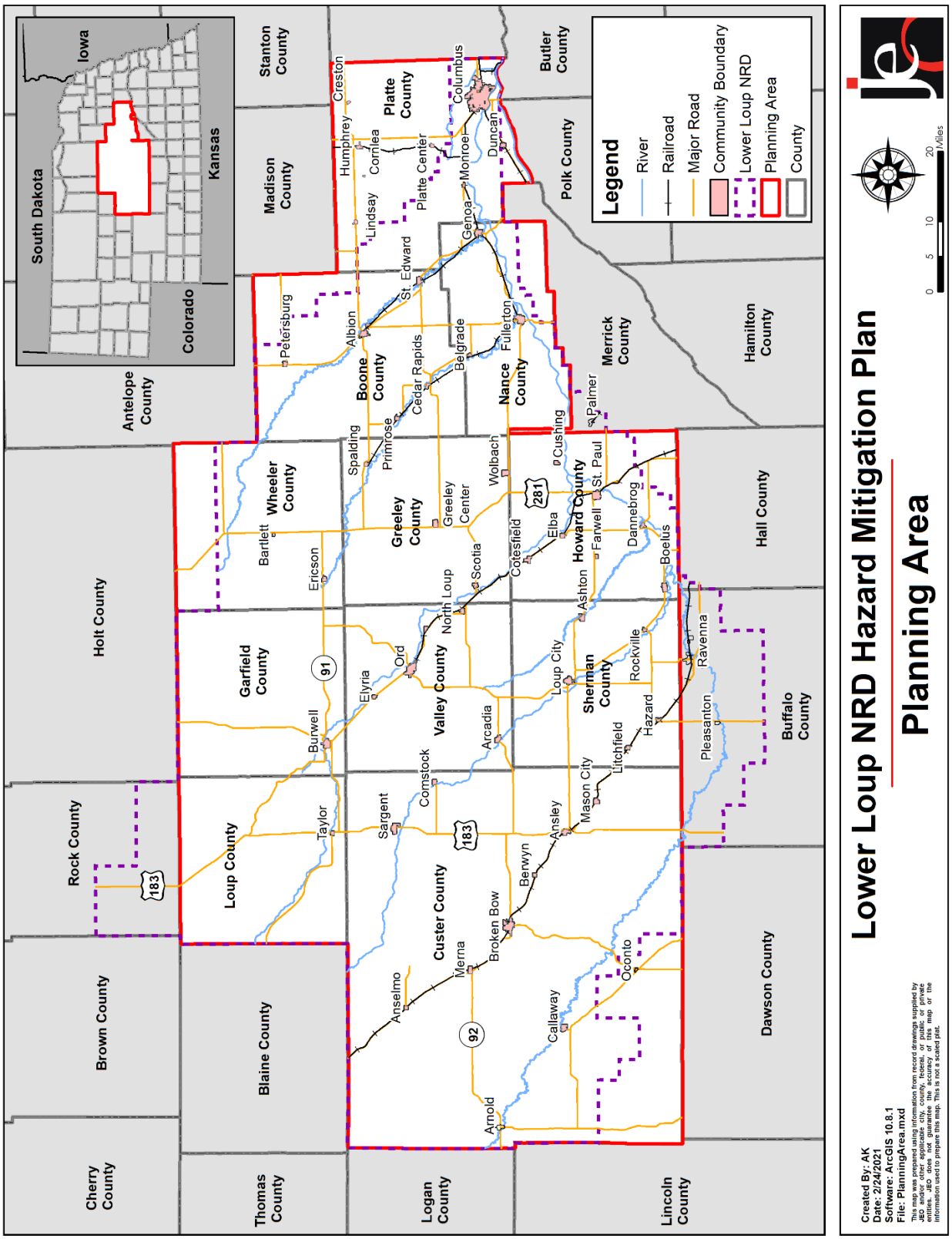
Goal 3: Increase Public Awareness and Education about Hazard Events

SUMMARY OF CHANGES

Several changes were made to the 2022 Hazard Mitigation Plan and planning process to reflect shifting priorities, new requirements, or improvements to the overall HMP since 2017. Changes from the 2017 Hazard Mitigation Plan and planning process in this update included: combined risk assessment for hazards with similar mitigation strategies (High Winds and Tornadoes and Severe Thunderstorms with Hail); modified public meeting planning process to respond to the COVID-19 pandemic; and the inclusion of Plan Maintenance sections to individual community profiles.

It should be noted as well that due to the COVID-19 outbreak in between 2019 and 2021, numerous changes were made to the planning process to accommodate local planning team members safety. To best protect residents and staff members in the planning area, Round 1 public meetings were held virtually in spring 2021. Round 2 meetings were resumed as in-person meetings in fall 2021 under the assumption outbreaks were contained and many local team members had received vaccinations. Additional changes and summary of the planning process are described in Section Two.

Figure 1: Map of Planning Area



PLAN IMPLEMENTATION

Various communities across the planning area have implemented hazard mitigation projects following the 2017 Hazard Mitigation Plan. Many of these projects are related to hazard monitoring, warning systems and/or educating community members. In order to build upon these prior successes and to continue to implement mitigation projects, despite limited resources, communities will need to continue relying upon multi-agency coordination as a means of leveraging resources. Communities across the LLNRD 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): University of Nebraska-Lincoln (UNL), Nebraska Forest Service (NFS), Nebraska Department of Energy and Environment (NDEE), Nebraska Department of Transportation (NDOT), Nebraska Department of Natural Resources (NeDNR); Nebraska Emergency Management Agency (NEMA), United States Department of Agriculture (USDA), and Federal Emergency Management Agency (FEMA).

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 occurrence and recurrence interval, historic losses (physical and monetary), impacts to the built environment (including privately owned structures as well as critical facilities), and the local risk assessment.

If should be noted the following occurrences and counts for hazard events include the entirety of the eleven-county planning area. While some zonal events may have occurred outside the planning area, such as within Platte County, all events are reported here. The planning area includes all of Boone, Custer, Garfield, Greeley, Howard, Loup, Nance, Platte, Sherman, Valley and Wheeler Counties. The following tables provide an overview of the risk assessment for each hazard and the losses associated with each hazard.

Table 2: Hazard Occurrence

Hazard	Previous Occurrences	Approximate Annual Probability	Likely Extent
Agricultural Animal Disease	195	7/7 = 100%	Mean ~189 animal per event; Median ~2 animal per event
Agricultural Plant Disease	101	21/21 = 100%	Unavailable
Dam Failure	12	7/130 = 5%	Varies by structure; Inundation of floodplain downstream from dam
Drought	444 events/1,512 months	29.3%	Mild Drought (D1)
Earthquakes	31	6/121 = 6%	~2.0 – 4.0 magnitude
Extreme Heat	Avg. 3 days per year	108/128 = 84%	>100°
Flooding	208	23/25 = 92%	Inundation of structures and roads near streams likely. Some evacuations of people may be necessary. Moderate flooding extent anticipated.
Grass/Wildfires	1,743	21/21 = 100%	Avg. fire <40 acres; Moderate homes and structures threatened or at risk
Hazardous Materials – Fixed Sites	67	26/31 = 84%	Avg. spill ~526 gallons. Localize to the facilities and adjacent surroundings
Hazardous Materials – Transportation	29	20/31 = 65%	<800 gallons, Limited (<0.5 mile) from release site
High Winds	258	23/25 = 92%	8 BWF
Levee Failure	2	~1%	Structures located in protected areas*
Public Health Epidemic	3 outbreak events	>1%	Varies by event; >1 fatality
Severe Thunderstorms	2,928	25/25 = 100%	≥1” rainfall 25-40 mph winds
Severe Winter Storms	840	25/25 = 100%	.25 - .5” ice 10-20°below zero (wind chills) 4-8” snow 25-40 mph winds
Terrorism	3	1/45 = <1%	Undefined
Tornadoes	142	24/25 = 96%	EF0

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

Table 3: Hazard Loss History

Hazard Type		Count	Property Loss	Crop Loss	Other Impacts
Agricultural Disease	Animal Disease	195	13,778 animals	N/A	
	Plant Disease	101	N/A	$1,096,715	
Dam Failure		12	$0	N/A	
Drought		444 out of 1,512 months	$34,000,000	$211,993,088	
Earthquakes		31	$0	$0	
Extreme Heat		Avg 3 days/yr	$0	$45,079,958	
Flooding	Flash Flood	120	$23,259,200	$3,009,032	2 fatalities
	Flood	88	$30,258,000		
Grass/Wildfires		1,743	69,276 acres	$500,295,574	26 injuries 2 fatalities 141 structures threatened 17 destroyed structures
Hazardous Materials	Fixed Sites	67	$0	N/A	35 evacuated 3 injuries
	Transportation	29	$929,130	N/A	
Levee Failure		2	$2,365,000	N/A	
Public Health Epidemic		~12,022 cases	N/A	N/A	
Severe Thunderstorms	Hail	2,148	$28,886,800	$139,624,554	
	Heavy Rain	63	$565,000	$51,112,752	
	Lightning	17	$569,000	N/A	2 injuries
	Thunderstorm Wind	700	$15,577,700	N/A	1 injury
Severe Winter Storms	Blizzard	111	$4,529,500	$7414,950	
	Extreme Cold/Wind Chill	63	$0		
	Heavy Snow	56	$0		
	Ice Storm	40	$6,961,000		1 fatality
	Winter Storm	401	$12,328,000		1 injury
	Winter Weather	169	$25,000		
Terrorism		3	$0	N/A	
Tornadoes and High Winds	High Winds	258	$6,110,400	$26,828,922	17 injuries
	Tornadoes	142	$13,298,000	$46,958	2 injuries
Total		**6,559**	**$179,661,730**	**$986,502,503**	**5 fatalities; 52 injuries**

N/A: Data not available

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

DROUGHT

Drought is a regular and reoccurring phenomenon in the planning area and the state of Nebraska. Historic data shows that droughts have occurred with regularity across the planning area and recent research indicates that trend will continue and potentially intensify. The most common impacts resulting from drought is focused on the agricultural industry. Over $211 million in total crop loss was reported for the planning area since 2000.

Prolonged drought events can have a profound effect on the planning area and the individual communities. Expected impacts from prolonged drought events include (but are not limited to): economic loss in the agricultural sector, loss of employment in the agricultural sector, limited water supplies (drinking and fire suppression), and decrease in recreational opportunities.

FLOODING

Flooding is one of the most costly hazards in the planning area. Flash flooding and riverine flooding are common for the planning area due to the regular occurrence of severe thunderstorms in spring and summer, the proximity of rivers to many communities, and aged or undersized stormwater drainage infrastructure. Flooding can occur on a local level, only affecting a few streets, but can also extend throughout an entire district, affecting whole drainage basins.

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 a series, with one area having the potential to be impacted multiple times in one day. Impacts from severe thunderstorms can occur from thunderstorm grade winds, hail, heavy rain, and/or lightning. Severe thunderstorms are most likely to occur between the months of May and September with the highest number of events occurring in June. The NCEI recorded over two thousand severe thunderstorm events in 20 years. These events caused over $45.5 million in property damages. Typical impacts resulting from severe thunderstorms include (but are not limited to): loss of power, obstruction to transportation routes, grass/wildfires starting from lightning strikes, localized flooding, and damages discussed in the hazard profiles for hail and high winds as these are typical component of severe thunderstorms. While all segments of the population are vulnerable to the impacts of severe thunderstorms, there are a few groups with higher levels of vulnerability. Community members who reside in mobile homes are at an increased risk of injury and loss resulting from hail storms and high winds. Elderly residents may also be more vulnerable to hail events due to decreased mobility and may suffer from prolonged power outages.

SEVERE WINTER STORMS

Severe winter storms are an annual occurrence for the planning area. Winter storms can bring extreme cold temperatures, freezing rain and ice, and heavy or drifting snow. Blizzards and ice accumulation is particularly dangerous in the planning area and can have significant impacts on residents. Severe winter storms typically occur between November and March. The NCEI reported 840 severe winter storm events that caused over $23 million in property damages in 20 years. Impacts resulting from severe winter storms include (but are not limited to): hypothermia

and frost bite, death to those trapped outdoors, closure of transportation routes, downed power lines and prolonged power outages, collapse of roofs from heavy snow loads, death of livestock, and closure of critical facilities. The most vulnerable citizens within the planning area are children, elderly, individuals and families below the poverty line, and those new to the area.

TORNADOES AND HIGH WINDS

Tornadoes and high winds occur in the planning area on an annual basis. The NCEI reports 310 tornado and high wind events in the planning area since 1996. These events have caused over $14.6 million in property damages. Tornado events ranged from EF0 to F3 with many events reporting damages. Impacts from past tornadoes and high winds in the planning area include: damages to homes, vehicles, and agricultural buildings; downed power lines; and destroyed center pivot irrigation systems.

Vulnerable populations within the planning area include residents living in mobile homes, aged housing stock, facilities without storm shelters which house large numbers of people (such as nursing homes, schools, factories, etc.), homeowners without storm shelters or basements, and residents with decreased mobility. The majority of communities in the planning area have outdoor warning sirens; however, many noted sirens and emergency alert systems should be updated or improved.

MITIGATION STRATEGIES

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

The following table shows the most common mitigation actions that can be implemented to prevent future losses.

Table 4: Key Mitigation Strategies

Hazard	Mitigation Strategies
Agricultural Plant and Animal Disease	-Public education and awareness -Outbreak emergency exercises
Dam Failure	-Diversion Dam Gate updates -Emergency exercise -Public education and awareness -Improve flood/dam failure warning sirens
Drought	-Develop drought management plans/ordinances -Improve drought education/reduce water demand -Water system improvements -Identify additional water sources -Expand water storage capacity
Earthquake	None Identified
Extreme Heat	-Short term cooling centers
Flooding	-Property acquisition or flood-proofing of structures in the floodplain -Improve or upgrade drainage structures and stormwater management systems -Bank stabilization or channel improvements -Improve warning and alert systems

Hazard	Mitigation Strategies
Grass/Wildfire	-Improve emergency response access to rural areas and communities -Hazardous fuels/trees reduction -Additional personnel, training and equipment for local fire departments -Water system improvements -Upgrade/expand fire facilities -Public education and awareness
Hazardous Material Fixed Site and Transportation Spills	-Public education and awareness -Chemical spill emergency exercises -Shelter in place or HAZMAT training
Levee Failure	None Identified
Public Health Epidemic	-Purchase or upgrade health facility equipment and facilities
Severe Thunderstorms	-Purchase and install backup power generators for redundant power -Install static detectors, surge protectors, and/or lightning rods -Remove hazardous trees -Design and construct storm shelters and safe rooms -Upgrade and maintain emergency warning sirens and early notification systems -Bury power lines or harden critical infrastructure
Severe Winter Storms	-Incorporate use of snow fences to protect vulnerable transportation routes -Purchase and install backup power generators for redundant power -Remove hazardous trees -Review and improve snow/ice removal protocols -Upgrade and maintain emergency warning sirens and early notification systems -Bury power lines or harden critical infrastructure
Terrorism	-Improve local security systems for critical facilities for both physical and cyber concerns
Tornadoes and High Winds	-Remove hazardous trees -Design and construct storm shelters and safe rooms -Upgrade and maintain emergency warning sirens and early notification systems -Bury power lines or harden critical infrastructure

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SECTION ONE: INTRODUCTION

HAZARD MITIGATION PLANNING

Hazard events are inevitable, it is just a matter of when they happen and what jurisdictions have done to mitigate the potential impacts. Mitigation reduces risk and is a socially and economically responsible action to prevent long term risks from natural and human-caused hazard events.

FEMA definition of Hazard Mitigation

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

Natural hazards, such as severe winter storms, tornadoes and high winds, severe thunderstorms, flooding, extreme heat, drought, agricultural diseases (plant and animal), earthquakes, and wildfires are part of the world around us. Human-caused hazards are a product of society and can occur with significant impacts to communities. Human-caused hazards include levee or dam failure, hazardous chemical spills (either fixed sites or transportation), and terrorism or civil disorder events. These hazard events can occur as a part of normal operations 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 Lower Loup Natural Resources District (LLNRD) prepared this multi-jurisdictional multi-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 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 LBNRD, LBBNRD, and the participating jurisdictions herein eligible for federal funding programs under the Hazard Mitigation Assistance (HMA) program. This plan was also developed 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 and more resilient community.

DISASTER MITIGATION ACT OF 2000

The U.S. Congress passed the Disaster Mitigation Act of 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

[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.

eligible for pre- and post-disaster mitigation funding.[2] These funds include the Hazard Mitigation Grant Program (HMGP)[3], Flood Mitigation Assistance (FMA)[4], and the newly released Building Resilient Infrastructure and Communities (BRIC)[5]. BRIC replaced the Pre-Disaster Mitigation (PDM) Program in 2020. The Federal Emergency Management Agency (FEMA) administers these programs under the Department of Homeland Security (DHS).[6] The Nebraska Emergency Management Agency (NEMA) administers these grants at the state level.

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, minimally every five years, to maintain compliance with the legislature per 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.

Each HMA program was authorized by separate legislative actions and, as such, each program differs slightly in scope and intent. All three grant programs require jurisdictions to have participated in and adopted a FEMA-approved mitigation plan and are selected for funding through a competitive application process.

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:** This program provides funds to states, territories, Indian tribal governments, local governments, and other eligible participants 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:** This program provides grant funds to implement projects such as acquisition or elevation of flood-prone homes. Jurisdictions must be participating communities in the National Flood Insurance Program (NFIP) to qualify.

[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-grantprogram.
[4] Federal Emergency Management Agency. "Flood Mitigation Assistance Grant Program." Last modified July 11, 2017. https://www.fema.gov/flood-mitigationassistance-grant-program.
[5] Federal Emergency Management Agency. "Building Resilient Infrastructure and Communities." Last modified September 8, 2020. https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities.
[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.

- **BRIC:** This program replaces the Pre-Disaster Mitigation Program and provides funds on an annual allocation basis to local jurisdictions for implementing programs and projects to improve resiliency and local capacity before disaster events.

PLAN FINANCING AND PREPARATION

In regard to plan financing and preparation, in general, the LLNRD 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.

SECTION TWO: PLANNING PROCESS

INTRODUCTION

The process utilized to develop a hazard mitigation plan is often as important as the final planning document. For this planning process the LLNRD adapted the four step hazard mitigation planning process outlined by FEMA to fit the needs of the participating jurisdictions. The following section describes the planning process including: the development and establishment of both the Regional and Local Planning Teams; the function of each type of planning team; project meeting times, dates, agendas, and attendees; outreach efforts to the general public, neighboring jurisdictions, and available stakeholders; general information relative to the risk assessment process; general information relative to local/regional capabilities; plan review and adoption; and a brief discussion of 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:

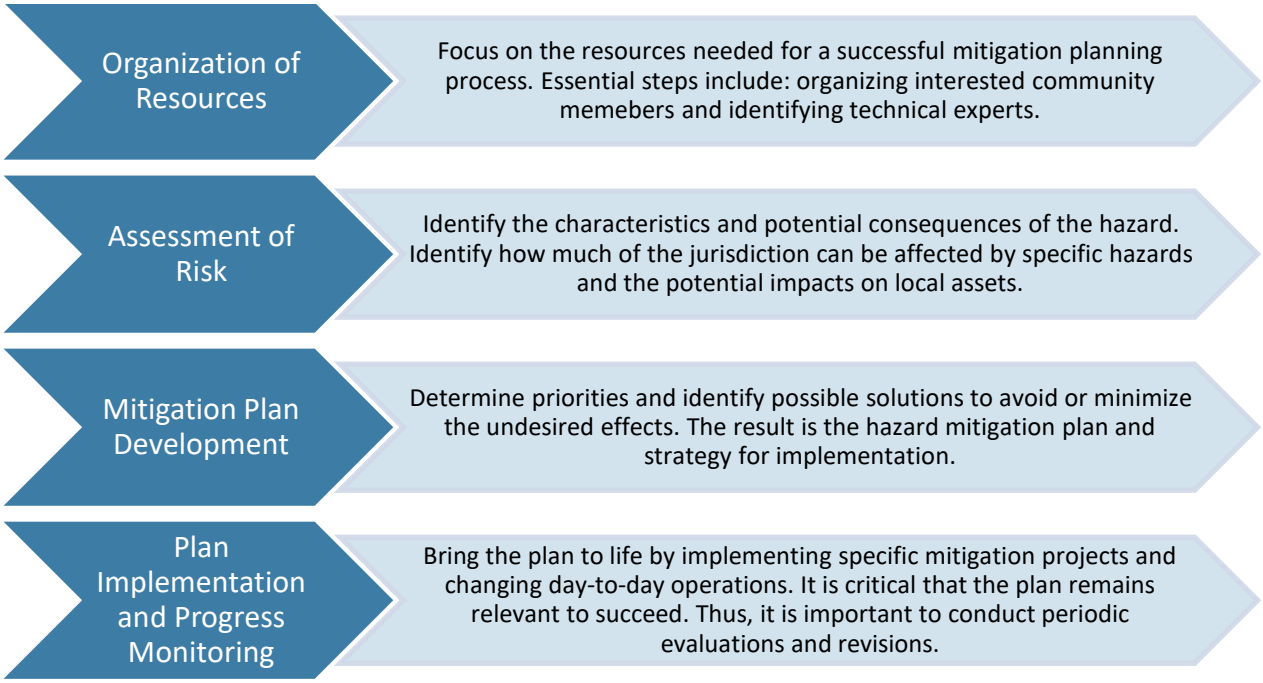
- It provides a comprehensive approach to the mitigation of hazards that affect multiple jurisdictions;
- It allows economies of scale by leveraging individual capabilities and sharing cost and resources;
- It avoids duplication of efforts; and
- It imposes an external discipline on the process.

Both FEMA and NEMA recommend this multi-jurisdictional approach through the cooperation of counties, regional emergency management, and natural resources districts. The LLNRD utilized the multi-jurisdictional planning process recommended by FEMA resources (Local Mitigation Plan

Review Guide[9], Local Mitigation Planning Handbook[10], and Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards[11]) to develop this plan.

HAZARD MITIGATION PLANNING PROCESS

The hazard mitigation planning process as outlined by FEMA has four general steps, which include: organization of resources; assessment of risks; development of mitigation strategies; and, implementation and annual monitoring of the plan's progress. The mitigation planning process is rarely a linear process. It is characteristic of the process 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 may result in new goals or additional risk assessment. The four-step approach is described in the figure below.



ORGANIZATION OF RESOURCES

PLAN UPDATE PROCESS

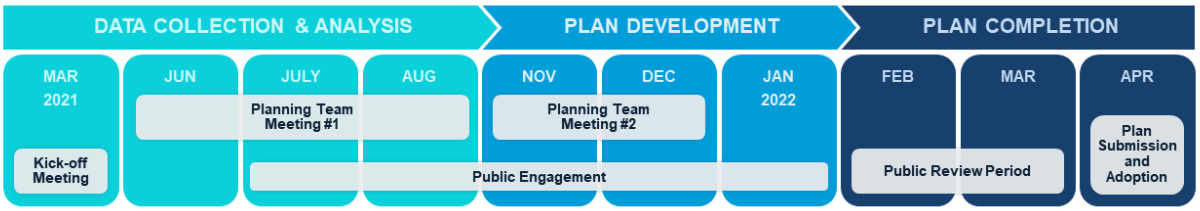
The LLNRD contracted JEO Consulting Group (JEO) in january 2020 to facilitate the update of their 2021 multi-jurisdictional hazard mitigation plan (HMP) update. The LLNRD secured a Pre-Disaster Mitigation (PDM) grant in August 2020. JEO's responsibilities included to guide and facilitate the planning process and assemble the multi-jurisdictional hazard mitigation plan. For the planning area, Larry Schultz (Information/Education Coordinator with LLNRD) 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.

9 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

10 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.

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

Figure 2: Project Timeline



REGIONAL PLANNING TEAM ESTABLISHMENT

At the beginning of the planning process, the NRD sponsor and JEO staff identified key contacts to serve as the Regional Planning Team. This Regional Planning Team comprised of county representatives for the eleven-county planning area, state agencies, and the consultant, was established to guide the planning process; review the 2017 HMP and discuss planning process changes or plan requirements; and serve as the liaison between the project sponsor and consultant to local participating jurisdictions. Those invited to be a part of the Regional Planning Team included contacts from: Lower Loup NRD; county emergency management and county planning officials/floodplain administrators from Boone, Custer, Garfield, Greeley, Howard, Loup, Nance, Platte, Sherman, Valley, and Wheeler Counties; Region 26 and Region 44 Emergency Management Agencies; Nebraska Department of Natural Resources; Nebraska Emergency Management Agency; and JEO Consulting Group. The following table provides a list of Regional Planning Team Members who attended the Kick-off Meeting and/or participated in this plan update process.

Table 5: Hazard Mitigation Regional Planning Team

Name	Title	Jurisdiction
Alma Beland	Director	Region 26 Emergency Management Agency (Loup, Valley, Wheeler, Sherman, Garfield, Greeley Counties)
Denise Ziemba	Emergency Management	Region 44 EMA (Boone and Nance Counties)
Doug Reiten	County Emergency Manager	Wheeler County
Larry Schultz	County Emergency Manager	Lower Loup NRD
Mark Rempe	County Emergency Manager	Custer County
Mary Ziemba	Floodplain Administrator	Boone County
Ron Tubbs	County Emergency Manager	Howard County
Tim Hofbauer	County Emergency Manager	Platte County
Heather Thole*	Hazard Mitigation Planning Specialist	NEMA
Marisa Alvarez*	Hazard Mitigation Planning Specialist	NEMA
Lexy Hindt*	Deputy State Hazard Mitigation Officer	NEMA
Brooke Seachord*	Project Coordinator	JEO Consulting Group, Inc.
Kayla Vondracek*	Project Planner	JEO Consulting Group, Inc.

**Served as a consultant or advisory role*

A virtual project Kick-off Meeting was held on March 9, 2021 with the Regional Planning Team and JEO to discuss an overview of the planning process. Discussion at this meeting included participation requirements for eligible jurisdictions, HMP update project description, updates and

changes to the HMP, review and revision of Plan Goals, identify hazards for risk assessment, identifying all potential plan participants or key stakeholders, and general schedule for the planning process. This meeting also assisted in clarifying roles and responsibilities of Regional Planning Team and Local Planning Teams, strategies for public engagement throughout the process, and a brief discussion of applicable COVID-19 safety measures and contingency plans for the HMP update. The following table shows the date, location, and attendees from the Kick-off Meeting.

Table 6: Meeting Locations and Times

Location and Time	Agenda Items
April 14, 2016	
Lower Loup NRD Virtual Meeting 10:00 AM	-Consultant responsibilities -Planning Team responsibilities -Dates/Locations for meetings -Plan Goals/Objectives -Workshop Details

PUBLIC INVOLVEMENT AND OUTREACH

At the beginning of the planning process, the Regional Planning Team worked to identify stakeholder groups that could serve as "hubs of communication" throughout the planning process. Stakeholders can provide valuable information to regional risk assessment and community mitigation strategy implementation, while not directly eligible to participate in the HMP as a 'Participant'. A wide range of potential stakeholders were contacted and encouraged to participate which included airports, assisted living facilities, economic development districts, hospitals, long-term care or nursing homes, power districts, and state agencies. The following table lists stakeholder groups encouraged to participate in the planning process.

Table 7: Notified Stakeholder Groups

Organizations		
Albion Municipal Airport	Cram Field Airport	Matelyn Retirement Community
Arbor Care Centers - Fullerton	Custer Care	Meridian Gardens
Arbor Care Centers - Ord	Edgewood Columbus Senior Living	Nebraska Department of Natural Resources
Boone County Health Center	Emerald Nursing & Rehab Columbus	Nebraska Emergency Management Agency
Broken Bow Municipal Airport/Keith Glaze Field	Evelyn Sharp Field Airport	Northeast Nebraska Economic Development District
Brookefield Park	Friendship Home Assisted Living	Off Broadway Apartments
Brookestone Acres	Genoa Community Hospital	Prairie Village Retirement Center
Brookestone View	Genoa Municipal Airport	Quality Senior Villages
Callaway District Hospital	Good Samaritan Society - Albion	Red Cross
Callaway Good Life Center	Good Samaritan Society - Samaritan Estates	Region 26 Emergency Management
Central Nebraska Economic Development District	Grandview Assisted Living Facility	Rose Lane Home

Organizations		
Clovelodge Care Center	Greeley Care Home	Sargent Municipal Airport
Columbus Community Hospital	Howard County Medical Center	United States Forest Service
Columbus Municipal Airport	Howard Greeley Rural Public Power District	Valley County Hospital
Community Memorial Health Center	Jennie M Melham Memorial Medical Center	
Cottonwood Place	Loup City Municipal Airport	

Representatives from Broadview Manor in Broken Bow attended meetings and provided input for their community section.

NEIGHBORING JURISDICTIONS

Neighboring jurisdictions were notified of the LLNRD HMP update and invited to participate in the planning process. The following table lists the neighboring communities or entities notified of the planning process. Letters and emails were sent to county/city/village clerks, county emergency managers, and NRDs, at their respective jurisdictions and disseminated appropriately in early May 2021. There was no participation from jurisdictions outside of the planning area.

Table 8: Neighboring Jurisdictions Notified

Notified Nebraska Jurisdictions	
Antelope County	Madison County
Blaine County	Merrick County
Buffalo County	Polk County
Butler County	Rock County
Colfax County	Stanton County
Dawson County	Central Platte NRD
Hall County	Lower Platte North NRD
Holt County	Lower Elkhorn NRD
Lincoln County	Twin Platte NRD
Logan County	Upper Loup NRD

PARTICIPANT INVOLVEMENT

Participants play a key role in reviewing goals; identification of 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.

In order to be a participant in the development of this plan update, jurisdictions were required to:

- Attend Round 1 and Round 2 meetings or a one-on-one meeting with JEO staff
- Provide relevant information throughout the plan update process, and
- Pass an Adoption Resolution for the approved HMP.

Jurisdictions had to have at least one representative present at meetings. Some jurisdictions sent multiple representatives to meetings. For jurisdictions who only had one representative at meetings, they were encouraged to take materials back to their governing bodies and include a diverse input on the meeting documents. Sign-in and attendance 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 meeting, to participate in the planning process.

Outreach to eligible jurisdictions included notification prior to all public meetings, letters, phone calls, emails, and calendar meeting invitations. Due to the development of COVID-19 during the planning period, an emphasis was made on virtual and electronic outreach. The following table provides a summary of outreach activities utilized in this process.

Table 8 provides a summary of outreach activities utilized in this process.

Table 9: Outreach Activity Summary

Action	Intent
Project Website	To inform the public and local/planning team members of past, current, and future activities (https://jeo.com/lower-loup-hmp)
Project Announcement	Project announcement mailed and emailed to potential participants and stakeholders (http://jeo.com/llhmp/)
Meeting Invitations (Round 1 and Round 2)	Letters, electronic calendar invitations, emails and phone calls were used to notify participants of meeting agenda/data/time/locations for Round 1 and Round 2 meetings. Round 1 meetings were held virtually. Round 2 meetings were held in-person.
Follow-up Emails and Phone Calls	Potential participants were called to remind them about upcoming meetings. Correspondence was provided to remind and assist participating jurisdictions with the collection and submission of required local data
Project Flyer	A fact sheet flyer was developed and shared with all planning team members to post locally. Information included why and how to be involved in the process.
Local Outreach	Project sponsors and members of Regional Planning Team provided follow up to jurisdictions on an as needed basis.
Social Media	The local sponsors, county Emergency Management Agencies, and local communities were encouraged to share updates on HMP process via local social media channels.
Word-of-Mouth	Staff discussed the plan with jurisdictions throughout the planning process

ASSESSMENT OF RISK

ROUND 1 MEETINGS: HAZARD IDENTIFICATION

Jurisdictional representatives from each community, including those members who attended meetings and those who contributed to profile development, made up the Local Planning Teams. At the Round 1 meetings, the Local Planning Team reviewed an updated *Community Profile* with information from the 2017 LLNRD HMP. Additional questions and input was requested for local impacts, historical occurrences, and development changes in the community over the past five years. The following table shows the dates and times for Round 1 Meetings. Note that due to the lingering impact of COVID-19, Round 1 Meetings were held virtually. A recording of the Round 1 meeting was also uploaded and available for participants on the project Google Drive to review.

Table 10: Round 1 Meeting Dates and Locations

Agenda Items	Date and Time
General overview of the HMP planning process, discuss participation requirements, begin the process of risk assessment and impact reporting, update critical facilities, capabilities assessment, and status update on current mitigation projects	Option 1: Tuesday, June 8 at 2:00pm Option 2: Thursday, June 10 at 6:00pm

The intent of these meetings was to familiarize the jurisdictional representatives with an overview of the work to be completed over the next year as the plan progressed, discuss the responsibilities of being a participant, and to collect preliminary information to update the HMP. Data collected at these meetings included: review and updates to local demographic and development trends in the community; hazard prioritization evaluation and updates from 2017 HMP for each jurisdiction; review/update critical facilities; and review and update of local capabilities. These meetings also served as an opportunity to gather input on hazard events. The following table shows the attendees for each jurisdiction who attended Round 1 meetings. Follow up one-on-one meetings were held for communities who did not have representatives present at public meetings through in-person meetings or conference calls with JEO Staff.

Table 11: Round 1 Meeting Attendees

Name	Title	Jurisdiction
Tuesday, June 8, 2021 at 2:00PM		
Alec Bailie	Mayor	Loup City
Alma Beland	EMA Director	Greeley County/Loup County/Wheeler County
Amy McKay	Principal	Village of Spalding/Spalding Academy School
Ben Rutten	County Commissioner	Cedar Rapids
Brittany Toof		Custer County EMA
Carla Kimball	Disaster Recovery Coordinator	Central Nebraska Economic Development District
Catie Larsen	Emergency Response Coordinator	Loup Basin Public Health Department
Chuck Sliva	Public Works Director	Columbus
Darci Tibbs	Zoning/Floodplain Administrator	Custer County Zoning
Darcia Kovarik	Village Clerk	Taylor
Denise Ziemba	Emergency Manager	Boone County/Nance County
Dorothy Drabek	Zoning Administrator	Sherman County
Eric Person	Interim Hwy Superintendent/FP Manager	Sherman County
Gwenda Horky	City Clerk	City of Sargent
Jaramie Van Leer	Floodplain Administrator	City of Ord
Jason Baum	Fire Chief	Broken Bow Fire Department
Jason Lamb	Fire Deputy	Merna Fire and Rescue
Kali Bolli (Sweet)	Planning, Zoning, and Flood Plain Administrator	Garfield County
Kiley White	Village Treasurer	Village of Elyria
Lanett Conroy	Village Clerk	Callaway

Name	Title	Jurisdiction
Lanette Doane	Village Clerk	Ansley
Larry Schultz	I & E Coordinator	LLNRD
Mark Rempe	Emergency Manager	Custer County/Village of Oconto/Oconto Fire Department
Marvin Hulinsky	Emergency Manager	Garfield County
Matt Lukasiewicz	General Manager	Farwell Irrigation District
Matt Helzer	Utilities Superintendent	St. Paul
Michelle Woitalewicz	Fire Deputy	Farwell Fire Department
Mike Wells	General Manager	Twin Loups Reclamation District
Mike Williams	Superintendent	Arcadia Public Schools
Reece Jensen	Utility Superintendent/Fire Chief	City of Sargent/Sargent Fire Department
Rod Brestel	Utility Superintendent	Callaway
Ron Tubbs	Emergency Manager	Howard County
Rosmarie Ritz	Village Clerk	Arcadia
Russel Jensen	Treasurer	Village of Boelus
Sandy Benson	Community Wildfire Protection Plan Coordinator	Nebraska Forest Service
Sandy Weltruski	Board Chairman	Village of Spalding
Shelby Steenson	Village Clerk	Wolbach
Terry Webb	Village Manager	Dannebrog
Tim Hofbauer	County Emergency Manager	Columbus/Platte County Emergency Management
Todd Sargent	Co-Manager	Sargent Irrigation District
Todd Schipporeit	Assistant General Manager	LLNRD
Tylr Naprstek	Administrator	Callaway Good Life Center/Oconto Fire and Rescue
Vicky Hendricks	Dispatch Operator	Region 26 Emergency Management
Virginia Michalski	Mayor	Loup City
Thursday, June 10, 2021 at 6:00PM		
Alma Beland	Emergency Manager	Region 26 Emergency Management
Billy Zoucha	Utilities Supervisor	Village of Monroe
Cathie Jo Mills	Board Chairman	Village of Ansley
Cindy Sorenson	City Council President	Village of Saint Edward
Donna Hoblyn-Bittner	Village Clerk	Village of Mason City
Deborah Ritz	Clerk	Village of Comstock
Ervie Ferguson	Assistant Fire Chief	Ansley Fire District
Josh Dahlberg	Board Member/Fire Chief	Village of Duncan/Duncan Fire District
Karla Costello	Clerk	Greeley Village
Lorissa Anderson	Board Member	Village of Berwyn
Patrick Siemek	Secretary	Duncan Fire District
Rod Smith	Mayor	City of Genoa

Name	Title	Jurisdiction
Scott Philbrick	Emergency Manager	Valley County
Tammy Burnett	Village Clerk/Floodplain Administrator	Village of Anselmo
Gerry Sheets	General Manager	Middle Loup Public Power & Irrigation District

The following table lists one-on-one meeting dates, time, and attendees.

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

Name	Title	Jurisdiction
City of Albion – Thursday, June 17, 2021 at 10:30AM		
Warren Myers	Water Commissioner/Building Inspector	City of Albion
Andrew Devine	City Administrator, Floodplain Administrator	City of Albion
Bruce Benne	Fire Chief	City of Albion
Brooke Seachord	Project Coordinator	JEO Consulting Group
Kayla Vondracek	Project Planner	JEO Consulting Group
Village of Petersburg – Thursday, June 17, 2021 at 1:00PM		
Sundae Provender	Village Clerk	Village of Petersburg
Corey Stokes	Board Chairman	Village of Petersburg
Brooke Seachord	Project Coordinator	JEO Consulting Group
Kayla Vondracek	Project Planner	JEO Consulting Group
Wheeler County and Communities – Friday, June 18, 2021 at 1:00PM		
Jack Paulson	Village Clerk	Village of Ericson
Travis Hemz	County Commissioner	Wheeler County
Roy Plugge	County Commissioner	Wheeler County
Doug Reiter	County Emergency Manager/Board Member	Wheeler County/Village of Bartlett
Brooke Seachord	Project Coordinator	JEO Consulting Group
Kayla Vondracek	Project Planner	JEO Consulting Group
Village of Duncan – Friday, June 18, 2021 at 10:00AM		
Don Reves	Village Maintenance	Village of Duncan
Patrick Siemek	Fire Department Secretary	Village of Duncan/Duncan Fire and Rescue
Josh Dahlberg	Fire Chief/Village Board Member	Village of Duncan/Duncan Fire and Rescue
Brooke Seachord	Project Coordinator	JEO Consulting Group
Kayla Vondracek	Project Planner	JEO Consulting Group

Mitigation Plan Development

Round 2 Meetings: Mitigation Strategy, Maintenance, and Integration

The identification and prioritization of mitigation measures is an essential component in developing effective hazard mitigation plans. Round 2 meetings are designed to allow participating jurisdictions an opportunity to identify and describe new mitigation strategies to address prioritized hazards or identified gaps in planning, response, or resiliency from Round 1 meetings. Participating jurisdictions were also asked to review the information collected from Round 1 meetings related to their community through this planning process. The Local Planning

Teams were asked to ensure all information included was up-to-date and accurate. Information/data reviewed include, but was not limited to: local hazard prioritization results; identified critical facilities and their location within the community; future development and overall growth trends.

Round 2 meetings are also used as an opportunity to discuss Plan Integration and Plan Maintenance components. Each participating jurisdiction was asked to either describe or provide a copy of other planning mechanisms which support the goals and intent of the HMP for inclusion. These included Local Emergency Operations Plans, Comprehensive Plans, 1- & 6-Year Plans, Zoning Ordinances, Floodplain Ordinances, Building Codes, or other plans used by the jurisdiction. Newly added to Round 2 meetings also included a discussion of Plan Maintenance by the Local Planning Team and the importance of updating local profiles as priorities change, mitigation actions are completed, or after a disaster event.

A brief status update on project schedule, public review period, final local adoption, and the approval and grant opportunities available once the plan is approved by NEMA and FEMA was also provided to all participants. Round 2 meetings were held both in-person and vitually. The following table shows the attendees for each jurisdiction who attended a virtual Round 2 meeting. Follow up one-on-one meetings were held for communities who did not have representatives present at public meetings through conference calls with JEO Staff or who requested additional assistance.

Table 13 shows the date and location of meetings held for the Mitigation Strategies phase of this project.

Table 13: Round 2 Meeting Dates and Locations

Agenda Items	
Update past and identify new mitigation actions, review of local data, evaluate plan integration mechanisms, plan maintenance, discuss review process.	
Location and Time	**Date**
Albion Fire Hall	Tuesday, November 9th at 10:00 AM
Broken Bow City Auditorium	Tuesday, November 16th at 1:00 PM
Ord Fire Hall	Wednesday, November 17th at 9:00 AM
Virtual Zoom Meeting	Wednesday, November 10th at 6:00 PM

Meeting attendees are identified in Table 14.

Table 14: Round 2 Meeting Attendees

Name	Title	Jurisdiction
November 9, 2021; 10:00am; Albion NE		
Chuck Sliva	Public Works Director	City of Columbus
Franz Trumler	Planning and Zoning Administrator	Greeley County
Bruce Benne	Fire Chief	Albion Fire and Rescue
Matt Helzer	Utilities Superintendent	City of St. Paul
Joel Bergman	Mayor	City of St. Paul
Mike Williams	Superintendent	Arcadia Schools
Penny Schack	Council Member	City of St. Edward
Libby Finochico	Emergency Response Coordinator	East Central Health District

Name	Title	Jurisdiction
Ron Tubbs	Emergency Manager	Howard County
Dean Hamling		City of St. Edward
Andrew Devine	City Administrator	City of Albion
Larry Schultz	I/E Coordinator	Lower Loup NRD
Brooke Seachord	Project Coordinator	JEO Consulting Group
Kayla Vondracek	Project Planner	JEO Consulting Group
November 16, 2021; 1:009m; Broken Bow NE		
Lanette Doane	Clerk	Village of Ansley
Travis Harrap	Fire Chief	Village of Ansley
Tim Hofbauer	Emergency Manager	Platte County
Nick Shea	Maintenance	Brookestone View – Broken Bow
Reece Jensen	City Administrator	City of Sargent
Lori Bonde	Clerk	Village of Callaway
Donna Hoblyn-Bittern	Clerk	City of Mason City
Lorissa Anderson	Board Member	Village of Berwyn
Lexy Hindt	Deputy State Hazard Mitigation Officer	NEMA
Brittany Toot	Office Manager	Custer County
Gordon Goodman	Superintendent	Ansley Public School
Carla Kimball	Disaster Recovery Coordinator	Custer County
Craig Granwell	Water Superintendent	City of Broken Bow
Marisa Alvarez	Planning Specialist	NEMA
Darci Tibbs	Zoning Administrator	Custer County
Judy Petersen	Executive Director	Custer County
Gwenda Norky	City Clerk	City of Sargent
Dean De Lahne	Superintendent	Village of Arnold
Dan Knoell	City Administrator	City of Broken Bow
Mark Rempe	Emergency Manager	Custer County/Village of Oconto
Brooke Seachord	Project Coordinator	JEO Consulting Group
Kayla Vondracek	Project Planner	JEO Consulting Group
November 17, 2021; 8:00am; Ord NE		
Alma Beland	Director	Region 26 Emergency Management
Darcia Kovarik	Clerk	Village of Taylor
Marvin Hulinsky	Fire Chief/Emergency Manager	Burwell Fire Department
Mike Wells	Manager	Twin Loups Reclamation District
Randy Faaborg	Fire Chief/Village Board	Elba Fire and Rescue/Village of Cotesfield
Scott Philbrick	Emergency Manager	Valley County
Ben Young	Support and Service Director	Valley County Health Services
Laura Kravs	Emergency Manager	Loup County
Mitch Lamm	Deputy Emergency Manager	Loup County

Name	Title	Jurisdiction
Larry Schultz	I/E Director	Lower Loup NRD
John Poppett	Superintendent	St. Paul Public Schools
Arlene Johnson	Clerk	Village of Elba
Craig Kamla	Clerk, Utility Superintendent	Village of Ashton
Karla Costello	Clerk	Village of Greeley
Jeramie VanLeer	Utility Superintendent	City of Ord
Ryan Simpson	Emergency Management	Valley County
Mark Bauer	Emergency Manager	Greeley County
Todd Schippareit		Sargent Irrigation District
Timeree Andreasen	Board Chairperson	Village of Farwell
Daniel Kopershi	Board Member	Village of Cushing
Catie Larsen	Emergency Response Coordinator	Loup Basin Health Department
Robert Sevenker	Chairperson	Valley County
Brooke Seachord	Project Coordinator	JEO Consulting Group
Kayla Vondracek	Project Planner	JEO Consulting Group
November 10, 2021; 6:00pm; Virtual Meeting		
Russell Jensen	Utility Superintendent	Village of Boelus
Carrie Hansen	Clerk	Village of Scotia/Village of North Loup
Shelby Steenson	Clerk	Village of Wolbach
Jenna Clark	Director	Region 44 EMA – Boone, Nance
Marisa Alvares	Planning Specialist	NEMA
Karen Collins	Clerk	Village of Elyria
Tammy Burnett	Clerk	Village of Anselmo
Larry Schultz	I/E Coordinator	LLNRD
John Schroder	Fire Chief	Loup County Fire Department
Larry Copp	Fire Chief	Ord Fire Department
Tim Kusek	Board Member/Sewer & Water Commissioner	Village of Rockville
Terry Webb	Fire Chief/Board Member	Dannebrog Fire Deprartment/Village of Dannebrog
Heath Kursave	Board Member	Village of Arcadia
Ashley Thieman	Trustee	Village of Petersburg

The following table lists one-on-one meeting dates, time, and attendees.

Table 15: Round 2 One-on-One Meeting Attendees

Name	Title	Jurisdiction
Village of Hazard – November 2, 2021		
Judy Hughes	Village Clerk	Village of Hazard
Brooke Seachord	Project Coordinator	JEO Consulting Group
Village of Duncan – November 9, 2021		
Don Reves	Village Maintenance	Village of Duncan
Patrick Siemek	Fire Department Secretary	Village of Duncan/Duncan Fire and Rescue

Josh Dahlberg	Fire Chief/Village Board Member	Village of Duncan/Duncan Fire and Rescue
Brooke Seachord	Project Coordinator	JEO Consulting Group
Kayla Vondracek	Project Planner	JEO Consulting Group
Wheeler County and Communities – November 15, 2021		
Jack Paulson	Village Clerk	Village of Ericson
Travis Hemz	County Commissioner	Wheeler County
Roy Plugge	County Commissioner	Wheeler County
Doug Reiter	County Emergency Manager/Board Member	Wheeler County/Village of Bartlett
Brooke Seachord	Project Coordinator	JEO Consulting Group
Kayla Vondracek	Project Planner	JEO Consulting Group
City of Fullerton – December 9, 2021		
Patty Noble	City Clerk	City of Fullerton
Brooke Seachord	Project Coordinator	JEO Consulting Group
Sherman County – December 20, 2021		
Marvin Beck	Board Member	Village of Litchfield
Eric Person	Highway Superintendent	Sherman County
Marcy Sekutera	County Clerk	Sherman County
Alec Baillie	Mayor	City of Loup City
Tim Bandur	County Commissioner	Sherman County
Larry Griffith	County Commissioner	Sherman County
Dan Patterson	Emergency Manager	Sherman County
Alma Beland	Director	Region 26 Emergency Management
Brooke Seachord	Project Coordinator	JEO Consulting Group
Valley County – December 21, 2021		
Ryan Simpson	Emergency Manager	Valley County
Jim Goodrich	Board Chairperson	Village of North Loup
Amos Lange	General Manager	North Loup Rural Public Power and Irrigation District
Jack Van Slyke	County Commissioner	Valley County
Helen Cullers	County Commissioner	Valley County
Alma Beland	Director	Region 26 Emergency Management
Brooke Seachord	Project Coordinator	JEO Consulting Group

DATA SOURCES AND INFORMATION

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

Table 16: General Plans, Documents, and Information

Documents	
Benefit-Cost Analysis https://www.fema.gov/grants/guidance-tools/benefit-cost-analysis	Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards (2013) https://www.fema.gov/media-library-data/20130726-1904-25045-0186/fema_mitigation_ideas_final508.pdf
Disaster Mitigation Act of 2000 https://www.congress.gov/bill/106th-congress/house-bill/707#:~:text=Requires%20the%20President%2C%20in%20determining,future%20natural%20disasters%3B%20(3)	Mitigation Planning and the Community Rating System Key Topics Bulletin https://www.fema.gov/media-library-data/1560365486495-6e5bdaa89de4bf2363596e615f4c7575/MitigationPlanningandtheCommunityRatingSystemKeyTopicsBulletin.pdf
Hazard Mitigation Assistance Guidance and Addendum (2015) https://www.fema.gov/media-library-data/1424983165449-38f5dfc69c0bd4ea8a161e8bb7b79553/HMA_Addendum_022715_508.pdf	National Flood Insurance Program Community Rating System https://www.fema.gov/media-library-data/1535126505943-439b296e7778b037d05f698f65c7891b/2018NFIP_CRS_Brochure_June_2018_508OK.pdf
Hazard Mitigation Assistance Unified Guidance (2013) https://www.fema.gov/media-library-data/15463cb34a2267a900bde4774c3f42e4/FINAL_Guidance_081213_508.pdf	National Flood Insurance Program Community Status Book (2020) https://www.fema.gov/flood-insurance/work-with-nfip/community-status-book
Local Mitigation Plan Review Guide (2011) https://www.fema.gov/sites/default/files/2020-06/fema-local-mitigation-plan-review-guide_09_30_2011.pdf	National Response Framework (2019) https://www.fema.gov/emergency-managers/national-preparedness/frameworks/response
Local Mitigation Planning Handbook (2013) https://www.fema.gov/sites/default/files/2020-06/fema-local-mitigation-planning-handbook_03-2013.pdf	Robert T. Stafford Disaster Relief and Emergency Assistance Act (2019) https://www.fema.gov/sites/default/files/2020-03/stafford-act_2019.pdf
PLANS AND STUDIES	
Flood Hazard Mitigation Plan State of Nebraska (2013) https://nema.nebraska.gov/sites/nema.nebraska.gov/files/doc/flood-hazmit-plan.pdf	Lower Loup NRD Hazard Mitigation Plan (2017) https://jeo.com/lower-loup-hmp
Flood Insurance Studies https://www.fema.gov/flood-maps/change-your-flood-zone/status/flood-insurance-study	Public Power in Nebraska (2018) https://nebraskalegislature.gov/pdf/reports/research/public_power_2018.pdf
Fourth National Climate Assessment https://nca2018.globalchange.gov/	State of Nebraska Hazard Mitigation Plan (2014) https://nema.nebraska.gov/sites/nema.nebraska.gov/files/doc/hazmitplan.pdf
National Climate Assessment (2014) https://nca2014.globalchange.gov/	State of Nebraska Hazard Mitigation Plan (2019) https://nema.nebraska.gov/sites/nema.nebraska.gov/files/doc/hazmitplan2019.pdf
Nebraska State Drought Plan (2000) https://carc.nebraska.gov/docs/NebraskaDrought.pdf	State of Nebraska Hazard Mitigation Plan (2021) https://nema.nebraska.gov/sites/nema.nebraska.gov/files/doc/hazmitplan2021.pdf
TECHNICAL AND DATA RESOURCES	
Arbor Day Foundation – Tree City Designation (2019) https://www.arborday.org/programs/treecityusa/directory.cfm	Nebraska Department of Natural Resources – Dam Inventory https://gis.ne.gov/portal/apps/webappviewer/index.html?id=2aab04a13817421992dc5398ad462e22
CDC Social Vulnerability Index https://www.atsdr.cdc.gov/placeandhealth/svi/index.html	Nebraska Department of Transportation http://dot.nebraska.gov/

CDC Underlying Cause of Death https://wonder.cdc.gov/ucd-icd10.html	Nebraska Emergency Management Agency http://www.nema.ne.gov
Census Bureau – My Tribal Area https://www.census.gov/tribal/	Nebraska Flooding: March 2019 (Storymap) https://storymaps.arcgis.com/stories/9ce70c78f5a44813a326d20035cab95a
Federal Emergency Management Agency https://www.fema.gov/	Nebraska Forest Service (NFS) http://www.nfs.unl.edu/
FEMA Disaster Declarations https://www.fema.gov/openfema-data-page/disaster-declarations-summaries-v1	Nebraska Forest Service – Wildland Fire Protection Program http://nfs.unl.edu/fire
FEMA Flood Map Service Center https://msc.fema.gov/portal/advanceSearch	Nebraska Local Health Departments http://dhhs.ne.gov/Pages/Local-Health-Departments.aspx
FEMA Hazard Mitigation Plan Status https://fema.maps.arcgis.com/apps/webappviewer/index.html?id=ec2fb023df744cf480da89539338c386	Nebraska Power Review Board https://nprb.gworks.com/
High Plains Regional Climate Center http://climod.unl.edu/	Nebraska Rural Electric Association https://www.nrea.org/nrea-member-systems
Midwestern Regional Climate Center https://mrcc.illinois.edu/gismaps/cntytorn.htm#	Nebraska State Historical Society http://www.nebraskahistory.org/histpres/index.shtml
National Agricultural Statistics Service http://www.nass.usda.gov/	NOAA – Billion Dollar Weather and Climate Disasters https://www.ncdc.noaa.gov/billions/overview
National Centers for Environmental Information https://www.ncei.noaa.gov/	NWS – Seasonal Drought Outlook https://www.cpc.ncep.noaa.gov/products/expert_assessment/sdo_summary.php
National Consortium for the Study of Terrorism and Responses to Terrorism (START) http://www.start.umd.edu/gtd/	PHMSA Incident Statistics https://www.phmsa.dot.gov/hazmat-program-management-data-and-statistics/data-operations/incident-statistics
National Drought Mitigation Center – Drought Impact Reporter http://droughtreporter.unl.edu/map/	Small Business Administration – Disaster Loan Assistance https://disasterloan.sba.gov/ela/Declarations/Index
National Drought Mitigation Center – Drought Monitor http://droughtmonitor.unl.edu/	Stanford University - National Performance of Dams Program https://npdp.stanford.edu/
National Environmental Satellite, Data, and Information Service http://www.nesdis.noaa.gov/	Storm Prediction Center Statistics http://www.spc.noaa.gov
National Fire Protection Association https://www.nfpa.org/	The Census of Agriculture (2012) https://www.nass.usda.gov/Publications/AgCensus/2012/
National Flood Insurance Program https://www.fema.gov/national-flood-insuranceprogram	The Census of Agriculture (2017) https://www.nass.usda.gov/Publications/AgCensus/2017/index.php
National Flood Insurance Program https://dnr.nebraska.gov/floodplain/floodinsurance	Union of Concerned Scientists – Killer Heat Interactive Tool https://www.ucsusa.org/resources/killer-heat-interactive-tool?location=lancaster-county--ne
National Historic Registry https://www.nps.gov/subjects/nationalregister/index.htm	United States Army Corps of Engineers – National Levee Database https://levees.sec.usace.army.mil/#/
National Interagency Fire Center https://www.nifc.gov/fireInfo/fireInfo_statistics.html	United States Census Bureau https://data.census.gov/cedsci/
National Oceanic Atmospheric Administration (NOAA) http://www.noaa.gov/	United States Department of Agriculture http://www.usda.gov
National Weather Service http://www.weather.gov/	United States Department of Agriculture – Risk Management Agency http://www.rma.usda.gov
National Weather Service StormReady and TsunamiReady https://www.weather.gov/stormready/communities	United States Department of Agriculture – Web Soil Survey https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Natural Resources Conservation Service www.ne.nrcs.usda.gov	United States Department of Transportation – Pipeline and Hazardous Materials Safety Administration https://www.phmsa.dot.gov/
NE DHHS Rosters of Facilities and Services http://dhhs.ne.gov/licensure/Pages/Rosters-of-Facilities-and-Services.aspx	United States Geological Survey http://www.usgs.gov/
Nebraska Association of Resources Districts http://www.nrdnet.org	United States National Response Center http://www.nrc.uscg.mil/
Nebraska Climate Assessment Response Committee http://carc.agr.ne.gov	UNL – College of Agricultural Sciences and Natural Resources – Schools of Natural Resources http://casnr.unl.edu
Nebraska Department of Agriculture – Livestock Disease https://nda.nebraska.gov/animal/reporting/index.html	UNL – County Extension Offices https://extension.unl.edu/statewide/hal/officeslist/
Nebraska Department of Education http://nep.education.ne.gov/	UNL IANR – Nebraska Landslides http://snr.unl.edu/data/geologysoils/landslides/landslidedatabase.aspx
Nebraska Department of Education http://educdirsrc.education.ne.gov/	USACE National Inventory of Dams https://nid.sec.usace.army.mil/ords/f?p=105:1
Nebraska Department of Environment and Energy http://www.deq.state.ne.us/	USDA – Disaster Assistance Programs https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/index
Nebraska Department of Health and Human Services http://dhhs.ne.gov/Pages/default.aspx	USGS – Landslide Inventory https://usgs.maps.arcgis.com/apps/webappviewer/index.html?id=ae120962f459434b8c904b456c82669d
Nebraska Department of Natural Resources http://www.dnr.ne.gov	Wildfire Risk to Communities https://wildfirerisk.org/
Nebraska Department of Natural Resource – Geographic Information Systems (GIS) https://dnr.nebraska.gov/data	

PUBLIC REVIEW

Once the draft of the HMP was completed, a public review period was opened to allow for participants and community members at large to review the plan and provide comments and changes, if any at that time. The public review period was open from January 31, 2022 to February 28, 2021. Participating jurisdictions were emailed and mailed a letter notifying them of this public review period. The HMP was also made available on the project website (https://jeo.com/lower-loup-natural-resources-district-hazard-mitigation-plan-update) to download the document, and a notification was posted to the LLNRD website http://www.llnrd.org/). Received comments and suggested changes were incorporated into the plan. Examples of such revisions are listed in the table below.

To be updated after Public Review Period

Table 17: Public Review Revisions

Plan Section	Name, Title, and/or Agency	Comment/Revision

PLAN ADOPTION

Based on FEMA requirements, this multi-jurisdictional hazard mitigation plan must be formally adopted by each participant's governing body through the approval of an *Adoption Resolution.* The approval creates 'individual ownership' of the plan by each participating entity. 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 jurisdiction 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.

HMPs need to be living documents. Once adopted, participants are responsible for implementing and updating the plan as described in their *Community Profiles*. 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 as projects are completed and particularly after major events occur. Participating jurisdictions outlined individual maintenance goals in respective profiles and were notified such amendments and updates can be shared via the plan sponsor or JEO for inclusion in the HMP. Additionally, HMPs should be integrated into other planning mechanism as they are reviewed and updated. This includes county and local comprehensive or capital improvement plans as applicable.

Plan Implementation and Progress Monitoring

Hazard mitigation plans need to be a living document. To ensure this, the plan must be monitored, evaluated, and updated on a five-year or less cycle. This includes incorporating the mitigation plan into county and local comprehensive or capital improvement plans as they stand or are developed. *Section Six* describes the system that jurisdictions participating in the LLNRD 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.

SECTION THREE: PLANNING AREA PROFILE

INTRODUCTION

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

PLANNING AREA GEOGRAPHIC SUMMARY

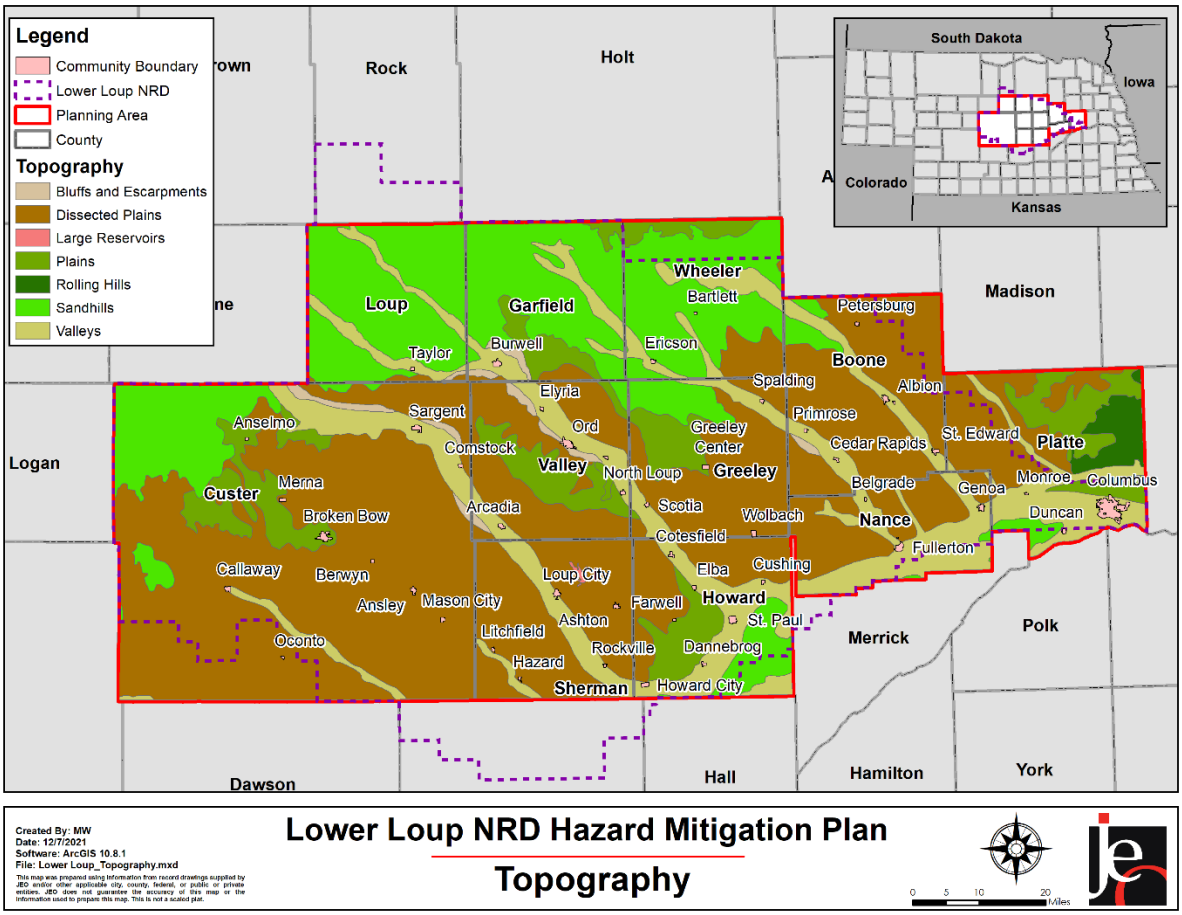
The LLNRD is located is central Nebraska and covers 5,070,720 acres in all or parts of the following counties: Boone, Buffalo, Butler, Custer, Garfield, Greeley, Hall, Howard, Loup, Merrick, Nance, Platte, Rock, Sheridan, Valley, and Wheeler. The district encompasses 514 miles of rivers, including the drainage systems of the lower reaches of the North, Middle, and South Loup River systems.

The planning area includes portions of several topographic regions: dissected plains, valleys, plains, sand hills, and scattered pieces of bluffs and escarpments. Dissected Plains are hilly land with moderate to steep slopes, sharp ridge crests and remnants of the old, nearly level plain. Valleys are flat-lying land along major streams made of stream-deposited silt, clay, sand and gravel. Plains are flat-lying land that lies above the valley with materials of sandstone or stream-deposited silt, clay, sand and gravel overlain by wind-deposited silt. Sand hills are hilly land composed of low to high dunes of sand stabilized by a grass cover. And Bluffs and Escarpments are rugged land with very steep and irregular slopes. Bedrock materials, such as sandstone, shale and limestone are often exposed in these areas.[12]

The planning area rests within the watersheds of the Middle Loup River and North Loup River and is home to numerous rivers, tributaries, creeks, or other bodies of water including Sherman Reservoir and Calamus Reservoir. Much of the planning area is comprised of small to moderate sized communities, agricultural land, and rivers or water bodies.

[12] Center for Applied Rural Innovation. August 2001. "Topographic Regions Map of Nebraska." https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1062&context=caripubs.

Figure 3: Planning Area Topography



DEMOGRAPHICS

Demographic and asset information can be used to determine differing levels of vulnerability via population and housing, structural inventories and valuations, critical facilities, and vulnerable areas analysis. In general, the planning area is a mixture of rural and incorporated areas. While the NRD and U.S. Census Bureau do not collect specific demographic information for the planning area, the Lower Loup NRD serves approximately ,000 people.

This population includes a range of demographic cohorts and persons at risk to natural and human-caused disasters. The following table depicts the estimated population per county in 2000, 2010, and 2018 population. At the time of this plan development, the U.S. 2020 census data was not available and is thus not included.

Table 18: Estimated Population of the Planning Area

County	2010 Population	2019 Population	Percent Change
Boone County	5,553	5,279	-5.0%
Custer County	11,001	10,826	-1.6%
Garfield County	2,081	2,001	-3.8%
Greeley County	2,542	2,382	-6.3%
Howard County	6,302	6,417	1.8%
Loup County	635	605	-4.7%

County	2010 Population	2019 Population	Percent Change
Nance County	3,755	3,544	-5.6%
Platte County	32,237	33,174	2.9%
Sherman County	3,152	3,033	-3.8%
Valley County	4,260	4,206	-1.3%
Wheeler County	818	783	-4.3%
Total	**72,336**	**72,250**	**-**

Source: U.S. Census Bureau[13]

Table 19: Percentage of Population for the Planning Area by Cohort (2019)

Age	Planning Area	State of Nebraska
<5	6.2%	6.9%
5 – 19	17.4%	20.7%
20 – 64	53.0%	57.6%
>64	23.4%	14.8%
Median	46.3	36.3

Source: U.S. Census Bureau

The population for the planning area has declined only slightly since the 2010 census (72,336 persons to 72,250 persons). The region accounts for approximately 4% of the total population for the state in 2019. Nine of the eleven counties are experiencing population decline. As these areas experience population decline, they become more vulnerable to the impacts from natural and human-caused hazards. Howard County and Platte County are the only two counties which are experiencing growth.

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."[14]

Dependent children under 19 years old are one of the most vulnerable populations to disasters.[15] 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. As a result, this demographic group experiences increased vulnerability to the following list of hazards: tornadoes (especially daytime events), severe thunderstorms, severe winter storms, extreme heat, water shortage created by drought, and chemical releases. Lack of awareness can at times be a concern for people in this age range as well as an inability to recognize and respond to environmental stimuli, which could lead to

[13] U.S. Census Bureau. 2000/2010/2019 Estimated Total Population. https://data.census.gov/cedsci/.
[14] United States Department of Homeland Security. June 2016. “National Response Framework Forth Edition.” https://www.fema.gov/media-librarydata/1572366339630-0e9278a0ede9ee129025182b4d0f818e/National_Response_Framework_4th_20191028.pdf.
[15] Flanagan, Gregory, Hallisey, Heitgerd, & Lewis. 2011. “A Social Vulnerability Index for Disaster Management.” Journal of Homeland Security and Emergency Management, 8(11): Article 3.

increased vulnerability to flooding (especially flash flooding), severe thunderstorms, tornadoes, and severe winter storms.

Despite this vulnerability, children are generally overlooked in disaster planning because the presence of a care-taker is assumed. With over a quarter of the planning area's total population younger than 19, children are a key vulnerable group to address in the planning process. A significant portion of this subset are additionally children under the age of five, further exacerbating their vulnerability.

There are a number of school districts within the planning area. Schools house a high number of "at risk" residents 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 eleven-county planning area, and Figure 4 is a map of the school district boundaries. This list is comprehensive by county and does not represent only the school districts that are participating in this plan.

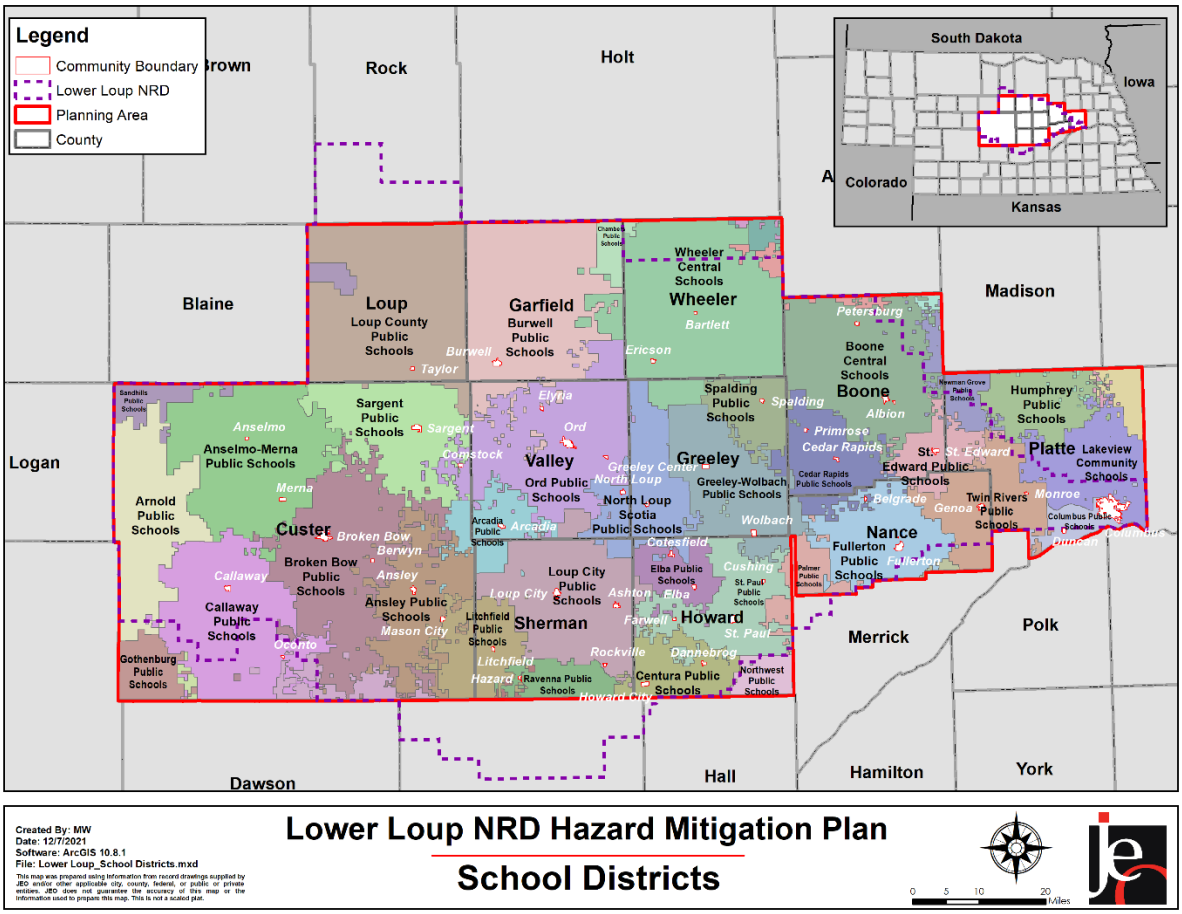
Table 20: School Inventory

School District	Communities with Schools	Total Enrollment (2020-2021)
Anselmo-Merna Public Schools	Merna	255
Ansley Public Schools	Ansley	193
Arcadia Public Schools	Arcadia	124
Arnold Public Schools	Arnold	177
Boone Central Schools	Albion	646
Broken Bow Public Schools	Broken Bow	892
Burwell Public Schools	Burwell	318
Callaway Public Schools	Callaway	186
Central Valley Public Schools	Greeley	298
Christ Lutheran Elementary School	Columbus	39
Columbus Christian School	Columbus	21
Columbus Public Schools	Columbus	4,159
Elba Public Schools	Elba	127
Fullerton Public Schools	Fullerton	307
Holy Family Schools	Lindsay	100
Humphrey Public Schools	Humphrey	287
Immanuel Lutheran Elem School	Columbus	149
Lakeview Community Schools	Columbus	922
Litchfield Public Schools	Litchfield	112
Loup City Public Schools	Loup City	328
Loup County Public Schools	Taylor	74
Ord Public Schools	Ord	571
Riverside Public Schools	Spalding	254
Sargent Public Schools	Sargent	166
Scotus Central Catholic	Columbus	375
Spalding Academy	Spalding	76
St Anthony Elementary School	Columbus	105
St Bonaventure Elem School	Columbus	240
St Edward Public Schools	St Edward	182
St Francis Schools	Humphrey	204
St Isidore Elementary School	Columbus	314

School District	Communities with Schools	Total Enrollment (2020-2021)
St John Lutheran Elem School	Columbus	56
St Mary's Elementary School	Ord	31
St Michael's Elementary School	Albion	98
St Paul Public Schools	St Paul	730
Twin River Public Schools	Genoa	432
Wheeler Central Schools	Bartlett	106

Source: Nebraska Department of Education[16]

Figure 4: Regional School Districts



Like minors, seniors (age 65 and greater) are often times more significantly impacted by temperature extremes. During prolonged heat waves seniors may lack resources to effectively address the hazards 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.[17] The 2011 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

[16] Nebraska Department of Education. 2021. "Nebraska Education Profile: District and School Data." Accessed July 2021. http://nep.education.ne.gov/
[17] Center for Injury Research and Policy. January 2011. "Snow Shoveling Safety." Accessed July 2017. http://www.nationwidechildrens.org/cirp-snow-shoveling.

during snow removal. On the other hand, women can have a more difficult time during post-disaster recovery than men, often due to sector-specific employment, lower wages, and family care responsibilities.

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. The Table 15 identifies the location and capacity of care facilities throughout the planning area.

Table 21: Inventory of Care Facilities

County	Number of Hospitals	Number of Hospital Beds	Number of Health Clinics	Long Term /Adult Care Home	Long Term /Adult Care Home Beds	Assisted Living Homes	Assisted Living Beds
Boone	1	25	0	2	107	1	28
Custer	2	35	0	2	95	3	74
Garfield	0	0	0	1	64	1	18
Greeley	0	0	0	1	26	1	12
Howard	1	10	0	1	70	1	66
Loup	0	0	0	0	0	0	0
Nance	1	19	0	2	114	4	88
Platte	1	50	2	2	225	5	276
Sherman	0	0	0	1	64	1	12
Valley	1	16	0	1	60	1	50
Wheeler	0	0	0	0	0	0	0

Source: Nebraska Department of Health and Human Services[18],[19],[20],[21]

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 16 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 22: At Risk Population

County	Percent That Speaks English as Second Language	All People Below Poverty Level
Boone	1.6%	5.8%
Custer	4.0%	11.5%
Garfield	1.2%	9.2%
Greeley	3.0%	10.2%
Howard	2.5%	7.9%
Loup	0.0%	8.6%
Nance	1.6%	11.4%
Platte	16.8%	8.7%

[18] Department of Health and Human Services. February 2021. "Hospitals." http://dhhs.ne.gov/publichealth/Documents/Hospital%20Roster.pdf.
[19] Department of Health and Human Services. February 2021. "Health Clinics." http://dhhs.ne.gov/licensure/Documents/HC_ASC_ESRD%20Lic%20Roster.pdf.
[20] Department of Health and Human Services. February 2021. "Assisted Living Facilities." http://dhhs.ne.gov/publichealth/Documents/ALF%20Roster.pdf.
[21] Department of Health and Human Services. February 2021. "Long Term Care Facilities." http://dhhs.ne.gov/publichealth/Documents/LTCRoster.pdf.

County	Percent That Speaks English as Second Language	All People Below Poverty Level
Sherman	3.3%	12.4%
Valley	2.3%	9.4%
Wheeler	1.8%	13.2%

Source: U.S. Census Bureau[22],[23]

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 not 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.

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. Similarly, 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 planning area is primarily White alone, with little change in diversity since 2010. Small changes in racial inequity will likely not significantly affect the region's overall vulnerability to hazards.

Race	2010		2019		% Change
	Number	% of total	Number	% of total	
White alone	69,668	97.1%	69,574	96.3%	-0.8%
Black or African American	111	0.2%	279	0.4%	+0.2%
American Indian and Alaskan Native	218	0.3%	231	0.3%	0.0%
Asian alone	129	0.2%	393	0.5%	+0.3%
Native Hawaiian & Other Pacific Islander	0	0.0%	11	0.02%	+0.02%
Other Races	671	0.9%	1,026	1.4%	+0.5%
Two Or More Races	926	1.3%	736	1.0%	-0.3%
Total Population	71,723	-	72,250	-	

[22] U.S. Census Bureau. 2019. "Language Spoken at Home: 2019 American Community Survey (ACS) 5-year estimates." https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#.
[23] U.S. Census Bureau. 2019. "Selected Economic Characteristics: 2019 ACS 5-year estimate." https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#.

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

BUILT ENVIRONMENT AND STRUCTURAL INVENTORY

Data related to the built environment is an important component of a hazard mitigation plan. It is essential that during the planning process communities and participating jurisdictions display an understanding of their built environment and work to identify needs that may exist within their planning area. The US Census provides information related to housing units and potential areas of vulnerability. The selected characteristics examined below include: lacking complete plumbing facilities; lacking complete kitchen facilities; no telephone service available; housing units that are mobile homes; and housing units with no vehicles.

Table 23: Selected Housing Characteristics

County	Occupied housing units	Lacking complete plumbing facilities	Lacking complete kitchen facilities	No landline telephone service available	Mobile Homes	Housing Unit with No vehicles available
Boone	2,644 87.4%	6 0.3%	28 1.2%	51 2.2%	54 2.0%	92 4.0%
Custer	5,655 86.0%	69 1.4%	112 2.3%	125 2.6%	187 3.3%	265 5.5%
Garfield	1,230 71.9%	10 1.1%	18 2.0%	14 1.6%	155 12.6%	15 1.7%
Greeley	1,302 78.3%	11 1.1%	20 2.0%	10 1.0%	40 3.1%	24 2.4%
Howard	3,101 87.7%	22 0.8%	28 1.0%	78 2.9%	193 6.2%	150 5.5%
Loup	447 65.8%	0 0.0%	0 0.0%	0 0.0%	85 19.0%	1 0.3%
Nance	1,856 83.3%	19 1.2%	8 0.5%	17 1.1%	52 2.8%	54 3.5%
Platte	13,784 93.9%	33 0.3%	264 2.0%	172 1.3%	608 4.4%	676 5.2%
Sherman	1,952 70.1%	0 0.0%	24 1.8%	31 2.3%	298 15.3%	40 2.9%
Valley	2,303 81.0%	5 0.3%	6 0.3%	19 1.0%	78 3.4%	91 4.9%
Wheeler	561 61.7%	4 1.2%	3 0.9%	3 0.9%	119 21.2%	5 1.4%
Total	**34,835**	**179 (0.01%)**	**511 (1.5%)**	**520 (1.5%)**	**1,869 (5.4%)**	**1,413 (4.1%)**

Source: U.S. Census Bureau[26]

Approximately 1.5 percent of housing units lack access to landline telephone service. This does not necessarily indicate that there is not a phone in the housing unit, as cellular telephones are increasingly a primary form of telephone service. However, this lack of access to landline telephone service does represent a population at increased risk to disaster impacts. Reverse 911 systems are designed to contact households via landline services and as a result, some homes

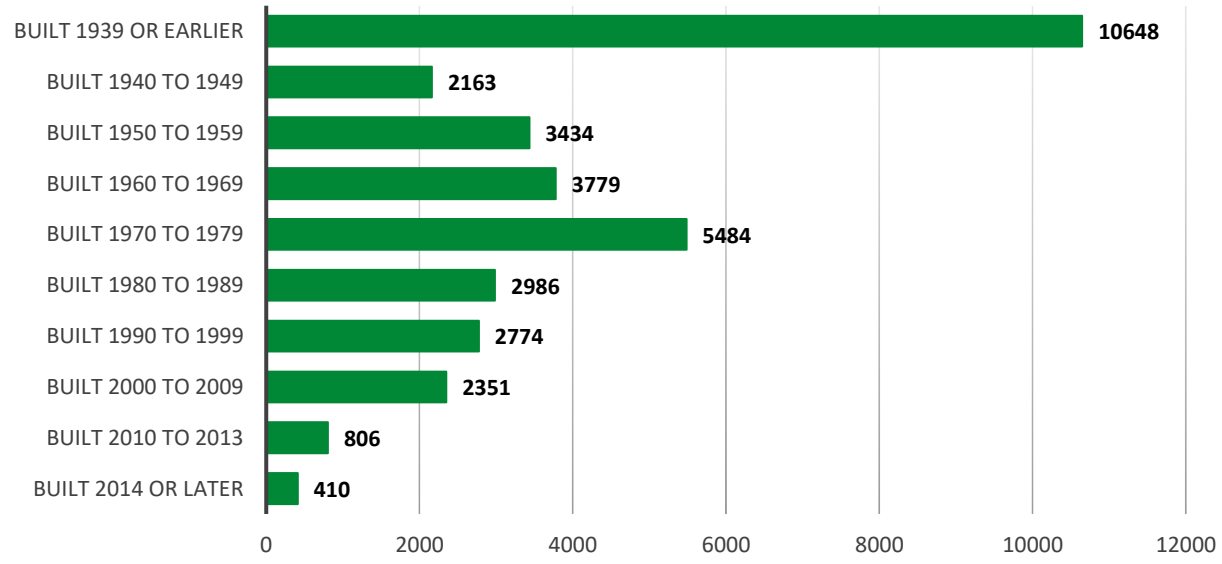
[24] U.S. Census Bureau. 2019. "Race: 2019 ACS 5-year estimates." https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#.
[25] U.S. Census Bureau. 2019. "Race: 2010 ACS 5-year estimate." https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#.
[26] U.S.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

in hazard prone areas may not receive notification of potential impacts in time to take protective actions. Emergency managers should work to promote the registration of cell phone numbers with Reverse 911 systems.

Over five percent of housing units in the planning area are mobile homes. In Garfield, Sherman, Loup, and Wheeler counties more than ten percent of the housing stock are mobile homes. 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.
Loup and Wheeler counties have an extremely high percentage of unoccupied housing units. Unoccupied homes may not be maintained as well as occupied housing, thus adding to their vulnerability. Furthermore, approximately four percent of all housing units 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 vast majority of homes in the planning area were built prior to 1939 (Figure 5). Housing age can serve as an indicator of risk, as structures built prior to state building codes being developed may be more vulnerable. According to the Department of Housing and Urban Development (HUD), older homes are at greater risk of poor repair and dilapidation resulting in blighted or substandard properties. Residents living in these homes maybe at higher risk to the impacts of high winds, tornadoes, severe winter storms, and thunderstorms. Across the state, the first building codes were adopted in 1987, but prior to this time, codes and building standards were established (or not) by each county and community. The State of Nebraska later adopted the International Building Code (IBC) 2000 codes (adopted in 2003), the IBC 2009 codes (adopted in 2010), and the IBC 2018 codes as of 2020.

Figure 5: Housing Age in Planning Area



Source: U.S. Census Bureau

SOCIAL VULNERABILITY INDEX

All communities have some vulnerability to natural and human-caused hazard events. Various social conditions such as poverty rates, vehicle access, language, or housing stock contribute to

a community's overall social vulnerability. The Center for Disease Control (CDC) has developed a Social Vulnerability Index to help public health officials and emergency responders identify communities at greater risk before, during, and after major hazardous events. The index evaluates 15 social factors and breaks down vulnerability into four domains: socioeconomic status; household composition and disability; minority status and language; housing and transportation. Several of these factors have been discussed in more depth earlier in this section. The following table lists the overall Social Vulnerability Index score for counties in the planning area.

Table 24: Social Vulnerability Index Score by County

County	Overall Score	Vulnerability Level
Boone	0.0283	Low
Custer	0.1818	Low
Garfield	0.0430	Low
Greeley	0.0411	Low
Howard	0.0803	Low
Loup	0.0045	Low
Nance	0.0825	Low
Platte	0.2994	Low to Moderate
Sherman	0.0739	Low
Valley	0.1484	Low
Wheeler	0.0048	Low

Source: CDC Social Vulnerability Index, 2018[27]

State and Federally Owned Properties

The following table provides an inventory of state and federally owned properties within the planning area by county. Note that this list does not include federally or state-owned highway systems or specific buildings within each community.

Table 25: State and Federally Owned Facilities

Facility	Nearest Community
Boone County	
Beaver Bend Wildlife Management Area	St. Edward
Custer County	
Myrtle E. Hall Wildlife Management Area	Sargent
Berggren-Young Wildlife Management Area	Merna
Arcadia Diversion Dam Wildlife Management Area	Comstock
Victoria Springs State Recreation Area (SRA)	Anselmo
Pressey State Wildlife Management Area (WMA)	Oconto
Garfield County	
Calamus Reservoir State Recreation Area & WMA	Burwell
Mirdan Canal Wildlife Management Area	Burwell
Greeley County	
Davis Creek Wildlife Management Area	Scotia
Howard County	
Harold W. Andersen Wildlife Management Area	Dannebrog
Leonard A. Koziol Wildlife Management Area	St. Paul
Marsh Wren Wildlife Management Area	Elba
Loup Bottoms Wildlife Management Area	Cotesfield

[27] Center for Disease Control Social Vulnerability Index. 2018. "CDC's Social Vulnerability Index (SVI): SVI Interactive Map" https://svi.cdc.gov/map.html

Facility	Nearest Community
North Loup State Recreation Area	St. Paul
Loup County	
Myrtle E. Hall Wildlife Management Area	Sargent (Custer County)
Calamus Reservoir State Recreation Area & WMA	Burwell (Garfield County)
Kent Diversion Dam Operations & WMA	Taylor
Nance County	
Sunny Hollow Wildlife Management Area	Genoa
Don Dworak Wildlife Management Area	Genoa
Council Creek Wildlife Management Area	Genoa
Loup River Public Power District Wildlife Management Area	Genoa
Platte County	
Maple Creek Recreation Area (NRD)	Creston
Lee Rupp Wildlife Management Area	Monroe
Wilkinson Wildlife Management Area	Columbus
George Syas State Wildlife Management Area	Genoa
Sherman County	
Sherman Reservoir State Recreation Area & Wildlife Management Area	Loup CIty
Valley County	
Fort Hartsuff State Historical Park	Elyria, NE
Scotia Canal Wildlife Management Area	North Loup
Davis Creek Wildlife Management Area	North Loup
Wheeler County	
None	N/A

Source: Nebraska Game and Parks[28]

HISTORICAL SITES

According to the National Register of Historic Places for Nebraska by the National Park Service (NPS), there are 85 historic sites located in the planning area. Structures identified as cultural or historic resources represent assets that are unique to the planning area and are, in many situations, irreplaceable and have local significance.

Table 26: Historical Sites

Title	Date Published	Nearest Community	County	In Floodplain?
US Post Office--Albion	5/11/1992	Albion	Boone	No
St. Anselm's Catholic Church, Rectory and Parish Hall	3/12/2008	Anselmo	Custer	Yes
First National Bank--Steinmeier Building	8/10/2011	Ansley	Custer	No
Groat, Stillman P., House	8/10/2011	Ansley	Custer	No
Finch Memorial Library	7/1/2015	Arnold	Custer	No
A. T. Ranch Headquarters	5/2/1990	Bartlett	Wheeler	No
Wheeler County Courthouse, Former	1/10/1990	Bartlett	Wheeler	No

[28] Nebraska Game and Parks. 2020. "Public Access ATLAS." [Web Map]. Accessed September 2020. http://outdoornebraska.gov/publicaccessatlas/

Title	Date Published	Nearest Community	County	In Floodplain?
Cottonwood Creek Archeological Site	10/18/1974	Belgrade	Nance	Unknown – Address Restricted
Arrow Hotel	9/12/1985	Broken Bow	Custer	No
Broken Bow Carnegie Library	3/5/1998	Broken Bow	Custer	Yes
Broken Bow Commercial Square Historic District	11/21/2006	Broken Bow	Custer	Yes
Custer County Courthouse and Jail	4/19/1979	Broken Bow	Custer	No
Security State Bank Building	11/30/1987	Broken Bow	Custer	Yes
Burwell Bridge	6/29/1992	Burwell	Garfield	No
Burwell Carnegie Library	7/11/2006	Burwell	Garfield	No
Garfield County Frontier Fairgrounds	5/9/1985	Burwell	Garfield	No
Hub Building	7/12/2006	Burwell	Garfield	No
Bruha, Josef, and Anna Beran, House	4/5/1990	Burwell	Valley	Unknown – Address Restricted
Lincoln Highway--Gardiner Station	7/3/2007	Butler Township	Platte	Unknown – Address Restricted
First Custer County Courthouse	1/10/1990	Callaway	Custer	No
Cedar Rapids City Hall and Library	7/1/1994	Cedar Rapids	Boone	No
St. Anthony's Church and School	3/9/2000	Cedar Rapids	Boone	No
Behlen, Walter and Ruby, House	3/11/2003	Columbus	Platte	No
Columbus Commercial Historic District	11/21/1996	Columbus	Platte	No
Columbus Izaak Walton League Lodge	11/29/2001	Columbus	Platte	Yes
Columbus Loup River Bridge	6/29/1992	Columbus	Platte	Yes
Evans, Dr. Carroll D. and Lorena R. North, House	3/14/1991	Columbus	Platte	No
Glur's Tavern	7/30/1975	Columbus	Platte	No
Gottschalk, Frederick L. and L. Frederick, Houses	6/25/1982	Columbus	Platte	No
Platte County Courthouse	1/10/1990	Columbus	Platte	No
Segelke, C., Building	6/25/1982	Columbus	Platte	No
Snyder, H. E., House	7/10/1986	Columbus	Platte	No
Stenger, Albert and Lina, House	12/27/2007	Columbus	Platte	No

Title	Date Published	Nearest Community	County	In Floodplain?
Dowse, William R., House	12/1/1986	Comstock	Custer	Unknown – Address Restricted
Rad Slavin cis. 112 Z. C. B. J. Halll	11/12/1992	Comstock	Valley	Unknown – Address Restricted
Coufal Site	10/15/1966	Cotesfield	Howard	Unknown – Address Restricted
Citizens State Bank	4/24/2013	Creston	Platte	No
Feye Archeological Site	1/21/1974	Creston	Platte	Unknown – Address Restricted
Wurdeman-Lawson Archeological Site	7/12/1974	Creston	Platte	Unknown – Address Restricted
Columbia Hall	7/22/2005	Dannebrog	Howard	Yes
Dannevirke Danish Lutheran Church and Community Hall	6/25/1999	Elba	Howard	No
Fort Hartsuff	3/24/1978	Elyria	Valley	Unknown – Address Restricted
Cunningham Archeological Site	2/13/1975	Fullerton	Nance	Unknown – Address Restricted
Evangelical United Brethren Church	9/4/2013	Fullerton	Nance	No
Fullerton Archeological Site	11/1/1974	Fullerton	Nance	Unknown – Address Restricted
Horse Creek Pawnee Village	7/12/1974	Fullerton	Nance	Unknown – Address Restricted
Merrill, Moses, Baptist Camp	4/14/2004	Fullerton	Nance	Unknown – Address Restricted
Burkett Archeological Site	7/12/1974	Genoa	Nance	Unknown – Address Restricted
Genoa Site	10/15/1970	Genoa	Nance	Unknown – Address Restricted
Pawnee Mission and Burnt Village Archeological Site	8/7/1974	Genoa	Nance	Unknown – Address Restricted
U.S. Indian Industrial School	5/22/1978	Genoa	Nance	No

Title	Date Published	Nearest Community	County	In Floodplain?
Wright Site	8/14/1973	Genoa	Nance	Unknown – Address Restricted
Greeley County Courthouse	1/10/1990	Greeley	Greeley	No
Humphrey City Hall	6/21/1996	Humphrey	Platte	No
Archeological Site 25SM20	2/12/2002	Loup City	Sherman	Unknown – Address Restricted
Frederick Hotel	10/16/2002	Loup City	Sherman	No
Loup City Township Carnegie Library	12/27/2007	Loup City	Sherman	No
Sherman County Courthouse	1/10/1990	Loup City	Sherman	No
Mason City School	3/2/2006	Mason City	Custer	No
Brenizer Library	7/3/2007	Merna	Custer	No
Kellenbarger, Benjamin and Mary, House	7/3/2007	Merna	Custer	No
First Welch Calvinistic Methodist Church and Cemetery	6/25/1999	Monroe	Platte	No
Hill--Rupp Site	9/30/1985	Monroe	Platte	Unknown – Address Restricted
Larson, Hanna, Archeological Site	2/20/1975	Monroe	Platte	Unknown – Address Restricted
Monroe Congregational Church and New Hope Cemetery	11/28/1990	Monroe	Platte	Unknown – Address Restricted
North Loup Bridge	6/29/1992	North Loup	Valley	Yes
Schultz Site	10/15/1966	North Loup	Valley	Unknown – Address Restricted
St. Peder's Dansk Evangelical Lutheran Kirke	3/21/2007	Nysted	Howard	No
Church of the Visitation of the Blessed Virgin Mary	2/23/1984	O'Connor	Greeley	No
People's Unitarian Church	6/14/1984	Ord	Valley	Unknown – Address Restricted
Valley County Courthouse	1/10/1990	Ord	Valley	No
Palmer Site	10/15/1966	Palmer	Howard	Unknown – Address Restricted
Petersburg Jail	3/15/2005	Petersburg	Boone	No

Title	Date Published	Nearest Community	County	In Floodplain?
St. Bonaventure Church Complex	10/19/1982	Raeville	Boone	No
Sargent Bridge	6/29/1992	Sargent	Custer	Yes
Scotia Chalk Building	10/11/1979	Scotia	Greeley	Unknown – Address Restricted
First Presbyterian Church	4/14/2004	Spalding	Greeley	No
Spalding Power Plant and Dam	12/31/1998	Spalding	Greeley	No
St. Michael's Catholic Church Complex	12/15/1983	Spalding	Greeley	No
Howard County Courthouse	1/10/1990	St. Paul	Howard	No
Sweetwater Archeological Site	7/29/1974	Sweetwater	Sherman	No
St. Michael's Catholic Church	11/28/1990	Tarnov	Platte	No
Pavillion Hotel	11/27/1989	Taylor	Loup	No
Williams, Thomas and Mary, Homestead	12/31/1998	Taylor	Loup	Unknown – Address Restricted
Lincoln Highway--Duncan West	7/3/2007	Village of Duncan and Butler Townshi	Platte	Unknown – Address Restricted

Source: National Park Service[29]

29 National Park Service. January 2022. "National Register of Historic Places NPGallery Database." https://npgallery.nps.gov/nrhp.

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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 27: 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 same methodology as 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.

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

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.

planning area, Section Seven will discuss 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 have been 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 are 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 which there is a robust historic record and for which monetary damaged 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.

- **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 community.

An example of the Event Damage Estimate is found below:

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

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 are not all inclusive and the database 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 were from 2000 to 2020. Data for all the hazards are not always available, so only those with an available dataset are included in the loss estimation.

Annual probability can be calculated based on the total years of record and the total number of years in which an event occurred. An example of the annual probability estimate is found below:

$$Annual\ Probability\ (\%) = \frac{Total\ Years\ with\ an\ Event\ Occurring\ (\#)}{Total\ Years\ Recorded\ (\#)}\ x\ 100$$

HAZARD IDENTIFICATION

The identification of relevant hazards for the planning area began with a review of the 2021 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 the previous 2016 Lower Loup NRD HMP to determine 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 28: Hazards Addressed in the Plan

Hazards Addressed in the Plan		
Agricultural Disease (Animal and Plant)	Flooding	Severe Thunderstorms
Dam Failure	Grass/Wildfires	Severe Winter Storms
Drought	Hazardous Chemicals	Terrorism
Earthquakes	Levee Failure	Tornadoes and High Winds
Extreme Heat	Public Health Epidemic	

HAZARD ELIMINATION OR CHANGES

Given the location and history of the planning area the following hazards listed in the 2021 State of Nebraska HMP were not included in this HMP. A brief explanation of why the hazards were eliminated is provided below.

Animal Disease: This hazard is addressed for the planning area under Agricultural Disease and is not broken out specifically.

Human Infectious Disease: This hazard is addressed under the title of Public Health Epidemic.

Plant Disease and Pests: This hazard is addressed for the planning area under Agricultural Disease and is not broken out specifically.

Power Failure: Power failure commonly occurs as an impact after major hazard events. Additionally, there are limited data resources available to quantify power failure events and cost estimates.

Additionally, several hazards from the 2016 Lower Loup NRD 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:

- Severe Thunderstorms and Hail
- Tornadoes and High Winds

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. 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 in this section.

Table 29: Regional Risk Assessment

Hazard	Previous Occurrences	Approximate Annual Probability	Likely Extent
Agricultural Animal Disease	195	7/7 = 100%	Mean ~189 animal per event; Median ~2 animal per event
Agricultural Plant Disease	101	21/21 = 100%	Unavailable
Dam Failure	12	7/130 = 5%	Varies by structure; Inundation of floodplain downstream from dam
Drought	444 events/1,512 months	29.3%	Mild Drought (D1)
Earthquakes	31	6/121 = 6%	~2.0 – 4.0 magnitude
Extreme Heat	Avg. 3 days per year	108/128 = 84%	>100°
Flooding	208	23/25 = 92%	Inundation of structures and roads near streams likely. Some evacuations of people may be necessary. Moderate flooding extent anticipated.
Grass/Wildfires	1,743	21/21 = 100%	Avg. fire <40 acres; Moderate homes and structures threatened or at risk
Hazardous Materials – Fixed Sites	67	26/31 = 84%	Avg. spill ~526 gallons. Localize to the facilities and adjacent surroundings
Hazardous Materials – Transportation	29	20/31 = 65%	<800 gallons, Limited (<0.5 mile) from release site
High Winds	258	23/25 = 92%	8 BWF
Levee Failure	2	~1%	Structures located in protected areas*
Public Health Epidemic	3 outbreak events	>1%	Varies by event; >1 fatality
Severe Thunderstorms	2,928	25/25 = 100%	≥1” rainfall 25-40 mph winds
Severe Winter Storms	840	25/25 = 100%	.25 - .5” ice 10-20°below zero (wind chills) 4-8” snow 25-40 mph winds
Terrorism	3	1/45 = <1%	Undefined
Tornadoes	142	24/25 = 96%	EF0

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

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

Table 30: Loss Estimation for the Planning Area

Hazard Type		Count	Property Loss	Crop Loss	Other Impacts
Agricultural Disease	Animal Disease	195	13,778 animals	N/A	
	Plant Disease	101	N/A	$1,096,715	
Dam Failure		12	$0	N/A	
Drought		444 out of 1,512 months	$34,000,000	$211,993,088	
Earthquakes		31	$0	$0	
Extreme Heat		Avg 3 days/yr	$0	$45,079,958	
Flooding	Flash Flood	120	$23,259,200	$3,009,032	2 fatalities
	Flood	88	$30,258,000		
Grass/Wildfires		1,743	69,276 acres	$500,295,574	26 injuries 2 fatalities 141 structures threatened 17 destroyed structures
Hazardous Materials	Fixed Sites	67	$0	N/A	35 evacuated 3 injuries
	Transportation	29	$929,130	N/A	
Levee Failure		2	$2,365,000	N/A	
Public Health Epidemic		~12,022 cases	N/A	N/A	
Severe Thunderstorms	Hail	2,148	$28,886,800	$139,624,554	
	Heavy Rain	63	$565,000	$51,112,752	
	Lightning	17	$569,000	N/A	2 injuries
	Thunderstorm Wind	700	$15,577,700	N/A	1 injury
Severe Winter Storms	Blizzard	111	$4,529,500	$7414,950	
	Extreme Cold/Wind Chill	63	$0		
	Heavy Snow	56	$0		
	Ice Storm	40	$6,961,000		1 fatality
	Winter Storm	401	$12,328,000		1 injury
	Winter Weather	169	$25,000		
Terrorism		3	$0	N/A	
Tornadoes and High Winds	High Winds	258	$6,110,400	$26,828,922	17 injuries
	Tornadoes	142	$13,298,000	$46,958	2 injuries
Total		**6,559**	**$179,661,730**	**$986,502,503**	**5 fatalities; 52 injuries**

HISTORICAL DISASTER DECLARATIONS

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

FARM SERVICE AGENCY SMALL BUSINESS ADMINISTRATION DISASTERS

The U.S. Small Business Administration (SBA) was created in 1953 as an independent agency of the federal government to aid, counsel, assist, and protect the interests of small business concerns, to preserve free competitive enterprise, and maintain and strengthen the overall economy of our nation. A program of the SBA includes disaster assistance for those affected by major natural disasters. The following table summarizes the SBA Disasters involving the planning area in the last from 2005-2015 (latest available data from SBA).

Table 31: SBA Declarations

Disaster Declaration Number	Declaration Date	Description	Primary Counties	Contiguous Counties
NE-00059	1/28/2015	Drought	Custer, Garfield, Loup, Sherman, Valley	Greeley, Howard, Wheeler
NE-0061	7/31/2014	Tornadoes, High Winds, Flooding	Stanton	Platte
NE-0060	6/17/2014	Drought	Custer, Garfield, Loup, Sherman, Valley	Greeley, Howard, Wheeler
NE-00053	12/10/2013	Drought	Boone, Custer, Garfield, Greeley, Loup, Nance, Platte, Sherman, Valley, Wheeler	
NE-00049	4/1/2013	Drought	Garfield, Loup, Platte, Wheeler	Boone, Custer, Greeley, Howard, Nance, Sherman, Valley
NE-00038	09/07/2011 08/12/2011 11/18/2011	Drought		Custer
NE-00011	1/7/2007	Severe Winter Storms	Boone, Custer, Garfield, Greeley, Howard, Loup, Nance, Platte, Sherman, Valley, Wheeler	

**Denotes date of grant application deadline, rather than disaster declaration date*

PRESIDENTIAL DISASTER DECLARATIONS

The presidential disaster declarations involving the planning area from 2001 to 2021 are summarized in the following table.

Table 32: Presidential Disaster Declarations

Disaster Declaration Number	Declaration Date	Hazards	Declared County/Area*
DR-4521	2020	COVID-19 Pandemic	Boone, Custer, Garfield, Howard, Greeley ,Loup, Platte, Nance, Sherman, Valley, Wheeler
DR-4420	2019	Severe Winter Storm, Straight-Line Winds, and Flooding	Boone, Custer, Garfield, Howard, Greeley ,Loup, Platte, Nance, Sherman, Valley, Wheeler
DR-4375	2018	Severe Winter Storm and Straight-Line Winds	Boone, Custer, Garfield, Howard, Greeley ,Loup, Platte, Nance, Sherman, Valley, Wheeler
DR-4325	2017	Severe Storms, Tornadoes, and Straight-Line Winds	Platte
DR-4321	2017	Severe Winter Storms and Straight-Line Winds	Custer, Garfield, Loup, Valley
DR-4185	2014	Severe Thunderstorms, Tornadoes, High Winds, Flooding	Valley
DR-4156	2013	Severe Thunderstorms, Severe Winter Storms, Tornadoes, Flooding	Greeley, Howard, Sherman
DR-3483	2020	COVID-19	Boone, Custer, Garfield, Howard, Greeley ,Loup, Platte, Nance, Sherman, Valley, Wheeler
DR-3245	2005	Hurricane Katrina	Boone, Custer, Garfield, Greelye, Howard, Loup, Nance, Platte, Sherman, Wheeler, Valley
DR-1924	2010	Severe Thunderstorms, Flooding, Tornadoes	Boone, Custer, Garfield, Greeley, Howard, Loup, Nance, Platte, Sherman, Valley, Wheeler
DR-1902	2010	Severe Thunderstorms, Ice Jams, Flooding	Greeley, Howard, Loup, Nance, Platte, Valley, Wheeler
DR-1878	2010	Severe Winter Storms	Garfield, Nance
DR-1853	2009	Floods, Tornadoes, Severe Thunderstorms	Custer
DR-1770	2008	Floods, Tornadoes, Severe Thunderstorms	Boone, Custer, Garfield, Greeley, Howard, Loup, Nance, Platte, Valley, Wheeler
DR-1714	2007	Floods, Severe Thunderstorms	Custer County, Greeley County, Howard County, Loup County, Valley County, Wheeler County

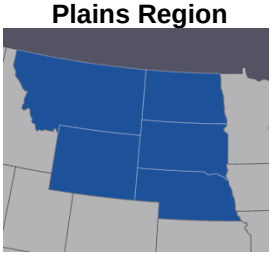
Disaster Declaration Number	Declaration Date	Hazards	Declared County/Area*
DR-1706	2007	Severe Winter Storms	Custer County, Garfield County, Loup County, Wheeler County
DR-1674	2007	Severe Winter Storms	Boone County, Custer County, Garfield County, Greeley County, Howard County, Loup County, Nance County, Platte County, Sherman County, Valley County, Wheeler County
DR-1627	2006	Severe Winter Storms	Custer County, Garfield County, Greeley County, Loup County, Nance County, Sherman County, Valley County, Wheeler County
DR-1590	2005	Floods, Severe Thunderstorms	Howard County
DR-1517	2004	Floods, Tornadoes, Severe Thunderstorms	Greeley County, Howard County, Nance County, Sherman County
DR-1480	2003	Tornadoes, Severe Thunderstorms	Greeley County, Howard County, Platte County, Valley County
DR-1373	2001	Floods, Tornadoes, Severe Thunderstorms	Custer County

*Source: Federal Emergency Management Agency, 2001-2021; *Only counties within planning area are included*

CLIMATE ADAPTATION

Long-term climate trends have shifted throughout the 21st century and have created significant changes in precipitation and temperature which have altered the severity and subsequent impacts from severe weather events. The Regional and Local Planning Teams identified changes in the regional climate as a top concern impacting communities, Indian tribes, residents, local economies, and infrastructure throughout the planning area. Discussions on temperature, precipitation, and climate impacts are included below.

Figure 6: Great Plains Region



The planning area is located in the Northern Great Plains region of the United States, which stretches from Montana and North Dakota southward to Wyoming and Nebraska. A large elevation change across the region contributes to high geographical, ecological, and climatological variability, including a strong gradient of decreasing precipitation moving from east to west across the region. Significant weather extremes impact this area, including winter storms, extreme heat and cold, severe thunderstorms, drought, and flood producing rainfall.

The Fourth National Climate Assessment has provided an overview of potential impacts within the planning area.

- **Water**: Water is the lifeblood of the Northern Great Plains, and effective water management is critical to the region's people, crops and livestock, ecosystems, and energy industry. Even small changes in annual precipitation can have large effects downstream; when coupled with the variability from extreme events, these changes make

managing these resources a challenge. Future changes in precipitation patterns, warmer temperatures, and the potential for more extreme rainfall events are very likely to exacerbate these challenges.

- **Agriculture:** Agriculture is an integral component of the economy, the history, and the culture of the Northern Great Plains. Recently, agriculture has benefited from longer growing seasons and other recent climatic changes. Some additional production and conservation benefits are expected in the next two to three decades as land managers employ innovative adaptation strategies, but rising temperatures and changes in extreme weather events are very likely to have negative impacts on parts of the region. Adaptation to extremes and to longer-term, persistent climate changes will likely require transformative changes in agricultural management, including regional shifts of agricultural practices and enterprises.
- **Recreation and Tourism:** Ecosystems across the Northern Great Plains provide recreational opportunities and other valuable goods and services that are at risk in a changing climate. Rising temperatures have already resulted in shorter snow seasons, lower summer streamflow's and higher stream temperatures. These changes have important consequences for local economies that depend on winter or river-based recreational activities. Climate-induced land-use changes in agriculture can have cascading effects on closely entwined natural ecosystems, such as wetlands, and the diverse species and recreational amenities they support. For the planning area, potential impacts to Sandhills Crane habitat can have a significant impact on the local tourism economy.
- **Energy:** Fossil fuel and renewable energy production and distribution infrastructure is expanding within the Northern Great Plains. Climate change and extreme weather events put this infrastructure at risk, as well as the supply of energy it contributes to support individuals, communities, and the U.S. economy as a whole. The energy sector is also a significant source of greenhouse gases and volatile organic compounds that contribute to climate change and ground-level ozone pollution.

Nebraska's Changing Climate

The United States as a whole is experiencing significant changes in temperature, precipitation, and severe weather events resulting from climate change. Long term climate trends have and will continue to increase the risk to hazards within the planning area. Since 1895, Nebraska's overall average temperature has increased by about 1.5°F. This trend will lead to an increase in the frequency and intensity of hazardous events, which will cause a number of significant economic, social, and environmental impacts on Nebraskans.

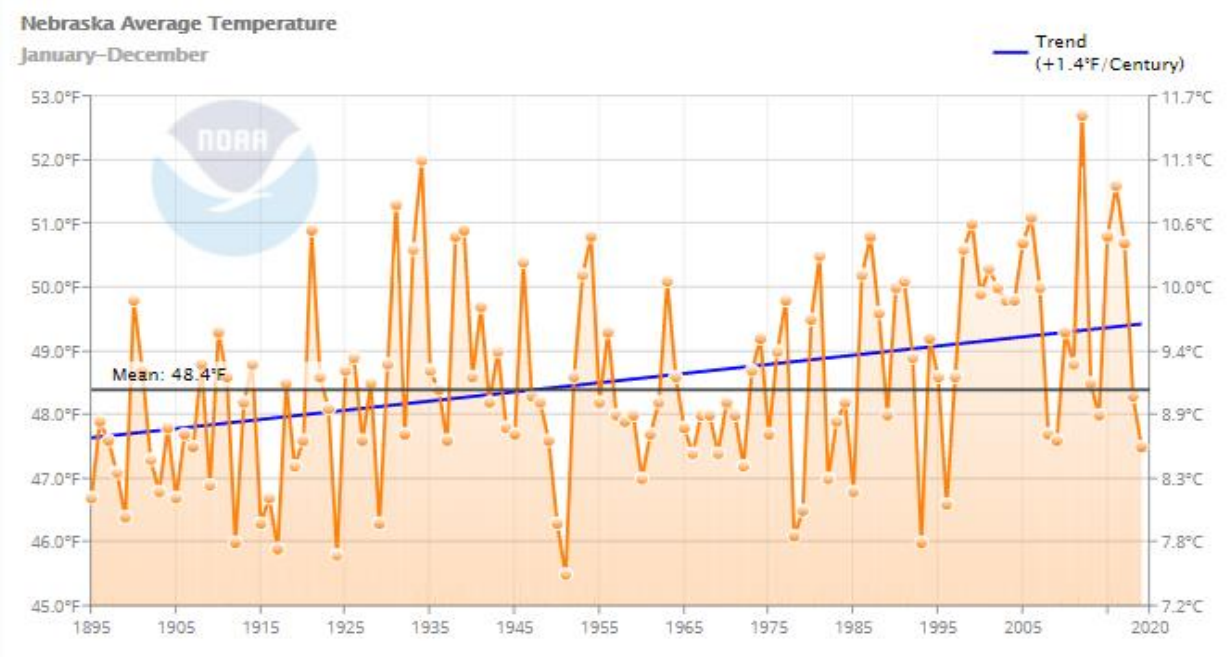
According to a University of Nebraska report (*Understanding and Assessing Climate Change: Implications for Nebraska, 2014*), the following changes can be expected for Nebraska's future climate:

- Increase in extreme heat events (days over 100°F)
- 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 and Platte River from reduced snowpack in the Rocky Mountains
- Additional 30-40 days in the frost-free season

Changes in Temperature

Since 1895 Nebraska's overall average temperature has increased by almost 1.5°F (Figure 7). The Great Plains region has additionally seen the greatest increase in overall temperature in the past two decades. While overall temperature shifts have not been consistent, the trend for increasing temperatures is apparent. Climate modeling suggests warmer temperature conditions will continue in the coming decades and rise steadily into mid-century. 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.

Figure 7: Nebraska Average Temperature (1895-2020)



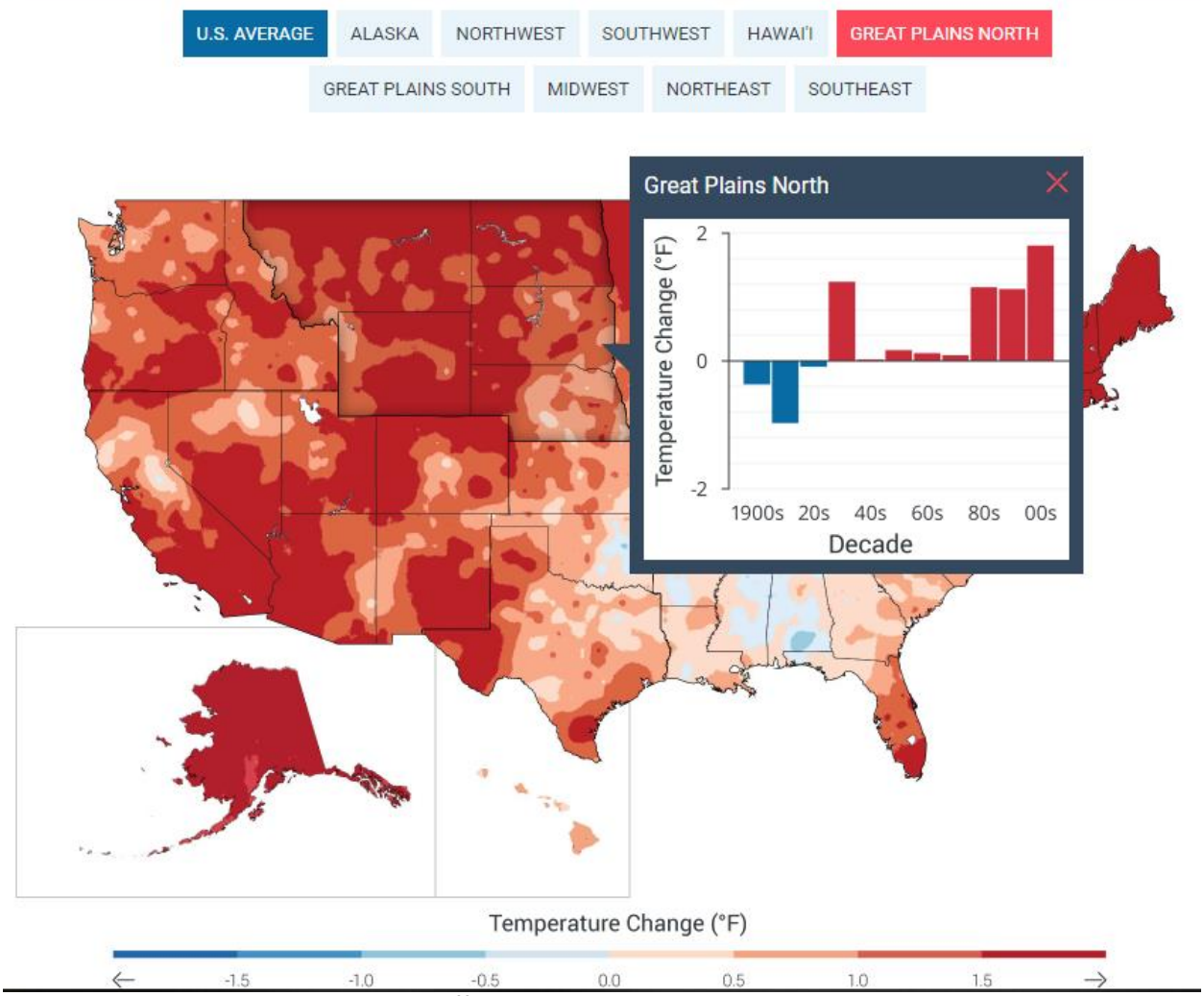
Source: NOAA, 2020[30]

Additionally, the length of the frost-free season (i.e. growing season) has been increasing nationally since the 1980s. While a longer growing season may provide some benefit for heavily agricultural areas, concurrent changes in temperature, water availability, and pest pressures may cause additional impacts. For instance, longer growing seasons coinciding with periods of drought and extreme heat can indicate lower production from increased plant mortality and increased risk to wildfire ignition probability and fuel load potentials. On average, the Great Plains has seen an increase of ten days to the annual growing season.[31]

[30] NOAA. 2020. "Climate at a Glance: Statewide Time Series.". Accessed September 2020. https://www.ncdc.noaa.gov/cag/statewide/time-series/25/tavg/12/12/1895-2020?base_prd=true&begbaseyear=1901&endbaseyear=2000&trend=true&trend_base=100&begtrendyear=1895&endtrendyear=2020

[31] U.S. Global Change Research Program. "2014 National Climate Assessment: Frost-free Season." Accessed 2020. https://nca2014.globalchange.gov/report/our-changing-climate/frost-free-season#tab2-images

Figure 8: Observed U.S. Temperature Change



Source: National Climate Assessment, 2014[32]

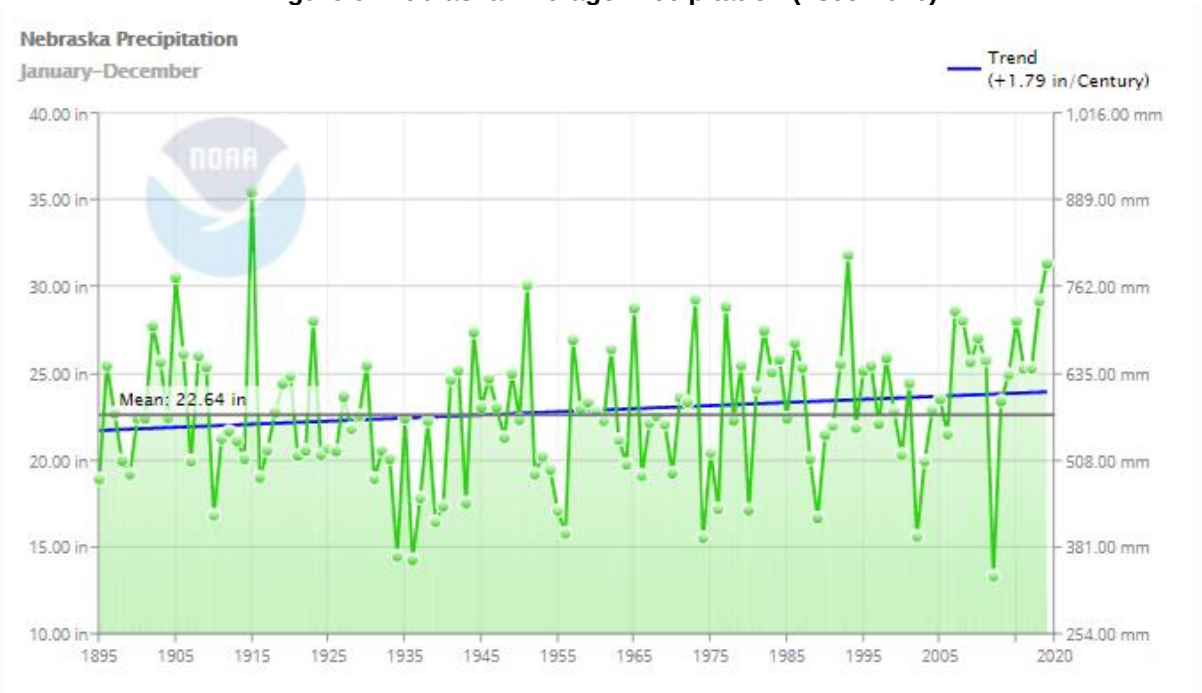
Changes in Precipitation

Changing extremes in precipitation are anticipated in the coming decades, with more significant rain and snowfall events and more intense drought periods. Seasonal variations will be heightened, with more frequent and more significant rainfall expected in the spring and winter and hotter, drier periods in the summer. Since 1895, yearly annual precipitation for Nebraska has increased slightly. This trend is expected to continue as the impacts of climate change continue to be felt. Climate modeling may show only moderate precipitation and streamflow changes; however, most of the Northern Great Plains region is already at risk to large annual and seasonable variability as seen by flooding and drought events occurring in concurrent years. There will likely be more days with a heavy precipitation event (rainfall of greater than one inch per day) across the region and subsequent impacts to riverine flooding events or overwhelmed local stormwater management systems. Groundwater and reservoir water sources are increasingly important to communities and residents in the planning area to meet water needs during periods of shortage. Precipitation varies significantly across the state (Figure 10) and

[32] U.S. Global Change Research Program. "2014 National Climate Assessment." Accessed 2020. https://nca2014.globalchange.gov/

moves in a longitudinal gradient. The east receives twice as much precipitation (35 inches annually) as the Nebraska Panhandle (15 inches) on average.[33] The planning area is located nearly equidistant from either end of the state.

Figure 9: Nebraska Average Precipitation (1895-2020)

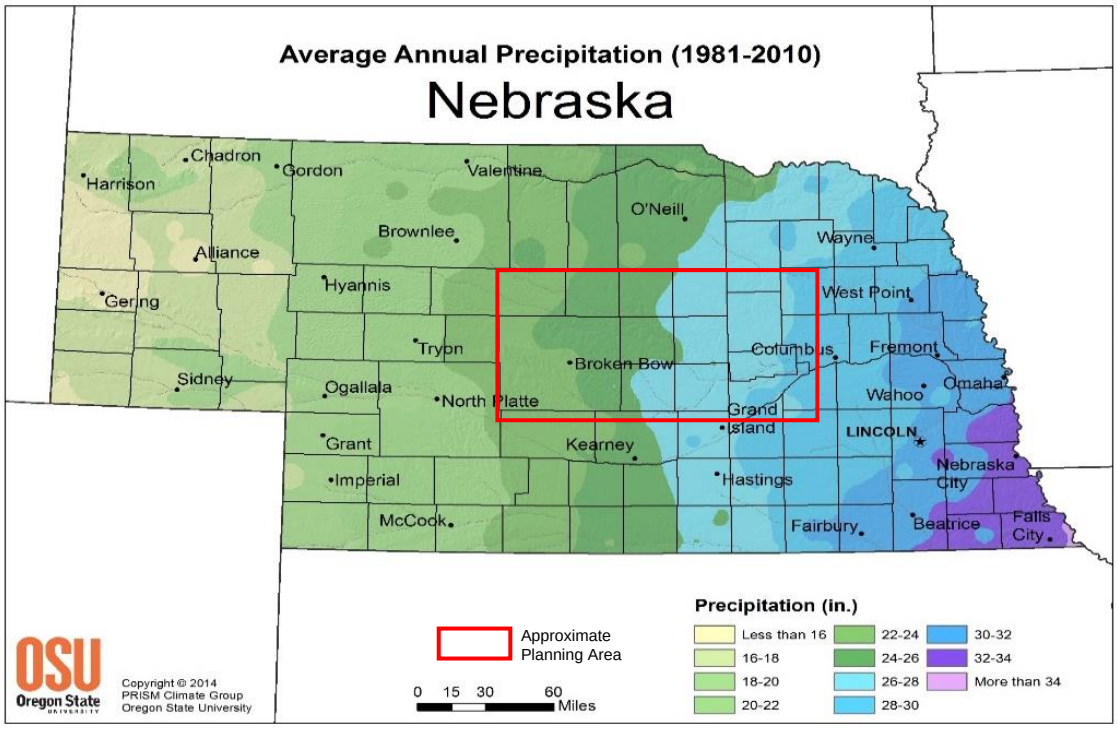


Source: NOAA, 2020[34]

[33] North Central Climate Collaborative. January 2020. "NC3 Nebraska Climate Summary." Accessed April 2021. https://northcentralclimate.org/files/2020/01/nc3-Nebraska-Climate-Summary-FINAL_2.12.pdf?x24082

[34] NOAA. 2020. "Climate at a Glance: Statewide Time Series.". Accessed September 2020. https://www.ncdc.noaa.gov/cag/statewide/time-series/25/pcp/12/12/1895-2020?base_prd=true&begbaseyear=1901&endbaseyear=2000&trend=true&trend_base=100&begtrendyear=1895&endtrendyear=2020

Figure 10: Average Annual Precipitation for Nebraska (1981-2010)



Source: Oregon State University PRISM Climate Group, 2014

Impacts from Climate Change

Observed changes in the intensity and frequency of extreme events are a significant concern now and in the future because of the social, environmental, and economic costs associated with their impacts. Challenges that are expected to affect communities, environments, and residents as a result of climate change include:

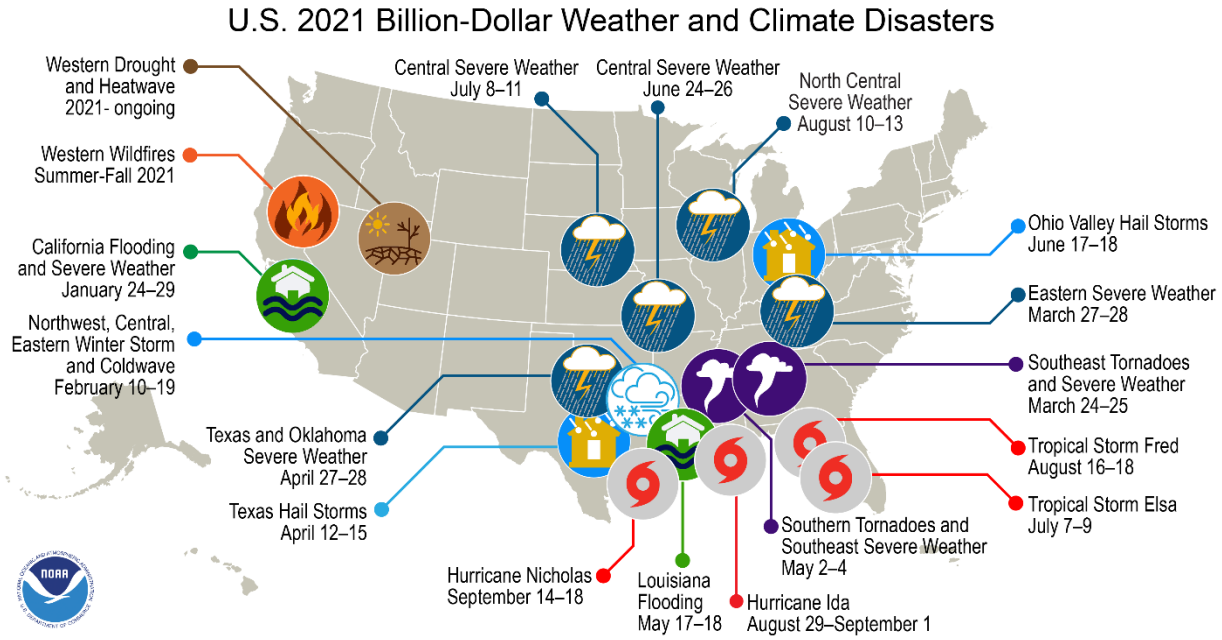
- Developing and maintaining sustainable agricultural systems
- Resolving increasing competition among land, water, and energy resources
- Conserving vibrant and diverse ecological systems
- Enhancing the resilience of the region's people to the impacts of climatic extremes

Certain groups of people may face greater difficulty when dealing with the impacts of a changing climate. Older adults, immigrant communities, and those living in poverty are particularly susceptible. Additionally, specific industries and professions tied to weather and climate, like outdoor tourism, commerce, and agriculture, are especially vulnerable.[35]

As seen in the figure below, the United States is experiencing an increase in the number of billion-dollar natural disasters.

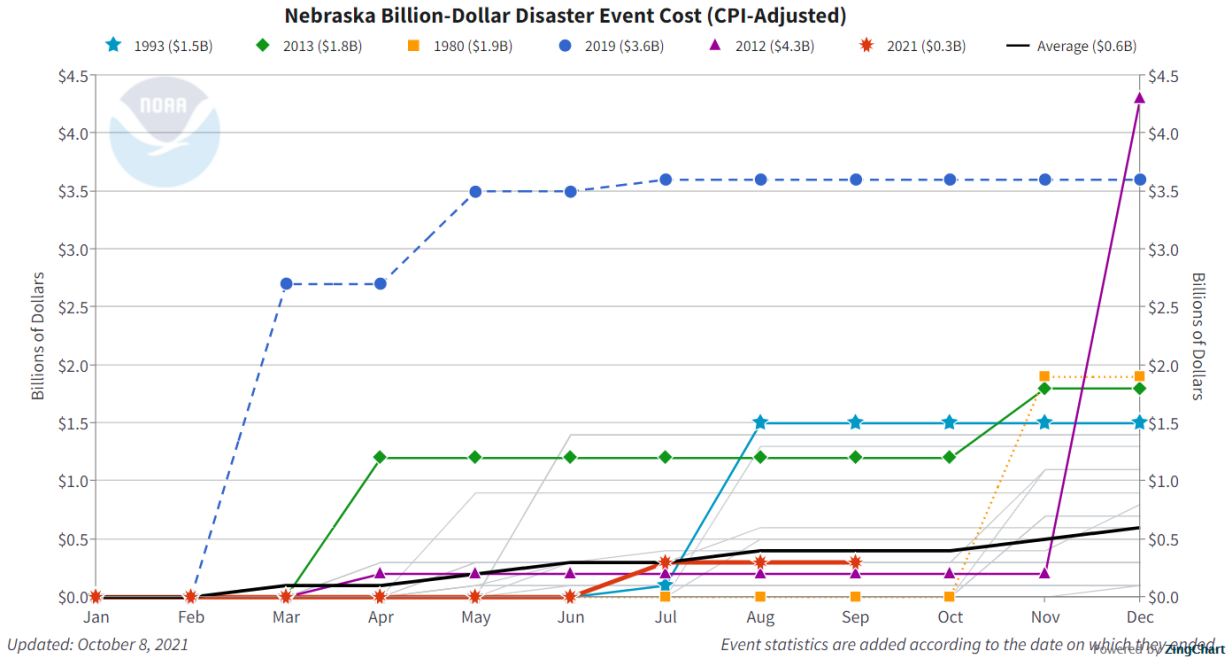
[35] U.S. Environmental Protection Agency. "Climate Impacts on Society." Accessed April 2021. https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-society_.html

Figure 11: Billion Dollar Weather and Climate Disasters (Oct 2021)



Source: NOAA, 2021[36]

Figure 12: Billion Dollar Disaster Costs in Nebraska



Source: NOAA, 2021

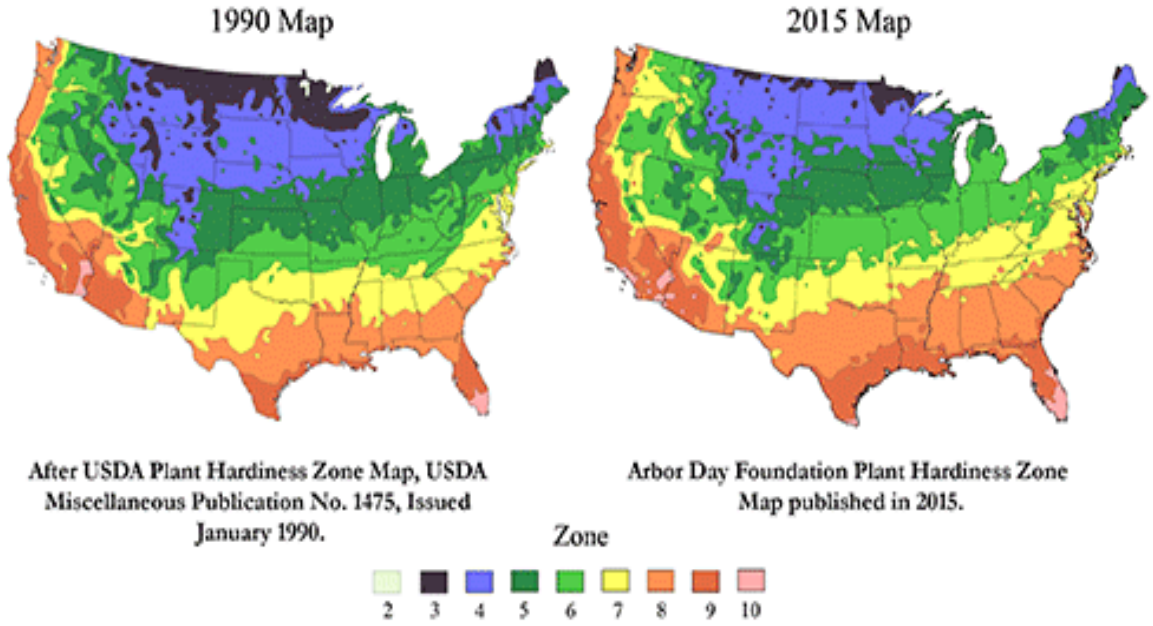
Agriculture

The agricultural sector will experience an increase in droughts, an increase in grass and wildfire events, changes in the growth cycle as winters warm, an influx of new and damaging agricultural diseases or pests, and changes in the timing and magnitude of rainfall. As described in the Plant

[36] NOAA. 2020. "Billion-Dollar Weather and Climate Disasters: Overview. Accessed April 2021. https://www.ncdc.noaa.gov/billions/overview

Hardiness Zone map (Figure 13) available for the United States, these changes have shifted the annual growing season and expected agricultural production conditions. Nebraska is vulnerable to changes in growing season duration and growing season conditions as a heavily agriculturally dependent state. These added stressors on agriculture could have devastating economic effects if new agricultural and livestock management practices are not adopted.

Figure 13: Plant Hardiness Zone Change



Source: Arbor Day Foundation, 2018[37]

Air Quality

Rising temperatures will also impact air quality. Harmful air pollutants and allergens increase as temperatures increase. More extended periods of warmth contribute to longer pollen seasons that allow plant spores to travel farther and increase exposure to allergens. More prolonged exposure to allergens can increase the risk and severity of asthma attacks and worsen existing allergies in individuals.[38] An increase in air pollutants can occur from the growing number of grass and wildfires. The public can be exposed to harmful particulate matter from smoke and ash that can cause various health issues. Depending on the length of exposure, age, and individual susceptibility, effects from wildfire smoke can range from eye and respiratory irritation to severe disorders like bronchitis, asthma, and aggravation of pre-existing respiratory and cardiovascular diseases. [39]

Drought and Extreme Heat

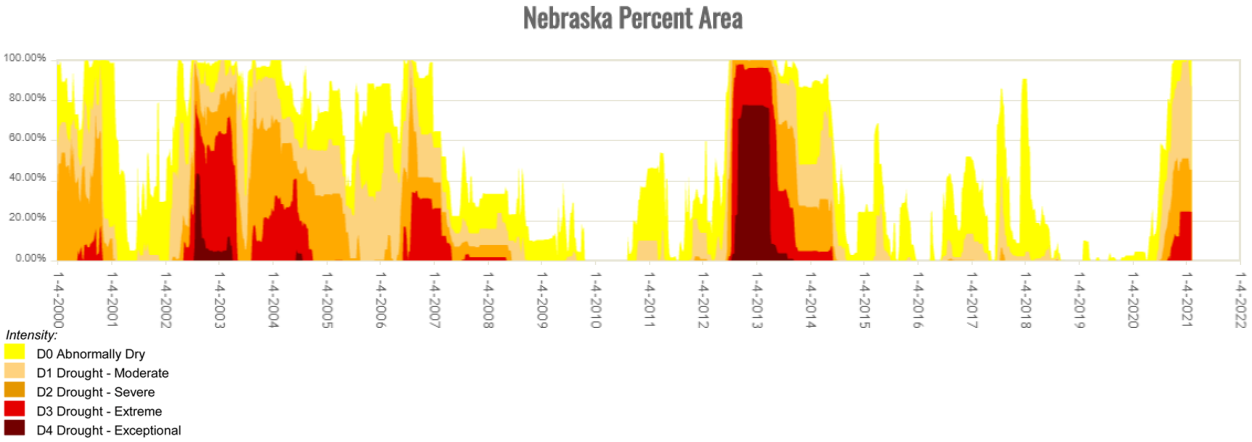
An increase in average temperatures will contribute to the rise in the frequency and intensity of hazardous events like extreme heat and drought, which will cause significant economic, social, and environmental impacts on Nebraskans. Although drought is a natural part of the climate system, increasing temperatures will increase evaporation rates, decrease soil moisture, and lead

[37] Arbor Day Foundation. 2018. "Hardiness Zones." https://www.arborday.org/media/map_change.cfm.
[38] Asthma and Allergy Foundatino of America. 2010. "Extreme Allergies and Climate Change." Accessed 2021. https://www.aafa.org/extreme-allergies-and-climate-change/
[39] AirNow. 2019. "Wildfire Smoke: A Guide for Healthcare Professionals." Accessed 2021. https://www.airnow.gov/sites/default/files/2020-10/wildfire-smoke-guide-revised-2019-chapters-1-3_0.pdf

to more intense droughts in the future, having negative impacts on dryland farming. Extreme heat events have adverse effects on both human and livestock health. Heatwaves may also impact plant health, with negative effects on crops during essential growth stages. Increasing temperatures and drought may reduce the potential for aquifers to recharge, which has long-term implications for the viability of agriculture in Nebraska.

Changes in precipitation are tied to changes in drought patterns. The following figure shows the percent of Nebraska's area that experienced significant increases in moderate (D1) to exceptional drought (D4) from 2000 to January 2021. Record dryness occurred in Nebraska between June through August of 2012. Nebraska in 2012 had the driest year on record. The area will remain vulnerable to periodic drought as most projected increases in precipitation are anticipated to occur during the winter months, while increasing temperatures lead to increased soil drying.

Figure 14: Drought Severity 2000-January 2021



Source: NOAA, 2018

Energy

Shifting climate trends will have a direct impact on water and energy demands. As the number of 100°F days increases, along with warming nights, the stress placed on the energy grid will likely increase and possibly lead to more power outages. Severe weather events also stress energy production, infrastructure transmission, and transportation. Roads, pipelines, and rail lines are all at risk of damages from flooding, extreme heat, erosion, or added stress from increased residential demands.[40] Critical facilities and vulnerable populations that are not prepared to handle periods of power outages, particularly during heat waves, will be at risk.

Precipitation

With a changing climate, winter and spring precipitation is projected to increase across Nebraska. Average annual precipitation varies across the state, with the panhandle receiving 15 inches and the southeast receiving up to 35 inches. According to climate projections, winter and spring will likely become 20 percent wetter, with summers becoming 10 percent drier.

Winter precipitation is projected to increase in intensity and may benefit Nebraska's agricultural economy by improving soil moisture but could potentially delay crop planting in the summer.

[40] USGCRP, 2018: Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II: Report-in-Brief [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 186 pp.

Increased spring precipitation may lead to heightened runoff and flooding, reducing water quality and eroding soils.[41]

Water Quality

Increasing temperatures, shifting precipitation patterns, and extreme weather events impact water quality throughout the state. As average temperatures increase, water temperatures also rise and put water bodies at risk for eutrophication and excess algal growth that reduce water quality. Extreme weather events and shifting precipitation can lead to fluctuating river flows, erosion, sediment accumulation, and morphological changes to water bodies and surrounding landscapes. In agricultural landscapes, major storm events can cause sediment and nutrients such as phosphorous and nitrogen to runoff into nearby water sources. Runoff can contribute to the buildup of nutrients in the water, increasing plant and algae growth that can deplete oxygen and kill aquatic life. Nutrient enrichment can lead to toxic cyanobacterial harmful algae blooms (cyanoHABs), which can be harmful to animal and human health. CyanoHABs can cause economic damage such as decreasing property values, reducing recreational revenue, and increasing the costs for treating drinking water.[42]

With the increasing intensity and frequency of extreme precipitation events, impacts to water systems ultimately threaten human health. Events can lead to flooding and stormwater runoff that can carry pollutants across landscapes and threaten human health by contaminating water wells, groundwater, and other bodies of water. Common pollutants include pesticides, bacteria, nutrients, sediment, animal waste, oil, and hazardous waste. Flooding impacts property, infrastructure, economies, and the ecology of water bodies.

Grass/Wildfire

Rising temperatures can increase the frequency and intensity of wildfires across the state. Warmer temperatures cause snow to melt sooner and create drier soils and forests, which act as kindling to ignite and spread fires. Additionally, warmer nighttime temperatures contribute to the continued spread of wildfires over multiple days.[43]

Severe Storms

Nebraska experiences frequent snowstorms and ice storms during winter, which can produce heavy snowfall and high wind gusts that lead to whiteout conditions. In the warmer months, convective storms are common and include flash flood-producing rainstorms and severe thunderstorms capable of producing hail, damaging winds, and tornadoes. As temperatures continue to rise, more water vapor evaporates into the atmosphere, creating increased humidity, which can develop intense storms.

Future Adaptation and Mitigation

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

[41] NOAA NCEI. 2017. "Nebraska State Climate Summary." Accessed 2021. https://statesummaries.ncics.org/chapter/ne/

[42] USGS. "Nutrients and Eutrophication". Accessed February 2021. https://www.usgs.gov/mission-areas/water-resources/science/nutrients-and-eutrophication?qt-science_center_objects=0#qt-science_center_objects

[43] NASA Global Climate Change. September 2019. "Satellite Data Record Shows Climate Change's Impact on Fires." Accessed 2021. https://climate.nasa.gov/news/2912/satellite-data-record-shows-climate-changes-impact-on-fires/

Jurisdictions in the planning area should consider past and future climate changes and impacts when incorporating mitigation actions into local planning processes.

HAZARD PROFILES

Based on research and the 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 examine the identified hazards across the region, local concerns or deviations from the regional risk assessment will be addressed in *Section Seven* of this plan as applicable per jurisdiction.

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

Table 33: Top Hazards of Concern by Jurisdiction

Jurisdiction	Agricultural Disease	Dam Failure	Drought	Earthquakes	Extreme Heat	Flooding	Grass/Wildfire	Hazardous Materials	Levee Failure	Public Health Epidemic	Severe Thunderstorms	Severe Winter Storms	Terrorism	Tornadoes and High Winds
Lower Loup NRD														
Boone County		X	X			X		X			X	X		
City of Albion & Albion Fire and Rescue		X				X	X	X			X	X		X
Village of Cedar Rapids		X				X					X			X
Village of Petersburg						X					X	X		X
Village of Primrose						X						X		X
City of St. Edward						X	X				X			X
Custer County	X	X				X					X			X
Village of Anselmo						X		X						X
Village of Ansley						X		X			X			X
Village of Arnold						X					X	X		X
Village of Berwyn			X		X	X					X	X		X
City of Broken Bow						X			X					
Village of Callaway	X		X			X					X	X		X
Village of Comstock						X	X							X
Village of Mason City						X	X					X	X	
Village of Oconto			X			X	X				X	X		X
City of Sargent						X	X					X		X
Garfield County	X	X				X	X				X	X	X	X
Village of Burwell		X				X					X	X		X
Greeley County		X				X	X				X	X		
Village of Greeley						X		X			X			X
Village of Scotia		X	X			X					X	X		X
Village of Spalding		X				X					X	X		X
Village of Wolbach					X	X	X				X	X		X
Howard County	X	X				X		X			X			X

Jurisdiction	Agricultural Disease	Dam Failure	Drought	Earthquakes	Extreme Heat	Flooding	Grass/Wildfire	Hazardous Materials	Levee Failure	Public Health Epidemic	Severe Thunderstorms	Severe Winter Storms	Terrorism	Tornadoes and High Winds
Village of Boelus			X			X					X	X		X
Village of Cotesfield		X				X					X	X		X
Village of Cushing						X	X			X	X	X		X
Village of Dannebrog			X			X		X	X		X	X		X
Village of Elba			X			X		X		X	X	X		X
Village of Farwell						X		X			X	X		
City of St. Paul			X			X		X			X	X		X
Loup County	X	X				X	X				X			X
Village of Taylor						X					X			X
Nance County		X	X		X	X					X	X		
Village of Belgrade						X		X		X	X	X		X
City of Fullerton			X			X					X	X		X
City of Genoa						X					X	X		X
Platte County		X				X		X			X	X		X
City of Columbus	X					X		X	X		X	X		X
Village of Duncan								X			X	X		
Sherman County		X				X	X				X	X		X
Village of Ashton						X					X	X		X
Village of Hazard						X					X	X		X
Village of Litchfield						X		X			X	X		X
City of Loup City	X					X					X			X
Village of Rockville						X					X	X		X
Valley County		X	X			X					X			
Village of Arcadia						X					X	X		X
Village of North Loup		X	X			X								
City of Ord			X			X					X	X		X
Wheeler County	X	X				X						X		X
Village of Bartlett	X							X				X		X

Jurisdiction	Agricultural Disease	Dam Failure	Drought	Earthquakes	Extreme Heat	Flooding	Grass/Wildfire	Hazardous Materials	Levee Failure	Public Health Epidemic	Severe Thunderstorms	Severe Winter Storms	Terrorism	Tornadoes and High Winds
Village of Ericson						X		X			X			X
Special Jurisdictions														
Arcadia Public Schools											X			
Duncan Fire District						X	X				X	X		X
Elba Fire and Rescue District							X							
Farwell Irrigation District		X	X			X							X	
Loup Basin Public Health Department						X				X	X	X		
Sargent Irrigation District		X	X			X							X	
Twin Loups Irrigation District		X				X			X					
Wheeler Central Schools	X						X	X			X			
Wheeler County Rural Fire Protection District							X							X

As identified by the local planning teams of participating jurisdictions, top hazards of concern in the planning area from greatest concern to least concern are:

1. Flooding
2. Severe Thunderstorms
3. Tornadoes and High Winds
4. Severe Winter Storms
5. Dam Failure
6. Grass/Wildfire
7. Hazardous Materials
8. Drought
9. Agricultural Animal and Plant Disease
10. Levee Failure
11. Public Health Epidemic
12. Terrorism
13. Extreme Heat
14. Earthquakes

AGRICULTURAL ANIMAL AND PLANT DISEASE

Agricultural diseases include 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 for Nebraska of agricultural products sold was estimated at $22 billion; this total is split between crops (estimated $9.3 billion) and livestock (estimated $12.7 billion). For the planning area, the market value of sold agricultural products exceeded $3.2 billion ($2.3 billion animal sales and $1 billion crop sales).[44]

The following table 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 34: Livestock Inventory

County	Market Value of 2017 Livestock Sales	Cattle and Calves	Hogs and Pigs	Poultry Egg Layers	Sheep and Lambs
Boone	$312,442,000	87,605	177,107	370	540
Custer	$597,650,000	329,990	(D)	1,535	991
Garfield	$43,940,000	329,990	(D)	1,535	991
Greeley	$127,314,000	69,586	(D)	(D)	295
Howard	$152,484,000	80,586	2,827	1,310	586
Loup	$26,412,000	28,924	(D)	63	405
Nance	$79,889,000	33,485	64,727	462	207
Platte	$496,964,000	138,324	594,888	2,068	571
Sherman	$58,420,000	65,196	623	113	734
Valley	$146,224,000	103,629	1,054	666	395
Wheeler	$262,213,000	131,572	(D)	149	(D)
Total	**$2,303,952,000**	**1,398,887**	**841,226**	**8,271**	**5,715**

Source: 2017 U.S. Census of Agriculture

44 US Department of Agriculture, National Agricultural Statistics Server. 2020. "2017 Census of Agriculture – Nebraska." https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/Nebraska/

Feedlot near Broken Bow

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

Table 35: Land and Value of Farms in the Planning Area

County	Number of Farms	Land in Farms (acres)	Market Value of 2017 Crop Sales
Boone	524	432,231	$161,337,000
Custer	1,108	1,505,139	$183,505,000
Garfield	202	342,498	$10,780,000
Greeley	369	339,287	$66,026,000
Howard	617	280,566	$82,699,000
Loup	130	279,800	$4,391,000
Nance	375	220,091	$75,414,000
Platte	836	383,635	$191,598,000
Sherman	384	310,819	$80,928,000
Valley	362	350,834	$77,667,000
Wheeler	215	357,279	$20,934,000
Total	**5,122**	**4,802,179**	**$955,279,000**

Source: 2017 U.S. Census of Agriculture

Table 36: Crop Values

County	Corn		Soybeans		Wheat	
	Acres Planted	Value (2017)	Acres Planted	Value (2017)	Acres Planted	Value (2017)
Boone	161,778	101,081,000	106,825	57,689,000	(D)	(D)
Custer	229,451	137,373,000	81,655	36,608,000	4,360	872,000
Garfield	229,451	7,507,000	81,655	(D)	4,360	N/A
Greeley	74,757	44,517,000	37,865	19,586,000	326	78,000
Howard	98,472	44,517,000	38,761	19,586,000	1,574	78,000

County	Corn		Soybeans		Wheat	
	Acres Planted	Value (2017)	Acres Planted	Value (2017)	Acres Planted	Value (2017)
Loup	4,326	(D)	802	366,000	N/A	N/A
Nance	80,439	45,917,000	54,835	27,605,000	460	142,000
Platte	172,895	112,994,000	132,206	69,745,000	890	106,000
Sherman	78,614	52,921,000	41,328	25,364,000	223	38,000
Valley	76,415	47,744,000	43,056	21,905,000	1,809	385,000
Wheeler	23,074	14,499,000	9,618	5,224,000	N/A	N/A
Total	**1,229,672**	**609,070,000**	**628,606**	**283,678,000**	**14,002**	**1,699,000**

Source: 2017 U.S. Census of Agriculture
N/A- Data not available

LOCATION

Given the agricultural presence in the planning area, animal and plant disease have the potential to occur across the planning area. If a major outbreak were to occur, the economy in the entire planning area would be affected, including urban areas. Loup County has the smallest amount of land used for agriculture and number of agricultural farms; however, many residents work in industries closely tied to surrounding agriculture producers which could be impacted by disease outbreaks.

The primary land uses where animal and/or plant diseases will be observed include: agricultural lands; range or pasture lands; forests; and/or concentrated animal feeding operations (CAFOs). It is possible that animal or plant disease will occur in domestic animals or crops in urban areas but their impacts will be limited in scope and severity.

HISTORICAL OCCURRENCES

Animal Disease

NDA provides reports on diseases occurring in the planning area. There were 195 instances of animal diseases reported between 2014 and 2020 by the NDA (Table 31). These outbreaks affected 13,778 animals.

Table 37: Livestock Diseases Reported in the Planning Area

Disease	Year	County	Population Impacted
Anaplasmosis	2014	Platte	1
	2016	Custer; Garfield; Nance; Platte; Valley	3; 1; 3; 1; 3
	2017	Boone; Howard; Nance	3; 2; 42
	2018	Boone; Custer; Greeley; Howard; Nance; Platte; Valley	1; 2; 94; 3; 31; 17; 100
	2019	Boone; Custer; Greeley; Platte	6; 2; 1; 5
	2020	Custer; Greeley; Platte	3; 2; 1
Bluetongue Disease	2014	Howard	1
	2016	Howard; Valley	1; 1
	2017	Howard	1
	2018	Boone	2
	2019	Custer	1

Disease	Year	County	Population Impacted
	2020	Boone	1
Bovine Genital Campylobacteriosis	2016	Valley	1
Bovine Viral Diarrhea	2014	Custer; Greeley; Howard; Loup; Platte; Sherman; Valley	1; 1; 2; 1; 1; 1; 2,553
	2015	Sherman; Valley	125; 270
	2016	Boone; Custer; Platte	1; 2; 2
	2017	Custer; Garfield; Wheeler	1; 1; 1
	2018	Howard; Valley	300; 2
	2019	Boone; Sherman	5; 1
	2020	Boone; Custer; Garfield; Greeley	1; 1; 3; 2
Brucellosis	2018	Howard	1
	2020	Custer	1
Epizootic Hemorrhagic Disease (Blue Tongue)	2019	Garfield	1
	2020	Custer	1
Enzootic Bovine Leukosis	2014	Custer; Garfield; Platte	1; 1; 150
	2015	Custer	200
	2016	Custer; Nance; Valley	3; 1; 2
	2017	Custer; Howard	2; 1
	2018	Garfield; Platte	501; 2
	2019	Greeley; Valley	2; 1
	2020	Howard; Platte; Wheeler	1; 1; 1
Equine Rhinopneumonitis	2019	Custer	3
Infectious bovine Rhiotracheitis/Infectious Pustula	2014	Loup; Wheeler	1; 1
	2018	Nance	1
	2019	Howard; Nance	2; 1
	2020	Greeley; Valley	3; 1
Leptospirosis	2014	Custer; Platte	1; 6
	2016	Custer; Greeley	2; 1
	2018	Custer	1
	2019	Boone; Custer; Platte; Wheeler	2; 1; 1; 1
	2020	Custer; Nance	1; 4
Paratuberculosis	2014	Boone; Custer; Nance; Platte; Valley	1; 105; 8; 1; 1
	2015	Custer; Garfield; Nance; Valley; Wheeler	1,400; 200; 140; 110; 25
	2016	Boone; Custer; Garfield; Howard; Nance; Platte; Valley	5; 13; 4; 1; 4; 1; 1
	2017	Boone; Custer; Garfield; Greeley; Howard; Nance; Valley; Wheeler	205; 614; 2; 3; 33; 6; 4; 1
	2018	Custer; Garfield; Greeley; Howard; Nance; Platte; Wheeler	8; 5; 84; 3; 5; 31; 107
	2019	Boone; Custer; Garfield; Greeley; Howard; Nance; Platte; Sherman; Valley; Wheeler	4; 14; 2; 3; 2; 13; 4; 1; 2; 1

Disease	Year	County	Population Impacted
	2020	Boone; Custer; Garfield; Greeley; Howard; Nance; Platte; Sherman; Valley; Wheeler	2; 9; 3; 1; 5; 2; 4; 1; 2; 1
Porcine Circovirus	2014	Platte	1
	2016	Nance	2
Porcine Delta Coronavirus	2016	Platte	2
	2018	Boone	3
	2019	Boone	2
Porcine Epidemic Diarrhea	2014	Custer; Nance; Platte	1; 1; 4
	2016	Boone; Greeley; Platte; Wheeler	8; 2; 1; 1
	2017	Boone; Howard	3; 1
	2019	Boone	1
Porcine Reproductive and Respiratory Syndrome	2014	Custer; Greeley; Platte; Sherman; Valley	2; 2; 3; 2; 1
	2015	Boone; Platte	2,650; 2,500
	2016	Boone; Platte; Sherman; Valley; Wheeler	1; 6; 4; 2; 2
	2017	Boone; Sherman	6; 2
	2018	Boone; Platte; Sherman; Valley	2; 503; 9; 3
	2019	Sherman; Valley	5; 1
	2020	Custer; Platte	4; 3
Salmonellosis	2019	Platte	1
Seneca Valley Virus	2017	Boone; Greeley; Wheeler	5; 3; 1
	2019	Platte	1
	2020	Platte	1
Trichomoniasis	2014	Custer; Greeley; Howard; Loup	1; 1; 2; 1
	2018	Custer	31
Tuberculosis	2017	Wheeler	250
Vesicular Stomatitis	2014	Wheeler	5

Source: Nebraska Department of Agriculture

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, being:

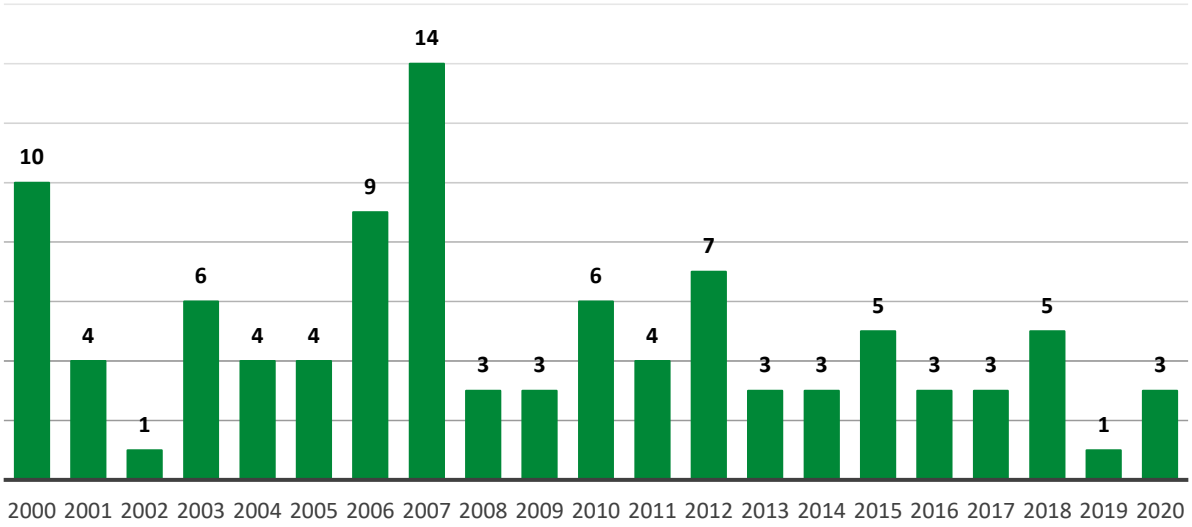
Table 38: Common Crop Diseases in Nebraska by Crop Types

Crop Type	Crop Disease	
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	Pot and Stem Blight
	Bacterial Blight	Purple Seed Stain
	Bean Pod Mottle	Rhizoctonia Root Rot
	Brown Spot	Sclerotinia Stem Rot

Crop Type	Crop Disease	
	Brown Stem Rot	Soybean Mosaic Virus
	Charcoal Rot	Soybean Rust
	Frogeye Leaf Spot	Stem Canker
	Phytophthora Root and Stem Rot	Sudden Death Syndrome
Wheat	Barley Yellow Dwarf	Leaf Rust
	Black Chaff	Tan Spot
	Crown and Root Rot	Wheat soy-borne Mosaic
	Fusarium Head Plight	Wheat Streak Mosaic
Sorghum	Ergot	Zonate Leaf Spot
	Sooty Stripe	
Trees	Burr Oak Blight	Dutch Elm Disease
	Powdery Mildew	Leaf Spot and Blight
	Canker (various types)	Root Rot
	Pine Wilt Disease	Crown Gall

The RMA provides data on plant disease events and plant losses in the planning area. There are 101 instances of plant diseases reported from 2000-2020 by the RMA (**Error! Reference source not found.**). These outbreaks caused $1,096,715 in crop losses.

Figure 15: Plant Disease Events by Year



Source: NDA, 2000-2020

EMERALD ASH BORER

The spread and presence of the Emerald Ash Borer (EAB) has become a rising concern for many Nebraskan communities in recent years. The beetle spreads through transport of infected ash trees, lumber, and firewood. All species of North American ash trees are vulnerable to infestation. Confirmed cases of EAB have been in three Canadian provinces and 35 U.S. states, primarily in the eastern, southern and midwestern regions. Nebraska's confirmed cases occurred on private land in Omaha and Greenwood in 2016 and Lancaster County in 2018.[45] Figure 16 shows the locations of Nebraska's confirmed EAB cases as of October 2020. Additional confirmed cases

[45] Emerald Ash Borer Information Network. April 2018. "Emerald Ash Borer." http://www.emeraldashborer.info/.

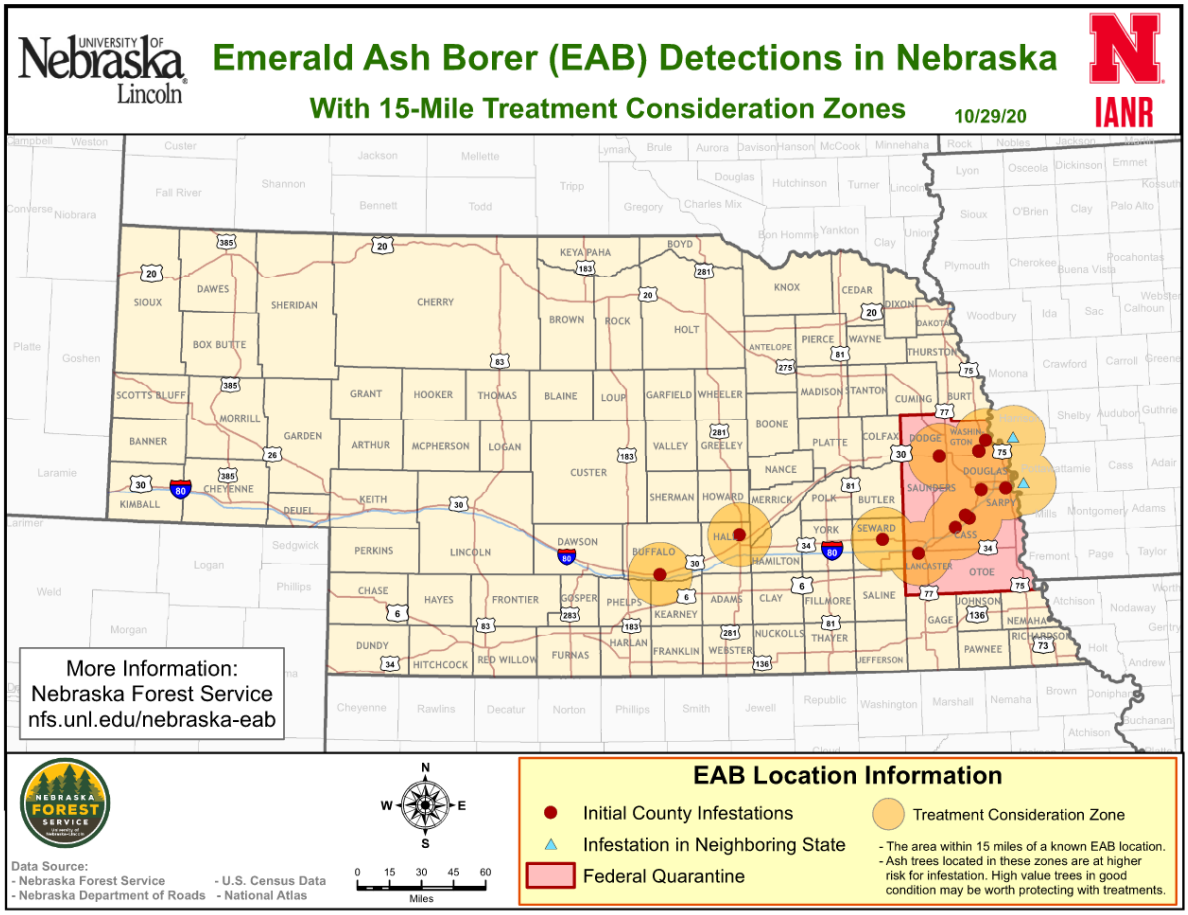
have likely occurred since then and many communities across the state and planning area are prioritizing the removal of ash trees to help curb potential infestations and tree mortality.

While adult beetles cause little damage, larvae damage trees by feeding on the inner bark of mature and growing trees, causing tunnels. Effects of EAB infestation include: extensive damage to trees by birds, canopy dieback, bark splitting, and water sprout growth at the tree base, and eventual tree mortality. EAB has impacted millions of trees across North America, killing young trees one to two years after infestation and mature trees three to four years after infestation.[46] Estimated economic impacts to Nebraska's 44 million ash trees exceeds $961 million.[47] Dead or dying trees affected by EAB are also more likely to cause damage during high winds, severe Thunderstorms, or severe winter storms from weakened or hazardous limbs and can contribute a significant fuel load to grass/wildfire events. The Nebraska Forest Service estimates that across the state communities will be forced to commit over $275 million to protect themselves from infested, publicly-owned ash trees.

Because of the Nebraska infestations, a quarantine order has been established in Cass, Dodge, Douglas, Otoe, Sarpy, Saunders, Lancaster, and Washington Counties that restricts the movement of ash trees and lumber to further mitigate the spread of EAB. No counties in the planning area have reported confirmed cases of EAB; however, it is a rising concern in the planning area. Howard County is at greatest risk of spreading EAB from Hall County which has a confirmed case. The Nebraska Department of Agriculture regulate and monitor the sale and distribution of firewood in their respective states to restrict the flow of firewood from outside the state.

[46] Arbor Day Foundation. 2015. "Emerald Ash Borer." https://www.arborday.org/trees/health/pests/emerald-ash-borer.cfm.
[47] Nebraska Department of Agriculture. 2019. "Emerald Ash Borer." https://nda.nebraska.gov/plant/entomology/eab/index.html.

Figure 16: EAB Confirmation in Nebraska



JAPANESE BEETLES

Japanese beetles are a rising concern in the state and planning area. Japanese beetles are invasive pests found in Custer, Sherman, Howard, Nance, and Boone counties. These beetles cause damage at the larval state (root damage) and adult stage (defoliation). Chemical pesticides provide temporary protection however there are no long range protection measures.

AVERAGE ANNUAL LOSSES

According to the USDA RMA (2000-2020) there have been 101 plant disease events in the planning area. The RMA does not track losses for livestock, but annual crop losses from plant disease can be estimated. The USDA RMA also does not include losses associated with ash tree mortality from EAB. With the lack of reporting and data gathering, it is hard to determine an accurate account of disease and pests that occur in livestock and plants.

Table 39: Agricultural Plant Disease Losses

Hazard Type	Number of Events	Events per Year	Total Crop Loss	Average Annual Crop Loss
Plant Disease	101	4.8	$1,096,715	$52,224
Animal Disease	195	27.9	13,778 animals	1,968 animals/yr

Source: USDA RMA, 2000-2020; NDA, 2014-2020

EXTENT

There is no standard for measuring the magnitude of agricultural disease. Historical events have impacted livestock ranging from a single individual to 2,650 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 area's economy.

PROBABILITY

Given the historic record of occurrence for animal disease (at least one animal disease outbreak reported in all seven years), for the purposes of this plan, the annual probability of animal disease occurrence is 100 percent. Given the historic record of occurrence for agricultural plant disease events (at least one plant disease outbreak reported in all 19 years), the annual probability of agricultural plant disease occurrence is 100%.

COMMUNITY TOP HAZARD STATUS

The following table lists jurisdictions which identified Agricultural Plant and Animal Disease as a top hazard of concern:

Table 40: Agricultural Disease Top Concern by Community

Jurisdictions	
Bartlett	Howard County
Callaway	Loup City
Columbus	Loup County
Custer County	Wheeler Central Schools
Garfield County	Wheeler County

REGIONAL VULNERABILITIES

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

Table 41: Regional Agricultural Vulnerabilities

Sector	Vulnerability
People	-Those in direct contact with infected livestock -Potential food shortage during prolonged events -Residents in poverty if food prices increase
Economic	-Economic power tied to the agricultural industry -Large scale or prolonged events may impact tax revenues and local capabilities -Land values may largely drive population changes within the planning area
Built Environment	None
Infrastructure	-Transportation routes can be closed during quarantine
Critical Facilities	-None
Climate	-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."[48]

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 42: 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[49]

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.

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

48 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.

49 Nebraska Department of Natural Resources. 2013. "Classification of Dams: Dam Safety Section." https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/damsafety/resources/Classification-Dams.pdf.

- 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

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

- **Minimal Hazard Potential** - failure of the dam expected to result in no economic loss beyond the cost of the structure itself and losses principally limited to the owner's property.
- **Low Hazard Potential** - failure of the dam expected to result in no probable loss of human life and in low economic loss. Failure may damage storage buildings, agricultural land, and county roads.
- **Significant Hazard Potential** - failure of the dam expected to result in no probable loss of human life but could result in major economic loss, environmental damage, or disruption of lifeline facilities. Failure may result in shallow flooding of homes and commercial buildings or damage to main highways, minor railroads, or important public utilities.
- **High Hazard Potential** - failure of the dam expected to result in loss of human life is probable. Failure may cause serious damage to homes, industrial or commercial buildings, four-lane highways, or major railroads. Failure may cause shallow flooding of hospitals, nursing homes, or schools.

LOCATION

Communities or areas downstream of a dam, especially high hazard dams, are at greatest risk of dam failure. In total, there are 146 dams located within the planning area with classifications ranging from minimal hazard to high hazard. Of these, 124 dams are rated low, 6 are significant, and 5 are rated a high hazard dam. Figure 6 maps the location of these dams in the planning area.

Dam owners and the NeDNR have opted, at this time, to not include dam breach maps or inundation maps in hazard mitigation plans due to the sensitive nature of this information. Requests can be made of the dam owner or the Dam Safety Division of NeDNR to view an inundation map specific to a dam.

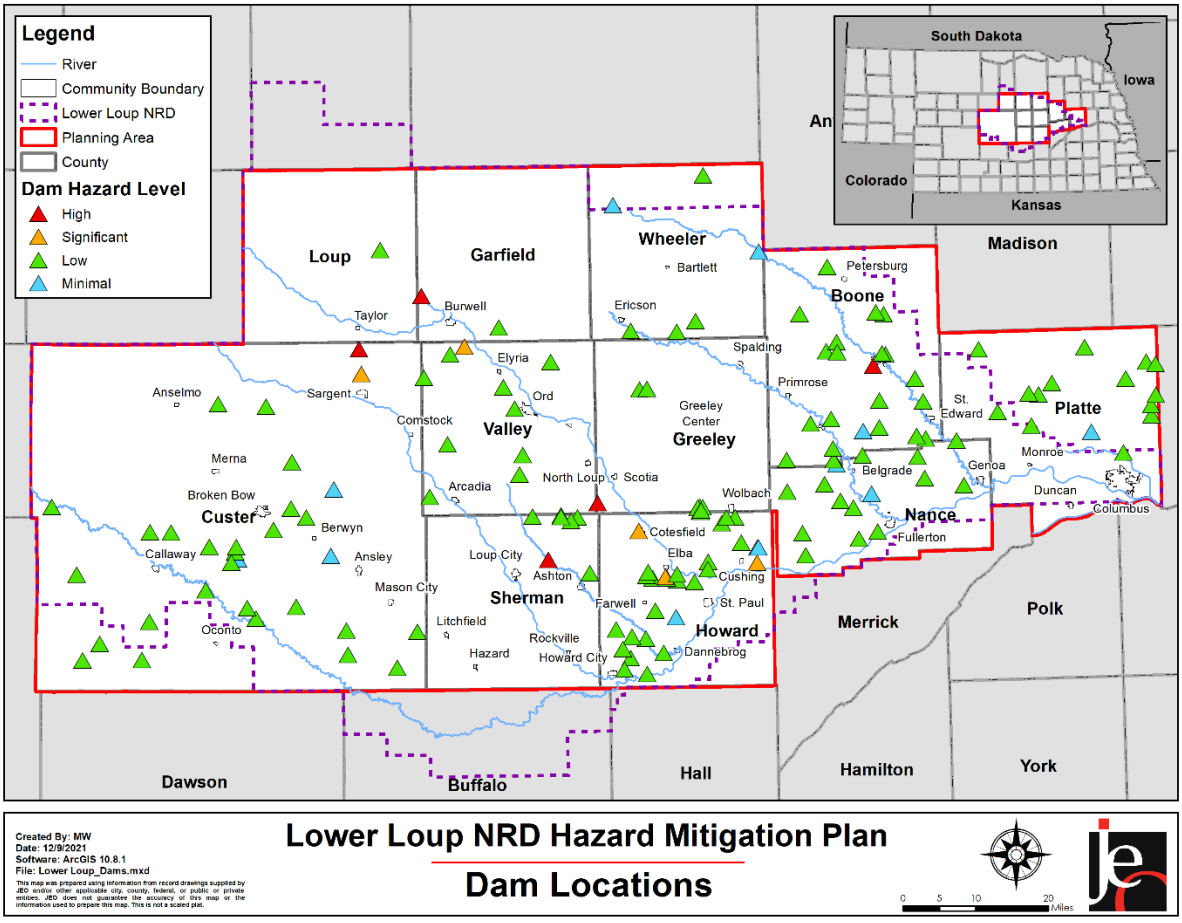
Table 43: Dams in the Planning Area

County	Minimal Hazard	Low Hazard	Significant Hazard	High Hazard
Boone County	2	21	0	1
Custer County	3	26	1	0
Garfield County	0	1	0	1
Greeley County	0	8	0	1
Howard County	3	22	3	0

County	Minimal Hazard	Low Hazard	Significant Hazard	High Hazard
Loup County	0	1	0	0
Nance County	1	11	0	0
Platte County	1	15	0	0
Sherman County	0	6	0	1
Valley County	0	9	1	1
Wheeler County	2	4	0	0
Total	**12**	**124**	**6**	**5**

Source: NeDNR, 2021

Figure 17: Dam Locations in the Planning Area



Dams that are 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 conditions are present. The EAP includes information regarding the efficiency of emergency response entities so that

proper action can be taken to prevent the loss of life and property. Local emergency response entities generally included in an EAP include but are not limited to 911 Dispatch, County Sheriffs, Local Fire Departments, Emergency Management Agency Director, County Highway Department, and the National Weather Service (NWS).

The following table lists dams classified as “High Hazard” in the planning area.

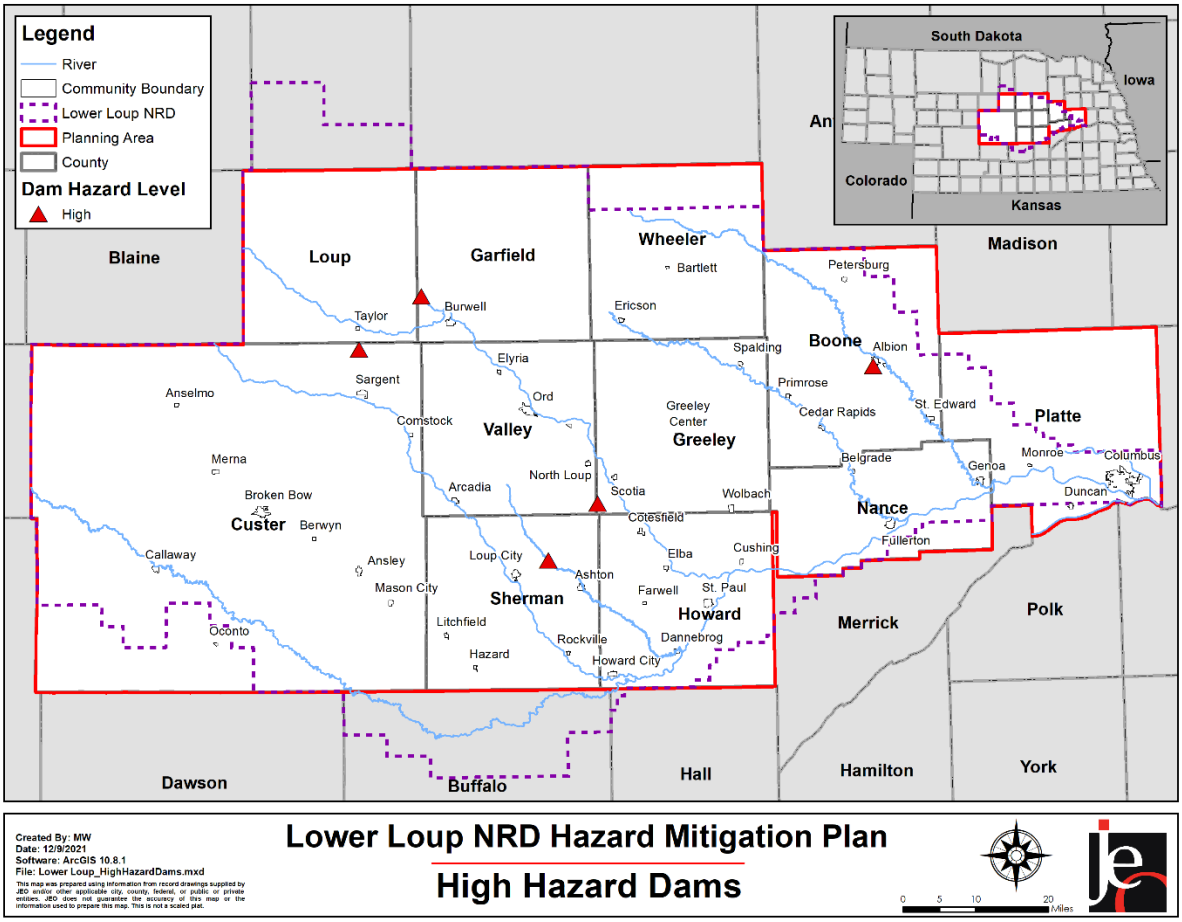
Table 44: High Hazard Dams

NID	Dam Name	Owner	Location	Stream Name	Max Storage (acre-feet)	EAP
NE02342	Davis Creek Dam	US Bureau of Reclamation	Davis Creek Reservoir (south of North Loup)	Jacks Canyon	46,179	Yes
NE02287	Virginia Smith Dam	US Bureau of Reclamation	Northwest of Burwell	Calamus Reservoir	169,530	Yes
NE00153	Kohtz City of Albion Dam	City of Albion	Southwest of Albion	TR-Beaver Creek	102	Yes
NE01077	Sherman Dam	Farwell Irrigation District	Sherman Reservoir	Oak Creek	125,477	Yes
NE08484	Taylor South Highway 183 Dam	NDOT	Taylor NE	TR-Leydell Canyon Creek	561	No*
NE00264	Bredthauer Dam	Private Owner	Bredthauer Reservoir	N BR Mira Creek	665	No*

Source: NeDNR, 2021

**Bredthauer Dam breached and has not been rebuilt, EAP for Taylor South Highway has not yet been developed.*

Figure 18: High Hazard Dam Locations



UPSTREAM DAMS OUTSIDE THE PLANNING AREA

According to the Counties' Local Emergency Operations Plan (LEOPs), there are no upstream dams (upstream of the planning area) which could affect the planning area.

EXTENT

While a breach of a high hazard dam would certainly impact those in inundation areas, the total number of people and property exposed to this threat would vary based on the dam location. Since inundation maps are not made publicly available for security reasons, the following is provided as a description of areas affected in the inundation area from each County's Local Emergency Operations Plan (LEOP) where available for specific high hazard dams. Note that not all of the high hazard dams in each county are given extended descriptions in the LEOP.

Boone County

Kohtz-Albion Dam – Failure would impact a swath northeast of the dam. This would impact approximately 15% of Albion. There is the potential for up to 18 homes and Fuller Park in southwest Albion to experience substantial flooding if the dam were to fail. Most of the streets within the City of Albion including Highways 14/39 and 91 could experience dangerous levels of flooding. In addition, the Boone County Health Center, Boone Central Schools, St. Michael's School, Albion City Hall, Albion City Police Department, up to 110 homes, and several downtown businesses may experience shallow flooding.

Spalding Dam – Failure would affect the Cedar River in all Boone and Nance Counties. In Boone County, the area affected would be slightly greater than the 100-year floodplain with the greatest effect on Primrose and Cedar Rapids.

Custer County
According to the Custer County LEOP, there are no dams that could affect the county and zero percent of the population would be affected by the failure of dams within Custer County.

Garfield County
Virginia Smith Dam—The Garfield County LEOP does not specify the percentage of the population that would be affected by the failure of the Virginia Smith Dam. However, the LEOP does say that the affected area would be within the 100-year floodplain and approximately 10 percent of the county's population reside within the 100-year floodplain.

Greeley County
There are nine dams in Greeley County. One of these dams has been identified as a high hazard dam. The Greeley County LEOP identified the Virginia Smith Dam controlling the Calamus Reservoir as one that could impact the county if it were to fail. If a dam were to fail, the likely impacts would include loss of property and loss of roads that affect emergency response. If the dam were to fail, it could affect approximately two percent of the county's population.

The high hazard dam in Greeley County at Davis Creek Reservoir would affect populations in downstream counties.

Howard County
There are 28 dams in Howard County. None of these dams have been identified as a high hazard dam. If a dam were to fail in the county, the likely impacts would be flooding of agricultural lands, loss of rural housing, loss of agricultural land, and loss of livestock.

According to the Howard County LEOP, the following upstream dams could affect Howard County: Sherman Dam, Davis Creek Dam, and Virginia Smith Dam. A small percent of the population of Howard County could be affected by the failure of one or another of these dams.

Loup County
There is one dam in Loup County. This dam has not been identified as a high hazard dam. According to the Loup County LEOP, there are three dams that could affect approximately two percent of the population of Loup County if they were to fail. These dams are the Taylor Diversion Dam, Kent Diversion Dam, and Gracie Creek Dam.

Nance County
There are 11 dams in Nance County. None of these dams have been identified as a high hazard dam. If a dam were to fail, the likely impacts would be crop damage. However, there are three upstream dams that could affect Nance County. These dams are Sherman Dam, Davis Creek Dam, and Calamus Reservoir Dam. It is estimated that ten percent of the population of Nance County could be affected by the failure of one or another of these dams.

Platte County
Loup Public Power Canal – According to the Platte County LEOP the Indian Hills Subdivision located north of Columbus could be inundated in the case of failure.

There are 16 dams identified in the county. The Platte County LEOP identifies these facilities in the inundation area: Columbus Waste Water System, Highway 81/30 Bridge south of Columbus, Union Pacific Railroad bridge and tracks just southwest of Columbus.

Sherman County
Sherman Dam – According to the Sherman County LEOP, if Sherman Dam were to fail, approximately three percent of the population of the Sherman County would be affected. It would affect the Middle Loup River as far as St. Paul. In Sherman County, the affected area would be slightly greater than the 100-year flood plain with the greatest effect on Ashton, which would approach 100 percent inundation.

Valley County
In 2010, the Bredthauer Dam failed causing the village of North Loup to flood. The Bredthauer Dam has not been rebuilt as of this plan writing.

According to the Valley County LEOP, an upstream dam that could affect the county is the Virginia Smith Dam. If this dam were to fail, approximately 3.7% of the population of the county would be affected.

Wheeler County
According to the Wheeler County LEOP, the Lake Ericson Dam would affect "a small portion of Wheeler County if failure occurs at the dam".

HISTORICAL OCCURRENCES
There have been 12 reported dam failure events in the planning area. The following table describes dam failure events in the planning area according to NeDNR.

Table 45: Dam Failure Events in the Planning Area

NID	County	Dam Name	Hazard Class	Year of Failure	Description of Failure
NE02969	Custer	Wood Dam 2969	Minimal	1980E	Auxiliary spillway erosion
NE08513	Custer	Cooksleys Clear Creek Farms East Dam	Low	2017	Internal erosion along conduit
NE01258	Greeley	Walker Dam	Low	2010E	Auxiliary spillway erosion
NE03006	Howard	Klinginsmith Dam	Low	1982E	Unknown breach
NE00212	Loup	Morgan Dam 212	Low	2010	Overtopped
NE02661	Loup	Gracie Creek Road Dam	Low	2010	Overtopped
NE00327	Nance	Fullerton Plant Dam	Unlisted	1966	Damaged In flood
NE00576	Sherman	Lewandowski Dam	Low	2017	Internal erosion along conduit
NE00264	Valley	Bredthauer Dam	Low	2010	Overtopped
NE02138	Wheeler	Merlyn Schrunk Dam	Low	1984	Auxiliary spillway erosion. No grass cover in spillway. Failed after rapid snowmelt
NE00274	Wheeler	Ericson Dam	Significant	2010	Erosion in auxiliary spillway

NID	County	Dam Name	Hazard Class	Year of Failure	Description of Failure
NE08503	Wheeler	Rittscher Farm & Ranch Dam	Minimal	2019E	Failed along PS Conduit Alignment. Significant headcutting in AS. May have overtopped during 2019 Flood.

*Source: NeDNR private correspondence, 2020; *E indicates year of failure is estimated*

In June of 2010, heavy rain caused the failure of six dams across the planning area: Bredthauer Dam in Valley County, Ericson Dam in Wheeler County, Gracie Creek Road Dam in Loup County, Morgan Dam in Loup County, Ord-North Loup Diversion Dam in Valley County, and Taylor-Ord Diversion Dam in Loup County. According to the NeDNR, the dam failures did not cause any significant property damages, nor did they cause any loss of life. Alternatively, NCEI estimated flooding damages in North Loup to be a million dollars after this event.

Figure 19: Lake Ericson Dam Failure, June 2010

AVERAGE ANNUAL DAMAGES

Due to lack of data and the sensitive nature of this hazard, potential losses are not calculated for this hazard. Community members in the planning area that wish to quantify the threat of dam failure should contact their County Emergency Management, LLNRD, or the NeDNR.

PROBABILITY

According to the 2021 Nebraska State Hazard Mitigation Plan and NeDNR, the probability of a high hazard dam failing is “very low” due to the high design standards for this class of dam. There is a higher possibility of a significant or low hazard dam failing as those dams are not designed to the same standard. However, dams in the state have an average age of over 44 years and many have already exceeded their original 50-year design life.

There have been 7 years with a reported dam failure out of 130 years, so the probability of dam failure will be stated as five percent annually. The NeDNR has stated that there is typically at least one dam failure in the State of Nebraska each year. According to Tim Gokie, Dam Safety Section, NeDNR: "*Large storm systems that result in regional flooding, like the widespread flood events of 2010 and 2019, often result in several dam failures. The majority of the dams that fail are small, low hazard potential dams located in rural areas where the resulting damage is mostly limited to the dam itself and the dam owners' property. Low and minimal hazard potential dams are typically designed to safely pass either a 50-year or 100-year design flood event, so larger events will overtop the dam, which can result in dam failure. Dams that are classified as significant and high hazard potential are required to meet higher standards and failure of these dams is rare.*"

COMMUNITY TOP HAZARD STATUS

The following table lists jurisdictions which identified Dam Failure as a top hazard of concern:

Table 46: Dam Failure Top Concern by Community

Jurisdictions	
Albion and Albion Fire	Nance County
Boone County	North Loup
Burwell	Platte County
Cedar Rapids	Sargent Irrigation District
Cotesfield	Scotia
Custer County	Sherman County
Farwell Irrigation District	Spalding
Garfield County	Twin Loups Irrigation District
Greeley County	Valley County
Howard County	Wheeler County
Loup County	

REGIONAL VULNERABILITIES

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

Table 47: Regional Dam Failure Vulnerabilities

Sector	Vulnerability
People	-Those living downstream of high hazard dams -Evacuation likely with high hazard dams -Hospitals, nursing homes, and the elderly at greater risk due to low mobility
Economic	-Businesses located in the inundation areas would be impacted and closed for an extended period of time -Employees working in the inundation area may be out of work for an extended period of time
Built Environment	-Damage to homes and buildings
Infrastructure	-Transportation routes could be closed for extended period of time
Critical Facilities	-Critical facilities in inundation areas are vulnerable to damages
Climate	-Increased annual precipitation contributes to sustained stress on systems

Sector	Vulnerability
	-Changes in water availability and supply can constrain energy production and reservoir stores

DROUGHT

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

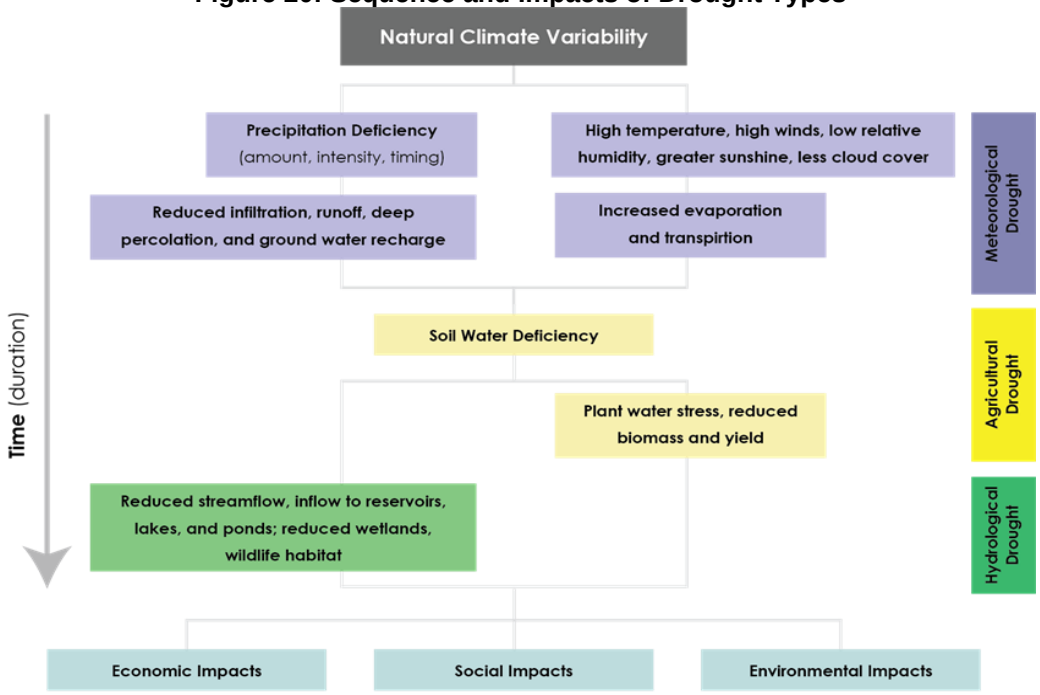
Drought is a slow-onset, creeping phenomenon that can affect a wide range of people and industries. While many drought impacts are non-structural, there is the potential that during extreme or prolonged drought events structural impacts can occur. Drought normally affects more people than other natural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

- **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 include, but are not limited to, water, forage, food grains, fish, and hydroelectric power. [50]

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

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

Figure 20: Sequence and Impacts of Drought Types



Source: National Drought Mitigation Center, University of Nebraska-Lincoln, 2017[51]

LOCATION

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

HISTORICAL OCCURRENCES

The Palmer Drought Severity Index (PDSI) is utilized by climatologists to standardize global long-term drought analysis. The data for the planning area was collected for Climate Region 5, which is within the planning area. This particular station's period of record started in 1895. Table 49 shows the data from this time period. The negative Y axis represents a drought, for which '-1' indicates a mild drought, '-2' a moderate drought, '-3' a severe drought, and '-4' an extreme drought. Table 46 shows the details of the Palmer classifications.

Table 48: Palmer Drought Severity Index Classification

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

Source: NCEI

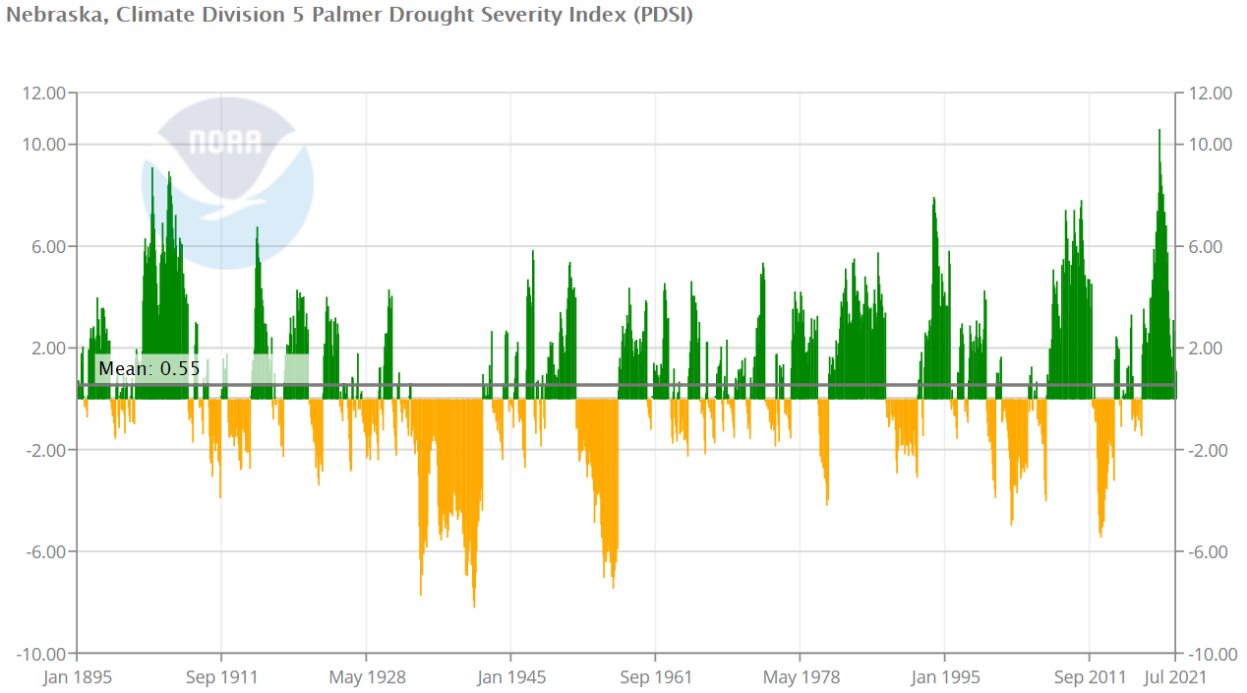
[51] National Drought Mitigation Center. 2017. "Types of Drought." http://drought.unl.edu/DroughtBasics/TypesofDrought.aspx.

Table 49: Historic Droughts

Drought Magnitude	Months in Drought	Percent Chance
-1 Magnitude	188/1,512	12%
-2 Magnitude	100/1,512	7%
-3 Magnitude	49/1,512	3%
-4 Magnitude	107/1,512	7%

Source: NCEI

Figure 21: Palmer Drought Severity Index



Source: NCEI, Climate Region 5

The 2012 drought event is the most recent significant event 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. As many as 81 municipal water systems in the state experienced drought-related water supply issues in 2021 according to the Nebraska Department of Health and Human Services. Local planning teams reported a few impacts from the 2012 drought which were primarily lower water well levels and some communities encouraged water restrictions.

EXTENT

Using the date from NOAA, it is reasonable to expect extreme drought to occur in 7 percent of years of months for the planning area (107 extreme drought months in 1,512 months). Severe drought occurred in 49 months of the 1,512 months of record (3 percent of months). Moderate drought occurred in 100 months of the 1,512 years of record (7 percent of months), and mild drought occurred in 188 of the 1,512 months of record (12 percent of months). Non-drought conditions (incipient dry spell, near normal, or wet spell conditions) occurred in 1,068 months, or

71 percent of months. These statistics show that the drought conditions of the planning area are highly variable.

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 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 damage to infrastructure. The NCEI database reported $70,400,000 in property damages and over $268,000,000 in crop damages from drought.

Table 50: Loss Estimate for Drought

Hazard Type	Total Property Loss[1]	Average Annual Property Loss[1]	Total Crop Loss[2]	Average Annual Crop Loss[2]
Drought	$34,000,000	$1,360,000	$211,993,088	$10,094,909

1 Indicates the data is from NCEI (January 1996 to December 2020); 2 Indicates data is from USDA RMA (2000 to 2020)

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 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%.[52]

PROBABILITY

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

Table 51: Period of Record in Drought

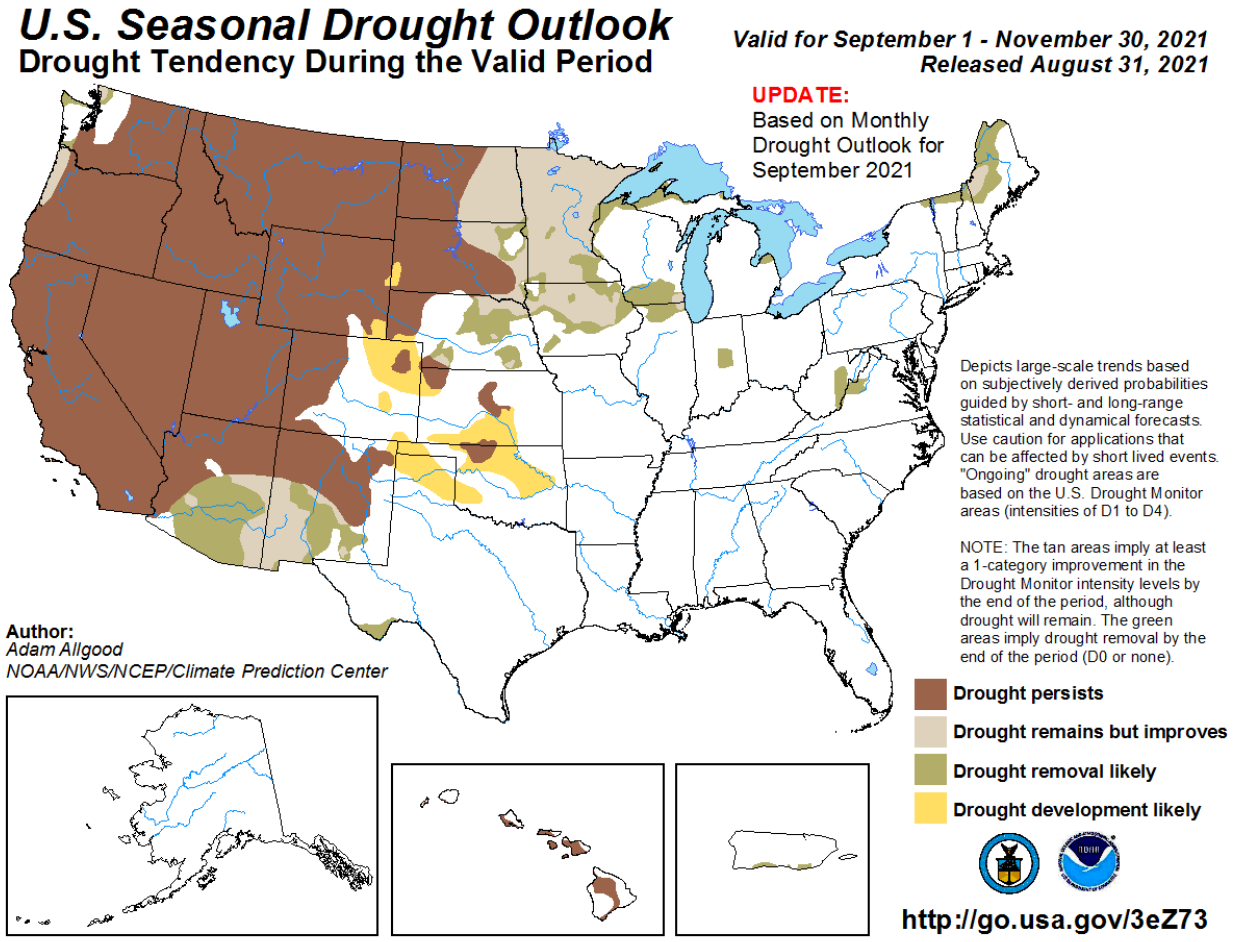
Magnitude	Drought Occurrences by Month	Monthly Probability
No Drought	1,068/1,512	70.6%
Mild Drought	188/1,512	12.4%
Moderate Drought	100/1,512	6.6%
Severe Drought	49/1,512	3.2%
Extreme Drought	107/1,512	7.1%

Source: NCEI, 1895-2020

The U.S. Seasonal Drought Outlook (Figure 9) 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 from September 2021 as an example.

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

Figure 22: U.S. Seasonal Drought Outlook



Source: NCEI, September 2021

COMMUNITY TOP HAZARD STATUS

The following table lists jurisdictions which identified Drought as a top hazard of concern:

Table 52: Drought Top Concern by Community

Jurisdictions	
Berwyn	Nance County
Boelus	North Loup
Boone County	Oconto
Callaway	Ord
Dannebrog	Scotia
Elba	St. Paul
Farwell Irrigation District	Valley County
Fullerton	

REGIONAL VULNERABILITIES

The Drought Impact Reporter has recorded a total of 44 drought-related impacts throughout the region. This is not a comprehensive list of droughts which may have impacted the planning area, but only those with reported impacts. These impacts are summarized in the following table.

Category	Date	Affected Counties	Title
Agriculture, Plants & Wildlife	9/17/2020	Custer County	Grass growth slowed in western Nebraska
Agriculture	7/5/2017	Custer County, NE, Sargent, NE, Loup County, NE, Taylor, NE	Dryland fields, pastures affected by dry conditions in central Nebraska
Agriculture	8/6/2017	Custer County, NE	Pastures, hay crop affected; producer selling older cows in Custer County, Nebraska
Agriculture	8/10/2017	Custer County, NE	Producer selling cattle in Custer County, Nebraska
Agriculture, Plants & Wildlife	9/29/2016	Howard County, NE	Dry weather leads to brown grass in Howard County, Nebraska
Agriculture, Plants & Wildlife	6/9/2014	Loup County, NE	Loup County, Nebraska, alfalfa crop delayed
Agriculture, Relief, Response & Restrictions	2/7/2014	Custer County, NE, Garfield County, NE, Greeley County, NE, Howard County, NE, Loup County, NE, Sherman County, NE, Valley County, NE, Wheeler County, NE	Drought-Related USDA Disaster Declarations in 2014
Relief, Response & Restrictions, Water Supply & Quality	12/16/2013	Boone County, NE, Platte County, NE	Moratorium on new irrigation in Lower Platte North Natural Resources District in eastern Nebraska
Society & Public Health	9/26/2013	Platte County, NE	Drought alleviated some of the flooding that would have otherwise occurred along the Platte River in southern Nebraska
Fire, Relief, Response & Restrictions, Tourism & Recreation	9/3/2013	Custer County, NE	Campers in western Nebraska were urged to be particularly careful with campfires over the Labor Day weekend
Plants & Wildlife, Water Supply & Quality	7/15/2013	Platte County, NE	Low water, warm water temperatures killing fish in Platte River in south central Nebraska
Agriculture, Relief, Response & Restrictions, Water Supply & Quality	4/24/2013	Platte County, NE	Water use restrictions for irrigators in the Lower Elkhorn Natural Resources District in northeastern Nebraska
Agriculture, Relief, Response & Restrictions	5/17/2013	Boone County, NE, Custer County, NE, Garfield County, NE, Greeley County, NE, Howard County, NE, Loup County, NE, Nance County, NE, Platte County, NE, Sherman County, NE, Valley County, NE, Wheeler County, NE	Drought-related USDA disaster declarations in 2013

Category	Date	Affected Counties	Title
Agriculture	4/22/2019	Boone County, NE, Nance County, NE	Corn chopped for silage in eastern Nebraska
Agriculture, Water Supply & Quality	4/23/2019	Boone County, NE, Custer County, NE, Garfield County, NE, Greeley County, NE, Howard County, NE, Loup County, NE, Nance County, NE, Platte County, NE, Sherman County, NE, Valley County, NE, Wheeler County, NE	Nebraska ranchers hauling water to livestock
Agriculture, Plants & Wildlife	7/25/2012	Garfield County, NE, Burwell, NE	Cattle being culled around Burwell, Nebraska
Agriculture, Relief, Response & Restrictions, Water Supply & Quality	7/20/2012	Greeley County, NE, Howard County, NE, Nance County, NE, Platte County, NE, Valley County, NE	Low flow in several Nebraska rivers brought surface irrigation closures
Fire, Relief, Response & Restrictions	2/22/2018	Boone County, NE, Custer County, NE, Garfield County, NE, Greeley County, NE, Howard County, NE, Loup County, NE, Nance County, NE, Platte County, NE, Sherman County, NE, Valley County, NE, Wheeler County, NE	Nebraskans urged to leave the fireworks to the professionals
Plants & Wildlife, Tourism & Recreation, Water Supply & Quality	8/22/2012	Platte County, NE, Columbus, NE	Lower Platte River in Nebraska experiencing record low flows
Plants & Wildlife	6/13/2013	Custer County, NE, Loup County, NE	Many trees in western Nebraska died from drought, high temperatures and strong winds in 2012
Agriculture, Plants & Wildlife	7/25/2012	Garfield County, NE	Native grassland near Burwell, Nebraska not growing well
Agriculture, Plants & Wildlife	12/17/2012	Boone County, NE, Custer County, NE, Garfield County, NE, Greeley County, NE, Howard County, NE, Loup County, NE, Nance County, NE, Sherman County, NE, Valley County, NE, Wheeler County, NE	Drought led ranchers in western Nebraska to cull cow herds by 25 to 60 percent
Relief, Response & Restrictions, Water Supply & Quality	4/24/2013	Platte County, NE	More than $100,000 paid to assist those with dry domestic wells in northeastern Nebraska
Relief, Response & Restrictions	9/28/2006	Boone County, NE, Greeley County, NE, Platte County, NE	Relief, Response & Restrictions impact from Media submitted on 9/28/2006
Relief, Response & Restrictions	9/14/2006	Custer County, NE, Sherman County, NE	Relief, Response & Restrictions impact from Media submitted on 9/14/2006
Relief, Response & Restrictions	7/17/2006	Boone County, NE, Custer County, NE, Garfield County, NE, Greeley	Relief, Response & Restrictions impact from

Category	Date	Affected Counties	Title
		County, NE, Howard County, NE, Loup County, NE, Nance County, NE, Sherman County, NE, Valley County, NE, Wheeler County, NE	Media submitted on 7/17/2006
Agriculture	6/28/2006	Valley County, NE	Agriculture impact from Media submitted on 6/28/2006
Agriculture	6/13/2006	Custer County, NE, Garfield County, NE, Loup County, NE, Sherman County, NE, Wheeler County, NE	Agriculture impact from Media submitted on 6/13/2006
Agriculture	6/22/2006	Custer County, NE	Agriculture impact from Media submitted on 6/22/2006
Agriculture	7/29/2006	Sherman County, NE, Valley County, NE	Agriculture impact from Public submitted on 7/29/2006
Water Supply & Quality	8/9/2005	Platte County, NE	Water Supply & Quality impact from Media submitted on 8/9/2005
Relief, Response & Restrictions	10/14/2005	Sherman County, NE	Relief, Response & Restrictions impact from Media submitted on 10/14/2005
Relief, Response & Restrictions	11/1/2005	Custer County, NE, Garfield County, NE, Greeley County, NE, Howard County, NE, Loup County, NE, Sherman County, NE, Valley County, NE, Wheeler County, NE	Relief, Response & Restrictions impact from Media submitted on 11/1/2005
Relief, Response & Restrictions	9/30/2005	Boone County, NE, Custer County, NE, Garfield County, NE, Greeley County, NE, Loup County, NE, Nance County, NE, Platte County, NE, Sherman County, NE, Valley County, NE, Wheeler County, NE	Relief, Response & Restrictions impact from Media submitted on 9/30/2005
Relief, Response & Restrictions	11/3/2005	Boone County, NE	Relief, Response & Restrictions impact from Media submitted on 11/3/2005
Plants & Wildlife	11/7/2005	Boone County, NE, Custer County, NE, Garfield County, NE, Greeley County, NE, Howard County, NE, Loup County, NE, Nance County, NE, Platte County, NE, Sherman County, NE, Valley County, NE, Wheeler County, NE	Plants & Wildlife impact from Media submitted on 11/7/2005
Relief, Response & Restrictions	3/1/2006	Boone County, NE, Custer County, NE, Garfield County, NE, Greeley County, NE, Howard County, NE, Loup County, NE, Nance County, NE, Platte County, NE, Sherman County, NE, Valley County, NE, Wheeler County, NE	Relief, Response & Restrictions impact from Media submitted on 3/1/2006

Category	Date	Affected Counties	Title
Agriculture	10/24/2007	Custer County, NE, Garfield County, NE, Greeley County, NE, Howard County, NE, Loup County, NE, Sherman County, NE, Valley County, NE, Wheeler County, NE	Agriculture impact from Media submitted on 10/24/2007
Agriculture	2/17/2006	Custer County, NE, Garfield County, NE, Greeley County, NE, Howard County, NE, Loup County, NE, Sherman County, NE, Valley County, NE, Wheeler County, NE	Agriculture impact from Media submitted on 2/17/2006
Relief, Response & Restrictions	11/17/2005	Greeley County, NE	Relief, Response & Restrictions impact from Media submitted on 11/17/2005
Relief, Response & Restrictions	10/28/2005	Boone County, NE, Platte County, NE	Relief, Response & Restrictions impact from Government submitted on 10/28/2005
Relief, Response & Restrictions	10/28/2005	Nance County, NE	Relief, Response & Restrictions impact from Government submitted on 10/28/2005
Relief, Response & Restrictions	12/15/2005	Boone County, NE, Custer County, NE, Sherman County, NE	Relief, Response & Restrictions impact from Government submitted on 12/15/2005
Relief, Response & Restrictions	2/22/2006	Boone County, NE, Custer County, NE,	Relief, Response & Restrictions impact from Government submitted on 2/22/2006

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

Table 53:Regional Drought Vulnerabilities

Sector	Vulnerability
People	-Insufficient water supply -Loss of jobs in agricultural sector -Residents in poverty if food prices increase
Economic	-Closure of water intensive businesses (carwashes, pools, etc.) -Loss of tourism dollars -Decrease of land prices→ jeopardizes educational funds
Built Environment	-Cracking of foundations (residential and commercial structures) -Damages to landscapes
Infrastructure	-Damages to waterlines below ground -Damages to roadways (prolonged extreme events) -Stressing of electrical systems (brownouts during peak usage)
Critical Facilities	-None
Climate	-Increased risk of wildfire events, damaging buildings and agricultural land

EARTHQUAKES

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

Table 54: Richter Scale

Richter Magnitudes	Earthquake Effects
Less than 3.5	Generally not felt, but recorded
3.5 – 5.4	Often felt, but rarely causes damage
Under 6.0	At most, slight damage to well-designed buildings. Can cause major damage to poorly constructed buildings over small regions
6.1 – 6.9	Can be destructive in areas up to about 100 kilometers across where people live
7.0 – 7.9	Major earthquake. Can cause serious damage over larger areas
8 or Greater	Great earthquake. Can cause serious damage in areas several hundred kilometers across.

Source: FEMA, 2016[53]

Table 55: Modified Mercalli Intensity Scale

Scale	Intensity	Description of Effects	Corresponding Richter Scale Magnitude
I	Instrumental	Detected only on seismographs	
II	Feeble	Some people feel it	< 4.2
III	Slight	Felt by people resting, like a truck rumbling by	
IV	Moderate	Felt by people walking	
V	Slightly Strong	Sleepers awake; church bells ring	< 4.8
VI	Strong	Trees sway; suspended objects swing, objects fall off shelves	< 5.4
VII	Very Strong	Mild alarm; walls crack; plaster falls	< 6.1
VII	Destructive	Moving cars uncontrollable; masonry fractures, poorly constructed buildings damaged	
IX	Ruinous	Some houses collapse; ground cracks; pipes break open	< 6.9
X	Disastrous	Ground cracks profusely; many buildings destroyed; liquefaction and landslides widespread	< 7.3

[53] Federal Emergency Management Agency. 2020. "Earthquake Risk." https://www.fema.gov/emergency-managers/risk-management/earthquake

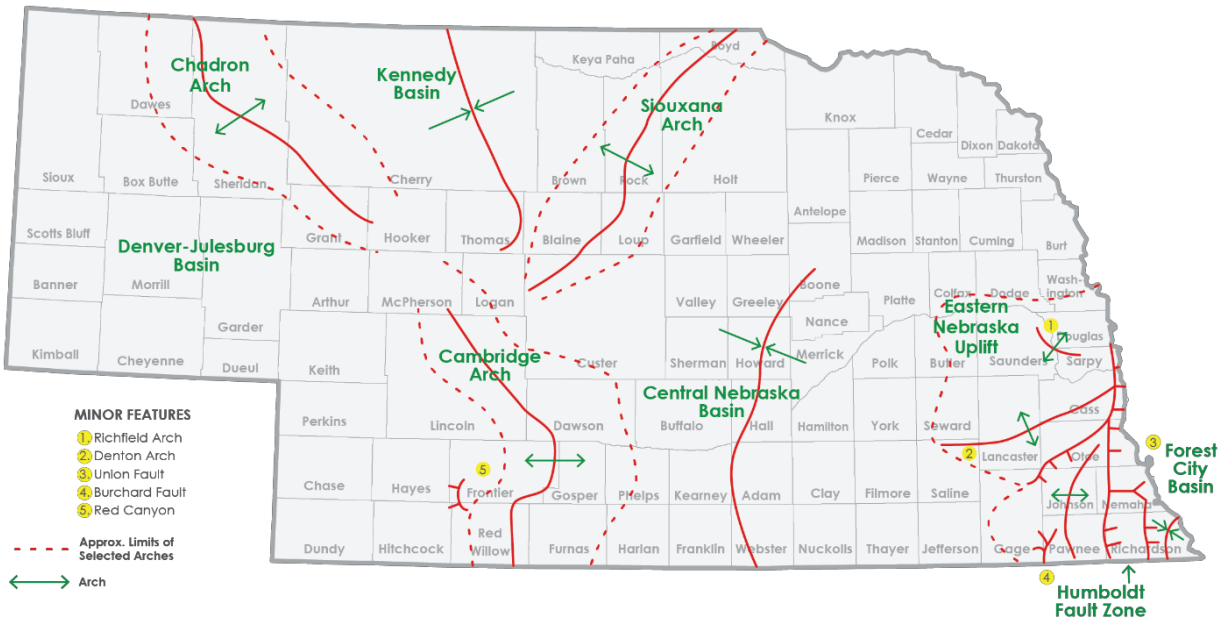
Scale	Intensity	Description of Effects	Corresponding Richter Scale Magnitude
XI	Very Disastrous	Most Buildings and bridges collapse; roads, railways, pipes, and cables destroyed; general triggering of other hazards	< 8.1
XII	Catastrophic	Total destruction; trees fall; ground rises and falls in waves	> 8.1

Source: FEMA, 2020

LOCATION

The most likely locations in the planning area to experience an earthquake are those located near a fault line (Figure 23). The Siouxana Arch and Central Nebraska Basin lie within the planning area.

Figure 23: Fault Lines in Nebraska



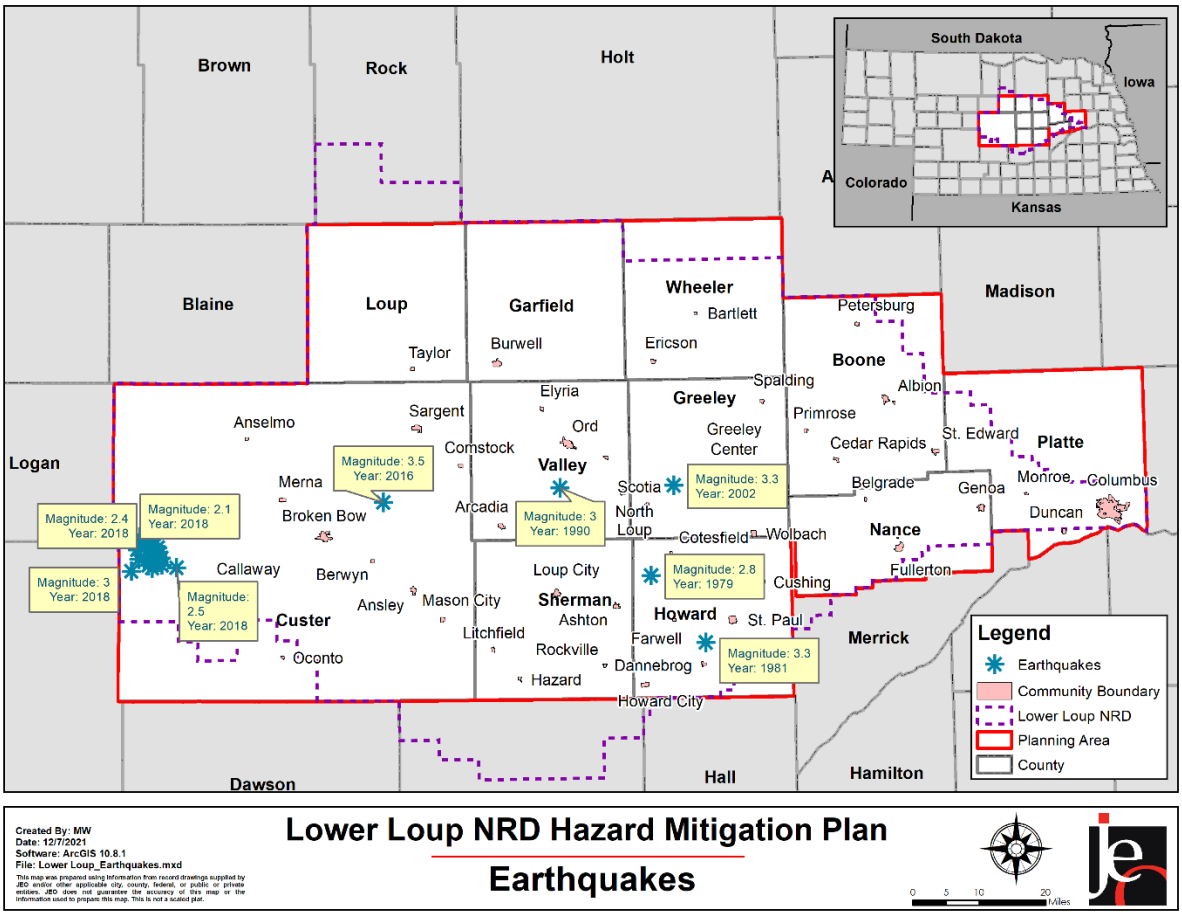
EXTENT

If an earthquake were to occur in the planning area, it would likely measure 5.0 or less on the Richter Scale. Based on historical record, the magnitude for earthquakes in the planning area ranges from approximately 2 to 4 on the Richter Scale.

HISTORICAL OCCURRENCES

According to the United States Geological Survey (USGS), there have been 31 earthquakes in the planning area since 1900. The most significant events included a 4.1, 3.9, and 3.8 magnitude events near Arnold in 2018 and a 5.1 magnitude event near Columbus in 1877. The 1877 quake matches the largest earthquake in Nebraska history. The 30 second shock split the courthouse walls in nine places and damaged the schoolhouse walls.

Figure 24: Earthquake Occurrences



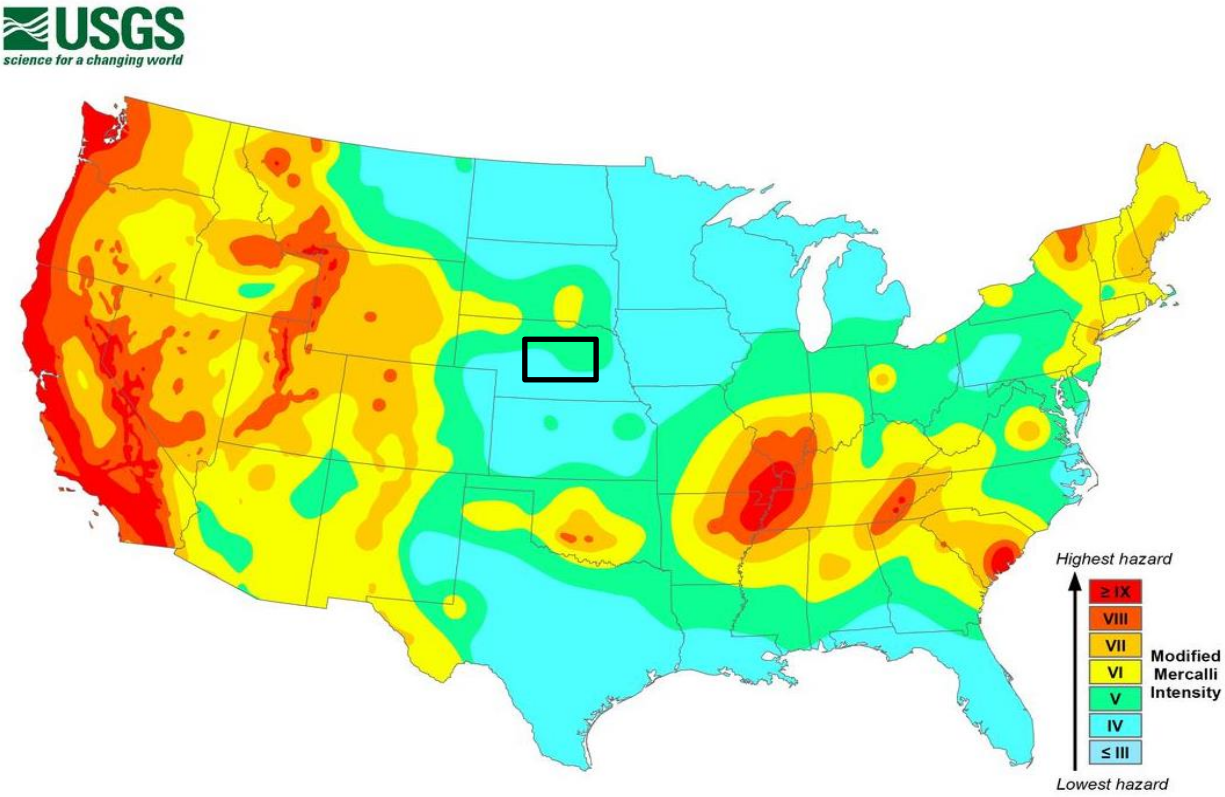
AVERAGE ANNUAL LOSSES

Due to the lack of sufficient earthquake data, limited resources, extremely low earthquake risk for the area, and no recorded damages with the reports of historical occurrences, it is not feasible to utilize the 'event damage estimate formula' to estimate potential losses for the planning area.

PROBABILITY

The following figure summarizes the probability of an intense earthquake occurring in the planning area. Based on the six years with a recorded occurrence of an earthquake over a 121-year period, the probability of an earthquake in the nine-county region in any given year is approximately five percent.

Figure 25: Earthquake Probability



USGS map showing the intensity of potential earthquake ground shaking that has a 2% chance of occurring in 50 years

Source: USGS 2009 PSHA Model

COMMUNITY TOP HAZARD STATUS

No participating jurisdictions identified Earthquakes as a hazard of top concern.

REGIONAL VULNERABILITIES

Particularly vulnerable populations for earthquake include, but are not limited to:

- *Low income individuals*
  - Often, low income individuals and families live in lower cost homes (older homes, mobile homes) that are less able to withstand disaster.
- *Older homes and mobile homes*
  - These may not have been constructed using the most advanced building codes or have received updates and retrofits that would have increased their stability and ability to withstand seismic events. Damages resulting from the 1994 Northridge earthquake in California were disproportionately focused on low and moderate income rental housing units that were older and thus more vulnerable to seismic damages.
- *Elderly citizens*
  - Senior citizens living on a fixed income may lack the disposable income necessary to upgrade their homes to withstand seismic events. In addition, senior citizens may lack the mobility required to implement low cost mitigation measures. A 2006 Census Bureau report found that 20-percent of the US Population age 65 and older report some level of disability.

Future development and growth would likely increase the intensity of earthquake impacts across the planning area. Future development and growth would have impacts including increased development near dams and levees; increased density in urban areas, and new structures built without reinforcements.

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

Table 56: Regional Earthquake Vulnerabilities

Sector	Vulnerability
People	-Risk of injury or death from falling objects and structures
Economic	-Short-term to long-term interruption of business
Built Environment	-Cracking of foundations (residential and commercial structures) -Damage to structures
Infrastructure	-Damages to subterranean infrastructure (e.g. waterlines, gas lines, etc.) -Damages to roadways
Critical Facilities	-Same as all other structures
Climate	-None

EXTREME HEAT

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

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

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

The NWS is responsible for issuing excessive heat outlooks, excessive heat watches, and excessive heat warnings.

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

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.

LOCATION

This hazard may occur anywhere in the planning area.

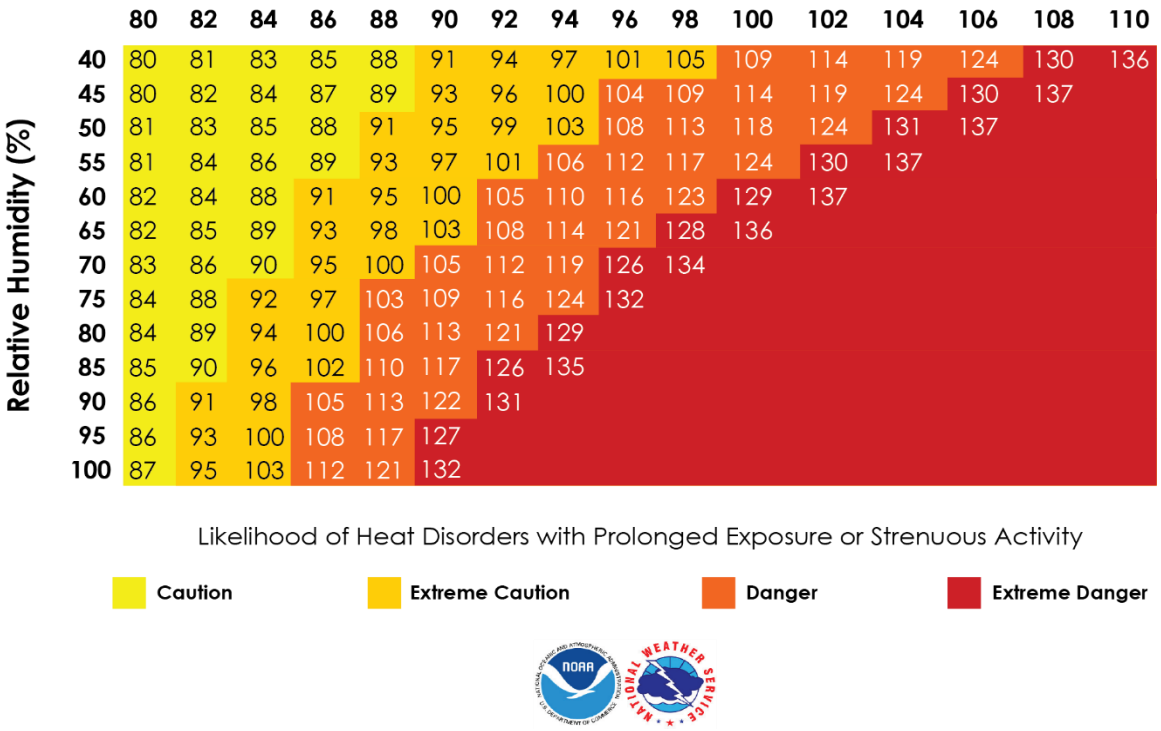
EXTENT

A key factor to consider in regards to extreme heat situations is the humidity level relative to the temperature. As is indicated in the following figure, as the Relative Humidity increases, the temperature needed to cause a dangerous situation decreases. For example, for 100 percent Relative Humidity, dangerous levels of heat begin at 86°F where as a Relative Humidity of 50

percent, require 94°F. The combination of relative humidity and temperature result in a Heat Index as demonstrated below:

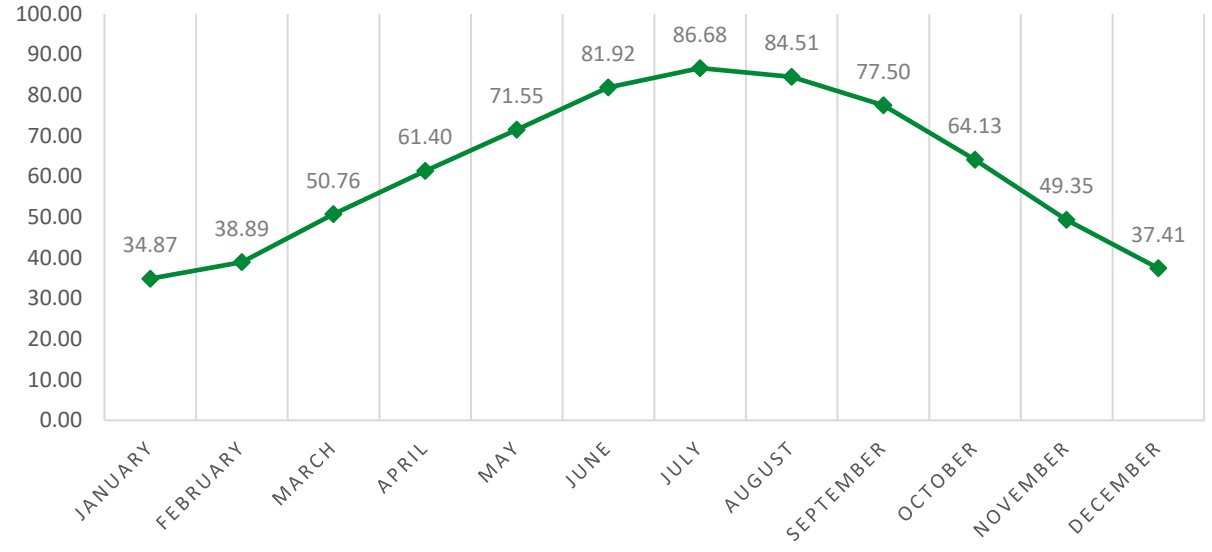
$$100\%\ Relative\ Humidity + 86°F = 112°F\ Heat\ Index$$

Figure 26: NOAA Heat Index



The figure above is designed for shady and light wind conditions. Exposures to full sunshine or strong hot 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 average temperatures are June, July, and August.

Figure 27: Monthly Climate Normals Max Temperatures

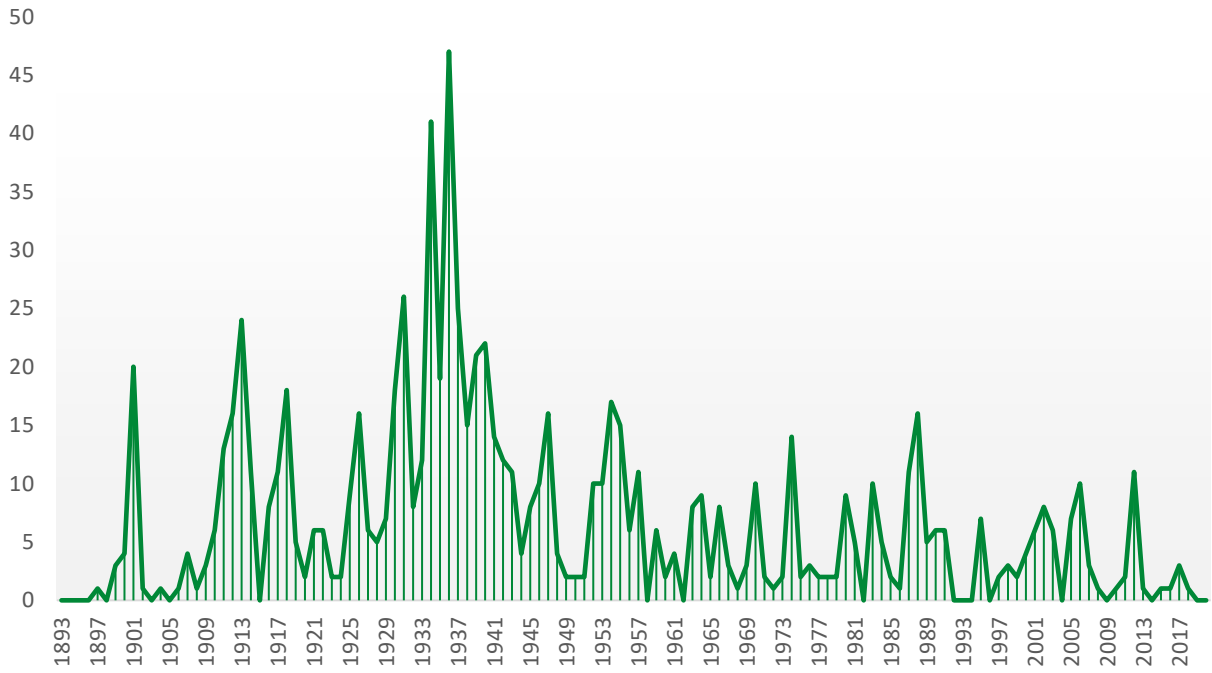


Source: NCEI, 2020

HISTORICAL OCCURRENCES

According to the High Plains Regional Climate Center (HPRCC), on average, the planning area experiences 3 days above 100°F per year. The planning area experienced the most days on record above 100°F in 1936 with 47 days and 1934 with 41 days. Conversely, 2020 was the most recent 'coolest' year on record with no reported days above 100°F. However, this is likely attributed to a lack of reported data.

Figure 28: Number of Days Above 100°F



Source: NOAA, HPRCC

AVERAGE ANNUAL LOSSES

The direct and indirect effects of extreme heat are difficult to quantify. There is no way to place a value on the loss of human life. Potential losses such as power outages could affect businesses, homes, and critical facilities. High demand and intense use of air conditioning can overload the electrical systems and cause damages to infrastructure.

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

Table 57: Extreme Heat Loss Estimation

Hazard Type	Avg. # Days over 100°F[1]	Total Property Loss[2]	Average Annual Property Loss	Total Crop Loss[3]	Average Annual Crop Loss
Extreme Heat	3	$0	$0	$211,993,088	$10,094,909

Source: 1 indicates the data is from MRCC; 2 NCEI; 3 USDA RMA (2000-2020)

ESTIMATED LOSS OF ELECTRICITY

According to the FEMA publication "What is a Benefit: Guidance on Benefit-Cost Analysis of Hazard Mitigation Project (June 2009)", 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. 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 58: Loss of Electricity - Assumed Damage by Jurisdiction

Jurisdiction	2019 (est) Population	Population Affected (assumed 10%)	Electric Loss of Use Assumed Damage Per Day
Boone County	5,279	527	$66,402
Custer County	10,826	1,082	$136,332
Garfield County	2,001	200	$25,200
Greeley County	2,382	238	$29,988
Howard County	6,417	641	$$80,766
Loup County	605	60	$7,560
Nance County	3,544	354	$44,604
Platte County	33,174	3,317	$417,942
Sherman County	3,033	303	$38,178
Valley County	4,206	420	$52,920
Wheeler County	783	78	$9,828

PROBABILITY

Extreme heat is a regular part of the climate; with 108 years out of 128 having at least one day over 100°F. On average the planning area experiences three days over 100°F. The probability that extreme heat will occur in any given year in the planning area is 84 percent.

COMMUNITY TOP HAZARD STATUS

The following table lists jurisdictions which identified Extreme Heat as a top hazard of concern:

Table 59: Extreme Heat Top Concern by Community

Jurisdictions	
Berwyn	Wolbach
Nance County	

REGIONAL VULNERABILITIES

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

Table 60: Regional Extreme Heat Vulnerabilities

Sector	Vulnerability
People	-Heat exhaustion -Heat Stroke -Vulnerable populations include: -People working outdoors -People without air conditioning -Young children outdoors or without air conditioning -Elderly outdoors or without air conditioning
Economic	-Short-term interruption of business -Loss of power -Agricultural losses
Built Environment	None
Infrastructure	-Overload of electrical systems -Damages to roadways
Critical Facilities	-Loss of power
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 has been a major problem for many of the communities in the LLNRD. Many of the communities were settled and developed largely because of their proximity to water resources. 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. Urban flooding is also a major concern for some communities in the planning area.

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 1 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, result from convective precipitation usually due to intense thunderstorms or sudden release from an upstream impoundment created behind a dam, landslide, or levee. Flash floods are distinguished from a regular flood by a timescale less than six hours and 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-caused 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.

Urban 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 capacity. 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 urban flooding, is becoming increasingly prevalent as development exceeds the capacity of drainage infrastructure, therefore limiting its ability to properly convey stormwater. Flooding also occurs due to combined storm and sanitary sewers being overwhelmed by the high flows that often accompany storm events. Typical impacts range from dangerously flooded roads to water backing into homes or basements, which damages mechanical systems and can create serious public health and safety concerns.

LOCATION

The major rivers in the planning area include the Loup River, Middle Loup River, North Loup River, and its tributaries. These rivers as well as smaller streams and creeks are potential locations for flooding to occur.

Most jurisdictions throughout the planning area also have FIRMS at the municipal level. However, effective Digital Flood Insurance Rate Maps (DFIRM) were not available for all jurisdictions within the planning area. Specifically Custer and Boone Counties do not have effective DFIRMS. Therefore, the best available digital data for depicting the flood hazard for these counties is a modeled floodplain using Hazards United States Multi-Hazard (HAZUS-MH). In the absence of DFIRM data, HAZUS-MH Level 1 analysis was used to generate a 1 percent annual flood event for major rivers and creeks (those with a 10-square mile minimum drainage area). Hazus does not provide a perfect reflection of the situation on the ground. There may be rivers or streams which cause flooding damages, but have drainages areas smaller than 10 square miles: these streams will not be included for analysis. A USGS 30-meter resolution digital elevation model (DEM) was used as the terrain base in the model; features smaller than 30 square meters may not be included in analysis. The Special Flood Hazard Areas shown in this plan are not regulatory, and are only approximations of vulnerability. Table 61 shows current statuses of FIRM panels. For additional details on localized flood risk such as flood zone types, please refer to the official FIRM available from FEMA's Flood Map Service Center. Figure 29 shows the DFIRMs and modeled floodplain for the planning area. For jurisdictional specific maps as well as an inventory of structures in the floodplain, please refer to *Section Seven: Community Profiles.*

Figure 29: 1% Annual Chance Flood Risk Area

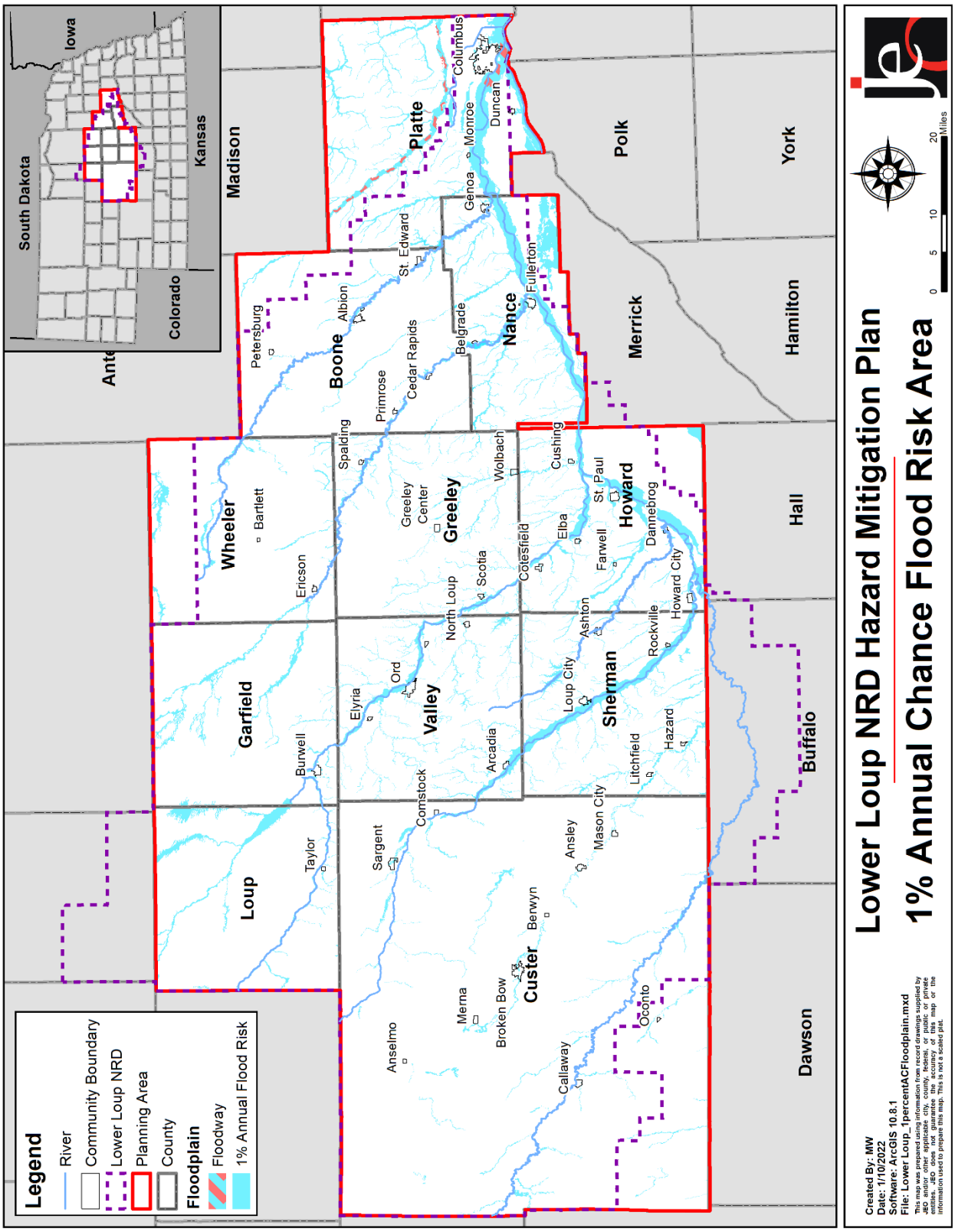


Table 61: FEMA FIRM Panel Status

Jurisdiction	Panel Number	Effective Date
Boone County	**31011CIND0; 31011C0025C; 31011C0050C; 31011C0075C; 31011C0100C; 31011C0125C; 31011C0150C; 31011C0175C; 31011C0177C; 31011C0200C; 31011C0225C; 31011C0250C; 31011C0275C; 31011C0300C; 31011C0309C; 31011C0325C; 31011C0328C; 31011C0350C; 31011C0375C; 31011C0400C; 31011C0409C; 31011C0417C; 31011C0425C; 31011C0450C; 31011C0475C; 31011C0478C; 31011C0486C; 31011C0500C; 31011C0525C; 31011C0550C; 31011C0575C**	**12/06/99**
Albion	31011C0309C, 31011C0325C, 31011C0328C, 31011C0350C	12/06/99
Cedar Rapids	31011C0409C, 31011C0417C, 31011C0425C	12/06/99
Petersburg	31011C0177C	12/06/99
St. Edwards	31011C0478C; 31011C0486C	12/06/99
Custer County	**310428IND0A; 3104289999B; 3104280003B; 3104280004B; 3104280005B; 3104280007B; 3104280008B; 3104280009B; 3104280010B; 3104280011B; 3104280012B; 3104280013B; 3104280014B; 3104280015B; 3104280016B; 3104280017B; 3104280018B; 3104280019B; 3104280020B; 3104280021B; 3104280022B; 3104280023B; 3104280024B; 3104280025B; 3104280026B; 3104280027B; 3104280028B; 3104280029B; 3104280030B**	**3/1/02**
Anselmo	-	-
Ansley	3103400001A	8/19/87
Arnold	310342	8/15/75
Broken Bow	3100510001B, 3100510001	9/29/78
Callaway	-	-
Sargent	-	-
Garfield County	**31071CIND0A[; 31071C0025B; 31071C0050B; 31071C0075B; 31071C0125B; 31071C0150B; 31071C0175B; 31071C0200B; 31071C0225B; 31071C0250B; 31071C0275B; 31071C0300B; 31071C0325B; 31071C0350B; 31071C0375B**	**4/16/08**
Burwell	31071C0225B, 31071C0250B	4/16/08
Greeley County	**31077CIND0A; 31077C0025B; 31077C0050B; 31077C0075B; 31077C0100B; 31077C0105B; 31077C0115B; 31077C0125B; 31077C0150B; 31077C0175B; 31077C0195B; 31077C0200B; 31077C0225B; 31077C0250B; 31077C0275B; 31077C0280B; 31077C0300B; 31077C0325B; 31077C0345B; 31077C0350B; 31077C0375B**	**5/16/08**
Greeley	31077C0195B, 31077C0200B	5/16/08
Scotia	31077CO280B, 31077CO300B	5/16/08
Spalding	31077C0100B, 31077C0105B, 31077C0115B	5/16/08

Jurisdiction	Panel Number	Effective Date
Wolbach	31077C0345B; 31077C0375B	5/16/08
Howard County	**31093CIND0B; 31093C0025C; 31093C0050C; 31093C0075C; 31093C0100C; 31093C0110C; 31093C0125C; 31093C0140C; 31093C0150C; 31093C0175C; 31093C0190C; 31093C0200C; 31093C0210C; 31093C0225C; 31093C0230C; 31093C0235C; 31093C0240C; 31093C0245D; 31093C0255D; 31093C0275D; 31093C0303C; 31093C0304C; 31093C0315C; 31093C0325C; 31093C0331D; 31093C0335D; 31093C0350D; 31093C0375D; 31093C0400C**	**7/7/14 & 10/19/2004**
Boelus	31093C0303C, 31093C0304C	10/19/04
Cotesfield	31093C011C	10/19/04
Cushing	31093C0190C	10/19/04
Dannebrog	31093C0331D	7/7/14
Elba	31093C0410C	10/19/04
Farwell	31093C0210C, 31093C0230C	10/19/04
St. Paul	31093C0255D, 31093C0275D	7/7/14
Loup County	**31115CIND0A; 31115C0025B; 31115C0050B; 31115C0075B; 31115C0100B; 31115C0125B; 31115C0150B; 31115C0175B; 31115C0200B; 31115C0225B; 31115C0250B; 31115C0275B; 31115C0300B; 31115C0325B; 31115C0350B; 31115C0375B; 31115C0425B; 31115C0450B; 31115C0475B; 31115C0500B**	**5/16/08**
Taylor	31115C0325B, 31115C0350B	5/16/08
Nance County	**31125CIND0A; 31125C0025C; 31125C0050C; 31125C0075C; 31125C0100C; 31125C0125C; 31125C0150C; 31125C0152C; 31125C0154C; 31125C0155C; 31125C0175C; 31125C0188C; 31125C0189C; 31125C0200C; 31125C0225C; 31125C0228C; 31125C0230C; 31125C0240C; 31125C0275C; 31125C0300C; 31125C0325C; 31125C0326C; 31125C0327C; 31125C0350C; 31125C0375C; 31125C0400C**	**8/4/05**
Belgrade	31125C0152C, 31125C0154C	8/4/05
Fullerton	31125C0188C, 31125C0189C, 31125C0325C, 31125C0326C, 31125C0327C	8/4/05
Genoa	31125C0228C	8/4/05
Platte County	**31141CIND0A; 31141C0010E; 31141C0025E; 31141C0030E; 31141C0035E; 31141C0050E; 31141C0065E; 31141C0075E; 31141C0080E; 31141C0090E; 31141C0100E; 31141C0125E; 31141C0150E; 31141C0175E; 31141C0185E; 31141C0200E; 31141C0205E; 31141C0215E; 31141C0225E; 31141C0250E; 31141C0275E; 31141C0300E; 31141C0305E; 31141C0310E; 31141C0315E; 31141C0320E; 31141C0330E;**	**4/19/10**

Jurisdiction	Panel Number	Effective Date
	31141C0335E; 31141C0340E; 31141C0345E; 31141C0375E; 31141C0400E	
Columbus	31141C0310E, 31141C0320E, 31141C0330E, 31141C0335E, 31141C0340E, 31141C0345E	4/19/10
Duncan	31141C0300E; 31141C0315E	4/19/10
Monroe	31141C0300E	4/19/10
Newman Grove	3119C0220D	2/4/05
Platte Center	31141C0200E; 31141C0215E	4/19/10
Sherman County	**31163CIND0A; 31163C0025C; 31163C0050C; 31163C0075C; 31163C0100C; 31163C0125C; 31163C0150C; 31163C0175C; 31163C0190C; 31163C0200C; 31163C0220C; 31163C0225C; 31163C0250C; 31163C0270C; 31163C0275C; 31163C0300C; 31163C0325C; 31163C0335C; 31163C0350C; 31163C0375C; 31163C0400C; 31163C0405C; 31163C0425C; 31163C0450C; 31163C0455C; 31163C0475C; 31163C0500C**	**5/16/08**
Ashton	31163C0220C; 31163C0225C; 31163C0225C; 31163C0335C; 31163C0350C	5/16/08
Hazard	31163C0405C	5/16/08
Litchfield	31163CIND0A; 31163C0270C	5/16/08
Loup City	31163C0190C; 31163C0200C; 31163C0325C	5/16/08
Rockville	31163C0455C	5/16/08
Valley County	**31175CIND0A; 31175C0025C; 31175C0045C; 31175C0050C; 31175C0075C; 31175C0100C; 31175C0125C; 31175C0150C; 31175C0155C; 31175C0160C; 31175C0175C; 31175C0195C; 31175C0200C; 31175C0220C; 31175C0225C; 31175C0240C; 31175C0250C; 31175C0275C; 31175C0285C; 31175C0300C**	**8/19/08**
Arcadia	31175C0220C, 31175C0225C, 31175C0240C, 31175C0250C	8/19/08
Elyria	31175C0045C, 31175C0050C, 31175C0075C	8/19/08
North Loup	31175C0195C, 31175C0285C	8/19/08
Ord	31175C0075C, 31175C0155C, 31175C0160C	8/19/08
Wheeler County	**31183CIND0A; 31183C0025A; 31183C0050A; 31183C0075A; 31183C0100A; 31183C0125A; 31183C0200A; 31183C0225A; 31183C0250A; 31183C0275A; 31183C0300A; 31183C0325A; 31183C0350A; 31183C0375A; 31183C0425A; 31183C0450A; 31183C0475A; 31183C0500A**	**1/2/08**
Bartlett	31183C0200A, 31183C0325A	1/2/08
Ericson	31183C0300A	1/2/08

Source: FEMA National Flood Insurance Program Source[54]

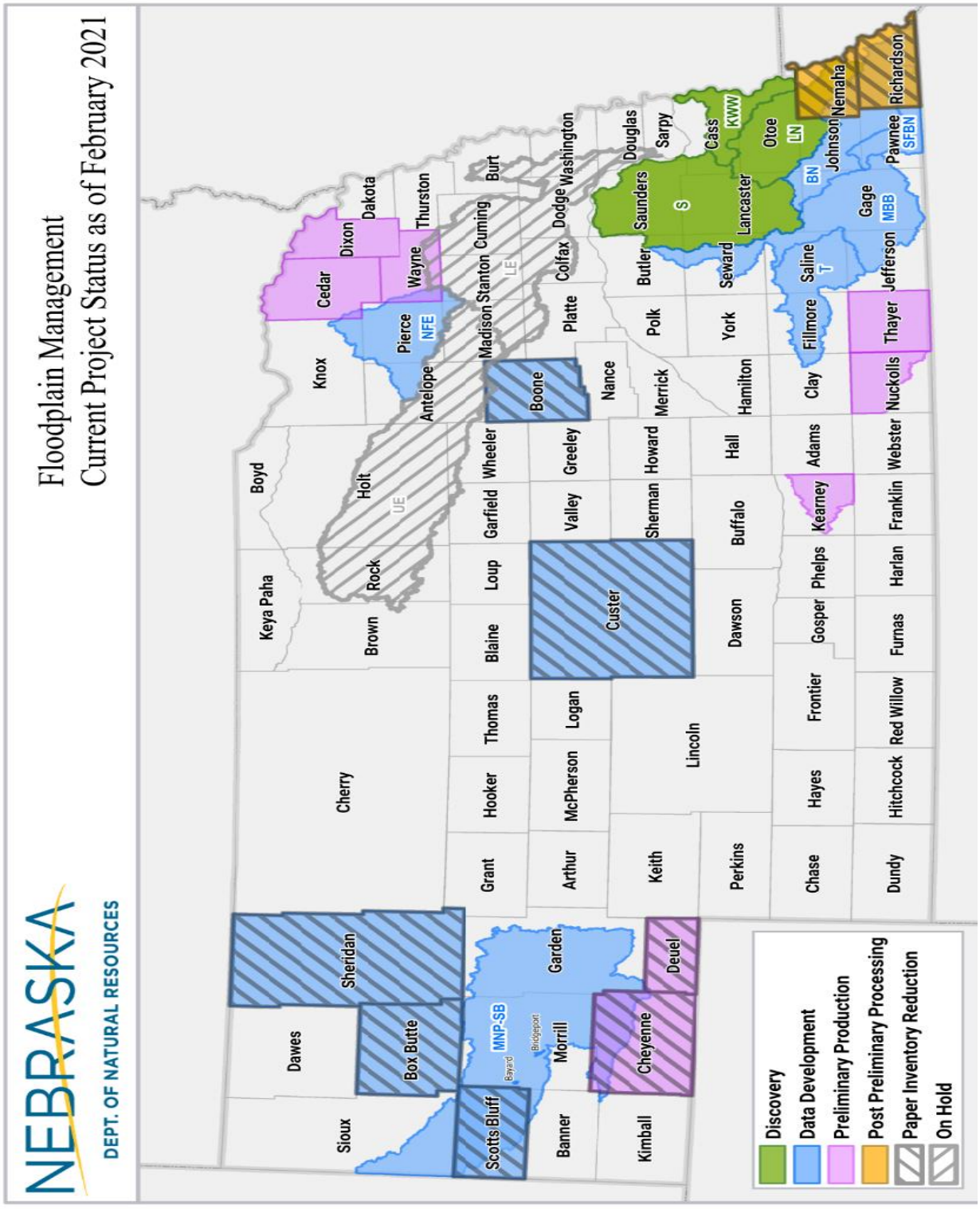
[54] Federal Emergency Management Agency. Accessed February 2021. "FEMA Flood Map Service Center." http://msc.fema.gov/portal/advanceSearch .

Risk Map Products

Risk Mapping, Assessment, and Planning (Risk MAP) is a FEMA program that provides communities with flood information and additional flood risk data (e.g. flood depth grids, percent chance grids, etc.) that can be used to enhance their mitigation plans and take action to better protect their citizens. As of 2021, portions of the planning area are currently undergoing dave development and paper inventory reduction activities (Figure 30).

Mapping projects are planned for portions of Boone and Custer Counties for data development and the northern edges of Garfield, Wheeler, and Platte Counties within the Elkhorn watershed. Currently there are no Flood Risk Reports for any of the eleven counties in the planning area. As data becomes available, NeDNR hosts the Risk Map products on an interactive web map, which can be viewed here: https://dnr.nebraska.gov/floodplain/interactive-maps. Other regulatory products reviewed and utilized in this planning process include Letter of Map Amendments (LOMAs), Letter of Map Revisions (LOMR), and Flood Insurance Studies (FIS) as available and applicable for each of the nine counties in the planning area. Specific LOMAs as identified in the planning process are described in their appropriate community profiles in *Section Seven.* Data can also be obtained from the FEMA Flood Map Service Center.

Figure 30: NeDNR Floodplain Management Projects



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, 120 flash flooding events resulted in $23,259,200 in property damage, while 88 riverine flooding events caused $30,258,000 in property damage. USDA RMA data does not distinguish the difference between riverine flooding damages and flash flooding damages. The total crop loss according to the RMA is $3,009,032.

The most significant flood events occurred in the planning area in 2010 and 2019. A brief description of each flood event from NCEI is provided below:

- ***June 2010, $3,818,000 in damages****- Multiple rounds of severe thunderstorms, mainly producing damaging winds and torrential rainfall, made for a very active Friday evening and early Saturday morning across much of South Central Nebraska. The initial wave of severe storms developed during the mid to late evening hours, mainly west of Highway 183 in the vicinity of a quasi-stationary surface front draped from Northwest Kansas to East Central Nebraska. As the initial cluster of storms pushed east toward the Highway 281 corridor toward midnight, wind damage became increasingly common. As this intial wave of storms weakened somewhat, another severe squall line surged into western sections of South Central Nebraska after midnight, aided by strong convergence along the nose of a 40-50 knot low level jet. With this line of late-night storms, damaging winds were not only reported along the leading edge of the outflow, but also in association with a wake low pressure system that developed behind the main squall line.*

  In addition to fairly widespread wind damage, portions of South Central Nebraska received heavy rainfall of 2 to 4 inches during the night. With the ground already saturated in areas mainly north of Interstate 80, flooding resulted. One of the most noteworthy flash flooding events affected the community of North Loup in Valley County along the Mira Creek. A dam break on the Bredthauer Dam, located approximately five miles northwest of town, allowed 1 to 2 feet of water to inundate much of North Loup on Saturday afternoon, with evacuations necessary. A foot of water covered Highway 91 from mile marker 35 to 37 between Brewster and Taylor. The Highway 183 bridge across the North Loup River was washed away as 4 to 6 inches of rain fell over the river basin. Numerous secondary roads were under water or washed away. Water levels at the Ericson Dam exceeded the maximum dam height and water flowed into the emergency spillway. Reports indicated that the spillway began to erode before 7 p.m. CST and the spillway breached thereafter, causing water to drain from the lake. Ericson Dam in Wheeler County, Nebraska failed Sunday evening, June 13th. Heavy rainfall contributed to water levels at the Ericson Dam that exceeded the maximum dam height, and water flowed into the emergency spillway. As debris gathered the spillway began to erode before 7 p.m. CST and the spillway breached, thereafter causing water to drain from the lake. Water levels behind the dam were estimated at 23 or 24 feet prior to dam failure. The floodwater flowed down Cedar River where the floodwater impacted approximately 15 homes and farmland in Wheeler County. At 845 p.m. CST, the floodwater reached the Wheeler and Greeley County line, with 6 inches of water was flowing over the Highway 281 bridge. The heavier rain upstream of Boone county caused flooding along the Cedar River which was aggravated by the failure of a dam on the river near Ericson which sent flood waters to another dam near Spalding which was then over-topped. The flooding in Boone county washed away 2 sections of a wooden bridge southwest of Primrose and also flooded farmland and a few county roads in the area.

- **March 2019, two deaths, $41,367,000 -** *A 971mb bomb cyclone moved out of the central Rockies on Wednesday, March 13, 2019 and helped to create widespread, moderate to*

major, and in many cases historic, flooding across eastern Nebraska and western Iowa. From 4 to 15 inches of snow cover remained across the mid Missouri River valley, and the ground was frozen with existing frost depths of 15 to 23 inches. The deepest snow was over Valley, Greeley, Nance, and Polk counties with 10 to 17 inches on the ground. Sherman, Howard, Fillmore, and Thayer counties also had as much as 12 inches on the ground part of that time. Because of the excessive cold, extensive ice formed on all rivers and creeks, and the ground was frozen to a depth of 25 inches. Warm temperatures allowed all of the snow to rapidly melt and record moisture allowed 1 to 2.5 inches of rain to fall over a 48 hour period. Due to the frozen ground, and that 1 to 2 feet of thick ice remained in area rivers, widespread, and in many cases, catastrophic flooding developed. Four individuals lost their lives due to the extreme conditions, and several hundred people required rescue via air or boat. Tens of thousands of people were evacuated from their homes or businesses. Nearly 50 levees were breached on the Platte, Elkhorn and Missouri Rivers due to the large volume of water. About 2,000 miles of state roads including 15 Nebraska state highway bridges and numerous local bridges, roughly 20 percent of the entire state road system were impacted. Nebraska and Iowa severe flooding impacts culminated in Federal Disaster Declaration 4420.

The Loup Power District enacted their emergency action plan necessitating the evacuation of the south side of Genoa. The hospital and nursing home were also evacuated. Highways were already closed in the area which complicated the evacuation. The Highway 22 bridge over the Loup Canal was washed out at both ends, and a large break occurred on one side of the canal itself. A home was also swept away in the North Loup River just north of St. Paul. Water covered hundreds of gravel and paved roads, including state and federal highways, making them impassable. Hundreds of roads (primarily gravel/county roads) were washed out or severely damaged, including some paved state and federal highways. Some of the most extensive damage to paved roads occurred to state Highways 14, 22, and 39 in Nance county. State Highway 14 was severely damaged with large chunks of pavement caved-in after the ground underneath was eroded away by swiftly moving water. At the peak of the flooding, so many roads were closed that Buffalo, Dawson, Howard, Phelps, and Sherman counties ran out of barricades. Dozens of bridges were washed out, primarily on county roads. Most of the washed out bridges were over creeks on gravel roads, but one was across the Middle Loup River south of Boelus. Bridges on paved roads were also affected. Where bridges weren't washed out severe erosion occurred to the abutments, even on some railroad bridges. Thirty-seven bridges were damaged in Howard county alone.

As increasing flows on area rivers broke up the ice, ice jams occurred on the Middle Loup River near Arcadia and southeast of Rockville, on the Cedar River near Belgrade, on the upstream side of the Highway 14 bridge in Nance county, north of Fullerton. An ice jam on the upstream side of the bridge over Mud Creek, near Ravenna, was broken up by an excavator. Large slabs of ice were also deposited and jaggedly piled-up by flood waters onto bridges and adjacent road leading up to the bridges. Just south of Fullerton, ice covered the Highway 14 bridge over the Loup River, keeping it impassable even after flood waters receded. Flood waters on the Middle Loup River deposited slabs of ice the size of pickup trucks onto the Highway 68 bridge at Rockville. People were evacuated in Belgrade, Dannebrog, Genoa, Gibbon, North Loup, Pleasanton, Shelton, and Wood River, some even by boat. Red Cross shelters were opened in North Loup, Boelus, and at the high school in Wood River. Ethanol plants in Ravenna, Ord, and Central City were impacted and could not get ethanol to market because of damaged tracks.

Impacts to agriculture were tremendous. As flood waters receded, pasture land and fields next to rivers and creeks were covered in sand and silt inches to feet deep, which ruined many acres for grazing. This flooding occurred in the middle of calving season. Hundreds of calves perished. Some reported livestock carcasses floating away. In some locations, cattle were isolated on islands. This combined with numerous damaged or flooded roads made travel to and around some farms impossible. Farmers in other parts of the country responded. Truckloads of hay were brought to Grand Island and staged at Fonner Park, from within the state, and from as far away as Ohio. One convoy of nine trucks delivered 200 tons of hay from Dickenson, ND to Fullerton. Hay also came from northwest Ohio to Pleasanton. Grain was also donated from farms in Ohio. Similar to the aftermath of the blizzard of January 1949, hay was airlifted by helicopters, from Fonner park, to stranded cattle in parts of Nance, Greeley, and surrounding counties.

The NeDNR has collected and reviewed extensive data records from the 2019 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.

Flooding in Valley County, June 2010

EXTENT

The NWS has three categories to define the severity of a flood once a river reaches flood stage as indicated in Table 62. Actual impacts will vary by community.

Table 62: Flooding Stages

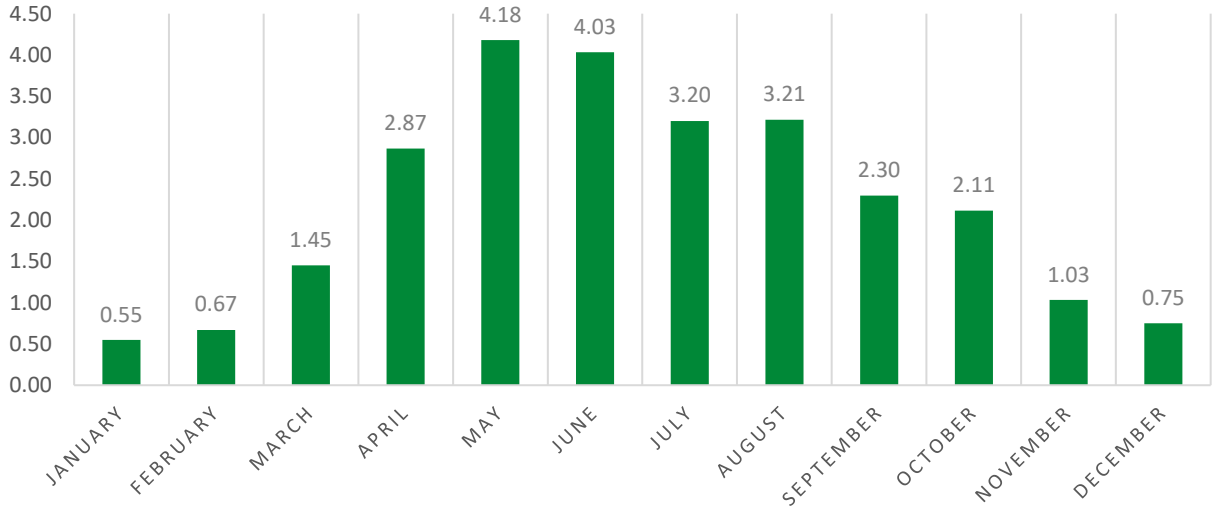
Flood Stage	Description of flood impacts
Minor Flooding	Minimal or no property damage, but possible some public threat or inconvenience
Moderate Flooding	Some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary

Major Flooding	Extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations

Source: NOAA, 2017[55]

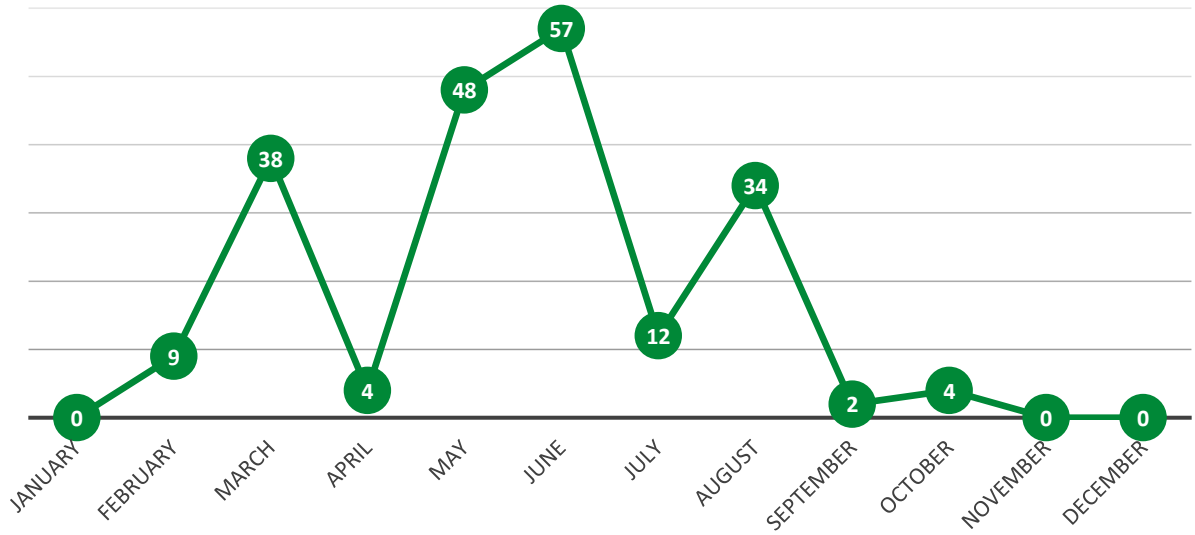
Figure 31 shows the normal average monthly precipitation for the planning area, which is helpful in determining whether any given month is above, below, or near normal in precipitation. As indicated in Figure 32, the most common months for flooding within the planning area are May and June. While it is possible that major flood events will occur, the likely extent of flood events within the planning area is classified as moderate.

Figure 31: LLNRD Average Monthly Precipitation



Source: NCEI, 2021

Figure 32: Monthly Trend for Floods/Flash Flood in the LLNRD (1996-2020)



Source: NCEI, 2021

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

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 that participate 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. The following tables summarize NFIP participation and active policies within the planning area as of December 2021.

Table 63: NFIP Participants

Jurisdiction	Eligible-Regular Program	Date Current Map	Sanction	Suspension	Rescinded	Participation in NFIP
Boone County	**9/18/1987**	**12/6/1999**	**-**	**-**	**-**	**Yes**
Albion	4/2/1986	12/06/99(M)	-	-	-	Yes
Cedar Rapids	12/6/1999	12/6/1999	-	-	-	Yes
Petersburg	12/6/1999	12/06/99(M)	-	-	-	Yes
Primrose	-	-	-	-	-	No
St. Edward	2/1/1990	12/6/1999	-	-	-	Yes
Custer County	**3/1/2002**	**03/01/02(L)**	**-**	**-**	**-**	**Yes**
Anselmo		(NSFHA)	-	-	-	Yes
Ansley	8/19/1987	08/19/87(M)	-	-	-	Yes
Arnold	-	8/15/75	8/15/76	-	-	No
Berwyn	-	-	-	-	-	No
Broken Bow	9/29/1978	9/29/1978	-	-	-	Yes
Callaway	-	-	-	-	-	No
Comstock	-	-	-	-	-	No
Mason City	-	-	-	-	-	No
Merna	-	-	-	-	-	No
Sargent		(NSFHA)	-	-	-	Yes
Garfield County	**4/16/2008**	**4/16/2008**	**-**	**-**	**-**	**Yes**
Burwell	4/2/2001	04/16/08(M)	-	-	-	Yes
Greeley County	**5/16/2008**	**5/16/2008**	**-**	**-**	**-**	**Yes**
Greeley	4/2/2001	5/16/2008	-	-	-	Yes
Scotia	5/16/2008	5/16/2008	-	-	-	Yes
Spalding	5/16/2008	5/16/2008	-	-	-	Yes
Wolbach	2/1/1987	05/16/08(M)	-	-	-	Yes

Jurisdiction	Eligible-Regular Program	Date Current Map	Sanction	Suspension	Rescinded	Participation in NFIP
Howard County	**9/30/1997**	**7/7/2014**	**-**	**-**	**-**	**Yes**
Boelus	9/27/1985	10/19/04(M)	-	-	-	Yes
Cotesfield	-	10/19/04	10/19/05	-	-	No
Cushing	-	10/19/04	10/19/05	-	-	No
Dannebrog	1/3/1990	7/7/2014	-	-	-	Yes
Elba	10/19/2004	10/19/2004	-	-	-	Yes
Farwell	-	10/19/04	10/19/05	-	-	No
St. Paul	10/19/2004	7/7/2014		-	-	Yes
Loup County	**-**	**5/16/08**	**5/16/09**	**-**	**-**	**No**
Taylor	7/1/1987	05/16/08(M)	-	-	-	Yes
Nance County	**8/4/2005**	**8/4/2005**	**-**	**-**	**-**	**Yes**
Belgrade	8/4/2005	8/4/2005		-	-	Yes
Fullerton	2/1/1987	08/04/05(L)	-	-	-	Yes
Genoa	8/19/1987	08/04/05(M)	-	-	-	Yes
Platte County	**4/19/2010**	**4/19/2010**	**-**	**-**	**-**	**Yes**
Columbus	4/19/2010	4/19/2010	-	-	-	Yes
Duncan	4/19/2010	04/19/10(M)	-	-	-	Yes
Monroe	4/19/2010	04/19/10(M)	-	-	-	Yes
Sherman County	**5/16/2008**	**5/16/2008**	**-**	**-**	**-**	**Yes**
Ashton	5/16/2008	5/16/2008	-	-	-	Yes
Hazard	-	5/16/08	5/16/09	-	-	No
Litchfield	2/1/1987	05/16/08(M)	-	-	-	Yes
Loup City	5/1/1987	05/16/08(M)	-	-	-	Yes
Rockville	5/16/2008	5/16/2008	-	-	-	Yes
Valley County	**8/19/2008**	**08/19/08(M)**	**-**	**-**	**-**	**Yes**
Arcadia	8/19/2008	08/19/08(M)	-	-	-	Yes
Elyria	8/19/2008	08/19/08(M)	-	-	-	Yes
North Loup	8/1/1987	08/19/08(M)	-	-	-	Yes
Ord	12/7/1984	08/19/08(M)	-	-	-	Yes
Wheeler County	**1/2/2008**	**1/2/2008**	**-**	**-**	**-**	**Yes**
Bartlett	-	-	-	-	-	No
Ericson	-	-	-	-	-	No

Source: FEMA, NFIP Community Status Book Report[56]

[56] Federal Emergency Management Agency. 202. "The National Flood Insurance Program Community Status Book." https://www.fema.gov/cis/NE.html.

Note: (M) – No elevation determined – All Zone, A, C, and X; (L) – Original FIRM by Letter – All Zone A, C, and X

Table 64: NFIP Policies in Place and Total Payments

Jurisdiction	Total Premium	Policies In-force	Total Coverage	Total Losses	Total Payments
Rural Boone County	$2,324	3	$820,000	3	$9,033
Albion	$1,191	1	$73,300	0	$-
Cedar Rapids	$3,463	5	$220,800	0	$0
Petersburg	N/A	0	N/A	N/A	N/A
Primrose	N/A	0	N/A	N/A	N/A
St. Edward	$17,623	20	$1,558,100	9	$137,184
Rural Custer County	**$9,685**	**15**	**$1,488,900**	**3**	**$74,734**
Anselmo	$519	1	$350,000	0	$-
Ansley	$15,496	19	$852,200	4	$2,368
Arnold	N/A	0	N/A	N/A	N/A
Berwyn	N/A	0	N/A	N/A	N/A
Broken Bow	$22,149	16	$1,234,100	2	$0
Callaway	N/A	0	N/A	N/A	N/A
Comstock	N/A	0	N/A	N/A	N/A
Mason City	N/A	0	N/A	N/A	N/A
Merna	N/A	0	N/A	N/A	N/A
Sargent	$1,505	2	$335,000	2	$6,334
Rural Garfield County	**N/A**	**0**	**N/A**	**N/A**	**N/A**
Burwell	$375	1	$175,000	0	$-
Rural Greeley County	$394	1	$140,000	0	$-
Greeley	N/A	0	N/A	N/A	N/A
Scotia	$519	1	$350,000	0	$-
Spalding	N/A	0	N/A	N/A	N/A
Wolbach	N/A	0	N/A	N/A	N/A
Rural Howard County	**$22,878**	**23**	**$4,550,400**	2	$27,672
Boelus	N/A	0	N/A	1	$1,246
Cotesfield	N/A	0	N/A	N/A	N/A
Cushing	N/A	0	N/A	N/A	N/A
Dannebrog	$21,616	18	$1,449,800	12	$161,060
Elba	N/A	0	N/A	N/A	N/A
Farwell	N/A	0	N/A	N/A	N/A
St. Paul	$1,587	3	$787,000	0	$0
Rural Loup County	**N/A**	**0**	**N/A**	**N/A**	**N/A**
Taylor	N/A	0	N/A	N/A	N/A
Rural Nance County	**$13,876**	**11**	**$2,193,500**	**3**	**$9,900**

Jurisdiction	Total Premium	Policies In-force	Total Coverage	Total Losses	Total Payments
Belgrade	$437	1	$280,000	0	$-
Fullerton	$1,955	2	$510,000	0	$-
Genoa	N/A	0	N/A	N/A	N/A
Rural Platte County	**$55,009**	**72**	**$16,258,300**	**12**	**$302,081**
Columbus	$65,356	121	$37,884,700	40	$784,066
Duncan	N/A	0	N/A	N/A	N/A
Monroe	N/A	0	N/A	N/A	N/A
Rural Sherman County	**N/A**	**0**	**N/A**	**N/A**	**N/A**
Ashton	N/A	0	N/A	N/A	N/A
Hazard	N/A	0	N/A	N/A	N/A
Litchfield	N/A	0	N/A	1	$7,046
Loup City	$2,202	4	$655,000	0	$-
Rockville	N/A	0	N/A	N/A	N/A
Rural Valley County	$530	2	$29,300	0	$-
Arcadia	$796	1	$65,000	1	$47,472
Elyria	N/A	0	N/A	N/A	N/A
North Loup	$519	1	$350,000	4	$23,556
Ord	$519	1	$350,000	3	$39,636
Rural Wheeler County	$693	2	$315,000	2	$7,763
Bartlett	N/A	0	N/A	N/A	N/A
Ericson	N/A	0	N/A	N/A	N/A
Planning Area Total	**$263,216**	**347**	**$73,275,400**	**104**	**$1,641,151**

Source: FEMA, HUDEX Policy Loss Data, November 30 2020[57]

This plan highly recommends and strongly encourages each plan participant to remain in good standing and continue involvement 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 Coordinator's Manual (FIA-15/2013). As of December 2021, no communities in the 11-county planning area participate in the CRS.

NFIP REPETITIVE LOSS STRUCTURES

NeDNR and FEMA Region VII were contacted to determine if any existing buildings, infrastructure, or critical facilities are classified as NFIP Repetitive Loss Structures. Note there are two definitions for repetitive loss structures. Severe repetitive loss is a grant definition for HMA purposes that has specific criteria while repetitive loss is a general NFIP definition. There are 17

[57] Federal Emergency Management Agency: National Flood Insurance Program. December 2019. Policy & Claim Statistics for Flood Insurance." Accessed November 2020. https://www.fema.gov/policy-claim-statistics-flood-insurance.

repetitive loss properties located in the planning area as of October 2021. Only jurisdictions with reported properties are included in the following table.

Table 65: Repetitive Loss Structures

Jurisdiction	Number of Properties	Type of Property	Total Losses	Total Payments
Columbus	1	Single Family	2	$12,013.88
Ord	1	Single Family	2	$34,645.26
Sargent	1	Single Family	2	$6,334.19
St. Edward	1	Single Family	2	$7,152.89

Source: NeDNR, October 2021 (personal correspondence)

NFIP RL: Repetitive Loss Structure refers to a structure covered by a contract for flood insurance under the NFIP that has incurred flood-related damage on two occasions during a 10-year period, each resulting in at least a $1,000 claim payment.

NFIP SRL: Severe Repetitive Loss Properties are defined as single or multifamily residential properties that are covered under an NFIP flood insurance policy and:

(1) That have incurred flood-related damage for which four or more separate claims payments have been made, with the amount of each claim (including building and contents payments) exceeding $5,000, and with the cumulative amount of such claim payments exceeding $20,000; or
(2) For which at least two separate claims payments (building payments only) have been made under such coverage, with cumulative amount of such claims exceeding the market value of the building.

(3) In both instances, at least two of the claims must be within 10 years of each other, and claims made within 10 days of each other will be counted as one claim.

HMA RL: A repetitive loss property is a structure covered by a contract for flood insurance made available under the NFIP that:

(1) Has incurred flood-related damage on two occasions, in which the cost of the repair, on the average, equaled or exceeded 25 percent of the market value of the structure at the time of each such food event; and

(2) At the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage.

HMA SRL: A severe repetitive loss property is a structure that:

(1) Is covered under a contract for flood insurance made available under the NFIP.

(2) Has incurred flood related damage –

(a) For which four or more separate claims payments (includes building and contents) have been made under flood insurance coverage with the amount of each such claim exceeding $5,000, and with the cumulative amount of such claim payments exceeding $20,000; or

(b) For which at least two separate claims payments (includes only building) have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the insured structure.

Purpose of the HMA definitions: The HMA definitions were allowed by the Biggert-Waters Flood Insurance Reform Act of 2012 to provide an increased federal cost share under the FMA grant when a property meets the HMA definition.

AVERAGE ANNUAL DAMAGES

The average damage per event estimate was determined based upon the 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. Flooding caused a total average of $53,517,200 in property damages and $3,009,033 in crop losses per year for the planning area.

Table 66: Flood Loss Estimate

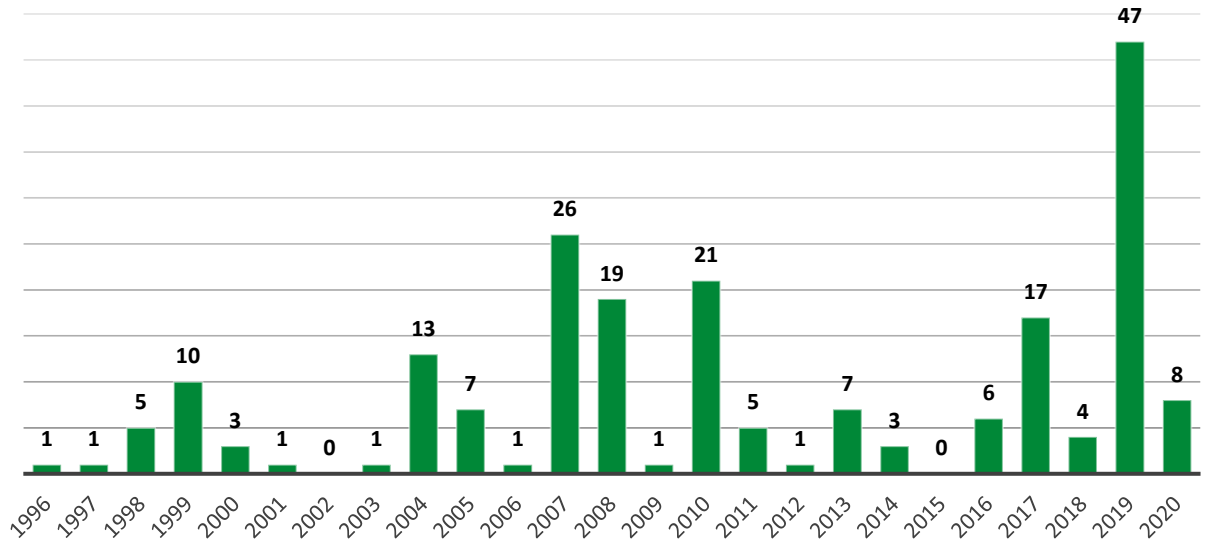
Hazard Type	Number of Events[1]	Number of Events Per Year	Total Property Loss[1]	Average Annual Property Loss [1]	Total Crop Loss[2]	Average Annual Crop Loss [2]
Flood Events	88	3.5	$30,258,000	$1,210,320	$3,009,033	$143,287
Flash Flood	120	4.8	$23,259,200	$930,368		
Total	**208**	**8.3**	**$53,517,200**	**$2,140,688**	**$3,009,033**	**$143,287**

1 Indicates data from NCEI (January 1996 to December 2020) 2 Indicates data from RMA (2000 to 2020)

PROBABILITY

The NCEI reports 88 flooding and 120 flash flooding events from January 1996 to December 2020. Some years had multiple flooding events. The following figure shows the events broken down by year. Based on the historic record and reported incidents by participating communities with 23 out of 25 years with a reported flood event, there is a 92 percent probability that flooding will occur annually in the planning area. It is worth noting that while no events were reported for 2021, flood events likely occurred during 2021 but were not reported here.

Figure 33: Flood Events by Year



Source: NCEI, 2020

COMMUNITY TOP HAZARD STATUS

The following table lists jurisdictions which identified Flooding as a top hazard of concern:

Table 67: Flooding Top Concern by Community

Jurisdictions	
Albion and Albion Fire	Greeley County
Anselmo	Hazard
Ansley	Howard County
Arcadia	Litchfield
Arnold	Loup Basin Public Health
Ashton	Loup City
Belgrade	Loup County
Berwyn	Mason City
Boelus	Nance County
Boone County	North Loup
Broken Bow	Oconto
Burwell	Ord
Callaway	Petersburg
Cedar Rapids	Platte County
Columbus	Primrose
Comstock	Rockville
Cotesfield	Sargent
Cushing	Sargent Irrigation District
Custer County	Scotia
Dannebrog	Sherman County
Duncan Fire District	Spalding
Elba	St. Edward
Ericson	St. Paul
Farwell	Taylor

Jurisdictions	
Farwell Irrigation District	Twin Loups Irrigation District
Fullerton	Valley County
Garfield County	Wheeler County
Genoa	Wolbach

REGIONAL VULNERABILITY

An updated national study examining social vulnerability as it relates to flood events found that low-income and minority populations are disproportionately vulnerable to flood events.[58] 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 and renters are more likely to live in areas vulnerable to the threat of flooding, yet lack the resources necessary to purchase flood insurance. And finally 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.

Any future development in floodplains should be discouraged to protect future assets. Land-use regulations should be used to limit development in floodplains and other flood prone areas as well as a protecting natural flood mitigation features. Buyout programs can be used to eliminate properties located in floodplains, especially properties that have experienced repetitive losses. Communities may also consider incorporating “Green Infrastructure” to address flooding concerns, and examples of this would include using permeable surfaces for parking areas, using rainwater retention swales, developing rain gardens, developing green roofs, and establishing greenways. Building codes currently require tie-down straps for propane tanks.

Nebraska’s minimum standards for floodplain management require that all new construction and substantial improvements of residential structures shall have the lowest floor (including basements) elevated to or above one foot above the base flood elevation. Nebraska standards also require that new structures for human habitation are not permitted in the floodway. These requirements will help reduce flood impacts and damages by requiring a one foot “freeboard” to allow for known flood hazards and also result in lower premiums for those participating in the NFIP.

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

[58] Tate, E., Rahman, M.A., Emrich, C.T. *et al.* Flood exposure and social vulnerability in the United States. *Nat Hazards* (2021). https://doi.org/10.1007/s11069-020-04470-2

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

Table 68:Regional Flooding Vulnerabilities

Sector	Vulnerability
People	-Low income and minority populations may lack the resources needed for evacuation, response, or to mitigate the potential for flooding -Elderly or residents with decreased mobility may have trouble evacuating -Residents in low-lying areas, especially campgrounds, are vulnerable during flash flood events -Residents living in the floodplain may need to evacuate for extended periods
Economic	-Business closures or damages may have significant impacts -Agricultural losses from flooded fields or cattle loss -Closed roads and railroads would impact commercial transportation of goods
Built Environment	-Building may be damaged
Infrastructure	-Damages to roadways and railways
Critical Facilities	-Wastewater facilities are at risk, particularly those in the floodplain -Critical facilities, especially those in the floodplain, are at risk to damage (critical facilities are noted within individual community profiles)
Climate	-Changes in seasonal and annual precipitation normals will likely increase frequency and magnitude of flood events

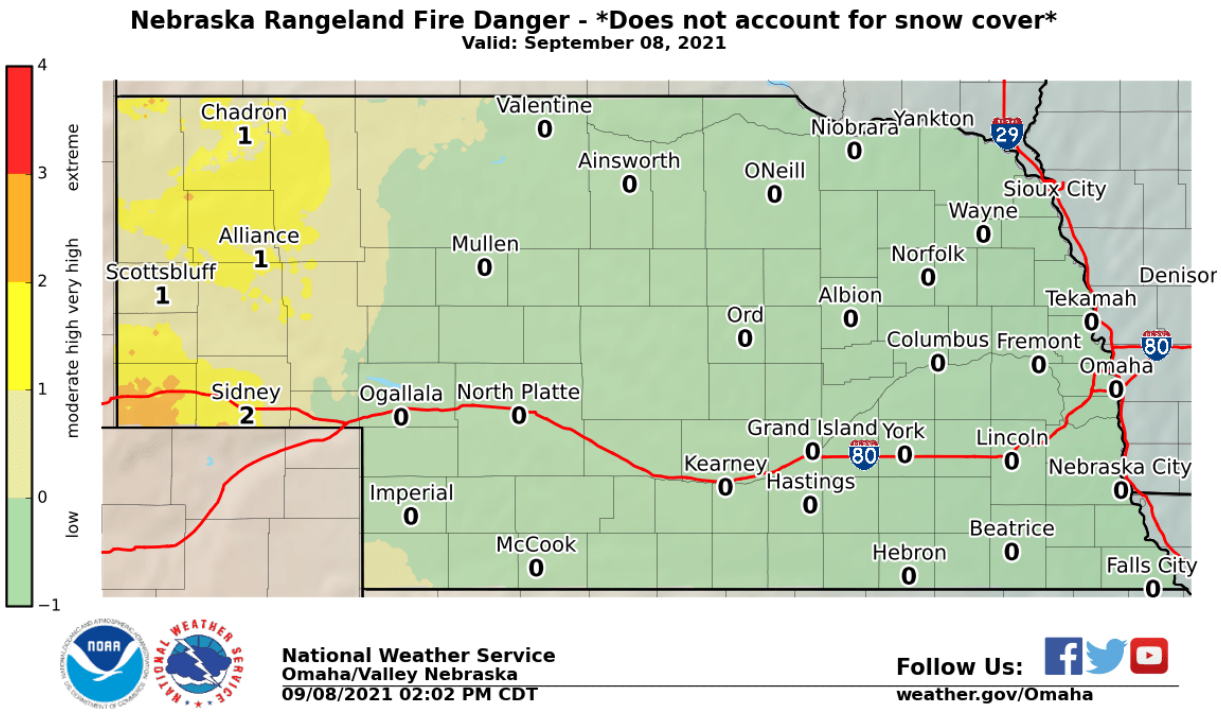
GRASS/WILDFIRE

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

Wildfires are a growing hazard in most regions of the United States, posing a threat to life and property, particularly where native ecosystems meet urban developed areas. 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.

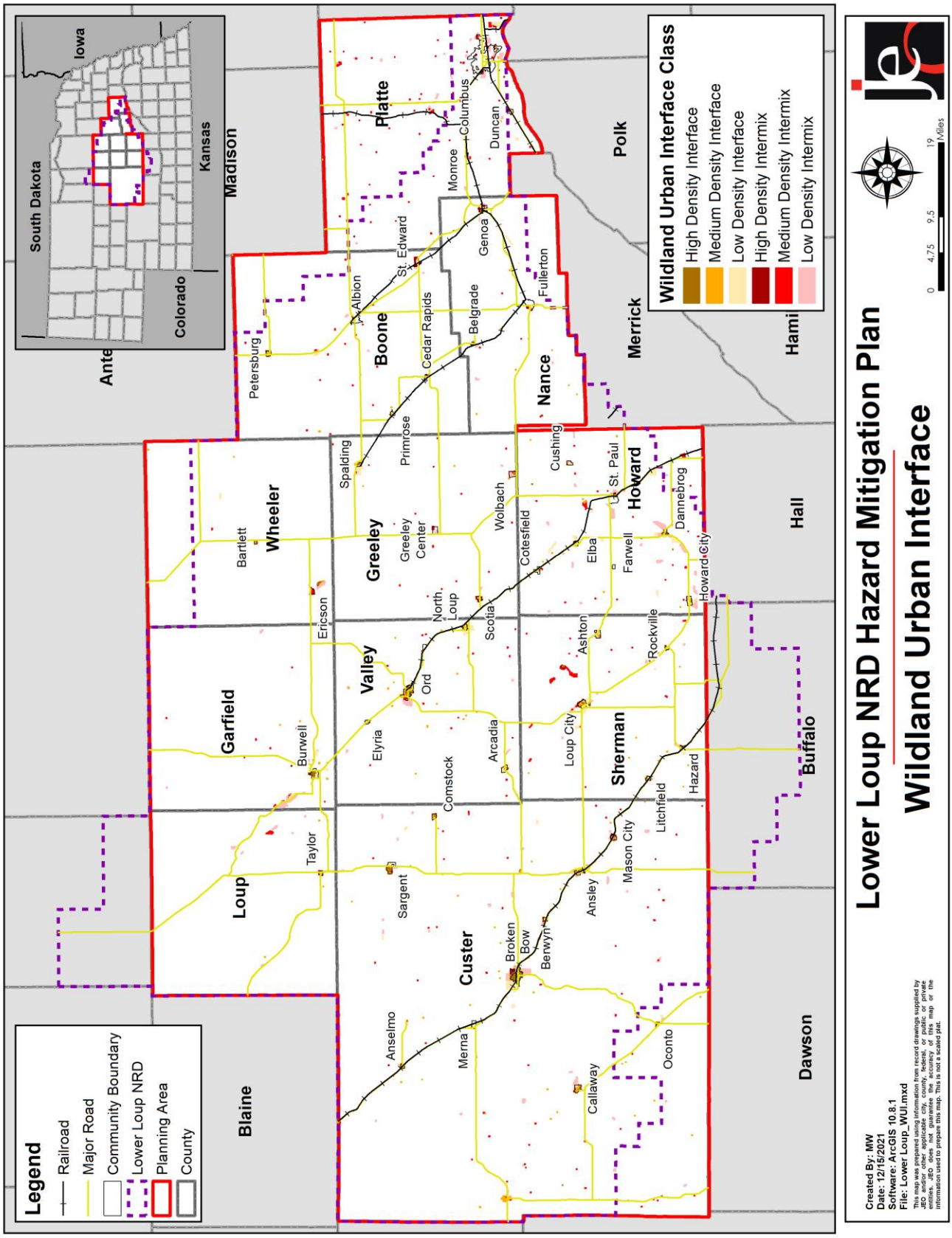
Wildfires are characterized in terms of their geographical characteristics including topography, weather, and fuels; or physical properties such as flame length and propagation. Wildfire behavior is often complex and variably dependent on factors such as fuel type, moisture content in the fuel, humidity, wind speed, topography, geographic location, ambient temperature, and the effect of weather on the fire. Fuel and structure durability are the primary factors people can control and are 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 34). Fire danger predictions are updated regularly and should be reviewed frequently by community leaders and fire department officials.

Figure 34: Rangeland Fire Danger Example



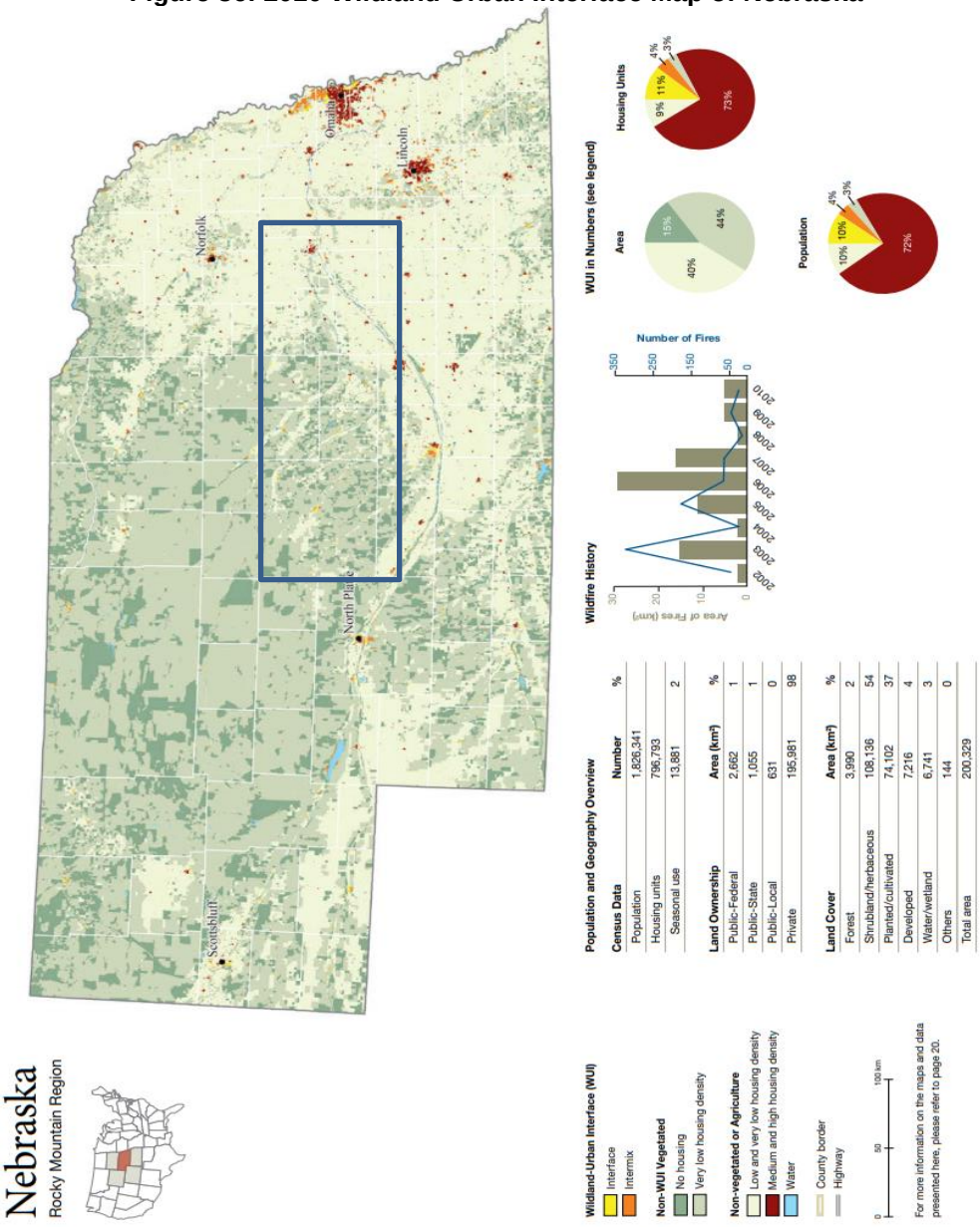
In recent decades, as the population of the United States has decentralized and residents have moved farther away from the center of villages and cities, the Wildland Urban Interface (WUI) has developed significantly, in both terms of population and building stock. The WUI is defined as the zone of transition between developed areas and undeveloped wilderness, where structures and other human development meet wildland. The expansion of the WUI increases the likelihood that wildfires will threaten people and homes, making this area the focus of the majority of wildfire mitigation efforts.

Figure 35: WUI in the Planning Area



The following figure produced by the USDA Forest Service displays the State of Nebraska's WUI conditions as of 2010. The approximate location of the planning area is indicated by the black outline. Areas that are indicated by the WUI, either interface (yellow) or intermix (orange) are primarily found in portions of Gage and Adams Counties. The rest of the planning area is located in primarily non-WUI vegetated designated areas, with no or low-density housing with a mix of vegetated, non-vegetated, and agricultural land.

Figure 36: 2010 Wildland Urban Interface Map of Nebraska



The Nebraska Forest Service (NFS) develops Community Wildfire Protection Plans (CWPP) for regions across the state. Custer, Loup, Garfield, Wheeler, Valley, and Greeley Counties are located within the 2019 Central Sandhills CWPP, Boone and Platte Counties are covered by the

Middle Northeast CWPP (under development as of this HMP's development), and Howard, Sherman, and Nance Counties are within the 2019 Central Platte CWPP.[59]

The Central Sandhills CWPP noted the following areas of concern for its counties.

- Custer County – areas around Mason City, the area between Comstock and Arcadia, the northeast part of the Sargent Fire District, and the McKinley Road vicinity between Callaway and Broken Bow, including the difficult terrain straddling the Callaway and Broken Bow Fire Districts.
- Garfield and Loup Counties – the Burwell fire chief identified the recreational-residential developments surrounding the Calamus Reservoir as of particular concern. This area includes subdivisions – some with only one way in and out – with more than 50 homes, narrow roads, flammable windbreaks, and proximity to heavy fuels and rough terrain. Some areas lack water within an effective distance. This is a fast-growing area with limited access and many large homes. Other high-risk regions include canyons and rough terrain northeast and southwest of Burwell. There are several areas where eastern redcedar has encroached into grasslands, creating high fire hazard.
- Greeley - Locations of special concern include population centers adjacent to grasslands, canyons, and areas where eastern redcedar has encroached into grasslands, creating high fire hazard, such as the area is north of Spalding and the area north of Scotia that straddles the Scotia and Ord fire districts. The southwest corner of the county, around the Davis Creek WMA, has limited road access and rough terrain. The Scotia fire chief identified the area known as Will's Washout, two miles northeast of Cotesfield in Howard County but within the Scotia Fire District. This area contains heavy fuels, homes with ingress/egress issues, rough topography, and a lack of water within an effective distance. The Scotia fire chief said that bridge weight limits are a major concern in the county.
- Valley - Locations of special concern include population centers adjacent to grasslands, canyons, and areas where eastern redcedar has encroached into grasslands, creating high fire hazard. The northwest corner of the county and part of the east boundary with Greeley County have rugged terrain and some access issues. The Ord fire chief identified West Ord Acres as a subdivision with only one way in and out, and there are other areas west and south of Ord with heavy fuels.
- Wheeler - The area most at-risk from wildfire is the residential/recreational subdivision at Ericson Lake, where there are numerous homes in proximity to heavy fuels. The Ericson Lake Corporation is a homeowners association whose board may be interested in participating in community preparedness activities. All of Wheeler County's population centers, dispersed ranches and farms, and forested areas along the rivers and streams lie within the boundaries of the WUI.

The Central Platte CWPP noted the following areas of concern for its counties.

- Howard – Locations of special concern include population centers adjacent to grasslands and areas where eastern redcedar has encroached into deciduous woodlands and grasslands, creating high fire hazard. The Dannebrog fire chief identified areas northeast and southwest of Dannebrog as being of particular concern due to multiple structures, heavy fuels, difficult access, and only one way in and out. Many of the houses being built in these areas have narrow driveways, which makes access difficult, and often there is little room for fire trucks. The Elba and Scotia fire chiefs identified "Will's Washout" northwest of Cotesfield as an issue, with rough topography, multiple homes, heavy fuels, difficult access, and lack of water within effective distance. There are other areas at-risk from wildfire located along the Loup Rivers and in the rough terrain in the northern part of

[59] Nebraska Forest Service. 2020. "Community Wildfire Protection Plans." https://nfs.unl.edu/publications/community-wildfire-protection-plans.

the county. All of Howard County's population centers, dispersed farms and ranches, and wooded areas along the rivers and streams lie within the boundaries of the WUI.

- Nance – The Genoa fire chief has identified river bottoms as of particular concern due to rough terrain, one way in and out, and heavy fuels. The St. Edward fire department noted that in general, multiple structures, along with difficult or limited access, rough terrain, and lack of water within an effective distance is problematic. Other at risk areas are located around population centers and in rough, cedar-encroached terrain north of the Loup River. All of Nance County's population centers, rural areas, and wooded waterways lie within the boundaries of the WUI.
- Sherman - The Rockville fire chief identified undergrazed pastureland as being a concern. Other areas of concern include population centers adjacent to grasslands, the area surrounding Sherman Reservoir and nearby subdivisions, areas with rough terrain and poor access, and wooded areas along the rivers. All of Sherman County's population centers, rural areas, and wooded waterways lie within the boundaries of the WUI.

The following figures identify areas of concern in the planning area as identified in the Central Platte CWPP and Central Sandhills CWPP.

Figure 37: Central Platte CWPP Priority Landscapes

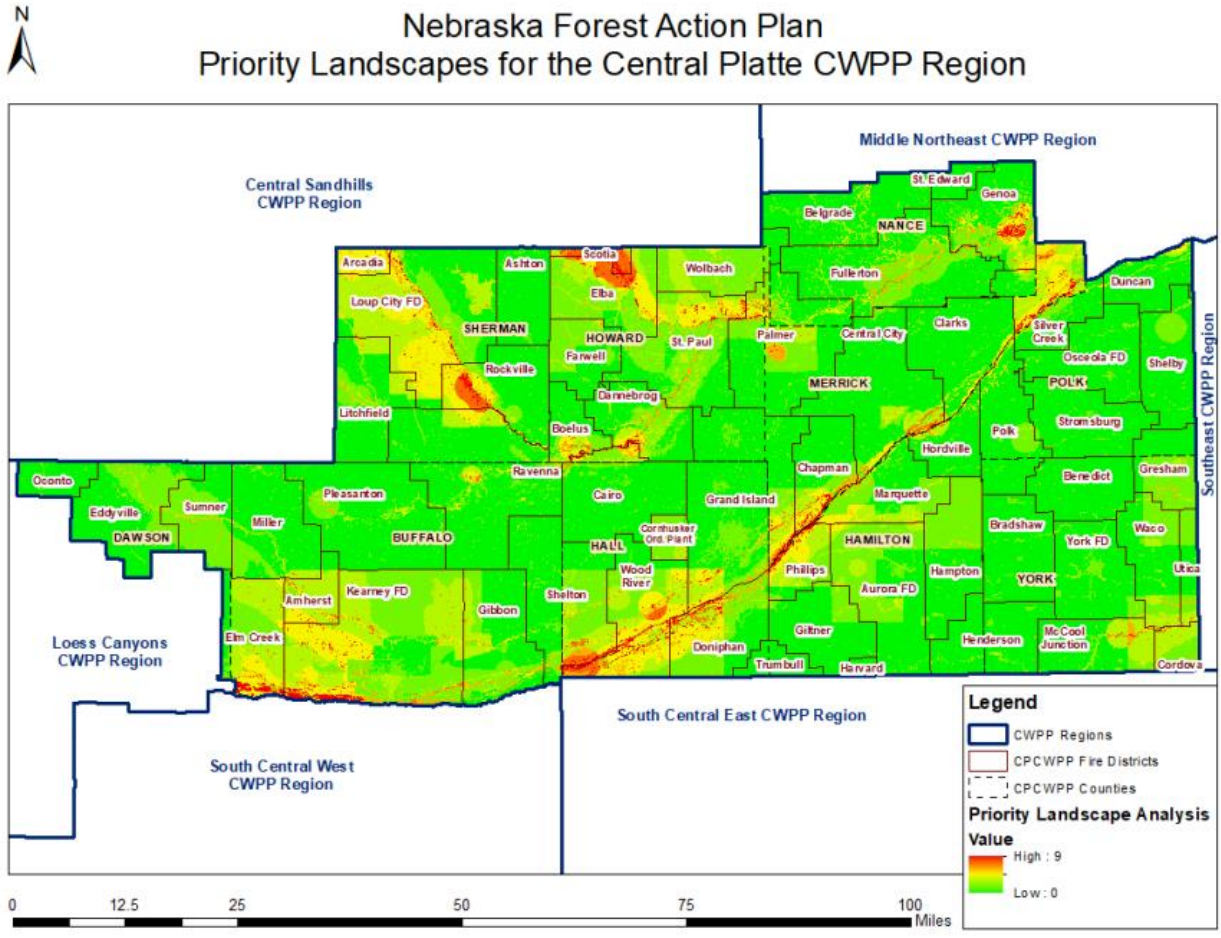
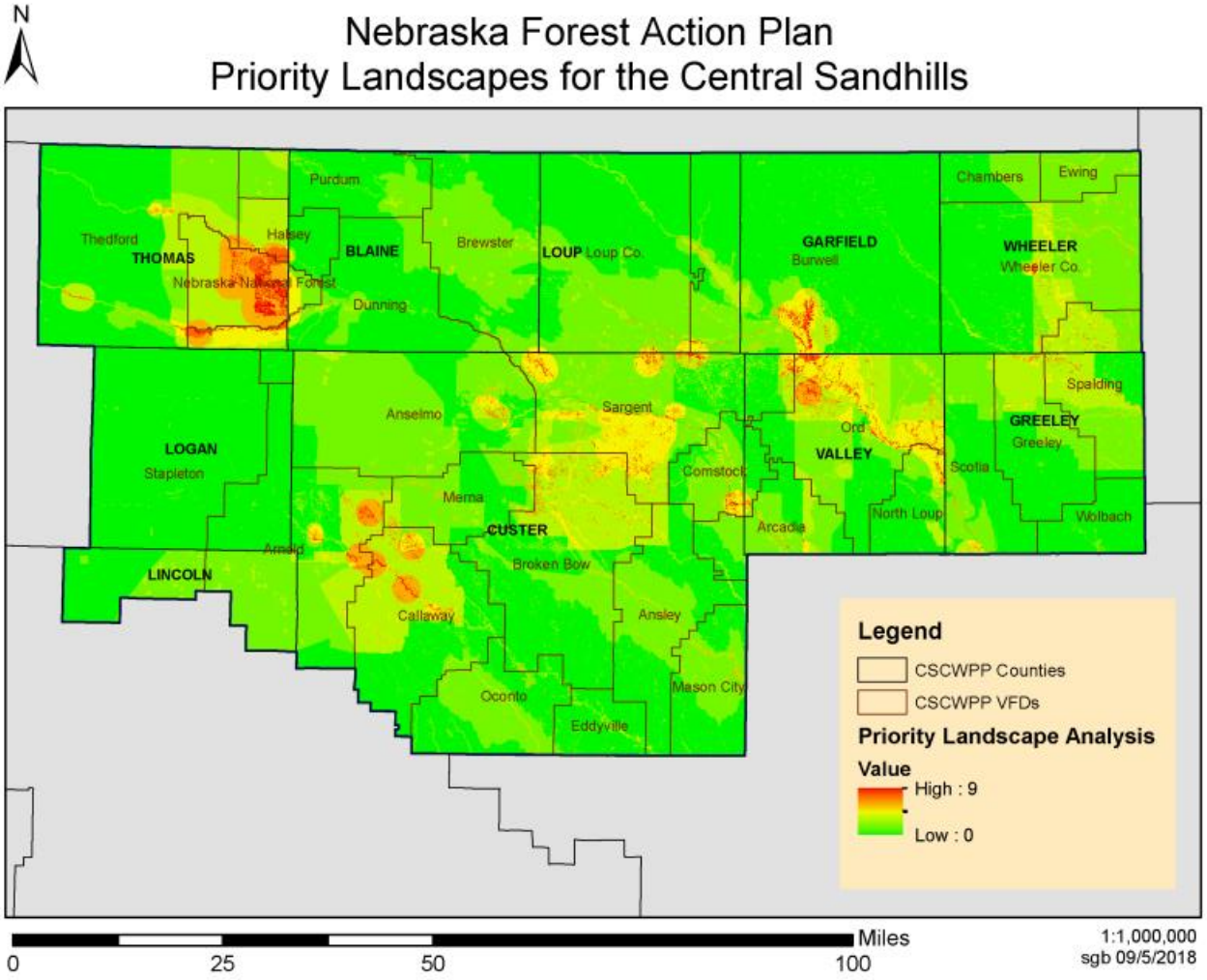


Figure 38: Central Sandhills CWPP Priority Landscapes



LOCATION

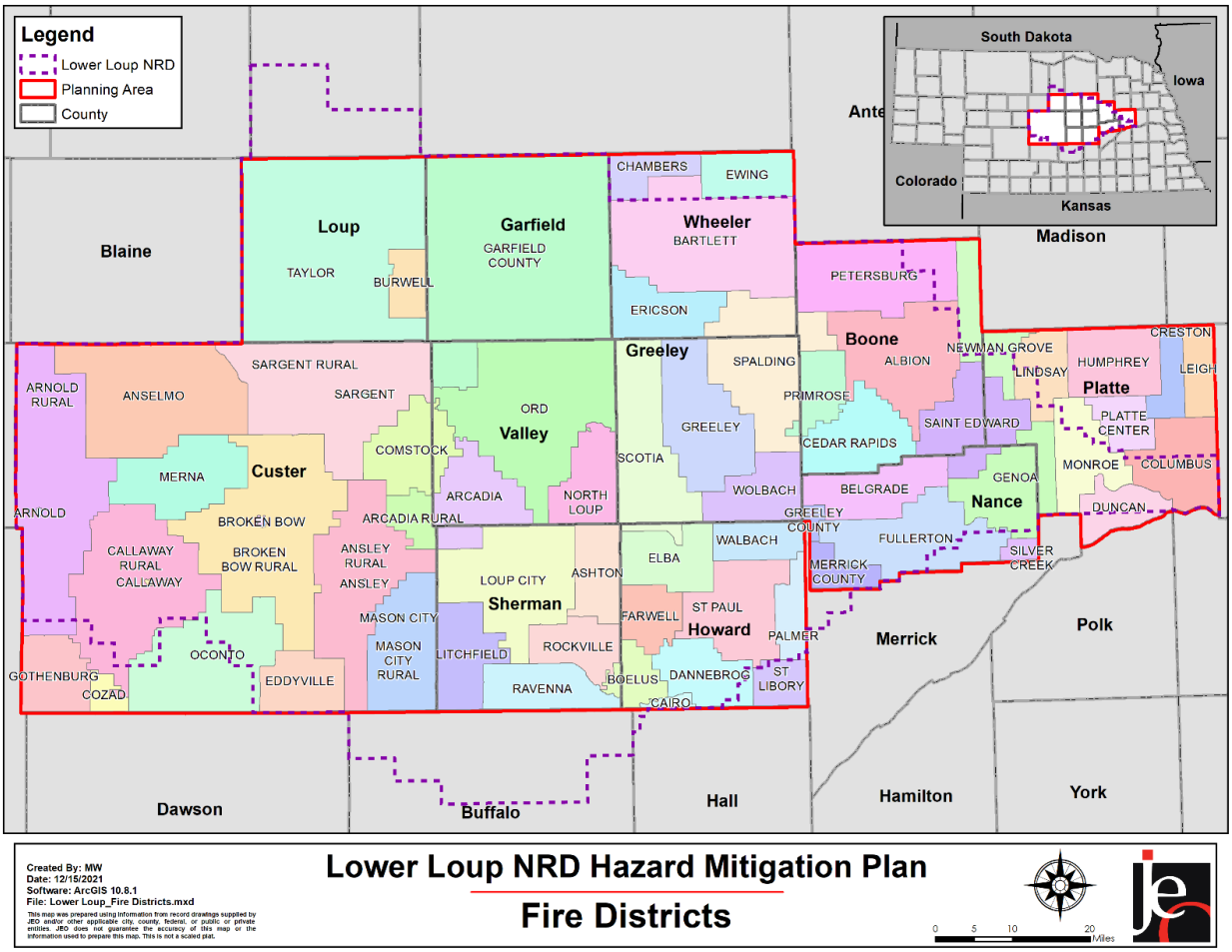
For the planning area, 47 fire districts were identified to report events. The following table lists fire departments in the planning area. These fire districts respond to both wildfires and structural fires in cities and villages.

Table 69: Fire Departments in the LLNRD Planning Area

Fire Department Name			
Albion Volunteer Fire Department	Cedar Rapids Volunteer Fire Department	Hazard Volunteer Fire Department	Petersburg Volunteer Fire & Rescue
Anselmo Volunteer Fire Department	Columbus Fire Department	Humphrey Fire Department	Platte Center Rural Fire District
Ansley Volunteer Fire Department	Comstock Rural Fire Protection District	Lindsay Fire & Rescue	Primrose Rural Fire District 5
Arcadia Volunteer Fire Department	Creston Volunteer Fire Department	Litchfield Volunteer Fire Department	Rockville Volunteer Fire Department
Arnold Volunteer Fire Department	Dannebrog Volunteer Fire & Rescue Department	Loup City Volunteer Fire Department	Sargent Volunteer Fire Department
Ashton Fire & Rescue	Duncan Fire Department	Loup County Fire Department	Scotia Rural Fire Protection District
Bartlett Volunteer Fire Department	Elba Fire & Rescue	Mason City Volunteer Fire Department	Spalding Volunteer Fire Department
Belgrade Volunteer Fire Department	Ericson Volunteer Fire Department	Merna Volunteer Fire Department	St Edward Volunteer Fire & Rescue
Boelus Fire Department	Farwell Volunteer Fire Department	Monroe Fire & Rescue	St Libory Fire Department
Broken Bow Rural Fire District 1	Fullerton Volunteer Fire Department	North Loup Volunteer Fire Department	St Paul Volunteer Fire Department
Burwell Volunteer Fire Department	Genoa Volunteer Fire Department	Oconto Volunteer Fire Department	Wolbach Fire & Rescue
Callaway Rural Fire Department	Greeley Volunteer Fire Department	Ord Volunteer Fire Department	

Source: Nebraska Forest Service

Figure 39: Fire Districts in the Planning Area



The United States Department of Agriculture Forest Service created the interactive web resource *Wildfire Risk to Communities*[60] to help communities and jurisdictions understand, explore, and reduce wildfire risk. The following figures show wildfire risk to homes per county in the planning area.

[60] United States Department of Agriculture, United States Forest Service. 2021. "Wildfire Risk to Communities." Accessed December 2021. https://wildfirerisk.org/.

Figure 40: Wildfire Risk to Homes – Boone County

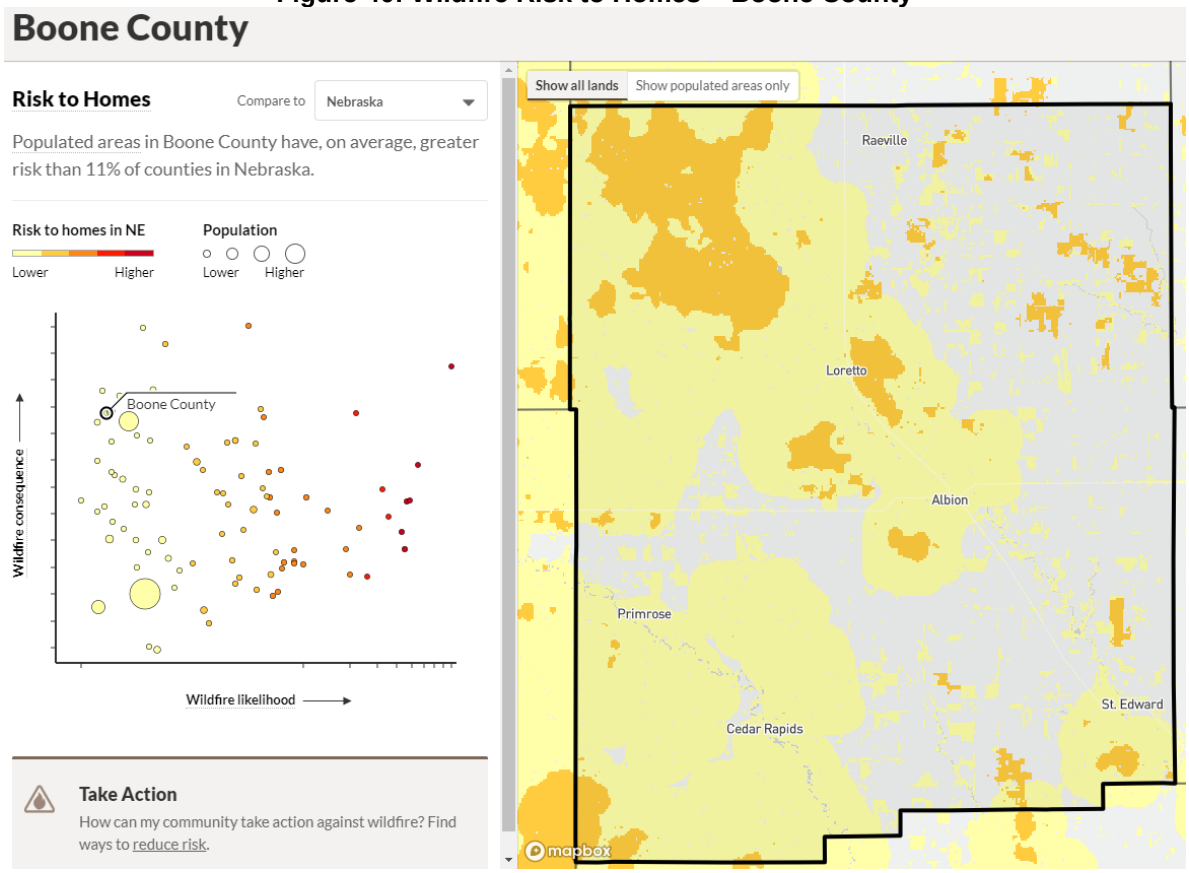


Figure 41: Wildfire Risk to Homes – Custer County

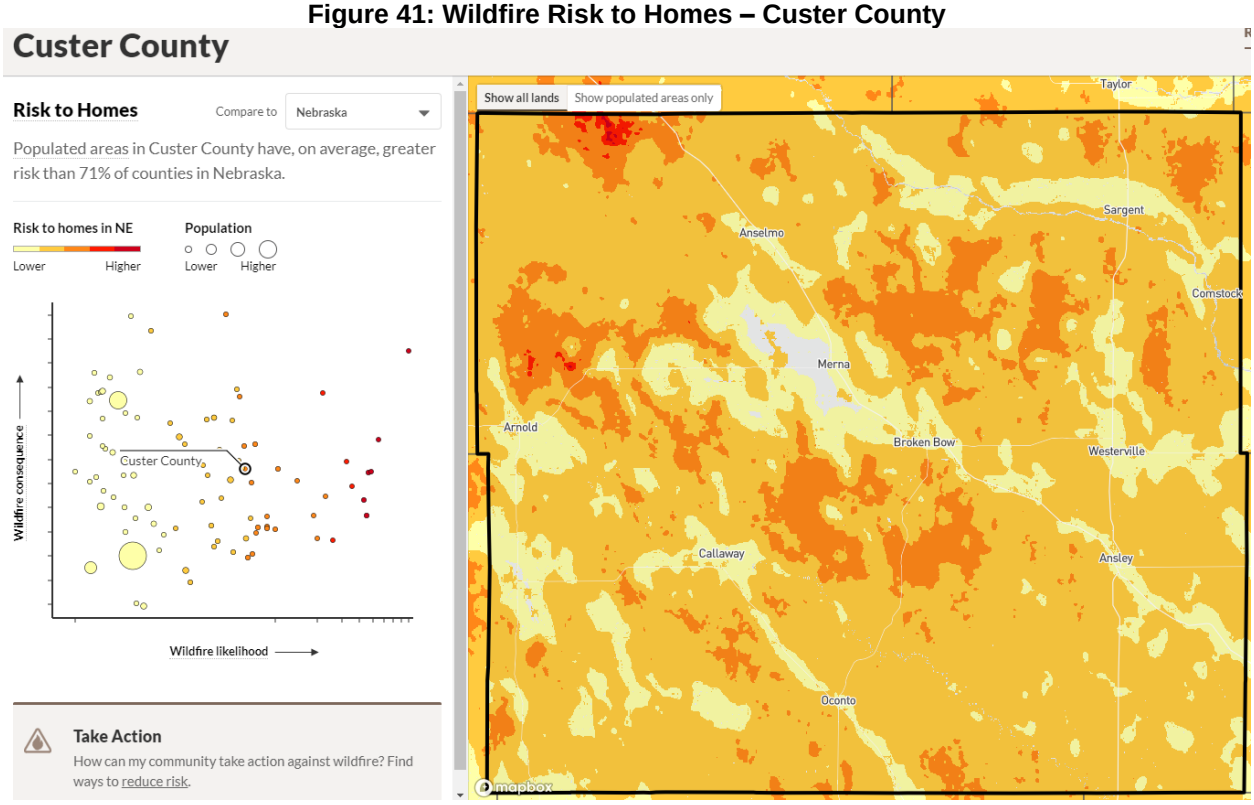


Figure 42: Wildfire Risk to Homes – Garfield County

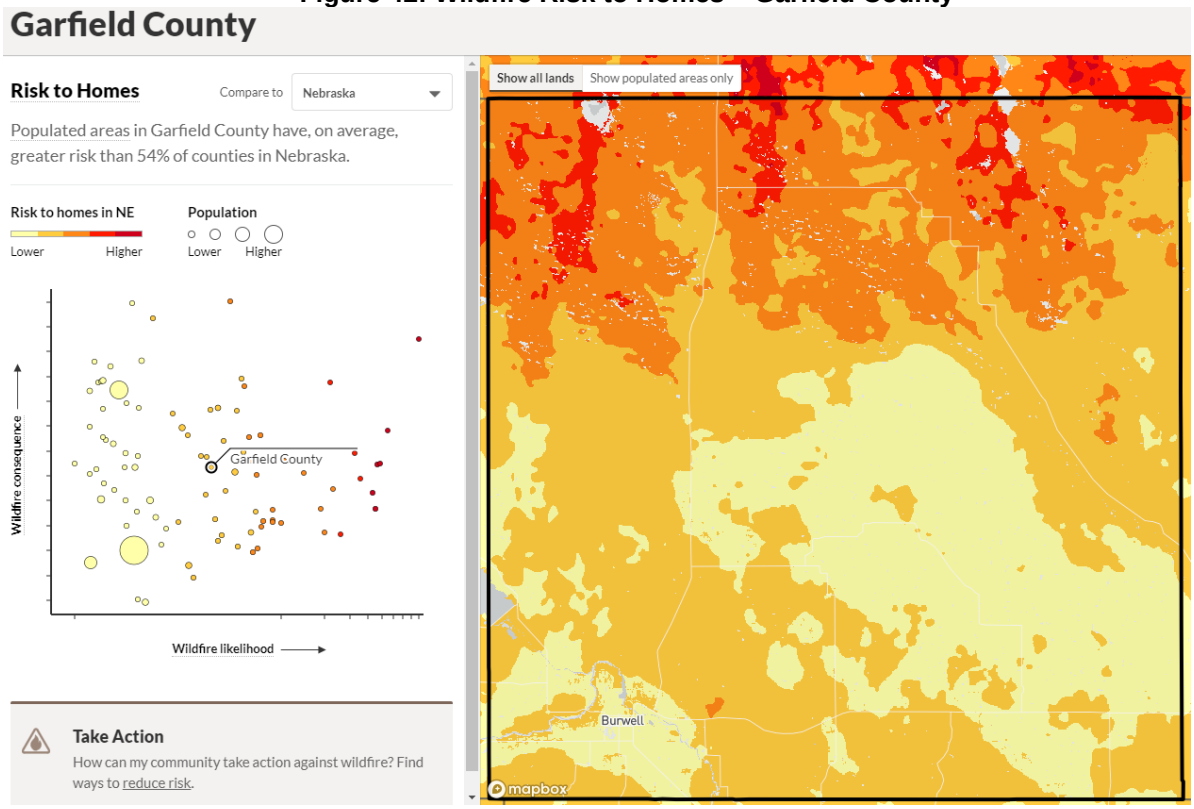


Figure 43: Wildfire Risk to Homes – Greeley County

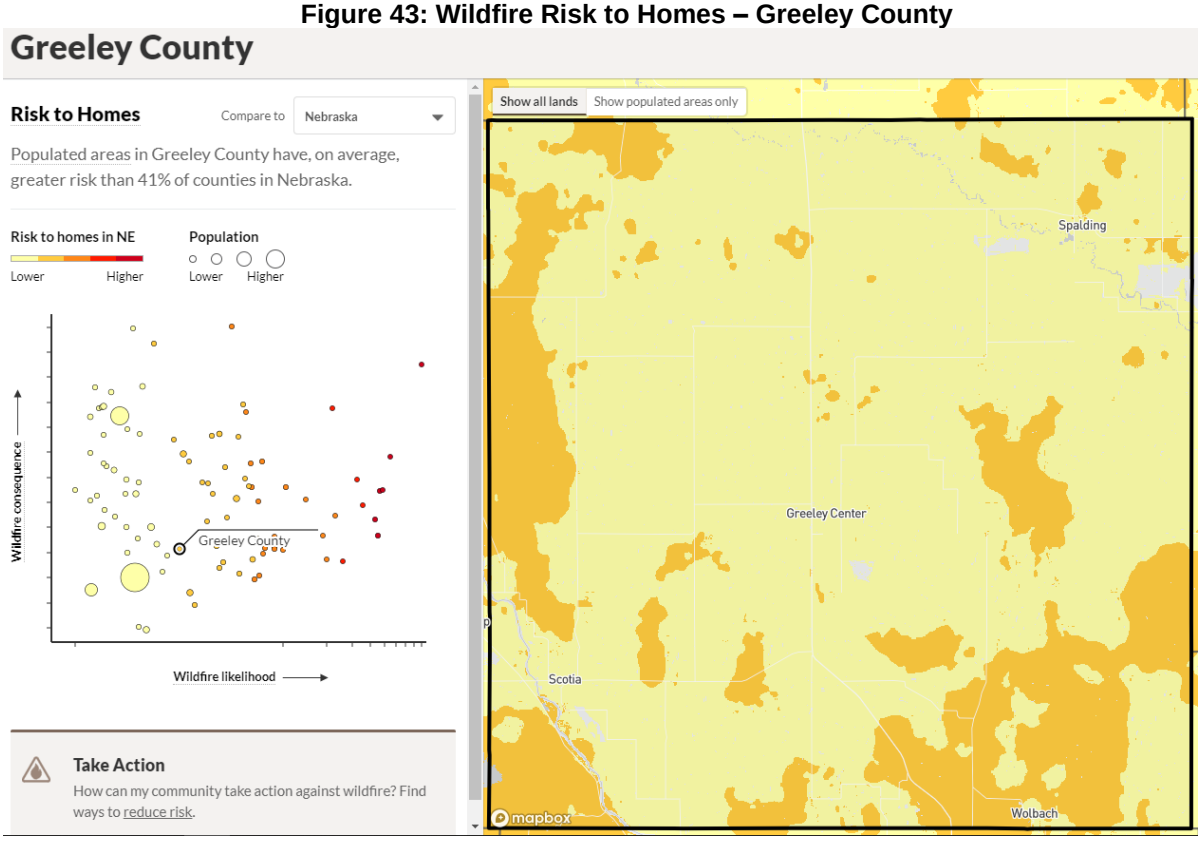


Figure 44: Wildfire Risk to Homes – Howard County

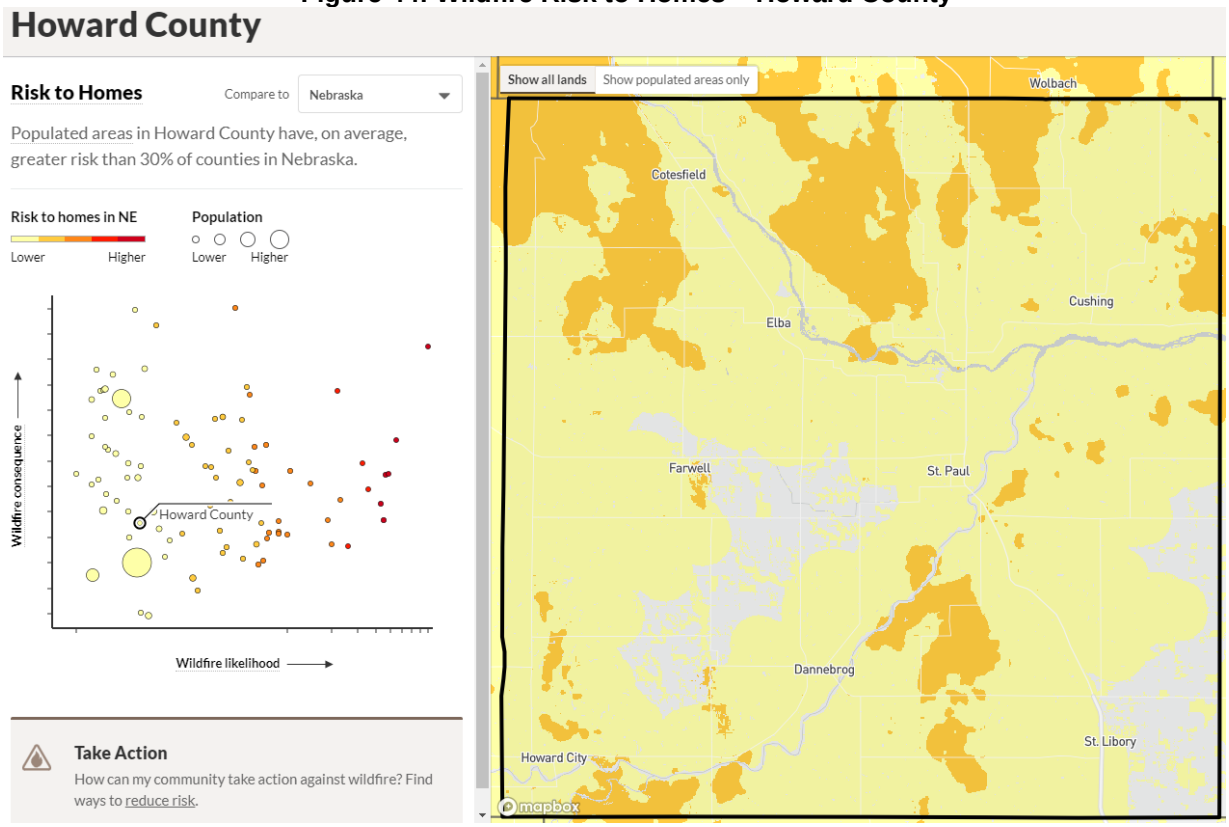


Figure 45: Wildfire Risk to Homes – Loup County

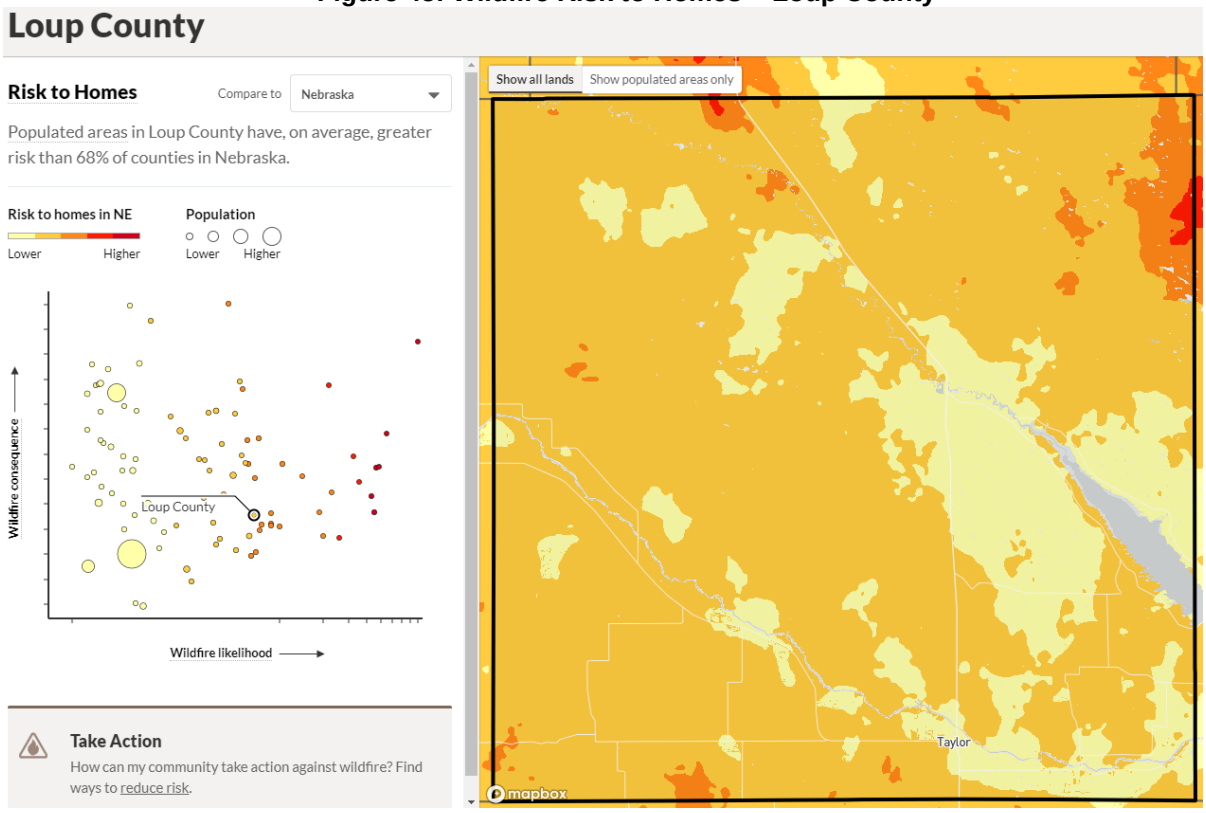


Figure 46: Wildfire Risk to Homes – Nance County

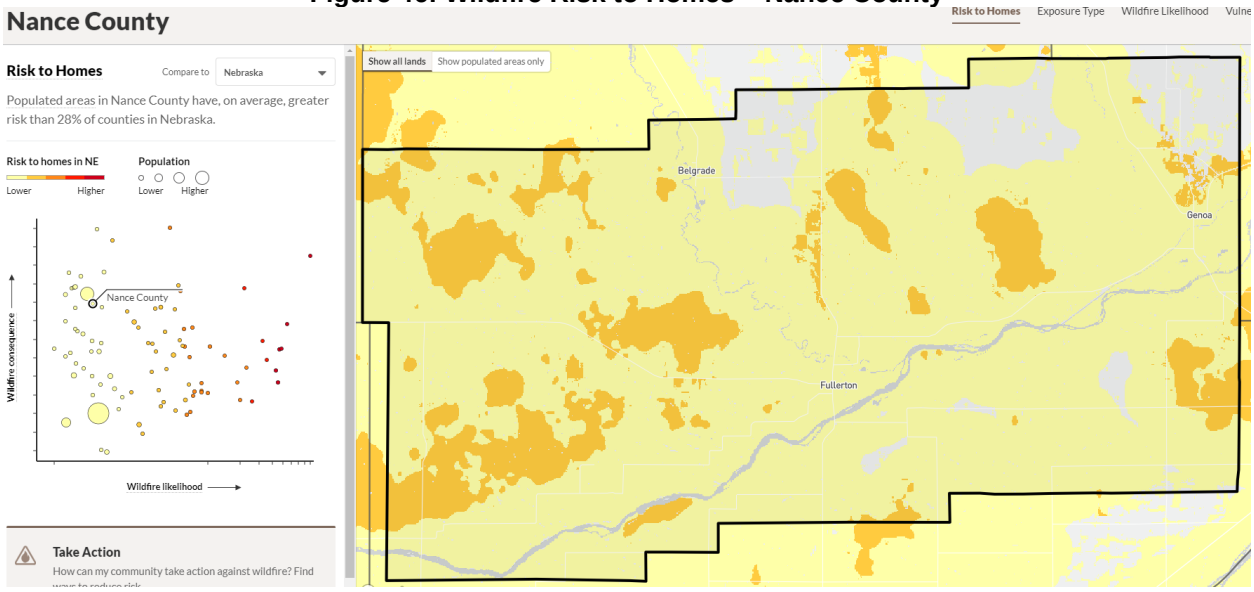


Figure 47: Wildfire Risk to Homes – Platte County

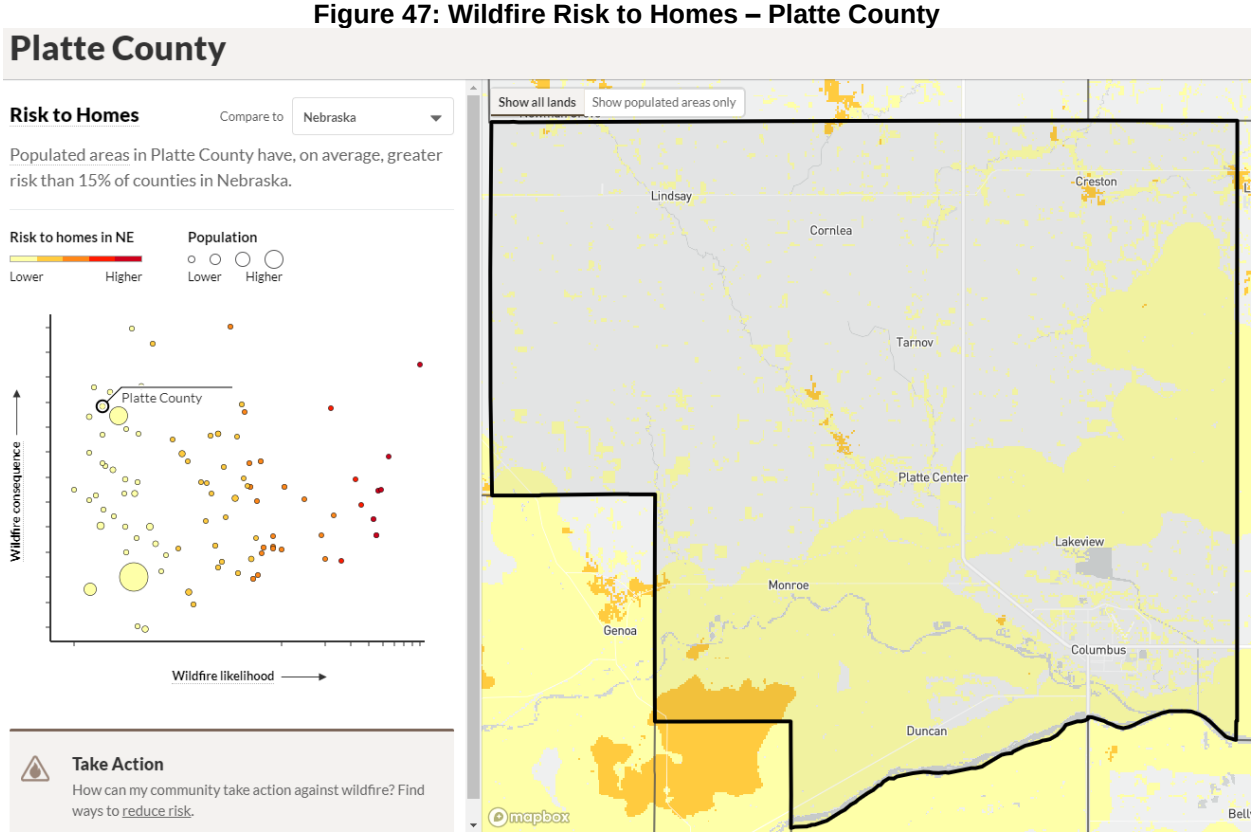


Figure 48: Wildfire Risk to Homes – Sherman County

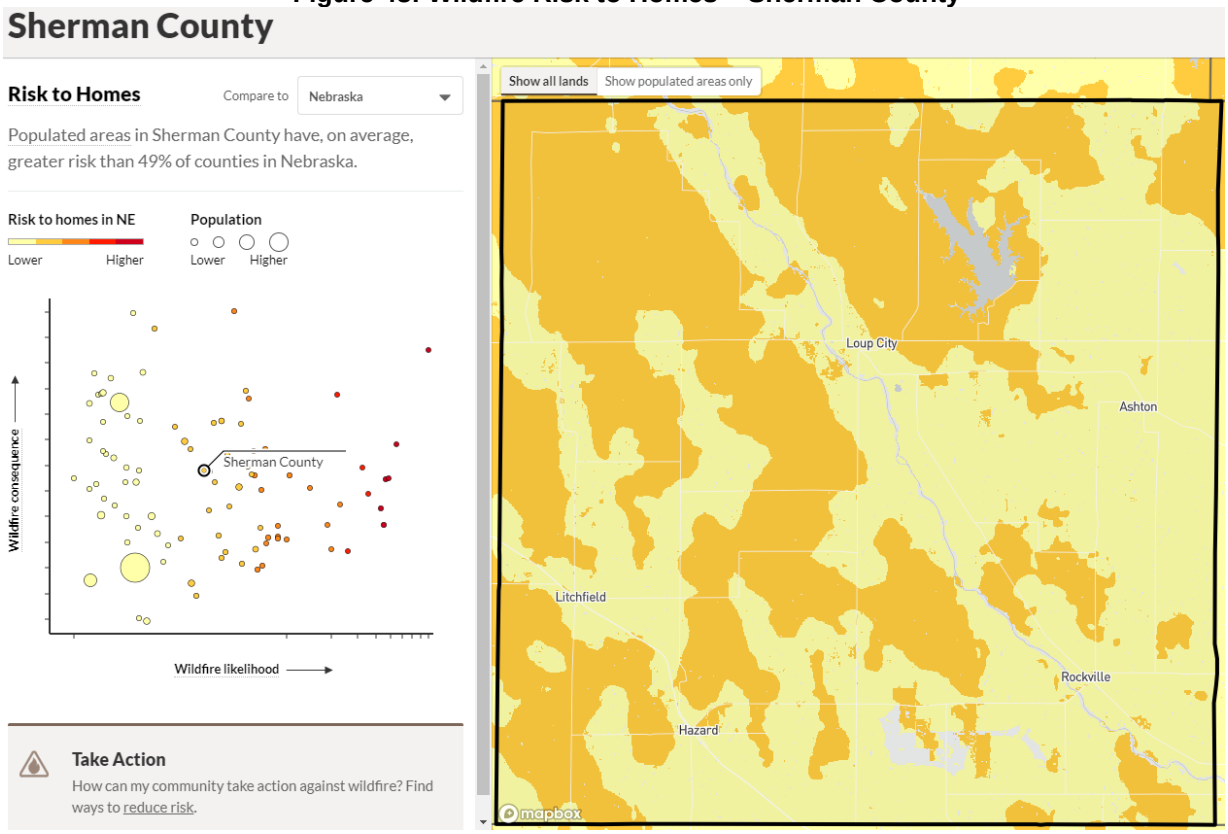


Figure 49: Wildfire Risk to Homes – Valley County

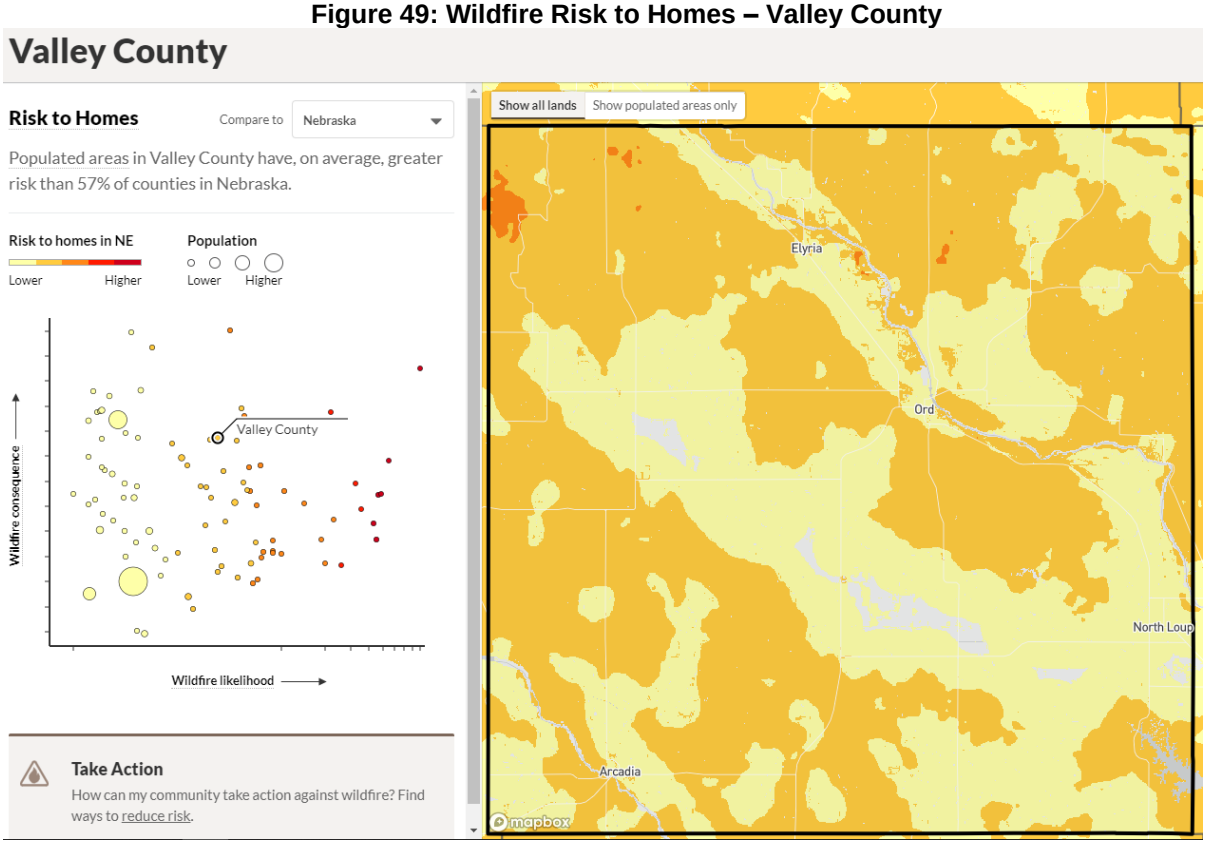
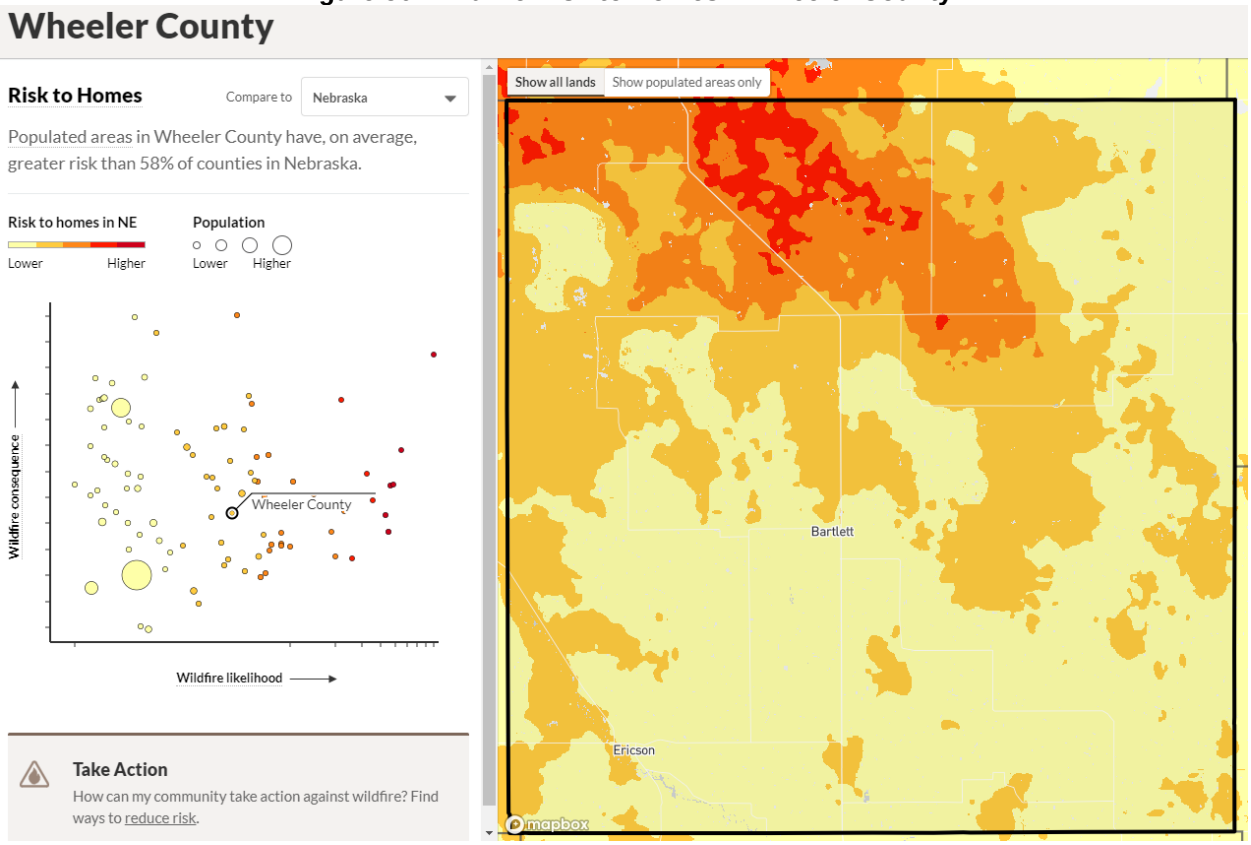


Figure 50: Wildfire Risk to Homes – Wheeler County



As the number of reported wildfires by the county indicates, the greatest threat of wildfire that could impact people and homes is in portions of Custer and Platte Counties.

Table 70: Reported Wildfires by County

County	Reported Wildfires	Acres Burned
Boone	150	3,864
Custer	390	19,021
Garfield	81	4,416
Greeley	176	17,406
Howard	95	1,781
Loup	18	206
Nance	130	1,860
Platte	447	3,433
Sherman	84	7,743
Valley	119	6,953
Wheeler	53	2,593
Total	**1,743**	**69,276**

Source: Nebraska Forest Service, 2000-2020

EXTENT

Figure 53 illustrates the number of wildfires by cause in the planning area from January 2000 to August 2020, which burned 69,276 acres in total. There were 1,743 reported wildfires in the planning area between 2000 and 2020. Ninety-one fires burned 100 acres or more, with the

largest wildfire burning 10,000 acres in Greeley County in April 2000. While much of the planning area has adopted a culture of absolute fire suppression, due to agricultural concerns, it is important to recognize that in a natural environment, some areas experience higher levels of vulnerability to grass and wildfires.

Grass/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 51: FEMA Flood and Fire

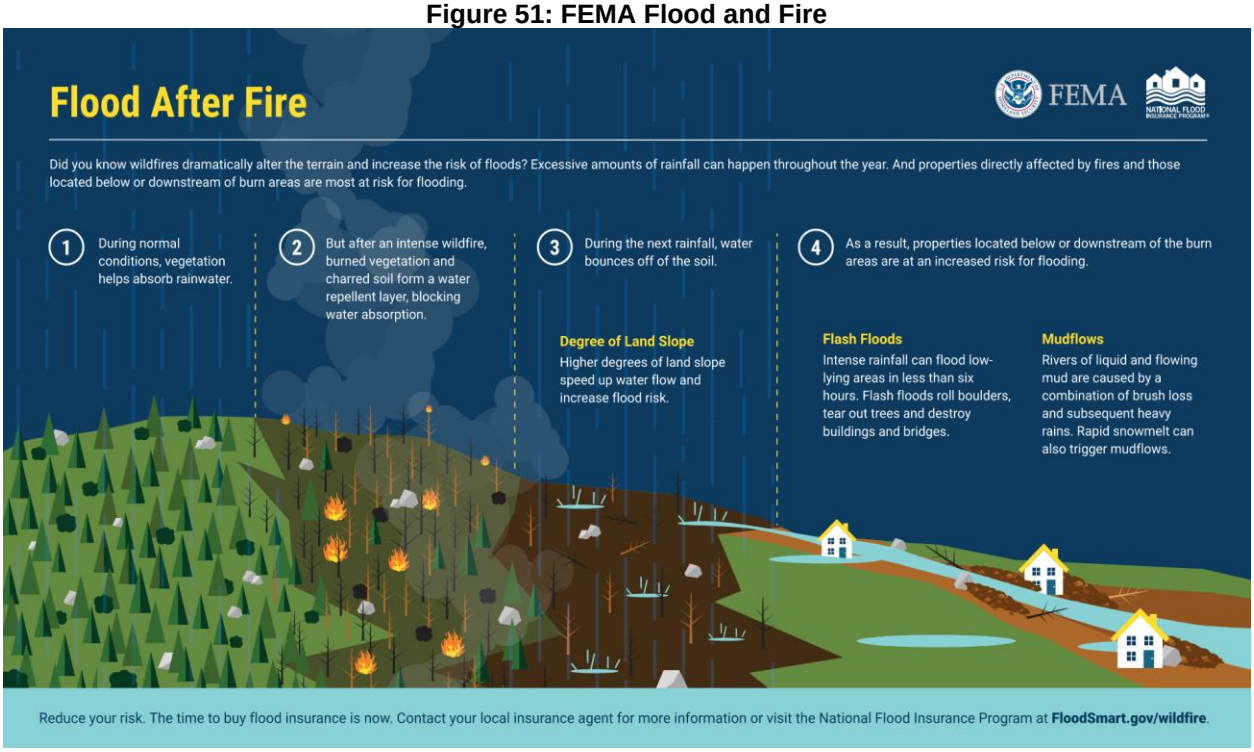
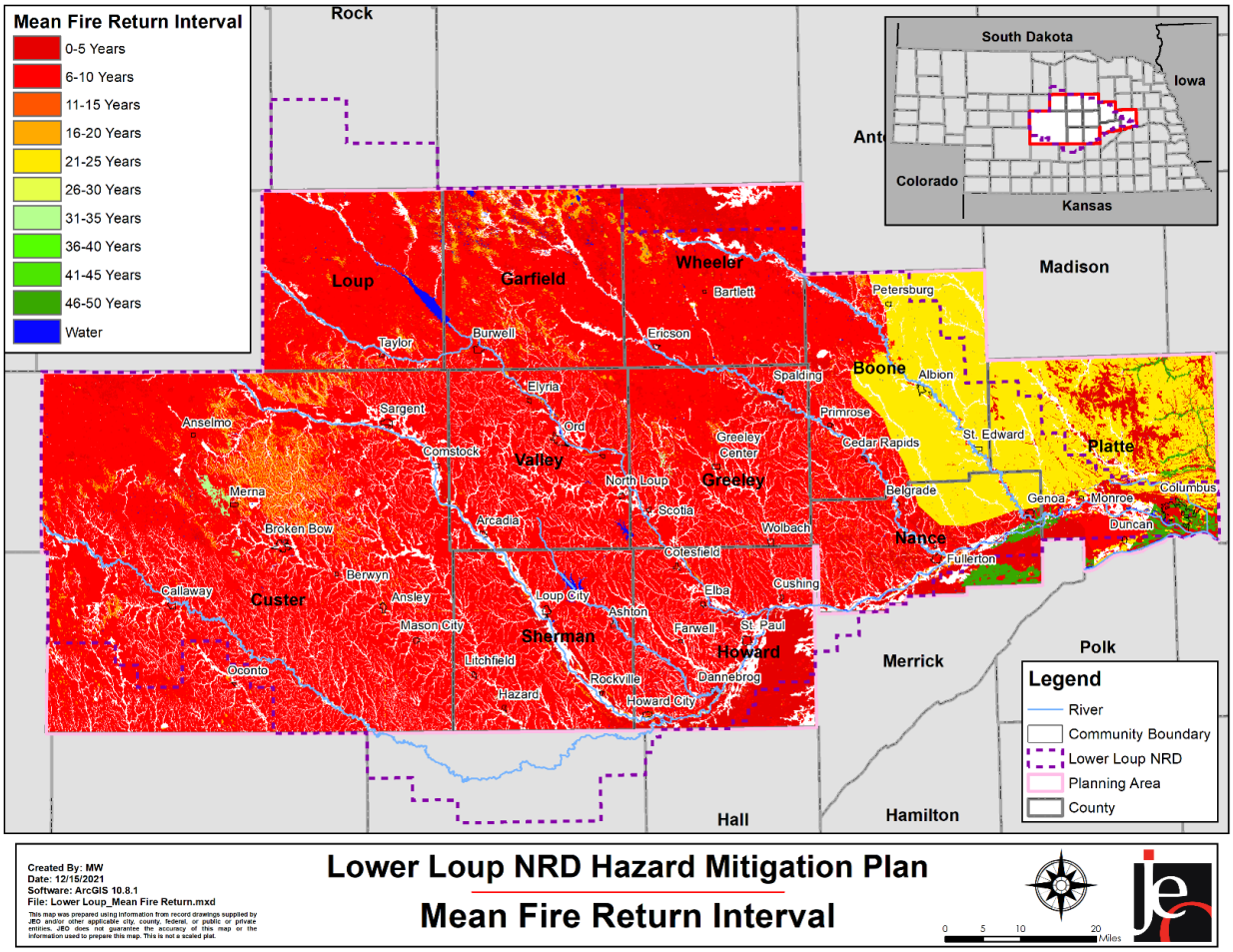


Figure 52 shows the USGS' Mean Fire Return Interval. This model considers a variety of factors, including landscape, fire dynamics, fire spread, fire effects, and spatial context. These values show how often fires occur in each area under natural conditions.

Figure 52: Mean Fire Return Interva



HISTORICAL OCCURRENCES

It is important to note that there is no comprehensive fire event database. Fire events, magnitude, and local responses were 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 data. Wildfire count data was provided by the Nebraska Forest Service from January 2000 to August 2020. As the number of reported wildfires by county indicates, wildfire events can occur in any county within the planning area.

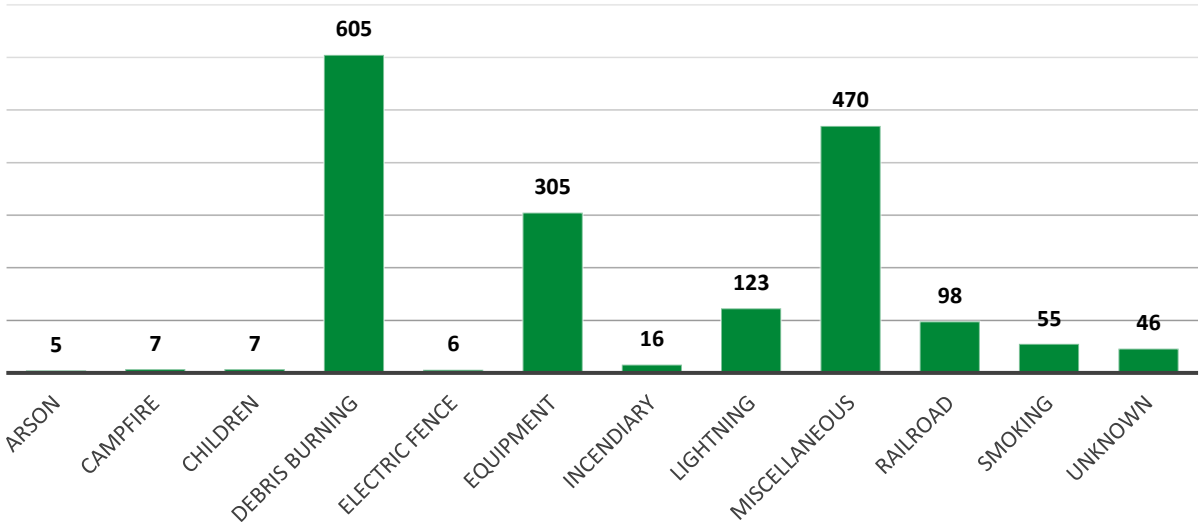
For the planning area, there were 1,743 reported wildfires by 47 different fire departments according to the NFS from 2000 to 2020. The reported events burned 69,276 acres. The reported fire events caused $500,295,574 in crop damages and $660,638 in property damages. Wildfires are most likely to be started by debris burning (34.7%). Miscellaneous causes (27.0%) and equipment (17.5%) are the second and third leading causes of fires in the planning area. Most wildfires that occur in the planning area will likely be kept to under 100 acres.

Table 71: Reported Wildfires by County

County	Reported Wildfires	Acres Burned	Other Impacts
Boone	150	3,864	1 injury; 14 structures threatened; 7 structures destroyed
Custer	390	19,021	21 injuries; 2 fatalities; 19 structures threatened; 3 structures destroyed
Garfield	81	4,416	9 structures threatened; 3 structures destroyed
Greeley	176	17,406	7 structures threatened
Howard	95	1,781	18 structures threatened; 1 structure destroyed
Loup	18	206	2 structures threatened; 1 structure destroyed
Nance	130	1,860	1 structure threatened
Platte	447	3,433	1 injury; 25 structures threatened; 2 structures destroyed
Sherman	84	7,743	37 structures threatened
Valley	119	6,953	1 injury; 3 structures threatened
Wheeler	53	2,593	2 injuries; 6 structures threatened
Total	**1,743**	**69,276**	**26 injuries; 2 fatalities; 141 structures threatened; 17 structures destroyed**

Source: NFS, 2000-2020[61]

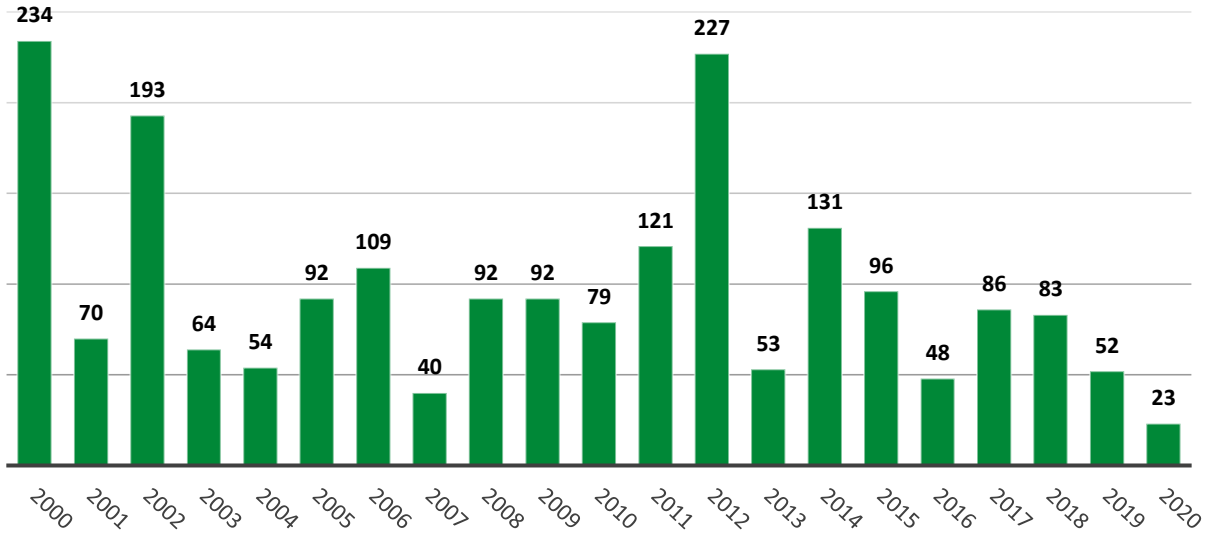
Figure 53: Wildfires by Cause for the Planning Area 2000-2020



Source: Nebraska Forest Service, 2000-2020

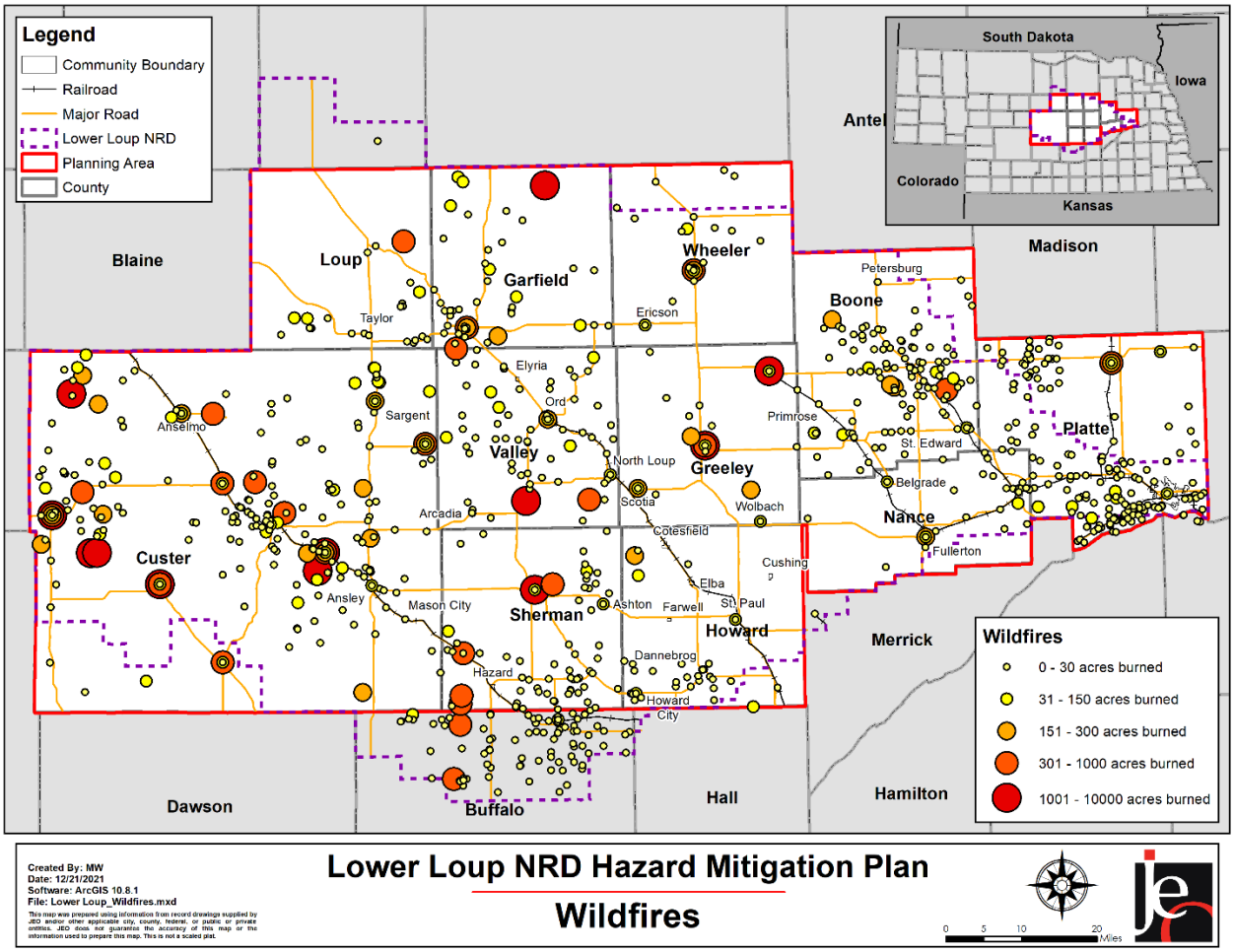
[61] Nebraska Forest Service. 2020. "Fire Incident Type Summary." Data Files 2000-2018 provided by NFS.

Figure 54: Number of Wildfires by Year for the Planning Area



Source: Nebraska Forest Service, 2000-2020

Figure 55: Wildfire Occurrence in the Planning Area



AVERAGE ANNUAL DAMAGES

The average damage per event estimate was determined based upon U.S. Forest Service wildfires database from 2000 to 2020 and number of historical occurrences. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life. During the 21-year period, wildfires burned 69,276 acres and caused $500,295,574 in crop damages and $660,638 in property damages.in the planning area.

Table 72: Wildfire Loss Estimation

Hazard Type	Number of Events[1]	Events Per Year	Average Acres Per Fire	Total Property Loss[1]	Total Crop Loss[2]
Grass/Wildfires	1,743	83	39.6 acres	$660,638	$500,295,574

1 Indicates data is from NFS (2000-2020); 2 Indicates data is from RMA (2000 to 2020)

Table 73: Wildfire Threats

Hazard Type	Injuries	Fatalities	Homes Threatened	Homes Destroyed	Other Structures Threatened	Other Structures Destroyed
Grass/Wildfires	26	2	85	2	56	15

Source: Nebraska Forest Service, 2000-2020

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 of reported incidents, there is a 100 percent probability (21 out of 21 years with an occurrence) that a grass/wildfire event will occur annually in the planning area.

COMMUNITY TOP HAZARD STATUS

The following table lists jurisdictions which identified Grass/Wildfire as a top hazard of concern:

Table 74: Grass/Wildfire Top Concern by Community

Jurisdictions	
Albion and Albion Fire	Loup County
Comstock	Mason City
Cushing	Oconto
Custer County	Sargent
Duncan Fire District	Sherman County
Elba Fire District	St. Edward
Garfield County	Wheeler Central Schools
Greeley County	Wolbach

REGIONAL VULNERABILITIES

The *Wildfire Risk to Communities* tool outlines specific vulenrabilities per county as well. The following tables describes other specific risks and vulnerabilities seen across the planning area.

Table 75: Wildfire Vulnerability by County

County	Risk to Homes (compared to all NE counties)	Exposure Type	Wildland Likelihood (compared to all NE counties)
Boone	Greater risk than 11% of NE Counties	Directly Exposed (22%) Indirectly Exposed (56%) Not Exposed (22%)	Greater risk than 8% of NE Counties
Custer	Greater risk than 71% of NE Counties	Directly Exposed (34%) Indirectly Exposed (65%) Not Exposed (1%)	Greater risk than 71% of NE Counties
Garfield	Greater risk than 54% of NE Counties	Directly Exposed (31%) Indirectly Exposed (68%) Not Exposed (1%)	Greater risk than 52% of NE Counties
Greeley	Greater risk than 41% of NE Counties	Directly Exposed (35%) Indirectly Exposed (64%) Not Exposed (1%)	Greater risk than 42% of NE Counties
Howard	Greater risk than 30% of NE Counties	Directly Exposed (33%) Indirectly Exposed (63%) Not Exposed (4%)	Greater risk than 29% of NE Counties
Loup	Greater risk than 68% of NE Counties	Directly Exposed (51%) Indirectly Exposed (59%) Not Exposed (0%)	Greater risk than 74% of NE Counties
Nance	Greater risk than 28% of NE Counties	Directly Exposed (33%) Indirectly Exposed (66%) Not Exposed (1%)	Greater risk than 25% of NE Counties
Platte	Greater risk than 15% of NE Counties	Directly Exposed (17%) Indirectly Exposed (5%) Not Exposed (77%)	Greater risk than 12% of NE Counties
Sherman	Greater risk than 49% of NE Counties	Directly Exposed (31%) Indirectly Exposed (69%) Not Exposed (0%)	Greater risk than 48% of NE Counties
Valley	Greater risk than 57% of NE Counties	Directly Exposed (29%) Indirectly Exposed (70%) Not Exposed (1%)	Greater risk than 57% of NE Counties
Wheeler	Greater risk than 58% of NE Counties	Directly Exposed (59%) Indirectly Exposed (41%) Not Exposed (0%)	Greater risk than 60% of NE Counties

Source: Wildfire Risk to Communities, 2021[62]

Table 76: Wildfire Vulnerable Populations by County

County	Families in Property	People with Disabilities	People over 65	Difficulty with English	Households with No Vehicle	Mobile Homes
Boone	53 (3.5%)	621 (11.9%)	1,170 (22%)	13 (0.3%)	91 (4%)	26 (1.1%)
Custer	260 (7.9%)	1,399 (13.1%)	2,343 (21.6%)	87 (0.9%)	235 (4.8%)	156 (3.2%)
Garfield	22 (3.7%)	301 (15.6%)	558 (28.3%)	0 (0%)	16 (1.8%)	29 (3.3%)

[62] United States Department of Agriculture, United States Forest Service. 2021. "Wildfire Risk to Communities." https://wildfirerisk.org/.

County	Families in Property	People with Disabilities	People over 65	Difficulty with English	Households with No Vehicle	Mobile Homes
Greeley	42 (6.2%)	350 (14.7%)	603 (25%)	4 (0.2%)	23 (2.2%)	33 (3.2%)
Howard	137 (7.5%)	844 (13.2%)	1,349 (21.1%)	28 (0.5%)	83 (3.1%)	151 (5.6%)
Loup	8 (4.1%)	101 (17.3%)	169 (28.9%)	0 (0%)	2 (0.7%)	43 (15.4%)
Nance	64 (6.5%)	545 (15.8%)	714 (20.1%)	7 (0.2%)	49 (3.2%)	15 (1%)
Platte	524 (6.1%)	3,167 (9.7%)	5,585 (16.9%)	1,500 (4.9%)	558 (4.3%)	461 (3.5%)
Sherman	78 (9.1%)	469 (15.7%)	795 (26.1%)	15 (0.5%)	30 (2.2%)	72 (5.3%)
Valley	87 (7%)	656 (15.7%)	1,031 (24.4%)	19 (0.5%)	84 (4.6%)	57 (3.1%)
Wheeler	17 (7.3%)	127 (15.5%)	194 (23.6%)	0 (0%)	5 (1.4%)	37 (10.4%)

Source: Wildfire Risk to Communities, 2021

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, three days above 100°F each year. During a severe drought, dry conditions, and/or windy conditions, large wildfires can more easily spread.

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, including on tribal reservation lands. Wildfires can cause extensive damage to both urban and rural building stock and properties including critical facilities and infrastructure, as well as agricultural producers which support the local industry and economy. Damaged homes can reduce available housing stock for residents, causing them 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 may be located within the WUI, particularly in communities with a large amount of intermix overlap. 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. Other notable vulnerabilities exist for fire departments which service both urban and rural areas, such as in the City of Albion, as many fire districts lack adequate staff to respond to multi-fire complexes or events in separate areas. The utilization and development of mutual aid agreements or memorandum of understandings are an important tool for districts to share resources and/or coverage.

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

Table 77: Regional Wildfire Vulnerabilities

Sector	Vulnerability
People	-Risk of injury or death for residents and firefighting personnel -Displacement of people and loss of homes -Lack of transportation poses risk to low-income individuals, families, and elderly -Transportation routes may be blocked by fire, preventing evacuation efforts
Economic	-Damages to buildings and property can cause significant losses to business owners -Loss of businesses
Built Environment	-Property damages
Infrastructure	-Damage to power lines and utility structures
Critical Facilities	-Risk of damages
Climate	-Changes in seasonal temperature and precipitation normals can increase frequency and severity of wildfire events -Changes in climate can help spread invasive species, changing potential fuel loads in wildland areas
Other	-Increase chance of landslides, erosion, and land subsidence -May lead to poor water quality -Post fire, flash flooding events may be exacerbated

HAZARDOUS MATERIALS

The following description for hazardous materials is provided by the Federal Emergency Management Agency (FEMA):

> *Chemicals are found everywhere. They purify drinking water, are used in agriculture and industrial production, fuel our vehicles and machines, and simplify household chores. But chemicals also can be hazardous to humans or the environment if used or released improperly. Hazards can occur during production, storage, transportation, use, or disposal. The community is at risk if a chemical is used unsafely or released in harmful amounts.*

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

Chemical manufacturers are one source of hazardous materials, but there are many others, including service stations, hospitals, and hazardous materials waste sites. Varying quantities of hazardous materials are manufactured, used, or stored at an estimated 4.5 million facilities in the United States—from major industrial plants to local dry cleaning establishments or gardening supply stores.

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

Fixed-sites are those that involve chemical manufacturing sites and stationary storage facilities. The Environmental Protection Agency (EPA) requires the submission of the types and locations of hazardous chemicals being stored at any facility within the state over the previous calendar year. This is completed by submitting a Tier II form to the EPA as a requirement of the Emergency Planning and Community Right-to-Know Act of 1986. Likewise, the U.S. Department of Transportation, through the U.S. Pipeline and Hazardous Materials Safety Administration (PHMSA), has broad jurisdiction to regulate the transportation of hazardous materials, including the discretion to decide which materials shall be classified as hazardous. These materials are placed into one of nine hazard classes based on their chemical and physical properties. The hazard schedules may be further subdivided into divisions based on their characteristics. Because the properties and characteristics of materials are crucial in understanding the dynamics of a spill during a transportation incident, it is important for response personnel to understand the hazard classes and their divisions.

The transportation of hazardous materials is defined by PHMSA as "…a substance that has been determined to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce…" According to PHMSA, hazardous materials traffic in the U.S. now exceeds 1,000,000 shipments per day. Nationally, the U.S. has had 108 fatalities associated with the transport of hazardous materials between 2007 through 2016. While such fatalities are a low probability risk, even one event can harm many people. For example, a train derailment in Crete,

Nebraska in 1969 allowed anhydrous ammonia to leak from a rupture tanker. The resulting poisonous fog killed nine people and injured 53.

Table 78 demonstrates the nine classes of hazardous material according to the 2016 Emergency Response Guidebook.

Table 78: Hazardous Material Classes

Class	Type of Material	Divisions
1	Explosives	Division 1.1 – Explosives with a mass explosion hazard Division 1.2 – Explosives with a projection hazard Division 1.3 – Explosives predominantly a fire hazard Division 1.4 – Explosives with no significant blast hazard Division 1.5 – Very insensitive explosives with a mass explosion hazard Division 1.6 – Extremely insensitive articles
2	Gases	Division 2.1 – Flammable gases Division 2.2 – Non-flammable, non-toxic gases Division 2.3 – Toxic gases
3	Flammable liquids (and Combustible liquids)	
4	Flammable solids; Spontaneously combustible materials	Division 4.1 – Flammable solids Division 4.2 – Spontaneously combustible materials Division 4.3 – Water-reactive substances/Dangerous when wet materials
5	Oxidizing substances and Organic peroxides	Division 5.1 – Oxidizing substances Division 5.2 – Organic peroxides
6	Toxic substances and infections substances	Division 6.1 – Toxic substances Division 6.2 – Infectious substances
7	Radioactive materials	
8	Corrosive materials	
9	Miscellaneous hazardous materials/products, substances, or organisms	

Source: Emergency Response Guidebook, 2016[63]

LOCATION

Nebraska has approximately 3,624 facilities across the state that house hazardous materials according to the Tier II reports submitted to the Nebraska Department of Environment and Energy (NDEE) in 2019. Of those, 187 locations are located in the planning area. These locations are shown in the following figure.. A listing of hazardous material storage sites can be found in *Section Seven: Community Profiles* for each jurisdiction.

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

Figure 56: Fixed Chemical Sites in the Planning Area

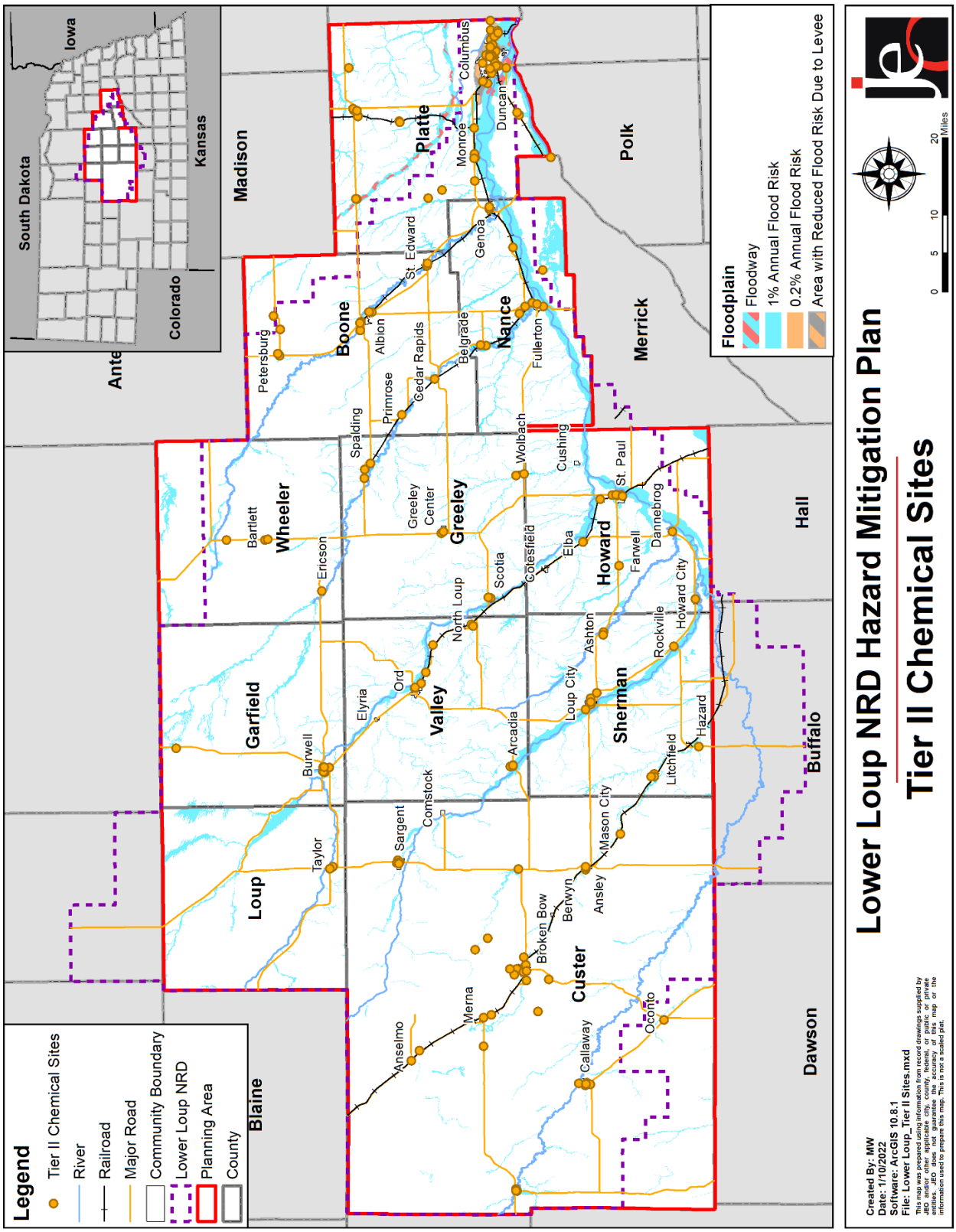
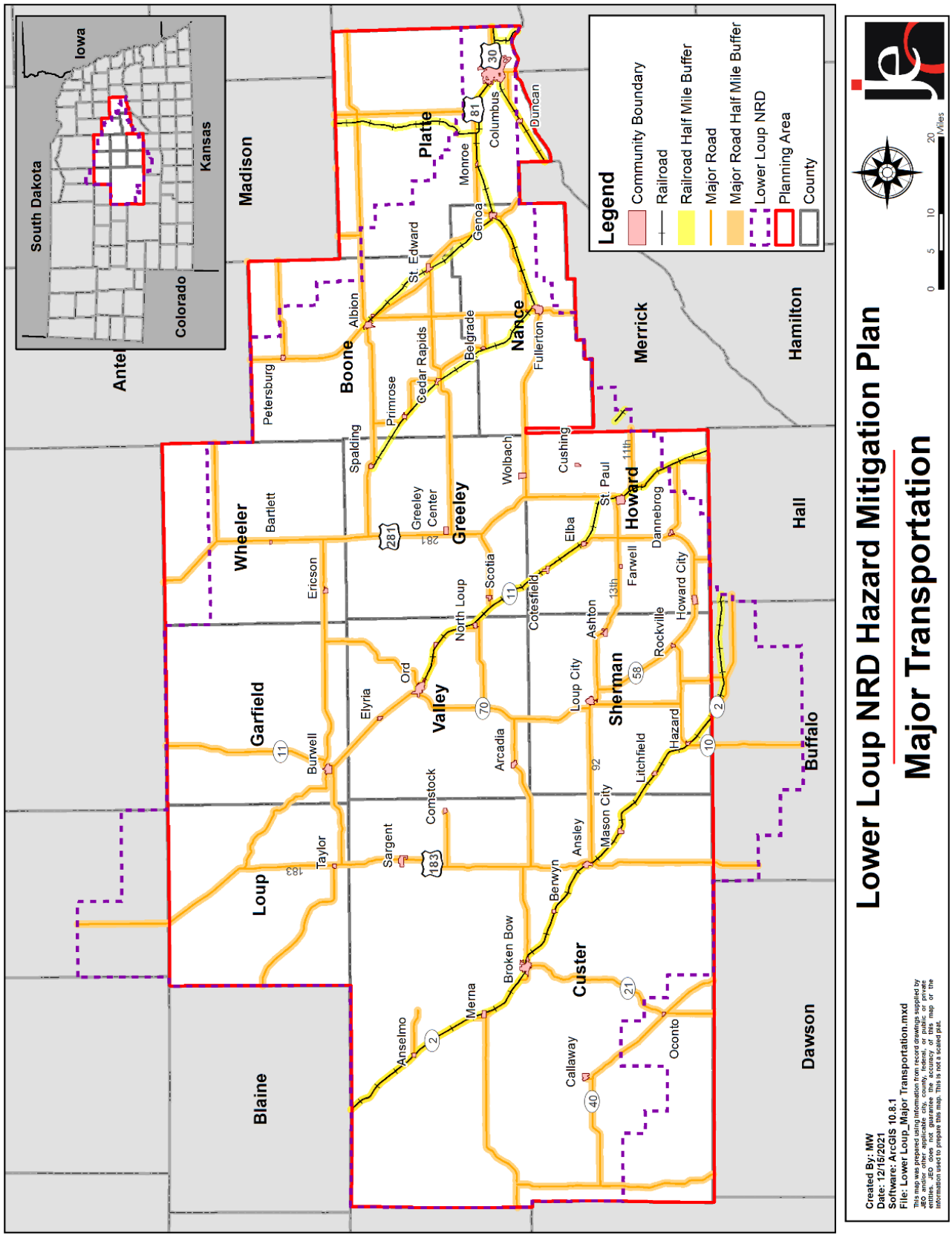


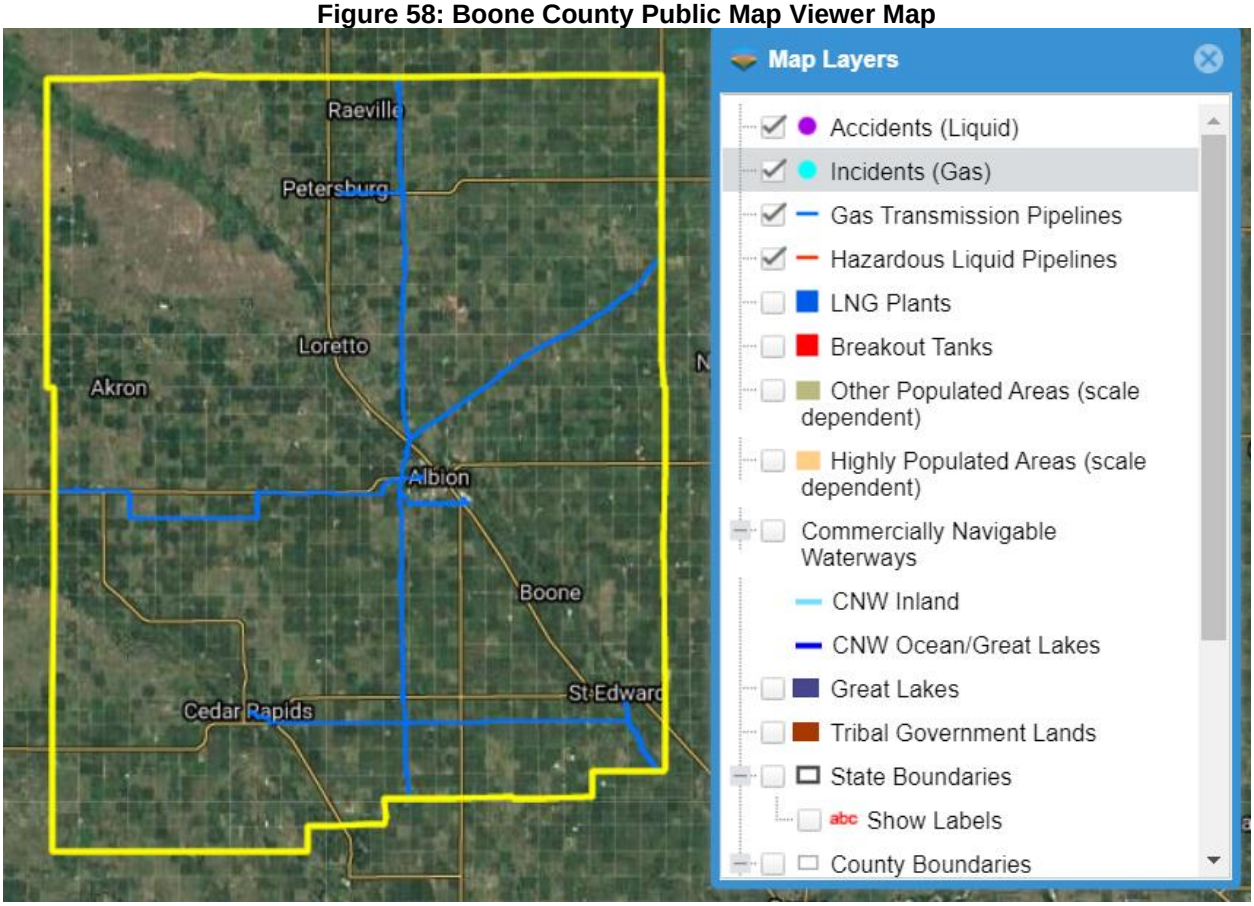
Figure 57: Major Transportation Routes with Half Mile Buffer



Hazardous material releases during transportation primarily occur on major transportation routes as identified in Figure 57. Railroads providing service through the planning area have developed plans to respond to chemical releases along rail routes. A large number of spills also typically occur during the loading and unloading of chemicals for highway and pipeline chemical transport. Transportation corridors in the planning area are primarily US Routes and County Highways throughout each county. No interstates are located in the planning area.

According to PHMSA, there are several gas transmission and hazardous liquid pipelines located in the planning area. Maps of pipelines and incidents from PHMSA for each of the 11 counties in the planning area can be seen below (Figure 58 through Figure 68).[64]

Figure 58: Boone County Public Map Viewer Map



[64] Pipeline and Hazardous Materials Safety Administration. 2020. "National Pipeline Mapping System." https://www.npms.phmsa.dot.gov/ .

Figure 59: Custer County Public Map Viewer Map

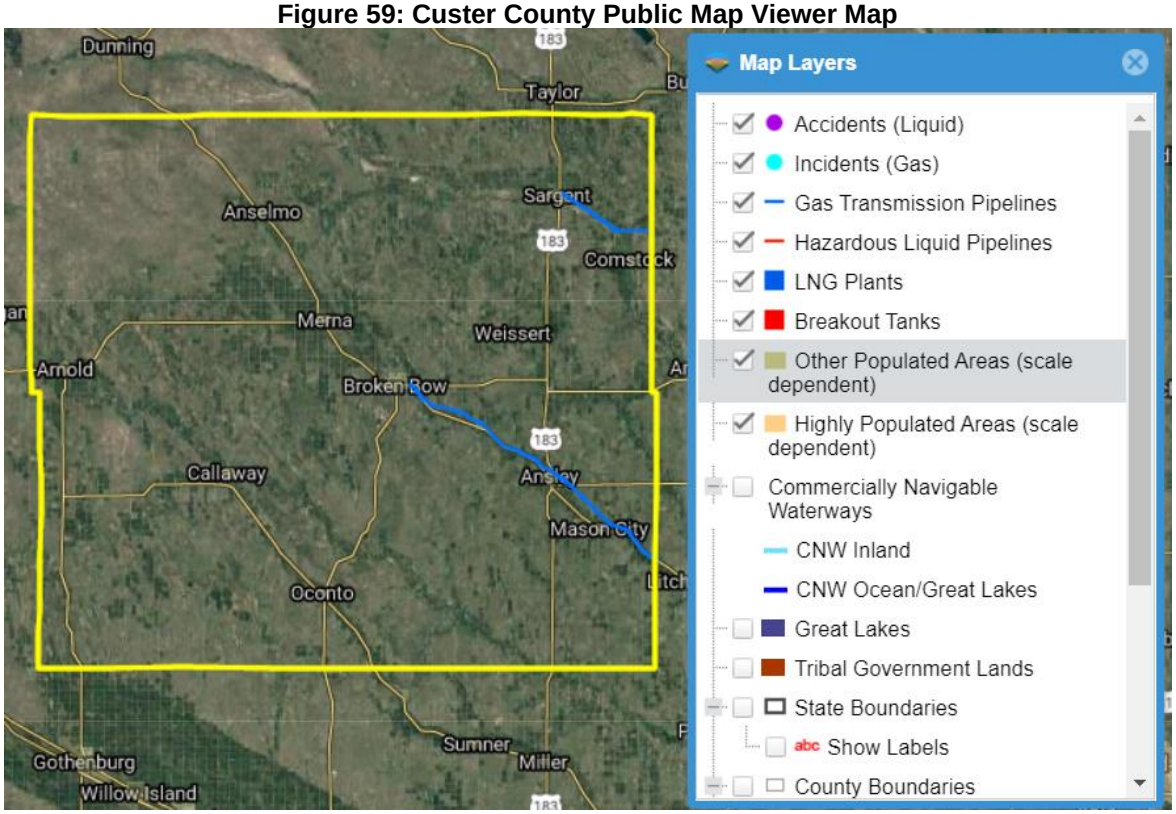


Figure 60: Garfield County Public Map Viewer Map

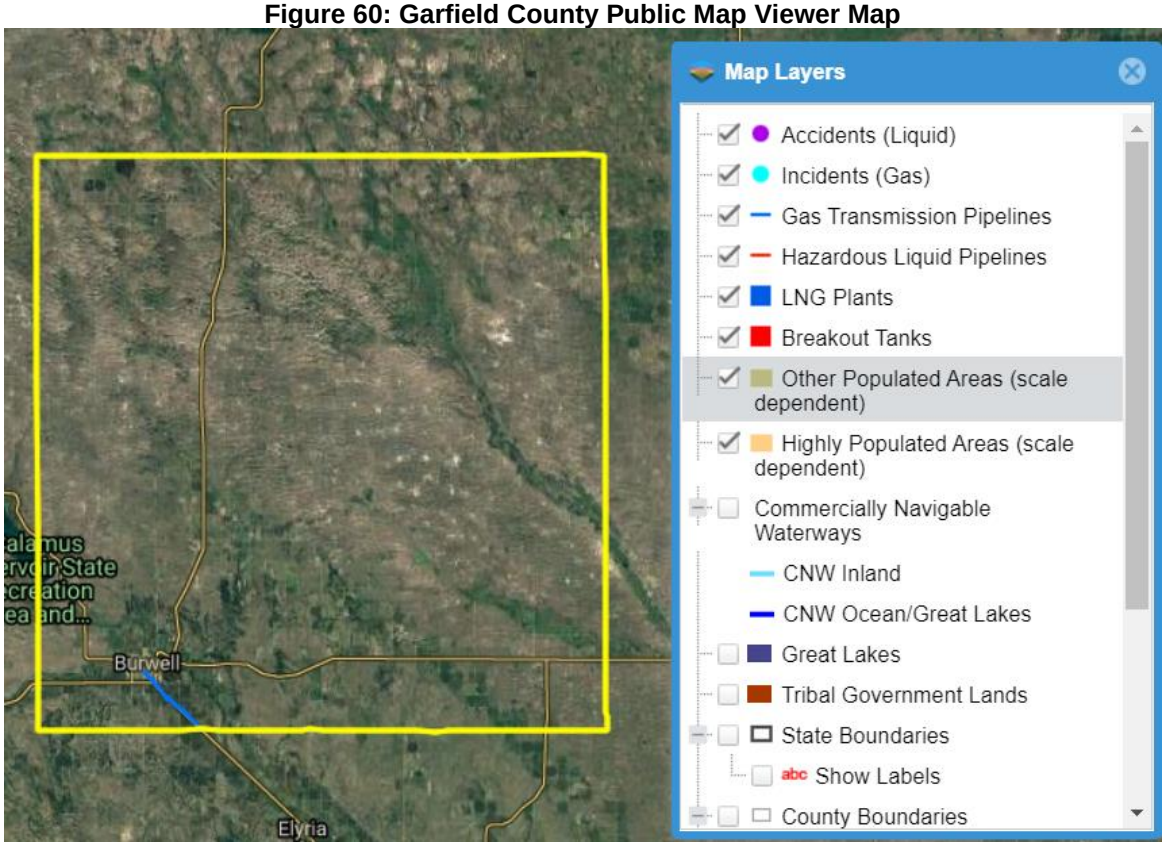


Figure 61: Greeley County Public Map Viewer Map

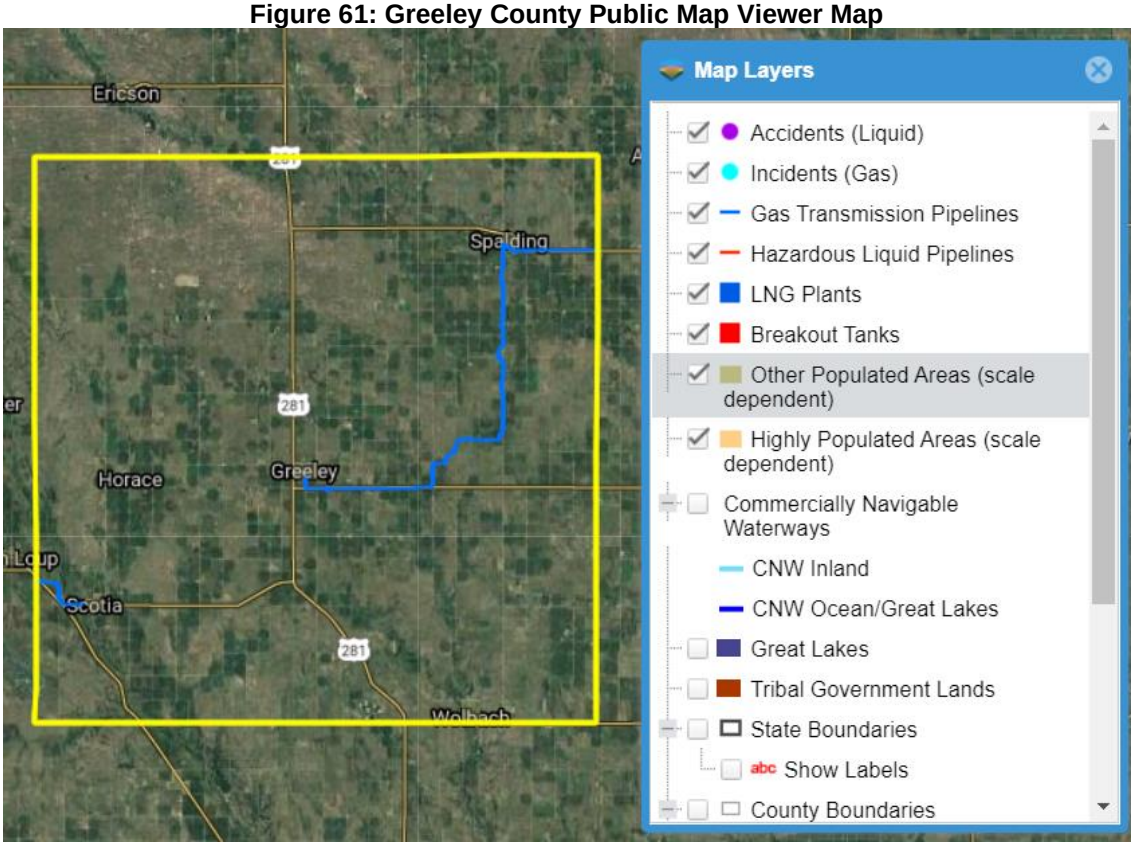


Figure 62: Howard County Public Map Viewer Map

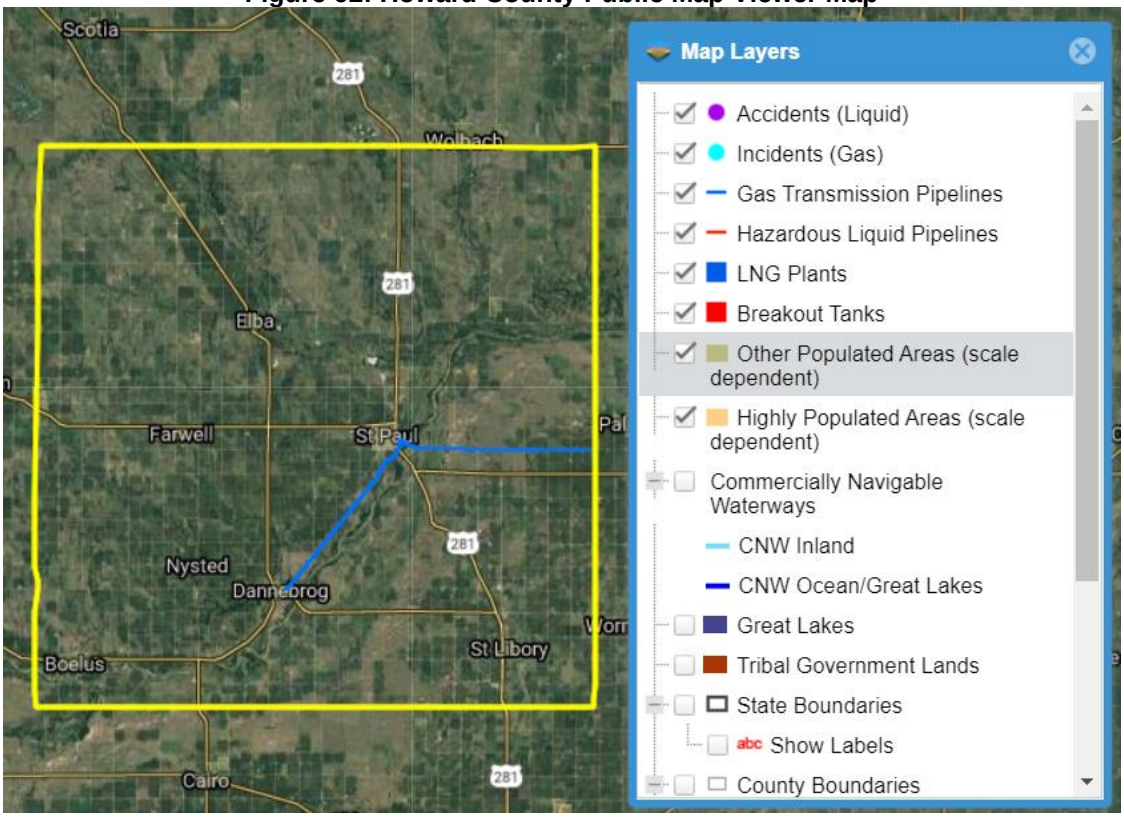


Figure 63: Loup County Public Map Viewer Map

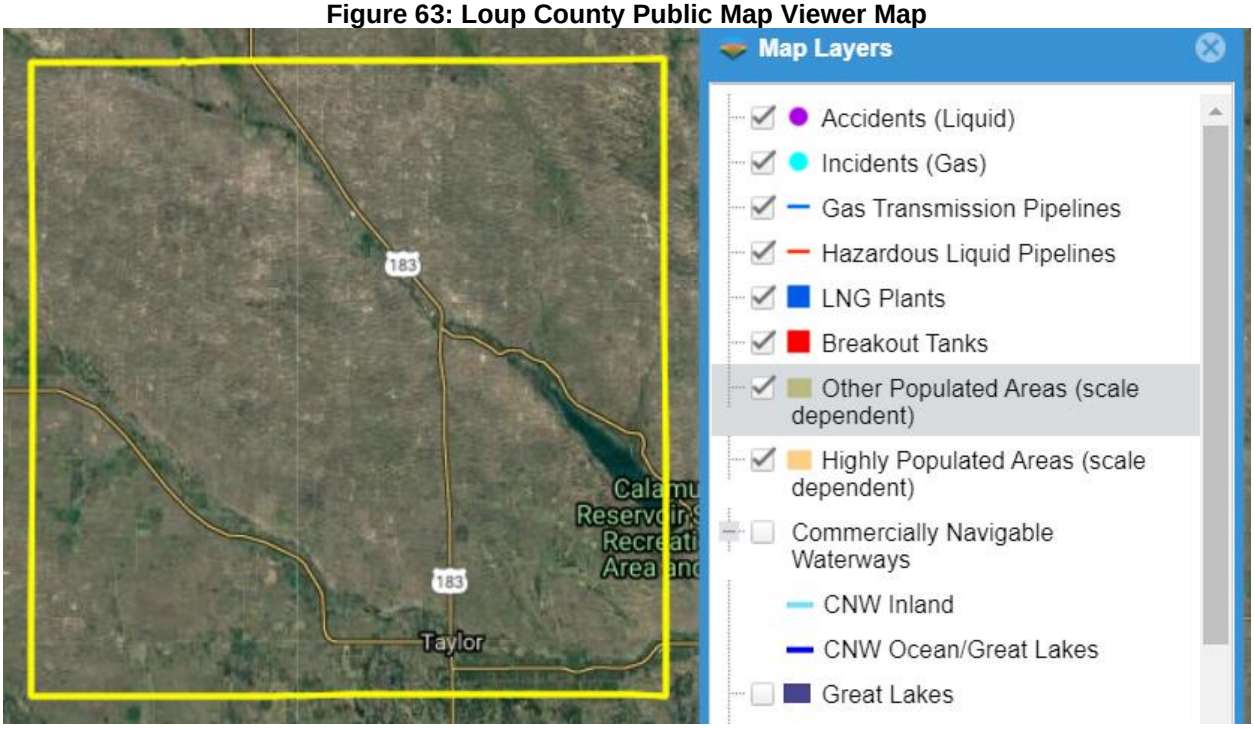


Figure 64: Nance County Public Map Viewer Map

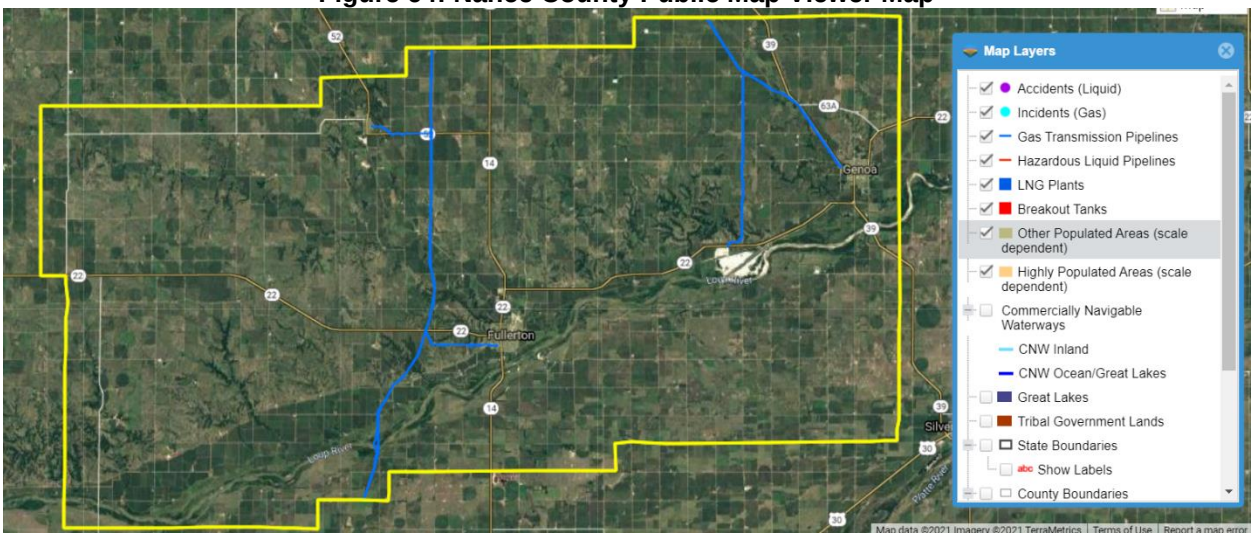


Figure 65: Platte County Public Map Viewer Map

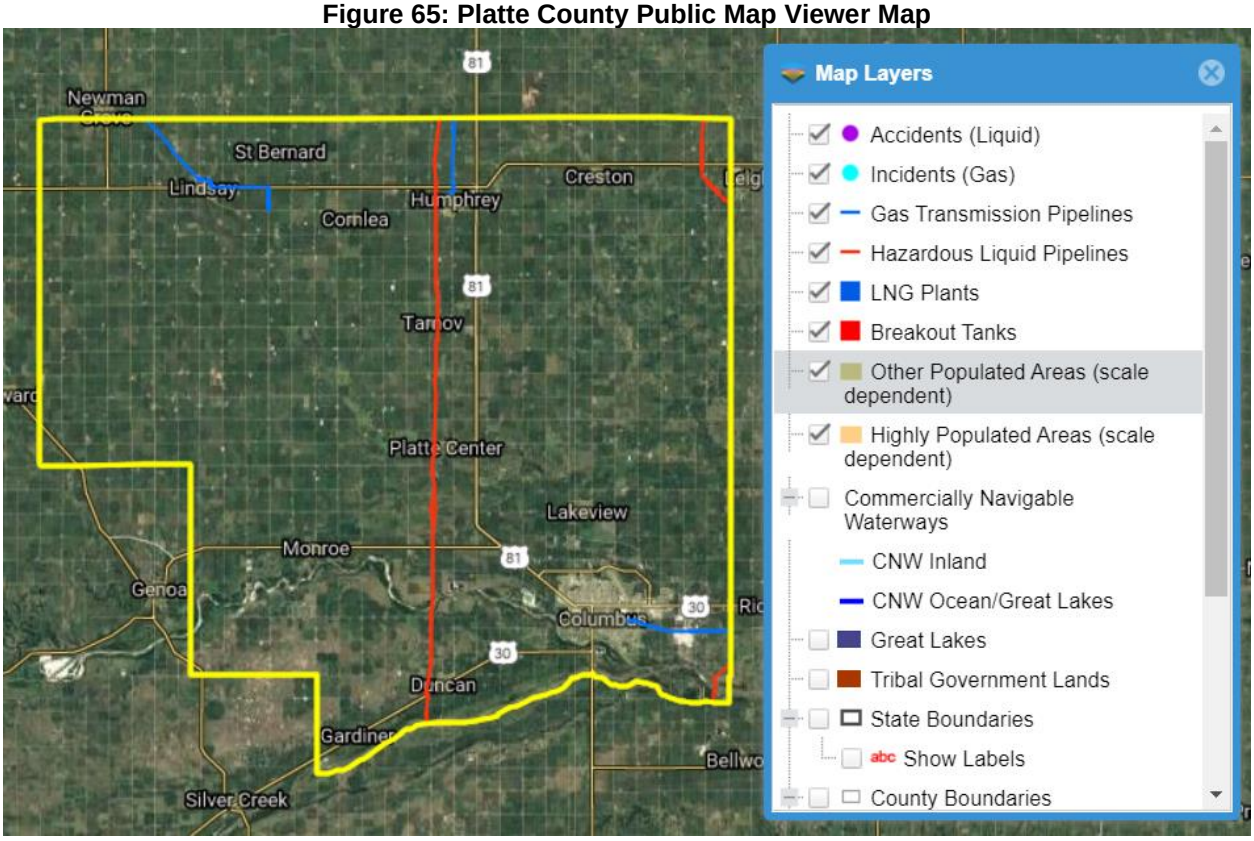


Figure 66: Sherman County Public Map Viewer Map

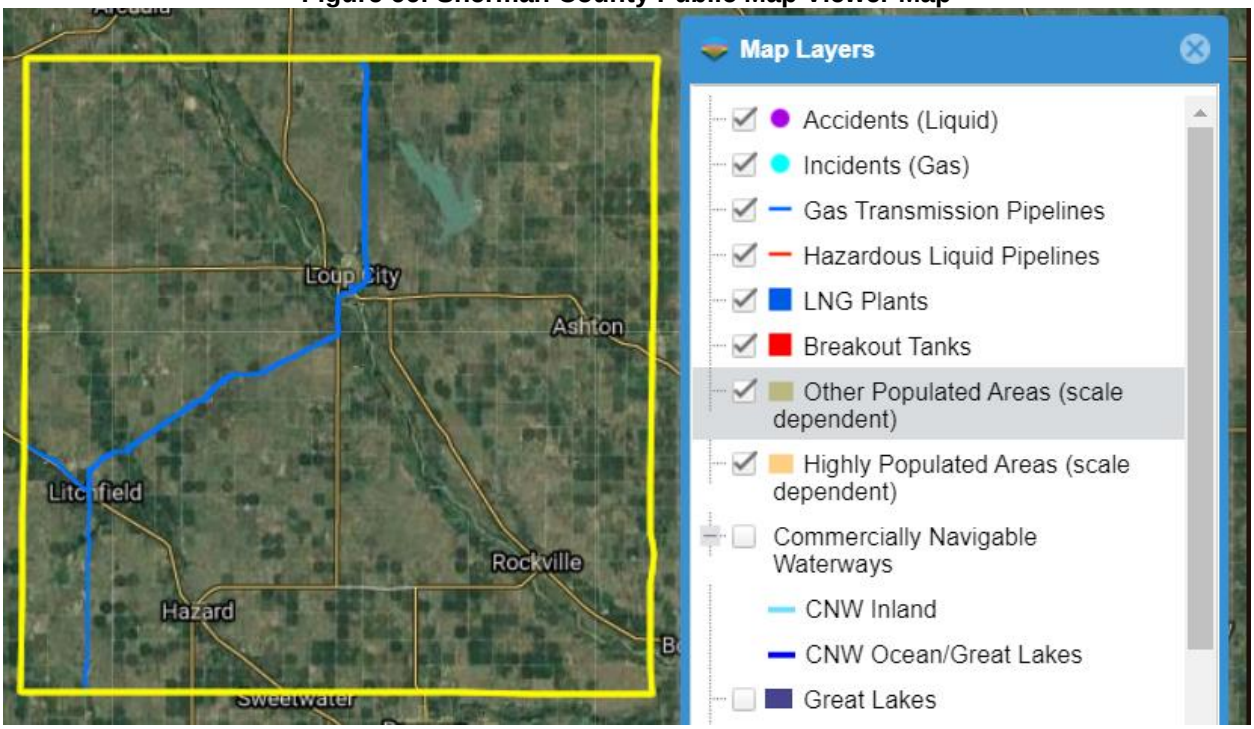


Figure 67: Valley County Public Map Viewer Map

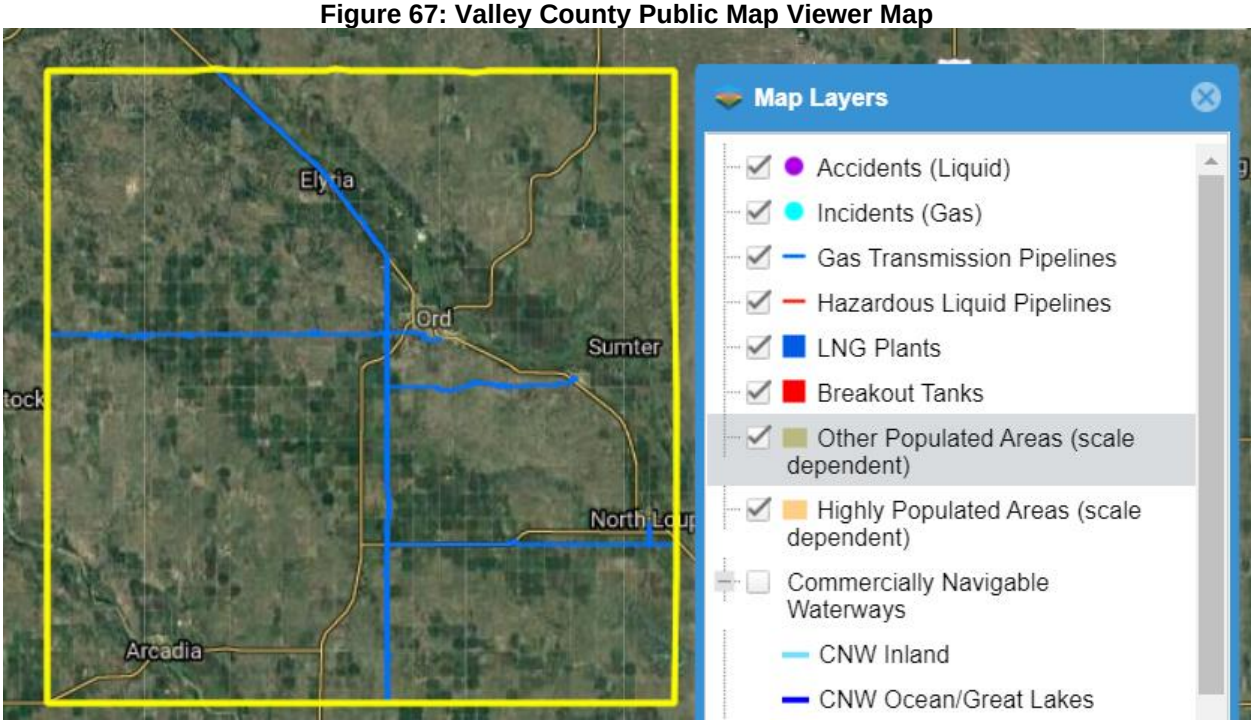
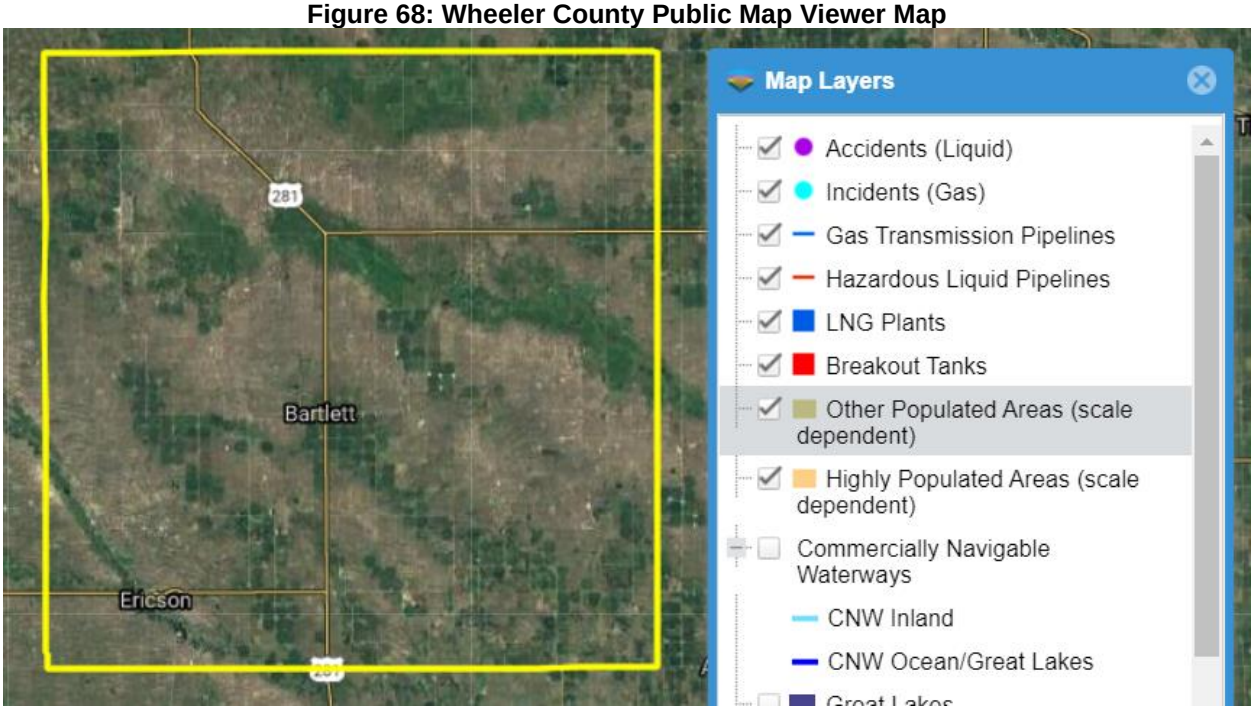


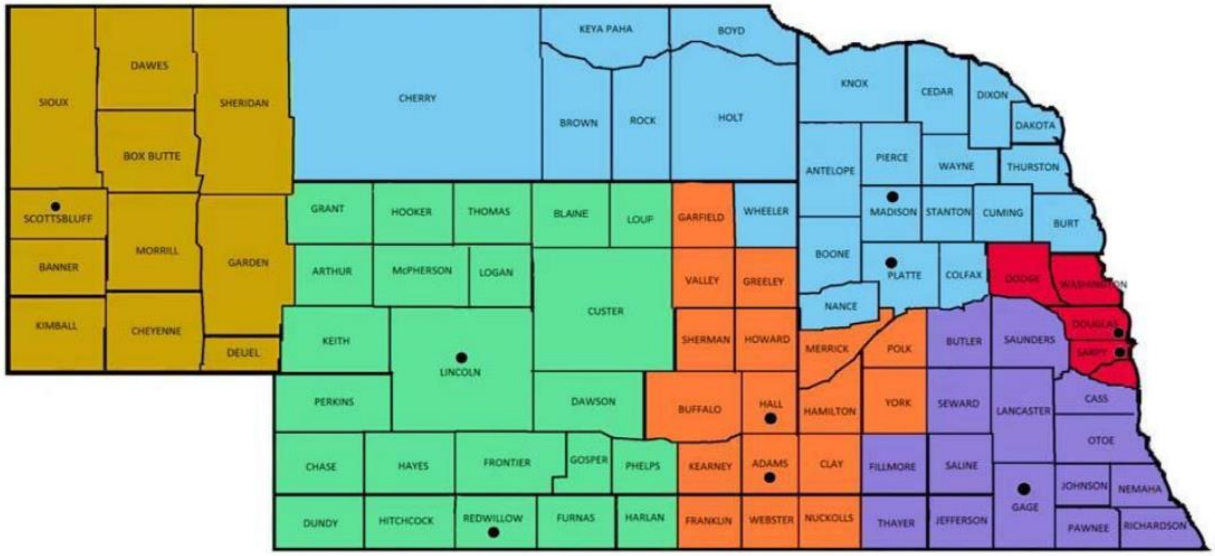
Figure 68: Wheeler County Public Map Viewer Map



There are ten State Emergency Response Teams (SERTs) stationed across the State of Nebraska which are trained to respond to large scale hazardous material incidents. Each department includes personnel at the technical, incident commander, and safety officer levels.

There are three SERT districts in the planning area with no teams located within the 11 county planning area.[65]

Figure 69: Nebraska CERTs Map



HISTORICAL OCCURRENCES

Fixed Site Spills

According to the U.S. Coast Guard's National Response Center database (NRC), there have been 67 fixed site chemical spills from 1990 – 2020 in the planning area. There were no property damages reported for these chemical spills. The following table displays the larger spills that have occurred throughout the planning area (>500 gallons).

Table 79: Fixed Site Chemical Spills

Date of Event	Location of Release	Quantity Spilled	Material Involved	Number of Injuries	Property Damage
4/21/2014	Columbus	500 Gallons	Other Oil (Used Oil Mixed with Rain Water)	0	$0
7/17/2010	Broken Bow	2490 Gallons	Caustic Soda and Water	0	$0
12/6/2010	Columbus	1000 pounds	Sulfuric Acid	0	$0
7/12/2008	Columbus	500 Gallons	Ethanol	0	$0
6/30/2007	Ord	1200 Gallons	Gasoline	0	$0
10/2/2002	St. Paul	2500 Pounds	Anhydrous Ammonia	0	$0
9/3/2000	Ord	21000 Gallons	Fertilizer	0	$0

[65] NEMA. June 2020. "Nebraska: Emergency Assistance to a Hazardous Materials Incident." https://nema.nebraska.gov/sites/nema.nebraska.gov/files/doc/hazmat-blue-book.pdf.

Date of Event	Location of Release	Quantity Spilled	Material Involved	Number of Injuries	Property Damage
9/4/1998	Merna	1900 Pounds	Anhydrous Ammonia	1	$0
11/7/1995	Columbus	3462 Gallons	Ethanol (90%), Gasoline (10%)	0	$0
4/18/1993	Dannebrog	21000 Gallons	Liquid Fertilizer	0	$0
4/16/1993	Columbus	6000 Gallons	Sulfur Dioxide	2	$0

Source: National Response Center, 1990-2020

Transportation Spills

According to PHMSA, 29 hazardous materials releases occurred during transportation in the planning area between 1990 and 2020. Duplicate records of spills in the planninga area have been removed since the 2017 HMP. During these events, there were no injuries, no fatalities, and $929,130 in damages. The following table provides a list of the historical transportation chemical spills.

Rail line carrying ethanol near Ord

Table 80: Historical Chemical Transportation Spills, 1990-2021

Date	Location of Release	Material Involved	Method of Transportation	Quantity Spilled	Total Damages
4/4/1990	Duncan	Flammable liquids, n.o.s.	Rail	5 LGA	$50
4/12/1990	Oconee	Ammonia anhydrous	Rail	0	$850
2/19/1992	Columbus	Hazardous waste, solid, n.o.s.	Highway	5 SLB	$-
4/28/1993	Berwyn	Denatured alcohol	Rail	12,916 LGA	$149,041
4/28/1993	Columbus	Hydrochloric acid, solution	Highway	10 LGA	$10
4/28/1993	Columbus	Sulfur, molten	Rail	300 LGA	$1,100
4/28/1993	Columbus	Compound, cleaning, liquid (containing phosphoric acid, acetic acid, sodium hydroxide or potassium hydroxide)	Highway	0.2LGA	$45
4/28/1993	Mason	Fuel oil, no. 1, 2, 4, 5, or 6	Rail	8,000 LGA	$35,000
10/7/1994	Columbus	Sodium aluminate, solution	Highway	10 LGA	$-
6/27/1995	Broken Bow	Sulfuric acid with not more than 51% acid	Highway	0 LGA	$5
4/25/1996	Columbus	Flammable liquids, n.o.s.	Highway	1 LGA	$-
1/7/1997	Columbus	Coating solution (includes surface treatments or coatings used for industrial or other purposes such as vehicle undercoating, drum or barrel lining)	Highway	1 LGA	$-
4/14/1997	Columbus	Coating solution (includes surface treatments or coatings used for industrial or other purposes such as vehicle undercoating, drum or barrel lining)	Highway	1 LGA	$-
7/1/1998	Columbus	Fuel oil, no. 1, 2, 4, 5, or 6	Rail	10 LGA	$-
9/9/1998	Columbus	Environmentally hazardous substances, liquid, n.o.s.	Highway	0 LGA	$150
2/1/2000	Columbus	Fuel oil, no. 1, 2, 4, 5, or 6	Rail	0 LGA	$-
3/21/2000	Columbus		Highway	0 LGA	$-
8/10/2000	Columbus		Highway	0 LGA	$-
10/23/2002	Columbus	Aerosols, non-flammable, (each not exceeding 1 l capacity)	Highway	0 LGA	$-
5/21/2004	Columbus	Phosphoric acid solution	Rail	5 LGA	$6,112
4/4/2005	Columbus	Nitric acid other than red fuming, with at least 65 percent, but not more than 70 percent nitric acid	Highway	0.5 LGA	$-
4/18/2005	Broken Bow	Flammable liquids, n.o.s.	Highway	0.1 LGA	$-
4/19/2005	Columbus	Organic peroxide type f, liquid	Highway	100 LGA	$28,000
2/13/2007	Broken Bow	Carbon dioxide, solid or dry ice	Air	0 LGA	$-

Date	Location of Release	Material Involved	Method of Transportation	Quantity Spilled	Total Damages
1/15/2008	Duncan	Corrosive liquids, toxic, n.o.s.	Rail	0.3 LGA	$81,000
10/29/2009	Broken Bow	Hydrochloric acid	Highway	330 LGA	$27,500
1/20/2014	Columbus	Fuel oil (no. 1, 2, 4, 5, or 6)	Rail	1 LGA	$4,103
3/12/2014	Columbus	Isopropanol or isopropyl alcohol	Highway	0.3 LGA	$-
3/12/2014	Columbus	Isopropanol or isopropyl alcohol	Highway	0.5 LGA	$-
6/21/2015	Duncan	Flammable liquids, n.o.s.	Rail	5 LGA	$50
7/10/2017	Oconee	Ammonia anhydrous	Rail	0 LGA	$850
2/12/2019	Columbus	Hazardous waste, solid, n.o.s.	Highway	5 LGA	$-
2/20/2020	Berwyn	Denatured alcohol	Rail	12,916 LGA	$149,041
7/30/2020	Columbus	Hydrochloric acid, solution	Highway	10 LGA	$10

Source: PHMSA, 1990-2020

AVERAGE ANNUAL DAMAGES

There have been 67 chemical fixed site spills in the planning area reported from the NRC and 29 transportation spills as reported by PHMSA. Neither the NRC nor PHMSA track crop losses from chemical spills. These events reported $929,130 in property damages. This does not include losses from displacement, functional downtime, economic loss, injury, or loss of life.

Table 81: Chemical Fixed Site Average Annual Losses

Hazard Type	Number of Events	Events Per Year	Injuries	Total Evacuated	Total Damages	Average Annual Loss
Chemical Spills	67	2.2	3	35	$0	$0
Transportation Spills	29	0.9	0	0	$929,130	$29,972

Source: National Response Center, 1990-2016; PHMSA, 1990-2020

EXTENT

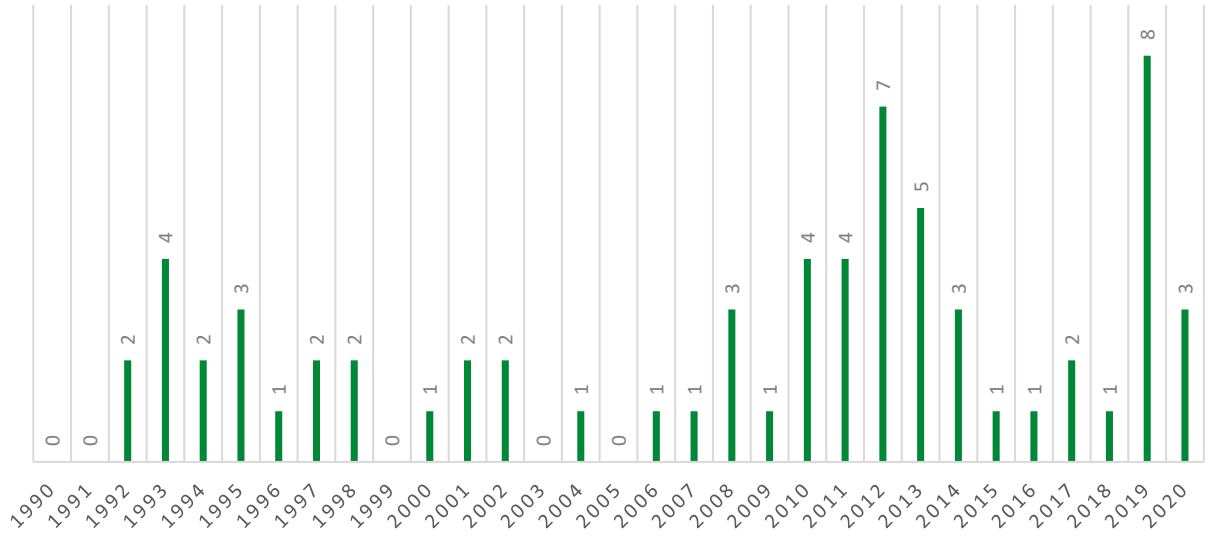
The extent of chemical spills at fixed sites varies and depends on the type of chemical that is released with a majority of events localized to the facility. The probable extent of chemical spills during transportation is difficult to anticipate and depends on the type and quantity of chemical released. In total 67 fixed site releases have occurred in the planning area, and the total amount spilled ranged from 0 gallons to 21,000 gallons. Of the 67 chemical spills, two spills led to evacuations and two spills led to injuries. The evacuations were minor; involving 35 people total. Two separate spills caused three injuries in total. Transportation spills ranged from no material released to over 12,900 liquid gallons of material with an average quantity spilled of 748 liquid gallons.

Based on historic records, it is likely that any spill involving hazardous materials will not affect an area larger than a quarter mile from the spill location.

PROBABILITY

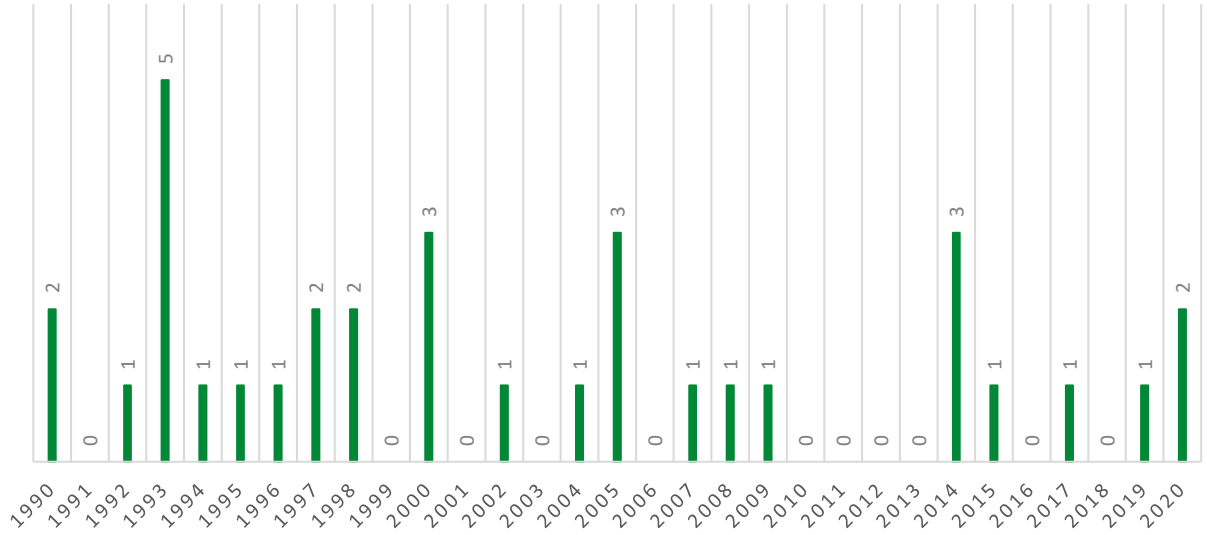
Given the historic record of occurrence for fixed chemical spill events (at least one chemical spill reported in 26 of 31 years), for the purposes of this plan, the annual probability of a fixed chemical spill is 84 percent. Given the historic record of occurrence for chemical transportation spill events (20 out of 31 years with a reported event), for the purposes of this plan, the annual probability of chemical transportation occurrence is 65%.

Figure 70: Chemical Fixed Site Events by Year



Source: National Response Center, 1990-2016

Figure 71: Chemical Transportation Events by Year



Source: PHMSA, 1990-2020

COMMUNITY TOP HAZARD STATUS

The following table lists jurisdictions which identified Chemical Fixed Sites as a top hazard of concern:

Table 82: Chemical Fixed Sites Top Concern by Community

Jurisdictions	
Albion and Albion Fire	Elba
Anselmo	Ericson
Ansley	Farwell
Bartlett	Howard County
Belgrade	Litchfield
Boone County	Platte County
Columbus	St. Paul
Dannebrog	Wheeler Central Schools
Duncan	

REGIONAL VULNERABILITIES

To reduce the risk to people and property damage, future development should encourage chemical storage and manufacturing facilities to be built away from critical facilities such as hospitals, schools, daycares, nursing homes, and other residential areas. Likewise development and critical facilities should be built away from major transportation corridors used for chemical transportation. Specific vulnerabilities exist for critical facilities or vulnerable population centers (schools, daycares, hospital, etc.) which are most heavily populated during the daytime as most chemical transportation incidents occur during the weekday daytime hours.

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

Table 83: Regional Hazardous Materials Vulnerabilities

Sector	Vulnerability
People	-Those in close proximity could have minor to moderate health impacts -Possible evacuations -Hospitals, nursing homes, and the elderly at greater risk due to low mobility
Economic	-A chemical plant shutdown in smaller communities would have significant impacts to the local economy -Evacuations and closed transportation routes could impact businesses near spill
Built Environment	-Risk of fire or explosion
Infrastructure	-Transportation routes can be closed during evacuations or cleanup
Critical Facilities	-Risk of fire, explosion, or other damages -Risk of evacuation
Climate	-More extreme weather events and flood events put sites at risk of flooding at greater risk

LEVEE FAILURE

According to FEMA:

> "The United States has thousands of miles of levee systems. These human-caused structures are most commonly earthen embankments designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water to provide some level of protection from flooding. Some levee systems date back as far as 150 years. Some levee systems were built for agricultural purposes. Those levee systems designed to protect urban areas have typically been built to higher standards. Levee systems are designed to provide a specific level of flood protection. No levee system provides full protection from all flooding events to the people and structures located behind it. Thus, some level of flood risk exists in these levee-impacted areas."

Levee failure can occur several ways. A breach of a levee is when part of the levee breaks away, leaving a large opening for floodwaters to flow through. A levee breach can be gradual by surface or subsurface erosion, or it can be sudden. A sudden breach of a levee often occurs when there are soil pores in the levee that allow water to flow through causing an upward pressure greater than the downward pressure from the weight of the soil of the levee. This under seepage can then resurface on the backside of the levee and can quickly erode a hole to cause a breach. Sometimes the levee actually sinks into a liquefied subsurface below.

Another way a levee failure can occur is when the water overtops the crest of the levee. This happens when the flood waters simply exceed the lowest crest elevation of the levee. An overtopping can lead to significant erosion of the backside of the levee and can result to a breach and thus a levee failure.

The USACE, who is responsible for federal levee oversight and inspection of levees, has three ratings for levee inspections.

Table 84: USACE Levee Rating Categories

Ratings	Description
Acceptable	All inspection items are rated as Acceptable
Minimally Acceptable	One or more inspection items are rated as Minimally Acceptable or one or more items are rated as Unacceptable and an engineering determination concludes that the Unacceptable inspection items would not prevent the segment/system from performing as intended during the next flood event
Unacceptable	One or more items are rated as Unacceptable and would prevent the segment/system from performing as intended, or a serious deficiency noted in past inspections has not been corrected within the established timeframe, not to exceed two years

Source: USACE

LOCATION

According to the U.S. Army Corps of Engineers (USACE), there are 132 levee systems in the State of Nebraska which include 304 individual structures and span 346 miles of levee embankments. Beyond the USACE's National Levee Database, there is no known comprehensive list of levees that exists in the planning area for private agricultural levees. Thus, it is not possible at this time to document the location of non-federal levees, the areas they protect, nor the potential impact of these levees. According to USACE's database, there are seven levees located within the planning area. Table 85 lists details for each levee protected area in the planning area.

Table 85: Levees in LLNRD

Name	Sponsor	Location	River	Length (miles)	Federal or Non-Federal	Risk Level	Population in Leveed Area	Structures in Leveed Areas	Property Value in Leveed Areas
Broken Bow - Mud Creek LB	BNSF Railroad, City of Broken Bow	Broken Bow, Custer County	North Branch Mud Creek	0.43	Federal	Low	25	18	$3.81M
Broken Bow - Mud Creek RB	City of Broken Bow	Broken Bow, Custer County	South Branch Mud Creek	0.83	Federal	Low	95	77	$26.1M
Columbus - Lost Creek RB	City of Columbus	Columbus, Platte County	Lost Creek	1.35	Federal	Low	48	20	$2.7M
Columbus - Loup River LB	City of Columbus	Columbus, Platte County		5.17	Federal	Low	3,665	1,599	$318M
Loup River - Custer	Undefined	Sargent, Custer County	Loup River	1.16	Non-federal	Not Screened	6	3	$904k
Vorhees Creek Levee	Boone County	Albion, Boone County	Vorhees Creek	0.4	Non-federal	Not Screened	0	0	$0
White Tail Lake	City of Columbus	Columbus, Platte County	White Tail Lake, Barnum Creek	1.53	Non-federal	Not Screened	177	107	$45.2M

Source: USACE Levee Database, 2021

Figure 72: Broken Bow Leveed Areas

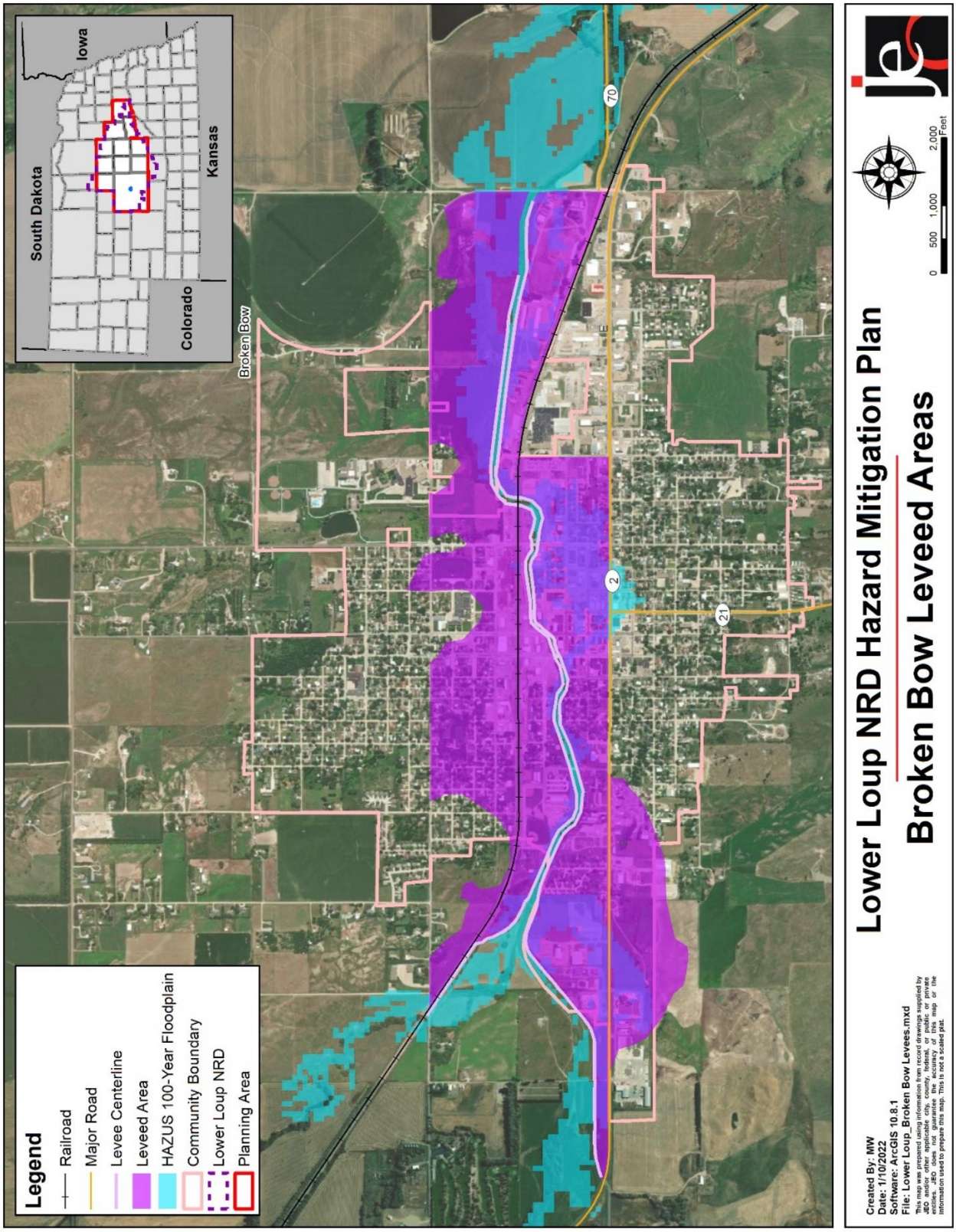
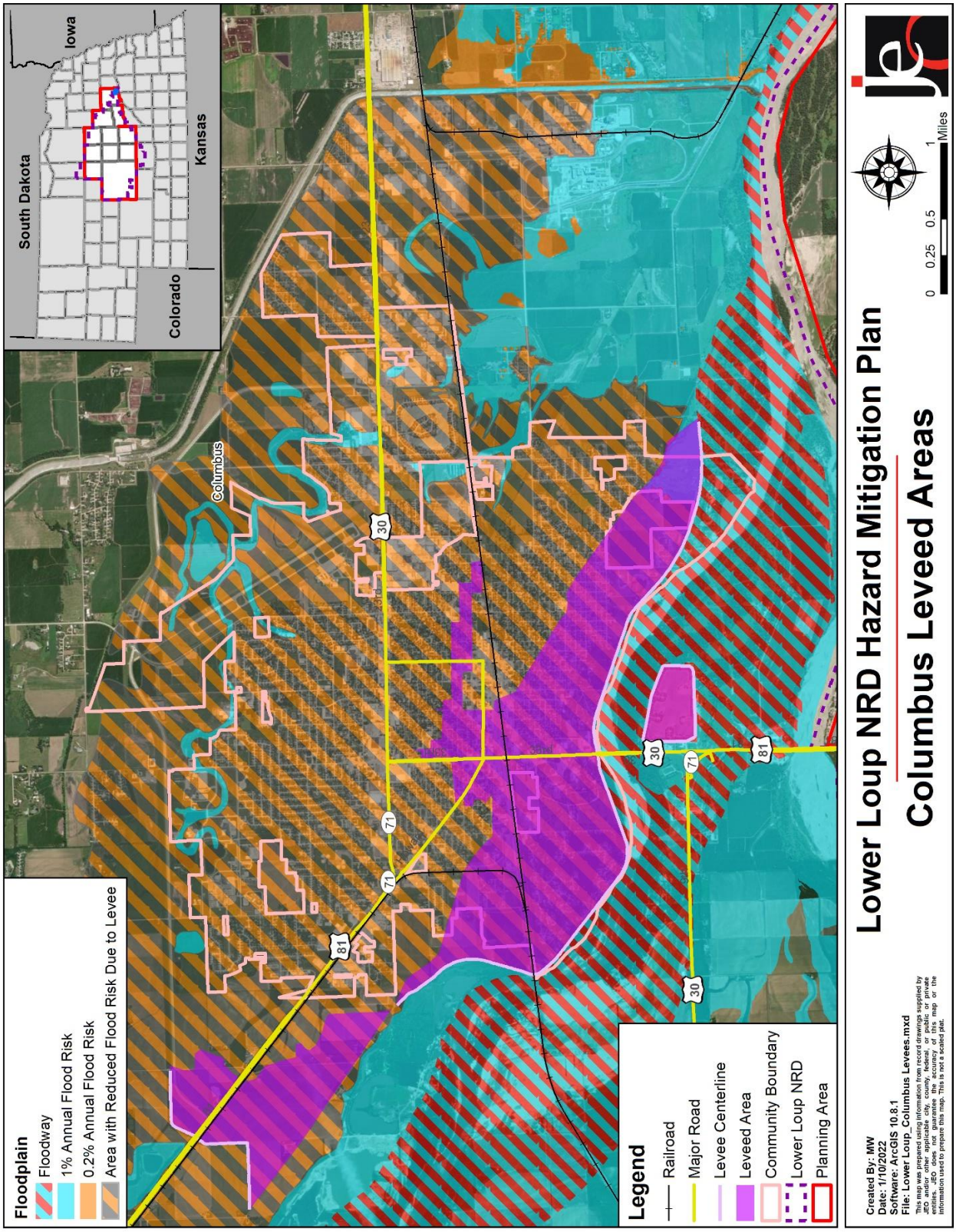


Figure 73: Columbus Leveed Areas



EXTENT

USACE, who is responsible for federal levee oversite and inspection of levees, has three ratings for levee inspections. Any levee failure events in the planning area will fall within USACE's rating system; however, it is not currently possible to determine what level of damage each levee system will experience. Non-federal levees are not inspected and thus do not have ratings.

Table 86: USACE Levee Rating Categories

Ratings	Description
Acceptable	All inspection items are rated as Acceptable
Minimally Acceptable	One or more inspection items are rated as Minimally Acceptable or one or more items are rated as Unacceptable and an engineering determination concludes that the Unacceptable inspection items would not prevent the segment/system from performing as intended during the next flood event.
Unacceptable	One or more items are rated as Unacceptable and would prevent the segment/system from performing as intended, or a serious deficiency noted in past inspections has not been corrected within the established timeframe, not to exceed two years.

Source: USACE

Levee Improvements and FEMA Accreditation

In 2004, as it initiated work under the Flood Map Modernization Initiative (Map Mod), FEMA determined that analysis of the role of levees in flood risk reduction would be an important part of the mapping efforts. A report issued in 2005 noted that the status of the Nation's levees was not well understood and the condition of many levees and floodwalls had not been assessed since their original inclusion in the NFIP. As a result, FEMA established policies to address existing levees. As DFIRMs are developed, levees fall under one of the three following categories:

1) Accredited Levee - With the exception of areas of residual flooding (interior drainage), if the data and documentation specified in 44 CFR 65.10 is readily available and provided to FEMA, the area behind the levee will be mapped as a moderate-risk area. There is no mandatory flood insurance purchase requirement in a moderate-risk area, but flood insurance is strongly recommended.

2) Provisionally Accredited Levee (PAL) - If data and documentation is not readily available, and no known deficiency precludes meeting requirements of 44 CFR 65.10, FEMA can allow the party seeking recognition up to two years to compile and submit full documentation to show compliance with 44 CFR 65.10. During this two-year period of provisional accreditation, the area behind the levee will be mapped as moderate-risk with no mandatory flood insurance purchase requirement.

3) De-Accredited Levees – If the information established under 44 CFR 65.10 is not readily available and provided to FEMA, and the levee is not eligible for the PAL designation, the levee will be de-accredited by FEMA. The area behind the levee will be mapped as a high risk area, subject to mandatory flood insurance purchase.

As of December 2021, levee systems in the planning area held the following accreditations:

Table 87: Levee System Accreditation

Levee System	Accreditation Level
Broken Bow - Mud Creek LB	Non Accredited
Broken Bow - Mud Creek RB	Accredited
Columbus - Lost Creek RB	Non-Accredited
Columbus - Loup River LB	Provisionally Accredited Levee
Loup River - Custer	Accredited
Vorhees Creek Levee	Accredited
White Tail Lake	Provisionally Accredited Levee

Source: USACE

HISTORICAL OCCURRENCES

There is no known database of historical occurrences for levee failure. Instead, the planning team and the USACE was consulted for any previous occurrences of levee failure. After the March 2019 flood event, USACE reported 41 breaches and numerous damages to federal and non-federal levees across the State of Nebraska. The failure of these structures significantly impacted subsequent flooding in neighboring communities. During the March 2019 flood event, three levee segments in the planning area were damaged and required repairs.

- Broken Bow - Mud Creek RB/LB Restoration Information. Background: The Broken Bow - Mud Creek Left and Right Bank Levee Systems were damaged during the 2019 Flood Event, leading to the Project Sponsor submitting a Public Law (PL) 84-99 Rehabilitation Assistance Request to the U.S. Army Corps of Engineers - Omaha District. Status: 08 November 2019 – Work on the Broken Bow Levee repair contract is complete. Total contract amount: $165,000.
- Columbus – Loup River LB Restoration Information. Background: The Columbus Loup River Left Bank Levee System was damaged during the 2019 flood event, leading to the project sponsor submitting a PBUlic Law 84-99 Rehabilitation Assistance request to the US Army Corps of Engineers. Status: 08 September 2020 – Work on the Columbus levee repair contract is complete and final inspection occurred on 28 August 2020. Total contract amount: $2.2 million.

POTENTIAL LOSSES

To determine potential losses for levee failure, a parcel inventory from the levee breach areas was utilized. Based on the nature of the assessor's parcel data, it is not possible to do a true structural inventory with structure-specific impacts. Instead, inundated parcels were used as a proxy for structural data. The following table show the number of parcels included in the leveed areas for the 11-county planning area. A total of 2,702 parcels are within the leveed area, which are valued at $281,179,003

Table 88: Potential Losses in Levee Breach Area

Location	Number of Parcels in Leveed Area	Value of Improvements within Leveed Area
Broken Bow	675	$63,088,503
Columbus	2,027	$218,090,500

Source: Custer County Assessor, Platte County Assessor

PROBABILITY

While several levees within the planning area were significantly damaged during the March 2019 flood event, no other historical records of levee failure were found. While it is possible for levee failure to occur in the future, this is considered a low probability. For the purposes of this plan, the probability of levee failure will be stated as one percent annually.

COMMUNITY TOP HAZARD STATUS

The following table lists jurisdictions which identified Levee Failure as a top hazard of concern:

Table 89: Levee Failure Top Concern by Community

Jurisdictions	
Broken Bow	Dannebrog
Columbus	Twin Loups Irrigation District

REGIONAL VULNERABILITIES

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

Table 90: Regional Levee Failure Vulnerabilities

Sector	Vulnerability
People	-Those living in federal or non-federal levee protected areas -Residents with low mobility or with no access to a vehicle are more vulnerable during a levee failure - Students at high school, and elementary school who may need additional assistance while evacuating -Those without adequate notification may be at greater risk
Economic	- Parts of Broken Bow and Columbus are in the levee protected areas, these businesses are at risk -Business and industry protected by levees are at risk
Built Environment	-All buildings within levee protected areas are at risk to damages
Infrastructure	-Major transportation corridors and bridges at risk to levee failure
Critical Facilities	Many Critical Facilities such as the following are within the levee inundation area in Columbus: - Mobile Home Park - Alltel Tower - Water Tower - National Guard Armory - Wastewater Facility - Water Wells - Sewage Treatment Plant
Climate	-Changes in seasonal precipitation and temperature normals can increase strain on infrastructure

PUBLIC HEALTH EPIDEMIC

According to the World Health Organization, a public health emergency is:

> "an occurrence or imminent threat of an illness or health condition, caused by bio terrorism, epidemic or pandemic disease, or (a) novel and highly fatal infectious agent or biological toxin, that poses a substantial risk of a significant number of human facilities or incidents or permanent or long-term disability" (WHO/DCD, 2001). The declaration of a state of public health emergency permits the governor to suspend state regulations, change the functions of state agencies.[66]

The number of cases that qualifies as a public health emergency depends on several factors including the illness, it's symptoms, ease in transmission, incubation period, and available treatments or vaccinations. With the advent of sanitation sewer systems and other improvements in hygiene since the 19th century, the spread of infectious disease has greatly diminished. Additionally, the discovery of antibiotics and the implementation of universal childhood vaccination programs have played a major role in reducing human disease impacts. Today, human disease incidences are carefully tracked by the Centers for Disease Control and Prevention (CDC) and state organizations for possible epidemics and to implement control systems. Novel illnesses or diseases have the potential to develop annually and significantly impact residents and public health systems. Both chronic and infectious diseases can become epidemic in a population, but for the purposes of this plan, infectious diseases are of more concern because of their generally acute effects resulting in higher mortality and morbidity rates.

Pandemics are global or national disease outbreaks. These types of illnesses, such as influenza, can spread easily person-to-person, cause severe illness, and are difficult to contain. An especially severe pandemic can lead to high levels of illness, death, social disruption, and economic turmoil. Past public health emergency events include:

- 1918 Spanish Flu: the H1N1 influenza virus spread world-wide during 1918 and 1919. It is estimated that at least 50 million people worldwide died during this pandemic with about 675,000 deaths alone in the United States. No vaccine was ever developed and control efforts included self-isolation, quarantine, increased personal hygiene, disinfectant use, and social distancing.
- 1957 H2N2 Virus: a new influenza A (H2N2) virus emerged in Eastern Asia and eventually crossed into coastal U.S. cities in summer of 1957. In total 1.1 million people worldwide died of the flu with 116,000 of those in the United States.
- 1968 H3N2 Virus: an influenza A virus discovered in the United States in September 1968 which killed over 100,000 citizens. The majority of deaths occurred in people 65 years and older.
- 2009 H1N1 Swine Flu: a novel influenza A virus discovered in the United States and spread quickly across the globe. This flu was particularly prevalent in young people while those over 65 had some antibody resistance. The CDC estimated the U.S. had over 60.8 million cases and 12,469 deaths.
- 2019 COVID-19: the coronavirus disease 2019 is a contagious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which originated in Wuhan China and spread globally. As of December 2021 the CDC reported in the U.S. over 50 million cases and 800,000 deaths attributed to COVID-19. Efforts to control and limit the virus included face coverings, self-isolation, quarantine, increased cleaning measures, and social distancing. Significant impacts to the national and global economy have been caused by COVID-19.

[66] World Health Organization. 2008. Accessed April 2020. "Glossary of humanitarian Terms." https://www.who.int/hac/about/definitions/en/.

The State of Nebraska Department of Health and Human Services (DHHS) requires doctors, hospitals, and laboratories to report on many communicable diseases, including cases of food poisoning and bioterror agents, and conditions to monitor disease rates for epidemic events. Additionally, regional or county health departments monitor local disease outbreaks and collect data relevant to public health. The current national opioid epidemic will also be considered because of its widespread and acute nature.

In their Community Health Assessments, the two local public health departments in the LLNRD, East Central District Health Department and Loup Basin Public Health Department, have identified hepatitis A, hepatitis B, pneumonia, influenza, West Nile Virus, tuberculosis, sexually transmitted diseases/infections, and shingles as the most likely infectious diseases to occur in the area.

LOCATION

Human disease outbreaks can occur anywhere in the planning area. Epidemic threshold levels are dependent on disease, location, and season. Normal infectious disease patterns are changing due to increasing human mobility globally and climate change. Rural areas of Nebraska are particularly at risk from animal-related diseases, tularemia, West Nile Virus, influenza, and pesticide poisoning. Urban areas of Nebraska are particularly at risk from community spread type illnesses such as influenza, norovirus, and other communicable diseases. All residents throughout the planning area are at risk during public health emergencies. All areas within the planning area experienced impacts from COVID-19 specifically since 2020.

EXTENT

Those most affected by public heath emergencies are typically the very young, the very old, the immune-compromised, the economically vulnerable, and the unvaccinated. Roughly 24% of the planning area's population is 19 years old or younger, and over 23% of the planning area is 64 years old or older, while approximately 7% of the population lives below the poverty line. Current estimates for vaccination rates are not publicly available. As of December 2021, vaccines and subsequent booster shops for COVID-19 were available to all residents.

It is not possible to determine the extent of individual public health emergency events, as the type and severity of a novel outbreak cannot be predicted. However, depending on the disease type, a significant portion of residents may be at risk to illness or death. The extent of a public health emergency is also closely tied to the proximity or availability of health centers. The following table identifies hospitals in the planning area.

Table 91: Hospitals in the Planning Area

County	Facility Name	Nearest Community	Total Licensed Beds
Boone	Boone County Health Center	Albion	25
Custer	Jennie M Melham Memorial Medical Center	Broken Bow	23
Custer	Callaway District Hospital	Callaway	12
Howard	Howard County Medical Center	St. Paul	10
Nance	Genoa Community Hospital	Genoa	19
Platte	Columbus Community Hospital	Columbus	50
Valley	Valley County Hospital	Ord	16

Source: Nebraska Department of Health and Human Services[67]

[67] Department of Health and Human Services. December 2021. "Hospitals." https://dhhs.ne.gov/licensure/Documents/Hospital%20Roster.pdf.

The extent to which these populations are affected by communicable diseases depends greatly on the attack rate and duration of the disease, and the extent to which herd immunity has been established by the community through effective vaccination programs. Nebraska state law (Title 173) requires all students have the following vaccinations: tetanus, diphtheria, pertussis, measles, mumps, rubella, varicella, and hepatitis B, with the option to wave the requirements for religious objections. Nebraska state law also requires that postsecondary educational institutions recommend meningococcal vaccination. Diphtheria, tetanus, pertussis, poliovirus, haemophilus influenza type b, measles, hepatitis B and varicella vaccination rates in are recommended for children 19-35 months. Influenza vaccinations are recommended yearly for those over 6 months old. The Vaccines for Children (VFC) program is a federally funded and state-operated vaccine supply program that provides free vaccines to children under 18 who are of American Indian or Alaska Native descent, enrolled in Medicaid, uninsured, or underinsured. Additionally, the HPV vaccination series is recommended for teenagers and influenza vaccinations are recommended yearly for those over six months old. Individuals without vaccinations are at greater risk of contracting diseases or carrying diseases to others.

HISTORICAL OCCURRENCES

Cases and fatalities associated with Public Health Emergencies vary between illness types and severity of outbreak. Past major outbreaks in Nebraska have specifically included the H1N1 Swine Flu in 2009, mumps outbreak in 2019, and COVID-19 in 2020.

- H1N1 Swine Flu (2009) – outbreaks were first reported in mid-April 2009 and spread rapidly. The new flu strand for which immunity was nonexistent in persons under 60 years old was similar in many ways to typical seasonal influenza. Symptoms of H1N1 included fever greater than 100F, cough, and sore throat. County specific counts of H1N1 are not available, however a total of 71 confirmed cases were reported by June 12, 2009.[68] Outbreaks in Nebraska were typically seen sporadically with occasional cluster outbreaks at summer camps for youth. The U.S. Public Health Emergency for the H1N1 Influenza outbreak expired on June 23, 2010. The CDC developed and encouraged all US residents to receive a yearly flu vaccination to protect against potential exposures. The H1N1 continues to appear annually and persons in the planning area are at risk of infection in the future.
- Mumps (2019) –In August 2019, 30 attendees at a Nebraska wedding developed mumps after being exposed to one asymptomatic patient. Transmission from this event resulted in 31 secondary cases, 27 tertiary cases, and three quaternary cases. Isolation and a communitywide third-dose MMR vaccination campaign helped end the outbreak.[69]
- COVID-19 (2020) – In January 2020 the CDC confirmed the first case of COVID-19 in the United States and it quickly spread across the country. By March 2020 the World Health Organization declared COVID-19 a pandemic and travel bans were instituted around the globe. Primary symptoms of the infection included cough, fever or chills, shortness of breath or difficulty breathing, fatigue, muscle and body aches, headache, loss of taste or smell, sore throat, and others.

The first confirmed case of COVID-19 in the State of Nebraska was a 36-year old Omaha resident in early March. Counties and cities throughout the planning area have experienced cases and fatalities of residents which have strained local medical resources. The table below displays COVID-19 confirmed cases and vaccination rates as of December 3, 2020.

[68] CDC. June 2009. "Novel H1N1 Flu Situation Update." https://www.cdc.gov/h1n1flu/updates/061209.htm.
[69] Donahue M, Hendrickson B, Julian D, et al. Multistate Mumps Outbreak Originating from Asymptomatic Transmission at a Nebraska Wedding — Six States, August–October 2019. MMWR Morb Mortal Wkly Rep 2020;69:666–669. DOI: http://dx.doi.org/10.15585/mmwr.mm6922a2external icon.

Table 92: COVID-19 in the Planning Area

County	Overall Positive Cases	% of Population 5+ Fully Vaccinated
Boone	833	53%
Custer	1,627	39%
Garfield	308	40%
Greeley	315	44%
Howard	844	47%
Loup	70	44%
Nance	609	39%
Platte	6,294	56%
Sherman	451	45%
Valley	578	42%
Wheeler	93	33%

Source: Nebraska DHHS COVID-19 Dashboard, December 21, 2021

According to the historical occurrences of diseases over the last three years, the most likely types of epidemics will be influenza A, emerging infectious diseases such as Ebola and Zika, antibiotic resistant infections, healthcare-related bloodstream infections, opioid overdoses, hunting and agricultural animal pathogens, tick and mosquito transmitted infections, and communicable diseases such as COVID-19.

PROBABILITY

There is no pattern as to when public health emergencies will occur. Based on historical records, it is likely that small-scale disease outbreaks will occur annually within the planning area. However, large scale emergency events (such as seen with COVID-19) cannot be predicted.

COMMUNITY TOP HAZARD STATUS

The following table lists jurisdictions which identified Public Health Epidemic as a top hazard of concern:

Table 93: Public Health Epidemic Top Concern by Community

Jurisdictions	
Belgrade	Elba
Cushing	Loup Basin Public Health Department

REGIONAL VULNERABILITIES

Health care access is critical for those exposed to acute infectious diseases. In the LLNRD, Custer, Howard, Valley, Boone, Nance, and Platte Counties have hospital and satellite clinic facilities. Garfield, Greeley, and Sherman Counties have access only to satellite healthcare clinics. There are no hospitals or satellite clinics in Wheeler and Loup Counties.

An independent study conducted in 2019 by Trust for America's Health gave Nebraska a score of six out of ten for their efforts to reduce vulnerability to the spread of infectious diseases. The report noted: "Nebraska's public health outcomes stack up unevenly against those of the United States, but it has taken several steps that strengthened its preparedness for public health emergencies. Deaths owed to drug misuse, alcohol, or suicide trail the country as a whole. Its rates of obesity and related conditions indicate a mixed picture, with the percentage of adults with obesity higher than the U.S. median, even as rates of diabetes and hypertension rank low. Finally, the state achieved a score of six out of a possible 10 measures of public health preparedness for

diseases, disasters, and bioterrorism." The following figure describes Nebraska's overall statistics.

Figure 74: Trust for America Public Health Statistics

Source: Trust for America's Health, 2019

Table 94: Regional Public Health Emergency Vulnerabilities

Sector	Vulnerability
People	-Vulnerable populations include the very young, the very old, the unvaccinated, the economically vulnerable, and those with immunodeficiency disorders or other comorbidities. -Institutional settings such as prisons, dormitories, long-term care facilities or health care facilities, meat-packing plants, daycares, and schools are at higher risk to contagious diseases -Poverty, rurality, underlying health conditions, and drug or alcohol use increase chronic and infectious disease rates
Economic	-Large scale or prolonged events may cause businesses to close, which could lead to significant revenue loss and loss of income for workers
Built Environment	None
Infrastructure	-Transportation routes may be closed if a quarantine is put in place -Healthcare facilities in the planning area may be overwhelmed quickly by widespread events
Critical Facilities	-Healthcare facilities in the planning area may be overwhelmed quickly by widespread events -Critical facilities could see suspended action or reduced resources due to sick staff
Climate	-Climate change impacts on extreme weather, air quality, transmission of disease via insects and pests, food security, and water quality increase threats of disease
Other	-Long-term public health emergencies can have negative impacts on resident's mental health

SEVERE THUNDERSTORMS

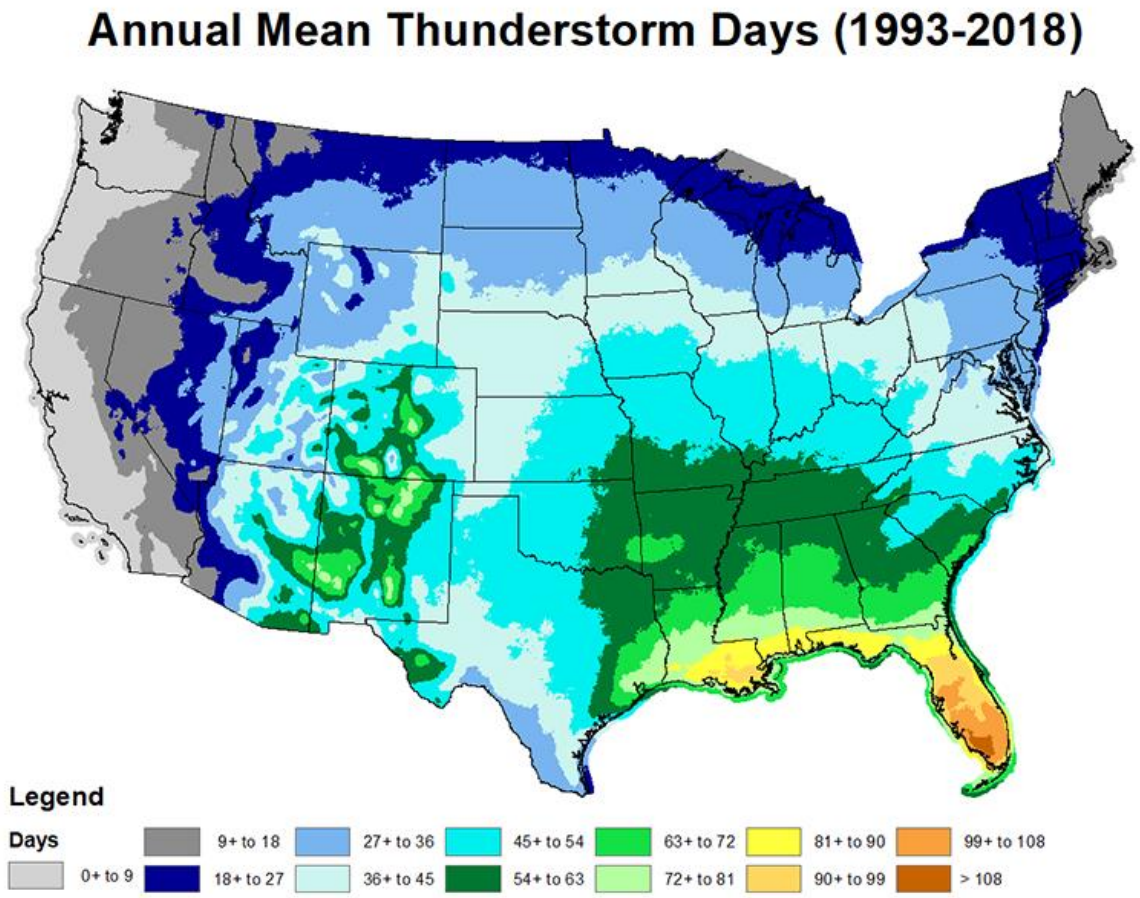
Severe thunderstorms are common and unpredictable seasonal events throughout Nebraska. A thunderstorm is defined as a storm that contains lightning and thunder, which is caused by unstable atmospheric conditions. When the upper air, which is cold, sinks and the warm, moist air rises, storm clouds or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

Thunderstorms can develop in less 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 be harmful to humans and animals, cause fires to buildings and agricultural lands, and cause 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, it is when lightning comes in contact with the ground that society is potentially impacted. Lightning generally occurs when warm air is mixed with colder air masses resulting in atmospheric disturbances necessary for polarizing the atmosphere.

Economically, thunderstorms are generally beneficial in that they provide moisture necessary to support Nebraska’s largest industry, agriculture. The majority of thunderstorms do not cause damage, but when they escalate to the point of becoming severe, the potential for damages include crop losses from wind and hail, property losses due to building and automobile damages due to hail, wind, or flash flooding, and death or injury to humans and animals from lightning, drowning, or getting struck by falling or flying debris. Figure 75 displays the average number of days with thunderstorms across the country each year. The planning area experiences an average of 36 to 45 thunderstorms over the course of one year.

Figure 75: Average Number of Thunderstorms

Figure 76: Average Annual Thunderstorms



Source: NWS, 2018[70]

LOCATION

The entire 11-county planning area is at risk of severe thunderstorms and associated damages from heavy rain, lightning, hail, and thunderstorm level winds.

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 95 outlines the TORRO Hail Scale.

Table 95: TORRO Hail Ranking

Class	Type of Material	Divisions
H0: Hard Hail	5 mm; 0.2 in	No damage

[70] National Weather Service. 2020. "Global Weather: Introduction to Thunderstorms." https://www.weather.gov/jetstream/tstorms_intro#:~:text=It%20is%20estimated%20that%20there,its%20share%20of%20thunderstorm%20occurrences.

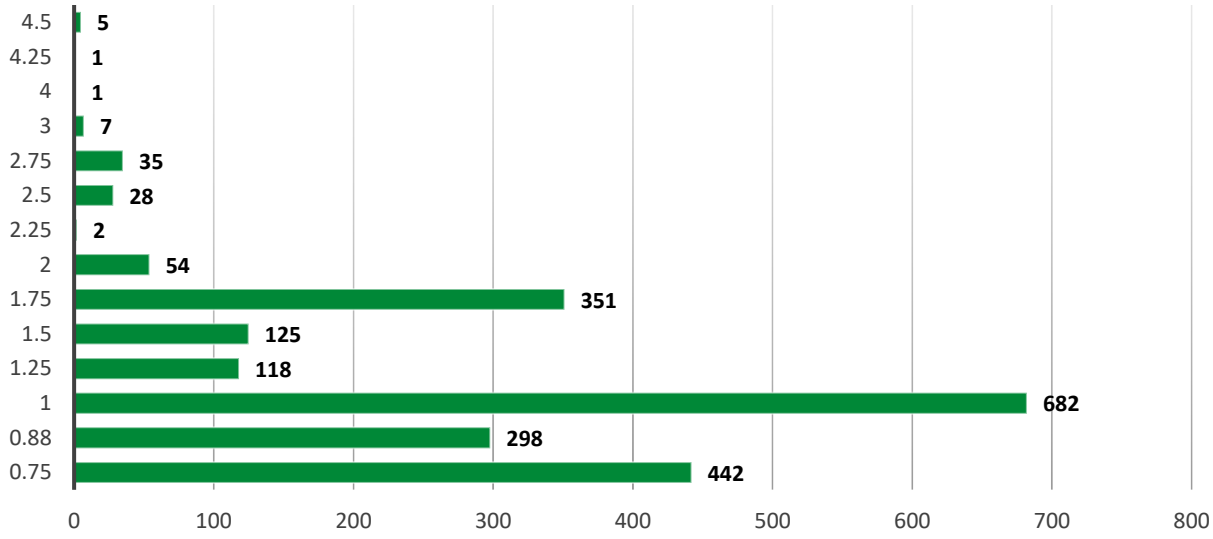
Class	Type of Material	Divisions
	(pea size)	
H1: Potentially Damaging	5-15 mm; 0.2-0.6in (marble)	Slight general damage to plants and crops
H2: Significant	10-20 mm; 0.4-0.8 in (grape)	Significant damage to fruit, crops, and vegetation
H3: Severe	20-30 mm; 0.8-1.2 in (walnut)	Severe damage to fruit and crops, damage to glass and plastic structures
H4: Severe	30-40mm; 1.2-1.6 in (squash ball)	Widespread damage to glass, vehicle bodywork damaged
H5: Destructive	40-50 mm; 1.6-2.0 in (golf ball)	Wholesale destruction of glass, damage to tiled roofs; significant risk of injury
H6: Destructive	50-60 mm; 2.0-2.4 in (chicken egg)	Grounded aircrafts damaged, brick walls pitted; significant risk of injury
H7: Destructive	60-75 mm; 2.4-3.0 in (tennis ball)	Severe roof damage; risk of serious injuries
H8: Destructive	75-90 mm; 3.0-3.5 in (large orange)	Severe damage to structures, vehicles, airplanes, risk of serious injuries
H9: Super Hail	90-100 mm; 3.5-4.0 in (grapefruit)	Extensive structural damage, risk of severe or even fatal injuries to persons outdoors
H10: Super Hail	>100 mm; >4 in (melon)	Extensive structural damage; risk of severe or even fatal injuries to persons outdoors.

Source: TORRO, 2017[71]

The NCEI reported 2,149 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 1.19 inches. Events of this magnitude correlate to an H3 Severe classification. It is reasonable to expect H3 classified events to occur several times in a year throughout the planning area. In addition, it is reasonable, based on the number of occurrences, to expect larger hailstones to occur in the planning area annually. The planning area has endured seven H10 hail events (>4.0 inches) during the period of record. Figure 77 shows hail events based on the size of the hail.

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

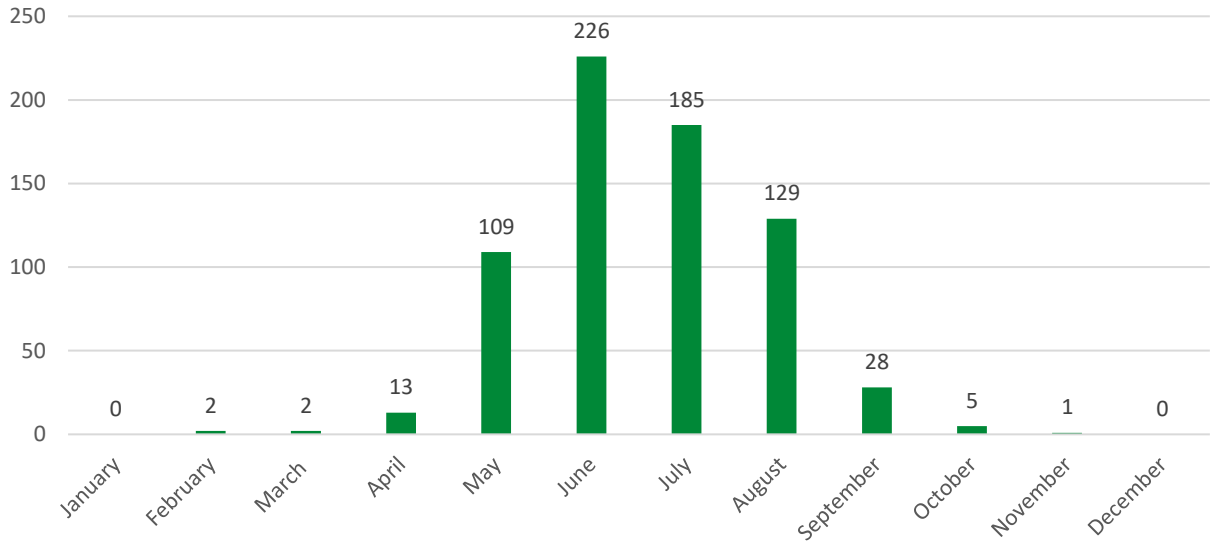
Figure 77: Hail Events by Magnitude



HISTORICAL OCCURRENCES

Severe thunderstorms in the planning area usually occur in the afternoon and evening during the spring and summer months (Figure 78).

Figure 78: Thunderstorm Wind Events by Month



Source: NCEI

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 700 thunderstorm wind, 63 heavy rain, 17 lightning, and 2,149 hail events in the planning area from January 1996 to December 2020. In total these events were responsible for $44,464,500 in property damages. The USDA RMA data does not specify severe

thunderstorms as a cause of loss, however heavy rains and hail which may be associated with severe thunderstorms caused $190,737,306 in crop damages. There were three injuries but no fatalities reported in association with these storm events.

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 nearly $2 million per year in property damages and over $9 million per year in crop damages.

Table 96: 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	2,148	86	$28,886,800	$1,155,472	$197,737,306	$9,416,062
Heavy Rain	63	3	$565,000	$22,600		
Lightning	17	0.7	$569,000	$22,760		
Thunderstorm Wind	700	28	$15,577,700	$623,108		
Total	**2,928**	**117**	**$45,598,500**	**$1,823,940**	**$197,737,306**	**$9,416,062**

1 Indicates the data is from NCEI (January 1996 to December 2020); 2 Indicates data is from USDA RMA (2000 to 2020)

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 severe thunderstorm event (hail, lightning, heavy rain, or thunderstorm winds) in every year on record (1996-2020), resulting in 100 percent chance annually for thunderstorms.

COMMUNITY TOP HAZARD STATUS

The following table lists jurisdictions which identified Severe Thunderstorms as a top hazard of concern:

Table 97: Severe Thunderstorms Top Concern by Community

Jurisdictions	
Albion and Albion Fire	Genoa
Ansley	Greeley County
Arcadia	Hazard
Arnold	Howard County
Ashton	Litchfield
Belgrade	Loup City
Berwyn	Loup County
Boelus	Loup Basin Public Health Department
Boone County	Nance County
Burwell	Oconto
Callaway	Ord
Cedar Rapids	Petersburg
Columbus	Platte County

Jurisdictions	
Cotesfield	Rockville
Cushing	Scotia
Custer County	Sherman County
Dannebrog	Spalding
Duncan	St. Edward
Duncan Fire District	St. Paul
Elba	Taylor
Ericson	Valley County
Farwell	Wheeler Central Schools
Fullerton	Wolbach
Garfield County	

REGIONAL VULNERABILITIES

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

Table 98: Regional Thunderstorm Vulnerabilities

Sector	Vulnerability
People	-Elderly citizens with decreased mobility may have trouble evacuating or seeking shelter -Mobile home residents are at risk of injury and damage to their property if the mobile home is not properly anchored -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 lighting can cause power outages and down power lines -Roads may wash out from heavy rains and become blocked from downed tree limbs
Critical Facilities	-Power outages are possible -Critical facilities may sustain damage from hail, lightning, and wind
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 inhibits 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 causing structural damage to buildings.

Extreme Cold

Along with snow and ice storm events, extreme cold can be dangerous to the well-being of people and animals. What constitutes extreme cold varies from region to region, but is generally accepted as being 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 14.3°F). The average high temperatures for the months of January, February, and December are near 37.0°F.

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 ice falls in the form of rain 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 rail 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, and causing structural damage to buildings.

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. Ice Storm Warnings are issued when accumulation of at least 0.25 inches is expected from a storm, which controlling for high winds, would tend to classify ice storms in Nebraska as SPIA Level 2 or higher. The most common accumulation during ice storms was a quarter of an inch. The following figure shows the SPIA index.

Figure 79: SPIA Index

The Sperry-Piltz Ice Accumulation Index, or "SPIA Index"

Copyright, February, 2009

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	

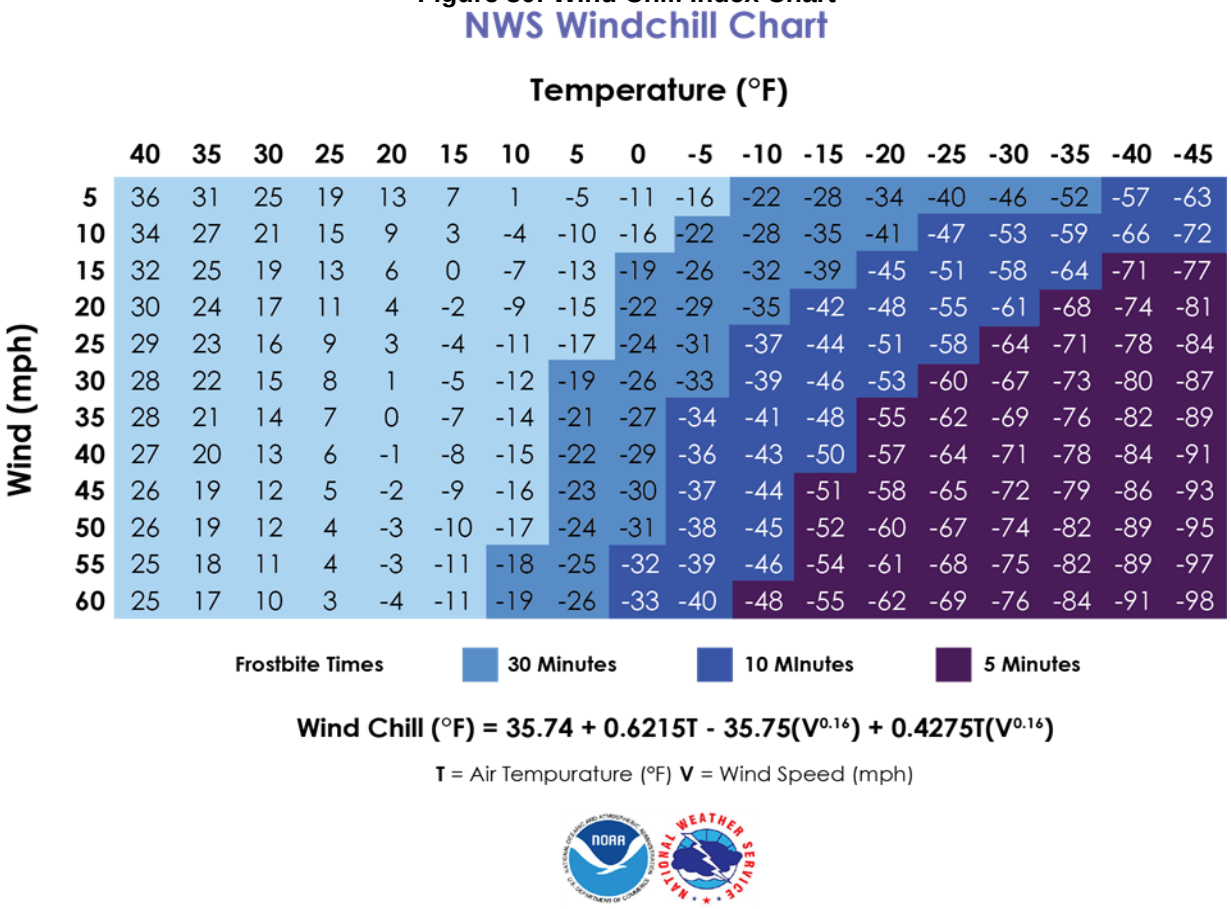
(Categories of damage are based upon combinations of precipitation totals, temperatures and wind speeds/directions.)

Source: SPIA-Index[72]

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 28 shows the wind chill index used by the NWS.

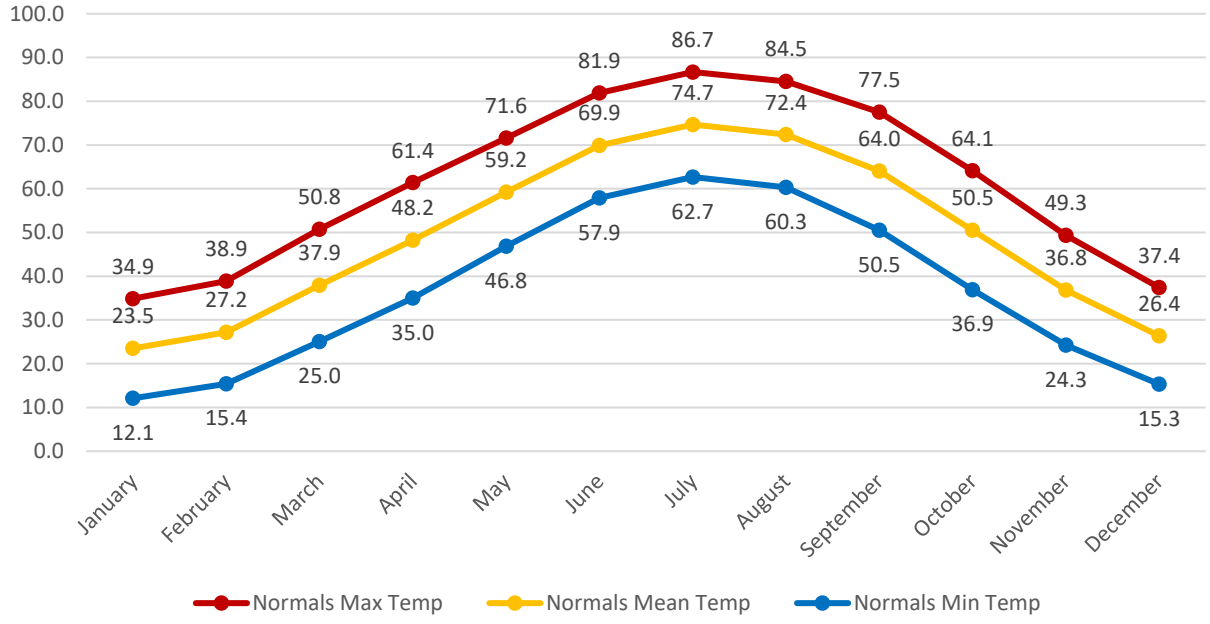
[72] SPIA-Index. 2009. "Sperry-Piltz Ice Accumulation Index." https://www.spia-index.com/.

Figure 80: Wind Chill Index Chart



Source: NWS

Figure 81: Monthly Normal Temperature (1991-2020)



Source: NCEI

For the planning area, the coldest months of the year are January, February, and December and normal lows for these months average 14.3°F.

HISTORICAL OCCURRENCES

Figure 82: Snow Clearing in Greeley County

Due to the regional scale of severe winter storms, the NCEI reports events as they occur in each county. According to the NCEI, there was a combined 840 severe winter storm events for the planning area from January 1996 to December 2020. These recorded events caused a total of $12,043,000 in property damages, one fatality, and one injury.

The most damaging event was a winter storm event in 2006 which caused $8,000,000 in damages in Boone County. The NCEI noted the following from this event: *Freezing rain accumulated over 1 inch over most of Boone county on trees, power lines, vehicles and other untreated objects. The weight of the ice, and a mix of light sleet and snow that fell briefly late Saturday night, caused widespread tree damage and also felled numerous power lines and power poles. Fallen trees also caused damage to cars and houses. Many towns in Boone county lost power, some for days. The storm caused an estimated 8 million dollars worth of damage to Utility companies.*

An ice storm in 1998 reported one fatality in Custer County and a winter storm event in 1996 led to one injury in Custer County. NCEI descriptions of these events are below:

- *Ice Storm – 3/16/1998*
  A 52 year old man was found frozen to death in his garage in Arnold Ne., Custer County on the 18th. Power lines whipped by the high winds caused 200k damage to a power substation in Broken Bow, Custer Co.
- *Winter Storm – 1/17/1996*
  Periods of freezing drizzle caused several accidents due to icy roads. One of the accidents involved an injury in which a following vehicle slid into a vehicle slowing to make a turn.

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 $953,740 per year in property damages and $353,093 per year in crop damage for the planning area.

Table 99: Severe Winter Storms 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
Blizzard	111	4.4	$4,529,500	$181,180	$7,414,950	$353,093
Extreme Cold	63	2.5	$0	$0		

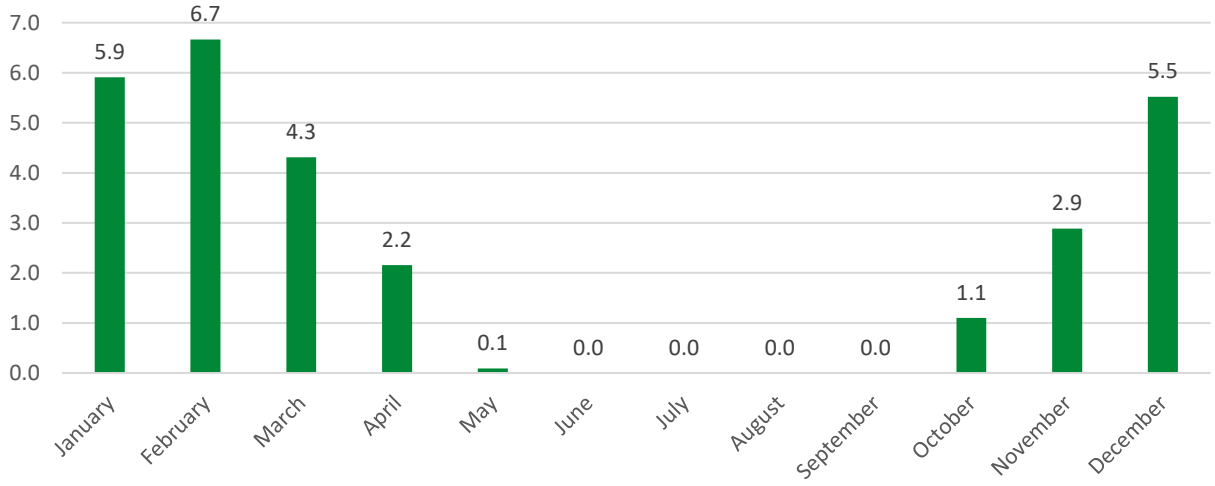
Hazard Type	Number of Events[1]	Average # events per year	Total Property Loss[1]	Average Annual Property Loss	Total Crop Loss[2]	Average Annual Crop Loss
Heavy Snow	56	2.2	$0	$0		
Ice Storms	40	1.6	$6,961,000	$278,440		
Winter Storms	401	16	$12,328,000	$493,120		
Winter Weather	169	6.8	$25,000	$1,000		
Total	**840**	**33.5**	**$23,843,500**	**$953,740**	**$7,414,950**	**$353,093**

1 Indicates the data is from NCEI (January 1996 to December 2020); 2 Indicates data is from USDA RMA (2000 to 2020)

PROBABILITY

Average monthly snowfall for the planning area is shown in Figure 83, which shows the snowiest months are between December and March. A common snow event (likely to occur annually) will result in accumulation totals between one and three 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 83: Monthly Normal Snowfall in Inches (1997-2020)



Source: High Plains Regional Climate Center

Based on the historical record and reported events, severe winter storms are likely to occur on an annual basis. The NCEI reported a severe winter storm event (blizzard, extreme cold, heavy snow, ice storms, winter storms, or winter weather) in every year on record (1996-2020), resulting in 100 percent chance annually for severe winter storms.

COMMUNITY TOP HAZARD STATUS

The following table lists jurisdictions which identified Severe Winter Storms as a top hazard of concern:

Table 100: Severe Winter Storms Top Concern by Community

Jurisdictions	
Albion and Albion Fire	Genoa
Arcadia	Greeley County
Arnold	Hazard
Ashton	Litchfield
Bartlett	Loup Basin Public Health Department
Belgrade	Mason City
Berwyn	Nance County
Boelus	Oconto
Boone County	Ord
Burwell	Petersburg
Callaway	Platte County
Columbus	Primrose
Cotesfield	Rockville
Cushing	Sargent
Dannebrog	Scotia
Duncan	Sherman County
Duncan Fire District	Spalding
Elba	St. Paul
Farwell	Wheeler County
Fullerton	Wolbach
Garfield County	

REGIONAL VULNERABILITIES

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

Table 101: Regional Severe Winter Storm Vulnerabilities

Sector	Vulnerability
People	-Elderly citizens at higher risk of 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.
Climate	-Changes in seasonal precipitation and temperature normals can increase frequency and magnitude of severe storm events.

TERRORISM

According to the Federal Bureau of Investigation (FBI), there is no single, universally accepted, definition of terrorism. Terrorism is defined in the Code of Federal Regulations as "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 a political or social objectives" (28 C.F.R. Section 0.85).

The FBI further describes terrorism as either domestic or international, depending on the origin, base, and objectives of the terrorist organization. For the purpose of this report, the following definitions from the FBI will be used:

- Domestic terrorism is the unlawful use, or threatened use, of force or violence by a group or individual based and operating entirely within the United States or Puerto Rico without foreign direction committed against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof in furtherance of political or social objectives.

- International terrorism involves violent acts or acts dangerous to human life that are a violation of the criminal laws of the United States or any state, or that would be a criminal violation if committed within the jurisdiction of the United States or any state. These acts appear to be intended to intimidate or coerce a civilian population, influence the policy of a government by intimidation or coercion, or affect the conduct of a government by assassination or kidnapping. International terrorist acts occur outside the United States or transcend national boundaries in terms of the means by which they are accomplished, the persons they appear intended to coerce or intimidate, or the locale in which their perpetrators operate or seek asylum.

There are different types of terrorism depending on the target of attack, which are

- Political Terrorism
- Bio-Terrorism
- Cyber-Terrorism
- Eco-Terrorism
- Nuclear-Terrorism
- Narco-terrorism
- Agro-terrorism

Terrorist activities are also classified based on motivation behind the event such as ideology (i.e. religious fundamentalism, national separatist movements, and social revolutionary movements). Terrorism can also be random with no ties to ideological reasoning.

The FBI also provides clear definitions of a terrorist incident and prevention:

- A terrorist *incident* is a violent act or an act dangerous to human life, in violation of the criminal laws of the United States, or of any state, to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives.

- Terrorism *prevention* is a documented instance in which a violent act by a known or suspected terrorist group or individual with the means and a proven propensity for violence is successfully interdicted through investigative activity.

Note: The FBI investigates terrorism-related matters without regard to race, religion, national origin, or gender. Reference to individual members of any political, ethnic, or religious group in this report is not meant to imply that all members of that group are terrorists. Terrorists represent a small criminal minority in any larger social context.

Primarily, threat assessment, mitigation and response to terrorism are federal and state directives and work primarily with local law enforcement. The Office of Infrastructure Protection within the Federal Department of Homeland Security is a component within the National Programs and Protection Directorate.

The Office of Infrastructure Protection leads the coordinated national program to reduce and mitigate risk within 18 national critical infrastructure and key resources (CIKR) sectors from acts of terrorism and natural disasters and to strengthen sectors' ability to respond and quickly recover from an attack or other emergency. This is done through the National Infrastructure Protection Plan (NIPP).

Under the NIPP, a Sector-Specific Agency (SSA) is the federal agency assigned to lead a collaborative process for infrastructure protection for each of the 18 sectors. The NIPP's comprehensive framework allows the Office of Infrastructure Protection to provide the cross-sector coordination and collaboration needed to set national priorities, goals, and requirements for effective allocation of resources. More importantly, the NIPP framework integrates a broad range of public and private CIKR protection activities.

The SSAs provide guidance about the NIPP framework to state, tribal, territorial and local homeland security agencies and personnel. They coordinate NIPP implementation within the sector, which involves developing and sustaining partnerships and information-sharing processes, as well as assisting with contingency planning and incident management.

The Office of Infrastructure Protection has SSA responsibility for six of the 18 CIKR sectors. Those six are:

- Chemical
- Commercial Facilities
- Critical Manufacturing
- Dams
- Emergency Services
- Nuclear Reactors, Materials and Waste

SSA responsibility for the other 12 CIKR sectors is held by other Department of Homeland Security components and other federal agencies. Those 12 are:

- Agriculture and Food – Department of Agriculture; Food and Drug Administration
- Banking and Finance – Department of the Treasury
- Communications – Department of Homeland Security
- Defense Industrial Base – Department of Defense
- Energy – Department of Energy
- Government Facilities – Department of Homeland Security
- Information Technology – Department of Homeland Security
- National Monuments and Icons – Department of the Interior
- Postal and Shipping – Transportation Security Administration
- Healthcare and Public Health – Department of Health and Human Services
- Transportation Systems – Transportation Security Administration; U.S. Coast Guard
- Water – Environmental Protection Agency

The NIPP requires that each SSA prepare a Sector-Specific Plan, review it annually, and update it as appropriate.

The Department of Homeland Security and its affiliated agencies are responsible for disseminating any information regarding terrorist activities in the country. The system in place is the National Terrorism Advisory System (NTAS). NTAS replaced the Homeland Security Advisory System (HSAS) which was the color coded system put in place after the September 11th attacks by Presidential Directive 5 and 8 in March of 2002. NTAS replaced HSAS in 2011.

NTAS is based on a system of analyzing threat levels and providing either an imminent threat alert or an elevated threat alert.

An ***Imminent Threat Alert*** warns of a credible, specific and impending terrorist threat against the United States.

An ***Elevated Threat Alert*** warns of a credible terrorist threat against the United States.

The Department of Homeland Security, in conjunction with other federal agencies, will decide whether a threat alert of one kind or the other should be issued should credible information be available. Each alert provides a statement summarizing the potential threat and what, if anything should be done to ensure public safety.

The NTAS Alerts will be based on the nature of the threat: in some cases, alerts will be sent directly to law enforcement or affected areas of the private sector, while in others, alerts will be issued more broadly to the American people through both official and media channels.

An individual threat alert is issued for a specific time period and then automatically expires. It may be extended if new information becomes available or the threat evolves. The ***sunset provision*** contains a specific date when the alert expires as there will not be a constant NTAS Alert or blanket warning that there is an overarching threat. If threat information changes for an alert, the Secretary of Homeland Security may announce an updated NTAS Alert. All changes, including the announcement that cancels an NTAS Alert, will be distributed the same way as the original alert.

LOCATION

Terrorist activities could occur throughout the entire planning area. In rural areas, concerns are primarily related to agro-terrorism and tampering with water supplies. In urban areas, concerns are related to political unrest, activist groups, and others that may be targeting businesses, police, and federal buildings.

EXTENT

Terrorist attacks can vary greatly in scale and magnitude, depending on the location, method, and target of the attack. Previous terrorist attacks in the planning area have been limited to primarily individual private property.

HISTORICAL OCCURRENCES

Previous accounts of terrorism in the planning area were gathered from the Global Terrorism Database, maintained by the University of Maryland and the National Consortium for the Study of Terrorism and Responses to Terrorism (START). This database contains information for over 140,000 terrorist attacks. According to this database, there have been three terrorist incidents since 1970 within the planning area. These incidents are related to one event. Between May 3-7, 2002, a college student placed eighteen pipe bombs in rural mailboxes throughout five Midwestern states, causing seven injuries and widespread panic in the region. The bombs placed

in mailboxes in the planning area did not detonate, and no injuries were suffered. The attacks were meant to bring attention to the perpetrator's antigovernment sentiment.

Table 102: Terrorist Incidents in the Planning Area

Date	Location	Perpetrator Group	Fatalities	Injuries	Target	Property Damage
5/4/2002	Scotia	Individual	0	0	US Mail Boxes	None
5/4/2002	Columbus	Individual	0	0	US Mail Boxes	None
5/4/2002	Albion	Individual	0	0	US Mail Boxes	None

Source: START Global Terrorism Database, 1970-2017, http://www.start.umd.edu/gtd/

Threat assessment, mitigation, and response to terrorism are federal and state directives that work in conjunction with local law enforcement. Terroristic events are addressed at the federal level by the U.S. Department of Homeland Security and at the state level by the Nebraska Emergency Management Agency.

AVERAGE ANNUAL DAMAGES

The average damage per event estimate was determined based upon the START Global Terrorism Database information since 1970. This does not include losses from displacement, functional downtime, or economic loss. It should also be noted that none of the pipe bombs detonated, therefore there were no reported damages. If a terrorist event were to occur in the planning area, damages can range from minimal (in rural areas, <$1 million) to significant (in metropolitan areas, >$10 million).

Table 103: Terrorism Incidents Loss Estimate

Hazard Type	Number of Events	Average Number of Events Per Year	Total Property Loss	Annual Property Loss	Total Crop Loss	Annual Crop Loss
Terrorism	3	<0.1	$0	$0	$0	$0

Source: START Global Terrorism Database, 1970-2017

PROBABILITY

Given one year with reported terrorism incidents over the course of 48 years, the annual probability for terrorism in the planning area is reported as less than one percent annually. This does not indicate that a terrorist event will occur with that frequency within the planning area as terrorist events are typically clustered in timeframe due to extenuating circumstances.

COMMUNITY TOP HAZARD STATUS

The following table lists jurisdictions which identified Terrorism as a top hazard of concern:

Table 104: Terrorism Top Concern by Community

Jurisdictions	
Farwell Irrigation District	Mason City
Garfield County	

REGIONAL VULNERABILITIES

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

Table 105: Regional Terrorism Vulnerabilities

Sector	Vulnerability
People	-Police officers and first responders at risk of injury or death -Media personnel at risk
Economic	-Damaged businesses can cause loss of revenue and loss of income for workers -Agriculture attacks could cause significant economic losses for the region
Built Environment	-Targeted buildings may sustain heavy damage
Infrastructure	-Water supply, power plants, utilities all at risk of damage
Critical Facilities	-Police stations and governmental offices are at higher risk
Climate	-Activism pertaining to climate can place first responders and residents at risk

TORNADOES AND HIGH WINDS

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.

Figure 84: Supercell near Burwell NE, 2014

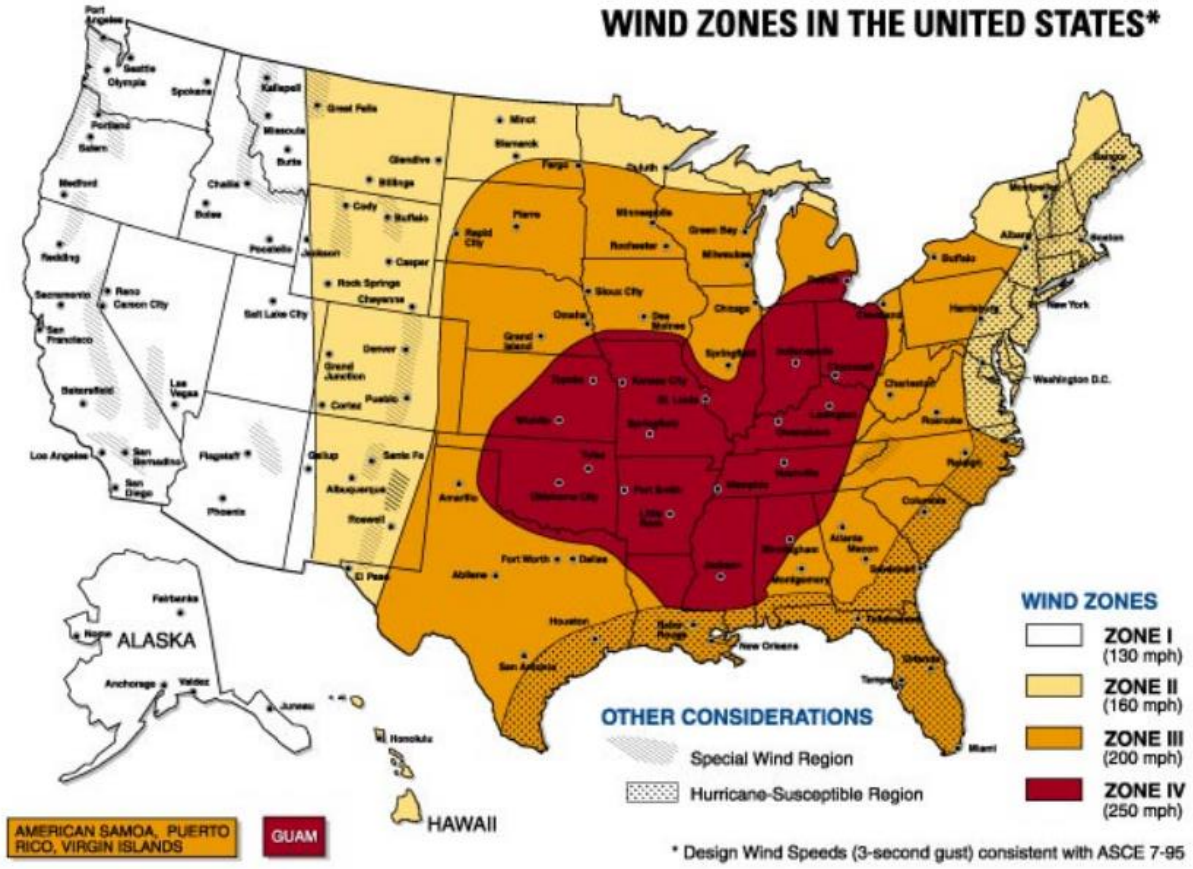
The National Weather Service (NWS) defines high winds as sustained wind speeds of 40 mph or greater lasting for 1 hour or longer, or winds of 58 mph or greater for any duration.[73] The NWS issues High Wind Advisories when there are sustained winds of 25 to 39 miles per hour and/or gusts to 57 mph. Figure 85 shows the wind zones in the United States. The wind zones are based on the maximum wind speeds that can occur from a tornado or hurricane event. The planning area is located in Zone III which has maximum winds of 200 mph equivalent to an EF4/5 tornado.

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

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

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

Figure 85: Wind Zones in the U.S.

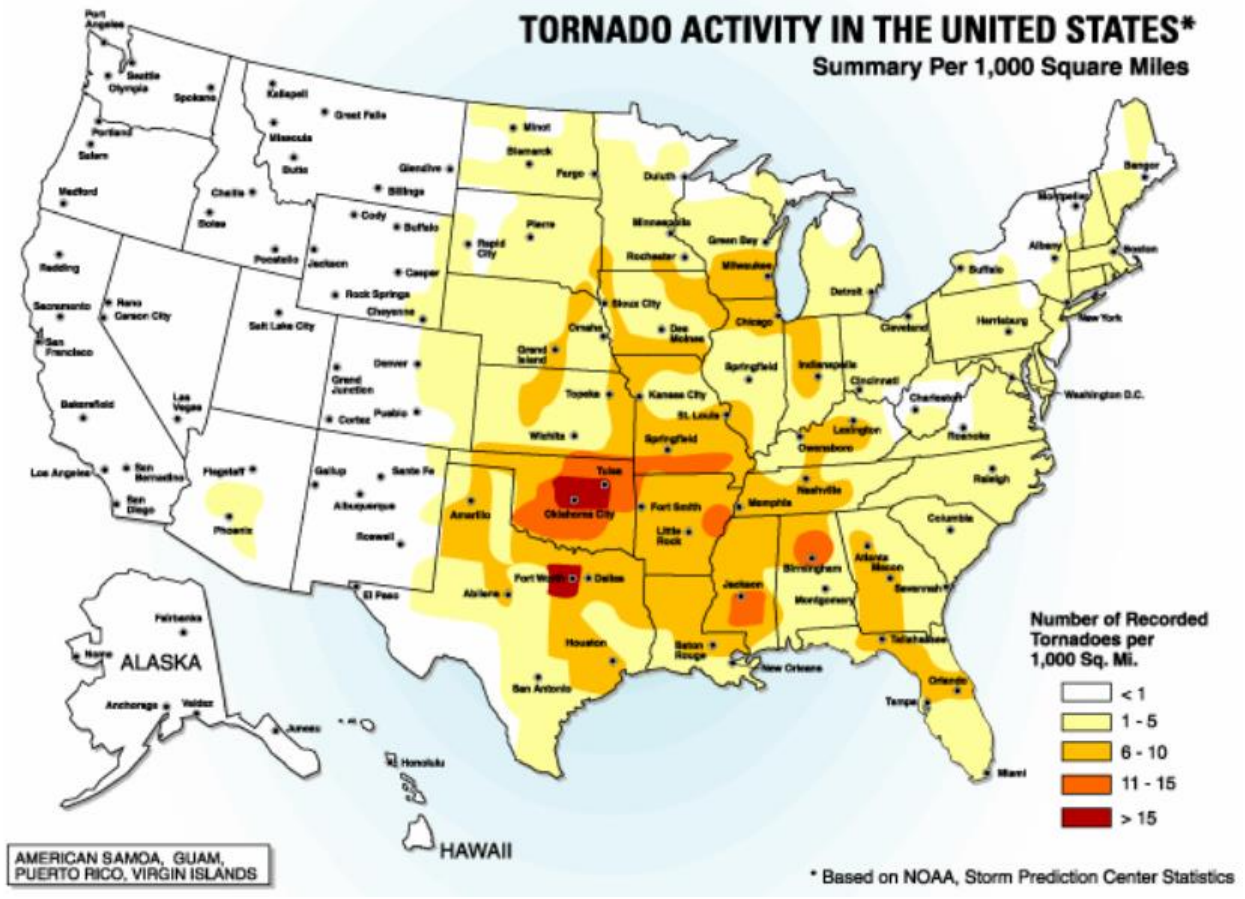


Source: FEMA

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 1,000 tornadoes are reported annually in the contiguous United States (NOAA 2012). Tornadoes can travel distances over 100 miles and reach over 11 miles above ground. Tornadoes usually stay on the ground no more than 20 minutes. Nationally, the tornado season typically occurs between April and July. On average, 80 percent of tornadoes occur between noon and midnight. In Nebraska, 77 percent of all tornadoes occur in the months of May, June, and July.

Nebraska is ranked fifth in the nation for tornado frequency with an annual average of 57 tornadoes between 1991 and 2020.

Figure 86: Tornado Activity in the United States

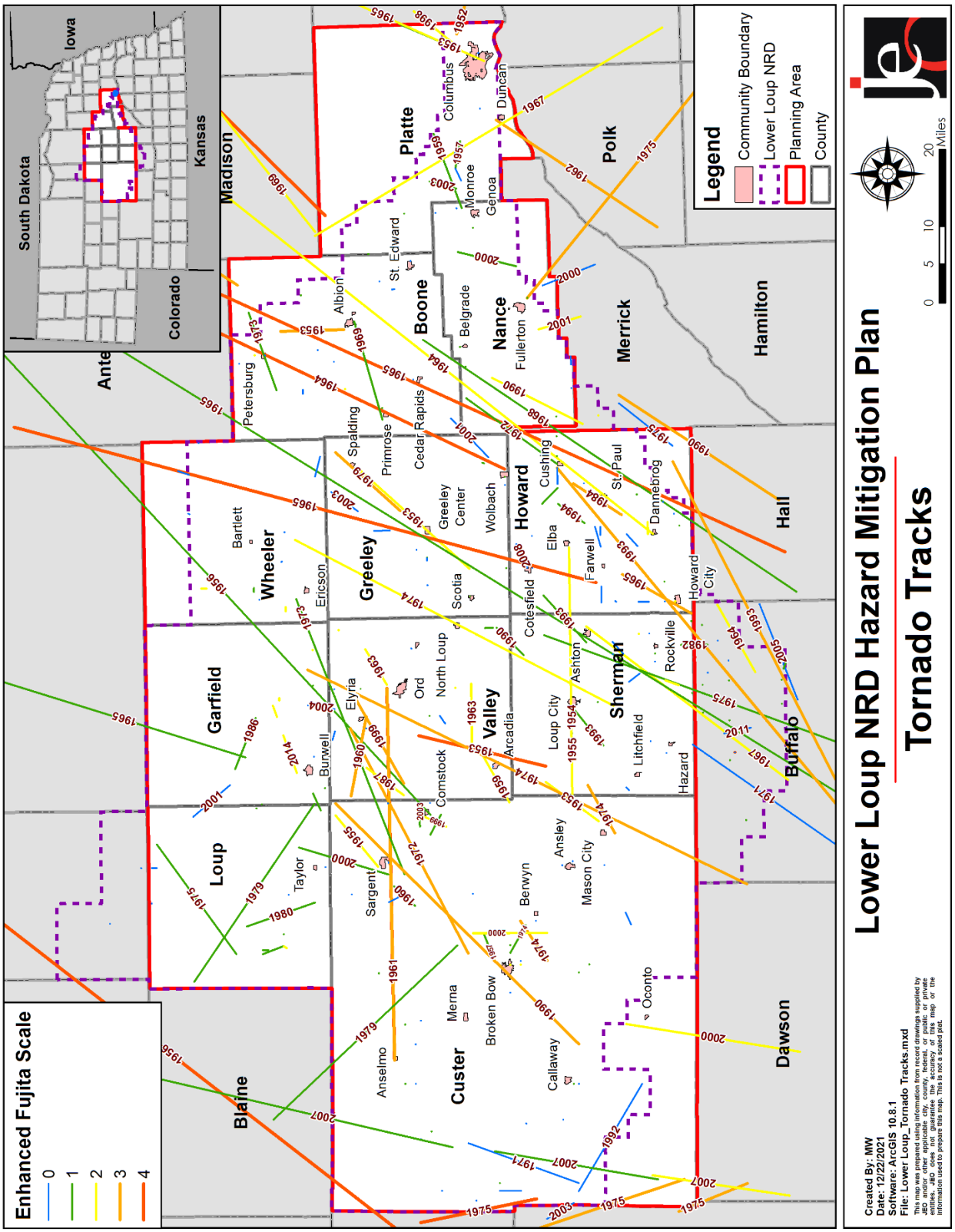


Source: FEMA

LOCATION

High winds and tornadoes can occur throughout the planning area. The impacts would be greater in more densely populated areas, such as Columbus or Albion. The following map shows the historical track locations across the region 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 11-county planning area.

Figure 87: 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. The following table outlines the Beaufort scale including wind speed ranking, range of wind speeds per ranking, and a brief description of conditions for each.

Table 106: 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	39-49 mph	Breaks twigs off tree; generally, impedes progress
9	50-54 mph	Slight structural damage; chimneypots and slates removed
10	55-63 mph	Trees uprooted; considerable structural damages; improperly or mobiles homes with no anchors overturned
11	64-72 mph	Widespread damages; very rarely experienced
12 - 17	72 - > 200 mph	Hurricane; devastation

Source: Storm Prediction Center, 2017[74]

After a tornado passes through an area, an official rating category is determined, which provides a common benchmark that allows comparisons to be made between different tornadoes. The 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 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.[75]

[74] Storm Prediction Center: National Oceanic and Atmospheric Administration. 1805. "Beaufort Wind Scale." http://www.spc.noaa.gov/faq/tornado/beaufort.html.
[75] Kuligowski, E.D., Lombardo, F.T., Phan, L.T., Levitan, M.L., & Jorgensen, D.P. March 2014. "Final Report National Institute of Standards and Technology(NIST) Technical Investigation of the May 22, 2011, Tornado in Joplin, Missouri."

Table 107: Enhanced Fujita Scale

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

Source: NOAA; FEMA

Table 108: 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 homes (MHSW)	17	Low-rise (1-4 story) buildings
4	Double-wide mobile homes (MHDW)	18	Mid-rise (5-20 story) buildings
5	Apartment, condo, townhouse (3 stories or less)	19	High-rise (over 20 stories)
6	Motel	20	Institutional buildings (hospital, government, or university)
7	Masonry apartment or motel	21	Metal building systems
8	Small retail buildings (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

Number	Damage Indicator	Number	Damage Indicator
12	Large, isolated (“big box”) retail building	26	Free standing pole (light, flag, luminary)
13	Automobile showroom	27	Tree- hardwood
14	Automotive service building	28	Tree -softwood

Source: NOAA; FEMA

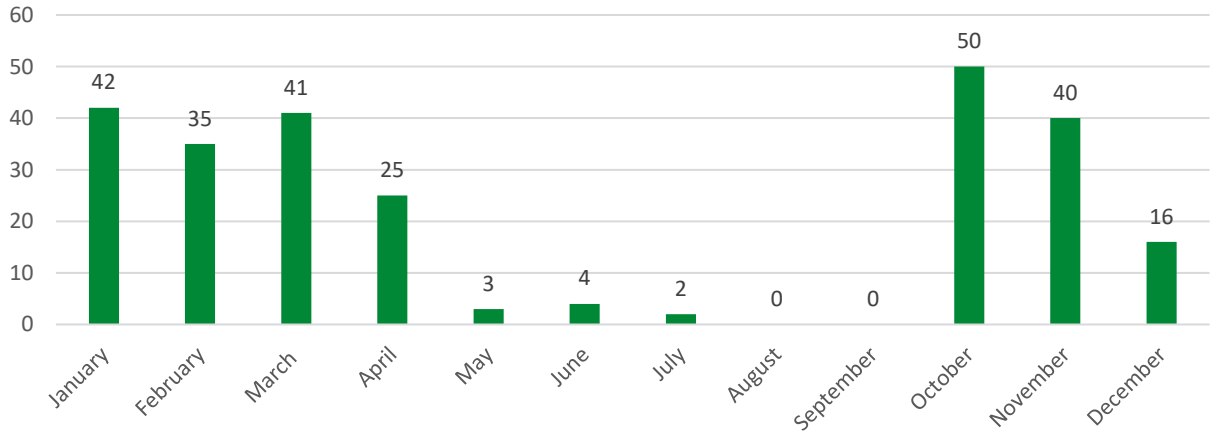
Using the NCEI reported events, the most common high wind event in the planning area is a level 8 on the Beaufort Wind Ranking scale. The reported high wind events ranged from 35 mph to 69 mph, with an average speed of 49 mph. Based on the historical record, it is most likely that tornadoes that occur within the planning area will be of EF0 strength. Of the 142 reported tornado events, 105 were EF/F0, 22 were EF/F1, 14 were EF/F2, and one event was F3.

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 258 high wind events that occurred between 1996 and 2020 and 142 tornadic events ranging from a magnitude of EF0 to F3. These events were responsible for $19,408,400 in property damages and $26,875,879 in crop damages. No deaths were reported; however, 19 injuries were cited over two events.

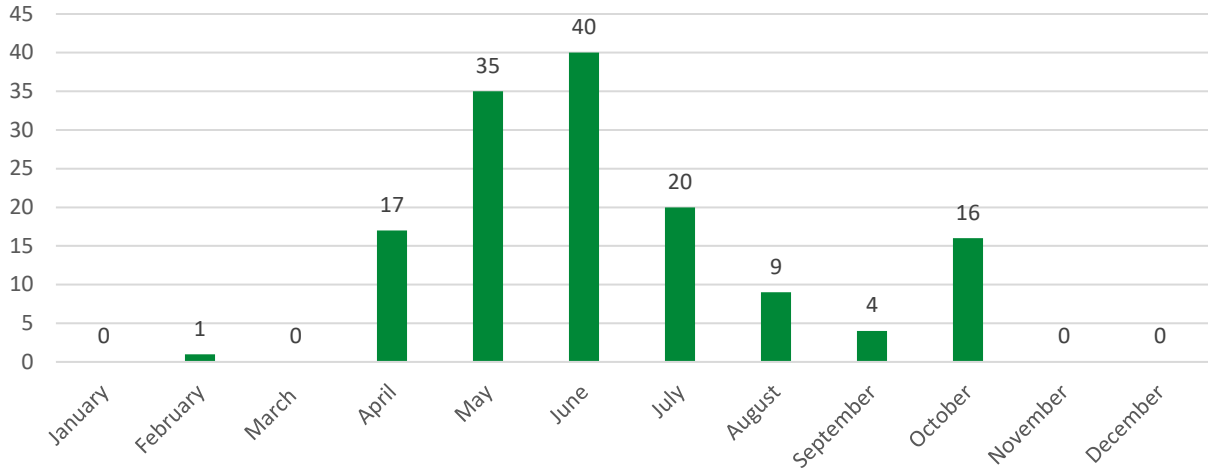
The most damaging tornado occurred in Platte County in 1998, causing $4 million in damages. This F2 tornado destroyed two farm houses, severely damaged six farm houses, overturned center pivots, and injured 17 people. As seen in the following figures, the majority of high wind events occur in the spring and winter months, while most tornado events occur in the summer.

Figure 88: High Wind Events by Month



Source: NCEI, 1996-2020

Figure 89: Tornado Events by Month



Source: NCEI, 1996-2020

Event descriptions from NCEI for the most damaging events (those including injuries, fatalities, or greatest property damage estimates) are provided below.

- **6/23/1998 Tornado –** 17 injuries, $4,000,000 in property damages. *Two farm houses destroyed. Six farm houses severely damaged. One house blown off foundation. Barn destroyed. Center pivots overturned. Severe crop damage.*
- **6/3/1999 Tornado -** $1,500,000 in property damages. *Late in the evening of June 3rd, a severe thunderstorm produced a large tornado across northwest Valley county. The thunderstorm entered the western part of the county around 11 pm. Shortly thereafter, the tornado touched down 12 miles west of Ord and snaked its way northeast before lifting after midnight about 7 miles north of Ord. This F3 tornado had a damage path almost one-half mile wide at one point. It completely destroyed two farmsteads and damaged two others along its path. At the two destroyed farmsteads, residents took shelter in the basement upon warning. The tornado tossed cars and farm equipment up to 300 feet, strewn irrigation pipe across the countryside and killed livestock. The two destroyed homes were completely wiped from the foundation. However, given sufficient warning, no one in the storms path was injured or killed.*
- **10/31/2000 Tornado -** $2,000,000 in property damages. *The tornado moved out of Dawson county into south central Custer county 7 miles south southwest of Oconto. The tornado traveled across open rangeland until destroying a modular home 1 mile south of Oconto. The tornado then moved directly through the small community of Oconto producing extensive damage. Every building along main street was either damaged or destroyed. A community center was destroyed while 19 children and 4 adults were in the basement. Over half the homes in the small town suffered minor to major damage. The community was declared a disaster areas by the governor. The tornado knocked down a power line 2 miles north of Oconto before lifting.*
- **7/12/2004 Tornado –** 2 injuries, $170,000 in property damages. *The tornado touched down in a cornfield and overturned a center pivot irrigation system as it moved west southwestwards. Nearby, large tree limbs were broken off and a roof was taken off an open detached garage at a farmstead. Then the tornado encountered a second farmstead where it lifted an unanchored manufactured home and smashed it on top of a camper trailer and a detached garage, destroying them. It also lifted a semi-trailer and dropped it*

onto a John Deere tractor and a pickup sitting next to it. Debris from the house and garage was carried into the cornfield to the west. The tornado continued moving west southwestwards breaking tree limbs before lifting. A husband, wife, and their daughter were inside the home when it was destroyed. The woman was hospitalized with a broken neck and the girl required numerous stitches from lacerations on her leg. The man only received minor cuts and bruises.

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 $244,416 per year in property damages and $1,277,568 per year in crop damages. Tornadoes have caused an average of over $531,920 per year in property damages; however, damages from tornadoes vary greatly depending on the severity or magnitude of each event.

Table 109: High Winds and Tornado Losses

Hazard Type	# of Events[1]	Average # events per year	Total Property Loss[1]	Average Annual Property Loss	Total Crop Loss[2]	Average Annual Crop Loss
High Winds	258	10.3	$6,110,400	$244,416	$26,828,922	$1,277,568
Tornadoes	142	5.7	$13,298,000	$531,920	$46,958	$2,236

Source: 1 NCEI (1996-2020), 2 USDA RMA (2000-2020)

PROBABILITY

Given the historic record of occurrence for high wind events (23 out of 25 years with reported events), for the purposes of this plan, the annual probability of wind event occurrence is 92 percent. However, high wind events may be more common than presented here but have simply not been reported in past years.

Given the historic record of occurrence for tornado events (24 out of 25 years with reported events), for the purposes of this plan, the annual probability of tornado occurrence is 96 percent. However, it is worth noting that data utilized during this analysis only encompassed through December 2020. Tornado events in 2021 were likely experienced in the planning area but were not reflected here.

COMMUNITY TOP HAZARD STATUS

The following table lists jurisdictions which identified Tornadoes as a top hazard of concern:

Table 110: Tornadoes Top Concern by Community

Jurisdictions	
Albion and Albion Fire	Garfield County
Anselmo	Genoa
Ansley	Hazard
Arcadia	Howard County
Arnold	Litchfield
Ashton	Loup City
Bartlett	Loup County

Jurisdictions	
Belgrade	Oconto
Berwyn	Ord
Boelus	Petersburg
Burwell	Platte County
Callaway	Primrose
Cedar Rapids	Rockville
Columbus	Sargent
Comstock	Scotia
Cotesfield	Sherman County
Cushing	Spalding
Custer County	St. Edward
Dannebrog	St. Paul
Duncan Fire District	Taylor
Elba	Wheeler County
Ericson	Wolbach
Fullerton	

REGIONAL VULNERABILITIES

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

Table 111: Regional Tornado and High Wind Vulnerabilities

Sector	Vulnerability
People	-Vulnerable populations include those living in mobile homes (especially if improperly anchored), nursing homes, schools, or in substandard housing -People outside during events -Citizens without access to shelter below ground or in reinforced rooms -Elderly with decreased mobility or poor hearing may be at higher risk -Lack of multiple ways to receive 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 events

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The primary focus of the mitigation strategy is to identify action items to reduce the effects and impacts from the identified top hazards of concern per community. These action items should help reduce impacts on existing infrastructure and property in a cost effective and technically feasible manner. Mitigation strategy development is also based upon the established Project Goals determined by the Regional Planning Team at the Kick-off meeting.

At the Kick-off Meeting the Regional Planning Team reviewed the goals from the 2017 HMP and discussed recommended additions and modifications. The intent of each goal and set of objectives is to develop strategies to account for risks associated with hazards and identify ways to reduce or eliminate those risks. Each goal and set of objectives is followed by 'mitigation alternatives,' or actions. Participating jurisdictions were provided a copy of the project goals at public meetings and through the project website to review and provide comments. For the purposes of this plan, all jurisdictions used the same goals.

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.*

GOALS

Below is the final list of goals as determined by the participants and Planning Team. These goals provide direction to guide participants in reducing future hazard related losses.

Goal 1: Protect Public Health and Safety from Hazard Events

Goal 2: Protect Existing and New Properties from Hazard Events

Goal 3: Increase Public Awareness and Education about Hazard Events

Mitigation Alternatives (Action Items)

After establishing the goals, mitigation actions were evaluated, updated, and prioritized for the 2022 plan. Alternatives considered included: the mitigation actions identified per community/jurisdiction in the previous plan; additional mitigation actions discussed during the planning process; and recommendations from JEO for additional mitigation actions based on identified needs. JEO reviewed identified mitigation actions per community and provided

suggestions to each participant to address gaps or vulnerabilities unaddressed in the hazards of top concern.

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 identified hazards of top concern per community. Alternatives must also be specific activities that are concise and can be implemented individually. The local planning teams and project contributors reviewed past mitigation actions to help identify more measurable and applicable mitigation actions. 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. Such actions should be discussed and noted in the HMP during the annual plan maintenance process.

Finally, not all mitigation actions may be eligible for funding through the Hazard Mitigation Assistance programs (HMGP, BRIC, or FMA). Ineligibility for these grant programs should not preclude a community from identifying or pursuing a mitigation action. Numerous funding sources have been identified across the state and planning area to assist jurisdictions fund projects (see *Appendix D)*. All mitigation strategies aimed at reducing risk to natural or human-caused hazards should be identified and discussed in the HMP.

Mitigation Action Descriptions

- Mitigation actions identified by participants of the Lower Loup NRD HMP are found in the Mitigation Alternative Project Matrix below. Additional information about selected actions can be found in *Section Seven: Community Profiles*. Each action includes the following information in the respective community profile:
- Mitigation Action – general title of the action item
- Description – brief summary of what the action item(s) will accomplish
- Hazard(s) Addressed – which hazard the mitigation action aims to address
- Estimated Cost – a general cost estimate for implementing the mitigation action for the appropriate jurisdiction
- Potential funding – a list of any potential funding mechanisms to fund the action

- Timeline – a general timeline as established by planning participants
- Priority –a general description of the importance and workability in which an action may be implemented (high/medium/low); priority may vary between each community, mostly dependent on funding capabilities and the size of the local tax base
- Lead agency – listing of agencies or departments which may lead or oversee the implementation of the action item
- Status – a description of what has been done, if anything, to implement the action item

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

MITIGATION ALTERNATIVE PROJECT MATRIX

During the Round 2 meetings, each participating jurisdiction was asked to review mitigation projects listed in the previously approved 2017 HMP and review a list of potential mitigation alternatives which would lead to action items to reduce the effects of hazards. Projects selected varied amongst participating jurisdictions depending upon the significance of each hazard present. The information listed in the matrices below is a compilation of the mitigation alternatives identified by jurisdiction and organized by the goal to be met.

Table 112: Mitigation Alternatives Selected by Each Jurisdiction

Mitigation Alternatives	LLNRD	Boone County	Albion & Albion Fire	Cedar Rapids	Petersburg	Primrose	St. Edward	Custer County	Anselmo	Ansley	Arnold	Berwyn	Broken Bow	Callaway	Comstock	Mason City	Oconto	Sargent	Garfield County	Burwell	Greeley County	Greeley	Scotia	Spalding	Wolbach
		Boone County						Custer County											Garfield		Greeley				
Acquire/Improve Wildfire Response Resources																								X	X
Backup and Emergency Generators		X	X	X	X	X	X	X	X	X	X		X			X	X	X		X	X	X		X	X
Backup Municipal Records		X																			X				
Building Improvements																									
Channel and Bridge Improvements	X																				X				
Civil Service Improvements		X																							
Community Education and Awareness				X	X																X			X	
Community Master Plan and Flood Projects																					X				
Construct Flood Control Structures													X												
Continuity Planning		X																			X				
Creek Maintenance													X												
Critical Facility Siting			X					X																	
Dam Failure Emergency Action/Evacuation Plans																									
Database of Vulnerable Populations																					X				
Defensible Space																					X				
Develop a Drought Management Plan		X																							

Mitigation Alternatives	LLNRD	Boone County	Albion & Albion Fire	Cedar Rapids	Petersburg	Primrose	St. Edward	Custer County	Anselmo	Ansley	Arnold	Berwyn	Broken Bow	Callaway	Comstock	Mason City	Oconto	Sargent	Garfield County	Burwell	Greeley County	Greeley	Scotia	Spalding	Wolbach
		Boone County						Custer County											Garfield		Greeley				
Develop Dam Failure Emergency Action/Evacuation Plan																									
Develop Emergency Snow & Evacuation Routes		X								X															
Develop Flood Assistance Strategies																									
Develop/Implement Hazard/Emergency Operations & Response Plan	X																								
Develop/Update Floodplain Information				X						X						X									
Diversion Dam Gate Update																								X	
Drainage Ditches and Culvert Cleaning												X													
Drainage Study/Stormwater Master Plan			X																		X				
Education Program for Chemical Releases			X																						
Emergency Exercise: Dam Failure																									
Emergency Exercise: Drought Tournament																									
Emergency Exercise: Flooding																		X			X				
Emergency Exercise: Hazardous Spill		X						X																	

Mitigation Alternatives	LLNRD	Boone County	Albion & Albion Fire	Cedar Rapids	Petersburg	Primrose	St. Edward	Custer County	Anselmo	Ansley	Arnold	Berwyn	Broken Bow	Callaway	Comstock	Mason City	Oconto	Sargent	Garfield County	Burwell	Greeley County	Greeley	Scotia	Spalding	Wolbach
		Boone County						Custer County											Garfield		Greeley				
Emergency Fuel Supply Plan		X			X																				
Evaluate/Improve Berm, Floodwall and/or Levee	X																								
Expand Water Capacities and Supplies																									X
Facilities for Vulnerable Populations																		X							
Facility Flood Proofing		X					X						X												
Facility Improvements																									
Fire Prevention Program/Planning and Training			X															X							
Firewise Community			X															X			X				
FIRM Mapping								X					X												
First Aid Training		X									X							X			X				
Flood Control Structures											X														
Groundwater Recharge	X																								
Hail Insurance					X																				
Hazardous Fire Fuels Reduction			X																						
Hazardous Spill Emergency Exercise																									
Impact Resistant Roof Coverings		X																			X				
Implement Water System Improvements																									

Mitigation Alternatives	LLNRD	Boone County	Albion & Albion Fire	Cedar Rapids	Petersburg	Primrose	St. Edward	Custer County	Anselmo	Ansley	Arnold	Berwyn	Broken Bow	Callaway	Comstock	Mason City	Oconto	Sargent	Garfield County	Burwell	Greeley County	Greeley	Scotia	Spalding	Wolbach
		Boone County						Custer County											Garfield		Greeley				
Improve and Revise Snow/Ice Removal and Rescue Program			X											X											
Improve Construction Standards & Building Survivability														X											X
Improve Drainage			X								X						X	X			X				
Improve Drainage Infrastructure																									
Improve Electrical Service		X								X	X							X			X				
Improve Emergency Communication		X			X			X			X					X					X		X	X	
Improve Emergency Responder Access During Hazards/Emergencies		X																							
Improve Flood and Dam Failure Warning System																									
Improve Intra-cooperation and Aid Agreements																									
Improve Roads																									
Improve Snow Removal Resources																									
Improve Stream Bed/Bank Stabilization	X						X						X												
Improve Warning Systems		X	X		X		X		X		X		X			X	X			X	X				X
Improve Water Infrastructure																									
Increase Soil & Water Conservation																									

Mitigation Alternatives	LLNRD	Boone County	Albion & Albion Fire	Cedar Rapids	Petersburg	Primrose	St. Edward	Custer County	Anselmo	Ansley	Arnold	Berwyn	Broken Bow	Callaway	Comstock	Mason City	Oconto	Sargent	Garfield County	Burwell	Greeley County	Greeley	Scotia	Spalding	Wolbach
		Boone County						Custer County											Garfield		Greeley				
Increase Soil and Water Conservation																									
Infrastructure Assessment Study																									
Install New Culverts																X									
Install Vehicle Barriers																									
Land Use Regulations (Chemical Spills)		X																							
Monitor Drought Conditions																									
Mud Creek Bridge Improvements												X													
New Structural Engine																									
New Well																									
Parcel Level Evaluation of Flood Prone Properties											X														
Project Scoping as a Result of the WFPO Program	X									X		X	X			X									
Provide Adequate Public Safe Rooms & Post Disaster Storm Shelters													X		X							X	X		
Provide Short Term Residency Shelters																									
Public Education on Hazard Events & Preparedness	X	X					X	X		X			X	X	X	X				X					
Public Safe Rooms & Post-Disaster Storm Shelters		X								X						X		X	X		X	X	X	X	X

Mitigation Alternatives	LLNRD	Boone County	Albion & Albion Fire	Cedar Rapids	Petersburg	Primrose	St. Edward	Custer County	Anselmo	Ansley	Arnold	Berwyn	Broken Bow	Callaway	Comstock	Mason City	Oconto	Sargent	Garfield County	Burwell	Greeley County	Greeley	Scotia	Spalding	Wolbach
		Boone County						Custer County											Garfield		Greeley				
Reduce Damage in Floodplain		X					X								X	X		X				X			X
Reduce Impact of Drought																	X								
Reduce Storm Water Damage									X	X				X								X			
Reduce Stream & Drainage Bottlenecks/Flow Restrictions									X													X	X		X
Reduce Tree Damage & Damage from Trees	X	X					X				X				X	X	X				X				X
Reduce Water Demand/Improve Drought Education	X	X							X					X	X										
Reduce Wildfire Damage	X																								
Rehabilitate Well #3			X																						
Reinforced Barrier for Sheltering Location																									
Relocate Municipal Infrastructure					X								X					X			X				
Relocate Refrigeration Systems																									
Replace Sewer Line																									
Resurface Roads					X																				
Shelter in Place		X	X																						
Site Security																									
Snow Fences		X	X																		X				
Static Detectors		X																			X				
Storm Shelter Identification																									

Mitigation Alternatives	LLNRD	Boone County	Albion & Albion Fire	Cedar Rapids	Petersburg	Primrose	St. Edward	Custer County	Anselmo	Ansley	Arnold	Berwyn	Broken Bow	Callaway	Comstock	Mason City	Oconto	Sargent	Garfield County	Burwell	Greeley County	Greeley	Scotia	Spalding	Wolbach
		Boone County						Custer County											Garfield		Greeley				
Stormwater System Improvements																									
Stream Bed/Bank Stabilization											X										X				
Study/Improve Drinking Water Supply																									
Surge Protectors		X																			X				
Transportation Drainage Improvements			X																						
Tree Planting																		X			X				
Update Comprehensive Plan		X									X														
Water Storage & Availability Assessment																					X				
Water System Improvements			X							X											X				
Water Tower Improvements																									
Wildfire Education			X																						
Wildfire Protection Plan																					X				
Wind Breaks Studies																					X				

Table 113: Mitigation Alternatives Selected by Each Jurisdiction

Mitigation Alternatives	Howard County	Boelus	Cotesfield	Cushing	Dannebrog	Elba	Farwell	St. Paul	Loup County	Taylor	Nance County	Belgrade	Fullerton	Genoa	Platte County	Duncan	Columbus	Sherman County	Ashton	Hazard	Litchfield	Loup City	Rockville
	Howard County								Loup County		Nance County				Platte County			Sherman County					
Acquire/Improve Wildfire Response Resources																							
Backup and Emergency Generators	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X		X	X	X	X
Backup Municipal Records																							
Building Improvements																							
Channel and Bridge Improvements																							
Civil Service Improvements														X									
Community Education and Awareness						X					X			X				X			X		
Community Master Plan and Flood Projects																							
Construct Flood Control Structures																							
Continuity Planning											X												
Creek Maintenance																							
Critical Facility Siting																							
Dam Failure Emergency Action/Evacuation Plans																							
Database of Vulnerable Populations											X												
Defensible Space																							
Develop a Drought Management Plan																							
Develop Dam Failure Emergency Action/Evacuation Plan																							
Develop Emergency Snow & Evacuation Routes																							
Develop Flood Assistance Strategies																							

Mitigation Alternatives	Howard County	Boelus	Cotesfield	Cushing	Dannebrog	Elba	Farwell	St. Paul	Loup County	Taylor	Nance County	Belgrade	Fullerton	Genoa	Platte County	Duncan	Columbus	Sherman County	Ashton	Hazard	Litchfield	Loup City	Rockville
	Howard County								Loup County		Nance County				Platte County			Sherman County					
Develop/Implement Hazard/Emergency Operations & Response Plan																	X						
Develop/Update Floodplain Information																	X						
Diversion Dam Gate Update																							
Drainage Ditches and Culvert Cleaning																				X			
Drainage Study/Stormwater Master Plan																							
Education Program for Chemical Releases																							
Emergency Exercise: Dam Failure																							
Emergency Exercise: Drought Tournament																							
Emergency Exercise: Flooding																							
Emergency Exercise: Hazardous Spill																							
Emergency Fuel Supply Plan		X												X									
Evaluate/Improve Berm, Floodwall and/or Levee																							
Expand Water Capacities and Supplies																							
Facilities for Vulnerable Populations																							
Facility Flood Proofing										X					X		X				X		
Facility Improvements																							
Fire Prevention Program/Planning and Training																							
Firewise Community																							

Mitigation Alternatives	Howard County	Boelus	Cotesfield	Cushing	Dannebrog	Elba	Farwell	St. Paul	Loup County	Taylor	Nance County	Belgrade	Fullerton	Genoa	Platte County	Duncan	Columbus	Sherman County	Ashton	Hazard	Litchfield	Loup City	Rockville
	Howard County								Loup County		Nance County				Platte County			Sherman County					
FIRM Mapping																							
First Aid Training											X												
Flood Control Structures																							
Groundwater Recharge																							
Hail Insurance		X																					
Hazardous Fire Fuels Reduction																							
Hazardous Spill Emergency Exercise						X																	
Impact Resistant Roof Coverings																							
Implement Water System Improvements																							
Improve and Revise Snow/Ice Removal and Rescue Program																							
Improve Construction Standards & Building Survivability											X											X	
Improve Drainage																			X				
Improve Drainage Infrastructure									X	X													
Improve Electrical Service														X	X							X	
Improve Emergency Communication								X	X		X	X			X		X	X			X	X	
Improve Emergency Responder Access During Hazards/Emergencies																							
Improve Flood and Dam Failure Warning System					X														X				
Improve Intra-cooperation and Aid Agreements																							
Improve Roads									X														
Improve Snow Removal Resources				X																			

Mitigation Alternatives	Howard County	Boelus	Cotesfield	Cushing	Dannebrog	Elba	Farwell	St. Paul	Loup County	Taylor	Nance County	Belgrade	Fullerton	Genoa	Platte County	Duncan	Columbus	Sherman County	Ashton	Hazard	Litchfield	Loup City	Rockville
	Howard County								Loup County		Nance County				Platte County			Sherman County					
Improve Stream Bed/Bank Stabilization	X													X	X		X					X	
Improve Warning Systems	X	X			X	X		X	X		X	X			X		X	X					
Improve Water Infrastructure													X										
Increase Soil & Water Conservation																						X	
Increase Soil and Water Conservation																							
Infrastructure Assessment Study											X												
Install New Culverts																							
Install Vehicle Barriers																					X		
Land Use Regulations (Chemical Spills)																							
Monitor Drought Conditions		X																					
Mud Creek Bridge Improvements																							
New Structural Engine																							
New Well																							
Parcel Level Evaluation of Flood Prone Properties																							
Project Scoping as a Result of the WFPO Program																					X		
Provide Adequate Public Safe Rooms & Post Disaster Storm Shelters			X											X			X					X	
Provide Short Term Residency Shelters		X									X												
Public Education on Hazard Events & Preparedness	X		X					X															
Public Safe Rooms & Post-Disaster Storm Shelters	X		X	X	X	X	X	X	X						X		X	X	X		X	X	X
Reduce Damage in Floodplain			X							X				X	X			X					

Mitigation Alternatives	Howard County	Boelus	Cotesfield	Cushing	Dannebrog	Elba	Farwell	St. Paul	Loup County	Taylor	Nance County	Belgrade	Fullerton	Genoa	Platte County	Duncan	Columbus	Sherman County	Ashton	Hazard	Litchfield	Loup City	Rockville
	Howard County								Loup County		Nance County				Platte County			Sherman County					
Reduce Impact of Drought																							
Reduce Storm Water Damage															X								
Reduce Stream & Drainage Bottlenecks/Flow Restrictions	X		X												X			X				X	
Reduce Tree Damage & Damage from Trees		X	X					X				X			X		X				X		
Reduce Water Demand/Improve Drought Education	X						X			X				X	X		X						X
Reduce Wildfire Damage																						X	
Rehabilitate Well #3																							
Reinforced Barrier for Sheltering Location																							
Relocate Municipal Infrastructure																							
Relocate Refrigeration Systems																							
Replace Sewer Line										X													
Resurface Roads																							
Shelter in Place																					X		
Site Security																							
Snow Fences														X									
Static Detectors																							
Storm Shelter Identification																			X		X		
Stormwater System Improvements					X																		
Stream Bed/Bank Stabilization																							
Study/Improve Drinking Water Supply															X		X						
Surge Protectors						X															X		

Mitigation Alternatives	Howard County	Boelus	Cotesfield	Cushing	Dannebrog	Elba	Farwell	St. Paul	Loup County	Taylor	Nance County	Belgrade	Fullerton	Genoa	Platte County	Duncan	Columbus	Sherman County	Ashton	Hazard	Litchfield	Loup City	Rockville
	Howard County								Loup County		Nance County				Platte County			Sherman County					
Transportation Drainage Improvements																							
Tree Planting														X									
Update Comprehensive Plan																							
Water Storage & Availability Assessment																							
Water System Improvements																X							
Water Tower Improvements																X							
Wildfire Education																							
Wildfire Protection Plan																							
Wind Breaks Studies																							

Table 114: Mitigation Alternatives Selected by Each Jurisdiction

Mitigation Alternatives	Valley County	Arcadia	North Loup	Ord	Wheeler County	Bartlett	Ericson	Arcadia Public Schools	Duncan Fire District	Elba Fire	Farwell Irrigation	Loup Basin Public Health Dept.	Sargent Irrigation	Twin Loup Irrigation	Wheeler Central Schools	Wheeler County Rural Fire
	Valley County				Wheeler County			Special Districts								
Acquire/Improve Wildfire Response Resources																
Backup and Emergency Generators	X	X	X	X	X	X		X	X	X	X		X		X	X
Backup Municipal Records																
Building Improvements									X							
Channel and Bridge Improvements																
Civil Service Improvements																
Community Education and Awareness																
Community Master Plan and Flood Projects																
Construct Flood Control Structures																
Continuity Planning																
Creek Maintenance																
Critical Facility Siting																
Dam Failure Emergency Action/Evacuation Plans													X			
Database of Vulnerable Populations																
Defensible Space																
Develop a Drought Management Plan													X			

Mitigation Alternatives	Valley County	Arcadia	North Loup	Ord	Wheeler County	Bartlett	Ericson	Arcadia Public Schools	Duncan Fire District	Elba Fire	Farwell Irrigation	Loup Basin Public Health Dept.	Sargent Irrigation	Twin Loup Irrigation	Wheeler Central Schools	Wheeler County Rural Fire
	Valley County				Wheeler County			Special Districts								
Develop Dam Failure Emergency Action/Evacuation Plan														X		
Develop Emergency Snow & Evacuation Routes		X														
Develop Flood Assistance Strategies											X		X			
Develop/Implement Hazard/Emergency Operations & Response Plan						X										
Develop/Update Floodplain Information																
Diversion Dam Gate Update																
Drainage Ditches and Culvert Cleaning																
Drainage Study/Stormwater Master Plan																
Education Program for Chemical Releases																
Emergency Exercise: Dam Failure													X	X		
Emergency Exercise: Drought Tournament													X			
Emergency Exercise: Flooding																
Emergency Exercise: Hazardous Spill																

Mitigation Alternatives	Valley County	Arcadia	North Loup	Ord	Wheeler County	Bartlett	Ericson	Arcadia Public Schools	Duncan Fire District	Elba Fire	Farwell Irrigation	Loup Basin Public Health Dept.	Sargent Irrigation	Twin Loup Irrigation	Wheeler Central Schools	Wheeler County Rural Fire
	Valley County				Wheeler County			Special Districts								
Emergency Fuel Supply Plan																
Evaluate/Improve Berm, Floodwall and/or Levee																
Expand Water Capacities and Supplies																
Facilities for Vulnerable Populations																
Facility Flood Proofing																
Facility Improvements						X										
Fire Prevention Program/Planning and Training																
Firewise Community																
FIRM Mapping																
First Aid Training																
Flood Control Structures																
Groundwater Recharge																
Hail Insurance																
Hazardous Fire Fuels Reduction																
Hazardous Spill Emergency Exercise																
Impact Resistant Roof Coverings																
Implement Water System Improvements														X		

Mitigation Alternatives	Valley County	Arcadia	North Loup	Ord	Wheeler County	Bartlett	Ericson	Arcadia Public Schools	Duncan Fire District	Elba Fire	Farwell Irrigation	Loup Basin Public Health Dept.	Sargent Irrigation	Twin Loup Irrigation	Wheeler Central Schools	Wheeler County Rural Fire
	Valley County				Wheeler County			Special Districts								
Improve and Revise Snow/Ice Removal and Rescue Program																
Improve Construction Standards & Building Survivability																
Improve Drainage																
Improve Drainage Infrastructure																
Improve Electrical Service																
Improve Emergency Communication				X	X	X	X						X			
Improve Emergency Responder Access During Hazards/Emergencies																
Improve Flood and Dam Failure Warning System																
Improve Intra-cooperation and Aid Agreements												X				
Improve Roads																
Improve Snow Removal Resources																
Improve Stream Bed/Bank Stabilization		X		X												
Improve Warning Systems	X		X	X	X	X	X									
Improve Water Infrastructure																
Increase Soil & Water Conservation																

Mitigation Alternatives	Valley County	Arcadia	North Loup	Ord	Wheeler County	Bartlett	Ericson	Arcadia Public Schools	Duncan Fire District	Elba Fire	Farwell Irrigation	Loup Basin Public Health Dept.	Sargent Irrigation	Twin Loup Irrigation	Wheeler Central Schools	Wheeler County Rural Fire
	Valley County				Wheeler County			Special Districts								
Increase Soil and Water Conservation	X															
Infrastructure Assessment Study																
Install New Culverts																
Install Vehicle Barriers																
Land Use Regulations (Chemical Spills)																
Monitor Drought Conditions													X	X		
Mud Creek Bridge Improvements																
New Structural Engine									X							
New Well							X									
Parcel Level Evaluation of Flood Prone Properties													X			
Project Scoping as a Result of the WFPO Program			X													
Provide Adequate Public Safe Rooms & Post Disaster Storm Shelters			X	X												
Provide Short Term Residency Shelters																
Public Education on Hazard Events & Preparedness																

Mitigation Alternatives	Valley County	Arcadia	North Loup	Ord	Wheeler County	Bartlett	Ericson	Arcadia Public Schools	Duncan Fire District	Elba Fire	Farwell Irrigation	Loup Basin Public Health Dept.	Sargent Irrigation	Twin Loup Irrigation	Wheeler Central Schools	Wheeler County Rural Fire
	Valley County				Wheeler County			Special Districts								
Public Safe Rooms & Post-Disaster Storm Shelters	X				X	X	X									X
Reduce Damage in Floodplain				X												
Reduce Impact of Drought																
Reduce Storm Water Damage																
Reduce Stream & Drainage Bottlenecks/Flow Restrictions			X		X											
Reduce Tree Damage & Damage from Trees				X		X					X		X			
Reduce Water Demand/Improve Drought Education																
Reduce Wildfire Damage	X															
Rehabilitate Well #3																
Reinforced Barrier for Sheltering Location															X	
Relocate Municipal Infrastructure																
Relocate Refrigeration Systems															X	
Replace Sewer Line																
Resurface Roads																
Shelter in Place																

Mitigation Alternatives	Valley County	Arcadia	North Loup	Ord	Wheeler County	Bartlett	Ericson	Arcadia Public Schools	Duncan Fire District	Elba Fire	Farwell Irrigation	Loup Basin Public Health Dept.	Sargent Irrigation	Twin Loup Irrigation	Wheeler Central Schools	Wheeler County Rural Fire
	Valley County				Wheeler County			Special Districts								
Site Security											X		X			
Snow Fences		X														
Static Detectors																
Storm Shelter Identification																
Stormwater System Improvements																
Stream Bed/Bank Stabilization					X											
Study/Improve Drinking Water Supply																
Surge Protectors																
Transportation Drainage Improvements																
Tree Planting		X														
Update Comprehensive Plan		X														
Water Storage & Availability Assessment																
Water System Improvements											X		X			
Water Tower Improvements																
Wildfire Education																
Wildfire Protection Plan																
Wind Breaks Studies																

SECTION SIX: PLAN IMPLEMENTATION AND MAINTENANCE

MONITORING, EVALUATING, AND UPDATING THE PLAN

> ***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.*

Participants of the LLNRD HMP will be responsible for monitoring, 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, business owners, and stakeholders. Unless otherwise specified by each participant's governing body and/or lead agencies identified in the mitigation action, the participant's governing body will be responsible for implementation of the recommended projects. The lead agency (or appropriate department/staff) identified on each mitigation action will report on the status of projects and include which implementation processes worked well, any difficulties encountered, how coordination efforts are proceeding, and which strategies could be revised.

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

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

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

Worksheets in Appendix C may also be used to assist with plan updates. In addition, the governing body will be responsible for ensuring that the HMP's goals are incorporated into applicable revisions of each participant's comprehensive plan and any new planning projects undertaken by the participant. The HMP will also consider any changes in comprehensive plans and incorporate the information accordingly in its next update.

CONTINUED PUBLIC INVOLVEMENT

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

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

UNFORESEEN OPPORTUNITIES

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

INCORPORATION INTO EXISTING PLANNING MECHANISMS

The Planning Team utilized a variety of plan integration tools to help communities determine how their existing planning mechanisms were related to the Hazard Mitigation Plan. Utilizing FEMA's *Integrating the Local Natural Hazard Mitigation Plan into a Community's Comprehensive Plan*[76] guidance, as well as FEMA's *2015 Plan Integration*[77] guide, each community engaged in a plan integration discussion. Specific questions which highlighted hazard mitigation principles from various types of planning mechanisms were discussed. This process offered an easy way for participants to notify the Planning Team of existing planning mechanisms, and if they interface with the Hazard Mitigation Plan.

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 these communities that lack existing planning mechanisms, especially smaller villages, the Hazard Mitigation Plan may be used as a guide for future activity and development in the community.

[76] 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/20130726-1908-25045-0016/integrating_hazmit.pdf.

[77] 8 Federal Emergency Management Agency. July 2015. "Plan Integration: Linking Local Planning Efforts." https://www.fema.gov/media-librarydata/1440522008134-ddb097cc285bf741986b48fdcef31c6e/R3_Plan_Integration_0812_508.pdf.

SECTION SEVEN: COMMUNITY PROFILES

PURPOSE OF COMMUNITY PROFILES

Community Profiles contain information specific to jurisdictions which have participated in the LLNRD 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
- Employment and Economics
- Hougins
- Governance
- Capabilities
- Plan Integration
- Future Development Trends
- Community Lifelines
    - Transportation
    - Hazardous Materials
    - Critical Facilities
    - Health and Medical Facilities
- Parcel Improvements and Valuation
- Hazard Prioritization
- Mitigation Strategy
- Plan Maintenance

In addition, maps specific only to each jurisdiction are included such as: critical facilities as identified by the jurisdiction, flood prone areas (including those delineated through HAZUS), available flood drainage studies or other applicable reports, and future land use or zoning maps (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. The 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 referred to in *Section Four: Risk Assessment.*