RESOLUTION NO. R25-19

A RESOLUTION OF THE CITY COUNCIL AUTHORIZING THE ADOPTION OF THE 2024 EASTERN MONTANA REGION HAZARD MITIGATION PLAN AND ANNEX K FOR YELLOWSTONE COUNTY.

WHEREAS, the City of Laurel recognizes the threat that natural hazards pose to people and property within our community;

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

WHEREAS, an adopted Hazard Mitigation Plan is required as a condition of future funding for mitigation projects under multiple Federal Emergency Management Agency pre- and post- disaster mitigation grant programs;

WHEREAS, Yellowstone County, City of Laurel resides within the Planning Area, and fully participated in the mitigation planning process to prepare this Hazard Mitigation Plan; and

WHEREAS, the Montana Disaster & Emergency Services and Federal Emergency Management Agency, Region VIII officials have reviewed the 2024 Eastern Montana Region Hazard Mitigation Plan and related Annex K for Yellowstone County and approved it contingent upon this official adoption of the participating governing body.

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Laurel, Montana, as follows:

1. That the City Council of the City of Laurel hereby adopts the Eastern Montana Region Hazard Mitigation Plan and related Annex K for Yellowstone County, as an official plan; and

2. That the City of Laurel, in conjunction with Yellowstone County, will submit this Adoption Resolution to the Montana Disaster & Emergency Services and Federal Emergency Management Agency, Region VIII officials to enable the Plan's final approval.

Introduced at a regular meeting of the City Council on the 11th day of March 2025, by Council Member Mackay.

PASSED and APPROVED by the City Council of the City of Laurel the 11th day of March 2025.

APPROVED by the Mayor the 11th day of March 2025.

CITY OF LAUREL

Dave Waggoner, Mayor

CITY OF LAUREL SEAL YELLOWSTONE COUNTY, MONTANA

ATTEST:

Kelly Strecker, Clerk-Treasurer

APPROVED AS TO FORM:

Michele L. Braukmann, Civil City Attorney

EASTERN MONTANA

Regional Hazard Mitigation Plan

2024-2029

wsp

Contents

Jurisdictional Annexes

Jurisdictional Addendums

Appendices:

1 Introduction

1.1 Executive Summary

The Eastern Montana Region Hazard Mitigation Plan (HMP) is the product of a regional planning process coordinated by Montana Disaster & Emergency Services (MT DES) in 2022-2023 to develop regional hazard mitigation plans covering the entire State of Montana. The following jurisdictions have prepared this Plan and will adopt it once it has been approved:

- Big Horn County
  - City of Hardin
  - Town of Lodge Grass
- Carbon County
  - Town of Bearcreek
  - Town of Bridger
  - Town of Fromberg
  - Town of Joliet
  - City of Red Lodge
- Carter County
  - Town of Ekalaka
- Crow Tribe
- Custer County
  - City of Miles City
  - Town of Ismay
- Daniels County
  - City of Scobey
  - Town of Flaxville
- Dawson County
  - City of Glendive
  - Town of Richey
- Fallon County
  - City of Baker
  - Town of Plevna
- Garfield County
  - Town of Jordan
- Golden Valley County
  - Town of Ryegate
  - Town of Lavina
- McCone County
  - Town of Circle
- Musselshell County
  - Town of Melstone
  - Town of Roundup
- Powder River County
  - Town of Broadus
- Prairie County
  - Town of Terry
- Richland County
  - Town of Fairview
  - Town of Sidney
- Roosevelt County
  - City of Wolf Point
  - City of Poplar
  - Town of Bainville
  - Town of Culbertson
  - Town of Froid
- Rosebud County
  - City of Colstrip
  - City of Forsyth
- Sheridan County
  - City of Plentywood
  - Town of Medicine Lake
  - Town of Outlook
  - Town of Westby
- Stillwater County
  - Town of Columbus
- Treasure County
  - Town of Hysham
- Valley County
  - City of Glasgow
  - Town of Fort Peck
  - Town of Nashua
  - Town of Opheim
- Wibaux County
  - Town of Wibaux
- Yellowstone County
  - City of Billings
  - Town of Broadview
  - City of Laurel

The purpose of hazard mitigation is to reduce or eliminate long-term risk to people and property from disasters or hazard events. The impacts of hazards can often be lessened or even avoided if appropriate

actions are taken before events occur. Studies have found that hazard mitigation is extremely cost-effective, with every dollar spent on mitigation saving an average of $6 in avoided future losses. By reducing exposure to known hazard risks, communities will save lives and property and minimize the social, economic, and environmental disruptions that commonly follow hazard events.

The 2023 Eastern Montana Region HMP (also referred to as "Plan") will serve as a blueprint for coordinating and implementing hazard mitigation policies, programs, and projects across the Region. It identifies mitigation goals and related actions to assist the participating jurisdictions in reducing risk and preventing loss from future hazard events. The goals of the 2023 Eastern Montana Region HMP are:

Goal 1: Reduce impacts to people, property, the environment, and the economy from hazards by implementing whole-community risk reduction and resilience strategies.

Goal 2: Protect community lifelines and critical infrastructure to ensure the continuity of essential services during and after a disaster.

Goal 3: Support education and outreach to the public through improved communications and capacity building that enhances resilience among underserved communities.

Goal 4: Promote regional cooperation and leverage partnerships with the private sector, non-profit organizations, and other key stakeholder groups in mitigation solutions.

Goal 5: Sustain and enhance jurisdictional capabilities and resources to enact and implement mitigation activities.

Goal 6: Integrate hazard mitigation into other plans, processes, and regulations.

Goal 7: Ensure local mitigation programs address underrepresented groups and protect socially vulnerable populations.

Goal 8: Incorporate the potential impacts of climate change into all mitigation activities when possible.

These goals were tailored for the Eastern Region during group exercises at a series of mitigation strategy workshops. This Plan was also developed to maintain the participating jurisdictions' eligibility for federal disaster assistance, specifically the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Assistance (HMA) grants including the Hazard Mitigation Grant Program (HMGP), Flood Mitigation Assistance (FMA) program, and Building Resilient Infrastructure and Communities (BRIC) grant program, as well as the Rehabilitation of High Hazard Potential Dam (HHPD) grant program.

It is important that local decision-makers stay involved in mitigation planning to provide new ideas and insight for future updates to the Regional HMP. As a long-term goal, the Regional HMP and the mitigation strategies identified within will be fully integrated into the daily decisions and routines of local government. This will continue to require dedication and hard work, and to this end, this Plan update continues efforts to further strengthen the resiliency of the Eastern Region.

1.2 Purpose

The participating jurisdictions of the Eastern Montana Region prepared this Regional HMP to guide hazard mitigation planning and to better protect the people and property of the planning area from the effects of hazard events. This Plan demonstrates the Region's commitment to reducing risks from hazards and serves as a tool to help decision-makers direct mitigation activities and resources. This Plan also maintains the jurisdictions' eligibility for federal mitigation grants under FEMA's HMA grant programs. This Plan demonstrates the Region and participating jurisdictions' commitment to reducing risks from hazards and serves as a tool to help decision-makers direct mitigation activities and resources.

1.3 Background and Scope

Each year in the United States, disasters take the lives of hundreds of people and injure thousands more. Nationwide, taxpayers pay billions of dollars annually to help communities, organizations, businesses, and individuals recover from disasters. These monies only partially reflect the true cost of disasters because additional expenses to insurance companies and nongovernmental organizations (NGOs) are not reimbursed by tax dollars. Many disasters are predictable, and much of the damage caused by these events can be alleviated or even eliminated.

Hazard mitigation is defined by FEMA as any sustained action taken to reduce or eliminate long-term risk to human life and property from a hazard event. The results of a three-year, congressionally mandated independent study to assess future savings from mitigation activities provides evidence that mitigation activities are highly cost-effective. On average, each dollar spent on mitigation saves society an average of $6 in avoided future losses in addition to saving lives and preventing injuries (Natural Hazard Mitigation Saves, 2019 Report).

Hazard mitigation planning is the process through which hazards that threaten communities are identified, likely impacts of those hazards are determined, mitigation goals are set, and appropriate strategies to lessen impacts are developed, prioritized, and implemented. This Plan documents the planning region's hazard mitigation planning process, identifies relevant hazards and risks, and identifies the strategies that each participating jurisdiction will use to decrease vulnerability and increase resiliency and sustainability.

This Plan was prepared pursuant to the requirements of the Disaster Mitigation Act of 2000 (Public Law 106-390) and the implementing regulations set forth by the Interim Final Rule published in the Federal Register on February 26, 2002 (44 Code of Federal Regulations [CFR] §201.6) and finalized on October 31, 2007 (hereafter, these requirements and regulations will be referred to collectively as the Disaster Mitigation Act (DMA)). While the DMA emphasized the need for mitigation plans and more coordinated mitigation planning and implementation efforts, the regulations established the requirements that local hazard mitigation plans must meet for a local jurisdiction to be eligible for certain federal disaster assistance and hazard mitigation funding under the Robert T. Stafford Disaster Relief and Emergency Act (Public Law 93-288). Because the Eastern Region planning area is subject to many kinds of hazards, access to these programs is vital.

Information in this Plan will be used to help guide and coordinate mitigation activities and decisions for local land use policy in the future. Proactive mitigation planning will help reduce the cost of disaster response and recovery to communities and property owners by protecting critical community facilities, reducing liability exposure, and minimizing overall community impacts and disruption. The jurisdictions in the Eastern Region planning area have been affected by hazards in the past and are thus committed to reducing future disaster impacts and maintaining eligibility for federal funding.

1.4 Plan Organization

The Eastern Montana Region HMP is organized in alignment with the DMA planning requirements and the FEMA plan review tool as follows:

- Chapter 1: Introduction
- Chapter 2: Region Profile
- Chapter 3: Planning Process
- Chapter 3.4: Hazard Analysis and Risk Assessment
- Chapter 5: Mitigation Strategy
- Chapter 6: Plan Adoption, Implementation, and Maintenance

- County and Tribal Annexes and Addendums
- Appendices

Each annex provides a more detailed assessment of each jurisdiction's unique risks as well as their mitigation strategy to reduce long-term losses. Each annex contains the following:

- Mitigation Planning and County Planning Team
- Community Profile
- Hazard Identification and Risk Assessment
- Vulnerability to Specific Hazards
- Mitigation Capabilities Assessment
- Mitigation Strategy
- Plan Implementation and Maintenance

When this Plan was organized and initiated in 2022 several counties in the Region had recently approved HMPs. It was determined by MT DES and FEMA Region VIII to only require implementation updates associated with the mitigation strategy in an Addendum that complied with current FEMA policy guidance and aligned with and supplemented the counties existing HMP, rather than conducting new analysis in an Annex. Each addendum discusses the following topics, as each relates to plan implementation and maintenance:

- Mitigation Planning
- Summary Overview of the jurisdiction's recently approved HMP's progress
- Social Vulnerability
- Hazard Events within the Planning Area (natural hazard events that have occurred since the jurisdiction's HMP was recently approved)
- Changes in Risk Exposure in the Planning Area
- Mitigation Capabilities Assessment
- Review of the Mitigation Action Plan

1.5 Multi-Jurisdictional Planning

This Plan was prepared as a regional, multi-jurisdictional plan. The Eastern Montana Region is comprised of 23 counties and three tribal reservations, as established by MT DES. All tribes, counties, and incorporated municipalities in the Region were invited to participate in the planning process. The Fort Peck Tribes, as known as Fort Peck Assiniboine and Sioux Tribes; Northern Cheyenne Tribe; and Wheatland County elected not to participate in the Regional plan. Wheatland County and Northern Cheyenne Tribe elected not to participate due to limited staff and resources; the Fort Peck Tribes did not participate because they were already developing a full HMP update. All other tribes, counties, and incorporated municipalities fully participated in the planning process, and have committed to adopt and implement the Regional HMP. The participating jurisdictions seeking FEMA approval of this plan are listed in Section 1.1.

2 Region Profile

This section provides a brief overview of the geography of the planning area. A base map of the planning region is illustrated in Figure 2-1 below.

2.1 Geography and Climate

The Eastern Montana Region is comprised of the following 22 counties and one tribal reservation that participated in the Regional HMP planning process:

- Big Horn County
- Carbon County
- Carter County
- Crow Tribe
- Custer County
- Daniels County
- Dawson County
- Fallon County
- Garfield County
- Golden Valley County
- McCone County
- Musselshell County
- Powder River County
- Prairie County
- Richland County
- Roosevelt County
- Rosebud County
- Sheridan County
- Stillwater County
- Treasure County
- Valley County
- Wibaux County
- Yellowstone County

The Eastern Region is dominated by prairie landscape as part of the Great Plains. Some parts of eastern Montana, in areas most prone to drying chinooks, have near-desert conditions and scrub rather than grassland. Eastern Montana also has breaks and highlands that are widely forested, such as the Custer National Forest and areas around Fort Peck Lake. Eastern Montana has a semi-arid steppe climate with low precipitation that is to some extent countered by low evaporation rates. According to Western Regional Climate Center (WRCC), probably the driest part of Montana is along the Clark Fork of the Yellowstone River in Carbon County. In this area, eight miles south-southwest of Belfry, the average precipitation for a 16-year period is 6.59 inches. In the Eastern Region, summers are short but hot and winters are long, cold, and extremely variable. The major rivers that flow through the Eastern Region include the Missouri River, Yellowstone River, Milk River, Clark's Fork, Big Horn, Powder River, and Tongue River. The Missouri River, the longest river in the United States and Yellowstone County, the most populous county in Montana, are both included in the Eastern Region. The National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information also noted that tornadoes occur almost entirely in the Eastern Region. Blizzards are also most common in the northeastern part of the State, occurring about five times per year. The eastern part of the State can also experience bitterly cold temperatures, occasionally lower than −30°F.

Major roadways include Interstate 94, Interstate 90, Highway 2, Highway 12, Highway 212, Highway 59, and Highway 87. Figure 2-2 below shows the land ownership within Eastern Montana.

As mentioned previously, the Eastern Region receives lower annual precipitation compared to the western part of the State. Precipitation is typically higher in the southeastern portion of the region compared to the northwestern portion. The Eastern Region also experiences distinct seasons. Spring and fall tend to be relatively short transitional periods, with mild temperatures. The Eastern Region can also experience rapid weather changes, with significant temperature swings during these seasons. Winters in the Eastern Region are cold, with average temperatures ranging from the 20s°F to the low 30s°F. Temperatures can drop well

below freezing, and snowfall is common. Blizzards and strong winds can occur during the winter months, creating hazardous travel conditions. Summers are generally hot and dry, with average high temperatures ranging from the upper 80s°F to 90s°F. Heatwaves are not uncommon, and temperatures can occasionally exceed 100°F during the hottest months of July and August. Additional geography and climate data for each jurisdiction within the Eastern Region can be found in the Community Profile section of each jurisdictional annex and addendum.

Figure 2-1 Eastern Montana Region Base Map

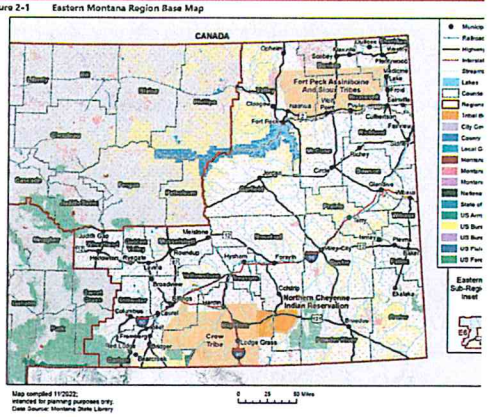


Figure 2-2 Federal Lands and Indian Reservations Montana

2.2 Population

Table 2-1 summarizes the estimated population and population change for the Eastern Region planning area as a whole and for the individual counties. Data is based on the Decennial Census and American Community Survey (ACS) Five-Year Estimates data from the US Census Bureau. Carter, Fallon, Musselshell, Richland, and Yellowstone Counties have experienced significant growth over the past decade. Daniels, Garfield, Golden Valley, Rosebud, Stillwater, Treasure, and Wibaux Counties have experienced a net population loss. The Eastern Region was home to 25.4% of Montana's total population of 1,104,271 in 2021. Overall, the Eastern Region is experiencing moderate growth, but the percent change varies by county within the Eastern Region.

Table 2-1 Eastern Region Population Change

County	2010 Census	2016 Estimate	2017 Estimate	2018 Estimate	2019 Estimate	2020 Census	2021 Estimate	% Change 2010 to 2021
Big Horn County	12,865	13,214	13,290	13,376	13,387	13,124	13,198	2.6%
Carbon County	10,078	10,340	10,466	10,546	10,597	10,473	10,488	3.9%
Carter County	1,160	1,295	1,320	1,318	1,331	1,415	1,349	14.0%
Custer County	11,699	11,980	11,895	11,845	11,729	11,867	11,968	2.3%
Daniels County	1,751	1,787	1,788	1,753	1,730	1,661	1,739	-0.7%
Dawson County	8,966	9,431	9,324	9,191	9,017	8,940	9,003	0.4%
Fallon County	2,890	2,913	2,925	2,838	2,921	3,049	3,074	5.9%
Garfield County	1,206	1,061	1,086	1,141	1,036	1,173	972	-24.1%
Golden Valley County	884	730	747	724	728	823	820	-7.8%
McCone County	1,734	1,678	1,728	1,630	1,790	1,729	1,805	3.9%
Musselshell County	4,538	4,778	4,766	4,807	4,766	4,730	4,813	5.7%
Powder River County	1,743	1,648	1,610	1,619	1,607	1,694	1,759[1]	0.9%
Prairie County	1,179	1,414	1,325	1,342	1,252	1,088	1,227	3.9%
Richland County	9,746	11,392	11,405	11,360	11,199	11,491	11,375	14.3%
Roosevelt County	10,425	11,230	11,218	11,228	11,175	10,794	10,884	4.2%
Rosebud County	9,233	9,348	9,292	9,250	9,152	8,329	8,464	-9.1%

County	2010 Census	2016 Estimate	2017 Estimate	2018 Estimate	2019 Estimate	2020 Census	2021 Estimate	% Change 2010 to 2021
Sheridan County	3,384	3,645	3,568	3,574	3,483	3,539	3,522	3.9%
Stillwater County	9,117	9,342	9,342	9,410	9,466	8,963	8,916	-2.2%
Treasure County	718	846	790	777	668	762	693	-3.6%
Valley County	7,369	7,576	7,561	7,532	7,471	7,578	7,553	2.4%
Wheatland County	2,168	2,109	2,108	2,149	2,142	2,069	2,082	-4.1%
Wibaux County	1,017	1,143	1,121	1,175	1,122	937	1,018	0.1%
Yellowstone County	147,972	155,344	156,332	157,816	159,008	164,731	163,593[2]	9.5%
Total	**261,842**	**274,244**	**275,007**	**276,401**	**276,777**	**280,959**	**280,315**	**6.9%**

NOTES:
1 – During review of this plan, Powder River County noted their 2022 population was 1,725 people according to the ACS.
2 - During review of this plan, Yellowstone County noted their 2021 population estimate was not accurate due to an algorithm error by the US Census Bureau, and there has not been a growth decline. The 2022 population estimate for Yellowstone County is 169,852 according to the ACS.
Source: US Census Bureau ACS 5-year Estimates, https://data.census.gov/

2.3 Development Trends

The population of the Eastern Region has been consistently growing since 2010, and the Montana Department of Commerce projects that this growth will continue through the year 2040. Please note that the population change projections for Tribal Nations are not available. Table 2-2 below lists the projected 2040 populations of each county within the Eastern Region. Counties such as Yellowstone, Big Horn, Custer, and Richland have seen some of the greatest concentrations of population growth and urban development in the Eastern Region and the State, although not all these counties' populations are projected to increase by 2040. Based on the estimates from the Montana Department of Commerce, through the year 2040, Treasure, Powder River, Garfield, and Stillwater counties are projected to see the highest rates of population increase. Additional details on specific growth and development trends are provided in each county's respective annex and addendum.

Table 2-2 Eastern Montana 2020 Census and 2040 Projections

County	2020 Census	2040 Projections	% Change
Big Horn County	13,124	11,178	-14.8%
Carbon County	10,473	13,425	28.2%
Carter County	1,415	1,464	3.5%
Custer County	11,867	10,923	-8.0%
Daniels County	1,661	1,534	-7.6%
Dawson County	8,940	8,067	-9.8%
Fallon County	3,049	2,910	-4.6%
Garfield County	1,173	1,481	26.3%
Golden Valley County	823	1,005	22.1%

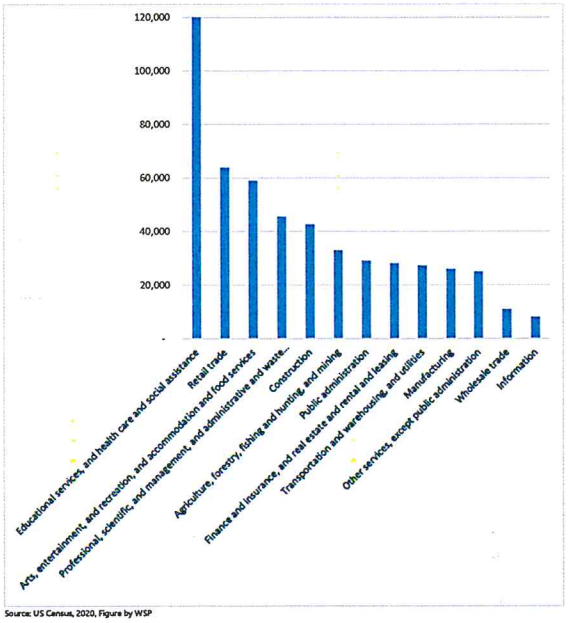
County	2020 Census	2040 Projections	% Change
McCone County	1,729	1,562	-9.7%
Musselshell County	4,730	3,970	-16.1%
Powder River County	1,694	2,381	40.6%
Prairie County	1,088	1,145	5.2%
Richland County	11,491	10,712	-6.8%
Roosevelt County	10,794	8,790	-18.6%
Rosebud County	8,329	6,323	-24.1%
Sheridan County	3,539	3,097	-12.5%
Stillwater County	8,963	12,873	43.6%
Treasure County	762	1,007	32.2%
Valley County	7,578	8,346	10.1%
Wheatland County	937	2,334	12.8%
Wibaux County	2,069	1,090	16.3%
Yellowstone County	164,731	178,358	8.3%
Total	**280,959**	**293,975**	**4.6%**

Sources: US Census Bureau ACS 5-year Estimates, https://data.census.gov/; Montana Regional Economic Models Incorporated (REMI) https://dataportal.mt.gov/t/DOC/views/CEIC_REMI_POPULATION_PROJECTION_COUNTY_AGE_RACE_SEX/Trend?%3Aorigin=card_share_link&%3Aembed=y

2.4 Economy

Figure 2-3 displays a breakdown of the total employment by industry statewide. According to the 2020 US Census, Montana's economy is largely based on the educational services, health care, and social assistance industry with 120,662 people. This is followed by retail trade with 63,971 total people. Third is arts, entertainment, and recreation, and accommodation and food services with 59,115 people, followed by professional, scientific, and management, and administrative and waste management services with 45,656 people. These four sectors comprise 56% of employment in the Eastern Region.

Figure 2-3 Montana Industry Type by Percentage of Total Workers Employed



Source: US Census, 2020, Figure by WSP

2.5 Capability Assessment

Included in this Regional HMP is a capability assessment to review and document the Eastern Region planning area's current capabilities to mitigate risk and vulnerability from natural hazards. By collecting information about existing local and tribal government programs, policies, regulations, ordinances, and emergency plans, the planning team and MT DES can assess those activities and measures already in place that contribute to mitigating some of the risks and vulnerabilities identified. The capabilities assessment is divided into five sections: regulatory mitigation capabilities, administrative and technical mitigation capabilities, financial mitigation capabilities, education and outreach, and mitigation partnerships. The results of this assessment are captured in each jurisdictional annex and addendum.

County/Tribe	Original Plan Approval	Last Adoption
Garfield County	2007	2015
Golden Valley County	2007	2022
McCone County	2014	2022
Musselshell County	2007	2022
Powder River County	2005	2015
Prairie County	2005	2013
Richland County	2014	2022
Roosevelt County	2008	2017
Rosebud County	2007	2022
Sheridan County	2008	2017
Stillwater County	2010	2022
Treasure County	2007	2022
Valley County	2008	2017
Wibaux County	2014	2022
Yellowstone County	2004	2019

Regional Planning. While each county and tribe in Montana has an Emergency Management Coordinator, MT DES has recognized that the process of developing and updating DMA 2000 compliant HMPs can often be beyond local and tribal capabilities and expertise. Instead of each county and tribe hiring their own consultant, MT DES took the lead in procuring and funding a professional hazard mitigation planning consultant through a competitive bid process. In 2022, WSP USA Environment & Infrastructure Inc. (WSP) was selected by MT DES to provide assistance to the Eastern Region under a multi-year, multiple region contract. As the planning consultant, WSP's role was to:

- Provide guidance on a planning organization for the entire planning area representative of the participants;
- Ensure the plan meets all the DMA requirements as established by federal regulations, following FEMA's most recent planning guidance;
- Facilitate the entire planning process;
- Identify the data requirements that the participating counties, tribes, and municipalities could provide, and conduct the research and documentation necessary to augment that data;
- Develop and help facilitate the public input process;
- Produce the draft and final plan documents; and
- Ensure acceptance of the final Plan by MT DES and FEMA Region VIII.

Prior to initiating the development of this Regional HMP in 2022, a substantial coordination effort took place to ensure the participation of the counties and tribes within Eastern Montana. Each jurisdiction designated the Emergency Management Coordinator as the primary point of contact. Each Coordinator was required to undertake a coordination role within their respective counties to help fulfill DMA planning requirements. The county Emergency Management Coordinators then contacted each of the incorporated communities, offering them the opportunity to participate in the development of the Regional HMP. Most

3 Planning Process

Requirements §201.6(b) and §201.6(c)(1): 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.

[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.

i. Tribal Requirement §201.7(c)(1): Documentation of 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. This shall include:

ii. An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval, including a description of how the Indian tribal government defined "public;"

As appropriate, an opportunity for neighboring communities, tribal and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia, and other private and non-profit interests to be involved in the planning process.

3.1 Background on Mitigation Planning in Eastern Montana

The 2023 Eastern Montana Regional HMP is the first regional HMP for Eastern Montana. The plan's development over 2022-2023 will comply with the five-year update cycle required by the DMA 2000 going forward and reflects mitigation priorities for the five-year span between 2023-2028.

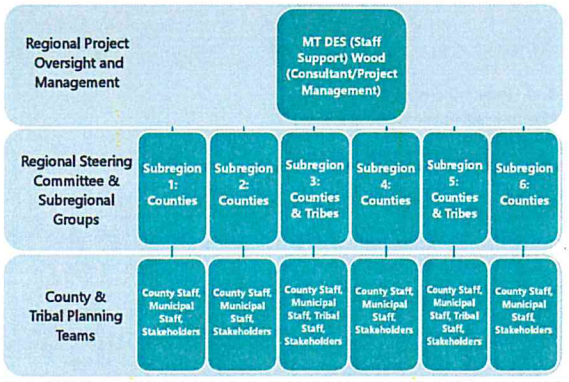
Prior to 2023, the counties and tribes of Eastern Montana had adopted jurisdictional-specific hazard mitigation plans over the years. Table 3-1 provides a summary of when each jurisdiction's hazard mitigation plan was originally developed, including the most recent adoption. Information on how the jurisdictions integrated the mitigation plan into other planning mechanisms can be found in Section 11.1 of each jurisdictional annex or addendum.

Table 3-1 Eastern Montana Local and Tribal HMP History, Adoption, and Integration

County/Tribe	Original Plan Approval	Last Adoption
Big Horn County	2006	2022
Carbon County	2005	2021
Carter County	2005	2022
Crow Tribe	2007	2015
Custer County	2005	2017
Daniels County	2008	2016
Dawson County	2014	2022
Fallon County	2013	2022

incorporated communities within the counties, as well as the tribes, chose to participate in the development of this Regional Plan. Figure 3-1 illustrates the regional planning framework.

Figure 3-1 Eastern Montana Regional Hazard Mitigation Planning Committee Framework



The Emergency Management Coordinator from each participating county and tribe served on the Regional Hazard Mitigation Planning Committee (HMPC), as well as convening and facilitating a County Planning Team (CPT) or Tribal Planning Team (TPT) in concert with MT DES and the consultant team.

3.2 Government Participation

The DMA planning regulations and guidance stress that each local and tribal government seeking FEMA approval of their mitigation plan must participate in the planning effort in the following ways:

- Participate in the process as part of the Regional HMPC through participation in a CPT or TPT,
- Detail areas within the planning area where the risk differs from that facing the entire area,
- Identify specific projects to be eligible for funding, and
- Have the governing board formally adopt the plan.

For the Eastern Montana Regional HMP's HMPC, "participation" meant:

- Providing input by attending and participating in HMPC meetings, separate side-bar meetings, or email and phone correspondence;
- Establishing/reconvening a local steering committee;
- Providing available data requested by the HMPC coordinator and planning consultant;
- Providing/updating the hazard profile and vulnerability details specific to jurisdictions;
- Developing/updating the local mitigation strategy (action items and progress);

- Advertising and assisting with the public input process;
- Reviewing and commenting on plan drafts; and
- Coordinating the formal adoption of the plan by the governing boards.

This Regional Plan includes the participation of most of the counties and the municipalities in Eastern Montana as noted in Chapter 1 and detailed further in Section 3.3.1. Documentation of participation is included in Appendix B in the form of meeting sign-in sheets, meeting summaries, monthly meeting participation, and additional documentation.

3.3 The 10-Step Planning Process

The HMPC established the planning process for the Eastern Montana Region HMP using the DMA planning requirements and FEMA's associated guidance. This guidance is structured around a four-phase process:

1) Organize Resources
2) Assess Risks
3) Develop the Mitigation Plan
4) Implement the Plan and Monitor the Progress

Into this four-phase process, WSP integrated a more detailed 10-step planning process used by FEMA's Community Rating System (CRS) and FMA programs. Thus, the modified 10-step process used for this plan meets the requirements of all of FEMA's HMA grant programs, the CRS program, and flood control projects authorized by the US Army Corps of Engineers. Additionally, FEMA's May 2023 Local Mitigation Planning Handbook recommends a nine-task process within the four-phase process. Table 3-2 summarizes the four-phase DMA process, the detailed CRS planning steps and work plan used to develop the plan, the nine handbook planning tasks from FEMA's 2023 Local Mitigation Planning Handbook, and where the results are captured in the Plan. Tribal elements of the Regional HMP were designed to be fully compliant with the requirements of 44 CFR 201.7 as detailed in FEMA's 2019 Tribal Multi-Hazard Mitigation Planning Guidance. The sections that follow describe each planning step in more detail.

Table 3-2 Mitigation Planning Process Used to Develop the Regional Hazard Mitigation Plan

FEMA 4 Phase Guidance	CRS Planning Steps (Activity 510)	FEMA Local Mitigation Planning Handbook Tasks (44 CFR Part 201)	Location in Plan
Phase I: Organize Resources	Step 1. Organize Resources	1: Determine the Planning Area and Resources	Chapters 1, 2 and 3
		2: Build the Planning Team 44 CFR 201.6(c)(1)	Chapter 3, Section 3.3.1
	Step 2. Involve the public	3: Create an Outreach Strategy 44 CFR 201.6(b)(1)	Chapter 3, Section 3.3.1
	Step 3. Coordinate with Other Agencies	4: Review Community Capabilities 44 CFR 201.6(b)(2) & (3)	Chapter 3, Section 3.3.1 and annexes
Phase II: Assess Risks	Step 4. Assess the hazard	5: Conduct a Risk Assessment 44 CFR 201.6(c)(2)(i) 44 CFR 201.6(c)(2)(ii) & (iii)	Chapter 4 and annexes
	Step 5. Assess the problem		Chapter 4 and annexes
Phase III: Develop the Mitigation Strategy	Step 6. Set goals	6: Develop a Mitigation Strategy 44 CFR 201.6(c)(3)(i); 44 CFR 201.6(c)(3)(ii); and 44 CFR 201.6(c)(3)(iii)	Chapter 5, Section 5.2
	Step 7. Review possible activities		Chapter 5, Section 5.3

In these instances, WSP worked closely with the CPT's representing those jurisdictions to ensure there were additional one-on-one meetings and plan review sessions scheduled to gather input and ensure their annexes and addendums accurately reflected those jurisdictions hazard risks (see Appendix A).

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 were also invited to participate and provide input. In eastern Montana, neighboring communities included Philips, Petroleum, Fergus, Judith Basin, Meagher, Sweetgrass, and Park counties. Both MT DES and Golden Valley, Musselshell, Garfield, and Valley counties (that border these counties) invited the jurisdictions to participate in the online public survey and to review the public review draft plan. MT DES also extended the public review period to ensure these neighboring communities had additional time to review and provide input on the plan. Additional invitations were extended as appropriate to other federal, state, tribal, and local stakeholders, as well as to members of the public, throughout the planning process but specifically through invites to the planning meeting series, announcements distributed during the circulation of the public survey, and social media posts and announcements advertised to all stakeholder groups during public review (e.g., email invitations, save the date flyers, etc.). A full list of local government departments and stakeholders that participated can be found in Appendix A. More details with documentation of participation included are in Appendix B.

During the advertisement of the planning meetings and the circulation of the online public survey, MT DES, the HMPC, and the CPTs and TPTs targeted outreach to inform and involve underserved and socially vulnerable populations throughout the counties in eastern Montana through email invitations, follow-up phone calls, and public survey reminders. Stakeholder groups that represent underserved and socially vulnerable populations were actively engaged in the urban areas of Eastern Montana, such as Billings and Miles City. This allowed for a more comprehensive understanding of the diverse needs and perspectives of vulnerable populations, such as the elderly, veterans, homeless population, and low-income families, facilitating the development of more equitable and effective interventions and policies. For example, planning efforts were made to schedule additional in-person mitigation strategy planning meetings in Eastern Montana to enhance participation and engagement among the more rural counties in the region compared to the central and western regions. These small, rural, and isolated communities typically lack the opportunity to attend in-person workshops; therefore three additional meetings were scheduled in Sidney, Wolf Point, and Miles City to maximize input from stakeholders that represent vulnerable populations and from local community leaders (e.g., Council members, County Commissioners). Two of the five mitigation strategy planning meetings were also held at a senior center (i.e., Roosevelt Aging Services/Senior Center) and community health center (i.e., Billings Riverview Health) to attract participation from underrepresented and socially vulnerable communities that best represent the health care and elderly community, group care homes, and health care leaders in eastern Montana. However, given there are over 45 jurisdictions across Eastern Montana that consist of mostly small, rural, and isolated communities, additional effort during the plan implementation process will focus on continued targeted outreach and engagement with the stakeholder groups that represent the underserved and socially vulnerable populations in these rural counties.

The community-based organizations and medical clinics that represent vulnerable populations in eastern Montana who were invited to participate in the planning meetings are listed below (those noted with an asterisk also participated in the meetings):

- Faith Lutheran Home*
- Milk River Group Homes*

FEMA 4 Phase Guidance	CRS Planning Steps (Activity 510)	FEMA Local Mitigation Planning Handbook Tasks (44 CFR Part 201)	Location in Plan
	Step 8. Draft an action plan		Chapter 5, Section 5.3.3 and annexes
Phase IV: Adopt and Implement the Plan	Step 9. Adopt the plan	8: Review and Adopt the Plan	Chapter 6
	Step 10. Implement, evaluate, revise	7: Keep the Plan Current	Chapter 6
		9: Create a Safe and Resilient Community 44 CFR 201.6(c)(4)	Chapter 6

3.3.1 Phase 1: Organize Resources

Planning Step 1: Organize the Planning Effort

With each jurisdiction's commitment to developing a Regional Plan, WSP worked with MT DES and each County and Tribal Emergency Management Coordinator to establish the framework and organization for the process. Organizational efforts were initiated with each county to inform and educate the plan participants of the purpose and need for the Regional HMP. The planning consultant held an initial conference call using Microsoft Teams (Teams) to convene the HMPC, discuss the organizational aspects of the planning process with the Emergency Management Coordinators, and review plan participation expectations. Following FEMA planning guidance, MT DES and the consultant directed each participating county and tribe to develop their respective planning teams, comprised of representative county, tribal, and municipal staff members, prior to this meeting to ensure complete representation and active participation in the plan update process. In some instances, small jurisdictions with limited staff capacity agreed to have County staff represent their community, and in eastern Montana it is common that one staff at one jurisdiction may represent multiple jurisdictions in an official capacity in their day-to-day role. Numerous small jurisdictions were invited to participate in all planning meetings, but had County representatives, often the County DES Coordinator represent them during the planning process. These small jurisdictions and the counties that represented them during the planning meetings and workshops are listed below:

- City of Baker (Fallon County)
- Town of Bear Creek, Town of Joliet (Carbon County)
- Town of Bridger (Carbon County)
- Town of Fromberg (Carbon County)
- Town of Flaxville (Daniels County)
- City of Glendive (Dawson County)
- Town of Ekalaka (Carter County)
- City of Hardin (Big Horn County)
- Town of Ismay (Custer County)
- City of Lodge Grass (Big Horn County)
- Town of Bainville (Roosevelt County
- City of Colstrip (Rosebud County)
- Town of Circle (McCone County)
- City of Forsyth (Rosebud County)
- Town of Fairview (Richland County)
- Town of Medicine Lake (Sheridan County)
- Town of Nashua (Valley County)
- Town of Hysham (Treasure County)
- Town of Lavina (Golden Valley County)
- City of Plevna (Fallon County)
- City of Plentywood (Sheridan County)
- Town of Ryegate (Golden Valley County)
- Town of Roundup (Musselshell County)
- Town of Melstone (Musselshell County)
- Town of Opheim (Valley County)
- Town of Outlook (Sheridan County)
- Town of Scobey (Daniels County)
- Town of Sidney (Richland County)
- Town of Westby (Sheridan County)
- Town of Wibaux (Wibaux County)

- Milk River Inc.*
- Prairie Ridge Village*
- Salvation Army
- American Red Cross*
- Prairie Community Hospital
- Powder River Clinic
- Glasgow Clinic
- Nemont Manor
- Riverstone Health*
- St. Vincent's Hospital
- Billings Clinic*
- Big Sky Economic Development

Additional stakeholder groups that represent vulnerable populations for each of the respective counties are referenced in the annexes and addendums.

Media platforms that use an innovative approach and commit to inclusivity are able to leverage their platforms to reach vulnerable populations. Being able to ensure that their communication resonates with a wide range of audiences is important in the planning process. The community-based media platforms who were invited to participate in the planning meetings are listed below:

- KATL Radio
- KVCK Radio

Through targeted outreach efforts, stakeholders can be informed throughout the plan development process. Outreach can facilitate partnerships and collaboration among various stakeholders, fostering a sense of shared responsibility and collective action towards mitigation goals. This can result in greater resource mobilization, improved coordination of efforts, and a better approach to risk reduction. Additional media platforms that were contacted in each of the respective counties are referenced in the annexes and addendums.

Throughout the plan development process, communication amongst the CPTs and TPTs occurred through a combination of face-to-face meetings, virtual meetings, conference calls, phone interviews, planning workshops, and email correspondence. During the kickoff meeting, WSP presented information on the scope and purpose of the plan update, the participation requirements of HMPC members, and the proposed project work plan and schedule. Each CPT and TPT were also required to complete a Plan Update Guide and submit relevant plans and program documentation related to their current HMP, particularly for plans that integrated the previous HMP. A plan for public involvement (Step 2) and coordination with other agencies and departments (Step 3) were discussed. During the kickoff meeting, the HMPC reviewed the hazard identification information for each jurisdiction and the Eastern Region and refined the list of identified hazards to mirror that of the Montana Multi-Hazard Mitigation Plan. In follow-up to the meeting, participants were provided a Geographic Information Systems (GIS) needs worksheet to facilitate the collection of information needed to support the plan update, and a summary of the conference call.

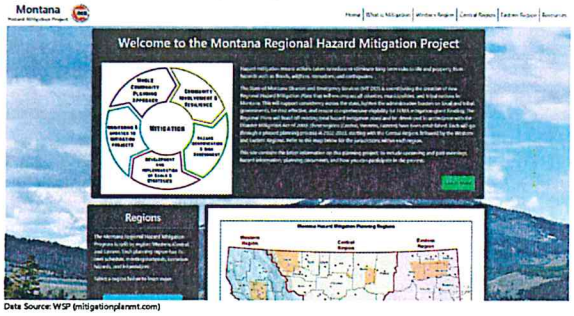
Following the initial coordination efforts, a series of planning workshops were held during the plan's development between March 2022 and August 2023. The meeting schedule and topics are listed below. In addition, monthly conference calls were held with the Emergency Management Coordinators, MT DES and WSP to discuss the process including upcoming milestones and information needs. The sign-in sheets, meeting summaries, and agendas for each of the meetings are documented in Appendix B. HMPC planning workshops were scheduled as follows.

- **Workshop #1:** Kickoff Meeting
  - August 9, 2022
- **Workshop #2:** Hazard Identification and Risk Assessment and Goals Update
  - December 14, 2022
  - The purpose of this workshop was to review the results of the risk assessment and review and update/develop goals.
- **Workshop #3:** Mitigation Strategy Update
  - Five in-person workshops were held in the Eastern Region:
    - April 3, 2023 – Billings, Montana
    - April 4, 2023 – Sidney, Montana
    - April 5, 2023 – Wolf Point, Montana
    - April 6, 2023 – Miles City, Montana
    - April 7, 2023 – Billings, Montana
  - This workshop focused on the update of the mitigation strategy and brainstorming new mitigation actions to include in the Regional HMP.

To further supplement the meetings, the WSP developed a project website to help explain the background details of the project, provide education and information on the processes of hazard mitigation planning, advertise public outreach efforts, and post-meeting materials and plan documents to be available for review. Each CPT and TPT were also asked to advertise the project website to inform and involve their stakeholders and their communities. Figure 3-2 shows a snapshot of the homepage of the project website, which is also available at mitigationplanmt.com.

The public survey included a question on ranking hazard significance. The results generally track with the significance levels noted in Chapter 4 of this Plan, with severe winter weather, severe summer weather, wildfire, and drought rated the most significant, and tornado and windstorms and flooding rated medium significance. The following graph is a display of the results from Question 17, which asked what types of mitigation actions should have the highest priority in the Eastern Region HMP. The results indicate that electrical power resiliency, improve reliability of communication systems, and public education awareness were popular mitigation topics with the public Figure 3-3). The full results of the survey are included in Appendix C.

Figure 3-2 Montana Hazard Mitigation Project Website



Data Source: WSP (mitigationplanmt.com)

In some cases, HMPC meetings were supplemented with additional meetings, emails, and telephone discussions to further engage the municipalities in the process. During the supplemental meetings, MT DES and the CPTs and TPTs worked on the Plan Update Guides and later in the process Plan Revision Needs Lists designed to capture additional and more detailed information on county capabilities, hazard risks, mitigation actions, and outreach efforts. As previously noted, the Fort Peck Tribes, Northern Cheyenne Tribe, and Wheatland County elected not to participate in the Regional Plan. Wheatland County recently updated their county HMP in 2021 and had limited staff resources. The Northern Cheyenne Tribe elected not to participate due to limited staff and resources, and the Fort Peck Tribes are currently updating their plan as part of a separate process.

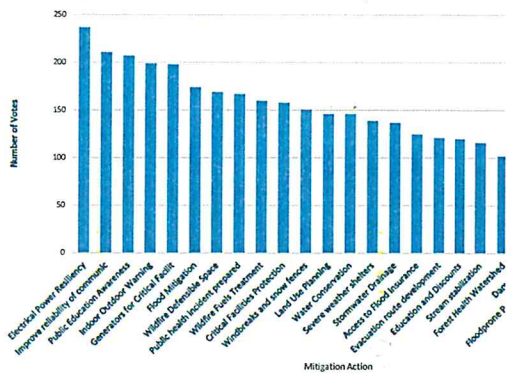
Planning Step 2: Involve the Public

The 2022-2023 planning process was an open one, with the public informed and involved throughout the process. In some cases, the HMPC meetings included members of the public and/or local media. Public outreach included social media notices, a public survey, and a public comment form to allow the public the opportunity to share comments on the draft plan.

2022 Public Survey

Early in the planning process, a public survey was developed as a tool to gather public input. The survey was for the public to provide feedback to the CPTs and TPTs on topics related to hazard concerns and reducing hazard impacts. The survey provided an opportunity for public input during the planning process, prior to the finalization of the plan update. The survey gathered public feedback on what hazards concern them and solicited input on strategies to reduce their impacts. The survey was released as an online tool in September 2022 and closed in December 2022. The counties and tribes provided links to the public survey by distributing it using social media, email, and posting the link on websites. In total, 407 survey responses were received and shared with the CPTs and TPTs to inform the process.

Figure 3-3 Eastern Montana Public Survey Results



Prior to finalizing, a draft of the regional plan was made available to the public for review and comment from February 21, 2024, to March 29, 2024 (over 1-month comment period). The plan was placed on the MT DES web page, on the MTDES website (mitigationplanmt.com), as well as via an online engagement space, as shown in Figure 3-4. The counties used social media and email blasts to announce the public comment period. An online feedback form was provided to collect specific comments. One comment from the City of Sidney was received through the form, and no additional email or public comments were provided. The one comment received on the plan noted a minor error in reference to the City of Sidney that was corrected; no other meaningful changes were made to the HMP or its Annexes.

Figure 3-4 Regional Hazard Mitigation Plan Virtual Public Engagement Space

Planning Step 3: Coordinate with Other Departments and Agencies

Early in the planning process, the HMPC determined that data collection, mitigation strategy development, and Plan approval would be greatly enhanced by inviting state and federal agencies and other organizations to participate in the process. Neighboring communities, tribal and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development, as well as other businesses, academia, and private and NGO organizations, were also invited to provide feedback. Based on their involvement in hazard mitigation activities or their role in land stewardship in the Eastern Region, representatives from several state and federal agencies and local businesses were included in the HMPC in 2022 and are noted in Appendix A. Many of these stakeholders participated in planning meetings or were provided an opportunity to review the draft plan before it was finalized. If they did not have an opportunity to review the plan during early stakeholder engagement efforts, they were provided the plan during the public review period. Some of the State and Federal agencies, which were invited to participate in the process, provided data and information for the Plan update, or provided feedback on the Plan include:

- Montana Department of Natural Resources & Conservation (DNRC)
- Montana Department of Transportation
- Montana Bureau of Mines & Geology
- Montana Fish, Wildlife, & Parks
- FEMA Region VIII
- EPA
- US Forest Service
- US Air Force
- Bureau of Indian Affairs

- Bureau of Land Management
- Bureau of Reclamation
- NOAA/NWS
- US Army Corps of Engineers

Coordination with certain agencies occurred on a regular basis during the planning process, including a bi-weekly (and weekly in the initial months of the project) coordination call with WSP, MT DES and other stakeholders. Other federal stakeholders that participated in these meetings included FEMA Region VIII, the Environmental Protection Agency (EPA), and the US Army Corps of Engineers (USACE). Other stakeholders included private NGOs (i.e., Headwaters Economics), and a consulting firm involved in the update of the Montana State Multi-Hazard Mitigation Plan. USACE representatives also participated in regional mitigation strategy workshops, including providing information on funding programs and suggestions for partnerships on mitigation actions.

Other Community Planning Efforts and Hazard Mitigation Activities

Coordination with other community planning efforts is an important aspect of mitigation planning. Hazard mitigation planning involves identifying existing policies, tools, and actions that will reduce a community's risk and vulnerability to natural hazards. Each county, the tribes, and most municipalities in the Region use a variety of comprehensive planning mechanisms, such as master plans and ordinances, to guide growth and development. Integrating existing planning efforts and mitigation policies and action strategies into this plan establishes a credible and comprehensive plan that ties into and supports other community programs. The development of this plan incorporated information from the following existing plans, studies, reports, and initiatives as well as other relevant data from neighboring communities and other jurisdictions. Examples of this include.

- County comprehensive plans
- Community Wildfire Protection Plans (CWPPs)
- Montana State Multi-Hazard Mitigation Plan (2018)
- Existing Local and Tribal HMPs
- Montana Forest Action Plan (2020)
- Montana Climate Solutions Plan (2020)

Other documents were reviewed and cited, as appropriate, during the collection of data to support Planning Steps 4 and 5, which include the hazard identification, vulnerability assessment, and capability assessment, are noted in Appendix E References.

3.3.2 Phase 2: Assess Risks

Planning Steps 4 and 5: Identify the Hazards and Assess the Risks

WSP led the HMPC and CPT/TPTs to identify and document all the hazards that have, or could, impact the planning area. The existing county and tribal HMPs, and the Montana State Multi-Hazard Mitigation Plan provided a knowledge basis for many of the hazard profiles. Where data permitted, GIS was used to display, analyze, and quantify hazards and vulnerabilities. Quantitative spatial analyses for dam inundation, flood, earthquake, and wildfire hazards were performed by WSP that included an analysis of flood risk based on the Digital Flood Insurance Rate Maps (DFIRMs), where available. A more detailed description of the risk assessment process and the results are included in Chapter 4 Hazard Analysis and Risk Assessment.

Also included in the Eastern Regional HMP is a capability assessment to review and document the planning area's current capabilities to mitigate risk and vulnerability from hazards. By collecting information about existing government programs, policies, regulations, ordinances, and emergency plans, the HMPC can assess those activities and measures already in place that contribute to mitigating some of the risks and

vulnerabilities identified. The results of the updated capability assessment are captured in each annex and addendum.

During this phase, the tribes and participating jurisdictions reviewed hazard significance levels, as described in Chapter 4, to determine if any changes in priorities were needed. Additional feedback on priority levels was solicited during Workshop #2, using an online polling tool and in-person during Workshop #3.

3.3.3 Phase 3: Develop the Mitigation Plan

Planning Steps 6 and 7: Set Goals and Review Possible Activities

WSP facilitated a week of discussion sessions (Workshop #3) with the HMPC that described the purpose and the process of developing planning goals, a comprehensive range of mitigation alternatives, and a method of selecting and defending recommended mitigation actions using a series of selection criteria. This process was used to update and enhance the mitigation action plan for each jurisdiction and tribe, which is the essence of the planning process and one of the most important outcomes of this effort. This process consisted of five mitigation strategy workshops scheduled across the Eastern Montana region, including several meetings scheduled and advertised in rural communities (e.g., Sidney, Wolf Point) and at senior centers and community health facilities. The action plans are detailed in each county and tribe annex and addendum; the process used to identify and prioritize mitigation actions is described in greater detail in Chapter 5 Mitigation Strategy.

During this phase the tribes and participating jurisdictions reviewed mitigation action priority levels, as described in Chapter 5, to determine if any changes in priorities were needed using a mitigation action status tool. The tribes and participating jurisdictions also developed and prioritized new mitigation actions. Figure 3-5 shows the CPTs and TPTs developing new mitigation actions during the Workshop #3 series in Eastern Montana.

Figure 3-5 Eastern Montana HMP Workshops – Mitigation Strategy Update

Data Source: WSP 2023

Planning Step 8: Draft an Action Plan

Based on input from the HMPC regarding the draft risk assessment and the goals and activities identified in Planning Steps 6 and 7, WSP produced a complete first draft of the Eastern Regional Plan. This complete draft was shared for HMPC and CPT/LPT review and comment by email from the consultant and posted on the project website and cloud-based share drive. During this time, MT DES and WSP identified areas where additional one-on-one meetings and additional data was needed in the plan, and then collected that data and input and incorporated the final revisions. Comments were integrated into the second draft, which was advertised and distributed to collect public input and comments. Other agencies and neighboring county Emergency Management Coordinators were also invited to comment on this draft. WSP integrated comments and issues from the public, as appropriate, along with additional internal review comments and produced a final draft for MT DES and FEMA Region VIII to review and approve, contingent upon final adoption by the governing boards of each participating jurisdiction.

3.3.4 Phase 4: Implement the Plan and Monitor Progress

Planning Step 9: Adopt the Plan

To secure buy-in and officially implement the plan, the plan was adopted by the governing boards of each participating jurisdiction. As the adoption process follows the FEMA plan review and approval, copies of the adoption resolution will be included electronically in Appendix D.

Planning Step 10: Implement, Evaluate, and Revise the Plan

The true worth of any mitigation plan is in the effectiveness of its implementation. Each recommended action includes key descriptors, such as a lead manager and possible funding sources, to help initiate implementation. Progress on the implementation of specific actions identified in the plan is captured in a discussion and the mitigation action plan summary table in Chapter 5 Mitigation Strategy. An overall implementation strategy is described in Chapter 6 Plan Adoption, Implementation and Maintenance.

Finally, there are numerous organizations within the Eastern Region whose goals and interests interface with hazard mitigation. Coordination with these other planning efforts, as addressed in Planning Step 3, is important to the ongoing success of this plan, and mitigation in Eastern Montana and is addressed further in Chapter 6. A plan update and maintenance schedule and a strategy for continued public involvement are also included in Chapter 6, and specifics are also in the annexes for the participating counties and tribes.

3.4 Tribal Mitigation Planning Process

The Eastern Montana Regional HMP meets the requirements for Tribal Mitigation Plans described in Title 44 of the Code of Federal Regulations, Section 201.7 (44 CFR § 201.7). Under the Sandy Recovery Improvement Act of 2013, federally recognized tribal governments could obtain their major disaster declaration for the first time, enabling them to apply to FEMA for disaster assistance independent of the state obtaining a declaration. The Tribal Mitigation Planning Handbook outlines a 7-step planning process for the development of mitigation plans, which meet the needs of tribal governments. These 7 steps are summarized in Table 3-3.

Table 3-3 Tribal Mitigation Planning 7-Step Process

Planning Step	Title	Description
1	Describe your community	Describe the planning area, Tribal assets, and any unique characteristics of your Tribe.
2	Identify your hazards	Figure out what natural hazards could occur in your planning area.
3	Explain impacts that hazards can have on the community	Describe what the natural hazards could do to your people, property, and land and determine the Tribe's biggest hazard concerns.
4	Review your current capability to mitigate the impacts	Inventory your Tribe's plans, policies, and programs that could be used to protect your community.
5	Develop the strategy	Keeping in mind your risks and your capabilities, identify your Tribe's mitigation goals and actions.
6	Develop an action plan	Prioritize your actions and develop the details to assist with implementation.
7	Keep track of progress	Observe and record progress in implementing your mitigation program using a defined method and schedule.

3.5 EPA Regional Resilience Toolkit

The EPA, in partnership with FEMA, has developed the Regional Resilience Toolkit to focus on the development of resilient communities on the regional scale at which disasters happen. As stated in the toolkit, with more and more communities facing the effects of disasters, decision-makers and community members need tools and guidance to help them take action that can protect them from natural disasters while also creating great places to live, work, and play. This Regional Resilience Toolkit provides:

- A coordinated process for meeting many different state and federal planning requirements.
- Communication and outreach guidance and resources for engaging a broad coalition of stakeholders across a region.
- Guidance for project teams who are conducting vulnerability assessments, writing required plans, and implementing projects.
- Clear information and tools that can be used with an advisory group and bring in decision-makers and community leaders to guide the overall action plan and ensure its successful implementation.
- Detailed appendices with worksheets to help inform and guide work, as well as additional information and resources for each step.

The toolkit includes five steps designed so that users can follow at any point of the process depending on their progress with community resilience planning. These five steps are shown in Figure 3-6 below:

Figure 3-6 EPA Regional Resilience Toolkit Planning Steps

Source: EPA Regional Resilience Toolkit, https://www.epa.gov/smartgrowth/regional-resilience-toolkit

The toolkit also relies in part on engaging state and federal partners who have funding, policies, and programs intended to support local efforts to create sustainable and resilient communities, helping to supplement the mitigation strategy of this regional HMP. Like the FEMA mitigation planning process, the steps of the resilience toolkit are intended to ideally work in a continuous loop improving planning and community resilience over time. This is a valuable tool for the development of the Eastern Montana Regional HMP, due to the large scale of the planning area and the history of hazards that have had regional impacts.

4 Hazard Identification and Risk Assessment

44 CFR Requirement 201.6(c)(2):

[The plan shall include] a risk assessment that provides the factual basis for activities proposed in the strategy to reduce the 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.

As defined by the Federal Emergency Management Agency (FEMA), risk is a combination of hazard, vulnerability, and exposure. "It is the impact that a hazard would have on people, services, facilities, and structures in a community and refers to the likelihood of a hazard event resulting in an adverse condition that causes injury or damage."

The risk assessment process identifies and profiles relevant hazards and assesses the exposure of lives, property, and infrastructure to these hazards. The process allows for a better understanding of a jurisdiction's potential risk to hazards and provides a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events.

This risk assessment builds upon the methodology described in the 2013 FEMA Local Mitigation Planning Handbook, which recommends a four-step process for conducting a risk assessment:

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

Data collected through this process has been incorporated into the following sections of this chapter:

Section 4.1 Hazard Identification identifies the hazards that threaten the planning area and describes why some hazards have been omitted from further consideration.

Section 4.2 Hazard Profiles discusses the threat to the planning area and describes previous occurrences of hazard events, the likelihood of future occurrences, and the Region's vulnerability to particular hazard events.

Additional County Annexes include a summary of community assets including population, building stock, critical facilities, and historic, cultural, and natural resources. Additional details on vulnerability to specific hazards where they vary from those of the Region are noted in the annexes.

4.1 Hazard Identification

Requirement 201.6(c)(2)(i):

The risk assessment shall include a] description of the type of all natural hazards that can affect the jurisdiction.

4.1.1 Results and Methodology

Using existing hazards data, plans from participating jurisdictions, and input gained through planning and public meetings, the County and Tribal Planning Teams (CPT/TPTs) agreed upon a list of hazards that could affect the Region.

Hazards data from FEMA, Montana Disaster and Emergency Services (DES), the 2018 State of Montana Multi-Hazard Mitigation Plan, approved county and tribal plans from the participating Eastern Region counties, and many other sources were examined to assess the significance of these hazards to the planning area. The hazards evaluated in this plan include those that have occurred historically or have the potential to cause significant human and/or monetary losses in the future.

The final list of hazards identified and investigated for the 2022/2023 Eastern Region Multi-Hazard Mitigation Plan includes:

- Communicable Disease
- Cyber Attack
- Dam Failure
- Drought
- Earthquake
- Flooding
- Hazardous Materials Incidents
- Landslide
- Severe Summer Weather
- Severe Winter Weather
- Human Conflict
- Tornadoes & Windstorms
- Transportation Accidents
- Volcanic Ash
- Wildfire

Members of each CPT and TPT used a hazards worksheet to rate the significance of hazards that could potentially affect the region. Significance was measured in general terms, focusing on key criteria such as the likelihood for future occurrences of the event, frequency of past occurrences, geographical area affected, and damage and casualty potential. Table 4-1 represents the worksheet used to identify and rate the hazards and is a composite that includes input from all the participating jurisdictions. Note that the significance of the hazard may vary from jurisdiction to jurisdiction. The County Annexes include further details on hazard significance by county and municipality.

Table 4-1 Eastern Region Hazard Significance Summary Table

Hazard	Geographic Area	Magnitude/ Severity	Probability	Significance
Communicable Disease	Extensive	Critical	Occasional	Medium
Cyber-Attack	Significant	Critical	Occasional	Medium
Dam Failure	Significant	Limited	Unlikely	Low
Drought	Extensive	Critical	Highly Likely	High
Earthquake	Significant	Limited	Likely	Low
Flooding	Limited	Critical	Likely	High
Hazardous Material Incidents	Limited	Negligible	Highly Likely	Low
Landslide	Limited	Negligible	Occasional	Low
Severe Summer Weather: hail, excessive heat, heat, heavy rain, lightning	Extensive	Critical	Highly Likely	High
Severe Winter Weather: blizzard, cold/wind chill, extreme cold/wind chill, heavy snow, ice storm, winter storm, winter weather	Extensive	Critical	Highly Likely	Medium
Human Conflict (Terrorism, Civil Unrest, etc.)	Significant	Critical	Occasional	Medium
Tornadoes & Windstorms	Extensive	Critical	Highly Likely	High
Transportation Accidents	Significant	Limited	Highly Likely	Medium
Volcanic Ash	Extensive	Limited	Unlikely	Low
Wildfire	Extensive	Critical	Highly Likely	High

Geographic Area
Negligible: Less than 10 percent of planning area or isolated single-point occurrences
Limited: 10 to 25 percent of the planning area or limited single-point occurrences
Significant: 25 to 75 percent of planning area or frequent single-point occurrences
Extensive: 75 to 100 percent of planning area or consistent single-point occurrences

Potential Magnitude/Severity
Negligible: Less than 10 percent of property is severely damaged, facilities and services are unavailable for less than 24 hours, injuries and illnesses are treatable with first aid or within the response capability of the jurisdiction.
Limited: 10 to 25 percent of property is severely damaged, facilities and services are unavailable between 1 and 7 days, injuries and illnesses require sophisticated medical support that does not strain the response capability of the jurisdiction, or results in very few permanent disabilities.
Critical: 25 to 50 percent of property is severely damaged, facilities and services are unavailable or severely hindered for 1 to 2 weeks, injuries and illnesses overwhelm medical support for a brief period of time or result in many permanent disabilities and a few deaths. overwhelmed for an extended period of time or many deaths occur.
Catastrophic: More than 50 percent of property is severely damaged, facilities and services are unavailable or hindered for more than 2 weeks, the medical response system is overwhelmed for an extended period of time or many deaths occur.

Probability of Future Occurrences
Unlikely: Less than 1 percent probability of occurrence in the next year or has a recurrence interval of greater than every 100 years.
Occasional: Between a 1 and 10 percent probability of occurrence in the next year or has a recurrence interval of 11 to 100 years.
Likely: Between 10 and 90 percent probability of occurrence in the next year, or has a recurrence interval of 1 to 10 years
Highly Likely: Between 90 and 100 percent probability of occurrence in the next year or has a recurrence interval of less than 1 year.

Overall Significance
Low: Two or more of the criteria fall in the lower classifications or the event has a minimal impact on the planning area. This rating is also sometimes used for hazards with a minimal or unknown record of occurrences/impacts or for hazards with minimal mitigation potential.
Medium: The criteria fall mostly in the middle ranges of classifications and the event's impacts on the planning area are noticeable but not devastating. This rating is also sometimes utilized for hazards with a high impact rating but an extremely low occurrence rating.
High: The criteria consistently fall along the high ranges of the classification and the event exerts significant and frequent impacts on the planning area. This rating is also sometimes utilized for hazards with a high psychological impact or for hazards that the jurisdiction identifies as particularly relevant.

4.1.2 Other Hazards Considered but not Profiled

As part of the hazard identification process, the Regional Steering Committee and CPT/TPTs also noted other hazards that could impact the region but are not further profiled as impacts tend to be more isolated or do not result in local, state, or federal disaster declarations. These include wildlife hazards associated with human/wildlife interaction and collisions, and avalanches. Avalanche terrain exists on the far southwestern portion of the Eastern region but typically impacts isolated and undeveloped areas.

4.1.3 Disaster Declaration History

As part of the hazard identification process, the Regional Steering Committee and CPT/TPTs researched past events that triggered federal and/or state emergency or disaster declarations in the planning area. Federal and/or state disaster declarations may be granted when the severity and magnitude of an event surpasses the ability of the local government to respond and recover. Disaster assistance is supplemental and sequential. When the local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. Should the disaster be so severe that both the local and state governments' capacities are exceeded, a federal emergency or disaster declaration may be issued allowing for the provision of federal assistance.

The federal government may issue a disaster declaration through FEMA, the U.S. Department of Agriculture (USDA), and/or the Small Business Administration (SBA). FEMA also issues emergency declarations, which are more limited in scope and without the long-term federal recovery programs of major disaster declarations. The quantity and types of damage are the determining factors.

A USDA declaration will result in the implementation of the Emergency Loan Program through the Farm Services Agency. This program enables eligible farmers and ranchers in the affected county as well as contiguous counties to apply for low interest loans. A USDA declaration will automatically follow a major disaster declaration for counties designated major disaster areas and those that are contiguous to declared counties, including those that are across state lines. As part of an agreement with the USDA, the SBA offers low interest loans for eligible businesses that suffer economic losses in declared and contiguous counties that have been declared by the USDA. These loans are referred to as Economic Injury Disaster Loans.

Table 4-2 provides information on federal emergencies and disasters declared in the Eastern Region counties between 1953 and 2022. Table 4-3 provides information on state emergencies and disasters declared in the Central Region and documented in the 2023 SHMP update.

Table 4-2 Federal Disaster Declarations in the Eastern Region, 1953-2022

Year	Declaration Title	Disaster Number	Area Impacted
1975	Rains, Snowmelt, Storms & Flooding	DR-472-MT	Wheatland
1977	Drought	EM-3050-MT	Golden Valley, Musselshell
1978	Flooding, Severe Storms	DR-558-MT	Big Horn, Carbon, Powder River, Rosebud, Stillwater, Treasure, Yellowstone
1986	Heavy Rains, Landslides & Flooding	DR-761-MT	Daniels, Dawson, Valley
1986	Severe Storms & Flooding	DR-777-MT	McCone, Rosebud, Valley
1997	Severe Storms, Ice Jams, Snow Melt, Flooding	DR-1183-MT	All counties in Eastern Region
1999	Fishel Creek Fire Complex	FSA-2266-MT	Musselshell
2000	Willie Fire	FSA-2326-MT	Carbon
2000	Wildfires	DR-1340-MT	Most counties in Eastern Region except Daniels, Dawson, McCone, Prairie, Richland, Sheridan, Valley, and Wibaux
2000	Winter Storm	DR-1350-MT	Carter, Fallon, McCone, Richland, Roosevelt, Sheridan, Wibaux
2001	Severe Storms	DR-1377-MT	Big Horn
2003	Missouri Breaks Fire Complex	FM-2483-MT	Garfield
2005	Hurricane Katrina Evacuation	EM-3253-MT	Statewide
2006	Saunders Fire	FM-2652-MT	Stillwater
2006	Derby Fire	FM-2671-MT	Stillwater
2006	Emerald Hills Fire	FM-2669-MT	Yellowstone
2007	Ford Road Fire	FM-2723-MT	Yellowstone
2008	Severe Winter Storm	DR-1767-MT	Carter, Custer, Fallon, Powder River
2009	Eagle Mount Fire	FM-2837-MT	Stillwater
2011	Severe Storms and Flooding	DR-1996-MT	All counties in Eastern Region
2011	Canyon Creek Fire	FM-2950-MT	Yellowstone
2012	Dahl Fire	FM-2988-MT	Musselshell
2012	Ask Creek Fire	FM-2989-MT	Powder River, Rosebud
2012	Montana Wildfires	DR-4074-MT	Rosebud, Powder River
2013	Flooding	DR-4127-MT	Musselshell, Rosebud, Custer, Dawson, McCone, Valley, Garfield
2014	Ice Jams and Flooding	DR-4172-MT	Stillwater, Wheatland, Golden Valley, Musselshell, Rosebud, Prairie, Dawson, Richland
2014	Severe Storms, Straight-Line Winds, and Flooding	DR-4198-MT	Carter, Musselshell, Valley

Year	Declaration Title	Disaster Number	Area Impacted
2016	Tornado	DR-4275-MT	Fallon
2017	Lodgepole Fire Complex	FM-5194-MT	Garfield
2018	Flooding	DR-4388-MT	Valley
2018	Flooding	DR-4405-MT	Carbon, Custer, Golden Valley, Musselshell, Treasure
2019	Flooding	DR-4437-MT	Daniels, Valley, McCone, Power River, Treasure, Stillwater
2020	Covid-19	EM-3476-MT	Statewide
2020	Covid-19 Pandemic	DR-4508-MT	Statewide
2020	Snider/Rice Fire Complex	FM-5345-MT	Custer, Powder River, Rosebud
2020	Huff Fire	FM-5343-MT	Garfield
2020	Bobcat Fire	FM-5344-MT	Musselshell, Yellowstone
2020	Falling Star Fire	FM-5324-MT	Stillwater, Yellowstone
2021	Poverty Flats Fire	FM-5403-MT	Big Horn
2021	Straight-Line Winds	4608-DR-MT	Garfield, McCone, Roosevelt, Richland, Dawson
2021	Robertson Draw Fire	FM-5392-MT	Carbon
2021	Richard Spring Fire	FM-5406-MT	Rosebud
2021	Richard Spring Fire	4623-DR-MT	Rosebud, Big Horn
2021	Buffalo Wildfire	FM-5399-MT	Yellowstone
2022	Severe Storms and Flooding	DR-4655-MT	Carbon, Stillwater, Yellowstone

Source: FEMA

Table 4-3 State-declared emergencies and disasters presented in the 2023 SHMP

Year	Hazard	State Declaration		County (Town)
1978	Flood	E0-13-78	PA-ST-78-12	Petroleum County
1978	Flood	E0-13-78	PA-ST-78-11	Petroleum County (Winnett)
1979	Flood	PA-ST-79-10		Fergus County (Denton)
1979	Flood	PA-ST-79-11		Petroleum County
1991	Flood	EO-15-91	MT-2-91	Blaine County
1991	Flood	EO-33-91	MT-4-91	Blaine County
1991	Flood	EO-12-91	MT-1-91	Teton County
1992	Drought	EO 13-92		Statewide
1993	Drought	EO 14-92		Statewide
1994	Flood	EO-04-94	MT-1-94	Petroleum County
1998	Flood	EO-10-98	MT-2-98	Hill County
2005	Flood	EO-11-2005	MT-2-05	Chouteau County
2010	Flood	EO-21-2010	MT-4-10	Petroleum County
2018	Cold & Blizzard Conditions	EO 5-2018		Blackfeet Nation, Fort Belknap Reservation, Northern Cheyenne Reservation, Glacier County, Golden Valley County
2018	Flood	EO-20-2018		Cascade County, Lewis and Clark County, Lewis and Clark County (Great Falls)
2018	Flood	EO-11-2018		Fort Belknap Indian Reservation, Town of Chester, Counties: Pondera, Hill, Blaine, Valley, Toole, Liberty, Petroleum

Year	Hazard	State Declaration		County (Town)
2018	Flood	EO-11-2018		Liberty County (Chester)
2019	Severe Winter Weather	EO 15-2019		Statewide
2019	Flood	EO-13-2019		Teton County
2020	Wildfire	EO-8-2020		Statewide
2021	Wildfire	EO-12-2021		Statewide
2021	Drought	EO 11-2021		Statewide
2022	Harsh Winter Conditions	EO 1-2022		Statewide

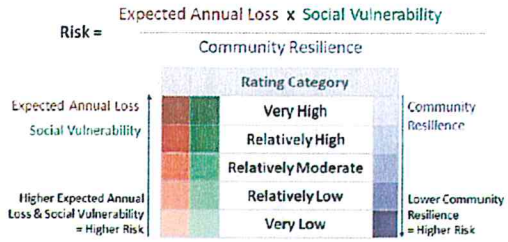
Source: State of Montana

4.1.4 National Risk Index Overview

During the 2022/2023 planning process a relatively new online risk assessment tool became available from FEMA. The National Risk Index (NRI) is a dataset and online tool that helps illustrate the United States communities most at risk for 18 natural hazards. It was designed and built by FEMA in close collaboration with various stakeholders and partners in academia; local, state, and federal government; and private industry. The NRI leverages available source data for natural hazard and community risk factors to develop a baseline relative risk measurement for each United States county and census tract. The NRI's interactive mapping and data-based interface enables users to visually explore individual datasets to better understand what is driving a community's natural hazard risk. Users may also create reports to capture risk details on a community or conduct community-based risk comparisons, as well as export data for analysis using other software. Intended users of the NRI include planners and emergency managers at the local, regional, state, and federal levels, as well as other decision makers and interested members of the general public.

The NRI provides relative Risk Index scores and ratings based on data for Expected Annual Loss (EAL) due to natural hazards, social vulnerability, and community resilience. Separate scores and ratings are also provided for each component: Expected Annual Loss, Social Vulnerability, and Community Resilience. Figure 4-1 illustrates the NRI risk equation and components that define risk based on the expected annual loss times the social vulnerability divided by a community's resilience to that potential hazard.

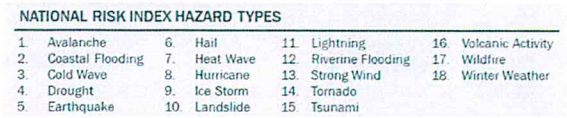
Figure 4-1 Generalized National Risk Index Risk Equation and Components



Source: FEMA NRI Technical Documentation 2021

For the Risk Index and EAL, scores and ratings can be viewed as a composite score for all hazards or individually for each of the 18 hazard types. These 18 hazard types are listed in Figure 4-2.

Figure 4-2 National Risk Index Hazard Types



The NRI was evaluated by the Regional Steering Committee and Montana DES's planning consultant to determine its applicability to the Eastern Region HIRA. An added benefit of leveraging NRI data for the regional plan included standardized methods for assessing risk on a county-by-county scale for most of the natural hazards in the HIRA. This included composite risk indicators for hazards previously lacking necessary data, consisting of subsets of summer and winter storms including cold wave, lightning, wind, and ice storms. The other benefit is that moving forward, FEMA will be periodically updating and improving the NRI, which should provide a valuable and standardized resource for future HIRA updates.

The HIRA sections for Drought, Landslide, Flood, Severe Summer Weather, Severe Winter Weather, and Tornadoes & Windstorms contain the following aggregate risk products, mapped by WSP using NRI data:

- Annualized Frequency
- Composite Risk Index Rating
- Expected Annual Loss

Sources of hazards and exposure data includes SHELDUS, National Oceanic and Atmospheric Administration (NOAA), U.S. Geological Survey (USGS), National Weather Service (NWS), and the USDA. Consequences of hazard occurrences are categorized into three different types: buildings, population, and agriculture.

These lifeline categories standardize the classification of critical facilities and infrastructure that provide indispensable service, operation, or function to a community. A lifeline is defined as providing indispensable service that enables the continuous operation of critical business and government functions, and is critical to

and safety, or economic security. These categorizations are particularly useful as they:

- Enable effort consolidations between government and other organizations (e.g., infrastructure owners and operators).
- Enable integration of preparedness efforts among plans; easier identification of unmet critical facility needs.
- Refine sources and products to enhance awareness, capability gaps, and progress towards stabilization.
- Enhance communication amongst critical entities, while enabling complex interdependencies between government assets.
- Highlight lifeline related priority areas regarding general operations as well as response efforts.

A summary of the critical facilities inventory for the Eastern Region can be found in Table 4-4 below.

Table 4-4 Summary of Critical Facilities Exposure Summarized by FEMA Lifelines

County	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Total
Big Horn	41	53	28	6	0	33	137	298
Carbon	38	37	18	3	3	35	86	220
Carter	11	5	1	0	1	11	44	73
Custer	29	25	9	2	4	30	76	175
Daniels	12	14	0	0	0	13	40	79
Dawson	34	14	6	5	2	26	110	197
Fallon	21	41	4	2	0	16	39	123
Garfield	16	1	3	0	1	12	32	65
Golden Valley	2	16	4	0	2	10	20	54
McCone	20	13	4	2	1	10	49	99
Musselshell	1	2	11	0	3	17	1	35
Petroleum	0	0	0	0	0	0	1	1
Phillips	0	0	0	0	0	0	2	2
Powder River	14	3	4	0	1	14	25	61
Prairie	10	12	3	1	2	9	49	86
Richland	32	40	8	14	5	29	104	232
Roosevelt	53	38	9	11	0	40	62	213
Rosebud	52	41	15	2	4	30	119	263
Sheridan	27	24	6	1	2	19	68	147
Stillwater	32	26	7	4	2	35	98	204

Additional details can be referenced in the FEMA NRI Technical documentation 2021, available at https://hazards.fema.gov/nri/.

4.1.5 Assets Summary

Building and Critical Facility Assets

Assets inventoried for the purpose of determining vulnerability include people, buildings, critical facilities, and natural, historic, or cultural resources. For the regional planning process two standard databases were utilized for the basis of building and critical facility data. The Montana Spatial Data Infrastructure (MSDI) Cadastral Parcel layer (April 2022) was used for improved parcel and building inventory throughout the region. This information provided the basis for building exposure and property types. Data current as of 2022 was downloaded for all the counties within the Eastern Region, which was then analyzed using Geographic Information Systems (GIS) to create a centroid, or point, representing the center of each parcel polygon, for vulnerability analysis. A critical facility is defined as one that is essential in providing utility or direction either during the response to an emergency or during the recovery operation. Much of this data is based on GIS databases associated with the 2022 Homeland Infrastructure Foundation-Level Data (HIFLD). Other critical facility databases were also used, such as the National Bridge Inventory (NBI) and data from Montana DES. Where applicable, this information was used in an overlay analysis for hazards such as flood and wildfire. More detail on assets potentially exposed to hazards can be found in the county annexes.

FEMA organizes critical facilities into seven lifeline categories as shown in Figure 4-3.

Figure 4-3 FEMA Lifeline Categories

County	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Total
Treasure	7	13	2	0	1	7	34	64
Valley	58	40	15	1	2	33	105	254
Wheatland	16	25	3	0	2	15	32	93
Wibaux	5	7	2	0	1	9	29	53
Yellowstone	232	78	63	37	26	157	295	888
Total	**763**	**568**	**225**	**91**	**65**	**610**	**1,657**	**3,979**

Source: HIFLD 2022, Montana DES, NBI

Natural Resource Assets

In addition to building and critical facility assets, natural resource assets such as wetlands, forests, animals, and protected areas, are important to include in benefit-cost analyses for future hazard mitigation projects. Natural resources are valuable to communities due to their benefits to water quality, wildlife protection, recreation, and education. Additionally, awareness of these resources may be used to leverage additional funding for projects and contribute to a community's goal in protecting sensitive resources.

To further understand natural resources that may be particularly vulnerable to a hazard event, as well as those that need consideration when implementing mitigation activities, it is important to identify at-risk species (i.e., endangered species) in the planning area. An endangered species is any species of fish, plant life, or wildlife that is in danger of extinction throughout all or most of its range. A threatened species is a species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Both endangered and threatened species are protected by law and any future hazard mitigation projects are subject to these laws. The U.S. Fish and Wildlife Service Montana Ecological Services Field Office maintains a database which documents a list of threatened and endangered species in the State of Montana. Table 4-5 below summarizes these species and their status. A list of other natural resource assets by county and tribe can be found in the corresponding annexes.

Table 4-5 State of Montana Threatened and Endangered Species

Common Name	Scientific Name	Status	Range-Montana
Black-footed Ferret	*Mustela nigripes*	E/XN	Prairie dog complexes; eastern Montana
Whooping Crane	*Grus americana*	E	Wetlands; migrant eastern Montana
Pallid Sturgeon	*Scaphirhynchus albus*	E	Bottom dwelling: Missouri, Yellowstone, Marias, Milk, Poplar, Powder, Tongue Rivers
White Sturgeon (Kootenai River population)	*Acipenser transmontanus*	E	Bottom dwelling: Kootenai River
Grizzly Bear	*Ursus arctos horribilis*	T	Alpine/subalpine coniferous forest; Western Montana
Piping Plover	*Charadrius melodus*	T/CH	Missouri and Yellowstone River sandbars, alkali beaches; northeastern Montana. Alkali lakes in Sheridan County; riverine and reservoir shoreline in Garfield, McCone, Phillips, Richland, Roosevelt and Valley counties

Common Name	Scientific Name	Status	Range-Montana
Ute Ladies'-tresses	*Spiranthes diluvialis*	T	River meander wetlands; Jefferson, Madison, Beaverhead, Gallatin, Broadwater counties
Bull trout (Columbia River basin and St. Mary - Belly River populations)	*Salvelinus confluentus*	T/CH	Clark Fork, Flathead, Kootenai, St. Mary and Belly River basins; cold water rivers & lakes. Portions of rivers, streams, lakes and reservoirs within Deer Lodge, Flathead, Glacier, Granite, Lake, Lewis and Clark, Lincoln, Mineral, Missoula, Powell, Ravalli, Sanders counties
Canada Lynx (contiguous U.S. population)	*Lynx canadensis*	T/CH	Western Montana Resident – core lynx habitat; montane spruce/fir forests; Transient – secondary/peripheral lynx habitat. Western Montana - montane spruce/fir forest
Spalding's Catchfly	*Silene spaldingii*	T	Upper Flathead River and Fisher River drainages; Tobacco Valley - open grasslands with rough fescue
Yellow-billed cuckoo (western population)	*Coccyzus americanus*	T	Population west of the Continental Divide; riparian areas with cottonwoods and willows
Red Knot	*Calidris canutus rufa*	T	Migrant; eastern Montana plains along shorelines
Northern Long-eared Bat	*Myotis septentrionalis*	T	Eastern Montana; caves, abandoned mines; roosts in live trees and snags
Meltwater Lednian Stonefly	*Lednia tumana*	T	High elevation meltwater streams; Glacier, Flathead, and Lake Counties
Western Glacier Stonefly	*Zapada glacier*	T	Typically found in clean, cold running waters that have high oxygen content. Glacier and Carbon Counties
Whitebark Pine	*Pinus albicaulis*	T	Western, central, and southwestern Montana, in forests at upper subalpine elevations and near treeline
ENDANGERED (E) - Any species that is in danger of extinction throughout all or a significant portion of its range.			
THREATENED (T) - Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.			
NON-ESSENTIAL EXPERIMENTAL POPULATION (XN) - A population of a listed species reintroduced into a specific area that receives more flexible management under the Act.			
CRITICAL HABITAT, PROPOSED CRITICAL HABITAT (CH, PCH) - The specific areas (i) within the geographic area occupied by a species, at the time it is listed, on which are found those physical or biological features (I) essential to conserve the species and (II) that may require special management considerations or protection; and (ii) specific areas outside the geographic area occupied by the species at the time it is listed upon determination that such areas are essential to conserve the species.			

Source: Montana Ecological Services Field Office, https://www.fws.gov/office/montana-ecological-services/species

4.1.6 Social Vulnerability

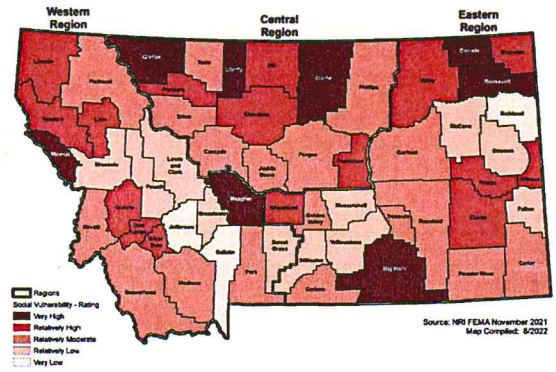
Social vulnerability is broadly defined as the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood. Social vulnerability considers the social, economic, demographic, and housing characteristics of a community that influence its ability to prepare for, respond to, cope with, recover from, and adapt to environmental hazards.

The NRI has incorporated a social vulnerability index (SoVI) rating[1] as a "consequence enhancing risk component" using the SoVI compiled by the Hazards and Vulnerability Research Institute in the Department of Geography at the University of South Carolina. This SoVI is a location-specific assessment and measures the social vulnerability of U.S. counties to environmental hazards utilizing 29 socioeconomic variables which have been deemed to influence a community's vulnerability. The comparison of SoVI values between counties within the State allows for a more detailed depiction of variances in risk and vulnerability. Figure

[1] As of 2024 the NRI has switched to use the social vulnerability index (SVI) produced by the CDC. The analysis here was done using the SoVI model described here. Both indices produce comparable results, with some important differences. Also see Tarling, H.A. (2017) Comparative analysis of social vulnerability indices: CDC's SVI and SoVI®, Lund University, Sweden, Masters Thesis, 75p.

4-4 shows this social vulnerability rating by county in Montana, with those counties shaded in darker red having the highest levels of social vulnerability.

Figure 4-4 Social Vulnerability Rating by County in Montana (2021)



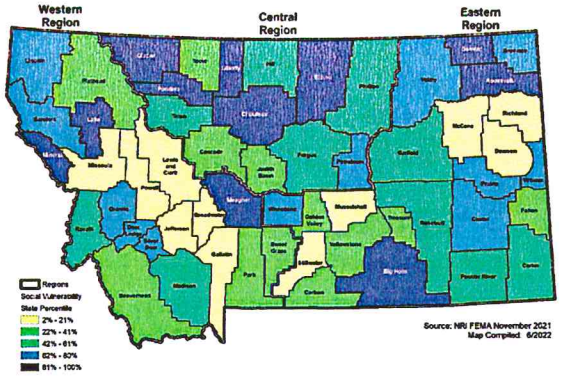
The index can be used by the State to help determine where social vulnerability and exposure to hazards overlaps and how and where mitigation resources might best be used. The SoVI provides a score between 0.01 and 100, with higher scores indicative of higher levels of social vulnerability. According to the index, the following, listed in order, are Montana's ten most socially vulnerable counties:

1. Glacier County (Score 75.72)
2. Roosevelt County (Score 70.60)
3. Big Horn County (Score 70.32)
4. Liberty County (Score 63.07)
5. Meagher County (Score 62.99)
6. Blaine County (Score 61.14)
7. Daniels County (Score 59.71)
8. Mineral County (Score 59.05)
9. Lake County (Score 55.77)
10. Chouteau County (Score 54.59)

Of these ten most socially vulnerable counties, only two, Roosevelt and Big Horn counties, are in the eastern region. Daniels County is also one of the counties in eastern Montana ranked "very high" for social

vulnerability. In addition to the ten counties listed above, Wheatland, Valley, Sanders, Granite, Sheridan, Deer Lodge, Silver Bow, Petroleum, and Lincoln also rank in the top 20% most socially vulnerable counties nationwide. Figure 4-5 below shows the percentile of each county's social vulnerability ranking on a national scale.

Figure 4-5 Social Vulnerability State Percentile



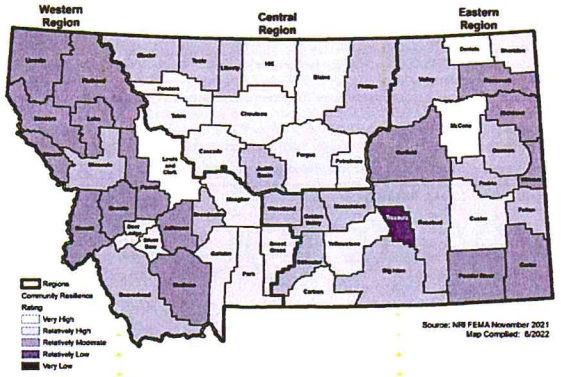
Community Resilience

Related to social vulnerability, the NRI utilizes community resilience as a "consequence reduction component". Community Resilience can essentially be thought of as an inverse to social vulnerability. The NRI defines community resilience as the ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions. There are multiple, well-established ways to define community resilience at the local level, and key drivers of resilience vary between locations. Because there are not nationally available, bottom-up community resilience indices available, the Social Vulnerability and Community Resilience Working Group chose to utilize a top-down approach. The NRI relies on using broad factors to define resilience at a national level and create a comparative metric to use as a risk factor.

The Community Resilience score is a consequence reduction risk factor and represents the relative level of community resilience in comparison to all other communities at the same level. A higher Community Resilience score results in a lower Risk Index score. Because Community Resilience is unique to a geographic location—specifically, a county—it is a geographic risk factor. Community resilience data are supported by the University of South Carolina's Hazards and Vulnerability Research Institute (HVRI) Baseline Resilience Indicators for Communities (BRIC). HVRI BRIC provides a sound methodology for quantifying community resilience by identifying the ability of a community to prepare and plan for, absorb, recover from, and more

successfully adapt to the impacts of natural hazards. The HVRI BRIC dataset includes a set of 49 indicators that represent six types of resilience: social, economic, community capital, institutional capacity, housing/infrastructure, and environmental. It uses a local scale within a nationwide scope, and the national dataset serves as a baseline for measuring relative resilience. The data can be used to compare one place to another and determine specific drivers of resilience, and a higher HVRI BRIC score indicates a stronger and more resilient community. Figure 4-6 below shows the community resilience rating for each county in Montana.

Figure 4-6 Community Resilience Rating by County in Montana



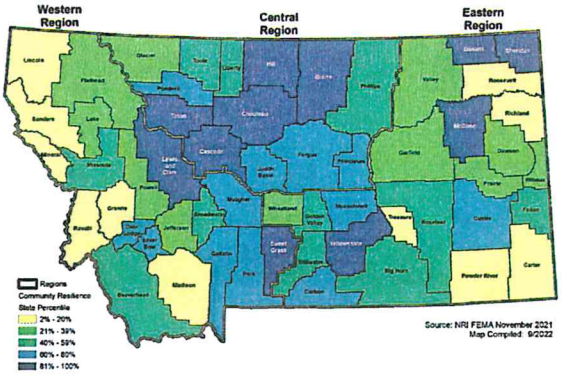
The community resilience rating can be useful in determining counties which have higher levels of ability to cope with hazards and identify success stories for building resilience. According to the index (2021), the following, listed in order, are Montana's ten most resilient counties:

1. Daniels County (58.16)
2. Lewis and Clark County (57.80)
3. Cascade County (57.72)
4. Sheridan County (57.49)
5. Yellowstone County (56.92)
6. Hill County (56.90)
7. Chouteau County (56.79)
8. Teton County (56.71)

9. Sweet Grass County (56.63)
10. Blaine County (56.17)

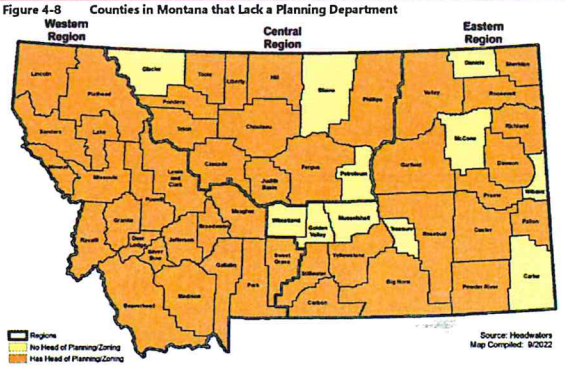
Only a select few of the above counties are in the top 20 percent in the nation in terms of community resilience with those being limited to Daniels, Lewis and Clark, and McCone counties. The average community resilience score for the State of Montana is 54.43, which is slightly lower than the national average score of 54.59. Only 11.1% of counties in the country have a higher level of community resilience than Montana's highest rated county, Daniel County. In addition to the ten counties listed above, Petroleum, Silver Bow, Custer, Pondera, Carbon, Meagher, Gallatin, and Fergus counties each are identified as having relatively high levels of community resilience. Figure 4-7 below shows the percentile of each county's community resilience ranking on a national scale.

Figure 4-7 Community Resilience State Percentile



Adaptive capacity is the potential for a system to adjust to change and to potential damage and take advantage of opportunities, and cope with consequences. As such, other indicators of community resilience include whether local municipalities have planning departments and administrative and technical staff capabilities to address community needs during hazard events through effective planning processes, community engagement, and planning projects related to resiliency. Data from Headwater Economics was reviewed to map those counties that lack a Planning Department and/or a Zoning Ordinance. Figure 4-8 shows the counties in Montana that do not have a Planning Department. In other words, these are the counties in the State that lack formal planning resources and have less capability for land use and hazard mitigation planning. These include the counties of Glacier, Blaine, Wheatland, Golden Valley, Musselshell, Treasure, Carter, McCone, and Daniels.

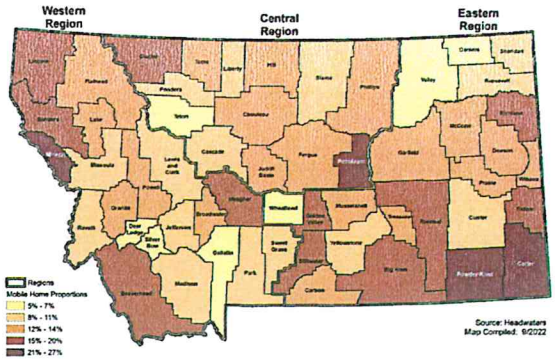
Figure 4-8 Counties in Montana that Lack a Planning Department



Mobile Homes

Mobile and manufactured homes are the most common unsubsidized, affordable housing in the United States. Research shows that these structures face a disproportionately higher risk of flooding and also damage from wind events (Headwater Economics 2022). Approximately 9.2% of the housing types in Montana are mobile homes compared to approximately 5.6% mobile homes in the United States (U.S. Census 2020). Compared to those who live in other types of housing, mobile home residents have higher exposure to natural hazards such as wind, tornadoes, hurricanes, extreme heat, wildfire, and particularly flooding. For example, according to analysis by Headwater Economics, one in seven mobile homes is located in an area with high flood risk, compared to one in 10 for all other housing types (Headwater Economics 2022). Figure 4-9 shows the number of mobile homes as a proportion to the number of households within the County.

Figure 4-9 Mobile Homes in Montana



As shown above, Mineral, Petroleum, Powder River, and Carter counties have the highest number of mobile homes as a proportion to the number of households in that County. Other counties with 15% to 20% mobile home proportions include Lincoln, Sanders, Beaverhead, Glacier, Meagher, Stillwater, Golden Valley, Big Horn, Rosebud, Richland, and Fallon counties.

4.2 Hazard Profiles

Requirement §201.6(c)(2)(i):

[The risk assessment shall include a] description of the...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

The hazards identified in Section 4.1 are profiled individually in this section. Much of the profile information came from the same sources used to initially identify the hazards.

4.2.1 Profile Methodology

Each hazard is profiled in a similar format that is described below.

Hazard/Problem Description

This subsection gives a description of the hazard and associated problems, followed by details on the hazard specific to the Region.

Geographical Area Affected

This subsection discusses which areas of the Region are most likely to be affected by a hazard event.

Negligible: Less than 10 percent of planning area or isolated single-point occurrences

Limited: 10 to 25 percent of the planning area or limited single-point occurrences

Significant: 25 to 75 percent of planning area or frequent single-point occurrences

Extensive: 75 to 100 percent of planning area or consistent single-point occurrences

Past Occurrences

This subsection contains information on historic incidents, including impacts where known. Information provided by the Regional Steering Committee is included here along with information from other data sources, including NOAA's National Centers for Environmental Information (NCEI) Storm Events Database and other data sources. When available, tables showing county-specific data from the NCEI database may be found in each hazard profile.

Frequency/Likelihood of Occurrence

The frequency of past events is used in this section to gauge the likelihood of future occurrences. Based on historical data, the likelihood of future occurrences is categorized into one of the following classifications:

- **Highly Likely**—90 to 100 percent chance of occurrence in next year or happens every year.
- **Likely**—Between 10 and 90 percent chance of occurrence in next year or has a recurrence interval of 10 years or less.
- **Occasional**—Between 1 and 10 percent chance of occurrence in the next year or has a recurrence interval of 11 to 100 years.
- **Unlikely**—Less than 1 percent chance of occurrence in next 100 years or has a recurrence interval of greater than every 100 years.

The frequency, or chance of occurrence, was calculated where possible based on existing data. Frequency was determined by dividing the number of events observed by the number of years and multiplying by 100. Stated mathematically, the methodology for calculating the probability of future occurrences is:

$$\frac{\text{\# of known events}}{\text{years of historic record}} \times 100$$

This gives the percent chance of the event happening in any given year. An example would be three droughts occurring over a 30-year period which equates to 10 percent chance of that hazard occurring any given year.

Climate Change Considerations

This describes the potential for climate change to affect the frequency and intensity of the hazard in the future.

Potential Magnitude and Severity

This subsection discusses the potential magnitude of impacts, or extent, from a hazard event. Magnitude classifications are as follows:

- **Negligible:** Less than 10 percent of property is severely damaged, facilities and services are unavailable for less than 24 hours, injuries and illnesses are treatable with first aid or within the response capability of the jurisdiction.

- **Limited**: 10 to 25 percent of property is severely damaged, facilities and services are unavailable between 1 and 7 days, injuries and illnesses require sophisticated medical support that does not strain the response capability of the jurisdiction, or results in very few permanent disabilities.
- **Critical**: 25 to 50 percent of property is severely damaged, facilities and services are unavailable or severely hindered for 1 to 2 weeks, injuries and illnesses overwhelm medical support for a brief period of time or result in many permanent disabilities and a few deaths, overwhelmed for an extended period of time or many deaths occur.
- **Catastrophic**: More than 50 percent of property is severely damaged, facilities and services are unavailable or hindered for more than two weeks, the medical response system is overwhelmed for an extended period of time or many deaths occur.

Vulnerability Assessment

The primary function of the *Vulnerability Assessment* section for each hazard is to identify which assets are both likely to be exposed to a hazard and susceptible to damage from that exposure. In this context, assets are (1) people, (2) property, (3) critical facilities and lifelines, (4) the economy, (5) historic and cultural resources, and (6) natural resources. Exposure is defined here as interacting with a hazard, and likely to be exposed indicates a presence in areas deemed to be especially likely to experience a hazard. Susceptible is meant to indicate assets that are easily damaged from exposure to a hazard. Finally, vulnerability under future conditions is considered as it relates to both climate change and existing and future development.

Susceptible is a peculiar term in the context of hazard mitigation plans. FEMA does not specifically define the term and yields to the common definition of "easily harmed by something." In practice, estimating susceptibility of assets or lifelines to each hazard is a complex task. Even defining which assets are, or are not, susceptible is subject to an implicit judgment of how easily harmed is enough to be deemed susceptible? FEMA's 2023 Local Mitigation Planning Policy Guide provides a statement that plan participants may identify which specific assets are most susceptible to damage or loss from hazards (FEMA 2023). In the Eastern Montana plan, MT DES in coordination with each county and tribe, describes which assets are susceptible to a given hazard to best assess their communities' unique vulnerabilities and particular assets most susceptible to hazard risk.

Another limitation of the vulnerability assessment is the inconsistent ability to define which specific assets are vulnerable. The reasons for this are many, but the most common problem is that GIS datasets may not contain consistent information about the characteristics of specific assets. Information about the characteristics of each asset could also allow a judgment of which assets are susceptible to damage. For example, if a dataset only contains the location of houses, it is easy to identify which houses exist within a high-hazard area. However, not all houses are equally susceptible to damage. Some were built to comply with older housing codes, some may not be well maintained and improved, and some may be oriented in ways or located on sites that cause subtle differences in exposure to a hazard such as wind. In the absence of reliable data on key characteristics, judging which assets are susceptible to harm becomes a 'best estimate' rather than a determination. Another example is if one dataset has the location of assets in a different format than is used to define a hazard area. In this case it is not possible to determine which assets are within a hazard area without additional analysis. Given these limitations, this is why FEMA recommends counties and tribes update their plans and vulnerability assessments every five years, in part to refine and address changing conditions and integrate new points of view from stakeholders and the public.

Development Trends Related to Hazards and Risk

This section describes how future development and growth could impact vulnerability to each hazard. Specific trends can be found in each county or tribal annex.

Ongoing COVID-19 Pandemic

Since March 2020, the State of Montana, the nation, and the world were dealing with the COVID-19 pandemic. The COVID-19 virus has a much higher rate of transmission than the seasonal flu, primarily by airborne transmission of droplets and bodily fluids. Common symptoms include fever, cough, fatigue, shortness of breath or breathing difficulties, and loss of smell and taste. While most people have mild symptoms, some people develop acute respiratory distress syndrome, with roughly one in five requiring hospitalizations. Recent studies have shown the average area-specific COVID-19 case fatality rate to be 2% - 3% worldwide, higher than previously reported estimates (Cao, Hiyoshi and Montgomery 2020). Case fatality rate, also called case fatality risk or case fatality ratio, in epidemiology, is the proportion of people who die from a specified disease among all individuals diagnosed with the disease over a certain period of time (Harrington 2022). The key challenge in containing the spread has been the fact that it can be transmitted by asymptomatic people.

2022 US Monkeypox Outbreak

According to the Center for Disease Control and Prevention (CDC), monkeypox is a rare disease caused by infection with the monkeypox virus. Monkeypox virus is part of the same family of viruses as smallpox. Monkeypox symptoms are similar to smallpox symptoms but milder, and monkeypox is rarely fatal. Symptoms of monkeypox can include fever, headache, muscle aches, swollen lymph nodes, chills, exhaustion, and a rash that can look like pimples or blisters. The rash goes through different stages before healing completely. Some people get a rash first, followed by other symptoms, while others only experience a rash. The illness typically lasts 2 to 4 weeks and can spread from the time symptoms start until the rash has fully healed and a fresh layer of skin has formed. People who do not have monkeypox symptoms cannot spread the virus to others.

The virus can spread from person to person through:

- Direct contact with the infectious rash, scabs, or bodily fluids;
- Touching items (such as clothing or linens) that previously touched the infectious rash or bodily fluids;
- Respiratory secretions during prolonged, face-to-face contact, or intimate physical contact;
- Touching items (such as clothing or linens) that previously touched the infectious rash or body fluids; and
- Placenta from pregnant person to fetus.

It is also possible for people to get monkeypox from infected animals, either by being scratched or bitten by the animal or by preparing, eating, or using products from an infected animal.

Monkeypox was discovered in 1958 when two outbreaks of a pox-like disease occurred in colonies of monkeys kept for research. Despite being named "monkeypox," the source of the disease remains unknown. However, African rodents and non-human primates (like monkeys) might harbor the virus and infect people. The first human case of monkeypox was recorded in 1970. Before the 2022 outbreak, monkeypox had been reported in people in several central and western African countries. Previously, almost all monkeypox cases in people outside of Africa were linked to international travel to countries where the disease commonly occurs or through imported animals. These cases occurred on multiple continents.

Based on CDC's data, as of December 2, 2022, there are 82,021 cases all over the world in 110 countries. There are 29,630 cases in the US and 7 in the State of Montana. The World Health Organization (WHO) declared Monkeypox Spread a Global Health Emergency on July 23, 2022.

Hantavirus Pulmonary Syndrome (HPS)

According to the State of Montana's Department of Public Health and Human Services (DPHHS), Hantavirus Pulmonary Syndrome (HPS) is another communicable disease of concern to the State of Montana. HPS is

Risk Summary

The primary function of the *Risk Summary* section for each hazard is to describe the potential severity of loss to vulnerable assets and the impact that loss has on jurisdictions. In the context of hazard mitigation planning, vulnerability can be viewed as what is likely to be damaged, while risk can be viewed as how severe the damage will be to those assets and to the community. Risk is sometimes described as the consequence or effect a hazard has on assets.

This section summarizes risk by county and tribe according to the area affected, likelihood, and magnitude of impacts. Overall hazard significance is summarized for the region and by county and tribe. If the hazard has impacts on specific towns or cities in the region that differ from the county, they are noted here, where applicable.

4.2.2 Communicable Disease

Hazard/Problem Description

A communicable disease spreads from one person to another through a variety of ways that include contact with blood and bodily fluids, breathing in an airborne virus, or being bitten by an insect.

The scale of a communicable disease outbreak or biological incident is described by the extent of the spread of disease in the community. An outbreak can be classified as an endemic, an epidemic, or a pandemic depending on the prevalence of the disease locally and around the world.

- An endemic is defined as something natural to or characteristic of a particular place, population, or climate. For example, threadworm infections are endemic in the tropics.
- An epidemic is defined as a disease that spreads rapidly through a demographic segment of the human population, such as everyone in a given geographic area, a similar population unit, or everyone of a certain age or sex, such as the children or women of a region.
- A pandemic is defined as an extensive epidemic with effects felt worldwide.

While many potentially devastating diseases are spread through ingestion or insects, airborne diseases and those spread through physical contact pose higher risks to the community as they are difficult to control. Diseases such as influenza, pertussis, tuberculosis, and meningitis are all spread through these methods and pose a threat to communities. Health agencies closely monitor for diseases with the potential to cause an epidemic and seek to develop and promote immunizations.

A pandemic can be defined as a public health emergency that spans several countries or continents, usually affecting many people. Pandemics are most often caused by new subtypes of viruses or bacteria to which humans have little or no natural immunity. Even when there is a strong healthcare system in place, disease outbreaks can strain and overwhelm community resources.

A pandemic disease could easily spread person-to-person, causing serious illness, and can sweep across the country and around the world in a very short time. Impacts could range from school and business closings to the interruption of basic services such as public transportation, health care, and the delivery of food and essential medicines. An especially severe pandemic could lead to high levels of illness, death, social disruption, and economic loss.

Because of the process utilized to prepare vaccines, it is impossible to have vaccines pre-prepared to combat pandemics. Additionally, for novel viruses, identification of symptoms, mode of transmission, and testing and identification may require development, causing significant delays in response actions. A portion of the human and financial cost of a pandemic is related to the lag time to prepare a vaccine to prevent the future spread of the novel virus. In some cases, current vaccines may have limited activity against novel strains.

an illness caused by a family of viruses called hantaviruses. HPS is a rare but often serious illness of the lungs. In Montana, the deer mouse is the reservoir for the hantavirus. The virus is found in the droppings, urine, and saliva of infected mice. The most common way that a person can get HPS is by breathing in the virus when it is aerosolized (stirred up into the air). People can also become infected after touching mouse droppings or nesting materials that contain the virus and then touching their eyes, nose, or mouth.

Geographical Area Affected

The entirety of the Montana Eastern Region is susceptible to the spread of infectious diseases therefore the geographic area affected is **extensive**. Disease usually spreads throughout vulnerable populations and in areas where people live and work in close quarters. Depending on the specifics of the illness, these areas can include shelters, senior homes, schools, and places of business. In general, it is likely that the more populated areas may be affected sooner and may experience higher infection rates.

The Montana DPHHS has reported 319,023 cases of COVID-19 statewide and 3,600 deaths as of December 2, 2022. The current COVID-19 pandemic has affected all the counties in the Eastern Region. Table 4-6 shows the total cases and deaths specific to the Eastern Region. Data specific to tribes are included in the nearest counties. The Eastern Region comprises approximately 24% of the statewide total cases and 32% of the statewide total deaths. In general, it is likely that the more-populated areas municipal areas may be affected sooner and may experience higher infection rates.

Table 4-6 COVID-19 Cases and Deaths by County (as of December 09, 2022)

County	Cases	Cases Per Total Pop*	Deaths	Deaths Per Total Pop.
Big Horn	5,619	42.6%	*102*	0.8%
Carbon	2,406	22.9%	*29*	0.3%
Carter	*287*	21.3%	*5*	0.4%
Custer	3,463	28.9%	*52*	0.4%
Daniels	454	26.1%	*9*	0.5%
Dawson	2,724	30.3%	*59*	0.7%
Fallon	775	25.2%	*11*	0.4%
Garfield	250	25.7%	*3*	0.3%
Golden Valley	166	20.2%	*5*	0.6%
McCone	436	24.2%	*9*	0.5%
Musselshell	1,075	22.3%	*31*	0.6%
Powder River	412	23.4%	*10*	0.6%
Prairie	289	23.6%	*4*	0.3%
Roosevelt	3,786	34.8%	*75*	0.7%
Rosebud	3,070	36.3%	*62*	0.7%
Sheridan	882	25.0%	*13*	0.4%
Stillwater	1,701	19.1%	*32*	0.4%
Treasure	145	20.9%	*1*	0.1%
Valley	2,072	27.4%	*39*	0.5%
Wibaux	243	23.9%	*8*	0.8%
Wheatland	450	21.6%	*14*	0.7%
Yellowstone	49,760	29.8%	*588*	0.4%
Eastern Region	*80,465*	29.5%	*1,161*	0.40%

Source: MT DPHHS COVID Dashboard *Population total is based on U.S. Census Bureau ACS 5-Year Estimates

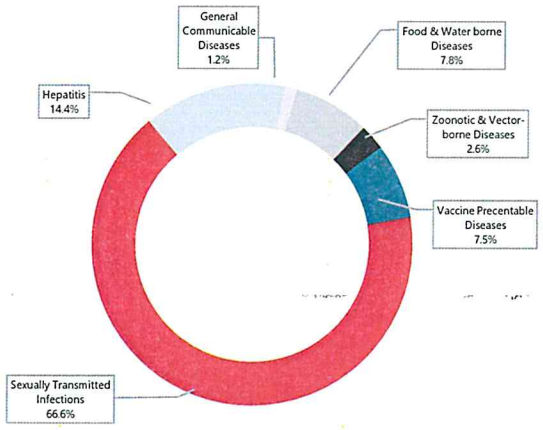
Past Occurrences

Since the early 1900s, five lethal pandemics have swept the globe:

- **1918-1919 Spanish Flu:** The Spanish Flu was the most severe pandemic in recent history. The number of deaths was estimated to be 50-100 million worldwide and 675,000 in the United States. Its primary victims were mostly young, healthy adults. At one point, more than 10% of the American workforce was bedridden.
- **1957-1958 Asian Flu:** The 1957 Asian Flu pandemic killed 1.1 million people worldwide, including about 70,000 people in the United States, mostly the elderly and chronically ill. Fortunately, the virus was quickly identified, and vaccine production began in May 1957.
- **1968-1969 H3N2 Hong Kong Flu:** The 1968 Hong Kong Flu pandemic killed one million people worldwide and approximately 100,000 people in the United States. Again, the elderly were more severely affected. This pandemic peaked during school holidays in December, limiting student-related infections, which may have kept the number of infections down. Also, people infected by the Asian Flu ten years earlier may have gained some resistance to the new virus.
- **2009-2010 H1N1 Swine Flu:** This influenza pandemic emerged from Mexico in early 2009 and was declared a public health emergency in the US on April 26. By June, approximately 18,000 cases had been reported in the US and the virus had spread to 74 countries. Most cases were fairly mild, with symptoms similar to the seasonal flu, but there were cases of severe disease requiring hospitalization and some deaths. On May 11, 2009, the Montana DPHHS reported the state's first confirmed case of swine flu. As of January 21, 2010, there were 801 confirmed cases and 18 confirmed deaths in Montana.
- **2020-Ongoing COVID-19:** The COVID-19 or novel coronavirus was detected in December 2019 and was declared a pandemic in March 2020. As of December 2, 2022, 643 million cases and 6.6 million deaths have been reported globally, including approximately 98.3 million cases and 1.1 million deaths in the US. Worldwide there have been 13.0 billion vaccine doses administered. The response to the COVID-19 Pandemic included numerous public health orders, including stay-home orders, massive testing infrastructure, the establishment of alternate care sites to support the hospital system, and an unprecedented community-wide vaccination push. Montana's news leader KTVQ noted on December 2021 that COVID-19 was the leading cause of death among Montana's Native Americans in 2020. According to a report released by the State's Department of Public Health and Human Services, COVID-19 was responsible for 251 of the 1,022 total deaths among Montana's Native Americans in 2020. While Native Americans only make up around 7% of the state's population, they accounted for 32% of the deaths and 19% of cases in the state from March to October of 2020 (Schubert 2021).

According to the 2019 DPHHS Communicable Disease in Montana Annual Report, the most recent annual report available, sexually transmitted diseases rank the highest among all the reported communicable diseases, followed by hepatitis, food & water borne diseases, and vaccine-preventable diseases, as shown in Figure 4-10.

Figure 4-10 2019 Montana DPHHS Communicable Disease Rates



The report also noted a sudden increase in the incidence of hepatitis A. While hepatitis A is spread through ingestion of the virus, primarily through close person contact or the sharing of contaminated food or drinks, the 2019 outbreak was predominantly linked to injection drug use and transmission among people experiencing homelessness. Of the cases of hepatitis, A reported in Montana in 2019, almost half were reported in Yellowstone County.

Also noted was the continued increase in the incidence of gonorrhea. However, it is believed that the increase in reported cases is partially due to an increase in screening tests being performed across the state, suggesting that gonorrhea has been underreported for many years.

Frequency/Likelihood of Occurrence

Although it is impossible to predict the next disease outbreak, recent history shows these outbreaks are not uncommon and are likely to reoccur. Based on the five pandemics that have affected the United States in roughly the last 100 years, a pandemic occurs on average roughly every 20 years. In other words, there is a 5% probability that a pandemic that affects the entire United States will occur in any given year. As a result, the likelihood of occurrence for communicable disease is **occasional.**

For the current COVID-19 pandemic, due to the virus's ability to mutate and rapidly infect those who are not vaccinated, the pandemic may extend for several years, and booster vaccines may be necessary to prevent future outbreaks. In just the last couple of decades, the world has drastically increased points of

transmissions through global travel and trade to levels unseen in human history – this may have a drastic impact on the frequency of pandemics and the speed with which they spread in coming years.

Climate Change Considerations

As the Earth's climate continues to warm, researchers predict wild animals will be forced to relocate their habitats — likely to regions with large human populations — dramatically increasing the risk of a viral jump to humans that could lead to the next pandemic. This link between climate change and viral transmission is described by an international research team led by scientists at Georgetown University, published in *Nature* (Georgetown University 2022). The scholars noted that the geographic range shifts due to climate change could cause species that carry viruses to encounter other mammals, sharing associated viruses thousands of times, which may then further be spread to humans. In addition, rising temperatures caused by climate change will impact bats, which account for the majority of novel viral sharing. Bats' ability to fly will allow them to travel long distances and share viruses in geographically dispersed places. Altogether, the study suggests that climate change will become the biggest upstream risk factor for disease emergence — exceeding higher-profile issues like deforestation, wildlife trade, and industrial agriculture. The authors highlight a need to pair wildlife disease surveillance with real-time studies of environmental change (Carlson, C.J., Albery, G.F., Merow, C. *et al.*, 2022).

Potential Magnitude and Severity

The magnitude of a disease outbreak or public health emergency will range significantly depending on the aggressiveness of the virus in question, the ease of transmission, and the efficacy of public health and medical responses. Pandemic influenza is easily transmitted from person to person but advances in medical technologies have greatly reduced the number of deaths caused by influenza over time.

Today, a large percentage of the world's population is clustered in cities, making them ideal breeding grounds for epidemics. Additionally, the explosive growth in air travel means a virus could spread around the globe within hours, quickly creating a pandemic. Under such conditions, there may be very little warning time. It is estimated that one to six months will have lapsed between the time that a dangerous new influenza strain is identified and the time that outbreaks begin to occur in the United States. Outbreaks are expected to occur simultaneously throughout much of the nation, preventing shifts in human and material resources that normally occur with other natural disasters. These aspects make influenza pandemic unlike most other public health emergencies or community disasters. Pandemics typically last for several months to years. Considering the variations in viruses, the potential magnitude of communicable disease is **critical**.

As seen with the ongoing COVID-19 pandemic, the rapid spread of a virus combined with the need for increased hospital and coroner resources, testing centers, first responders, and vaccination administration sites causes significant strain on the medical system and public health departments. Additionally, other public health-related triggers or commingled public health hazards (such as an outbreak of another pathogen) or even more contagious strains of COVID such as the recent Omicron, BA.5 and Delta B.1.617.2 variant, can quickly lead to even more outbreaks.

The Pandemic Intervals Framework (PIF) is a six-phased approach to defining the progression of an influenza pandemic. This framework is used to guide influenza pandemic planning and provides recommendations for risk assessment, decision-making, and action. These intervals provide a common method to describe pandemic activities that can inform public health actions. The duration of each pandemic interval might vary depending on the characteristics of the virus and the public health response.

The six-phase approach was designed for the easy incorporation of recommendations into existing national and local preparedness and response plans. Phases 1 through 3 correlates with preparedness in the pre-pandemic interval, including capacity development and response planning activities, while Phases 4 through 6 signal the need for response and mitigation efforts during the pandemic interval.

Pre-Pandemic Interval

Phase 1 is the natural state in which influenza viruses circulate continuously among animals (primarily birds) but do not affect humans.

Phase 2 occurs when an animal influenza virus circulating among domesticated or wild animals is known to have caused infection in humans and is thus considered a potential pandemic threat. Phase 2 involves cases of animal influenza that have circulated among domesticated or wild animals and have caused specific cases of infection among humans.

Phase 3 represents the mutation of the animal influenza virus in humans so that it can be transmitted to other humans under certain circumstances (usually very close contact between individuals). At this point, small clusters of infection have occurred.

Phase 4 is characterized by verified human-to-human transmission of the virus able to cause "community-level outbreaks." The ability to cause sustained disease outbreaks in a community marks a significant upward shift in the risk for a pandemic. Phase 4 involves community-wide outbreaks as the virus continues to mutate and becomes more easily transmitted between people (for example, transmission through the air)

Phase 5 is characterized by verified human-to-human spread of the virus in at least two countries in one WHO region. While most countries will not be affected at this stage, the declaration of Phase 5 is a strong signal that a pandemic is imminent and that the time to finalize the organization, communication, and implementation of the planned mitigation measures is short.

Phase 6, the pandemic phase, is characterized by community-level outbreaks in at least one other country in a different WHO region in addition to the criteria defined in Phase 5. The designation of this phase will indicate that a global pandemic is underway.

Vulnerability Assessment

People

Pandemics can affect large segments of the population for long periods. The number of hospitalizations and deaths will depend on the virulence of the virus. Risk groups cannot be predicted with certainty; the elderly, people with underlying medical conditions, and young children are usually at higher risk, but as discussed above, this is not always the case. People without health coverage or access to good medical care are also likely to be more adversely affected.

According to the 2020 ACS 5-Year Estimates of the Eastern Region, 18.5% of the Region's population is 65 years of age or older, 5.7% of the population is 5 years of age or younger, and 11.7% experienced poverty in the prior 12 months. For comparison, within the State of Montana, those over 65 years of age make up 18.7% of the population, those under five years of age make up 5.8% of the population, and 12.8% of the State's population had income in the past 12 months below poverty level. This shows that the population at risk to communicable disease in Eastern Montana is similar to the State's population exposure.

However, impacts, mortality rates, speed and type of spread are disease specific. As seen with the current COVID-19 pandemic statewide, according to the State's DPHHS, the most positive cases occurred in the 30-49 age group. Hospitalizations and deaths, however, happened more within the over 50 age group.

Property

Communicable diseases would not have direct impacts on infrastructure or the built environment. Should infrastructure require human intervention to fulfill vital functions, these functions could be impaired by absenteeism, sick days and isolation, quarantine, and disease prophylaxis measures. As concerns about contamination increase, property may be quarantined or destroyed as a precaution against spreading illness. Additionally, traditional sheltering facilities, including shelters for persons experiencing homelessness or facilities to support displaced persons during an evacuation, cannot be done in a

congregate setting. This requires additional planning considerations or the use of facilities that allow for non-congregate shelter settings which may require an approval from FEMA and may have an increased cost.

Critical Facilities and Lifelines

The impacts of a communicable disease on critical infrastructure and lifelines would center on service disruption due to staff missing work and on shortages in essential resources and supplies to perform services, as seen with personal protective equipment during the COVID-19 pandemic within the health and medical sector.

While automated systems and services that allow for the physical distancing of staff from other persons may fare better through a communicable disease incident, all critical infrastructure sectors and lifelines would likely be affected due to the globalization of supply chains, services, and interdependency of most communities.

Economy

A widespread communicable disease outbreak could have devastating impacts on the Eastern Region's economy. The economic impacts fall under two categories – economic losses as a result of the disease, and economic losses to fight the disease. Economic impacts as a result of a disease include those costs associated with lost work and business interruption. Depending on the disease and the type and rate of spread, businesses could see a loss of consumer base as people self-isolate or avoid travel. This could last for a protracted amount of time, compounding economic loss. Economic costs are also associated with incident response. Two of the biggest areas of cost are public information efforts and mass prophylaxis.

In a normal year, lost productivity due to illness costs US employers an estimated $530 billion. During a pandemic, that figure would likely be considerably high and could trigger a recession or even a depression. According to an October 2020 report by The Journal of American Medical Association (JAMA) Network, the estimated cumulative financial costs of the COVID-19 pandemic related to the COVID-19 economic recession and compromised health (premature death, mental health, long-term health impairment) in the US population was almost $16 trillion. As of July 29, 2021, the Montana Coronavirus Relief Fund has awarded over $819 million to businesses and nonprofits across the State to support economic recovery efforts.

Historic and Cultural Resources

As mentioned previously, communicable diseases would not have specific impacts on the built or natural environment, including historic and cultural resources. However, historic and cultural resources are often intertwined with the tourism industry, therefore reduced tourism could lead to impacts such as a loss of revenue needed for resource maintenance.

Natural Resources

Impacts on natural resources can vary. Some ecosystems showed signs of improvement during peak covid-19 lockdown. However, some zoonotic diseases can spread from animals to humans, wreaking havoc on both populations. Examples of zoonotic diseases include avian flu, swine flu, tuberculosis, plague, and rabies.

Development Trends Related to Hazards and Risk

Population growth and development contribute to pandemic exposure. Future development in the Eastern Region has the potential to change how infectious diseases spread through the community and impact human health in both the short and long term. New development may increase the number of people and facilities exposed to public health hazards and greater population concentrations (often found in special needs facilities and businesses) put more people at risk. During a disease outbreak, those in the immediate isolation area would have little to no warning, whereas the population further away in the dispersion path

may have some time to prepare and mitigate against disease depending on the hazard, its transmission, and public notification.

Risk Summary

In summary, the Communicable Disease hazard is considered to be overall **Medium** significance for the Region. Variations in risk by jurisdiction are summarized in the table below, along with key issues from the vulnerability assessment.

- Pandemics affecting the U.S. occur roughly once every 20 years, meaning there is a roughly 5% chance a pandemic will happen each year, but they cannot be reliably predicted.
- Effects on people will vary, while the elderly, people with underlying medical conditions, and young children are usually at higher risk.
- Effects on property are typically minimal, although quarantines could result in short-term closures.
- Effects on economy: lost productivity due to illness and potential business closures could potentially have severe economic impacts. Social distancing requirements and fear of public gatherings could significantly reduce in-person commerce.
- Effects on critical facilities and infrastructure: community lifelines, such as healthcare facilities, like hospitals will be impacted and may be overwhelmed and have difficulty maintaining operations due to bed availability, medical staffing shortages, and lack of PPE and other supplies.
- Unique jurisdictional vulnerability: As mentioned above, COVID-19 was the leading cause of death in Montana's Native American tribes, likely due to economic and societal structures.
- Ongoing mitigation activities should focus on disease prevention, especially during flu season. This includes, but is not limited to, pre-season community outreach campaigns to educate the public about risks and available support; establishing convenient vaccination centers; reaching out to vulnerable populations and caregivers; and issuing advisories and warnings.
- Related Hazards: Human Conflict.

Table 4-7 Risk Summary Table: Communicable Disease

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
Eastern Region	Medium		
Big Horn	High	Hardin, Lodge Grass	Big Horn has the lowest rate of insurance, and the highest rate of COVID-19 infections in the Eastern region, which suggest vulnerability to communicable disease.
Carbon	Medium	Bearcreek, Bridger, Joliet, Fromberg, Red Lodge	None
Carter	Medium	Ekalaka	None
Custer	Medium	Ismay, Miles City	None
Crow Tribe	Medium		NA
Daniels	Medium	Scobey, Flaxville	None
Dawson	Low	Richey, Glendive	None
Fallon	Medium	Plevna, Baker	Societal and economic structures have increased poor outcomes from communicable diseases in Native communities.
Garfield	Medium	Jordan	Garfield has the lowest population density of all counties in Montana which lowers the risk of communicable disease spread.
Golden Valley	Medium	Ryegate, Lavina	None
McCone	Low	Circle	Dawson has a low population density and a high rate of health insurance, lowering the risk of spread

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
			and increasing the probability of medical intervention.
Musselshell	Medium	Melstone, Roundup	None
Powder River	Low	Broadus	None
Prairie	Medium	Terry	A significant portion of Prairie County's population is over the age of 65 and is therefore more susceptible to communicable diseases.
Richland	Medium	Fairview, Sidney	None
Roosevelt	High	Wolf Point, Poplar, Bainville, Culberson, Froid	Roosevelt has the highest rate of poverty in the Eastern Region which would impact its ability to adapt to a communicable disease event.
Rosebud	Medium	Colstrip, Forsyth	None
Sheridan	Medium	Plentywood, Medicine Lake, Outlook, Westby	None
Stillwater	Medium	Columbus	None
Treasure	Medium	Hysham	None
Valley	Low	Glasgow, Fort Peck, Nashua, Opheim	None
Wibaux	Medium	Wibaux	None
Yellowstone	High	Billings, Broadview, Laurel	Yellowstone has the largest population per square mile of all counties in Montana, which increases the likelihood of disease spread.

4.2.3 Cyber-Attack

Hazard/Problem Description

The Merriam-Webster dictionary defines cyber-attacks as "an attempt to gain illegal access to a computer or computer system to cause damage or harm." Cyber-attacks use malicious code to alter computer operations or data. The vulnerability of computer systems to attacks is a growing concern as people and institutions become more dependent upon networked technologies. The Federal Bureau of Investigation (FBI) reports that "cyber intrusions are becoming more commonplace, more dangerous, and more sophisticated," with implications for private- and public-sector networks. Cyber threats can take many forms, including:

- **Phishing attacks:** Phishing attacks are fraudulent communications that appear to come from legitimate sources. Phishing attacks typically come through email but may come through text messages as well. Phishing may also be considered a type of social engineering meant to exploit employees into paying fake invoices, providing passwords, or sending sensitive information.
- **Malware attacks:** Malware is malicious code that may infect a computer system. Malware typically gains a foothold when a user visits an unsafe site, downloads untrusted software, or may be downloaded in conjunction with a phishing attack. Malware can remain undetected for years and spread across an entire network.
- **Ransomware:** Ransomware typically blocks access to a jurisdiction's/agency's/ business' data by encrypting it. Perpetrators will ask for a ransom to provide the security key and decrypt the data, although many ransomware victims never get their data back even after paying the ransom.
- **Distributed Denial of Service (DDoS) attack:** Perhaps the most common type of cyber-attack, a DDoS attack seeks to overwhelm a network and causes it to either be inaccessible or shut down. A DDoS typically uses other infected systems and internet-connected devices to "request" information from a specific network or server that is not configured or powerful enough to handle the traffic.

- **Data breach:** Hackers gaining access to large amounts of personal, sensitive, or confidential information has become increasingly common in recent years. In addition to networked systems, data breaches can occur due to the mishandling of external drives.
- **Critical Infrastructure/SCADA System attack:** There have been recent critical infrastructure Supervisory Control and Data Acquisition (SCADA) system attacks aimed at taking down lifelines such as power plants and wastewater facilities. These attacks typically combine a form of phishing, malware, or other social engineering mechanisms to gain access to the system.

Cyber-attacks are rapidly increasing in the United States. The FBI Internet Crime Complaint Center (IC3) was developed to provide the public with a direct way to report cybercrimes to the FBI. In 2021, the FBI Internet Crime Report reported a record number of cyber-attacks, with a 7% increase from 2020. The events reported to the FBI are used to track the trends and threats from cyber criminals to combat cyber threats and protect U.S. citizens, businesses, and government from future attacks.

Geographical Area Affected

Cyber-attacks can and have occurred in every location regardless of geography, demographics, and security posture. Anyone with information online is vulnerable to a cyber-attack. Incidents may involve a single location or multiple geographic areas. A disruption can have far-reaching effects beyond the location of the targeted system; disruptions that occur far outside the State can still impact people, businesses, and institutions within Eastern Region. All servers in the Eastern Region are potentially vulnerable to cyber-attacks. Businesses, industry, and even individuals are also susceptible to cyber-attacks. Therefore, the geographic extent of cyber-attack is **significant**.

Past Occurrences

According to the FBI's 2021 Internet Crime Report, the FBI received 2.76 million complaints with $18.7 billion in losses over the last five years due to cyber-attacks. The Crime Report also noted a trend of increasing cybercrime complaints and losses each year. Nationwide losses in 2021 alone exceeded $6.9 billion, a 392% increase since 2017. According to the 2021 Report, Montana ranked 48/57 among U.S. territories in the total number of victims, with 1,188 victims of cyber-crime, and 49th in total victim losses, with $10,107,283 in total losses.

Data on past cyber-attacks impacting Montana was gathered from The Privacy Rights Clearinghouse. The Privacy Rights Clearinghouse, a non-profit organization based in San Diego, maintains a timeline of 9,741 data breaches resulting from computer hacking incidents in the United States from 2005-2021. The database lists 35 data breaches against systems located in Montana totaling almost 1.5 million impacted records; it is difficult to know how many of those affected residents in the Montana Eastern Region. Attacks happening outside of the State can also impact local businesses, personal identifiable information, and credit card information. Table 4-8 shows several of the most significant cyber-attacks in Montana in recent years. The data aims to provide a general understanding of the impacts of cyber-attacks by compiling an up-to-date list of incidents but is limited by the availability of data: "This is an incomplete look at the true scope of the problem due in part to varying state laws."

Table 4-8 Major Cyber Attacks Impacting Montana (10,000+ Records), 2005-2021

Date Reported	Target	City	Organization Type	Total Records	Type of Attack
7/7/2014	Montana Department of Public Health & Human Services	-	Healthcare	1,062,509	Hacked by an Outside Party or Infected by Malware
1/30/2008	Davidson Companies	Great Falls	Business	226,000	Hacked by an Outside Party or Infected by Malware

Date Reported	Target	City	Organization Type	Total Records	Type of Attack
3/11/2011	OrthoMontana	Billings	Healthcare	37,000	Portable Device (lost, discarded or stolen laptop, PDA, smartphone, memory stick, CDs, hard drive, data tape, etc.)
1/15/2016	New West Health Services dba New West Medicare	Kalispell	Healthcare	23,209	Portable Device (lost, discarded or stolen laptop, PDA, smartphone, memory stick, CDs, hard drive, data tape, etc.)
4/14/2017	Eastern Health Screening	-	Healthcare	15,326	PHYS

Source: The Privacy Rights Clearinghouse

In total, the Privacy Rights Clearinghouse has reported 35 attacks in Montana since 2005 with a total of 1,471,889 records. Of these records lost in Montana, a majority were from healthcare organizations. It is difficult to know how many of these incidents affected residents in the Montana Eastern Region.

The Montana Department of Agriculture temporarily took the USAHERDS web-based software offline in the year 2021 to allow the application's developer to beef up security following a suspected Chinese state-sponsored cyberattack. USAHERDS is used to track livestock by at least 18 US states. The suspected attacker – APT41, had carried out a hacking campaign that comprised the networks of at least six US state governments (Power 2022).

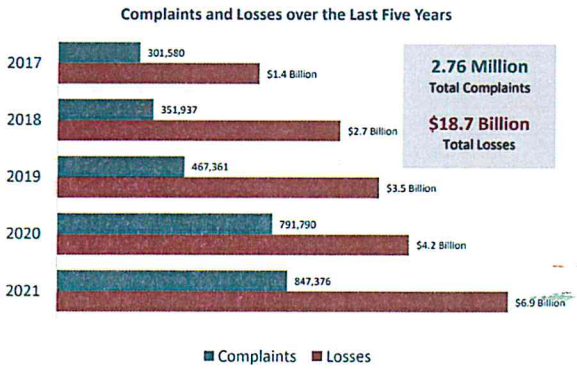
In February 2020, it is reported that Ryuk ransomware hacked the computer system of the Havre Public Schools. Despite the major scare, it was eventually concluded that the hackers did not gain access to student and employee information (Dragu 2020).

On April 3, 2015, Eastern Montana Clinic notified almost 7,000 patients of a payment data hack. The hacker bypassed the Clinic website's security measures and obtained access to the demographic and credit card information of 6,994 patients who paid their bill(s) via the link on the Clinic's website. The information available to the hacker included patient names, addresses, telephone numbers, email addresses, dates and amounts of credit card transactions, and the last four digits of patients' credit card numbers. In addition, approximately 44 patients' full credit card information was compromised. The Clinic took steps to mitigate any further harm to patients from this security incident ("Eastern Montana Clinic Notifies Almost 7,000 Patients Of Payment Data Hack" 2015).

Frequency/Likelihood of Occurrence

Small-scale cyber-attacks such as DDoS attacks occur daily, but most have negligible impacts at the local or regional level. Data breaches are also extremely common, but again most have only minor impacts on government services. Additionally, the FBI Internet Crime Report 2021 found that there is a trend of increasing cyber-attacks over the past 5 years. These trends are shown in Figure 4-11.

Figure 4-11 Trends of the Frequency of Cyber-attacks, 2017-2021



Source: The FBI Internet Crime Report 2021

Perhaps of greatest concern to the Eastern Region are ransomware attacks, which are becoming increasingly common. It is difficult to calculate the odds of the Eastern Region or one of its jurisdictions being hit with a successful ransomware attack in any given year, but it is likely to be attacked in the coming years.

The possibility of a larger disruption affecting systems within the Region is a constant threat, but it is difficult to quantify the exact probability due to such highly variable factors as the type of attack and intent of the attacker. Major attacks specifically targeting systems or infrastructure in the Eastern Region cannot be ruled out. Therefore, the probability of future cyber-attack is **occasional**.

Climate Change Considerations

Changes in development have no impact on the threat, vulnerability, and consequences of a cyber-attack.

Potential Magnitude and Severity

There is no universally accepted scale to explain the severity of cyber-attacks. The strength of a DDoS attack is often explained in terms of a data transmission rate. One of the largest DDoS disruptions ever, known as the Dyn Attack which occurred on October 21, 2016, peaked at 1.2 terabytes per second and impacted some of the internet's most popular sites, including Amazon, Netflix, PayPal, Twitter, and several news organizations.

Data breaches are often described in terms of the number of records or identities exposed. The largest data breach ever reported occurred in August 2013, when hackers gained access to all three billion Yahoo accounts. The hacking incidents associated with Montana in the Privacy Rights Clearinghouse database are

of a smaller scale, ranging from 201 records to approximately 1.06 million, along with several cases in which an indeterminate number of records may have been stolen.

Ransomware attacks are typically described in terms of the amount of ransom requested, or the amount of time and money spent to recover from the attack. One report from cybersecurity firm Emsisoft estimates the average successful ransomware attack costs $81 million and can take 287 days to recover from. Therefore, the potential magnitude and severity of cyber-attack is **Critical**.

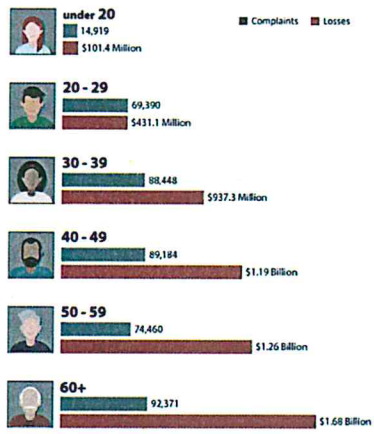
Vulnerability Assessment

People

Injuries or fatalities from cyber-attacks would generally only be possible from a major cyber-terrorist attack against critical infrastructure. More likely impacts on the public are financial losses and an inability to access systems such as public websites and permitting sites. Indirect impacts could include interruptions to traffic control systems or other infrastructure.

The FBI Internet Crime Reports on the victims of cyber-attack by age group. While the number of cyber-attack complaints is comparable across age groups, the losses increase significantly as age group increases, with individuals 60 years and older experiencing the greatest losses. This is likely due to seniors being less aware of cyberthreats, lack of the tools to identify cyberthreats, and "Grandparent Scams," which is a cyberattack where criminals impersonate a loved one in need, such as a grandchild, and ask for money. Figure 4-12 displays the breakdown of victims by age group in 2021.

Figure 4-12 Victims by Age Group in 2021



Source: The FBI Internet Crime Report 2021

Property

Most cyber-attacks affect only data and computer systems and have minimal impact on the general property. However, sophisticated attacks have occurred against the SCADA systems of critical infrastructure, which could potentially result in system failures on a scale equal to natural disasters. Facilities and infrastructure such as the electrical grid could become unusable. A cyber-attack took down the power grid in Ukraine in 2015, leaving over 230,000 people without power. A ransomware attack on the Colonia Pipeline in 2021 caused temporary gas shortages on the East Coast. The 2003 Northeast Blackout, while not the result of a cyber-attack, caused 11 deaths and an estimated $6 billion in economic loss.

Critical Facilities and Lifelines

An article posted on July 31, 2022, by government technology mentions that despite the lack of major headline-grabbing cyber-attacks against U.S. critical infrastructure so far in 2022, our global cyber battles continue to increase. Worldwide cyber actions are becoming less covert. Besides, according to IBM's 2022 annual Cost of a Data Breach Report, almost 80 percent of critical infrastructure organizations studied don't adopt zero-trust strategies, seeing average breach costs rise to $5.4 million – a $1.17 million increase compared to those that do. All while 28 percent of breaches amongst these organizations were ransomware or destructive attacks (Lohrmann 2022).

Cyber-attacks can interfere with emergency response communications, access to mobile data terminals, and access to critical pre-plans and response documents. According to the Cyber & Infrastructure Security Agency (CISA), cyber risks to 9-1-1 systems can have "severe impacts, including loss of life or property; job disruption for affected network users; and financial costs for the misuse of data and subsequent resolution." CISA also compiled a recent list of attacks on 9-1-1 systems including a DDoS in Arizona, unauthorized access with stolen credentials in Canada, a network outage in New York, and a ransomware attack in Baltimore.

Moreover, the delivery of services can be impacted since governments rely to a great extent on the electronic delivery of services. Most agencies rely on server backups, electronic backups, and remote options for Continuity of Operations and Continuity of Government. Access to documents on the network, OneDrive access, and other operations that require collaboration across the Eastern Region will be significantly impacted.

In addition, public confidence in the government will likely suffer if systems such as permitting, DMV, voting, or public websites are down for a prolonged amount of time. An attack could raise questions regarding the security of using electronic systems for government services.

Economy

Data breaches and subsequent identity thefts can have huge impacts on the public. The FBI Internet Crime Report 2021 reported losses in Montana due to cyber-attacks totaled $10,107,283 in 2021 alone.

Economic impacts from a cyber-attack can be debilitating. The cyber-attack in 2018 that took down the City of Atlanta cost at least $2.5 million in contractor costs and an estimated $9.5 million additional funds to bring everything back online. The attack in Atlanta took more than a third of the 424 software programs offline and recovery lasted more than 6 months. The 2018 cyber-attack on the Colorado Department of Transportation cost an estimated $1.5 million. None of these statistics consider the economic losses to businesses and ongoing IT configuration to mitigate a future cyber-attack.

Additionally, a 2016 study by Kaspersky Lab found that roughly one in five ransomware victims who pay their attackers never recover their data. A 2017 study found ransomware payments over a two-year period totaled more than $16 million. Even if a victim is perfectly prepared with full offline data backups, recovery from a sophisticated ransomware attack typically costs far more than the demanded ransom.

Historic and Cultural Resources

Most cyber incidents have little to no impact on historic, cultural, or natural resources. A major cyber terrorism attack could potentially impact the environment by triggering a release of hazardous materials, or by causing an accident involving hazardous materials by disrupting traffic control devices.

Natural Resources

Most cyber-attacks would have a limited impact on natural resources. There are cases, such as a cyber-attack on a hydroelectric dam, that could result in catastrophic consequences to natural and human-built environments in the case of a flood. If a cyber-attack occurred on several upstream dams and released significant amounts of water downstream, the additional pressure put on downstream dams could fail, resulting in massive flood events. This would not only jeopardize the energy system that relies on these dams but also cause significant damage to the natural environment.

Development Trends Related to Hazards and Risk

Changes in development have no impact on the threat, vulnerability, and consequences of a cyber-attack. Cyber-attacks can and have targeted small and large jurisdictions, multi-billion-dollar companies, small mom-and-pop shops, and individual citizens. The decentralized nature of the internet and data centers means that the cyber threat is shared by all, regardless of new construction and changes in development.

4.2.4 Dam Failure

Hazard/Problem Description

A dam is a barrier constructed across a watercourse that stores, controls, or diverts water. Dams are constructed for a variety of uses, including flood protection, power, agriculture/irrigation, water supply, and recreation. The water impounded behind a dam is referred to as the reservoir and is usually measured in acre-feet, with one acre-foot being the volume of water that covers one acre of land to a depth of one foot. Depending on local topography, even a small dam may have a reservoir containing many acre-feet of water. Dams serve many purposes, including irrigation control, providing recreation areas, electrical power generation, maintaining water levels, and flood control.

Dam failures and releases from dams during heavy rain events can result in downstream flooding. Water released by a failed dam generates tremendous energy and can cause a flood that is catastrophic to life and property. Two factors that influence the potential severity of a full or partial dam failure are the amount of water impounded and the density, type, and value of downstream development and infrastructure. The speed of onset depends on the type of failure. If the dam is inspected regularly then small leaks allow for adequate warning time. Once a dam is breached, however, failure and resulting flooding occurs rapidly. Dams can fail at any time of year, but the results are most catastrophic when the dams fill or overtop during winter or spring rain/snowmelt events.

A catastrophic dam failure could challenge local response capabilities and require evacuations to save lives. Impacts to life safety would depend on the warning time and the resources available to notify and evacuate the public and could include major loss of life and potentially catastrophic damage to roads, bridges, and homes. Associated water quality and health concerns could also be an issue.

Dam failures are often the result of prolonged rainfall and overtopping, but can happen in any conditions due to erosion, piping, structural deficiencies, lack of maintenance and repair, or the gradual weakening of the dam over time. Other factors that can lead to dam failure include earthquakes, landslides, improper operation, rodent activity, vandalism, or terrorism.

According to FEMA, dams are classified in three categories that identify the potential hazard to life and property:

- **High hazard** - Dams where failure/mis-operation will probably cause loss of human life.
- **Significant hazard** - Dams where failure or mis-operation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.
- **Low hazard** - Dams where failure or mis-operation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

Dam inundation can also occur from non-failure events or incidents such as when outlet releases increase during periods of heavy rains or high inflows. Controlled releases to allow water to escape when a reservoir is overfilling can help prevent future overtopping or failure. When outlet releases are not enough, spillways are designed to allow excess water to exit the reservoir and prevent overtopping. This can protect the dam but result in flooding downstream. Dam safety incidents are defined as situations at dams that require an immediate response by dam safety engineers. Detailed below in Table 4-10 are the high, significant, and low hazard dams organized by county in the Eastern region. The Eastern region has the lowest number of high hazard dams of the three regions in the State, and 100% of the high hazard dams have Emergency Action Plans (EAPs) on file.

Risk Summary

- Overall, cyber-attacks are rated as a **Medium** significance in the planning area.
- Cyber-attacks can occur anywhere and on any computer network, therefore, this hazard is rated as **significant** location.
- There is an increasing trend in the number of cyber-attacks in the U.S. each year, therefore, the frequency of cyber-attack is rated as **likely.**
- Cyber-attacks can result in significant economic losses, interruptions of critical facilities and services, and confidential data leaks; therefore, magnitude is ranked as **Critical.**
- People ages 60+ are the most likely age group to experience the greatest monetary losses, although anyone of any age can be a victim to a cyber-attack.
- Small businesses worth less than $10 million and local governments are increasingly becoming targets for cyber-attack, with criminals assuming these smaller organizations will lack the resources to prevent an attack.
- Critical infrastructure, such as the energy grid and first responder communication, is vulnerable to cyber-attack and disruption.
- Significant economic losses can result from cyber-attacks if the attackers ask for ransom.
- Jurisdictions with a significantly large population and advanced infrastructure are most likely to experience cyber-attacks.

Table 4-9 Risk Summary Table: Cyber-Attack

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
Eastern Region	Medium		None
Big Horn	Medium	Hardin, Lodge Grass	None
Carbon	Medium	Bearcreek, Bridger, Joliet, Fromberg, Red Lodge	None
Carter	Medium	Ekalaka	None
Custer	Medium	Ismay, Miles City	None
Crow Tribe	Medium		
Daniels	Medium	Scobey, Flaxville	None
Dawson	Medium	Richey, Glendive	None
Fallon	Medium	Plevna, Baker	None
Garfield	Medium	Jordan	None
Golden Valley	Medium	Ryegate, Lavina	None
McCone	Medium	Circle	None
Musselshell	Medium	Melstone, Roundup	None
Powder River	Medium	Broadus	None
Prairie	Medium	Terry	None
Richland	Medium	Fairview, Sidney	None
Roosevelt	Medium	Wolf Point, Poplar, Bainville, Culberson, Froid	None
Rosebud	Medium	Colstrip, Forsyth	None
Sheridan	Medium	Plentywood, Medicine Lake, Outlook, Westby	None
Stillwater	Medium	Columbus	None
Treasure	Medium	Hysham	None
Valley	Medium	Glasgow, Fort Peck, Nashua, Opheim	None
Wibaux	Medium	Wibaux	None
Yellowstone	High	Billings, Broadview, Laurel	None

Table 4-10 Eastern Region Dam Summary Table

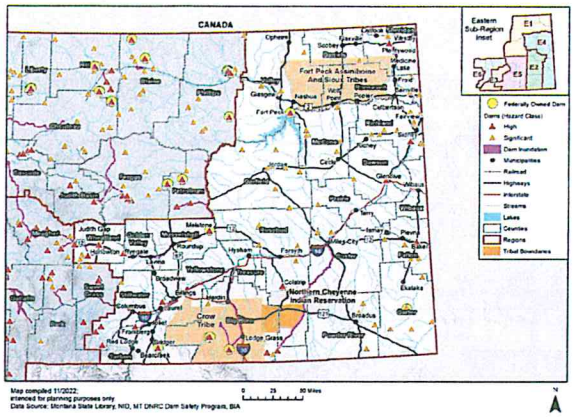
County	# High Hazard	# Significant	# Low	Total	Percentage of High hazard Dam with EAP
Big Horn	5	3	64	72	100%
Carbon	2	-	11	13	100%
Carter	-	7	104	111	-
Custer	-	3	173	176	-
Daniels	-	1	19	20	-
Dawson	1	1	62	64	100%
Fallon	2	4	30	36	100%
Garfield	-	8	236	244	-
Golden Valley	-	-	8	8	-
McCone	1	8	111	120	100%
Musselshell	1	1	28	30	100%
Powder River	-	4	43	47	-
Prairie	-	1	48	49	-
Richland	1	10	67	78	100%
Roosevelt	-	4	35	39	-
Rosebud	4	5	261	270	100%
Sheridan	1	1	22	24	100%
Stillwater	4	-	7	11	100%
Treasure	-	-	16	16	-
Valley	-	5	140	145	-
Wheatland	8	5	23	36	100%
Wibaux	-	-	13	13	-
Yellowstone	1	2	22	25	100%
Total	31	73	1,543	1,647	

Source: Montana Department of Natural Resources and Conservation (DNRC) Dam Safety Program, Montana State Library, NID, HIFLD 2022, Montana DES, NBI

Geographical Area Affected

The geographical area affected by dam failure is potentially **significant**. According to the National Inventory of Dams (NID), there are a total of 1,647 dams throughout the counties of the Eastern Region. Thirty-one (31) of these dams are high hazard, and 73 are significant hazard dams, with the remainder are low hazard dams. These dams are mapped in Figure 4-13 and described in detail in the jurisdictional annexes. All the high hazard dams in the Eastern Region have EAPs on file. In some cases, inundation mapping is available for analysis, but typically limited to privately owned high hazard dams, based on data from the MT DNRC. Additionally, there are limited inundation zones for dams owned by the Bureau of Indian Affairs (BIA), used with permission. Other federally owned dams are highlighted in yellow and do not have publicly available inundation mapping. It is important to note that a lack of mapped inundation areas prevents identifying assets likely to be affected by dam failure but does not indicate the absence of risk.

Figure 4-13 Eastern Region Dams



Dam failure floods in Montana have primarily been associated with riverine and flash flooding. According to the 2023 Montana State Hazard Mitigation Plan (SHMP) and the Montana Department of Natural Resources and Conservation (Montana DNRC), aging infrastructure is largely to blame for a number of failed dams in Montana. There have been numerous small failures primarily related to deterioration of corrugated metal pipe outlet works, which causes slow release of reservoir contents along the outside of the outlet pipe, with minimal downstream property damage but serious damage to the structure. Dams with potential for loss of life downstream are subject to stringent permitting, inspection, operation, and maintenance requirements. Deficiencies and problems are identified in advance and actions taken to mitigate the chance that the deficiency leads to failure. If a deficiency cannot be immediately addressed due to lack of data or lack of dam owner resources, risk reduction measures are put in place.

According to the 2023 State of Montana Multi-Hazard Mitigation Plan, there have been three past dam failures or incidents in the Eastern Region. The following information concerning these events is excerpted from the 2018 SHMP:

- March 1937 – The Midway Dam, located 40 miles northwest of Nashua in Valley County, suffered a breach during a flood on the Porcupine Creek. The spillway was undermined by floating ice, leading to a failure and subsequent four-foot wall of water which swept through the valley and caused extensive damage.
- July 1946 – The Carrol Dam, in Sheridan County eight miles northwest of Plentywood, failed after several inches of rainfall in the area over a short period of time. There were no fatalities in this incident, but there was extensive damage and destruction of homes and farm buildings throughout the valley beneath the dam.
- June 23, 2002 – Ross Dam in Garfield County failed, prompting downstream evacuations, but with limited damage downstream. Once house was flooded and several downstream stock dams broke, and gravel roads were washed out.

Frequency/Likelihood of Occurrence

Dam failures in the United States typically occur in one of four ways:

- Dam overtopping occurs when the water level behind the dam exceeds the top of the dam. Overtopping accounts for 34% of all dam failures, can occur due to inadequate spillway design, settlement of the dam crest, blockage of spillways, and other factors.
- Foundation defects due to differential settlement, slides, slope instability, uplift pressures, and foundation seepage can also cause dam failure. These account for 30% of all dam failures.
- Internal erosion or piping of an earth dam takes place when water that seeps through the dam carries soil particles away from the embankment, filters, drains, foundation, or abutments of the dam. Failure due to piping and seepage accounts for 20% of all failures. These are caused by internal erosion due to piping and seepage, erosion along hydraulic structures such as spillways, erosion due to animal burrows, and cracks in the dam structure.
- Failure due to problems with conduits and valves, typically caused by the piping of embankment material into conduits through joints or cracks, constitutes 10% of all failures.

Eastern Region currently rated as being in poor condition: the Melstone Detention Dam on the Musselshell River near the Town of Melstone in Musselshell County and the Depression Detention Dam near the Town of Bridger. According to correspondence between MT DES and the Montana Dam Safety Program Supervisor in the Water Resources Division there were no dams identified in Eastern Montana that meet the HHPD eligibility criteria as specified in the notice of funding opportunity. See Annex A Carbon County and Addendum R Musselshell County for more details on these dams. MTDES and the participating jurisdictions will continue to monitor dam conditions and may amend this plan if additional high hazard potential dams are assessed as being in poor condition.

Terrorism and vandalism are serious concerns that all operators of public facilities must plan for; these threats are under continuous review by public safety agencies.

All of these factors considered, and taking into consideration the record of past events, the likelihood of a catastrophic dam failure is unlikely, but still possible. This gives a probability rating for dam failure of **unlikely**. Compared to the other regions in the state, the relative lack of high and significant hazard dams in the Eastern Region means a generally lower risk of future severe consequences or casualties from this hazard. However, low hazard dams could still potentially fail and cause issues downstream, though not enough data is available to determine the magnitude or detail how impactful a low hazard dam could be on their surrounding communities.

Climate Change Considerations

Changes in rainfall, runoff, and snowpack conditions may each have significant impacts on water resources, including dams. As of this HMP update it is not clear if climate change will affect dam hazards negatively, but some level of caution is warranted. Dam safety is a high priority in Montana, the state has made a considerable investment developing laws and rules for the design, construction, and maintenance of dams to ensure dam safety. The state has a staffed dam safety program that conducts a sophisticated inspection program. However, dam failures have happened when events occurred that were unforeseen when the structures were designed and built.

For example, the Carrol Dam in Sheridan County and the Ross Dam in Garfield County, both located in the Eastern Region failed in 1946 and 2002, respectively due to several inches of rainfall over a short period of time.

With regard to climate change, a fundamental concern is that future conditions will be different from past conditions used to develop design parameters for existing dams. Extreme weather events have occurred throughout history, a pattern that seems to be accelerating as climate change progresses. Further complicating matters, many climate change impacts are indirect and difficult or impossible to predict. The 2021 Montana Climate Change and Human Health report considers climate "surprises" to be the third greatest concern with climate change impacts to human health.

Cascading effects of wildfire are one potential source of climate change "surprise" that is especially relevant to dam safety. Wildfire scars can alter watershed hydrology, causing extreme, unprecedented runoff that causes flash flooding and often causes debris flows that can impact nearby dam facilities. The concern in this case is that a future wildfire regime could leave unprecedented fire scars. If an extreme precipitation

Summaries for Montana. Not is the issue explicitly addressed on the Montana Dam Safety Program landing page (https://dnrc.mt.gov/Water-Resources/Dam-Safety/).

Despite the lack of study to document specific impacts of climate change on dam safety, it is prudent to continue to monitor changing science-based studies in future HMP updates.

Potential Magnitude and Severity

As noted above, dams are classified as High Hazard Potential if failure is likely to result in loss of life, or Significant Hazard Potential if failure is likely to cause property damage, economic loss, environmental damage, or disruption of lifeline facilities. The US Army Corp of Engineers (USACE) uses three categories to classify a dam's potential hazard to life and property:

- High hazard indicates that a failure would most probably result in the loss of life.
- Significant hazard indicates that a failure could result in appreciable property damage.
- Low hazard indicates that failure would result in only minimal property damage and loss of life is unlikely.
- Undetermined hazard dams have not been rated or their hazard rating is not known.

These dam hazard designations can be used as an indicator of the potential magnitude and severity that is possible on a site-by-site basis. Based on the record of past events in the region and the hazard rankings of the region's dams, the impacts of dam failure or incident is **limited**.

The potential magnitude of a dam failure in the planning area could change in the future; the hazard significance of certain dams could increase if development occurs in inundation areas.

Vulnerability Assessment

The dam failure *Vulnerability Assessment* identifies assets are both likely to be exposed in the event of a dam failure and susceptible to damage from that exposure. In this context, assets are (1) people, (2) property, (3) critical facilities and lifelines, (4) the economy, (5) historic and cultural resources, and (6) natural resources.

Exposure is defined here as interacting with dam failure hazards, and likely to be exposed indicates a presence in areas deemed to be especially likely to experience dam failure hazards. Susceptible indicates a strong likelihood of damage from exposure to dam failure hazards. Finally, vulnerability under future conditions is considered below as it relates to development in the section titled *Development Trends Related to Hazards and Risk*. The effects of climate change on future conditions are considered above in the subsection titled *Climate Change Considerations*.

The analysis of dam failure vulnerability is simplified somewhat by the assumption that any person or physical object that comes into contact with flooding from a dam failure is susceptible to damage. This assumption is based on some key characteristics of dam failure hazards. Dam failure flooding can be among the most violent hazards in existence. The flooding hazard also has definite boundaries. Finally, dam failure flooding can occur with little or no warning and possibly at night when warning and evacuation are difficult.

For hazard mitigation planning purposes, it is assumed that anything in the designated flood inundation zone is vulnerable. Susceptibility is discussed further in the asset-specific subsections, below.

A key limitation of hazard mitigation planning is that flood inundation areas for federally owned dams are typically not available. This prevents identification of many assets that are vulnerable to dam-failure hazards. A solution to this limitation is to reference the hard-copy maps that are available within Emergency Action Plans associated with these dams and on file with the local emergency management offices.

People

Flooding caused by dam failure is among the most violent and destructive of hazard events. People are certainly susceptible to injury or death when exposed to dam inundation hazards. From a planning perspective, all populations exposed to dam failure hazards are considered vulnerable, but the elderly, people with disabilities, young children, and individuals that face challenges evacuating the inundation zone (individuals that do not own a vehicle) are the most vulnerable.

Fortunately, the population exposed to dam failure hazards is variable. The presence of people within dam inundation areas can be reduced in many ways, such as limiting development in high hazard areas. Also, providing advance warning of approaching dam failure hazards can be effective when the warning is received and successfully acted upon to evacuate the area. However, even if advance warning exists, any population that does not receive and act on that warning also remains vulnerable. Even when warnings are received and acted upon, the time to successfully evacuate may be brief and insufficient for vulnerable populations. People prevented from evacuating by blocked or otherwise inaccessible evacuation paths also remain vulnerable. Improving any of the above-mentioned factors will reduce the vulnerability of people to dam failure hazards. Aiding the evacuation of certain populations deserves special consideration, most notably the elderly, people with disabilities, young children, and individuals that do not own a vehicle. These issues are considered more thoroughly in Section 5, *Mitigation Strategy*.

According to GIS analysis conducted for this vulnerability assessment, there are an estimated 22,746 people residing in identified dam inundation zones throughout the Eastern Region. This number does not include people downstream of federally owned dams that do not release information on dam inundation zones. This estimate was derived by taking the number of residential parcels within the inundation zone and multiplying them by the average household size for each county per the U.S. Census Bureau American Community Survey estimates. The breakdown of these exposed populations per county and jurisdiction are shown in Table 4-11 below.

Property

The potentially destructive nature of dam failure hazards makes property that exists within the dam inundation area susceptible to damage and therefore potentially vulnerable. Low-lying areas are subject to additional flood hazards since they exist where dam waters would collect.

Table 4-11 summarizes the estimated number of improved parcels, building values, and people within inundation zones (private dams only) for each county in the Eastern Region. Counties with the highest exposure of people and property include Yellowstone, Custer, and Carbon counties. Table 4-12 summarizes the estimated number of parcels, building values, and people within inundation zones for each Tribe in the Eastern Region.

Table 4-11 Eastern Region Parcels at Risk to Overall Dam Inundation by County and Jurisdiction

County	Jurisdiction	Improved Parcels	Improved Value	Content Value	Total Value	Population
Big Horn	Crow Tribe	314	$27,051,775	$19,085,857	$46,137,632	1,007

County	Jurisdiction	Improved Parcels	Improved Value	Content Value	Total Value	Population
	Big Horn County	22	$2,507,695	$1,965,058	$4,472,753	29
	Total	336	$29,559,470	$21,050,915	$50,610,385	1,036
Carbon	Joliet	268	$34,910,122	$19,545,855	$54,455,977	585
	Red Lodge	418	$81,783,960	$42,929,156	$124,713,116	952
	Carbon County	540	$139,084,832	$82,742,566	$221,827,398	1,023
	Total	1,226	$255,778,914	$145,217,577	$400,996,491	2,560
Custer	Miles City	3,275	$457,747,587	$255,949,474	$713,697,061	7,353
	Custer County	584	$74,246,037	$47,024,649	$121,270,686	1,233
	Total	3,859	$531,993,624	$302,974,122	$834,967,746	8,586
Fallon	Baker	180	$22,765,807	$12,321,269	$35,087,076	377
	Fallon County	5	$405,041	$251,441	$656,482	7
	Total	185	$23,170,848	$12,572,709	$35,743,557	384
Garfield	Garfield County	7	$279,990	$139,995	$419,985	17
	Total	7	$279,990	$139,995	$419,985	17
Golden Valley	Lavina	106	$9,412,853	$6,177,639	$15,590,492	207
	Ryegate	124	$9,347,421	$5,986,023	$15,333,444	250
	Golden Valley County	33	$3,223,648	$2,755,364	$5,979,012	29
	Total	263	$21,983,922	$14,919,026	$36,902,948	486
Musselshell	Roundup	134	$7,925,167	$4,025,413	$11,950,580	273
	Musselshell County	106	$5,923,568	$4,165,939	$10,089,507	185
	Total	240	$13,848,735	$8,191,352	$22,040,087	458
Richland	Total	5	$734,424	$509,317	$1,243,741	8
Rosebud	Northern Cheyenne Indian Reservation	57	$3,089,925	$1,756,822	$4,846,747	214
	Rosebud County	131	$10,719,734	$7,884,477	$18,604,211	249
	Total	193	$14,544,083	$10,150,616	$24,694,699	463
Sheridan	Plentywood	940	$121,121,067	$72,008,009	$193,129,076	1,939
	Sheridan County	38	$12,707,566	$16,106,768	$28,814,334	60
	Total	978	$133,828,633	$88,114,776	$221,943,409	1,999
Treasure	Treasure County	1	$366,520	$366,520	$733,040	-
	Total	1	$366,520	$366,520	$733,040	0
Wheatland	Harlowton	214	$14,033,469	$7,521,986	$21,555,455	491
	Wheatland County	170	$21,505,215	$19,038,660	$40,543,875	287
	Total	384	$35,538,684	$26,560,646	$62,099,330	778
Yellowstone	Billings	1,373	$331,662,987	$225,615,257	$557,278,244	3,017

County	Jurisdiction	Improved Parcels	Improved Value	Content Value	Total Value	Population
	Yellowstone County	1,365	$415,127,399	$403,256,080	$818,383,479	2,954
	Total	2,739	$746,790,386	$628,681,337	$1,375,671,723	5,971
	Grand Total	10,411	$1,807,683,809	$1,253,139,589	$3,056,823,398	22,746

Source: County Assessor data, NID, MT DNRC, WSP GIS Analysis

Table 4-12 Eastern Region Parcels at Risk to Dan Inundation by Tribe

Tribe	Improved Parcels	Improved Value	Content Value	Total Value	Population
Crow Tribe	314	$27,051,775	$19,085,857	$46,137,632	1,007
Fort Peck Assiniboine and Sioux Tribe	-	-	-	-	-
Northern Cheyenne Indian Reservation	57	$3,089,925	$1,756,822	$4,846,747	214
Total	**371**	**$30,141,700**	**$20,842,679**	**$50,984,379**	**1,221**

Source: County Assessor data, NID, MT DNRC, WSP GIS Analysis

Critical Facilities and Lifelines

A total dam failure can cause catastrophic impacts to areas downstream of the water body, including critical infrastructure. Any critical asset located under the dam in an inundation area would be susceptible to the impacts of a dam failure. Transportation routes are vulnerable to dam inundation and have the potential to be washed out in flooding following dam failure incidents, creating isolation and emergency response issues. Those that are most vulnerable are those that are already in poor condition and would not be able to withstand a large water surge. Utilities such as overhead power lines, cable and phone lines could also be vulnerable. Loss of these utilities could create additional isolation issues for the inundation areas.

Based on the critical facility inventory considered in the updating of this plan there are 352 critical facilities throughout the Eastern Region which lie within mapped dam inundation areas. These at-risk facilities are listed in Table 4-13 below by critical facility classification as based on the FEMA Lifeline categories.

Table 4-13 Eastern Region Critical Facilities at Risk to Dam Inundation by Jurisdiction and FEMA Lifeline

County	Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Total
Big Horn	Lodge Grass	-	-	2	-	-	1	-	3
	Big Horn County	3	4	6	-	-	3	36	52
	Total	3	4	8	0	0	4	36	55
Carbon	Joliet	-	-	3	-	1	2	1	7
	Red Lodge	-	2	-	-	-	1	2	5
	Carbon County	1	1	2	-	-	-	24	28
	Total	1	3	5	0	1	3	27	40
	Miles City	3	4	6	-	3	22	2	40

County	Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Total
Custer County	Custer County	1	4	1	1	-	4	13	24
	Total	4	8	7	1	3	26	15	64
Fallon	Baker	-	-	-	-	-	1	2	3
	Fallon County	-	-	1	-	-	-	3	4
	Total	0	0	1	0	0	1	5	7
Golden Valley	Lavina	-	3	1	-	1	4	1	10
	Ryegate	-	-	2	-	1	6	1	10
	Golden Valley County	-	-	1	-	-	-	6	7
	Total	0	3	4	0	2	10	8	27
Musselshell	Roundup	-	-	-	-	-	-	1	1
	Musselshell	-	-	1	-	-	-	9	10
	Total	0	0	1	0	0	0	10	11
Petroleum	Petroleum County	-	-	-	-	-	-	1	1
	Total	0	0	0	0	0	0	1	1
Richland	Richland County	-	-	-	-	-	-	1	1
	Total	0	0	0	0	0	0	1	1
Rosebud	Rosebud County	1	3	2	-	1	7	11	25
	Total	1	3	2	0	1	7	11	25
Sheridan	Plentywood	4	2	1	-	1	-	8	16
	Sheridan County	-	2	1	-	-	-	5	8
	Total	4	4	2	0	1	0	13	24
Treasure	Treasure County	-	-	-	-	-	-	3	3
	Total	0	0	0	0	0	0	3	3
Wheatland	Harlowton	-	-	-	-	-	1	-	1
	Wheatland County	1	2	2	-	-	2	11	18
	Total	1	2	2	0	0	3	11	19
Yellowstone	Billings	7	2	1	4	-	7	10	31
	Yellowstone County	5	9	3	7	2	1	17	44
	Total	12	11	4	11	2	8	27	75
	Grand Total	**26**	**38**	**36**	**12**	**10**	**62**	**168**	**352**

Sources: Montana DNRC Dam Safety Program, Montana State Library, NID, HIFLD 2022, Montana DES, NBI

Economy

The economy in the Eastern Region is both exposed and susceptible to dam failure. For example, a dam failure would likely cause the long-term loss of a reservoir. Reservoirs are often critical water sources for potable or irrigation water needs, support tourism, and provide wildlife habitat. The loss of potable water could directly cause businesses to close, at least temporarily, and the loss of a reservoir could indirectly disrupt tourism. Downstream flooding would cause additional indirect impacts of economic disruption.

Historic and Cultural Resources

Reservoirs themselves are often significant cultural and economic resources for tourism and recreation. A dam failure and subsequent loss of a reservoir would be potentially catastrophic to these resources. In addition, downstream flooding is also capable of damaging or destroying historic and cultural resources such as historic buildings, aquatic habitat, or additional dams downstream. Specific historic resources have

not been identified, but historic buildings in the cities and towns of Miles City, Ryegate, and Billings may have more exposure than other jurisdictions in the Region based on the overall numbers of developed parcels within inundation areas and concentration of assets and historic buildings in downtown areas.

Natural Resources

Reservoirs held behind dams affect many ecological aspects of a river. Rivers often experience wide fluctuations in key aspects of aquatic habitat such as flow rate, temperature, and suspended sediment. But below dams, rivers often experience relatively stable conditions with very little suspended sediment. These conditions can provide ideal habitat for desirable species such as trout. A dam failure can completely alter this arrangement.

Dam failure also can cause severe downstream flash flooding, depending on the magnitude of the failure. Loss of the water resource from dam failure could impair the supply of water for potable or irrigation water needs.

Development Trends Related to Hazards and Risk

Specific areas experiencing growth and development below dams in Montana has not been assessed, but it's possible there has been development within inundation zones, which are not as regulated as flood hazard areas. Development below dams can cause vulnerability to increase and have significant financial impact on dam owners. When new development occurs in the inundation area below an existing dam that previously lacked downstream hazards, the dam could be redassified as "high hazard". High hazard dams are required to meet stringent requirements for design, construction, inspection, and maintenance. Bringing a dam up to high hazard design standards can be costly for a dam owner. Even for dams already classified as high hazard, additional downstream development can still have a financial impact. Spillway design standards are based on potential for loss of life downstream. As the population at risk increases, the spillway design standard increases. A dam that is currently in compliance with state design standards can suddenly be out of compliance after a subdivision is built downstream.

Risk Summary

Dam failure is a hazard that presents an unlikely chance of occurrence, but a potentially significant negative impact should a dam failure occur. Major impacts to downstream populations, property, infrastructure, and natural and cultural resources could occur.

- The overall significance rating of dam failure for the eastern region is **low** in part due to low probability of occurrence.
- Dam failures, especially those of high hazard dams, could potentially result in people downstream caught in inundation area flooding with little to no warning.
- Property and buildings located within the inundation area are vulnerable to damage or destruction in the event of a dam failure; counties with the highest exposure of people and property include Yellowstone, Custer, Carbon Counties.
- Direct economic losses in terms of property damage, as well as indirect losses in terms of impeded tourism and loss of cultural or recreational resources like reservoirs, could result from dam failures. There is an estimated $3,066,823,398 in total property value located within inundation areas in the Eastern Region exclusive to privately owned high hazard dams.
- Critical facilities and infrastructure, most notably roads and bridges, located in the inundation zones are also vulnerable to damage or complete loss in the event of a dam failure.
- Related hazards: flooding, earthquake, landslide

Table 4-14 Risk Summary Table: Dam Failure

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
Eastern Region	Low		32 HHPDs exist in the Eastern Region, affecting most, but not all jurisdictions. Many cities and variable land uses exist downstream of high hazard dams. Many dam inundation area delineations are unavailable and extent of risk is unquantified.
Big Horn	Low	Hardin, Lodge Grass	There are five HHPDs in Big Horn County, including Yellowtail, Willow Creek, Tongue River Dam, Carbone Flood Control Dam, and Yellowtail Afterbay. Most areas at risk are on the Crow Tribe reservation.
Carbon	Medium	Bearcreek, Bridger, Joliet, Fromberg, Red Lodge	There are four HHPDs in Carbon County, including Cooney, Glacier Lake North, Depression Detention Dam, and Glacier Lake South Dam. Carbon County has the third highest total value of exposed property within mapped inundation areas.
Carter	Low	Ekalaka	There are no high hazard dams in Carter County.
Custer	Medium	Ismay, Miles City	There are no high hazard dams in Custer County. There are high hazard dams upstream which do pose a threat to Custer County. The county has the second highest total value of exposed property within mapped inundation areas, with most of this in Miles City.
Crow Tribe	Medium		The 525-ft tall Yellowtail Dam sits near the town of Fort Smith, upstream of the reservation on the Bighorn River. Possibly affected areas along the Bighorn River include the town of St. Xavier.
Daniels	Low	Scobey, Flaxville	There are no high hazard dams in Daniels County.
Dawson	Low	Richey, Glendive	There is one HHPD in Dawson County called the Crisafulli Lake Dam.
Fallon	Low	Plevna, Baker	There are two HHPDs in Fallon County, including the Upper Baker Dam and the Lower Baker Dam. Baker has more parcels at risk than the unincorporated areas
Garfield	Low	Jordan	There are no high hazard dams in Garfield County
Golden Valley	Low	Ryegate, Lavina	There are no high hazard dams in Golden Valley County
McCone	Medium	Circle	The Missouri River forms the northern border of McCone County. The surrounding area would be severely affected by failure of Fort Peck Dam, which

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
			sits on the upstream, western end of the county.
Musselshell	Low	Melstone, Roundup	There is one HHPD in Musselshell County called Melstone Detention Dam.
Powder River	Medium	Broadus	There are no high hazard dams in Powder River County
Prairie	Low	Terry	There are no high hazard dams in Prairie County
Richland	Medium	Fairview, Sidney	There is one HHPD in Richland County called Gartside Dam.
Roosevelt	Medium	Wolf Point, Poplar, Bainville, Culberson, Froid	Towns along the Missouri River on the southern border of the county could be affected by failure of Fort Peck Dam. These towns include Wolf Point, Poplar, and Culberson.
Rosebud	Low	Colstrip, Forsyth	There are four HHPDs in Rosebud County, including Colstrip Evaporation Pond Dam, Castle Rock Reservoir Dam, Colstrip Diversion Dam, and Castle Rock Saddle Dam.
Sheridan	Medium	Plentywood, Medicine Lake, Outlook, Westby	There is one HHPD in Sheridan County called Box Elder Dam. Plentywood has higher exposure than the rest of the County.
Stillwater	Medium	Columbus	There are four HHPDs in Stillwater County called Mystic Lake Dam, Stillwater Hertzler Tailings Dam, Stillwater Nye Tailings Dam, and Mystic Dike.
Treasure	Low	Hysham	There are no high hazard dams in Treasure County but the Town of Hysham would be impacted by dam incidents (overtopping) at the Yellowtail Dam and Afterbay Dam. There are also several critical facilities (including bridges) exposed to dam failure hazards in Treasure County in the towns of Hysham, Meyers, and Sanders. See the Treasure County Annex for further information on jurisdictional variability in dam failure vulnerability.
Valley	Medium	Glasgow, Fort Peck, Nashua, Opheim	On the Missouri River, Fort Peck Dam holds up to 18 million acre-feet of water and creates Fort Peck Lake, which serves as more than half the southern border of Valley County.
Wheatland	Low	Harlowton, Judith Gap	There are 8 HHPDs in Wheatland County. Harlowton has more exposure.
Wibaux	Low	Wibaux	There are no HHPDs in Wibaux County.
Yellowstone	Medium	Billings, Broadview, Laurel	There is one HHPD in Yellowstone County called Lakeside Dam. Yellowstone County has the highest total value of exposed property within mapped dam inundation

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
			zones but roughly equal amounts in Billings and the unincorporated areas

4.2.5 Drought

Hazard/Problem Description

Drought is a condition of climatic dryness that is severe enough to reduce soil moisture and water below the minimum necessary for sustaining plant, animal, and human life systems. Influencing factors include temperature patterns, precipitation patterns, agricultural and domestic water supply needs, and growth. Lack of annual precipitation and poor water conservation practices can result in drought conditions.

Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or wildland fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and can take years before the consequences are realized. It is often not obvious or easy to quantify when a drought begins and ends. Droughts can be a short-term event over several months or a long-term event that lasts for years or even decades.

Drought is a complex issue involving many factors—it occurs when a normal amount of moisture is not available to satisfy an area's usual water-consuming activities. Drought can often be defined regionally based on its effects:

- **Meteorological drought** is usually defined by a period of below average water supply.
- **Agricultural drought** occurs when there is an inadequate water supply to meet the needs of the state's crops and other agricultural operations such as livestock.
- **Hydrological drought** is defined as deficiencies in surface and subsurface water supplies. It is generally measured as streamflow, snowpack, and as lake, reservoir, and groundwater levels.
- **Socioeconomic drought** occurs when a drought impacts health, well-being, and quality of life, or when a drought starts to have an adverse economic impact on a region.

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. The most significant impacts associated with drought in Montana are those related to water intensive activities such as agriculture, wildland fire protection, municipal usage, commerce, tourism, recreation, and wildlife preservation. An ongoing drought may leave an area more prone to beetle kill and associated wildland fires. Previous drought events in Montana have led to grasshopper infestations. Drought conditions can also cause soil to compact, increasing an area's susceptibility to flooding, and reduce vegetation cover, which exposes soil to wind and erosion. A reduction of electric power generation and water quality deterioration are also potential problems. Drought impacts increase with the length of a drought, as carry-over supplies in reservoirs are depleted and water levels in groundwater basins decline.

Much of the State was in a drought during the late 1980's. In response to this, and to assist with increasing awareness of and planning for drought in the future, the Governor's Drought Advisory Committee was formed in 1991. This committee, comprised of state and federal water supply and moisture condition experts, meets monthly to evaluate conditions for each county in the State and supports watershed groups and county drought committees by providing planning support and information. Water supply and moisture status maps are produced monthly from February to October by the Committee unless above average moisture conditions are prevalent.

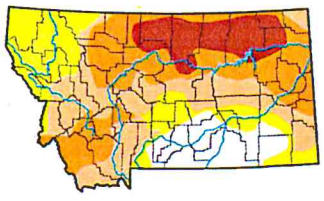
Geographical Area Affected

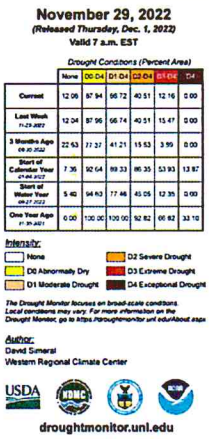
Droughts are often regional events, impacting multiple counties and states simultaneously. Therefore, as the climate of the planning area is contiguous, it is reasonable to assume that a drought will impact the entire planning region. Based on this information, the geographic extent rating for drought is **extensive.**

Drought in the United States is monitored by the National Integrated Drought Information System (NIDIS). A major component of this portal is the U.S. Drought Monitor. The Drought Monitor concept was developed jointly by the NOAA's Climate Prediction Center, the National Drought Mitigation Center, and the USDA's Joint Agricultural Weather Facility in the late 1990s as a process that synthesizes multiple indices, outlooks, and local impacts into an assessment that best represents current drought conditions. The outcome of each Drought Monitor is a consensus of federal, state, and academic scientists who are intimately familiar with the conditions in their respective regions. The rating criteria for drought and a snapshot of the most current drought conditions in Montana can be found in Figure 4-14.

Figure 4-14 Drought Rating Criteria and Status September 2022 in the State of Montana

Category	Description	Possible Impacts	Ranges				
			Palmer Drought Severity Index (PDSI)	CPC Soil Moisture Model (Percentiles)	USGS Weekly Streamflow (Percentiles)	Standardized Precipitation Index (SPI)	Objective Drought Indicator Blends (Percentiles)
D0	Abnormally Dry	Going into drought: • short-term dryness slowing planting, growth of crops or pastures Coming out of drought: • some lingering water deficits • pastures or crops not fully recovered	-1.0 to -1.9	21 to 30	21 to 30	-0.5 to -0.7	21 to 30
D1	Moderate Drought	• Some damage to crops, pastures • Streams, reservoirs, or wells low, some water shortages developing or imminent • Voluntary water use restrictions requested	-2.0 to -2.9	11 to 20	11 to 20	-0.8 to -1.2	11 to 20
D2	Severe Drought	• Crop or pasture losses likely • Water shortages common • Water restrictions imposed	-3.0 to -3.9	6 to 10	6 to 10	-1.3 to -1.5	6 to 10
D3	Extreme Drought	• Major crop/pasture losses • Widespread water shortages or restrictions	-4.0 to -4.9	3 to 5	3 to 5	-1.6 to -1.9	3 to 5
D4	Exceptional Drought	• Exceptional and widespread crop/pasture losses • Shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less	0 to 2	0 to 2	-2.0 or less	0 to 2





Source: U.S. Drought Monitor Montana | U.S. Drought Monitor (unl.edu)

Past Occurrences

Between 2012 and 2021, there were 79 USDA disaster declarations due to drought in the Eastern Region. Table 4-15 provides a list of these events with impacted counties.

Table 4-15 USDA Drought Disaster Declarations (2012-2021)

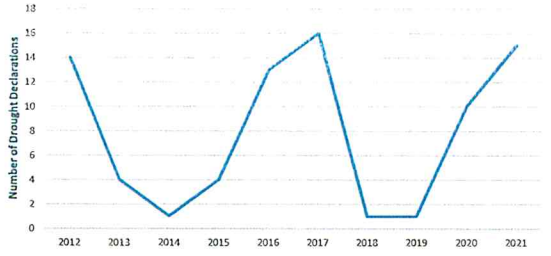
Year	Declaration	Counties Included
2012	S3317	Carter
	S3319	Carter, Powder River
	S3350	Big Horn, Carbon, Powder River
	S3365	Big Horn, Carbon, Carter, Custer, Fallon, Garfield, Golden Valley, Musselshell, Powder River, Prairie, Rosebud, Stillwater, Treasure, Yellowstone
	S3374	Carter, Fallon
	S3391	Big Horn, Carbon, Carter, Custer, Fallon, Golden Valley, Musselshell, Powder River, Rosebud, Stillwater, Treasure, Wheatland Yellowstone
	S3416	Big Horn, Carter, Custer, Fallon, Garfield, Musselshell, Powder River, Prairie, Rosebud, Treasure, Wibaux, Wheatland, Yellowstone
	S3432	Custer, Garfield, Golden Valley, McCone, Musselshell, Prairie, Rosebud, Valley, Wheatland
	S3436	Sheridan
	S3437	Custer, Dawson, Fallon, Garfield, McCone, Prairie, Richland, Roosevelt, Rosebud, Valley, Wibaux
	S3467	Richland, Roosevelt, Wibaux
2013	S3508	Big Horn, Carbon, Carter, Powder River
	S3521	Big Horn, Carbon, Golden Valley, Musselshell, Powder River, Rosebud, Stillwater, Treasure, Yellowstone
	S3522	Carter, Fallon
	S3620	Sheridan
2014	S3804	Fallon, Richland, Sheridan, Wibaux
2015	S3959	Sheridan
	S3960	Fallon, Richland, Roosevelt, Sheridan, Wibaux
	S3961	Fallon, Wibaux
	S3972	Carter, Custer, Fallon, Garfield, Powder River, Prairie, Rosebud
2016	S3982	Big Horn, Carbon, Powder River
	S3988	Carter, Powder River
	S3999	Carter, Custer, Fallon, Powder River
	S4000	Carter, Fallon
	S4002	Powder River
	S4035	Big Horn, Carter, Custer, Fallon, Powder River, Prairie, Rosebud, Wibaux
	S4036	Fallon
	S4061	Golden Valley, Wheatland
	S4066	Big Horn, Carbon, Golden Valley, Powder River, Rosebud, Stillwater, Treasure, Wheatland, Yellowstone
	S4070	Carbon
	S4138	Fallon Wibaux
2017	S4185	Custer, Daniels, Dawson, Garfield, McCone, Prairie, Richland, Roosevelt, Rosebud, Sheridan, Valley
	S4186	Fallon, Richland, Roosevelt, Sheridan, Wibaux
	S4190	Carter, Custer, Dawson, Fallon, McCone, Prairie, Richland, Wibaux
	S4191	Richland, Roosevelt, Wibaux

Year	Declaration	Counties Included
	S4193	Big Horn, Custer, Dawson, Garfield, Golden Valley, McCone, Musselshell, Powder River, Richland, Roosevelt, Rosebud, Treasure, Valley, Wheatland, Wibaux, Yellowstone
	S4195	Carter, Custer, Dawson, Fallon, Garfield, McCone, Powder River, Prairie, Rosebud, Wibaux
	S4198	Carter, Fallon
	S4210	Big Horn, Carbon, Golden Valley, Musselshell, Rosebud, Stillwater, Treasure, Yellowstone
	S4211	Carter
	S4214	Big Horn, Carter, Custer, Fallon, Powder River, Rosebud
	S4217	Big Horn, Carbon, Golden Valley, Musselshell, Powder River, Rosebud, Stillwater, Treasure, Wheatland, Yellowstone
	S4219	Carter, Powder River
	S4221	Wheatland
	S4330	Fallon, Richland, Roosevelt, Sheridan, Wibaux
2018	S4432	Daniels, McCone, Richland, Roosevelt, Sheridan, Valley
2019	S4640	Sheridan
2020	S4746	Big Horn, Carbon, Powder River
	S4777	Big Horn, Carter, Custer, Powder River, Rosebud
	S4785	Powder River
	S4864	Daniels, McCone, Richland, Roosevelt, Sheridan, Valley
	S4871	Big Horn, Carbon, Carter, Custer, Fallon, Powder River, Rosebud, Treasure, Yellowstone
	S4889	Custer, Rosebud, Big Horn, Carter, Fallon, Garfield, Musselshell, Powder River, Prairie, Treasure, Yellowstone
	S4891	Carter, Powder River
	S4948	Fallon, Richland, Roosevelt, Sheridan, Wibaux
	S4949	Sheridan
	S4950	Fallon
2021	S4926	Big Horn, Carbon, Powder River
	S4931	Carbon, Carter, Powder River
	S4939	Fallon, Richland, Roosevelt, Sheridan, Wheatland, Wibaux
	S4960	Carter, Custer, Daniels, Dawson, Fallon, McCone, Prairie, Richland, Roosevelt, Sheridan, Valley, Wibaux, Garfield, Powder River, Rosebud
	S4964	Carter, Fallon
	S4970	Garfield, Custer, McCone, Prairie, Rosebud, Valley
	S4993	Golden Valley, Musselshell, Powder River, Rosebud, Big Horn, Carter, Custer, Garfield, Stillwater, Treasure, Yellowstone
	S5001	Golden Valley, Wheatland,
	S5007	Carbon, Stillwater, Treasure, Yellowstone, Big Horn, Golden Valley, Musselshell, Rosebud, Wheatland
	S5016	Wheatland
	S5022	Big Horn, Carbon, Powder River, Rosebud, Treasure, Yellowstone
	S5203	Fallon, Richland, Roosevelt, Sheridan, Wibaux

Source: USDA

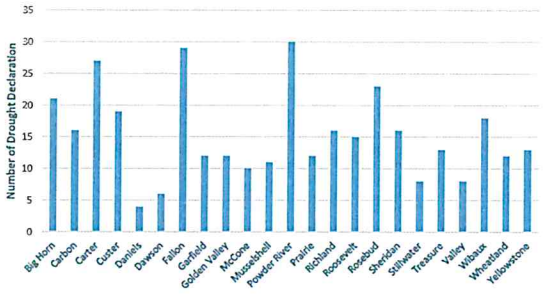
Figure 4-15 displays the temporal trend in USDA disaster declarations from drought by year in the Eastern Region. While there is evident variability in the number of declarations from year to year, there has been a gradual increase in the number of declarations due to drought in the Eastern Region, with the greatest number of declarations occurring in 2017. Figure 4-16 displays the breakdown of declarations by county. In the Eastern Region, Powder River County has experienced the greatest number of USDA disaster declarations, followed by Fallon and Carter Counites.

Figure 4-15 USDA Drought Disaster Declarations by Year (2012-2021)



Source: USDA

Figure 4-16 USDA Drought Disaster Declarations by County (2012-2021)



Source: USDA

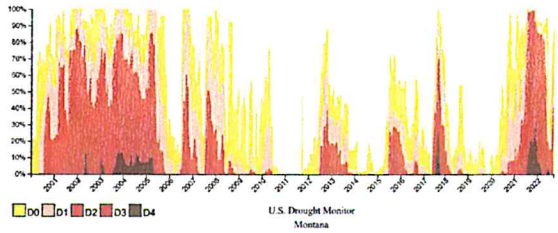
The 2021 Teton County Hazard Mitigation Plan and 2018 State of Montana Hazard Mitigation Plan provide details of drought history in the State of Montana:

- **1917-1923:** Rising wheat prices encouraged farmers to transform grasslands into farmland for wheat, corn, and row crops. This resulted in significant losses of soil and overconsumption of water for crops.

- **1928-1939:** The driest period in the historic record, the Palmer Hydrologic Drought Index (PHDI) showed the entire state was in a hydrologic deficit for over 10 years. Better conservation practices, such as strip cropping, helped to lessen the impacts of the worst water shortages.
- **Mid-1950's:** Montana faced a period of reduced rainfall in eastern and central portions of the state. By November of 1956, a total of 20 Montana counties had applied for federal drought assistance.
- **1961:** By August of 1961, 24 counties had applied for federal drought disaster aid. Montana's State Crop and Livestock Reporting Service called it the worst drought since the 1930's.
- **1966:** The entire state was experiencing yet another episode of drought. Although water shortages were not as great as in 1961, a study of ten weather recording stations across Montana showed all had recorded below normal precipitation amounts for a ten-month period.
- **1977:** In June, officials from Montana were working with others from Idaho, Washington, and Oregon on the Northwest Utility Coordination Committee to moderate potential hydroelectricity shortages. On June 23, Governor Judge issued an energy supply alert and ordered a mandatory ten percent reduction in electricity use by state and local governments.
- **1979-1981:** By October of 1980, estimates of 1980 federal disaster payments were five times those paid in 1979. Total drought related economic losses from Montana in 1980 were estimated to be $380 million (equivalent to $1.26 billion in 2021). Large May storms in 1981 brought flooding to formerly parched areas.
- **1984:** By July, Montana was again experiencing water shortages and rationing schedules were put into effect. Crop losses were estimated at $12-15 million. Numerous forest and range fires burned out of control across the state in August.
- **1985:** All 56 counties received disaster declarations for drought. Cattle herds were reduced by approximately one-third. The state's agriculture industry lost nearly $3 billion in equity.
- **1999-2008:** This period of dryness and hydrologic deficits mimicked the Dust Bowl years in every measurable factor besides duration. Area aquifers as well as municipal water supplies suffered severe water losses.
- **2017:** Northeastern Montana had record dry conditions for much of 2017, especially through August.
- **2021-2022:** By December of 2021, every county in Montana was identified as experiencing some level of drought. A third of the state was classified as "D4" or "exceptional" drought, a designation the U.S. Department of Agriculture expects to occur in any one location just once every 50 to 100 years.

Figure 4-17 displays data from the U.S. Drought Monitor for the State of Montana from 2000-2022. "D0" represents least severe drought conditions and "D4" is most severe. The chart shows peak drought conditions in the years 2002-2005, 2017, and 2021-2022 across the State.

Figure 4-17 US Drought Monitor: State of Montana Drought Conditions (2000-2022)



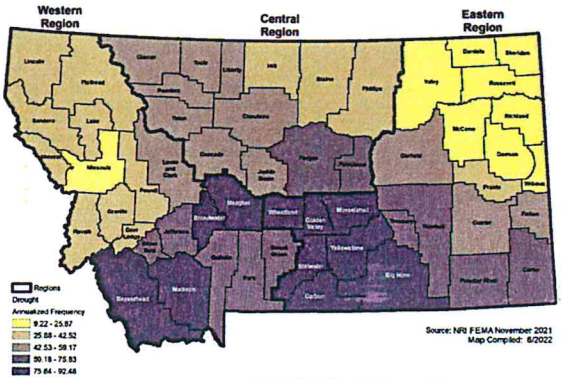
Source: U.S. Drought Monitor

Frequency/Likelihood of Occurrence

The likelihood of drought somewhere in the Eastern Region is **highly likely** based on the US Drought Monitor. The 2018 State of Montana Hazard Mitigation Plan also reported that, despite variation in drought severity, drought losses are incurred every year in Montana.

Figure 4-18 depicts annualized frequency of drought at a county level based on the NRI. The mapping shows a trend towards increased likelihood in the southwestern portion of the Eastern Region, particularly in Big Horn, Carbon, Golden Valley, Musselshell, Stillwater, Wheatland, and Yellowstone Counties.

Figure 4-18 Annualized Frequency of Drought Events by County



Map by WSP, Data Source: FEMA National Risk Index, https://hazards.fema.gov/nri/determining-risk

Climate Change Considerations

Montana's future drought hazard is largely a story of how climate change will impact precipitation, compared to how it will impact evapotranspiration. Evapotranspiration is sensitive to temperature and climate-change associated increases in temperature are fairly certain to increase transpiration for the foreseeable future. The more dynamic part of the drought story is how climate change will affect precipitation.

Changes in the seasonal distribution of precipitation in Montana are becoming evident. The 2021 Montana Climate Change and Human Health Study documents summer precipitation has decreased slightly and is roughly offset by slightly increased spring and fall precipitation. This observation is consistent with observations of increasing drought in recent years and the early stages of anticipated changes due to climate change.

Looking farther into the future, Figure 4-19 shows the projected change in monthly average precipitation for 2040-2069 relative to 1971-2000. During the spring, precipitation is expected to increase in coming decades. The springtime increase in precipitation is likely to offset increases in evapotranspiration driven by increasing temperature. However, during summer months, precipitation is expected to remain relatively stable or continue to decline slightly. This stable or slightly decreasing precipitation, combined with higher evapotranspiration rates due to increasing temperatures, can reasonably be anticipated to increase the drought hazard during summer months. Fall and winter months are less certain but are more likely to resemble the springtime pattern described above.

The magnitude of climate change impact on drought, especially during the summer, is significant and worthy of attention, but not necessarily catastrophic. The Fifth National Climate Assessment confirms that drought is increasing in Montana, and is projected under moderate climate change scenarios to be 10% more frequent by 2050, and 20% by 2100.

Figure 4-19 Projected Change in Montana Monthly Precipitation

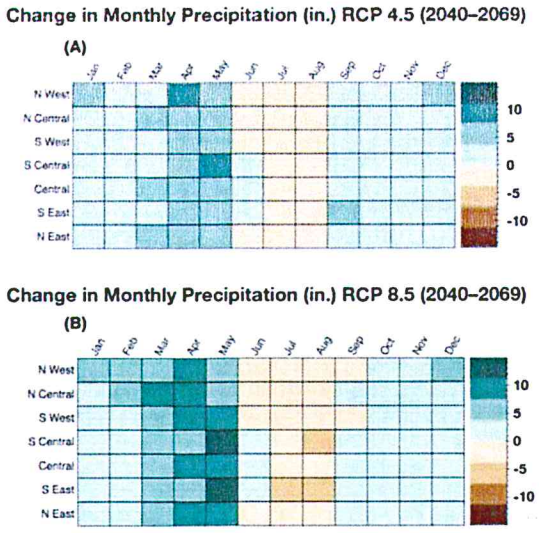


Figure source: Montana Climate Change and Human Health report, 2021. RCP 4.5 (figure A) is described as the "stabilization scenario" and RCP 8.5 (figure B) is described as the upper-bound emission scenario.

Climate science has advanced far in recent years but limitations in our understanding of climate change remain, especially at projecting changes at small spatial scales. Scientifically defensible projections do not yet exist to differentiate the effects of climate change on the drought hazard in each jurisdiction within the Eastern Region. For example, current scientific information indicates exposure to summertime drought is likely to get worse throughout the region. However, there is virtually no scientific information regarding if

CATEGORY	HISTORICALLY OBSERVED IMPACTS
D4 – Exceptional Drought	• Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small • Fire season is very costly; number of fires and area burned are extensive • Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear

Source: U.S. Drought Monitor

Drought impacts are far-reaching and may be economic, environmental and/or societal; therefore, the potential magnitude and severity is ranked as **critical**. The most significant impacts associated with drought in the Eastern Region are those related to water-intensive activities such as agriculture, wildfire protection, municipal usage, and wildlife preservation. A reduction of electric power generation and deterioration of water quality are also potential problems, as seen in the history of droughts in Montana. Drought conditions can also cause soil to compact and not absorb water well, potentially making an area more susceptible to flooding. Indirect effects include those impacts that ripple out from the direct effect and include reduced business and income for local retailers, increased credit risk for financial institutions, capital shortfalls, loss of tax revenues and reduction in government services, unemployment, and outmigration. Figure 4-20 displays the number of impacts from drought in the Eastern Region by impact type and county based on the Drought Impact Reporter.

or how drought will get worse in one part of the Eastern Region relative to another part. In summary, the intensities of droughts will increase because of increased summer temperatures and decreased overall summer precipitation. Droughts are also projected to increase in frequency and have a longer duration due to shifts in seasonal precipitation patterns, including drier summers and less precipitation falling as snow in early spring.

Susceptibility to drought may also shift from jurisdiction to jurisdiction in ways that are difficult to predict and may or may not be related to climate change. For example, consider a scenario where deteriorating infrastructure degrades the reliability of irrigation water supply in a specific jurisdiction. Susceptibility to drought would increase in the affected jurisdiction more than in others. Whatever the cause of increase susceptibility to drought, climate change will amplify the consequence of the change. Future updates to this plan should revisit the topic of future drought conditions and susceptibility as scientific knowledge progresses and note any trends that emerge over time.

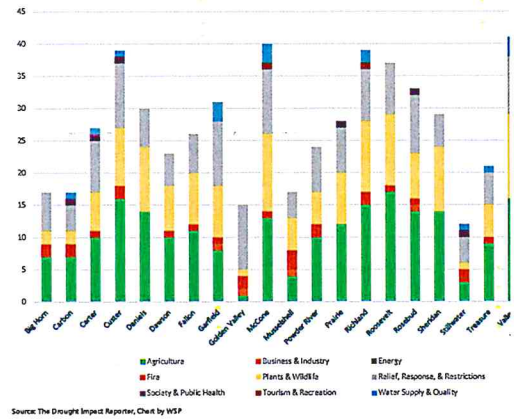
Potential Magnitude and Severity

The magnitude of a drought's impact is directly related to the severity and length of the drought. The severity of a drought depends on water availability and moisture deficiency, the time period, and the size and location of the affected area. The longer the drought persists and the larger the area effected, the more severe the potential impacts. Droughts can be a short-term event over several months or a long-term event that lasts for years or even decades. Table 4-16 summarizes the historically observed impacts by category for drought in California.

Table 4-16 Historically Observed Impacts by Drought Monitor Category

CATEGORY	HISTORICALLY OBSERVED IMPACTS
D0 – Abnormally Dry	• Soil is dry; irrigation delivery begins early • Dryland crop germination is stunted • Active fire season begins
D1 – Moderate Drought	• Dryland pasture growth is stunted; producers give supplemental feed to cattle • Landscaping and gardens need irrigation earlier; wildlife patterns begin to change • Stock ponds and creeks are lower than usual
D2 Severe Drought	• Grazing land is inadequate • Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent • Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase
D3 – Extreme Drought	• Livestock need expensive supplemental feed; cattle and horses are sold; little pasture remains; fruit trees bud early; producers begin irrigating in the winter • Fire season lasts year-round; fires occur in typically wet parts of the State; burn bans are implemented • Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted

Figure 4-20 Drought Impacts by County and Impact Type (2000-2021)



Source: The Drought Impact Reporter, Chart by WSP

Vulnerability Assessment

The drought *Vulnerability Assessment* identifies, or at least discusses, assets that are both likely to be exposed to drought and are susceptible to damage from that exposure. In this context, assets are (1) people, (2) property, (3) critical facilities and lifelines, (4) the economy, (5) historic and cultural resources, and (6) natural resources. Exposure indicates interacting with drought hazards, and likely to be exposed indicates a presence in areas deemed to be especially likely to experience drought hazards. Susceptible indicates a strong likelihood of damage from exposure to drought hazards and is described in greater detail in Section 4.2.1, subsection titled *Vulnerability Assessment*. Finally, vulnerability under future conditions is considered as it relates to both climate change and development.

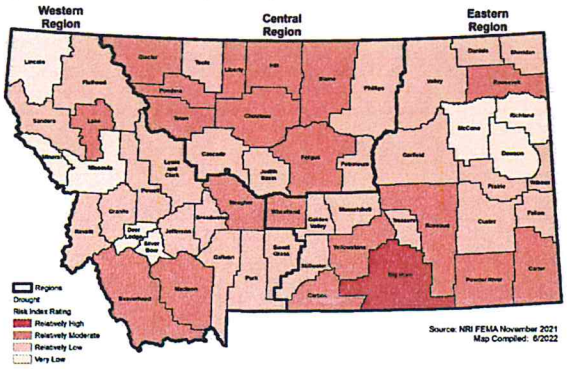
The high-hazard zone for drought extends throughout the Eastern Region of Montana. Variability in the hazard severity exists from drought to drought, but over time all parts of the Eastern Region are exposed to severe drought conditions. Susceptibility to drought is variable throughout the Eastern Region and is discussed further in the asset-specific subsections, below.

The role of climate change in future vulnerability to drought is discussed above in the section titled, *Climate Change Considerations*, while the effect of future development is considered below in the section titled *Development Trends Related to Hazards and Risk*.

A key limitation of hazard mitigation planning is that most drought impacts other than to the agricultural sector are indirect. This complicates the evaluation of assets that are vulnerable to drought hazards.

Figure 4-21 shows the NRI risk index rating for drought in Montana counties. The risk index calculation considers the expected annual losses from drought, social vulnerability, and community resilience in each county. Counties in the Eastern Region have a wide range of risk, varying from *very low* to *relatively high*. As shown in the figure, Big Horn County has a relatively high-risk rating to drought whereas the counties of McCone, Dawson, and Richland have very flow risk rating.

Figure 4-21 NRI Risk Index Rating for Drought



Map by WSP, Data Source: FEMA National Risk Index, https://hazards.fema.gov/nri/determining-risk

People

The historical and potential impacts of drought on populations include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Other public health issues can include impaired drinking water quality, increased incidence of mosquito-borne illness, increased wildlife-human confrontations, and respiratory complications due to declined air quality in times of drought.

Farmers are likely to experience economic losses due to drought. The Montana Governor's Drought Report of May 2004 referenced the economic and societal effects of drought: "The state's biggest drought story remains the deepening socio-economic drought. The drought threatens to change the very fabric of Montana's rural communities and landscape. It is the final straw that can bankrupt 4th and 5th generation farmers and ranchers, placing the birthright of descendants of pioneer families on the auction block. And like the changing vistas, many of the well-established County agri-businesses are disappearing forever, along with other main street institutions."

Exposure to drought occurs similarly across the Eastern Region. The vulnerability of people to that exposure is variable and is what drives the variability in drought impacts described in the opening paragraph of this subsection. Relationships between drought exposure, susceptibility, and impact are generally consistent throughout the planning area. For example, rain-fed agriculture is susceptible to the effects of drought

wherever it occurs in the Eastern Region and when crops fail jobs are lost in a similar fashion across the Eastern Region. Individual annexes discuss drought vulnerabilities that are particularly important at the jurisdiction-level.

Property

Direct structural damage from drought is rare, though it can happen. Drought can affect soil shrinking and swelling cycles and can result in cracked foundations and infrastructure damage. Droughts can also have significant impacts on landscapes, which could cause a financial burden to property owners. There is a greater threat of structure damage in a drought-affected area due to the secondary impacts of drought. For example, drought increases the risk of wildfire and may create water shortages that inhibit adequate fire response. Additionally, heavy rains after prolonged drought conditions can result in significant flooding, which can damage property.

Critical Facilities and Lifelines

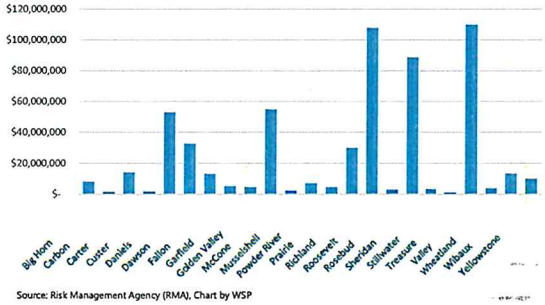
Water systems are the most susceptible to drought. As shown in Figure 4-20 above, nearly half the counties in the Eastern Region have experienced impacts to water supply and quality due to drought. Additionally, hydroelectric power is susceptible to being reduced during periods of drought. Drought-caused reduction of biofuel seedstock, can cause energy conservation mandates. Most critical facility infrastructure is more likely to experience losses due to the secondary hazards caused by drought, such as wildfire and flooding.

Exposure to drought occurs similarly across the Eastern Region, especially in the long-term. Vulnerability of critical facilities and lifelines follows the pattern of susceptibility described above. In other words, everything is exposed to drought, critical facilities and lifelines that are susceptible to damage are vulnerable. The general pattern of exposure, susceptibility, and vulnerability of critical facilities and lifelines to that exposure typically holds true for each participating jurisdiction. Some variability is discussed further in the jurisdiction-specific annexes.

Economy

Economic impact will be largely associated with industries that use water or depend on water for their business. For example, landscaping businesses were affected in the droughts of the past as the demand for service significantly declined because landscaping was not watered. Additionally, drought can exacerbate the risk of wildfires and flooding, increase the cost of municipal water usage, and deplete water resources used for recreation, all of which may impact the local economy. Agricultural industries will be impacted if water usage is restricted for irrigation. The Risk Management Agency (RMA) reported that from 2007-2021 $575,895,266.30 was lost as indemnity payments to farmers due to lost crops from drought in the Eastern Region, primarily in Daniels, McCone, Roosevelt, Sheridan, and Valley counties. Figure 4-22 displays indemnity payments by county from 2007-2021.

Figure 4-22 Crop Indemnity Losses due to Drought by County 2007-2021

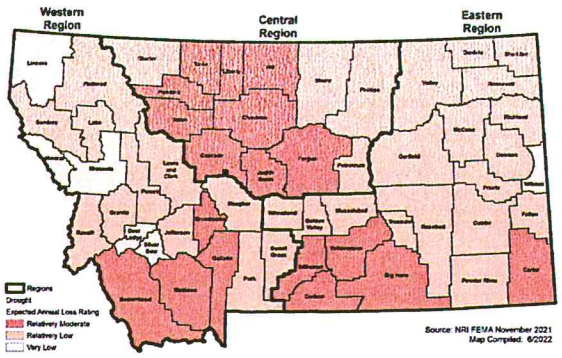


Source: Risk Management Agency (RMA), Chart by WSP

Exposure to drought occurs similarly across the Eastern Region. The pattern of susceptibility of the economy to that exposure that is described above is consistent within each participating jurisdiction, unless specified otherwise in the jurisdiction-specific annexes. For example, some counties are more or less dependent on rain-fed agriculture, but the pattern is consistent that as dependence on rain-fed agriculture increases, vulnerability to drought increases. Patterns of vulnerability to secondary impacts also follow similar patterns throughout the region.

Figure 4-23 illustrates the NRI ratings for Expected Annual Loss (EAL) due to drought for Montana counties. Most counties in the Region have a relatively moderate to relatively low rating; none have a high or very high-risk EAL rating. The EAL calculation provides an account of direct impacts to agriculture using agricultural value exposed to drought, annualized frequency for drought, and historical direct loss to agricultural for drought. The EAL rating is thus heavily based on direct agricultural impacts.

Figure 4-23 NRI Drought Expected Annual Loss Rating



Map by WSP, Data Source: FEMA National Risk Index, https://hazards.fema.gov/nri/determining-risk

Historic and Cultural Resources

Historic and cultural resources are susceptible to drought because of the long-standing, multi-generational farms that exist in the Eastern Region. Past droughts have threatened to bankrupt farmers and ranchers and alter the farming tradition in the State. This pattern holds true within each participating jurisdiction, unless specified otherwise in the jurisdiction-specific annexes.

Natural Resources

Susceptibility of natural resources to drought is most commonly associated with plants, animals, and wildlife habitat; and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation. However, many species will eventually recover from this temporary aberration and may even depend on it. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity, soil loss during the dust bowl years is a notable example. Although environmental losses are difficult to quantify, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects.

Exposure to drought occurs similarly across the Eastern Region. Vulnerability exists where natural resources are susceptible to drought hazards. The pattern of susceptibility of natural resources to that exposure that is described above is consistent within each participating jurisdiction, unless specified otherwise in the jurisdiction-specific annexes.

Development Trends Related to Hazards and Risk

The effect of development on vulnerability to drought is a result of either changing the assets that are exposed to drought or by changing the susceptibility of assets to drought. Neither of these factors were cause for concern among plan participants. In addition, the Montana Department of Environmental Quality (DEQ) is responsible for monitoring and regulating public water systems and they consider the impact of future development with respect to drought to be low.

Additionally, the Governor's Drought Advisory Committee was established by an act of the Montana State Legislature in 1991 following the drought years of the late 1980s, including the highly publicized Yellowstone National Park wildfire year of 1988. The rationale behind the initiative to create a state drought advisory committee was that if state, local, and federal officials who monitor water supply and moisture conditions can be brought together on a regular basis, and ahead of the seasons when impacts are most likely to occur to Montana's economy and natural resources, advance measures could be taken to lessen the degree of those impacts.

While development is generally not a significant concern, variability inevitably exists throughout the planning area. The jurisdiction-specific annexes address these relatively isolated concerns regarding development and vulnerability to drought hazards.

Risk Summary

Overall, drought is considered to be overall **high** significance for the Region. Variations in risk by jurisdiction are summarized in the table below, as well as key issues from the vulnerability assessment.

- Frequency of drought is rated as **highly likely** because the Eastern Region experiences agricultural losses from drought every year and the US Drought Monitor indicates a high frequency of drought conditions.
- Due to historic economic losses from drought in the Eastern Region, magnitude of drought is ranked as **critical.**
- Drought, like other climate hazards, occurs on a regional scale and can impact every county in the Eastern Region; therefore, geographic extent is rated as **extensive.**
- Drought impacts to people include public health issues such as impaired drinking water quality, increased incidence of mosquito-borne illness, increased wildlife-human confrontations, and respiratory complications because of declined air quality in times of drought.
- Most common impacts to property from drought are damage from secondary hazards such as flooding and wildfire. However, direct impacts from drought such as structural damage resulting from lack of moisture in the soil, do occur.
- Significant economic impacts are likely to result from drought from direct damages to crops and livestock, as well as indirect economic losses from business disruptions.
- Water systems are at significant risk to drought, as are energy systems that depend on biofuels or hydropower.
- Related Hazards: Wildfire, Flooding, Severe Summer Weather

Table 4-17 Risk Summary Table: Drought

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
Eastern Region	High		
Big Horn	High	Hardin, Lodge Grass	High annualized frequency of drought
Carbon	High	Bearcreek, Bridger, Joliet, Fromberg, Red Lodge	High annualized frequency of drought

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
Carter	High	Ekalaka	Large amount of USDA drought declarations
Custer	Medium	Ismay, Miles City	Many drought impact reports on agriculture
Crow Tribe	High		None; Crow Tribe TPT noted this was a high hazard concern.
Daniels	Medium	Scobey, Flaxville	Higher crop indemnity losses due to drop
Dawson	Medium	Richey, Glendive	None
Fallon	High	Plevna, Baker	Large number of USDA drought declarations. High annualized frequency of drought. High crop indemnity losses due to drought
Garfield	Medium	Jordan	None. High crop indemnity losses due to drought
Golden Valley	Medium	Ryegate, Lavina	Medium to high annualized frequency of drought
McCone	High	Circle	Higher crop indemnity losses due to drought
Musselshell	Medium	Melstone, Roundup	Medium to high annualized frequency of drought. High crop indemnity losses due to drought
Powder River	High	Broadus	Has had the most USDA drought declarations in the Eastern Region
Prairie	High	Terry	None
Richland	High	Fairview, Sidney	None
Roosevelt	Medium	Wolf Point, Poplar, Bainville, Culberson, Froid	Higher crop indemnity losses due to drought
Rosebud	Medium	Colstrip, Forsyth	None. High crop indemnity losses due to drought
Sheridan	High	Plentywood, Medicine Lake, Outlook, Westby	Higher crop indemnity losses due to drought
Stillwater	Medium	Columbus	High annualized frequency of drought
Treasure	Medium	Hysham	High crop indemnity losses due to drought
Valley	Medium	Glasgow, Fort Peck, Nashua, Opheim	Higher crop indemnity losses due to drop
Wibaux	Medium	Wibaux	Very low expected annual loss due to drought
Yellowstone	High	Billings, Broadview, Laurel	High annualized frequency of drought

4.2.6 Earthquake

Hazard/Problem Description

An earthquake is the vibration of the earth's surface following a release of energy in the earth's crust. This energy can be generated by a volcanic eruption or by the sudden dislocation of the crust, which is the cause of most destructive earthquakes. The crust may first bend and then, when the stress exceeds the strength

of the rocks, break and snap to a new position. In the process of breaking, vibrations called "seismic waves" are generated. These waves travel outward from the source of the earthquake at varying speeds.

Earthquakes can last from a few seconds to over five minutes; they may also occur as a series of tremors over several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death; casualties generally result from falling objects and debris. Disruption of communications, electrical power supplies and gas, sewer, and water lines should be expected. Earthquakes may trigger fires, dam failures, landslides, or releases of hazardous material, compounding their disastrous effects.

Earthquakes east of the Rocky Mountains are generally less frequent than in the western United States and are typically felt over a much broader region. Most of North America east of the Rocky Mountains has infrequent earthquakes, and the region from the Rockies to the Atlantic Ocean can go years without an earthquake large enough to be felt. The earthquakes that do occur in this region are typically small and occur at irregular intervals.

Earthquakes tend to reoccur along faults, which are zones of weakness in the crust. Even if a fault zone has recently experienced an earthquake, there is no guarantee that all the stress has been relieved. Another earthquake could still occur. Thousands of faults have been mapped in Montana, but scientists think only about 95 of these faults have been active in the past 1.6 million years (the Quaternary Period). Although it has been over six decades since the last destructive earthquake in Montana, small earthquakes are common in the region, occurring at an average rate of 4-5 earthquakes per day according to the Great Montana Shake Out, Montana Department of Transportation, and National Earthquake Information Center. Scientists continue to study faults in Montana to determine future earthquake potential.

A "great" earthquake is defined as any earthquake classified as a magnitude 8 or larger on the Richter Scale. Montana has not experienced a great earthquake in recorded history. A great earthquake is not likely in Montana, but a major earthquake (magnitude 7.0-7.9) occurred near Hebgen Lake in 1959 and dozens of active faults have generated magnitude 6.5-7.5 earthquakes during recent geologic time.

Liquefaction is the process by which water-saturated sediment temporarily loses strength due to strong ground shaking and acts as a fluid. Buildings and road foundations may lose load-bearing strength and cause major damage if liquefaction occurs beneath them. The increased water pressure that accompanies liquefaction can also cause landslides and dam failure.

Seismic events may lead to landslides, uneven ground settling, flooding, and damage to homes, dams, levees, buildings, power and telephone lines, roads, tunnels, and railways. Broken natural gas lines may also ignite fires as a cascading hazard.

Geographical Area Affected

The geographic extent of earthquakes in the planning area is **significant.** All of the Eastern Region could be impacted by earthquakes, but the greatest potential for damaging quakes is in the very southwestern portion of the Region.

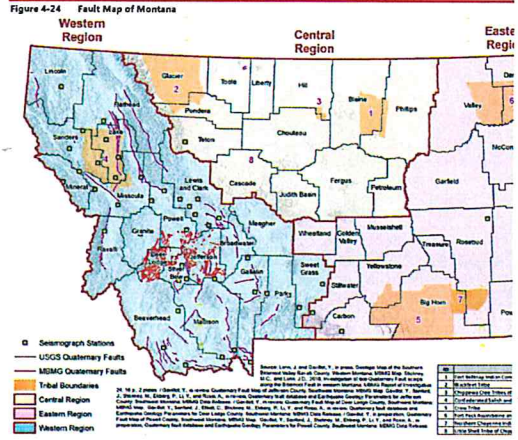
Montana is one of the most seismically active states in the United States according to the USGS. There is a belt of seismicity known as the Intermountain Seismic Belt which extends through western Montana. This Intermountain Seismic Belt ranges from the Flathead Lake region in the northwest corner of the state to the Yellowstone National Park region. Since 1925, the state has experienced five shocks that reached intensity VIII or greater (Modified Mercalli Scale). During the same interval, hundreds of less severe tremors were felt within the state.

Montana's earthquake activity is concentrated mostly in the mountainous western third of the state, which lies within the Intermountain Seismic Belt and is relatively far from the Eastern Region when compared to the Central and especially the Western Region, see Figure 4-24 below. However, large seismic events

centered in the Central and Western Regions may still cause impacts in the Eastern Region. As shown in Figure 4-25 below, the Eastern Region has a low to moderate liquefaction susceptibility in general. No area in the Eastern Region has a high liquefaction susceptibility.

Figure 4-25 Liquefaction Map of the Eastern Region

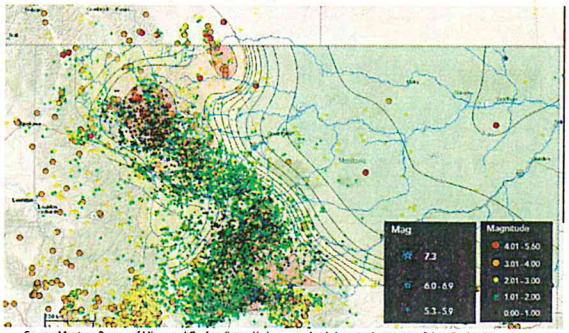
Figure 4-24 Fault Map of Montana



Past Occurrences

As mentioned previously, Montana's earthquake activity occurs primarily in the western third of the state. In the Eastern Region, although earthquake events happen less frequently, there have been a few recorded earthquakes that are relatively bigger, in the 4-5.6 magnitude range. As mentioned in the 2018 Montana SHMP, one significant earthquake occurred in Northeast Montana on May 16, 1909, with a magnitude of 5.5. Most of the rest of the recorded earthquakes are relatively smaller, in the magnitude 1 to 3 range. These types of earthquakes very rarely cause any structural damage or injuries. As mentioned above, earthquake events tend to occur in the western part of the state more frequently, and numerous earthquakes in the western part of the state have been felt in the Eastern Region. A map of recorded earthquakes is presented in Figure 4-26 below based an online mapping tool developed by the Montana Bureau of Mines and Geology (https://mbmg.mtech.edu/mapper/mapper.asp?view=Quakes&).

Figure 4-26 Statewide Map of Earthquake Epicenters, 1982-2022



Source: Montana Bureau of Mines and Geology(https://mbmg.mtech.edu/mapper/mapper.asp?view=Quakes&).

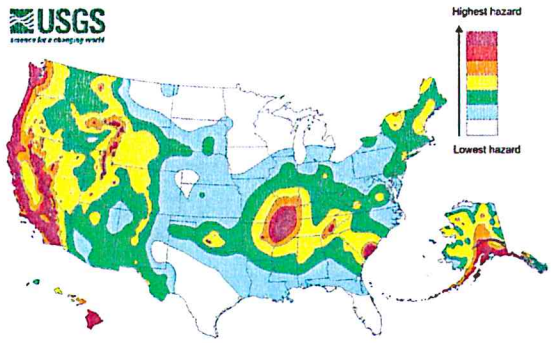
Frequency/Likelihood of Occurrence

The frequency of earthquakes in the Eastern Region is ranked as **likely,** but damaging events are more **occasional** (between 1 and 10 percent chance of occurrence in the next year or has a recurrence interval of 11 to 100 years). Earthquakes will continue to occur in Montana; however, the precise time, location, and magnitude of future events cannot be predicted. As discussed above, earthquake hazard areas in Montana are concentrated in the western portion of the state, which is part of the Intermountain Seismic Belt.

The USGS issues National Seismic Hazard Maps with updates approximately every five years. These maps provide various acceleration and probabilities for time periods. Figure 4-27 below is from the most recent USGS models for the contiguous U.S., showing peak ground accelerations having a 2 percent probability of being exceeded in 50 years, for a firm rock site. The models are based on seismicity and fault-slip rates and take into account the frequency of earthquakes of various magnitudes. Until recently, the 500-year map was often used for planning purposes for average structures and was the basis of the most current Uniform

Building Code. The new International Building Code, however, uses a 2,500-year map as the basis for building design.

Figure 4-27 USGS Long-Term National Seismic Hazard Map



Source: USGS

Climate Change Considerations

Impacts of global climate change on earthquake hazards are not anticipated to occur and unknown. As mentioned in the 2023 State Multi-Hazard Mitigation Plan, some scientists say glaciers could induce tectonic activity. For example, as ice melts and water runs off, tremendous amounts of weight are shifted on the earth's crust. As newly freed crust returns to its original, pre- glacier shape, it could cause seismic plates to slip and stimulate volcanic activity, according to research into prehistoric earthquakes and volcanic activity. NASA and USGS scientists found that retreating glaciers in southern Alaska may be opening the way for future earthquakes (NASA 2004).

Potential Magnitude and Severity

The expected magnitude of earthquakes in the Eastern Region is **limited**. Earthquakes can cause structural damage, injury, and loss of life, as well as damage to infrastructure networks, such as water, power, communication, and transportation lines. Damage and loss of life can be particularly devastating in communities where buildings were not designed to withstand seismic forces (e.g., historic structures). Other damage-causing effects of earthquakes include surface rupture, fissuring, settlement, and permanent horizontal and vertical shifting of the ground. Secondary impacts can include landslides, rock falls, liquefaction, fires, dam failure, and hazardous materials (HAZMAT) incidents.

In simplistic terms, the severity of an earthquake event can be measured in the following terms:

- How hard did the ground shake?
- How did the ground move (horizontally or vertically)?
- How stable was the soil?
- What is the fragility of the built environment in the area of impact?

Earthquakes are typically classified in one of two ways: By the amount of energy released, measured as magnitude; or by the impact on people and structures, measured as intensity. A comparison of magnitude and intensity is shown in the Table 4-18 below.

Table 4-18 Magnitude and Modified Mercalli Scales for Measuring Earthquakes

Magnitude	Modified Mercalli Intensity
1.0 – 3.0	I
3.0 – 3.9	II, III
4.0 – 4.9	IV – V
5.0 – 5.9	VI – VII
6.0 – 6.0	VII – IX
7.0 and higher	VIII or higher

Source: USGS Earthquake Hazards Program

Magnitude

Magnitude measures the energy released at the source of the earthquake and is measured by a seismograph. Currently the most used magnitude scale is the moment magnitude (Mw) scale, with the follow dassifications of magnitude:

- Great—Mw > 8.
- Major—Mw = 7.0 – 7.9.
- Strong—Mw = 6.0 – 6.9.
- Moderate—Mw = 5.0 – 5.9.
- Light—Mw = 4.0 – 4.9.
- Minor—Mw = 3.0 – 3.9.
- Micro—Mw < 3.

Estimates of Mw scale roughly match the local magnitude scale (ML), commonly called the Richter scale. One advantage of the Mw scale is that, unlike other magnitude scales, it does not saturate at the upper end. That is, there is no value beyond which all large earthquakes have about the same magnitude. For this reason, Mw scale is now the most often used estimate of large magnitude earthquakes.

Intensity

Intensity is a measure of the shaking produced by an earthquake at a certain location and is based on felt affects. Currently the most used intensity scale is the modified Mercalli intensity scale, with ratings defined as follows in Table 4-19.

Table 4-19 Modified Mercalli Intensity (MMI) Scale

Magnitude	Mercalli Intensity	Effects	Frequency
Less than 2.0	I	Micro-earthquakes, not felt or rarely felt; recorded by seismographs.	Continual
2.0-2.9	I to II	Felt slightly by some people; damages to buildings.	Over 1M per year
3.0-3.9	II to IV	Often felt by people; rarely causes damage; shaking of indoor objects noticeable.	Over 100,000 per year

Magnitude	Mercalli Intensity	Effects	Frequency
4.0-4.9	IV to VI	Noticeable shaking of indoor objects and rattling noises; felt by most people in the affected area; slightly felt outside; generally, no to minimal damage.	10K to 15K per year
5.0-5.9	VI to VIII	Can cause damage of varying severity to poorly constructed buildings; at most, none to slight damage to all other buildings. Felt by everyone.	1K to 1,500 per year
6.0-6.9	VII to X	Damage to a moderate number of well-built structures in populated areas; earthquake-resistant structures survive with slight to moderate damage; poorly designed structures receive moderate to severe damage; felt in wider areas; up to hundreds of miles/kilometers from the epicenter; strong to violent shaking in epicenter area.	100 to 150 per year
7.0-7.9	VIII<	Causes damage to most buildings, some to partially or completely collapse or receive severe damage; well-designed structures are likely to receive damage; felt across great distances with major damage mostly limited to 250 km from epicenter.	10 to 20 per year
8.0-8.9	VIII<	Major damage to buildings, structures likely to be destroyed; will cause moderate to heavy damage to sturdy or earthquake-resistant buildings; damaging in large areas; felt in extremely large regions.	One per year
9.0 and Greater	VIII<	At or near total destruction - severe damage or collapse to all buildings; heavy damage and shaking extends to distant locations; permanent changes in ground topography.	One per 10-50 years

Source: USGS Earthquake Hazards Program, 1989

Vulnerability Assessment

The earthquake *Vulnerability Assessment* identifies, or at least discusses, assets that are both likely to be exposed to earthquake and are susceptible to damage from that exposure. In this context, assets are (1) people, (2) property, (3) critical facilities and lifelines, (4) the economy, (5) historic and cultural resources, and (6) natural resources. Exposure indicates interacting with earthquake hazards, and likely to be exposed indicates a presence in areas deemed to be especially likely to experience earthquake hazards. Susceptible indicates a strong likelihood of damage from exposure to earthquake hazards and is described in greater detail in Section 4.2.1, subsection titled *Vulnerability Assessment*. Finally, vulnerability under future conditions is considered as it relates to both climate change and development.

Numerous factors contribute to determining areas of vulnerability such as historical earthquake occurrence, proximity to faults, soil characteristics, building construction, and population density. Earthquake vulnerability data was generated during the 2022 planning process using a Level 1 Hazus-MH analysis for the Eastern Region. Hazus-MH estimates the intensity of the ground shaking, the number of buildings damaged, the number of casualties, the damage to transportation systems and utilities, the number of people displaced from their homes, and the estimated cost of repair and clean up. Details specific to the HAZUS analysis for each county are provided in each county's respective annex.

The HAZUS analysis also incorporates information on what assets are susceptible to earthquake damage and provides information on earthquake vulnerability. The results of the HAZUS analysis are discussed further in the asset-specific subsections, below.

The role of climate change in future vulnerability to earthquake is discussed above in the section titled, *Climate Change Considerations* and notes climate change effects on earthquakes is largely unknown, while the effect of future development is considered below in the section titled *Development Trends Related to Hazards and Risk.*

People

The entire population of the Eastern Region is within an earthquake hazard area and are potentially exposed to direct and indirect impacts from earthquakes, but more so in the southwestern counties. The degree of exposure is dependent on many factors, the soil type their homes are constructed on, and their proximity to fault location and earthquake epicenter. The degree of susceptibility to earthquake hazards is also dependent on various factors, such as including the age and construction type of the structures people live in.

Whether impacted directly or indirectly, the entire population will have to deal with the consequences of an earthquake to some degree. Business interruption could keep people from working, road closures could isolate populations, and loss of functions of utilities could impact populations that suffered no direct damage from an event itself.

Impacts on persons and households in the planning area were estimated for the entire region for a 2,500-Year probabilistic earthquake scenario (2% chance of occurrence in 50 years) resulted in low potential impacts. Table 4-20 summarizes the results of displaced households. It is estimated in a 2 p.m. time of occurrence scenario that there would be a total of 37 injuries across the region, four of which would require hospitalization. There would not be any fatalities. Additionally, there could be increased risk of damage or injury from rock fall or landslides to travelers, hikers, and others recreating outdoors at the time of the earthquake. More detailed descriptions of the numbers of estimated casualties in the Eastern Region under the various time of occurrence scenarios are available in the county annexes.

Table 4-20 Estimated Earthquake Impacts on Persons and Households

Scenario	Number of Displaced Households	Number of Persons Requiring Short-Term Shelter
2,500-Year Earthquake	27	15

Source: HAZUS-MH Global Summary Report, WSP Analysis

Property

The HAZUS analysis estimates that there are 119,000 buildings in the planning area for the Eastern Region, with a total replacement value of $27.91 billion. Because all structures in the planning area are exposed to earthquake impacts to varying degrees and susceptible to earthquake impacts to varying degrees. This total represents the regionwide property exposure to seismic events. Most of the buildings and most of the associated building value are residential. According to the model and shown in Table 4-21, about 1,652 buildings will be at least moderately damaged, with 3 buildings completely destroyed.

Table 4-21 Estimated Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	1024.20	0.92	47.59	0.87	21.63	1.31	3.45	2.69	0.13	3.87
Commercial	5914.34	5.29	376.54	6.85	178.71	10.82	30.57	23.94	1.34	40.67
Education	284.41	0.25	14.25	0.26	6.35	0.38	0.95	0.74	0.04	1.36
Government	312.01	0.28	16.17	0.29	6.85	0.41	0.92	0.72	0.04	1.35
Industrial	1521.82	1.36	104.86	1.91	53.69	3.25	9.34	7.29	0.29	8.60
Other Residential	16626.78	14.88	1820.01	33.09	917.10	55.51	54.94	42.99	1.17	35.42
Religion	625.43	0.56	32.86	0.59	13.89	0.84	1.92	1.50	0.10	3.04
Single Family	65442.42	78.46	3067.57	56.14	453.93	27.48	25.89	20.22	0.18	5.51
Total	111,751		5,500		1,652		128		3	

Source: HAZUS-MH Global Summary Report, WSP Analysis

The HAZUS model provides estimates of building related losses in the earthquake scenario, broken out into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

For the 2,500-year probabilistic earthquake scenario, the total building related losses for the entire planning area is an estimated $133.27 million, as shown in Table 4-22. Of this total, direct building losses are estimated at $104.6 million and $28.68 million in income related losses. A map of these losses per county is shown in Figure 4-28 below.

Table 4-22 HAZUS Building Related Economic Loss Estimates for 2,500-Year Scenario (Millions of Dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.7135	5.3439	0.1375	0.5015	6.6964
	Capital-Related	0.0000	0.3038	4.8199	0.0905	0.0870	5.3012
	Rental	0.8998	1.3440	3.1215	0.0603	0.1638	5.5894
	Relocation	2.8937	1.8012	4.6889	0.4261	1.2810	11.0909
	Subtotal	3.7935	4.1625	17.9742	0.7144	2.0333	28.6779
Capital Stock Losses							
	Structural	5.6987	3.3790	6.2527	0.9743	1.9266	18.2313
	Non_Structural	31.8007	10.4014	12.6666	2.8401	3.8091	61.5179
	Content	11.2479	2.1543	6.7518	1.8043	2.2430	24.2013
	Inventory	0.0000	0.0000	0.2475	0.3195	0.0749	0.6419
	Subtotal	48.7473	15.9347	25.9186	5.9382	8.0536	104.5924
	Total	52.54	20.10	43.89	6.65	10.09	133.27

Source: HAZUS-MH Global Summary Report, WSP Analysis

The HAZUS analysis also estimated the amount of earthquake-caused debris in the planning area for the 2,500-Year probabilistic earthquake scenario event, which is estimated to be 29,000 tons.

Critical Facilities and Lifelines

Many critical facilities and infrastructure in the planning area are exposed to earthquakes. HAZMAT releases can occur during an earthquake from fixed facilities or transportation-related incidents. Transportation corridors can be disrupted during an earthquake, leading to the release of materials to the surrounding environment. Facilities holding HAZMAT are of particular concern because of possible isolation of neighborhoods surrounding them. During an earthquake, structures storing these materials could rupture and leak into the surrounding area or an adjacent waterway, having a disastrous effect on the environment.

HAZUS-MH classifies the vulnerability of essential facilities to earthquake damage in two categories: at least moderate damage or complete damage. The analysis did not indicate any damages in these categories to specific facilities. The model also anticipates pipeline breaks and leaks in the Eastern Region's potable water, wastewater, and natural gas lines. Across these linear networks, the earthquake is expected to cause 625 pipeline leaks and 156 complete fractures in the potable water, wastewater, and natural gas systems. The model also estimates lifeline damages to linear networks such as transportation and utilities. Damage to the transportation system is estimated at $7.8 million and utility lifelines at $239 million. The steep terrain in the southwestern counties of the Eastern Region would likely experience multiple rockslides that could damage roadways and disrupt traffic along the rail, highway, and road corridors.

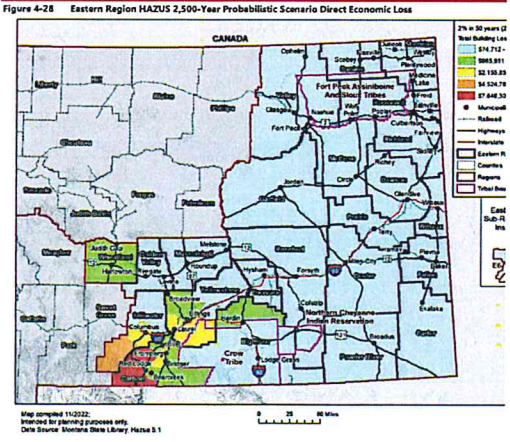
Economy

Economic impacts of an earthquake could be staggering in the impacted areas. Not only the costs of direct damages to property, infrastructure, and inventory, but the losses incurred from businesses forced to close temporarily or permanently. As mentioned above, the total income-related economic losses are estimated by the model to be $28.68 million in the 2,500-year scenario. HAZUS-MH models many other estimated impacts, which are summarized in Table 4-23 and Table 4-24 below. Yellowstone and Carbon counties have the highest potential losses; Stillwater, Wheatland and Big Horn counties also have higher loss ratios.

Table 4-23 HAZUS-MH Earthquake Loss Estimation 2,500-Year Scenario Results

Type of Impact	Impacts to Region
Total Buildings Damaged	Slight: 5,500 Moderate: 1,652 Extensive: 128 Complete: 3
Building and Income Related Losses	$133.27 million 55% of damage related to residential structures 22% of loss due to business interruption
Total Economic Losses (includes building, income, and lifeline losses)	$380.16 Million - Total Building: $133.27 Million Income: $28.68 Million Transportation/Utility: $246.89 Million
Casualties (based on 2 a.m. time of occurrence)	Without requiring hospitalization: 14 Requiring hospitalization: 1 Life threatening: 0 Fatalities: 0
Casualties (based on 2 p.m. time of occurrence)	Without requiring hospitalization: 33 Requiring hospitalization: 4 Life threatening: 0 Fatalities: 0
Casualties (based on 5 p.m. time of occurrence)	Without requiring hospitalization: 23 Requiring hospitalization: 3

Figure 4-28 Eastern Region HAZUS 2,500-Year Probabilistic Scenario Direct Economic Loss



Type of Impact	Impacts to Region
	Life threatening: 0 Fatalities: 0
Fire Following Earthquake	0 Ignitions
Debris Generation	29,000 tons of debris generated 1,160 estimated truckloads to remove
Displaced Households	27
Shelter Requirements	15

Source: HAZUS-MH Global Summary Report, WSP Analysis

Table 4-24 Direct Economic Losses by County (In thousands of Dollars)

	Capital Stock Losses					Income Losses				
	Cost Structural Damage	Cost Non-struct. Damage	Cost Contents Damage	Inventory Loss	Loss Ratio %	Relocation Loss	Capital Related Loss	Wages Losses	Rental Income Loss	Total Loss
Montana										
Prairie	24	53	18	0	0.06	12	2	4	5	118
Treasure	35	78	26	1	0.14	18	4	5	7	172
McCone	57	120	40	1	0.07	26	9	13	13	289
Sheridan	143	383	149	4	0.10	54	40	66	44	903
Yellowstone	10 257	31 653	12,079	386	0.27	6 265	3,181	3 870	3,364	71 054
Big Horn	554	1,953	761	12	0.26	352	142	183	144	4 111
Carbon	3 168	13 974	6 003	91	1.21	1 953	862	1 099	920	28 071
Carter	66	162	56	2	0.15	36	12	19	14	367
Custer	549	1 589	575	13	0.15	356	232	264	186	3 794

Very few, if any, natural resources are susceptible to direct damage from earthquakes. Secondary hazards associated with earthquakes can have damaging effects on natural resources. For example, earthquake-induced landslides can potentially impact surrounding habitat. Dam failure is also associated with earthquake and can result in the loss of entire reservoirs, permeant alteration of unique downstream habitat, and damage caused by catastrophic flash flooding. Where relevant, secondary impacts on natural resources from earthquake are discussed in sections for other hazards.

Development Trends Related to Hazards and Risk

Future population growth and building development in general will increase the exposure of the Eastern Region to earthquake by increasing the number of people and value of building inventory in the planning area. Replacing old buildings with new buildings constructed to modern building codes can help limit the overall vulnerability created by development. For example, development may lead to the abandonment or replacement of old structures built to old building codes, especially those in poor condition. In this case the development would lead to a decrease in susceptibility of the building asset. In the case of Eastern Montana, development concerns with regard to earthquake were generally not raised by plan participants and development in general is stable with exceptions in certain counties like Yellowstone County that has experienced higher growth and development trends. Jurisdiction-specific concerns are discussed further in jurisdiction annexes, where relevant.

Risk Summary

Overall, earthquake is considered a **low** significance hazard due the unlikely nature of a severe earthquake in the Eastern Region, and the lack of history of damaging events in the planning area.

- Effects on people: People can be injured or killed in earthquakes due to falling items or structures, as well as from cascading events triggered by the earthquake. Regionwide, a maximum of 37 injuries are estimated by the HAZUS scenario, as well as 27 displaced households.
- Effects on property: Impacts on property include direct damage to structures from the shaking. Regionwide, 1,783 buildings are estimated to be at least moderately damaged, with 3 of them completely destroyed, resulting in $133.27 million in building damage.
- Yellowstone and Carbon counties have the highest potential losses; Stillwater, Wheatland and Big Horn counties also have higher loss ratios.
- Effects on the economy: economic impacts can be from direct damages to structures as well as lost wages and income. The total economic loss is projected to be $380.16 million.
- Effects on critical facilities and infrastructure: Linear facilities, such as pipelines, railroads, and roadways, are largely at much greater risk than other facility types. $246.89 million in damages to linear facility networks are projected.
- Unique jurisdictional vulnerability: the vulnerability is generally low throughout the Eastern Region, but the potential for damage is greater in the southwestern portion of the Eastern Region.
- Related hazards: landslide, dam incidents

	Capital Stock Losses					Income Losses				
	Cost Structural Damage	Cost Non-struct. Damage	Cost Contents Damage	Inventory Loss	Loss Ratio %	Relocation Loss	Capital Related Loss	Wages Losses	Rental Income Loss	Total Loss
Musselshell	295	553	194	6	0.14	130	61	82	52	1,296
Garfield	34	73	21	1	0.07	16	6	7	7	165
Richland	196	474	153	4	0.06	115	52	70	57	1,120
Wibaux	16	33	8	0	0.05	6	2	3	3	75
Fallon	86	185	58	2	0.08	53	22	32	21	458
Roosevelt	206	585	221	10	0.09	126	43	74	56	1,323
Golden Valley	75	178	65	3	0.24	38	11	16	15	401
Stillwater	1,345	6,045	2,513	76	0.66	740	279	361	294	11,655
Powder River	117	361	148	5	0.28	66	40	45	29	903
Wheatland	220	675	255	5	0.39	128	48	76	58	1,465
Rosebud	389	1,154	443	10	0.18	261	99	149	139	2,644
Valley	256	748	266	5	0.10	181	79	121	94	1,730
Dawson	170	382	104	4	0.05	97	47	65	53	902
Daniels	57	146	58	2	0.08	31	29	32	15	370
Total	10,332	61,518	24,301	642	0.21	11,091	6,301	6,807	6,993	133,272
Region Total	10,332	61,518	24,301	642	0.21	11,091	6,301	6,807	6,993	133,272

Source: HAZUS-MH Global Summary Report, WSP Analysis

		Joliet, Fromberg, Red Lodge	Fromberg.
Carter	Low	Ekalaka	None
Crow Tribe	Low		None
Custer	Low	Ismay, Miles City	None
Daniels	Low	Scobey, Flaxville	None
Dawson	Low	Richey, Glendive	None
Fallon	Low	Plevna, Baker	None
Garfield	Low	Jordan	None
Golden Valley	Low	Ryegate, Lavina	None
McCone	Low	Circle	None
Musselshell	Low	Melstone, Roundup	None
Powder River	High	Broadus	None
Prairie	Low	Terry	None
Richland	Low	Fairview, Sidney	None
Roosevelt	Low	Wolf Point, Poplar, Bainville, Culberson, Froid	None
Rosebud	Low	Colstrip, Forsyth	None
Sheridan	Low	Plentywood, Medicine Lake, Outlook, Westby	None
Stillwater	Medium	Columbus	Greater losses expected near Columbus.
Treasure	Low	Hysham	None
Valley	Low	Glasgow, Fort Peck, Nashua, Opheim	None
Wibaux	Low	Wibaux	None
Yellowstone	Medium	Billings, Broadview, Laurel	Greater losses expected near Laurel and Billings.

4.2.7 Flooding

Hazard/Problem Description

Riverine flooding is defined as when a watercourse exceeds its "bank-full" capacity and is usually the most common type of flood event. Riverine flooding generally occurs because of prolonged rainfall, or rainfall that is combined with soils already saturated from previous rain events. The area adjacent to a river channel is its floodplain. In its common usage, "floodplain" most often refers to that area that is inundated by the 100-year flood, the flood that has a 1 percent chance in any given year of being equaled or exceeded. Other types of floods include general rain floods, thunderstorm generated flash floods, alluvial fan floods, snowmelt, rain on snow floods, dam failure and dam release floods, and local drainage floods. The 100-year flood is the national standard to which communities regulate their floodplains through the National Flood Insurance Program (NFIP).

The potential for flooding can change and increase through various land use changes and changes to land surface. A change in environment can create localized flooding problems inside and outside of natural floodplains by altering or confining watersheds or natural drainage channels. These changes are commonly created by human activities. These changes can also be created by other events such as wildland fires. Wildland fires create hydrophobic soils, a hardening or "glazing" of the earth's surface that prevents rainfall from being absorbed into the ground, thereby increasing runoff, erosion, and downstream sedimentation of channels.

Montana is susceptible to the following types of flooding:

- Rain in a general storm system
- Rain in a localized intense thunderstorm
- Melting snow
- Rain on melting snow
- Ice Jams
- Levee failure
- Dam failure
- Urban stormwater drainage
- Rain on fire damaged watersheds

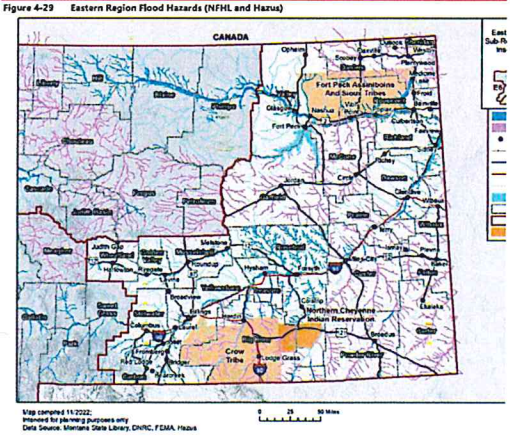
Slow rise floods associated with snowmelt and sustained precipitation usually are preceded with adequate warning, though the event can last several days. Flash floods, by their nature, occur very suddenly but usually dissipate within hours. Even flash floods are usually preceded with warning from the NWS in terms of flash flood advisories, watches, and warnings.

The average total annual precipitation in Montana is roughly 15.37 inches. The average total annual snowfall is 49 inches. Generally, the flood season extends from late spring and early summer, when snowmelt runoff swells rivers and creeks, to fall. Much of the rainfall occurs with thunderstorms during April to August. Within the Eastern Region, Carbon County, where the Custer Gallatin National Forest is located, has the highest annual average of precipitation with 16.98 inches.

Geographical Area Affected

The Missouri River, along with the tributaries within the watershed are Eastern Montana's primary waterways that result in flood hazards. Among the tributaries located within the different watersheds are the Big Muddy, Poplar, Powder, Rosebud, Tongue, and Yellowstone waterways. The Missouri River is the longest river in the United States, rising in the Rocky Mountains of the Eastern Centennial Mountains of Southwestern Montana and flowing east and south, and then flowing from east to west through Richland and Roosevelt counties, and then proceeding westward. Flooding along the Missouri typically occurs during the spring and is caused by long rainstorms and due to snowmelt runoff. Localized thunderstorms during the summer monsoons can also result in flash flooding throughout the Eastern Region planning area. In addition to flooding from the Yellowstone River, a large portion of the Eastern Region near Billings in Yellowstone County is also prone to flooding along ditches and drains and other open waterways owned and maintained by private ditch companies that carry water away from the City towards the Yellowstone River during flooding, irrigation from field runoff, and other stormwater runoff. The geographical extent of flooding across the Eastern Region is **limited.** Figure 4-29 illustrates the geographical area affected by flooding based on the National Flood Hazard Layer (NFHL) and Hazus geospatial flood datasets.

Figure 4-29 Eastern Region Flood Hazards (NFHL and Hazus)



Past Occurrences

Flooding is a natural event and rivers and tributaries in the study area have experienced periodic flooding with associated floods and flash floods. There has been 10 federally declared disasters within the 23 counties and three Indian Reservations located in the Eastern Region from 1975 to 2022. The federal declarations since 2010 to present are summarized in Table 4-26 below. According to the NCEI database, Montana's Eastern Region has also incurred $23,587,000 in property damages, $665,000 in crop damages and three deaths due to flooding since 1995.

Table 4-26 Federally Declared Flooding Events Montana Eastern Region 1974-2022

Year	Declaration Title	Disaster Number	County/Reservation Impacted
2022	Severe Storm and Flooding	DR-4655-MT	Carbon, Stillwater, Treasure, Yellowstone
2019	Flooding	DR-4437-MT	Daniels, McCone, Powder River, Stillwater, Treasure, Valley
2019	Flooding	DR-4405-MT	Carbon, Custer, Golden Valley, Musselshell, Treasure
2018	Flooding	DR-4388-MT	Valley
2014	Ice Jams and Flooding	DR-4172-MT	Dawson, Golden Valley, Musselshell, Prairie, Rosebud, Richland, Stillwater, Wheatland
2013	Flooding	DR-4127-MT	Custer, Dawson, Garfield, McCone, Musselshell, Rosebud, Valley
1987	Severe Storms & Flooding	DR-777-MT	Garfield, McCone, Rosebud, Valley
1986	Heavy Rains, Landslides & Flooding	DR-761-MT	Daniels, Dawson, Valley
1978	Severe Storms & Flooding	DR-558-MT	Big Horn, Carbon, Powder River, Rosebud, Stillwater, Treasure, Yellowstone
1975	Rains, Snowmelt, Storms & Flooding	DR-472-MT	Wheatland

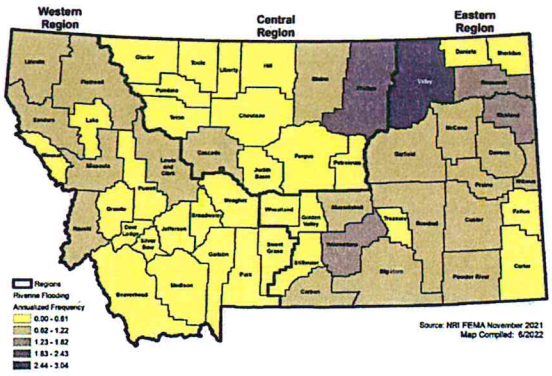
Source: FEMA 2022

Frequency/Likelihood of Occurrence

The Eastern Region has experienced multiple catastrophic flood events resulting in large-scale property damages. Snowmelt runoffs present a threat of serious flooding along rivers and creeks in the study area each year. Flash floods that produce debris flows and mudflows occur regularly and have caused significant damages in the past to homes, roads, bridges, and culverts. Based on the historical record of the ten federally declared events in the past 47 years from 1975 to present within the Eastern Region, the Region has a major flood resulting in a FEMA declaration every 5 years on average. Using past occurrences as an indicator of future probability, flooding has the probability of future occurrence rating of **likely** throughout the Eastern Region.

Figure 4-30 depicts the annualized frequency of riverine flooding at a county level based on the NRI. The mapping shows a trend toward increased likelihood of flooding in the northern portion of the Eastern Region with Valley County having a 2.44 – 3.04 annualized frequency of riverine flooding; this trend is supported by the County having the highest number of flood insurance claims (see discussion in Vulnerability subsection). Richland and Roosevelt counties have a 1.83 – 2.43 annualized frequency of riverine flooding while all other counties in the study area have a 0.00 – 1.22 frequency.

Figure 4-30 Annualized Frequency of Riverine Flooding by County



Climate Change Considerations

As documented in Section 4.2.7 *Flooding*, precipitation is one factor of several that determine flooding. Other factors include existing soil moisture conditions, frozen soils, rainfall rate, and special conditions such as rain-on-snow events. In urban areas, stormwater infrastructure is perhaps the single greatest determinant of flooding. Other infrastructure, in the form of large dams that are abundant across the planning area, provides a large degree of protection from flooding in rural and urban areas. Perhaps the biggest concern of climate change impacts on flooding involves complex cascading effects that start with increased drought, which drives increased wildfire, which leaves more and larger fire scars, which can dramatically increase runoff and create flooding or debris flows on a scale that did not previously exist. These factors complicate the impact of climate change on flooding. Nevertheless, much can be said about the current and future effects of climate change on flooding in the planning area.

The Climate Change and Human Health report documents that a shift in the seasonality of precipitation amount is occurring. Spring precipitation has slightly increased, which has been offset by decreases during other times of the year (see Section 4.2.5 Drought, subsection titled Climate Change Considerations, and Figure 4-19).

The Montana Climate Change and Human Health report (2021) projects the seasonal shift from snow to rain will occur earlier, as will peak runoff on streams. Peak runoff already occurs 10-20 days earlier than in 1948. The Climate Change and Human Health report also documents research indicating peak runoff at the end of the century is projected to occur 5-35 days earlier than it did from 1951-1980.

This early-and-rapid snowmelt scenario can cause spring flooding or even ice-jam flooding and appears to already be playing out. In recent years these have been problems on many rivers in Montana, leading to great damage and loss of life, as documented in the 2021 Montana Climate Change and Human Health

report. It is unclear if increasing late winter snow and early spring rain will increase the probability of rain-on-snow events, but this issue is potentially serious and worthy of monitoring in future HMPs.

Ice jams are responsible for much of the worst flooding in Montana's history. Ice-jam flooding typically occurs along mountain streams, when heavy rainfall or upstream melting raises stream flows to the point of breaking up the ice cover, which can pile up on bridge piers or other channel obstructions and cause flooding behind the jam. Once the ice jam breaks up, downstream areas are vulnerable to flash floods. The increasing possibility of midwinter thaws and heavy early spring rainfall events could increase the risk of sudden ice break up. The situation is further exacerbated if the ground is still frozen and unable to soak up rainwater.

Further, according to the Fifth National Climate Assessment, the Northern Great Plains region, which includes Montana is experiencing unprecedented climate-driven extremes related to flooding. For example, record floods along the Missouri River and its tributaries in 2011 and 2019 caused evacuations and billions of dollars in damages and research suggested that these records floods were caused by natural variability within the system. Also, while trends show that annual peak streamflow runoff will decrease across the region, with a few exceptions, according to the Fifth National Climate Assessment, portions of Montana should expect to experience some of the highest increases in annual flood damage across the U.S. due to climate change. While it is not possible to define with further specificity the impacts related to climate change on each jurisdiction within the Region related to flooding risk exacerbated by climate change, future updates to this plan should revisit this topic as scientific reports are updated and trends become more apparent.

Potential Magnitude and Severity

Magnitude and severity can be described by several factors that contribute to the relative vulnerabilities of certain areas in the floodplain. Development, or the presence of people and property in the hazardous areas, is a critical factor in determining vulnerability to flooding. Additional factors that contribute to flood vulnerability range from specific characteristics of the floodplain to characteristics of the structures located within the floodplain. The following is a brief discussion of some of these flood factors which pose risk.

- **Elevation:** The lowest possible point where floodwaters may enter a structure is the most significant factor contributing to its vulnerability to damage, due to the higher likelihood that it will come into contact with water for a prolonged amount of time.
- **Flood depth:** The greater the depth of flooding, the higher the potential for significant damages due to larger availability of flooding waters.
- **Flood duration:** The longer duration of time that floodwaters are in contact with building components, such as structural members, interior finishes, and mechanical equipment, the greater the potential for damage.
- **Velocity:** Flowing water exerts forces on the structural members of a building, increasing the likelihood of significant damage (such as scouring).
- **Construction type:** Certain types of construction and materials are more resistant to the effects of floodwaters than others. Typically, masonry buildings, constructed of brick or concrete blocks, are the most resistant to damages simply because masonry materials can be in contact with limited depths of flooding without sustaining significant damage. Wood frame structures are more susceptible to damage because the construction materials used are easily damaged when inundated with water.

Major flood events present a risk to life and property, including buildings, contents, and their use. Floods can also affect lifeline utilities (e.g., water, sewage, and power), transportation, the environment, jobs, and the local economy.

County	Date Joined	Effective Firm Date	Dollars Paid (Historical)	Flood Claims	Current Policies	Coverage ($)
Wibaux	3/4/1983	2/18/1998	$77,084.26	3	6	$430,300
Yellowstone	11/18/1981	11/6/2013	$1,814,878.16	263	275	$76,606,000
		Total	$7,868,905.37	1005	1272	$951,790,600.00

Source: FEMA Pivot NFIP Data as of August 10th, 2022, FEMA Community Status Book Report

Repetitive Loss

Repetitive losses are NFIP-insured structures that have had at least two paid flood losses of more than $1,000 each in any ten-year period since 1978. The Eastern Region has a total of 61 repetitive loss properties as of 2022, with the majority being located in Valley and Yellowstone Counties.

Severe Repetitive Loss (SRL) properties have either four or more separate claims for flood damage (with each claim exceeding $5,000 and with the sum of all payments exceeding $20,000,) or two or more separate claims where the total of all claims exceeds the value of the property. The Eastern Region has one SRL property, a single-family structure, in Dawson County.

Table 4-28 below lists the repetitive loss structures that have been identified throughout the Eastern Region study area. Valley County has the highest amount of repetitive loss structures, claims and totals paid out overall with 25 structures, 27 repetitive loss claims, and nearly $1 million dollars paid out due to repeated flooding and flood insurance loss claims. This is followed by Yellowstone County which has 21 repetitive loss structures, 53 repetitive loss claims and $747,592.02 in funding paid. It should be noted that a flood insurance claim can be filed when a property and its adjacent property is inundated.

Table 4-28 Eastern Region Repetitive Loss Properties by County

County	Repetitive Loss Structures per County	Repetitive Loss Claims	Structure Type Single - Family	Structure Type – Multi-Family	Structure Type – Business/ Non-Residential	Total Paid Out
Carbon County	3	7	3	-	-	$76,356.50
Dawson County	1 (1SRL)	2	1	-	-	$137,967.31
Musselshell County	8	19	7	-	1	$638,988.46
Philips County	3	5	3	-	-	$27,673.46
Valley County	25	57	21	1	3	$946,466.37
Yellowstone County	21	53	19	-	2	$747,592.02
Total	61	143	54	1	6	$2,575,044.12

Source: FEMA Region VIII as of 9/10/2022.

Vulnerability Assessment

Figure 4-31 depicts the risk index rating for riverine flooding based on FEMA's NRI. The NRI defines risk as the potential for negative impacts as a result of a natural hazard and determines a community's risk relative to other communities by examining the expected annual loss and social vulnerability in a given community in relation to that community's resilience. The Eastern Region has four counties with a relatively high riverine flooding risk based on the NRI. They are Big Horn, Custer, Roosevelt, and Valley counties, all of which have a higher risk of riverine flooding. This can be attributed to both the Missouri and Yellowstone watersheds passing through each of these areas. There are seven counties that are classified as having a relatively low riverine flooding risk level. These counties within the Eastern Region are Carbon, Dawson, Musselshell, Powder River, Rosebud, Wheatland, and Yellowstone. The other remaining 11 counties are considered to have a low riverine flooding risk and Daniels County has no rating in correlation to riverine inundation risks currently.

Past flood events in Montana's Eastern Region have damaged roads, bridges, private property, businesses, and critical lifeline facilities. Future events may result in greater damages depending on patterns of growth, land use development and climate change. In summary, the magnitude of flood hazards in the Eastern Region is **critical.**

National Flood Insurance Program Policy Analysis

The NFIP aims to reduce the impact of flooding on private and public structures by providing affordable insurance to property owners and by encouraging communities to adopt and enforce floodplain management regulations. These efforts help mitigate the effects of flooding on new and improved structures. The State has analyzed NFIP flood-loss data to determine areas of Montana's Eastern Region with the greatest flood risk. Montana's Eastern Region flood-loss information was obtained from FEMA's "Montana's Coverage Claims" for Montana's Eastern Region, which documents losses from 1978. This section was updated based on information obtained from FEMA's PIVOT database through Montana Department of Natural Resources and Conservation (MT DNRC) dated August 10, 2022.

There are several limitations to analyzing flood risk entirely on this data, including:

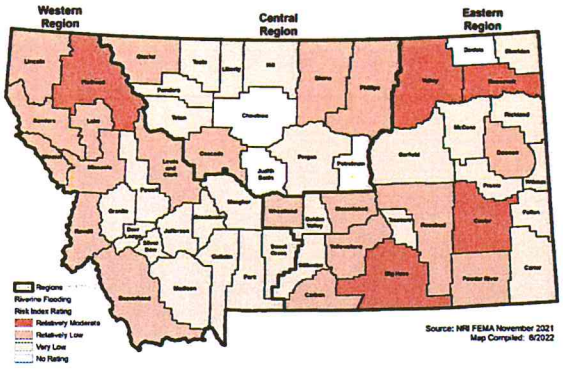
- Only losses to participating NFIP communities are represented;
- Communities joined the NFIP at various times since 1978;
- The number of flood insurance policies in effect may not include all structures at risk to flooding; and
- Some of the historical loss areas have been mitigated with property buyouts.

Montana's Eastern Region has a total of $951,790,600 in NFIP coverage, with 1,005 total flood claims, 1,272 current polices and $7,868,905 dollars paid out total due to flood damage and losses. NFIP data and statistics for the Eastern Region is summarized in Table 4-27 below. Yellowstone County has the highest amount of dollars paid out due to flood claims with $1,814,878, followed by Valley County with $1,590,563 in claims.

Table 4-27 Montana Eastern Region NFIP Statistics

County	Date Joined	Effective Firm Date	Dollars Paid (Historical)	Flood Claims	Current Policies	Coverage ($)
Big Horn	9/2/1981	9/2/1981	$245,116.75	16	8	$1,901,900.00
Carbon	11/4/1981	7/5/2017	$1,089,354.17	61	77	$20,190,100.00
Carter	$0	$0	$0	$0	$0	$0
Custer	9/1/1987	7/22/2010	$400,061.25	155	730	$119,513,500.00
Daniels	$0	$0	$0	$0	$0	$0
Dawson	5/1/1999	05/01/99(L)	$144,610.47	7	8	$2,465,500.00
Fallon	8/4/1988	8/4/1988	$0	1	2	$700,000,000
Garfield	3/20/1979	3/20/1979	$0	1	11	$562,600
Golden Valley	9/16/1981	11/5/2021	$0	$0	1	$255,000
McCone	6/4/2007	6/4/2007	$0	$0	$0	$0
Musselshell	3/1/2001	11/15/2019	$1,201,833.38	60	18	$1,624,700
Powder River	6/1/2010	06/01/10(L)	$25,382	7	4	$616,000
Prairie	5/8/1979	5/8/1979	$0	$0	$0	$0
Richland	12/4/1985	8/15/2019	$96,344.22	12	14	$3,589,400
Roosevelt	11/1/1996	11/01/96(L)	$59,144.95	8	5	$942,500
Rosebud	9/1/1997	11/15/2019	$15,452.01	12	5	$1,443,000
Sheridan	2/4/2019	6/4/2007	$72.89	1	$0	$0
Stillwater	11/15/1985	10/16/2015	$915,175.10	56	64	$16,937,600
Treasure	12/18/1986	12/18/86(M)	$0	$0	2	$47,000
Valley	1/1/1987	01/01/87(L)	$1,590,365.62	274	23	$3,043,600
Wheatland	9/16/1981	9/16/1981	$20,726.62	18	6	$439,000

Figure 4-31 Risk Index Rating for Riverine Flooding by County



There is an increased risk of flash flooding and debris flows in Montana in general as a result of recent active fire seasons. Most burn areas will be prone to flash flooding and debris flows for at least two years after the fire. Locations downhill and downstream from burned areas are most susceptible, especially near steep terrain. Rainfall that would normally be absorbed will run off extremely quickly after a wildfire, as burned soil can be as water repellant as pavement. As a result, much less rainfall is required to produce a flash flood. As water runs downhill through burned areas it can create major erosion and pick up large amounts of ash, sand, silt, rocks and burned vegetation.

People

Vulnerable populations in Montana's Eastern Region include those that live within known floodplains or near areas vulnerable to flash floods, as well as people traveling through or in areas used for recreational purposes prone to flash flooding. Within the Eastern Region Custer County has the highest amount of people located in the floodplain with 6,711. This is followed by Yellowstone County with 1,830. The third highest amount of people reside in Big Horn County with 856. Of these populations residing in floodplains, certain populations are particularly vulnerable, such as the elderly and very young, those living in long-term care facilities, mobile homes, hospitals, low-income housing areas, or temporary shelters, people who do not speak English well, tourists and visitors, and those with developmental, physical, or sensory disabilities. Table 4-29 below highlights the people who are located on reservation land that are located in the floodplain, including a significant number of persons of the Crow Tribe.

The impacts of flooding on vulnerable populations can potentially be the most severe. Families may have fewer financial resources to prepare for or recover from a flood, and they may be more likely to be uninsured or underinsured. Individuals with disabilities may need more time to evacuate, so evacuation notices will

need to be issued as soon as feasible, and communicated by multiple, inclusive methods. Population totals for the counties located in Montana's Eastern region are shown in Table 4-29 below.

Table 4-29 Eastern Region Population Located in the 1% Annual Chance Floodplain

County	Population
Big Horn	356
Carbon	709
Carter	147
Crow Tribe	681
Custer	6,711
Daniels	2
Dawson	340
Fallon	84
Fort Peck	337
Garfield	60
Golden Valley	32
McCone	46
Musselshell	393
Northern Cheyenne Indian Reservation	5
Powder River	219
Prairie	5
Richland	218
Roosevelt	353
Rosebud	64
Sheridan	391
Stillwater	605
Treasure	15
Valley	418
Wheatland	204
Wibaux	64
Yellowstone	1,830
Total	**14,789**

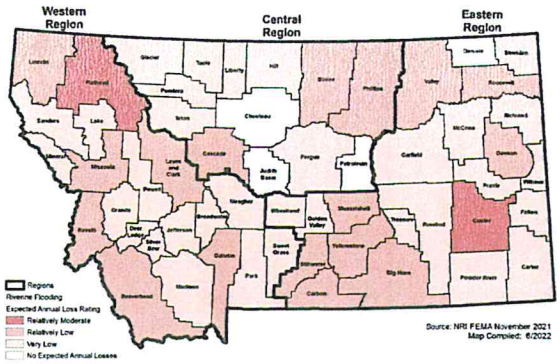
Sources: DNRC, Hazus, FEMA NFHL

Flood hazards do not stop at the 1% chance flood line and an additional analysis was completed of the 0.2% chance flood zone (500-year flood). Data describing the 0.2% flood zone are more limited. In fact, 0.2% flood zone data were available for only 11 counties and no tribal reservations. Nevertheless, analysis of a more expansive flood zone has value and was completed for these 11 counties (Table 4-30). The absence of 13 counties and 2 tribal reservations in Table 4-30 does not indicate a lack of 0.2% flood risk in these jurisdictions.

One additional nuance exists in the 0.2% floodplain analysis. The values reported in Table 4-30 indicate the people located between the maximum extent of the 1% chance floodplain and the 0.2% chance floodplain. To get the total number of people within the 0.2% chance floodplain, the values in Table 4-29 and Table 4-30 must be combined.

Yellowstone County has 1,183 people located in the area between the maximum extent of the 1% chance floodplain and the 0.2% chance floodplain, the most of the 11 counties included in this analysis (Table 4-30). This is followed by Carbon and Stillwater Counties with 225 and 155 people, respectively.

Figure 4-32 Expected Annual Loss Rating Riverine Flooding by County



GIS analysis was used to further estimate Montana's Eastern Region potential property and economic losses. The April 2022 MSDI Cadastral Parcel layer was used as the basis for the inventory of developed parcels. GIS was used to create a centroid, or point, representing the center of each parcel polygon, which was overlaid on the best available floodplain layer. Multiple flood layers from different sources were used in the analysis to create a full coverage of flood hazard for the Eastern Region through the utilization of FEMA's NFHL (as of 6/1/2022), and other sources. The DNRC provided digitized flood mapping from paper maps that FEMA has not yet converted over to the NFHL. FEMA Region VIII also provided 1% annual chance flood risk areas based on Hazus flood models to help fill in areas where FEMA has not mapped. For the purposes of this analysis, the flood zone that intersected the centroid was assigned as the flood zone for the entire parcel. Another assumption with this model is that every parcel with an improvement value greater than zero was assumed to be developed in some way. Only improved parcels, and the value of those improvements, were analyzed and aggregated by region, county, jurisdiction, property type and flood zone. The summarized results for the Eastern Region are shown below. More detailed summarized results for each county and community by property type are shown in the tables and maps provided within each jurisdictional Annex.

Table 4-31 below summarizes the counts and improved value of parcels in the region, broken out by each county, that fall within the 1% chance floodplains. Additionally, Table 4-31 also shows loss estimate values which are calculated based upon a proportion of the improved value and estimated contents value and FEMA depth-damage relationships. A two-foot flood is assumed for the purposes of this planning-level flood loss estimate, which generally equates to a 25% loss based on structure and contents value.

Custer County has the highest amount of properties exposed to flooding and an estimated loss value of over $131 Million. Yellowstone County has loss values with over $70 Million in estimated losses, followed

Table 4-30 Eastern Region Population Located in the 0.2% Annual Chance Floodplain

County	Population
Big Horn	0
Carbon	225
Dawson	155
Fallon	41
Golden Vall	18
Musselshell	50
Richland	45
Rosebud	0
Stillwater	170
Wheatland	106
Yellowstone	1,183
Total	**1,992**

- These data indicate the population between the maximum extent of the 1% floodplain and the 0.2% chance floodplain. To get the total number of people within the 0.2% chance floodplain, add these values to the values reported in Table 4-29.
- Availability of 0.2% chance floodplain mapping limits this analysis to 11 counties in the Eastern Region.
- Sources: DNRC, Hazus, FEMA NFHL

Property

The NRI defines risk as the potential for negative impacts as a result of a natural hazard and determines a community's risk relative to other communities by examining the expected annual loss and social vulnerability in a given community in relation to that community's resilience. This information is categorized in Figure 4-32 below. Montana's Eastern Region has one county with a relatively moderate expected loss rating based on the NRI: Custer County. This also coincides with Custer County having substantial floodplain development in and around Miles City, though levees in the area provide some level of protection. Other counties with relatively low expected loss rating due to floods include Carbon, Big Horn, Dawson, Musselshell, Roosevelt, Stillwater, Valley, and Yellowstone counties.

by Carbon County with estimated loss parcel values with over $38 Million in losses. Overall Montana's Eastern Region has $1.5Billion in total value exposed and a combined estimated loss of over $384 Million for 1% annual chance flooding. There are also 7,050 parcels located in the floodplain and 14,789 people at risk in the Eastern Region. The jurisdictional break down for each county is located within each annex. The summarized results for the Eastern Region are shown in Table 4-31 below.

Table 4-31 Eastern Region Parcels at Risk to 1% Flood Hazard by County and Jurisdiction

County	Improved Parcels	Improved Value	Content Value	Total Value	Estimated Loss
Big Horn	320	$42,048,541	$28,419,080	$70,467,621	$17,616,905
Carbon	390	$94,893,650	$59,013,360	$153,907,010	$38,476,753
Carter	117	$9,409,733	$7,233,297	$16,643,030	$4,160,757
Custer	3,011	$339,329,544	$186,052,204	$525,381,748	$131,345,437
Daniels	19	$1,306,490	$1,274,230	$2,580,720	$645,180
Dawson	184	$23,263,219	$12,985,725	$36,248,944	$9,062,236
Fallon	60	$7,098,177	$4,648,789	$11,746,966	$2,936,741
Garfield	54	$3,949,454	$3,149,022	$7,098,476	$1,774,619
Golden Valley	26	$2,615,550	$2,147,890	$4,763,440	$1,190,860
McCone	73	$5,663,177	$4,813,339	$10,476,516	$2,619,129
Musselshell	221	$12,948,261	$8,252,576	$21,200,837	$5,300,209
Powder River	164	$11,476,921	$8,399,881	$19,876,802	$4,969,200
Prairie	12	$1,438,540	$1,351,150	$2,789,690	$697,423
Richland	156	$18,497,151	$13,398,821	$31,895,972	$7,973,993
Roosevelt	170	$42,111,267	$49,333,508	$91,444,775	$22,861,194
Rosebud	76	$9,189,124	$7,556,857	$16,745,981	$4,186,495
Sheridan	235	$23,978,537	$14,143,794	$38,122,331	$9,530,583
Stillwater	291	$55,596,478	$32,888,481	$88,484,959	$22,121,240
Treasure	44	$4,493,676	$4,232,678	$8,726,354	$2,181,589
Valley	361	$41,285,741	$28,490,501	$69,776,242	$17,444,060
Wheatland	113	$11,816,349	$10,001,820	$21,818,169	$5,454,542
Wibaux	38	$2,031,999	$1,344,740	$3,376,739	$844,185
Yellowstone	915	$168,328,469	$114,391,695	$282,720,164	$70,680,041
Total	**7,050**	**$932,770,048**	**$603,523,431**	**$1,536,293,479**	**$384,073,370**

Sources: DNRC, Hazus, FEMA NFHL

The three tribal reservations located in the Eastern Region were identified to have 412 improved parcels with an estimated loss of over $22 Million. The Crow Tribe in particular has $11,984,383 in estimated potential losses and the Fort Peck Assiniboine and Sioux tribes have $10,106,363 in potential estimated losses due to flooding. While the Northern Cheyenne Indian Reservation is vastly smaller with $499 in estimated potential losses. There is a total of 1,023 people on reservation land located within the 1% annual chance of flooding Special Flood Hazard Area (SFHA). The 0.2% risk for the Tribal Nations has not been mapped, preventing quantification of potential loss from 0.2% annual chance floods on tribal lands. Totals are listed in Table 4-32 below.

Table 4-32 Eastern Region Parcels at Risk to 1% Annual Chance by Tribe

Tribal	Improved Parcels	Improved Value	Content Value	Total Value	Estimated Loss	Population
Crow Tribe	230	$28,443,085	$19,494,447	$47,937,532	$11,984,383	681
Fort Peck Assiniboine and Sioux Tribe	181	$21,611,356	$18,814,097	$40,425,453	$10,106,363	337

Tribal	Improved Parcels	Improved Value	Content Value	Total Value	Estimated Loss	Population
Northern Cheyenne Indian Reservation	1	$1,330	$665	$1,995	$499	5
Total	412	$50,035,771	$38,309,209	$88,344,983	$22,091,245	1,023

Sources: DNRC, Hazus, FEMA NFHL

Data describing the 0.2% flood zone are more limited. In fact, 0.2% flood zone data were available for only 11 counties and no tribal reservations. Nevertheless, analysis of a more expansive flood zone has value and was completed for these 11 counties (Table 4-33). The absence of 13 counties and 2 reservations in Table 4-33 does not indicate a lack of flood risk in these jurisdictions.

One additional nuance exists in the 0.2% floodplain analysis. The values reported in Table 4-33 indicate the property located between the maximum extent of the 1% chance floodplain and the 0.2% chance floodplain. To get the total number of people or value of property within the 0.2% chance floodplain the values, the values in Table 4-30 and Table 4-33 must be combined. (Table 4-33).

Yellowstone County has over $109 million of property located between the maximum extent of the 1% annual chance floodplain and 0.2% annual chance floodplain, with losses projected to be $27 million. This is the most of the 11 counties in the 0.2% chance analysis. Carbon County is second in loss values with over $7 Million in estimated losses. Stillwater County ranks third in estimated loss parcel values with over $6 Million in presumed losses. Overall Montana's Eastern Region has $202,028,564 in total value exposed and a combined estimated loss of $50,507,141 for the area between the maximum extent of the 1% chance floodplain and 0.2% annual chance floodplain. There are also 942 parcels and 1,992 people in this area, classified by FEMA as Zone X-shaded.

Note that many areas are not mapped by FEMA, or have the Zone-X shaded mapped, thus the true risk is likely much larger to these more severe but less frequent floods; these areas are not required to be regulated by the NFIP. The jurisdictional break down for each county is located within each annex. The summarized results for the Region are shown in Table 4-33 below.

Table 4-33 Eastern Region Parcels at Risk to 0.2% Flood Hazard by County and Jurisdiction

County	Improved Parcels	Improved Value	Content Value	Total Value	Estimated Loss	Population
Big Horn	3	$129,490	$129,490	$258,980	$64,745	-
Carbon	103	$18,241,620	$9,788,475	$28,030,095	$7,007,524	225
Dawson	76	$8,190,582	$4,670,336	$12,860,918	$3,215,230	155
Fallon	22	$3,873,675	$2,850,223	$6,723,898	$1,680,974	41
Golden Valley	14	$907,333	$716,397	$1,623,730	$405,932	18
Musselshell	32	$1,934,689	$1,320,100	$3,254,789	$813,697	50
Richland	25	$4,373,014	$2,751,437	$7,124,451	$1,781,113	45
Rosebud	1	$220,840	$220,840	$441,680	$110,420	-
Stillwater	81	$17,796,252	$9,852,691	$27,648,943	$6,912,236	170
Wheatland	47	$2,769,818	$1,507,214	$4,277,032	$1,069,258	106
Yellowstone	538	$70,086,518	$39,697,532	$109,784,050	$27,446,012	1,183
Total	942	$128,523,831	$73,504,733	$202,028,564	$50,507,141	1,992

Sources: DNRC, Hazus, FEMA NFHL, *Tribal Reservations parcel data is reflected in their respective counties

Critical Facilities and Lifelines

To estimate the potential impact of floods on critical facilities, a GIS overlay was performed of the flood hazard layer with critical facility point locations data. Critical facilities at-risk to the 1% annual chance flood

by county and FEMA Lifeline are listed in Table 4-34 below. Impacts to any of these facilities could have wide ranging ramifications, in addition to property damage and other cascading impacts.

Table 4-34 Eastern Region Critical Facilities at Risk to 1% Annual Chance of Flood by Facility Type

County	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Total
Big Horn	4	1	5	0	0	4	58	72
Carbon	0	0	4	1	0	0	50	55
Carter	0	0	1	0	0	0	29	30
Custer	2	7	6	1	1	10	32	59
Daniels	0	0	0	0	0	0	23	23
Dawson	0	0	3	0	0	0	38	41
Fallon	2	2	1	0	0	1	24	30
Garfield	0	0	0	0	0	0	15	15
Golden Valley	0	0	1	0	0	0	5	6
McCone	0	0	2	0	0	0	19	21
Musselshell	0	0	1	0	0	0	17	18
Powder River	0	0	1	0	0	1	18	20
Prairie	0	0	0	0	0	0	16	16
Richland	0	0	1	1	0	0	24	26
Roosevelt	1	3	3	0	0	2	27	36
Rosebud	0	0	1	0	0	0	36	37
Sheridan	0	2	2	0	0	0	51	55
Stillwater	0	0	2	1	0	0	38	41
Treasure	0	0	1	0	0	0	7	8
Valley	3	6	5	0	0	0	46	60
Wheatland	0	1	2	0	0	0	12	15
Wibaux	0	0	1	0	0	0	9	10
Yellowstone	6	5	2	2	0	1	55	71
Total	18	27	45	6	1	19	649	765

Sources: Montana DNRC, FEMA, HAZUS, HIFLD 2022, Montana DES, NBI

The 1% annual chance of flooding for the Eastern Region shows that the majority of facilities that have the most critical facilities at risk to flood damage are within the Transportation lifelines with 651 total. It should be noted that the majority of these are bridges and may have a lower risk of flooding. Bridges like these can be a cause of concern. Food, Water and Shelter facilities have the second highest FEMA Lifeline facilities at risk with 45 total. Energy critical facilities are third with 45 total facilities. Energy facilities could be at risk of losing power, potentially affecting the surrounding communities.

Economy

Flooding can have major negative impacts on the local and regional economy, including indirect losses such as business interruption, lost wages, reduced tourism and visitation, and other downtime costs. Flood events can cut off customer access to a business as well as close a business for repairs or permanently. A quick response to the needs of businesses affected by flood events can help a community maintain economic

vitality in the face of flood damage. Responses to business damages can include funding to assist owners in elevating or relocating flood-prone business structures. Tourism and outdoor recreation are an important part of the Region's economy. If part of the Eastern Region planning area were damaged by flooding, tourism and outdoor recreation could potentially suffer, as witnessed during the Yellowstone flooding in 2022. Additionally, flooding can impact the economy through the direct damages and losses to property and costs to recover, as summarized in the property section above.

Historic and Cultural Resources

Floodplains and their adjacent areas are regularly used for environmental conservation, leisure, recreation, and tourism. Historic and cultural resources are also known to occur within floodplains. In the event of a major flooding event, damages to historic and cultural resources are possible.

Natural Resources

Natural resources are generally resistant to flooding and floodplains provide many natural and beneficial functions. Wetlands, for example, exist because of natural flooding incidents. Nonetheless, after periods of previous disasters such as drought and fire, flooding can impact the environment in negative ways. Areas recently suffering from wildfire damage may erode because of flooding, which can temporarily alter an ecological system. Fish can wash into roads or over dikes into flooded fields, with no possibility of escape.

Pollution from roads, such as oil, and hazardous materials can wash into rivers and streams during floods, as these can settle onto normally dry soils, polluting them for agricultural uses. Human development such as bridge abutments can increase stream bank erosion, causing rivers and streams to migrate into non-natural courses.

Development Trends Related to Hazards and Risk

Potential expansion in the future and construction overall in Eastern Montana's floodplains can heighten the susceptibility of the region to flooding by expanding the amount of people and value of the property inventory within the planning area. Development in Eastern Montana's floodplains should be enforced using hazard mitigation measures available through the NFIP and local floodplain activities. Such as floodproofing, relocation, elevation or demolition and relocation to low-risk areas. Other influences that should be considered in projections of future flood risks are land cover, flow and water-supply management, soil moisture and channel conditions. In addition to discouraging development in flood-prone areas and protecting natural systems such as wetlands, local government planners and engineers in urbanized parts of the Region should consider infrastructure designs that accommodate growth and future trends in precipitation.

Risk Summary

The Eastern Region averages a major flood event every 5 years which equates to a probability of future occurrence rating of **likely** throughout the Eastern Region. Flooding has a high significance hazard overall in the region but there is significant variability by jurisdiction.

- There is an estimated 14,789 people located within the 1% Annual Chance of Flooding within the Eastern Region. Custer County makes up nearly half with 6,711 people, followed by Yellowstone County with 1,830 people and Big Horn County with 856 people. These three counties make up 80% of the people located within the designated 1% floodplain.
- The Eastern Region has a total of $384 Million in estimated property losses due to flood damages. Custer, Yellowstone, and Carbon counties have the highest estimated loss totals with the study area. These three counties make up more than half of the potential property losses within the region.
- Flooding can have major negative impacts on the local and regional economy, including indirect losses such as business interruption, lost wages, reduced tourism and visitation, and other downtime costs.

- There is a total of 765 critical facilities in the Eastern Region exposed to flood hazards. The highest exposure of FEMA Lifeline facilities is transportation (bridges) followed by the Food, Water, Shelter category.
- Related hazards: Dam Failure, Landslide, Wildfire

Table 4-35 Risk Summary Table: Flooding

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
Eastern Region	High		
Big Horn County	Medium	Hardin, Lodge Grass	Crow Tribe has more exposure to flooding.
Carbon County	Medium	Bearcreek, Bridger, Joliet, Fromberg, Red Lodge	None
Carter County	Medium	Ekalaka	None
Custer County	High	Ismay, Miles City	High risk with Miles City and portions of the unincorporated area due to population and property in the floodplain; some risk is mitigated through levees (currently not showing as certified to provide 1% annual chance flood protection) and other preventive measures in Custer County.
Crow Tribe	High		NA
Daniels County	Medium	Scobey, Flaxville	None
Dawson County	Medium	Richey, Glendive	None
Fallon County	Medium	Plevna, Baker	None
Garfield County	Medium	Jordan	None
Golden Valley County	Medium	Ryegate, Lavina	None
McCone County	Medium	Circle	None
Musselshell County	Medium	Melstone, Roundup	None
Powder River County	Medium	Broadus	None
Prairie County	Medium	Terry	None
Richland County	Medium	Fairview, Sidney	None
Roosevelt County	Medium	Wolf Point, Poplar, Bainville, Culberson, Froid	None
Rosebud County	Medium	Colstrip, Forsyth	None
Sheridan County	Medium	Plentywood, Medicine Lake, Outlook, Westby	None
Stillwater County	Medium	Columbus	None
Treasure County	Medium	Hysham	None
Valley County	High	Glasgow, Fort Peck, Nashua, Opheim	None
Wibaux	Medium	Wibaux	None
Yellowstone County	High	Billings, Broadview, Laurel	None

4.2.8 Hazardous Materials Incidents

Hazard/Problem Description

A hazardous material incident is defined as any actual or threatened uncontrolled release of a hazardous material, its hazardous reaction products or the energy released by its reactions that pose a significant risk to human life and health, property and/or the environment. Hazardous materials incidents may also include chemical, biological, radiological, nuclear, and explosive (CBRNE) incidents. CBRNE incidents can cause a variety of impacts in Montana, depending on the nature of the incident, material used, and environmental factors.

Hazardous materials incidents can occur anywhere hazard materials are stored or transported. There are no designated transportation routes throughout the region, Although there are several fixed facilities within some of the city limits. Routes that are used for transporting nuclear and hazardous materials through the Eastern Region by vehicle are Interstate 15 and State Highways 2, 87, 191, and 200. In the 2018 SHMP, it's noted that a 0.25-mile buffer is placed around all highways, major roadways, railroads, and Risk Management Program (RMP) facilities as a proxy for potential impact areas. The major highways and railways within Montana and its Eastern Region are shown in Figure 4-33 and Figure 4-34 below.

In 2020 there were 42 Tier II facilities located throughout Eastern Montana, although most are located along Interstate 94 and State Highways 2, 12, 87, 212, and 310. Tier II facilities store regulated hazardous materials that exceed certain threshold amounts.

As a general rule, any hazmat release is anticipated to have an impact of no more than one mile around the spill area. The impact to life and property from any given release depends primarily on:

- The type and quantity of material released.
- The human act(s) or unintended event(s) necessary to cause the hazard to occur.
- The length of time the hazard is present in the area.
- The tendency of a hazard, or that of its effects, to either expand, contract, or remain confined in time, magnitude, and space.
- Characteristics of the location and its physical environment that can either magnify or reduce the effects of a hazard.

Figure 4-34 Eastern Region Hazardous Materials Transportation Routes

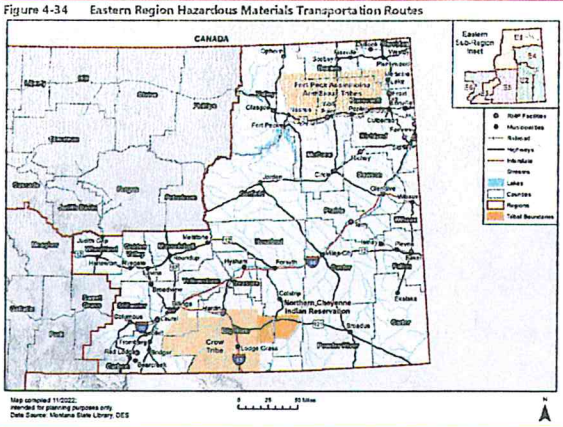
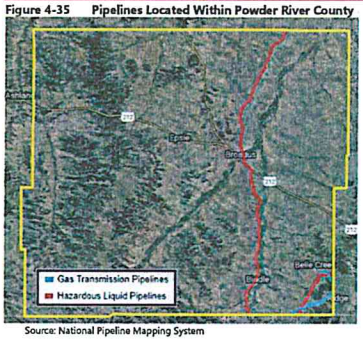
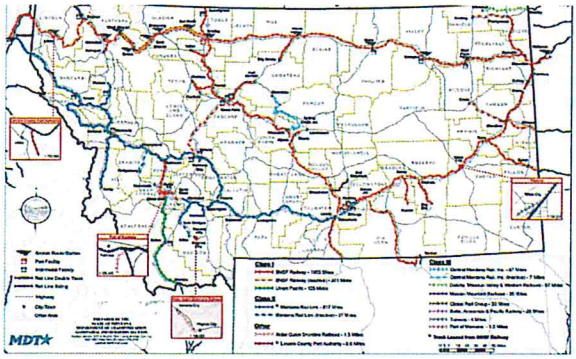


Figure 4-35 Pipelines Located Within Powder River County



Source: National Pipeline Mapping System

Figure 4-33 Montana's Rail Systems



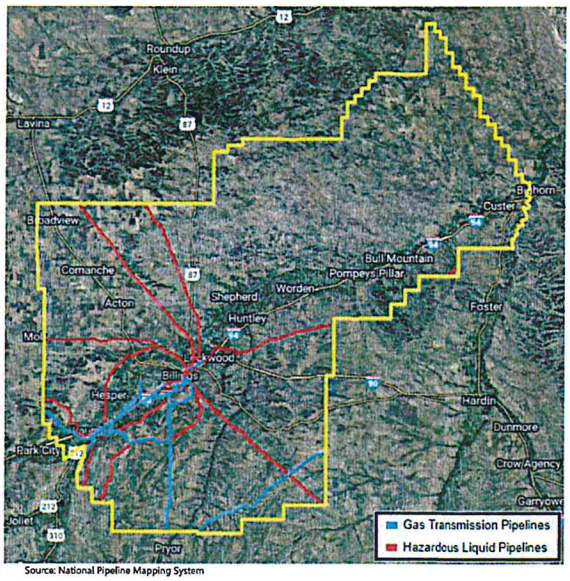
Geographical Area Affected

Hazmat incidents can occur at a fixed facility or during transportation. Hazardous materials facilities are identified and mapped by the counties they reside in, along with the types of materials stored there; facilities generally reside in and around communities. The EPA requires facilities containing certain extremely hazardous substances to generate Risk Management Plans (RMPs) and resubmit these plans every five years. As of 2022 there are 42 RMP facilities located in Montana's Eastern Region. In transportation, hazardous materials generally follow major shipping routes where possible (including road, rail, and pipelines), creating a hazard area immediately neighboring these routes.

Information provided by the National Pipeline Mapping System (NPMS) indicate several pipelines conveying gas or hazardous liquids across the planning area. Pipeline ruptures can result in major spills, or even explosions. These pipelines also pass through areas where denser populations of people and property are located. Powder River County had the most pipeline hazmat incidents (41 incidents or 25% of all pipeline incidents in the Eastern Region), followed by Yellowstone County with 20% of all pipeline incidents, and Fallon County which had 13% of all pipeline incidents in the Region.

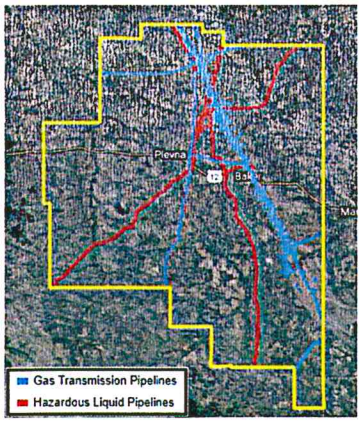
The designated transportation routes, and gas and hazardous liquid pipelines for these counties are shown in Figure 4-34, Figure 4-35, Figure 4-36 and Figure 4-37 below. These figures illustrate the geographical area affected by hazardous material incidents along transportation routes. Overall hazardous material incidents have a **limited** geographical extent in the Eastern Region.

Figure 4-36 Pipelines Located Within Yellowstone County



Source: National Pipeline Mapping System

Figure 4-37 Pipelines Located Within Fallon County



Source: National Pipeline Mapping System

Past Occurrences

There are a variety of mechanisms to get an idea of the number and types of past hazardous materials incidents in the Eastern Region. One such repository is the catalog of hazardous materials spill and accident reports at the National Response Center (NRC) as part of the Right to Know Network (RTK NET). According to this database, between 1990 and 2022 there were three incidents reported across the two Tribal Reservations and 1,156 incidents in the counties within the region. Table 4-36 below shows the 32-year record for reported incidents in Montana's Eastern Region.

Table 4-36 NRC Reported Incidents Central Montana Region 1990-2022

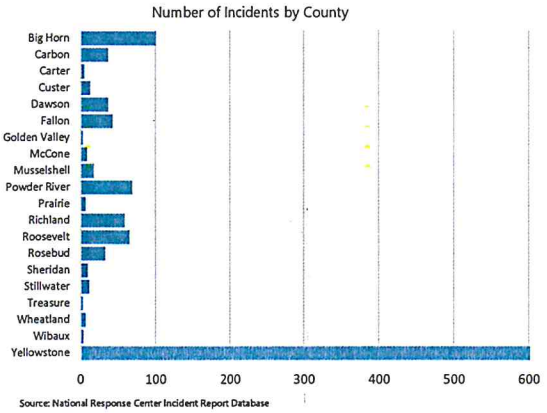
County	# of Incidents
Big Horn	101
Carbon	37
Carter	5
Custer	13
Dawson	37
Fallon	43
Golden Valley	3
McCone	9
Musselshell	18

County	# of Incidents
Powder River	69
Prairie	7
Richland	59
Roosevelt	65
Rosebud	33
Sheridan	10
Stillwater	12
Treasure	3
Wheatland	7
Wibaux	4
Yellowstone	621

Source: National Response Center Incident Report Database

According to the data, during the time period between 1990 and 2022 the Eastern Region saw an average of 35 NRC-reported incidents per year, which means that each county can reasonably expect multiple hazardous materials responses annually. Yellowstone and Big Horn counties have had the highest amount of hazmat incidents and spills. Figure 4-38 shows the number of hazardous material incidents by county between 1990 and 2022.

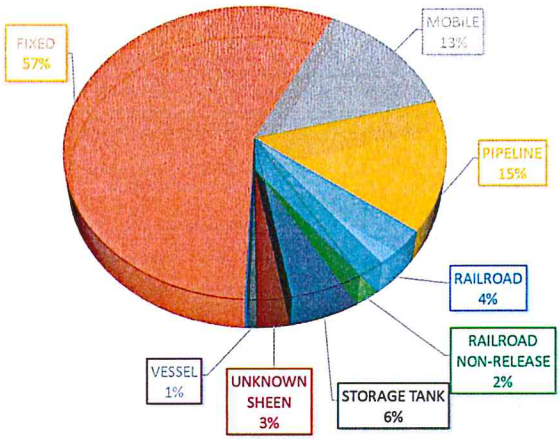
Figure 4-38 Hazardous Materials Incidents Reported to the NRC by County – Eastern Region: 1990-2022



Source: National Response Center Incident Report Database

Figure 4-39 shows the percentage of each type of incident over the 32-year period between 1990 and 2022. Spills from fixed non-mobile facilities such as Tier II or RMP facilities have the highest percentage of hazmat incidents reported, accounting for 57% total. The second most common percentage of incident types accrued are pipeline incidents with 16%. Regular maintenance and detailed planning locations are necessary to ensure that these incident types are properly accounted and prepared for. Mobile incidents are third with 13% of the total. These can occur when hazmat materials are being transported along state highways and interstates and where injuries or fatalities are more likely to potentially occur.

Figure 4-39 Hazardous Materials Incidents Reported to the NRC by Type - Eastern Region: 1990-2022



Source: National Response Center Incident Report Database

Frequency/Likelihood of Occurrence

The study area experiences multiple hazardous materials incidents each year, with different degrees of effect. Based on the history of past occurrences, there is a 100% chance that the Eastern Region will be impacted by a hazardous materials incident in any given year making this hazard have a **highly likely** potential for occurrence. Hazardous material spills and releases, both from fixed facilities and during transport, will continue to occur in Montana's Eastern Region annually.

Climate Change Considerations

Modifications in future conditions are unlikely to impact the rates of occurrence for human-caused hazards, such as hazardous material incidents. Nevertheless, it is possible that an increase or change in the occurrence of other hazards, such as severe storms and fire events, may increase the likelihood of an accidental hazardous materials release from transportation events.

Potential Magnitude and Severity

Potential effects that could occur from hazardous waste spills or releases include:

- Injury
- Loss of life (human, livestock, fish, and wildlife)
- Evacuations
- Property damage
- Air pollution
- Surface or ground water pollution/contamination
- Interruption of commerce and transportation

Various considerations go into the impacts of a hazardous materials release, including method of release, the type of material, location of release, weather conditions, and time of day. This makes it complicated to pinpoint definite impacts. It can still be ascertained that items found in the study area will have at least one of the impacts listed above. The overall magnitude for hazardous material incidents is **negligible.**

The vast majority of hazardous material incidents in the Eastern Region are minor spills with no significant impacts beyond localized cleanup. Of the 1,194 Eastern Region incidents in the NRC database between1990 and 2022, only 122 (3.5%) caused significant impacts. Those 122 significant incidents resulted in a total of14 evacuations, 52 injuries, 33 fatalities, and $21.7 million in property damages. Annualized over 32 years, that equates to an average of 3.8 significant incidents, 1.0 fatalities, 1.6 injuries, 0.4 evacuations, and $677,027 in property damages annually.

However, it is important to note that the NRC counts all injuries or damages resulting from an accident where hazardous materials were involved, whether or not the injuries or damages were caused by exposure to the hazardous substance. Closer analysis show that a majority of the injuries, fatalities, and property damages were from the physical impacts of the accident that caused the release, rather than the exposure to the hazardous materials themselves.

Vulnerability Assessment

The Eastern Region has energy pipelines, railroad tracks which carry many types of hazardous materials, and state highways running through its boundaries. A variety of hazardous materials originating in the Region or elsewhere are transported along these routes and could be vulnerable to accidental spills. Consequences can vary depending on whether the spill affects a populated area vs an unpopulated but environmentally sensitive area.

No specific hazardous materials routes are designated in Eastern Region; any routes used to carry hazardous materials introduce an element of risk of materials release to the area immediately adjacent to them. The Region noted that many petroleum and other flammable products are transported by truck, and many have mixed payloads that don't list material amounts.

People

Hazardous materials incidents can cause injuries, hospitalizations, and even fatalities to people nearby. People living near hazardous facilities and along transportation routes may be at a higher risk of exposure, particularly those living or working downstream and downwind from such facilities. For example, a toxic

spill or a release of an airborne chemical near a populated area can lead to significant evacuations and have a high potential for loss of life.

In addition to the immediate health impacts of releases, a handful of studies have found long term health impacts such as increased incidence of certain cancers and birth defects among people living near certain chemical facilities. However there has not been sufficient research done on the subject to allow detailed analysis.

Property

The impact of a fixed hazardous facility, such as a chemical processing facility is typically localized to the property where the incident occurs. The impact of a small spill (i.e., liquid spill) may also be limited to the extent of the spill and remediated if needed. A blanket answer for potential impacts is hard to quantify, as different chemicals may present different impacts and issues.

Property within a half mile in either direction of designated hazardous materials routes is at increased risk of impacts. While cleanup costs from major spills can be substantial, they do not typically cause significant long-term impacts to property. However, some larger incidents involving pipelines, railroads, or explosive materials may cause significant and overwhelming damage to the surrounding communities.

Critical Facilities and Lifelines

There are 42 RMP facilities located throughout the Eastern Region. Some of these are discussed in more detail in the County Annexes. Yellowstone County has nine of these facilities, and Richland County has eight. These two counties possess over 40% of the RMP facilities within the study area. The RMP facilities for each county in the Eastern Region are summarized in Table 4-37 below.

Table 4-37 RMP Facilities in the Eastern Region

County	Jurisdiction	Number of Facilities
Big Horn	Big Horn County	2
Carbon	Carbon County	3
Dawson	Dawson County	2
	Richey	2
Fallon	Fallon County	1
McCone	McCone County	2
Prairie	Prairie County	1
Richland	Richland County	8
Roosevelt	Froid	4
	Roosevelt County	6
Yellowstone	Billings	2
	Yellowstone County	9
Total	**Total**	**42**

Source: http://www.rtknet.org/db/ems, HIFLD 2022

Economy

Potential losses can vary greatly for hazardous material incidents. For even a small incident, there are cleanup and disposal costs. In a larger scale incident, cleanup can be extensive and protracted. There can be deaths or injuries requiring doctor's visits, hospitalization, and disabling chronic injuries. Soil and water contamination can occur, necessitating costly remediation. Evacuations can disrupt home and business activities. Large-scale incidents can easily reach $1 million or more in direct damages.

Historic and Cultural Resources

Historic and cultural facilities can be impacted by hazardous materials spills the same as other facilities or areas.

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
Fallon	Low	Plevna, Baker	Fallon County has an intensive network of gas and hazardous liquid pipelines.
Garfield	Low	Jordan	Garfield County has not reported an NRC hazardous materials incident during the past 32 years.
Golden Valley	Low	Ryegate, Lavina	None
McCone	Low	Circle	None
Musselshell	Low	Melstone, Roundup	Musselshell County has sparce transmission line and, no RMP facilities.
Powder River	Medium	Broadus	Powder River Canyon has experienced 66 NRC hazardous materials incidents in the last 32 years.
Prairie	Low	Terry	None
Richland	Medium	Fairview, Sidney	Richland County has an extensive network of gas and hazardous liquid pipelines, a large number of RMP facilities, and a history of hazmat incidents.
Roosevelt	Medium	Wolf Point, Poplar, Bainville, Culberson, Froid	Roosevelt County has a moderate history of hazardous materials incidents and the third highest number of RMP facilities in the State.
Rosebud	Low	Colstrip, Forsyth	None
Sheridan	Low	Plentywood, Medicine Lake, Outlook, Westby	None
Stillwater	Low	Columbus	None
Treasure	Low	Hysham	Treasure County has few gas hazardous liquid transmission lines and few prior hazmat incidents.
Valley	Medium	Glasgow, Fort Peck, Nashua, Opheim	Valley County has not reported an NRC hazardous materials incident during the past 32 years.
Wibaux	High	Wibaux	None
Yellowstone	High	Billings, Broadview, Laurel	Yellowstone County has reported experienced more hazardous materials incidents in the last 32 years than all other Eastern Region counties combined.

4.2.9 Landslide

Hazard/Problem Description

A landslide is a general term for a variety of mass movement processes that generate a downslope movement of soil, rock, and vegetation under gravitational influence. Landslides are a serious geologic hazard common to almost every state in the United States. It is estimated that nationally they cause up to $2 billion in damage and 25 to 50 deaths annually.

Some landslides move slowly and cause damage gradually, whereas others move so rapidly that they can destroy property and take lives suddenly and unexpectedly. Gravity is the force driving landslide movement. Factors that allow the force of gravity to overcome the resistance of earth material to landslide movement include saturation by water, steepening of slopes by erosion or construction, alternate freezing or thawing, earthquake shaking, and volcanic eruptions.

Landslides are typically associated with periods of heavy rainfall or rapid snow melt and tend to worsen the effects of flooding that often accompanies these events. In areas burned by forest and brush fires, a lower threshold of precipitation may initiate landslides, rockfall or other geological events.

Landslides are defined as a rapid slipping of a mass of earth or rock from a higher elevation to a lower level under the influence of gravity and water lubrication. More specifically, rockslides are the rapid downhill

Natural Resources

Hazardous material incidents may affect a small area at a regulated facility or cover a large area outside such a facility. Widespread effects occur when hazards contaminate the groundwater and eventually a potential county or jurisdiction's water supply, or they migrate to a major waterway or aquifer. Impacts on wildlife and natural resources can also be significant. These types of widespread events may be more likely to occur during a transportation incident, such as a pipeline spill, and can have far reaching and devastating impacts on the natural environment and habitats if they occurred near one of the several wildlife refuges in the Eastern Region planning area.

Development Trends Related to Hazards and Risk

Future development is expected to increase the number of people potentially exposed to the impacts of hazardous materials incidents. The number of hazardous materials that are stored, used, and transported across the Region may continue to increase over the coming years if regional growth continues.

Risk Summary

The Eastern Region experiences multiple hazardous materials incidents each year, with different degrees of effect. Based on the history of past occurrences, there is a 100% chance that the Eastern Region will see a hazardous materials incident in any given year, however programs in place for fixed hazardous facilities minimize risk. The significance for hazardous material incidents overall is **Low.**

- Hazardous materials incidents can cause injuries, hospitalizations, and even fatalities to people nearby. In addition to the immediate health impacts of releases, a handful of studies have found long term health impacts such as increased incidence of certain cancers and birth defects among people living near certain chemical facilities.
- The impact of a fixed hazardous facility, such as a chemical processing facility is typically localized to the property where the incident occurs. The impact of a small spill maybe limited to the extent of the spill and remediated if needed.
- Potential losses can vary greatly for hazardous material incidents. For even a small incident, there are cleanup and disposal costs. In a larger scale incident, cleanup can be extensive and protracted.
- Yellowstone County has nine of these facilities, and Richland County has eight. These two counties possess over 40% of the RMP facilities within the study area.
- Related Hazards: Cyber- Attack, Human Conflict, Transportation Accidents

Table 4-38 Risk Summary Table: Hazardous Materials Incidents

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
Eastern Region	Low		
Big Horn	Medium	Hardin, Lodge Grass	Big Horn County experienced 101 hazardous materials incidents between 1990 and 2022. This accounts for 9% of the total incidents in the Eastern Region.
Carbon	Low	Bearcreek, Bridger, Joliet, Fromberg, Red Lodge	None
Carter	Low	Ekalaka	None
Custer	Low	Ismay, Miles City	None
Crow Tribe	Low		None
Daniels	Low	Scobey, Flaxville	Daniels County does not have gas or hazardous liquid pipelines within County limits and has not reported an NRC hazardous materials incident during the past 32 years.
Dawson	Low	Richey, Glendive	None

movement of large masses of rock with little or no hydraulic flow, similar to an avalanche. Water-saturated soil or clay on a slope may slide downhill over a period of several hours. Earthflows of this type are usually not serious threats to life because of their slow movement, yet they can cause blockage of roads and do extensive damage to property.

Geographical Area Affected

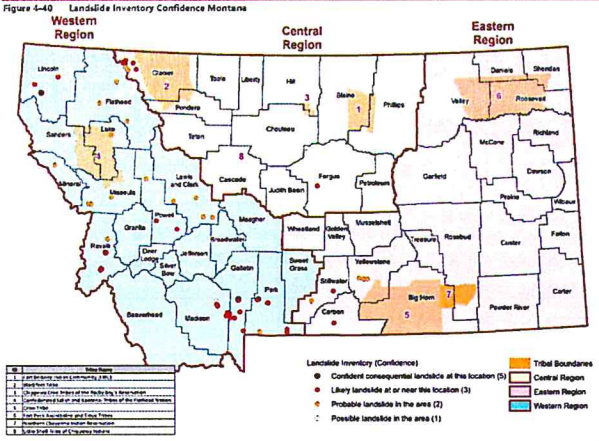
Areas that are generally prone to landslide hazards include existing old landslides, the bases of steep slopes, the bases of drainage channels, and developed hillsides where leach-field septic systems are used. Areas that are typically considered safe from landslides include areas that have not moved in the past, relatively flat-lying areas away from sudden changes in slope, and areas at the top or along ridges, set back from the tops of slopes.

While landslides are infrequent events in Montana, they have occurred. The Montana Department of Transportation (MDT) has spent substantial time stabilizing landslides throughout the State, focusing primarily on federal and State highways. The confidence of landslides ranges from probable to likely in the Eastern Region, as shown in Figure 4-40.

The Montana Bureau of Mines and Geology's (MBMG) Landslide Hazards Program aims to identify, map, and categorize areas across the State of Montana to better understand spatial distribution and causes of ground failure to help mitigate against landslide hazards. Figure 4-41 shows areas mapped by MBMG as susceptible to landslides, as well as areas where debris indicates landslide events have occurred in the last 100,000 and 250,000 years.

Eastern Montana, in contrast to Western Montana, which is more mountainous and elevated, is exposed to a lower landslide risk. Counties in the southern portion of the region like Carbon, Yellowstone, and Big Horn, where some tribal reservations are located, have more landslide areas mapped. There are also landslide areas mapped along the Missouri River valley within Garfield County. The Eastern Region's overall area affected is **limited.**

Figure 4-40 Landslide Inventory Confidence Montana



	Valley	flooding in the affected areas.

Frequency/Likelihood of Occurrence

Although historical landslide occurrence data is limited it can be assumed that these geological processes will continue to occur and result in an **occasional** likelihood of occurrence in the future. Landslides and expansive soils may typically occur most often during wet climate cycles or following heavy rains, but in certain areas of the study area. It is plausible to presume that destructive events have among a 10 and 100 percent chance of occurrence with the next year, or a recurrence interval of 10 years or less. Hence, landslides, rockfalls or debris flows are predicted to **occasionally** occur. Heavy periods of precipitation or substantial development could have an influence on slope strength. Characteristically, there is a landslide/rockfall "season" that correlates with enhanced freeze-thaw phases and wetter weather in the spring and summer.

Within the Eastern Region all 23 counties and three Indian Reservations have a Landslide Annualized Frequency of 0.01, except Yellowstone and Stillwater counties. Although this is the lowest risk rating that the NRI categorizes, landslides can still be a detrimental and unexpected natural hazard if not taken into proper account. The expected frequency results for the Eastern Region are shown in Figure 4-42 below.

Figure 4-41 Montana Hazard Mitigation Planning Region Landslides

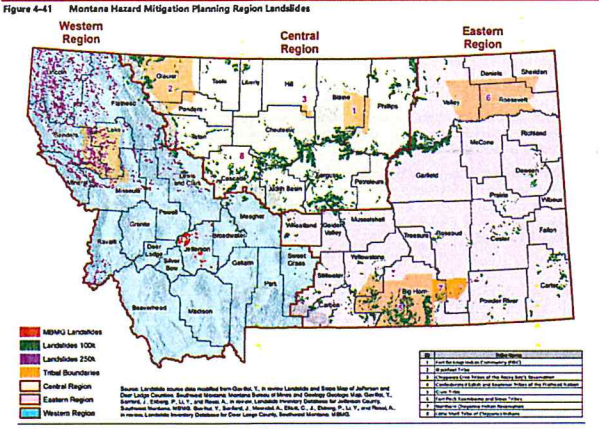
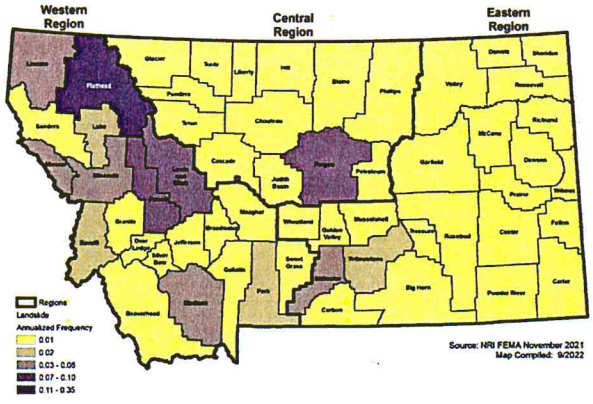


Figure 4-42 NRI Annualized Landslide Frequency Montana Eastern Region



Climate Change Considerations

Landslides or mudflows can be triggered by climatic events, especially periods of intense rainfall and runoff. Climate change appears to be increasing early spring rainfall (see Section 4.2.5 *Drought*, subsection *Climate Change Considerations*, especially Figure 4-19). This trend is likely to continue for the foreseeable future and could amplify landslide hazards.

In addition, the increased wildfire occurrence expands the area affected by burn scars. Burn scar areas are especially prone to landslide and debris flows. Soils in these areas can become hydrophobic and dramatically increase rainfall runoff at the same time that slopes lack vegetation to stabilize soils. While this process is well known and has led to disastrous flooding and debris flows in other areas, it is not clear that the issue has been explicitly studied in eastern Montana. This issue should be monitored in future HMPs.

Potential Magnitude and Severity

The extent of landslides and debris flow events within the Eastern Montana Region range from **negligible** to significant, depending on the event. While landslides and rockslides can result in the destruction of infrastructure such as roadways, water, and sewer lines, electrical and telecommunications utilities and drainage where they are present, the potential magnitude of landslides, rockfall and debris flows would typically be isolated in most counties in the region. However even a small, isolated event has potential to close state or US highways in the region that can result in long detours for days or weeks. With the added cost of detours, and the potential for life safety impacts, some landslides could have greater costs. There is relatively limited potential for complete destruction of buildings and death and injury from landslides and debris flow.

Landslides can be classified using the Alexander Scale, shown in Table 4-40. The scale is predicated on landslide debris impacting the built environment. Based on the history the highest extent level expected within the planning area is level 5 (Very Serious), but this is likely to be isolated to limited areas in where maintenance is limited and wooden buildings, roofs, or porches are collapsed or disconnected from foundations.

Table 4-40 Alexander Scale for Landslide Scale Damage

Level	Damage	Description
0	None	Building is intact
1	Negligible	Hairline cracks in walls or structural members; no distortion of structure or detachment of external architectural details
2	Light	Buildings continue to be habitable; repair not urgent. Settlement of foundations, distortion of structure, and inclination of walls are not sufficient to compromise overall stability.
3	Moderate	Walls out of perpendicular by one or two degrees, or there has been substantial cracking in structural members, or the foundations have settled during differential subsidence of at least 6 inches; building requires evacuation and rapid attention to ensure its continued life.
4	Serious	Walls out of perpendicular by several degrees; open cracks in walls; fracture of structural members; fragmentation of masonry; differential settlement of at least 10 inches compromising foundations; floors may be inclined by one or two degrees or ruined by heave. Internal partition walls will need to be replaced; door and window frames are too distorted to use; occupants must be evacuated, and major repairs carried out.
5	Very Serious	Walls out of plumb by five or six degrees; structure grossly distorted; differential settlement has seriously cracked floors and walls or caused major rotation or slewing of the building (wooden buildings are detached completely from their foundations).

Level	Damage	Description
		Partition walls and brick infill will have at least partly collapsed; roofs may have partially collapsed; outhouses, porches, and patios may have been damaged more seriously than the principal structure itself. Occupants will need to be re-housed on a long-term basis, and rehabilitation of the building will probably not be feasible.
6	Partial Collapse	Requires immediate evacuation of the occupants and the cordoning off of the site to prevent accidents with falling masonry.
7	Total Collapse	Requires clearance of the site.

Source: FEMA

The severity of landslides or rockslides depends on the amount of material (soil, debris, or rocks) moves and where it stops moving (e.g. on roadway). Although the extent of the hazard is geographically small, the severity of landslides and rockfalls can be critical with potential to cause severe injuries, shutdown transportation corridors to critical infrastructure, and damage property.

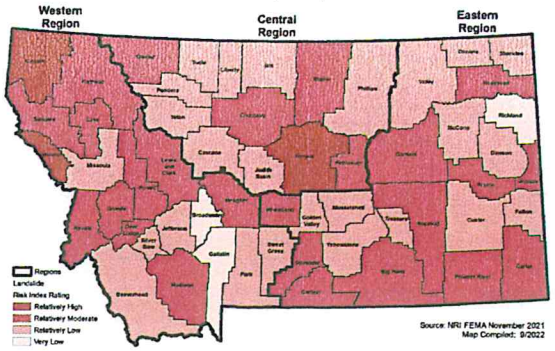
Vulnerability Assessment

The landslide *Vulnerability Assessment* identifies, or at least discusses, assets that are more likely to be exposed to landslide hazards and are susceptible to damage from that exposure. In this context, assets are (1) people, (2) property, (3) critical facilities and lifelines, (4) the economy, (5) historic and cultural resources, and (6) natural resources. Exposure indicates interacting with landslide hazards, and likely to be exposed indicates a presence in areas deemed to be especially likely to experience landslide hazards. Susceptible indicates a strong likelihood of damage from exposure to landslide hazards and is described in greater detail in Section 4.2.1, subsection titled *Vulnerability Assessment*. Finally, vulnerability under future conditions is considered as it relates to both climate change and development.

The role of climate change in future vulnerability to landslide is discussed above in the section titled, *Climate Change Considerations*, while the effect of future development is considered below in the section titled *Development Trends Related to Hazards and Risk*.

Detailed data are not available to identify or analyze specific structures, facilities, or people at risk of landslide. However, Figure 4-43 depicts the NRI risk index rating for landslide at a county level. Most of the Eastern Region is rated as a mixture of *relatively moderate* and *low*. The counties with a Landslide Risk Rating of *relatively moderate* are Big Horn, Carbon, Carter, Garfield, Powder River, Prairie, Roosevelt, Stillwater, and Wibaux counties. The Eastern Montana counties with a *relatively low* landslide risk rating are Carter, Daniels, Dawson, Fallon, Golden Valley, McCone, Musselshell, Sheridan, Treasure, Valley, and Yellowstone counties. The one county in the Eastern Region with a *low* rating is Richland County which borders North Dakota and contains more of a plains landscape.

Figure 4-43 Risk Index Rating for Landslide by County



People

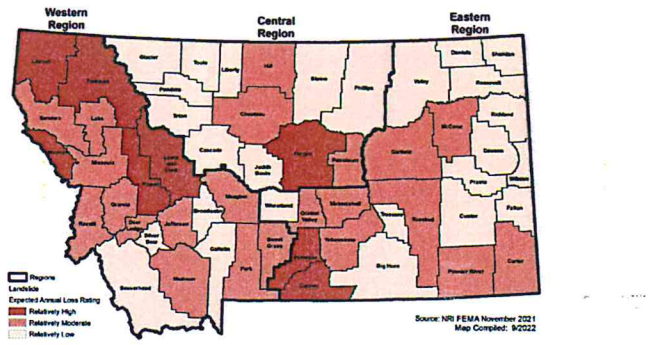
People living in, traveling through, or recreating in landslide areas are all potentially exposed to this hazard. There have been no recorded deaths or injuries due to landslides in Montana. However, people are conceivably susceptible to death or injury from these hazards, such as when traveling in a vehicle where rockfall has a higher confidence of occurring. The Eastern Region's elderly and people with disabilities and access and functional needs are both at greater risk to landslide hazards given it may be more difficult for these population groups to travel around a landslide hazard area during an event, such as finding an alternative route. This risk is also mostly likely to occur during spring or summer months following heavy rainfall and affect some of the more popular recreation areas in the Eastern Region, such as Yellowstone County and Carbon County. Overall, there is some vulnerability of people to landslide.

Property

Landslides are more known for damaging structures. This happens in two general ways: 1) disruption of structural foundations caused by differential movement and deformation of the ground upon which the structure sits, and 2) physical impact of debris moving downslope against structures located in the travel path. Landslides have been known to create temporary dams in some locations, partially or fully blocking rivers at the toe of the slide. These dams can subsequently burst as the pressure of the impounded water builds, leading to flood damage for structures and communities downstream as well.

Within the Eastern Region, NRI data indicates that Carbon and Stillwater counties have expected annual loss ratings due to landslides that are relatively high. This is followed by Carter, Garfield, McCone, Powder River, Rosebud, and Yellowstone counties have a relatively moderate estimation of annualized losses due to landslide damages. The other 12 counties in the Eastern Region have a relatively low expected annual loss to landslide hazards. The risk for each county in the Eastern Region is detailed in Figure 4-44 below.

Figure 4-44 NRI Expected Annual Loss Rating Montana Eastern Region



Critical Facilities and Lifelines

Transportation systems are usually the most unprotected critical facility type in the region to rockfall, landslide and debris flow incidents. Residents and visitors alike are impacted when roads are damaged by rockfall and landslides. The loss of transportation networks could potentially cause secondary damage to the overall region's infrastructure, including revenue, transportation availability, emergency response mechanisms and other essential capabilities by preventing the means of these resources from activating or moving between locations.

Pipelines and other buried infrastructure are notably susceptible to extension, bending, and compression caused by ground deformation. Failure of any component along the pipeline can result in failure to deliver service over a large region. Once broken, transmission of the commodity through the pipeline ceases, which can have catastrophic repercussions down the line: loss of power to critical facilities such as hospitals, impaired disposal of sewage, contamination of water supplies, disruption of all forms of transportation, release of flammable fuels, and so on. Therefore, the overall impact of pipeline failures, including secondary failure of systems that depend on pipelines, can be much greater than the impact of individual building failures.

Economy

Losses as a result of geologic hazards can result in economic damages sustained to buildings and property. These losses can also result in indirect losses, such as lowered property values in hazard exposure areas, the extended closing of businesses that are damaged, and as a result lost wages and revenue if workers are not able to go to work. Tourism can also be interrupted.

Historic and Cultural Resources

Landslides can damage or destroy historic or cultural sites, just like any other property. The biggest impact would likely be on older properties such as wooden or masonry buildings, though reinforced masonry structures would be much more resilient during these types of incidents.

Natural Resources

Landslides and other geologic hazards are considered a natural process; however, they can have varying impacts to the natural environment, with the potential to permanently alter the natural landscape. For example, landslide effects on the environment and natural resources could be very destructive depending on the size of the landslide event and secondary/cascading effects from an event (e.g., rockfall). Additionally, rockfalls to rivers can cause blockages causing flooding, damage rivers or streams, potentially harming water quality, fisheries, and spawning habitat. Also, hillsides that provide wildlife habitat can be lost for prolonged periods of time.

Development Trends Related to Hazards and Risk

In general, the Eastern Region has a lower risk for landslide and other geological hazards in comparison to the entire state of Montana. For most of the geologic hazards profiled, the greatest risk is along the Missouri River where geography makes processes such as landslides and mudflows more likely. As counties such as Glacier and Cascade see growth in population and housing units the exposure could increase as well unless careful consideration of landslide hazards is included in land use decisions. Steps to mitigate these risks should be taken as the Eastern Region accommodates future growth, such as mapping of hazard areas, adoption and enforcement of engineering and building codes for soil hazards, and ordinances to limit development on steep slopes.

Risk Summary

- Although historical landslide occurrence data is limited it can be assumed that these geological processes will continue to occur occasionally in the future but the overall risk to landslides is **low**.
- People exposed to landslide hazards are most at risk to death or injury from these hazards. This includes not only people residing in areas prone to landslides but also outdoor recreationists and travelers in the region.
- Within the Eastern Region, Carbon, and Stillwater both have an expected annual loss rating due to landslides of relatively high. Carbon and Stillwater counties has an expected annual loss rating due to landslides of relatively high. Meanwhile Carter, Garfield, McCone, Powder River, Rosebud, and Yellowstone counties have a relatively moderate estimation of annualized losses due to landslide damages.
- Losses as a result of geologic hazards can result in economic damages sustained to buildings and property.
- Transportation systems are usually the most unprotected critical facility type in the region to rockfall, landslide and debris flow incidents. Residents and visitors alike are impacted when roads are damaged by rockfall and landslides.
- Related Hazards: Earthquake, Floods, Severe Summer Weather, Wildfire

Table 4-41 Risk Summary Table: Landslide

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
Eastern Region	**Low**		None
Big Horn County	**Low**	Hardin, Lodge Grass	None
Carbon County	**Medium**	Bearcreek, Bridger, Joliet, Fromberg, Red Lodge	Unincorporated areas with greater topographical relief may be more susceptible.

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
Carter County	**Low**	Ekalaka	None
Custer County	**Low**	Ismay, Miles City	None
Crow Tribe	**Medium**		None
Daniels County	**Low**	Scobey, Flaxville	Daniels County has reported landslide events following heavy rain and flooding.
Dawson County	**Low**	Richey, Glendive	County has reported landslide events following heavy rain and flooding.
Fallon County	**Low**	Plevna, Baker	None
Garfield County	**Low**	Jordan	None
Golden Valley County	**Low**	Ryegate, Lavina	None
McCone County	**Low**	Circle	None
Musselshell County	**Low**	Melstone, Roundup	None
Powder River County	**Medium**	Broadus	None
Prairie County	**Low**	Terry	None
Richland County	**Low**	Fairview, Sidney	None
Roosevelt County	**Low**	Wolf Point, Poplar, Bainville, Culberson, Froid	None
Rosebud County	**Low**	Colstrip, Forsyth	None
Sheridan County	**Low**	Plentywood, Medicine Lake, Outlook, Westby	None
Stillwater County	**Medium**	Columbus	None
Treasure County	**Low**	Hysham	None
Valley County	**Low**	Glasgow, Fort Peck, Nashua, Opheim	None
Wibaux County	**Medium**	Wibaux	None
Yellowstone County	**Low**	Billings, Broadview, Laurel	Unincorporated areas of with more topography to the southwest may be more susceptible to landslides.

4.2.10 Severe Summer Weather

Hazard/Problem Description

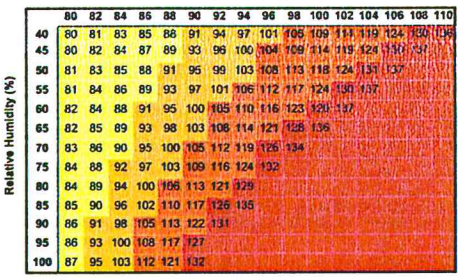
For this plan, severe summer weather in Montana includes extreme heat events, hail, heavy rain, and lightning. A brief description of these weather phenomena is presented below. More information on thunderstorm winds, high winds, and microbursts can be found in 4.2.13 Tornadoes & Windstorms.

Extreme Heat

Extreme heat occurs from a combination of high temperatures (significantly above normal) and high humidity. At certain levels, the human body cannot maintain proper internal temperatures and may experience heat stroke. The NWS heat index (Figure 4-45) is a measure of what the temperature feels like to the human body when relative humidity is combined with the air temperature, in shade conditions. In most of the United States, extreme heat is defined as a long period (2 to 3 days) of high heat and humidity with temperatures above 90 degrees. It is generally a prolonged period of excessively hot weather when temperatures are above average. Montana has less extreme heat risks than most of other states, and MT DES defines extreme heat when there are approximately five days per year of dangerous heat events that can lead to heat-related illnesses and death to vulnerable populations. In extreme heat, evaporation is

slowed and the body must work extra hard to maintain a normal temperature. This can lead to health impacts by overworking the human body. Extreme heat often results in the highest number of annual deaths among all weather-related hazards.

Figure 4-45 NWS Heat Index and Potential for Health Effects



Likelihood of Heat Disorders with Prolonged Exposure and/or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Image adapted from https://www.weather.gov/ama/heatindex

Note: Heat index values shown here are for shady locations. Exposure to direct sunlight can increase these values by up to 15°F.

Hail

Hail forms when updrafts carry raindrops into extremely cold areas of the atmosphere where the drops freeze into ice. Hail falls when it becomes heavy enough to overcome the strength of the updraft and is pulled by gravity towards the earth. The process of falling, thawing, moving up into the updraft and refreezing before falling again may repeat many times, increasing the size of the hailstone. The severity of hail is often measured in inches and referred to by objects of similar size (Table 4-42). Hailstones are usually less than two inches in diameter but have been reported much larger and may fall at speeds of up to 120 mph. Severe hail is classified as hail 1-inch in diameter or large. Hail is typically associated with thunderstorms and occurs in the summer months in the Eastern Region.

Table 4-42 Hail Diameter and Common Description

Hail Diameter (inches)	Object Analog Reported
0.50	Marble, moth ball
0.75	Penny
0.88	Nickel
1.00	Quarter
1.25	Half dollar

Hail Diameter (inches)	Object Analog Reported
1.50	Walnut, ping pong ball
1.75	Golf ball
2.00	Hen egg
2.50	Tennis ball
2.75	Baseball
3.00	Tea cup
4.00	Softball
4.50	Grapefruit

Data attained from https://www.spc.noaa.gov/misc/tables/hailsize.htm

Heavy Rain

Heavy rain is typically associated with thunderstorm conditions and can result in flash flooding. Rainfall severity is typically measured in inches of rainfall or inches or rainfall per hour. In Central Montana, more than 0.1" of rain per hour is considered moderate, and more than 0.3" per hour is considered heavy rain. The reviewed history of heavy rain events in the Eastern Region of Montana mentions roads and ditches being flooded due to heavy rains, but there was no repeated location given in the dataset. On occasion, heavy rains and melting snow have been reported to cause ice jams and flash flooding. It is rarely reported that flash floods cause an accumulation of water in structures in the planning area.

Lightning

Lightning is an electrical discharge that results from the buildup of positive and negative charges within a thunderstorm and the earth's surface. When the buildup becomes strong enough, lightning appears as a "bolt." This visible electrical discharge produced by a thunderstorm can occur within or between clouds, between the cloud and air, between a cloud and the ground or between the ground and a cloud. Cloud-to-ground lightning is the most damaging and dangerous type of lightning, though it is also less common. It frequently strikes away from the rain core, either ahead or behind the thunderstorm, and can strike 5-10 miles from the storm in areas that most people do not consider to be a threat. Lightning's electrical charge and intense heat can electrocute on contact, split trees, ignite fires, and cause electrical failures. The severity of lightning can be measured on a scale of lightning activity level (Table 4-43).

Table 4-43 Lightning Threat Levels

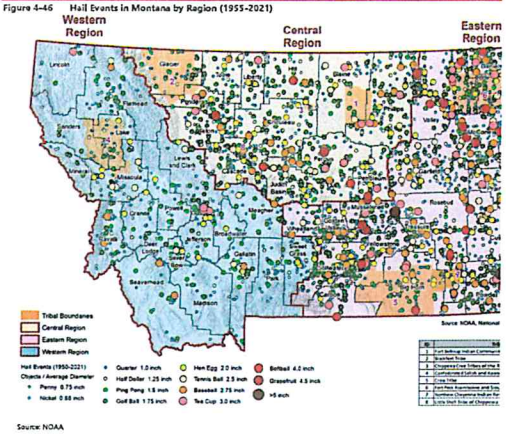
Lightning Threat Level	Threat Level Descriptions
Extreme	**"An Extreme Threat to Life and Property from Lightning."** • Within 12 miles of a location, a moderate likelihood of CG lightning (or 50% thunderstorm probability), with storms capable of excessive CG lightning. • AND/OR...a high likelihood of CG lightning (or 60% to 70% thunderstorm probability), with storms capable of frequent CG lightning. • AND/OR...a very high likelihood of CG lightning (or 80% to 90% thunderstorm probability), with storms capable of occasional CG lightning.
High	**"A High Threat to Life and Property from Lightning."** • Within 12 miles of a location, a low likelihood of CG lightning (or 30% to 40% thunderstorm probability), with storms capable of excessive CG lightning. • AND/OR...a moderate likelihood of CG lightning (or 50% thunderstorm probability), with storms capable of frequent CG lightning.

Lightning Threat Level	Threat Level Descriptions
	• AND/OR...a high likelihood of CG lightning (or 60% to 70% thunderstorm probability), with storms capable of occasional CG lightning.
Moderate	**"A Moderate Threat to Life and Property from Lightning."** • Within 12 miles of a location, a very low likelihood of CG lightning (or 10% to 20% thunderstorm probability), with storms capable of excessive CG lightning. • AND/OR...a low likelihood of CG lightning (or 30% to 40% thunderstorm probability), with storms capable of frequent CG lightning. • AND/OR...a moderate likelihood of CG lightning (or 50% thunderstorm probability), with storms capable of occasional CG lightning.
Low	**"A Low Threat to Life and Property from Lightning."** • Within 12 miles of a location, a very low likelihood of CG lightning (or 10% to 20% thunderstorm probability), with storms capable of frequent CG lightning. • AND/OR...a low likelihood of CG lightning (or 30% to 40% thunderstorm probability), with storms capable of occasional CG lightning.
Very Low	**"A Very Low Threat to Life and Property from Lightning."** • Within 12 miles of a location, a very low likelihood of CG lightning (or 10% to 20% thunderstorm probability), with storms capable of occasional CG lightning.
Non-Threatening	**"No Discernable Threat to Life and Property from Lightning."** • Within 12 miles of a location, environmental conditions do not support CG lightning.

Note:

- With cloud-to-ground (CG) lightning, every strike is potentially lethal
- Occasional - CG lightning at the rate of 1 to 3 flashes per minute
- Frequent - CG lightning at the rate of 4 to 11 flashes per minute
- Excessive - CG lightning rate of 12 flashes or more per minute

Figure 4-46 Hail Events in Montana by Region (1955-2021)



Source: NOAA

Geographical Area Affected

The geographic extent of summer weather is **extensive**. The entire Eastern Region is vulnerable to experiencing severe summer weather, but there are regional variations apparent when looking at the frequency of events. Some types of hazards, such as extreme heat events, occur on a regional scale and typically impact several or all counties in the Eastern Region planning area at once. Other hazards, such as lightning, hail, and heavy rain, impact more local areas. Lightning tends to strike a single point and it is rare for lightning to strike people or property multiple times in one storm event. Hail and heavy rain generally occur in small pockets of an accompanying storm. Figure 4-46 below shows the history of hail events in the Eastern Region.

Past Occurrences

The National Centers for Environmental Information (NCEI) database was used to gather information on historic severe summer weather events in the Eastern Region of Montana. The NCEI data is a comprehensive list of oceanic, atmospheric, and geophysical data across the United States and aggregated by county and zone. It is important to note that weather events that occurred on Crow Tribe and North Cheyenne Tribe are also included in the dataset tables down below. However, instead of individual records, tribal data records were grouped into the closest/nearest County.

The NCEI dataset contains information on hail events from 1955 to March of 2022, in addition to lightning, heavy rain, and excessive heat events from 1996 to March of 2022. Table 4-44 summarizes the data from NCEI. It is important to note that not all severe summer weather events get reported by the NCEI and losses are estimates, therefore, actual losses may be higher than those reported below. Based on this data, hail is the most frequently occurring and damaging severe summer weather event in the Eastern Region. Excessive heat and lightning events have resulted in casualties. Excessive heat events had no reported property or crop damages in the NCEI dataset.

Table 4-44 Summary of Losses by Hazard in the Eastern Region, 1996-2022

	Deaths	Injuries	Property Loss	Crop Loss	Days with Events	Total Events
Excessive Heat	1	0	-	-	4	7
Hail	0	5	$21,580,100	$ 31,954,000	1,008	5,062
Heavy Rain	0	0	$2,000	-	67	150
Lightning	5	12	$ 68,100	-	21	21
Total	**6**	**17**	**$ 31,650,200**	**$ 31,954,000**	**1,100**	**5,240**

Source: NCEI

There are variations in losses and frequency of hazards across the Eastern Region. According to the NCEI database, Yellowstone and Valley counties experienced significantly more hail events than the rest of the planning area. Valley County also experienced the greatest number of reported heavy rain events in the planning area, followed by Carbon County. Twelve counties have reported previous lightening events. Six counties have documented excessive heat events. Table 4-45 and Figure 4-47 display the summary of total severe weather events by county.

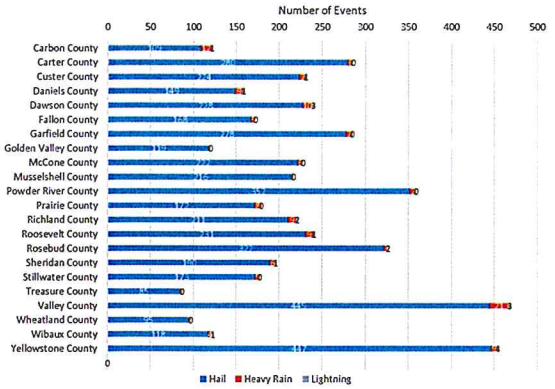
Table 4-45 Summary of Severe Summer Weather Events by County in the Eastern Region, 1996-2022

	Excessive Heat	Hail	Heavy Rain	Lightning
Big Horn	-	228	5	1
Carbon	-	109	12	1
Carter	-	280	6	0
Custer	-	224	7	1
Daniels	1	149	9	1
Dawson	2	228	10	3
Fallon	-	168	5	0
Garfield	1	278	7	0
Golden Valley	-	119	1	0
McCone	-	222	6	0
Musselshell	-	216	1	0
Powder River	-	352	7	0
Prairie	-	172	8	0
Richland	1	211	9	2

	Excessive Heat	Hail	Heavy Rain	Lightning
Roosevelt	1	231	9	1
Rosebud	-	322	3	2
Sheridan	-	190	6	1
Stillwater	-	173	5	0
Treasure	-	85	2	0
Valley	1	445	21	3
Wheatland	-	95	2	0
Wibaux	-	118	4	1
Yellowstone	-	447	5	4
Total	**7**	**5,062**	**150**	**21**

Source: NCEI

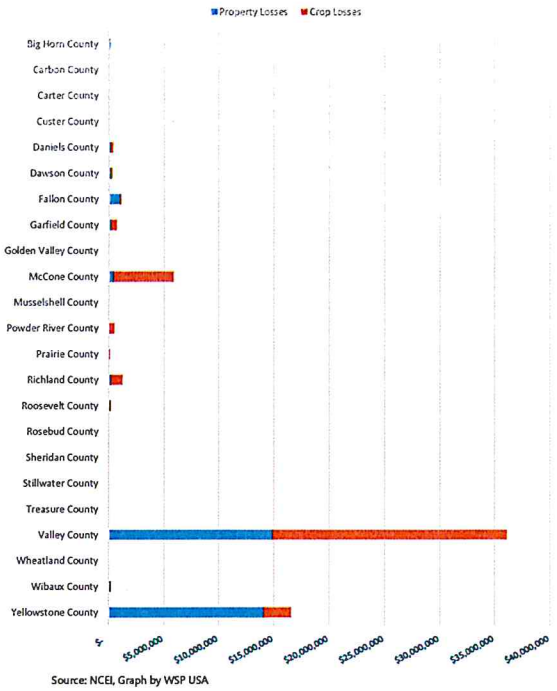
Figure 4-47 Summary of Severe Summer Weather Events by County in the Eastern Region



Source: NCEI, Graph by WSP USA

There are also variations between counties in the Eastern Region in terms of losses from severe summer weather events. A summary of losses reported by the NCEI dataset by county is displayed in Table 4-46 and Figure 4-48. Based on this data, Valley County has experienced both the greatest property loss and crop loss from severe summer weather events. All crop losses and nearly all property losses are due to hail events in the Eastern Region. There have also been 17 reported injuries due to hail and lightning, and five deaths due to lightning in the Eastern Region.

Figure 4-48 Summary of Severe Summer Weather Events by County in the Eastern Region



Source: NCEI, Graph by WSP USA

The NCEI dataset reports details on several of the severe summer weather events in the Eastern Region:

- July 4, 1998 (Yellowstone County): Several reports of hail up to 1.75 inches in diameter were reported in and around Billings from spotters, amateur radio operators and law enforcement. The hail severely

Table 4-46 Summary of Losses by County in the Eastern Region

	Deaths	Injuries	Prop. Loss	Crop Loss
Big Horn	1	0	$115,000	0
Carbon	1	0	0	0
Carter	0	0	$5,000	0
Custer	1	0	$500	0
Daniels	0	0	$156,000	$230,000
Dawson	1	1	$154,000	$168,000
Fallon	0	0	$1,055,000	$55,000
Garfield	0	1	$183,000	$555,000
Golden Valley	0	0	0	0
McCone	0	3	$419,100	$5,455,000
Musselshell	0	0	0	0
Powder River	0	0	$15,000	$505,000
Prairie	0	0	$16,000	$85,000
Richland	0	4	$152,000	$1,100,000
Roosevelt	0	1	$138,500	$60,000
Rosebud	0	3	$31,000	$5,000
Sheridan	0	0	$42,000	$25,000
Stillwater	0	0	$5,000	0
Treasure	0	0	0	0
Valley	0	2	$14,902,600	$21,206,000
Wheatland	0	0	$5,000	0
Wibaux	0	0	$170,000	$5,000
Yellowstone	1	2	$14,085,500	$2,500,000
Total	**5**	**17**	**$31,650,200**	**$31,954,000**

Source: NCEI

damaged several cars and roofs. The hail also caused heavy damage to crops in the Billings area. The property and crop losses of this event were $4,000,000 and $1,000,000 respectively.

- July 31, 1998 (Yellowstone County): Numerous observations of large hail were reported by spotters, amateur radio operators and NWS personnel. The hail damaged several vehicles in the Billings area, and also caused heavy damage to crops. This event resulted in $8,000,000 of property losses and $1,000,000 of crop losses.
- June 25, 1999 (Custer County): A 14-year-old boy was struck and killed by lightning while standing on a front tire of a tractor in a field.
- May 16, 2001 (Rosebud County) Three men suffered minor injuries when lightning struck their truck as they were crack sealing on Interstate 94.
- June 16, 2007 (Valley County): During the late afternoon and evening of June 16, 2007, a high precipitation supercell thunderstorm tracked from across northern Montana, just to the north of a warm front. This was the most devastating hailstorm to affect the area since at least 199- and prompted 22 severe thunderstorm and 6 tornado warnings in Glasgow county warning area. Properties such as homes, vehicles and businesses suffered severe damage. Trees were uprooted. Horses and cattle were injured by hail and wind, so were wildlife such as birds and small animals. Acres of crops such as alfalfa, wheat and corn were also completely destroyed. This event results in $8,000,000 of property losses and $15,000,000 of crop losses. According to the NCEI database, the overall estimated damage in this event, including hail and wind damage, as well as the subsequent flooding, is estimated to be $34.2 million.
- June 16, 2010 (Valley County): A strong system ejecting out of the central Rockies brought heavy rainfall and severe thunderstorms to the area during the evening. This episode produced an EF1 tornado in northern McCone County and a microburst in eastern Roosevelt County that killed one person near Froid, Montana. This event also caused $2,000 of property damage.

Frequency/Likelihood of Occurrence

The frequency of severe summer weather events in the Eastern Region is ranked as **highly likely**. All counties in the planning area are likely to experience a severe summer hazard yearly. Since 1955, 5,240 severe summer weather events over 1,100 days have been recorded in the Eastern Region. As discussed above, there are variations in frequency and severity of damage from severe summer weather across the Eastern Region. Several few counties in the Eastern Region, including counties of Valley, Powder River, Yellowstone, Rosebud, Carter, and Garfield had highest exposure to severe weather in the 2018 SHMP. As shown above in the NCEI data demonstrated, Valley and Yellowstone Counties experience a higher frequency of reported events than the rest of the counties in the Eastern Region.

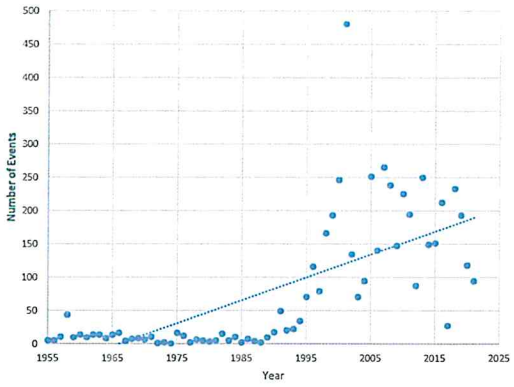
Extreme heat is uncommon in the Eastern Region. In the 27 years from 1996-20222, one extreme heat event has occurred in five counties in the Eastern Region: Daniels, Garfield, Richland, Roosevelt, and Valley counties. Only Dawson County has experienced two extreme heat events in the same time period. All of these counties are in the northern end of the Eastern Region. It is probable that extreme heat is most likely to occur in the northern part of the Eastern Region.

While there is some variation between counties in Eastern Region, all counties are likely to experience at least one hail event per year. Counties such as Wheatland and Treasure averages less than two extreme hail events per year, while some counties, such as Yellowstone and Valley Counties, average more than six hail events per year. Figure 4-49 displays the trend of hail events by year in the Eastern Region from 1955 to 2021, showing a sharp increase in hail events in recent years.

Heavy rain events occur in all Eastern Region Counties. The frequency of heavy rain events ranges from once per 26 years (Golden Valley and Musselshell Counties) to once per 1.2 years (Valley County). Valley County experiences nearly twice as many heavy rainfall events (1996-2022) than any other county in the region (Table 4-45).

All parts of the Eastern Region experience lightning, though only six counties have reported damaging lightning events from 1996-2022 and none has reported more than two damaging lightning events in this 26-year period (Table 4-45). This could indicate a trend in the lightning hazard, or perhaps inconsistent and incomplete reporting of lightning events in the NCEI database.

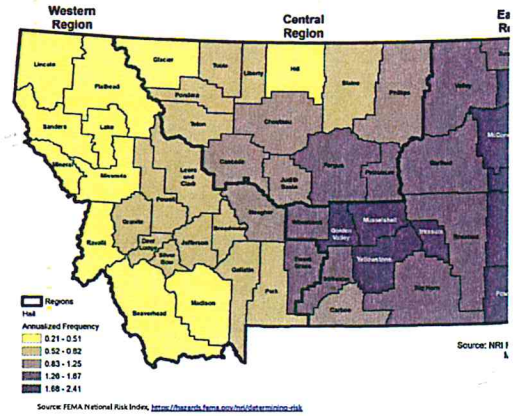
Figure 4-49 Hail Events by Year in the Eastern Region (1955-2021)



Source: NCEI, Chart by

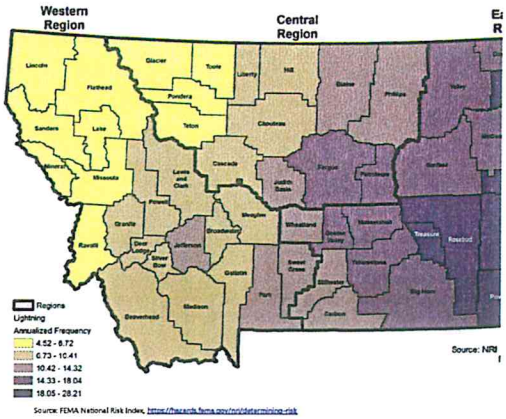
The figures below depict annualized frequency of hail and lightning at a county level based on the NRI. The NRI data shows dramatically higher hail frequency throughout the Eastern Region compared to the Western and Central Regions. This difference between regions is confirmed in the NCEI data charted in Figure 4-49, when compared to equivalent figures in the Central Region and Western Region base reports.

Figure 4-50 NRI Annualized Frequency of Hail Events by County



Source: FEMA National Risk Index, https://hazards.fema.gov/nri/determining-risk

Figure 4-51 NRI Annualized Frequency of Lightning Events by County

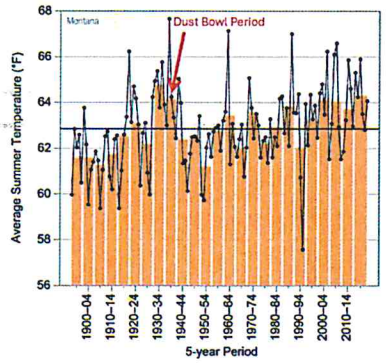


Source: FEMA National Risk Index, https://hazards.fema.gov/nri/determining-risk

Climate Change Considerations

The planning area is warming due to climate change and even conservative estimates indicate the trend will continue and even accelerate in the future. Increasing exposure to extreme heat is described as the greatest concern for human health in the 2021 Montana Climate Change and Human Health study. This study documented statewide average temperatures have increased 2-3 °F from the 65-year period from 1950-2015 and are projected to increase 4-6 °F by 2069 relative to average temperatures 1971-2000, roughly 85 years of warming. The Montana Climate Change and Human Health study provides state-wide estimates, but states that changes between climate divisions are slight. Seasonally, temperature increases were greatest in summer and winter (Figure 4-52), with August having the greatest average temperature increase in all climate divisions.

Figure 4-52 Observed Average Summer Temperature, 1895-2020



Dots represent summer average temperature for a specific year. Bars are 5-year averages of summer temperature.
Black horizontal line is the average summer temperature for all years, 1895-2020.
Figure adapted from: 2022 NOAA State Climate Summaries, Montana. https://statesummaries.ncics.org/chapter/mt/

Exposure to extreme heat will increase due to climate change, heat-related health impacts will increase, but it is useful to keep the situation in perspective; the fifth National Climate Assessment notes that extreme heat in the Northern Great Plains region remains modest relative to much of the country. The NRI rates the planning area as having a *relatively low* or *very low* risk of Heat Wave impacts for current conditions. Even under future warming scenarios, it appears unlikely the NRI ratings will change dramatically.

Hail is presently a relatively low impact hazard according to the National Risk Assessment and little is known about how it will be affected by climate change. The 2022 NOAA Climate Summary for Montana acknowledges that hail exists in Montana. The Fifth National Climate Assessment includes projections of

large hail increasing in frequency and season length throughout the Northern Great Plains. The 2021 Montana Climate Change and Human Health report mentions hail three times, acknowledging it exists, that it can damage crops, and that the link between severe summer storms and climate change is not well understood or easily predicted, though there is a solid physics-based linkage between the two. Hail can be an extremely damaging hazard and the linkages with climate change are worthy of monitoring in future HMP updates.

To date, climate change has not increased the frequency or severity of heavy rain and it is unclear if it will in the future. Increasing rainfall intensity is a commonly cited impact of climate change. However, neither the 2021 Montana Climate Change and Human Health study, the Fifth National Climate Assessment, or NOAA's 2022 Climate Summary address rainfall (or hail) intensity directly. As described in Section 4.2.7 *Flooding*, subsection *Climate Change Considerations*, multiple sources document spring rainfall has increased slightly in total amount and/or is projected to increase substantially in the future. However, none of these sources document an observed or projected climate-change caused increase in heavy rainfall.

Lightning is another summer-weather hazard that is relatively modest in scale. The NRI rates counties in the planning area either *relatively low* or *very low* for lightning risk. There are presently no data or studies that document lightning is increasing in the planning area. Likewise, no projections exist to suggest the hazard is likely to increase or decrease in the future due to climate change. The 2022 NOAA Climate Summary acknowledges that lightning exists. The Fifth National Climate Assessment mentions lightning once, as a potential source of ignition for wildfire. The 2021 Montana Climate Change and Human Health study states both that lightning exists in the planning area and that it is a potential source of ignition of wildfire.

Potential impacts of severe summer weather hazards are discussed in the Vulnerability subsection of this hazard profile, as well as the impacts of population changes and development trends. Current variability in vulnerability by jurisdiction, based on existing conditions, is discussed in these sections and jurisdictional annexes. Due to the uncertainty with climate change on severe summer weather, it is not possible to define with further specificity the impacts and variability related to climate change on each jurisdiction within the Region. Future updates to this plan should revisit this topic as scientific knowledge progresses and note any trends that emerge.

Potential Magnitude and Severity

As mentioned in the 2018 SHMP, severe summer weather can cause damage to buildings, homes, and other property but rarely cause death, serious injury, or long-lasting health effects. Straight-line winds are responsible for most thunderstorm damage. The NWS reports that severe summer weather has caused $51.5 million in property damage and $26.3 million in crop damage over the past 60 years in the State. Eight deaths and 31 injuries were attributed to lightning strikes. Across the country, large hail results in nearly $1 billion in damage annually to property and crops. In the Eastern Region alone, 6 fatalities, 17 injuries, $31,650,200 in property damages, and $31,954,000 crop damages have been recorded since 1955.

The individual scales for each severe summer weather hazards are summarized in the beginning of this chapter.

Vulnerability Assessment

The severe summer weather *Vulnerability Assessment* identifies, or at least discusses, assets that are in a high hazard area for severe summer weather and are susceptible to damage from that exposure. In this context, assets are (1) people, (2) property, (3) critical facilities and lifelines, (4) the economy, (5) historic and cultural resources, and (6) natural resources. Exposure indicates interacting with severe summer weather hazards, and likely to be exposed indicates a presence in areas deemed to be

especially likely to experience severe summer weather hazards. Susceptible indicates a strong likelihood of damage from exposure to severe summer weather hazards and is described in greater detail in Section 4.2 *Hazard Profiles*, subsection 4.2.1 *Profile Methodology*, subsection *Vulnerability Assessment*. Finally, vulnerability under future conditions is considered above as it relates to climate change and below as it relates to development.

Figure 4-53 and
Figure 4-54 illustrates the relative Risk Index (RI) rating to hail and lightning events for Montana counties based on data in the NRI. The RI calculation takes into account various factors, including the expected annual losses from these events, social vulnerability, and community resilience in each county across Montana. Most counties in the region have a very low to moderate rating; none have a high or very high RI rating.

Figure 4-53 NRI Risk Index Rating for Hail

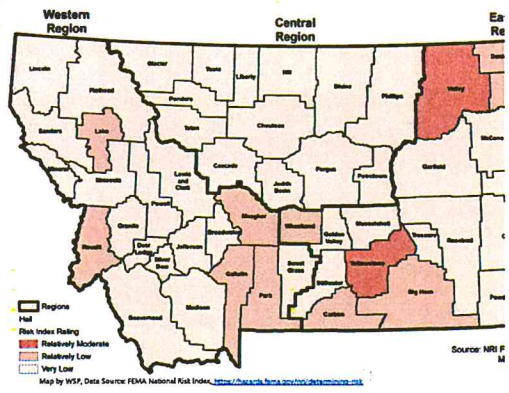
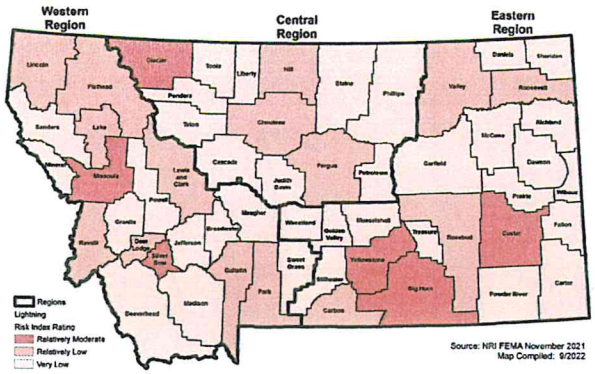


Figure 4-54 NRI Risk Index Rating for Lightning



Source: FEMA National Risk Index, https://hazards.fema.gov/nri/determining-risk

be unable to drive to work due to flash flooding or extreme hail events. These will result in disruption in local economies.

Figure 4-55 and Figure 4-56 illustrate the relative risk of Expected Annual Loss (EAL) rating due to hail and lightning for Montana counties based on data in the NRI. For hail, most counties in the region have a very low to relatively low EAL rating. Yellowstone has a relatively moderate rating. For lightning, the majority of the Counties have a very low to relatively low rating. Big Horn and Custer Counties have a relatively moderate rating. Yellowstone County has a relatively high rating. For The EAL calculation takes into account agriculture value exposed to hail and lightning, annualized frequency for hail and lightning, and historical losses.

All people are potentially susceptible to injury or possibly death from summer weather. Some groups, such as the elderly, young children, outdoor workers, and people with respiratory illnesses or weakened immune systems are typically the most susceptible to especially extreme heat, especially if they lack access to air conditioning or do not have adequate breaks for water and to refuel. Outdoor enthusiasts and workers are most likely to be caught outdoors and exposed to hail and lightning; this may include outdoor workers on farms or working in the oil and gas fields in the far eastern portion of the Eastern Region. Young children playing outdoors are also a concern. Lastly, unhoused persons are more vulnerable to heavy rain, especially if they inhabit floodplain areas prone to flash flooding. Most of the planning participants noted that severe summer weather events do have greater impacts on their seniors, young children, outdoor workers, and individuals with health conditions.

Property

Individual storms have a limited extent, but over time all outdoor property is likely to be exposed to heavy rain, extreme heat, and hail. Lightning typically strikes the highest objects in an area but can cause hazardous power surges that extend much further. Lightning strikes can also start fires. The secondary effects of fire are discussed in the section below titled *Wildfire*.

Some property is especially susceptible to damage. Houses and cars have a reputation for receiving expensive-to-repair damage from hail events. Electrical equipment is often susceptible to the effects of lightning far from the strike location. Lightning can cause power outages with potentially serious secondary effects.

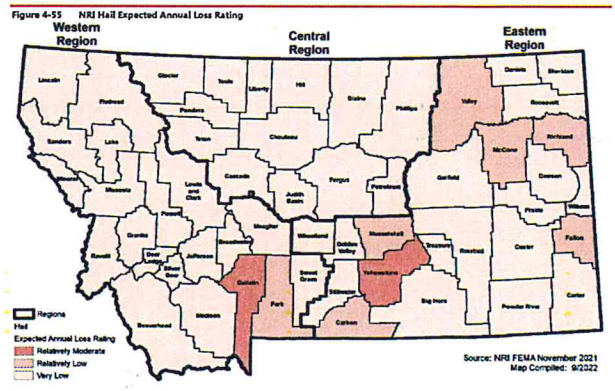
Susceptibility of property to heat and heavy rain is less of a problem in the planning area. Heat can expand metal and cause problems with infrastructure. Heavy rain can damage foundations, especially where water is allowed to accumulate near a foundation rather than being channeled away. Secondary effects of heavy rain include flash flooding and are discussed in the section above titled *Flooding*. Despite the hazards of heat and heavy rain, there are no reported property damages from excessive heat or heavy rain in the planning area.

Critical Facilities and Lifelines

All infrastructure and critical facilities located outdoors are similarly exposed to heat and hail. Lightning typically strikes the highest objects in an area but can cause hazardous power surges that extend throughout electrical circuits.

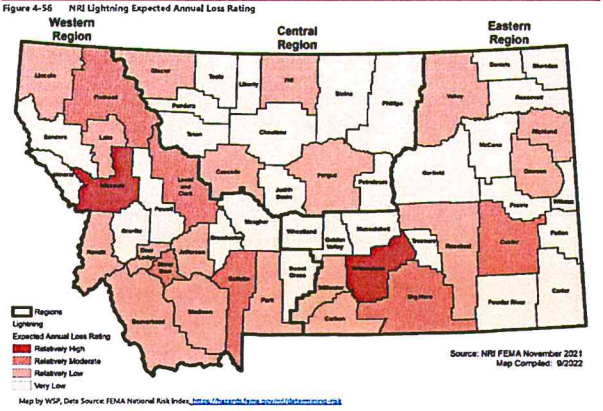
Infrastructure can be susceptible to damage from extreme heat. Heat expands roadbuilding materials and can cause road surfaces to crack. Power infrastructure is especially susceptible to heat. Heat expands above-ground power lines, causing them to lengthen and sag. Sagging power lines are a well-known fire hazard and were at least partially at fault for recent catastrophic fires in California and Colorado. A mitigation technique in certain states is to simply turn off power distribution during these times. Heat also reduces the efficiency of power generation, transmission, and distribution. This happens at the same time that demand peaks due largely to the increased use of air conditioners. The result of this puts stress on the power delivery system. The full range of heat effects on power infrastructure is complex and far reaching.

Figure 4-55 NRI Hail Expected Annual Loss Rating



Source: FEMA National Risk Index, https://hazards.fema.gov/nri/determining-risk

Figure 4-56 NRI Lightning Expected Annual Loss Rating



Map by WSP, Data Source: FEMA National Risk Index, https://hazards.fema.gov/nri/determining-risk

Fallon	Medium	Plevna, Baker	None
Garfield	Medium	Jordan	None
Golden Valley	Medium	Ryegate, Lavina	None
McCone	Medium	Circle	A higher number of weather-related events have occurred in McCone County.
Musselshell	Medium	Melstone, Roundup	None
Powder River	High	Broadus	None
Prairie	High	Terry	None
Richland	Medium	Fairview, Sidney	None
Roosevelt	Medium	Wolf Point, Poplar, Bainville, Culberson, Froid	None
Rosebud	Medium	Colstrip, Forsyth	None
Sheridan	Medium	Plentywood, Medicine Lake, Outlook, Westby	None
Stillwater	Medium	Columbus	None
Treasure	Medium	Hysham	None
Valley	Medium	Glasgow, Fort Peck, Nashua, Opheim	A higher number of weather-related events have occurred in Valley County.
Wibaux	High	Wibaux	None
Yellowstone	High	Billings, Broadview, Laurel	A higher number of weather-related events have occurred in Yellowstone County; newer development built to code is better designed to withstand severe summer weather.

4.2.11 Severe Winter Weather

Hazard/Problem Description

Severe winter weather presents one of the greatest threats to life of any hazard in Montana. Statistics on winter deaths are difficult to obtain, but nationwide there are on average 100 lives directly and indirectly lost to winter weather, more than lightning, hurricanes, or tornadoes. Winter storms are considered to be deceptive killers because most deaths are indirectly related to the storm. People die in traffic accidents on snow- or ice-covered roads, from hypothermia due to prolonged exposure to cold, and from heart attacks due to overexertion.

Winter storms may be categorized as blizzards, heavy snow, ice storms, winter storms, and winter weather. These storms vary in size and intensity and may affect a small part of the state or several states at once. The NWS defines common winter storm characteristics as follows:

Natural Resources

Vegetation such as trees, crops, and landscape are vulnerable to extreme heat events. Similarly, hail has been documented to cause significant crop damage in the planning area and was also documented to break branches off trees. The most significant crop damages reported by the NCEI occurred in Yellowstone and Valley counties. Lightning has also been documented to strike trees and cause fires, which can impact vegetation and crops.

Development Trends Related to Hazards and Risk

There are no clear trends that recent development has changed vulnerability to severe summer weather. Nor is it evident that future development changes will affect vulnerability to severe summer weather. In most cases existing development in older and more rural towns will continue to be more susceptible to weather hazards. Whereas new development that is built to current code should be better designed to withstand the effects of severe summer weather.

Risk Summary

- The hazard significance of severe summer weather (excessive heat, hail, heavy rain, and lightning) in the Eastern Region is ranked as **high.**
- The entire Eastern Region can be impacted by severe summer weather; therefore, the geographic extent is rated as **extensive**
- 1,100 days of severe summer weather events occurred in the Eastern Region over the course of 67 years, from 1955 to March 2022. This averages roughly 16.4 days with severe summer event(s) per year; therefore, the probability of future occurrence is ranked as **highly likely.**
- Six deaths, 17 injuries, $31,650,200 in property damages, and $31,954,000 in crop damages occurred from severe weather events since 1955, therefore the potential magnitude is ranked as **critical.**
- People most vulnerable to severe summer weather events are children, the elderly, individuals with preexisting medical conditions, outdoor workers/enthusiasts, and people living in dense urban areas.
- All outdoor property is vulnerable to severe weather events. Properties and vehicles are most frequently reported as damaged property in the Eastern Region.
- Critical infrastructure such as roadways and electric equipment are especially vulnerable to severe summer weather. Power outages, house fires, and damages to vehicles have been documented by the NCEI dataset.
- Economic losses typically occur from severe hail events and associated cost of repairs from hail damage. Areas with high infrastructure, such as major cities, are more likely to experience economic damages from hail than urban areas due to greater quantity of property to be damaged.
- Related hazards: Drought, Wildfire. Wind & tornadoes

Table 4-47 Risk Summary Table: Severe Summer Weather

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences
Eastern Region	High		
Big Horn	Medium	Hardin, Lodge Grass	None

defines extreme cold varies in different parts of the country. In this plan, extreme cold is considered cold temperatures below zero that are sufficient to cause damage to property, crops, or people.

Heavy Snow: This generally means:

- Snowfall accumulating to 4" or more in depth in 12 hours or less; or
- snowfall accumulating to 6" or more in depth in 24 hours or less.
- In forecasts, snowfall amounts are expressed as a range of values, e.g., "8 to 12 inches." However, in heavy snow situations where there is considerable uncertainty concerning the range of values, more appropriate phrases are used, such as "...up to 12 inches..." or alternatively "...8 inches or more..."

Ice Storm: An ice storm is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. Significant accumulations of ice pull down trees and utility lines resulting in loss of power and communication. These accumulations of ice make walking and driving extremely dangerous.

Winter Storm: A winter weather event that has more than one significant hazard (i.e., heavy snow and blowing snow; snow and ice; snow and sleet; sleet and ice; or snow, sleet, and ice) and meets or exceeds locally/regionally defined 12 and/or 24-hour warning criteria for at least one of the precipitation elements. Normally, a Winter Storm would pose a threat to life or property.

Winter Weather: A winter precipitation event that causes a death, injury, or a significant impact to commerce or transportation, but does not meet locally/regionally defined warning criteria. A Winter Weather event could result from one or more winter precipitation types (snow, or blowing/drifting snow, or freezing rain/drizzle). The Winter Weather event can also be used to document out-of-season and other unusual or rare occurrences of snow, or blowing/drifting snow, or freezing rain/drizzle.

Geographical Area Affected

All counties in the Eastern Region are impacted by severe winter weather; therefore, the geographic extent of severe winter storms is ranked as **extensive.** The 2018 SHMP explains that the entire State is considered equally vulnerable to severe winter weather. Arctic cold fronts typically enter the state from the northeast and may cross the Continental Divide, affecting mainly the western portion of the State rather than the Eastern Region. Arctic fronts meeting wet maritime fronts often combine to cause heavy snowfall, which can occur in all parts of the State. The lowest temperatures are typically experienced in the northeast, whereas the heaviest snowfall most often occurs in the mountain region in the southwest portion of the Eastern Region.

Past Occurrences

The NCEI database was used to gather information on historic severe winter weather events in the Eastern Region of Montana. It is important to note that weather events that occurred on Crow Tribe and North Cheyenne Tribe are also included in the dataset tables down below. However, instead of individual records, tribal data records were grouped into the nearest County. The NCEI dataset contains information on severe winter weather events from 1996 to March of 2022. The specific hazards selected for severe winter weather consist of blizzard, cold/wind chill, heavy snow, ice storm, winter storm, and winter weather events.

Table 4-48 summarizes winter weather data from NCEI. Not all severe winter weather events get reported by the NCEI and losses are estimates, therefore actual losses may be higher than those reported below. Based on these data, winter storms are the most frequently occurring and damaging type of severe winter weather event in the Eastern Region. Heavy snow is another frequently occurring event in the Region. Blizzards, heavy snow, and winter storms are the only types of severe winter weather with documented property losses. Blizzards, cold/wind chill, winter storm and winter weather events have resulted in a total of 14 injuries and 13 deaths in the Eastern Region.

Table 4-48 Summary of Losses by Hazard in the Eastern Region

	Deaths	Injuries	Property Loss	Days with Events	Total Events
Blizzard	1	5	$1,792,000	68	307
Cold/Wind Chill	4	0	$0	93	397
Heavy Snow	2	4	$1,236,000	210	701
Ice Storm	0	0	$0	11	56
Winter Storm	3	1	$6,331,700	285	1,138
Winter Weather	5	7	$0	71	209
Total	**13**	**14**	**$9,359,700**	**738**	**2,808**

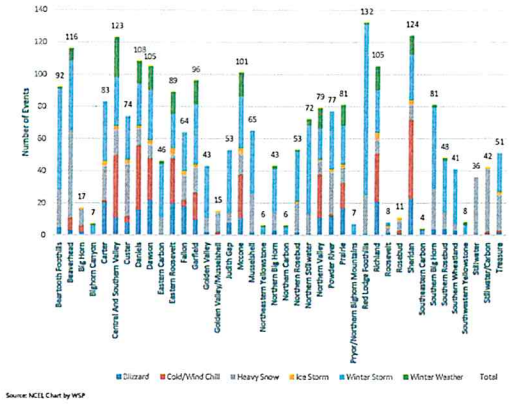
Source: NCEI

There are variations in losses and frequency of hazards across the Eastern Region. Due to the regional nature of severe winter storms, the NCEI records all severe winter weather events by zone rather than by county. The zones used by NCEI can extend over county lines, and many counties contain more than one zone. Table 4-49 and Figure 4-57 provides the total number of severe winter weather events by zone. Red Lodge Foothills Zone has the greatest number of events.

Table 4-49 Summary of Severe Winter Weather Events by Zone in the Eastern Region

Zone Name	Blizzard	Cold/ Wind Chill	Heavy Snow	Ice Storm	Winter Storm	Winter Weather	Total
Beartooth Foothills (Zone)	5	0	23	0	63	1	92
Beaverhead (Zone)	3	8	54	0	43	8	116
Big Horn (Zone)	2	4	10	1	0	0	17
Bighorn Canyon (Zone)	0	0	0	0	6	1	7
Carter (Zone)	21	1	21	3	37	0	83
Central and Southern Valley (Zone)	11	39	15	3	30	25	123
Custer (Zone)	8	4	32	3	27	0	74
Daniels (Zone)	16	40	10	2	26	14	108
Dawson (Zone)	22	26	8	3	31	15	105
Eastern Carbon (Zone)	1	0	10	0	33	2	46
Eastern Roosevelt (Zone)	20	28	2	4	21	14	89
Fallon (Zone)	18	4	15	3	24	0	64
Garfield (Zone)	10	17	15	2	37	15	96
Golden Valley (Zone)	2	0	9	0	32	0	43
Golden Valley/Musselshell (Zone)	0	2	12	1	0	0	15
Judith Gap (Zone)	8	0	6	0	39	0	53
McCone (Zone)	11	27	12	4	32	15	101
Musselshell (Zone)	2	0	24	0	39	0	65
Northeastern Yellowstone (Zone)	0	0	0	0	5	1	6
Northern Big Horn (Zone)	3	0	11	0	27	2	43

Figure 4-57 Summary of Severe Winter Weather Events by Zone in the Eastern Region



Source: NCEI, Chart by WSP

Zone Name	Blizzard	Cold/ Wind Chill	Heavy Snow	Ice Storm	Winter Storm	Winter Weather	Total
Northern Carbon (Zone)	0	0	0	0	5	1	6
Northern Rosebud (Zone)	2	0	18	1	31	1	53
Northern Stillwater (Zone)	1	0	12	0	55	4	72
Northern Valley (Zone)	11	27	8	1	19	13	79
Powder River (Zone)	12	1	26	2	36	0	77
Prairie (Zone)	17	16	9	2	24	13	81
Pryor/Northern Bighorn Mountains	0	0	0	0	7	0	7
Red Lodge Foothills (Zone)	1	0	24	0	106	1	132
Richland (Zone)	21	30	8	5	26	15	105
Roosevelt (Zone)	2	0	3	1	2	0	8
Rosebud (Zone)	1	2	6	2	0	0	11
Sheridan (Zone)	23	49	9	3	28	12	124
Southeastern Carbon (Zone)	0	0	0	0	3	1	4
Southern Big Horn (Zone)	4	0	25	0	50	2	81
Southern Rosebud (Zone)	4	0	10	0	32	2	48
Southern Wheatland (Zone)	3	0	4	0	34	0	41
Southwestern Yellowstone (Zone)	0	0	0	0	6	2	8
Stillwater (Zone)	1	0	35	0	0	0	36
Stillwater/Carbon (Zone)	1	1	39	1	0	0	42
Treasure (Zone)	2	1	22	2	24	0	51
Valley (Zone)	1	0	3	1	4	0	9
Western Carbon (Zone)	1	0	41	0	0	0	42
Western Roosevelt (Zone)	14	48	5	3	24	14	108
Wheatland	0	0	8	0	0	0	8
Wheatland/Park/Sweet Grass (Zone)	1	0	40	1	0	0	42
Wibaux (Zone)	18	18	10	1	29	13	89
Yellowstone (Zone)	2	3	44	1	41	2	93
Yellowstone/Big Horn	0	0	3	0		0	3
Total	**307**	**397**	**701**	**56**	**1,138**	**209**	**2,808**

Source: NCEI

The NCEI dataset reported $9,359,700 in total property losses in the Eastern Region since 1996. No crop damage was reported in the region. Three zones accounted for 88% of the property damage reported. Table 4-50 summarizes property loss by zone in the Eastern Region.

Table 4-50 Summary of Property Losses from Winter Weather Events by Zone in the Eastern Region

Zone	Total Property Damage ($)
Big Horn (Zone)	1,200,000
Carter (Zone)	4,500,000
Dawson (Zone)	57,000
Garfield (Zone)	240,000
McCone (Zone)	2,000
Northern Valley (Zone)	5,000
Prairie (Zone)	10,000
Richland (Zone)	435,000
Roosevelt (Zone)	362,000
Sheridan (Zone)	2,500,000
Wibaux (Zone)	34,700
Yellowstone (Zone)	14,000
Total	**9,359,700**

Source: NCEI

The NCEI reported details on several significant events in the Eastern Region:

- **November 1, 2000:** A major winter storm hit eastern Montana leaving over 1,500 residents without power as nearly 2,000 power poles snapped in half. The storm started as rain and produced several hours of sleet before changing to snow. After the ice turned to all snow, strong winds from 30 to 45 mph with gusts to 60 mph developed creating blizzard conditions with 6 to 12 inches of snow. Drifts up to 5 and 6 feet were reported in Sheridan County. This event impacted quite a few zones/counties in the Eastern Region and resulted in a combined $3,306,700 of property losses.
- **April 9, 2001:** An early spring snowstorm impacted parts of South Central and Southeast Montana on April 8th and April 9th. Southern Big Horn County was the hardest hit. An estimated 600 power poles were knocked down from heavy, wet snow, ice, and wind. Thousands of people were without power for up to 7 days. The hardest hit area was along Route 314 in the Kirby/Decker area and in the western end of the Northern Cheyenne Indian Reservation. This event resulted in $1,200,000 of property losses.
- **February 19, 2009:** An arctic cold front moved across the forecast area during the late evening hours of the 19th and early morning hours of February 20th. Upslope flow developed behind the front. This resulted in heavy snow across the foothills of the Beartooth/Absaroka Mountains with minor accumulations across the plains. However, very slick roads resulted in dangerous traveling conditions. As a result of the icy roads, a 16-year-old girl died in a one-vehicle crash on Interstate 90 near Dunmore, Montana. In addition, two women died in a two-vehicle crash on Highway 212, about 8 miles west of Ashland. Although road conditions were icy and snow packed at the time of the accidents, Montana State Patrol reported speed was also a factor.
- **March 29, 2009:** A second major snowstorm and blizzard within a week's time brought heavy snow and strong winds to portions of Southern Montana and Northern Wyoming. This storm impacted areas that were hit hard by the March 23-24 storm. Winds across the area were sustained in the 25 to 35 mph range with gusts from 30 to 40 mph. These winds combined with heavy snow resulted in visibilities being reduced to a quarter mile at many locations. In addition, snowfall exceeded 12 in Carbon, Stillwater, and Custer Counties. The storm resulted in one death. A 19-year-old woman was killed on Highway 39 near Forsyth after losing control of her car on the snow-covered highway. This event resulted in $1,500,000 of property losses.

- **November 9, 2012:** A low-pressure system from the Gulf of Alaska descended over the Rocky Mountain region, then moved northeast, emerging over the northern high plains. An arctic air mass from Alberta combined with warmer temperatures from the south to steer plentiful moisture through the area, bringing the first major winter storm of the season to northeast Montana. This event caused three deaths and one injury, as well as $25,000 in property losses.
- **May 10, 2016:** A very strong low-pressure system from the pacific northwest stalled over southern Montana and northern Wyoming with plentiful moisture. Significant amounts of moderate and heavy rain spread across many locations while enough cold air from the Canadian Rockies wrapped around the system to change the precipitation to a heavy, very wet snow for some higher elevations of central and northern Montana. This event resulted in $240,000 of property losses.

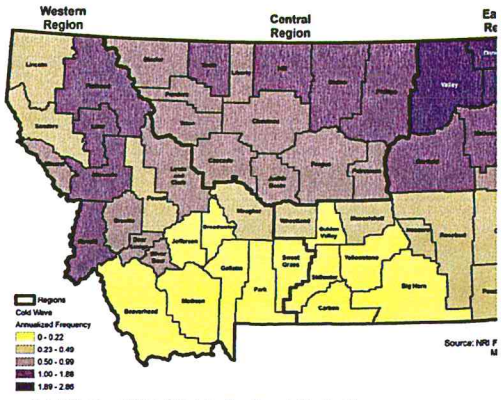
Frequency/Likelihood of Occurrence

The frequency of severe winter weather in the Eastern Region is ranked as **highly likely**. Severe winter weather impacts the state annually with blowing and drifting snow, extreme cold, hazardous driving conditions, and utility interruption. The NCEI dataset reported 738 days with severe weather events over 26 years, which averages to nearly 29 days a year with severe winter weather events in the Eastern Region. According to the 2023 SHMP, winter weather typically affects the state from November to April each year, but late storms can extend into June.

Figure 4-58 below depicts the annualized frequency of cold events at a county level based on the NRI. A trend exists of increased frequency in the northern part of the region, particularly in Daniels, Valley, Roosevelt, and Sheridan counties.

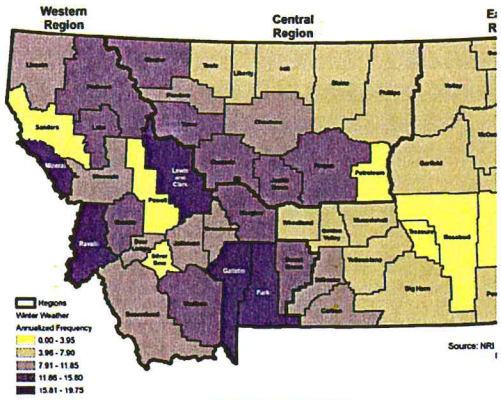
Figure 4-59 depicts annualized frequency of winter weather events at a county level based on the NRI. A trend exists towards increased frequency in the southwestern region, particularly Stillwater and Carbon counties.

Figure 4-58 NRI Annualized Frequency of Cold Events by County



Map by WSP, Data Source: FEMA National Risk Index, https://hazards.fema.gov/nri/determining-risk

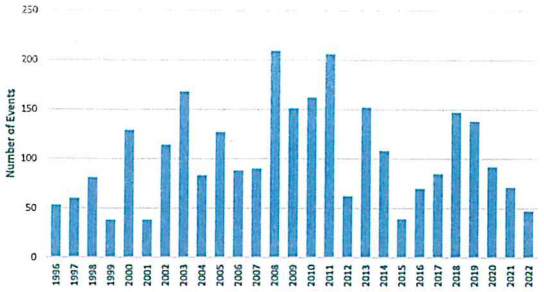
Figure 4-59 NRI Annualized Frequency of Winter Weather Events by County



Map by WSP, Data Source: FEMA National Risk Index, https://hazards.fema.gov/nri/determining-risk

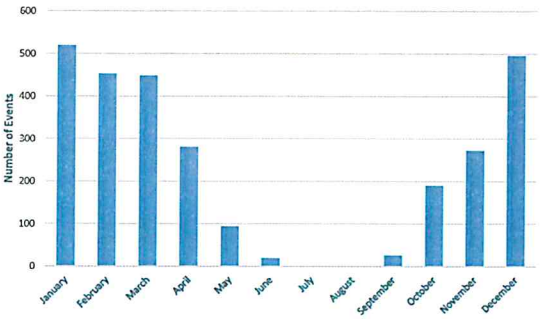
Between 1996 and 2022, winter weather events have occurred more frequently, then less frequently (Figure 4-60). It is not clear if this indicates a meaningful trend moving forward. The frequency of events by month is provided in Figure 4-61.

Figure 4-60 Yearly Trend of Winter Weather Events in the Eastern Region (1995-2022)



Source: NCEI, Chart by WSP

Figure 4-61 Monthly Trend of Winter Weather Events in the Eastern Region (1996-2022)



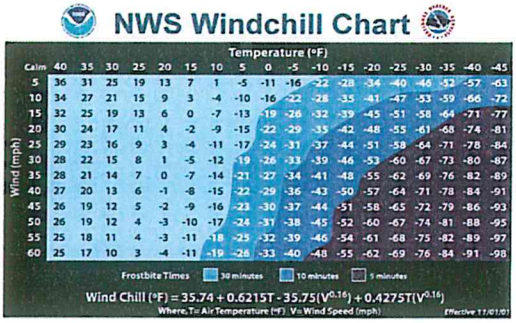
Source: NCEI, Chart by WSP

Potential Magnitude and Severity

The 2018 Montana SHMP explains that the magnitude of severe weather is measured by the severity of the event and the resulting damage. Winter storms are generally slow in developing and advance notice often lessens their effects on the population. Severe winter weather that results in loss of life, extended road closures, long-term power outages, or significant isolation problems represent high-magnitude weather events for Montana. Routine damages to property are largely due to frozen pipes. Collapsed roofs from snow loads are not common due to the low percent moisture in typical snow loads. In the Eastern Region, millions of dollars have been lost in property damage, in addition to the loss of life and several injuries, most of which occurred from a transportation accident due to severe winter weather. Several disaster declarations were issued in the Eastern Region due to severe winter storms on December 6, 2000, May 28, 2001, and June 13, 2008. In the Eastern Region, NCEI reported 13 deaths, 14 injuries, and almost $9.4 million in property losses; therefore, magnitude of severe winter weather is ranked as **critical**.

In 2001, the NWS implemented an updated Wind Chill Temperature index as shown in Figure 4-63. This index was developed to describe the relative discomfort/danger resulting from the combination of wind and temperature. Wind chill is based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature.

Figure 4-63 National Weather Service Wind Chill Chart



Source: NWS

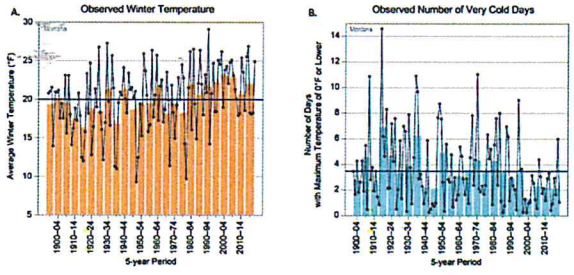
The severity of ice storms can be measured with the Sperry-Piltz Ice Accumulation (SPIA) Index, shown in Table 4-51. The SPIA Index is a forecasting of ice accumulation and ice damage that uses various parameters that can help predict the projected extent of ice storms. Historical measurements of ice storms using the SPIA Index are unavailable.

Climate Change Considerations

The 2021 Climate Change and Human Health in Montana report documents that annual average temperatures have increased in Montana 2-3 °F since 1950 in both summer and winter. This is greater than most of the U.S. due to the mid-continent location of the state. This trend is expected to continue and by mid-century the Montana Climate Assessment anticipates Montana will be 4.5-6.0 °F warmer than it was from 1971-2000. Precipitation has not changed significantly, but the 2021 Montana Climate Change and Human Health report anticipates precipitation to increase slightly, perhaps an inch/year, mostly from March-May.

With regard to winter weather, NOAA's 2022 National Climate Assessment documents that average winter temperatures in Montana have increased, with a striking reduction in the observed number of very cold days, especially in the last 20 years as shown in Figure 4-62. Both the Montana Climate Assessment and NOAA reports anticipate the number of cold days will continue to decline. Recent academic research also indicates the frequency of blizzards are on the decline in Montana, including a dramatic reduction in the number of blizzards in 2011-2020 relative to 2000-2010.[2]

Figure 4-62 Winter Temperature Observations in Montana



Dots represent annual average temperature (A.) and the number of days with a high temperature of 0°F or lower (B.).
Bars are 5-year averages (both A. and B.).
Black horizontal line is the average summer temperature for all years, 1895-2020.
Figure adapted from: 2022 NOAA State Climate Summaries, Montana. https://statesummaries.ncics.org/chapter/mt/

Neither the Montana Climate Assessment or the NCA5 chapter on the Northern Great Plains explicitly address climate change effects on blizzard, wind chill, heavy snowfall, ice storms, winter storms, or winter weather, other than to state that winters are expected to become warmer.

Due to the relatively coarse resolution of climate change effects on severe winter weather, it would be speculative to make judgements on differences between each jurisdiction within the region. Future updates to this plan should revisit this topic as scientific knowledge progresses.

[2] Browne, A., & Chen, L. (2023). Investigating the occurrence of blizzard events over the contiguous United States using observations and climate projections. *Environmental Research Letters, 18*(11), 114044.

Table 4-51 Sperry-Piltz Ice Accumulation Index

ICE DAMAGE INDEX	DAMAGE AND IMPACT DESCRIPTIONS
0	Minimal risk of damage to exposed utility systems; no alerts or advisories needed for crews, few outages.
1	Some isolated or localized utility interruptions are possible, typically lasting only a few hours. Roads and bridges may become slick and hazardous.
2	Scattered utility interruptions expected, typically lasting 12 to 24 hours. Roads and travel conditions may be extremely hazardous due to ice accumulation.
3	Numerous utility interruptions with some damage to main feeder lines and equipment expected. Tree limb damage is excessive. Outages lasting 1 – 5 days.
4	Prolonged & widespread utility interruptions with extensive damage to main distribution feeder lines & some high voltage transmission lines/structures. Outages lasting 5 – 10 days.
5	Catastrophic damage to entire exposed utility systems, including both distribution and transmission networks. Outages could last several weeks in some areas. Shelters needed.

Source: NWS

The extent rating of winter storms that cause issues in Montana includes storms forecasted with Winter Storm Warnings or Blizzard Warnings. The NWS issues a Winter Storm Warning when conditions that can quickly become life threatening and are more serious than an inconvenience are imminent or already occurring. Heavy snows, or a combination of snow, freezing rain or extreme wind chill due to strong wind, may bring widespread or lengthy road closures and hazardous travel conditions, plus threaten temporary loss of community services such as power and water. Deep snow and additional strong wind chill or frostbite may be a threat to even the appropriately dressed individual or to even the strongest person exposed to the frigid weather for only a short period.

The most dangerous of all winter storms is the blizzard. A blizzard warning is issued when winds of 35 miles an hour will occur in combination with considerable falling and/or blowing snow for at least 3 hours. Visibilities will frequently be reduced to less than 1/4 mile and temperatures are usually 20 degrees Fahrenheit or lower. The blizzard marks the upper extent of severe winter storms that could be experienced in Montana.

NOAA's NCEI produces the Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern two thirds of the U.S. The RSI ranks snowstorm impacts on a scale from 1 to 5, similar to the Fujita scale for tornadoes or the Saffir-Simpson scale for hurricanes (Table 4-52). As shown in Table 4-52 RSI is a regional index; a separate index is produced for each of the six NCEI climate regions in the eastern two-thirds of the nation. Montana is included in the Northern Rockies and Plains Region, along with Nebraska, North Dakota, Wyoming, and South Dakota.[3] RSI ratings from 1 to 5 are possible in Montana. RSI values for historical

[3] The RSI is assigned according to methods outlined in:

events are unavailable for the state of Montana or are ambiguous as to the geographic extent of storms in the northern Rockies and Plains states.

Table 4-52 Regional Snowfall Index (RSI) Ratings for Significant Snowstorms

Category	Description
1	Notable
2	Significant
3	Major
4	Crippling
5	Extreme

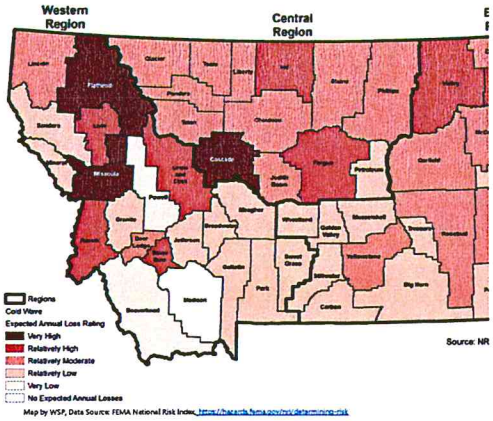
Winter storms and blizzards can result in multiple injuries and illnesses; major or long-term property damage that threatens structural stability; and/or interruption of essential facilities and services for 24-72 hours. This can include property damage, local and regional power and phone outages, and closures of streets, highways, schools, businesses, and nonessential government operations. People can also become isolated from essential services in their homes and vehicles. A winter storm can escalate, creating life threatening situations when emergency response is limited by severe winter conditions. Other issues associated with severe winter weather include hypothermia and the threat of physical overexertion that may lead to heart attacks or strokes. Snow removal costs can impact budgets significantly. Heavy snowfall during winter can also lead to flooding or landslides during the spring if the area snowpack melts too quickly and contribute to high ground water tables and seepage into foundations. High snow loads also cause damage to buildings and roofs.

Vulnerability Assessment

Severe winter weather occurs in the planning area as extreme cold, ice storm, or severe snow, which can be combined with high winds. Snow events can be classified several ways, including winter weather, snow, heavy snow, winter storm, snow and blowing snow, or blizzard if accompanied by high winds. The National Risk Index categorizes these conditions together as *winter weather*, and also has layers for extreme cold and ice storm. The NRI is useful to simplify the vulnerability analysis by providing information on the exposure of assets to these hazards and to some extent the susceptibility of those assets to damage from exposure. The NRI risk index is calculated as expected annual loss (EAL) multiplied by social vulnerability, divided by community resilience and provides a measure of how severely extreme winter weather is experienced. NRI data for cold waves is provided in

Squires et al. (2014) The regional snowfall index. Bulletin of the American Meteorological Society, 95(12), 1835-1848.
For more information see https://www.ncei.noaa.gov/access/monitoring/rsi/.

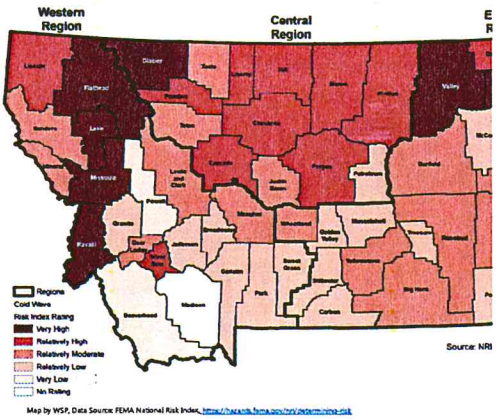
Figure 4-64 NRI Expected Annual Loss Rating from Cold Waves



Map by WSP, Data Source: FEMA National Risk Index, https://hazards.fema.gov/nri/determining-risk

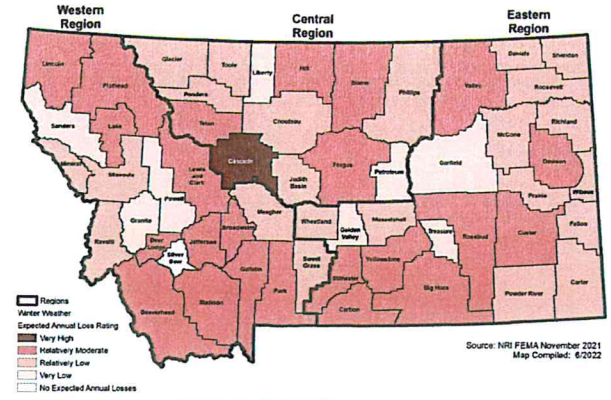
Figure 4-64 for expected annual loss and risk index in Figure 4-65. The NRI risk index rating for ice storm is not shown below. The ice storm risk is the lowest possible rating in most of the Eastern Region, *very low*. Roosevelt County is rated one-classification higher risk, *relatively low*, and Yellowstone, Richland, and Sheridan Counties are rated one additional classification higher risk a *relatively moderate* ice storm risk. NRI data for winter weather are provided below for expected annual loss (Figure 4-66) and risk index (Figure 4-67).

Figure 4-65 NRI Risk Index Rating for Cold Waves



Map by WSP, Data Source: FEMA National Risk Index, https://hazards.fema.gov/nri/determining-risk

Figure 4-66 NRI Expected Annual Loss Rating from Winter Weather



Map by WSP, Data Source FEMA National Risk Index, https://hazards.fema.gov/nri/determining-risk

Individuals who depend on electricity are also vulnerable during blackouts caused by severe winter weather. People without appropriate shelter or who work outside are more vulnerable to cold-related illnesses. In all the cases of injury or death reported by the NCEI due to winter weather events, the impacted individuals were on the road during a severe winter weather event and suffered injuries due to an accident. The NCEI reported one death and ten injuries due to severe winter weather events.

Property

All property located outdoors is exposed to severe winter weather events. Accumulation of snow and ice on roofs can cause collapse, especially on old or poorly constructed facilities. Ice storms can coat the exterior of a facility and can cause superficial damages. Prolonged cold can cause significant damages to poorly insulated facilities. The NCEI reported property losses in the Eastern Region were primarily due to blackouts caused by downed powerlines and poles, as well as damages to cars from automobile crashes. Communities in the Eastern region that have experienced recent development may report that these structures are better able to withstand severe winter weather as new construction is built to current code and roof loads are better designed to withstand greater snow loads.

Critical Facilities and Lifelines

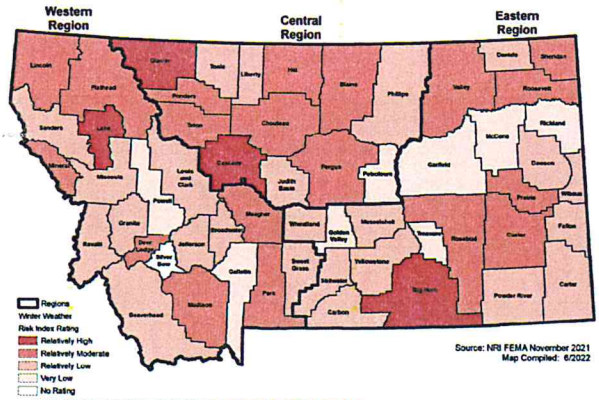
The safe and efficient flow of traffic is susceptible to extreme winter weather. Automobile crashes are more frequent during extreme winter weather and roads can become difficult or impossible to travel. These problems can isolate many people and create a dangerous situation for stranded motorists. Additionally, overhead power lines are susceptible to damage from the accumulation of snow and ice. This can cause power outages that lead to a dangerous loss of heat or electricity needed to operate medical equipment, all during periods likely to be extremely cold and possibly windy.

Economy

The economy is susceptible to extreme winter weather hazards. Examples include lower economic activity due to business interruptions associated with poor road conditions. Indirectly, power outages can cause very costly impacts. The NCEI reported $9.3 million in property losses in the Eastern Region.

Expected Annual Loss due to cold waves as shown in

Figure 4-67 NRI Risk Index Rating for Winter Weather



Map by WSP, Data Source FEMA National Risk Index, https://hazards.fema.gov/nri/determining-risk

Figure 4-64 and Figure 4-66. Losses from cold waves are greatest in the northern end of the Eastern Region, while losses are generally highest in the south and southwest parts of the region.

Historic and Cultural Resources

Historic and cultural resources are somewhat susceptible to extreme winter weather. Historic buildings, in particular, are unlikely to be insulated to the standard common to new construction. This leads to less protection for property and people inside the buildings from extreme cold temperatures and wind, greater susceptibility to damage from power outages, and increased probability of damage to or caused by frozen pipes.

Natural Resources

Trees, landscaping, and crops can be damaged due to prolonged periods of extreme cold weather and the accumulation of snow and ice. Trees that break due to the weight of snow and ice have also been reported in the NCEI dataset.

Development Trends Related to Hazards and Risk

There are no clear trends that recent development has changed vulnerability to severe winter weather one way or the other. Nor is it evident that future development will affect vulnerability to severe winter weather, other than new construction should be better designed to handle greater snow loads and the effects of extreme temperatures through better insulation and efficient building materials.

Risk Summary

In summary, the Severe Winter Weather hazard is considered to be overall high significance for the Eastern Region. Variations in risk by jurisdiction are summarized in the table below, followed by key issues noted in the vulnerability assessment.

- Severe winter weather includes blizzards, cold/wind chill, heavy snow, ice storm, winter weather, and winter storm. The hazard significance rating for this hazard is a **Medium.**
- These events can impact anywhere in the planning region; therefore, the hazard extent is rated as **extensive.**
- The NCEI data reported 1,738 days with severe weather events over 26 years, which averages to nearly 28 days a year with severe winter weather events in the Eastern Region; therefore, the future occurrence is rated as **highly likely.**
- The NCEI reported 13 death, 14 injuries, and $9,359,700 in property damages, therefore the magnitude is rated as **Critical.**
- People who are dependent on electricity and populations who work outdoors or in transportation are most vulnerable to severe winter weather events. People who do not have appropriate shelter or who live in homes without proper insulation from winter weather, such as homeless populations and those in mobile homes, are most vulnerable to winter weather.
- Power outages and poor road conditions are likely impacts of severe winter storms. Structures can collapse under the weight of snow and ice. Most property damage in the Region occurred due to car accidents because of poor road conditions from winter storms.
- Significant economic losses can occur from business and transportation disruptions, as well as from repairing damaged infrastructure.
- Related hazards: Extreme Temperatures, Windstorms, Transportation Accidents

Table 4-53 Risk Summary Table: Severe Winter Weather

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
Eastern Region	Medium		
Big Horn	Medium	Hardin, Lodge Grass	None

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
Carbon	Medium	Bearcreek, Bridger, Joliet, Fromberg, Red Lodge	None
Carter	Medium	Ekalaka	None
Custer	Medium	Ismay, Miles City	None
Crow Tribe	High	None	None
Daniels	Medium	Scobey, Flaxville	None
Dawson	Medium	Richey, Glendive	None
Fallon	Medium	Plevna, Baker	None
Garfield	Medium	Jordan	None
Golden Valley	Medium	Ryegate, Lavina	None
McCone	Medium	Circle	None
Musselshell	Medium	Melstone, Roundup	None
Powder River	High	Broadus	None
Prairie	High	Terry	None
Richland	Medium	Fairview, Sidney	None
Roosevelt	Medium	Wolf Point, Poplar, Bainville, Culberson, Froid	None
Rosebud	Medium	Colstrip, Forsyth	None
Sheridan	Medium	Plentywood, Medicine Lake, Outlook, Westby	None
Stillwater	Medium	Columbus	None
Treasure	Medium	Hysham	None
Valley	Medium	Glasgow, Fort Peck, Nashua, Opheim	None
Wibaux	High	Wibaux	None
Yellowstone	Medium	Billings, Broadview, Laurel	Likely greater risk due to presence of more property and infrastructure vulnerable to winter weather.

4.2.12 Human Conflict

Hazard/Problem Description

Human conflict includes terrorism, active shooters, and civil unrest. Descriptions of these hazards are presented below:

Terrorism

The FBI defines terrorism, domestic or international, as the unlawful use of force or violence against persons or property to intimidate or coerce a government or civilian population in furtherance of political or social objectives. The US State Department designates 72 groups as Foreign Terrorist Organizations around the world. There is no similar list of domestic terrorist groups. The Global Terrorism Database (GTD) maintained by the National Consortium for the Study of Terrorism and Responses to Terrorism lists 241 groups known or suspected of carrying out terrorist attacks on US soil since 1970.

Incidents involving weapons of mass destruction (WMDs) are a special subset of terrorism and mass violence incidents. Such incidents may involve chemical, biological, radioactive, nuclear, or explosive (CBRNE) weapons with the potential to cause high numbers of injuries or fatalities.

Historically explosives have been the most common terrorist weapon, accounting for 51% of all attacks since 1970. Hazard impacts are typically instantaneous; secondary devices may be used, lengthening the

duration of the hazard until the attack site is determined to be clear. The extent of damage is determined by the type and quantity of explosive. Effects are generally static other than cascading consequences and incremental structural failures. Some areas could experience direct weapons' effects: blast and heat; others could experience indirect weapons' effect.

Biological terrorism is the use of biological agents against persons or property. Liquid or solid contaminants can be dispersed using sprayers/aerosol generators or by point of line sources such as munitions, covert deposits and moving sprayers. Biological agents vary in the amount of time they pose a threat. They can be a threat for hours to years depending upon the agent and the conditions in which it exists.

Another type of biological attack is agroterrorism, directed at causing societal and economic damage through the intentional introduction of a contagious animal disease or fast-spreading plant disease that affects livestock and food crops and disrupts the food supply chain. Such an attack could require the agriculture industry to destroy livestock and food crops, disrupt the food supply both nationally and globally, and could also affect consumer confidence in the food supply resulting in tremendous economic damage for potentially an extended period.

Chemical terrorism involves the use or threat of chemical agents against persons or property. Effects of chemical contaminants are like biological agents. Radiological terrorism is the use of radiological materials against persons or property. Radioactive contaminants can be dispersed using sprayers/aerosol generators, or by point of line sources such as munitions, covert deposits and moving sprayers or by the detonation of a nuclear device underground, at the surface, in the air or at high altitude.

Active Shooter

The FBI defines an active shooter as one or more individuals actively engaged in killing or attempting to kill people in a populated area. Implicit in this definition is the shooter's use of one or more firearms. The "active" aspect of the definition inherently implies the ongoing nature of the incidents, and thus the potential for the response to affect the outcome. Typically, active shooters are not interested in taking hostages or attaining material gain, and frequently are not even interested in their own survival. Unlike organized terrorist attacks, most active shooter incidents are carried out by one or two individuals. School shootings are a special subset of active shooter incidents.

The US Department of Homeland Security notes that "in most cases, active shooters use firearms(s) and there is no pattern or method to their selection of victims...situations are unpredictable and evolve quickly...and are often over within 10 to 15 minutes." However, the presence or suspected presence of secondary devices can lengthen the duration of the event until the attack site is determined to be clear. Although this definition focuses on an active shooter, the elements remain the same for most active threat situations.

Civil Unrest

The federal law defines civil disorder, or civil unrest, as "any public disturbance involving acts of violence by assemblages of three or more persons, which causes an immediate danger of or results in damage or injury to the property or person of any other individual" (18 U.S. Code 232). FEMA noted that civil unrest can be triggered by a variety of reasons, including "disputes over exploitation of workers, standard living conditions, lack of political representation, poor health care and education, lack of employment opportunities, and racial issues" (FEMA 1993).

Geographical Area Affected

Although human conflict events can occur anywhere in the Eastern Region, individual events will typically only impact localized cities. Past events indicate that the reported terrorist attack and civil unrest events in the Eastern Region have been concentrated to eight (8) cities in the Region listed below. Therefore, geographic extent of these events is rated as **significant**.

- Rosebud County
  - Lame Deer
- Custer County
  - City of Miles City
- Carbon County
  - Town of Joliet
  - City of Red Lodge
- Big Horn County
  - Crow Agency
  - City of Hardin
- Yellowstone County
  - City of Billings
  - City of Laurel

Acts of terrorism are typically a pre-meditated, targeted attack on a specific place or group such as religious or ethnic groups or sites of significant economic, strategic, military, or cultural significance. Consequently, areas of higher risk include densely populated cities and counties and military facilities. Large venue events, such as a sporting event attended by tens of thousands of people might be considered a desirable target. Again, such events typically occur in densely populated areas since those areas can provide the infrastructure support (hotels, eateries, etc.) for large numbers of people. Even a small-scale terrorist incident in one of these locations would likely cause cascading impacts to the communities in Eastern Montana. Like terrorist attacks, active shooter incidents most frequently occur in high-population areas. The FBI report Active Shooter Incidents, 20-Year Review from 2000-2019 found that 29% of active shooter incidents in the U.S. occur in businesses open to pedestrians, 15% in open spaces, 13% in schools (Pre-K-12), and 12% in businesses closed to pedestrians.

Civil unrest, such as protests and demonstrations, can also occur anywhere. The 2020 George Floyd protests occurred in cities across the United States and even extended to other counties across the world. Highly populated cities are more likely to see large protests that can turn violent and result in property damage and death. Protests can also be localized to a single city or organization.

Past Occurrences

Terrorism

The GTD catalogues more than 200,000 domestic and international terrorist attacks from 1970 to 2020. Table 4-54 displays a list of the GTD reported seven events that have occurred in the State of Montana since 1970. Of the seven terrorist attack events reported in Montana, one occurred in the Eastern Region. This terrorist attack occurred in the City of Billings (Yellowstone County) on March 15, 1970, and was aimed at the police. No injuries or deaths were recorded.

Table 4-54 Terrorist Attacks in the State of Montana 1970-2020

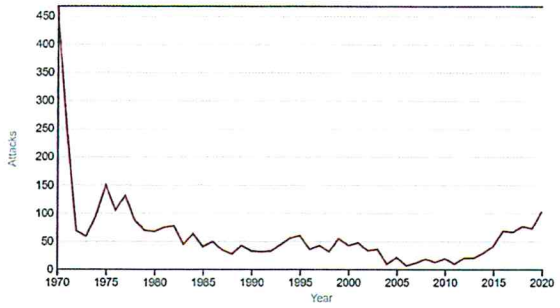
Date	City	Perpetrator Group	Fatalities	Injuries	Target Type
2017-05-16	Three Forks	Anti-Police extremists	2	5	Police
1997-04-02	Bozeman	Anti-Abortion extremists	0	0	Abortion Related
1994-10-11	Kalispell	Anti-Abortion extremists	0	0	Abortion Related
1994-01-00	Helena	Anti-Abortion extremists	0	0	Abortion Related
1992-01-18	Helena	Anti-Abortion extremists	0	0	Abortion Related
1987-04-19	Missoula	Aryan Nation (suspected)	0	0	Police

Date	City	Perpetrator Group	Fatalities	Injuries	Target Type
1970-03-15	Billings	Unknown	0	0	Police

Source: GTD 1970-2020

As shown in Figure 4-68, GTD data shows that there was an overall decreasing trend in the number of terrorist attacks from 1970 to 2005. However, since 2010, there has been an uptake in the number of terrorist attacks in the United States once again.

Figure 4-68 Terrorist Attacks on US Soil, 1970-2020



Source: GTD, https://www.start.umd.edu/gtd/

The increase in attacks over the last decade has been driven primarily by domestic, not international, terrorism. A domestic terrorist attack is a terrorist attack in which victims "within a country are targeted by a perpetrator with the same citizenship as the victims" (Predicting Malicious Behavior: Tools and Techniques for Ensuring Global Security). A recent report by the Center for Strategic and International Studies records 980 domestic terrorist attacks in the US since 1994, with sharp growth over the last 10 to 15 years. Figure 4-69 shows the increase in domestic terrorist attacks from 1994 to 2021 broken down by the ideology of the attacker. As shown in the chart, the rise in domestic terrorist attacks since 2015 has been largely driven by violent far-right groups. Data for 2021 was not complete at the time of this risk assessment, and this explains the drop in attacks shown for that year.

Montana alone, 293 protests were reported across the State: 228 in the Western Region, 42 in the Eastern Region, and 23 in the Eastern Region. Table 4-55 provides details on these events. 5,178 people attended these protests in total.

Table 4-55 Protests in the Eastern Region, Jan. 2017 – Jan. 2021

Date	City	County	Attendees	Event
1/25/2021	Billings	Yellowstone	30	Civil Rights
1/6/2021	Billings	Yellowstone	50	Executive
8/29/2020	Hardin	Big Horn		Other
8/16/2020	Red Lodge	Carbon	200	Other
7/30/2020	Billings	Yellowstone	100	Other
6/7/2020	Billings	Yellowstone	1300	Racial Injustice
5/30/2020	Billings	Yellowstone	50	Racial Injustice
4/19/2020	Billings	Yellowstone	100	Healthcare
2/24/2020	Hardin	Big Horn		Other
12/17/2019	Billings	Yellowstone		Executive
9/23/2019	Hardin	Big Horn	100	Other
8/29/2019	Hardin	Big Horn	100	Other
6/12/2019	Billings	Yellowstone	20	Civil Rights
5/21/2019	Billings	Yellowstone	60	Civil Rights
5/21/2019	Billings	Yellowstone	10	Civil Rights
4/5/2019	Billings	Yellowstone	400	Other
2/26/2019	Billings	Yellowstone		Education
2/26/2019	Miles City	Custer		Education
2/14/2019	Lame Deer	Rosebud		Other
1/19/2019	Billings	Yellowstone		Civil Rights
12/31/2018	Lame Deer	Rosebud	100	Other (Criminal Justice)
11/1/2018	Crow Agency	Big Horn		Legislative
10/31/2018	Miles City	Custer	5	Healthcare
9/6/2018	Billings	Yellowstone	50	Executive
7/25/2018	Billings	Yellowstone	20	Executive
6/30/2018	Billings	Yellowstone	100	Immigration (Families Belong Together)
6/26/2018	Billings	Yellowstone	60	Civil Rights (Pro-Choice)
6/9/2018	Billings	Yellowstone	150	Healthcare (Opioid Epidemic)
4/7/2018	Billings	Yellowstone	100	Guns (Second Amendment)
3/24/2018	Billings	Yellowstone	3	Guns
3/24/2018	Billings	Yellowstone	400	Guns (March for Our Lives)
3/14/2018	Billings	Yellowstone		Guns (National Walkout Day)
1/26/2018	Billings	Yellowstone		Education (School Choice)
1/20/2018	Billings	Yellowstone	1000	Civil Rights (Women's March)
1/20/2018	Miles City	Custer	60	Civil Rights (Women's March)
9/5/2017	Billings	Yellowstone	10	Immigration
6/17/2017	Billings	Yellowstone	200	Civil Rights (Pride)
5/12/2017	Billings	Yellowstone	100	Executive
4/29/2017	Billings	Yellowstone	100	Environment (People's Climate March)
4/21/2017	Billings	Yellowstone	50	Executive
3/28/2017	Laurel	Yellowstone	100	Education (Principal Fired)
1/21/2017	Miles City	Custer	50	Civil Rights (Women's March)

Source: https://countlove.org/

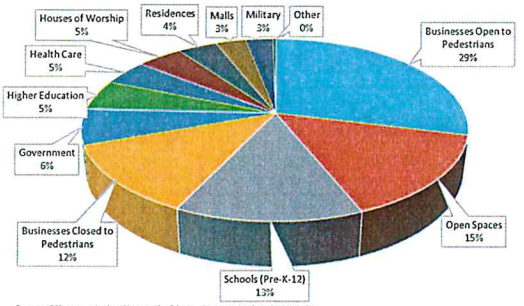
Figure 4-69 Domestic Terrorist Attacks in the US, 1994-2021

Source: Center for Strategic and International Studies

Active shooters

The FBI reported 434 active shooter incidents from 2000 to2021 in the United States: 333 of these events occurred between 2000 to2019 and were reported in the FBI 20-year active shooter review. Figure 4-70 shows the location of where these incidents took place. The FBI reported an additional 40 incidents in 2020 and 61 incidents in 2021. While none of these 434 incidents took place in the State of Montana, trends from past events can be used to predict the likelihood of future events.

Figure 4-70 Active Shooter Incident Locations, 2000-2019



Source: FBI report Active Shooter Incidents, 20-Year Review 2000-2019

Civil Unrest

Count Love is an open-source database containing a comprehensive list of U.S. protests from January 20th, 2017, to January 21st, 2021. The dataset reported 27,270 protests across 4,042 cities in the United States. In

Frequency/Likelihood of Occurrence

The probability of a terrorist attack, active shooter attack, and civil unrest can be difficult to quantify, largely due to different definitions and data collection methods. In Montana, seven terrorist attacks have been reported in the State since 1970, only one of which took place in the Eastern Region. The FBI recorded 434 active shooter incidents from 2000 to2021, none of which occurred in the State. While both terrorist attack and active shooter attacks are rare in Montana, civil unrest is a more common occurrence. Over the course of 4 years from 2017 to 2021, 42 protest events were recorded in the Eastern Region of Montana, most of which occurred in the City of Billings. This averages out to about 10 or 11 protests per year in the Eastern Region. Based on the limited number of past events, the likelihood of these events is **occasional**.

Climate Change Considerations

Climate change has the potential to impact terrorism and civil unrest in the future. Extreme weather has been known to worsen social tensions, poverty, and hunger. Social instability and global conflict brought on by climate change could result in an increase in the number of both domestic and international terrorist attacks and civil unrest. While it is unlikely that climate change will have a significant impact on human conflict in the Eastern Region of Montana, if conditions continue to worsen, it is possible in the future.

Potential Magnitude and Severity

The severity of these incidents can be measured in multiple ways including length of incident, fatalities, casualties, witnesses, and number of perpetrators. Although an active threat may only directly impact one specific piece of infrastructure (e.g., a school, theater, or concert venue), it indirectly impacts the community in many ways, including ongoing closures for investigation, local and national media logistics, VIP visits, mental health concerns, need for additional support services, avoidance of similar infrastructure, and subsequent impacts to businesses. The psychological impact is often much worse than the direct impacts and can continue to affect a community for years. Thus, the overall significance of this hazard is **Critical**.

Terrorism

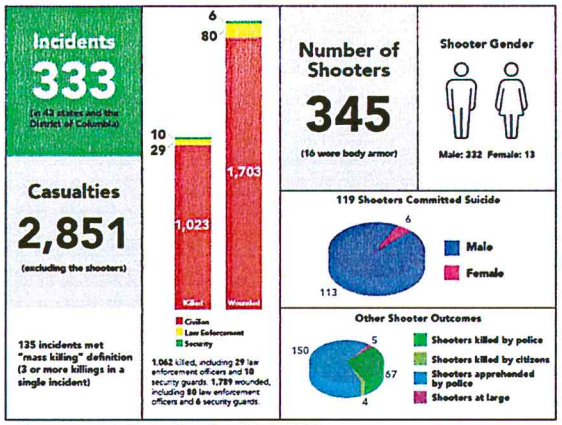
The GTD catalogues more than 200,000 terrorist attacks between 1970 and 2020 (the most recent year the GTD has analyzed). Those incidents averaged roughly one fatality and five injuries per incident. However, this data is to a large extent skewed by a handful of deadly attacks. These five attacks account for 64% of the fatalities and 87% of the injuries from terrorist attacks in the US:

- **September 11, 2001,** attacks on New York and Washington, DC, which killed 1,385 and injured 10,878 – more than all other terrorist attacks in the US since 1970 combined.
- **October 1, 2017,** shooting at the Route 91 Harvest Festival concert in Las Vegas, Nevada, which killed 59 and wounding 851.
- **April 4, 2013,** Boston Marathon Bombing killed three and injured 264.
- **April 19, 1995,** bombing of the Murrah Federal Building in Oklahoma City, killing 168 and injuring 650.
- **September–October 1984** salmonella food poisoning attack in Dalles, Oregon, which sickened 751 people.

Active Shooter

Figure 4-71 summarizes the outcomes of 333 active shooter incidents in the US from 2000 to2019 studied by the FBI. Casualties for active shooter incidents vary widely, with 2,851 casualties from 333 incidents, averaging over 8 deaths per incident.

Figure 4-71 Active Shooter Incident Outcomes, 2000-2019



Source: FBI report Active Shooter Incidents, 20-Year Review 2000-2019

Civil Unrest

Civil unrest resulting in large scale protests and demonstrations can have significant impacts to people and infrastructure in a community. The U.S. Crisis Monitor is a database to facilitate efforts in tracking, preventing, and mitigation political violence in America in partnership with the Armed Conflict Location and Event Data Project (ACLED). The U.S. Crisis Monitor reported that in 2020, 11 people in the United States were killed while participating in political demonstrations and another 14 died in incidents linked to political unrest. Property damage, such as broken windows and vandalism, are also commonly reported during violent protests in the United States.

Vulnerability Assessment

People

Most terrorist attacks are primarily intended to kill and injure as many people as possible. Physical harm from a firearms attack or explosive device is not completely dependent on location, but risk is greater in areas where higher numbers of people gather. If a biological or chemical agent were released indoors, it could result in exposure to a high concentration of pathogens, whereas an outdoors release could affect many more people but probably at a lower dose. Symptoms of illness from a biological or chemical attack could go undetected for days or even weeks. Local healthcare workers may observe a pattern of unusual illness or early warning monitoring systems may detect airborne pathogens. People could also be affected by an attack on food and water supply. In addition to impacts on physical health, any terrorist attack would likely cause significant stress and anxiety.

Depending on the motivation behind the attack, incidents will most likely be focused on so-called "soft targets." Protective design of buildings can reduce the risk of an active shooter incident, and if one occurs, can mitigate, or reduce the impacts and number of potential victims.

Risk Summary

In summary, the human conflict hazard is overall **medium** significance for the Region. Variations in risk by jurisdiction are summarized in the table below, followed by key issues noted in the vulnerability assessment.

- There were no recorded incidents of active shooters, one recorded terrorist attack, and forty-two (42) recorded civil unrest cases in the Eastern Region, most of which occurred in Billings; therefore, the ranking of frequency for human conflict is rated as **occasional.**
- Based on potential for death, injury, and significant damage to critical infrastructure and property, magnitude is ranked as **critical.**
- Although human conflict events can occur anywhere in the Region, individual events will typically only impact localized cities. Past events indicate that these events in the Eastern Region have primarily occurred in 8 cities in the Region; therefore, geographic extent of these events is rated as **significant.**
- Impacts on people from human conflict include injury and death, as well as psychological damage from being in an incident.
- Impacts on property include vandalism, theft, and damage. Total destruction of property is possible in the case of an extreme terrorist attack.
- Significant economic damages are possible in the case of a significant terrorist attack due to repairs and business closures.
- In a severe human conflict case, it would be possible for significant disruption of critical facilities including loss of power, transportation interruptions, and disruption of first responders.
- Unique jurisdictional vulnerability: the City of Billings experienced a disproportionate amount of civil unrest.
- Related Hazards: Cyber-attack

Table 4-56 Risk Summary Table: Human Conflict

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
Eastern Region	Medium		
Big Horn	Medium	Hardin, Lodge Grass	Miles City had four documented civil unrest cases; Lodge Grass had none
Carbon	Medium	Bearcreek, Bridger, Joliet, Fromberg, Red Lodge	Joliet had one documented civil unrest incident
Carter	Medium	Ekalaka	N/A
Custer	Medium	Ismay, Miles City	Miles City had four documented civil unrest cases, Ismay had none
Crow Tribe	Medium		N/A
Daniels	Medium	Scobey, Flaxville	None
Dawson	Medium	Richey, Glendive	None
Fallon	Medium	Plevna, Baker	None
Garfield	Medium	Jordan	N/A
Golden Valley	Medium	Ryegate, Lavina	None
McCone	Medium	Circle	N/A
Musselshell	Medium	Melstone, Roundup	N/A
Powder River	Low	Broadus	N/A
Prairie	Medium	Terry	N/A
Richland	Medium	Fairview, Sidney	None

Similarly, most active shooters primarily target people, attempting to kill or injure large numbers of individuals. The number of injuries and fatalities are highly variable, dependent on many factors surrounding the attack including the location, the number of type of weapons used, the shooter's skill with weapons, the amount of people at the location, and law enforcement response time. Psychological effects of the incident, on not only victims and responders but also the public, may last for years. Civil unrest and large political demonstrations can also result in death or injuries to protestors, responders, and community members.

Property

The potential for damage to property is highly dependent on the type of attack. Terrorist attacks involving explosives or other weapons, may damage buildings and infrastructure. For most attacks, impacts are highly localized to the target of the attack, although attacks could potentially have much broader impacts. Active shooter incidents rarely result in significant property damage, although crime scene measures may deny the use of targeted facilities for days after the incident. Civil unrest can result in damaged property such as broken windows, vandalism, damaged vehicles, stolen property, and fires.

Critical Facilities and Lifelines

Impacts to critical infrastructure would depend on the site of the attack. Short or long-term disruptions in operations could occur, as well as gaps in continuity of business or continuity of government, depending on who the victims of the attack are, and whether a continuity plan is in place. While active shooter incidents rarely cause major property damage directly, indirect effects can be significant, such as the loss of critical facilities for days or weeks due to crime scene concerns. Terrorists could disrupt communication and electric systems through cyber-attacks. Additionally, terrorism, active shooter incidents, and civil unrest can result in a drain on first responder resources and personnel for days to weeks following the incident.

Economy

Active shooter or terrorist incidents could have significant economic impacts. Specific examples could include short-term or permanent closing of the site of the attack. Another economic impact could be caused by general fear – as an example, an attack in a crowded shopping center could cause potential patrons to avoid similar places and disrupt economic activity. Potential economic losses could include cost of repair or replacement of damaged facilities, lost economic opportunities for businesses, loss of food supplies, disruption of the food supply chain, and immediate damage to the surrounding environment.

As an extreme example, after the September 11, 2001, terrorist attacks in New York and Washington the U.S. stock market lost $1.4 trillion, the Gross Domestic Product of New York City lost an estimated $27 billion, and commercial air travel decreased by 20%.

Historic and Cultural Resources

Terrorists have been known to target sites with historic or cultural significance. Civil unrest and protests also frequently target historically or politically significant areas, such as capital buildings, which can be damaged during a civil unrest event if a protest turns violent. Additionally, active shooters can target cultural significant areas if the motive is for religious or political reasons.

Natural Resources

Generally, active shooter incidents would not have an impact on the natural environment. Agro-terrorism or chemical terrorism could result in significant damage to the environment in areas near the attack. These events can pollute the environment and cause nearby plants and animals to get sick or die. Contaminated material that gets into the air or water supply can affect humans further away from the incident site.

Development Trends Related to Hazards and Risk

The link between increased development and terrorist attacks is uncertain at best. Many terrorist attacks have targeted larger metropolitan areas, so a larger population could potentially make public events more attractive targets. Population growth and development could expose more people and property to the impacts of an explosive or other large-scale attack.

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
Roosevelt	Medium	Wolf Point, Poplar, Bainville, Culberson, Froid	None
Rosebud	Medium	Colstrip, Forsyth	Lame Deer had two civil unrest cases, neither Colstrip nor Forsyth had documented human conflict
Sheridan	Low	Plentywood, Medicine Lake, Outlook, Westby	None
Stillwater	Medium	Columbus	N/A
Treasure	Medium	Hysham	N/A
Valley	Low	Glasgow, Fort Peck, Nashua, Opheim	None
Wibaux	Low	Wibaux	None
Yellowstone	High	Billings, Broadview, Laurel	Billings experienced more than half of the total civil unrest incidents in the Region and the only terrorist attack, Laurel had one documented civil unrest incident

4.2.13 Tornadoes & Windstorms

Hazard/Problem Description

Tornadoes

Tornadoes are one of the most destructive types of severe weather. According to the 2018 SHMP, a tornado is a violently rotating column of air in contact with the ground and extending from the base of a thunderstorm. Until 2006, tornadoes were categorized by the Fujita scale based on the tornado's wind speed. The Enhanced Fujita (EF) Scale was implemented in place of the Fujita scale and began operational use on February 1, 2007. The EF scale has six categories from zero to five representing increasing degrees of damage. It was revised to better align wind speeds closely with associated storm damage. It also adds more types of structures as well as vegetation, expands degrees of damage, and better accounts for variables such as differences in construction quality. The EF-scale is a set of wind estimates based on damage. It uses three-second estimated gusts at the point of damage. These estimates vary with height and exposure. Forensic meteorologists use 28 damage indicators and up to 9 degrees of damage to assign estimated speeds to the wind gusts. Table 4-57 describes the EF-scale ratings versus the previous Fujita Scale used prior to 2007 (NOAA 2007).

Table 4-57 The Fujita Scale and Enhanced Fujita Scale

Fujita Scale	Derived		Operational EF Scale			
F Number	Fastest ¼ mile (mph)	3-second gust (mph)	EF Number	3-second gust (mph)	EF Number	3-second gusts (mph)
0	40-72	45-78	0	65-85	0	65-85
1	73-112	79-117	1	86-109	1	86-110
2	113-157	118-161	2	110-137	2	111-135
3	158-207	162-209	3	138-167	3	136-165
4	208-260	210-261	4	168-199	4	166-200
5	261-318	262-317	5	200-234	5	Over 200

Notes: EF = Enhanced Fujita; F = Fujita; mph = Miles per Hour

Windstorms

Windstorms represent the most common type of severe weather. Often, accompanying severe thunderstorms cause significant property and crop damage, threaten public safety, and disrupt utilities and

communications. Straight-line winds are generally any wind not associated with rotation and in rare cases can exceed 100 miles per hour (mph). The NWS defines high winds as sustained wind speeds of 40 mph or greater lasting for one hour or longer, or winds of 58 mph or greater for any duration. Windstorms are often produced by super-cell thunderstorms or a line of thunderstorms that typically develop on hot and humid days. According to the 2023 SHMP, high winds can occur with strong pressure gradients or gusty frontal passages. These winds can affect the entire State with wind speeds of more than 75-100 mph.

For this hazard, three different classifications of windstorms were analyzed: high winds, strong winds, and thunderstorm winds. The most significant distinction between high winds and thunderstorm winds in the NCEI dataset is that high winds are most frequently reported in the winter months (December, January, and February) and are recorded on a zonal scale, whereas thunderstorm winds are most reported in the summer months (June, July, and August) and recorded on a local county or city scale. Strong winds are another type of windstorm, which originates from thunderstorms and are any wind exceeding 58 mph. Strong winds are the least frequently documented category of wind in the Eastern Region. Despite these differences, the wind speeds and associated impacts from these winds are comparable.

Wind speed can also be rated on the Beaufort wind scale (Table 4-58). The Beaufort wind scale is particularly useful for estimating wind speed in the absence of instrumentation. This HMP update uses the aforementioned NCEI wind speed classifications and data to evaluate wind hazard extent.

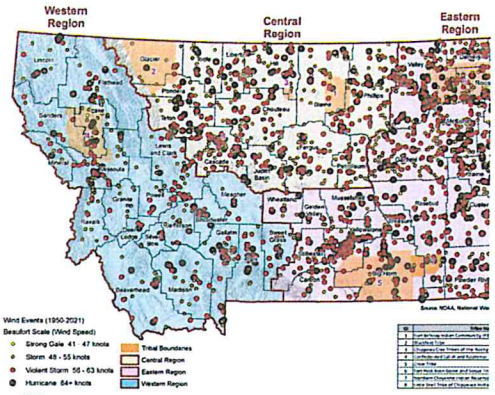
Table 4-58 Beaufort Wind Scale

Force	Speed (mph)	Description
0	0-1	Calm
1	1-3	Light Air
2	4-7	Light Breeze
3	8-12	Gentle Breeze
4	13-18	Moderate Breeze
5	19-24	Fresh Breeze
6	25-31	Strong Breeze
7	32-38	Near Gale
8	39-46	Gale
9	47-54	Severe Gale
10	55-63	Storm
11	64-72	Violent Storm
12	72-83	Hurricane

Geographical Area Affected

The spatial extent rating for both tornadoes and wind hazards is **extensive**. Windstorms and tornadoes can occur anywhere in the Eastern Region. The rural, unpopulated areas of the County typically experience the highest frequency of wind events due to the abundance of flat, open land in rural areas of the region. The Montana State Hazard Mitigation Plan 2018 highlights that greatest monetary losses due to property damages are likely to occur in cities with concentrated infrastructure. Figure 4-72 and Figure 4-73 display the historic tornado and wind events in the State of Montana by region.

Figure 4-73 Wind Events in Montana by Region 1955-2021



Source: NOAA

Past Occurrences

The NCEI database was used to gather information on historic severe summer weather events in the Eastern Region of Montana. The NCEI data is a comprehensive list of oceanic, atmospheric, and geophysical data across the United States and aggregated by county and zone. It is important to note that weather events that occurred in Crow Tribe and North Cheyenne Tribe are also included in the dataset tables down below. However, instead of individual records, tribal data records were grouped into the nearest county. The NCEI uses unique methods of recording various hazards. High wind and strong wind are recorded by zone rather than by county and these datasets begin in 1996. Thunderstorm wind is recorded by county and the dataset starts in 1955. Tornadoes are also recorded by county and the dataset begins in 1950. All these datasets contain information up to March 2022.

The NCEI database reported 4,730 windstorm events on 1,218 days and 252 tornado events on 172 days. A summary of these events is captured in Table 4-59. In total, over $68.4 million was lost in property damages and over $10.6 million in crop losses. Eleven fatalities and 35 injuries were also reported in the Eastern Region. It is important to note that due to the nature of the NCEI data, losses from unreported events are not included in the dataset and some losses may be duplicated between counties; therefore, the real losses from severe windstorms and tornadoes are likely different than what is displayed in the table below, but estimates are useful for planning purposes.

Table 4-59 Summary of Losses by Hazard in the Eastern Region

	Deaths	Injuries	Property Loss	Crop Loss	Days with Events	Total Events
High Wind	0	3	$930,000	$0	404	1,492
Strong Wind	0	0	$8,000	$0	4	5
Thunderstorm Wind	7	15	$25,199,200	$10,550,000	810	3,233
Tornadoes	4	17	$42,279,250	$80,000	172	252
Total	**11**	**35**	**$68,416,450**	**$10,630,000**	**1,390**	**4,982**

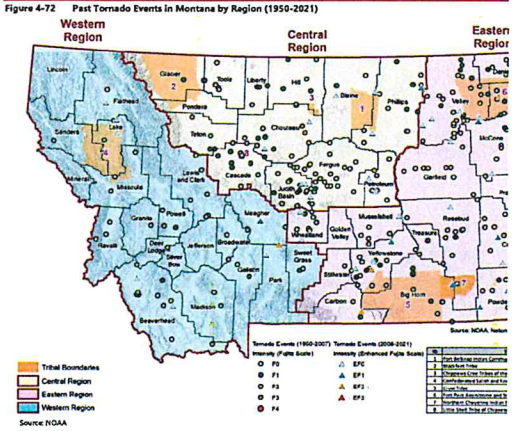
Source: NCEI

The NCEI dataset reports variation in the frequency of events across the Eastern Region. Thunderstorm Winds are the most common type of windstorm event. The Southern Wheatland Zone experiences the highest frequency of high wind events. Both the Southern Wheatland and Central and Southern Valley Zones also experience a high frequency of high wind events in comparison to the other zones in the planning area. Table 4-60 and Figure 4-74 below display a summary of high wind and strong wind events by zone.

Table 4-60 Total High Wind and Strong Wind Events by Zone (1996 to 2022)

Zone	High Wind	Strong Wind	Total
Absaroka / Beartooth Mountains (Zone)	3	0	3
Absarokee / Beartooth Mountains (Zone)	5	0	5
Beartooth Foothills (Zone)	81	0	81
Big Horn (Zone)	12	0	12
Carter (Zone)	50	0	50
Central And Southern Valley (Zone)	89	4	93
Crazy Mountains (Zone)	3	0	3
Custer (Zone)	43	0	43
Daniels (Zone)	36	0	36
Dawson (Zone)	78	0	78

Figure 4-72 Past Tornado Events in Montana by Region (1950-2021)



Source: NOAA

Zone	High Wind	Strong Wind	Total
Eastern Carbon (Zone)	18	0	18
Eastern Roosevelt (Zone)	24	0	24
Fallon (Zone)	56	0	56
Garfield (Zone)	83	1	84
Golden Valley (Zone)	23	0	23
Golden Valley/Musselshell (Zone)	5	0	5
Judith Gap (Zone)	69	0	69
McCone (Zone)	65	0	65
Musselshell (Zone)	57	0	57
Northern Big Horn (Zone)	16	0	16
Northern Rosebud (Zone)	49	0	49
Northern Stillwater (Zone)	71	0	71
Northern Valley (Zone)	29	0	29
Powder River (Zone)	17	0	17
Prairie (Zone)	37	0	37
Red Lodge Foothills (Zone)	21	0	21
Roosevelt (Zone)	9	0	9
Rosebud (Zone)	8	0	8
Sheridan (Zone)	61	0	61
Southern Big Horn (Zone)	33	0	33
Southern Rosebud (Zone)	14	0	14
Southern Wheatland (Zone)	101	0	101
Stillwater (Zone)	2	0	2
Stillwater/Carbon (Zone)	13	0	13
Valley (Zone)	10	0	10
Western Roosevelt (Zone)	44	0	44
Wheatland (Zone)	2	0	2
Wheatland/Park/Sweet Grass (Zone)	44	0	44
Wibaux (Zone)	39	0	39
Yellowstone (Zone)	72	0	72
Total	1,492	5	1,497

Source: NCEI

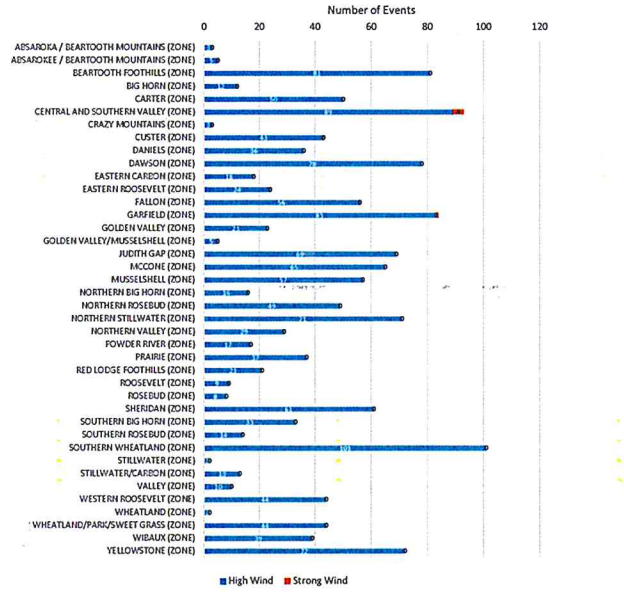
Table 4-61 Total Thunderstorm Wind and Tornado Events by County

	Thunderstorm Wind	Tornadoes
Big Horn Co.	128	11
Carbon Co.	28	3
Carter Co.	105	18
Custer Co.	215	8
Daniels Co.	63	9
Dawson Co.	205	15
Fallon Co.	91	14
Garfield Co.	221	12
Golden Valley Co.	14	0
McCone Co.	161	9
Musselshell Co.	43	5
Powder River Co.	121	18
Prairie Co.	102	3
Richland Co.	192	13
Roosevelt Co.	236	16
Rosebud Co.	172	9
Sheridan Co.	107	10
Stillwater Co.	66	1
Treasure Co.	47	3
Valley Co.	512	39
Wheatland Co.	23	7
Wibaux Co.	76	8
Yellowstone Co.	300	21
Total	3,233	252

Source: NCEI

Figure 4-75 and Figure 4-76 display crop and property losses by county from tornado and thunderstorm wind events. According to the dataset, Roosevelt County experienced the highest property loss and Dawson and Garfield Counties experienced the greatest crop loss from thunderstorm wind events. Yellowstone County experienced the greatest property loss from tornado events.

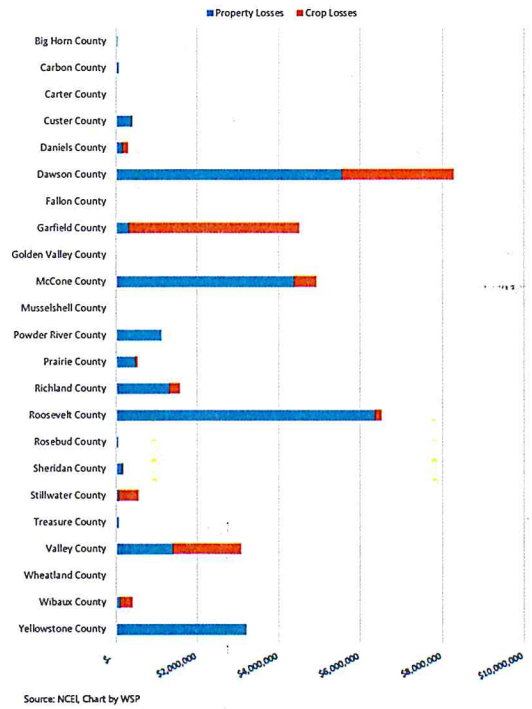
Figure 4-74 Total High Wind and Strong Wind Events by Zone (1996 to 2022)



Source: NCEI, Chart by WSP

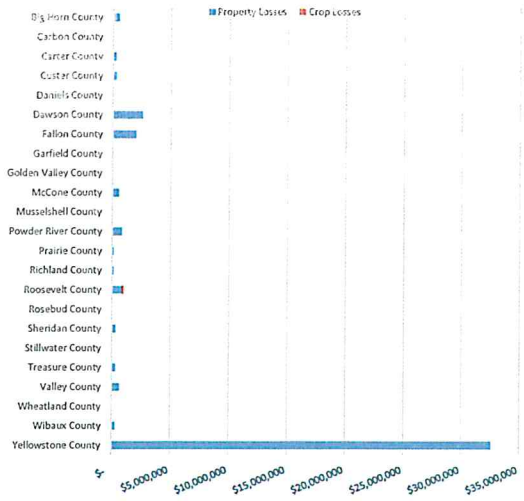
Similar to high wind and strong wind, there are variations in thunderstorm wind and tornado events between counties in the Eastern Region. Valley County experienced the greatest number of recorded events in both thunderstorm wind and tornado events. In total, there were 3,233 thunderstorm wind events since 1955 and 252 tornado events since 1950 in the Eastern Region. Table 4-61 displays a summary of these events.

Figure 4-75 Total Losses from Thunderstorm Wind by County



Source: NCEI, Chart by WSP

Figure 4-76 Total Losses from Tornadoes by County



Source: NCEI, Chart by WSP

The NCEI reported details on significant events in the Eastern Region:

- **July 13, 2005:** A severe bow echo raced from west to east across Roosevelt County and caused extensive damage from Poplar to Culbertson between 8 and 9 pm. Various properties and crops suffered from severe damage, including but not limited to two hangers from the airport were blown off; quite a few vehicles were blown off track; homes and businesses suffered roof and siding damage; large grain bins were destroyed; many trees were also damaged. This event resulted in $3M of property damage.
- **November 12, 2007:** A strong cold front moved across Western Montana and produced heavy snowfall and high winds in the Bitterroot and Sapphire Mountains as well as high winds in the Anaconda and Deer Lodge areas. This event resulted in $650,000 of property damage and 2 injuries.
- **June 20, 2010:** A very moist and unstable atmosphere was in place across portions of the Billings Forecast area during the afternoon and evening of the 20th. A moist, southeast surface flow, strong

wind shear aloft, and ample afternoon heating provided the necessary ingredients for severe weather. Numerous thunderstorms, some of which became rapidly severe producing tornadoes and large hail, developed across South Central Montana. Debris from an arena impacted other nearby businesses creating additional damage, mainly in the form of broken windows. Debris from the arena was reported to have landed as far away as a mile from the tornado touchdown. This event resulted in $30M of property damage.

- **July 27, 2015:** A low-pressure circulation over southeastern Montana; favorable winds, and warm, moist air all combined with an approaching strong upper-level storm system quickly developed and maintained well-organized severe thunderstorms over many locations; there was also a macroburst in the Glendive area. This event resulted in $2.5M of property damage.
- **September 28, 2019:** Strong east winds developed on the western side of the Whitefish and Mission ranges as high pressure settled into north-central Montana resulting in considerable damage. Severe wind caused various damages, including but not limited to damages to trees and powerlines; power outages that lasted for almost two days for thousands of customers; boat and dock damage as waves reached certain heights. This event resulted in $300,000 in property damage.

Frequency/Likelihood of Occurrence

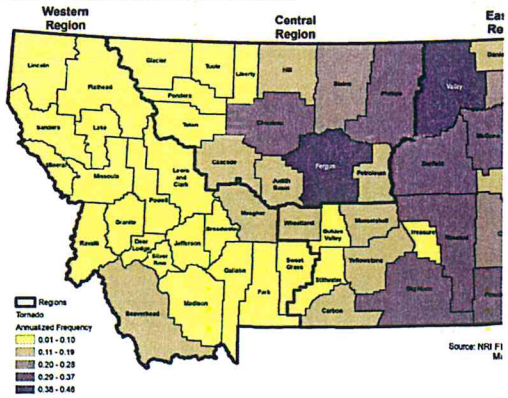
According to the NCEI dataset, there has been 4,982 total recorded severe windstorm and tornado events on 1,390 days over the past 72 years in the Eastern Region; therefore, there is an average of nearly 20 days with severe wind and tornado events per year in the planning area. This corresponds to a **highly likely** probability of occurrence.

Strong wind is the least documented type of windstorm in the Region and thunderstorm winds are the most common. Based on the NCEI dataset, tornadoes are likely to occur somewhere in the Region around 3.5 times a year on average. Valley County experienced the greatest number of recorded events in both thunderstorm wind and tornado events. The highest number of high wind events occur in the Southern Wheatland and Southern and Central Valley zones.

Figure 4-77 below depicts the annualized frequency of tornado events at a county level based on the NRI. The mapping shows a trend towards increased likelihood in the western and southern regions, particularly in Valley and Carter Counties. Counties in the eastern and northeastern portions of the Region have a relatively lower frequency of tornado events.

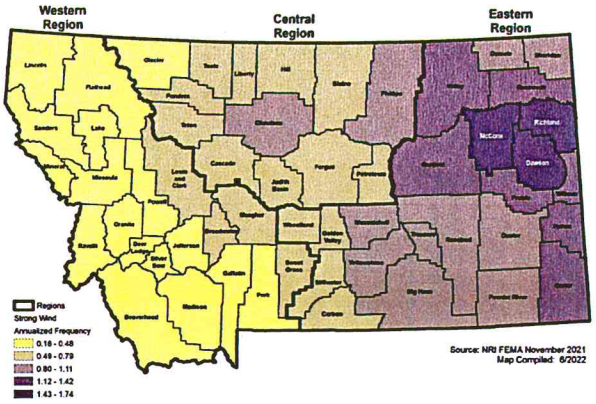
Figure 4-78 below depicts the annualized frequency of strong wind events at a county level based on the NRI. A majority of the counties in the region are ranked as moderate and moderate to high frequency, with the highest frequency of events occurring in McCone, Richland, and Dawson Counties.

Figure 4-77 Annualized Frequency of Tornado Events by County



Map by WSP, Data Source: FEMA National Risk Index, https://hazards.fema.gov/nri/determining-risk

Figure 4-78 Annualized Frequency of Strong Wind Events by County



Map by WSP, Data Source: FEMA National Risk Index, https://hazards.fema.gov/nri/data-resources#csv

Figure 4-79 and

if a trend currently exists. The Fifth National Climate Assessment does not directly address climate-change impacts on summertime wind. This assessment also did not suggest a trend in wind conditions exists, nor is anticipated. Additionally, the 2021 Montana Climate Change and Human Health report does not directly address the issue of summertime high winds. Interestingly, this report discusses an increase in wind erosion of soil in wheat production, but attributes this to increased summer drought and changing precipitation patterns, without mention of changes in wind conditions.

Potential impacts are discussed in the vulnerability subsection of this hazard profile, as well as the impacts of population changes and development trends. Current variability in vulnerability by jurisdiction, based on existing conditions, is discussed in these sections and jurisdictional annexes. Due to the uncertainty with climate change on tornadoes and windstorms, it would be speculative to define with further specificity the impacts related to climate change on each jurisdiction within the Region. Future updates to this plan should revisit this topic as scientific knowledge progresses.

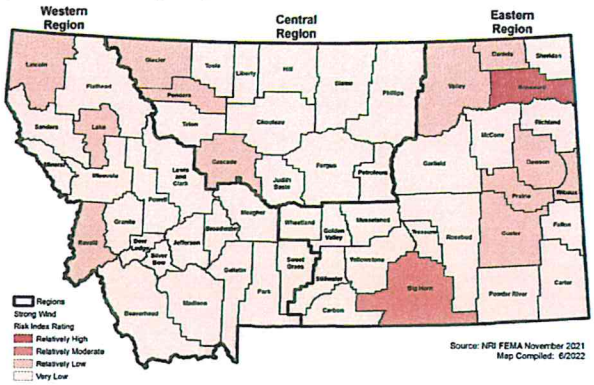
Potential Magnitude and Severity

To calculate a magnitude and severity rating for comparison with other hazards, and to assist in assessing the overall impact of the hazard on the planning area, information from the event of record is used as well as the Beaufort Wind Scale (see Table 4-58). In some cases, the event of record represents an anticipated worst-case scenario, and in others, it reflects common occurrence. While it is possible these estimates are greater than actual losses due to potential duplicates in the dataset, these losses provide an understanding of the likely magnitude in the planning area.

Overall, windstorm or tornado impacts in Eastern Region are generally **Critical**. While wind occurs rather frequently in the area, most events cause little to no damage. The impact on quality of life or critical facilities and functions in the affected area would be minimal. Injuries or deaths are possible due to wind-thrown trees in the backcountry or from other blown debris.

Vulnerability Assessment

Figure 4-79 NRI Risk Index Rating for Strong Wind



Map by WSP, Data Source: FEMA National Risk Index, https://hazards.fema.gov/nri/determining-risk

Other populations vulnerable to tornado and wind hazards include the elderly, low-income or linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Power outages due to severe wind or tornadoes can be life-threatening to those dependent on electricity for life support. These populations face isolation and exposure during thunderstorm wind, high wind, and tornado events and could suffer more secondary effects of the hazard. Overall, however, the vulnerability of people to tornado and wind hazards is low

Property

Exposure to windstorms and tornadoes is low throughout most of the planning area, property in poor condition or in particularly vulnerable locations may be susceptible to damage when these hazards do occur. Property located at higher elevations and on ridges may be more prone to wind damage. Property located under or near overhead powerlines or large trees may be damaged in the event of a collapse.

Older buildings in the planning area may be built to low code standards or none at all, making them more susceptible to severe wind and tornado events. Mobile homes are disproportionately at risk due to the design of homes. Tornadoes often create flying debris which can cause damages to homes, vehicles, and landscape.

In the Eastern Region, property damages due to wind and tornadoes totaled over $68.4M. Reported impacts from high wind in the planning area include damage to trees, mobile homes, roofs, power lines, and vehicles.

Critical Facilities and Lifelines

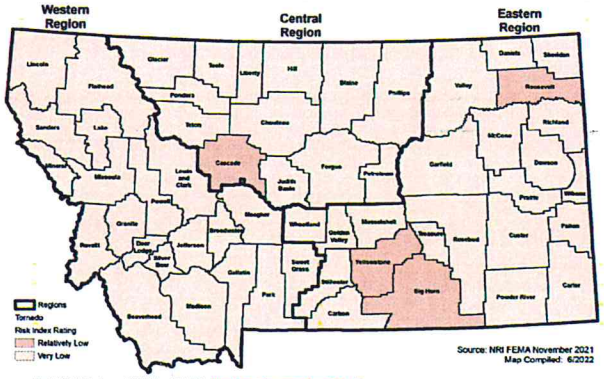
Transportation is susceptible to wind and tornado caused blockage of roads by downed trees or power lines. Of particular concern are roads providing access to isolated areas and the elderly. Temporary loss of utilities, most notably power, is a susceptibility. Downed power lines can cause blackouts, leaving large areas isolated, which was reported several times in the NCEI dataset. Phone, water, and sewer system service can be interrupted. Loss of phone connection, cellular or landline, would leave populations isolated and unable to call for assistance.

Economy

Exposure of the economy of the Eastern Region to ill effects is somewhat different for tornado and windstorm hazards. Windstorms are more frequent in the Eastern Region and have less intense impact over a wider area. In contrast, tornadoes are relatively rare, effect a relatively small area, but have a well-deserved reputation for causing intense destruction over a relatively narrow area. Both hazards expose local economies to potential property damage, business closures, loss of services such as power and transportation, displacement of people, loss of tourism and difficult to predict cascading effects. However, the economy is exposed to these factors somewhat differently depending on the storm type. For example, tornadoes are more likely to cause displacement of people, while windstorms can cumulatively cause very expensive damage, especially to housing.

In addition, the economy of the Eastern region is susceptible to damage from exposures such as property damage, business closures, loss of services such as power and transportation, displacement of people, and loss of tourism. The economy is also susceptible to cascading effects caused by these exposures.

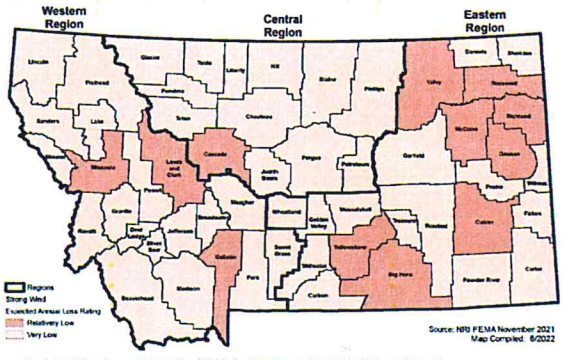
Figure 4-80 NRI Risk Index Rating for Tornadoes



Map by WSP, Data Source: FEMA National Risk Index, https://hazards.fema.gov/nri/determining-risk

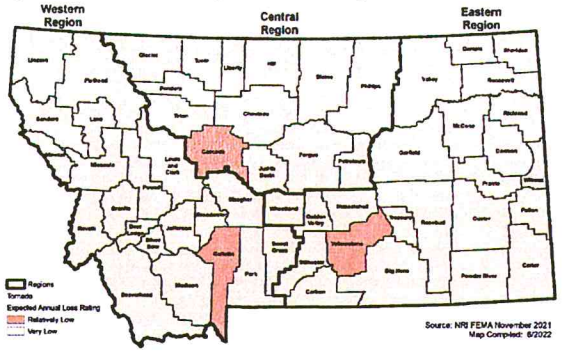
tornado hazards in all Eastern Region counties. The EAL calculation takes into account agriculture value exposed to these events, annualized frequency, and historical losses. The EAL rating is thus heavily based on agricultural impacts.

Figure 4-81 NRI Strong Wind Expected Annual Loss Rating



Map by WSP, Data Source: FEMA National Risk Index, https://hazards.fema.gov/nri/determining-risk

Figure 4-82 NRI Tornado Events Expected Annual Loss Rating



Map by WSP, Data Source: FEMA National Risk Index, https://hazards.fema.gov/nri/determining-risk

Historic and Cultural Resources

Historic and cultural resources are exposed to tornadoes and windstorms similarly to other assets. In terms of susceptibility, historic buildings are typically built to old building codes or no codes at all and are more likely to sustain damage than newer buildings. This causes historic buildings and their contents to be more vulnerable to windstorms and tornadoes than newer buildings. Historic assets within newer buildings, such as a more recently built museum, are likely no more vulnerable to windstorm and tornadoes than non-historic assets.

Natural Resources

The environment is highly exposed to severe winds and tornadoes. Large swaths of tree blowdowns can occur, particularly in the beetle-killed forests prevalent in the region. Severe winds can spread wildfire or even trigger wildfire near overhead power lines. Crops are also at risk of losses. The NCEI dataset reported over $10.6 M in crop losses from windstorm and tornado events in the Eastern Region.

Development Trends Related to Hazards and Risk

All future development will be exposed to severe winds and tornadoes. The ability to withstand impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction. Development regulations that require safe rooms, basements, or other structures that reduce risk to people would decrease vulnerability but may not be cost-effective given the relative infrequency of damaging tornadoes in the Eastern Region.

The State of Montana has adopted the 2012 International Building Code IBC. The IBC includes a provision that buildings must be constructed to withstand a wind load of 75 mph constant velocity and three-second

gusts of 90 mph. Buildings must be designed to withstand a snow load of 30 pounds per square foot minimum.

Risk Summary

In summary, the tornadoes and windstorms hazard are considered to be of overall high significance for the Region. with key issues summarized below. Variations in risk by jurisdiction are summarized in the table below.

- Severe windstorms (high wind, strong wind, thunderstorm wind) and tornado events are rated as having **high** overall significance for the Eastern Region
- These events can impact anywhere in the planning region; therefore, the hazard extent is rated as **extensive.**
- The NCEI data reported 1,390 days with severe weather events over 72 years, which averages to nearly 20 days a year with severe winter weather events in the Eastern Region; therefore, future occurrence is rated as **highly likely.**
- The NCEI reported 11 deaths, 35 injuries, over $68.4 million in property damages and over $10.6 million in crop damages, therefore, the magnitude is rated as **critical.**
- People who are dependent on electricity and populations who work outdoors or in transportation are most vulnerable to severe windstorm events and tornadoes. Individuals living in mobile homes are also disproportionately likely to experience losses from wind and tornado events.
- Power outages and damage to buildings are frequently reported impacts to property of severe windstorm events and tornadoes.
- Downed power lines resulting in communication and electricity failures are the most common impacts on critical facilities.
- Significant economic losses are possible in the event of a severe windstorm or tornado due to infrastructure repair and business/service disruptions.
- Related Hazards: Wildfire, Severe Summer Weather, Severe Winter Weather, Transportation Accidents

Table 4-62 Risk Summary Table: Tornadoes and Windstorms

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences
Eastern Region	Medium		
Big Horn	Medium	Hardin, Lodge Grass	None
Carbon	Medium	Bearcreek, Bridger, Joliet, Fromberg, Red Lodge	None
Carter	Medium	Ekalaka	None
Custer	Medium	Ismay, Miles City	None
Crow Tribe	High		None
Daniels	Medium	Scobey, Flaxville	None
Dawson	High	Richey, Glendive	There have been a higher number of wind events that resulted in losses in Dawson County
Fallon	Medium	Plevna, Baker	None
Garfield	Medium	Jordan	There have been a higher number of wind events that resulted in losses in Garfield County
Golden Valley	Medium	Ryegate, Lavina	None
McCone	Medium	Circle	There have been a higher number of wind events that resulted in losses in McCone County

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences
Musselshell	Medium	Melstone, Roundup	None
Powder River	Medium	Broadus	None
Prairie	Medium	Terry	None
Richland	Medium	Fairview, Sidney	None
Roosevelt	High	Wolf Point, Poplar, Bainville, Culberson, Froid	There have been a higher number of wind events that resulted in losses in Roosevelt County
Rosebud	Medium	Colstrip, Forsyth	None
Sheridan	Medium	Plentywood, Medicine Lake, Outlook, Westby	None
Stillwater	Medium	Columbus	None
Treasure	Medium	Hysham	None
Valley	High	Glasgow, Fort Peck, Nashua, Opheim	There have been a higher number of wind events that resulted in losses in Valley County
Wibaux	Medium	Wibaux	None
Yellowstone	High	Billings, Broadview, Laurel	There have been a higher number of wind events that resulted in losses in Yellowstone County

4.2.14 Transportation Accidents

Hazard/Problem Description

This hazard encompasses air transportation, highway transportation, waterway transportation, railway transportation, and wild animal vehicle collisions. The transportation incidents can involve any mode of transportation that directly threatens life and which results in property damage and/or death(s)/injury(s) and/or adversely impact a community's capabilities to provide emergency services. Incidents involving buses and other high occupancy vehicles could trigger a response that exceeds the normal day-to-day capabilities of response agencies.

Air Transportation

An air transportation incident may involve a military, commercial or private aircraft. Airplanes and helicopters are used to transport passengers for business and recreation as well as thousands of tons of cargo. A variety of circumstances can result in an air transportation incident; mechanical failure, pilot error, enemy attack, terrorism, weather conditions and on-board fire can all lead to an air transportation incident.

Highway Transportation

Highway transportation incidents are complex. Contributing factors can include a roadway's design and/or pavement conditions (e.g., rain, snow, and ice), a vehicle's mechanical condition (e.g., tires, brakes, lights), a driver's behavior (e.g., speeding, inattentiveness, and seat belt usage), the driver's condition (e.g., alcohol use, age-related conditions, physical impairment) and driver inattention by using a wireless device. In fact, the driver's behavior and condition factors are the primary cause in an estimated 67 percent of highway crashes and a contributing factor in an estimated 95 percent of all crashes.

Railway Transportation

A railway transportation incident is a train accident that directly threatens life and/or property, or adversely impacts a community's capabilities to provide emergency services. Railway incidents may include

derailments, collisions and highway/rail crossing accidents. Train incidents can result from a variety of causes; human error, mechanical failure, faulty signals, and/or problems with the track. Results of an incident can range from minor "track hops" to catastrophic hazardous material incidents and even human/animal casualties.

Waterway Transportation

A waterway incident is an accident involving any water vessel that threatens life, property, or adversely affects a community's capability to provide emergency services. Waterway incidents primarily involve pleasure watercraft on rivers and lakes. Waterway incidents may also include events in which a person, persons, or object falls through the ice on partially frozen bodies of water. Impacts include fuel spillage, drowning, and property damage.

Wild Animal Vehicle Collisions

Wild animal vehicle collisions consist of any roadway transportation accident where an animal is involved in the accident. These accidents typically occur at dusk, from 6pm-9pm, when deer and other wildlife are most active and when the visibility of drivers decreases. Deer are the most common wild animal involved in roadway transportation accidents in the United States and in the Eastern Region.

Geographical Area Affected

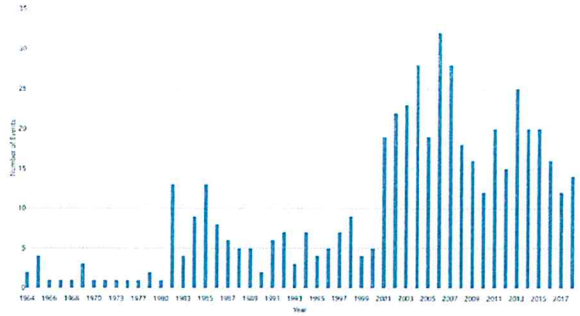
All counties in the Eastern Region are prone to transportation incidents. Due to transportation accidents typically occurring along roadways, waterways, or near airports, the significance rating for the geographic area affected in the Eastern Region is rated as **significant** (10-50% of planning area). Roads with frequently reported roadway transportation accidents in the Eastern Region include Highway 2, Highway 12, U.S. Route 191, Interstate 90, and Interstate 94. The BNSF railway is the most significant railway running through the Eastern Region; therefore, the counties that contain the BNSF railway will be more likely to experience railway accidents. The Eastern Region is also home to Billings Logan International Airport, as well as several smaller regional or general aviation airports, any of which could be the location of an aircraft accident. However, documented aircraft crashes have happened across the planning area and are most frequently documented as being small civilian aircrafts.

Past Occurrences

Air Transportation Incidents:

The National Transportation Safety Board (NTSB) reported 505 air transportation incidents in the State from 1964 to 2018. Figure 4-83 displays the annual trends of total fatal air transportation accidents. The greatest number of incidents were reported in 2006 with 32 total incidents. Since 2001, there has been a significant increase in the number of events reported. Most crashes have been small, private planes. Small Cessna and Piper aircrafts were frequently reported in the dataset.

Figure 4-83 Annual Aircraft Incidents in the State of Montana



Source: NTSB, Chart by WSP

Highway Transportation Incidents:

The Montana Department of Transportation's Office of Traffic and Safety maintains traffic crash statistics and location maps by county. Table 4-63 and Figure 4-84 shows the trend of crashes in the Eastern Region between 2016 and 2020. This dataset was extracted from the MDT's Crash Database compiled for the purpose of safety enhancement of potential accident sites, hazardous roadway conditions, or railway-highway crossings. The dataset has reported 26,984 road transportation events over the course of 4 years across the counties in the Eastern Region. Yellowstone County had the greatest number of reported crash events by far, with a total of 16,475 reported events, comprising 61% of the total incidents in the Region from 2016- to 2020.

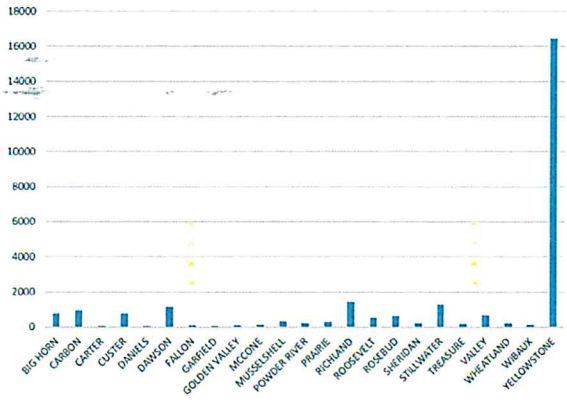
Table 4-63 Roadway Crash Statistics by County in the Eastern Region (2016-2020)

County	Number of Accidents (2016-2020)
Big Horn	782
Carbon	966
Carter	68
Custer	777
Daniels	78
Dawson	1,153
Fallon	87
Garfield	77
Golden Valley	95
McCone	134
Musselshell	342
Powder River	227
Prairie	307

County	Number of Accidents (2016-2020)
Richland	1,447
Roosevelt	534
Rosebud	656
Sheridan	234
Stillwater	1,291
Treasure	203
Valley	694
Wheatland	218
Wibaux	139
Yellowstone	16,475
Grand Total	**26,984**

Source: Montana Department of Transportation 2016-2020

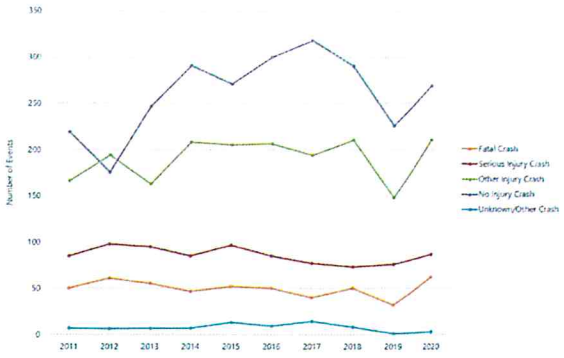
Figure 4-84 Roadway Crash Statistics by County in the Eastern Region (2016-2020)



Source: Montana Department of Transportation 2016-2020

The Montana DoT also reported crash severity from 2011 to 2020 for the entire state of Montana. Figure 4-85 displays the temporal trends of crash severity. Throughout the state, accidents with no injury are most commonly reported, followed by accidents with minimal injuries. Since 2011, 499 fatal crashes have been reported across the state and 858 serious injury crashes. There is an average of 49.9 fatal crashes per year in the State of Montana.

Figure 4-85 Roadway Crash Severity in Montana (2011-2020)



Source: Montana Department of Transportation 2011-2020

Wildlife Car Accidents

The Montana DoT also documented the number of accidents caused by wildlife and the animal carcasses recovered. Montana DoT emphasizes that this dataset is best used to identify patterns in wildfire car accidents, but the data is incomplete due to not all carcasses being reported on a regular schedule or some carcasses not being reported at all. According to the Montana DoT dataset, there were 28,652 wildlife car accidents from 2016 to2020. Figure 4-86 displays the animal carcass data by county in Montana. Most of the Eastern Region has experienced between 1-348 wildlife car accidents, however, Carbon, Custer, and Dawson County have experienced significantly more.

Figure 4-86 Wildlife Crash Statistics by County in Montana (2016-2020)

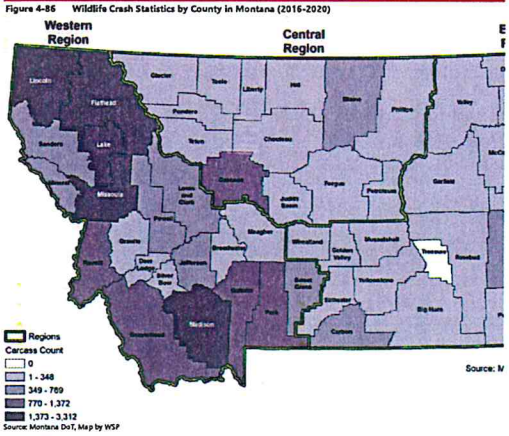
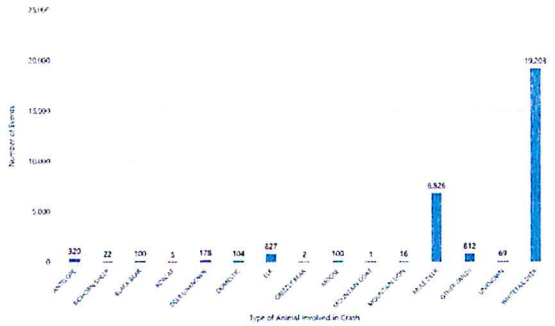


Figure 4-87 displays a breakdown of the crashes by species of animal involved. Whitetail deer was by far the most reported animal with 19,203 incidents in the past 4 years, followed by mule deer in second place with 6,826 reported incidents.

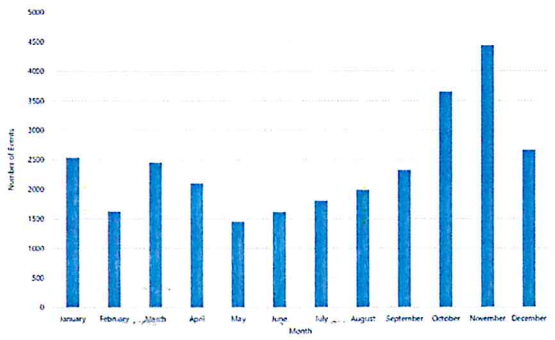
Figure 4-87 Wildlife Crash Statistics by Carcass Type in the Montana (2016-2020)



Source: Montana Department of Transportation 2016-2020

The Montana DOT also reported on the date that these wildlife accidents occurred. Figure 4-88 displays the temporal trends of these crashes. The greatest frequency of events occurs in the months of October and November. This is likely because deer mating season occurs at this time of year and therefore, they are more active and likely to wonder onto roadways. Accidents with deer are most likely to occur from 6 pm – 9 pm due to the crepuscular nature of deer, meaning that they are most active during twilight.

Figure 4-88 Wildlife Crash Statistics by Month in Montana (2016-2020)



Source: Montana Department of Transportation 2016-2020

Waterway Transportation Incidents

Montana has a number of glacial-fed lakes and free-flowing rivers that provide opportunities for tourism and recreation. Several major rivers in the Eastern Region include the Yellowstone River and Missouri River. Fort Peck Lake also provides space for outdoor recreation in the Eastern Region. With extensive opportunities for water recreation in the state, there are associated risks including boating accidents and drownings.

The U.S. Coast Guard documents annual recreational boating statistics across the United States. Table 4-64 below displays information from the annual reports for the State from 2017 to2021. In total, 82 accidents have been reported in Montana over the past 5 years, resulting in 32 deaths and 41 injuries, as well as $450,925.95 in property damages.

Table 4-64 Boating Accidents by Year in Montana (2017-2021)

	Number of Accidents				Persons Involved			
Year	Total	Fatal	Non-Fatal	Property Damage	Total	Deaths	Injured	Damages
2021	16	4	6	6	12	5	7	$56,050.00
2020	25	7	9	9	20	7	13	$178,600.00
2019	13	4	6	3	13	5	8	$59,275.95
2018	19	9	6	4	22	13	9	$144,900.00
2017	9	2	3	4	6	2	4	$12,100.00
Total	82	26	30	26	73	32	41	$450,925.95

Source: U.S. Coast Guard 2017-2021 Recreational Boating Statistics

Frequency/Likelihood of Occurrence

Overall, transportation accidents are all but certain to occur on a yearly basis; therefore, the frequency/likelihood of occurrence is rated as **highly likely** for the Eastern Region. Air traffic overall is more limited and any planes that crash are likely to be small planes with no more than a pilot and potentially one to a few passengers. However, since there are many commercial planes that fly over the Eastern Region, there is always a chance for a major crash. More people are utilizing air travel now than in the past. The NTSB documented 505 aircraft accidents over 54 years, which averages over 9 aircraft accidents per year across the region. The trend of increasing numbers of people flying is likely to continue as will the crowdedness of airports and the skies above Montana.

Although traffic engineering, inspection of traffic facilities, land use management of areas adjacent to roads and highways, and the readiness of local response agencies have increased, highway incidents will continue to occur. As the volume of traffic on the state's streets, highways, and interstates increases, the number of traffic accidents will likely also increase. The combination of large numbers of people on the road, wildlife, unpredictable weather conditions, potential mechanical problems, and human error always leaves the potential for a transportation accident open. Local jurisdictions should continue to look at where traffic signals and speed limit changes are needed to protect the public. Montana DoT reported 26,984 roadway traffic accidents from 2016 to 2020 in the Eastern Region, or an average of 6,746 accidents per year. Collisions involving wildlife is commonly reported in Montana. The Montana DoT carcass database reported 28,652 accidents resulting in an animal carcass from 2016 to 2020, or an average of 7,163 accidents a year.

Many ponds, rivers, and lakes are used for recreation, including angling, boating, and swimming. The number of users of Montana lakes and rivers is increasing with increased tourism and population growth in the area. Minor incidents involving one or two boats and/or individuals can occur that tie up response resources and cause death and injury are possible but unlikely each year. Incidents will be recreational-related, as opposed to transportation-related, because the waterways are too small to support barges. Waterway accidents are less likely to occur than roadway incidents. However, the U.S. Coast Guard reported 82 waterway accident events from 2017 to 2021 across the State of Montana, or an average of 16 events per year.

Based on the available information, the probability of air transportation, highway, waterway, or railway incident that directly threatens life and which results in property damage and/or death(s)/injury(s) and/or adversely impact a community's capabilities to provide emergency services is "Highly Likely" as multiple occurrences happen each year.

Climate Change Considerations

If projections regarding milder winters come to fruition, climate change impacts may reduce the number of transportation incidents associated with some severe weather. However, if ice occurs, rather than snow, this could result in higher incidents of weather-related accidents. Extreme heat can also impact the performance of motor vehicles, especially planes (McFadden, 2021). Increasing temperatures due to climate change could therefore pose threats to aircrafts.

Potential Magnitude and Severity

The U.S. Department of Transportation Federal Highway Administration issued a technical advisory in 1994 providing suggested estimates of the cost of traffic crashes to be used for planning purposes. These figures were converted from 1994 dollars to 2020 dollars. The costs are listed below in Table 4-65. Injuries and deaths are also impacts of transportation accidents. While transportation accidents are frequent in the Eastern Region, most accidents result in minor property injuries to vehicles involved; therefore, the magnitude ranking for transportation incidents in Eastern Region is **limited**.

Table 4-65 Costs of a Traffic Crash

Severity	Cost per injury (in 2020 $)
Fatal	$4,645,467
Evident Injury	$64,320
Possible Injury	$33,948
Property Damage Only	$3,573

Source: U.S. DOT Federal Highway Administration Technical Advisory T 7570.2, 1994. Adjusted to 2020 dollars

Vulnerability Assessment

People

All people are vulnerable to transportation accidents in the Eastern Region. Travelers, truckers, delivery personnel, and commuters are always at risk on the road. During rush hours and holidays the number of people on the road is significantly higher. This is also true before and after major gatherings such as sporting events, concerts, and conventions. Pedestrians and bystanders of the community are less vulnerable unless they are in the roadway. Any individual incident will have a direct impact on only a few people. Individuals involved in a transportation accident can have cuts, bruises, broken bones, loss of limbs, and death. It is also common for individuals involved in an accident to experience psychological effects from a severe accident.

Not all people are equally vulnerable to transportation incidents. According to a study, An Analysis of Traffic Fatalities by Race and Ethnicity 2021, by the Governors Highway Safety Association, found that traffic fatalities are more common in low-income areas and among Native and Black Americans. The study found that in 2020, total traffic deaths in the United States rose by 7.2%, but total traffic deaths among Black Americans increased by 23%. The study reported several reasons for this, including poor road quality in low-income areas, pedestrians being disproportionally Black, and members of the low-income population being unable to stay home from work during the pandemic.

Property

All property is vulnerable to transportation accidents, including the modes of transportation themselves and all associated equipment. Roadway accidents can impact surrounding infrastructure, including surrounding buildings, poles, or guardrails. Railway accidents frequently result in damages to the railway tracks which can be expensive to repair and result in delays in the transportation of goods. Aircraft accidents frequently result in damaged or destroyed planes, as well as damage to infrastructure in the landing area. Boating incidents can cause extensive damage to ships, bridges, and docks.

Critical Facilities and Lifelines

Transportation accidents can result in delayed responses for emergency vehicles and severe or multi-car accidents can put a strain on response services and hospital capacity. The transportation of goods can also be delayed due to road closures from an accident. Power outages are also possible due to damages infrastructure.

Economy

There are significant economic impacts likely to result from transportation accidents. Cost of repairing property and hospital bills for those impacted by the accident can be substantial. The U.S. DoT reported the estimated cost of a fatality is over $4.6 million in damages. Additionally, lost revenue from business disruptions and disruptions in the transportation of goods can be significant.

Historic and Cultural Resources

Historic and cultural resources are equally vulnerable to transportation accidents as other types of property.

Natural Resources

The impacts of transportation accidents to natural resources are typically minimal. These accidents can result in debris and fuel leakage into the environment, which can harm the surrounding ecosystem. Trees and

other landscaping can be damaged when a vehicle leaves the roadway. Wildlife is also at risk to injury or death due to vehicles on the road. Significant threat to natural resources could occur if a transportation accident involving hazardous materials occurs.

Development Trends Related to Hazards and Risk

Increasing roadway infrastructure and number of cars on the road will likely result in an increase in the number of transportation accidents in the Eastern Region. Increase in air travel is likely to continue and therefore the increase in number of aircraft disasters. Construction and re-routing of local roads also increases the chances of a traffic accident.

Risk Summary

In summary, the transportation accidents hazard is considered to be overall **medium** significance for the Region. Variations in risk by jurisdiction are summarized in the table below, as well as key issues noted in the vulnerability assessment.

- These events typically impact areas along roadways, railways, waterways, or near airports; therefore, the hazard extent is rated as **significant**.
- The data sources used for each type of transportation accidents reported significantly more than one accident a year, therefore, frequency is rated as **highly likely.**
- While transportation accidents commonly occur, most accidents impact only the people and vehicles involved and therefore magnitude is ranked as **limited.**
- People who work in transportation and spend extensive time on the road, such as truck drivers or deliver drivers, are most likely to experience transportation accidents. Studies have found that Black and Native Americans are disproportionately likely to be involved in a transportation accidents and accidents are more likely to occur in low-income areas.
- Transportation accidents are likely to cause damage to the vehicles involved as well as surrounding infrastructure. First responder services may be delayed due to multi-car pileup accidents or significant train derailments.
- Significant economic losses can result from business interruptions due to delays in the transportation of goods and from repairs to transportation vehicles and infrastructure.
- Critical infrastructure such as bridges and major roads can be blocked off or closed due to major roadway accidents. Railroads can also be closed for extended periods of time due to track damage, which would limit the movement of goods in and out of the areas impacted.
- The frequency of transportation accidents is frequent across jurisdictions, but some counties such as Yellowstone County are likely to experience greater losses due to larger populations and greater concentration of transportation systems.
- Related Hazards: Hazardous Materials Accident

Table 4-66 Risk Summary Table: Transportation Accidents

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
Eastern Region	Medium		
Big Horn	Low	Hardin, Lodge Grass	Railway in Big Horn County, through Hardin and Lodge Grass
Carbon	Low	Bearcreek, Bridger, Joliet, Fromberg, Red Lodge	N/A
Carter	Low	Ekalaka	N/A
Custer	Low	Ismay, Miles City	Railway through Miles City; I-94 crosses county

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
Crow Tribe	Low		Studies have shown Native American populations may be at increased vulnerability for traffic accidents
Daniels	Low	Scobey, Flaxville	None
Dawson	Low	Richey, Glendive	Railway through Glendive; I-94 crosses county
Fallon	Low	Plevna, Baker	Railway through Plevna and Baker, Highway 12 crosses county
Garfield	Low	Jordan	None
Golden Valley	Low	Ryegate, Lavina	Railway crosses county
McCone	Low	Circle	N/A
Musselshell	Low	Melstone, Roundup	Highways 12 and 87 intersect in central Musselshell County
Powder River	Medium	Broadus	N/A
Prairie	Low	Terry	Railway through Terry; I-94 crosses county
Richland	Low	Fairview, Sidney	None
Roosevelt	Low	Wolf Point, Poplar, Bainville, Culberson, Froid	Railway through Wolf Point and Poplar; Highway 2 crosses county
Rosebud	Low	Colstrip, Forsyth	Railway through Forsyth; I-94 crosses county
Sheridan	Low	Plentywood, Medicine Lake, Outlook, Westby	Railway through County, crosses through multiple towns
Stillwater	Medium	Columbus	Railway through County; I-90 crosses county
Treasure	Low	Hysham	Railway through Hysham; I-94 crosses county
Valley	Medium	Glasgow, Fort Peck, Nashua, Opheim	Railway through Valley County,
Wibaux	Low	Wibaux	None
Yellowstone	Medium	Billings, Broadview, Laurel	Billings is the largest city in the State, and Yellowstone County is the most populous county. This high level of traffic volume coupled with extensive transportation infrastructure of multiple modes gives Yellowstone County the greatest numbers of incidents by far in the region

4.2.15 Volcanic Ash

Hazard/Problem Description

A volcano is a vent in the earth's crust, or a mountain formed by the eruption of subsurface material including lava, rock fragments, ash, and gases, onto the earth's surface. Volcanoes produce a wide variety of hazards that can damage and destroy property and cause injury and death to people caught in its path. These hazards related to volcanic activities include eruption columns and clouds, volcanic gases, lava/pyroclastic flows, volcanic landslides, and mudflows or debris flows (called lahars). Large explosive eruptions can cause damage several hundred miles away from the volcano, primarily from ashfall.

Volcanic eruptions are generally not a major concern in Montana due to the relatively low probability of events in any given year. However, Montana is within a region with a significant component of volcanic

activity and has experienced the effects of volcanic activity as recently as 1980 during the eruption of Mount St. Helens in the State of Washington.

Based on the evidence of past activity, volcanoes can be considered "active", "dormant", or "extinct." "Active" volcanoes usually have evidence of eruption during historic times. Volcanoes have a wide degree of variability in their eruptions, from mild lava flows to large explosions that eject tons of material and ash into the air. The degree of volcano hazard depends largely on if the volcano has a reasonable probability of erupting, the nature of the eruption, and the associated hazards that may be triggered. There are 20 active or potentially active volcanoes in the United States. The two volcanic centers affecting Montana in recent geologic time are: 1) the Cascade Range of Washington, Oregon, and California; and 2) the Yellowstone Caldera in Wyoming and eastern Idaho. Based on the historic trends of past eruptions, volcanic eruptions in the Cascade Mountains are more likely to impact Montana than Yellowstone eruptions. The primary effect of the Cascade volcanic eruptions in Montana would be ash fall.

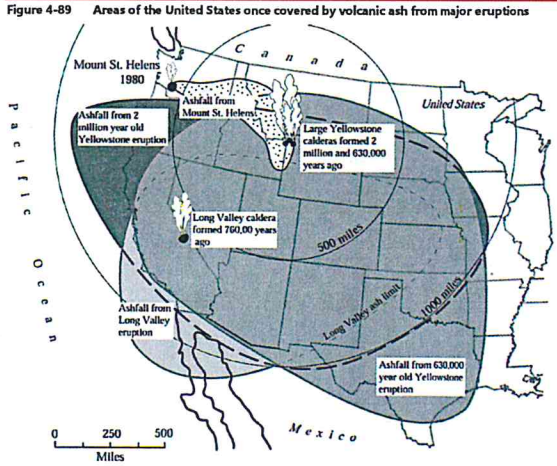
The distribution of ash from a violent eruption is a function of the weather, particularly wind direction and speed and atmospheric stability, and the duration of the eruption. As the prevailing wind in the mid-latitudes of the northern hemisphere is generally from the west, volcanic ash is usually spread eastward from the volcano. Exceptions to this rule do, however, occur. Ash fall, because of its potential widespread distribution can result in significant volcanic hazards.

According to the U.S. Geological Survey, Yellowstone National Park has been identified as a prominent hot spot for geologic activity. The hot spot is presumed to exist under the continental crust in the region of Yellowstone National Park and northwestern Wyoming. Large calderas under the park were produced by three gigantic eruptions during the past two million years, the most recent of which was approximately 600,000 years ago. That particular volcanic eruption blasted molten rock into the air at 1,000 times the volume of the 1980 Mount St. Helen's eruption subsequently collapsing to create the Yellowstone Caldera (Tracking Changes in Yellowstone's Restless Volcanic System, USGS Website). Ash deposits from these volcanic eruptions have been mapped in Iowa, Missouri, Texas, and northern Mexico. Thermal energy from the hot spots fuel hot pools, springs, geysers, and mud pots in the park today. According to recent surveys, parts of the Yellowstone region rise and fall as much as 1 centimeter a year, indicating the area is still geologically active (Kious, Jacqueline and Robert Tilling ND). However, these measurable ground movements, which most likely reflect hydrothermal pressure changes, do not necessarily signal renewed volcanic activity in the area." (Kious, Jacqueline and Robert Tilling ND)

Geographical Area Affected

The geographical extent of volcanic ash is **extensive.** All areas of the Eastern Region would be affected by a volcanic eruption of the Yellowstone caldera. According to the 2018 Montana SHMP, western and southwestern Montana are most vulnerable to eruptions and ashfall from the Cascade Volcanoes. As shown in Figure 4-89 below, almost all of the state of Montana has been covered with volcanic ash at some point in the recent geologic history.

Figure 4-89 Areas of the United States once covered by volcanic ash from major eruptions



Source: U.S. Geological Survey

Past Occurrences

Since the late 1700s, volcanic eruptions in the continental United States have occurred in Oregon, Washington, and California. The most recent volcanic activity in the Yellowstone region occurred 70,000 years ago in the form of a lava flow. However, the volcanic ash fallout from the eruption of Mount St. Helens in 1980 was the most recent occurrence of volcanic activity to impact the region. Local news sources reported the sky appeared to be foggy, and a thin layer of gritty, dull, grey powder was deposited in many areas of Montana. The 2018 Montana SHMP notes travel was restricted in western Montana for over a week because of concerns for public health, and that the main hazards associated with ash were reduced visibility (resulting in closed roads and airports), clogging of air filters, and a health risk to children, the elderly, and people with cardiac or respiratory conditions.

Frequency/Likelihood of Occurrence

The frequency of volcanic as in the Eastern Region is ranked as **unlikely.** Ashfall from a Cascade Volcano is the primary hazard to which the State may be vulnerable in the future. Future eruptions in the Cascades are certain and have occurred at an average rate of 1-2 times per century during the last 4,000 years. Seven volcanoes in the Cascades have erupted in the last 200 years. The next eruption in the Cascades could affect hundreds of thousands of people. The effect in Montana would depend on the interaction of such variables as source location, frequency, magnitude and duration of eruptions, the nature of the ejected material and

the weather conditions. Therefore, the entire State may be considered vulnerable to ashfall to some degree in the event of a volcanic eruption.

Three major periods of activity in the Yellowstone system have occurred at intervals of approximately 600,000 years, with the most recent occurring about 600,000 years ago. The evidence available is not sufficient to confirm that calderas such as the one in Yellowstone erupt at regular intervals, so the amount of time elapsed is not necessarily a valid indicator of imminent activity. There is no doubt, however, that a large body of molten magma exists, probably less than a mile beneath the surface of Yellowstone National Park. The presence of this body has been detected by scientists who discovered that earthquake waves passing beneath the park behave as if passing through a liquid. The only liquid at that location that could absorb those waves is molten rock. The extremely high temperatures of some of the hot springs in the park further suggest the existence of molten rock at shallow depth. A small upward movement in the magma could easily cause this magma to erupt at the surface. If a major eruption occurred, the explosion would be "comparable to what we might expect if a major nuclear arsenal were to explode all at once, in one place" (Roadside Geology of Montana, Alt and Hyndman, 1986).

Climate Change Considerations

While climate change is not expected to impact the size or frequency of eruptions, eruptions themselves can have a huge impact on climate. Eruptions can inject millions of tons of gases and debris into the atmosphere, which can circulate far away from the incident site and disrupt normal climate patterns. Large-scale volcanic activity may only last a few days, but the massive outpouring of gases and ash can influence climate patterns for years, influencing both heating and cooling.

For example, the 1883 eruption of the Krakatoa volcano in Indonesia resulted in far reaching global climate impacts, with the average summer temperatures in the Northern Hemisphere falling by 0.72 degrees Fahrenheit the year after the eruption. The 1815 Mt. Tambora eruption, also in Indonesia, was the deadliest volcanic eruption in recorded history. It also led to global climate impacts resulting in 1816 being referred to as "the Year Without a Summer". According to NASA, average global temperatures dropped with frost and snow experienced in the middle of summer as far away as New England and Europe, leading to massive crop losses and famine. A similar scale eruption of the Yellowstone Caldera would also likely eject massive amounts of gasses which would affect the global climate, as well as the Eastern Montana.

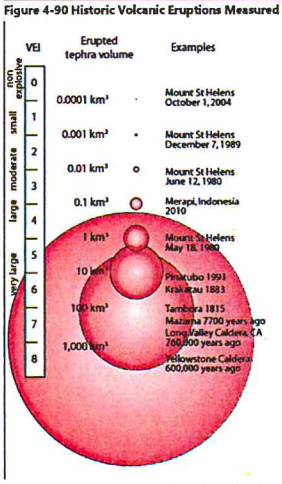
Potential Magnitude and Severity

The potential magnitude and severity of volcanic ash is **limited**. Populations living near volcanoes are most vulnerable to volcanic eruptions and lava flows, although volcanic ash can travel and affect populations many miles away and cause aviation issues. The USGS notes specific characteristics of volcanic ash. Volcanic ash is composed of small, jagged pieces of rocks, minerals, and volcanic glass the size of sand and silt. Very small ash particles can be less than 0.001 millimeters across. Volcanic ash is not the product of combustion, like the soft fluffy material created by burning wood, leaves, or paper. Volcanic ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet.

Volcanic ash is formed during explosive volcanic eruptions. Explosive eruptions occur when gases dissolved in molten rock (magma) expand and escape violently into the air, and also when water is heated by magma and abruptly flashes into steam. The force of the escaping gas violently shatters solid rocks. Expanding gas also shreds magma and blasts it into the air, where it solidifies into fragments of volcanic rock and glass. Once in the air, wind can blow the tiny ash particles thousands of miles away from the volcano.

Cataclysmic eruptions of the Yellowstone volcano 2.0, 1.3, and 0.6 million years ago ejected huge volumes of rhyolite magma; each eruption formed a caldera and extensive layers of thick pyrodastic-flow deposits. The caldera is buried by several extensive rhyolite lava flows that erupted between 75,000 and 150,000 years ago.

Figure 4-90 Historic Volcanic Eruptions Measured on the Volcanic Explosivity Index Scale



Historic eruptions measured on the Volcanic Explosivity Index scale. Red spheres indicate the volume of ash ejected. Image adapted from USGS.

Vulnerability Assessment

People

All people in the planning area are potentially exposed to volcanic ash fallout, as well as indirect effects of volcanic ash. Direct exposure to volcanic ash can be reduced, though not eliminated, for people inside buildings.

People are susceptible to complex health risks, related to both the physical effects of ash and secondary impacts related to disruption caused by the ash fallout. The health impacts of volcanic ash are complex. The abrasiveness of the volcanic ash particles can scratch the surface of skin and eyes and in general cause discomfort and inflammation. Inhaling volcanic ash can cause a wide range of health impacts, including death. The International Volcanic Health Hazard Network (IVHHN) provides a good reference to the current research and information on the health hazards and impacts of volcanic eruptions (http://www.ivhhn.org/).

Populations that are especially vulnerable include children, the elderly, and individuals with cardiac and respiratory considerations. The US Department of Health and Human Services tracks Medicare beneficiaries

who rely on electricity-depending medical equipment, such as ventilators, oxygen concentrator equipment, and implanted cardiac devices. Many of these same individuals will be vulnerable to effects of volcanic ash.

Property

Virtually all property is potentially exposed to volcanic ash. Building exteriors and property located outdoors are exposed to a greater degree, but property located indoors is also exposed. In fact, the USGS website on impacts & mitigation of volcanic ashfall impacts contains a page dedicated to indoor cleanup procedures (https://volcanoes.usgs.gov/volcanic_ash/cleaning_up_inside.html).

Susceptibility of property to damage caused by exposure to volcanic ash hazards is variable but potentially extensive. Paint in general and especially on cars is susceptible to the abrasive nature of volcanic ash. Non-structural elements of rooftops, such as gutters and drains, are susceptible to damage from as little as a few millimeters of ashfall. Gutters tend to collect ash from the rooftop, can become blocked, and collapse from the weight, especially when the ash becomes wet. In extreme cases, roofs have collapsed from the weight of wet ash.

Building interiors can also be susceptible to damage from ash. Ash may clog ventilation grills and cooling fans, which may cause overheating of buildings. Ash certainly passes through ventilation systems and can coat interior surfaces. Some electronic equipment is especially susceptible, such as keyboards and mice. Hard drives, however, are well sealed and not particularly susceptible to damage. Damage may become apparent months or years later due to corrosion that is chemically accelerated by ash.

Generally speaking, nearly everything is exposed to ashfall hazards and susceptibility to damage is extensive. Cleanup is complex, difficult, and expensive. After the Mount Saint Helen eruption in 1980 extensive cleanup efforts were required throughout Montana. Vulnerability of property to ash is high but is fortunately muted somewhat by the low probability of ashfall occurring.

Critical Facilities and Lifelines

Critical facilities and infrastructure are most vulnerable to the effects of ashfall. As stated earlier, nearly everything is potentially exposed to volcanic ash following an eruption. As is the case with property, susceptibility is widespread. The supply of electricity is susceptible to ashfall. Air intakes for backup generators are also susceptible to becoming clogged by airborne ash post eruption. Telephone and radio communications can also be susceptible to interruption due to ashfall.

Potable water supply can be susceptible to ash. Water treatment is susceptible to decreased quality of raw water sources, both from increased turbidity and from chemical changes in the water, both caused by ash. Cleanup also creates a high demand for water, which puts additional stress on the water supply.

Stormwater systems collect great amounts of ash from a broad area and can become clogged and cause surface flooding. Clearing underground accumulation of ash in stormwater systems can be extremely difficult. Pumps used in stormwater systems are especially susceptible to damage from volcanic ash.

Wastewater collection systems are also susceptible to damage from ashfall. Buildup of ash in drainage systems can result in stormwater flooding. Ash-laden sewage that makes its way to wastewater treatment plants can cause mechanical damage and, if it makes it further through the system, it will settle and reduce the capacity of biological reactors, increasing the volume of sludge and changing its composition.

Transportation infrastructure is also vulnerable to the impacts of ashfall. Roads, highways, and airport runways can be made impassable due to the slippery ash and reduction of visibility. The abrasive volcanic ash can have damaging effects on aircraft, notably causing the engine(s) to stall. Volcanic ash can also lead to the failure of critical navigational and operational instruments.

Economy

Virtually everything that affects the economy is potentially exposed to volcanic ash. The economy is susceptible to both the direct costs of damage and cleanup, as well as indirect effects of reduced economic

activity following ashfall. The economy can be impacted for years following a significant ashfall. Vulnerability is difficult to calculate but is fortunately muted to a large degree by the low probability of ashfall occurring.

Historic and Cultural Resources

All historic and cultural resources are potentially exposed to ashfall. Historical buildings and historical assets within and outside of buildings all are susceptible. Terrestrial and especially aquatic ecosystems are vulnerable to ashfall, which damages recreation and tourism.

Natural Resources

Volcanic ash can collect carbon dioxide and fluorine gases that can be toxic to humans and have significant impacts on the natural environment. Windblown ash can spread and pollute areas that had previously been unaffected. Vegetation is also vulnerable to the impacts of ashfall. Ashfall can result in decreased plant photosynthesis and reduced pollination, impacting the overall vegetative population in the region. Visual inspection of vegetation in a large area of the State of Washington impacted by the Mount Saint Helens eruption showed three broad categories of plant damages: (1) Breakage due to the weight of ash (2) physiological changes such as decreased plant growth and (3) chemical damages to the leaves (Ayris, Delmelle, 2012).

Water bodies are also vulnerable to the effects of ashfall and can cause chemical changes that can affect water quality. The following table from the USGS Volcanic Ashfall Impacts Working Group show the typical effects of ashfall on the quality of surface waterbodies.

Table 4-67 Typical Effects of Ashfall on the Quality of Surface Water Bodies

Turbidity	Ash suspended in water will increase turbidity in lakes, reservoirs, rivers, and streams. Very fine ash will settle slowly, and residual turbidity may remain in standing water bodies. In streams, ash may continue to be mobilized by rainfall events, and lahars may be a hazard in some regions.
Acidity (pH)	Fresh ashfall commonly has an acidic surface coating. This may cause a slight depression of pH (not usually below pH 6.5) in low-alkalinity surface waters.
Potentially Toxic Elements	Fresh ash has a surface coating of soluble salts that are rapidly released on contact with water. The most abundant soluble elements are typically Ca, Na, K, Mg, Al, Cl, S and F. Compositional changes depend on the depth of ashfall and its "cargo" of water-soluble elements; the area of the catchment and volume available for dilution; and the pre-existing composition of the water body. 4In rivers and streams, there will be a short-lived pulse of dissolved constituents. 4In lakes and reservoirs, the volume is usually large enough that changes in composition are not discernible. The constituents most likely to be elevated above background levels in natural waters are Fe, Al, and Mn, because these are normally present at very low levels. Thus, water is likely to become unpalatable due to discoloration or a metallic taste before it becomes a health hazard.

Source: USGS Volcanic Ashfall Impacts Working Group, Volcanic Ash Impacts & Mitigation - Water Supply (usgs.gov)

Development Trends Related to Hazards and Risk

All development that occurs in the planning area will be exposed to volcanic ash hazards. Susceptibility is widespread. Overall, vulnerability of development to ashfall is high, but muted to some extent by the low probability of occurring.

Risk Summary

Overall volcanic ash is considered a low significance hazard throughout the Eastern Region due to the long recurrence intervals between events. While low probability, effects can be widespread and cause serious impacts.

- Effects on people: Serious adverse health impacts can occur, such as scratches and abrasion to the skin and eyes from direct contact with ash, and ultimately death potentially if ash is inhaled and cements in the lungs.
- Effects on property: exterior of buildings can have abrasive damage to roofs and gutters can be blocked, and the collapse of roofs if too much ash accumulates.
- Effects on the economy: ashfall can lead to disruptions in the tourism industries, through the prevention of travel and access to affected areas, as well as massive losses to agriculture if heavy ashfall were to occur during the growing season.
- Effects on critical facilities and infrastructure: ash can seriously damage electrical and mechanical components of infrastructure, disrupt air travel and EMS/first responder operations, and lead to backups and damage of wastewater systems.
- Unique jurisdictional vulnerability: the vulnerability is largely uniform as this hazard would likely result in impacts on a large scale, regionwide manner.
- Related hazards: earthquake

Table 4-68 Risk Summary Table: Volcanic Ash

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
Eastern Region	Low		
Big Horn	Low	Hardin, Lodge Grass	None
Carbon	Low	Bearcreek, Bridger, Joliet, Fromberg, Red Lodge	None
Carter	Low	Ekalaka	None
Custer	Low	Ismay, Miles City	None
Crow Tribe	Low		None
Daniels	Low	Scobey, Flaxville	None
Dawson	Low	Richey, Glendive	None
Fallon	Low	Plevna, Baker	None
Garfield	Low	Jordan	None
Golden Valley	Low	Ryegate, Lavina	None
McCone	Low	Circle	None
Musselshell	Low	Melstone, Roundup	None
Powder River	Low	Broadus	None
Prairie	Low	Terry	None
Richland	Low	Fairview, Sidney	None
Roosevelt	Low	Wolf Point, Poplar, Bainville, Culberson, Froid	None
Rosebud	Low	Colstrip, Forsyth	None
Sheridan	Low	Plentywood, Medicine Lake, Outlook, Westby	None
Stillwater	Low	Columbus	None
Treasure	Low	Hysham	None
Valley	Low	Glasgow, Fort Peck, Nashua, Opheim	None
Wheatland	Low	Harlowton, Judith Gap	None
Wibaux	Low	Wibaux	None
Yellowstone	Low	Billings, Broadview, Laurel	None

litter load with a shrub component where wildfire spread rate is usually moderate (5-20 chains per hour) and flame lengths are predicted to be low (1-4 feet). Low-elevation forests comprised of species such as Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*) usually exhibit TU2 fuels. TU5 fuels are characterized by fuelbeds with a high load of conifer litter and a shrub understory where wildfire spread rate and flame lengths are moderate. Higher elevation forests comprised of species such as subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*), and lodgepole pine (*Pinus contorta*) usually exhibit TU5 fuels.

Topography: A region's topography is determined by slope and aspect. Normally, wildfire behavior, such as fire intensity and rate of spread, is more pronounced on steep slopes due to convective heat transfer (i.e., heat rising up the slope). South facing slopes are typically drier due to receiving more sunlight than north facing slopes. Thus, they normally contain drier and finer fuels that are more prone to producing faster rates of spread than the fuels seen on wetter north facing slopes. Eastern Montana's topography is diverse. It contains hilly rangelands; steep forested mountains; deep canyons; forested hills; valley rangelands; flat grasslands and shrublands; and flat farmlands.

Weather: Important weather characteristics, such as precipitation, wind speed, wind direction, temperature, relative humidity, and lightning can affect both the potential for wildfire and spread of wildfire. Low precipitation, high temperatures, and low relative humidity in drought years dry out live and dead fuels. These dry fuels can amplify wildfire activity and result in more extreme fire behavior. Additionally, antecedent wet years can build up finer fuels that may contribute to extreme wildfire behavior during summer or fall droughts. Weather regimes in the Eastern Montana region can vary drastically between low and high elevations, where the mountains to the east receive more precipitation than the eastern plains (PRISM 2022). Specifically, the Beartooth Mountains, Pryor Mountains, and Big Horn Mountains in Carbon and Big Horn Counties receive the most annual precipitation, while the plains to the east are comparatively dry. For precipitation across the Eastern Region, April through July are usually the wettest months of the year, December through February are usually the driest months. The latter summer and early fall months of August and September are comparatively dry compared to the spring and early summer months. Hazardous wildfire risk and activity are most likely to occur in late summer and early fall (Whitlock et al 2017).

4.2.16 Wildfire

Hazard/Problem Description

As defined by the National Wildfire Coordinating Group (NWCG), a "wildland fire" is any non-prescribed, non-structure fire that occurs in the wildland" (NWCG 2012). Eastern Montana's semi-arid to mesic climate, rural setting, variable terrain makes most of the region vulnerable to frequent and potentially severe wildfire. As such, wildfire is an ongoing concern for the residents of eastern Montana. The two main types of wildfires affecting the Eastern Region are rangeland fires (wildfires occurring on rangeland) and forest fires (wildfires occurring within a forest); however, while infrequent, wildfires can also occur in agricultural areas. Fires can occur at any time of the year in Montana, but historically, the fire season extends from spring to fall, with large fires being more common in the later summer months and early fall months when fire conditions are more probable. Prime wildfire conditions occur when accumulated fuels become sufficiently dry from high temperatures and drought and can more easily ignite. Furthermore, high winds during the summer and fall can favor the chance of wildfire spreading. Climate change has led to hotter summers and has caused an increase in fuel drying, which has resulted in increases to wildfire size, intensity, frequency, and fire season length (NIFC, 2022a) as well as wildfire suppression costs (NIFC, 2022b). Throughout Montana, these trends are expected to be exacerbated as climate change progresses (Whitlock et al 2017; Steblein 2021).

Historically, wildfire has been an important and normal component of the forest and rangeland ecosystems in eastern Montana. Wildfires are necessary for maintaining the natural conditions and ecology of the region (MT DNRC 2020a). Until the latter 20th century, fire suppression was the dominant fire management policy across private, state, and federal lands across the western U.S. As a result, high levels of fuels have built up in many fire prone ecosystems, including eastern Montana (MT DNRC 2020a). Management goals in wildland areas typically are focused on bringing fire regimes back to their natural historic range of variation. However, in areas with heavy human use, fuel maintenance and land management strategies will be required to replace the historic role of wildfires. These can include, but are not limited to, prescribed burns, targeted livestock grazing, and mechanical fuel removal treatments (MT DNRC 2020a).

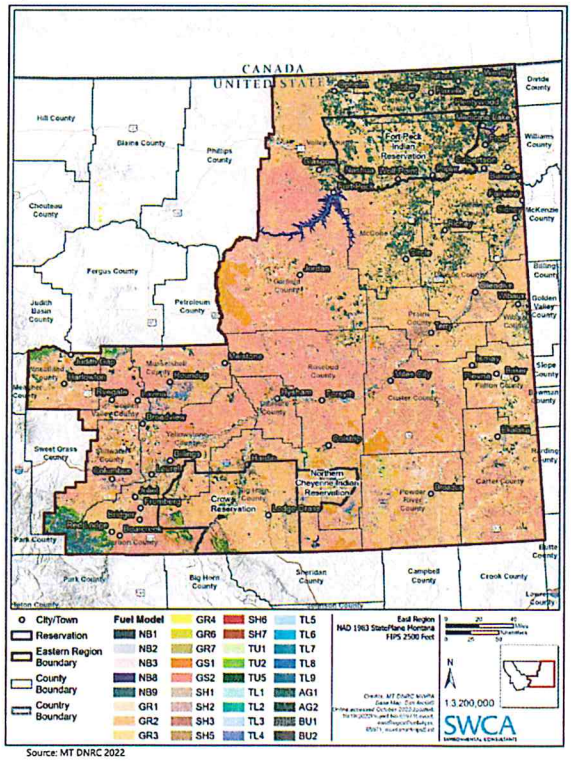
Generally, there are three major factors that predict wildfire behavior and predict a given area's potential to burn. These factors include fuel, topography, and weather.

Fuel: In order for fire to occur, fuel (a combustible material) must be available to burn. Fires are generally determined by fuel type and volume. Generally, the various fuel types and fuel characteristics that cover a landscape have significant impacts on wildfire behavior. Fuel types vary drastically throughout the eastern Region. Fuel sources can vary from dead fine grasses, leaves, and needles to live large trees. Combustible manmade structures also contribute to fuel sources. Fuels can be modified by humans through land use and land management (e.g., prescribed burns, mechanical fuel removal, invasive plant management, and grazing, among others). Scott and Burgan's (2005) fire behavior fuel models were used to model fuels in in the Eastern Region of Montana.

The primary fuel types in the Eastern Region are grass and grass-shrub fuels, as shown in Figure 4-91. Grass-shrub (GS2) fuels are the most commonly observed fuels in the region and are characterized as lands with up to 50% shrub cover with shrub height ranging from 1 to 3 feet high and accompanied with a moderate grass load. Wildfire spread rate for GS2 fuels is usually high (20-50 chains per hour [1 chain is equal to 66ft]) and flame lengths are moderate (4-8 feet). Sagebrush (Artemisia sp.) ecosystems usually exhibit GS2 fuels. GR2 (grass) fuels are also commonly observed fuels. Scott and Burgan (2005) describe GR2 fuels as moderately coarse continuous grass with an average depth of about 1 foot. Wildfire spread rate is usually high and flame lengths are moderate. Bunchgrass ecosystems typically exhibit GR2 fuels.

In the forested portions (e.g., the Beartooth Mountains, the Pryor Mountains, northern terminus of the Big Horns, and other scattered island mountainous terrain in the region) of the Eastern Region primary fuel types are timber-understory (TU2 and TU5) fuels. TU2 fuels are characterized by fuelbeds with a moderate

Figure 4-91 Wildfire Fuel Model of the Eastern Region

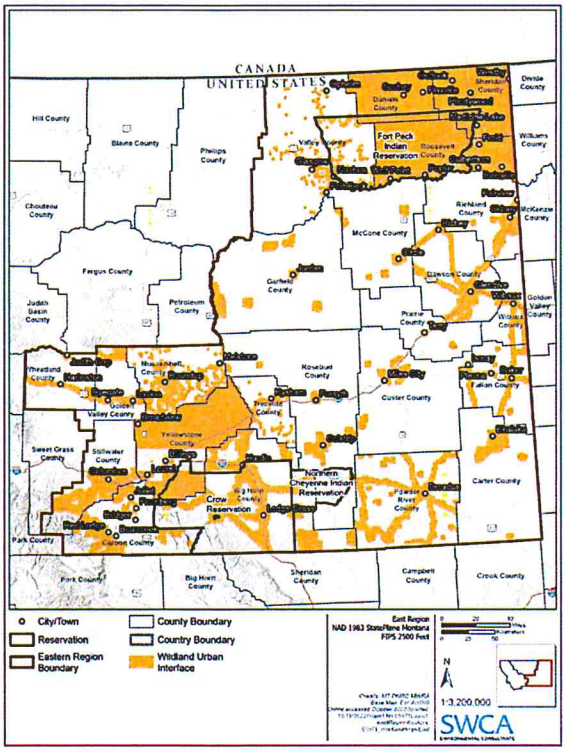


Source: MT DNRC 2022

Wildland-Urban Interface: The wildland-urban interface (WUI) is defined as the zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuel (MT MHMP 2018). Starting in 2011, Montana DNRC compiled WUI boundaries for all counties within the state based upon information provided from countywide Community Wildfire Protection Plans (CWPPs) or through consultation between the County and the MT DNRC. The methods for WUI delineation vary by County (MT DNRC, 2020b), which is why some WUI areas encompass an entire county land mass, and some areas are more nuanced, based on fuels, hazards, population density, infrastructure, and other factors. (see Figure 4-92).

In Eastern Montana, humans are a significant cause of wildfire ignitions. This is especially true is Eastern Montana's WUI, where wildfire risk is strongly with the WUI (e.g., exurban areas human caused ignitions and utilities and vehicle/roadside ignitions); however, lighting strikes during thunderstorms are also a major source of ignition (see Figure 4-95; MT DNRC 2022a). Most of the counties in the Eastern Region, with some notable exceptions (e.g., the Billings area), have not experienced significant population trends or increases in development (US Census 2020); however, property located in the WUI will likely experience greater risk from wildfire due to increasing trends in human caused wildfires and a warming climate (MT DNRC 2020a).

Figure 4-92 Wildland Urban Interface Delineation



Source: MT DNRC 2020b

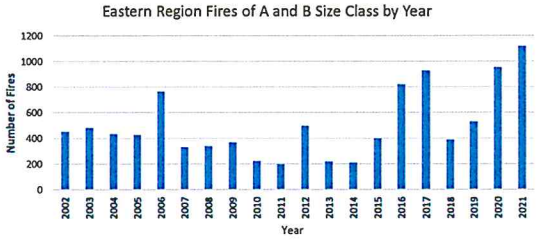
Geographical Area Affected

The climate of the Eastern Region varies from arid to semi-arid to mesic. All climates, combined with continuous loading of rangelands, grassland, and some forest fuels, make most of the region susceptible to wildfire; the geographical area affected for wildfire is therefore **extensive** (PRISM 2022; MTDNRC 2022). The two main types of fires that can occur in the Eastern Region are rangeland and forest fires. These fire types are reflected in the mapped risks from wildfire (in Figure 4-105 in the Wildfire Risk Section) The rangelands of the central portion the eastern regions that have complex topography and occasional patchwork of dry coniferous forests have historically been most at risk of wildfire (Figure 4-105). Large rangeland and forest fires in the region have most commonly occurred in the counties of Powder River, Big Horn, Yellowstone, Treasure, Rose Bud, Musselshell, Garfield, Carbon County, and Stillwater (Figure 4-97). Almost the entire Eastern Region is at-risk and/or susceptible to wildfire. Large tracts of land with agricultural crop cover (especially in the northeastern portion of the region) are usually at less risk of wildfire compared to undeveloped rangelands and forests.

Past Occurrences

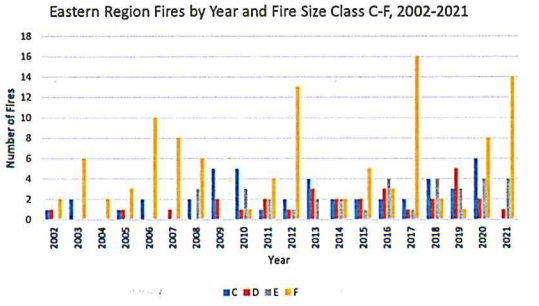
The Montana Wildfire Risk Assessment (MWRA) database, maintained by the Montana Department of Natural Resources and Conservation (MT DNRC), includes perimeter GIS layers for recent wildfires throughout the state of Montana (MT DNRC 2022a). According to the MWRA, wildfires in the Eastern Region occur on an annual basis and are usually contained early with little to no damage. Most wildfires are usually less than 1,000 acres; between 2002 and 2021 there have been 106 wildfires greater than 1,000 acres (Figure 4-94). Large (fires greater than 1,000 acres) and potentially destructive fires can occur in any year. Over the last 20 years there has been an increase in the number of Class F fires (fires greater than 1,000 acres). Years where there are larger and more destructive fires (e.g., the 2003, 2007, 2012, 2017 and 2021 wildfire seasons) are correlated with drought conditions and/or warmer growing season temperatures (PRISM 2022). Generally, the majority of wildfire occurrences are small (less than 10 acres) and cause no meaningful damage. From 2002 to 2021 there were 10,079 fires that burned 10 acres or less (Figure 4-93); however, in the same time frame there have also been 216 fires greater than 10 acres with approximately half of these (106 fires) being greater than 1,000 acres (Figure 4-94).

Figure 4-93 Number of Wildfire in Eastern Montana Region by Year and Size Class A-B, 2002 to 2021



* Size Class: A = 0.25 acre or less; B = greater than 0.25 to 10 acres.
Source: MT DNRC 2022

Figure 4-94 Number of Wildfire in Eastern Montana Region by Year and Size Class C-F, 2002 to 2021



* Size Class: A = 0.25 acre or less; B = greater than 0.25 to 10 acres; C = 10 to 100 acres; D = 100 to 300 acres; E = 300 to 1,000 acres; F = 1,000+ acres.

As shown in Figure 4-95, natural wildfire occurrences (e.g., lightning ignitions) in the Eastern Region are common and particularly common in the high elevation rangelands in south-central portion of the region where there are expansive tracts of, mostly, wild rangelands intermixed with patches of forests. Human caused wildfire occurrences are also common and are, generally, concentrated near the region's municipalities or infrastructure. Regional fire managers and emergency planners should take note that over the last decade there has been a consistent increase in the number of wildfires attributed to human causes. From 2017 to 2021 the number of human-caused wildfires outnumbered the number of natural caused wildfires (MT DNRC 2022a). Figure 4-96 shows the total acres burned by year.

Figure 4-95 Number of Wildfires by Cause, 2002 to 2021

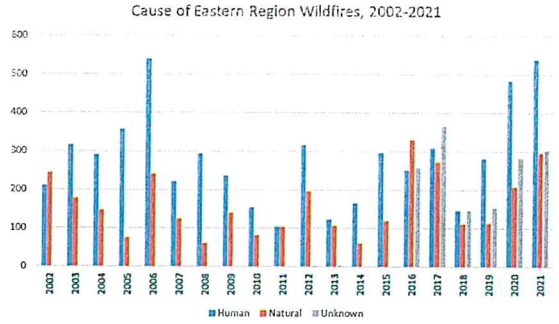
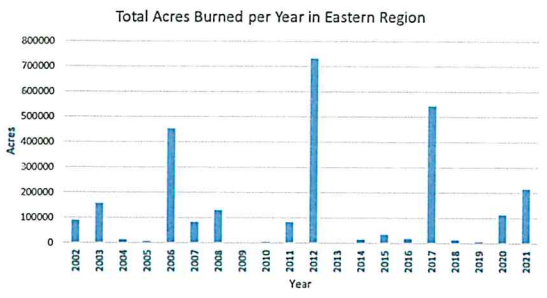


Figure 4-96 Total Acres of Burned per Year in Eastern Region, 2002 to 2021



Over the last 20 years, the larger fires in the region have generally occurred in areas that are an intermix of rangelands and forests. Figure 4-97 shows the fire occurrence history in the Eastern Region. Figure 4-98 shows fire history in the Eastern Region.

Two notable wildfire incidents include the Ash Creek Fire Figure 4-99 and the Lodgepole Complex. The Ash Creek Fire was a highly destructive lightning caused fire that occurred in the late spring and summer months of 2012. It impacted privately managed land, tribal managed lands, and Bureau of Land Management (BLM) managed lands. This fire burned 249,714 acres across Powder River County, Rosebud County, and the Northern Cheyenne Reservation. The fire destroyed 39 structures (including 19 residential homes); killed and displaced livestock; caused evacuations, and damaged regional infrastructure (Great Fall Tribune 2017; Billings Gazette 2013). Additionally, the Lodgepole Complex of 2017 burned 271,422 acres of Rangeland and Ponderosa Pine savannah in Petroleum and Garfield Counties. The Lodgepole Complex destroyed 16 homes and 16 structures. In total, the state spent $6 million fighting this fire (Garfield County 2017). Finally, to emphasize that wildfire risk is year-round, the West Wind Fire of Late November and early December of 2021 occurred in and around Denton, MT (in the Central Region) and was started by a powerline. This fire burned 10,644 acres of grasslands, pasture, and riparian wetlands. The fire was particularly destructive as it destroyed 25 primary structures, 18 secondary structures and 6 commercial structures in and around Denton (NWCG 2022). Among the structures lost were family homes, historic grain elevators, and a bridge (3KRTZ 2021). The consequences of these rangeland fires exemplify the threats that wildfire can pose in Eastern Montana's rangelands.

Figure 4-97 Fire Occurrence History in Eastern Montana, 2002 to 2021

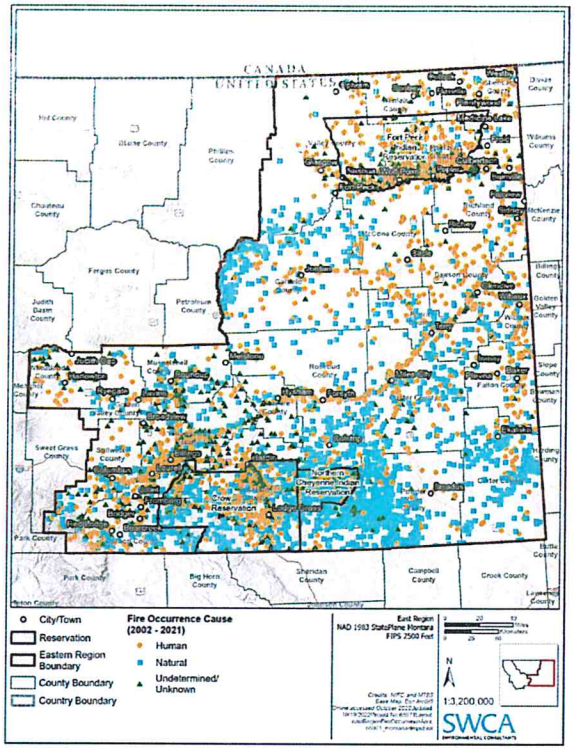
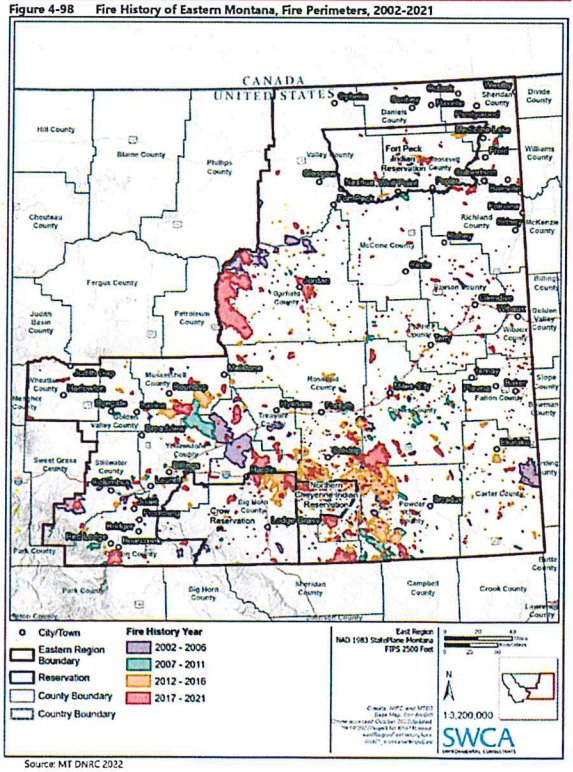
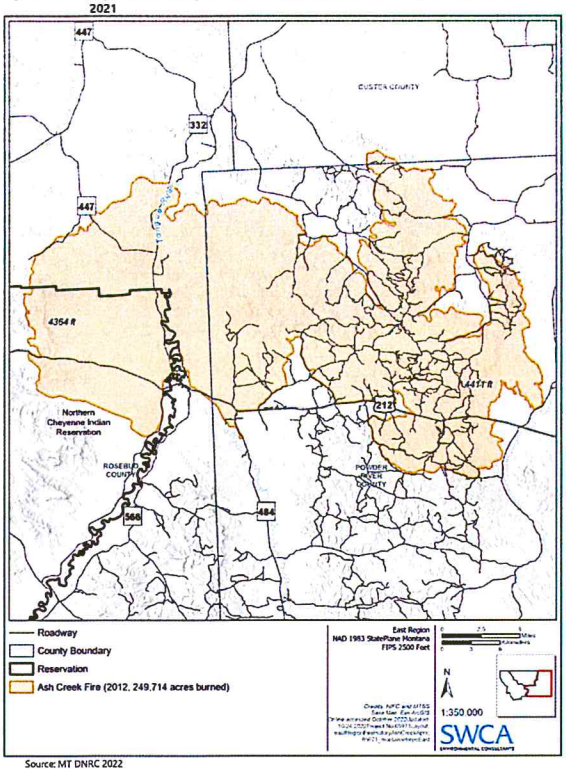


Figure 4-98 Fire History of Eastern Montana, Fire Perimeters, 2002-2021



Source: MT DNRC 2022

Figure 4-99 Representative Large Rangeland Wildfire in the Eastern Region – Ash Creek Fire of 2021



Source: MT DNRC 2022

Frequency/Likelihood of Occurrence

Wildfires occur every year throughout the region and could occur in any county in any given year; therefore, the probability of occurrence is **highly likely**. Generally, the rangelands in the central portions of the Eastern region exhibit a high annual burn probability, usually around 1% annual burn probability. These rangelands are typically hilly and exhibit complex topography. The regions with a patchwork of rangelands and dry coniferous forests exhibit the highest annual burn probability (2%). These regions are also topographically complex and are found in Powder River, Rosebud, and Yellowstone Counties. The northeastern portion of the Eastern Region displays the lowest annual burn probabilities. These areas are typically grasslands and/or farmlands with annual burn probabilities ranging from 0.01% to 0.1%. Figure 4-101 illustrates the annualized frequency of wildfire events by County. Figure 4-102 illustrates the annual burn probability for the Eastern Region.

Figure 4-101 Annualized Frequency of Wildfire Events by County

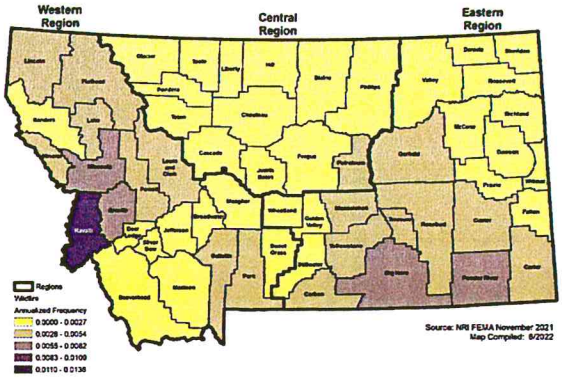
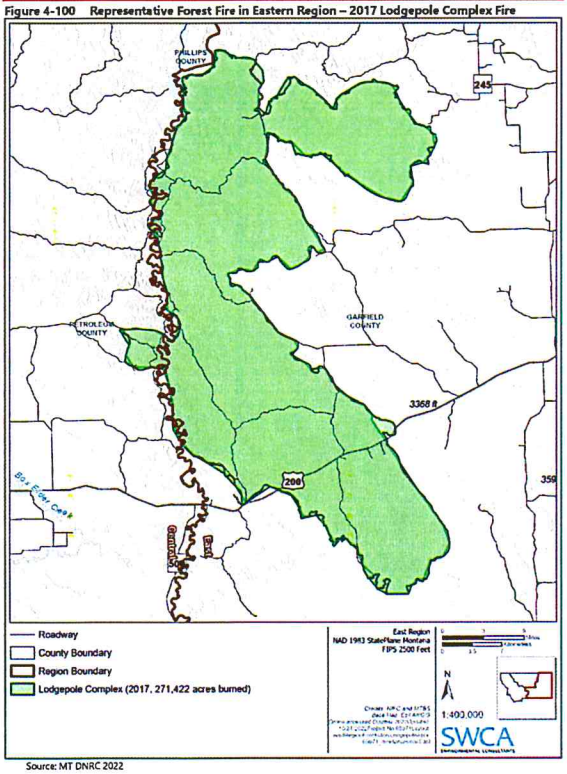
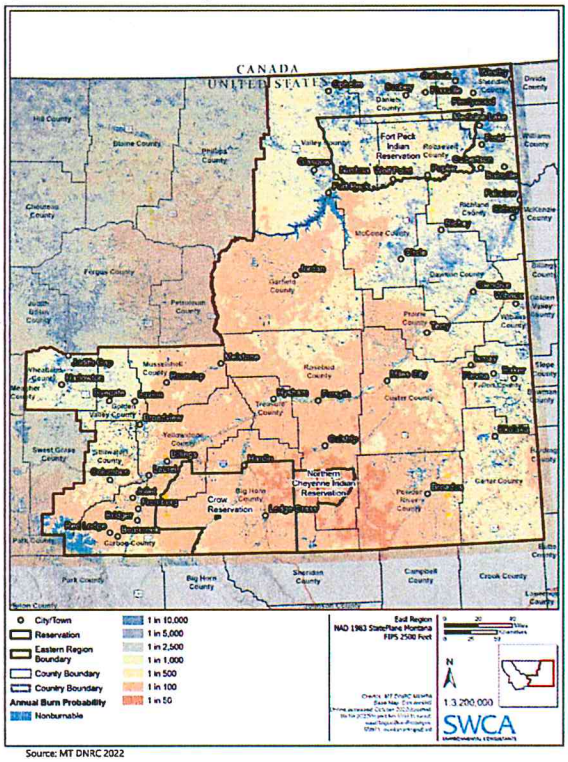


Figure 4-100 Representative Forest Fire in Eastern Region – 2017 Lodgepole Complex Fire



Source: MT DNRC 2022

Figure 4-102 Eastern Montana Region Annual Burn Probability



Source: MT DNRC 2022

The counties with a high degree of undeveloped wildland rangelands and forests are usually more likely to experience wildfire and experience larger wildfires (see Table 4-69 for summary breakdown of wildfire statistics by county). Counties with a larger proportion of agricultural crop cover are less likely to experience wildfire (Table 4-69). While many rangeland wildfires in the region can be small, large rangeland fires can and do occur. It is important to note that the risk from wildfire is substantially higher during drought years. The years with the largest wildfires in Montana have normally occurred during periods of drought with associated high temperatures (Whitlock et al 2017).

Table 4-69 Average Number of Wildfires per year for Eastern Region Counties, 2002-2021

County/Reservation	Annual Average Number of Wildfire Occurrences (includes all ignitions)	Annual Average of Acres Burned
Big Horn	155.05	20,911.93
Carbon	13.20	3,918.39
Carter	16.05	5,522.75
Custer	14.75	8,896.93
Crow Reservation	134.70	7,243.89
Daniels	1.35	107.12
Dawson	5.85	415.19
Fallon	4.15	72.66
Fort Peck Reservation	115.45	1,254.90
Garfield	12.05	27,098.30
Golden Valley	1.75	211.68
McCone	4.25	418.30
Musselshell	6.05	6,748.50
Northern Cheyenne Reservation	59.55	6,297.85
Powder River	32.20	20,156.13
Prairie	7.20	435.34
Richland	5.05	634.89
Roosevelt	105.65	1,176.11
Rosebud	62.65	19,763.00
Sheridan	2.10	2.09
Stillwater	7.30	3,902.09
Treasure	2.10	1,047.03
Valley	14.65	1,294.70
Wheatland	3.05	358.06
Wibaux	3.50	160.42
Yellowstone	37.30	12,004.65
Total	**826.95**	**150,052.90**

Climate Change Considerations

The 2021 Montana Climate Change and Human Health report states that climate change is and will continue to increase wildfire and smoke hazards throughout Montana. The report declares reduced air quality due to wildfire smoke to be the second greatest concern for human health related to climate change, after extreme heat. Similarly, NOAA's 2022 Climate Summary cites that climate change will increase in severity and frequency of wildfires.

Annual average temperatures across the state, including daily minimums and maximums have risen 2.0 – 3.0°F between 1950 and 2015 (Whitlock et al 2017). Furthermore, Montana's growing season length has increased, as spring has come on earlier and fall freezes have occurred later. Between 1951 and 2010, Montana's growing season increased by 12 days. All regions of Montana are expected to experience warming in all seasons and under all future emissions scenarios. By 2050, Montana's average annual

temperatures are expected to increase 4.5-6.0°F. Additionally, the number of days where 90°F will be exceeded will increase under future conditions. Finally, in the Eastern Region there has seen a significant increase in spring precipitation. However, compared to the rest of the state, the Eastern Region is also expected to experience the greatest increase in number of days where the temperature exceeds 90°F (Whitlock et al 2017; Steblein 2021). Across the Eastern region, wetter springs could fuel the growth of more fine fuels while hotter summers could amplify fire risk.

Taken together these climate change effects have contributed to increases in wildfire frequency and severity across the state and will exacerbate the future fire wildfire risk conditions across Eastern Montana. These climate impacts are also affecting forest and rangeland health. Hotter and longer summers and prolonged drought are known to put increased physiological stress on trees and increase mortality caused by diseases. such as mountain pine beetle, Douglas-fire beetle, and spruce budworm, among others. Degraded forest health, significantly attributed to climate change, has already been linked with increased fire risk throughout large portions of Montana's forested regions (MT DNRC 202c). As climate change exacerbates disease outbreaks in Montana's forested areas, there will be an increased build up in hazardous fuels (Whitlock et al 2017). Currently large tracts of Ponderosa Pine forests in the Eastern Region are experiencing attacks from pine beetles (MT DNRC 2021). These attacks are especially prevalent in Powder River and Rosebud Counties (MT DNRC 2021). These attacks are resulting in decreased forest health and build-up in dead, dry fuels. Additionally, climate change can result in an increase in invasive grass and weed abundance in grasslands and rangelands, which can contribute to increased wildfire risk in these systems (Whitlock et al 2017). As the fire season increases there will be a higher likelihood of wildfires coinciding with high wind events during fall, winter, and spring storms, especially during drought years. When wildfire, wind, and drought converge they can create conditions for particularly destructive wildfires, even outside of the traditional wildfire season (e.g., the Denton, MT West Wind Fire of December 2021, a wildfire that occurred in the Central Region).

While the idea that climate change has worsened wildfire hazards, it is less clear how bad the situation will get in coming decades. There are no projections for wildfire ignitions or acreage burned specific to the planning area that are available in other states. Projections of future wildfire exist but are at large spatial scales with limited applicability to the specific situation of the planning area. For example, a well-cited 2022 report by the UN Environment Programme[4] presented results from modeling studies that predict a 20%-30% increase in wildfire events from 2020 to 2050 and a 31%-57% increase by 2100. These ranges reflect modeling uncertainty and the use of different climate change scenarios. It's noteworthy that the scenarios modeled were in the low to mid-range climate projections (RCP2.6 and RCP6.0). Despite the coarse scale of this study, it serves to provide an indication of the magnitude of future wildfire in the study area. It also highlights the potential for a future study to model wildfire potential under various climate change scenarios.

Potential Magnitude and Severity

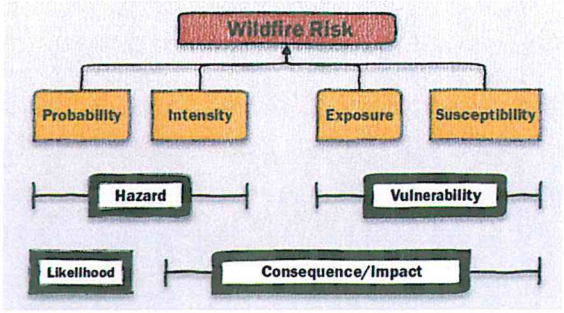
Montana Wildfire Risk Assessment

The Montana Wildfire Risk Assessment (MWRA) provides information about the wildfire hazard and risk to highly valued resources and assets (HVRAs) across Montana. This information is essential for planning wildfire response, fuel management, and land planning. The MWRA is a quantitative assessment of how human and natural resources are both influenced and affected by wildfire. The MWRA considers the following state-wide spatial components when quantifying wildfire risk: likelihood of fire burning, the intensity of a potential fire, the exposure of assets and resources based on their location, and the susceptibility of those assets and resources (MT DNRC 2020c). Wildfire vulnerability to wildfire is determined by wildfire exposure and susceptibility, whereas wildfire hazard is determined by wildfire intensity and

[4] Sullivan, Andrew, et al., 2022, Spreading like wildfire: The rising threat of extraordinary landscape fires. Accessed 6-5-24 at: https://www.unep.org/resources/report/spreading-wildfire-rising-threat-extraordinary-landscape-fires

wildfire probability. This conceptual relationship is depicted in Figure 4-103. Overall based on the combination of the likelihood of a wildfire, the intensity of a wildfire, and the exposure of assets, the magnitude for the Eastern Region is critical.

Figure 4-103 Conceptual Breakdown of the Components and Meaning of the Montana Wildfire Risk Assessment



Source: MT DNRC 2022

MWRA Components

Wildfire Hazard. Wildfire hazard is determined by wildfire intensity and wildfire probability (MT DNRC 2022a). Areas that experience frequent and intense wildfire have the greatest wildfire hazard, while areas that experience low intensity fires over longer time scales have the lowest wildfire hazard.

Wildfire likelihood is the annual probability of wildfire burning in a specific location. At the community level, wildfire likelihood is averaged where housing units occur. It is the probability that any specific location may experience wildfire in any given year. It does not say anything about the intensity of fire if it occurs. Wildfire likelihood is derived from fire behavior modeling across thousands of simulations of possible fire seasons. Factors contributing to the model, such as weather, topography, and ignitions are varied based on trends observed in recent decades. It is important to note that wildfire likelihood is not predictive and does not reflect any currently forecasted weather or fire danger conditions (MT DNRC 2022a). The regions of Eastern Montana that display an intermix of rangelands and ponderosa pine forests are more likely to experience wildfire than continuous rangelands. Rangelands dominated by grass-shrub fuels (GS) are more likely to experience wildfire than rangelands dominated by only grass fuels (GR). Agricultural areas and alpine areas above tree line are least likely to experience wildfire (Figure 4-102).

Wildfire intensity is a measure of the energy expected from a wildfire and is mainly determined by the topography and vegetative fuels of a landscape. Greater fuel loads (e.g., forests compared to grass lands), especially on steeper terrain, typically produce greater wildfire intensity. Wildfire intensity is technically measured in units of heat transfer per length of fire perimeter. However, it can also be observed and expressed in terms of flame length (MT DNRC 2022a). The MWRA (MT DNRC 2022a) uses wildfire intensities calculated in fire behavior modeling simulations. Modeled tall flame lengths (i.e., more intense fires) are

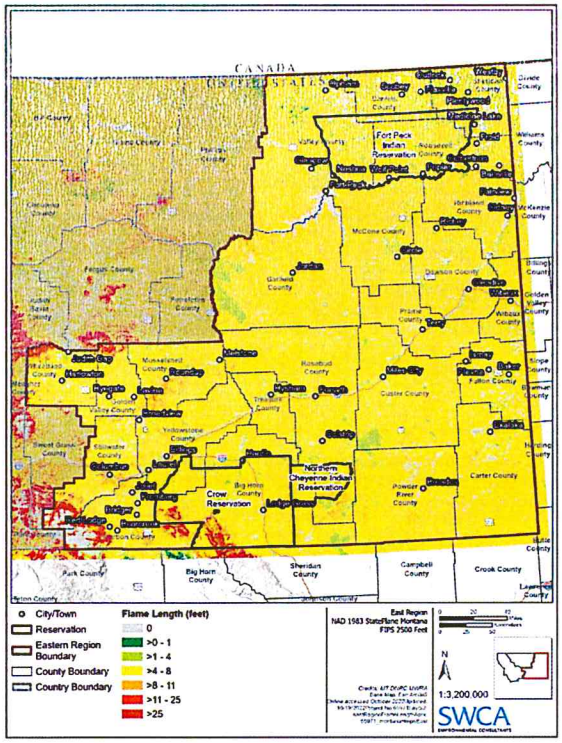
more likely to occur in regions comprised of forested areas (Figure 4-104). More intense and taller fires are usually more difficult to control (Table 4-70). Only the forested portions with steep slopes in the Eastern Region are predicted to have flame lengths greater than 25 feet when conditions are extreme enough. The vast majority of the region is predicted to have flame lengths 4 to 8 feet in length. Areas with extensive crop cover are more likely to experience flames lengths under 4 feet.

Table 4-70 Control Efforts Associated with Different Flame Lengths

Flame Length	Interpretations
Less than 4 feet	• Fires can generally be attacked at the head or flanks by firefighters using hand tools. • Handline should hold fire.
4 to 8 feet	• Fires are too intense for direct attack in the head with hand tools. • Handline cannot be relied on to hold the fire. • Dozers, tractor-plows, engines, and retardant drops • can be effective.
8 to 11 feet	• Fires may present serious control problems: torching, crowning, and spotting. • Control efforts at the head will probably be ineffective.
over 11 feet	• Crowning, spotting, and major fire runs are probable. • Control efforts at the head of the fire are ineffective.

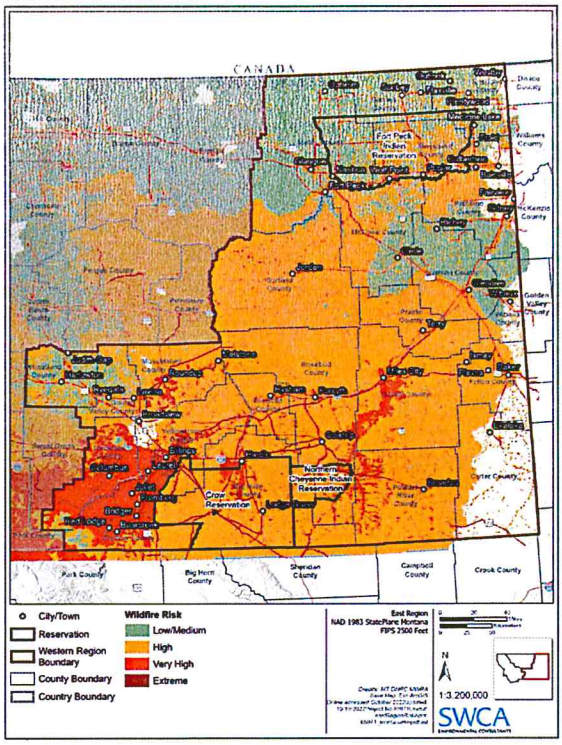
Source: Andrews et al. 2011

Figure 4-104 Eastern Montana Region Estimated Flame Length



Source: MT DNRC 2022

Figure 4-105 Eastern Region Wildfire Risk Summary as Determined by eNVC



*Blank areas have burnable fuels but no HVRAs have been mapped for the area (MT DNRC 2020c).
Source: MT DNRC 2022

Vulnerability: Wildfire vulnerability to wildfire is determined by wildfire exposure and susceptibility (MT DNRC 2022a). For example, fire susceptible structures and/or infrastructure located in high fire intensity and high fire likelihood environments would have high exposure and high susceptibility to fire. In other words, they would be vulnerable to wildfire.

Wildfire exposure. Exposure is the spatial coincidence of wildfire likelihood and intensity to homes and communities. Homes are exposed to wildfire if they are located where there is any chance wildfire could occur (i.e., burn probability is greater than zero). Communities can be directly exposed to wildfire from adjacent wildland vegetation (e.g., homes situated in a forest), or indirectly exposed to wildfire from embers and home-to-home ignition (MT DNRC 2022a).

Wildfire susceptibility. Susceptibility is the propensity of a home or community to be damaged if a wildfire occurs. The susceptibility of a Highly Valued Resource or Asset (HVRA) to wildfire is determined by how easily it is damaged by varying degrees of wildfire intensity and type. Assets that are fire-hardened and can withstand very intense fires without damage (i.e., low susceptibility), whereas non-fire hardened structures are more easily damaged by fire (i.e., high susceptibility). The MWRA generalizes the concept of susceptibility. The MWRA assumes all homes that encounter wildfire will be damaged, and the degree of damage is directly related to wildfire intensity. The greater the wildfire intensity, the greater the percent damage to the structure. A community's wildfire risk is the combination of likelihood and intensity (together called "hazard") and exposure and susceptibility (together called "vulnerability") (MT DNRC 2022a).

Wildfire Risk

As described previously, wildfire risk is calculated by combining the following components: likelihood of fire burning, the intensity of a potential fire, the exposure of assets and resources based on their location, and the susceptibility of those assets and resources (MT DNRC 2022a). To quantitatively assess wildfire risk MWRA utilized an expected net value change (eNVC) analysis. The eNVC is an effects analysis that helps to quantify wildfire risk to various highly valued resources and assets (HVRA) for example homes, infrastructure, water resources, utility lines etc. (Finney, 2005; Scott et al., 2013; MT DNRC 2020c). The methodology is described in detail in the MWRA Report (https://mwra-mtdnrc.hub.arcgis.com/documents/montana-wildfire-risk-assessment-report/explore). As shown in Figure 4-105, the overall risk of loss to those HVRAs is categorized from low to extreme.

The risk to highly valued resources and assets from wildfire varies from low/medium to extreme throughout the region but the risk from wildfire to people and property is usually greatest within and near the inhabited areas (Figure 4-105) (i.e., see extreme risk ratings in inhabited areas). The municipalities most notably at risk from wildfire include, but are not limited to, Red Lodge, Bridger, Bear Creek, Columbus, Billing's sub-urban and ex-urban communities, Roundup, Hardin, and Miles City. Across the region, agricultural areas generally have low to medium risk from wildfire, while the rangelands and forested areas range from high to extreme risk from wildfire, respectively. Forests and rangelands in areas with more complex topography and/or drier dimates generally have higher risk than forests and rangelands on flatter or less complex topography.

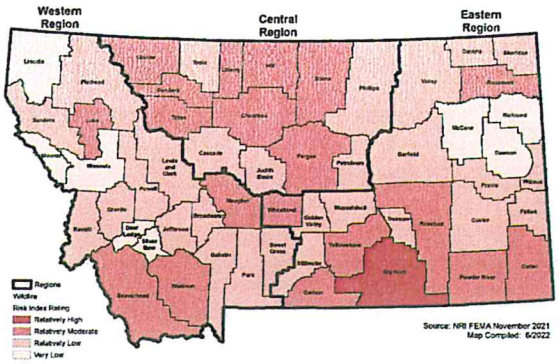
It is important to note, however, that many of the towns and municipalities throughout the region have very high to extreme risk from wildfire, regardless of the risk of surrounding landscapes. This is because the expected net value change (eNVC) risk assessment model provides more weight in assessing detrimental changes (or expected losses) to structures and infrastructure than to wildlands or agricultural areas. Thus, HVRAs (typically structures or infrastructure) are given higher levels of weight (i.e., importance) in the model. The results of these expected losses are then summed by each pixel displayed in the map. Thus, areas (or pixels) with a high concentration of HVRAs (e.g., towns and municipalities) will display far greater risk to wildfire even if the likelihood of fire occurring on the surrounding landscape is low. Thus, the results of these eNVC risk assessment should be taken in context and interpreted with caution. To summarize, the observed trends are mainly driven by risk to structures and infrastructure within the region's towns and municipalities. Figure 4-106. Most of these structures/infrastructures are susceptible to fire (where they tend to be damaged if a wildfire occurs) and are exposed (located where there is a chance wildfire could occur), to some degree, to wildfire occurrence, which accounts for the high risk overall in Figure 4-106.

Generally, however, towns/municipalities surrounded by undeveloped forests and rangelands (i.e., landscapes with a higher probability of fire occurring and fire spreading) have higher levels of risk to wildfire than towns surrounded by more agricultural areas. However, agricultural fires can and do occur (see Denton fire of 2021) and these fires can have substantial economic impacts (Agricultural Climate Network 2021). It is also important to note that the MWRA was developed by the MT DNRC at the statewide scale. Assessments at these scales may omit finer resolution, and more precise assessment of risk, as well as input by local subject matter experts. Some county-wide or multi-county community wildlife protection plans (CWPPs) have been developed for counties covering the Eastern region. For example, the 2016 Powder River County CWPP provides a fine-scale local, wildfire risk assessment that incorporates recent wildfire effects, community input, and recent wildfire mitigation efforts (Powder River County Commission 2016). CWPPs for all counties in Eastern Montana can be accessed at the MT DNRC website (see http://dnrc.mt.gov/divisions/forestry/fire-and-aviation/cwpps) (note: many CWPPs in Eastern Montana have not been updated in over decade). In the event that a County has recently completed a CWPP with fine scale risk assessment, land managers and fire responders should carefully consider if those locally derived assessments provide a more accurate, authoritative dataset for use in addressing and mitigating wildfire risk, than the statewide assessment.

Vulnerability Assessment

Figure 4-106 depicts the risk index rating for wildfire at a county level based on the NRI. The western and southeastern parts of the region show a trend towards a relatively low rating, while the central, northern, and northeastern parts of the region trend towards a relatively moderate rating.

Figure 4-106 Risk Index Rating for Wildfire by County



People

The most exposed population are those that are living within the WUI. The WUI in the Eastern Region is expansive, but generally, population densities within the WUI are highest in the region's more populated municipalities/towns. More populated areas, generally, have more property and, thus, a greater degree of property exposure to wildfire. Counties with higher portions of their property and infrastructure exposed to fire prone landscapes (e.g., greater wildfire risk to structures and infrastructure) will have more of their population vulnerable to the negative effects of wildfire than counties with lower portions of property and infrastructure exposed to fire prone landscapes The vulnerability to property is discussed further below

People can also experience deleterious mental and physical health effects from fire. A study conducted in California found that extreme wildfire (and it associated impacts) can result in post-traumatic stress disorder, depression, and exacerbate pre-existing mental illness (Silveira et al 2021). Another study conducted in California found that particulate air pollution from wildfire had greater impacts on respiratory health than particulate air pollution from traditional sources (e.g., vehicle and power plant emissions) (Aguilera et al 2021). In Montana specifically, a study conducted on pulmonary function for community members living in Seeley Lake found that that lung function diminished significantly when exposed to extreme levels of smoke during the 2017 wildfire season (mostly due to the Rice Ridge Fire) and that lung function continued to decline even one year post fire (Orr et al 2020). In the Western US, ten of the largest years for wildfire (by total acres burned) have occurred since 2004. These large wildfires have been directly linked to poor air quality and have led to adverse physical and mental health effects and costs to society (EPA 2022). As climate change progresses, it is likely Eastern Montana will have larger and more frequent wildfires. Planning to address the needs of populations at risk will be become increasingly important to mitigate property damage and health impacts from wildfire.

Populations especially at risk from wildlife include socially vulnerable populations. As defined by the US Forest Services Wildfire Risk to Communities (USFS 2022) socially vulnerable populations include the

following: families living in poverty, people with disabilities, people over 65 years, people who have difficulty with English, households with no car, and people living in mobile homes. Across the Eastern Region, wildland fire fighters are also populations at risk from wildfire. Wildland fire fighting is an inherently dangerous profession where firefighters risk their health and lives while battling fires. During the 2017 Lolo Peak Complex in western Montana, two wildland fire fighters were killed while battling the fire (Reuters, 2017). Wildland fire fighters are especially vulnerable to medium- and long-term health and safety risks associated with smoke and chemical inhalation and other conditions while firefighting, as well as immediate risks that may endanger their lives due to the fire environment.

In order to determine the total general population living in wildfire risk areas, the structure count of residential buildings within the various wildfire risk areas and applying the census estimated household size for each county to the total number of structures. This provides an estimated figure for the number of residents living in areas exposed to elevated wildfire risk.

Across the Eastern Region counties, there are an estimated 8,743 residents exposed to high-risk wildfire areas, 100,683 residents exposed to very high risk wildfire areas, and 92,179 residents exposed to extreme risk wildfire areas, as summarized in Table 4-71 below. Additionally, based on this analysis there are an estimated 2,381 people residing within wildfire risk areas on the Crow Reservation, 5,211 people on the Fort Peck Reservation, and 353 people on the Northern Cheyenne Indian Reservation. However, these residents are included in the counts for their respective counties of residence in the table below.

Table 4-71 Population Within Wildfire Risk Areas in Eastern Montana

County	High Risk Population	Very High-Risk Population	Extreme Risk Population
Big Horn	350	1,380	5,390
Carbon	241	3,810	7,397
Carter	53	318	261
Custer	460	5,766	3,399
Daniels	199	1,098	437
Dawson	707	5,242	970
Fallon	163	1,417	913
Garfield	31	357	689
Golden Valley	86	457	131
McCone	239	528	550
Musselshell	254	1,890	2,509
Powder River	62	236	682
Prairie	97	888	292
Richland	1,441	3,853	133
Roosevelt	660	2,591	3,873
Rosebud	130	2,303	3,280
Sheridan	390	1,464	1,540
Stillwater	1,124	6,458	1,415
Treasure	46	315	33
Valley	475	2,387	3,356
Wheatland	172	1,927	59
Wibaux	62	559	19
Yellowstone	1,300	55,442	54,852
Total	8,743	100,683	92,179

Source: MSDI 2022, MWRA, US Census Bureau

Property

The potential impacts of wildfire on property include crop loss; timber loss; injury and death of livestock and pets; devaluation of property; and damage to infrastructure, homes and other buildings located throughout the wildfire risk area. The greatest potential impact on property, buildings and infrastructure is likely to occur to those structures located within high and very high hazard zones including the WUI, and buildings and infrastructure located within fire prone forests and rangelands.

Federal, state, and county lands throughout the Eastern Regions have high amounts of property and infrastructure that are susceptible to wildfire. Public property lost or damaged by wildfire can exhaust budgets (due to rebuilding and repair efforts), result in degraded conditions (e.g., damaged roads and recreational facilities), and degrade the value of natural resources (which could inhibit leasing efforts and result in lost revenue generation). There are multiple state and federal grants available which can ease costs due to damages from wildfire (MT DNRC 2022b; FEMA 2022)).

Another method of estimating vulnerability is to determine the value of structures that are located within wildfire risk areas. Another method of estimating vulnerability is to determine the number and value of structures that are located within wildfire risk areas. For this plan update loss estimations for the wildfire hazard were modeled by using April 2022 MSDI Cadastral Parcel layer as the basis for the inventory of developed parcels. GIS was used to create a centroid, or point, representing the center of each parcel polygon, which was then intersected with the Montana Wildfire Risk Assessment (MWRA) data. Wildfires typically result in a total building loss, including contents. Content values were estimated as a percentage of building value based on their property type, using FEMA/HAZUS estimated content replacement values. This includes 100% of the structure value for commercial and exempt structures, 50% for residential structures and 100% for vacant improved land. Improved and contents values were summed to obtain a total exposure value. Table 4-72 through Table 4-75 below summarizes the estimated exposed value of improvements in each wildfire risk category for the counties and the Tribes in the Eastern Region. Figure 4-107 show the wildfire risk to structures in the Eastern Region. Loss Ratio is the ratio of the improved parcels at risk compared to the overall number of improved parcels in each county.

Table 4-72 Exposure and Value of Structures at High Risk to Wildfire by County

County	Improved Parcels	Improved Value	Content Value	Total Value	Loss Ratio
Big Horn	261	$69,696,592	$80,783,876	$150,480,468	9%
Carbon	248	$52,826,918	$43,797,984	$96,624,902	4%
Carter	109	$14,510,555	$12,844,693	$27,355,248	12%
Custer	342	$57,135,447	$45,742,464	$102,877,911	7%
Daniels	217	$27,659,178	$24,814,628	$52,473,806	13%
Dawson	508	$68,141,966	$45,277,149	$113,419,115	12%
Fallon	155	$23,759,705	$17,623,048	$41,382,753	9%
Garfield	145	$12,924,853	$12,390,997	$25,315,850	16%
Golden Valley	89	$9,995,274	$7,954,322	$17,949,596	14%
McCone	238	$24,405,086	$19,610,653	$44,015,739	17%
Musselshell	236	$22,969,386	$17,882,548	$40,851,934	8%
Powder River	154	$15,626,169	$14,252,815	$29,878,984	15%
Prairie	137	$11,667,759	$9,932,175	$21,599,934	16%
Richland	752	$169,699,932	$119,830,227	$289,530,159	15%
Roosevelt	394	$56,489,395	$44,629,488	$101,118,883	12%
Rosebud	197	$20,528,752	$17,777,771	$38,306,523	7%
Sheridan	340	$45,788,993	$41,760,992	$87,549,985	12%
Stillwater	680	$179,346,702	$124,273,341	$303,620,043	14%
Treasure	86	$10,736,876	$8,950,580	$19,687,456	19%
Valley	438	$80,198,087	$68,976,744	$149,174,831	10%

County	Improved Parcels	Improved Value	Content Value	Total Value	Loss Ratio
Wheatland	126	$18,929,630	$14,766,850	$33,696,480	10%
Wibaux	71	$10,416,620	$9,028,040	$19,444,660	12%
Yellowstone	800	$500,526,347	$352,211,744	$852,738,091	1%
Total	6,723	$1,503,980,222	$1,155,113,124	$2,659,093,346	6%

Sources: MSDI 2022, MWRA

Table 4-73 Exposure and Value of Structures at Very High Risk to Wildfire by County

County	Improved Parcels	Improved Value	Content Value	Total Value	Loss Ratio
Big Horn	470	$84,697,265	$55,600,450	$140,297,715	16%
Carbon	2,090	$547,758,151	$338,899,010	$886,657,161	33%
Carter	194	$16,622,939	$11,777,870	$28,400,809	22%
Custer	2,619	$355,987,960	$205,139,052	$561,127,012	51%
Daniels	597	$49,379,383	$29,321,872	$78,701,255	37%
Dawson	2,534	$298,389,201	$160,992,812	$459,382,013	59%
Fallon	666	$82,437,643	$50,468,650	$132,906,293	39%
Garfield	211	$20,592,843	$13,824,137	$34,416,980	24%
Golden Valley	235	$27,723,611	$20,667,195	$48,390,806	37%
McCone	279	$23,816,544	$16,536,307	$40,352,851	20%
Musselshell	1,027	$104,380,896	$60,240,354	$164,621,250	36%
Powder River	213	$31,077,010	$29,785,330	$60,862,340	21%
Prairie	431	$23,090,380	$13,659,171	$36,749,551	49%
Richland	1,620	$276,214,590	$150,699,173	$426,913,763	33%
Roosevelt	881	$71,918,345	$43,188,463	$115,106,808	28%
Rosebud	970	$105,865,876	$63,965,597	$169,831,473	35%
Sheridan	758	$83,050,450	$64,111,850	$147,162,300	27%
Stillwater	2,865	$567,115,185	$316,256,337	$883,371,522	58%
Treasure	210	$16,963,574	$10,550,781	$27,514,355	48%
Valley	1,161	$160,221,477	$90,507,557	$250,729,034	27%
Wheatland	871	$67,516,048	$39,657,448	$107,173,496	66%
Wibaux	293	$23,250,971	$14,174,318	$37,425,289	49%
Yellowstone	24,939	$6,151,318,658	$3,597,410,593	$9,748,729,251	39%
Total	46,134	$9,189,389,000	$5,397,434,321	$14,586,823,321	39%

Sources: MSDI 2022, MWRA

Table 4-74 Exposure and Value of Structures at Extreme Risk to Wildfire by County

County	Improved Parcels	Improved Value	Content Value	Total Value	Loss Ratio
Big Horn	1,550	$202,949,949	$137,934,621	$340,884,570	53%
Carbon	3,296	$693,167,480	$378,618,127	$1,071,785,607	52%
Carter	152	$14,455,913	$11,113,807	$25,569,720	17%
Custer	1,521	$217,038,271	$114,139,069	$331,177,340	30%
Daniels	228	$24,807,057	$15,066,852	$39,873,909	14%
Dawson	466	$54,701,745	$33,992,742	$88,694,487	11%
Fallon	439	$54,146,980	$36,121,450	$90,268,430	26%
Garfield	300	$23,256,363	$13,039,702	$36,296,065	33%
Golden Valley	69	$4,487,390	$2,921,733	$7,409,123	11%
McCone	266	$23,428,567	$13,039,210	$36,467,777	19%
Musselshell	1,267	$116,264,790	$72,757,969	$189,022,759	44%

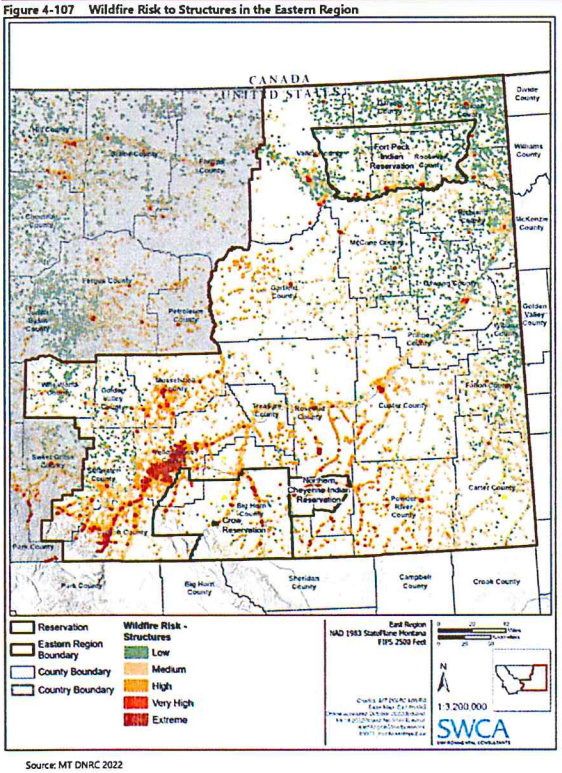
County	Improved Parcels	Improved Value	Content Value	Total Value	Loss Ratio
Powder River	339	$26,943,938	$14,775,338	$41,719,276	33%
Prairie	132	$9,161,738	$4,667,220	$13,828,958	15%
Richland	65	$6,399,632	$3,980,141	$10,379,773	1%
Roosevelt	1,233	$102,809,163	$59,724,939	$162,534,102	39%
Rosebud	1,241	$135,545,674	$81,799,109	$217,444,783	45%
Sheridan	752	$92,607,505	$57,328,988	$149,936,493	27%
Stillwater	602	$101,028,261	$56,171,507	$157,199,768	12%
Treasure	20	$793,239	$471,790	$1,265,029	5%
Valley	1,596	$207,970,575	$114,419,411	$322,389,986	38%
Wheatland	27	$2,881,529	$2,102,472	$4,984,001	2%
Wibaux	10	$1,265,355	$875,373	$2,140,728	2%
Yellowstone	24,107	$5,095,993,537	$2,674,222,521	$7,770,216,058	38%
Total	**39,678**	**$7,212,204,651**	**$3,899,284,086**	**$11,111,488,737**	**33%**

Sources: MSDI 2022, MWRA

Table 4-75 Eastern Region Parcel Exposure and Value of Structures at Risk to Wildfire by Tribe

Tribe	Extreme	Very High	High	Medium	Total Improved Parcels	Improved Value	Content Value	Total Value	Loss Ratio
Crow Tribe	294	278	157	325	1,054	$151,771,796	$122,155,017	$273,926,813	69%
Fort Peck Assiniboine and Sioux Tribe	975	523	335	849	2,682	$268,133,296	$229,133,296	$497,786,897	68%
Northern Cheyenne Indian Reservation	112	7	2	9	130	$8,645,052	$6,278,875	$14,923,837	93%
Total	**1,381**	**808**	**494**	**1,183**	**3,866**	**$429,070,449**	**$357,567,098**	**$786,637,547**	**69%**

Figure 4-107 Wildfire Risk to Structures in the Eastern Region



Source: MT DNRC 2022

Critical Facilities and Lifelines

Buildings, equipment, vehicles, and communications and utility infrastructure are exposed and lost to wildfires every year. Potential risk exists to water treatment facilities, government buildings, public safety facilities and equipment, and healthcare services. Scour on bridge pilings may result in bridge and road closures. Wildfire impacts to critical facilities can include structural damage or destruction, risk to persons located within facilities, disruption of transportation, shipping, and evacuation operations, and interruption of facility operations and critical functions. To estimate the potential impact of wildfire on critical facilities and lifelines a GIS vulnerability analysis was performed similarly to the property vulnerability analysis, by intersecting the Montana Wildfire Risk Assessment (MWRA) data with critical facility data from HIFLD, Montana DES, and National Bridge Inventory (NBI).

Summary tables of these results are shown below in Table 4-76 through Table 4-78, highlighting the type and number of facilities in each county that are located in High, Very High, or Extreme Wildfire risk areas.

Table 4-76 Critical Facilities at Risk to Extreme Wildfire Hazards

County	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Total
Big Horn	33	30	15	2	0	12	10	102
Carbon	24	26	10	0	2	23	13	98
Carter	8	1	0	0	1	5	3	18
Custer	20	15	0	0	1	9	3	48
Daniels	2	0	0	0	0	0	0	2
Dawson	10	0	0	0	1	1	1	13
Fallon	13	7	1	0	0	12	0	33
Garfield	11	1	1	0	1	7	5	26
Golden Valley	2	1	1	0	1	5	1	11
McCone	13	1	1	0	0	4	1	20
Musselshell	16	18	9	0	2	10	3	58
Petroleum	-	-	-	-	-	-	-	-
Phillips	-	-	-	-	-	-	-	-
Powder River	14	2	2	0	1	9	0	28
Prairie	4	5	0	0	1	0	0	10
Richland	2	1	0	0	1	4	0	8
Roosevelt	31	5	2	0	1	18	2	59
Rosebud	40	22	10	0	3	19	5	99
Sheridan	4	3	1	0	0	5	0	13
Stillwater	15	17	0	0	0	4	1	37
Treasure	6	8	0	0	0	0	0	14
Valley	13	1	3	0	1	9	5	32
Wheatland	6	1	0	0	0	4	0	11
Wibaux	1	0	0	0	0	4	0	5
Yellowstone	108	42	14	2	10	36	39	251
Total	**396**	**207**	**70**	**4**	**27**	**200**	**92**	**996**

Source: HIFLD 2022, Montana DES, NBI, MWRA

Table 4-77 Critical Facilities at Risk to Very High Wildfire Hazards

County	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Total
Big Horn	1	1	4	0	0	4	37	47
Carbon	5	5	3	2	1	2	46	64
Carter	3	1	1	0	0	3	6	14
Custer	1	3	4	1	3	12	15	39
Daniels	9	13	0	0	0	11	1	34
Dawson	14	5	1	3	1	17	26	67
Fallon	3	24	1	0	0	2	8	38
Garfield	1	0	0	0	0	4	5	10
Golden Valley	0	12	0	0	1	4	3	20
McCone	1	10	0	0	1	0	8	20
Musselshell	0	0	0	0	0	1	9	10
Petroleum	-	-	-	-	-	-	-	-
Phillips	-	-	-	-	-	-	-	-
Powder River	0	0	0	0	0	2	5	7
Prairie	1	5	1	0	1	9	2	19
Richland	17	21	4	3	1	12	20	78
Roosevelt	12	23	2	1	0	14	4	56
Rosebud	4	10	1	0	0	4	28	47
Sheridan	12	18	0	0	2	11	7	50
Stillwater	3	4	3	0	2	21	42	75
Treasure	0	4	0	0	1	4	4	13
Valley	31	37	2	1	1	12	17	101
Wheatland	10	19	0	0	2	9	4	44
Wibaux	3	7	1	0	1	5	6	23
Yellowstone	50	18	16	15	2	42	134	277
Total	**181**	**240**	**44**	**26**	**20**	**205**	**437**	**1,153**

Source: HIFLD 2022, Montana DES, NBI, MWRA

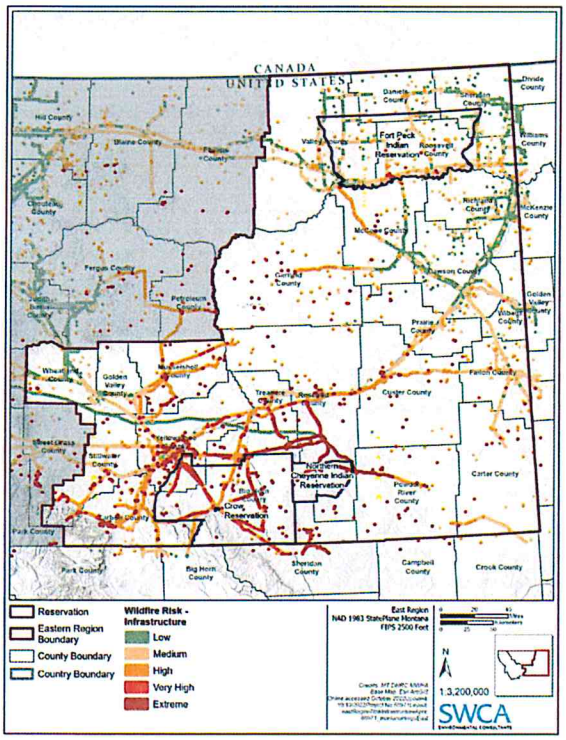
Table 4-78 Critical Facilities at Risk to High Wildfire Hazards

County	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Total
Big Horn	0	8	2	1	0	0	33	44
Carbon	5	2	1	0	0	0	6	14
Carter	0	1	0	0	0	1	13	15
Custer	4	0	0	1	0	1	31	37
Daniels	1	1	0	0	0	0	16	18
Dawson	4	2	0	1	0	2	42	51

County	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Total
Fallon	0	0	1	2	0	0	18	21
Garfield	2	0	1	0	0	1	8	12
Golden Valley	0	0	1	0	0	0	6	7
McCone	0	1	0	2	0	0	14	17
Musselshell	2	0	1	0	0	0	4	7
Petroleum	-	-	-	-	-	-	-	-
Phillips	-	-	-	-	-	-	-	-
Powder River	0	0	0	0	0	1	7	8
Prairie	1	0	0	1	0	0	27	29
Richland	3	2	0	6	0	2	38	51
Roosevelt	4	0	2	3	0	0	29	38
Rosebud	3	0	1	1	0	0	51	56
Sheridan	5	0	2	1	0	0	27	35
Stillwater	10	0	1	3	0	0	24	38
Treasure	1	0	1	0	0	0	20	22
Valley	9	0	0	0	0	0	31	40
Wheatland	0	1	3	0	0	0	9	13
Wibaux	0	0	0	0	0	0	6	6
Yellowstone	13	1	0	4	1	1	39	59
Total	67	19	17	26	1	9	499	638

Source: HIFLD 2022, Montana DES, NBI, MWRA

Figure 4-108 Wildfire Risk to Infrastructure in the Eastern Region



Source: MT DNRC 2022

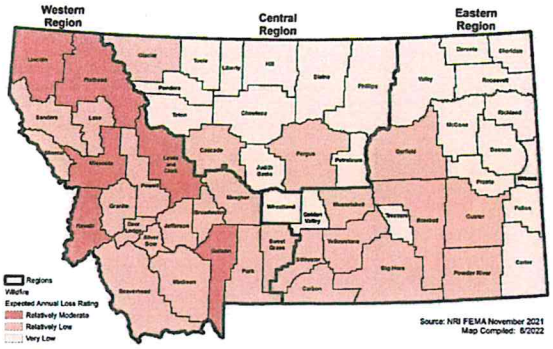
Economy

The economic impacts of wildfire include loss of property, direct agricultural sector job loss, secondary economic losses to businesses in or near wildland resources like parks and national forests, and loss of public access to recreational resources. Damage to these assets or disruption of access to them can have far reaching negative impacts to the local economy in the form of reduced revenues. In addition to the monetary losses resulting from direct building losses. Fire suppression may also require increased cost to local and state government for water acquisition and delivery, especially during periods of drought when water resources are scarce.

Tourism and outdoor recreation are vital components of the Eastern Region economy. Wildland fires can have a direct impact on the County's scenery and environmental health, adversely affecting the presence of tourism activities and the ability of the regions residents to earn a living from the related industries. The Eastern Region's scenic beauty and cultural resources are a main draw for tourism, so the entire region can suffer economic losses from tourists not coming to the area due to wildfires.

Figure 4-109 illustrates the relative risk of EAL rating due to wildfire. Most counties in the Eastern Region have very low risk, although Garfield, Rosebud, Custer, Powder River, Musselshell, Big Horn, Yellowstone, Stillwater, and Carbon have a slightly higher risk score (but still relatively low overall).

Figure 4-109 NRI Wildfire Expected Annual Loss Rating by County



Historic and Cultural Resources

Historic structures are often at high risk to wildfire due to wood frame construction methods and being constructed long before modern building and fire codes. Cultural resources include the natural and recreational resources also mentioned in the Economy and Natural Resources sections. These resources add not only monetary value and ecosystem goods and services to the region but can also serve as a source of regional identity and pride for the residents of the Eastern Region. This makes these vital resources for the various communities which are vulnerable to wildfire.

Natural Resources

Wildfire can be both beneficial and destructive to the Eastern Region's natural resources. In the rangeland and forest systems of Eastern Montana, fire is an essential component of the region's ecosystems and is necessary to maintain its native ecology (MT DNRC 2020a). However, in recent decades fire suppression, fuel buildup, climate change, and non-native invasive plant species have altered the natural fire regimes and increased the likelihood of high severity wildfire. These changing conditions have put much of the region's natural resources at risk (MT DNRC 2020a).

Across the western US, watershed vulnerability to wildfire has increased with the increasing wildfire conditions. Larger and more extreme, high severity wildfires have resulted in degradation to watershed quality. High severity wildfires can result in increased flows (due to increased hydrophobicity of the burned soil); higher amounts of sedimentation and contamination (due to destabilization of topsoil), loss of aquatic habitat, and degradation of aquatic ecology (Montana Free Press 2022; Rhoades et al 2019). As watersheds become more vulnerable to wildfire, more mitigation efforts will be required to protect watershed health.

Recreation is a valuable natural resource in the region. The region contains vast areas of highly valued public lands, which include, but are not limited to, the Eastern portion of the Beartooth Mountains and Wilderness; The Yellowstone River; The Missouri River; The Big Horn Canyon National Recreation Area; The Little Big Horn Battlefield National Monument; Charles M Russell National Wildlife Refuge; Custer National Forest; BLM managed lands, and multiple state parks. Increasing wildfire conditions can put these recreational resources at risk. Increasing wildfire conditions, especially extreme large fires, can threaten access (due to temporary closures), impact air and water quality, and alter visual aesthetics. Taken together, these impacts can potentially deter visitation and hurt the region's tourist economy (Kim and Jakus 2019).

Timber extraction in the Eastern region is carried out in limited capacity and predominantly occurs in areas with continuous forests, such as the eastern edge of the Beartooth's and the southern Big Snowy Mountains. Increasing wildfire conditions can halt timber sales (due to closures) and damage and potentially destroy harvestable trees, impacting the timber industry. In recent years forest wildfires have become larger and more severe. Historically, however, wildfires of all frequencies and severities occurred in the regions forests and were necessary for maintaining stand structure and native forest ecology (MT DNRC 2020c). Timber management should be aligned with fire management, such that it allows natural fire regimes and their dependent ecology to be restored and/or persist while minimizing the vulnerability of region's timber industry.

Public and privately managed rangelands across the Eastern Region provide ample grazing for livestock, making the region highly valued for ranching. Increasing wildfire conditions can put ranches and livestock at risk and threaten this region's industry in the event of large fires. However, it is important to note that, historically, the rangelands throughout the region required a mosaic of conditions created by wildfire (i.e., a landscape that exhibits different severities of wildfire and time since wildfire) to maintain their native ecology. For instance, wildfire can clear woody shrubs, favor the growth of grasses and forbs, and increase vegetative productivity (Cooper et al 2011); all of which can bolster ranching in the region. Wildfire should be carefully managed to both maintain the region's natural ecology and to minimize risk to local ranchers.

Wildfire can also threaten the region's farmlands. Currently counties with a proportion of farmlands are less vulnerable to wildfire. However, much of the region has an intermix of farmland and undeveloped rangelands. These would likely be more vulnerable to wildfire. For example, wildfire on undeveloped rangelands could threaten nearby farms and their crops. This is especially possible in the later summer and early fall when wildfire could threaten dry fields of wheat. When wheatfields do catch fire they spread at fast rates, are hard to control, and can cause crop loss and property damage (Western Farm Press 2017). Additionally, indirect impacts from wildfire, primarily smoke impacts, can also negatively affect produce harvest, quality, and sales (AEI 2021). Overall, increasing wildlife conditions are making the Eastern Region's farmlands more vulnerable to wildfire.

Development Trends Related to Hazards and Risk

In recent decades, many counties in Eastern Montana have either experienced population declines or no meaningful population trends. Stillwater and Yellowstone Counties, however, have experienced a large growth in population. Most population growth in the Eastern Region has occurred in and around Billings. Many of the new developments occurring in and around Billings (including the surrounding communities) is occurring within the WUI. Trends across the state and the Western US have demonstrated that the WUI is a desirable location for development, even though it presents increased wildfire risk (MT DNRC 2020a). Current houses/structures and future houses/structures in high-risk WUI areas places lives and property in the path of wildfires. Furthermore, the increasing wildfire risk brought on by climate change is also putting greater risk on homes and infrastructure already located within the WUI throughout the region. Regulating growth and decreasing fire risk in these areas will be a delicate balance between protecting private property rights and promoting public safety. Local governments may wish to consider regulation of subdivision entrance/exit roads and bridges for the safety of property owners and fire personnel, building considerations pertaining to land on slopes greater than 25% (in consideration of access for fire protection of structures), and water supply requirements to include ponds, access by apparatus, pumps, and backup generators. Such standards serve to protect residents and property, as well as emergency services personnel. Additionally, as climate change progresses, the wildfire conditions will likely be exacerbated. Regional planners and property owners should also consider efforts to improve the wildfire resiliency of homes, structures, and critical infrastructure currently situated in the WUI to prepare for potential increased risk from wildfire.

Risk Summary

In summary, wildfire is considered to be overall High significance for the Region. Variations in risk by jurisdiction are summarized in the table below, as well as key issues from the vulnerability assessment. The frequency of wildfires in the Eastern Region overall is highly likely, although the forested and rangeland areas have a higher burn probability and somewhere in the region fires occur annually.

- Wildfire ignitions occur most frequently in the southwestern and western portions of the Eastern Region, where there are large portions of mostly undeveloped rangelands.
- The counties with large areas of forests and rangelands in the western part of the Eastern Region are likely to experience the most acres burned in any given year.
- Socially vulnerable populations are likely to experience the worst effects of wildfire.
- Property, structures, and critical infrastructure is at moderate to extreme risk from throughout the region.
- Jurisdictions surrounded by more fire prone landscapes (e.g., forests and rangelands), generally, have structures and critical infrastructure most at risk to extreme wildfire.
- As climate change increases, drought will be more likely and the detrimental impacts on human health and the built environment from wildfire will likely increase.
- Related Hazards: Drought, Flooding, Severe Summer Weather (lightning)

Table 4-79 Risk Summary Table: Wildfire

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
Eastern Region	High		
Big Horn	High		None
Carbon	High	Bearcreek, Bridger, Joliet, Fromberg, Red Lodge	Higher risk located within the WUI near the incorporated towns
Carter	Medium	Ekalaka	Lower risk than the Region but higher risk in WUI around Ekalaka

5 Mitigation Strategy

Local Plan Requirement §201.6(c)(3): [The plan shall include] a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools. This section shall include:

(i) A description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

(ii) A section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

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

Tribal Requirement §201.7(c)(3): A mitigation strategy that provides the Indian tribal government's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools. This section shall include:

(i): A description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

(ii): A section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

(iii): An action plan describing how the actions identified in paragraph (c)(3)(ii) of this section will be prioritized, implemented, and administered by the Indian Tribal government.

5.1 Mitigation Strategy: Overview

This section describes the mitigation strategy process and mitigation action plan for the Eastern Montana Region HMP. It describes how the participating jurisdictions in the Region met the following requirements from the 10-step planning process:

- Planning Step 6: Set Goals
- Planning Step 7: Review Possible Activities
- Planning Step 8: Draft an Action Plan

The results of the planning process, the risk assessment, the goal setting, the identification of mitigation actions, and the hard work of each jurisdiction's CPT/TPT led to this mitigation strategy and action plan. Section 5.2 below identifies the goals of this plan and Section 5.4 describes the mitigation action plan.

5.2 Mitigation Goals

Up to this point in the planning process, each jurisdiction's CPT/TPT has organized resources, assessed hazards and risks, and documented mitigation capabilities. The resulting goals and mitigation actions were reviewed and updated based on these tasks. During the 2022-2023 update of this plan, each CPT/TPT held a series of meetings designed to achieve a collaborative mitigation strategy as described further throughout this section.

Goals were defined for the purpose of this mitigation plan as broad-based public policy statements that:

- Represent basic desires of the community;
- Encompass all aspects of community, public and private;

Jurisdiction	Overall Significance	Additional Jurisdictions	Jurisdictional Differences?
Custer	High	Ismay, Miles City	None
Crow Tribe	High		High risk located within the WUI within the reservation lands
Daniels	Medium	Scobey, Flaxville	Lower risk than Region
Dawson	Low	Richey, Glendive	Lower risk than Region
Fallon	Medium	Plevna, Baker	Higher risk around Plevna, Baker, and Ismay WUI
Garfield	High	Jordan	None
Golden Valley	Low	Ryegate, Lavina	WUIs in the County, such as Town of Jordan
McCone	Low	Circle	Lower risk than Region
Musselshell	High	Melstone, Roundup	None
Powder River	High	Broadus	None
Prairie	Medium	Terry	Lower risk than Region
Medium	Low	Fairview, Sidney	Lower risk than Region
Roosevelt	Medium	Wolf Point, Poplar, Bainville, Culberson, Froid	Lower risk than Region
Rosebud	High	Colstrip, Forsyth	None
Sheridan	Medium	Plentywood, Medicine Lake, Outlook, Westby	Lower risk than Region
Stillwater	Medium	Columbus	Lower risk than Region
Treasure	Medium	Hysham	Lower risk than Region
Valley	Medium	Glasgow, Fort Peck, Nashua, Opheim	None
Wheatland	Low	Harlowton, Judith Gap	Lower risk than Region
Wibaux	Medium	Wibaux	None
Yellowstone	High	Billings, Broadview, Laurel	None

- Are nonspecific, in that they refer to the quality (not the quantity) of the outcome;
- Are future-oriented, in that they are achievable in the future; and
- Are time-independent, in that they are not scheduled events.

Goals are stated without regard to implementation. Implementation cost, schedule, and means are not considered. Goals are defined before considering how to accomplish them so that they are not dependent on the means of achievement. Goal statements form the basis for objectives and actions that will be used as means to achieve the goals.

During the mitigation strategy workshops held in April 2023, the jurisdictions reviewed the results of the hazard identification, vulnerability assessment, and capability assessment. They then reviewed the goals of the previous county and tribal hazard mitigation plans in the Eastern Region, as well as the Montana State Multi-Hazard Mitigation Plan. This analysis of the risk assessment identified areas where improvements could be made and provided the framework for the counties and tribes to update planning goals and to base the development of new or updated mitigation strategies for the counties and tribes in the Eastern Region. The participating jurisdictions decided to collaborate and develop a set of new, uniform goals, which were adopted by all counties in the Eastern Region:

Goal 1: Reduce impacts to people, property, the environment, and the economy from hazards by implementing whole-community risk reduction and resilience strategies.

Goal 2: Protect community lifelines and critical infrastructure to ensure the continuity of essential services during and after a disaster.

Goal 3: Support education and outreach to the public through improved communications and capacity building that enhances resilience among underserved communities.

Goal 4: Promote regional cooperation and leverage partnerships with the private sector, non-profit organizations, and other key stakeholder groups in mitigation solutions.

Goal 5: Sustain and enhance jurisdictional capabilities and resources to enact and implement mitigation activities.

Goal 6: Integrate hazard mitigation into other plans, processes, and regulations.

Goal 7: Ensure local mitigation programs address underrepresented groups and protect socially vulnerable populations.

Goal 8: Incorporate the potential impacts of climate change into all mitigation activities.

Objectives are an optional intermediate step between goals and mitigation actions that define strategies to attain the goals and are more specific and measurable. After discussion, the HMPC decided not to include regional objectives. Each county and tribe were given the opportunity to set objectives to meet their unique situation and complement the regional goals. See Section 6 of each jurisdictional annex or addendum for details.

5.3 Identification and Analysis of Mitigation Actions

The next step in the mitigation strategy is to identify and analyze a comprehensive range of specific mitigation actions and projects to reduce the effects of each hazard on new and existing buildings and infrastructure. During the 2022-2023 Regional HMP process, each jurisdiction's CPT/TPT analyzed viable mitigation options by hazard that supported the identified goals. The CPTs/TPTs were provided with the following list of categories of mitigation actions, which originate from the CRS:

- **Plan and Regulations (Prevention):** Administrative or regulatory actions or processes that influence the way land and buildings are developed and built.

- **Property Protection:** Actions that involve the modification of existing buildings or structures to protect them from a hazard or remove them from the hazard area.
- **Structural and Infrastructure Projects:** Actions that involve the construction of structures to reduce the impact of a hazard.
- **Natural Resource Protection:** Actions that, in addition to minimizing hazard losses, also preserve or restore the functions of natural systems.
- **Public Information/Education and Awareness:** Actions to inform and educate citizens, elected officials, and property owners about the hazards and potential ways to mitigate them.
- **Emergency Services:** Actions that protect people and property during and immediately after a disaster or hazard event.

To identify and select mitigation actions in support of the mitigation goals, the HMPC evaluated each hazard identified and profiled in Chapter 3.4. A link to reference documents titled "Mitigation Ideas" and "Mitigation Action Portfolio" developed by FEMA was referenced in the meeting presentation and made available as hard copies distributed during Workshop #3 to support the planning exercises. These documents list common alternatives for mitigation by hazard and best practices. The jurisdictions considered both future and existing buildings in considering possible mitigation actions. A facilitated discussion then took place to examine and analyze the options.

The mitigation strategy is based on existing local and tribal authorities, policies, programs, and resources, as well as the ability to expand on and improve these existing tools. As part of the Regional HMP development, the CPTs and TPTs reviewed existing capabilities for reducing long-term vulnerability to hazards. Those capabilities are noted by the jurisdiction in the county and reservation annexes and addendums and can be assessed to identify gaps to be addressed and strengths to enhance through new mitigation actions. For instance, gaps in the design or enforcement of existing regulations be addressed through additional personnel or a change in procedure or policy.

Based upon the key issues identified in the risk assessment, including the capability assessment, the counties and tribes came to a consensus on proposed mitigation actions for each hazard for their jurisdictions. Certain hazards' impacts were best reduced through multi-hazard actions. A lead for each new action, where applicable, was identified to provide additional details on the project so they could be captured in the plan. Final action strategies are summarized in Section 5.4 and detailed within the respective jurisdictional annexes.

5.3.1 Prioritization Process

Once the mitigation actions were identified, the CPTs and TPTs were provided FEMA's recommended prioritization criteria STAPLEE to assist in deciding why one recommended action might be more important, more effective, or more likely to be implemented than another. STAPLEE is an acronym for the following:

- **Social**: Does the measure treat people fairly? (e.g., different groups, different generations)
- **Technical**: Is the action technically feasible? Does it solve the problem?
- **Administrative**: Are there adequate staffing, funding, and other capabilities to implement the project?
- **Political**: Who are the stakeholders? Will there be adequate political and public support for the project?
- **Legal**: Does the jurisdiction have the legal authority to implement the action? Is it legal?
- **Economic**: Is the action cost-beneficial? Is there funding available? Will the action contribute to the local economy?
- **Environmental**: Does the action comply with environmental regulations? Will there be negative environmental consequences from the action?

Other criteria used to assist in evaluating the priority of a mitigation action included:

- Does the action address hazards or areas with the highest risk?

- Does the action protect lives?
- Does the action protect infrastructure, community assets or critical facilities?
- Does the action meet multiple objectives?

At the mitigation strategy workshops, the counties and tribes used STAPLEE to determine which of the newly identified actions were most likely to be implemented and effective. Keeping the STAPLEE criteria in mind, each jurisdiction prioritized the new mitigation actions by giving an indication of relative priority, which was then translated into 'high,' 'medium' and 'low.' The results of the STAPLEE evaluation process produced prioritized mitigation actions for implementation within the planning area. Continued actions were also assessed to see if priority changes were needed; most of these remained the same, but in some cases, priorities were changed.

The process of identification and analysis of mitigation alternatives allowed the county and tribal planning teams to come to a consensus and prioritize recommended mitigation actions for their jurisdictions. During the voting process, emphasis was placed on the importance of a benefit-cost review in determining project priority as this is a requirement of the DMA regulations; however, this was a planning-level analysis as opposed to a quantitative analysis. A quantitative cost-benefit analysis will be considered in additional detail when seeking FEMA mitigation grant funding for eligible projects identified in this plan.

Each mitigation action developed for this plan contains a brief description of the problem and proposed project, the entity with primary responsibility for implementation, a cost estimate, and a schedule for implementation. The development of these project details further informed the determination of a high, medium, or low priority for each. During the plan update, the jurisdictions in the Eastern Region identified some mitigation actions to be carried forward from their previous county HMPs. Priority levels on these actions were revisited during Workshop #3 and through the distribution of a Mitigation Action Tracker tool and, in some cases, modified to reflect current priorities based on the STAPLEE principles.

5.4 Mitigation Action Plan

This section outlines the development of the mitigation action plan. The action plan consists of the specific projects, or actions, designed to meet the plan's goals. Over time the implementation of these projects will be tracked as a measure of demonstrated progress on meeting the plan's goals.

5.4.1 Progress on Previous Mitigation Actions

This Eastern Regional HMP represents a plan update for all counties and tribes. As part of the update process, the jurisdictions reviewed actions identified in their previous plans to assess progress on implementation. These reviews were completed using worksheets to capture information on each action including if the action was completed or deferred to the future. Actions that were not completed were discussed for continued relevance and were either continued into the Regional Plan or in some cases recommended for deletion.

The participating jurisdictions have been working steadily towards meeting the goals of their previous plans. While several remain to be completed, many were noted as in-progress. Progress on mitigation actions previously identified in these planning mechanisms is detailed in the jurisdictional annexes. These action plans were also shared amongst the Regional Plan participants to showcase progress and stimulate ideas amongst the respective planning committees in each county and tribe. Reasons that some actions have not been completed include low priority, lack of funding, or lack of administrative resources.

Table 5-1 summarizes the progress in implementing mitigation actions by tribe and county (including the municipalities). In total, 29 actions have been completed, and 24 were deleted as being no longer relevant or feasible. A total of 948 actions were carried over into the Regional Plan, along with 104 new actions developed during the planning effort.

Table 5-1 Mitigation Action Progress Summary by Jurisdiction

County/Reservation	Completed	Deleted	Continuing	New Actions in 2023	Total Continuing and New Actions
Big Horn	0	0	79	2	81
Carbon	1	3	69	12	81
Carter	0	0	19	6	25
Crow Tribe	0	0	13	1	14
Custer	2	0	96	6	102
Daniels	5	2	20	7	27
Dawson	0	0	32	1	33
Fallon	0	0	22	3	25
Garfield	0	0	10	1	11
Golden Valley	1	0	61	1	62
McCone	2	2	24	1	25
Musselshell	0	0	74	2	76
Powder River	0	0	12	2	14
Prairie	3	1	8	6	14
Richland	1	0	33	2	35
Roosevelt	3	0	34	3	37
Rosebud	0	0	39	0	39
Sheridan	3	0	21	4	25
Stillwater	0	16	43	17	60
Treasure	2	0	55	1	56
Valley	6	0	70	18	88
Wibaux	0	0	27	3	30
Yellowstone	9	14	64	5	69
Total	**29**	**24**	**948**	**104**	**1,052**

5.4.2 Continued Compliance with NFIP

Given the significance of the flood hazard throughout the planning area, an emphasis will be placed on continued compliance with the National Flood Insurance Program (NFIP). Jurisdictions that participate in the NFIP are noted in the respective annexes' and addendums' Capability Assessment and will continue to make every effort to remain in good standing with the program. This includes continuing to comply with the NFIP's standards for adopting floodplain maps and maintaining and periodically updating local floodplain regulations. Actions related to continued compliance include:

- Continued designation of a local floodplain manager whose responsibilities include reviewing floodplain development permits to ensure compliance with the local floodplain management ordinances and rules;
- Suggest changes to improve enforcement of and compliance with regulations and programs;
- Participate in Flood Insurance Rate Map (FIRMs) updates by adopting new maps or amendments to maps;
- Utilize DFIRMs in conjunction with GIS to improve floodplain management, such as improved risk assessment and tracking of floodplain permits;
- Promote and disperse information on the benefits of flood insurance.

Also, to be considered are the flood mitigation actions contained in this Eastern Regional Plan that support the ongoing efforts by participating jurisdictions to minimize the risk and vulnerability of the community to the flood hazard, and to enhance their overall floodplain management program.

5.4.3 Mitigation Action Plan

The action plan presents the recommendations developed by the county and tribal planning teams, outlining how each jurisdiction and the Region can reduce the risk and vulnerability of people, property, infrastructure, and natural and cultural resources to future disaster losses. The mitigation actions developed by each participating jurisdictions are detailed in the jurisdictional annexes in Section 10. These details include the action description, hazard(s) mitigated, lead and partner agencies responsible for initiating implementation, costs, and timeline. Many of the action items included in this plan are a collaborative effort among local, state, tribal, and federal agencies, and stakeholders in the planning area.

Table 5-2 summarizes the mitigation actions that address each hazard relevant to that jurisdiction.

Table 5-2 Mitigation Actions by Hazard and Jurisdiction

County/Reservation	Communicable Disease	Cyber Threat	Dam Failure	Drought	Earthquake	Flooding	Hazmat Incident	Human Conflict	Landslide	Severe Summer Weather	Severe Winter Weather	Tornadoes & Windstorms	Transportation Accidents	Volcanic Ash	Wildfire
Big Horn County	13	10	19	5	15	23	16	20	12	19	19	15	13	16	36
City of Hardin	7	4	9	1	6	10	9	10	5	10	10	7	4	7	15
Town of Lodge Grass	7	3	10	0	8	13	10	12	7	12	11	8	6	8	19
Carbon County	3	3	11	6	10	19	13	10	10	11	12	9	9	9	33
Town of Bearcreek	0	0	4	1	4	5	4	4	4	4	5	4	4	4	7
Town of Bridger	0	0	4	0	4	5	4	4	4	4	5	4	4	4	5
Town of Fromberg	0	1	5	2	5	6	4	5	4	5	6	5	4	5	7
Town of Joliet	0	2	6	1	6	10	4	6	4	7	8	6	4	6	7
City of Red Lodge	0	0	6	1	5	13	5	4	5	6	5	5	4	5	10
Carter County	3	3	1	2	1	3	5	3	1	2	3	1	1	1	4
Town of Ekalaka	1	2	1	1	1	4	1	2	1	2	2	1	2	1	1
Crow Tribe	3	1	6	1	6	8	7	5	5	6	6	7	2	6	9
Custer County	21	9	20	8	17	24	21	21	16	25	25	18	20	18	32
City of Miles City	20	8	17	7	15	33	22	21	14	23	24	16	21	16	28
Town of Ismay	20	4	14	5	13	15	17	14	13	19	19	14	16	14	17
Daniels County	1	0	5	0	0	5	3	5	0	4	4	5	0	0	11
City of Scobey	1	0	4	0	0	7	2	4	0	3	3	4	0	0	9
Town of Flaxville	1	0	3	0	0	5	2	4	0	3	4	4	0	0	9
Dawson County	1	1	3	1	2	14	7	3	2	9	8	2	1	2	3
City of Glendive	0	1	2	1	1	11	2	2	0	4	2	1	0	1	1
Town of Richey	0	0	1	1	0	2	1	1	0	5	2	1	0	0	0
Fallon County	4	5	5	4	2	4	5	5	2	5	5	2	3	2	5
City of Baker	2	3	5	3	2	4	2	3	2	3	3	2	2	2	2
Town of Plevna	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Garfield County	1	1	2	1	2	4	3	2	3	3	4	2	2	2	4
Town of Jordan	1	1	2	1	2	4	3	2	2	2	3	2	2	2	4
Golden Valley County	9	8	10	7	8	15	8	11	6	15	15	8	9	8	20
Town of Ryegate	8	6	6	4	5	10	5	7	4	11	11	5	4	5	15
Town of Lavina	8	7	7	4	6	11	5	9	4	11	11	6	4	6	14

County/Reservation	Communicable Disease	Cyber Threat	Dam Failure	Drought	Earthquake	Flooding	Hazmat Incident	Human Conflict	Landslide	Severe Summer Weather	Severe Winter Weather	Tornadoes & Windstorms	Transportation Accidents	Volcanic Ash	Wildfire
McCone County	5	0	12	0	0	14	11	9	7	15	14	0	0	0	12
Town of Circle	1	0	2	0	0	2	1	1	1	2	2	0	0	0	1
Musselshell County	9	6	14	6	11	21	14	13	10	17	17	11	13	10	24
Town of Melstone	8	3	6	4	4	4	6	7	4	7	7	4	5	4	11
Town of Roundup	9	4	8	5	6	15	10	9	6	11	11	6	8	6	11
Powder River County	1	1	2	1	2	5	4	1	2	3	3	2	1	1	4
Town of Broadus	1	1	1	1	1	6	3	1	1	3	2	1	1	1	1
Prairie County	1	3	3	3	3	4	1	3	1	5	7	3	1	3	3
Town of Terry	0	2	2	2	2	4	0	2	0	3	3	2	0	2	2
Richland County	2	1	1	3	1	5	3	2	2	7	9	2	1	1	2
Town of Fairview	0	0	0	0	0	1	1	1	0	6	8	2	0	0	0
Town of Sidney	0	0	0	0	1	9	3	2	0	12	14	1	0	0	2
Roosevelt County	8	0	6	0	7	10	8	1	0	10	10	1	1	0	8
City of Wolf Point	10	0	6	0	8	10	8	0	0	10	10	0	0	0	7
City of Polar	9	0	6	0	8	10	7	0	0	10	10	0	0	0	7
Town of Bainville	9	0	7	0	8	8	8	0	0	10	10	0	0	0	7
Town of Culbertson	8	0	5	0	7	9	8	0	0	9	9	0	0	0	7
Town of Froid	10	0	6	0	8	10	9	1	0	11	11	1	0	0	8
Rosebud County	5	1	8	5	7	9	9	5	7	9	7	7	7	4	13
City of Colstrip	4	0	7	5	6	6	8	3	6	7	6	6	4	3	10
City of Forsyth	4	2	9	4	8	10	7	4	8	9	8	8	4	3	12
Sheridan County	5	1	3	1	0	9	5	4	0	7	7	7	1	0	5
City of Plentywood	5	1	3	1	0	6	3	3	0	6	7	5	1	0	8
Town of Medicine Lake	6	1	3	1	0	7	4	5	0	4	4	4	1	0	10
Town of Outlook	5	1	3	1	0	9	5	4	0	7	7	7	1	0	11
Town of Westby	5	1	3	1	0	9	5	4	0	7	7	7	1	0	11
Stillwater County	4	6	11	2	9	18	9	12	11	12	12	9	8	7	25
Town of Columbus	3	4	3	1	2	10	1	3	1	6	5	2	2	1	10
Treasure County	8	5	13	7	10	18	14	11	10	14	14	11	8	8	21
Town of Hysham	8	6	10	6	9	14	10	12	8	12	12	10	7	9	12
Valley County	10	0	0	1	10	25	16	0	0	18	18	16	1	0	23
City of Glasgow	9	0	0	1	9	25	13	0	0	11	11	11	0	0	18
Town of Fort Peck	10	0	0	1	10	17	15	0	0	15	15	14	0	0	24
Town of Nashua	10	0	0	1	10	27	16	0	0	16	16	16	0	0	22
Town of Opheim	4	1	1	0	4	3	1	1	0	4	5	5	0	1	7
Wibaux County	3	2	4	4	4	11	11	5	3	13	12	10	4	4	11
Town of Wibaux	1	2	2	1	2	2	1	2	1	2	2	2	1	2	2
Yellowstone County	9	7	12	3	11	22	17	15	10	18	17	11	6	9	23
City of Billings	8	4	6	3	5	18	11	10	5	10	9	5	3	4	13
Town of Broadview	8	3	4	1	4	6	6	7	3	8	7	4	3	4	11
City of Laurel	8	4	5	2	4	8	11	9	3	9	8	4	3	4	12
Total	369	156	383	147	345	719	491	365	239	606	606	379	238	240	753

6 Plan Adoption, Implementation, and Maintenance

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

Tribal Requirement §201.7(c)(4): [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan.

Requirement §201.6(c)(5): [The hazard mitigation plan shall include] documentation that the plan has been formally approved by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, county commissioner, Tribal Council).

Implementation and maintenance of the plan is critical to the overall success of hazard mitigation planning. This is Planning Step 10 of the 10-step planning process. This chapter provides an overview of the strategy for plan implementation and maintenance and outlines the method and schedule for monitoring, updating, and evaluating the regional plan. The chapter also discusses methods for incorporating the plan into existing planning mechanisms and how to address continued public involvement. The system for implementation and maintenance was created during the 2022-2023 development of the regional plan.

6.1 Formal Adoption

The purpose of formally adopting this plan is to secure buy-in from participating jurisdictions, raise awareness of the plan, and formalize the plan's implementation. The adoption of this plan completes Planning Step 9 of the 10-step planning process: Adopt the Plan. The governing board for each participating jurisdiction has adopted this local hazard mitigation plan by passing a resolution. A copy of the generic resolution and the executed copies are included in Appendix D, Plan Adoptions. The Eastern Regional HMP will be updated and re-adopted every five years in concurrence with the required DMA local and tribal plan update requirements.

6.2 Implementation

Once adopted, the Plan faces the truest test of its worth: continued implementation. While this Plan contains many worthwhile actions, each county, jurisdiction, and tribe will need to decide which action(s) to undertake or continue. Two factors will help with making that decision: the priority assigned to the actions in the planning process and funding availability. Low or no-cost actions most easily demonstrate progress toward successful plan implementation.

Mitigation is most successful when it is incorporated into the day-to-day functions and priorities of government and development. Implementation will be accomplished by adhering to the schedules identified for each action and through constant, pervasive, and energetic efforts to network and highlight the benefits to the counties, tribes, communities, and stakeholders. This effort is achieved through the routine actions of monitoring meeting agendas for hazard mitigation-related initiatives, coordinating on the topic at meetings, and promoting a safe, sustainable community. Additional mitigation strategies could include consistent and ongoing enforcement of existing policies and vigilant review of programs for coordination and multi-objective opportunities.

Simultaneous to these efforts, it is important to maintain constant monitoring of funding opportunities that can be leveraged to implement some of the more costly recommended actions. This will include creating and maintaining a bank of ideas on how to meet local match or participation requirements. When funding does become available, the Eastern Region and its counties and tribes will be able to capitalize on the opportunity. Funding opportunities to be monitored include special pre- and post-disaster funds, state and

The actions included in this mitigation strategy are subject to further review and refinement; alternatives analyses; and reprioritization due to funding availability and/or other criteria. The participating jurisdictions are not obligated by this document to implement any or all of these projects. Rather, this mitigation strategy represents the desires of the communities to mitigate the risks and vulnerabilities from identified hazards. The jurisdictions realize that new needs and priorities may arise as a result of a disaster or other circumstances and reserve the right to support new actions, as necessary, as long as they conform to their overall goals, as listed in this plan.

See the jurisdictional annexes and addendums for their list of mitigation actions, as well as more details on progress on implementation of previous actions.

federal earmarked funds, benefit assessments, and other grant programs, including those that can serve or support multi-objective applications.

6.2.1 Role of Hazard Mitigation Planning Committee in Implementation and Maintenance

With the adoption of this Plan, the Eastern Region, its counties, municipalities, and the tribe will be responsible for the Plan implementation and maintenance. Each county and tribe, led by their Emergency Management Coordinators, will reconvene their HMPC for plan implementation and maintenance. MT DES staff will assist in the coordination of the regional HMPCs. This HMPC will be the same committee (in form and function, if not actual individuals) that developed this Plan and will also be responsible for the next formal update to the plan in five years.

The county level and tribal planning teams will:

- Act as a forum for hazard mitigation issues;
- Disseminate hazard mitigation ideas and activities to all participants;
- Pursue the implementation of high-priority, low/no-cost recommended actions;
- Ensure hazard mitigation remains a consideration for community decision-makers;
- Maintain vigilant monitoring of multi-objective cost-share opportunities to help the community implement the plan's recommended actions for which no current funding exists;
- Monitor and assist in the implementation and update of this plan;
- Report on plan progress and recommended changes to county and municipal officials; and
- Inform and solicit input from the public.

MT DES staff will:

- Assist with procurement of consultant support/additional technical assistance.
- Provide technical assistance and support to the delivery of an effective stakeholder and public engagement/outreach strategy. This includes providing assistance with the planning and facilitation of stakeholder and public outreach/ engagement meetings both in person and virtual. This also includes coordinating with other Montana state agencies (e.g., Dept. of Commerce, DNRC, Dept. of Environmental Quality, etc.) and their field staff and stakeholders to ensure a whole government approach to participation, involvement, and regional planning outcomes. This includes assistance in how underserved communities and socially vulnerable populations will be engaged in tangible activities throughout plan implementation and maintenance and in the next plan update (see also Section 6.3.4).
- Provide technical assistance and support with data and resources needed to meet the mitigation planning requirements.
- Assist during the mitigation action phase of the planning process and help guide communities/stakeholders on the development of holistic and comprehensive mitigation actions.

Each HMPC will not have any powers over the respective county or tribal staff; it will be purely an advisory body. The primary duty is to see the plan successfully carried out and to report to the county commissioners, municipal boards, tribal councils, and the public on the status of plan implementation and mitigation opportunities. Other duties include reviewing and promoting mitigation proposals, considering stakeholder concerns about hazard mitigation, passing concerns on to appropriate entities, and posting relevant information on county websites (and others as appropriate).

6.3 Plan Maintenance

Plan maintenance implies an ongoing effort to monitor and evaluate plan implementation and to update the plan as progress, roadblocks, or changing circumstances are recognized. The regulation at 44 CFR§201.6(d)(3) requires that a local jurisdiction must review and revise its plan to reflect changes in

development, progress in local mitigation efforts, and changes in priorities, and resubmit it for approval within five (5) years to continue to be eligible for mitigation project grant funding.

Similarly, a tribal government is required by 44 CFR 201.7(d)(3) to review and revise its plan to reflect any changes in development, progress in mitigation efforts, and changes in priorities and to resubmit it for approval within 5 years to continue eligibility for FEMA assistance.

6.3.1 Maintenance Schedule

MT DES will work with the Emergency Management Coordinators to initiate annual plan reviews, in consultation with the heads of participating departments in their own counties and tribes. In order to monitor progress and update the mitigation strategies identified in the action plan, each county and tribe and their standing CPT/TPT will conduct an annual review of this Plan and/or following a hazard event. An annual mitigation action progress report will be prepared by the Emergency Management Coordinators based on the HMPC input and kept on file to assist with future updates. The annual review will be conducted by reconvening each HMPC in November or December of each year in coordination with MT DES.

This plan will be updated, approved, and adopted within a five-year cycle as per Requirement §201.6(c)(4)(i) (for local governments) and §201.7(d)(3) (for tribes) of the DMA of 2000 unless a disaster or other circumstances (e.g., changing regulations) require a change to this schedule. The Eastern Region and its counties and tribe will inquire with MT DES and FEMA for funds and or technical assistance to assist with the update. The next plan update should be completed and reapproved by MT DES and FEMA Region VIII within five years of the FEMA final approval date. The planning process to prepare the update should begin no later than 12 months prior to that date. Note that the addendums developed during this current planning process will be converted to annexes in the next update. Additional information on the plan maintenance schedule for each participating jurisdiction is included in the annexes and addendums.

6.3.2 Maintenance Evaluation Process

Evaluation of progress can be achieved by monitoring changes in vulnerabilities identified in the plan. Changes in vulnerability can be identified by noting:

- Decreased vulnerability as a result of implementing recommended actions;
- Increased vulnerability as a result of new or altered hazards; and
- Increased vulnerability as a result of new development.
- To best evaluate any changes in vulnerability as a result of plan implementation, each county and tribe will adhere to the following process:
- A representative from the responsible office identified in each mitigation action will be responsible for tracking and reporting on an annual basis to the department lead on action status and provide input on whether the action, as implemented, meets the defined objectives and is likely to be successful in reducing vulnerabilities.
- If the action does not meet identified objectives, the lead will determine what additional measures may be implemented, and an assigned individual will be responsible for defining the action scope, implementing the action, monitoring the success of the action, and making any required modifications to the plan.

Evaluation is used not only to measure progress, but to evaluate the effectiveness of the plan itself and if goals are being achieved. Changes will be made to the plan to accommodate for actions that were not successful or were not considered feasible after a review of their consistency with established criteria, time frame, community priorities, and/or funding resources. Actions that were not ranked high but were identified as potential mitigation activities will be reviewed as well during the monitoring and update of this plan to determine the feasibility of future implementation.

Updating of the Plan will be by written changes and submissions, as each HMPC deems appropriate and necessary, and as approved by the respective participating agencies. In keeping with the five-year update process, the HMPC will convene public meetings to solicit public input on the Plan and its routine maintenance and the final product will be adopted by the governing council of each participating jurisdiction. Updates to this plan will:

- Consider changes in vulnerability due to action implementation;
- Document success stories where mitigation efforts have proven effective;
- Document areas where mitigation actions were not effective;
- Document any new hazards that may arise or were previously overlooked;
- Incorporate new data or studies on hazards and risks;
- Incorporate new capabilities or changes in capabilities;
- Incorporate growth and development-related changes to infrastructure inventories; and
- Incorporate new action recommendations or changes in action prioritization.

The jurisdictional annexes explain in further detail the monitoring system for tracking the initiation and status of projects as well as project closeouts, indicating who will be responsible for implementing and maintaining this system for the respective tribes.

6.3.3 Incorporation into Existing Planning Mechanisms

Another important implementation mechanism that is highly effective and low-cost is the incorporation of the HMP recommendations and their underlying principles into other county or tribal plans and mechanisms. Where possible, plan participants will use existing plans and/or programs to implement hazard mitigation actions. As described in each county and reservation annexes and addendums' capability assessment section, the jurisdictions already implement policies and programs to reduce losses to life and property from hazards. This Plan builds upon the momentum developed through previous and related planning efforts and mitigation programs and recommends implementing actions, where possible, through these other program mechanisms. Where applicable, these existing mechanisms could include:

- County, tribal or community comprehensive plans
- County, tribal or community land development codes
- County, tribal or community Emergency Operations Plans (EOPs)
- Threat and Hazard Identification and Risk Assessments (THIRA)
- CWPPs
- Transportation plans
- Capital improvement plans and budgets
- Recovery planning efforts
- Watershed planning efforts
- Wildfire planning efforts on adjacent public lands
- Master planning efforts
- River corridor planning efforts
- Future updates to the Montana State Water Plan
- Other plans, regulations, and practices with a mitigation aspect

The jurisdictional annexes and County HMPs with addendums note where the previous versions of the individual county and tribal HMPs have been incorporated into existing planning mechanisms in the past 5 years. Each annex and addendum also notes specific opportunities to integrate the mitigation plan into other mechanisms in the future in Section 7. The addendums do not have sections on these specific opportunities, but these opportunities are described in the base plan in Section 6.

HMPC members involved in these other planning mechanisms will be responsible for integrating the findings and recommendations of this plan with these other plans, programs, etc., as appropriate. As described in Section 6.2 Implementation, incorporation into existing planning mechanisms will be done through the process of:

- Monitoring other planning/program agendas;
- Attending other planning/program meetings;
- Participating in other planning processes;
- Ensuring that the related planning process cross-references the hazard mitigation plan, where appropriate, and
- Monitoring community budget meetings for other community or tribal program opportunities.

The successful implementation of this mitigation strategy will require constant and vigilant review of existing plans and programs for coordination and multi-objective opportunities that promote a safe, sustainable community.

Efforts should continuously be made to monitor the progress of mitigation actions implemented through these other planning mechanisms and, where appropriate, their priority actions should be incorporated into updates of this HMP.

6.3.4 Continued Public Involvement

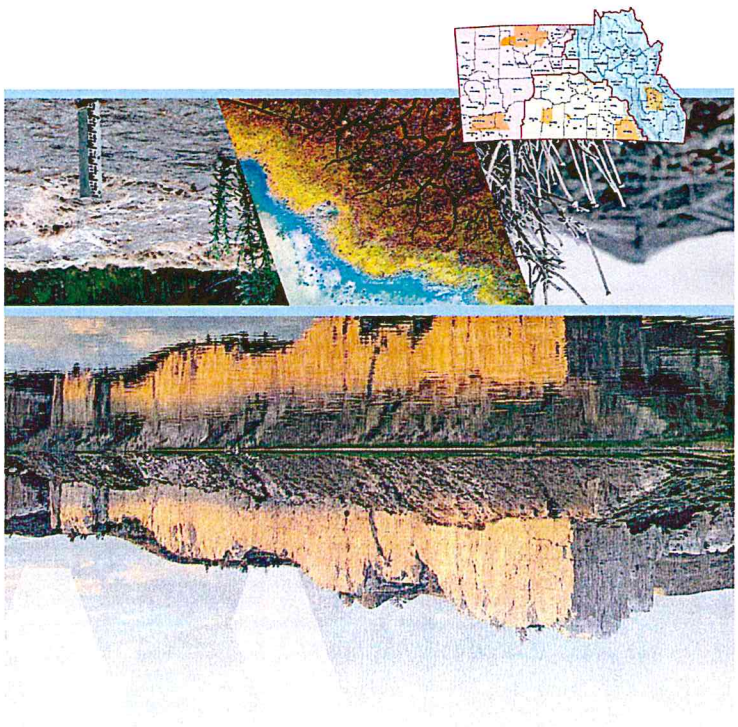
Continued public involvement is imperative to the overall success of the plan's implementation. The update process provides an opportunity to solicit participation from new and existing stakeholders and publicize success stories from the Plan implementation and seek additional public comment. The Plan maintenance and update process will include continued public and stakeholder involvement and input through attendance at designated committee meetings, web postings, social media postings, press releases to local media, and through public hearings. To ensure the meaningful participation during continued involvement activities of underserved communities and socially vulnerable populations, including the elderly, youth, veterans, homeless individuals, and low-income families, the HMPC will employ targeted outreach strategies. Partnerships with CBOs, NGOs, and individual government agencies—such as the American Red Cross and local senior and healthcare facilities—will be key to facilitating communication and engagement, as this strategy was successful for outreach in the Eastern Region. Meetings will be held in accessible locations like senior centers and healthcare clinics, and materials will be provided in multiple languages to overcome barriers like transportation, childcare, and language differences.

These communities will also be encouraged to participate in various activities that will be led by County staff and representatives from CBOs and NGOs. Activities will include public meetings, focus groups, and surveys with each regional CPT or TPT. Their feedback will be used to evaluate mitigation actions and shape future plan updates. The feedback from underserved communities and socially vulnerable populations will also be used to develop HMA grant applications, where applicable. CPTs and TPTs will ensure an open line of communication and that feedback is recorded and addressed. Additionally, potential training and capacity-building initiatives can empower these communities to take a more active role in future hazard mitigation planning processes. Feedback will be documented and integrated into future updates, with follow-up reports demonstrating how community input has influenced the plan.

When each HMPC reconvenes for the update, they will coordinate with all stakeholders participating in the planning process—including those that joined the committee since the planning process began—to update and revise the Plan. Public notice will be posted, and public participation will be invited, at a minimum, through available website postings and press releases to the local media outlets, primarily newspapers. Based on DMA requirements the public will be provided an opportunity to provide input during the plan update process, and before the plan is finalized. This can be accomplished through public surveys or

meetings. Public comments will be solicited on the plan update draft by posting the plan online and soliciting review and comment for a minimum of two weeks.

dsw



Annex K Yellowstone County

K.1 Mitigation Planning and County Planning Team

This County Annex builds on previous versions of the Yellowstone County Hazard Mitigation Plan (HMP) completed in 2019. As part of the regional planning process, the County established a County Planning Team (CPT) to develop the mitigation plan and identify potential mitigation projects. The following incorporated communities participated in the DMA planning process with the County:

- City of Billings
- City of Laurel
- Town of Broadview

More details on the planning process followed and how the counties, municipalities and stakeholders participated can be referenced in Chapter 3 of the base plan. A full list of local government departments and stakeholders that were invited to participate and that participated can be found in Appendix A.

K.2 Community Profile

K.2.1 Geography and Climate

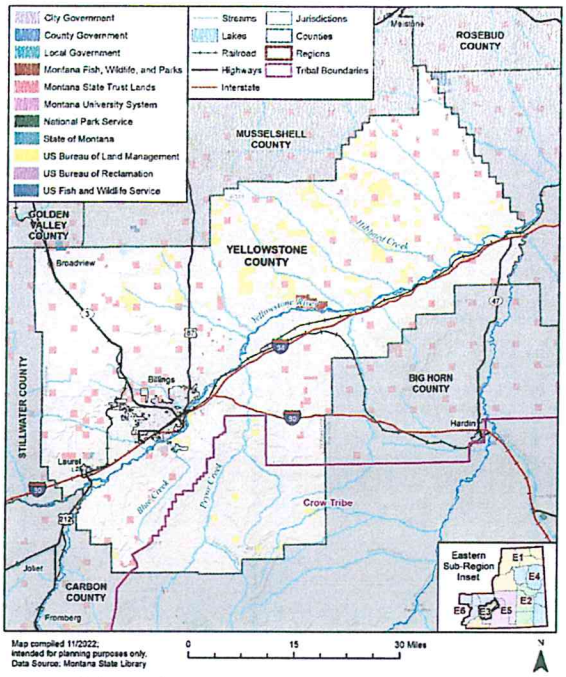
Yellowstone County is in south-central Montana, between the Great Plains and the Rocky Mountains. The County is bordered by Musselshell County to the north, Treasure County to the northeast, Big Horn County to the southeast, Carbon County to the southwest, Stillwater County to the west, and Golden Valley County to the northwest. Billings, the County seat, is in central Yellowstone County and at 43 square miles is the largest city in Montana. The Crow Indian Reservation occupies the southeast portion of Yellowstone County. Figure K-1 presents a location map of Yellowstone County.

The Yellowstone River forms the dominant physiographic feature in Yellowstone County. As the river winds its way from the southwest portion of the County near Laurel to the northeast corner near Custer, it is flanked by a broad alluvial valley. The only tributaries of the Yellowstone River that carry water year-round are the Clarks Fork of the Yellowstone River, Bighorn River, and Pryor Creek. The Clarks Fork defines a small segment of the west County boundary while the Bighorn River forms a small segment of the east County boundary. Other County drainages that flow intermittently but with some regularity include Alkali Creek, Blue Creek, and Canyon Creek. There are approximately seven lakes and reservoirs in the County.

Plains occupy the largest portion of the County north and south of the Yellowstone River. The topography of the plains varies with the thickness of the underlying shale and the presence of sandstone beds. Thicker shale beds translate into more gently rolling terrain cut by steep-sided coulees. Rimrocks, rough ridges and frequent outcrops occur where eroded shale layers expose the interbedded sandstone formations. Elevation in the County ranges from 2,680 feet above sea level on the Yellowstone River near Custer to 4,971 feet at Stratford Hill in the southwest corner.

Yellowstone County consists of approximately 1,693,751 acres. Eighty-two (82) percent of the County is under private ownership, while federal land managers (BLM, U. S. Bureau of Reclamation, and U.S. Fish & Wildlife Service) administer 5 percent of the land area. State agencies, including Montana DNRC (responsible for State Trust Land), and the Montana Dept. of Fish Wildlife and Parks (responsible for State Parks and fishing accesses), administer 4 percent of the acreage. The Crow Indian Reservation comprises 8 percent of the County. Figure K-1 also shows the landownership in Yellowstone County. Population density in Yellowstone County is 64.2 persons per square mile. Yellowstone County is the most populous county in Montana with approximately 164,731 people according to the 2020 US Census. There are three incorporated towns and cities in Yellowstone County: City of Billings, City of Laurel, and Town of

Figure K-1 Yellowstone County Base Map and Land Stewardship



K.2.2 Population Trends

According to the 2020 U.S. Census, Yellowstone County is the most populous county in Montana with a total population of 164,731. The U.S. Census Bureau reported the County experienced a 11.3% increase in population since the 2010 census. Trends show that the population has increased in the County and the

Broadview. Interstates 90 and 94 are the major transportation routes in the County, in addition to State Highways 87, 47, and 212, which are north-south routes that intersect Interstate 90.

Yellowstone County has a semiarid climate which is relatively mild with few significant weather events during an average year. Extremely low temperatures, less than 0 degrees Fahrenheit, may prevail in the winter for short periods of time. High wind events are possible in the spring and summer and may include rare tornadic activity. Heavy rainfall is rare, but localized thunderstorms can deposit significant rainfall in a small area resulting in flashfloods. Flooding is a problem on the Yellowstone River and tributaries particularly when warmer temperatures rapidly melt snow and ice during spring break up.

Yellowstone County's complex topography and lack of common slopes or drainage pattern result in a wide variety of local microclimates. In general, the Yellowstone River valley, where most of the population resides, has the greatest range of highs and lows. The areas outside of the river valley tend to have lower temperatures. Precipitation rates vary along a west to east gradient, dropping significantly from Laurel to Custer. Winter Chinooks originating in the mountains move northeastward through the County, moderating winter temperatures. Cold fronts from the north tend to affect the eastern highlands more than they do the rest of the County. Cultivated lands usually experience little variance in the growing season, which averages 129 days, normally extending from mid-May through mid-September.

The average annual rainfall is 15.09 inches, with an average of 57 inches of snow. Forty (40) percent of the precipitation falls in the wet spring months of April, May and June. The maximum monthly rainfall recorded was in May 1981, 7.7 inches, while the maximum 24-hour rainfall was recorded at 2.9 inches in June 8, 1997. The maximum monthly snowfall was 42.3 inches in April 1955, while the maximum in 24 hours was 23.7 inches, also in April 1955.

Winters are cold, but usually not severe. January's average maximum is 36 degrees and minimums average 18 degrees. Summers are warm with good sunshine and low humidities, but the nights are generally cool. Extremes in temperature have ranged from 106° F in 1937 to -38°F in 1936. The average number of days per year with temperatures of 90° F or above is 28. The number of days with temperatures of 32°F and below is 48.

Average wind speeds are greatest during the winter months when they range from 10.5 mph to 12.5 mph. The most blustery month is December when wind speeds average 12.5 mph. Winds are slowest in July and August when speeds average 9.0 mph. The average prevailing wind is from the southwest. In June 1968, the extreme wind speed of 79 mph was recorded.

incorporated jurisdictions like Billings and Laurel. Specific demographic variables for the County are provided in Table K-1 below.

Table K-1 Population Trends in Yellowstone County, 1980-2020

Incorporated Community	1980	1990	1980-1990 Change	2000	1990-2000 Change	2010	2000-2010 Change	2020	2010-2020 Change
City of Billings	68,361	81,151	+18.7%	89,847	+10.7%	104,170	+15.9%	117,116	+12.4%
Town of Broadview	125	133	+6.4%	150	+12.8%	192	+28.0%	139	-27.6%
City of Laurel	5,469	5,686	+4.0%	6,255	+10.0%	6,718	+7.4%	7,222	+7.5%
Yellowstone County	107,661	113,419	+5.3%	129,352	+14.0%	147,972	+14.4%	164,7311	+11.3%

NOTES:
1 - During review of this plan, Yellowstone County noted their population was larger than counted by the 2020 US Census and the 2021 American Community Survey estimate. The 2022 population estimate for **Yellowstone County is 169,852 according to the ACS, and this is a more current estimate of the County's** population at the time of this plan development.
Source: Decennial Census, https://data.census.gov/

K.2.3 Demographics

The 2016-2020 American Community Survey (ACS) reports demographic estimates for Yellowstone County which are summarized in the table below Table K-2.

Table K-2 Demographic Estimates for Yellowstone County (2016-2020 ACS)

Characteristic	Yellowstone County	State of Montana
Percentage of persons below 150% poverty estimate	19.9%	24.1%
Unemployment Rate estimate	2.3%	4.0%
Percentage of housing cost-burdened occupied housing units with annual income less than $75,000 (30% + of income spent on housing costs) estimate	19.4%	21.4%
Percentage of persons with less than a high school diploma (age 25+) estimate	6.6%	7.5%
Percentage uninsured in the total civilian noninstitutionalized population estimate	8.5%	9.6%
Percentage of persons aged 65 and older estimate	22.5%	22.1%
Percentage of persons aged 17 and younger estimate	21.1%	21.3%
Percentage of civilian noninstitutionalized population with a disability estimate	16.2%	15.6%
Percentage of single-parent households with children under 18 estimate	3.2%	3.9%
Percentage of persons (age 5+) who speak English "less than well" estimate	0.0%	0.3%
Minority (other than white non-Hispanic) estimate	9.9%	14.6%
Percentage of housing in structures with 10 or more units estimate	1.9%	3.3%
Percentage of mobile homes estimate	7.3%	13.1%
Percentage of occupied housing units with more people than rooms estimate	0.9%	2.1%
Percentage of households with no vehicle available estimate	5.2%	4.9%
Percentage of persons in group quarters estimate	2.5%	2.8%
Percentage Female estimate	50.7%	49.7%

Characteristic	Yellowstone County	State of Montana
Median Age estimate	38.7	40.1
Median Gross Rent estimate	$910	$836
Median House Value estimate*	$330,800*	$366,400*
Percent Unoccupied Housing Units estimate	6.2%	15.3%

Source: ACS 2016-2020, https://data.census.gov/ | *2022 ACS 1-year estimate

K.2.4 Social Vulnerability

Social vulnerability is broadly defined as the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood. Social vulnerability considers the social, economic, demographic, and housing characteristics of a community that influences its ability to prepare for, respond to, cope with, recover from, and adapt to environmental hazards. Additional details on social vulnerability and the National Risk Index (NRI) can be found in Section 4.1.1.5 of the Base Plan.

The social vulnerability index (SoVI) rated the social vulnerability in Yellowstone County as "Relatively Low", with a score of 32.8. Thus, Yellowstone County is less socially vulnerable than roughly three-fourths of all Montana Counties. Refer to Hazard Identification and Risk Assessment (HIRA) for more information on social vulnerability. Demographic factors that can influence the social vulnerability rating are displayed in Table K-2, such as percentage below poverty level or over the age of 65. The ACS reports that most of these factors are at or below statewide averages.

With regards to hazards, socially vulnerable populations may be disproportionately impacted by hazards that include flooding, wildfires, and dam failures. Severe weather hazards may result in power outages that could have a greater impact on these socially vulnerable populations including those dependent on electricity for medical reasons and those that lack access to a vehicle to safely get to a community center or shelter location with electricity.

K.2.5 Development Trends

According to the Montana Department of Commerce Regional Economic Models Incorporated Population Projections[1], the population of Yellowstone County is expected to increase to 179,726 by 2030, a 6.0% growth from the 2022 ACS 5-year estimate. To accommodate the growth, new commercial, industrial, and residential development will occur. However, at this time, residential development is the most rapidly growing sector of land use in Yellowstone County. Most of the anticipated growth is expected to occur within and near the communities of Billings and Laurel.

The County has experienced an increased demand for housing. Since the 2008 Recession, new construction rates have remained low, creating a deficit of over 4,000 residential units. This created a housing shortage for residents and new arrivals. This shortage was further exacerbated by COVID-19 pandemic and the heavy shift of urban dwellers relocating into smaller, more rural areas like Yellowstone County and Billings.

In 2008, the Yellowstone County Board of County Commissioners and the City of Billings adopted updates to the Yellowstone County / City of Billings Growth Policy. This plan includes individual neighborhood growth plans to better reflect the communities' vision for development. Specific growth trends by jurisdictions are listed below:

- **Yellowstone County:** According to the CPT, the housing shortage for current residents and those

[1] https://ceic.mt.gov/People-and-Housing/Population

new to Yellowstone County has caused housing prices to rise by nearly 41%, making the average home price $357,000. However, according to the 2022 ACS 1-Year Estimates (which is the most recent ACS publication), the median value of a home in Yellowstone County is $330,800. While the amount of development growth has remained low and the implementation of the Yellowstone County Growth Policy limits growth, population growth in the County has increased and thereby slowly increased the overall exposure of people within the County to atmospheric/weather hazards.

- **City of Billings:** The City of Billings and Yellowstone County are seen as ideal for new business because there is not only an airport located nearby, but Billings has one of the largest populations in the state. New businesses interest seems to favor the relocation or new creation of data/server centers in the area. There has been a decrease in demand for traditional office space, which is believed to be a result of the pandemic. Overall, there is seen to be an increase in businesses throughout the City of Billings. Billings and Yellowstone County are also seeing increased interest in shovel ready sites for development. There have been requests for building and warehouse spaces larger than 30,000 square feet. Being the commerce hub for a 400+ mile radius region with two major interstates dissecting the area and a north/south interstate corridor nearby, easy access to the major airport, and rail service make this area highly desirable. There are also several new, large building projects including the new Coca-Cola manufacturing plant south of the interstate and two new warehouse projects between west Billings and downtown. The City of Billings Growth Policy has helped the City manage population growth and housing development; however the City's steady increase in population has gradually increased the overall exposure of the City to atmospheric hazards.
- **City of Laurel:** The City of Laurel has prime proximity to I-90 providing optimum conditions for growth. Within the city limits, Highway 10 and the SE 4th Street corridors provide opportunity for business growth with some vacant industrial and commercial zoned tracts. The potential for large industrial sites remains small due to infrastructure concerns and the inability for the city to provide water without investing in substantial upgrades. Where the city's greatest potential lies is in the redevelopment of vacant commercial buildings located in the downtown area, as well as along First Avenue south of the underpass. The City of Laurel has experienced some population growth over the past five years, which has resulted in a slight increase in the overall exposure of the City to hazards.
- **Town of Broadview:** The growth potential of the Town of Broadview was analyzed and found to be constrained by the development of a better water supply and the construction of a railroad spur from the Bull Mountain Mine to the railroad main line southeast of town. Without a better, more reliable water supply, additional growth is not likely. The Montana Bureau of Mines and the Montana DNRC have collaborated with the town to define and evaluate favorable sites for development of additional viable groundwater sources. Because the limited water supply the Town has experienced a gradual decline in population growth and development, which has resulted in a slight decrease in the overall hazard exposure of the Town.

The U.S. Census Bureau Building Permit Survey provides information and local statistics on new privately-owned residential construction. Figure K-2 below displays the new privately owned housing unit authorizations by year in Yellowstone County. This data indicates that there was a sharp increase in housing units in 2013, which has remained fairly high since. An increase in the number of housing unit authorizations in the County could indicate an increase in the total number of buildings exposed to hazard events. However, it is unknown how this development will impact vulnerability to specific hazards, such as wildfire and flooding.

Figure K-2 New Privately Owned Housing Unit Authorizations

K.2.6 Economy

Table K-3 below provides a brief overview of economic characteristics in Yellowstone County. The following information is provided by the U.S. Census Bureau ACS 5-year estimates from 2016-2020.

Table K-3 Yellowstone County Economic Profile

Economic Characteristics	Yellowstone County
Families Below Poverty Level	6.9%
Individuals Below Poverty Level	18.4%
Median Home Value	$330,800
Median Household Income	$62,630
Per Capita Income	$37,261
Population > 16 Years Old in Labor Force	66.7%
Population Employed	64.3%

Source: U.S. Census Bureau ACS 5-year estimates, 2020

Table K-4 below shows the breakdown of employment in Yellowstone County by the industry sector. According to the ACS, the leading employment sectors in the County are "Educational, Healthcare, and Social Assistance Services" which composes of over 20% of the total employment in the County with 19,395 people. This is followed by "retail trade" with 9,969 people. A close third is the "Arts, entertainment, and recreation, and accommodation and food services" industry with over 10% of the population in Yellowstone County employed.

Table K-4 Yellowstone County Occupation by Industry Profile

Industry	Population Employed	Percent of Labor Force
Educational services, and health care and social assistance	19,395	23.8%
Retail trade	9,969	12.2%
Arts, entertainment, and recreation, and accommodation and food services	8,892	10.9%
Professional, scientific, and management, and administrative and waste management services	8,006	9.8%
Construction	6,805	8.3%
Transportation and warehousing, and utilities	5,817	7.1%
Finance and insurance, and real estate and rental and leasing	4,771	5.8%
Other services, except public administration	4,409	5.4%
Manufacturing	4,325	5.3%
Public administration	3,070	3.8%
Wholesale trade	2,705	3.3%
Agriculture, forestry, fishing and hunting, and mining	2,201	2.7%
Information	1,244	1.5%

Source: U.S. Census Bureau ACS 5-year estimates, 2016-2020

K.3 Hazard Identification and Risk Assessment

K.3.1 Identified Hazards

The CPT reviewed significant hazards for inclusion in the HMP. Some changes were made from the 2019 Yellowstone County Hazard Mitigation Plan to be consistent with the 2023 Eastern Montana Region Hazard Mitigation Plan. The previous 2019 Yellowstone County HMP profiled the following hazards:

- Severe Weather and Drought
- Wildfire
- Ditch and Drain Failure
- Terrorism, Violence, and Civil Unrest
- Cyber Security
- Hazardous Material Incidents
- Transportation Accidents
- Flooding and Dam Failure
- Communicable Disease
- Landslide /Rockfall

In this plan update, severe weather hazards are organized into severe summer weather and severe winter weather. Terrorism, Violence, and Civil Unrest are covered in Human Conflict. Cyber Security is covered in Cyber Threats. Dam Failure is also a stand-alone section. Ditch and Drain Failure is also covered in this Annex, but not in the Eastern Montana Regional HMP. Table K-5 provides a summary of the overall hazard significance for the hazards evaluated in this plan, showing variability by jurisdiction. More details on hazards can be found in Chapter 4 of the base plan.

Table K-5 Yellowstone County Overall Hazard Significance by Hazard and Jurisdiction*

Hazard	Yellowstone County	City of Billings	Town of Broadview	City of Laurel
Avalanche	Low	Low	Low	Low
Communicable Disease	High	High	High	High
Cyber-Attack	Medium	High	High	High
Dam Failure	Low	Medium	Low	Medium
Ditch & Drain Failure	High	High	Low	High
Drought	High	High	High	High
Earthquake	Low	Medium	Medium	Medium
Flooding	High	High	High	High
Hazardous Materials Incident	High	High	High	High
Human Conflict	High	High	Medium	Medium
Landslide	Low	Low	Low	Low
Severe Summer Weather	High	High	High	High
Severe Winter Weather	High	High	High	High
Tornadoes & Windstorms	High	High	High	High
Transportation Accidents	Medium	Medium	Medium	Medium
Volcanic Ash	Low	Low	Low	Low
Wildfire	High	High	High	High

*Significance based on a combination of Geographic Extent, Potential Magnitude/Severity and Probability as defined below

Geographic Extent

Negligible: Less than 10 percent of planning area or isolated single- point occurrences

Limited: 10 to 25 percent of the planning area or limited single-point occurrences

Significant: 25 to 75 percent of planning area or frequent single-point occurrences

Extensive: 75 to 100 percent of planning area or consistent single- point occurrences

Potential Magnitude/Severity

Negligible: Less than 10 percent of property is severely damaged, facilities and services are unavailable for less than 24 hours, injuries and illnesses are treatable with first aid or within the response capability of the jurisdiction.

Limited: 10 to 25 percent of property is severely damaged, facilities

and services are unavailable between 1 and 7 days, injuries and illnesses require sophisticated medical support that does not strain the response capability of

Probability of Future Occurrences

Unlikely: Less than 1 percent probability of occurrence in the next year or has a recurrence interval of greater than every 100 years.

Occasional: Between a 1 and 10 percent probability of occurrence in the next year or has a recurrence interval of 11 to 100 years.

Likely: Between 10 and 90 percent probability of occurrence in the next year, or has a recurrence interval of 1 to 10 years

Highly Likely: Between 90 and 100 percent probability of occurrence in the next year or has a recurrence interval of less than 1 year.

Overall Significance

Low: Two or more of the criteria fall in the lower classifications or the event has a minimal impact on the planning area. This rating is also sometimes used for hazards with a minimal or unknown record of occurrences/impacts or for hazards with minimal mitigation potential.

the jurisdiction, or results in very few permanent disabilities.

Critical: 25 to 50 percent of property is severely damaged, facilities and services are unavailable or severely hindered for 1 to 2 weeks, injuries and illnesses overwhelm medical support for a brief period of time or result in many permanent disabilities and a few deaths. overwhelmed for an extended period of time or many deaths occur.

Catastrophic: More than 50 percent of property is severely damaged, facilities and services are unavailable or hindered for more than 2 weeks, the medical response system is overwhelmed for an extended period of time, or many deaths occur.

Medium: The criteria fall mostly in the middle ranges **of classifications and the event's impacts on the** planning area are noticeable but not devastating. This rating is also sometimes utilized for hazards with a high impact rating but an extremely low occurrence rating.

High: The criteria consistently fall along the high ranges of the classification and the event exerts significant and frequent impacts on the planning area. This rating is also sometimes utilized for hazards with a high psychological impact or for hazards that the jurisdiction identifies as particularly relevant.

K.3.2 Building Inventory and Assets

People, property, critical facilities/infrastructure, and other important assets in Yellowstone County are exposed to the hazards identified in this plan. Table K-6 summarizes the property inventory for the County and each participating jurisdiction, based on improvement value (i.e., structures) and includes the building count and value grouped by parcel type and jurisdiction. This is an assessment of the overall property exposed within the County and by jurisdiction.

Assets inventoried to determine vulnerability include people, structures, critical facilities, and natural, historic, or cultural resources. For the regional planning process, locally available GIS databases were utilized. Parcel and assessor data was obtained **through Montana's MSDI Cadastral website.** This Statewide database provided the basis for building exposure and property types. The focus of the analysis **was on "improved" or developed parcels. These parcels were identified based on an improvement value** greater than zero. Property Types were used to identify occupancy types as shown in the following table, which includes summations of total improved value for the various property types.

Table K-6 Yellowstone County Building Inventory and Value by Jurisdiction

Jurisdiction	Improved Parcels	Improved Value	Content Value	Total Value
Billings	43,604	$11,862,503,189	$6,844,972,623	$18,707,475,812
Broadview	95	$9,153,276	$5,253,798	$14,407,074
Crow Tribe	111	$19,469,548	$15,982,369	$35,451,917
Laurel	3,039	$545,083,990	$311,062,124	$856,146,114
Yellowstone County	17,137	$4,260,860,990	$2,697,545,405	$6,958,406,395
Total	**63,986**	**$16,697,070,993**	**$9,874,816,319**	**$26,571,887,312**

NOTE – A portion of the Crow Tribe is in Yellowstone County, although predominantly located in Big Horn County. Source: MSDI Cadastral database, https://msl.mt.gov/geoinfo/msdi/cadastral/

Total building exposure with contents within Yellowstone County based on an analysis of improved parcels is over $26 billion, with over $16 billion in improved value properties and $9 billion of contents. The City of Billings accounts for more than $18 billion of this total number. Residential properties represent the greatest

portion of structures in the County, accounting for over $21 billion of the nearly $26.5 billion improved property value, as shown in

Table K-7 below.

Table K-7 Yellowstone County Total Exposure by Jurisdiction and Property Type

Jurisdiction	Property Type	Improved Parcels	Improved Value	Content Value	Total Value
Billings	Agricultural	2	$257,990	$257,990	$515,980
	Commercial	321	$131,041,427	$131,041,427	$262,082,854
	Exempt	736	$1,599,410,120	$1,599,410,120	$3,198,820,240
	Industrial	35	$45,193,570	$67,790,355	$112,983,925
	Residential	42,487	$10,080,254.702	$5,040,127,351	$15,120,382,053
	Vacant	23	$6,345,380	$6,345,380	$12,690,760
	Total	**43,604**	**$11,862,503,189**	**$6,844,972,623**	**$18,707,475,812**
Broadview	Exempt	8	$896,680	$896,680	$1,793,360
	Industrial	1	$228,820	$343,230	$572,050
	Residential	86	$8,027,776	$4,013,888	$12,041,664
	Total	**95**	**$9,153,276**	**$5,253,798**	**$14,407,074**
Crow Tribe	Agricultural	62	$11,182,680	$11,182,680	$22,365,360
	Commercial	2	$582,910	$582,910	$1,165,820
	Exempt	7	$727,950	$727,950	$1,455,900
	Residential	38	$6,974,358	$3,487,179	$10,461,537
	Vacant	2	$1,650	$1,650	$3,300
	Total	**111**	**$19,469,548**	**$15,982,369**	**$35,451,917**
Laurel	Commercial	11	$1,417,180	$1,417,180	$2,834,360
	Exempt	46	$62,847,717	$62,847,717	$125,695,434
	Industrial	4	$6,387,680	$9,581,520	$15,969,200
	Residential	2,978	$474,431,413	$237,215,707	$711,647,120
	Total	**3,039**	**$545,083,990**	**$311,062,124**	**$856,146,114**
Yellowstone County	Agricultural	993	$196,379,255	$196,379,255	$392,758,510
	Commercial	95	$38,448,680	$38,448,680	$76,897,360
	Exempt	190	$195,326,541	$195,326,541	$390,653,082
	Industrial	38	$351,257,020	$526,885,530	$878,142,550
	Residential	15,748	$3,477,888,190	$1,738,944,095	$5,216,832,285
	Vacant	73	$1,561,304	$1,561,304	$3,122,608
	Total	**17,137**	**$4,260,860,990**	**$2,697,545,405**	**$6,958,406,395**

Jurisdiction	Property Type	Improved Parcels	Improved Value	Content Value	Total Value
	Grand Total	**63,875**	**$16,677,601,445**	**$9,858,833,950**	**$26,536,435,395**

Source: MSDI Cadastral database, https://msl.mt.gov/geoinfo/msdi/cadastral/

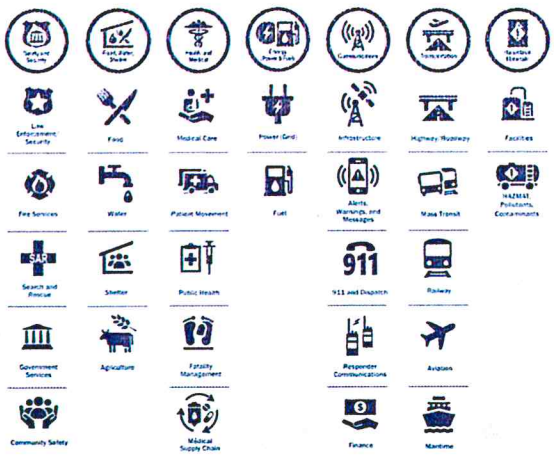
Critical Facilities, Infrastructure, and Other Important Community Assets

A critical facility is defined as one that is essential in providing utility or direction either during the response to an emergency or during the recovery operation. Much of this data is based on GIS databases associated with the 2022 Homeland Infrastructure Foundation-Level Data (HIFLD). Other critical facility databases were also used, such as the National Bridge Inventory (NBI), with supplementation from the Hazard Mitigation Planning Committee (HMPC). Where applicable, this information was used in an overlay analysis for hazards such as dam failure, flood, and wildfire.

FEMA organizes critical facilities into seven lifeline categories as shown in Figure K-3. These lifeline categories standardize the classification of critical facilities and infrastructure that provide indispensable service, operation, or function to a community. A lifeline is defined as providing indispensable service that enables the continuous operation of critical business and government functions, and is critical to human health and safety, or economic security. These categorizations are particularly useful as they:

- Enable effort consolidations between government and other organizations (e.g., infrastructure owners and operators). Enable integration of preparedness efforts among plans; easier identification of unmet critical facility needs.
- Refine sources and products to enhance awareness, capability gaps, and progress towards stabilization.
- Enhance communication amongst critical entities, while enabling complex interdependencies between government assets.
- Highlight lifeline related priority areas regarding general operations as well as response efforts.

Figure K-3 FEMA Lifeline Categories



Source: FEMA

Table K-8 below summarizes the number of critical facilities by jurisdiction. Figure K-4 through Figure K-7 display the location of critical facilities by FEMA Lifeline in Yellowstone County, the City of Billings, the Town of Broadview, and the City of Laurel.

Table K-8 Yellowstone County Critical Facilities by Jurisdiction

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Total
Billings	85	9	37	15	16	106	55	323
Broadview	-	1	-	-	1	1	-	3
Laurel	4	1	8	-	1	6	1	21
Yellowstone County	143	67	18	22	8	44	239	541
Total	**232**	**78**	**63**	**37**	**26**	**157**	**295**	**888**

Source: HIFLD 2022, Montana DES, National Bridge Inventory

Figure K-4 Yellowstone County Critical Facilities

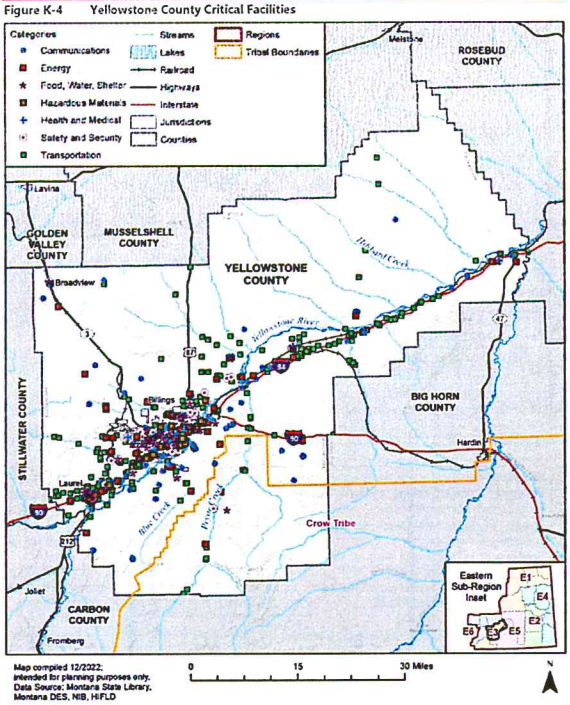


Figure K-5 City of Billings Critical Facilities

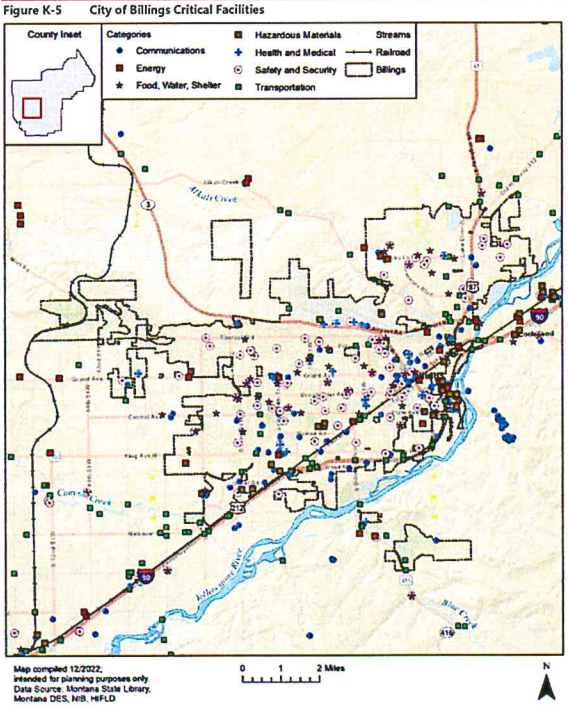
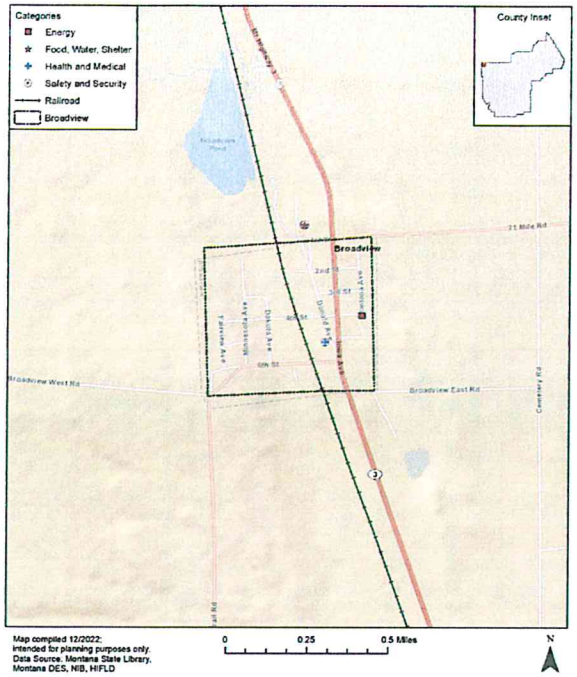


Figure K-6 Town of Broadview Critical Facilities



Natural, Historic, and Cultural Assets

Assessing the vulnerability of Yellowstone County to hazards also involves inventorying the natural, historical, and cultural assets of the area. This step is important for the following reasons:

- The community may decide that these types of resources warrant more protection due to their unique and irreplaceable nature and contribution to the overall economy.
- If these resources are impacted by a hazard, knowing so ahead of time allows for more prudent care in the immediate aftermath, when the potential for additional impacts are higher.
- The rules for reconstruction, restoration, rehabilitation, and/or replacement are often different for these types of designated resources.
- Natural resources can have beneficial functions that reduce the impacts of natural hazards, such as wetlands and riparian habitat, which help absorb and attenuate floodwaters.

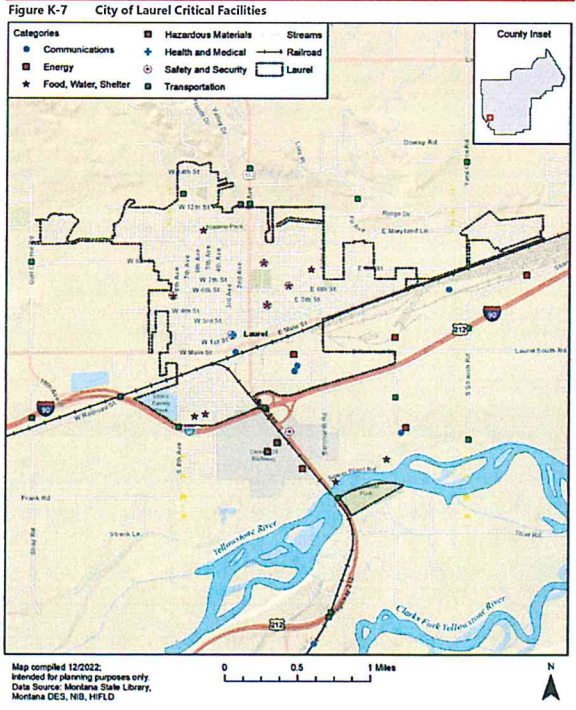
Historic and Cultural Assets

By definition, a historic property not only includes buildings or other types of structures, such as bridges and dams, roads, byways, historic landscapes, and many other features. The National Register of Historic Places (NRHP), managed by the National Park Service and U.S. Department of Interior, is the nation's official list of cultural resources worthy of preservation. Table K-9 below lists the properties that are identified as having cultural and historic significance in Yellowstone County as recorded by the National Register of Historic Places.

Table K-9 Historic Properties and Districts on National Registers

Property Name	City/Town	Location	Date Listed
Huntley Project Office	Ballantine	2291 2nd Street W	6/5/2017
Acme Building	Billings	109-111 N. Broadway	11/9/2005
Armour Cold Storage	Billings	1 S. Broadway	7/7/2004
Babcock Theatre Building	Billings	114-124 N. 28th Avenue & 2808-2812 2nd Avenue	4/9/2013
Billings Chamber of Commerce Building	Billings	303 N. 27th Street	1/20/1972
Billings Communal Mausoleum	Billings	1704 Central Avenue	06/28/2021
Billings Historic District	Billings	Roughly bounded by N. 23rd Street & N. 25th Street, 1st Avenue & Montana Avenue	3/13/1979
Billings Old Town Historic District	Billings	Generally bounded by Montana Ave. on the N, S. 26th on the E, 1st Avenue S on the S, & S. 30th Street on the W	09/16/2010
Billings Townsite Historic District (Boundary Increase)	Billings	2600(2528), 2604-2606, 2608, 2610-2614, & 2624 Montana Avenue	4/20/2006
Billings West Side School	Billings	415 Broadwater Avenue	3/20/2002
Black Otter Trail	Billings	Black Otter Trail	1/5/2007
Boothill Cemetery	Billings	N of Billings	4/17/1979
Dude Rancher Lodge	Billings	415 N. 29th Street	7/22/2010
Electric Building	Billings	113-115 Broadway	3/1/2002
Fire House #2	Billings	201 E. 30th Street	2/29/1980

Figure K-7 City of Laurel Critical Facilities



Property Name	City/Town	Location	Date Listed
Fratt-Link House	Billings	142 Clark Avenue	11/9/2020
Garfield School	Billings	3212 1st Avenue S.	10/3/2012
Graf, Arnold, House	Billings	633 Highland Park Drive	4/20/2015
Hoskins Basin Archeological District	Billings	Address Restricted	11/20/1974
James F. Battin Federal Building (Courthouse & Federal Office Building)	Billings	316 N. 26th Street	1/13/2023
Kate Fratt Memorial Parochial School	Billings	205 N. 32nd Street	7/28/2020
L and L Building	Billings	2624 Minnesota Avenue	12/19/2008
Masonic Temple	Billings	2806 3rd Avenue N.	4/17/1986
McKinley Elementary School	Billings	820 N. 31st Street	3/16/2021
McMullen Hall	Billings	1500 University Drive	9/8/2015
Montana National Bank	Billings	201 North Broadway	3/14/2022
Moss, Preston B, House	Billings	Address Restricted	4/30/1982
North Elevation Historic District	Billings	Bounded by 12th Avenue N., alley between N. 31st Street & N. 30th Street, 9th Avenue N. & 32nd Street N.	11/29/2016
North, Austin, House	Billings	622 N. 29th Steet	11/23/1977
Northern Hotel	Billings	19 N. Broadway	6/12/2013
O'Donnell, I.D., House	Billings	105 Clark Avenue	11/23/1977
Oliver Building	Billings	2702 Montana Avenue	12/19/2008
Parmly Billings Memorial Library	Billings	2822 Montana Avenue	10/26/1972
Pictograph Cave	Billings	7 miles SE of Billings in Indian Caves Park	10/15/1966
Pioneer Park	Billings	Roughly bounded by Parkhill Drive, 3rd Street W., & Virginia Lane	4/13/2021
Prescott Commons	Billings	Rimrock Road	4/30/1982
Ruth, Harold and Marion, House	Billings	111 Emerald Drive	6/21/2007
US Post Office & Courthouse – Billings	Billings	2602 1st Avenue N.	3/14/1986
Yegen, Christian, House	Billings	208 S. 35th Street	10/1/1979
Yegen, Peter, House	Billings	209 S. 35th Street	4/16/1980
Antelope Stage Station	Broadview	E of Broadview	1/19/1983
Erb, Abraham & Carrie, House	Laurel	110 4th Avenue	6/9/2005

Property Name	City/Town	Location	Date Listed
Laurel Downtown Historic District	Laurel	Roughly bounded by the Burlington Northern Santa Fe Railway Company tracks to the S, Third S to the N, Wyoming Ave	9/16/2010
Mossman Overpass	Laurel	Mile 57, N. of I-90 Frontage Road	3/26/2012
Pompey's Pillar	Pompey's Pillar	W. of Pompey	10/15/1966
Huntley Bridge	Huntley	Mile 12, MT 312	3/26/2012

Source: National Register of Historic Places National Archives (records up until end of 2012) https://www.nps.gov/subjects/nationalregister/database-research.htm; National Register of Historic Places, NPGallery Database (records listed after 2013) https://npgallery.nps.gov/nrhp

Natural Resources

Natural resources are important to include in benefit-cost analyses for future projects and may be used to leverage additional funding for projects that also contribute to community goals for protecting sensitive natural resources. Awareness of natural assets can lead to opportunities for meeting multiple objectives. For instance, protecting wetlands preserves sensitive habitats as well as attenuates and stores flood waters.

Wetlands are a valuable natural resource for communities, due to their benefits to water quality, wildlife protection, recreation, and education, and play an important role in hazard mitigation. Yellowstone County has over 7 lakes and reservoirs. The County is made up of approximately 16 square miles of water.

Endangered Species

A table of endangered and threatened species in the State of Montana, as identified by the U.S. Fish and Wildlife Service, Montana Ecological Services Field Office, can be found in the Assets Summary Section in Chapter 4 of the base plan.

K.4 Vulnerability to Specific Hazards

Vulnerability to hazards that can affect the Eastern Region is described in Section 4.2 Hazard Profiles of the Eastern Region base plan. The analysis of vulnerability in the base plan includes the type, location, and extent of hazards. In addition, the base plan provides an analysis of the vulnerability of seven classes of assets (People; Property; Critical Facilities and Lifelines; the Economy; Historic and Cultural Resources; and Natural Resources). Subsections within Section 4.2 of the Eastern Region base plan provide descriptions and analysis of the exposure of each asset class to each hazard, the susceptibility of each asset class to damage from exposure to each hazard, and the overall vulnerability of each class of asset to each hazard.

This section details quantifiable vulnerability to specific hazards, only where it differs from that of the Region as a whole. The results of detailed GIS analyses used to estimate potential for future losses are presented here, in addition to maps of hazard areas, details by jurisdiction, and building type. For a discussion of the methodology used to develop the loss estimates, refer to Chapter 4 of the base plan. In many cases, Chapter 4 contains information that differentiates the risk by county, thus the information is not duplicated here. For most of the weather-related hazards the risk does not vary significantly enough from the rest of the Region and thus the reader should refer to Chapter 4. Only unique issues or vulnerabilities are discussed, where applicable.

Hazards considered in this HMP update annex are as follows.

- Avalanche
- Communicable Disease

- Cyber-Attack
- Dam Failure
- Drought
- Earthquake
- Flooding
- Hazardous Materials Incident
- Landslide
- Severe Summer Weather
- Severe Winter Weather
- Human Conflict
- Tornadoes & Windstorms
- Transportation Accidents
- Volcanic Ash
- Wildfire
- Ditch and Drain Failure

K.4.1 Avalanche

An avalanche is a low significance hazard for Yellowstone County and its jurisdictions (Table K-5). To distinguish between counties where avalanches have not occurred and those that have no possibility of avalanche occurrence, FEMA created a control table overlaying avalanche forecast zones and counties which have experienced losses due to credible avalanche events. Based on this analysis, Yellowstone County was determined to be an area where avalanches have no possibility of occurrence. Therefore, mitigation actions were not included for this hazard.

Refer to Chapter 4 for a discussion of the avalanche risk relative to Yellowstone County and the Eastern Region.

K.4.2 Communicable Disease

All populations are vulnerable to communicable disease. Elder populations, young children, and individuals with pre-existing medical conditions are more likely to face long lasting impacts from communicable disease. While areas of high population density are likely to experience a greater number of cases due to a larger population, these larger cities also have greater access to medical resources.

Communicable disease is ranked as a high significance hazard for Yellowstone County and there were no noted jurisdictional differences. As Billings is the largest city in an approximately 500-mile radius, it serves as a medical hub for approximately two-thirds of Montana and a significant portion of boarding states, making communicable disease a significant threat in Yellowstone County.[2] Billings is also the only city in Montana with a certified Level 1 Trauma Center.[3] As of October 2023, according to data from the Centers for Disease Control and Prevention (CDC), Yellowstone County reported approximately 47,850 confirmed cases of COVID-19 in Yellowstone County. Among these cases, 2,913 individuals were hospitalized directly related to COVID-19, with 302 admitted to the ICU, and nearly 580 deaths. According to USA Facts, the pandemic resulted in a 12% increase in closures of retail food establishments and 13% increase closures of wholesale food establishments. All K-12 schools were closed from March 16, 2020, through May 6, 2020.

Refer to Chapter 4 for a discussion of the communicable disease risk relative to Yellowstone County and the Eastern Region.

[2] https://riverstonehealth.org/about-billings-montana/
[3] https://www.billingsclinic.com/services-specialties/emergency-services/trauma-services/

K.4.3 Cyber-Attack

All servers, networks, and users are vulnerable to cyber-attacks in Eastern Montana. Yellowstone County is ranked high, along with most other counties in the Region. There have been no recorded cyber- attack events occurring in the County or its jurisdictions, however, minor cyber-attacks such as phishing emails often go unreported. While all networks and servers are equally vulnerable to cyber-attacks, the City of Billings has a greater population and therefore more people exposed to a cyber-attack event.

Refer to Chapter 4 for a discussion of the cyber-attack risk relative to Yellowstone County and the Eastern Region.

K.4.4 Dam Failure

Dam failure in Yellowstone County and the Town of Broadview is rated a low significance hazard. The City of Billings and the City of Laurel rate dam failure as a medium significance hazard (Table K-5). Chapter 4 provides a discussion of the dam failure risk in the Eastern Region, including Yellowstone County. See Section 4.2.4 *Dam Failure*.

There is one high hazard dam (HHPD) in Yellowstone County (Lakeside Dam), and two significant hazard potential dams in the County (Table K-10, Figure K-8). GIS delineations of the dam failure inundation zoned for these dams are unavailable. This prevents identification of specific assets that could be exposed in the event of a dam failure. The analysis of vulnerable assets, below, does not consider failure of these three dams. Refer to Chapter 4 for a discussion of the dam failure risk relative to Yellowstone County and the Eastern Region, and of the typical reasons that dam failure inundation zones are not made available for hazard mitigation planning. At least two additional HHPDs exist upstream of Yellowstone County and are discussed below.

Table K-10 Dams in Yellowstone County

Hazard Class	Dam Name	Owner	River	Nearest Downstream City	Distance to Nearest Downstream City (miles)	Emergency Action Plans (EAP)
High	Lakeside	Lakeside Homeowners Association	Off Stream (High Ditch)	Billings	0	Yes; Prepared 1/5/2021
Significant	Dreves	Oreves Farming Corp	Coulee	None	0	Not Required
Significant	Retriever #1	Montana Retriever Club	Twelve Mile Creek Off Stream	Huntley	6	Not Required

Source: National Inventory of Dams (NID)

The Cooney Dam is an HHPD upstream of Yellowstone County in Carbon County, seven miles west of Boyd and 19 miles west of Joliet (Figure K-8). This irrigation reservoir is owned by the Montana DNRC, measures 102 feet tall, nearly a half-mile wide, and has the potential to inundate parts of both Laurel and Billings. The inundation zone for this dam was made available for this HMP update and is shown in purple on Figure K-8. The delineation extends just past Billings and stops, despite the fact that dam failure hazards would continue further downstream. The analysis of assets in Yellowstone County that are vulnerable to dam failure hazards is based entirely on this one delineation.

The Yellowtail Dam and Reservoir is another HHPD upstream of Yellowstone County. This dam is a concrete thin-arch hydroelectric dam, towering 525 feet and stretching 1,480 feet across Bighorn Canyon in Big Horn

County. Failure of this dam would inundate the land along the Bighorn River on the eastern boundary of Yellowstone County. The dam inundation zone for the Yellowtail Dam is unavailable and the potential impact of failure of this dam on assets is not included in the vulnerability analysis below.

The SoVI-based rating of social vulnerability is relatively low in Yellowstone County (Section K.2.4 Social Vulnerability). Regardless of how Yellowstone County rates in social vulnerability, severe floods can be devastating events that are difficult to recover from both financially and emotionally. Floods may result in injuries or fatalities in situations with limited warning or when evacuation orders are not adhered to.

Table K-11

Table K-11 summarizes the estimated number of improved parcels, building values, and people within inundation zones in Yellowstone County by property type. A total of 5,971 people reside within the dam inundation zone in Yellowstone County, over 3% of the total County population. Half of these people 3,017, live in Billings.

Yellowstone County has a $1.3 billion total property value located within the inundation zone. Residential property types represent the greatest total number of improved parcels and most property value, with approximately $621 million in total property value at risk. A substantial amount of people (over 5,000 estimated) reside within the limited inundation area mapped in the County (primarily Cooney Dam); thus the risk of loss of life and injury would be significant without adequate warning and evacuation.

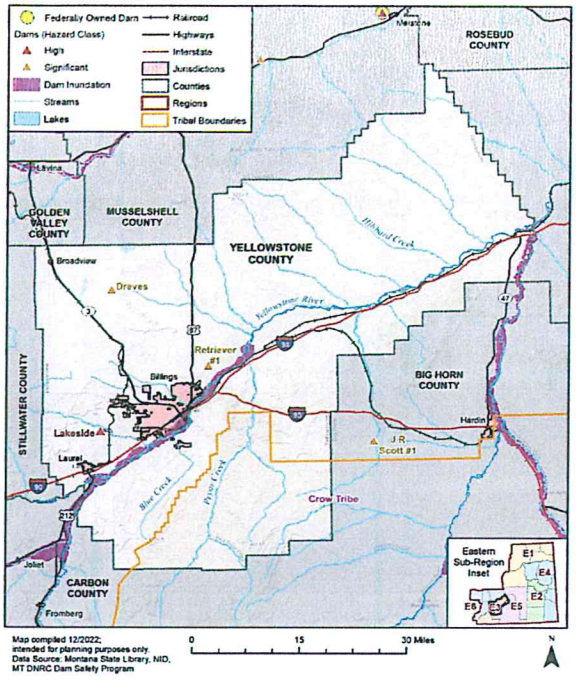
The SoVI-based rating of social vulnerability is relatively low in Yellowstone County (Section K.2.4 Social Vulnerability). Regardless of how Yellowstone County rates in social vulnerability, severe floods can be devastating events that are difficult to recover from both financially and emotionally. Floods may result in injuries or fatalities in situations with limited warning or when evacuation orders are not adhered to.

Table K-11 Yellowstone County Parcels at Risk to Dam Inundation by Property Type

Jurisdiction	Property Type	Improved Parcels	Improved Value	Content Value	Total Value	Population
Billings	Commercial	9	$2,129,410	$2,129,410	$4,258,820	-
	Exempt	41	$80,771,767	$80,771,767	$161,543,534	-
	Industrial	13	$18,304,530	$27,456,795	$45,761,325	-
	Residential	1,306	$230,399,990	$115,199,995	$345,599,985	3,017
	Vacant	4	$57,290	$57,290	$114,580	-
	Total	**1,373**	**$331,662,987**	**$225,615,257**	**$557,278,244**	**3,017**
Yellowstone County	Agricultural	35	$8,934,450	$8,934,450	$17,868,900	-
	Commercial	4	$1,972,630	$1,972,630	$3,945,260	-
	Exempt	20	$59,791,770	$59,791,770	$119,583,540	-
	Industrial	7	$160,264,770	$240,397,155	$400,661,925	-
	Residential	1,279	$183,987,409	$91,993,705	$275,981,114	2,954
	Vacant	21	$176,370	$176,370	$352,740	-
	Total	**1,366**	**$415,127,399**	**$403,266,080**	**$818,393,479**	**2,954**
	Grand Total	**2,739**	**$746,790,386**	**$628,881,337**	**$1,375,671,723**	**5,971**

Source: County Assessor data, NID, MT DNRC, WSP GIS Analysis

Figure K-8 Yellowstone County Dam Inundation



There are several known fault systems throughout the State of Montana, mostly concentrated in the Western Region (Figure 4-24). The probability of exposure to earthquake hazards, however, is not uniform across the state. Most but not all earthquake epicenters are well west of the Eastern Region and Yellowstone County and Yellowstone County is roughly on the edge of the area identified by USGS as having a slightly elevated earthquake risk on the Long-Term National Seismic Map (Figure 4-27).

In terms of susceptibility to earthquake damage, Yellowstone County has a few key concerns. First, most parts of Yellowstone County have soils with an insignificant risk of liquefaction. However, liquefaction risk is elevated and even moderate in river valleys, where most development has occurred (Figure 4-25). Second, Yellowstone County is physically closer to seismically active areas than most counties in the Eastern Region (Figure 4-24). Third, Yellowstone County has relatively well-developed cities, especially Billings but also Broadview and Laurel. Taken together, Yellowstone County is near enough to seismically active areas to experience harmful ground shaking, has soils that could magnify the impacts of shaking on buildings, and has many structures that would be exposed to ground shaking hazards in the event of a major earthquake.

According to a Hazus probabilistic loss analysis conducted for a scenario with 2% in 50 years recurrence. The probabilistic scenario estimated Yellowstone County will experience the highest total economic losses in the Eastern Region of any county in the Eastern Region. Hazus-simulated economic losses in Yellowstone County were $71,054,000, which is over half of all losses in the Eastern Region and more than double the next-most impacted county (Table 4-24). While all jurisdictions in the County have adopted building codes, the City of Billings and City of Laurel are likely to experience greatest losses due to the concentration of population and infrastructure and therefore have higher risk ratings. Older and historic buildings, constructed before adoption of building codes, are more vulnerable to earthquake shaking.

Chapter 4 provides a further discussion of the earthquake risk relative to Yellowstone County and the Eastern Region.

K.4.7 Flooding

Flooding is rated as a high significance hazard in Yellowstone County and all three participating jurisdictions (Table K-5).

Table K-12 below summarizes the building counts and improved value of parcels in the County that fall within the 1% chance floodplains. A total of 1,830 people reside within the 1% chance floodplain in Yellowstone County, approximately 1% of the total County population. Of these people, 6% (111) live in Billings and 360 (~20%) live in Laurel.

Additionally, Table K-12 summarizes loss estimate values, which are calculated based upon the improved value of parcels that fall within the 1% chance floodplain, and estimated contents value and assumes a two-foot-deep flood which usually results in losses equal to 25% of the total value, based on FEMA depth-damage curves. NFHL flood data was used to perform this analysis.

For context, Yellowstone County as a whole has the second greatest total value within the 1% annual chance flood zone and the second greatest estimated loss of any county in the Eastern Region, behind only Custer County (Table 4-31 in the base plan). The greatest liability in terms of flood damage is to residential property. Residential parcels make up 87% of the parcels and 65% of the total value within the 1% annual chance flood zone in Yellowstone County, Billings, Laurel, and the Crow Indian Reservation (Table K-12). Nearly 1,800 people reside in the 1% annual chance floodplain, the majority within the unincorporated area and Laurel.

The SoVI-based rating of social vulnerability is *relatively low* in Yellowstone County (Section K.2.4 *Social Vulnerability*). Regardless of how Yellowstone County rates in social vulnerability, severe floods can be devastating events that are difficult to recover from both financially and emotionally. Floods may result in

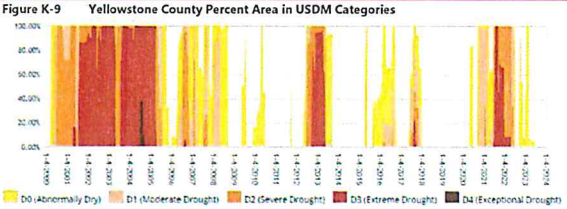
K.4.5 Drought

Drought was rated as a hazard of high significance hazard in Yellowstone County and all three participating jurisdictions (Table K-5). Yellowstone County experienced 12 USDA drought declarations from 2012-2021. These declarations occurred in 2012, 2013, 2016, 2017, 2019, 2020, and 2021. Per the Billings Chamber of Commerce, **"The major crops grown in Yellowstone County are** alfalfa, wheat, barley, corn, and sugar beets. Alfalfa and other hay grown in the area is predominantly raised and saved to feed livestock during the colder months."[4] The Drought Impact Reporter recorded 16 drought impact reports in Yellowstone County between 2000-2023, including, low hay reserves and slowing alfalfa growth.[5,6]

The U.S. Drought Monitor (USDM) is a national data set released weekly, showing the severity of drought in locations across the nation. Figure K-9 displays a time series showing the severity of drought in Yellowstone County between 2000 and 2023. The figure indicates that the County experienced exceptional drought (D4) in 2004. The HMPC and CPT noted that the Governor's Drought and Water Supply Advisory Committee meets monthly to share water supply and moisture conditions to effectively manage natural resources and support constituents most likely to be affected by drought. Refer to Chapter 4 for a discussion of the drought risk relative to Yellowstone County and the Eastern Region.

Chapter 4 of the base plan provides a discussion of the drought risk relative to Yellowstone County and the Eastern Region. In particular, all assets are exposed to drought, but assets are variably impacted by drought. In the case of Yellowstone County and its jurisdictions, dry-land agriculture is especially vulnerable. In terms of financial impact to agriculture, Yellowstone County is not among the most impacted counties in the Eastern Region (Figure 4-22), though the County does have an expected annual loss rating of relatively moderate from the NRI (Figure 4-23). As is the case across the Eastern Region, climate change is projected to cause a moderate increase in drought frequency in coming decades (see the base plan, Section 4.2.5, subsection *Climate Change Considerations*).

Figure K-9 Yellowstone County Percent Area in USDM Categories



Source: USDM; www.drought.gov

K.4.6 Earthquake

Earthquake is rated as low significance hazard in Yellowstone County overall, though all three participating jurisdictions within the County rated it as a medium significance hazard (Table K-5).

[4] https://www.billingschamber.com/business-advocacy/agriculture/
[5] https://www.ktvq.com/news/local-news/montana-growers-navigating-hay-shortage-during-drought
[6] https://unldroughtcenter.maps.arcgis.com/apps/dashboards/46afe627bb60422f85944d70069c09cf

injuries or fatalities in situations with limited warning or when evacuation orders are not adhered to.

Confirming the high vulnerability to flood hazards, Yellowstone County has experienced the highest historical National Flood Insurance Program (NFIP) dollars paid of any county in the Eastern Region (see Table 4-27 in the Base Plan, section *National Flood Insurance Program Policy Analysis*).

Table K-12 Yellowstone County Parcels at Risk to 1% Flood Hazard by Jurisdiction

Jurisdiction	Property Type	Improved Parcels	Improved Value	Content Value	Total Value	Estimated Loss	Population
Billings	Commercial	1	$57,920	$57,920	$115,840	$28,960	-
	Exempt	5	$10,596,740	$10,596,740	$21,193,480	$5,298,370	-
	Residential	48	$12,421,652	$6,210,826	$18,632,478	$4,658,120	111
Crow Tribe	Agricultural	1	$59,260	$59,260	$118,520	$29,630	-
	Exempt	1	$160,640	$160,640	$321,280	$80,320	-
Laurel	Commercial	3	$447,840	$447,840	$895,680	$223,920	-
	Exempt	1	$178,540	$178,540	$357,080	$89,270	-
	Residential	156	$4,546,671	$2,273,336	$6,820,007	$1,705,002	360
Yellowstone County	Agricultural	94	$19,337,510	$19,337,510	$38,675,020	$9,668,755	-
	Commercial	1	$68,070	$68,070	$136,140	$34,035	-
	Exempt	5	$1,579,000	$1,579,000	$3,158,000	$789,500	-
	Industrial	4	$13,960,030	$20,940,045	$34,900,075	$8,725,019	-
	Residential	588	$104,865,256	$52,432,628	$157,297,884	$39,324,471	1,358
	Vacant	7	$49,340	$49,340	$98,680	$24,670	-
	Total	**915**	**$168,328,469**	**$114,391,695**	**$282,720,164**	**$70,680,041**	**1,830**

NOTE – A portion of the Crow Tribe is located in Yellowstone County, although predominantly located in Big Horn County. Sources: DNRC, Hazus, FEMA NFHL

Yellowstone County has a total of 71 critical facilities located in the 1% annual chance floodplain. 55 are transportation lifelines, six are communication facilities, five are energy facilities, two are food, water and shelter and one is Safety and Security facilities. This is shown in Table K-13. Floodplain hazard areas are shown in Figure K-10 through Figure K-13.

Table K-13 Critical Facilities at Risk to 1% Annual Chance Flood Hazards by FEMA Lifeline

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health & Medical	Safety and Security	Transportation	Total
Billings	2	-	-	-	-	-	8	10
Laurel	1	-	-	-	-	-	-	1
Yellowstone County	3	5	2	2	-	1	47	60
Total	6	5	2	2	0	1	55	71

National Flood Insurance Program

The NFIP aims to reduce the impact of flooding on private and public structures by providing affordable insurance to property owners and by encouraging communities to adopt and enforce floodplain management regulations. These efforts help mitigate the effects of flooding on new and improved structures. The State has analyzed NFIP flood-loss data to determine areas of Montana's Eastern Region with the greatest flood risk. Montana's Eastern Region flood-loss information was obtained from FEMA's "Montana's Coverage Claims" for Montana's Eastern Region, which documents losses from 1978. This section was updated based on information obtained from FEMA's PIVOT database through Montana Department of Natural Resources and Conservation (MT DNRC) dated August 10, 2022.

There are several limitations to analyzing flood risk entirely on this data, including:

- Only losses to participating NFIP communities are represented;
- Communities joined the NFIP at various times since 1978;
- The number of flood insurance policies in effect may not include all structures at risk to flooding; and
- Some of the historical loss areas have been mitigated with property buyouts.

Yellowstone County has a total of $76,606,000 in NFIP coverage, with 263 total flood claims, and 275 current policies in place. It also had the highest amount of dollars paid out due to flood claims with $1,814,878 dollars paid out. NFIP data and statistics for Yellowstone County is summarized in Table K-14.

Table K-14 Yellowstone County NFIP Statistics

County	Date Joined	Effective Firm Date	Dollars Paid (Historical)	Flood Claims	Current Policies	Coverage ($)
Yellowstone	11/18/1981	11/6/2013	$1,814,878.16	263	275	$76,606,000

Source: FEMA Pivot NFIP Data as of August 10th, 2022; FEMA Community Status Book Report

Repetitive Loss

Repetitive losses are NFIP-insured structures that have had at least two paid flood losses of more than $1,000 each in any ten-year period since 1978. Yellowstone County has a total of 21 repetitive loss properties as of 2022. Ten of these structures are in Billings, four are in Laurel, two are in Worden, and the remaining five are in the unincorporated County.

Severe Repetitive Loss (SRL) properties have either four or more separate claims for flood damage (with each claim exceeding $5,000 and with the sum of all payments exceeding $20,000,) or two or more separate claims where the total of all claims exceeds the value of the property. Yellowstone County has no SRL properties.

Table K-15 below lists that Yellowstone County has 21 repetitive loss structures, 53 repetitive loss claims and $747,592.02 in funding paid.

Table K-15 Repetitive Loss Properties in Yellowstone County

County	Repetitive Loss Structures per County	Repetitive Loss Claims	Structure Type Single - Family	Structure Type – Multi-Family	Structure Type – Business/ Non-Residential	Total Paid Out
Yellowstone County	21	53	19	-	2	$747,592.02

Source: FEMA Region VIII as of 9/10/2022.

Figure K-10 Yellowstone County Flood Hazard and Structures

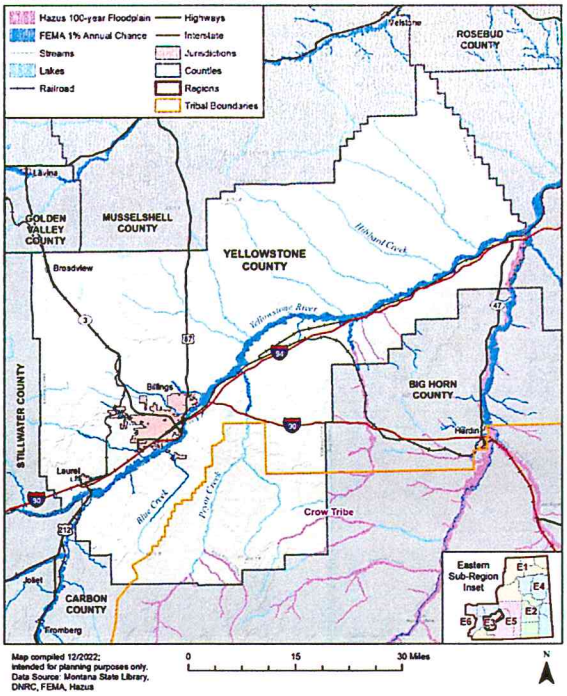


Figure K-11 City of Billings Flood Hazard and Structures

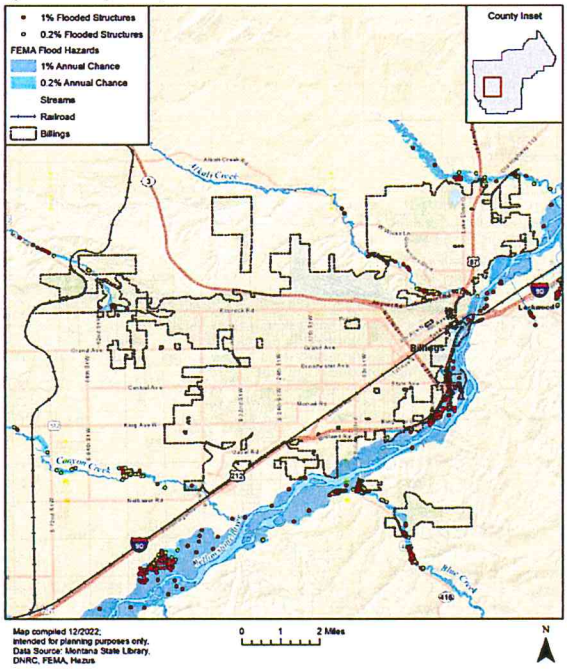


Figure K-12 Town of Broadview Flood Hazard and Structures

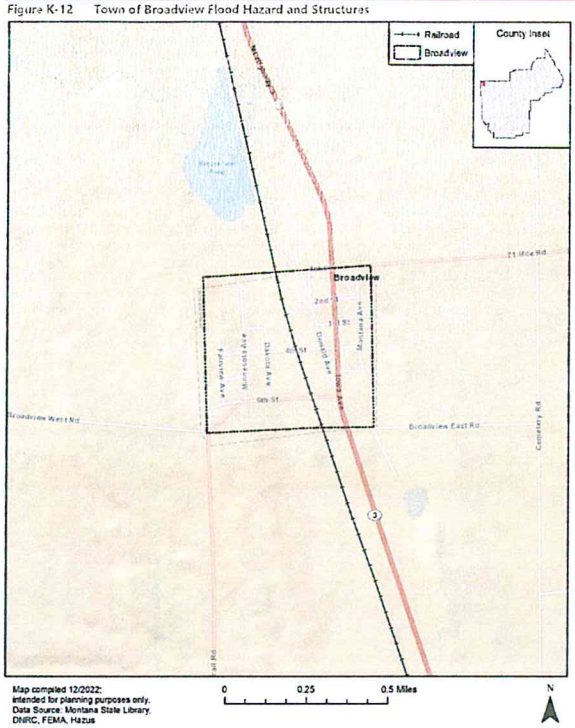


Figure K-13 City of Laurel Flood Hazard and Structures

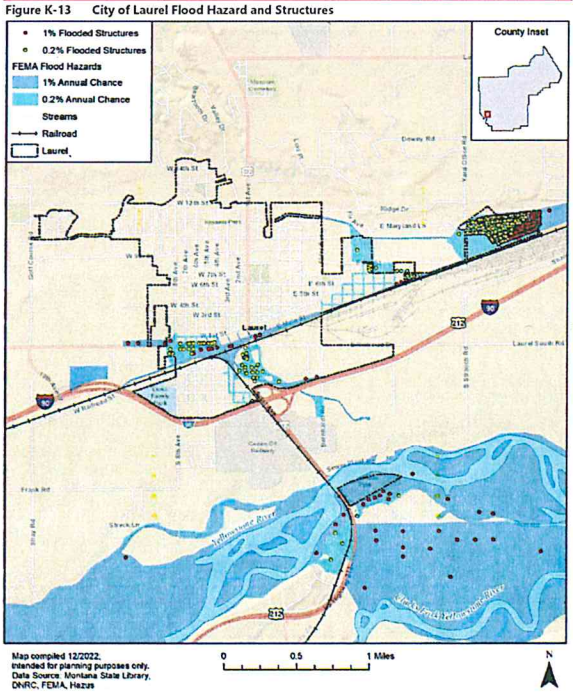
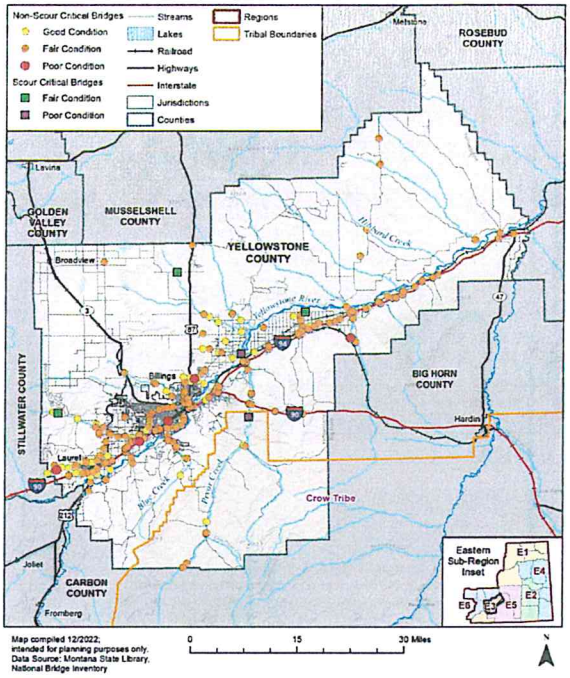


Figure K-14 below displays the location of bridges in Yellowstone County and their condition. Refer to Chapter 4 of the base plan for a discussion of the flood risk relative to Yellowstone County and the Eastern Region.

Figure K-14 Yellowstone County Bridges



K.4.8 Hazardous Materials Incident

Hazardous Materials Incidents are ranked as a high overall significance hazard for Yellowstone County. Yellowstone County has 11 Risk Management Program (RMP) facilities, and according to the National Response Center (NRC), there were 621 reported hazardous material incidents in the County since 1990, the greatest number in the Eastern Region. Yellowstone County also has gas transmission pipelines present, which travel through the communities of Billings and Laurel, as well as the unincorporated County. Hazardous liquid pipelines also traverse the County, going through Lockwood and Billings, as well as the unincorporated County. Many major transportation routes also cross Yellowstone County, including US Interstates 90 and 94, US Highways 87, 212, and 310, and Montana State Highways 3 and 47. These transportation routes are likely locations for future occurrences of hazardous material incidents in transit.

Refer to Chapter 4 for a discussion of the hazardous materials incident risk relative to Yellowstone County and the Eastern Region.

K.4.9 Landslide

Landslide is rated as a low significance hazard in Yellowstone County and all three participating jurisdictions (Table K-5).

Section 4.2.9 *Landslide* provides an analysis of the landslide hazard in the Eastern Region. Yellowstone County has an unusually high exposure to landslide hazards relative to the typically-very low exposure in most parts of the Eastern Region (Figure 4-40, 4-41). Yellowstone is one of two counties in the Eastern Region recognized as having an elevated landslide frequency (Figure 4-42). Nevertheless, the NRI rates Yellowstone County as having a relatively low risk index rating and a relatively moderate expected annual loss rating (Figure 4-43 and 4-44).

Unincorporated areas in the southwest of the County greater relief may be more likely to experience landslides. The probability of landslide is greater in spring. The greatest area of concern is in the Billings area below the Rimrocks, a geological rimrock sandstone formation, also called the Rims. Table K-16 lists landslide events in Yellowstone County that were recorded by the United States Geological Survey (USGS) or included in the 2019 Yellowstone County HMP. Although certain events are documented by both sources, it's important to note that no single database comprehensively captures the entire history of landslide events, therefore this is an inexhaustive list.

If landslide hazards occur, some assets are susceptible to damage, following a similar pattern as is discussed for each class of asset in Section 4.2.9, subsection titled *Vulnerability Assessment*.

According to the CPT, Yellowstone County has spent hundreds of thousands of dollars in mitigation, repair, and response to landslide and rockfall events over the last few years. The County CPT says a landslide occurring to the Billings Bench Water Association (BBWA) ditch is one of the most eminent and dangerous threats currently facing the County. Such an event could lead to a breach of the BBWA ditch, which would cause major flooding to the downtown area.

For more information refer to Chapter 4 for a discussion of the landslide risk relative to Yellowstone County and the Eastern Region.

Table K-16 Recorded Landslide Events in Yellowstone County

Date	Event Summary
October 9, 2010*	No one was hurt when a huge boulder crashed through the back of a house at 1313 Granite Ave. in Billings. A wet spot just below the top of the rimrocks showed where a large slab of sandstone fell off the side of the Rims. It broke into dozens of pieces when it hit the earth below, and the largest piece slammed through the back of a wooden house. The rock fall caused a noise described as thunder or an explosion and the dust cloud was larger than the Rims.
May 12, 2014*	Two rock falls during March led to the closure of Zimmerman Park. The park was closed for approximately two months until a stabilization project was completed, and the city road crew repaired the guardrail and damaged pavement. The MT Dept. of Transportation paid a contractor over $700,000 for a rock removal and stabilization project at six locations along Zimmerman Trail. Rockslide areas were also identified at Swords Park and several hundred tons of rock were removed to mitigate rocks from falling onto Sixth Avenue North.
May 18, 2016*^	Phipps Park, on Molt Road west of Billings, was forced to close after a rockslide. A park user witnessed the rockslide and said a large portion of the rock just separated from the rimrock. A geotechnical survey was done of the area and existing trails in the rock fall zone were re-routed.
May 31, 2017^	A rockfall incident of medium scale, with an unknown trigger, originated from the Rimrocks in northern Billings, causing a significant rockslide in the area. Massive boulders were thrown through a residential structure, resulting in substantial damage.
June 26, 2018*^	A resident was lying in bed when she heard the roaring noise of about 150 yards of sandstone cliff face breaking free from the rimrocks and rolling towards her house below. The rockslide smashed through her garage on the 220 block of Mountain View Boulevard and covered roughly 75 yards of road below the Rims with rocks and debris. No one was injured.
August 15, 2018^	Massive boulders, comparable in size to an all-terrain vehicle and the cab of a semi-truck, detached from the Rims. These sizable pieces of sandstone were propelled through a residence in Billings, with one boulder finding its resting place inside what appeared to be the living room area. The family was not injured in the incident and no gas lines were damaged.

Source: * – 2019 Yellowstone County Hazard Mitigation Plan; ^ – USGS Landslide Inventory, https://www.usgs.gov/tools/us-landslide-inventory

K.4.10 Severe Summer Weather

Severe summer weather is rated as a high significance hazard in Yellowstone County and all three participating jurisdictions (Table K-5).

The impact of summer weather hazards in Yellowstone County is variable but by far most significant for hail. According to the National Centers for Environmental Information (NCEI) Storm Events Database, Yellowstone County experienced the second greatest number of total severe summer weather events in Eastern Region, including 447 hail events, 5 heavy rain and 4 lightning events.[7] Property losses from severe summer weather in Yellowstone County totaled to $14,085,500 from 1955 to 2022 (44.5% of total losses in the Eastern Region), mainly due to hail events. Yellowstone County also experienced $2,500,000 in total crop losses from severe summer weather during the same time period (7.8% of total crop losses in the Eastern Region).

[7] The NCEI Database records tornado events from January 1950 to present; tornado, thunderstorm wind, and hail from January 1955 to present and all other hazard events from January 1996 to present.

All assets located outdoors are exposed to hail, extreme heat, and heavy rain. Lightning typically strikes the highest objects in an area but can cause hazardous power surges that extend much further. Lightning strikes can also start fires. The secondary effects of fire are discussed in the section below titled *Wildfire*. The greatest property losses are likely to occur in the City of Billings, where people and infrastructure are concentrated. Refer to Chapter 4 for a discussion of the severe summer weather risk relative to Yellowstone County and the Eastern Region.

K.4.11 Severe Winter Weather

Severe winter weather is rated as a high significance hazard in Yellowstone County and all three participating jurisdictions (Table K-5).

Section 4.2.11 *Severe Winter Weather* in the Eastern Region base plan provides an analysis of these hazards in the region and relative to Yellowstone County. The main hazards of concern are blizzard, cold, heavy snow, ice storms, winter storms and winter weather, defined in Section 4.2.11. From that analysis, all assets located outdoors are exposed to these hazards and indoor plumbing is an additional concern for cold. Many assets in Yellowstone County are susceptible to damage from severe winter weather, following the pattern described in Section 4.2.11, subsection *Vulnerability Assessment*.

Yellowstone County experienced the tenth greatest number of NCEI recorded severe winter weather events in the Eastern Region and the NRI rated Yellowstone County as "relatively low" risk index rating for winter weather.

The NCEI Storm Events Database recorded a total of $14,000 in property losses due to severe winter events in Yellowstone County from 1996 to (<1% of total recorded losses in the Eastern Region). However, the Storm Events Database uses data from the National Weather Service (NWS) for historical and current events, so any property loss data that was not reported to NWS will not be represented. The USDA recorded over $4 million in crop losses in Yellowstone from cold winter weather, freeze, and frost, between 2007 and 2021.

Portions of the population are particularly susceptible to winter hazards. These populations include those who are houseless or who work outside. Susceptibility of agriculture operations is also a significant concern. Further analysis of winter weather impacts, including NRI ratings, is provided in Section 4.2.11 *Severe Winter Weather*.

K.4.12 Human Conflict

Human conflict is ranked as an overall high significance for Yellowstone County. Only one of the seven reported terrorist attacks in Montana occurred in the Eastern Region, a 1970 event that targeted police in Billings. Additionally, Billings experienced more than half of the total civil unrest incidents in the Region recorded by Count Love, while Laurel had one documented civil unrest incident.[8] All cities and towns are vulnerable to human conflicts, human conflict events tend to occur in more populated areas.

Refer to Chapter 4 for a discussion of the human conflict risk relative to Yellowstone County and the Eastern Region.

K.4.13 Tornadoes & Windstorms

Tornadoes and windstorms are rated as a high significance hazard in Yellowstone County and all three participating jurisdictions (Table K-5).

Chapter 4 of the base plan, specifically Section 4.2.13 *Tornadoes & Windstorms*, provides an analysis of

[8] Count Love recorded public displays of protests between January 20, 2017, and January 31, 2021, that were not a part of "regular business;" they did not include awareness events, townhalls, or political campaign rallies. https://countlove.org/faq.html

this hazard relative to Yellowstone County and the Eastern Region. From that analysis, all assets are exposed to tornadoes and windstorms. According to the NCEI Storm Events Database, Yellowstone County experienced the sixth greatest number of high wind and strong wind events in the Eastern Region, with 72 total events between January 1996 and December 2022. Additionally, Yellowstone County experienced the second greatest number of thunderstorm wind events (between January 1996 and January 2022) and tornado events (between January 1950 and December 2022), with a combined 321 events

Many assets in Yellowstone County are susceptible to damage from tornadoes and windstorms, following the pattern described in Section 4.2.13, subsection *Vulnerability Assessment*. Most significantly for Yellowstone County, Mobile homes, which are disproportionately susceptible to tornado and windstorm events, comprise 7.3% of total housing in Yellowstone County.

Yellowstone County experienced the fifth greatest losses recorded by the NCEI Storm Events Database from thunderstorm wind events in the Eastern Region, with over $3.2 million in recorded property and crop damages, two deaths and three injuries. Yellowstone County also experienced the greatest losses from tornado events in the Eastern Region, with $32.58 million in recorded property and crop damages, together with three injuries

K.4.14 Transportation Accidents

Transportation accidents are an overall high significance hazard for Yellowstone County. Yellowstone County has reported by far the greatest number of roadway crashes in the Eastern Region, with 16,475 crashes between 2016 and 2020. On average, this equates to 3,295 reported crashes annually.

While transportation accidents can occur along any type of transportation route in the County and the Region, a greater frequency of accidents occur along heavily traveled roadways, such as US Interstate 90 (I-90), which traverses the County, intercepting the Cities of Billings and Laurel, and Montana State Highway 3, which connects Billings to Great Falls, intercepting the Town of Broadview. Due to the presence of these roadways, along with the significant tourism volume, and the much higher population density than much of the Region, there is a high likelihood that this hazard will continue to occur at generally higher frequencies than most other counties in the Region.

Refer to Chapter 4 for a discussion of the transportation accident risk relative to Yellowstone County and the Eastern Region.

K.4.15 Volcanic Ash

All counties in the Eastern Region and all jurisdictions within Yellowstone County ranked volcanic ash as a low significance hazard.

Chapter 4, specifically Section 4.2.15 *Volcanic Ash*, provides an analysis of this hazard relative to Yellowstone County and the Eastern Region. The frequency and extent of volcanic ashfall is likely to be consistent across the Eastern Region and is discussed in Section 4.2.15, subsections *Past Occurrences* and *Frequency/Likelihood of Occurrence*. All assets are potentially exposed to volcanic ash. Even assets located indoors are exposed when ash penetrates the ventilation system of buildings. Many assets in Yellowstone County are susceptible to damage from volcanic ash, following the pattern described in Section 4.2.15, subsection *Vulnerability Assessment*.

K.4.16 Wildfire

Wildfire is rated as a high significance hazard in Yellowstone County and all three participating jurisdictions (Table K-5).

Wildfire hazards in the Eastern Region and Yellowstone County are evaluated in the base plan, Section 4.2.16 *Wildfire*. Many assets in Yellowstone County are susceptible to damage from wildfire, following the pattern described in Section 4.2.13, subsection *Vulnerability Assessment*. The analysis below compliments the base plan and provides greater detail relevant to Yellowstone County, the City of Billings, City of Laurel, and the Town of Broadview.

Yellowstone County has been included in seven federal disaster declarations for wildfire, including two declarations in 2020 and one in 2021. These fires, the Bobcat Fire (2020), the Falling Star Fire (2020), and the Buffalo Fire (2021), resulted in evacuations, tens of thousands of burned acres, and minimal damage to structures, but no deaths or injuries. The CPT did not single out any wildfire events in the past five years.

Billings is the largest city in the State, and Yellowstone County is the most populous county. This high population density lends itself to high numbers of individuals living in fire risk areas. Yellowstone County has by far the greatest number of individuals in the Eastern Region in wildfire risk areas, with over 85% of the population (about 140,000 people) living in a fire risk area, representing 60% of all Eastern Region residents who live in fire risk areas (Table K-17). All participating jurisdictions exist in very high and extreme fire risk zones.

The SoVI-based rating of social vulnerability is *relatively low* in Yellowstone County (Section K.2.4 *Social Vulnerability*). Regardless of how Yellowstone County rates in social vulnerability, wildfires can be devastating events that are difficult to recover from both financially and emotionally. Wildfires may result in injuries or fatalities in situations with limited warning or when evacuation orders are not adhered to.

Table K-17 summarizes the estimated exposed value of improvements in each wildfire risk category. Based on this analysis, roughly 116,702 improved parcels are exposed to low/medium or higher wildfire risk, totaling about $39.0 billion in improved building and content value. This represents 99.9% of the total building inventory and building and content value in the County. Wildfires typically result in a total building loss including contents. See Chapter 4 in the base plan for details on the methodology of this analysis.

Table K-17 Yellowstone County Parcels at Risk to Wildfire by Jurisdiction and Risk Rating

At Risk Rating	Jurisdiction	Improved Parcels	Improved Value	Content Value	Total Value	Population
At Risk to **Extreme** Wildfire Hazards	Billings	16,535	$3,424,937,681	$1,796,724,678	$5,221,112,359	33,135
	Broadview	70	$7,021,967	$4,186,749	$11,208,703	143
	Crow Tribe	8	$1,253,830	$997,595	$2,251,425	17
	Laurel	2,049	$342,180,182	$186,038,753	$528,218,935	4,675
	Yellowstone County	7,447	$1,321,149,887	$686,274,747	$2,007,424,634	16,881
	Total	**24,107**	**$5,095,993,537**	**$2,674,222,521**	**$7,770,216,058**	**54,852**
At Risk to **Very High** Wildfire Hazards	Billings	16,918	$4,190,610,857	$2,507,107,422	$6,697,718,279	38,076
	Broadview	20	$1,671,139	$836,960	$2,508,099	44
	Crow Tribe	54	$10,038,442	$7,482,196	$17,520,638	106
	Laurel	843	$113,685,217	$64,472,341	$178,157,558	1,915
	Yellowstone County	7,104	$1,835,313,003	$1,017,511,675	$2,852,824,678	15,301
	Total	**24,939**	**$6,151,318,658**	**$3,597,410,593**	**$9,748,729,251**	**55,442**
At Risk to **High** Wildfire Hazards	Billings	278	$305,806,288	$197,503,398	$503,309,686	589
	Broadview	-	$-	$-	$-	-
	Crow Tribe	14	$1,696,300	$1,689,150	$3,385,450	4
	Laurel	10	$8,608,263	$4,304,132	$12,912,395	23
	Yellowstone County	498	$184,415,496	$148,715,065	$333,130,561	684
	Total	**800**	**$500,526,347**	**$352,211,744**	**$852,738,091**	**1,300**
At Risk to **Medium/Low** Wildfire Hazards	Billings	11,875	$3,941,698,363	$2,343,637,126	$6,285,335,489	26,346
	Broadview	-	$-	$-	$-	-
	Crow Tribe	35	$6,480,976	$5,813,428	$12,294,404	34
	Laurel	137	$80,610,328	$56,246,899	$136,857,227	266
	Yellowstone County	2,022	$904,048,783	$830,152,183	$1,734,200,966	3,477
	Total	**14,069**	**$4,932,838,450**	**$3,235,849,636**	**$8,168,688,086**	**30,122**

NOTE – A portion of the Crow Tribe is located in Yellowstone County, although predominantly located in Big Horn County. Source: MSDI 2022, MWRA

Table K-18 summarizes the potential impact of wildfire on critical facilities and lifelines in Yellowstone County and its associated jurisdictions. The table highlights the type and number of facilities in each jurisdiction in the County in Wildfire risk areas. See Chapter 4 for the methodology of the critical facilities at risk analysis.

Figure K-15 Yellowstone County Wildfire Hazard

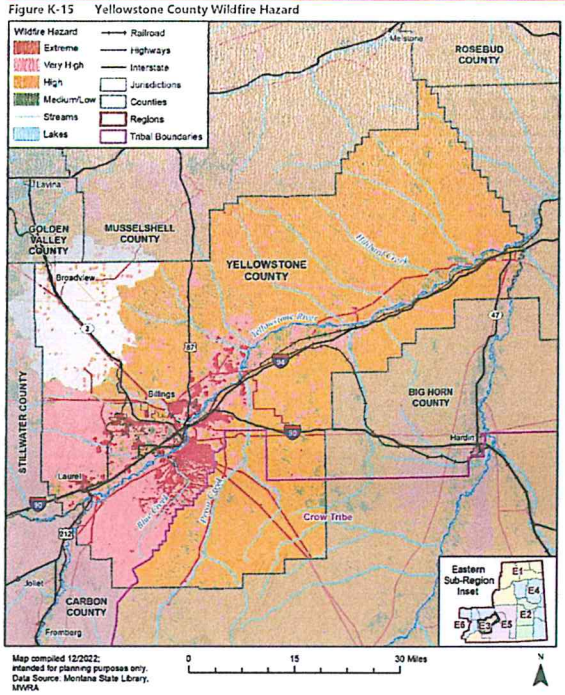


Table K-18 Critical Facilities at Risk to Wildfire Hazards by Jurisdiction, Facility Type, and Risk Rating

At Risk Rating	Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Total
At Risk to **Extreme** Wildfire Hazards	Billings	10	2	3	-	4	11	7	37
	Broadview	-	-	-	-	1	1	-	2
	Laurel	-	-	5	-	-	2	1	8
	Yellowstone County	98	40	6	2	5	22	31	204
	Total	**108**	**42**	**14**	**2**	**10**	**36**	**39**	**251**
At Risk to **Very High** Wildfire Hazards	Billings	27	-	10	8	2	32	21	100
	Broadview	-	1	-	-	-	-	-	1
	Laurel	1	1	1	-	-	-	-	3
	Yellowstone County	22	16	5	7	-	10	113	173
	Total	**50**	**18**	**16**	**15**	**2**	**42**	**134**	**277**
At Risk to **High** Wildfire Hazards	Billings	3	1	-	3	-	1	5	13
	Yellowstone County	10	-	-	1	1	-	34	46
	Total	**13**	**1**	**0**	**4**	**1**	**1**	**39**	**59**
At Risk to **Medium/Low** Wildfire Hazards	Billings	45	6	24	4	10	62	22	173
	Laurel	3	-	2	-	1	4	-	10
	Yellowstone County	13	11	7	12	2	12	61	118
	Total	**61**	**17**	**33**	**16**	**13**	**78**	**83**	**301**

NOTE – A portion of the Crow Tribe is located in Yellowstone County, although predominantly located in Big Horn County. Source: HIFLD 2022, Montana DES, NBI, MWRA

Yellowstone County has many efforts in place to protect its residents from the threat of wildfire. The Yellowstone County Fire Protection Services and Rural Fire Council consist of both municipal and volunteer fire departments. Billings and Laurel have municipal fire departments, with seven fire stations in Billings, including Central Headquarters at Fire Station #1. The City of Laurel operates one fire station. Additionally, fire departments are present at key locations such as the Billings-Logan International Airport, Phillips 66, Par Montana, and CHS refineries.

In Yellowstone County, a volunteer fire protection system is established to combat wildfires. This system is divided into several fire districts, each having its own volunteer fire department, including Blue Creek VFD, Broadview VFD, Custer VFD, Fuego VFD, Haley Bench VFD, Lockwood VFD, Molt VFD, Shepherd VFD, and Worden VFD. The Rural Fire Council, comprising these volunteer fire departments, offers advice and information to the Yellowstone Board of County Commissioners concerning fire and life safety services. The council fosters collaboration and communication among its members, enhancing operational efficiency and ensuring community fire protection. Mutual aid agreements have been signed within Yellowstone County and with adjacent counties, as well as state and federal fire control agencies.

Montana's Department of Natural Resources and Conservation (MT DNRC) Forestry Division is responsible for forestry and fire management programs across the state. The Fire and Aviation Management Bureau coordinates resources and leadership to protect lives, property, and natural resources from wildland fires, working closely with local, tribal, state, and federal partners. Montana DNRC focuses on fire preparedness through fire prevention, training, equipment development, and financial support programs. The Bureau of Land Management (BLM) Montana/Dakota District Office is involved in planning activities for public land within Yellowstone County, with an initial attack MOU for BLM or County fires.

The National Fire Prevention Association's (NFPA) FireWise Communities Program promotes safety by engaging homeowners in wildfire risk mitigation. It's a key part of the Fire Adapted Communities approach and is co-sponsored by various federal agencies. The program educates people about living with wildfire and encourages community action to prevent losses and protect lives and property.

K.4.17 Ditch and Drain Failure Hazards

Ditch and drain failure hazards in Yellowstone County, Montana, primarily pertain to the potential dangers associated with the extensive network of ditches and canals in the region. These hazards are typically connected to irrigation canals, drainage, and stormwater management systems and can pose risks to public safety and property. The irrigation facilities were constructed to deliver water to areas far removed from the original water intake. Yellowstone County is intersected by a total of 23 ditches, with 7 of these ditches situated within the boundaries of the City of Billings. Many of the ditches carry irrigation water for agriculture and private lawns and gardens, and parks and provide a valuable function to agricultural operations, residential and commercial outdoor watering, and groundwater recharge. Many of the ditches are open waterways with steep sides; however, there are several miles of culverts and pipes that carry ditch water beneath the City of Billings.

The (BBWA) is the most prominent canal in Billings. It is a gravity-fed canal that is diverted from the Yellowstone River near Laurel. The canal consists of 63 miles of main canal and over 200 laterals, distribution canals, and two storage reservoirs. It runs 20 miles through the City of Billings, somewhat parallel to Poly Drive before disappearing through an 1,800- foot tunnel in the rimrocks and Alkali Creek, then flows north through Billings Heights before discharging into Five Mile Creek. Ninety (90) percent of the farms from the Heights to Shepherd depend on the BBWA for irrigation. The value of the crops along the canal is in the millions of dollars. The BBWA has 1,463 customers and the canal waters the greens of three golf courses and lawns at many adjoining residences. The County also contains several other ditches and canals in the Billings area, such as the Hi-Line Ditch, Big Ditch, and Cove Ditch in West Billings.

Most of the ditches and drains are controlled and maintained through easements and prescriptive rights by private ditch companies, and the City of Billings and Yellowstone County do not have any ownership other than repair and replacement of street culvert crossings. Therefore, to address these ditch hazards and promote public safety, Yellowstone County would need regulations and procedures in place to manage ditches effectively. This could involve regular maintenance, inspections, and the enforcement of guidelines for construction and land use near ditches. According to the 2019 Yellowstone County HMP, there are approximately 112,093 acres in Yellowstone County (6.6 percent) located within ditch and drain failure impact areas. Because ditch and drain failure can greatly impact residences, commercial and industrial buildings, and critical facilities, future residential development along the Yellowstone River Valley in these areas should be minimized to reduce property losses. As noted in Section K.4.10, the County has spent hundreds of thousands of dollars in mitigation, repair, and response to landslide and rockfall events over the last few years. And an active landslide occurring on the BBWA ditch is one of the most eminent threats and contributing factors that may result in the breach of the BBWA ditch, given this hazard would cause major flooding to downtown Billings.

Residents and property owners in the County should be aware of the potential hazards associated with ditches, and they should take measures to ensure their safety, such as avoiding constructing structures in or near ditches, reporting blockages and erosion, and being prepared for potential flooding events. Also, local government and authorities typically work to mitigate these hazards and protect public safety, while also ensuring that the essential functions of the ditches, such as irrigation and drainage, are not compromised.

K.5 Mitigation Capabilities Assessment

As part of the regional plan development, the Region and participating jurisdictions developed a mitigation capability assessment. Capabilities are those plans, policies and procedures that are currently in place that contribute to reducing hazard losses. Combining the risk assessment with the mitigation capability assessment results in "net vulnerability" to disasters and more accurately focuses the goals, objectives, and proposed actions of this plan. The CPT used a two-step approach to conduct this assessment. First, an inventory of common mitigation activities was made using a matrix. The purpose of this effort was to identify policies and programs that were either in place or could be undertaken, if appropriate. Second, the CPT conducted an inventory and review of existing policies, regulations, plans, projects, and programs to determine if they contribute to reducing hazard related losses.

K.5.1 Regulatory Mitigation Capabilities

Table K-19 lists planning and land management tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in the Eastern Region and each participating jurisdiction.

Table K-19 Yellowstone County and Jurisdictions Regulatory Mitigation Capabilities

Plans & Regulations	Yellowstone County	City of Billings	City of Laurel	Town of Broadview
Building Codes	State	Yes	Yes	No
Building Codes Year	2022	2022	2023	No
BCEGS Rating	-	-	-	
Capital Improvements Program (CIP) or Plan	Yes. Yellowstone County FY 2023	Yes. City of Billings Capital Improvement Plan FY20-FY24	N/A	No
Community Rating System (CRS)	Yes. CRS-7	No	No	N/A
Community Wildfire Protection Plan (CWPP)	Yes. Version 2006	Part of County Plan	Part of County Plan	Part of County Plan
Comprehensive Master or General Plan	Yes. Current planning of neighborhoods, community, & transportation.	Yes. Community Master Plans	Yes. Community Master Plans	No
Economic Development Plan	Yes	Yes	Yes	No
Elevation Certificates	Yes	N/A	N/A	N/A
Emergency Operations Plan (EOP)	Yes	Part of County Plan	Part of County Plan	Part of County Plan
Erosion/Sediment Control Program	No	N/A	N/A	N/A
Floodplain Management Plan	Yes	Yes	Yes	No
Flood Insurance Study	Yes	N/A	N/A	N/A
Growth Management Ordinance	Yes. Adopted 2008.	Yes. Adopted 2016.	Yes. Adopted 2020.	No
Hazard-Specific Ordinance or Plan (Floodplain, Steep Slope, Wildfire)	Yes. HAZMAT, Wildfire, Floodplain, Communicable Disease, Source Water Protection	Part of County Plans.	Part of County Plans.	Part of County Plans.
National Flood Insurance Program (NFIP)	Yes	Yes	Yes	No
Site Plan Review Requirements	Yes	N/A	N/A	N/A
Stormwater Program, Plan, or Ordinance	Yes	Yes	Yes	Yes

Plans & Regulations	Yellowstone County	City of Billings	City of Laurel	Town of Broadview
Zoning Code or Ordinance	Yes	Yes	Yes. 2020	Yes
Climate Adaptation or Resiliency Plan	Yes	N/A	N/A	N/A
Subdivision Ordinance	Yes	Yes	Yes. Code of Ordinances Title 16	No
Open Space/Conservation Program	Yes, through Zoning Regulations, development planning, and the Billings Parks and Recreation Department	Yes, through Zoning Regulations, development planning, and the Billings Parks and Recreation Department.	N/A	N/A
Resource Management Plan	No	No	No	No
Threat Hazard Identification and Risk Assessment (THIRA)	Yes	Part of County Plan	Part of County Plan	Part of County Plan
Other?	-	-	-	-

Discussion on Existing Regulatory Mitigation Capabilities

The CPT noted that in accordance with the City of Billings Site Development Ordinance, specific regulations mandate the implementation of mitigation measures concerning stormwater management along the Rimrock geologic formation. These measures necessitate the on-site storage of stormwater to minimize the discharge of water over the Rimrock formations. Subdivision regulations also require the evaluation of potential flood hazards, floodplains, landslides, steep slopes, stormwater management and high-water tables. This evaluation is conducted in collaboration with the City's Planning Department.

The City/County Planning Division is responsible for overseeing Subdivision Regulations within both the City of Billings and Yellowstone County. These regulations stipulate requirements for assessing flood hazards whenever certain predetermined thresholds or parameters are met. Furthermore, the Subdivision Regulations prohibit the development of areas with slopes exceeding 25%, and such areas must be clearly indicated on plats. In addition, there are specific environmental assessment requirements, especially within the County, which demand an in-depth analysis of natural hazards related to geology, soils, and slopes. Details on Flood Hazard Evaluation requirements can be located in Appendix K of the subdivision regulations.

The CPT emphasized that the City of Billings is obligated to align its building codes with those adopted by the State of Montana. As of September 1, 2022, the City of Billings has officially adopted a set of codes, accessible at this link: https://billingsmt.gov/323/Adopted-Codes. The responsibility for enforcing these building codes within the City Limits falls under the jurisdiction of the City Building Division. These codes encompass various hazard-specific considerations, including fire prevention requirements, as well as mandatory structural design criteria for wind and snow loads.

It's important to note that the State of Montana operates on a 3-year code update cycle. Consequently, the City of Billings is anticipated to adopt the subsequent set of updated codes in either 2024 or 2025. The State Fire Marshal's Office oversees the adoption of the fire code, which is then enforced within the

city by the Fire Prevention Bureau.

In a distinct capacity, the City/County Planning Division does not manage building codes. However, the planning staff plays an integral role in the permitting process within the City Limits, conducting site reviews. In the zoned areas of Yellowstone County, the Division is responsible for administering County Zoning Regulations, which encompass site and structural requirements. The approval of new developments within these zoned areas necessitates a County Zoning Compliance Permit.

Montana state law (Montana Code Annotated [MCA] Title 76 Land Resources and Use, Chapter 5 Flood Plain and Floodway Management 1-4) contains land use regulations that require floodplain management regulations within sheetflood areas as determined by FEMA. It is in the best interest of the political subdivision (e.g., incorporated cities or towns or any county) and the public to manage the regulation of flood-prone lands and waters in a manner consistent with prudent land and water use practices. This approach aims to prevent and alleviate threats posed by flooding to human life and health, while also reducing economic losses incurred by both individuals and the public.

Discussion on NFIP Participation and Compliance

Yellowstone County, along with the cities of Billings and Laurel, actively participate in the NFIP. This program necessitates that jurisdictions implement floodplain development regulations. In return for the local adoption and enforcement of regulations which adhere to the NFIP's minimum criteria, FEMA offers the availability of flood insurance coverage within Yellowstone County and the Cities of Billings and Laurel. Additionally, Yellowstone County began participation in the Community Rating System (CRS) in 2003. As of July 2024, the County is currently Class 7, which makes structures in the special flood hazard area (SFHA) eligible for a 15% discount on flood insurance, and those outside of the SFHA eligible for a 5% discount.

According to the 2022 Yellowstone County Floodplain Hazard Management Regulations, the County Floodplain Administrator is appointed and is the responsibility of the Office of the County Public Works Department. Within the County Public Works Department, the building official is appointed to serve as the floodplain administrator and shall administer and implement the provisions of the 2013 City of Billings Floodplain Hazard Management Regulations. According to the 2018 City of Laurel Floodplain Hazard Management Regulations, the City Floodplain Administrator is appointed and is the responsibility of the City Planner. The most recent flood insurance rate maps (FIRMs) were adopted in 2013 for the City of Billings, City of Laurel, and Yellowstone County.

Each jurisdiction's floodplain regulations set forth baseline standards for development within the regulated flood hazard areas and significantly influence decisions related to land use. Every jurisdiction requires a floodplain permit for development projects in a mapped floodplain. Artificial obstructions and alternations may be allowed by permit within the floodway, provided they are designed and constructed to ensure that they do not adversely affect the flood hazard on other properties and are reasonably safe from flooding and ensure that the carrying capacity of the floodway is not reduced. Yellowstone County typically issues an average of ten floodplain permits each year.

Additionally, following a hazard event in each jurisdiction, it is the role of that floodplain administrator to notify structure owners about the potential necessity for a permit required for alterations or substantial improvements before beginning the repair or reconstruction of damaged structures. Property owners are informed that structures experiencing substantial damage or undergoing substantial improvements must go through the floodplain application and permit process. Additionally, these structures must be upgraded during the repair or reconstruction process to meet the minimum building standards outlined in the regulations. This approach ensures compliance with floodplain management measures, enhancing the overall safety and resilience of the affected structures. Each jurisdiction's floodplain administrator is

also responsible for educating the community about floodplain management and the various ways property owners and businesses can participate in the process by learning about floodplain regulations and building codes in flood prone areas, modifying or retrofitting existing buildings, and controlling stormwater runoff.

The Town of Broadview does not participate in the NFIP as neither a FIRM nor a flood hazard boundary map has been identified for the Town, thus participation is optional.

K.5.2 Administrative and Technical Mitigation Capabilities

Table K-20 identifies the County and participating jurisdictions personnel responsible for activities related to mitigation and loss prevention in Yellowstone County.

Table K-20 Yellowstone County Jurisdictions Administrative/Technical Mitigation Capabilities

Administrative & Technical	Yellowstone County	City of Billings	City of Laurel	Town of Broadview
Emergency Manager	Yes	Yes	Yes	Yes
Floodplain Administrator/ Position/ Department	Yes	Yes	Yes	No
Community Planning	-	-	-	-
- Planner/Engineer (Land Development)	Yes	Yes	Yes	No
- Planner/Engineer/Scientist (Natural Hazards)	Yes	Yes	No	Yes
- Engineer/Professional (Construction)	Yes	Yes	Yes	No
- Resiliency Planner	-	-	-	-
- Transportation Planner	Yes	Yes	Yes	No
Full-Time Building Official	Yes	Yes	Yes	No
GIS Specialist & Capability	Yes	Yes	Uses County	Uses County
Grant Manager, Writer, or Specialist	No	No	No	No
Housing Authority	Yes	Yes	Yes	Yes
Warning Systems	Yes	Yes	Yes	Yes
- Sirens	No	No	No	No
- Reverse 911	No	No	No	No
- IPAWS/ Wireless Emergency Alerts (WEA)	Yes	Yes	Yes	Yes
- Opt-In Notification (CodeRed, EverBridge, etc)	Yes	Yes	Yes	Yes

K.5.3 Financial Capabilities

Table K-21 identifies the County and participating jurisdictions financial tools or resources that the jurisdictions have access or are eligible to use and could potentially be used to help fund mitigation activities.

Table K-21 Yellowstone County Jurisdictions Financial Capabilities

Financial Capabilities	Yellowstone County	City of Billings	City of Laurel	Town of Broadview
Ability to fund projects through Capital Improvements funding	Yes	Yes	Yes	Yes
Ability to incur debt through general obligation bonds	Yes. Up to $2M w/o voter approval	No	No	No
Ability to incur debt through private activities	No	No	No	No
Ability to incur debt through special tax bonds	Yes	No	No	No
Authority to levy taxes for a specific purpose with voter approval	Yes	Yes	Yes	Yes
Authority to withhold spending in hazard prone areas	No	No	No	No
Community Development Block Grants	Yes	Yes	Yes	Yes
FEMA Hazard Mitigation Assistance grants	Yes	Yes	Yes	Yes
FEMA Public Assistance funds	Yes	Yes	Yes	Yes
Stormwater Service Fees	Yes	Yes	Yes	No
System Development Fee	No	Yes	Yes	No
Utility fees (water, sewer, gas, electric, etc)	Yes	Yes	Yes	No
Other?	No	No	No	No

FEMA and Other Grant Funding Leveraged for Hazard Mitigation

Funding for the proposed mitigation projects may come from a variety of sources. Below is a list of funding possibilities. This list is not tied directly to each proposed project; however, these programs could work for specific projects or multiple projects.

- FEMA Hazard Mitigation Assistance Grants including:
  - Building Resilient Infrastructure and Communities (BRIC)
  - Flood Mitigation Assistance Program (FMA).
  - Hazard Mitigation Grant Program (HMGP).
- US Army Corp of Engineers funding
- USDA Environmental Quality Incentive Program
- USDA Conservation Reserve and Conservation Reserve Enhancement Program.
- USDA Small Watersheds (NRCS).

There are many more potential funding opportunities available to the municipalities and County. Funding research will be done during the scoping process for each project. New funding mechanisms may be present that were not before. Yellowstone County and its jurisdictions have participated in several of these hazard mitigation assistance projects in the past, as summarized in Table K-22 below.

Table K-22 Yellowstone County Hazard Mitigation Assistance Projects

Program	Date Approved	Project Type	Status	Location
HMGP	4/23/1999	106.1: Other Non-Construction (Regular Project Only)	Closed	Yellowstone
HMGP	11/6/1999	201.1: Relocation of Private Structures – Riverine	Closed	Yellowstone
HMGP	11/6/1999	401.1: Water & Sanitary Sewer System Protective Measures	Closed	Yellowstone
HMGP	2/16/2001	401.1: Water & Sanitary Sewer System Protective Measures	Closed	Yellowstone
HMGP	2/20/2002	201.1: Relocation of Private Structures – Riverine	Closed	Yellowstone
HMGP	3/13/2007	201.1: Relocation of Private Structures Riverine	Closed	Yellowstone
HMGP	9/15/2009	401.1: Water Sanitary Sewer System Protective Measures	Closed	Yellowstone
HMGP	2/9/2015	106.1: Other Non-Construction (Regular Project Only)	Closed	Yellowstone
HMGP	11/28/2016	201.1: Relocation of Private Structures - Riverine	Closed	Yellowstone
HMGP	1/28/2021	106.1: Other Non-Construction (Regular Project Only)	Obligated	Yellowstone & 52 other counties*
* Other 52 counties: Beaverhead, Big Horn, Blaine, Broadwater, Carbon, Carter, Cascade, Chouteau, Custer, Daniels, Dawson, Fallon, Fergus, Flathead, Gallatin, Garfield, Glacier, Golden Valley, Granite, Hill, Jefferson, Judith Basin, Lake, Lewis and Clark, Liberty, Lincoln, Madison, McCone, Meagher, Mineral, Missoula, Park, Petroleum, Phillips, Pondera, Powder River, Powell, Prairie, Ravalli, Richland, Roosevelt, Rosebud, Sanders, Sheridan, Silverbow, Sweet Grass, Teton, Toole, Treasure, Valley, Wheatland, & Wibaux				
HMGP	2/10/2022	106.1: Other Non-Construction (Regular Project Only)	Approved	Yellowstone & 21 other counties**
** Other 21 counties: Carbon, Carter, Custer, Daniels, Dawson, Fallon, Garfield, Golden Valley, McCone, Musselshell, Powder River, Prairie, Richland, Roosevelt, Rosebud, Sheridan, Stillwater, Treasure, Valley, Wheatland, & Wibaux				

Source: FEMA Opendata

K.5.4 Education and Outreach Capabilities

Table K-23 identifies the education and outreach programs in place at the County and participating jurisdictions are or could be used to help promote mitigation activities.

Table K-23 Yellowstone County Education and Outreach Capabilities

Education & Outreach Programs	Yellowstone County	City of Billings	City of Laurel	Town of Broadview
Ongoing public education programs (fire safety, responsible water use, household preparedness, etc.)	Yes. DES & City of Billings Fire Department	Yes	Yes	Yes
Local citizen groups that communicate hazard risks	Yes. LEPC & Yellowstone County COAD	Yes	Yes	Yes
Firewise or other fire mitigation program	Yes. Hazardous Fuels Program	Yes	Yes	Yes
National Weather Service StormReady	Yes	Yes	Yes	Yes

Yellowstone's CPT notes a range of resources used for education and outreach – primarily warning tools used to communicate emergencies to the community.

K.5.5 Non-Governmental Organizations (NGOs) and Mitigation Partnerships

Table K-24 shows the local chapters partnered with the County and participating jurisdictions.

Table K-24 Yellowstone County Non-Governmental Organizations (NGOs)

Non-Governmental Organizations (NGOs)	Yellowstone County	City of Billings	City of Laurel	Town of Broadview
American Red Cross	Yes	Yes	Yes	Yes
Chamber of Commerce	Yes	Yes (2)	Yes	Yes
Community Organizations (Lions, Kiwanis, etc.)	Yes. Breakfast Exchange & Optimist	Yes	Yes	Yes
Environmental Groups	Yes	Yes	Yes	Yes
Homeowner Associations	Yes	Yes	Yes	Yes
Neighborhood Associations	Yes. Billings Task Forces.	Yes	Yes	Yes
Salvation Army	Yes	No	No	Yes
Veterans Groups	Yes	Yes	Yes	Yes
Other	Yes. United Way	-	-	-

K.5.6 Opportunities for Enhancement

Based on the capabilities assessment, Yellowstone County has the potential for expanding these hazard mitigation capabilities, but it is circumscribed primarily by budgetary constraints and the limitations of available staff resources. If grant funding for mitigation projects is not secured or if the County fails to allocate matching funds for these initiatives, their progression becomes unfeasible. Currently, the DES Office manages most of the grant applications, from the initial submission to project closure. Given the constraints of a two-person, full-time equivalent (FTE) team working within standard 40-hour workweeks, it becomes challenging to juggle these responsibilities alongside their daily duties and obligations.

It would also be beneficial for the incorporated jurisdictions to provide more information on their websites about potential hazards, emergency preparedness, and response information. A webpage with consolidated information like evacuation routes, emergency alerts, and links to County, State, and Federal resources would be helpful for residents to learn more and access the information they if an incident occurs.

With support from other County departments like emergency management, the County grant writer should research potential funding new staff positions and opportunities for post-disaster support aimed at reaching vulnerable populations. Improved cross jurisdictional communication can also help identify areas for collaboration and support staffing and other capacity gaps. Other specific opportunities for improvement are listed below:

Yellowstone County:

- Explore opportunities to improve CRS class rating, particularly for public outreach activities.
- Explore additional partnerships with area agencies to develop hazard mitigation programs.
- Consider employing a grant writer to enhance access to funding opportunities.
- Address ditch and drain failure in County growth policies, Subdivision Regulations, and Zoning Ordinances.

City of Billings:
- Consider developing an economic development plan to ensure future development aligns with City goals and vision.
- Consider joining FEMA CRS to lower the cost of flood insurance.
- Consider ways to establish ongoing public outreach on hazard awareness and preparedness.

City of Laurel:
- Consider joining FEMA CRS to lower the cost of flood insurance and better protect residents and structures located in the floodplain.

Town of Broadview:
- Continue to collaborate with Yellowstone County and the City of Billings and City of Laurel on emergency preparedness and hazard mitigation activities.
- Consider working with the City of Billings Planning Department to adopt and enforce Building Codes that apply to the Town of Broadview.

K.6 Mitigation Strategy

This section describes the mitigation strategy and mitigation action plan for Yellowstone County. See Chapter 5 of the base plan for more details on the process used to develop the mitigation strategy.

K.6.1 Goals

During the creation of the 2023 Regional Plan, the counties in the Eastern Montana Region decided to collaborate and develop a set of new, uniform goals, which were adopted by all counties in the Region and move away from hazard-specific goals. The adopted goals are as follows:

Goal 1: Reduce impacts to people, property, the environment, and the economy from hazards by implementing whole-community risk reduction and resilience strategies.

Goal 2: Protect community lifelines and critical infrastructure to ensure the continuity of essential services during and after a disaster.

Goal 3: Support education and outreach to the public through improved communications and capacity building that enhances resilience among underserved communities.

Goal 4: Promote regional cooperation and leverage partnerships with the private sector, non-profit organizations, and other key stakeholder groups in mitigation solutions.

Goal 5: Sustain and enhance jurisdictional capabilities and resources to enact and implement mitigation activities.

Goal 6: Integrate hazard mitigation into other plans, processes, and regulations.

Goal 7: Ensure local mitigation programs address underrepresented groups and protect socially vulnerable populations.

Goal 8: Incorporate the potential impacts of climate change into all mitigation activities when possible.

The Yellowstone County Planning Team also developed the following County-specific objectives to supplement the region-wide goals:

The 2019 Yellowstone County Hazard Mitigation Plan outlined the following goals:
- Goal 1: Reduce impacts from severe weather and drought.
- Goal 2: Reduce impacts from wildfire.
- Goal 3: Reduce impacts from ditch and drain failure.

- Goal 4: Reduce impacts from terrorism, violence, civil unrest, and cyber security.
- Goal 5: Reduce impacts from transportation accidents and hazardous materials incidents.
- Goal 6: Reduce impacts from flooding and dam failure.
- Goal 7: Reduce impacts from communicable disease.
- Goal 8: Reduce impacts from landslides and rock falls.
- Goal 9: Reduce impacts associated with all hazards.

K.6.2 Progress on Previous Actions

During the 2023 planning process, the Yellowstone CPT reviewed all the mitigation actions from the 2019 plan. As shown in Table K-25, of 87 actions in the previous plan, 14 have been completed, and 9 have been deleted.

Table K-25 Completed and Deleted Actions

ID	Action Name & Description	Hazard(s) Mitigated	Jurisdiction	Status
DELETED ACTIONS				
1.2.4	Support drought programs implemented through the Conservation District, NWS, FSA, NRCS, DNRC, and MSU Extension.	Drought	Yellowstone	Too vague. Too hard to measure.
2.1.4	Conduct feasibility study to identify best method to dispose of fuel mitigated material so all of it doesn't have to travel long distances to a landfill.	Wildfire	Yellowstone	Lack of plans/ projects and Loss of funding.
3.2.4	Conduct study on how to improve drains and outlet structures to mitigate flood risk.	Ditch & Drain Failure	Billings	Too vague/ hard to measure & too large to fund.
5.2.1	Improve public messaging when episodes of refinery flaring occur.	HAZMAT Incidents	Yellowstone, Billings, & Laurel	Refineries handle in-house.
9.1.6	Recruit and train emergency response personnel.	All Hazards	All Jurisdictions	Too vague.
9.3.2	Develop plan for short-term water supply in Billings.	All Hazards	Billings	Not feasible/ no money available.
COMPLETED ACTIONS				
1.3.1	Encourage utility companies to ensure right of way around power lines are free of trees or limbs that could cause damage.	Severe Weather	All Jurisdictions	2019
1.4.2	Promote the use of hurricane clips for buildings vulnerable to high winds.	Severe Weather	All Jurisdictions	2021
2.1.2	Develop database of hazardous fuel assessments and landowner fuel reductions projects to support future grants.	Wildfire	Yellowstone & Billings	2023
2.5.2	Develop database of water supplies, access points, fire breaks, and other relevant criteria to enhance fire agency response.	Wildfire	Yellowstone & Broadview	2023
3.1.1	Remove unstable rocks above North 14th Street that could fall and block BBWA ditch at tunnel entrance.	Ditch & Drain Failure	Billings	2019

ID	Action Name & Description	Hazard(s) Mitigated	Jurisdiction	Status
3.1.2	Re-establish City-County Drain Outfall, at Washington Street, with an adjustable weir and 4,500 feet of 48-inch diameter pipe washed out in the 2018 spring runoff.	Ditch & Drain Failure	Billings	2019
3.1.4	Evaluate, maintain and improve rip-rap along Yellowstone River from Laurel to Huntley near ditch head gates to prevent failures that may cause uncontrolled flows into ditches increasing flood risk.	Ditch & Drain Failure	Yellowstone, Billings, & Laurel	2019
3.1.5	Install rip-rap along Yellowstone River for approximately 2,200 feet at Huntley Project to protect diversion dam and drainage ditch and maintain irrigation.	Ditch & Drain Failure	Yellowstone	2019
3.2.1	Assess legal status of existing irrigation ditches and drains to determine Municipal legal authority for operations and maintenance responsibilities.	Ditch & Drain Failure	Billings	2021
3.3.1	Obtain easements to access ditches and drains for operational and maintenance purposes.	Ditch & Drain Failure	Billings	2019
4.3.3	Develop cloud-based backup system for city County network systems.	Cyber Security	Yellowstone, Billings, & Laurel	2023
6.4.2	Consider certifying dikes around water and wastewater treatment plants to ensure adequate protection.	Flooding	Billings & Laurel	2023
6.4.3	Update flood protection measures at Riverside Park in Laurel to prevent flooding.	Flooding	Laurel	2022
7.3.2	Expand list serve for Health Alert Network	Communicable Disease	All Jurisdictions	2019-2020
9.1.1	Implement mass notification capabilities throughout Yellowstone County.	All Hazards	All Jurisdictions	2019
9.1.2	Enhance rural communications by coordinating and cooperating on getting First Net in place in Yellowstone County to improve first responder communications.	All Hazards	All Jurisdictions	2019

K.6.3 NFIP Continued Compliance

Compliance with the NFIP is also important to reducing losses to future development is continued. The County, the City of Billings, and the City of Laurel will continue to make every effort to remain in good standing with the program. This includes continuing to comply with the NFIP regarding adopting floodplain maps and implementing, maintaining, and updating floodplain ordinances. See Section 5.4.2 in the base plan for more discussion on NFIP compliance.

K.6.4 Mitigation Action Plan

As a part of the 2023 regional planning process, the CPT developed an updated list of hazard mitigation actions or projects specific to Yellowstone County and its jurisdictions. The process used to identify, develop, and prioritize these actions is described in Chapter 5 of the base plan. Yellowstone County has 64 continuing or in progress mitigation actions carried over from the previous plan and has added an additional 5 new actions.

Table K-26 lists the 2023 Mitigation Action Plan for Yellowstone County and its participating jurisdictions. The CPT identified and prioritized the following mitigation actions based on the risk assessment and goals, and objectives. It is grouped by hazard(s) mitigated. Background information as well as information on how the action will be implemented and administered, such as ideas for implementation, responsible office, partners, potential funding, estimated cost, and timeline also are described. Per the DMA requirement, actions have been identified that address reducing losses to existing development as well as future development.

The Cost Estimate column describes the estimated project costs using the following categories:

- **Little to no cost**
- **Low**: Less than $10,000
- **Moderate**: $10,000-$100,000
- **High**: $100,000-$1,000,000
- **Very High**: More than $1,000,000

The Timeline column describes the estimated time of completion for each project using the following categories:

- **Short Term**: 1-2 years
- **Medium Term**: 3-5 years
- **Long Term**: 5+ years
- **Ongoing**: action is implemented every year

The Status/Implementation Notes column describes the progress made on the actions so far using the following categories:

- **Not Started**: project is carried over from the previous Yellowstone County Plan; little to no work has been completed.
- **In Progress**: project is carried over from the previous Yellowstone County Plan; work has begun on the project and is proceeding.
- **Annual**: project is carried over from the previous Yellowstone County Plan and is implemented every year on an ongoing basis.
- **New in 2023**: The action is new to this plan update; little to no work has been completed.

Table K-26 below lists the mitigation actions for each participating jurisdiction in Yellowstone County. All jurisdictions have developed mitigation actions for each identified hazard in the HMP.

Table K-26 Mitigation Actions by Hazard and Jurisdiction Summary

ID	Action Name & Description	Hazards Mitigated	Jurisdictions	Lead Agency	Partner Agencies	Cost Estimate	Potential Funding	Timeline	Priority	Status & Implementation Notes
1	Obtain mobile repeaters for patrol cars to improve communications to prepare for and respond to natural hazard events and transportation accidents.	Dam Failure, Ditch and Drain Failure, Earthquake, Flooding, Hazardous Material Incident, Landslide, Transportation Accidents, Wildfire	Yellowstone County	County Sheriff's Office	N/A	High	County General Funds	Medium-Term	High	Not Started
2	Interact with public safety officials and schools on planning for emergencies to enhance public awareness and education on hazard impacts and mitigation.	Dam Failure, Ditch and Drain Failure, Earthquake, Flooding, Hazardous Material Incident, Landslide, Severe Summer and Winter Weather, and Wildfire Hazards.	Yellowstone County, Billings, Broadview, Laurel	Yellowstone County DES	LEPC, School Resource Officers, City of Billings Planning & Community Services, City of Laurel Fire Department, Town of Broadview Town Council	High	County & City School District General Funds	Ongoing	High	Annual Implementation
3	Obtain stationary and/or mobile generators for critical facilities and emergency shelters and install hookups during severe weather events.	Severe Summer and Weather	Yellowstone County, Billings, Broadview, Laurel	Yellowstone County DES	DES, Critical Facility Owners, City of Billings Communication Center City of Laurel Fire Department, Town of Broadview Town Council	Medium	County & State General Funds	Medium-Term	High	Not Started
4	Identify facilities that meet national standards to serve as emergency shelters during severe weather events and create Memorandums of Understanding.	Severe Summer and Winter Weather	Yellowstone County, Billings, Broadview, Laurel	Yellowstone County DES	DES, American Red Cross, City of Billings Planning & Community Services, City of Laurel Fire Department, Town of Broadview Town Council	Medium	County & State General Funds	Medium-Term	High	In-Progress
5	Continue to aggressively address hazards around rural properties, such as flooding	Flooding, Wildfire	Yellowstone County	Yellowstone County Dispatch	County Planning Department, City of	Medium	State County & City General	Ongoing	High	Annual Implementation

ID	Action Name & Description	Hazards Mitigated	Jurisdictions	Lead Agency	Partner Agencies	Cost Estimate	Potential Funding	Timeline	Priority	Status & Implementation Notes
	to numerous failure points representing complete failure of 911, public safety resource dispatching of all city/county responder agencies. All community alerting/warning and three dozen city county state and federal agencies communicators with no viable consistencies	Materials Incidents, Landslide, Severe Summer, and Winter Weather, Human Conflict, Tornadoes and Windstorms, Transportation Accidents, Volcanic Ash, Wildfire, Ditch and Drain Failure	Broadview, Laurel		DOJ, State Highway Patrol		BHC, Local Budget			
10	Increase immunization rates for vaccine preventable communicable disease in all populations.	Communicable Disease	Yellowstone County, Billings, Broadview, Laurel	RiverStone Health Administration Department	County DES, City of Billings Planning & Community Services, City of Laurel Fire Department, Town of Broadview Town Council	High	County, City, & Town General Funds	Ongoing	High	Annual Implementation
11	Continue to prevent and control communicable disease by surveillance	Communicable Disease	Yellowstone County, Billings, Broadview, Laurel	RiverStone Health Administration Department	County DES, City of Billings Planning & Community Services, City of Laurel Fire Department, Town of Broadview Town Council	High	County, City, & Town General Funds	Ongoing	High	Annual Implementation
12	Continue to conduct risk based inspections of all food service establishments.	Communicable Disease	Yellowstone County, Billings, Broadview, Laurel	RiverStone Health Administration Department	County DES, City of Billings Planning & Community Services, City of Laurel Fire Department, Town of Broadview Town Council	High	County, City, & Town General Funds	Ongoing	High	Annual Implementation
13	Continue to promote public education on preventing communicable disease	Communicable Disease	Yellowstone County, Billings, Broadview, Laurel	RiverStone Health Administration Department	County DES, City of Billings Planning & Community Services, City of Laurel Fire Department, Town of	High	County, City, & Town General Funds	Ongoing	High	Annual Implementation

ID	Action Name & Description	Hazards Mitigated	Jurisdictions	Lead Agency	Partner Agencies	Cost Estimate	Potential Funding	Timeline	Priority	Status & Implementation Notes
	and wildfire.				Billings Planning & Community Services, City of Laurel Fire Department, Town of Broadview Town Council		Funds			
6	Provide special needs facilities with guidelines for disaster preparedness, including pet needs	Dam Failure, Ditch and Drain Failure, Earthquake, Flooding, Hazardous Material Incident, Landslide, Transportation Accidents, Wildfire	Yellowstone County, Billings, Broadview, Laurel	Yellowstone County DES	Special Needs Facilities, MT Migrant Worker Council, City of Billings Planning & Community Services, City of Laurel Fire Department, Town of Broadview Town Council	Medium	County, City, & General Funds, Special Needs Facilities budgets	Ongoing	High	Not Started
7	Update growth policies and subdivision regulations as needed to consider hazard mitigation	Dam Failure, Ditch & Drain Failure, Earthquake, Flooding, HAZMAT Incident, Landslide, Transportation Accidents, Wildfire	Yellowstone County & Billings	County Planning Department	City of Billings Planning Department	High	County & City Staff Resources	Ongoing	High	Not Started
8	Enhance GIS data to better assist with natural hazard mitigation	Dam Failure, Ditch and Drain Failure, Earthquake, Flooding, Hazardous Material Incident, Landslide, Transportation Accidents, Wildfire	Yellowstone County, Billings, Broadview, Laurel	County GIS	N/A	Low	County Staff Resources	Ongoing	Medium	Annual Implementation
9	City/County emergency communications/ resiliency - current facility is overly exposed	Dam Failure, Earthquake, Flooding, Hazardous	Yellowstone County, Billings,	City of Billings Sheriff's Office	Yellowstone County DES, MT DES, MT	Very High	FEMA HMA Grants, HMGP,	Short-Term	High	New in 2023

ID	Action Name & Description	Hazards Mitigated	Jurisdictions	Lead Agency	Partner Agencies	Cost Estimate	Potential Funding	Timeline	Priority	Status & Implementation Notes
					Broadview Town Council					
14	Continue to provide education and/or training for Health Department staff and key partners in medical community.	Communicable Disease	Yellowstone County, Billings, Broadview, Laurel	RiverStone Health Administration Department	County DES, City of Billings Planning & Community Services, City of Laurel Fire Department, Town of Broadview Town Council	High	County, City, & Town General Funds	Ongoing	High	Annual Implementation
15	Collaborate with community partners to train and exercise public health emergency response plans.	Communicable Disease	Yellowstone County, Billings, Broadview, Laurel	RiverStone Health Administration Department	County DES, City of Billings Planning & Community Services, City of Laurel Fire Department, Town of Broadview Town Council	High	County, City, & Town General Funds	Ongoing	High	Annual Implementation
16	Collaborate and coordinate with community partners to review and update public health emergency response plans annually	Communicable Disease	Yellowstone County, Billings, Broadview, Laurel	RiverStone Health Administration Department	County DES, City of Billings Planning & Community Services, City of Laurel Fire Department, Town of Broadview Town Council	High	County, City, & Town General Funds	Ongoing	High	Annual Implementation

ID	Action Name & Description	Hazards Mitigated	Jurisdictions	Lead Agency	Partner Agencies	Cost Estimate	Potential Funding	Timeline	Priority	Status & Implementation Notes
17	Begin multi-hazard public education and awareness campaign to help residents understand what hazards are present, how to prepare and personal accountability. Keeping residents informed about natural hazards and opportunities for mitigating risks can help protect public health, safety, and welfare. Special consideration will be given to meeting the needs of vulnerable and underserved populations. Planned activities for this program include hosting annual briefings on recent advancements in mitigation strategy, distribute topic specific brochures and mailers prior to vulnerable seasons such as promoting Firewise practices in the spring to help property owners take preventative action against summer wildfires, organize storm spotting course in partnership with local NWS office, and provide online resources for home insurance policies and details on flood insurance/NFIP.	Communicable Disease, Drought, Flooding, Wildfire, Severe Summer Weather, Severe Winter Weather	Yellowstone County, Billings, Broadview, Laurel	Yellowstone County DES	City of Billings Planning & Community Services, City of Laurel Fire Department, Town of Broadview Town Council	Low	City and Town General Funds and Time	Ongoing	High	New in 2023
18	Continue to provide end user training on email related threats.	Cyber Attack	Yellowstone County, Billings, Broadview, Laurel	RiverStone Health Administration Department	County DES, City of Billings Information Technology, City of City of Laurel Fire Department, Town of Broadview Town Council	High	County, City, & Town General Funds	Ongoing	High	Annual Implementation
19	Continue to conduct vulnerability assessment of critical cyber infrastructure with priorities for enhanced security.	Cyber Attack	Yellowstone County, Billings, & Laurel	Yellowstone County IT Department	City & Town IT Departments	High	County, City, & Town General Funds	Ongoing	High	Annual Implementation
20	EOC and Comms backup location. Currently only have 1 location for EOC and Comms	Cyber Attack	Yellowstone County, Billings,	Yellowstone County 911	County DES, Elected Officials, State, City of	Very High	FEMA HMA HMGP, BRIC	Medium-Term	High	New in 2023

ID	Action Name & Description	Hazards Mitigated	Jurisdictions	Lead Agency	Partner Agencies	Cost Estimate	Potential Funding	Timeline	Priority	Status & Implementation Notes
25	Locate and re-establish unloader structures used to divert surge flow throughout the County and Billings and identify potential downstream impacts.	Flooding	Yellowstone County & Billings	Yellowstone County DES	Billings Public Works, BBWA, City of Billings	Medium	BBWA & Other Ditch Associations, County & City General Funds, USACE Small Flood Control Projects, Silver Jackets	Long Term	High	In Progress
26	Conduct bank stability assessment of BBWA canal and laterals within the Billings City limits.	Flooding	Yellowstone County & City of Billings	BBWA (no specific department)	County DES, City of Billings Public Works Flood Administrators	High	BBWA General Funds	Medium-Term	High	In Progress
27	Conduct feasibility study to reduce risk of ditch failure that could impact EOC, City-County dispatch and both hospitals.	Flooding	City of Billings	Billings Public Works	N/A	High	City General Funds, HMGP, BRIC, FMA, CDBG, Economic Development Administration (EDA) Public Works Program, USACE Planning Assistance to States (PAS)	Short Term	High	In Progress
28	Encourage BBWA to implement recommendations of Main Canal Evaluation Study.	Flooding	City of Billings	Billings Public Works	City of Billings Planning & Community Services	High	BBWA General Funds, Local Staff Time	Long Term	High	In Progress

ID	Action Name & Description	Hazards Mitigated	Jurisdictions	Lead Agency	Partner Agencies	Cost Estimate	Potential Funding	Timeline	Priority	Status & Implementation Notes
	Center equipment in vulnerable location.		Broadview Laurel	Dispatch	Billings Communication Center, City of Laurel Fire Department, Town of Broadview Town Council		Grants			
21	Participate in dam failure exercises on high hazard dams, such as Lakeview Dam within the County and upstream dams like Yellowtail Dam and Cooney Dam that could impact Yellowstone County.	Dam Failure	Yellowstone County, Billings & Laurel	Yellowstone County DES	City of Billings & City of Laurel Planning & Community Services, Dam Owners, Lakeside Home Owners Association, Bureau of Reclamation, State Water Projects	High	DES, Local Staff Time	Ongoing	Medium	Annual Implementation
22	Create an alternate water supply for the City of Billings with off stream storage and water treatment.	Drought	City of Billings	City of Billings Public Works Department	N/A	Medium	Billings General Funds	Medium-Term	High	In-Progress
23	Encourage water conservation by domestic, municipal, and industrial users.	Drought	Yellowstone County, Billings & Laurel	Yellowstone County DES	City of Billings Planning & Community Services, City of Laurel, & Billings and Laurel Public Works	High	Billings & Laurel City General Funds, Local Staff Time	Ongoing	High	Annual Implementation
24	Address earthquake hazards on older and historic buildings in the County constructed before adoption of building code by conducting an inventory of these buildings to determine if seismic retrofits are needed to preserve the integrity of the County's historical assets.	Earthquake	Yellowstone County, City of Billings, City of Laurel, Town of Broadview	Yellowstone County	Yellowstone County Planning Division	Medium	FEMA HMA HMGP, BRIC Funds, General Funds, Local Staff Time	Long Term	Low	New in 2023

ID	Action Name & Description	Hazards Mitigated	Jurisdictions	Lead Agency	Partner Agencies	Cost Estimate	Potential Funding	Timeline	Priority	Status & Implementation Notes
29	Continue to provide outreach to citizens that dumping of debris on ditch bank or within ditch can adversely impact the City's stormwater system and increase potential for flooding and cause ditch bank overflows.	Flooding	Yellowstone County, Billings & Laurel	Billings Public Works	City of Laurel Fire Department	High	Billings & Laurel City General Funds	Ongoing	High	Annual Implementation
30	Continue to implement Stormwater Master Plan to reduce impacts to private property from surface water runoff.	Flooding	Billings	Billings Public Works	N/A	Medium	Billings General Funds, HMGP, BRIC, FMA, CDBG, EDA Public Works Program, USACE PA	Ongoing	High	Annual Implementation
31	Evaluate and replace culverts at street crossings in Billings. Upgrade and maintain culverts, bridges, and roads to improve conveyance of flood water elsewhere in the County.	Flooding	Yellowstone County, Billings, Broadview, Laurel	County Road Department	All Public Works, City of Billings Public Works, City of Laurel Fire Department, Town of Broadview Town Council	High	County and City General Funds, HMGP, BRIC, FMA, CDBG, EDA Public Works Program, USACE PA	Ongoing	High	Annual Implementation
32	Continue community outreach on potential for flooding.	Flooding	Yellowstone County, Billings & Laurel	County Road Department	County Public Works, City of Billings Public Works, City of Laurel Fire Department	High	County and City General Funds, FMA, Community Assistance Program (CAP)	Ongoing	High	Annual Implementation
33	Promote those homeowners in flood prone areas purchase flood insurance through National Flood Insurance Program.	Flooding	Yellowstone County, Billings, Broadview, Laurel	City of Laurel Flood Administrators	City of Billings & Town of Broadview Flood Administrators	High	County and City General Funds, FMA, CAP	Ongoing	High	Annual Implementation
34	Study options for mitigating stormwater runoff from Highway 3 near Billings Airport.	Flooding	Billings	Yellowstone County DES	Billings Public Works	High	DES, Billings Public Works,	Medium-Term	High	Not Started

ID	Action Name & Description	Hazards Mitigated	Jurisdictions	Lead Agency	Partner Agencies	Cost Estimate	Potential Funding	Timeline	Priority	Status & Implementation Notes
							FEMA HMA PMA			
35	Assess flood potential at Zoo Montana property and address options for managing 200 animals in the event of a flood.	Flooding	Billings	Yellowstone County DES	Billings Public Works	High	DES, Billings Public Works, County and City General Funds	Long Term	Medium	In Progress
36	Update boundaries of approximate study areas for future floodplain mapping.	Flooding	Billings	Yellowstone County DES	County Floodplain Administrator, DNRC, City of Billings Public Works	Medium	DES, County Floodplain Administrator, DNRC	Medium Term	High	Annual Implementation
37	Construct two small storage features on Cove and Little Cove Creeks and improve flood conveyance through the West Billings area.	Flooding	Billings	Billings Public Works	N/A	Medium	Billings Public Works, FEMA HMA PMA	Ongoing	High	Not Started
38	Review NFIP Repetitive Loss properties in Yellowstone County and address means to eliminate or reduce impacts from flooding.	Flooding	Yellowstone County	County Floodplain Administrator	Yellowstone County Public Works, Yellowstone County DES, Yellowstone County GIS, Billings Public Works, Billings Floodplain Administrator, Laurel Floodplain Administrator	Medium	County General Funds, Floodplain Administrator, Local Staff Time	Long Term	Medium	Annual Implementation
39	Strengthen subdivision regulations to ensure homes are not built where potentially impacted by flood flows from dry washes.	Flooding	Yellowstone County	County Floodplain Administrator	Yellowstone County Public Works, Yellowstone County DES & GIS, Billings Public Works & Floodplain Admin, Laurel Floodplain Admin, City/County Planning Department	High	County General Funds, Local Staff Time	Medium Term	Medium	Annual Implementation
40	BBWA Breach - move the ditch	Flooding, Landslide, Drain and Ditch	Yellowstone County	Yellowstone County DES	Billings Public Works, BBWA	Very High	FEMA HMA Grants, FMA	Medium Term	High	New in 2023

ID	Action Name & Description	Hazards Mitigated	Jurisdictions	Lead Agency	Partner Agencies	Cost Estimate	Potential Funding	Timeline	Priority	Status & Implementation Notes
	when needed.		& Laurel		of Billings Public Works, City of Laurel Fire Department		Local Staff Time			
48	Increase participation of local, state and federal partners, industry, and utilities in Yellowstone County LEPC.	Hazardous Materials Incidents	Yellowstone County, Billings, Broadview, Laurel	Yellowstone County DES	LEPC, City of Billings Public Works, City of Laurel Fire Department, Town of Broadview Town Council	High	County General Funds	Ongoing	High	Annual Implementation
49	Identify and prioritize intersections that could be improved to enhance safety.	Hazardous Materials Incidents	Yellowstone County, Billings, & Laurel	County Public Works	MDT, City of Laurel Fire Department, Billings Public Works	High	County & City General Funds, Local Staff Time	Short Term	High	Annual Implementation
50	Protect storm drains in industrial areas to ensure no hazardous materials are released to the river.	Hazardous Materials Incidents	Laurel	Laurel Public Works	N/A	Medium	City General Funds	Short Term	High	In Progress
51	Continue active shooter preparedness training	Human Conflict	Yellowstone County, Billings, Broadview, Laurel	Yellowstone County DES	County Law Enforcement, DHS, City of Billings Public Works, City of Laurel Fire Department, Town of Broadview Town Council	High	County & City General Funds, DHS	Ongoing	High	Annual Implementation
52	Coordinate state/federal agencies and private industry on potential threats that may target critical facilities or large events.	Human Conflict	Yellowstone County & Billings	Yellowstone County LEPC	DHS, MT Dept. of Justice, MATIC, FBI, Private Industry, City of Billings Public Works	Medium	County & City General Funds, State & Federal Partners, Private Industry	Ongoing	High	Annual Implementation

ID	Action Name & Description	Hazards Mitigated	Jurisdictions	Lead Agency	Partner Agencies	Cost Estimate	Potential Funding	Timeline	Priority	Status & Implementation Notes
		Failure								
41	Rail accident at downtown 27th - spill no fire, spill with fire, BLEVE Plume access evacs and test/exercise plan	Hazardous Materials Incidents	Yellowstone County, City of Billings	County DES	Billings Public Works, National Weather Service, LEPC, BNSF, DOT, elected officials DEQ, EPA, NTSB, FRA	High	FEMA HMA Grants, County and City General Funds	Short Term	High	New in 2023
42	Laurel Railyard - spill no fire, spill with fire, BLEVE Plume access evacs and test/exercise plan	Hazardous Materials Incidents	Yellowstone County, City of Laurel	County DES	National Weather Service, LEPC, BNSF, DOT, elected officials DEQ, EPA, NTSB, FRA, Laurel Fire Department	High	FEMA HMA Grants, County and City General Funds	Short Term	High	New in 2023
43	Encourage legislative support for funding of Billings Regional HAZMAT Response Team.	Hazardous Materials Incidents	Yellowstone County, Billings, Broadview, Laurel	County Commissioners	County DES, Fire Departments, City of Laurel Fire Department, Town of Broadview Town Council, Town of Billings Public Works	High	County & City General Funds	Medium Term	High	Annual Implementation
44	Obtain personal protective kits for Laurel first responders and patrol cars so they can secure scene before HAZMAT Team arrive.	Hazardous Materials Incidents	City of Laurel	Laurel Fire Department	Billings HAZMAT Team, LEPC, City of Laurel Fire Department	Medium	Laurel City General Funds	Medium Term	High	Annual Implementation
45	Provide basic and refresher HAZMAT response training with first responders and exercise regularly.	Hazardous Materials Incidents	Yellowstone County, Billings, & Laurel	County DES	All Fire Departments, HAZMAT Team, City of Laurel Fire Department, City of Billings Public Works	High	County & City General Funds	Ongoing	High	Annual Implementation
46	Update and maintain resource list of emergency response supplies and vendors.	Hazardous Materials Incidents	Yellowstone County, Billings, Broadview, Laurel	Yellowstone County	City of Billings Public Works, City of Laurel Fire Department, Town of Broadview Town Council	High	County General Funds	Ongoing	High	Annual Implementation
47	Identify railroad point of contact and establish protocol to shut down rail traffic	Hazardous Materials Incidents	Yellowstone County, Billings,	County DES	All Fire Departments, LEPC, Railroads, City	High	County & City General Funds,	Short Term	High	Annual Implementation

ID	Action Name & Description	Hazards Mitigated	Jurisdictions	Lead Agency	Partner Agencies	Cost Estimate	Potential Funding	Timeline	Priority	Status & Implementation Notes
53	Continue physical hardening of critical facilities and schools (i.e. anti-vehicle barricades / interior barricades for locking doors [door locks, door stops] / perimeter fencing / controlled access gates).	Human Conflict	Yellowstone County, Billings, Broadview, Laurel	Yellowstone County DES	DES, Law Enforcement, Building Departments, City of Billings Public Works, City of Laurel Fire Department, Town of Broadview Town Council	Medium	County & City/Town General Funds, Homeland Security Grant Program (HSGP), Transit Security Grant Program (TSGP), Buffer Zone Protection Program (BZPP), Infrastructure Security and Resilience (ISP) Grant Program, Department of Defense (DoD) Defense Critical Infrastructure Program (DCIP), U.S. Department of Education's Project SERV (School Emergency Response to Violence)	Ongoing	High	Not Started

ID	Action Name & Description	Hazards Mitigated	Jurisdictions	Lead Agency	Partner Agencies	Cost Estimate	Potential Funding	Timeline	Priority	Status & Implementation Notes
54	Raise level of awareness on what public can do to prevent and for mitigate threat of lone gunman/active shooter incident (report suspicious or unusual behavior, stop the bleed training, etc.)	Human Conflict	Yellowstone County, Billings, & Laurel	Yellowstone County DES	DHS, Chamber of Commerce, MT Migrant Worker Council, City of Billings Public Works, City of Laurel Fire Department	High	County General Funds, DHS	Ongoing	High	Annual Implementation
55	Conduct comprehensive vulnerability assessment of critical facilities with priorities for enhanced security.	Human Conflict	Yellowstone County, Billings, & Laurel	Yellowstone County DES	DES, DHS, Law Enforcement, City and County Building Departments, City of Billings Public Works, City of Laurel Fire Department	High	County and City/Town General Funds, DHS SHSGP	Medium Term	High	Annual Implementation
56	Review Crisis Action Plans in all schools and hospitals to ensure adequate security measures are in place.	Human Conflict	Yellowstone County, Billings, Broadview, Laurel	Yellowstone County School Resource Officers	DES, Hospitals, City of Billings Public Works, City of Laurel Fire Department, Town of Broadview Town Council	Medium	County and City/Town General Funds, Hospitals	Ongoing	High	Not Started
57	Identify, preserve, and stabilize rock fall prone areas	Landslide	Yellowstone County & Billings	Yellowstone County DES	Billings Public Works	Medium	County and City General Funds, FEMA HMA HMGP	Ongoing	High	Annual Implementation

ID	Action Name & Description	Hazards Mitigated	Jurisdictions	Lead Agency	Partner Agencies	Cost Estimate	Potential Funding	Timeline	Priority	Status & Implementation Notes
62	Encourage development of tornado safe rooms in schools, including Broadview Elementary.	Severe Summer Weather, Tornadoes & Windstorms	Yellowstone County, Billings, Broadview, Laurel	Yellowstone County DES	LEPC, School Districts, City of Billings Planning, City of Laurel Fire Department, Town of Broadview Town Council	Medium	School District Funding, FEMA HMA HMGP/HMGP, BRIC, CDBG, USDA Rural Development Community Facilities Programs, CDBG-MIT	Medium-Term	Medium	Not Started
63	Continue to maintain NWS StormReady status for Yellowstone County and City of Billings and enhance communications and support with the City of Laurel.	Severe Summer and Winter Weather, Tornadoes & Windstorms	Yellowstone County, Billings, & Laurel	Yellowstone County DES	City of Billings Planning, City of Laurel Planning	High	NWS, County Resources, Billings & Laurel General Funds	Ongoing	High	Annual Implementation
64	Conduct wildland fire mapping to identify high-risk areas	Wildfire	Yellowstone County	Yellowstone County DES	Yellowstone County DES & GIS, BLM, DNRC, Southern Land Office	High	County General Funds, DNRC Fire Suppression Fund, BLM Fuels Management Program	Short Term	High	Not Started
65	Provide timely messaging on wildfire smoke to protect vulnerable populations.	Wildfire	Yellowstone County, Billings, Broadview, Laurel	Yellowstone County DES	NWS, City of Billings Planning, City of Laurel Planning, Town of Broadview Town Council	High	County General Funds	Ongoing	High	Annual Implementation
66	Continue grants programs to support hazardous fuel assessments and cost-share opportunities for landowners to create defensible space in the WUI.	Wildfire	Yellowstone County, Billings, Broadview, Laurel	Yellowstone County DES	BLM, DNRC, City of Billings Planning, City of Laurel Planning, Town of Broadview Town Council	High	NPC Rural Fire Assistance Grant, USDA Community Fire Protection Program, USDA National Fire Plan, USDA Forest Service's	Ongoing	High	Annual Implementation

ID	Action Name & Description	Hazards Mitigated	Jurisdictions	Lead Agency	Partner Agencies	Cost Estimate	Potential Funding	Timeline	Priority	Status & Implementation Notes
58	On older structures as needed, install 3 mil window film on windows of schools and critical facilities to prevent shattering.	Severe Summer and Winter Weather	Yellowstone County, Billings, Broadview, Laurel	Yellowstone County School Districts	City of Billings Public Works, City of Laurel Fire Department, Town of Broadview Town Council	High	School District Funding, USDA Community Facilities Direct Loan & Grant Program, HUD Community Development Block Grant Mitigation (CDBG-MIT)	Ongoing	Medium	Not Started
59	Continue community outreach on preparation and safety during severe storms and tornadoes.	Severe Summer and Winter Weather	Yellowstone County	Yellowstone County DES	City of Billings Planning, City of Laurel Fire Department, Town of Broadview Town Council	High	County Resources, NWS	Ongoing	High	Annual Implementation
60	Encourage community partners to participate in NWS Weather Ready Nation Ambassador program.	Severe Summer and Winter Weather	Yellowstone County, Billings, Broadview, Laurel	Yellowstone County DES	LEPC, City of Billings Planning, City of Laurel Fire Department, Town of Broadview Town Council	High	County General Funds	Ongoing	High	Annual Implementation
61	Encourage utility companies to bury electric and communication lines in hazard prone areas.	Severe Summer Weather, Tornadoes & Windstorms	Yellowstone County, Billings, Broadview, Laurel	Yellowstone County Commissioners	LEPC, City of Billings Planning, City of Laurel Fire Department, Town of Broadview Town Council	Medium	County General Funds	Ongoing	High	Not Started

ID	Action Name & Description	Hazards Mitigated	Jurisdictions	Lead Agency	Partner Agencies	Cost Estimate	Potential Funding	Timeline	Priority	Status & Implementation Notes
							Community Wildfire Defense Grant (CWDG), USDA NRCS Environmental Quality Incentives Program (EQIP)			
67	Update Yellowstone County Community Wildfire Protection Plan.	Wildfire	Yellowstone County, Billings, Broadview, Laurel	Yellowstone County DES	Fire Council, City of Billings Planning, City of Laurel Planning, Town of Broadview Town Council	High	FEMA Grant, MT DES, DNRC Fire Suppression Fund	Medium-Term	High	Not Started
68	Continue community outreach on FireWise building practices in the wildland urban interface.	Wildfire	Yellowstone County, Billings, Broadview, Laurel	Yellowstone County DES	Fire Council, City of Billings Planning, City of Laurel Planning, Town of Broadview Town Council	High	County General Funds, Local Staff Time	Short Term	High	In Progress
69	Promote and encourage individual fire departments to implement a FireWise program that will create fire adapted communities throughout the County.	Wildfire	Yellowstone County, Billings, Broadview, Laurel	Yellowstone County DES	Fire Council, DNRC, City of Billings Planning, City of Laurel Planning, Town of Broadview Town Council	High	County & City General Funds	Ongoing	High	Not Started
70	Continue pushing out information on Red Flag Warnings for broadcast when conditions exist.	Wildfire	Yellowstone County, Billings, Broadview, Laurel	Yellowstone County DES	NWS, City of Billings Planning, City of Laurel Fire Department, Town of Broadview Town Council	High	NWS, County General Funds, staff time	Ongoing	High	Annual Implementation
71	Explore whether subdivision regulations could be strengthened to require defensible space and construction with fire-proof materials.	Wildfire	Yellowstone County, Billings, & Laurel	Yellowstone County Planning Department	City of Billings & City of Laurel Planning Departments	Medium	County & City General Funds	Ongoing	High	Not Started

ID	Action Name & Description	Hazards Mitigated	Jurisdictions	Lead Agency	Partner Agencies	Cost Estimate	Potential Funding	Timeline	Priority	Status & Implementation Notes
72	Continually improve fire agency training and infrastructure	Wildfire	Yellowstone County, Billings, Broadview, Laurel	Fire Council	County DES, City of Billings Planning Department, City of Laurel Fire Department, Town of Broadview Town Council	High	County & City General Funds, Local Staff Time	Ongoing	High	Annual Implementation
73	Install HVAC systems that meet air quality system specifications for high dust and ash filtration at all designated County emergency shelters to mitigate volcanic ash risk	Volcanic Ash	Yellowstone County, Billings, Broadview, Laurel	Yellowstone County DES	County DES, City of Billings Council, Laurel Fire Department, Town of Broadview Town Council	Medium	FEMA HMA, HMGP Grants	Long Term	Low	New in 2023

NOTES: Acronyms for lead agency, partners, and funding are defined below:
BBWA – Billings Bench Water Association
BLM – Bureau of Land Management
BNSF – BNSF Railway
BRIC – Building Resilient Infrastructure and Communities Program
BZPP – Buffer Zone Protection Program
CAP – Community Assistance Program
CDBG-MT – HUD Community Development Block Grant Mitigation
COAD – Community Organizations Active in Disaster
DCIP – Department of Defense (DoD) Defense Critical Infrastructure Program
DEQ – Department of Environmental Quality
DES – Department of Emergency Services
DHS – Department of Health Services
DPHHS - Department of Public Health and Human Services
DOT – Department of Transportation
EDA – Economic Development Administration
EPA – Environmental Protection Agency
EQIP – Environmental Quality Incentives Program
FMA – Flood Mitigation Assistance
FRA – Federal Railroad Administration
HMA – Hazard Mitigation Assistance
HMGP – Hazard Mitigation Grant Program
HSGP – Homeland Security Grant Program
ISR – Infrastructure Security and Resilience Grant Programs
LEPC – Local Emergency Planning Committee
MT DNRC - Department of Natural Resources and Conservation
NRCS – USDA Natural Resources Conservation Service
NTSB – National Transportation Safety Board
NWS - National Weather Service
PAS – Planning Assistance to States
Project SERV – U.S. Department of Education's Project School Emergency Response to Violence
TSGP – Transit Security Grant Program
USACE – US Army Corps of Engineers
USDA – U.S. Department of Agriculture
USACE - U.S. Army Corps of Engineers

mitigation plan into their respective planning mechanisms. The County Public Works Department recently updated the Flood Emergency Response Plan to address water and sewer system operations more effectively. The department also oversees the stormwater management program, guided by the Stormwater Management Manual, which is mandated for subdivision infrastructure and site development. This manual provides a framework to mitigate stormwater runoff from new development and redevelopment, aligning with the broader goals of the mitigation plan.

The growth policies for Billings and Yellowstone County reflect the unique needs and priorities of each area. These policies evaluate various elements, such as housing, the economy, community facilities, local services, and natural resources. Despite their differences, these growth policies are designed to be complementary and can function synergistically with other adopted community plans. Although they are not regulatory and do not exclusively dictate planning, their integration with the mitigation plan enhances their effectiveness and ensures that risk management and mitigation objectives are woven into the fabric of local development strategies.

When the opportunity arises, each jurisdiction will follow the process outlined in Section 6.3.3 of the Eastern Region Base Plan to integrate information from the HMP into planning mechanisms. The process for incorporation of the Regional HMP into other planning mechanisms by each jurisdiction can be as simple as cross-referencing the Hazard Mitigation Plan where applicable or including data, goals, or actions from the HMP in these mechanisms. Mitigation projects associated with wildfire can be integrate into the future version of the County's community wildfire protection plan. The Cities of Billings and Laurel and Town of Broadwater each utilize growth or zoning policies to guide development. Findings from the hazard profiles can be incorporated into future revisions of these policies to ensure limited or appropriate growth in high-hazard areas. The CPT will collaborate with the staff responsible for these plans or programs.

Additional opportunities for integration for each jurisdiction are listed below.

Yellowstone County:

- Yellowstone County Growth Policy, 2008
- Yellowstone County Floodplain Regulations, 2017
- Yellowstone County Community Wildfire Protection Plan, 2006
- Yellowstone County Dept. of Emergency & General Services, Capabilities Assessment and Strategic Improvement Plan, FY2023-2028
- Yellowstone County Emergency Operations Plan, 2019
- Yellowstone County Emergency Resource Information, 2016

- Highland Neighborhood Lockwood Community Plan, 2006
- Lockwood Growth Policy, 2016
- North Elevation Neighborhood Plan, 1994
- North Park Neighborhood Plan, 2008
- Northwest Shiloh Neighborhood Plan, 2005
- Shepherd Community Action Plan
- South Billings Master Plan, 2012
- Southside Neighborhood Plan, 2008
- West Billings Plan, 2001
- City of Billings Strategic, 2014
- City of Billings Capital Improvement Plan, FY 2020 to FY 2024
- Billings Urban Area Transportation Improvement Program, 2015-2019
- Billings water/Wastewater Master Plan, 2006
- Billings Long-Range Transportation Plan, 2014

City of Laurel:

- City of Laurel Growth Management Plan, 2013

Town of Broadview:

- Town of Broadview Zoning Regulations

The CPT noted that creating a regional hazard mitigation plan will offer insights into the hazards and challenges faced by surrounding counties, aiding in the revision of current plans and the development of future exercises and drills. It will also enhance understanding of how hazards in neighboring counties can impact each jurisdiction, allowing for more effective and efficient planning and response.

K.7.2 Monitoring, Evaluation and Updating the Plan

Yellowstone County will follow the procedures to review and update this plan in accordance with Eastern Montana Region as outlined in Chapter 6 of the Regional Plan. The County and municipalities realize that it is important to review and update this plan regularly and update it on a five-year cycle. The Yellowstone County Annex to the Eastern Montana Region HMP will be evaluated on a regular basis to determine the effectiveness of programs, and to reflect changes in land development or programs that may affect mitigation priorities.

K.7.3 Continued Public Involvement

Yellowstone County, along with Billings, Laurel, and Broadview, is committed to involving the public in the review and updates of the MJHMP. The CPT and DES office will review and update the plan annually or as needed. Public feedback will be encouraged, with copies of the plan available at the Yellowstone County DES office, Clerk and Recorder's office, and Billings Public Library. The Plan and proposed changes will also be posted on the Yellowstone County website, which will provide contact information for submitting